1960 FORD

Thunderbird

SHOP MANUAL

1960 THUNDERBIRD

SHOP MANUAL

SERVICE DEPARTMENT
FORD DIVISION
FORD MOTOR COMPANY

INDEX

(SPECIFICATIONS AT END OF EACH GROUP)

FOREWORD

This manual provides information for the proper servicing of the 1960 Thunderbird. The descriptions and specifications contained in this manual were in effect at the time the manual was approved for printing. The Ford Division of Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.

SERVICE DEPARTMENT
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THUNDERBIRD IDENTIFICATION

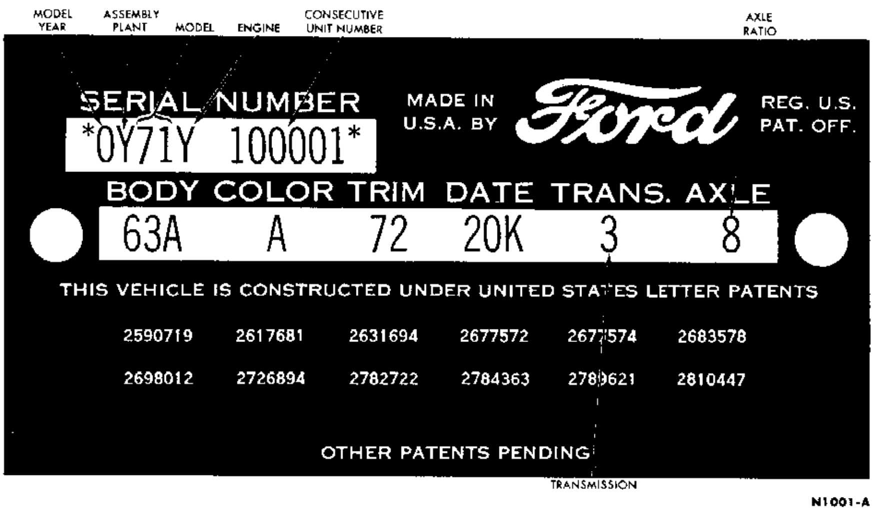


FIG. 1—Thunderbird Rating Plate

Figure 1 illustrates a Thunderbird rating plate and its elements. The rating plate is attached to the left door front pillar.

MODEL YEAR

The number "0" designates 1960.

ASSEMBLY PLANT

The letter "Y" designates the Lincoln plant at Wixom, Mich.

MODEL

71	Tudor Hardtop
73	Convertible

ENGINE

Y	352 cubic inch V-8
J	430 cubic inch 4V V-8

CONSECUTIVE UNIT NUMBER

The assembly plant, with each model year, begins with consecutive unit number 100001 and continues on for each unit built.

BODY

63A	Tudor Hardtop
76A	Convertible

COLOR

SOLID COLOR

A	Black	N
B	Dark Blue Metallic	R
C	Light Aqua	S
E	Medium Blue Metallic	T
F	Light Blue	U
H	Beige Metallic	V
X	Burgundy Metallic	W
J	Red	Y
K	Turquoise Metallic	Z

TWO-TONE COLOR

	Lower Color	Upper Color
AM	Black	White
MA	White	Black
ZA	Light Gray Metallic	Black
AZ	Black	Light Gray Metallic
ZM	Light Gray Metallic	White
YM	Dark Gray Metallic	White
JM	Red	White
MJ	White	Red
JA	Red	Black
RM	Yellow	White
RA	Yellow	Black
XM	Burgundy Metallic	White
UM	Rose Beige Metallic	White
VM	Pink	White
VA	Pink	Black
HM	Beige Metallic	White
MH	White	Beige Metallic
KM	Turquoise Metallic	White
MK	White	Turquoise Metallic
CK	Light Aqua	Turquoise Metallic
KC	Turquoise Metallic	Light Aqua
CM	Light Aqua	White
MC	White	Light Aqua

TWO-TONE COLOR—Continued

	Lower Color	Upper Color
FE	Light Blue	Medium Blue Metallic
EF	Medium Blue Metallic	Light Blue
BN	Dark Blue Metallic	Ice Blue
NB	Ice Blue	Dark Blue Metallic
BM	Dark Blue Metallic	White
MB	White	Dark Blue Metallic
EM	Medium Blue Metallic	White
ME	White	Medium Blue Metallic
FM	Light Blue	White
MF	White	Light Blue
NE	Ice Blue	Medium Blue Metallic
EN	Medium Blue Metallic	Ice Blue
FB	Light Blue	Dark Blue Metallic
SM	Dark Green Metallic	White
MS	White	Dark Green Metallic
TM	Medium Green Metallic	White
MT	White	Medium Green Metallic
WM	Light Green	White
WT	Light Green	Medium Green Metallic
TW	Medium Green Metallic	Light Green
WS	Light Green	Dark Green Metallic

DATE

The date code shows the day and month when the Thunderbird was completed. The months are designated as follows:

A	January	G	July
B	February	H	August
C	March	J	September
D	April	K	October
E	May	L	November
F	June	M	December

TRANSMISSION

1	Conventional Drive
2	Overdrive
4	Cruise-O-Matic

AXLE

3	3.10 to 1
8	2.91 to 1
9	3.70 to 1

GROUP 1

ENGINES AND EXHAUST SYSTEM

PART 1-1 GENERAL ENGINE SERVICE

This part covers engine trouble diagnosis, tune-up, and in-chassis tests and adjustments for the Thunderbird 352 and 430 Special V-8 engines. In addition, the cleaning, inspection, repair, and overhaul procedures are covered.

For engine removal, disassembly, assembly, and installation procedures, refer to Part 1-2 or 1-3.

1 ENGINE TROUBLE DIAGNOSIS

Engine performance complaints usually fall under one of the basic headings listed in the "Engine Trouble Diagnosis Guide." This guide lists procedures and checks to be performed to help isolate the cause of the trouble. When a particular trouble can not be traced to a definite cause by a simple check, the possible items that could be at fault are listed in the order of their probable occurence. Therefore, in most cases, the items should be checked in the order listed. For example, under Poor Acceleration, the ignition system is listed as a probable cause of the trouble. All the ignition system items that affect acceleration are listed. These items should all be checked before proceeding to the next probable cause listed.

ENGINE TROUBLE DIAGNOSIS GUIDE

ENGINE WILL NOT CRANK	The cause of this trouble is usually in the starting system (Part 11-2). If the starting system is not at fault, check for a hydrostatic lock or a seized engine. Remove the spark plugs, then attempt to crank the engine with the starter. If the engine cranks, it indicates that water is leaking into the cylinders. Remove the cylinder head(s) and inspect the gasket(s) and/or head(s) for cracks. Also examine the cylinder block for cracks.
ENGINE CRANKS NORMALLY, BUT WILL NOT START	Check the fuel supply. If there is sufficient fuel in the tank, the cause of the trouble probably lies in either the ignition or the fuel system. To determine which system is at fault, disconnect all the spark plug wires. Check the spark intensity of one wire at a time. Install a terminal adapter in the terminal of the wire to be checked. Hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine. **NO SPARK OR A WEAK SPARK AT THE SPARK PLUGS** The cause of the trouble is in the ignition system. To determine if the cause of the trouble is in the primary or the secondary circuit, remove the coil high tension lead from the top of the distributor. Hold it approximately 3/16 inch from the cylinder head.

CONTINUED ON NEXT PAGE

ENGINE TROUBLE DIAGNOSIS GUIDE (Continued)

ENGINE CRANKS NORMALLY, BUT WILL NOT START (Continued)

With the ignition on and the engine turning over, check for a spark.

If the spark at the coil high tension lead is good, the cause of the trouble is probably in the distributor cap, rotor, or the spark plug wires.

If there is no spark or a weak spark at the coil high tension lead, the cause of the trouble is probably in the primary circuit, coil to distributor high tension lead, or the coil.

A GOOD SPARK AT THE SPARK PLUGS

If the spark is good at the spark plugs, check the spark plugs and the ignition timing. If the spark plugs or the ignition timing are not at fault, check the following items:

AUTOMATIC CHOKE

Check the position of the choke plate. If the engine is hot, the plate should be open. If the plate is not open, the engine will load up due to the excessively rich mixture and will not start. If the engine is cold, the plate should be closed, if the plate is not operating properly, check the following items:

The choke linkage for binding.

The fast idle cam for binding.

Thermostatic spring housing adjustment.

Fast idle speed screw for proper adjustment.

FUEL SUPPLY AT CARBURETOR

Work the throttle by hand several times. Each time the throttle is actuated, fuel should spurt from the accelerating pump discharge nozzles.

If fuel is discharged by the accelerating pump, the engine is probably flooded, or there is water in the fuel system, or an engine mechanical item, such as valves, is at fault.

If fuel is not discharged by the accelerating pump, disconnect the carburetor fuel inlet line at the carburetor. Use a suitable container to catch the fuel. Crank the engine to see if fuel is reaching the carburetor.

If fuel is not reaching the carburetor, check:

The fuel filter.

The fuel pump.

The carburetor fuel inlet line for obstructions.

The fuel pump flexible inlet line for a collapsed condition.

The fuel tank line for obstructions.

The fuel tank vent.

If fuel is reaching the carburetor, check:

The fuel inlet system including the fuel inlet needle and seat assembly, and the float assembly.

Check for dirt in the carburetor, not allowing fuel to enter or be discharged from the idle system.

ENGINE STARTS, BUT FAILS TO KEEP RUNNING

FUEL SYSTEM

Idle fuel mixture needles not properly adjusted.

Engine idle speed set too low.

The choke not operating properly.

Float setting incorrect.

Fuel inlet system not operating properly.

Dirt or water in fuel lines, fuel filter, or carburetor.

Carburetor icing.

Fuel pump defective.

IGNITION SYSTEM

Breaker points not properly adjusted.

Defective spark plugs.

Leakage in the high tension wiring.

ENGINE RUNS, BUT MISSES

Determine if the miss is steady or erratic and at what speed the miss occurs by operating the engine at various speeds under load.

MISSES STEADILY AT ALL SPEEDS

Isolate the miss by operating the engine with one cylinder not firing.

CONTINUED ON NEXT PAGE

ENGINE TROUBLE DIAGNOSIS GUIDE (Continued)

ENGINE RUNS, BUT MISSES (Continued)

This is done by operating the engine with the ignition wire removed from one spark plug at a time, until all cylinders have been checked. Ground the spark plug wire removed.

If the engine speed changes when a particular cylinder is shorted out, the cylinder was delivering power before being shorted out. If no change in the engine operation is evident, the miss was caused by that cylinder not delivering power before being shorted out. Check the:

IGNITION SYSTEM

If the miss is isolated in a particular cylinder, perform a spark test on the ignition lead of the cylinder.

If a good spark does not occur, the trouble is in the secondary circuit of the system, check the:

Spark plug wire.

Distributor cap.

If a good spark occurs, check the spark plug. If the spark plug is not at fault, a mechanical component of the engine is probably at fault.

ENGINE

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES ERRATICALLY AT ALL SPEEDS

EXHAUST SYSTEM

Exhaust gas control valve inoperative or sticking—352 engine.

Exhaust system restricted.

IGNITION SYSTEM

Breaker points not properly adjusted.

Defective breaker points, condenser, secondary wiring, coil, or spark plugs.

High tension leakage across the coil, rotor, or distributor cap.

FUEL SYSTEM

Choke not operating properly.

Float setting incorrect.

Fuel inlet system not operating properly.

Dirt or water in fuel lines, fuel filter, or carburetor.

COOLING SYSTEM

Check the cooling system for internal leakage and/or for a condition that prevents the engine from reaching normal operating temperature.

ENGINE

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES AT IDLE ONLY

FUEL SYSTEM

Idle fuel mixture needles not properly adjusted.

IGNITION SYSTEM

Defective coil, condenser, breaker points, rotor, ignition wiring, or spark plugs.

Excessive play in the distributor shaft.

Worn distributor cam.

VACUUM BOOSTER PUMP

Leaking pump, lines, or fittings.

ENGINE

Perform a compression test to determine which mechanical component of the engine is at fault.

MISSES AT HIGH SPEED ONLY

FUEL SYSTEM

Power valve clogged or damaged—Ford carburetor.

Vacumeter not operating properly—Carter carburetor.

Low or erratic fuel pump pressure.

Fuel inlet system not operating properly.

Restricted fuel filter.

COOLING SYSTEM

Engine overheating.

ROUGH ENGINE IDLE

FUEL SYSTEM

Engine idle speed set too low.

Idle fuel mixture needles not properly adjusted.

Float setting incorrect.

Air leaks between the carburetor and the manifold and/or fittings.

Fuel leakage at the carburetor fuel bowls.

Idle fuel system air bleeds or fuel passages restricted.

Fuel bleeding from the accelerating pump discharge nozzles.

Throttle plates not closing.

Improper secondary throttle plate stop adjustment—Ford carburetor.

CONTINUED ON NEXT PAGE

ENGINE TROUBLE DIAGNOSIS GUIDE (Continued)

ROUGH ENGINE IDLE (Continued)	**IGNITION SYSTEM** Improperly adjusted or defective breaker points. Fouled or improperly adjusted spark plugs. Incorrect ignition timing. Spark plug misfiring. **EXHAUST SYSTEM** Exhaust gas control valve inoperative or sticking—352 engine. **VACUUM BOOSTER PUMP** Leaking pump, lines, or fittings. **ENGINE** Loose engine mounting bolts or worn insulator. Cylinder head bolts not properly tightened. Intake manifold seals leaking—352 engine.
POOR ACCELERATION	**IGNITION SYSTEM** Incorrect ignition timing. Fouled or improperly adjusted spark plugs. Improperly adjusted or defective breaker points. Distributor not advancing properly. **FUEL SYSTEM** Inoperative accelerating pump inlet. Inoperative accelerating pump discharge ball check. Accelerating pump diaphragm or piston defective. Float setting incorrect. Throttle linkage not properly adjusted. Accelerating pump stroke not properly adjusted. Leaky power valve, gaskets, or accelerating pump diaphragm or accelerating pump piston. Dirt or corrosion in accelerating system. Distributor vacuum passages in the carburetor blocked. **EXHAUST SYSTEM** Exhaust gas control valve inoperative or sticking—352 engine. **BRAKES** Improper adjustment. **TRANSMISSION** Clutch slippage—manual-shift transmissions. Improper band adjustment—automatic transmissions. Converter one-way clutch—automatic transmission.
ENGINE DOES NOT DEVELOP FULL POWER, OR HAS POOR HIGH SPEED PERFORMANCE	**PRELIMINARY** Determine if the trouble exists when the engine is cold, at normal operating temperature, or at all engine temperatures. **ENGINE COLD** **EXHAUST SYSTEM** Exhaust gas control valve inoperative or sticking—352 engine. **FUEL SYSTEM** Clogged or undersize main jets and/or low float setting. Clogged or undersize secondary jets. Power valve clogged or damaged. Secondary throttle plates not opening. Fuel pump pressure incorrect. Distributor vacuum passage in the carburetor blocked. Restricted fuel filter. **COOLING SYSTEM** Thermostats inoperative or incorrect heat range. **ENGINE AT NORMAL OPERATING TEMPERATURE** **EXHAUST SYSTEM** Exhaust gas control valve inoperative or sticking—352 engine.

CONTINUED ON NEXT PAGE

ENGINE TROUBLE DIAGNOSIS GUIDE (Continued)

ENGINE DOES NOT DEVELOP FULL POWER, OR HAS POOR HIGH SPEED PERFORMANCE (Continued)	**FUEL SYSTEM** Same items as for engine cold. **ALL ENGINE TEMPERATURES** **IGNITION SYSTEM** Ignition timing not properly adjusted. Defective coil, condenser, or rotor. Distributor not advancing properly. Excessive play in the distributor shaft. Distributor cam worn. Fouled or improperly adjusted spark plugs or spark plugs of improper heat range. Improperly adjusted or defective breaker points. **FUEL SYSTEM** Restricted air cleaner. Same items as for engine cold. **ENGINE** Perform an engine compression test to determine which mechanical component is at fault. One or more camshaft lobes worn beyond wear limit. **EXHAUST SYSTEM** Restriction in system. **TRANSMISSION** Improper band adjustment (automatic transmissions).
EXCESSIVE FUEL CONSUMPTION	Determine the actual fuel consumption with test equipment installed in the car. If the test indicates that the fuel consumption is not excessive, demonstrate to the owner how improper driving habits will affect fuel consumption. If the test indicates that the fuel consumption is excessive, make a preliminary check of the following items before proceeding to the fuel and ignition systems. **PRELIMINARY CHECKS** **CHASSIS ITEMS** Check: Tires for proper pressure. Front wheel alignment. Brake adjustment. **EXHAUST SYSTEM** Check the exhaust gas control valve operation—352 engine. **ODOMETER** Check calibration. **IGNITION SYSTEM** Check ignition timing. **FINAL CHECKS** **FUEL SYSTEM** Check: Fuel pump pressure. Engine idle speed. Idle fuel mixture needles for proper adjustment. Automatic choke for proper operation. Fast idle speed screw for proper adjustment. Accelerating pump stroke adjustment. Anti-stall dashpot for proper adjustment. Air cleaner for restrictions. Float setting or fuel level. Jets for wear and/or damage. Power valve or Vacumeter operation. Air bleeds for obstructions. Accelerating pump discharge nozzles for siphoning. **IGNITION SYSTEM** Check: Ignition timing. Spark plug condition and adjustment. Distributor spark advance operation. **ENGINE** Perform an engine compression test to determine which mechanical component of the engine is at fault. **COOLING SYSTEM** Check thermostat operation and heat range. **TRANSMISSION** Check band adjustment (automatic transmissions).

CONTINUED ON NEXT PAGE

ENGINE TROUBLE DIAGNOSIS GUIDE (Continued)

ENGINE OVERHEATS	**TEMPERATURE SENDING UNIT AND GAUGE** Unit or gauge defective, not indicating correct temperature. **EXHAUST SYSTEM** Exhaust gas control valve inoperative or sticking—352 engine. Restriction in system. **ENGINE** Cylinder head bolts not properly tightened.	Low oil level or incorrect viscosity oil used. **COOLING SYSTEM** Insufficient coolant. Cooling system leaks. Drive belt tension incorrect. Radiator fins obstructed. Thermostat(s) defective. Cooling system passages blocked. Water pump inoperative. **IGNITION SYSTEM** Incorrect ignition timing.
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE	**TEMPERATURE SENDING UNIT AND GAUGE** Unit or gauge defective, not indicating correct temperature.	**COOLING SYSTEM** Thermostats inoperative, incorrect heat range, or thermostats not installed.
LOSS OF COOLANT	**COOLING SYSTEM** Leaking radiator. Loose or damaged hose connections. Water pump leaking. Radiator cap defective. Overheating. **ENGINE** Cylinder head gasket defective.	Intake manifold to cylinder head gasket defective. Improper tightening of cylinder head or intake manifold bolts. Cylinder block core plugs leaking. Temperature sending unit leaking. Cracked cylinder head or block, or warped cylinder head or block gasket surface.
NOISY HYDRAULIC VALVE LIFTER	A noisy valve lifter can be located by operating the engine at idle speed and placing a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a shock will be felt when the valve seats. Another method of identifying a noisy lifter is by the use of a piece of hose. With the engine operating at idle speed, place one end of the hose near the end of the valve stem and the other end to the ear and listen for a metallic noise. Repeat this procedure on each intake and exhaust valve until the noisy lifter(s) has been located. The most common causes of hydraulic valve lifter troubles are dirt, gum, varnish, carbon deposits, and air bubbles. Dirt in the lifter assembly can prevent the disc valve from seating, or it may become lodged between the plunger and body surfaces. In either case, the lifter becomes inoperative due to failure to "pump-up," or because the internal parts are no	longer free to function properly. When dirt is found to be responsible for lifter malfunction, remove the lifter assembly and thoroughly clean it. Recommended engine oil and filter change intervals should be followed to minimize lifter problems caused by dirt. Deposits of gum and varnish cause similar conditions to exist which may result in lifter malfunction. If these conditions are found to be present, the lifter should be disassembled and cleaned in solvent to remove all traces of deposits. Air bubbles in the lubricating oil, caused by an excessively high or low oil level, may likewise cause lifter malfunction. A damaged oil pick up tube may allow air to be drawn into the lubricating system. To check for the presence of air, remove a valve rocker arm shaft cover and note the condition of the oil as it flows from the valve rocker arm shaft assembly. Perform corrective action as required to remove air from the lubricating oil.

2 TUNE-UP

The Tune-Up Schedule (Table 1) is applicable for either a minor or major tune-up. Refer to the "Maintenance Guide" in Group 17 for the proper mileage interval for minor tune-up and major tune-up.

Refer to that part of the manual which describes, in detail, the procedure to be followed. Perform the operations in the sequence listed.

TABLE 1—Tune-Up Schedule

Operation	Perform on		Recommended Procedure
	Minor	Major	
SPARK PLUGS Clean, adjust, and test.	X	X	Part 2-1
ENGINE COMPRESSION Take compression reading of each cylinder.		X	Part 1-1
INTAKE MANIFOLD Check and tighten bolts.	X*	X	Part 1-2 or 1-3
DRIVE BELTS Check and adjust tension.	X	X	Part 4-1
BATTERY Clean cables and terminals.		X	Part 12-1
Tighten cable clamps.		X	
Grease battery terminals.		X	
Check battery state of charge.	X	X	
ELECTRICAL Check generator output.		X	Part 12-1
Check generator regulator.		X	
Check starter motor current draw.		X	Part 12-2
Check coil output.		X	Part 2-1
Perform a primary circuit resistance test.		X	
Perform a spark intensity test of each spark plug wire.		X	
DISTRIBUTOR Check the condition of the breaker points.	X		Part 2-1
Replace the breaker points and the condenser.		X	
Lubricate the distributor cam. Oil the lubricating wick. Lubricate the distributor bushing through the oil cup.		X	
DISTRIBUTOR (Continued) Check and adjust centrifugal advance.		X	Part 2-1
Check and adjust vacuum advance.		X	
Clean distributor cap and rotor.	X	X	
FUEL SYSTEM Clean fuel pump sediment bowl.*	X	X	Part 3-1
Replace fuel filter.		X	
Check fuel pump pressure and capacity.		X	
Clean carburetor fuel bowls and adjust float setting.		X	
ADJUSTMENTS Check and adjust ignition timing.	X	X	Part 2-1
Check and adjust engine idle speed.	X	X	Part 3-1
Adjust idle fuel mixture.	X	X	
EXHAUST Free the exhaust gas control valve.*	X	X	Part 1-4
COOLING SYSTEM Inspect the radiator, hoses, and engine for leaks.		X	Part 4-1
Add rust inhibitor to radiator if water is used as coolant.		X	

*On 352 engine only.

3 TESTS AND ADJUSTMENTS—ENGINE INSTALLED

CAMSHAFT LOBE LIFT

1. Remove the valve rocker arm shaft assembly and install a solid tappet-type push rod in the push rod bore of the camshaft lobe to be checked.

2. Make sure the push rod is in the lifter push rod cup. Install a dial indicator in such a manner as to have the actuating point of the indicator in the push rod socket and in the same plane as the push rod movement (Fig. 1).

3. Turn the crankshaft damper slowly in the direction of rotation until the lifter is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.

4. Zero the dial indicator.

5. Continue to rotate the damper slowly until the push rod is in the fully raised position.

6. Compare the total lift recorded on the indicator with specifications.

7. To check on the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero.

VALVE CLEARANCE

A 0.060-inch shorter push rod (color coded white) or a 0.060-inch longer push rod (color coded yellow) are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Valve stem to valve rocker arm clearance should be 0.078-0.218 inch with the hydraulic lifter completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease this clearance to the point that if not compensated for, the hydraulic valve lifter will cease to function.

The correct operating range of the hydraulic valve lifter plunger must be maintained because:

If the plunger travel is excessive, the lifter pump-up time will be prolonged resulting in excessive valve train noise following engine start-up. If the travel is insufficient to compensate for normal expansion of the valve operating components, the valve would not be permitted to seat properly resulting in a rough engine and/or premature valve failure.

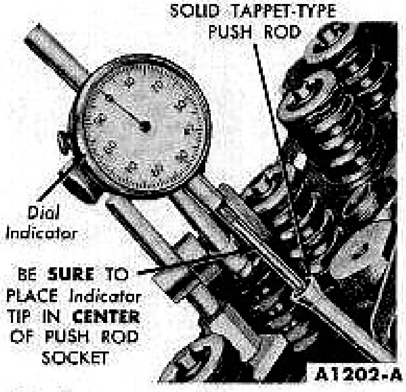


FIG. 1—Camshaft Lobe Lift

To check the valve clearance:

1. **Position the crankshaft as outlined in Steps 5 and 6.**

2. Install the hydraulic lifter compressor tool on the rocker arm and slowly apply pressure to bleed down the hydraulic lifter until the plunger is completely bottomed (Fig. 2). Hold the lifter in the fully collapsed position.

3. Insert the correct end of the clearance gauge between the valve stem and the rocker arm of the valve being checked.

4. If the first step of the gauge enters, a standard length push rod may be used.

If the first step of the gauge does not enter, replace the standard push rod with a 0.060-inch shorter push rod.

If the second step of the gauge enters, the operating range of the lifter is excessive. This indicates that the incorrect push rod has been installed or severe wear has occurred at the push rod ends, rocker arm, or valve stem. In this case, it will be necessary to determine the area of discrepancy and the incorrect or defective part(s) replaced.

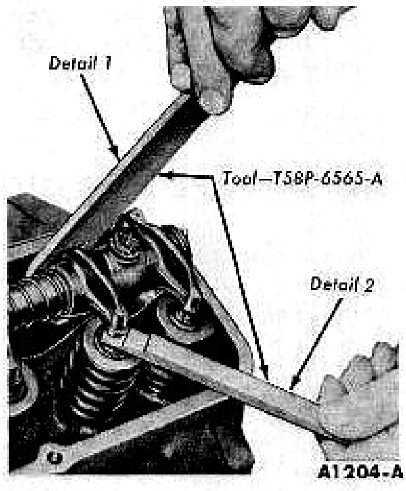


FIG. 2—Valve Clearance

If all the valve train components except the push rod are within limits, install a 0.060-inch longer push rod.

5. Rotate the crankshaft until No. 1 piston is on T.D.C. at the end of the compression stroke. With No. 1 piston on T.D.C., check the following valves:

No. 1 Intake	No. 1 Exhaust
No. 3 Intake	No. 4 Exhaust
No. 7 Intake	No. 5 Exhaust
No. 8 Intake	No. 8 Exhaust

6. Position No. 6 piston on T.D.C. and check the following valves:

No. 2 Intake	No. 2 Exhaust
No. 4 Intake	No. 3 Exhaust
No. 5 Intake	No. 6 Exhaust
No. 6 Intake	No. 7 Exhaust

When compressing the valve spring to remove push rods, be sure the piston in the individual cylinder is below T.D.C. to avoid contact between the valve and the piston.

To replace a push rod, it will be necessary to remove the valve rocker arm shaft assembly.

Upon replacement of a valve push rod and/or valve rocker arm shaft assembly, the engine should not be cranked or rotated until the hydraulic lifters have had an opportunity to leak down to their normal operating position. The leak down rate can be accelerated by using the tool shown in Fig. 2 on the valve rocker arm, applying pressure in a direction to collapse the lifter.

MANIFOLD VACUUM TEST

A manifold vacuum test aids in determining the condition of an engine and also helping to locate the cause of poor engine performance. To test manifold vacuum:

1. Operate the engine for a minimum of 30 minutes at 1200 rpm.

2. Install an accurate, sensitive vacuum gauge on the intake manifold vacuum line or on the fitting in the intake manifold.

3. Operate the engine at recommended idle rpm.

4. Check the vacuum reading on the gauge.

TEST CONCLUSIONS

Manifold vacuum is affected by carburetor adjustment, valve timing, the condition of the valves, cylinder compression, and leakage of the manifold, carburetor, or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors is at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted where necessary in order to arrive at the correct diagnosis of the trouble.

Table 2 lists various types of readings and their possible causes.

Allowance should be made for the effect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

TABLE 2—Manifold Vacuum Gauge Readings

Gauge Reading	Engine Condition
18 inches	Normal.
Low and steady.	Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low.	Manifold, carburetor, or cylinder head gasket leak.
Needle fluctuates steadily as speed increases.	A partial or complete loss of power in one or more cylinders caused by a leaking valve, cylinder head or intake manifold gasket leak, a defect in the ignition system, or a weak valve spring.
Gradual drop in reading at engine idle.	Excessive back pressure in the exhaust system.
Intermittent fluctuation.	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of the needle.	Improper idle mixture adjustment, carburetor or intake manifold gasket leak, or possibly late valve timing.

ENGINE COMPRESSION TEST

1. Be sure the battery is properly charged. Operate the engine for a minimum of 30 minutes at 1200 rpm. Turn the ignition switch off, then remove all the spark plugs.

2. Set the primary throttle plates and the choke plate in the wide open position.

3. Install a compression gauge in No. 1 cylinder.

4. Crank the engine several times and record the highest reading registered. Note the number of compression strokes required to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine the same number of times for each cylinder as was required to obtain the highest reading on No. 1 cylinder.

TEST CONCLUSIONS

A variation of ±20 pounds from specified pressure is satisfactory. However, the compression of all cylinders should be uniform within 10 pounds.

A reading of more than the allowable tolerance above normal indicates excessive deposits in the cylinder.

A reading of more than the allowable tolerance below normal indicates leakage at the cylinder head gasket, piston rings, or valves.

A low even compression in two adjacent cylinders indicates a cylinder head gasket leak. This should be checked before condemning the rings or valves.

To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of heavy oil into the combustion chamber, then crank the engine to distribute the oil and repeat the compression test. The oil will temporarily seal leakage past the rings. If approximately the same reading is obtained, the rings are satisfactory, but the valves are leaking. If the compression has increased 10 pounds or more over the original reading, there is leakage past the rings.

During a compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, it indicates a sticking or stuck valve.

4 CLEANING, INSPECTION, AND RECONDITIONING

INTAKE MANIFOLD

Clean the manifolds in a suitable solvent, then dry them with compressed air.

On the 352 engine, scrape all carbon deposits from the center exhaust passage below the carburetor heat riser. This carbon acts as an insulator restricting the heating action of the hot exhaust gases.

Inspect the manifold for cracks, leaks, or other defects that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. **Remove all filings and foreign matter that may have entered the manifold as a result of repairs.**

On the 352 engine, check the baffle plate on the underside of the manifold for looseness and be sure the maze screen is in place. Clean off any varnish accumulation.

EXHAUST MANIFOLD

Inspect the manifolds for cracks, leaks, or other defects that would make them unfit for further service.

On the right exhaust manifold of the 352 engine, clean out the automatic choke air heat chamber (Fig.

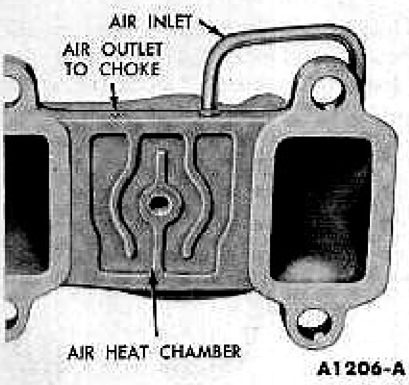


FIG. 3—Automatic Choke Air Heat Chamber—352 Engine

3). Make sure the air inlet and outlet holes are completely open and the cover does not leak. Blow out the automatic choke air heat tube with compressed air.

VALVE ROCKER ARM SHAFT ASSEMBLY

Clean all the parts thoroughly. Make sure that all oil passages are open.

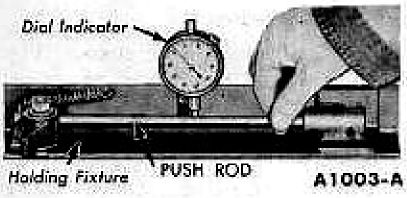


FIG. 4—Push Rod Runout

Check the clearance between each rocker arm and the shaft by checking the I.D. of the rocker arm bore and the O.D. of the shaft. If the clearance between any rocker arm and the shaft exceeds the wear limit, replace the shaft and/or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs. Dress up minor surface defects with a hone.

Inspect the pad at the valve end of the rocker arms for a grooved radius. If the pad is grooved, replace the rocker arm. **Do not attempt to true this surface by grinding.**

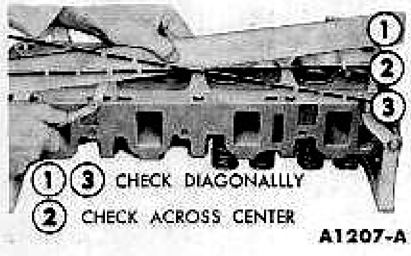


FIG. 5—Cylinder Head Flatness

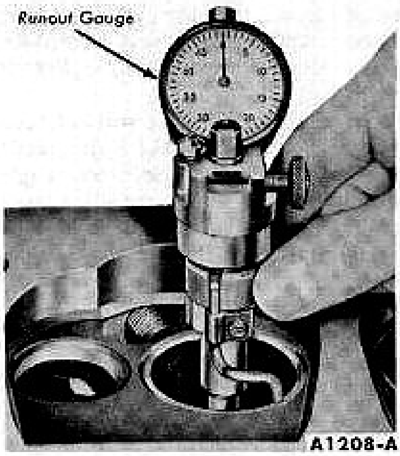


FIG. 6—Valve Seat Runout

Check for broken locating springs.

PUSH RODS

Check the ends of the push rods for nicks, grooves, roughness, or excessive wear.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator (Fig. 4). If the runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**

CYLINDER HEADS

CLEANING AND INSPECTION

With the valves installed to protect the valve seats, remove deposits from the combustion chambers (352 engine) and valve heads with a scraper and a wire brush. **Be careful not to scratch the cylinder head gasket surface.** After the valves are removed, clean the valve guide bores with a valve guide cleaning tool. Use cleaning solvent to remove dirt, grease, and other deposits.

Check the cylinder head for cracks, and the gasket surface for burrs and nicks. Replace the head if it is cracked. **Do not plane or grind more than 0.010 inch from the cylinder head gasket surface.** Remove all burrs or scratches with an oil stone.

CYLINDER HEAD FLATNESS

Check the flatness of the cylinder head gasket surface (Fig. 5).

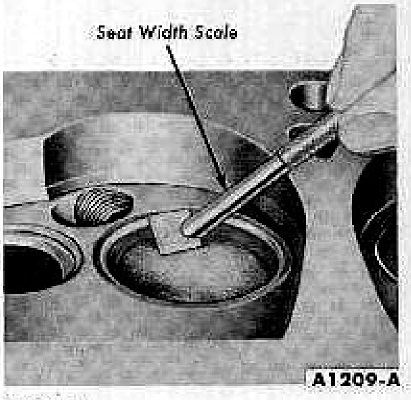


FIG. 7—Valve Seat Width

VALVE SEAT RUNOUT

Check the valve seat runout with an accurate gauge (Fig. 6). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat.

VALVE SEAT WIDTH

Measure the valve seat width (Fig. 7).

REAMING VALVE GUIDES

If it becomes necessary to ream a valve guide (Fig. 8) to install a valve with an oversize stem, a reaming kit is available which contains the following reamer and pilot combinations: a 0.003-inch O.S. reamer with a standard diameter pilot, a 0.015-inch O.S. reamer with a 0.003-inch O.S. pilot, and a 0.030-inch reamer with a 0.015-inch O.S. pilot.

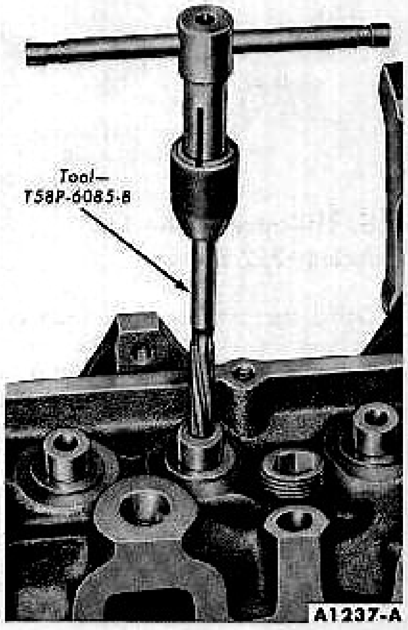


FIG. 8—Reaming Valve Guides

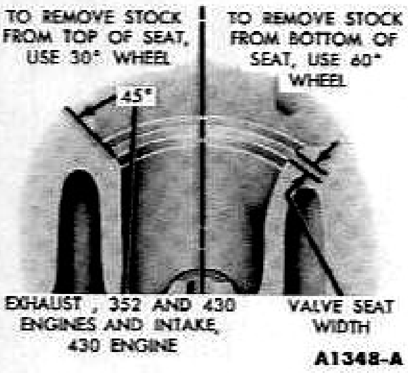


FIG. 9—Valve Seat Refacing—Exhust 352 and 430 and Intake 430

When going from a standard size valve to an oversize valve, always use the reamers in sequence. **Always reface the valve seat after the valve guide has been reamed.**

REFACING VALVE SEATS

Refacing of the valve seats should be closely co-ordinated with the refacing of the valve face so that the finished seat will match the valve face and be centered. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

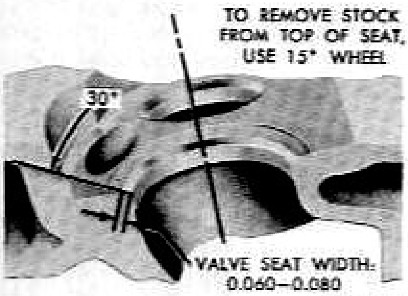


FIG. 10—Intake Valve Seat Refacing—352 Engine

Grind the exhaust valve seats of both engines and the intake valve seats of the 430 engine to a true 45° angle (Fig. 9). Grind the intake valve seat of the 352 engine to a true 30° angle (Fig. 10). Remove only enough stock to clean up pits, grooves, or to correct the valve seat runout. After the seat has been refaced, measure the seat width (Fig. 7). Narrow the seat, if necessary, to bring it within limits.

If the valve seat width exceeds the maximum limits, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications (Fig. 9 or 10).

On the exhaust valve seats of both engines and the intake valve seats of the 430 engine, use a 60° angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 30° angle wheel to remove stock from the top of the seats (lower the seats).

On the intake valve seats of the 352 engine, use a 15° angle grinding wheel to remove stock from the top of the seats (lower the seats).

The finished valve seat should contact the approximate center of the valve face. To determine where the valve seat contacts the face, coat the seat with Prussian blue, then set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

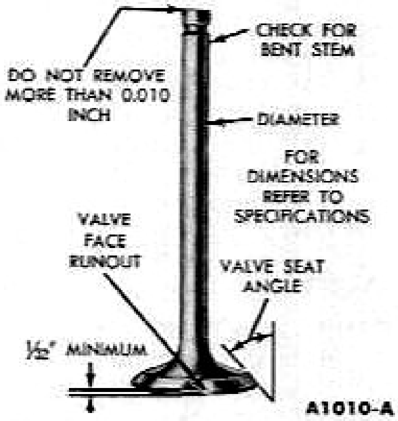


FIG. 11—Critical Valve Tolerances

After refacing the valve seat, it is good practice to lightly lap in the valve with a medium grade lapping compound. Remove all the compound from the valve and seat after the lapping operation.

VALVES

CLEANING AND INSPECTION

Remove all deposits from the valve with a fine wire brush or buffing wheel. The critical inspection points and tolerances of the valves are illustrated in Fig. 11.

Inspect the valve face and the edge of the valve head for pits, grooves, scores, or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for signs of burning or erosion, warpage, and cracking. Defects, such as minor pits, grooves, etc. may be removed. Discard valves that are severely damaged.

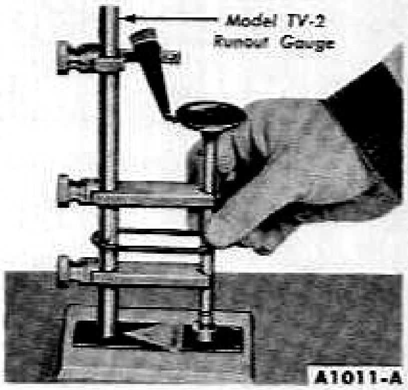


FIG. 12—Valve Face Runout

Inspect the valve springs, valve spring retainers, locks, and sleeves for defects. Discard any visually defective parts.

VALVE FACE RUNOUT

Check the valve face runout (Fig. 12). It should not exceed the wear limit.

VALVE STEM CLEARANCE

Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 13 or its equivalent.

If the clearance exceeds the wear limit, try a new valve.

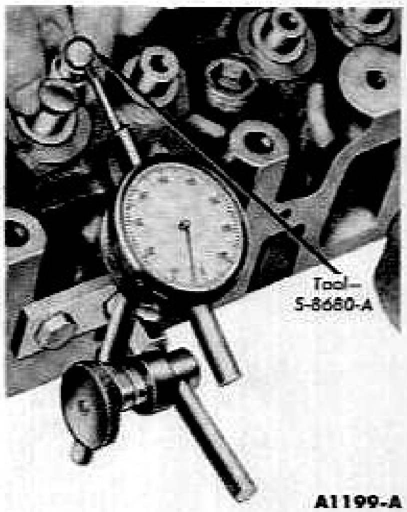


FIG. 13—Valve Stem Clearance

VALVE SPRING PRESSURE

Check the spring for proper pressure (Fig. 14). Do not remove the damper spring from the 430 engine when checking the pressure. Weak valve springs cause poor engine performance; therefore, if the pressure of any spring exceeds the wear limit, replace the spring.

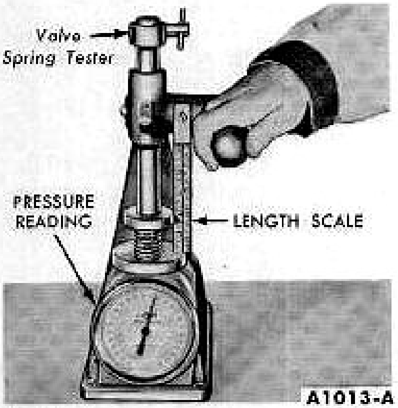


FIG. 14—Valve Spring Pressure

VALVE SPRING SQUARENESS

Check each spring for squareness, using a steel square and a surface plate (Fig. 15). Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square. If the spring is out of square more than 1/16 inch, replace it.

REFACING VALVES

The valve refacing operation should be closely co-ordinated with the valve seat refacing operation so that the finished angle of the valve face will match the valve seat. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

If the valve face runout is excessive and/or to remove pits and grooves, reface the exhaust valves of both engines and the intake valves of the 430 engine to a true 44° angle. Reface the intake valves of the 352 engine to a true 29° angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than 1/32 inch after grinding, replace the valve as the valve will run too hot in the engine.

Remove all grooves or score marks from the end of the valve stem, then chamfer as necessary. Do not remove more than 0.010 inch from the stem.

After refacing the valves, it is good practice to lightly lap in the valves with a medium grade lapping compound to match the seats. Be sure to remove all the compound from the valve and seat after the lapping operation.

SELECT FITTING VALVES

If the valve stem to valve guide clearance exceeds the wear limit, ream the valve guide for the next oversize valve stem. Valves with oversize stem diameters of 0.003, 0.015, and 0.030 inch are available for service. **Always reface the valve seat after the valve guide has been reamed.**

HYDRAULIC VALVE LIFTERS

The lifter assemblies should be kept in proper sequence so that they can be installed in their original position. Inspect and test each lifter separately so as not to intermix the internal parts. **If any part of the lifter assembly needs replacing, replace the entire assembly.**

CLEANING AND INSPECTION

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint free cloth.

Inspect the parts and discard the entire lifter assembly if any part shows signs of pitting, scoring, galling, or evidence of non-rotation. Also, replace the entire assembly if the plunger is not free in the body. The plunger should drop to the bottom of the body by its own weight.

Assemble the lifter assembly and check the assembly for freeness of operation by pressing down on the push rod cup. Also, the lifter assemblies can be tested with a hydraulic valve lifter tester to test the leak down rate. The leak down rate specification is 8-45 seconds. Follow the instructions of the test unit manufacturer.

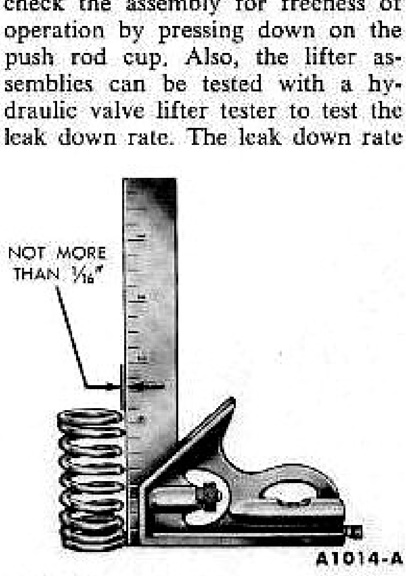


FIG. 15—Valve Spring Squareness

ROCKER ARM TO VALVE CLEARANCE

If the valve and/or valve seat have been refaced, it will be necessary to check the clearance between the rocker arm pad and the valve stem with the valve train assembly installed in the engine (Page 1-9).

TIMING CHAIN

Clean all parts in solvent and dry them with compressed air. Inspect the chain for broken links and the sprockets for cracks, and worn or damaged teeth. It is recommended that all the components be replaced if any one item needs replacement.

CAMSHAFT AND BEARINGS

Clean the camshaft in solvent and wipe dry. Inspect the camshaft lobes for scoring, and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general area of the nose portion of the lobe. This pitting is not detrimental to the operation of the camshaft, therefore, the camshaft should not be replaced until the lobe lift loss has exceeded 0.005 inch.

The lift of camshaft lobes can only be accurately checked with the camshaft installed in the engine. Refer to "Camshaft Lobe Lift" in Section 3 of this part.

Check the camshaft journal to bearing clearances by measuring the diameter of the journals and the I.D. of the bearings. If the clearance exceeds the wear limit, the camshaft journals should be refinished for undersized bearings or the camshaft replaced, and/or the bearings should be replaced. Bearings are available prefinished to size for standard and 0.015-inch undersize journal diameters.

Check the distributor drive gear for broken or chipped teeth.

Remove light scuffs, scores, or nicks from the camshaft machined surfaces with a smooth oilstone.

CRANKSHAFT

CLEANING AND INSPECTION

Handle the crankshaft with care to avoid possible fractures or damage to the finished surfaces. Clean the crankshaft with solvent, then blow out all oil passages with compressed air.

Inspect main and connecting rod journals for cracks, scratches, grooves, or scores. Dress minor imperfections with an oilstone. Refinish severely marred journals.

Measure the diameter of each journal in at least four places to determine out-of-round, taper, or undersize condition (Fig. 16).

If the journals exceed the wear limit, they should be refinished to size for the next undersize bearing.

REFINISHING JOURNALS

Refinish the journal to give the proper clearance with the next undersize bearing. If the journal will not "clean up" to give the proper clearance with the maximum undersize bearing available, replace the crankshaft.

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

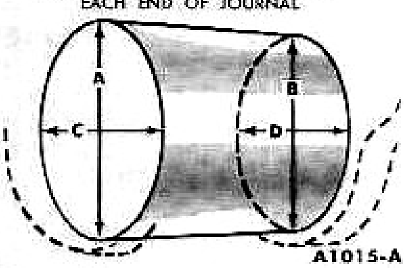


FIG. 16—Crankshaft Journal Measurements

After refinishing the journals, chamfer the oil holes, then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may be used also as a polishing agent.

CONNECTING RODS

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves.

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined crankpin, or a tapered connecting rod bore.

Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

CLEANING AND INSPECTION

Remove the bearings from the rod and cap. Identify the bearings if they are to be used again.

Clean the connecting rod in solvent, including the rod bore and the back of the inserts. **Do not use a caustic cleaning solution.** Blow out all passages with compressed air.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits and/or if the connecting rod is fractured, it should be replaced.

On a 352 engine, check the piston pin to connecting rod bushing clearance. Replace the connecting rod if the bushing is so worn that it cannot be reamed or honed for an oversize pin.

On a 430 engine, check the I. D. of the connecting rod piston pin bore and the O. D. of the piston pin. Replace the connecting rod if the pin bore is not within specifications. Replace the piston and pin if the pin is not within specifications. To check the interference fit of the pin in the connecting rod, refer to Part 1-3.

Replace defective connecting rod nuts and bolts.

After the connecting rods are assembled to the piston, check the connecting rods for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist is excessive, the connecting rod should be straightened or replaced.

PISTONS, PINS, AND RINGS

CLEANING AND INSPECTION

Remove deposits from the piston surfaces and from the underside of the piston head. Clean gum or varnish from the piston skirt, piston pins, and rings with solvent. **Do not use a caustic cleaning solution or a wire brush to clean pistons.** Clean the ring grooves with a ring groove cleaner (Fig. 17). Make sure the oil ring slots (or holes) are clean.

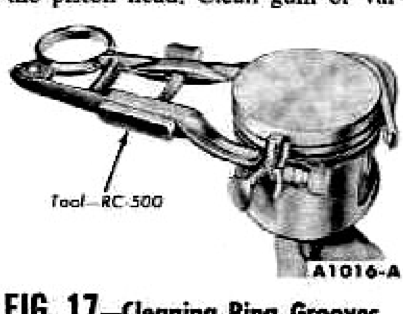


FIG. 17—Cleaning Ring Grooves

Carefully inspect the pistons for fractures at the ring lands, skirts, and pin bosses, and for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves have high steps, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation, or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands, fractures, and/or damage from detonation or pre-ignition.

Check the piston to cylinder bore clearance with a tension scale and ribbon (covered under "Fitting Pistons") and the ring side clearance (covered under "Fitting Piston Rings").

Replace piston pins showing signs of fracture or etching and/or wear.

On a 352 engine, check the piston pin fit in the piston and rod bushing.

To check the pin fit in the connecting rod of a 430 engine, refer to Part 1-3.

Replace all rings that are scored, chipped, or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling the engine. **Rings should not be transferred from one piston to another regardless of mileage.**

FITTING PISTONS

Pistons are available for service in standard sizes and 0.020, 0.030, 0.040, and 0.060-inch oversize. Standard size pistons are divided into two sizes and are identified by a daub of red or blue paint. Refer to Part 1-5 for the available sizes.

The piston to cylinder bore clearance should be from 0.0011-0.0029 inch (352 engine) or 0.0008—0.0026 inch (430 engine). The wear limit is 0.005 inch.

If the clearance is greater than the maximum limit, recheck calculations to be sure that the proper size piston has been selected, check for a damaged piston, then try a new piston.

If the clearance is less than the minimum limit, recheck calculations before trying another piston. If none can be fitted, refinish the cylinder for the next size piston.

When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.

If the taper and out-of-round conditions of the cylinder bore are within limits, new piston rings will give satisfactory service provided the piston clearance in the cylinder bore is within limits. If the new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall "glaze."

To fit a piston:

1. Calculate the size piston to be used by taking a cylinder bore check (Fig. 25).

2. Select the proper size piston to provide the desired clearance.

Make sure the piston and cylinder bore are at room temperature (70°F). **After any refinishing operation, allow the cylinder bore to cool and make sure the piston and bore are clean and dry before the piston fit is checked.**

3. Attach a tension scale to the end of a feeler gauge ribbon that is free of dents or burrs. The feeler ribbon should be ½ inch wide and of one of the thicknesses listed in Table 3.

4. Position the ribbon in the cylinder bore so that it extends the entire length of the piston at 90° from the piston pin location.

5. Invert the piston and install it in the bore so that the end of the piston is about 1½ inches below the top of the cylinder block and the piston pin is parallel to the crankshaft axis.

6. Hold the piston and slowly pull the scale in a straight line with the ribbon, noting the pull required to remove the feeler ribbon (Fig. 18).

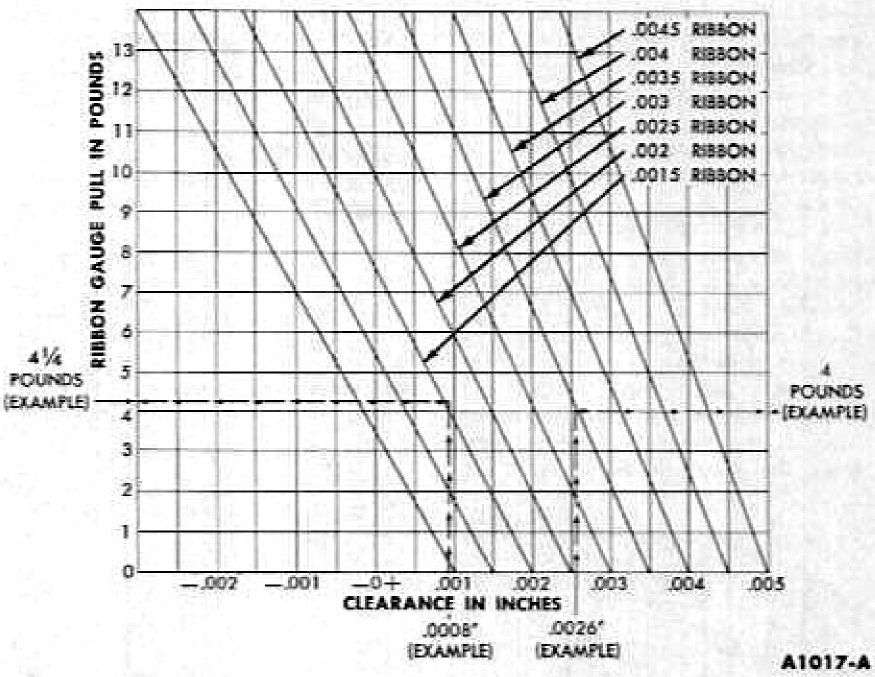
In Table 3, the diagonal lines represent feeler ribbons of various thicknesses, the horizontal lines represent the pounds pull, and the vertical lines represent the clearances. To determine the clearance, locate the line representing the pounds pull required to remove the feeler ribbon from the cylinder bore. Follow the horizontal line to the right until it intersects the diagonal line representing the feeler ribbon. Read down the vertical line for the clearance.

Example 1. If a 0.0015-inch feeler ribbon is used and it takes approximately 4¼ pounds pull to remove the feeler ribbon, the clearance is approximately 0.0008 inch. This is determined by locating the pounds pull (4¼) in Table 3 and following the line to the right until it intersects with the diagonal line representing the 0.0015-inch feeler ribbon. Read down the vertical line for the clearance (approximately 0.0008 inch).

Example 2. If a 0.003-inch feeler ribbon is used and it takes approximately 9 pounds pull to remove the ribbon, the resultant clearance is approximately 0.0015 inch.

Example 3. If a 0.003-inch feeler ribbon is used and it takes approximately 4 pounds pull to remove the feeler ribbon, the resultant clearance is approximately 0.0026 inch.

TABLE 3—Piston Clearance



FITTING PISTON RINGS

1. Select the proper ring set for the size piston to be used.

2. Position the ring in the cylinder bore in which it is going to be used.

3. Push the ring down into the cylinder bore area where normal ring wear is not encountered.

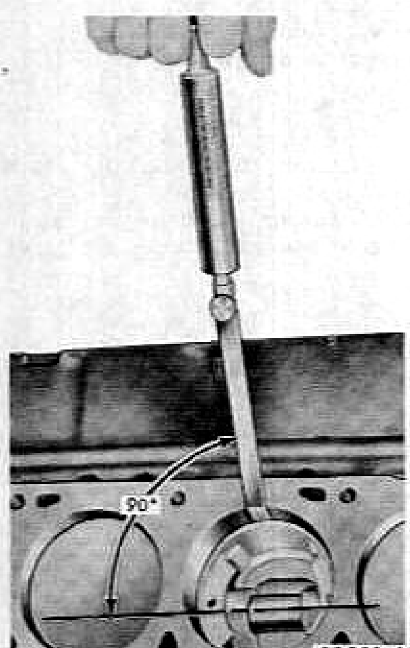


FIG. 18—Checking Piston Fit

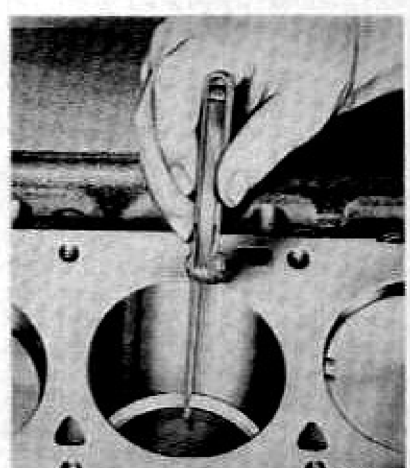


FIG. 19—Piston Ring Gap

4. Use the head of a piston to position the ring so that the ring is square with the cylinder wall. **Use caution to avoid damage to the ring or cylinder bore.**

5. Measure the gap between the ends of the ring with a feeler gauge (Fig. 19). If the gap is less than the recommended lower limit, try another ring set.

6. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 20).The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**

FIG. 20—Ring Side Clearance

FITTING PISTON PINS

The piston pin fit should be a light thumb press fit at normal temperature (70°F). Standard piston pins are coded green.

Pins of 0.001-inch oversize (color coded blue) and 0.002-inch oversize (color coded yellow) are available for the 352 engine.

Oversize piston pins are not available for the 430 engine. Piston and pins are serviced only as an asembly on this engine.

On a 352 engine, if the pin hole in the piston must be reamed, use an expansion-type piloted reamer. Place the reamer in a vise and revolve the piston around the reamer. Set the reamer to the size of the pin bore, then expand the reamer slightly and trial ream the pin bore. Take a light cut. Use a pilot sleeve of the nearest size to maintain alignment of the bores. Check the hole size, using the new piston pin. If the bore is small, expand the reamer slightly and make another cut. Repeat the procedure until the proper fit is obtained. Check the piston pin for fit in the respective rod bushing. If necessary, ream or hone the bushing to fit the pin.

MAIN AND CONNECTING ROD BEARINGS

CLEANING AND INSPECTION

Clean the bearing inserts and caps thoroughly. Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of bearing failure and their causes are shown in Fig. 21. Check the clearance of bearings that appear to be satisfactory with Plastigage. Fit new bearings following the recommended procedure.

BEARING REPLACEMENT

The main and connecting rod bearing inserts are selective fit and do not require reaming to size upon installation. **Do not file or lap bearing caps or use shims to obtain the proper bearing clearance.**

Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of red or blue paint. Refer to Part 1-5 for the available sizes. **Red marked bearings increase the clearance; blue marked bearings decrease the clearance.** Undersized bearings, which are not selective fit, are available for use on journals that have been refinished.

Normally, bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal, be sure to fit the bearing to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter with minimum clearance, interference may result, causing an early failure. It is not recommended that bearings be fitted to a crankshaft journal which exceeds the maximum out-of-round specifications. **When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.**

When checking the width of the Plastigage, check at the widest point in order to get the minimum clearance. Check at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.

If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, refinish the crankshaft journal, then install undersize bearings.

Do not get foreign matter under the inserts. In time the foreign matter may distort the bearing and cause bearing failure.

Main Bearings—Engine Installed

1. **Replace one bearing at a time, leaving the other bearings securely fastened.** Remove the main bearing cap to which new bearings are to be installed.

2. Insert the upper bearing removal tool (tool 6331) in the oil hole in the crankshaft.

3. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

4. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block. Using tool 6331 in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

5. Replace the cap bearing.

6. Clean the crankshaft journal and bearing inserts.

7. Support the crankshaft so its weight will not compress the Plasti-

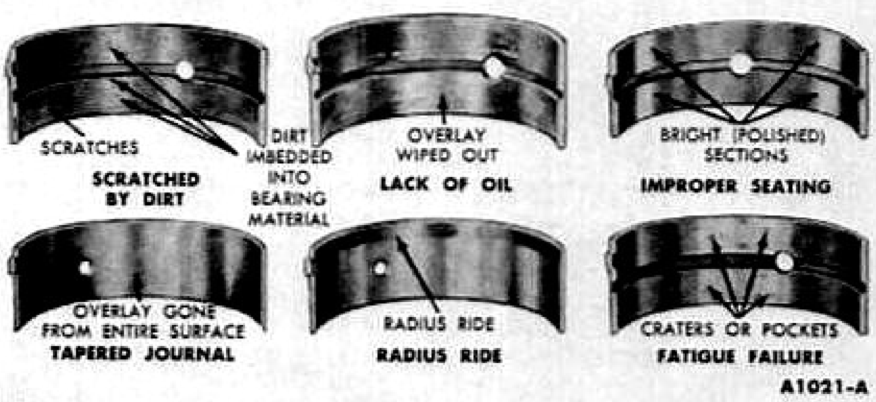


FIG. 21—Typical Bearing Failures

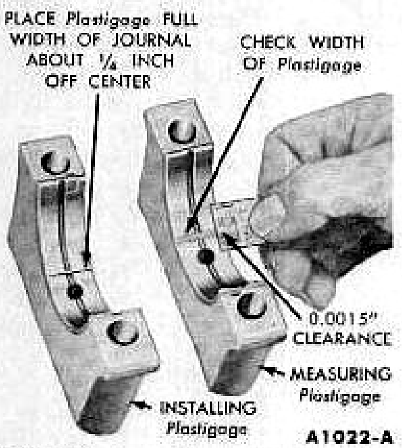


FIG. 22—Installing and Measuring Plastigage—Engine in Chassis

gage and provide an erroneous reading. Position a small jack so it will bear against the counterweight adjoining the bearing which is being checked.

8. Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about ¼ inch off center (Fig. 22).

9. Install the cap and tighten the bolts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

10. Remove the cap, then using the Plastigage scale, check the width of the Plastigage.

11. After the bearing has been checked and found to be satisfactory, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Tighten the cap bolts to specifications.

12. If the rear main bearing is replaced, replace the lower oil seal in the rear main bearing cap and the side seals. The upper oil seal (in the block) cannot be replaced with the crankshaft installed.

Main Bearings—Engine Removed

1. With the engine inverted on the workstand, remove the bearing insert from the cap and block of

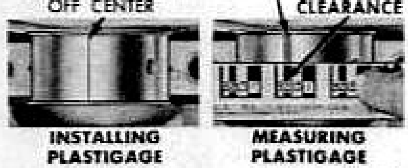


FIG. 23—Installing and Measuring Plastigage—Engine Removed

those bearings that are to be replaced.

2. Follow steps 4 thru 6 under "Main Bearings–Engine Installed."

3. Place a piece of Plastigage on the crankshaft journal, the full width of the journal and about ¼ inch off center (Fig. 23).

4. Follow steps 9 thru 12 under "Main Bearings–Engine Installed."

Connecting Rod Bearings.

1. Install the new bearings in the connecting rod and cap.

2. Pull the connecting rod assembly down firmly on the crankshaft journal.

3. Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about ¼ inch off center.

4. Install the cap and tighten the connecting rod nuts to specifications. **Do not turn the crankshaft while the Plastigage is in place.**

5. Remove the cap, then using the Plastigage scale check the width of the Plastigage.

6. After the bearing clearance has been checked and found to be satisfactory, apply a light coat of engine oil to the journal and bearings, then install the connecting rod cap.

7. Repeat the procedure for the remaining connecting rods that require new bearings.

FLYWHEEL—MANUAL-SHIFT TRANSMISSIONS

INSPECTION

Inspect the flywheel for cracks, heat check, or other defects that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout.

FLYWHEEL FACE RUNOUT

Install a dial indicator so that the indicator point bears against the flywheel face (Fig. 24). Turn the flywheel, making sure that it is full forward or rearward so that crankshaft end play will not be indicated as flywheel runout.

If the runout exceeds the maximum limit, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft flywheel face if the mounting flange runout is excessive.

RING GEAR REPLACEMENT

Heat the defective ring gear with a blow torch on the engine side of the gear, then knock it off the flywheel. **Do not hit the flywheel when removing the ring gear.**

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. **Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the ring gear teeth.**

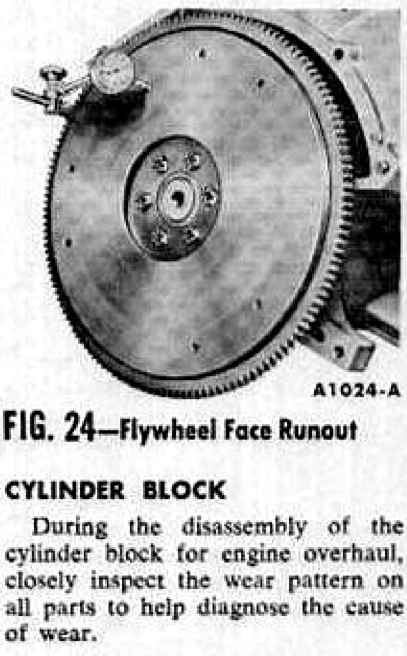


FIG. 24—Flywheel Face Runout

CYLINDER BLOCK

During the disassembly of the cylinder block for engine overhaul, closely inspect the wear pattern on all parts to help diagnose the cause of wear.

CLEANING AND INSPECTION

Thoroughly clean the block in solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs which seal oil passages, then clean out all the passages. Blow out all passages, bolt holes, etc. with compressed air. Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

After the block has been thoroughly cleaned, make a check for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in denatured alcohol. If cracks are present, the coating will become discolored at the defective area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches, and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head.

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle, and bottom with the gauge placed at right angles and parallel to the centerline of the engine (Fig. 25).

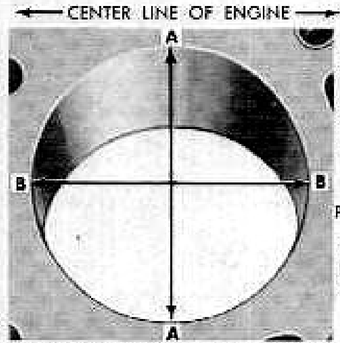


FIG. 25—Cylinder Bore Out-of-Round and Taper

Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the wear limits.

If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder walls and installing new service piston rings providing the piston clearance is within limits. Use the finest grade of honing stone for this operation.

REFINISHING CYLINDER WALLS

Honing is recommended for refinishing cylinder walls only when the walls have minor imperfections, such as light scuffs, scratches, etc. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. Before any cylinder is refinished, all main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the refinishing operation.

Refinish only the cylinder or cylinders that require it. **All pistons are the same weight, both standard and oversize; therefore, various sized pistons can be intermixed without upsetting engine balance.**

Refinish the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when refinished for the maximum oversize piston recommended, replace the block.

Refinish the cylinder to within approximately 0.0015 inch of the required oversize diameter. This will allow enough stock for the final step of honing so that the correct surface finish and pattern are obtained. Use clear sharp hones of No. 220-280 grit for this operation.

For the proper use of the refinishing equipment, follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work.

After the final operation in either of the two refinishing methods described and prior to checking the piston fit, thoroughly wash the cylinder walls with solvent to remove all abrasive particles, then thoroughly dry the walls. Check the piston fit. Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons fitted, thoroughly clean the entire block to remove all particles from the bearing bores, oil passages, cylinder head bolt holes, etc. Coat the cylinder walls with oil.

OIL PAN AND OIL PUMP (AND 430 ENGINE VACUUM BOOSTER)

OIL PAN

Scrape any dirt or metal particles from the inside of the pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign matter is removed from below the baffle plate.

Check the pan for cracks, holes, damaged drain plug threads, a loose baffle, and a nicked or warped gasket surface.

Repair any damage, or replace the pan if repairs can not be made.

OIL PUMP

Cleaning. Wash all parts in a solvent and dry them thoroughly. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and chips are removed.

Clean the vacuum pump housing, rotor, and vanes (430 engine).

Inspection. Check the inside of the pump housing and the outer race and rotor for damage or excessive wear.

Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored, or grooved, replace the cover.

Measure the outer race to housing clearance (Fig. 26).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the rotor end play clearance between the straight edge and the rotor and outer race (Fig. 27).

The outer race, shaft and rotor are replaceable only as an assembly.

Check the drive shaft to housing bearing clearance by measuring the

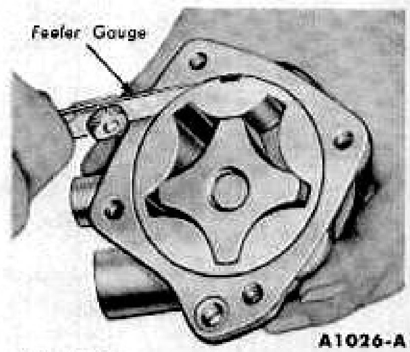


FIG. 26—Outer Race to Housing Clearance

O.D. of the shaft and the I.D. of the housing bearing.

Inspect the relief valve spring for a collapsed or worn condition.

Check the relief valve spring tension. If the spring tension is not within specifications and/or the spring is defective, replace the spring.

Check the relief valve piston for scores and free operation in the bore.

On a 430 engine pump, inspect all the vacuum pump parts for damage. Replace the complete vacuum pump if any part is damaged.

CRANKCASE VENTILATION SYSTEM MAINTENANCE

Refer to Group 17 for the correct mileage interval for maintenance.

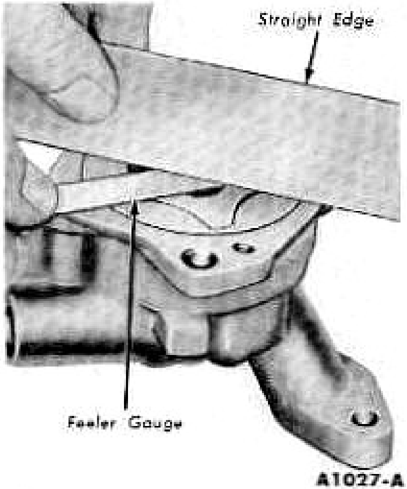


FIG. 27—Rotor End Play

The breather cap located on the oil filler tube should be cleaned with a solvent at the proper mileage interval. After cleaning, oil the mesh screen in the cap with light engine oil.

The road draft tube seldom requires cleaning except during a high mileage engine overhaul. However, if there is evidence of crankcase pressure, the tube should be checked for excessive sludge and cleaned out if necessary. In addition, on the 352 engines, the maze screen in the intake manifold baffle plate should be cleaned in solvent to remove any accumulation of sludge deposits.

PART 1-2 THUNDERBIRD 352 SPECIAL V-8

1 DESCRIPTION

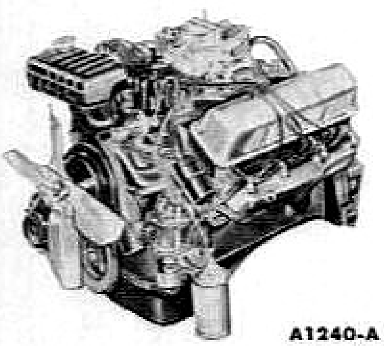

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FIG. 1—Thunderbird 352 Special V-8 Engine

The Thunderbird 352 Special V-8 engine (Figs. 1 and 2) has a 4.00-inch bore and a 3.50-inch stroke and a total piston displacement of 352 cubic inches. It has a compression ratio of 9.6:1. The patent plate symbol for the engine is "H."

MANIFOLDS

The intake manifold, which also serves as the valve push rod chamber cover, contains a passage through the center section and under the carburetor, through which hot exhaust gases are directed to assist in vaporizing the incoming fuel charge (Fig. 3).

The exhaust gases are directed into the intake manifold by a thermostatically controlled exhaust valve (Fig. 4). The valve is located at the outlet of the right exhaust manifold. When the valve is in the closed (heat on) position, part of the exhaust gases are directed from the right exhaust manifold, through the heat riser passage, to the left exhaust manifold. When the valve opens (heat off), more of the exhaust gases from the right manifold are permitted to flow directly out the exhaust system in the normal manner.

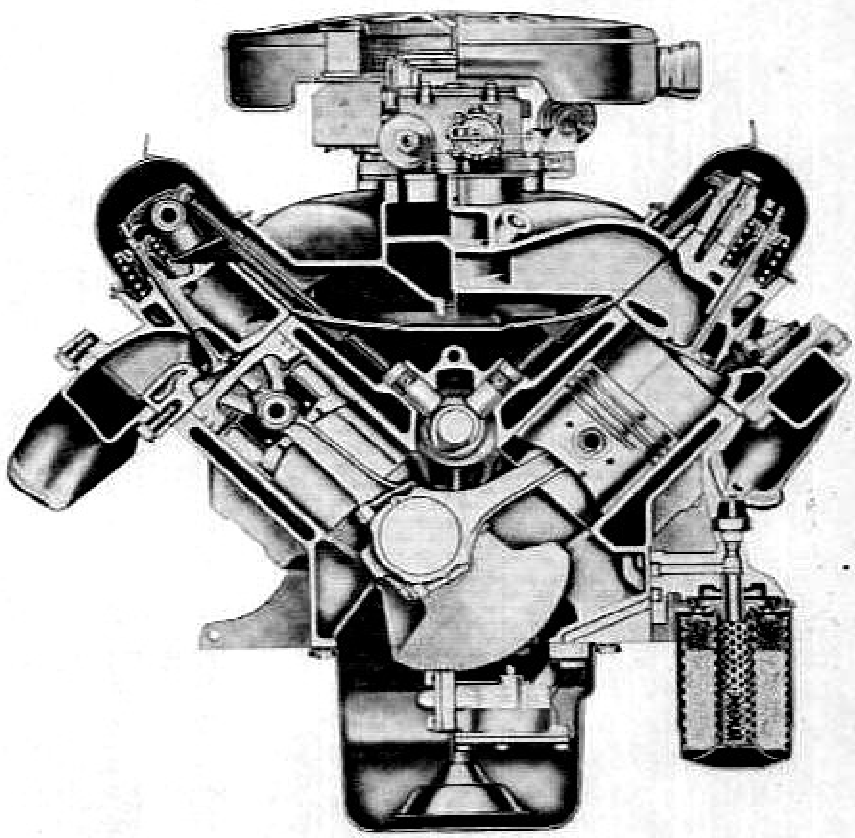
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FIG. 2—Sectional View of Thunderbird 352 Special V-8 Engine

The intake manifold has two sets of fuel passages, each with its own

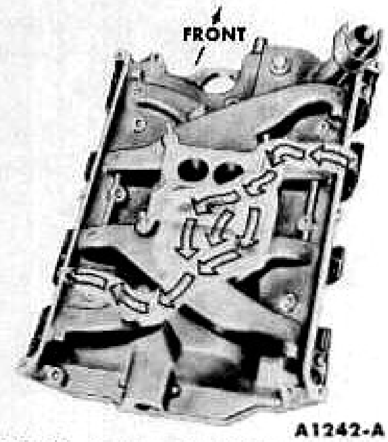


FIG. 3—Intake Manifold Exhaust Gas Passages

separate inlet connection to the carburetor (Fig. 5). The right barrels of the carburetor feed Nos. 1, 4, 6, and 7 cylinders and the left barrels feed Nos. 2, 3, 5, and 8 cylinders.

The distributor is mounted at the left front of the intake manifold.

CYLINDER HEADS

The cylinder head assemblies contain the valves and the valve rocker arm shaft assembly. The combustion chambers are cast in the head. Valve guides are an integral part of the head. The valves are arranged from front to rear on both banks E-I-E-I-I-E-I-E (Fig. 6).

CYLINDER BLOCK

The cylinders are numbered from front to rear on the right bank 1, 2, 3, 4 and on the left bank 5, 6, 7, 8. The firing order is 1-5-4-2-6-3-7-8.

The crankshaft is supported by five insert main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The top compression ring of the piston is chrome-plated and the lower

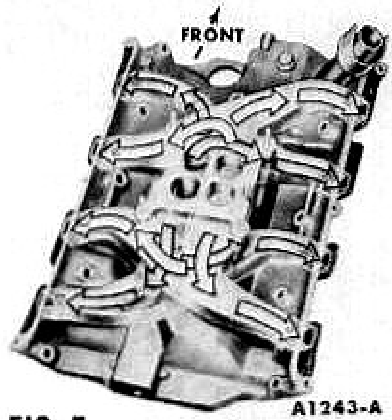


FIG. 5—Intake Manifold Fuel Passages

compression ring is phosphate-coated. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.

VALVE TRAIN

The intake and exhaust valve assemblies are the rotating-type.

The valve rocker arms do not have adjusting screws because there is no valve lash adjustment with hydraulic valve lifters.

The camshaft is supported by five bearings pressed into the block.

The camshaft is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft end play is controlled by a thrust button and spring located be-

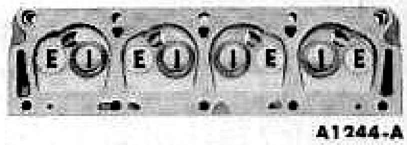


FIG. 6—Valve Port Arrangement

tween the camshaft sprocket bolt and the cylinder front cover.

Hydraulic valve lifters are used which provide zero valve lash and minimize valve train noise. The operation and parts identification of the hydraulic valve lifters are shown in Fig. 7.

When the valve is closed, the lifter assembly is on the base circle of the camshaft lobe and the valve push rod is in its lowest position. With the lifter assembly in this position, the plunger spring expands forcing the plunger upward. This action is transmitted to the valve rocker arm via the valve push rod until there is solid contact between the valve and the valve end of the valve rocker arm (zero valve lash). In this position, the oil hole in the lifter and plunger is indexed with the lifter oil gallery and oil is forced under pressure into the plunger. This creates a pressure differential above and below the valve disc. The high pressure above the valve disc forces the valve disc open and the oil fills the area below the plunger, equalizing the pressure on each side of the valve disc.

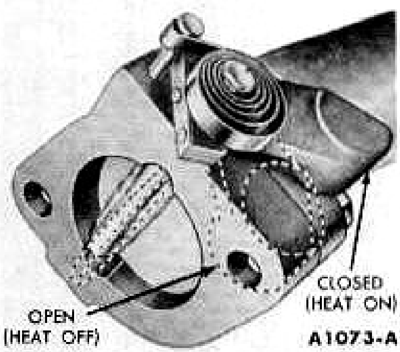


FIG. 4—Exhaust Gas Control Valve

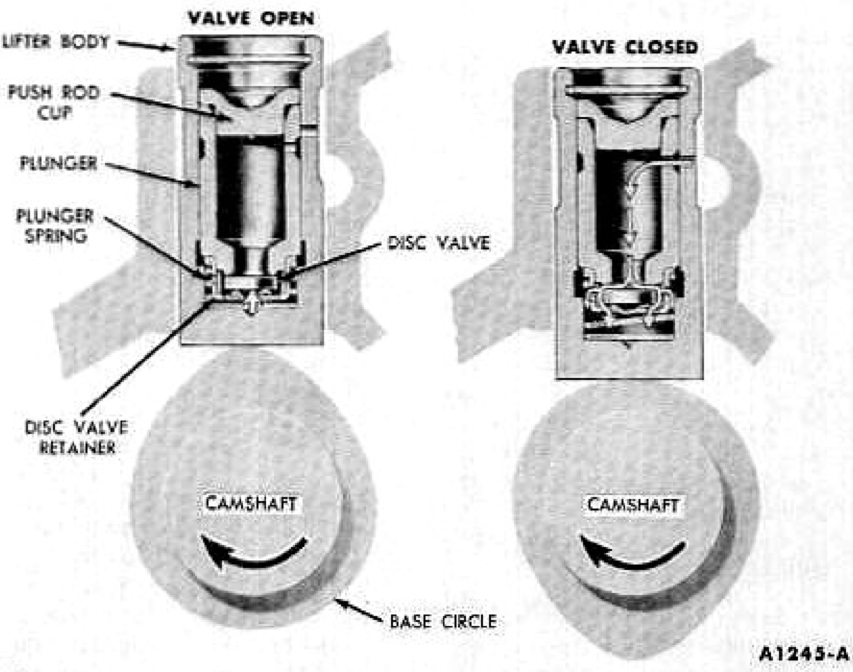


FIG. 7—Typical Hydraulic Valve Lifter Operation

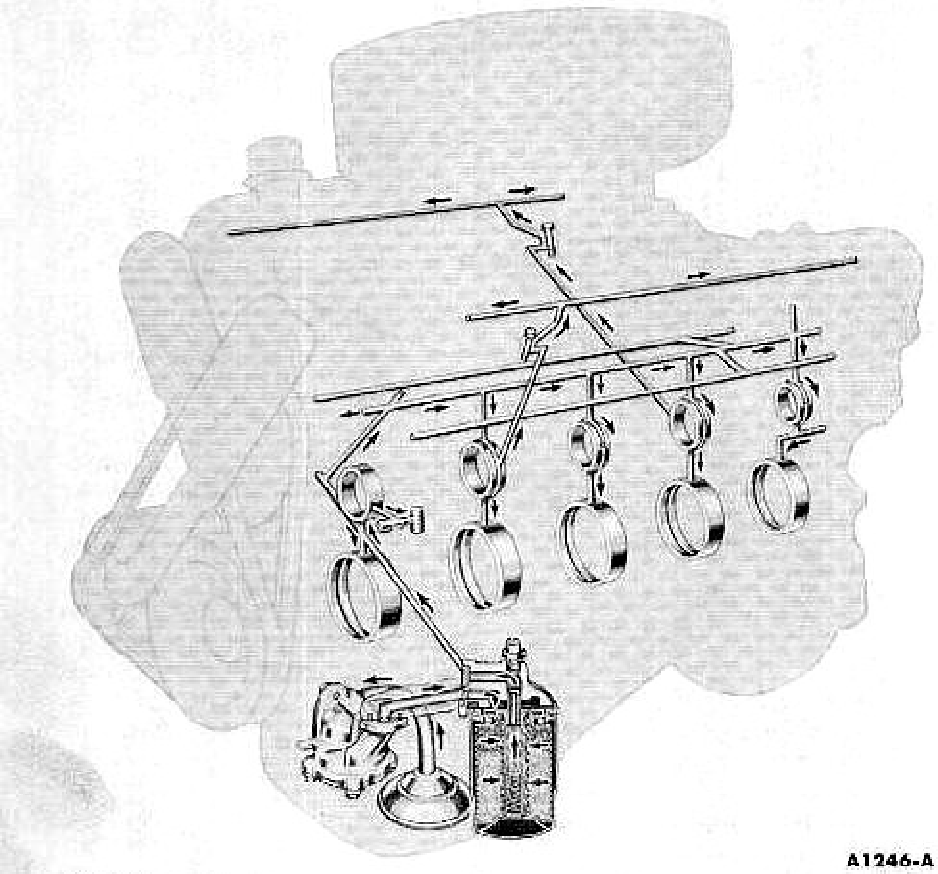


FIG. 8—Lubrication System

Whenever clearance between the valve and the valve rocker arm tends to be present, the plunger spring expands pushing the plunger until there is solid contact between all parts of the valve train mechanism.

As the camshaft rotates (valve opening), the valve lifter is raised and the sudden increase in oil pressure below the plunger forces the valve disc closed and the lifter becomes a hydraulic ram. During this period, a slight leakage of oil from below the plunger occurs. As the high point on the camshaft lobe rotates past the lifter, the push rod forces the valve lifter down and reseats the valve. The pressure on the oil below the plunger is relieved and the valve disc opens so that the chamber can again be filled. This cycle is repeated for each revolution of the camshaft.

LUBRICATION SYSTEM

Oil from the oil pan sump is forced through the pressure-type lubrication system (Fig. 8) by a rotor oil pump. The oil pump is mounted in the front of the crankcase. A spring loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

A full-flow filter filters the entire output of the pump before it enters the engine. A relief valve in the filter permits oil to bypass the filter if it becomes clogged.

The oil from the filter flows into the main oil gallery which supplies oil to each camshaft bearing, through drilled passages in the block. Passages are drilled from each camshaft bearing to each main bearing. Number 1 camshaft bearing feeds No. 1 main bearing, and No. 2 camshaft bearing feeds No. 2 main bearing, etc.

The oil then flows through notches or grooves in the main bearings to lubricate the crankshaft journals. A jiggle pin in the main oil gallery front plug allows any air that may be trapped in the oil to escape. The timing chain and sprockets are splash lubricated by oil from the jiggle pin.

The crankshaft is drilled from the main bearings to the connecting rod bearings. The oil flow is a follows:

Main Bearing		Connecting Rod Bearing
No. 1	Serves	No. 1
No. 2	Serves	Nos. 2 and 5
No. 3	Serves	Nos. 3 and 6
No. 4	Serves	Nos. 4 and 7
No. 5	Serves	No. 8

A small groove is located in the connecting rod at the mating face where the cap contacts the connecting rod. This groove is used as an oil squirt hole for cylinder wall lubrication. Oil from the connecting rod squirt hole lubricates the opposite cylinder will. For example, the No. 1 connecting rod oils No. 5 cylinder, etc. As the crankshaft turns, the hole in the connecting rod bearing aligns with the hole in the journal causing a direct squirt of oil onto the cylinder wall.

Oil passages are drilled from the main oil gallery to each valve lifter oil gallery. Oil from here feeds the valve lifter assemblies. A reservoir at each valve lifter bore boss traps oil so that oil is available for valve lifter lubrication as soon as the engine starts.

An oil passage is drilled from No. 2 camshaft bearing web to the left cylinder head between Nos. 5 and 6 cylinders to lubricate the valve rocker arm shaft assembly (Fig. 9). The oil passage in the cylinder head is drilled from the cylinder head bolt bore to the No. 2 valve rocker arm shaft support.

The oil flows through the valve rocker arm shaft through drilled holes in each valve rocker arm to lubricate the shaft bore and both ends of the valve rocker arm. The excess oil spirals down the rotating push rods and

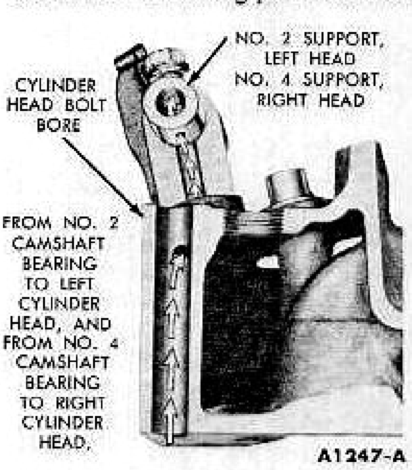


FIG. 9—Valve Rocker Arm Shaft Lubrication

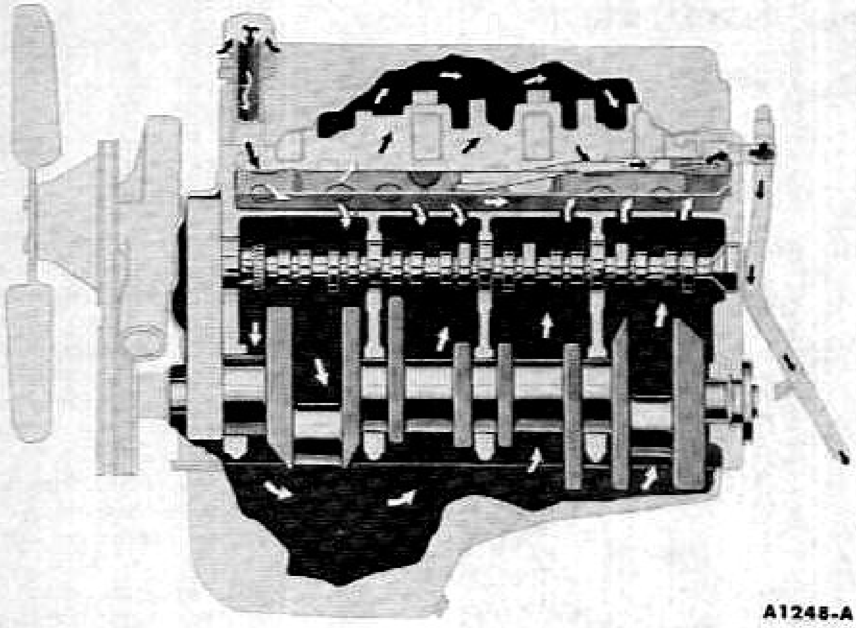


FIG. 10—Crankcase Ventilation System

lubricates the push rod seats. The right valve rocker arm shaft assembly is similarly lubricated from No. 4 camshaft bearing via the No. 4 valve rocker arm shaft support.

A baffle located under the valve rocker arm shaft assembly shields the valve stems from oil splash. Excess oil is returned to the oil pan through drain back holes located at each end of the cylinder head and in the push rod chamber floor.

CRANKCASE VENTILATION

A crankcase ventilation tube is located at the rear of the engine. The forward motion of the car causes a partial vacuum to be formed at the tube outlet. This vacuum action causes air to be drawn through the engine from the oil filler cap located at the front of the intake manifold (Fig. 10). The filler cap contains a filtering element which filters the incoming air.

From the filler cap, the air flows into the front section of the valve push rod chamber where there are few contaminating vapors. Here, the incoming air has a chance to warm up before contacting contaminating vapors originating in the crankcase. Warm ventilating air minimizes the formation of crankcase sludge.

The ventilating air is directed by a baffle, located on the underside of the intake manifold, upward into the front of both valve rocker arm chambers. The baffle also directs air to the front of the lower crankcase and into the timing chain chamber.

Air from the valve rocker arm chamber and from the crankcase flows into the rear of the valve push rod chamber. All air is then directed out the crankcase ventilation tube.

COOLING SYSTEM

The coolant is drawn from the bottom of the radiator by the water pump which delivers the coolant to the cylinder block (Fig. 11).

The coolant travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder heads where it cools the combustion chambers, valves, and valve seats on its return to the front of the engine.

The coolant from each cylinder head flows through the water passages in the intake manifold and past the water thermostat, if it is open, into the radiator supply tank. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation. The entire system is pressurized to 13-15 psi.

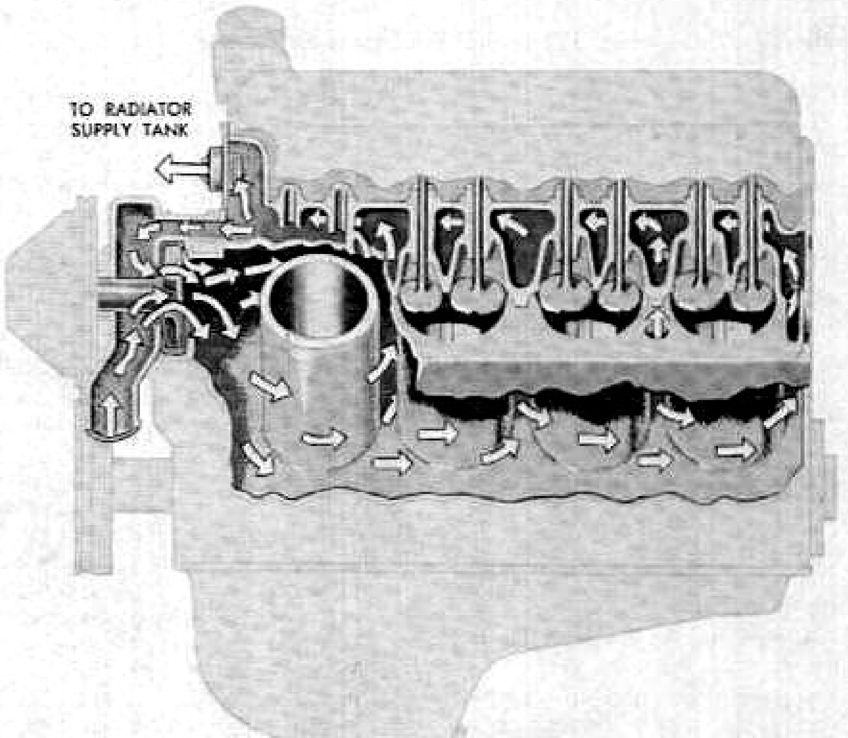


FIG. 11—Cooling System

2 ENGINE REMOVAL AND INSTALLATION

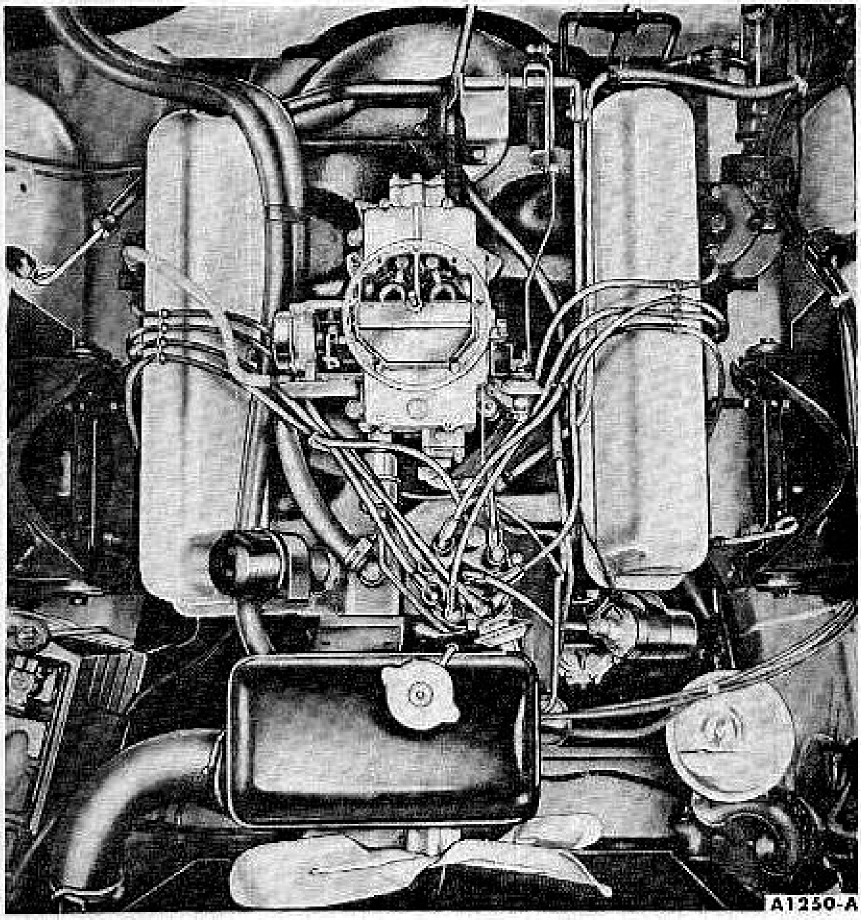


FIG. 12—Thunderbird 352 Special V-8 Engine Installation

The procedures given are for the engine without the transmission attached. If the engine and transmission are removed as an assembly, install standard eye bolts with ½-14 threads in the bosses at the top rear of the exhaust manifolds. Then attach the engine lifting bracket and sling to the eye bolts. The engine installation is shown in Fig. 12.

REMOVAL

1. Drain the cooling system and the crankcase.

2. Disconnect the battery ground cable at the engine.

3. Remove the hood, radiator, and the air cleaner.

4. Remove the oil level dipstick and the coil.

5. Disconnect the oil pressure sending unit wire at the sending unit and the flexible fuel line at the fuel tank line.

6. Disconnect the flexible windshield wiper line at the vacuum pump and position it out of the way.

7. Remove the wire loom from the clips on the left valve rocker arm cover and position the wires out of the way.

8. On a car with a windshield washer, disconnect the three lines at the washer pump and position them out of the way.

9. On a car with a manual-shift transmission, disconnect the accelerator. Remove the accelerator retracting spring.

10. On a car with an automatic transmission, disconnect the accelerator rod and the transmission rod at the accelerator cross shaft bracket and secure them to the dash panel.

11. On a car with power steering, disconnect the power steering pump bracket from the water pump, then wire the power steering pump to the hood left hinge in a position that will prevent the oil from draining out.

12. On a car with power brakes, disconnect the power brake line at the intake manifold and at the flexible line, then release the line from the brackets on the left valve rocker arm cover and remove the line.

13. On a car with an air conditioner, disconnect the magnetic clutch wire. Isolate the compressor.

14. Disconnect the heater hose at the water pump and at the intake manifold.

15. Disconnect the generator wires at the generator.

16. Disconnect the engine temperature sending unit wire at the sending unit.

17. Remove the engine ground strap and the starter cable retaining bracket from the rear of the right cylinder head.

18. Raise the front of the car.

19. Remove the starter and dust seal (and the automatic transmission fluid filler tube bracket). Remove the crankcase ventilation tube.

20. Disconnect the muffler inlet pipes from the exhaust manifolds, and the engine right and left support insulators at the engine.

21. On a car with an automatic transmission, remove the converter housing lower access cover and the cover assembly. Remove the flywheel to converter nuts. Secure the converter assembly in the housing. Remove the converter housing to engine lower bolts, and remove the oil cooler lines retaining clamp from the engine block.

22. On a car with a manual-shift transmission, remove the flywheel housing inspection cover and the clutch pedal retracting spring. Disconnect the clutch release bracket at the equalizer rod and remove the bracket from the engine. Remove the flywheel housing to engine upper bolts.

23. Lower the car, then support the transmission. Remove the converter or flywheel housing upper retaining bolts.

24. Install the engine left lifting bracket on the front of the left cylinder head where the coil mounts. Install the engine right lifting bracket at the rear of the right cylinder head. Attach the engine lifting sling (Fig. 13.)

25. Raise the engine slightly and carefully pull it from the transmission.

26. Lift the engine out of the engine compartment and install it on a work stand (Fig. 14).

INSTALLATION

1. Position the exhaust gas control valve, with a new gasket on each side, on the right exhaust manifold studs. Temporarily tie the valve to the manifold. Place a new gasket over the studs of the left exhaust manifold.

2. Loosen the engine right and left support insulators at the underbody.

3. Attach the engine lifting brackets and sling (Fig. 13), then remove the engine from the work stand.

4. Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and the dowels in the block engage the holes in the flywheel housing or converter housing.

5. On a car with an automatic transmission, start the converter pilot into the crankshaft.

6. On a car with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

7. Install the crankcase ventilation tube and the flywheel housing or converter housing upper bolts. Tighten the bolts to specifications.

8. Start the engine right and left support insulator to engine bolts. Disconnect the engine lifting sling and remove the lifting brackets.

9. Raise the front of the car. Install the flywheel housing or converter housing lower retaining bolts. Tighten the bolts to specifications.

10. On a car with an automatic transmission, remove the retainer securing the converter in the housing, then install the flywheel to converter lockwashers and nuts. Tighten the nuts to specifications. Install the converter lower access plate and the housing cover assembly. Install the oil cooler lines retaining clamp.

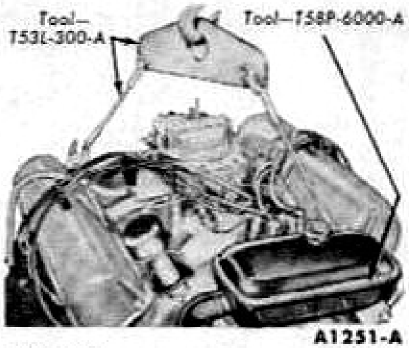


FIG. 13—Engine Lifting Brackets and Sling

11. On a manual-shift transmission, install the clutch bracket. Connect the clutch release rod and install the clutch retracting spring. Install the flywheel housing lower cover.

12. Tighten all the engine front support insulator bolts and nuts to 45-50 foot-pounds torque.

13. Remove the retainer securing the exhaust gas control valve, then connect both exhaust manifolds to the muffler inlet pipes. Tighten the nuts to specifications.

14. Position the dust seal and install the starter (and the automatic transmission fluid filler tube bracket).

15. Remove the support from the transmission and lower the car.

FIG. 14—Engine Work Stand

16. Connect the generator wires.

17. Connect the engine temperature sending unit wire. Connect the heater hose at the intake manifold.

18. Connect the engine ground strap and install the starter cable retaining clamp to the rear of the right cylinder head.

19. Connect the flexible fuel line, the oil pressure sending unit wire, and the windshield wiper vacuum line.

20. Install the coil and connect the coil primary and high tension wires.

21. Install the oil level dipstick.

22. Position the wire loom in the retaining clips on the left valve rocker arm cover.

23. On a car with a windshield washer, connect the three washer pump lines.

24. On a car with an automatic transmission, connect the accelerator rod and the transmission rod.

25. On a car with a manual-shift transmission, install the accelerator retracting spring. Connect the accelerator rod.

26. On a car with power steering, connect the power steering pump bracket to the water pump.

27. On a car with power brakes, connect the power brake line to the intake manifold and to the flexible line and install the line in the retaining clips on the left valve rocker arm cover.

28. On a car with an air conditioner, connect the magnetic clutch wire and the compressor lines.

29. Install the radiator.

30. Fill and bleed the cooling system. Connect the heater hose at the water pump.

31. Fill the crankcase with the proper grade and quantity of engine oil.

32. Operate the engine at fast idle and check all gaskets and hose connections for leaks.

33. On a car with an automatic transmission, adjust the transmission control linkage.

34. Install the air cleaner.

3 ENGINE DISASSEMBLY—ENGINE REMOVED

INTAKE MANIFOLD AND DISTRIBUTOR

1. Disconnect the wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers.

2. Remove the distributor cap and spark plug wire assembly.

3. Disconnect the distributor vacuum line at the distributor.

4. Remove the carburetor fuel inlet line, the vacuum pump lines, then remove the fuel pump and discard the gasket.

5. Remove the radiator supply tank.

6. Slide the clamp on the water pump bypass hose toward the water pump.

7. Remove the automatic choke heat tube.

8. Remove the valve rocker arm covers.

9. Crank the engine until the No. 1 piston is at T.D.C. at the end of the compression stroke.

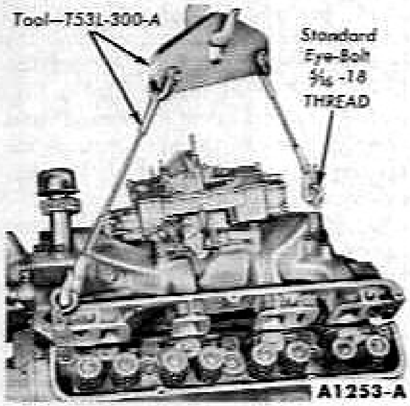


FIG. 15—Intake Manifold Removal or Installation

10. Rotate the crankshaft damper an additional 45°.

11. Starting at the No. 4 cylinder, loosen the right valve rocker arm shaft support bolts in sequence, two turns at a time. After the bolts are all loosened, remove the valve rocker arm shaft assembly and the oil baffle plate.

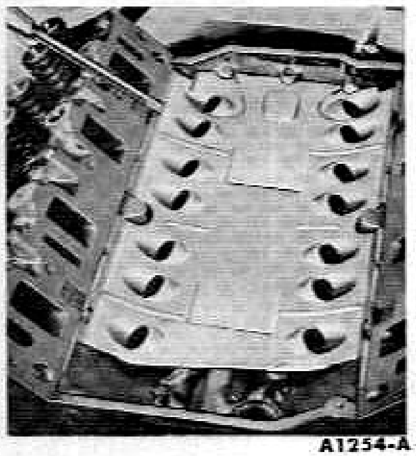


FIG. 16—Baffle Plate Removal

12. Starting at the No. 5 cylinder, follow the same procedure on the left valve rocker arm shaft support bolts. **This procedure must be followed to avoid damage to the valve mechanism.**

13. Remove the valve push rods in sequence.

14. Remove the distributor hold down bolt and clamp and remove the distributor.

15. Remove the intake manifold retaining bolts.

16. Install standard eye bolts with 5/16-18 threads in the left front and right rear rocker arm cover screw holes and attach the engine lifting sling (Fig. 15).

17. Raise the manifold and carefully remove it from the engine.

18. Remove the intake manifold gaskets and seals.

19. Remove the baffle plate from the valve push rod chamber floor by prying up on the baffle with a screwdriver (Fig. 16).

20. Lift the hydraulic valve lifters from the cylinder block and place them in a rack so that they can be installed in their original bore. **The internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts.** Keep the assemblies intact until they are to be cleaned.

21. If the hydraulic valve lifters can not be removed with the fingers, remove them with the tool shown in Fig. 17.

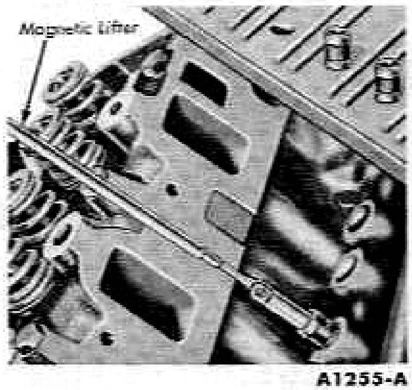


FIG. 17—Hydraulic Valve Lifter Removal

CYLINDER HEADS

1. Remove the exhaust manifold lower retaining bolts and tab washers and remove the exhaust manifolds. Remove the spark plugs.

2. Remove the cylinder head bolts, and then install the cylinder head holding fixtures (Fig. 18).

3. Lift the cylinder head off the block. **Do not pry between the head and the block.** Remove and discard the cylinder head gasket.

OIL FILTER AND ADAPTER

Unscrew the oil filter from the adapter. Remove the oil filter adapter assembly and oil pressure sending unit as an assembly. Discard the gasket.

OIL PAN AND OIL PUMP

1. Invert the engine on the work stand.

2. Remove the oil pan retaining screws and remove the oil pan. Discard the gasket.

3. Remove the oil pump attaching bolts and remove the oil pump and inlet tube as an assembly. Remove the oil pump drive shaft. Discard the oil pump gasket.

FLYWHEEL

1. On a flywheel for a manual-shift transmission, mark the pressure plate cover so that it can be replaced in the same position, and remove the clutch pressure plate and cover assembly.

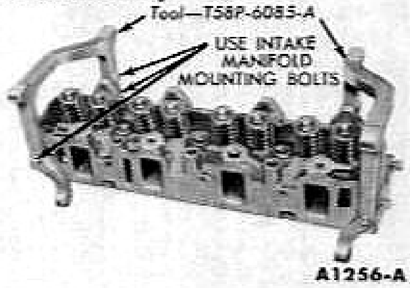


FIG. 18—Cylinder Head Holding Fixtures

2. Remove the flywheel retaining bolts and remove the flywheel.

CYLINDER FRONT COVER

1. Disconnect the drive belt adjusting arm at the generator.

2. Remove the generator support bolt at the water pump and the bracket bolt at the cylinder block.

3. Remove the generator, brackets, and drive belts.

4. Remove the water pump, pulley, and fan as an assembly.

5. On a car with power steering, remove the power steering pulley.

6. Remove the crankshaft damper cap screw and washer from the end of the crankshaft.

7. Install the puller on the crankshaft damper (Fig. 19) and remove the damper.

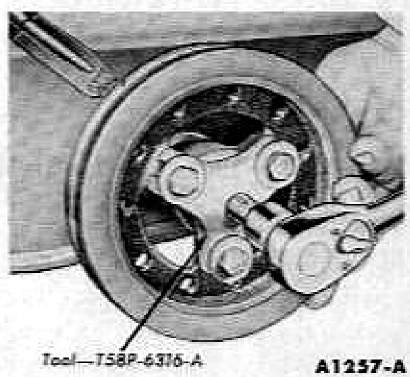


FIG. 19—Crankshaft Damper Removal

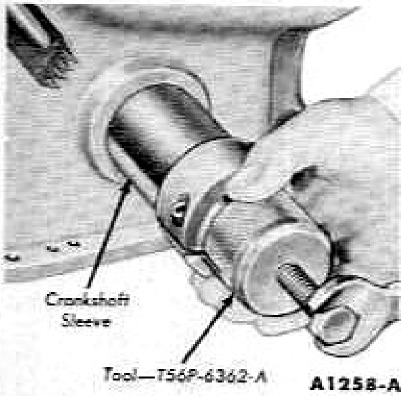


FIG. 20—Crankshaft Sleeve Removal

8. If the crankshaft sleeve is not stepped down (the same O.D. on both ends), remove it as shown in Fig. 20. If the crankshaft sleeve is stepped down (different O.D. on each end), remove it with a three-jawed puller (tool 7675-N).

9. Remove the cylinder front cover. Discard the cylinder front cover gasket.

TIMING CHAIN AND SPROCKETS

1. Remove the crankshaft front oil slinger.

2. Remove the camshaft thrust button and spring, the sprocket cap screw, the thrust button spring retainer, and the fuel pump eccentric.

3. Slide both sprockets and the timing chain forward, and remove the sprockets and timing chain as an assembly (Fig. 21).

CONNECTING ROD ASSEMBLIES

1. Turn the engine on the work stand so that the front end is up.

2. Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

3. Make sure all connecting rods and caps are marked so that they can be installed in their original locations.

4. Turn the crankshaft until the connecting rod being removed is down.

5. Remove the connecting rod cap.

6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankpin or the cylinder wall when removing the piston and rod.**

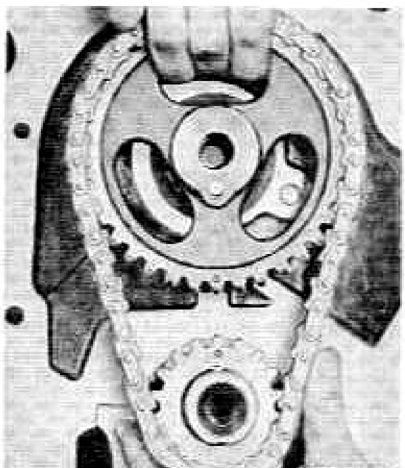


FIG. 21—Timing Chain Removal or Installation

7. Remove the bearing inserts from the connecting rods and caps.

CRANKSHAFT

1. Remove the main bearing caps.

2. Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

3. Remove the rear journal oil seal from the block and rear bearing cap, and remove the cap to block side seals.

4. Remove the main bearing inserts from the block and bearing caps.

CAMSHAFT

Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

CAMSHAFT BEARINGS

Drill a ½-inch hole in the camshaft rear bearing bore plug and use tool T-7600-E to remove the plug. Remove the camshaft bearings (Fig. 22).

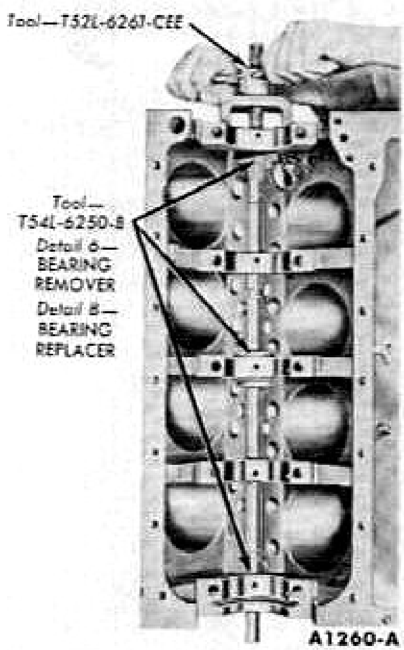


FIG. 22—Camshaft Bearing Removal or Installation

4 DISASSEMBLY AND ASSEMBLY OF COMPONENT PARTS

VALVE ROCKER ARM SHAFT

DISASSEMBLY

1. Remove the cotter pins from each end of the valve rocker arm shaft, then remove the flat washers and spring washers.

2. Slide the rocker arms, springs, and the supports off the shaft. Be sure to identify all the parts.

3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce one plug. Insert a steel rod through the plug and knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

ASSEMBLY

1. Lubricate all parts with engine oil. Apply Lubriplate to the pad of the valve rocker arms.

2. If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the rocker arm shaft.

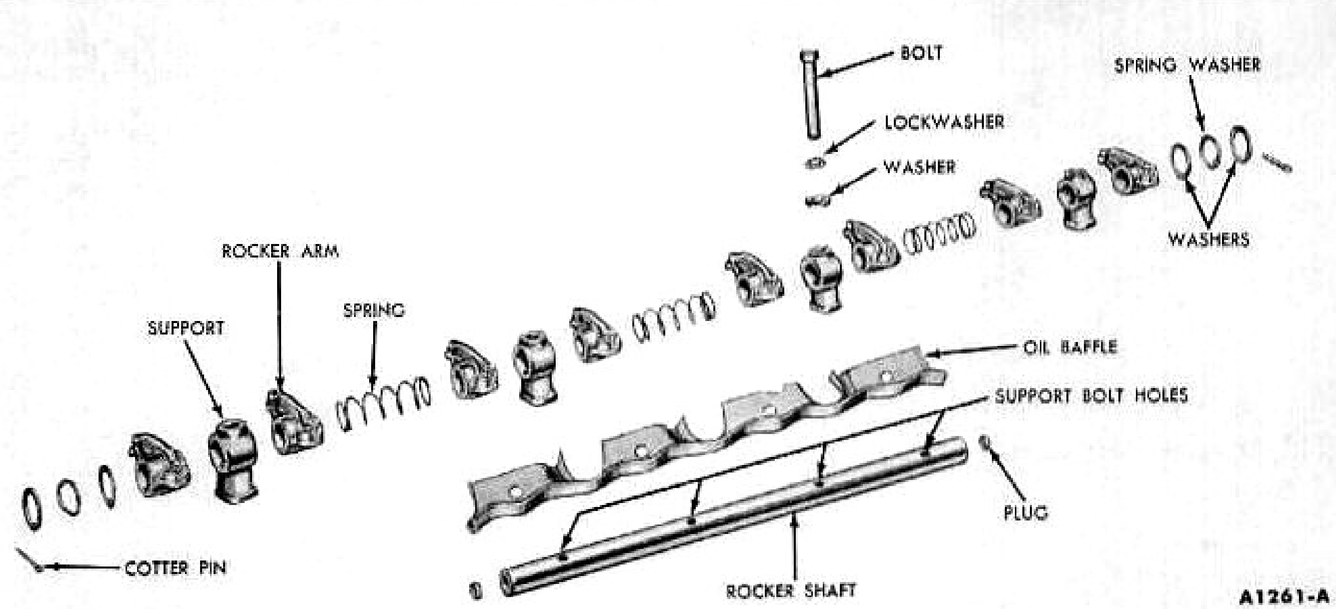


FIG. 23—Valve Rocker Arm Shaft Assembly

3. Install the rocker arms, supports, and springs in the order shown in Fig. 23. **Be sure the oil holes in the shaft are facing downward.** Complete the assembly by installing the remaining two flat washers with the spring washer between them and install the cotter pin.

CYLINDER HEADS

DISASSEMBLY

1. Clean the carbon out of the cylinder head combustion chambers before removing the valves.

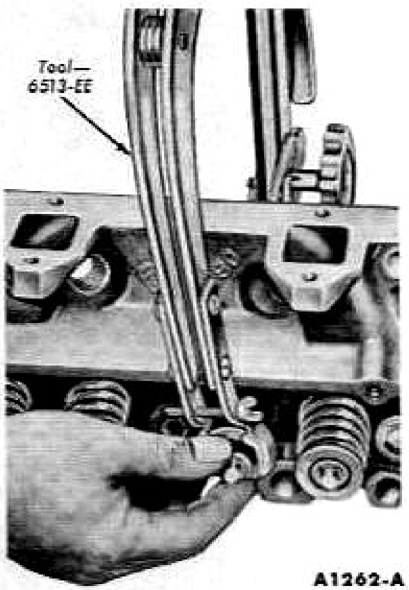


FIG. 24—Valve Spring Retainer Locks Removal or Installation

2. Compress the valve springs (Fig. 24). Remove the spring retainer locks, and release the spring.

3. Remove the sleeve, spring retainer, spring, stem seal, and valve. Discard the valve stem seals. Identify all valve parts.

ASSEMBLY

1. Install each valve (Fig. 25) in the guide from which it was removed or to which it was fitted. Install a new stem seal on the valve.

2. Install the valve spring over the valve, and then install the spring retainer and sleeve.

3. Compress the spring and install the retainer locks (Fig. 24).

4. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 26). Check the dividers against a scale. If the assembled height is greater than $1\frac{27}{32}$ inches, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height of $1\frac{13}{16}$-$1\frac{27}{32}$ inches. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs which will lead to excessive load and spring breakage.**

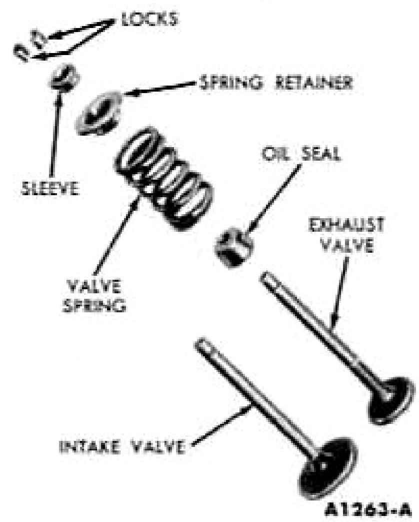


FIG. 25—Valve Assembly

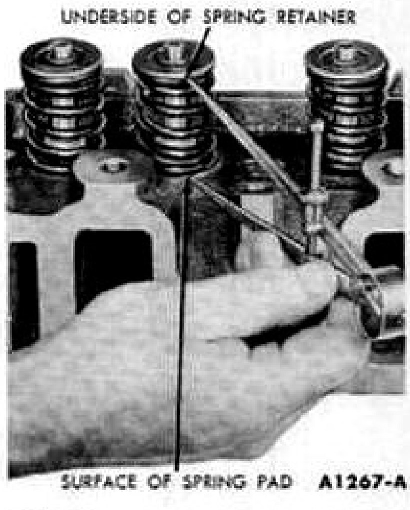


FIG. 26—Valve Spring Assembled Height

HYDRAULIC VALVE LIFTERS

Each valve lifter is a matched assembly. If the parts of one lifter are

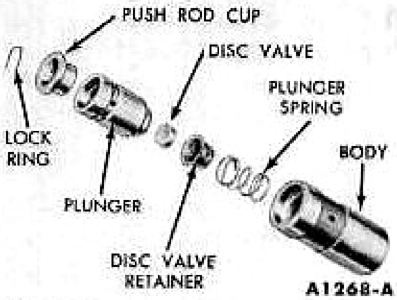


FIG. 27—Typical Hydraulic Valve Lifter Assembly

inter-mixed with those of another, improper valve operation may result. Disassemble and assemble each lifter separately. Keep the lifter assemblies in proper sequence so that they can be installed in their original bore.

DISASSEMBLY

1. Grasp the lock ring with needle nose pliers to release it from the groove. If necessary, depress the plunger to fully release the lock ring.
2. Remove the push rod cup, plunger, and spring.
3. Invert the plunger assembly and remove the disc valve retainer by carefully prying up on it with a screwdriver. Then remove the disc valve and spring.

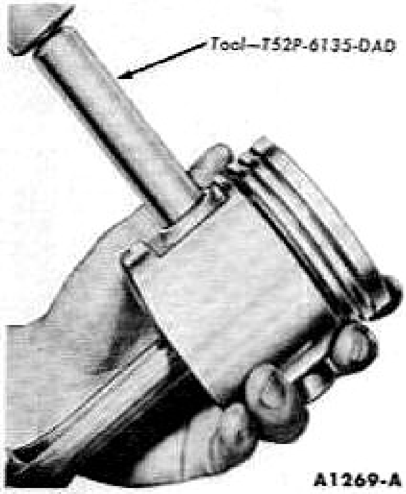


FIG. 28—Piston Pin Removal

ASSEMBLY

A typical hydraulic valve lifter is shown in Fig. 27.

1. Place the plunger upside down on a clean work bench.
2. Place the disc valve in position over the oil hole on the bottom of the plunger. Set the disc valve spring on top of the disc.
3. Position the disc valve retainer

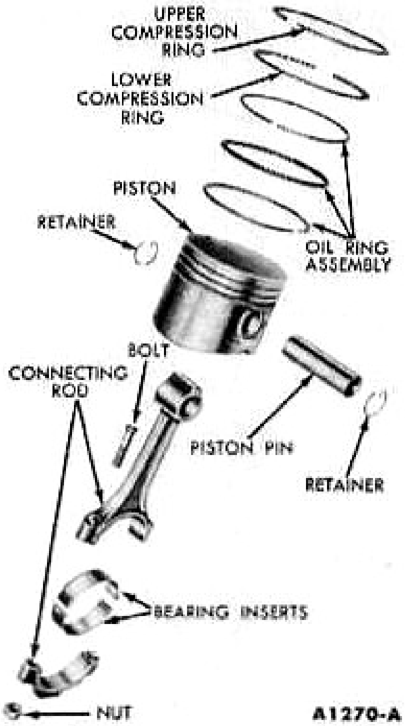


FIG. 29—Piston, Connecting Rod, and Related Parts

over the disc and spring and push the retainer down into place on the plunger.

4. Place the plunger spring, and then the plunger (open end up) into the lifter body.
5. Place the push rod seat in the plunger.
6. Depress the plunger. Position the closed end of the lock ring in the groove of the lifter body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, then depress it again to fully seat the lock ring.

PISTONS AND CONNECTING RODS

DISASSEMBLY

1. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed.
2. Remove the piston rings. Remove the piston pin retainers, then drive the pin out of the piston and connecting rod (Fig. 28). Discard the retainers.

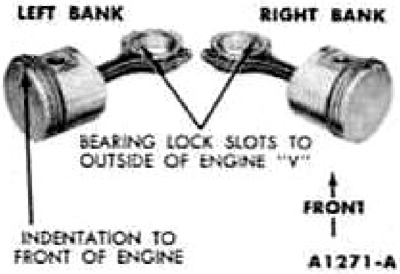


FIG. 30—Connecting Rod and Piston Assembly

ASSEMBLY

The piston, connecting rod, and related parts are shown in Fig. 29.

1. Lubricate all parts with light engine oil.
2. Position the connecting rod in the piston and push the pin into place. Assemble the piston and connecting rod so that the bearing lock slots will be to the outside of the engine "V" (Fig. 30).
3. Insert new piston pin retainers by spiraling them into the piston with the fingers. Do not use pliers.
4. Follow the instructions contained on the piston ring package and install the piston rings.
5. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (step 6 under "Fitting Piston Rings" in Part 1-1).
6. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

OIL PUMP

DISASSEMBLY

1. Remove the oil inlet tube from the oil pump and remove the gasket.

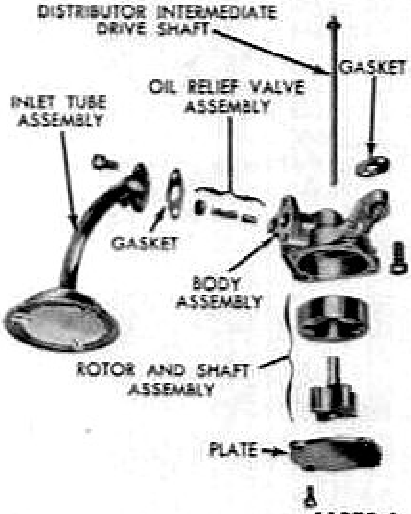


FIG. 31—Oil Pump Assembly

2. Remove the cover retaining screws, then remove the cover. Remove the inner rotor and shaft assembly, then remove the outer race.

3. Insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

ASSEMBLY

The oil pump assembly is shown in Fig. 31.

1. Oil all parts thoroughly.

2. Install the oil pressure relief valve plunger, spring, and a new cap.

3. Install the outer race, and the inner rotor and shaft assembly. **The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.** Install the cover and tighten the cover retaining screws to 6-9 foot-pounds torque.

4. Position a new gasket and the oil inlet tube on the oil pump and install the retaining bolts.

5 ENGINE ASSEMBLY—ENGINE REMOVED

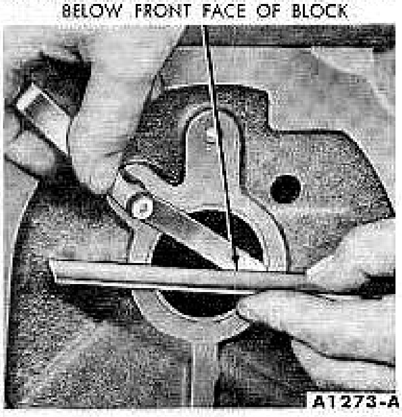


FIG. 32—Camshaft Front Bearing Measurement

CAMSHAFT BEARINGS

Camshaft bearings are available pre-finished to size for standard and 0.015-inch undersize journal diameters. The bearings are not interchangeable from one bore to another. The bearings must be installed in their respective bores.

1. Position the new bearing at the bearing bore, and press it into place with the tool shown in Fig. 22. Align the oil holes in the bearing with the oil holes in the cylinder block when the bearings are installed. **Be sure the camshaft front bearing is installed 0.005-0.020 inch below the front face of the cylinder block (Fig. 32).**

2. Clean out the camshaft rear bearing bore plug recess thoroughly.

3. Coat the flange of a new plug with water resistant sealer and install it with the flange facing in (Fig. 33).

4. Drive the plug in until it is flush or slightly below the casting surface.

CAMSHAFT

The camshaft and related parts are shown in Fig. 34.

Oil the camshaft and apply Lubriplate to all lobes, then carefully slide it through the bearings.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 35.

1. Be sure that the rear journal oil seal grooves are clean. Install a new rear journal oil seal in the block (Fig. 36) and rear main bearing cap (Fig. 37). After installation, cut the ends of the seals flush.

2. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.

Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

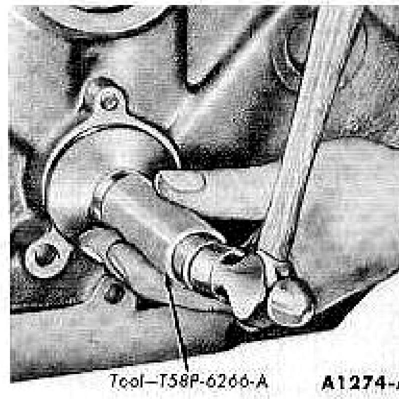


FIG. 33—Camshaft Rear Bearing Bore Plug Installation

3. Install the lower main bearing inserts in the bearing caps.

4. Carefully lower the crankshaft into place. **Be careful not to damage the surfaces.**

5. Check the clearance of each main bearing, following the proced-

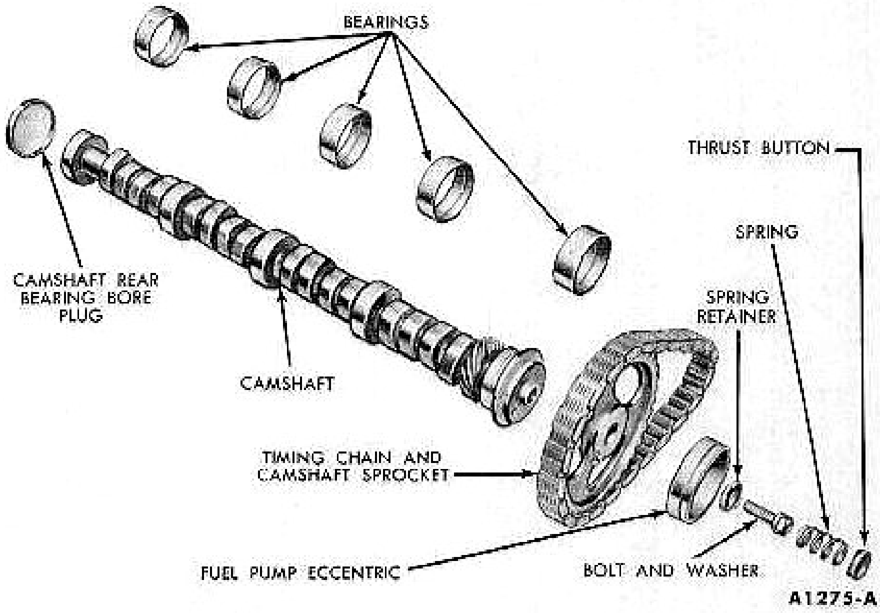


FIG. 34—Camshaft and Related Parts

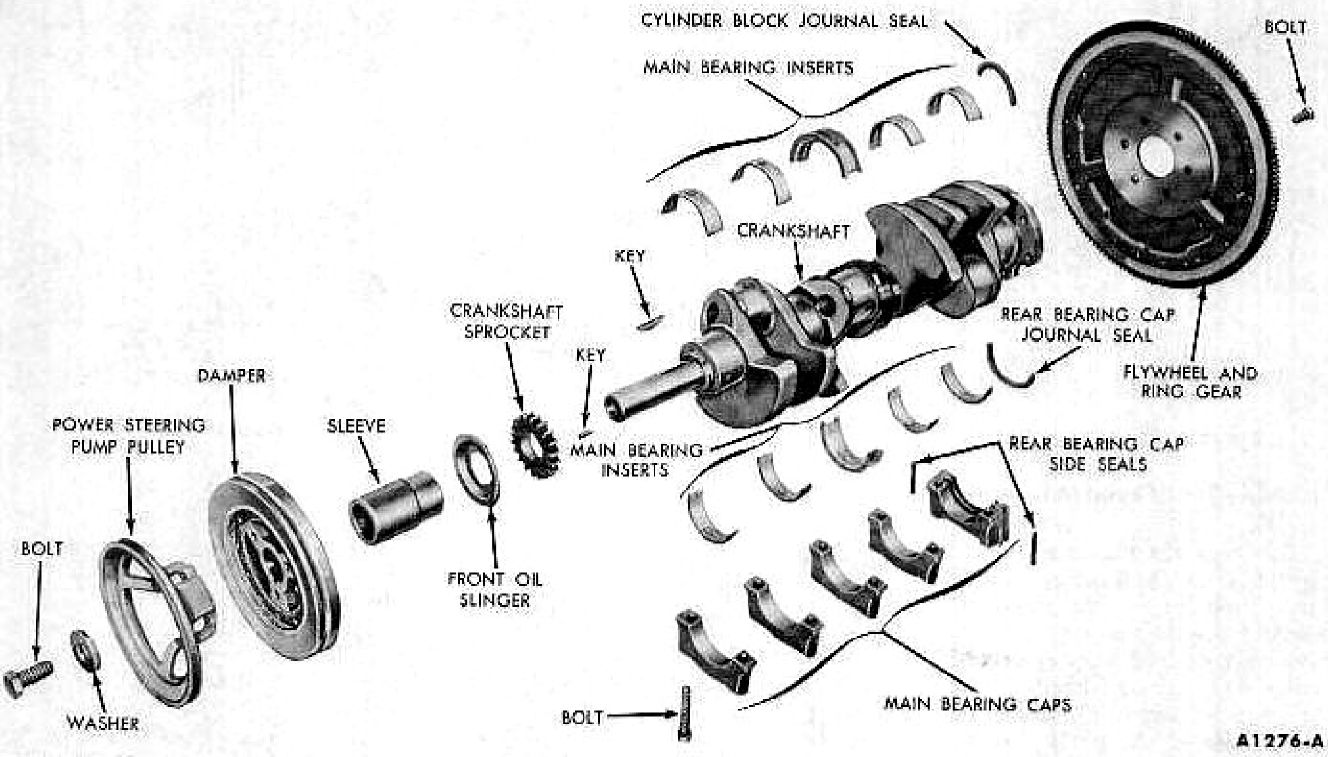


FIG. 35—Crankshaft and Related Parts

ure under "Main Bearing Replacement" in Part 1-1.

6. If the bearing clearances are satisfactory, apply a light coat of engine oil to the journals and bearings, then install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Main bearing caps are numbered 1 thru 5 starting at the front of the engine. The arrows on the cap should be pointed toward the front of the engine.** Tighten the bearing cap bolts to specifications.

7. Install the thrust bearing cap with the bolts finger tight.

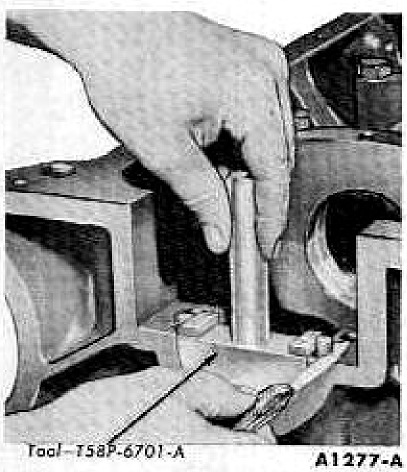


FIG. 36—Seal to Block Installation

8. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 38).

9. Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 38). This will align the thrust surfaces of both halves of the bearing.

10. Retain the forward pressure on the crankshaft, and tighten the cap bolts to specifications (Fig. 38).

11. Force the crankshaft toward the rear of the engine.

12. Install a dial indicator, so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 39).

13. Set the dial at zero. Push the crankshaft forward and note the reading on the dial.

14. If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces, following the recommended procedure (steps 7, 8, 9, and 10). Recheck the end play.

15. Dip the rear bearing cap side seals in light engine oil. Immediately install them in the grooves. **Do not use sealer on the side seals, the seals are designed to expand when dipped in oil. Using sealer may retard this expansion.** It may be necessary to tap the seals into place for the last ½ inch of travel. Do not cut the seal projecting ends.

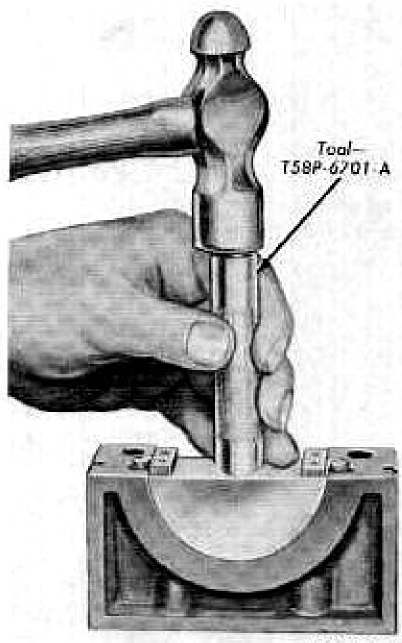


FIG. 37—Seal to Rear Bearing Cap Installation

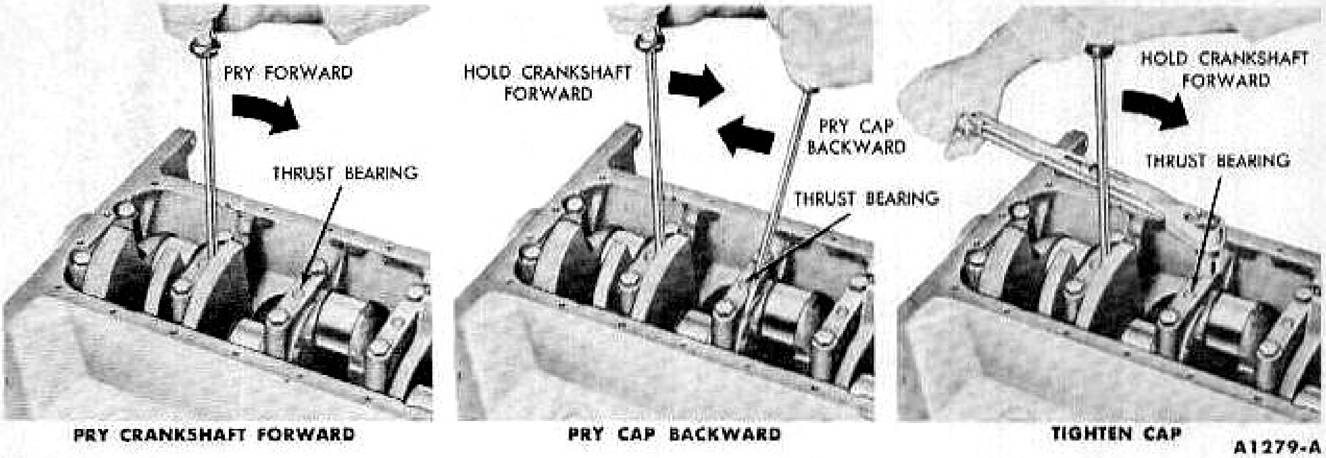


FIG. 38—Thrust Bearing Alignment

16. Check the rear main bearing cap side seals for leaks by squirting a few drops of oil into the parting lines between the bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the seal grooves.**

CONNECTING ROD ASSEMBLIES

1. Turn the engine on the work stand so that the front end is up.

2. Oil the piston rings, pistons, and cylinder walls with light engine oil.

3. **Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. Each connecting rod and bearcap are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**

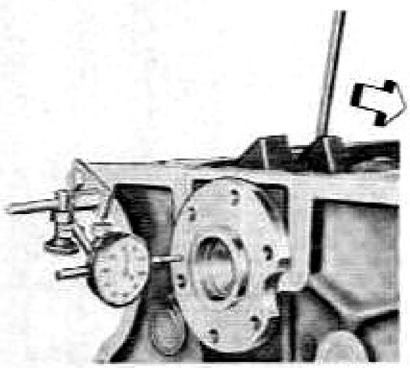


FIG. 39—Crankshaft End Play

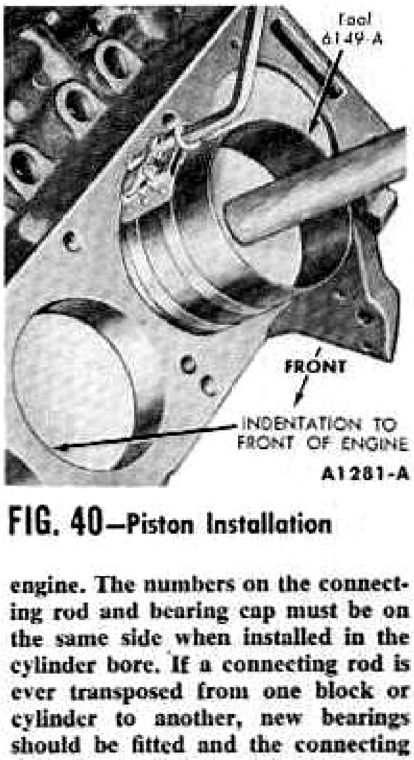


FIG. 40—Piston Installation

4. Make sure the ring gaps are properly spaced around the circumference of the piston.

5. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 40). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation in the piston head toward the front of the engine. When installed, the bearing lock slots in the connecting rod should be toward the outside of the engine.**

6. Check the clearance of each bearing, following the procedure under "Connecting Rod Bearing Replacement" in Part 1-1.

7. If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings.

8. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.

9. Install the connecting rod cap, then tighten the nuts to specifications.

10. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 41).

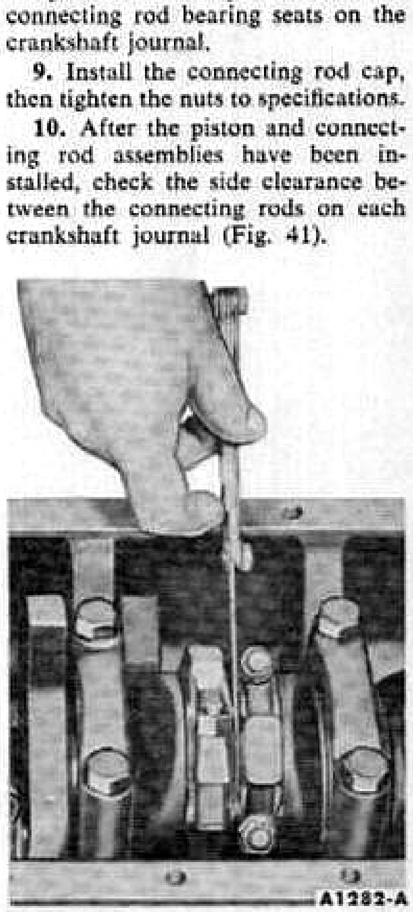


FIG. 41—Connecting Rod Side Clearance

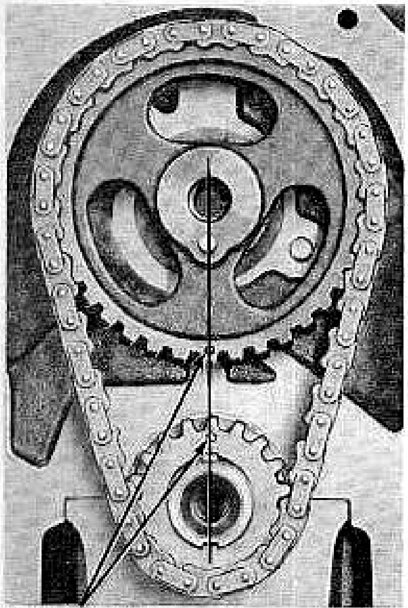


FIG. 42—Aligning Timing Marks

TIMING CHAIN AND SPROCKETS

1. Lubricate the timing chain and sprockets with engine oil. Place the key in position in the slot on the crankshaft.

2. Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 21). Be sure the timing marks on the sprockets are positioned as shown in Fig. 42.

3. Rotate the crankshaft in a clock-

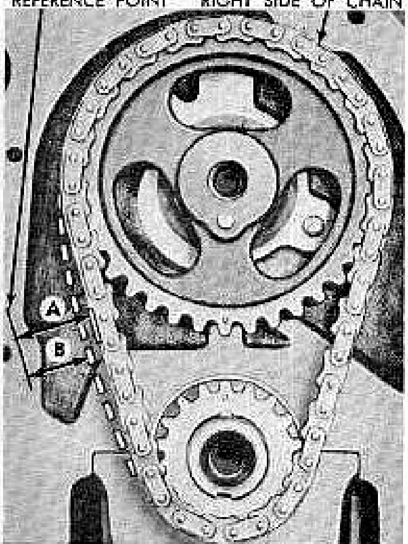


FIG. 43—Timing Chain Deflection

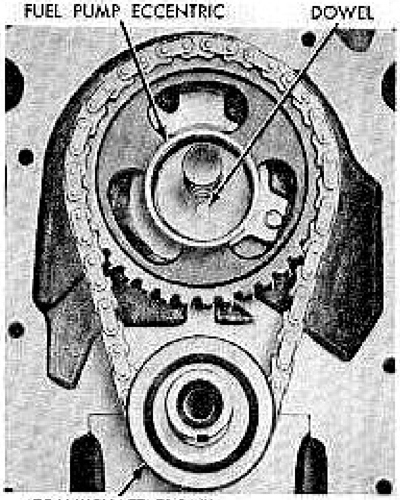


FIG. 44—Fuel Pump Eccentric and Front Oil Slinger Installed

wise direction (as viewed from the front) to take up the slack on the left side of the chain.

4. Establish a reference point on the block and measure from this point to the chain (Fig. 43).

5. Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

6. If the deflection exceeds ½ inch, replace the timing chain and/or sprockets.

7. Install the fuel pump eccentric (Fig. 44), and the camshaft sprocket cap screw and thrust button spring retainer. Tighten the sprocket cap screw to specifications. Install the camshaft thrust button spring and thrust button. Install the crankshaft front oil slinger.

CYLINDER FRONT COVER AND FRONT OIL SEAL

FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

1. Drive out the old seal with a pin punch, then clean out the recess in the cover.

2. Coat a new seal with grease. Install the seal (Fig. 45).

3. Drive the seal in until it is fully seated in the recess.

4. After installation, check the seal to be sure the spring is properly positioned in the seal.

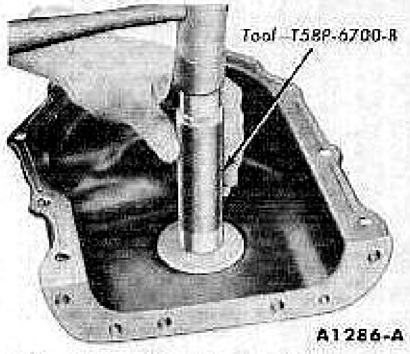


FIG. 45—Oil Seal Installation

CYLINDER FRONT COVER INSTALLATION

1. Clean the cylinder front cover and the cylinder block gasket surfaces.

2. Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

3. Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 46).

4. Install the cylinder front cover bolts finger tight. Position the generator support bracket and the generator adjusting arm bracket, then install the bolts.

While pushing in on the pilot, tighten the cover bolts to specifications. Remove the pilot.

5. Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease.

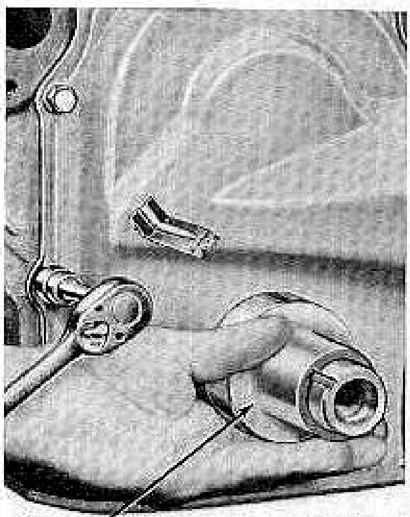


FIG. 46—Cylinder Front Cover Alignment

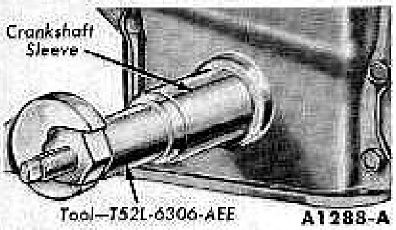


FIG. 47—Crankshaft Sleeve Installation

6. Install the crankshaft sleeve (Fig. 47) with the smallest O.D. end into the cylinder front cover bore if the sleeve is stepped down (different O.D. on each end).

7. Line up the damper keyway with the key on the crankshaft. Install the damper on the crankshaft (Fig. 48).

8. Install the damper cap screw and washer, and tighten the screw to specifications.

On an engine with a separate power steering pulley, install the pulley on the crankshaft damper. Tighten the screws to specifications.

9. Clean the water pump gasket surfaces and apply sealer. Position new gaskets on the pump and install the water pump, pulley, and fan as an assembly.

On an engine with a power steering pump, the pump is retained by the water pump retaining bolts.

10. Using a new gasket, install the fuel pump. Install the generator, brackets, and drive belts.

OIL PUMP AND OIL PAN

1. Invert the engine on the work stand. Position the oil pump drive shaft into the oil pump socket. With the shaft firmly seated in the distributor socket, position the oil pump into place. The stop on the shaft should touch the roof of the crankcase. Remove the shaft and oil pump and position the stop as necessary.

2. With the stop properly positioned, insert the oil pump drive shaft into the oil pump.

3. Position a new gasket on the pump housing and install the pump and shaft as an assembly (Fig. 49).

4. Position a new gasket on the oil pan and place the oil pan assembly on the block. Install the retaining screws and tighten them, from the center outward, to specifications.

FLYWHEEL

1. Position the flywheel on the crankshaft and install the retaining bolts. Tighten the bolts to specifications.

2. On a flywheel for a manual-shift transmission, use tool 7563 to locate the clutch disc. Install the pressure plate. Tighten the retaining bolts to specifications.

OIL FILTER AND ADAPTER

The oil filter assembly is shown in Fig. 50.

1. Clean the oil filter adapter gasket surfaces.

2. Apply sealer to a new adapter gasket, and install the adapter assembly and gasket.

3. Clean the adapter filter recess. Coat the gasket on a new filter with oil. Place the filter in position on the adapter. Hand tighten the filter until the gasket contacts the adapter face, and then advance it ½-turn.

CYLINDER HEADS

1. Clean the cylinder head and block gasket surfaces.

2. Inspect the head for any damage and repair as necessary.

3. Apply cylinder head gasket sealer to both sides of a new gasket.

4. Guided by the word "Front" on the gasket, install the gasket over the cylinder head dowels.

5. Place the cylinder head on the engine, then remove the holding fixtures.

6. Install the cylinder head bolts.

7. The cylinder head bolts are tightened in three progressive steps. Follow the sequence shown in Fig. 51. Tighten the bolts to 60-70 foot-pounds torque, then tighten them to 70-80 foot-pounds torque. Finally, tighten the bolts to 80-90 foot-pounds torque in the same sequence. **After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.**

8. Coat the mating surfaces of the exhaust manifold with a light film of graphite grease.

9. On the right exhaust manifold, using a new gasket, install the automatic choke air chamber cover on

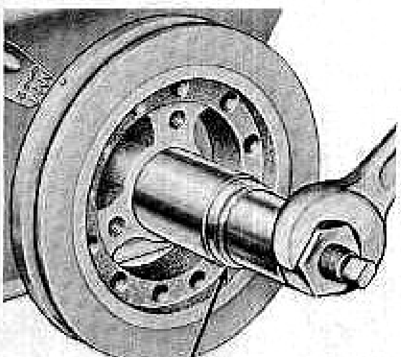


FIG. 48—Crankshaft Damper Installation

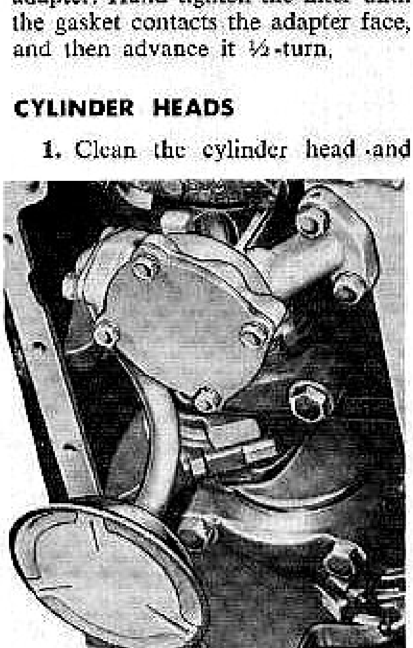


FIG. 49—Oil Pump and Inlet Tube Installed

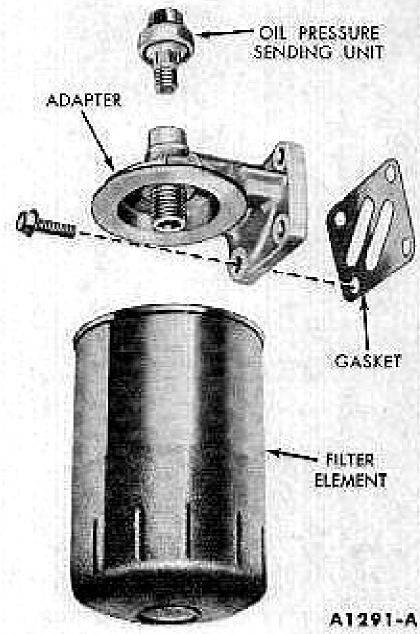


FIG. 50—Oil Filter Assembly

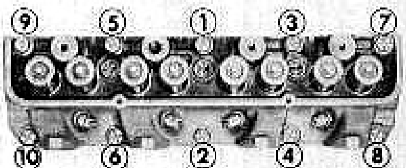


FIG. 51—Cylinder Head Bolt Tightening Sequence

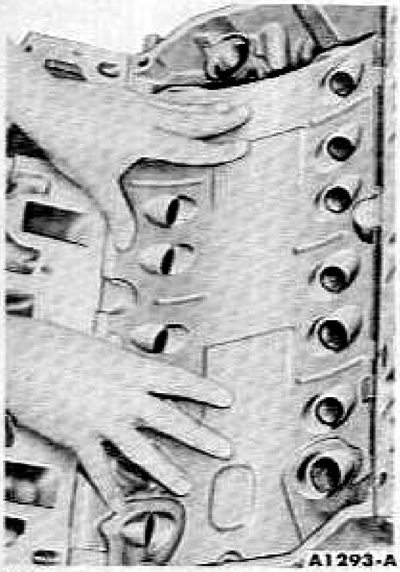


FIG. 52—Baffle Plate Installation

the manifold. **Be sure the cover is securely fastened.** Position the exhaust gas control valve over the muffler inlet pipe studs of the manifold, using a new gasket on each side of the valve. Temporarily tie the valve to the exhaust manifold.

10. Position a new gasket over the muffler inlet pipe studs of the left exhaust manifold.

11. Position the exhaust manifold on the cylinder head and install the retaining bolts and tab washers. Tighten the retaining bolts to specifications, working from the center to the ends. Lock the bolts by bending one tab of the washer over a flat on the bolt.

12. Install the spark plugs.

13. Position the baffle plate in the valve push rod chamber. Press it into place with the hands (Fig. 52).

VALVE LIFTERS

Coat the outside of each valve lifter with engine oil to provide initial lubrication. **Do not fill the lifters with oil. The lifters will fill much faster after the engine is started, if they are free of any oil film which may cause an oil seal between the plunger and the lifter body.** Place each lifter in the bore from which it was removed.

INTAKE MANIFOLD AND DISTRIBUTOR

The intake manifold assembly is shown in Fig. 53.

1. Clean the mating surfaces of the intake manifold, cylinder heads, and cylinder block.

2. Coat the intake manifold and cylinder block seal surfaces with oil resistant sealer.

3. Position new seals on the cylinder block and new gaskets on the cylinder heads with the gasket resting on the cylinder head gasket tabs. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads. The correct installation of the gaskets and seals are shown in Fig. 54.

4. Install the eye bolts in the intake manifold and attach the engine lifting sling and carefully lower the intake manifold on the engine (Fig. 15).

5. Position the intake manifold by inserting the distributor in place. **After the intake manifold is in place, run a finger around the front and rear seal areas to make sure the seals are in place. If the seals are not in place, remove the intake manifold and reposition the seals.**

6. Start the water pump by-pass hose on the intake manifold.

7. Be sure the holes in the manifold gaskets and manifold are in alignment. Install the manifold retaining bolts and tighten them to specifications, working from the center to the ends.

8. Remove the distributor and the engine lifting sling and eye bolts. Install the radiator supply tank.

FIG. 54—Intake Manifold Gaskets and Seals Installation

9. Lubricate both ends of the valve push rods with engine oil. Install the valve push rods in their proper sequence, making sure the lower ends of the rods are positioned in the lifter push rod cup.

10. Crank the engine until the No. 1 piston is on T.D.C. at the end of the compression stroke.

11. Rotate the crankshaft damper an additional 45°.

12. Install the right valve rocker arm shaft assembly and the baffle plate on the cylinder head with the

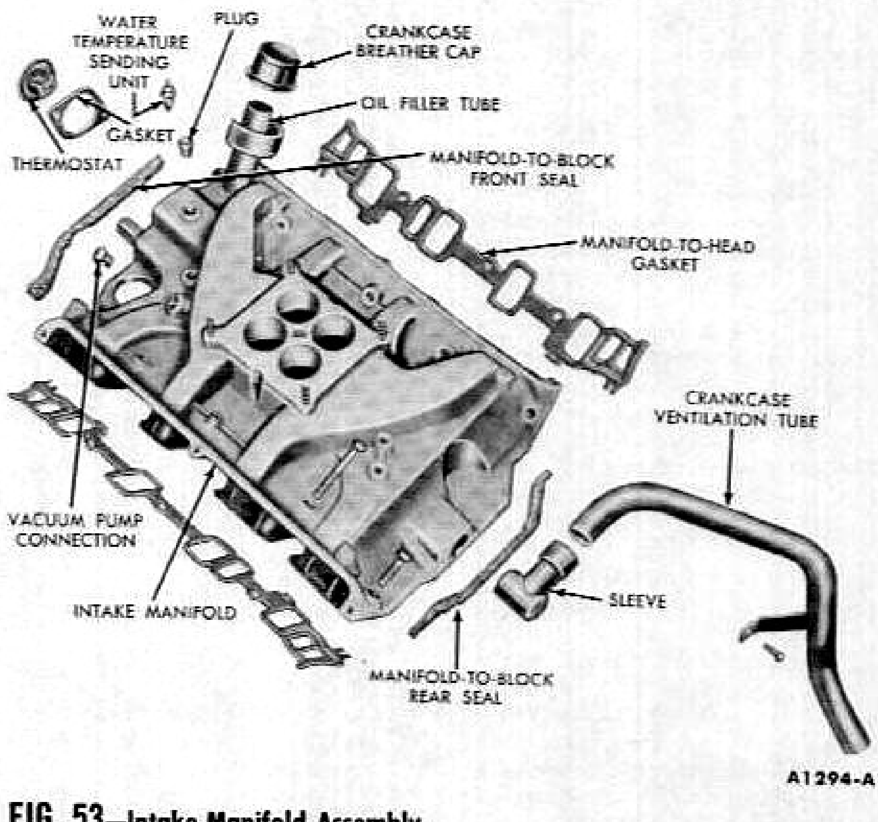


FIG. 53—Intake Manifold Assembly

valve push rods in place and the rocker shaft support bolts finger tight. **Be sure the shaft is turned so that the oil holes are to the bottom.**

13. Starting at the No. 4 cylinder, tighten the bolts in sequence, two turns at a time, until the supports fully contact the cylinder head. Tighten the bolts in sequence to specifications.

14. Starting at the No. 5 cylinder, follow the same procedure for the left valve rocker arm shaft support bolts. The additional time consumed in this procedure will permit the hydraulic lifters to leak down. This will minimize the possibility of bending the push rods, valves, or the rocker arms. **Be sure that the hydraulic lifters have leaked down to their normal operating position before cranking the engine. This is necessary in order to avoid possible damage to the valves, push rods, or valve rocker arms.**

15. Install the automatic choke heat tube.

16. Rotate the crankshaft damper until the No. 1 piston is on T.D.C., then position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open. Install the hold down clamp.

17. Connect the distributor vacuum line. Install the distributor cap. Install the valve rocker arm covers. Connect the spark plug wires. Be sure the spark plug wires for No. 7 and 8 cylinders are properly positioned. See Fig. 8—Part 2-1. Install the vacuum booster pump line and the carburetor fuel inlet line.

6 REPAIR OPERATIONS—ENGINE INSTALLED

ENGINE SUPPORTS

The front supports are located on each side of the crankcase and the rear support is located at the transmission extension housing.

ENGINE FRONT SUPPORT

The engine front support is shown in Fig. 55. The procedures given apply to either a right or left installation.

Removal

1. Remove the insulator assembly to engine retaining bolts, and insulator to underbody retaining nut and washer.

If only one support is being removed, loosen the other support.

2. Raise the engine about 1 inch with a jack and a block of wood placed under the oil pan, then remove the insulator assembly.

Installation

1. Position the insulator assembly. Install, but do not tighten, the insulator to engine lockwashers and bolts. If both supports have been removed, install the bolts on the opposite side before proceeding with step 2.

2. Lower the engine, then install the underbody to insulator lockwasher and nut and tighten the nut to specifications. Tighten the insulator to engine bolts to specifications.

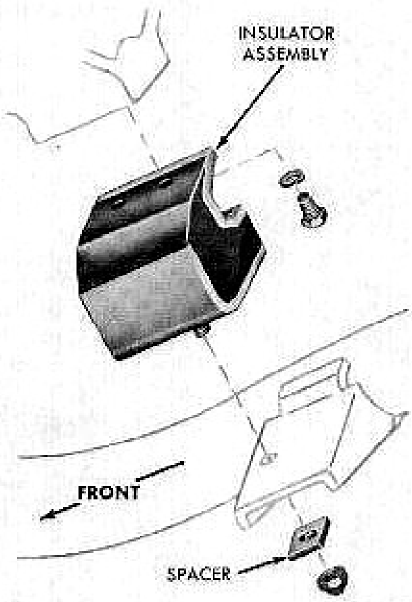


FIG. 55—Engine Front Support

ENGINE REAR SUPPORT

The engine rear support is shown in Fig. 56.

Removal

1. Remove the support retainer bolts and washers, and remove the support assembly to underbody bolts.

2. Raise the extension housing slightly to relieve the pressure on the support assembly. Remove the support assembly and retainer.

Installation

1. Raise the extension housing enough to position the support assembly and retainer. Install the support retainer to extension housing flat washers, lockwashers, and bolts, the support assembly to underbody bolts, lockwashers and nuts.

2. Remove the jack from the extension housing, then tighten the support retainer bolts and the support assembly nuts to specifications.

INTAKE MANIFOLD

REMOVAL

1. Drain the cooling system. Remove the air cleaner.

2. On a car with a manual-shift transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator retracting spring.

3. On a car with an automatic transmission, disconnect the accelerator rod at the carburetor. Remove the accelerator cross shaft bracket from the intake manifold and position it out of the way.

4. Remove the carburetor fuel inlet line, the windshield wiper vacuum line, and the vacuum booster pump line.

5. Disconnect the coil high tension lead, and the coil wires at the coil. Disconnect the oil pressure sending unit wire at the sending unit. Remove the wire loom from the retaining clips on the left valve rocker arm cover and position it out of the way.

6. Disconnect the spark plug wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers.

7. Remove the distributor cap and spark plug wire assembly. Disconnect the distributor vacuum line at the distributor.

8. Disconnect the radiator upper

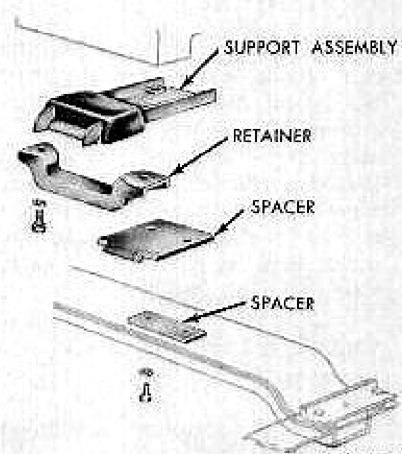


FIG. 56—Engine Rear Support

hose at the radiator supply tank, then remove the supply tank. Remove the heater hose at the intake manifold, and the water temperature sending unit wire at the sending unit.

9. Remove the battery ground strap retaining screw from the thermostat housing. Slide the clamp on the water pump by-pass hose toward the water pump.

10. Remove the automatic choke heat tube. Disconnect the crankcase ventilation tube from the intake manifold.

11. Clean the outside of the valve rocker arm covers and remove the covers.

12. Complete the removal procedure by following steps 9 thru 17 under "Intake manifold and Distributor" on page 1-25.

INSTALLATION

1. Follow steps 1 thru 17 under "Intake Manifold and Distributor" on page 1-35.

2. Connect the battery ground strap, the water temperature sending unit, the heater hose, and the radiator upper hose.

3. Install the wire loom in the retaining clips on the left valve rocker arm cover.

4. Connect the oil pressure sending unit wire, the coil high tension leads, and the coil wires.

5. On a car with an automatic transmission, install the accelerator cross shaft bracket. Connect the accelerator rod.

6. On a car with a manual-shift transmission, install the accelerator retracting spring and connect the accelerator rod.

7. Fill and bleed the cooling system. Install the air cleaner.

8. On a car with an automatic transmission, adjust the transmission control linkage.

CYLINDER HEADS

REMOVAL

1. Remove the intake manifold and distributor, following the procedure in this section.

2. Remove the exhaust manifolds. If the left cylinder head is to be removed, remove the ignition coil.

3. Remove the cylinder head bolts. Install the cylinder head holding fixtures (Fig. 18).

4. Lift the cylinder heads off the block. **Do not pry between the head and the block.** Remove and discard the cylinder head gasket.

INSTALLATION

1. Clean the cylinder head and cylinder block gasket surfaces. Apply cylinder head gasket sealer to both sides of a new gasket. Guided by the word "FRONT" on the gasket, install the gasket over the cylinder head dowels.

2. Place the cylinder head on the engine, then remove the holding fixture. Install the cylinder head bolts.

3. The cylinder head bolts are tightened in three progressive steps. Follow the sequence shown in Fig. 51. Tighten the bolts to 60-70 foot-pounds torque, then tighten them to 70-80 foot-pounds torque. Finally, tighten the bolts to 80-90 foot-pounds torque.

4. Install the exhaust manifolds.

5. Install the intake manifold, valve rocker arm shaft assembly, and distributor, following steps 1 thru 17 under "Intake Manifold and Distributor" on page 1-35.

CRANKSHAFT DAMPER

REMOVAL

1. Drain the cooling system. Remove the hood, radiator supply tank, and the radiator.

2. Remove the drive belts.

On a car with power steering, remove the power steering pump pulley from the crankshaft damper.

3. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft damper (Fig. 19) and remove the damper.

INSTALLATION

1. Line up the damper keyway with the key on the crankshaft. Then install the damper on the crankshaft (Fig. 48).

2. Install the damper cap screw and washer, and tighten the screw to specifications.

On a car with power steering, install the power steering pump pulley on the damper. Tighten the screws to specifications.

3. Install the drive belts, the radiator, radiator supply tank, and hood. Fill and bleed the cooling system.

CYLINDER FRONT COVER AND TIMING CHAIN

REMOVAL

1. Drain the cooling system and the crankcase. Remove the hood, air cleaner, radiator, and radiator supply tank.

2. Disconnect the carburetor fuel inlet line, manifold vacuum line, the windshield wiper vacuum line at the fuel pump. Disconnect the flexible fuel line.

3. Remove the fuel pump and gasket.

4. On a car equipped with power steering, disconnect the power steering pump bracket from the water pump, then wire the pump to the hood left hinge in a position that will prevent the oil from draining out.

5. Disconnect the heater hose at the water pump. Slide the water pump by-pass hose tube clamp toward the engine. Disconnect the drive belt adjusting arm at the water pump.

6. Loosen the generator mounting bolts at the generator. Remove the drive belt. Remove the generator support bolt at the water pump. Remove the water pump, drive belt adjusting arm, pulley, and fan as an assembly.

7. Remove the crankshaft damper and crankshaft sleeve. Remove the screws fastening the cylinder front cover to the block and oil pan, then remove the cylinder front cover.

On a car equipped with an air conditioner, the compressor brackets are retained by cylinder front cover screws.

8. Discard the cylinder front cover gasket. Remove the oil pan.

9. Remove the crankshaft front oil slinger. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 42. Remove the camshaft thrust button and spring, the sprocket cap screw, the thrust button spring retainer, and the fuel pump eccentric.

10. Slide both sprockets and the timing chain forward, and remove the sprockets and timing chain as an assembly (Fig. 21).

INSTALLATION

1. Place the key in position in the slot on the crankshaft.

2. Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 21). Be sure the timing marks on the sprockets are positioned as shown in Fig. 42.

3. Install the fuel pump eccentric, and the camshaft sprocket cap screw and thrust button spring retainer. Tighten the sprocket cap screw to specifications. Install the camshaft thrust button spring and thrust button. Install the crankshaft front oil slinger.

4. Clean the cylinder front cover, oil pan, and the block gasket surfaces.

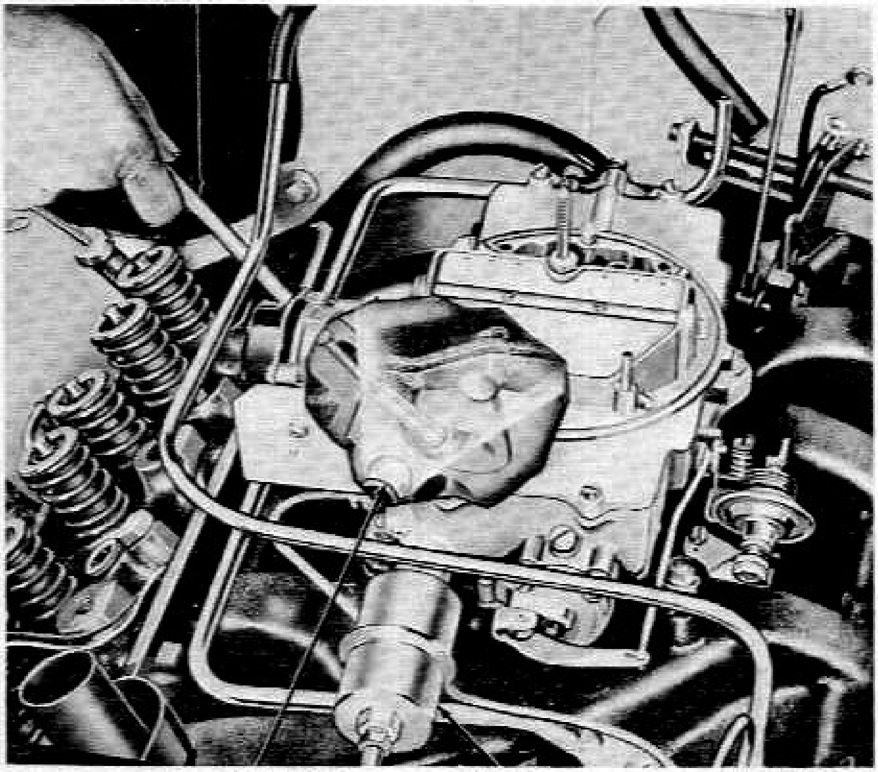


FIG. 57—Valve Lifter Replacement

5. Working from the front of the engine, position the oil pan on the engine block. Install, but do not tighten, the oil pan to engine block retaining bolts.

6. Replace the crankshaft front oil seal.

7. Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

8. Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 46).

9. Install the cylinder front cover bolts finger tight. Position the generator support bracket and the generator adjusting arm bracket, then install the bolts.

While pushing in on the pilot, tighten the cover bolts to specifications. Remove the pilot.

10. Install the oil pan to cylinder front cover bolts, then tighten all the oil pan bolts to specifications, working from the center of the pan outward.

11. Install the fuel pump, using a new gasket.

12. Install the crankshaft sleeve, then install the damper following the procedure in this section.

13. Install the water pump, drive belt adjusting arm, pulley and fan as an assembly.

14. Connect the carburetor fuel inlet line, the flexible fuel line, the manifold vacuum line, and the windshield wiper vacuum line.

15. Connect the heater hoses. Slide the water pump by-pass tube clamp forward on the tube.

16. Install the radiator, radiator supply tank, and the hood. Fill and bleed the cooling system. Connect the heater hose to the water pump.

17. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

CAMSHAFT

REMOVAL

1. Drain the cooling system and the crankcase. Remove the radiator, radiator supply tank, and the hood.

2. Remove the crankshaft damper, cylinder front cover, timing chain and sprockets, and the intake manifold, following the procedures in this section.

3. Lift the hydraulic valve lifters from the cylinder block and place them in a rack so that they may be installed in their original bore. It is not necessary to remove the baffle plate from the valve push rod chamber floor to remove the valve lifters. **The internal part of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts.** Keep the assemblies intact until they are to be cleaned.

4. Carefully remove the camshaft by pulling it toward the front of the engine.

INSTALLATION

1. Oil the camshaft and apply Lubriplate to the lobes, then carefully slide it through the bearings.

2. Install the hydraulic valve lifters in the bores from which they were removed. Install the baffle plate if it was removed.

3. Install the intake manifold, timing chain and sprockets, cylinder front cover, and the crankshaft damper, following the procedures in this section.

4. Install the radiator, the radiator supply tank, and the hood. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

5. Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

HYDRAULIC VALVE LIFTER REPLACEMENT

To remove one or all of the hydraulic valve lifters:

1. Remove the air cleaner.

If all the lifters are to be removed, or if a lifter on the right bank of the engine is to be removed, remove the choke heat tube.

2. Disconnect the spark plug wires at the plugs, and remove the rocker arm cover(s) and gasket(s).

3. Remove the valve rocker arm shaft assembly by following steps 9 thru 12 under "Intake Manifold and Distributor" on page 1-25.

4. Remove the valve lifters through the push rod openings with a magnetic lifter (Fig. 57).

5. Install the new valve lifter(s) through the push rod opening with a magnetic lifter.

6. Install the push rods in their original bores.

7. Install the valve rocker arm shaft assembly by following steps 10 thru 14 under "Intake Manifold and Distributor" on page 1-35.

FIG. 58—Oil Filter Replacement

8. Install the valve rocker arm cover(s) and gasket(s). Install the choke heat tube if it was removed. Connect the spark plug wires and install the air cleaner.

The preceding procedure can not be used if the hydraulic valve lifters are stuck in their bore by excessive varnish, etc. In this case, it will be necessary to remove the intake manifold following the procedure in this section. After the intake manifold has been removed, remove the hydraulic valve lifter with the tool shown in Fig. 17.

FLYWHEEL

REMOVAL

1. Disconnect the transmission from the engine and slide it to the rear as outlined in Group 5 (manual-shift transmission) or Group 6 (automatic transmission).

2. On a manual-shift transmission, mark the pressure plate cover and flywheel to facilitate assembly, then loosen the cover to flywheel bolts evenly to release the pressure plate spring tension. Remove the pressure plate and cover assembly.

3. Remove the flywheel retaining bolts and remove the flywheel.

INSTALLATION

1. Install the flywheel on the crankshaft flange and install the retaining bolts. Tighten the bolts in sequence across from each other to specifications.

2. On a manual-shift transmission, install the pressure plate and cover assembly on the flywheel, and start the cover bolts. Use tool 7563 to align the clutch disc, and then evenly tighten the cover bolts to specifications.

3. Connect the transmission to the engine as outlined in Group 5 (manual-shift transmission) or Group 6 (automatic transmission).

OIL FILTER REPLACEMENT

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

2. Coat the gasket on the new filter with oil, and place the filter in position on the adapter (Fig. 58). Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

3. Operate the engine at fast idle and check for leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

OIL PAN AND OIL PUMP

REMOVAL

1. Drain the cooling system and the crankcase. Disconnect the radiator upper hose at the radiator supply tank.

2. Remove the oil pan retaining screws and lower the oil pan to the underbody cross member. Position the crankshaft so that the counterweight will clear the oil pan and move the pan forward.

3. Remove the coil retaining bolts and position the coil out of the way.

4. Install the engine lifting brackets and sling. Raise the engine high enough to place tension on the engine mounts.

5. Remove the engine front insulator to engine retaining bolts. Raise the engine high enough to permit removal of the oil pump retaining bolts, then remove the bolts. Remove the oil pan and the oil pump.

INSTALLATION

1. Raise the engine high enough to allow installation of the oil pump and the oil pan. Position a new gasket on the oil pump housing and on the oil pan. Place the oil pump in the oil pan and position the oil pan on the underbody cross member. Insert the oil pump drive shaft into the oil pump housing and install the oil pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.** Tighten the oil pump retaining screws to specifications.

2. Hold the oil pan in place against the cylinder block and install a retaining screw on each side of the oil pan. Install the remaining screws and tighten them, from the center outward, to specifications.

3. Lower the engine, then install the engine right and left front support retaining bolts. Tighten the bolts to specifications. Remove the engine lifting bracket and sling. Install the coil and connect the radiator upper hose. Fill the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for leaks.

PART 1-3 THUNDERBIRD 430 SPECIAL V-8

1 DESCRIPTION

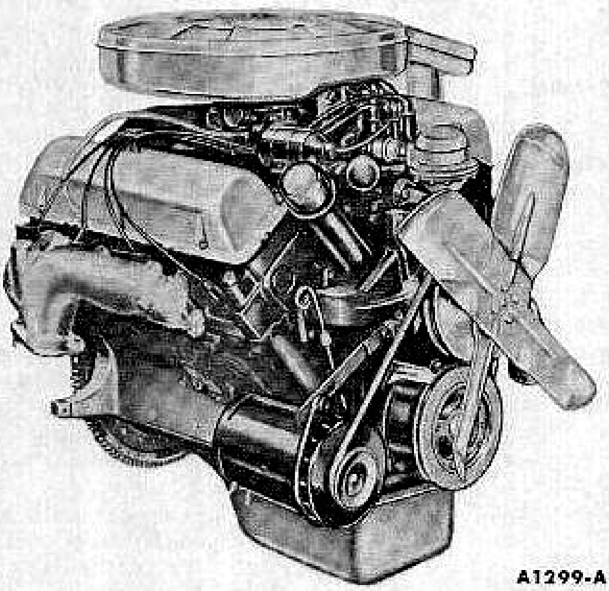


FIG. 1—Thunderbird 430 Special V-8

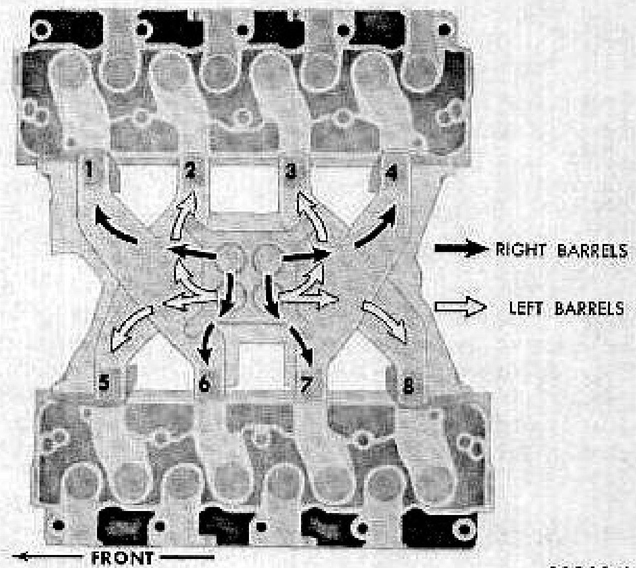


FIG. 2—Intake Manifold Fuel Passages

The Thunderbird 430 Special V-8 engine (Fig. 1) has a 4.30-inch bore and a 3.70-inch stroke and a total piston displacement of 430 cubic inches. It has a compression ratio of 10.0:1. The patent plate symbol for the engine is "J."

MANIFOLDS

The intake manifold is water heated to assist in vaporizing the incoming fuel charge. The water passages are located beneath the fuel passages. Refer to "Cooling System" in this section for a description of the water circulation through the manifold.

The intake manifold has two sets of fuel passages, each with its own separate inlet connection to the carburetor (Fig. 2). The right side of the carburetor feeds Nos. 1, 4, 6 and 7 cylinders and the left side feeds Nos. 2, 3, 5, and 8 cylinders.

CYLINDER HEADS

The cylinder head assemblies contain the valves and the valve rocker arm shaft assembly. Valve guides are an integral part of the head. The valve ports (Fig. 3) are water jacketed and are arranged so that no two exhaust valves are adjacent. The valves are arranged from front to rear on the right bank I-E-I-E-I-E-I-E, and on the left bank E-I-E-I-E-I-E-I.

CYLINDER BLOCK

The combination oil and vacuum pump is mounted in the engine block

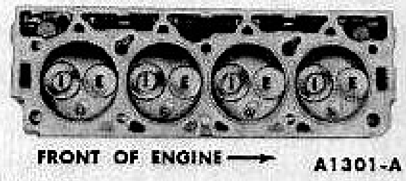


FIG. 3—Valve Port Arrangement

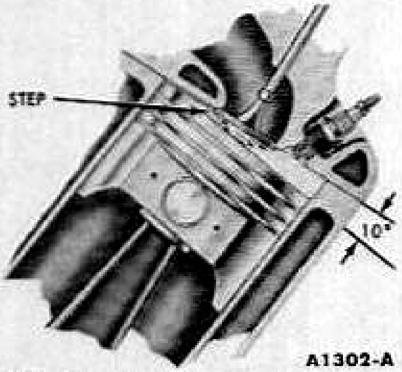


FIG. 4—Combustion Chamber and Piston

at the front. The distributor is located at the front of the engine and drives the oil pump through an intermediate drive shaft.

The combustion chambers are located in the cylinder block. The chambers are formed by casting the top of each bank at a 10° angle with the piston (Fig. 4). The cylinders are numbered from front to rear on the right bank 1, 2, 3, 4 and on the left bank 5, 6, 7, 8.

The crankshaft is supported by five main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The step piston has two compression rings and one oil control ring. The top compression ring is chromium-plated and the lower compression ring is phosphate-coated. The oil control ring consists of a serrated spring and two chromium-plated steel rails. The piston pin is an interference fit in the connecting rod and a light thumb press fit in the piston. Piston pin retainers are not used.

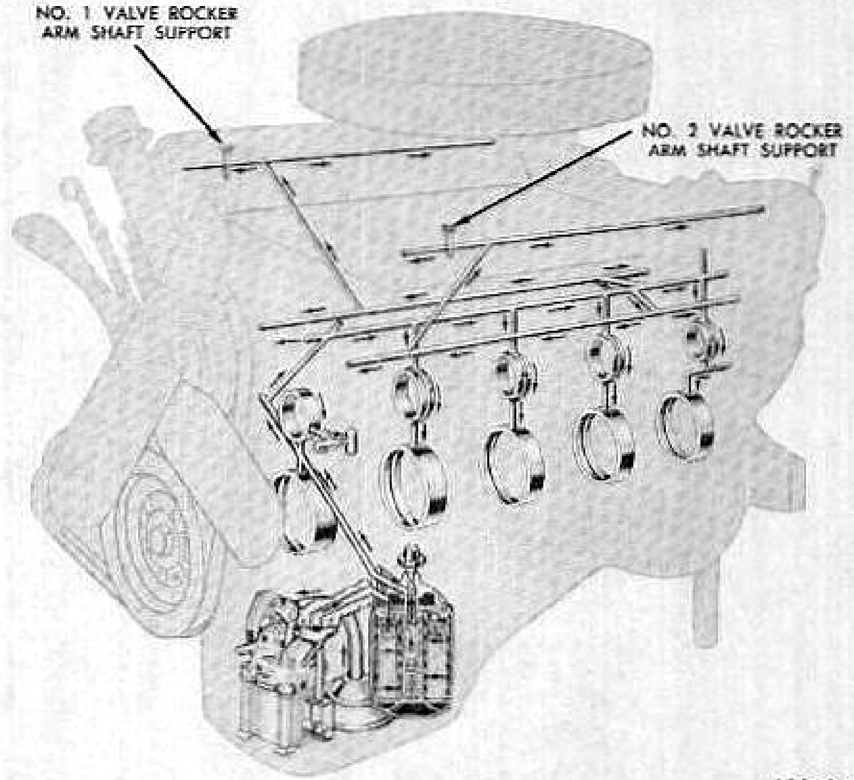


FIG. 5—Lubrication System

VALVE TRAIN

The intake and exhaust valve assemblies are the rotating-type.

Inasmuch as there is no valve lash adjustment with hydraulic valve lifters, the valve rocker arms do not have adjusting screws.

The camshaft is supported by five bearings pressed into the block. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft end play is controlled by the camshaft lobes. The angle at which the camshaft lobes are ground forces the camshaft rearward, as the camshaft lobes raise the lifters. The thrust face on the camshaft sprocket controls the distance the camshaft can move to the rear. An eccentric bolted to the front of the camshaft operates the fuel pump by means of a push rod.

A complete description of the hydraulic valve lifters is covered in Part 1-2.

LUBRICATION SYSTEM

Oil from the oil pan sump, located in the front of the oil pan, is forced through the pressure-type lubrication system (Fig. 5) by a rotor-type oil pump. The oil pump is driven by the distributor through an intermediate drive shaft. A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

All the oil discharged by the pump passes through a full-flow-type filter before it enters the engine. The filter is mounted in a vertical position at the lower left front of the engine. A relief valve in the filter permits oil to by-pass the filter, if the element becomes clogged.

From the filter, the oil flows into

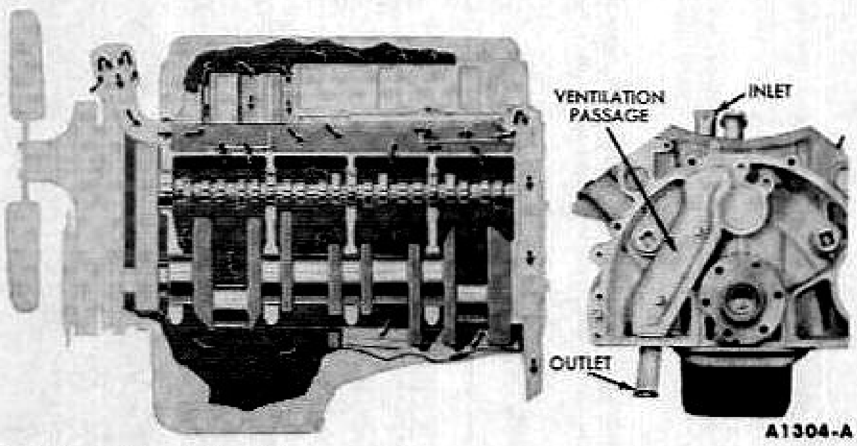


FIG. 6—Crankcase Ventilation System

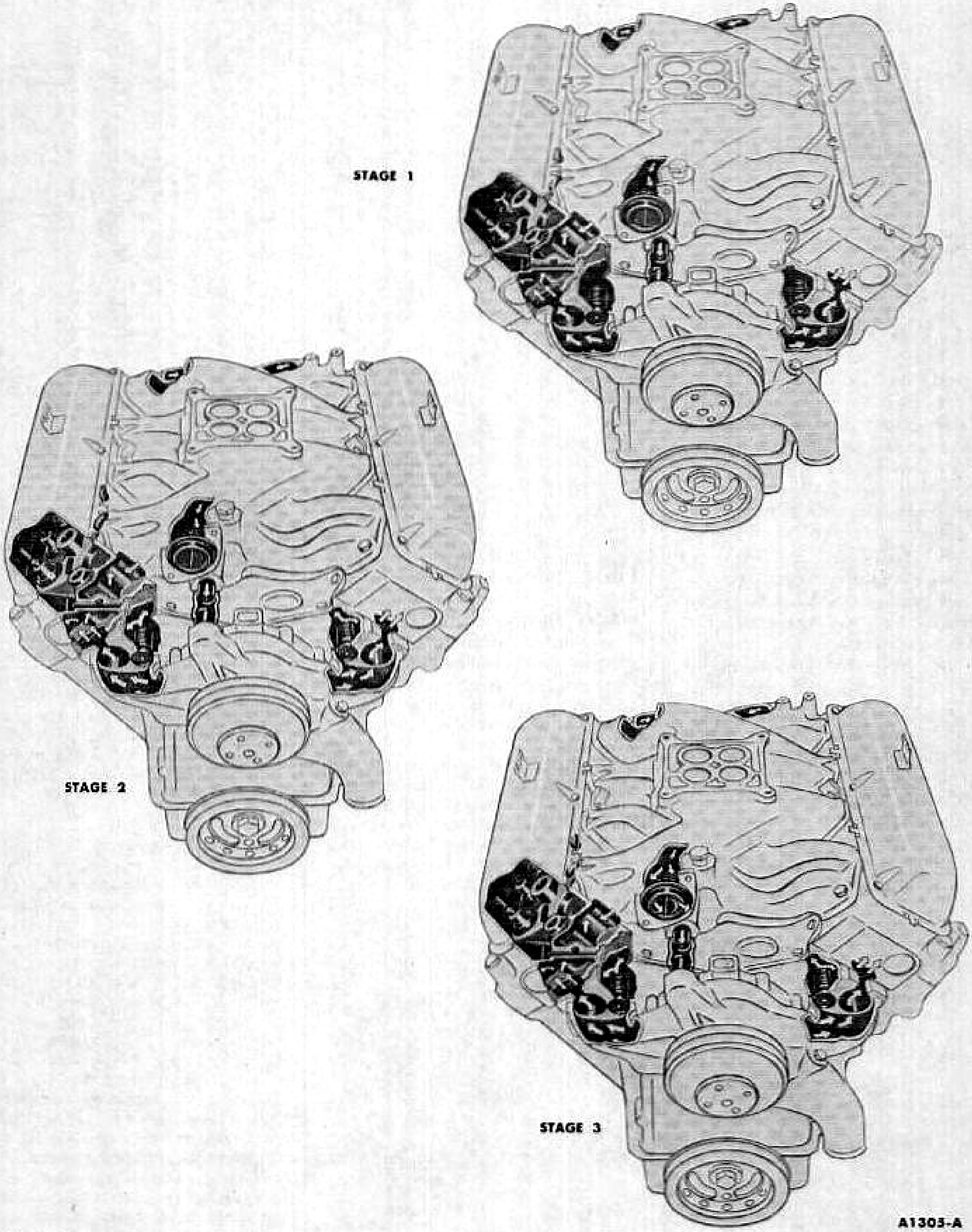


FIG. 7—Cooling System

the main oil gallery which is located in the center of the valve lifter chamber floor. The oil gallery supplies oil to each individual camshaft bearing, through drilled passages in the block. Passages are drilled from each camshaft bearing to each main bearing. Number 1 camshaft bearing feeds No. 1 main bearing, and No. 2 camshaft bearing feeds No. 2 main bearing, etc. The oil then flows through notches or grooves in the main bearings to lubricate the crankshaft journals.

The crankshaft is drilled from the main bearings to the connecting rod bearings. The oil flow is as follows:

Main Bearing		Connecting Rod Bearing
No. 1	Serves	No. 1
No. 2	Serves	Nos. 2 and 5
No. 3	Serves	Nos. 3 and 6
No. 4	Serves	Nos. 4 and 7
No. 5	Serves	No. 8

A small groove is located in the connecting rod at the mating face where the cap contacts the connecting rod. This groove is used as an oil squirt hole for cylinder wall lubrication. Oil from the connecting rod squirt hole lubricates the opposite cylinder wall. For example, the No. 1 connecting rod oils No. 5 cylinder, etc. As the crankshaft turns, the hole in the connecting rod bearing aligns with the hole in the journal causing a direct squirt of oil onto the cylinder wall.

An oil passage is drilled from the main oil gallery to the right cylinder head between Nos. 1 and 2 cylinders to lubricate the valve rocker arm shaft assembly. The oil passage in the cylinder head is drilled from the cylinder head bolt bore to the No. 1 valve rocker arm shaft support.

The oil flows through the valve rocker arm shaft through drilled holes in each rocker arm to lubricate the shaft bore and both ends of the valve rocker arm. The excess oil spirals down the rotating push rods and lubricates the push rod seats.

The left valve rocker arm shaft assembly is similarly lubricated by a passage between Nos. 5 and 6 cylinders to the No. 2 valve rocker arm shaft support.

The oil returns from the valve chamber of the cylinder head to the push rod chamber through holes provided at the lower front and rear corners of the cylinder heads.

Oil drains from the front camshaft bearing to the thrust face of the camshaft sprocket that rides against the front cylinder block surface. The rotation of the camshaft sprocket sprays the oil onto the timing chain and crankshaft sprocket.

CRANKCASE VENTILATION

The ventilation tube consists of three sections:

1. One section projects from the top of the valve lifter chamber floor into a recess in the valve lifter chamber cover. This feature eliminates oil pull-over into the crankcase ventilation tube.

2. The second section is formed as part of the block and has a removable cover.

3. The third section (or outlet) projects from the lower face of the block.

The forward motion of the car causes a partial vacuum to be formed at the outlet projecting from the crankcase. This vacuum action causes air to be drawn through the engine from the oil filler cap located at the front of the intake manifold (Fig. 6). The filler cap contains a filtering element which filters the incoming air.

From the filler cap, the air flows into the front section of the valve push rod chamber where it is directed by a baffle located on the valve lifter chamber floor in three directions:

1. Upward, through the push rod holes into both valve rocker arm chambers. The air flows to the rear of the valve rocker arm chamber and out through the push rod holes into the ventilation tube inlet.

2. From the front section of the push rod chamber through a hole in the front wall of the cylinder block into the timing chain chamber and downward into the crankcase.

3. Air is also diverted through holes in the valve lifter chamber floor into the crankcase. From here it rises upward through holes in the rear of the valve lifter chamber floor and out the ventilation tube.

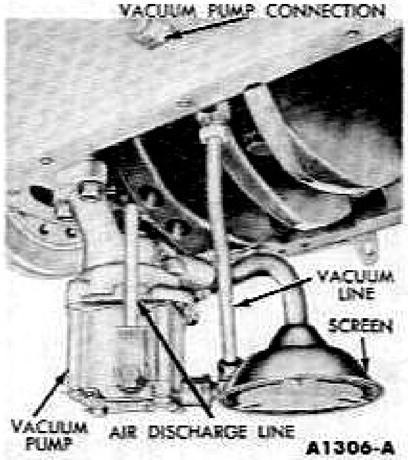


FIG. 8—Oil-Vacuum Pump

COOLING SYSTEM

The cooling system (Fig. 7) has three stages of operation. A thermostat is located at the front of the intake manifold and one thermostat is located on each side of the block at the water pump mounting legs. The thermostats on each side of the block open first and allow coolant to enter the block. The thermostat in the intake manifold allows the coolant to re-circulate through the radiator.

In stage 1, the three thermostats are closed. The coolant flows through each leg of the water pump into the front of the block and into the cylinder heads through a connecting passage. The coolant circulates through the cylinder heads and into the rear of the intake manifold through a connecting passage. The coolant flows to the front of the intake manifold and is returned to the water pump for recirculation through the by-pass connection. Stage 1 circulation continues until the coolant temperature reaches approximately 140°F.

In stage 2, the two thermostats in the block open and the coolant is free to flow into the cylinder block as well as the cylinder heads, as in stage 1. The coolant flows through the cylinder block and up into the rear of each head through mating passageways and then into the intake manifold where it is returned to the water pump for recirculation. Stage 2 circulation continues until the coolant temperature reaches approximately 180°F.

In stage 3, the thermostat in the intake manifold opens and the coolant is allowed to circulate through the radiator. Coolant flows from the radiator to the water pump and is circulated through the engine.

VACUUM PUMP

The dual-vane positive displacement vacuum pump is mounted to the oil pump (Fig. 8). The vacuum pump is driven by the distributor intermediate shaft through a hex drive lug. A vacuum pump inlet check valve assembly is located on the outside of the block for vacuum to the windshield wiper.

Two spring loaded vanes are fitted within a slotted rotor. The vanes rotate concentrically while the rotor rotates eccentrically.

As the intermediate drive shaft rotates the rotor, air received from the pump inlet fills a pocket at the slack or inlet side of the vanes. The oncoming vane presses this air into the narrowing wedge of the outlet side of the pump where it is forced out the pump outlet into the crankcase. This same cycle is in process by the opposite vane creating a high speed intake and exhaust of air, which creates a vacuum of 24.5-26.5 inches Hg at 2000 rpm.

2 ENGINE REMOVAL AND INSTALLATION

The procedures given are for the engine with the transmission attached. The engine installation is shown in Fig. 9.

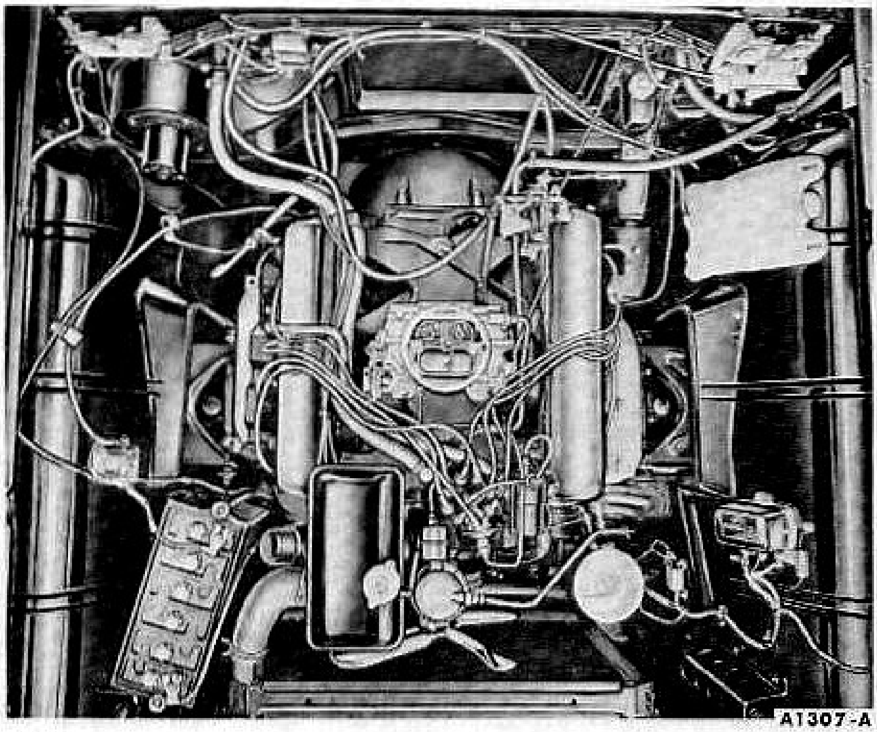


FIG. 9—430 Engine Installation

REMOVAL

1. Drain the cooling system and the crankcase.

2. Disconnect the battery ground cable at the engine.

3. Remove the hood, air cleaner assembly, and the radiator.

4. Disconnect the heater hose at the water pump and the heater hose at the intake manifold and position them out of the way.

5. Disconnect the engine ground strap at the right rocker arm cover.

6. Disconnect the accelerator rod at the accelerator cross shaft bracket and secure it to the dash panel.

7. Disconnect the primary wire at the coil and the oil pressure sending unit wire at the sending unit.

8. Disconnect the engine temperature sending unit wire at the sending unit.

9. Remove the wire loom from the clips on the left valve rocker arm cover and position the wires out of the way.

10. On a car with power brakes, disconnect the power brake vacuum line at the intake manifold vacuum fitting.

11. Raise the car and place it on safety stands.

12. Disconnect the flexible fuel line at the fuel tank line and install a cap on the line.

13. Remove the crankcase ventilation tube outlet. It is a press fit into the block.

14. Disconnect the starter cable at the starter.

15. Disconnect the muffler inlet pipes from the exhaust manifolds.

16. Disconnect the generator wires at the generator.

17. Remove the idler arm bracket to underbody retaining bolts and lower the drop link assembly.

18. Remove the engine right and left support insulator.

19. Disconnect the transmission manual-shift rod at the transmission. Disconnect the speedometer cable at the transmission and install a rubber plug in the transmission.

20. Remove the drive shaft.

21. Remove the engine rear support retainer.

22. Install standard eye bolts with ½-14 threads in the boss at the rear of each exhaust manifold. Attach the engine lifting bracket and sling (tool T53L-300-A) to the eye bolts. Raise the engine slightly.

23. Remove the engine rear support (crossmember).

24. Raise the engine and carefully remove the engine and transmission from the car.

25. Place the engine on wood blocks. Remove the oil cooler line retaining bracket from the right side of the engine. Remove the flywheel housing lower inspection cover. Remove the starter.

26. Remove the converter to flywheel retaining nuts. Remove the transmission oil level filler tube from the right exhaust manifold. Remove the transmission throttle control rod at the accelerator cross shaft bracket.

27. Secure the transmission to a transmission jack.

28. Remove the flywheel housing to engine retaining bolts.

29. Remove the flywheel housing, transmission, and the oil cooler lines as an assembly.

30. Install the engine on a work stand (Fig. 10).

INSTALLATION

1. Remove the engine from the stand and place it on wood blocks.

2. Install two transmission guide studs in the engine block.

3. Place the transmission in position against the block, aligning the converter studs with the stud holes in the flywheel.

4. Install two flywheel housing retaining bolts and remove the guide studs. Install the remaining flywheel housing bolts. Remove the transmission jack.

5. Install the drive plate to converter nuts. Tighten the nuts to specifications. Secure the transmission oil cooler lines to the side of the engine with the retaining clamp.

6. Install the starter and the flywheel housing lower inspection cover.

7. Attach the transmission oil filler tube to the right exhaust manifold upper rear stud. Tighten the retaining nut to specifications.

8. Connect the transmission throttle control rod at the accelerator cross shaft bracket.

9. Clean the gasket surfaces of the exhaust manifolds and the muffler inlet pipes. Place a new gasket over the muffler inlet pipe studs of the exhaust manifolds.

10. Install the engine lifting sling and bracket on the engine. Lower the engine and transmission assembly into the car. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes.

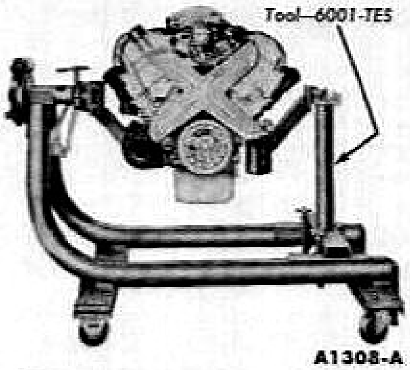


FIG. 10—Engine Work Stand

11. Place a jack under the transmission and raise the transmission. Remove the engine lifting sling and bracket and the eye bolts.

12. Install the engine rear support (crossmember). Remove the jack from the transmission.

13. Install the engine rear support retainer.

14. Remove the rubber plug from the transmission and connect the speedometer cable. Install the drive shaft. Install the engine right and left front support retainers.

15. Install the idler arm bracket. Connect the starter cable and the transmission manual-shift rod.

16. Install the crankcase ventilation tube outlet. Connect the flexible fuel line to the fuel tank line.

17. Connect the generator wires.

18. Install the exhaust manifold to muffler inlet pipes, lockwashers and nuts. Remove the safety stands and lower the car.

19. Connect the accelerator rod to the accelerator cross shaft bracket, the heater hose to the intake manifold, and the heater hose to the water pump.

20. Connect the engine ground strap to the right valve rocker arm cover.

21. Install the wire loom on the clips on the left valve rocker arm cover.

22. Install the engine temperature and oil pressure sending unit wires. Connect the coil primary wire.

23. On a car with power brakes, connect the power brake vacuum line to the intake manifold vacuum fitting.

24. Connect the battery ground cable at the engine.

25. Install the radiator and the hood.

26. Fill and bleed the cooling system.

27. Fill the crankcase with the proper grade and quantity of engine oil.

28. Operate the engine at fast idle and check all gaskets and hose connections for leaks.

29. Adjust the transmission control linkage.

30. Install the air cleaner assembly.

3 ENGINE DISASSEMBLY—ENGINE REMOVED

INTAKE MANIFOLD AND DISTRIBUTOR

1. Disconnect the fuel pump inlet line at the fuel pump and remove the line.

2. Disconnect the carburetor fuel inlet line at the sediment bowl and remove the fuel pump and sediment bowl.

3. Remove the access plug from the top of the cylinder front cover, then remove the fuel pump push rod.

4. Disconnect the wires at the spark plugs and remove the wires from the ignition harness bracket on each valve rocker arm cover.

5. Remove the coil high tension wire and the primary ignition wire from the coil. Remove the distributor cap and spark plug wires as an assembly.

6. Remove the coil.

7. Disconnect the distributor vacuum line at the distributor. Remove the distributor retaining bolt and clamp and remove the distributor.

8. Remove the radiator supply tank.

9. Disconnect the automatic choke heat tube at the carburetor and remove the tube from the exhaust manifold. Slide the clamp on the coolant by-pass hose toward the water pump.

10. Remove the intake manifold retaining bolts (the oil filler tube bracket is retained by the intake manifold right front bolt).

11. Remove the intake manifold (and gaskets) and carburetor as an assembly.

12. Clean the top of the valve push rod chamber cover and remove the cover.

CYLINDER HEADS

1. Remove the valve rocker arm covers and gaskets.

2. Rotate the crankshaft damper until No. 1 piston is on T.D.C. at the end of the compression stroke.

3. Rotate the crankshaft damper an additional 45°.

4. Starting at the No. 4 valve rocker arm shaft support, loosen the right valve rocker arm shaft support bolts in sequence, two turns at a time. After the bolts are all loosened, remove the valve rocker arm shaft assembly.

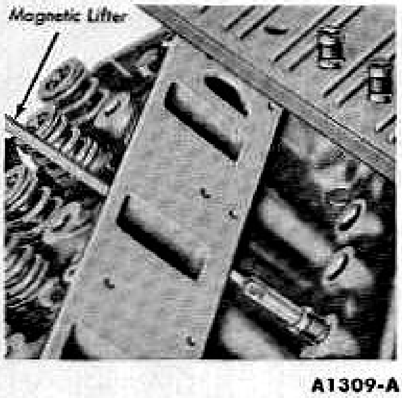


FIG. 11—Hydraulic Valve Lifter Removal

5. Follow the same procedure on the left valve rocker arm shaft support bolts, starting at No. 1 valve rocker arm shaft support.

6. Remove the valve push rods in sequence.

7. Lift the hydraulic valve lifters from the cylinder block and place them in a rack so that they can be installed in their original bore. **The internal parts of each hydraulic valve lifter assembly are matched sets. Do not intermix the parts.** Keep the assemblies intact until they are to be cleaned. If the hydraulic valve lifters can not be removed with the fingers, remove them with the tool shown in Fig. 11.

8. Remove the exhaust manifold retaining bolts and tab washers, then remove the exhaust manifolds and heat shields.

9. Remove the spark plugs.

10. Install the cylinder head holding fixtures (Fig. 12).

11. Remove the cylinder head bolts.

12. Lift the cylinder head off the block. **Do not pry between the head and block.** Remove and discard the cylinder head gasket.

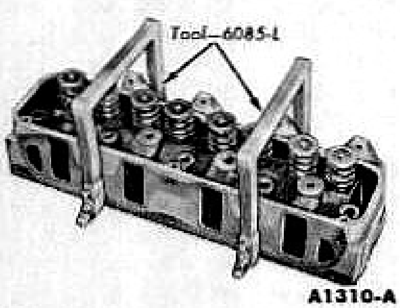


FIG. 12—Cylinder Head Holding Fixtures

OIL FILTER AND ADAPTER

Unscrew the oil filter from the adapter. Remove the oil filter adapter assembly and oil pressure sending unit as an assembly. Discard the gasket.

OIL PAN AND OIL-VACUUM PUMP

1. Invert the engine on the work stand.

2. Remove the oil pan retaining screws and remove the oil pan. Discard the gasket.

3. Disconnect the vacuum connection at the cylinder block.

4. Remove the oil-vacuum pump attaching bolts and remove the oil-vacuum pump and inlet tube as an assembly.

5. Remove the oil-vacuum pump drive shaft. Discard the oil-vacuum pump gasket.

CYLINDER FRONT COVER

1. Loosen the drive belt adjusting arm at the generator.

2. Remove the water pump drive belts. Disconnect the drive belt adjusting arm at the water pump.

3. Remove the generator and adjusting arm bracket.

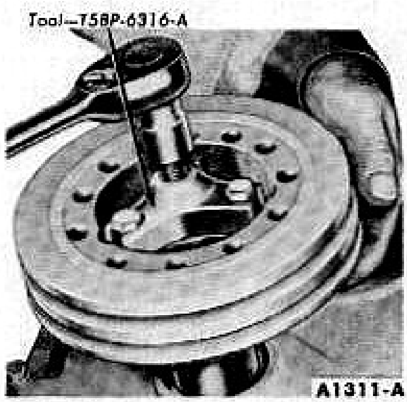


FIG. 13—Damper Removal

4. On an engine with a windshield washer pump, remove the pump bracket from the water pump.

5. Remove the water pump, pulley, and fan as an assembly.

6. On an engine with a power steering pump pulley, remove the two cap screws and lockwashers securing the power steering pulley to the crankshaft damper, then remove the pulley.

7. Remove the cap screw and washer from the end of the crankshaft.

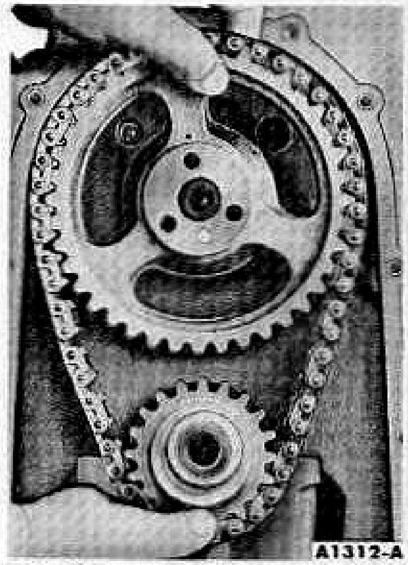


FIG. 14—Camshaft Sprocket and Timing Chain Removal or Installation

8. Install the puller on the crankshaft damper (Fig. 13) and remove the damper.

9. Remove the Woodruff key and crankshaft sleeve from the crankshaft.

10. Remove the screws fastening the cylinder front cover to the block. The timing pointer is fastened to the engine by one cylinder front cover screw. Remove the cylinder front cover.

11. Discard the cylinder front cover gasket.

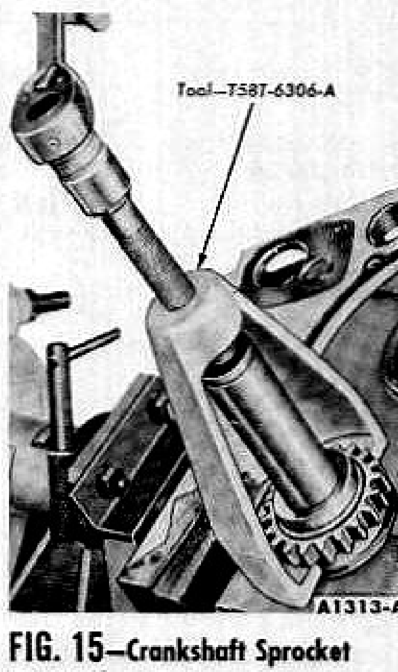


FIG. 15—Crankshaft Sprocket Removal

TIMING CHAIN AND SPROCKETS

1. Remove the crankshaft front oil slinger. Remove the three retaining screws and lock ring from the camshaft sprocket, then remove the fuel pump eccentric.

2. Remove the camshaft sprocket and timing chain (Fig. 14).

3. Remove the crankshaft sprocket (Fig. 15). Remove the Woodruff key.

CAMSHAFT

Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging the journals and lobes.

CYLINDER BLOCK THERMOSTATS

Remove the cylinder block thermostats as outlined in Part 4-1.

FLYWHEEL, CRANKSHAFT, AND CONNECTING ROD ASSEMBLIES

1. Remove the flywheel attaching bolts and remove the flywheel.

2. Remove the crankcase ventilation cover and gasket.

3. Remove the crankcase ventilation tube outlet. The tube is a press fit in the block.

4. Turn the engine on the work stand so that the front end is up.

5. Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.** After the ridge has been removed, remove the cutter from the cylinder bore, then turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth with the cuttings.

6. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.

7. Turn the crankshaft until the connecting rod being removed is down.

8. Remove the nuts from the connecting rod bolts, then pull the cap off the rod.

9. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankpin or the cylinder wall when removing the piston and rod.**

10. Remove the bearing inserts from the connecting rods and caps.

11. Remove the main bearing caps.

12. Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

13. Remove the rear journal oil seal from the block and rear bearing cap, and remove the cap to block side seals.

14. Remove the main bearing inserts from the block and bearing caps.

CAMSHAFT BEARINGS

Drill a ½-inch hole in the camshaft rear bearing bore plug and use tool T-7600-E to remove the plug. Remove the camshaft bearings (Fig. 16).

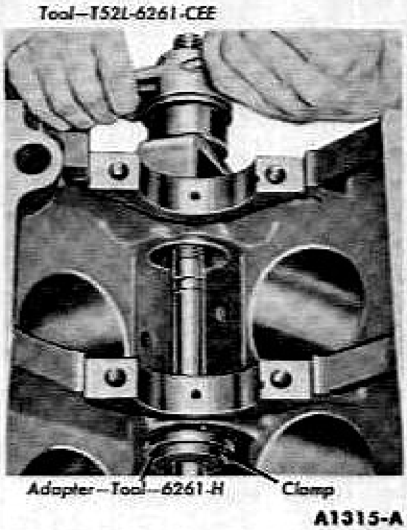


FIG. 16—Camshaft Bearing Replacement

4 DISASSEMBLY AND ASSEMBLY OF COMPONENT PARTS

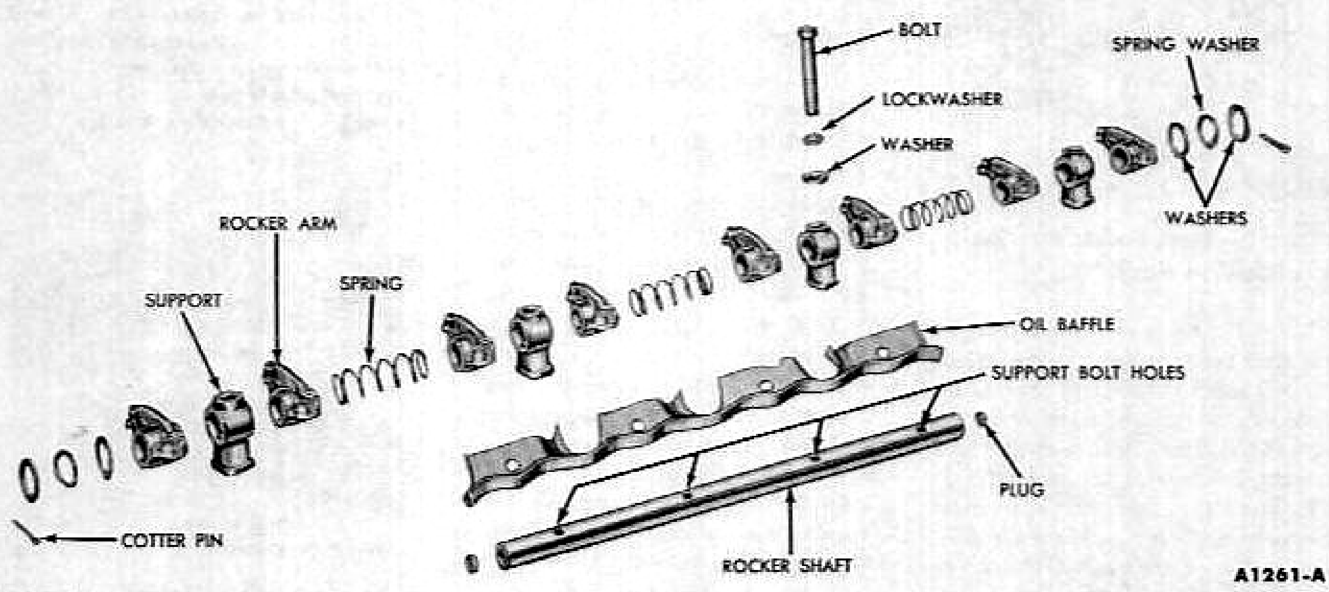


FIG. 17—Valve Rocker Arm Shaft Assembly

VALVE ROCKER ARM SHAFT

DISASSEMBLY

1. Remove the cotter pins from each end of the valve rocker arm shaft, then remove the flat washers and spring washers.

2. Slide the rocker arms, springs, and the supports off the shaft. Be sure to identify all parts.

3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce one plug, then insert a steel rod through the plug and knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

ASSEMBLY

1. Lubricate all moving parts with engine oil. Apply Lubriplate to the pad of the valve rocker arm.

2. If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the rocker arm shaft.

3. Install the rocker arms, supports, and springs in the order shown

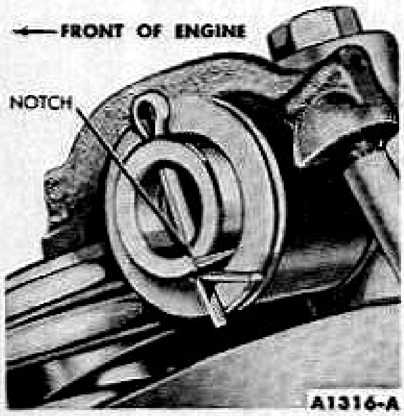


FIG. 18—Valve Rocker Arm Shaft Identification Notch

in Fig. 17. **Be sure the oil holes in the shaft are facing downward.** When the left valve rocker arm shaft is assembled, the identification notch on the shaft must be downward and toward the rear of the engine (Fig. 18). The right rocker arm shaft must be assembled so that the identification notch on the shaft faces downward and to the front of the engine. Complete the assembly by installing

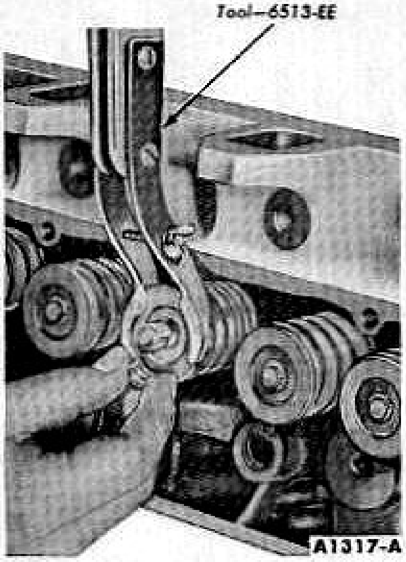


FIG. 19—Valve Spring Retainer Locks Removal or Installation

the remaining two flat washers with the spring washer between them and install the cotter pin.

CYLINDER HEADS

DISASSEMBLY

1. Clean deposits from the cylinder head before removing the valves.

2. Compress the valve springs (Fig. 19), then remove the spring retainer locks, and release the spring.

3. Remove the sleeve, spring retainer, spring assembly stem seal, and valve. Discard the valve stem seals. Identify all valve parts.

ASSEMBLY

1. Lubricate the valve guides and valve stems with engine oil. Apply Lubriplate to the tip of the valve stems.

2. Install each valve (Fig. 20) in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve.

3. If the damper spring was removed from the valve spring, install the damper spring inside the valve spring. Be sure that the damper spring coils are not caught between the valve spring coils. Install the valve spring assembly over the valve so that the closed coils are toward the head. Install the spring retainer and sleeve.

4. Compress the spring and install the retainer locks (Fig. 19).

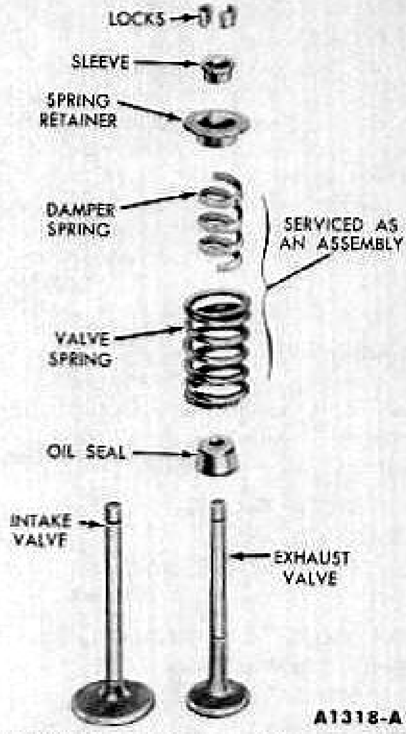


FIG. 20—Valve Assembly

5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 21).

6. Check the dividers against a scale. If the assembled height is 1 55/64 inches or greater, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension of 1 13/16-1 55/64 inches. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs which will lead to excessive load loss and spring breakage.**

FIG. 21—Valve Spring Assembled Height

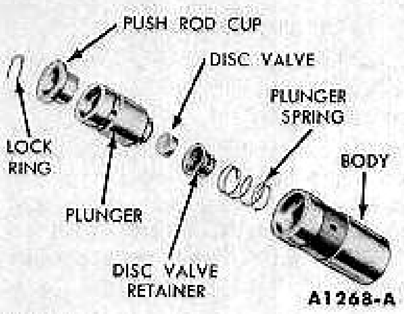


FIG. 22—Typical Hydraulic Valve Lifter Assembly

HYDRAULIC VALVE LIFTERS

Each valve lifter is a matched assembly. If the parts of one lifter are inter-mixed with those of another, improper valve operation may result. Disassemble and assemble each lifter separately. Keep the lifter assemblies in proper sequence so that they can be installed in their original bores.

DISASSEMBLY

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.

2. Remove the push rod cup, plunger, and spring.

3. Invert the plunger assembly and remove the disc valve retainer by carefully prying up on it with a screwdriver, then remove the disc valve and spring.

ASSEMBLY

A typical valve lifter is shown in Fig. 22.

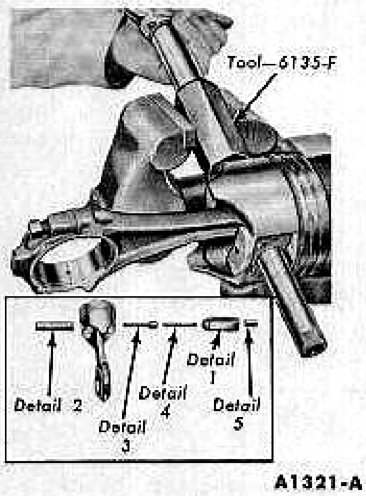


FIG. 23—Piston Pin Removal—Manually

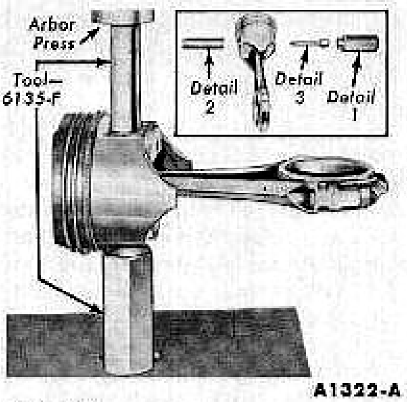


FIG. 24—Piston Pin Removal on Arbor Press

1. Place the plunger upside down on a clean work bench.

2. Place the disc valve in position over the oil hole on the bottom of the plunger. Set the disc valve spring on top of the disc.

3. Position the disc valve retainer over the disc and spring and push the retainer down into place on the plunger.

4. Place the plunger spring, then the plunger (open end up) into the lifter body.

5. Place the push rod seat in the plunger.

6. Depress the plunger, then position the closed end of the lock ring in the groove of the lifter body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, then depress it again to fully seat the lock ring.

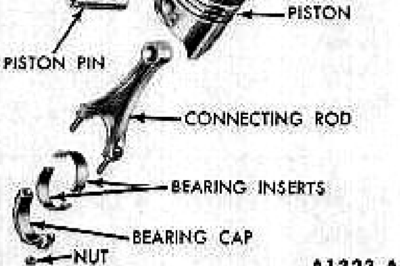


FIG. 25—Piston, Connecting Rod, and Related Parts

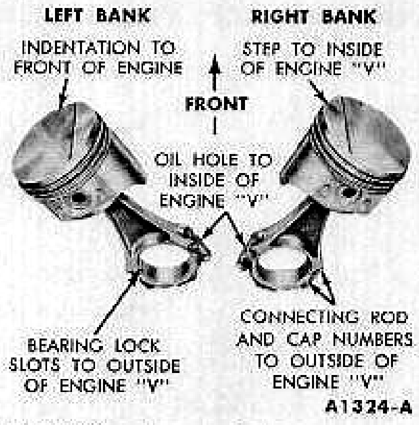


FIG. 26—Piston and Connecting Rod Assembly

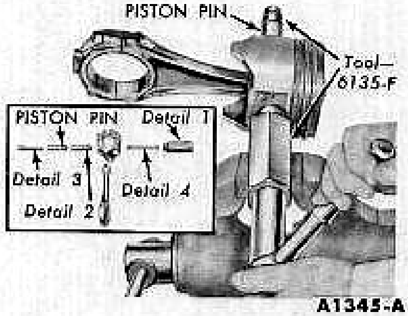


FIG. 27—Piston Pin Installation—Manually

PISTONS AND CONNECTING RODS

DISASSEMBLY

1. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed. Remove the piston rings.

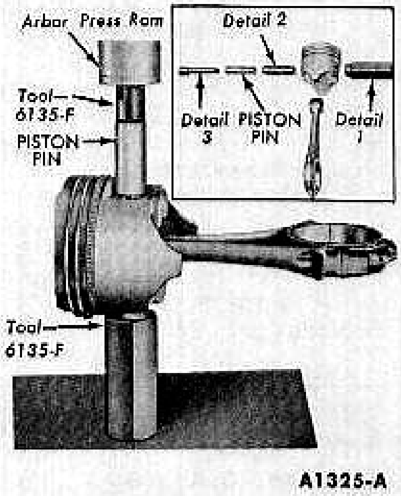


FIG. 28—Piston Pin Installation on Arbor Press

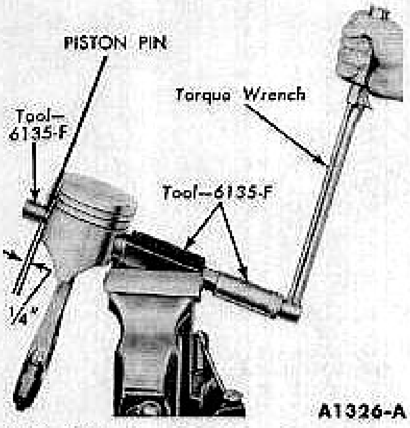


FIG. 29—Checking Interference Torque Required to Seal Piston Pin

2. Remove the piston pin from the piston and connecting rod (Fig. 23 or 24).

ASSEMBLY

The piston, connecting rod, and related parts are shown in Fig. 25.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod so that the step on the piston and the oil squirt holes in the connecting rod will be toward the inside of the engine "V" (Fig. 26). The indentation on the piston is toward the front of the engine. **Pistons are not interchangeable from one cylinder bank to the other.**

2. Start the piston pin in the piston and connecting rod as shown in Fig. 27 or 28. Press the piston pin through the piston and connecting rod until the end of the pin is approximately ¼ inch from the piston boss (Fig. 29). If a press is used to install the piston pin, remove the piston and connecting rod assembly from the press when the pin is pressed in within ¼ inch from the piston boss and install it in a vise.

3. Using a torque wrench, tighten the nut on the tool (Fig. 29) until the piston pin is fully seated (until detail 1 has seated against detail 2). A minimum torque limit of 20 foot-pounds is required to fully seat the pin.

4. If the torque required to seat the pin is less than 20 foot-pounds, remove the piston pin and replace the connecting rod. The piston pin bore of the new connecting rod must be within the limits of 0.9737-0.9742 inch. The diameter of the piston pin must be within the limits of 0.9750-0.9753 inch. If the piston pin is not within specifications, replace the piston and piston pin assembly. **Check the fit of the new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

5. Follow the instructions contained on the piston ring package and install the piston rings.

6. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (step 6 under "Fitting Piston Rings" in Part 1-1).

7. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts may distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

OIL-VACUUM PUMP

DISASSEMBLY

1. Remove the oil inlet tube and screen assembly from the oil pump and discard the gasket.

2. Disconnect the vacuum pump inlet line from the vacuum pump body.

3. Remove the screws and locking plates that secure the vacuum pump assembly to the oil pump body.

4. Scribe an index mark on the side of the cover plate and the vacuum pump, then remove the cover plate and drive lug.

5. Remove the vacuum pump rotor and vanes as an assembly. **Do not drop the vanes.**

6. Remove the inner rotor and shaft assembly, then remove the outer race.

7. Insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

ASSEMBLY

The oil-vacuum pump assembly is shown in Fig. 30.

1. Oil all parts thoroughly.

2. Install the oil pressure relief valve plunger, spring, and a new cap.

3. Install the outer race, and the inner rotor and shaft assembly in the oil pump body. **The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.**

4. Position the vanes in the vacuum pump rotor.

5. Compress the vanes into the rotor and position the assembly in the vacuum pump body.

6. Position the drive lug in the vacuum pump rotor. Using the index marks as a guide, position the cover plate on the vacuum pump housing with the oil groove on the plate facing upward. Install the two cover plate screws. Position the vacuum pump on the oil pump and install the lock plates and retaining screws.

7. Install, but do not tighten, the vacuum pump inlet tube.

8. Install the oil inlet tube and screen assembly.

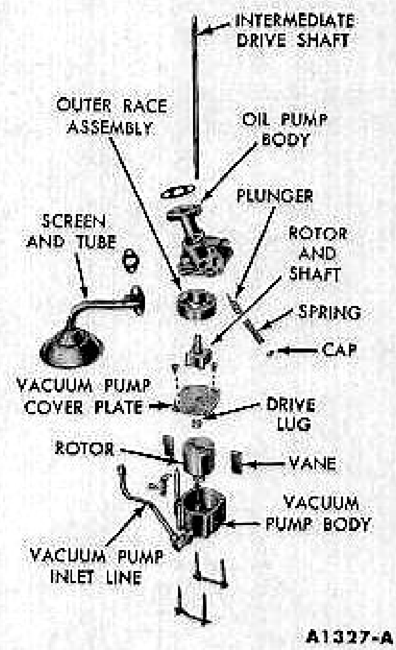


FIG. 30—Oil-Vacuum Pump Assembly

5 ENGINE ASSEMBLY—ENGINE REMOVED

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and 0.015-inch undersize journal diameters. The bearings are not interchangeable from one bore to another. The bearings must be installed in their respective bores.

1. Position the new bearing at the bearing bore, and press it into place with the tool shown in Fig. 16. Align the oil holes in the bearings with the

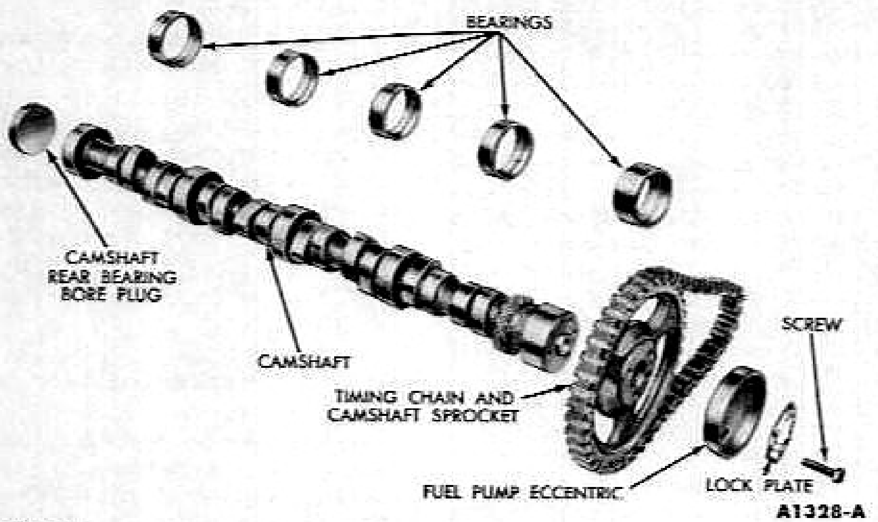


FIG. 31—Camshaft and Related Parts

oil holes in the cylinder block when the bearings are installed. **Be sure the camshaft front bearing is installed 0.005-0.020 inch below the front face of the cylinder block** (refer to Fig. 32 in Part 1-2).

2. Clean out the camshaft rear bearing bore plug recess thoroughly.

3. Coat the flange of a new plug with water resistant sealer and install it with the flange facing in. Drive the plug in until it is flush or slightly below the casting surface.

CAMSHAFT

The camshaft and related parts are shown in Fig. 31.

Oil the camshaft and apply Lubriplate to all the lobes, then carefully slide it through the bearings.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 32.

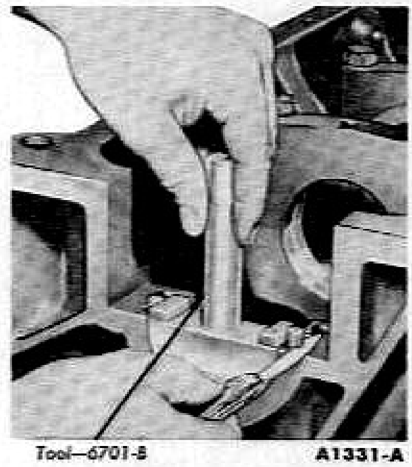


FIG. 33—Seal to Block Installation

1. Be sure that the rear journal oil seal grooves are clean, then install a new rear journal oil seal in the block (Fig. 33) and rear main bearing cap (Fig. 34). After installation, cut the ends of the seals flush.

2. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. **Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts may distort the bearing and cause a failure.**

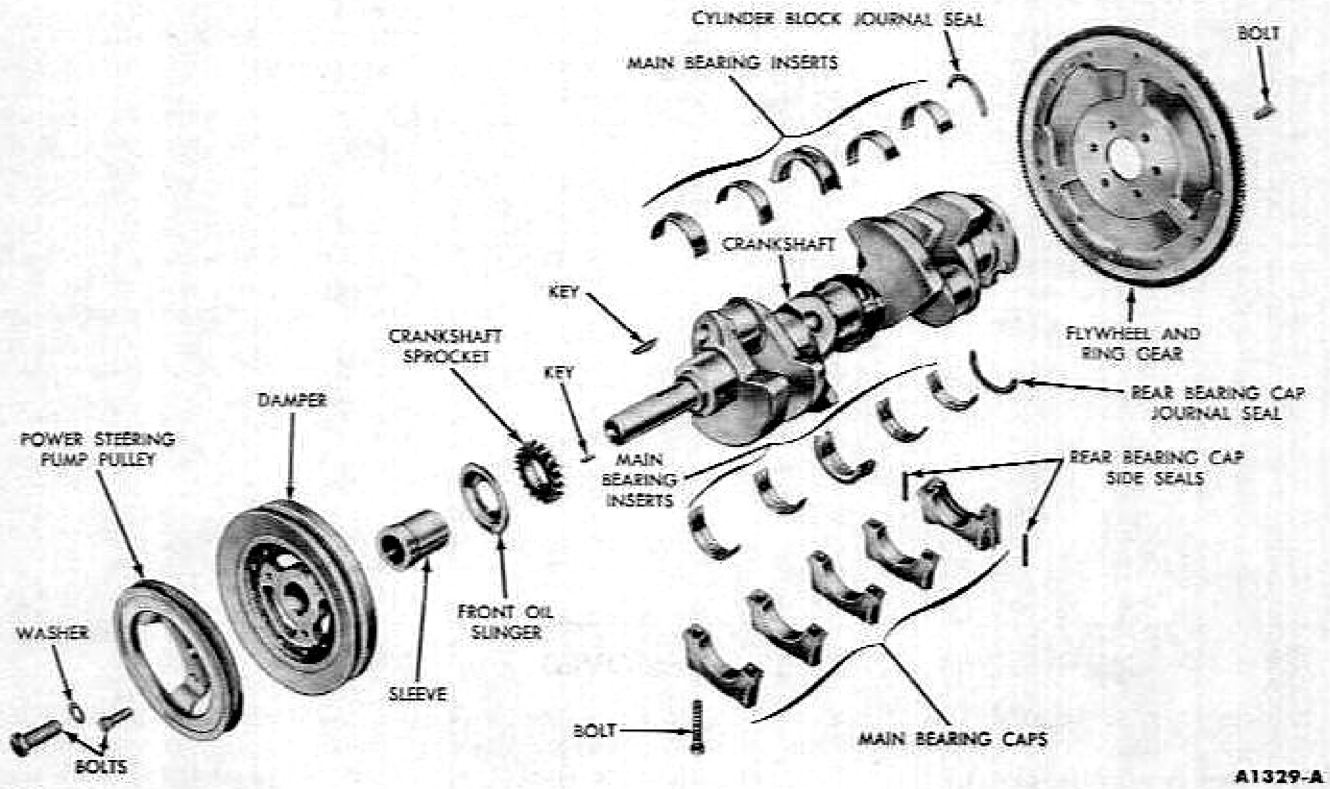


FIG. 32—Crankshaft and Related Parts

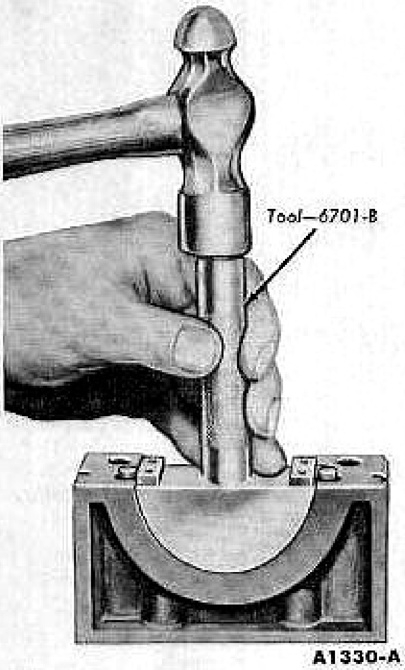


FIG. 34—Seal to Rear Bearing Cap Installation

Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.

3. Install the lower main bearing inserts into the bearing caps.

4. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**

5. Check the clearance of each main bearing, following the procedure under "Main Bearing Replacement in Part 1-1.

6. If the bearing clearances are satisfactory, apply a light coat of engine oil to the journals and bearings, then install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Main bearing caps are numbered 1 thru 5 starting at the front of the engine. The arrows on the cap should be pointed toward the front of the engine.** Tighten the bearing cap bolts to specifications.

7. Install the thrust bearing cap with the bolts finger tight.

8. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 35).

9. Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 35). This will align the thrust surfaces of both halves of the bearing.

10. Retain the forward pressure on the crankshaft, and tighten the cap bolts to specifications (Fig. 35).

11. Force the crankshaft toward the rear of the engine.

12. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 36).

13. Set the dial on zero. Push the crankshaft forward and note the reading on the dial.

14. If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or foreign matter. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces, following the recommended procedure (steps 7, 8, 9, and 10), then recheck the end play.

15. Dip the rear bearing cap side seals in light engine oil, then immediately install them in the grooves. **Do not use sealer on the side seals, the seals are designed to expand when dipped in oil. Using sealer may retard this expansion.** It may be necessary to tap the seals into place for the last ½ inch of travel. Do not cut the seal projecting ends.

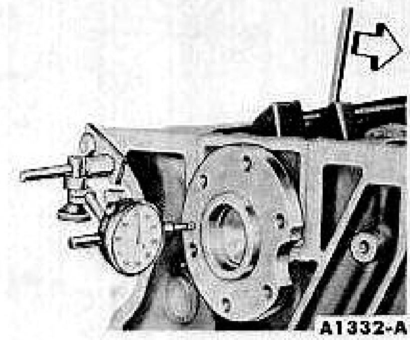


FIG. 36—Crankshaft End Play

16. Check the rear bearing cap side seals for leaks by squirting a few drops of oil into the parting lines between the bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the seal grooves.**

17. Apply sealer to a new crankcase ventilation cover gasket and install the gasket and cover. Tighten the cover screws to specifications. Install the flywheel. Tighten the retaining bolts to specifications. Install the crankcase ventilation tube outlet.

CONNECTING ROD ASSEMBLIES

1. Turn the engine on the work stand so that the front end is up.

2. Apply a light coat of engine oil to the piston rings, pistons, and cylinder walls.

3. **Piston assemblies are not interchangeable from one cylinder bank to the other. Right and left pistons**

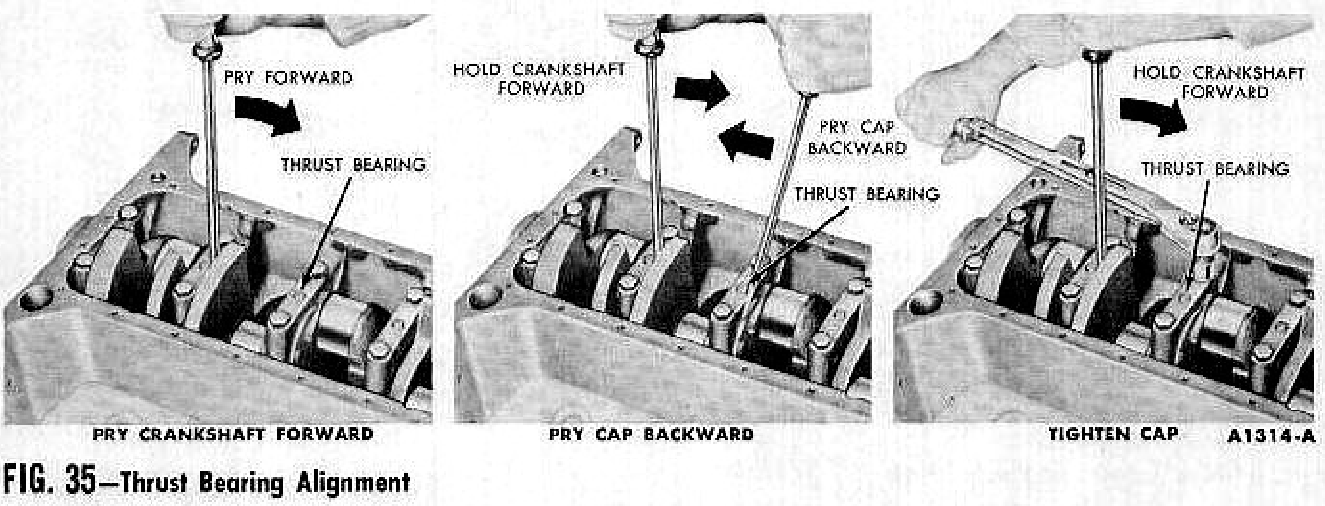


FIG. 35—Thrust Bearing Alignment

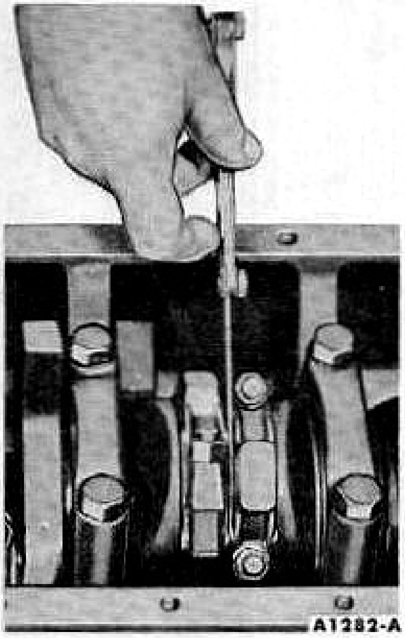


FIG. 37—Connecting Rod Side Clearance

must be installed in their respective bank of the cylinder block.

Each connecting rod and bearing cap are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

4. Make sure the ring gaps are properly spaced around the circumference of the piston.

5. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder. Be sure to guide the connecting rods to avoid damaging the crankshaft journals. Install the piston with the indentation in the piston head toward the front of the engine and the step on

FIG. 38—Crankshaft Sprocket Installation

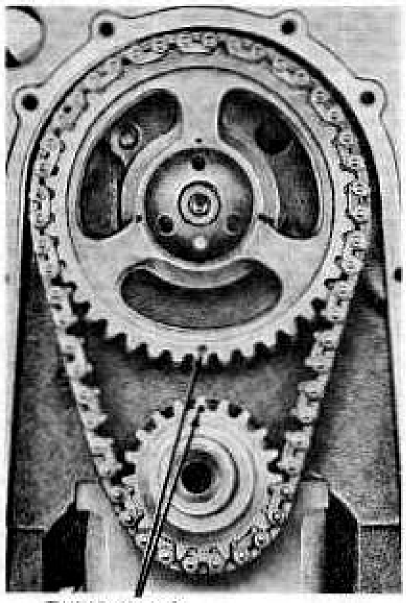


FIG. 39—Aligning Timing Marks

the piston toward the inside of the engine "V." The bearing lock slots in the connecting rod should be toward the outside of the engine "V" when installed.

6. Check the clearance of each bearing, following the procedure under "Connecting Rod Bearing Replacement" in Part 1-1.

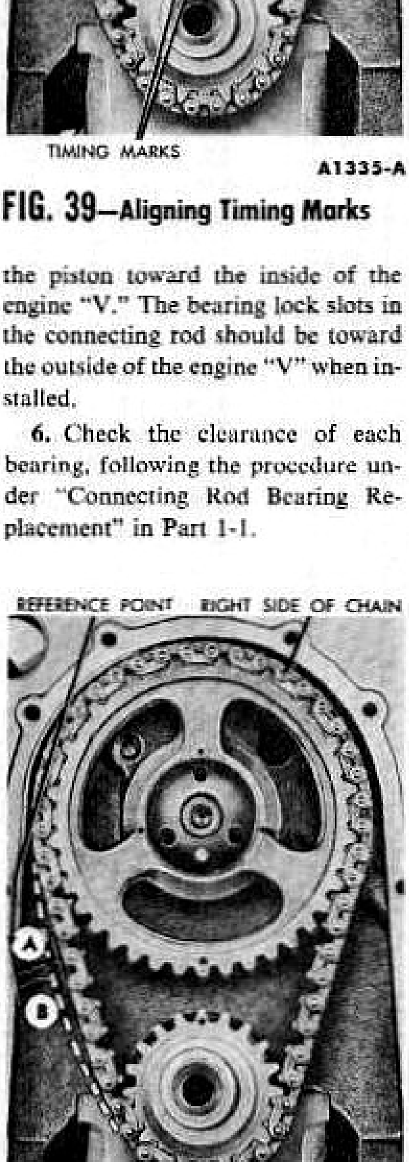


FIG. 40—Timing Chain Deflection

7. If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings.

8. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.

9. Install the connecting rod cap. Tighten the nuts to specifications.

10. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 37).

TIMING CHAIN AND SPROCKETS

1. Lubricate the timing chain and sprockets with engine oil. Place the key in position in the slot in the crankshaft. Install the crankshaft sprocket (Fig. 38).

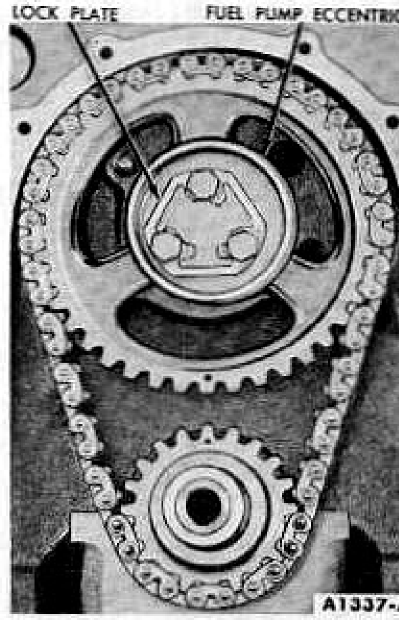


FIG. 41—Fuel Pump Eccentric Installed

2. Place the timing chain in position on the camshaft sprocket. Install the camshaft sprocket and timing chain (Fig. 14), aligning the timing mark on the crankshaft sprocket (Fig. 39).

3. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.

4. Establish a reference point on the block and measure from this point to the chain (Fig. 40).

5. Rotate the crankshaft in the op-

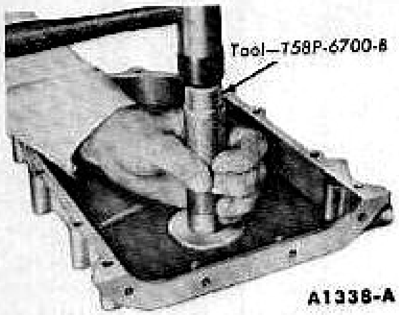


FIG. 42—Oil Seal Installation

posite direction to take up the slack on the right side of the chain, then force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

6. If the deflection exceeds ½ inch, replace the timing chain and/or sprockets.

7. Install the fuel pump eccentric, lock plate, and screws (Fig. 41). Install the crankshaft front oil slinger.

CYLINDER FRONT COVER AND FRONT OIL SEAL

FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

1. Drive out the old seal with a pin punch, then clean out the recess in the cover.

2. Coat a new seal with grease. Install the seal (Fig. 42).

3. Drive the seal in until it is fully seated in the recess.

4. After installation, check to be sure the spring is properly positioned in the seal.

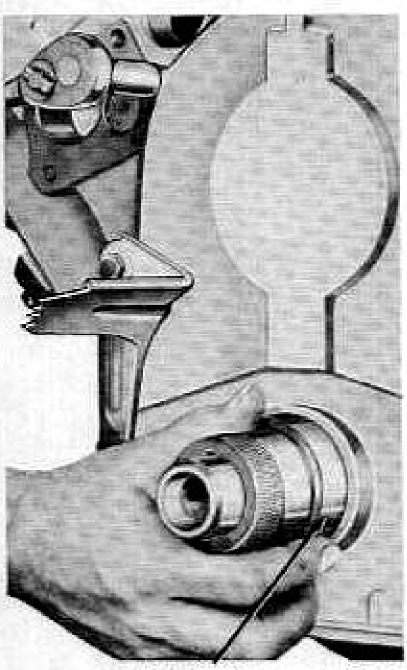


FIG. 43—Cylinder Front Cover Alignment

CYLINDER FRONT COVER INSTALLATION

1. Clean the cylinder front cover and the cylinder block gasket surfaces.

2. Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

3. Install the cylinder front cover alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 43).

4. Install the cylinder front cover bolts finger tight. The timing pointer is retained by one of the cylinder front cover screws.

While pushing in on the pilot, tighten the cover bolts to specifications. Remove the pilot.

5. Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease. Install the crankshaft sleeve.

6. Line up the damper keyway with the key on the crankshaft, then install the damper on the crankshaft (Fig. 44).

7. Install the damper cap screw and washer, and tighten the screws to specifications.

On a car with power steering, install the pulley on the crankshaft damper.

8. Install the cylinder block thermostats as outlined in Part 4-1.

9. Clean the water pump gasket surfaces and apply sealer. Position new gaskets on the pump and position the water pump, pulley, and fan on the block. Install the water pump left bolts finger tight.

10. On an engine with a windshield washer pump, position the pump bracket and install the water pump lower right bolt.

11. Install the water pump upper right bolt, then tighten all the water pump bolts.

12. Position the fuel pump push rod in the top of the cylinder front cover, then install the plug.

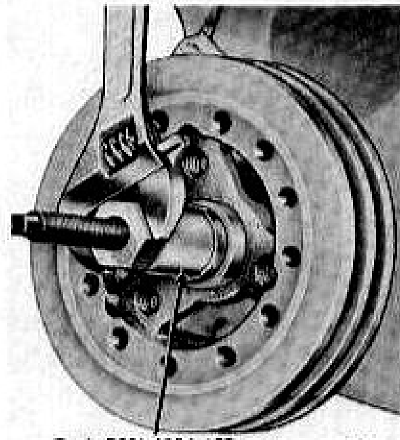


FIG. 44—Damper Installation

13. Apply sealer to a new fuel pump gasket, then install the gasket, fuel pump, and sediment bowl.

OIL PAN AND OIL-VACUUM PUMP

1. Invert the engine on the work stand. Position the intermediate drive shaft into the oil pump socket. With the shaft firmly seated in the socket, position the oil pump into place. The stop on the shaft should touch the roof of the crankcase. Remove the shaft and oil pump and position the stop as necessary.

2. With the stop properly positioned, insert the oil pump drive shaft into the oil pump.

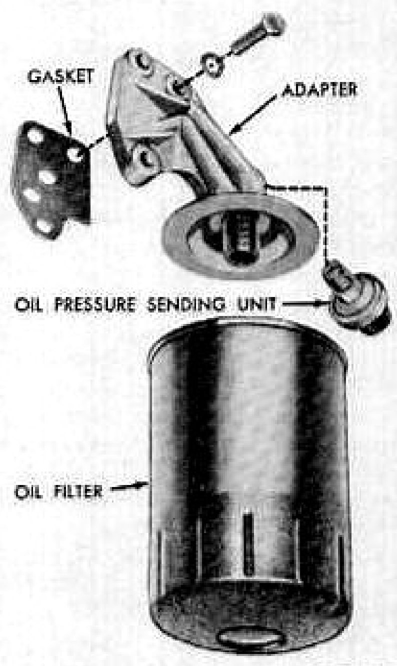


FIG. 45—Oil Filter Assembly

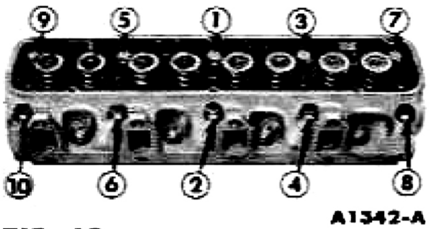


FIG. 46—Cylinder Head Bolt Tightening Sequence

3. Position a new gasket on the oil pump housing and install the oil-vacuum pump, inlet tube assembly, and shaft as an assembly (Fig. 8). Tighten the oil pump retaining screws to specifications.

4. Connect the vacuum pump inlet line. Tighten the fittings at the pump and cylinder block.

5. Position a new gasket on the oil pan and place the oil pan assembly on the block by positioning the front of the oil pan over the oil pump inlet tube and screen assembly. Install the retaining screws and tighten them, from the center outward, to specifications.

OIL FILTER AND ADAPTER

The oil filter assembly is shown in Fig. 45.

1. Clean the oil filter adapter gasket surfaces.

2. Apply sealer to a new adapter gasket, and install the adapter assembly and gasket.

3. Clean the adapter filter recess. Coat the gasket on a new filter with oil, then place the filter in position on the adapter. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

4. Install the oil pressure sending unit.

CYLINDER HEADS

1. Clean the cylinder head and block gasket surfaces.

2. Apply a coating of head gasket sealer to both sides of a new gasket. Guided by the word "FRONT" on the gasket, install the head gasket over the cylinder head dowels.

3. Place the cylinder head on the engine. Remove the holding fixtures. Install the cylinder head bolts.

4. The cylinder head bolts are tightened in three progressive steps. Follow the sequence shown in Fig. 46. Tighten the bolts to 75 foot-pounds torque, then tighten them to 85 foot-pounds torque. Finally, tighten the bolts to 95-105 foot-pounds torque. **After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.**

5. Coat the mating surfaces of the exhaust manifold with a light film of graphite grease.

On the right exhaust manifold, using a new gasket, install the automatic choke air chamber cover on the manifold. **Be sure the cover is securely fastened.** Position a new gasket over the muffler inlet pipe studs of the exhaust manifolds.

6. Position the exhaust manifold and heat shield on the cylinder head and install the retaining bolts and tab washers. Tighten the retaining bolts to specifications, working from the center to the ends. Lock the bolts by bending one tab of the washer over a flat on the bolt.

7. Install the spark plugs.

8. Coat the outside of each valve lifter with engine oil to provide initial lubrication. Do not fill the lifters with oil. **The lifters will fill much faster after the engine is started if they are free of any oil film which may cause an oil seal between the plunger and the lifter body.** Place each lifter in the bore from which it was removed.

9. Install the valve push rods in their proper sequence, making sure the lower ends of the rods are positioned in the lifter push rod cup.

10. Crank the engine until the No. 1 piston is on T.D.C. at the end of the compression stroke.

11. Rotate the crankshaft damper an additional 45°.

12. Install the right valve rocker arm shaft assembly on the cylinder head with the valve push rods in place and the rocker shaft support bolts finger tight. **Be sure the identification notch in the shaft is down and to the front.**

13. Starting at the first valve rocker arm support, tighten the bolts in sequence, two turns at a time, until the supports fully contact the cylinder head. Tighten the bolts, in sequence, to specifications.

14. Follow step 11 for the left valve rocker arm shaft assembly. **Be sure the identification notch on the left shaft is down and to the rear.**

15. Follow step 13 for the left valve rocker arm shaft.

16. Cement or staple a new gasket to the valve rocker arm covers so that the word "TOP" on the gasket tab is to the top when the gasket is installed. Install the valve rocker arm covers.

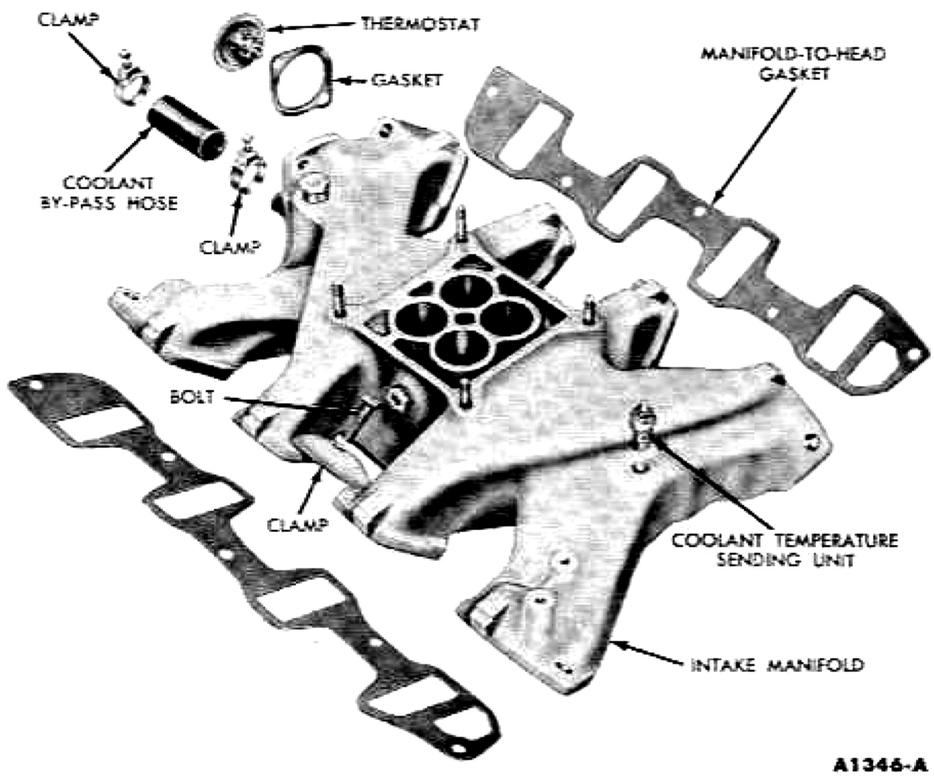


FIG. 47—Intake Manifold Assembly

INTAKE MANIFOLD AND DISTRIBUTOR

The intake manifold assembly is shown in Fig. 47.

1. Install a new gasket on the valve push rod chamber cover, using an oil resistant sealer on the gasket.

2. With the gasket in position, tilt the front of the cover upward and install the rear of the cover over the ventilation tube. Lower the front of the cover into position, making certain the rubber grommet in the cover is not dislodged by the distributor clamp stud. Tighten the cover screws to specifications.

3. Clean the gasket surfaces of the cylinder heads and intake manifold.

4. Guided by the word "FRONT" on the gaskets, install the gaskets on the cylinder heads. Temporarily install the manifold clamp mounting bolts in the cylinder heads to keep the gaskets in place. **Intake manifold gaskets are interchangeable from one cylinder bank to the other.**

5. Carefully lower the intake manifold into position. Insert the water pump by-pass tube into the by-pass hose as the intake manifold is lowered into position. Be sure the bolt holes in the manifold gaskets are aligned with the bolt holes in the intake manifold. Remove the clamp mounting bolts. Position the manifold clamps, install the retaining bolts (the oil filler tube bracket is retained by the intake manifold right front bolt). Tighten them to specifications, working from the center to the ends.

6. Install the thermostat gasket and thermostat, and the radiator supply tank.

7. With No. 1 piston on T.D.C. after the compression stroke, install the distributor in the block with the rotor at the No. 1 firing position and the breaker points open. Install the hold down clamp. Connect the distributor vacuum line. Connect the carburetor fuel inlet line to the fuel pump. Install the coil.

8. Install the distributor cap and the spark plug wire assembly. Connect the coil high tension wire and coil primary wire.

6 REPAIR OPERATIONS—ENGINE INSTALLED

ENGINE SUPPORTS

The front supports are located on each side of the crankcase and the rear support is located at the transmission extension housing.

ENGINE FRONT SUPPORT

The engine front support is shown in Fig. 48. The procedures given apply to either a right or left installation.

Removal

1. Remove the insulator assembly to underbody retaining nut. The nut must be removed from both insulators so that the engine can be raised.

2. Raise the engine about 1 inch with a jack and a wood block placed under the oil pan, then remove the rebound insulator, spacer, and insulator assembly.

Installation

1. Position the insulator assembly, spacer, and rebound insulator. If both insulators have been removed, install the parts on the opposite side before proceeding with step 2.

2. Lower the engine, then install the underbody to insulator nut and tighten the nut to 40-45 foot-pounds torque.

ENGINE REAR SUPPORT

The engine rear support is shown in Fig. 49.

Removal

1. Remove the support assembly to reinforcement assembly nuts and washers. Remove the support assembly to insulator assembly nut, lockwasher, rebound insulator, and spacer.

2. Raise the extension housing slightly to relieve the pressure on the support assembly. Remove the support assembly.

3. Remove the insulator assembly to adapter plate nuts and lockwashers.

Installation

1. Install the insulator assembly on the adapter plate.

2. Raise the extension housing enough to position the support assembly.

3. Install the support assembly to reinforcement assembly lockwashers and nuts.

4. Install the spacer, rebound insulator, lockwasher, and nut.

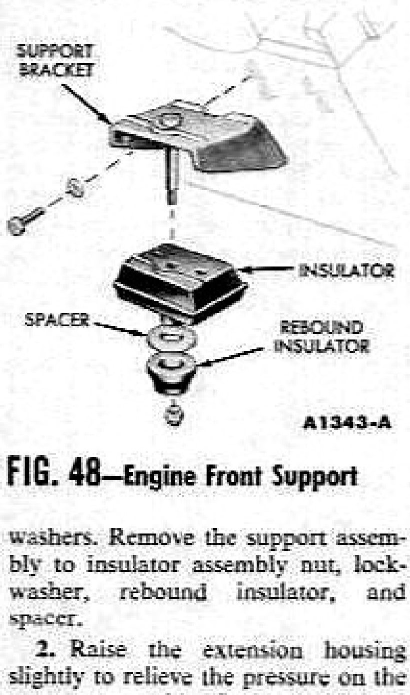


FIG. 48—Engine Front Support

INTAKE MANIFOLD

REMOVAL

1. Drain the cooling system. Remove the air cleaner.

2. Disconnect the radiator upper hose at the radiator supply tank. Remove the automatic choke heat tube.

3. Remove the carburetor fuel inlet line.

4. Disconnect the engine temperature sending unit wire at the sending unit. Disconnect the coil high tension lead at the coil, then remove the distributor cap and spark plug wire assembly.

5. Disconnect the vacuum line from the distributor and the heater hose from the water pump.

6. Disconnect the accelerator rod and secure the rod to the dash panel.

7. On a car with power steering, disconnect the power steering vacuum line at the intake manifold vacuum fitting.

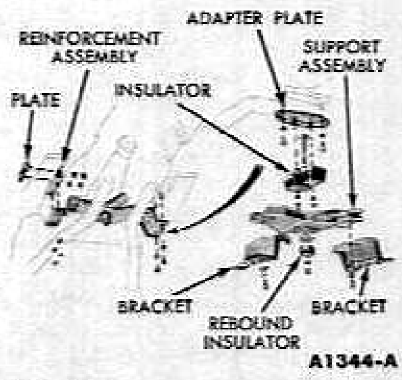


FIG. 49—Engine Rear Support

8. Remove the radiator supply tank. Loosen the water pump by-pass hose clamp at the water pump and slide the clamp toward the intake manifold.

9. Remove the intake manifold retaining bolts and clamps and remove the intake manifold and carburetor as an assembly. Discard the intake manifold gaskets.

INSTALLATION

1. Clean the gasket surfaces of the head and intake manifold.

2. Guided by the word "FRONT" on the gaskets, install the gaskets on the cylinder heads. Temporarily install the manifold clamp mounting bolts in the cylinder heads to keep the gaskets in place. **Intake manifold gaskets are interchangeable from one cylinder bank to the other.**

3. Carefully lower the intake manifold into position. Insert the water pump by-pass tube into the connection on the water pump as the intake manifold is lowered into position. Be sure the bolt holes in the manifold gaskets are aligned with the bolt holes in the intake manifold. Remove the clamp mounting bolts. Position the manifold clamps, install the retaining bolts and tighten them to specifications, working from the center to the ends. The oil filler tube bracket is retained by the intake manifold right front bolt.

4. Tighten the water pump by-pass clamp at the water pump. Connect the heater hose at the intake manifold. Connect the automatic choke heat tube.

5. Clean the radiator supply tank mounting surface. Apply sealer to a new radiator supply tank gasket and position the gasket on the tank. Position the thermostat in the intake manifold. Position the radiator supply tank on the intake manifold and install the retaining bolts. Connect the radiator hose to the radiator supply tank.

6. Connect the accelerator rod at the accelerator cross shaft bracket and the heater hose at the water pump. Install the carburetor fuel inlet line. Connect the ignition primary wire to the coil. Install the distributor cap and connect the distributor wires. Connect the engine temperature sending unit.

7. On a car with power brakes, connect the power brake vacuum line at the intake manifold vacuum fitting.

8. Fill and bleed the cooling system.

9. Operate the engine and check all gaskets and hose connections for leaks. Install the air cleaner.

CYLINDER HEADS

REMOVAL

1. Remove the intake manifold, following the procedure in this section.

2. Remove the wire loom from the left valve rocker arm cover and position the wiring out of the way. Remove the coil.

3. Remove the distributor hold down clamp retaining nut and remove the distributor and hold down clamp. Remove the valve push rod chamber cover and gasket.

4. Remove the left valve rocker arm cover retaining screws and remove the valve rocker arm cover and gasket.

5. Remove the right valve rocker arm cover and gasket (the engine ground strap is retained by the outside center screw).

6. Rotate the crankshaft damper until No. 1 piston is on T.D.C. at the end of the compression stroke. Rotate the crankshaft damper an additional 45°. Starting at the No. 4 valve rocker arm shaft support, loosen the support bolts in sequence, two turns at a time. After the bolts are all loosened, remove the valve rocker arm shaft assembly, then remove the valve push rods in sequence. Starting at the No. 1 valve rocker arm shaft support, follow the same procedure on the left valve rocker arm shaft support bolts, then remove the valve push rods in sequence.

7. Disconnect the muffler inlet pipes from the exhaust manifolds.

8. Remove the cylinder head retaining bolts. Install standard eye bolts with 5/16-18 threads and install the lifting bracket and sling and lift the cylinder head off the block. **Do not pry between the head and the block.** Remove and discard the gasket.

INSTALLATION

1. Clean the cylinder head and cylinder block gasket surfaces.

2. Apply cylinder head gasket sealer to both sides of a new gasket.

3. Guided by the word "FRONT" on the gasket, install the gasket over the cylinder dowels.

4. Clean the gasket surfaces of the muffler inlet pipes.

5. Position the cylinder head on the engine, then remove the lifting sling and eye bolts.

6. The cylinder head bolts are tightened in three progressive steps. Follow the sequence shown in Fig. 46. Tighten all the bolts to 75 foot-pounds torque, then tighten to 85 foot-pounds torque. Finally tighten the bolts to 95-105 foot-pounds torque. **After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.**

7. Apply sealer to the valve push rod chamber cover and position the gasket on the cylinder block, then install the cover.

8. Rotate the crankshaft damper until No. 1 piston is on T.D.C. after the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open. Install the hold down clamp.

9. Install the intake manifold and related parts, following the procedure in this section.

10. Lubricate both ends of the push rods with engine oil. Install the valve push rods in their proper sequence, making sure the lower ends are positioned in their lifter push rod cup.

11. Install the valve rocker arm shaft assemblies following the procedure under "Cylinder Heads" in Section 5.

12. Install the valve rocker arm covers following step 16 on page 1-55. The coil is retained by the left cover inside front retaining bolt and the wiring loom is retained by the right cover inside rear and center retaining bolts.

13. Connect the ignition primary wires at the coil. Install the distributor cap and spark plug wire assembly. Connect the coil high tension wire.

14. Install new gaskets on the exhaust manifolds and connect the muffler inlet pipes.

15. Fill and bleed the cooling system. Start the engine and check all hose connections and fittings for leaks. Adjust the ignition timing.

16. Adjust the transmission control linkage. Install the air cleaner.

CRANKSHAFT DAMPER

REMOVAL

1. Remove the hood. Drain the cooling system. Remove the air cleaner, radiator, radiator supply tank, and the fuel pump.

2. Remove the drive belts.

On a car with power steering, remove the power steering pump pulley from the crankshaft damper.

3. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft damper (Fig. 13) and remove the damper.

INSTALLATION

1. Line up the damper keyway with the key on the crankshaft. Install the damper on the crankshaft (Fig. 44).

2. Install the damper cap screw and washer, and tighten the screw to specifications.

3. On a car with power steering, install the power steering pump pulley on the damper. Tighten the screws to specifications.

4. Install the drive belts, the fuel pump, radiator supply tank, the radiator, the hood, and air cleaner. Fill and bleed the cooling system.

CYLINDER FRONT COVER AND TIMING CHAIN

REMOVAL

1. Drain the cooling system and the crankcase. Remove the hood, air cleaner, radiator, radiator supply tank, and fuel pump (and fuel pump push rod).

2. Disconnect the battery cable from the water pump, then remove the water pump, pulley, and fan as an assembly.

3. Set the crankshaft damper to 14° B.T.D.C. Remove the crankshaft damper. Remove the damper key and the sleeve from the crankshaft.

4. Remove the oil pan as outlined in this section.

5. Remove the generator mounting bracket to cylinder front cover retaining bolt. Remove the cylinder front cover retaining bolts and remove the cylinder front cover and discard the gasket.

6. Remove the crankshaft front oil slinger. Crank the engine until the timing marks on the sprocket are positioned as shown in Fig. 39. Remove the three retaining screws and lock ring from the camshaft sprocket, then remove the fuel pump eccentric. Remove the camshaft sprocket and timing chain (Fig. 14).

INSTALLATION

1. Place the timing chain in position on the camshaft sprocket. Install the camshaft sprocket and timing chain (Fig. 14) aligning the timing mark on the camshaft with the timing mark on the crankshaft sprocket (Fig. 39).

2. Install the fuel pump eccentric, lock plate, and screws (Fig. 41). Install the crankshaft front oil slinger.

3. Clean the cylinder front cover, oil pan, and block gasket surfaces.

4. Replace the crankshaft front oil seal.

5. Coat the gasket surface of the block and cover and the cover bolt threads with sealer. Position a new gasket on the block.

6. Install the alignment pilot tool on the cylinder front cover so that the keyway in the pilot aligns with the key in the crankshaft. Position the cover and pilot over the end of the crankshaft and against the block (Fig. 43).

7. Position the generator support bracket on the cover and install the bolt finger tight. Position the timing pointer on the cylinder front cover and install the bolt finger tight. Install the remaining bolts finger tight.

8. While pushing in on the pilot, tighten the cover bolts to specifications. Remove the pilot.

9. Position a new gasket on the oil pan and install the oil pan and related parts as outlined in this section.

10. Install the sleeve on the crankshaft, then install the crankshaft damper. Clean the block water pump gasket surfaces. Apply sealer on new water pump gaskets and position the gaskets on the water pump. Position the water pump, pulley, and fan assembly on the block. Install the water pump left bolts finger tight. Position the windshield washer pump bracket and install the water pump lower right bolt. Position the battery ground strap and install the water pump upper right bolt. Tighten all the water pump retaining bolts. Tighten the water pump by-pass hose clamp. Connect the heater hose to the water pump.

11. Position the fuel pump push rod in the cylinder front cover and install the plug. Install and adjust the drive belts. Install the fuel pump and connect the fuel pump inlet line. Install the carburetor fuel inlet line.

12. Install the radiator supply tank, radiator, and hood. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check all hose connections and fittings for leaks. Install the air cleaner.

CAMSHAFT

REMOVAL

1. Drain the cooling system and the crankcase. Remove the hood, radiator, radiator supply tank, and grille.

2. Remove the crankshaft damper, cylinder front cover, oil pan, timing chain and camshaft sprocket, following the procedures in this section. Remove the distributor cap and spark plug wire assembly. Remove the distributor.

3. Remove the valve rocker arm covers. Remove the valve rocker arm shaft assemblies and the push rods by following step 6 under "Cylinder Head Removal" in this section.

4. Remove the hydraulic valve lifters with a magnetic lifter through the valve push rod holes in the cylinder heads. Keep the lifters in order so that they can be installed in their original bores.

5. Carefully remove the camshaft by pulling it toward the front of the engine.

INSTALLATION

1. Oil the camshaft and apply Lubriplate to the lobes, then carefully slide it through the bearings.

2. Working through the push rod openings in the cylinder head, install the hydraulic valve lifters in their original bores with a magnetic lifter.

3. Install the valve push rods and the valve rocker arm assemblies, following steps 10 and 11 under "Cylinder Head Installation" in this section.

4. Install the timing chain and camshaft sprocket, cylinder front cover, damper, water pump, pulley, and fan, following the procedures in this section. Install and adjust the drive belts.

5. Install the grille, radiator, radiator supply tank and the hood. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

6. Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

HYDRAULIC VALVE LIFTER REPLACEMENT

Refer to Fig. 57 in Part 1-2. To remove one or all of the hydraulic valve lifters:

1. Remove the air cleaner.

If all the lifters are to be removed,

or if a lifter on the right bank of the engine is to be removed, remove the automatic choke heat tube.

2. Disconnect the spark plug wires at the spark plugs and the valve rocker arm cover(s). Remove the valve rocker arm cover(s) and gasket(s).

3. Remove the valve rocker arm shaft assembly by following step 6 under "Cylinder Head Removal" in this section.

4. Remove the valve push rod(s). If more than one push rod is removed, keep them in order so that they can be installed in their original bore.

5. Using a magnetic lifter, remove the valve lifter(s) through the push rod opening(s) in the cylinder head.

6. Install the valve lifter(s) with a magnetic lifter through the push rod opening(s) in the cylinder head.

7. Install the push rods in their original bores.

8. Install the valve rocker arm shaft assembly by following step 11 under "Cylinder Head Installation" in this section.

9. Install the valve rocker arm cover(s) by following step 12 under "Cylinder Head Installation" in this section. Connect the spark plug wires to the spark plugs and secure the wires in the cover brackets.

10. Install the choke heat tube if it was removed. Install the air cleaner.

FLYWHEEL

REMOVAL

1. Disconnect the transmission from the engine as outlined in Group 6.

2. Remove the flywheel retaining bolts and remove the flywheel.

INSTALLATION

1. Install the flywheel on the crankshaft flange and install the retaining bolts. Criss-cross tighten the bolts to specifications.

2. Connect the transmission to the engine as outlined in Group 6.

OIL FILTER REPLACEMENT

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

2. Coat the gasket on the new filter with oil, then place the filter in position on the adapter. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½ turn.

3. Operate the engine at fast idle and check for leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

OIL PAN AND OIL-VACUUM PUMP

REMOVAL

1. Crank the engine until the 14° B.T.D.C. mark on the timing pointer is aligned with the timing mark on the damper. Drain the crankcase.

2. Remove the engine right and left front support insulators as outlined under "Engine Front Support Removal" in this section.

3. Remove the engine right and left support to underbody nuts. Raise the engine with a jack and wood block placed under the oil pan. Position a 1-inch wooden block between the engine front support brackets and underbody and block. Remove the jack from underneath the oil pan and allow the engine to rest on the wood blocks.

4. Remove the oil pan retaining screws and lower the oil pan to the underbody crossmember.

5. Remove the oil pump inlet tube and screen assembly lower retaining screw and loosen the upper screw so that the inlet tube can swing freely.

6. Remove the oil pan in a lowering forward motion.

7. Remove the oil pump inlet tube and screen assembly.

8. Disconnect the vacuum pump inlet line at the cylinder block.

9. Remove the oil-vacuum pump retaining bolts and remove the assembly, mounting gasket, and intermediate drive shaft.

INSTALLATION

1. Clean the gasket surfaces of the cylinder block, oil pan, oil-vacuum pump, and the oil pump inlet tube and screen assembly.

2. Loosen the vacuum pump inlet line at the pump elbow. Install a new gasket on the oil pump.

3. Position the intermediate drive shaft into the oil pump and install the oil pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.** Tighten the oil-vacuum pump retaining screws to specifications. Connect the vacuum pump inlet line to the fitting on the cylinder block and tighten each end of the line.

4. Position a new gasket on the oil pump inlet tube and screen assembly and position the assembly on the oil-vacuum pump. Install the lower retaining screw and washer loose, permitting the assembly to swing freely.

5. Apply oil resistant sealer to a new oil pan gasket and position the gasket on the oil pan.

6. Position the oil pan on the underbody crossmember. Align the pick-up tube and screen assembly and install the upper retaining washer and screw. Tighten both retaining screws.

7. Hold the oil pan in place against the block and install a retaining screw on each side of the oil pan. Tighten the screws to specifications, working from the center outward.

8. Raise the engine with a jack and piece of wood placed under the oil pan. Remove the wood blocks placed between the engine mount bracket and the underbody bracket. Install the engine support nut.

9. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for leaks.

PART 1-4 EXHAUST SYSTEM

1 DESCRIPTION

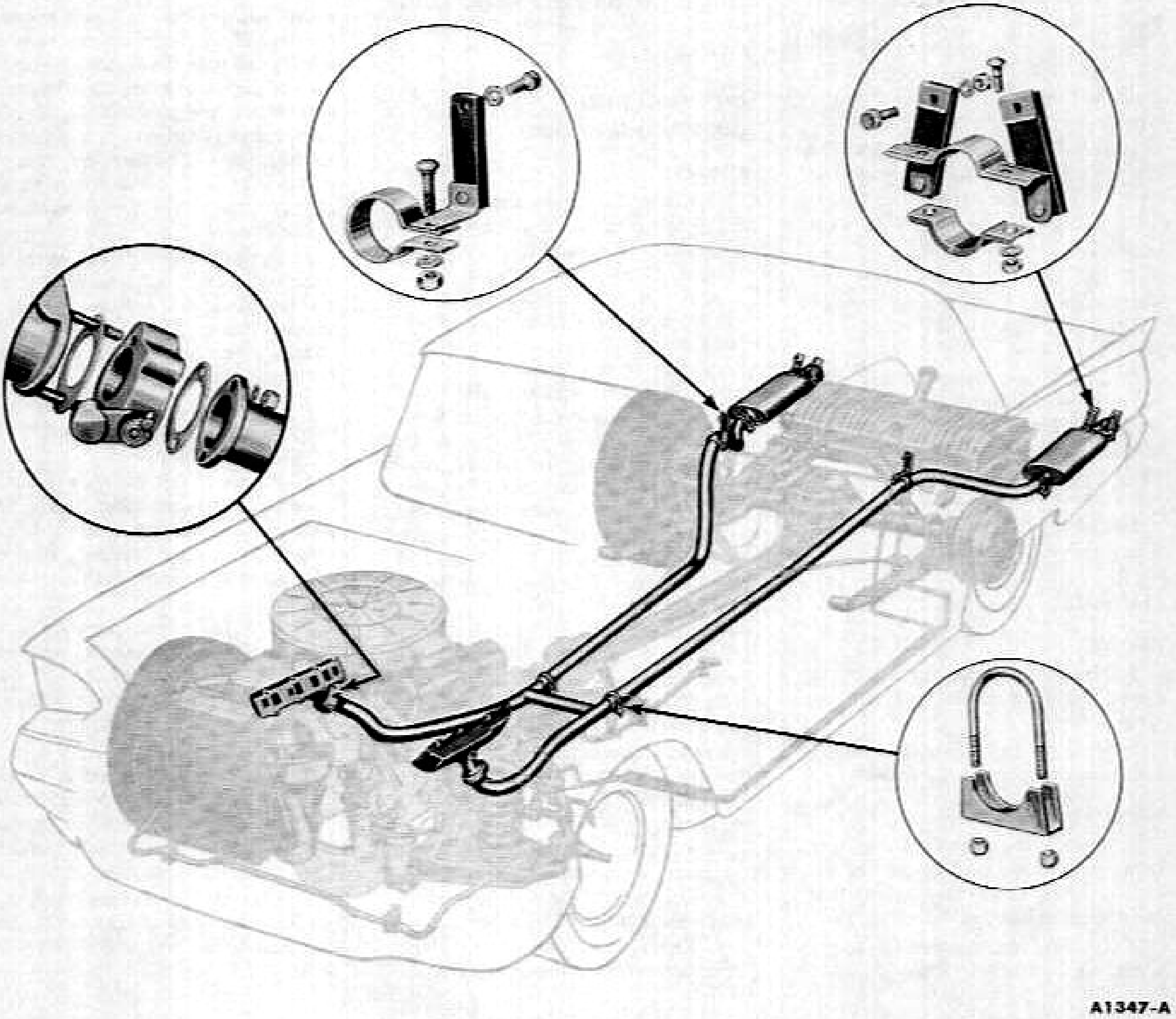


FIG. 1—Exhaust System

A dual exhaust system (Fig. 1) is used on all Thunderbirds. The system consists of a separate muffler, muffler inlet pipe rear section, and muffler outlet pipe for each exhaust manifold. The right and left muffler inlet pipe front sections are a one-piece assembly and are serviced as such.

The exhaust gas control valve on the Thunderbird 352 Special V-8 is located between the right exhaust manifold and the muffler inlet pipe. The intake manifold of the Thunderbird 430 engine is water heated, therefore, an exhaust gas control valve is not used on this engine.

2 EXHAUST GAS CONTROL VALVE MAINTENANCE—THUNDERBIRD 352 SPECIAL V-8

The exhaust gas control valve should be periodically checked to make sure it is operating properly. A valve that is stuck in the open position will result in poor engine performance during initial warm-up because insufficient heat will pass through the heat riser for proper fuel vaporization. If the valve is stuck in the closed position, the intake manifold will be supplied with excessive heat after the initial warm-up period. This will cause poor acceleration, a lack of power, and will cause poor high speed performance in general.

Check the thermostatic spring of the valve to make sure it is hooked on the stop pin. The spring stop is at the top of the valve housing when the valve is properly installed. The action of the valve is illustrated in Fig. 2.

To check the exhaust gas control valve on the car, make sure the spring holds the valve closed when the engine is cold. Actuate the counterweight by hand to make sure it moves freely through approximately 90° of rotation without binding.

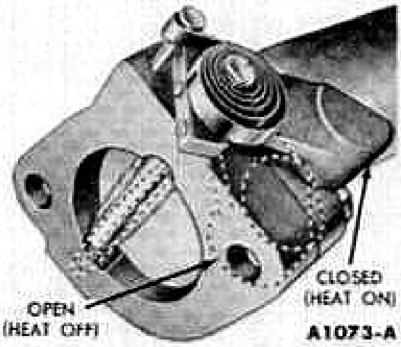


FIG. 2—Exhaust Gas Control Valve—Thunderbird 352 Special V-8

The valve is closed when the engine is at normal operating temperature and running at idle speed. However, a properly operating valve will open when very light finger pressure is applied to the counterweight. Rapidly accelerate the engine to make sure the valve momentarily opens. The valve is designed to open when the engine is at normal operating temperature and is operated at high rpm.

Free stuck valves with a penetrating oil and graphite mixture.

To replace the valve:

1. Remove the right exhaust manifold, then remove the control valve from the muffler inlet pipe.

2. Clean the inlet pipe and manifold flanges.

3. Place a new gasket on both sides of the control valve and position it over the muffler inlet pipe studs of the exhaust manifold. Temporarily tie the valve to the exhaust manifold. Install the exhaust manifold.

3 INLET PIPE, MUFFLER, AND OUTLET PIPE REPLACEMENT

MUFFLER INLET PIPE

The right and left muffler inlet pipe front sections are serviced as one piece.

1. Loosen the muffler inlet pipe front bracket clamp bolt and slide the clamp from the bracket. Disconnect the inlet pipes at the exhaust manifolds.

2. Remove the retaining clamp from the rear section of the inlet pipe. Disconnect the rear bracket from the rear section of the inlet pipe.

3. Remove the rear section of the inlet pipe.

4. Remove the inlet pipe front section.

On a 352 engine, remove the exhaust gas control valve from the right exhaust manifold and discard the gaskets.

5. Position the clamp on the rear section of the new inlet pipe. Connect the front and rear sections. Place a new gasket on the exhaust manifolds.

On a 352 engine, position the exhaust gas control valve on the right exhaust manifold. Position a new gasket on the exhaust gas control valve.

6. Position the inlet pipe assembly on the exhaust manifold studs and on the extension of the mufflers.

7. Connect the inlet pipe to the exhaust manifolds and tighten the nuts to 23-28 foot-pounds torque.

8. Align the inlet pipe assembly and connect the brackets.

MUFFLER AND OUTLET PIPE

The procedure applies to either a right or left assembly.

1. Loosen the muffler inlet pipe rear clamp, then spread the clamp and slide it off the muffler.

2. Remove the lower half of the muffler rear clamp. Remove the muffler from the inlet pipe.

3. Position the new muffler and outlet pipe assembly on the inlet pipe. Slide the muffler forward into the inlet pipe until the slots in the muffler extension are blocked. The overlap must not be greater than 1¾ inches.

4. Align the muffler and outlet pipe assembly. Position the muffler inlet pipe clamp and install the retaining bolts. Install the muffler rear clamp.

PART 1-5 SPECIFICATIONS

NOTE: All Specifications are given in inches unless otherwise noted.

GENERAL

ENGINE MODELS AND PISTON DISPLACEMENT—Cubic Inches

Thunderbird Special V-8	352
Thunderbird Special V-8	430

COMPRESSION RATIO

352	9.6:1
430	10.0:1

BRAKE HORSEPOWER @ Specified RPM

352	300 @ 4600
430	350 @ 4600

TORQUE—FOOT-POUNDS @ Specified RPM

352	381 @ 2800
430	490 @ 2800

BORE AND STROKE—Inches

352	4.00 x 3.50
430	4.30 x 3.70

COMPRESSION PRESSURE—Sea Level @ CRANKING SPEED

352	180 ± 20
430	200 ± 20

TAXABLE HORSEPOWER

352	51.20
430	59.17

FIRING ORDER

352 and 430	1-5-4-2-6-3-7-8

VALVE ARRANGEMENT—Front to Rear

352	E-I-E-I-I-E-I-E
430—Right head	I-E-I-E-I-E-I-E
Left head	E-I-E-I-E-I-E-I

ENGINE IDLE RPM*

Conventional Drive or Overdrive

352	500-525

Cruise-O-Matic (Drive Range)

352 and 430	450-475

*If equipped with air conditioner, it should be run for at least 20 minutes before setting idle speed.

ENGINE IDLE MANIFOLD VACUUM—Minimum Inches of Mercury @ Specified Engine Neutral Idle rpm—SEA LEVEL

352 and 430	18

GENERAL (Continued)

INITIAL IGNITION TIMING—B.T.D.C.

352—Conventional Drive or Overdrive	3°
—Cruise-O-Matic	6°
430	6°
352 and 430—Minimum	2°
—Maximum	10°

CRANKCASE OIL CAPACITY*

352 and 430	5 quarts

*Add one quart extra when changing oil filter.

OIL PRESSURE—Psi hot @ 2000 rpm

352 and 430	35-55

CYLINDER HEAD

GASKET SURFACE FLATNESS

0.002 inch in any 6 inches or 0.005 inch overall

VALVE GUIDE BORE STANDARD DIAMETER

Intake and Exhaust

352 and 430	0.3725-0.3735

VALVE SEAT WIDTH

Intake and Exhaust

352 and 430	0.070-0.090

VALVE SEAT ANGLE

Intake

352	30°
430	45°

Exhaust

352 and 430	45°

VALVE SEAT RUNOUT

352 and 430	0.002—Wear Limit 0.0025

VALVE MECHANISM

VALVE CLEARANCE*

352 and 430 .... 0.078-0.2180

*Hydraulic valve lifters—Clearance specified is obtained at the valve stem tip with the lifter collapsed.

VALVE STEM DIAMETER

Standard	
Intake	
352 and 430	0.3711-0.3718
Exhaust	
352 and 430	0.3693-0.3700
0.003 Oversize	
Intake	
352 and 430	0.3741-0.3748
Exhaust	
352 and 430	0.3723-0.3730
0.015 Oversize	
Intake	
352 and 430	0.3861-0.3868
Exhaust	
352 and 430	0.3843-0.3850
0.030 Oversize	
Intake	
352 and 430	0.4011-0.4018
Exhaust	
352 and 430	0.3993-0.4000

VALVE STEM TO VALVE GUIDE CLEARANCE

Intake	
352 and 430	0.0010-0.0024—Wear Limit 0.0045
Exhaust	
352 and 430	0.0028-0.0042—Wear Limit 0.0055

VALVE HEAD DIAMETER

Intake	
352	2.022-2.037
430	2.080-2.090
Exhaust	
352	1.551-1.561
430	1.770-1.780

INTAKE AND EXHAUST VALVE FACE RUNOUT

352 and 430 .... 0.002—Wear Limit 0.0025

VALVE SPRING APPROXIMATE FREE LENGTH

352	2.25
430	2.03

VALVE SPRING MAXIMUM OUT-OF-SQUARE

352 and 430 .... 0.072

VALVE MECHANISM (Continued)

VALVE SPRING PRESSURE (LBS.) @ SPECIFIED LENGTH

352	94-104 @ 1.820
	Wear Limit 89 @ 1.820
	180-198 @ 1.420
	Wear Limit 163 @ 1.420
430	66-77 @ 1.830
	Wear Limit 60 @ 1.830
	240-260 @ 1.000
	Wear Limit 225 @ 1.000

VALVE SPRING ASSEMBLED HEIGHT

352	$1\frac{13}{16}$-$1\frac{27}{32}$
430	$1\frac{13}{16}$-$1\frac{55}{64}$

VALVE PUSH ROD RUNOUT

352 and 430 .... 0.020

VALVE TAPPET STANDARD DIAMETER

352 and 430 .... 0.8740-0.8745

VALVE TAPPET TO TAPPET BORE CLEARANCE

352 and 430 .... 0.0005-0.0020
Wear Limit 0.005

HYDRAULIC VALVE LIFTER LEAK DOWN RATE

352 and 430 .... 8-45 Seconds

ROCKER ARM TO ROCKER SHAFT CLEARANCE

352 and 430 .... 0.003-0.005—Wear Limit 0.006

ROCKER ARM SHAFT OUTSIDE DIAMETER

352 and 430 .... 0.839-0.840

ROCKER SHAFT BORE DIAMETER

352 and 430 .... 0.843-0.844

CAMSHAFT AND TIMING CHAIN

CAMSHAFT JOURNAL STANDARD DIAMETER

352	2.1238-2.1248
430	2.264-2.265

CAMSHAFT JOURNAL RUNOUT

352 and 430 .... 0.005

CAMSHAFT JOURNAL TO BEARING CLEARANCE

352 and 430 .... 0.001-0.003—Wear Limit 0.006

TIMING CHAIN DEFLECTION—INCHES

352 and 430 .... 0.5

INTAKE AND EXHAUST CAMSHAFT LOBE LIFT

352	0.232—Wear Limit 0.227
430	0.2316—Wear Limit 0.2266

MAXIMUM ALLOWABLE LOBE LIFT LOSS

352 and 430—Intake and Exhaust 0.005

CAMSHAFT BEARINGS

INSIDE DIAMETER
352 .... 2.1258-2.1268
430 .... 2.2660-2.2670

LOCATION IN RELATION TO FRONT FACE OF BLOCK CAM BEARING BORE—NO. 1 BEARING ONLY—BELOW
352 and 430 .... 0.005-0.020

CRANKSHAFT

MAIN BEARING JOURNAL STANDARD DIAMETER
352 .... 2.7484-2.7492
430 .... 2.8994-2.9002

MAIN BEARING JOURNAL MAXIMUM RUNOUT
352 and 430 .... 0.002—Wear Limit 0.003

CONNECTING ROD AND MAIN BEARING JOURNALS MAXIMUM OUT-OF-ROUND
352 and 430 .... 0.0004—Wear Limit 0.0006

CONNECTING ROD AND MAIN BEARING JOURNALS TAPER
352 and 430 .... 0.0005—Wear Limit 0.001

THRUST BEARING JOURNAL LENGTH
352 and 430 .... 1.124-1.126

MAIN BEARING JOURNAL THRUST FACE RUNOUT
352 and 430 .... 0.001

CONNECTING ROD JOURNAL DIAMETER
352 .... 2.4380-2.4388
430 .... 2.5992-2.5996

CRANKSHAFT FREE END PLAY
352 and 430 .... 0.004-0.008—Wear Limit 0.012

ASSEMBLED FLYWHEEL CLUTCH FACE RUNOUT
352 .... 0.010

ASSEMBLED FLYWHEEL RUNOUT
352 .... 0.007

ASSEMBLED SPROCKET OR GEAR FACE RUNOUT
352 and 430 .... 0.006

MAIN BEARINGS

JOURNAL CLEARANCE
352 .... 0.0007-0.0029—Wear Limit 0.0039
430 .... 0.0009-0.0029—Wear Limit 0.0039

CONNECTING ROD

PISTON PIN BORE OR BUSHING—INSIDE DIAMETER
Standard
352 .... 0.9752-0.9755
430 .... 0.9736-0.9741

PISTON PIN BUSHING MAXIMUM OUT-OF-ROUND
352 .... 0.0002

PISTON PIN BUSHING MAXIMUM TAPER
352 .... 0.0002

BEARING BORE DIAMETER
352 .... 2.5907-2.5915
430 .... 2.7522-2.7530

BEARING BORE MAXIMUM OUT-OF-ROUND AND TAPER
352 and 430 .... 0.0004

CONNECTING ROD CENTER-TO-CENTER LENGTH
352 .... 6.538-6.542
430 .... 6.599-6.601

CONNECTING ROD
Twist Total Difference—Maximum
352 and 430 .... 0.012
Bend Total Difference—Maximum
352 and 430 .... 0.004

CONNECTING ROD ASSEMBLY—Assembled to crankshaft
Side Clearance
352 .... 0.006-0.016—Wear Limit 0.019
430 .... 0.005-0.015—Wear Limit 0.018

CONNECTING ROD BEARINGS

BEARING TO CRANKSHAFT CLEARANCE
352 and 430 .... 0.0007-0.0028—Wear Limit 0.0038

PISTON

PISTON DIAMETER
Red Color Code
352 .... 3.9983-3.9989
430 .... 4.2983-4.2989
Blue Color Code
352 .... 3.9995-4.0013
430 .... 4.2995-4.3001
0.003 Oversize
352 .... 4.0007-4.0013
430 .... 4.3007-4.3013

PISTON TO BORE CLEARANCE AT BOTTOM OF SKIRT
352 .... 0.0011-0.0029—Wear Limit 0.005
430 .... 0.0008-0.0026—Wear Limit 0.005

PISTON PIN

PISTON PIN DIAMETER
Standard (Color Coded Green)
352 .... 0.9750-0.9753
430 .... 0.9749-0.9752
0.001 Oversize (Color Coded Blue)
352 .... 0.9760-0.9763
0.002 Oversize (Color Coded Yellow)
352 .... 0.9770-0.9773

PISTON PIN LENGTH
352 .... 3.156-3.170
430 .... 3.480-3.500

PISTON PIN TO PISTON LOOSE CLEARANCE
352 .... 0.0001-0.0003—Wear Limit 0.0008
430 .... 0.0002-0.0004—Wear Limit 0.0008

PISTON PIN TO CONNECTING ROD BUSHING LOOSE CLEARANCE
352 .... 0.0001-0.0005—Wear Limit 0.001

PISTON PIN TO CONNECTING ROD INTERFERENCE FIT
430 .... minimum of 20 ft.-lbs. torque

PISTON RINGS

RING WIDTH
Upper Compression Ring
352 .... 0.0775-0.0780
430 .... 0.0770-0.0780
Lower Compression Ring
352 .... 0.0930-0.0935
430 .... 0.0680-0.0690

SIDE CLEARANCE
Upper Compression Ring
352 .... 0.0020-0.0035—Wear Limit 0.006
430 .... 0.0015-0.0030—Wear Limit 0.006
Lower Compression Ring
352 .... 0.0020-0.0040—Wear Limit 0.006
430 .... 0.0010-0.0030—Wear Limit 0.006
Oil Ring
352 and 430 .... Snug

RING GAP WIDTH
Compression Ring (Standard Bore—Upper and Lower)
352 .... 0.013-0.030
430 .... 0.015-0.030
Oil Ring (Standard Bore)*
352 and 430 .... 0.015-0.062

*Steel rail

CYLINDER BLOCK

CYLINDER BORE DIAMETER (Standard, spread for 8 grades)
352 .... 4.0000-4.0024
430 .... 4.3000-4.3024

CYLINDER BLOCK (Continued)

CYLINDER BORE MAXIMUM OUT-OF-ROUND
352 and 430 .... 0.001—Wear Limit 0.003

CYLINDER BORE TAPER
352 and 430 .... 0.001—Wear Limit 0.005

HEAD GASKET SURFACE FLATNESS
352 .... 0.003 inch in any 6 inches or 0.004 inch overall
430 .... 0.002 inch in any 6 inches or 0.004 inch overall

OIL PUMP

RELIEF VALVE SPRING TENSION—LBS. @ SPECIFIED LENGTH
352 and 430 .... 9.0-9.6 @ 1.53 inches

RELIEF VALVE CLEARANCE
352 and 430 .... 0.0015-0.0029

DRIVE SHAFT TO HOUSING BEARING CLEARANCE
352 and 430 .... 0.0015-0.0029

ROTOR ASSEMBLY END CLEARANCE—PUMP ASSEMBLED
352 and 430 .... 0.0015-0.0040

OUTER RACE TO HOUSING—RADIAL CLEARANCE
352 .... 0.003-0.008
430 .... 0.006-0.011

DRIVE SHAFT LENGTH—ROTOR ASSEMBLY FACE TO SHAFT END
352 and 430 .... 2.24-2.26

VACUUM PUMP STATIC VACUUM
(Inches Hg @ 2000 rpm)
430 23-25

TORQUE LIMITS (Foot-Pounds)

MAIN BEARING CAP BOLTS—OILED THREADS
352 and 430 95-105

CYLINDER HEAD BOLTS—OILED THREADS
352 80-90
430 95-105

OIL PAN TO CYLINDER BLOCK
352 12-15
430 10-13

MANIFOLDS TO CYLINDER HEAD
Intake
352 and 430 30-35
Exhaust
352 23-28
430 15-21

TORQUE LIMITS (Foot-Pounds) (Continued)

FLYWHEEL TO CRANKSHAFT
352 and 430....75-85

OIL PUMP TO CYLINDER BLOCK
352 and 430....23-28

OIL PUMP COVER PLATE
352 and 430....6-9

OIL FILTER ANGLE ADAPTER TO CYLINDER BLOCK
352 and 430....12-15

OIL FILTER TO ADAPTER OR CYLINDER BLOCK
352 and 430....Hand tighten until gasket contacts adapter face. Then tighten ½ turn more.

CYLINDER FRONT COVER
352....12-15
430....10-13

WATER OUTLET HOUSING
352....12-15
430....8-13

WATER PUMP TO CYLINDER BLOCK OR FRONT COVER
352 and 430....23-28

CAMSHAFT SPROCKET TO CAMSHAFT
352....35-45
430....12-15

DAMPER OR PULLEY TO CRANKSHAFT
352....130-145
430....75-90

CONNECTING ROD NUTS
352 and 430....45-50

VALVE ROCKER ARM COVER
352 and 430....5.0-8.0

VALVE ROCKER SHAFT SUPPORT TO CYLINDER HEAD
352 and 430....45-50

VALVE PUSH ROD CHAMBER COVER
430....2.0-2.5

OIL PICK-UP TUBE TO OIL PUMP
352 and 430....10-12

FUEL PUMP TO CYLINDER BLOCK OR CYLINDER FRONT COVER
352 and 430....23-28

ENGINE FRONT SUPPORT
Bracket to Engine
352 and 430....35-40
Insulator to Frame
352 and 430....40-45
Insulator to Bracket
352 and 430....50-60

ENGINE REAR SUPPORT
Support Retainer to Extension Housing
352 and 430....25-30
Support to Frame
352 and 430....40-45

STANDARD TORQUE LIMITS FOR VARIOUS SIZE BOLTS

CAUTION: **Special torque limits listed in the preceding tables should be used in preference to these standard limits wherever they apply.**

Size (Inches)	¼-20	¼-28	5/16-18	5/16-24	⅜-16	⅜-24
Torque (Foot-Pounds)	6-9	6-9	12-15	15-18	23-28	30-35
Size (Inches)	7/16-14	7/16-20	½-13	½-20	9/16-18	⅝-18
Torque (Foot-Pounds)	45-50	50-60	60-70	70-80	85-95	130-145

GROUP 2

IGNITION SYSTEM

PART 2-1 IGNITION SYSTEM MAINTENANCE

1 TROUBLE DIAGNOSIS, TESTING, ADJUSTMENTS, AND MINOR REPAIRS

The ignition system consists of a primary (low voltage) and a secondary (high voltage) circuit (Fig. 1). The battery, ignition switch, primary resistance wire, primary windings of the ignition coil, breaker points, and the condenser are in the primary circuit. When starting the engine, the primary resistance wire is by-passed through a set of contacts in the starter relay. This applies full battery voltage to the coil when starting.

The secondary circuit is composed of the secondary windings of the ignition coil, distributor rotor, distributor cap, high tension wires, and the spark plugs.

When the breaker points are closed, the primary or low voltage current flows from the battery through the ignition switch to the primary windings in the coil, then to ground through the closed breaker points. When the breaker points open, the magnetic field built up in the primary windings of the coil moves through the secondary windings of the coil producing high voltage current. **High voltage current is produced each time the breaker points open.** The high voltage flows through the coil high tension lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap. The process is repeated for every power stroke of the engine.

Ignition system troubles are caused by a failure in the primary and/or the secondary circuit, or incorrect ignition timing.

The "Engine Trouble Diagnosis Guide" in Part 1-1 lists various ignition system components that could be at fault for some basic engine complaints together with quick tests to be made to determine which component is at fault.

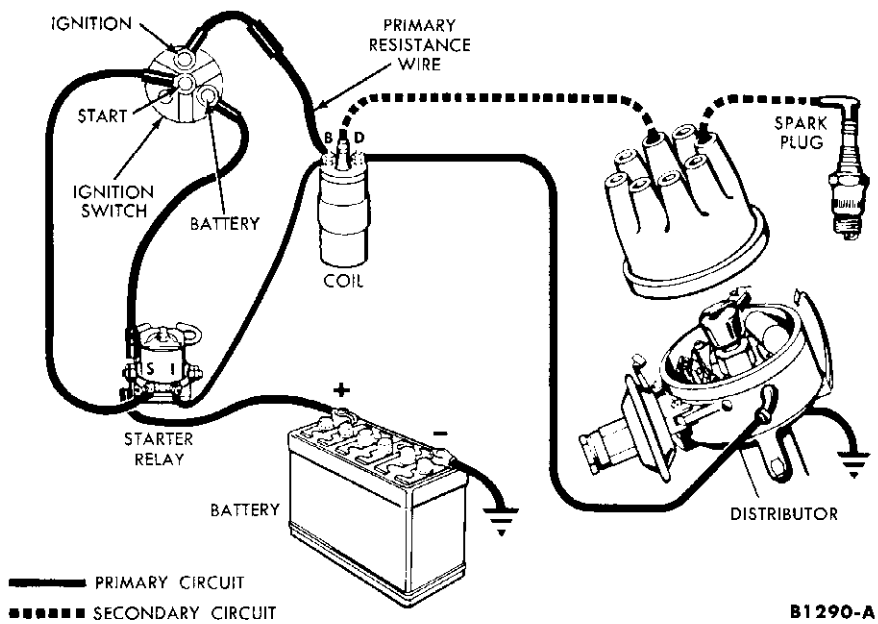


FIG. 1—Ignition Circuit

However, at times, a complete check of the ignition system is desirable or necessary. Such a check should include the battery and cables, coil, distributor, primary and secondary wiring, and the spark plugs. This section describes the tests for all these units except the battery and the distributor. The battery, because it is part of the electrical supply system, is covered in Part 11-1. Distributor tests and adjustments are covered in Section 2.

PRELIMINARY CHECKS

Inspect the battery for corrosion due to acid and dirt. If necessary clean the battery and cables with a baking soda solution. Be sure that the cable connectors and the contacting surfaces on the battery, engine, and starter relay are clean. Tighten the cables securely upon installation. Test the battery (Part 11-1).

Inspect all the primary wiring for worn insulation, broken strands, and loose or corroded terminals. Replace any defective wiring. Make sure that all connections are tight. Remove the coil to distributor high tension lead and the spark plug wires one at a time from the distributor cap and from the spark plugs. Inspect the

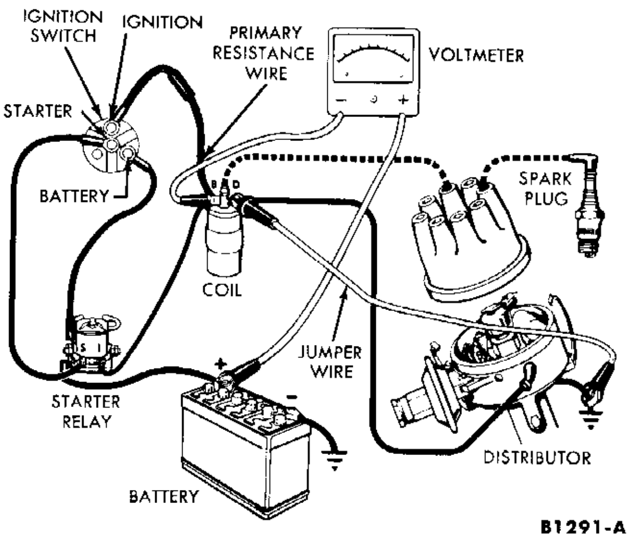


FIG. 2—Battery to Coil Test

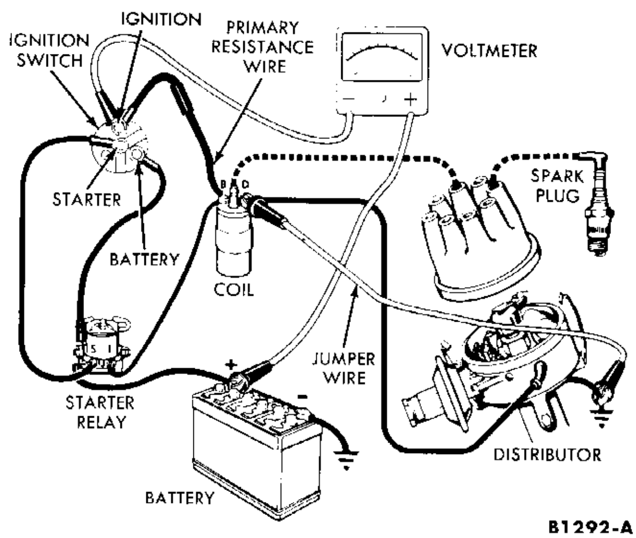


FIG. 3—Ignition Switch Test

terminals for looseness and corrosion. Inspect the wires for breaks and cracked insulation. Replace all defective wiring.

Clean the inside of the distributor cap, and inspect it for cracks, burned contacts, or permanent carbon tracks. Remove dirt or corrosion from the sockets. Inspect the rotor for cracks or a burned tip. Replace the cap and/or rotor if they are defective.

PRIMARY CIRCUIT

A break down or energy loss in the primary circuit can be caused by:

1. Defective primary wiring.

2. Burned breaker points or improperly adjusted breaker points (covered under "Distributor Tests and Adjustments" — Section 2 of this part).

3. A defective coil.

4. A defective primary resistance wire.

5. A defective condenser (covered under "Distributor Tests and Adjustments"—Section 2 of this part).

PRIMARY CIRCUIT RESISTANCE TEST

A complete test of the primary circuit consists of checking for excessive voltage drop from the battery to the coil and from the coil to ground.

Excessive voltage drop in the primary circuit will lessen the secondary output of the ignition coil, resulting in hard starting and poor performance.

Battery to Coil Test. The following tests are made with the ignition switch turned on and the accessories and lights off.

Connect the positive lead of the voltmeter to the positive terminal of the battery (Fig. 2). Connect the negative lead of the voltmeter to the battery terminal of the coil. Connect a jumper wire from the distributor terminal of the coil to ground.

If the voltmeter reading is 6.9 volts or less, the primary circuit from the battery to the coil is satisfactory. If the voltmeter reading is greater than 6.9 volts, check for:

1. Bad connections at any point from the battery to the coil (Fig. 1).

2. Defective ignition switch.

3. Defective primary resistance wire.

4. Defective starter relay to ignition switch wire.

Check all connections in the circuit as outlined under "Preliminary Checks." If the connections are satisfactory, proceed as follows:

1. Leave the jumper wire connected and leave the positive lead of the voltmeter connected to the positive terminal of the battery.

2. Remove the ignition switch from the instrument panel, leaving the wires connected, so that the switch terminals are available for test connections.

3. Connect the negative lead of the voltmeter to the "COIL" or "IGN" terminal of the ignition switch (Fig. 3). The voltage drop should not be greater than 0.3. If the voltage drop is satisfactory, the ignition switch and the relay to switch wire are satisfactory.

If the voltage drop is greater than 0.3 volt, shift the negative voltmeter lead to the "BAT" or "AM" terminal of the ignition switch. If the voltage drop is now normal (0.3 volt or less), the ignition switch is defective and should be replaced.

If the voltage drop is still excessive, the wire from the switch to the battery terminal of the starter relay is defective. Repair or replace the wire.

4. If the voltage drop in step 3 is satisfactory, make a resistance wire test. The voltage drop across the resistance wire should not be greater than 6.6 volts. If the voltage drop is greater than 6.6 volts, the resistance wire or the wire from the battery terminal of the coil to the resistance wire is defective. Repair or replace as required.

Resistance Wire Test. To check the voltage drop of the resistance wire, connect the negative lead of the voltmeter to the battery terminal of the coil and the positive lead to the "IGN" or "COIL" terminal of the ignition switch (Fig. 4). The voltage drop should not be greater than 6.6 volts. If the voltage drop is greater than 6.6, it will be necessary to replace the resistance wire.

Starting Ignition Circuit Test. Check the resistance in the starting ignition circuit by connecting the voltmeter positive lead to the positive terminal of the battery and the negative lead to the battery terminal of the coil. Remove the jumper wire previously used (Fig. 5). Disconnect the high tension lead at the distributor cap and ground the lead. Crank

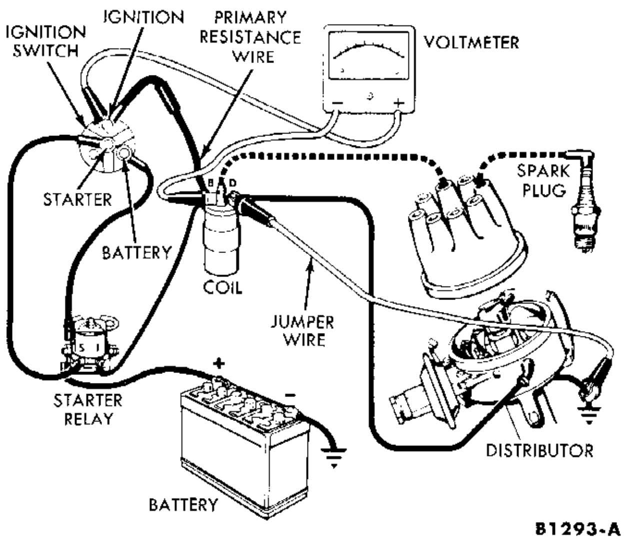


FIG. 4—Resistance Wire Test

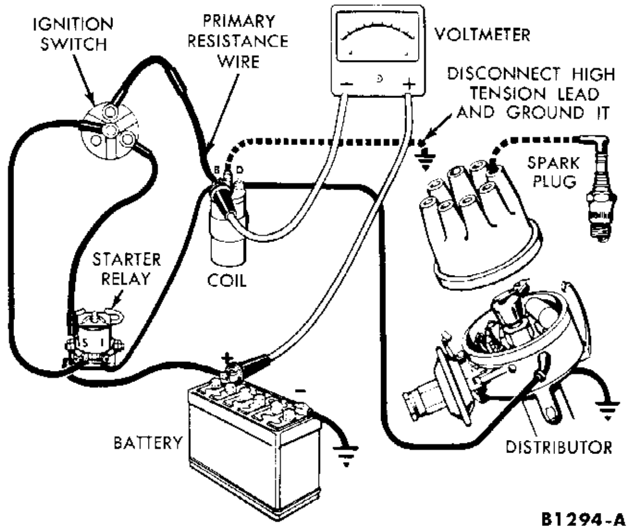


FIG. 5—Starting Ignition Circuit Test

the engine while observing the voltage drop. It should not exceed 0.1 volt. If the voltage drop is excessive, clean and tighten the terminals or replace wiring as necessary.

Coil to Ground Test. The following test is made with the ignition switch on and the breaker points closed.

Connect the positive lead of the voltmeter to the distributor terminal of the coil, and the negative lead to ground. The voltage drop should not exceed 0.1 volt. If the voltage drop is excessive, test the voltage drop of each of the following:

1. Coil to distributor wire.
2. The movable breaker point and the breaker plate.
3. The breaker plate and the distributor housing.
4. The distributor housing and engine ground.

COIL

Coil tests can be made with the coil installed on the engine or on a test set. The coil tests include coil heat, secondary continuity, and coil capacity.

A coil may break down after it has reached operating temperature; therefore, a coil heat test is made to test the coil at operating temperature. The coil secondary continuity test is performed to test the coil secondary windings for high resistance. The coil capacity test is made to determine the condition of the windings of the coil.

Perform all tests following the instructions of the test set manufacturer.

REMOVAL

1. Disconnect the high tension lead and the primary leads from the coil.
2. Remove the coil mounting screws and remove the coil.

INSTALLATION

1. Place the coil in position and install the mounting screws.
2. Insert the high tension lead into the coil socket. Push the weather seal tight against the socket.
3. Connect the primary wires to the coil. Be sure the wires are properly installed.

RESISTANCE WIRE REPLACEMENT

Because of its resistance do not attempt to splice the ignition resistance wire.

1. Fabricate a 3-inch 16-gauge jumper wire with a bullet-type terminal on one end and an eyelet-type terminal on the other end. Solder the terminals to the wire.
2. Disconnect the defective resistor wire (pink) from the coil terminal of the ignition switch. Cut the wire off at the point where it enters the taped area of the harness.
3. Connect the 3-inch jumper wire to the coil terminal of the ignition switch. Connect the replacement resistor wire to the other end of the jumper wire, using a bullet terminal connector.
4. Route the replacement resistor wire along the harness (Fig. 6), and through the grommet in the dash panel. Tape the wire to the harness where necessary to prevent it from hanging loose.
5. Disconnect the defective resistor wire from the bullet connector in the engine compartment, and connect the replacement wire in its place (Fig. 6).
6. Cut the defective wire off at the point where it enters the taped area of the harness.

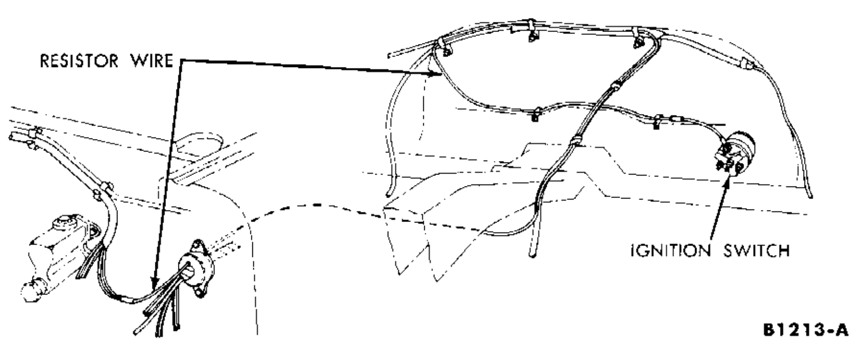


FIG. 6—Ignition Resistor Wire Replacement

SECONDARY CIRCUIT

A break down or energy loss in the secondary circuit can be caused by:

1. Fouled or broken spark plugs, or plugs incorrectly adjusted.
2. Defective high tension wiring.
3. High-tension leakage across the coil, distributor cap, or rotor.

SPARK PLUGS

Removal

1. Remove the wire from each spark plug by grasping the moulded cap only. **Do not pull on the wire as this may seperate the wire connection inside the cap or damage the weather seal.**
2. Clean the area around each spark plug with compressed air. Then remove the spark plugs.

Inspection. Examine the firing ends of the spark plugs, noting the type of deposits and the degree of electrode erosion. The various types of spark plug fouling and the normal condition of the spark plug after usage are shown in Fig. 7.

Oil fouling (Fig. 7) is usually identified by wet, sludgy deposits. These are traceable to excessive oil entering the combustion chamber through worn rings and pistons, excessive clearance between the valve guides and stems, or worn or loose bearings.

Gas fouling (Fig. 7) is usually identified by dry, black, fluffy deposits which result from incomplete combustion. Too rich a fuel-air mixture can cause incomplete burning. In addition, a defective coil, defective breaker points, or a defective ignition cable can reduce the voltage supplied to the spark plug and cause misfiring.

Burned or overheated spark plugs (Fig. 7) are usually identified by a white, burned, or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling, improper ignition timing, the wrong type of fuel, or loose spark plugs can cause general overheating.

Normal conditions (Fig. 7 left) where regular or unleaded gasolines have been used are usually identified by a rusty-brown to grayish-tan, powdery deposit and minor electrode erosion, indicating proper ignition and combustion conditions.

Normal conditions (Fig. 7 right) where highly leaded gasolines have been used are usually identified by white, powdery deposits. If the spark plugs are cleaned at recommended intervals and normal service conditions are encountered, these deposits

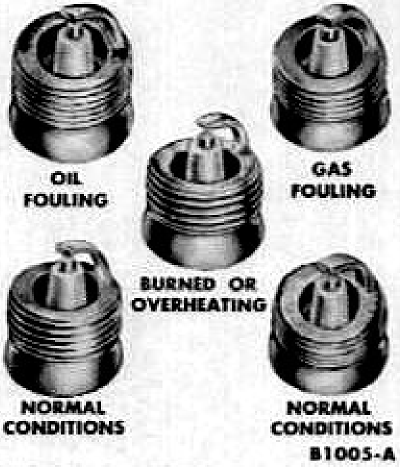


FIG. 7—Spark Plug Inspection

have little effect on plug performance. However, prolonged high-speed, high load operation will fuse these deposits to form a yellowish glaze. At high temperatures, this glaze may be conductive, resulting in spark plug "missing" or fouling.

Cleaning. Clean the plugs on a sand blast cleaner, following the manufacturer's instructions. **Do not prolong the use of the abrasive blast as it will wear the insulator.** Remove carbon and other deposits from the threads with a stiff wire brush. Any deposits will retard the heat flow from the plug to the cylinder head, causing spark plug overheating and preignition.

Clean the electrode surfaces with a small file. Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.

After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrodes, or other signs of failure. Replace as required.

Adjustment. Set the spark plug gap (0.032-0.036 inch) by bending the ground electrode.

Testing. Set the gap, and test the plugs on a testing machine. Compare the sparking efficiency of the cleaned and regapped plug with a new plug. Replace the plug if it fails to meet requirements.

Test the plugs for compression leakage at the insulator seal. Apply a coating of oil to the shoulder of the plug where the insulator projects through the shell, and to the top of the plug, where the center electrode and terminal project from the insulator. Place the spark plug under pressure. Leakage is indicated by air bubbling through the oil. If the test indicates compression leakage, replace the plug. If the plug is satisfactory, wipe it clean.

Installation

1. Clean the area around the spark plug port to insure proper seating of the plug.
2. Install the plugs. Then tighten each plug to 15-20 foot-pounds torque.

HIGH TENSION (SECONDARY) WIRES

The high tension wires include the wires connecting the distributor cap to the spark plugs and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

The high tension wires are the radio resistance-type which filter out the high frequency electrical impulses that are the source of ignition noise interference. The wires can be identified by the words "Radio Resistance" stamped on each cable. The resistance of each wire should not exceed 24,500 ohms. **When checking the resistance of the wires or when setting ignition timing, do not puncture the wires with a probe. The probe may cause a separation in the conductor.** A spark plug wire set is available for service.

At regular intervals, clean and inspect the wires for cracked insulation and loose terminals. Repair or replace the wires as required.

When removing the wires from the spark plugs, grasp the moulded cap only. Do not pull on the wire as this may separate the wire connection inside the cap or damage the weather seal.

Spark Intensity. Disconnect all spark plug wires at the plugs. Take one spark plug wire at a time and install a terminal adapter in the wire terminal. Hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine. The spark should jump the gap regularly.

If the spark intensity of all leads is satisfactory, the coil, condenser, rotor, distributor cap, and the high tension cables are probably satisfactory.

If the spark is good at only some leads, perform a high resistance test of the faulty leads.

If the spark is equal at all leads, but weak or intermittent, make a high resistance check of the coil, distributor cap, and the coil to distributor high tension lead. Follow the instructions of the test set manufacturer when making the test.

SPARK PLUG WIRE REPLACEMENT

The ignition wiring installation is shown in Fig. 8.

Removal

1. Disconnect the wires from the spark plugs and distributor cap.

2. Pull the wires from the brackets on the valve rocker arm covers and remove the wires.

Installation

1. Insert each wire in the proper distributor cap socket. Be sure the wires are forced all the way down into their sockets. The No. 1 socket is identified on the cap. Install the wires in a counterclockwise direction in the firing order (1-5-4-2-6-3-7-8) starting at the No. 1 socket. Cylinders are numbered from front to rear—right bank, 1-2-3-4: left bank, 5-6-7-8.

2. Remove the brackets from the old spark plug wire set and install them on the new set in the same relative position. Install the wires in the brackets on the valve rocker arm covers (Fig. 8), then connect the wires to the proper spark plugs. Install the coil high tension lead. **Be sure No. 7 spark plug wire is positioned in the bracket as indicated in Fig. 8.**

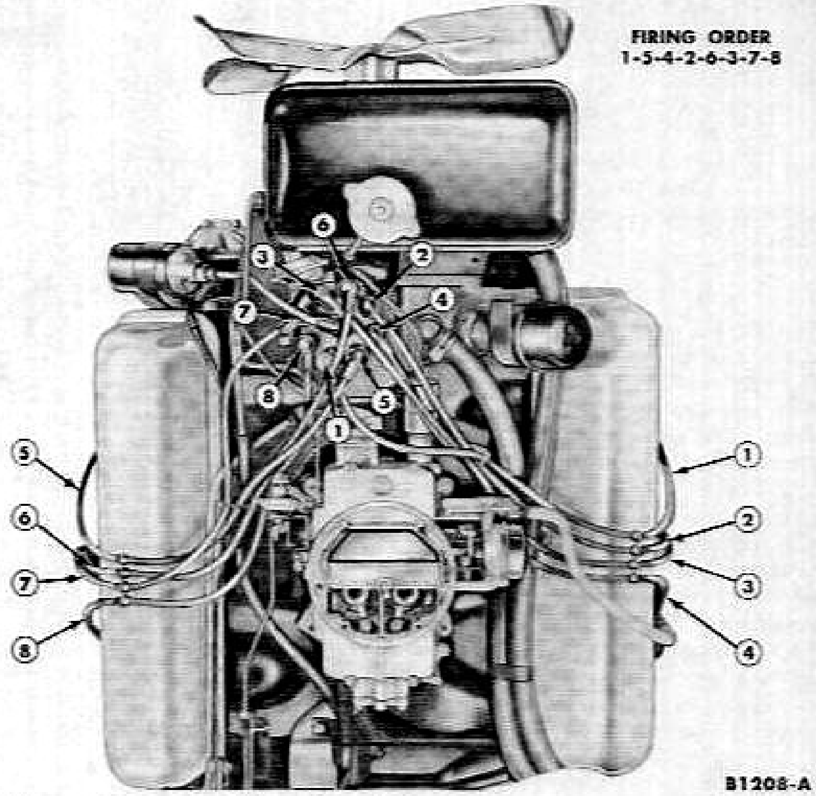


FIG. 8—Typical Ignition Wiring Installation

IGNITION TIMING

Incorrect ignition timing can be caused by:

1. Timing incorrectly adjusted.

2. Distributor bushing and/or shaft worn, or a bent distributor shaft.

3. Defective vacuum advance system.

4. Defective centrifugal advance.

5. Pre-ignition (caused by spark plugs of the wrong heat range), fouled plugs, improperly adjusted plugs, etc.

The timing pointer on the 352 engine has timing marks (Fig. 9), ranging from top dead center (T.D.C.) to 10° before top center (B.T.C.) in 2° increments.

The timing pointer on the 430 engine has timing marks ranging from top dead center (T.D.C.) to 20° before top dead center in 2° increments (Fig. 10).

Refer to Part 2-3 for the correct ignition timing specifications.

CHECKING IGNITION TIMING

1. Disconnect the distributor vacuum line, then connect the timing light high tension lead to the No. 1 spark plug and the other two leads of the timing light to the battery terminals.

2. Clean the dirt from the timing marks on the pointer and the pin on the damper.

3. Operate the engine at idle speed. Be sure the engine is idling below 550 rpm so that there will be no centrifugal advance. The timing light should flash just as the pin lines up with the proper mark on the pointer, indicating correct timing. The operator's eye should be in line with the center of the damper and the timing pointer.

4. If the proper timing mark and the pin do not line up, rotate the distributor until the correct mark and the pin are in line.

The timing is advanced by clockwise rotation of the distributor body, and retarded by counterclockwise rotation.

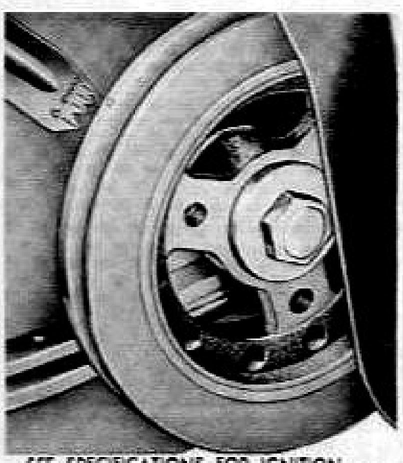


FIG. 9—352 Engine Timing Marks

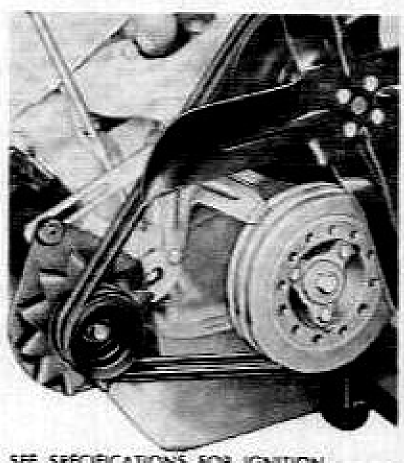


FIG. 10—430 Engine Timing Marks

5. After the ignition timing has been properly set, connect the distributor vacuum line, then check the distributor to determine if the advance mechanism is operating. To do this, hold the timing light so that the timing marks and pin can be seen, and accelerate the engine. If no advance is evident, one of the following is the probable cause; no vacuum available at the distributor, vacuum advance diaphragm leaking or disconnected from the breaker plate, centrifugal advance not functioning properly, breaker plate binding.

2 DISTRIBUTOR TESTS AND ADJUSTMENTS

SPARK ADVANCE ADJUSTMENTS

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

Mount the distributor on a test set and calibrate the test set following the instructions of the manufacturer. Check the dwell angle. If the dwell is not between 26°-28½°, adjust the breaker points to the correct dwell angle. Check the breaker arm spring tension (17-20 ounces), and adjust it if necessary.

The dual advance distributor has two independently operated spark advance systems. Each system is adjusted separately. **Adjust the centrifugal advance before adjusting the vacuum advance.**

Centrifugal Advance

1. Do not connect the test set vacuum line to the diaphragm. Operate the distributor in the direction of rotation (counterclockwise) and increase the rpm until the spark begins to advance, then reduce the rpm setting until there is no advance. Set the advance scale to zero.

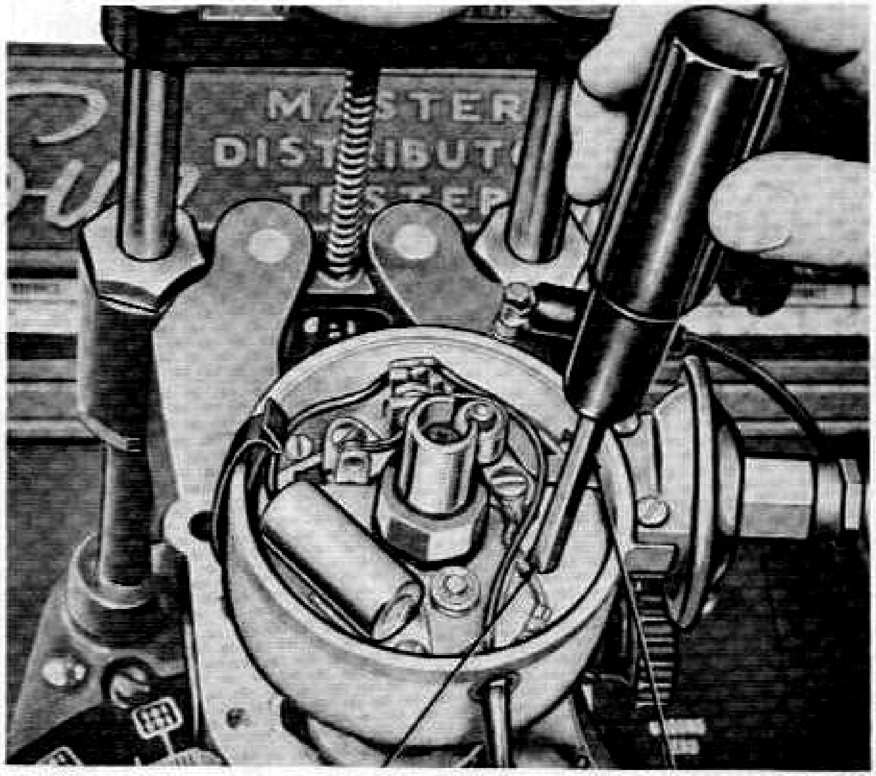


FIG. 11—Centrifugal Advance Adjustment

2. Slowly increase the rpm to the setting specified for the first advance reading listed in the specifications (Part 2-3).

3. If the correct advance is not indicated at this rpm, stop the distributor and bend one spring adjustment bracket to change its tension (Fig. 11). Bend the adjustment bracket away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension). After the adjustment is made, identify the bracket.

4. After an adjustment has been made to one spring, check the minimum advance point again.

5. Operate the distributor at the specified rpm to give an advance just below the maximum. If this advance is not to specifications, stop the distributor and bend the other spring bracket to give the correct advance.

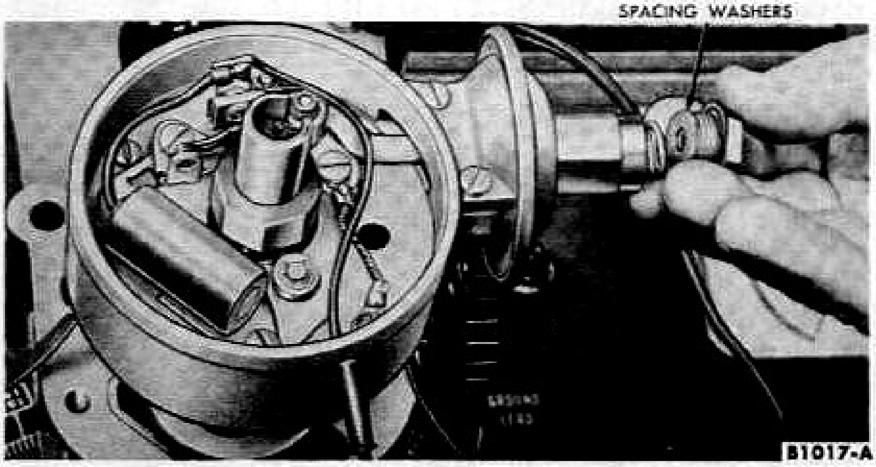


FIG. 12—Vacuum Advance Adjustment

6. Check the advance at all rpm settings listed in the specifications. Operate the distributor both up and down the rpm range.

Vacuum Advance

1. Connect the test set vacuum line to the fitting on the diaphragm. Set the test set to 0° advance, 0 vacuum, and at 1000 rpm.

2. Check the advance at the first vacuum setting given in the specifications.

3. If the advance is incorrect, change the spacing washers between the vacuum chamber spring and nut (Fig. 12). After installing or removing the washers, position the gasket in place and tighten the nut. **The addition of a washer will decrease advance and the removal of a washer will increase advance.**

4. After one vacuum setting has been adjusted, the other should be checked. **Do not change the original rpm setting when going to a different vacuum setting.** If the other settings are not within limits, it indicates incorrect spring tension or leakage in the vacuum chamber and/or line.

BREAKER POINTS

The breaker point assembly consists of the stationary point bracket assembly, breaker arm, and the primary wire terminal. The assembly is mounted on the breaker plate, as a unit, and can be replaced without removing the distributor from the engine.

Breaker points should be inspected, cleaned, and adjusted at regular intervals. Breaker points can be cleaned with chloroform and a stiff bristle brush. Replace the breaker point assembly if the contacts are badly burned or excessive metal transfer between the points is evident. Metal transfer is considered excessive when it equals or exceeds the gap setting.

Burned breaker points are generally the result of an accumulation of oil and dirt on the breaker points. This is usually caused by oil bleeding from the distributor base bushing onto the breaker points, by excessive or improper cam lubricant being thrown off onto the breaker points, and/or neglect to clean the breaker points periodically.

Excessive metal transfer between the breaker points is generally caused by incorrect alignment, voltage regulator setting that is incorrect, a radio condenser installed to the distributor side of the coil, an ignition condenser of improper capacity, or extended operation of the engine at speeds other than normal.

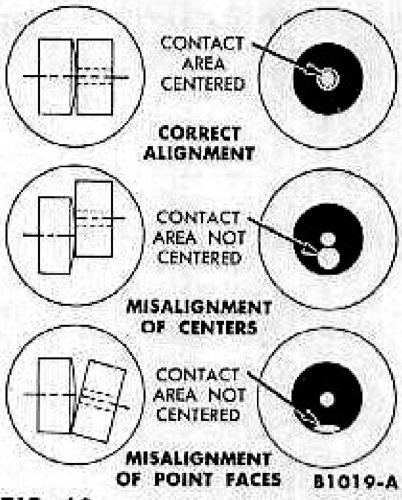


FIG. 13—Breaker Point Alignment

REMOVAL

1. Remove the distributor cap and rotor.

2. Disconnect the primary and condenser leads.

3. Remove the screws that secure the breaker point assembly to the breaker plate, then remove the breaker point assembly.

INSTALLATION

1. Place the primary and condenser leads on the breaker point assembly primary terminal. Install the lockwasher and nut, then tighten the nut securely.

2. Position the breaker point assembly on the breaker plate, then install the hold down screws. Make sure the ground wire terminal is on the screw furthest from the adjustment slot.

3. Adjust the breaker point gap.

BREAKER POINT GAP OR DWELL

New Breaker Points. New breaker points can be installed and adjusted on the car with a feeler gauge. However, a more accurate adjustment can be made with a dwell meter following the instructions of the manufacturer. The dwell angle should be 26°-28½° (0.014-0.016 inch gap). New points should be adjusted to the low tolerance of the dwell angle (26°), or to the larger opening of the gap (0.016 inch), to provide for rubbing block wear. After new points are installed, apply a light film of high temperature non-fiber grease to the cam. **Do not use engine oil to lubricate the cam.**

Used Breaker Points. If the gap of used breaker points is being checked, use a dwell meter to test the dwell angle. It is not advisable to use a feeler gauge to adjust or to check the gap of used breaker points because the roughness of the points make an accurate gap reading or setting impossible.

BREAKER POINT ALIGNMENT

The vented-type breaker points used in Ford distributors must be accurately aligned and strike squarely in order to realize the full advantages provided by this design, and assure normal breaker point life. Any mis-

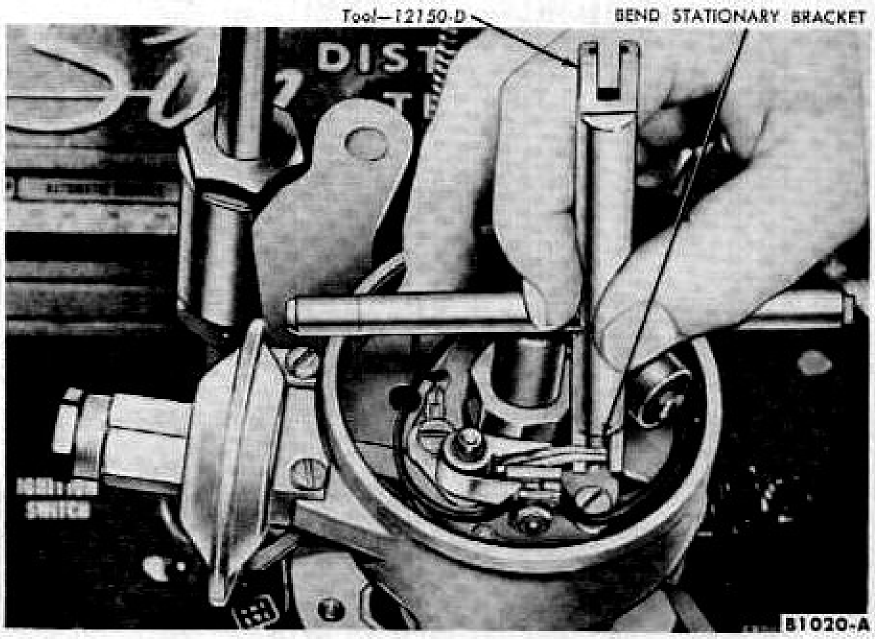


FIG. 14—Aligning Breaker Points

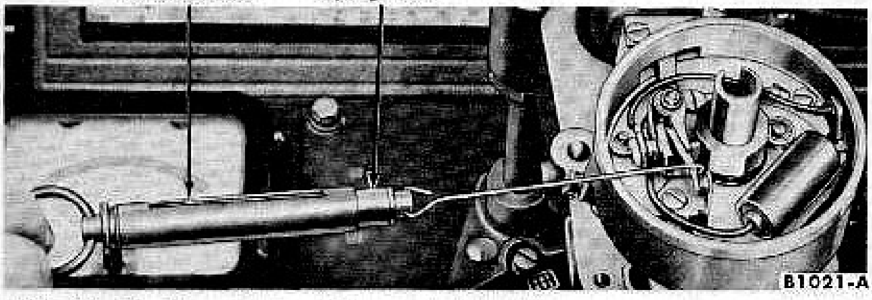


FIG. 15—Checking Breaker Point Spring Tension

alignment of the breaker point surfaces will cause premature wear, overheating, and pitting.

1. Turn the cam so that the breaker points are closed and check the alignment of the points (Fig. 13). Align the breaker points to make full face contact by bending the stationary breaker point bracket (Fig. 14). **Do not bend the breaker arm.**

2. After the breaker points have been properly aligned, adjust the breaker point gap or dwell.

BREAKER POINT SPRING TENSION

Correct breaker point spring tension is essential to proper engine operation and normal breaker point life. If the spring tension is too great, rapid wear of the breaker arm rubbing block will result, causing the breaker point gap to close up and retard the spark timing. If the spring tension is too weak, the breaker arm will flutter at high engine rpm resulting in an engine miss.

To check the spring tension, place the hooked end of the spring tension gauge over the movable breaker point, then pull the gauge at a right angle (90°) to the movable arm until the breaker points just start to open (Fig. 15). If the tension is not within specifications (17-20 ounces), adjust the spring tension.

To adjust the spring tension (Fig. 16):

1. Disconnect the primary and condenser leads at the breaker point assembly primary terminal.

2. Loosen the nut holding the spring in position, then move the spring toward the breaker arm pivot to decrease tension and in the opposite direction to increase tension.

3. Tighten the locknut, and check spring tension. Repeat the adjustment until the specified spring tension is obtained.

4. Install the primary and condenser leads with the lockwasher and tighten the nut securely.

CONDENSER

A capacity test, a leakage test, and a series resistance test should be performed on the condenser. The tests can be made with the condenser installed in the distributor or with the condenser installed on a test unit. Use reliable test equipment and follow the instructions of the manufacturer. The capacity is 0.21-0.25 microfarads, leakage should not be less than 5 megohms at room temperature, and series resistance should be 1 ohm or less. The condenser should be replaced if it does not meet the above specifications.

CAM LOBE ACCURACY

Worn cam lobes will cause the corresponding cylinders to fire out of time and result in a loss of power.

Install the distributor on a test set and check the accuracy of the cam lobes following the instructions of the manufacturer. If the test indicates that any lobe is worn, replace the cam.

DIAPHRAGM LEAKAGE AND FREENESS OF OPERATION

These tests can be made with the distributor installed on the engine or on a distributor test set. The tests are sufficient for an engine tune-up. However, if there are indications that the spark advance is not functioning properly, remove the distributor from the engine and check it on a distributor test set following the instructions under "Spark Advance Adjustments."

Check the vacuum advance mechanism for freeness of operation by manually rotating the breaker plate in the direction of rotation. **Do not rotate the plate by pushing on the condenser or the points, use a hook or other suitable instrument in the breaker point adjustment slot.** The breaker plate should turn without binding and return to its original position when released. If the breaker plate binds, remove the plate. Clean, inspect, and lubricate the breaker plate.

To check the diaphragm for leakage:

1. Adjust the vacuum gauge to 25 inches Hg., following the instructions of the test set manufacturer.

2. Install the vacuum hose on the diaphragm vacuum line fitting. The vacuum gauge reading should not fall off when the vacuum is applied to the diaphragm assembly if no leak exists. If a leak is indicated by the test, replace the diaphragm assembly.

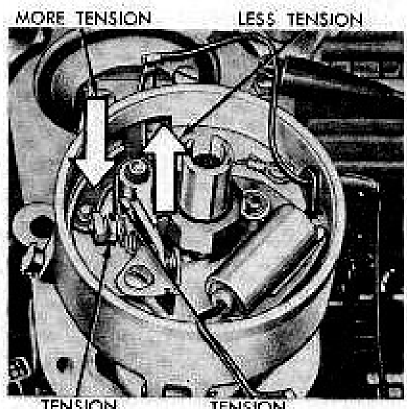


FIG. 16—Breaker Point Spring Tension Adjustment

BREAKER PLATE WEAR TEST

A worn breaker plate will cause the breaker point gap and dwell angle to change as engine speed and load conditions are varied.

Perform the test following the instructions of the dwell meter manufacturer. There should not be over a 5° variation in dwell between engine idle speed and 2500 rpm. If the dwell angle changes more than 5° there is excessive wear at one or all of the following:

1. Distributor shaft bushing.

2. Breaker plate bushing.

3. Stationary sub-plate pin.

DISTRIBUTOR SHAFT END PLAY

Remove the distributor from the engine. Place the distributor in the holding tool and clamp it in a vise. Push the distributor shaft downward as far as it will go, then check the end play with a feeler gauge placed between the collar and the distributor base. The end play should be 0.022-0.030 inch.

The distributor gear backlash can not be accurately checked.

PART 2-2 DISTRIBUTOR

1 DISTRIBUTOR OPERATION

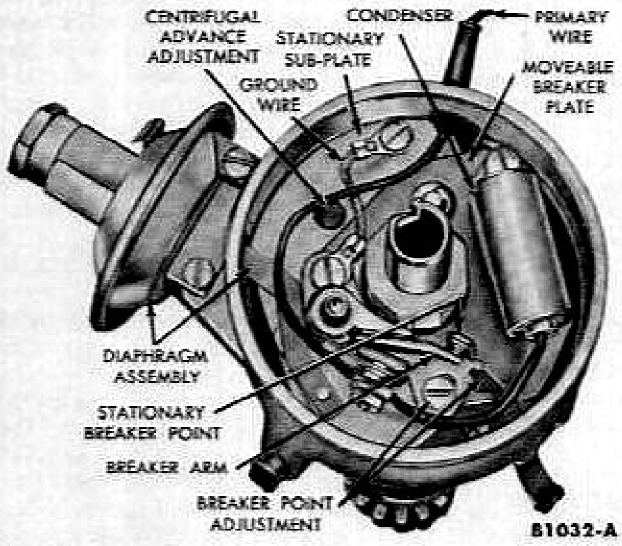


FIG. 1—Dual Advance Distributor

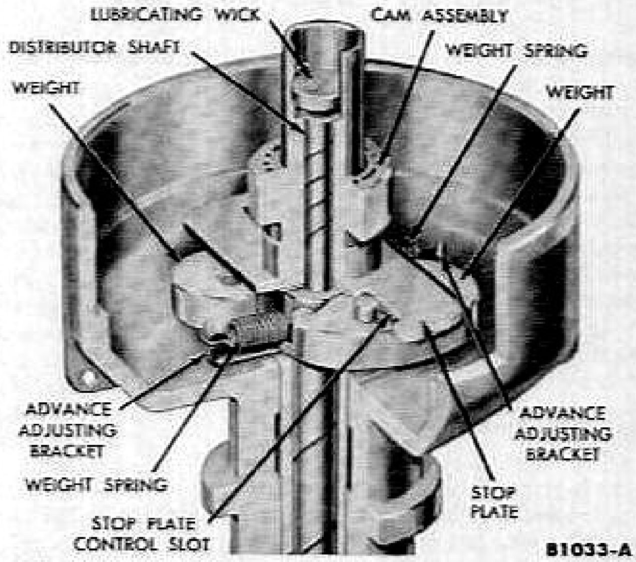


FIG. 2—Centrifugal Advance Mechanism

The distributor (Fig. 1) has two independently operated spark advance systems. A governor-type centrifugal advance mechanism is located below the stationary sub-plate (Fig. 2), and a vacuum operated spark control diaphragm is located on the side of the distributor base (Fig. 3).

The centrifugal weights cause the cam to advance or move ahead with respect to the distributor drive shaft. This action causes the cam to open

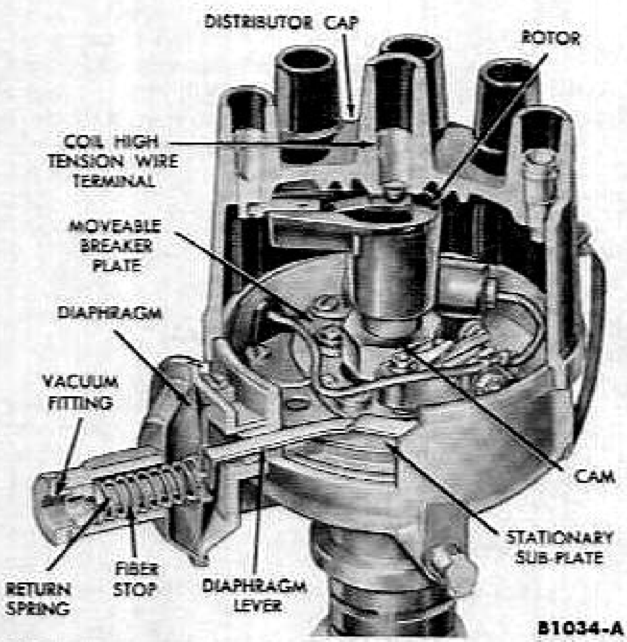


FIG. 3—Vacuum Advance Mechanism

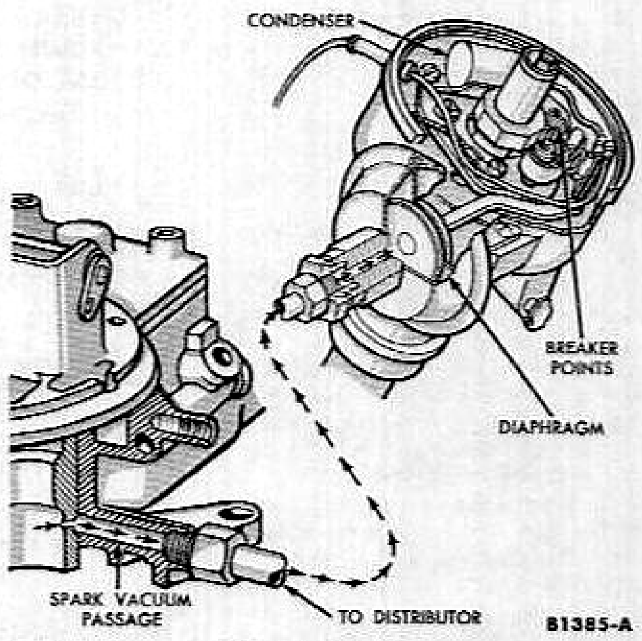


FIG. 4—Vacuum Advance Controls

and close the breaker points earlier. The weights turn the cam by means of a stop plate that has two slots which fit over pins in the weights. The slots determine the maximum amount of advance and the rate of advance is controlled by calibrated springs.

The vacuum advance mechanism has a spring-loaded diaphragm (Fig. 4) which is connected to the breaker plate. The spring loaded side of the diaphragm is air tight and is connected through a vacuum line to the carburetor throttle bore. When the throttle plates open, the distributor vacuum passage is exposed to manifold vacuum which causes the diaphragm to move against the tension of the spring. This action causes the breaker plate to advance and the breaker points open and close earlier.

When the engine is operated under a light load, additional advance is required for maximum part throttle power and economy. Under this condition, engine manifold vacuum is high enough to actuate the diaphragm and advance the spark. The amount of spark advance is limited by a stop.

At low engine speeds or at idle, a retarded spark is necessary. Because the vacuum passage opening, in the carburetor, is above the closed throttle plate, there is no vacuum to the diaphragm. The breaker plate is held in a retarded position by the calibrated return spring which bears against the diaphragm.

During acceleration or when there is a heavy load on the engine, there is not enough vacuum to actuate the diaphragm, and the breaker plate once again is held in a retarded position.

When the engine is being operated under a light load, such as on a level road at 40 mph, and the throttle is suddenly opened further, the manifold vacuum will decrease and the diaphragm spring will quickly force the breaker plate to a retard position. However, the advance provided by the centrifugal mechanism remains unchanged until the engine speed changes. At any particular engine speed, there will be a certain amount of centrifugal advance plus a **possible** vacuum advance.

2 DISTRIBUTOR REMOVAL AND INSTALLATION

DISTRIBUTOR REMOVAL

1. Disconnect the primary wire at the coil and the vacuum advance line at the distributor, and remove the distributor cap.

2. Scribe a mark on the distributor body and engine block indicating the position of the body in the block, and scribe another mark on the distributor body indicating the position of the rotor. These marks can be used as guides when installing the distributor in a correctly timed engine.

3. Remove the distributor hold down cap screw and clamp. Then lift the distributor out of the block.

DISTRIBUTOR INSTALLATION

The distributor installation is shown in Fig. 5.

1. If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine. Turn the engine until No. 1 piston is on T.D.C. (after the compression stroke). Align the pin on the crankshaft damper with the T.D.C. on the timing pointer. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open.

FIG. 5—Distributor Installation

2. If the crankshaft has not been rotated, position the distributor in the block using the marks previously scribed on the distributor body and engine block as guides.

Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, after the distributor drive gear is partially engaged, in order to engage the oil pump intermediate shaft.

3. Install the rotor and the distributor cap. Connect the coil to distributor cap high tension lead, and connect the primary wire to the coil.

4. Check the ignition timing with a timing light and adjust it if necessary. Connect the vacuum line, and check the advance with the timing light when the engine is accelerated.

3 DISTRIBUTOR DISASSEMBLY, CLEANING AND INSPECTION, AND ASSEMBLY

DISTRIBUTOR DISASSEMBLY

1. Remove the rotor. Remove the spring clip securing the diaphragm link to the breaker plate, then disconnect the diaphragm assembly from the distributor base and remove the diaphragm assembly.

2. Disconnect the primary wire from the breaker points, then remove the wire from the distributor. Pull the wire through the hole in the distributor working from the outside to the inside of the distributor.

3. Remove the breaker point assembly and condenser.

4. Remove the breaker plate retainer, flat washer, and spring washer from the pivot pin.

5. Lift the breaker plate from the sub-plate.

6. Remove the two sub-plate screws and remove the sub-plate.

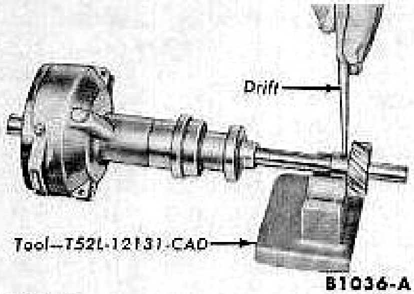


FIG. 6—Gear Pin Removal or Installation

7. Remove the lubricating wick from the cam assembly. Then remove the cam assembly retainer. Remove the cam assembly and the upper thrust washer.

8. Carefully unhook and remove the distributor weight springs. Mark each spring, bracket, and the adjusting post to which they are attached.

9. **If the gear and shaft are to be used again, mark the gear and shaft so the pin holes can be easily aligned for assembly.** Remove the gear roll pin (Fig. 6), then remove the gear (Fig 7).

10. Remove the shaft collar roll pin (Fig 8).

11. Invert the distributor and place it on a support plate in a position that will allow the distributor shaft to clear the support plate. Then press the shaft out of the collar and the distributor housing (Fig. 9).

12. Remove the distributor shaft bushing (Fig. 10).

DISTRIBUTOR CLEANING AND INSPECTION

Soak all parts of the distributor assembly (except the condenser, breaker point assembly, lubricating wick,

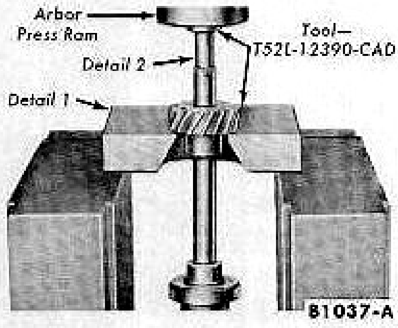


FIG. 7—Gear Removal

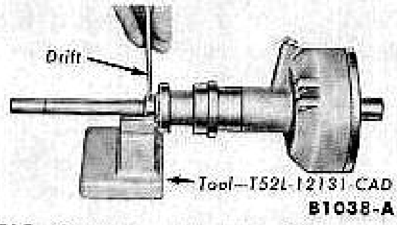


FIG. 8—Collar Retaining Pin Removal or Installation

vacuum diaphragm, and electrical wiring) in a mild cleaning solvent or mineral spirits. **Do not use a harsh cleaning solution.** Wipe all parts that cannot be immersed in a solvent with a clean dry cloth.

After foreign deposits have been loosened by soaking, scrub the parts with a soft bristle brush. **Do not use a wire brush, file, or other abrasive object.** Dry the parts with compressed air.

Examine the bushing surface of the distributor shaft and the bushing for wear. The minimum allowable shaft diameter at the bushing is 0.4675 inch and the maximum allowable inside diameter of the bushing is 0.4690 inch. Replace worn parts.

Inspect the distributor cam lobes for scoring and signs of wear. If any lobe is scored or worn, replace the cam assembly.

Inspect the sub-plate assembly for signs of distortion. It must fit into the base without binding. The pivot pin must be tight and perpendicular to the sub-plate. The three nylon buttons must be firmly seated in the plate and uniform in height. Replace the sub-plate assembly if it is defective.

Inspect the breaker plate for signs of distortion. The pivot pin bushing must be securely attached to the breaker plate. Replace the breaker plate assembly if it is defective.

The breaker point assembly and condenser should be replaced whenever the distributor is overhauled.

Inspect all electrical wiring for fraying, breaks, etc., and replace any that are not in good condition.

Check the distributor base for cracks or other damage. Check the diaphragm housing, bracket, and link

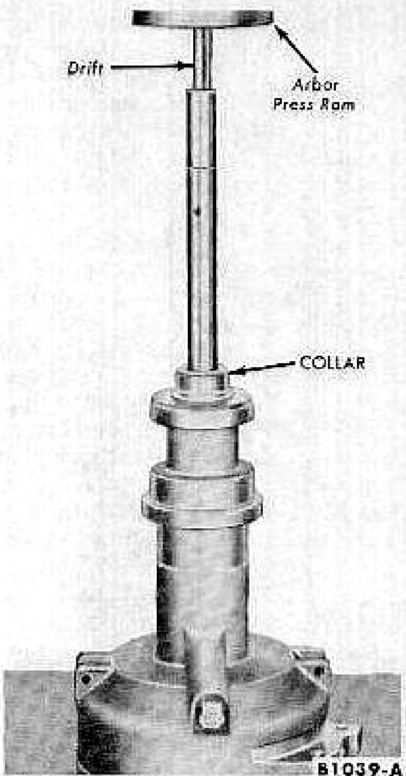


FIG. 9—Shaft Removal

for damage. Check the vacuum line fitting for stripped threads or other damage. Test the vacuum fittings, case, and diaphragm for leakage as explained under "Distributor Tests and Adjustments." Replace all defective parts.

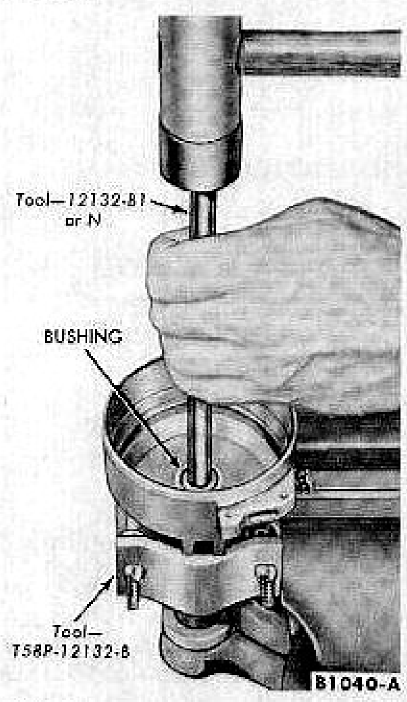


FIG. 10—Bushing Removal

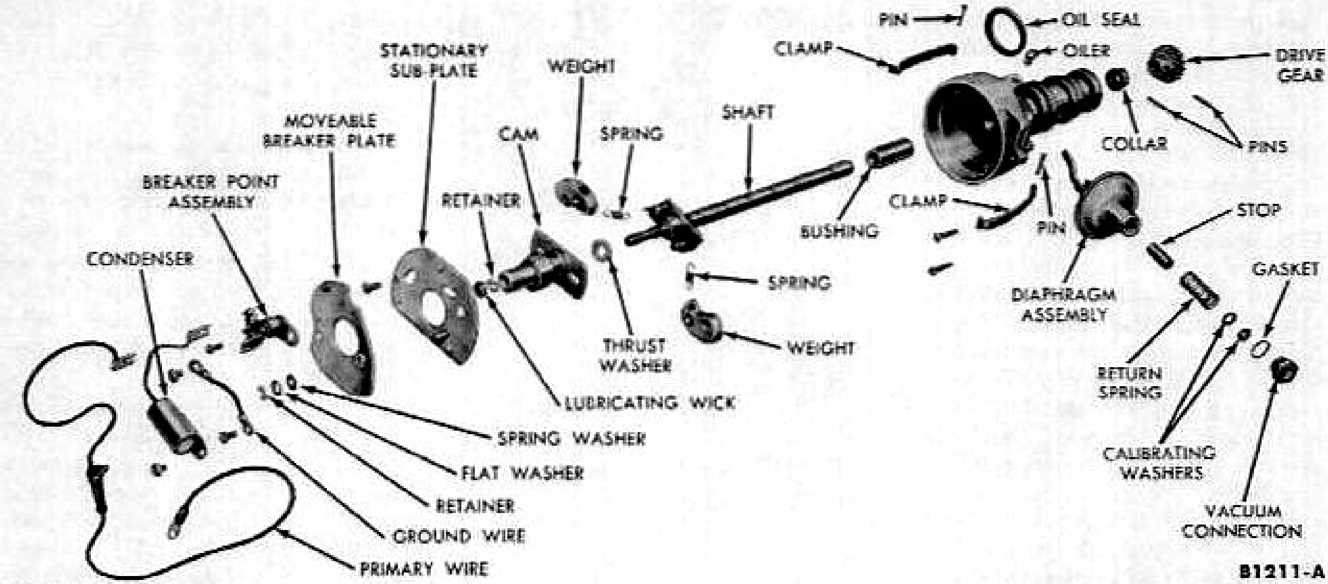


FIG. 11—Distributor Assembly

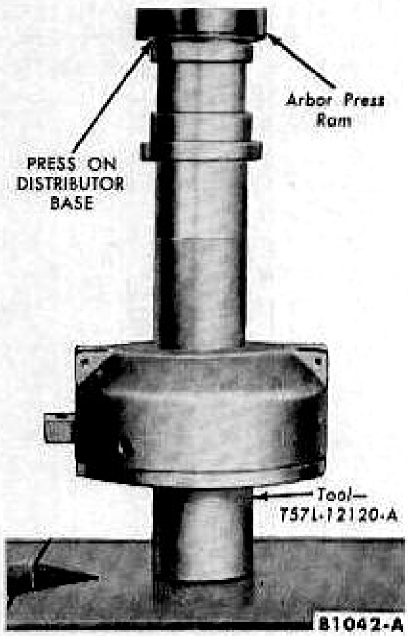


FIG. 12—Bushing Installation

DISTRIBUTOR ASSEMBLY

Refer to Fig. 11 for the correct location of the parts.

1. Oil the new bushing, and install it on the bushing replacer tool, then install the bushing (Fig. 12). When the tool bottoms against the distributor base, the bushing will be installed to the correct depth.

2. Burnish the bushing to the proper size (Fig. 13).

3. If the old shaft is being installed, oil the shaft and slide it into the distributor body. **The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other.**

4. Place the collar in position on the shaft and align the holes in the collar and shaft, then install a new pin (Fig. 8).

5. Check the shaft end play with a feeler gauge placed between the collar and the distributor base. If the end play is not within limits (0.022-0.030 inch), replace the shaft.

6. Press the gear on the shaft (Fig. 14), using the marks made on the gear and shaft as guides to align the pin holes.

7. Check the gear location dimension. With all end play removed (gear pushed toward the distributor base), this dimension should be 5.111-5.116 inches from the bottom face of the gear to the bottom face of the distributor mounting pad (Fig. 14). Install the gear retaining pin (Fig. 8).

8. If a new shaft and gear are being installed, oil the new shaft and slide it into the distributor body. At-

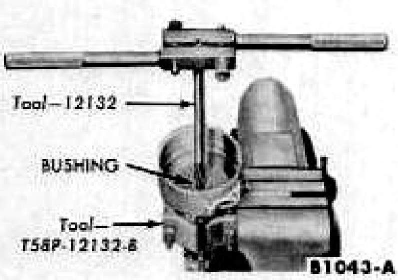


FIG. 13—Burnishing Bushing

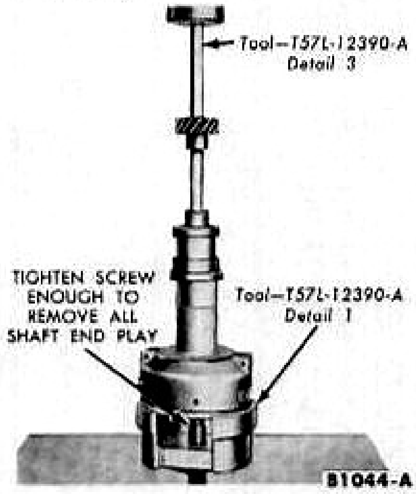


FIG. 14—Gear Installation

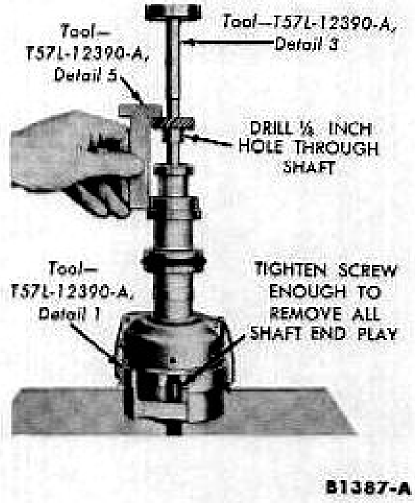


FIG. 15—New Shaft Installation

tach the distributor shaft supporting tool to the distributor and place the assembly in a press (Fig. 15). Insert a 0.022-inch feeler gauge between the centrifugal advance adjusting bracket plate and the top of the bushing. Tighten the backing screw on the tool enough to remove all shaft end play. Place the collar in position and support the shaft. While holding the collar in position against the distributor housing, drill a ⅛-inch hole through the shaft using the access hole in the collar as a pilot. With the supporting tool and the 0.022-inch feeler gauge still installed, install the drive gear (Fig. 14). Remove the assembly from the press and remove the supporting tool and feeler gauge. Drill a ⅛-inch hole through the gear and shaft, using the hole in the gear shoulder as a pilot. Install a new pin in the gear (Fig. 6) and the collar (Fig. 8).

9. Install the weights and springs, then fill the groove in the weight pivot pin with a high melting point ball bearing lubricant. Be sure that the proper weight, spring, and adjustment bracket are assembled together.

10. Lubricate the inside diameter of the cam assembly with a high melting point ball bearing lubricant. Install the upper thrust washer, then install the cam and secure it with the spring retainer. Apply a light film of cam lubricant to the cam lobes. Saturate the wick with S.A.E. 10W engine oil. Then install the wick in the cam assembly (Fig. 16).

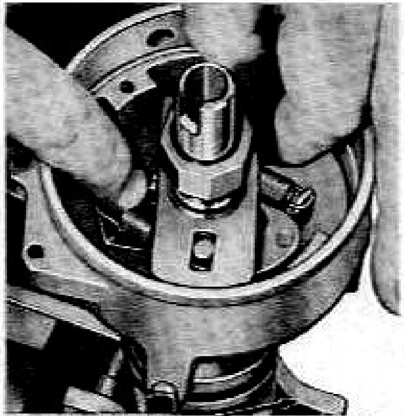


FIG. 16—Weights, Springs, and Cam Installed

11. Install a new condenser and breaker point assembly. Install the ground wire on the breaker point attaching screw furthest from the breaker point adjustment slot.

12. Apply a film of cam lubricant to the three nylon buttons on the sub-plate.

13. Apply a film of cam lubricant to the pivot pin and bushing.

14. Place the breaker plate on the sub-plate. Proper positioning is determined by aligning the larger center holes.

15. Place the spring washer on the pivot pin with the concave surface up.

16. Apply cam lubricant to the spring washer.

17. Install the flat washer and retainer on the pivot pin. The spring washer should hold the breaker plate firmly on the three nylon buttons.

18. Install the assembled plates into the base assembly. The sub-plate attaching screw, which also attaches the ground wire, is a locater and must be installed first.

19. Pass the primary wire assembly through the hole in the distributor working from the inside to the outside of the distributor housing. Pull the wire through the hole until the locating stop is flush with the inside of the distributor. Connect the condenser wire and the primary wire to the breaker points.

20. Position the diaphragm assembly and hook the diaphragm link over the pin on the breaker plate. Secure the link with the spring retainer. Secure the diaphragm assembly to the distributor base.

21. Align the breaker points, adjust the spring tension, and adjust the breaker point gap.

22. Install the distributor on a test set, check the breaker point dwell and resistance, and adjust the centrifugal and vacuum advance.

PART 2-3 SPECIFICATIONS

IGNITION TIMING

MANUAL SHIFT TRANSMISSION

352 ENGINE

Recommended Setting....................3° B.T.D.C.

Allowable Range....................2°-10° B.T.D.C.

CRUISE-O-MATIC TRANSMISSION

352 AND 430 ENGINES

Recommended Setting....................6° B.T.D.C.

Allowable Range....................2°-10° B.T.D.C.

DISTRIBUTOR

GENERAL

352 AND 430 ENGINES

Breaker Arm Spring Tension (Ounces)..........17-20

Contact Spacing (Inches)..................0.014-0.016

Dwell Angle at Idle Speed..................26°-28½°

GEAR LOCATION DIMENSION

Distance from bottom of mounting flange to bottom of gear (Inches)....................5.111-5.116

SHAFT END PLAY CLEARANCE (INCHES)

352 Engine..........................0.022-0.030

430 Engine..........................0.022-0.032

ADVANCE CHARACTERISTICS

Note: **The advance characteristics given apply to the distributor with the indicated number only. The distributor number is stamped on the distributor housing or on a plate attached to the distributor housing.**

352 ENGINE (DISTRIBUTOR NO. COAF-12127-B)

CENTRIFUGAL ADVANCE. Set test stand to 0° @ 200 rpm. Disconnect the vacuum line.

Distributor RPM	Advance (Degrees)	Vacuum (Inches of Mercury)
300	0	0
500	1-2	0
1200	7-8¼	0
2000	13¾-15¼	0

Maximum Advance Limit......................18°

VACUUM ADVANCE. Set test stand to 0° @ 1000 rpm and 0 inches of vacuum.

Distributor RPM	Advance (Degrees)	Vacuum (Inches of Mercury)
1000	0 - 1	5
1000	5¼- 8¼	10
1000	8½-11½	15

Maximum Advance Limit......................11½°

430 ENGINE (DISTRIBUTOR NO. B9MF-12127-B)

CENTRIFUGAL ADVANCE. Set test stand to 0° @ 250 rpm. Disconnect the vacuum line.

Distributor RPM	Advance (Degrees)	Vacuum (Inches of Mercury)
375	0-	0
500	½- 1½	0
1100	6 - 7¼	0
2000	14¼-15¾	0

Maximum Advance Limit......................18°

VACUUM ADVANCE. Set test stand to 0° @ 1000 rpm and 0 inches of vacuum.

Distributor RPM	Advance (Degrees)	Vacuum (Inches of Mercury)
1000	0 - 3	6½
1000	5 - 8	10
1000	9½-12½	15

CONDENSER

352 AND 430 ENGINES

Capacity (Microfarads)....................0.21-0.25

Minimum Leakage (Megohms)....................5

Maximum Series Resistance (Ohms)................1

COIL

352 AND 430 ENGINES

Primary Resistance (Ohms)*.........1.40-1.54 (75°F.)

Secondary Resistance (Ohms).......8000-8800 (75°F.)

COIL (Continued)

Amperage Draw
Engine Stopped............................4.5
Engine Idling.............................2.5
*Primary Circuit Resistor...........1.30-1.40 (75°F.)

SPARK PLUGS

Type..........................Champion F-11Y
Size.................................18 mm
Gap (Inches)...........................0.032-0.036
Torque (Foot-Pounds)......................15-20*

*When a new spark plug is installed in a new replacement cylinder head the torque of the plugs should be 20-30 foot-pounds.

GROUP 3

FUEL SYSTEM

PAGE

PART 3-1 FUEL SYSTEM MAINTENANCE

1 TROUBLE DIAGNOSIS AND TESTING

FUEL TANK AND LINES

Water and dirt that accumulates in the fuel tank can cause carburetor or fuel pump malfunction. Condensation, which is the greatest cause of water entering the fuel tank, is formed by moisture in the air when it strikes the cold walls of the fuel tank.

If the accumulation of sediment in the fuel pump sediment bowl is excessive, the fuel tank should be removed and flushed and the line from the fuel pump to the tank should be blown out.

FUEL PUMPS AND VACUUM BOOSTER

Incorrect fuel pump pressure and low capacity are the two most likely fuel pump troubles that will affect engine performance. Low pressure will cause a lean mixture at high speeds and excessive pressure will cause high fuel consumption and carburetor flooding. Low capacity will cause fuel starvation at high speeds.

TESTS

The tests are performed with the fuel pump installed on the engine.

PRESSURE TEST

1. On a 352 engine, disconnect the fuel filter from the carburetor. Install a pressure gauge and a T-fitting with a petcock between the fuel filter and the carburetor.

2. On a 430 engine, disconnect the fuel inlet line at the carburetor. Install a pressure gauge and a T-fitting with a petcock between the fuel inlet line fitting and the carburetor.

3. Vent the system, by opening the petcock momentarily, before taking a pressure reading.

4. Operate the engine at the specified rpm (Part 3-5). After the pressure has stabilized, it should be within specifications (Part 3-5).

5. If the pressure is not to specifications, remove the fuel filter from the system and take another pressure test.

If the pressure is within specifications with the fuel filter removed, the fuel filter was restricted and a new one should be installed.

If the pressure is not within specifications with the fuel filter removed, the fuel pump is defective.

CAPACITY TEST

Perform this test only when the fuel pump pressure is within specifications.

1. Operate the engine at specified rpm.

2. Open the petcock and expel the fuel into a suitable container. Observe the time to expel one pint. It should be within specifications (Part 3-5).

VACUUM BOOSTER TEST—352 ENGINE

1. Connect a vacuum gauge to the windshield wiper connection of the pump.

2. Disconnect the pump to manifold line at the manifold and plug the line.

3. Operate the engine at specified rpm and observe the vacuum gauge. The vacuum should be within specifications (Part 3-5).

FUEL PUMP TROUBLE DIAGNOSIS GUIDE

LOW FUEL PUMP PRESSURE	Diaphragm stretched or leaking. Spring weak. Rocker arm worn. Excessive clearance between rocker arm, vacuum link, and fuel pump link.	Fittings loose or cracked. Fuel line cracked or broken. Valve improperly seating. Dirt in the fuel tank and/or lines. Fuel tank vent restricted. Diaphragm ruptured.
HIGH FUEL PUMP PRESSURE	Spring too strong or improper spring.	
FUEL PUMP LEAKS FUEL	Main body retaining screws loose. Diaphragm defective. Fittings loose.	Threads on fittings stripped. Body cracked.

CONTINUED ON NEXT PAGE

FUEL PUMP TROUBLE DIAGNOSIS GUIDE (Continued)

FUEL PUMP LEAKS OIL	Pull rod oil seal defective. Fuel pump mounting bolts loose.	Mounting gasket defective.
FUEL PUMP NOISE	Mounting bolts loose. Rocker arm worn.	Rocker arm spring weak or broken.
LOSS OF BOOSTER PUMP VACUUM	Vacuum pump cover retaining screws loose. Valves not seating properly.	Spring weak. Diaphragm defective.

CARBURETOR

Dirt accumulation in the fuel and air passages, improper idle adjustments, and improper fuel level are the major sources of carburetor troubles.

TESTS

Accelerating Pump Discharge

1. Remove the air cleaner.
2. Open the primary throttle plates.
3. Observe the fuel flow from the accelerating pump discharge nozzles.

If the system is operating satisfactory, a quick steady stream will flow from the discharge nozzles.

Power Valve. Invert the carburetor. Remove the glass bowl from the fixture (Fig. 1). Fill the bowl half-full of water. Install the bowl on the fixture.

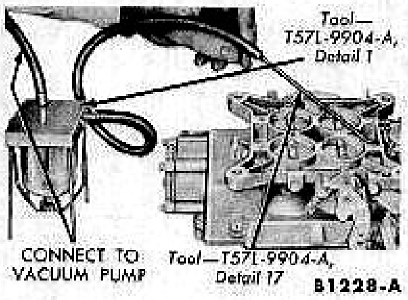


FIG. 1—Ford Power Valve Check

Connect a line from a vacuum pump to the fitting on top of the fixture. Insert the large O.D. end of the wand in the tube and attach the other end of the tube to the fitting on the side of the fixture. Slip the rubber gasket (furnished with the tool) over the small O.D. end of the wand. Hold this end against the power valve vacuum pick-up port. Look for bubble formations in the water in the bowl. A continuous stream of bubbles indicates leakage through the power valve diaphragm or gasket, or the cover or gasket.

If leakage is encountered, the power valve, power valve gasket, the cover, and cover gasket, should be replaced one at a time with a new part and the check repeated until the source of leakage has been found. If the source of leakage can not be found, the gasket seats are damaged and the defective parts should be replaced.

A few bubbles may be noticed immediately upon attaching the vacuum line. The bubbling should stop within approximately 15 seconds or after the air has been removed from the system. If no bubbles are seen, the power valve, gaskets, and cover are sealing properly.

CARBURETOR TROUBLE DIAGNOSIS GUIDE

HARD STARTING (HOT OR COLD)	**BOTH CARBURETORS** Improper starting procedure causing a flooded engine. Improper carburetor fuel level. Improper idle adjustments. Sticking or incorrectly seating fuel inlet needle. Incorrect fuel pump pressure. Improper carburetor gasket and spacer combination.	Incorrect setting of choke thermostatic spring housing. Choke linkage or plate binding. Restrictions or air leaks in the choke vacuum and hot air passages. **CARTER CARBURETOR** Incorrect choke linkage adjustment.
ROUGH IDLE	In addition to the items listed under "Poor Performance Caused By A Lean Mixture" or "Poor Performance Caused By A Rich Mixture," the following items will cause rough idle: Incorrect idle mixture adjustment.	Idle adjusting needles grooved, worn, or otherwise damaged. Idle air bleeds restricted. Idle air or fuel passages restricted. Idle discharge holes restricted. Idle discharge holes not in proper relation to the throttle plates.

CONTINUED ON NEXT PAGE

CARBURETOR TROUBLE DIAGNOSIS GUIDE (Continued)

POOR ACCELERATION	Poor acceleration complaints fall under one of three headings; the engine is sluggish on acceleration, the engine stalls when accelerated, or the engine hesitates or develops a flat spot when accelerated. Poor acceleration is caused by either an excessively lean or rich mixture on acceleration. A lean mixture on acceleration can be caused by: Accelerating pump diaphragm (Ford) or cup (Carter) defective. Incorrect pump stroke adjustment. Accelerating pump fuel inlet valve not seating on acceleration. Low fuel level or float setting. Restriction in the accelerating pump discharge passage. Discharge ball check and/or needle (Ford) or needle (Carter) not coming fully off its seat or failing to seat properly on the reverse stroke. Air leak between the carburetor and the manifold caused by loose mounting bolts or defective gasket. Air leak at the throttle shaft caused by worn shaft. Air leak at the accelerating pump cover caused by defective gasket or worn pump cover (Ford). A rich mixture on acceleration can be caused by: High fuel level or float setting. Malfunctioning automatic choke. Excessively dirty air cleaner. Incorrect accelerating pump stroke adjustment.
POOR PERFORMANCE CAUSED BY LEAN MIXTURE	Restricted fuel filter. Low fuel level or float setting. Restriction in main fuel passages. Sticking fuel inlet needle. Low fuel pump pressure.
POOR PERFORMANCE CAUSED BY RICH MIXTURE	Excessive dirt in the air cleaner. High fuel level or float setting. Fuel inlet needle not seating properly or worn needle and/or seat. Power valve leaking (Ford). Restricted air bleeds. Worn or damaged main metering jet. Accelerating pump discharge ball check and/or weight not seating properly. Fuel pump pressure excessive. Fuel siphoning from secondary main fuel system.
FLOODING OR LEAKING CARBURETOR	Cracked main body. Defective main body gaskets. High fuel level or float setting. Fuel inlet needle not seating properly or worn needle and/or seat. Ruptured accelerating pump diaphragm (Ford). Excessive fuel pump pressure.
SECONDARY SYSTEM NOT CUTTING IN	Defective secondary diaphragm (Ford). Air leak where secondary vacuum pick-up tube fits into air horn, between air horn and main body, or between the secondary diaphragm housing cover and housing (Ford). Secondary diaphragm return spring too stiff (Ford). Secondary throttle plates wedged in barrels. Bent secondary throttle shaft. Secondary throttle plates operating rod binding, or disconnected from secondary diaphragm or secondary throttle lever (Ford). Secondary vacuum passage ball check stuck on its seat (Ford). Secondary vacuum probe restricted or not properly positioned (Ford).

2 FUEL FILTER MAINTENANCE

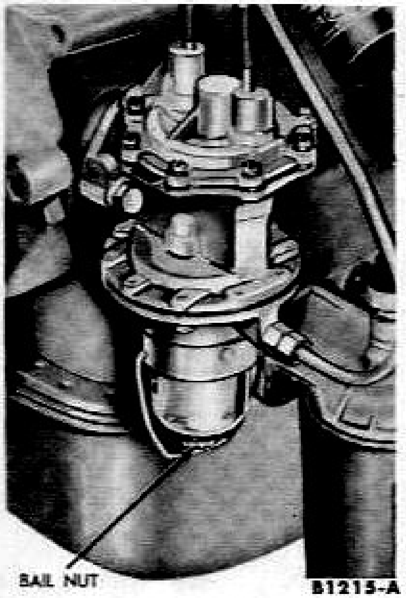


FIG. 2—352 Engine Sediment Bowl Installation

Check the "Maintenance and Lubrication Guides"—Group 17 for the proper maintenance interval.

SEDIMENT BOWL—352 ENGINE

A wire filter screen is used in the fuel pump sediment bowl (Figs. 2 and 3).

REMOVAL

Loosen the bowl bail assembly and remove the bowl and filter screen.

CLEANING AND INSPECTION

Clean the sediment bowl in solvent and dry it with compressed air.

Clean the filter screen in solvent.

INSTALLATION

Place the filter screen on the sediment bowl. Position the sediment bowl on the fuel pump and tighten the bail nut.

FUEL LINE FILTER

The fuel line filter screws into the carburetor fuel inlet on the 352 engine (Fig. 4) and into the fuel pump outlet on the 430 engine (Fig. 5). There is no provision for cleaning the fuel line filter. Replace it if it becomes clogged and at the recommended interval.

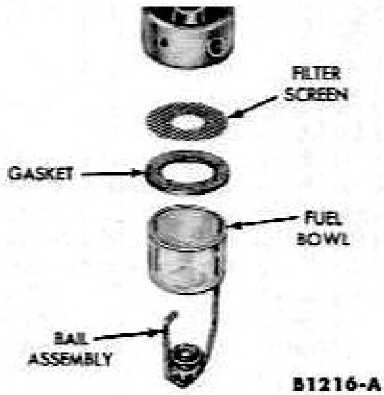


FIG. 3—352 Engine Sediment Bowl Assembly

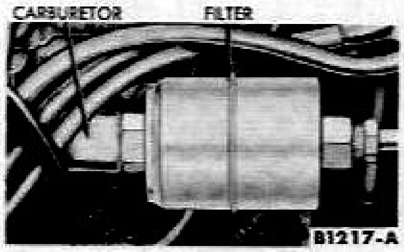


FIG. 4—352 Engine Fuel Line Filter

REMOVAL

1. Disconnect the fuel line at the filter.

2. Remove the filter from the carburetor (352 engine) or from the fuel pump (430 engine).

INSTALLATION

1. Install the filter in the carburetor fuel inlet (352 engine) or in the fuel pump outlet (430 engine).

2. Connect the fuel line to the filter.

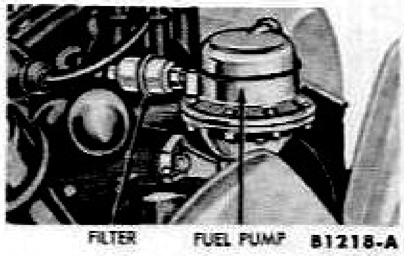


FIG. 5—430 Engine Fuel Line Filter

3 CARBURETOR IN-CHASSIS ADJUSTMENTS

The specified clearances for the various adjustments are listed in Part 3-5.

FORD CARBURETOR

Refer to Fig. 6 for the location of the adjustment points.

IDLE ADJUSTMENTS

For purposes of an engine tune-up, the idle adjustments should be made in the sequence listed.

Engine Idle Speed. The engine idle speed must be adjusted to proper hot and fast settings.

1. Operate the engine for 30 minutes at 1200 rpm.
2. When the engine temperature has stabilized and the choke fast idle cam is in the slow position (bottom stop on cam contacting the fast idle adjusting screw), back off the fast idle screw from the fast idle cam.
3. Attach a tachometer to the engine.
4. On a car with Cruise-O-Matic, set the parking brake. Place the selector lever in D1 or D2. Check the engine idle speed. Adjust the engine idle speed to the drive range specifications by turning the screw in to increase the speed or by turning the screw out to decrease the speed.

5. On a car with a manual-shift transmission, the engine idle speed is checked and adjusted with the transmission selector lever in neutral position. Adjust the engine idle speed to specifications by turning the screw in to increase the speed or by turning the screw out to decrease the speed.

6. After the correct engine idle speed has been obtained, open the throttle by hand and allow it to close normally. Recheck the engine idle speed.

7. The adjusting screw on the right side of the carburetor contacts steps on one edge of the fast idle cam which permit a faster engine idle

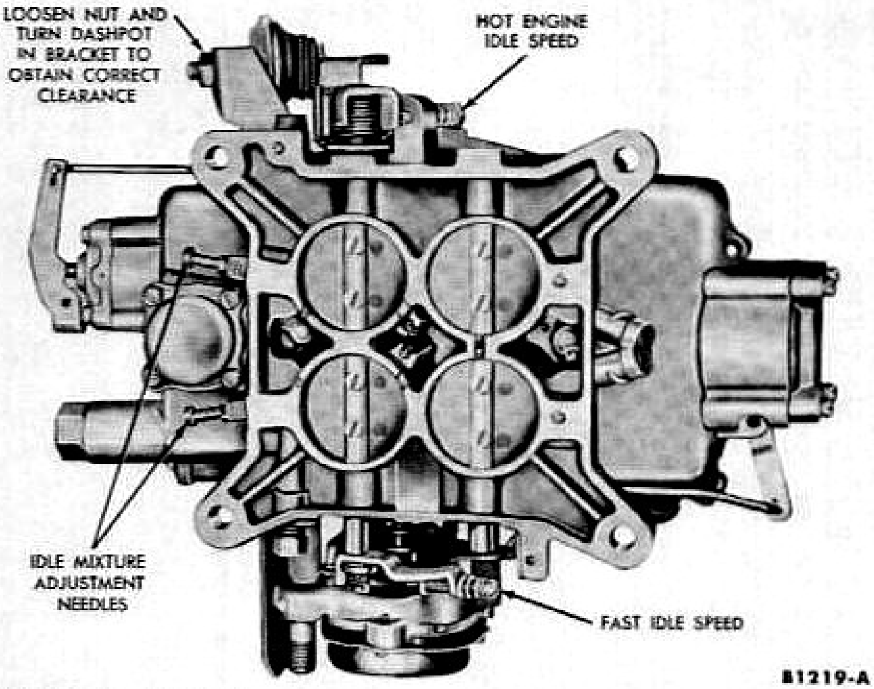


FIG. 6—Ford Idle Adjustments

speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Each step on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

Align the top step of the fast idle cam (identified by the letter -V) with the fast idle screw. With the fast idle screw resting on the first step, turn the screw in to obtain 1800 rpm.

8. Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can be rechecked after the idle fuel mixture has been adjusted.

Idle Fuel Mixture. The idle fuel

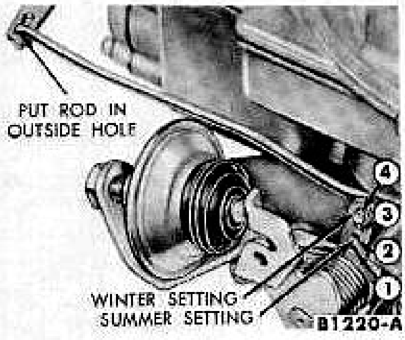


FIG. 7—Ford Accelerating Pump Stroke

mixture is controlled by the idle mixture adjusting needles.

1. Adjust the engine idle speed.

2. Turn the idle mixture needles in until the engine begins to run rough from the lean mixture. **Do not turn a needle against the seat tight enough to groove the point. If a needle is damaged, it must be replaced before a proper mixture adjustment can be obtained.** Turn the needles out until

FIG. 8—Ford Automatic Choke Adjustment

the engine begins to "roll" from the rich mixture. Then, turn the needles in until the engine runs smoothly. Always favor a slightly rich mixture rather than a lean mixture.

3. Recheck the engine idle speed and readjust it if necessary.

Anti-Stall Dashpot — Cruise-O-Matic

1. With the engine idle speed and idle mixture properly adjusted, and the engine at normal operating temperature, loosen the anti-stall dashpot locknut.

2. Hold the throttle in the closed position and depress the plunger with a screwdriver blade. Check the clearance between the throttle lever and the plunger tip with a feeler gauge of the proper thickness. Turn the anti-stall dashpot in its bracket in a direction to provide the specified clear-

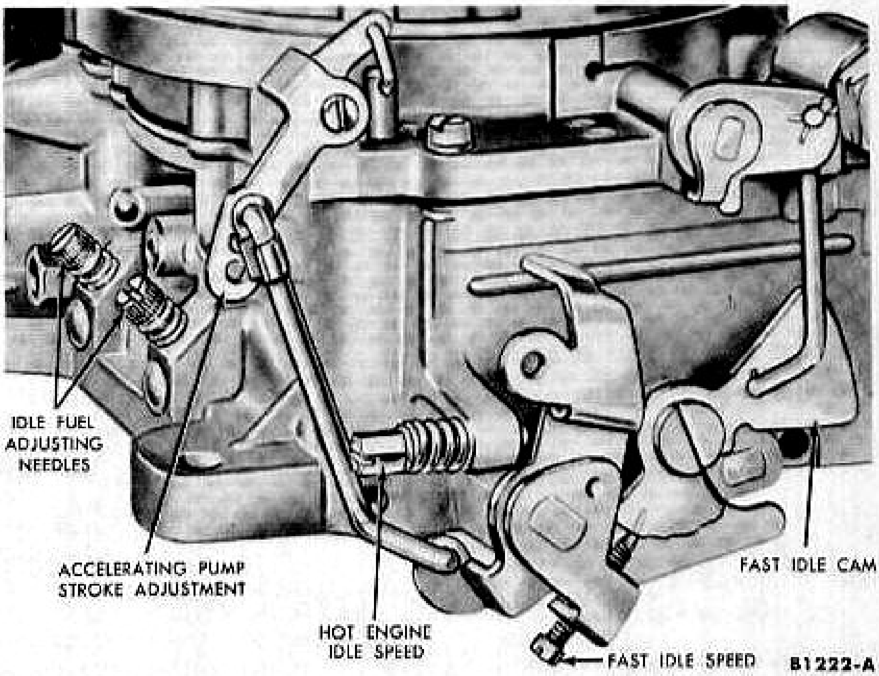


FIG. 9—Carter Idle Adjustments

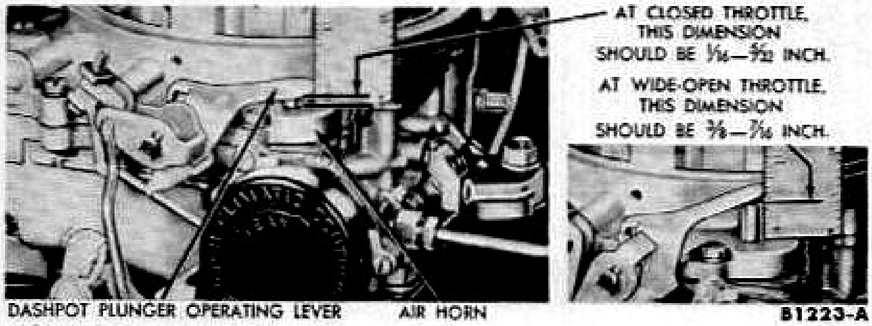


FIG. 10—Carter Anti-Stall Dashpot Adjustment

ance (Part 3-5). Tighten the locknut to secure the adjustment.

Accelerating Pump Stroke. The over-travel lever has four holes and the accelerating pump link has two holes to control the accelerating pump stroke for different engine applications (Fig. 7). Install the accelerating

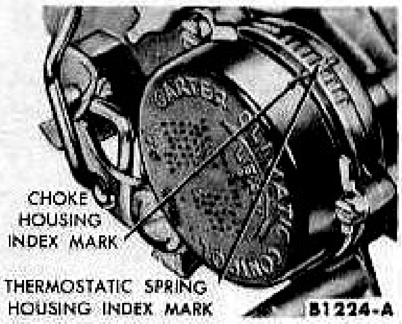


FIG. 11—Carter Automatic Choke Adjustment

pump operating rod in the No. 4 (top) hole for winter operation or in the No. 2 hole for summer operation in the over-travel lever. Install the accelerating pump operating rod in the outside hole in the accelerating pump link for all climatic conditions.

Automatic Choke. The automatic choke is provided with an adjustment to control its reaction to engine temperature (Fig. 8).

1. Loosen the three screws that retain the thermostatic spring housing to the choke housing.

2. Align the index mark on the thermostatic spring housing with the third mark in the lean direction on the choke housing. The final choke setting may be varied two notches from the initial setting to suit operating conditions.

3. Tighten the retaining screws.

FLOAT SETTING

Refer to "Bench Adjustments" for the Ford carburetor in Part 3-2.

CHOKE PLATE TO CHOKE HOUSING SHAFT ADJUSTMENT

1. Loosen the thermostatic spring housing retaining screws and turn the housing 90° counterclockwise from the index mark (in the rich direction).

2. Move the choke plate toward the open position by pressing on the lower portion of the choke plate until resistance to movement is felt. At this point, the clearance between the front edge of the choke plate and the air horn should be 5/32 inch. Check the clearance with a 5/32-inch drill or tool T109-154.

3. If there is not enough clearance, hold the choke housing lever firmly against the stop in the choke housing and press the choke plate open with enough force to bend the lever tang the required amount to obtain the clearance. After the lever has been bent, check the clearance.

4. If there is too much clearance, decrease the clearance to less than specified, then increase the clearance to specifications by following step 3. To decrease the clearance, move the choke housing lever to the right (clockwise) as far as it will go. Hold the lever firmly in this position and move the choke plate toward the closed position with sufficient force to bend the lever tang. Check the clearance, then follow step 3 to bring the clearance within specifications.

CARTER CARBURETOR

Refer to Fig. 9 for the location of the adjustment points.

IDLE ADJUSTMENTS

For purposes of an engine tune-up, the idle adjustments should be made in the sequence listed.

Engine Idle Speed. The engine idle speed must be adjusted to the proper hot and fast settings.

1. Operate the engine for 30 minutes at 1200 rpm.

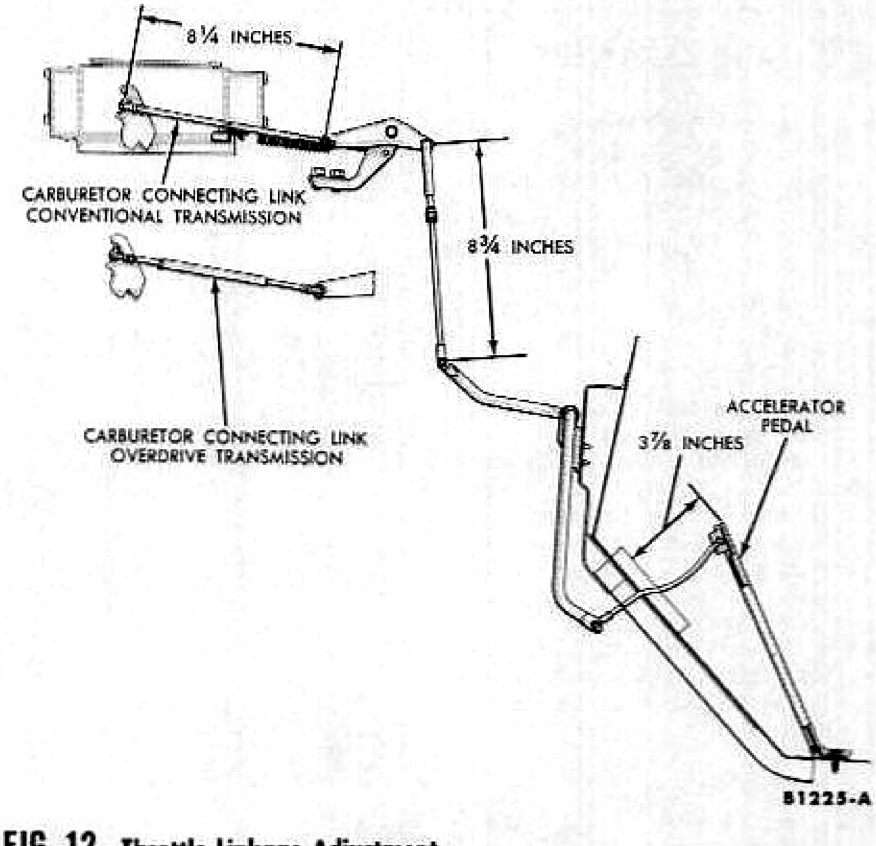


FIG. 12—Throttle Linkage Adjustment

2. When the engine temperature has stabilized and the choke fast idle cam is in the slow position (bottom step on cam contacting the fast idle adjusting screw), back off the fast idle screw from the fast idle cam.

3. Attach a tachometer to the engine.

4. Set the parking brake. Place the selector lever in D1 or D2. Check the engine idle speed. Adjust the engine idle speed to the drive range specifications by turning the screw in to increase the speed or by turning the screw out to decrease the speed.

5. After the correct engine idle speed has been obtained, open the throttle by hand and allow it to close normally. Recheck the engine idle speed.

6. The fast idle screw contacts steps on the fast idle cam during the engine warm-up period and controls the fast idle speed.

Align the bottom step of the fast idle cam with the fast idle screw. With the fast idle cam in the slow position (lowest step on cam contacting the fast idle adjusting screw), turn the fast idle adjusting screw in to obtain 600-650 rpm in D1 or D2. **In localities where normal setting of the fast idle speed may be considered unnecessarily high, the speed may be reduced by backing off the adjusting screw not in excess of one full turn.**

7. Remove the tachometer if the idle fuel mixture is not going to be adjusted. If the idle fuel mixture is to be adjusted, leave the tachometer installed so that the idle speed can be rechecked after the idle fuel mixture has been adjusted.

Idle Fuel Mixture. Follow the procedure under the Ford carburetor.

Anti-Stall Dashpot.

1. With the primary throttle plates closed to the normal position, there should be a 1/16-5/32-inch clearance between the dashpot plunger operating lever and the top surface of the air horn. To adjust, bend the dashpot lever in the area between the lever arm base and the dashpot plunger (Fig. 10).

2. With the primary throttle plates wide open, there should be a clearance of 3/8-7/16 inch between the dashpot plunger operating lever and the top surface of the air horn. To adjust, bend the stop tang on the opposite side of the lever arm (Fig. 10).

Accelerating Pump Stroke. The accelerating pump operating lever should be in the top hole of the accelerating pump link for all climatic conditions. For other accelerating pump stroke adjustments, refer to "Bench Adjustments" for the Carter carburetor in Part 3-2.

Automatic Choke. The automatic choke is provided with an adjustment to control its reaction to engine temperature (Fig. 11).

1. Loosen the three screws that retain the thermostatic spring housing to the choke housing.

2. Align the index mark on the thermostatic spring housing with the middle index mark on the choke housing. The final choke setting may be varied two notches from the initial setting to suit operating conditions.

3. Tighten the retaining screws.

FLOAT SETTING

Refer to "Bench Adjustments" for the Carter carburetor in Part 3-2.

THROTTLE LINKAGE

MANUAL-SHIFT TRANSMISSION

Adjust the engine idle speed to specifications. Set the accelerator pedal height to 3⅞ inches and adjust the carburetor connecting link, as necessary, to allow smooth operation (Fig. 12).

CRUISE-O-MATIC

The throttle linkage adjustments for Cruise-O-Matic are covered in Part 6-2.

4 AIR CLEANERS

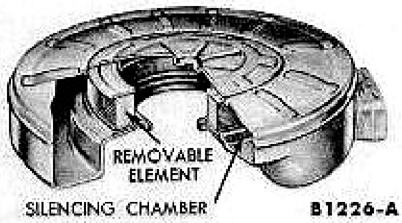


FIG. 13—Air Cleaner

The engines are equipped with a dry-type air cleaner that has a replaceable cellulose fiber filtering element (Fig. 13). The air from the engine compartment enters the air cleaner through the opening on the side and passes through a silencing chamber and then through the filter element. After leaving the filter element, the air is deflected down into the carburetor. The dust particles are trapped in the filter element as the air rushes through it.

352 ENGINE

REMOVAL

1. Remove the wing nut retaining the air cleaner on the carburetor, then lift the air cleaner off the carburetor.

2. Remove the cover and lift the element out of the air cleaner body.

MAINTENANCE

Refer to Group 17 for the recommended maintainance mileage interval.

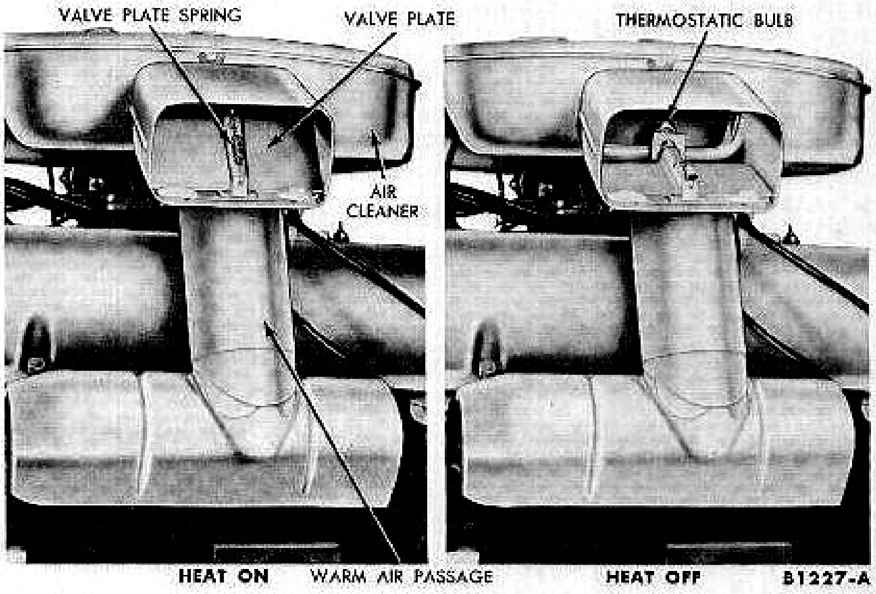


FIG. 14—430 Air Intake

1. Hold the filter element and strike the sealing surfaces flatly against a flat surface. **Do not tap hard enough to deform the element. Do not immerse it in a cleaning solvent.**

2. Clean compressed air can be used to clean the element. Direct the air stream against the element in the opposite direction of normal air flow, that is, from the inside of the filter out. When the element is cleaned or replaced, clean the air cleaner body and cover in cleaning solvent, then wipe it dry.

INSTALLATION

1. Place the air cleaner body on the carburetor so that the word "FRONT" faces the front of the car.

2. Place the element in the air cleaner body. Install the cover.

430 ENGINE

The temperature of the air entering the air cleaner is thermostatically controlled by a carburetor air duct assembly (Fig. 14). Air from the engine compartment, or heated air from a shroud around the exhaust manifold, is available to the engine.

A thermostatic bulb in the air duct is exposed to the incoming air. A spring-loaded valve plate is connected to the thermostatic bulb through linkage. The valve plate spring holds the valve in the closed position (heat on) until the thermostatic bulb overcomes the valve tension.

During the engine warm-up period when the air temperature entering the air duct is less than 75°F, the thermostat is in the retracted position and the valve plate is held in the up position (heat on) by the valve plate spring, thus shutting off the air from the engine compartment. All air is then drawn from the shroud around the exhaust manifold.

As the temperature of the air passing the thermostatic bulb approaches 85° F, the thermostat starts to expand, and pulls the valve plate down. This allows cooler air from the engine compartment to enter the air cleaner. When the temperature of the air reaches approximately 105° F, the valve plate will be in the down position (heat off) so that only engine compartment air is allowed to enter the air cleaner.

REMOVAL

1. Remove the wing nut securing the air cleaner to the carburetor.

2. Carefully lift the air cleaner and air duct as an assembly from engine.

3. Remove the wing bolt securing the air duct assembly to the air cleaner and separate the air duct from the air cleaner.

MAINTENANCE

Refer to the procedure under the "352 Engine."

TESTING THE AIR DUCT

1. Place the air duct assembly in a container of cool water (below 75° F.). Be sure that the thermostat is covered by the water.

2. Place a thermometer in the water and observe the temperature.

3. With water temperature at 75° F. or below, the valve should be in the heat on position.

4. Using a hot plate or other suitable device, heat the water slowly.

5. When the water temperature reaches 85° F., the valve should start to open. **If the valve does not start to open at this time, stabilize the water temperature at 85° F. for eight minutes before condemning the unit.**

6. When the water temperature reaches 100° F. or higher, the valve should be in the full heat off position.

7. If the operation of the valve is unsatisfactory, remove the thermostat and spring assembly and check the valve plate shaft for binding.

8. If the valve plate moves freely, replace the thermostat and spring assembly. Retest the heat on and the heat off temperatures.

9. If the valve does not operate correctly, adjust the thermostat rod. By increasing the rod length, the valve plate will be moved toward the heat off position. By decreasing the rod length, the valve plate will be moved toward the heat on position.

DISASSEMBLY OF THE AIR DUCT

1. Disconnect the valve plate spring.

2. Remove the retainer securing the thermostat rod assembly to the valve plate, and disconnect the rod from the plate. Slide the thermostat rod assembly from the thermostat and remove the rod from the air duct.

3. Carefully bend up the tabs holding the thermostat and spring assembly in the air duct. Remove the thermostat and spring assembly.

ASSEMBLY OF AIR DUCT

1. Place the thermostat and spring assembly in the air duct and carefully bend the tabs to hold the thermostat and spring assembly in place.

2. Insert the thermostat rod assembly through the air duct into the thermostat and spring assembly. Connect the opposite end of the rod to the valve plate. Secure the rod to the plate with the retainer.

INSTALLATION

1. Center the air duct shroud on the exhaust manifold and push it into place.

2. Install the valve assembly on the air duct.

3. Carefully place the air cleaner body on the carburetor. Check the alignment of the valve assembly to the air cleaner and tighten the wing nut securing the valve assembly to the air cleaner.

4. Install the air cleaner filter and cover.

PART 3-2 CARBURETORS

1 FORD 4-BARREL CARBURETOR

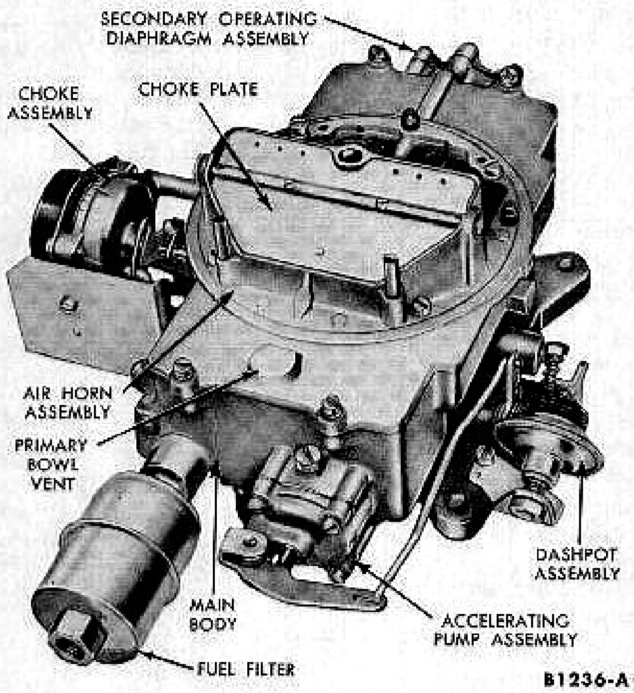


FIG. 1—Ford 4-Barrel Carburetor

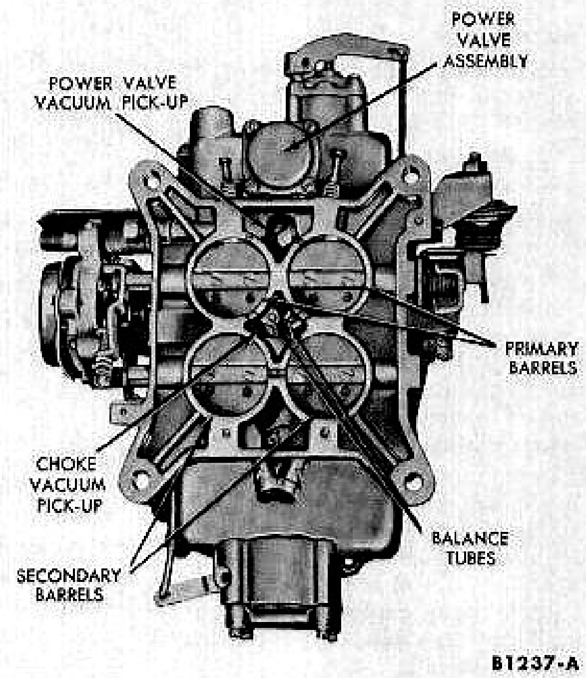


FIG. 2—Ford 4-Barrel Carburetor

The carburetor (Figs. 1, 2, and 3) has two main assemblies, the air horn and the main body.

The air horn assembly, which serves as the main body cover, contains the choke plate, the vents for the fuel bowls, and the secondary throttle control vacuum tube.

The primary and secondary throttle plates, the accelerating pump assembly, the power valve assembly, the secondary operating diaphragm assembly, and the fuel bowls are in the main body. The automatic choke housing is attached to the main body.

The two primary (front) barrels each contain a main and booster venturi, main fuel discharge, accelerating pump discharge, idle fuel discharge, and a primary throttle plate.

The two secondary (rear) barrels each have a main and booster venturi, idle fuel discharge, secondary main fuel discharge, and a vacuum operated throttle plate.

OPERATION

The carburetor has four primary stage fuel systems and three secondary stage fuel systems.

A fuel inlet system for both the primary and secondary stages provides the various fuel systems with a constant supply of fuel. In addition, an automatic choke system provides a means of temporarily enriching the mixture to aid in starting and operating a cold engine.

FUEL INLET SYSTEM

A separate fuel bowl is provided for the primary and secondary stages (Fig. 4). Each bowl contains a float assembly, and a fuel inlet needle and seat assembly. The fuel first enters the primary fuel bowl through the fuel inlet. A drilled passage through the right side of the main body connects the fuel bowls. The pressure in the two fuel bowls is balanced by means of a pressure equalizing chamber built in the left side of the main body.

The amount of fuel entering the fuel bowl is regulated by the distance the fuel inlet needle is raised off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a pre-set level, the float lowers the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used.

A retracting clip is attached to the fuel inlet needle and hooks over the tab of the float assembly. This clip assures reaction of the fuel inlet

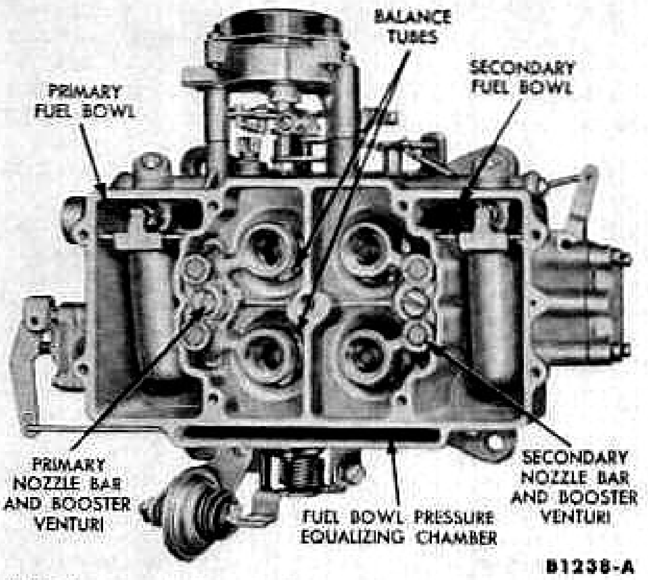


FIG. 3—Ford 4-Barrel Carburetor

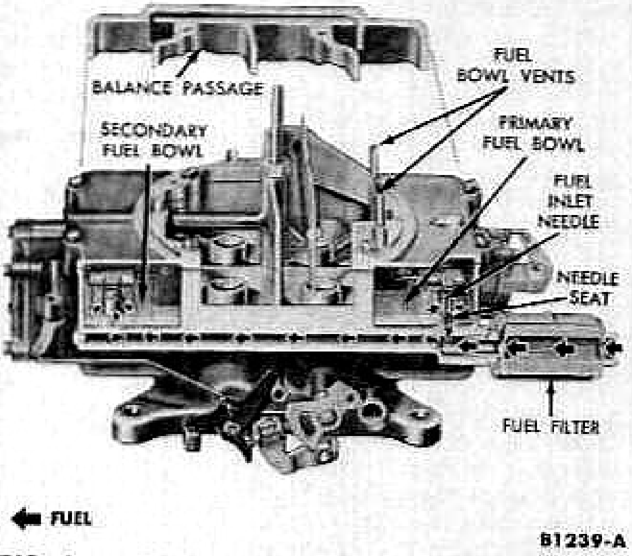


FIG. 4—Fuel Inlet System

needle to any movement of the float.

The primary fuel bowl is vented externally at all times. In addition, both the primary and secondary fuel bowls are internally vented into the air cleaner.

AUTOMATIC CHOKE SYSTEM

The choke plate, located in the air horn above the primary barrels, when closed, provides a high vacuum above as well as below the throttle plates. With a vacuum above the throttle plates, fuel will flow from the main fuel system as well as from the idle fuel system, thus bringing about the extremely rich fuel mixture necessary for cold engine operation.

The carburetor choke shaft is linked to a thermostatic choke control mechanism mounted on the main body (Fig. 5).

The bi-metal thermostatic spring mechanism unwinds when cold and winds up when warm. When the engine is cold, the thermostatic spring, through attaching linkage, holds the choke plate in a closed position. When the engine is started, enough air is drawn through the holes in the choke plate to enable the engine to run and prevent flooding.

As the engine continues to run, manifold vacuum, channeled through a passage on the bottom of the main body to the choke housing, draws heated air from the exhaust manifold heat chamber. The amount of air entering the choke housing is controlled by restrictions in the air passages in the carburetor.

The warmed air enters the choke housing and heats the thermostatic spring, causing it to wind up. The tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to

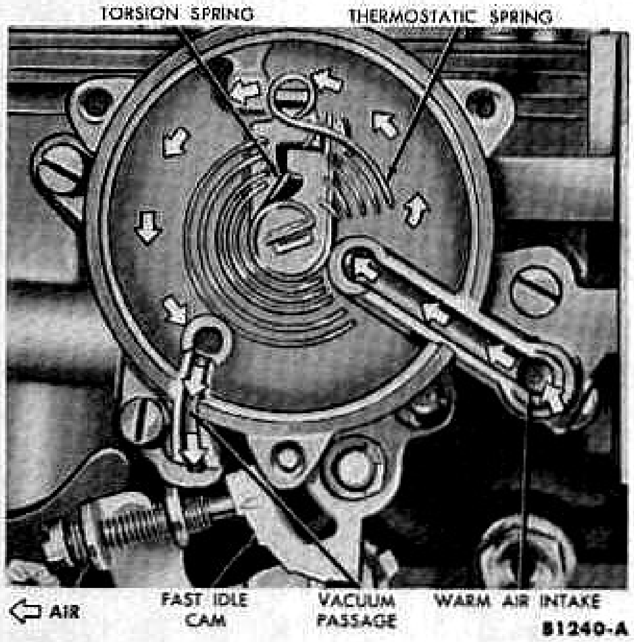


FIG. 5—Automatic Choke System

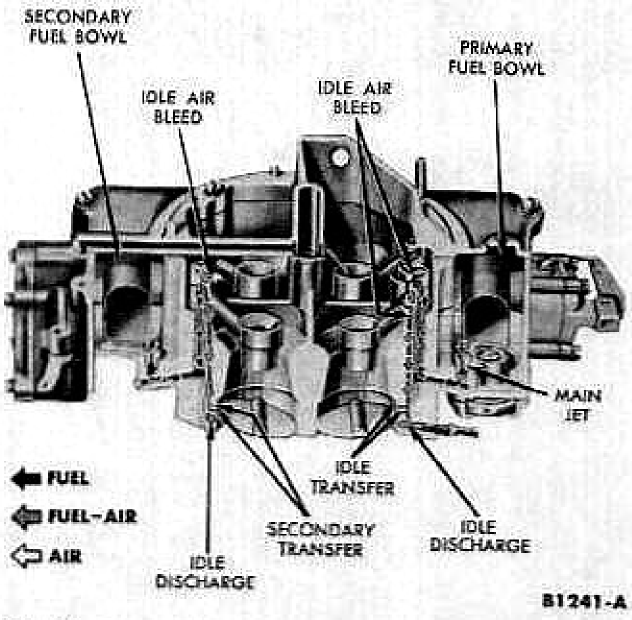


FIG. 6—Idle Fuel System

open. The air is exhausted into the intake manifold.

When the engine reaches its normal operating temperature, the spring no longer exerts an opposing tension on the choke plate. The air velocity acting on the offset choke plate as well as manifold vacuum acting below the choke plate forces it to the full open position.

The fast idle cam pick-up rod actuates the fast idle cam during choking. Steps on one edge of the fast idle cam contact the fast idle adjusting screw which permits a faster engine idle speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the pick-up lever rotates the fast idle cam. Each step on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

During the warm-up period, if the engine should reach the stall point due to a lean mixture, manifold vacuum will drop considerably. The tension of the torsion spring then overcomes the lowered vacuum and air velocity acting on the choke plate, and the choke plate will be moved toward the closed position, providing a richer mixture to help prevent stalling.

The linkage between the choke lever and the throttle shaft is designed so that the choke plate will partially open when the accelerator pedal is fully depressed. This permits unloading of a flooded engine.

IDLE FUEL SYSTEM

The difference in pressure between the fuel bowls and the idle discharge ports force fuel through the primary and secondary stage idle fuel systems.

Primary Stage. Fuel flows from the primary stage fuel bowl through the main jet and into the bottom of the main well (Fig. 6).

From the main well, the fuel flows up through the idle tube and through a short diagonal passage in the booster venturi assembly into the idle passage in the main body. A calibrated restriction at the upper tip of the idle tube meters the flow of fuel.

Air enters the idle system from the air bleed which is located directly above the idle tube. The air bleed also acts as a vent to prevent siphoning at off idle or high speeds and when the engine is stopped. Additional air is bled into the system through an air bleed located at the bottom of the diagonal passage in the booster venturi where the fuel enters the idle passage in the main body.

Fuel flows down the idle passage in the main body past two idle transfer holes. The idle transfer holes act as additional air bleeds at curb idle. The fuel then flows past the pointed tip of the adjusting needle which controls the idle fuel discharge in the primary stage. From the adjusting needle chamber, the fuel flows through a short horizontal passage and is discharged below the primary throttle plates.

During off idle when the primary throttle plate is moved slightly past the idle transfer holes, each hole begins discharging fuel as it is exposed to manifold vacuum. As the primary throttle plate is opened still wider and engine speed increases, the air flow through the carburetor is also increased. This creates a vacuum in the booster venturi strong enough to bring the primary stage main fuel system into operation. Fuel flow from the primary idle fuel system begins tapering off as the main fuel system begins discharging fuel.

Secondary Stage. Fuel flows from the secondary stage fuel bowl through the main jet and into the bottom of the main well (Fig. 6).

From the main well, the fuel flows up through the idle tube and through a short diagonal passage in the booster venturi assembly into the idle passage in the main body. A calibrated restriction at the upper tip of the tube meters the flow of fuel.

Fuel flows down the idle passage in the main body past two transfer holes above the closed throttle plate and flows through a metered restriction into a short horizontal passage and is discharged into the secondary barrel below the closed throttle plate. The transfer holes act as air bleeds at idle. The secondary idle fuel system continues discharging fuel until the secondary main fuel system comes into operation.

Air is introduced into the secondary stage idle fuel system from the

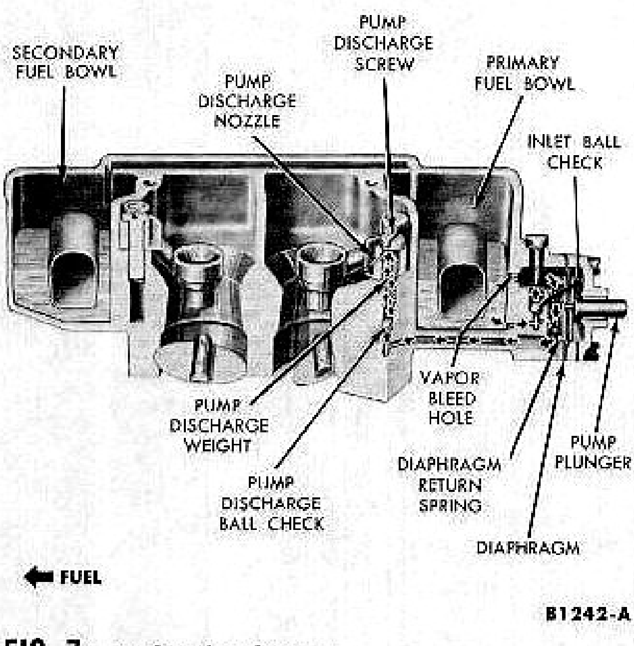


FIG. 7—Accelerating System

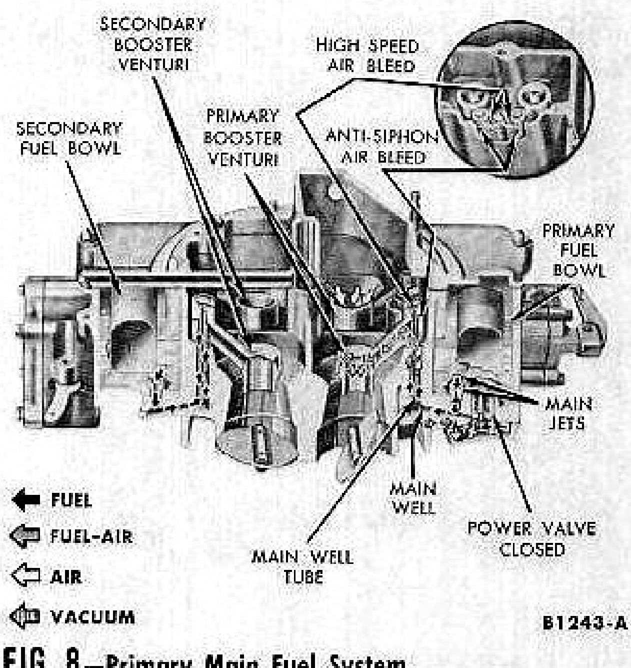


FIG. 8—Primary Main Fuel System

idle air bleed which is located directly above the idle tube. The air bleed also acts as a vent to prevent siphoning in the idle fuel system at high speeds and when the engine is stopped.

ACCELERATING SYSTEM

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the fuel, which is heavier than air, can gain speed and maintain the desired balance of fuel and air. During this interval, the accelerating system (Fig. 7) supplies fuel until the other systems can once again provide the proper mixture.

When the throttle is closed, the diaphragm return spring forces the diaphragm toward the cover, drawing fuel into the chamber through the inlet. The inlet has a ball check which opens to admit fuel from the primary fuel bowl and closes when the accelerating pump is operated to prevent a reverse flow. A discharge weight and ball check prevents air from entering when fuel is drawn into the chamber.

When the throttle is opened, the diaphragm rod is forced inward, forcing fuel from the chamber into the discharge passage. Fuel under pressure forces the pump discharge weight and ball off their seat and fuel passes through the accelerating pump discharge screw and is sprayed into each primary booster venturi through discharge ports.

An air bleed in the wall of the accelerating pump fuel chamber prevents siphoning of fuel when the accelerating pump is not operating.

PRIMARY STAGE MAIN FUEL SYSTEM

As engine speed increases, the air passing through the booster venturi creates a vacuum. The amount of vacuum is determined by the air flow through the venturi, which in turn is regulated by the speed of the engine. The difference in pressure between the main discharge port and the fuel bowl causes fuel to flow through the main fuel system (Fig. 8).

At a predetermined venturi vacuum, fuel flows from the primary fuel bowl, through the main jets, and into the bottom of the main well. The fuel moves up the main well tube past air bleed holes. Filtered air from the high speed air bleed enters the fuel flow in the main well tube through holes in the side of the tube. The high speed air bleed meters an increasing amount of air to the fuel as venturi vacuum increases, maintaining the required fuel-air ratio. The mixture of fuel and air is lighter than raw fuel and responds faster to changes in venturi vacuum. It also vaporizes more readily than raw fuel. The fuel and air continue up the main well tube past another air bleed which also acts as a vent to prevent siphoning when the engine is shut down. The fuel is discharged into the booster venturi where it is vaporized and mixed with the air flowing through the carburetor.

The throttle plate controls the amount of the fuel-air mixture admitted to the intake manifold, regulating the speed and power output of the engine.

A balance tube is located in each primary barrel directly below the booster venturi. When decelerating, the balance tube siphons off any excess fuel droplets remaining around the edge of the booster venturi and discharges the droplets into the equalizing slots in the base of the carburetor where they are mixed with the idle fuel. The balance tube also acts as an additional air bleed during the idle fuel system operation.

POWER FUEL SYSTEM

During periods of increased road loads or high speed operation, the fuel-air ratio must be increased for added power. The added fuel required during this period is supplied by the power fuel system (Fig. 9) which is controlled by manifold vacuum.

Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. The manifold vacuum, acting on the power valve at idle speed or normal road load conditions, is great enough to hold the power valve diaphragm down, overcoming the tension of the spring on the valve stem and holding the valve closed. When high power operation places a greater load on the engine and manifold vacuum drops

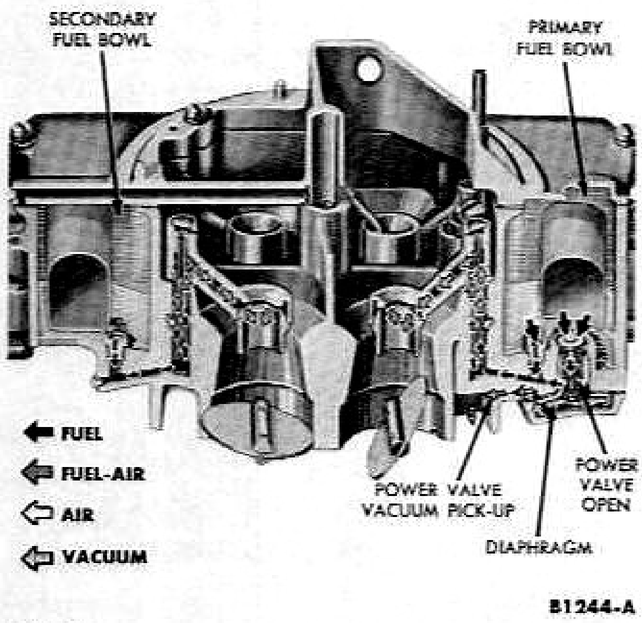


FIG. 9—Power Fuel System

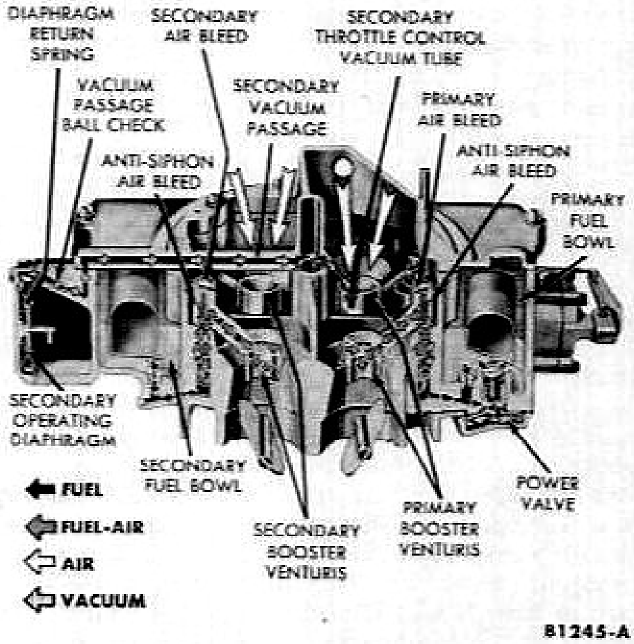


FIG. 10—Secondary Stage Main Fuel System

below a predetermined value, the spring opens the power valve. Fuel from the primary fuel bowl flows through the power valve and into passages leading to both primary stage main fuel wells. Here the fuel is added to the fuel from the primary stage main fuel system, enriching the mixture.

As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the power valve.

SECONDARY THROTTLE OPERATION AND MAIN FUEL SYSTEM

To provide sufficient fuel-air mixture to operate the engine at maximum power, the mixture supplied by the primary stage is supplemented by an additional quantity of fuel-air mixture from the secondary stage (Fig. 10).

This additional supply of fuel-air mixture is delivered through the two secondary (rear) barrels of the carburetor. The secondary stage throttle plates are operated by a spring-loaded vacuum diaphragm assembly attached to the main body and linked to the secondary throttle shaft.

Opening of the secondary throttle plates is controlled by vacuum from the left primary booster venturi. The vacuum is transmitted from the secondary throttle control vacuum tube through passages in the air horn, main body, and behind the secondary operating diaphragm.

As the primary throttle plates are opened, primary venturi vacuum increases. When the vacuum reaches a predetermined amount, it starts to act on the secondary stage operating diaphragm, which in turn starts to open the secondary throttle plates.

A ball check, located in the vacuum passage in the diaphragm housing, controls the rate at which the secondary throttle plates are allowed to open. Any rapid increase in vacuum, which would tend to open the secondary throttle plates too suddenly, holds the ball check against its seat. The opening of the secondary throttle plates is slowed to a rate governed by the amount of vacuum passing through a bleed in the ball seat.

As the secondary throttle plates

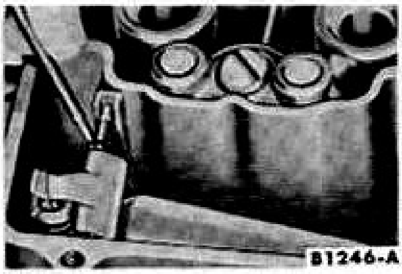


FIG. 11—Float Shaft Retainer Removal

begin to open, fuel flows from the secondary fuel bowl through the secondary main jets into the bottom of the main well and up the main well tube past air bleed holes. Air is introduced through an air bleed at the top of the tube. When the secondary throttle plates are moved slightly past the secondary transfer holes, each hole begins discharging fuel as it is exposed to manifold vacuum. As secondary venturi vacuum is increased, the fuel is discharged into the secondary booster venturi. Fuel from the transfer holes tapers off and the holes act as additional air bleeds.

When decelerating, vacuum in the primary venturi decreases, and the secondary throttle plates begin to close. The ball check in the diaphragm housing passage will unseat when the throttle is closed quickly, allowing the low pressure on the vacuum side of the diaphragm to rapidly return to atmospheric pressure. As the vacuum acting on the diaphragm is lessened, the load on the diaphragm spring will start closing the secondary plates.

CARBURETOR REMOVAL

1. Remove the air cleaner. Remove the throttle rod from the throttle lever. Disconnect the distributor vacuum line, the fuel inlet line, and the choke heat tube at the carburetor.

2. Remove the carburetor retaining nuts and lockwashers, then remove the carburetor. Remove the spacer and two gaskets from the manifold.

3. Install bolts, about 2¼ inches long of the correct diameter, through the carburetor retaining stud holes with a nut above and below the flange (or install carburetor legs) to facilitate working on the carburetor and prevent damage to the throttle plates.

CARBURETOR INSTALLATION

1. Be sure all the old gasket material is removed from the manifold heat riser flange. Place the spacer between two new gaskets and position them on the manifold. Position the carburetor on the manifold, and secure it with the lockwashers and nuts. Tighten the nuts alternately to specifications.

2. Connect the throttle rod, the choke heat tube, and the distributor vacuum line. Refer to "Carburetor In-Chassis Adjustments" in Part 3-1 and adjust the engine idle speed, the idle fuel mixture, and the anti-stall dashpot. Install the air cleaner.

CARBURETOR DISASSEMBLY

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly

For a complete carburetor overhaul, follow all the steps. To partially overhaul the carburetor or to install a new gasket kit, follow only the applicable steps.

AIR HORN

1. Remove the air cleaner anchor screw and lockwasher.

2. Remove the choke plate rod hairpin retainer and disconnect the choke plate rod from the choke housing lever.

3. Remove the air horn retaining screws and lockwashers. Remove the air horn by tilting it slightly as it is lifted off the main body to remove the choke plate operating rod from

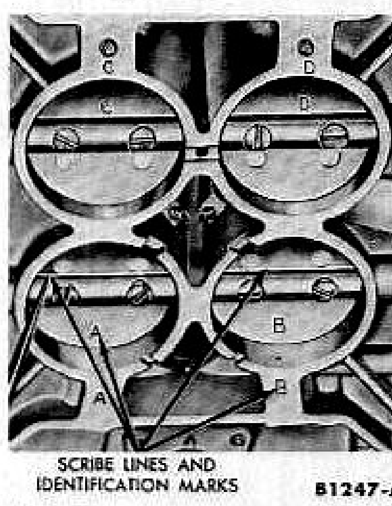


FIG. 12—Throttle Plate Removal

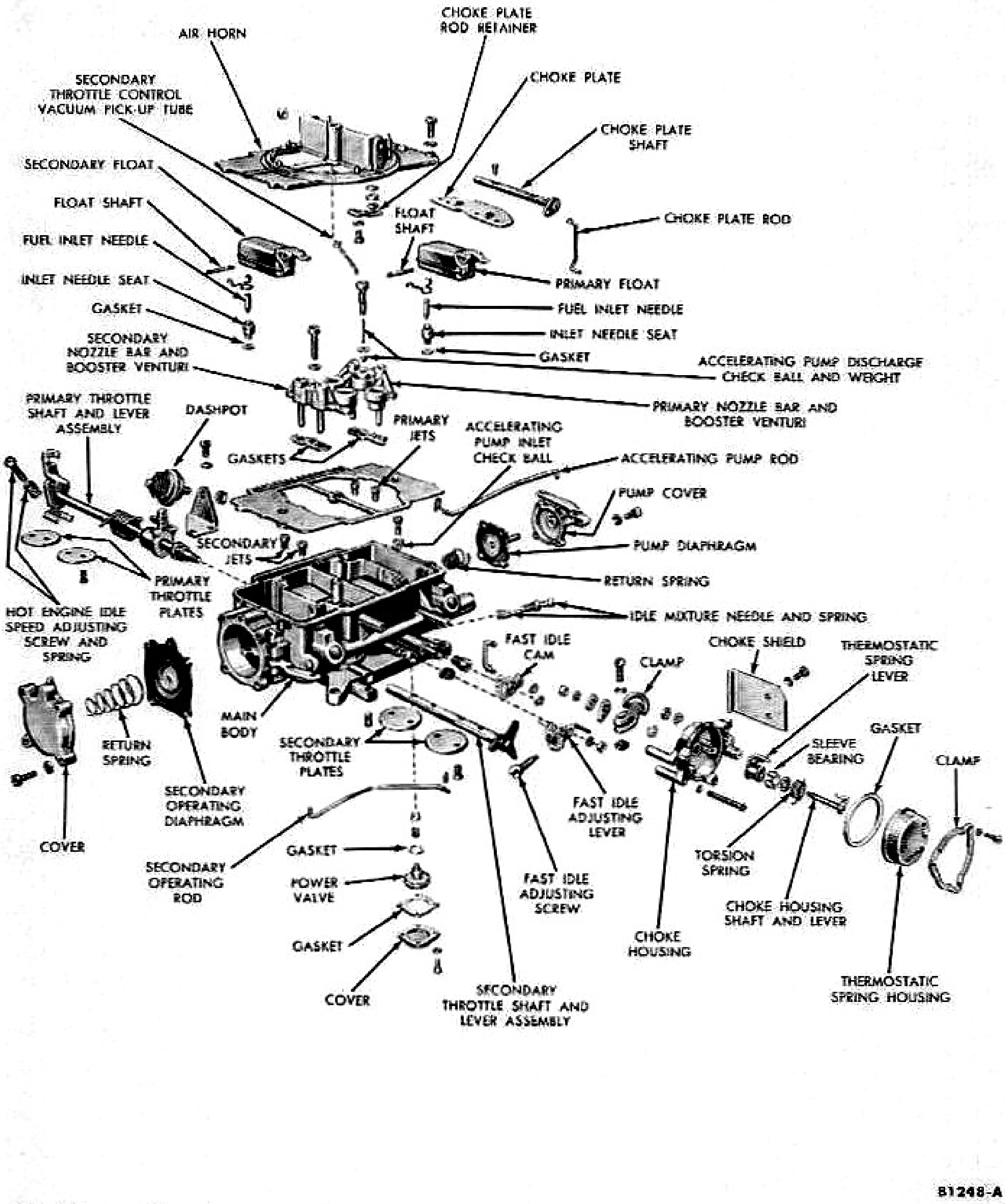


FIG. 13—Ford 4-Barrel Carburetor Assembly

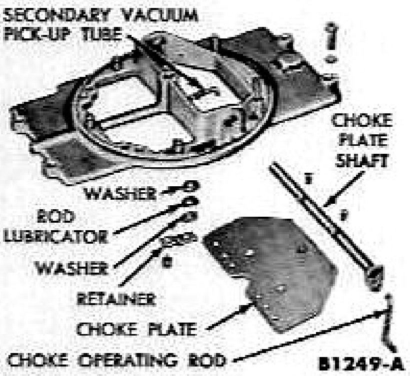


FIG. 14—Air Horn Assembly

the choke housing lever. Remove the air horn gasket.

4. Remove the choke rod seal retainer from the air horn and slide the felt seal and two washers off the rod.

5. If it is necessary to remove the choke plate, remove the secondary throttle control vacuum tube by prying it out with needle nose pliers. Discard the tube after removal. Remove the choke plate screws, then remove the choke plate by sliding it out of the shaft from the bottom of the air horn. Remove the choke plate rod, then slide the choke shaft from the air horn.

MAIN BODY

1. Remove the fuel filter.

2. Using a hook, disconnect the float shaft retainer from each float (Fig. 11). Remove the float and shaft, and the fuel inlet needle and clip from each fuel bowl.

3. Using a jet wrench, remove the fuel inlet needle seat and float shaft retainer from each fuel bowl. Using a jet wrench, remove the primary stage and secondary stage main jets.

4. Remove the primary stage booster venturi assembly and gasket. Invert the main body and let the accelerating pump discharge weight and ball fall into the hand.

5. Remove the secondary stage booster venturi assembly and gasket.

6. Remove the accelerating pump operating rod. Remove the accelerating pump cover, diaphragm assembly, and spring. Remove the inlet ball check retainer screw and gasket. Invert the main body and let the accelerating pump inlet ball check fall into the hand.

7. Remove the secondary diaphragm operating rod. Remove the diaphragm cover, return spring, and diaphragm. The secondary ball check is not removable.

8. Invert the main body and remove the power valve cover and gasket. Using a box wrench, remove the power valve and gasket. Remove the idle fuel adjusting needles and springs.

9. Remove the choke shield. Remove the fast idle cam pick-up rod retainer and disconnect the rod at the fast idle cam. Remove the thermostatic spring housing clamp, and gasket.

10. Remove the choke housing and gasket.

11. Remove the choke housing lever retaining nut, spacer, and lever. Loosen the screw on the bellcrank clamp and slide the bellcrank off the choke housing shaft.

12. Remove the retainer from the choke housing shaft and slide the shaft assembly out of the choke housing. Remove the spacer, lever, and torsion spring from the shaft.

13. Remove the fast idle cam retainer and slide the cam off the boss on the main body.

14. Remove the nut and washer securing the fast idle adjusting lever assembly to the primary throttle shaft and remove the lever assembly.

15. Remove the distributor vacuum line fitting, the anti-stall dashpot if so equipped, and the hot engine idle adjusting screw and spring.

16. If it is necessary to remove the throttle plates, lightly scribe the

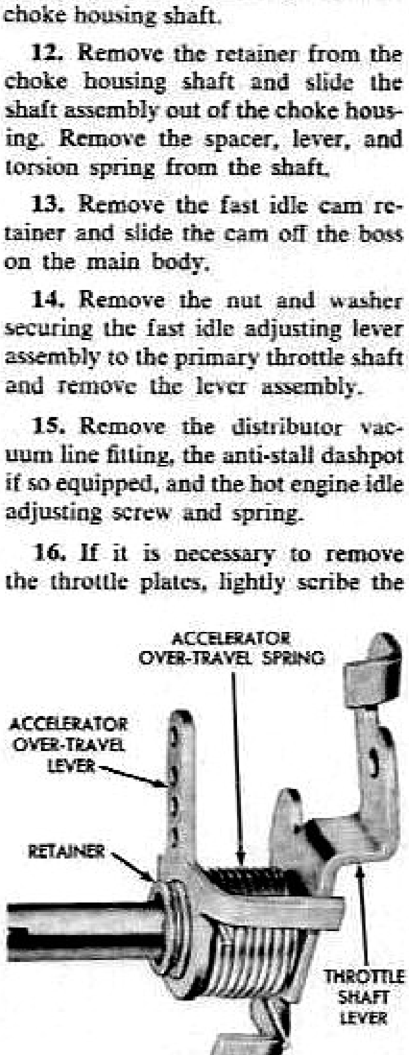


FIG. 15—Accelerator Over-Travel Spring and Lever Installation

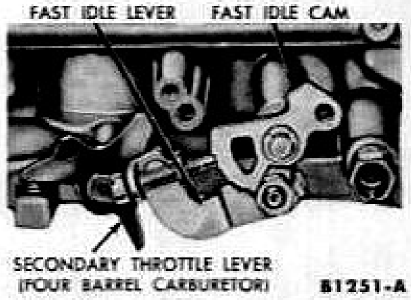


FIG. 16—Fast Idle Cam and Lever Installation

primary and secondary throttle plates along the throttle shafts and mark each plate and its corresponding bore with a number or letter for proper installation (Fig. 12).

17. Slide the primary and secondary throttle shafts out of the main body.

18. Remove accelerating pump over-travel lever retainer and slide the spring and lever off the primary throttle shaft.

CLEANING AND INSPECTION

Carburetor cleaning and inspection are covered in Section 3 of this part.

CARBURETOR ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Make sure the accelerating pump diaphragm and secondary operating diaphragm are not torn or cut. The carburetor assembly is shown in Fig. 13.

AIR HORN

Refer to Fig. 14 for the correct location of the parts.

1. If the choke plate was removed, position the choke plate shaft in the air horn. Slide the choke plate rod through the opening in the air horn assembly and connect it to the choke shaft lever.

2. Slide the choke plate in the shaft through the bottom of the air horn. Close the choke plate and position it in the shaft, then install the screws. Tighten and stake the screws. Position the rod seal between the two brass washers and slide them on the choke plate rod. Secure them in place with the seal retainer.

3. Start a new secondary throttle

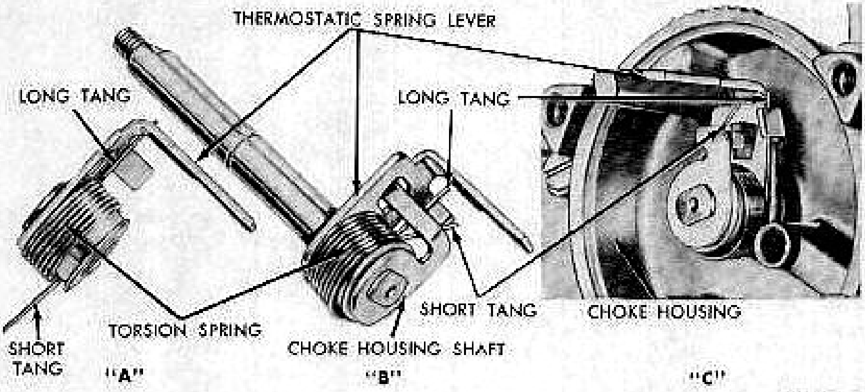


FIG. 17—Choke Housing Torsion Spring Installation

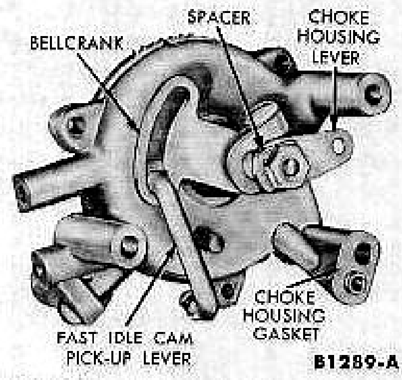


FIG. 18—Choke Housing Bellcrank and Lever Installation

control vacuum tube into the air horn so that the pick-up end of the tube is perpendicular (or as near as possible) to the mounting surface of the air horn. Drive the tube into the air horn by grasping it lightly below the shoulder with pliers and striking the pliers with a hammer. Drive the tube in until it stops against its shoulder. **Do not crush or bend the tube.**

MAIN BODY

1. If the throttle plates were removed, place the accelerator over-travel spring, with the shortest tang end first, over the boss on the over-travel lever. Place the short tang of the spring under the lug on the lever. Slide the over-travel lever and spring assembly on the throttle shaft. Hook the longest tang of the spring over the closed throttle lug of the throttle lever (Fig. 15). Install the over-travel lever retainer. Slide the primary throttle shaft assembly into the main body.

2. Referring to the lines scribed on the throttle plates, install the primary throttle plates in their proper location with the screws snug, but not tight. Invert the main body and hold it up to the light. Little or no light should show between the throttle plates and the throttle bores. Tap the plates lightly with a screwdriver handle to seat them. Tighten and stake the screws.

3. Slide the secondary shaft into the main body. Referring to the lines scribed on the secondary throttle plates, install the throttle plates in their proper location. Follow the procedure in step 2 for the primary throttle plates. Adjust the secondary throttle plates (refer to "Carburetor Bench Adjustments").

4. Install the hot engine idle spring and screw.

5. Install the anti-stall dashpot if so equipped.

6. Install the distributor vacuum passage fitting. Place the fast idle lever assembly on the primary throttle shaft and install the retaining washer and nut (Fig. 16). Slide the fast idle cam on the boss on the main body and install the retainer (Fig. 16).

7. Position the torsion spring on the thermostatic spring with the long tang against the lug on the lever (Fig. 17-A).

8. Slide the lever and spring assembly on the choke housing shaft with the short tang of the spring resting on the lug on the shaft and the lug positioned in the slot in the thermostatic spring lever (Fig. 17-B). Place the spacer on the choke housing shaft. Slide the assembly into the choke housing (Fig. 17-C). Install the retaining clip in the groove on the choke plate shaft.

9. Position the bellcrank on the choke housing shaft and temporarily tighten the screw (Fig. 18).

10. Place the choke housing lever and spacer on the choke housing shaft and install the retaining nut.

11. Place the gasket on the vacuum pick-up port of the choke housing and install the choke housing on the main body. Insert the fast idle cam pick-up lever into the fast idle cam as the choke housing is positioned into place. Install the pick-up lever retainer.

12. Position the thermostatic spring housing gasket and housing on the choke housing. **Be sure that the thermostatic spring engages the tang on the lever in the choke housing.** Align the index mark on the spring housing with the middle index mark on the choke housing. Install the clamp and retaining screws.

13. Drop the accelerating pump inlet ball check in the inlet passage of the accelerating pump chamber and install the washer and retaining screw. Install the diaphragm return spring on the boss in the chamber. Insert the diaphragm assembly in the cover and place the cover and diaphragm assembly in position on the main body. Install the cover screws finger tight, then push the accelerating pump plunger the full distance of its travel and tighten the cover screws. Install the accelerating pump operating rod (refer to "Carburetor In-Chassis Adjustments" in Part 3-1).

14. Invert the main body. Using a socket wrench, install the power valve and gasket. Install the cover and gasket. Install the idle adjusting needles and springs. Turn the needles in gently with the fingers until they just touch the seat, then back them off 1-1½ turns for a preliminary idle adjustment.

15. Install the secondary operating diaphragm on the secondary operating lever. Install the diaphragm return spring on the cover. Install the cover with the screws finger tight. With the diaphragm in the extended position, tighten the cover screws. Install the secondary diaphragm operating rod.

16. Using a jet wrench, install the primary main jets. **Be sure the correct jets are installed.** Position the float shaft retainer in the groove on the fuel inlet needle seat. Slide the float shaft in the float lever. Install the clip in the groove on the fuel inlet needle and hook the assembly on the float tab. **The fuel inlet needle and seat are matched assemblies. Be sure the correct needle and seat are assembled together.** Install the float assembly in the fuel bowl so that the fuel inlet needle enters the needle seat, and the float shaft rests in its guides. Using a hook, position the shaft retainer in the grooves on the shaft. Refer to "Carburetor Bench Adjustments," and check the float setting.

17. Repeat step 16 on the secondary stage fuel bowl.

18. Drop the accelerating pump discharge ball into its passage in the primary side of the main body. Seat the ball with a brass drift and a light hammer. Make sure the ball is free. Drop the accelerating pump discharge weight on top of the ball. Position the primary booster venturi assembly and gasket in the main body.

Install the retaining screw. **The primary booster venturi retaining screw is hollow.**

19. Position the secondary booster venturi assembly and gasket in the main body and install the gasket and retaining screw.

20. Position the air horn gasket on the main body (Fig. 19). Position the air horn on the main body so that the choke plate rod engages the choke housing lever. Install the air horn retaining screws. Using needle nose pliers, install the choke plate rod to choke housing lever retaining pin. Install the air cleaner anchor screw.

CARBURETOR BENCH ADJUSTMENTS

After the carburetor has been overhauled, the following adjustments are usually made on the bench. However, the adjustments can be made with the carburetor installed on the engine.

FLOAT ADJUSTMENT

1. Remove the air horn.

2. Place the float gauge in the corner of the enlarged end section of the fuel bowl (Fig. 20). The gauge should touch the float near the end, but not on the end radius. Depress the float tab to seat the fuel inlet needle. The height of both the primary and secondary floats should be the specified distance from the gasket surface on the main body with the gasket removed. Refer to Part 3-5 for the specified distance. The float should just touch the low point on the gauge and should not touch the high point. If necessary, bend the tab on the float arm to bring the float setting within limits. This should provide the proper fuel level.

FAST IDLE CAM AND BELLCRANK LEVER

1. Open the throttle plates approximately ½ full open.

2. Hold the choke plate in the closed position by turning the choke housing shaft to the left (counterclockwise).

3. Measure the clearance between the cast stop on the back of the choke housing and the edge of the fast idle cam. The clearance should be 0.030 inch.

4. To adjust the clearance, loosen the bellcrank lever screw and turn the bellcrank lever as required to obtain the correct clearance. After the correct adjustment is obtained, tighten the bellcrank lever screw.

SECONDARY THROTTLE PLATE ADJUSTMENT

1. Hold the secondary throttle plates closed.

2. Turn the secondary throttle shaft lever adjusting screw out (Fig. 21) until the secondary throttle plates stick in the throttle bores and there is 0.009-inch clearance between the screw and the secondary throttle lever.

3. Turn the screw in one full turn.

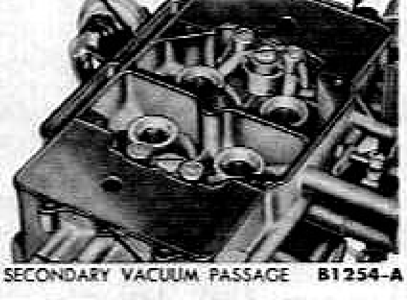


FIG. 19—Main Body Gasket Installation

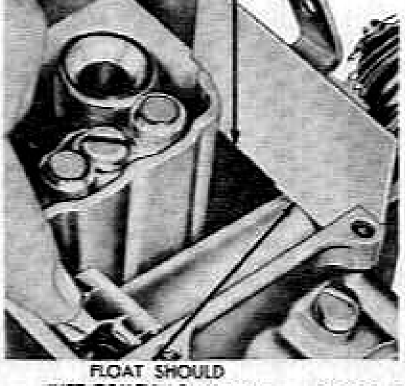


FIG. 20—Float Setting

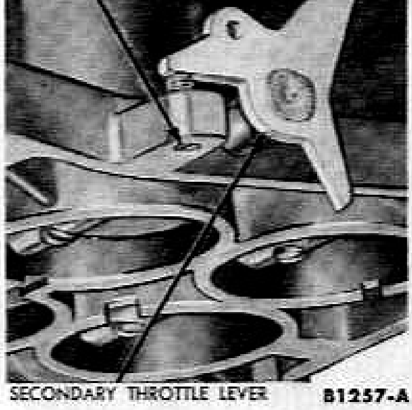


FIG. 21—Secondary Throttle Plate Adjustment

2 CARTER 4-BARREL CARBURETOR

The Carter 4-barrel carburetor (Figs. 22, 23, and 24) has two main assemblies. They are the air horn and the main body.

The air horn assembly, which serves as the main body cover, contains the choke plate, the fuel inlet, the float assemblies, the accelerating pump assembly, and the Vacumeters.

The main body contains the primary and secondary throttle plates, the secondary auxiliary throttle plates, the booster venturis, the anti-stall dashpot plunger assembly, the fuel bowls, balance passage, and the fuel passages. The automatic choke housing is mounted on the main body.

OPERATION

The carburetor has a low speed (idle fuel system), an accelerating pump system, a primary high speed system (primary fuel system), and a secondary high speed system (secondary main fuel system). In addition, an automatic choke system provides the correct mixture necessary for quick cold engine starting and warm-up. Vacuum operated metering rods (Vacumeters) in the main metering jets control the amount of fuel admitted to the nozzle. An internal anti-stall dashpot prevents stalling on quick deceleration and slows the closing of the throttle plates. A fuel inlet system provides the various fuel metering systems with a constant supply of fuel.

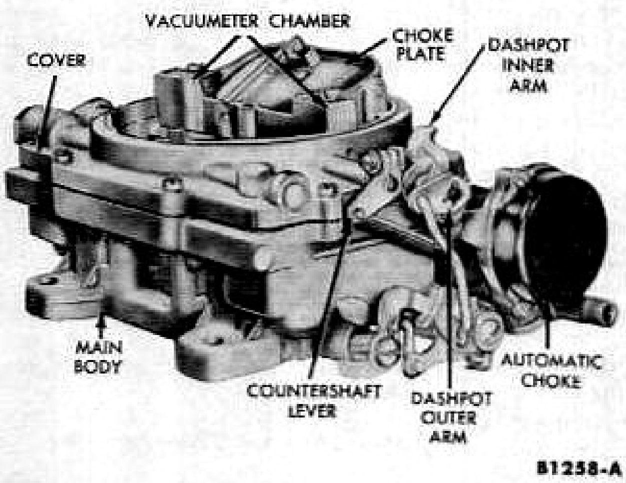


FIG. 22—Carter 4-Barrel Carburetor

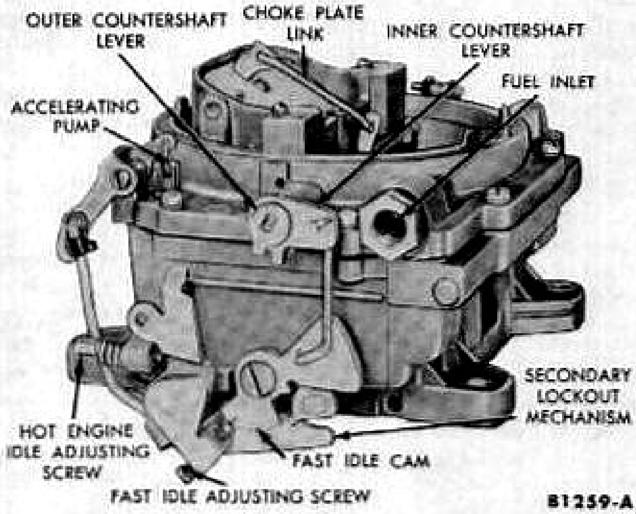


FIG. 23—Carter 4-Barrel Carburetor

FUEL INLET SYSTEM

There are two separate fuel inlet systems. Each system supplies fuel to a low speed system, and a primary and secondary high speed system.

Each system (Fig. 25) has a fuel bowl, an inlet needle and seat assembly, and a fuel baffle plate. The fuel enters through the fuel inlet fitting. A drilled passage through the air horn assembly connects both fuel bowls.

The amount of fuel entering either fuel bowl is regulated by the distance the fuel inlet needle is lowered off

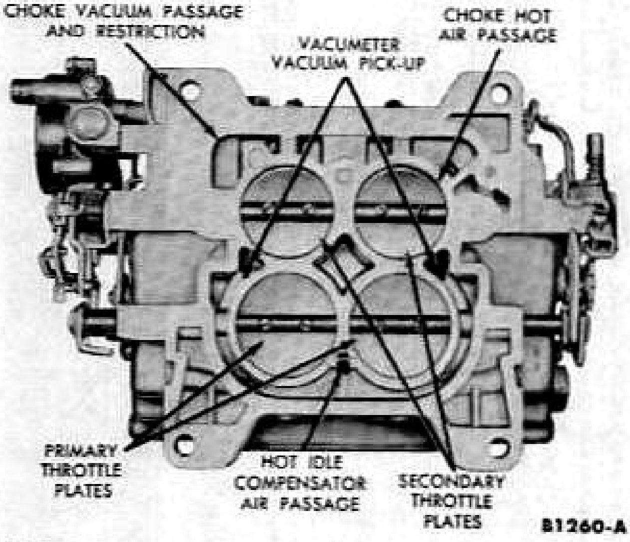


FIG. 24—Carter 4-Barrel Carburetor

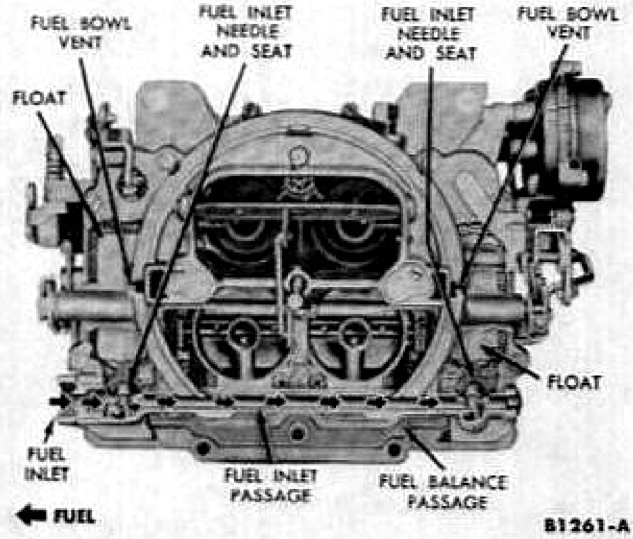


FIG. 25—Fuel Inlet System

its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to its seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a pre-set level, the float raises the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used.

The fuel inlet needle seats are installed at an angle to provide positive seating of the needles (Fig. 26).

A combination internal and external venting system vents the fuel bowls internally into the air cleaner and externally to the outside of the carburetor. An internal vent is located at the outside edge of each Vacumeter tower. An external vent is drilled into each internal vent passage just below the air cleaner mounting flange.

A balance passage in the main body connects the fuel bowls. This passage balances the fuel level between the two fuel bowls.

AUTOMATIC CHOKE SYSTEM

A choke countershaft over the secondary barrels connects the choke linkage to the choke plate.

When the engine is cold, tension of the thermostatic spring holds the choke plate closed (Fig. 27). When the engine is started, air velocity against the offset choke plate causes it to open slightly against the thermostatic spring tension. Intake manifold vacuum applied to the choke piston also tends to pull the choke plate open. The choke plate assumes a position where tension of the thermostatic

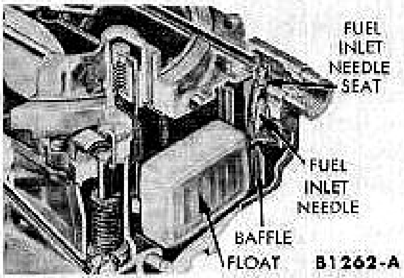


FIG. 26—Float Assembly

spring is balanced by the pull of vacuum on the piston and force of air velocity on the offset choke plate.

When the engine starts, slots located in the side of the choke piston cylinder allow intake manifold vacuum to draw air from the heat chamber in the exhaust manifold. The warmed air then enters the thermostatic spring housing and heats the spring causing it to lose its tension. The thermostatic spring loses its tension gradually until the choke plate reaches full-open position.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic spring to momentarily, partially close the choke plate, providing a richer mixture.

A baffle plate, located in the choke housing, passes the air either directly or indirectly unto the thermostatic spring. At low temperature when the choke plate is closed, the air is passed by a longer alternate route which slows up the rate of temperature rise. When the spring allows the choke plate to be fully opened, the baffle plate rotates and the heated air is passed directly onto the spring. The thermostatic spring thus remains fully open until the engine is stopped and allowed to cool.

The heated air from the choke plate housing is exhausted through a passage in the base of the carburetor flange into the left primary barrel and across the edge of each primary throttle plate. This eliminates ice formation at the edges of the primary throttle plates.

During the warm-up period, it is necessary to provide a fast idle speed to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke countershaft. The fast idle adjusting screw on the throttle lever contacts the fast idle cam and prevents the throttle plates from returning to a normal warm engine idle position while the automatic choke is in operation.

If during the starting period the engine becomes flooded, the choke plate may be opened manually to clean out excessive fuel in the intake manifold. This is accomplished by fully depressing the accelerator pedal and engaging the starter. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke plate.

LOW SPEED (IDLE FUEL) SYSTEM

At idle and part throttle operation, the primary throttle plates are almost closed. This produces strong manifold vacuum below the throttle plates which creates a great enough difference in pressure between the fuel bowls and the idle discharge ports to operate the low speed or idle fuel system (Fig. 28). The low speed sys-

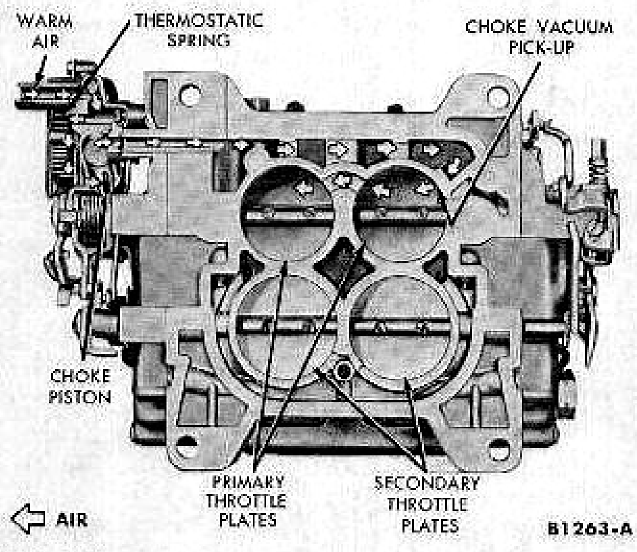


FIG. 27—Choke System

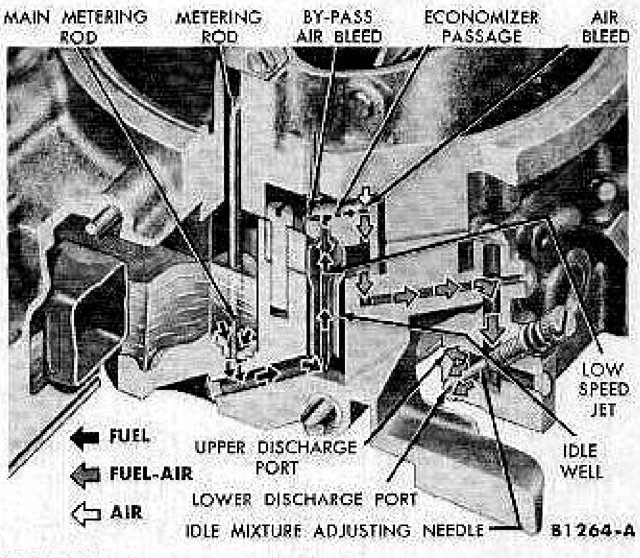


FIG. 28—Low Speed Idle System

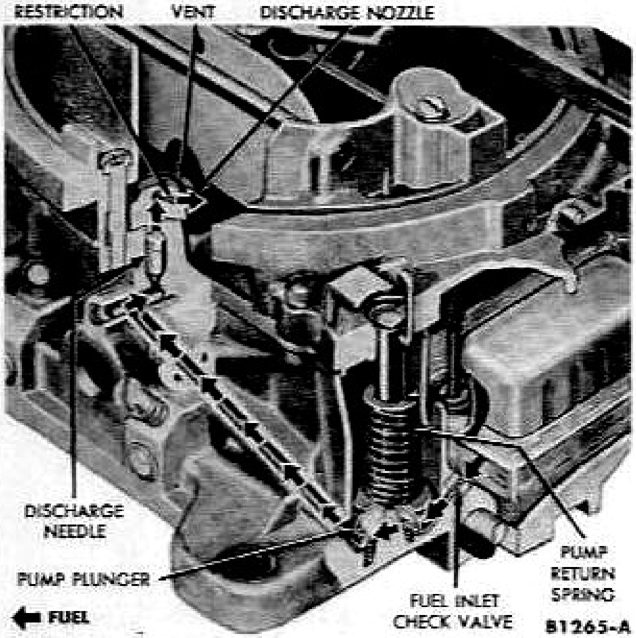


FIG. 29—Accelerating Pump System

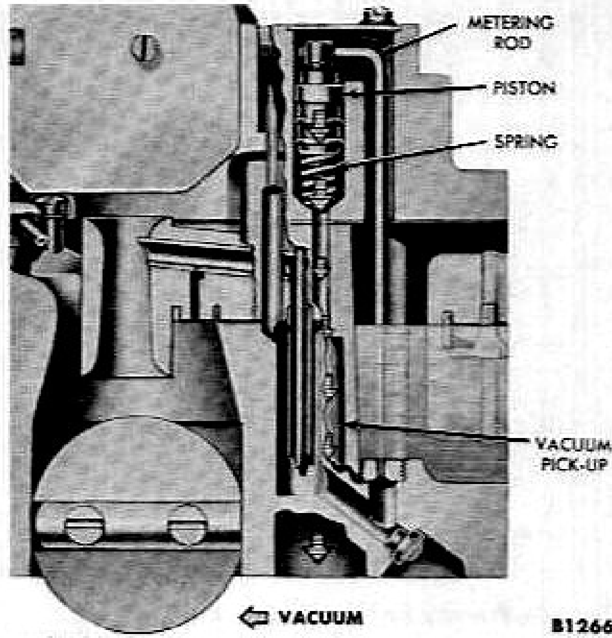


FIG. 30—Vacumeter

tem is located in the primary barrels.

Fuel under air cleaner pressure is forced from the fuel bowl through the main jet to the bottom of the main well. From here it flows through a short diagonal passage to the low speed jet which meters the fuel for idle and part throttle operation. The fuel flows up the low speed jet where it is mixed with metered air from the by-pass air bleed. The by-pass air bleed acts as an anti-siphoning device during off-idle operation and when the engine is stopped.

From the low speed jet, the air and fuel flow through an economizer passage (restriction) where it is mixed and partially vaporized. After leaving the restriction, air is bled into the mixture from an additional air bleed. The mixture then flows down a vertical passage to the idle passage in the main body to the upper and lower discharge ports. The upper discharge is a vertical slot-type port which is located so that the upper portion is above the throttle plate at idle. The throttle plates are milled at the location of the upper discharge ports so that a small portion of the port is exposed to manifold vacuum at curb idle. At curb idle, the upper portion of the port acts as an additional air bleed. The lower discharge port is exposed to manifold vacuum at all times.

As the throttle is opened, a larger portion of the upper discharge port is exposed to manifold vacuum and a correspondingly larger quantity of fuel is discharged into the air stream. Further opening of the throttle plate results in a decrease in manifold vacuum and a decrease in the amount of idle fuel discharged. As the idle fuel tapers off, the high speed circuit begins discharging fuel.

A thermostatically controlled hot idle compensator is located in the web between the secondary booster venturis. At carburetor air high inlet temperatures, the hot idle compensator will open and allow air to by-pass the throttle plates and be exhausted directly into the intake manifold. This improves idle stability and minimizes the effect of fuel vapors due to high under hood temperatures.

ACCELERATING PUMP SYSTEM

The accelerating pump system (Fig. 29), located in the primary side, provides a measured amount of fuel necessary for smooth engine operation on acceleration at low speeds.

When the throttle is closed, the pump plunger moves upward in its cylinder and fuel is drawn into the pump cylinder through the intake check valve. The discharge check valve is seated at this time to prevent air from being drawn into the cylinder. When the throttle is opened, the pump plunger moves downward forcing fuel out through the discharge passage. The fuel is forced through a diagonal passage to the discharge needle. The force of the fuel unseats the needle and the fuel is free to flow through a restriction into the discharge nozzles. When the plunger moves downward, the intake check valve is closed preventing fuel from being forced back into the bowl.

At high speed, accelerating pump discharge is not necessary for smooth acceleration. When the throttle plates are opened a predetermined amount, the accelerating plunger bottoms in the cylinder eliminating discharge.

During high speed operation, a vacuum exists at the discharge nozzles. To prevent fuel from being drawn through the system, the discharge nozzles are vented by a cavity between the pump restrictions and discharge nozzles. This allows air instead of fuel to be drawn through the discharge nozzles.

HIGH SPEED SYSTEM

Primary Side. The position of the metering rod (Vacumeter) in the main metering jet (Fig. 30) controls the amount of fuel admitted to the nozzles. The position of the metering rod is controlled by manifold vacuum applied to the Vacumeter piston.

During part throttle operation, manifold vacuum pulls the piston and rod assembly down, holding the large diameter of the metering rod in the main metering jet. This is true at all times that the vacuum under the piston is strong enough to overcome the tension of the Vacumeter piston spring. Fuel is then metered around the metering rod in the jet.

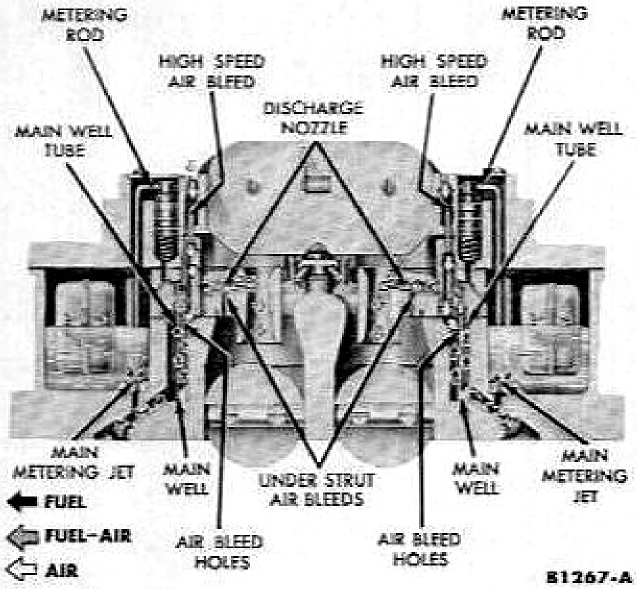


FIG. 31—Primary High Speed System

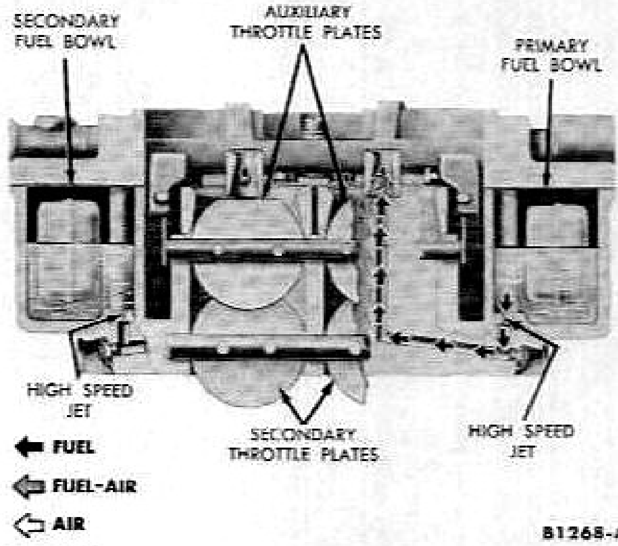


FIG. 32—Secondary High Speed System

Under any operating condition, where the tension of the spring overcomes the pull of vacuum under the piston, the metering rod will move up so that its smaller diameter or power step is in the jet. This allows more fuel to flow through the jet.

As engine speed increases, the air passing through the booster venturi creates a vacuum. The amount of vacuum is determined by the air flow through the venturi, which in turn is regulated by the speed of the engine. The difference in pressure between the venturi and fuel bowl causes fuel to flow through the primary high speed circuit (Fig. 31).

At a predetermined venturi vacuum, fuel flows from the fuel bowl, through the primary high speed jet into the bottom of the main well. The fuel moves up the main well tube past air bleed holes. Filtered air from the high speed air bleed enters the fuel flow in the main well tube through holes in the side of the tube.

The fuel and air mixture continues up the main well tube and is discharged into the booster venturi where it is vaporized and mixed with the air flowing through the carburetor. The high speed air bleed also acts as an anti-percolating vent when a hot engine is stopped or at idling speed. This will help vent fuel vapors in the main well before the pressure is sufficient to push fuel out of the nozzles and into the intake manifold.

The throttle plates control the amount of fuel-air mixture admitted to the intake manifold, regulating the speed and power of the engine.

An air bleed is also located under the strut of each primary booster venturi assembly. The air bleed connects to the main discharge nozzle passage and smooths out the flow of fuel. The air bleed into the passage is proportional to the vacuum at the nozzle.

Secondary Side. To provide sufficient fuel-air mixture to operate the engine at maximum power, the mixture supplied by the primary stage of the carburetor is supplemented by an additional quantity of fuel-air mixture from the secondary high-speed system (Fig. 32).

The secondary throttle plates are mechanically connected to the primary throttle shaft. Secondary auxiliary throttle plates are located above the secondary throttle plates just below the secondary booster venturis. A counterweight is located on each end of the auxiliary throttle plate shaft. The auxiliary throttle plates start to open when the air pressure on top of the plates is great enough to overcome the effect of the counterweights.

When the primary throttle plates are ¾ full throttle and the choke plate is open, the secondary throttle plates start to open. The secondary side of the carburetor does not start to discharge fuel until the auxiliary throttle plates start to open. The amount of opening achieved by the off-set auxiliary throttle plates is controlled by the air velocity through the secondary barrels.

The secondary throttle plates lockout lever is located on the right side of the carburetor. The lever prevents the secondary throttle plates from opening until the choke plate is open. This improves cold engine driveaway at wide open throttle.

Two transition holes are located in each secondary booster venturi just above the auxiliary throttle plates. As the auxiliary throttle plates begin to open and are moved slightly beyond each transition hole, fuel is drawn from the transition hole by venturi vacuum. The fuel flows from the fuel bowl through the secondary high-speed jet into the transition fuel tube. The fuel flows up the tube where air is introduced through the transition discharge air bleed. The fuel and air are then discharged through the transition holes.

As the auxiliary plates are opened still further, fuel is discharged through the main secondary discharge nozzles. The fuel flows up the secondary main well tube. Air is introduced from the secondary high speed air bleed through holes in the side of the tube. The fuel and air are discharged into the main secondary discharge nozzles. The high speed air bleed also acts as an anti-percolator vent when a hot engine is stopped or at idling speed. This will help vent fuel vapor pressure in the high speed well before it is sufficient to push fuel out of the nozzles.

Fuel flow from the transition holes tapers off as the fuel is discharged through the secondary nozzles.

When the primary throttle plates begin to close on deceleration, the secondary plates close mechanically. The auxiliary secondary throttle plates are closed by counterweights.

ANTI-STALL DASHPOT

To slow the closing of the throttle plates to idle position, an internal anti-stall dashpot is incorporated (Fig. 33) in the carburetor.

When the throttle is opened, the anti-stall dashpot plunger spring pushes the plunger upward. The intake ball check valve opens, allowing fuel above the plunger to fill the cylinder below the plunger. When the throttle is closed, the plunger is pushed downward. The intake ball check valve is closed and fuel below the plunger is forced through a small restriction, delaying the closing of the throttle plates.

CARBURETOR REMOVAL

1. Remove the air cleaner assembly.

2. Remove the throttle rod from the throttle lever.

3. Disconnect the distributor vacuum line, fuel line, and the choke heat tube at the carburetor.

4. Remove the carburetor retaining nuts and lockwashers, then remove the carburetor, spacer, and two gaskets.

5. To facilitate working on the carburetor and to prevent damage to the throttle plates, install bolts 2¼ inches long of the correct diameter through the carburetor retaining stud holes with a nut above and below the flange or install carburetor legs.

CARBURETOR INSTALLATION

1. Be sure all the old gasket material is removed from the manifold heat riser flange. Place the spacer between two new gaskets and position them on the manifold. Position the carburetor on the manifold, and secure it with the lockwashers and nuts. Tighten the nuts alternately to specifications.

2. Connect the throttle rod, the choke heat tube, and the distributor vacuum line. Refer to "Carburetor In-Chassis Adjustments" in Part 3-1 and adjust the engine idle speed, the idle fuel mixture, and the anti-stall dashpot. Install the air cleaner.

CARBURETOR DISASSEMBLY

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly.

AIR HORN

1. Remove the air cleaner anchor screw.

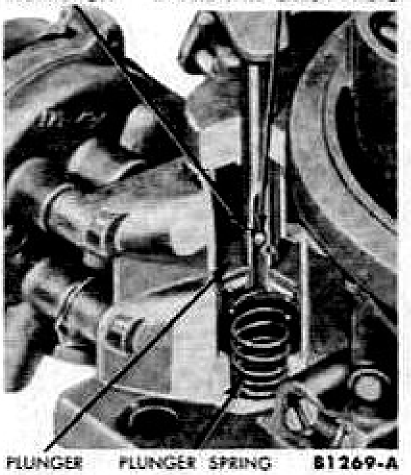


FIG. 33—Anti-Stall Dashpot

2. From the choke side of the carburetor, remove the anti-stall dashpot arm, anti-stall dashpot operating lever, and the choke countershaft lever.

3. From the fuel inlet side, disconnect the fast idle connector rod at the inside choke countershaft lever, and disconnect the accelerating pump operating rod at the accelerating pump arm.

4. Remove the ten retaining screws, then remove the air horn from the main body.

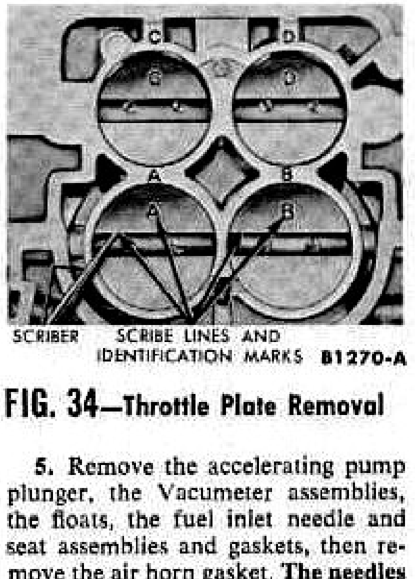


FIG. 34—Throttle Plate Removal

5. Remove the accelerating pump plunger, the Vacumeter assemblies, the floats, the fuel inlet needle and seat assemblies and gaskets, then remove the air horn gasket. **The needles and seats are matched assemblies. If they are to be used again, be sure the correct needle is kept with its seat.**

6. Remove the fuel inlet fitting and gasket.

7. Remove the choke plate connector link, then slide the choke plate countershaft out of the air horn assembly.

8. Remove the stake marks from the choke plate screws, then remove the screws and the choke plate. Slide the choke shaft out of the air horn assembly.

MAIN BODY

1. Remove the accelerating pump spring, and the anti-stall dashpot piston and spring.

2. Remove the primary booster venturi assemblies and gaskets, and remove the accelerating pump discharge nozzle assembly, gasket, and discharge needle.

3. Remove the hot idle compensator and the secondary booster venturis.

4. Lift the secondary auxiliary throttle plates out of the main body.

5. Remove the primary and secondary main jets.

6. Remove the accelerating pump inlet check valve from the left fuel bowl.

7. Remove the fuel bowl baffles.

8. Remove the idle mixture adjusting needles and springs.

9. Remove the thermostatic spring housing gasket and baffle plate from the choke housing.

10. Remove the choke housing from the main body.

11. Remove the choke connector rod from the choke housing shaft, then remove the shaft, and piston and lever assembly.

12. Remove the throttle connecting rod.

13. Remove the primary throttle shaft arm retaining screw, spacer, outer arm, inner arm, and spring.

14. Remove the secondary throttle operating lever screw and spacer.

15. Remove the secondary throttle operating lever and spring.

16. Remove the hot engine idle adjusting screw and spring.

17. Remove the fast idle cam and connector rod, and the secondary throttle plate lock-out lever.

18. Remove the accelerating pump operating rod and the fast idle adjusting screw.

19. If it is necessary to remove the throttle plates, lightly scribe the primary and secondary throttle plates along the throttle shaft and mark the plates and their corresponding bore with a number or letter for proper installation (Fig. 34). File the stake marks from the retaining screws, then remove the screws and remove the throttle plates. **Do not scratch the edge of the plates or walls of the barrels.** Remove the throttle shafts.

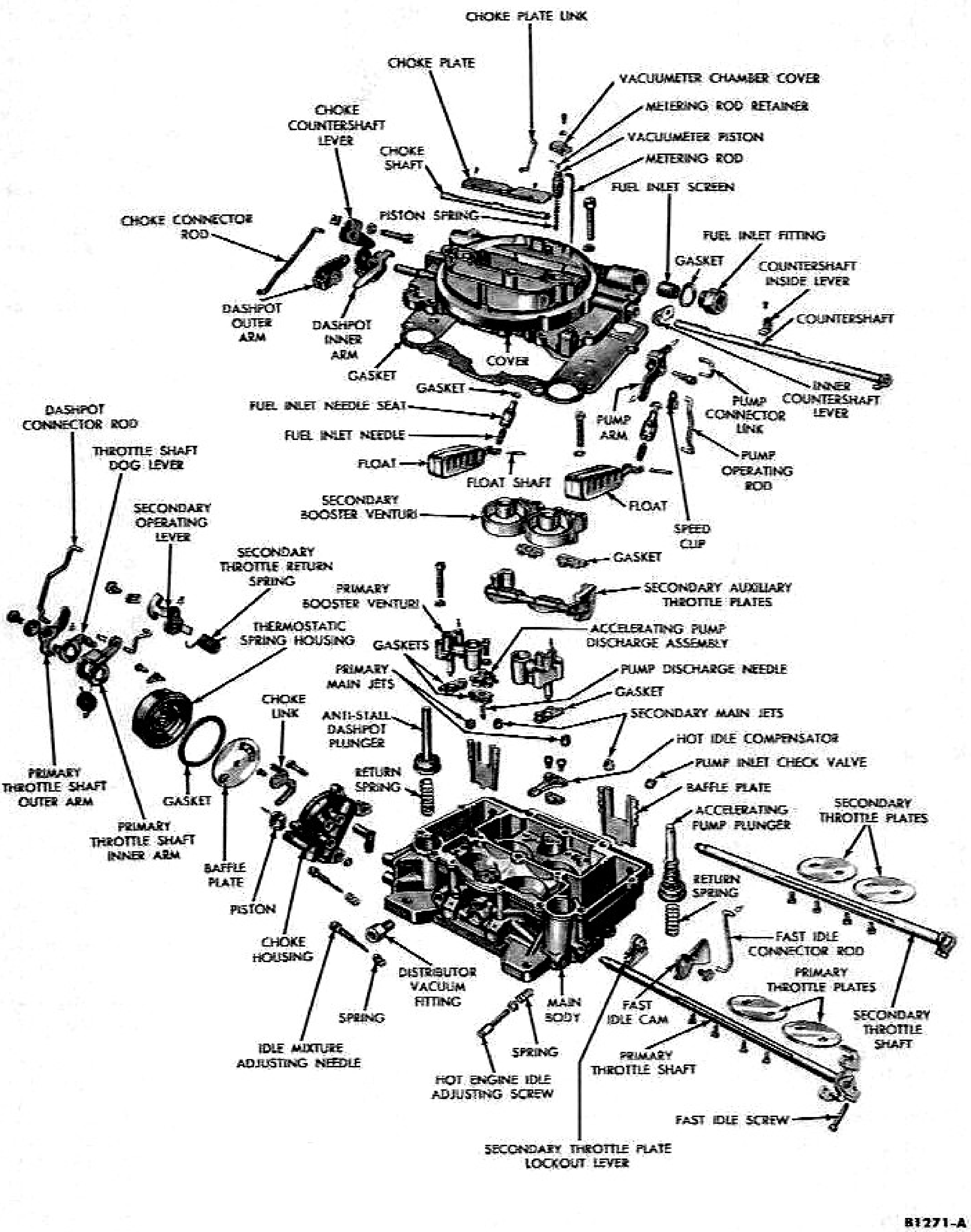


FIG. 35—Carter 4-Barrel Carburetor Assembly

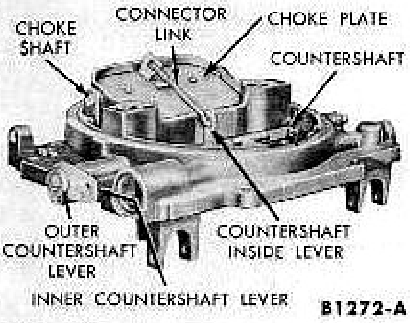


FIG. 36—Choke Plate and Shaft Installation

CARBURETOR CLEANING AND INSPECTION

Carburetor cleaning and inspection are covered in Section 3 of this part.

CARBURETOR ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Refer to Fig. 35 for the correct location of parts.

The carburetor parts have a "C" enclosed in a circle stamped on them. When the parts are installed, this identification mark always faces to the top or to the outside of the carburetor depending upon where the part is installed.

AIR HORN ASSEMBLY

1. Slide the choke plate shaft into the air horn. Position the choke plate on the shaft with the identification "C" facing up. Install and stake the retaining screws.
2. Slide the countershaft inside lever on the shaft so that the identification "C" is to the outside.
3. Slide the countershaft in the air horn from the fuel inlet side.
4. Connect the choke plate connector link to the choke plate and to the countershaft center lever, then install the lever on the countershaft (Fig. 36).
5. Install the fuel inlet gasket and fitting.
6. Place a new air horn gasket on the air horn, then install the fuel inlet needle seats, gaskets, and needles (Fig. 37). **Install the fuel inlet needles in their matched seats. Do not install the left needle in the right seat or vice versa. Inlet needles and seats are matched assemblies.**
7. Install the floats on the same side of the carburetor from which they were removed (Fig. 37), then refer to "Carburetor Bench Adjustments" and adjust the float alignment, float setting, and float drop.

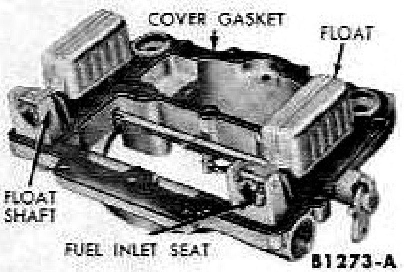


FIG. 37—Fuel Inlet Needle, Seats, and Float Installed

MAIN BODY

1. If the throttle plates have been removed, slide the primary and secondary throttle shafts in the main body. Referring to the line scribed on the throttle plates, install the plates in their proper location with the screws snug, but not tight. Hold the throttle plates tightly closed, and tap both plates with a screwdriver handle. When the plates are correctly seated, tighten the attaching screws, then stake them.
2. Install the fast idle adjusting screw and the hot engine idle adjusting screw and spring.
3. Install the secondary throttle plate lock-out lever on the boss on the main body with the identification "C" to the outside and the slot in the lever engaging the tang on the secondary throttle shaft lever.
4. Install the fast idle cam with the steps toward the fast idle screw and the identification "C" to the outside.
5. Position the secondary throttle return spring on the shaft with the straight tang end against the carburetor and underneath the stop (Fig. 38).
6. Position the secondary throttle operating lever on the shaft with the curved shoe portion up and the identification "C" to the outside. Wind the secondary throttle return spring clockwise and catch the bent tang end over the lug of the secondary throttle operating lever (Fig. 38).
7. Install the secondary throttle lever spacer and screw.
8. Position the secondary over-ride spring in the primary throttle shaft inner arm and slide the assembly on the primary throttle shaft as shown in Fig. 39-A.
9. Invert the carburetor and position the throttle shaft dog lever on the primary throttle shaft and hook the inside tang of the spring in the groove on the lever arm (Fig. 39-B). Hook the primary throttle shaft outer arm on the outside tang of the spring and position the arm on the primary throttle shaft as shown in Fig. 39-C.
10. Position the spacer on the primary throttle shaft with the identification "C" to the outside. Install the retaining screw.
11. Position the secondary throttle connector rod in the secondary operating lever and the primary throttle shaft inner arm with the retaining

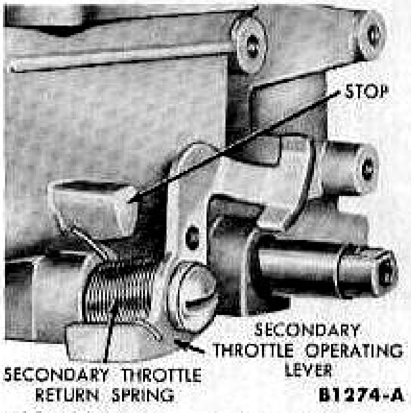


FIG. 38—Secondary Throttle Return Spring Installed

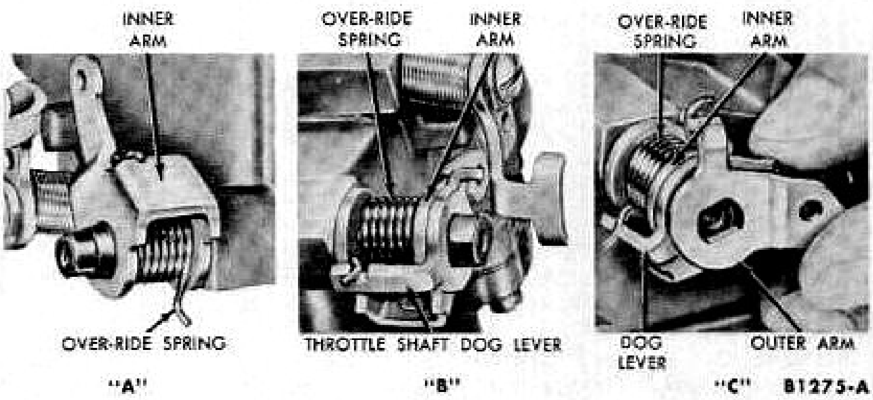


FIG. 39—Secondary Over-Ride Spring Installed

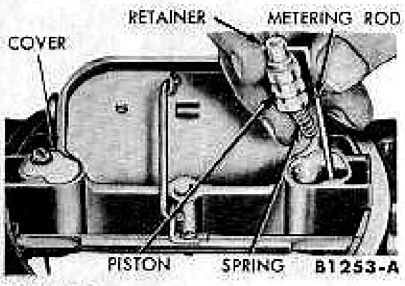


FIG. 40—Vacumeter Installation

grooves to the outside. Install the retainers.

12. Position the choke piston and lever assembly in the choke housing. Slide the choke lever and shaft into the choke housing and position the piston lever on the shaft. Install the retaining screw.

13. Install the curved end of the choke connector rod in the choke housing lever with the upset end away from the choke housing.

14. Install a new gasket in the recess in the choke housing vacuum passage. Position the choke housing on the main body and install the attaching screws. The thermostatic spring housing and related parts are installed after the choke countershaft linkage is adjusted.

15. Install the low speed and high speed jets, and the accelerating pump inlet valve.

16. Install the fuel bowl baffle plates with the identification "C" to the front of the carburetor and the cut-out portion facing up.

17. Position the primary booster venturi gaskets in the main body. The primary gaskets are interchangeable from side to side. Position the booster venturis in the main body with the high speed air bleed tube to the inside. A cut-out notch on each primary booster venturi mates with a step in the main body. The primary booster venturi assemblies are not interchangeable from side to side. Install the retaining screws.

18. Position the secondary auxiliary throttle shaft with the identification "C" on the plates to the inside of the carburetor and facing up.

19. Position the secondary booster venturi gaskets in the main body. The secondary gaskets are interchangeable from side to side. Place the secondary booster venturis in the main body. A cut-out notch on each secondary booster venturi mates with a step in the main body. The secondary booster venturi assemblies are not interchangeable from side to side. Install the retaining screws.

20. Position the hot idle compensator gasket in place between the secondary booster venturis. Install the hot idle compensator.

21. Drop the accelerating pump discharge needle into its passage, then install the gasket and pump discharge nozzle assembly.

22. Place the accelerating pump spring in the accelerating pump chamber (on left side of carburetor). The accelerating pump spring is shorter than the anti-stall dashpot spring. A new accelerating pump spring can be identified by its red color. Place the accelerating pump plunger over the spring.

23. Place the anti-stall dashpot spring in the dashpot chamber (on right side of carburetor). Place the dashpot plunger on the spring.

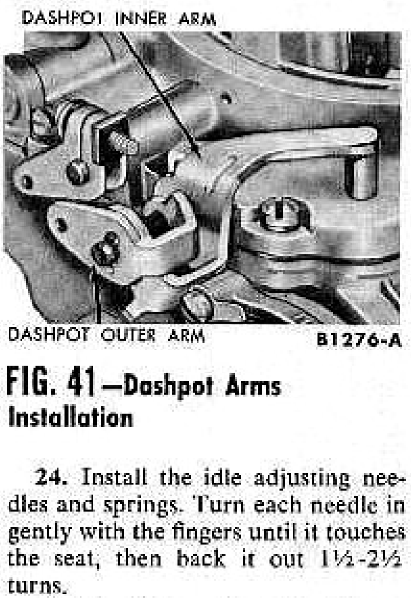


FIG. 41—Dashpot Arms Installation

24. Install the idle adjusting needles and springs. Turn each needle in gently with the fingers until it touches the seat, then back it out 1½-2½ turns.

25. Carefully position the air horn on the main body. Be sure the anti-stall dashpot plunger stem and the accelerating pump stem and the primary booster venturi air bleed tubes enter their respective holes in the air horn. Be sure that the upper baffle plates are on the float side of the lower baffle plates when the air horn is positioned on the main body.

26. Install the retaining screws and lockwashers. Install the two longest screws at the center retaining screw hole locations. Tighten the screws evenly, working from the center to the outside.

27. Place the springs in the Vacumeter pistons, then place the pistons and metering rods in their chambers (Fig. 40). Install the Vacumeter covers. **Do not force the metering rods into position.**

28. Place one leg of the dashpot outer arm in between the two legs of the dashpot inner arm and slide them into position on the air horn (Fig. 41). The identification "C" on both parts should be to the outside and the inner dashpot arm lever contacting the dashpot plunger. Install the retainer.

29. Install the dashpot connector rod on the dashpot outer lever and the primary throttle shaft outer lever. The long angular portion of the rod is to the top and the ends of the rod face the carburetor. Install the retainers.

30. Connect the choke connector rod to the countershaft lever. Slide the countershaft lever on the countershaft with the "C" identification facing out. Working on the other end of the countershaft lever, be sure the tang on the countershaft outer lever is over the tang on the countershaft inner lever (Fig. 42). Tighten the countershaft lever snug, but not tight.

31. Install the fast idle cam connector rod in the fast idle cam and the countershaft inner lever. Install the retainer at the countershaft inner lever end of the rod.

32. Position the accelerating pump arm on the boss on the air horn and install the retaining screw.

33. Insert the retainer end of the accelerating pump connector link in the accelerating pump arm and the other end of the link in the accelerating pump plunger. Install the retainer.

34. Install the accelerating pump operating rod in the throttle lever and install the retainer. Using the copper speed clip, install the other end of the rod in the top hole of the accelerating pump arm.

FIG. 42—Countershaft Lever Installation

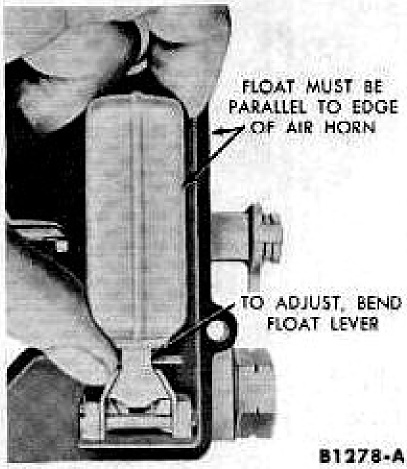


FIG. 43—Float Alignment

CARBURETOR BENCH ADJUSTMENTS

FLOAT

There are three adjustments that should be made on each float and lever assembly.

Float Alignment

1. Sight down the side of each float shell to determine if the side of the float is parallel to the outer edge of the air horn casting (Fig. 43).

2. To adjust float alignment, bend the float lever by applying pressure to the end of the float shell with the fingers while supporting the float lever with the thumb. **Apply only enough pressure to bend the float lever.**

3. After aligning the float, remove as much clearance as possible between the arms of the float lever and the lugs on the air horn by bending the float lever. The arms of the float lever should be as parallel to the inner surfaces of the lugs on the air horn as possible.

Float Setting

1. With the air horn inverted, the air horn gasket in place, and the fuel inlet needle seated, check the clearance between the end of each float and the air horn gasket (Fig. 44). The clearance should be $\frac{3}{16}$ inch.

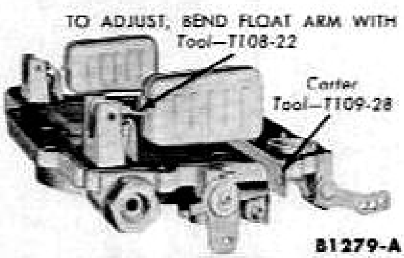


FIG. 44—Float Setting

2. Bend the float arm (up to increase the clearance or down to decrease the clearance) by applying up or down pressure to the end of the float shell with the fingers. **Apply only enough pressure to bend the float arm.**

Float Drop

1. With the air horn held in an upright position, measure the distance between the top of each float and the air horn gasket at the center of each float (Fig. 45). The distance should be $\frac{23}{32}$ inch.

2. Bend the stop tab on the float bracket, as necessary, to adjust the drop.

ACCELERATING PUMP

1. Back out the hot engine idle adjusting screw until the throttle plates seat in the carburetor. **Be sure the choke is wide open so that the fast idle cam does not hold the throttle plates open.**

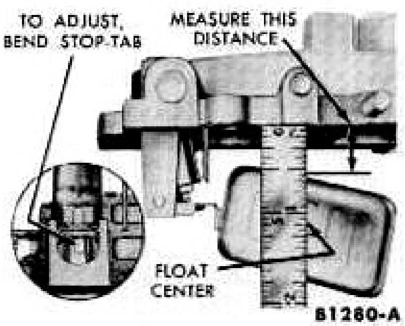


FIG. 45—Float Drop

2. With the pump link in the center hole (medium stroke) of the pump arm, measure the distance from the top of the air horn to the top of the plunger shaft (Fig. 46). The distance should be $\frac{27}{64}$ inch.

3. To adjust, bend the accelerating pump operating rod at the lower angle as necessary.

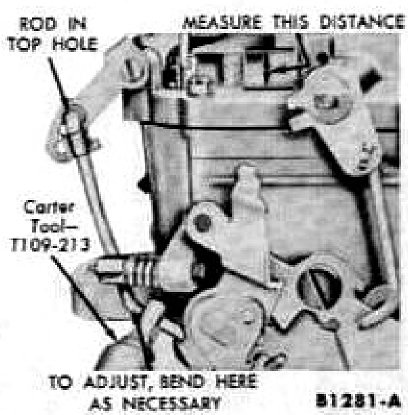


FIG. 46—Accelerating Pump Adjustment

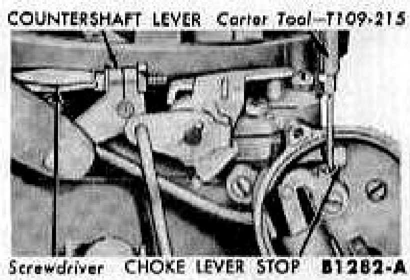


FIG. 47—Choke and Countershaft Linkage Adjustment

CHOKE AND COUNTERSHAFT LINKAGE

1. Loosen the countershaft lever clamp screw.

2. Hold the choke plate tightly closed.

3. Place a 0.086-inch gauge between the choke lever and stop in the choke housing (Fig. 47). With the gauge in place, take the slack out of the linkage by pressing the countershaft lever toward the closed choke position. Hold in place and tighten the clamp screw.

4. Place the baffle plate in position in the choke housing with the revolving portion of the plate to the outside (identified by the "C" on the face). The slotted portion of the inner plate and the round hole in the outer plate fit over the choke lever.

5. Lay the gasket in place on the choke housing.

6. Place the thermostatic spring housing on the choke housing. Be sure the thermostatic spring is engaged between the tangs on the choke lever.

7. Align the index mark on the thermostatic spring housing with the middle index mark on the choke housing. Install the retainers and screws.

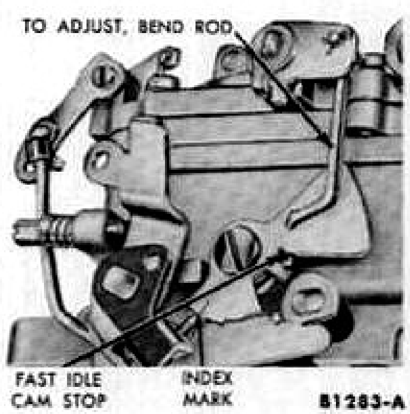


FIG. 48—Fast Idle Cam Adjustment

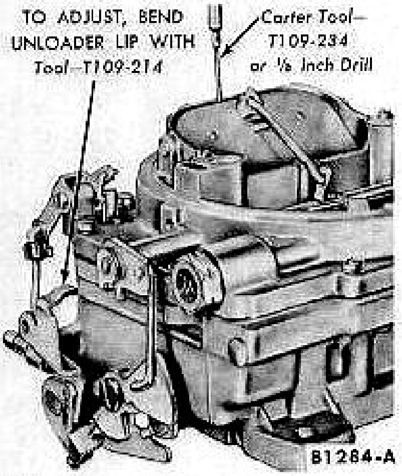


FIG. 49—Unloader Adjustment

AUTOMATIC CHOKE ADJUSTMENT

Refer to step 7 in the preceding adjustment.

FAST IDLE CAM

1. Hold the choke plate tightly closed by pressing on the countershaft lever at the center (Fig. 48).

2. With the lug on the outer countershaft lever contacting the inner countershaft lever, align the fast idle cam index mark with the fast idle adjusting screw by bending the fast idle cam connector rod.

UNLOADER

1. With the throttle wide open, there should be a clearance of 1/8 inch between the upper edge of the choke plate and the wall of the air horn (Fig. 49).

2. To adjust, bend the unloader arm on the throttle lever.

ANTI-STALL DASHPOT

1. With the primary throttle plates closed to the normal position, there should be a 1/16-5/32-inch clearance between the dashpot plunger operating lever and the top surface of the air horn. To adjust, bend the dashpot lever in the area between the lever arm base and the dashpot plunger (Fig. 50).

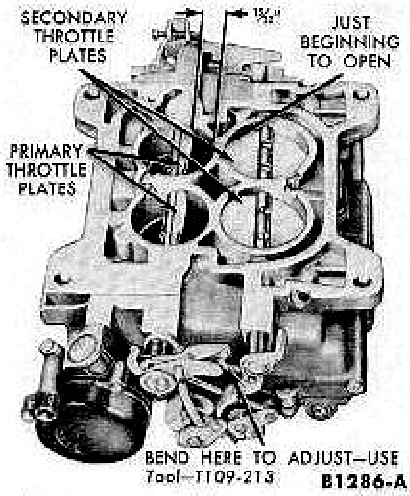


FIG. 51—Secondary Throttle Plate Adjustment

2. With the primary throttle plates wide open, there should be a clearance of 3/8-7/16-inch between the dashpot plunger operating lever and the top surface of the air horn. To adjust, bend the stop tang on the opposite side of the lever arm (Fig. 50).

SECONDARY THROTTLE LEVER

1. Block the choke plate open.

2. Open the primary throttle plates until there is 13/32 inch between the lower edge of the throttle plate and the throttle base (side opposite the idle port). At this point, the secondary throttle plate should just start to open. To adjust, bend the throttle operating rod at the existing bend (Fig. 51).

3. When both the primary and secondary throttle plates are completely closed, there should be 0.010-0.030-inch clearance between the positive closing shoes on the primary and secondary throttle levers. To adjust, bend the shoe on the secondary throttle lever (Fig. 52).

FAST IDLE ADJUSTMENT

With the choke plate tightly closed and the fast idle adjusting

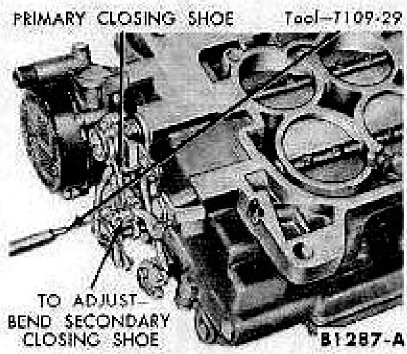


FIG. 52—Primary and Secondary Closing Shoe Clearance

screw resting on the fast idle cam at the index mark, turn the fast idle adjusting screw until there is a clearance of 0.040-inch between the primary throttle plate and the throttle bore at the side opposite the idle port (Fig. 53).

SECONDARY THROTTLE LOCKOUT ADJUSTMENT

1. Open the throttle plates slightly, then manually open and close the choke plate. As the fast idle cam moves the lockout plate, the tang on the secondary throttle lever should freely engage in the notch.

2. To adjust the secondary throttle lever, bend the tang as required.

3. Hold the lockout plate to the left and tight against the stop on the main body casting (secondary throttle plates partially open). The clearance between the tang on the secondary throttle lever and the ramp on the lockout plate should be 0.015-0.040 inch.

4. To adjust the clearance, bend the arm at the slot on the lockout plate as required.

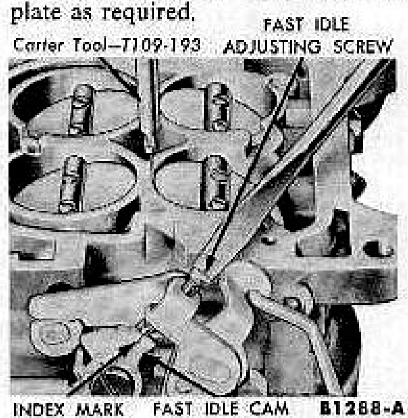


FIG. 53—Fast Idle Bench Adjustment

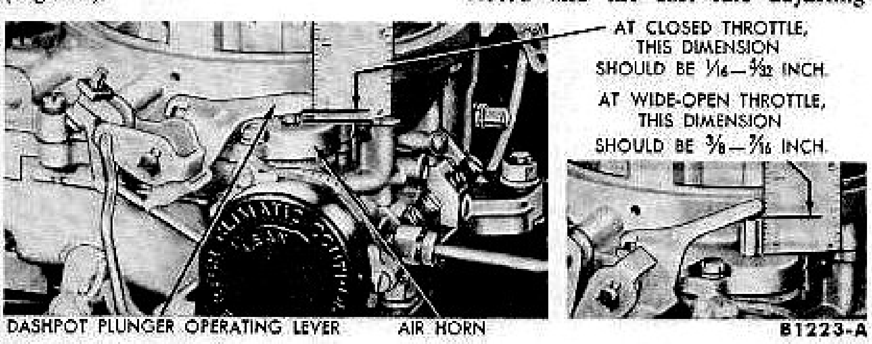


FIG. 50—Anti-Stall Dashpot Adjustment

3 CARBURETOR CLEANING AND INSPECTION

The cleaning and inspection of only those parts not included in the carburetor overhaul repair kit are covered here. All gaskets and parts included in the repair kit should be installed when the carburetor is assembled and the old gaskets and parts should be discarded.

Wash all the carburetor parts (except the anti-stall dashpot—Ford, the accelerating pump plunger—Carter, and the anti-stall dashpot plunger—Carter) in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, lacquer thinner or denatured alcohol may be used. Rinse the parts in kerosene to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that can not be immersed in solvent with a clean, soft, dry cloth.

Force compressed air through all the carburetor passages. Do not use a wire brush to clean any parts or a drill or wire to clean out any openings or passages in the carburetor. A drill or wire may enlarge the hole or passage changing the calibration of the carburetor.

Check the choke shaft for wear and excessive looseness or binding in the air horn. Inspect the choke plate for nicked edges and the choke plate valve for ease of operation.

If the throttle shafts are excessively loose or bind in the main body, or if the plates are burred preventing proper closure, replace the main body.

Check the floats for leaks by holding them under water that has been heated to just below the boiling point. Bubbles will appear if there is a leak. If a float leaks, replace it. Replace the float if the arm needle contact surface is grooved. If the floats are serviceable, polish the needle contact surface of the arm. Replace the float shafts if they are worn.

Replace all screws and nuts that have stripped threads.

Replace all distorted or broken springs.

Inspect the idle tubes in each nozzle bar assembly. If they are plugged, bent, or broken, replace the booster venturi and nozzle bar assembly.

On the Ford carburetor, examine the power valve gasket mating surface, and replace the main body if this surface is damaged so that the valve gasket will not seal properly. This would cause fuel to leak past the power valve.

On the Ford carburetor, inspect the rubber boot of the anti-stall dashpot for proper installation in the groove of the stem bushing. Check the stem movement for smooth operation. Do not lubricate the stem. Replace the assembly if it is defective.

Inspect all gasket surfaces. Repair or replace any parts that have damaged gasket surfaces. Replace the thermostatic spring housing if it is cracked, if the gasket surface is chipped, or if the thermostatic spring is broken.

PART 3-3 FUEL PUMPS, VACUUM BOOSTER, FUEL TANK, AND LINES

1 352 ENGINE COMBINATION VACUUM BOOSTER AND FUEL PUMP

The fuel pump is mounted on the left side of the cylinder front cover and it is actuated by the camshaft eccentric.

The combination vacuum booster and fuel pump is shown disassembled in Fig. 1.

TESTS

Tests are covered in Section 1 of this part.

REMOVAL

1. Disconnect the fuel lines at the pump.
2. Disconnect the vacuum lines at the vacuum booster.
3. Remove the pump retaining screws, then remove the pump and gasket.

INSTALLATION

1. Apply sealer to both sides of a new gasket.
2. Position the gasket on the pump flange, and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric.
3. Press the pump tight against the pad, install the retaining bolts, and alternately tighten them to 23-28 foot-pounds torque. Connect the vacuum lines and the fuel lines.

DISASSEMBLY

1. Remove the sediment bowl, filter screen, and gasket.
2. Scribe a line to identify the pulsator chamber position. Remove the pulsator chamber retaining screw with a clutch-type screwdriver, then remove the pulsator chamber and pulsator.
3. Scribe a line on the fuel pump cover and body so that its original position can be retained upon assembly.
4. Hold the fuel pump cover against the pump body and remove the cover retaining screws. Remove the cover.
5. Hold the vacuum booster cover against the pump body, and remove the retaining screws, then remove the cover.

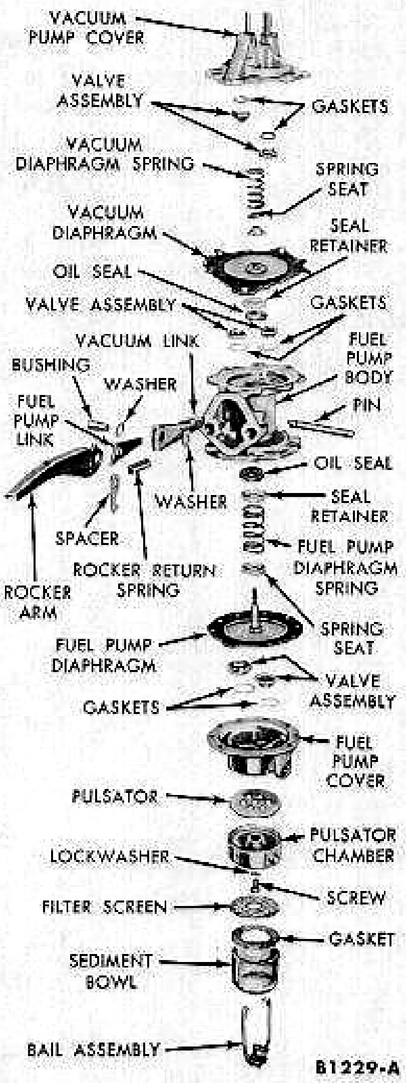


FIG. 1—352 Engine Combination Vacuum Booster and Fuel Pump

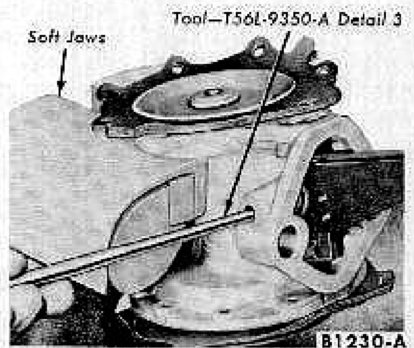


FIG. 2—Rocker Arm Pin Removal or Installation

6. Remove the spring and spring seat.
7. Remove the upset on the end of the rocker arm pin. Remove the retaining washer, then drive the pin out (Fig. 2) and work the fuel pump and booster links out of the diaphragm stems.
8. Remove the vacuum booster diaphragm.
9. Remove the fuel pump diaphragm, spring seat, and spring.
10. Remove the rocker arm and link assembly.
11. Remove the staking marks around the valves, and flip the valves out with a screwdriver. **Note the position of the inlet and outlet valves so that the new valves can be installed in the same manner.**
12. Remove the vacuum booster valve located in the pump body near the mounting pad.
13. Scrape away the staking marks and remove the other valve.
14. Scrape away the staking marks, and remove the valves in the cover. **Note the position of these valves so that the new valves can be installed in the same manner.**
15. Scrape away the staking marks, and remove the diaphragm rod oil seals and retainers.

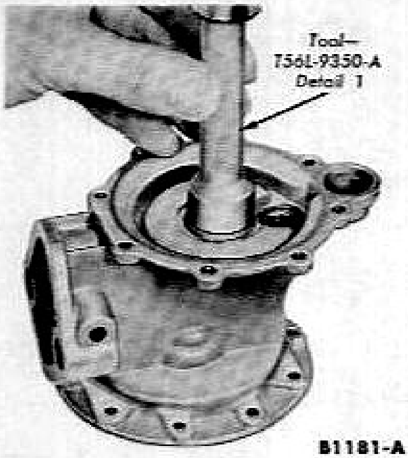


FIG. 3—Diaphragm Rod Oil Seal and Retainer Installation

CLEANING AND INSPECTION

Clean the bowl, filter screen, pump body, and the covers in solvent. Blow out all cover passages. Inspect the body, bowl, and covers for cracks or damage and replace them if necessary. Inspect the staked areas around the valve and seal counterbores for high spots which may cause distortion of the new parts upon installation. Remove all high spots. Inspect the mounting flange for distortion. Replace the pump body or lap the distorted flange if necessary.

ASSEMBLY

Install all the parts included in the overhaul kit.

1. Install the diaphragm rod oil seals and seal retainers (Fig. 3), then stake the seal retainers in place.

2. Press the booster pump valves and gaskets in the pump body and vacuum pump cover (Fig. 4), then stake the valves in place.

3. Install the gaskets and fuel valves in the fuel pump cover, using the tool shown in Fig. 3, then stake them in place.

4. Place the fuel pump link (short link), with the hook up, inside the return spring retainer spacer. Place this assembly inside the vacuum pump link (long link). Place all these parts inside the rocker arm, and install the bushing. The cam contact surface of the rocker arm faces up.

5. Install a thin washer, then a thick washer on each end of the bushing.

6. Place the rocker arm return spring over the boss in the pump body. Place the rocker arm and link assembly in the pump body and hold them in place (Fig. 2).

7. Install the rocker arm pin. Place the retaining washer on the end of the pin, then peen the pin.

8. Lubricate the fuel pump diaphragm rod with grease.

9. Assemble the spring seat (cup side toward the spring) and spring on the fuel pump diaphragm rod. Insert the rod through the fuel pump oil seal, and hook the rod slot over the short link (Fig. 5).

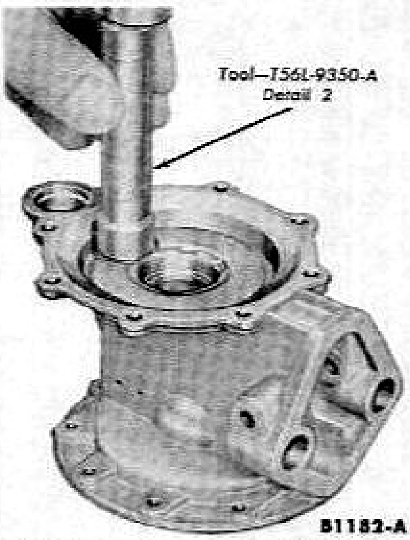


FIG. 4—Booster Pump Valve and Gasket Installation

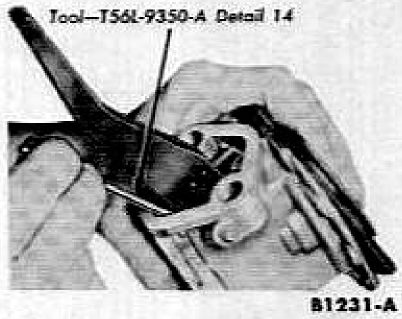


FIG. 5—Fuel Pump Diaphragm Installation

10. Lubricate the booster diaphragm rod with grease. Insert the booster diaphragm rod through the oil seal, and hook the slot in the rod in the long link.

11. Install the spring seat with the cup side toward the diaphragm.

12. Position the spring and the cover. Hold the cover tight against the diaphragm and pump body, and install the cover retaining screws. Make sure the diaphragm extends evenly around the edge of the cover. Tighten the screws evenly.

13. Place the fuel pump cover on the diaphragm, aligning the scribed line on the cover with the line on the pump body. Be sure the diaphragm extends evenly all around the edge of the cover. Compress the spring with the rocker arm, and install the cover retaining screws. Tighten the screws evenly, then release the rocker arm.

14. Install the pulsator diaphragm and the pulsator chamber. Be sure the scribe marks on the pulsator chamber and fuel pump cover are aligned.

15. Install the filter screen, bowl gasket, and sediment bowl. Rotate the bowl against the gasket before tightening the bail nut to make sure the bowl seats evenly against the gasket.

2 430 ENGINE FUEL PUMP

The fuel pump (Fig. 6) is mounted on the top portion of the cylinder front cover and is actuated by the fuel pump eccentric thru a push rod.

TESTS

Refer to Section 1 of this part for the test procedures.

REMOVAL

1. Disconnect the fuel pump inlet line from the fuel pump.

2. Disconnect the carburetor fuel inlet line from the fuel filter.

3. Loosen, but do not remove, the two cap screws securing the pump assembly to the front cover.

4. Using an auxiliary starter cable, "crank" the engine until the fuel pump eccentric, on the camshaft, is in a position which applies the least tension on the fuel pump rocker arm.

5. Remove the two cap screws and remove the pump assembly.

6. Remove the fuel pump push

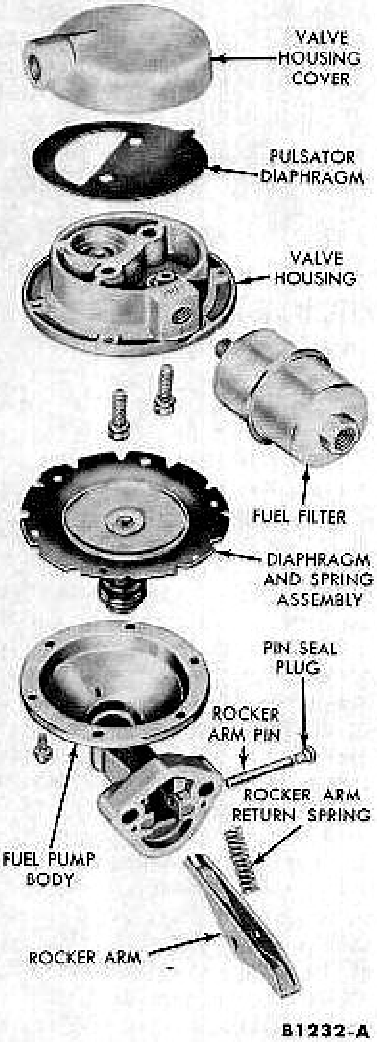


FIG. 6—430 Engine Fuel Pump

rod access plug, if removal of the push rod is necessary.

7. Remove the fuel pump push rod.

INSTALLATION

1. Install the fuel pump push rod if it was removed and install the push rod access plug on the engine front cover. **Be certain that the rod is installed with the bronze tip down.**

2. Using a new gasket, install the pump assembly. Tighten the cap screws to specifications.

3. Connect the fuel lines.

4. Start the engine. Check for leaks and proper operation of the fuel pump assembly.

DISASSEMBLY

1. Remove the filter assembly.

2. Scribe marks on the fuel pump body, valve housing, and valve housing cover so that these parts can be assembled in their original position.

3. Remove the valve housing assembly. Separate the valve housing from the cover and note the position of the pulsator diaphragm so that it may be assembled in its proper position. **Do not remove the fuel valves from the valve housing. The valve housing is replaced as an assembly.**

4. Remove the rocker arm return spring.

5. Remove the rocker arm pin seal plug as shown in Fig. 7.

6. Press the fuel pump diaphragm into the fuel pump body to release the tension on the rocker arm and allow the rocker arm pin to fall out. If the pin does not come out freely, use needle nose pliers (Fig. 8).

7. Press the diaphragm into the fuel pump body and pull the rocker arm out to unhook the rod from the rocker arm link (Fig. 9).

8. Remove the fuel pump diaphragm assembly. Do not disassemble as the diaphragm and spring are serviced as an assembly.

CLEANING AND INSPECTION

Clean the fuel pump body, valve housing, and cover in solvent. Blow out all body, housing, and cover passages. Inspect the pump body, valve housing, and cover for cracks or damage and replace them if necessary. If the fuel valves are not serviceable and replacement is necessary, replace the valve housing and valves as an assembly. Inspect the mounting flange for distortion. Remove the pump body or lap the distorted flange if necessary.

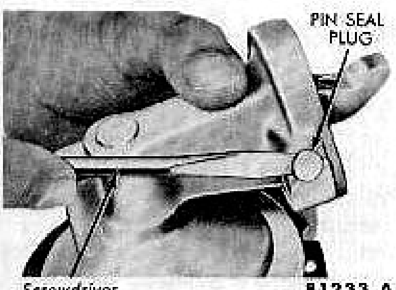


FIG. 7—Rocker Arm Pin Seal Plug Removal

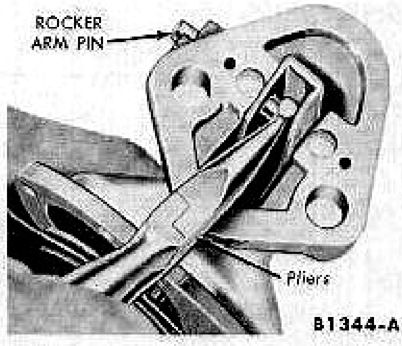


FIG. 8—Rocker Arm Pin Removal or Installation

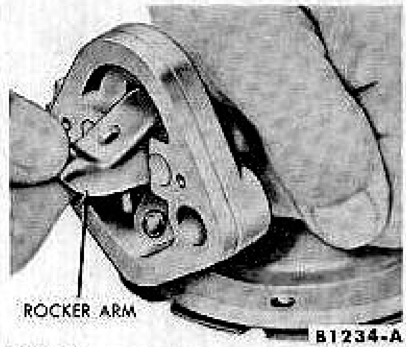


FIG. 9—Fuel Pump Diaphragm Removal or Installation

ASSEMBLY

1. Position the fuel pump diaphragm assembly into the pump body. Then apply pressure on the diaphragm spring so that the rocker arm can be hooked on the rod as shown in Fig. 9.

2. Align the rocker arm pin holes by applying slight pressure on the diaphragm spring, then install the rocker arm pin (Fig. 8).

3. Install a new rocker arm pin seal plug.

4. Position the rocker arm return

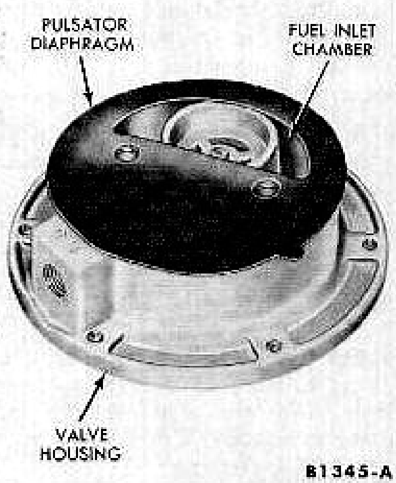


FIG. 10—Pulsator Diaphragm Installation

spring on the boss in the pump body. Compress the spring and slip it over the tang in the rocker arm.

5. Place a new pulsator diaphragm on the valve housing in the position previously noted on disassembly (opening in the diaphragm over the fuel inlet chamber as shown in Fig. 10). Position the cover on the valve housing, aligning the scribed lines on the cover with the line on the valve housing. Be sure the pulsator diaphragm extends evenly around the edge of the cover. Install and tighten to specifications the two retaining screws and lockwashers inside the valve housing.

6. Align the scribe line on the valve housing and the line on the fuel pump body. Hold the valve housing assembly tight against the fuel pump body and install the six screws and lockwashers. Be sure the fuel pump diaphragm extends evenly around the edge of the valve housing before tightening the retaining screws to specifications.

7. Install the filter assembly.

3 FUEL TANK AND LINES

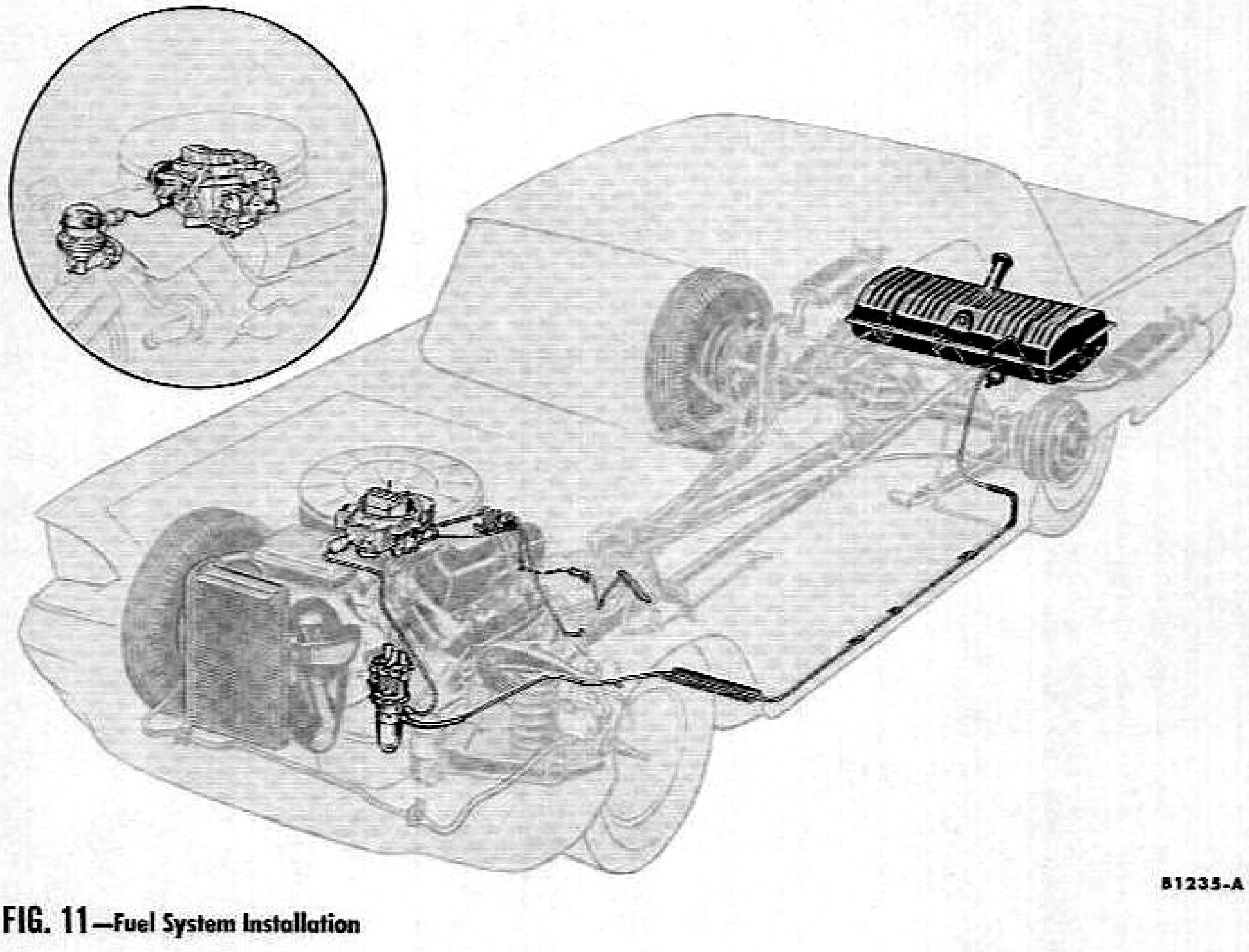


FIG. 11—Fuel System Installation

The fuel system installation is shown in Fig. 11.

FUEL TANK REPLACEMENT

1. Remove the fuel tank filler cap and the filler pipe grommet. Remove the drain plug and drain all the fuel from the tank. Disconnect the fuel line at the tank.

2. Position a jack under the tank, then remove the two nuts retaining the tank support straps to the body floor pan at the rear of the tank, and remove the straps. Lower the tank slightly and disconnect the fuel gauge sending unit wire. Remove the fuel tank, then remove the fuel gauge sending unit from the tank.

3. Install the fuel tank drain plug and the fuel gauge sending unit with a new gasket in the new tank. Install the tank insulators.

4. Use a jack to position the tank, then connect the fuel gauge sending unit wire. Hook the support straps to the retainers in the floor pan at the front of the tank. Position the straps over the studs, then install the nuts retaining the straps to the body floor pan at the rear of the tank. Remove the jack.

5. Connect the fuel line, then install the filler pipe grommet. Fill the tank, install the filler cap, and check all connections for leaks.

FUEL LINE REPLACEMENT

The fuel line that runs from the fuel pump flexible hose to the tank is not serviced as an assembly. It must be made up from the $\frac{5}{16}$-inch (O.D.) line serviced in 25-foot rolls.

1. Drain the fuel from the tank. Disconnect the fuel line at the tank and at the fuel pump flexible hose. Remove the line from the holding clips along the underbody.

2. Cut the new line to approximately the same length as the original, allowing extra length for flaring the ends of the line. Square the ends of the line with a file. Ream the inside edges of the line with the reamer blade on the tube cutter. Be sure that the metal chips are removed from the inside of the tube.

3. Position the wire wrap on the new line. Place a new fitting on the line for the tank connection and flare both ends. Bend the line to conform with the contour of the original line.

Position the line in the underbody clips. Connect the line to the tank and the fuel pump flexible hose. Fill the tank and check the line and connections for leaks.

PART 3-4 SPECIFICATIONS

FUEL PUMP

FUEL PUMP STATIC PRESSURE (PSI AT 500 ENGINE RPM)
352 Engine....4.0-6.0
430 Engine....4.5-6.5

MINIMUM FUEL PUMP VOLUME (FLOW AT 500 ENGINE RPM)
352 and 430 Engines....1 pint in 20 seconds

MINIMUM INTAKE VACUUM (INCHES OF MERCURY @ 500 ENGINE RPM)
352 and 430 Engines....6.0

MINIMUM BOOSTER PUMP VACUUM (INCHES OF MERCURY)
352 Engine (@ 500 rpm)....10.0
430 Engine (@ 2000 rpm)....23-25

ECCENTRIC TOTAL LIFT
352 Engine....0.690-0.710 inch
430 Engine....0.234-0.260 inch

CARBURETOR

FORD FOUR-BARREL CARBURETOR

Thunderbird 352 Special V-8 carburetor Nos. COAE-9510-J and -K only. The number is stamped on the left side of the primary fuel bowl. Carburetor is to be used with distributor No. COAF-12127-B.

MAIN METERING JET IDENTIFICATION NO.

PRIMARY
0-5000 feet....COAE-9510-J....54
-K....53
5000-10,000 feet....COAE-9510-J....52
-K....51
10,000-15,000 feet....COAE-9510-J....50
-K....49

SECONDARY
0-5000 feet....63
5000-10,000 feet....61
10,000-15,000 feet....59

POWER VALVE IDENTIFICATION NO.
0-5000 feet....None
5000-10,000 feet.... No. 65
10,000-15,000 feet.... No. 55

CARBURETOR (Continued)

DRY FLOAT SETTING (FOR INITIAL SETTING ONLY)

PRIMARY AND SECONDARY
0.435-0.465 inch from top surface of main body to top of free end of float with float in uppermost position.

FUEL LEVEL SETTING
PRIMARY AND SECONDARY...0.880-0.940 inch below top machined surface of main body.

VENTURI SIZE
PRIMARY....1⅛ inches
SECONDARY....1³⁄₁₆ inches

CHOKE THERMOSTATIC SPRING HOUSING INITIAL SETTING....3 digits lean

ANTI-STALL DASHPOT CLEARANCE (COAE-9510-K ONLY) 0.060-0.090 inch

INITIAL IDLE MIXTURE ADJUSTMENT....1-1½ turns open

FAST IDLE ADJUSTMENT (COLD)....1800 RPM with Fast Idle Screw on the Starting Step of the Cam (Hot Engine)

CARTER FOUR-BARREL CARBURETOR

Thunderbird 430 Engine carburetor No. COLE-9510-A only. The number is stamped on the front of the air cleaner flange. Carburetor is to be used with distributor No. B9MF-12127-B.

MAIN METERING JET AND METERING ROD IDENTIFICATION NO.

PRIMARY
0-5000 feet....166
5000-10,000 feet....166
10,000-15,000 feet....166

SECONDARY
0-5,000 feet....158
5,000-10,000 feet....158
10,000-15,000 feet....158

METERING ROD
0-5,000 feet....16-99
5,000-10,000 feet....16-99

DRY FLOAT SETTING
0.172-0.203 inch between end of float and surface of gasket. Air horn inverted.

CARBURETOR (Continued)

VENTURI SIZE
- Primary .... $1\frac{3}{16}$ inches
- Secondary .... $1\frac{9}{16}$ inches

CHOKE THERMOSTATIC SPRING HOUSING INITIAL SETTING .... At index

ANTI-STALL DASHPOT CLEARANCE .... $\frac{3}{8}$-$\frac{7}{16}$ inch between dashpot operating lever and air horn with throttle wide open. $\frac{1}{16}$-$\frac{5}{32}$ throttle closed.

INITIAL IDLE MIXTURE ADJUSTMENT .... $1\frac{1}{2}$-$2\frac{1}{2}$ turns open

CARBURETOR (Continued)

FAST IDLE ADJUSTMENT—
- BENCH .... 0.030 inch clearance between primary throttle plate and bore (opposite idle port), with fast idle screw opposite index mark on cam.
- VEHICLE .... 600-650 RPM in drive with fast idle screw on the first step of cam.

FUEL TANK CAPACITY

352 and 430 Engines .... 20 gallons

GROUP 4

COOLING SYSTEM

PART 4-1 COOLING SYSTEM

The cooling system consists of the radiator and radiator cap, water pump, thermostat, fan assembly, and the fan drive belt.

1 TROUBLE DIAGNOSIS

Engine overheating and slow engine warm-up are the two engine troubles most commonly attributed to the cooling system.

Loss of coolant and the accumulation of rust and scale in the system are the main causes of overheating. Coolant loss can be caused by external leakage at the radiator, radiator supply tank, water pump, hose connections, heater, and core plugs. Coolant loss can be caused also by internal leakage due to a defective cylinder head gasket, improper tightening of the cylinder head bolts, or warped cylinder head or cylinder block gasket surface. Internal leakage can be detected by operating the engine at fast idle and looking for the formation of bubbles in the radiator. Oil in the radiator may indicate leakage in the engine block or a leak in the oil cooler for automatic transmissions. Also, water formation on the oil level dipstick could be an indication of internal leakage.

Rust and scale that form in the engine water passages are carried into the small radiator passages by the circulation of the coolant. This clogs the radiator passages and causes overheating. If the coolant has a rusty or muddy appearance, rust is present.

A defective thermostat valve that remains open will cause slow engine warm-up.

TROUBLE DIAGNOSIS

ENGINE OVERHEATS	Insufficient coolant. Loss of coolant. Belt tension incorrect. Radiator fins obstructed. Thermostat defective. Cooling system passages blocked by rust or scale. Water pump inoperative.
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE	Thermostat inoperative or incorrect heat range. Temperature sending unit defective (causing gauge to indicate low engine temperature). Temperature gauge defective (not indicating true engine temperature).
LOSS OF COOLANT	Leaking radiator. Loose or damaged hose connections. Water pump leaking. Cylinder head gasket defective. Improper tightening of cylinder head bolts. Cylinder block core plugs leaking. Cracked cylinder head or block, or warped cylinder head or block gasket surface. Radiator cap defective.

2 GENERAL MAINTENANCE

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes periodic flushing of the entire system, keeping the radiator fins clean, and a periodic inspection of the cooling system for leakage.

Use care when removing the radiator cap to avoid injury from escaping steam or hot water.

CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use either FoMoCo Regular Cooling System Cleanser or in severe cases use Heavy Duty Cleanser. Removal of such material restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head bolts are properly tightened to prevent possible water leakage into the cylinders.

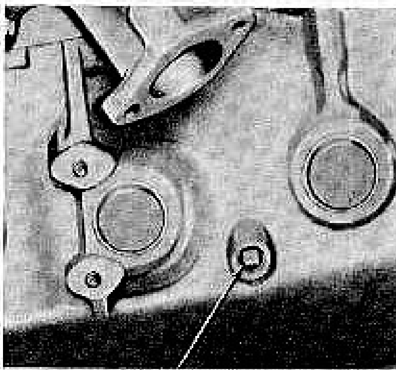


FIG. 1—Typical Cylinder Block Drain Plug

Always remove the thermostat prior to pressure flushing.

A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

RUST INHIBITOR

Use FoMoCo Rust Inhibitor after the cooling system has been cleaned to prevent additional corrosion or rust. Rust inhibitor does not remove rust nor dissolve rust. It is a preventive only and not a cleaner.

All anti-freeze sold by reputable manufacturers contains anti-rust additive. Therefore, the addition of rust inhibitor when anti-freeze is used is not necessary.

DRAINING AND FILLING THE COOLING SYSTEM

To drain the radiator, open the drain cock located at the left bottom corner of the radiator. Drain the cylinder block by removing the drain plugs located on both sides of the block (Fig. 1).

To fill the cooling system, close the radiator drain cock and replace the drain plugs. Disconnect the heater outlet hose at the water pump, to bleed or release trapped air in the system. Fill the system until the coolant begins to flow from the heater hose, then connect the heater outlet hose. Run the engine and add more coolant, if necessary, to fill the radiator to the proper level.

3 RADIATOR, HOSES, AND THERMOSTATS

RADIATOR REPLACEMENT

1. Drain the cooling system.

2. On a car with Cruise-O-Matic, disconnect the oil cooler inlet and outlet lines at the radiator.

3. Remove the fan blade, and spacer (not used with air conditioner), then disconnect the radiator upper and lower hoses at the radiator.

4. Remove the radiator upper and lower support bolts, then remove the radiator. The radiator supply tank need not be removed unless required. If a new radiator is to be installed, remove the drain cock from the old radiator and install it on the new radiator.

5. Position the radiator in the chassis and install and tighten the support bolts.

6. On a car with Cruise-O-Matic, connect the oil cooler inlet and outlet lines.

7. Connect the radiator upper and lower hoses. Then install the fan blade and spacer.

8. Close the drain cock, then fill and bleed the cooling system. Operate the engine and check for coolant leaks and the Cruise-O-Matic oil cooler lines for leakage. Check the Cruise-O-Matic fluid level.

RADIATOR SUPPLY TANK REPLACEMENT

1. Drain the cooling system. Then disconnect the radiator upper hose at the radiator supply tank.

2. Remove the screws retaining the supply tank to the intake manifold, then remove the supply tank (and ignition coil and bracket on air conditioned units).

3. Remove all the gasket material from the mounting surfaces of the supply tank and the intake manifold. Coat a new supply tank gasket with sealer, then position the gasket on the intake manifold opening. **The supply tank gasket must be posi-**

tioned on the manifold before the thermostat is installed.

4. Install the thermostat in the manifold opening with the word "TOP" toward the top of the engine and the valve end of the thermostat facing outward. **If the thermostat is improperly positioned, it can cause a retarded flow of coolant.**

5. Position the supply tank against the manifold (also install the coil and bracket on air conditioned units), then install and tighten the retaining screws.

6. Connect the radiator hose. Fill and bleed the cooling system. Check for leaks and proper coolant level after the engine has reached normal operating temperature.

RADIATOR HOSES

Radiator hoses should be replaced whenever they become cracked or soggy.

1. Drain the radiator, then loosen the clamps at each end of the hose to be removed. Slide the hose off the radiator connection and the radiator supply tank connection (upper hose) or the water pump connection (lower hose).

2. Position the clamps on each end of the hose. Slide the hose on the connections, then tighten the clamps firmly. Make sure the clamps are beyond the bead on the connections. Fill the radiator with coolant. Operate the engine for several minutes, then check the hoses and connections for leaks.

THERMOSTAT—352 ENGINE

The engine is equipped with a single spring cartridge-type thermostat, mounted inside the thermostat housing at the radiator supply tank mounting surface.

The standard production thermostat operating temperatures are from 177°-182°F. for use with water or permanent-type anti-freeze. A thermostat with operating temperatures of 157°-162°F. is available for use

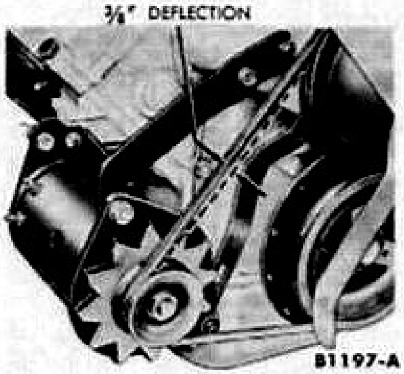


FIG. 2—Typical Fan Belt Deflection

with non-permanent-type anti-freeze and water.

Do not attempt to repair the thermostat. It should be replaced if it is not operating properly.

To remove or install the thermostat, refer to "Radiator Supply Tank Replacement."

THERMOSTAT TEST

1. Insert a piece of 0.003-inch feeler stock 1/8 inch under the valve. Suspend the thermostat, by the feeler stock, in a large container of water so that it is completely submerged, and 1 to 2 inches from the bottom.

Suspension of the thermostat in this manner will give an accurate indication when the valve starts to open. The thermostat will drop off the feeler stock when the valve starts to open. If the thermostat will not stay on the feeler stock when it is first inserted, discard the thermostat.

2. Suspend a thermometer in the water so that the bulb is at the same level as the thermostat element. Heat the water slowly, and stir it frequently to normalize the temperature. If the valve opens at a temperature of more than 5° below the start-to-open specification, or if the valve does not open at a temperature of more than 5° above the start-to-open specification, the thermostat should be replaced. The butterfly valve should open 0.40-0.50 inch from its seat in boiling water. If the valve will not open this far, the thermostat should be replaced.

THERMOSTATS—430 ENGINE

INTAKE MANIFOLD THERMOSTAT

Refer to the removal, test, and installation procedures for the 352 engine.

CYLINDER BLOCK THERMOSTATS

Removal

1. Remove water pump.

2. Pry the cylinder block thermostats from the cylinder block with a screwdriver or thin blade chisel (Fig. 3).

It is impossible to check the cylinder block thermostats due to the distortion that occurs upon their removal. **Do not attempt to repair them.** Install new thermostats.

Installation

1. Clean the cylinder block thermostat bores to remove rust and foreign material.

2. Coat the outside flange of the thermostats with water resistant sealer.

3. Install the thermostats with the temperature reaction bulb facing the inside.

4. Carefully tap the thermostats into position. Use care to prevent damage or distortion while performing this operation.

5. Install the water pump and the engine and cooling system component parts previously removed.

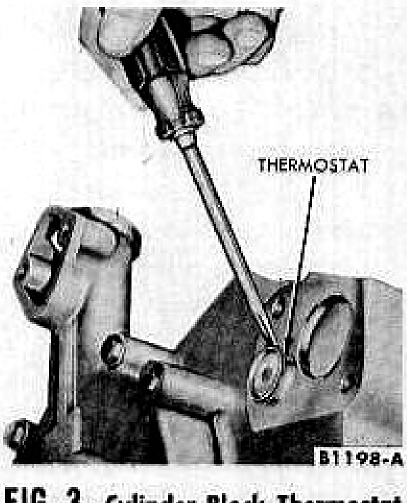


FIG. 3—Cylinder Block Thermostat Removal—430 Engine

4 FAN AND BELTS

The fan is mounted on a hub which is pressed on the water pump shaft. One belt drives the water pump, fan, and generator on a 352 engine. On a 430 engine, dual belts drive the water pump, fan and generator.

FAN

The fan is bolted to the hub by four cap screws and lockwashers. The screws used to fasten the fan also retain the water pump pulley, and fan spacer (not used with an air conditioner).

FAN REPLACEMENT

1. Loosen the generator adjusting arm bolt and the two generator mounting bolts at the generator. Move the generator toward the engine, then remove the fan belt(s).

2. Remove the screws and lockwashers retaining the fan, spacer, and pulley to the hub. Remove the fan blades, spacer, and pulley.

3. To install the fan, position the water pump pulley, spacer, and fan assembly, then install the lockwashers and screws.

4. Position the fan belt(s) on the pulleys, then adjust and tighten the generator adjusting arm bolt and the mounting bolts.

FAN BELT(S)

The fan belt(s) should be properly adjusted at all times. A loose belt causes improper generator, fan, and water pump operation. A belt that is too tight places a severe strain on the water pump and the generator bearings.

ADJUSTMENT

Loosen the generator mounting bolts and the generator adjusting arm bolt. Move the generator toward or away from the engine, until the correct belt deflection under light thumb pressure, is obtained.

The deflection (Fig. 2) should be ⅜ inch. After the correct deflection is obtained, tighten the generator adjusting arm bolt and the mounting bolts.

REPLACEMENT

1. Loosen the generator mounting bolts and the generator adjusting arm bolt. Move the generator toward the engine. Remove the belt(s) from the generator and crankshaft pulleys, and lift it over the fan.

2. Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley, and generator pulley grooves. Adjust the tension.

PART 4-2 WATER PUMP REPAIR

1 REMOVAL AND DISASSEMBLY

A single water pump assembly is used and is shown disassembled in Fig. 1. The pump is equipped with a sealed bearing integral with the water pump shaft. The bearing requires no lubrication. The hole in the water pump housing (Fig. 4) is a bleed hole to allow water that may leak past the seal to be thrown out by the slinger. **This is not a lubrication hole.**

REMOVAL

1. Drain the cooling system. Remove the generator adjusting arm bolt at the generator and loosen the adjusting arm bolt at the water pump. Loosen the two generator mounting bolts at the bracket. Move the generator inward and remove the fan belt(s).

2. Disconnect the radiator lower hose and heater hose at the water pump.

On a 352 engine, loosen the fuel pump assembly retaining bolts and slide the fuel pump out on the bolts one inch for access to the water pump lower left retaining bolt.

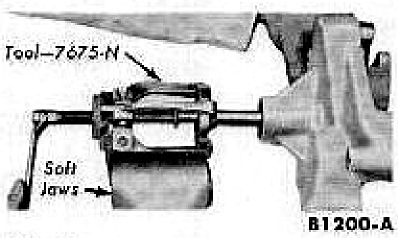


FIG. 2—Hub Removal

3. Remove the generator bracket retaining bolt at the water pump. Loosen the generator bracket retaining bolt at the cylinder block and move the bracket away from the water pump.

4. Loosen and move the water pump by-pass hose front clamp to the rear. Remove the bolts retaining the water pump to the block, and remove the water pump assembly and gaskets.

5. Remove the fan, spacer, and pulley. Remove the generator adjusting arm retaining bolt and remove the arm from the pump.

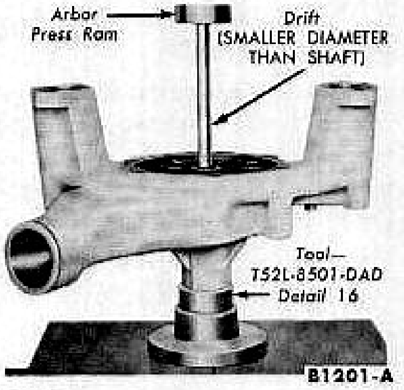


FIG. 3—Shaft Removal

DISASSEMBLY

1. Remove the back plate and gasket from the water pump, then remove the hub from the impeller shaft (Fig. 2).

2. Position the pump on an arbor press and press the shaft off the impeller and out of the housing (Fig. 3).

3. Press out the pump seal (Fig. 4).

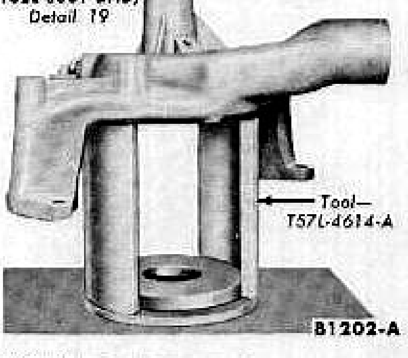


FIG. 4—Seal Removal

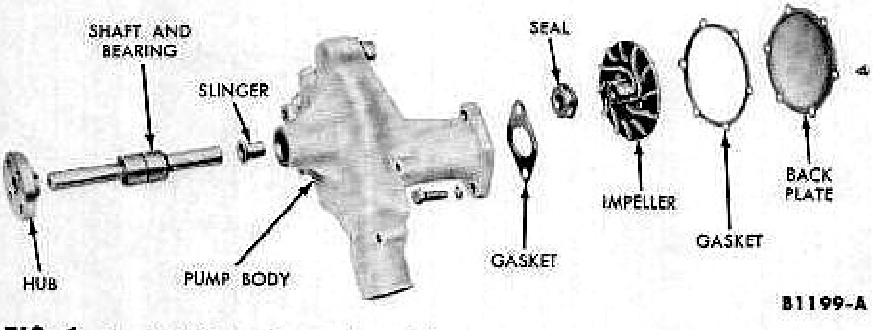


FIG. 1—Typical Water Pump Assembly

2 ASSEMBLY AND INSTALLATION

ASSEMBLY

1. Remove all gasket material from the mounting faces of the pump and the block.

2. Install the new slinger on the new bearing and shaft assembly furnished in the repair kit (Fig. 5). Locate the slinger in the same relative position as the slinger on the old shaft.

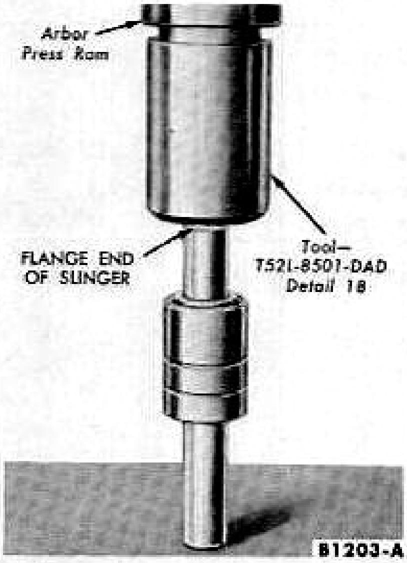


FIG. 5—Replacing Slinger

3. Apply a light film of waterproof sealer on a new seal and press the seal into the housing (Fig. 6).

4. Coat the bearing outer diameter lightly with grease, and press the shaft and bearing into the pump housing (Fig. 7).

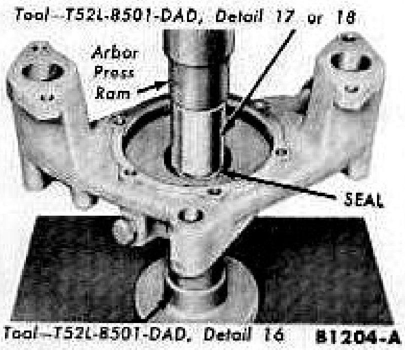


FIG. 6—Seal Installation

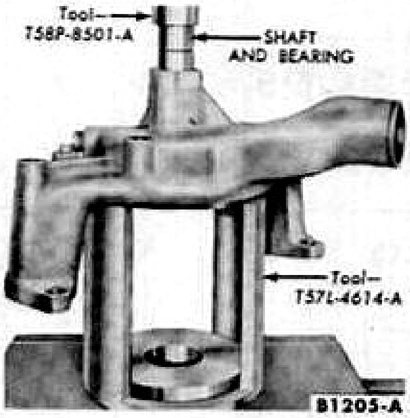


FIG. 7—Shaft Installation

5. Replace the impeller if it is worn or damaged. Coat the seal rubbing face of the impeller lightly with grease. Press the shaft into the impeller (Fig. 8). **Press the shaft into the impeller until the pump housing lightly touches the face of the adapter ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the adapter ring, the pump bearing will be damaged. Impeller to pump housing clearance is 0.030-0.040 inch.**

6. Tighten the set screw in the bottom of the fixture plate until the screw touches the end of the shaft. Position the fan hub over the shaft and press it into place, holding the specified distance from the housing mounting face to the front face of the hub (Fig. 9).

7. Coat a new back plate gasket with sealer, then install the back plate and gasket.

INSTALLATION

1. Install the generator adjusting arm, fan, spacer, and pulley to the water pump.

2. Remove all the gasket material from the mounting surfaces of the water pump and the cylinder block. Position new gaskets, coated on both sides with sealer, on the cylinder block, then install the pump.

3. Position the water pump by-pass hose front clamp. Install the generator mounting bracket to the pump, then tighten the generator mounting bracket bolt at the cylinder block.

On a 352 engine, position the fuel pump assembly and tighten the retaining bolts.

4. Connect the radiator lower hose and heater hose.

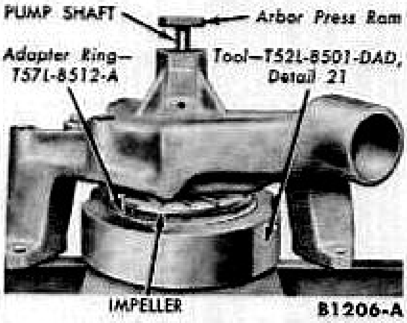


FIG. 8—Impeller Installation

5. Position the fan belt(s) over the pulleys and install the generator adjusting arm bolt at the generator. Adjust the tension and tighten the generator adjusting arm bolts, and the mounting bolts at the bracket.

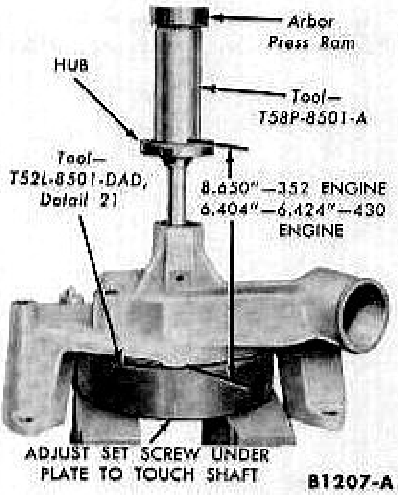


FIG. 9—Hub Installation

6. Fill and bleed the cooling system. Operate the engine until normal operating temperature has been reached, then check for leaks.

PART 4-3 SPECIFICATIONS

WATER PUMP, DRIVE BELTS, AND THERMOSTATS

WATER PUMP DRIVE ARRANGEMENT

352 Engine—Single belt drives water pump, fan, and generator.

430 Engine—Dual belt drives pump, fan, and generator.

WATER PUMP TO ENGINE RATIO

352 Engine	0.90:1
430 Engine	0.93:1

PULLEY OR PULLEY HUB TO WATER PUMP HOUSING FACE DIMENSION

352 Engine—8.650 inches from front face of pulley hub.

430 Engine—6.404-6.424 inches from front face of pulley hub.

IMPELLER TO HOUSING CLEARANCE

352 Engine	0.080-0.090 inch*
430 Engine	0.095-0.105 inch

*To housing cover mounting surface.

WATER PUMP, DRIVE BELTS, AND THERMOSTATS (Continued)

DRIVE BELT DEFLECTION

Between Generator and Water Pump Pulley (Right Side)

352 and 430 Engines	½ inch

Between Water Pump and Air Conditioner Pulley

352 and 430 Engines	½ inch

THERMOSTAT (352 AND 430 ENGINES)

Low Temperature	
Opens °F	157°-162°
Fully Open	182°
High Temperature	
Opens °F	175°-180°
Fully Open	200°
Cylinder Block Thermostats	
Opens °F	137°-142°
Fully Open °F	162°

COOLING SYSTEM CAPACITY

STANDARD	Quarts
352 and 430 Engines	20*

*Add 1 quart extra for heater.

GROUP 5

CLUTCH AND MANUAL-SHIFT TRANSMISSIONS

PART 5-1 CLUTCH

A semi-centrifugal, single dry-plate, cushion-disc clutch (Fig. 1) is used with the 3-speed Conventional Drive transmission and the Overdrive transmission.

The centrifugal action of the assembly is provided by the engine's rotation and the weighted fingers of the pressure plate.

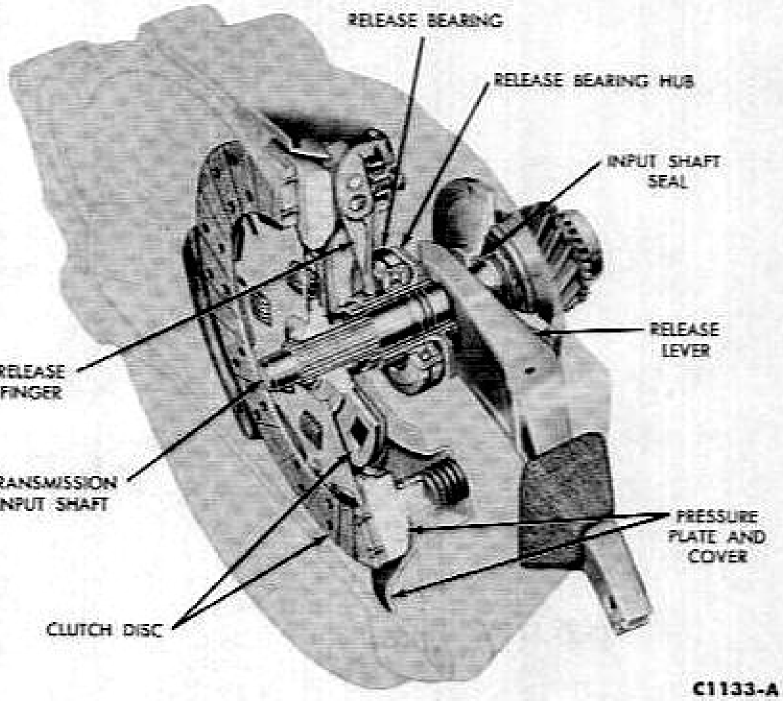


FIG. 1—Typical Clutch

1 TROUBLE SHOOTING

TROUBLE SYMPTOMS AND POSSIBLE CAUSES

CLUTCH NOISY WITH ENGINE STOPPED	Noise that occurs when the pedal is moved up and down with the engine stopped is probably in the clutch linkage or the pressure plate and cover. If the linkage needs lubrication, use engine oil—S.A.E. 10W. If the pressure plate lugs squeak, they need lubrication. Use a lithium-base grease between the driving lugs and the edges of the pressure plate openings (Fig. 2).
CLUTCH NOISY WHEN PEDAL FREE TRAVEL IS TAKEN OUT	With the engine running, depress the clutch pedal until all free travel is taken out. This brings the release bearing in contact with the release fingers and causes the bearing to spin. If noise occurs at this point, the clutch release bearing has probably failed and must be replaced. Bearing failure may be caused by improper travel adjustment, flywheel housing misalignment, or an improperly mounted bearing or release lever. **In cases of release bearing failures, always find and correct the cause in order to prevent repeat failures.**
CLUTCH NOISY WHEN PEDAL IS THREE-QUARTERS TO FULLY DEPRESSED	If noise occurs only when the pedal is three-quarters to fully depressed with the engine running, the probable cause is misalignment between the engine and flywheel housing, friction between the pressure plate lugs and the openings in the cover, or a loose or worn pilot bearing or bushing.

CONTINUED ON NEXT PAGE

TROUBLE SYMPTOMS AND POSSIBLE CAUSES (Continued)

CLUTCH DOES NOT ENGAGE OR DISENGAGE PROPERLY	If the clutch slips, chatters, or grabs, check and, if necessary, adjust the clutch pedal free travel. Inspect the clutch facings for oil or grease. Lubricant leaks should be found and corrected. The leak may be from the release bearing, pilot bushing, release lever pivot, transmission, or engine. Check for loose, worn, or damaged parts, and replace any part that is not operating properly.

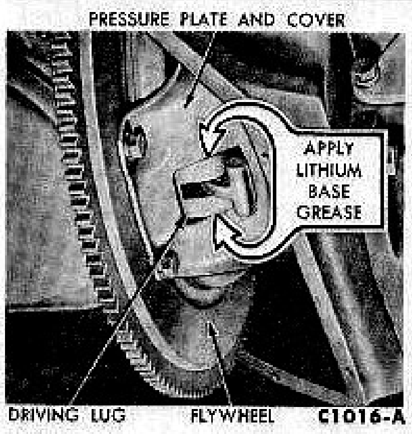


FIG. 2–Clutch Pressure Plate Lubrication

2 CLUTCH PEDAL ADJUSTMENT

Adjust the clutch pedal whenever the clutch does not disengage or engage properly, or when new clutch parts are installed. Both the total travel and the free travel of the pedal should be adjusted.

1. Measure the total travel of the pedal. If the travel is less than specification, move the clutch pedal bumper and bracket (Fig. 3) up or down until the travel is within these limits.

2. With the clutch pedal against its bumper (pedal released), measure the distance between the assist spring eye centers (Fig. 3). If this distance is not within specification, adjust the retainer (Fig. 3).

3. Depress the pedal just enough to take up the free travel and note the reading on the ruler. The difference between this reading and the reading when the pedal is released is the clutch pedal free travel.

4. If clutch pedal free travel is not within specification, adjust the clutch release lever rod.

5. To increase free travel, turn the adjusting nut clockwise. To reduce free travel, turn the adjusting nut counterclockwise.

6. As a final check, measure the free travel with the engine running at approximately 3000 rpm. This check can be made while the car is standing and the transmission is in neutral. Free travel reduction, when the engine is running, is normal. It is due to the action of the centrifugal weights on the release fingers.

7. Readjust, if necessary, to obtain at least ½-inch free travel at 3000 rpm. Lack of free travel at 3000 rpm will allow the pressure plate fingers to contact the release bearing, with resultant premature failure of the bearing due to continuous operation.

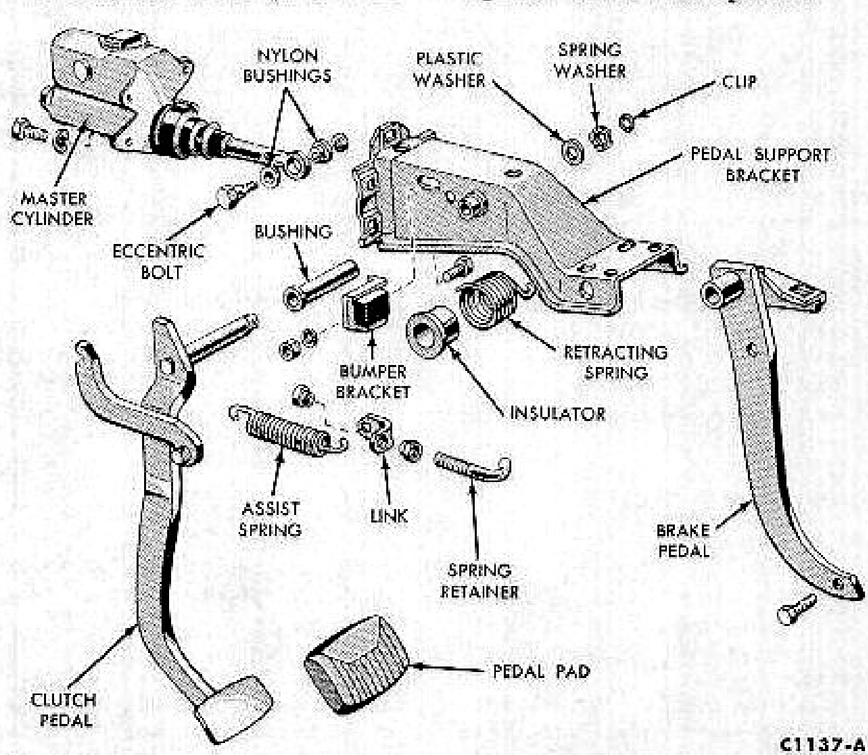


FIG. 3–Clutch Pedal Mounting Details

3 CLUTCH OVERHAUL AND PEDAL REPLACEMENT

CLUTCH REMOVAL

1. Raise the car on a hoist.

2. Disconnect the drive shaft at the rear axle. Slide the drive shaft off the transmission output shaft and insert the tool shown in Fig. 14, Part 5-2, over the output shaft and into the extension housing oil seal.

3. Disconnect the speedometer cable.

4. Remove the gear shift rods at the transmission levers.

5. If the car is equipped with overdrive, disconnect the solenoid and governor wires at their connectors. Remove the overdrive wiring harness from the transmission. Disconnect the overdrive control cable.

6. Remove the bolts that attach the engine rear support to the extension housing.

7. Raise the rear of the engine with a jack or support bar, and remove the engine rear support from the cross member.

8. Remove the transmission housing attaching bolts, and install guide pins in the 2 lower holes.

9. Slide the transmission toward the rear until the input shaft clears the flywheel housing.

10. Remove the flywheel housing cover.

11. Remove the release lever retracting spring, and slide the release bearing and hub off the release lever.

12. Loosen the six cover attaching bolts evenly to release the pressure plate spring tension. **If the same pressure plate and cover is to be installed after the clutch is overhauled, mark the cover and flywheel, so that the pressure plate can be installed in the same position.**

13. Remove the cover and pressure plate and the clutch disc through the opening at the bottom of the flywheel housing.

14. Remove the clutch release lever.

PARTS INSPECTION

RELEASE BEARING

Wipe all oil and dirt off the release bearing before removing it from the hub. **The bearing is pre-lubricated and should not be cleaned with solvent.**

Hold the inner race and rotate the outer race while applying pressure to it. If the bearing rotation is rough or noisy, replace the bearing.

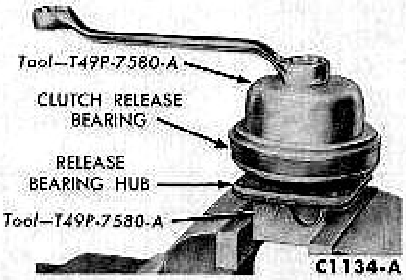


FIG. 4—Release Bearing Installation

Most release bearing failures are caused by improper clutch pedal adjustments. If the clutch linkage does not have enough free travel, the release bearing will constantly touch the release fingers and will spin whenever the engine is running. If the bearing is not properly installed on the hub, failure may occur. To seat the bearing squarely and fully on the hub, use the tool shown in Fig. 4.

Release bearing failure can be caused by the release lever contact points being out of plane. Check the wear on the release bearing hub where the release lever contacts it. The wear should be approximately equal. If one side shows more wear than the other, the release lever is bent or is not centering on the bracket on the flywheel housing. The release lever is grooved to 0.050-0.070 inches deep at the pivot point.

Misalignment between the engine and transmission can cause release bearing failure. Other symptoms of misalignment are: excessive transmission gear wear, transmission jumping out of gear, especially in third gear, vibration in the drive line, and excessive wear in the pilot bushing.

PRESSURE PLATE AND COVER

Inspect the surface of the pressure plate for burn marks, scores, or ridges. Generally, pressure plate resurfacing is not recommended. However, minor burn marks, scores, or ridges may be removed. During the removal of minor surface defects, the flatness of the pressure plate must be maintained. If the pressure plate is badly heat-checked or deeply scored, replace the pressure plate and cover assembly.

Place the plate on the floor, being careful not to score or scratch the surface. Force each individual finger down, then release quickly. If the finger does not return quickly, a binding condition is indicated, and the pressure plate should be replaced.

To check for uneven release finger height, follow this procedure:

1. Place the pressure plate and cover assembly on a new flywheel with three ¼-inch (0.250-inch) shims between the pressure plate and flywheel directly under the release fingers. Drill rod or precision washers may be used for the 0.250-inch shims. **Do not use a clutch disc as a spacer.**

2. Install the pressure plate attaching bolts and tighten evenly. Tap each finger lightly to stabilize its location.

3. Mount a dial indicator on a block. With the indicator block resting on the flywheel, check the difference in finger height. If a height difference of .031″ or more between any two fingers is noted, replace the pressure plate.

CLUTCH DISC

Inspect the clutch disc facings for oil or grease. An excessive amount of grease in the pilot bushing will find its way to the disc facings. Too much lubricant in the transmission or a plugged transmission vent will force the transmission lubricant out the input shaft and onto the disc facings.

Inspect the clutch disc for worn or loose facings. Check the disc for distortion and for loose rivets at the hub. Check for broken springs. Loose springs ordinarily do not cause noise when the car is operating. Replace the disc assembly if any of these defects are present. Do not drop a new disc or contaminate it with oil or grease.

PILOT BUSHING

Check the fit of the clutch pilot bushing in the bore of the crankshaft. The bushing is pressed into the crankshaft and should not be loose. Inspect the inner surface of the bushing for wear or a bell-mouthed condition. Replace the bushing if it is worn or damaged.

PILOT BUSHING REPLACEMENT

1. Using tool 7600-E, remove the bushing from the crankshaft.

2. Coat the pilot bushing bore in the crankshaft with a small quantity of wheel bearing lubricant. **Avoid using too much lubricant as it may be thrown onto the clutch disc when the clutch revolves.**

3. Install the service bearing with tool 7600-C.

CLUTCH INSTALLATION

1. Install the clutch release lever.
2. Place the clutch disc and pressure plate and cover assembly in position on the flywheel. Start the cover attaching bolts to hold the pieces in place, **but do not tighten them.**
3. Insert tool 7563-N to align the clutch disc, and torque the six cover attaching bolts evenly to specification. Remove the pilot tool.
4. Install the release bearing and hub on the clutch release lever. **Do not place any lubricant in the release bearing hub.** Apply a light film of lubricant on the bearing retainer journal.
5. Slide the transmission into its normal position on the guide pins. Remove the guide pins and install the transmission mounting bolts, and torque them to specification.
6. Fasten the engine rear support to the transmission extension housing. Then lower the engine and install the engine support mounting bolts and nuts.
7. Connect the gear shift rods at the transmission shift levers. Install the speedometer cable.
8. Remove the tool from the extension housing oil seal and install the drive shaft.
9. If the car is equipped with Overdrive, connect the solenoid and governor wires and replace the overdrive wiring harness in its clip. Connect the overdrive control cable.
10. Install the flywheel housing cover. Connect the release lever retracting spring.
11. Check and, if necessary, adjust the clutch pedal total travel and clutch pedal free travel.

CLUTCH PEDAL REPLACEMENT

When damage or normal wear in the clutch release linkage cannot be corrected by adjusting the clutch release lever rod, the damaged or worn parts must be removed for repair or replacement.

REMOVAL

1. Remove the headlight dimmer switch, remove the left cowl trim panel, and release the hood catch.
2. Remove the hood control cable from its bracket, and remove the bracket. On a car with Overdrive, remove the overdrive control handle and the bracket. Remove the driver's seat.
3. Remove the left vent-air register panel. Lower the brake handle and remove the panel.
4. Disconnect the stoplight switch wires at the brake master cylinder, and remove the brake bolt.
5. Flush the master cylinder by depressing the brake pedal all the way several times.
6. Remove the master cylinder.
7. Depress the clutch pedal to relieve spring tension, and back off the nut on the forward side of the assist spring link. Remove the spring, spring link, and spring retainer (Fig. 3).
8. Disconnect the clutch pedal to equalizer rod at the pedal.
9. If the car is equipped with a radio, remove the radio power unit, and disconnect the wires from the steering column.
10. Remove the clip, the spring washer, and the plastic washer from the right side of the clutch pedal shaft (Fig. 3).
11. Disconnect the push rod from the brake pedal by removing the eccentric bolt lock nut, the eccentric bolt, and 2 nylon bushings. Remove the push rod from the master cylinder boot.
12. Remove the steering column bracket from the instrument panel, and remove the 2 pedal support bracket bolts.
13. Slide the support bracket out of the mounting holes in the dash panel, pull the clutch pedal to the rear, and remove the clutch pedal (with the shaft) and plastic bushing from the left side of the mounting bracket.

INSTALLATION

1. Position the support bracket (with the brake pedal assembly positioned), and turn the assembly to the left. Insert the clutch pedal shaft in the left boss of the support bracket, pushing the clutch pedal shaft all the way through the bracket.
2. Insert the push rod in the master cylinder opening, and install the 2 mounting bracket bolts in the instrument panel.
3. Install the steering column bracket on the instrument panel.
4. Install the plastic washer, the spring washer, and the clip on the right end of the pedal shaft.
5. Position the master cylinder and install the mounting nuts (including the support bracket mounting nut located above the master cylinder). Torque the mounting nuts to specification.
6. Install the brake bolt, using new gaskets, and fill the reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck.
7. Depress the brake pedal several times to allow air to escape at the brake bolt, and then tighten the brake bolt. Check the fluid level in the reservoir, and install the filler cap. Connect the stop light wires.
8. Connect the brake pedal retracting spring, and insert the push rod in the master cylinder boot. Position the 2 nylon bushings in the push rod bore, and secure the push rod to the brake pedal with the eccentric bolt and the lock nut.
9. Install the radio power unit.
10. Connect the clutch pedal to equalizer rod. **The clutch release rod must be set in the clutch release lever before the pedal to equalizer rod is connected.**
11. Install the clutch pedal assist spring, the spring link, and the retainer. Adjust the spring tension at the spring retainer.
12. Check and, if necessary, adjust free travel in both the clutch pedal and the brake pedal.
13. Connect the wires to the steering column.
14. Install the vent-air register panel, the hood cable mounting bracket, and the control cable. If the car is equipped with Overdrive, install the control cable and the mounting bracket. Install the left cowl trim panel and the headlight dimmer switch. Install the driver's seat.

4 FLYWHEEL HOUSING ALIGNMENT

Alignment of the flywheel housing bore and rear face with the engine should be checked as a possible cause when any of the following occur: excessive transmission gear wear, transmission jumping out of gear, especially in third gear, vibration of the drive line, excessive pilot bushing wear, or noisy release bearings.

INSPECTION

With the transmission and clutch release bearing removed, install the indicator pilot tool shown in Fig. 5. Clean the faces of the flywheel housing bolt bosses, and remove all burrs, nicks, and paint from the mounting face of the housing.

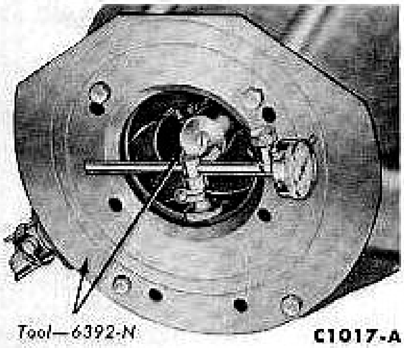


FIG. 5—Face Alignment Check

Install the adapter plate on the housing (Fig. 5). Install the dial indicator on the pilot and adjust the holder to locate the indicator button between the scribed lines. Remove the flywheel housing cover and pull the engine flywheel outward or push it inward to remove normal crankshaft end play. Set the dial indicator face to read zero.

Remove the engine spark plugs for easier turning, and pull the engine through one revolution. The crankshaft must be all the way out or all the way in. Note the indicator readings at each of the 4 bolts attaching the adapter plate. Take 2 readings at each bolt. Total indicator reading must not exceed 0.007 inch.

Remove the adapter plate and position the dial indicator to check the bore alignment (Fig. 6). The bore must be clean and free of burrs, nicks and paint.

Pull the engine through one revolution and note the indicator reading at four equally spaced points. Take 2 readings at each point. Total indicator reading must not exceed 0.010 inch.

CORRECTION

ENGINE IN CAR

Since any change in face alignment will change bore alignment, it may be possible to correct bore alignment by changing face alignment. Face alignment can be changed by shimming between the flywheel housing and engine. Figure 7 shows the type of shim which can be made locally.

Not more than 0.010 inch in shims may be used between the flywheel housing and engine. If a 0.010-inch shim will not bring face and bore alignment within limits, replace the flywheel housing or use the old housing and place additional shims between the transmission and flywheel housing. Not more than 0.010 inch in shims may be used between the transmission and flywheel housing.

The shim required is one half the maximum minus (—) indicator reading, and should be located at the point of maximum minus (—) indicator reading.

If both the bore and face alignment are out of limits, shim between the flywheel housing and engine to bring face alignment within limits. Check the bore alignment. If it is not within limits now, replace the housing.

If bore alignment is out of limits and face alignment is within limits, shim the flywheel housing to the limit of face misalignment and check the bore alignment. If it is not within limits, replace the housing.

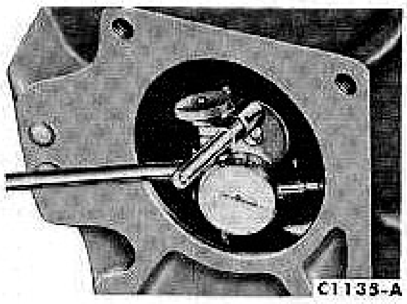


FIG. 6—Bore Alignment Check

If bore alignment is within limits and face alignment is out of limits, shims should be placed between the flywheel housing and the transmission.

ENGINE OUT OF CAR

The same procedure to correct alignment may be used with the engine out of the car or in the car, up to the point of replacing the flywheel housing. If the bore alignment cannot be brought within limits by shimming, follow this procedure.

Remove the flywheel housing from the engine and remove the dowel pins between the engine and flywheel housing. Install the flywheel housing and tighten the attaching bolts to normal torque.

Install the adapter plate and dial indicator (Fig. 5). Check the face alignment, and shim as required to bring face alignment within limits (0.007 inch total indicator reading).

Position the indicator to check bore alignment (Fig. 6). If bore alignment is not within limits, reduce the tension on the flywheel housing attaching bolts so that the housing can be moved by striking it with a lead hammer or a block of wood and a steel hammer.

The lateral alignment should be brought within limits so that an indicator reading is within limits between the 9 o'clock and 3 o'clock positions on the bore circle. When the lateral alignment is within limits, the housing usually can be moved straight up or down without disturbing the lateral alignment. When the bore alignment is within limits, tighten the flywheel housing bolts to normal torque and recheck bore alignment.

If the flywheel housing cannot be moved enough to bring the alignment within limits, mark the holes restricting movement, and then remove the housing and drill the marked bolt holes 1/32 inch larger.

When the flywheel housing bore alignment is within limits and the attaching bolts are at normal torque, ream the dowel pin holes 1/32 inch larger. Use a straight reamer and ream from the flywheel housing side. Oversize dowel pins can be made from drill rod stock.

Remove the flywheel housing and then install the oversize dowel pins in the engine block. Complete the assembly in the usual way.

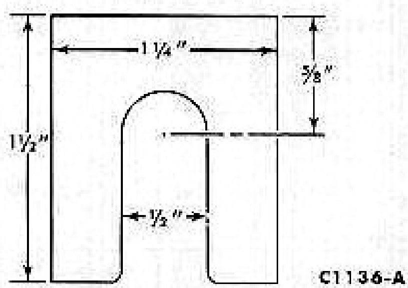


FIG. 7—Flywheel Housing Shim

PART 5-2 3-SPEED CONVENTIONAL DRIVE TRANSMISSION

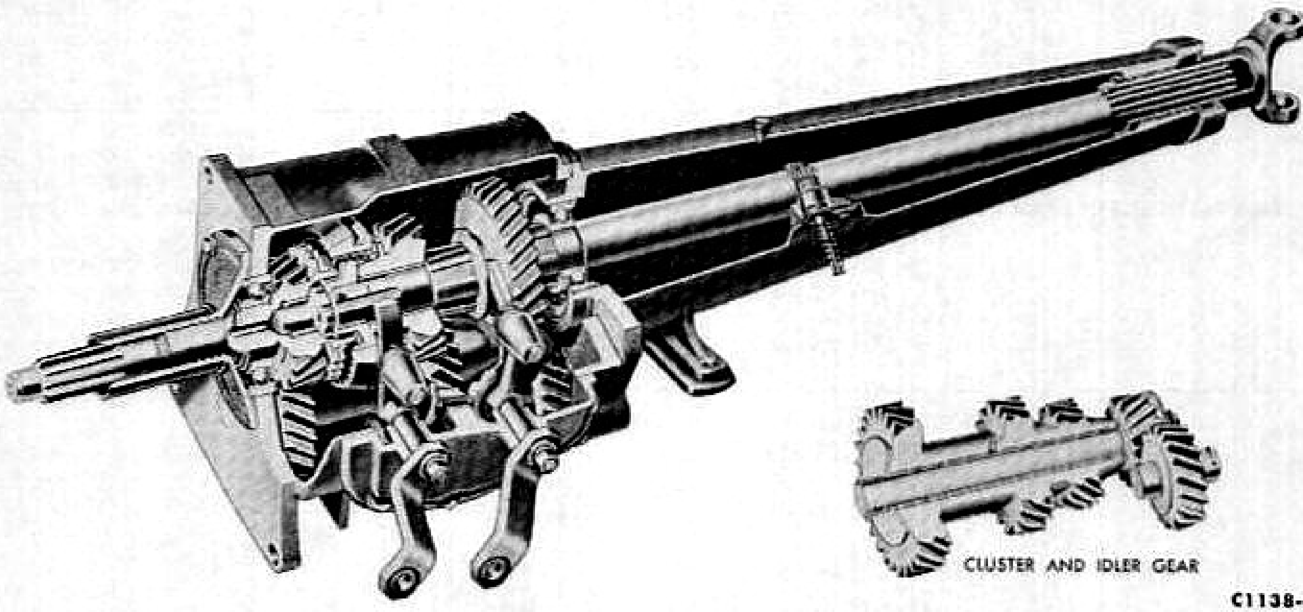


FIG. 1—3-Speed Conventional Drive Transmission

1 TROUBLE SHOOTING

Always check the possibility that trouble may exist in the clutch, drive shaft, U-joints, or rear axle before removing the transmission from the car for inspection.

TROUBLE SYMPTOMS AND POSSIBLE CAUSES

TRANSMISSION IS NOISY	Excessive noise may be caused by misalignment due to loose mounting bolts, flywheel housing misalignment, dirt or metal chips in the lubricant, or not enough lubricant in the transmission. Tighten loose mounting bolts and nuts to the specified torque. Check the condition and the level of the lubricant. Drain and refill, if necessary, or add lubricant if the level is low. Transmission noise may be caused by worn or damaged parts. Replace the parts as required to correct the noise, or overhaul the transmission assembly.
TRANSMISSION SHIFTS HARD	Check the transmission and/or clutch linkage adjustment, and adjust or repair if necessary. Inspect the transmission linkage for binding caused by bent or worn parts. Replace or repair all worn or damaged parts. Hard shifting may be caused by improper lubricant in the transmission. Drain and refill, if necessary, with the correct type of lubricant.

CONTINUED ON NEXT PAGE

TROUBLE SYMPTOMS AND POSSIBLE CAUSES (Continued)

TRANSMISSION JUMPS OUT OF GEAR	Improper shifting may cause the transmission to jump out of gear. Be sure the gears are completely engaged before releasing the clutch pedal. Check the transmission linkage for worn and bent parts, and check the adjustment. Check the flywheel housing alignment, and tighten any loose mounting bolts. Check for excessive end play caused by wear in the shift forks, sliding gear fork grooves, thrust washers, output shaft or countershaft bearings, or clutch pilot bushing. Check for misalignment or excessive clearance between the sliding gear and the output shaft. Check the operation of the gear shift housing assembly, and replace any broken or damaged parts.
TRANSMISSION LEAKS	Fluid leaks may be caused by overfilling the transmission or by using a lubricant that foams and expands while the car is in operation. Check the lubricant, and drain and refill with the correct type of lubricant if necessary. Loose gear shift housing cap screws may allow the lubricant to escape between the housing and the transmission case. Tighten the screws if they are loose. Check the condition of the bearing retainers and gaskets, and replace any that are worn or damaged. Check the transmission vent.

2 TRANSMISSION OVERHAUL

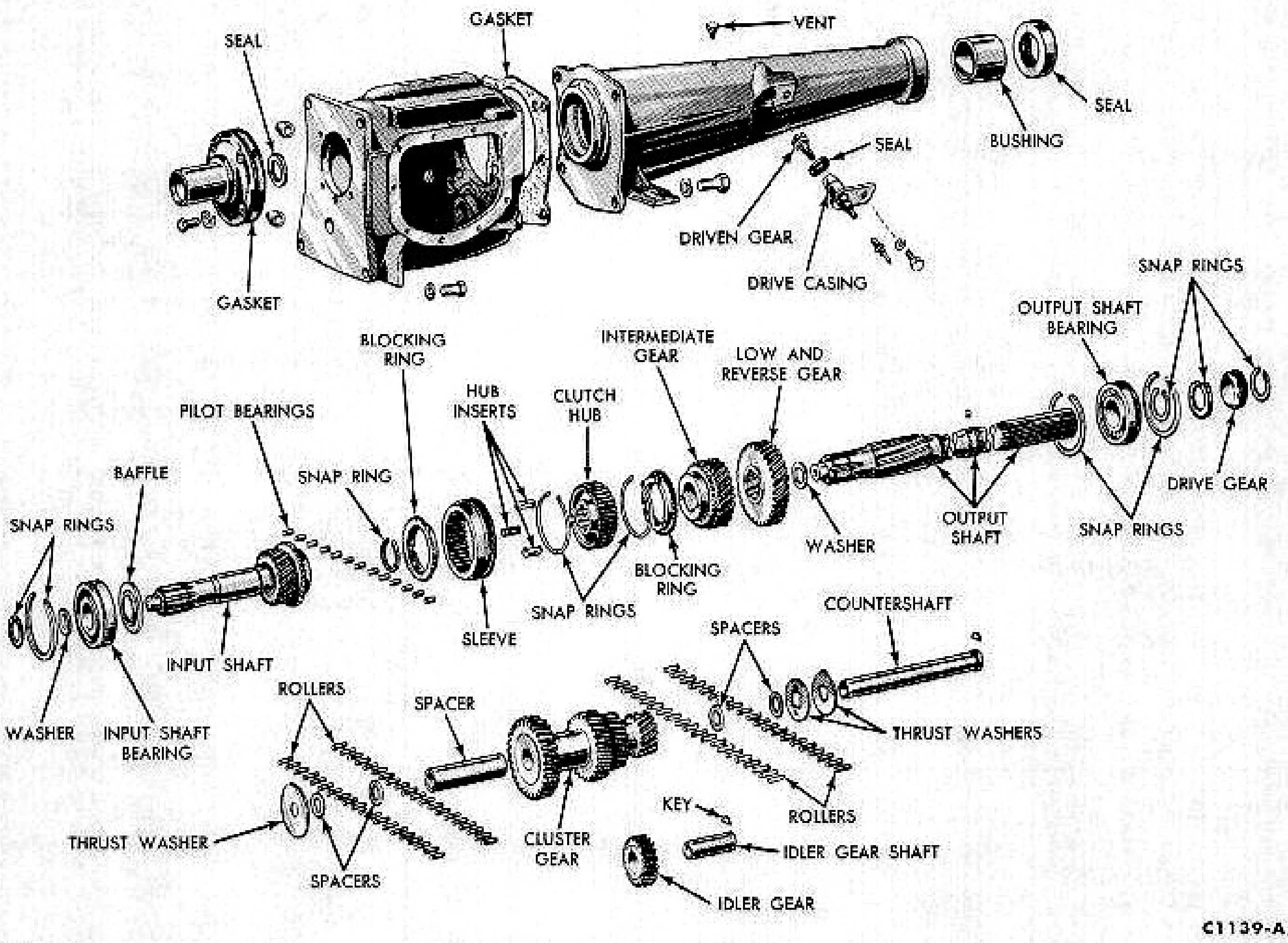


FIG. 2—3-Speed Conventional Drive Transmission Details

TRANSMISSION REMOVAL

1. Drain the transmission.

2. Disconnect the drive shaft at the rear U-joint, disconnect the parking brake adjusting rod, and disconnect the parking brake cables from the equalizer.

3. Disconnect the exhaust inlet assembly at the manifolds and at the couplings. Remove the exhaust inlet assembly.

4. Remove the 2 bolts that secure the transmission to the engine rear support.

5. Position a transmission jack, and raise the transmission enough to eliminate all weight on the cross member.

6. Remove the cross member attaching bolts, and move the cross member out of the way of transmission removal.

7. Disconnect the speedometer cable bracket, and disconnect the cable at the transmission.

8. Disconnect the shift rods from the shift levers, and remove the rods.

9. Remove the bolts that attach the transmission to the flywheel housing, and remove the transmission.

TRANSMISSION DISASSEMBLY

1. Mount the transmission in a holding fixture.

2. Remove the gear shift housing and destroy the gasket.

3. Remove the input shaft bearing retainer.

4. Remove the snap ring and the spacer washer from the input shaft, and remove the snap ring from the input shaft bearing (Fig. 2).

5. Remove the bolts that hold the extension housing on the transmission case, and pull the housing toward the rear of the transmission. Pull the input shaft forward, being careful not to lose any of the pilot bearing rollers.

6. Slide the synchronizer sleeve forward, tilt the case and the output shaft so that the output shaft gears

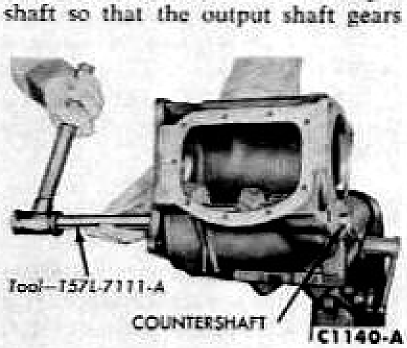


FIG. 3—Countershaft Removal

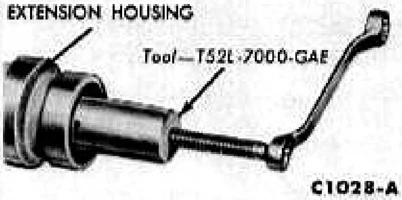


FIG. 4—Bushing Removal

clear the countershaft gears, and remove the output shaft (with the extension housing).

7. Remove the input shaft and bearing through the gear shift opening, and remove the rollers from the input shaft.

8. Using the pilot tool shown in Fig. 3, remove the countershaft. As the front end of the shaft clears the rear of the case, the cluster gear will drop to the bottom of the case. Take the gear out of the case, and remove the spacer washers, bearings, and thrust washers. Remove the Woodruff key from the shaft.

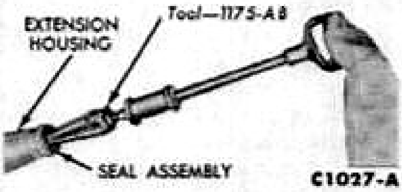


FIG. 5—Oil Seal Removal

9. Using a brass drift, drive out the idler gear shaft, and remove the Woodruff key.

10. Remove the snap ring that holds the synchronizer on the output shaft, and remove the synchronizer, the blocking rings, the intermediate gear, and the low and reverse gear. Disassemble the synchronizer.

11. Remove the snap ring that holds the output shaft bearing in the extension housing, and remove the output shaft from the extension housing.

12. Remove the speedometer gear rear snap ring, and remove the gear and the ball. Remove the speedometer gear front snap ring.

13. If the extension housing bushing (Fig. 2) is worn or damaged, remove it, using the tool shown in Fig. 4. If the seal only is to be removed, use the tool shown in Fig. 5. **The bushing should be installed only when the output shaft is in the housing.**

14. If, **after cleaning and inspection**, it is determined that the output shaft bearing should be replaced, remove the bearing with the tool shown in Fig. 6.

15. If the input shaft bearing is to be replaced, use the tools shown in Fig. 7. If a baffle is used with this bearing, the baffle spins with the shaft. **It must be installed with the dished side away from the bearing** so that the baffle does not rub the outer race of the bearing.

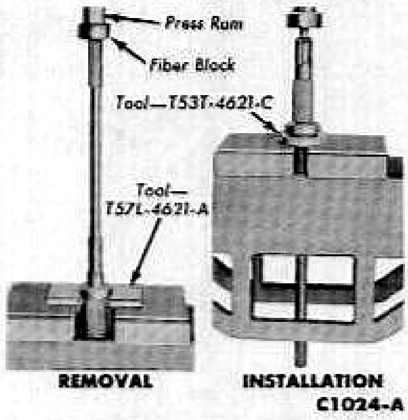


FIG. 6—Output Shaft Bearing Replacement

GEAR SHIFT HOUSING INSPECTION AND DISASSEMBLY

The gear shift housing does not need to be disassembled for inspection of the housing parts (Fig. 8). Check the condition of the shift levers and forks. If there is any binding or possibility of shifting into two gears at once when the lever is operated, disassemble the housing as follows:

1. Remove the shift levers from the cam and shaft assemblies.

2. Remove the cam retaining pins and pull the shifter fork and cams

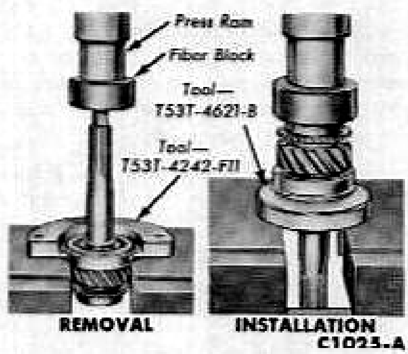


FIG. 7—Input Shaft Bearing Replacement

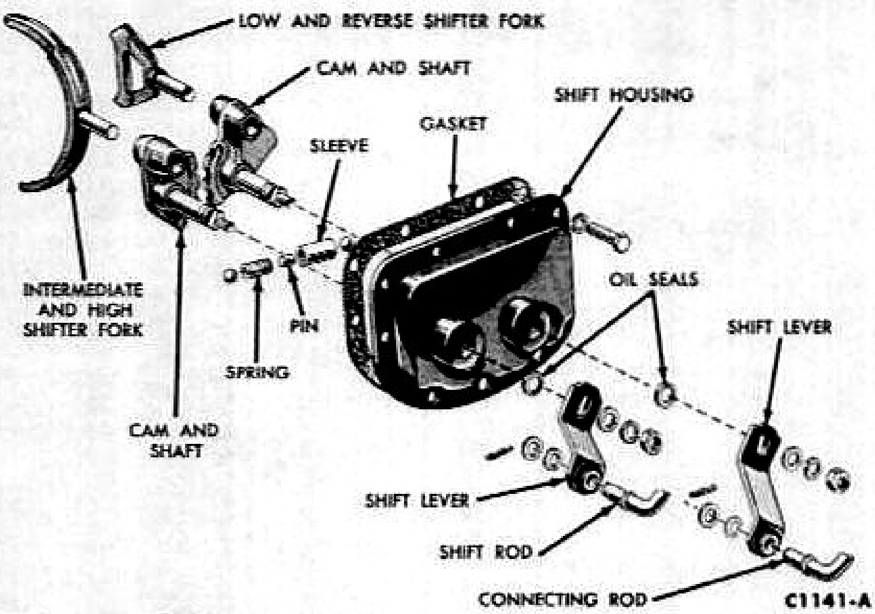


FIG. 8—Gear Shift Housing Details

out of the gear shift housing. With the cams removed, the interlock balls, retainer, and spring will fall out of the gear shift housing.

3. Pull the shifter forks out of the cams, and remove the seal rings from the cams.

TRANSMISSION CLEANING AND INSPECTION

CLEANING

1. After the transmission has been disassembled, soak the parts (except the bearings) in a cleaning solvent until all the old lubricant is dissolved or loosened. Brush or scrape all foreign matter from the parts. Do not damage any of the parts with the scraper.

2. Blow compressed air on the parts or wipe them until they are thoroughly dry.

3. To clean the bearings, rotate the bearings in the solvent until all old lubricant is removed. Dry the bearings with compressed air, **but do not spin them.** Slowly turn the bearings by hand and direct the air at right angles to the assemblies.

When the bearings are dry, lubricate them thoroughly with transmission lubricant, and cover them with a clean, lint-free cloth until ready for use.

INSPECTION

Inspect all transmission parts before assembly to determine if they should be replaced.

Inspect the case for cracks, worn or damaged bearing bores, damaged threads or other damage. If any of these conditions are present, replace the case.

Inspect the front face of the case, and file or grind off any minor nicks or burrs that could cause misalignment of the transmission with the flywheel housing.

The transmission vent must be open.

Check the operation and condition of the shift levers, forks, and interlock. If binding occurs when the levers are operated, disassemble the housing assembly, and replace the faulty parts.

Examine the bearing assemblies for cracked races. Check the races for roughness. Inspect the balls and rollers for looseness, wear, end play, or other damage. Check the bearings for looseness in the bores. If any of these conditions are present, replace the bearings.

Replace the cluster gear if the gear teeth are chipped or badly worn. Replace the countershaft if the shaft is bent, grooved, or has badly worn bearing surfaces.

Check the end play between the cluster gear and the thrust washers of the transmission case. If the end play is not between 0.004-0.018 inch, replace the thrust washer.

Replace the reverse idler gear if the gear is badly worn or if the gear teeth are chipped or burred. Replace the reverse idler gear shaft if it is excessively worn or scored.

If the bushing in the reverse idler gear is worn or damaged, replace the gear and bushing assembly. The bushing is not serviced separately.

Replace the input shaft if it is worn or damaged, or if the gear teeth are chipped or worn. If the pilot roller bearing bore is rough, replace the shaft and rollers.

Replace the intermediate gear and the low and reverse sliding gear if they are chipped, burred or badly worn.

Check the intermediate to high sleeve for free movement on its hub. Check the sleeve for wear at the spline teeth ends.

Check the blocking rings for wear on the grooves and teeth.

If the transmission jumps out of low gear, check the fit of the low and reverse sliding gear on the output shaft splines. Replace the gear on the output shaft if the outside diameter fit of the helical splines is excessive.

Replace the speedometer driving gear if the gear teeth are worn or broken. Be sure to install the correct size replacement gear.

Replace the output shaft if the splines are worn.

Inspect the bushing and seal in the extension housing.

GEAR SHIFT HOUSING ASSEMBLY

To assemble the gear shift housing follow this procedure:

1. Install new seal rings in the grooves in the shifter cams.

2. Place one cam assembly in position in the gear shift housing and install the retaining pin.

3. Assemble the interlock spring and balls in the interlock and install the interlock assembly in the gear-shift housing.

4. Place the other cam assembly in position and install the retaining pin.

Do not drive the retaining pins into place. Wedge the pins to obtain a secure fit only.

5. Install the gear shift levers on the cams and position the shifter forks in the cams.

6. Place a new gear shift housing gasket on the transmission case and retain in place with gasket sealer.

7. Shift the high and intermediate sleeve and the low and reverse sliding gear to their neutral positions. Shift the shifter forks into their neutral positions.

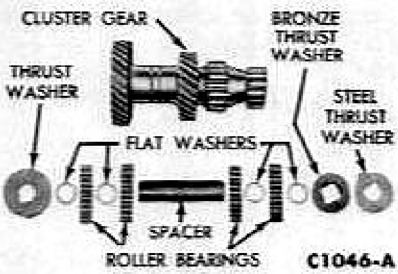


FIG. 9—Countershaft Cluster Gear

8. Install the gear shift housing. Torque the bolts to specification.

9. Check the transmission operation in all gear positions.

TRANSMISSION ASSEMBLY

1. If the output shaft bearing was removed, install a new bearing, using the tool shown in Fig. 6.

2. Install the speedometer gear front snap ring, and position the gear and ball, holding them in place with Lubriplate or a similar lubricant. Install the retaining snap ring.

3. Tap the output shaft and bearing into the extension housing, and install the snap ring that holds the shaft in the housing.

4. Coat the output shaft with transmission lubricant, and position the low and reverse gear (shift fork groove to the front) on the shaft. Position the intermediate gear on the shaft, with the synchronizer teeth and the taper toward the front.

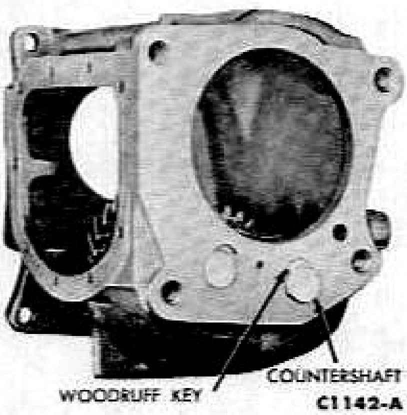


FIG. 10—Woodruff Key Installation in Countershaft

5. Assemble the synchronizer by placing a spring at each end of the hub, with the ends of the springs between the same two inserts. Position the inserts in the hub grooves, and slide the sleeve (with the shift fork groove to the rear) onto the hub.

6. Slide the synchronizer (with the shoulder of the hub forward) onto the shaft, and install the snap ring. Use a snap ring that allows 0.003-0.012 inch clearance between the rear side of the ring and the synchronizer hub when the hub is forced as far back as possible.

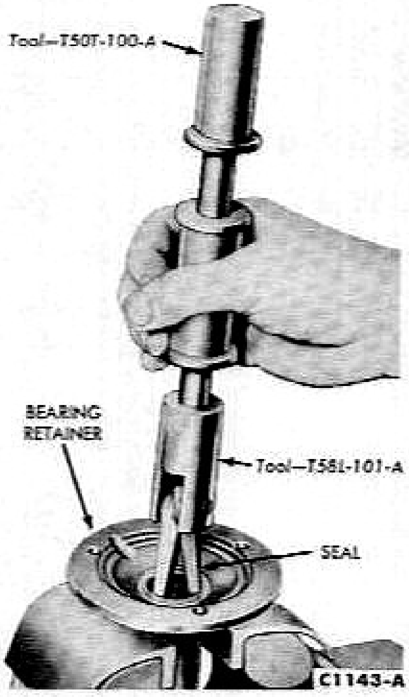


FIG. 11—Input Shaft Seal Removal

7. Position the pilot tool (Fig. 3) in the countershaft cluster gear, and slide the spacer onto the tool. Place a set of 20 rollers in each end of the countershaft gear. Slide a spacer washer onto the tool, and place another set of 20 rollers in each end of the gear. Install a spacer washer on each end of the tool, and hold the rollers in place with Lubriplate or a similar lubricant (Fig. 9).

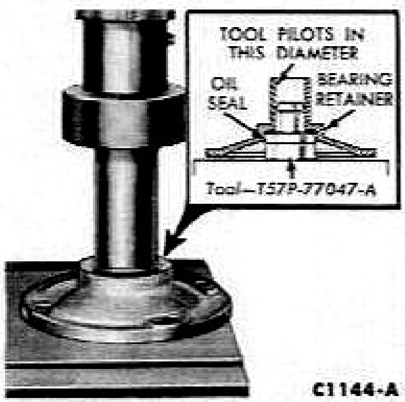


FIG. 12—Input Shaft Seal Installation

8. Coat the countershaft gear front washer with heavy lubricant, and position it in the front end of the transmission case, with the washer tab in its slot.

9. Coat the countershaft rear inner thrust washer with heavy lubricant, and position the washer in the gear pocket.

10. Carefully position the cluster gear assembly in the transmission case, being careful not to dislodge the thrust washers. The countershaft rear outer thrust washer must be kept in position with its tab upward.

11. Start the countershaft into the rear bore. Center the gear and the thrust washers, and continue to slide the shaft into the gear. As the shaft is pushed forward, it will drive out the pilot tool through the front of the case. Before the rear end of the shaft enters the case, place the Woodruff key in its slot, making sure the key lines up with the keyway in the case. Drive the shaft the rest of the way in until it is flush with, or slightly inside, the machined rear surface of the case (Fig. 10).

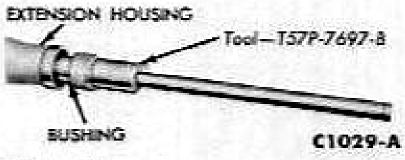


FIG. 13—Bushing Installation

12. Position the reverse idler gear in the transmission case, with the large shoulder to the rear, and install the gear shaft, as in step 11.

13. If the input shaft seal is to be replaced, use the tools shown in Figs. 11 and 12.

FIG. 14—Seal Installation

14. Position the pilot rollers in the input shaft, and install the shaft and bearing in the case. Install the bearing retainer, using a new gasket and lining up the oil drain in the retainer with the hole in the case. Torque the retainer bolts to specification.

15. After positioning a new gasket on the extension housing flange, position the output shaft and the extension housing through the rear of the transmission case. Install the extension housing bolts, and torque them to specification.

16. If installation of the extension housing bushing and/or the seal is necessary, use the tools shown in Figs. 13 and 14.

TRANSMISSION INSTALLATION

1. Position the transmission in the car, and install the bolts that attach the transmission to the flywheel housing. Torque the bolts to specification.

2. Install the shift rods, and connect the speedometer cable to the transmission. Install the speedometer cable bracket.

3. Install the cross member and the engine rear support. Torque the cross member bolts and the rear support bolts to specifications.

4. Install the exhaust inlet assembly, and torque the nuts and bolts to specification.

5. Connect the parking brake cables, the parking brake adjusting rod, and the drive shaft.

6. Fill the transmission, and adjust the shift rods.

3 GEAR SHIFT LINKAGE ADJUSTMENT

If shifting gears becomes difficult, the gear shift linkage should be adjusted.

1. Place the gear shift lever in the neutral position.

2. Remove the cotter pins and flat washers from the connecting rod adjustment sleeves, and pull the sleeves out of the gear shift levers.

3. Rotate the sleeves either clockwise or counterclockwise enough so that cross-over movement is smooth when the selector lever is moved to its various positions (with the sleeves connected).

PART 5-3 OVERDRIVE TRANSMISSION

1 TROUBLE SHOOTING

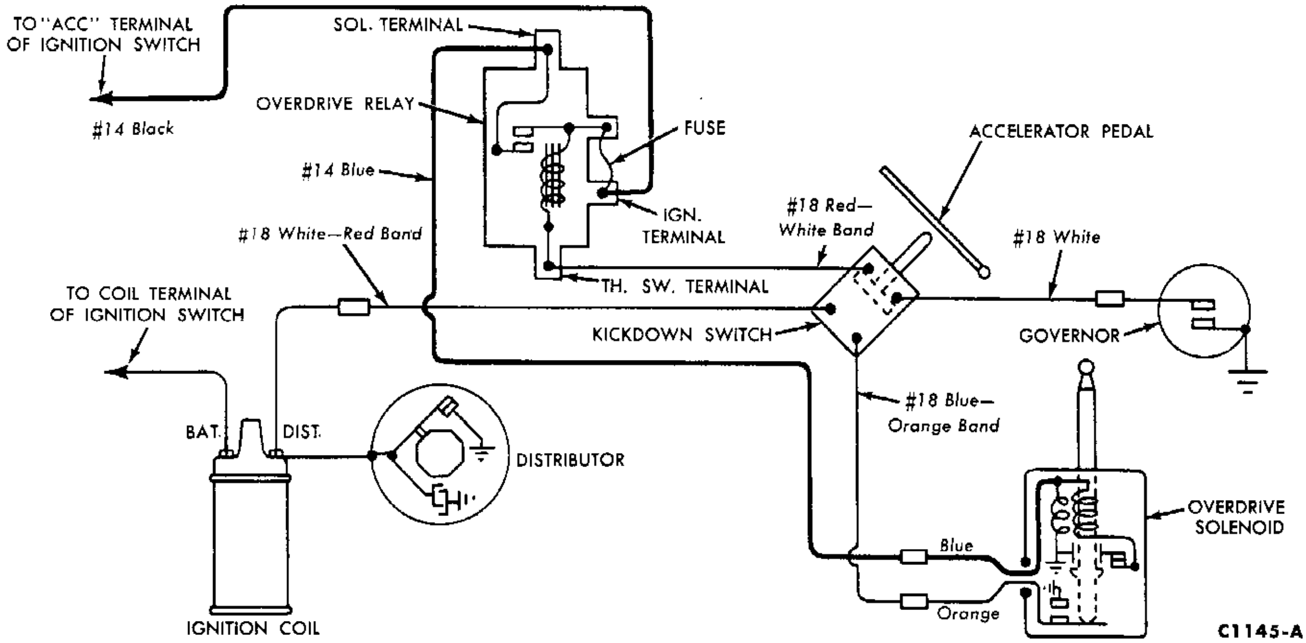


FIG. 1—Overdrive Electrical Control System

When trouble occurs in the overdrive unit, check the mechanical operation of the unit before checking the operation of the overdrive electrical control system.

MECHANICAL CHECKS

OVERDRIVE CONTROL HANDLE CLEARANCE CHECK

Check for the specified clearance between the overdrive control handle shank and the support bracket on the instrument panel.

OVERDRIVE CONTROL LEVER POSITION CHECK

Raise the car and check the position of the overdrive control lever at the overdrive unit housing. The lever should rest firmly against its stop at the rear. If the lever is not all the way back, the overdrive shift rail may be locking the pawl and preventing it from engaging the balk ring gear.

With the engine stopped and the clutch engaged, shift the transmission to third or second gear and shift the overdrive control lever to the automatic (rearward) position. The drive shaft should then turn freely in a clockwise direction (when viewed from the front), but should lock up when turned counterclockwise.

With the transmission remaining in third or second gear, shift the overdrive control lever to the locked-out (forward) position. The drive shaft should lock up when turned either clockwise or counterclockwise.

PAWL ENGAGEMENT CHECK

Check the mechanical engagement of the pawl with the balk ring gear, using the following procedure:

1. Turn on the ignition switch, and raise the car.

2. Shift the overdrive control lever to the locked-out (forward) position, and shift the transmission to neutral.

3. Remove the cap from the overdrive solenoid.

4. Turn the drive shaft clockwise and, at the same time, ground the white governor wire with a jumper. The solenoid will then become energized, and the solenoid stem should move in about ⅛ inch. The solenoid plunger should move in about ½ inch.

5. Keep the solenoid energized, and shift the transmission to third or second gear to lock the transmission output shaft against rotation. Shift the overdrive control lever to the automatic (rearward) position.

6. Turn the drive shaft clockwise, and watch the movement of the solenoid stem. At less than ¼ turn of the drive shaft, the solenoid stem should move in about ⅜ inch, indicating that the pawl has engaged the balk ring gear. This engagement will lock the drive shaft against rotation in both directions.

If the pawl does not engage the balk ring gear, replace the solenoid and repeat the test. If the pawl still does not engage, remove the overdrive unit from the car for inspection and repair.

ELECTRICAL CHECKS

GOVERNOR CIRCUIT CHECK

1. Turn the ignition switch on and off, and listen for the relay or solenoid to click. If either clicks as soon as the ignition switch is turned on, the governor circuit (Fig. 1) is grounded or the relay is defective.

2. To determine which condition is present, remove the wire from the TH-SW terminal or the relay and turn on the ignition switch. If the relay clicks, the relay is defective. If it does not click, the governor circuit is grounded.

3. To check the governor operation when the relay does not click as the ignition switch is turned on, disconnect the wire at the TH-SW terminal.

4. Raise the rear wheels off the floor.

5. Connect a test lamp between the battery and the wire removed from the TH-SW terminal.

6. Start the engine and, with the transmission in third, bring the speedometer reading up through 28 mph. The lamp should light at or about this speed.

7. Throttle the engine down through 22 mph and at or about this speed the lamp should go out. If the lamp lights and goes out at or about these speeds, the governor and governor circuit are working properly. If the lamp does not light at any time, replace the wire at the TH-SW terminal.

8. Turn the ignition switch on and raise the car. Disconnect the yellow wire from the white wire at the connector.

9. Ground the white wire on the transmission case. If the relay and solenoid click, the governor circuit is working properly from the TH-SW terminal to the connector (Fig. 1), and the trouble is in the yellow wire or the governor. If the relay and solenoid do not click when the white wire is grounded, the trouble is between the TH-SW terminal and the connector (Fig. 1).

SOLENOID CIRCUIT CHECK

1. With the engine stopped and the ignition switch on, ground the TH-SW terminal on the relay. If the relay and solenoid click as the ground is made and broken, the solenoid circuit is working properly. If the relay does not click as the TH-SW terminal is grounded, check the relay IGN terminal with a test lamp.

2. With the ignition switch on, the test lamp should light when it is connected between the IGN terminal on the relay and at a ground. If it does not, the trouble is between the ignition switch and the IGN terminal.

3. Connect the test lamp at the other end of the fuse and at a ground. If the lamp lighted at the IGN end and not at the other, replace the fuse. **Sometimes the fuse will "open" under the fuse end caps where the "open" cannot be seen.**

4. With current at both ends of the fuse, connect the test lamp between the solenoid terminal and at a ground. Ground the TH-SW terminal. The lamp should light. If it does not, replace the relay.

5. With the relay working properly, the solenoid should click when the TH-SW terminal is grounded. If it does not, connect a jumper from the SOLENOID terminal to the short blue wire separated from its connector near the solenoid. If the solenoid doesn't click when the relay closes with the jumper wire connected, replace the solenoid. If it does click, replace the wire from the SOLENOID relay terminal to the connector.

INTERRUPTER CIRCUIT CHECK

If the interruptor circuit does not ground the engine ignition momentarily when the driver depresses the accelerator pedal to the floor, the overdrive unit cannot shift from overdrive to direct.

1. The first check of the ignition interruptor circuit is at the ignition coil. The white wire with a red band, which runs from the ignition coil to the kickdown switch, must be connected to the DIST terminal on the coil. Sometimes this wire is improperly connected to the BAT terminal during ignition work.

2. Raise the car and pull the blue wire with an orange band (Fig. 1) from its connector near the solenoid, and ground it to the transmission case with a jumper.

3. With the engine running at fast idle, push the kickdown switch stem down until it bottoms. When the stem bottoms, the engine should stop. If it doesn't stop, the circuit is open between the DIST terminal and the connector.

4. To check the ignition grounding contacts inside the solenoid, disconnect the jumper and remove the solenoid from the overdrive unit.

5. Attach the solenoid to the adapter so that the stem can extend fully when the solenoid is energized.

6. Connect both solenoid wires at their connectors.

7. Ground the governor wire with a jumper.

8. With the engine running at fast idle, press down on the kickdown switch stem until it bottoms. The engine should stop. If it doesn't, replace the solenoid.

2 OPERATION

The overdrive transmission (Fig. 2) consists of a 3-speed transmission with an electrically-controlled 2-speed overdrive unit attached to an adapter on the rear end of the transmission case.

MECHANICAL OPERATION

DIRECT, FREE-WHEELING DRIVE

When the control handle is pushed in, the drive through the overdrive unit from start to speeds at about 28 mph is direct (1.0:1) and free-wheeling.

The power flow is from the transmission output shaft, through the overrunning clutch (free-wheel unit) to the overdrive main shaft (Fig. 3).

This drive is said to be free-wheeling, because the overrunning clutch permits the transmission output shaft to drive the overdrive main shaft, but it does not permit the drive to reverse.

The driving action of the clutch rollers while the transmission output shaft is driving the overdrive main shaft is shown in Fig. 4. The clutch cam rotation has moved the rollers higher on the cam surfaces and wedged them against the outer race. This permits the cam, which is splined

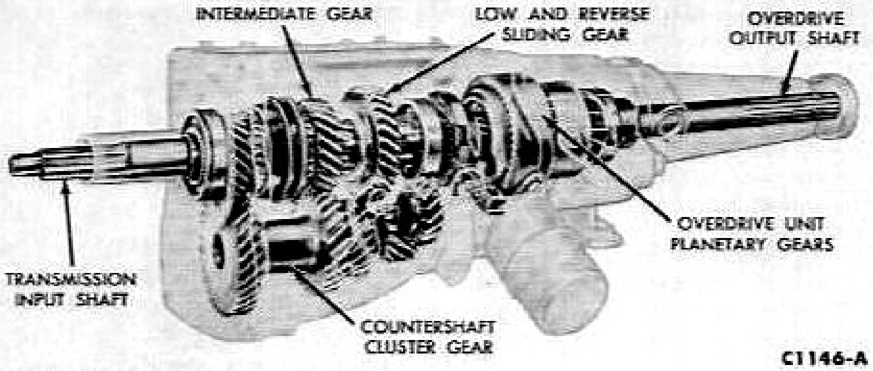


FIG. 2—Transmission and Overdrive Unit Gearing

to the transmission output shaft, to drive the clutch outer race, which is splined to the overdrive output shaft.

The overrunning action of the clutch rollers when the overdrive main shaft tries to drive the transmission output shaft is shown in Fig. 4. The outer race turns faster than the clutch cam. This moves the rollers lower on the cam surfaces and away from the outer race, unwedging the roller and permitting the outer race to overrun the clutch cam.

In a free-wheeling drive, the engine can drive the rear wheels, but the rear wheels cannot drive the engine.

In direct, free-wheeling drive, the planetary gearing is in neutral, because the sun gear can run free. It can rotate clockwise (from the front), counterclockwise, or stand still, depending on the relative speeds of the planet carrier (transmission output shaft), and the internal ring gear (overdrive main shaft). At a 0.70:1 ratio, the sun gear will stand still. At a higher ratio, the sun gear will turn clockwise (from the front). At a lower ratio than 0.70:1, it will turn counterclockwise.

OVERDRIVE

To shift the overdrive unit from direct (1.0:1) to overdrive (0.70:1) the sun gear is held against rotation (Fig. 3). This is accomplished by engaging a pawl in the balk ring gear which is splined to the sun gear.

In overdrive (Fig. 3) the power flow is from the transmission output shaft to the planet carrier splined to it, through the planet gears and then to the sun gear. With the sun gear held against rotation, the planet gears are forced to "walk around" the sun gear and drive the internal ring gear. The transmission output shaft will then drive the overdrive main shaft at a ratio of 0.70:1.

In overdrive, the overrunning clutch is uncoupled because the outer race (overdrive main shaft) is turning faster than the clutch cam (transmission output shaft). Overdrive is a two-way drive; the engine can drive the rear wheels and the rear wheels can drive the engine.

To shift from overdrive back to direct, the pawl is disengaged from the balk ring gear, permitting the sun gear to run free. The overdrive gearing is now in neutral. As soon as the speed of the transmission output shaft comes up to the speed of the overdrive main shaft, the overrunning clutch automatically locks up and direct drive is restored.

LOCKED-OUT DRIVE

When the control handle is pulled out, the automatic two-speed overdrive unit cannot function at any car speed. This lockout is accomplished inside the overdrive unit by the shift rail moving the sun gear into engagement with the lock-up teeth on the planet carrier (Fig. 3).

When the sun gear is locked to the planet carrier, the planetary gearing is locked with one mechanical unit; the transmission output shaft is locked to the overdrive main shaft. This lock-up is necessary in reverse, because the transmission output shaft reverses its rotation and therefore

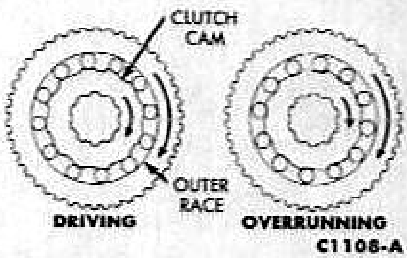


FIG. 4—Over-Running Clutch (Free-Wheel Unit) Operation

cannot drive the overdrive main shaft through the overrunning (one-way) clutch. The lock-up in reverse is accomplished by the low and reverse position. This locked-up drive is also necessary when the car is pushed to start the engine, since the overrunning clutch will not transmit power from the overdrive main shaft to the transmission output shaft.

ELECTRICAL SYSTEM

The overdrive electrical system, which engages and disengages the pawl, consists of a relay, a manual

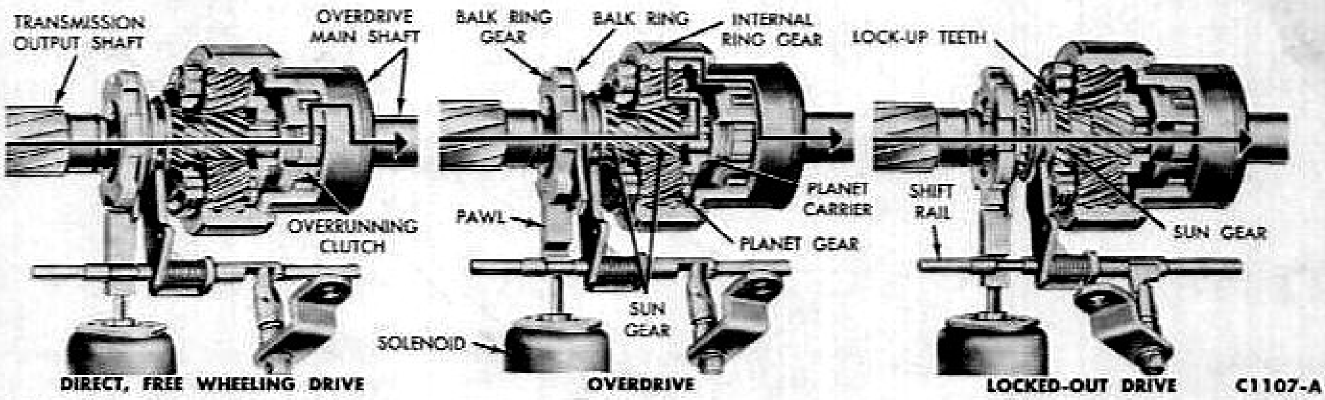


FIG. 3—Overdrive Power Flow Operation

kickdown switch, a solenoid, a centrifugal governor, and the circuit wiring.

There are three separate circuits (Fig. 1) in the electrical system: a governor circuit which opens and closes the relay, a solenoid circuit which supplies current through the relay to energize the solenoid, and an ignition interrupter circuit, which momentarily grounds the engine ignition for full-throttle downshift (kickdown).

PAWL ENGAGEMENT

The electrical system does not operate until car speed reaches about 28 mph. At this speed, the governor contacts close, permitting current to flow from the battery through the relay to the solenoid. There are two coils in the solenoid, usually referred to as the "pull-in" and "hold-in" coils. The pull-in coil is energized only while the solenoid plunger is being pulled in. As soon as the plunger is in, a set of points inside the solenoid opens the pull-in circuit.

As the plunger is pulled in, an engaging spring and a return spring are engaged.

Under pressure from the pawl engaging spring, the pawl is pushed in until it strikes the balk ring.

The usual position of the balk ring when the solenoid engaging spring pushes the pawl against it is shown in the left-hand view of Fig. 5. When the transmission output shaft is driving the overdrive main shaft through the overrunning clutch, all elements of the planetary gearing are revolving as a unit, and in a counterclockwise (from the rear) direction. This rotates the balk ring against the pawl.

When the driver releases the throttle, the overdrive main shaft overruns the transmission output shaft. When this overrun exceeds the ratio of 1:0.70, the sun gear and balk ring is reversed, releasing the pawl to engage the balk ring gear (Fig. 5).

The position of the balk ring, should the solenoid be energized when the car is coasting (engine idling) up through 28 mph, is shown in the right-hand view of Fig. 5. Under this condition the sun gear will be rotating clockwise (from the rear) and the pawl will be blocked.

The pawl engages when the engine speeds up, and brings the transmission output shaft up through the 0.70:1 ratio with the overdrive main shaft. This action will cause the sun gear to reverse its clockwise (from the rear) rotation and release the pawl to engage the balk ring gear (Fig. 5).

PAWL DISENGAGEMENT

The pawl disengages under two conditions. First, when the car speed drops below about 22 mph, the governor opens the circuit through the relay and de-energizes the solenoid, permitting the return spring to pull out the pawl. Second, the driver may shift the overdrive back to direct drive at any road speed, by pressing the accelerator pedal to the floor so that it depresses the kickdown switch stem.

When this happens, the kickdown switch opens the governor circuit through the relay, and de-energizes the solenoid, permitting the return spring to try to pull out the pawl.

Also, it closes the interrupter circuit and grounds the ignition long enough for the return spring to pull out the pawl.

Normal ignition is restored as soon as the pawl comes out, and the solenoid stem opens the ignition grounding contacts. The actual time of ignition interruption is equal to that required for one revolution of the crankshaft.

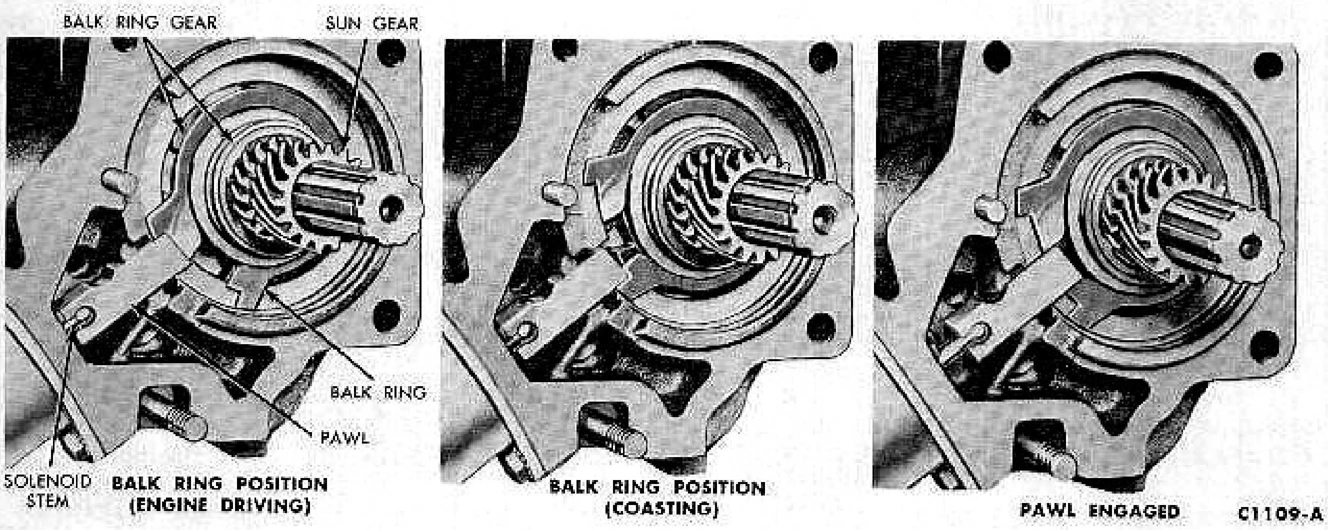


FIG. 5—Pawl and Balk Ring Positions

3 OVERHAUL

REMOVAL

The overdrive unit cannot be removed from the car as a separate assembly. Remove the transmission and overdrive as a unit, and then remove the overdrive unit from the transmission.

To remove the overdrive transmission follow the same procedure as that for the 3-speed Conventional Drive transmission plus the following:

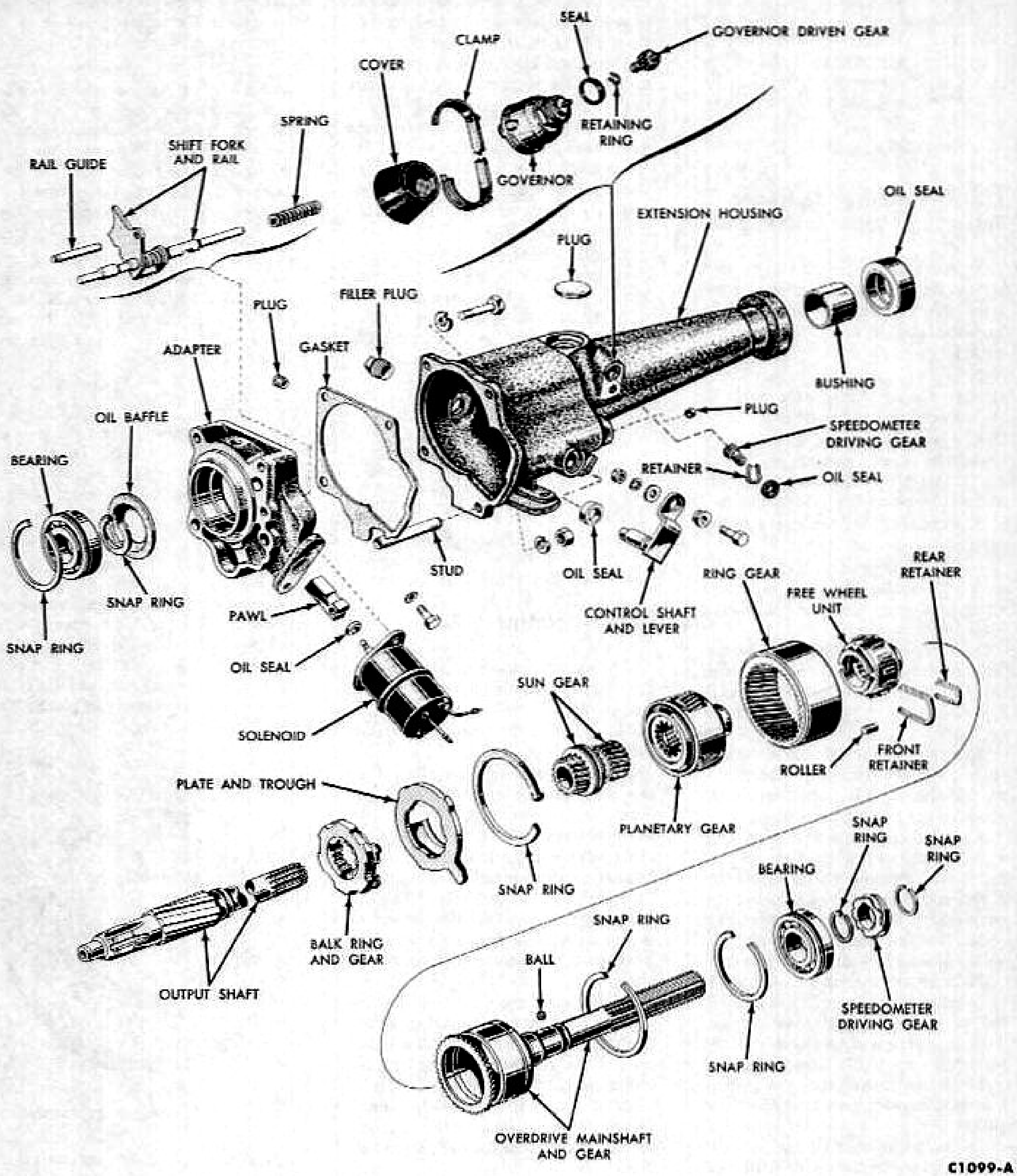


FIG. 6—Overdrive Unit

1. Disconnect the solenoid and governor wires at the connectors near the solenoid.

2. Remove the overdrive wiring harness from its clip on the transmission.

3. Disconnect the overdrive control cable.

DISASSEMBLY

1. Mount the transmission on the bench fixture. Drain the transmission and overdrive.

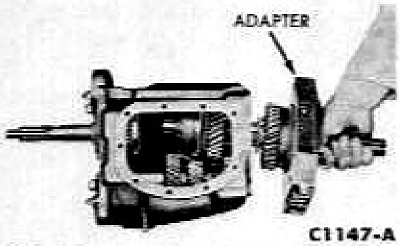


FIG. 7—Overdrive Adapter and Transmission Output Shaft Removal

2. After removing the bolts that secure the gear shift housing to the transmission case, remove the housing and shifter forks. Discard the gasket.

3. With a sharp punch, pierce and remove the snap ring hole cover in the extension housing (Fig. 6).

4. From the bottom, drive out the overdrive manual control shaft lock pin. Pull the manual control lever and shaft out as far as it will go.

5. Remove the overdrive housing attaching bolts.

6. Insert snap ring pliers in the overdrive housing snap ring hole, and spread the snap ring that retains the main shaft bearing.

7. Remove the overdrive housing. To free the output shaft bearing from the housing, it may be necessary to tap on the shaft with a soft-faced hammer.

8. Remove the overdrive main shaft from the assembly. Catch any of the clutch rollers that drop out. Remove the rest of the rollers.

9. After removing the snap ring from the end of the transmission output shaft, remove the overrunning clutch and planet carrier. Remove the snap ring at the rear of the sun gear.

10. Remove the sun gear and the shift rail and fork assembly together.

11. Remove the snap ring that retains the plate and trough assembly in the adapter. The plate and trough, balk ring gear, and pawl can then be removed.

12. Remove the input shaft bearing retainer and gasket. Discard the gasket.

13. If the input shaft seal is to be replaced, use the tools which are used for the 3-speed Conventional Drive transmission (Figs. 11 and 12, Part 5-2).

14. Tap the input shaft forward as far as it will go.

15. Remove the overdrive adapter and transmission output shaft assembly from the case (Fig. 7).

16. With a drift, drive the countershaft from the front of the case and toward the rear until the countershaft clears the front hole. Remove the Woodruff key from the rear of the countershaft as soon as the key clears the case.

17. Push the countershaft through the cluster gear with the bearing retainer tool (Fig. 8). Make sure the cluster gear drops to the bottom of the case. Remove the countershaft from the case.

18. Remove the snap ring from the input shaft bearing outer race. With a soft-faced hammer, drive the input shaft and bearing toward the rear until the bearing clears the case.

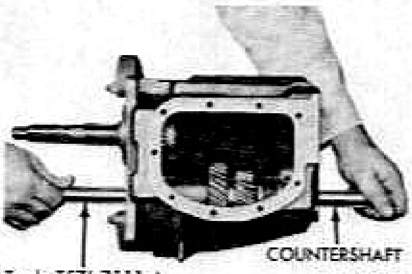


FIG. 8—Countershaft Removal

19. Remove the input shaft and bearing through the gear shift housing opening.

20. Remove the cluster gear from the case.

21. Drive the reverse idler shaft out through the rear of the case. Remove the Woodruff key from the shaft as soon as it clears the case.

22. Remove the snap ring that retains the synchronizer assembly to the transmission output shaft. Slide the synchronizer, blocking ring, intermediate gear, and low and reverse sliding gear from the transmission output shaft.

23. Remove the snap ring that retains the output shaft bearing in the adapter. Tap the bearing and shaft out of the adapter. Remove the oil baffle from the adapter.

24. If the transmission output shaft or overdrive output shaft bearings are to be replaced, use the tools shown in Fig. 6, Part 5-2.

25. The input shaft bearing should be replaced with the tools shown in Fig. 7, Part 5-2.

26. The synchronizer can be disassembled by sliding the high and intermediate sleeve from the hub.

CLEANING AND INSPECTION

Clean and inspect the transmission unit parts in the same way as for the conventional transmission. Clean all overdrive parts thoroughly.

Check the balk ring tension, as shown in Fig. 10, for the specified pull. Read the spring scale while the balk ring is turning because the initial effort required to turn the ring may be considerably higher than the specified pull. Replace the assembly if the tension is not within specification.

Check the inner surface of the free-wheel unit outer race. If this surface is worn, the overdrive main shaft must be replaced. Check the free-wheel unit rollers for cracks and wear. Replace the **complete set** of 12 rollers if **any** are cracked or worn.

ASSEMBLY

Always use new gaskets and gasket sealer during assembly. To provide initial lubrication, apply a thin coating of lubricant on all parts before installation.

1. Place the pilot tool (Fig. 8) in the cluster gear. Slide the spacer over the bearing retainer tool. Install at each end of the cluster gear a row of needle bearings, a flat washer, a second row of needle bearings, and a second flat washer. Place the thrust washers (front and rear) on the cluster gear, and keep them in place with heavy lubricant (Fig. 9, Part 3-2).

FIG. 9—Synchronizer Assembly

2. Place the cluster gear assembly in the case. The tab on the front thrust washer must enter the slot cast in the case. The tab on the steel washer at the rear must be at the top.

3. Place the reverse idler gear in position in the case, with chamfered gear teeth ends toward the front. Install the reverse idler shaft and Woodruff key.

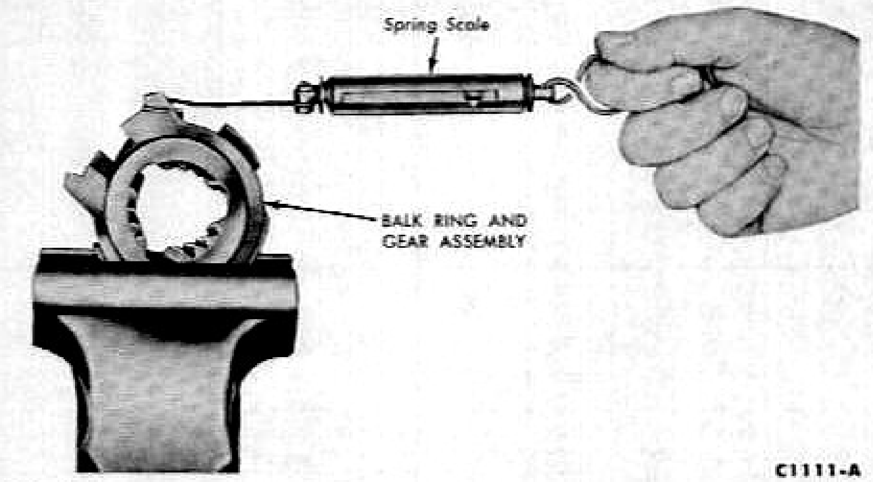


FIG. 10—Balk Ring Tension Check

4. Assemble the pilot rollers in the input shaft. Install the input shaft and bearing through the side of the case and tap into place with a soft-faced hammer. Install the snap ring on the input shaft bearing outer race. Place a new gasket on the bearing retainer and install it.

5. Turn the transmission upside down and work the cluster gear into position. Start the countershaft from the rear of the case, and push the bearing retainer tool out the front. Install the Woodruff key and drive the countershaft until flush with the rear face of the transmission case.

6. Slide the oil baffle onto the transmission output shaft, with the dished side next to the bearing.

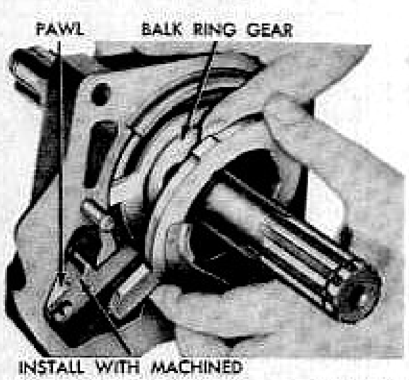


FIG. 11—Plate and Trough Installation

7. Install the transmission output shaft and bearing in the overdrive adapter. Install the selective-fit snap ring which secures the bearing in the adapter.

8. Install the low and reverse sliding gear on the output shaft, with the shifter fork groove toward the front.

9. Install the intermediate and high gear on the output shaft, with the clutch teeth toward the front.

10. Assemble the synchronizer by placing the three inserts in position. Place a spring at each end of the hub, and hook one spring end in an insert (Fig. 9). Align the etched marks on the sleeve and hub splines, and slide the sleeve over the hub with the shifter fork groove toward the rear.

11. Slide the synchronizer assembly onto the output shaft, with the rear blocking ring in place, and install the snap ring.

12. Place the pilot roller bearing flat washer on the output shaft journal, and retain with grease.

13. Place a new gasket on the front side of the adapter and retain with gasket sealer.

14. Install the output shaft assembly and adapter in the case (Fig. 7). Secure the adapter in place with a bolt.

15. Place the balk ring assembly in the adapter with the balk ring side out.

16. Install the pawl with the machined recess in line with the shift rail hole, and then install the plate and trough assembly. Install the snap ring.

17. Install the overdrive shift rail and fork assembly and sun gear at the same time (Fig. 10). Install the snap ring in the transmission output shaft groove at the rear of the sun gear.

18. Slide the planet carrier and clutch cam onto the output shaft, and install the snap ring.

19. Install the clutch rollers and hold in place with a strong rubber band. Slide the overdrive main shaft carefully over the clutch rollers.

20. Align the overdrive shift rail spring with the holes in the housing.

21. Place a new gasket (Fig. 6) on the adapter and hold it there with gasket sealer.

22. Install the overdrive housing over the main shaft and shift rail, and start the bolts. Install the overdrive main shaft bearing snap ring. Install a new cover.

23. Tighten the overdrive housing attaching bolts.

24. Engage the overdrive control shaft and lever by pushing it inward. Install the retaining pin.

25. If replacement of the overdrive housing bushing and/or seal is necessary, use the tools shown in the following illustrations:

Seal removal—Fig. 4, Part 5-2.
Bushing removal—Fig. 5, Part 5-2.
Bushing installation—Fig. 13, Part 5-2.
Seal installation—Fig. 14, Part 5-2.

26. With the cap drain hole at the bottom, rotate the solenoid ¼ turn from normal position, so that the half-ball on the solenoid stem can engage the pawl. Install the two cap screws.

27. Install the drain plugs in the transmission case and overdrive housing.

FIG. 12—Sun Gear and Shift Rail Installation

INSTALLATION

To install the overdrive transmission, follow the same procedure as that for the 3-speed Conventional Drive transmission plus the following:

1. Connect the overdrive control cable so that there is ¼-inch clearance between the handle shank and dash bracket when the lever at the overdrive housing is against its rear stop.

2. Connect the solenoid and governor wires, and replace the overdrive wiring harness in its clip.

PART 5-4 SPECIFICATIONS

CLUTCH ADJUSTMENTS

	Inches
Clutch Pedal Free Travel (Engine Idling)	1.00
Clutch Pedal Total Travel	6⅝ - 6⅞
Maximum Variation of Finger Height	0.031

CLUTCH ADJUSTMENTS (Continued)

	Inches
Maximum Indicator Reading of Concentricity—Flywheel Housing Bore to Crankshaft Centerline	0.010
Maximum Indicator Reading of Face Squareness—Flywheel Housing Mounting Face to Crankshaft Centerline*	0.007

*Using Tool No. 6392-N

CLUTCH IDENTIFICATION

Engine	Pressure Plate			Disc	
	Diameter (inches)	Number of Springs	Spring Color	Number of Springs	Spring Color
352 V-8	11	9	Pea Green	12	Blue

TRANSMISSION GEAR RATIOS

Engine	1st Gear		2nd Gear		3rd Gear		Reverse Gear		4th Gear
	Conventional Drive	Overdrive	Conventional Drive	Overdrive	Conventional Drive	Overdrive	Conventional Drive	Overdrive	Overdrive
352 V-8	2.49	2.49	1.59	1.59	1.00	1.00	3.15	3.15	0.72

LUBRICANT REFILL CAPACITIES

	Pints (Approximate)
Conventional Drive	3
Overdrive	4

TRANSMISSION ADJUSTMENT

	Inches
Cluster Gear End Play	0.004 - 0.018

TORQUE SPECIFICATIONS

Bolts	Foot Pounds
Flywheel Housing to Block	40-50
Clutch Pressure Plate and Cover Plate Assembly to Flywheel	23-28
Lower Access Cover Plate to Flywheel Housing	17-20
Transmission Extension to Transmission Case	37-42
Rear Mount Attaching Retainer to Transmission	40-45

GROUP 6

CRUISE-O-MATIC TRANSMISSION

PART 6-1 DESCRIPTION AND OPERATION

Two Cruise-O-Matic transmissions are used in 1960 Thunderbirds.

The transmission used with the 352 V-8 engine has a COSP-7003-A part number and a PBL-AH serial number prefix. Serial numbers on both transmissions begin at 10,001.

The transmission used with the 430 V-8 engine has a PBB-7003-M part number and a PBB-M (260) serial number prefix.

The two transmissions are identical in torque converter, control valve body, clutch, servo, and planetary gear operation. They differ in size and, in some cases, in construction. The service procedures given here apply to both transmissions unless otherwise noted. In the text, the transmissions are referred to as the PBL and the PBB.

1 TORQUE CONVERTER

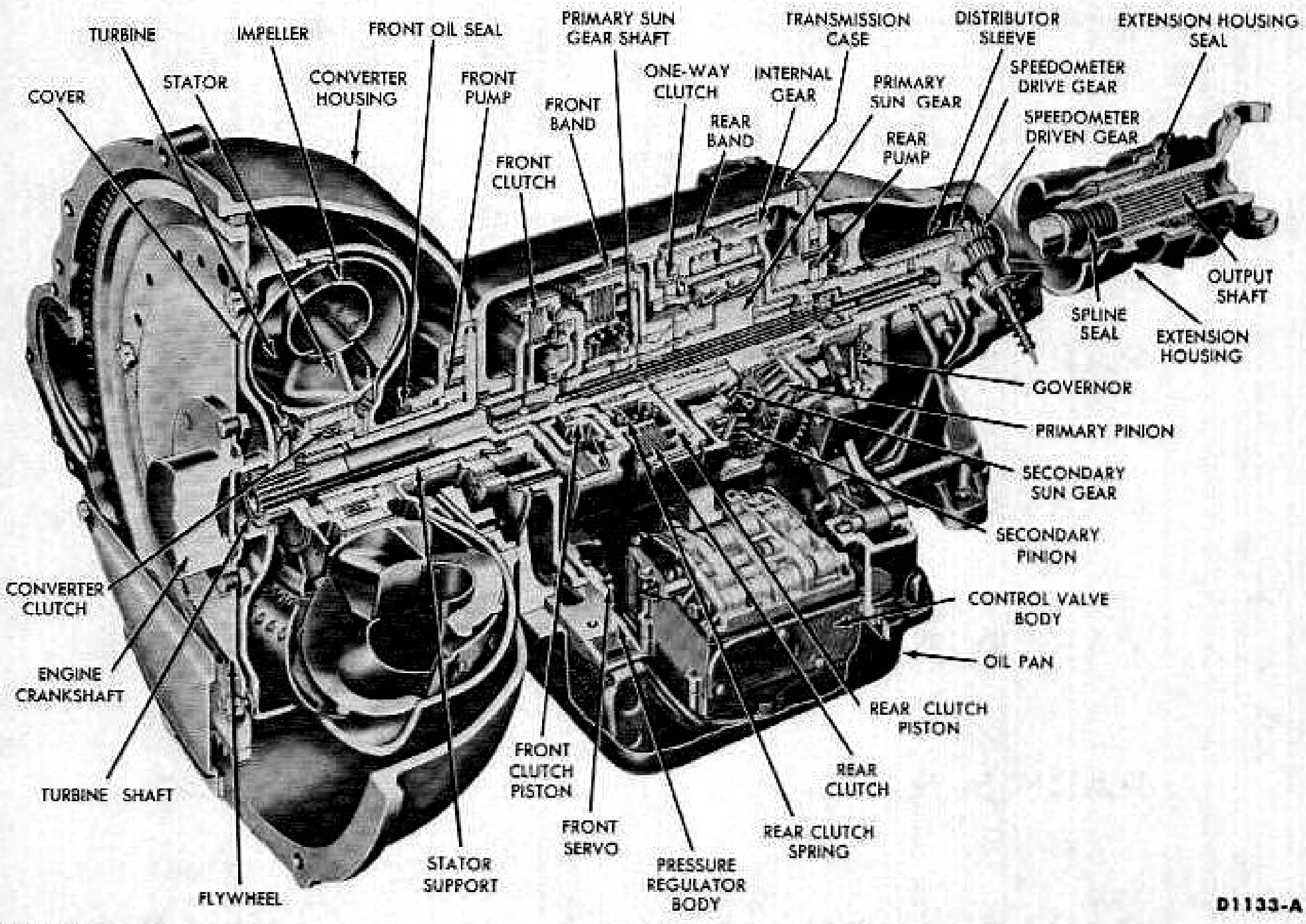


FIG. 1—Typical Cruise-O-Matic Transmission

The hydraulic torque converter (Fig. 2) consists of an impeller (pump), a turbine, and a stator. All these parts are enclosed and operate in a fluid-filled housing.

When the engine is running, the fluid in the torque converter flows from the impeller to the turbine and back to the impeller through the

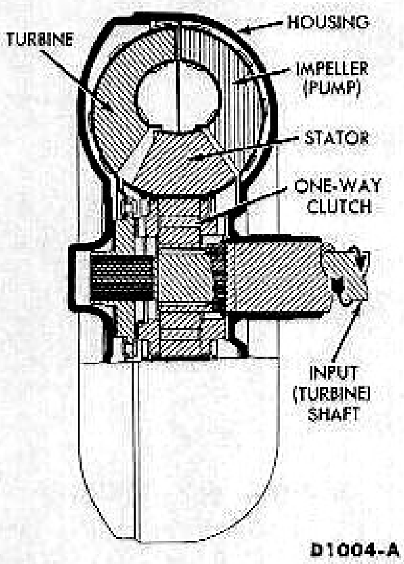


FIG. 2—Cross-Section of Typical Torque Converter

stator. This flow produces a maximum torque increase of about 2 to 1 when the turbine is stalled. When enough torque is developed by the engine and impeller, the turbine begins to rotate, turning the turbine shaft.

The converter torque multiplication gradually tapers off as turbine speed approaches impeller speed, and it becomes 1 to 1 when the turbine is being driven at 9/10 impeller speed. This is known as the "coupling point."

When the turbine is rotating at less than 9/10 impeller speed, the converter is multiplying torque. The fluid leaving the turbine blades strikes the front face of the stator blades. These blades are held stationary by the action of a one-way clutch (Fig. 2) as long as the fluid is directed against the front face of the blades.

When the turbine rotates faster than 9/10 impeller speed, the converter no longer multiplies torque. The fluid is directed against the back face of the stator blades. As the one-way clutch permits the stator to rotate only in the direction of impeller rotation, the stator begins to turn with the impeller and turbine. The converter operates as an efficient fluid coupling as long as the turbine speed remains greater than 9/10 impeller speed.

A constant flow of fluid into and out of the converter is maintained. Some of the fluid coming out of the converter is forced through a cooler located in the radiator tank (Fig. 3).

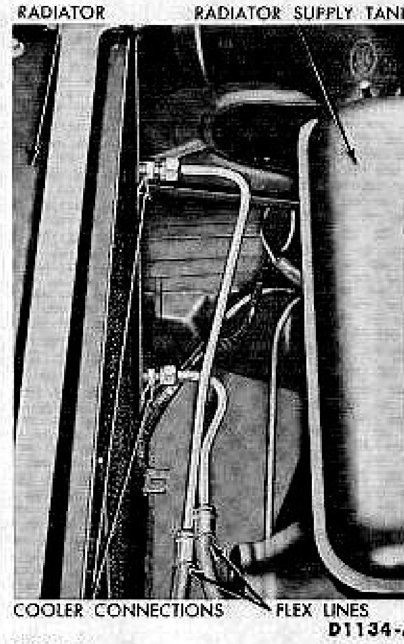


FIG. 3—Transmission Fluid Cooler Location

2 PLANETARY GEAR TRAIN, CLUTCHES, BANDS, AND SERVOS

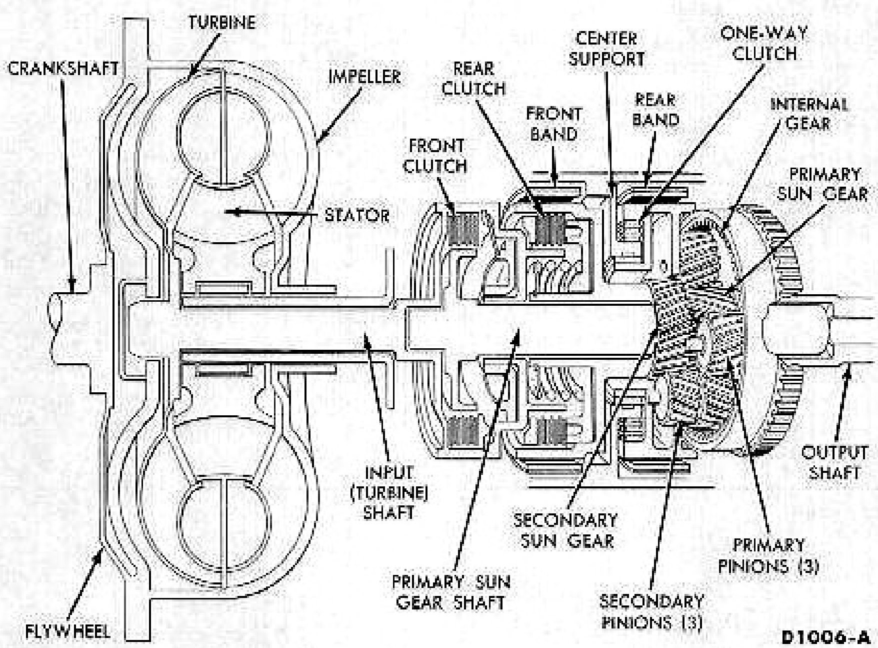


FIG. 4—Planetary Gear Train

The compound planetary gear train transmits power from the torque converter turbine shaft to the transmission output shaft. Hydraulic clutches and servo-operated bands drive or hold certain gears to provide the various transmission output ratios.

PLANETARY GEAR TRAIN

The planetary gear train consists of a primary sun gear, secondary sun gear, primary and secondary pinions which are held in a common carrier, and an internal gear to which the transmission output shaft is attached (Fig. 4).

FRONT CLUTCH

The front clutch drive plates (Fig. 5) are connected to the turbine shaft

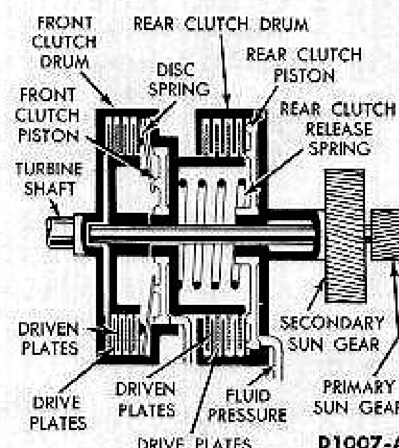


FIG. 5—Front and Rear Clutches

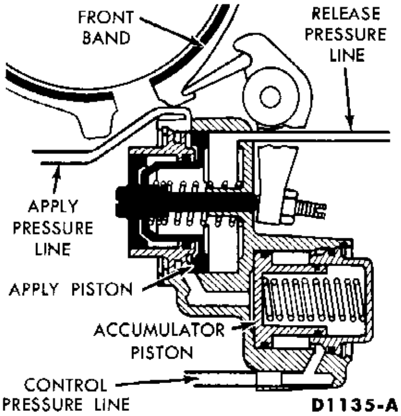


FIG. 6—Front Servo

through the front clutch drum. The driven plates are connected to the primary sun gear shaft.

The front clutch is operated by fluid pressure against the clutch piston. The piston moves against a disc spring which acts as a lever to lock the drive and driven plates together. When the clutch is applied, the primary sun gear is locked to and driven by the turbine shaft. The piston is returned to the release position by the disc spring when the fluid pressure is removed (Fig. 5).

In neutral, the front clutch drum and steel plates are being driven while the bronze plates are stationary. In reverse, the clutch is not applied, since the steel and bronze plates must rotate in opposite directions.

REAR CLUTCH

The rear clutch (Fig. 5) is operated by fluid pressure against the clutch piston. Movement of the piston compresses the release spring and locks the multiple-disc clutch. The rear clutch drive plates are splined to the front clutch drum and the driven plates are connected to the rear clutch drum and secondary sun gear. When the rear clutch is applied (in the reverse and third gear ratios) the secondary sun gear is driven. The piston is returned to the released position by the release spring (Fig. 5).

In neutral, the rear clutch bronze plates are being driven while the steel plates are free. In second gear, the bronze plates are driven, but the steel plates are held stationary. In first gear, the bronze plates are driven clockwise at engine speed while the steel plates are driven counterclockwise.

FRONT BAND AND SERVO

One end of the front band, which encircles the rear clutch drum, is anchored to the transmission case, and the other end is connected to the front servo.

Fluid pressure moves the front servo piston against the inner end of the front servo actuating lever. Force is transmitted through a strut between the outer end of the lever and the end of the band to tighten the band around the rear clutch drum. Under certain conditions, the servo is released by directing fluid pressure to the opposite side of the piston, assisted by release spring force.

An accumulator piston in the front servo operates with the apply piston to cushion band application. Fluid pressure is exerted against both the apply piston and the accumulator piston at the same time. However, the apply piston offers less resistance to the pressure than the accumulator piston, and rapidly moves out to start band application (Fig. 6).

When the fluid pressure overcomes the resistance of the accumulator piston, this piston is forced to move out. At this time, both pistons offer equal resistance to the pressure, and continue to move out together more slowly to cushion final band application.

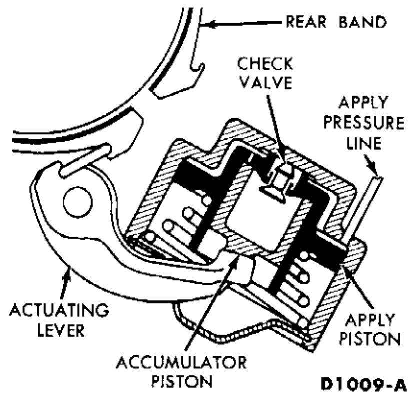


FIG. 7—Rear Servo

REAR BAND AND SERVO

The rear band fits around the planetary gear drum. One end of the band contacts the end of the band adjusting screw, and the other end connects to the rear servo.

Two rear servo pistons apply the rear band (Fig. 7). The small (fast-acting) piston, which is in direct contact with the servo lever, is located inside the large piston.

Fluid pressure against the large piston flows through a check valve to work against the small piston, which has low pressure resistance from the spring force of the rear band and whatever friction is in the servo lever and band struts. At a very low apply pressure and small volume of fluid flow, the small piston moves out and tightens the rear band on the pinion carrier.

When the apply pressure builds up to about 10 psi, the large piston moves out against its return spring, allowing the check valve to close. When the check valve closes, the fluid in the small piston is trapped, and the apply force of the large piston is added to that of the small piston.

With full band application, the trapped fluid can bleed out through an orifice, allowing the small piston to bottom on the large piston.

3 POWER FLOWS

Table 1 lists the ratios obtained through the various power flows.

POWER FLOW—NEUTRAL

When the transmission is in neutral (Fig. 8), none of the gear train members is held or driven, and no power is transmitted to the output shaft.

POWER FLOW—FIRST GEAR, L

In first gear when the selector lever is at L, the primary sun gear is driven and the pinion carrier is held by the rear band (Fig. 8). Power is transmitted to the primary pinions, the secondary pinions, and the internal gear, driving the internal gear in the same direction as the primary sun gear. The secondary sun gear turns free in the reverse direction and has no effect on the gear train.

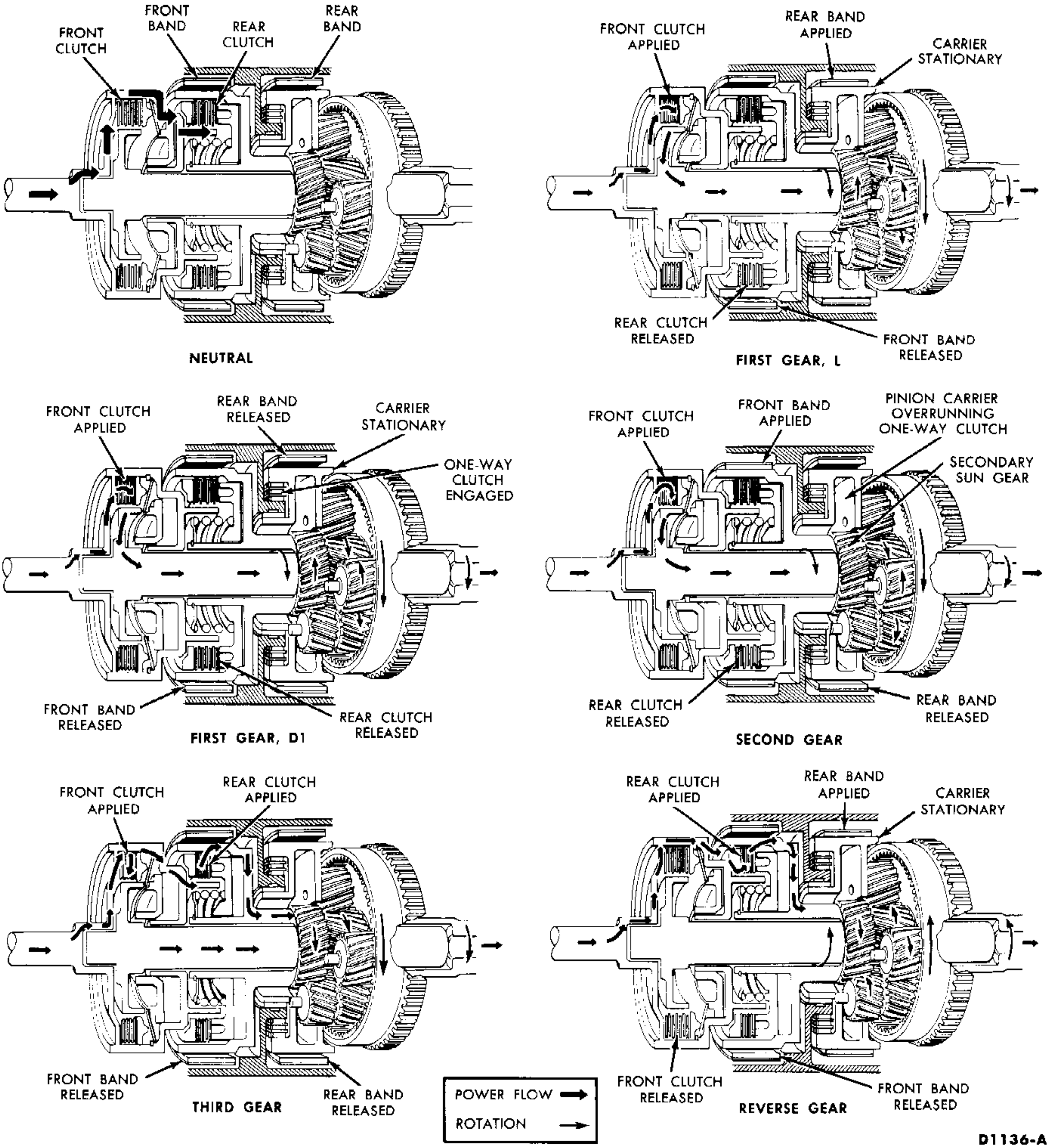


FIG. 8—Power Flows

POWER FLOW—FIRST GEAR, D1

In first gear at the D1 selector lever position, the pinion carrier is held against rotation by the one-way clutch instead of by the rear band (Fig. 8). First gear at D1 is the only gear that uses the one-way clutch.

POWER FLOW—SECOND GEAR

Second gear ratio is obtained by driving the primary sun gear and holding the secondary sun gear (Fig. 8). The primary pinions drive the secondary pinions, causing them to "walk" around the secondary sun gear and to carry the internal gear and output shaft around with them.

POWER FLOW—THIRD GEAR

In third gear, the primary and secondary sun gears are locked together and driven as a unit (Fig. 8). Therefore, the pinions cannot rotate and the entire planetary train revolves as a unit, which causes the output shaft to rotate at the same speed as the turbine shaft.

TABLE 1—Cruise-O-Matic Gear Ratios

Gear	Selector Lever Postion	Clutch Applied	Band Applied	Gear Ratio : 1	
				PBL	PBB
Neutral	N	None	None	—	—
First	D1 or L	Front	Rear*	2.40	2.37
Second	D1 or D2	Front	Front	1.47	1.48
Third	D1 or D2	Front and Rear	None	1.00	1.00
Reverse	R	Rear	Rear	2.00	1.84

*In first gear D1, the planet carrier is held against rotation by the one-way clutch.

POWER FLOW—REVERSE GEAR

Reverse gear is obtained by driving the secondary sun gear and holding the pinion carrier (Fig. 8). The secondary pinions drive the internal gear in the reverse direction. The primary sun gear and the primary pinions rotate freely and have no effect on the gear train.

POWER FLOW—PARK POSITION

When the selector lever is in the P (park) position, the parking pawl engages the external teeth on the internal gear to lock the internal gear and output shaft to the case. This locks the rear wheels to prevent movement of the car.

4 HYDRAULIC CONTROL SYSTEM OPERATION

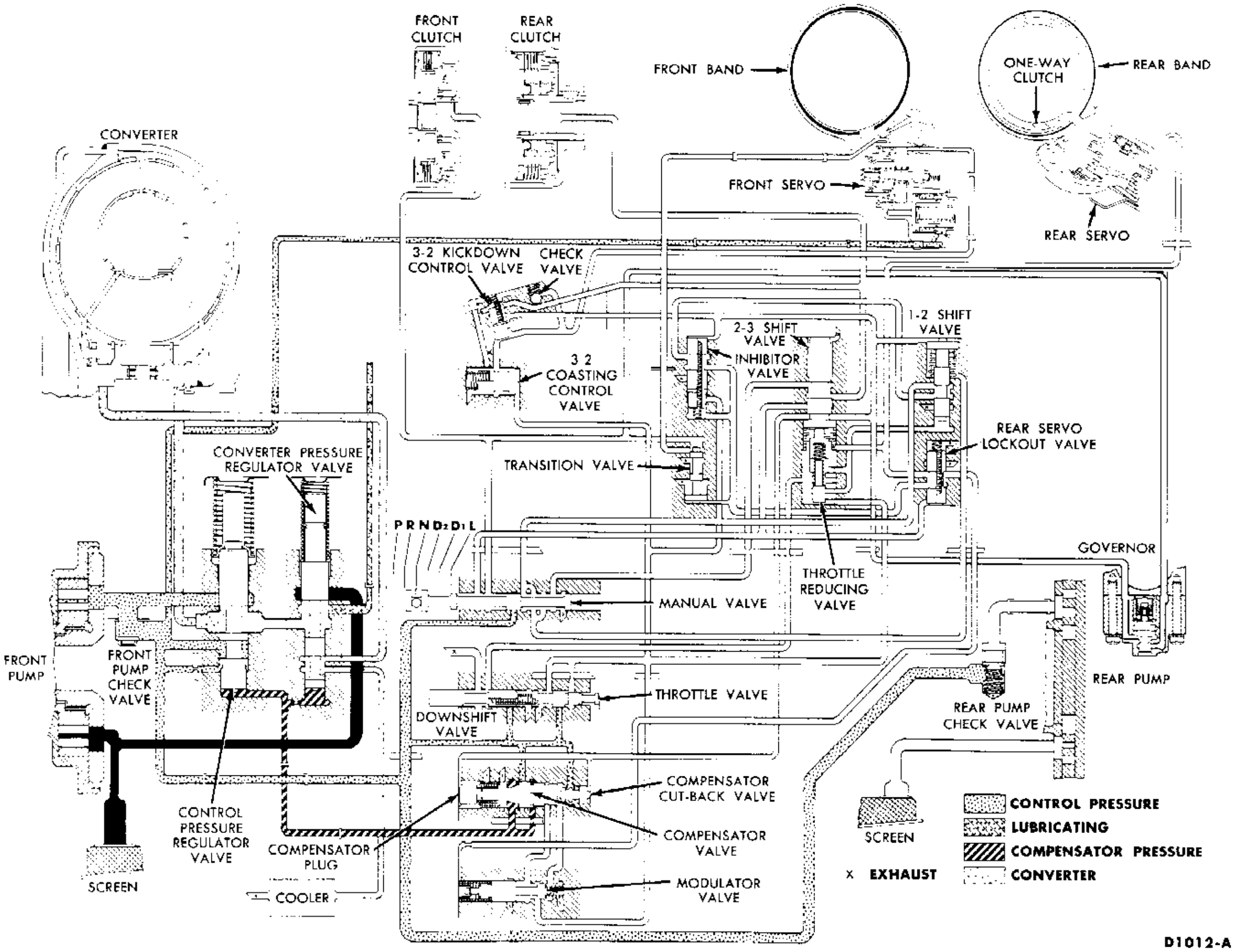


FIG. 9—Hydraulic Control System—Neutral Position

PRESSURE PUMPS

The front pump (Fig. 9), driven by the converter impeller, delivers fluid pressure to the transmission hydraulic control system whenever the engine runs. The rear pump, driven by the transmission output shaft, delivers fluid pressure to the control system when the car moves forward.

Both pumps deliver fluid pressure to the control pressure regulator and control valve body. A regulated control pressure is available at the control valve body whenever the engine is running or the car is moving forward above approximately 15 mph.

THROTTLE PRESSURE

Throttle pressure adjusts transmission operation to engine torque. This pressure is produced from control pressure by the throttle valve (Fig. 9), and is controlled by the compression on the throttle valve spring when the accelerator pedal is depressed.

Throttle pressure will vary from zero (at closed throttle) to the same pressure as maximum control pressure (at wide-open throttle).

MODULATED THROTTLE PRESSURE

In D1 and D2, a modulated throttle pressure is directed to one face on the compensator valve to adjust compensator pressure to accelerator pedal depression (engine torque).

In L and R, the modulator valve is positioned by control pressure so that full throttle pressure is directed to two faces on the compensator valve. This causes a greater decrease in compensator pressure with throttle opening; hence, a greater increase in control pressure.

SHIFT VALVE PLUG PRESSURE

Before throttle pressure is admitted to the 2-3 shift delay valve, it must open a passage past the spring-loaded throttle reducing valve.

Approximately 20 psi throttle pressure is required to move the plug against its spring far enough to open the passage; hence, the pressure past the plug is reduced.

GOVERNOR PRESSURE

Governor pressure is produced from control pressure by the valve in the governor body which rotates at output shaft speed.

Governor pressure acting on a valve face balances centrifugal force acting on the governor weight and governor valve, and is, therefore, proportional to road speed.

CONTROL PRESSURE AND COMPENSATOR PRESSURE

Control pressure is regulated by the spring-loaded control pressure regulator valve (Fig. 9). It is adjusted to engine torque, road speed, and selector lever position.

To accomplish this, compensator pressure under various conditions is adjusted by throttle pressure (engine torque), governor pressure (road speed), or selector lever position. Compensator pressure, in turn, adjusts control pressure.

CONVERTER PRESSURE

Like control pressure, converter pressure is regulated by the converter pressure regulator valve spring and is adjusted to driving conditions by compensator pressure.

DOWNSHIFT VALVE

The downshift valve is in the control valve body bore with the throttle valve. The inner throttle lever contacts one end of the spring-loaded downshift valve.

Control pressure is directed to a land of the valve. Linkage is connected between the accelerator pedal and throttle lever. The downshift valve is moved to open a passage to direct control pressure to the 2-3 shift valve and 1-2 shift valve when the accelerator pedal is depressed through the detent.

TRANSITION VALVE

The transition valve makes possible a 3-1 closed throttle downshift in D1 operation. This valve admits or blocks control pressure to the front servo apply piston. It is opened by control pressure to the front servo, and is closed by control pressure through the 1-2 valve.

INHIBITOR VALVE

The inhibitor valve prevents a shift into first gear when the selector lever is moved to L above 28 mph by blocking control pressure to the rear servo. The valve is closed by governor pressure and is opened by spring force and throttle pressure.

REAR SERVO LOCKOUT VALVE

The rear servo lockout valve blocks control pressure flow to the rear servo in D1 and D2 ranges.

1-2 SHIFT VALVE

The 1-2 shift valve controls the 1-2 shift, the closed-throttle 3-1 shift, and the partial-to-full-throttle 2-1 shift. The valve is held in its rest position by a spring and throttle pressure, and is opened by governor pressure.

3-2 COASTING CONTROL VALVE

The 3-2 coasting control valve (Fig. 9) operates in the front servo release passage.

During a 3-2 closed-throttle downshift in D2 range, the valve is positioned by its spring so that front servo release pressure must exhaust slowly through an orifice. This slow exhaust of release pressure provides a slow front band application.

During a partial-to-full-throttle 3-2 downshift, the 3-2 coasting control valve is positioned by throttle pressure so that the front servo release pressure can exhaust rapidly to provide a rapid front band application.

3-2 KICKDOWN CONTROL VALVE

The 3-2 kickdown control valve operates in the front servo release pressure passage between the 2-3 valve and the front servo. A check valve is installed parallel with the kickdown valve in the same passage so that release pressure flow to the servo by-passes it.

The kickdown valve controls the rate of front servo release pressure exhaust (flow from the servo), and thereby the rate of front band application.

The 3-2 kickdown control valve eliminates the possibility of a runaway condition in the transmission during a 3-2 kickdown at low car speeds (about 25 mph). It also eliminates the possibility of a tie-up during the same shift at higher speeds (50 mph and more).

HYDRAULIC CONTROL SYSTEM—NEUTRAL

The manual valve at N selector lever position blocks the fluid flow to both clutches and both bands. With no fluid pressure in the clutches or servos, the clutches and bands are released by spring pressure, preventing power being transmitted to the transmission output shaft.

Neutral operation of the transmission keeps control pressure up to its proper value, maintains a full torque converter, lubricates the transmission, and maintains a flow of fluid through the cooling system.

HYDRAULIC CONTROL SYSTEM—D1, FIRST GEAR

When the selector lever is moved from N to D1, the manual valve opens three passages to control pressure. From left to right (Fig. 9), the first passage admits control pressure to supply the 2-3 valve and close the rear servo lockout valve. The second passage admits control pressure to apply the front clutch, supply the governor and transition valve. The third passage admits control pressure to flow through the 1-2 and inhibitor valves and close the transition valve.

With the front clutch applied, the primary sun gear tries to drive the pinion carrier in a counterclockwise direction. Counterclockwise rotation at the pinion carrier is prevented by the one-way clutch. With the front clutch applied and the pinion carrier held, the transmission is in first gear.

HYDRAULIC CONTROL SYSTEM—D1, SECOND GEAR

The 1-2 shift occurs when governor pressure force on the 1-2 shift valve overcomes shift plug pressure and spring forces. The 1-2 valve moves inward, exhausting the fluid which holds the transition valve closed. The transition valve opens and admits control pressure to apply the front band.

The front clutch remains on, and the front band applies to put the transmission in second gear.

HYDRAULIC CONTROL SYSTEM—D1, THIRD GEAR

The 2-3 shift occurs when governor pressure force overcomes spring and shift plug pressure force at the 2-3 shift valve. When the shift valve opens, control pressure flows through it to apply the rear clutch and release the front band. With both clutches applied, the transmission is in third gear.

HYDRAULIC CONTROL SYSTEM—D2, SECOND GEAR

When the manual valve is at the D2 selector lever position, control pressure to the 1-2 shift valve is cut off. This condition permits control pressure to flow through the transition valve to apply the front band.

With the front clutch and the front band applied, the transmission operates in second gear.

HYDRAULIC CONTROL SYSTEM—D2, THIRD GEAR

Operation in D2 range, third gear is the same as in D1 range, third gear except that the closed throttle downshift is from third to second in D2 instead of from third to first as in D1.

HYDRAULIC CONTROL SYSTEM—D1 AND D2, 3-2 KICKDOWN

When the accelerator pedal is depressed through the detent, the downshift valve opens a passage that admits control pressure behind the 2-3 shift plug to oppose governor pressure. If the transmission is in high and road speed is below 54-67 mph, the 2-3 valve will be forced closed against governor pressure. When the 2-3 valve closes, control pressure which has been applying the rear clutch and releasing the front band is exhausted. The apply pressure that was in the front servo in third gear is now free to apply the front band. As soon as the front band applies, the transmission is in second gear.

HYDRAULIC CONTROL SYSTEM—L, FIRST GEAR

In L range, first gear, control pressure is directed by the manual valve to apply the front clutch and rear band. Control pressure is also directed by the manual valve to lock the 1-2 and 2-3 shift valves in their closed positions. Since neither shift valve can move, the transmission will stay in first gear regardless of throttle position or road speed.

HYDRAULIC CONTROL SYSTEM—REVERSE

When the manual valve is shifted into reverse, control pressure is directed to apply the rear clutch and rear band. Governor supply pressure is cut off by the manual valve; hence, the transmission cannot shift automatically.

PART 6-2 LUBRICATION AND ADJUSTMENTS

1 LUBRICATION

TRANSMISSION FLUID RECOMMENDATIONS

Ford Automatic Transmission Fluid B8A-19582-A is recommended for use in Cruise-O-Matic transmissions. Substitute fluids or oils may affect the operation of the transmission.

Oil-soluble red dye, useful in detecting transmission fluid leaks, can be added to the fluid without harmful effects to the transmission.

TRANSMISSION FLUID LEVEL CHECK

The transmission fluid level should be checked at 1000-mile intervals.

1. Make sure the car is standing level, and then firmly apply the parking brake.
2. Run the engine at normal idle speed. If the transmission fluid is cold, run the engine at fast idle speed (about 1200 rpm) until the fluid reaches its normal operating temperature. When the fluid is warm, slow the engine down to normal idle speed.
3. Shift the selector lever through all positions, and place the lever at P.
4. Clean all dirt from the transmission fluid dipstick cap before removing the dipstick from the filler tube.
5. Pull the dipstick out of the tube, wipe it clean, and push it all the way back into the tube.
6. Pull the dipstick out of the tube again, and check the fluid level. If necessary, add fluid through the filler tube to raise the fluid level to the F (full) mark on the dipstick. **Do not overfill.**

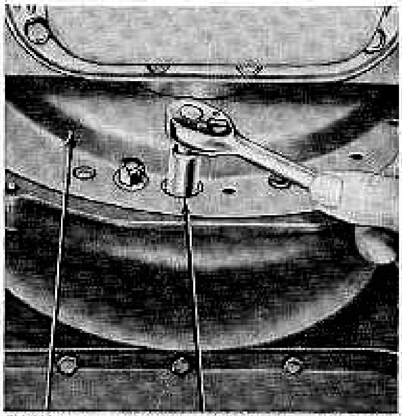


FIG. 1—Converter Drain Plug Removal

TRANSMISSION FLUID CHANGE

The transmission fluid should be changed as recommended in Group 17. The approximate refill capacity is 10 quarts for the PBL transmission, and 10½ quarts for the PBB transmission.

1. Remove the cover from the lower front side of the converter housing.
2. Remove one of the converter drain plugs (Fig. 1).
3. Rotate the converter 180° and remove the other plug. **Do not attempt to turn the converter with a wrench on the converter stud nuts.**
4. Disconnect the fluid filler tube from the transmission oil pan.
5. When the fluid has stopped draining from the transmission and converter, remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.
6. Place a new gasket on the oil pan, and install the screen and pan on the transmission.
7. Connect the filler tube to the oil pan, and tighten the fitting securely.
8. Install both drain plugs in the converter cover, and torque them to 15-28 foot-pounds.
9. Install the converter housing cover.
10. Add 5 quarts of fluid to the transmission through the filler tube.
11. Run the engine at idle speed for about 2 minutes, and add 5 more quarts of fluid. Run the engine at fast idle speed (about 1200 rpm) until it reaches its normal operating temperature. **Do not race the engine.**
12. Shift the selector lever through all the positions, place it at P, and check the fluid level. If necessary, add enough fluid to the transmission to raise the level to the F (full) mark on the dipstick. **Do not overfill.**

2 CONTROL LINKAGE ADJUSTMENTS

The transmission control linkage adjustments should be performed in the order in which they appear in this section of the manual.

THROTTLE LINKAGE ADJUSTMENT

PRELIMINARY ADJUSTMENT

1. Apply the parking brake, and place the selector lever at N.
2. Run the engine at normal idle speed. If the engine is cold, run the engine at fast idle speed (about 1200

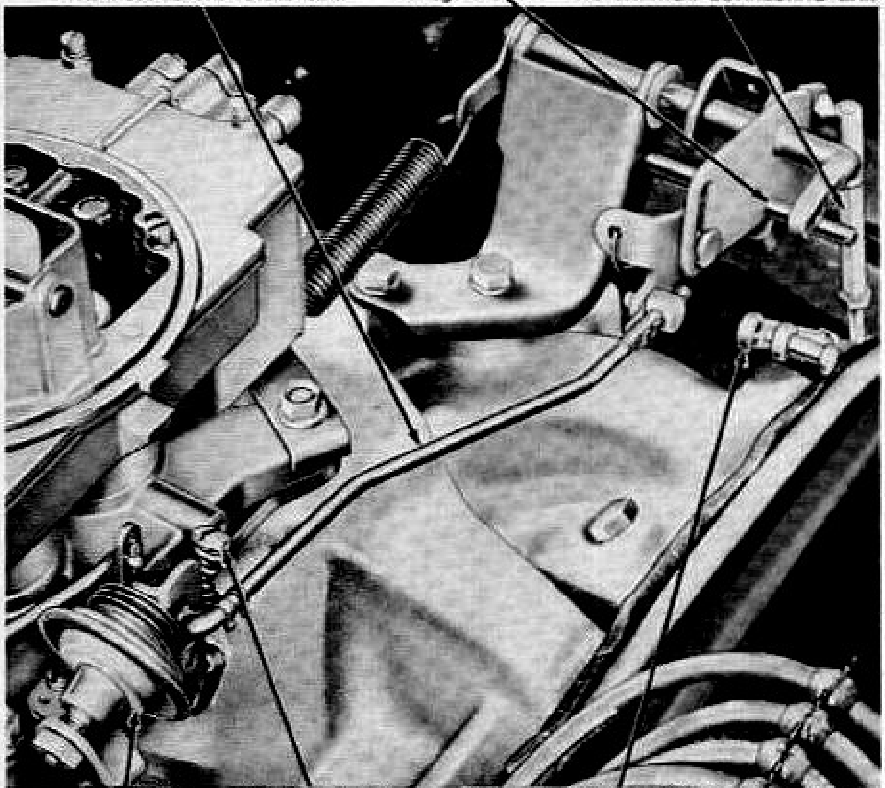


FIG. 2—Throttle Linkage

rpm) until it reaches normal operating temperature. When the engine is warm, slow it down to normal idle speed.

3. Connect a tachometer to the engine.

4. Adjust engine idle speed to 450-475 rpm with the transmission selector in D1 or D2.

The carburetor throttle lever must be against the idle adjusting screw (Fig. 2) at 450-475 rpm in D1 or D2. To make sure that the carburetor throttle lever is against the adjusting screw, make the following checks:

Check for clearance between the bottomed dashpot plunger and the carburetor lever at engine idle.

Check the position of the fast idle cam. It must be in the hot position.

5. After the engine idle speed has been properly adjusted, stop the engine and adjust the anti-stall dashpot clearance.

On cars with an external type dashpot (Fig. 2), check the clearance between the dashpot plunger and the throttle lever. Bottom the dashpot plunger against its spring, and then adjust the clearance between the bottomed plunger and the throttle lever to 0.060-0.090 inch.

On cars with an internal type dashpot (Carter Carburetor), the dashpot is checked at the closed-throttle and wide-open throttle positions (Fig. 3).

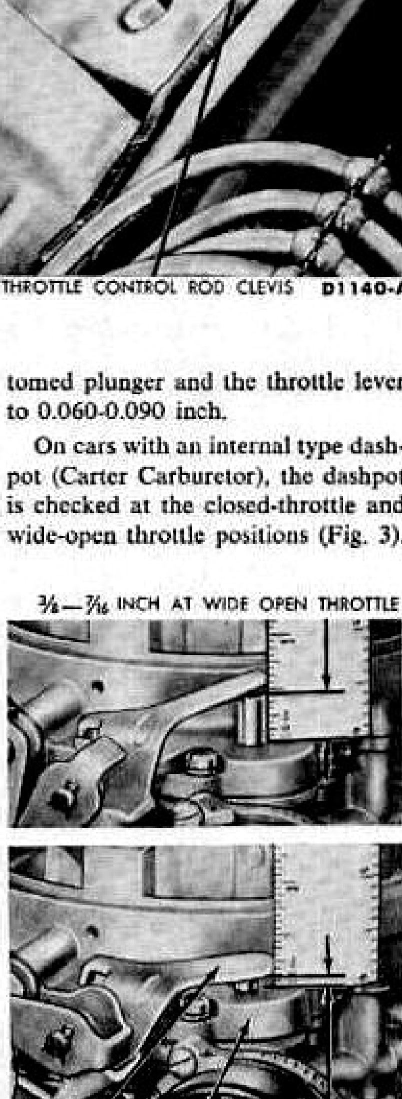


FIG. 3—Dashpot Adjustment on Carter Carburetor

With the primary throttle plates closed to the hot idle position, there should be a 1/16—3/32-inch clearance between the dashpot plunger operating lever and the top surface of the air horn (Fig. 3).

With the primary throttle plates wide open, there should be a clearance of 3/8-7/16-inch between the dashpot plunger operating lever and the top surface of the air horn.

If clearances are not within limits, refer to Part 3-1 for adjustment procedures.

6. Disconect the throttle control rod clevis from the accelerator assembly.

7. Disconnect the carburetor connecting link from the accelerator assembly.

8. Insert a gauge pin (1/4 inch drill rod) through the gauging holes as shown in Fig. 2.

9. Lift the carburetor connecting link to its normal operating position. Maintain forward pressure on it so that the carburetor throttle lever is held solidly against the idle adjusting screw. With forward pressure on the link, adjust its length so that the trunnion can be freely fitted into the accelerator assembly lever. From this free-fit position, rotate the trunnion one full turn counterclockwise to lengthen the link. Remove the gauge pin and connect the link to the accelerator assembly lever.

10. Check the alignment of the gauge pin holes. Open the throttle and permit the throttle linkage retracting spring to return the linkage to its hot idle position. Now, the pin must enter freely. If necessary, readjust the carburetor connecting link to obtain a free entry for the gauge pin.

11. Remove the gauge pin and adjust the throttle control rod. Pull upward gently but firmly on the rod to hold the transmission lever against its internal stop.

12. Rotate the clevis until the clevis pin freely fits the accelerator assembly lever. Lengthen the throttle control rod by rotating the clevis 3 turns counterclockwise to obtain an approximate setting.

13. Connect the throttle control rod to the accelerator assembly lever.

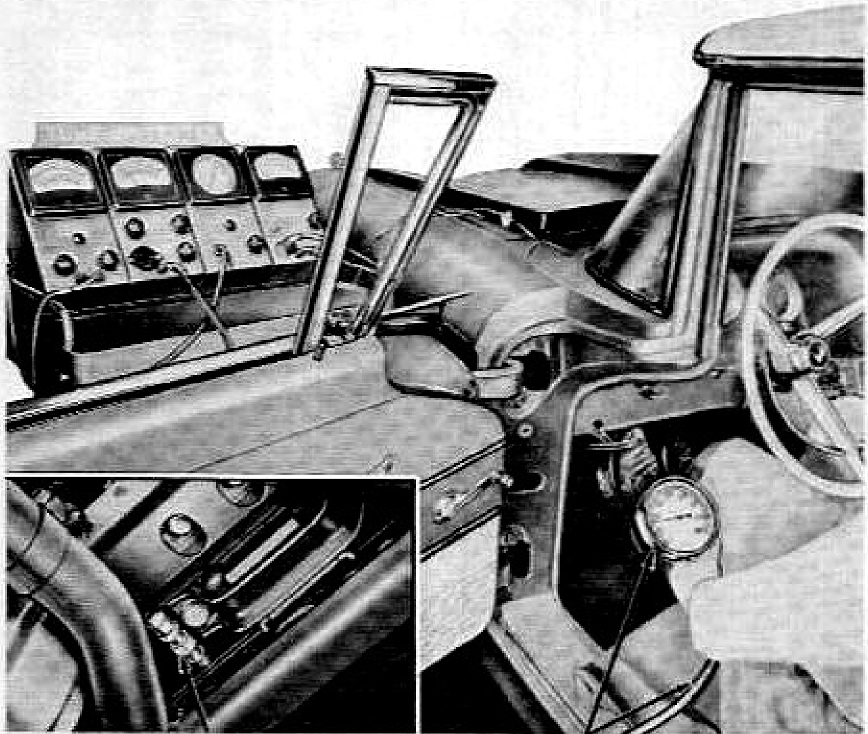


FIG. 4—Final Adjustment of Throttle Linkage

14. Adjust the accelerator connecting link to obtain a pedal height of 4½ inches. Measure from the top corner of the pedal to the floor.

Final adjustment of the throttle control rod must now be made by the Pressure Method of linkage adjustment.

FINAL ADJUSTMENT—PRESSURE METHOD

1. Apply the parking brake to prevent operation of the rear pump and for safety.

2. Raise the car on a hoist, and remove the ⅛-inch pipe plug located on the transmission case rear face.

3. Install the pressure gauge.

4. Lower the car to the floor.

5. Position the gauge so that it can be read from the driver's seat, and connect a tachometer to the engine (Fig. 4).

6. Shift the selector lever to D2 or D1.

7. Increase the engine speed to 1000 rpm and note the gauge reading. If the pressure reading is below 80 psi, the throttle rod clevis must be rotated to lengthen the rod. If the pressure reading is more than 85 psi, the clevis must be rotated to shorten the rod.

To obtain consistant gauge readings, advance the engine throttle so that 1000 rpm is not exceeded. If 1000 rpm is exceeded, reduce engine speed to idle and then advance to 1000 rpm.

8. Secure the throttle control rod clevis to the linkage and tighten the locknut to secure the adjustment.

9. Check the pressure adjustments at idle and stall speeds. Acceptable pressure limits for idle and stall conditions are shown in Table 1.

If idle pressure is above specifications and linkage cannot be shortened further, the throttle lever internal stop must be bent away from the valve body. If the idle pressure is below specifications or is unsteady, trouble may exist in the transmision, and normal diagnosis procedures should be followed.

If stall speed is not within specifications, normal diagnosis procedures must be followed. **Do not operate the car for long periods of time under stall or partial stall conditions. Obtain pressure readings quickly and decrease engine speed to idle.**

TABLE 1—Fluid Pressure Ranges

Engine Speed	Selector Lever Position	Gauge Reading (psi)
Idle	All	56-72
1000 rpm	D1 or D2	80-85
Stall	D1 or D2	150-170
Stall	R	196-216
Stall	L	196-216

MANUAL LINKAGE ADJUSTMENT

1. With the engine stopped, disconnect the upper end of the manual shift rod and clevis (Fig. 3) from the shift selector lever.

2. Position the selector lever so that the pointer is down against the steering column stop in the D1 position.

3. Shift the manual lever on the transmission to the D1 detent position (second from the bottom).

4. Rotate the clevis on the manual shift rod until it can be easily installed on the selector lever pin. Then, lengthen the rod by turning the clevis three turns counterclockwise.

5. Lock the clevis in place, and connect the rod and clevis to the selector lever.

6. Check the pointer alignment for all positions of the selector lever.

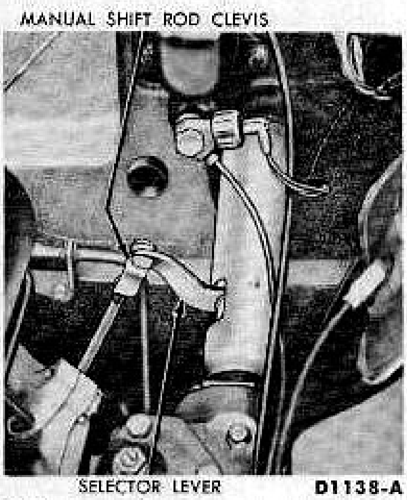


FIG. 5—Transmission Manual Linkage

STARTER NEUTRAL SWITCH ADJUSTMENT

Check the starter circuit in all selector lever positions. The circuit must be open in all positions except N and P.

To adjust the starter neutral switch, loosen the screws that attach the switch to the steering column (Fig. 4). Position the switch so that the starter circuit is closed when the selector lever is at N and P.

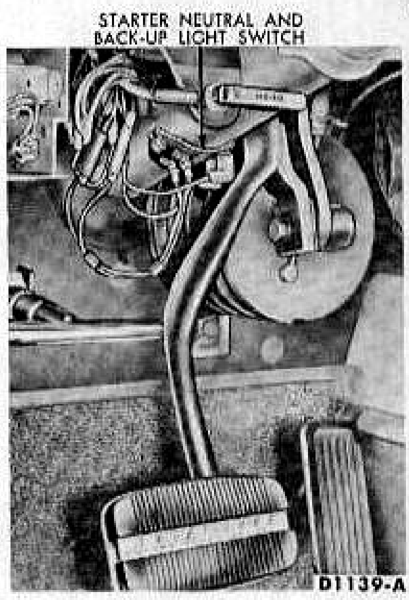


FIG. 6—Starter Neutral Switch

3 BAND ADJUSTMENTS

The transmission front and rear bands should be adjusted after the first 1000 miles of operation, and at 12,000-mile intervals during normal operation.

FRONT BAND ADJUSTMENT

1. Disconnect the fluid filler tube from the oil pan, and drain the fluid from the transmission. **If the same fluid is to be used again in the transmission after the band adjustment, filter the fluid through a 100-mesh screen as it drains from the transmission. Make sure that the container is clean. Re-use the fluid only if it is in good condition.**

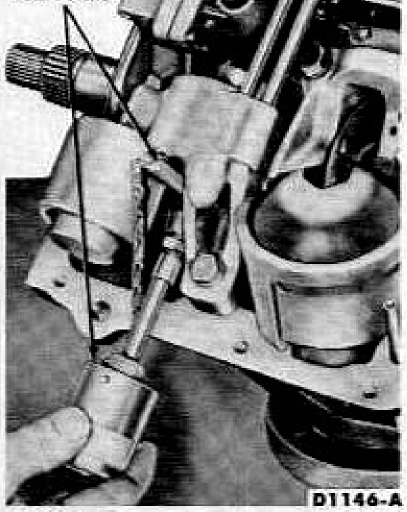


FIG. 7—Front Band Adjustment

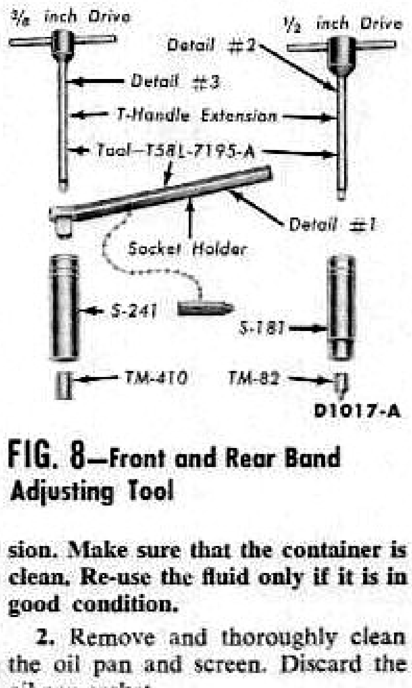


FIG. 8—Front and Rear Band Adjusting Tool

2. Remove and thoroughly clean the oil pan and screen. Discard the oil pan gasket.

3. Loosen the front servo adjusting screw locknut two full turns with a 9/16-inch wrench. Check the adjusting screw for free rotation in the actuating lever after the locknut is loosened, and free the screw if necessary.

4. Pull the adjusting screw end of the actuating lever away from the servo body, and insert the adjusting tool gauge block (Fig. 7) between the servo piston stem and the adjusting screw. If the tool shown in Fig. 8 is to be used to adjust the front band, the gauge block for this tool should be inserted between the piston stem and the screw.

5. Tighten the screw with the adjusting tool wrench until the wrench overruns the screw, and then back off the screw exactly one full turn. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly one full turn.**

With the tool shown in Fig. 8 install the socket handle on the 9/16-inch socket. Insert the T-handle extension through the socket handle and socket, and install the screwdriver socket on the T-handle exten-

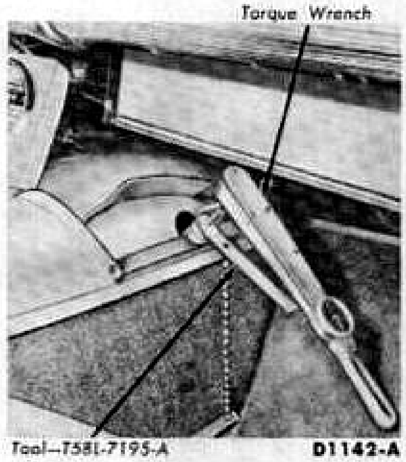


FIG. 9—Rear Band Adjustment

sion. Place the tool on the adjusting screw so that the screwdriver socket engages the screw and the 9⁄16-inch socket engages the locknut. With a torque wrench on the T-handle extension, tighten the adjusting screw to 10 inch-pounds torque, and then back off the screw exactly one full turn.

6. Hold the adjusting screw stationary, and torque the locknut to 20-25 foot-pounds.

7. Remove the gauge block from the transmission.

8. Place a new gasket on the oil pan, and install the screen and pan on the transmission.

9. Connect the filler tube to the oil pan.

10. Fill the transmission with fluid, using the fluid changing procedure given on page 6-9. **If the fluid that was drained from the transmission is to be used again, filter the fluid through a 100-mesh screen as it is poured back into the transmission. Re-use the fluid only if it is in good condition.**

REAR BAND ADJUSTMENT

1. Remove the front console (Fig. 9) to expose the access hole, and then remove the cover from the hole.

2. Wipe all dirt from the rear band adjusting screw threads, and oil the threads.

3. Place the socket holder on the 3⁄4-inch socket (Fig. 8). Insert the T-handle extension through the handle and socket.

4. Place the 5⁄16-inch 8-point socket on the extension. Place a torque wrench on the T-handle extension.

5. Insert the assembled tool in the access hole so that it engages the adjusting screw and the locknut.

6. Loosen the adjusting screw locknut.

7. Tighten the adjusting screw to 10 foot-pounds torque.

8. Remove the torque wrench from the T handle extension and back off the adjusting screw exactly 1½ turns. **Severe damage may result to the transmission if the adjusting screw is not backed off exactly 1½ turns.**

9. Hold the adjusting screw stationary, and torque the locknut to 35-40 foot-pounds.

10. Install the access hole cover and replace the front console.

PART 6-3 TROUBLE SHOOTING

1 PRELIMINARY CHECKS

The following preliminary checks should be made on a Cruise-O-Matic transmission before proceeding with any other trouble-shooting checks.

TRANSMISSION FLUID LEVEL CHECK

Check the transmission fluid level, using the procedure given in Part 6-2. A low fluid level can affect the operation of the transmission, and may indicate fluid leaks that could cause transmission damage.

A fluid level that is too high will cause the fluid to become aerated. Aerated fluid will cause a low control pressure and the aerated fluid may be forced out the vent tube.

TRANSMISSION FLUID LEAKAGE CHECKS

Check the speedometer cable connection at the transmission. Replace the rubber seal if necessary.

Inspect the governor inspection plate for leakage. Install a new gasket if needed.

Leakage at the oil pan gasket often can be stopped by tightening the attaching bolts to not more than 10-13 foot-pounds torque. If necessary, replace the gasket.

Check the fluid filler tube connection at the transmission oil pan. If leakage is evident here, tighten the fitting.

Check the fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fitting, replace the leaking parts.

Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator tank is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines at the cooler fittings and applying 5 psi air pressure to the fittings. If the cooler is leaking and will not hold this pressure, the radiator must be replaced. **The cooler cannot be replaced separately.**

If leakage is found at either the throttle lever shaft or the manual lever shaft, replace the corresponding seal.

Inspect the hexhead pipe plug on the left side of the transmission case at the front. If the plug leaks, tighten the plug to 7-15 foot-pounds torque. If tightening does not stop the leak, replace the plug.

If the converter drain plugs leak, remove the plugs with a sixpoint wrench. Coat the threads with FoMoCo Perfect Seal Sealing Compound or its equivalent, and install the plugs. Tighten the drain plugs to 15-28 foot-pounds torque. **Fluid leakage from the converter housing may be caused by engine oil leaking past the rear main bearing or from oil gallery plugs. Be sure to determine the exact cause of the leak.**

Oil-soluble aniline or fluorescent dyes premixed at the rate of ½ teaspoon of dye powder to ½ pint of transmission fluid have proved helpful in locating the source of the fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the oil cooler leaks into the engine coolant system. A black light, however, must be used with the fluorescent dye solution.

ENGINE IDLE SPEED CHECK

Check and, if necessary, adjust the engine idle speed, using the procedure given in Part 6-2.

If the idle speed is too low, the engine will run rough. An idle speed that is too high will cause the car to creep when the transmission is shifted out of neutral.

ANTI-STALL DASHPOT CLEARANCE CHECK

After the engine idle speed has been properly adjusted, check the anti-stall dashpot clearance. Follow the procedure given in Part 6-2 for checking and adjusting this clearance.

THROTTLE LINKAGE CHECK

When the engine has been properly tuned and the idle speed and anti-stall dashpot clearance adjustments are correct, check the throttle linkage. Complete pressure adjustment procedures are given in Part 6-2.

MANUAL LINKAGE CHECKS

Correct manual linkage adjustment is necessary to position the manual valve for proper fluid pressure direction to the different transmission components. Improperly adjusted manual linkage may cause cross-leakage and subsequent transmission failure. Refer to Part 6-2, for detailed manual linkage adjustment procedures.

STALL TEST

The stall test is made in D2, D1, L, or R (at full throttle only) to determine if the bands and clutches are holding properly. **While making this test, do not hold the throttle open for more than five seconds at a time.**

Connect a tachometer, and start the engine to allow it to reach its normal temperature. Apply both the parking and service brakes.

Place the selector lever at D2, then press the accelerator to the floor. Note the engine speed. Stall speeds are given in Table 1.

Cruise-O-Matic will not downshift in either D1 or D2 when the car is standing still and the accelerator pedal is depressed through the detent.

In D1 (car standing still), the front clutch and the one-way clutch are engaged at all accelerator pedal positions.

In D2 (car standing still), the front clutch and front band are engaged at all accelerator pedal positions.

In L, the front clutch and rear band are applied.

In R, the rear clutch and rear band are applied.

If the engine speed is below the limits given in Table 1, and the engine is tuned, the probable trouble is in the converter. Remove the converter and check the stator clutch as described in Part 6-6.

If the engine speed exceeds the maximum limits of Table 1, release the accelerator immediately because clutch or band slippage is indicated.

The band or clutch that is causing the slippage can be found by testing in another selector lever position. For example, should the transmission slip in D2 but not in D1, the probable cause is the front band.

TABLE 1—Stall Speeds

Selector Lever Position	Clutch Applied	Band Applied	Engine RPM	
			352 V-8	430 V-8
D2	Front	Front	1690-1890	1590-1790
D1	Front	One-Way Clutch	1690-1890	1590-1790
L	Front	Rear	1690-1890	1590-1790
R	Rear	Rear	1690-1890	1590-1790

2 PERFORMANCE CHECKS

Performance checks should be made only after all preliminary checks have been completed and the trouble has not been found. If an unsatisfactory operating condition is found during these checks, stop the checks and proceed to final diagnosis and correction of trouble.

INITIAL ENGAGEMENT CHECKS

Initial engagement checks are made to determine if initial band and clutch engagements are smooth.

Run the engine until the normal operating temperature is reached. With the engine at the correct idle speed, shift the selector lever from N to D2, and from N to D1. Observe the initial band and clutch engagements.

Repeat this operation in L and R. Band and clutch engagements should be smooth in all positions. Rough initial engagements are caused by high engine idle speed, high throttle pressure, high control pressure, faulty operation of the pressure regulator valve or of the main control valve.

SHIFT POINT CHECKS

Check the light throttle upshifts in D1. The transmission should start in first gear and shift to second at about 12 mph, and then shift to third at about 22 mph (Table 2).

While the transmission is in third gear, depress the accelerator pedal through the detent. If the car speed is above 32 mph, the transmission should shift from third to second. If car speed is below 24 mph, the transmission should shift from third to first.

Check the closed throttle downshift from third to first by coasting down from about 30 mph in third gear. The shift should occur at about 8 mph. In first gear, D1, the car will free-wheel if the drive shaft speed in first gear is relatively higher than engine crankshaft speed.

Partial-throttle downshifts in D1 may be checked by using the service brakes as a load. With the transmission in third gear, D1, and car speed at about 30 mph, depress and hold the accelerator at a half-throttle position. At the same time, apply the service brakes to the point that road speed is slowly reduced. The third to second and then second to first shifts should occur as road speed decreases.

When the selector lever is at D2, the transmission can operate only in second and third gears. Shift points for second to third and third to second are the same in both D2 and D1.

If the transmission is in third gear and road speed is above about 28 mph, the transmission should shift to second gear when the selector lever is moved from D2 to D1 to L. When the same manual shift is made below about 20 mph, the transmission will shift from second or third to first.

OPERATIONAL CHECKS

Operational checks are made to supplement stall test data.

When the stall test speeds are low and the engine is properly tuned, converter stator clutch problems are indicated. A road test must be performed to determine the exact cause of the trouble.

If the stall test speeds are 300 to 400 rpm below the values shown in Table 1 and the car cruises properly but has very poor acceleration, the stator clutch is slipping.

If the stall test speeds are 300 to 400 rpm below the values shown in Table 1 and the car drags at cruising speeds and acceleration is poor, the stator clutch is installed backwards.

When the stall test shows normal speeds, the acceleration is good, but the car drags at cruising speeds, the difficulty is due to a seized stator assembly.

TABLE 2—Cruise-O-Matic Shift Points (Approximate)

Rear Axle Ratio	Automatic Shift Speeds (mph)								Manual Shift Speeds (mph)
	D1		D1 or D2		D1	D1 or D2	D1	D2	L
	1-2 Minimum Throttle	1-2 Maximum Throttle	2-3 Minimum Throttle	2-3 Maximum Throttle	3-1 Minimum Throttle	3-2 Maximum Throttle	2-1 Maximum Throttle	3-2 Minimum Throttle	2-1
2.91	9-14	40-49	13-24	64-76	5-10	58-71	25-32	5-10	19-27
3.10	8-13	38-45	12-23	60-72	5-9	54-67	24-30	5-9	17-25

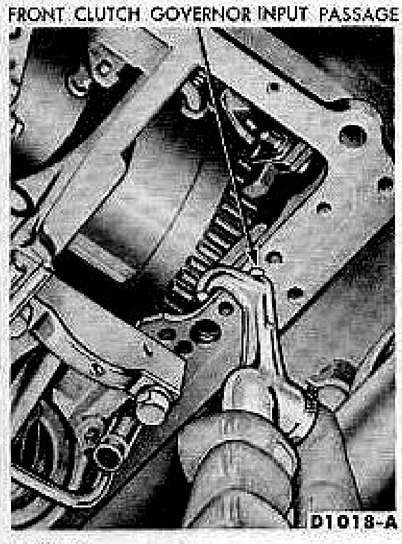


FIG. 1—Typical Front Clutch Air Check

CONTROL PRESSURE CHECKS

The control pressure checks are made to determine if the control pressures are within the limits shown in Table 1, Part 2.

Attach the pressure gauge at the transmission case rear face.

Connect a tachometer to the engine to check and adjust idle speed if required.

Set the parking brake and with the gauge and tachometer installed, allow the engine and transmission to reach normal operating temperature.

Place the selector lever at D1 or D2 and check the idle pressure. This pressure should be within the range shown in Table 1, Part 2.

Increase the engine speed to 1000 rpm and note the control pressure indicated on the gauge (80-85 psi required). If the control pressure does not fall within the acceptable pressure range at 1000 rpm, adjust the throttle control rod to obtain the required pressure, then recheck idle pressure.

With the selector lever still at D1 or D2, increase engine speed to a stall condition. Note the gauge pressure and check the engine speed. Stall pressures should be within the range specified.

If idle pressure is above normal, the main control throttle lever stop must be bent away from the valve body. If idle pressure is below normal or is not steady, follow normal diagnosis procedures to locate the cause of the hydraulic problem (pressure regulator or main control assembly malfunction).

If pressures at 1000 rpm and at stall cannot be obtained or are unsteady, check the pressure regulating parts as outlined for idle speed pressure problems.

Move the selector lever to R and repeat the pressure checks at idle, 1000 rpm, and stall.

Idle pressure should be the same in R as it was in D1 or D2. Control pressure in R and L at 1000 rpm and at stall should be above that obtained in D1 or D2. See Table 1, Part 6-2.

AIR PRESSURE CHECKS

A "NO DRIVE" condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.

When the selector lever is at D2, a "NO DRIVE" condition may be caused by an inoperative front clutch or front band. A "NO DRIVE" condition at D1 may be caused by an inoperative front clutch or one-way clutch. When there is no drive in L, the difficulty could be caused by improper functioning of the front clutch or the rear band. Failure to drive in reverse range could be caused by a malfunction of the rear clutch or rear band. Erratic shifts could be caused by a malfunction of the governor.

To make the air pressure checks, drain the transmission fluid, then remove the oil pan and the control valve assembly.

The inoperative units can be located by introducing air pressure into the transmission case passages leading to the clutches, rear servo, and governor, and into the front servo apply, release, and accumulator tubes.

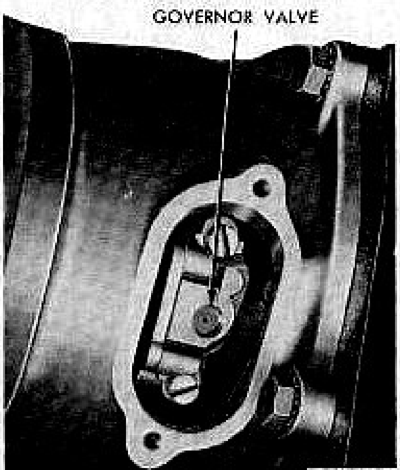


FIG. 2—Governor Valve

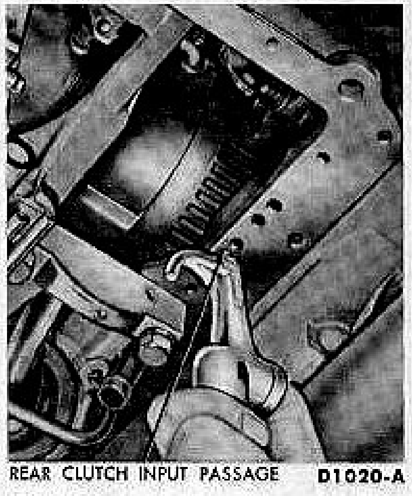


FIG. 3—Typical Rear Clutch Air Check

FRONT CLUTCH

Apply air pressure to the transmission case front clutch passage (Fig. 1). A dull thud can be heard when the clutch piston is applied. If no noise is heard, place the finger tips on the drum and again apply air pressure to the front clutch passage. Movement of the piston can be felt as the clutch is applied.

GOVERNOR

Remove the governor inspection cover from the extension housing. Apply air pressure to the front clutch passage, listen for a sharp click, and watch to see if the governor weight snaps inward (Fig. 2). Inward weight movement indicates correct governor valve operation.

REAR CLUTCH

Apply air pressure to the rear clutch passage (Fig. 3). A dull thud indicates that the rear clutch piston has moved to the applied position. If no noise is heard, place the finger tips on the rear drum and again apply air pressure to detect movement of the piston.

FRONT SERVO

Hold the air nozzle in the front servo apply tube. Operation of the front servo is indicated by a tightening of the front band around the drum. Continue to apply air pressure to the front servo apply tube, and introduce air pressure into the front servo release tube. **Hold a cloth over the release tube while applying the**

servo to catch the spray from the release tube. The front servo should release the band against the apply pressure.

REAR SERVO

Apply air pressure to the rear servo apply passage (Fig. 4). The rear band should tighten around the drum if the rear servo is operating properly.

If either servo is inoperative, remove the inoperative unit and apply air pressure directly to its passages. Proper operation of the servos indicates that the trouble is in the case passages. If the servo does not operate, disassemble, clean, and inspect it to locate the source of the trouble.

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove and, with air pressure, check the fluid passages at the output shaft aluminum sleeve for correct indexing with the shaft holes. Check the primary sun gear shaft assembly passages with air pressure to detect obstructions (Fig. 5).

If the output shaft and primary sun gear shaft passages are clear, remove the clutch assemblies, and clean and inspect the malfunctioning clutch to locate the trouble.

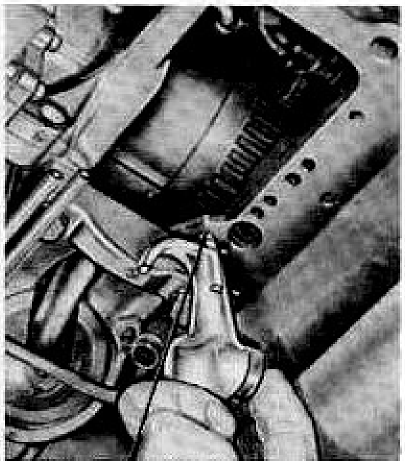


FIG. 4—Typical Rear Servo Air Check

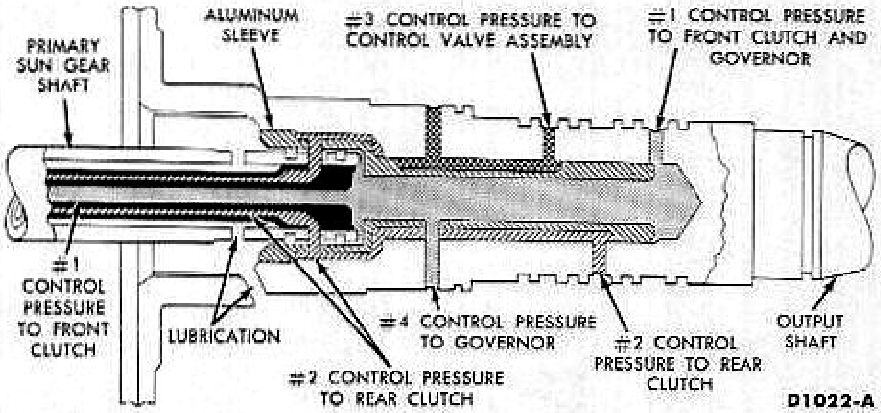


FIG. 5—Output and Primary Sun Gear Shaft Fluid Passages

3 DIAGNOSIS GUIDE

The Cruise-O-Matic Diagnosis Guide (next page) lists the most common trouble symptoms that may be found and gives the items that should be checked to find the cause of the trouble. In most cases, only the general locations of the trouble are given, and the exact causes will have to be determined by examination.

Conditions of improper operation, noise, and external fluid leakage are listed in the table on next page. Opposite each condition are the probable causes, arranged in a logical sequence which should be followed for quickest results. The letter symbols are explained in the key shown below. If items A, B, C, K, and the stall test have already been checked under preliminary check and adjustments, they need not be repeated.

Key to Diagnosis Guide

A. Fluid Level	M. Converter Drain Plugs
B. Throttle Linkage	N. Oil Pan Gasket, Drain Plug or Tube
C. Manual Linkage	O. Oil Cooler and Connections
D. Governor	P. Manual or Throttle Lever Shaft Seal
E. Valve Body	Q. ⅛-inch Pipe Plug in Side of Case
F. Pressure Regulator	R. Perform Air-Pressure Check
G. Front Band	S. Extension Housing to Case Gaskets and Lockwashers
H. Rear Band	T. Center Support Bolt Lockwashers
I. Rear Servo	U. Extension Housing Rear Oil Seal
J. Front Servo	V. Governor Inspection Cover Gasket
K. Engine Idle Speed	W. Perform Control Pressure Check
L. Inner and Outer Throttle Levers	X. Speedometer Driven Gear Adapter Seal
a. Front Clutch	h. Planetary Assembly
b. Rear Clutch	i. Planetary One-Way Clutch
c. Leakage in Hydraulic System	j. Engine Rear Oil Seal
d. Front Pump	m. Front Pump Oil Seal
e. Rear Pump	n. Converter One-Way Clutch
f. Fluid Distributor Sleeve in Output Shaft	p. Front Pump to Case Gasket
g. Parking Linkage	

Trouble Symptom	Items to Check	
	Transmission in Car	Transmission Out of Car
Rough Initial Engagement	K B H W F E	
1-2 or 2-3 Shift Points Incorrect	A B C D W E L	
Rough 2-3 Shift	B G F E J	
Engine Overspeeds on 2-3 Shift	B G E	
No 1-2 or 2-3 Shift	D E	b c f
No 3-1 Shift	K B E	
No Forced Downshifts	B W E L	
Runaway Engine on Forced Downshift	G F E J	c
Rough 3-2 or 3-1 Shift at Closed Throttle	K B E	
Creeps Excessively in D1 or D2	K	
Slips or Chatters in First Gear	A B H W F E L	a c f i
Slips or Chatters in Second Gear	A B G W F E J	a c
Slips or Chatters in R	A B H W F E I	b c f
No Drive in D1	C E	i
No Drive in D2	G E R	a c f
No Drive in L	C H I E R	c f
No Drive in R	H I E R	b c f
No Drive in Any Selector Lever Position	A C W F E R	c
Lockup in D1	C I J	b g c
Lockup in D2	C H I J	b g c i
Lockup in L	G J E	b g c
Lockup in R	G J	a g c i
Parking Lock Binds or Does Not Hold	C	g
Engine Does Not Start by Pushing Car	A C F E	e c
Transmission Overheats	O F	n
Maximum Speed Too Low, Poor Acceleration		n
Transmission Noisy in N	F	j a d
Transmission Noisy in First, Second, or Third Gear	F	h a b d
Transmission Noisy in R	F	h a b d
Transmission Noisy in P	F	d
Transmission Noisy During Coast at 30-20 mph in N, Engine Stopped		e
Fluid Leak at Converter Housing	M	j m p
Fluid Leak at Transmission Oil Pan	N	
Fluid Leak at Left Side of Case	P Q T	
Fluid Leak at Right Side of Case	Q T O	
Fluid Leak at Front of Extension Housing	S V	
Fluid Leak at Rear of Extension Housing	U	
Fluid Leak at Speedometer Driven Gear Adapter	X	

PART 6-4 REPLACEMENT

1 SUB-ASSEMBLY REPLACEMENT—TRANSMISSION IN CAR

GOVERNOR REPLACEMENT

1. Raise the car so that the transmission extension housing is accessible.

2. Remove the governor inspection cover from the extension housing.

3. Rotate the drive shaft until the governor is in line with the inspection hole (Fig. 1).

4. Remove the governor valve body from the counterweight. **Do not drop the attaching bolts or the valve parts into the extension housing.**

5. Lubricate the new governor valve parts with transmission fluid. **The valve must move freely in the valve body bore.**

6. Install the governor valve body on the counterweight so that the valve body cover is facing rearward.

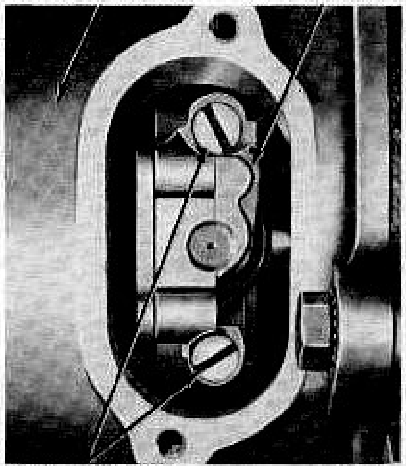


FIG. 1—Governor in Extension Housing

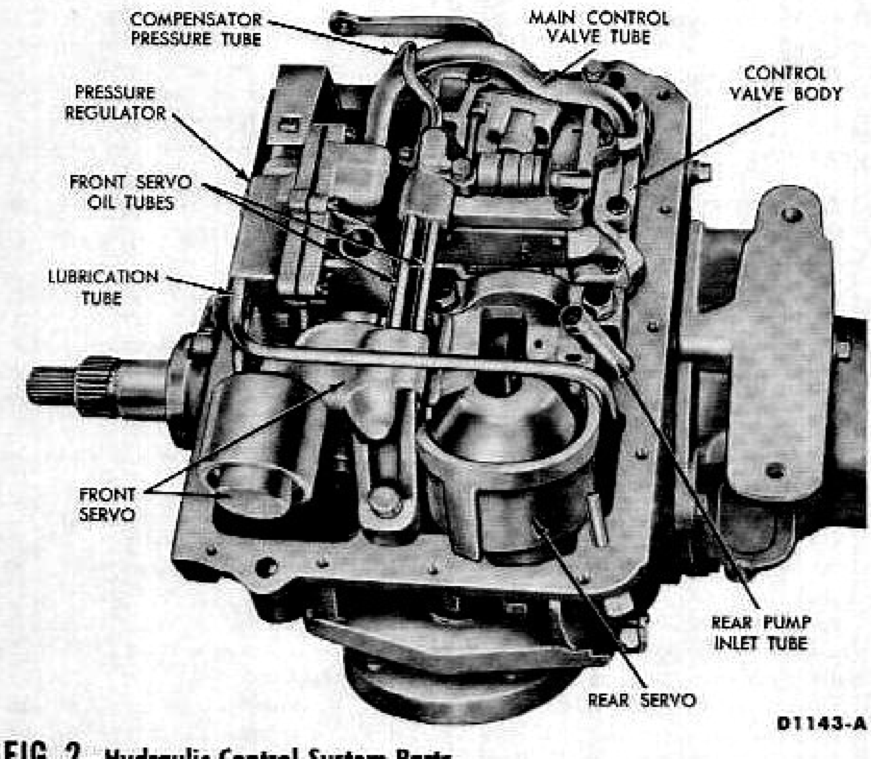


FIG. 2—Hydraulic Control System Parts

Tighten the two attaching bolts securely.

7. Install the governor inspection cover and a new gasket on the extension housing. Torque the attaching screws to 50-60 inch-pounds.

OIL PAN AND CONTROL VALVE BODY REPLACEMENT

1. Raise the car so that the transmission oil pan is accessible.

2. Disconnect the fluid filler tube from the oil pan, and drain the fluid from the transmission. **If the same fluid is to be used again, filter the fluid through a 100-mesh screen as it drains from the transmission. Make sure that the container is clean. Re-use the fluid only if it is in good condition.**

3. Remove the oil pan and gasket, and discard the gasket.

4. Remove the fluid screen retaining clip and the screen.

5. Remove the two tubes which connect to the pressure regulator and the control valve body. **The regulator lubrication tube (Fig. 2) does not have to be removed.**

6. Loosen the front servo attaching bolts three turns.

7. Remove the three control valve body attaching bolts, and lower the valve body while pulling it off the front servo oil tubes (Fig. 2). **Be careful not to damage the valve body or the tubes.**

8. Before installing the control valve body, check for a bent manual valve. This is done by rolling the valve on a flat surface.

9. Install the control valve body by aligning the front servo oil tubes with the holes in the valve body. Shift the manual lever to the L detent, and place the inner throttle lever between the throttle lever stop and the downshift valve. **The manual valve must engage the actuating pin in the manual detent lever.**

10. Install, but do not tighten the control valve body attaching bolts.

11. Install the two tubes to the pressure regulator and the control valve body.

12. Move the control valve body toward the center of the case as far as the attaching bolts will permit. This movement is made to take up clearance between the manual valve and the actuating pin on the manual detent lever.

13. Torque the attaching bolts to 8-10 foot-pounds.

14. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the body away from the center of the case. Move the body only enough to relieve the binding. Torque the attaching bolts and recheck the manual valve for binding.

15. Torque the front servo attaching bolts to 30-35 foot-pounds.

16. Adjust the front band, following the procedure given in Part 6-2.

17. Install the fluid screen and the screen retaining clip.

18. Position a new oil pan gasket on the bottom of the transmission case, and install the oil pan. Torque the oil pan screws to 10-13 foot-pounds torque.

19. Connect the fluid filler tube to the oil pan, and tighten the fitting securely.

20. Adjust the rear band, following the procedure given in Part 6-2.

21. Fill the transmission with Automatic Transmission Fluid Ford B8A-19582-A, using the fluid changing procedure given on page 6-9. **If the fluid that was drained from the transmission is to be used again, filter the fluid through a 100-mesh screen as it is poured back into the transmission. Re-use the fluid only if it is in good condition.**

22. If the control valve body was replaced, adjust the transmission control linkage (throttle and manual).

FRONT SERVO REPLACEMENT

1. Drain the fluid from the transmission, and remove the oil pan and fluid screen.

2. Remove the pressure regulator lubrication tube (Fig. 2).

3. Loosen the three control valve body attaching bolts.

4. Remove the attaching bolts from the front servo (Fig. 2), hold the strut with the fingers, and remove the servo.

5. To install the front servo, position the front band forward in the case with the ends of the band facing downward. Align the large end of the servo strut with the servo actuating lever, and align the small end with the band end.

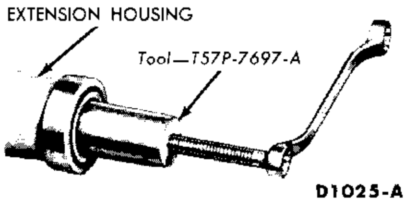


FIG. 3—Extension Housing Bushing and Rear Seal Removal

6. Rotate the band, strut, and servo to align the anchor end of the band with the anchor in the case.

Push the servo body onto the control valve body and the pressure regulator tubes.

7. Install the attaching bolt and torque to 30-35 foot-pounds.

8. Torque the control valve body attaching bolts to 8-10 foot-pounds. Check the clearance between the manual valve and the manual lever actuating pin as given above in OIL PAN AND CONTROL VALVE BODY REPLACEMENT.

9. Install the pressure regulator lubrication tube (Fig. 2).

10. Adjust the front band, following the procedure on page 6-12.

11. Install the fluid screen and oil pan, and fill the transmission with fluid, using the procedure given in Part 6-2.

12. Adjust the throttle and manual linkage.

REAR SERVO REPLACEMENT

1. Drain the fluid from the transmission, and remove the oil pan and fluid screen.

2. Remove the pressure regulator lubrication tube (Fig. 2).

3. Remove the control valve body and the two front servo oil tubes.

4. Remove the attaching bolts from the rear servo, hold the actuating and anchor struts with the fingers, and remove the servo.

5. To install the rear servo, position the servo anchor strut on the servo band, and rotate the band to engage the strut.

6. Hold the servo anchor strut in position with the fingers, position the actuating lever strut, and install the servo.

7. Install the servo attaching bolts, and torque them to 45-50 foot-pounds. **The longer bolt must be installed in the inner bolt hole.**

8. Install the two front servo oil tubes and the control valve body.

Check the clearance between the manual valve and manual lever actuating pin.

9. Install the pressure regulator lubrication tube.

10. Adjust the rear band, following the procedure given in Part 6-2.

11. Install the fluid screen and oil pan, and fill the transmission with fluid, using the procedure given on page 6-9.

PRESSURE REGULATOR REPLACEMENT

1. Drain the fluid from the transmission, and remove the oil pan and fluid screen.

2. Remove the pressure regulator lubrication tube (Fig. 2).

3. Remove the small compensator pressure tube and the large control pressure tube from the control valve body and the pressure regulator.

4. Remove the pressure regulator spring retainer, springs, and spacer. **Maintain pressure on the retainer to prevent the springs from flying out.**

5. Remove the pressure regulator attaching bolts and washers, and remove the regulator. Leave the pressure regulator to front servo accumulator tube in the front servo body.

6. Position the replacement regulator body on the transmission case and onto the accumulator tube. Install the attaching bolts. Torque the bolts to 17-22 foot-pounds.

7. Check the converter pressure and control pressure valves to be sure the valves operate freely in the bores.

8. Install the valve springs, spacer, and retainer.

9. Install the large control pressure tube, small compensator pressure tube, and the pressure regulator lubrication tube.

10. Install the fluid screen and the oil pan, and fill the transmission with fluid, using the procedure given on page 6-9.

EXTENSION HOUSING BUSHING AND REAR SEAL REPLACEMENT

1. Disconnect the drive shaft from the transmission.

2. Remove the bushing and the rear seal together when the bushing requires replacement (Fig. 3). When

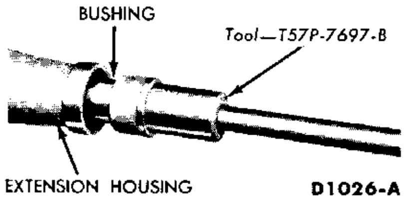


FIG. 4—Extension Housing Bushing Installation

only the rear seal needs replacing, remove the rear seal from the extension housing with tool 1175-AE or -W.

3. When installing a new bushing use the special tool shown in Fig. 4.

4. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.

5. Inspect the counterbore of the housing for burrs. Polish off all burrs with crocus cloth.

6. Coat the outer diameter of the new seal with FoMoCo Perfect Seal Sealing Compound or its equivalent, and position the seal in the bore of the extension housing with the felt side of the seal to the rear.

7. Drive the seal into the housing with the tool shown in Fig. 5. The seal should be firmly seated in the bore. Install the drive shaft.

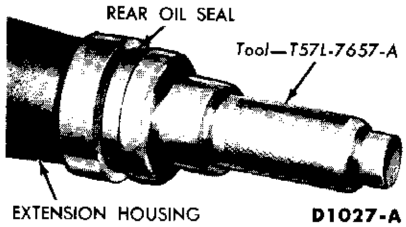


FIG. 5—Extension Housing Rear Seal Installation

OIL COOLER FLUSHING PROCEDURE

When a clutch or band failure or other internal trouble has occurred in the transmission, any metal particles or clutch plate or band material that may have been carried into the cooler should be removed from the system by flushing the cooler before the transmission is put back into service.

1. Disconnect the fluid return from the rear of the transmission case.

2. Start the engine and drain about two quarts of fluid from the cooler into a pan. Discard the drained fluid. If there is no fluid flow or the fluid does not flow freely from the return line, shut off the engine and disconnect both lines at the cooler and transmission.

3. Use an air hose (with not more than 100 psi air pressure) and reverse flush the lines and the cooler.

4. Connect both lines at the cooler, and the pressure line at the transmission.

5. Start the engine and check the fluid flow. If the fluid flows freely, connect the return line at the transmission and fill the transmission with new fluid to the specified level. If there is no fluid flow or if the flow is restricted, replace the radiator. **Do not attempt to correct cooler or cooling line leaks by closing off the lines.**

OIL COOLER REPLACEMENT

When fluid leakage is found at the oil cooler, the entire radiator must be replaced as described in Part 4-1. **The oil cooler cannot be removed from the radiator for replacement.**

OIL COOLER TUBE REPLACEMENT

When one or more of the oil cooler steel tubes must be replaced, each replacement tube must be fabricated from the same size and grade of tubing as the original line.

Using the old tube as a guide, bend the new tube as required. Add the necessary fittings, and install the tube.

After the fittings have been tightened, add fluid as needed, and check for fluid leaks.

2 TRANSMISSION REPLACEMENT—PBL MODELS

TRANSMISSION REMOVAL WITHOUT CONVERTER

1. Raise the car on a hoist.

2. Disconnect the fluid filler tube from the oil pan and drain the fluid.

3. Remove the cover from the lower front side of the converter housing. Remove one of the converter drain plugs (Fig. 1, Part 6-2). Then rotate the converter 180° and remove the other plug. **Do not attempt to turn the converter with a wrench on the converter stud nuts.**

4. Disconnect the drive shaft at the pinion flange, and remove the drive shaft. Install the seal replacer in the extension housing seal.

5. Disconnect the inlet pipes from the engine exhaust manifolds.

6. Disconnect the front inlet pipe assembly from the rear inlet pipes.

7. Disconnect the parking brake equalizer rod from the equalizer lever.

8. Disconnect the cooler lines from the transmission.

9. Disconnect the manual and throttle control rods at the transmission.

10. Disconnect the speedometer cable at the extension housing.

11. Remove the two engine rear support to transmission bolts.

12. Position a transmission jack under the transmission and raise it slightly to take the weight off the cross member.

13. Remove the cross member bolts and cross member. With the transmission jack in position, remove the four transmission to converter housing bolts.

14. Tilt the rear of the transmission assembly slightly upward, and with the jack move the assembly toward the rear until clear of the turbine shaft. Lower the assembly and remove it from the car.

TRANSMISSION (GEAR CASE) INSTALLATION

1. Install guide pins in the two top transmission to converter housing attaching bolt holes.

2. Mount the transmission on the jack and position it under the car. **Be sure to align the turbine shaft splines with the turbine splines and the converter impeller lugs with the slots in the front pump drive gear.**

3. Raise the transmission, move it toward the front of the car, and position it on the converter housing.

4. Install the transmission to converter housing lower attaching bolts. Remove the two guide pins and install the two upper bolts. Torque the bolts to 40-45 foot-pounds.

5. Install the frame cross member and bolts.

6. Lower the transmission onto the cross member, and install the

engine rear support to transmission bolts.

7. Connect the oil cooler to transmission oil inlet and outlet lines to the transmission. Tighten the fittings securely.

8. If a new transmission is being installed, position a new rubber extension housing shield over the end of the housing.

9. Slide the universal joint yoke onto the output shaft, then connect the drive shaft at the rear axle. **Lubricate the front universal slip yoke with Ford lubricant B8A-19589-A.**

10. Connect the speedometer cable to the extension housing.

11. Connect the manual linkage to the transmission manual lever, and connect the throttle linkage to the transmission throttle lever.

12. Adjust the linkage.

13. Install the converter drain plugs and converter lower cover.

14. Install the muffler inlet pipes.

15. Connect the fluid filler tube to the oil pan. Tighten the fittings securely.

16. Lower the car to the floor, and fill the transmission with fluid. Then check the fluid level as described in Part 6-2.

3 TRANSMISSION REPLACEMENT—PBB MODELS

CONVERTER REMOVAL

1. Remove the transmission.

2. Remove the four stud nuts that attach the converter to the flywheel. Replace the converter housing lower front cover to prevent the converter from falling when the housing is removed.

3. Remove the starter cable, then remove the starter.

4. Remove 6 converter housing to engine block bolts.

5. Work the converter housing off the engine dowel pins and remove the housing and converter.

CONVERTER INSTALLATION

1. Place the converter in the housing, and retain it there by installing the lower front cover.

2. Raise the housing and converter into position and start the housing on the engine dowel pins.

3. Start the 6 converter housing to engine bolts.

4. Remove the converter housing lower front cover and position the converter on the flywheel. Install the four converter to flywheel stud flat washers and nuts. Torque to 20-25 foot-pounds.

5. Torque the converter housing to engine bolts to 40-45 foot-pounds.

6. Install the converter housing lower front cover.

On the PBB models, the converter and transmission (gear case) must be removed as an assembly. The converter housing is attached to the transmission case by **six** bolts. Four of the bolts go through the transmission case and thread into the converter housing. These four bolts can be removed with the transmission in the car.

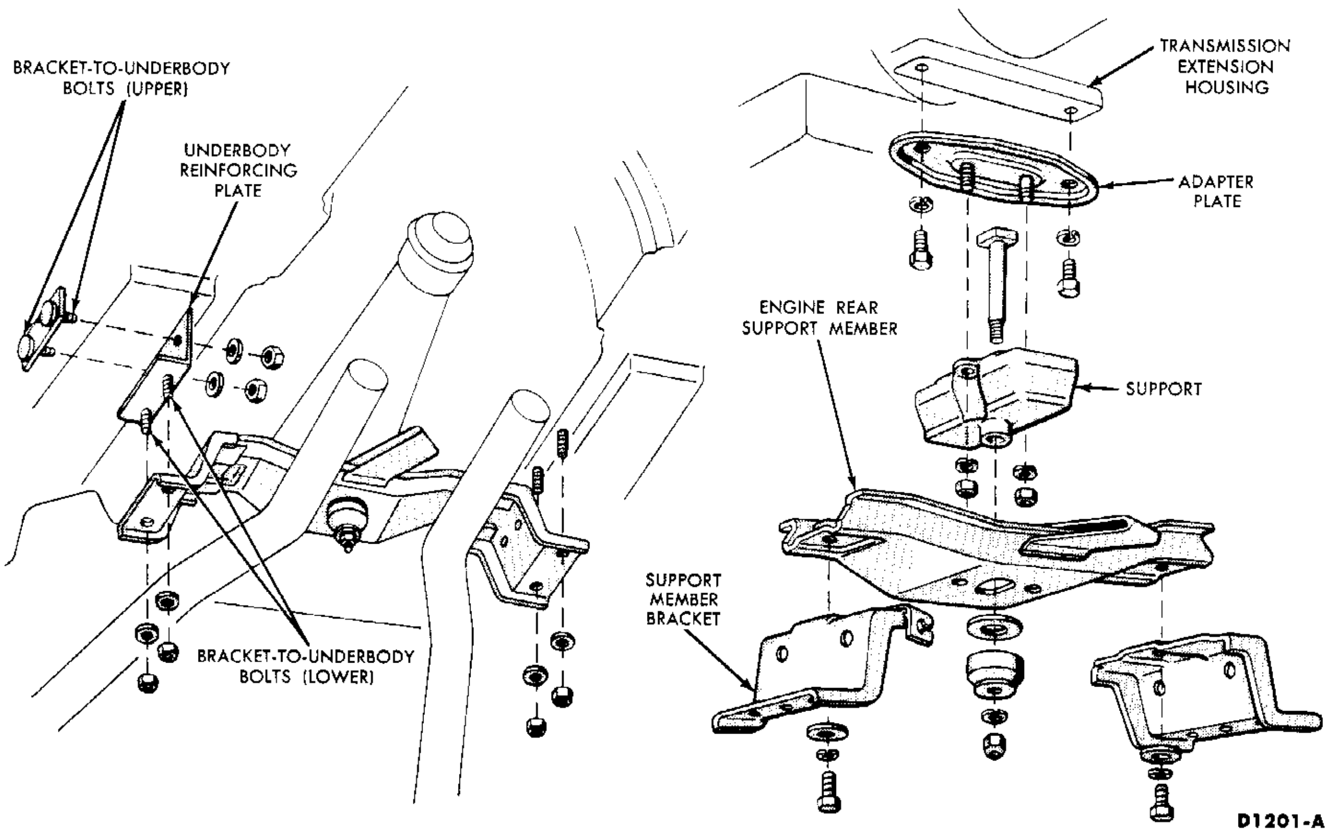


FIG. 6—Engine and Transmission Rear Support

Two bolts go through the converter housing and thread into the transmission case. These bolts cannot be removed until the converter is removed, since the bolt heads are behind the converter.

REMOVAL

1. Before the car is raised, remove the upper (4) converter housing to engine block bolts. Remove the upper (2) starter mounting bolts.

2. Raise the car and drain the transmission pan.

3. Disconnect the muffler front inlet pipes at both engine exhaust manifolds. Separate the muffler front inlet pipe assembly from the rear inlet pipes.

4. Remove the engine starter.

5. Remove the converter housing lower cover. Drain the converter. **Do not attempt to turn the converter with a wrench on the converter to flywheel stud nuts.**

6. Remove the converter to flywheel stud nuts (4).

7. Disconnect the drive shaft and the speedometer cable.

8. Disconnect the throttle and manual linkage at the transmission.

9. Disconnect the oil cooler lines at the transmission.

10. Remove the parking brake equalizer rod from the equalizer lever from its bracket. Remove the parking brake cable housing from its retainer.

11. Remove the two bracket to engine rear support member bolts (Fig. 6).

12. On each bracket, remove the upper (2) bracket to underbody bolt nuts. These bolts are pressed into a plate (Fig. 6). Push the bolts out of the brackets.

13. Raise the transmission with a jack, so that the engine rear support member is clear of the brackets.

14. On each bracket, remove the lower (2) bracket to underbody bolt nuts. Remove the brackets. With the brackets removed from the underbody, the transmission can be removed with the support member still attached to the extension housing.

15. Lower the transmission and engine, until the engine rests on the tubular cross member.

16. Remove the two remaining converter housing to engine block bolts.

17. Move the converter housing away from the engine block and at the same time move the converter away from the flywheel. Secure the converter to the converter housing.

18. Lower the transmission and remove it from under the car.

19. Remove the converter.

20. Remove the coverter housing from the transmission case.

21. Remove the vent tube.

22. Remove the engine rear support from the transmission extension housing (Fig. 6).

INSTALLATION

1. Install the engine rear support and support member on the transmission extension housing (Fig. 6).

2. Install the converter housing on the transmission case. Install the converter. Align the converter drain plugs with the flywheel openings, and then secure the converter to the converter housing.

3. Install the transmission vent tube.

4. Raise the transmission to its approximate normal running position. Start the lower (2) converter housing to engine block bolts. As the bolts are tightened the converter pilot must enter the crankshaft and the converter studs and drain plugs must enter the holes in the flywheel. At the same time, check for binding between the converter housing and the dowel pins in the engine block. If binding is evident, raise or lower the transmission to relieve the bind.

5. Torque the converter housing to engine block bolts to 40-45 foot-pounds.

6. Install the converter to flywheel stud nuts and flat washers. Torque the nuts to 20-25 foot-pounds. Install the cover.

7. Raise the transmission and install the engine rear support member brackets.

8. Lower the transmission so that the support member rests on the brackets. Remove the transmission jack.

9. Install the bracket to support member bolts.

10. Install the parking brake linkage and cables.

11. Connect the oil cooler lines and the filler tube.

12. Install the starter.

13. Connect the throttle and manual linkage.

14. Connect the speedometer cable and the drive shaft.

15. Install the muffler front inlet pipe assembly.

16. Lower the car and install the upper converter housing to engine block bolts. Install the starter upper bolts.

17. Fill the transmission with fluid as described in Part 6-2.

18. Adjust the throttle and manual linkage.

19. Road test the transmission.

PART 6-5 TRANSMISSION OVERHAUL

1 REMOVAL OF SUB-ASSEMBLIES

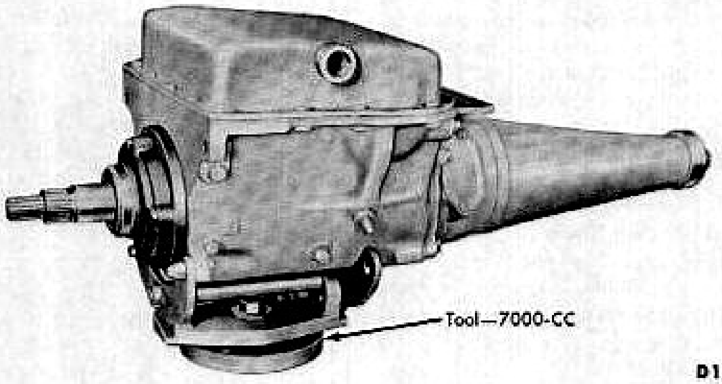


FIG. 1—Transmission Mounted on Bench

Before removing any of the transmission sub-assemblies, thoroughly clean the outside of the transmission case to prevent dirt from getting inside the mechanism.

REMOVAL OF HYDRAULIC CONTROL SYSTEM PARTS

1. Remove the breather tube, and then place the transmission in a holding fixture. For the PBL transmission, the fixture shown in Fig. 1 may be used. For the PBB transmission, use fixture T57L-500-A.

2. Remove the oil pan, gasket, and screen clip. Lift the screen off the forward tube, and off the rear tube.

3. Remove the spring seat from the pressure regulator. **Maintain constant pressure on the seat to prevent distortion of the spring seat and the sudden release of the springs.** Remove the pressure regulator springs and pilots, but do not remove the valves.

4. Loosen, but do not remove, the control valve body attaching bolts.

5. Remove the lubrication tube from the pressure regulator and rear pump. If necessary, tap the tube with a soft hammer. **Be careful not to bend or distort the tube.**

6. Lift the rear pump intake tube out of the bore in the transmission case. **Be careful not to bend the tube.**

7. Remove the small compensator pressure tube, and then remove the large control pressure tube from the pressure regulator and the control valve body. **If necessary, tap the tubes with a soft hammer but do not distort them.**

8. Loosen the front and rear servo band adjusting screws 5 turns. Loosen the front servo attaching bolts 3 turns.

9. Remove the control valve body attaching bolts. Align the levers to

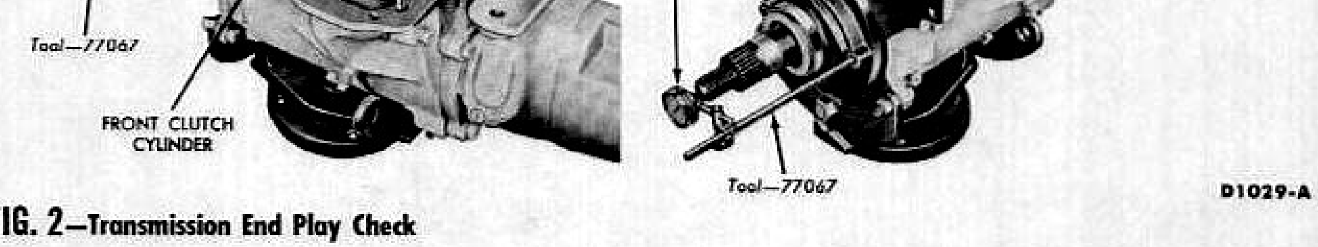


FIG. 2—Transmission End Play Check

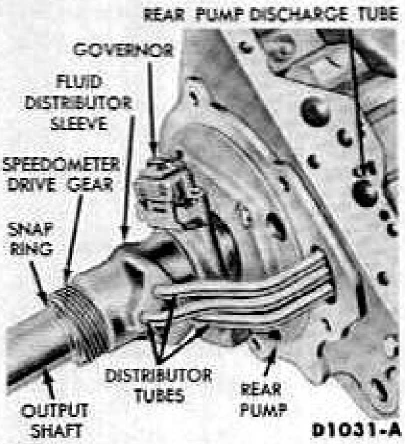


FIG. 3—Output Shaft, Governor, and Rear Pump

permit removal of the valve body, and lift the valve body clear of the transmission case. Pull the body off the servo tubes, and remove it from the case.

10. Remove the regulator body from the case. **Keep the control pressure valve and the converter pressure regulator valve in the pressure regulator to avoid damage to the valves.**

11. Remove the front servo apply and release tubes by twisting and pulling at the same time.

12. Remove the front servo attaching bolts. Hold the front servo strut with the fingers, and lift the servo assembly from the case.

13. Remove the rear servo attaching bolts.

14. Hold the actuating and anchor struts with the fingers, and lift the servo from the case.

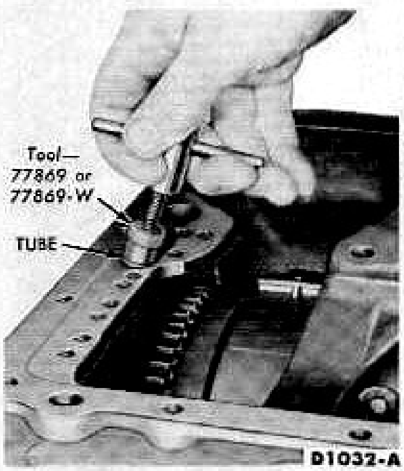


FIG. 4—Rear Pump Discharge Tube Removal

TRANSMISSION END PLAY CHECK

1. Remove one of the front pump attaching bolts.

2. Mount the dial indicator support tool in the front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft as shown in Fig. 2.

3. Install the extension housing seal replacer on the output shaft to provide support for the shaft.

4. Pry the front clutch cylinder to the rear of the transmission with a large screwdriver (Fig. 2). Set the dial indicator to zero while maintaining a slight pressure on the screwdriver.

5. Remove the screwdriver and pry the units toward the front of the transmission by inserting the screwdriver between the large internal gear and the transmission case (Fig. 2).

6. Record the indicator reading for use during transmission assembly. End play should be 0.010 to 0.029 inch.

7. Remove the indicator support, and remove the seal replacer from the output shaft.

REMOVAL OF CASE AND EXTENSION HOUSING PARTS

1. Remove the remaining front pump attaching bolts. Then remove the front pump assembly and gasket. **If necessary, tap the cap screw bosses with a soft hammer to loosen the pump from the case.**

2. Remove the 5 transmission to extension housing bolts. These bolts also attach the rear pump to the case. Hold the rear pump in position and remove the extension housing.

3. Remove the speedometer drive gear snap ring (Fig. 3) from the output shaft without moving the speedometer drive gear. Place one hand under the output shaft below the speedometer drive gear. Then remove the speedometer drive gear. If the drive gear drive ball does not fall out, remove the ball from the seat in the output shaft.

4. Remove the distributor sleeve and tubes from the transmission. On the PBB transmission, remove the flat washer which is installed at the front of the distributor sleeve.

5. Remove the 4 seal rings from the output shaft with the fingers to prevent breaking the rings.

6. Remove the governor snap ring from the output shaft. Slide the governor assembly off the output shaft. Then remove the governor drive ball.

7. On the PBL transmission, install the tube extractor tool in the rear pump discharge tube (Fig. 4), and remove the tube.

8. Remove the rear pump from the case. Then remove the extension housing and pump gaskets.

9. Remove the rear pump drive key from the output shaft. Then remove the bronze thrust washer from the output shaft.

10. Hold the pinion carrier forward, and remove the output shaft.

11. Remove the selective thrust washer from the rear of the pinion carrier.

12. Remove the two seal rings from the primary sun gear shaft. Remove the pinion carrier.

13. Remove the primary sun gear rear thrust bearing and race from the pinion carrier.

14. Note the rear band position for reference in assembly. The end of the band next to the adjusting screw has a depression (dimple) in the center of the boss. On the PBL transmission, squeeze the ends of the rear band together, tilt the band to the rear, and remove the rear band from the case.

15. Remove the two center support outer bolts (one each side) from the transmission case. On the PBB transmission, expand the rear band so that the center support and clutches may be removed through it. The rear band strut may be used as a spacer to hold the band ends apart.

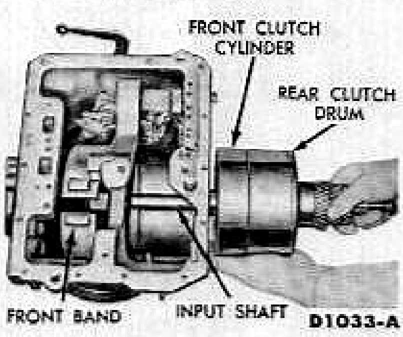


FIG. 5—Input Shaft and Clutch Removal or Installation

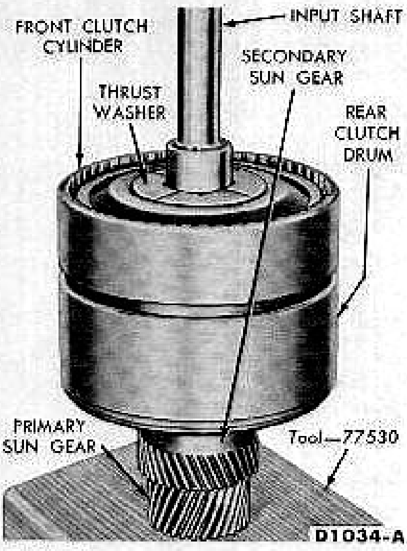


FIG. 6—Input Shaft, Clutches, and Primary Sun Gear

16. Exert enough pressure on the end of the turbine shaft to hold the clutch units together. Then remove the center support, front and rear clutch assemblies as a unit (Fig. 5).

17. Install the clutch assemblies in the bench fixture (Fig. 6).

18. Remove the thrust washer from the front of the turbine shaft.

19. Remove the front band from the case. Lift the front clutch assembly from the primary sun gear shaft.

20. Remove the bronze and steel thrust washers from the secondary sun gear shaft. Wire the thrust washers together to assure correct installation.

21. Remove the front clutch seal rings from the primary sun gear shaft.

22. Lift the rear clutch assembly from the primary sun gear shaft. **Two types of needle bearings are used in the rear clutch hub and drum. One type contains needles that are held in place by the bearing race. The other contains loose needles. Be careful not to lose the individual needles on transmissions so equipped.**

23. Remove the rear clutch seal rings from the primary sun gear shaft. **Do not break the seal rings.**

24. Remove the primary sun gear front thrust washer.

2 GENERAL INSPECTION

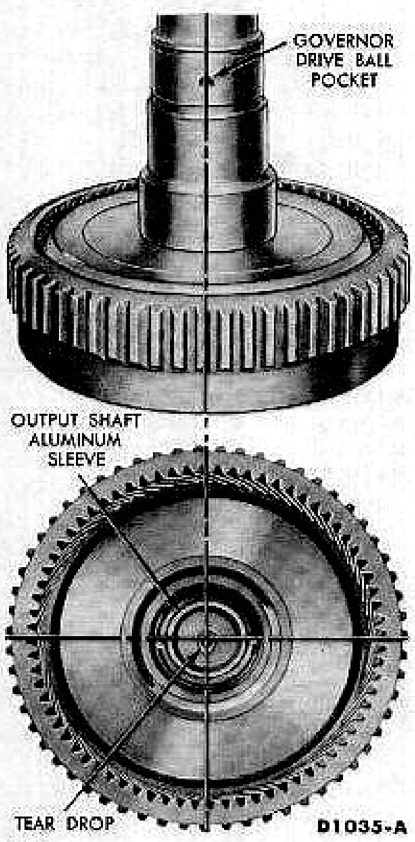


FIG. 7—Correct Position of Output Shaft Aluminum Sleeve

OUTPUT SHAFT AND PRIMARY SUN GEAR SHAFT

1. Inspect the thrust surfaces and journals for scores. Inspect the internal gear for broken or worn teeth.

2. Inspect the aluminum sleeve for scores or leakage. Inspect the ring grooves for burrs.

3. Inspect the keyway and drive ball pocket for wear, and inspect the splines for burrs or wear.

4. Inspect the output shaft sleeve for alignment with the governor drive ball (Fig. 7).

5. Inspect the external parking gear teeth for damage and the speedometer drive gear teeth for burrs.

6. If either the output shaft or ring gear has been replaced, place the assembled unit with the gear face down on the bench, push the shaft downward, and check the clearance between the top of the snap ring and its groove (Fig. 8). If this clearance exceeds 0.002 inch, replace the snap ring with a thicker ring to reduce the clearance to less than 0.002 inch. Selective snap rings are available in several thicknesses for this purpose.

7. Inspect the rubber seal and stop ring at the front of the output shaft spline. If wear or damage is evident replace the seal.

8. Inspect the primary sun gear for broken or worn teeth. Inspect all thrust surfaces and journals for scores. Check all fluid passages (Fig. 9) for obstructions and leakage. Inspect the seal ring grooves for burrs.

9. Inspect the sun gear shaft splines for burrs and wear. Check the front clutch lubrication valve for free movement.

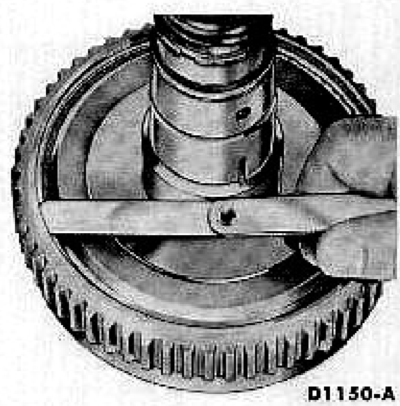


FIG. 8—Checking Output Shaft Snap Ring Clearance

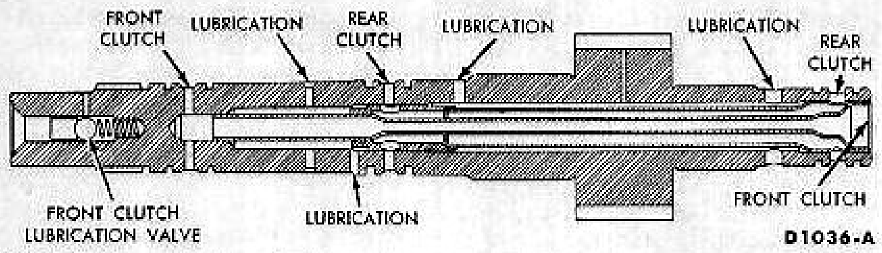


FIG. 9—Cross-Section of Primary Sun Gear Shaft

DISTRIBUTOR SLEEVE

1. Inspect the distributor sleeve for scores or excessive ring wear. Inspect the distributor sleeve passages for obstructions.

2. Check the fit of the fluid tubes in the distributor.

PINION CARRIER

1. On the pinion carrier, inspect the clutch outer race (Fig. 10) for roughness.

2. Inspect the center support inner race for roughness.

3. Inspect the sprag ends for flat spots.

EXTENSION HOUSING

1. Inspect the housing for cracks. Inspect the gasket surface for burrs or warpage. Check for leakage around the governor inspection cover and gasket. If leakage is found, install a new gasket.

2. Inspect the bushing for scores or wear. If required, replace the bushing as described in Part 6-4.

3. Inspect the rear seal for hardness, cracks, or wear. If the seal shows wear or deterioration, replace the seal as follows:

Install the extension housing on the transmission case. Install the puller (1175-AE or -W), and remove the extension housing seal.

Inspect the seal counterbore and remove all burrs and scores with crocus cloth.

Coat the outer diameter of a new seal with FoMoCo Sealing Compound, or its equivalent, and position the seal in the extension housing counterbore. **The felt side of the seal must be toward the rear.** Drive the seal into place with the tool shown in Fig. 5, Part 6-4, until it is firmly seated in the counterbore.

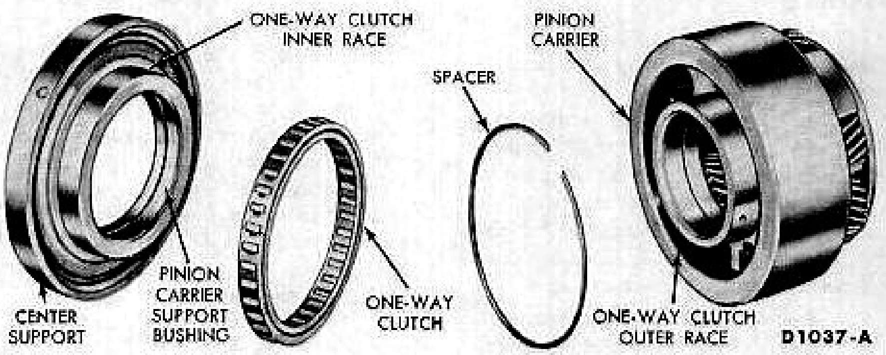


FIG. 10—Pinion Carrier, One-Way Clutch, and Center Support

3 REPAIR AND ASSEMBLY OF SUB-ASSEMBLIES

During the repair of the sub-assemblies, certain general instructions which apply to all units of the transmissions must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission before assembly with transmission fluid. **Do not use any other lubricants.** Thrust washers may be coated with petroleum jelly to facilitate assembly. **Always install new gaskets when assembling the parts of the transmission.**

Tighten all bolts and screws to the recommended torque.

PRIMARY SUN GEAR SHAFT

1. Position the primary sun gear shaft in the clutch bench fixture.

2. Check the fit of the seal rings in the grooves of the primary sun gear shaft. The rings should enter the grooves freely without bind.

3. Check the fit of the seal rings in their respective bores. A clearance of 0.002-0.009 inch should exist between the ends of the rings.

4. Install the seal rings on the shaft, and check them for free movement in the grooves.

5. If the front clutch lubrication valve is not operating properly, repair it by installing a new kit.

REAR CLUTCH

1. Remove the clutch pressure plate snap ring, and remove the pressure plate from the drum. Remove the bronze and steel plates from the drum.

2. Compress the spring in an arbor press with the proper tool, and remove the snap ring. On the PBL transmission only, the tool shown in Fig. 11 may be used. Tool T59L-77515-B may be used on both transmissions.

3. Guide the spring retainer while releasing the press to prevent the retainer from locking in the snap ring groove.

4. Position an air hose and the primary sun gear shaft on the rear clutch as shown in Fig. 12. Place the hose nozzle in one of the holes in the shaft, place one finger over the other hole, and then force the clutch piston out of the clutch drum with air pressure.

5. Remove the clutch piston inner seal ring from the clutch drum. Remove the cluch piston outer seal ring from the groove in the piston.

6. Inspect the drum band surface, the bushing, and thrust surfaces for scores. Minor scores may be removed

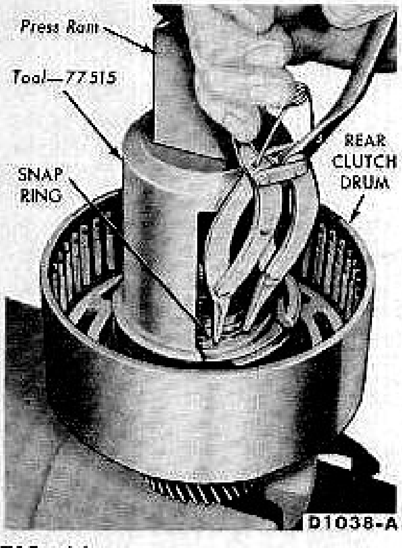


FIG. 11—Clutch Spring Snap Ring Removal

with crocus cloth. Badly scored parts must be replaced.

7. Inspect the needle bearing for worn rollers. Inspect the clutch piston bore and the piston inner and outer bearing surfaces for scores.

8. Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.

9. Inspect the clutch plates for scores, and check the plates for fit on the clutch hub serrations. Replace all plates that are badly scored or do not fit freely in the hub serrations. **Front clutch plates differ in friction characteristics from rear clutch plates and are not interchangeable.**

10. Position the steel plates on a flat surface. Then check the coning with a feeler gauge (Fig. 13). The plates are coned to 0.010-inch clearance.

11. Inspect the clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release spring for distortion.

12. Lubricate all parts to facilitate

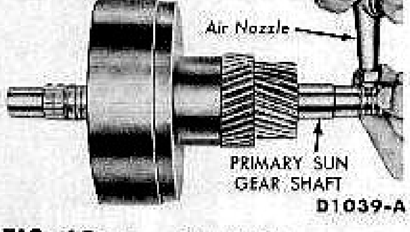


FIG. 12—Rear Clutch Piston Removal

assembly. Install the clutch piston inner seal ring in the groove in the drum.

13. Install a new outer seal ring on the piston, and install the piston in the clutch drum.

14. On the PBL transmission, install 6 bronze and 6 steel clutch plates alternately, starting with a steel plate. **Because of coning, all steel plates must face the same direction with either all concave or all convex sides up.** On the PBB transmission, install 5 bronze and 5 steel plates.

15. Install the clutch pressure plate with the bearing surface down. Then install the clutch pressure plate snap ring. Make sure the snap ring is fully seated in the groove.

16. Install the clutch release spring, and position the retainer on the spring.

17. Position the clutch assembly in an arbor press, and then position the proper tool on the spring retainer. Compress the clutch spring, and install the snap ring. **While compressing the spring, guide the retainer to avoid interference of the retainer with the snap ring groove. Make sure the snap ring is fully seated in the groove.**

FRONT CLUTCH

1. Remove the clutch cover snap ring with a screwdriver, and remove the turbine shaft from the clutch drum.

2. Remove the thrust washer from the thrust surface of the clutch hub. Insert one finger in the clutch hub, and lift the hub straight up to remove the hub from the clutch drum.

3. Remove the four bronze and the three steel clutch plates, and then remove the pressure plate from the clutch drum.

4. On the PBL transmission, place the front clutch spring compressor on the release spring, position the clutch drum on the bed of an arbor press, and then compress the release spring with the arbor press until the release spring snap ring can be removed (Fig. 14). This tool is not necessary for removing the spring on the PBB transmission.

5. Remove the clutch release spring from the clutch drum.

6. Install the special nozzle shown in Fig. 12 on an air hose. Place the nozzle against the clutch apply hole in the front clutch housing, and force the piston out of the housing.

7. Remove the piston inner seal from the clutch housing. Remove the piston outer seal from the groove in the piston.

8. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace

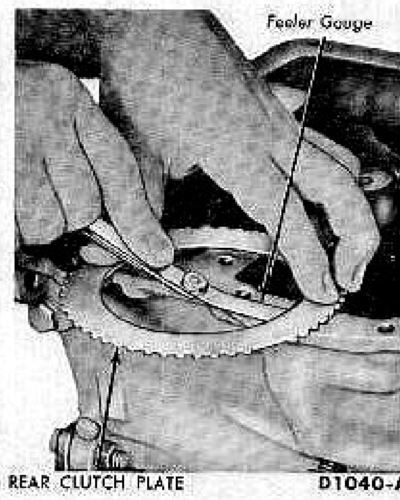


FIG. 13—Checking Rear Clutch Plate Coning

the clutch cylinder if it is badly scored or damaged.

9. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages.

10. Inspect the clutch piston for scores and replace if necessary. Check the clutch piston check valve for free movement and proper seating (Fig. 15).

11. Check the clutch release spring for distortion and cracks. Replace the spring if it is distorted or cracked.

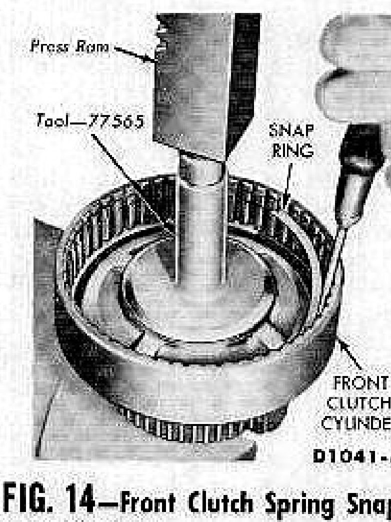


FIG. 14—Front Clutch Spring Snap Ring Removal

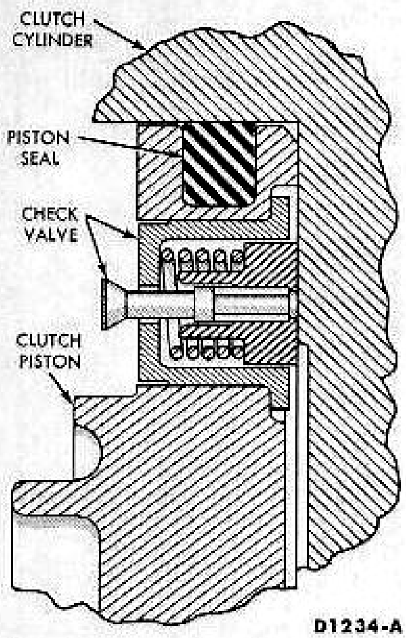


FIG. 15—Front Clutch Piston Check Valve

12. Inspect the bronze and steel clutch plates and the clutch pressure plate for scored bearing surfaces. Replace all parts that are deeply scored.

13. Check the clutch plates for flatness and for fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat. **Front clutch plates differ in friction characteristics from the rear clutch plates and are not interchangeable.**

14. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.

15. Inspect the turbine shaft bearing surfaces for scores. If excessive clearance or scores are found, discard the unit.

16. Check the splines on the turbine shaft for wear and replace them if they are excessively worn.

17. Inspect the bushing in the turbine shaft for scores.

18. Lubricate all parts with automatic transmission fluid. Install a new piston inner seal ring in the clutch cylinder as shown in Fig. 15.

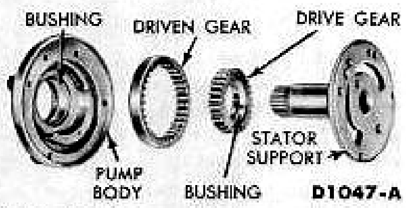


FIG. 16—Front Pump Disassembled

19. Install a new piston outer seal in the groove in the piston as shown in Fig. 15.

20. Install the piston in the clutch housing. **Make sure the steel bearing ring is in place on the piston.**

21. On the PBL transmission, position the release spring in the clutch cylinder with the concave side up. Place the release spring compressor on the spring, compress the release spring with an arbor press, and then install the snap ring as shown in Fig. 14. **Make sure the snap ring is fully seated in the groove.**

22. The front clutch should not be assembled further until the front clutch housing is installed on the rear clutch and primary sun gear shaft assembly (Fig. 26).

FRONT PUMP

1. Remove the stator support attaching screws and lockwashers, and then remove the stator support.

2. Mark the top surface of the pump driven gear with prussian blue to assure correct assembly. **Do not scratch or punch marks on the pump gears.**

3. Remove the drive and driven gears from the pump body.

4. Refer to Fig. 16 for a disassembled view of the front pump. Inspect the pump body bushing, drive gear bushing, gear pockets, and crescent for scores.

5. Inspect the mating surfaces of the pump body and cover for burrs.

6. Inspect the drive and driven gear bearing surface for scores, and check the gear teeth for burrs. Inspect the stator support splines for burrs and wear.

7. Check the fluid passages for obstructions.

8. If any parts other than the stator support are found defective, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth. The stator support is serviced separately.

9. Bolt the front pump to the transmission case with capscrews.

10. Install an oil seal remover, and pull the front seal from the pump body. **The front seal is ½ inch thick.**

11. Clean the pump body counterbore. Then inspect the bore for rough spots. Smooth up the counterbore with crocus cloth.

12. Remove the pump body from the transmission case.

FIG. 17—Front Seal Installation

13. Coat the outer diameter of a new seal with FoMoCo Sealing Compound, or its equivalent, then position the seal in the pump body. Drive the seal into the pump body with the tool shown in Fig. 17, until it is firmly seated in the body.

14. Place the pump driven gear in the pump body with the mark on the gear facing upward. Install the drive gear in the pump body.

15. Install the stator support, attaching screws, and lockwashers. Check the pump for free movement.

REAR PUMP

1. Remove the screws and lockwashers which secure the pump cover to the pump body, then remove the cover.

2. Mark the top face of the pump drive and driven gear with prussian blue to assure correct installation of gears at assembly (Fig. 18). **Do not scratch or punch marks on the pump gears.**

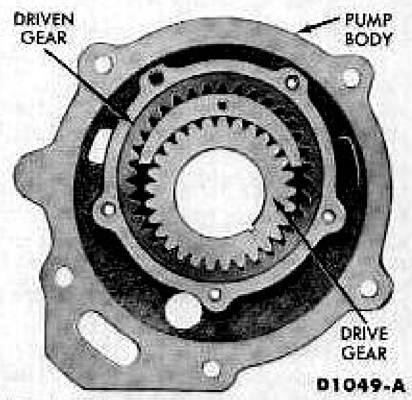


FIG. 18—Rear Pump

3. Remove the drive and driven gears from the pump body.

4. Inspect the gear pockets and the crescent of the pump body for scores or pitting.

5. Inspect the inner bushing and the drive and driven gear bearing surfaces for scores.

6. Check all fluid passages for obstructions, and check mating surfaces and gasket surfaces of the pump body and cover for burrs.

7. Inspect the pump cover bearing surface for scores. Minor burrs or scores may be removed with crocus cloth.

8. If any pump parts, other than the pump cover, are defective, replace the pump as a unit. The pump cover can be replaced separately.

9. Place the pump driven gear in the pump body with the mark (placed on the gear at disassembly) facing upward.

10. Install the drive gear in the pump body with the mark facing upward.

11. Install the pump cover, attaching screws, and lockwashers. Torque the ¼-inch screws to 80-90 inch-pounds, and the 10-24 screw to 25-35 inch-pounds. Check the pump gears for free movement.

PRESSURE REGULATOR

1. Remove the valves from the regulator body.

2. Remove the regulator body cover attaching screws, and remove the cover.

3. Remove the separator plate, and then remove the front pump check valve and spring from the regulator cover.

4. Wash all parts thoroughly in clean solvent and blow dry with moisture-free compressed air.

5. Inspect the regulator body and cover mating surfaces for burrs.

6. Check all fluid passages for obstructions.

7. Inspect the control pressure and converter pressure valves (Fig. 19) and bores for burrs and scores. Remove all burrs carefully with crocus cloth.

8. Check free movement of the valves in their bores. The valves should fall freely into the bores when both the valve and bore are dry.

9. Inspect the valve springs for distortion.

10. When assembling the parts, avoid damaging them. Position the check valve spring and valve in the regulator cover.

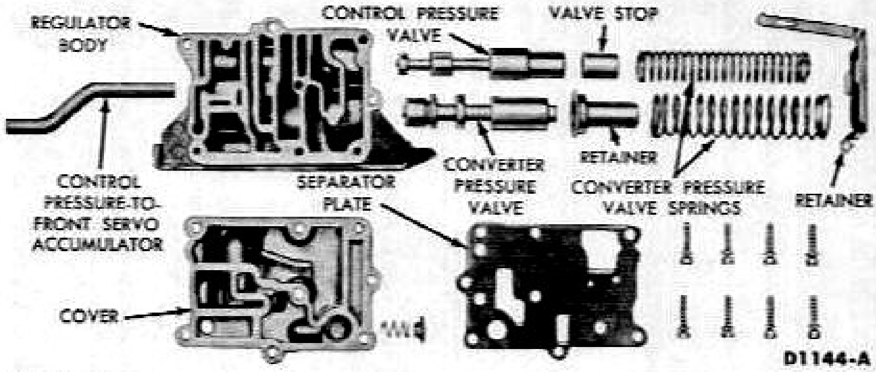


FIG. 19—Pressure Regulator

11. Position the separator plate on the regulator cover.

12. Position the regulator cover and separator plate on the regulator body, then install the attaching screws. Torque the screws to 20-30 inch-pounds.

13. Insert the valves in the pressure regulator body (Fig. 19).

CONTROL VALVE BODY

During the disassembly of the control valve assembly, keep the valve parts clean. **Do not separate the valve bodies until after the valves have been removed.**

DISASSEMBLY

1. Remove the manual valve.

2. Remove one screw attaching the separator plate to the lower valve body.

3. Remove the upper body front plate (Fig. 20). **The plate is spring loaded. Apply pressure to the plate while removing the attaching screws.**

4. Remove the compensator sleeve and plug, and then remove the compensator valve springs. Remove the compensator valve.

5. Remove the modulator valve assembly. Remove the downshift valve and throttle valve spring.

6. Remove the two screws which attach the throttle valve return spring to the upper body, and remove the spring. Remove the remaining screw attaching the upper valve body rear plate to the body, and remove the plate.

7. Remove the throttle valve, and then the compensator cut back valve.

8. Remove the lower body side plate (Fig. 20). **The plate is spring loaded. Apply pressure to the plate while removing the attaching screws.**

9. Remove the 1-2 shift valve spring and valve. Remove the inhibitor valve and spring.

10. Remove the lower body end plate. **The end plate is spring loaded. Apply pressure to the plate while removing the attaching screws.**

11. Remove the rear servo lockout valve and spring.

12. Remove the 2-3 throttle reducing valve and spring, the 2-3 shift valve sleeve, and the 2-3 delay shift valve.

13. Remove the 2-3 shift valve spring and valve. Remove the transition valve.

14. On the valve body cover, remove the 3-2 kickdown control valve and check valve cover (Fig. 20).

15. Remove the check ball spring and check ball. Remove the kickdown control valve spring and valve.

16. Remove the 3-2 coasting control valve spring retainer from the cover. Remove the valve and spring.

17. Remove the four through bolts and three screws, and separate the bodies.

18. Inspect the rear pump check valve which is installed in the lower body. The valve seat is staked for a firm fit in the casting and should not be removed, unless a new one is to be installed.

INSPECTION

1. Clean all parts thoroughly in clean solvent, then blow dry with moisture-free compressed air.

2. Inspect all valve and plug bores for scores. Check all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs or distortion. Inspect all plugs and valves for burrs and scores. **Crocus cloth can be used to polish valves and plugs if care is taken to avoid rounding the sharp edges of the valves and plugs.**

3. Inspect all springs for distortion. Check all valves and plugs for free movement in their respective

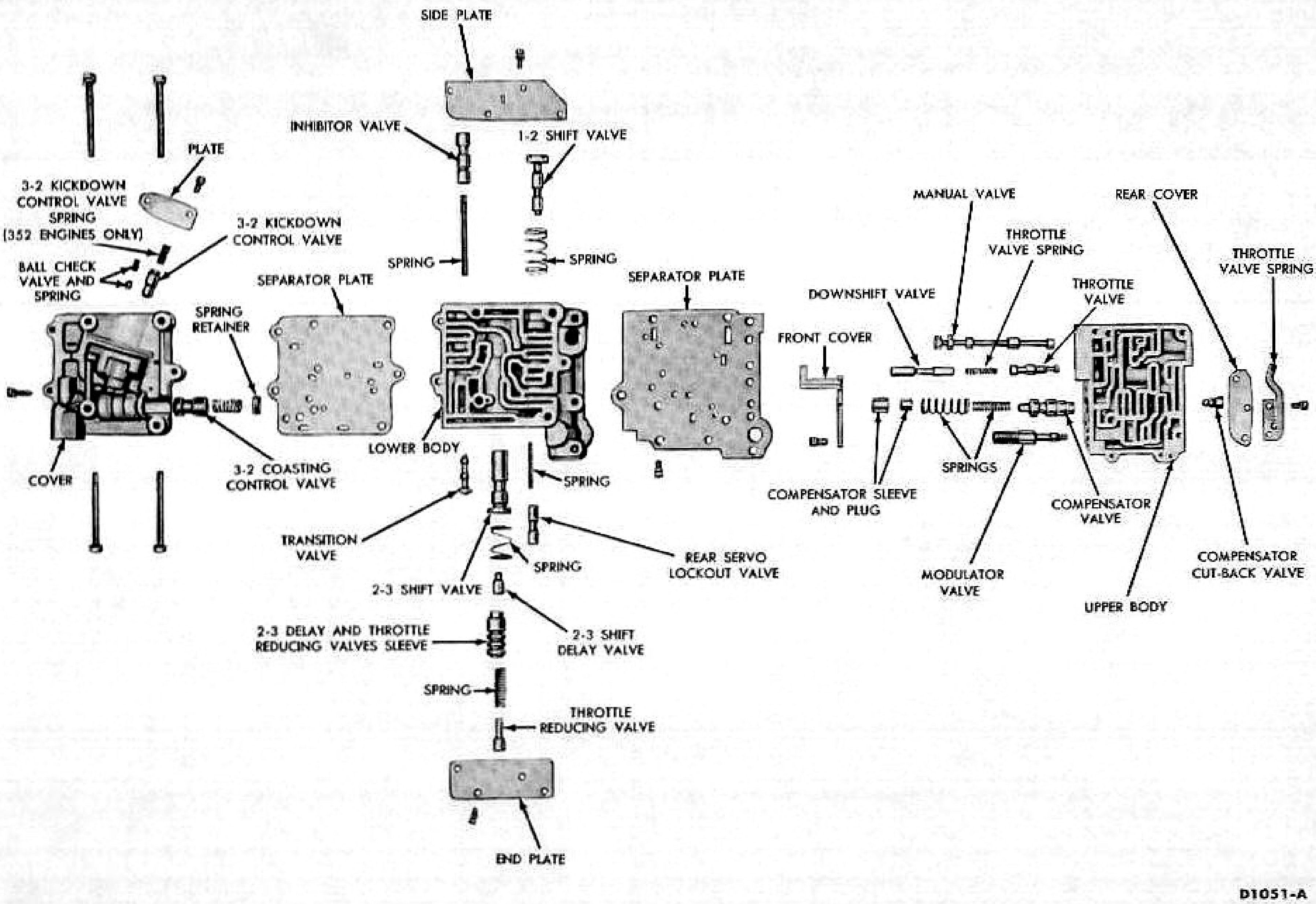


FIG. 20—Control Valve Body

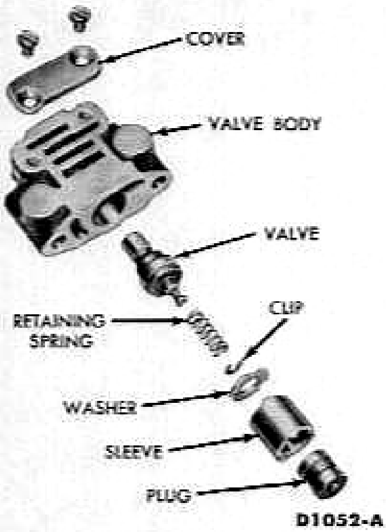


FIG. 21—Governor

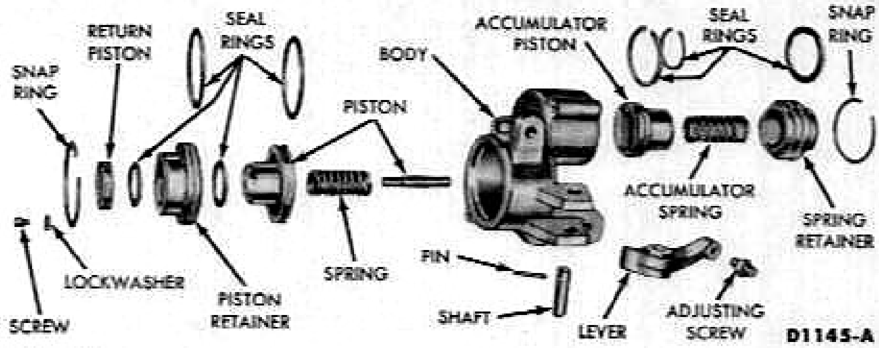


FIG. 22—Front Servo

bores. Valves and plugs, when dry, must fall from their own weight in their respective bores.

4. Roll the manual valve on a flat surface to check it for a bent condition.

ASSEMBLY

1. Arrange all parts in their correct position. Rotate the valves and plugs when inserting them in their bores to avoid shearing of soft body castings.

2. Install the separator plate on the upper body. **Do not tighten the screws.**

3. Install the check valve spring, valve, and seat in the lower body. Position the lower body on the upper body, then start **but do not tighten** the attaching screw.

4. Position the cover and separator plate on the lower body and start the four through bolts.

5. Align the valve body attaching bolt holes in the separator plate and the lower body. Torque the four valve body bolts, equally, to 4-6 foot-pounds. **Excessive tightening of these bolts may distort valve bodies, causing valves or plugs to stick.**

6. Install the three cover to lower body screws. Torque the cover and body screws to 28-30 inch-pounds. Tighten the other screws.

7. Install the 3-2 kickdown control valve and spring and the ball check valve and spring in the cover. Install the plate.

8. Install the 3-2 coasting control valve, spring, and spring retainer in the cover.

9. Install the transition valve in the lower body. Install the 2-3 shift valve, spring, sleeve, shift delay valve, inner spring, and throttle reducing valve.

10. Install the rear servo lockout valve spring and valve. Install the lower body end plate.

11. Install the inhibitor valve spring and valve in the lower body.

12. Install the 1-2 shift valve spring and valve. Install the lower body side plate.

13. Install the throttle valve and compensator cut-back valve in the upper body.

14. Install the upper body rear plate and throttle valve return spring.

15. Install the throttle valve spring and downshift valve. Install the modulator valve assembly.

16. Install the compensator valve, inner and outer compensator springs, and the compensator sleeve and plug. Install the upper body front plate.

17. Install the manual drive.

GOVERNOR

1. Remove the governor valve body cover.

2. Remove the governor valve body from the counterweight (Fig. 21).

3. Remove the plug, sleeve, washer, and valve from the body.

4. Inspect the governor valve and bore for scores. Minor scores may be removed with crocus cloth. Replace the governor if the valve or body is deeply scored.

5. Check for free movement of the valve in the bore. Inspect fluid passages in the valve body and counterweight for obstructions. **All fluid passages must be clean.**

6. Inspect the mating surfaces of the governor body and counterweight for burrs and distortion. Mating surfaces must be smooth and flat.

7. Install the governor valve in the bore of the valve body. Install the washer, sleeve, and plug. Make sure that the three points on the end of the sleeve seat in the slots in the washer.

8. Install the body on the counterweight. **Make sure the fluid passages in the body and the counterweight are aligned.**

9. Position the valve body cover on the body, and install the screws.

FRONT SERVO

1. Remove the servo piston retainer snap ring (Fig. 22). **The servo piston is spring loaded. Apply pressure to the piston when removing the snap ring.**

2. Remove the servo piston retainer, servo piston, and the return piston from the servo body. It may be necessary to tap the piston stem lightly with a soft hammer to separate the piston retainer from the servo body.

3. Remove the screw and washer from the end of the piston stem, and separate the piston retainer, return piston, and servo piston.

4. Remove all the seal rings, and remove the spring from the servo body.

5. Apply pressure against the accumulator spring retainer, and remove the retainer snap ring from the servo body. Separate the accumulator piston and spring retainer.

6. Remove the seal rings from the accumulator piston and the retainer.

7. Inspect the servo body for cracks and the piston bore and the servo piston stem for scores (Fig. 22). Check fluid passages for obstructions.

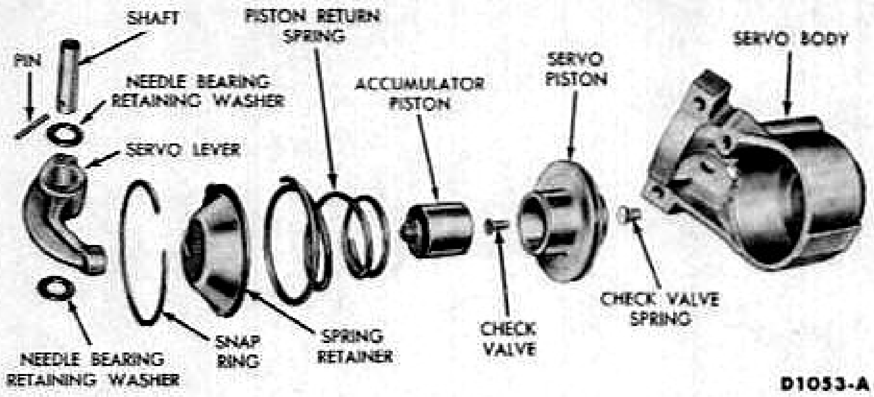


FIG. 23—Rear Servo

8. Check the actuating lever for free movement, and inspect it for wear. If necessary to replace the actuating lever or shaft, remove the retaining pin and push the shaft out of the bracket. If the shaft is not retained by a pin, it is retained in the body by serrations on one end of the shaft. These serrations cause a press fit at that end. To remove the shaft press on the end opposite the serrations.

Inspect the adjusting screw threads and the threads in the lever.

9. Check the servo spring and servo band strut for distortion.

10. Inspect the servo band lining for excessive wear and bonding to the metal. **The band should be replaced if worn to a point where grooves are not clearly evident.**

11. Inspect the band ends for cracks and check the bands for distortion.

12. To assemble, reverse the disassembly procedure.

REAR SERVO

1. Remove the servo actuating lever shaft retaining pin with a ⅛-inch punch. Remove the shaft and actuating lever needle bearings and thrust washers.

2. Press down on the servo spring retainer, and remove the snap ring. **Release the pressure on the retainer slowly to prevent the spring from flying out.**

3. Remove the retainer and servo spring.

4. Force the piston out of the servo body with air pressure. **Hold one hand over the piston to prevent damage.**

5. Remove the piston seal ring. Remove the accumulator piston from the servo piston.

6. Inspect the servo body for cracks and the piston bore for scores (Fig. 23). Inspect the servo body to transmission case mating surface for burrs.

7. Check the fluid passages for obstructions. Inspect the fluid passage plugs for tightness in the body. Inspect the check valve in the servo piston for freedom of movement and proper seating.

8. Inspect the accumulator piston stem for scores. Inspect the actuating lever socket for scores and wear. Check the actuating lever and shaft for wear.

9. Inspect the band and the struts for distortion. Inspect the band ends for cracks.

10. Inspect the servo spring for distortion.

11. Inspect the servo band lining for excessive wear and bond to metal band. **The band should be replaced if worn to a point where grooves are not clearly evident.**

12. Inspect the accumulator piston and bore for scores. **Be sure that the piston slides freely in the bore.**

13. Install the accumulator piston in the servo piston.

14. Install a new seal ring on the servo piston.

15. Install the piston in the servo body. **Lubricate the parts to facilitate assembly.** Install the servo spring with the small coiled end against the servo piston.

16. Install the spring retainer. Compress the spring with a C-clamp. Then install the snap ring. **The snap ring must be fully seated in the grove.**

17. Install the needle bearings in the actuating lever. Install the actuating lever and thrust washers with the socket in the lever bearing on the piston stem. Install the actuating lever shaft aligning the retaining pin holes, and install the pin.

18. Check the actuating lever for free movement.

4 TRANSMISSION CASE AND LINKAGE REPAIR

DISASSEMBLY

1. Remove the inner throttle lever shaft nut. Then remove the inner throttle lever.

2. Remove the outer throttle lever and shaft. Remove the throttle shaft seal from the counterbore in the manual lever shaft.

3. Remove the cotter pin from each end of the parking pawl torsion rod, then remove the rod.

4. Rotate the manual shaft until the detent lever clears the detent plunger. Then remove the detent plunger and spring. **Do not allow the detent plunger to fly out of the case.**

5. Remove the manual lever shaft nut, and remove the detent lever. Remove the outer manual lever and shaft from the transmission case.

6. Remove the clip retaining the torsion lever assembly and disassemble the assembly.

7. Tap the toggle lever sharply toward the rear of the case to remove the plug and pin.

8. Remove the pawl pin by working the pawl back and forth. Remove the pawl and toggle lever assembly, and disassemble.

9. Remove the manual shaft seal.

INSPECTION

Clean the case thoroughly with clean solvent. Blow out all passages (Fig. 24).

Inspect the case for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the breather tube for

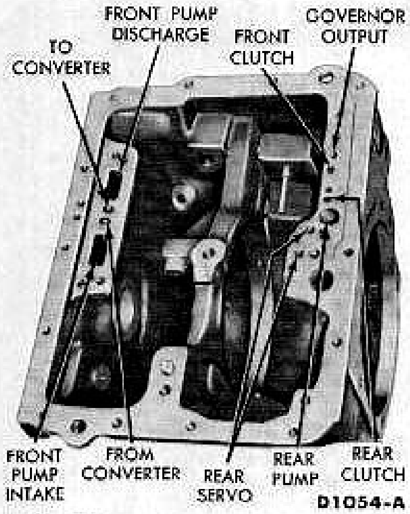


FIG. 24—Transmission Case Fluid Passages

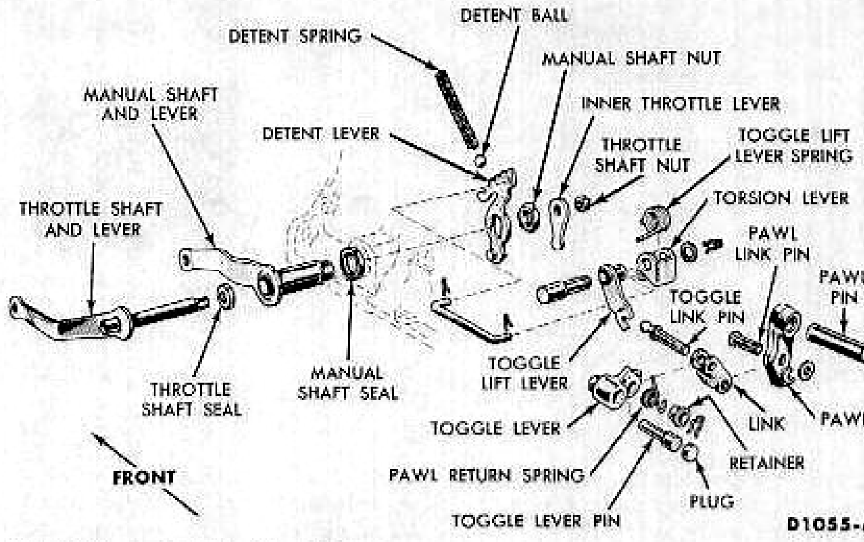


FIG. 25—Typical Parking Linkage

obstructions. Check all fluid passages for obstructions and leakage.

Inspect the case bushing and center support bushing for scores. Inspect the torsion lever pin for wear.

Check all parking linkage parts (Fig. 25) for wear or damage.

ASSEMBLY

1. Assemble the toggle lever and pawl assembly and install in the case.

2. Install the torsion lever assembly, using two screwdrivers to position the spring on the lever.

3. Coat the outer diameter of a new manual shaft seal with gasket sealer and install the seal in the case.

4. Install the manual lever and shaft in the case.

5. Install the detent lever and the attaching nut. Torque the nut to 35-40 foot-pounds.

6. Install the detent spring and ball using a tube to depress the ball and spring while rotating the lever.

7. Complete the lever installation using a new throttle lever shaft seal.

8. Check for free linkage operation.

5 INSTALLATION OF SUB-ASSEMBLIES

CLUTCHES AND GEAR TRAIN ASSEMBLY AND INSTALLATION —PBL TRANSMISSION

1. Install the bronze thrust washer on the primary sun gear shaft. Lubricate all parts to facilitate assembly.

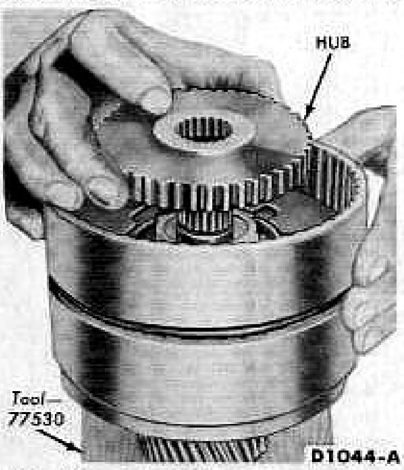


FIG. 26—Clutch Hub Installation

2. Install the rear clutch on the primary sun gear shaft. **Center the seal rings on the primary sun gear shaft to prevent breakage. If the rear clutch hub is equipped with a needle bearing that contains loose needles, be sure that all the needles are in place before assembling the clutch assembly on the sun gear shaft. Needles may be held in place with a light film of grease.**

3. Install the steel and bronze thrust washer on the secondary sun gear shaft. **The flats on the steel washer I.D. must be aligned with the flats on the secondary sun gear shaft. If the outer edge of the steel washer is chamfered on one side, install it with chamfered side down.**

4. Install the front clutch seal rings and the front clutch housing on the primary sun gear shaft. Rotate the clutch units to mesh the rear clutch plates with the serrations on the clutch hub. **Do not break the seal rings.**

5. Install the clutch hub in the clutch cylinder with the deep counter-

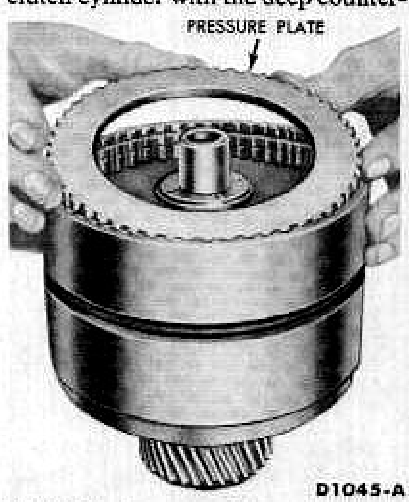


FIG. 27—Pressure Plate Installation

FIG. 28—Clutch Plate Installation

bore down (Fig. 26). Install the thrust washer on the clutch hub.

6. Install the pressure plate in the clutch cylinder with the flat side up (Fig. 27).

7. Install the four bronze and the three steel clutch plates alternately, starting with a bronze plate (Fig. 28). Lubricate the plates as they are installed.

8. Install the turbine shaft in the clutch cylinder, then install the snap ring. **Make sure the snap ring is fully seated in the groove.**

9. Install the thrust washer on the turbine shaft.

10. Install the front band in the transmission case so that the anchor end is aligned with the anchor in the case. Lift the clutch assemblies out of the holding block. **Do not let the clutches separate.**

11. Install the sub-assemblies in the transmission case, from the rear, while positioning the servo band on the drum. Hold the units together while installing them (Fig. 5).

12. On the bench, install the one-way clutch on the center support with the flanged side of the cage rings up (Fig. 29).

FIG. 29—One-Way Clutch Installation on Center Support

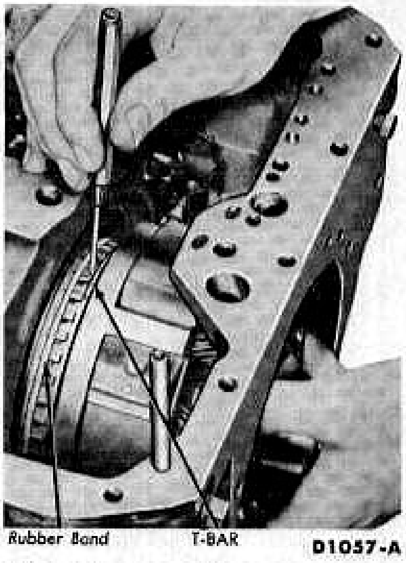


FIG. 30—Pinion Carrier Installation

13. Carefully compress each drag spring as it is started on the inner race. After all the drag springs are started on the race, rotate the clutch to tilt the sprags, then push the clutch all the way down on the center support. Place a strong rubber band around the sprag outer ends (Fig. 30).

14. Install the center support and clutch in the case.

15. Install the right and left-hand center support outer bolts and external tooth lockwashers. **The lockwashers must be installed with the rolled edge toward the transmission case to insure a tight seal.**

16. Position the rear band in the case (Fig. 30). Install the primary sun gear rear thrust bearing and race and the one-way clutch spacer in the pinion carrier (Fig. 31).

17. Install the pinion carrier in the case and start the pinion carrier front pilot in the center support bushing. Depress the T-bar and work the pinion carrier forward until the sprags are started on the clutch outer race.

18. Remove the rubber band (Fig. 32).

19. Work the pinion carrier forward to the point that the one-way clutch is barely visible. Rotate the pinion carrier counterclockwise (from the rear) and note whether the clutch rotates with the pinion carrier or remains stationary with the center support.

20. The clutch T-bar frictional grip on the clutch outer race is

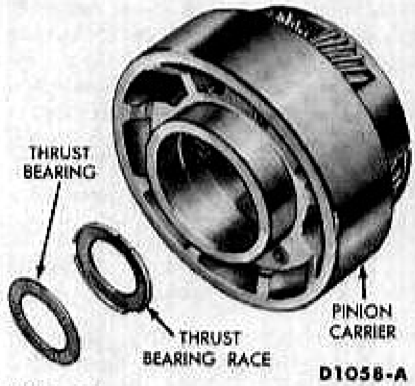


FIG. 31—Primary Sun Gear Rear Thrust Bearing and Race

stronger than the drag spring frictional grip on the inner race, so the clutch should rotate with the pinion carrier. If it does not rotate with the pinion carrier, replace the clutch.

21. Install the selective thrust washer on the pinion carrier rear pilot. **If the end play was not within specifications when checked prior to disassembly, replace the washer with one of proper thickness. Selective washers are available in thicknesses of 0.063-0.061 inch, 0.076-0.074 inch, 0.069-0.067 inch, and 0.083-0.081 inch.**

22. Install the output shaft, carefully meshing the internal gear with the pinions.

CLUTCHES AND GEAR TRAIN ASSEMBLY AND INSTALLATION —PBB TRANSMISSION

1. Install the bronze thrust washer on the primary sun gear shaft. Lubricate all parts to facilitate assembly.

2. Install the rear clutch on the primary sun gear shaft. **Center the**

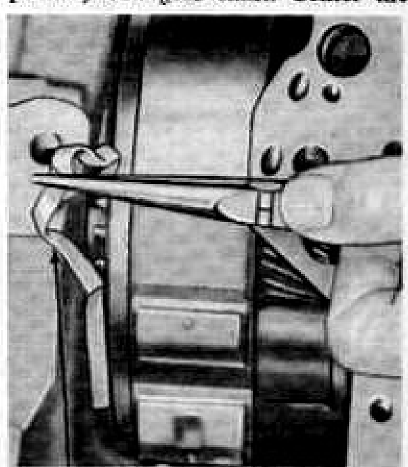


FIG. 32—Rubber Band Removal

seal rings on the primary sun gear shaft to prevent breakage. If the rear clutch hub is equipped with a needle bearing that contains loose needles, be sure that all the needles are in place before assembling the clutch assembly on the sun gear shaft. Needles may be held in place with a light film of grease.

3. Carefully invert the assembly on the bench fixtures.

4. Install the one-way clutch on the center support with the flanged side of the cage rings up (Fig. 29). Carefully compress each drag spring as it is started on the inner race. After all the springs are started on the race, rotate the clutch to tilt the sprags, and then push the clutch all the way down on the center support. Place a strong rubber band around the sprag outer ends.

5. Place the center support over the inverted rear clutch and primary sun gear assembly.

6. Start the planet carrier into the center support bushing and over the one-way clutch.

7. Depress the T-bar and slowly turn the pinion carrier counterclockwise (from the top) until all the clutch sprags are started into the pinion carrier.

8. Remove the rubber band. Hold the center support and turn the pinion carrier counterclockwise (from the top) to permit the pinion carrier to slide downward over the sprags.

9. Carefully invert the assembly on the bench fixture.

10. Install the steel thrust washer and then install the bronze thrust washer on the secondary sun gear shaft. **The flats on the steel washer I.D. must be aligned with the flats on the secondary sun gear shaft. If the outer edge of the steel washer is chamfered on one side, install it with the chamfered side down.**

11. Install the front clutch housing on the primary sun gear shaft by rotating the clutch units to mesh the rear clutch plates with the serrations on the clutch hub. **Do not break the seal rings.**

12. Install the clutch hub in the clutch cylinder with the deep counterbore down (Fig. 26). Install the thrust washer on the clutch hub.

13. Install the pressure plate in the clutch cylinder with the flat side up (Fig. 28).

14. Install the four bronze and the three steel clutch plates alternately, starting with a bronze plate (Fig. 28). Lubricate the plates as they are installed.

15. Install the turbine shaft in the clutch cylinder. Then install the snap ring. **Make sure the snap ring is fully seated in the groove.**

16. Install the thrust washer on the turbine shaft.

17. Place the front and rear bands in the case. Place the rear band strut crossways between the rear band ends. This will provide enough clearance for the center support to clear the band.

18. Carefully lift the pinion carrier, center support and clutch assemblies off the bench fixture and insert it into the transmission case.

19. After the assembly is firmly seated forward in the case, turn the pinion carrier clockwise (from the rear) until the center support bolt holes are aligned with the holes in the case.

20. Install the center support bolts and torque them to 20-25 foot-pounds.

21. Install the selective thrust washer on the pinion carrier rear pilot. **If the end play was not within specifications when checked prior to disassembly, replace the washer with one of proper thickness. Selective washers are available in thicknesses of 0.063-0.061 inch, 0.076-0.074 inch, 0.069-0.067 inch, and 0.083-0.081 inch.**

22. Install the seal rings on the primary sun gear shaft.

23. Install the output shaft, carefully meshing the internal gear with the pinions.

REAR PUMP

1. Position the rear pump drive key in the keyway on the output shaft.

2. Position new front and rear gaskets on the pump body. Retain the gaskets with transmission fluid. On the PBB transmission, install a new O-ring on the rear pump discharge hole in the case.

3. Install the thrust washer on the pump body with the bronze side up. Align the thrust washer tangs with the bosses on the pump body, and install the rear pump. **Be sure the drive key is aligned with the keyway in the pump drive gear.**

GOVERNOR

1. Position the governor drive ball in the pocket in the output shaft. Retain the ball with transmission fluid.

2. Install the governor assembly aligning the groove with the ball in the output shaft. **Install the governor with the governor body plate toward the rear of the transmission.**

3. Install the governor snap ring. On the PBB transmissions the governor must be all the way forward and against a shoulder on the shaft.

DISTRIBUTOR

1. Place the four seal rings in the distributor sleeve, and check the ring gap.

2. Check the fit of the seal rings in the grooves in the output shaft. The rings should rotate freely. Install the rings in the grooves of the output shaft. On the PBB transmission, install the flat washer.

3. Install the three tubes in the distributor sleeve (Fig. 3).

4. Install the distributor sleeve on the output shaft, chamfer forward. Lubricate parts to facilitate assembly. Slide the sleeve forward over the four rings and at the same time start the tubes into the case. The distributor sleeve is located between the governor snap ring and speedometer driving gear.

5. Install a new seal on the rear pump outlet tube and install the tube in the transmission case and rear pump body.

EXTENSION HOUSING

1. Position the speedometer drive gear ball in the pocket of the output shaft. Retain it with fluid. Install the speedometer drive gear. Install the speedometer gear snap ring.

2. Insert the extension housing oil seal replacer and pilot in the housing, and then install the extension housing on the transmission case. Install the extension housing attaching bolts and external tooth lockwashers. **The lockwashers must be installed with the rolled edge toward the transmission case to insure a tight seal.**

3. Torque the extension housing attaching bolts to 28-38 foot-pounds.

4. Install the governor inspection cover and a new gasket on the housing.

FRONT PUMP

1. Position a new front pump gasket in the counterbore of the transmission case.

2. Install the front pump, aligning the pump bolt holes with the holes in the case.

3. Install three of the front pump attaching bolts. Torque the bolts to 17-22 foot-pounds.

CHECK TRANSMISSION END PLAY

1. Mount the dial indicator support in a front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft (Fig. 2).

2. Use a large screwdriver to pry the front of the clutch drum toward the rear of the transmission (Fig. 2). Set the dial indicator to zero.

3. Remove the screwdriver and pry the units toward the front of the transmission by inserting a screwdriver between the large internal gear and the transmission case (Fig. 2). Note the indicator reading. End play should be 0.010 to 0.029 inch.

4. Remove the indicator, and remove the tool from the extension housing.

5. Install the one remaining front pump attaching bolt. Torque the bolt to 17-22 foot-pounds torque.

FRONT SERVO

1. Position the front band forward in the case with the band ends up.

2. Position the servo strut with the slotted end aligned with the servo actuating lever and the small end aligned with the band end. Rotate the band, strut, and servo into position engaging the anchor end of the band with the anchor pin in the case.

3. Locate the servo on the case, and install the attaching bolts.

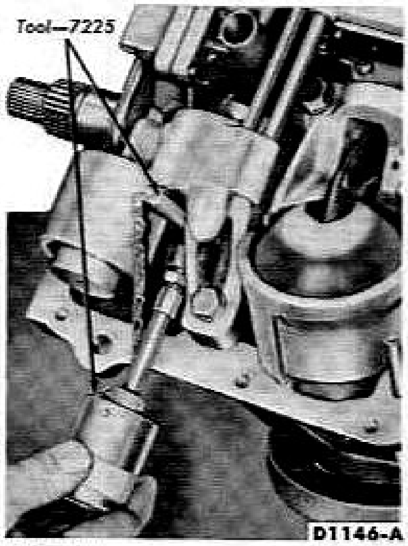


FIG. 33—Front Servo Adjustment

Tighten the attaching bolts only two or three threads.

4. Install the servo tubes.

REAR SERVO

1. Position the servo anchor strut, then rotate the rear band to engage the strut.

2. Position the servo actuating lever strut with a finger, and then install the servo and attaching bolts. Torque the bolts to 40-45 foot-pounds.

PRESSURE REGULATOR BODY

1. Install the pressure regulator body and attaching bolts. Install the tube between the regulator body and front servo. Then torque the attaching bolts to 17-22 foot-pounds.

2. Install the control and converter valve guides and springs. Install the spring retainer.

3. Install a new seal ring on the rear pump intake tube, and install the tube in the case.

CONTROL VALVE BODY

1. Install the control valve assembly, using care to align the servo tubes with the control valve. Align the inner throttle lever between the throttle lever stop and the downshift valve, and at the same time push the throttle valve in to clear the transmission case. **Align the manual valve with the actuating pin in the manual detent lever. Do not tighten the attaching bolts.**

2. Install the large control pressure tube in the valve body and regulator.

3. Install the small control pressure compensator tube in the valve body and regulator.

4. Move the control valve body toward the center of the case as far as the attaching bolts will permit. This movement is made to take up the clearance between the manual valve and the actuating pin on the manual detent lever.

5. Torque the attaching bolts to 8-10 foot-pounds.

6. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the valve body away from the center of the case. Move the body only enough to relieve the binding. Torque the attaching bolts and recheck the manual valve for binding.

7. Install the lubrication tube in the rear pump and the regulator body.

8. Torque the control body attaching bolts to 8-10 foot-pounds. Torque the front servo attaching bolts to 30-35 foot-pounds.

FRONT SERVO ADJUSTMENT

1. Loosen the front servo adjusting screw lock nut, and then back the nut off three turns.

2. Loosen the adjusting screw five complete turns.

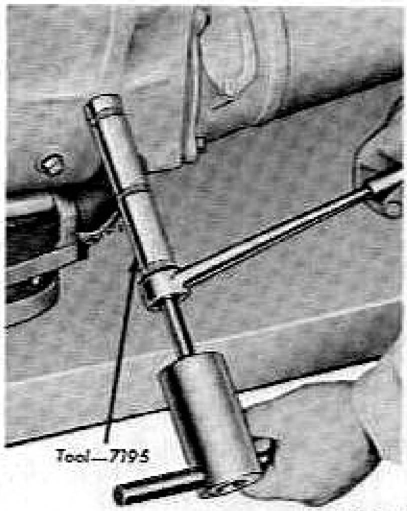


FIG. 34—Rear Servo Adjustment

3. Using the front band adjusting wrench shown in Fig. 33, insert a ¼-inch spacer between the lever and the stem, and tighten the screw until the ratchet overruns.

4. Back out the adjusting screw one complete turn, then tighten the lock nut.

REAR SERVO ADJUSTMENT

1. Loosen the adjusting screw lock nut 3 turns with the ¾-inch socket of the rear band adjusting wrench.

2. Back off the adjusting screw until free travel is obtained.

3. Use the special tool shown in Fig. 34 to tighten the adjusting screw until the ratchet overruns, and then back off the adjusting screw 1½ turns.

4. Hold the rear servo adjusting screw stationary, and tighten the lock nut.

FLUID SCREEN AND PAN

1. Position the fluid screen over the rear pump inlet tube, then over the front pump inlet tube. Press the screen down firmly. Install the screen retaining clip.

2. Place a new gasket on the transmission case, and then install the pan. Install the attaching bolts and lockwashers. Torque the bolts to 10-13 foot-pounds.

6 HYDRAULIC SYSTEM BENCH TESTS

After the transmission has been assembled and is ready for installation in the car, check the hydraulic system to make sure it is operating properly. These hydraulic tests can be made on the bench so that most malfunctions of the system can be corrected before the transmission is installed in the car.

TESTING TOOL INSTALLATION

1. Install a plug in the filler tube hole in the oil pan, then pour four quarts of Ford Automatic Transmission Fluid B8A-19582-A into the transmission through the speedometer gear opening.

2. Install the bench testing tool on the transmission.

3. Remove the ⅛-inch pipe plug at the transmission case rear face. Turn the front pump in a clockwise direction at 75-100 rpm until a regular flow of transmission fluid leaves the hole in the transmission case. This operation "bleeds" the air from the pump.

4. Install the pressure gauge (77820 or T57L-77820-A) as shown in Fig. 35.

PRESSURE TESTS

Turn the front pump at 75-100 rpm and note the gauge readings. The pressure readings on the bench test must be within the limits set for a transmission in the car. For example, on bench test the transmission must develop, at closed throttle, 56-72 psi in all manual valve positions. While maintaining 56-72 psi, push the throttle lever down slowly and note that a pressure rise is obtained.

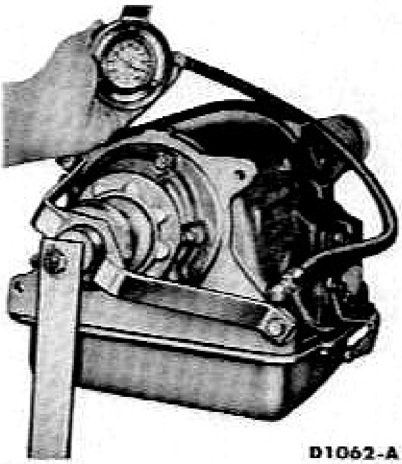


FIG. 35—Bench Testing Tool Installation

Maximum pressures must be within the limits given in Table 1, Part 6-2. Pressures in R and L are higher because compensator pressure is not present with advanced throttle in R and L.

Think of the hydraulic control system as a main line pressure system with feeder lines running from it. When the manual valve is shifted, these feeder lines are "cut-in" and "cut out" of the system. By noting the positions in which the pressure is low, it is possible to locate a leak. For example, pressure readings might be:

Manual Valve Position	P	R	N	D2	D1	L
Closed Throttle Pressure (psi)	60	20	60	60	60	60

Since the pressure is low in R only, the leak is in the passage that is in the system only in reverse. That passage is the rear clutch apply passage.

Again, pressure readings on a bench test might be:

Manual Valve Position	P	R	N	D2	D1	L
Closed Throttle Pressure (psi)	60	60	60	20	20	20

Since pressure is normal in all positions except D2, D1, and L, check for a passage that is in the system in D2, D1, and L only. That passage is the front clutch and governor supply passage.

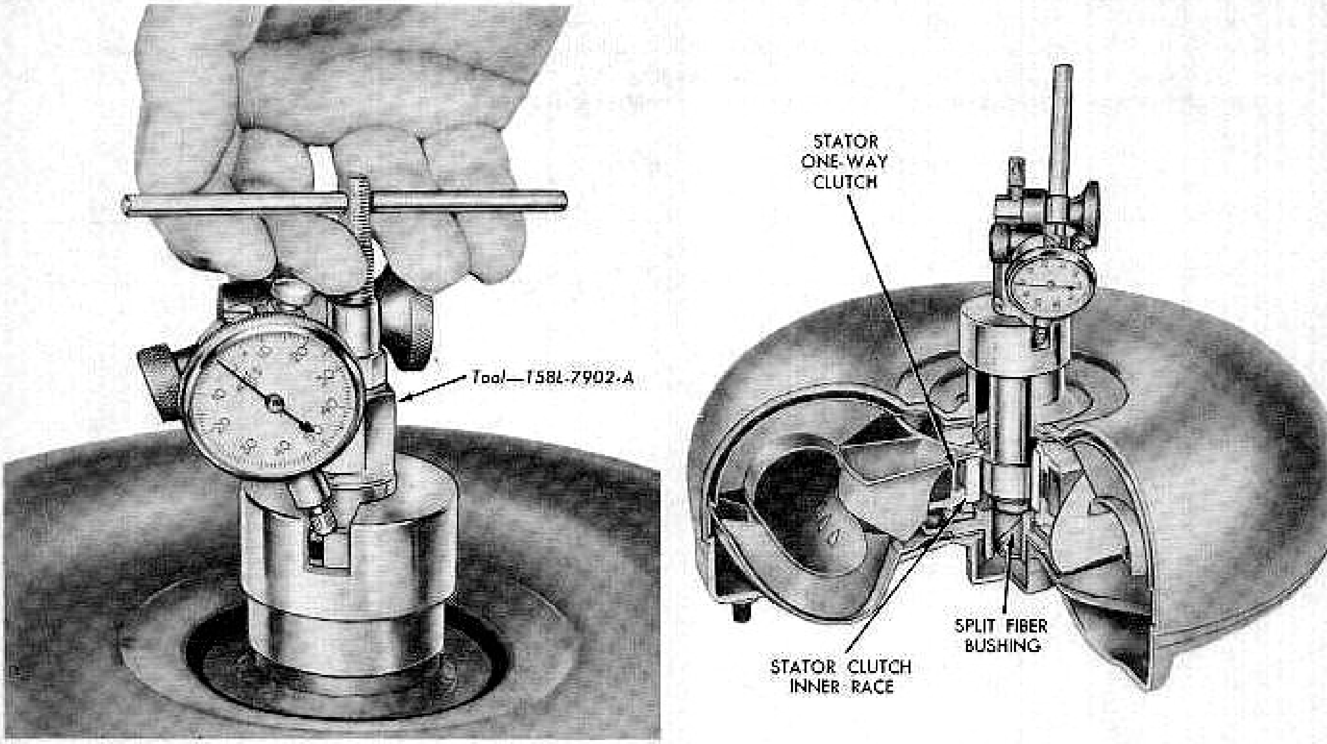
If pressure readings are normal until the throttle is advanced, then the pressure drops, it is an indication that the throttle pressure system is leaking. Throttle pressure is in the system only when the throttle lever is advanced.

The cause of low pressure is seldom found in the control valve body. The control valve body on high mileage units may have excessive wear and internal leakage.

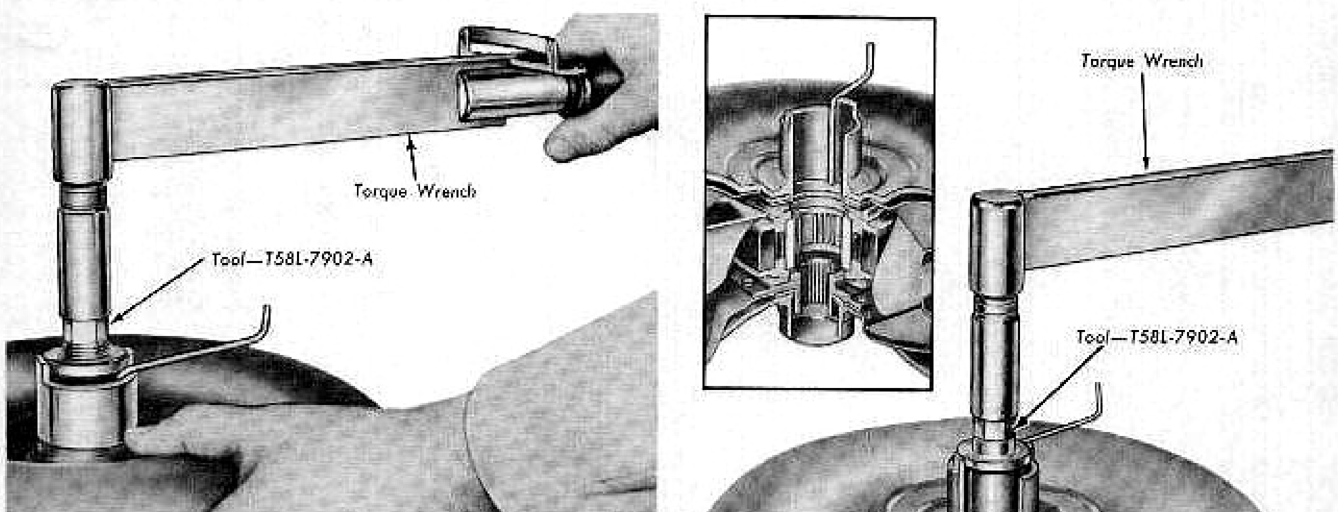
If pressure is normal in any of the manual positions, the front pump, throttle valve bore and the throttle, modulator, compensator, and control pressure regulator valves are all operating properly. If these units were not operating properly, the pressure rise would not occur within limits or at all.

Sticking 2-1 or 2-3 shift valves, inhibitor or transition valves will not cause low pressure. If these valves are stuck open, a "pressure-tight" passage has been opened. When a 2-3 shift valve sticks in the open position, the transmission will start in high instead of in intermediate. A pressure gauge installed on a transmission with this condition would give a normal reading. All "on" and "off" valves in the control valve body are manufactured so that their exhaust ports close before their inlet ports open.

Scratched valves or valve bores seldom cause low pressure in the transmission.



END PLAY CHECK



STATOR CLUTCH CHECK

D1064-A

FIG. 1—Converter End Play and Stator Clutch Check

PART 6-6 CONVERTER CHECKS

The torque converter is enclosed in a welded steel housing, and cannot be disassembled for service. A special tool (Fig. 1) is provided to check turbine and stator end play and the operation of the one-way stator clutch.

TURBINE AND STATOR END PLAY CHECK

1. Insert the tool into the converter pump drive hub until it bottoms.
2. Install the guide over the converter pump drive hub.
3. Expand the split fiber bushing (Fig. 1) in the turbine spline by tightening the adjusting nut. Tighten the nut until the tool is securely locked to the spline.
4. Attach a dial indicator to the tool (Fig. 1). Position the indicator button on a converter pump drive hub lug, and set the dial face to zero.
5. Lift the tool upward as far as it will go and note the indicator reading. The indicator reading is the total end play which the turbine and stator share. If the total end play exceeds 0.060 inch, replace the converter unit.

STATOR ONE-WAY CLUTCH CHECK

1. Loosen the adjusting nut to free the split bushing, then remove the tool from the converter.
2. Install the stator outer race holding tool in one of the four holes provided in the stator (Fig. 1).
3. Insert the tool in the converter pump drive hub. As the tool enters the converter, the pins will engage the stator clutch inner race spline.
4. Place a torque wrench on the tool (Fig. 1). The tool (and stator inner race) should turn freely clockwise (from the pump drive hub side of the converter). It should lock up and hold a 10 foot-pound pull when the wrench is turned counterclockwise. Try the clutch for lockup and hold in at least five different locations around the converter.
5. If the clutch fails to lockup and hold a 10 foot-pounds torque, replace the converter unit.

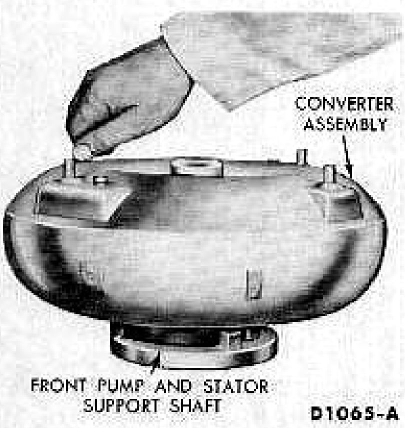


FIG. 2—Stator to Impeller Interference Check

STATOR TO IMPELLER INTERFERENCE CHECK

1. Position a front pump assembly on a bench with the spline end of the stator shaft pointing up (Fig. 2).
2. Mount a converter on the pump so that the splines on the one-way clutch inner race engage the mating splines of the stator support, and the converter hub engages the pump drive gear.
3. While holding the pump stationary, try to rotate the converter counterclockwise. The converter should rotate freely without any signs of interference or scraping within the converter assembly.
4. If there is an indication of scraping, the trailing edges of the stator blades may be interfering with the leading edges of the impeller blades. In such cases, replace the converter.

STATOR TO TURBINE INTERFERENCE CHECK

1. Position the converter on the bench front side down.
2. Install a front pump assembly to engage the mating splines of the stator support and stator, and pump drive gear lugs.
3. Install the input shaft, engaging the splines with the turbine hub (Fig. 3).
4. While holding the pump stationary, attempt to rotate the turbine with the input shaft. The turbine should rotate freely in both directions without any signs of interference or scraping noise.
5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, the converter must be replaced.

CONVERTER CLEANING

The converter cannot be disassembled for cleaning. If the converter has an excessive amount of foreign material in it, the following cleaning procedure should be used.

1. With the converter on the bench, remove both drain plugs and tilt the converter in all directions so that as much fluid as possible is drained.
2. Install the drain plugs and fill the converter through the pump drive hub with a light-body oil such as

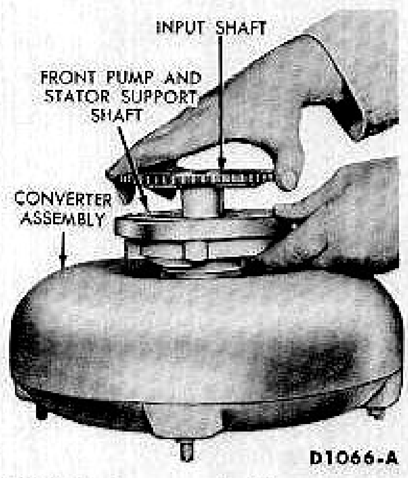


FIG. 3—Stator to Turbine Interference Check

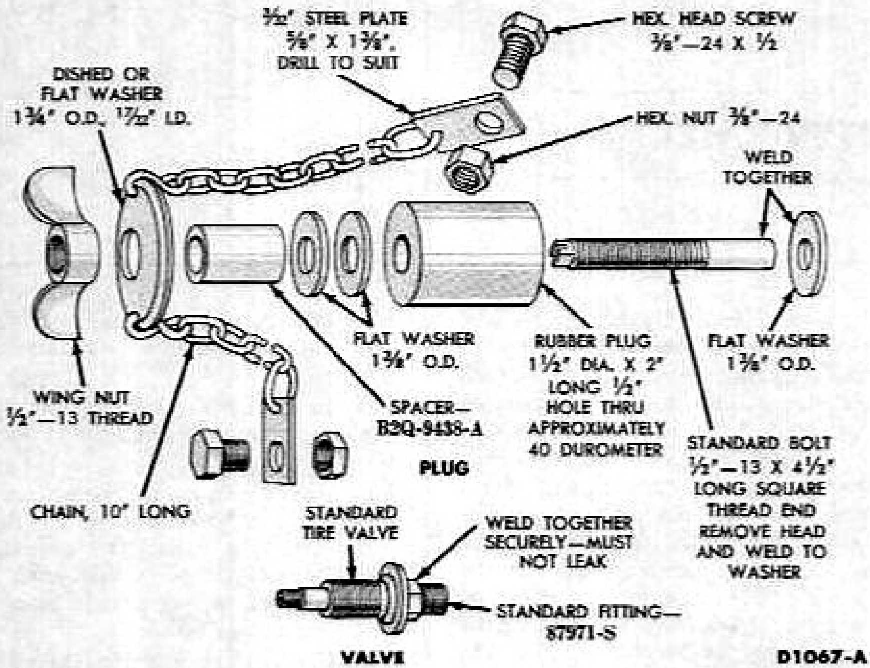


FIG. 4—Converter Leak Checking Tool

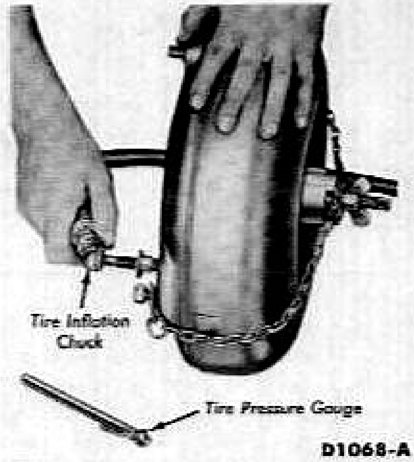


FIG. 5—Converter Leak Checking Tool Installation

kerosene, or a cleaning solvent suitable for transmission cleaning.

3. Install the tool shown in Fig. 1 in the converter. Expand the bushing in the turbine spline. Rotate the tool to circulate the fluid in the converter.

4. Remove both drain plugs and thoroughly drain the converter.

5. Repeat the procedure given in steps 2, 3, and 4, as required, to remove excessive foreign material.

6. Install the drain plugs.

LEAKAGE CHECK

If there are indications that the welds on the torque converter housing are leaking, the following check should be made before the unit is replaced.

A leak checking tool (Fig. 4) can be made from standard parts. The tool can be used to check both Cruise-O-Matic and Fordomatic converters.

1. Install the plug in the converter (Fig. 5) and expand it by tightening the wing nut. Attach the safety chains.

2. Install the air valve in one of the drain plug threads.

3. Introduce air pressure into the converter housing. Check the pressure with a tire gauge and adjust it to 20 psi.

4. Place the converter in a tank of water. Observe the weld areas for bubbles. If no bubbles are observed, it may be assumed that the welds are not leaking.

PART 6-7 SPECIFICATIONS

FLUID PRESSURE LIMITS

Engine Speed	Selector Lever Position	Pressure Gauge Reading (psi)
Idle	All	56-72
1000 rpm	D1 or D2	80-85
Stall (At Detent)	D1 or D2	150-170
	R	196-216
Stall (through Detent)	L	196-216

LUBRICANT REFILL CAPACITY

Type of Lubricant	Approximate Capacity
Ford Automatic Transmission Fluid B8A-19582-A	10 Quarts (PBL) 10½ Quarts (PBB)

CHECKS AND ADJUSTMENTS

Operation	Specification
Transmission End Play Check	0.010-0.029 inch Selective Thrust Washers Available: 0.063-0.061 inch, 0.069-0.067 inch 0.076-0.074 inch, 0.083-0.081 inch
Turbine and Stator End Play Check	0.060 inch (maximum)
Front Band Adjustment (Use ¼-inch spacer between adjustment screw and servo piston stem)	Adjust screw to 10 inch-pounds torque, and back off one full turn; lock nut to 20-25 foot-pounds
Rear Band Adjustment	Adjust screw to 10 foot-pounds torque, and back off 1½ turns; lock nut to 35-40 foot-pounds
Primary Sun Gear Shaft Ring End Gap Check	0.002-0.009 inch
Accelerator Pedal Height Adjustment	3 7/16 inches above floor mat
Rear Clutch Steel Plate Coning Clearance Check	0.010 inch (maximum)

TRANSMISSION GEAR RATIOS

Gear	Selector Lever Position	Clutch Applied	Band Applied	Gear Ratio	
				PBL	PBB
Neutral	N	None	None	—	—
First	D1	Front	Rear*	2.40:1	2.37:1
Second	D1 or D2	Front	Front	1.47:1	1.48:1
Third	D1 or D2	Front and Rear	None	1.00:1	1.00:1
Reverse	R	Rear	Rear	2.00:1	1.84:1

*In first gear D1, the planet carrier is held against rotation by the one-way clutch.

TRANSMISSION SHIFT POINTS (APPROXIMATE)

Rear Axle Ratio	Automatic Shift Speeds (mph)								Manual Shift Speeds (mph)
	D1		D1 or D2		D1	D1 or D2	D1	D2	L
	1-2 Minimum Throttle	1-2 Maximum Throttle	2-3 Minimum Throttle	2-3 Maximum Throttle	3-1 Minimum Throttle	3-2 Maximum Throttle	2-1 Maximum Throttle	3-2 Minimum Throttle	2-1
2.91	9-14	40-51	13-25	64-78	5-10	58-73	25-33	5-10	19-28
3.10	8-13	38-48	12-24	60-74	5-9	54-69	24-31	5- 9	17-26

STALL SPEEDS

Selector Lever Position	Clutch Applied	Band Applied	Engine RPM	
			352 V-8	430 V-8
D2	Front	Front	1690-1890	1590-1790
D1	Front	One-Way Clutch		
L	Front	Rear		
R	Rear	Rear		

TORQUE SPECIFICATIONS

Name	Foot Pounds
Converter Housing to Transmission Case Bolts	35-45
Front Pump to Transmission Case Bolts	17-22
Front Servo to Transmission Case Bolts	30-35
Rear Servo to Transmission Case Bolts	40-50
Planetary Support to Transmission Case Screws	20-25
Upper Valve Body to Lower Valve Body Bolts	4-6
Control Valve Body to Transmission Case Bolts	8-10
Pressure Regulator Assembly to Transmission Case Screws	17-22
Extension Assembly to Transmission Case Bolts	28-38
Oil Pan to Transmission Case Bolts	10-13
Case Assembly—Gauge Hole Plugs	7-15
Rear Band Adjusting Screw Locknut	35-40
Front Band Adjusting Screw Locknut	20-25
Manual Control Lever Nut	35-40
Inner Throttle Lever Nut	17-20
Front Pump Cover Screws	25-35*
Rear Pump Cover Screws (¼-20)	80-90*
Rear Pump Cover Screws (10-24)	25-35*
Governor Inspection Cover Screws	50-60*
Converter Cover Drain Plug	15-28
Converter Housing to Engine Bolts	45-50
Transmission Vent Assembly	7-10
Governor Valve Body to Counterweight Screws	50-60*
Governor Valve Body Cover Screws	20-30*
Pressure Regulator Cover Screws	20-30*
Control Valve Body Screws	20-30*
Case Assembly—Oil Cover Inlet & Outlet Plugs	10-15
Front Servo Release Piston to Servo Piston Screws	20-30*
Lower Valve Body Cover Side Plate to Lower Body Cover Screws	20-30*

*Inch-Pounds

GROUP 7

REAR AXLE AND DRIVE LINE

PAGE

PART 7-1 REAR AXLE TROUBLE SHOOTING AND MINOR REPAIRS

A deep-offset hypoid rear axle (Fig. 1) with a welded pressed-steel banjo housing is used on the 1960 Thunderbird.

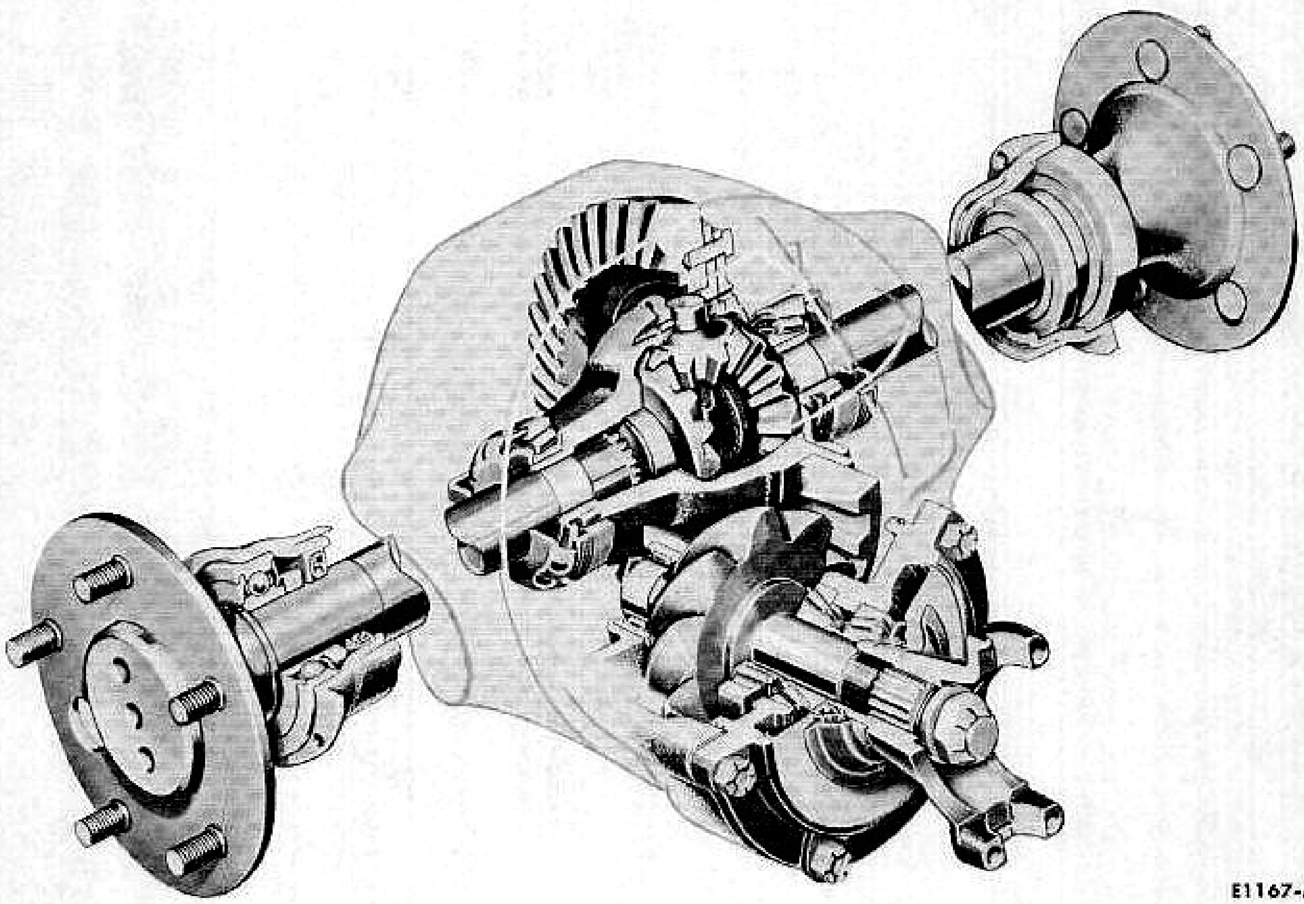


FIG. 1—Deep-Offset Hypoid Rear Axle

1 TROUBLE SHOOTING

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, tires, and other parts of the car. For this reason, be sure that the cause of the trouble is in the rear axle or drive line before adjusting, repairing, or replacing any of the axle parts.

REAR AXLE TROUBLE SYMPTOMS AND POSSIBLE CAUSES

EXCESSIVE REAR AXLE NOISE	Since gears are in mesh, some rear axle noise is normal. However, excessive noise often indicates the beginning of other troubles in the axle. A road test can help determine whether the noise is being caused by trouble in the rear axle or in other parts of the car. **Before road-testing the car, make sure that the tire pressures and the rear axle lubricant level are normal. Then drive the car far enough to warm the axle lubricant to its normal operating temperature.** With the car stopped and the transmission in neutral, run the engine at various speeds. If the noise still exists during this test, it probably comes from the engine or the exhaust system. To determine if the noise is being caused by the rear axle or the tires, drive the car over several different types of road surfaces. Smooth asphalt or black-top roads minimize tire noises. Tire noises may be eliminated by cross-switching the tires. Snow tires often cause noises not heard with conventional tires. Noise caused by a worn or damaged wheel bearing is often loudest when the car is coasting at low speeds, and it usually stops when the brakes are gently applied. To find the noisy bearing, jack up each wheel and check each bearing for roughness while the wheel is rotating. If all possible external sources of noise have been checked and eliminated, and the noise still exists, road-test the rear axle under all four driving conditions — drive, cruise, float, and coast. Then remove, disassemble, and inspect the axle.
EXCESSIVE REAR AXLE BACKLASH	Excessive backlash in the axle driving parts may be caused by worn axle shaft splines, loose axle shaft flange nuts, loose U-joint flange mountings, excessive backlash between the drive pinion and drive gear, excessive backlash in the differential gears, or bearings which are worn or out of adjustment.
DRIVE LINE NOISE OR VIBRATION	Excessive noise or vibration may be caused by lack of lubrication, worn U-joint bearings, missing drive shaft balance weights, and sprung or damaged drive lines. Make the necessary repairs as required. Undercoating on the drive shaft can destroy the balance and cause vibration.

2 REAR AXLE SHAFT, WHEEL BEARING, AND OIL SEAL REPLACEMENT

The rear axle shafts, wheel bearings, and oil seals can be replaced without removing the differential assembly from the axle housing.

1. Remove the wheel and tire from the brake drum.

2. Remove the nuts that secure the brake drum to the axle flange, and then remove the drum from the flange.

3. Working through the hole provided in the axle shaft flange, remove the nuts that secure the wheel bearing retainer. Then pull the axle shaft assembly out of the axle housing (Fig. 2). **The brake carrier plate must not be dislodged. Install one nut to hold the plate in place after the axle shaft is removed.**

4. If the rear wheel bearing is to be replaced, loosen the inner retainer

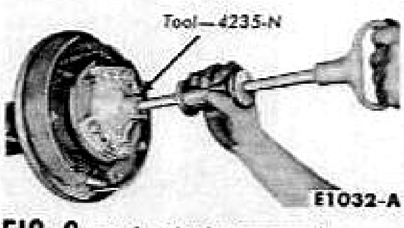


FIG. 2—Axle Shaft Removal

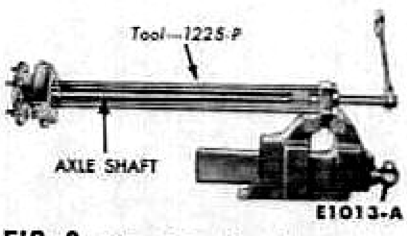


FIG. 3—Wheel Bearing Removal

FIG. 4—Wheel Bearing Installation

by tapping it with a soft hammer.

5. Remove the bearing and inner retainer from the axle shaft with the tool shown in Fig. 3.

6. Inspect the machined surface of the axle shaft and the axle housing for rough spots or other irregularities which would affect the sealing action of the oil seal. Carefully remove any burrs or rough spots.

7. With the tool shown in Fig. 4, press a new rear wheel bearing on the axle shaft. **The bearing should seat firmly against the shoulder on the shaft.**

8. With the bearing installation tool, press the bearing inner retainer on the shaft until the retainer seats firmly against the bearing.

9. If the axle shaft oil seal is to be replaced, remove the seal with the tool shown in Fig. 11, Part 7-2. Install the new seal with tool 1177 or 1177-N.

10. Place a new gasket on each side of the brake carrier plate, and then slide the axle shaft into the housing. Start the axle splines into the side gear, and push the shaft in until the bearing bottoms in the housing.

11. Install the bearing retainer and the nuts that secure it. Torque the nuts to 30-35 foot-pounds.

12. Install the brake drum and the drum retaining nuts.

13. Install the wheel and tire on the drum.

3 DRIVE PINION OIL SEAL REPLACEMENT

The drive pinion oil seal can be replaced without removing the differential assembly from the axle housing.

1. Disconnect the drive shaft from the rear U-joint.

2. Mark the pinion shaft nut, the end of the pinion shaft, and the U-joint flange inner surface for realignment.

3. Hold the flange with the tool shown in Fig. 9, Part 7-2. Remove the pinion nut and the flat washer.

4. Mark the pinion shaft spline and the U-joint flange spline for realignment.

5. Clean the carrier housing around the drive pinion oil seal. Place a drain pan under the seal, or raise the front of the car higher than the rear.

6. Remove the U-joint flange (Fig. 10, Part 7-2). **Remove the flange carefully to avoid later misalignment of the drive shaft.**

7. Using the tool shown in Fig. 11, Part 7-2, remove the drive pinion oil seal.

8. Clean the oil seal seat.

9. Coat the outer edge of the new seal with oil-resistant sealer. Then install the seal, using the tool shown in Fig. 22, Part 7-2.

10. Align the U-joint flange spline mark with the pinion shaft spline mark, and install the U-joint flange (Fig. 23, Part 7-2).

11. Install the flat washer and the pinion shaft nut. Tighten the nut until the marks are aligned (see step 2).

12. Connect the drive shaft to the U-joint.

13. Check the lubricant level. If additional lubricant is required refer to Group 17 for the proper type.

4 DRIVE LINE REPAIR

All drive shafts are balanced. Therefore, if the car is to be undercoated, cover the drive shaft to prevent undercoating material getting on the shaft or U-joints.

To inspect or replace U-joints, follow this procedure.

1. Disconnect the rear U-joint from the drive pinion flange. Pull the drive shaft toward the rear of the car until the front U-joint yoke clears the transmission extension housing and the seal.

2. Remove the snap rings which retain the bearings in the yoke and drive shaft.

3. Place the U-joint in a vise or under a press.

4. Select a socket slightly smaller in its outside diameter than the U-joint bearings. Select another socket slightly larger in its inside diameter than the bearing outside diameter.

5. Place the sockets at opposite bearings so that the smaller socket becomes a bearing driver and the larger socket becomes a bearing receiver, when the vise jaws come together (Fig. 5).

6. Close the vise jaws until both bearings are free of the drive shaft. Remove the bearings from the spider.

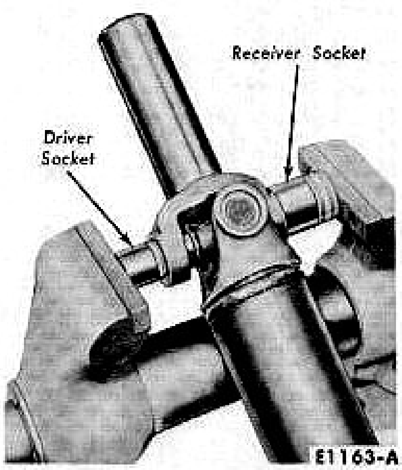


FIG. 5—U-Joint Removal

7. Turn the spider and yoke ¼ turn and use the same procedure to press the bearings out of the yoke.

8. Check the new bearings for adequate grease.

9. Press one bearing part way into place in the drive shaft.

10. Position the new spider in the partially installed bearing. If the new spider has a grease fitting, install the spider with the grease fitting toward the drive shaft tube.

11. Press the second bearing into place in the drive shaft. Install the bearing retaining snap ring for each bearing.

12. Press one new bearing part way into the yoke.

13. Install the yoke on the spider and press the second yoke bearing into place. Install the snap ring for each bearing.

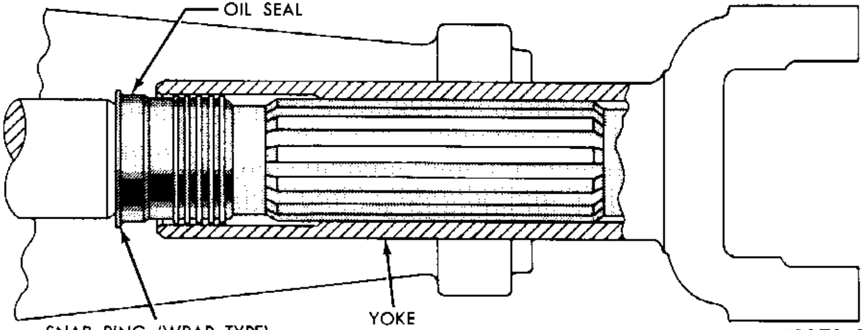


FIG. 6—Output Shaft Spline Seal

14. Use the same procedure to remove and replace the rear U-joint spider and bearings.

15. If the rubber bellows-type seal installed on the end of the transmission extension housing is damaged in any manner, install a new seal.

16. On a manual-shift transmission, lubricate the yoke spline with B6A-19580-A or -B. On a Cruise-O-Matic transmission, lubricate the yoke spline with B8A-19589-A. This spline is sealed so that the transmission fluid does not "wash" away the spline lubricant (Fig. 6). Install the yoke on the transmission output shaft.

17. Install the U-bolts and nuts which attach the U-joint to the drive pinion flange.

18. Grease the front and rear U-joint with general chassis grease.

PART 7-2 REAR AXLE OVERHAUL

1 DIFFERENTIAL CARRIER REPLACEMENT

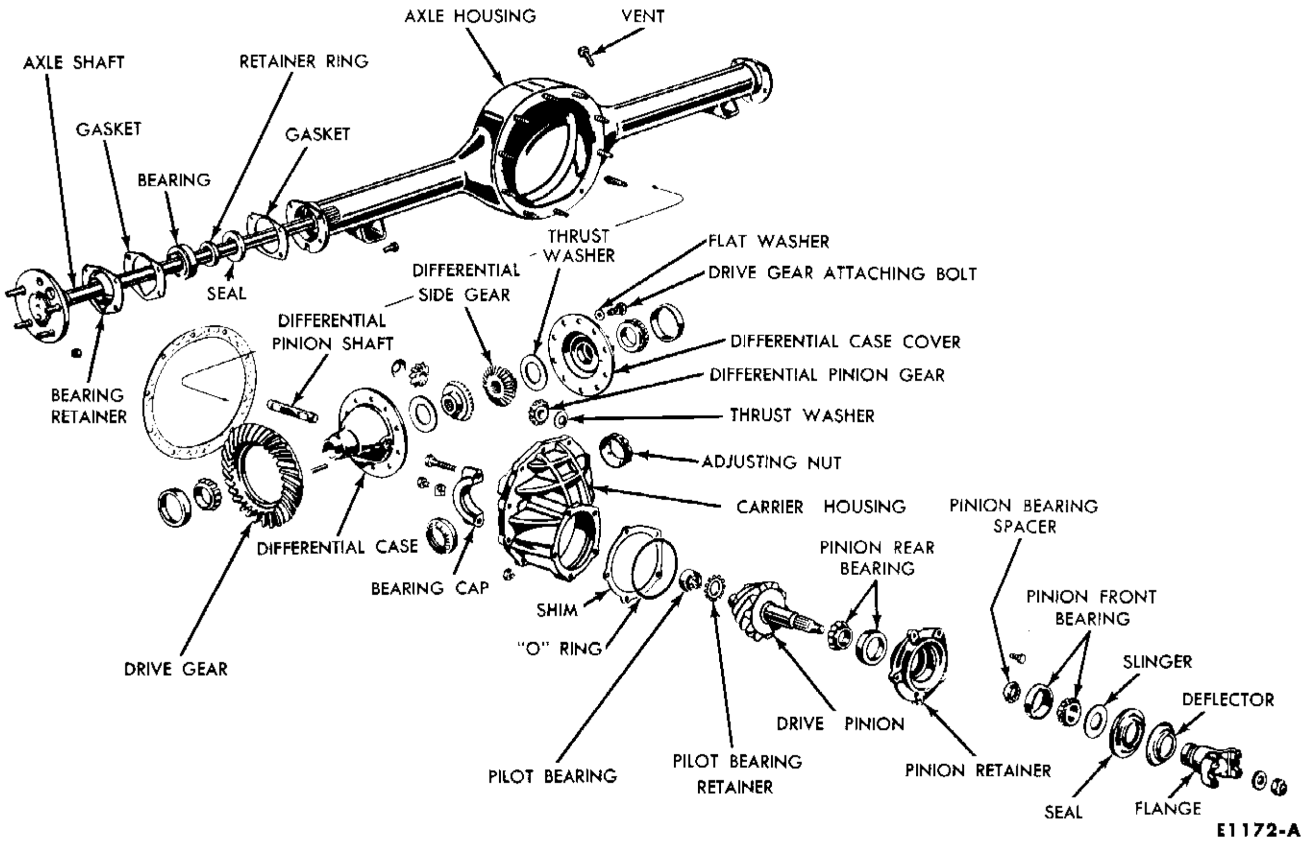


FIG. 1—Rear Axle—Disassembled

REMOVAL

1. Use a wire brush to clean dirt from the area around the carrier and housing mating surfaces (Fig. 1). Then wipe the area clean with a cloth dampened with solvent.

2. Remove the axle shafts (Fig. 2, Part 7-1) and drive shaft.

3. Remove the 10 nuts which attach the differential carrier to the housing. Drain the old lubricant into a pan and discard it. Remove the carrier from the housing.

INSTALLATION

1. After the gear tooth pattern has been checked and is satisfactory, install the differential carrier in the axle housing.

2. Torque the carrier to housing attaching nuts to 30-40 foot-pounds.

3. Install the axle shafts and drive shaft, and fill the axle housing with the proper amount of the specified lubricant (see Group 17).

2 DIFFERENTIAL CARRIER DISASSEMBLY AND ASSEMBLY

INSPECTION BEFORE DISASSEMBLY

The differential carrier should be inspected before any parts are removed. It should also be inspected as it is disassembled. These inspections can help to find the cause of the trouble and to determine the corrections needed.

Mount the carrier in the holding fixture shown in Fig. 2.

Wipe the lubricant from the internal working parts, and visually inspect the parts for wear or damage.

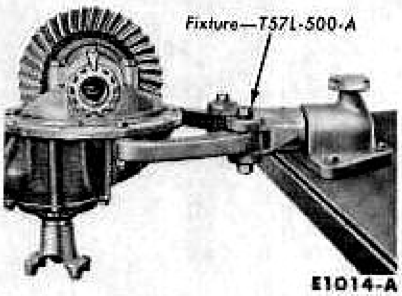


FIG. 2—Bench Fixture for Carrier Overhaul

Rotate the gears to see if there is any roughness which would indicate defective bearings or chipped gears. Check the gear teeth for scoring or signs of abnormal wear.

Set up a dial indicator (Fig 3) and check the backlash at several points around the drive gear. Backlash should be between 0.004 and 0.009 inch.

If no obvious defect is noted, check the gear tooth contact. Paint the gear teeth with suitable gear marking compound, such as a paste made with dry red lead and oil. A mixture that is too wet will run and smear. Too dry a mixture cannot be pressed out from between the teeth. As shown in Fig. 4, wrap a cloth around the drive pinion flange to act as a brake. Rotate the drive gear back and forth (use a box wrench on the drive gear attaching bolts for a lever) until a clear tooth contact pattern is obtained.

Certain types of gear tooth contact patterns on the drive gear indicate

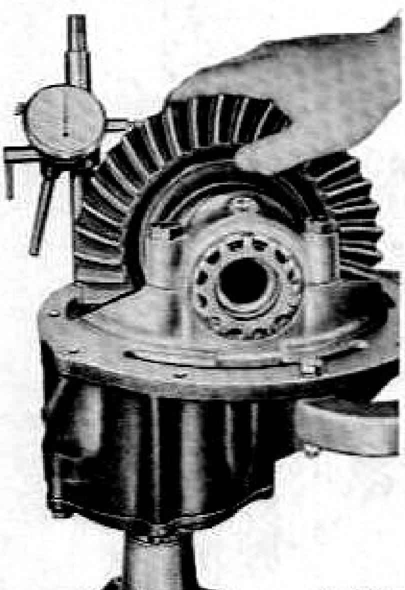


FIG. 3—Backlash Check

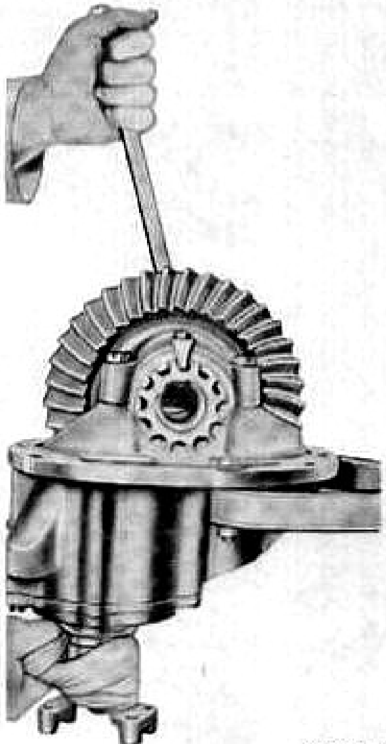


FIG. 4—Gear Tooth Contact Check

incorrect adjustment. Noise caused by incorrect adjustment can often be corrected by readjusting the gears. Typical patterns and the necessary corrections are explained in the assembly procedures.

Gear tooth runout can sometimes be detected by an erratic pattern on the teeth. However, a dial indicator should be used to measure the runout of the back face of the drive gear, as shown in Fig. 5. This runout should not exceed 0.003 inch.

Loosen the differential bearing cap bolts, and torque them to 25 foot-pounds. Remove the adjusting nut locks. Carefully loosen one of the adjusting nuts to determine if any differential bearing preload remains. If at least one notch of preload remains, the differential bearings may be reused, provided they are not pitted or damaged.

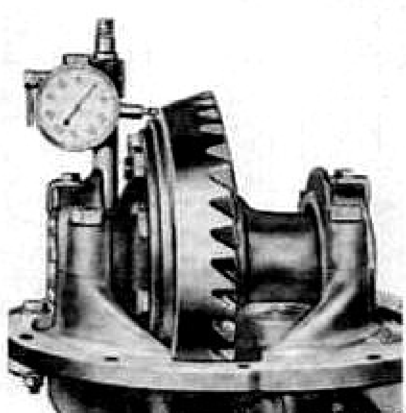


FIG. 5—Drive Gear Runout Check

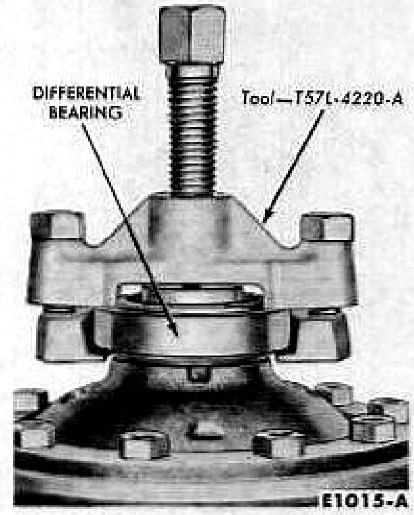


FIG. 6—Differential Bearing Removal

CARRIER DISASSEMBLY

1. Mark one differential bearing cap and the mating bearing support to help position the parts properly during assembly of the carrier.
2. Remove the adjusting nut locks, bearing caps, and adjusting nuts. Then lift the differential assembly out of the carrier.
3. If the differential bearings are to be removed, use the tool shown in Fig. 6.

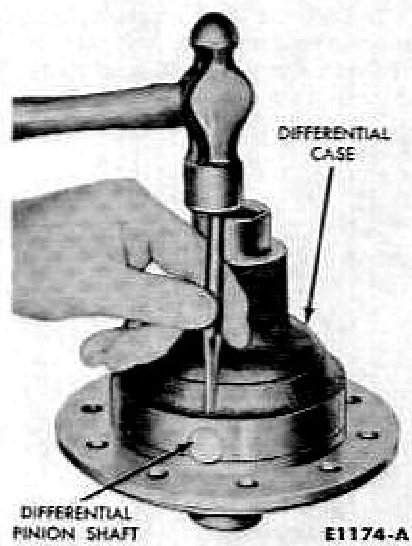


FIG. 7—Differential Pinion Shaft Retainer Removal

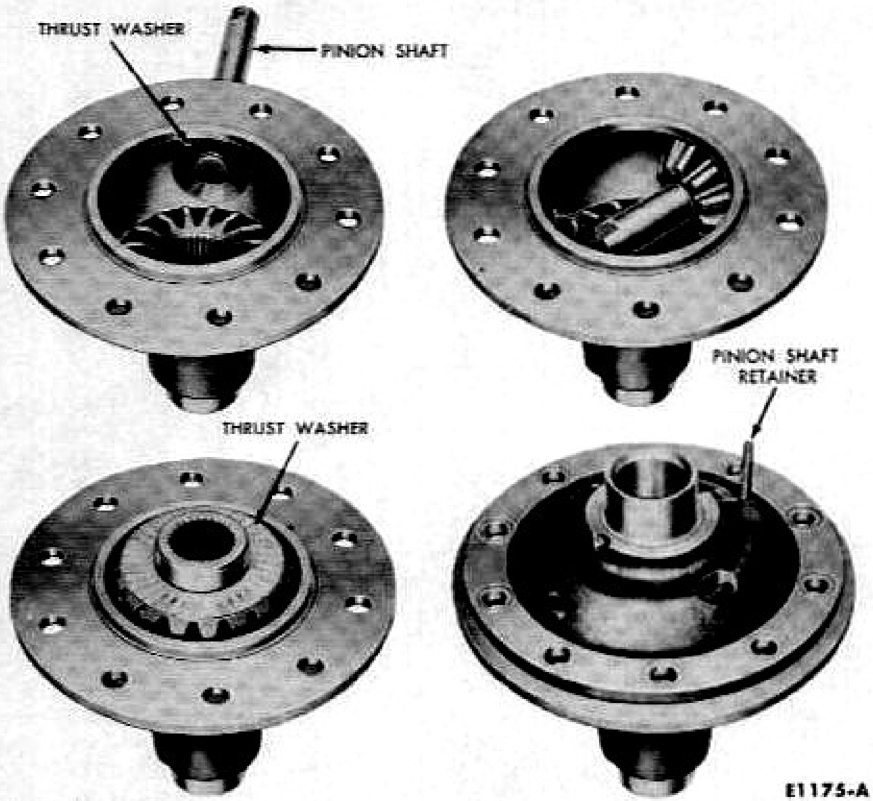


FIG. 8—Differential Case Assembly

4. Remove the bolts that attach the drive gear to the differential case. Press the drive gear from the case or tap it off with a soft-faced hammer.

5. With a drift, drive out the differential pinion shaft retainer (Fig. 7), and separate the 2-piece differential case.

6. Drive out the pinion shaft (Fig. 8) with a brass drift. Remove the gears and thrust washers.

7. Turn the carrier case upright, and remove the pinion shaft nut (Fig. 9). Then remove the U-joint flange (Fig. 10).

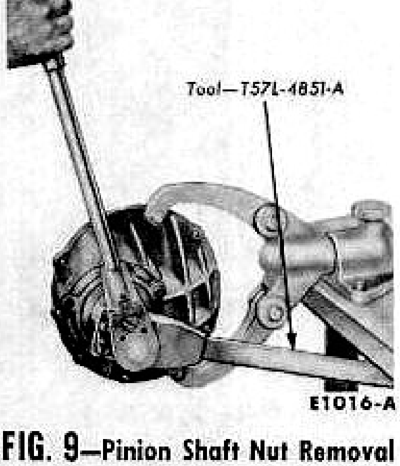


FIG. 9—Pinion Shaft Nut Removal

8. Remove the seal (Fig. 11) and the slinger.

9. Remove the pinion shaft and bearing retainer from the carrier housing. Measure the shim thickness with a micrometer. **Be very careful not to damage the mounting surfaces of the retainer and carrier.**

10. If the pilot bearing is to be replaced, use the tool shown in Fig. 12 to drive the pilot bearing and the bearing retainer out together. To install the bearing, use the same tool (Fig. 13), and drive the bearing in only until it bottoms. With the same tool, install a new retainer with the concave side up.

11. Place a protective sleeve (hose) on the pinion pilot bearing surface. Press the pinion shaft out of the pinion front bearing cone (Fig. 14).

12. Remove the pinion rear bearing cone (Fig. 15).

13. Do not remove the pinion

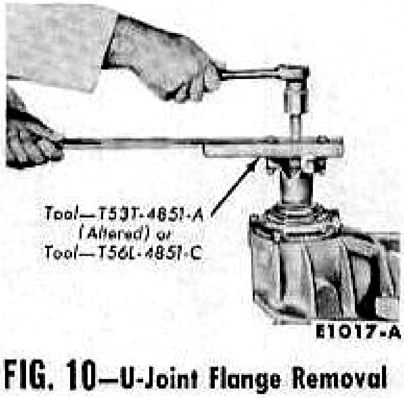


FIG. 10—U-Joint Flange Removal

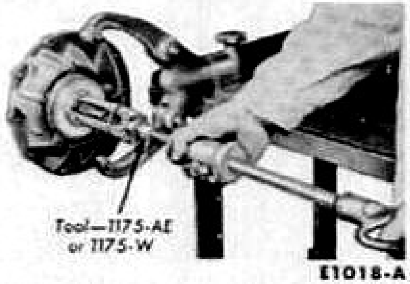


FIG. 11—Flange Seal Removal

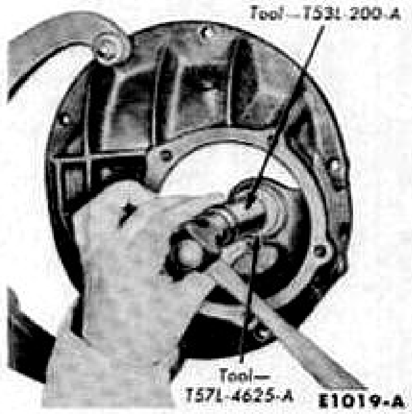


FIG. 12—Pilot Bearing Removal

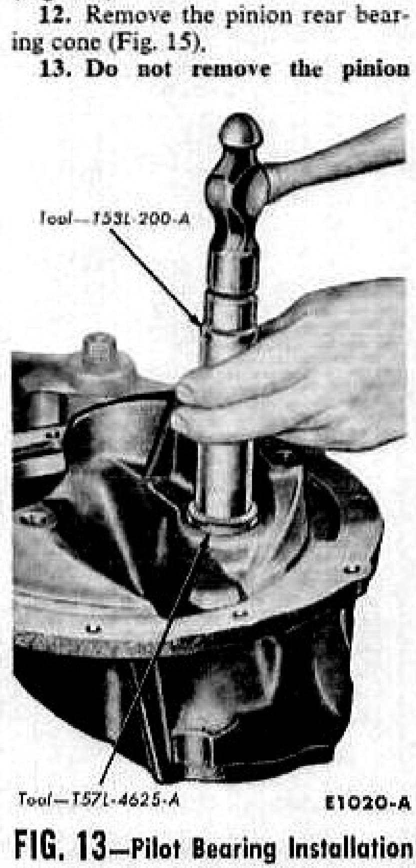


FIG. 13—Pilot Bearing Installation

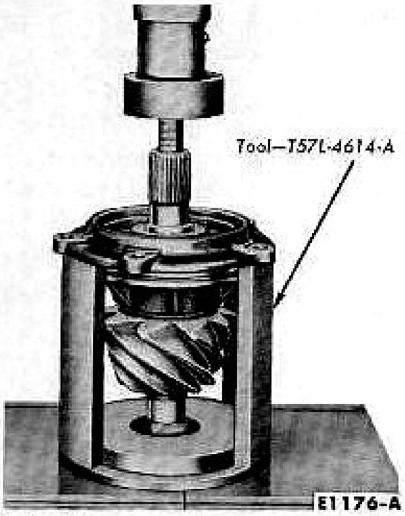


FIG. 14—Pinion Front Bearing Cone Removal

bearing cups from the retainer unless the cups are worn or damaged. The flange and pilot of the retainer are machined during manufacture by locating on these cups after they are installed in their bores. If the cups are worn or damaged, they may be removed and replaced as shown in Figs. 16 and 17.

After the new cups are installed, make sure they are seated in the retainer by trying to insert a 0.0015-inch feeler gauge between the cup and the bottom of the bore.

INSPECTION AFTER DISASSEMBLY

Thoroughly clean all parts. **Always use clean solvent when cleaning bearings.** Oil the bearings immediately to prevent rusting.

Inspect the parts for any major defects. Clean the inside of the carrier before rebuilding and assembling the

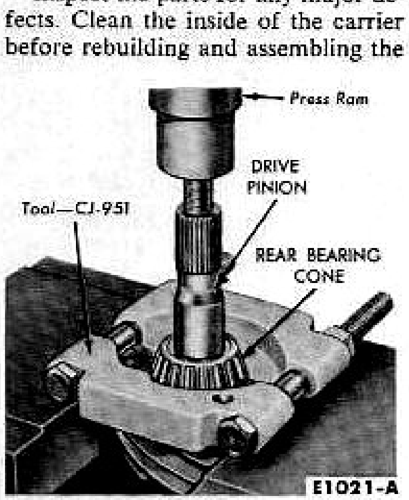


FIG. 15—Pinion Rear Bearing Cone Removal

parts. Inspect individual parts as outlined below.

GEARS

Examine the pinion and drive gear teeth for scoring or excessive wear. Extreme care must be taken not to damage the ground pilot bearing surface of the pinion. This surface is actually a bearing race and the slightest imperfection will cause noisy operation.

The pattern taken during disassembly should be helpful in judging if gears can be reused. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring is the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be reused.

Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of the differential gear can cause a "chucking" noise known as "chuckle" when the car is driven at low speeds. Wear of splines, thrust surfaces, or thrust washers can contribute to excessive drive line backlash.

BEARING CUPS

Check bearing cups for rings, scores, galling, or erratic wear patterns. Pinion cups must be solidly seated. Check by attempting to insert a 0.0015-inch feeler between these cups and the bottoms of their bores.

CONE AND ROLLER ASSEMBLIES

When operated in the cups, these parts must turn without roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates the bearings were not preloaded properly or the rollers were slightly misaligned.

DIFFERENTIAL BEARING ADJUSTING NUTS

Temporarily install the bearing caps and test the fit of the adjusting nuts in their threads. The nuts should turn easily when the caps are tightened to specification. The faces of the nuts that contact the bearing cups must be smooth and square. Polish these with a fine abrasive on a flat surface. Replace the nuts or examine the threads in the carrier, if their fit is not proper. Be sure that the bearing caps are on the side they were machined to fit.

U-JOINT FLANGE

Be sure that the ears of the flange have not been damaged in removing

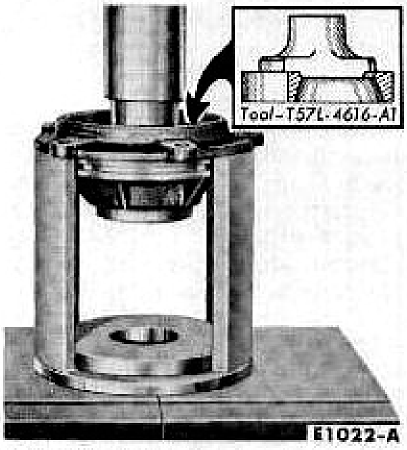


FIG. 16—Pinion Bearing Cup Removal

the drive shaft or in removing the flange from the axle. The end of the flange that contacts the oil slinger must be smooth. Polish this face if necessary. Roughness aggravates backlash noises, and causes wear of the slinger with a resultant loss in pinion bearing preload.

PINION RETAINER

Be sure that the pinion bearing cups are seated. Remove any chips or burrs from the mounting flange. Clean the groove for the "O" ring seal and all lubricant passages. If the cups were removed, examine the bores carefully. Any nicks or burrs in these bores must be removed to permit proper seating of the cups.

CARRIER HOUSING

Make sure that the differential bearing bores are smooth and the threads are not damaged. Remove

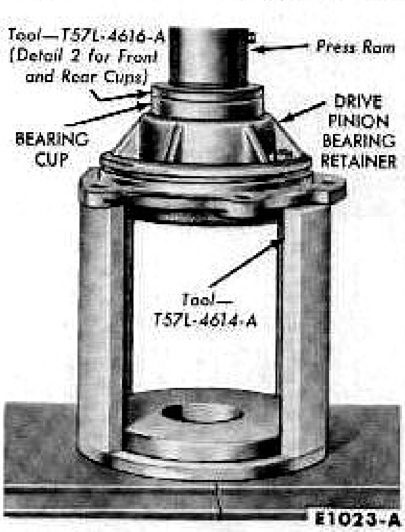


FIG. 17—Pinion Bearing Cup Installation

any nicks or burrs from the mounting surfaces of the carrier housing.

DIFFERENTIAL CASE

Make sure that the hubs where the bearings mount are smooth. Check the fit of the differential gears in the counterbores. Carefully examine the thrust surface, which may have been damaged when the bearings were removed. The bearing assemblies will fail if they do not seat firmly on the hubs. Be sure that the mating surfaces of the two parts of the case are smooth and free from nicks or burrs.

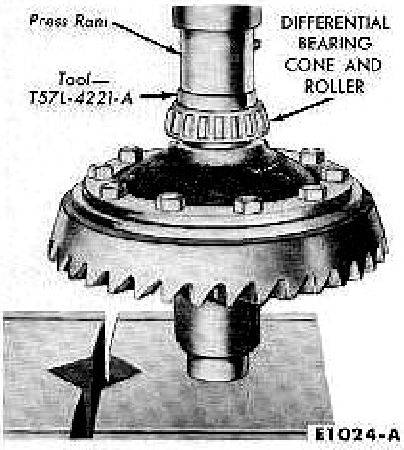


FIG. 18—Differential Bearing Installation

DIFFERENTIAL ASSEMBLY

1. Place a side gear and thrust washer in the differential case bore (Fig. 8). **Lubricate all differential parts liberally with axle lubricant during assembly.**

2. With a soft-face hammer, drive the pinion shaft into the case only far enough to retain a pinion thrust washer and pinion gear.

3. Place the second pinion and thrust washer in position, and drive the pinion shaft into place. **Carefully line up the pinion shaft retainer holes.**

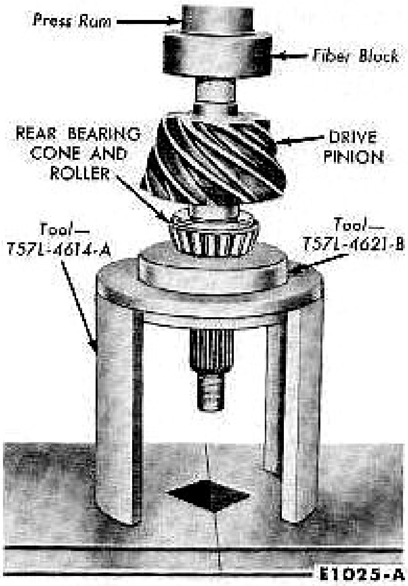


FIG. 19—Pinion Bearing Cone Installation

4. Place the second side gear and thrust washer in position (Fig. 8), and install the cover of the differential case. Install the retainer. A pinion or axle shaft spline can be inserted in the side gear spline to check for free rotation of the differential gears.

5. Insert two 7/16 (N.F.) bolts 2 inches long through the differential flange, and thread them 3 or 4 turns into the drive gear as a guide in aligning the drive gear bolt holes. Press or tap the drive gear into position.

6. Install and tighten the drive gear bolts and washers evenly, and torque them alternately across the gear to 65-75 foot-pounds.

7. If the differential bearings have been removed, press them on as shown in Fig. 18.

ASSEMBLY OF DRIVE PINION AND BEARING RETAINER

1. Install the drive pinion rear bearing cone and roller on the pinion shaft (Fig. 19). Place a new spacer on the pinion shaft (Fig. 20).

2. Place the bearing retainer on the pinion shaft, and install the front bearing cone and roller. Press the front bearing cone and roller into position as shown in Fig. 21. **As the bearing is pressed into position, rock the bearing retainer. Do not press the bearing on the shaft until all "play" is removed from between the bearing retainer and the bearings, as the spacer may be compressed too much.**

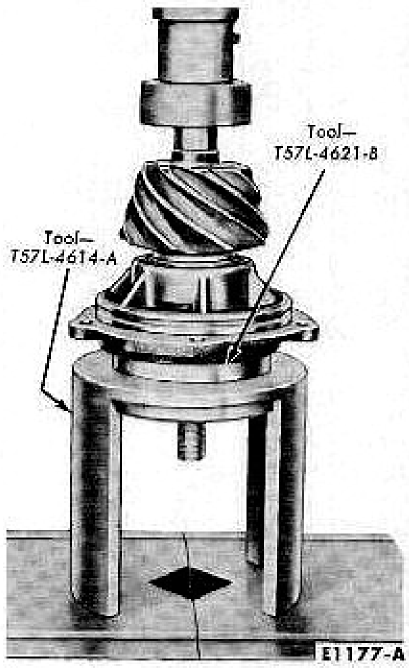


FIG. 21—Pinion Front Bearing Cone Installation

3. Lubricate both pinion bearings with axle lubricant. Place the slinger on the pinion shaft.

4. Coat the outside edge of a new oil seal with an oil resistant sealer and install it with the tool shown in

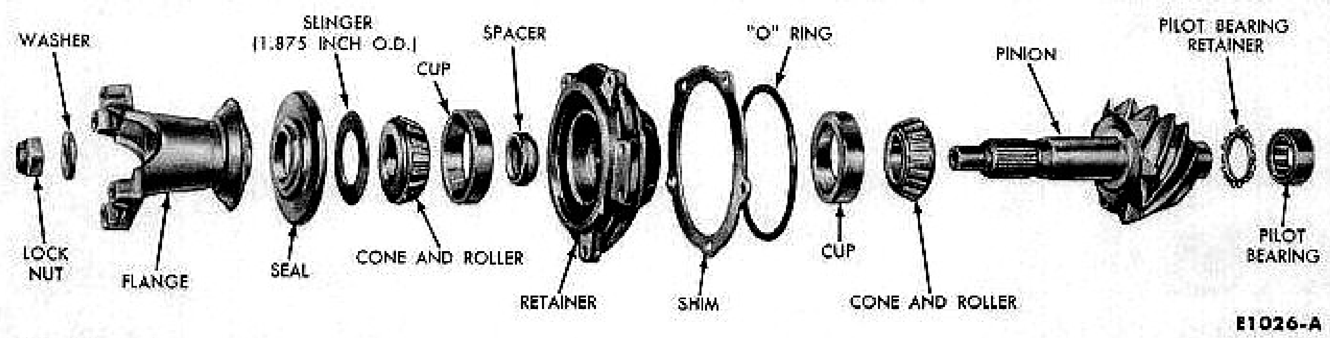


FIG. 20—Pinion and Retainer Assembly

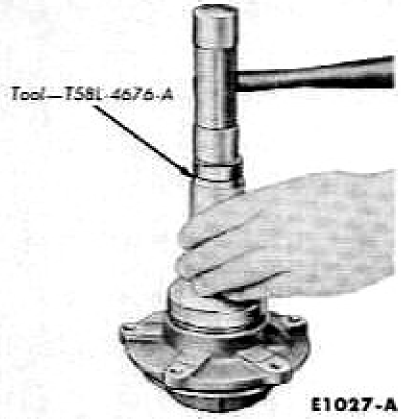


FIG. 22—Seal Installation

Fig. 22. **New seals need not be soaked before installation.**

5. Install the U-joint flange (Fig. 23).

6. Place the flat washer over the

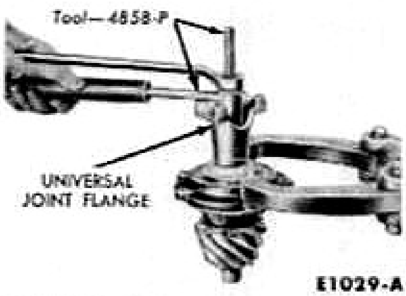


FIG. 23—U-Joint Flange Installation

pinion shaft and start the pinion shaft nut.

7. Hold the flange (Fig. 9) and tighten the pinion shaft nut until the torque required to turn the pinion shaft is 8-12 inch-pounds (used bearings) or 17-27 inch-pounds (new bearings). As the pinion shaft nut is

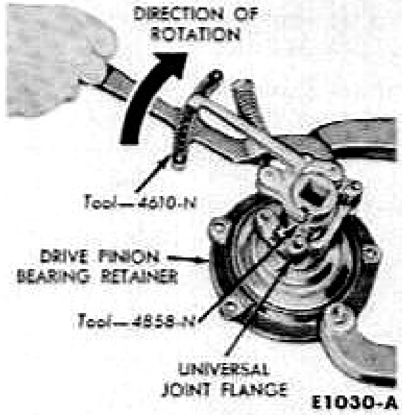


FIG. 24—Pinion Bearing Preload Check

tightened, rotate the pinion shaft frequently to allow the bearing to seat. Check the bearing pre-load with the tool shown in Fig. 24.

3 DRIVE PINION AND DRIVE GEAR ADJUSTMENTS

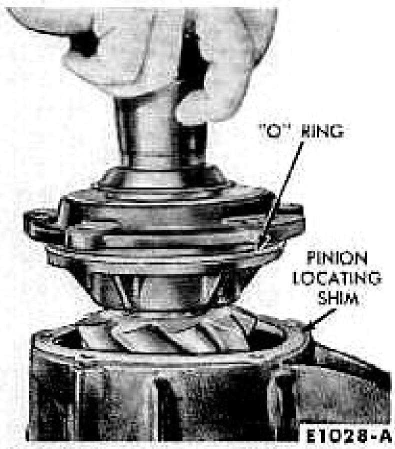


FIG. 25—Pinion Assembly Installation

SHIM SELECTION

Pinion bore dimension tolerances and the operating positions of the gears require the use of an adjusting shim between the pinion retainer and the carrier (Fig. 25).

Manufacturing objectives are to make axles that require a 0.015-inch shim. When a new assembly is being built, a 0.015-inch shim should be used for a tentative build-up. Shims are available in thicknesses ranging from 0.010 inch to 0.029 inch in steps of 0.001 inch.

The drive pinion and drive gear marking are shown in Fig. 26. The number "170" is the matching number that appears on both the drive pinion and the drive gear. **When a new gear set is being installed in an axle, be sure that the same matching number appears on both the drive pinion and the drive gear.**

The number "+ 1" on the pinion gear in Fig. 26 indicates that a shim 0.001 inch thicker than a standard 0.015-inch shim should be used with this pinion gear. A positive (+) number always means that a thicker shim should be installed to move the pinion gear away from the drive gear. A negative (−) number means that a thinner shim should be used to move the pinion gear closer to the drive gear. A pinion gear marked "0" (zero) is a standard pinion which requires a standard 0.015-inch shim.

To select the correct shim thickness for the pinion gear to be used, follow these steps:

1. Measure the thickness of the original shim with a micrometer.

2. Note the shim adjustment number on both the old pinion and the new pinion.

3. Refer to Table 1 to determine the correct amount of shim thickness change. The amount shown in Table 1 under the old pinion shim adjustment number and in line with the new pinion number is the amount of change that should be made to the original shim thickness.

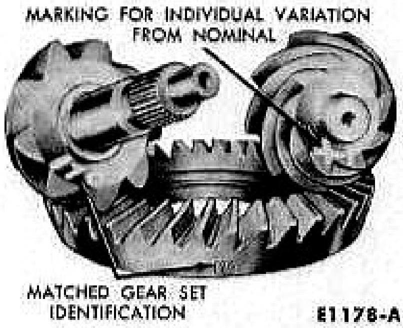


FIG. 26—Pinion and Drive Gear Markings

DRIVE PINION AND DIFFERENTIAL INSTALLATION AND ADJUSTMENT

1. Lubricate the O-ring with axle lubricant and install it in its groove in the pinion retainer (Fig. 25). Be careful not to twist it.

2. Place the shim on the carrier, and install the pinion and retainer assembly.

3. Install the pinion retainer bolts. Torque the bolts to 30-40 foot-pounds.

TABLE 1—Drive Pinion Adjusting Shim Thickness Changes (Inches)

New Pinion Marking	Old Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

4. Wipe a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.

5. Place the cups on the bearings and set the differential case assembly in the carrier. Slide the assembly along the bores until a slight amount of backlash is felt between the gear teeth.

6. Set the adjusting nuts in the bores so that they just contact the bearing cups. The nuts should be engaging about the same number of threads on each side.

7. Carefully position the bearing caps on the carrier. Match the marks made when the caps were removed.

8. Install the bearing cap bolts and alternately torque them to 70-80 foot-pounds.

9. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and again inspect for damaged threads or incorrectly positioned caps. Tightening the bolts to the specified torque is done to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 20 foot-pounds before making adjustments.

10. Loosen the right-hand nut until it is away from the cup. Tighten the left-hand nut until the drive gear is just forced into the pinion with no backlash. (Recheck the right-hand nut at this time to be sure that it is still loose). **The left-hand adjusting nut is on the drive gear side of the carrier. The right-hand nut is on the pinion side. Tightening the left-hand nut moves the drive gear into the pinion to decrease backlash, and tightening the right-hand nut moves the drive gear away.**

11. Tighten the right-hand nut two notches below the position where it first contacts the bearing cup. Rotate the drive gear several revolutions in each direction while the bearings are loaded, to seat the bearings in their cups. **This step is important.**

12. Again loosen the right-hand nut to release the pre-load. If there is any backlash between the gears, tighten the left-hand nut just enough to remove this backlash. Carefully tighten the right-hand nut until it just contacts the cup. Set preload of 2½ to 3 notches tight by the right-hand nut. As preload is applied from the right-hand side, the drive gear is forced away from the pinion and usually results in the correct backlash. The specified backlash for new gears is 0.004 to 0.009 inch.

13. Torque the differential cap bolts to 70-80 foot-pounds.

14. Measure the backlash as shown in Fig. 3. Measure the backlash on several teeth around the drive gear. If the measurements vary more than 0.003 inch, there is excessive runout in the gears or their mountings, which must be corrected to obtain a satisfactory unit. If the backlash is out of specification, loosen one adjusting nut and tighten the opposite nut an equal amount, to move the drive gear away from or toward the pinion. **When moving the adjusting nuts, the final movement should always be made in a tightening direction. For example, if the left-hand nut had to be loosened one notch, loosen the nut two notches, then tighten it one. This procedure makes it certain that the nut is contacting the bearing cup, and that the cup cannot shift after being put in service.**

GEAR TOOTH CONTACT PATTERN CHECK

The surface of the gear teeth is coated with a manganese-phosphate coating to prevent scoring during the break-in process.

Paint the gear teeth and roll a contact pattern as shown in Fig. 4. Some minor differences will exist on individual gear sets but, in general, desirable patterns should have these characteristics:

a. The drive pattern should be centered on the tooth.

b. The coast pattern should be centered on the tooth but may be slightly toward the toe.

c. There should be some clearance between the pattern and the top of the tooth.

d. There should be no hard lines where the pressure is high.

Figure 27 shows some drive and coast patterns and indicates the changes required to obtain the correct operating positions of the gears.

The movement of tooth contact patterns can be summarized as follows:

1. Decreasing backlash moves the ring gear closer to the pinion:

a. Drive pattern (convex side of gear) moves slightly lower and toward the toe.

b. Coast pattern (concave side of gear) moves lower and toward the toe.

2. Increasing backlash moves the ring gear away from the pinion:

a. Drive pattern moves slightly higher and toward the heel.

b. Coast pattern moves higher and toward the heel.

3. Thinner shim with the backlash constant moves the pinion closer to the ring gear:

a. Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.

b. Coast pattern moves deeper on the tooth and toward the heel.

4. Thicker shim with the backlash constant moves the pinion further from the ring gear:

a. Drive pattern moves toward the top of the tooth (face contact) and toward the heel.

b. Coast pattern moves toward the top of the tooth and slightly toward the toe.

If the patterns are not correct, make the changes as indicated. The pinion need not be disassembled to change a shim. All that is required is to remove the retainer assembly and install a different shim. If the shim is changed, the differential assembly will have to be readjusted to maintain the correct backlash. **Do not install the carrier in the housing until a satisfactory pattern is obtained. Clean the marking compound from the gear teeth, and lubricate.**

When the carrier is assembled and the gear tooth contact pattern is satisfactory, replace the adjusting nut locks. Torque the lock bolts to 15-20 foot-pounds.

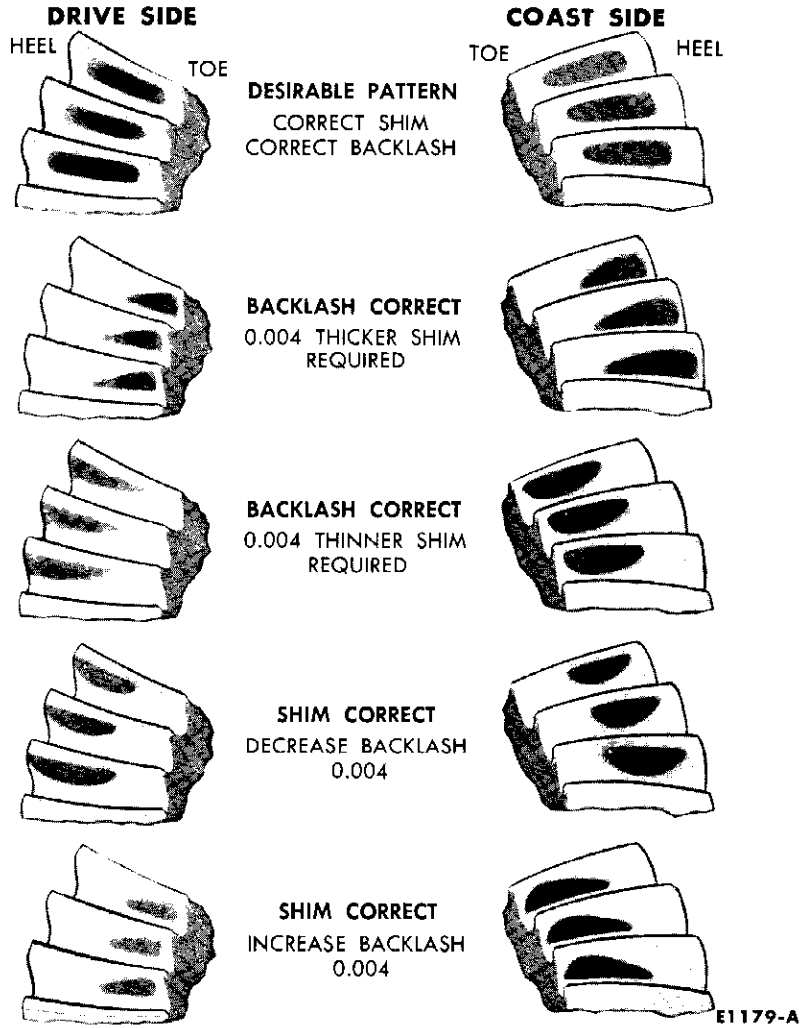


FIG. 27—Typical Gear Tooth Contact Patterns

PART 7-3 SPECIFICATIONS

LUBRICANT REFILL CAPACITY

Capacity
4½ pints

ADJUSTMENTS

	Inches
Backlash Between Ring Gear and Pinion	0.004-0.009
Maximum Backlash Variation between Teeth	0.003
Maximum Runout of Backface of Ring Gear as Assembled	0.003
Differential Side Gear Thrust Washers Thickness	0.030-0.032
Differential Pinion Gear Thrust Washers Thickness	0.030-0.032

TORQUE SPECIFICATIONS

	Foot Pounds
Differential Bearing Cap Screws	70-80
Differential Bearing Adjusting Nut Lock Bolts	15-20
Carrier to Housing Stud Nuts	30-40
Pinion Retainer to Carrier Cap Screws	30-40

TORQUE SPECIFICATIONS (Continued)

		Foot Pounds
Ring Gear Attaching Cap Screws		65-75
Rear Axle Shaft Bearing Retainer Bolts		30-35
Minimum Torque Required to Tighten Pinion Nut to Obtain Correct Pinion Bearing Preload		175*
Pinion Bearing Preload	New Bearings	17-27 inch-pounds
	Used Bearings	8-12 inch-pounds
Differential Bearing Preload		2½-3 notches tight

*Used spacer. If this torque is not possible, use new spacer.

PINION AND DRIVE GEAR IDENTIFICATION

Engine	Transmission	Ratio	Number of Teeth	
			Drive Gear	Pinion
352	Std. & O.D.	3.70:1	37	10
352	Cruise-O-Matic	3.10:1	31	10
430	Cruise-O-Matic	2.91:1	32	11

DRIVE PINION ADJUSTING SHIM THICKNESS CHANGES (INCHES)

New Pinion Marking	Old Pinion Marking								
	−4	−3	−2	−1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003
0	+0.004	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004
−1	+0.003	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005
−2	+0.002	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006
−3	+0.001	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007
−4	0	−0.001	−0.002	−0.003	−0.004	−0.005	−0.006	−0.007	−0.008

GROUP 8

WHEELS, TIRES, CHASSIS SUSPENSION, AND UNDERBODY

PART 8-1 FRONT WHEEL ALIGNMENT

Front wheel alignment (caster, camber, and toe-in) inspection and adjustment operations should be performed by someone thoroughly familiar with alignment work and with the checking equipment being used.

For necessary hoisting and jacking procedures, see Part 8-4.

1 PRELIMINARY FRONT END INSPECTION

Do not check and adjust front wheel alignment without first making the following inspection for front-end maladjustment, damage, or wear.

1. Check for specified air pressures in all 4 tires.

2. Raise the front of the car off the floor. **The lower arms should not be used as supports.** Shake each front wheel. Check the front suspension ball joints and mountings for looseness, wear, and damage. Check the brake carrier plate mountings. Torque all loose nuts and bolts to specifications.

3. Check the steering gear mountings and all steering linkage connections for looseness. Torque all mountings to specifications. If any of the linkage is worn or bent, replace the parts.

4. Check the front wheel bearings. If any in-and-out free play is noticed, adjust the bearings to eliminate the free-play. Replace worn or damaged bearings.

5. Spin each front wheel with a wheel spinner, and check and balance each wheel as required.

6. Check the action of the shock absorbers (Part 8-2). If the shock absorbers are not in good condition, the car may not settle in a normal, level position, and front wheel alignment may be affected.

2 FRONT WHEEL ALIGNMENT INSPECTION

Do not attempt to check and adjust front wheel alignment without first making a preliminary inspection of the front-end parts.

EQUIPMENT INSTALLATION

Equipment used for front wheel alignment inspection must be accurate. If portable equipment is being used, perform all inspection operations on a level floor.

1. Drive the car in a straight line far enough to establish the straight-ahead position of the front wheels, and then mark the steering wheel hub and the steering column collar (Fig. 1). **Do not adjust the steering wheel spoke position at this time.** If the front wheels are turned at any time during the inspection, align the marks to bring the wheels back to the straight-ahead position.

2. Install the wheel alignment equipment on the car. Whichever type of equipment is used, follow the installation and inspection instructions provided by the equipment manufacturer.

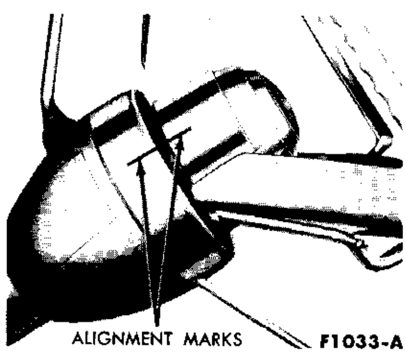


FIG. 1—Straight-Ahead Position Marks

INSPECTION

Check all the factors of front wheel alignment except toe-out on turns before making any adjustments. Toe-out on turns should be checked only after caster, camber, and toe-in have been adjusted to specifications.

CASTER

Check the caster angle at each front wheel. The caster angle is measured between a true vertical line and the center line through the upper and lower ball joints. The correct caster angle, or backward (positive) tilt, is ½° to 1½°. The maximum difference between both front wheel caster angles should not exceed ½°.

CAMBER

Check the camber angle at each front wheel. The camber angle is measured between a true vertical line and the centerline through the plane of the wheel and tire. The correct camber angle, or outward (positive) tilt, is +½° to +1½°. The maximum difference between both front wheel camber angles should not exceed ½°. However, a difference of not more than ¼° is preferred.

TOE-IN

Check the toe-in with the front

wheels in the straight-ahead position. **When checking toe-in of a car equipped with power steering, run the engine so that the power steering control valve will be in the center (neutral) position.** Toe-in is measured between the extreme front of both front wheels and between the extreme rear of both wheels, and is the difference between the two distances. Correct toe-in, or inward pointing of both front wheels at the front, is 1/16 - 1/8 inch.

TOE-OUT ON TURNS

After caster, camber, and toe-in have been adjusted to specifications, check the toe-out on a left turn. When the outside wheel (outer wheel on a turn) is turned inward 20°, the inside wheel should turn outward 24¼°. If this angle is not correct, the spindle arm on the inside wheel is probably bent and should be replaced.

3 FRONT WHEEL ALIGNMENT ADJUSTMENTS

After front wheel alignment factors have been checked, make the necessary adjustments. **Do not attempt to adjust front wheel alignment by bending the suspension or steering parts.**

CASTER AND CAMBER ADJUSTMENTS

Caster and camber can be adjusted by removing or installing shims between the inner shaft of the front suspension upper arm and the mounting bracket on the underbody in the engine compartment (Fig. 2).

Both caster and camber adjustments can be made at the same time by loosening the nuts on the two bolts that fasten the inner shaft to the mounting bracket. After the required shims have been removed or installed, torque the nuts to 65-90 foot-pounds. Caster and camber adjusting shims are available in 1/32-inch and 1/8-inch thicknesses.

FIG. 2—Caster and Camber Adjusting Shims

CASTER

To adjust caster, remove or install shims at either the front bolt or the rear bolt (Fig. 2).

The removal of shims at the front bolt or the installation of shims at the rear bolt will cause the upper ball joint to move forward. The removal of shims at the rear bolt or the installation of shims at the front bolt will cause the ball joint to move rearward. A 1/16-inch change of shim thickness at either bolt will change the caster angle ½°. The difference between the shim stack thicknesses at the two bolts should not exceed 1/8 inch (Fig. 3).

CAMBER

To adjust camber, remove or install equal shim thicknesses at both bolts (Fig. 2).

FIG. 3—Shim Stack Thickness Limits

The removal of equal shims at both bolts will move the upper ball joint inward. The installation of equal shims at both bolts will move the ball joint outward. A 1/16-inch change of shim thickness at both bolts will change the camber angle ¼°. The total shim stack thickness at each bolt should not exceed 5/16 inch (Fig. 3).

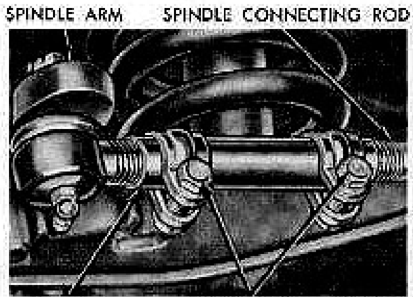


FIG. 4—Spindle Connecting Rod Sleeve

TOE-IN AND STEERING WHEEL ALIGNMENT ADJUSTMENTS

Check the steering wheel spoke position when the front wheels are in the straight-ahead position. If the spokes are not in their normal position, they can be properly adjusted while toe-in is being adjusted.

1. Loosen the two clamp bolts on each spindle connecting rod sleeve (Fig. 4).

2. Adjust toe-in. If the steering wheel spokes are in their normal position, lengthen or shorten both rods equally to obtain correct toe-in (Fig. 5). If the steering wheel spokes are not in their normal position, make the necessary rod adjustments to obtain correct toe-in and steering wheel spoke alignment (Fig. 6).

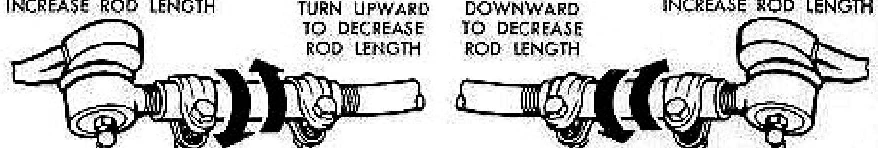


FIG. 5—Spindle Connecting Rod Adjustments

3. Recheck toe-in and steering wheel spoke alignment. If toe-in is correct and the steering wheel spokes are still not in their normal position, turn both connecting rod sleeves upward or downward the same number of turns to move the steering wheel spokes (Fig. 6).

4. When toe-in and steering wheel spoke alignment are both correct, torque the clamp bolts on both connecting rod sleeves to 11-14 foot-pounds. On cars equipped with power steering, both bolts on the left-hand sleeve should be in a vertical position on the forward side of the sleeve to prevent interference with the control valve. **The sleeve position should not be changed when the clamp bolts are tightened.**

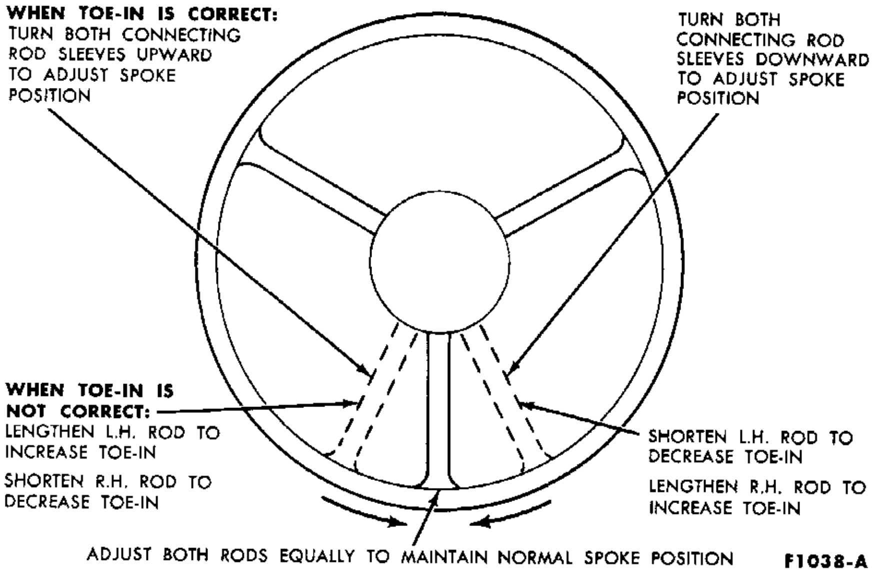


FIG. 6—Toe-in and Steering Wheel Spoke Alignment Adjustments

PART 8-2 FRONT AND REAR SUSPENSION

Ball joint independent front suspension (Fig. 1), with coil springs and a torsion bar stabilizer, is standard equipment on 1960 Thunderbirds. Conventional leaf spring suspension is used in the rear.

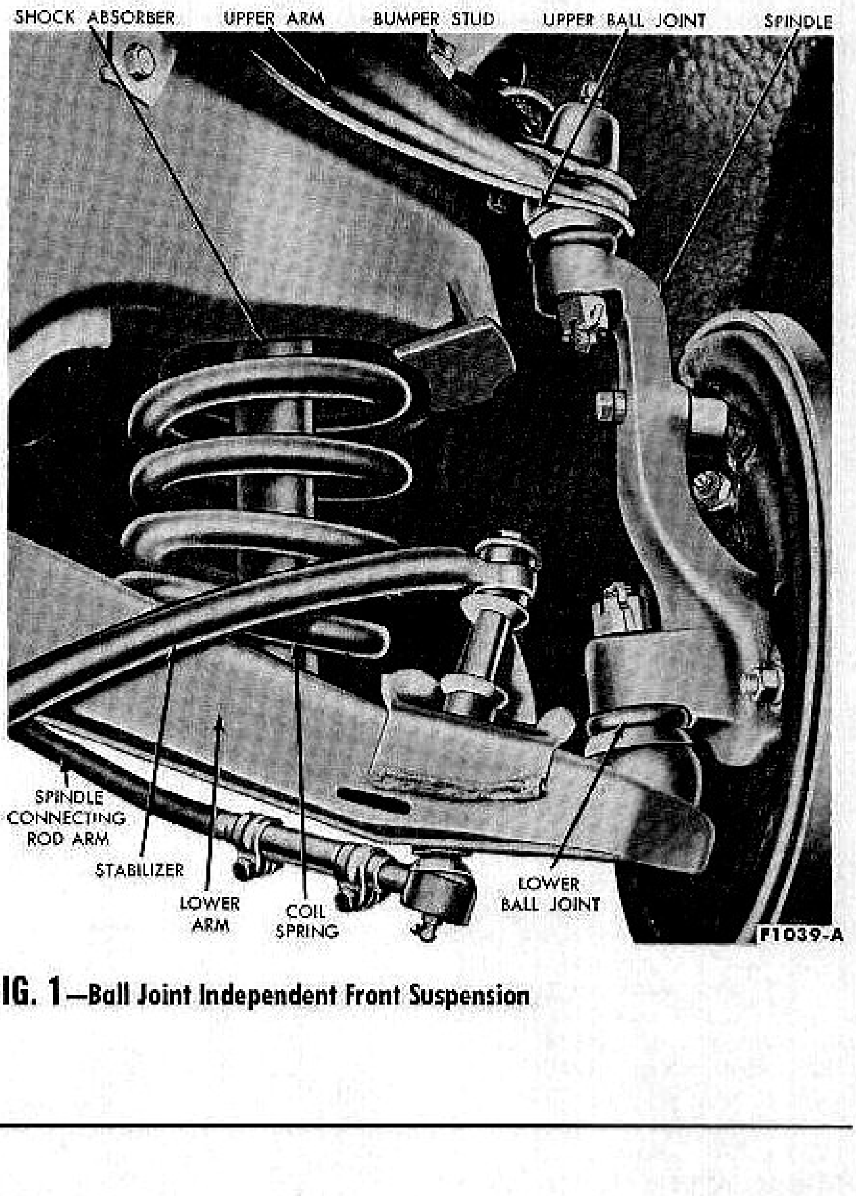


FIG. 1—Ball Joint Independent Front Suspension

1 TROUBLE SHOOTING

PRELIMINARY CHECKS

Before performing any trouble shooting operations, check for specified tire pressures in all tires.

SYMPTOMS AND CAUSES

Table 1 lists various front and rear suspension trouble symptoms and possible causes. Several of these symptoms are also common to wheel and tire and steering troubles. For this reason, be sure that the cause of the trouble is in the front or rear suspension before adjusting, repairing, or replacing any of the suspension parts.

TABLE 1—Front and Rear Suspension Trouble Symptoms and Possible Causes

Possible Causes of Trouble Symptoms	Trouble Symptoms							
	Abnormal or Irregular Tire Wear	Squeals, Thumps, or Rattles	Sag at One Wheel	Hard or Rough Ride	Shimmy or Wheel Tramp	Side-to-Side Wander	Pull to One Side	Body Sway or Roll
Incorrect Tire Pressure	x		x	x	x	x	x	x
Incorrect Front Wheel Alignment	x	x			x	x	x	
Incorrect Front Wheel Bearing Adjustment	x	x		x	x		x	
Tire Sizes Not Uniform	x		x				x	
Wheel Out of Balance	x	x		x	x			
Out-of-Round Wheel or Brake Drum	x	x		x	x			
Unequal Brake Adjustment	x	x					x	
Sagging or Broken Spring	x	x	x	x	x	x	x	x
Overloaded Spring or Tire	x		x	x				
Loose or Worn Shock Absorber		x	x	x				x
Loose or Worn Suspension Arm Bushings		x						
Lack of Lubrication		x						

2 FRONT SUSPENSION REPAIR

For necessary hoisting and jacking procedures, see Part 8-4.

BALL JOINT LOOSENESS CHECK

1. Raise the front of the car with a hoist or jack under the lower control arm.

2. Tighten the front wheel bearing to remove any play caused by the bearing.

3. Attach a dial indicator to the lower "A" frame. Adjust the dial indicator so that it is perpendicular to the wheel and it makes contact with the edge of the wheel rim.

4. Measure the in and out travel of the wheel by applying steady hard inward and outward pressure to the wheel. The total travel from the extreme inboard to outboard position should not exceed 0.125 inch (1/8 inch).

UPPER BALL JOINT REPLACEMENT (ARM IN CAR)

1. Raise the car high enough to provide working space, and place a support under the lower arm.

2. Remove the wheel and tire.

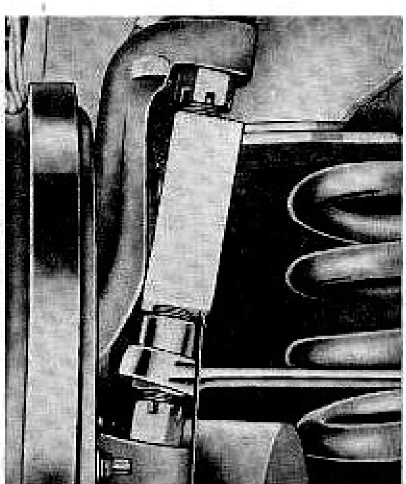
3. Using a large chisel, cut off the upper ball joint retaining rivets.

4. Remove the cotter pin and nut from the upper ball joint stud.

5. Place a box wrench over the lower end of the ball joint remover tool, and position the tool as in Fig. 2. The tool should seat firmly against the ends of both studs, and not against the lower stud nut.

6. Turn the wrench until both studs are under tension, and then, with a hammer, tap the spindle near the upper stud to loosen the stud from the spindle. **Do not loosen the stud with tool pressure alone.** Remove the ball joint.

7. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.



Tool—T57P-3006-A F1040-A

FIG. 2—Ball Joint Remover Tool

8. Attach the new ball joint to the upper arm. **Use only the specified bolts, nuts, and washers. Do not rivet the new ball joint to the arm.** Torque the nuts to 28-45 foot-pounds.

9. Position the ball joint stud in the spindle bore, and torque the retaining nut to 60-80 foot-pounds. Install a new cotter pin.

10. Lubricate the ball joint, and install the wheel and tire.

11. Remove the support, and lower the car.

12. Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

UPPER ARM REMOVAL

1. Raise the car until the front wheel clears the floor, and place a support under the lower arm.

2. Remove the wheel and tire.

3. Remove the cotter pin from the nut on the upper ball joint stud, and loosen the nut one or two turns. **Do not remove the nut from the stud at this time.**

4. Place a box wrench over the lower end of the ball joint remover tool, and install the tool between the upper and lower ball joint studs (Fig. 2). **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

5. Turn the wrench until the tool places the studs under tension, and then tap the spindle near the upper stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud in the spindle with tool pressure only.** If both arms are being removed, loosen the lower stud in the same manner as the upper stud.

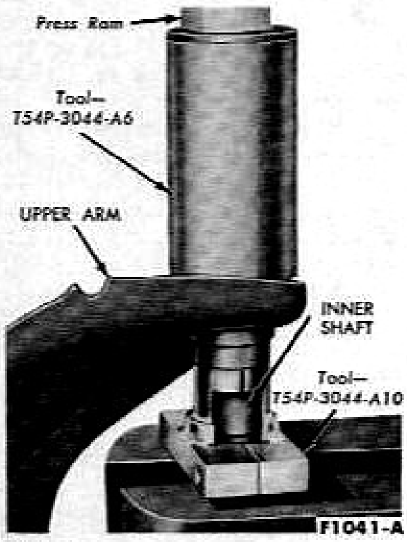


FIG. 3—Upper Arm Front Bushing Removal

6. Remove the nut from the upper stud and lift the stud out of the spindle.

7. Remove the nuts from the retaining bolts on the upper arm inner shaft.

8. Remove the upper arm from the mounting bracket, and measure and note the total shim thickness at each inner shaft bolt.

9. Wipe off all loose dirt from the upper arm parts. **Do not wash the ball joint with a solvent.**

UPPER ARM PARTS INSPECTION

Inspect the upper arm and the inner shaft for cracks, bends, or other damage. Replace the parts as required.

Check the condition of the bushings and the rubber seal on the ball joint stud. If any of these parts are cracked, torn, distorted, or worn, replace them.

Install the nut on the ball joint stud, and turn the stud in the ball joint with a torque wrench. If the turning effort is not within 20-35 inch-pounds torque, replace the ball joint.

UPPER ARM BUSHING AND INNER SHAFT REPLACEMENT

Always replace both upper arm bushings if either bushing is worn or damaged.

1. Remove the bolts and washers from both ends of the inner shaft.

2. Install the bushing remover tool at the front bushing, and press the bushing out of the arm (Fig. 3).

3. Remove the inner shaft from the rear bushing, and press the rear bushing out of the arm (Fig. 4).

4. Press a new rear bushing into the arm (Fig. 5). The bushing flange should be at the outer side of the arm.

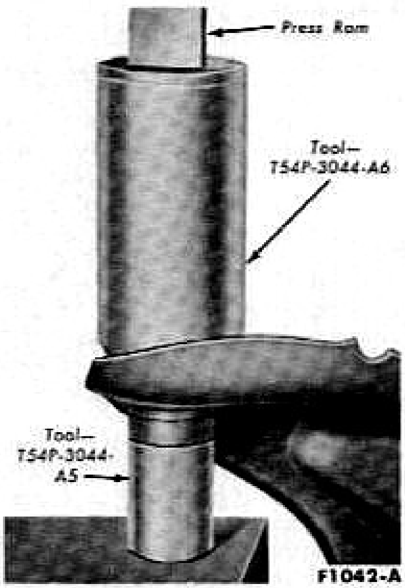


FIG. 4—Upper Arm Rear Bushing Removal

5. Insert the end of the inner shaft in the rear bushing, and press a new front bushing into the arm (Fig. 6).

6. Install the bolts and washers on both ends of the shaft, but do not tighten the bolts until the upper arm is installed on the mounting bracket.

UPPER BALL JOINT REPLACEMENT (ARM REMOVED)

The upper ball joint cannot be repaired and must be replaced if it is worn or damaged. **The upper ball joint may be removed with the upper arm installed (page 8-6).**

1. Remove the ball joint from the arm. If the ball joint is riveted to the

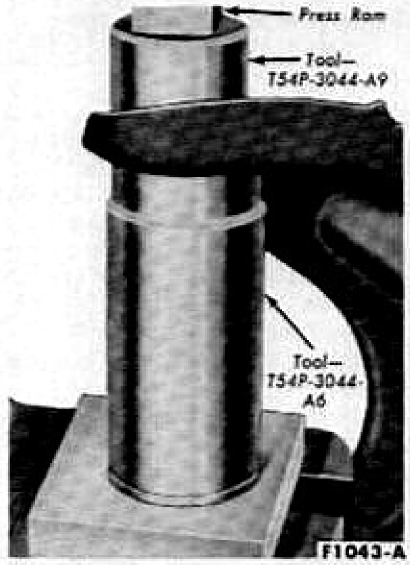


FIG. 5—Upper Arm Rear Bushing Installation

arm, drill a ⅛-inch pilot hole completely through each rivet, and then drill off the rivet head through the pilot hole with a ⅜-inch drill. Drive all rivets out of the holes.

2. Clean the end of the arm, and remove all burrs from the hole edges. check for cracks in the metal at the holes, and replace the arm if it is cracked.

3. Install a new ball joint on the arm. **Use only the specified bolts, nuts, and washers. Do not attempt to rivet the new ball joint to the arm.**

4. Torque the ball joint retaining nuts and bolts to 28-45 foot-pounds.

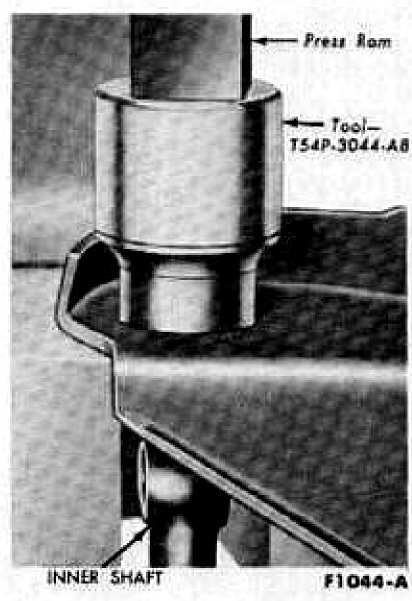


FIG. 6—Upper Arm Front Bushing Installation

UPPER ARM INSTALLATION

1. Position the upper arm on the underbody mounting bracket, and install but do not tighten the nuts and lockwashers on the two inner shaft retaining bolts. **The specified keystone-type lockwashers must be used.**

2. Install the adjusting shims on both bolts between the inner shaft and the underbody bracket. **Install the same shim thicknesses that were removed from both bolts during disassembly.** Torque the nuts to 65-90 foot-pounds.

3. Position the upper ball joint stud in the top of the wheel spindle, and install the stud nut. Torque the nut to 60-80 foot-pounds, and continue to tighten it until the cotter pin hole and slots line up. Install a new cotter pin.

4. Torque the bolts on the ends of the inner shaft to 36-46 foot-pounds.

5. Install the wheel and tire, and then remove the support from under the lower arm.

6. Lubricate the upper ball joint.

7. Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, be sure to check the front wheel alignment.**

LOWER BALL JOINT REPLACEMENT (ARM IN CAR)

1. Raise the car high enough to provide working space, leaving the lower arm free to drop as coil spring tension is eased.

2. If the ball joint is riveted to the arm, drill a ⅛-inch pilot hole completely through each rivet. Then drill off the rivet head through the pilot hole with a ⅜-inch drill, and drive out both rivets.

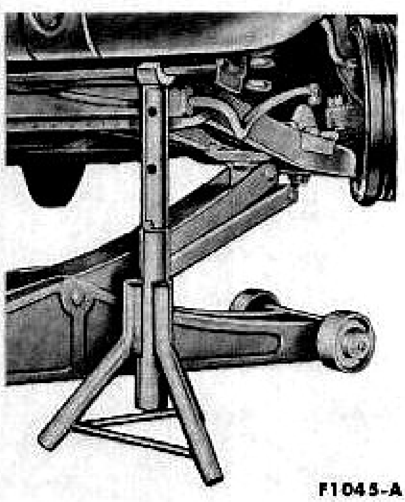


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FIG. 7—Jack Positioned Under Lower Arm

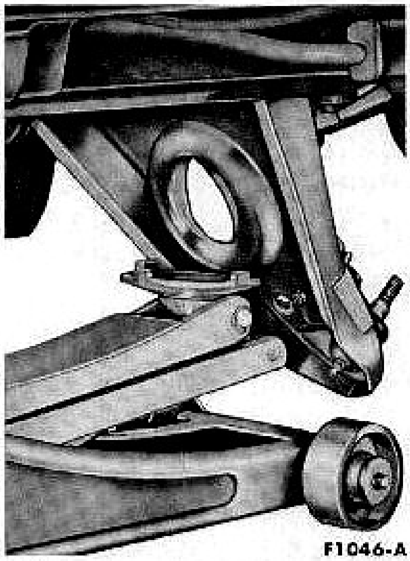

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FIG. 8—Lowering or Raising Lower Arm

3. Position a jack or safety stand under the lower arm, and lower the car about 6 inches to offset the coil spring tension.

4. Remove the cotter pin from the ball joint stud, and remove the nut.

5. Place a box wrench over the lower end of the tool shown in Fig. 2, and position the tool. **The tool should seat firmly against the ends of both studs, and not against the upper stud nut.**

6. Turn the wrench until both studs are under tension, and then, with a hammer, tap the spindle near the lower stud to loosen the stud from the spindle. **Do not loosen the stud with tool pressure alone.** Remove the ball joint.

7. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.

8. Position the stud of the new ball joint in the spindle bore, and install the retaining nut finger-tight.

9. Attach the ball joint to the lower arm. **Use only the specified bolts, nuts, and washers. Do not rivet the new ball joint to the arm.** Torque the nuts to 28-45 foot-pounds.

10. Torque the ball joint stud nut to 70-90 foot-pounds, and install a new cotter pin.

11. Remove the jack or safety stand, and lubricate the ball joint.

12. Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

LOWER ARM AND COIL SPRING REMOVAL

1. Raise the car so that the front wheels are about 8 inches off the floor, and place a support under the front end of the underbody side rail on the side being worked on.

2. Disconnect the stabilizer at the arm.

3. Remove shock absorber.

4. Remove the cotter pin from the nut on the lower ball joint stud, and loosen the nut one or two turns. **Do not remove the nut from the stud at this time.**

5. Straighten the cotter pin on the upper ball joint stud nut, place a box wrench over the lower end of the ball joint remover tool, and install the tool between the upper and lower ball joint studs (Fig. 2). **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

6. Turn the wrench until the tool places the studs under tension, and tap the spindle near the lower stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud in the spindle with tool pressure only.** If both arms are being removed, loosen the upper stud in the same manner as the lower stud.

7. Place a jack under the lower arm at approximately a 60° angle away from the wheel and toward the center of the car. Hook the saddle of the jack over the outer edge of the spring seat (Fig. 7).

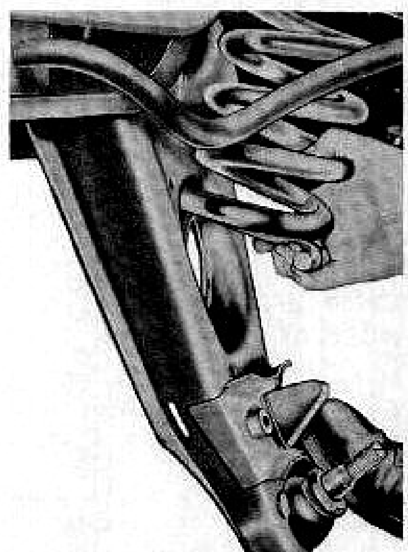

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FIG. 9—Coil Spring Removal or Installation

8. Remove the nut from the lower ball joint stud, and slowly lower the arm until the spring is fully extended (Fig. 8).

9. Apply foot pressure to the lower suspension arm to push the arm inward so that the spring and insulator assembly may be lifted from the car (Fig. 9). Note the number of shims used, if any.

10. Remove the lower arm retaining bolts, washers, and shims, and remove the arm from the car. **Note the respective front and rear positions of the 2 different retaining bolts.**

LOWER ARM PARTS INSPECTION

Inspect the lower arm for cracks, bends, or other damage, and replace the arm if necessary.

Check the condition of the ball joint and socket, the bushings, the rubber seal on the ball joint stud, and the rubber bumper on the arm. If any of these parts are cracked, torn, distorted, or worn, replace them.

FIG. 10—Lower Arm Bushing Removal

LOWER ARM BUSHING REPLACEMENT

Always replace both lower arm bushings if either bushing is worn or damaged.

1. Install the bushing remover tool (Fig. 10) and press both bushings out of the arm.

2. Press new bushings into the arm with the tools shown in Fig. 11. **The bushing flanges must be at the inner side of the lower arm.**

LOWER BALL JOINT REPLACEMENT (ARM REMOVED)

The lower ball joint cannot be repaired and must be replaced if it is worn or damaged. **The lower ball joint may be removed with the lower arm installed (page 8-8).**

1. Remove the ball joint from the arm. If the ball joint is riveted to the arm, drill a ⅛-inch pilot hole completely through each rivet, and then drill off the rivet head through the pilot hole with a ⅜-inch drill. Drive all rivets out of the holes.

2. Clean the end of the arm, and remove all burrs from the hole edges. Check for cracks in the metal at the holes, and replace the arm if it is cracked.

3. Install a new ball joint on the arm. **Use only the specified bolts, nuts, and washers. Do not attempt to rivet the new ball joint to the arm.**

4. Torque the ball joint retaining nuts and bolts to 28-45 foot-pounds.

LOWER ARM AND COIL SPRING INSTALLATION

1. Position the lower arm on the underbody cross members, and install shims as needed to remove fore-and-aft movement, but do not tighten the retaining bolts.

2. Tape the insulator (and shims, if used) to the top of the coil spring. Position the insulator and spring in the upper suspension arm spring pocket, and hook the lower end over the edge of the lower arm pocket by applying foot pressure inward on the lower arm (Fig. 9). **The spring coil end must be seated correctly in the lower pocket.**

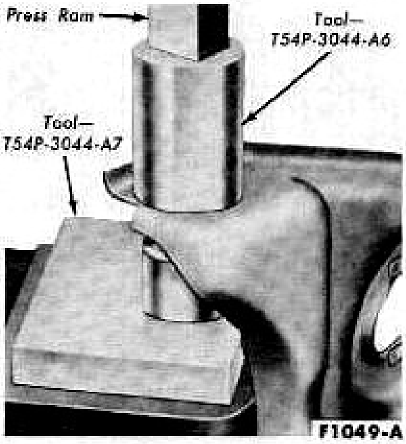

FIG. 11—Lower Arm Bushing Installation

3. Position the jack directly behind the lower arm at approximately a 60° angle away from the wheel and toward the center of the car. Push the jack outboard as it is raised to align the ball stud with the spindle bore (Fig. 12).

4. Apply downward pressure on the top of the wheel to permit the

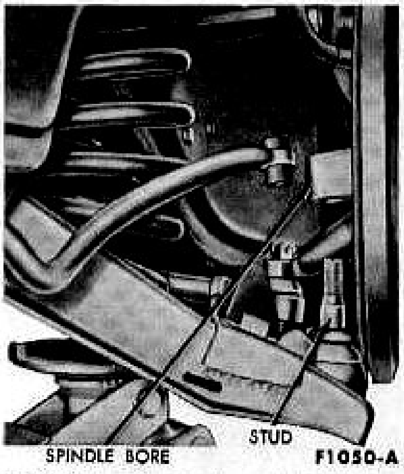

FIG. 12—Ball Stud and Spindle Bore Alignment

ball joint shoulder to slip over the edge of the bore into position.

5. Torque the lower ball joint nut to 70-90 foot-pounds, and remove the jack.

6. Install the lower ball joint retaining nut cotter pin, and bend the upper ball joint retaining nut cotter pin.

7. Torque the lower arm retaining bolts to 36-46 foot-pounds. **The lower arm should be in a normal load position when the retaining bolts are tightened.**

8. Install the shock absorber.

9. Connect the stabilizer to the lower arm.

10. Lubricate the lower ball joint. **Do not lubricate the lower arm bushings.**

11. Check and, if necessary, adjust caster, camber, and toe-in. **Whenever any part of the front suspension has been removed and installed, front wheel alignment must be checked.**

FRONT WHEEL SPINDLE REMOVAL

1. Raise the car until the front wheel clears the floor, and place a support under the lower arm.

2. Remove the wheel and drum.

3. Remove the brake carrier plate from the spindle. Support the plate to prevent damage to the brake hose.

4. Disconnect the spindle connecting rod end from the spindle arm.

5. Remove the cotter pins from both ball joint stud nuts, and loosen the nuts one or two turns. **Do not remove the nuts from the studs at this time.**

6. Place a box wrench over the lower end of the ball joint remover

tool, and install the tool between the upper and lower ball joint studs (Fig. 2). **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

7. Turn the wrench until the tool places the studs under tension, and, with a hammer, tap the spindle near the studs to loosen them in the spindle. **Do not loosen the studs in the spindle with tool pressure only.**

8. Remove the stud nuts and the spindle from both studs.

FRONT WHEEL SPINDLE INSTALLATION

1. Position the spindle on both ball joint studs and install both stud nuts.

2. Torque the upper stud nut to 60-80 foot-pounds and the lower stud nut to 70-90 foot-pounds. Continue to tighten both nuts until the cotter pin holes and slots line up. Install new cotter pins.

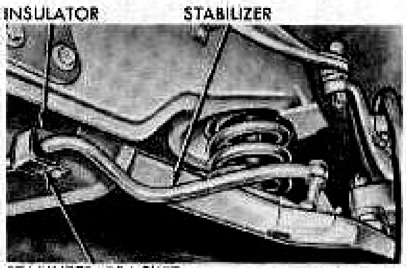

FIG. 13—Stabilizer

3. Connect the spindle connecting rod end to the spindle arm.

4. Install the brake carrier plate on the spindle, and torque the brake shoe anchor pin bolt to 80-100 foot-pounds. Torque the lower bolts to 25-29 foot-pounds.

5. Install the wheel and drum, and adjust the wheel bearing.

6. Check and, if necessary, adjust caster, camber, and toe-in.

STABILIZER REMOVAL

1. Raise the car high enough to provide working space, and place supports under both front wheels.

2. Disconnect the stabilizer from both lower arms (Fig. 13). Disconnect both stabilizer retaining brackets, and remove the front cross member guard. Remove the stabilizer.

STABILIZER INSTALLATION

1. Coat the necessary parts of the stabilizer with RuGLYDE or a comparable lubricant, and slide new insulators onto the stabilizer.

2. Connect the stabilizer retaining brackets, and connect the stabilizer to both suspension arms. Torque the cap screws to 30-35 foot-pounds, and the nut for the special 5/16-inch bolt to 10-15 foot-pounds.

3. Install the front cross member guard.

4. Remove the supports and lower the car.

3 REAR SUSPENSION REPAIR

For necessary hoisting and jacking procedure, see Part 8-4.

REAR SPRING REMOVAL

1. Raise the car until the rear wheels clear the floor, and place supports beneath the underbody and beneath the axle.

2. Disconnect the parking brake cable spring (Fig. 14) from the outer spring clip.

3. Disconnect the lower end of the shock absorber from the spring clip plate.

4. Remove the spring clip nuts, the clips, and the spring clip plate.

5. Remove the front hanger stud from the forward end of the spring (Fig. 15).

6. Remove the shackle from the shackle hanger and spring, and remove the spring from the car.

REAR SPRING INSPECTION AND REPAIR

Inspect the rubber bushings, shackle and studs, and hanger and stud, for wear or damage. Replace parts where necessary.

Check for broken spring leaves. Inspect the anti-squeak inserts between the leaves, and replace them if

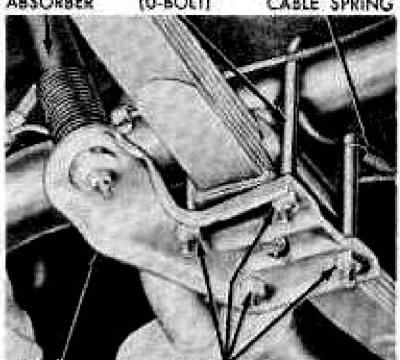

FIG. 14—Rear Spring Installation at Axle

they are worn. **The spring leaves must be dry and free of oil and dirt before new inserts are installed.**

Inspect the spring clips for worn or damaged threads. Check the spring clip plate for distortion.

REAR SPRING INSTALLATION

1. Position the spring under the rear axle. **The shorter end of the spring between the center tie bolt and the spring eye should be toward the front of the car.**

2. Install the shackle and shackle hanger, leaving the locknuts finger tight.

3. Install the front hanger stud in the spring and hanger, and torque the locknut to 30-40 foot-pounds.

4. Torque the shackle locknuts to 20-25 foot-pounds.

5. Install the spring clips, plate, and clip nuts. **Be sure that all parts are properly seated in the spring and rear axle.**

6. Torque the clip nuts to 30-45 foot-pounds. **Do not exceed the maximum torque because the rear wheel camber may be affected.**

7. Connect the lower end of the shock absorber to the rear spring clip plate.

8. Connect the parking brake cable spring to the outer spring clip.

FIG. 15—Rear Spring Front Hanger

4 SHOCK ABSORBER REPLACEMENT

FRONT SHOCK ABSORBER REMOVAL

1. Raise the front end of the car and place supports under both suspension lower arms. **Be sure that the lower end of the shock absorber remains accessible for servicing.**

2. Disconnect the shock absorber from the suspension lower arm and the mounting on the underbody. Free the lower stud pin and bushing from the lower arm by removing one mounting bolt and loosening the other bolt.

3. Remove the bushing and washers from the shock absorber stud. Remove the bushing from the lower end of the shock absorber (Fig. 16) if the shock absorber is serviceable and the bushing requires replacement.

FRONT SHOCK ABSORBER INSTALLATION

1. Apply RuGLYDE or a comparable lubricant to the lower bushing, and install the bushing on the shock absorber (Fig. 17) with one quick drive of the press arm.

2. Extend the shock absorber and position the lower washer and bushing on the stud. Install it inside the coil spring with the stud inserted through the hole in the mounting bracket. **Be sure the mounting bracket is free of burrs.** Torque the lower mounting bolts to 12-15 foot-pounds.

3. Install the upper bushing and the outer washer on the stud, and torque the nut to 25-29 foot-pounds.

REAR SHOCK ABSORBER REMOVAL

1. Disconnect the shock absorber from the spring clip plate and the bracket on the underbody (Fig. 14).

2. Compress the shock absorber and remove it from the car. Remove the bushings and washers from the shock absorber studs.

REAR SHOCK ABSORBER INSTALLATION

1. Place the bushings and washers on the shock absorber studs in the order shown in Fig. 14.

2. Connect the upper stud to the bracket on the underbody, and install the bushing, washer, and nut on the stud. Torque the nut to 15-25 foot-pounds.

3. Connect the lower stud to the spring clip plate, and install the bushing, washer, and nut on the stud. **Be sure the spring clip plate is free of burrs.** Tighten the nut to 15-25 foot-pounds.

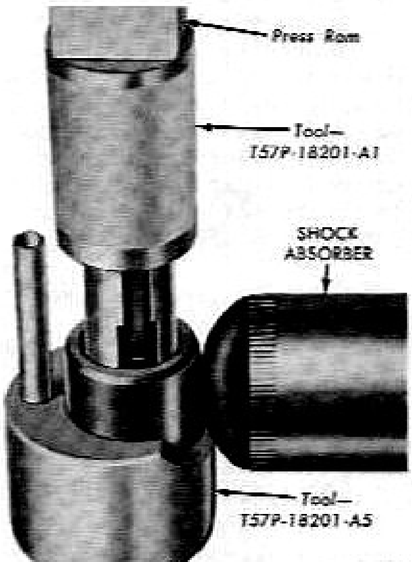

FIG. 16—Shock Absorber Bushing Removal

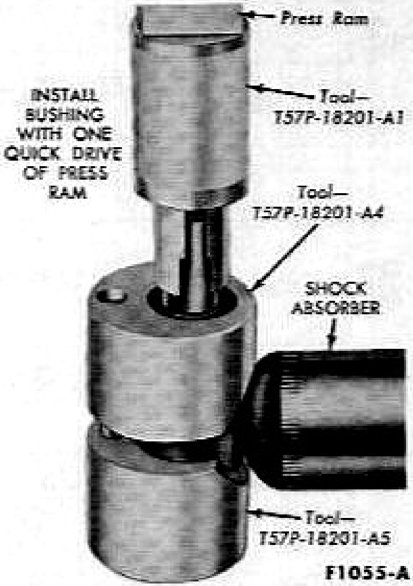

FIG. 17—Shock Absorber Bushing Installation

PART 8-3 WHEELS AND TIRES

1 TROUBLE SHOOTING

Several symptoms which appear to be caused by wheel and tire troubles are also common to suspension and steering troubles. For this reason, be sure that the wheels, hubs, bearings, or tires are causing the trouble before adjusting, repairing, or replacing any of these parts.

WORN OR DAMAGED FRONT WHEEL BEARINGS

When the front wheel bearings are excessively worn or damaged, check the bearing cups for proper installation before removing them for replacement. If a cup is improperly seated in the hub, inspect the hub for burrs, rough spots, or other irregular surfaces that would prevent seating the cup properly.

Bearing damage is often caused by lack of lubrication or improper adjustment. When installing bearing cups or cones and rollers, make sure that the specified lubricant is properly used. Adjust the bearings after installation, and make sure that a cotter pin is installed.

WORN OR DAMAGED TIRES

Much abnormal tire wear is caused by poor driving habits and road conditions as well as by defective or poorly adjusted parts. High-speed driving, fast acceleration and braking, sharp turns at excessive speeds, and similar types of driving will cause tires to wear more rapidly than normal. High temperatures, rough or abrasive road surfaces, steep hills and grades, and tire overloading are also important factors in damaging tires and reducing tire life.

Irregular tire wear is generally caused by defective or improperly adjusted suspension and steering parts. Underinflation and overinflation will also cause irregular tire wear.

2 WHEEL MAINTENANCE AND REPLACEMENT

WHEEL INSPECTION AND MAINTENANCE

Wheel stud nuts should be inspected and tightened regularly to avoid accidental loosening of the wheels. Loose wheel stud nuts may cause shimmy and vibration. Elongated stud holes in the wheels may also result from loose stud nuts.

Keep the wheels and hubs clean. Stones wedged between the wheel and drum and lumps of mud or grease can unbalance a wheel and tire.

Check for damage that would affect the runout of the wheels. Wobble or shimmy caused by a damaged wheel will eventually damage the wheel bearings. Inspect the wheel rims for dents that could permit air to leak from the tires.

WHEEL REPLACEMENT

1. Pry off the wheel cover and loosen but do not remove the wheel stud nuts.

2. Raise the car until the wheel and tire clear the floor.

3. Remove the wheel stud nuts and the wheel and tire from the hub and drum.

4. Clean all dirt from the hub and drum. Be sure that the replacement wheel and tire are clean.

5. Position the wheel and tire on the hub and drum, and install the wheel stud nuts. For proper balance, line up the notch on the drum with the valve stem on the wheel. Tighten the nuts enough to hold the wheel firmly in place. **Always tighten alternate nuts to draw the wheel evenly against the hub and drum.**

6. Lower the car to the floor, and torque the wheel stud nuts to 55-85 foot-pounds. **On new cars, and each time a wheel and tire are installed, the wheel stud nuts should be checked for tightness.**

3 FRONT HUBS, BEARINGS, AND GREASE RETAINERS

The front hubs are attached to the front brake drums. The front wheel bearing cones and rollers rotate in bearing cups which are pressed into each hub. Grease retainers are installed at the inner ends of the hubs to prevent lubricant from leaking into the brake drums.

FRONT WHEEL BEARING ADJUSTMENT

The front wheel bearings should be adjusted if the wheel is loose on the spindle or if the wheel does not rotate freely.

1. Raise the car until the wheel and tire clear the floor.

2. Pry off the wheel cover and remove the grease cap (Fig. 1) from the hub.

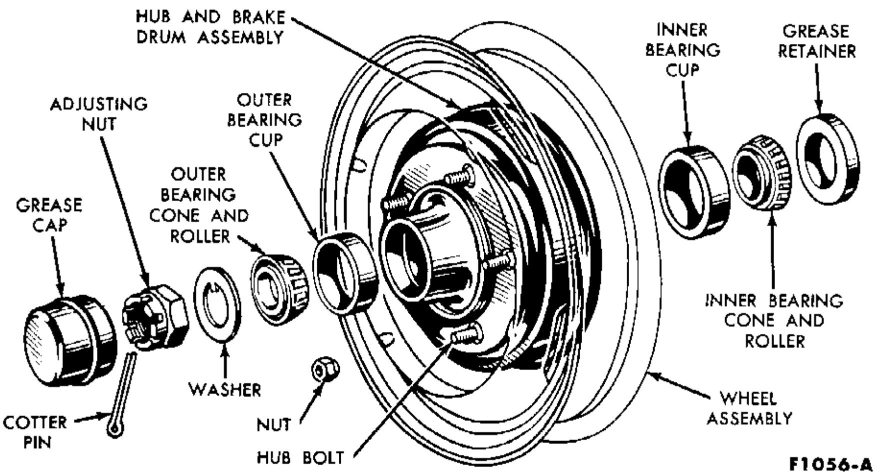

FIG. 1—Front Hub, Bearings, and Grease Retainer

3. Remove the cotter pin from the adjusting nut and spindle, and tighten the nut until the bearing is just seated in the cup, as the wheel is rotated back and forth. This operation will seat the cones and rollers properly in the bearing cups.

4. Loosen the adjusting nut just enough to line up the nearest slot in the nut with the cotter pin hole in the spindle. Install a new cotter pin. **Bend the ends of the cotter pin away from the end of the spindle and back over the flat side of the nut to prevent interference with the radio static collector in the grease cup.**

5. Check the front wheel rotation. If the wheel rotates properly, install the grease cap and the hub cap or wheel cover. If the wheel is still loose, or it rotates roughly or noisily, the bearing cones and rollers and the cups are worn or dirty and should be cleaned or replaced.

FRONT WHEEL BEARING REPLACEMENT

If the front wheel rotates roughly or noisily and cannot be properly adjusted to rotate freely without looseness, the bearing cones and rollers and the cups should be inspected and, if necessary, replaced.

1. Raise the car until the wheel and tire clear the floor, and then remove the wheel and tire from the hub.

2. Back off the brake shoe adjusting screw so that the shoes do not contact the brake drum.

3. Remove the grease cap from the hub.

4. Remove the cotter pin and adjusting nut from the spindle, and then remove the flat washer and the outer bearing cone and roller.

5. Pull the hub and drum off the wheel spindle, and then remove the grease retainer, the inner bearing cone and roller from the hub.

6. Wipe the lubricant off the inner and outer bearing cups, and inspect the cups for scratches, pits, excessive wear, and other damage. If the cups are worn or damaged, remove them with a drift.

7. Clean the inner and outer bearing cones and rollers with solvent, and dry them thoroughly. **Do not spin the bearings dry with compressed air.**

8. Inspect the cones and rollers for wear or damage, and replace them if necessary. The cones and rollers and the bearing cups should be replaced at the same time.

9. Inspect the grease retainer, and replace it if it is worn or damaged. If a new grease retainer is to be installed, soak it in light engine oil for at least 30 minutes before installation.

10. To remove all old lubricant, thoroughly clean the spindle and the inside of the hub.

11. Cover the spindle with a clean cloth, and brush all loose dust and dirt from the brake assembly. **To prevent getting dirt on the spindle, carefully remove the cloth from the spindle.**

12. Install the inner and outer bearing cups in the hub with the tool shown in Fig. 2. **Be sure to seat the cups properly in the hub.**

13. Pack the inside of the hub with wheel bearing grease. Fill the hub until the grease is flush with the inside diameters of both bearing cups.

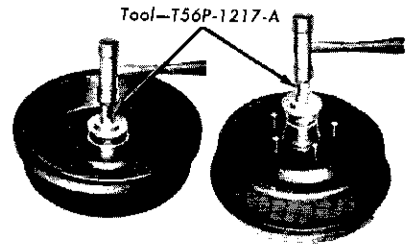

FIG. 2—Front Wheel Bearing Cup Installation

14. Pack the bearing cones and rollers with wheel bearing grease. A bearing packer is desirable for this operation. If a packer is not available, work as much lubricant as possible between the rollers and cages. Lubricate the cone surfaces with grease.

15. Place the inner bearing cone and roller in the inner cup, and install the grease retainer with the reverse end of the tool shown in Fig. 2. **Be sure that the retainer is properly seated.**

16. Install the hub and drum on the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.**

17. After installing the outer bearing cone and roller and the flat washer on the spindle, install the adjusting nut.

18. Install the wheel and tire on the hub, and tighten the wheel stud nuts.

19. Adjust the wheel bearings, and install a new cotter pin. **Bend the ends of the cotter pin away from the end of the spindle and back over the flat side of the nut to prevent interference with the radio static collector in the grease cap.**

20. Install the grease cap, torque the stud nuts to 55-85 foot-pounds, and install the wheel cover.

4 TIRE MAINTENANCE

TIRE INSPECTION AND MAINTENANCE

The tires should be checked frequently to be sure that the air pressures are correct. The air pressures should agree with those specified for the tires being checked.

All five tires on a car should be cross switched, as shown in Fig. 3, after each 6000 miles of driving or at least twice each year. This change helps to equalize tire wear and prevents deterioration of the spare tire caused by lack of use.

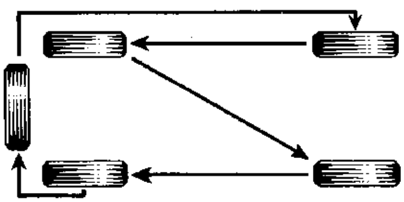

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FIG. 3—Tire Cross-Switching Diagram

Inspect the tire treads, and remove all stones, nails, glass, or other objects that may be wedged in the tread grooves. Check for holes or cuts that may permit air leakage from the tire, and make the necessary repairs.

Inspect the tire side walls for cuts, bruises and other damage. If internal damage is suspected, demount the tire from the wheel for further inspection and repair or replacement.

Check the tire valve for air leaks, and replace the valve if necessary. If the valve cap is missing, install a new cap.

TIRE DEMOUNTING

After the wheel and tire have been removed from the car, the tire can be demounted on a mounting machine. If the tire irons are used to demount the tire, follow the procedure given here. **Demount the tire with the outer side of the wheel downward.**

1. Remove the valve core, and deflate the tire completely.
2. Loosen the tire beads with the tool shown in Fig. 4.
3. Insert two tire irons about 8 inches apart between the tire bead and the back side of the wheel rim. **Use only tire irons with rounded edges or irons designed for demounting tubeless tires.**
4. Leave one tire iron in position, and pry the rest of the bead over the rim with the other iron. **Take small "bites" around the tire with the iron to prevent damaging the tire bead.**
5. Stand the wheel and tire upright with the tire bead in the drop center well at the bottom of the wheel. Then insert the tire iron between the bead and the edge of the wheel rim and pry out the wheel.

TIRE MOUNTING

Mount the tire with the outer side of the wheel downward.

1. Inspect the tire and wheel before mounting the tire. Remove all dirt and old tire mounting compound. Use emery cloth or fine steel wool to clean the rim. Check the rim for dents and other uneven spots. Inspect the wheel for loose rivets.
2. Apply RuGLYDE or a similar tire mounting compound to both tire beads, and then pry the beads over the wheel rim with two tire irons. **Do not use a hammer or mallet to force the beads over the rim.** A mounting machine can also be used to mount the tire on the wheel.

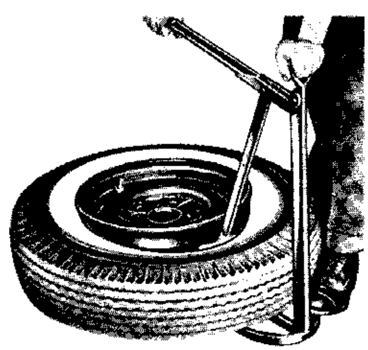

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FIG. 4—Bead Loosening Tool

3. Position the balance mark on the tire next to the tire valve, and then use a mounting band (Fig. 5) to force the beads against the rim flanges to create the initial seal. If a mounting band is not available, tie a tourniquet of heavy cord around the circumference of the tire, and tighten the cord with a tire iron.

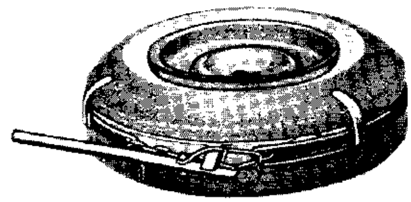

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FIG. 5—Tubeless Tire Mounting Band

4. Give the tire a few quick bursts of air to seat the beads properly, and then inflate the tire to 40 pounds pressure. Check to see that the bead positioning ribs (outer rings near the side walls) are evenly visible just above the rim flanges all the way around the tire. If the ribs are not even, deflate the tire completely, and then inflate it again.
5. When the ribs are properly positioned, deflate the tire to the recommended pressure.

TUBELESS TIRE VALVE REPLACEMENT

1. Demount the tire.
2. Remove the valve.
3. Inspect the valve hole in the rim for burrs and sharp edges. File or rasp the edges of the hole smooth before installing a new tire valve.
4. Coat the new valve with RuGLYDE or a similar rubber lubricant, and position the valve. Use a rubber hammer or a valve replacing tool to seat the valve firmly against the inside of the rim. **The valve must be installed straight.**
5. Mount the tire on the wheel, and check the new valve for air leaks.

PART 8-4 UNDERBODY

The unitized body-frame construction and the rear suspension of the 1960 Thunderbird require special precautions and procedures when the car is jacked up or hoisted. In some cases, special hoist adapters must be used as recommended by specific hoist manufacturers.

1 HOISTING

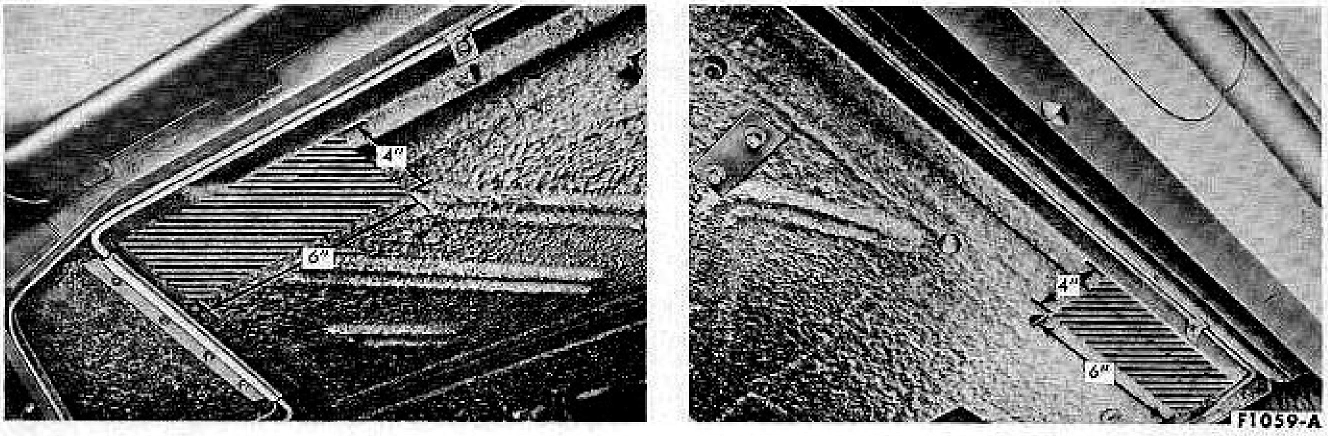

FIG. 1—Frame Hoist Contact Area—Front and Rear

DRIVE-ON TYPE HOIST

To prevent possible damage to the underbody, do not drive the car onto the drive-on type hoist without first checking for possible interference between the upright flanges of the hoist rails and the underbody. Should there be interference, the hoist flanges should be modified as necessary and/or the approach ramps built up to provide the needed clearance.

RAIL TYPE (FREE WHEELING) HOIST

FRONT

The front adapters or hoist plates must be carefully positioned in contact with the lower suspension arms to assure safe, secure lifting.

REAR

The hoist adapters must be positioned carefully under the rear axle to prevent damage to the shock absorbers when the car is raised. The hoist rails should be raised slowly and the position of the adapters checked.

FORK LIFT (TWIN POST) HOIST

FRONT

To assure safe hoisting, the front post adapters must be positioned carefully to contact the lower suspension arms. The adapters must be large enough to cover the entire spring seat area.

REAR

To prevent damage to the shock absorbers, the rear forks must contact the axle at points not farther outboard than 1 inch from the circumference welds near the differential housing. Carefully raise the rear post and check the position of the fork.

FRAME CONTACT HOIST

Frame contact hoist adapters are necessary to lift the car. The hoist adapter pads should each cover at least 24 square inches of underbody area. Figure 1 shows recommended contact points.

2 JACKING

When a stationary floor jack or a roll jack is to be used, there are several specific recommended points of contact. Either side of the car may be raised at the front by jack contact at either coil spring pocket. **Raise the car by contacting a lower arm only when the jack saddle is large enough to accommodate the spring pocket securely.** Either side of the front end of the car may also be raised by jack pressure on the front cross member, or on the cross member to which the stabilizer is connected.

Either side of the rear end of the car may be raised by jack pressure on the rear cross member. Do not put pressure on the fuel tank.

To raise the front of the car with a bumper jack, position the jack directly in front of the parking light. At the rear, the bumper jack should be placed under the inner tail light.

PART 8-5 SPECIFICATIONS

FRONT WHEEL ALIGNMENT

CASTER

Caster Angle	½°-1½°
Maximum Caster Angle Difference Between Wheels	½°
Maximum Allowable Difference Between Shim Stack Thicknesses at Both Bolts	⅛ inch
Amount of Caster Angle Change With 1/16-inch Change of Shim Thickness at Either Bolt	½°

CAMBER

Camber Angle	½°-1½°
Maximum Camber Angle Difference Between Wheels	½° (¼° preferred)
Maximum Allowable Thickness of Shim Stack at Each Bolt	9/16 inch
Amount of Camber Angle Change With 1/16-inch Change of Shim Thickness at Both Bolts	¼°

TREAD WIDTH AND WHEELBASE

Front Tread Width	60 inches
Rear Tread Width	57 inches
Wheelbase	113 inches

TOE-IN AND TOE-OUT

Toe-In	1/16-⅛ inch
Toe-Out on Turn (Angle of Inside Wheel When Outside Wheel is Turned 20°)	17⅛°

TORQUE LIMITS

Connecting Rod Sleeve Clamp Bolts	11-14 foot-pounds

FRONT AND REAR SUSPENSION

TORQUE LIMITS—FRONT SUSPENSION

Description	Ft.-Lbs.
Lower Arm Ball Joint Assembly to Spindle Nut	70-90
Upper Arm Ball Joint Assembly to Spindle Nut	60-80
Upper Arm Inner Shaft to Mounting Bracket Nuts	65-90
Stabilizer to Lower Arm Nuts	12-15
Shock Absorber Stud Nut	25-29
Stabilizer Bushing Brackets	12-15
Upper Arm Ball Joint Preload	20-35*
Upper Arm Bumper Stud Nut	20-35
Lower Arm Bumper Stud Nut	20-35
Anchor Pin	80-100
Front Brake Assembly to Spindle (Lower) Bolts	25-29
Arm and Bushing Assembly to Underbody Front Crossmember Bolt	36-46
Arm and Bushing Assembly to Underbody #2 Crossmember Bolt	36-46
Shock Absorber Pin and Bushing to Lower Arm Nut	12-15

*Inch Pounds

FRONT COIL SPRING FREE HEIGHT

Purple Marking	15½ inches
Yellow Marking	15¾ inches

TORQUE LIMITS—REAR SUSPENSION

Description	Ft.-Lbs.
Rear Shock Absorber Stud Nut (Upper or Lower)	15-25
Rear Spring to Front Hanger Stud Nut	30-40
Rear Spring Shackle Bar to Underbody Nut	20-25
Rear Spring Shackle to Rear Spring Nut	20-25
Rear Spring U-Bolt Nut	30-45*

*10 pounds less torque for a used nut.

REAR LEAF SPRING

Number of Leaves	Capacity at Normal Loaded Height	Spring Length at Normal Load
6	965-1005 pounds	55 inches

WHEELS AND TIRES

Tire Size and Ply Rating		8:00 x 14-4 8:50 x 14-4
Inflation Pressure (psi)	Front	24
	Rear	24
Wheel Nut Torque Limits (Ft.-Lbs.)		55-85

GROUP 9

STEERING

PAGE

PART 9-1 STEERING GEAR AND LINKAGE

1 TROUBLE SHOOTING

Table 1 lists various steering gear and linkage trouble symptoms and possible causes. Several of these symptoms are also common to suspension and wheel and tire troubles. **Be sure that the cause of any trouble is in the steering gear or linkage before adjusting, repairing, or replacing any of the steering system.**

TABLE 1—Steering Gear and Linkage Trouble Symptoms and Possible Causes

POSSIBLE CAUSES OF TROUBLE SYMPTOMS	Trouble Symptoms									
	Jerky Steering	Loose Steering	Hard Steering	Hard Turning When Stationary	Rattles	Shimmy	Pull To One Side	Side-To-Side Wander	Body Sway Or Roll	Tire Squeal on Turns
Incorrect Tire Pressure			x	x		x	x	x	x	x
Incorrect Front Wheel Alignment	x		x			x	x	x		x
Incorrect Front Wheel Bearing Adjustment	x	x				x	x		x	
Tire Sizes Not Uniform			x	x		x	x	x		
Wheel Out of Balance	x					x				
Loose Steering Linkage Connections	x	x			x	x		x		
Loose Steering Gear Mountings		x			x	x		x	x	
Incorrect Steering Gear Adjustment	x	x	x	x		x		x	x	
Binding Front Suspension Ball Joints	x		x	x						
Bent Spindle Arm							x	x		x
Unequal Brake Adjustment							x			
Sagging or Broken Spring					x		x	x	x	
Lack Of Lubrication			x	x	x					

2 STEERING ADJUSTMENTS

STEERING WORM AND SECTOR GEAR ADJUSTMENTS

The ball nut assembly and the sector gear must be adjusted properly to maintain minimum steering shaft end play (a factor of preload adjustment) and minimum backlash between the sector gear and the ball nut (Fig. 1). There are only two possible adjustments within the recirculating ball type steering gear, and **these should be made in the following order to avoid damage or gear failure.**

1. Disconnect the sector shaft arm (Pitman arm) from the steering arm to idler arm rod. On a car with power steering, disconnect the arm from the control valve ball stud.

2. Loosen the steering gear housing attaching bolts to relieve possible binding between the steering column and the worm shaft.

3. Loosen the steering column bracket screws at the instrument panel.

4. Partially tighten the steering column bracket screws.

5. Torque the steering gear housing attaching bolts to specification.

6. Loosen the nut which locks the sector adjusting screw (Fig. 2), and

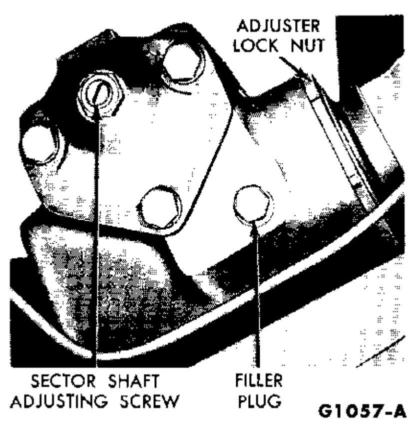

FIG. 2—Steering Gear Adjustments

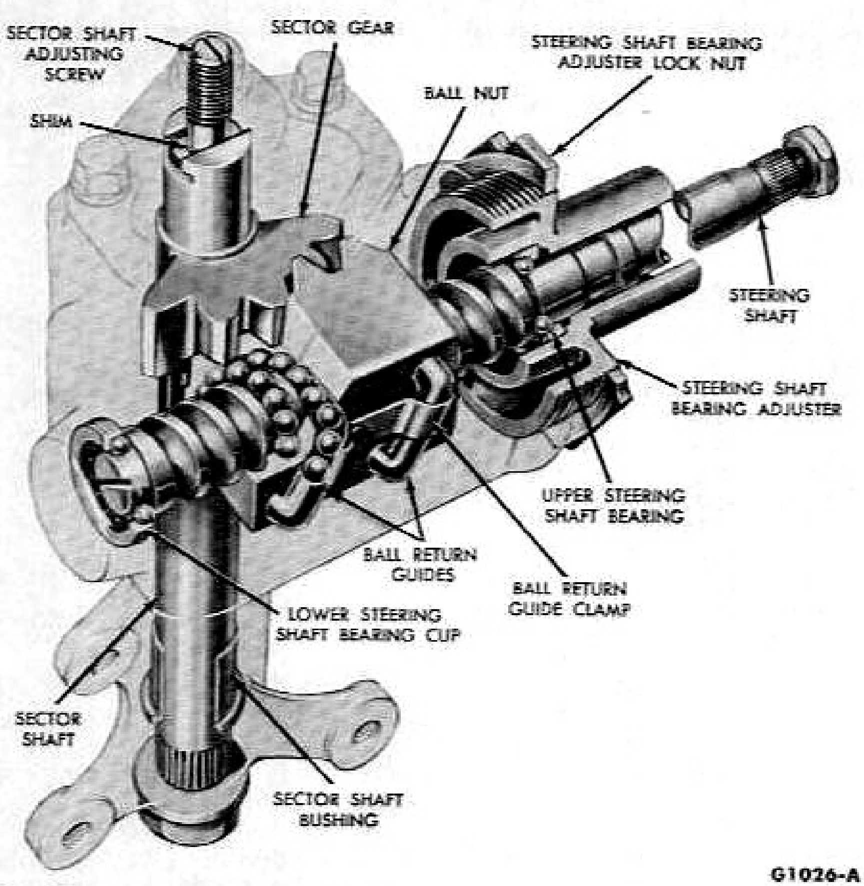

FIG. 1—Recirculating Ball Type Steering Gear

turn the adjusting screw counter-clockwise.

7. Measure the worm bearing preload by attaching a socket and torque wrench to the steering wheel retaining nut (Fig. 3). Read the pull required to keep the wheel moving for at least one complete turn. If the torque, or preload, is not within 3-6 inch-pounds, adjust as explained in the next step.

8. Loosen the steering shaft bearing adjuster locknut, and tighten or back off the bearing adjuster (Fig. 1) to bring the preload within the specified limits.

9. Tighten the steering shaft bearing adjuster locknut, and recheck the preload.

10. Turn the steering wheel slowly to either stop. **Turn gently against the stop to avoid possible damage to the ball return guides.** Then rotate the wheel 2¾ turns to center the ball nut.

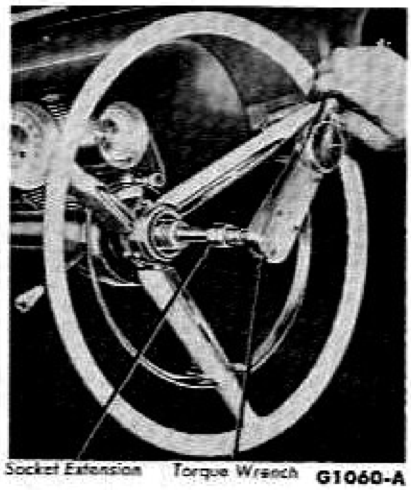

FIG. 3—Steering Gear Load Check

11. Turn the sector adjusting screw clockwise until a torque of 8-13 inch-pounds is necessary to rotate the worm past its center. **No perceptible backlash is permissible at 30° on either side of center.**

12. Tighten the sector adjusting screw locknut, and recheck the backlash adjustment.

13. Torque the steering column bracket screws to specification. Connect the sector shaft arm to the steering arm-to-idler arm rod. On a car with power steering, connect the arm to the control valve ball stud.

STEERING WHEEL SPOKE POSITION ADJUSTMENT

When the steering gear is on the high point, the front wheels should be in the straight-ahead position and the steering wheel spokes should be in their normal position with the sector shaft arm pointing directly forward. If the spokes are not in their normal position, they can be adjusted without disturbing the toe-in adjustment (Part 8-1).

BALL SOCKET PLUG ADJUSTMENT

The ball seats in the steering arm to idler arm rod ball socket are spring-loaded to compensate automatically for wear. Adjust the socket plug (Fig. 12) whenever the sector shaft arm (Pitman arm) ball stud has end play in the socket.

1. Remove the cotter pin from the end of the steering arm to idler arm rod.

2. Tighten the threaded plug in the end of the socket until all ball stud end play is removed, and then loosen the plug about 1½ turns.

3. Install a new cotter pin through the end of the steering arm to idler arm rod.

4. Check the adjustment by moving the steering arm to idler arm rod by hand. The rod should move freely without bind, but with no end play at the ball stud.

3 STEERING GEAR REPAIR

STEERING WHEEL REPLACEMENT

1. Remove the steering wheel hub.
2. Remove the nut from the end of the steering shaft, and remove the steering wheel from the shaft with the tool shown in Fig. 4.
3. With the front wheels straight forward, position the steering wheel on the steering shaft with the spokes properly centered and the splines on both parts properly aligned.

4. Install the steering wheel nut on the shaft, torque to specification, and stake the nut.

5. Install the steering wheel hub.

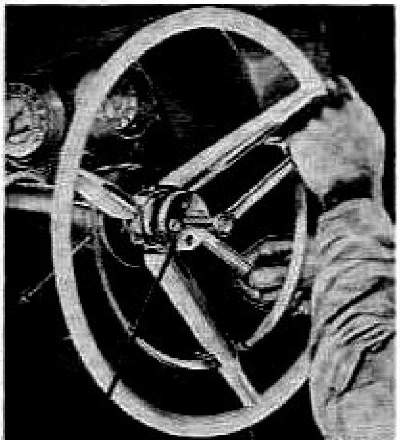

FIG. 4—Steering Wheel Removal

STEERING GEAR REMOVAL

1. Remove the steering wheel, using the tool shown in Fig. 4.

2. Disconnect the parking brake handle bracket, and remove the cowl side trim panel and the left vent control handle.

3. Disconnect the hood lock release cable bracket.

4. On a car with Cruise-O-Matic, remove the starter-neutral switch housing screws and move the switch to one side. Disconnect the horn wire.

5. Disconnect the wiring assembly from the steering column.

6. Remove the instrument panel lower panel retaining screws, and move the lower panel to one side.

7. Pull aside the steering column cover plate insulation, and disconnect the parking brake bracket from the steering column cover plate.

8. Remove the steering column cover plate and the parking brake handle.

9. Remove the steering column retaining bracket from the instrument panel. On a car with Conventional Drive or Overdrive, disconnect the clutch linkage as necessary to provide clearance for steering gear removal through the inside of the car.

10. Disconnect the gear shift lever(s) near the steering column.

11. Raise the front of the car to provide working room **(See Part 8-4 for hoisting and jacking instructions)**, and remove the sector shaft arm, using the tool shown in Fig. 5.

12. Remove the steering gear attaching bolts from the underbody, and remove the steering gear through the inside of the car.

STEERING GEAR DISASSEMBLY

1. Rotate the steering shaft 2¾ turns from either stop.

2. After removing the sector adjusting screw locknut and the housing cover bolts, remove the sector shaft with the cover. Remove the cover from the shaft by turning the screw clockwise. **Keep the shim with the screw.**

3. Loosen the adjuster nut, and remove the adjuster assembly and the upper steering shaft bearing.

4. Carefully pull the steering shaft and ball nut from the housing, and remove the lower steering shaft bearing. **To avoid possible damage to the ball return guides, keep the ball nut from running down to either end of the worm.**

Disassemble the ball nut only if there is binding or tightness.

5. Remove the ball return guide clamp and the guides from the ball nut. **Keep the ball nut clamp-side up until ready to remove the balls.**

6. Turn the ball nut over, and rotate the worm shaft from side to side until all 54 balls have dropped out of the nut into a clean pan. With the balls removed, the ball nut will slide off the worm.

Remove bearing cups, seals, or bushings only if preliminary inspection shows damage.

7. Place the bearing adjuster in a vise, and remove the upper bearing cup (Fig. 6). **Remove the lower bearing cup using the same tool.**

8. Press out both sector shaft bushings from the housing (Fig. 7).

STEERING GEAR CLEANING AND INSPECTION

Wash all parts in a cleaning sol-

FIG. 5—Sector Shaft Arm Removal

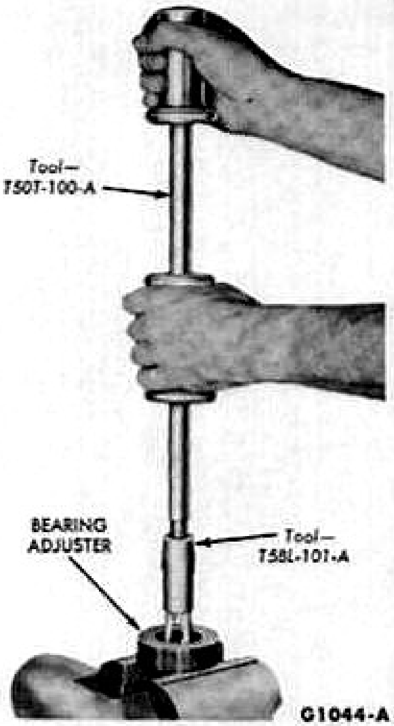

FIG. 6—Steering Shaft Upper Bearing Cup Removal

vent, and dry with a lint-free cloth. **The bearings should not be spun dry with compressed air.** Inspect the shaft and worm for scoring, cracks, or checks, and for straightness of the shaft. Check the splines and the

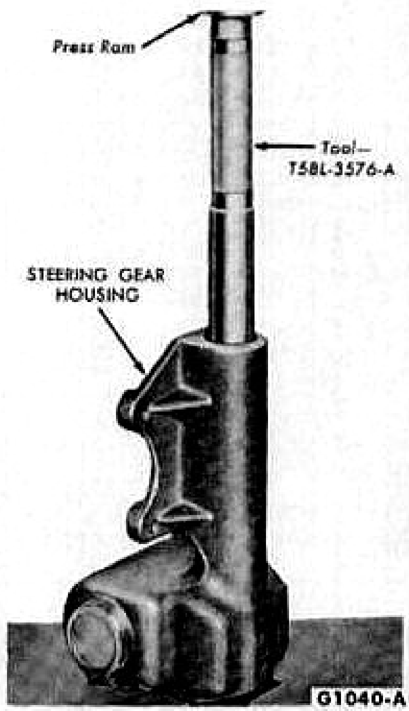

FIG. 7—Sector Shaft Bushing Removal

threads on the sector shaft for wear and burrs. Inspect the gear teeth for scoring, pitting, and other wear. Inspect the bearings for free movement, and the cups for wear or irregular surfaces. Check the housing for cracks and the bushings for scoring, pitting, or other wear.

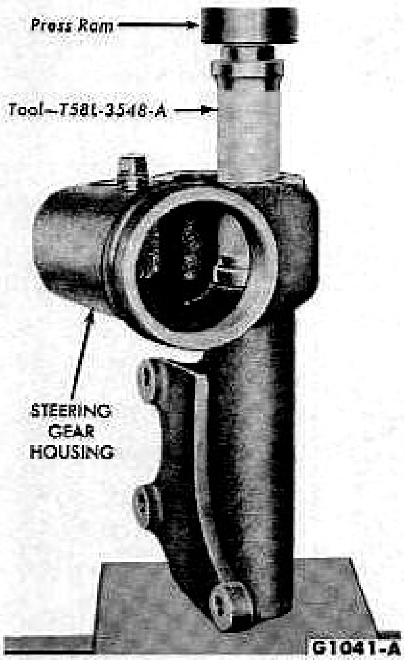

FIG. 8—Sector Shaft Bushing Installation

STEERING GEAR ASSEMBLY

1. If the sector shaft bushings have been removed, press new bushings into the housing (Fig. 8).

2. If the steering shaft upper and/or lower bearing cups were removed, press the new bearing cups into the housing (Figs. 9 and 10).

3. If the oil seal in the bearing adjuster was removed, install a new oil seal.

4. Lay the steering shaft on a bench, and position the ball nut on the shaft, with the guide holes up and the shallow end of the teeth to the left of the steering wheel position. Align the grooves in the worm and in the ball nut by sighting through the ball guide holes.

5. Count 27 balls, and drop as many of them as possible into one of the guide holes, slowly turning the worm away from the hole, until that circuit is full or until rotation is stopped by the end of the worm. If the balls are stopped by the end of the worm, hold in those already positioned, and turn the worm in the opposite direction. The filling of the circuit can then be continued until most of the balls are in place.

6. Lay one half of the ball return guide on the bench, and place the remainder of the 27 balls in it. Position the second half of the guide and, holding the 2 halves together, plug each open end with multi-purpose lubricant so the balls will stay in the guide when it is installed.

7. Push the guide into the guide holes of the ball nut, tapping lightly with the wooden handle of a screwdriver if necessary.

8. Assemble the second ball return circuit in the same way as the first.

9. Install the ball return guide clamp, and check the ball nut to see that it rotates freely.

10. Coat the threads of the steering shaft bearing adjuster, the housing cover bolts, and the sector adjusting screw with a suitable oil-resistant sealing compound. **Do not apply sealer to female threads, and especially avoid getting any sealer on the steering shaft bearings.**

11. Coat the bearings, bushings, and gear teeth with light engine oil.

12. Clamp the housing in a vise, with the sector shaft axis horizontal, and position the steering shaft lower bearing in its cup.

13. Position the steering shaft and ball nut assemblies in the housing.

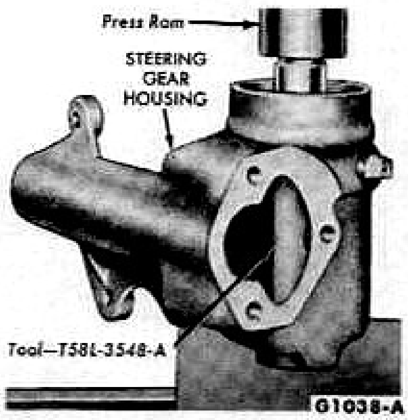

FIG. 9—Steering Shaft Lower Bearing Cup Installation

14. Position the upper steering shaft bearing on the top of the worm, and install the steering shaft bearing adjuster and the adjuster nut.

15. Position the sector adjusting screw and adjuster shim, and check the end clearance which should not exceed 0.002 inch between the screw head and the end of the sector shaft. If clearance is greater than 0.002 inch, replace the shim.

16. Start the sector shaft pilot into the housing cover, and then, using a screwdriver through the hole in the cover, turn the adjusting screw counterclockwise to pull the pilot into the cover.

17. Install a new gasket on the housing cover.

18. Rotate the steering shaft until the ball nut teeth are in position to mesh with the sector gear, tilting the housing so that the ball nut will tip toward the housing cover opening.

19. Push the housing cover and sector shaft assemblies into place, and install the 2 top housing cover bolts. The third bolt should be installed when lubricant is put into the gear housing. **Do not tighten the cover bolts until it is certain that there is some lash between the ball nut and the sector gear teeth.** Torque the bolts to specification.

STEERING GEAR INSTALLATION

1. Position the steering gear on the underbody by working the assembly through from the inside of the car. Partially install the steering gear housing bolts.

2. Partially install the 2 screws that fasten the steering column to instrument panel bracket to the instrument panel.

3. Install the sector shaft (Pitman) arm. Torque the retaining nut to 110-150 foot-pounds. The arm should be installed pointing straight forward

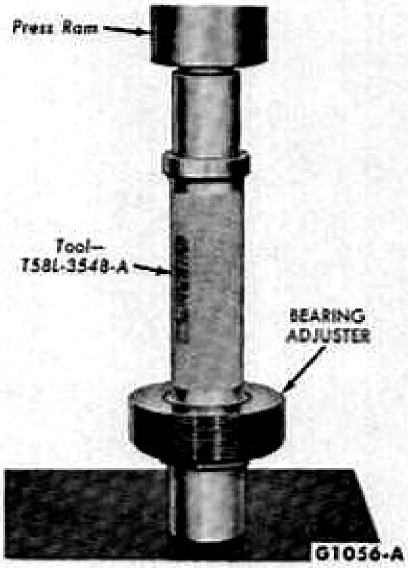

FIG. 10—Steering Shaft Upper Bearing Cup Installation

when the ball nut is at the mid-point of travel.

4. On a car with Conventional Drive or Overdrive, connect the clutch linkage.

5. Connect the gear shift lever(s).

6. Torque the steering gear housing attaching bolts to specification.

7. Install the parking brake handle and the steering column cover plate. Install the parking brake bracket on the cover plate, and position the cover plate insulation.

8. Install the instrument panel lower panel.

9. Connect the wiring assembly to the steering column, and install the starter-neutral switch.

10. Connect the hood lock release cable bracket.

11. Install the cowl side trim panel and the left vent control handle. Connect the parking brake handle bracket.

12. Torque the steering column bracket screws to specification.

13. Lower the car, and install the steering wheel. Check the operation of the horn and the turn indicator lights. On a car with Cruise-O-Matic, check the manual linkage adjustment (see Part 6-2) and the starter-neutral switch operation.

14. Turn the front wheels to the left, and fill the steering gear housing with lubricant until the lubricant comes out the lowest bolt hole in the cover. Install the bolt, and adjust the steering gear (Section 2).

4 STEERING LINKAGE REPAIR

The manual steering linkage (Fig. 11) consists of the sector shaft arm (Pitman arm), the steering arm to idler arm rod, the steering idler arm, the spindle connecting rods (tie rods), and one-piece spindles which include the spindle arms.

SPINDLE CONNECTING ROD END REPLACEMENT

The spindle connecting rod ends, which are threaded into the outer ends of the rod sleeves, have non-adjustable, spring-loaded ball studs. A rod end should be replaced when excessive looseness at the ball stud is noticed.

1. Remove the cotter pin and nut from the rod end ball stud (Fig. 13).

2. Place a support under the spindle arm near the stud, and then tap the stud with a soft metal hammer to drive it out of the spindle arm.

3. Loosen the connecting rod sleeve clamp bolts, and remove the rod end from the sleeve. Discard all rod end parts that were removed from the sleeve. **All new parts should be used when a spindle connecting rod end is replaced.**

4. Thread a new rod end into the sleeve, but do not tighten the sleeve clamp bolts at this time.

5. Install the seal on the rod end ball stud, insert the stud in the spindle arm hole, and install the stud nut. Torque the nut to specification and install the cotter pin.

6. Lubricate the rod end ball stud and, if necessary, the rest of the steering linkage.

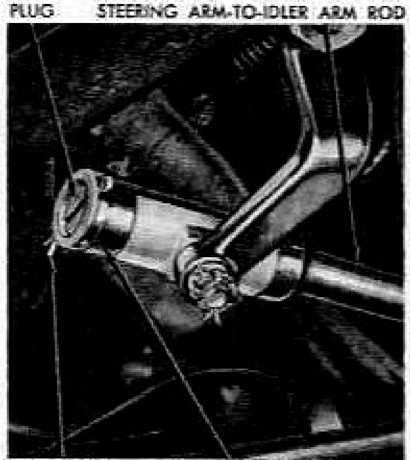

FIG. 12—Steering Arm to Idler Arm Rod Ball Socket

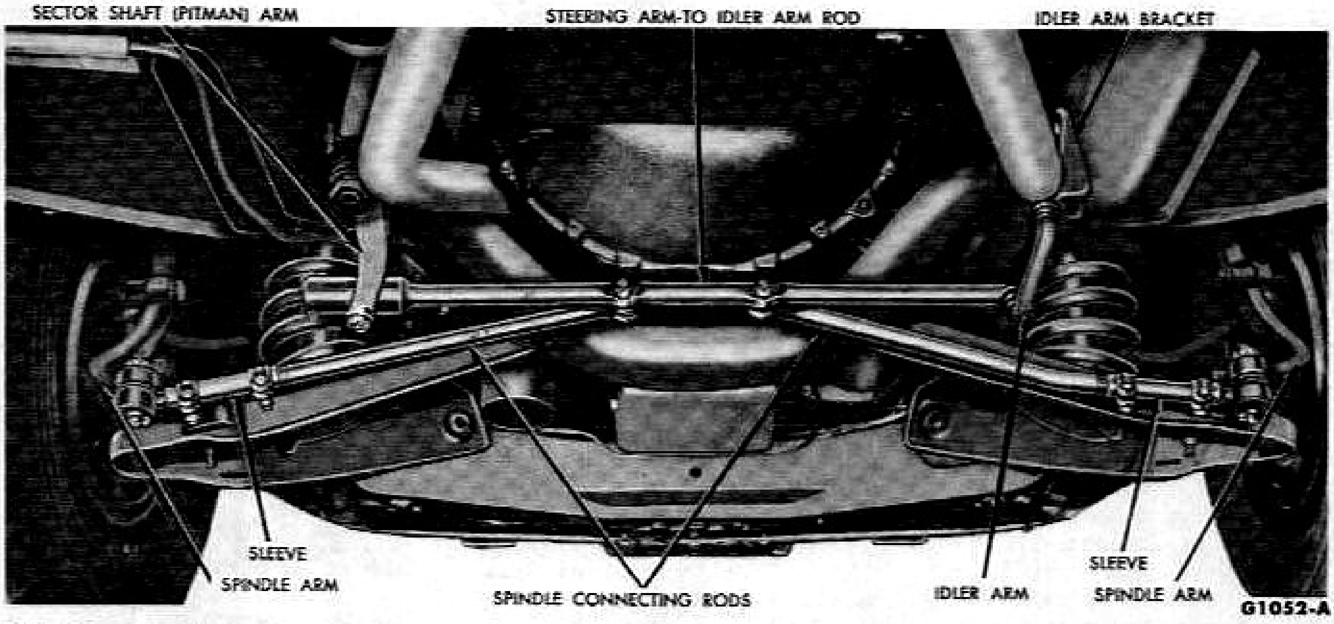

FIG. 11—Manual Steering Linkage

7. Check and, if necessary, adjust toe-in. **Be sure to tighten the sleeve clamp bolts after toe-in is checked and adjusted.**

SECTOR SHAFT ARM BALL STUD AND SEAT REPLACEMENT

If the sector shaft arm ball stud or seats in the steering arm to idler arm rod ball socket are worn so that an adjustment will not eliminate ball stud end play, replace the ball stud and seats.

1. Disconnect the sector shaft arm ball stud from the arm.

2. Remove the cotter pin and threaded plug from the socket on the steering arm to idler arm rod, and remove the ball stud parts from the socket.

3. Install new ball stud parts in the socket in the order shown in Fig. 13. **When using a ball stud repair kit to replace worn or damaged parts, install all parts supplied in the kit.**

4. Install the plug in the end of the socket, and connect the ball stud to the sector shaft arm. Torque the ball stud to specification.

5. Adjust the socket plug to provide proper movement of the steering arm to idler arm rod, and install a new cotter pin through the end of the rod.

6. Lubricate the ball stud parts in the socket and, if necessary, the rest of the steering linkage.

SPINDLE CONNECTING ROD REPLACEMENT

A spindle connecting rod should be replaced if it becomes worn or damaged. **Do not attempt to straighten a bent rod.**

1. Remove the cotter pin and nut which attach the spindle connecting rod ball stud to the steering arm to idler arm rod (Fig. 14). Tap the ball stud out of the rod. **Be careful not to loosen or bend any parts on the steering arm to idler arm rod.**

2. Loosen the connecting rod sleeve clamp bolts, and remove the rod from the sleeve.

3. Thread a new connecting rod into the sleeve, but do not tighten the sleeve clamp bolts at this time.

4. Install the connecting rod ball stud in the steering arm to idler arm rod, and install the nut on the ball stud. Torque the nut to specification. Install a new cotter pin.

5. Lubricate the connecting rod ball stud and, if necessary, the rest of the steering linkage.

6. Check and, if necessary, adjust toe-in. **Be sure to tighten the sleeve clamp bolts after toe-in is checked and adjusted.**

FIG. 14—Steering Idler Arm

STEERING ARM TO IDLER ARM ROD REPLACEMENT

The steering arm to idler arm rod should be replaced if it becomes worn or damaged. **Do not attempt to straighten a bent rod.**

1. Remove the cotter pin and threaded plug from the socket on the steering arm to idler arm rod, and pull the socket end of the rod off the sector shaft arm ball stud.

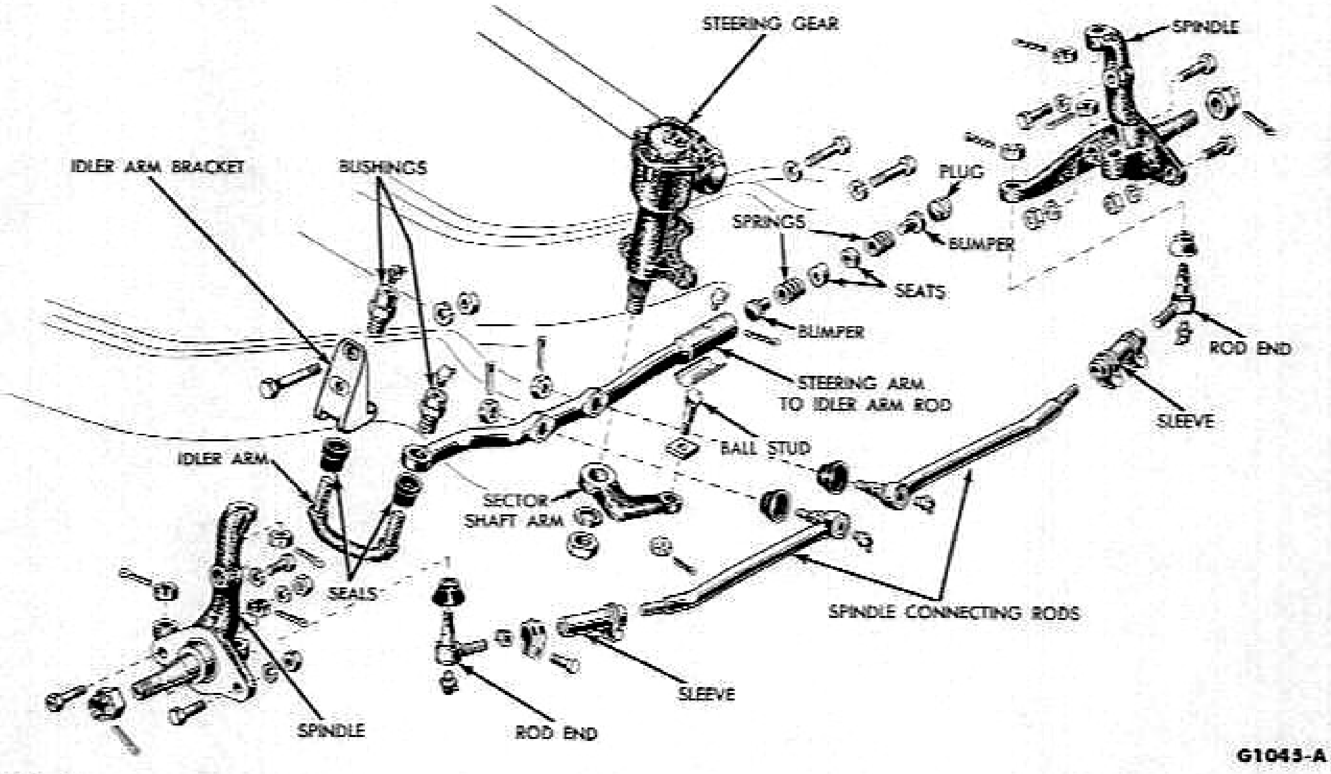

FIG. 13—Steering Linkage

2. Remove the cotter pins and nuts which attach both spindle connecting rod ball studs to the steering arm to idler arm rod (Fig. 13) and tap the ball studs out of the rod.

3. Remove the idler arm bushing that fastens the rod to the idler arm, and remove the rod from the arm.

4. Install the new steering arm to idler arm rod on the idler arm, and install the idler arm bushing. Torque the bushing to specification.

5. Install the spindle connecting rod ball studs in the steering arm to idler arm rod, and install the nuts on the ball studs. Torque the nuts to specification. Install new cotter pins.

6. Position the ball stud and the ball stud parts in the steering arm to idler arm rod socket (Fig. 13).

7. Adjust the socket plug (Section 2), and install a new cotter pin.

8. Lubricate the idler arm bushing, the ball stud parts in the socket and, if necessary, the rest of the steering linkage.

9. Check and, if necessary, adjust toe-in.

STEERING IDLER ARM AND BUSHING REPLACEMENT

Replace the steering idler arm if the threads are worn or if the arm is damaged. Replace the idler arm bushings if either the internal or external threads show excessive wear or damage. **A check for excessive movement (or sloppiness) must be made with the weight of the car on all four wheels.** The idler arm and linkage may seem loose if the car is on a frame hoist.

1. Remove the idler arm bracket (Fig. 14) from the underbody, and then remove the bracket and rear bushing from the idler arm.

2. Unthread the idler arm from the bushing in the steering arm to idler arm rod, and then remove the seals.

3. Remove the bushings from the idler arm bracket and the steering arm to idler arm rod.

4. Check the condition of the bracket, and replace it if it is cracked or bent. **Do not attempt to straighten the idler arm bracket.**

5. Install new bushings in the steering arm to idler arm rod and bracket, and torque the bushings to specification. **When using an idler arm and bushing kit to replace worn or damaged parts, install all of the parts supplied in the kit.**

6. Install new seals on both ends of the idler arm. Thread the arm into the bushing in the steering arm to idler arm rod until the arm bottoms. Then back off the arm about three-quarters of a turn.

7. Thread the idler arm bracket and bushing onto the arm until the bushing bottoms. Back off the bushing until the bracket mounting surface is parallel with the underbody surface.

8. Install the bracket on the underbody, and torque the mounting bolts to specification. Lubricate the bushings.

PART 9-2 POWER STEERING

Master-Guide Power Steering (Fig. 1) is a hydraulically controlled linkage-type steering system which includes a fluid reservoir and pump, a control valve, a power cylinder, the connecting fluid lines, and the steering linkage.

The roll-type hydraulic pump, belt-driven from the engine crankshaft, draws Ford Automatic Transmission Fluid B8A-19582-A from the reservoir and provides fluid pressure for the system. Within the pump itself is a flow-control and pressure-relief valve which governs the pressures within the steering system according to the varying conditions of operation. After fluid has passed from the pump to the control valve and the power cylinder, it returns to the reservoir.

The control valve, operated by steering wheel movement, directs the pressure developed by the pump. When the front wheels are in the straight-ahead position, the control valve spool is held in the center (neutral) position by its centering spring. Fluid then flows around the valve lands and returns to the reservoir (Fig. 2).

When pressure of about 4 pounds is exerted for a left turn, the valve spool overcomes the pressure of the centering spring and moves toward the right-hand end of the valve. As a result, pressure is exerted on the right-hand side of the power cylinder piston, and fluid in the left-hand end of the cylinder returns to the reservoir (Fig. 2).

When the direction of the pressure on the steering wheel is reversed, the front wheels will return to the straight ahead position. Or as pressure on the steering wheel falls below about 4 pounds, the valve spool centering spring forces the spool back to the center position and there the pressure on both sides of the power cylinder piston is equal. With normal forward driving movement of the car and in the absence of operative pressure within the power cylinder, the front wheels will seek to return to the straight-ahead position. This is a normal effect of the front wheel alignment and action of the torsion type bushings in the idler arm. For a right turn, the directional forces explained above are reversed (Fig. 2).

If, for any reason, the pump fails to deliver fluid pressure, the car may be steered without pump pressure.

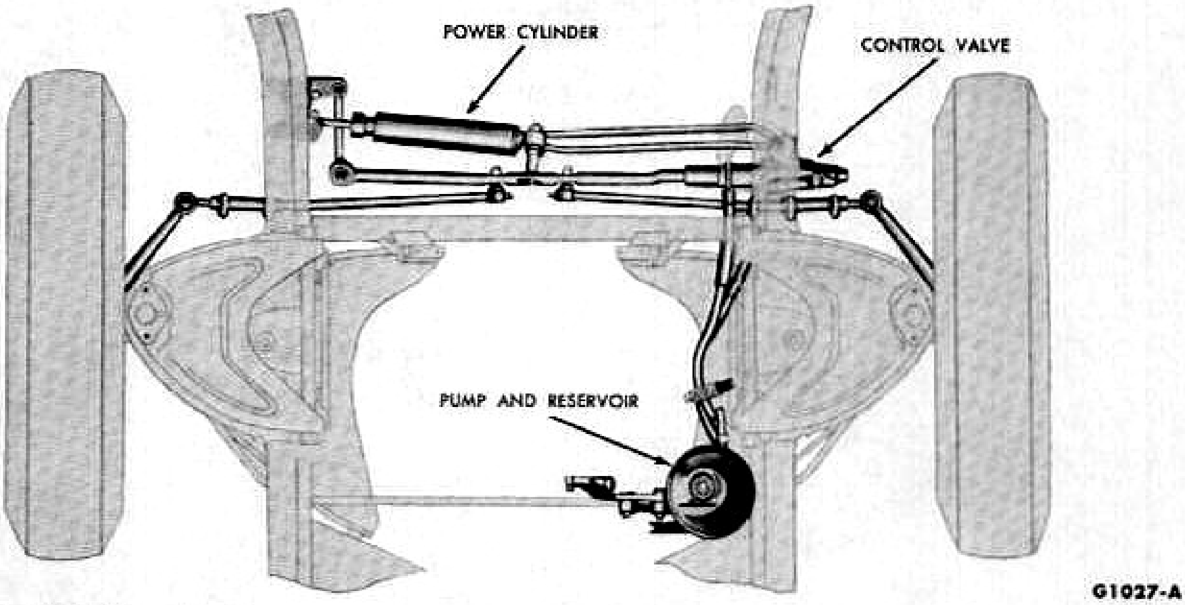

FIG. 1—Master Guide Power Steering

1 TROUBLE SHOOTING

PRELIMINARY CHECKS

The following preliminary checks should always be made before performing any trouble-shooting operations.

CHECK PUMP BELT

If the pump belt is broken, glazed, or worn, replace it with a new belt.

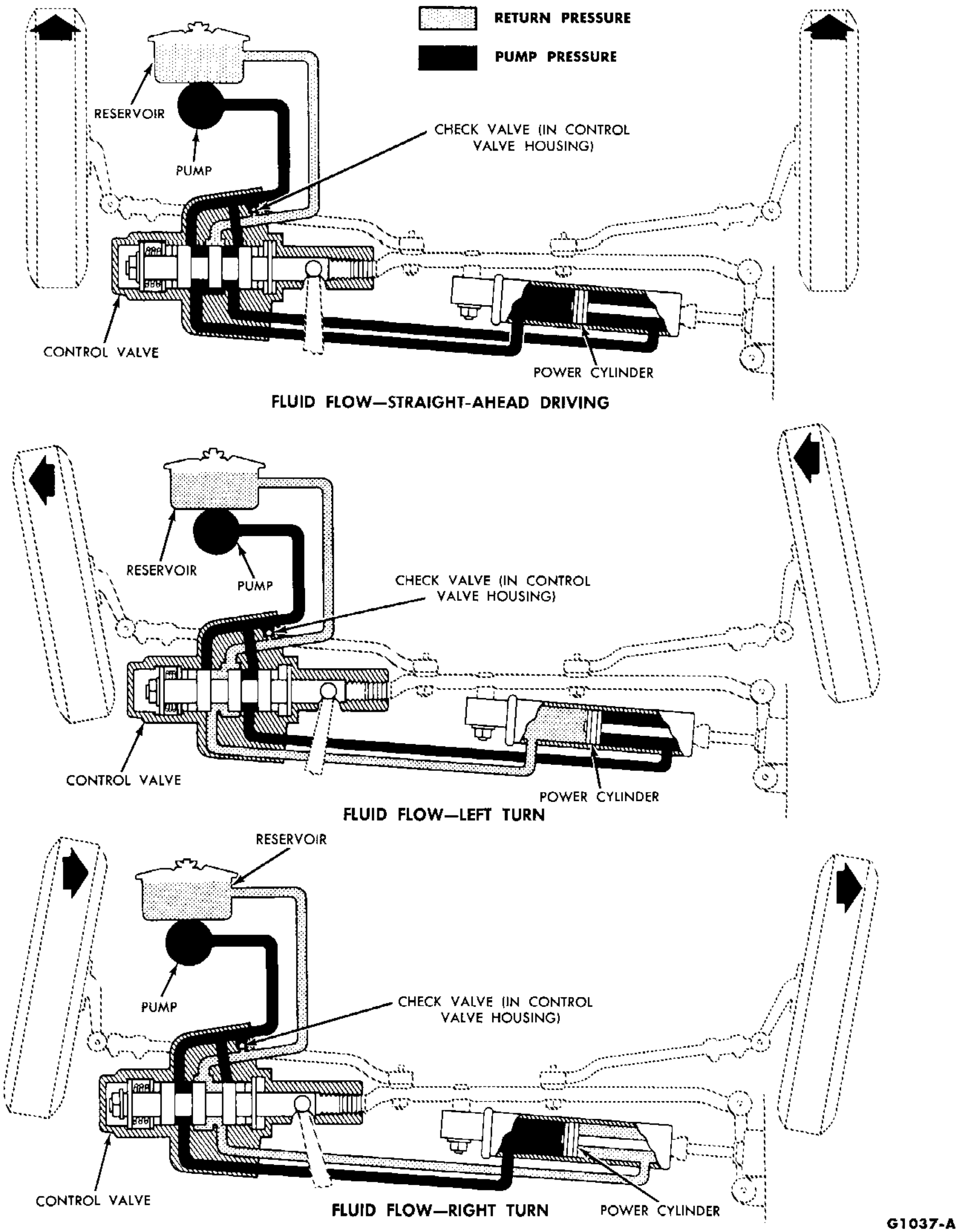

FIG. 2—Fluid Flow Diagrams

Use only the specified type of belt.

Check the belt tension. If the belt is too loose, or too tight, it should be adjusted to the proper tension. The following procedures are for necessary adjustment.

1. Loosen the bracket adjusting bolt and the pivot bolt enough to permit moving the pump (Fig. 3).

2. Adjust the bracket until the pulley slips against the belt friction at 25 foot-pounds torque.

3. Torque the pivot bolt and the bracket adjusting bolt each to specification.

4. When both bolts have been accurately tightened, make a final check of the pump belt tension.

CHECK FLUID LEVEL

Start the engine, turn the steering wheel all the way to the left and right several times, and shut off the engine.

Check the fluid level in the reservoir. If the level is low, add enough Ford Automatic Transmission Fluid B8A-19582-A to raise the level to a point ¼ inch from the top, or to the F mark on the dip stick. **Do not overfill the reservoir.**

CHECK FOR FLUID LEAKS

With the engine running, check all parts of the power steering system where fluid could leak out. Tighten all loose fittings, and replace any damaged or worn hoses.

CHECK TURNING EFFORT

With the front wheels properly aligned and tire pressures correct, check the effort required to turn the steering wheel.

1. With the car on dry concrete, set the parking brakes.

2. With the engine warmed up and running at idle speed, turn the steering wheel to the left and right several times to warm the fluid.

3. Attach a spring scale at a 90° angle to a spoke of the steering wheel (Fig. 4). Measure the pull required to turn the wheel at least one complete revolution in both directions. The steering effort should not exceed 12 pounds rim pull, and should be approximately equal in both directions.

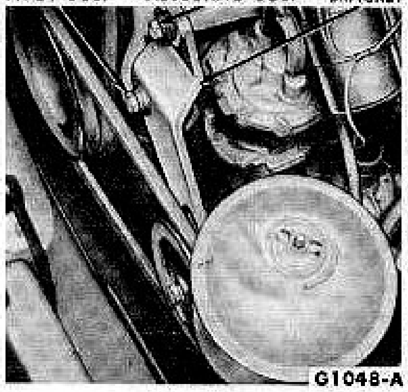

FIG. 3—Typical Power Steering Pump Bracket

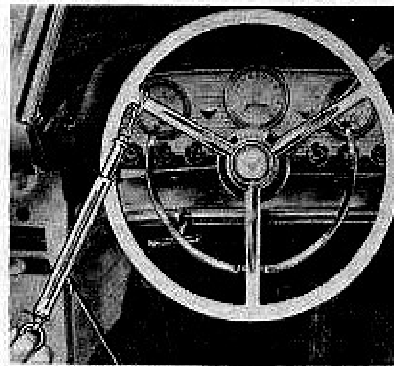

FIG. 4—Turning Effort Check

TROUBLE CHECKS

BINDING OR POOR RECOVERY	If the steering wheel binds or sticks when turned, or if poor recovery to the straight-ahead position occurs, check the sector shaft arm (Pitman arm) ball stud in the control valve sleeve. If the ball stud is rubbing against the edge of the sleeve slot, the roll pin may be missing and should be replaced. If any of the idler arm bushings are worn or damaged, replace all the bushings. Check the steering gear adjustments (Part 9-1). The worm bearing pre-load should be 3-6 inch-pounds. The worm and ball nut mesh adjustment should be 8-13 inch-pounds. Check the operation of the control valve spool in the valve housing. If the spool is binding in the housing, check the spool adjustment. If the adjustment is correct, overhaul or replace the control valve. Check for interference between the sector shaft arm and the dust shield at the ball stud, and, if necessary, replace the dust shield and/or the ball stud. Check the control valve travel regulator stop adjustment. If the stop is drawn up too tightly, the ball stud will bind in the seats. Adjust the stop as required. Check the control valve sleeve and the socket tube for damage. Replace parts that show signs of damage, and adjust the travel regulator stop.
HARD STEERING	If the effort required to turn the steering wheel is greater than normal for the entire travel of the front wheels, test the fluid pressure. Be sure that there are no leaks, that the reservoir is properly filled, and that the belt is properly adjusted. If the pump output pressure is low, the pump may be defective and should be overhauled or replaced. If the pressure test shows that the trouble is in the control valve or power cylinder, remove and inspect these units. Repair or replace any damaged parts. If the pressure test indicates that the pressures throughout the system are within specifications, check the following items in the order given: Check the control valve spool centering spring adjustment. Adjust if required (page 9-17). Check the control valve spool for movement. If the spool does not move freely, check for, and eliminate, interference between the socket tube

CONTINUED ON NEXT PAGE

TROUBLE CHECKS (Continued)

HARD STEERING (Continued)	and the valve sleeve. If the spool is sticking in the housing, remove the spool and check the spool lands for burrs. Small burrs may be removed with crocus cloth if the edges of the valve lands are not rounded in the process. If the spool cannot be repaired, replace the control valve. Check the control valve ball stud for free movement in the ball stud seats. If the stud is binding in the seats, adjust the travel regulator stop.
EXCESSIVE FREE PLAY	If excessive free play or lost motion is noticed when steering, check the steering gear worm and ball nut mesh adjustment. Check for excessive clearance between the steering arm ball stud and the ball stud seats. If the ball stud is loose in the seats, adjust the control valve travel regulator stop. Check the control valve centering spring adjustment. If the spring adjusting nut is loose, tighten the nut until it is snug, and then back off the nut not more than ¼ turn. **Excessive tightening may damage the stop pin.**
NOISE	Check the pump belt tension. A loose or glazed belt can cause belt squeal. A glazed belt, even when properly adjusted, may slip. Noise may result if the specified hose is not used or if it is improperly routed. If noise still exists with the specified hose installed, the pump should be removed from the car and inspected.
STEERING CHATTER	A loose pump belt can cause chatter against the wheel stops during an extremely sharp turn. Check the belt tension, and adjust it to specifications if necessary. Check for looseness in the idler arm rod connection. Looseness at this point may be due to worn mounting bushings or improper mounting nut torque. Replace the bushings if worn. Torque the nut to specification. Check the idler arm bushings for wear or damage, and replace them if necessary. Check the power cylinder piston rod insulators for looseness. If the insulators are worn, replace them. If the mounting nut is loose, torque it and the locknut to specifications.
RATTLES	Check the control valve spool centering spring adjustment. If the adjustment is loose, tighten the nut until snug, and then back off the nut not more than ¼ turn. **Excessive tightening may damage the stop pin.** Check for looseness between the control valve ball stud and the ball stud seats. If the stud is loose in the seats, adjust the travel regulator stop. Check for interference between the spindle connecting rod and the lubrication fitting in the control valve.
LOSS OF POWER ASSIST	Check the entire system for damage, replacing parts as necessary. Replace or tighten a broken or loose pump belt. Test the fluid pressure to determine whether the trouble is in the pump, the control valve, or the power cylinder. If the pressure test indicates that the pump is at fault, remove and overhaul the pump. If the pressure test indicates that the control valve or power cylinder is at fault, check as follows: Disconnect the power cylinder piston rod from the idler arm bracket. Operate the piston by hand to check for resistance to movement. If the piston moves easily with little or no resistance, the internal parts of the power cylinder are broken or damaged. Replace the power cylinder. Maladjustment of the control valve spool centering spring can cause a loss of either right or left power assist. Check the adjustment, and readjust if necessary. Replace all defective parts. Check the operation of the control valve check valve. If the check valve does not operate freely, replace the check valve assembly.

FLUID PRESSURE TEST

A fluid pressure test will show whether the pump or some other unit in the power steering system is causing trouble in the system.

1. Disconnect the pressure line hose from the pump outlet, and install the pressure testing tool between the hose and the pump outlet (Fig. 5). **Be sure that the pressure gauge is between the pump and the shut-off valve on the tool.**

2. Open the shut-off valve on the testing tool, and run the engine at idle speed. **If the pump normally operates quietly, ignore the louder pump noise when the pressure testing tool is connected to the system.** Allow at least 2 minutes for the fluid to warm up before starting the pressure tests.

3. Turn the front wheels all the way to the right and then to the left, noting the fluid pressure reading on the gauge when each wheel is against its stop. Normal fluid pressure at both positions is 700-850 psi. **Do not hold a wheel against its stop for more than 30 seconds at a time because the fluid may overheat.**

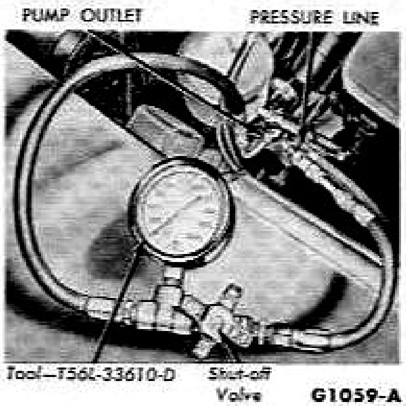

FIG. 5—Pressure Testing Tool Installation

4. If the fluid pressure, with a wheel against its stop, is less than 700 psi, turn the wheel off the stop. Slowly close the testing tool shut-off valve, and watch the gauge for an increase in pressure. **Do not leave the valve closed for more than 15 seconds.**

5. If the fluid pressure, with the shut-off valve fully closed, still shows less than 700 psi, the pump is causing the trouble. If the pressure increases to 700-850 psi, the trouble is in either the control valve or power cylinder.

6. After the fluid pressure test is complete, shut off the engine and remove the pressure testing tool. Make the necessary repairs or replacements to eliminate the trouble in the system.

2 PUMP AND FLUID RESERVOIR REPAIR

PUMP AND FLUID RESERVOIR REMOVAL

1. With a suction gun, remove as much fluid as possible from the reservoir.

2. Disconnect the 2 hoses at the pump, and fasten them in a raised position to prevent fluid from draining out.

3. Loosen and remove the pump belt.

4. Remove the pivot bolt and the adjusting bolt, and lift out the pump, reservoir, and bracket.

PUMP DISASSEMBLY

Handle all parts very carefully to avoid nicks, burrs, scratches, and dirt which could make the parts unfit for use.

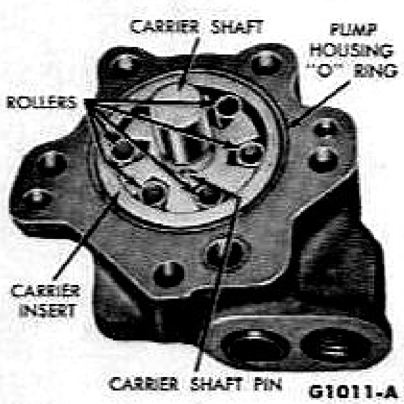

FIG. 7—Pump Housing, Carrier and Shaft

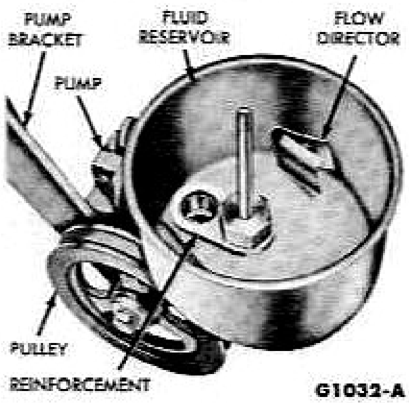

FIG. 6—Fluid Reservoir

1. Drain as much of the remaining fluid as possible from the pump and reservoir, and clamp the pump adjusting bracket in a vise.

2. Remove the retaining bolt or wing nut and stud, washer and the reservoir cover. Remove the reservoir retaining nut and reinforcement from inside the reservoir and lift the reservoir off the pump (Fig. 6).

3. Remove the 2 orifice O-rings from the top of the pump.

4. Remove the pulley and the pulley key from the carrier shaft.

5. Remove all the bolts from the pump, and separate the bracket, pump housing, and housing cover. If the parts do not pull apart easily, tap them gently with a soft hammer to loosen them. **Lift the cover vertically from the housing to prevent internal parts from falling out.**

6. Remove the O-rings from the flow director and the carrier insert (Fig. 7).

7. Using a feeler gauge and a straight-edge, check the end clearance of the carrier and the rollers in the pump housing (Fig. 8). If the clearance exceeds 0.0015 inch, replace the worn parts. **A damaged roller, carrier, or insert should not be replaced by itself; these parts are serviced in a kit, and all parts of the kit should be used.**

8. Remove the 6 rollers, and then pull out the carrier and shaft very

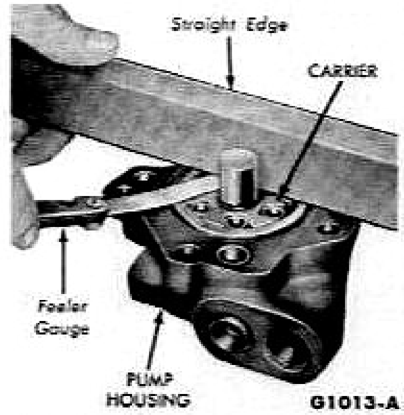

FIG. 8—Checking End Clearance of Carrier and Rollers

carefully to avoid damage to these parts or the oil seal. **Remove the carrier insert only for replacement.**

9. Remove the carrier retaining ring from the shaft, slide the carrier off the shaft, and remove the carrier shaft pin (Fig. 7). **Avoid scratching the shaft while removing the ring.**

10. Remove the relief valve retainer (Fig. 9) from the housing cover, and remove the O-ring from the retainer.

11. Remove the valve spring from the bore in the housing cover, and slide the valve out of the bore. If the valve does not slide out easily, tap the cover with a soft hammer. **Do not scratch or nick the valve when removing it from the cover.**

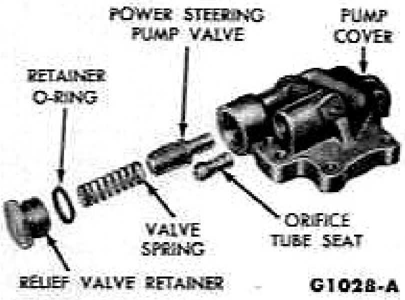

FIG. 9—Pump Cover

PUMP CLEANING AND INSPECTION

Wash all pump and reservoir parts in a cleaning solvent, and wipe them dry with a lint-free cloth.

Inspect the pump housing and cover for wear caused by turning of the rollers and the carrier. Check the carrier shaft bushings in the housing and the cover for wear or scores. If the bushings show wear or damage, replace the housing and/or the cover.

Inspect the carrier, shaft, and rollers for wear or any kind of damage. If there is wear or damage, replace the appropriate part(s). **A damaged roller, carrier, or insert should not be serviced alone; these parts are serviced in a kit, and all parts of the kit should be used.** If the retaining ring on the carrier shaft is bent or broken, replace it.

Be sure the valve assembly and its bore are dry. Insert the valve in the housing, and check for free movement of the valve in the bore. Using crocus cloth, remove any burrs from the valve.

Inspect the carrier shaft seal in the pump housing for wear or damage. If there is wear or damage, carefully remove the seal with a punch, avoiding damage to the shaft bushing. **Do not remove the seal except for replacement.**

Inspect the aluminum seat in the pressure hose port in the housing cover for damage, wear, or leakage.

ORIFICE TUBE SEAT REPLACEMENT

If damage, wear, or leakage makes replacement of this seat (Fig. 9) necessary, use the following procedure.

1. Tap the existing hole in the seat, using a starting tap of suitable size. **Be sure to remove all metal chips from the seat port after tapping.**

2. Place a nut and large flat washer on a bolt of the same size as the tapped hole. The washer must be large enough to cover the seat port.

3. Insert the bolt in the tapped hole and, using it as a puller, remove the seat.

4. Place a new seat in the port, and thread a bolt of suitable size into the port. Tighten the bolt enough to bottom the seat in the port.

CARRIER SHAFT SEAL REPLACEMENT

If the carrier seal was removed from the pump housing, install a new seal. **Do not install the old seal.**

1. Coat the lip of a new seal with Lubriplate or an equivalent lubricant.

2. Position the seal in the bore of the housing. **The lip of the seal must face toward the pump housing carrier chamber.**

3. Press the seal into the housing (Fig. 10) until it seats firmly and evenly against the shoulder in the bore.

PUMP ASSEMBLY

Before assembling the pump and reservoir, coat all parts with Ford Automatic Transmission Fluid B8A-19582-A. **If the carrier insert is to be replaced, the new insert must be installed so that the slot in the edge of the insert engages the small pin in the pump housing.**

1. If the carrier and related parts seem to be in good condition, install the key, pulley, washer, and retaining bolt on the shaft. **Install the retaining bolt finger-tight.**

2. **To avoid damaging the oil seal in the housing cover,** carefully insert the shaft (with pulley attached) through the housing, position the carrier shaft pin, and slide the carrier onto the shaft. Install the retaining ring and the rollers.

3. Remove the retaining bolt, washer, pulley, and key from the carrier shaft. **To avoid damage to the seal, be sure the shaft does not move back and forth in the housing.**

4. Position the valve assembly spring in the bore, install a new O-ring on the pump valve retainer, and install the retainer in the pump housing cover. Torque the retainer to specification.

5. Place a new O-ring in the groove around the insert in the pump housing, and install a new flow director O-ring in the face of the housing (Fig. 7).

6. Fasten the pump housing and cover together.

7. Clamp the adjusting bracket in a vise, and install the pump on the bracket. Torque all bolts to specification.

8. Install the key, pulley, washer, and retaining bolt on the carrier shaft.

9. Torque the pulley-retaining bolt to specification. **The carrier shaft should turn freely when the bolt is properly tightened.**

10. Place new O-rings in the grooves on the top of the pump housing.

11. Hold the reservoir on the pump housing, and install the reinforcement in the reservoir. **The ears on the reinforcement should be facing upward over the outer hole in the reservoir.**

12. Position a new cover gasket around the inside of the cover. Install only the dip stick type cover, washer, and retaining bolt at this time. **The cover must be seated evenly and tightly on the reservoir.**

PUMP AND FLUID RESERVOIR INSTALLATION

1. Position the pump, reservoir, and bracket in the engine compartment, and install the mounting bolts finger tight.

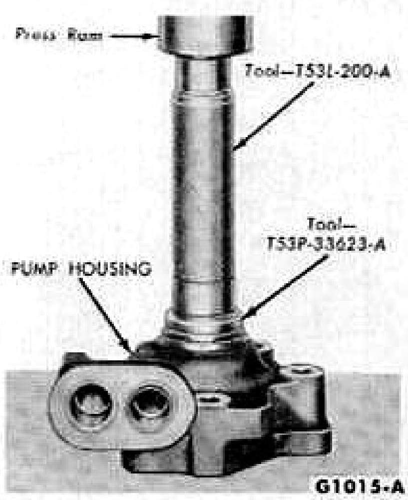

FIG. 10—Carrier Shaft Seal Installation

2. Position the pump belt, and check the alignment of the crankshaft and pump pulleys. If the pulleys are not aligned, the pump may be incorrectly installed, or spacers may be necessary.

3. Adjust the belt tension (Section 1).

4. Connect the 2 hoses at the pump and the fluid reservoir.

5. Fill the reservoir with Ford Automatic Transmission Fluid B8A-19582-A to a point ¼ inch from the top or to the F mark on the dipstick.

Install the non dipstick type cover at this time. **The cover must be seated evenly and tightly around the edge of the reservoir. Tighten the wing nut securely.**

6. Start the engine and run it at idle speed for about 2 minutes to warm the fluid in the power steering system.

7. After turning the steering wheel all the way to the left and right several times, check the system for leaks.

8. Increase the engine speed to about 1000 rpm, and turn the steering wheel all the way to the left and right several times.

9. Stop the engine, and check the pump, reservoir, and hose connections for fluid leaks. Correct the cause of any leaks.

10. Check the fluid level, and refill the reservoir if necessary.

3 CONTROL VALVE REPAIR

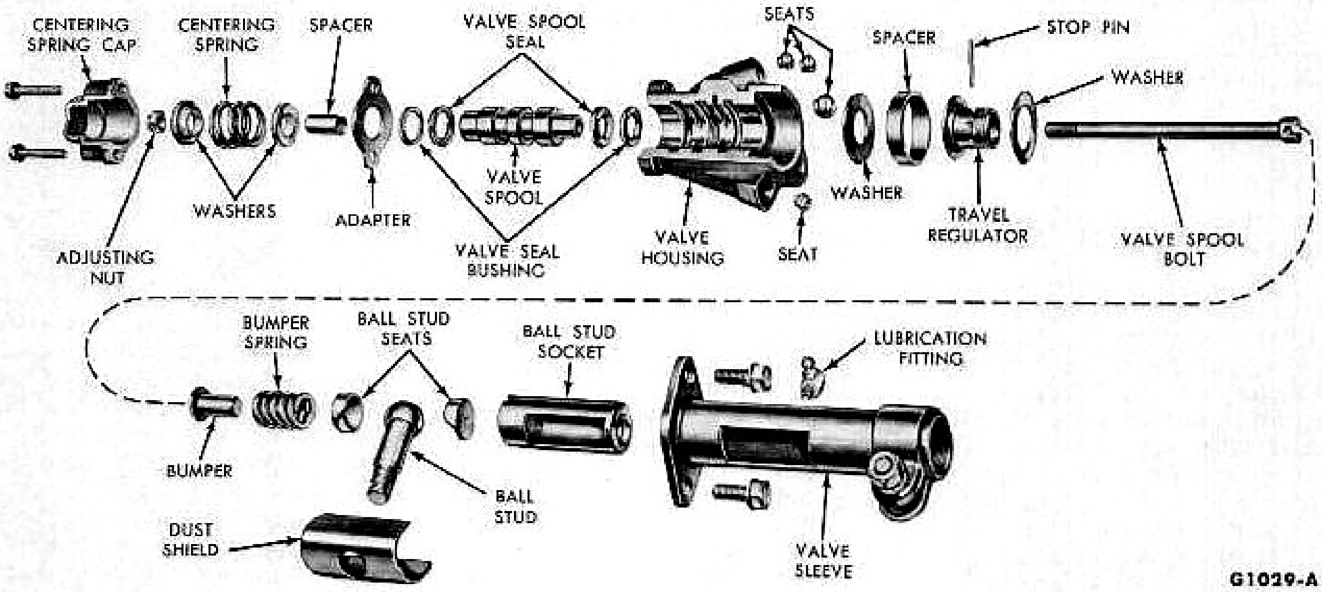

FIG. 11–Control Valve

CONTROL VALVE REMOVAL

1. Disconnect the 4 fluid line fittings at the control valve, and drain the fluid from the lines. Turn the front wheels to the left and right several times to force all the fluid from the system.

2. Loosen the clamping nut and bolt at the right-hand end of the sleeve.

3. Remove the roll pin from the steering arm to idler arm rod through the slot in the sleeve.

4. Remove the cotter pin from the control valve ball stud nut. Loosen the nut, and back it off far enough to cover the threads on the end of the ball stud.

5. Hold a soft hammer against the forward side of the sector shaft arm to absorb the shock, and lightly tap the ball stud with a hammer to loosen it from the arm. **Do not strike any part of the valve body while loosening the ball stud because damage may result.**

6. Remove the nut from the end of the ball stud, and raise the control valve high enough to remove the ball stud from the sector shaft arm.

7. After turning the front wheels fully to the left, turn the control valve counterclockwise to remove it from the steering arm to idler arm rod.

CONTROL VALVE DISASSEMBLY

1. Wipe all fluid and loose dirt from the outside of the control valve.

2. Remove the 2 centering spring cap bolts and the cap from the valve housing (Fig. 11). **When holding the control valve for disassembly, use a soft-jawed vise, and clamp the valve only around the sleeve flange to prevent damage to the housing, spool, or sleeve.**

3. Remove the nut from the end of the valve spool bolt. Remove the washers, spacer, centering spring, adapter, and bushing from the bolt and the valve housing.

4. Remove the 2 bolts that hold the valve housing and the sleeve together, and separate the housing from the sleeve.

5. Remove the lubrication fitting from the valve sleeve.

6. Push the valve spool out of the centering spring end of the valve

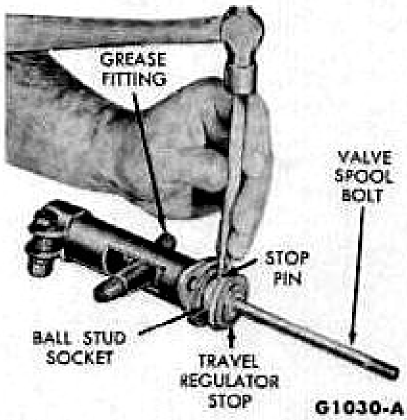

FIG. 12–Stop Pin Removal

housing, and remove the seal from the spool.

7. Remove the spacer, bushing, and seal from the sleeve end of the valve housing.

8. Drive the stop pin out of the travel regulator stop with a punch and hammer (Fig. 12). **Pull the head of the valve spool bolt tightly against the travel regulator stop before driving the pin out of the stop.**

9. Turn the travel regulator stop counterclockwise in the valve sleeve to remove the stop from the sleeve.

10. Remove the valve spool bolt, and spacer from the travel regulator stop.

11. Remove the dust shield from the valve sleeve.

12. Slide the bumper, spring, and ball stud seat out of the valve sleeve, and remove the ball stud socket from the sleeve.

CONTROL VALVE CLEANING AND INSPECTION

Wash all control valve parts in a cleaning solvent, and wipe them dry with a lint-free cloth.

Inspect the valve seals and bushings for wear or damage. Examine the lips of the seals carefully for nicks or scratches that could allow fluid to escape from the valve. Examine the bushings for nicks or scores. Replace the seals and bushings if necessary.

Inspect the valve housing and spool carefully for burrs or scoring. Remove any burrs with crocus cloth. **Be careful not to round off the sharp edges of the spool with the crocus cloth because the operation of the valve may be affected.** If the spool or the inside of the housing is badly scored, the valve assembly should be replaced.

Dry the spool and housing thoroughly, and insert the valve into the housing. The spool should fall freely of its own weight in the housing (the specified spool to housing clearance is 0.0002-0.0009 inch).

Inspect the mating surfaces of the ball stud socket and the valve sleeve for wear or damage. Minor burrs and scores may be removed with crocus cloth. Check the fit of the socket in the sleeve. The socket should slide freely in the sleeve.

RELIEF VALVE AND HOSE SEAT REPLACEMENT

If the relief valve (check valve) or a hose seat is worn or damaged, it should be replaced. A bolt of appropriate size should be used as a puller.

1. Tap the existing hole in the hose seat, using a starting tap of suitable size. **Be sure to remove all metal chips from the hose seat port after tapping.**

2. Place a nut and large flat washer on a bolt of the same size as the tapped hole. The washer must be large enough to cover the hose seat port.

3. Insert the bolt in the tapped hole, and using it as a puller, remove the hose seat. If the return line hose seat was removed, remove the relief valve from the port with a screwdriver, and install a new relief valve.

4. Place a new hose seat in the port, and thread a bolt of suitable size into the port. Tighten the bolt enough to bottom the seat in the port.

CONTROL VALVE ASSEMBLY

Before assembling the control valve, coat all parts with Ford Automatic Transmission Fluid B8A-19582-A.

1. Insert one of the ball stud seats (flat end first) into the ball stud socket, and insert the threaded end of the ball stud into the socket.

2. Place the socket in the control valve sleeve so that the threaded end of the ball stud can be pulled out through the slot in the sleeve (Fig. 13).

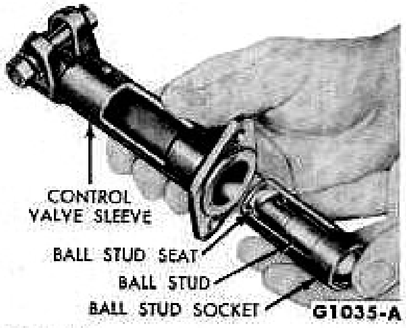

FIG. 13—Ball Stud, Seat, and Socket Installation

3. Place the other ball stud seat, the spring, and the bumper (Fig. 11) in the socket, and install and securely tighten the travel regulator stop.

4. Loosen the stop just enough to align the nearest hole in the stop with the slot in the ball stud socket, and install the stop pin in the ball stud socket, travel regulator stop, and valve spool bolt (Fig. 12).

5. Install the dust shield and the lubrication fitting on the control valve sleeve. **Make sure that the lubrication fitting is turned on tightly and does not bind on the ball stud socket.**

6. Insert the valve spool in the valve housing so that the large end of the spool will be at the centering spring end of the housing and the small end of the spool will face the sleeve end of the housing (Fig. 14). **Rotate the spool while inserting it in the housing.**

7. Move the spool toward the centering spring end of the housing, and place the small seal, bushing, and spacer in the sleeve end of the housing.

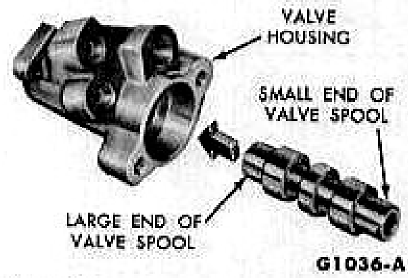

FIG. 14—Valve Spool Position

8. Press the valve spool against the inner lip of the seal and, at the same time, guide the lip of the seal over the spool with a small screwdriver. **Do not nick or scratch the seal or the spool during installation.**

9. Place the sleeve end of the housing on a flat surface so that the seal, bushing, and spacer are at the bottom end and push down on the valve spool until it stops.

10. Carefully install the spool seal and bushing in the centering spring end of the housing around the large end of the spool. Press the seal against the end of the spool, guiding the seal over the spool with a small screwdriver. **Do not nick or scratch the seal or the spool during installation.**

11. Pick up the housing, and slide the spool back and forth in the housing to check for free movement.

12. Place the valve sleeve on the housing so that the ball stud is on the same side of the housing as the ports for the 2 power cylinder lines. Install the two bolts in the sleeve, and torque them to specification.

13. Place the adapter on the centering spring end of the housing, and install the bushing, washers, spacers, and centering spring on the valve spool bolt.

14. Compress the centering spring, and install the nut on the bolt. After tightening the nut securely, loosen it not more than ¼ turn (Fig. 15). **Excessive tightening of the nut may break the stop pin at the travel regulator stop.**

15. Move the ball stud back and forth in the sleeve slot to check the spool for free movement. The spool

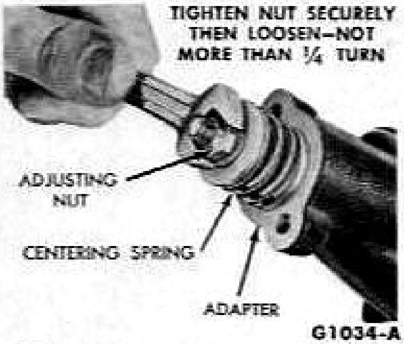

FIG. 15—Centering Spring Adjustment

should travel approximately 0.060 inch in each direction from center.

16. Install the centering spring cap on the valve housing, and torque the 2 cap bolts to specification.

17. Install the nut on the ball stud so that the valve can be positioned in a vise as shown in Fig. 16. Then push forward on the cap end of the valve to check the valve spool for free movement.

18. Turn the valve around in the vise, and push forward on the sleeve end to check the spool for free movement.

CONTROL VALVE INSTALLATION

1. Thread the valve on the steering arm to idler arm rod until about 4 threads are still visible on the rod.

2. Position the ball stud in the sector shaft arm.

3. Measure the distance between the center of the ball stud in the sector shaft arm and the center of the stud at the inner end of the left-hand spindle connecting rod (Fig. 17). **Be sure that the measurement is taken parallel to the centerline of the control valve.** The distance should be 10¾ inches. If the distance is not correct, disconnect the ball stud from the sector shaft arm and turn the valve on the steering arm to idler arm rod to increase or decrease the distance.

4. When the correct distance is obtained and the ball stud is positioned in the sector shaft arm, align the hole in the steering arm to idler arm rod with the slot near the end of the valve sleeve. Install the roll pin in the rod hole to lock the valve in position on the rod.

5. Torque the valve sleeve clamp bolt to specification.

6. Install the nut on the ball stud, and torque the nut to specification. Install a new cotter pin.

FIG. 16—Valve Spool Movement Inspection

7. Connect the 4 fluid lines to the control valve, and tighten all fittings securely.

8. Fill the fluid reservoir with Ford Automatic Transmission Fluid B8A-19582-A to a point ¼ inch from the top.

9. Start the engine and run it at idle speed for about 2 minutes to warm the fluid in the power steering system.

10. Turn the steering wheel all the way to the left and right several times, and check the system for fluid leaks.

11. Increase the engine speed to about 1000 rpm, and turn the steering wheel all the way to the left and right several times.

12. Stop the engine, and check the control valve and hose connections for fluid leaks. Correct the cause of any leaks.

13. Check the fluid level, and refill the reservoir if necessary.

14. With the engine running, check the position of the steering wheel when the front wheels are in the straight-ahead position. **Do not make any adjustments until toe-in is checked.**

15. Keep the engine running, and check toe-in. If either toe-in or steering wheel position is not correct, make all necessary adjustments at the spindle connecting rod sleeves.

16. Hook a spring scale to the rim of the steering wheel and measure the pull required to turn the wheel in both directions with the engine idling. The pull should be less than 6 pounds and should be about equal in both directions.

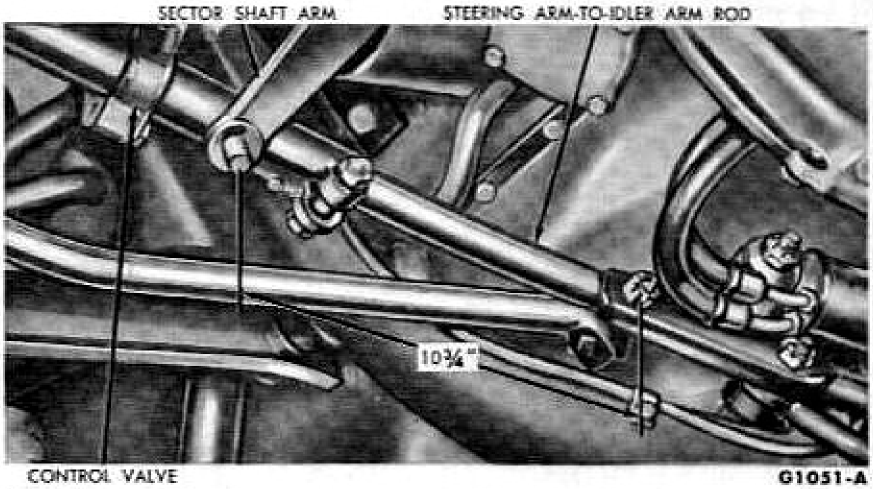

FIG. 17—Valve Installation Measurement

4 POWER CYLINDER REPAIR

POWER CYLINDER REMOVAL

1. Remove the 2 lines from between the power steering valve and the power cylinder. Move the front wheels to the left and right several times to force all the fluid from the power cylinder.

2. Remove the locknut, nut, washer, and insulator (Fig. 18) from the outer end of the piston rod. Do not remove the rod from the idler arm bracket at this time.

3. Remove the locknut that holds the cylinder on the mounting stud in the steering arm to idler arm rod.

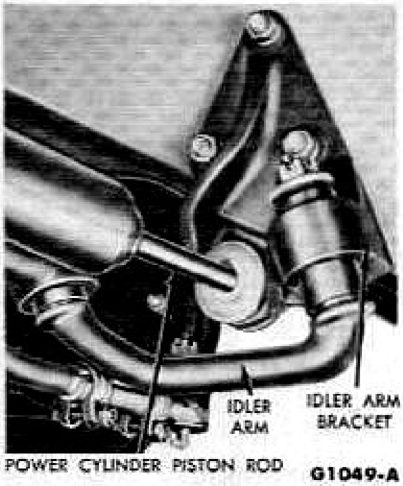

FIG. 18—Power Cylinder Piston Rod, Idler Arm and Bracket

Then pull the piston rod out of the idler arm bracket and remove the outer washer, bushing, and cylinder from the stud. Remove the inner bushing and washer from the stud, and pull the inner insulator and washer from the piston rod.

POWER CYLINDER CLEANING AND INSPECTION

Clean the outside of the power cylinder and piston rod, and wipe the parts dry.

Inspect the cylinder and piston rod for wear or damage. With the exception of the seals and the hose seats, the internal parts of the cylinder and the rod cannot be repaired or replaced. If either the cylinder or rod is worn or damaged, or if the piston is leaking internally, the entire power cylinder assembly must be replaced as a unit. The cylinder seals and hose seats are replaceable.

Inspect the mounting bushings and insulators for wear or damage, and replace them if necessary.

POWER CYLINDER SEAL REPLACEMENT

When replacing the power cylinder seals, install all of the parts supplied in the repair kit.

1. Clamp the power cylinder in a vise, and remove the snap ring from the end of the cylinder. **Be careful not to distort or crack the cylinder in the vise.**

2. Pull the piston rod out all the way to remove the scraper, bushing, and seals. If necessary, apply compressed air to the ports in the other end of the cylinder to blow the seals out of the cylinder.

3. Lubricate the new inner seal with Ford Automatic Transmission Fluid B8A-19582-A and place the seal, bushing, outer seal, and scraper on the piston rod. **The parts must be installed in proper order and relative position** (Fig. 19). Push the rod in all the way, and install the parts in the cylinder with a deep socket slightly smaller than the cylinder opening (Fig. 20).

4. Install the snap ring in the end of the cylinder.

POWER CYLINDER HOSE SEAT REPLACEMENT

If either hose seat is worn or damaged, both seats should be replaced.

1. Tap the hose seats with a tap of suitable size. **Be sure to remove all metal chips from the hole after tapping.**

2. Place a nut and a flat washer large enough to cover the seat port on a bolt of appropriate size. Then thread the bolt into the tapped hole and turn it to pull the seat out of the port.

3. Position a new seat in the port, and thread a bolt of the same size as the port into the port. Tighten the bolt until the seat bottoms in the port.

POWER CYLINDER INSTALLATION

1. Install the inner washer and bushing on the mounting stud in the steering arm to idler arm rod.

2. Install the inner insulator and washer on the power cylinder piston rod. Then position the cylinder on the mounting stud with the piston rod in the idler arm bracket.

3. Install the outer bushing, washer, and locknut on the mounting stud. If a new nut is installed, torque it to specification. If a used nut is installed, torque it to a different specification.

4. Install the outer insulator, washer, and nut on the piston rod, and torque the nut to specification. Install the locknut on the rod and torque it to specification (finger-tight plus 1/3 turn).

5. Connect the 2 lines to the control valve, and tighten all fittings securely.

6. Fill the fluid reservoir with Ford Automatic Transmission Fluid B8A-19582-A to a point 1/4 inch from the top or to the F mark on the dip stick.

7. Start the engine and run it at idle speed for about 2 minutes to warm the fluid in the power steering system.

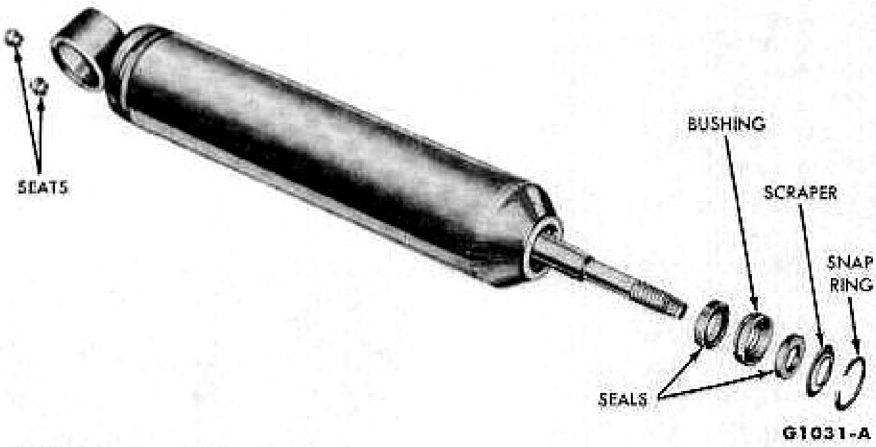

FIG. 19—Power Cylinder

8. Turn the steering wheel all the way to the left and right several times, and check the system for fluid leaks.

9. Increase the engine speed to about 1000 rpm and turn the steer-

FIG. 20—Power Cylinder Seal Installation

ing wheel all the way to the left and right several times.

10. Stop the engine, and check the power cylinder and hose connections for fluid leaks. Correct the cause of any leaks.

11. Check the fluid level, and refill the reservoir if necessary.

5 POWER STEERING LINKAGE REPAIR

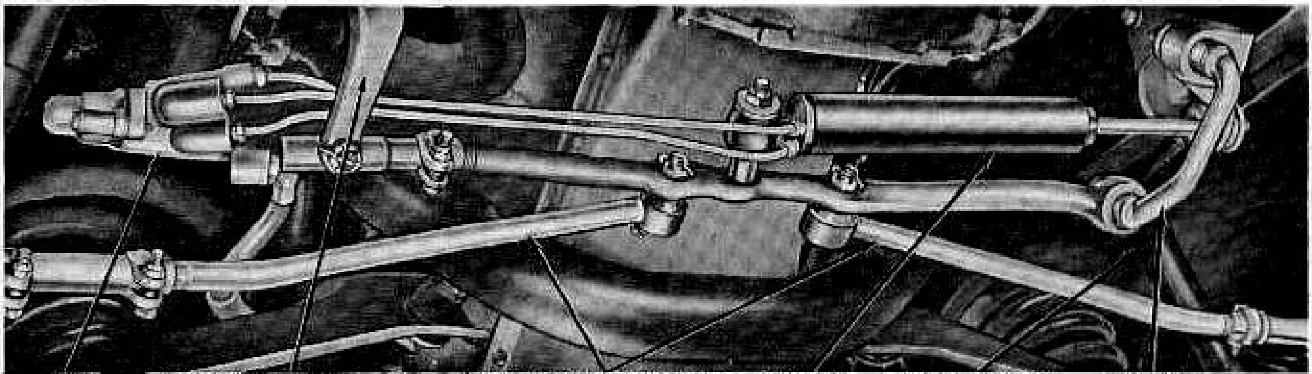

FIG. 21—Power Steering Linkage

The steering gear, sector shaft arm (Pitman arm), and spindle connecting rods (tie rods) on the power steering linkage (Fig. 21) are identical to those on the manual steering linkage. The following repair information covers the other linkage parts which are used only with power steering.

IDLER ARM BUSHING REPLACEMENT

If the idler arm is loose in the bushings, or if either bushing is worn or damaged, replace both bushings. When an idler arm and bushing kit is used for replacement of bushings, install all of the parts, including the idler arm, supplied in the kit.

1. Remove the cotter pins, nuts, and washers from both ends of the idler arm, and pull the arm out of the bracket and the steering arm to idler arm rod.

2. Install the idler arm bushing remover as shown in Fig. 22. Make sure that the chamfer on the No. 2 collar at the upper side of the bracket is next to the slanted side of the bracket, and that the driver on top of the bushing is firmly seated on the bushing.

3. Turn the hexagonal end of the tool clockwise until the bushing is forced out of the bracket. Then remove the tool and the bushing from the bracket.

4. Remove the bushing from the end of the steering arm to idler arm rod in the same manner.

5. Position a new bushing in the No. 3 spacer of the tool on the upper side of the bracket, and install the rest of the tool on the bracket as shown in Fig. 23. Make sure that the chamfer on the spacer is next to the slanted side of the bracket, and that the driver on top of the bushing is firmly seated on the bushing. The number 4 locator should be positioned with the end marked "BKT" against the lower side of the bracket.

6. Turn the hexagonal end of the tool clockwise until the bushing is firmly seated in the No. 4 locator, and remove the tool from the bracket.

7. Install a new bushing in the end of the steering arm to idler arm rod in the same manner. When installing the tool, position the No. 4 locator with the end marked "ROD" against the lower side of the rod.

8. Install the idler arm in the bushings, and install the washers and nuts on both ends of the arm. Torque the nuts to specification, and install new cotter pins.

STEERING ARM TO IDLER ARM ROD REMOVAL

The power cylinder mounting stud is part of the steering arm to idler arm rod, and cannot be removed separately.

1. Remove the locknut, nut, washer, and insulator from the outer

FIG. 22—Idler Arm Bushing Removal

FIG. 23—Idler Arm Bushing Installation

end of the power cylinder piston rod. Do not remove the rod from the idler arm bracket at this time.

2. Remove the locknut that holds the power cylinder on the mounting stud in the steering arm to idler arm rod, and pull the piston rod out of the idler arm bracket. Remove the outer washer, bushing, and cylinder from the stud.

3. Remove the cotter pins from the nuts which attach the spindle connecting rod studs to the steering arm to idler arm rod. Turn both nuts off far enough to cover the threads at the ends of the studs, and tap the studs while holding a hammer behind the rod until the studs are loose in the rod.

4. Remove the stud nuts, and remove the spindle connecting rods from the steering arm to idler arm rod.

5. Pull the roll pin out of the steering arm to idler arm rod, and loosen the control valve sleeve clamp bolt.

6. Remove the cotter pin from the nut that holds the idler arm on the steering arm to idler arm rod. Remove the nut, and tap the steering arm to idler arm rod off the idler arm.

7. Thread the steering arm to idler arm rod out of the end of the control valve.

STEERING ARM TO IDLER ARM ROD INSTALLATION

1. Thread the steering arm to idler arm rod into the end of the control valve until about 4 threads are still visible on the rod.

2. Position the rod on the idler arm, and place the left-hand spindle connecting rod stud in the hole in the steering arm to idler arm rod. Install the nut.

3. Measure the distance between the center of the ball stud in the sector shaft arm and the center of the stud at the inner end of the left-hand spindle connecting rod (Fig. 17). **Be sure that the measurement is taken parallel to the centerline of the control valve.** The distance should be 10¾ inches. If the distance is not correct, disconnect the steering arm to idler arm rod from the idler arm and the spindle connecting rod. Then turn the steering arm to idler arm in the control valve to increase or decrease the distance.

4. When the correct distance is obtained, torque the spindle connecting rod stud nut to specification, and install a new cotter pin. Align the hole in the steering arm to idler arm rod with the slot near the end of the valve sleeve. Install the roll pin in the rod hole to lock the valve in position on the rod.

5. Torque the valve sleeve clamp bolt to specification.

6. Position the right-hand spindle connecting rod stud in the steering arm to idler arm rod, and install the nut. Torque the nut to specification and install a new cotter pin.

7. Install the steering arm to idler arm rod in the idler arm, and install the nut and washer. Torque the nut to specification. Install a new cotter pin.

8. Install the power cylinder on the steering arm to idler arm rod and in the idler arm.

9. With the engine running, check the position of the steering wheel when the front wheels are in the straight-ahead position. **Do not make any adjustments until toe-in is checked.**

10. Keep the engine running, and check toe-in. If either toe-in or steering wheel position is not correct, make all necessary adjustments at the spindle connecting rod sleeves.

IDLER ARM BRACKET REPLACEMENT

Replace the idler arm bracket if the bracket is damaged or if the power cylinder piston rod mounting hole in the bracket is elongated.

PART 9-3 SPECIFICATIONS

STEERING GEAR AND LINKAGE

ADJUSTMENTS

Sector Shaft End Play—Steering Linkage Disconnected	None Perceptible.
Worm Bearing Pre-Load (Pull to keep steering wheel moving)	3-6 inch-pounds
Total Pre-Load— Mesh Load plus Worm Bearing Pre-Load (Pull to rotate worm past center high spot)	8-13 inch-pounds
Backlash permissible at 30° on either side of straight-ahead steering position	No Perceptible.
Ball Socket Plug Adjustment	Tighten fully; back off 1½ turns.

TORQUE LIMITS

Description	Ft.-Lbs.
Pitman Arm to Ball Stud Lock Nut	50-60
Spindle Connecting Rod to Steering Arm Idler Rod Lock Nut	45-55
Spindle Connecting Rod End to Spindle Arm Lock Nut	45-55
Spindle Connecting Rod Sleeve Clamp Lock Nut	11-14
Idler Arm Bushing to Idler Arm Rod Bolt	85-100
Idler Arm Bushing to Idler Arm Bracket Bolt	85-100
Steering Wheel Nut (Torque and Stake)	40-60
Steering Gear Housing—Cover Assy. to Housing Assy. Bolts	12-20
Steering (Pitman) Arm Nut	110-150
Steering Gear Assy. to Underbody Bolts	28-43

TORQUE LIMITS (Continued)

Description	Ft.-Lbs.
Steering Column Bracket to Inst. Panel Screw	5-7
Idler Arm Bracket to Underbody Bolts	25-30

DIMENSIONS

Sector Adjusting Screw Head to End of Sector Shaft Clearance	Max. .002

LUBRICANT—STEERING GEAR HOUSING

Capacity (Weight)	11 Ounces

POWER STEERING

ADJUSTMENTS

Worm Bearing Pre-Load	2-4.5 inch-pounds
Total Pre-Load	7-12 inch-pounds
Pump Belt Tension	25 ft.-lbs.
Maximum Pull Required to Turn Wheel at least One Complete Turn, Either Direction (Engine Idling)	6 lbs.
Normal Fluid Pressure against Either Stop (Engine Idling)	700-850 psi
Carrier to Pump Housing Maximum End Clearance	0.0016 in.
Control Valve Approximate Spool Travel (from Center)	0.080 in.

TORQUE LIMITS

Description	Torque Ft.-Lbs.
Steering Pitman Arm to Sector Shaft Assembly	110-150
Power Cylinder to Control Rod Locknut	60-70
Idler Arm to Bracket and Rod Nuts	50-60
Spindle Arm Connecting Rod to Control Rod Nut	45-55
Hydraulic Control Valve Clamp to Control Rod Nut	15-20
Hydraulic Cylinder to Idler Arm Bracket Nut	18-24
Hydraulic Cylinder to Idler Arm Bracket Locknut	3-5
Drive Pulley to Crankshaft Pulley—Single Sheaf	20-25
Drive Pulley and Crankshaft Pulley to Crankshaft—Double Sheaves	55-65
Pump Adjusting Bracket to Water Pump Housing Bolt	20-25
Pump Adjusting Bracket to Water Pump Housing Pivot Bolt	20-25
Hose Insulator Bracket Mounting Bolt	12-15

TORQUE LIMITS (Continued)

Description	Torque Ft.-Lbs.
Pump Valve Retainer	30-35
Pump to Adjusting Bracket	20-25
Spring Cap to Valve Housing Bolts	4-6
Control Valve Sleeve to Housing Bolt	12-17

DIMENSIONS

	Inches
Sector Shaft Arm Ball Stud to Spindle Connecting Rod Ball Stud	10¾
Control Valve Spool to Housing	0.0002—0.0009

LUBRICANT—POWER STEERING RESERVOIR

Capacity (Pints)	2½

GROUP 10

BRAKES

PART 10-1

HYDRAULIC AND PARKING BRAKES

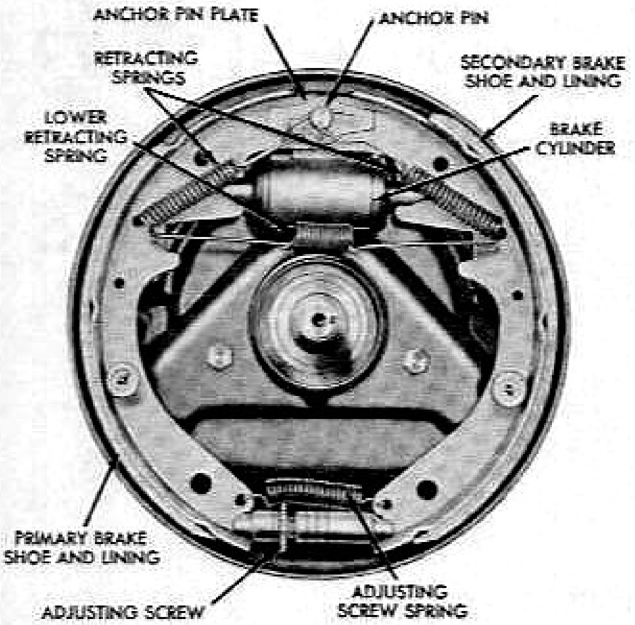

FIG. 1—Front Brake Assembly

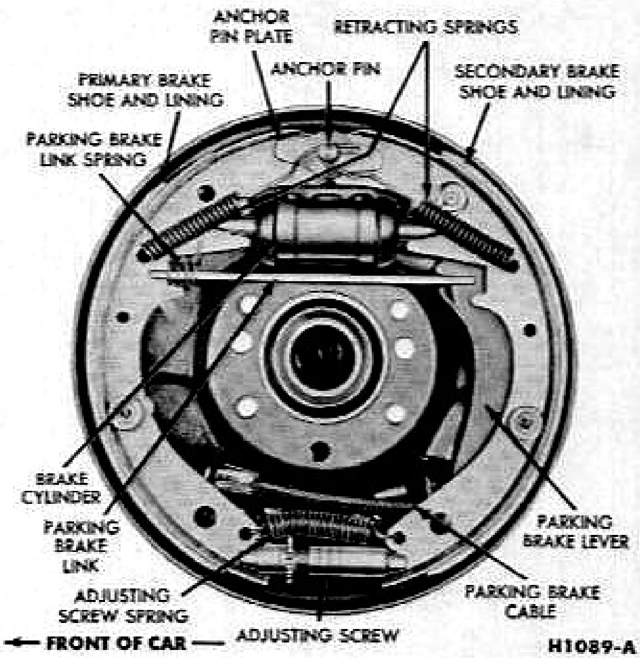

FIG. 2—Rear Brake Assembly

Single-anchor, internally expanding hydraulic brakes (Figs. 1 and 2) are used on the Thunderbird. The self-energizing primary and secondary brake shoes with duo-servo action operate against the inside surfaces of cast-iron brake drums.

An independent manually-operated parking brake operates the rear wheel brake shoes through a mechanical cable linkage.

1 TROUBLE SHOOTING

The trouble shooting symptoms and possible causes given in Table 1 apply to all parts of the brake system except the power brake vacuum booster.

PRELIMINARY CHECKS

Check the fluid level in the master cylinder, and add **heavy-duty** brake fluid if required.

Push the brake pedal down as far as it will go while the car is standing still. If the pedal can be pushed down more than halfway between the released position and the floor, adjust the brakes.

If the brakes will apply to stop the car safely, apply them at a speed of about 20 mph to see if the car stops in a straight line. If the car pulls to one side, inspect the brakes to determine the trouble.

Apply steady pressure to the brake pedal. If it moves slowly toward the floor, check for leaks in the master cylinder, brake cylinders, or elsewhere in the hydraulic system. If the brake pedal feels spongy, bleed the system to remove air from the lines.

Check the operation of the parking brakes. If they do not apply, check the brake cables.

TABLE 1—Brake Trouble Symptoms and Possible Causes

Possible Causes of Trouble Symptoms	Trouble Symptoms												
	One Brake Drags	All Brakes Drag	Hard Pedal	Spongy Pedal	Car Pulls to One Side	One Wheel Locks	Brakes Chatter	Excessive Pedal Travel	Pedal Gradually Goes to Floor	Brakes Uneven	Low Pedal Reserve	Noisy or Grabbing Brakes	Brakes Do Not Apply
Pedal Improperly Adjusted		x											
Damaged Linkage			x					x					
Brake Line Restricted	x	x	x		x								
Leaks or Insufficient Fluid				x				x	x				x
Improper Tire Pressure										x			
Improperly Adjusted or Worn Wheel Bearing	x												
Distorted or Maladjusted Brake Shoe	x		x			x						x	
Faulty Retracting Spring	x				x								
Drum out of Round	x				x		x						
Linings Glazed or Worn			x				x	x			x	x	
Oil or Grease on Lining					x	x	x			x		x	
Loose Carrier Plate						x	x						
Loose Lining							x						
Scored Drum										x		x	
Dirt on Drum-Lining Surface												x	
Faulty Brake Cylinder	x				x	x						x	
Dirty Brake Fluid	x	x								x			x
Faulty Master Cylinder		x							x				x
Air in System	x			x									x

TROUBLE CHECKS

BRAKES DO NOT APPLY

If the brake pedal travels all the way down to the floor without noticeable brake action, check the brake fluid level in the master cylinder reservoir. Refill the reservoir, if necessary, with heavy-duty brake fluid. Check the entire hydraulic system for fluid leaks, and make the necessary repairs.

If the brake pedal feels spongy when pushed down, air has entered the hydraulic lines. Air can enter the lines if the fluid level in the master cylinder reservoir is too low, or if the brake wheel cylinder pistons are not held firmly in place when the brake shoes are serviced. A defective check valve can cause a loss of residual pressure in the system causing air to enter at the wheel cylinder piston. Bleed the system to remove air from the lines, and adjust the brakes. Refill the master cylinder reservoir with heavy-duty brake fluid. If the brakes do not apply after making these checks and adjustments, fluid may be leaking past the piston cups in the master cylinder or brake wheel cylinder(s). If the trouble is in the master cylinder or brake wheel cylinder(s), remove and repair.

CONTINUED ON NEXT PAGE

TROUBLE CHECKS (Continued)

LOW PEDAL RESERVE	Check for air in the brake lines and bleed the system if necessary.	Adjust the brakes or replace the brake shoes as needed.
UNEVEN, NOISY, GRABBING, OR HARD OPERATING BRAKES	Remove the brake drums, and make a complete inspection of the brake assemblies to determine the cause of the trouble. Excessive dust and dirt in the brake lining rivet holes or in the brake drum can cause brake squeal. Remove the dirt with a scraper and an air hose. Drums which are out of round, or loose at the hub, frozen piston(s), defective check valve, improper brake shoe adjustment, warped or mis-	aligned shoes and webs, restricted brake lines, and glazed or greasy linings, incorrectly ground or wrong linings are a few of the causes for uneven, noisy, pulling, grabbing, or hard brakes. Adjust or replace the necessary parts to eliminate the trouble. Lining glaze can be removed by rubbing the lining with the medium-grade sandpaper until the lining has a dull finish. **Always adjust the brake assemblies after correcting these brake troubles.**
BRAKES DO NOT RELEASE	Check for an improperly adjusted brake pedal, a restricted by-pass port in the master cylinder, inoperative check valve, swollen master cylinder piston cups, or sticking brake cylinder pistons caused by dirty or contaminated brake fluid. Adjust the brake pedal if necessary. If the adjustment does not correct the trouble, check the condition of the brake fluid and replace it if it is dirty or contaminated. **Flush the en-**	**tire hydraulic system with clean denatured alcohol before adding new brake fluid.** If the trouble is in the master cylinder, remove and rebuild the cylinder. **If the car must be moved when the brakes are locked, open a brake cylinder bleeder screw for a moment to let out a few drops of brake fluid. This operation will release the brakes but will not correct the cause of the trouble.**

2 BRAKE ADJUSTMENTS

The brakes should be adjusted when lining wear has reduced the brake pedal reserve to less than one-half of the total travel to the floor.

PRELIMINARY INSPECTION

1. Remove one front wheel and drum from the car, and inspect the drum and brake shoe linings for wear or damage that would affect brake operation. **Do not let oil or grease touch the drum or linings.** If the linings are worn to within $\frac{1}{32}$ inch of the top of the rivets, replace the brake shoes. If the drum and linings are in good condition, install the wheel and drum. **The condition of the drums and linings of the other three wheels will usually be about the same as that found at the wheel that was removed.**

2. Add enough brake fluid to the master cylinder reservoir to bring the level to within ½ inch of the top of the filler neck. **Use only heavy-duty brake fluid.**

3. Raise the car and check the parking brake cables to make sure that the cables have not been adjusted so tightly as to pull the rear brake shoes off their anchor pin seat. **Be sure that the parking brake handle is fully released during this check.**

4. Check the front brake anchor pin bolt with a wrench. If the bolt is loose, torque it to 80-100 foot-pounds.

BRAKE SHOE ADJUSTMENT

The brake drums should be at normal room temperature when the brake shoes are adjusted. If the shoes are adjusted when the drums are hot and expanded, the shoe may drag as the drums cool and contract.

1. Raise the car until the wheels clear the floor. Fully release the parking brake. **If the car is raised on a frame-contact hoist, the parking brake cables should be disconnected to prevent the parking brakes from becoming partially applied when the rear axle and springs sag on the hoist.**

2. Remove the cover from the adjusting hole at the bottom of the brake carrier plate.

3. Insert an air hose nozzle in the hole and blow out the accumulated dust, then turn the adjusting screw inside the hole to expand the brake shoes until they drag against the brake drum (Fig. 3). Raise the end of the brake adjusting tool to tighten the brakes except on the left rear wheel. Lower the end of the tool to tighten the left rear brake.

4. When the shoes are against the drum, back off the adjusting screw 14 to 16 notches.

5. When the brake shoes are properly adjusted, install the adjusting hole cover on the brake carrier plate.

6. Check and adjust the other three brake assemblies. When adjusting the rear brake shoes, check the parking brake cables for proper adjustment. Make sure that the equalizer lever, near the rear of the transmission, operates freely.

7. Apply the brakes. If the pedal travels more than halfway down be-

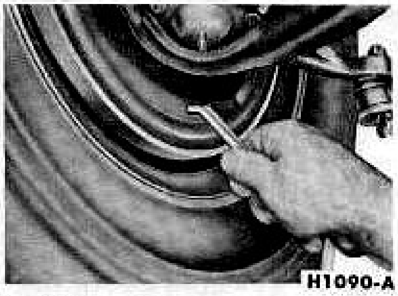

FIG. 3—Brake Shoe Adjustment

tween the released position and the floor, too much clearance exists between the brake shoes and the drums, and further adjustment, as outlined in steps 1 through 5 above, is necessary.

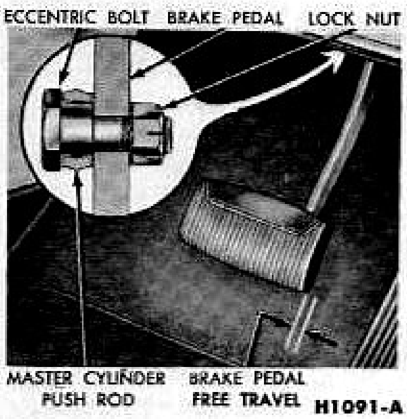

FIG. 4—Brake Pedal Free-Travel Check and Adjustment

8. When all brake shoes have been properly adjusted, road test the car and check the operation of the brakes.

BRAKE PEDAL ADJUSTMENT

When the brake pedal free-travel (Fig. 4), which is the movement of the brake pedal before the push rod touchs the master cylinder piston, is less than $\frac{5}{16}$ inch or more than $\frac{7}{16}$ inch, the brake pedal should be adjusted.

1. Push the brake pedal down by hand pressure, and check the free-travel.

2. Loosen the locknut on the eccentric bolt, and rotate the bolt until the free-travel is within $\frac{5}{16}$-$\frac{7}{16}$ inch.

3. Hold the bolt securely, and tighten the locknut.

4. Recheck the pedal free-travel to make sure that the adjustment did not change when the locknut was tightened.

PARKING BRAKE LINKAGE ADJUSTMENT

The rear brake shoes should be adjusted before the parking brake linkage is adjusted. In most cases, the rear brake shoe adjustment will also provide satisfactory parking brake action.

Check the parking brake cables when the brakes are fully released. If the cables are loose, adjust them as follows:

1. Loosen the locknut on the equalizer rod (Fig. 5), and then turn the nut in front of the equalizer several turns forward.

2. Turn the locknut forward against the equalizer until the cables are just tight enough to remove the slack. **Excessive tightening may pull the brake shoes off their anchors.**

3. When the cables are properly adjusted, tighten both nuts against the equalizer.

4. Check the cable between the equalizer lever and the parking brake control handle. If the cable is loose turn the equalizer lever nut forward far enough to remove the slack in the cable without moving the equalizer lever.

HYDRAULIC SYSTEM BLEEDING

When any part of the hydraulic system (Fig. 6) has been disconnected for repair or replacement, bleed the hydraulic system after it has been properly connected to be sure that all air is expelled from the brake cylinders and lines.

The hydraulic system can be bled manually or with pressure bleeding equipment.

MANUAL BLEEDING

Bleed the longest lines first. Keep the master cylinder reservoir filled with new heavy-duty brake fluid during the bleeding operation. **Never use brake fluid which has been drained from the hydraulic system.**

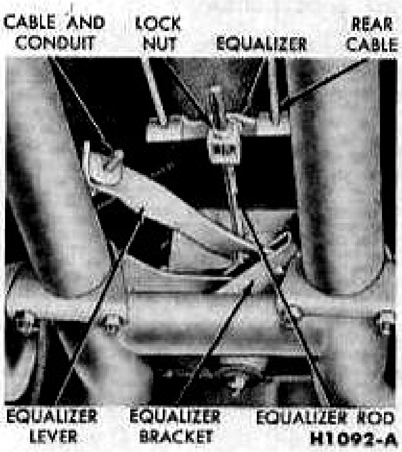

FIG. 5—Parking Brake Linkage

1. Attach a rubber drain tube to the bleeder screw at one of the brake cylinders. **The end of the tube should fit snugly around the bleeder screw.**

2. Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder screw.

3. Push the brake pedal down slowly by hand, allowing it to return slowly to the fully-released position. Repeat this operation until air bubbles cease to appear at the submerged end of the tube.

4. When the fluid is completely

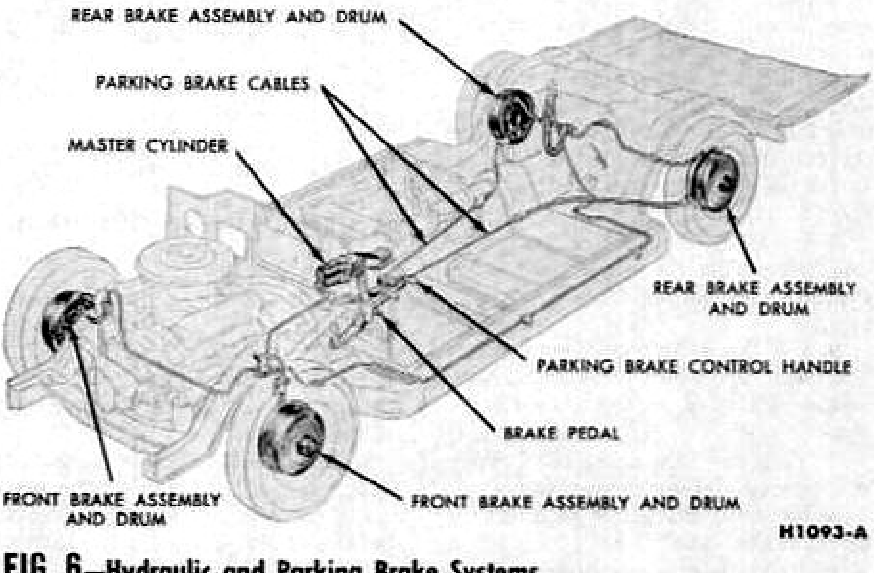

FIG. 6—Hydraulic and Parking Brake Systems

free of air bubbles, close the bleeder screw and remove the drain tube.

5. Repeat this procedure at each brake cylinder. Refill the master cylinder reservoir after each brake cylinder is bled and when the bleeding operation is completed.

PRESSURE BLEEDING

Bleed the longest lines first. **Never use brake fluid which has been drained from the hydraulic system.**

Be sure that there is enough new heavy-duty brake fluid in the bleeder tank to complete the bleeding operation, and that the tank is charged with 10-30 pounds of air pressure.

1. Clean all dirt from around the filler hole on the top of the master cylinder reservoir, and attach the bleeder tank hose to the filler hole.

2. Attach a rubber drain tube to the bleeder screw at one of the brake cylinders. **The end of the tube should fit snugly around the bleeder screw.**

3. Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder screw.

4. Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.

5. When air bubbles cease to appear in the fluid at the submerged end of the drain tube, close the bleeder screw and remove the tube.

6. Repeat this procedure at each brake cylinder.

7. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the filler hole. Refill the master cylinder reservoir to within ½ inch from the top of the filler neck.

3 MASTER CYLINDER, HYDRAULIC LINE, AND BRAKE PEDAL

The master cylinder (Fig. 7), mounted on the dash panel in the engine compartment, converts physical force on the brake pedal into hydraulic pressure against the brake cylinder pistons which, in turn, push the brake shoes against the brake drums.

MASTER CYLINDER REPLACEMENT

1. Disconnect the stop light switch wires from the switch. Remove the brake bolt and 2 copper gaskets from the master cylinder. Discard the gaskets.

2. Force as much brake fluid as possible from the cylinder into a suitable container by pushing down the brake pedal all the way several times.

3. Remove the 4 nuts that hold the master cylinder against the dash panel, and lift the cylinder and boot away from the push rod and out of the engine compartment.

4. To install the new master cylinder, guide the master cylinder boot over the end of the push rod, engage the cylinder on the mounting bolts. Install the mounting nuts, and torque them to 12-18 foot-pounds.

5. Install the brake fitting, gaskets, and bolt on the forward end of the cylinder. Do not tighten the brake bolt.

6. Fill the master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck.

7. Push down the brake pedal several times to let air escape from the cylinder at the fitting, and then tighten the brake bolt.

8. Refill the master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck, then install the filler cap. Wipe off any fluid from the outside of the cylinder and brake line.

9. Connect the stop light switch wires to the switch.

10. Check and, if necessary, adjust the brake pedal free-travel.

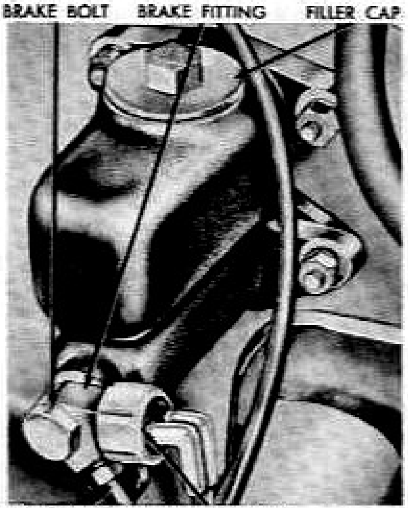

FIG. 7—Brake Master Cylinder

MASTER CYLINDER OVERHAUL

DISASSEMBLY

1. With the master cylinder removed, clean the outside of the master cylinder, and remove the filler cap and gasket. Pour out any brake fluid that may remain in the cylinder and reservoir.

2. Remove the rubber boot and snap ring from the bore at the rear end of the cylinder (Fig. 8). Remove the stop plate, piston, cup, spring, valve, and seat from the cylinder bore. If necessary, blow through the bolt hole at the forward end of the bore to remove the parts.

INSPECTION AND REPAIR

Clean all master cylinder parts in clean denatured alcohol, and inspect the parts for wear or damage, replacing them as required. **When a master cylinder repair kit is used, install all of the parts supplied in the kit.**

Check the ports and vents in the master cylinder to make sure that all are open and free of foreign matter. If the spring valve (riveted to the front end of the piston) is loose or has moved so that the piston ports are open, replace the piston. Inspect the cylinder walls for scores or rust, and recondition them if necessary. **Hone the cylinder walls no more than necessary (0.003 inch maximum) to obtain a smooth wall surface. Oversize pistons and cups are not available for excessively honed cylinders.** Remove any burrs or loose metal that may have resulted from the honing operation, and clean the cylinder with clean denatured alcohol.

ASSEMBLY

1. Dip all parts except the master cylinder body in clean hydraulic brake fluid. **Use only heavy-duty brake fluid.**

2. Install the valve seat, valve, spring, cup, piston, and stop plate in the cylinder bore (Fig. 8). Install the snap ring in the rear end of the bore and install the boot.

HYDRAULIC LINE REPLACEMENT

Steel pipe is used in the hydraulic lines between the master cylinder and the front brake pipe connector (Fig. 9), and between the rear brake pipe connector (Fig. 10) and the rear brake cylinders. Flexible hoses connect the brake pipe to the front brake cylinders and to the rear brake pipe connector.

When replacing hydraulic brake pipe, hoses, or connectors, always use new gaskets, and tighten all connections securely.

BRAKE PIPE REPLACEMENT

If a section of the brake pipe becomes damaged, the entire section should be replaced with pipe of the same type, size, shape, and length. **Copper tubing should not be used in a hydraulic system.** When bending brake pipe to fit body side rail or rear axle contours, be careful not to kink or crack the pipe.

All brake pipe should be flared properly to provide good leak-proof connections. Clean the brake pipe, by flushing with clean denatured alcohol, before installation.

BRAKE HOSE REPLACEMENT

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. A rear brake hose should be installed so that it does not touch the muffler outlet pipe or shock absorber.

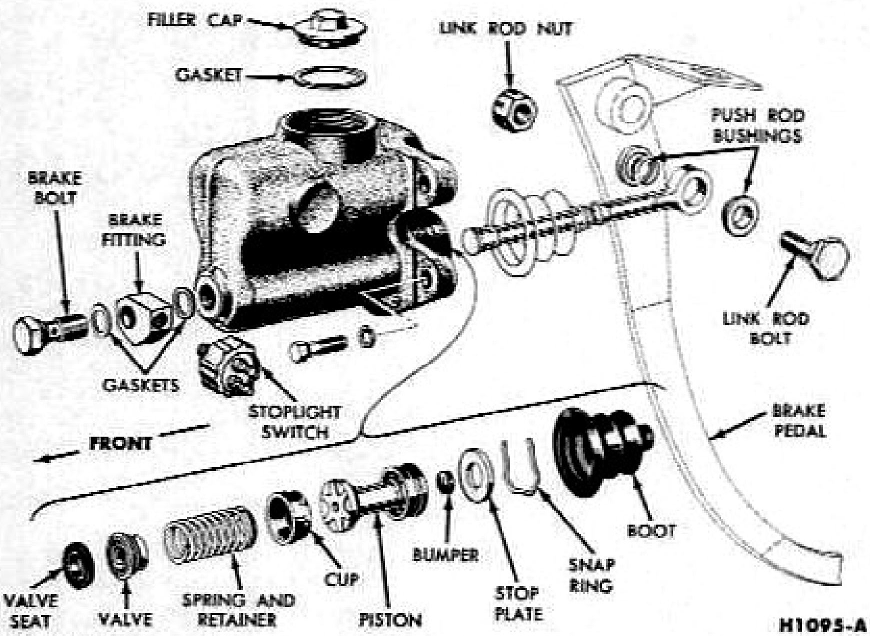

FIG. 8—Disassembled Brake Master Cylinder

BRAKE PEDAL REPLACEMENT

THUNDERBIRD WITH CRUISE-O-MATIC

1. Remove the headlight beam selector switch and remove the left cowl trim panel by removing the 2 screws and sliding the panel out of the retainer.

2. Loosen the hood control cable-to-mounting bracket retaining nut, run the nut off the threads of the shaft and remove the cable from the bracket. Remove the hood cable mounting bracket.

3. Remove the left vent-air register panel by removing the 6 screws and 3 attaching bolts. Lower the parking brake control handle, tilt the panel outward at the bottom, and remove the panel.

4. With a screwdriver, unseat the retracting spring from the brake pedal and from the hole in the pedal support bracket (Fig. 11).

5. Remove the hair spring clip, spring washer and plastic washer from the left end of the brake pedal shaft.

6. Remove the brake pedal shaft and plastic bushing out the right side of the pedal support bracket. Lower the brake pedal and master cylinder push rod from the support bracket, pulling the push rod out of the master cylinder boot, holding the boot in place as the push rod is withdrawn. Remove the pedal assembly from the car.

7. Remove the spring insulator, retracting spring, notched nylon insulator and rubber bumper from the brake pedal. Disconnect the push rod from the brake pedal by removing the eccentric bolt locknut, eccentric bolt, and 2 nylon bushings.

8. To aid installation, apply a small quantity of Lubriplate in the bore of the plastic bushing and the brake pedal.

9. Insert the rubber bumper in the pedal bracket. Slide the retracting spring over the pedal boss and insert the nylon insulator between the spring coils and the boss. Position the notched nylon insulator over the small boss on the right side of the pedal with the tabs against the boss.

10. Position the pedal assembly in the pedal support bracket (Fig. 11). Insert the brake pedal shaft and bushing from the right side of the support bracket and push the shaft all the way through the bracket. Install the plastic washer and spring washer on the left-hand end of the brake

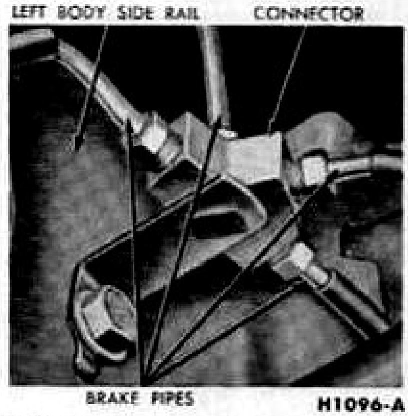

FIG. 9—Front Brake Pipe Connector

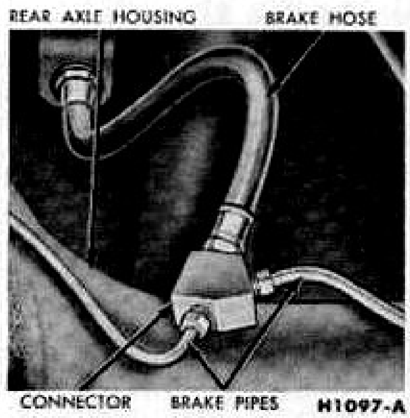

FIG. 10—Rear Brake Pipe Connector

pedal shaft. Secure the shaft to the bracket with the hair spring clip.

11. Insert the small end of the retracting spring into the support bracket. Connect the other end to the underside of the brake pedal.

12. Insert the push rod into the boot and bore of the master cylinder. Position the 2 nylon bushings in the push rod bore and secure the push rod to the brake pedal with the eccentric bolt and locknut.

13. Check and, if necessary, adjust the brake pedal free-travel.

14. Install the vent-air register panel, hood cable mounting bracket, and hood control cable. Install the left cowl trim panel and headlight beam selector switch.

THUNDERBIRD WITH CONVENTIONAL DRIVE OR OVERDRIVE

1. Remove the headlight beam selector switch and remove the left cowl trim panel by removing the 2 screws and sliding the panel out of the retainer.

2. Loosen the hood control cable-to-mounting bracket retaining nut, run the nut off the shaft and remove the cable from the bracket. Remove the hood cable mounting bracket. Remove the overdrive control handle and bracket if so equipped.

3. Remove the left vent-air register panel by removing the 6 screws and 3 attaching bolts. Lower the parking brake control handle, tilt the panel outward at the bottom, and remove the panel.

4. Open the hood. Disconnect the wires from the stoplight switch at the brake master cylinder. Remove the brake bolt from the master cylinder outlet. Discard the 2 gaskets.

5. Force as much brake fluid as possible from the cylinder into a suitable container by pushing down on the brake pedal all the way several times.

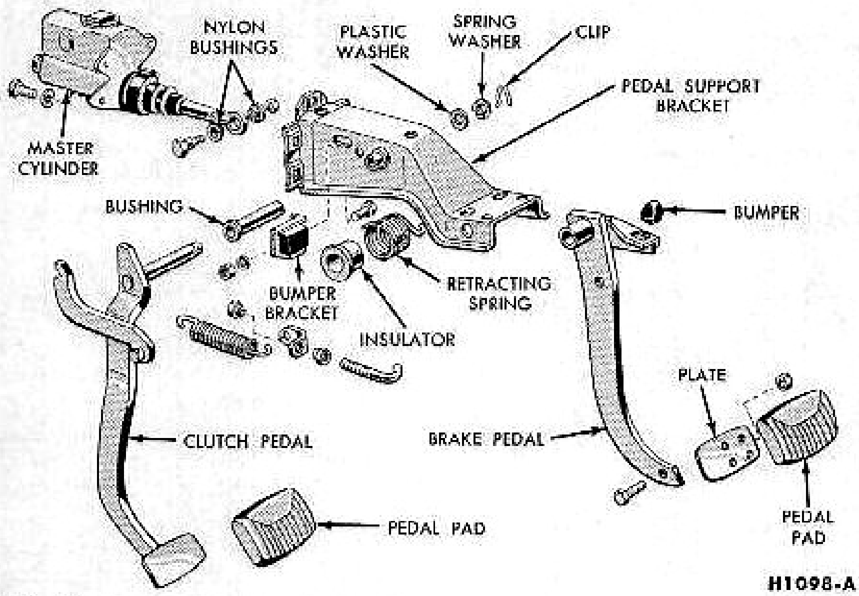

FIG. 11—Brake Pedal and Related Parts

6. Remove the 5 nuts and lockwashers which attach the master cylinder and pedal support bracket to the dash panel (Fig. 11). Remove the cylinder from the mounting bolts, sliding the boot from the push rod.

7. Depress the clutch pedal to relieve tension on the assist spring, and back off the nut on the forward side of the spring link. Remove the spring, spring link, and spring retainer.

8. Disconnect the clutch pedal-to-idler lever rod from the clutch pedal by removing the retaining pin and washer.

9. If the car is equipped with a radio, remove the radio power unit, secured to the left vent-air register, by removing the 4 mounting screws.

10. Disconnect the wires from the steering column.

11. Remove the cotter pin, spring washer, and plastic washer, from the right side of the clutch pedal shaft.

12. Disconnect the push rod from the brake pedal by removing the eccentric bolt locknut, eccentric bolt, and 2 nylon bushings.

13. Remove the 2 steering column mounting screws and remove the steering column bracket. Remove the 2 pedal support bracket bolts at the instrument panel end of the support bracket. Slide the support bracket out of the mounting holes in the dash panel, turn the support bracket to the left, pull the clutch pedal to the rear, and remove the clutch pedal (with shaft) and plastic bushing out the left side of the bracket. Lower the brake pedal assembly.

14. Remove the spring insulator, retracting spring, notched nylon insulator, and rubber bumper from the brake pedal.

15. Turn the pedal support bracket to the right, position the brake pedal assembly in the support bracket, insert a ½-inch diameter drift in right side of support bracket to maintain alignment of the brake pedal assembly (Fig. 11).

16. Turn the support bracket and brake pedal assembly to the left. Insert the clutch pedal shaft in the left-hand boss of the support bracket and push the shaft all the way through the bracket, using care to remove the drift at the same time.

17. Position the support bracket so that the 5 bolts line up with the holes in the dash panel, slide the bracket to the dash panel, inserting the push rod in the master cylinder opening, and secure the bracket with 2 bolts at the instrument panel end of the bracket.

18. Install the steering column bracket and secure with mounting screws. Install the plastic washer, spring washer, and cotter pin on the right-hand end of the clutch pedal shaft.

19. Install the master cylinder. Install the mounting nuts and the support bracket mounting nut above the master cylinder. Torque all 5 mounting nuts 12-18 foot-pounds.

20. Install the brake bolt finger tight, using 2 new gaskets.

21. Fill the master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck.

22. Push down on the brake pedal several times to let air escape from the cylinder at the fitting, and then tighten the brake bolt.

23. Refill the master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck, and install the filler cap. Wipe off any fluid from the outside of the cylinder and brake line. Connect the stop light switch wires to the switch. Close the hood.

24. Connect the retracting spring to the support bracket and brake pedal. Position the 2 nylon bushings in the push rod bore and secure the push rod to the brake pedal with the eccentric bolt and locknut.

25. If the car is equipped with a radio, install the radio power unit.

26. Connect the clutch pedal-to-idler lever rod to the clutch pedal with a washer and a retaining pin. **Make sure the clutch release rod is set in the clutch release lever before securing the idle lever rod to the clutch pedal.**

27. Install the clutch pedal assist spring, spring link, and retainer. Adjust the spring tension to its original setting at the spring retainer.

28. Check and, if necessary, adjust the brake pedal and clutch pedal free-travel.

29. Connect the wires to the steering column.

30. Install the vent-air register panel, hood cable mounting bracket and hood control cable. If the car is equipped with Overdrive, install the overdrive control cable and mounting bracket. Install the left cowl trim panel, and headlight beam selector switch.

4 BRAKE ASSEMBLY REPAIR

BRAKE DRUM

A brake drum should be replaced if the drum is cracked, distorted, or loose at the hub.

FRONT BRAKE HUB AND DRUM REPLACEMENT

1. Raise the car. Remove the hub cap, and wheel retaining nuts, and then remove the wheel and tire assembly. Back off the brake shoe adjustment.
2. Remove the grease cap, spindle nut cotter pin, spindle nut and washer.
3. Remove the drum assembly.
4. Clean the inner and outer bearing cone and rollers with solvent, and dry them thoroughly.
5. Inspect the cone and rollers for wear or damage and replace them if necessary.
6. Before installing the inner bearing and grease retainer in the new replacement drum, wash the assembly thoroughly with cleaning fluid to remove all protective grease and oil.
7. Follow the instructions outlined in Part 8 Section 3 (Front Hubs, Bearings, and Grease Retainers) concerning installation of bearings, retainer, and the proper method of lubrication.
8. Place the brake hub and drum on the wheel spindle. Install the washer, spindle nut, spindle nut cotter pin, and the grease cap.
9. Place the wheel and tire assembly on the hub and drum and install the retaining nuts.
10. Install the hub cap, adjust the brake shoes, and lower the car.

REAR BRAKE DRUM REPLACEMENT

1. Raise the car and remove the hub cap.
2. Remove the wheel and tire as an assembly. Then back off the rear brake shoe adjustment.
3. Remove the brake drum retaining nuts and remove the drum.
4. Before installing a new replacement brake drum, wash the drum thoroughly with cleaning fluid to remove all protective grease and oil.
5. Position the brake drum on the hub and install the retaining nuts.
6. Install the wheel and tire assembly. Adjust the brake shoes, replace the hub cap, and then lower the car.

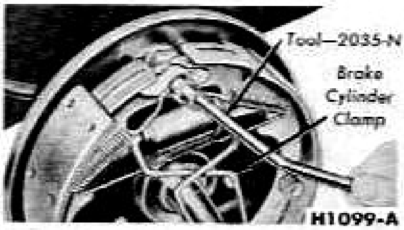

FIG. 12—Retracting Spring Removal

BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

If it has been determined that the brake drum requires turning, the following precautions should be exercised:

1. Make sure the brake drum turning tool bit is sharp. Dull tool bits result in improper drum surface finish.
2. The front wheel and tire assembly should be mounted on the drum to simulate conditions as the assembly will be on the car. Due to the loose assembly of the hub to the drum (hub is not staked to the drum), it is possible to misturn the drum due to drum cocking on the hub.
3. Maximum boring limits are .060 inch on the diameter. Do not remove any more material than is necessary to true the drum. In no instance should the .060-inch maximum limit be exceeded as excessive material removal will weaken the structure and may cause drum distortion during brake application.

If the diameter of the drum is less than 0.030 inch oversize after refinishing, install standard linings. If the diameter is .030 to .060 inch oversize, install oversize lining.

4. The rate of tool feed should not be excessive. Too fast a rate will not clean up the drum and may cause threading of the drum surface.

BRAKE SHOE REPLACEMENT

1. Remove the wheel and drum. **Do not push down the brake pedal while the brake drum is removed.**
2. Clamp the brake cylinder boots against the ends of the cylinder, and remove the brake shoe retracting springs from both shoes (Fig. 12). The lower retracting spring connects with the coils of the shoe retracting springs.
3. Remove the hold-down spring cups and springs from the shoes, and remove the shoes and the adjusting screw parts from the carrier plate. **Do not let oil or grease touch the brake linings.** Remove the hold-down spring pins from the carrier plate. On the rear brake, remove the parking brake lever, link, and spring with the shoes.
4. Remove the adjusting screw parts from the brake shoes.
5. Clean all brake assembly parts except the shoes and linings in cleaning fluid. If the adjusting screw does not operate freely, remove the socket and nut from the screw, and clean the parts. Wipe dirt and corrosion off the carrier plate. After cleaning, dry the parts thoroughly with compressed air or a clean cloth.
6. Inspect the other brake assembly parts, and replace any that are worn, broken, or bent.
7. Coat all points of contact between the brake shoes and the other brake assembly parts with Lubriplate or an equivalent lubricant. Lubricate the threads on the adjusting screw.

8. Place the adjusting screw, socket, and nut on the brake shoes so that the star wheel on the screw is opposite the adjusting hole, and install the adjusting screw spring.

9. Position the brake shoes and the adjusting screw parts on the carrier plate, and install the hold-down spring pins, springs, and cups. On the rear brake, install the parking brake lever, link, and spring with the shoes.

10. Install the brake shoe retracting springs on both shoes (Fig. 14), being careful not to bend the hooks or to stretch the springs beyond the attaching points. **The primary shoe spring must be installed first.** Install the lower retracting spring, inserting the ends of the spring into the coils of the shoe retracting springs.

11. Remove the clamp from the brake cylinder boots, and install the wheel and drum.

12. Adjust the brakes. When all the brake shoes have been properly adjusted, road test the car and check the operation of the brakes.

BRAKE SHOE RELINING

A brake shoe should be relined when the lining face is worn to within 1/32 inch of any rivet head or when the lining has been soaked with oil or grease. If a worn lining is not replaced, the brake drum may become severely damaged. **Always replace the primary and secondary brake shoe lining assemblies on both front or both rear brake assemblies at the same time.**

Before relining a brake shoe, inspect the shoe for distortion, cracks, or looseness between the rim and web. If one of these conditions exists, replace the shoe. **Do not attempt to repair a damaged brake shoe.**

1. Remove the rivets and remove the old lining.

2. Clean the shoe thoroughly with cleaning fluid, especially the rim surface. Wipe the shoe dry and remove all burrs or rough spots from the shoe.

3. Check the inside diameter of the brake drum. If the diameter is less than 0.030 inch oversize, install standard linings. If the diameter is 0.030-0.060 inch oversize, install oversize or shimmed linings.

4. Position the new linings on the shoe and install new rivets, beginning with the rivet holes near the center of the shoe. Since the primary lining is shorter than the secondary lining, position the primary lining to line up with the heel end of the shoe.

Do not let oil or grease touch the brake lining. If a brake lining kit is used to replace the worn linings, install all the parts supplied in the kit.

5. Check the clearance between the lining and the shoe rim. The lining must seat snugly against the rim with not more than 0.005-inch separation midway between any two rivets. Ford replacement linings are ground in production and do not require additional grinding.

BRAKE WHEEL CYLINDER

REPLACEMENT

1. Remove the wheel, drum, and brake shoes.

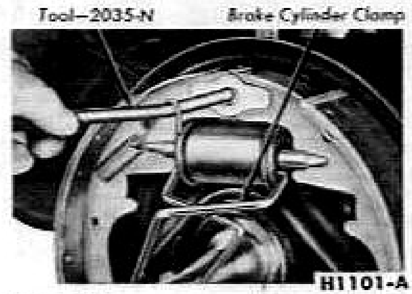

FIG. 14—Retracting Spring Installation

2. Disconnect the brake line from the brake cylinder. **On a car with a vacuum brake booster, be sure the engine is stopped and there is no vacuum in the system before disconnecting the hydraulic lines.**

3. Remove the brake cylinder retaining bolts and lockwashers, and then remove the cylinder from the carrier plate.

4. Position the brake cylinder on the carrier plate, and install the retaining bolts and lockwashers.

5. Install a new gasket on the brake line fitting and connect the line to the brake cylinder.

6. Install the brake shoes, drum, and wheel.

OVERHAUL

1. With the wheel cylinder removed, remove the rubber boots from the ends of the brake cylinder. Remove the pistons, cups, and piston return spring from the cylinder (Fig. 13).

2. Remove the bleeder screw from the cylinder.

3. Clean all brake cylinder parts in clean denatured alcohol. Inspect all parts for wear or damage. Check the cylinder bore for rust, scores, or other damage. Be sure that the bleeder screw passage is clean and open. Replace all parts that are worn or damaged. **When a brake cylinder repair kit is used, install all of the parts supplied with the kit.** If dirt is found in any part of the hydraulic system, flush the entire system with clean denatured alcohol.

4. Coat all brake cylinder parts with clean heavy-duty brake fluid.

5. Install the bleeder screw on the brake cylinder.

6. Place the piston return spring, cups, and pistons in the cylinder bore, and clamp the brake cylinder boots against the ends of the cylinder.

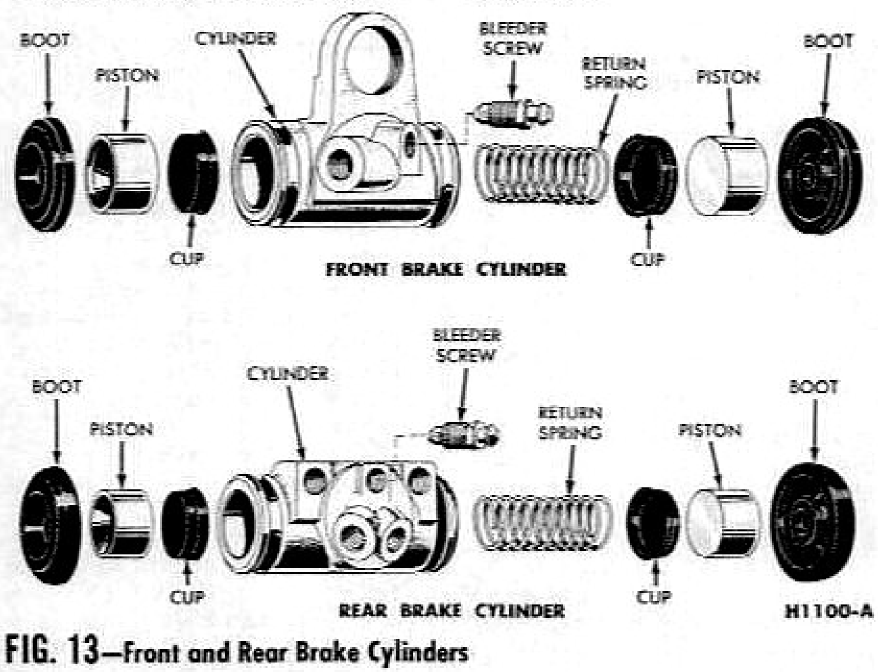

FIG. 13—Front and Rear Brake Cylinders

PART 10-2 POWER BRAKES—UNITS WITHOUT AIR CONDITIONING

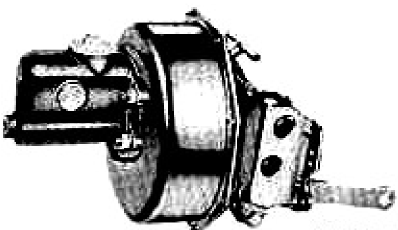

FIG. 1—Power Brake Booster

On a Thunderbird that is not equipped with air conditioning, the power brake assembly (Fig. 1), is mounted on the engine side of the dash panel. A vacuum reservoir, mounted on the left front fender splash shield, gets its vacuum from the engine intake manifold. A check valve, traps vacuum in the reservoir when the engine is stopped, and prevents the accumulation of raw gasoline in the reservoir and other parts of the booster unit. All other brake system components, are identical to the standard hydraulic system described in Part 10-1 of this group.

The vacuum reservoir maintains enough vacuum (after the engine has stopped) for several power-assisted brake applications. Should the power unit fail, the car can still be braked, although greater pedal pressure by the operator will be necessary for a given application.

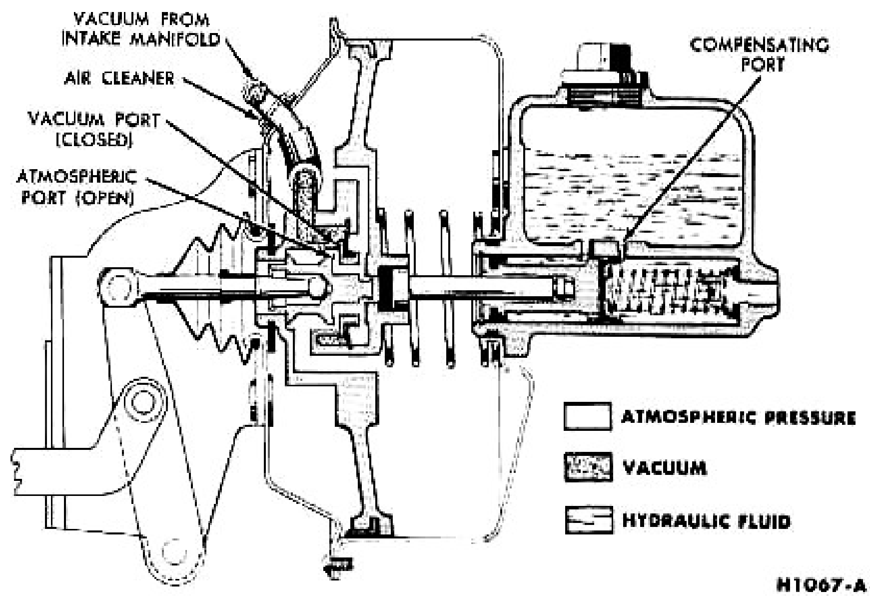

FIG. 2—Booster in Released Position

When the pedal is in the released position, the bellows chamber is open to atmospheric pressure, and vacuum pressure is cut off by the vacuum valve which is held closed by its spring (Fig. 2).

With the engine running and the brake pedal depressed, the atmospheric port (Fig. 3), closes and the vacuum valve opens. Thus, vacuum from the intake manifold (or the vacuum reservoir) removes air from the bellows chamber which contracts and exerts force on the brake pedal through the brake power lever. The amount of assist supplied by the power unit is always directly proportional to the amount of pressure being applied to the pedal. Gradual application of the brakes is thus possible. When the pedal is released, the trigger (attached to the brake pedal) allows the vacuum valve to close, and the air valve to open, eliminating the power assist to the power lever.

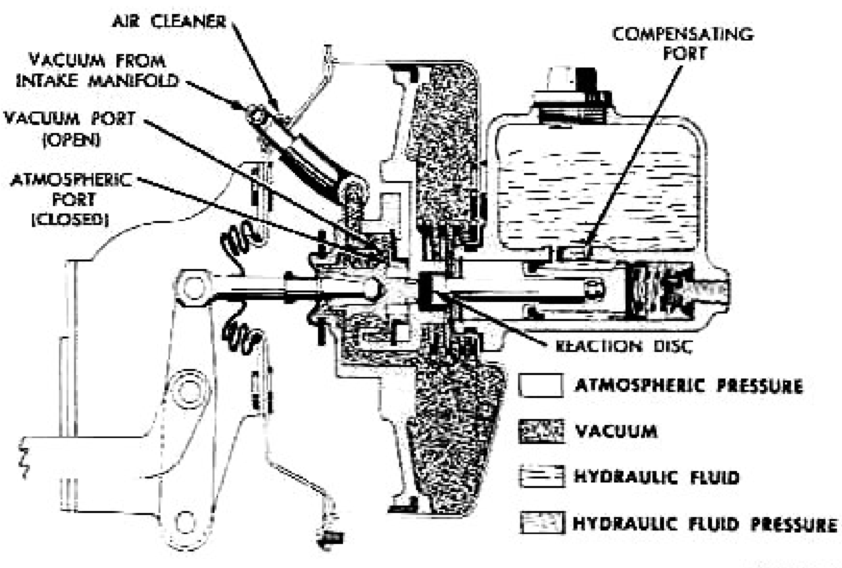

FIG. 3—Booster in Applied Position

1 TROUBLE SHOOTING

PRELIMINARY CHECKS

With the engine stopped, and after the brakes have been applied several times to eliminate vacuum from the system, preliminary checks can be made, similar to those for conventional brakes. The brake bleeding procedure is the same as for conventional brakes.

TROUBLE SHOOTING

HARD PEDAL	Check as follows to see if the power unit is operating: With the engine stopped, depress the brake pedal several times to eliminate all vacuum from the system. Apply the brakes, and while maintaining pressure on the pedal, start the engine. If the unit is operating, the brake pedal will move forward slightly when engine vacuum power is added to the foot pressure on the pedal. If the unit is not operating, there will be no pedal action. If this check shows that the unit is not operating, remove the hose from the power unit and check the vacuum source by placing a thumb over the hose. Remove the thumb and note the volume of the suction (gulp of air). If no trouble is found in the vacuum source, install the hose, making sure there are no kinks, and check the power unit. Check the air cleaner to make sure that is is clean and free of restrictions. Remove the vacuum cylinder and inspect the internal vacuum hose to see that it is properly installed and is not restricted. If the hose is faulty replace it. Also, be sure the inside of the cylinder is clean. Inspect the vacuum cylinder piston for faulty packing and replace if necessary. Also check the piston to make sure it is not jammed.
SLOW BRAKE PEDAL RETURN (OR FAIL TO RELEASE)	This condition may result from a clogged air cleaner or improper master cylinder push rod adjustment. Internal causes may be a restricted air passage, sticky valve plunger, broken return spring, or the atmosphere poppet valve stuck in a closed position. The air passages should be checked for restrictions and blown out. The valve plunger may be touched up lightly with crocus cloth. **DO NOT OIL.** Replace if necessary. If the return spring is broken, weak, or distorted it should be replaced. The power piston must be disassembled to locate and correct the cause of a sticking poppet valve. If the poppet valve appears faulty it should be replaced.

2 POWER BRAKE REPAIR

POWER UNIT REMOVAL

1. Working inside the car under the instrument panel, remove the eccentric bolt lock nut and push the eccentric bolt out through the brake pedal and the power brake push rod.

2. Open the hood. Disconnect the wires from the stoplight switch at the brake master cylinder. Remove the brake bolt from the master cylinder outlet. Discard the two gaskets.

3. Loosen the clamp that secures the manifold vacuum hose to the power unit. Remove the hose from the unit.

4. Loosen the clamp that secures the vacuum reserve tank hose to the power unit. Remove the hose.

5. Remove the four nuts and lock washers which secure the booster assembly to the cowl panel. Remove the assembly from the mounting bolts, sliding the push rod out through the cowl panel opening.

DISASSEMBLY OF POWER UNIT ASSEMBLY

Handle the hydraulic system parts carefully to prevent their coming in contact with mineral oil or grease. When overhauling the assembly, always use a repair kit. If the piston packing or diaphragm needs replacing, use a piston packing and diaphragm kit.

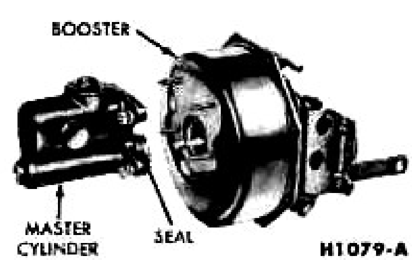

FIG. 4—Master Cylinder Removed

REMOVAL OF MASTER CYLINDER

1. Remove the four master cylinder attaching nuts and lockwashers and lift off the master cylinder (Fig. 4).

2. Remove the push rod from the power section of the booster and remove the rubber seal from the groove in the master cylinder.

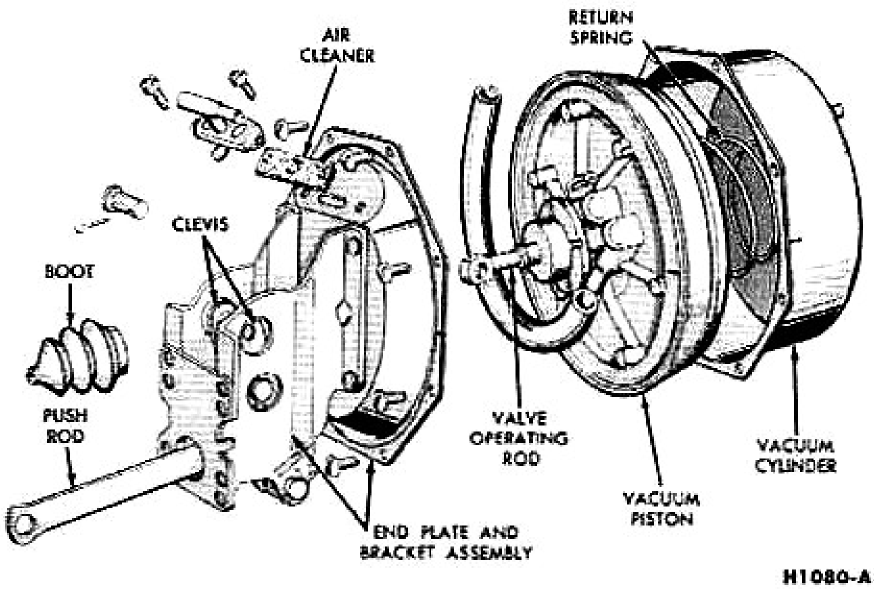

FIG. 5—End Plate and Piston Removed

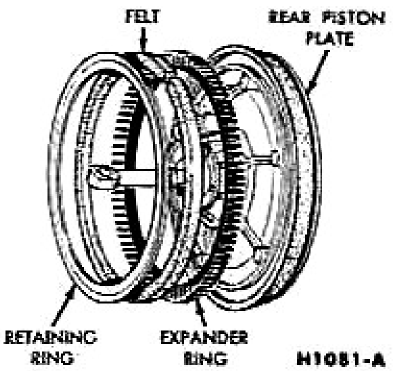

FIG. 6—Vacuum Piston Details

REMOVAL OF END PLATE, AIR CLEANER AND VACUUM PISTON

1. Scribe across the end plate and vacuum cylinder.

2. Remove the cotter pin and clevis pin from the end of the push rod and levers (Fig. 5), and then remove the rubber boot from the push rod.

3. Remove the eight end plate attaching screws and separate the end plate from the vacuum cylinder.

4. Disconnect the hose from the vacuum tube on the air cleaner. Remove the air cleaner attaching screws, air cleaner and air filter from the end plate.

5. Scribe across the piston and vacuum cylinder.

6. Pull out the vacuum piston from the cylinder and remove the vacuum hose. Remove the piston return spring.

REMOVAL OF FELT RETAINER, FELT AND EXPANDER RING

1. Spring the felt retaining ring sufficiently to disengage the ring from the grooves in the bosses on the rear piston plate (Figs. 6 and 7).

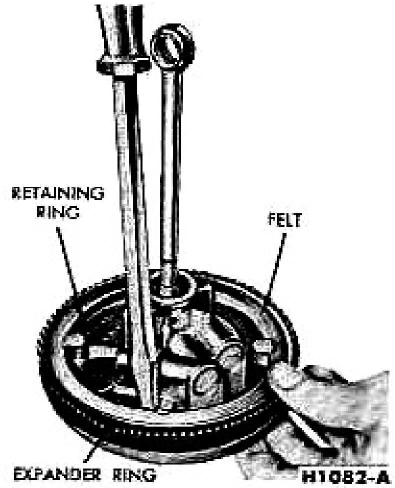

FIG. 7—Retaining Ring Removal

2. Remove the piston felt and expander ring from the piston assembly.

DISASSEMBLY OF VACUUM PISTON AND VALVE

1. Remove the rubber dust guard from the push rod and the rear piston plate (Fig. 8). Then remove the six cap screws from the front piston plate, lift off the rear piston plate, the leather piston packing, and remove the push rod with the valve plunger from the rear piston plate.

2. Remove the valve return spring, poppet and diaphragm assembly, poppet spring, and poppet support plate. Separate the poppet spring retainer and the poppet diaphragm from the poppet.

3. Remove the rubber reaction disc

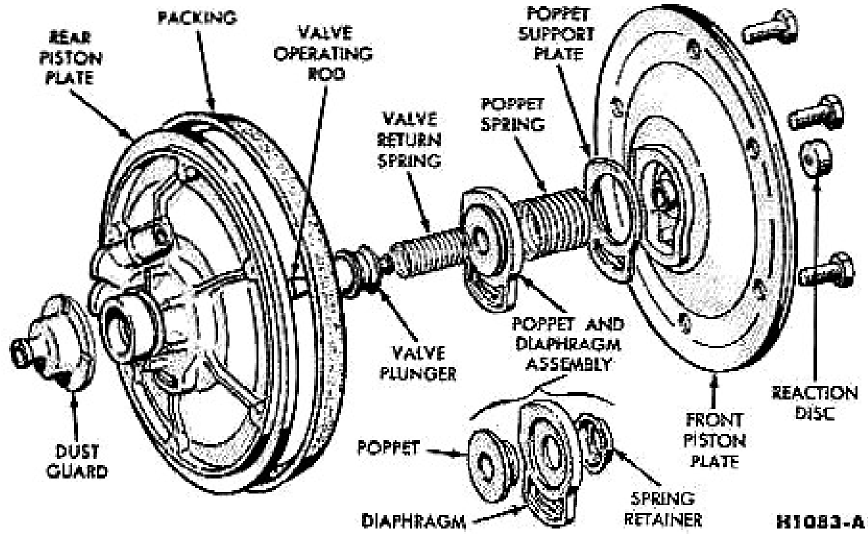

FIG. 8—Disassembled Piston and Valve

from the front piston plate. If necessary, use a piece of rod having a smooth flat end to push the reaction disc out of the piston plate.

Do not separate the valve operating rod from the valve plunger unless it is necessary to replace faulty or damaged parts. To replace either the valve operating rod or valve plunger, hold the assembly with the valve plunger down and inject alcohol in the valve plunger through the opening around the valve rod to wet the rubber lock in the plunger, then drive or pry the valve plunger off the valve rod.

DISASSEMBLY OF MASTER CYLINDER

For disassembly of the master cylinder, follow the steps outlined in "Master Cylinder Overhaul" page 10-6.

CLEANING

After disassembly, immerse all metal parts in a suitable solvent. Use only alcohol on rubber parts or parts containing rubber. After the parts have been thoroughly cleaned and rinsed in cleaning solvent, the metal parts which come in contact with hydraulic brake fluid should be rewashed in clean alcohol before assembly. Use an air hose to blow dirt and cleaning fluid from the recesses and internal passages. When overhauling a power booster, use all parts furnished in the repair kit. **Discard all old rubber parts.**

INSPECTION

Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts. If the inside of the vacuum cylinder is rusted or corroded, polish it with steel wool or fine emery cloth. Replace the cylinder shell when scored. Inspect the master cylinder bore for signs of scoring, rust, pitting or etching. Any of these conditions will require replacement of the cylinder.

ASSEMBLY OF POWER BRAKE ASSEMBLY

A disassembled view of the power brake booster is shown in Figure 9.

ASSEMBLY OF MASTER CYLINDER

Follow the assembly procedures, given in "Master Cylinder Overhaul" page 10-6.

ASSEMBLY OF VACUUM PISTON AND VALVE

1. If the valve operating rod and the valve plunger were separated, dip the valve plunger in alcohol and assemble it to the ball end of the valve operating rod. Make certain that the ball end of the rod is locked in place in the valve plunger. It may be necessary to tap the end of the rod to seat the ball end of the rod in the valve plunger.
2. Insert the valve rod through the hole in the rear piston plate from the side shown in Figure 9, and assemble the rubber guard over the end of the rod and over the shoulder on the piston plate.
3. Assemble the poppet diaphragm over the end of the poppet (Fig. 8). Make certain that the diaphragm is in the recess of the poppet.
4. Press the poppet spring retainer over the end of the poppet and diaphragm.
5. Clamp the valve operating rod in a vise with the rear piston plate up. Lay the leather piston packing on the rear plate with the lip of the leather over the edge of the plate.
6. Install the valve return spring over the end of the valve plunger.
7. Assemble the poppet spring retainer in the relief of the diaphragm and assemble the diaphragm with the retainer over the end of the poppet. Place the poppet assembly in the recess of the rear plate.
8. Install the poppet spring over the shoulder of the retainer.
9. Align and assemble the front piston plate to the rear piston plate.
10. Center the poppet spring on the front piston plate and center the valve plunger stem in the hole of the piston.
11. Hold the front and rear piston plates together and install the six piston plate cap screws. Leave the screws loose.
12. Insert the rubber reaction disc in the recess at the center of the front piston plate.

Use care not to lose the reaction disc out of the piston before the push rod is installed.

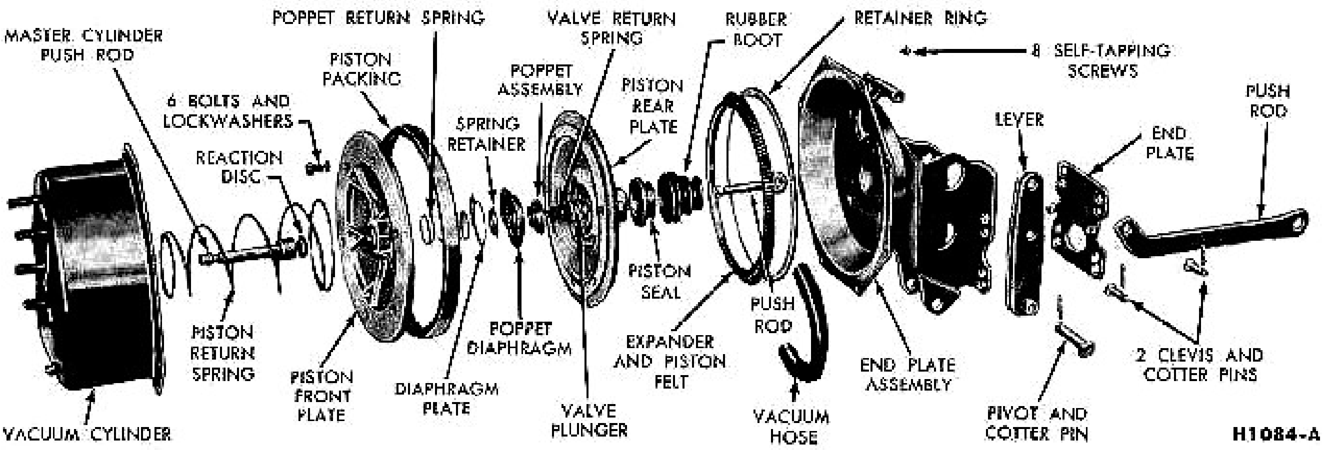

FIG. 9—Disassembled Power Brake Booster

ASSEMBLY OF PISTON EXPANDER RING, FELT, AND RETAINER

1. Turn the piston assembly upside down and assemble the expander ring against the inside lip of the leather packing as shown in Figs. 6 and 10.
2. Saturate the felt in vacuum cylinder oil and assemble it in the expander ring.
3. Assemble the retainer ring over the bosses on the rear piston plate making certain that the retainer is anchored in all six grooves of the pis-

ton plate. Securely tighten the six cap screws in the front piston plate.

ASSEMBLY OF VACUUM CYLINDER, POWER PISTON AND END PLATE

1. Attach the hose to the tube of the vacuum piston and align the hose to lay flat against the piston (Fig. 5).

2. Apply a thin coat of vacuum cylinder oil to the bore of the vacuum cylinder.

3. Saturate the felt with vacuum cylinder oil.

4. Assemble the air cleaner filter over the vacuum tube of the air cleaner and tube assembly and attach the air cleaner to the end plate in the position shown, with screws.

5. Install the end plate over the valve operating rod and attach the vacuum hose to the tube inside of the end plate.

6. Dip the rubber dust guard boot in alcohol and assemble it over the end of the valve operating rod and the flange of the end plate. Attach the valve rod to the levers using the clevis pin with a cotter pin.

Before proceeding further, make certain that the reaction disc is in place in front of the piston plate. Center the small diameter end of the piston return spring in the vacuum cylinder. Center the piston on the spring and check the alignment marks on the piston with the marks on the vacuum cylinder and end plate. Compress the spring and install two attaching screws at opposite sides to hold the end plate and cylinder together. Install balance of the screws and tighten all screws uniformly.

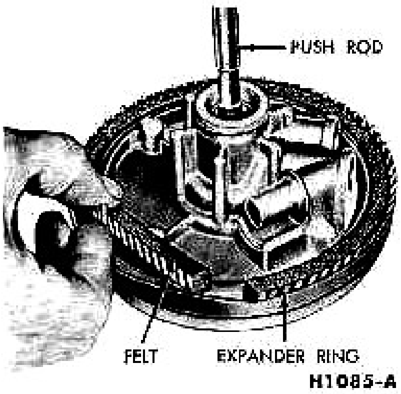

FIG. 10—Felt and Expander Ring Installation

INSTALLATION OF MASTER CYLINDER

1. Insert the large diameter end of the push-rod through the hole at the end of the vacuum cylinder and guide the rod into the hole at the center of the front piston plate.

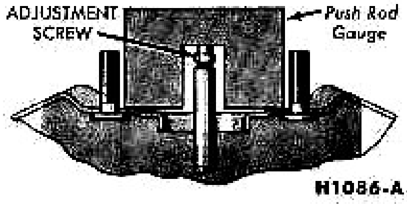

FIG. 11—Push Rod Adjustment

2. Before proceeding with the assembly, check the distance from the outer end of the push-rod to the master cylinder mounting surface on the vacuum cylinder. This dimension should be 0.962″-0.967″. For push-rod adjustment procedure see "Push-Rod Adjustment," which follows:

3. When the push-rod adjustment is correct, replace the rubber seal in the groove of the master cylinder housing and assemble the master cylinder to the vacuum cylinder using lockwashers and nuts. Securely tighten the nuts.

PUSH-ROD ADJUSTMENT

The push-rod is designed with a self-locking adjustment screw to provide the correct relationship between the vacuum power piston and the master cylinder piston. The adjustment screw is set to the correct height at the time of original assembly of the power unit. **Under normal service the adjustment screw does not require any further attention providing the push-rod assembly remains in the original unit.** However, when a new push-rod is used or the push-rod assembly is transferred to another unit, the distance from the end of the adjustment screw to the mounting surface of the vacuum cylinder should be rechecked either with a micrometer depth gauge to a dimension of 0.962-0.967 inch, or with a height gauge as shown in Fig. 11. The details for making a height gauge are given in Fig. 12.

After assembly of the master cylinder to the power section, the piston cup in the hydraulic cylinder should just clear the compensating port hole when the unit is in the fully released position. This can be checked by placing a few drops of brake fluid over the compensating port and applying light air pressure to the output port of the master cylinder. If air bubbles appear, the port is open. If the primary piston cup overlaps the compensating port, there will be no flow of air through the compensating port. If this condition exists, the adjustment screw should be turned into the push-rod a slight amount or until the compensating port is open.

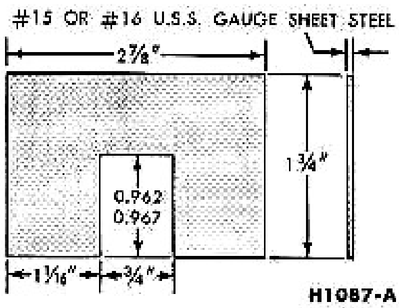

FIG. 12—Push Rod Gauge Dimensions

POWER UNIT INSTALLATION

1. To install, reverse the removal procedure.

2. After the assembly has been installed, bleed the brakes and adjust the push rod as outlined in Part 1 of this section.

BRAKE PEDAL REMOVAL AND INSTALLATION

The procedure for brake pedal removal and installation is the same as outlined in Part 1 of this section, on conventional brakes.

PART 10-3 POWER BRAKES—UNITS WITH AIR CONDITIONING

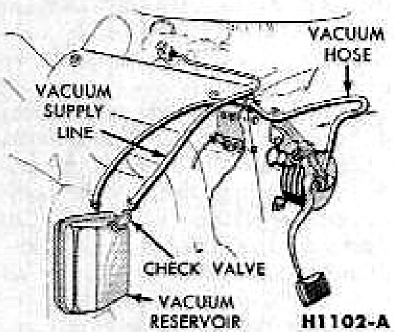

FIG. 1—Power Brake System

On a Thunderbird equipped with air conditioning, the power unit is mounted on the driver's side of the dash panel (Fig. 1). A vacuum reservoir, mounted on the back side of the left front fender splash shield, gets its vacuum from the engine intake manifold. A check valve, traps vacuum in the reservoir when the engine is stopped, and prevents the accumulation of raw gasoline in the reservoir and other parts of the booster unit. All other brake system components, from the master cylinder forward, are identical to the standard hydraulic system described in Part 10-1 of this group.

The vacuum reservoir maintains enough vacuum (after the engine has stopped) for about 3 power-assisted brake applications. Should the power unit fail, the car can still be braked, although greater pedal pressure by the operator will be necessary for a given application.

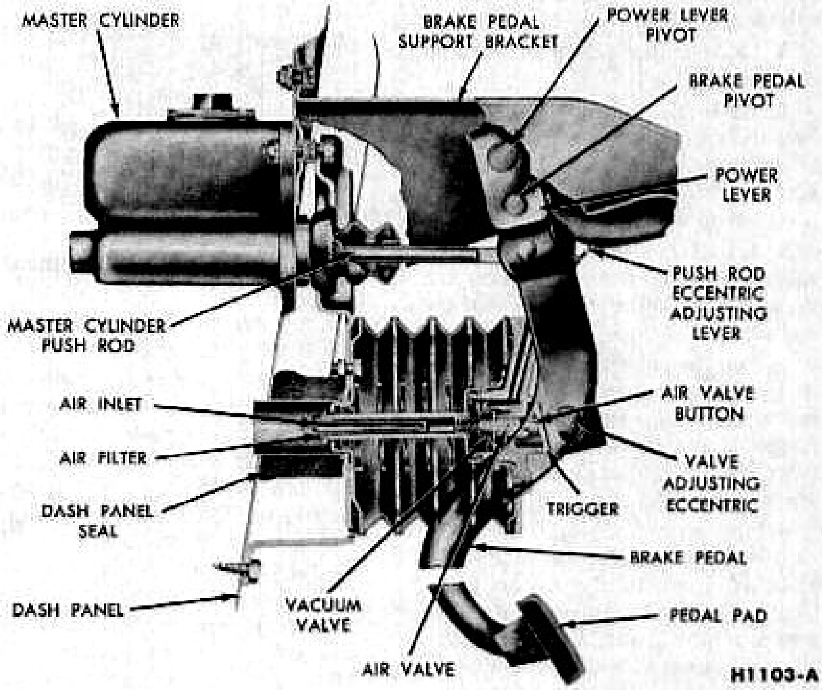

FIG. 2—Pedal Assist Power Brake

When the pedal is in the released position, the bellows chamber is open to atmospheric pressure, and vacuum pressure is cut off by the vacuum valve which is held closed by its spring (Fig. 2).

With the engine running and the brake pedal depressed, the air valve closes and the vacuum valve opens. Thus, vacuum from the intake manifold (or the vacuum reservoir) removes air from the bellows chamber which contracts and exerts force on the brake pedal through the brake power lever. The amount of assist supplied by the power unit is always directly proportional to the amount of pressure being applied to the pedal. Gradual application of the brakes is thus possible. When the pedal is released, the trigger (attached to the brake pedal) allows the vacuum valve to close, and the air valve to open, eliminating the power assist to the power lever.

1 TROUBLE SHOOTING

PRELIMINARY CHECKS

With the engine stopped, and after the brakes have been applied several times to eliminate vacuum from the system, preliminary checks can be made, similar to those for conventional brakes. The brake bleeding procedure is the same as for conventional brakes.

TROUBLE SHOOTING

HARD PEDAL	Check as follows to see if the power unit is operating: With the engine stopped, depress the brake pedal several times to eliminate all vacuum from the system. Apply the brakes, and while maintaining pressure on the pedal, start the engine. If the unit is operating, the brake pedal will move forward slightly when engine vacuum power is added to the foot pressure on the pedal. If the unit is not operating, there will be no pedal action. If this check shows that the unit is not operating, remove the hose from the power unit and check the vacuum source by placing a thumb over the hose. Remove the thumb and note the volume of suction (gulp of air). If no trouble is found in the vacuum source, install the hose, making sure there are no kinks, and check the unit for vacuum leaks. If no vacuum leaks are found, check the valve-adjusting eccentric adjustment (Fig. 1). Remove the master cylinder. Let the master cylinder push rod hang free in the dash panel opening. Loosen the valve-adjusting eccentric nut so that the eccentric can be turned. Turn the valve adjusting eccentric until the unit chatters when the pedal is depressed in an applying movement. Then turn the eccentric until the chatter disappears. Do not turn the eccentric more than necessary or unit "cut-in" will be excessively high. After the eccentric has been adjusted, tighten the eccentric nut to 15-19 foot-pounds torque. Check the eccentric adjustment after the nut is tightened. Install the master cylinder. Adjust the master cylinder push rod. If the power unit eccentric adjustment does not correct the trouble, check for a bent pedal trigger.
PEDAL CHATTERS ON BRAKE APPLICATION	This condition indicates improper adjustment of the valve-adjusting eccentric, or push rod eccentric, or both. Adjust the valve-adjusting eccentric as covered above. Adjust the master cylinder push rod.
SLOW BRAKE PEDAL RETURN	This condition results from a clogged air filter, or improper master cylinder push rod adjustment. To remove the air filter, the power unit must be removed from the car. The power unit can be removed by removing the 2 master cylinder mounting nuts, in the engine compartment, that are closest to the centerline of the car. Remove the valve-adjusting eccentric nut, washer, spring, and sleeve (Fig. 3). Slide the valve-adjusting eccentric to the left until the head of the eccentric contacts the brake pedal. Remove the 2 bolts at the upper end of the power unit mounting bracket, remove the 2 self-tapping screws at the lower end of the bracket. Using care, remove the power unit from the trigger and out of the car. Remove the air filter (Fig. 5) and clean with denatured alcohol, dry the filter thoroughly with compressed air. Reassemble the power unit, install the power unit in the car and adjust the valve-adjusting eccentric as covered above. Check and adjust the master cylinder push rod.

2 POWER BRAKE REPAIR

REMOVAL

POWER UNIT REMOVAL

1. Open the hood. Disconnect the wires from the stoplight switch at the brake master cylinder. Remove the brake bolt from the master cylinder outlet. Discard the 2 gaskets.

2. Force as much brake fluid as possible from the master cylinder into a suitable container by pushing all the way down on the brake pedal several times.

3. Remove the 4 nuts and lockwashers which mount the master cylinder to the dash panel. Remove the cylinder from the mounting bolts, sliding the boot from the push rod.

4. Remove the headlight beam selector switch and remove the left cowl trim panel by removing the 2 screws and sliding the panel out of the retainer.

5. Loosen the hood control cable-to-mounting bracket retaining nut, run the nut off the threads of the shaft, and remove the cable from the bracket. Remove the hood cable mounting bracket. On a car equipped with Overdrive, remove the overdrive control handle and bracket.

6. Remove the left vent-air register panel by removing the 6 screws and 3 attaching bolts. Lower the parking brake control handle, tilt the panel

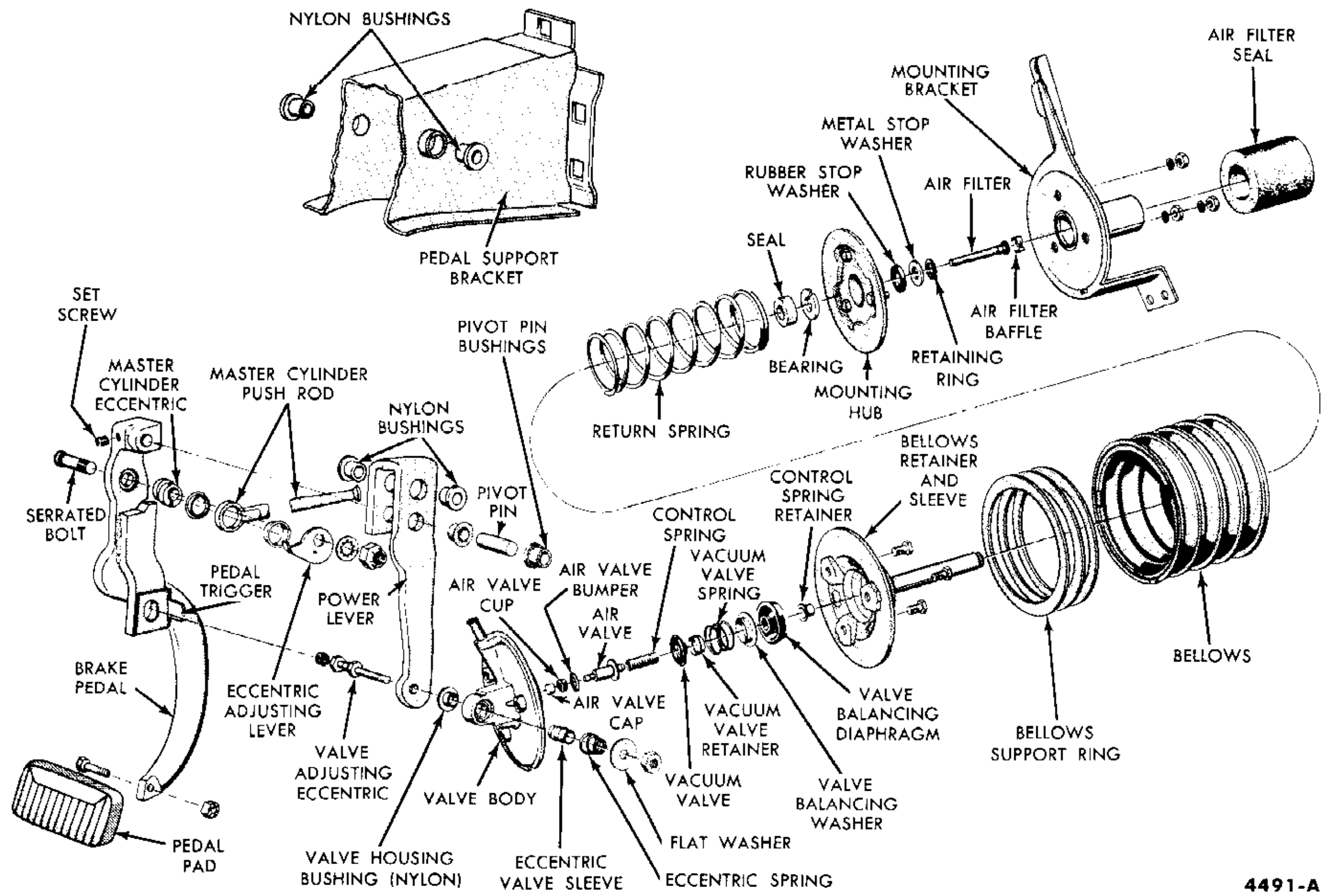

FIG. 3—Power Unit Disassembled

outward at the bottom, and remove the panel.

7. Disconnect the vacuum hose at the power unit. Remove the nut from the valve-adjusting eccentric, remove the flat washer, spring, and sleeve, and slide the eccentric to the left until the head of the eccentric contacts the brake pedal.

8. Remove the 2 bolts at the upper end of the power unit mounting bracket, remove the 2 self-tapping screws from the lower end of the bracket. Using care, remove the power unit from the trigger and out of the car (Fig. 3).

BRAKE PEDAL REMOVAL—POWER UNIT REMOVED

Removal With Cruise-O-Matic

1. Remove the hair spring clip and spring washer from the left end of the brake pedal shaft.

2. Remove the brake pedal shaft from the right side of the pedal support bracket, lower the brake pedal (with master cylinder push rod attached) and power lever from the support bracket, and remove the assembly from the car.

3. Remove the 2 nylon bushings from the outer sides of the support bracket.

Removal With Conventional Drive or Overdrive

1. Remove the pedal support bracket mounting nut and lockwasher above the master cylinder opening in the engine compartment.

2. Depress the clutch pedal to relieve tension on the assist spring, and back off the nut on the forward side of the spring link. Remove the spring, spring link, and spring retainer.

3. Disconnect the clutch pedal-to-idler lever rod from the clutch pedal by removing the retaining pin and washer.

4. If the car is equipped with a radio, remove the radio power unit, secured to the left vent-air register, by removing 4 mounting screws.

5. Disconnect the wires from the steering column.

6. Remove the cotter pin and spring washer from the right side of the clutch pedal shaft.

7. Remove the 2 steering column mounting screws and remove the steering column bracket.

8. Remove the 2 pedal support bracket bolts at the instrument panel end of the support bracket.

9. Slide the support bracket out of the mounting holes in the dash panel, turn the support bracket to the left, pull the clutch pedal to the rear and remove the clutch pedal (with shaft) and plastic bushing out the left side of the bracket. Lower the brake pedal (with master cylinder push rod attached) and power lever and remove them from the car.

10. Remove the 2 nylon bushings from the outer side of the support bracket.

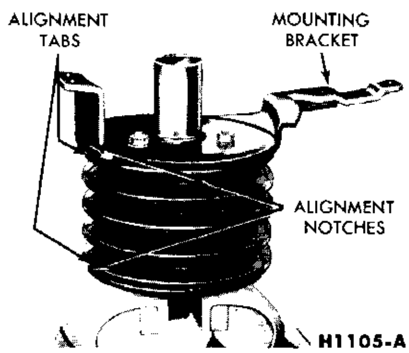

FIG. 4—Pedal Assist Power Unit

BUSHING REPLACEMENT—BRAKE PEDAL REMOVED

1. Remove the 2 nylon bushings from the outer sides of the power lever.

2. The brake pedal pivot pin bushings may now be replaced. Remove the set screw (Fig. 3) that locks the pedal pivot pin to the brake pedal. With a drift, drive the pivot pin out of the brake pedal and remove the power lever from the brake pedal. Remove the 2 pivot pin bushings from the inner sides of the power lever.

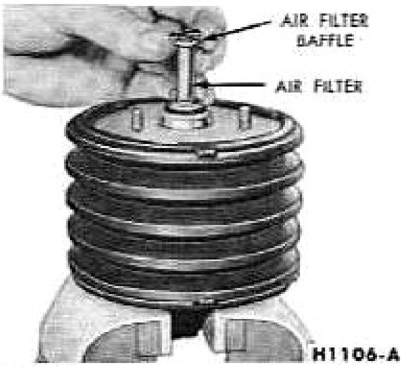

FIG. 5—Air Filter Baffle and Air Filter Removal

3. No special tools are required to replace the pivot pin bushings. Lubricate all nylon bushings with a small quantity of Lubriplate. Insert the pivot pin bushings at the inner sides of the power lever (Fig. 3).

4. Slide the lower end of the power lever over the end of the valve-adjusting eccentric, insert the pivot pin through the power lever, and secure it with a set screw.

5. Install 2 nylon bushings on the outer sides of the power lever and 2 on the outer sides of the support bracket.

6. Install the brake pedal and power lever, following the procedure for the type of transmission in the car.

BRAKE PEDAL INSTALLATION—POWER UNIT REMOVED

Installation With Cruise-O-Matic

1. Install the brake pedal and power lever in the pedal support bracket, setting the push rod in the master cylinder opening in the dash panel, using care to insure proper seating of the nylon bushings in the power lever.

2. Support the brake pedal and power lever, and insert the brake pedal shaft from the right side of the support bracket. Push the shaft all the way through and secure it at the left-hand end with the spring washer and hair spring clip.

Installation With Conventional Drive or Overdrive

1. Install the brake pedal and power lever in the support bracket, setting the master cylinder push rod in the master cylinder dash panel opening, using care to insure proper seating of the nylon bushings in the power lever. Insert a ½-inch drift through the right side of the bracket to maintain alignment of the pedal assembly in the support bracket.

2. Turn the support bracket and brake pedal assembly to the left. Insert the clutch pedal shaft in the left-hand boss of the support bracket and push the shaft all the way through the bracket, using care to remove the drift at the same time.

3. Position the support bracket so that the 3 bolts line up with the holes in the dash panel, slide the bracket to the dash panel, setting the push rod in the master cylinder opening, and secure the bracket with 2 bolts at the instrument panel end of the bracket.

4. Install the steering column bracket and secure it with mounting screws.

5. Install the spring washer and the cotter pin at the right-hand end of the clutch pedal shaft.

6. Install the clutch pedal assist spring, spring link, and retainer. Adjust the spring tension to its original setting at the spring retainer.

7. If the car is equipped with a radio, install the radio power unit.

8. Connect the clutch pedal-to-idler lever rod to the clutch pedal with a washer and a retaining pin. **Make sure the clutch release rod is set in the clutch release lever before securing the idler lever rod to the clutch pedal.**

9. Connect the wires to the steering column.

POWER UNIT DISASSEMBLY

1. Clamp the power unit in a vise equipped with soft jaws (Fig. 4). Remove the three nuts that retain the mounting bracket, and remove the bracket.

2. While pushing down and sideways, unhook the air filter baffle from the guide sleeve, and remove the baffle and filter (Fig. 5).

3. Position a snap ring tool as shown in Fig. 6, then press the mounting hub and bellows down and remove the snap ring, the steel stop washer, and the rubber stop washer from the guide sleeve.

4. While holding the mounting hub down against the return spring, remove the bellows from the hub (Fig. 7). Remove the mounting hub and return spring.

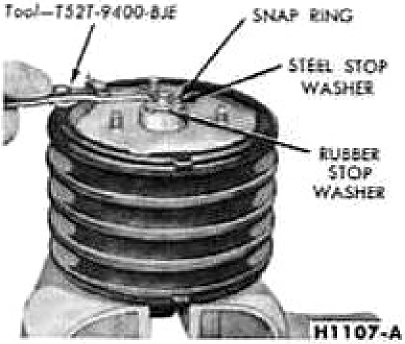

FIG. 6—Snap Ring Removal

5. Remove the three cap screws that secure the retainer and guide sleeve assembly to the valve housing (Fig. 8). Remove the retainer and guide sleeve assembly and bellows from the valve housing. The retainer and sleeve assembly may now be removed from the bellows.

6. Fig. 9 shows the assembly operations for installing the air valve and the vacuum valve. Refer to this figure and reverse the operation order to disassemble. Remove the valve housing from the vise.

INSPECTION

All metal parts, including the air filter, should be washed in alcohol or some other solvent which will not leave an oil film on the parts. Dry all parts thoroughly with moisture-free compressed air.

FIG. 7—Removal of Bellows from Mounting Hub

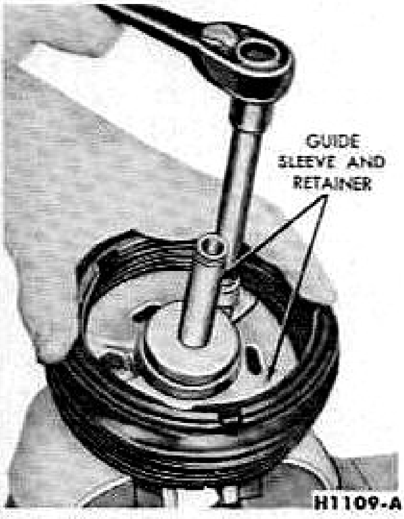

FIG. 8—Guide Sleeve and Retainer Removal

Rubber parts may be cleaned by washing them in a mild soap and water solution, rinsing in clean water, and drying with compressed air.

Replace all worn or damaged parts. Major and minor repair kits contain the parts most likely to need replacement. All parts in a kit should be used.

Carefully inspect the vacuum valve seat in the valve housing. If it is damaged, the housing must be replaced.

ASSEMBLY

1. Mount the valve housing in a vise equipped with soft jaws. Position it so that the alignment marks are readily visible (Fig. 4).

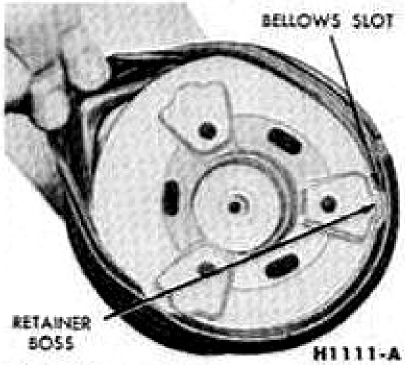

FIG. 10—Bellows to Guide Sleeve and Retainer Installation

2. Refer to Fig. 9 and assemble the air and vacuum valves. Lubricate all moving parts with a light coat of silicone lubricant. **If new valve parts to be installed are coated with this lubricant, do not wipe it off.**

Note that the retainer, which is shown in operation No. 4 (Fig. 9), is installed on the valve balancing diaphragm with the small diameter toward the diaphragm.

In operation No. 5 (Fig. 9), the retainer and the center diaphragm bead must be pressed down over the vacuum valve "neck."

3. If a new bellows is to be installed, remove the three support rings from the old bellows and insert them in the new one.

4. Assemble the bellows (either end) over the retainer and guide sleeve assembly. Be sure that the three bosses in the retainer are aligned with the three slots in the bellows (Fig. 10).

5. Carefully place the assembled bellows and retainer over the valve balancing diaphragm and in position on the valve housing. Start and tighten the three special cap screws finger-tight, then torque them evenly to 7-10 foot-pounds (Fig. 11).

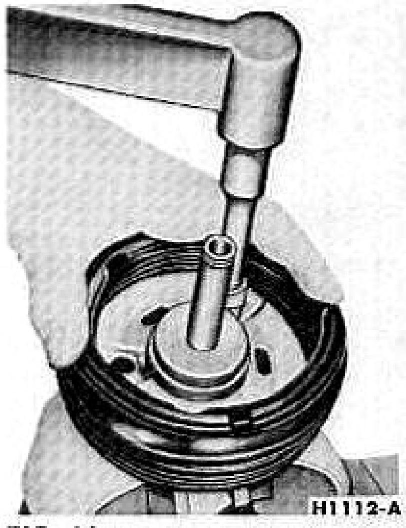

FIG. 11—Retainer and Guide Sleeve to Valve Housing Installation

6. Remove the unit from the vise. Sight down the guide sleeve to make certain the air valve control spring is seated squarely in its retainer (Fig. 2).

7. Test air valve operation (Fig. 12). As the air valve is pushed inward, two definite stages should be felt. At the beginning of air valve travel, only the air valve control spring is being compressed. When the air valve contacts the vacuum valve and moves it off its seat, the vacuum valve spring is also being compressed. When the valve is released it should snap back readily.

8. Place the unit in the vise. Position the return spring (either end up)

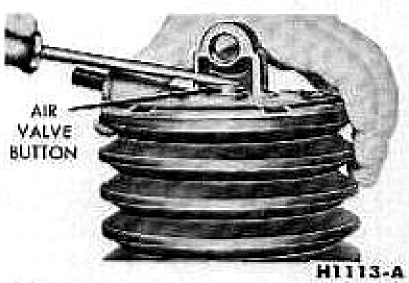

FIG. 12—Air Valve and Vacuum Valve Assembly Check

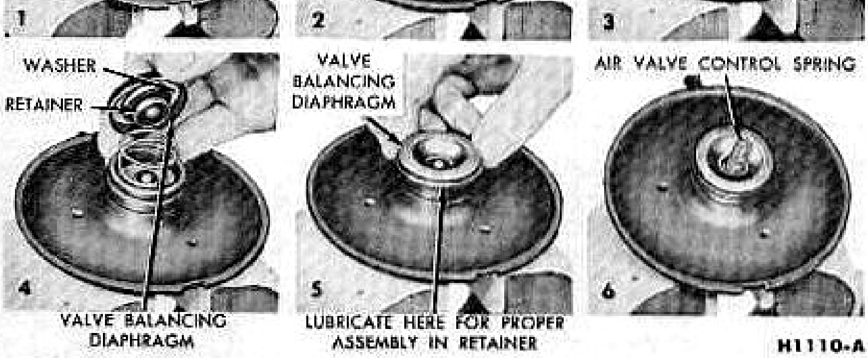

FIG. 9—Air Valve and Vacuum Valve Installation

on the guide sleeve, and slide the mounting hub onto the sleeve.

9. Hold the hub down against the return spring, and assemble the bellows over the mounting hub.

10. While holding the mounting hub down, place the rubber stop washer, and then the steel stop washer, over the guide sleeve (Fig. 6). Install the snap ring.

11. Install the air filter baffle on the filter, then install the filter and baffle in the guide sleeve. The filter baffle fits in the same groove, in the guide sleeve, with and above the snap ring.

12. Place the mounting bracket on the mounting hub. Align the notch in the mounting bracket with the tab on the bellows. Install the lockwashers and nuts, and torque them to 7-10 foot-pounds (Fig. 13).

13. Install the dash panel seal.

14. Remove the power unit from the vise and install the nylon bushing (Fig. 2) in the valve housing.

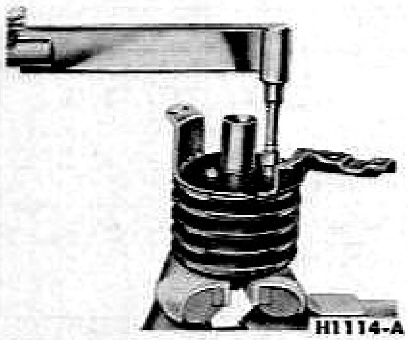

FIG. 13—Mounting Bracket Installation

INSTALLATION

1. Position the power unit mounting bracket on the dash panel. Be sure that brake pedal trigger (Fig. 2) is properly positioned against the end of the air valve button to avoid damage to the button. Install the bolts and self-tapping screws that secure the mounting bracket to the dash panel.

2. Slide the valve-adjusting eccentric and bumper through the brake pedal extension, power lever, and valve housing of the power unit (Fig. 2).

3. Slide the eccentric bushing (either end) over the valve-adjusting eccentric and into the valve housing.

4. Install the eccentric spring with the larger coils toward the housing. Install the flat washer and nut.

5. Tighten the valve-adjusting eccentric nut to the point that the eccentric bolt is firmly locked to the power lever, but can still be turned for adjustment.

6. Attach the vacuum hose.

ADJUSTMENTS

POWER UNIT OPERATION

1. Depress the brake pedal through full travel and check for binding or interference during pedal travel.

2. Check the routing of the vacuum hose to be sure that it passes over the pedal support bracket in a smooth curve and is free of kinks or sharp bends.

3. Check routing of the speedometer cable housing to be sure that housing does not chafe the bellows.

4. Start the engine. Turn the valve-adjusting eccentric until the unit chatters when the pedal is applied. Then turn the eccentric until the chatter disappears. Do not turn the eccentric more than necessary or the unit "cut-in" will be excessively high. If a satisfactory adjustment cannot be made on the valve-adjusting eccentric, the pedal trigger may be bent. Turn the ignition switch off.

5. Remove power unit, remove the brake pedal and the power lever from the car.

6. Separate the power lever from the brake pedal, remove the valve-adjusting eccentric out the right side of the brake pedal extension.

7. Measure the trigger location as shown in Fig. 14. The micrometer reading should be 0.950 inch plus or minus 0.005. If the micrometer reading is not within these limits, bend the trigger to the correct position or replace the pedal.

8. Reassemble the power lever to the brake pedal.

9. Install the brake pedal and power lever, and the power unit in the car.

10. After the eccentric adjustment is made, torque the eccentric nut to 15-19 foot-pounds. Check the eccentric adjustment after the nut has been torqued.

MASTER CYLINDER PUSH ROD LENGTH

1. Install the master cylinder, guiding the push rod into the boot and piston bore of the cylinder. Use care when inserting the boot in the dash panel opening. Install the mounting nuts and lockwashers.

2. Install the support bracket mounting nut above the master cylinder on a car with Conventional Drive or Overdrive. Torque all nuts to 12-18 foot-pounds.

3. Install the brake bolt finger tight, using 2 new gaskets.

4. Fill master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of filler neck.

5. Push down on the brake pedal several times to let air escape from the cylinder at the fitting, and then tighten the brake bolt.

6. Refill the master cylinder reservoir with heavy-duty brake fluid to within ½ inch of the top of the filler neck, then install the filler cap. Wipe off any fluid from the outside of the cylinder and brake line.

7. Connect the stop light switch wires to the switch.

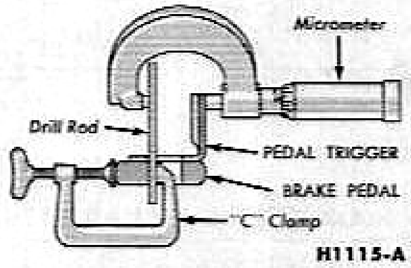

FIG. 14—Pedal Trigger Check

8. To adjust the master cylinder push rod, loosen the push rod eccentric locknut only enough to rotate the eccentric. Rotate the eccentric adjusting lever in an upward direction to its maximum travel. This will shorten the push rod and let the master cylinder piston return to the fully unapplied position. Rotate the eccentric adjusting lever in a downward direction until the master cylinder piston starts to resist movement of the push rod. Hold the eccentric and torque the locknut to 15-19 foot-pounds. Remove the master cylinder filler cap and check the master cylinder at the compensator port for bubbles or spurt, which indicates the push rod is properly adjusted.

9. Check the fluid level. Add fluid to the correct level if needed and reinstall the master cylinder filler cap. Close the hood.

10. Check, and if necessary, adjust the clutch pedal free-travel on a car with Conventional Drive or Overdrive.

11. Install the vent-air register panel, hood cable mounting bracket and hood control cable. If the car is equipped with Overdrive, install the overdrive control cable and mounting bracket.

12. Install the left cowl trim panel and headlight beam selector switch.

PART 10-4 SPECIFICATIONS

DIMENSIONS

Axle	Drum Inside Diameter (Inches)	Drum Maximum Boring Limit (Inches)	Lining Length (Inches)		Lining Width (Inches)		Wheel Cylinder Bore Diameter (Inches)	Master Cylinder Bore Diameter (Inches)
			Primary	Secondary	Primary	Secondary		
Front	11	11.060	11.62	11.93	2½	2½	1³⁄₃₂	1.000
Rear	11	11.060	11.62	11.93	2½	2½	²⁹⁄₃₂	1.000

BRAKE CHECKS AND ADJUSTMENTS

Type of Check or Adjustment	Specification	
Brake Pedal	Pedal Free Play	⁵⁄₁₆-⁷⁄₁₆ inch
Brake Shoe Repair	**Drum Diameter** 11.000-11.030 inch 11.030-11.060 inch	**Brake Lining Required** Standard Oversize
	Brake Lining Clearance (Midway between Rivets) Maximum 0.005 inch	
	Lining Wear Limit (From Top of Rivets) Maximum ¹⁄₃₂ inch	
Master Cylinder	Hydraulic Master Cylinder Bore, Honed Diameter. Maximum 1.003 inch	
Power Unit*	Pedal Trigger Location 0.950 inch ± 0.005 inch	

*Air-conditioner-equipped vehicles only.

TORQUE LIMITS

Description	Foot-Pounds
Front Anchor Pin Bolt	80-100
Spindle to Brake Carrier Plate Upper Bolts	62-72
Spindle to Brake Carrier Plate Lower Bolts	25-29
Master Cylinder Mounting Bolts	12-18
POWER BRAKES ONLY:	
Valve Adjusting Eccentric Nut	180-220 Inch-Pounds
Mounting Bracket to Mounting Hub Nuts	85-115 Inch-Pounds
Master Cylinder to Mastervac Booster	12-18
Mastervac Booster to Dash Panel Mounting Nuts	12-18

BRAKE MASTER CYLINDER LUBRICANT

Capacity	12.5 Fluid Ounces

GROUP 11

GENERATING AND STARTING SYSTEMS

PART 11-1 GENERATING SYSTEM AND BATTERY

The generating system consists of the generator which converts mechanical energy to the electrical energy used for ignition, lights, and various accessories. The regulator controls the generator output according to needs. The battery stores electrical power for starting the engine and for operating electrical units when the generator is not delivering sufficient output.

A schematic wiring diagram (Fig. 1) of the generating circuit shows the internal connections and windings of the various units. Color codes are shown to aid in tracing the circuit. Wire sizes are given as a guide for replacing any of the wires in the circuit.

Since the generator and generator regulator are precision built units, they must be checked with accurately calibrated instruments. Correct regulator setting requires that voltmeters be accurate to 0.05 (½ of one tenth) volt within the ranges of 13 to 16 volts, and that ammeters be accurate to 1 ampere between 30 and 40 amperes and between 50 and 60 amperes. All meters should be calibrated once a year and the date of calibration should be stamped on the meter face.

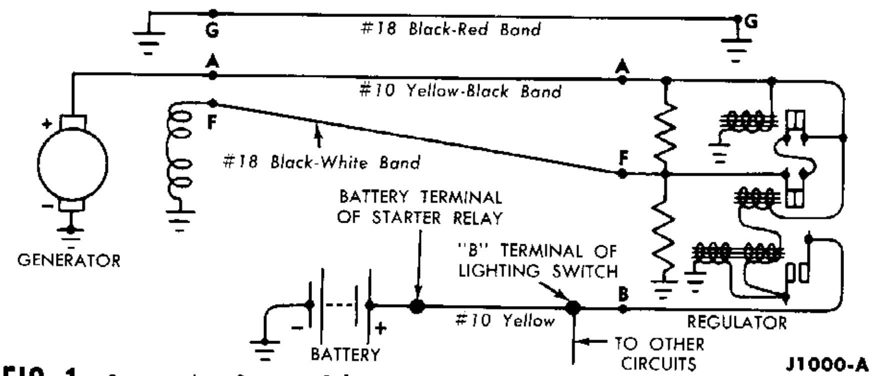

FIG. 1—Generating System Schematic

Certain tests outlined in this section are illustrated both in the form of an electrical schematic and a pictorial drawing. The schematic shows the complete electrical circuit. The pictorial drawing illustrates typical test equipment connections. In some test equipment, the necessary instruments and controls are combined in a single unit. Since these units are connected according to the particular make, be sure to follow the directions of the manufacturer when using such combined equipment.

1 TROUBLE SHOOTING

Possible causes of trouble in the generating system reveal themselves in one of two major "symptoms." Either the battery has failed or is low in charge, or the charging rate is too high. First determine the correct symptom by testing or by analyzing. Once the symptom has been confirmed, isolate the cause by following the "road map," which illustrates the procedure in outline form.

The "road map" combines all the procedures necessary for determining which particular trouble is causing a symptom. Follow the procedures in the order given in the write-up, as the procedures are listed in either the order of most probable cause or in the order which is the easiest to eliminate by testing.

For a clearer understanding of the trouble shooting procedure, be sure to follow the "road map" and the trouble shooting write-up concurrently. Test procedures in the body of the "road map" refer to headings in the trouble shooting write-up. The symptoms are used as headings for the procedures which are outlined in the following paragraphs:

BATTERY TROUBLE SHOOTING

BATTERY LOW IN CHARGE	Indications of a battery low in charge are slow cranking, hard starting, and headlights dim at engine idle speed. Causes are: the generator belt worn, or loose and slipping over the generator pulley; the battery in such poor condition that it will not hold or take a charge; the generator not producing its rated output; regulator units out of adjustment, and excessive resistance in the generator-to-battery circuit or in the battery-to-ground circuit. Before attempting any repairs, check the state of charge of the battery. Also check the generator belt adjustment and condition. If the belt is badly worn or too loose, a new belt or a belt adjustment might be needed. Figure 2 illustrates the Generating System Trouble Shooting — "Road Map."

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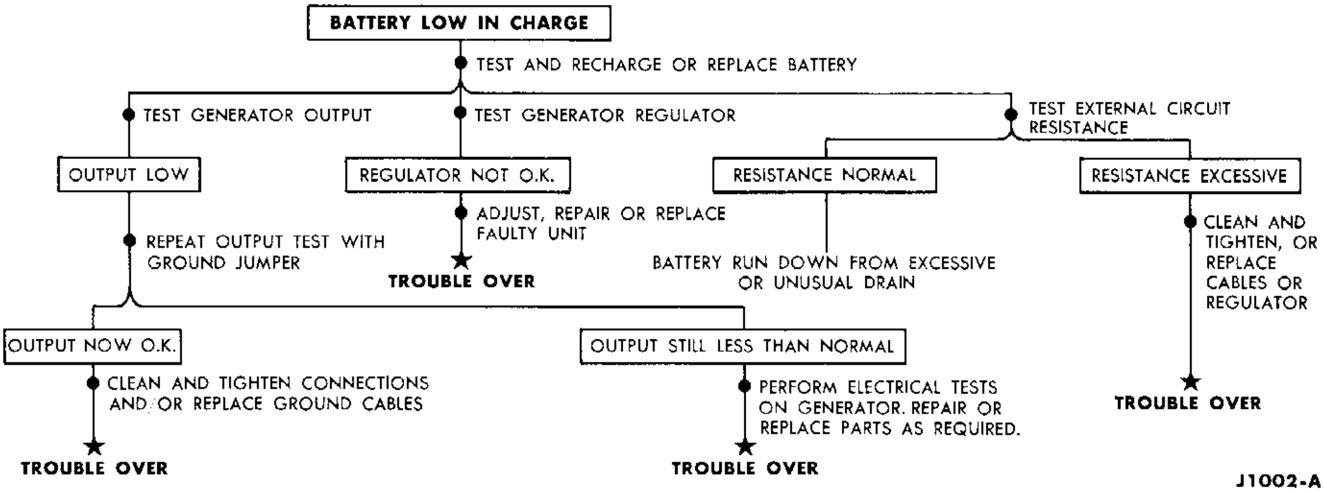

FIG. 2—Generating System Trouble Shooting "Road Map"

BATTERY TROUBLE SHOOTING (Continued)

BATTERY LOW IN CHARGE (Continued)

RECHARGE OR REPLACE BATTERY

Make a "Battery Capacity Test." If the battery does not test as having good capacity, make a "Battery Test Charge." Replace the battery if the test indicates it is worn out or under capacity. If the battery is worn out, it may have been the cause of the "Battery Low" symptom. If the battery tests OK, proceed as follows:

TEST GENERATOR OUTPUT

Test the generator output to determine if the generator is at fault. If the output reaches or is greater than the rating of the generator for the generator under test, proceed with "Test Generator Regulator" below. If the output is less than rated amperes, proceed as follows:

OUTPUT LESS THAN RATED

Connect a heavy jumper wire from the battery ground post to the generator ground terminal. Repeat the generator output test. If the output now reaches or exceeds rated output, either the generator or the battery is not properly grounded to the engine frame. Replace the battery-to-ground cable if it is corroded or partially

CONTINUED ON NEXT PAGE

A—DISCONNECT FIELD AND ARMATURE AT REGULATOR
B—CONNECT AMMETER-TO-FIELD TERMINAL (CONNECTIONS MARKED 1)
C—CURRENT SHOULD BE 1.4 TO 1.6 AMPERES AT 12 VOLTS. LOW CURRENT INDICATES POOR OR BROKEN CONNECTIONS. HIGH CURRENT INDICATES SHORTED COILS.
D—CONNECT AMMETER TO ARM. TERMINAL (CONNECTIONS MARKED 2)
E—CURRENT SHOULD BE 30 TO 40 AMPERES.
F—IF CURRENT IS LOW, PRESS DOWN BRUSHES. IF CURRENT BECOMES NORMAL, BRUSHES ARE STICKING.
G—IF CURRENT IS HIGH, LIFT A BRUSH FROM COMMUTATOR, CURRENT SHOULD DROP TO ZERO. IF ANY CURRENT FLOWS WITH BRUSH LIFTED, BRUSH HOLDER IS GROUNDED.

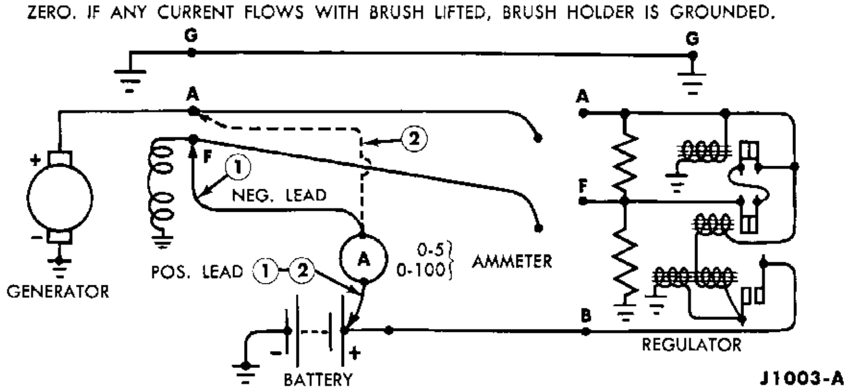

FIG. 3—Electrical Test of Generator—Diagram and Procedure

BATTERY TROUBLE SHOOTING (Continued)

BATTERY LOW IN CHARGE (Continued)

broken. Clean the cable connections at the battery and engine, and tighten the connections. Tighten the generator and generator mounting bracket bolts. The trouble should now be over as indicated by the star on the "road map."

OUTPUT STILL LESS THAN RATED

If the generator output is still less than normal, the generator output could be low due to an open or short circuit in the field, armature, brushes, or brush holders, or the brushes can be worn too short or may be sticking in the brush holder and not making good contact on the commutator. Perform the electrical tests of the generator on the vehicle, as illustrated in Fig. 3, to determine the exact part of the generator causing the trouble. Follow the particular heading below that applies.

Field Open or Shorted. If the test shows the field has an open or short circuit, remove the generator, disassemble and repair it, if possible. If no repairs can be made, replace the field coils and reassemble the generator. Mount the generator on the engine, and polarize the generator.

Armature Open or Shorted. If the armature test shows the armature circuit to have an open or short, remove the generator, disassemble and repair it, if possible. If the repair can not be made, replace the armature and assemble the generator. Mount the generator.

Brushes Making Poor Contact or Shorted. If the brush inspection shows that the brushes are making poor contact, or are shorted to the end plate, frame, or field coil leads, remove the generator, disassemble and repair it, if possible. If the brushes are stuck in the holder, clean, repair or replace the end plate and brushes. Replace the brushes if they are worn to less than ⅝ inch. Check the condition of the commutator. If necessary, turn down the commutator, as a poor commutator can cause excessive brush wear. If the positive brush holder is shorted to ground, repair the insulation if possible. If not, replace the end plate and assemble the generator. Install the generator.

TEST GENERATOR REGULATOR

If the generator output is normal, test the regulator to determine if it is properly adjusted. If the regulator is not OK, proceed as follows:

REGULATOR NOT OK

After checking all three regulator units, adjust or replace the regulator as necessary. These operations should bring you to the "Trouble Over" star on the "road map." If the regulator tests OK, test the circuit resistance.

TEST CIRCUIT RESISTANCE

Check the external circuit to determine if it has excessive resistance. If the resistance is normal, proceed as follows:

RESISTANCE NORMAL

If the resistance (voltage drop) is equal to or less than that specified for the vehicle, the battery is low in charge due to improper operation by the owner. Excessive night driving or use of accessories, insufficient operation of vehicle, accidental discharge of battery (lights, ignition, radio, etc., left on overnight), improper starting procedure (flooding engine, not using choke properly, etc.), or too heavy a grade of engine oil for the local climate, could take more current from the battery than the generator can replace. Instruct the owner in proper operation of his vehicle.

RESISTANCE EXCESSIVE

If the resistance (voltage drop) is greater than that specified for the vehicle, locate the exact part of the circuit with the excessive resistance and follow 1, 2, 3, or 4 below:

1. If the excessive resistance is in the generator-to-regulator circuit, clean and tighten the cable connections. Recheck the voltage drop. If it is still excessive, replace the cable.

2. If the excessive resistance is in the regulator cut-out contact, disconnect a battery cable from the battery. Remove the cover from the regulator. Remove oil and dirt from the cut-out contact surfaces by pulling a clean piece of bond paper or other lint-free substance between the contact surfaces while holding the contacts closed on the paper. On regulators which have been in service for some-time, paper cannot be used to clean the contact surfaces, as they are rough and pitted and the paper may become torn. Examine all soldered connections to see that they are in good condition. Install the battery cable and recheck the voltage drop. If it is still excessive, replace the regulator.

3. If the excessive resistance is in the regulator-to-battery circuit, clean

CONTINUED ON NEXT PAGE

BATTERY TROUBLE SHOOTING (Continued)

BATTERY LOW IN CHARGE (Continued)	and tighten the cable connections (regulator "BAT" terminal, battery terminal of starting relay, battery-to-starting-relay-cable connection on battery post). Examine all cables to see that they are in good condition.	**4.** If the resistance is in the battery-to-ground circuit, clean and tighten the cable connections. Recheck the voltage drop. If it is still excessive, replace the cable. The trouble should now be over.

GENERATOR AND REGULATOR TROUBLE SHOOTING

HIGH CHARGING RATE	Indications of this symptom are: generator, lights, fuses, or radio tubes burn out prematurely; the battery requires too frequent refilling; and the ignition contacts are burned. The most common cause of these troubles is high voltage, and the first step in trouble shooting is to correct possible high voltage regulation. In cases where the generator itself burns out, in addition to the high voltage, a high setting of the current limiter could account for the failure. **CHECK VOLTAGE REGULATION** Make certain that all connections,	including the regulator ground, are tight. Check the voltage regulation. If the voltage regulation is high, remove the regulator cover and depress the voltage regulator armature to see if the contacts are stuck and will not open. Check the contacts, and replace the regulator if the contacts are burned or oxidized. If the points are not sticking and are in good condition, adjust the voltage regulation to the specified limits. Recheck the setting with the cover in place.

2 GENERATOR

Standard generators are shunt wound (armature and field circuits connected in parallel), two-brush, high output generators. The generating system is a negative (—) ground system. Output is controlled by a regulator which is connected between the armature and field. The field is grounded internally (Fig. 1).

The armature shaft is supported by permanently-lubricated ball bearings which fit into the end plates (Fig. 12). The shaft is keyed to an integral pulley and cooling-fan assembly. The pulley is connected to the engine crankshaft pulley with a belt. The generator mounting is shown in Fig. 4.

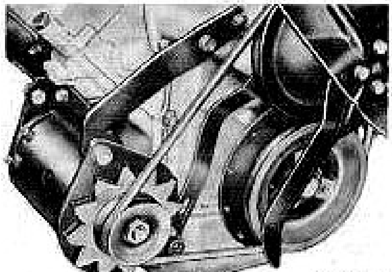

FIG. 4—Generator Mounting

GENERATOR TESTS

The necessary equipment used in the six generator tests outlined below is as follows:

0-10 / 0-100 } Ammeter
0-20 Voltmeter
"Growler" Tester
Storage battery, assorted connecting wires, and jumper wires equipped with suitable connectors.

Various makes of generator and regulator test benches combine all the above listed items into one unit and are equipped with a motor drive. Such equipment can be used to facilitate the generator tests. When such combined equipment is used, be sure to follow the manufacturer's instructions.

GENERATOR OUTPUT TEST

When a generator output test is conducted off the vehicle, a generator-regulator test bench must be used. In this case, the generator is placed on the test bench and driven by the motor. Follow the procedure given by the manufacturer.

To test the output of the generator on the car, proceed as follows (see Fig. 5):

Disconnect the regulator "ARM" and "FIELD" wires at the generator. Connect a jumper wire from the generator "ARM" terminal to the generator "FIELD" terminal and the positive lead of a 0-100 ammeter to the generator "ARM" terminal. Start the engine and while it is idling, connect the ammeter negative lead to the battery. Run the engine at 1500 rpm, and read the current output on the ammeter. The generator output should reach or exceed 30 amperes. **Stop the engine and disconnect the test leads as soon as the test is completed to prevent overheating the generator.**

ARMATURE TESTS

Checking the armature for open, short, or grounded circuits can be done "off the car" only.

Open Circuit Test. An open circuit in the armature can sometimes be detected by examining the commutator for evidence of burning. The spot burned on the commutator is caused by an arc formed every time the commutator segment connected to the open circuit passes under a brush.

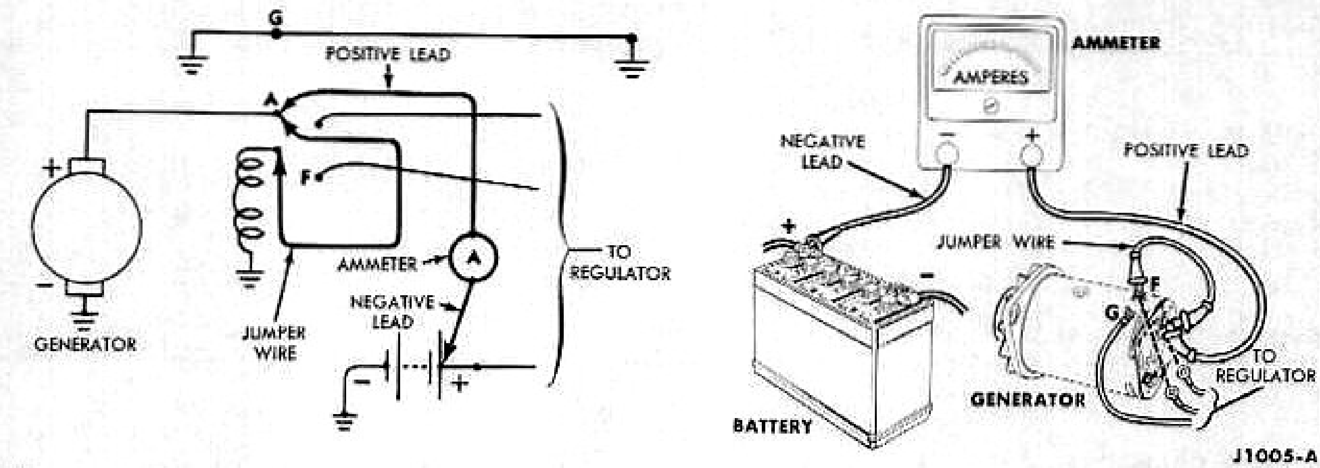

FIG. 5—Generator Output Test—Schematic and Connections

Short Circuit Test. To test the armature for a short circuit in the windings, a "growler" must be used as shown in Fig. 6. Rotate the armature slowly. When the shorted winding is under the steel strip, it will cause the strip to vibrate.

Grounded Circuit Test. To determine if the armature windings are grounded, make the connections as shown in Fig. 7. If the voltmeter indicates any voltage, the armature windings are grounded to the frame.

FIELD TESTS

Only two tests are necessary for checking the field. Both open and short circuits can be tested in one operation. The second test is for a grounded circuit.

Open or Short Circuit Test. Disconnect the "FIELD" lead from the generator terminal. Connect a 0-10 ammeter from the battery to the "FIELD" terminal as shown in Fig. 8. The normal current draw, as indicated by the ammeter, should be 1.5 to 1.6 amperes. If there is little or no current flow, the field has a high resistance or is open. A current flow, considerably higher than that specified above, indicates shorted or grounded turns.

Grounded Circuit Test. Remove the "GRD" terminal stud from the generator frame. Make the voltmeter and battery connections as shown in Fig. 9. If the voltmeter indicates any voltage, the field coils are grounded. **Be sure that the "GRD" terminal stud is not touching the housing.**

FIG. 6—Growler Test for Shorted Armature

GENERATOR REPAIR

The complete disassembly procedure is given in "Generator Overhaul." However, "Armature Replacement," "Commutator Turning and Undercutting," and "Brush Replacement" can be accomplished without completely disassembling the generator. A disassembled view of the generator is shown in Fig. 10.

REMOVAL AND INSTALLATION

Disconnect the armature, field, and ground wires at the generator terminals.

Remove the adjustment arm to generator bolt, the generator belt, and the two pivot bolts from the mounting bracket. Then remove the generator (Fig. 4).

To install the generator, first clean the mating surfaces of the generator frame and mounting bracket. Install the generator in the bracket with the two pivot bolts and lockwashers. Install the generator belt, and the adjustment arm to generator bolt. Adjust the belt tension and tighten all bolts securely. Install the armature, field, and ground leads on the generator terminals.

GENERATOR OVERHAUL

Use the procedures outlined below for generator overhaul or when it is necessary to completely disassemble a generator for such purposes as bearing replacement or field coil replacement.

Disassembly

1. Remove the two generator through bolts and the brush end plate. Slide the armature assembly out the other end of the frame. **Do not lose the locating dowel if it drops out of the front end plate.**

2. Clamp the armature in a vise equipped with soft jaws, and remove the retaining nut, lockwasher, pulley, and woodruff key from the armature shaft.

3. Slide the front end plate off the armature shaft. **Be sure to remove any burrs from the keyway before removing the front end plate.** Remove the bearing stop ring and remove the bearing from the front end plate.

4. Remove the "FIELD" and "GRD" terminal screws from the generator frame, and unscrew the field pole shoe screws as shown in Fig. 11. The arbor press prevents the tool

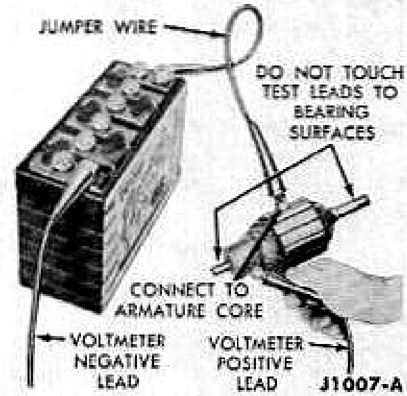

FIG. 7—Grounded Circuit Armature Test

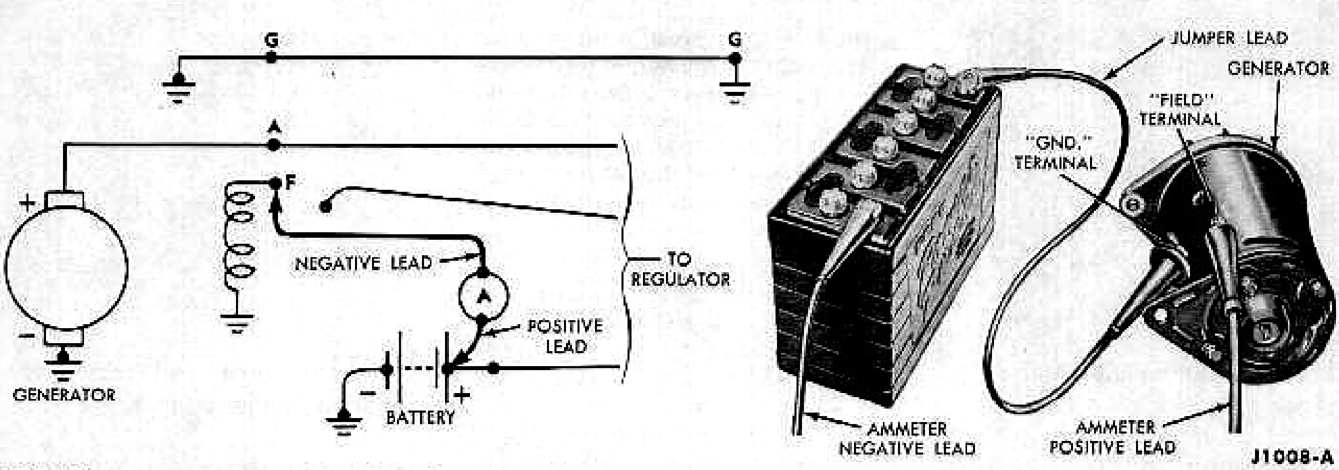

FIG. 8—Open Circuit Test of Field—Schematic and Connections

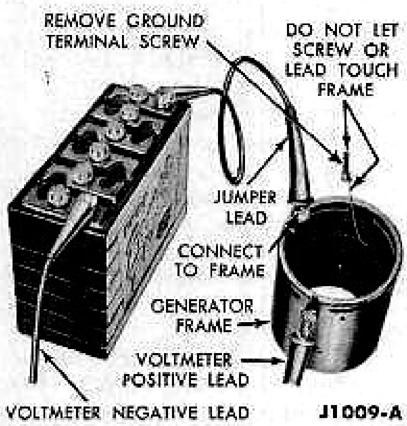

FIG. 9—Grounded Circuit Test of Field

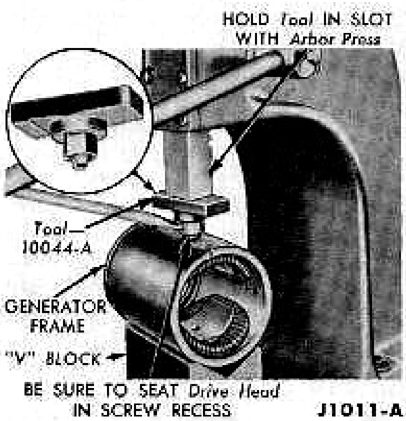

FIG. 11—Pole Shoe Screw Removal

from slipping out of the screw socket.

5. Slide the pole shoes and field windings out of the frame, and separate the windings and shoes.

Cleaning and Inspection

1. Wash all parts except the armature, field coils, and ball bearings in solvent and dry the parts thoroughly.

2. Wipe off the armature and field windings, the commutator, and the armature shaft.

3. Check the condition of the bearings. If the ball bearings are worn or have lost their lubricant they must be replaced.

4. Check the armature winding for worn insulation, overheating, and unsoldered connections.

5. Check the armature for shorts, opens or grounds.

6. Check the field windings for worn insulation and unsoldered connections at the terminal screws. Resolder any connections as required.

7. Replace the armature or the field coils if the insulation is worn.

8. Check the commutator for runout and uneven or scored surfaces. Turn down the commutator and undercut the mica if necessary.

9. Inspect the brush end plate for cracks, poor insulation or loose rivets. Replace the end plate if it is cracked or if the positive brush insulation is broken or cracked. Tighten any loose brush holder rivets.

10. Check the brush spring tension. If the tension is not between 32-40 ounces, replace the springs.

Assembly

1. Install the field coils on the pole shoes, and mount the shoe and coil assemblies in the frame.

2. Tighten the field pole shoe screws (Fig. 11). **As the screws are tightened, strike the frame several sharp blows with a soft faced hammer to seat and align the pole shoes.**

3. Install the "GRD" terminal

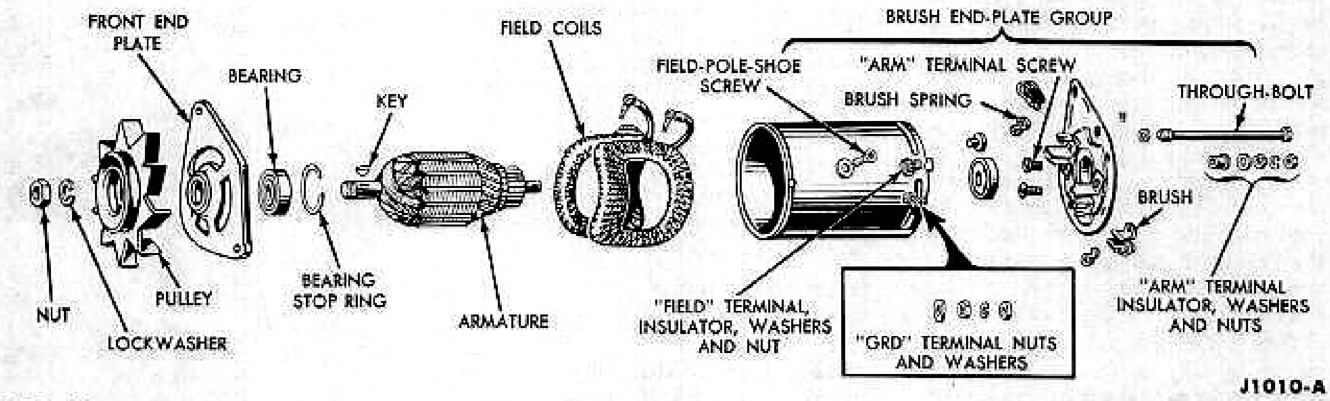

FIG. 10—Disassembled Generator

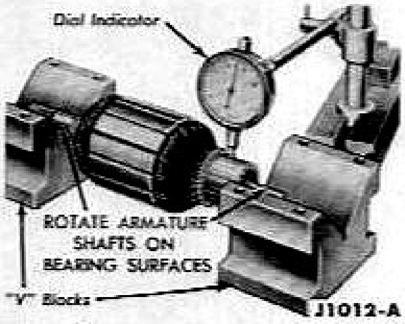

FIG. 12—Commutator Runout Check

screw, washer, and nut in the frame. Install the "FIELD" terminal screw, insulators, washer, and nut in the frame.

4. Insert new brushes in the brush holders, install the "ARM" terminal screw and insulators, and install the ground brush screw.

5. Move the brushes back in the holders until the brush springs ride against the side of the brushes to retain them in the retracted position.

6. Install the bearing in the front end plate and insert the bearing stop ring.

7. Slide the plate on the armature shaft (with the snap ring toward the armature windings), and install the woodruff key, pulley, lockwasher, and retaining nut.

8. Install the armature and front end plate assembly in the frame, locating the dowel in the frame groove.

9. Install the brush end plate (aligning the locating boss and frame groove), and install the through bolts with lockwashers.

10. Use a piece of stiff wire with a hooked end to reach through the ventilating slots, and position the brush springs on top of the brushes.

POLARIZING GENERATORS

Normally, it is only necessary to polarize a generator when a generator has been rebuilt and if new pole shoes have been installed. Generators are polarized during manufacture, and normally, there is enough residual magnetism left to allow the generator to start charging.

To polarize a rebuilt generator mounted on the car, disconnect the field wire and the battery wire from the regulator and momentarily connect the two wires together, engine not running.

CAUTION: **Do not polarize a generator by any method that applies battery voltage to the field terminal of the regulator, such as shorting from the battery terminal to the field terminal of the regulator, or by connecting a jumper wire directly from the battery to the generator field terminal. This action causes excessive current to flow from the battery through the regulator contacts to ground, thus burning the points.**

ARMATURE REPLACEMENT

1. Remove the two through bolts and the brush end plate. Slide the armature and front end plate assembly out of the frame.

2. Clamp the armature in a vise equipped with soft jaws, and remove the retaining nut, lockwasher, pulley, and woodruff key.

3. Remove any burrs or scratches from the keyway or shaft, and slide, the drive end plate off the shaft.

4. Install the front end plate on the new armature.

5. Install the woodruff key, pulley, lockwasher, and retaining nut.

6. Slide the armature and front end plate assembly into the frame, aligning the dowel with the frame slot.

7. Install new brushes in the brush end plate, retract the brushes, until the brush springs ride against the side of the brushes, to retain them in the retracted position.

8. Install the end plate (aligning the locating boss and the frame slot). Install the through bolts with lockwashers.

9. Use a piece of stiff wire with a hooked end to reach through the ventilating slots, and position the brush springs on top of the brushes.

COMMUTATOR TURNING AND UNDERCUTTING

Check the commutator runout as shown in Fig. 12. If the surface of the commutator is rough or more than 0.002 inch out of round, turn it down. Remove no more copper than necessary to clean up the commutator.

After the commutator is turned down, undercut the mica between the bars 1/32 inch below the copper. Figure 13 illustrates samples of proper and improper undercutting. Polish the commutator with #00 to #000 sandpaper to remove all burrs. **Brush all particles of copper from the mica insulation between the commutator segments.**

BRUSH REPLACEMENT

Replace the generator brushes when they are worn to 5/16 inch. Always change both brushes when replacement is required. If the brush wear has been excessive, check the condition of the commutator, and turn it down if necessary.

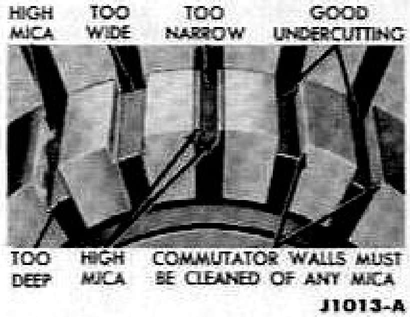

FIG. 13—Examples of Proper and Improper Undercutting

1. Remove the two through bolts from the generator frame.

2. Remove the brush end plate and the armature and front end plate assembly from the generator frame.

3. Disconnect the brush terminals and remove the brushes.

4. Clean the carbon and dirt from the brush end plate. Repair or replace the insulation between the brush holders and end plate and the "ARM" terminal and end plate if it is worn or cracked.

5. Make sure that the new brushes slide freely in the brush holders. Seat the new brushes by sanding them in as shown in Fig. 14.

6. Retract the brushes until the brush springs ride against the side of the brushes, to retain them in the retracted position.

7. Install the armature and front end plate assembly and the brush end plate (aligning the dowel and locating boss and the frame slots).

8. Install the through bolts with lockwashers.

9. Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush springs on top of the brushes.

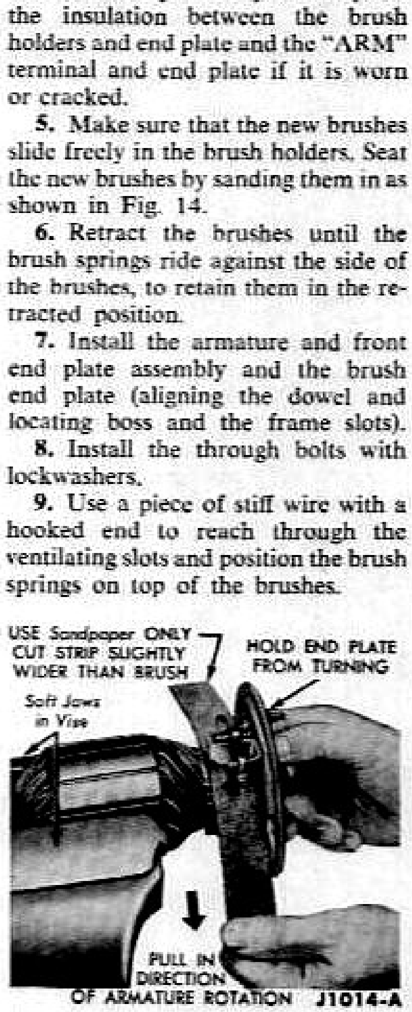

FIG. 14—Generator Brush Seating

3 GENERATOR REGULATOR

The generator regulator is composed of three control units mounted as an assembly (Fig. 15). Each unit has a set of contact points and an energizing coil for operating the points, and each of the units performs a separate function to maintain control of the generator.

When the engine is not operating, the contact points on the cut out relay (Fig. 15), are held open by spring tension. At approximately 12 volts, the coils are energized sufficiently to overcome the spring tension and close the cut out points connecting the generator to the external load.

The voltage limiter holds the generator voltage below a predetermined setting by controlling the amount of voltage applied to the field coils. The voltage limiter thus protects the system from high voltage when the system load demand is low.

The current limiter protects the generator armature windings by limiting the maximum amount of current supplied by the generator. Like the voltage limiter, the current limiter performs its function by controlling the amount of current that is supplied to the generator field coils. It thus protects the generator when the system load demand is high.

TEMPERATURE COMPENSATION

The generator regulator has not only been designed to exercise automatic control over the generating system, but it will also compensate for seasonal temperature changes. In cold weather a higher voltage output is required to handle the load. In warm weather, the voltage must be reduced to avoid over charging the battery. Therefore, it is necessary to establish a "normal" or stabilized regulator operating temperature to coincide with the specified voltage setting of 14.6 to 15.4 volts. The standard ambient air temperature established for this setting is 70° to 80° Fahrenheit. The regulator temperature for this or any setting, is defined as the temperature of the regulator after ½ hour of operation in the vehicle or, after the regulator has been heated until it becomes stabilized.

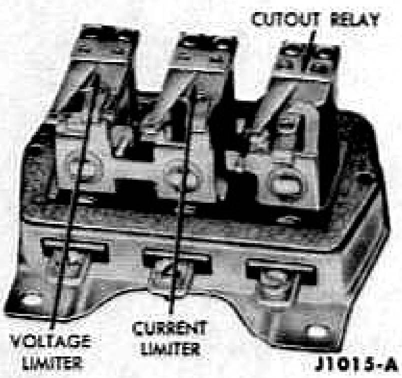

FIG. 15—Generator Regulator

CAUTION: **For correct voltage regulation adjustment, first be sure that the regulator has reached "Normal" operating temperature as just defined; then make the voltage adjustment setting to coincide with the prevailing, ambient air temperature. Table 1 shows the proper voltage limits for various ambient air temperatures.**

ON THE CAR

On the car, ambient air temperature will be the temperature of the engine compartment air. To measure the air temperature, first clip the voltage regulation setting thermometer (T56L-10505-A) onto the regulator cover (Fig. 16). **The voltage regulation setting thermometer T56L-10505-A has two voltage scales, one for the 12 volt standard regulator and the other for the 6 volt standard regulator.**

Run the engine to stabilize the regulator. The engine fan will cause the air in the engine compartment to circulate past the regulator until the regulator has stabilized at the ambient air temperature. After the regulator and thermometer have stabilized, the thermometer will show the voltage setting at which the regulator should be operating.

ON THE TEST BENCH

When the regulator is mounted on a regulator test bench, the ambient air temperature will be the room temperature. Clip the thermometer T56L-10505-A onto the regulator cover. Mount a small fan on the regulator test bench about 12 to 15 inches from the regulator. Operate the fan and the regulator to stabilize the regulator. The fan will provide sufficient air flow to ensure stabilization of the regulator at the temperature indicated by the thermometer. After stabilization, the thermometer will show the voltage setting at which the regulator should be operating.

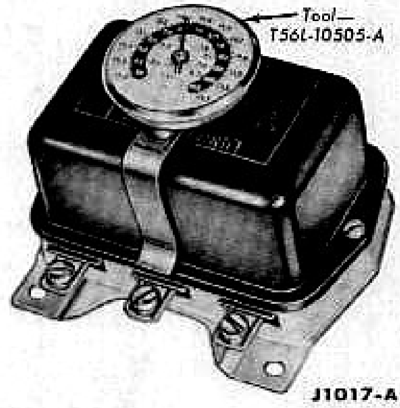

FIG. 16—Voltage Regulation Setting Thermometer

TABLE 1—Voltage Regulation Setting Versus Ambient Air Temperature

Ambient Temperature °F.	Voltage Regulation Setting (Volts)
25	15.1-15.9
35	15.0-15.8
45	14.9-15.7
55	14.8-15.6
65	14.7-15.5
75	14.6-15.4
85	14.5-15.3
95	14.3-15.1
105	14.2-15.0
115	14.1-14.9
125	13.9-14.7
135	13.8-14.6
145	13.6-14.4

REGULATOR AND CIRCUIT TESTS

Instruments and equipment for making the tests are listed below:

0-50 Ammeter

0-5, 0-25 Voltmeter

50 Ohm Field Rheostat (2 amp. rating)

Carbon Pile Rheostat (heavy duty)

1½ Ohm Resistor (200 watt rating)

Assorted connecting wires equipped with suitable connectors.

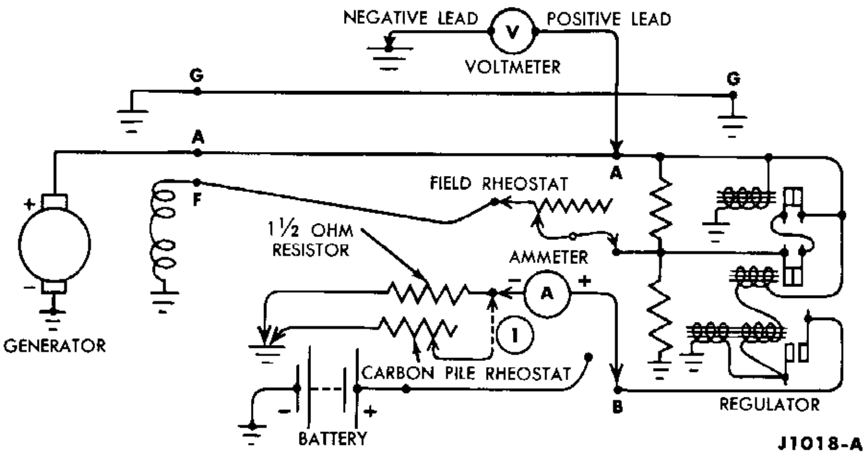

FIG. 17—Regulator Test Schematic

Special generator-regulator test benches incorporate the above equipment in one unit. When such combined equipment is used, be sure to follow the instructions of the manufacturer.

The four tests presented here are outlined for on-the-car operation and should be conducted in the sequence indicated. Be sure that the regulator is at "normal" operating temperature (equivalent to the temperature after 30 minutes of operation on the vehicle with 10 ampere load). Connect the test equipment as shown in Figs. 17 and 18.

CAUTION: **Always be careful when making any test connections to the regulator, so as not to short the battery lead or terminal to the regulator field terminal. To do so will burn the regulator contacts. It is recommended that a battery cable be disconnected while making these connections.**

CUTOUT TEST

Start the engine and run it at approximately 1500 rpm. Decrease the resistance in the field circuit, and the voltage output of the generator, indicated by the voltmeter, will increase until the cut out closes. The cut out closing will be indicated by a rise of the ammeter needle and a "dip" of the voltmeter needle. The maximum voltage at the time the voltmeter needle dips or drops back will be the closing voltage of the cut out relay. This operation should be repeated to accurately determine the closing voltage of the cut out.

VOLTAGE LIMIT TEST

Reduce the resistance in the field circuit to zero. The ammeter should show an approximate 10 ampere load. Read the voltage regulation on the voltmeter scale. Speed the engine momentarily to see if the voltage remains regulated.

CURRENT LIMIT TEST

Connect the carbon pile rheostat across the 1½-ohm resistor, (connection marked ① Figs. 17 and 18). With the engine speed at 1500 rpm, slowly decrease the resistance of the rheostat until the voltmeter reading drops to 13 volts. The ammeter will indicate the setting of the current limiter.

Remove all test leads except the voltmeter leads. Install the "BAT," and "FIELD," leads on the regulator terminals. Run the engine at 1500 rpm, and read the voltage regulation (under battery load) on the voltmeter. **The voltage reading will usually be low when the engine is first started because the battery is partially discharged. After a few moments of operation, the voltage will rise to the original value.**

EXTERNAL CIRCUIT RESISTANCE TEST

For the purpose of this test, the resistance values of the circuit have been converted to voltage drop readings for a current flow of 30 amperes. Connect the test equipment as shown in Fig. 19 to measure voltage drop around the circuit.

Crank the engine for 30 seconds with the ignition switch OFF to partially discharge the battery. Then

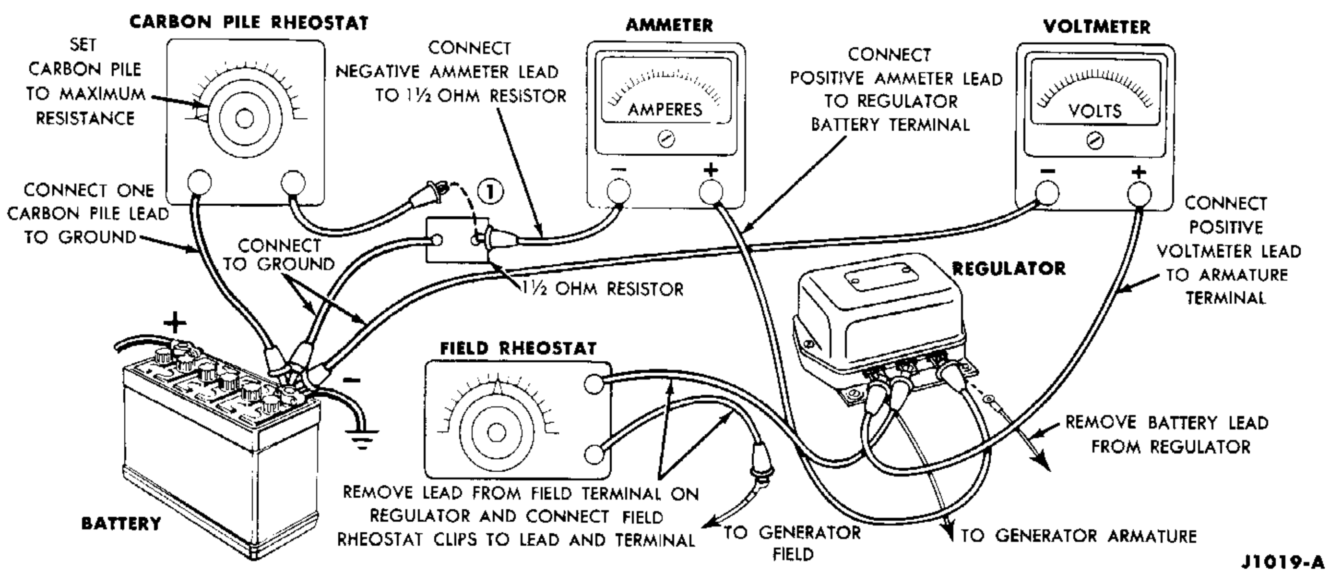

FIG. 18—Regulator Test Connections

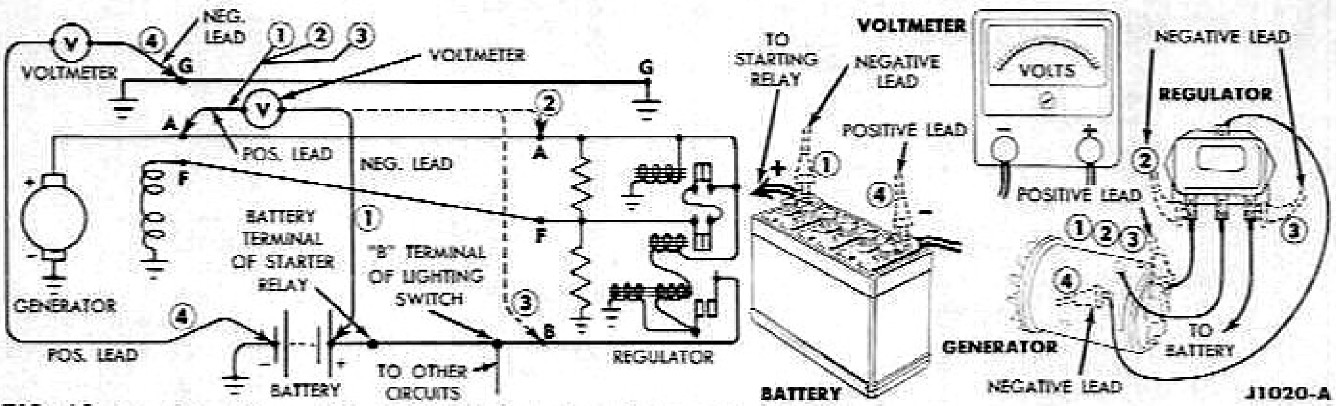

FIG. 19—Regulator External Circuit Test—Schematic and Connections

start the engine and run it at approximately 1500 rpm.

Touch the voltmeter negative lead to the center of the positive battery post (Fig. 19, connections marked ①) to check the generator to battery circuit. The voltage drop should be less than 0.7 volt.

If the voltage drop in the generator to battery circuit exceeds 0.7 volt, locate the exact part of the circuit wiring causing the trouble, by contacting the negative lead to other points of the circuit. Connect the lead to the "ARM" terminal of the regulator (connections marked ②). The voltage drop should be less than 0.2 volt. Connect the lead to the "BAT" terminal of the regulator (connections marked ③). The voltage reading should be less than 0.4 volt. If both these readings are within limits, the excessive resistance is in the regulator to battery wires or their connections. Check for loose connections or partially broken wires.

Check the battery to generator ground circuit by connecting the voltmeter as shown in Fig. 19 (connections marked ④). The voltage reading should be less than 0.1 volt.

REGULATOR ELECTRICAL ADJUSTMENT

Final adjustment of the regulator must be checked with the regulator at normal operating temperature. For any of the adjustments given below, remove the cover by removing the two cover screws. **After the adjustments have been made, recheck the settings with the cover in place.**

ADJUST CUT-IN VOLTAGE

The cut-in voltage is increased by bending the adjusting arm upward, or decreased by bending it downward (Fig. 20).

ADJUST VOLTAGE LIMIT

Make a regulator voltage setting test with the cover on. If the regulator voltage is not within the limits as shown in the table, for the ambient temperature involved, compute the difference as a positive or negative correction. Remove the regulator cover and make a new regulator voltage limit test. Adjust the new setting either up or down by the amount of the correction just computed. If the voltage is less than that specified, increase the spring tension by bending the adjusting arm upward (Fig. 21). To decrease the voltage, bend the adjusting arm downward. Check the voltage setting with the regulator cover replaced.

ADJUST CURRENT LIMIT

If the current limit on the regulator is less than that specified, increase the spring tension by bending the adjusting arm upward (Fig. 22). To decrease the current limit, bend the adjusting arm downward. Install the cover.

REGULATOR REPLACEMENT

Disconnect the battery ground cable. Disconnect the "ARM" "FIELD," and "BAT" leads at the regulator terminals. Remove the mounting screws and the regulator. **Always disconnect a battery cable when working on the regulator to prevent an accidental short circuit of the "BAT" lead to the ground.**

To install the regulator, replace it in position and install the mounting screws. Mount the ground wire terminal under the mounting screw closest to the "ARM" terminal. Connect the "ARM," "FIELD," and "BAT" regulator terminals. Connect the battery ground cable.

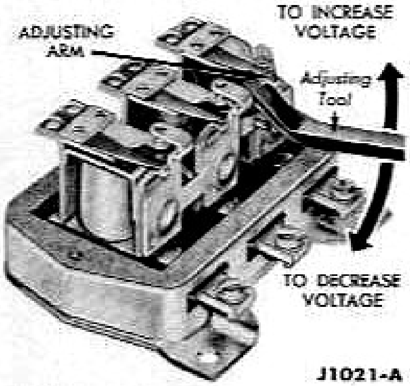

FIG. 20—Cut-In Voltage Adjustment

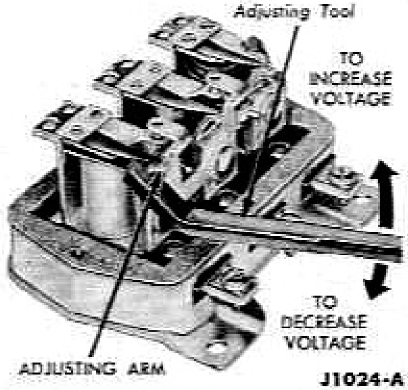

FIG. 21—Voltage Limit Adjustment

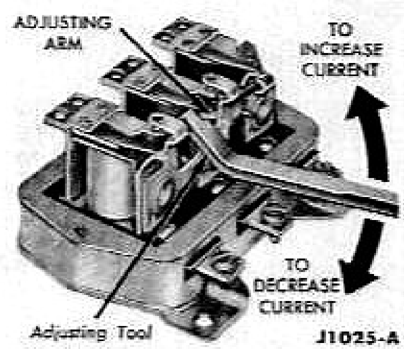

FIG. 22—Current Limit Adjustment

4 BATTERY

The primary function of the storage battery in the generating system is, as its name implies, to store energy for starting the engine and to operate electrical units when the generator is not delivering sufficient output.

A cutaway view of the 12-volt battery (Fig. 23) illustrates the internal construction.

BATTERY TESTS AND CONCLUSIONS

Tests are made on a battery to determine the state of charge and also the condition. The ultimate result of these tests is to show that the battery is good, needs recharging, or must be replaced.

If a battery in a vehicle is low in charge, good service demands that the reason for this condition be found. It may be necessary to follow trouble shooting procedures to locate the cause of the trouble.

Equipment required to make the various battery tests include:

0-20 voltmeter

Hydrometer or meter type charge tester

Fast charger

High discharge tester

Some battery test equipment combines the necessary instruments and controls in a single unit. Be sure to follow the directions of the manufacturer when using such combined equipment.

WARNING: **Hydrogen and oxygen gases are produced in the course of normal battery operation. Flames or sparks can cause this gas mixture to explode if they are brought near the vent openings of the battery. The sulphuric acid in the battery electrolyte can cause a serious burn if spilled on the skin or spattered in the eyes. It should be flushed away immediately with large quantities of clear water.**

BEFORE CHARGE TESTS

Much can be learned about the condition of a battery, even though the battery is only partially charged. The following battery capacity test will indicate these conditions.

BATTERY CAPACITY TEST

A battery capacity test is made by causing current to flow from the battery at a rate according to the size of the battery, and measuring the terminal voltage at the battery under load. A high-rate discharge tester in conjunction with a voltmeter is used for this purpose. Figure 24 shows the entire Battery Capaciy Test in outline form. **If the battery solution is not within 60°F. to 100°F., let it stand until warm before making this test.**

Add water if necessary to bring the battery solution to the proper level.

Fill only to the narrow ring near the bottom of each vent well. Connect the high-rate discharge tester and the appropriate voltmeter to the battery terminals. Adjust the discharge tester to draw three times the ampere hour rating of the battery. After 15 seconds and with the battery still under load, read the battery terminal voltage. **The voltmeter clips must contact the battery posts and not the high rate discharge tester clips. Unless this is done the actual battery terminal voltage will not be indicated.**

If the terminal voltage is 9.25 volts or more, the battery has good output capacity and will accept a normal charge. Test the specific gravity if water has not been recently added, and recharge if necessary.

If the terminal voltage is below 9.25 volts, make a test charge on the battery. **When making a capacity test in areas where consistent zero temperatures occur, the terminal test limit voltage should be increased from 9.25 volts to 9.65 volts.**

Battery Test Charge. The condition of a discharged battery may be tested by passing current through it. Connect a fast charger to the battery

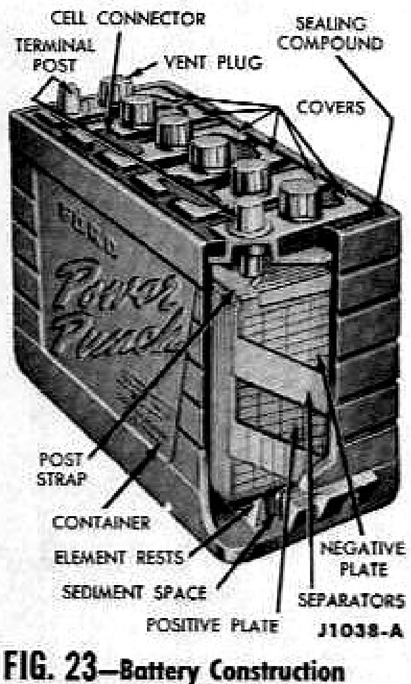

FIG. 23—Battery Construction Details

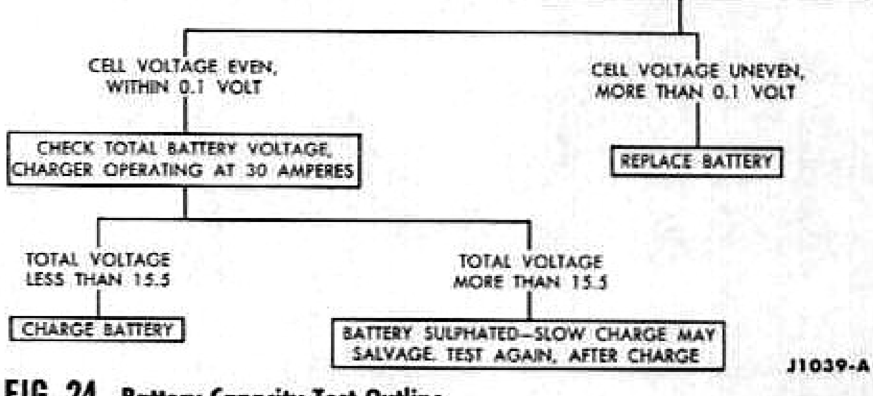

FIG. 24—Battery Capacity Test Outline

and charge the battery for 3 minutes at a rate of 30 amperes.

After 3 minutes of fast charge, and with the fast charger still operating, test the individual cell voltages of the battery.

If the cell voltages vary more than 0.1 volt, replace the battery.

If the cell voltages are even within 0.1 volt, test the total battery voltage (charger sill operating).

If the total battery voltage is now under 15.5 volts, the battery is satisfactory and may be safely fast charged (see Table 3). Always follow the fast charge with sufficient slow charge to bring the battery to a full charge.

If the total battery voltage was over 15.5 volts, the battery is probably sulphated. Place the battery on continued slow charge, and follow the instructions under "After Charge Tests."

BATTERY CHARGE TESTS

Battery charge may be tested by measuring the battery electrolyte solution specific gravity (hydrometer) or by measuring the voltage of the battery cells on open circuit (no current flow) with a battery charge tester (open circuit voltage tester).

Hydrometer. The hydrometer can be used only when there is sufficient electrolyte above the battery plates to fill the hydrometer tube. **Do not take hydrometer readings immediately after refilling a battery with distilled water.**

Remove the battery filler plugs. Draw electrolyte in and force it out of the hydrometer barrel several times to bring the temperature of the hydrometer float to that of the electrolyte, then draw in just enough electrolyte to lift the float. Read the specific gravity on the float scale. A specific gravity of 1.275-1.285 indicates a fully charged battery, 1.230-1.240 indicates approximately 60% charge. Most hydrometers have a thermometer incorporated in them so that compensation may be made for temperature, in order to make more accurate readings. If the specific gravity varies more than 0.025 between cells, replace the battery. **Some warm climate areas supply batteries with electrolyte of 1.260 specific gravity. This type of battery is fully charged at 1.260 specific gravity and is plainly marked to indicate the lower specific gravity.**

Battery Charge Tester. The battery charge tester tests the state of charge of a battery by measuring the voltage of the battery cells on open circuit (no current flow). It consists of an accurate, expanded-scale voltmeter equipped with test prods which are contacted to the terminals of each cell. The scale of the meter shows cell voltage from 1.9 volts to 2.3 volts in 1/100 volt divisions.

When testing a battery which has been charged just previous to the test, "surface charge" in the battery will give a false reading. To remove "surface charge," turn on the headlights of the car for the length of time indicated on the meter, then turn off the headlights and read the state of charge of the battery. **A 12-volt battery can be more easily discharged to the point where it will freeze during cold weather, than a standard 6-volt battery. A 12-volt battery discharged to the point where it will easily freeze will still crank the engine.**

Table 2 shows the temperatures at which batteries of various specific gravities will begin to freeze.

TABLE 2—Battery Freezing Temperatures

Specific Gravity	Freezing Temperature
1.280	—90°F.
1.250	—62°F.
1.200	—16°F.
1.150	+ 5°F.
1.100	+19°F.

AFTER CHARGE TESTS

After charge tests must be made to check apparently sulphated batteries that have been put on continued slow charge to try to make them serviceable. When the battery is fully charged (check with a hydrometer or battery charge tester) make a capacity test, as in "Before Charge Tests." If the terminal voltage is 9.25 volts or above, place the battery back in service. If the terminal voltage is below 9.25 volts, replace the battery.

BATTERY CHARGING

A battery that is not sulphated may be charged by either a fast charging or slow charging method. Most fast charge units may be adjusted for making a slow charge.

Wash all dirt from the battery, and clean the battery terminals before placing it on charge. **Do not allow dirt to enter the cells.**

Bring the electrolyte to the correct level in the cells. If the battery is extremely cold, allow it to warm up before adding water as the level will rise due to expansion in the cell chamber.

FAST CHARGING

As most fast charges are slightly different from each other, follow the instructions for your particular equipment when connecting the unit to the battery.

Make a gravity test first, using either a hydrometer or a battery charge tester. Then fast charge at about 30 to 40 amperes maximum for the length of time shown in Table 3 corresponding to the specific gravity measured. **Always follow a fast charge with sufficient slow-charging to bring the battery to a full charge.**

SLOW CHARGING

When a fast charger is used for slow charging, **always follow the manufacturer's instructions so as not to damage the charger.**

Slow charge 12-volt batteries of less than 70 ampere hour capacity at a 3 ampere rate. Slow charge 12-volt batteries of 70 ampere hour capacity or greater at a 4 ampere rate.

A battery may be considered fully charged when the specific gravity readings of all cells, taken at hourly intervals, show no further increase over a three hour period.

TABLE 3—Allowable Fast Charge Time

Specific Gravity	Fast Charge Up To
1.150 or less	1 hour
1.150 to 1.175	¾ hour
1.175 to 1.200	½ hour
1.200 to 1.225	¼ hour
Above 1.225	Slow Charge Only

PART 11-2 STARTING SYSTEM

The function of the starting system is to crank the engine at a high enough speed to permit it to start. The system includes the starter motor and drive, the battery, a remote control starter switch, and heavy circuit wiring.

A schematic diagram of the starting circuit, shown in Fig. 1, illustrates the internal connections of the starting system units.

Thunderbirds equipped with a Cruise-O-Matic transmission have a lockout switch, in the starter control circuit (Fig. 2), which prevents operation of the starter if the selector lever is not in the N (neutral) or P (park) position.

In most cases of starting difficulty, the trouble may be divided into three symptoms: the engine will crank but will not start; the engine cranks slowly; and the engine will not crank. Figure 3 shows the "road maps" which illustrate the trouble shooting procedures in outline form.

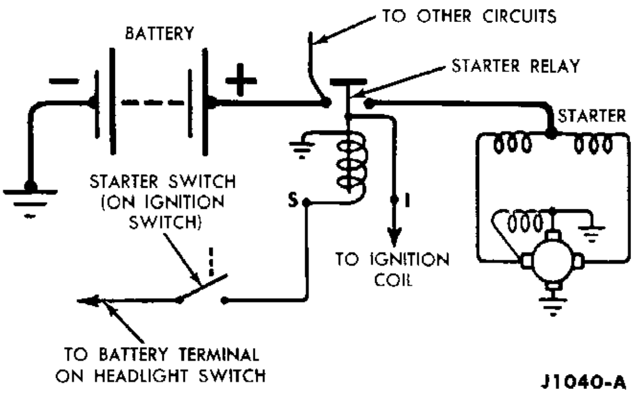

FIG. 1—Starting Circuit Schematic

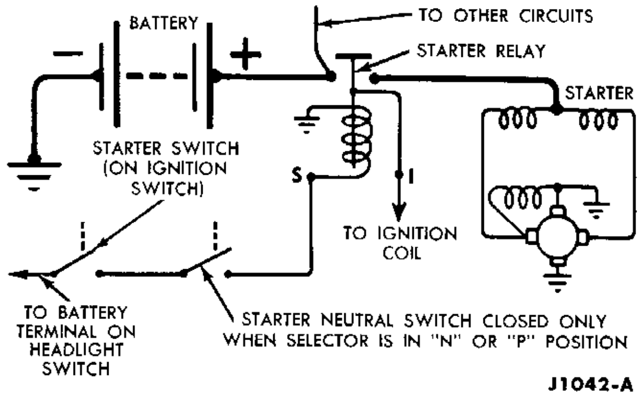

FIG. 2—Cruise-O-Matic Transmission Starting Circuit

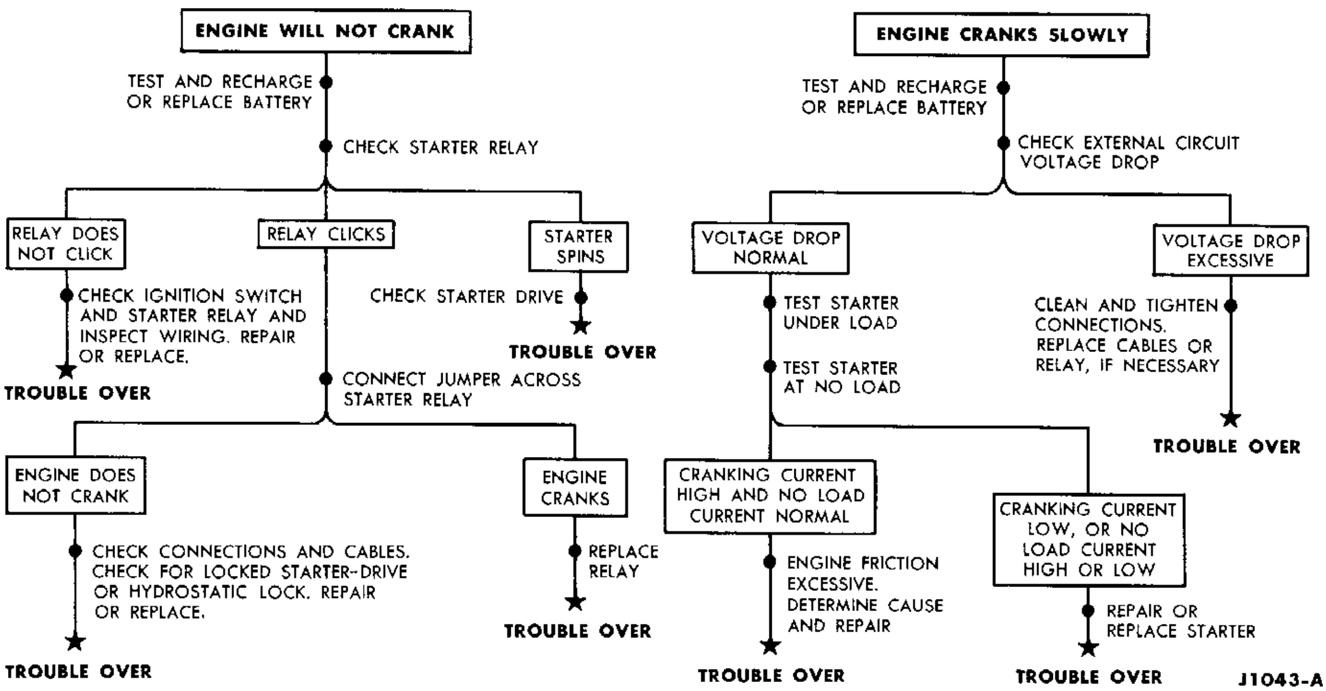

FIG. 3—Engine Trouble Shooting "Road Maps"

1 TROUBLE SHOOTING

If the engine cranks but will not start, the trouble is in the engine (fuel, ignition, engine parts) and not in the starting system. If the engine will not crank even with a booster battery connected, engine parts may be seized or the starter may be faulty. If the engine cranks but cannot be started with a booster battery connected, attempt to start it by pushing the car. If it still will not start, push or tow the car to the shop for a complete diagnosis. **Do not push or tow a car equipped with an automatic transmission for more than 12 miles, without raising the rear wheels off the ground, or disconnecting the driveshaft.**

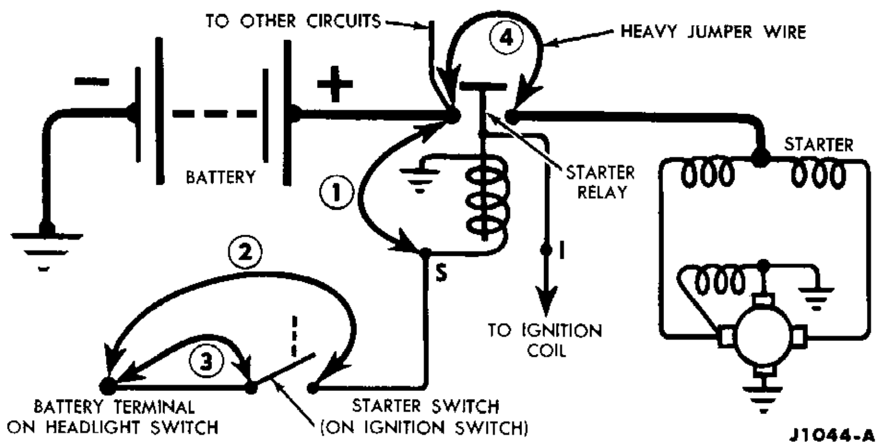

FIG. 4—Starting Circuit Test

STARTER TROUBLE SHOOTING

ENGINE WILL NOT CRANK WHEN IGNITION SWITCH IS OPERATED

The battery may be discharged. The ignition switch or starter may be inoperative. The circuit may be open or contain high resistance. The starter drive may be locked. The starter itself may be faulty or inoperative. The engine may be seized. Water may have leaked into the cylinders causing a hydrostatic lock. Figure 3 illustrates the "road map" for the symptoms.

TEST BATTERY

Test the state of charge of the battery, and follow the procedure that applies.

BATTERY DISCHARGED

Make a "Battery Capacity Test." If the battery tests as having good capacity, recharge the battery. If the battery does not test as having good capacity, make a "Battery Test Charge." Replace the battery if the test indicates that it is worn out or under capacity.

CHECK STARTER RELAY

If the battery is charged, operate the starter to crank the engine. If the engine will not crank and the relay does not click, see "Relay Does Not Click." If the relay clicks, see "Relay Clicks." If the starter motor spins but will not crank the engine, see "Starter Spins But Does Not Crank Engine." **On the following two checks, disconnect and ground the high tension lead from the spark coil so that the engine cannot start:**

RELAY DOES NOT CLICK

Connect a jumper from the battery terminal of the relay to the ignition switch terminal of the relay, Fig. 4, connection marked ①. If the engine does not crank, the starter relay is probably at fault. If the engine cranks, connect a jumper from the battery terminal on the lighting switch to the (ST) starter relay terminal of the ignition switch, Fig. 4, connection marked ②. If the engine does not crank, the wire connecting the starter relay to the ignition switch, or the wiring connecting the battery to the lighting switch is defective. If the engine cranks, connect the jumper between the lighting switch battery terminal and the "AM" or "BAT" terminal of the ignition switch, Fig. 4, connection marked ③. If the engine does not crank when the ignition switch is operated, the ignition switch is at fault. Replace the switch. If the engine cranks when the ignition switch is operated, the wire connecting the ignition switch to the battery terminal on the lighting switch is at fault. Replace the wire.

CONTINUED ON NEXT PAGE

STARTER TROUBLE SHOOTING (Continued)

ENGINE WILL NOT CRANK WHEN IGNITION SWITCH IS OPERATED (Continued)

RELAY CLICKS

If the relay clicks when the ignition switch is operated, connect a heavy jumper from the relay battery terminal to the relay starter motor terminal, Fig. 4, connection marked ④. If the engine cranks, replace the relay. If the engine does not crank, observe the spark when connecting and disconnecting the jumper. If there is a heavy spark, see "Check Engine and Starter Drive" below. If the spark is weak or if there is no spark at all, proceed as follows:

Check Cables and Connections. If the spark at the relay is weak when the jumper is connected, inspect the battery starter cables for corrosion and broken conductors. Check the ground cable to see if it is broken or badly corroded. Inspect all cable connections. Clean and tighten them if necessary. Replace any broken or frayed cables. If the engine still will not crank, the trouble is in the starter motor, and it must be repaired or replaced.

Check Engine and Starter Drive. If a heavy spark is obtained when the jumper wire is connected, remove all the spark plugs, and attempt to crank the engine with the starting motor.

If the engine cranks with the spark plugs removed, water has probably leaked into the cylinders causing a hydrostatic lock. The cylinder heads must be removed, and the cause of internal coolant leakage eliminated.

If the engine will not crank, rock the car back and forth with the transmission in high gear, or in case of a Cruise-O-Matic transmission or if the car cannot be rocked, loosen the starter mounting bolts to free the starter pinion. If the starter drive is locked, remove the starter from the engine, and examine the starter drive pinion for burred or worn teeth. Examine the teeth on the flywheel ring gear for burrs and wear. Replace the pinion or the flywheel ring gear if they are worn or damaged.

If the starter drive is not locked, remove the starter from the engine, and perform the no-load current test. The starter should run freely. Compare the reading obtained from the ammeter with the no-load current draw specification for the starter. If the current reading and no-load speed are below specifications, the starter has high resistance and should be repaired. If the current reading is above normal, and the starter is running slower than it should at no load, it is probably due to tight or defective bearings, a bent shaft, or the armature rubbing the field poles. A shorted coil in the starter also causes the current reading to be high. Disassemble the starter and determine the cause. Repair if possible, or replace the starter.

If the no-load current reading of the starter is normal, the engine is seized and cannot be turned by the starter. Disassemble the engine and repair or replace the defective parts.

STARTER SPINS BUT DOES NOT CRANK THE ENGINE

If the starter spins but will not crank the engine, the starter drive is worn or dirty and is sticking on the starter shaft, or is broken.

Remove the starter from the engine, and remove the starter drive. Clean the starter drive parts in kerosene and wipe dry. Replace worn or damaged parts as required. Assemble the starter drive, and mount the starter on the engine. **Do not use oil to lubricate the starter drive. It should work freely when cleaned in kerosene and wiped dry.**

ENGINE CRANKS SLOWLY

The battery may be low in charge; there may be excessive resistance in the starter circuit; the starter may be faulty; the engine may have excessive friction.

Figure 3 shows the "road map" for this symptom.

TEST BATTERY

Test the state of charge of the battery. If the battery is low in charge follow "Battery Discharged." If the battery is fully charged, check the external circuit voltage drop.

BATTERY DISCHARGED

Make a "Battery Capacity Test." If the battery tests good, recharge the battery, and check the starter relay for possible internal shorts to ground that may have caused the battery to

CONTINUED ON NEXT PAGE

STARTER TROUBLE SHOOTING (Continued)

ENGINE CRANKS SLOWLY (Continued)

discharge. If the battery does not test good, make a "Battery Test Charge." Replace the battery if the test indicates it to be worn out or under capacity.

CHECK EXTERNAL CIRCUIT VOLTAGE DROP

If the battery is charged, test the external circuit voltage drop. If the voltage drop is excessive, follow "Voltage Drop Excessive." If the voltage drop is normal, follow "Voltage Drop Normal."

VOLTAGE DROP (RESISTANCE) EXCESSIVE

If the voltage drop (resistance) is greater than that specified, locate the exact part of the circuit with the excessive resistance.

If the resistance is in the battery-to-starter-relay-cable, clean and tighten the cable connections. Recheck the voltage drop. If it is still excessive, replace the cable. If the resistance of the starter relay contacts is excessive, replace the starter relay.

If the resistance is in the starter relay-to-starter-motor cable, clean and tighten the cable connections. Recheck the voltage drop. If it is excessive, replace the cable.

If the resistance is in the battery-to-ground cable, clean and tighten the cable connections. Recheck the voltage drop. If it is still excessive, replace the cable.

VOLTAGE DROP NORMAL

If the voltage drop (resistance) is normal, test the starter current draw while the starter is cranking the engine (normal 155-190 amperes). Then test the starter at no load (normal 80 amperes maximum). Follow the heading below that applies:

Cranking Current Low or No Load Current High or Low. Remove the starter from the engine, and disassemble it. Determine the cause of the trouble, and correct it if possible. If the trouble can not be corrected, replace the faulty part, assemble the starter, and mount it on the engine.

Cranking Current High and No Load Current Normal. If the cranking current is high and the current draw at no load is normal, the starter is OK. The engine has excessive friction, and the cause must be determined. Repair or replace the faulty parts.

2 STARTER AND CIRCUIT

Heavy cables, connectors, and switches are used in the starting system because of the high current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. Loose connections, corroded relay contacts, and partially broken cables will result in slower than normal cranking speed, and may even prevent the starter from cranking the engine.

The starter is a four-brush, series-parallel wound unit. The circuit to the starter is completed by means of a relay controlled by a switch which is part of the ignition switch mounted on the instrument panel. The return circuit is through the starter housing, engine block, and battery ground cable to the battery.

Figure 5 shows the starter mounted on an engine equipped with a Cruise-O-Matic transmission.

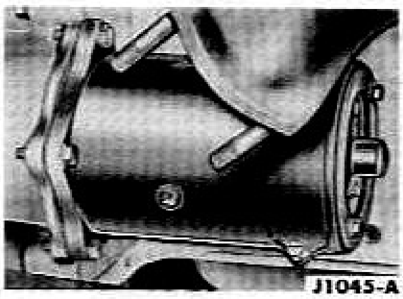

FIG. 5—Starter Mounting

STARTER AND CIRCUIT TESTS

Five different tests of the starter and its circuit are described. Arrangement of these tests is not intended to indicate an order of procedure. The selection of the test to be made is controlled by the circumstances encountered, usually as a result of analyzing troubles as covered in trouble shooting. The following units will be needed to perform the test procedures:

- 0-1, 0-20 Voltmeter
- 0-50, 0-300 Ammeter
- Carbon pile rheostat (heavy duty)
- Assorted connecting wires and jumper wires equipped with suitable connectors.

STARTER LOAD TEST

When this test is performed in conjunction with the "Starter No-Load Test," it will determine if the starter is faulty or if the engine has excessive friction.

Connect the test equipment as shown in Fig. 6. Be sure that no current is flowing through the ammeter and carbon pile rheostat portion of the circuit (rheostat at maximum resistance). Crank the engine with the ignition OFF, and determine the exact reading on the voltmeter.

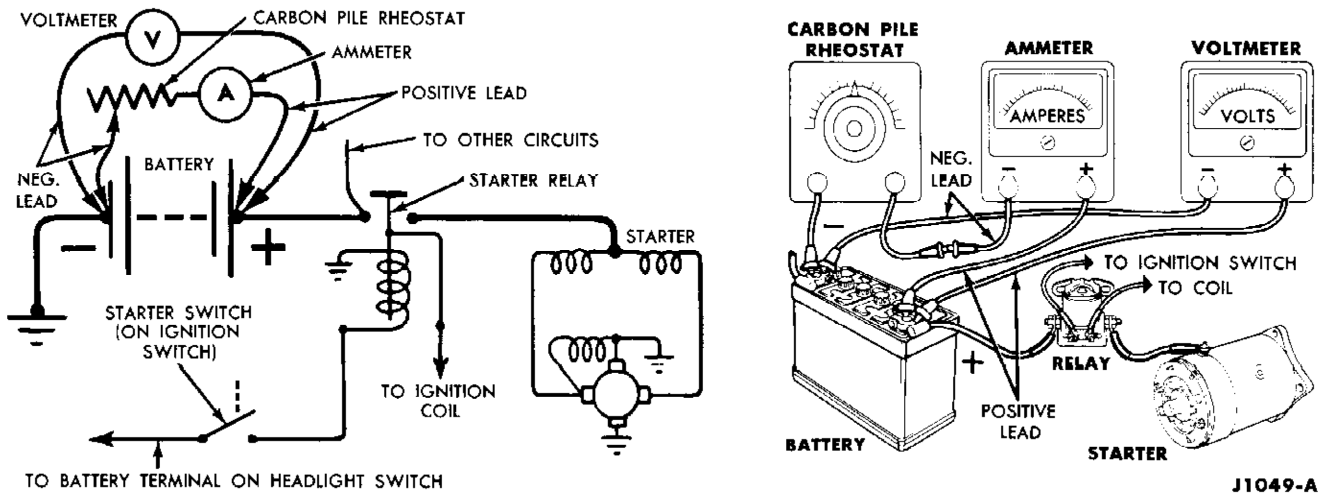

FIG. 6—Starter Load Test

This test is accomplished by disconnecting and grounding the high tension lead from the spark coil, and by connecting a jumper from the battery terminal of the starter relay to the ignition switch terminal of the relay.

Stop cranking the engine, and reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load. This reading should be a maximum of 190 amperes with the engine at normal operating temperature.

STARTER NO-LOAD TEST

This test will uncover such faults as open or shorted windings, rubbing armature, and bent armature shaft. The starter can be tested, at no-load, either on the engine or test bench.

On Engine. To test the starter, the engine must be running at idle speed

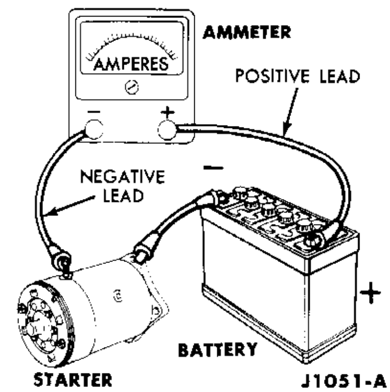

FIG. 8—Starter No Load Test on Test Bench

to prevent the starter drive from engaging the flywheel. With the engine idling, make the ammeter connections as shown in Fig. 7. The no-load current draw on the ammeter should be 80 amperes maximum.

On Test Bench. Connect the starter to a battery with an ammeter in the circuit as shown in Fig. 8. The starter will run at no-load, and the current draw indicated on the ammeter should be 80 amperes maximum.

ARMATURE AND FIELD OPEN CIRCUIT TEST—TEST BENCH ONLY

An open circuit armature may sometimes be detected by examining the commutator for evidence of burning. The spot burned on the commutator is caused by an arc formed every time the commutator segment connected to the open-circuit winding passes under a brush.

An open circuit test of the field can be made on the test bench by connecting a voltmeter and battery as shown in Fig. 9. Since the starter has three field windings, it will be necessary to check each of the windings separately. If no voltmeter reading is obtained, the coil is open.

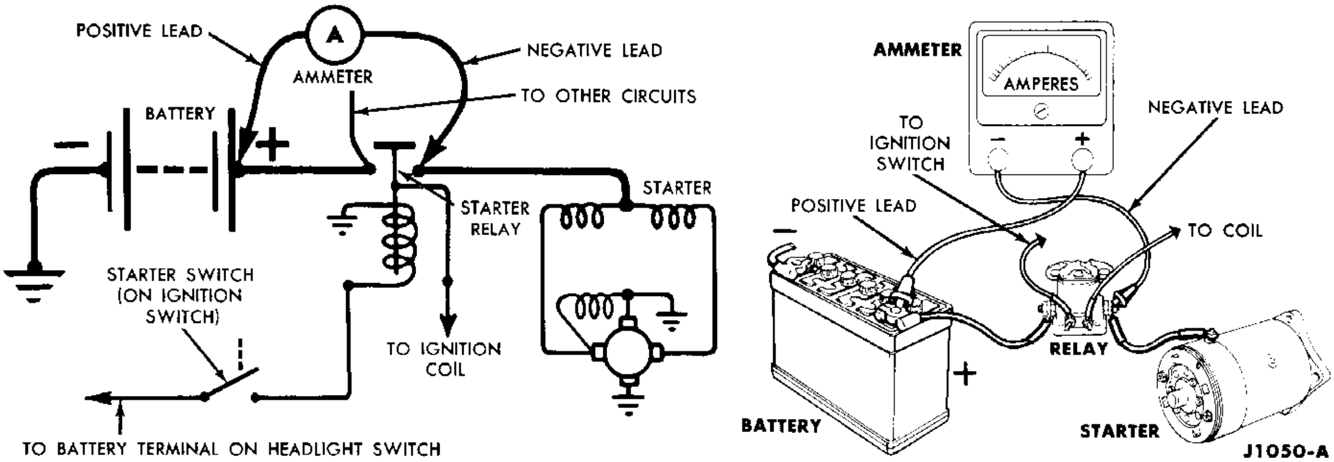

FIG. 7—Starter No Load Test

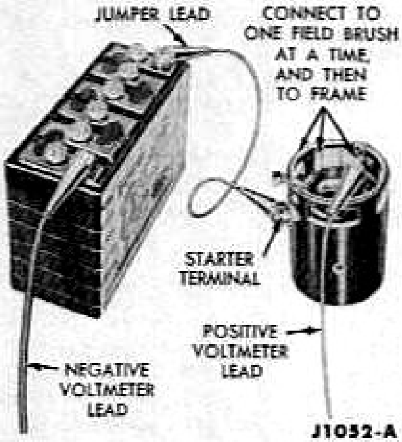

FIG. 9—Open Circuit Test of Field

ARMATURE AND FIELD GROUNDED CIRCUIT TEST—TEST BENCH ONLY

This test will determine if the winding insulation has failed, permitting a conductor to touch the frame or armature core.

To determine if the armature windings are grounded, make the connections as shown in Fig. 10. If the voltmeter indicates any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections as shown in Fig. 11. If the voltmeter indicates any voltage, the field windings are grounded.

STARTER CIRCUIT TEST

Excessive resistance in the starter circuit can be determined from the results of this test. Make the test connections as shown in Fig. 12. Crank the engine with the ignition OFF. **This test is accomplished by disconnecting and grounding the high tension lead from the spark coil and by connecting a jumper from the battery terminal of the starter relay to the ignition switch terminal of the relay.**

The voltage drop in the circuit will be indicated by the voltmeter. Maximum allowable voltage drop should be:

Connections marked ① . . . 0.5 volt
Connections marked ② . . . 0.1 volt
Connections marked ③ . . . 0.3 volt
Connections marked ④ . . . 0.1 volt

STARTER REPAIR

In many cases it will not be necessary to completely disassemble the starter to accomplish repair or replacement of certain parts. Paragraphs "Armature Replacement," "Commutator Turning," and "Brush Replacement," below, are procedures which eliminate the steps in disassembly that do not apply to these particular operations.

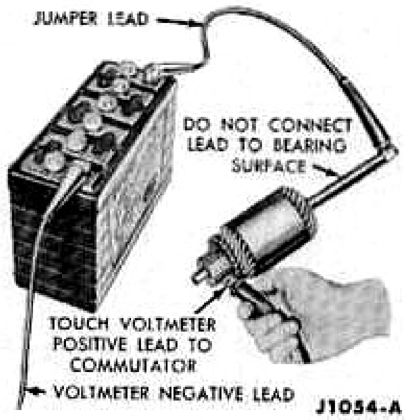

FIG. 10—Grounded Circuit Armature Test

REMOVAL AND INSTALLATION

Disconnect the starter cable at the starter terminal, remove the clutch housing to starter screws, then remove the starter assembly. **It may be necessary to tilt the starter slightly to clear the starter drive around the flywheel.**

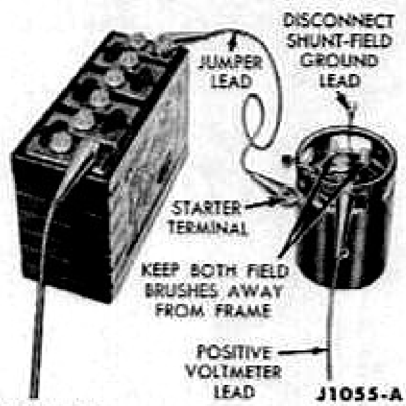

FIG. 11—Grounded Circuit Test of Field

When installing the starter, assemble the motor to the engine. Install the clutch housing to starter screws. Snug all bolts, then tighten to 15 to 20 foot pounds, tightening the middle bolt first. On a vehicle equipped with an automatic transmission, the automatic transmission dipstick tube bracket is mounted under the starter side mounting bolt.

Make certain that the rubber seal is properly positioned before mounting the starter. If trouble is encountered in keeping the seal in position, apply rubber cement to both the seal and the engine block to hold the seal in position while mounting the starter.

COMPLETE DISASSEMBLY

Use the following procedure when it becomes necessary to completely overhaul the starter. Figure 13 illustrates the starter completely disassembled.

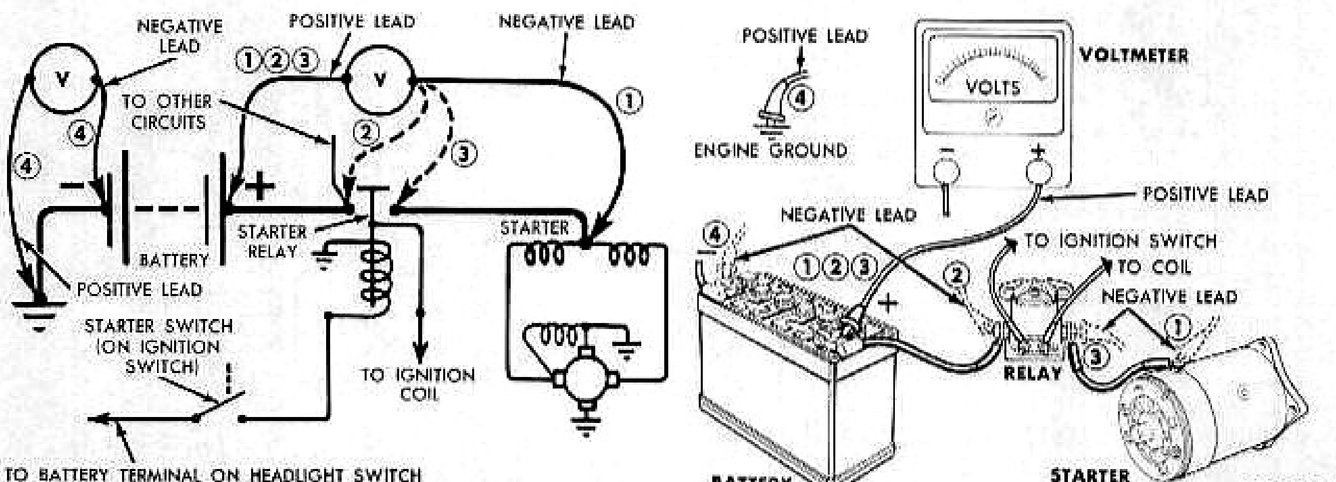

FIG. 12—Starter Circuit Test

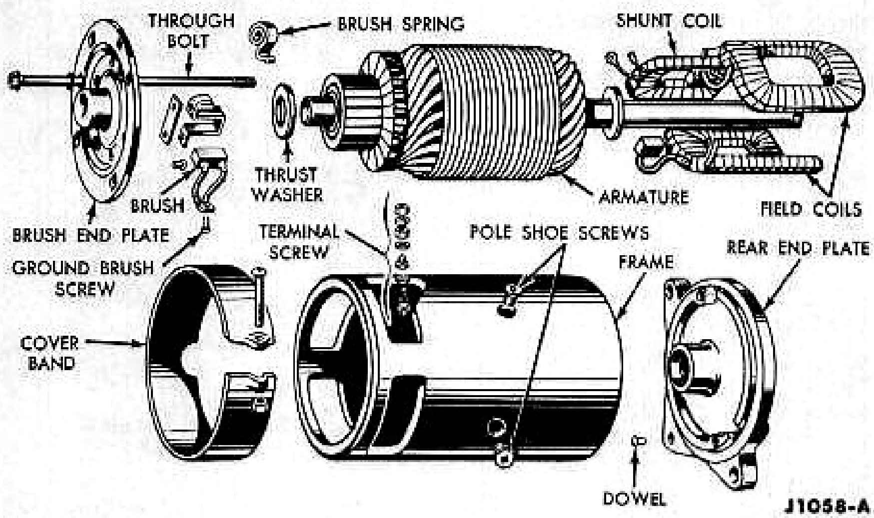

FIG. 13—Disassembled Starter Motor

Disassembly

1. Remove the starter drive, through bolts, and rear end plate (Fig. 13). **Be sure to remove all burrs from the shaft to prevent scoring the rear end plate bushing.**
2. Remove the armature and remove the cover band.
3. Remove the brushes from their holders, and remove the brush end plate.
4. Unscrew the ground brush screws, and remove the ground brushes.

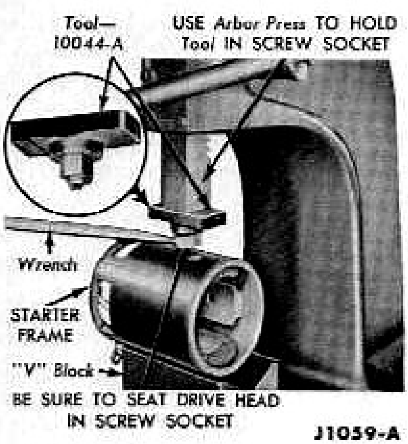

FIG. 14—Pole Shoe Screw Removal

5. Unscrew the three field-pole-shoe screws as shown in Fig. 14. The arbor press prevents the wrench from slipping out of the screw.
6. Unsolder the field coil leads from the terminal screw, and remove the pole shoes and field coils from the frame.
7. Remove the nut and washers from the terminal and remove the terminal. **Remove any excess solder from the terminal slot. Use a 300-watt soldering iron for soldering operations on the starter terminal.**

Cleaning and Inspection

1. Wipe the field coils, armature, and armature shaft with a clean cloth. Wash all other parts in solvent and dry the parts.
2. Inspect the armature windings for broken or burned insulation and unsoldered connections.
3. Check the armature for open circuits and grounds.
4. Check the commutator for runout (Fig. 15). Inspect the armature shaft and the two bearings for scoring and excessive wear.
5. Check the brush holders for broken springs and the insulated brush holders for shorts to ground.
6. Check the brush spring tension. It should be 48-56 ounces. Replace the springs if the tension is not within limits.
7. Inspect the field coils for burned or broken insulation. Check the field brush solder connections and lead insulation.

Assembly

1. Install the terminal screw with insulator washers and terminal nut. Be sure to position the slot in the screw parallel to the frame end surface.
2. Position the series field coils with the leads in the terminal screw slot, and the shunt coil as shown in Fig. 16.
3. Install the field pole shoes and screws. **As the pole shoe screws are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes.**
4. Solder all leads using rosin core solder.
5. Position the shunt coil ground lug under the ground brush terminal farthest from the starter terminal (Fig. 16). The other shunt coil lead is soldered to the series field coil lead farthest from the starter terminal.
6. Install the screws that connect the ground brushes to the starter frame.
7. Install the brush end plate making sure that the brush-plate boss is located in the slot in the starter frame. **Do not pinch the brush leads between the end plate and the frame.**
8. Place a thrust washer on each end of the shaft, slide the armature in place, and install the rear end plate with the end plate dowel located in the starter frame slot.
9. Install the through bolts.

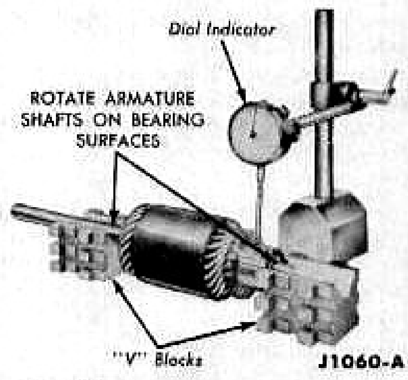

FIG. 15—Commutator Runout Check

10. Install the brushes in their holders being sure to center the brush springs on the brushes.
11. Place the cover band on the starter, and tighten the clamp screw.
12. Install the starter drive.

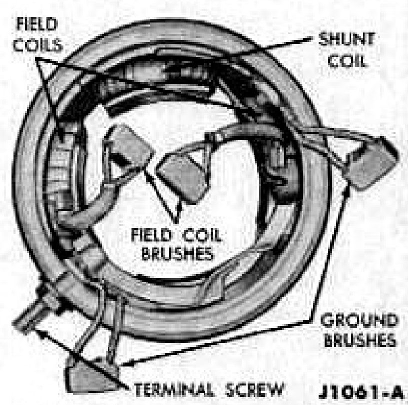

FIG. 16—Field Coil Assembly

ARMATURE REPLACEMENT

Remove the starter drive, through

bolts, rear end plate, and cover band. **Be sure to remove all burrs from the shaft to prevent scoring the rear end plate bushing.** Remove the armature.

Before installing the new armature, pull the brushes from their holders. Slide in the armature, and install the rear end plate and through bolts. **The end plate dowel must be aligned with the slot in the starter frame.**

Replace the brushes in their holders, and center the brush springs on the brushes. Install the starter drive.

COMMUTATOR TURNING

Check the commutator runout as shown in Fig. 15. If the surface of the commutator is rough or more than 0.002 inch out-of-round, turn it down.

Polish the commutator with #00 or #000 sandpaper to remove all burrs left by the turning operation. Be sure that no copper particles remain on the insulation between the segments. **It is not necessary to undercut the mica on the starter motor commutator.**

BRUSH REPLACEMENT

Replace the starter brushes when they are worn to 5⁄16 inch in length. Always install a complete set of new brushes.

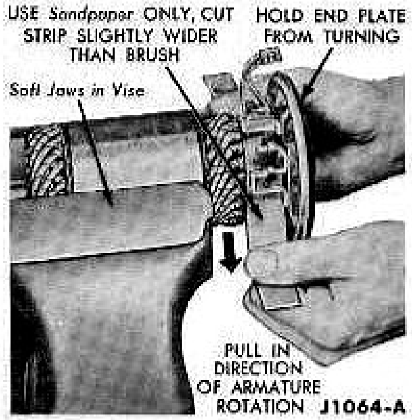

FIG. 17—Starter Brush Seating

1. Loosen and remove the cover band.
2. Remove the two through bolts from the starter frame.
3. Remove the brushes from their holders.
4. Remove the brush end plate and the armature rear end plate assembly.
5. Unsolder the brush leads from the field coils.
6. Unscrew the ground brush terminal screws, and remove the ground brushes.
7. Clean the carbon and dirt from the brush end plate. Replace the brush end plate if the insulation between the field brush holder and the end plate is cracked or broken.
8. Make sure that the new brushes slide freely in the holders. Seat the new brushes by sanding (Fig. 17).
9. Solder the new field brushes to the field coils.
10. Position the shunt coil ground lug under the ground brush terminal closest to the starter terminal. Connect the new ground brushes to the starter frame with the terminal screws.
11. Install the brush end plate.
12. Slide the armature rear end plate assembly in place. **Make sure that the locating boss in the brush end plate and the dowel in the rear end plate are located in the slots in the starter frame.**
13. Install the two through bolts in the starter end plates.
14. Place the brushes in their holders. Be sure to center the brush springs on the brushes.
15. Install the cover band and tighten the clamp screw.

3 STARTER DRIVE

The starter drive is the "Folo-Thru" type shown in Fig. 18. **The "Folo-Thru" drive is serviced only as a complete unit, because of the calibration requirements on the lock pin and anti-drift pin springs.**

REMOVAL AND INSTALLATION

To remove the "Folo-Thru" drive, compress the spring until the end anchor plate clears the drive pin. Remove the drive pin. Slide the drive assembly off the shaft.

To install the drive assembly, line up the pin hole with the hole in the shaft. Compress the spring enough to allow insertion of the drive pin. Insert the pin. The anchor plate covers up the pin holes and prevents the pin from coming out.

CLEANING AND INSPECTION

A sticking starter drive can be cleaned in kerosene. Use a brush to remove grease and dirt from the worm threads until all grit is removed. **Do not oil the starter drive. It should work freely after cleaning in kerosene and wiping dry.**

Inspect the pinion for burrs and broken or badly worn teeth. Check the action of the pinion on the worm threads. It should slide freely on the threads. Check the drive spring to see if it is cracked, broken, or the end tangs are bent. If any of the pinion teeth are badly worn, burred or broken, it will be necessary to replace the drive. **The "Folo-Thru" drive has a lock pin which holds the pinion from rotating when it is in the extended position. Once the pin has dropped into place, it will not disengage unless the starter is mounted on the car and the engine speed reaches 310-390 rpm. It cannot be forced out of position by hand.**

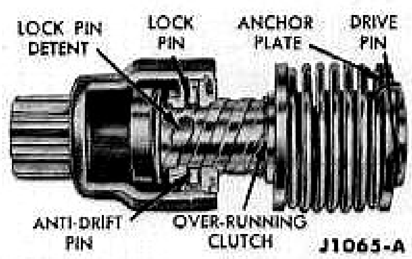

FIG. 18—"Folo-Thru" Starter Drive

PART 11-3 SPECIFICATIONS

GENERATOR

Field Current Draw @ 12 Volts (Amperes)	Maximum Commutator Runout (Inches)	Watts	Gen. rpm Charge Starts*	Maximum Charging Rate		Brushes		
				Amperes	Generator Speed (rpm)*	No.	Original Length (Inches)	Spring Tension (Ounces)
1.5-1.6	0.002	450	1300	30	2525	2	0.86	32-40
1.5-1.6	0.002	525	1460	35	2670	2	0.86	32-40

External Circuit Resistance (generator armature terminal to battery positive terminal) 0.7 Volt Maximum @ 30 Amperes.
*To find the equivalent engine rpm. divide the crankshaft pulley diameter by the generator pulley diameter, and multiply by the generator rpm.

REGULATOR

Current Rating (Amperes)	30	35
Cut-In Voltage	12.4—13.2	
Reverse Current to Open (Amperes)	6-9	2-6
Voltage Regulation @ 75°F.	14.6—15.4	
Current Regulation (Amperes)	28-32	33-37

ALLOWABLE BATTERY FAST CHARGE TIME (Domestic Only)

Specific Gravity	Maximum Fast Charge Time
Below 1.150	1 hour
1.150 to 1.175	¾ hour
1.175 to 1.200	½ hour
1.200 to 1.225	¼ hour
Above 1.225	Slow Charge Only

VOLTAGE REGULATION SETTING VERSUS AMBIENT AIR TEMPERATURE

Ambient Temperature °F.	Voltage Regulation Setting (Volts)
25	15.1-15.9
35	15.0-15.8
45	14.9-15.7
55	14.8-15.6
65	14.7-15.5
75	14.6-15.4
85	14.5-15.3
95	14.3-15.1
105	14.2-15.0
115	14.1-14.9
125	13.9-14.7
135	13.8-14.6
145	13.6-14.4

STARTER MOTOR

Current Draw Under Load (Amperes)	Normal Engine Cranking Speed (rpm)	Minimum Stall Torque @ 5 Volts (Foot-Pounds)	Maximum Load (Amperes)	No Load Amperage	Maximum Commutator Runout (Inches)
155-190	150-180	15.5	550	80-85	0.002

STARTER BRUSHES

Minimum Mfg. Length (Inches)	Wear Limit (Inches)	Brush Spring Tension (Ounces)	No. Used
0.43-0.46	5/16	48-56	4

BATTERY (12 VOLTS)

Original Equipment				Replace With
Filler Cap Color	Plates	Amp. Hours	Ground	Part Number
Red	66	55	Negative	B9A-10654-D
Gray	78	65		B9A-10S54-E
Yellow	66	70		B9A-10654-F

GROUP 12

LIGHTS, INSTRUMENTS, AND ACCESSORIES

PART 12-1 LIGHTING SYSTEM, HORNS, AND INSTRUMENTS

1 TROUBLE SHOOTING

Problems of the lighting, horn, and indicator systems are covered in one of the following trouble diagnosis guides. These guides list many of the sources of trouble encountered in the electrical systems. The items listed are not in the order of probable occurrence. Individual circumstances and experience will dictate which items to check first.

LIGHT TROUBLE DIAGNOSIS GUIDE

ALL HEADLIGHTS DO NOT LIGHT	If all the headlight do not light, check for the following: **1.** Loose battery cable. **2.** Loose or broken wire from the battery to the headlight switch (Fig. 1). **3.** Defective headlight switch (page 12-7). **4.** Disconnected or broken wire from the headlight switch to the beam selector switch (Fig. 1). **5.** Defective beam selector switch (page 12-7). **6.** All headlight bulbs burned out. This may be caused by a defective or improperly adjusted generator voltage regulator (page 11-11).
INDIVIDUAL LIGHTS DO NOT LIGHT	Check for the following: **1.** Burned out bulb. **2.** Loose or broken wires to the bulb.
LIGHTS BURN OUT REPEATEDLY	Lights burn out prematurely because of: **1.** Loose or corroded electrical connections. **2.** Excessive vibration. **3.** Improperly adjusted or defective generator voltage regulator (page 11-11).

HORN TROUBLE DIAGNOSIS GUIDE

HORNS DO NOT SOUND	Check for the following: **1.** Loose connection at the horn button contact. **2.** Open wire (blue-yellow band) to the horn button. **3.** Open wire (yellow) to the horn relay. **4.** Inoperative relay. **5.** Horns defective or out of adjustment (page 12-8).

CONTINUED ON NEXT PAGE

HORN TROUBLE DIAGNOSIS GUIDE (Continued)

ONE HORN FAILS TO OPERATE	Check for the following: 1. Broken or loose wire from the relay to the horn. 2. Horn defective or out of adjustment (page 12-8).
HORNS OPERATE CONTINUOUSLY	Check for the following: 1. Shorted wire to the horn button. 2. Shorted relay.

INSTRUMENT TROUBLE DIAGNOSIS GUIDE

OIL PRESSURE INDICATOR LIGHT INOPERATIVE	Check for the following: 1. Indicator bulb burned out. 2. Loose or broken wire from the light to the indicator switch. 3. Defective oil pressure indicator switch (page 12-10).
CHARGE INDICATOR LIGHT INOPERATIVE	Check for the following: 1. Burned out bulb. 2. Loose or broken wires to the armature terminal of the voltage regulator and/or generator. 3. Generator armature not grounded.
FUEL GAUGE ERRATIC OR INOPERATIVE	Check for the following: 1. Loose or broken wire from the constant voltage regulator to the fuel gauge. 2. Defective fuel gauge (page 12-10). 3. Loose or broken wire from the fuel gauge to the fuel tank sending unit. 4. Defective fuel tank sending unit (page 12-10). 5. Ground wire at the sending unit loose or broken.

CONTINUED ON NEXT PAGE

INSTRUMENT TROUBLE DIAGNOSIS GUIDE (Continued)

TEMPERATURE GAUGE ERRATIC OR INOPERATIVE	Check for the following: **1.** Loose or broken wire from the constant voltage regulator to the temperature gauge. **2.** Defective temperature gauge (page 12-11). **3.** Loose or broken wire from the temperature sending unit to the temperature gauge. **4.** Defective temperature sending unit (page 12-11).
BOTH FUEL AND TEMPERATURE GAUGES ERRATIC OR INOPERATIVE	Check for the following: **1.** Loose or corroded constant voltage regulator ground. **2.** Defective constant voltage regulator (page 12-10). **3.** Broken or loose wire from or to the constant voltage regulator.

2 LIGHTING SYSTEM

Four sealed-beam headlights are used, two in each fender. The two outboard lights have two filaments each for low beam and high beam, and are marked by a numeral "2" molded in the glass lens. Locating tabs molded in the glass allow the mounting of the No. 2 lights in the outboard headlight support frames only. The low beams are used for city driving, when meeting oncoming traffic on the highway, and for No. 2 headlight alignment.

The inboard headlights with a numeral "1" molded in the glass lens have only one filament and are used for highway driving along with the high beams of the No. 2 headlights. Locating tabs molded in the glass allow the mounting of the No. 1 lights in the inboard headlight support frames only. A conventional beam control switch is located on the floor board near the left.

Quick disconnect terminals are provided at the front of the left and right fender aprons, and at the rear of the left fender apron. The terminals are color coded. Like colored terminals are connected together. The green wire with a black band supplies current to the headlight high beams. The red wire with a black band supplies the low beam filaments. The black wire with a yellow band supplies the parking lights (Fig. 1).

Wiring diagrams are presented in Figs. 1 and 2. Assembly and disassembly operations are illustrated when it is necessary to show details or changes in procedure.

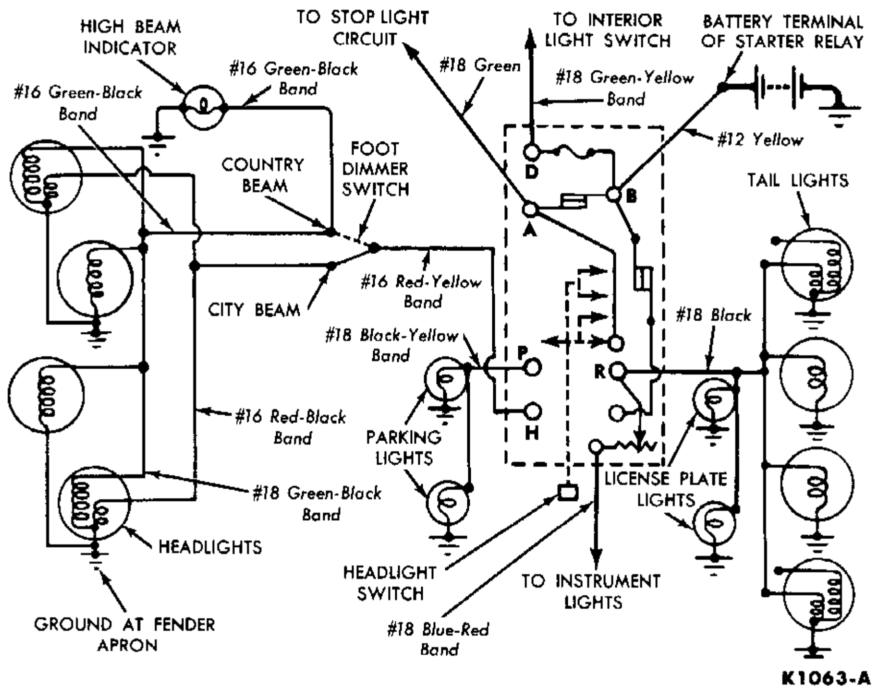

FIG. 1—Headlight Circuit Diagram

HEADLIGHT ALIGNMENT

All headlight adjustments should be made with a full gas tank, an empty car and recommended pressure in all tires. Before each adjustment, bounce the car by pushing on the center of both the front and rear bumpers, to level off the car.

Each headlight is adjusted by means of two screws located under the headlight trim ring as shown in Fig. 5.

To align the headlights by means of a wall chart, select a level portion of the shop floor. Lay out the floor and wall as shown in Fig. 3.

1. Using tool T59L-13007 (Head-

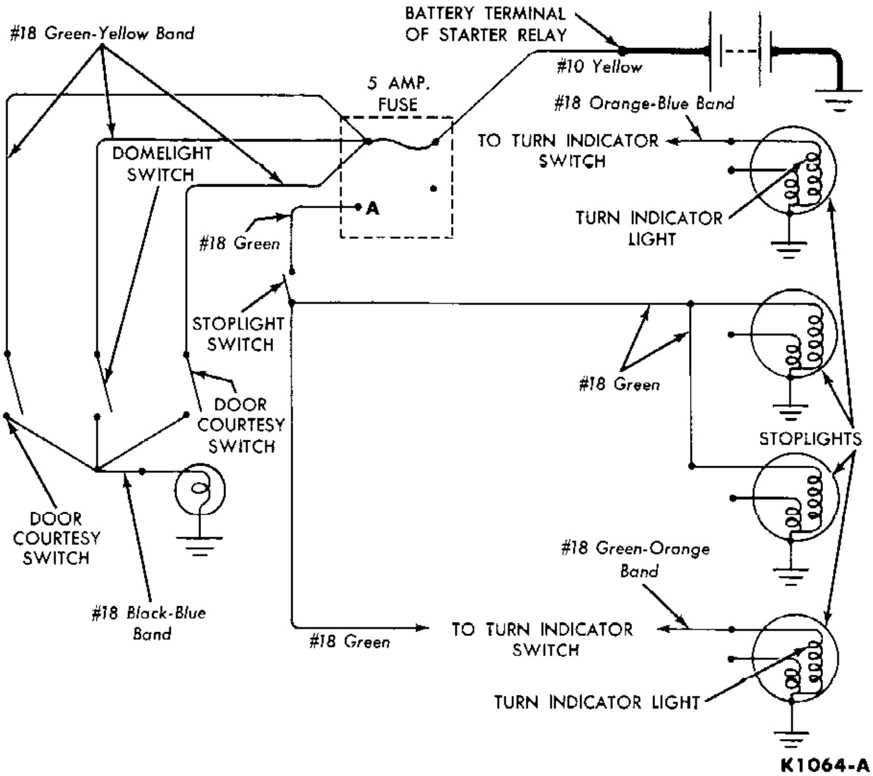

FIG. 2—Dome Light and Stop Light Diagram

light Alignment Wall Charts), center the vehicle in front of the charts, as shown in Fig. 4. **Although the vehicle headlights are positioned 10 feet from the charts, the charts are designed to provide a high beam drop of 2 inches in 25 feet. Check your state law, as an additional allowance will have to be made in states requiring a greater drop.**

2. Select the Thunderbird aiming charts and position them as shown in Fig. 4. Lock them in position by turning the stud caps 90°. Be sure that the bottom of each chart is located in the retainers.

3. Measure the distance from the floor to the headlight lens center of each outboard light. Record the average height. Subtract 20 inches from the average height. This dimension ("A" Fig. 4) is the distance that the No. 2 headlight horizontal line on each chart must be positioned above the 20 inch base line.

4. Adjust the chart up or down so that the distance between the 20 inch base line and the No. 2 headlight horizontal line on the chart, is equal to the dimension just computed.

5. Adjust each No. 1 (inboard) headlight hot spot on the target as shown on the inset (Fig. 4). **Cover the No. 2 lights when making this adjustment.**

6. Put the headlights on low beam. Adjust each No. 2 (outboard) headlight hot spot in the corner of the rectangular pattern as shown on the inset (Fig. 4).

Always bring each beam into final position by turning the adjusting screws clockwise so that the headlight will be held against the tension springs when the operation is completed.

BULB REPLACEMENT

Replacement of bulbs in the lighting system is illustrated in Figs. 6 through 11. These illustrations cover headlights, parking lights, tail, stop, and license plate lights, domelights, and instrument lights.

HEADLIGHTS

Remove the retaining screw and headlight trim ring.

Loosen the retaining ring screws (Fig. 6), rotate the retaining ring counterclockwise, and remove it. The headlight bulb may now be pulled forward far enough to disconnect the wiring assembly plug.

Plug in the new bulb, and place it in position, making sure that the locating tabs are placed in the positioning slots. Only No. 1 bulbs will mount in the inboard support frames, and only No. 2 bulbs will mount in the outboard support frames.

Install the retaining ring, rotating it clockwise under the screws, and tighten the screws.

Place the trim ring into position, and replace the mounting screw.

PARKING LIGHT

To replace the bulb in the parking light, remove the retaining screws, lens, and gasket (Fig. 7). The bulb is the double contact bayonet-type for use with the turn indicator. After the bulb is replaced, the gasket, lens, and retaining ring are then replaced.

TAIL AND STOP LIGHT AND LICENSE PLATE LIGHT

Four taillights are used, two on each side. All four lights are used for the stop lights. The outboard lights are used as turn indicator lights. All four lights may be removed for serv-

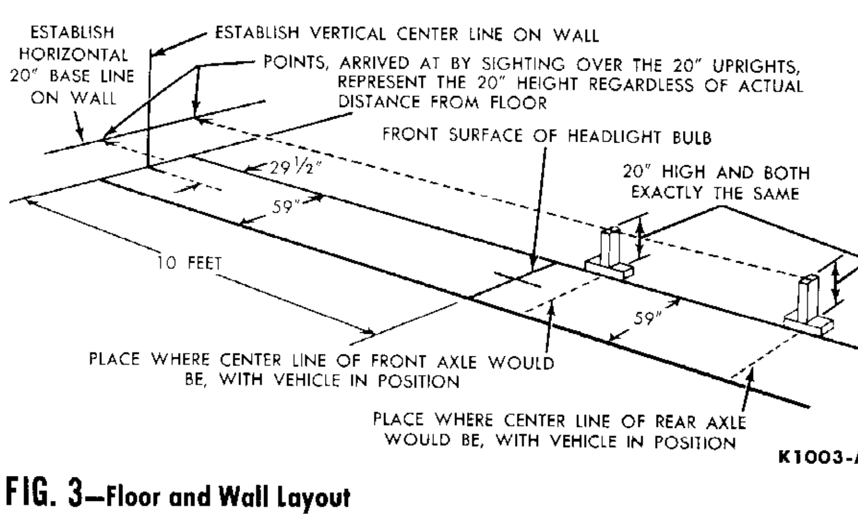

FIG. 3—Floor and Wall Layout

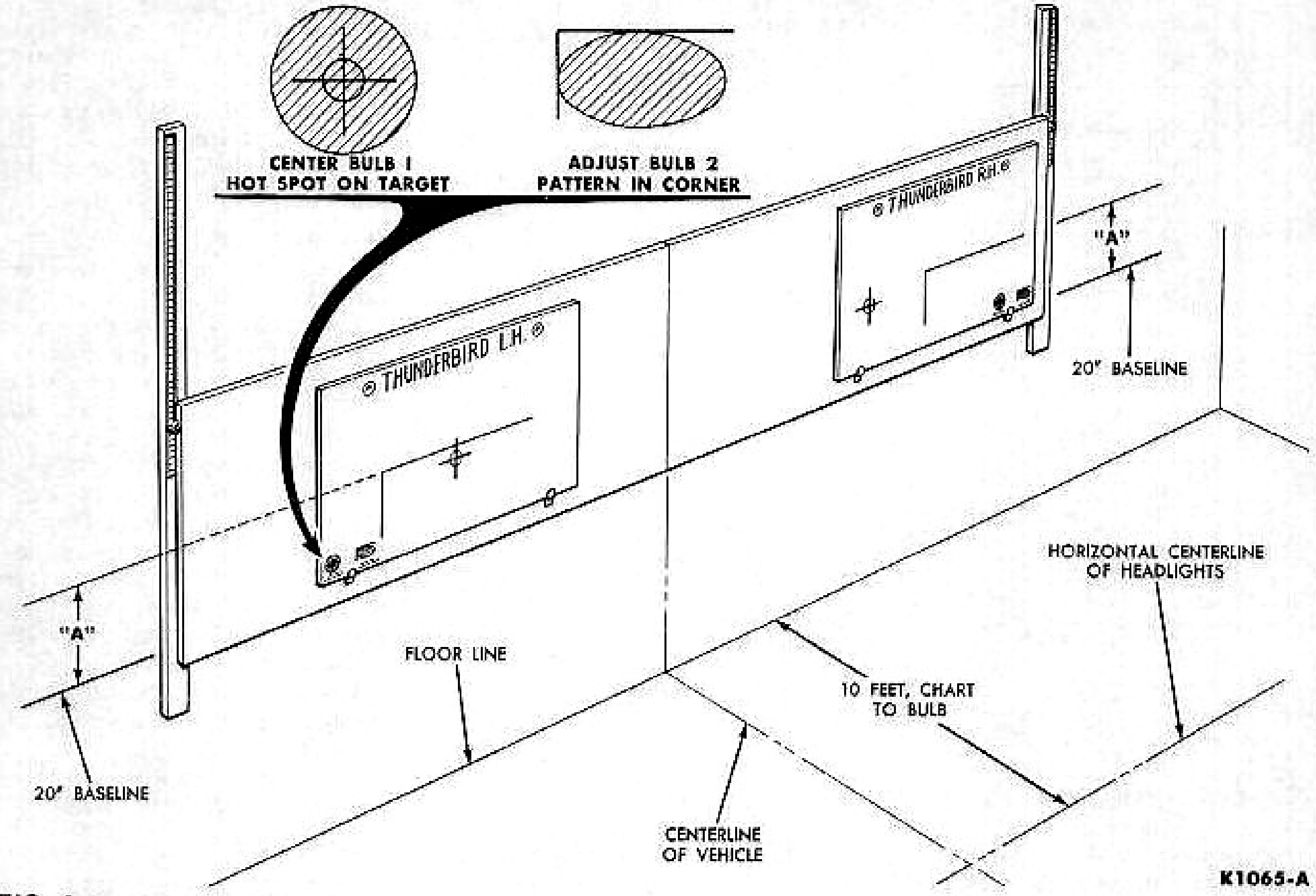

FIG. 4—Headlight Wall Charts

ice from inside the luggage compartment. First remove the interior trim panel on the side being worked on. The lights may then be removed by rotating the socket assembly one quarter turn to disengage the holding lugs.

Two lights illuminate the license plate. A disassembled view of one of the lights is shown in Fig. 8. The bulb and socket assembly snaps into the bezel and lens assembly which then mounts into the bumper guard (Fig. 8).

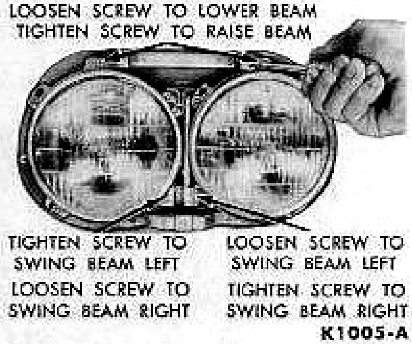

FIG. 5—Headlight Adjustment

INTERIOR LIGHTS

The dome light is a plastic unit, which is held to the roof by two screws. Access may be had for bulb replacement by removing the dome light (Fig. 9).

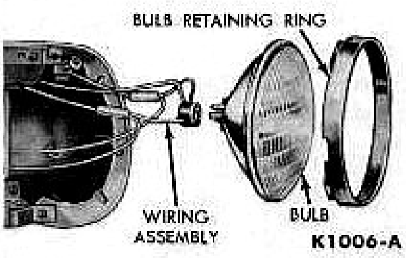

FIG. 6—Disassembled Headlight

INSTRUMENT LIGHTS

The instrument panel light bulbs can be replaced by pulling out the individual light sockets from the rear of the panel (Fig. 10).

SWITCHES

Illustrated procedures for the replacement of the headlight switch, beam-control switch, stop light switch, dome light switch, and ignition switch are given here.

HEADLIGHT AND BEAM SELECTOR SWITCH TESTS

The following tests may be made to determine whether a headlight switch or a beam selector switch is defective.

Set the headlight switch to the headlight position, and operate the beam selector switch. If none of the headlights turn on when the beam selector switch is operated, yet the instrument panel lights operate, the headlight switch or the red-yellow

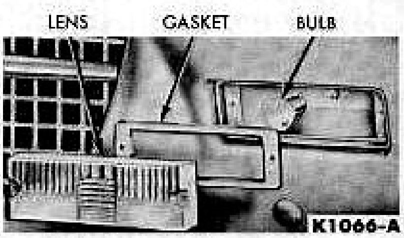

FIG. 7—Disassembled Parking Light

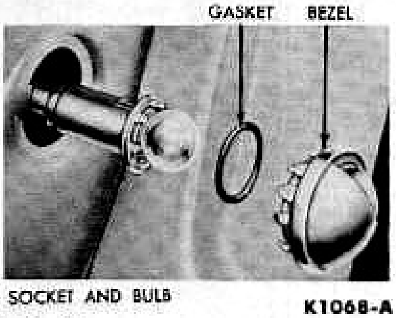

FIG. 8—License Plate Light

band wire from the headlight switch to the beam control switch is probably defective. Substitute a known good switch for the suspected switch to determine whether the switch or the wiring is at fault.

If the headlights operate only with the beam control switch in one position, the switch or the wiring from the switch to the headlight is defective. Substitute a known good switch for the suspected switch to determine whether the switch or the wiring is at fault.

CAUTION: **Before removing any switch, disconnect a battery cable from one of the battery terminals.**

HEADLIGHT SWITCH

Remove the control knob and shaft by pressing the knob release button on the switch housing (Fig. 11), with the knob in the OFF position. Turn the shaft slightly, and pull it out of the switch.

Unscrew the mounting nut, remove the bezel and switch, and disconnect the wires.

To install the switch, connect the wires to their terminals, insert the switch in the instrument panel, and install the bezel and mounting nut.

Install the knob and shaft assembly by inserting it all the way into the switch until a distinct click is heard. In some instances it may be necessary to rotate the shaft slightly until it engages the switch-contact carrier.

HEADLIGHT BEAM CONTROL SWITCH

Lay the floor mat back from the area of the switch, and remove the mounting plate screws (Fig. 12). Remove the switch from the mounting plate, and disconnect the wire terminal block from the switch.

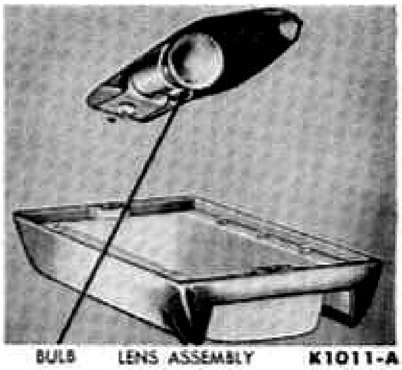

FIG. 9—Disassembled Dome Light

To install the switch, connect the terminal block to the switch, mount the switch on the mounting plate, and install the plate and switch to the floor. Replace the floor mat.

STOP LIGHT SWITCH

Disconnect the wires at the bullet connectors, and unscrew the switch from the master-cylinder (Fig. 13).

DOME LIGHT SWITCH

The dome light switch is a part of the headlight switch. It is actuated by rotating the switch control knob to the maximum counter-clockwise position. The dome light and headlight switch is replaced as a unit (Fig. 11).

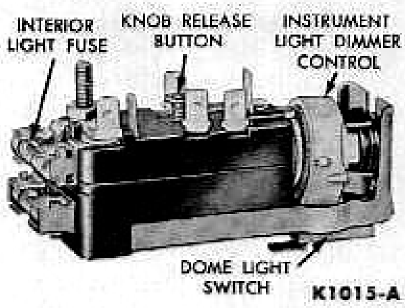

FIG. 11—Headlight Switch, Dome Light Switch, and Circuit Breaker Assembly

FIG. 12—Headlight Beam Control Switch

IGNITION SWITCH

The ignition switch is removed and installed at the rear of the instrument panel. Disconnect the battery. Press in the switch body from the rear of the panel. Rotate the bezel ¼ turn counterclockwise (Fig. 14), then remove the switch from the rear of the

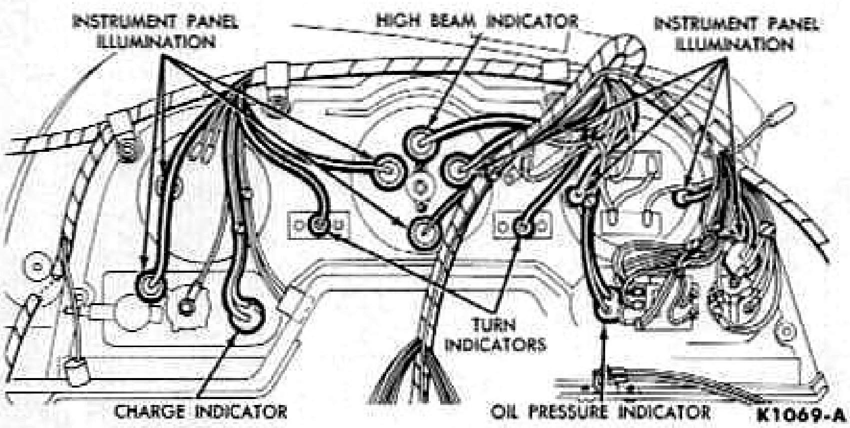

FIG. 10—Instrument Panel Lights

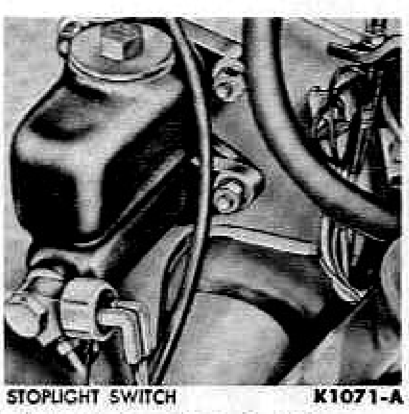

FIG. 13—Stop Light Switch

panel, and disconnect the wires from the switch terminals.

CIRCUIT BREAKER AND FUSES

A combination headlight switch, dome light switch, circuit breaker and fuse assembly is used (Fig. 11). One of the circuit breakers protects the headlight circuit, the second circuit breaker protects the instrument lights, parking lights and the stop light, and tail light circuits. One fuse protects the interior lighting circuit. The second fuse protects the turn signal lights.

The breaker assemblies are integral with the headlight switch and are serviced as an assembly. The unit is mounted as shown in Fig. 15. The fuses are mounted on the back of the assembly.

FIG. 14—Ignition Switch Removal

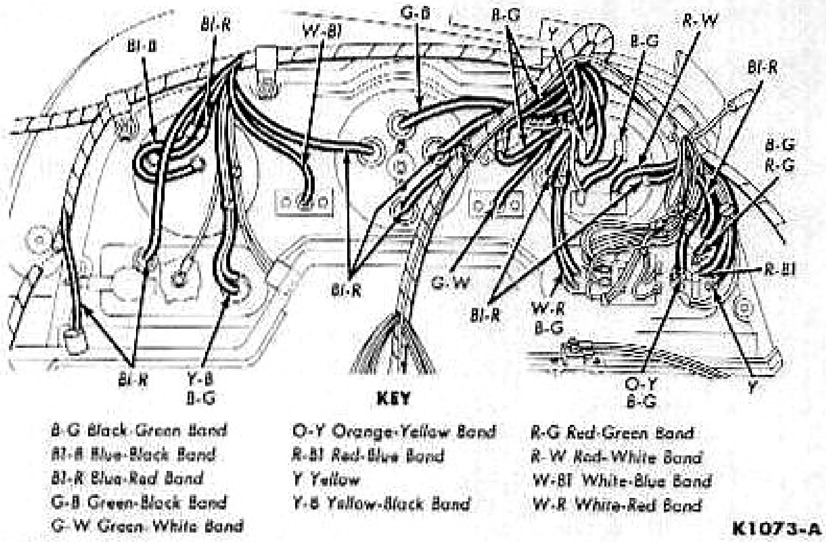

FIG. 15—Instrument Panel Wiring

3 HORNS

The Thunderbird is equipped with a pair of tuned horns controlled by a relay. The horn button closes the relay contacts, completing the circuit to the horns. One of the horns has a high-pitched tone; the other has a low-pitched tone. The horn circuit is shown in Fig. 16.

TEST AND ADJUSTMENT

The only test necessary on the horns is for current draw. The current adjustment also adjusts the tone of the horn.

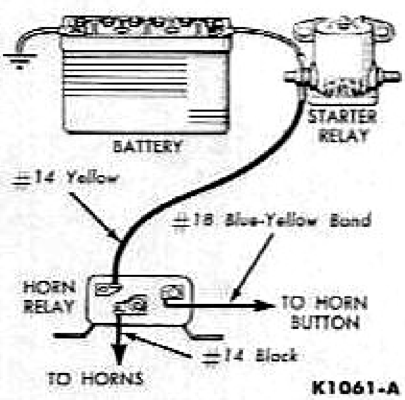

FIG. 16—Horn Circuit

CURRENT DRAW TEST

Connect a voltmeter and ammeter to the horn and to a voltage supply as shown in Fig. 17. The normal current draw for the horns at 12 volts is 9.0-10.0 amperes.

CURRENT ADJUSTMENT

Current is adjusted by changing the contact tension (Fig. 18). Connect the horn as shown in Fig. 17. Turn the tone-adjusting nut until the current is within the limits specified. **Do not attempt to adjust the horn while it is blowing.** If the current oscillates between 9 and 12 amperes, turn the adjusting nut clockwise a small amount. Replace the horn if it can not be adjusted.

REPLACEMENT

The horns are mounted at the left of the radiator on the fender apron. Remove the horn to horn mounting bracket stud nuts. Remove the horn from the bracket and disconnect the horn wire at the terminal.

To install, attach the horn wire to the horn terminal, then mount the horn in position.

HORN RING REMOVAL

A disassembled view of the horn ring is shown in Fig. 20. The horn ring is assembled to the steering wheel. The horn ring contact makes connection with the horn relay wire by means of a sliding contact mounted on a plastic plate which is attached to the end of the steering column. When the horn ring is depressed, the horn ring contact makes connection with ground through a "C" washer clipped to the steering wheel hub.

To remove the horn ring, pull off the decorative cover at the center of the steering wheel and remove the wheel from the steering gear shaft.

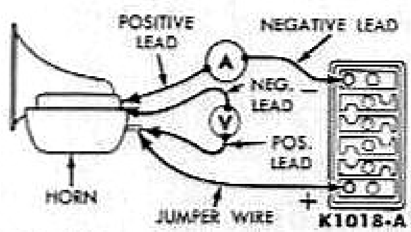

FIG. 17—Horn Current Draw Test

Remove the turn indicator cancelling cam and the ground contact ring (Fig. 20). Removal of the three retaining screws then allows complete disassembly of the remaining parts.

Assemble the insulators, horn ring,

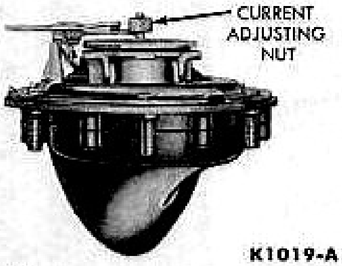

FIG. 18—Horn Adjustment

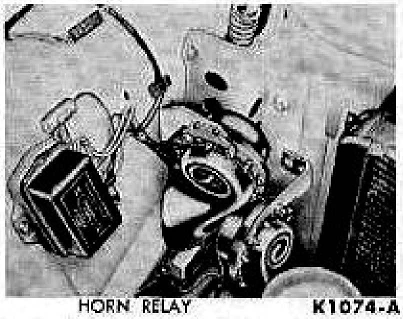

FIG. 19—Horn Installation

contact, spring and spring retainer in the order shown in Fig. 20. Install the ground contact "C" washer.

Install the turn indicator cancelling cam so that the opening in the cam is on the opposite side of the steering gear shaft from the cancelling pawls, when the steering wheel is in the straight ahead position.

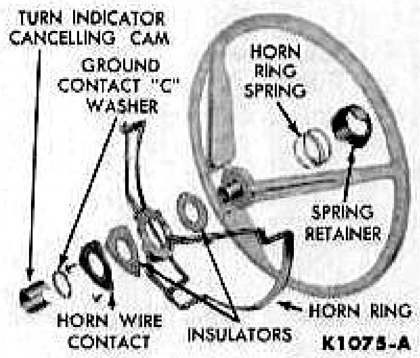

FIG. 20—Disassembled Horn Ring

4 INSTRUMENTS

This section contains information on the various units in the instrument cluster assembly. A circuit diagram showing the connections of the gauges and lights is shown in Fig. 21.

The instrument cluster includes a charge indicator light, fuel gauge, temperature gauge, oil pressure indicator light, speedometer, and provision for an electric clock. A gauge voltage regulator maintains a constant voltage supply to the fuel gauge and temperature gauge circuits. All of the instruments are electrically operated except the speedometer. Illumination is provided by eleven lights controlled by a rheostat on the lighting switch.

It is not necessary to remove the entire instrument cluster in order to remove the individual instruments, as the instruments are mounted on the outer surface of the cluster. To remove any instrument, pull off the bezel. Four mounting screws are then exposed to view. Remove the screws, pull the instrument away from the panel and disconnect the wires or cables.

When installing an instrument, follow the color coding as shown in Fig. 15 or 21 for attaching the wiring or installing the panel lights.

The fuel tank sending unit is attached to the fuel tank by a retaining ring. The retaining ring is removed

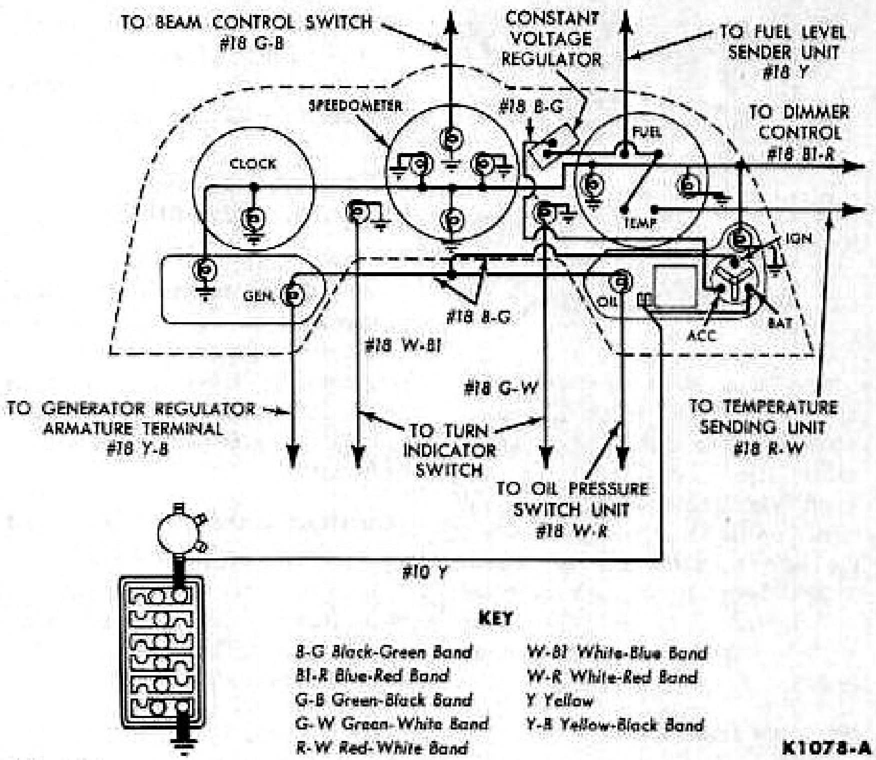

FIG. 21—Instrument Cluster Circuit

or installed by use of a special tool, T57L-99275-A. The sending unit is accessible through a covered opening under the center of the luggage compartment floor mat.

CHARGE INDICATOR LIGHT

A generator charge indicator light is used. This light flashes on if the battery is discharging and the generator is not supplying current.

To test the charge indicator light, turn the ignition switch on with the engine stopped. The light should come on. If it does not, the light is either burned out or the wiring to the light is defective. Figure 22 shows the charge indicator light circuit.

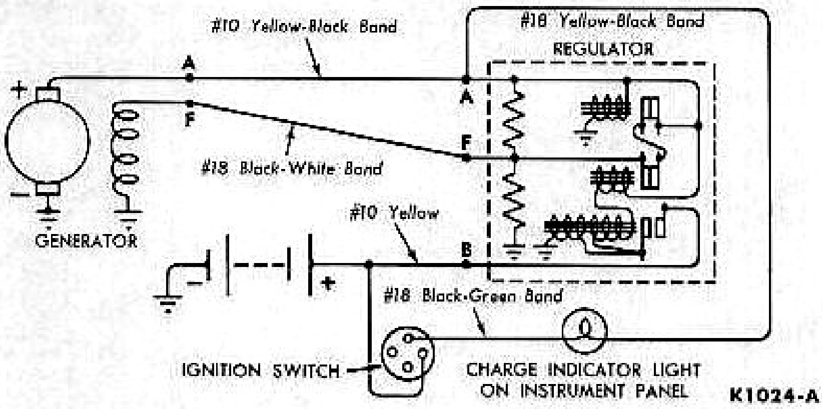

FIG. 22—Generator Charge Indicator Light Circuit

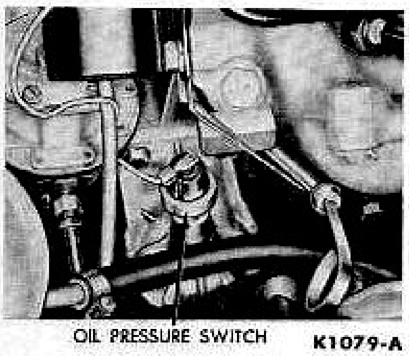

FIG. 23—Oil Pressure Switch Mounting

OIL PRESSURE INDICATOR LIGHT

The Thunderbird is equipped with an indicator light which flashes on when the oil pressure is below a safe value. The light should come on when the ignition switch is first turned on, and it should go out when the engine is started. The light is connected between the oil pressure switch unit and the "COIL" or "IGN" terminal of the ignition switch.

INDICATOR LIGHT TEST

To test the indicator light, turn on the ignition switch. Do not start the engine. The light should come on. Start the engine. The light should go out, indicating that the oil pressure has built up to a safe value.

To test the oil pressure switch on the engine, turn the ignition switch on (engine not running), the indicator light should come on. If the indicator light does not come on, short the terminal of the oil pressure switch unit to ground. If the light now comes on, the oil pressure switch is defective. If the light still does not come on, the bulb is burned out or the wires from the bulb to the ignition switch and oil pressure switch are defective.

OIL PRESSURE SWITCH REPLACEMENT

The oil pressure switch used with the indicator light unit is mounted on top of the oil filter (Fig. 23).

FUEL GAUGE AND TEMPERATURE GAUGE

The voltage regulator (Fig. 24) used with the fuel and temperature gauges maintains an average value of 5.0 volts at the gauge terminals. The regulator is temperature compensated for all expected ambient (surrounding air) temperatures, and is not adjustable.

CONSTANT VOLTAGE REGULATOR TEST

Turn the ignition switch ON. Check for voltage at the gauge feed wire (black with green band) at one of the gauges. The voltage should oscillate between zero and about 10 volts. If it does not, the constant voltage regulator is defective, or there is a short to ground between the voltage regulator and the gauges.

FUEL GAUGE

The fuel gauge consists of a sending unit, located on the gas tank, and a remote register unit (fuel gauge) mounted in the instrument cluster. The fuel gauge circuit is shown in Fig. 25.

Fuel Gauge System Test. The method presented for testing the fuel gauge unit can also be used to check the temperature gauge unit. The gauge unit test will determine the accuracy of the gauge unit.

Gauge Unit Test. Place the ignition switch in the off position, and connect the terminals of two, series connected, flashlight cells to the gauge terminals. The 3 volts should cause the gauge to read approximately full scale.

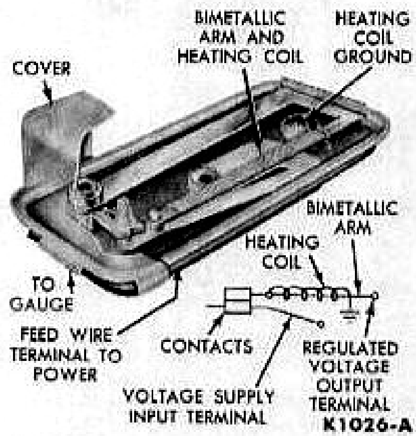

FIG. 24—Gauge Voltage Regulator and Circuit

Sending Unit Test. The sending unit can be tested by first making a gauge unit test to determine the accuracy of the instrument panel gauge unit. If the gauge unit is inaccurate or does not indicate, replace it with a good unit. If the gauge unit still indicates improperly or is erratic in its operation, the sending unit or wiring to the sending unit is faulty.

If the fuel gauge unit indicates improperly and at the same time the temperature gauge indicates improperly and in the same direction, the constant voltage regulator could be defective, as it supplies both gauges.

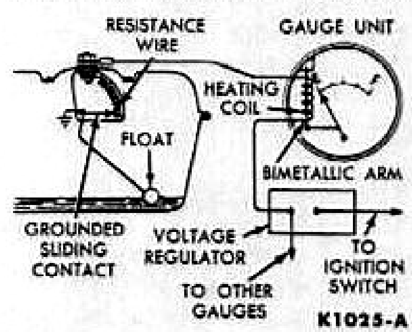

FIG. 25—Fuel Gauge Circuit

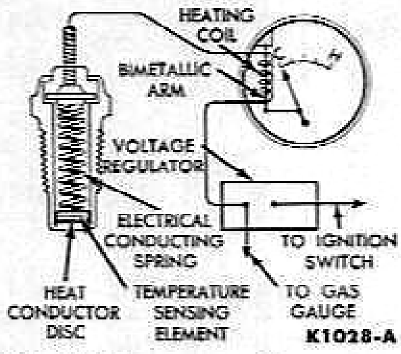

FIG. 26—Temperature Gauge Circuit

TEMPERATURE GAUGE

The temperature gauge consists of a sending unit mounted in the cylinder head, and a remote register unit, (temperature gauge) mounted on the instrument panel. The temperature gauge circuit is shown in Fig. 26.

Gauge Unit Test. Perform the same test as that described for the fuel gauge. The temperature gauge pointer should read approximately full scale. This test will determine the accuracy of the instrument panel gauge unit.

Sending Unit Test. The sending unit can be tested by first making a gauge unit test to check the accuracy of the gauge unit. Start the engine and allow it to warm up to normal temperature. If no reading is indicated on the gauge, check the sending unit to gauge wire by removing the wire from the sending unit and momentarily grounding the wire. If the gauge still does not indicate, the wire is defective. Repair or replace the wire. If the gauge now indicates, the sending unit is faulty.

If the temperature gauge unit indicates improperly and at the same time the fuel gauge indicates improperly and in the same direction, the constant voltage regulator could be defective, as it supplies both gauges.

SPEEDOMETER

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft, and a drive gear located inside the transmission. The flexible shaft drives the speedometer which registers speed in miles per hour and also drives an odometer which records distance traveled in miles and tenths of a mile.

TABLE 1—Speedometer Gear—Rear Axle—Tire Size Combinations

Tire size	8:00—14		8:50—14	
Rear Axle Ratio	Teeth in Drive Gear	Teeth in Driven Gear	Teeth in Drive Gear	Teeth in Driven Gear
2.91	—	—	9	19
3.10	8	18	—	—
3.70	7	19	—	—

SPEEDOMETER TESTS

To test the odometer accuracy, drive the vehicle over a "measured mile." Speedometer accuracy can be checked by comparing the speedometer in question against one known to be accurate, while two vehicles are moving at the same speed, or by timing the vehicle on a "measured mile."

Most cases of speedometer inaccuracy are due to a change to non-standard tire sizes without changing the speedometer drive gear ratio. Refer to Table 1 for the proper gears to use for various rear axle-tire size combinations.

REMOVAL AND REPLACEMENT

Pull the speedometer bezel from the instrument panel. Remove the four mounting screws, and pull the speedometer far enough from the instrument panel to disconnect the speedometer cable and remove the pilot lights.

Make certain that all the pilot lights are secure in their mounting holes when installing the speedometer. The top pilot light is the high beam indicator (green with black band Figs. 15 and 27).

SPEEDOMETER CABLE REPLACEMENT

To replace the speedometer drive cable, disconnect the cable housing at the speedometer, and pull the cable out of the housing. Lubricate the new cable with cable lubricant B5A-19581-A and insert it all the way into the housing, and twist it slightly to make sure that the squared drive is engaged in the speedometer driven gear. The housing is fastened to the transmission as shown in Fig. 28. **If a speedometer cable is broken, it will be necessary to disconnect both ends of the cable housing in order to remove the broken sections.**

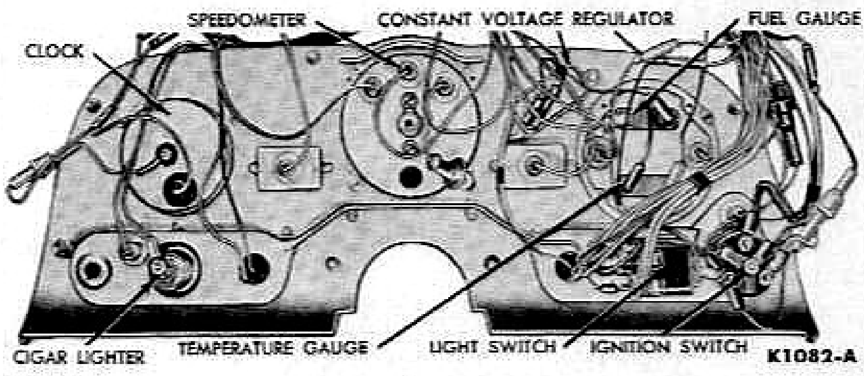

FIG. 27—Rear View of Instrument Cluster

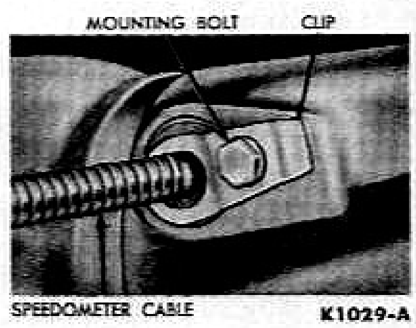

FIG. 28—Speedometer Cable Housing Transmission Mounting

The speedometer driven gear is held on to the speedometer shaft casing by a retainer clip. When replacing the driven gear, make certain that the gear is secure by placing the gear in position before inserting the retainer clip through the gear slots.

PART 12-2 ACCESSORIES

1 RADIO TROUBLE SHOOTING

Procedures for the location and elimination of the majority of minor troubles interfering with normal radio receiver operation, are presented here. The procedures given are not intended to cover all of the possible radio receiver troubles. Each procedure either locates the minor trouble or determines that the receiver should have a major repair. As a major repair on the radio should only be made by a competent radio repairman, do not go beyond the procedures given.

The following parts will be required to make the radio trouble shooting tests:

Spare Fuses (5 ampere)
Antenna and lead
Speaker
Radio Tubes (One each: 12AD6, 12AF6, 12BL6, 12AE6A)
Suppression Equipment (Complete Set)

CAUTION: **Pretest and mark all of the test parts (except fuses) so that these known good parts will not be left in a tested receiver.**

RADIO TROUBLE SHOOTING

NO RECEPTION	Turn the ignition switch to the accessory position and turn the receiver on. Check to see if the fuse is blown. If the fuse is blown, follow "Fuse Is Blown" below. If the fuse is not blown, follow "Fuse Is Not Blown" below. **FUSE IS BLOWN** If the fuse is blown, install a new fuse and check to see if the tubes are lighted. If the tubes do not light up, make certain that voltage is available at the "A" lead and if it is, or if the new fuse blows, remove the receiver for major repair. If at least one but not all of the tubes light up, replace those that do not light up. If the replacement tubes do not light up, remove the set for major repair. **FUSE IS NOT BLOWN** Check to see if the tubes are lighted. If all of the tubes are lighted, connect the test antenna to the receiver and hold it so that it protrudes out of the car. If this cures the trouble, make certain that the old antenna connector was clean and made a good connection, before discarding it, then install a new antenna and lead. If the antenna is not at fault, disconnect the speaker and plug in the test speaker. If this cures the trouble replace the old speaker. **Do not operate the radio without a speaker connected, since to do so may damage the power transistor.** If the speaker is not at fault, substitute the test tubes for those in the receiver, one at a time, allowing enough time for each tube to heat up before going on to the next. If the receiver still will not play, it must be removed for major repair. **It will seldom be necessary to replace a transistor output stage. Replacement and testing of transistors should be left to a competent radio service man. After performing all of the preceding checks, be sure to remove all tubes, and other parts which were marked and used for testing.**
NOISY OR ERRATIC RECEPTION	The cause of noisy or erratic reception can be isolated by finding out when the noise occurs. If it occurs while the car is at a standstill with the engine not running, the trouble lies in the radio receiver. If the noise occurs only while the car is standing with the motor running, it is probably caused by ignition or electrical units on the car. If the noise occurs only while the car is in motion, it is probably caused by wheel and tire static,

CONTINUED ON NEXT PAGE

RADIO TROUBLE SHOOTING (Continued)

NOISY OR ERRATIC RECEPTION (Continued)	or by intermittent shorting of the antenna. **NOISY WHILE STANDING—ENGINE NOT RUNNING** Tune in a local station, and jar the side of the receiver case with the hand. Make sure that the connector plugs are firmly seated. If the connectors are secure and the noisy reception continues as the receiver is jarred, tap the tubes gently with the finger tips, while holding the tubes in the socket to eliminate disturbing the tube contacts. If the receiver becomes noisy, with a sound like scratchy static, as any particular tube is tapped, replace the defective tube. If none of the tubes are noisy, the receiver must be removed for major repair. **NOISY RECEPTION—ENGINE RUNNING** Inspect the installation of suppression equipment (Fig. 7). If the suppression equipment is complete, substitute the good suppression test parts one at a time. Be sure that all condensers are properly grounded. Check the receiver mounting to determine if the paint and deadener were properly removed before the receiver was mounted. The receiver must make a good ground contact both at the support bracket mountings and where the receiver units contact the instrument panel. **NOISY RECEPTION—VEHICLE IN MOTION** Retract the antenna and flex it slightly to let it vibrate. Move and twist the lead-in slightly. If noise occurs when this is done, replace the antenna.
DISTORTED OR GARBLED SOUND	Distorted or garbled sound may be caused by the voice coil rubbing on the center pole piece of the speaker magnet, by a torn speaker cone, by foreign material coming in contact with the cone, or by a defective tube in the receiver. The voice coil may be thrown out of alignment by twisting or bending of the speaker frame if the speaker unit is improperly mounted in the speaker grille. To determine if the speaker is at fault, substitute the test speaker before removing the suspected unit. When installing a new speaker tighten the attaching nuts finger-tight only. If the reception is not improved, substitute tubes as described in paragraph "Fuse Is Not Blown" If the trouble is not corrected by these procedures, remove the receiver for major repairs.
WEAK RECEPTION	When reception is limited to a few strong local stations, adjust the antenna trimmer to align the receiver to the antenna. Substitute the test tubes as described in paragraph "Fuse Is Not Blown."

2 HEATER TROUBLE SHOOTING

Three symptoms of heater trouble are given below as "Insufficient or No Heat," "Insufficient or No Defrosting," and "Too Much Heat."

HEATER TROUBLE SHOOTING

INSUFFICIENT OR NO HEAT	Inspect the heater blower for a blown fuse or loose wires. Check for a poor ground, fan loose on the motor shaft, blower wheel or housing damaged (preventing rotation), foreign objects in the blower, and damaged or burned out heater switch. The temperature control unit could cause insufficient heat. With the engine at operating temperature and the temperature control lever at high, feel the heater unit, it should be warm.

CONTINUED ON NEXT PAGE

HEATER TROUBLE SHOOTING (Continued)

INSUFFICIENT OR NO HEAT (Continued)	Inspect all the control cables. Make certain that the cables are correctly attached at both ends, not kinked, and that they allow full travel of both the temperature-control valve and the air-control valve. If the heater unit is cool, the temperature control unit could be defective, or not allowing the water to circulate through the heater. Incorrect water flow could also cause insufficient heat. Check the water hoses to see that they are correctly routed and are not kinked or collapsed (possibly due to the water outlet elbow pointing in the wrong direction). Check the engine thermostat for proper installation and operation. Make certain that the heater unit is not at fault, such as a partially plugged core. Check for air leaks in the ventilating system. Look for grommets missing in the dash openings and not properly sealed. Make certain that the cowl air intake screen and the honeycomb of the heater core are not clogged with foreign material. Test for body air leaks caused by poor or missing seals around the doors or windows or by loose fitting doors.
INSUFFICIENT OR NO DEFROSTING	All of the preceding checks also apply to this subject. In addition, check the defroster control cable, it should be connected properly to allow full travel of the defroster valve in the plenum chamber. Make certain that the defroster holes are connected, the defroster valve is tight on the control shaft, the defroster nozzles are attached, and that the slot in the windshield moulding is free of obstructions.
TOO MUCH HEAT	A symptom of too much heat is caused by a completely open temperature control unit. A defective temperature control unit, or an incorrectly installed Bowden cable on the control unit could cause too much heat by allowing the water to circulate through the heater.

3 AIR CONDITIONING TROUBLE SHOOTING

The trouble shooting procedures for the air conditioner have been set up assuming that the test gauges used are accurate and that the manifold valves are in good condition. Figure 1 shows a "road map" to follow when trouble shooting the symptom, "Insufficient or No Cooling." Malfunctions of the system that will not affect the cooling function are listed under the heading "Other System Malfunctions."

TROUBLE SYMPTOMS, CAUSES, AND CORRECTIONS

INSUFFICIENT OR NO COOLING	First make certain that the evaporator is not clogged with ice because the thermostatic switch feeler tube is not properly contacting the fins. Check to make certain that all body openings are air tight. Check the adjustment and condition of the compressor belt. Replace the belt if necessary. Make sure that the compressor magnetic clutch is operating properly. Set all controls for maximum cooling, then check the air conditioning system for air output.

CONTINUED ON NEXT PAGE

TROUBLE SYMPTOMS, CAUSES, AND CORRECTIONS (Continued)

SET CONTROLS FOR MAXIMUM COOLING	Before making any of the following checks, **all** controls should be set for maximum cooling. Set both the upper and lower control levers at the off position. Pull out the right air control knob. Set the thermostatic switch control lever at the right end of its travel. Set the blower motor at high.
CHECK SYSTEM AIR OUTPUT	If the air output appears less than normal, check the air passages, including the evaporator, for dirt and obstructions. Clean where necessary. Make certain that the evaporator and blower air valves are adjusted properly. Check the blower motor for proper operation. Normal current draw for the high speed winding is 10 amperes at 12-12.5 volts. The slow speed winding current draw is 5 amperes at 12-12.5 volts. If the current drawn by the motor is not to specifications, remove the motor, determine the cause, and repair or replace the motor as required. Make certain that the voltage regulator is properly set to give full voltage to the blower. Check the two service valves, and make sure that both valves are at the maximum counterclockwise position.
CHECK THE SIGHT GLASS FOR BUBBLES	If the preceeding steps do not cure the trouble, check the sight glass for bubbles. Run the engine at 1500 rpm with the thermostatic switch control lever set for maximum cooling, and the blower on high. Bubbles in the sight glass indicate an undercharge of refrigerant. Check the system for leaks, repair if necessary and charge the system with the proper amount of Refrigerant-12. No bubbles in the sight glass will indicate either a full charge or a complete loss of refrigerant. To determine if there is refrigerant in the system, run the engine at 1500 rpm, and set the thermostatic switch control lever at the maximum cooling position. Open the high pressure service valve slightly. Allow the gas to escape through the gauge port slowly, observing the sight glass. If bubbles begin to appear, close the high pressure service valve, and make a partial charge of one pound of Refrigerant-12. The system will then have a complete charge. If no bubbles appear, check for refrigerant leaks, repair the breaks if necessary, and charge the system with the proper amount of Refrigerant-12.
CHECK THE SYSTEM PRESSURES	If no bubbles are seen in the sight glass after several minutes of operation, and a full refrigerant charge is evident, check the high and low pressures. Depending on the surrounding air temperatures, the high and low pressures should show an approximate differential pressure ratio of 6 or 7 to 1. The low pressure will be from 16-25 pounds, and the high pressure will be from 100-180 pounds at a surrounding air temperature of 75°F. **Check the system pressures with the engine running at 1500 rpm, all controls set for maximum cooling, and the front of the car at least 5 feet from any wall. At idle speed and a surrounding air temperature of 100°-110°F., the high pressure may go as high as 300 pounds or more.**
LOW PRESSURE BELOW NORMAL, HIGH PRESSURE NORMAL	These pressures indicate a restriction between the receiver and the expansion valve or between the expansion valve and the low pressure service valve. If the low pressure is actually a vacuum, the expansion valve is probably closed tightly. Shut the system down and allow it to warm to room temperature. Start the engine and if the evaporator will now become cool, the expansion valve was frozen because of moisture in the system. Release the refrigerant, replace the dryer-receiver assembly, check for leaks, then charge the system. Check the system between the receiver outlet and the low pressure service valve for restrictions, by feeling all of the connections and components. Any portion that is cold to the touch or that frosts up, with the pressures as indicated here, is restricting the refrigerant flow.

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TROUBLE SYMPTOMS, CAUSES, AND CORRECTIONS (Continued)

LOW PRESSURE ABOVE NORMAL, HIGH PRESSURE NORMAL	Observe both pressure gauges. If the low pressure is above normal (16-25 pounds at 75°F.) and the high pressure is at or near normal (100-180 pounds at 75°F.) the expansion valve is not operating properly. This condition may cause the compressor to receive slugs of liquid and thus to be very noisy. Also, the suction side of the compressor and the crankcase and head will be colder than normal and will "frost up." The expansion valve will allow too much liquid refrigerant to flow to the compressor if it is defective or, if the temperature sensing bulb is not making close contact with the evaporator outlet pipe. Make sure that the bulb is properly clipped to the outlet pipe, and properly covered. Remove the expansion valve and make an expansion valve test. Clean the valve orifice or replace the valve as required.
HIGH PRESSURE BELOW NORMAL, LOW PRESSURE ABOVE NORMAL	If the two pressures are equal within 30 pounds of each other, the compressor may be defective. Repair or replace the compressor as needed.
HIGH PRESSURE ABOVE NORMAL	High compressor head pressures are caused by an overcharge of refrigerant, air in the system, condenser air passages clogged, a restriction between the condenser inlet and the receiver, or high surrounding air temperatures. High head pressures are generally evidenced by a noisy compressor. Bleeding the system will relieve both an overcharge of refrigerant and entrapped air. NOTE: **Whenever the system has been opened three times the receiver dryer should be replaced as a precaution against internal icing of the expansion valve.**
POOR TEMPERATURE CONTROL	If cooling is obtained only when all the controls are set at the maximum cooling position, check the heater water valve. Make certain that the valve is not stuck in the open position, and that the vacuum valve on the control head is working properly.

4 TURN INDICATOR TROUBLE SHOOTING

Figure 2 shows the turn indicator schematic diagram and the turn indicator trouble shooting "Road Map."

TURN INDICATOR TROUBLE SHOOTING

TURN INDICATOR LIGHTS DO NOT OPERATE	The fuse may be blown, the flasher may be defective, the switch and wiring may be defective, or the lights may be burned out. Figure 2 shows a "road map" for this symptom. As the ignition switch must be on for the turn indicators to operate, be sure to turn the ignition key to the "ACC" Position, when testing this unit. Remove the fuse to see if it is blown. **FUSE IS BLOWN** If the fuse is blown, connect an ammeter between the "ACC" terminal of the ignition switch and the fuse holder terminal that connects to the flasher unit (with the fuse removed). Place the

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TURN INDICATOR TROUBLE SHOOTING (Continued)

TURN INDICATOR LIGHTS DO NOT OPERATE (Continued)	switch in both the left and right hand positions. The current being drawn with the flasher operating and the front, rear and pilot light on one side operating, should oscillate between 0 and 4 amperes at 12 volts. This is caused by the flasher turning on and off. If the current is greater than this in either the right or left-hand operation, check the manual switch, flasher unit and the associated wiring for shorts. Repair or replace parts as necessary. **FUSE IS NOT BLOWN** If the fuse is not blown, install the fuse, then test the flasher unit by removing the unit from the flasher receptacle and plugging in a new flasher assembly. If the lights now operate when the switch is operated, the flasher unit is defective. Replace the flasher with the new unit. If replacing the flasher assembly does not cure the trouble, the flasher unit may be assumed to be good. Remove the wires from the bullet connectors that connect to the switch and temporarily connect in a new switch. If the lights now burn when the switch is operated, repair or replace the switch and wiring.

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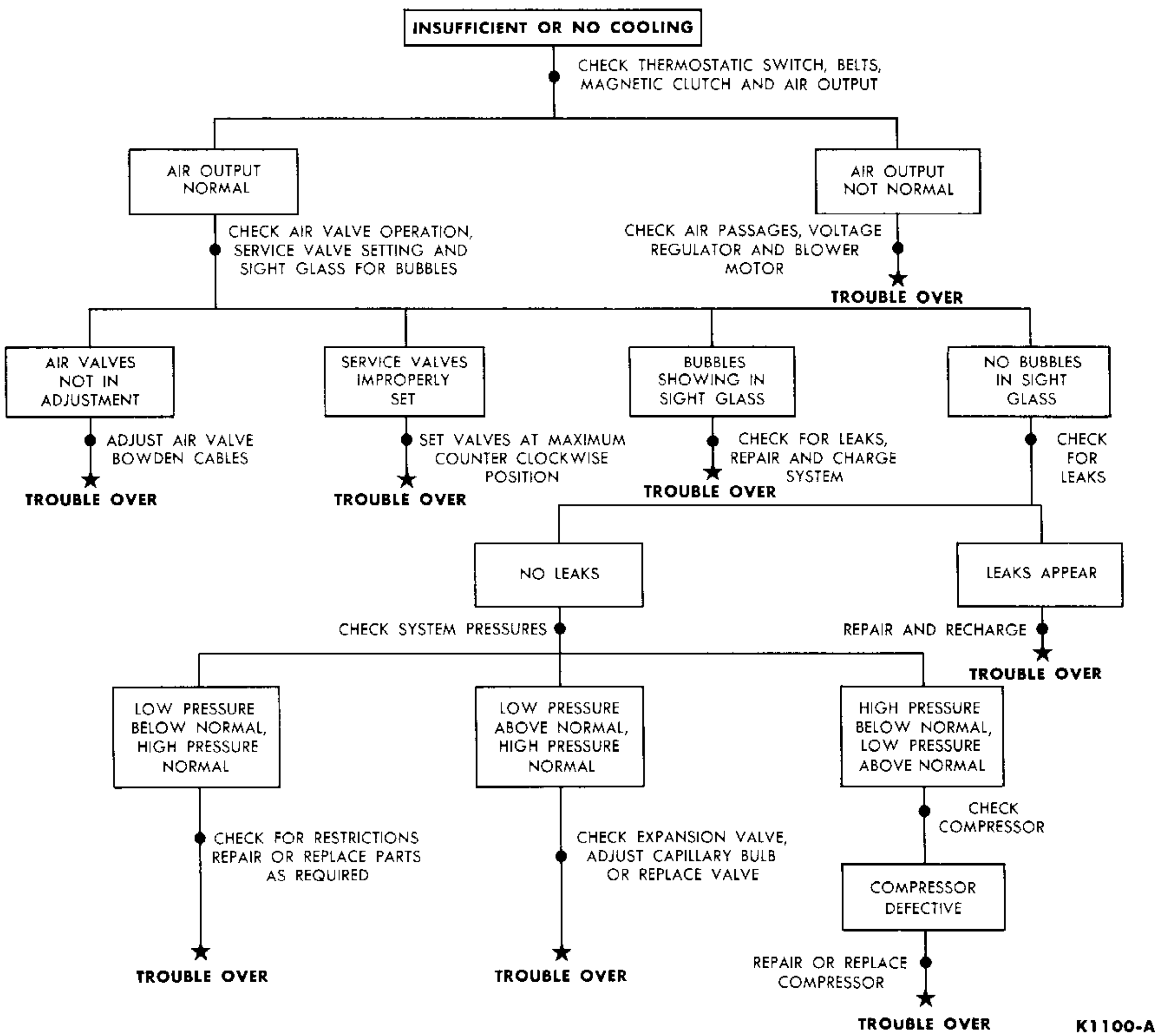


FIG. 1—Insufficient or No Cooling "Road Map"

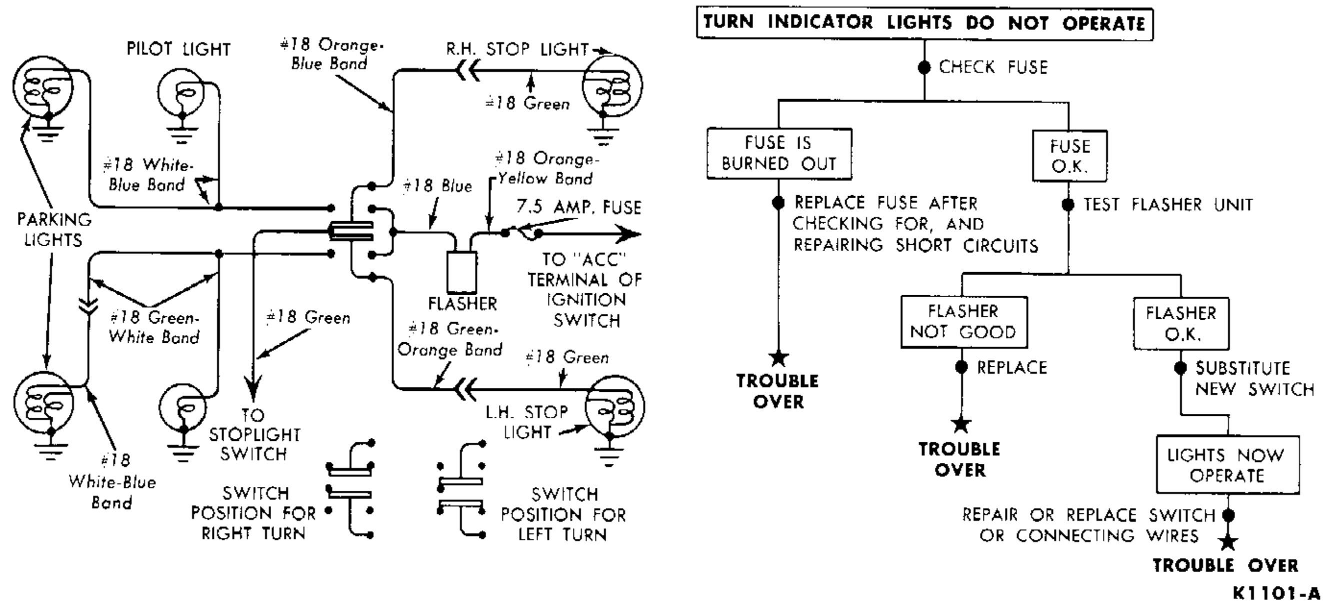


FIG. 2—Turn Indicator Schematic and "Road Map"

TURN INDICATOR TROUBLE SHOOTING (Continued)

ONE OR MORE TURN INDICATOR LIGHTS OUT	**ONE LIGHT OUT ON EITHER SIDE** If one light only is out, either the light is burned out on that side, or the wiring to the light is defective. Check first to see if the light is burned out. The rear lights may be checked by placing the manual switch in the center position and depressing the foot brake. Both rear lights should light. If the light in question does not light while the other one does, the light is either burned out or the wiring to the light is defective. The front lights may be tested by disconnecting the leads (white with blue band and green with white band), leading to the parking lights, from the connectors at the fender apron and connecting a jumper from the "positive" terminal of the battery to each lead. If the lights do not burn, the light is burned out or the wiring to the light is defective. Repair the wiring or replace the light, whichever is indicated.
IMPROPER TURN INDICATOR CANCELLATION	If the turn indicator cancels prematurely, check the tension of the conical, switch-hold-down spring (Fig. 62). Stretch the spring slightly to increase the tension. If the turn indicator does not cancel at all, make certain that the canceling cam on the steering wheel is making positive contact with the canceling pawls on the switch. The distance between the lower edges of the steering wheel spokes and the upper edge of the steering shaft housing should not be greater than 1/16 inch. If necessary, loosen the steering shaft housing and reposition it.

5 RADIO

GENERAL INFORMATION

A pictorial diagram showing the radio connections is shown in Fig. 3.

MODEL IDENTIFICATION

The model number (04MS) identifies the manufacturer (Motorola), and is the prefix to the serial number stamped on the side of the receiver (Fig. 4). The receiver uses four tubes plus two power transistors.

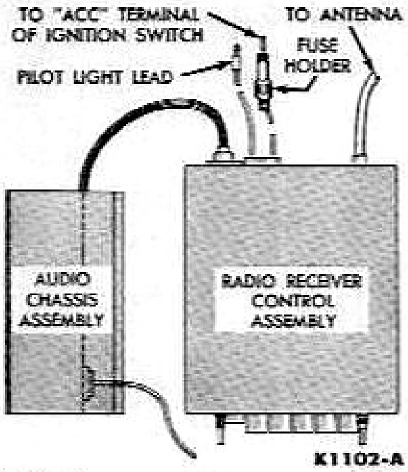


FIG. 3—Radio Wiring Connections

RADIO CONTROLS

Tuning is controlled by five push buttons and by the tuning knob to the right of the receiver dial. Actuation of any of the five push buttons turns the receiver on. A sixth push button turns the receiver off. Volume and tone are controlled by the dual knob to the left side of the receiver dial.

CHASSIS MOUNTINGS

The receiver is attached to the instrument panel with two hex nuts and lock washers and by a support bracket at the rear of the set. The audio chassis is mounted on the left fresh air inlet duct. The speaker is mounted on the underside of the tunnel trim panel (Fig. 5).

CHASSIS CONNECTIONS

The antenna connector, "A" lead, pilot light lead, and audio chassis power lead are at the back of the receiver (Fig. 4). The antenna trimmer adjusting screw is accessible through a hole in the bottom of the receiver (Fig. 4). The speaker lead plugs into a socket which is mounted on the audio chassis assembly (Fig. 4).

ACCESSIBILITY

The receiver can be tested (minor repair tests) and the tubes changed while the receiver is mounted in the vehicle. Removal of the bottom cover permits access to all tubes as shown in Fig. 11. In order to remove the bottom cover, it will be necessary to remove the access cover directly under the receiver, and to remove the heater control trim panel. Removal of the receiver cover mounting screws at the lower back edge of the receiver will then allow removal of the cover.

REMOVAL AND INSTALLATION

Be sure that the ignition switch is off before starting removal of the receiver, so that damage will not result to the power transistors when the speaker is disconnected.

Receiver Control Assembly.

1. Remove the control knobs and the two hex mounting nuts and lock washers.

2. Remove the radio access cover and the rear support bracket to instrument panel mounting bolt.

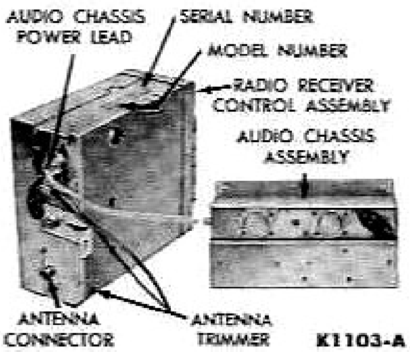


FIG. 4—Serial Number, Antenna Connector, and Trimmer Locations

3. Lower the receiver through the access hole.

4. Disconnect the antenna lead, pilot light lead, "A" lead, and the audio chassis cable, then remove the receiver.

When installing the receiver, attach the cables and leads before placing the receiver in position in the panel. Make certain that the chassis makes good electrical contact with the instrument panel at both the front and back support positions.

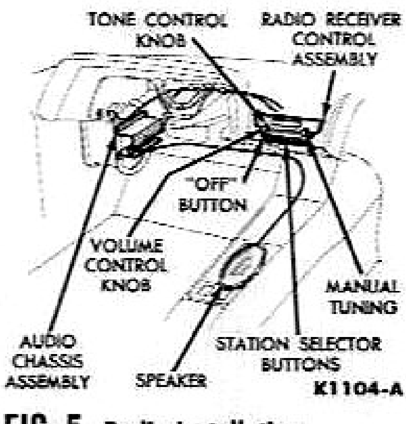


FIG. 5—Radio Installation

Audio Chassis Assembly.

1. To gain access to the audio chassis, remove the left heater control trim panel extension.

2. Disconnect the audio chassis cable from the receiver control chassis (Fig. 4).

3. Disconnect the speaker lead from the audio chassis, remove the four mounting screws and remove the chassis.

When mounting the audio chassis, make certain that there is good metal to metal contact between the chassis and the air inlet duct. It is necessary to have good electrical contact at this point for proper operation of the receiver. Make certain that the dash panel padding is positioned so that the metal foil backing can not come in contact with one of the power transistors.

Speaker.

1. Remove the heater control trim panel, and the tunnel trim panel.

2. Remove the four speaker mounting wing nuts, disconnect the speaker cable from the audio chassis and remove the speaker (Fig. 6).

3. Place the new speaker in position and install the four wing nuts finger tight only, so as not to distort the speaker.

4. Route the speaker lead along the tunnel and behind the instrument panel to the audio chassis and plug it into the speaker outlet socket (Fig. 4).

5. Install the tunnel trim panel and the heater control trim panel. Be careful not to pinch the speaker lead.

ANTENNA INSTALLATION

The antenna is mounted on the right front fender.

1. Use the template provided with the antenna to locate the mounting hole.

2. Drill a 1⅛ inch diameter hole. Insert the antenna into the hole

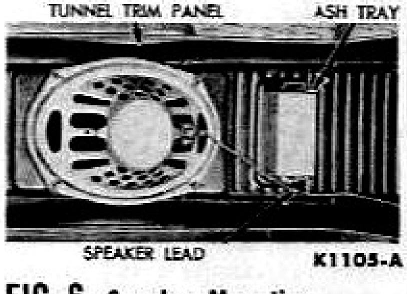


FIG. 6—Speaker Mounting

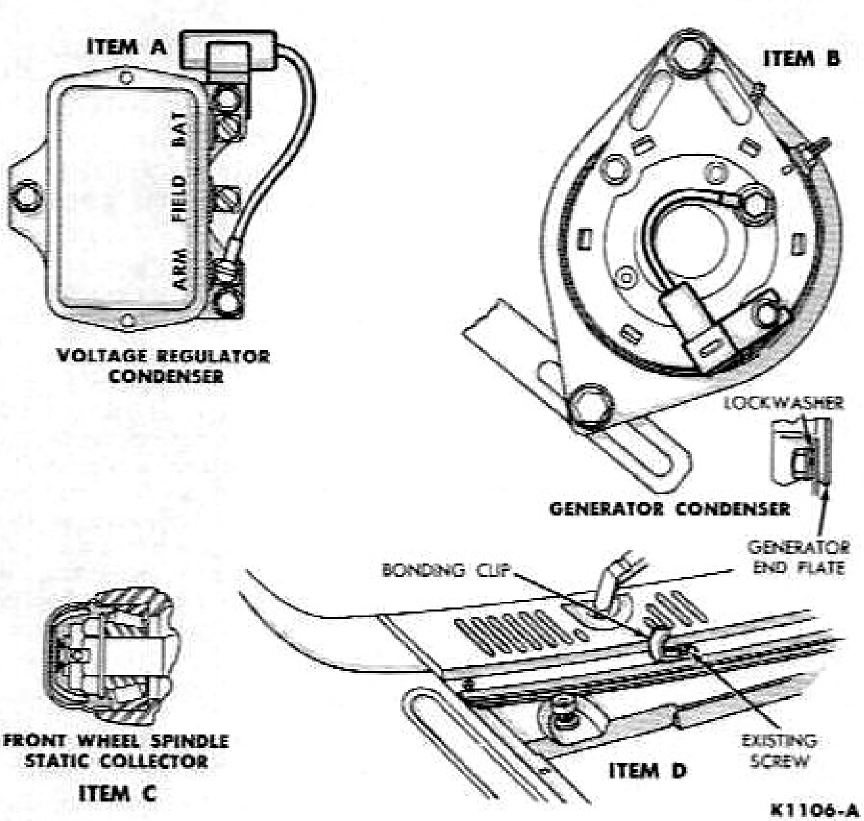


FIG. 7—Suppression Equipment Installation

through the opening in the fender apron.

3. Pull the antenna into position, and install the gasket, insulator, and antenna mounting nut.

4. Adjust the antenna during installation with a slight angle inward, by rotating the antenna base and insulator to match the contour at the fender.

5. Route the antenna lead-in through the existing windshield wiper hose grommet above the heater, and plug it into the antenna socket at the back of the receiver control assembly (Fig. 4).

A rear deck mounted antenna is also available. It is mounted at the center front of the back deck. The lead-in is routed under the left side of the rear seat, along the front of the seat and along the tunnel to the receiver control assembly.

SUPPRESSION EQUIPMENT

When installing suppression items, make certain that all paint and dirt have been removed from between the condensers and the vehicle. Tighten all nuts and bolts securely.

The high tension portion of the engine ignition system uses radio resistance wire as standard equipment. The balance of the suppression equipment is installed as follows:

Install the voltage regulator condenser as shown at "A" Fig. 7. Install the condenser bracket between the body sheet metal and the regulator.

It is not necessary to remove the generator assembly bolt to install the generator condenser. Loosen the bolt only enough to slide the mounting bracket under the lockwasher ("B" Fig. 7). Connect the condenser lead to the armature terminal of the generator.

Remove both front hub grease caps. Clean the caps and install the static collector as shown in "C" in Fig. 7. Bend the cotter pin away from the spindle center hole so that it will not interfere with the static collector. Install the grease caps and hub caps.

Install the bonding clip with the second existing screw from the right hand side ("D" Fig. 7).

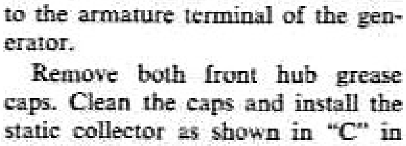


FIG. 8—Push Button Adjustment

ADJUSTMENTS

Be sure to warm up the receiver for 15 minutes before making the following adjustments.

ANTENNA TRIMMER

Extend the antenna to its maximum length. Remove the radio access plate. Tune in the weakest station between 12 and 16 on the dial and reduce the volume until the station is barely audible. Turn the antenna trimmer screw, Fig. 4, slowly in either direction until a peak of volume is reached.

PUSH BUTTON

Adjustment of the push buttons should be made during daylight hours due to the high sensitivity of the receiver.

Pull out the desired push button as shown in Fig. 8. Reduce the volume to a low value, and tune in the desired local station with the manual tuning knob. The station is correctly tuned in when the clearest tone is heard. Carefully push the button in all the way, then release it.

Adjust the remaining buttons and check all the positions for "repeat" accuracy. Repeat the procedure for any buttons that shift from the correct tuning point.

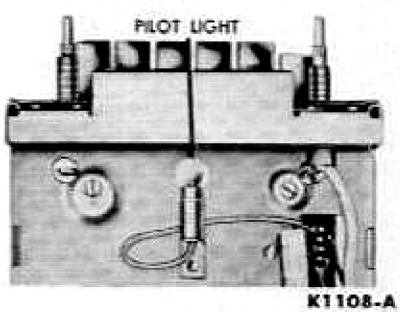


FIG. 9—Pilot Light Replacement

MINOR REPAIRS

Minor repairs involve mechanical adjustments and corrections of the tuning mechanism and antenna trimmer and replacement of pilot lights, and tubes.

ANTENNA TRIMMER

If the antenna trimmer will not "peak" the volume when the trimmer screw is rotated in either direction, remove the receiver bottom cover and examine the condenser tuning plate (Fig. 11) for movement while the trimmer screw is rotated. If there is no movement of the tuning plate, the screw threads are stripped, and the condenser must be replaced (Major Repair). If the plate does move, replace the R. F. tube (Fig. 11). If this does not cure the trouble, remove the radio for major repair.

PILOT LIGHT REPLACEMENT

Remove the receiver from the vehicle and remove the top cover. The pilot light is then accessible for replacement (Fig. 9).

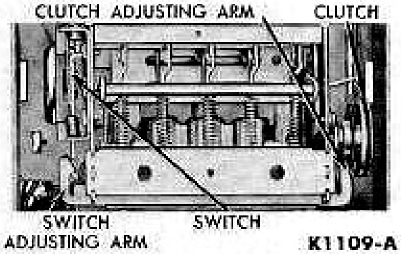


FIG. 10—Clutch and Switch Adjustment

CLUTCH RELEASE ADJUSTMENT

To repair inoperative or hard operating push buttons, check the clutch release clearance. The clutch should release when any tuning push button is depressed about ¼ inch. The clutch is adjusted by bending the clutch adjusting arm (Fig. 10).

To repair an inoperative on or off action of the push buttons, check the switch release adjusting arm (Fig. 10). The "OFF" push button should latch in the in postion when depressed. The "OFF" push button should release when any of the other buttons are depressed about ¼ inch. The switch release is adjusted by bending the switch adjusting arm (Fig. 10).

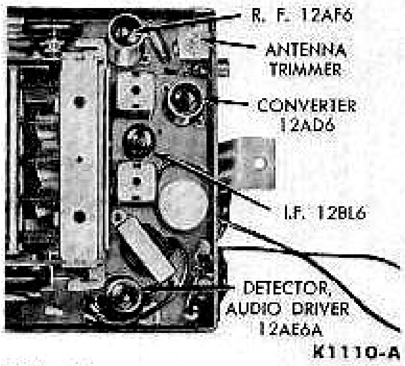


FIG. 11—Tube Arrangement

TUBE REPLACEMENT

All of the tubes may be easily replaced once the bottom cover is removed (Fig. 11). When the new tube is installed, be sure that it is firmly seated in its socket.

6 HEATER

The MagicAire fresh air heater is used on the Thunderbird. An electrical circuit diagram is shown in Fig. 12.

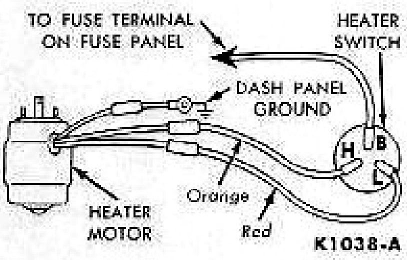


FIG. 12—Heater Circuit

OPERATING PRINCIPLES

The fresh air heater is designed to function in conjunction with the fresh air ventilating system. Incoming fresh air enters the car through a grille running the full width of the cowl. The grille is open at all times. Any water that may enter is directed to drain holes on either side of the car.

The fresh air intake chamber connects to the passenger compartment through a fresh air outlet on each side of the car under the ends of the instrument panel. An air valve in each outlet opens or closes the outlet. The heater blower couples to an outlet provided in the right side of the fresh air intake chamber (Fig. 13).

The heater control panel (Fig. 19) which is mounted on the tunnel directly under the instrument panel, controls the amount of heat and allows the selection of either outside fresh air or recirculated air for ventilation, heating or defrosting.

TEMPERATURE CONTROL UNIT

The temperature of the heated air is controlled by a capillary tube operated thermostat valve that automatically regulates the flow of water through the heater core. The capillary tube is located in the plenum chamber (Fig. 18). The action of the thermostat valve is regulated by the temperature control lever (top lever) in the heater control panel (Fig. 19). The thermostat controls the flow of hot water from completely off to full on.

AIR FLOW CONTROL

The middle lever (Fig. 19) controls two air valves (Fig. 13). With the control lever at the "OFF" position, the cowl air inlet valve is closed, shutting off outside air. This allows the blower to recirculate the air inside the passenger compartment. Movement of the lever to the "HEAT" position opens the cowl air inlet valve and closes the opening to the passenger compartment (Fig. 13). This allows the blower to force out-

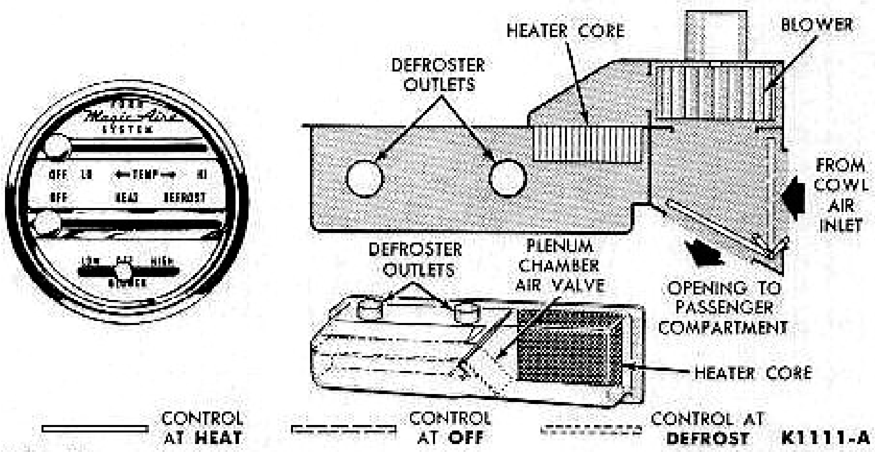


FIG. 13—Heater Air Flow

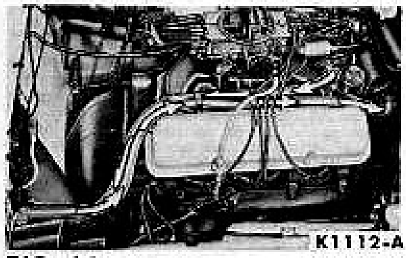


FIG. 14—Heater Hose Connections

side fresh air through the heater. Movement of the lever to the "DEFROST" position closes the plenum outlets and opens the defroster outlets (Fig. 13). This allows the blower to force outside air, heated or cool, across the windshield for defrosting or moisture removal.

The distribution of air between the defroster and the plenum chamber is regulated by the position of the control lever between HEAT and DEFROST.

The bottom lever controls two speed ranges for the blower fan by means of a switch and a two-speed three-wire-motor.

An air distributor (plenum chamber) contains numerous outlets that serve as nozzles to direct the air downward to the floor. The air then flows under the front seat and circulates through the entire passenger compartment.

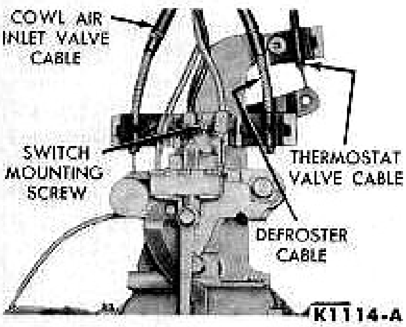


FIG. 16—Blower Switch Removal

NOTE: **When the control lever is at the "HEAT" or "DEFROST" position, it may be necessary to open a ventilator or window slightly to allow complete circulation of the outside air through the passenger compartment.**

REPLACEMENT

The fresh air heater consists of a heater unit, motor and blower assembly, heater control units, air distributor, defroster tube and nozzle, air vent assemblies, and controls. Individual units of the heating system can be removed if service is required. Figure 14 shows the heater hose connections on the engine.

HEATER BLOWER MOTOR

Removal and installation of the heater blower motor and fan is accomplished by disconnecting the motor wires and removing the four mounting screws (Fig. 15). After installing the blower motor and fan, be sure that the ground connection is clean and tight.

To remove the blower and motor housing assembly (Fig. 15), disconnect the blower wires, loosen the heater hose clamps and slide them forward, remove the five mounting screws and remove the assembly.

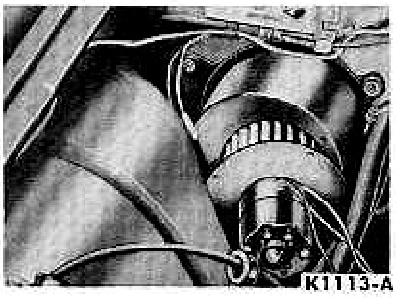


FIG. 15—Blower Motor Removal

HEATER CORE

1. Drain the radiator and disconnect the heater hoses at the heater core.
2. Remove the heater control trim panel and the right extension of this trim panel.
3. Remove the plenum air valve Bowden cable, remove the five plenum to heater core housing screws, and remove the plenum.
4. Disconnect the temperature control cable from the thermostat (Fig. 18), remove the three core mounting screws and remove the core.
5. Remove the thermostat water valve from the old heater core and install it on the new heater core with a new rubber gasket.
6. Mount the core assembly in the core housing, and attach and adjust the thermostat control cable.
7. Install the plenum chamber, attach the defroster coupling hoses, and attach and adjust the plenum air valve control cable.
8. Install the heater control trim panel and extension.
9. Attach the heater hoses to the heater core (Fig. 14), and fill the radiator.

HEATER CONTROL

The heater control is mounted on the tunnel directly under the instrument panel. To remove the control, remove the control trim panel, remove the control mounting screws, disconnect the Bowden cables, disconnect the heater blower and control light wires and remove the control. When installing a new control, adjust each Bowden cable for proper operation of the controls. The blower switch is attached to the underside of the control by a mounting screw (Fig. 16).

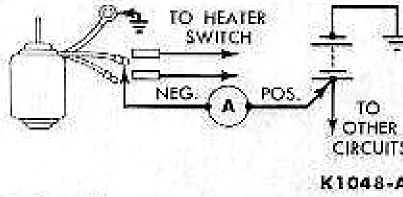


FIG. 17—Heater Motor Current Draw Test

TESTS AND ADJUSTMENTS

HEATER CURRENT DRAW TEST

Connect a 0-50 ammeter as shown in Fig. 17. The blower motor will operate independently of the control switch, and the current draw of the motor will be indicated on the ammeter. Normal current draw should be 4 to 5 amperes for the high speed position (orange wire). The slow speed current draw (red wire) is 3 to 4 amperes.

HEATER CONTROL ADJUSTMENT

The upper lever of the heater control assembly is connected to the thermostat on the heater (Figs. 16 and 17). Loosen the cable clamp on the control assembly and position the cable so that the thermostat valve is in the closed position (all the way over to the right, Fig. 18), when the tem-

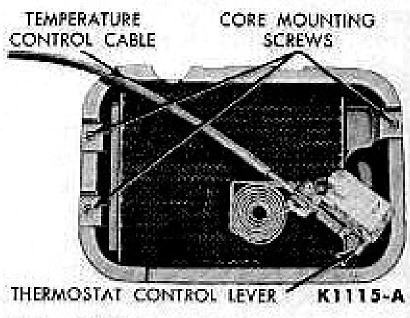


FIG. 18—Heater Thermostat Adjustment

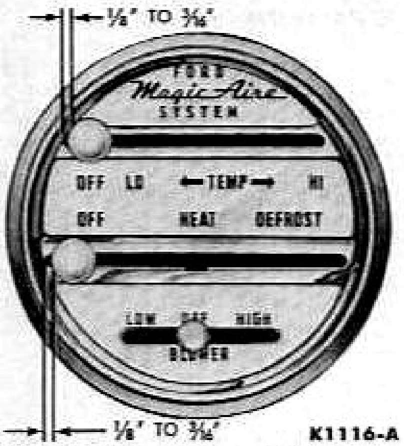


FIG. 19—Heater Control Lever Adjustment

perature lever is 1/8 to 3/16 inch from the left end of the slot (Fig. 19), and tighten the clamp.

The middle lever of the heater control assembly is connected to the defroster air valve and the cowl air inlet valve (Figs. 16, 20, and 21).

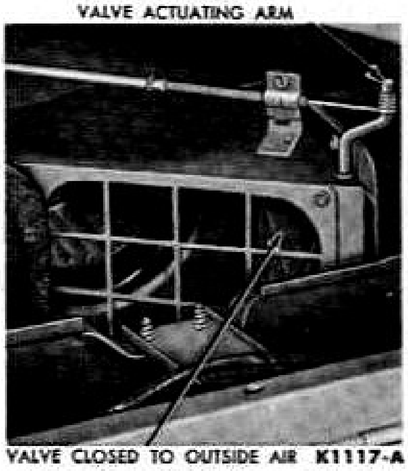


FIG. 20—Cowl Air Inlet Valve Adjustment

Place the lever 1/8 to 3/16 inch from the left end of the slot (Fig. 19). Remove the glove box and loosen the cable in the clamp on top of the air valve (Fig. 20). Adjust the cable so that the valve actuating arm is all the way to the right (valve closed to outside air), then tighten the clamp.

Move the middle lever to the "HEAT" position. Remove the heater control trim panel and loosen the cable in the clamp on the plenum chamber (Fig. 21). Adjust the cable so that the defroster valve actuating arm is as far to the right as possible, then tighten the clamp.

FIG. 21—Defroster Air Valve Adjustment

7 AIR CONDITIONING

BASIC AIR CONDITIONING SYSTEM

An air conditioning system consists of an evaporator, an expansion valve, a compressor and a condenser. In an automotive air conditioning system, the evaporator is exposed to air flow from the passenger compartment. The expansion valve releases liquid refrigerant into the evaporator coils, the heat from the air is absorbed by the boiling refrigerant and disappears in the refrigerant vapor. The refrigerant vapor containing the hidden heat, is pumped out of the evaporator by a compressor and forced under high pressure to the condenser which is located outside the passenger compartment. In the condenser, the refrigerant vapor condenses back to liquid and the heat, that was absorbed from the passenger compartment and hidden in the vapor, now reappears and passes off into the outside air stream.

The liquid refrigerant under high pressure, now passes from the condenser to a receiver where it is stored for re-use. The liquid refrigerant will not boil while it is stored in the receiver, because it is under high pressure which maintains the boiling point of the refrigerant above the temperature of the surrounding air. Thus, no heat can transfer from the outside air to the refrigerant in the receiver.

The receiver is connected to the expansion valve in the evaporator where the cooling cycle starts over again. When the expansion valve is opened, the high pressure liquid refrigerant from the receiver passes through an orifice in the expansion valve which releases the refrigerant into the evaporator at a greatly reduced pressure. Thus, the temperature, at which the liquid refrigerant will boil, is reduced below car air temperature. Now the liquid refrigerant, by absorbing heat from the car air, begins to vaporize.

It may seem difficult to understand how heat can be transferred from a comparatively cooler car passenger compartment to the hot outside air. The answer lies in the difference between the refrigerant pressure that exists in the evaporator and the pressure that exists in the condenser. In the evaporator, the expansion valve reduces the pressure and thereby reduces the boiling point below the temperature of the passenger compartment. Thus, heat transfers from the passenger compartment to the boiling refrigerant. In the condenser, the compressor raises the condensation point above the temperature of the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The expansion valve and the compressor simply create pressure conditions that permit the laws of nature to function.

AIR CONDITIONER OPERATION

The cooling portion of the Select-Aire Conditioner uses a receiver and expansion valve, an evaporator, a compressor, and a condenser. These parts, as just discussed, are the standard units which are used in any air cooling system. Besides these major cooling components, the SelectAire Conditioner unit uses a liquid sight glass, an oil separator (integral with the compressor), a cooling unit thermostatic switch, a heater water shut off valve, a heater core, a blower assembly, a control unit and the necessary connecting wires, ducts and hoses.

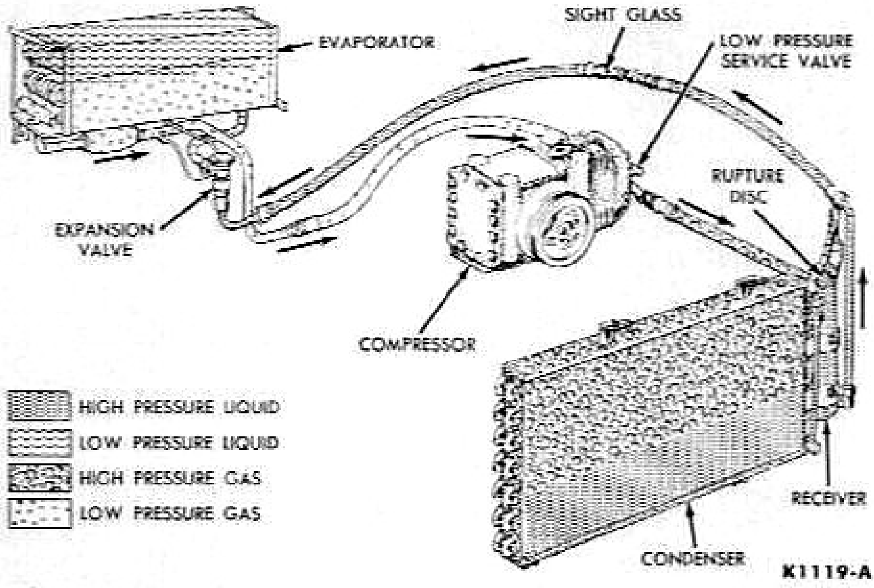


FIG. 22—SelectAire Air Cooling System

Figure 22 shows the entire Select-Aire cooling system in schematic form. Arrows indicate the direction of refrigerant flow. Figure 23 shows the electrical control circuits.

RECEIVER UNIT

The air cooling system stores the liquid Refrigerant-12 under pressure in a combination receiver and dehydrator (Fig. 24). The pressure in the receiver normally varies from about 100 to 250 psi (pounds per square inch), depending on the surrounding air temperature and compressor speed. The receiver and condenser comes charged and marked with the total weight, so that any leak can be detected before assembly.

The dehydrator serves the purpose of removing any traces of moisture that may have accumulated in the system. Even small amounts of moisture will cause an air cooling unit to malfunction. A rupture disc is screwed into the top of the receiver (Fig. 24). This disc will rupture and release the refrigerant when the pressure in the system reaches 475 to 575 psi, or when the refrigerant temperature exceeds 212° psi.

EVAPORATOR UNIT

When the cooling system is in operation, the liquid Refrigerant-12 flows from the combination receiver and dehydrator unit through a flexible hose to the evaporator (cooling unit) (Fig. 25), where it is allowed to evaporate at a reduced pressure. The evaporator is mounted on the engine compartment side of the dash.

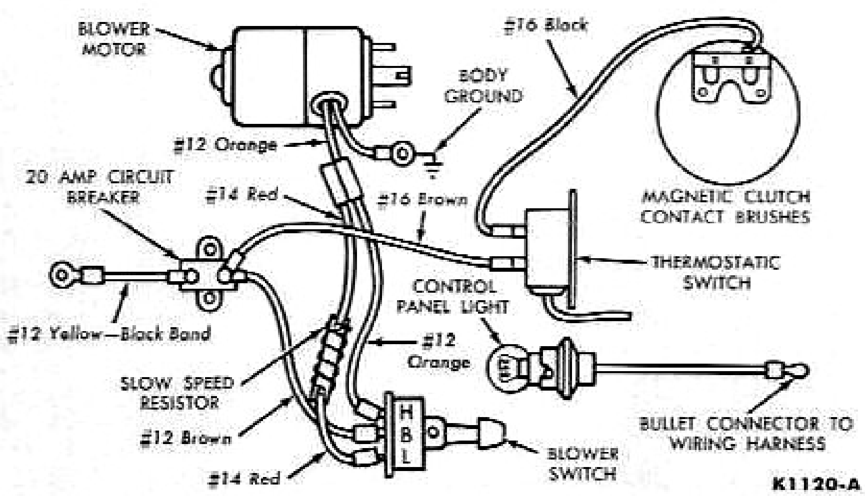


FIG. 23—Electrical Control Circuit

EXPANSION VALVE

The rate of refrigerant evaporation is controlled by an expansion valve (Fig. 25) which allows only enough refrigerant to flow into the evaporator to keep the evaporator operating efficiently, depending on its heat load.

The expansion valve consists of the valve and a temperature sensing capillary tube and bulb (Fig. 25). The bulb is clamped to the outlet pipe of the evaporator. Thus, the operation of the valve is controlled by the temperature of the evaporated liquid at the point where it leaves the evaporator or cooling unit. An equalizer connection at the evaporator outlet applies evaporator outlet pressure to one side of the valve diaphragm. Thus, the valve is controlled by both evaporator outlet temperature and outlet pressure.

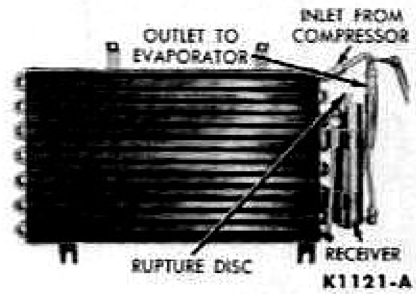


FIG. 24—Receiver and Condenser

The restricting effect of the expansion valve at the evaporator causes a low pressure on the low pressure side of the system of 16-55 psi, depending on the surrounding air temperature and compressor speed.

LIQUID SIGHT GLASS

A liquid sight glass is mounted in the high pressure refrigerant line along the left fender apron (Fig. 26). The sight glass is used to check whether or not there is enough liquid refrigerant in the system. At no time should bubbles be seen in the sight glass.

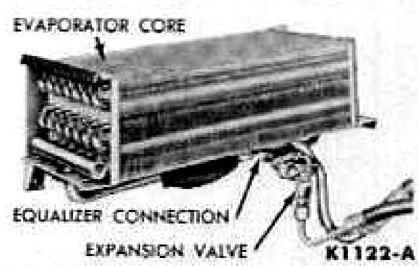


FIG. 25—Evaporator Core Assembly

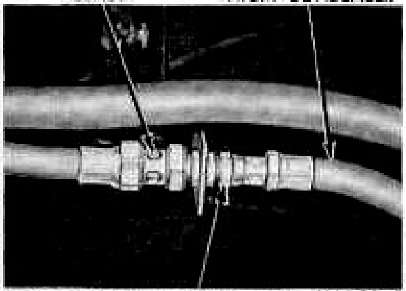


FIG. 26—Sight Glass

COMPRESSOR UNIT

The evaporated refrigerant leaving the evaporator, now in the form of a gas at a pressure of 16-55 psi, is pumped by the compressor (Fig. 27), located on the engine, (Fig. 35), into the top of the condenser (Fig. 24). The condenser is located in front of the radiator.

The compressor maintains a pressure on its high pressure side of from 100-250 psi, depending on the surrounding air temperature and compressor speed.

As the now heated and compressed refrigerant gas flows down through the condenser, it is cooled by air passing between the sections of the condenser, and the cooled, compressed refrigerant gas condenses to liquid refrigerant which then flows back into the receiver.

MAGNETIC CLUTCH

It is necessary to control the amount of cooling that the system produces. To accomplish this, the compressor is cut in and out of operation by the use of a magnetic clutch pulley mounted on the compressor crankshaft (Fig. 28). The magnetic clutch is controlled by a thermostatic sensing tube inserted in the fins of the evaporator core.

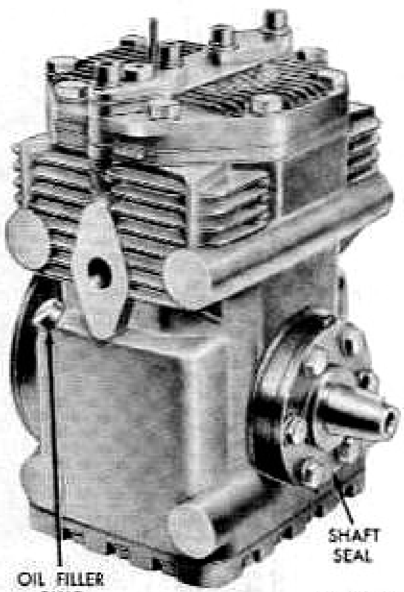


FIG. 27—Compressor

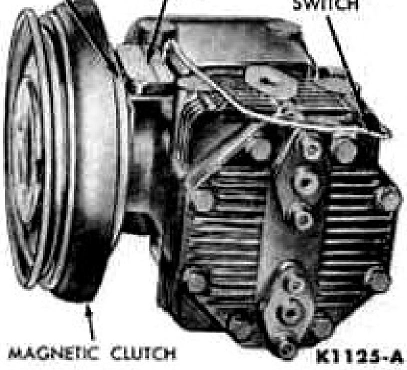


FIG. 28—Magnetic Clutch

THERMOSTATIC SWITCH

The thermostatic switch (Fig. 29), controls the operation of the compressor by controlling the compressor magnetic clutch. The temperature sensing tube of the switch is placed in contact with the evaporator fins. When the temperature of the evaporator becomes too cold, the thermostatic switch opens the magnetic clutch electrical circuit disconnecting the compressor from the engine. Refrigerant continues to flow until the high and low pressures equalize. When the temperature of the evaporator rises to the upper limit at which the thermostatic switch is set, the thermostatic switch closes and energizes the magnetic clutch. This connects the compressor to the engine and cooling action begins again.

When the ignition switch is off, or the cooling control (Fig. 30), is in the off position, the magnetic clutch is not energized, and the cooling system can not operate.

When the ignition switch is ON (engine running), and the cooling control is in the cooling range, the magnetic clutch is energized, the compressor is connected to the engine and the cooling system is in operation.

The thermostatic switch may be adjusted to maintain an average evaporator temperature of from 30°-60°F. The thermostatic switch operating differential temperature at any one setting is 6°F. The switch is controlled by the cooling control (Fig. 30 middle lever). The further to the left that the control is moved, the cooler the setting of the thermostatic switch.

SERVICE VALVES

The service valves on the compressor are used to test and service the cooling system (Fig. 22). The high pressure service valve, mounted at the outlet to the compressor, allows access to the high pressure side of the system for attaching a pressure gauge, or a servicing hose.

The low pressure valve, mounted at the inlet to the compressor, allows access to the low pressure side of the system for attaching a pressure gauge, or a servicing hose.

Both service valves may be used to shut off the rest of the system from the compressor during compressor service.

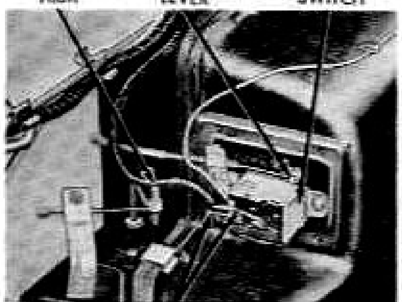


FIG. 29—Thermostatic Switch

CONTROL OPERATION

The operating controls for the SelectAire Conditioner consist of the control panel (Fig. 30) and the instru-

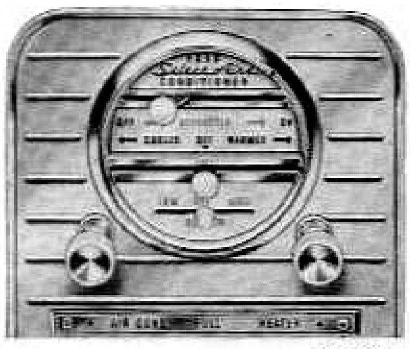


FIG. 30—Control Panel

ment panel air outlet register assembly (Fig. 31).

CONTROL PANEL

The SelectAire control (Fig. 30), is mounted directly below the instrument panel on the tunnel.

When the middle control lever is moved from the OFF position, the cooling or heating thermostats are actuated; heating to the right; cooling to the left. The distance from the OFF position determines the amount of heating or cooling.

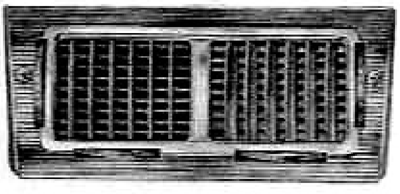


FIG. 31—Air Outlets

The upper control lever (Fig. 30) operates the defroster valve only. When the lever is in the OFF position, the defroster outlets in the plenum chamber (Fig. 32), are closed and the plenum chamber is open to the passenger compartment. Moving the upper lever to the DEFROSTER ON position closes the plenum outlets to the passenger compartment and opens the defroster outlets to the windshield.

The bottom control lever (Fig. 30) operates the blower motor through a three position switch for OFF, LOW and HIGH speed.

The lower left control knob (Fig. 30), actuates the evaporator-heater (blower outlet) air valve. When the knob is pulled out, the outlet to the heater core is closed and the opening from the blower to the evaporator is open (Fig. 32). Pushing the left control knob in, closes the passage from the blower to the evaporator and opens the heater core to the blower.

The lower right control knob (Fig. 30), actuates the cowl air inlet (blower inlet) valve. When the knob is pulled out, the opening from the passenger compartment is closed off from the blower and the cowl vent is open to the blower allowing fresh air to be delivered to the blower (Fig. 32). Pushing the right hand knob in, closes off the cowl vent from the blower and opens the passenger compartment to the blower.

For either cooling or heating the upper (defrost) control lever should be at the OFF position and the lower (blower) control lever can be moved either to the HIGH or LOW position depending upon the amount of air circulation desired.

For cooling action, the remaining controls should be set as follows:

1. Move the middle control lever to the LEFT (distance depending upon the degree of cooling desired).
2. Pull the lower LEFT knob OUT, and push the lower RIGHT knob IN. This arrangement permits the blower to circulate passenger compartment air through the evaporator.

For heating action, the controls should be arranged as follows:

1. Move the middle control lever to the RIGHT (distance depending upon the degree of heating desired).
2. Push the lower LEFT knob IN, and pull the lower RIGHT knob OUT. With this arrangement, the blower receives fresh air from the cowl vent and forces it through the heater core to the passenger compartment.

Leaving both lower knobs pushed IN closes off the cowl vent and permits the blower to recirculate passenger compartment air through the heater core.

For defrosting action, the controls are set the same as for heating action except that the upper control is moved from the OFF to the DEFROSTER ON position.

AIR OUTLETS

The SelectAire air outlets (Fig. 31), are mounted in the center of the instrument panel. Four thumb operated wheels direct two streams of air in various directions.

MAINTENANCE AND TEST PROCEDURES

SAFETY PRECAUTIONS

The refrigerant used in the Ford air conditioner systems is Refrigerant-12. Refrigerant-12 is nonexplosive, noninflammable, noncorrosive, has practically no odor, and is heavier than air. Although it is a safe refrigerant, certain precautions must be observed to protect the parts involved and the person who is working on the unit.

CAUTION: **Use only Refrigerant-12 in the SelectAire Conditioner.**

Liquid Refrigerant-12, at normal atmospheric pressures and temperatures, evaporates so quickly that it tends to freeze anything that it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

Refrigerant-12 is readily absorbed by most types of oil. It is therefore recommended that a bottle of sterile mineral oil and a quantity of weak boric acid solution be kept nearby when servicing the air conditioning system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out, then wash the eyes clean with the weak boric acid solution. Seek a doctor's

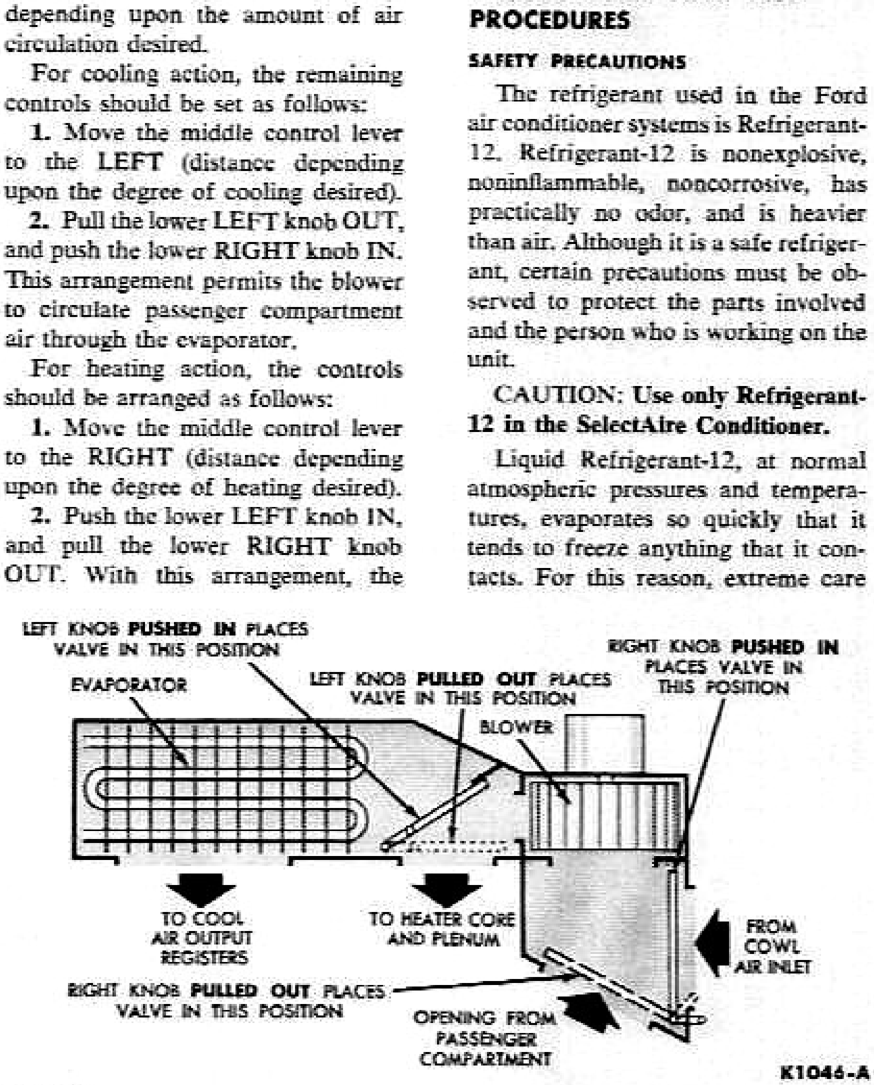


FIG. 32—Air Valves and Air Flow

aid immediately even though irritation may have ceased.

CAUTION: **Always wear safety goggles when servicing any part of the refrigerating system.**

The Refrigerant-12 in the system is always under pressure. Because the system is tightly sealed, heat applied to any part would cause this pressure to build up excessively.

CAUTION: **To avoid a dangerous explosion, never weld, use a blow torch, solder, steam clean, bake body finishes, or use any excessive amount of heat on, or in the immediate area of, any part of the air cooling system or refrigerant supply tank, while they are closed to the atmosphere whether filled with refrigerant or not.**

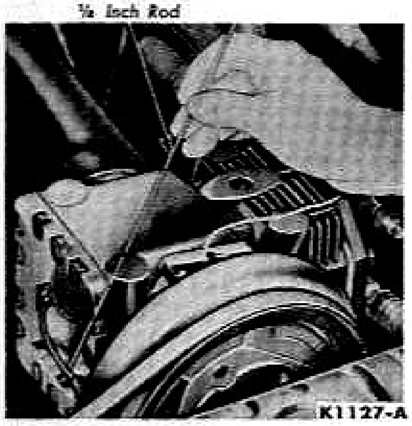


FIG. 33—Oil Level Adjustment

The liquid refrigerant evaporates so rapidly that the resulting refrigerant gas will displace the air surrounding the area where the refrigerant is released. To prevent possible suffocation in enclosed areas, always discharge the refrigerant from an air cooling system into the garage exhaust collector. Always maintain good ventilation surrounding the work area. **If the car is to be undercoated, make certain that the undercoating does not plug the evaporator drain tubes.**

Although Refrigerant-12 gas, under normal conditions, is non poisonous, the discharge of refrigerant gas near an open flame can produce a very poisonous gas. This gas will also attack all bright metal surfaces. This poisonous gas is generated in small quantities when the flame-type leak detector is used. Avoid inhaling the fumes from the leak detector. **Make certain that Refrigerant-12 is both stored and installed in accordance with all state and local ordinances.**

When admitting Refrigerant-12 gas into the cooling unit, always keep the tank in an upright position. If the tank is on its side or upside down, liquid Refrigerant-12 will enter the system and damage the compressor. **In surrounding air temperatures above 90°F., prolonged engine idle will result in excessively high compressor pressures.**

MAINTENANCE AND ADJUSTMENTS

Maintenance. The amount of Refrigerant-12 in an air cooling system is important if maximum efficiency of the system is to be obtained. Check the Refrigerant-12 at the beginning of each operating season.

A check of the refrigerant may be made by observing the liquid sight glass (Fig. 26). Observe the refrigerant flow for a minute with the engine running at 1500 rpm, and the cooling control lever at the maximum cooling position. If no bubbles appear in the liquid behind the glass, it may be assumed that there is enough refrigerant in the system, providing that the cooling system is working order. If bubbles do appear, add Refrigerant-12 to the system until the bubbles disappear, then add an additional one pound of refrigerant.

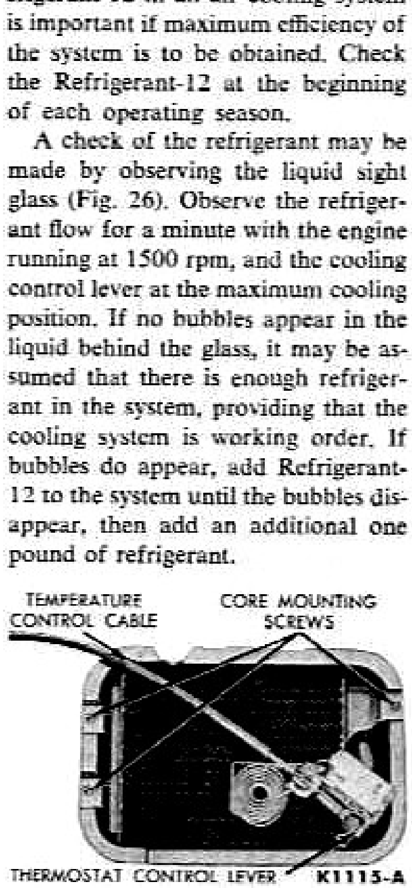


FIG. 34—Heater Thermostat Cable Adjustment

COMPRESSOR OIL LEVEL CHECK. Under normal conditions, when the air cooling system is operating satisfactorily, the compressor oil level need not be checked. There is no place for the oil to go except inside the sealed system. When the car is first started, some of the oil will be pumped into the rest of the system. After 15 minutes of operation, most of the oil is returned to the compressor crankcase.

Check the compressor oil level only if a portion of the refrigerant system is being replaced, or if there was a leak in the system and the refrigerant is being replaced.

Check the oil after the system has been charged and has been operating at an engine speed of 1500 rpm for 15 minutes in 60°F. surrounding air temperature or above, and with the compressor mounted on the engine. Turn off the engine, and isolate the compressor. Remove the oil filler plug from the compressor (Fig. 33), insert a ⅛ inch diameter rod in the oil filler hole until it bottoms. The rod should show ¾ inch of oil. This is equivalent to 9 ounces of oil. It may be necessary to rotate the compressor crankshaft slightly (by hand) so that the dip rod will clear the crankshaft. If additional oil is needed in the compressor, add Suniso 5-G, or Capella D refrigerator compressor oil, or equivalent.

If more than ¾ inch of oil is indicated, as might happen if a new compressor is installed and oil already in the system is pumped back to the compressor, draw out the excess oil until the proper quantity is indicated.

Replace the oil filler plug, then evacuate and connect the compressor back into the system. Be sure to check the compressor filler opening for leaks.

Adjustments. Efficient operation of the SelectAire Conditioner is dependent upon proper adjustment of the control cables. Make a check of the adjustment of all controls whenever the evaporator or control panel has been removed.

CONTROL CABLE ADJUSTMENT. Place the thermostat control lever at the center OFF position (middle lever Fig. 30). With the lever in this position, adjust the cable leading to the thermostatic switch (Fig. 29), so that the switch is off (switch control lever as far forward as possible). At the same time adjust the cable leading to the heater thermostat (Fig. 34), so that the thermostat is in the closed position (thermostat lever all the way to the right). **The heater thermostat used with the air conditioner is the Ranco type.**

Place the upper control lever (Fig. 30) at the OFF position. With the lever in this position, adjust the cable leading to the defroster air valve in the heater plenum, so that the defroster air valve is in the up position when the air valve arm is as far to the right as possible (Fig. 21).

Push the lower left hand control knob IN (Fig. 30). With the knob in this position, adjust the cable leading to the evaporator (blower outlet) air valve (Fig. 29) so that the air valve closes the opening to the evaporator (valve arm as far forward as possible).

Push the lower right hand control knob IN (Fig. 30). With the knob in this position, adjust the cable leading to the cowl air inlet valve (Fig. 35) so that the cowl air inlet valve is closed to the outside air (valve actuating arm as far to the right as possible).

COMPRESSOR BELT ADJUSTMENT. Proper belt tension is obtained when the belt deflects no more than one half inch under normal thumb pressure.

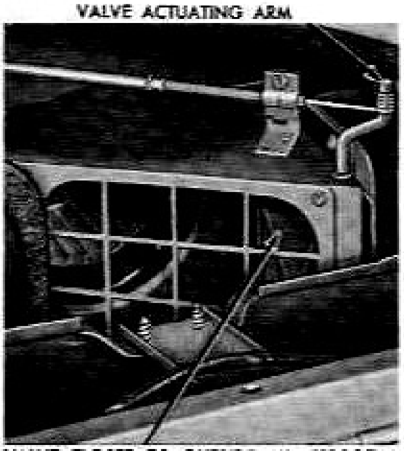


FIG. 35—Cowl Air Inlet Valve Adjustment

If the belt deflects more than one half inch, make a belt adjustment. Loosen the four mounting bolts, slide the compressor toward the outside of the car, then tighten the mounting bolts. Recheck the adjustment for proper deflection.

TEST PROCEDURES

To perform the test procedures, a test manifold and gauge set with connecting hoses, a refrigeration ratchet wrench, a tank of Refrigerant-12 (50 pound tank) a suitable scale for weighing the Refrigerant-12 tank, a leak detector, a thermometer, a plug and cap set, and safety goggles are required.

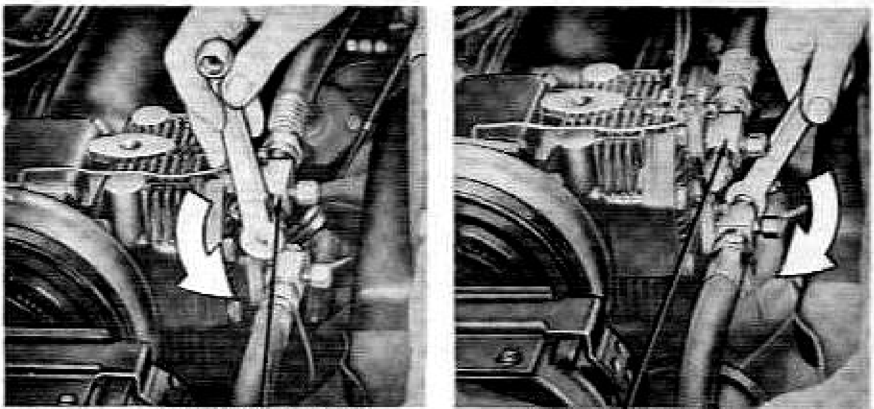


FIG. 36—Closing Service Valve Gauge Ports

CAUTION: **Before making any tests or working on the air conditioning system, be sure to read the safety precautions given on page 12-26.**

Manifold Gauge Set Installation. Remove the service valve stem covers and make sure that both service valves are at the maximum counterclockwise position (Fig. 36). Remove the service valve gauge port covers, and attach the flexible hoses to the gauge ports, to a vacuum pump and to a tank of Refrigerant-12 (Fig. 37). Turn both manifold gauge valves to the maximum clockwise position (Fig. 38) and close the vacuum pump valve. **The manifold valves are so arranged that when they are in the maximum clockwise or closed position, the center manifold connection is shut-off from the gauges, but the gauges continue to read the pressures in their respective hoses.**

Checking for Leaks. Attach the manifold gauge set (Fig. 37). Leave both manifold gauge valves at the maximum clockwise position (Fig. 38). Set both service valves at the center position. Both gauges should

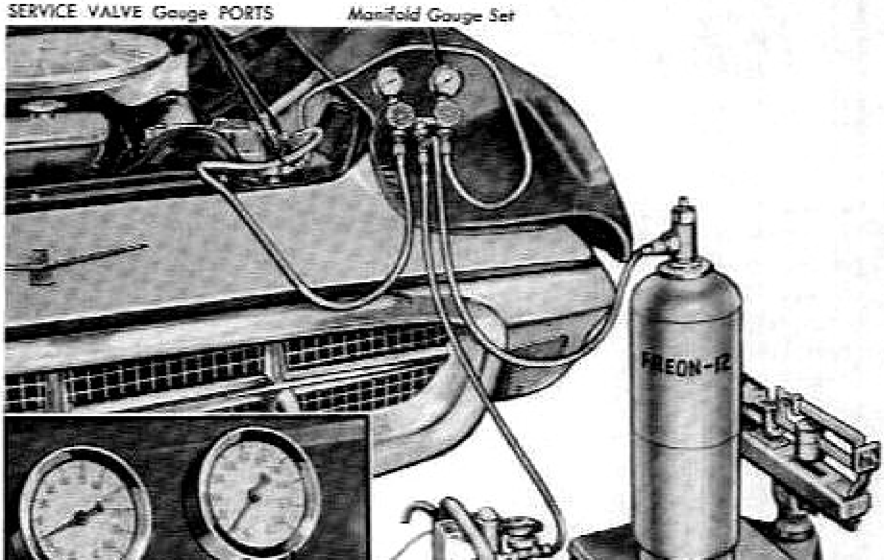


FIG. 37—Manifold Gauge Attached to System

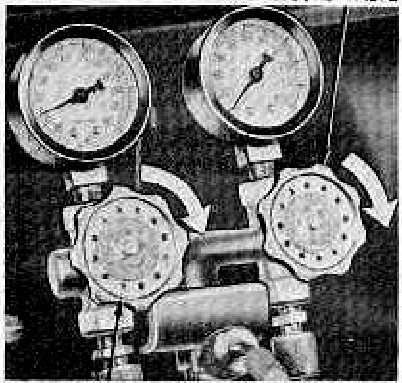


FIG. 38—Closing Manifold Valves

now show approximately 60 to 80 pounds pressure at 75°F. If very little or no pressure is indicated, leave the vacuum pump valve closed, open the Refrigerant-12 tank valve, and set the low pressure manifold gauge valve to the counterclockwise position. This opens the system to tank pressure. Check all connections and the compressor shaft seal for leaks, using a flame type leak detector (Fig. 39). Follow the directions with the leak detector. The smaller the flame the more sensitive it is to leaks. Therefore, to insure accurate leak indication keep the flame as small as possible. Hold the open end of the hose at each suspected leak point for two or three seconds. The flame will normally be almost colorless. The slightest leak will be indicated by a bright color to the flame. Be sure to check the manifold gauge set and hoses for leaks as well as the rest of the system.

CAUTION: **If the surrounding air is permeated with refrigerant gas, the leak detector will indicate this gas all the time. Good ventilation is necessary to prevent this situation. A fan, even in a well ventilated area, is very helpful in removing small traces of refrigerant vapor.**

Discharging the System. Discharge the refrigerant from the system before replacing any part of the system, except the compressor.

To discharge the system, connect the manifold gauge set to the system (Fig. 37). Do not connect the manifold center connection hoses to the Refrigerant-12 tank, or vacuum pump. Place the open end of these hoses in a garage exhaust outlet. Set the high pressure manifold gauge valve at the maximum counterclockwise or open position. Open the high pressure service valve a slight amount (Fig. 40), and allow the refrigerant to discharge slowly from the system.

CAUTION: **Do not allow the refrigerant to rush out, as the oil in the compressor will be forced out along with it.**

Charging the System. The procedure for charging depends on whether a partial charge or a complete charge is being made. When a complete charge is being made, check for leaks first, then release the pressure and evacuate the system.

EVACUATING THE SYSTEM. Attach the manifold gauge set, a tank of Refrigerant-12 and a vacuum pump to the system (Fig. 37). Make certain that the Refrigerant-12 tank valve is tightly closed. Set both service valves to the mid-position. Open both manifold valves (Fig. 41). Release any pressure in the system. Open the vacuum pump valve and run the pump until the low pressure gauge reads at least 25 inches, and as close to 30 inches of vacuum as possible. Continue vacuum pump operation for 20 to 30 minutes to boil any moisture out of the system. Close the pump valve. Turn off the pump.

MAKING A PARTIAL CHARGE. Attach the manifold gauge set (Fig. 37). Open both manifold valves (Fig. 41). Close the vacuum pump valve. Open the Refrigerant-12 tank valve. Purge the air from the high pressure hose by loosening the high pressure hose at the service valve, for a few seconds. Tighten the connections and set the high pressure manifold gauge valve at the maximum clockwise position. Loosen the low pressure gauge hose slightly at the low pressure service valve, for a few seconds, to purge the air from the hose. Tighten the connection. Set both service valves at the center position.

Run the engine at 1500 rpm with all controls at the maximum cold position. Charge the system until all bubbles disappear from the sight glass then add one additional pound of Refrigerant-12. Shut the Refrigerant-12 tank valve.

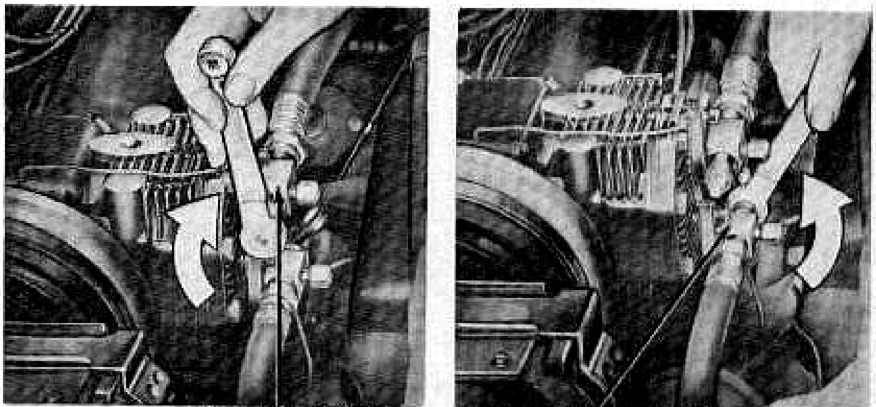


FIG. 40—Opening Service Valve Gauge Ports

It may be necessary to place the Refrigerant-12 tank in a container of hot water at about 150° F. to force the gas from the tank during charging.

CAUTION: **Never heat the Refrigerant-12 tank with a torch. A dangerous explosion may result.**

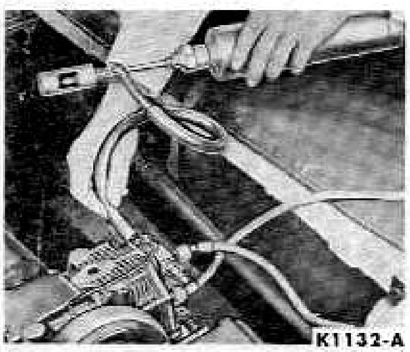


FIG. 39—Using Leak Detector

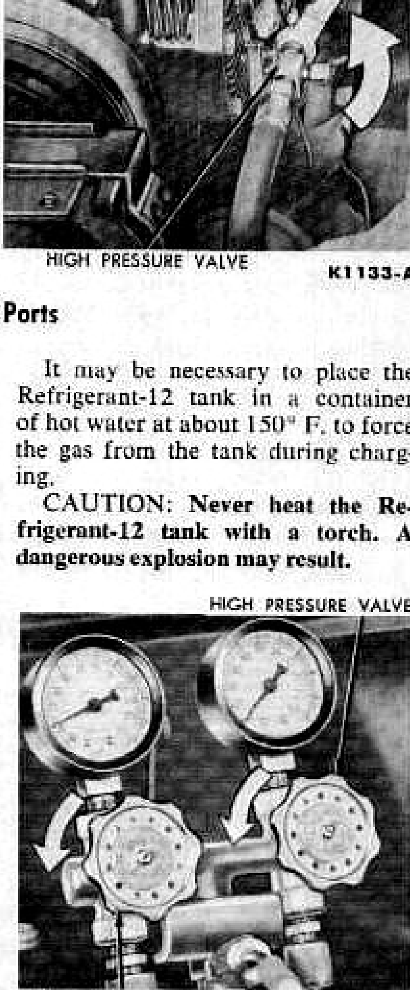


FIG. 41—Opening Manifold Valves

Set both service valves at the maximum counterclockwise position (Fig. 36). Remove the gauge set, and cap the service valve gauge ports and valve stems.

MAKING A COMPLETE CHARGE. Check for leaks first, then evacuate the system. Leave both service valves at the mid-position and the vacuum pump valve closed. Leave the low pressure manifold gauge valve at the maximum counterclockwise or open position (Fig. 41). Set the high pressure manifold gauge valve at the maximum clockwise or closed position (Fig. 38). Set all controls to the maximum cold position.

Open the Refrigerant-12 tank valve. Run the engine at 1500 rpm. Weigh 3½ pounds of Refrigerant-12 into the system. During the charging, the high pressure may build up to an excessive value. This can be caused by an overcharge of refrigerant, an overheated engine or air in the system, in combination with high surrounding temperatures. Never allow the high pressure to exceed 240 pounds. Stop the engine, determine the cause, and correct it.

When the proper charge has entered the system, no bubbles will be seen in the sight glass. The bubbles will begin to disappear when approximately 2½ pounds of refrigerant are in the system. After the proper charge has been made, close the Refrigerant-12 tank valve, and check the system pressures for proper operation. Set both service valves at the maximum counterclockwise position (Fig. 36). Remove the gauge set, and cap the service valve gauge ports and valve stems.

Checking System Pressures. The pressures developed on the high pressure and low pressure side of the compressor indicate whether or not the system is operating properly.

Attach the manifold gauge set (Fig. 37). It will not be necessary to attach the Refrigerant-12 tank unless refrigerant is to be added to the system. Set both manifold gauge valves at the maximum clockwise, or closed, position (Fig. 38). Set both service valves at the center position. Run the engine at 1500 rpm. Set all controls at the maximum cooling position. The actual pressures indicated on the gauges will depend on the temperature of the surrounding air and the humidity. Higher air temperatures along with low humidity, will give higher system pressures. The figures given are for an ambient (surrounding air) temperature of 75° F., 50% relative humidity. For every 10° F. increase in ambient air temperature, the pressures will increase approximately 20 pounds.

The low pressure gauge should indicate a pressure of from 16-25 pounds at 75°F. The high pressure gauge should indicate a pressure of from 100-180 pounds at 75°F. **With the engine at idle speed and the surrounding air temperature at 110°F., the above figures will not be true. High pressures of 300 pounds or more may be obtained under these severe conditions.**

TABLE 2—Refrigerant 12 Temperature-Pressure Relationships

Gas Temperature (° F.)	Gas Pressure (psi)	Gas Temperature (° F.)	Gas Pressure (psi)
—10	4.5		
— 5	6.8	70	70.1
0	9.2	75	76.9
5	11.9	80	84.1
10	14.7	85	91.7
15	17.7	90	99.6
20	21.1	95	108.1
25	24.6	100	116.9
30	28.5	105	126.2
35	32.6	110	136.0
40	37.0	115	146.5
45	41.7	120	157.1
50	46.7	125	168.4
55	52.0	130	180.2
60	57.7	135	192.6
65	63.7	140	205.5

Table 2 shows the temperature pressure relationships for Refrigerant-12. These are the pressures that would occur at the temperatures indicated when the system is not in operation. The temperature is the actual internal temperature of the refrigerant gas.

When the system is in operation, the internal pressures vary from point to point even though the two points in question may be close together and both on the high or low pressure side of the system. Under operating conditions it is very difficult to accurately measure the internal refrigerant gas temperature. Because of these facts, Table 2 should only be used as a general indication of what the pressures should be at surrounding air temperatures.

BLEEDING AIR FROM THE SYSTEM. Air trapped in the system will cause the high pressure to build up excessively. This air may be removed from the system by bleeding.

Attach the manifold gauge set to

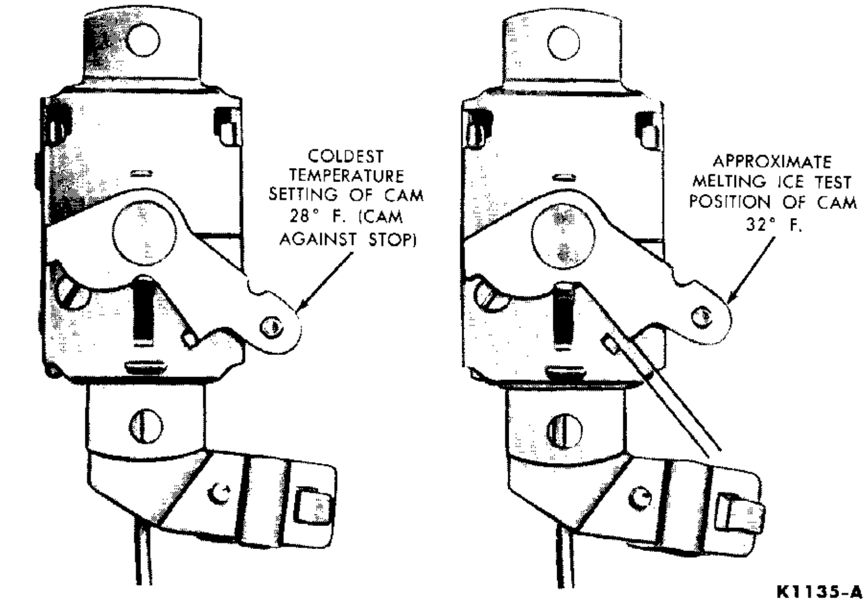


FIG. 42—Thermostatic Switch Cam Test Positions

the system (Fig. 37). Set both service valves at the center position. Run the engine at 1500 rpm with all controls at the maximum cold position. If air is trapped in the system, the high pressure may exceed 200 pounds, depending on the surrounding air temperature and the amount of air in the system.

Turn the engine off. Let the system stand for 10 or 15 minutes to allow the air to collect at the high pressure service valve. Loosen the high pressure gauge hose at the high pressure service valve slightly, and allow the gas and air to escape for 5-10 seconds. Tighten the connection, start the car, and check the pressure again. Repeat the procedure if necessary. After bleeding, check the liquid sight glass to make certain that too much refrigerant was not removed. Put a partial charge in the system if necessary.

Checking System Temperatures. A good indication may be had of overall cooling system operation by measuring the outlet air temperature.

Set all controls for maximum cooling. Place the stem of the thermometer through the right outlet air vent as far as it will go. Run the engine at 1500 rpm. Turn the blower switch to high.

The thermometer should indicate a temperature of approximately 40° F. with a room temperature of 75° F. and a relative humidity of 50%. The outlet air temperature should be about 35°F. below the surrounding air temperature with 50% relative humidity. In case the humidity is higher than 50% the temperature differential will be somewhat less. If the humidity is less than 50% the outlet air temperature will approach closer to the evaporator temperature setting of 32°F.

Thermostatic Switch Test. The switch must be removed for this test. Set the switch cam at the coldest temperature setting (Fig. 42). Place the sensing tube in a container filled with finely crushed ice and water (32°F.). If the switch clicks, it is defective and should be replaced. If the switch does not click, leave the sensing tube in the ice and turn the cam counterclockwise until a click is heard. The cam should move approximately 1/16 inch from the cold setting stop (Fig. 42), which represents the 32° F. setting, or the temperature of the melting ice.

With the sensing tube still in the ice, turn the cam back to the cold temperature setting. If the switch clicks it is defective and should be replaced. If the switch does not click, remove the unit from the ice and expose the sensing tube to the air (approximately 75°F.). The switch should click almost immediately after removal from the ice. If it takes longer than 5 or 6 seconds for the switch to click, it is defective and should be replaced. Air temperatures more or less than 75°F. will cause the switch to click sooner or later respectively. A known good thermostatic switch can be used as a comparison.

Expansion Valve Test. Remove the expansion valve from the evaporator and make the test set up shown in Fig. 43. Open the refrigerant-12 tank valve slightly. Refrigerant gas should come out of the expansion valve outlet. If no gas comes out of the outlet, the temperature sensing bulb has lost its charge and the expansion valve must be replaced.

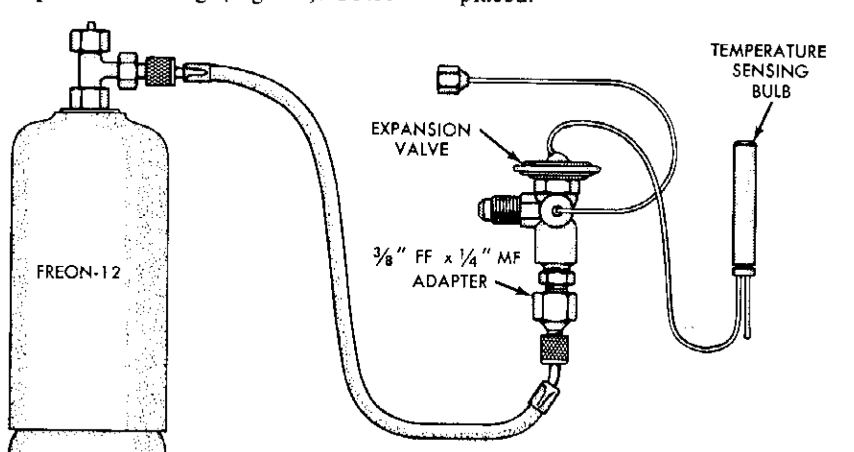


FIG. 43—Expansion Valve Test

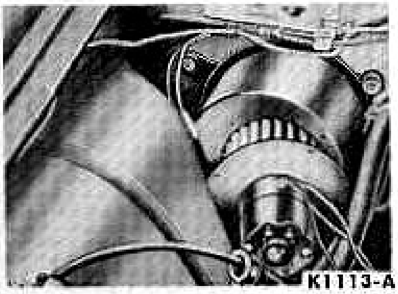


FIG. 44—Blower Motor Removal

Electrical Unit Current Draw. The current drawn by the various electrical units of the air conditioner at a voltage of 12 volts, is as follows:

SelectAire Blower	Hi	10 amperes
	Low	5 amperes
PolarAire Blower	Hi	5.5 amperes
	Med	4.5 amperes
	Low	3.0 amperes
Magnetic Clutch		1.8 amperes

UNIT REPLACEMENT

Possible malfunction, of the various units that comprise the air conditioning system, is determined by trouble shooting and test procedures presented previously. With the exception of the compressor, replacement rather than repair of the individual unit is always recommended. In the case of the compressor, replacement kits for certain components are available. When the use of such kits is unable to eliminate the trouble, the compressor must be replaced.

Replacement of the blower and motor assembly, the compressor, or the thermostatic switch can be effected without losing the refrigerant.

Replacement, of all other units or lines in the system, requires complete discharge of refrigerant before removal, and recharge after installation.

When any part of the refrigerant circuit is broken for service operation, install a new metal gasket in any fitting when the fitting mating surfaces are scored. Use of an old gasket or no gasket, when the mating surfaces are scored, may cause refrigerant leakage.

BLOWER AND MOTOR ASSEMBLY

Disconnect the three motor leads, remove the four blower mounting screws (Fig. 44), and remove the motor and blower assembly. Remove the fan from the motor shaft and remove the motor from the mounting plate.

When replacing a blower motor, make certain that the fan turns freely in the housing and that the motor ground wire makes good contact at its mounting point.

THERMOSTATIC SWITCH

The Thunderbird thermostatic switch is mounted on the right end of the evaporator case, which is in the engine compartment (Fig. 29).

1. Remove the switch cover. Disconnect the wires and the Bowden cable from the switch and remove the two mounting screws.

2. Remove the clips and screws that hold the sensing tube to the outside of the evaporator case, and remove the switch.

3. Insert the sensing tube of the new switch through the opening in the front of the evaporator case. The sensing tube should go into the evaporator core 8 inches.

4. Mount the switch to the cover, install the sensing tube mounting clips and screws. Attach and adjust the Bowden cable, install the thermostat wires, and install the switch cover.

EXPANSION VALVE

Before replacing an expansion valve, discharge the refrigerant from the system. Remove the evaporator and housing assembly from the car. After the new valve is installed, charge the system with refrigerant.

Removal. Remove the evaporator covers. Carefully slit the insulation that covers the temperature bulb and remove the insulation (Fig. 45). Remove the temperature bulb clamp.

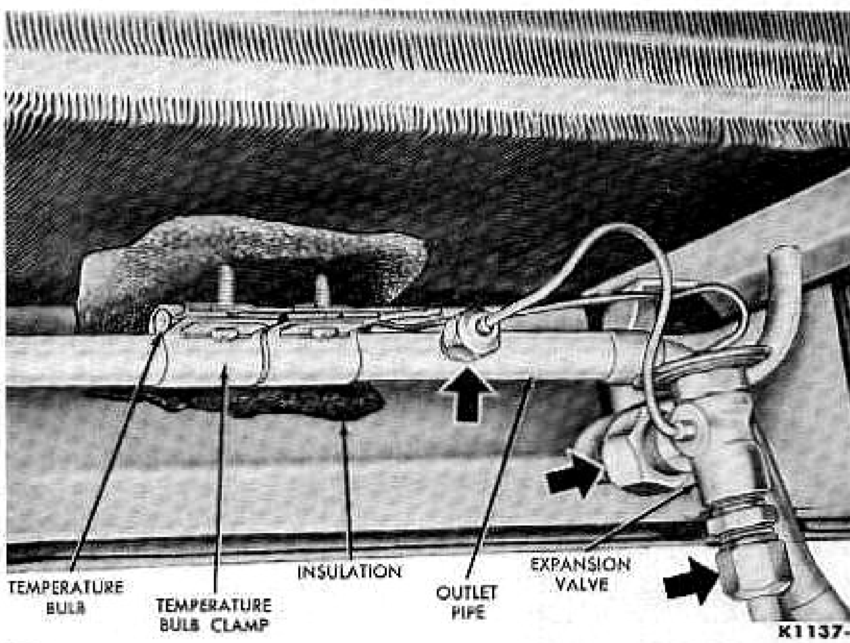


FIG. 45—Evaporator Connections

Disconnect the expansion valve at the three fittings indicated by the large arrows (Fig. 45). When disconnecting the valve from the evaporator connections, always use two wrenches in order not to put excessive pressure on the pipe connections.

Installation. Place the new valve into position and connect it to the three fittings indicated by the large arrows (Fig. 45). Clamp the temperature bulb to the outlet pipe, and cover the bulb and pipe with the insulation. Check for leaks at the expansion valve connections.

Install the cover and install the evaporator. Check for leaks. Evacuate and charge the system.

HEATER CORE

The heater used with the Thunderbird SelectAire unit is separate from the evaporator assembly. Follow the procedures for servicing this heater unit (page 12-21).

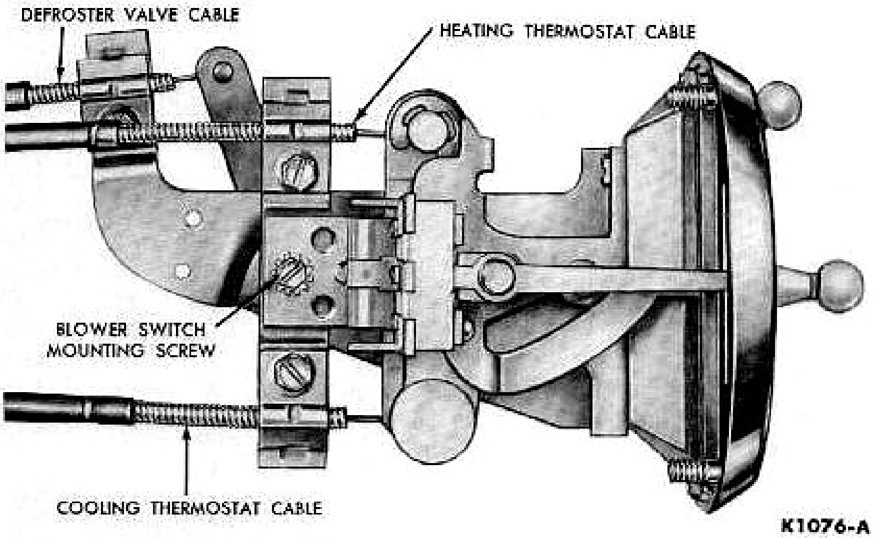


FIG. 46—Blower Switch Removal

EVAPORATOR REMOVAL

Discharge the refrigerant from the system.

1. Remove the thermostatic switch cover from the evaporator case and disconnect the switch control cable and wires from the switch (Fig. 29).

2. Disconnect the evaporator air valve control cable (Fig. 29).

3. Remove the clamp from between the blower and evaporator housing.

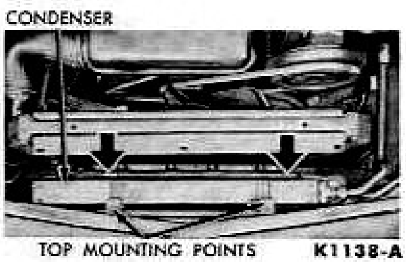


FIG. 47—Condenser Mounting

4. Remove the road draft tube from the intake manifold, and disconnect the accelerator linkage.

5. Disconnect the compressor to evaporator and the condenser to evaporator hoses at the evaporator.

6. Remove the two nuts and two screws that hold the evaporator assembly to the dash and remove the evaporator and case assembly.

7. Remove the thirteen clips, two bolts, and two screws that retain the covers and remove the covers (remove the evaporator inlet and outlet pipe cover and gasket first.)

8. The evaporator core may then be removed from the housing by removing the two evaporator core to housing expansion screws.

EVAPORATOR INSTALLATION

1. Install the old expansion valve on the new evaporator core, leak test the assembly, place the core in the housing and attach the two mounting screws.

2. Attach the housing covers and mount the assembly to the dash.

3. Attach the refrigerant hoses to the evaporator (Fig. 45).

4. Install the road draft tube to the intake manifold and connect the accelerator linkage.

5. Connect the thermostatic switch wires and control cable, and the evaporator air valve control cable and adjust both cables.

6. Install the thermostatic switch cover and then install the blower housing to evaporator housing clamp.

7. Leak test the system, then evacuate and charge the system.

CONTROL UNIT

When installing a control unit, adjust each Bowden cable for proper operation of the controls. The various cables are attached to the control as shown in Fig. 46. The blower switch is attached to the underside of the control (Fig. 46).

CONDENSER AND RECEIVER

If the condenser is to be replaced, remove the original receiver along with the condenser as one assembly; because the replacement condenser is supplied only as one assembly with the receiver. The receiver, however, can be replaced as a separate unit.

Condenser and Receiver Replacement. Remove the grille to radiator support bracket (this also removes the condenser top mounting bolts (Fig. 47). The condenser lower mounting points, shown by the large arrows in Fig. 47, are held in position by the

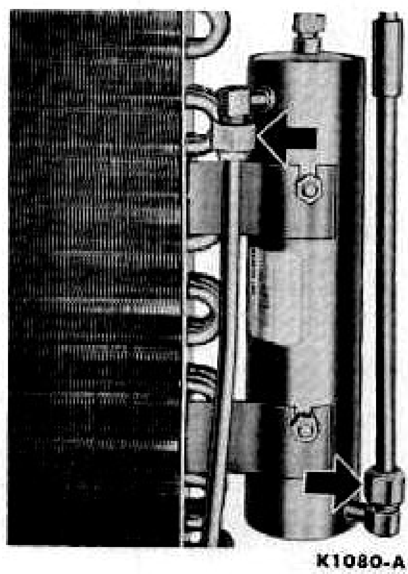


FIG. 48—Receiver Mounted to Condenser

two radiator lower mounting bolts. Remove the radiator lower mounting bolts, push the top of the radiator backwards a few inches and remove the condenser and receiver assembly.

After installing the condenser assembly, attach the refrigerant hoses, check for leaks, evacuate and charge the system. Install the grille to radiator support bracket.

Receiver Replacement. The receiver assembly is mounted at the right side of the condenser (Fig. 48). To remove the receiver, discharge the refrigerant, disconnect the two fittings indicated by the two large black arrows (Fig. 48), remove the mounting nuts and remove the receiver assembly. Position the new receiver to the mounting bracket and install the two mounting nuts finger tight (Fig. 48). Connect the copper tubes at the top and bottom of the receiver, then tighten the receiver mounting nuts. Test for leaks, evacuate and charge the system.

COMPRESSOR SERVICE

The compressor is not completely disassembled for service. All necessary repairs can be made by replacement of certain parts which are available in service kits. If none of the service kits restore normal operation, replace the compressor assembly.

Service kits for the valve plates, the suction and discharge fittings, and the crankshaft seal can be installed without removing the compressor from the car.

All compressor service operations, except belt replacement and magnetic clutch replacement can be performed only after the unit has been isolated from the rest of the system as described below.

Isolating the Compressor. To isolate the compressor from the system, turn both the high and the low pressure service valves to the extreme clockwise position (Fig. 40). Loosen the cap on the high pressure service valve gauge port, and allow the gas to escape until the compressor is relieved of refrigerant pressure.

CAUTION: **Loosen the cap a small amount only, and do not remove it until the pressure is completely relieved.**

To connect the compressor back into the system, evacuate the compressor at the high pressure service valve gauge port, close the vacuum pump valve, turn both service valves to the maximum counterclockwise position, and cap the high pressure service valve gauge port and service valve stems.

Valve Plate Replacement. Isolate the compressor, disconnect the service valves, then remove the ten head bolts.

Tap the cylinder head and valve plate lightly to loosen them, and remove these parts from the top of the compressor (Fig. 49).

CAUTION: **Be careful not to shear off the valve plate locating pins (Fig. 49).**

Remove and discard all gaskets, and be sure to clean gasket shreads from all gasket surfaces. Examine the cylinders and top of the pistons, particularly in case of valve breakage. If there are score marks, replace the compressor assembly.

If the cylinders and pistons are in good condition, check the valve plate and valve leaves for scratches or damage. If the valve leaves and plate assembly are in good condition, they can both be used again. If the valve plate is damaged, install the entire replacement kit which includes the valve plate, valve leaves, and the two gaskets (Fig. 49).

When either the valve leaves or plate assembly are reused, wash them in clean solvent and dry them in dry air. Check the oil for dirt. If the system is not clean, replace the oil.

CAUTION: **If the valve plate and leaves are reused, be sure to replace the leaves in their original positions on the valve plate.**

Starting with the valve plate gasket, assemble the parts in the order shown in Fig. 49. Insert the cylinder head bolts carefully to avoid damaging the gaskets.

Tighten the bolts finger tight, then torque the bolts a quarter turn at a time to 15-20 foot-pounds.

Check the oil level in the compres-

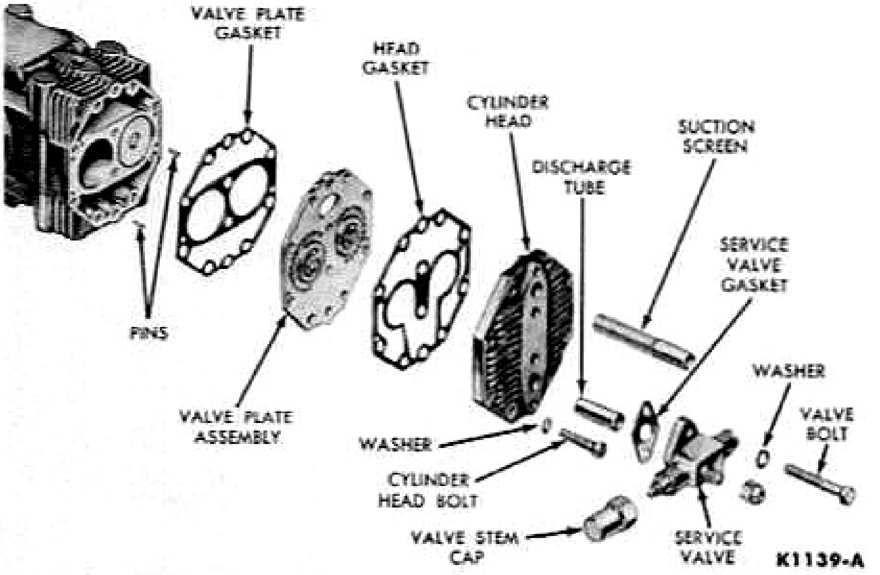


FIG. 49—Compressor Cylinder Head and Valve Assembly

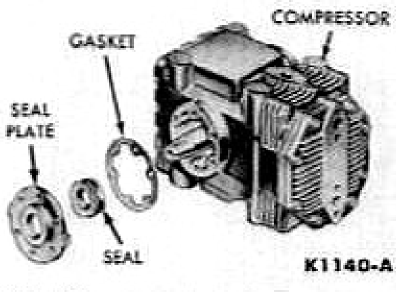


FIG. 50—Crankshaft Seal Assembly

sor, and add or remove oil if necessary. Connect the compressor into the system.

Service Valve Replacement. Discharge the refrigerant from the system. Remove the refrigerant hoses from the valves. Remove the attaching screws, fittings and gaskets.

Install the necessary replacement parts as shown in Fig. 49. If the strainer in the low pressure service valve fitting is not being replaced, clean it before installation.

Magnetic Clutch Replacement.

1. Energize the clutch and loosen and remove the clutch mounting bolt.
2. Install a 5/8-11 bolt in the clutch drive shaft hole. With the clutch still energized, tighten the bolt to loosen the clutch from the shaft.
3. Disconnect the clutch wire and remove the clutch and drive belt.
4. Make certain that there are no burrs or dirt on the compressor shaft. Then install the key, belt, and clutch.
5. Install the clutch mounting bolt and washer. Energize the clutch, and torque the bolt to 18-22 foot-pounds.
6. Adjust the belt tension.

Crankshaft Seal Replacement.

1. Remove the magnetic clutch, belt, and the slip ring brush assembly.
2. Remove the remaining seal plate bolts, and remove the plate and gasket.
3. Remove the carbon seal ring and seal housing assembly from the crankshaft. A disassembled view of the crankshaft seal assembly is shown in Fig. 50.
4. Clean all old gasket material from the seal plate and the compressor. Make certain that the shaft, seal are completely clean before installing the new seal.
5. Lubricate the new shaft seal parts in clean compressor oil, and position the seal assembly on the crankshaft, engaging the notches in the seal with the locating pins (Fig. 51).
6. Position the new gasket on the compressor and install the seal plate, attaching the slip ring brush assembly with two of the seal plate bolts.
7. Torque the bolts to 6-9 foot-pounds, and connect the clutch wire.
8. Install the magnetic clutch.

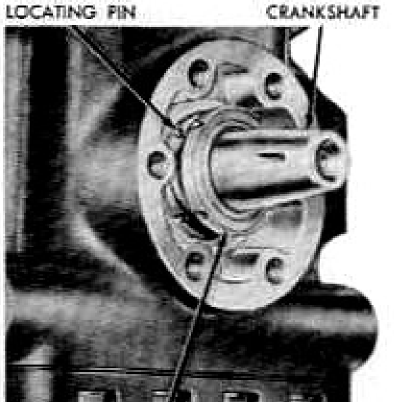


FIG. 51—Crankshaft Seal Installation

Belt Replacement.

1. Loosen the four compressor mounting bolts (large arrows Fig. 52).
2. Slide the compressor toward the center of the car and remove the belt.
3. Place the new belt in position, slide the compressor toward the out-plate and compressor gasket surfaces side of the car and tighten the four mounting nuts (Fig. 52).

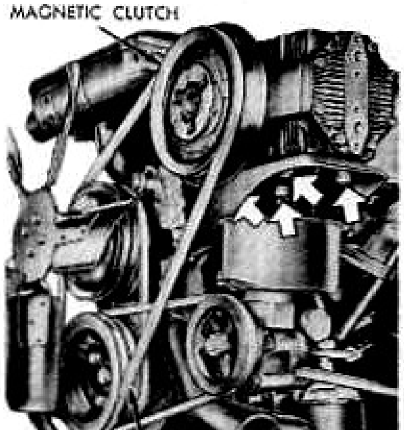


FIG. 52—Compressor Mounting

4. Adjust the belt for proper tension (page 12-28).

Compressor Replacement.

1. Isolate the compressor and disconnect the two service valves and hoses from the compressor.
2. Remove the magnetic clutch.
3. Disconnect the clutch wire at the bullet connector.
4. Loosen and remove the compressor mounting bolts (large arrows, Fig. 52), and remove the compressor.
5. With the compressor on the work bench, remove the key from the shaft.
6. Carefully remove any rust, oil, burrs or dirt that may be on the new compressor shaft. Then install the key in the shaft.
7. Clean any oil from the clutch shaft bore; mount the clutch on the shaft and install the mounting screw and washer finger tight.
8. Place the compressor on the mounting bracket and install the four mounting bolts finger tight (Fig. 52).
9. Connect the clutch wire, energize the clutch and torque the clutch mounting bolt to 18-22 foot-pounds. **If the new compressor was shipped with a bolt and washer in the end of the crankshaft, remove and discard the bolt and use a bolt with a nylon insert in it.**
10. Install and adjust the drive belt, and tighten the mounting bolts.
11. Install the service valves on the compressor (Fig. 53), using new gaskets. Leak test the compressor, then evacuate it and connect it back into the system.
12. Check the oil level in the compressor and add or remove oil if necessary. Follow the procedure as given on page 12-27.

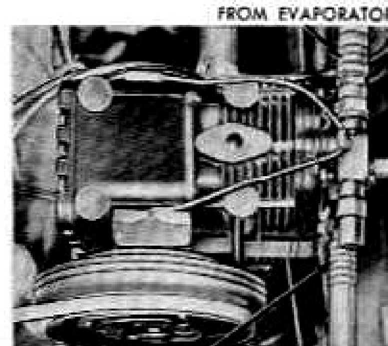


FIG. 53—Compressor Hose Connections

8 WINDSHIELD WIPER AND WINDSHIELD WASHER

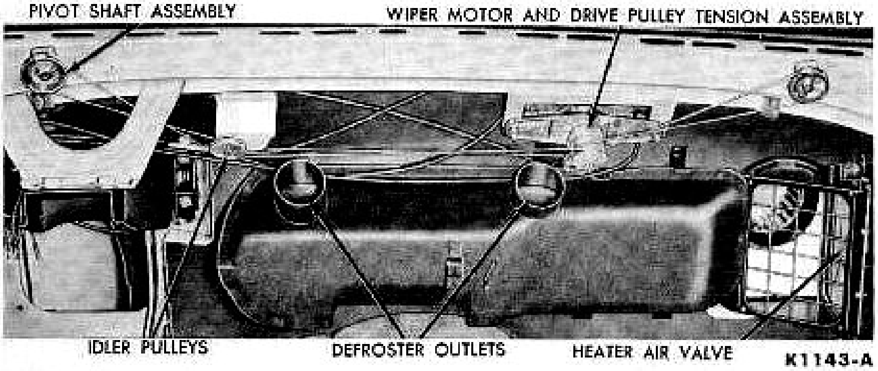


FIG. 54—Windshield Wiper and Heater Plenum

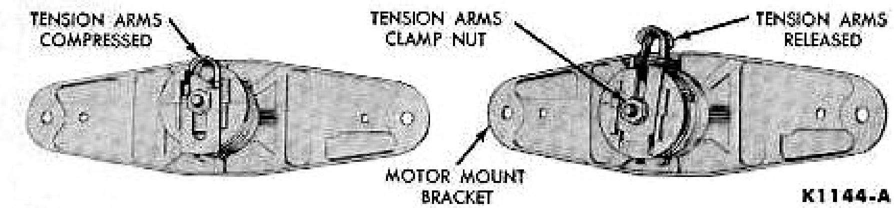


FIG. 55—Wiper Cable Tension Assembly

WINDSHIELD WIPER

The windshield wiper assembly is shown in Fig. 54.

If service is required on the motor assembly, control assembly, or pivot shaft assemblies they may be removed separately. To remove any of the windshield wiper assemblies it will first be necessary to remove the glove box.

To remove the wiper motor, in addition to the glove box, remove the right defroster air duct. Remove the motor bracket to bracket mount nuts, disconnect the pivot shaft cables, disconnect the vacuum hoses and control head cable and remove the motor. Remove the motor from the shaft assembly.

Before installing a new motor, loosen the motor drive pulley tension clamp nut, compress the tension arms and tighten the nut (Fig. 55). Mount the motor to the drive pulley assembly, install the drive head cable, attach the vacuum hoses, attach the drive cables (Figs. 54 and 56), and mount the assembly. Loosen the tension arms clamp nut to put tension on the cables then tighten it again.

To remove the pivot shaft assemblies, remove the wiper blade assemblies, remove the pivot shaft mounting nuts, slide the pivot assemblies out of the mounting holes, disconnect the cables from the motor drive pulley and remove the assemblies.

To gain access to the left pivot shaft assembly, remove the speedometer assembly. The pivot shaft assembly may then be removed through the speedometer mounting hole.

Before installing new pivot shaft assemblies, loosen the motor drive pulley tension arms clamp nut, compress the tension arms with a "C" clamp and tighten the nut (Fig. 55). Install the cables as shown in Figs. 54 and 56, mount the pivot shaft assemblies, release the tension arms clamp nut, then tighten it.

The control assembly may be removed from the instrument panel by removing the bezel nut after loosening and removing the control knob.

WINDSHIELD WASHER

The windshield washer unit operates in conjunction with the windshield wiper. The washer control lever is mounted on the left instrument panel extension. Pushing the lever forward opens the vacuum line to a

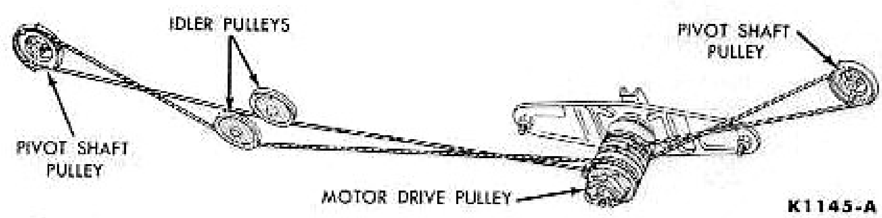


FIG. 56—Wiper Drive Cable Attachment

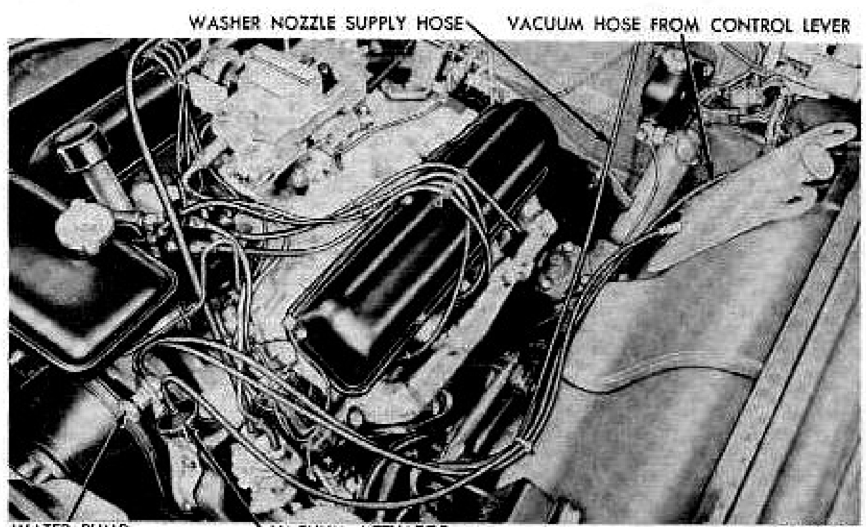


FIG. 57—Typical Windshield Washer Installation

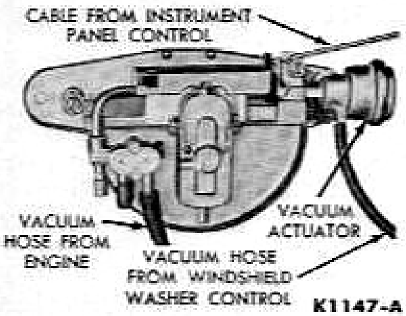


FIG. 58—Windshield Wiper Actuator

vacuum actuator (Fig. 57). The vacuum actuator connects a water pump to the fan belt through a friction drive. The water pump draws water from the water reservoir and delivers it to the washer nozzles which are mounted under the front edge of the fresh air inlet grille and screen assembly. As long as the control lever is held in the forward position, two steady streams of water are delivered to the windshield.

Actuation of the windshield washer control lever also opens the vacuum line to the vacuum operated windshield actuator assembly (Fig. 58). The wiper will continue to operate for several cycles after the washer control lever is released due to the delay action of the actuator assembly.

The adjustment clearance between the windshield washer pump drive wheel and the fan belt is ⅛ inch.

The windshield washer control assembly is removed by removing the left extension of the instrument panel,

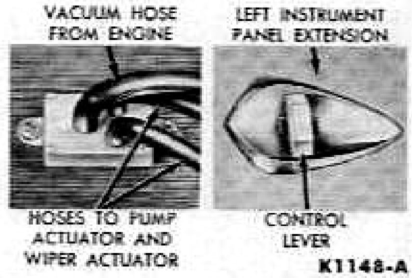


FIG. 59—Windshield Washer Control

and removing the two mounting screws (Fig. 59). When installing the control assembly, attach the large hose to the large pipe (Fig. 59). The hoses to the pump actuator and to the wiper actuator may be attached to either of the two smaller pipe outlets.

9 MISCELLANEOUS ACCESSORIES

CLOCK

Adjustment of the clock is automatic. If the clock runs slow or fast, merely reset the clock to the proper time. This action adjusts the clock automatically.

To replace the clock, remove the clock bezel by pulling it from the instrument panel, remove the mounting screws, pull the clock away from the instrument panel, then disconnect the clock supply wire and panel light.

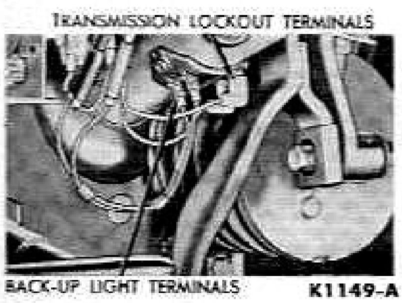


FIG. 60—Back-Up Light Switch

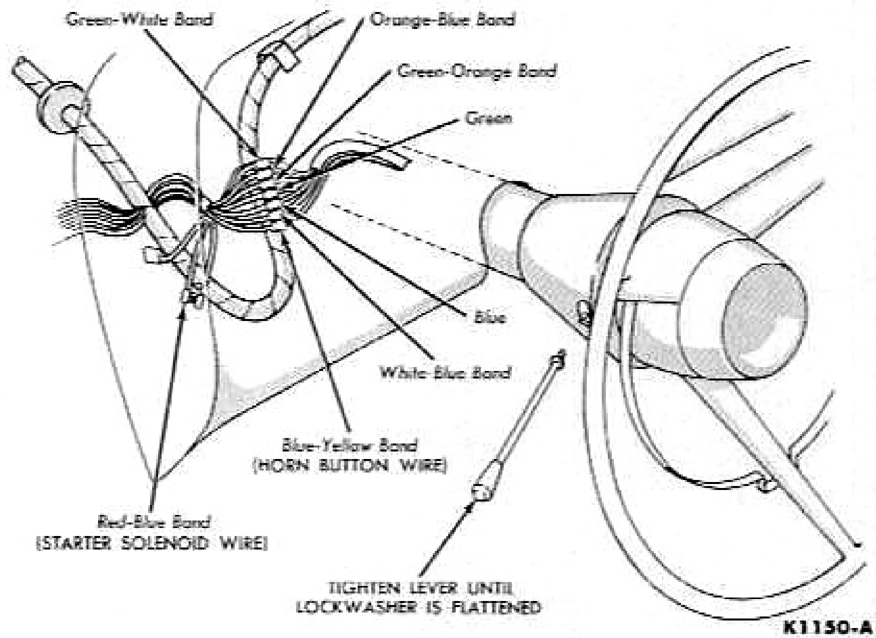


FIG. 61—Turn Indicator Wiring Connections

BACK-UP LIGHTS

The back-up lights are mounted inboard of each set of taillights. The standard transmission equipped Thunderbird has the back-up light switch mounted on the steering column in the engine compartment. Thunderbirds with an automatic transmission, have the back-up light switch mounted on the steering column just above the brake pedal. The switch on these units is integral with the automatic transmission lockout switch (Fig. 60).

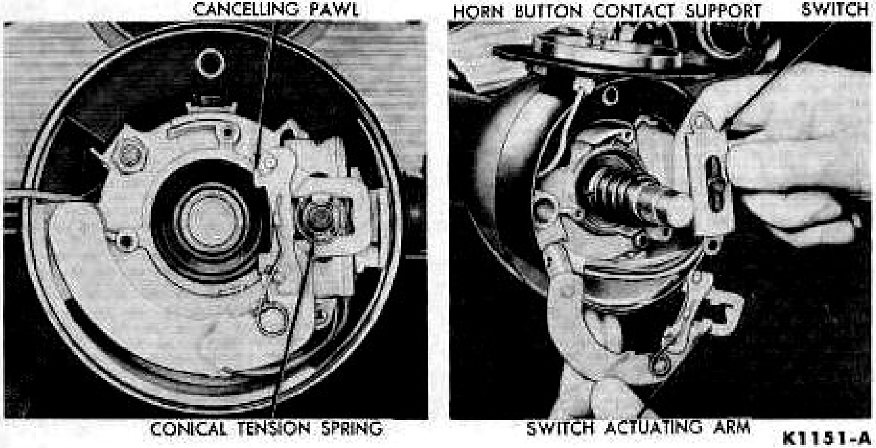


FIG. 62—Turn Indicator Switch

TURN INDICATOR

Figure 61 shows the turn indicator wiring connections. Figure 2 shows the turn indicator schematic diagram. To remove the turn indicator switch, remove the steering wheel and the plastic horn button contact support (Fig. 62). Unscrew the actuating lever, remove the conical tension spring, then remove the switch actuating arm. The turn switch may then be removed by removing the two mounting screws. Disconnect the wires at the steering column (Fig. 61), attach a heavy cord to the wire ends and pull the switch wires from the steering column. The heavy cord is used to pull the new switch wires down through the steering column.

PART 12-3 SPECIFICATIONS

LIGHTING SYSTEM, HORNS, AND INSTRUMENTS

FUSE AND CIRCUIT BREAKER CHART

Circuit	Protective Device	Location
Clock	1AG-1-Fuse	Cartridge in Feed Wire Behind Instrument Panel
Cigarette Lighter	Sulphur Disc	Back of Lighter Socket
Overdrive	3 AG-15 Fuse	Clip on Overdrive Relay
Back Up Lamps	Circuit Breaker	Integral with Headlight Switch
Head Lamps	Circuit Breaker	
Auxiliary Lamps (Park, Tail, Dash, Stop)	Circuit Breaker	
Dome Lamp	Circuit Breaker	
Interior Lamps (Dome Lamp Feed)	SFE-7.5 Fuse	Clips on Lighting Switch
Turn Signals	1 AG-5 Fuse	Clip on Light Switch
Radio	1 AG-5 Fuse	Cartridge in Feed Wire
Heater Blower	SFE-14 Fuse	Cartridge in Wire from Ignition Switch
Power Seats	(2) Circuit Breakers	Dash Panel (1) Right Air Duct (1)
Power Windows	(5) Circuit Breakers	Integral with Safety Relay (1) Right and Left Cowl Panel (2) On Floor Panel at Right and Left Rear Quarter (2)
Air Conditioning	Circuit Breaker	On Left Air Duct
Convertible Top Control	Circuit Breaker	Right Hand Side of Dash Panel—Engine Compartment

BULB CHART

Unit	Candle Power or Wattage	Trade No.
Headlamp—No. 1 (Inner)	37.5w	4001
Headlamp—No. 2 (Outer)	50/37.5w	4002
Front Turn Signal/Parking	32/4 c.p.	1034
Rear Turn Signal & Stop/Tail	32/4 c.p.	1034
Stop/Tail Only	32-4 c.p.	1034
License Plate	4 c.p.	67
Back-up Lamps	21 c.p.	1141
Spot Lamp	30w	4405
Luggage Compartment	6 c.p.	89
Instrument Panel Indicators:		
Hi Beam	2 c.p.	57
Oil Pressure	2 c.p.	57
Generator	2 c.p.	57
Turn Signal	2 c.p.	57
Illumination:		
Cluster	2 c.p.	57
Ash Receptacle	1.5 c.p.	1445

BULB CHART (Continued)

Unit	Candle Power or Wattage	Trade No.
Cigarette Lighter Socket & W/S Wiper	2 c.p.	57
Heater Control	2 c.p.	57
Heater & A/C Control	2 c.p.	57
Clock	2 c.p.	57
Ignition Key & Lighting Switch	2 c.p.	57
Radio Dial	1.9 c.p.	1891
Glove Compartment	2 c.p.	57
Courtesy and/or Map	6 c.p.	89
Automatic Transmission Control	1.5 c.p.	1445
Dome Lamp	15 c.p.	1003

INSTRUMENT VOLTAGE

Fuel and Temperature Gauges—Average Voltage at Gauge Terminals	5 v

STOP LIGHT SWITCH

Operating Pressure	5 psi

LIGHTING SYSTEM, HORNS, AND INSTRUMENTS (Continued)

ACCESSORIES

TURN INDICATOR

Current Draw at 12 v	0-4 Amperes

HORN

Horn Current Draw at 12 v	9.0-10.0 Amperes

HEATER MOTOR CURRENT DRAW

At Low Speed	5-6 Amperes at 12 volts
At Medium Speed	4-6 Amperes at 12 volts
At Fast Speed	7-8 Amperes at 12 volts

AIR CONDITIONER CURRENT DRAW

At Slow Speed	10 Amperes at 12 volts
At Fast Speed	5 Amperes at 12 volts

SPEEDOMETER GEAR—REAR AXLE— TIRE SIZE COMBINATIONS

Tire Size	8.00 x 14-4		8.50 x 14-4	
Rear Axle Ratio	Teeth in Drive Gear	Teeth in Driven Gear	Teeth in Drive Gear	Teeth in Driven Gear
2.91:1	—	—	9	19
3.10:1	8	18	—	—
3.70:1	7	19	—	—

POWER SEAT CURRENT DRAW

At No Load	8-10 Amperes at 12 volts

POWER WINDOW CURRENT DRAW

At No Load	8-10 Amperes at 12 volts
Operating Window	20 Amperes (Max.) at 12 volts
Stalled	30-50 Amperes at 12 volts

GROUP 13

BODY MAINTENANCE AND REPAIR

PART 13-1 GENERAL MAINTENANCE

1 BODY TUNE-UP

Most rattles are caused by a loose bolt or screw. Foreign objects such as nuts, bolts, or small pieces of body deadener in the door wells, pillars, and quarter panels are often the source of rattles. Door wells can be checked by carefully striking the underside of the door with a rubber mallet. The impact made by the mallet will indicate if loose objects are in the door well.

All bolts and screws should be tightened periodically. In the event that tightening the bolts and screws, located on such assemblies as the doors, hood, and deck lid, does not eliminate the rattles, the trouble is probably caused by misalignment. If this is the case, follow the adjustment and alignment procedures for these assemblies.

Rattles and squeaks are sometimes caused by weatherstripping and anti-squeak material that has slipped out of position. Apply additional cement or other adhesive, and install the material in the proper location to eliminate this difficulty.

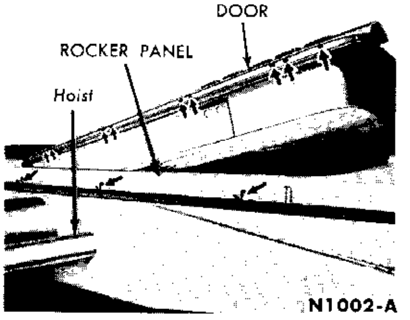


FIG. 1—Drain Holes

Drain holes (Fig. 1), located on the underside of each rocker panel, quarter panel, and door, should be cleared periodically.

A regular body tune-up preserves the car's appearance and reduces the cost of maintenance during the life of the car. The following steps are suggested as a guide for a regular body tune-up:

1. Vacuum the interior thoroughly and wash the car.
2. Check all openings for water leaks, and seal where necessary.
3. Cement all loose weatherstrips which are still usable. Apply silicone lubricant to the weatherstripping.
4. Replace all door and deck lid weatherstrips which are unfit for service.
5. Replace all cracked, fogged, or chipped glass.
6. Align hood, doors, and deck lid if necessary.
7. Inspect windshield wiper blades and replace if necessary.
8. Tighten sill plate and garnish moulding screws.
9. Clean the seats, door trim panels, and headlining. If the seats are worn or torn, install seat covers, or reupholster.
10. Touch-up or paint chipped or scratched areas.

2 EXTERIOR AND INTERIOR CLEANING

EXTERIOR CLEANING

The outside finish should be frequently washed. Never wipe the painted surfaces with a dry cloth. Dusting the finish when it is dry tends to rub the dust and dirt into the baked enamel, and leaves a sandpaper effect on the surface. To keep the finish bright and attractive, and eliminate the necessity of using polish, wash the vehicle whenever it has accumulated a moderate amount of dirt and road salt.

The bright metal parts of the car require no special care. Periodic cleaning will preserve the beauty and life of these finishes. Wash with clear water or if the parts are very dirty use a mild soap. Using a clean soft cloth or a sponge and water, rinse and wipe the parts dry. FoMoCo Chrome Cleaner may be used sparingly to remove rust or salt corrosion from chrome plated parts. Do not scour chrome finished parts with steel wool or polish them with products containing abrasives. A FoMoCo Polish will provide excellent protection for all bright metal parts.

INTERIOR CLEANING

Use a broom or a vacuum cleaner to remove dust and dirt from the upholstery or floor covering. Vinyl and woven plastic trim that is dusty can usually be cleaned with a damp cloth.

Dirty or stained upholstery can be cleaned with FoMoCo Interior Trim Cleaner. This cleaner may be used on leather, plastic, vinyl, imitation leather, fabric upholsteries, rubber mats, and carpeting. Be sure to follow the directions on the cleaner container.

PART 13-2 SEALING

1 DUST AND WATER LEAKS

The forward motion of the car creates a slight vacuum within the body, particularly if a window or ventilator is partially open. Any unsealed crevice or small opening in the lower section of the body will permit air to be drawn into the body. If dust is present in the air, it will follow any path taken by the air from the point of entry into the passenger and luggage compartments. Opening the fresh air outlets will equalize these pressures. Dust may work its way into the hollow, box-type, rocker panel which extends along the edge of the floor below the doors. Dust accumulates in the rocker panel, and may eventually work its way to the rear body pillar or kick-up, and follow the contour of the wheelhouse into the luggage compartment.

To eliminate dust leakage, determine the exact point at which the dust enters. As explained previously, the point of entry is often deceptive in that the dust may enter at one point and then follow the passages formed by interior trim.

Under certain conditions, water can enter the body at any point where dirt or dust can enter. Any consideration of water leakage must take into account all points covered under dust leaks.

Dust and/or water leaks may result from missing or improperly installed plugs and grommets. These are used in the underbody and the dash panel.

2 LOCATING DUST LEAKS

To determine the exact location of a dust leak, remove the following trim from the car:

1. Cowl trim panel.
2. Quarter trim panel.
3. Rear seat back and seat cushion.
4. Luggage compartment floor mats, side trim panel, and spare wheel.
5. Scuff plates.

After removing the trim, the location of most leaks will be readily evident. Seal these leaks, and road test the car on a dusty road to make sure all leaks are sealed. The entrance of dust is usually indicated by a pointed shaft of dust or silt at the point of entrance.

After the road test, check for indications of a dust pattern around the door openings, cowl panel, lower part of the quarter panel, and in the luggage compartment.

3 TYPES OF SEALERS AND APPLICATION

TYPES OF SEALERS AND APPLICATION

A wide variety of sealers are used by manufacturers. Since it would be difficult to stock all of these sealers, the all-purpose sealers described below have been selected for service use. The method and points of application are given under each sealer type.

BODY SEALER B8A-19562-A

This white sealer will not run, is fast drying, and remains semi-elastic. It duplicates the vinyl-type sealer used in assembly. It is easily cleaned up with a dry cloth, followed by solvent if necessary, and provides an excellent surface for paint. This sealer is used for all seam sealing jobs such as are found in the floor pan, wheelhouse, dash panel, rocker panel, door opening, quarter panel, or drip rail. It is also used to seal trim panel and outside moulding clip holes, and for windshield and back window installation.

BLACK CAULK AND SEALER B6A-19563-B

The combination black caulk and sealer is of the same composition as body sealer, and is used in the same areas. The color is gloss black instead of white, and this sealer is to be used with dark colored paint or in areas that are not visible.

BODY SEALER M-5397-B

This sealer has a plastic base with an asbestos filler, is heavy bodied, and is commonly known as "permagum." It is used on spotweld holes, around moulding clips, or between two surfaces not properly sealed by a gasket. Apply the sealer with a putty knife.

M-2G17-A CEMENT

This cement is recommended for instrument panel safety cover and body panel plastic water shield installation. It is also useful for repair or replacement of other vinyl and rubber trim.

AMBER TRANSPARENT CEMENT B6A-19563-C

Amber transparent cement is a universal adhesive for all types of rubber and fabric. It will not stain or bleed, is easy to clean up, and will not harm paint. This cement has an extra fast tacking action and a very strong grip. It is excellent for fastening weatherstrips to doors and deck lids, and for repair of cloth or vinyl trim.

RUBBER CEMENT 8A-19552-B

This rubber cement is a quick-drying, strong, adhesive material. It is designed to cement weatherstripping to doors, bodies, deck lids, cowl ventilators, and the surrounding metal. Windows and windshields which are set in rubber can be effectively sealed against leakage by flowing cement into affected areas.

Clean all grease, dirt, and old sealer from the surfaces to be cemented. Wash the surface thoroughly with a rag moistened with clean gasoline or cleaner's naphtha. For best results, apply a medium coat of cement to both surfaces, allow it to dry until tacky, and press both surfaces firmly together.

CLEANING SOLVENT B6A-19563-D

A general clean-up solvent is used to clean off new or old cement smears, wax, tars, oils, grease, caulk and sealer. When desired, it can be used to thin caulk and sealer. It is harmless to cured paint, and will be useful in new car pre-delivery.

SILICONE LUBRICANT B8A-19553-A

This lubricant is to be used on the door window weatherstrips. It is recommended that silicone lubricant be applied to the upper weatherstrips at every regular lubrication period. Its use makes the doors easier to close, avoids weatherstrip squeaks, retards excess weatherstrip wear from chafing between the door glass upper frame and the weatherstrip, and helps to retain door window alignment by reducing friction between the glass frame and rubber weatherstrip.

4 REPAIRING UNDERCOATED SHEET METAL

When repairing undercoated sheet metal, rough out the damaged portion, and apply moderate heat to the outside of the panel. This will soften the undercoating so that it can be scraped off with a putty knife. Remove any remaining material with a solvent.

Apply undercoating to the repaired metal with a putty knife or paint brush. Do not apply heat on freshly applied undercoating.

PART 13-3 REPAIR

Section | Page

1 BODY ALIGNMENT

Servicing the unitized body should not present any unusual difficulties or necessitate additional equipment other than that required for the conventional frame and body repair. The application of heat and the use of heavy duty jacks must be carefully controlled because of the difference in the gauge of the metal in the subframe of a unitized body and the stress points developed in a single welded unit construction. It is possible to pull damaged areas back into alignment with the use of light-weight jacks and hydraulic equipment without heating the metal.

Rough out badly damaged areas before taking measurements for squaring up a body. If necessary, remove the glass from the damaged area to prevent breakage. In severe cases, reinforcement brackets and other inner construction may have to be removed or cut to permit restoration of the outer shell and pillars without excessive strain on the parts. Straighten, install, and secure all such parts in place before attempting to align the body.

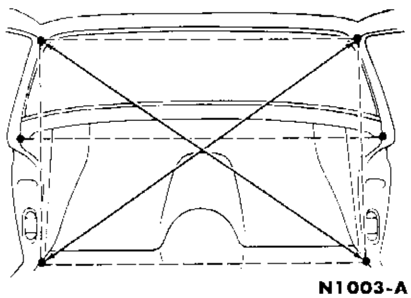


FIG. 1—Typical Body Measuring Points

In cases of severe or sharp bends, it may be necessary to use heat. Any attempt to cold-straighten a severely bent bracket may cause ruptures of the welds and may also cause cracks in the bent part. Never heat the area more than a dull red.

CHECKING BODY FOR MISALIGNMENT

To align or square up a body, take two opposite diagonal measurements between pillars (Fig. 1). Use a measuring tram for these measurements.

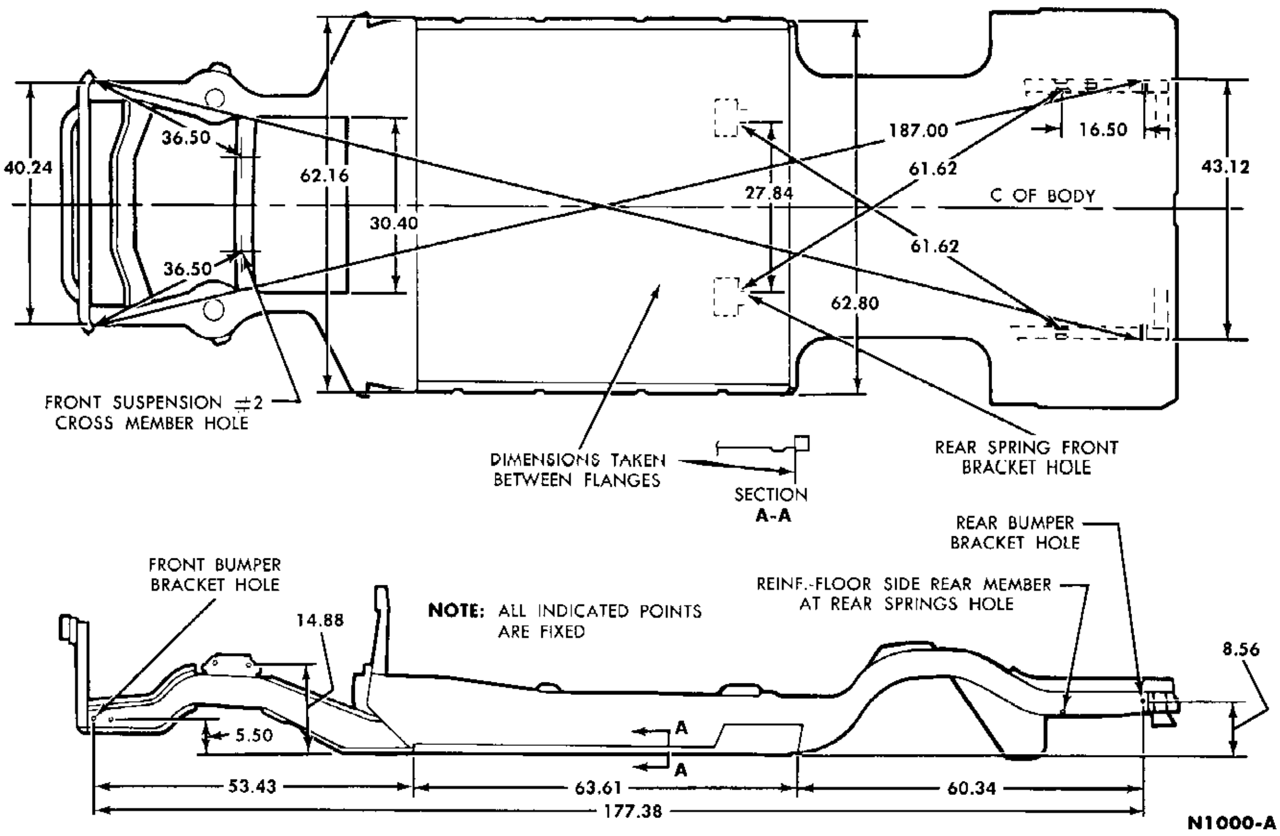


FIG. 2—Thunderbird Underbody Dimensions

Take the measurements between reference points such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured. Since all measurements should be made from the bare metal, remove all interior trim from the checking points.

In some cases, it is difficult to obtain proper body alignment when repairing a body that is damaged on both sides. In these cases, horizontal and vertical measurements can be taken from a body of the same body style. Once these basic dimensions are taken and established on the damaged body, alignment can be made by diagonal measurements taken from the measuring points on the two pillars.

When two opposite diagonal measurements are not the same, the body should be forced in the direction of the short diagonal. The distance to force that part of the body will be a little more than one half the difference in the two diagonals to compensate for "spring-back."

Do not attempt to correct any serious misalignment with one jacking operation. This is particularly true if other sections of the body also require aligning. Align each section proportionately until the proper dimensions are obtained.

Door openings are checked in the same manner as the body. Horizontal, vertical, and diagonal checking points are established on all four sides of the door opening that is being measured.

CHECKING UNDERBODY FOR MISALIGNMENT

The dimensions of the sub-frame must be restored in the repair of major body damage, to provide correct front and rear wheel geometry. Figure 2 shows the dimensions for aligning the underbody assembly. All the dimensions are detailed to the center line of existing holes in the underbody assembly. Once the frame and suspension members are properly aligned, the balance of the repair can be performed.

2 PANEL REPAIR

With proper equipment, an experienced body repair man can repair a damaged area in a body panel by one of three methods:

1. External or surface damage that can be bumped out or refinished.
2. External damage that can be repaired by removing a complete panel and installing a service panel.
3. Extensive damage necessitating the removal of the outer panels and the realignment or replacement of sections of the sub-frame. **When performing repairs of this type, measure sufficient overlap to assure an adequate area for a strong welded surface.**

In cases where only a portion of a panel requires replacement, a section of a service panel can be used. Complete service panels are available if the area is extensively damaged.

If a complete panel requires replacement, refer to Figure 4 which shows some of the hidden weld joints and sealer locations.

PANEL REPAIR PROCEDURE

The following procedure is one of several methods that can be used for cutting out and replacing a portion of the quarter panel. Although this procedure is used here for quarter panel repairs, it can be applied to other sections of the body as well.

Rough out and shape as much of the damaged area as possible. Measure the piece of metal to be cut out (Fig. 3). This measurement should be taken from a definite point, such as a moulding or bead.

Make the corresponding measurements on the service panel. Be sure measurements are taken from the same points. Scribe a line around the area to be cut from the service panel (preferably straight-line cuts).

Drill a ¼-inch hole at any one corner of the scribed line as a starting point for cutting. Use a suitable cutting tool and cut the new piece out along the scribed line.

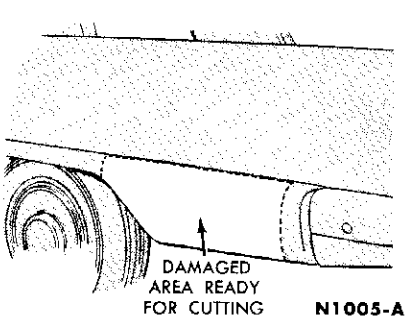


FIG. 3—Damaged Area Ready for Cutting

Straighten the edge of the piece that was cut out, and position it over the damaged area as a template. Secure the cut-out section of the service panel over the damaged area of the body, and scribe a line around the panel. Cut out the damaged area.

If the piece to be replaced is at the pillar post or at any point where the panel is spotwelded to other parts of the body, such as the body side reinforcement lower edge or wheelhousing assembly, the damaged piece should be split at the weld if possible. To split a spotweld, drive a sharp chisel between the two pieces of metal at the weld. In difficult cases, a spotweld may be split by drilling a ¼-inch hole into the center of the weld.

Straighten the cut edge of the panel. Fit the service panel portion into the cut-out area in the body panel. Be sure that the two panels do not overlap. Tack-weld at intervals, let the metal cool, and make a continuous weld around the two pieces. Wet asbestos putty may be used to

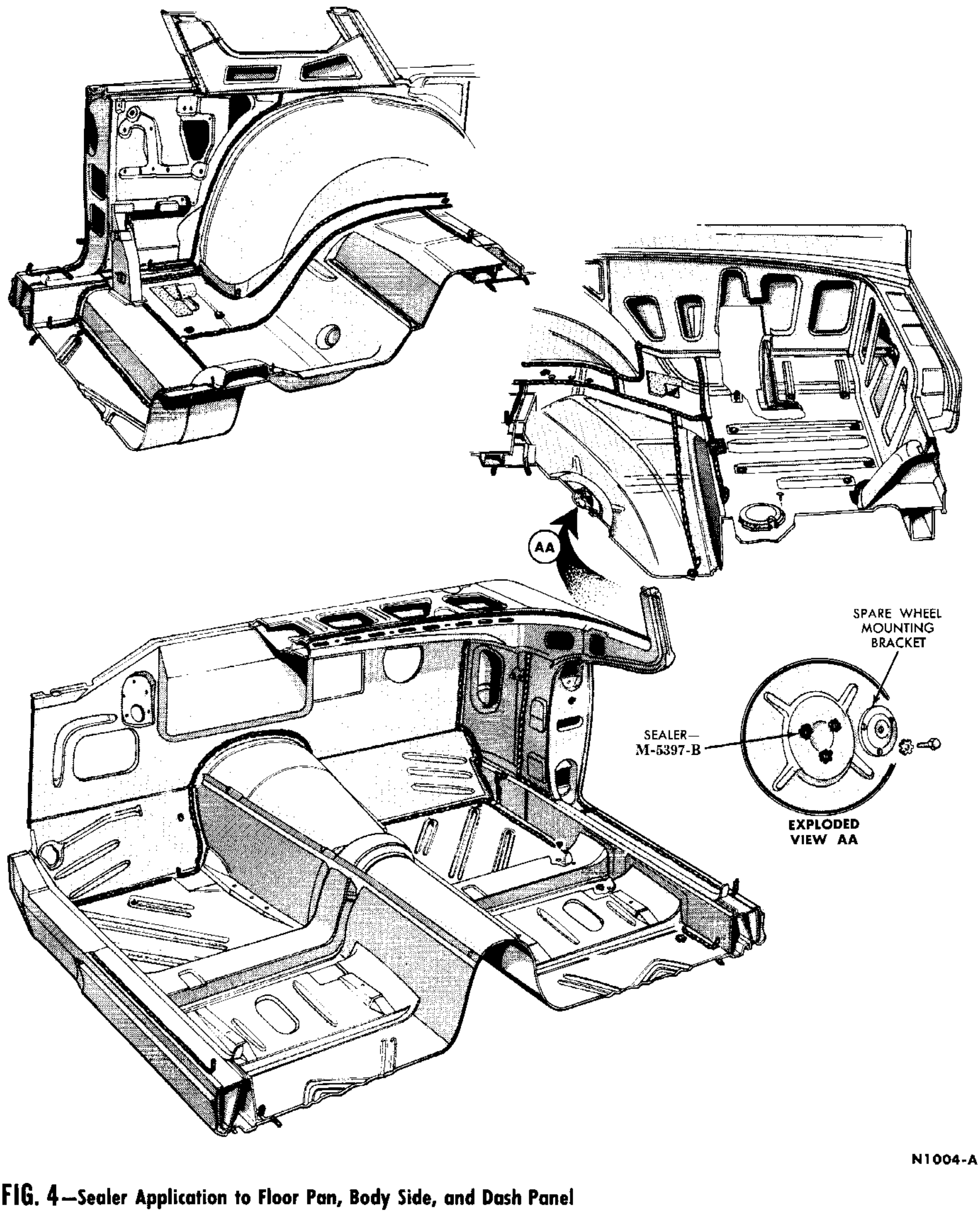


FIG. 4—Sealer Application to Floor Pan, Body Side, and Dash Panel

prevent the heat from traveling. Weld about 6 inches at a time. Stagger the welds to prevent excessive distortion.

Hammer the weld below the contours of the surface not more than 1/16 inch with a grooving dolly.

Metal-finish the repair area and file it smooth, taking care to produce the correct contour.

Grind the welded area clean, and tin.

Fill in with solder, taking care that sufficient solder is applied so that the final metal finish will not have indentations.

Metal-finish the panel to prepare it for painting.

GROUP 14

DOORS, DECK LID, LOCKS, AND WINDOWS

PART 14-1 DOORS AND DECK LID

1 DOOR REPLACEMENT AND ALIGNMENT

Replacement doors are furnished as a sheet metal shell in prime paint. They have no hinges, trim, glass or hardware. When a door is replaced, transfer all usable parts from the old door to the new one, and replace any parts which are damaged beyond repair.

DOOR REPLACEMENT

Repair any dings or dents in the new door which may have occurred in handling and storage. Sand, paint, and install the weatherstrip on the new door before assembly.

1. Remove all usable hardware, the trim panel and the plastic water shield. Remove the window and lock components, and all usable outside mouldings and clips.

2. Slide the door off the hinges. If a hinge is damaged, remove the four hinge pillar bolts, and replace the hinge.

3. Position the door on the hinges, tighten the bolts finger-tight, align the door, and tighten the bolts securely.

4. Install the window and lock mechanisms, glass and vent window assemblies. It may be necessary, at this time, to perform a final door alignment to obtain a satisfactory weather seal at the windshield pillar and/or the roof rail.

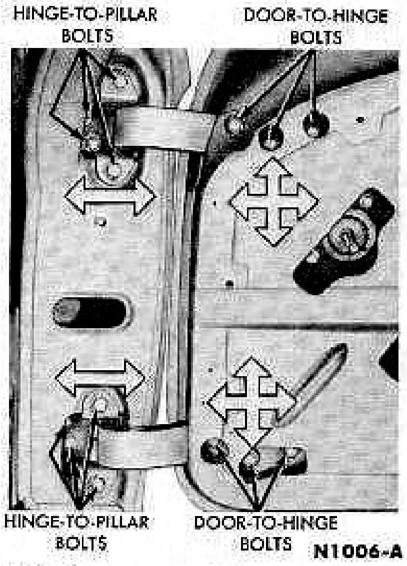


FIG. 1—Door Hinges

5. Install the exterior trim, the plastic water shield (M-2G17-A cement), and the interior trim panel.

DOOR ALIGNMENT

The door hinges provide sufficient adjustment latitude to correct most misalignment conditions. The elongated holes where the hinges attach to the pillars provide in-and-out movement of the front door to obtain flush fits with the front fenders (Fig. 1).

The bolt holes where the doors attach to the hinges are enlarged. This permits a circular movement of the front door to obtain proper spacing all around the door (Fig. 1).

ALIGNMENT PROCEDURE

1. Consult Fig. 1 to determine which hinge bolts must be loosened to move the door in the desired direction.

2. Loosen the hinge bolts enough to permit movement of the door with a padded pry bar.

3. Move the door the distance estimated to be necessary. Tighten the hinge bolts and check the door fit.

4. Repeat the operation until the desired fit is obtained, and check the striker plate alignment for proper door closing.

2 DECK LID—HARDTOP MODEL

New deck lids are furnished in prime paint without hardware. All usable hardware parts should be removed from the old deck lid so they can be installed on the new lid.

Before the old deck lid is removed and disassembled, time will be saved if the new deck lid is prepared for installation first. Inspect the new deck lid for dings and other minor damage, repair as necessary, and sand and paint it. While it is drying, remove and disassemble the old lid. When the new lid is dry, install the weatherstrip and hardware.

The deck lid is mounted on spring loaded hinges which permit easy lifting of the lid.

REPLACEMENT

1. Remove all hardware from the deck lid.

2. Remove the hinge to deck lid bolts (Fig. 2), and remove the deck lid. Remove the deck lid ornament and lock from the deck lid. If it is necessary to remove the hinge, remove the hinge bracket bolts (Fig. 2). **The hinge and spring are replaced as an assembly.**

3. If the hinges were removed, install the new hinges at the same approximate location as the old hinges. Position the deck lid, and install the hinge to deck lid bolts finger-tight.

4. Close the deck lid gently to check the fit. Adjust the deck lid and hinges for proper fit. Adjust the striker plate.

CHECKING DECK LID FIT

After the deck lid has been fitted

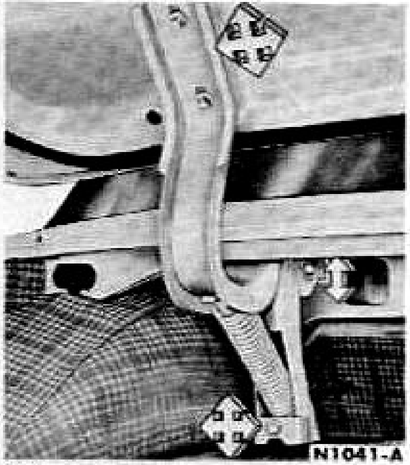


FIG. 2—Deck Lid Hinge and Adjustments

for a good exterior appearance, check the fit of the weatherstrip to the flange. Chalk the flange all the way around, and close the deck lid. Open the lid and check for a chalk mark all the way around the weatherstrip. If the chalk misses at any point, the flange should be bent to provide proper sealing.

ALIGNMENT

The deck lid can be shifted fore and aft, up and down, and from side to side as shown in Fig. 2. Care should be taken not to distort or mar the deck lid or body panel so that an unsightly appearance results.

STRIKER PLATE ADJUSTMENT

The deck lid striker plate (Fig. 3) can be adjusted up or down by loosening the bolts and moving it to the desired position. If lateral movement of the striker plate is required, it can be tilted slightly to obtain free operation of the lock.

FIG. 3—Deck Lid Striker Plate Adjustment

PART 14-2 LOCKS

1 DOOR LOCKS

The door locking mechanism (Fig. 1) consists of the door lock and rotor, lock cylinder, inside and outside handles, striker plate, and the linkage connecting these parts. Improperly aligned doors cause the major portion of lock failures by putting excessive strain on the striker plate and rotor. **Do not attempt to correct door misalignment with a striker plate adjustment.**

LUBRICATION

The accessible parts of the locking mechanism should be lubricated periodically, as shown in Part 17-2. Lubricate these points as follows:

1. Striker plate and nylon sliding block contact surfaces—apply stainless Stick Wax lubricant.

2. Lock rotor—apply Stick Wax to the rotor teeth. Apply one or two drops of fine oil to the rotor bearing.

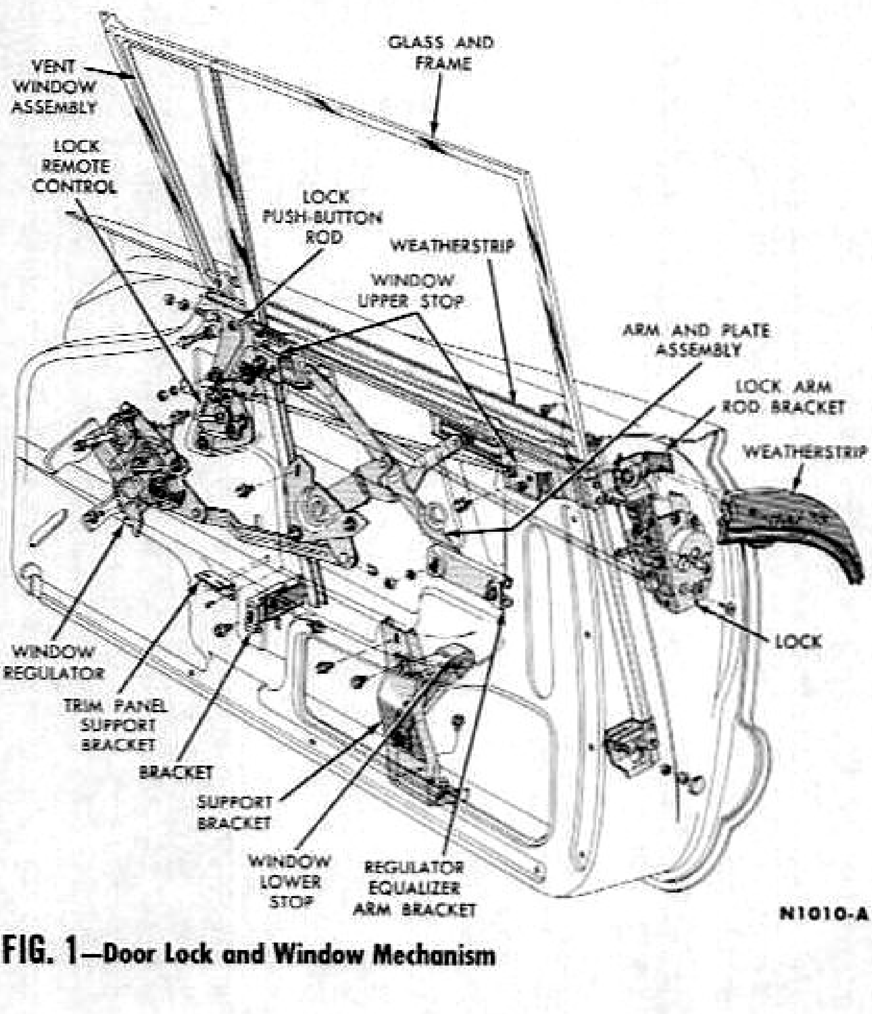


FIG. 1—Door Lock and Window Mechanism

FIG. 2—Lock Cylinder Removal

3. Lock cylinder—apply three or four drops of lock lubricant.

The parts of the lock mechanism on the inside of the door are lubricated at assembly and require no further attention. However, if it is necessary to repair or replace some part of the lock mechanism, Lubriplate should be applied to all new moving parts and to the related parts within the door. While the trim panel is off, the window regulator mechanism should also be lubricated.

DOOR LOCK REPLACEMENT

1. Raise the door glass, and remove the door trim panel. Loosen the plastic water shield enough to reveal the access holes.

2. Move aside the weatherstrip adjacent to the lock cylinder, remove the lock cylinder retainer (Fig. 2), and remove the lock cylinder assembly. Disconnect both of the remote con-

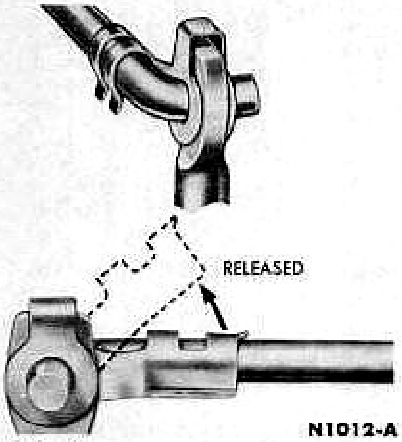


FIG. 3—Remote Control Rod Clips

trol assembly rod retaining clips (Fig. 3) and disconnect the rods from the lock assembly (Fig. 4).

3. Remove the door lock assembly retaining screws and remove the lock assembly from the door.

4. Position the lock assembly in the door panel and install the retaining screws. Position the lock remote control assembly rods and install the retaining clips (Fig. 3).

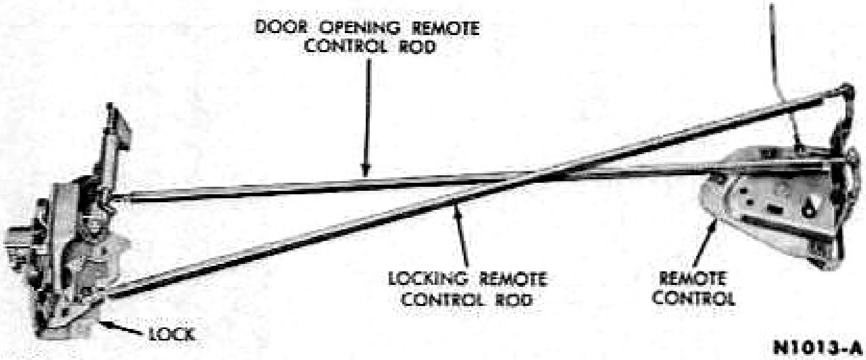


FIG. 4—Door Lock Mechanism

5. Position the lock cylinder in the door panel and install the lock cylinder retainer. Cement the door weatherstrip in place.

6. Check the door lock mechanism for ease of operation and adjust as required. Install the plastic water shield on the door panel with M-2G17-A cement, and install the trim panel and hardware.

DOOR LOCK REMOTE CONTROL REPLACEMENT

1. Raise the window to the closed position, remove the door trim panel, and loosen the plastic water shield enough to reveal the lower access hole and the remote control rod access hole.

2. Reach through the remote control rod access hole and disconnect the two remote control rods which connect to the door lock.

3. Remove the vent assembly lower retaining bracket bolt from the door panel. Remove the three screws retaining the remote control assembly. Push the lock remote control shaft into the door panel and remove the remote control.

4. If the lock remote control is to be replaced, transfer the push button rod to the new remote control. Position the lock remote control in the door and loosely install the three retaining screws.

5. Connect the rod (with the bend toward the outside of the car) to the lower arm of the remote control (Fig. 4). Then, install the remaining rod. Install the vent assembly lower retaining bracket bolt in the door panel.

6. Tighten the lock remote control retaining screws. Install the plastic water shield (M-2G17-A cement), the door trim panel, and the hardware.

STRIKER PLATE ADJUSTMENT

1. The door must be properly aligned before adjusting the striker plate. **The striker plate is not meant to correct door sag.**

2. Loosen the screws and move the striker plate **up or down** so that the level surface of the auxiliary plate is approximately 3/32 inch above the bottom of the roller (Fig. 5).

3. Scribe a pencil mark on the pillar to maintain the **up** and **down** adjustment, then move the striker plate **in** or **out** to provide a flush condition between the door and the quarter panel.

Shims must be added or removed between the striker plate and the lock pillar so that the rotor engages in the center of the striker plate teeth.

LOCK CYLINDER

When a lock cylinder is replaced, both door lock cylinders and the ignition lock cylinder should be replaced in a set. This will avoid carrying an extra key which will fit only one lock.

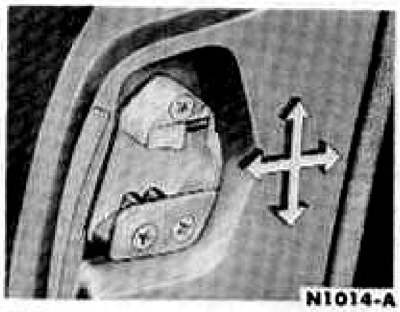


FIG. 5—Door Lock Striker Plate

The key code number is stamped on the shaft of the right hand door lock cylinder. If new keys are required, and the code number is not known, the lock cylinder can be removed to obtain the number.

REPLACEMENT

1. Move aside the weatherstrip adjacent to the lock cylinder.

2. Pull the clip out of the door far enough to release the lock cylinder (Fig. 2) and remove the lock cylinder.

3. Insert the cylinder in the door, making sure the two pins engage the holes in the lock assembly.

4. Slide the retainer clip into the door and cement the weatherstrip in place.

DOOR HANDLE REPLACEMENT

INSIDE HANDLE

1. Press the trim panel inward to expose the door handle retaining clip.

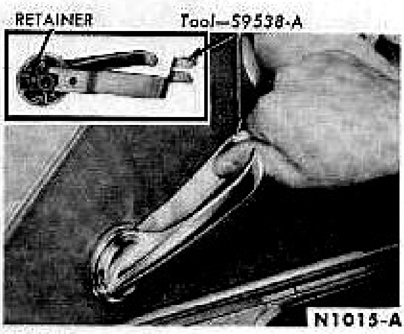


FIG. 6—Inside Door Handle Removal

Engage and remove the hairpin retaining clip with a tool similar to the one shown in Fig. 6. If the tool is not available, grind a hook on the end of a hack saw blade. The clip can be engaged and pulled out with this tool. Remove the handle, spacer, and clip.

2. Install the retainer clip in the slot on the handle. Install the handle horizontal with the body line and pointed forward. Then press the handle and spacer into position until the clip snaps into its groove on the remote control shaft.

OUTSIDE HANDLE

1. Remove the door trim panel, and loosen the plastic water shield enough to reveal the door handle access hole. Remove the door handle retaining screws (Fig. 7). Pull the handle out of the door, and remove the two pads (Fig. 8).

2. Hold the replacement handle assembly and pads in position on the door and check the free travel of the outside push button. The free travel distance should be approximately 1/16 inch. Tighten the nut locking the release pin in position.

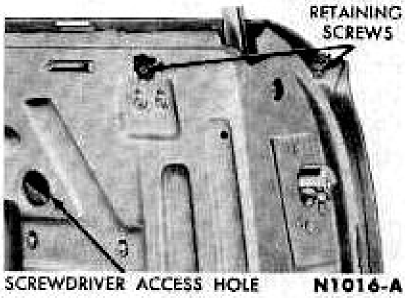


FIG. 7—Outside Door Handle Removal

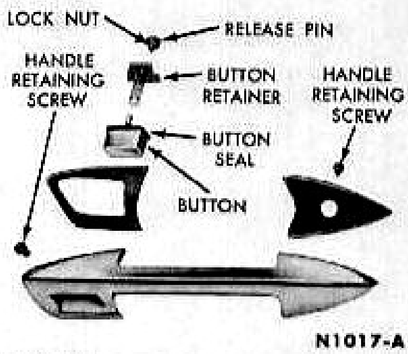


FIG. 8—Outside Door Handle

3. Install the pads and the door handle on the door. Check the free travel of the push button to insure a slight gap between the release pin and the lock release arm to prevent pre-loading of the lock mechanism. Install the door handle retaining screws.

4. Fasten the plastic water shield to the door inner panel with M-2G-17-A cement. Install the trim panel and hardware.

2 DECK LID LOCK

DECK LID LOCK CYLINDER REPLACEMENT

To replace the deck lid lock cylinder and sleeve, remove the nuts retaining the deck lid ornament, and remove the nut, washer, and spacer from the lock cylinder and remove the assembly (Fig. 9).

To remove the lock cylinder from the sleeve, turn the key 1/8 turn clockwise from the locked position, and push the release pin down with a small punch. Pull the key and cylinder out of the sleeve.

When installing the cylinder in

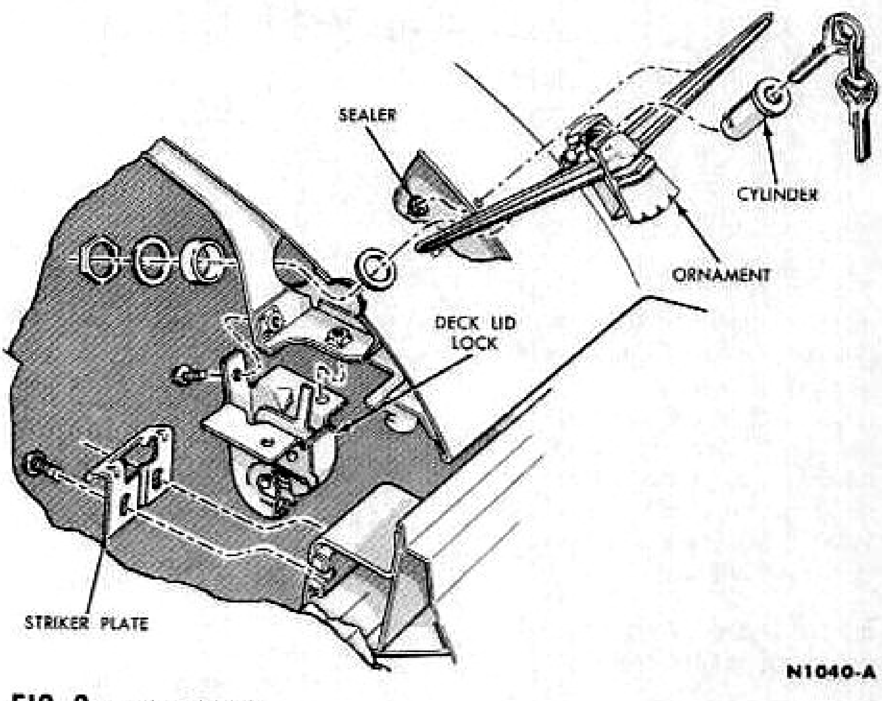


FIG. 9—Deck Lid Lock

the sleeve, turn the key in the cylinder ⅛ turn clockwise from the locked position, and insert the cylinder in the sleeve.

DECK LID LOCK REPLACEMENT

Remove the three lock retaining bolts and remove the lock (Fig. 9).

The lock is not adjustable in the deck lid. Positioning of the striker in relation to the lock is accomplished entirely at the striker plate.

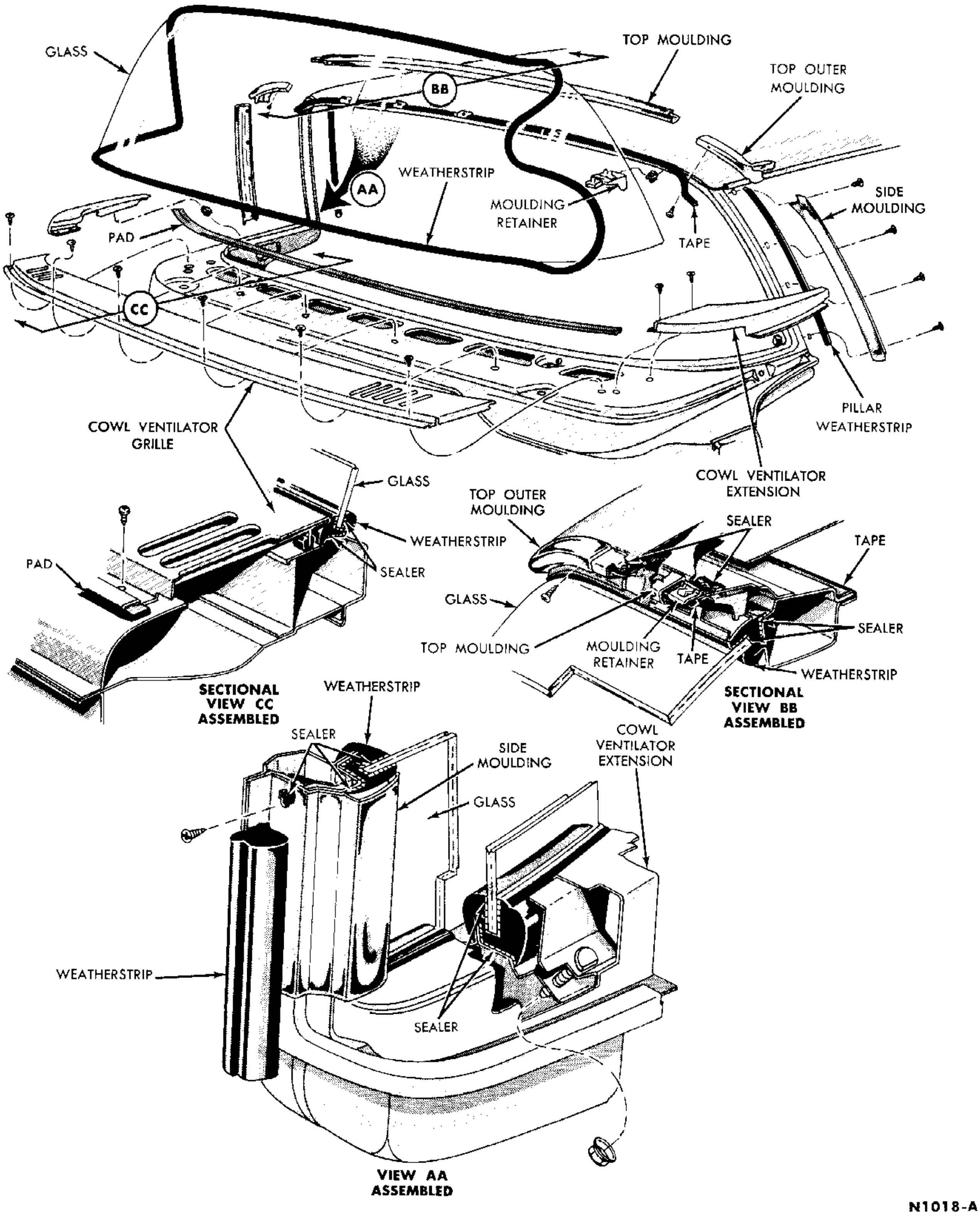


FIG. 1—Hardtop Model Windshield and Exterior Mouldings

PART 14-3 WINDOWS

1 WINDSHIELD AND BACK WINDOW

WINDSHIELD REPLACEMENT

1. Remove the sun visor brackets, windshield garnish mouldings, instrument panel extensions, and the rear view mirror bracket.

2. Remove the windshield wiper arms, the wiper pivot shaft cover plates, and the cowl ventilator grille.

3. Remove the windshield outer side mouldings (Fig. 1). Remove the two ventilator grille extensions.

4. Remove the windshield top outer mouldings, and remove the top moulding on a hardtop model by prying downward and outward with a long screwdriver (Fig. 2).

5. From inside the car, loosen the weatherstrip from the windshield opening flange, and push the windshield and weatherstrip assembly out of the opening.

6. Remove the weatherstrip from the glass.

7. After cleaning the old sealer from the windshield opening flange, the glass, and the weatherstrip, apply rubber cement to the weatherstrip in the groove for the glass, and install the weatherstrip on the windshield glass.

8. Apply a heavy bead of caulk and sealer (B6A-19563-B) all around the windshield opening flange.

9. After coating the weatherstrip mounting surfaces with RuGlyde, install a draw cord in the weatherstrip groove and overlap the cord about 18 inches at the top center.

10. After positioning the windshield assembly in the opening (with a helper applying pressure from the outside), pull the weatherstrip over the flange with the draw cord. Go across the top and around each lower corner first, then finish at the bottom center of the windshield.

11. With a sealer gun, apply a bead of caulk and sealer (B6A-19563-B) between the weatherstrip and the glass.

12. On a hardtop-model, position the top edge of the windshield top moulding, and press the bottom edge into each of the five retaining clips. Install the top outer mouldings and the side mouldings.

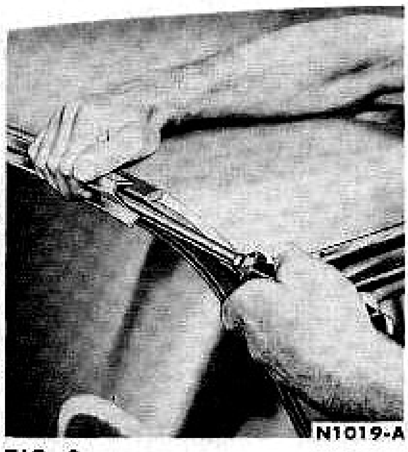


FIG. 2—Windshield Moulding Removal

13. Apply body sealer (M-5397-B) to the holes for the cowl top ventilating extension retaining bolts and install the right and left extensions.

14. Cement the cowl pad to the cowl with trim cement and install the cowl top ventilator assembly. Install the right and left wiper shaft cover plates.

15. Apply rubber cement to the body right and left front pillar and install the weatherstrip.

16. Install the windshield upper and lower center garnish mouldings, the lower extension garnish mouldings and the instrument panel extensions.

17. Install the windshield side garnish mouldings, the rear view mirror, and the sun visor assemblies.

18. Test the windshield for water leaks and seal as necessary. Install the wiper arms and blades.

BACK WINDOW REPLACEMENT

1. Remove the five screws retaining the upper outside moulding and remove the moulding (Fig. 3).

2. Remove the back window outer side moulding retaining screws from each side moulding and remove the mouldings.

3. Open the deck lid, remove the five window outer back panel attaching bolts, and remove the back panel.

4. Remove the three package tray retaining screws, and remove the two attaching clip retainer nuts and clips. Remove the two weatherstrip retainers from the outer bottom edge of the back window.

5. Remove the window center inside moulding cap retainer screw and remove the moulding.

6. Remove the left and right inside moulding retainer screws and remove the mouldings. Remove the package tray panel.

7. From the inside, loosen the weatherstrip at the flange, and push the window and weatherstrip assembly out of the opening.

8. Remove the weatherstrip from the glass. Clean the old sealer from the weatherstrip and the back window body flange.

9. Apply caulk and sealer (B6A-19563-B) to the back window opening flange and at the holes for the attaching clips.

10. Apply rubber cement to the weatherstrip in the groove for the glass, and position the weatherstrip on the glass.

11. Apply RuGlyde to the flange area of the weatherstrip, and install a draw cord in the flange crevice with about a 12 inch overlap at the top center.

12. Position the glass assembly in the opening, have a helper apply pressure on the outside, and pull the weatherstrip over the flange with the draw cord. Alternate from side to side when pulling the draw cord to keep the installation even.

13. Install the two weatherstrip retainers at the outer bottom edge of the back window. Position the left

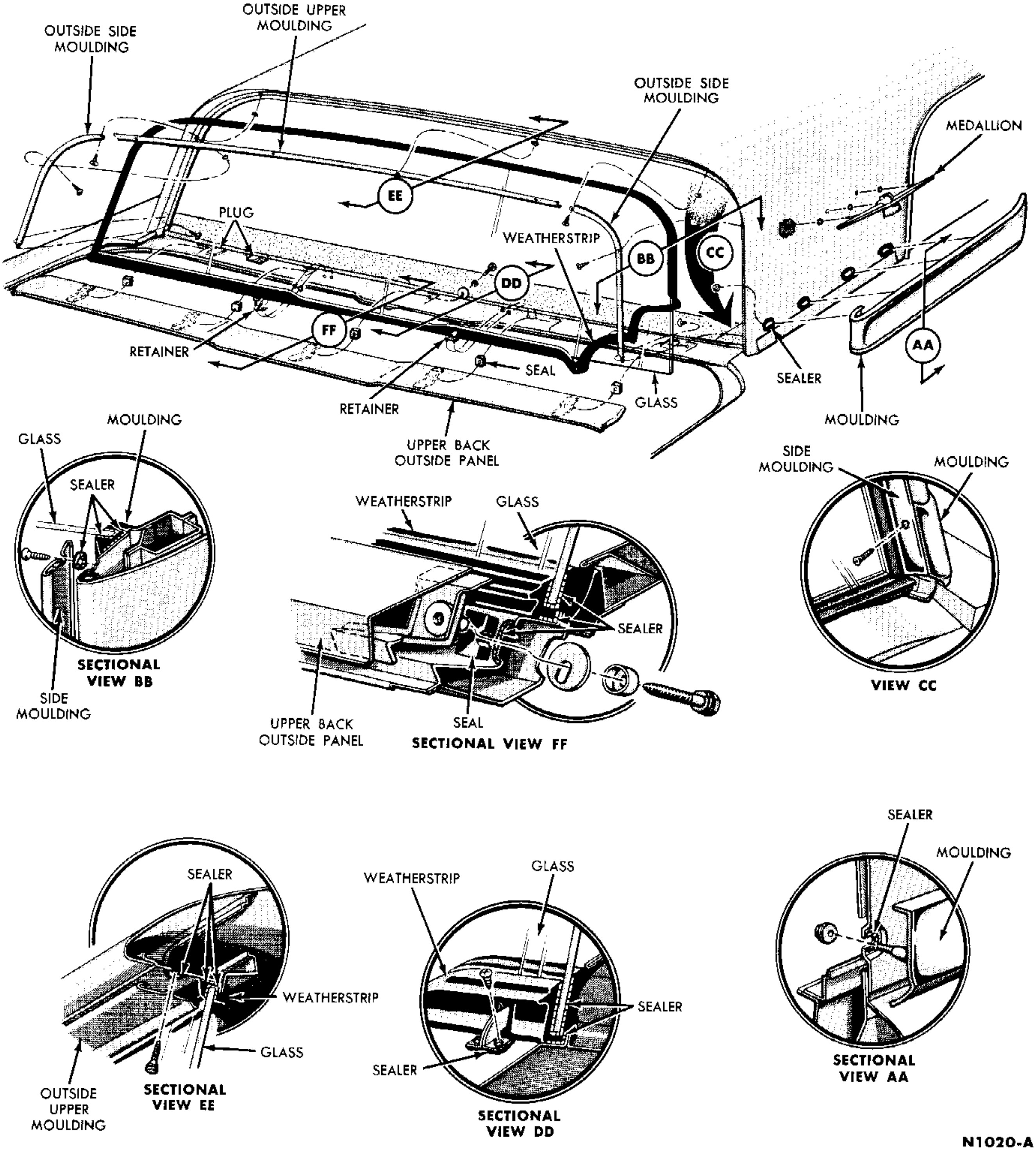


FIG. 3—Back Window and Exterior Mouldings

and right outer side mouldings and the belt moulding retainer clips and install the attaching screws. Install the upper outside moulding.

14. Position the package tray, install the retainer screws, and the attaching clips with retainer nuts. Position the window outside back panel and install the attaching bolts.

15. Position the left and right inside moulding and install the retainer screws. Position the inside cap moulding and install the retainer screw. Check the window for water leaks and seal as necessary.

2 DOOR WINDOW AND REGULATOR

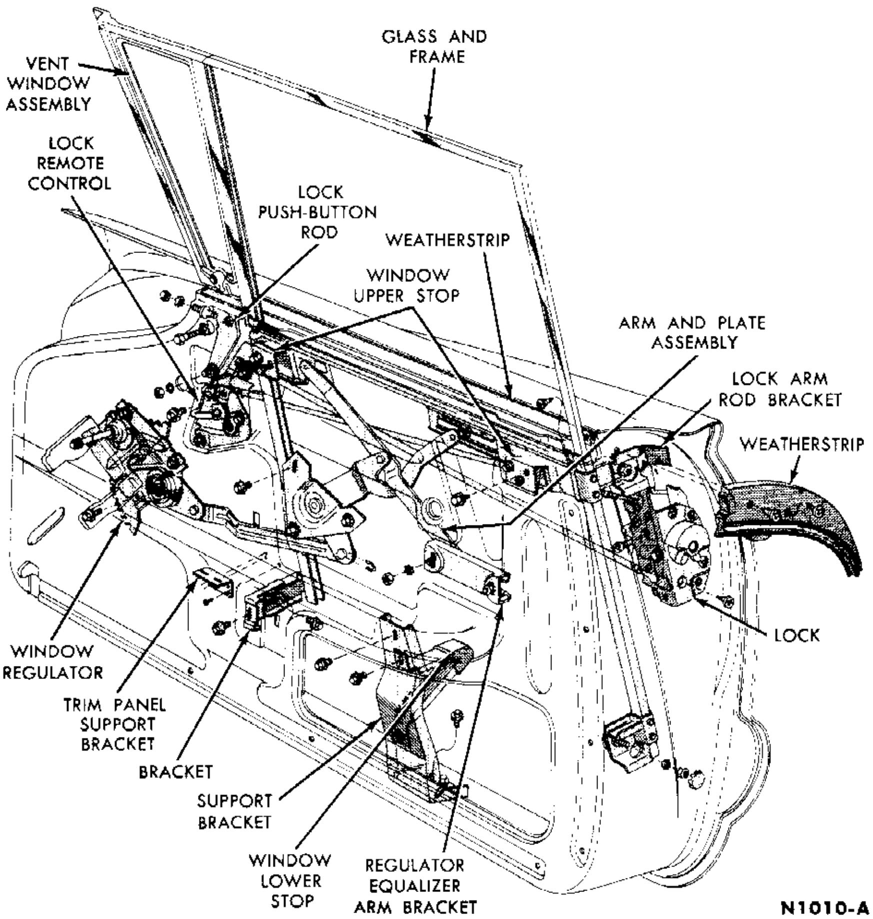


FIG. 4—Door Lock and Window Mechanism

WINDOW REPLACEMENT

1. Remove the lock and window regulator handles. Unscrew the lock push button, and remove the arm rest and the trim panel. Loosen the plastic water shield enough to reveal the access holes.

2. Disconnect the regulator arms from the glass channel roller assembly by pulling the roller clip out far enough to release the regulator arm pin (Fig. 7). By doing this, the roller assembly will remain intact and will not have to be reassembled.

3. Remove the window upper stops. Remove the three screws retaining the outer weatherstrip at the upper rear corner of the door and remove the weatherstrip.

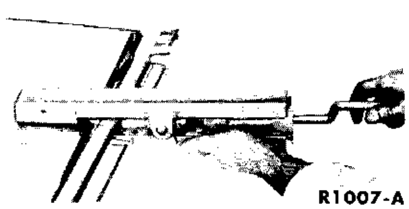


FIG. 5—Remove or Install Glass Channel

4. Loosen the rear run adjusting nut and remove the window assembly.

5. Remove the glass frame, the glass channel (Fig. 5), and the glass tape.

6. Install the glass channel on the glass (Fig. 5), using new glass tape. Trim the excess tape. Install the glass frame and the glass channel roller assembly (Fig. 7) if it was removed.

7. Position the door glass assembly in the door. Install the regulator arm pins in the roller assemblies. Install the window upper stops and adjust the window assembly (Fig. 6).

8. Apply rubber cement to the door outer weatherstrip, position the weatherstrip on the door, and install the retaining screw.

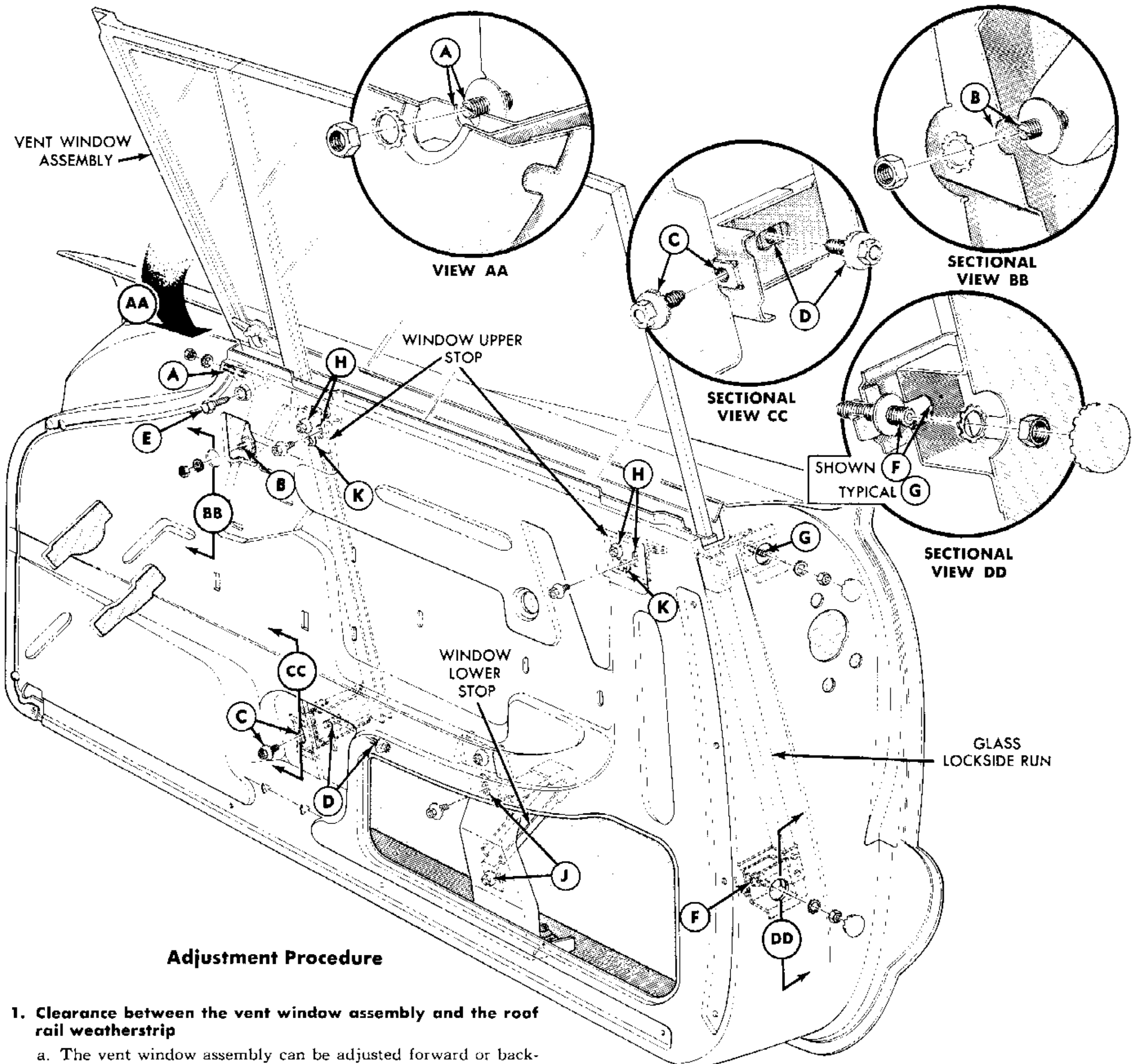
9. Install the plastic water shield with M-2G17-A cement. Install the trim panel, the arm rest, and the hardware.

REGULATOR REPLACEMENT

1. Remove the trim panel and loosen the plastic water shield enough to reveal the access holes.

2. Block the window in the raised position. Remove the regulator assembly arm retaining clip at the arm and plate assembly and remove the regulator arm from the plate assembly (Fig. 4).

If the arm and plate assembly must be removed, lower the window and disconnect the arms from the two glass roller assemblies. Then remove the arm and plate assembly retaining



Adjustment Procedure

1. **Clearance between the vent window assembly and the roof rail weatherstrip**
   a. The vent window assembly can be adjusted forward or backward at points "**A**", "**B**" and "**C**", after loosening the screw at point "**E**". The adjusting screws "**A**" or "**B**" can be rotated clockwise or counterclockwise as required.
   b. The vent window assembly can be adjusted to tilt toward the inside or outside of the body at points "**B**" and "**D**", after loosening points "**A**" and "**E**".

2. **Clearance between the door window assembly, the roof rail weatherstrip, and the forward edge of the quarter window**
   The following adjustments are performed with the window in the up position:
   a. The door window assembly can be adjusted forward or backward at points "**F**" and "**G**" by rotating the adjusting screws clockwise or counterclockwise as required.
   b. The door window assembly can be adjusted to tilt toward the inside or outside of the body at points "**F**" and "**G**" after loosening the locknuts.
   The vent window assembly must be readjusted simultaneously to obtain this adjustment.

3. **Clearance between the door window assembly and the roof rail weatherstrip**
   The window front and rear upper stops can be adjusted up or down at points "**H**" as required. After adjusting the stops, secure each stop in position by drilling a hole and installing a lockscrew in the approximate location of points "**K**".

4. **To level the top of the window at the belt line**
   Adjust the window lower stop up or down at points "**J**" as required. This adjustment is performed with the window assembly in the down position.

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FIG. 6—Door Window Adjustments

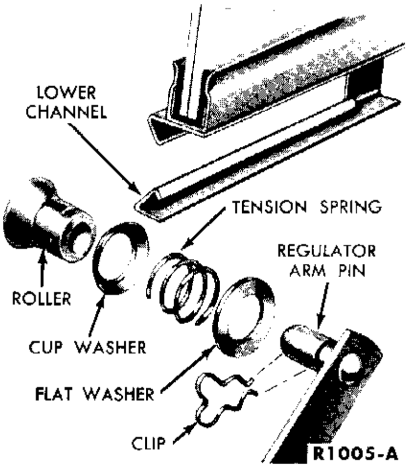


FIG. 7–Glass Channel Roller Assembly

screws and remove the assembly. This can be done without removing the regulator or the door glass.

3. Remove the regulator assembly retaining screws and remove the regulator assembly.

4. Position the window regulator assembly in the door panel and install the retaining screws.

If the arm and plate assembly was removed, install the assembly in the door, and connect the arms to the glass channel roller assembly.

5. Position the regulator arm on the arm and plate assembly and install the retaining clip. Remove the window block.

6. Install the plastic water shield with M-2G17-A cement. Seal the water shield holes with caulk and sealer (B6A-19563-A). Install the trim panel, the arm rest, and the hardware.

3 VENT WINDOW

REPLACEMENT

1. Unscrew the door lock push button, remove the lock and window regulator handles, and remove the trim panel.

2. Loosen the water shield enough to reveal the access holes.

3. Remove the three vent adjusting nut cover plate retaining screws and remove the cover (Fig. 4). Then remove the vent adjusting nut at the upper front of the door.

4. Remove the vent window assembly adjusting bolt at the lower end of the door pillar. Then remove the vent window assembly retaining bolt located below the vent window lock.

5. Remove the screw that retains the vent window lower bracket to the vent window assembly.

6. Remove the vent window weatherstrip retaining screw and loosen the weatherstrip from the vent window assembly.

7. Disconnect the arm and plate assembly arms from the glass channel rollers by pulling out the spring clips. **Pull the roller clip out just far enough to release the arm pin.**

8. Remove the upper window stops. From the upper rear edge of the door, remove the three screws that retain the door outer weatherstrip.

9. Loosen the rear run adjusting nut and remove the door window assembly.

10. Lift out the vent window assembly.

11. Position the vent window assembly in the door and install the retaining bolt below the vent window lock.

12. Install the vent assembly adjusting screw locknut at the upper front of the door. Then, install the vent assembly adjusting bolt at the lower end of the door pillar.

13. Position the vent window lower bracket and install the retaining screw.

14. Position the door glass assembly in the door and connect the arm and plate assembly arms in the rollers. Then install and adjust the upper window stops (Fig. 6).

15. Adjust the door and vent window assemblies and tighten the adjusting screws and nuts (Fig. 6).

16. Position the vent assembly front adjusting nut cover plate and install the retaining screws.

17. Apply rubber cement to the vent window weatherstrip, position the weatherstrip, and install the retaining screw.

18. Apply rubber cement to the door upper rear weatherstrip, and install the weatherstrip and retaining screws.

19. Install the water shield over the access holes with M-2G17-A cement. Seal the holes in the water shield with caulk and sealer (B6A-19563-A). Install the door trim panel.

4 QUARTER WINDOW AND REGULATOR

REPLACEMENT

1. Remove the rear seat cushion, seat back, arm rest, window regulator handle, garnish moulding, and trim panel. Remove the two garnish moulding retainers.

2. Remove the plastic water shield enough to reveal the access hole.

3. Disconnect the window regulator arms at the roller assemblies (Fig. 7). **Pull the hairpin clip from the roller assembly just far enough to release the regulator arm pin. By doing this, the roller assembly will remain intact and will not have to be reassembled.**

4. Remove the quarter window stop retaining nuts and washers, and remove the window stop (Figs. 8 and 9).

5. Remove the two cap screws and remove the guide button retainer.

6. Remove the regulator front locknuts and washers at the window glass assembly.

7. Remove the locknut and washer from the lower end of the front guide assembly. Remove the front run assembly from the quarter panel.

8. Remove the window assembly from the quarter panel. If the glass requires replacement perform steps as follows:

a. Remove the glass from the glass channel and frame assembly (Fig. 5).

b. Install the glass retaining strip, install the glass in the lower channel, and install the frame assembly. If the window regulator doesn't require replacement omit steps 9 and 10 and proceed with steps 11 thru 17.

9. Remove the window regulator retaining bolts and remove the regulator thru the access hole in the quarter panel.

10. Position the regulator in the quarter panel and install the retaining bolts.

11. Install the roller assembly in the glass frame, if necessary, and install the glass in the quarter panel.

12. Install the front run assembly and connect the regulator arms to the quarter glass assembly.

13. Install the guide button retainer in the glass assembly. Install the quarter window stop. Adjust the quarter window (Fig. 9).

14. Install the garnish moulding retainers, plastic water shield, and quarter trim panel.

15. Install the arm rest, garnish moulding, regulator handle, rear seat back, and seat cushion.

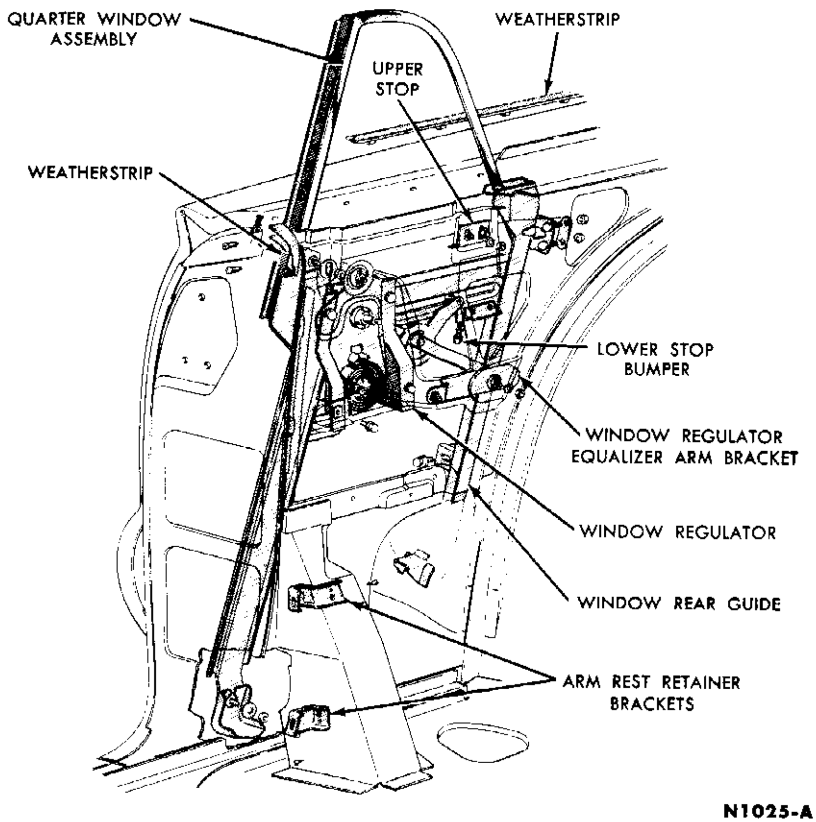
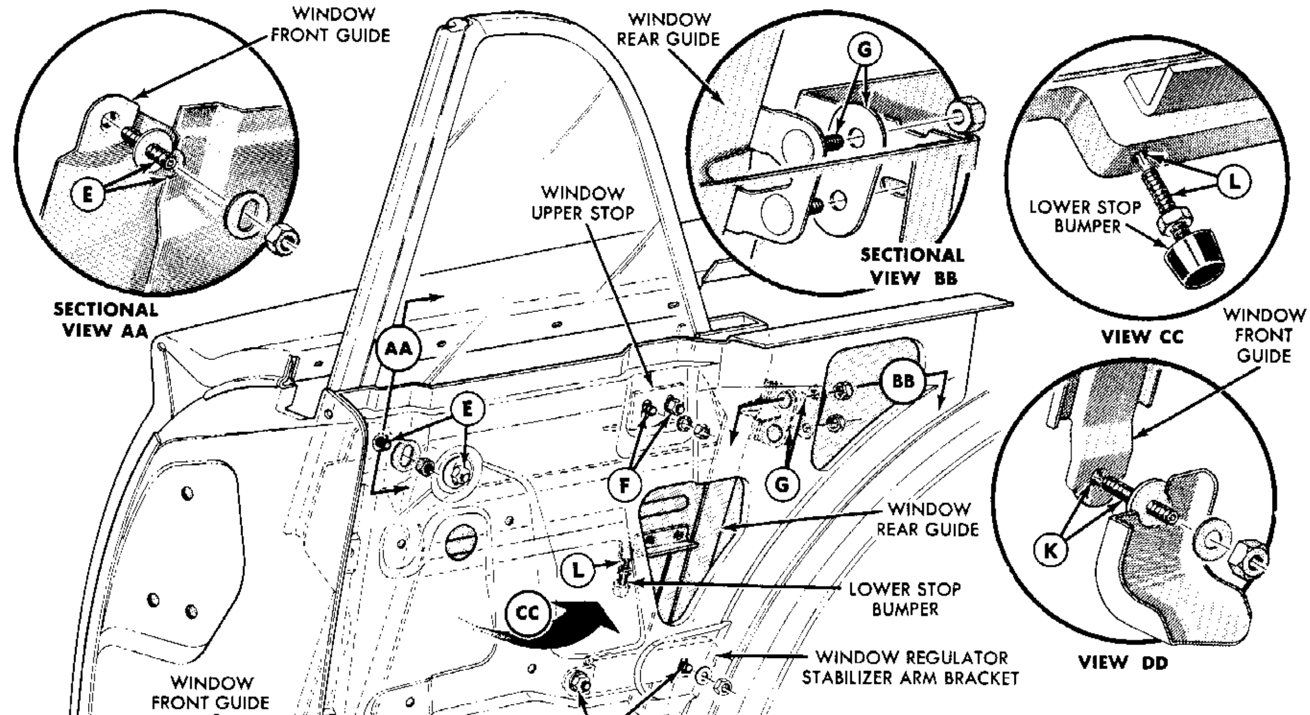
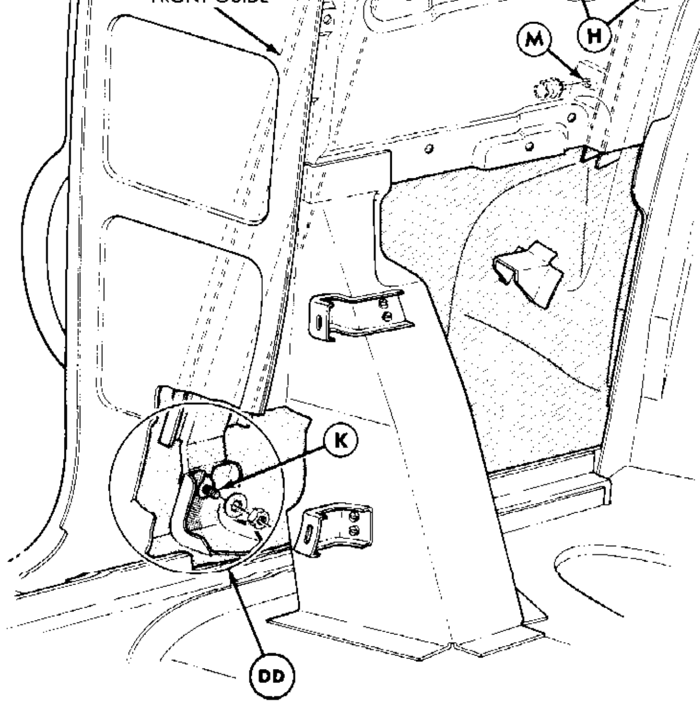


FIG. 8—Quarter Window Mechanism





Adjustment Procedure

1. Clearance between the quarter window assembly, the rear edge of the front door window, and the roof rail weather-strip

The following adjustments are performed with the window in the up position:

a. The window can be adjusted toward the inside or outside of the body at points "E" and "K" by rotating the screws clockwise or counterclockwise.

b. The window assembly can be adjusted up or down at points "E" and "K" after loosening the locknuts.

2. Clearance between the quarter window assembly and the roof rail weatherstrip

The following adjustments are performed with the window in the up position:

a. The window assembly can be adjusted toward the inside or the outside of the body at points "G" and "M" after loosening the locknuts.

b. The front guide assembly must be readjusted simultaneously for proper window alignment.

3. Clearance between the quarter window assembly and the rear edge of the front door window assembly

The following adjustment is performed with the window in the up position:

Move the window regulator stabilizer arm up or down at points "H" after loosening the locknuts.

4. Clearance between the quarter window assembly and the roof rail weatherstrip

Adjust the upper window stop up or down at point "F".

5. To level the quarter window assembly at the belt line

Adjust the lower stop bumper up or down at point "L". This adjustment is performed with the window in the down position.

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FIG. 9–Quarter Window Adjustments

5 POWER WINDOWS

OPERATION

Power to operate the windows is supplied from the battery terminal of the starter relay (Fig. 10). The lead wire from the starter relay goes to the window relay mounted on the engine side of the cowl panel. One lead from the window relay goes to a 30 ampere circuit breaker under the instrument panel mounted on the left air intake duct. The other lead from the window relay is connected to the accessory terminal of the ignition switch. When the ignition switch is turned on, current flows from the switch to the window relay causing its relay contacts to close, thus providing current through the 30 ampere circuit breaker to the window control switches.

As the window relay is actuated through the accessory terminal of the ignition switch, the windows can only be operated when the ignition switch is in the ON or ACC position.

When a control switch is actuated, current is supplied to one of the motor field coils and to the motor armature. The motor will turn in either direction, depending on which field coil is energized. The circuit is completed by grounding the field coil and armature through a 15 ampere circuit breaker.

Each motor has its own ground circuit breaker. For the front door window motors, these circuit breakers are mounted under the instrument panel. They are grounded through the mounting bolt. The circuit breakers for quarter window motors are mounted to the floor panel near the quarter panel and ground through a mounting bolt.

TROUBLE SHOOTING

The troubles given here are those most commonly encountered in the power window system. Before making any of the checks, make sure the battery is fully charged, and turn the ignition switch to the accessory position.

ALL WINDOWS DO NOT OPERATE

1. Connect a voltmeter from the power terminal (yellow wire) of the power window relay to ground (Fig. 10). If there is no voltage at this terminal, continue steps 2 and 3. If there is voltage at this terminal, skip to step 4.

2. Connect a voltmeter from the battery terminal of the window relay to ground. If there is no voltage at this terminal, repair or replace the lead wire from the starter relay to the relay.

3. Connect a voltmeter from the ignition terminal (red wire) of the window relay to ground. If there is no voltage at this terminal, repair or replace the ignition switch or the wire (red) from the ignition switch to the relay. If voltage is available at both the red and black wire terminals, replace the relay.

4. Under the left side of the instrument panel, find the 30 ampere circuit breaker which is mounted on the air intake duct. It will have one red-blue band wire on one terminal and one yellow wire on the other terminal. Connect a voltmeter from the terminal with the red-blue wire to ground. If there is no voltage, check the other terminal. If there is voltage at the yellow wire terminal, but none at the red-blue band wire terminal, replace the circuit breaker. However, if there is no voltage at the yellow wire terminal, repair or replace the yellow wire from the circuit breaker to the power window relay.

5. At the window control switches, connect a voltmeter from one of the red-blue wires to ground (Fig. 10). If there is no voltage, repair or replace the red-blue wire from the 30 ampere circuit breaker.

The power window and power seat electrical systems are connected through the same 30 ampere circuit breaker. If failure occurs in all the systems at the same time, the 30 ampere circuit breaker is probably the cause.

ONE WINDOW DOES NOT OPERATE

1. Operate the switch and listen for the noise of the motor running free. If the motor is running, it is not tightly mounted and has pulled away from its rubber coupling. Remount the motor.

2. Short out the ground circuit breaker of the inoperative window, and operate the switch. If the motor runs, replace the circuit breaker.

3. Slightly loosen the wiring connection at the inoperative window switch and, using a voltmeter with test prongs, check the switch for proper operation. **Be sure to check the bus bar connection between the front and quarter window switches for voltage.** Replace the window switch if it is defective.

4. If the switch operates properly, disconnect the armature wire, which is green in color, at the motor and check it for voltage when the switch is operated. If no voltage is available, check and repair or replace the wire from the switch to the motor.

5. If voltage is available at the green wire, check the yellow and the red wires from the switch to the motor for an open circuit. Repair or replace the wires if necessary.

6. Check the black wire on the inoperative door window motor, from the motor to the circuit breaker for an open circuit. Repair or replace the wire if necessary.

7. If voltage is available at the green, yellow, and red wires, replace the motor.

WINDOW OPERATES IN ONE DIRECTION ONLY

1. Check the switch for proper operation and if defective, replace the switch.

2. If the switch operates properly, check the red and yellow wires at the motor for voltage. If voltage is available, a field coil is open and the motor must be replaced.

WINDOW OPERATES OPPOSITE TO SWITCH

When a window goes up when it should go down, the wires are crossed at the motor. Check the wires for proper installation (Fig. 10).

WINDOW OPERATES SLUGGISHLY

1. Check the regulator and window runs for binding. Adjust the runs, repair and lubricate the regulator. Lubricate the runs with silicone lubricant.

2. Check for loose connections which will cause high resistance. Make sure paint is not insulating the ground circuit breakers from the body.

3. Disconnect the motor from the regulator. Connect an ammeter in

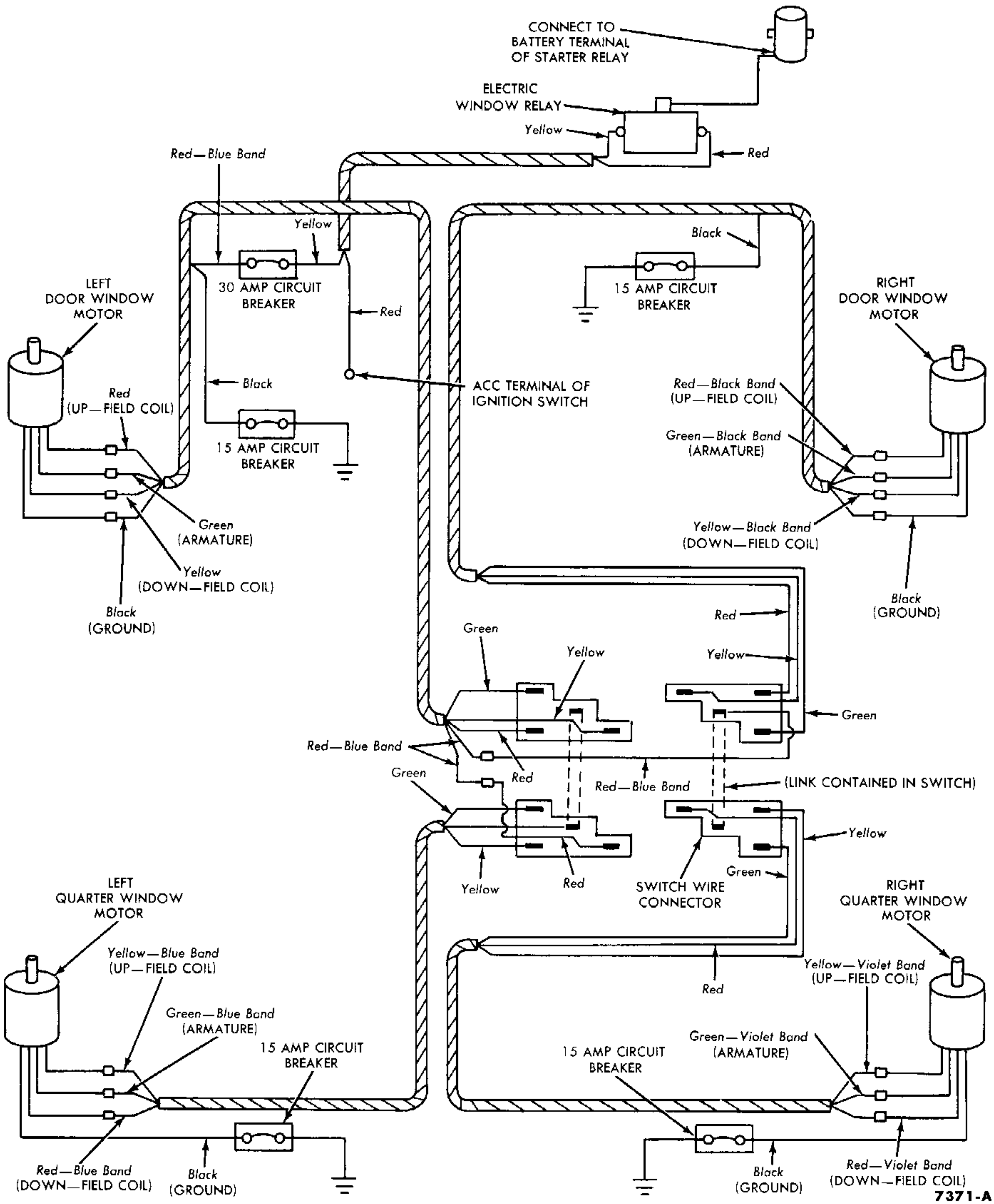


FIG. 10—Power Window Wiring System

series with the ground wire, and operate the switch. The motor no-load current draw should be 8-10 amperes at 12 volts. If the current draw is low, the motor brushes are worn or dirty and the motor must be replaced.

REGULATOR MOTOR REPLACEMENT

The power window regulator motor can be replaced without removing the entire regulator from the door or quarter panel. After the trim panel is removed, disconnect the motor wires at the bullet connectors, remove the motor mounting nuts and the motor brace, then pull the motor free of the rubber coupling.

POWER REGULATOR REPLACEMENT

To remove and install the power window regulator assembly, includ-

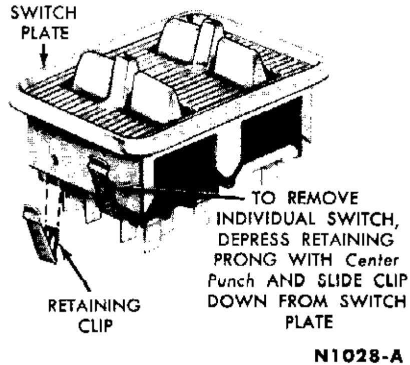


FIG. 11—Power Window Switch

ing the motor, follow the removal and installation procedures given for the manual window regulator. Connecting the wires presents no problem, as each wire is appropriately color coded.

If the regulator arm tension spring or the drive gear are the only parts of the regulator requiring replacement, they are easily replaced after the regulator assembly is removed.

CONTROL SWITCH REPLACEMENT

When a control switch requires replacement, snap out the control switch panel, containing the four window switches. Pull off the two wire connectors from the side containing the defective switch, and remove the bus bar connecting the two switches. Press a small punch into the hole on the side of the switch housing and slide the retaining clip from the housing (Fig. 11). This will release the switch from the cover plate. Remove the switch.

To install the switch, press the switch into the plate and slide the retaining clip into position. Install the switch bus bar and the wire connectors. Then, press the switch assembly into the console opening.

GROUP 15

INTERIOR TRIM, SEATS, HOOD, AND GRILLE

PART 15-1 INTERIOR TRIM

1 DOOR AND QUARTER TRIM PANELS

DOOR TRIM PANEL REPLACEMENT

1. Remove the control handles (Fig. 1), the arm rest screws, the corner mouldings, and the lower panel retaining screws (Fig. 2).

2. Remove the lock push button (Fig. 2). Then, pry the trim panel retaining clips out of the door inner panel with a putty knife or screwdriver, and remove the trim panel.

3. Transfer the trim panel retaining clips to the new trim panel. Install the trim panel and press the retaing clips into the door panel.

4. Insert the interior handle retaining clip in the handle, place the plate against the trim panel with the prongs facing the trim panel, and push the handles until the clip snaps into the groove.

Door handles should be horizontal and pointing forward. Window handles should be horizontal and pointing forward with the window in the raised position.

5. Install the lock push button, the panel retaining screws, the corner mouldings, and the arm rest screws.

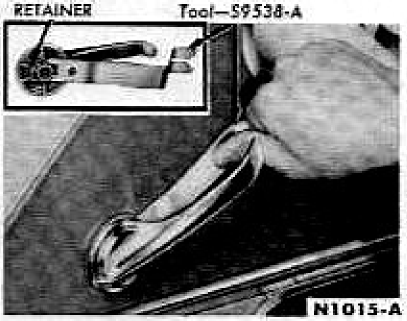


FIG. 1—Inside Door Handle Removal

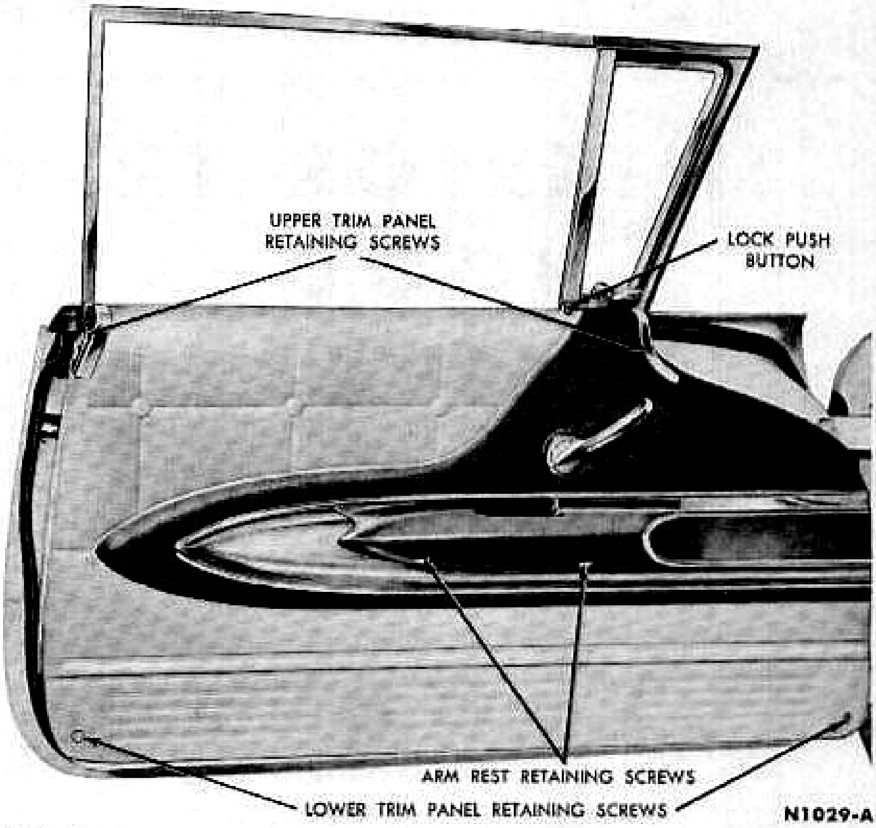


FIG. 2—Door Trim Panel

QUARTER TRIM PANEL REPLACEMENT

1. Remove the rear seat cushion from the car. Remove the rear seat back, the six quarter panel arm rest retaining screws and remove the arm rest.

2. Remove the quarter window regulator handle retaining clip and remove the handle.

3. Remove the two garnish moulding retaining screws, slide the moulding forward to clear the retaining clips, and remove the moulding. Then pry the trim panel retaining clips out of the inner panel with a putty knife and remove the trim panel.

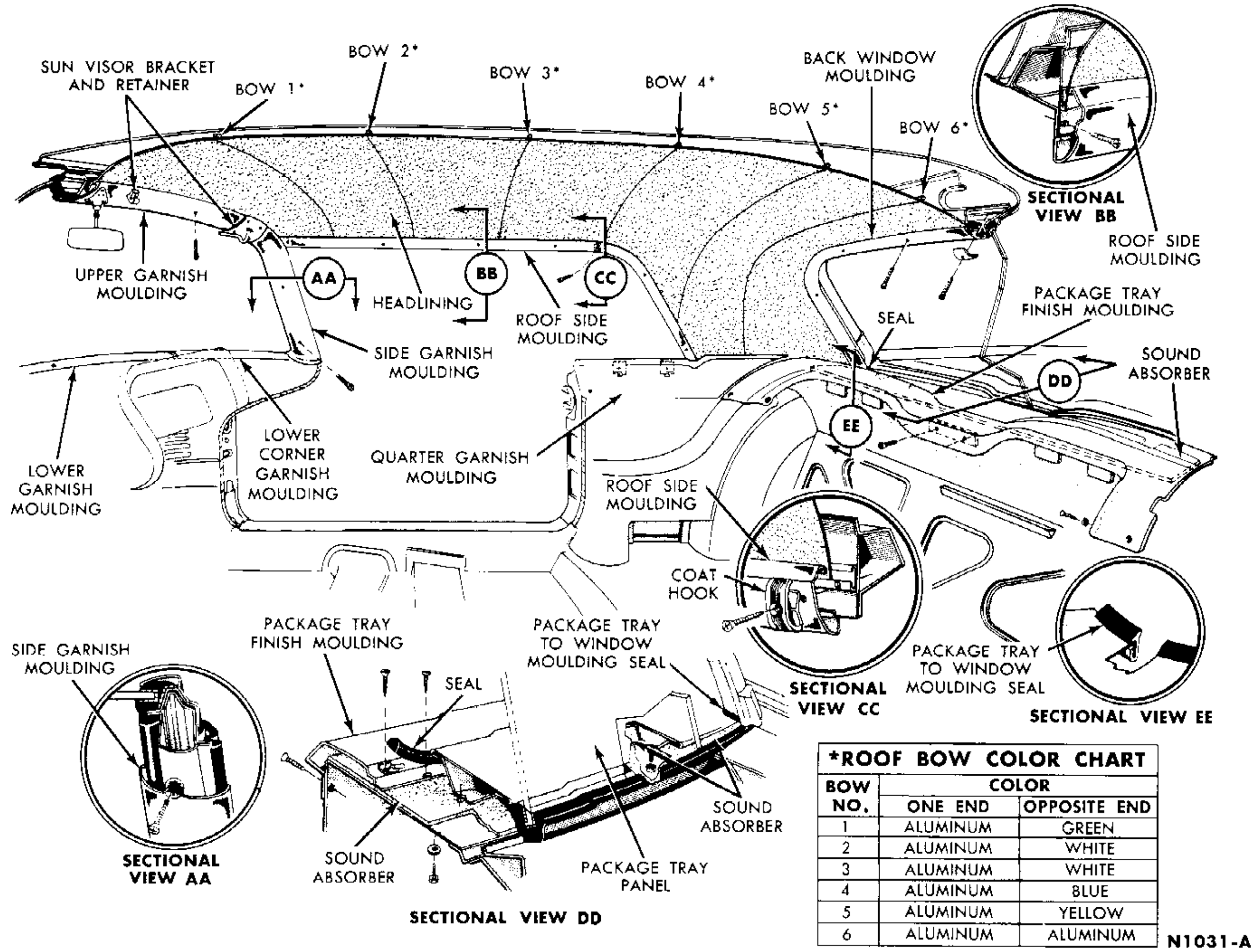
4. Install the trim panel, arm rest, garnish moulding retainers, and garnish moulding.

5. Insert the handle retaining clip in the handle, place the escutcheon assembly against the trim panel, and push the handle onto the shaft until the retaining clip snaps into the groove.

The quarter window regulator handle should be horizontal and pointing rearward with the window in the raised position.

6. Install the rear seat back and the rear seat cushion.

2 HEADLINING



***ROOF BOW COLOR CHART**

BOW NO.	COLOR ONE END	COLOR OPPOSITE END
1	ALUMINUM	GREEN
2	ALUMINUM	WHITE
3	ALUMINUM	WHITE
4	ALUMINUM	BLUE
5	ALUMINUM	YELLOW
6	ALUMINUM	ALUMINUM

FIG. 3—Roof Interior Mouldings

REPLACEMENT

1. Remove the rear view mirror, the sun visor assemblies, and the windshield side and upper garnish mouldings (Fig. 3). Pull the staples out of the windshield header tacking strip and loosen the headlining (Fig. 4).

2. From inside the luggage compartment, remove the three metal screws and washers and the two nuts and washers retaining the package tray panel.

3. Remove the rear seat cushion and the seat back. Remove the rear window garnish mouldings. Then pull the staples out of the rear window tacking strip and loosen the headlining.

4. Remove the package tray panel, Remove the package tray trim moulding retaining screws and remove the moulding.

5. Remove the quarter window garnish mouldings. Remove the coat hooks and the roof interior side mouldings. Then remove the dome light assembly and disconnect the light wires. Tape the dome light wires to prevent a short circuit.

6. Pull the staples out of the roof side tacking strip and loosen the headlining.

7. Starting at the front of the car, push the ends of the roof bows out of the side rails. At the rear bow, release the two rear bow retainers from the roof rear rail.

8. If a new headlining is to be installed, lay both the old and new headlinings on a clean work table and transfer the roof bows in sequence to the new headliner listings.

Roof bows are color coded at each end. When ordering new roof bows, be sure to note the color at each end of the bow (Fig. 3).

9. Install the rear bow in the side rails, and hook the two rear bow retainers to the bow and the roof rear rail.

10. Install the other roof bows, working from the rear toward the front of the car.

11. The headlining should be centered and the seams straight. Pull the headlining forward tight enough to remove all wrinkles, and staple the headlining to the windshield header tacking strip, starting at the center and working toward the sides. Cut off the excess material.

12. Staple the headlining around the rear window, starting at the center and working toward the sides, Pull the headlining just tight enough to remove the wrinkles. Cut off the excess material around the rear window.

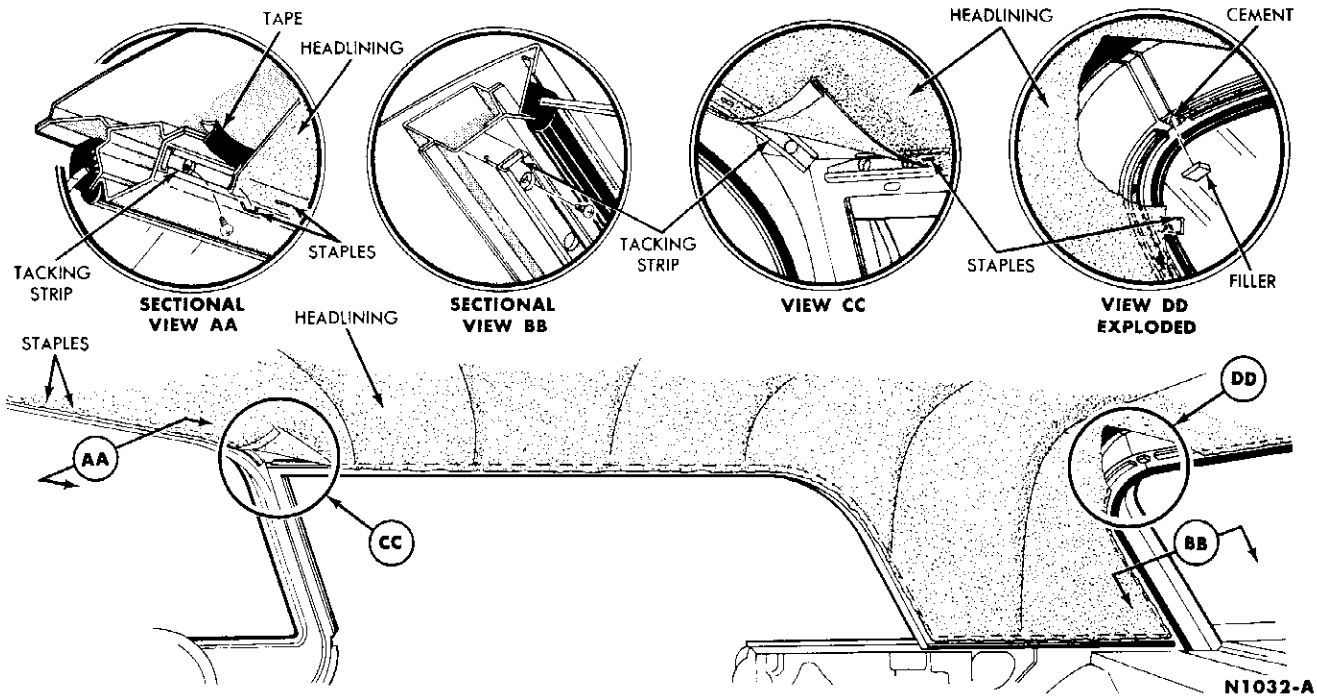


FIG. 4—Roof Interior Trim

13. Staple the headlining to the roof side tacking strip. Pull the headlining just tight enough to remove wrinkles. Cut off the excess headlining.

14. Install the roof interior side mouldings, coat hooks, and quarter window garnish mouldings.

15. Install the package tray trim moulding. Place the package tray panel in position and install the rear window garnish mouldings. From inside the luggage compartment, install the package tray retaining washers, nuts, and screws.

16. Install the windshield side and upper garnish mouldings, sun visor assemblies, and the rear view mirror.

If the headlining is slightly wrinkled spray steam through the dome light opening. As the headlining dries, it will shrink slightly, removing most wrinkles and sags.

17. Connect the wires to the dome light and install the assembly. Install the rear seat back and the seat cushion.

PART 15-2 SEATS

1 MANUAL SEAT TRACK

The manually operated front seat is mounted in the conventional manner on two seat tracks. The seat release is located at the lower front center of the seat, and is operated by pulling the lever up to release the seat track (Fig. 1).

SEAT TRACK REPLACEMENT

The seat tracks are most easily replaced if the seat assembly is removed from the car. One seat track can be replaced without removing the other.

1. From underneath the car, remove the nuts and washers from the four studs retaining the seat tracks to the floor panel. Remove the seat assembly from the car and place it on a clean work area.

2. If the seat release lever is attached to the seat track, remove the two screws retaining the seat release lever to the seat track (Fig. 1). Remove the two screws retaining the seat track to the seat cushion and remove the seat track.

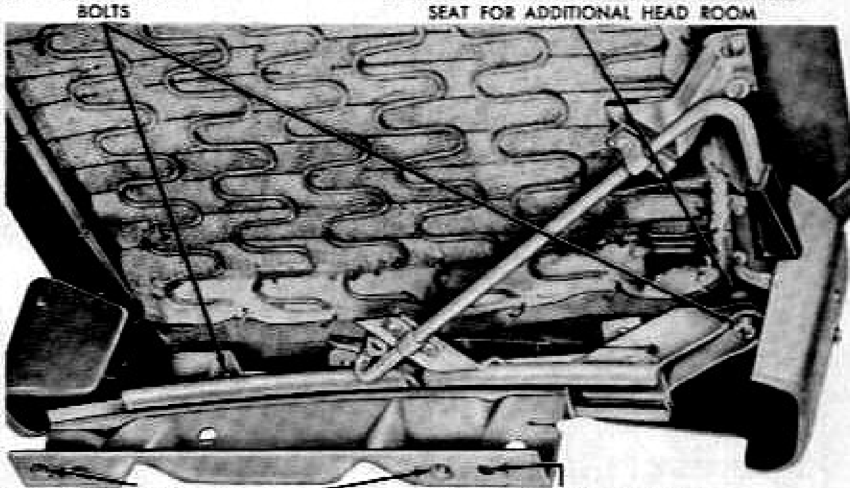


FIG. 1—Manual Seat Track

3. Position the spacers on the seat cushion, and place the seat track in position. Connect the seat release lever to the track, install the clamp and screws to retain the release lever, if the lever was disconnected. Install the two screws which retain the seat track to the seat cushion.

4. Place the seat assembly in the car and install the washers and nuts on the studs which retain the seat tracks to the floor panel.

2 POWER SEAT MECHANISM

The power seat is controlled by a toggle switch which can be operated in four directions. The switch is mounted on the seat cushion side shield.

Power for the seat operation is provided by two electric motors; one for seat vertical movement, and one for seat horizontal movement.

The vertical screw assembly transmits the up and down movement to the seat track assembly by a vertical equalizer bar.

The horizontal screw drives the seat right track. The seat left track slides freely and moves as the seat right track moves, since the seat cushion frame links the seat tracks.

TROUBLE SHOOTING

Figure 2 shows a pictorial wiring diagram of the power seat electrical circuit.

SEAT WILL NOT OPERATE

If both front seats are power operated and one seat is inoperative, the source of trouble is between the junction block and the inoperative seat mechanism.

1. Disconnect the red-blue band and the black wires, under the seat, which lead to the junction block under the console panel.

With a self powered test light check the black wire to see if the system is properly grounded. If the black wire is not grounded, remove the console panel and check the connections at the junction block and repair as necessary.

2. Check the red-blue band wire for voltage. If voltage is not available, check both terminals of the 30 am-

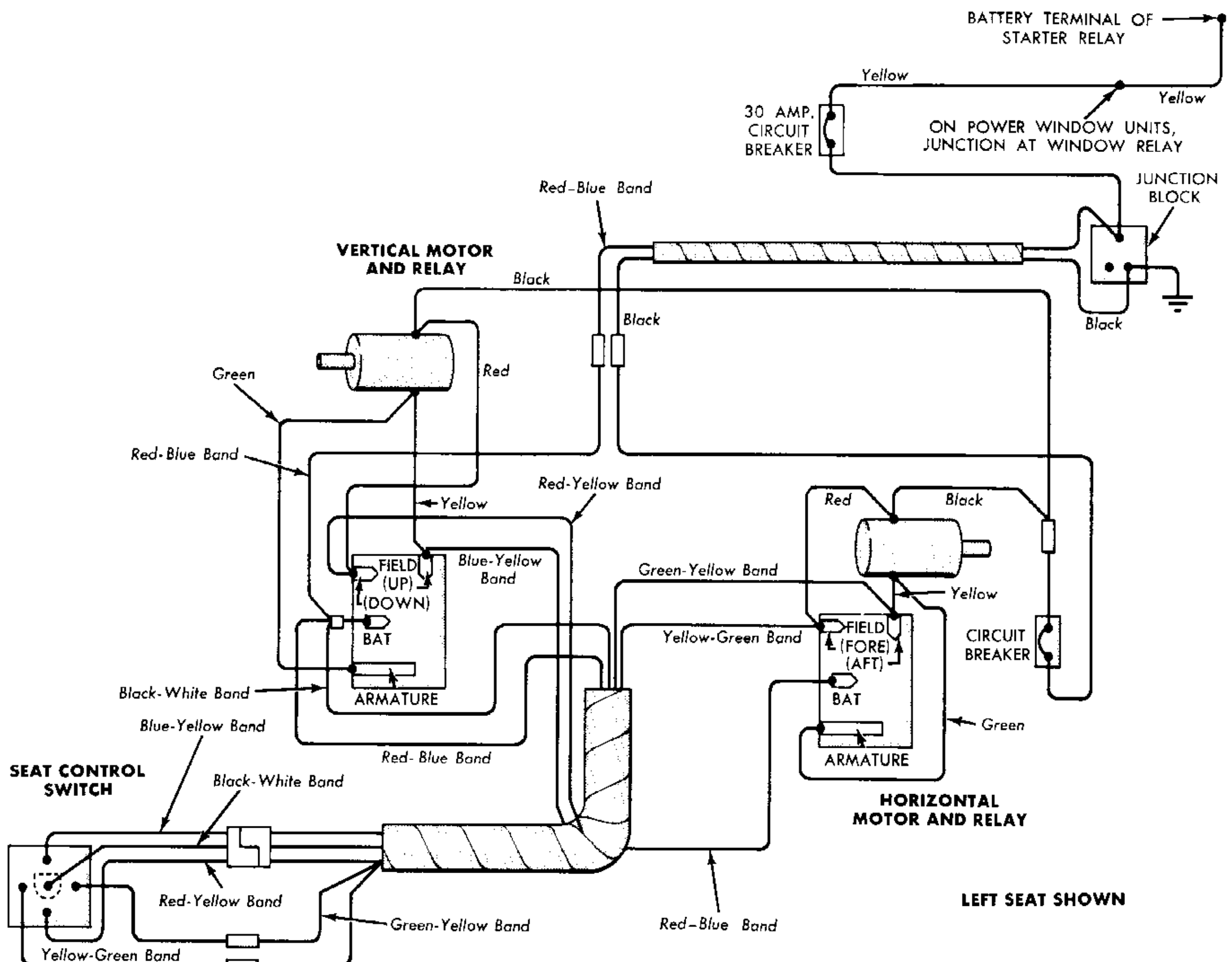


FIG. 2—Power Seat Wiring System

pere circuit breaker located under the left side of the instrument panel with a voltmeter. If voltage is available on both sides of the circuit breaker, remove the console panel and check the terminal of the junction block for voltage. If voltage is available at this point, repair or replace the wire between the junction block and the seat assembly. If voltage is not available at the junction block, repair or replace the wire from the 30 ampere circuit breaker to the junction block.

If voltage is available at only one of the two terminals of the 30 ampere circuit breaker, replace the circuit breaker.

If voltage is not available at the 30 ampere circuit breaker, continue checking for voltage from the circuit breaker to the battery terminal of the starter relay.

3. If voltage is available at the red-blue band wire, under the seat assembly, check the connections from the red-blue band wire to the seat relays for broken or loose wires. Repair or replace the wires as necessary. If the wires are all right, check the black wires from each motor to the 15 ampere circuit breaker for proper connection. Test across the terminals of the 15 ampere circuit breaker with a test light and if the circuit is not complete, replace the circuit breaker.

4. Pull the black-white band wire out of the switch and connect a voltmeter from it to ground (Fig. 2). If no voltage is available, repair or replace the black-white band wire between the switch and the relay.

Plug the black-white band wire back into the switch, and pull the other wires out of the switch. Connect a voltmeter from each of the switch terminals to ground and operate the switch. If voltage is not available at any one of the switch terminals when the switch is operated, replace the switch.

SEAT MOVES IN ONE PLANE ONLY

Test the switch as described in the preceding step 4. Check for broken wires between the switch and the relay. Test the inoperative motor relay for proper operation. Check the motor ground lead for a loose connection.

SEAT OPERATES OPPOSITE TO SWITCH

When the seat travels contrary to the direction in which the switch is operated, crossed wires at the switch or at the relay are indicated. Check the wiring connections for proper installation as shown in Fig. 2.

POWER SEAT MECHANISM REMOVAL

1. Disconnect the battery ground cable.

2. From under the car, remove the seat track retaining nuts and washers from the four studs. Disconnect the wires under the seat which lead to the junction block and remove the seat assembly.

3. Place the seat assembly on a clean work area and remove the four bolts retaining the seat track to the seat assembly. Disconnect the wires at the seat control switch and remove the seat track mechanism.

MOTOR REPLACEMENT

1. Remove the two nuts and washers retaining the motor to the drive assembly and remove motor and relay as an assembly. Slide the relay bracket and relay off the motor retaining bolts. Remove the rubber coupling from the motor shaft. Transpose the new motor leads for the defective motor leads (Fig. 2).

2. Install the rubber coupling and the relay and bracket assembly on the motor. Place the motor on the drive assembly, making sure the rubber coupling is properly installed on the drive gear shaft, and install the retaining nuts with washers.

SCREW MECHANISM DISASSEMBLY

1. Remove the motor, the relay bracket, and the rubber coupling from the drive assembly. Remove the cotter key and the pin retaining the gear housing to the seat track. Remove the two shoulder bolts retaining the screw assembly to the seat track assembly.

2. Remove the five screws retaining the cover to the gear housing assembly. Remove the cover and the gasket from the housing. Remove the nut from the housing end of the screw assembly. Press the screw assembly out of the housing.

3. Remove the gear and the key from inside the housing. Remove the spacer and the washer from the housing end of the screw assembly.

4. Install the washer and spacer on the screw assembly and press the screw assembly into the housing. Install the gear and the key in the housing. Install the gear retaining nut and lubricate the gear and worm.

5. Install the gasket and cover on the housing. Install the pin and cotter pin retaining the housing to the seat track. Install the two shoulder bolts retaining the screw assembly to the seat track assembly.

6. Install the rubber coupling, the relay assembly and bracket, and the motor to the drive assembly.

POWER SEAT MECHANISM REPLACEMENT

1. Install the control switch wires on the switch mounted on the seat cushion side shield and place the seat track mechanism in position on the seat assembly. Install the spacers between the seat track and seat, and install the retaining bolts.

2. Place the seat assembly in the car and install the washers and nuts on the studs which retain the seat track to the floor panel. Connect the seat wires to the junction block wiring harness. Connect the battery ground cable and test the seat assembly for proper operation.

3 SEAT BACK AND CUSHION

Repairs to seat cushions or seat backs are performed out of the car and are usually limited to replacement of torn or burned seat covers. In a few instances, the pads may be damaged and require replacement.

When installing a new seat cover or pad, refer to Figs. 3 and 4 for the location of listing wires, hog rings, anti-squeak pads, and seat pad stack-up.

FRONT SEAT COVER REPLACEMENT

SEAT REMOVAL

Remove the seat assembly from the car. Remove the cushion side shields, seat tracks, and the manual release lever handle and bracket from the seat assembly, if so equipped. Remove the seat back pivot arm covers and disconnect the seat cushion from the seat back.

CUSHION COVER REPLACEMENT

1. Remove the two seat back scuff plates and remove the hog rings retaining the seat cover on the seat frame (Fig. 3). Separate the bottom facing from the cushion cover insert and allow the facing to remain cemented to the foam rubber pad. Remove the cushion cover.

2. Place the new cover assembly over the pads and spring assembly and secure it to the bolster wire with 5 hog rings on one side of the cushion. Apply M-2G17-A cement to the bottom of the cushion cover insert and to the old facing which was left cemented to the foam rubber pad. Install the other edge of the cushion cover insert on the bolster wire with 5 hog rings. Attach the front and side listings of the cover to the spring assembly with 19 hog rings. Attach the rear listing of the cover to the spring assembly with 6 hog rings. Install the two scuff plates on the cushion.

BACK COVER REPLACEMENT

1. Remove the two seat back stops and remove the panel cover from the front seat back (Fig. 3). Remove the hog rings from the seat back assembly, bend the tabs up on the seat back, and remove the seat back cover.

2. Place the new cover over the pad and spring assembly, and with 15 equally spaced hog rings, secure the cover to the bolster wire. The lower rear edge of the cover is secured to each side of the spring assembly by piercing the cover over the lower tab, and installing two hog rings at each side of the spring assembly.

3. Pierce the cover over the remaining tabs, bend the tabs toward the center of the seat, and install the top rear edge of the cover on the spring assembly with 5 hog rings. Secure the lower rear center section of the cover to the spring assembly by bending the lower tab over the outer edge of the cover.

4. Install 5 hog rings across the rear bottom edge of the cover. Attach the lower rear end of the cover to each side of the spring assembly with one hog ring. Install the seat back panel with the retaining clips, and the two seat stops to the seat back assembly.

SEAT REPLACEMENT

Connect the seat back to the seat cushion and install the pivot arm covers. Install the seat cushion side shields, seat track assemblies, and

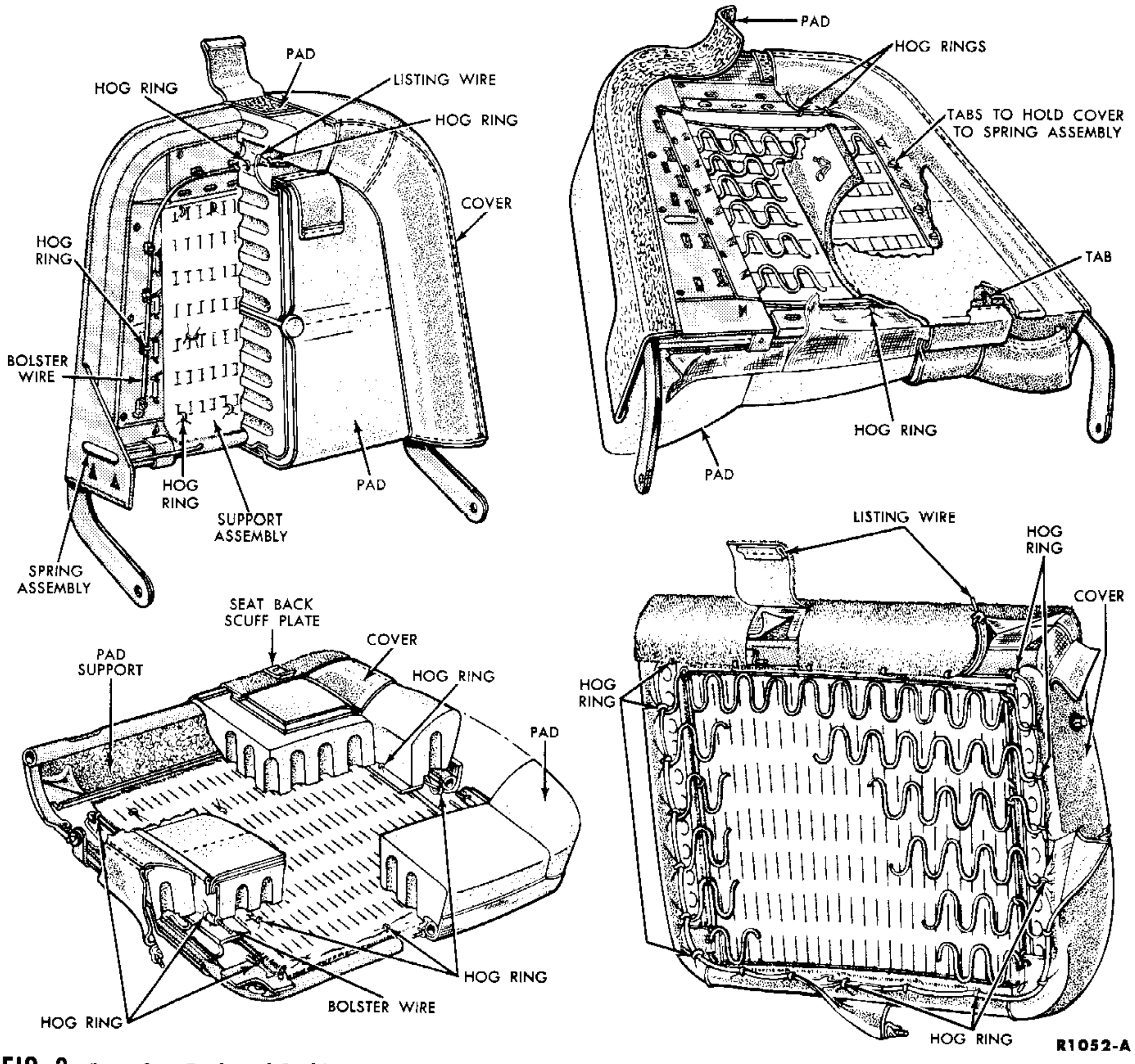


FIG. 3—Front Seat Back and Cushion

the manual release lever handle and brackets. Place the seat assembly in the car and install the four nuts and washers on the studs that retain the seat tracks to the floor panel.

REAR SEAT BACK AND CUSHION REPLACEMENT

CUSHION COVER REPLACEMENT

1. Raise the front of the rear seat cushion and lift the cushion assembly from the car. Place the cushion on a clean work area. Remove the hog rings retaining the cover to the spring assembly. Separate the bottom facing from the cushion cover insert and allow the facing to remain cemented to the foam rubber pad. Remove the cover. Inspect the pads and springs, and repair or replace as necessary.

2. Place the new cover assembly over the spring and pad assemblies. Attach the cover at each center bolster wire with 6 hog rings. Apply M-2G17-A cement to the bottom of the cushion cover inserts and to the old facing which was left cemented to the foam rubber pad. Attach the outer edges of the cushion cover insert to each of the bolster wires with 6 hog rings. Carefully turn the cushion upside down and with 15 equally spaced hog rings attach the cover to the spring assembly. Install the seat cushion in the car.

BACK COVER REPLACEMENT

1. Remove the rear seat cushion. Remove the two screws retaining the bottom edge of the seat back to the body. Lift the seat back slightly and remove the assembly from the car. Place the seat back assembly on a clean work area.

2. Remove the hog rings retaining the cover to the spring assembly, and remove the cover. Inspect the pad and spring assemblies, and repair or replace as necessary.

3. Place the cover over the pad and spring assemblies. Secure the cover to each of the bolster wires with 16 hog rings. Turn the seat upside down and attach the cover along the top, sides, and bottom of the spring assembly with 64 equally spaced hog rings.

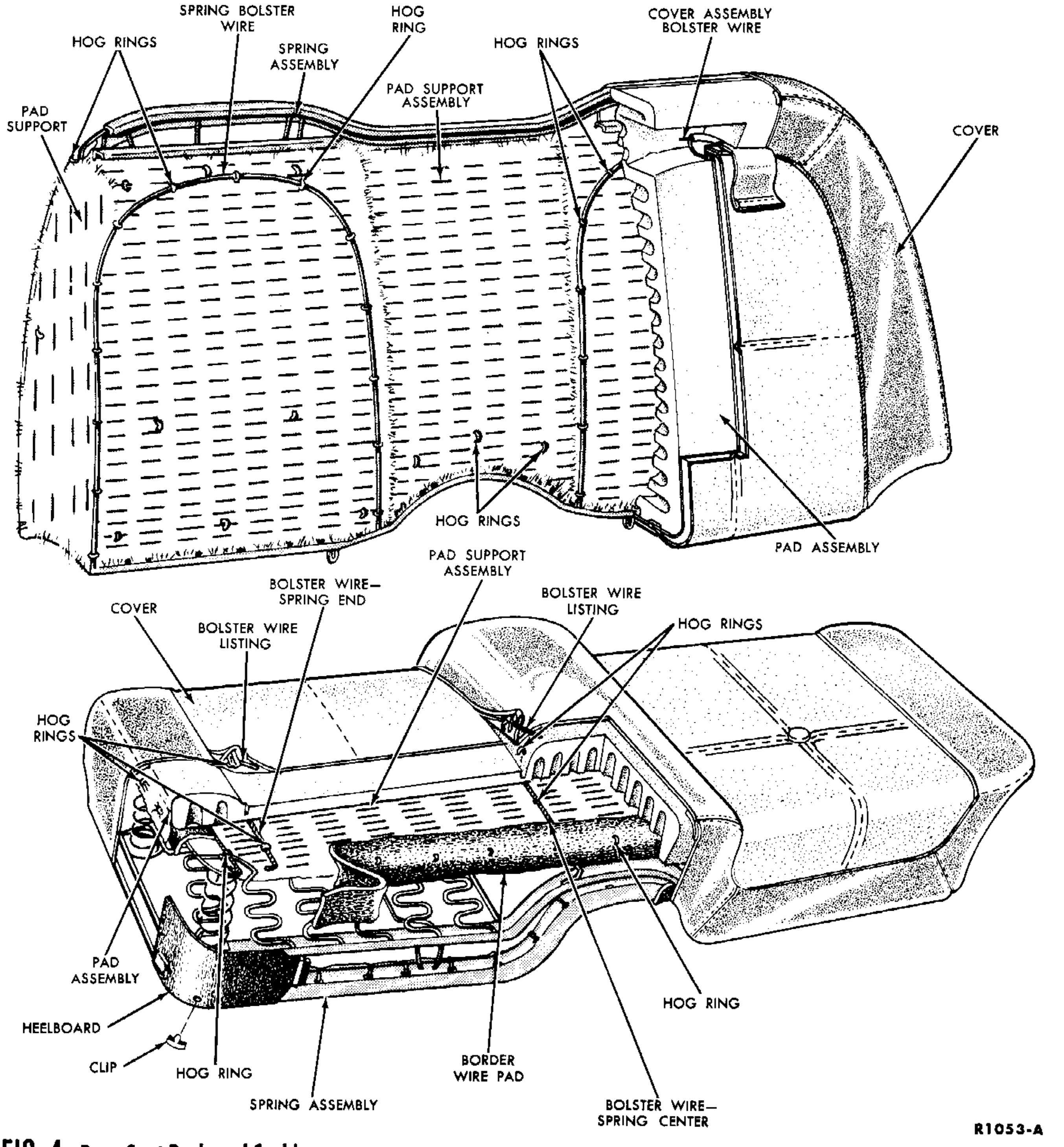


FIG. 4—Rear Seat Back and Cushion

PART 15-3 HOOD, GRILLE, AND FRONT BUMPER

1 HOOD

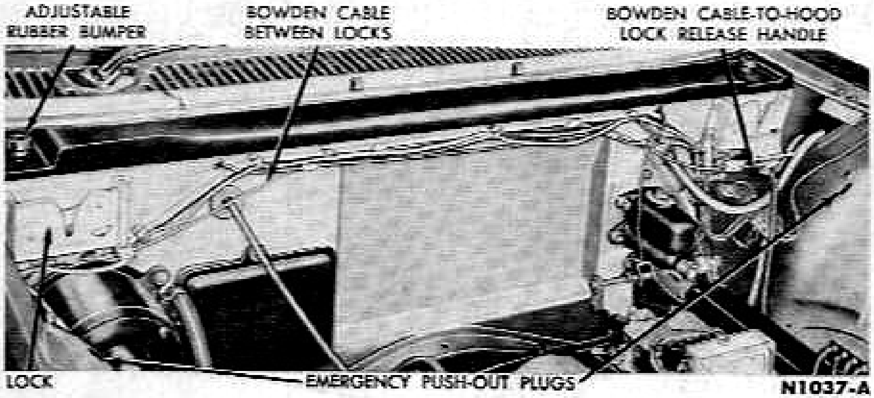


FIG. 1—Hood Locks

The right and left hood locks are located on the engine compartment side of the cowl. The hood locks are released by a Bowden wire control actuated from the passenger compartment. The hood is mounted on spring-loaded hinges which allow for easy raising after the hood is released.

It is possible to open the hood without using force, if a hood lock Bowden wire breaks, or some other malfunction causes one of the locks not to release. Push out the rubber plug (Fig. 1) in the fender apron, and use a screwdriver to actuate the hood lock release lever. The hood right lock release lever is actuated toward the left side of the car, while the left lock release lever is pressed toward the cowl.

If both of the locks fail to release, operate the hood left lock first, which in turn should release the hood right lock.

A safety catch, located on the left side of the hood, permits the hood to pop open only a few inches when the lock is released.

To release the safety catch, hold the hood down slightly and push the catch inward. **Do not let the hood rise by itself. It may lift too fast and damage the grille upper panel.**

HOOD REPLACEMENT

1. Remove the hood to hood hinge bolts (Fig. 2). Protect the fenders and grille upper panel with covers to avoid scratches. Then obtain assistance to lift the hood up and off the hinges.

2. With the help of an assistant, position the hood on the hinges and install the hood to hood hinge bolts. Check the hood alignment and correct as necessary.

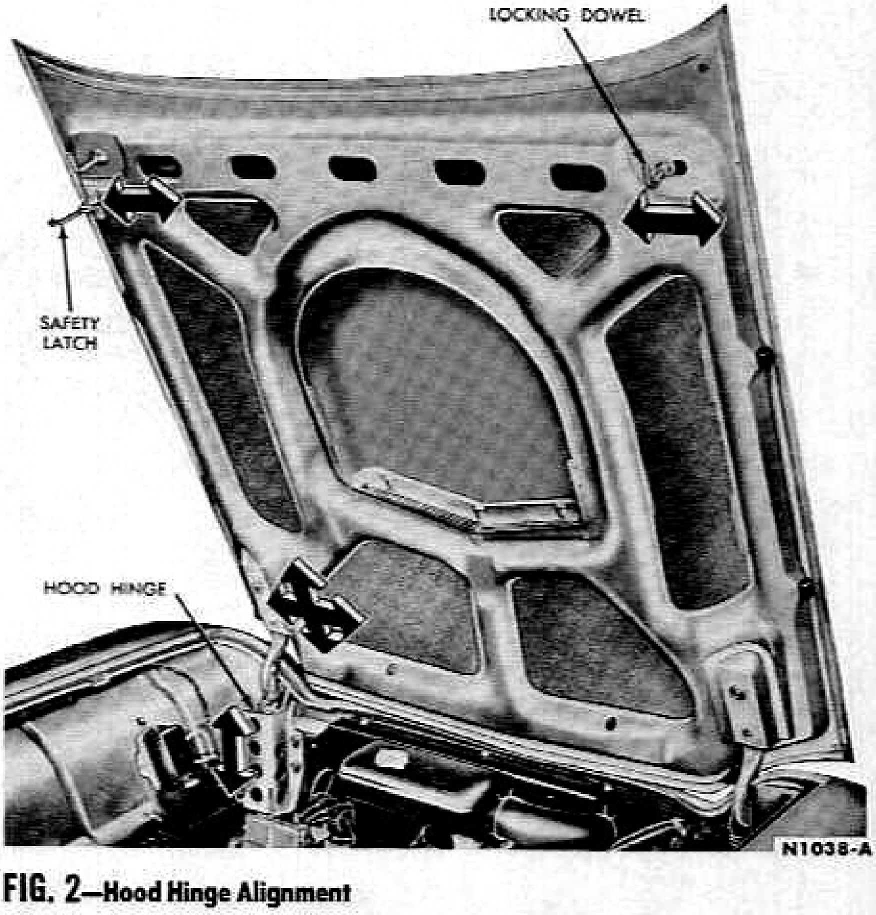


FIG. 2—Hood Hinge Alignment

HOOD ALIGNMENT

Hood adjustment points are provided at the hinges, the lock, the locking dowel, and the rubber bumpers.

Fore and aft or side to side movement of the hood is accomplished at the hood to hood hinge bolts (Fig. 2).

Up and down adjustment for the front of the hood is provided at the hinge to hinge support bolts (Fig. 2).

Adjustable rubber bumpers (Fig. 1) provide leveling adjustments at each rear corner of the hood.

The hood lock can be moved up and down to provide easy lock operation and an even flush line at the cowl. The hood locking dowel can be moved from side to side for easy entry into the lock (Fig. 1).

HOOD HINGE AND/OR SPRING REPLACEMENT

1. Remove the hood. If the right hinge is to be replaced, remove the battery.
2. Remove the hinge assembly.
3. After positioning the hinge in a vise, compress the spring about one inch and hold it securely in the compressed position.
4. After removing the spring retainer pin, remove the spring and the spring retainer from the hinge.
5. Position the hinge in the vise, and position the retainer and spring in the hinge.
6. Compress the spring, hold it in the compressed position, and install the spring retainer pin.
7. Position the hinge assembly on the car, and loosely install the retaining bolts.
8. Position the hood on the hinges, and loosely install the retaining bolts.
9. Adjust hood fit.

HOOD SAFETY CATCH

When installing a new safety catch, adjust it in or out so that the hood will catch the striker plate at the lowest portion of the hook when the hood is released. This adjustment should position the hook so it will meet the striker plate properly as the hood is closed. Check the closure operation carefully to avoid damage to the fender in case the safety catch is installed too far outboard.

2 GRILLE AND FRONT BUMPER

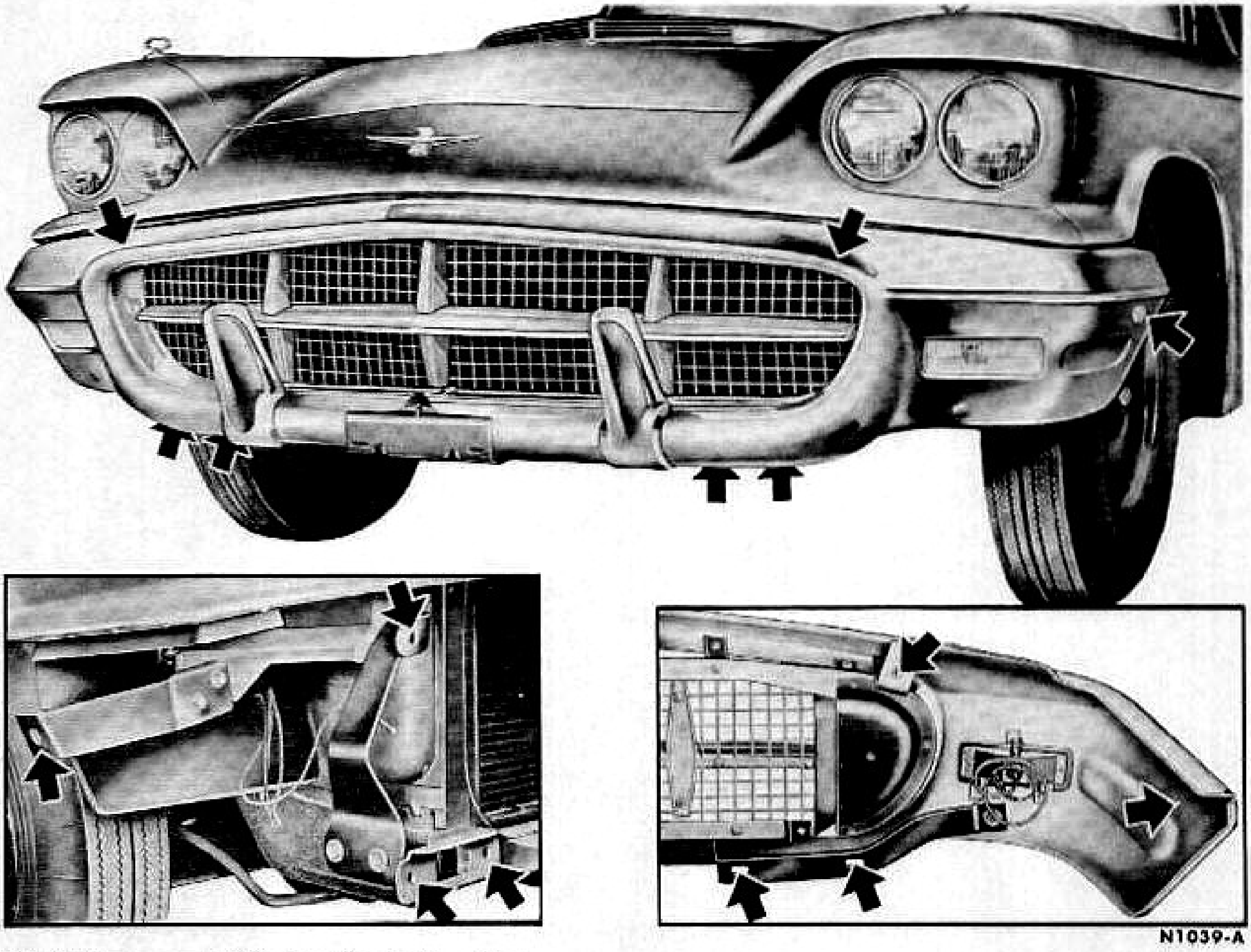


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FIG. 3—Bumper and Grille Mounting Bolt Locations

The following procedure includes the information necessary to replace any serviceable part(s) of the grille and/or front bumper.

1. Raise the front of the car and install safety stands.

2. Disconnect the right and left hand parking lamp wires and pull free from their grommets in the splash shield.

3. Remove the bumper upper bracket retaining bolt from each side of the grille. Remove the bumper retaining bolts from the lower retaining bracket (Fig. 3), and remove the bumper and grille assembly.

4. Remove 7 upper support bracket grille retaining bolts, 6 air deflector retaining bolts and 5 grille assembly to grille finish panel bolts and remove the air deflector and the grille assembly.

5. Remove the center moulding bar and 3 vertical moulding bars from the grille.

6. Transfer the right and left hand bumper supports and parking lamps to the new bumper.

7. Transfer the grille finish panel and the grille upper support brackets to the new bumper.

8. Install the center bar and 3 vertical moulding bars on the grille.

9. Position the grille assembly on the new bumper and install 10 retaining bolts and nuts finger-tight.

10. Position the right and left air deflectors and install 6 retaining bolts and nuts.

11. Secure all grille to bumper bar retaining bolts and nuts.

12. Position the front bumper and grille assembly on the car. Install the bumper retaining bolt at each fender finger-tight.

13. Align the remaining bolt holes, and install and tighten all bolts.

14. Route the parking lamp wires through the grommets at the splash shield, and connect the bullet connectors.

15. Remove the safety stands, and lower the car.

GROUP 16

CONVERTIBLE TOP

PART 16-1 TROUBLE SHOOTING

1 TOP OPERATION

The 1960 Thunderbird convertible soft top may be lowered into the luggage compartment. The cycle is automatic with the exception of unfastening the rear window and unlocking the top from the windshield header.

The operating principles will be divided into two cycles; a retraction cycle in which the top is lowered into the luggage compartment, and an erection cycle in which the top is raised. Each of these cycles will be further broken down to simplify the explanation. The deck lid and top linkages are powered by four hydraulic cylinders which receive pressure from one electrically reversible rotor pump. The hydraulic pressure application is controlled by three electrically operated solenoid valves. There are two reversible electric motors, ten power relays, seven limit switches, an actuating switch, and a neutral switch (Figs. 1 and 2). The electrical system is protected by four circuit breakers in the following circuits:

1. Control
2. Power
3. Ground of each reversible electric motor

Battery voltage is available at all times through a circuit breaker for the power circuit. Battery voltage is available to the top control switch only when the neutral switch is closed and the ignition switch is turned to the ON or ACC position. This closes a relay that feeds battery voltage from the auxiliary terminal of the headlight switch to the top control switch. The circuit is protected by a circuit breaker in the headlight switch. The neutral switch is closed only when the transmission selector lever is at N or P.

With the transmission in neutral or park, the top will retract when the switch is pulled back and held. When the switch is pushed forward and held, the top will erect. If the switch is released at any point, all motion stops. The direction of motion may be reversed at any point without com-

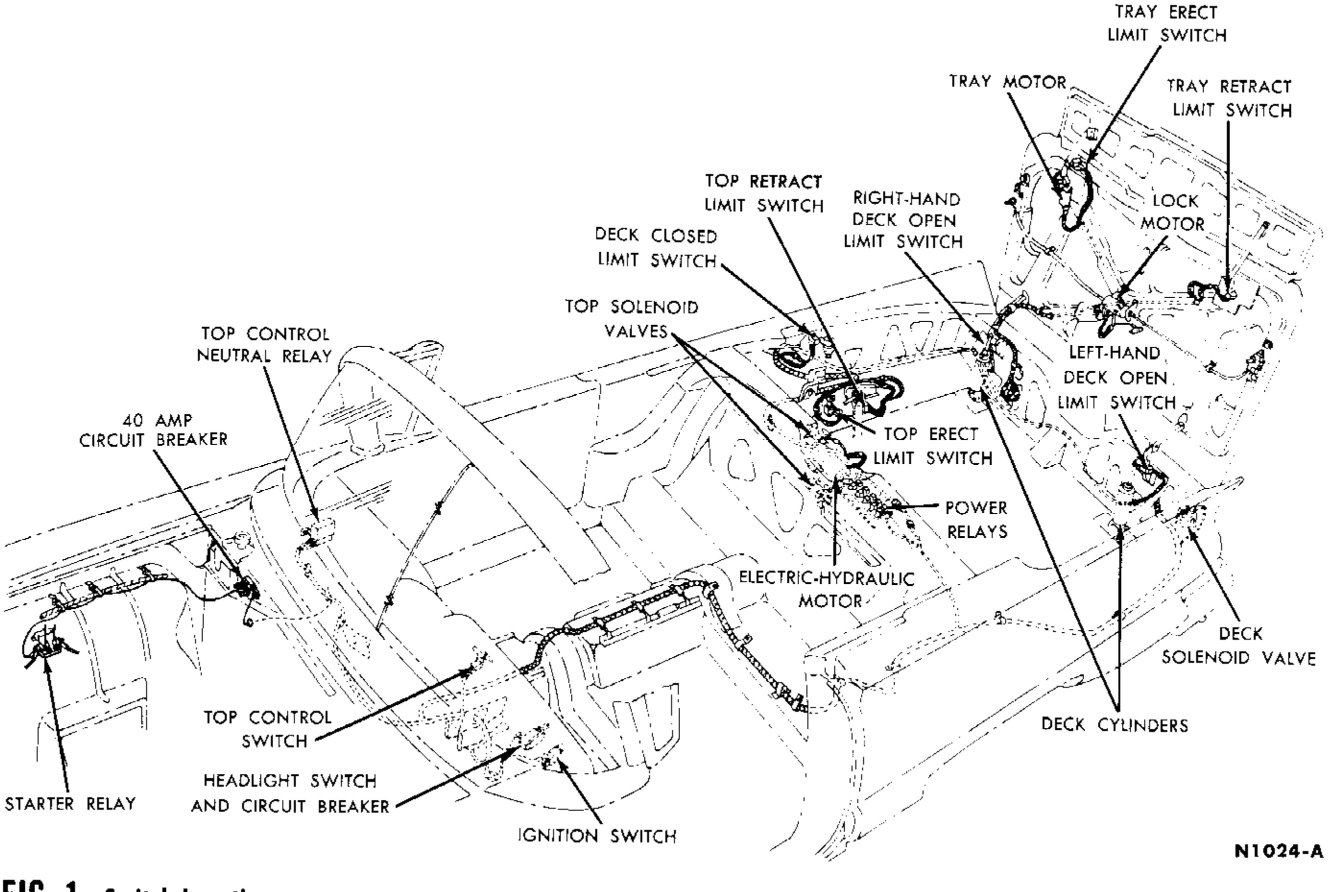

FIG. 1—Switch Locations

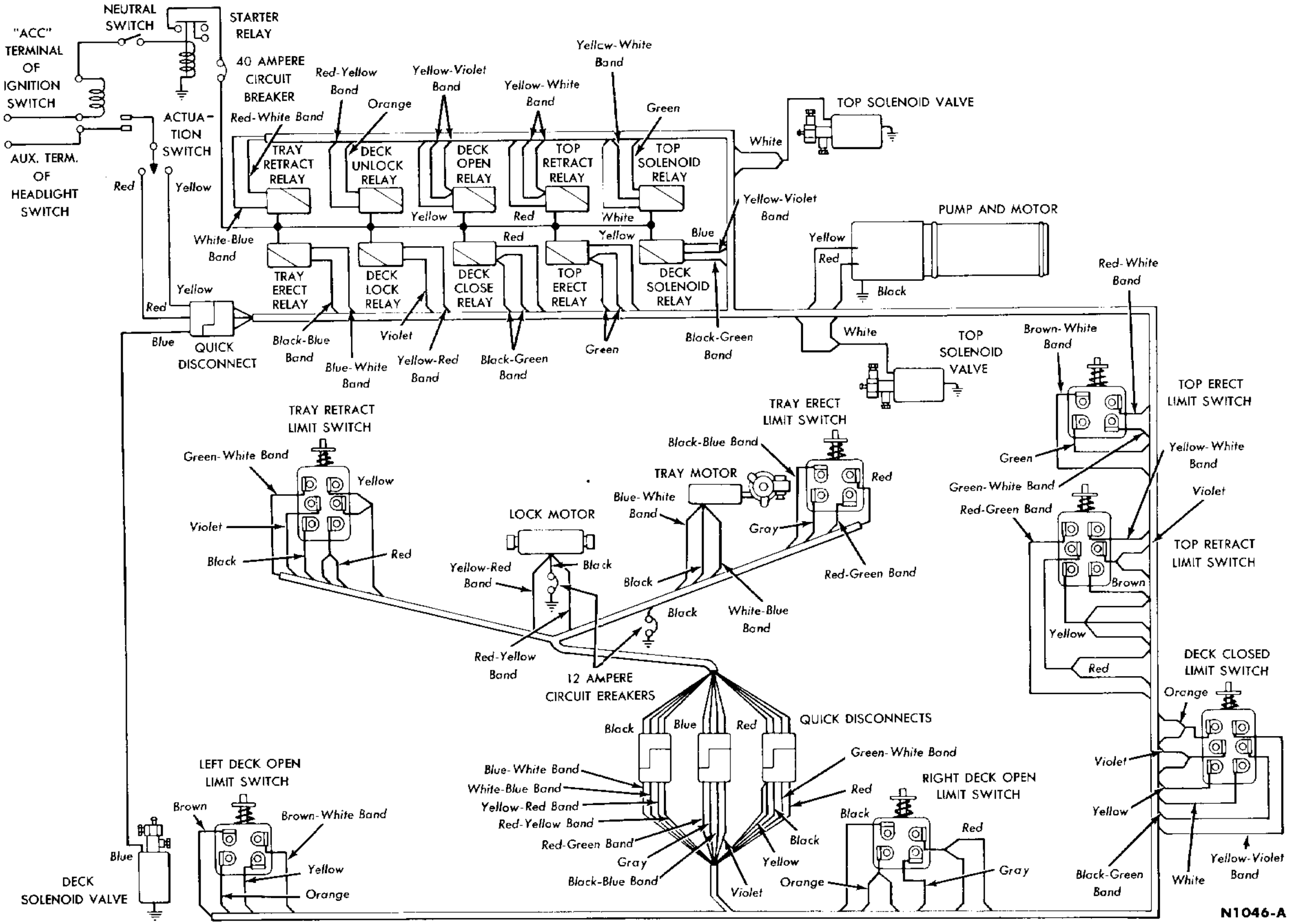

FIG. 2—Wiring Harness Connections

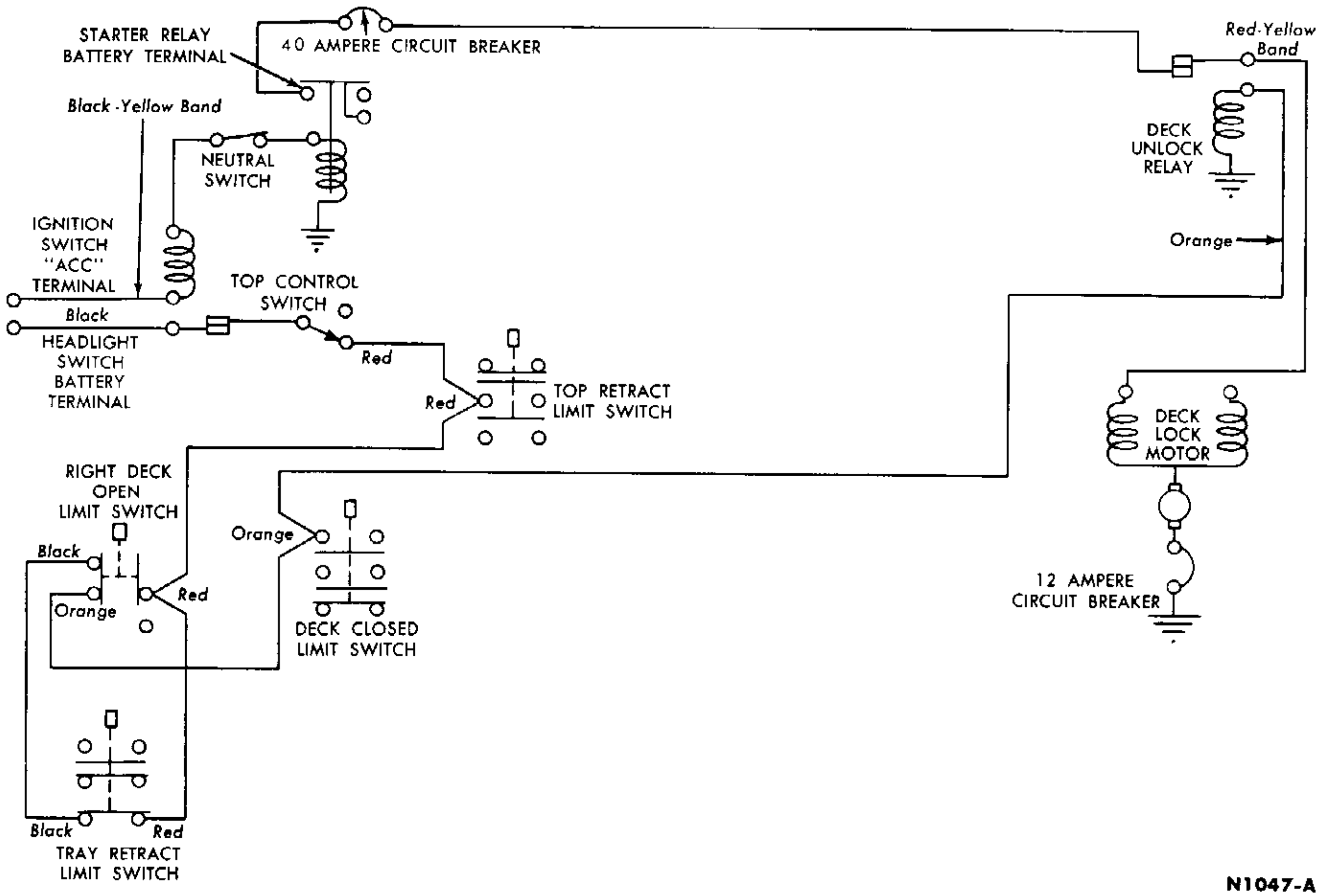

FIG. 3—Deck Lid Unlock—Top Retract Cycle

pleting the cycle, if the switch is moved in the opposite direction.

The control and power circuit wiring diagrams for the various phases of each cycle (retraction and erection) are shown in Figs. 3 through 13. The limit switch lead wires may be any color(s). The wire colors between connectors however, are as indicated.

RETRACTION CYCLE

This cycle starts with the top in the erected position and the deck lid closed and both locked. The top is manually unlocked, the rear window is **completely** unfastened, and the top control switch is pulled back and held.

DECK LID UNLOCK

Current flows from the top control switch through the tray retract limit switch (Fig. 3), the right hand deck open limit switch, and the deck unlock power relay, and actuates the deck lock motor. The motor, through two flexible drive shafts, unlocks the deck lid.

DECK LID OPENING

The mechanical motion of unlocking the deck lid actuates the deck closed limit switch. Actuation of this switch allows current to flow to the deck open and deck solenoid power relays (Fig. 4), actuating the electric-hydraulic motor and deck solenoid valve. Hydraulic pressure is delivered to the deck solenoid valve and then to the two deck cylinders (Fig. 14), raising the deck lid.

PACKAGE TRAY EXTEND

When the deck lid is fully raised, the right-hand deck-open limit switch is actuated, opening the deck open circuit and closing a second set of contacts (Fig. 5). Current flows through the right-hand deck open limit switch, the tray erect limit switch, to the tray erect power relay. The tray motor is actuated and extends the package tray so that it is parallel with the deck lid. The mechanical action of the tray, as it reaches its travel limit, actuates the tray erect limit switch which opens the tray erect relay circuit and closes the top down circuit (Fig. 6).

TOP RETRACT

Current flows from the tray erect limit switch through the top retract limit switch to the top retract and top solenoid power relays, actuating the electric-hydraulic motor and top solenoid valves. Hydraulic pressure is delivered to the top solenoid valves and then to the two top cylinders, lowering the top. When the top reaches the fully retracted position, it actuates the top retract limit switch and de-energizes the top solenoid valves which shuts off the hydraulic pressure to the top cylinders.

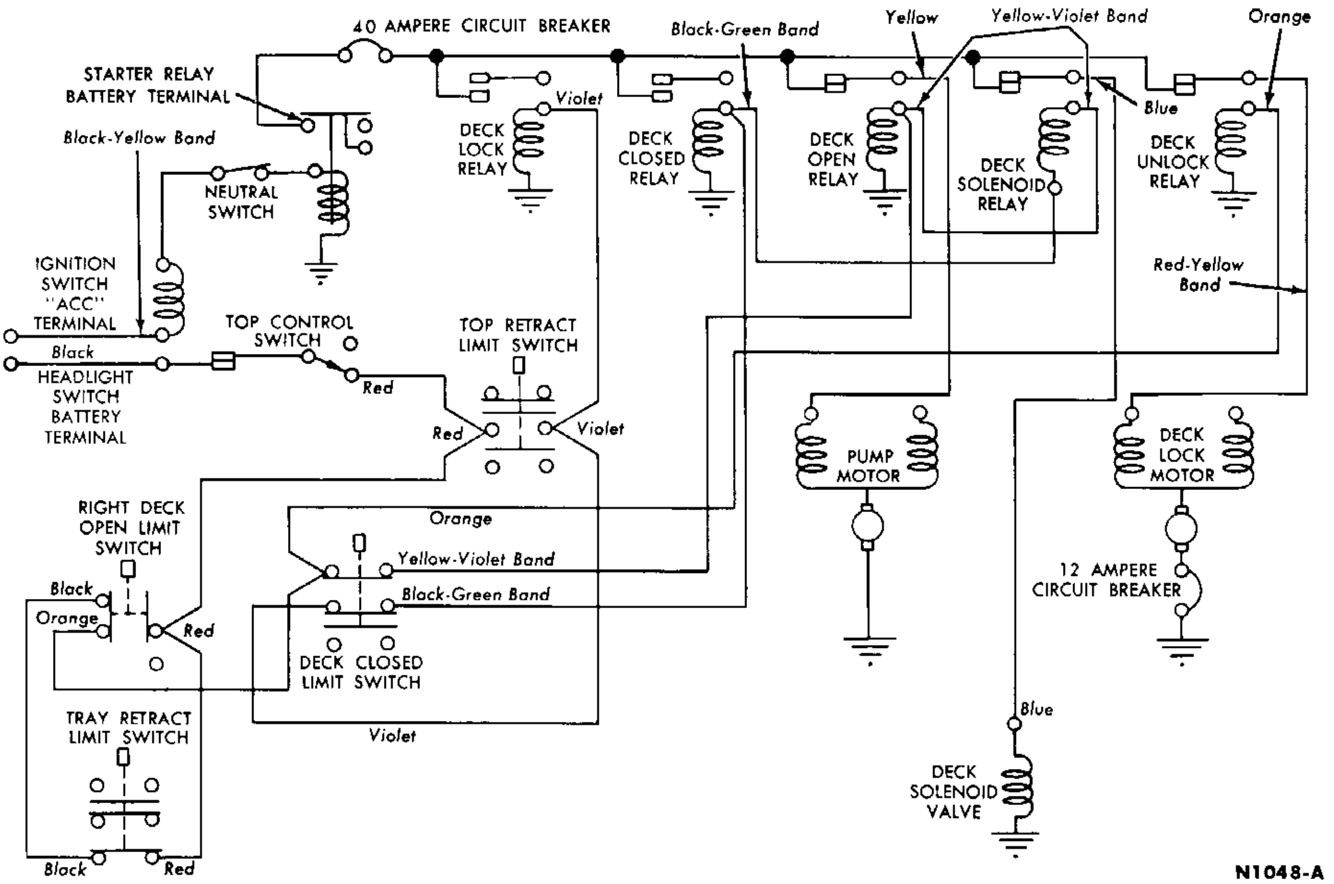

FIG. 4—Deck Lid Open—Top Retract Cycle

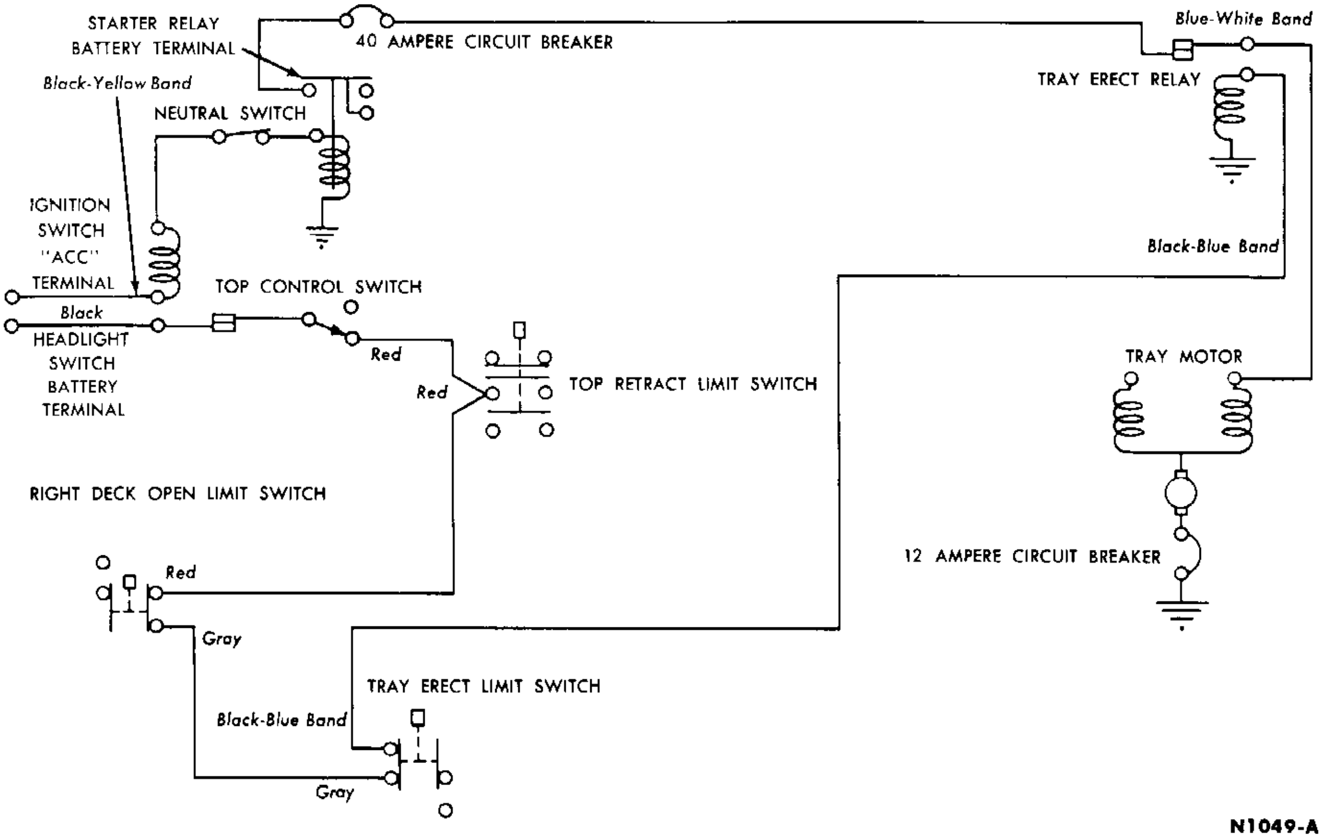

FIG. 5—Package Tray Extend—Top Retract Cycle

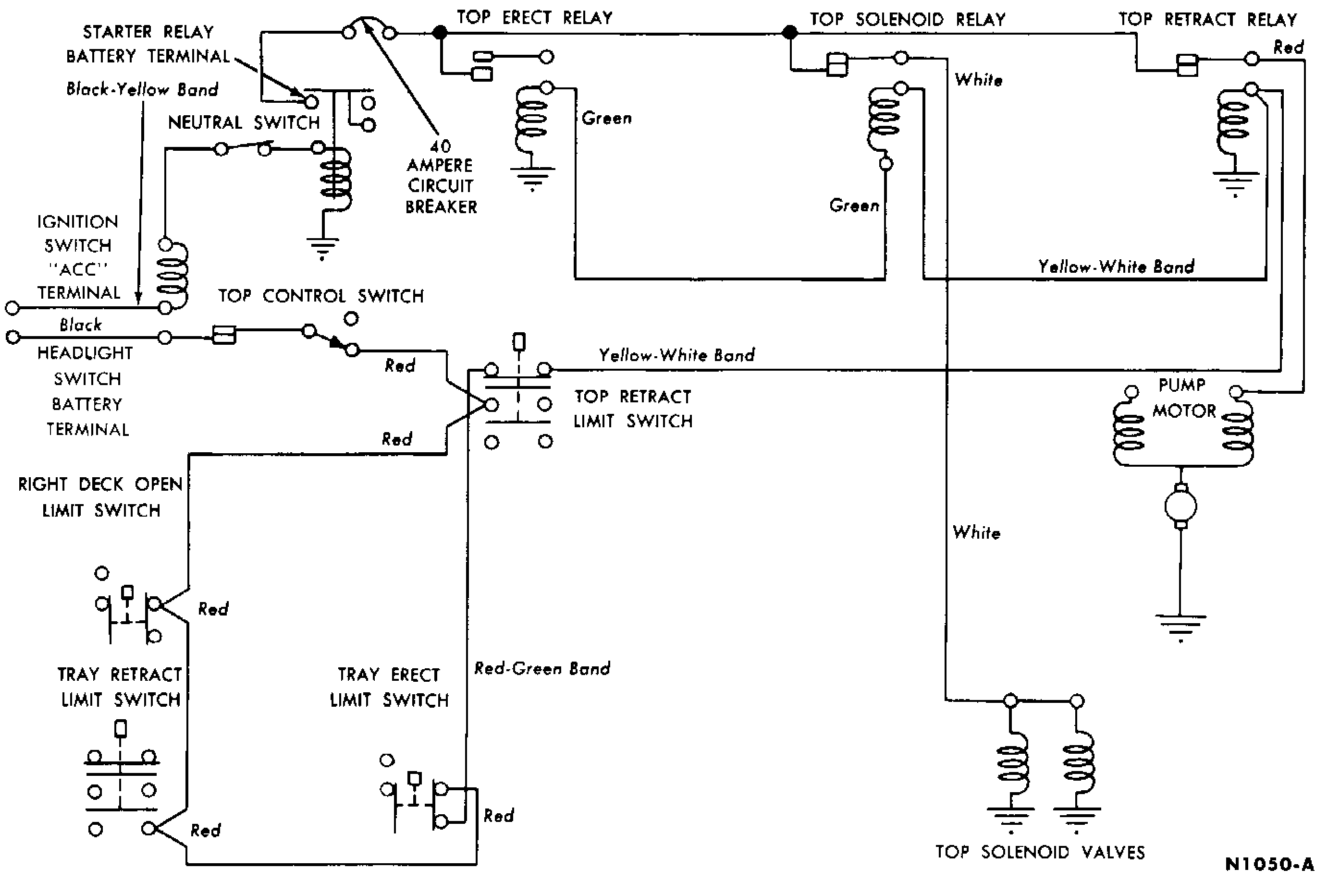

FIG. 6—Top Retract—Top Retract Cycle

DECK LID CLOSE AND LOCK

As the top retract limit switch opens and the top solenoid valves close, another set of contacts in the same switch close (Fig. 7), allowing current to flow to the deck lock relay and through the deck closed limit switch to the deck close and deck solenoid valve power relays. The electric-hydraulic motor is reversed, reversing the hydraulic fluid flow, and the deck solenoid valve is actuated. Hydraulic pressure is delivered to the two deck cylinders, lowering the deck lid. The deck lock motor locks the deck. As the deck lock screws draw the deck lid down, the deck closed limit switch is opened, stopping the electric-hydraulic motor. Releasing the top control switch cuts off the current to the locking circuit.

ERECTION CYCLE

This cycle starts with the top in the luggage compartment and the deck lid closed and locked.

DECK LID UNLOCK

With the top control switch pushed forward, current flows through the top retract limit switch (Fig. 8), and the left hand deck open limit switch, to the deck unlock power relay, actuating the deck lock motor. The motor drives the deck lock screws and unlocks the deck lid.

DECK LID OPENING

The mechanical motion of unlocking the deck lid closes the deck closed limit switch (Fig. 9). Current flows to the deck open and deck solenoid power relays, actuating the electric-hydraulic motor and the deck solenoid valve. Hydraulic pressure is delivered to the deck solenoid valve and then to the two deck cylinders, raising the deck lid. As the deck lid reaches the fully open position, the left hand deck open limit switch opens, and stops the deck lock and electric-hydraulic motors (Fig. 9).

TOP ERECTION

When the left hand deck open limit switch opens, another set of contacts in the same switch close (Fig. 10). Current then flows through the top erect limit switch to the top erect and top solenoid power relays, actuating the electric-hydraulic motor and top solenoid valves. Hydraulic pressure is delivered to the top solenoid valves and then to the two top cylinders, raising the top. When the top reaches the fully erected position, it opens the top erect limit switch which de-energizes the top solenoid relay and stops the electric-hydraulic motor.

PACKAGE TRAY FOLD

When the top erect limit switch opens, another set of contacts in the same switch close (Fig. 11). Current then flows through the tray retract limit switch to the top erect limit switch and then to the tray retract power relay which actuates the tray motor. This motor folds the tray under the deck lid. When the tray is completely folded, the tray retract limit switch opens, and thus stops the tray motor.

DECK LID CLOSE AND LOCK

As the tray retract limit switch opens, another set of contacts in the same switch close (Fig. 12), allowing current to flow to the deck lock relay and through the deck closed limit switch to the deck close and deck solenoid valve power relays. The electric-hydraulic motor and the deck solenoid valve are actuated. Hydraulic pressure is delivered to the two

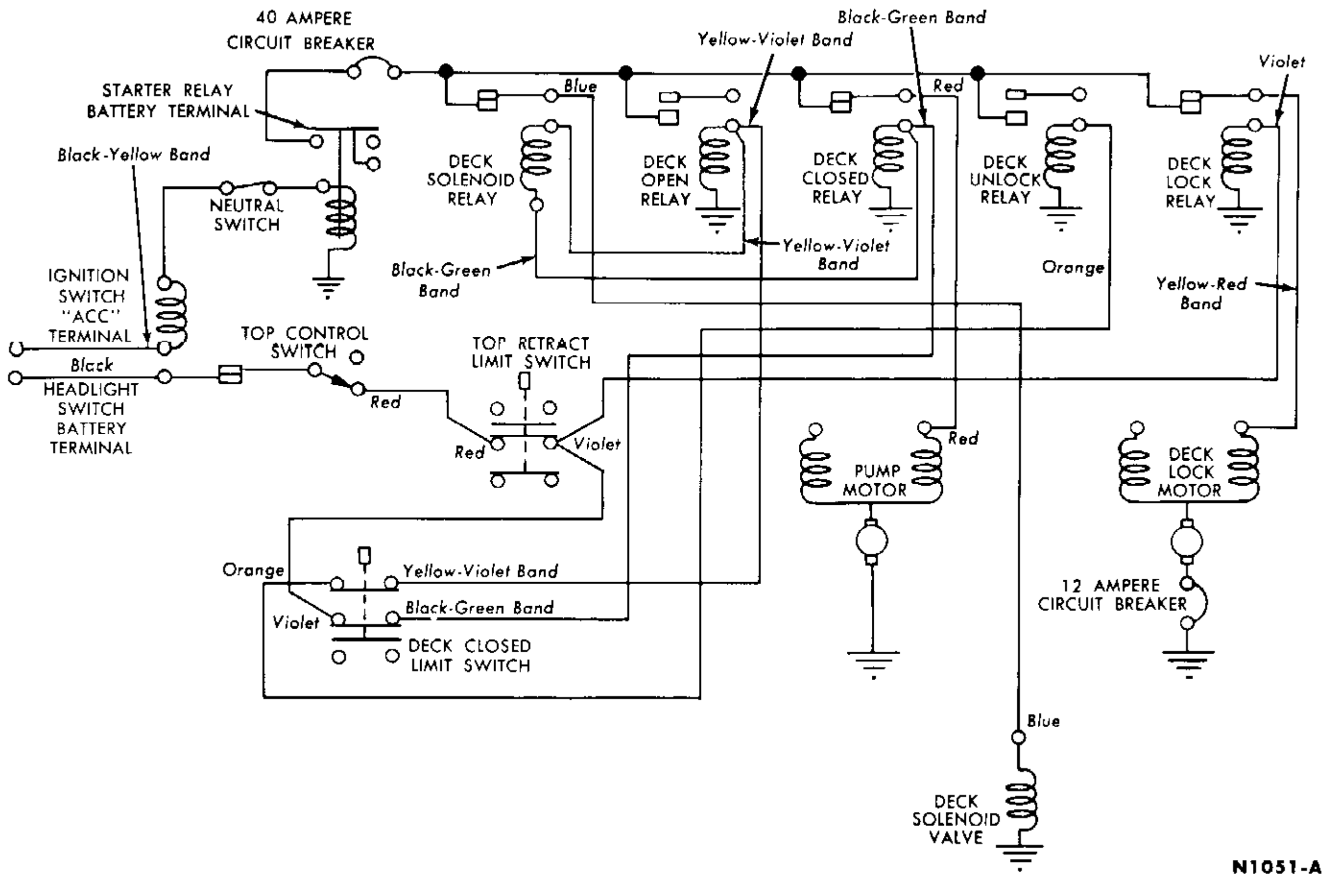

FIG. 7—Deck Lid Close and Lock—Top Retract Cycle

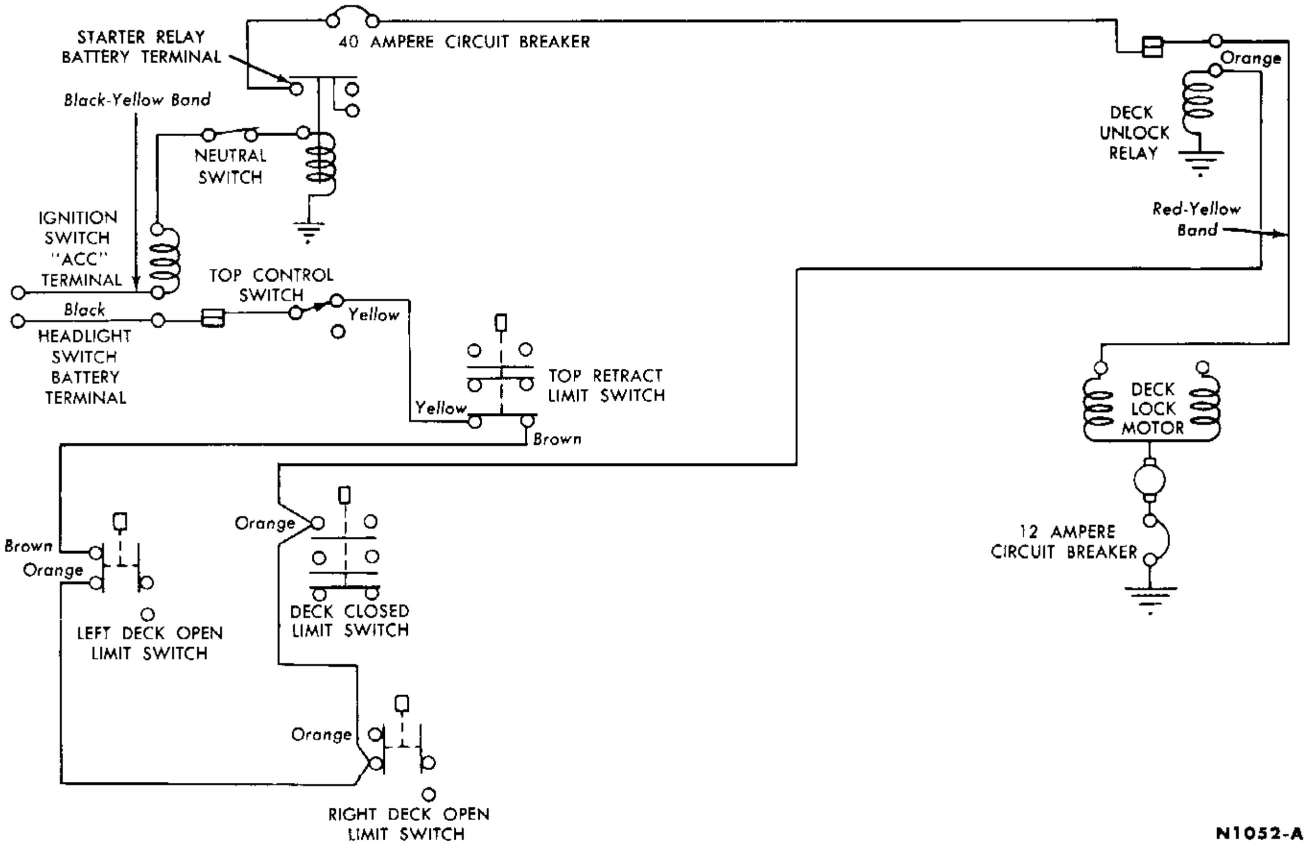

FIG. 8—Deck Lid Unlock—Top Erect Cycle

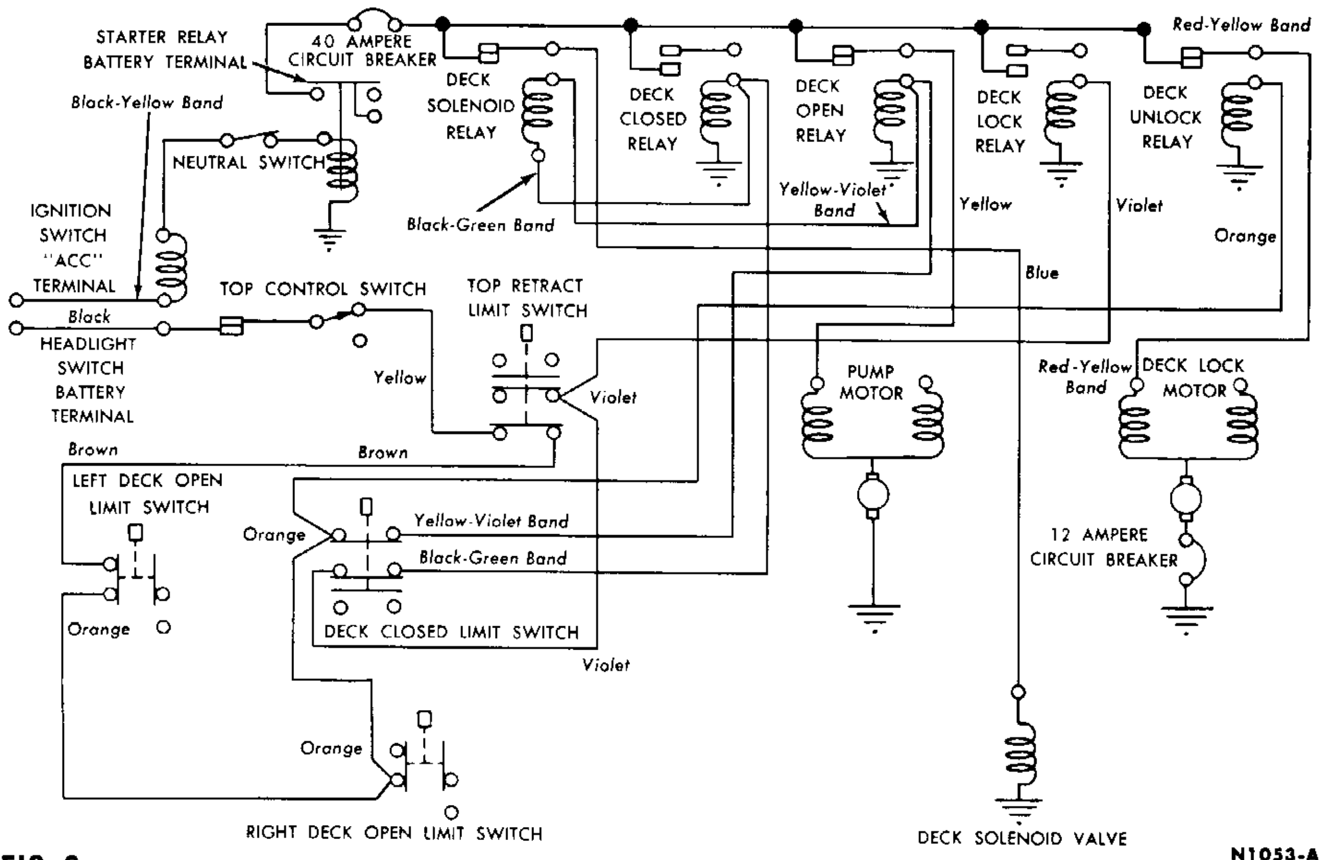

FIG. 9—Deck Lid Open—Top Erect Cycle

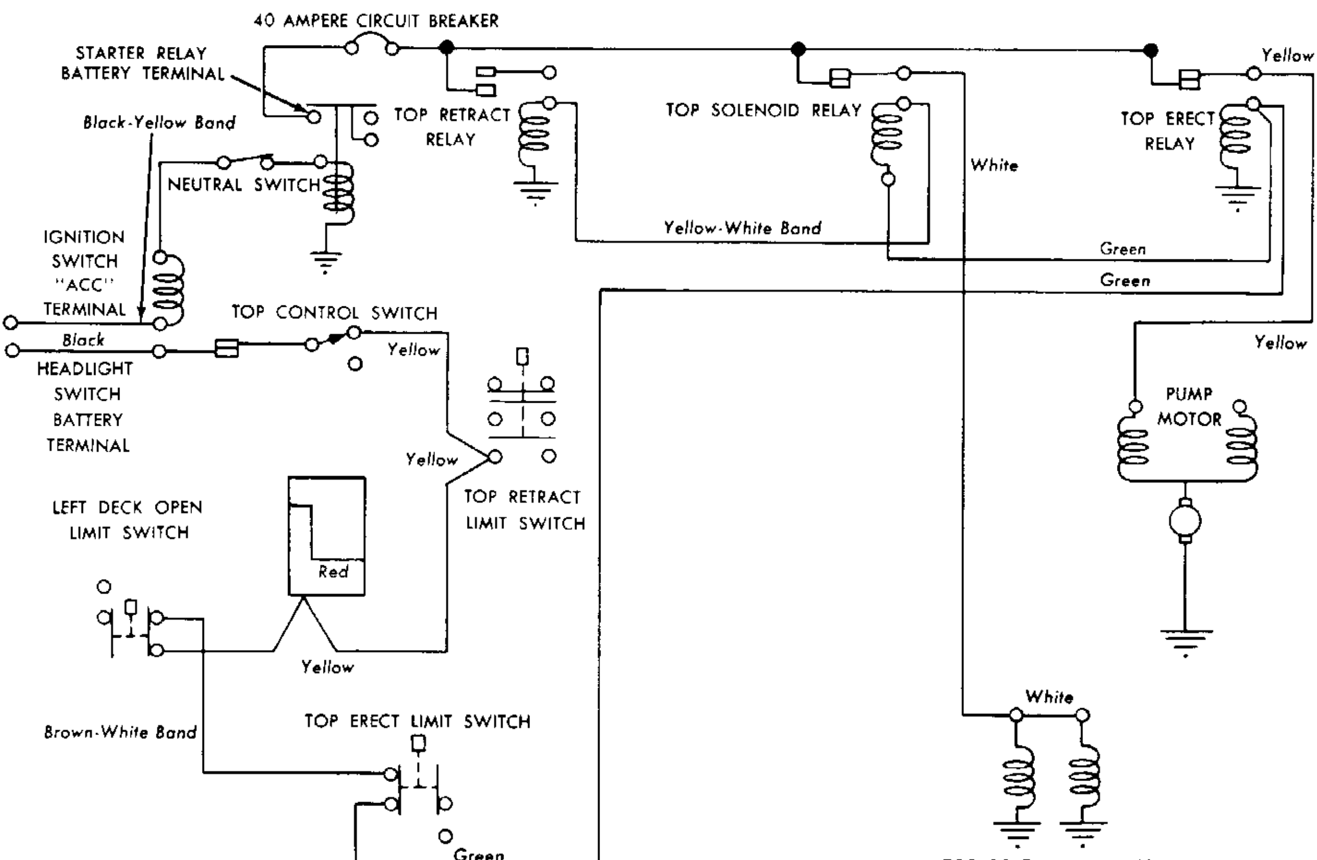

FIG. 10—Top Erect—Top Erect Cycle

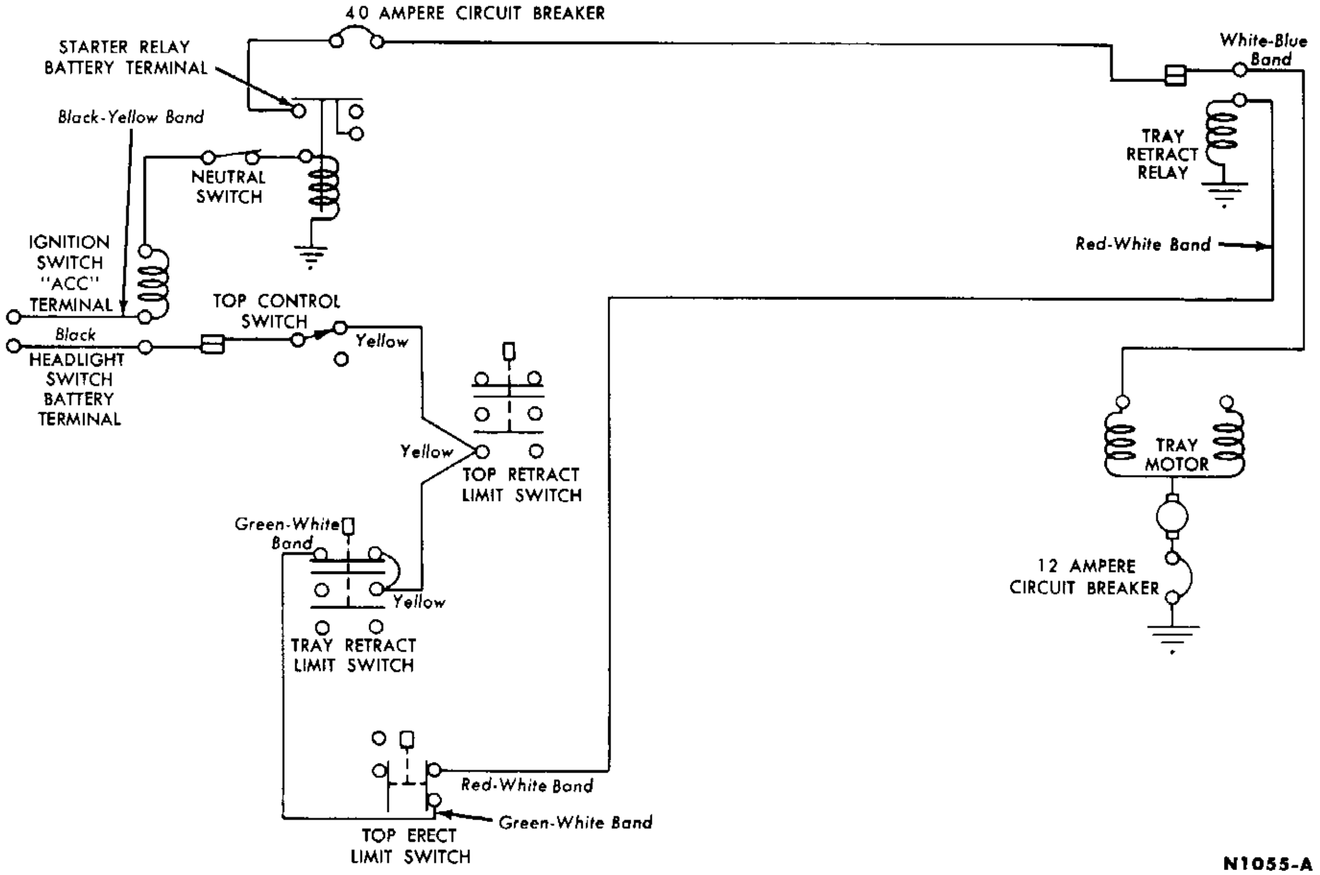

FIG. 11—Package Tray Fold—Top Erect Cycle

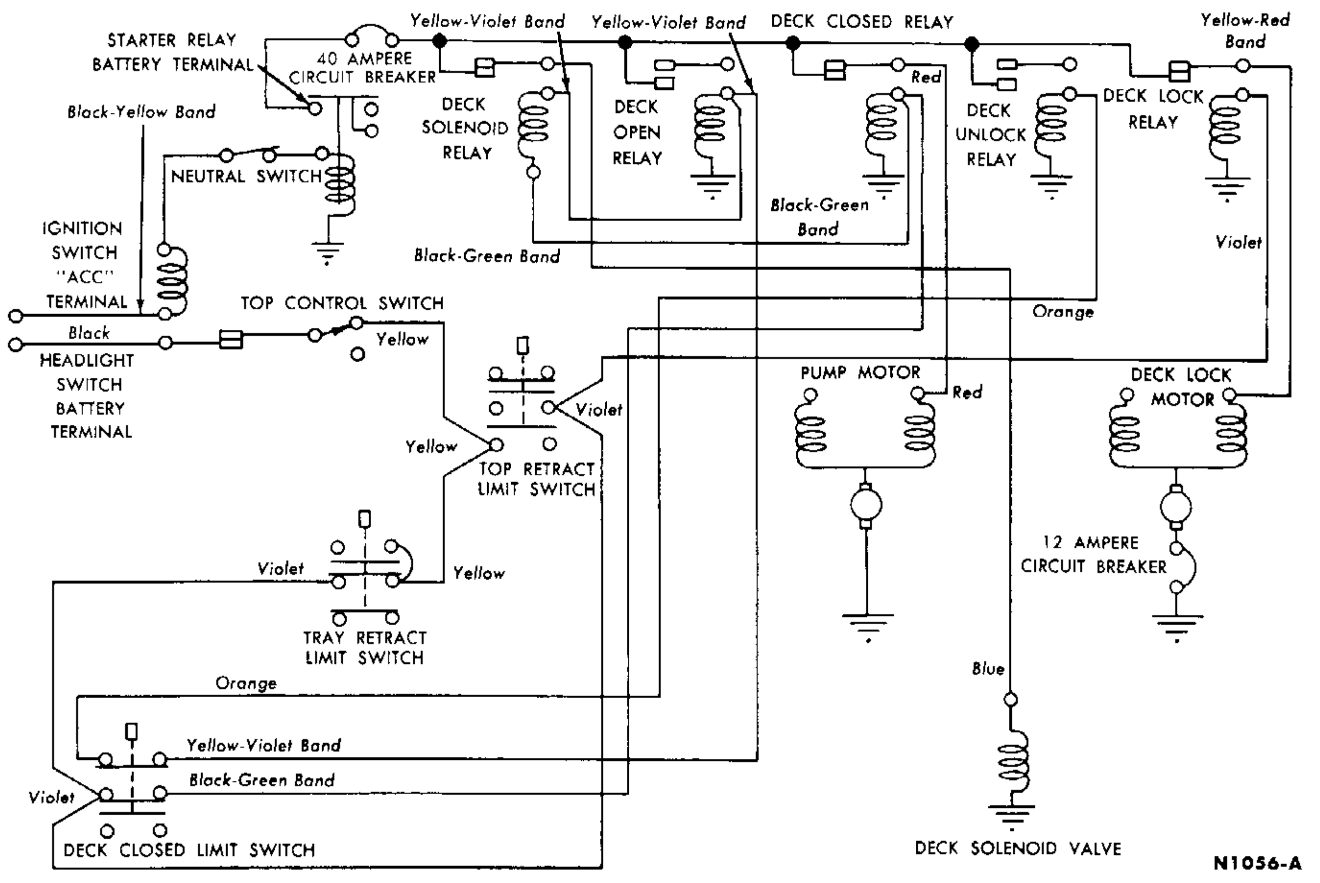

FIG. 12—Deck Lid Close and Lock—Top Erect Cycle

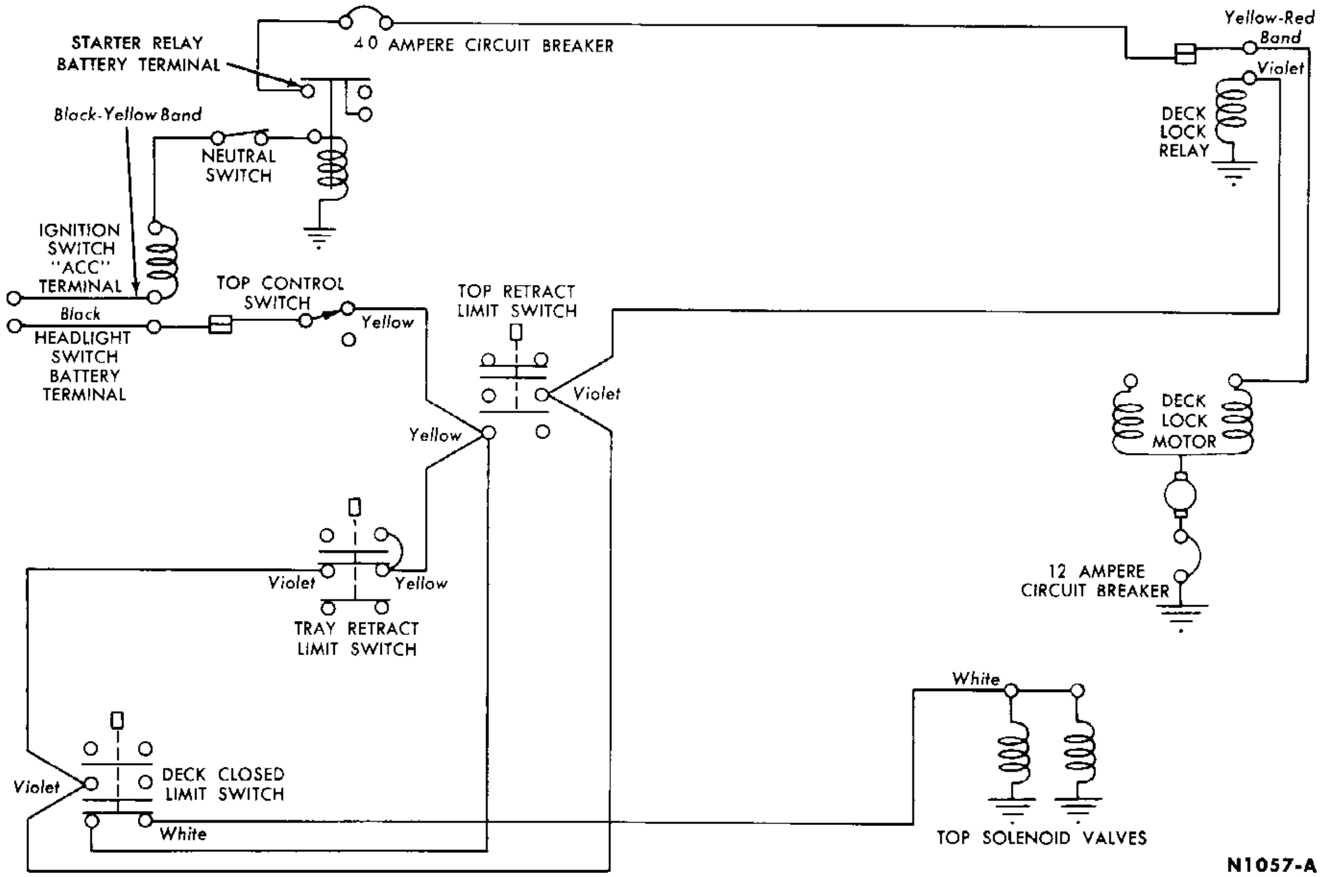

FIG. 13—Excess Pressure Relief—Top Erect Cycle

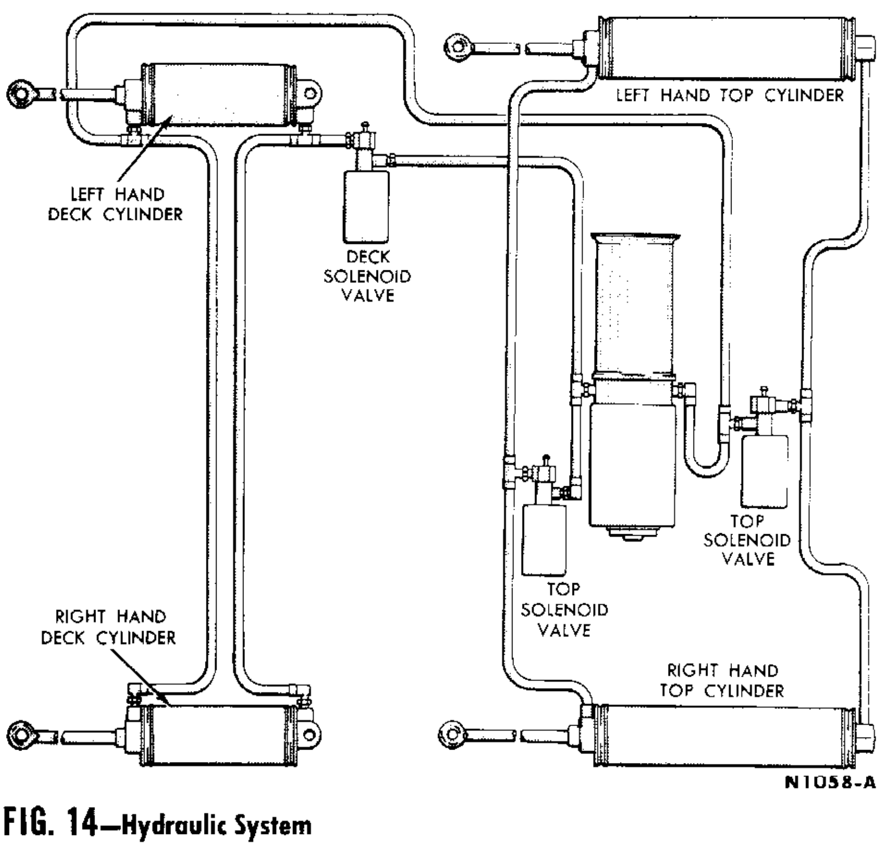

FIG. 14—Hydraulic System

deck cylinders, lowering the deck lid. The deck lock motor locks the deck. As the deck lock screws draw the deck lid down, the deck closed limit switch is opened, stopping the electric-hydraulic motor. As the deck closed limit switch is opened, another set of contacts in the same switch are closed (Fig. 13). Current flows to the top solenoid valves, holding the valves open to permit the hydraulic fluid to bleed off excess pressure in the top control lines. Releasing the top control switch cuts off the current to the locking circuit and top solenoid valves, thus completing the cycle.

HYDRAULIC SYSTEM

Hydraulic pressure is used to raise and lower both the top and deck lid. The pressure is produced by a reversible electric motor driven rotor pump. There are two cylinders for operating the top and two for the deck lid. They are interconnected by hydraulic hose lines to the rotor pump and the three solenoid valves as shown in Fig. 14.

2 DECK MANUAL OPENING PROCEDURES

If a part of the electrical, mechanical, or hydraulic system of the top does not work, the following manual procedures may be used to get at the malfunctioning part.

MANUAL OPENING PROCEDURES

Unlocking Deck Lid Manually. If the deck lock motor fails to operate, manually unlock the deck lid to gain access to the deck lock motor. Use the following procedure:

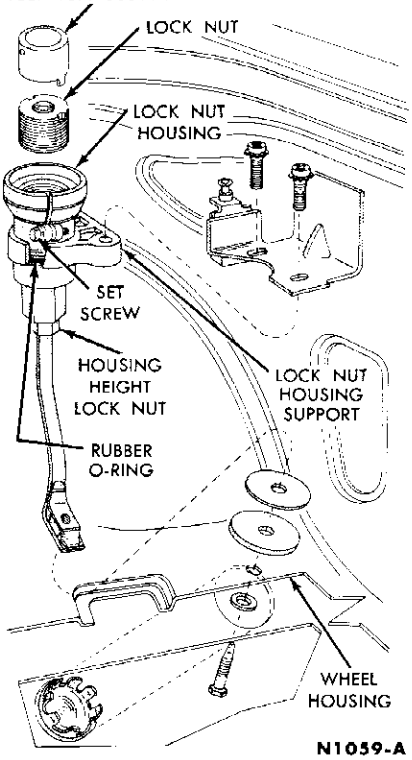

FIG. 15—Deck Lid Lock Screws

1. Raise the car approximately 10 inches by placing a floor jack under the frame rear crossmember.
2. From the underside of each wheelhouse, remove each deck lid lock retaining screw (Fig. 15).
3. After lifting the front edge of the deck lid about one inch, operate the top control switch to complete the opening of the deck lid.

Opening Deck Lid Manually. If the deck lid hydraulic cylinders fail to operate, the deck lid can be manually opened as follows:

1. Unlock the deck lid by operating the top control switch or by using the above procedure.
2. Loosen the two straps supporting the fuel tank, and lower the tank approximately one inch. It is not necessary to remove the straps or the tank.
3. From underneath the lower back panel, remove both of the deck cylinder retaining screws from each side (Fig. 16).
4. Complete the opening of the deck lid manually. If the deck lid locks have been released from the wheel housings, the nut and housing portion of the locks will remain attached to the deck lid.

Erecting Top Manually. It may be necesary to erect the top manually if the electric-hydraulic motor fails, if there is an open circuit in the motor feed, if the top solenoid valves fail, or there is an open circuit in the feed, if a top cylinder fails or if the linkage fails. Under one of these conditions, proceed as follows:

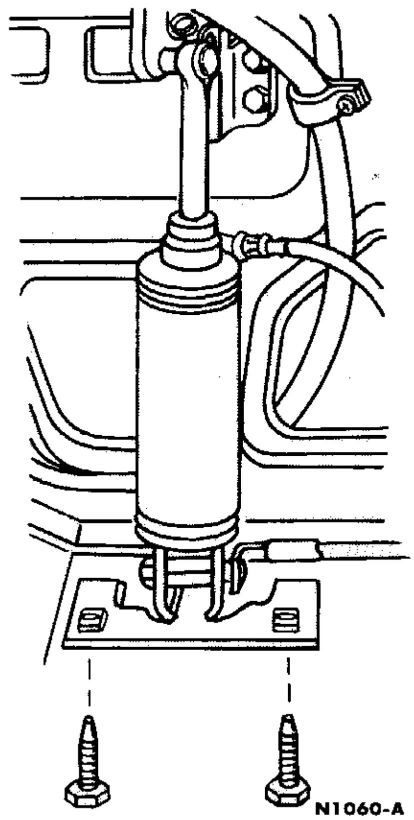

FIG. 16—Deck Cylinder Retaining Screws

1. Unlock and open the deck lid.
2. Energize both top solenoid valves, using suitable jumper wires and a 12 volt source. If either valve is inoperative, disconnect the hydraulic line(s) connected to the valve(s) so that there will be no hydraulic block in the top cylinders.
3. Manually erect the top.

3 MECHANICAL CHECKS

Improper top operation is usually due to a fault in the electrical or hydraulic systems. Make the necessary electrical and hydraulic checks and adjustments first. If the top still does not operate satisfactorily, check for bent or misaligned linkage. In some cases, the deck lid may be badly sprung, creating a bind, or the pivot pins at the lift cylinders top linkage may have become disengaged.

4 ELECTRICAL CHECKS

Before attempting to perform any trouble checks, read Section 1, "Top Operation," and then check the battery to be sure of an adequate power supply. The following trouble checks indicate the symptoms of most malfunctions and the item(s) to check which may have caused the difficulty.

To determine whether the control circuit is the cause of the malfunction, operate the basic motor or solenoid power circuit of that portion of the system that does not work. Any of the ten basic circuits can be operate by energizing the applicable power relay directly with a jumper wire from the hot bus bar to the relay actuating terminal. The molded rubber connector must be partially removed at the relay to gain access to the actuating terminal. All of the power relays are located behind the rear seat back (Fig. 1). This method of locating the faulty circuit by-passes all of the various limit switches and operates a particular motor or solenoid directly.

Before by-passing the control circuit to operate a motor, determine audibly that the motor is not stalled against a jammed lock screw or running free because of broken flexible driveshaft.

When a motor continues to run after releasing the top control switch, a defective power relay is indicated. Disconnect the battery to stop the motor and replace the faulty relay.

If a motor or solenoid operates when the control circuit is by-passed, make a continuity check of the components in the particular control circuit involved. Follow the wiring diagram for the particular control circuit.

If the motor or solenoid does not operate when the control circuit is by-passed, and no mechanical failure is evident, a failed power relay is indicated. The relay may be by-passed by connecting a jumper wire from the bus bar to the motor feed at the molded rubber connector. If the relay is not defective, a faulty motor or an open circuit in the motor feed is indicated. Do not overlook the possibility of a defective circuit breaker; there is a circuit breaker in each of the tray and lock motor ground leads. Also, the hydraulic system may be low and the fluid level should be checked at the pump.

It should be noted that the deck solenoid relay is grounded through either the deck open relay in conjunction with the deck unlock relay, or the deck close relay, depending on what part of the cycle is being completed. The same method of grounding exists in the top solenoid relay circuit through either the top erect relay in conjunction with the deck lock relay or the top retract relay. Also, the top control neutral relay is grounded through the starter relay. The relays through which the solenoid relays are grounded have a much lower resistance than the solenoid relays, and thus only the solenoid relay armatures will pull-in and make contact.

The trouble checks list possible troubles and their causes. The causes are listed in the order of their probable occurrence; therefore, the items should be checked in the order listed to avoid unnecessary disassembly. Figure 1 shows the location of all motors, switches and circuit breakers. The control and power circuit wiring diagrams for the various phases of each cycle (retract and erect) are shown in Figs. 3 through 13. When a power relay is indicated as an item to check, by-pass the control circuit at the relay, as previously described, and functionally check the relay. When a limit switch is indicated as a possible cause of failure, perform a continuity test and adjust the switch.

DECK LID WILL NOT UNLOCK

ONE SIDE

Check the:

- Deck lock flexible drive shaft
- Deck lock assembly

BOTH SIDES

Check the:

- Control wiring circuit breaker
- Power feed circuit breaker
- Neutral switch
- Top control switch
- Deck unlock power relay
- Tray retract limit switch (top retract cycle only)
- Right hand deck open limit switch (top retract cycle only)
- Top retract limit switch (top erect cycle only)
- Left hand deck open limit switch (top erect cycle only)
- Deck lock motor and circuit breaker
- Deck lock flexible drive shafts
- Deck lock assemblies

DECK LID UNLOCKS BUT WILL NOT OPEN

Check the:

- Deck open power relay
- Fluid level at hydraulic pump
- Deck unlock limit switch
- Deck solenoid power relay
- Deck close power relay
- Deck solenoid valve
- Deck lid cylinders

DECK LID OPENS, BUT HYDRAULIC PUMP WILL NOT STOP—TOP RETRACT CYCLE

Check the:

- Right hand deck open limit switch
- Deck open power relay

DECK LID WILL NOT CLOSE

TOP RETRACT CYCLE

Check the:

- Top retract limit switch
- Deck closed limit switch
- Deck close power relay
- Deck solenoid power relay
- Fluid level at hydraulic pump
- Deck solenoid valve
- Deck lid cylinders

TOP ERECT CYCLE

Check the:

- Tray retract limit switch
- Deck closed limit switch
- Deck close power relay
- Deck solenoid power relay
- Fluid level at hydraulic pump
- Deck solenoid valve
- Deck lid cylinders

DECK LID CLOSES, BUT WILL NOT LOCK

Check the:

- Deck lock motor and circuit breaker
- Deck lock power relay
- Deck lock flexible drive shafts
- Deck lock assemblies

DECK LID CLOSES, BUT HYDRAULIC PUMP WILL NOT STOP

Check the:

- Deck closed limit switch
- Deck close power relay

Note: The lock motor will operate until the top control switch is released.

TRAY WILL NOT EXTEND

Check the:

- Right hand deck open limit switch
- Tray erect limit switch
- Tray erect power relay
- Tray motor and circuit breaker

TRAY EXTENDS, BUT MOTOR WILL NOT STOP

Check the:

- Tray erect limit switch
- Tray erect power relay

TRAY WILL NOT FOLD

Check the:

Tray retract limit switch
Top erect limit switch
Tray retract power relay
Tray motor and circuit breaker

TRAY FOLDS, BUT MOTOR WILL NOT STOP

Check the:

Tray retract limit switch
Tray retract power relay

TOP WILL NOT ERECT

Check the:

Left hand deck open limit switch
Top erect limit switch
Top erect power relay
Top solenoid power relay
Top retract power relay
Top solenoid valves
Fluid level at hydraulic pump
Top cylinders

TOP WILL NOT RETRACT

Check the:

Tray erect limit switch
Top retract limit switch
Top retract power relay
Top solenoid power relay
Top solenoid valves
Fluid level at hydraulic pump top cylinders

5 HYDRAULIC CHECKS

Faulty hydraulic system operation can be caused by lack of fluid, leaks, air in the system, obstruction or kinks in the hoses, or faulty operation of a cylinder or the pump.

FLUID LEVEL CHECK

1. Retract the top.

2. Place absorbent cloths below the filler plug.

3. Remove the filler plug, and check the fluid level. It should be level with the bottom edge of the hole.

4. If the level is low, check the system for leaks, adding heavy duty brake fluid as necessary.

LIFT CYLINDER OPERATION CHECK

Operate the top control switch and observe the operation of the lift cylinders for the following:

If the movement of the piston rods is sluggish or uneven, check the hoses from the pump to the cylinders for kinks.

If one piston rod moves more slowly than the other, the cylinder with the slower rod is defective and should be replaced.

If both rods move slowly, or do not move at all, disassemble and repair the pump.

PART 16-2 ASSEMBLY REPLACEMENTS

1 MOTOR AND PUMP

A pump repair kit and a reservoir repair kit are available for service.

REMOVAL

1. Lower the top.

2. Disconnect the battery positive cable.

3. Disconnect the motor leads at the junction block, and disconnect the ground wire.

4. After removing the attaching screws, remove the motor and pump assembly. Do not lose the rubber grommets.

5. Vent the reservoir by removing the filler plug, and then install the filler plug. **The reservoir must be vented to avoid the possibility of fluid spraying when the hoses are disconnected.**

6. After placing cloths under the hose connections, disconnect the hoses and then plug the open fittings and lines.

DISASSEMBLY

1. Remove the filler plug, and drain the fluid from the reservoir into a clean container.

2. Scribe lines on the reservoir, pump body, and reservoir cover so that these parts can be assembled properly (Fig. 1).

3. Remove the center bolt from the reservoir cover (Fig. 2).

4. Remove the cover and reservoir, and the two O-ring seals at each end of the reservoir.

5. Remove the mounting bolts that hold the valve body on the pump body.

6. Place a cloth under the assembly, and carefully remove the valve body so that the check balls are not lost.

7. Remove both rotors and the drive ball (Fig. 2).

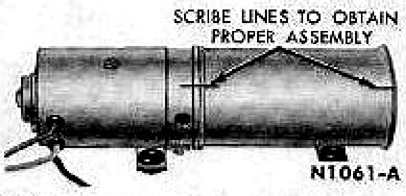

FIG. 1—Reservoir Marked Before Disassembly

ASSEMBLY

When assembling the pump, use all the parts supplied in the pump repair kit.

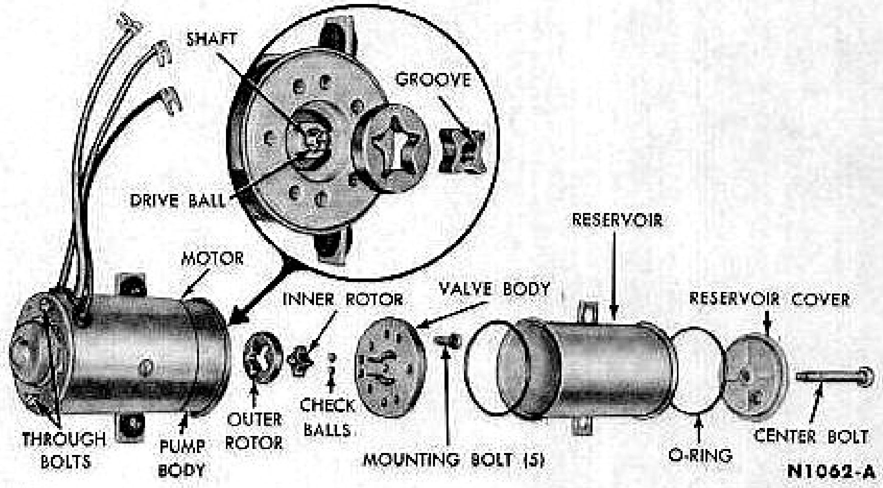

FIG. 2—Motor and Pump Disassembled

1. Install the drive ball and the inner rotor on the armature shaft.

2. Install the outer rotor, and place the check balls in the pump body channels.

3. Install the valve body on the pump body.

4. Install an O-ring seal in each end of the reservoir.

5. Install a new seal on the center bolt, and install the reservoir and cover on the valve body, using the lines previously scribed as guides (Fig. 1). The embossed lines in the cover must be positioned as in Fig. 3.

6. After positioning the assembly horizontally, fill the reservoir with heavy duty brake fluid to the level of the bottom of the filler plug hole. Install the filler plug with a new seal.

INSTALLATION

1. After removing the plugs from the lines and fittings, connect the lines to the pump.

2. Install the assembly, positioning the grommets properly.

3. Connect the motor lead wires at the junction block, and connect the ground wire.

4. Connect the battery positive cable.

5. Bleed the system by operating the top two or three times, and check the fluid level. The top must be in the raised position when the level is checked.

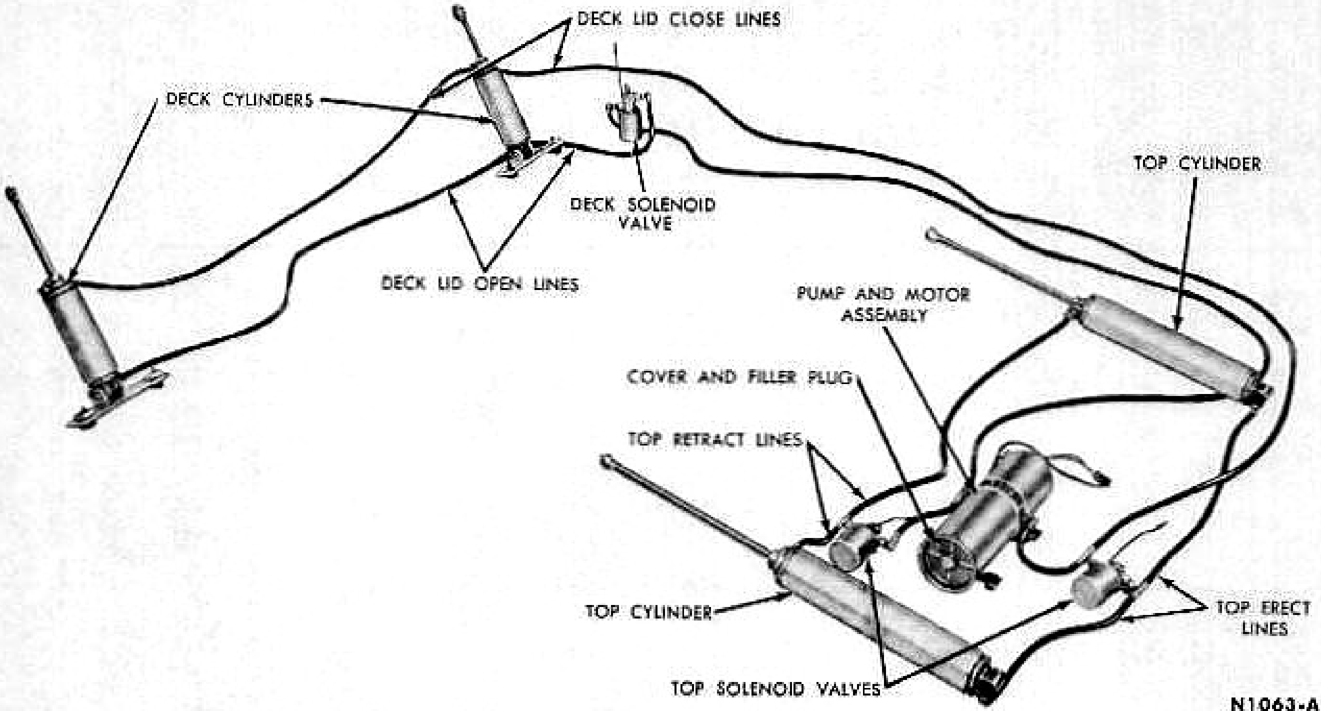

FIG. 3—Power Units

2 TOP LIFT CYLINDER

REMOVAL

1. Disconnect the battery positive cable.
2. Remove the rear seat cushion and back.
3. Disconnect and plug the hydraulic lines at both ends of the cylinder, using cloths to catch any leaking fluid.
4. After removing the hairpin clip and clevis pin at each end of the cylinder, remove the cylinder.

INSTALLATION

1. Position the cylinder in the car.
2. Install the clevis pins and hairpin clips at each end of the cylinder.
3. Connect the hydraulic lines.
4. Connect the battery positive cable.
5. Bleed the system by cycling the top two or three times, and check the fluid level.
6. Install the rear seat back and the cushion.

3 DECK LID LIFT CYLINDER

REMOVAL

1. Disconnect a battery cable.
2. Remove the back panel trim board on the side that the cylinder is to be replaced.
3. Remove the upper and lower clevis pins.
4. Remove the cylinder from the mounting, then place the cylinder into a suitable pan. Disconnect both hydraulic lines at the cylinder. Note the routing of each line, to assure correct installation (Fig. 14, page 16-10).

INSTALLATION

1. Connect the hydraulic lines.
2. Position the cylinder on the mounting and install the clevis pins.
3. Bleed the hydraulic system by cycling the top two or three times, then check and add fluid, if required.

PART 16-3 MAINTENANCE AND ADJUSTMENTS

1 MAINTENANCE

The top should be washed regularly with soap and water. Stains or spots not removable with ordinary washing may be eliminated by use of FoMoCo Interior Trim Cleaner or an abrasive cleaner used sparingly. **The seams should not be scrubbed with an abrasive cleaner.** After washing, the top should be rinsed thoroughly with clean water. The rear window should be washed with warm water and mild soap powder. The top should be allowed to dry while it is in the raised position with the header clamps fastened.

To keep the rear window slide fastener operating freely, apply a light coating of Stick Wax, preferably right after each washing.

2 ADJUSTMENTS

If the top is misaligned, corrections should not be made until after a check has been made for bent linkage. All pivot points in the top linkage should be lubricated periodically with light engine oil.

Before aligning the top, visually determine if the trouble results from top misalignment and/or window misalignment. It may be necessary to align both the top and the windows because of the relationship between the two. **Adjustments of the door and quarter windows must be checked and any necessary changes made before making top adjustments. These windows must be fully closed to insure proper adjustment.** Door and quarter window adjustments are outlined in Part 14-3.

There are four main adjustment areas for the top and the luggage compartment door: the header area, the rear rail area, the main pivot bracket area, and the luggage compartment door area.

HEADER AREA ADJUSTMENTS

HEADER BOW ADJUSTMENT

The header bow can be adjusted fore and aft to provide alignment with the header.

1. With a pencil, mark the present location of the joint between the header bow and the side rail. This mark provides a measuring point for adjustment.

2. Raise the top to a satisfactory working level, prop it in position, and remove the screws that hold the front part of the side rail forward weatherstrip to the side rail and the header bow. It is not necessary to remove the entire weatherstrip.

3. Using a putty knife loosen the front part of the weatherstrip from the side rail and the header.

4. Loosen the blind nuts (Fig.1), move the bow fore or aft to get proper alignment at the header, and tighten the nuts.

5. Loosen the dowels, and lower the top to check adjustment.

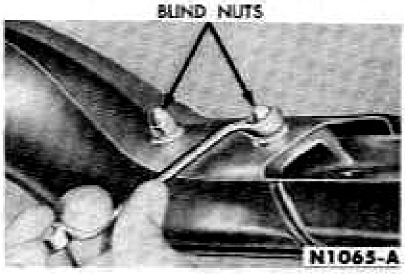

FIG. 1—Header Bow Adjustment

6. After making sure the dowels are aligned with their striker plates, tighten the dowels in position.

DOWEL ADJUSTMENT

The header bow dowels must be aligned with their striker plates in the header bow. After making any top adjustment, check the dowel alignment, and adjust if necessary. After removing the header bow weatherstrip, the dowels can be moved laterally by merely loosening the screws.

TOGGLE CLAMP ADJUSTMENT

The toggle clamps that hold the header bow against the header can be adjusted to provide a good seal.

1. To determine which side is not sealing, check the weatherstrip between the header bow and the header. Both toggle clamps need not be adjusted unless necessary.

2. Release the toggle clamps, and thread the toggle hook in or out until adequate sealing pressure is applied at the header weatherstrip.

REAR RAIL AREA ADJUSTMENTS

Side rail sag, top stack, and quarter window adjustments are made in the rear rail area (Fig. 2).

SIDE RAIL SAG

If the side rail sags above the door glass, adjust as follows, using the top of the door glass and the bottom of

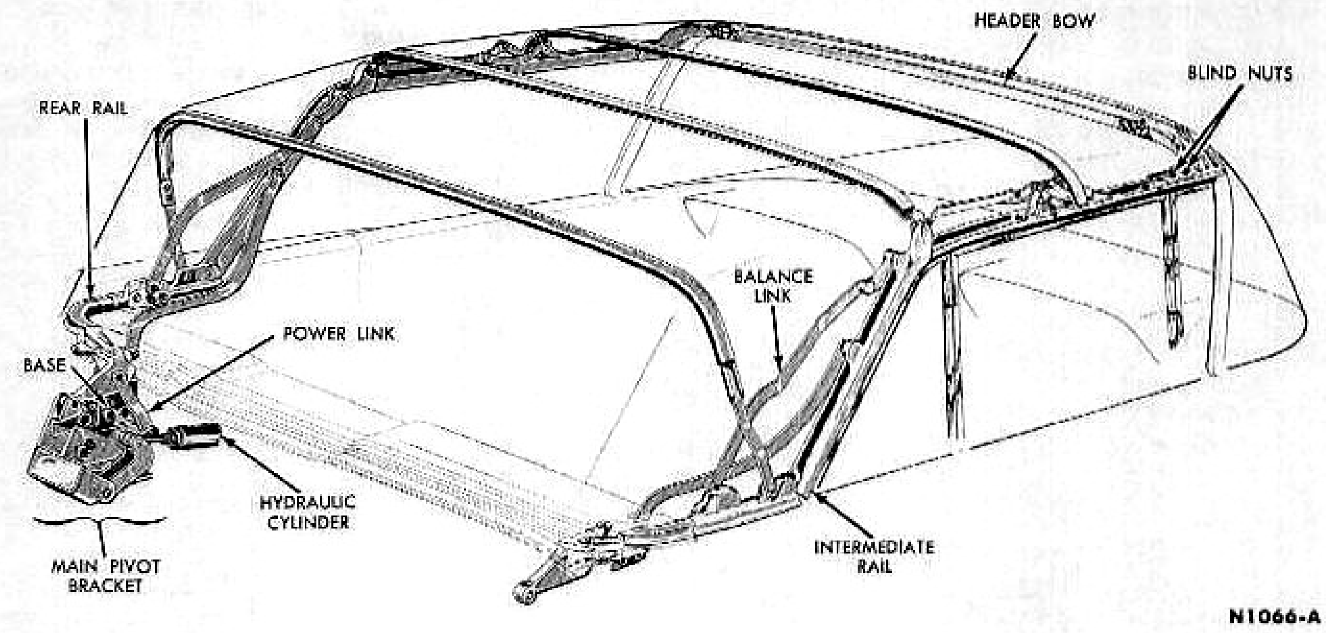

FIG. 2—Top Linkage

the side rail as points for measurement.

1. Release the toggle clamps.

2. Loosen the stack adjustment bolts shown in Fig. 3.

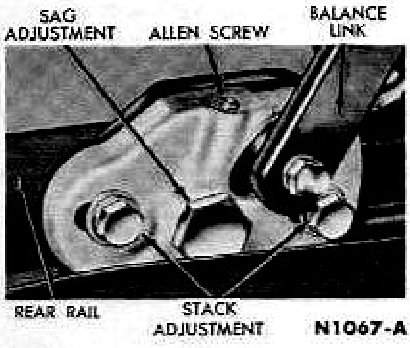

FIG. 3—Rear Rail Area Adjustments

3. Loosen the Allen set screw (Fig. 3), and turn the sag adjustment bolt until the door window top edge and the side rail weatherstrip are parallel. Make this check with the top clamped at the header.

4. Tighten the Allen screw and the stack adjustment bolts.

TOP STACK ADJUSTMENT

1. Stack the top.

2. If the top stack needs vertical adjustment for clearance, loosen the stack adjustment bolts shown in Fig. 3.

3. Move the bracket fore or aft to get suitable stack height, and tighten the bolts.

4. Raise the top slowly, checking for fore and aft clearance at the rear of the linkage, and fasten the clamps.

5. Check, and if necessary, adjust side rail sag.

QUARTER WINDOW CLEARANCE

Loosen the bolts marked "C" in Fig. 4, and adjust the serrations to get a snug fit between the rear quarter window and the intermediate side rail. After making this adjustment, check the top sag and the top stack adjustments.

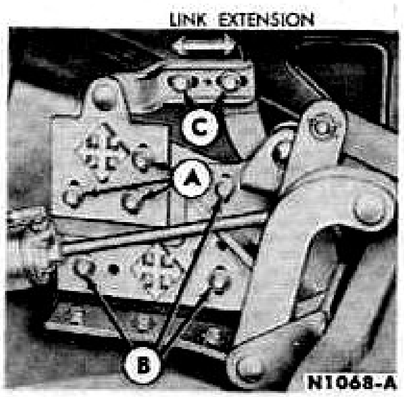

FIG. 4—Main Pivot Bracket Adjustments

MAIN PIVOT BRACKET AREA ADJUSTMENTS

The main pivot bracket and its support provide for shifting the entire top assembly fore and aft, vertically, and laterally. **Because movement of the main pivot bracket will disturb several other adjustments, move this bracket only after other adjustments have failed to solve a specific problem.**

FORE AND AFT ADJUSTMENT

This adjustment moves the top forward or rearward for a fit between the rear edge of the package tray and the body opening. This adjustment may also be necessary for proper mating of the header dowels and their strikers.

1. Loosen the bolts marked "A" and "B" in Fig. 4.

2. Move the top fore or aft to get a fit between the body and the rear edge of the package tray or to mate the header dowels and their strikers.

3. Tighten the bolts, and check other adjustments.

VERTICAL ADJUSTMENT

This adjustment moves the top for a fit between the rear edge of the package tray and the body opening.

1. Loosen the bolts marked "A" and "B" in Fig. 4.

2. Move the top up or down until the rear edge of the package tray is level with the body opening. There must be clearance for window movement.

3. Tighten the bolts, and check other adjustments.

LATERAL ADJUSTMENT

To obtain a centered fit between the side rail weatherstrips and the top edges of the door glasses and the quarter windows, the top may be moved sideways as follows:

1. At both main pivot brackets loosen the lateral adjustment bolts shown in Fig. 5.

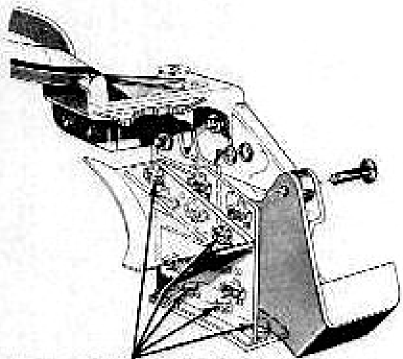

FIG. 5—Main Pivot Bracket Lateral Adjustment

2. Move the top to either side to get a centered fit at the side rail weatherstrips.

3. Tighten the bolts, and check other adjustments.

DECK LID AREA ADJUSTMENTS

FORE AND AFT ADJUSTMENT OF THE FINISH PANEL

Adjust the space between the edges of the finish panel and the deck lid and/or the body as follows:

1. Slightly loosen the screws that attach the finish panel hinge to the deck lid (Fig. 6).

2. Shift the finish panel so that there is equal space between the edges of the finish panel and the deck lid.

3. Tighten the retaining screws securely.

UP AND DOWN ADJUSTMENT OF THE FINISH PANEL

1. Slightly loosen the hinge arm retaining bolts at the finish panel (Fig. 6).

2. Raise or lower the finish panel until the finish panel is flush with the surface of the deck lid. Make certain that the weatherstrip seal is not disturbed.

3. Tighten the retaining bolts securely.

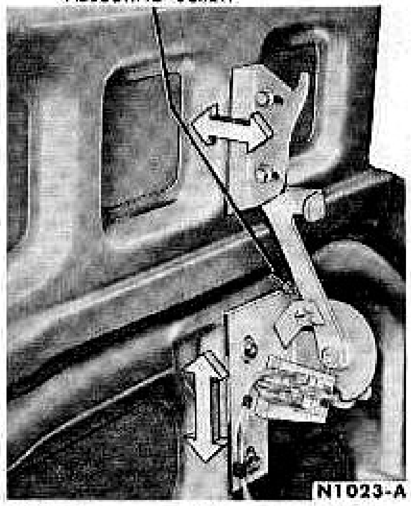

FIG. 6—Deck Lid Finish Panel Adjustment

SAG AND CROWN ADJUSTMENT OF THE FINISH PANEL

To adjust either sag or crown in the finish panel, turn the stop screw(s) shown in Fig. 6. Make certain that the lock nut is tightened after making the adjustment.

LATERAL OR FORE AND AFT DECK LID ADJUSTMENT

1. Slightly loosen the hinge retaining bolts (Fig. 7), at the deck lid.

2. Shift the deck lid either laterally, fore, or aft in the enlarged holes, until there is equal clearance along the sides and rear edges of the deck lid.

3. Tighten the hinge bolts securely.

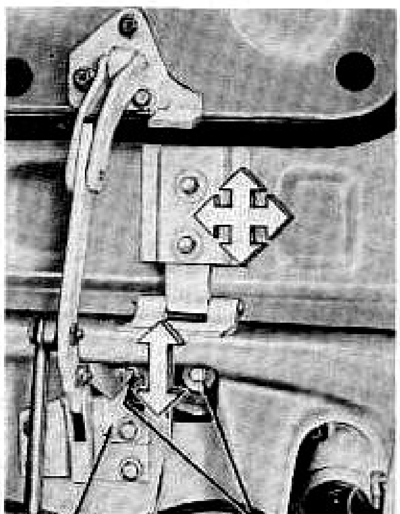

FIG. 7—Deck Lid Adjustment

UP OR DOWN ADJUSTMENT OF THE DECK LID

1. Loosen the deck lid hinge retaining bolts at the back panel. **It will be necessary to remove the limit switch (Fig. 7), to gain access to one of the hinge bolts.**

2. Raise or lower the hinge on the back panel until the deck lid is flush with the top surfaces of the quarter panels.

3. Tighten the hinge retaining bolts securely. Install and adjust the limit switch.

SWITCH ADJUSTMENTS

Figure 1, Page 16-2, shows the locations of the various switches.

TOP DOWN SWITCH

1. Lower the top to the full down position.

2. Place a 0.060 inch shim between the end of the switch shaft and the roof hinge arm.

3. Adjust the switch firmly to the end of its travel against the shim. Tighten the mounting screws and remove the shim.

DECK CLOSED SWITCH ADJUSTMENT

1. Use tool T57P-15780-A (Fig. 8).

2. Pull apart the switch quick disconnect and attach a continuity test light to the wires that go to the bottom set of contact terminals.

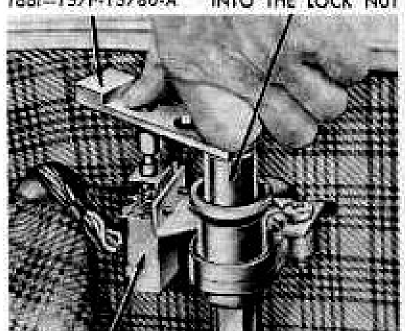

FIG. 8—Deck Closed Switch Adjustment

3. Press the tool firmly into the lock nut. Adjust the switch upward until the test light attached to the bottom set of contacts just goes on. Tighten the switch mounting screws and remove the tool.

DECK CLOSED SWITCH ACTUATOR ADJUSTMENT

1. Use tool T57P-15780-A (Fig. 9).

2. Position the tool over the lock screw (Fig. 9). Press the tool firmly against the lock screw shoulder.

3. Pivot the tool to line up with the switch actuator. Bend the actuator until it just touches the raised portion of the tool.

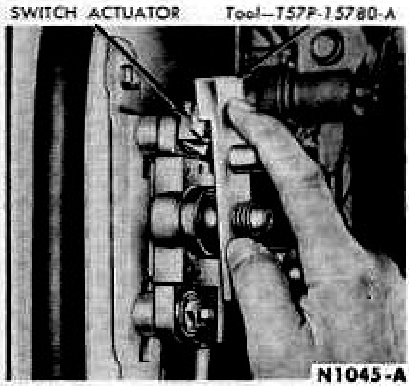

FIG. 9—Deck Closed Switch Actuator Adjustment

4. If the operation of the deck lid discloses that the deck lid pops up when opening, the switch actuator may be bent very slightly away from the deck lid.

TOP UP SWITCH

1. Raise the top to the full up position.

2. Place a 0.060 inch shim between the end of the switch shaft and the roof hinge arm.

3. Adjust the switch firmly to the end of its travel against the shim. Tighten the switch mounting screws, and remove the shim.

TRAY ERECT SWITCH

1. Extend the package tray on the deck lid to the end of its travel.

2. Place a 0.060 inch shim between the end of the switch shaft and the switch actuator on the tray support arm.

3. Adjust the switch firmly to the end of its travel against the shim. Tighten the switch mounting screws, and remove the shim.

TRAY RETRACT SWITCH

1. Retract the package tray on the deck lid to the end of its design travel.

2. Place a 0.060 inch shim between the end of the switch shaft and the switch actuator on the tray support arm.

3. Adjust the switch firmly to the end of its travel against the shim. Tighten the switch mounting screws, and remove the shim.

DECK OPEN SWITCHES

Both right and left deck open switches are adjusted as follows:

1. Raise the deck lid to the full open position.

2. Place a 0.060 inch shim between the end of the switch shaft and the actuator.

3. Adjust the actuator so that the switch shaft is fully depressed. Tighten the actuator mounting screws and remove the shim.

DECK LOCK ADJUSTMENT

For an adequate seal, the deck lock screw assembly must be adjusted to engage properly with the lock nut assembly.

DECK LOCK SCREW ASSEMBLY

Loosen the two nuts retaining the lock screw assembly to the deck lid and adjust the assembly fore or aft to align with the lock nut assembly.

DECK LOCK NUT HOUSING SUPPORT

Loosen the two screws retaining the lock nut housing support to the quarter panel and adjust the support side to side to align with the lock screw (Fig. 15 page 16-11).

DECK LOCK NUT SET SCREW

Loosen the set screw retaining the lock nut in the housing assembly and turn the lock nut in or out to the required position. The tool (T57P-53510-A) may be used to turn the lock nut as necessary (Fig. 15 page 16-11).

Do not attempt any trial locking of the deck unless the set screw is properly tightened.

DECK LOCK NUT HOUSING HEIGHT

The foot of the lock nut housing assembly may be adjusted up or down from the wheelhouse to insure the correct positioning of the O-ring. The O-ring should be centrally located in the housing support (Fig. 15 page 16-11).

PART 16-4 SLIDING ROOF PANEL

1 SLIDING ROOF PANEL REMOVAL AND INSTALLATION

When performing the following operations, refer to Figs. 1 and 2.

REMOVAL

1. Unlock the sliding roof and slide it rearward approximately 3 inches.

2. Remove the lock handle and cup.

3. Remove the right and left hand front slide track corners by removing the four retaining screws (Fig. 1).

4. Pry the front edge of the headliner lose from the sliding roof panel.

5. Remove the headliner by carefully sliding it forward and over the front edge of the opening.

6. Move the sliding roof panel to the fully closed position.

7. Remove the eight retaining screws from the front sliders and rear slider assembly and remove the roof panel.

8. Move the rear slider assembly forward and lift it out.

INSTALLATION

1. Position the rear slide assembly in the upper slot of the slide rails and slide it to the rearward position.

2. Position and center the roof panel in the opening.

3. Install the four retaining screws, securing the rear slider assembly to the roof panel.

4. Position the front sliders in the upper slot of the slide rails and install the four retaining screws finger tight.

5. Adjust the height of the forward roof panel edge by turning the adjusting collars so that the sliding roof panel is even with the roof top. Move the sliders outward to prevent excessive sidewise movement. Tighten the four retaining screws.

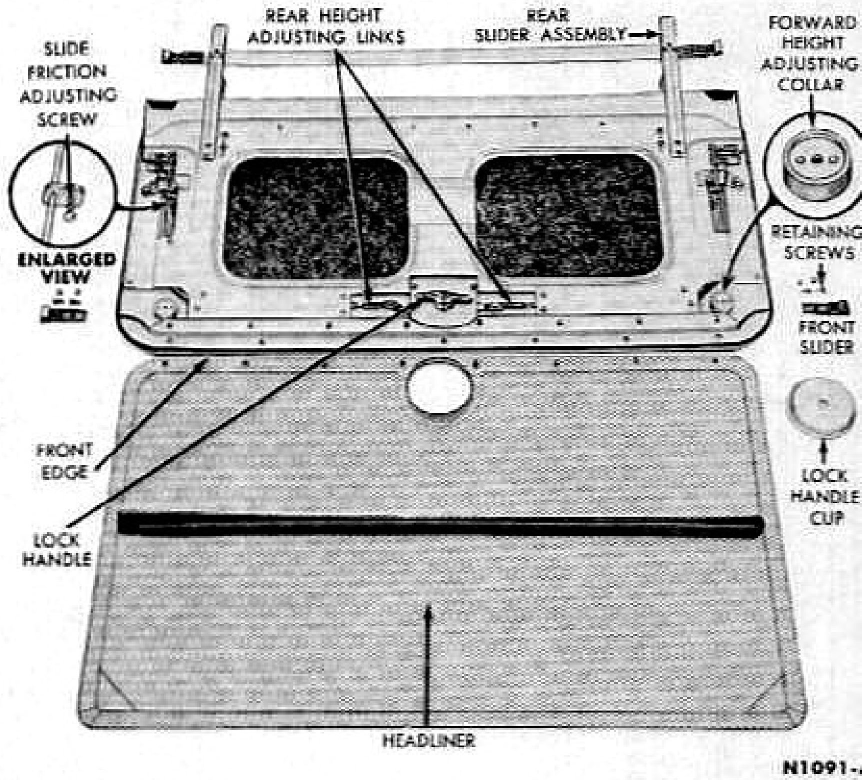

FIG. 1—Sliding Roof Panel and Headliner

6. Adjust the height of the rear roof panel edge by turning the adjusting links so that the roof panel is even with the roof top in the locked position.

7. Adjust the two slide friction adjusting screws (Fig. 2), so that the panel will remain in any position when the lock handle is turned.

8. Install the headliner by carefully sliding it into the lower slot of the slide rails.

9. Snap the headliner clips in place and install the lock handle cup and handle.

10. Install both front slide track corners with the four retaining screws.

11. Close and lock the sliding roof.

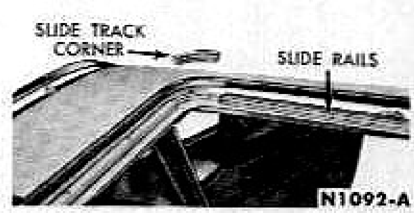

FIG. 2—Sliding Roof Panel Track and Corner

GROUP 17

MAINTENANCE AND LUBRICATION GUIDES, AND SPECIAL TOOLS

PAGE

PART 17-1 QUICK REFERENCE MAINTENANCE AND LUBRICATION GUIDE

Refer to Part 17-2 "Maintenance and Lubrication Procedure Guide" which describes the procedures to be followed for each operation listed in the "Quick Reference Maintenance and Lubrication Guide."

OPERATION	At Fuel Stop	Each 1000 Miles	Each 4000 Miles	Each 6000 Miles	Each 12,000 Miles	Each 24,000 Miles
Check Engine Crankcase Oil Level	X					
Check Radiator Coolant Level	X					
Check Battery Water Level	X					
Check Windshield Washer Reservoir Fluid	X					
Check Tire Air Pressures	X					
Lubricate Front Suspension Ball Joints and Steering Linkage		X				
Lubricate Universal Joints		X				
Lubricate Clutch Equalizer Bar		X				
Lubricate Door Lock Striker Plates		X				
Check Brake Master Cylinder Fluid Level			X			
Check Cruise-O-Matic Fluid Level			X			
Check Power Steering Reservoir Fluid Level			X			
Drain and Refill Engine Crankcase and Replace Oil Filter			X			
Check Manual-Shift Transmission Lubricant Level			X			
Check Rear Axle Lubricant Level			X			
Lubricate Transmission, Clutch, and Brake Linkage				X		
Perform Minor Engine Tune-Up				X		
Check Steering Gear Lubricant Level				X		

CONTINUED ON NEXT PAGE

OPERATION	At Fuel Stop	Each 1000 Miles	Each 4000 Miles	Each 6000 Miles	Each 12,000 Miles	Each 24,000 Miles
Check and Adjust Steering Gear Preload				X		
Adjust Clutch Linkage and Clutch Pedal Travel				X		
Lubricate Rubber Weatherstrips				X		
Lubricate Hood Lock and Catch				X		
Lubricate Deck Lid Latch				X		
Lubricate Door Locks				X		
Lubricate Door Lock Rotors				X		
Lubricate Glove Compartment Door Latch				X		
Lubricate Convertible Top Linkage				X		
Lubricate Door, Deck Lid, and Hood Pivots				X		
Perform Minor Brake Adjustment				X		
Clean Body and Door Drain Holes				X		
Cross Switch Tires				X		
Perform Major Engine Tune-Up					X	
Adjust Cruise-O-Matic Bands and Linkage					X	
Clean, Repack and Adjust Front Wheel Bearings					X	
Lubricate Window Regulators					X	
Lubricate 4-Way Power Seat Regulating Shaft					X	
Perform Major Brake Adjustment					X	
Check Headlight Alignment					X	
Lubricate Slip Yoke (Cruise-O-Matic Transmission Model)						X
Change Cruise-O-Matic Fluid						X
Replace Air Cleaner Element						X
Check Carburetor Throttle Shaft Wear						X
Check Exhaust System for Leaks						X
Check Rear Axle U-Bolt Torque						X
Check Shock Absorber Mounting and Bushings						X
Check Rear Spring Eye Bushings						X
Replace Spring Leaf Inserts						X
Check Convertible Top Operation and Alignment						X
Lubricate Speedometer Cable						X
Lubricate Heater and Air Controls and Blower Motor						X
Lubricate Air Conditioner Controls and Blower Motor						X
Lubricate Windshield Washer Control						X

PART 17-2 MAINTENANCE AND LUBRICATION PROCEDURE GUIDE

OPERATION AND LUBRICANT

CHECK ENGINE CRANKCASE OIL LEVEL	The level should be maintained between the "ADD OIL" and the "Full" mark on the dipstick. Use Engine Oil "For Service MS" S.A.E. 30 above 90°F. (prevailing temperatures) S.A.E. 20-20W between 20°F. and 90° F. S.A.E. 10W between −10°F. and 20°F. S.A.E. 5W below −10°F. (prevailing temperatures) Multi-viscosity oils (5W-20, 10W-30, etc.) may be used only if they are certified by the supplier to satisfy ASTM-GIV Test Sequences which describe the minimum requirements for API oil classification "For Service MS."
CHECK RADIATOR COOLANT LEVEL	The level should be maintained just below the bottom of the radiator filler neck.
CHECK BATTERY WATER LEVEL	The level should be maintained at the ring in the bottom of each battery cell vent well.
CHECK WINDSHIELD WASHER RESERVOIR FLUID	Refill the washer reservoir as required with water and the recommended proportion of FoMoCo All-Weather Windshield Washer Solution. Clean the washer nozzles if they are plugged.
CHECK TIRE AIR PRESSURES	The recommended air pressure is 24 pounds in all tires when cold. Somewhat higher pressures may occur after the vehicle has been driven some distance, however, do not remove air to reduce the pressure.
LUBRICATE FRONT SUSPENSION BALL JOINTS AND STEERING LINKAGE	Apply chassis lubricant with pressure gun.
LUBRICATE TRANSMISSION, CLUTCH, AND BRAKE LINKAGE	Aply engine oil—S.A.E. 10W.
LUBRICATE CLUTCH EQUALIZER BAR	Apply chassis lubricant with pressure gun.
LUBRICATE DOOR LOCK STRIKER PLATES	Apply stick wax.

CONTINUED ON NEXT PAGE

OPERATION AND LUBRICANT (Continued)

CHECK BRAKE MASTER CYLINDER FLUID LEVEL	The level should be maintained ½ inch below the top of the filler opening. Use heavy-duty brake fluid.
CHECK CRUISE-O-MATIC FLUID LEVEL	With the engine running at idle speed, the fluid at a normal operating temperature, and the transmission selector lever in "P" (Park), the level should be maintained at the full mark on the dipstick. Use Ford Automatic Transmission Fluid B8A-19582-A or Automatic Transmission Fluid—Type A, Suffix A. Other automatic transmission fluids marked "Type A" may not meet the operating requirements of this transmission. See Part 6-2 for complete procedures on checking and adding fluid.
CHECK POWER STEERING RESERVOIR FLUID LEVEL	The fluid level in the reservoir should be maintained ¼ inch from the top. Use Ford Automatic Transmission Fluid B8A-19582-A, or Automatic Transmission Fluid Type A, Suffix A.
DRAIN AND REFILL ENGINE CRANKCASE AND REPLACE OIL FILTER	Refer to "Check Engine Crankcase Oil Level". Follow instructions appearing on the cartridge when making oil filter replacement.
CHECK MANUAL-SHIFT TRANSMISSION LUBRICANT LEVEL	The level should be maintained at the bottom of the filler hole. Use Ford Lubricant B9A-19580-B (S.A.E. 80).
CHECK REAR AXLE LUBRICANT LEVEL	The level should be maintained at the bottom of the filler hole. Use Ford Lubricant B9A-19580-A (S.A.E. 90) above −25°F., B9A-19580-B (S.A.E. 80) below −25°F. Equivalent substitute lubricants must conform to Ford Specifications M-2C34 (S.A.E. 90) or M-2C42 (S.A.E. 80).
PERFORM MINOR ENGINE TUNE-UP	Clean, adjust and test the spark plugs. Check and tighten the intake manifold bolts. Check and adjust the tension of all drive belts. Check the state of charge of the battery. Check the condition of the distributor breaker points and clean the distributor cap and rotor. Check and adjust point dwell. Clean the fuel pump sediment bowl. Check and adjust ignition timing. Check and adjust the engine idle speed. Adjust the idle fuel mixture. Lubricate the exhaust control valve by applying lock lubricant or a mixture of penetrating oil and colloidal graphite to the pivot points. Clean the dry-type air cleaner filter element by removing the air cleaner assembly from the carburetor and lifting out the element. Tap the element against a flat surface to remove dust particles. Wipe the air cleaner housing and reassemble the components.
CHECK STEERING GEAR LUBRICANT LEVEL	Remove the lowest bolt in the steering gear housing cover and check for presence of lubricant. To add lubricant, turn the steering wheel to the left to move the ball nut below the filler hole, remove filler plug, and fill until lubricant comes out of the bolt hole. Use Ford Lubricant B8A-19578-A.
CHECK AND ADJUST STEERING GEAR PRELOAD	Steering gear preload is dependent primarily upon proper steering shaft bearing and sector gear adjustments. See Part 9-1 for detailed instructions regarding adjustments.

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OPERATION AND LUBRICANT (Continued)

ADJUST CLUTCH LINKAGE AND CLUTCH PEDAL TRAVEL	Clutch adjustments are required whenever the clutch does not engage or disengage properly, or when new clutch parts are installed. Both total and free travel of the pedal should be properly adjusted. See part 5-1 for complete adjustment procedure.
LUBRICATE RUBBER WEATHERSTRIPS	Apply Silicone lubricant.
LUBRICATE HOOD LOCK AND CATCH	Apply Lubriplate.
LUBRICATE DECK LID LATCH	Apply Lubriplate.
LUBRICATE DOOR LOCKS	Apply lock lubricant.
LUBRICATE DOOR LOCK ROTORS	Apply engine oil—S.A.E. 10W.
LUBRICATE GLOVE COMPARTMENT DOOR LATCH	Apply engine oil—S.A.E. 10W.
LUBRICATE CONVERTIBLE TOP LINKAGE	Apply engine oil—S.A.E. 10 W to all pivots.
LUBRICATE DOOR, DECK LID AND HOOD PIVOTS	Apply engine oil—S.A.E. 10W.
PERFORM MINOR BRAKE ADJUSTMENTS	Adjust the brakes whenever pedal travel is more than half the distance between the released position and the floor. See part 10-1 for adjustment procedures.
CLEAN BODY AND DOOR DRAIN HOLES	The drain holes are located in the underside of the body side and rocker panels and outboard of the weatherstrip at the bottom of the door. Check the drain holes for obstructions. Use a screwdriver to clear the openings.
CROSS SWITCH TIRES	All tires, including the spare, should be cross-switched as shown in Part 8-3. Torque wheel stud nuts to 55-85 foot-pounds.
PERFORM MAJOR ENGINE TUNE-UP	Clean, adjust and test the spark plugs. Check engine compression at each cylinder. Check and tighten intake manifold bolts. Check and adjust the tension of all drive belts. Check state of charge of the battery and clean and tighten cable clamps. Apply Lubriplate to battery terminals. Check the generator output. Check starter motor current draw. Check the coil output. Perform a primary circuit resistance test and a secondary circuit continuity test. Replace the breaker points and condenser if necessary. Check and adjust breaker arm spring tension. Lubricate the distributor cam with distributor cam grease. Oil the lubricating wick and the distributor bushing with engine oil—S.A.E. 10W. Check and adjust the point dwell. Check and adjust centrifugal advance. Check and adjust vacuum advance. Clean distributor cap and rotor. Clean fuel pump sediment bowl. Replace fuel filter cartridge. Check fuel pump pressure and capacity. Clean carburetor float bowls and adjust float settings. Check and adjust ignition timing. Adjust idle fuel mixture and engine idle speed. Lubricate the pivot points of the exhaust control valve with lock lubricant or a mixture of penetrating oil and colloidal graphite. Inspect radiator, radiator supply tank, hoses, and engine for leaks. Add rust inhibitor to radiator.

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OPERATION AND LUBRICANT (Continued)

ADJUST CRUISE-O-MATIC BANDS AND LINKAGE	Transmission band adjustments require special adjusting tools and procedures. See Part 6-2 for adjusting procedure details.
LUBRICATE SLIP YOKE (CRUISE-O-MATIC TRANSMISSION MODELS)	Apply Ford Lubricant B8A-19589-A to the splines. Inspect the rubber bellows-type seal on the end of the transmission extension housing after removing the drive shaft. If damaged, install a new seal.
CLEAN, REPACK AND ADJUST FRONT WHEEL BEARINGS	Clean the inner and outer bearing cones and rollers in solvent. Remove all lubricant from the hubs and spindles. Inspect all components for wear or damage. Replace if necessary. Repack bearings with wheel bearing grease and reassemble. See Part 8-3 for detailed procedures.
LUBRICATE WINDOW REGULATORS	Apply Lubriplate to the regulator assembly and all pivots.
LUBRICATE 4-WAY POWER SEAT REGULATING SHAFT	Apply Lubriplate to the threads of the regulating shaft.
PERFORM MAJOR BRAKE ADJUSTMENT	Remove all four drums and inspect linings. If lining thickness is less than 1/32 inch above the top of the rivets, replace the linings. Lubricate the brake shoe-backing plate contact areas with Lubriplate. Lubricate the parking brake strut and mechanism in the rear brake assembly. Inspect brake wheel cylinders for leaks and repair or replace if necessary. Install drums and adjust brakes. See part 10-1, 10-2, and 10-3 for detailed brake adjusting procedures.
CHECK HEADLIGHT ALIGNMENT	In the interest of safety and conformance to highway regulations, proper headlight alignment should be maintained at all times. However, it is imperative that suitable facilities and equipment are available to effect alignment that meets specifications. See part 12-1 for proper headlight alignment procedure.
CHANGE CRUISE-O-MATIC FLUID	Drain the converter and the transmission. Remove and clean the transmission oil pan and screen. Reassemble and add the proper amount of recommended transmission fluid. Check for leaks. Use Ford Automatic Transmission Fluid B8A-19582-A or Automatic Transmission Fluid Type A, Suffix A. See Part 6-2 for fluid change procedure details.
REPLACE AIR CLEANER ELEMENT	Remove the air cleaner from the carburetor. Remove the old element and clean the air cleaner body. Insert a new element and reassemble the components.
CHECK CARBURETOR THROTTLE SHAFT WEAR	See Part 3-2 for recommended procedure.
CHECK EXHAUST SYSTEM FOR LEAKS	Inspect the exhaust manifolds, muffler inlet pipe connection and mufflers for evidence of exhaust leakage. Tighten if loose and replace if burned through or cracked.

CONTINUED ON NEXT PAGE

OPERATION AND LUBRICANT (Continued)

CHECK REAR AXLE U-BOLT TORQUE	Torque rear axle U-bolts to 30-45 foot-pounds. Ten pounds less torque required with a used nut.
CHECK SHOCK ABSORBER MOUNTING AND BUSHINGS	With the car weight off the wheels, check the shock absorber mountings for looseness at the ends of the shock absorber. If the mountings are loose, tighten the mounting bolts. If the rubber bushings are cracked or torn, replace them. See Part 8-2 for replacement procedures.
CHECK REAR SPRING EYE BUSHINGS	With the car weight off the rear wheels, check for looseness at the front end of each rear spring. Inspect the eye bushing and replace if squashed or crumbled. See Part 8-2 for replacement procedure.
REPLACE SPRING LEAF INSERTS	The spring leaves must be dry and free of oil or dirt before new inserts are installed. Pry leaves apart to remove old inserts and install new ones (B8A-5586-A).
CHECK CONVERTIBLE TOP OPERATION AND ALIGNMENT	Lower the top to check its operation. Raise it to check fit at the header and the windows. See Part 16-3 for detailed specifications and adjustment instructions.
LUBRICATE SPEEDOMETER CABLE	Disconnect the cable housing at the speedometer and remove the cable from the housing. Inspect for kinks or worn spots. Lubricate the cable with cable lubricant B5A-19581-A and insert it into the housing. Rotate the cable to seat it all the way into the speedometer driven gear.
LUBRICATE HEATER AND AIR CONTROLS AND BLOWER MOTOR	Apply engine oil—S.A.E. 10W to all control pivots and to the motor bushings.
LUBRICATE AIR CONDITIONER CONTROLS AND BLOWER MOTOR	Apply engine oil—S.A.E. 10W to all pivots and to the motor bushings.
LUBRICATE WINDSHIELD WASHER CONTROL	Apply engine oil—S.A.E. 10W to the moveable components of the washer control.
LUBRICATE UNIVERSAL JOINTS	Apply chassis lubricant with pressure gun. See Part 7-1 for detailed procedure.

PART 17-3 SPECIAL TOOLS

ENGINE

Tool No.	Source	Tool Name and Purpose
LM-106	M	Valve Spring Tester
RC-500	Snap-On	Ring Groove Cleaner
835	KRW	Engine Stand (Existing)
1009	KRW	Engine Stand (New)
6001-ES	M	Engine Stand (New)
6001-102	M	Outboard Support (For 6001-ES Stand)
6001-AF	M	Adapters—Engine to Twin Post Stand
58-835-11	KRW	Outrigger Conversion Assembly (For 835 Stand)
3600-E	M	Piston Pull Scale
M-120-RA-72	M	Fixture—Connecting Rod Alignment
6059-B	M	Front Cover Pilot
6135-F	M	Piston Pin Remover & Installer
6261-H	M	Camshaft Bearing Remover and Replacer Adapter
6303-C 6303-N&P	M KRW	Engine Turning Wrench (Engine Removed)
6392-N	KRW	Adapter Plate—Check Flywheel Housing Runout (For Service Fix)
6513-CC	M	Valve Micrometer—Exhaust Valve
6513-EE	M	Compressor—Valve Spring
6701-B	M	Trimming Tool
S-8680-A S-8680-A-1 6505-F	Snap-On M	Gauge—Valve Stem Clearance
10505-C2 10505-N	M KRW	Generator Regulator Adjusting Wrench
12132 12132-Q	M KRW	Burnisher—Distributor Shaft Bushings
12132-A 12132-P	M KRW	Replacer—Distributor Shaft Bushings
12132-H 12132-N-1	M KRW	Remover—Distributor Shaft Bushings
12150-E 12150-N	M KRW	Wrench—Distributor Adjustment
12151 12151-N	M KRW	Tension Scale—Distributor Points

CARBURETOR

Tool No.	Source	Tool Name and Purpose
T109-22 9564-A	Carter M	Bending Tool
T109-29 9597-B	Carter M	Fast Idle Primary Throttle Plate Clearance (0.020 inch)
T109-193 9597-C	Carter M	Fast Idle Throttle Plate Clearance
T109-28 9550-AJ	Carter M	Float Level Gauge ($^3/_{16}$ inch)
T109-36 9545	Carter M	Unloader Clearance
T109-200 9545-A	Carter M	Fast Idle Linkage Setting (0.010 inch)
T109-213 9979-B	Carter M	Accelerating Pump Adjustment ($^{27}/_{64}$ inch)
T109-214 9581	Carter M	Primary Throttle Shaft Dog Adjustment
T109-215 9581-A	Carter M	Choke Linkage Setting (0.086 inch)
T109-234 9545-B	Carter M	Unloader Setting (0.067 inch) and Primary Throttle Shaft Dog Clearance (0.067 inch)

TRANSMISSION

Tool No.	Source	Tool Name and Purpose
1175-AE	M	Remover—Fordomatic and Cruise-O-Matic Front Pump and Extension Housing Oil Seal & Steering Gear Lower Worm Bearing Cup
7000-H 7000-SW	M KRW	Oil Drain Can with Removable Filter
7000-CJ 7000-W	M KRW	Holder—Transmission Assembly & Disassembly
7000-DD 7000-NW	M KRW	Air Nozzle Tip
7000-DE	M	Air Nozzle Assembly with Rubber Tip
7000-E	M	High Jack—Transmission
7000-EG	M	Universal Adapter for 7000-E
7052-N	KRW	Replacer—Drive Shaft & Overdrive Oil Seal
7059-N 7064	KRW M	Snap Ring Pliers
7113-N 7113-B	KRW M	Hook—Cluster Gear Alignment

TRANSMISSION continued on next page

TRANSMISSION (Continued)

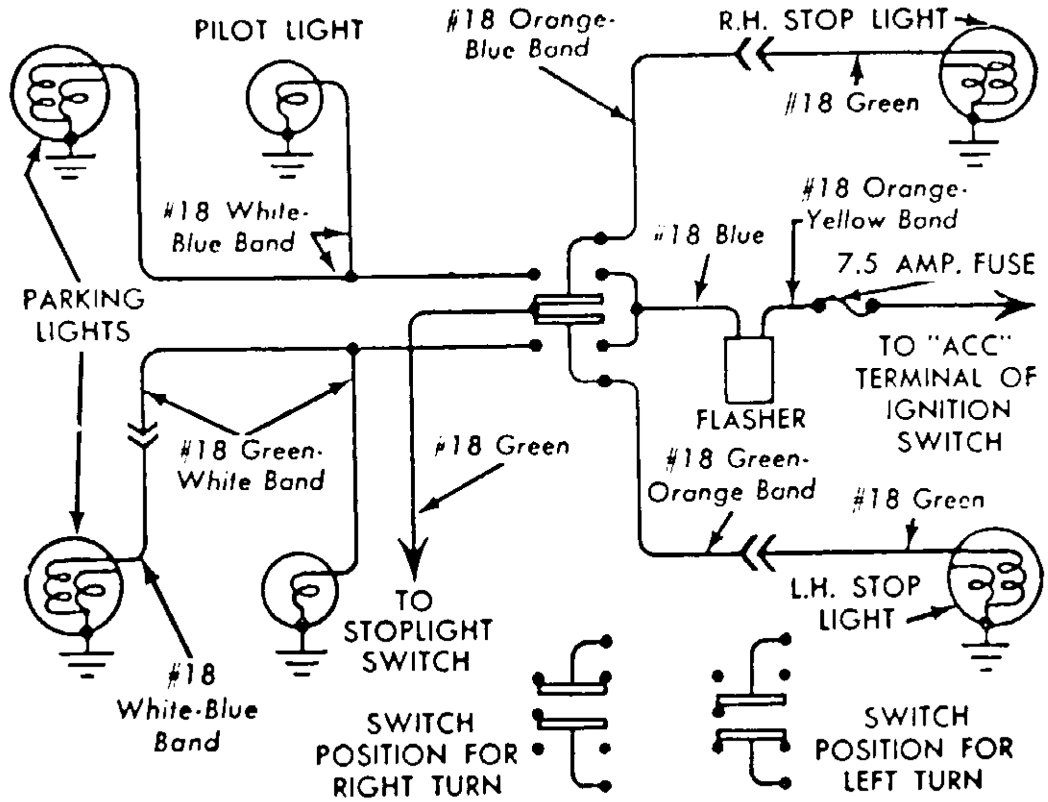
Tool No.	Source	Tool Name and Purpose
7195-C 7195-W	M KRW	Wrench—Rear Band Adjusting
7225-C 7225-W	M KRW	Wrench—Front Band Adjusting
7563-A 7563-N	M KRW	Clutch Disc Alignment Pilot
1011	OTC	Remover—Overdrive Free Wheeling Unit
7688-N 7688	KRW M	Replacer—Oil Seal Lockout Lever
7946 7946-W	M KRW	Replacer—One Way Clutch Inner Race (Overdrive)
7975 7975-W	M KRW	Guide Pin—Transmission to Converter Assembly
77067 77067-W	M KRW	Extension—Dial Indicator Support
77288 77288-W	M KRW	Replacer—Manual Shift Shaft Oil Seal
77530-A 77530-W	M KRW	Holder—Primary, Secondary Clutches & Converter Assembly
77565 77565-W	M KRW	Compressor—Front Clutch Spring
77763	M	Throttle Valve Stop Bending Tool
77837 77837-W	M KRW	Replacer—Front Pump Oil Seal
77869-A 77869-W	M KRW	Remover & Replacer—Rear Pump Discharge Tube
6915-AA 6916-N	M KRW	Positioning Tool—Overdrive Pawl
M207-5-12	M	Wrench for Overdrive Governor

FRONT SUSPENSION

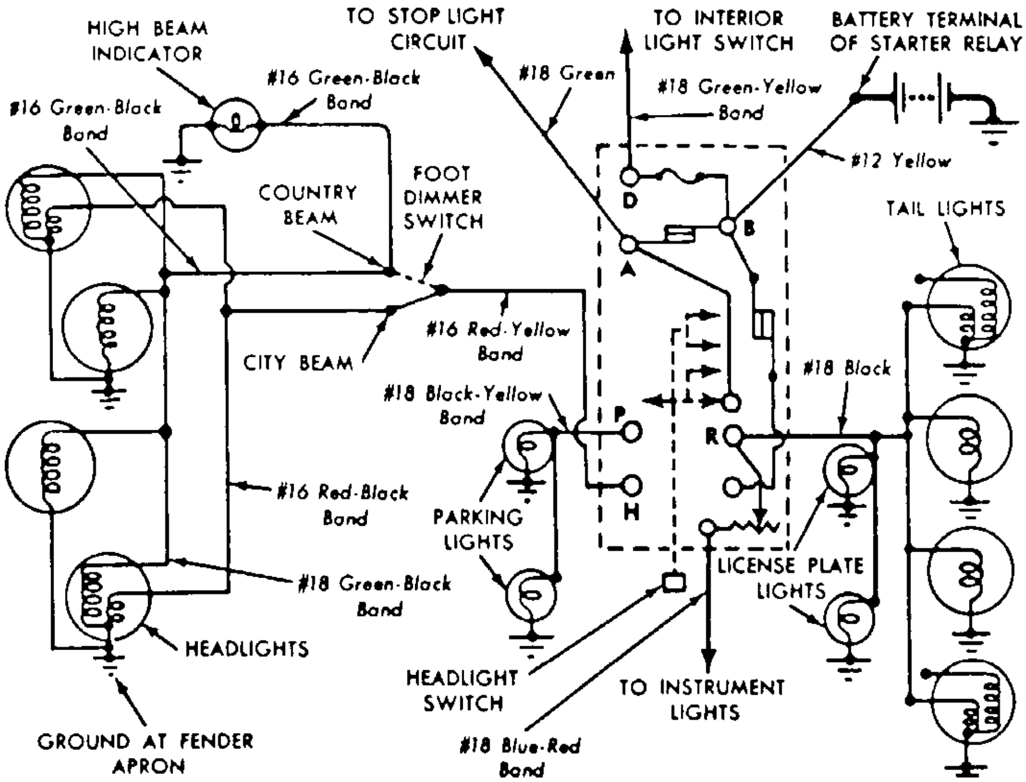
Tool No.	Source	Tool Name and Purpose
2086-L 3035-N	M KRW	Remover & Replacer—Brake Shoe Return Spring
CJ-94 3590-E	Snap-On M	Remover—Steering Arm
3600-AA 3600-N	M KRW	Remover—Steering Wheel

REAR AXLE AND SUSPENSION

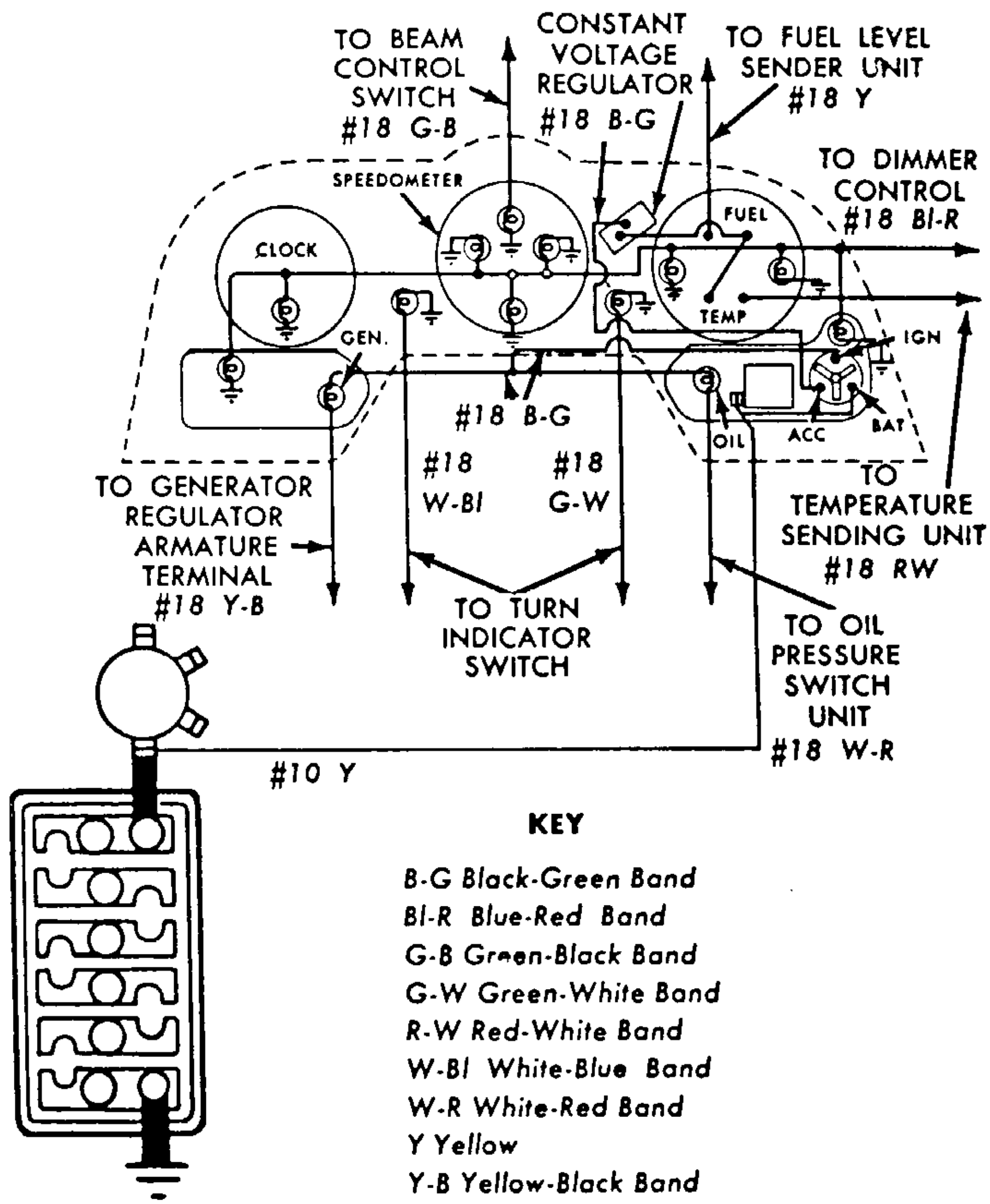
Tool No.	Source	Tool Name and Purpose
CJ-951 951	Snap-On OTC	Remover—Universal Bearing
1177 1177-N	M KRW	Replacer—Axle Shaft Oil Seal
1225-N 1225-B	KRW M	Replacer—Rear Axle Shaft Bearings
951	OTC	Remover—Axle Shaft Bearings
4201-C 4210-P	M KRW	Indicator—Ring Gear Backlash
4235-C 4235-N	M KRW	Remover—Axle Shaft & Bearing
4245-B	M	Replacer—Axle Bearing Oil Seal
4858-E 4858-P	M KRW	Replacer—Companion Flange and Pinion Bearing



1958-60 Turn Signal Circuit



1960 Headlight Circuit



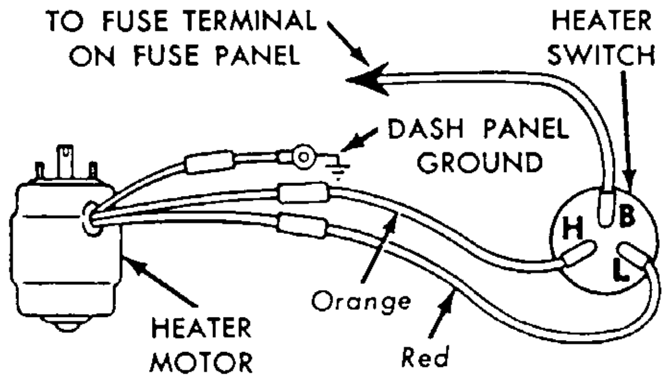
KEY

B-G Black-Green Band
Bl-R Blue-Red Band
G-B Green-Black Band
G-W Green-White Band
R-W Red-White Band
W-Bl White-Blue Band
W-R White-Red Band
Y Yellow
Y-B Yellow-Black Band

1958-60

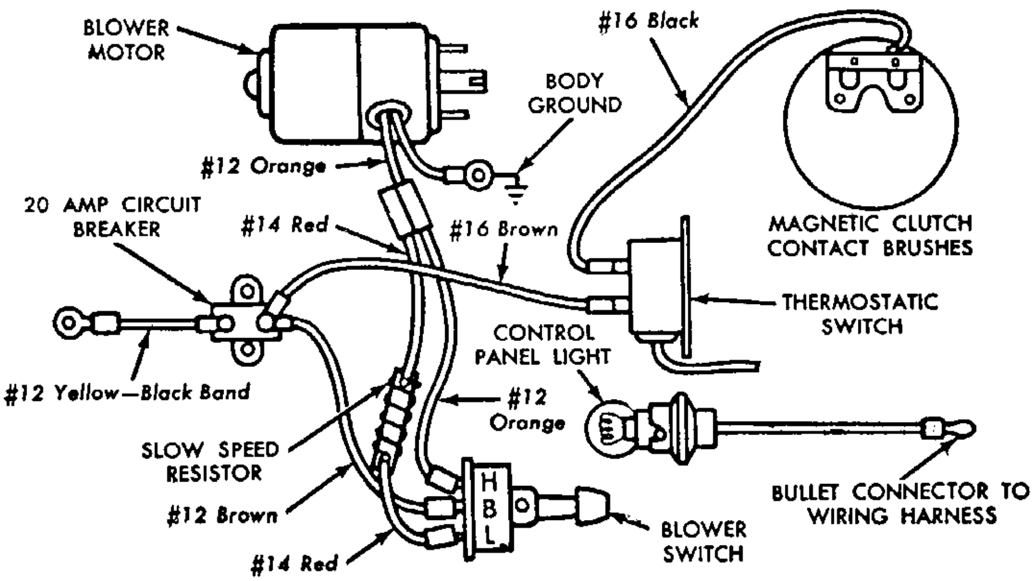
Instrument Cluster Circuit

THUNDERBIRD

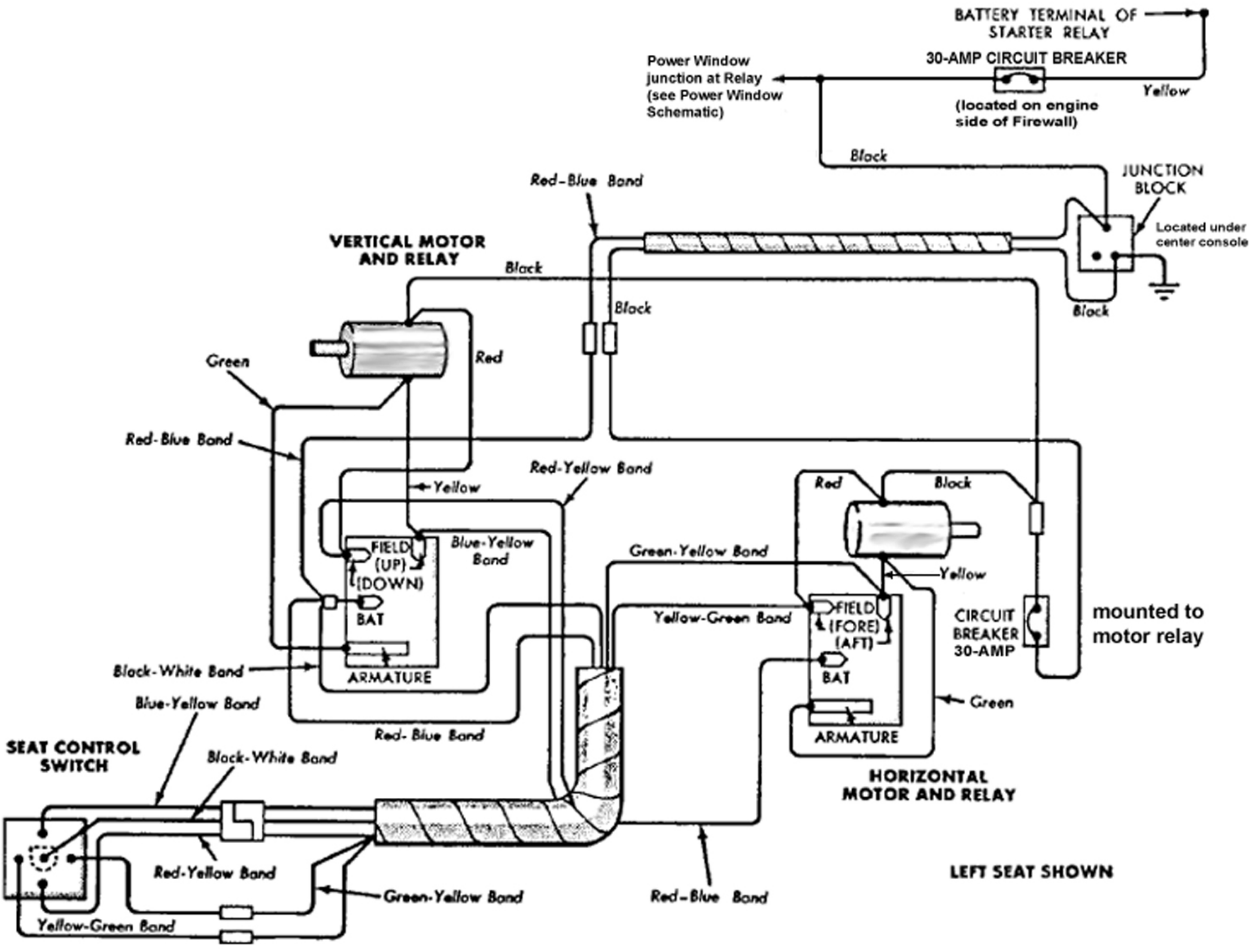


1960 Heater Circuit

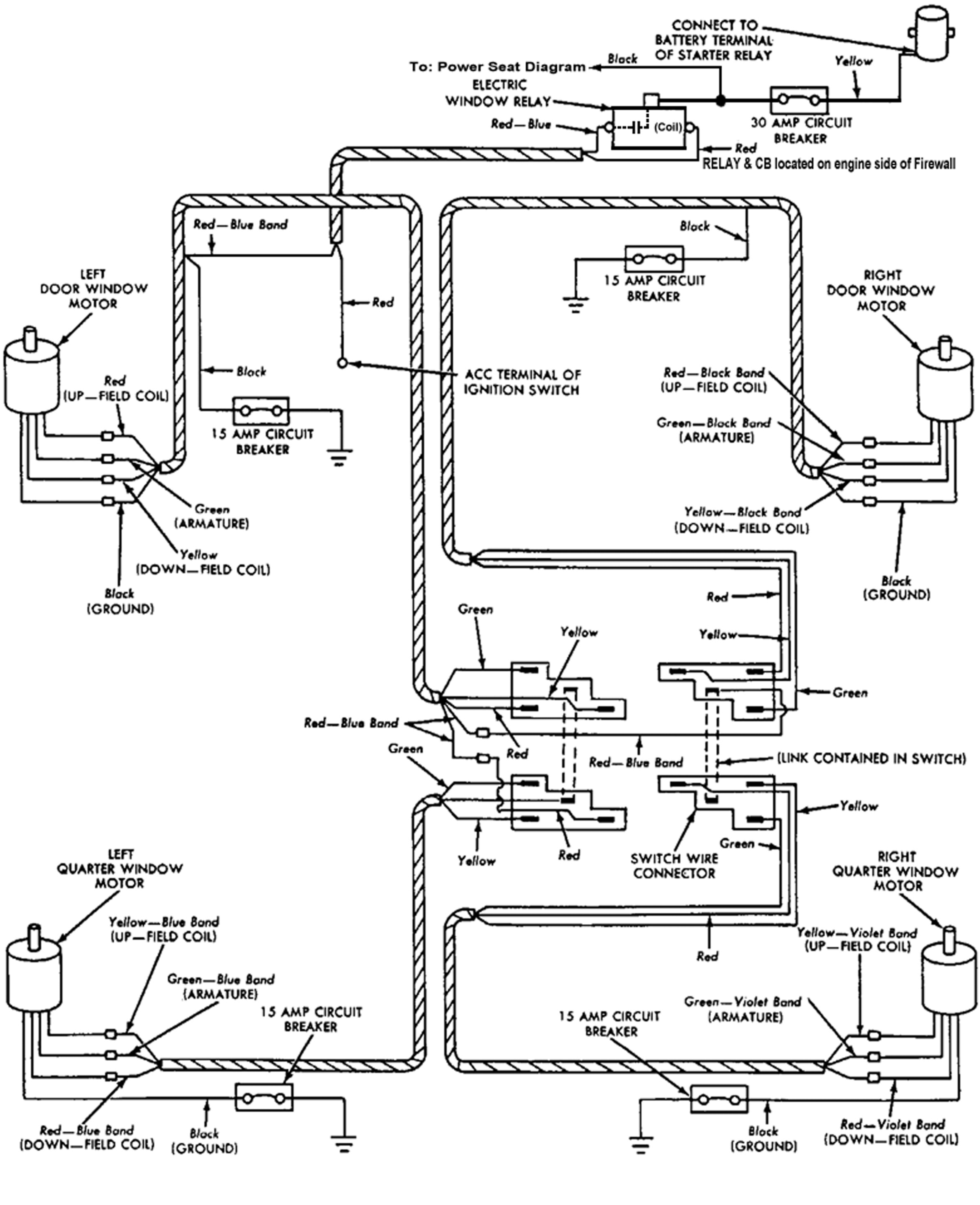
THUNDERBIRD 1960 Air Conditioner



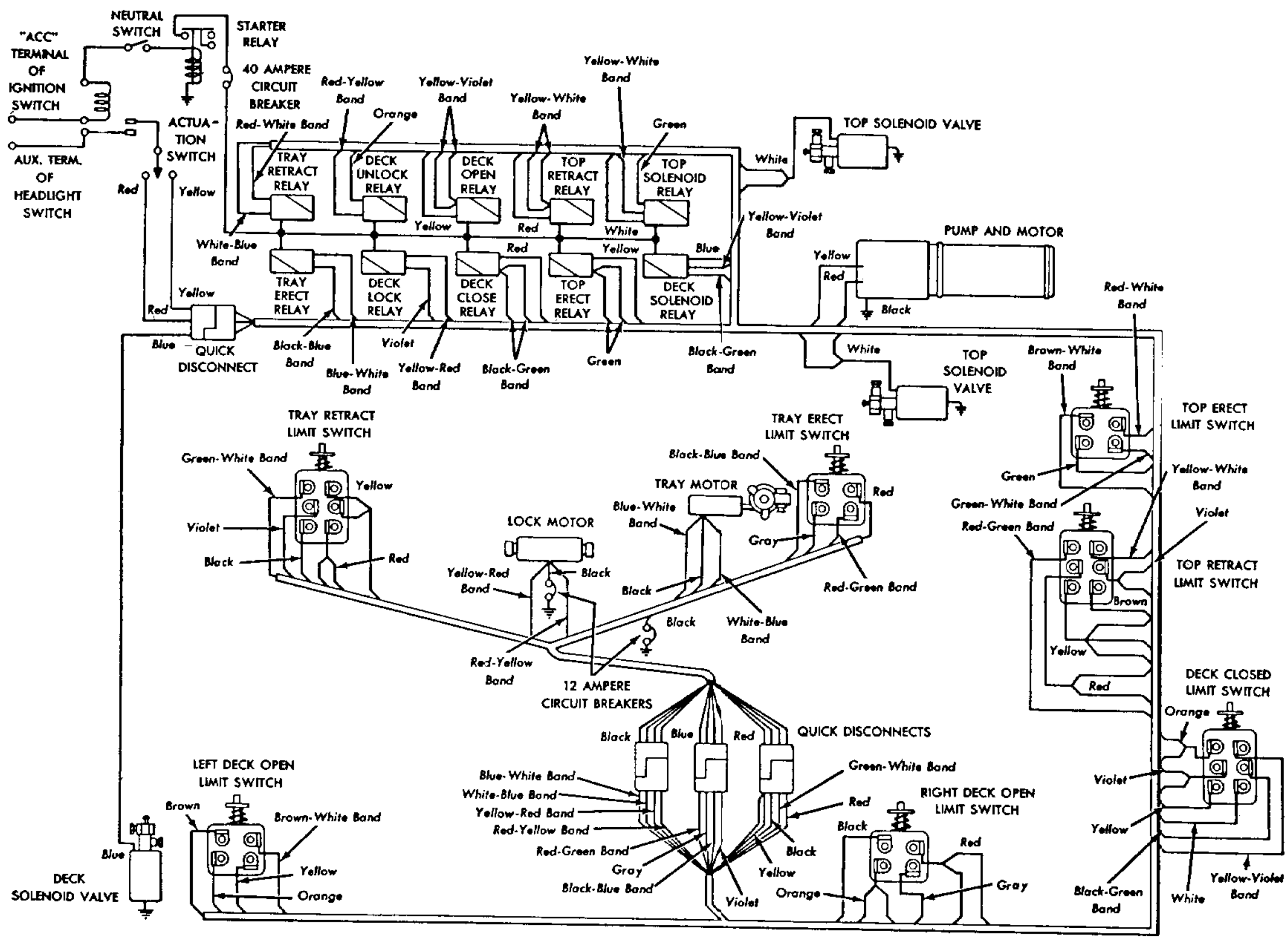
THUNDERBIRD 1958-60 Power Seat

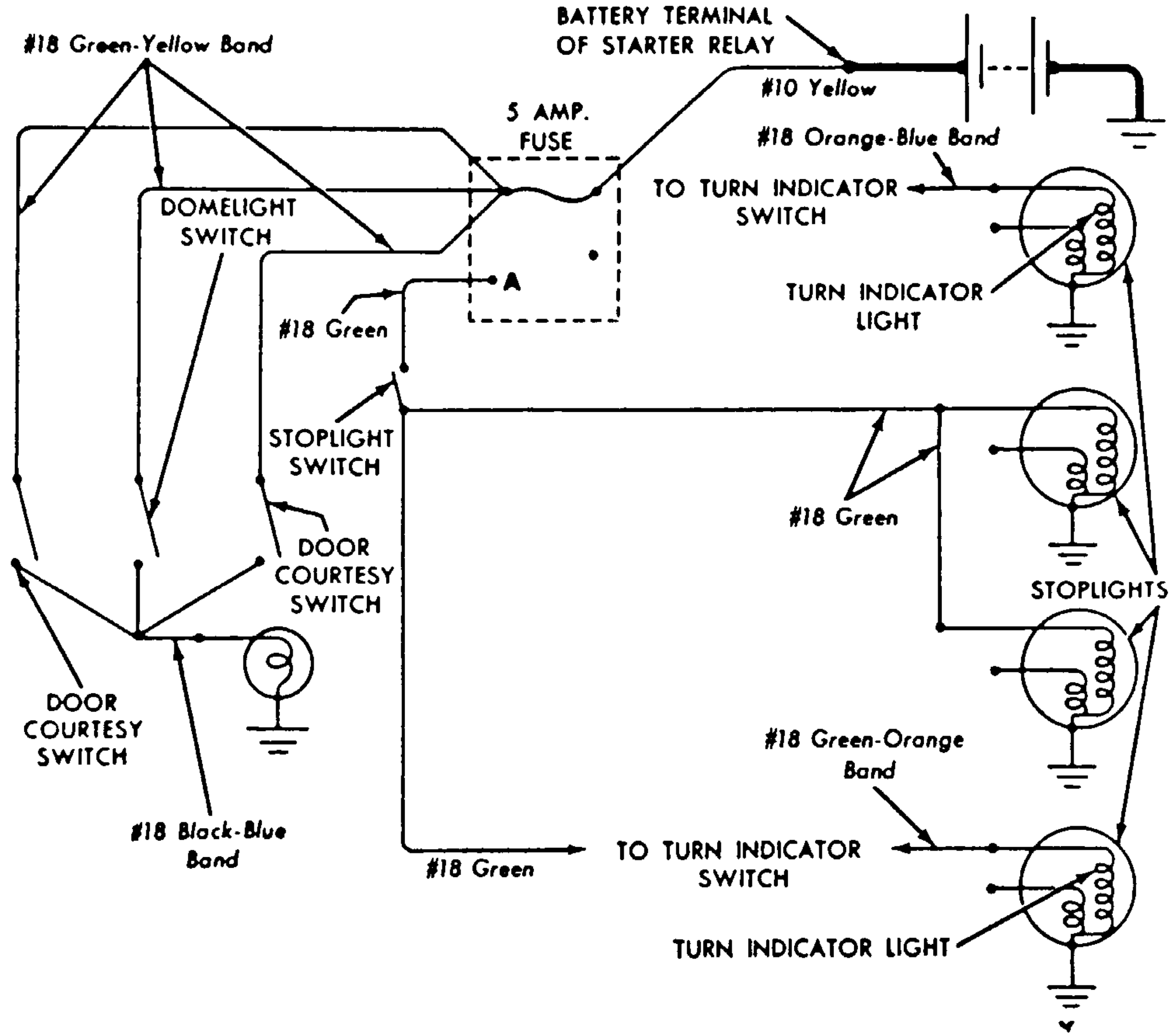


THUNDERBIRD 1958-60 Power Windows



THUNDERBIRD 1960 Deck Lid and Top Circuit





1960 Domelight and Stoplight Circuit

THUNDERBIRD 1957-60 Overdrive Circuit