

- (b) Remove the two screws and remove bezel by lifting bezel outward and upward (to clear metal retaining tabs).
- (c) Expose internal mechanism of mirror assembly by lifting top portion of back cover upward (to clear metal retaining tabs) and moving back cover rearward over mirror support. Move back cover rearward only far enough to provide access to potentiometer adjusters (Fig. 38).
- (d) To increase sensitivity of the "City" position, turn the arm of the potentiometer marked "City" in the direction indicated by the arrow.
- (e) To increase sensitivity for "Hi-way" driving, turn the arm of the potentiometer marked "Hi-way" in the direction indicated by the arrow.

**NOTE: To decrease sensitivity of either or both the potentiometers, turn potentiometer arms in the direction opposite to direction indicated by arrow.**

- (f) Replace back cover by positioning back cover over the two metal tabs and aligning screw holes in bottom of cover with threaded holes in mirror support.
- (g) Install bezel by aligning slots at top of bezel with metal tabs and aligning screw holes in bottom of bezel with threaded holes in mirror support replace screws (Fig. 36) and tighten securely.
- (h) Replace plastic switch knob.
- (i) Adjust mirror to desired position and test operation of unit.

## Section VII ENGINE DATA AND SPECIFICATIONS

### ENGINE

Type.....	90° V
Number of Cylinders.....	8
Bore—MC-1, MC-2.....	4.031"
MC-3, MY-1.....	4.188"
Stroke.....	3.750"
Piston Displacement—MC-1, MC-2.....	383 cu. in.
MC-3, MY-1.....	413 cu. in.
Compression Ratio.....	10.0 to 1
Compression Pressure at 150 rpm (plugs removed) Wide Open Throttle....	150 to 180 lbs.
Maximum Variation Between Cylinders (any one engine).....	25 lbs.
Firing Order.....	1-8-4-3-6-5-7-2

### CYLINDER NUMBERING

Left Bank.....	1-3-5-7
Right Bank.....	2-4-6-8

### CRANKSHAFT

Type.....	Fully Counter-Balanced
Bearings.....	Steel Backed Babbitt
Journal Diameter.....	2.7495 to 2.7505"
Crank Pin Diameter.....	2.374 to 2.375"
Maximum Out-of-Round Permissible.....	.001"
Number Main Bearings.....	5
Diametral Clearance Desired.....	.0005 to .0015"
End Play.....	.002 to .007"
Thrust Taken By.....	No. 3 Main Bearing
Finish at Rear Seal Surface.....	Diagonal Knurling
Interchangeability of Bearings.....	Upper Nos. 1, 2, 4, 5 Lower Nos. 1, 2, 4, 5

## ENGINE (Cont'd)

MAIN BEARINGS (Service) All Available in Standard and the following Undersizes.....	.001, .002, .003, .010, .012"
<b>CONNECTING RODS AND BEARINGS</b>	
Type.....	Drop Forged "I" Beam
Length (Center to Center).....	6.766—.770"
Weight (less bearing shells).....	29.4 oz.
Bearings.....	Steel-Backed Babbitt
Diameter and Length.....	2.375 x .927"
Diametral Clearance Desired.....	.0005 to .0015"
Maximum Allowable before Reconditioning.....	.0025"
Side Clearance.....	.009 to .017"
Bearings for Service.....	Standard .001, .002, .003, .010, .012" U.S.
Piston Pin Bore Diameter.....	1.0925 to 1.0928"
<b>CAMSHAFT</b>	
Drive.....	Chain
Bearings.....	Steel Backed Babbitt
Number.....	5
Thrust Taken by.....	Cylinder Block
Diametral Clearance.....	.001 to .003"
Maximum Allowable before Reconditioning.....	.005"
<b>CAMSHAFT BEARING JOURNALS</b>	
Diameter	
No. 1.....	1.998 to 1.999"
No. 2.....	1.982 to 1.983"
No. 3.....	1.967 to 1.968"
No. 4.....	1.951 to 1.952"
No. 5.....	1.748 to 1.749"
<b>CAMSHAFT BEARINGS</b>	
Diameter (after reaming)	
No. 1.....	2.000 to 2.001"
No. 2.....	1.984 to 1.985"
No. 3.....	1.969 to 1.970"
No. 4.....	1.953 to 1.954"
No. 5.....	1.750 to 1.751"
<b>TIMING CHAIN</b>	
Adjustment.....	None
Number of Links.....	50
Pitch.....	.50"
Width.....	.88"
<b>TAPPETS</b>	
Type.....	Hydraulic
Clearance in Block.....	.0005 to .0015"
Body Diameter.....	.9040 to .9045"
Clearance Between Valve Stem and Rocker Arm Pad.....	Dry Lash .060 to .210"
<b>PISTONS</b>	
Type.....	Horizontal Slot w/Steel Struts
Material.....	Aluminum Alloy Tin Coated

**ENGINE (Cont'd)**

Land Clearance (diametral).....	.041 to .047"
Clearance at Top of Skirt.....	.0005 to .0010"
Weight (std. through .040 oversize)	
MC-1, MC-2.....	724 gms.
MC-3, MY-1.....	780 gms.
Piston Length (overall).....	3.95"
Ring Groove Depth	
No. 1—MC-1 & MC-2.....	.213"
MC-3 & MY-1.....	.216"
No. 2—MC-1 & MC-2.....	.213"
MC-3 & MY-1.....	.216"
No. 3—MC-1 & MC-2.....	.195"
MC-3 & MY-1.....	.200"
Pistons for Service.....	Std. .005, .020, .040" O.S.
<b>PISTON PINS</b>	
Type.....	Press Fit in Rod
Diameter.....	1.0935 to 1.0937"
Length.....	3.4440 to 3.450"
Clearance in Piston.....	.00045 to .00075"
Interference in Rod.....	.0007 to .0012"
Piston Pins for Service.....	Standard Only
Direction Offset in Piston.....	Toward Right Side of Engine
<b>PISTON RINGS</b>	
Number of Rings per Piston.....	3
Compression.....	2
Oil.....	1
Width of Rings	
(Compression).....	.0775 to .0780"
(Oil).....	.1860 to .1865"
Piston Ring Gaps (all).....	.013 to .025"
<b>RING SIDE CLEARANCE</b>	
(Compression)	
Upper.....	.0015 to .0030"
Intermediate.....	.0015 to .0030"
(Oil).....	.0010 to .0030"
<b>VALVES—Intake</b>	
Material.....	Silicon—Chromium Steel
Head Diameter—MC-1, MC-2.....	1.95"
MC-3, MY-1.....	2.08"
Length (to top of valve face).....	4.79"
Stem Diameter.....	.372 to .373"
Stem to Guide Clearance.....	.001 to .003"
Maximum Allowable Before Reconditioning.....	.004"
Angle of Seat.....	45°
Adjustment.....	None
Lift.....	.389"
<b>VALVES—Exhaust</b>	
Material.....	Nitrogen Treated Manganese Chromium—Nickel Steel
Head Diameter.....	1.60"

## ENGINE (Cont'd)

Length (to top of valve face).....	4.79"
Stem Diameter.....	.371 to .372"
Stem to Guide Clearance.....	.002 to .004"
Maximum Allowable Before Reconditioning.....	.006"
Angle of Seat.....	45°
Adjustment.....	None
Lift.....	.389"
<b>VALVE SPRINGS</b>	
Number.....	16
Free Length.....	2.34"
Load when Compressed to (valve closed).....	1.860" @ 95 —105 lbs.
Load when Compressed to (valve open).....	1.470" @ 188—252 lbs.
Valve Springs I.D.....	1.010 to 1.030"
<b>CYLINDER HEAD</b>	
Number Used.....	2
Combustion Chamber.....	Wedge Type
Valve Seat Runout (maximum).....	.002"
Intake Valve Seat Angle.....	45°
Seat Width (finished).....	.060 to .085"
Exhaust Valve Seat Angle.....	45°
Seat Width (finished).....	.040 to .060"
Cylinder Head Gasket Compressed (thickness).....	.022"
<b>ENGINE LUBRICATION</b>	
Pump Type.....	Rotary, Full Pressure
Capacity (qts.).....	5*
Pump Drive.....	Camshaft
Operating Pressure at 40 to 50 mph.....	45 to 70 lbs.
Pressure Drop Resulting from Clogged Filter.....	7 to 9 lbs.

\*When Filter Element is Replaced, add 1 qt.

## TIGHTENING REFERENCE

	Torque Foot-Pounds	Thread Size
Connecting Rod Nut—Plain.....	45	3/8-24
Connecting Rod Nut—CST (Black).....	40	3/8-24
Cylinder Head Bolt.....	70	7/16-14
Main Bearing Cap Bolt.....	85	1/2-13
Spark Plug.....	30	14 mm
Camshaft Lockbolt.....	35	7/16-14
Carburetor to Manifold Nut.....	7	5/16-24
Chain Case Cover Bolt.....	15	5/16-18
Torque Converter Housing Bolt.....	30	3/8-16
Clutch Housing Bolt.....	30	3/8-16
Crankshaft Rear Bearing Seal Retainer.....	30	3/8-16
Crankshaft Bolt.....	135	3/4-16
Cylinder Head Cover Stud and Nut.....	40 in.-lbs.	1/4-28
Distributor Vacuum Line Tube Nut.....	95 in.-lbs.	3/8-24
Distributor Clamp Bolt.....	15	5/16-18

## TIGHTENING REFERENCE (Cont'd)

Engine Front Mounting to Frame Nut.....	85	1/2-20
Engine Front Mounting to Block Nut.....	45	7/16-20
Exhaust Manifold Bolt.....	30	3/8-16
Exhaust Pipe Flange Nut.....	40	7/16-20
Exhaust Pipe Clamp Bolt.....	20	3/8-24
Exhaust Pipe Support Clamp Bolt.....	20	3/8-24
Fan Attaching Bolt.....	15-18	5/16-18
Fan Belt Idler Pulley Nut.....	45	7/16-20
Fan Belt Idler Pulley Bracket Bolt.....	30	3/8-16
Flywheel Housing to Cylinder Block Bolt.....	50	7/16-14
Flywheel Housing Cover Bolt.....	7	1/4-20
Fuel Pump Attaching Bolt.....	30	3/8-16
Generator Bracket Bolt.....	50	7/16-14
Generator Mounting Nut.....	20	5/16-24
Generator Adjusting Strap Bolt.....	15	5/16-18
Generator Adjusting Strap Mounting Bolt.....	30	3/8-16
Intake Manifold Bolt.....	40	3/8-16
Manifold Heat Control Counterweight Bolt.....	50 in.-lbs.	#10-32
Oil Pan Drain Plug.....	35	5/8-14
Oil Pan Bolt.....	15	5/16-18
Oil Pump Cover Bolt.....	15	5/16-18
Oil Pump Attaching Bolt.....	35	3/8-16
Oil Filter Attaching Stud.....	30	3/4-16
Rocker Shaft Bracket Bolt.....	30	3/8-16
Starter Mounting Bolt.....	50	7/16-14
Vibration Damper Bolt.....	15	5/16-18
Valve Tappet Cover End Bolt.....	8	1/4-20
Water Pump to Housing Bolt.....	30	3/8-16
Water Pump Housing to Cylinder Block Bolt.....	30	3/8-16
A/C Compressor to Engine Bolt.....	30	3/8-16

## ENGINE

The new V-8 Engine, as shown in Figure 39, 40 and 41, is one of the finest, most efficient engines to be designed by Chrysler Engineering. It contains many weight reducing features.

Some of the new features, as shown in Figures 42, 43 and 44, are in-line overhead valves, wedge shaped combustion chambers, full length cylinder water jackets, rigid crankshaft and series flow cooling system. In addition, the volume of coolant in the engine has been reduced to improve engine warm up. The ignition distributor is located at the upper front end of the engine for easier servicing.

The lubrication system consists of an externally mounted rotor type oil pump of greater capacity, full flow oil filter and a series of passages where the oil is delivered to the engine. The oil filter can be installed by hand.

The engine has 10:1 compression ratio, is equipped with a dual carburetor on the Windsor Model (MC-1), and a 4-barrel carburetor on all other models, and uses premium fuel. The engine has exceptional smoothness and performance throughout the entire speed range.

### MINOR TUNE UP

A periodic engine tune up will assure maximum engine performance and fuel economy. The following procedures should be followed when performing minor engine tune up.

Check battery specific gravity, add water if necessary and clean and tighten battery connections. Clean and adjust the spark plugs (.035 inch gap). Tighten to 30 foot-pounds torque with Tool C-3054. Adjust the distributor contact points (.015 to .018

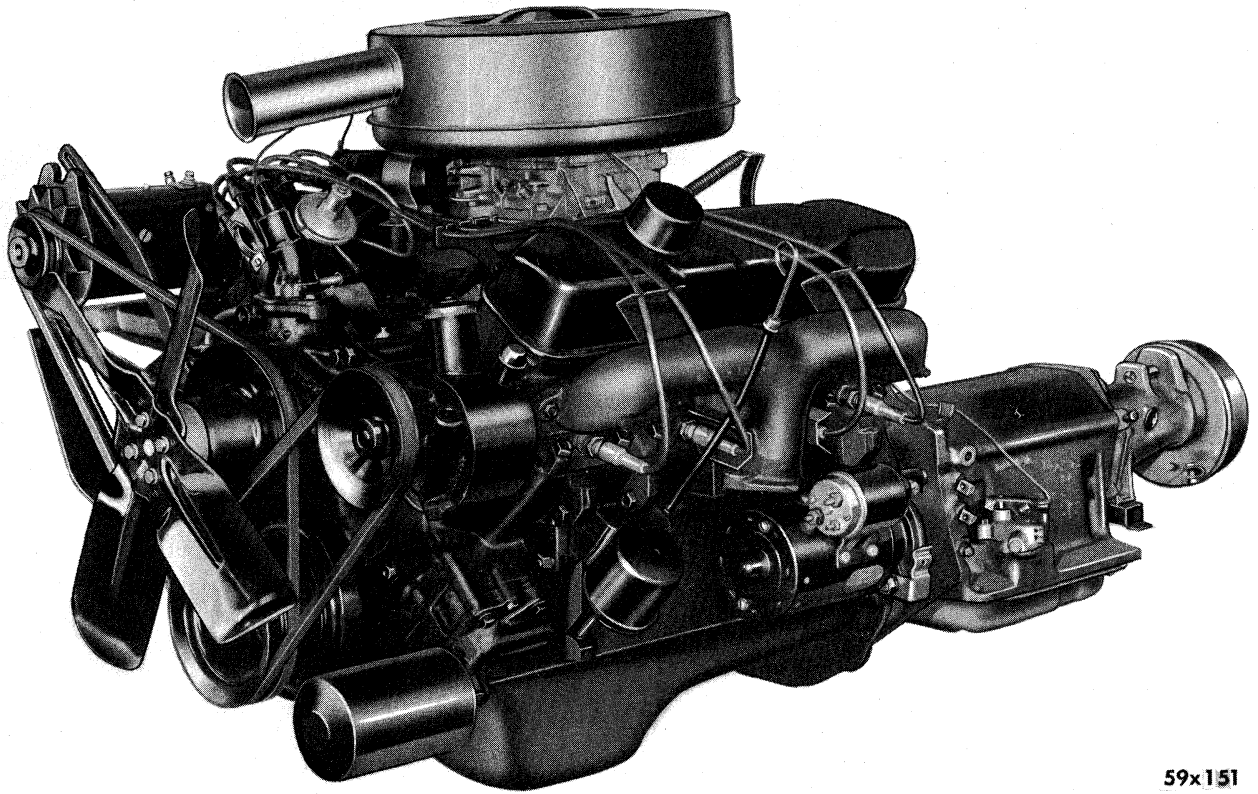


Fig. 39 — Chrysler Engine Assembly

59x151

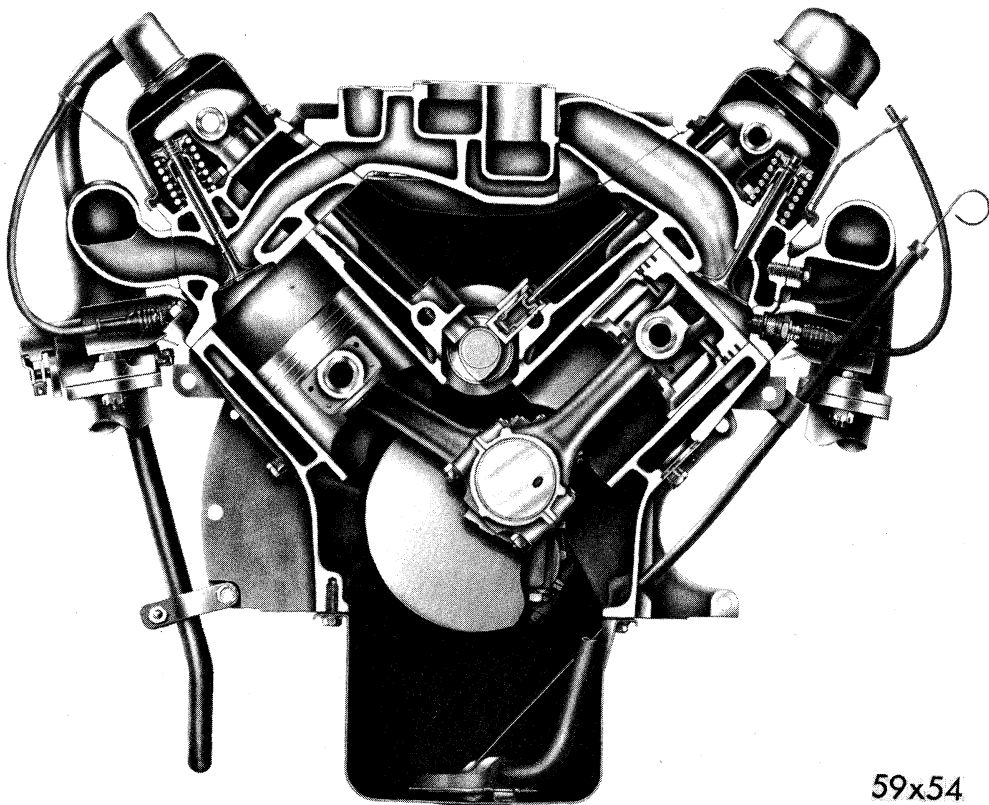


Fig. 40 — Engine End Sectional View

59x54

inch gap). Install new points if necessary. Check the distributor cap for cracks and corrosion. Inspect the rotor, rotor spring and plunger. Inspect the distributor to spark plug wires for brittle, cracked or frayed insulation. Inspect small lead wires for tightness, or damaged insulation. Check for excessive play in distributor vacuum advance plate bearing. Install a new plate if necessary. Reset the ignition timing. Inspect accessory belt drives referring to "Accessory Belt Drives," for proper adjustments. Tighten the carburetor flange nuts to **7 foot-pounds torque**. Set carburetor idle mixture adjustment. Adjust the throttle stop screw so engine idles at 450 to 500 rpm. Check manifold heat control valve in the right exhaust manifold for proper operation and apply Manifold Heat Control Valve Solvent Part Number 1879318 to the bushing and shaft, as shown in Lubrication Section.

#### MAJOR TUNE UP

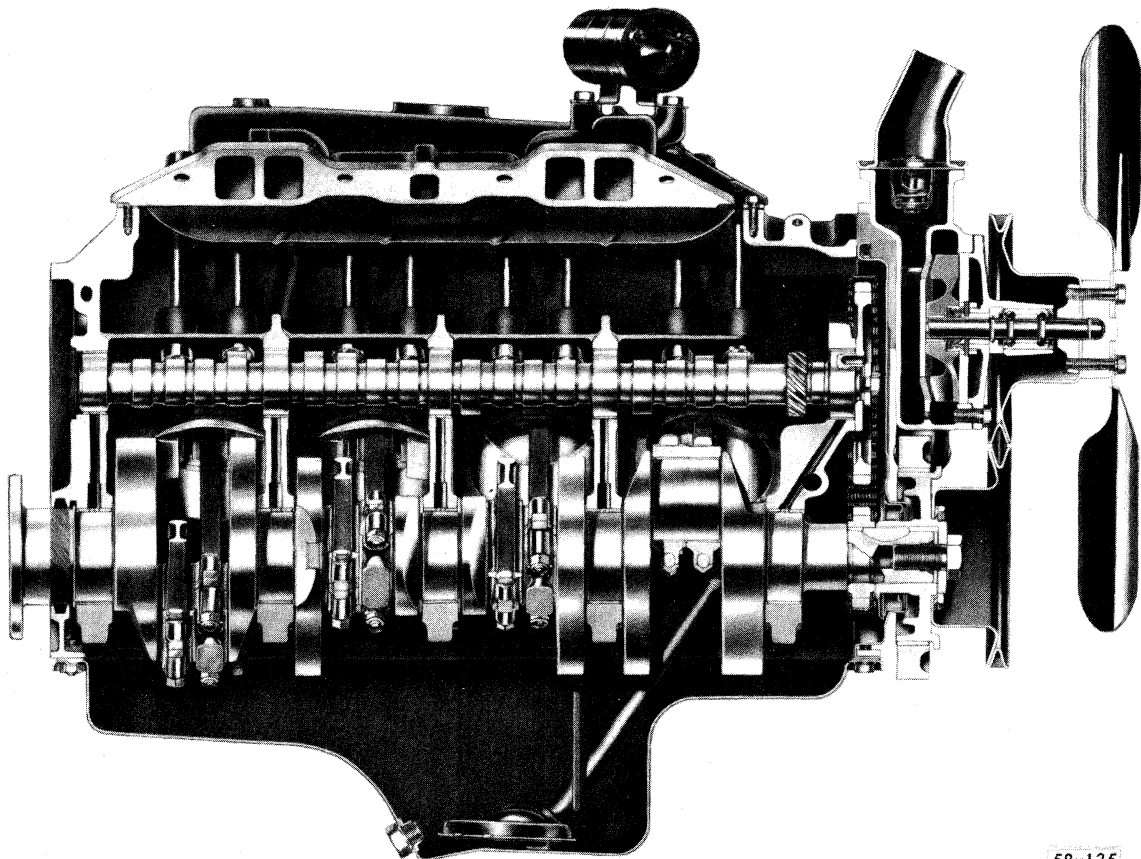
Perform all the steps of a "Minor Tune Up" and in addition, the following procedures should be followed when performing Major Engine Tune Up.

Tighten the manifold nuts. Perform the cylinder compression test. Compression pressures can be read from the top side of engine without interference using a 30 degree bend extension on the gauge. The compression should not vary more than 25 pounds between cylinders.

Refer to specifications for compression pressures. Test the coil, and condenser. Inspect the primary and secondary wires. Service the air cleaner — **DO NOT WASH OR OIL**. Service more frequently under severe dusty conditions. Replace air cleaner filter cartridge every 15,000 miles. Test fuel pump for pressure and vacuum. Refer to Fuel Section Specifications. Perform a combustion analysis. Adjust the carburetor. Road test the car as a final check.

#### REMOVAL OF THE ENGINE ASSEMBLY (From Car)

Drain the cooling system and remove the battery. Remove the fan shroud and radiator. Scribe the outline of hinge brackets on hood to assure proper adjustment when installing. Remove the hood. Disconnect fuel lines and wires attached to engine units.



58x135

Fig. 41 — Engine Side Sectional View

59x52

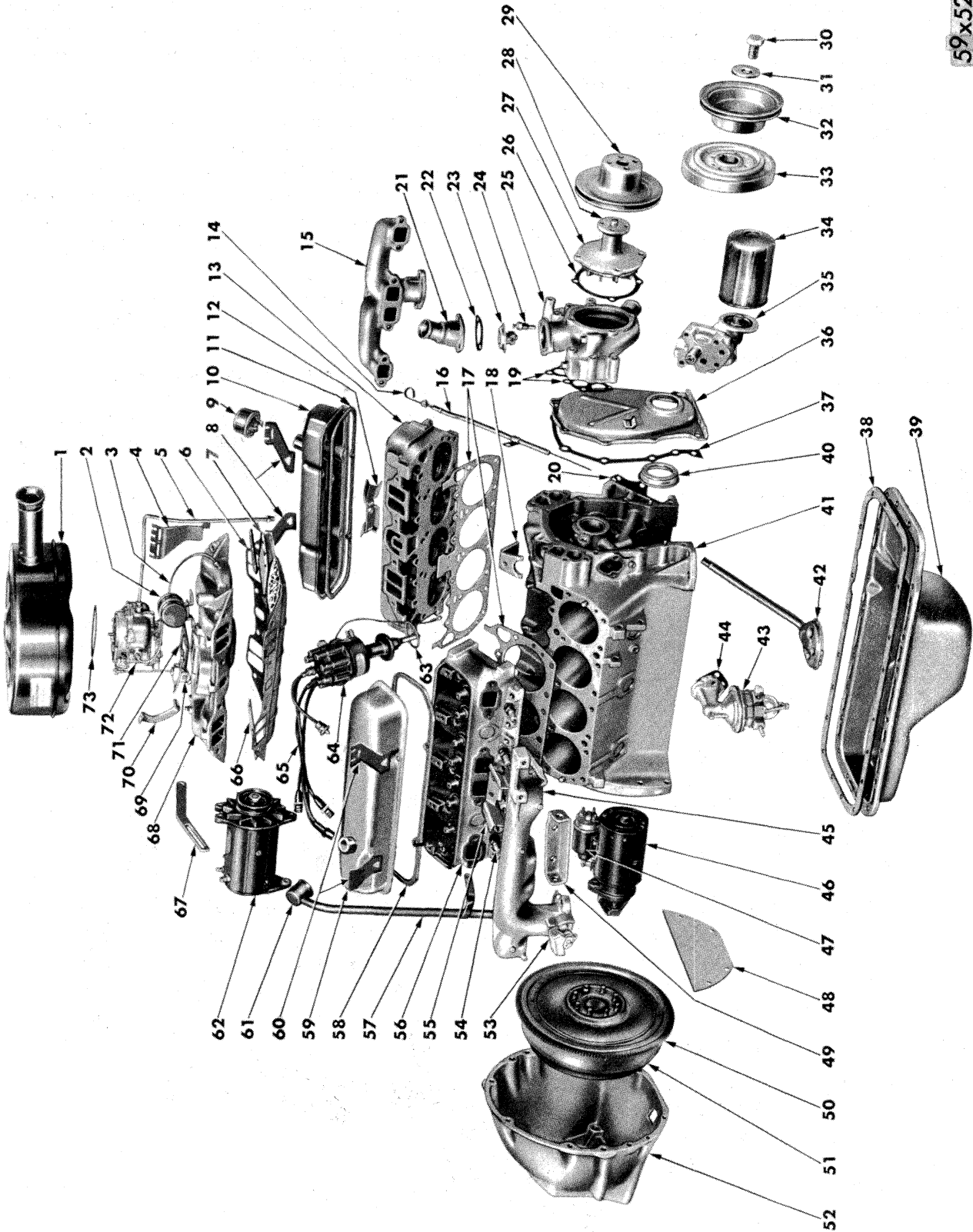


Fig. 42 — Engine External Parts



Fig. 42 — Engine External Parts

- |  |                               |  |                                   |
|--|-------------------------------|--|-----------------------------------|
| 1. Carburetor Air Cleaner                          | 18. Distributor Clamp         | 37. Chain Case Cover Gasket              | 56. Cylinder Head R               |
| 2. Coil  | 19. Water Pump Housing Gasket | 38. Oil Pan Gasket                       | 57. Crankcase Vent Tube           |
| 3. Vacuum Line                                     | 20. Oil Pump Housing Gasket   | 39. Oil Pan                              | 58. Rocker Cover Gasket R         |
| 4. Wiring Harness (bracket)                        | 21. Outlet Elbow              | 40. Chain Case Cover Oil Seal            | 59. Rocker Cover R                |
| 5. Fuel Line                                       | 22. Outlet Elbow Gasket       | 41. Cylinder Block                       | 60. Wiring Harness (brackets)     |
| 6. Tappet Chamber Cover and Intake Manifold Gasket | 23. Thermostat                | 42. Oil Screen Suction Pipe              | 61. Crankcase Vent Tube Cap       |
| 7. Reinforcement, silencer and Retainer            | 24. Temperature Sending Unit  | 43. Fuel Pump                            | 62. Generator                     |
| 8. Wiring Harness (brackets)                       | 25. Water Pump Housing        | 44. Fuel Pump Gasket                     | 63. Distributor Gasket            |
| 9. Oil Filler Cap                                  | 26. Water Pump Body Gasket    | 45. Exhaust Manifold R                   | 64. Distributor                   |
| 10. Rocker Cover L                                 | 27. Water Pump Body           | 46. Starter                              | 65. Wires                         |
| 11. Rocker Cover Gasket L                          | 28. Hub                       | 47. Solenoid                             | 66. Reinforcement                 |
| 12. Spark Plug Heat Shield                         | 29. Water Pump Pulley         | 48. Torque Converter Housing Dust Shield | 67. Generator Adjusting Strap     |
| 13. Cylinder Head L                                | 30. Bolt                      | 49. Generator Bracket                    | 68. Intake Manifold               |
| 14. Oil Level Indicator                            | 31. Washer                    | 50. Ring Gear                            | 69. Automatic Choke               |
| 15. Exhaust Manifold L                             | 32. Crankshaft Pulley         | 51. Torque Converter                     | 70. Control Spring Bracket        |
| 16. Oil Level Indicator Tube                       | 33. Vibration Damper          | 52. Torque Converter Housing             | 71. Carburetor Gasket             |
| 17. Cylinder Head Gasket                           | 34. Oil Filter                | 53. Manifold Heat Control Valve          | 72. Carburetor                    |
|  | 35. Oil Pump                  | 54. Spark Plug                           | 73. Carburetor Air Cleaner Gasket |
|  | 36. Chain Case Cover          | 55. Spark Plug Heat Shield               |                                   |

Remove the air cleaner and carburetor. Attach the engine lifting fixture Tool C-3466 to carburetor flange studs on the intake manifold and attach a chain hoist to the fixture eyebolt. Disconnect the propeller shaft, wires and linkage at transmission. Disconnect exhaust pipes at manifolds. Be sure the exhaust system is sufficiently supported while the engine is removed. Remove rear crossmember to transmission support attaching bolts.

**NOTE:** Place a rollaway jack under the transmission

to relieve weight from the crossmember. Place a wood block between jack and transmission to avoid damaging transmission oil pan.

The jack supports the weight of rear of engine and must be able to roll with the power plant as it is removed from the chassis. Remove rear crossmember engine support. Remove front engine mounting nuts. Raise the engine with chain hoist and work the engine out of the chassis. Remove transmission. Place the engine in repair stand C-3167 and Adapter

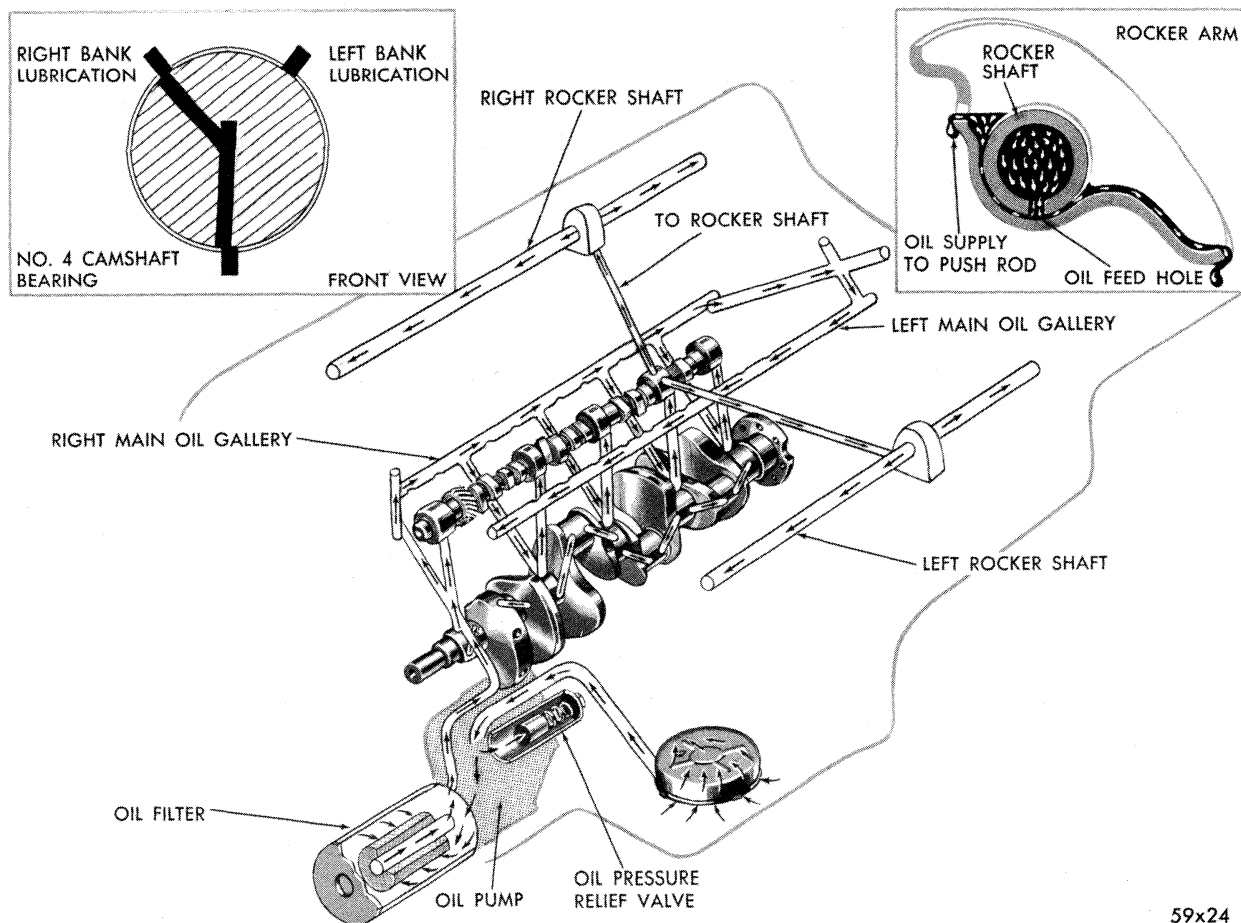


Fig. 43 — Engine Oiling System

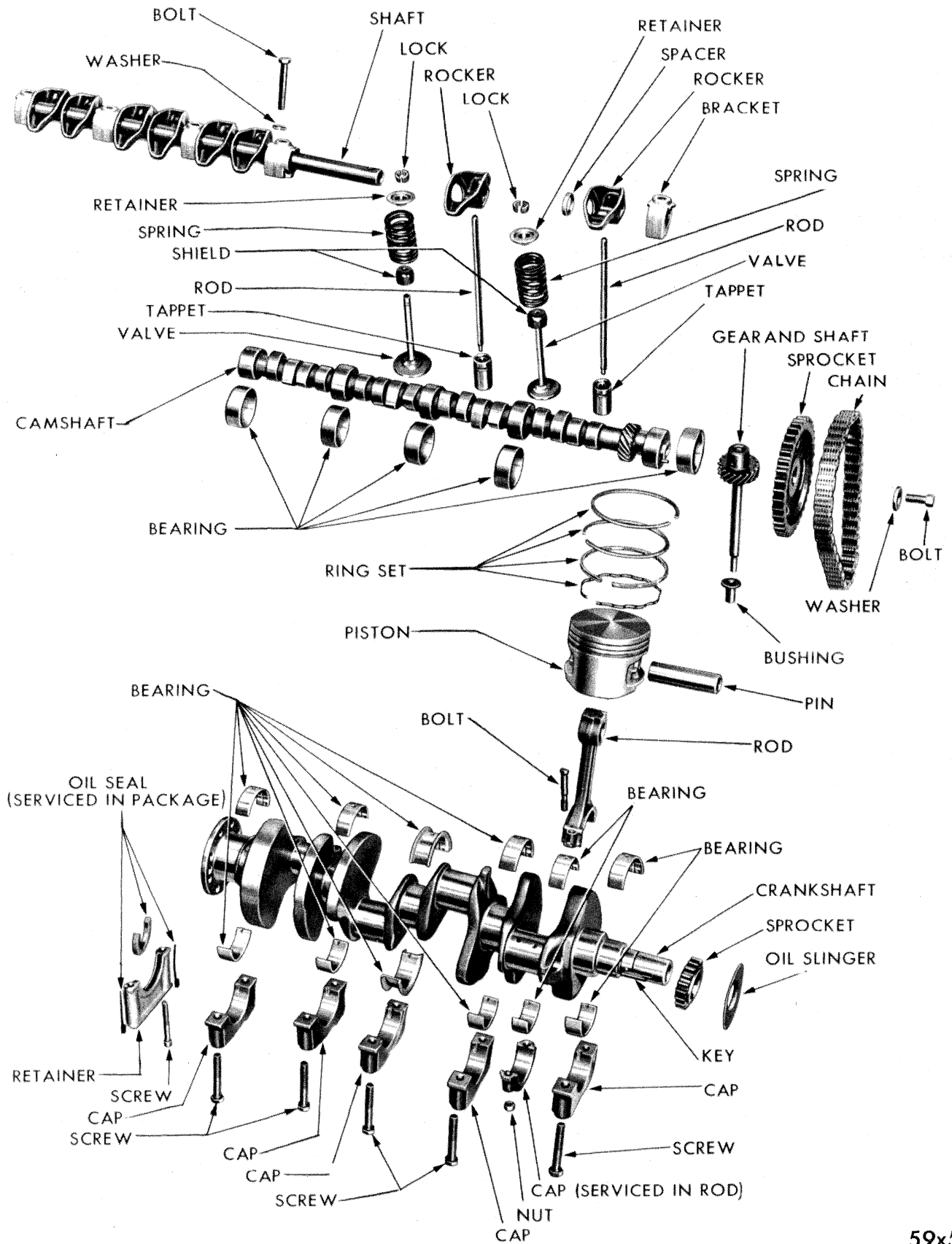


Fig. 44 — Engine Internal Parts

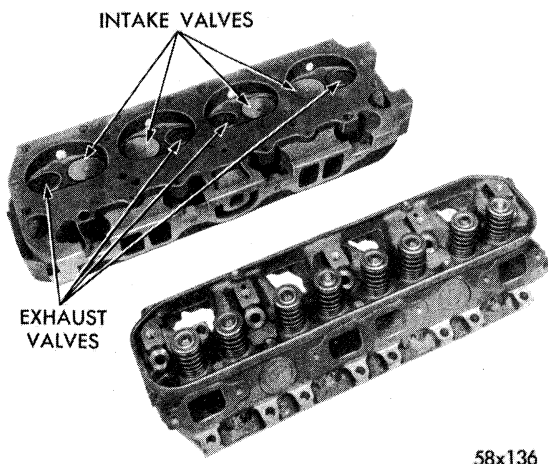
3662 for disassembly using the transmission mounting bolts.

**INSTALLING THE ENGINE ASSEMBLY (In Car)**

Remove the engine from repair stand and install transmission. Install the engine lifting fixture Tool C-3466 and attach the chain hoist to fixture eyebolt. Raise the engine. Lower the engine carefully into the car until front and rear of engine are approximately positioned. Place a rollaway jack under the transmission to support the weight of rear of the engine. Install the engine rear support crossmember. Position the engine and install the nuts at front engine mounts. Position and install rear engine support bolts and remove the jack, hoist and engine lifting fixture.

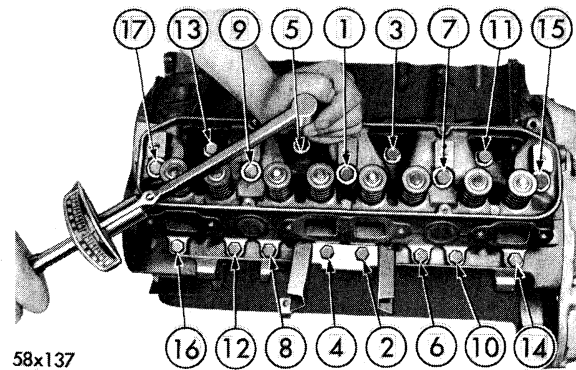
Install the carburetor, fuel lines, wiring and linkage. Install the radiator, fan shroud and radiator hoses. Connect exhaust pipes, using new gaskets. Install the hood, being sure to align hood by the scribe marks placed on the inside of hood at disassembly. Connect the propeller shaft at the transmission. Connect linkage and wires. Be sure all drain cocks are closed, and fill cooling system. Fill the engine crankcase and transmission. Refer to the lubrication Section for quantities and lubricants to use. Check the entire system for leaks and correct as necessary.

**NOTE:** Whenever an engine has been rebuilt and a new camshaft and/or new tappets have been installed, add one quart of factory recommended oil additive to engine oil to aid break-in (MoPar Engine Oil Additive, Part No. 1643234). The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.



58x136

Fig. 45 — Cylinder Heads



58x137

Fig. 46 — Tightening Sequence

Start the engine and run until normal operating temperature is reached. Check the timing and adjust carburetor as necessary. Road test the car.

**CYLINDER HEADS**

The chrome alloy cast iron cylinder heads as shown in Figure 45 are held in place by 17 bolts. The spark plugs enter the cylinder head horizontally and are located at the wide edge of the combustion chambers.

**a. Removal**

Drain the cooling system. Remove generator, carburetor air cleaner and fuel line. Disconnect the accelerator linkage. Remove the vacuum control tube at carburetor and distributor. Disconnect the distributor cap, coil wires and heater hose. Disconnect the heat indicator sending unit wire. Remove spark plugs located under the manifolds. Remove the intake manifold, ignition coil and carburetor as an assembly. Remove the tappet chamber cover. Remove cylinder head covers and gaskets.

**NOTE:** On air conditioned cars, number eight cylinder exhaust valve must be open to allow clearance between the right bank cylinder head cover and the heater housing.

Remove the generator. Remove exhaust manifolds. Remove the rocker arms and shaft assembly. Remove the push rods and place them in their respective slots in holder Tool C-3068. Remove the 17 head bolts from each cylinder head and remove cylinder heads. Place cylinder head in holding fixture Tool C-3626.

**b. Installation**

Clean the gasket surfaces of cylinder block and cylinder head. Check all surfaces with a straight edge if there is any reason to suspect leakage. Coat the

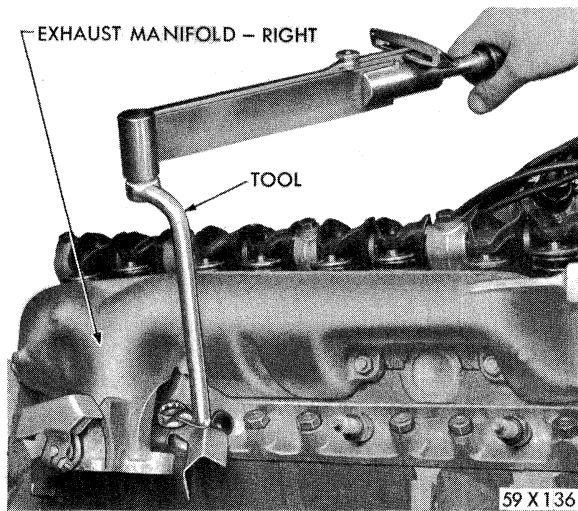


Fig. 47 — Checking Cylinder Head Bolt Torque

new gaskets with a suitable sealer, MoPar Part Number 1122893. Install the gaskets and cylinder heads. Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 70 foot-pounds torque in sequence, as shown in Figure 46, and using Tool C-3666 to check torque, as shown in Figure 47.

Repeat the procedure, retightening all head bolts to 70 foot-pounds torque. Inspect push rods and replace worn or bent rods. Install push rods with the small ends in tappets maintaining alignment using rod, as shown in Figure 48.

Install the rocker arm and shaft assembly starting each push rod into its respective rocker arm socket.

**NOTE: Use extreme care in tightening bolts 30 foot-pounds torque, so the tappets have time to bleed down to their operating length. Bulged tappet bodies,**

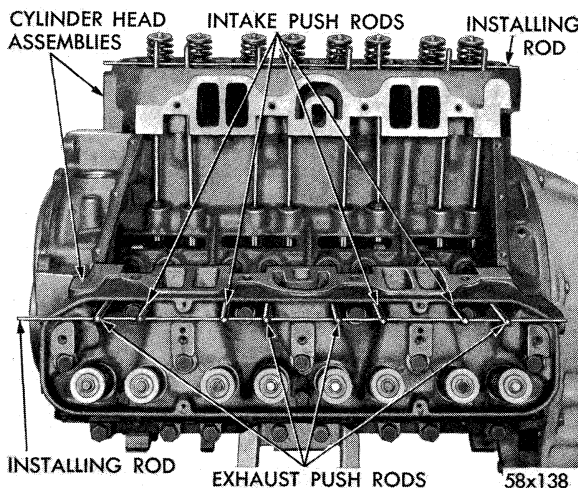


Fig. 48 — Push Rods Installed

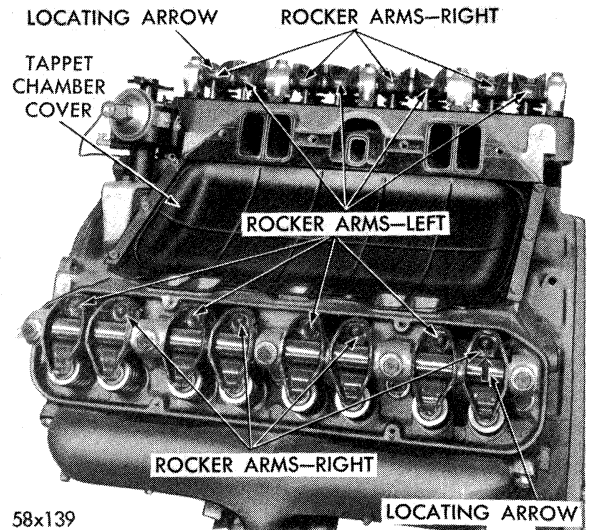


Fig. 49 — Rocker Arms Installed

**bent push rods, and permanently noisy operation may result if the tappets are forced down too rapidly.**

Place the new cylinder head cover gaskets in position and install cylinder head covers. Tighten the bolts to 40 inch-pounds torque. Install exhaust manifolds and tighten the bolts to 30 foot-pounds torque. Adjust spark plugs to .035 inch gap and install the plugs, and tighten to 30 foot-pounds torque with Tool C-3054. Install the tappet chamber cover and tighten end bolts to 8 foot-pounds torque (Fig. 49).

Install intake manifold, carburetor and ignition coil as an assembly and tighten manifold bolts to 40 foot-pounds torque. Install the distributor cap. Connect the coil wire, heat indicator sending unit wire, accelerator linkage, spark plug cables and insulators. Install the vacuum tube from carburetor to distributor. Install generator and tighten generator bracket bolts to 50 foot-pounds torque, and generator mounting nut to 20 foot-pounds torque. Install the fuel line and carburetor air cleaner. Fill the cooling system. Adjust belt tensions as outlined in "Accessory Belt Drives" in this supplement.

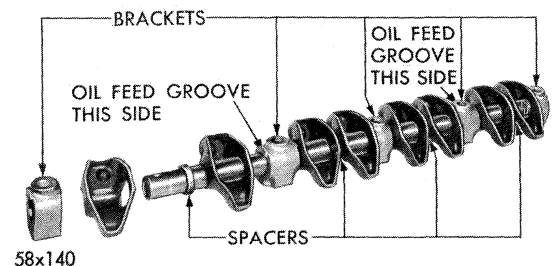


Fig. 50 — Rocker Arms & Shaft Assembly

**ROCKER ARMS AND SHAFT ASSEMBLY**

The rocker arms are of stamped steel and are arranged on one rocker arm shaft, per cylinder head. The push rod angularity tends to force the pairs of rocker arms toward each other where oilite spacers carry the side thrust at each rocker arm. Five brackets attach each rocker shaft to the cylinder head.

**a. Removal**

Remove cylinder head cover and gasket. Remove the bolts that attach rocker arm support brackets to cylinder head and remove the rocker arms, brackets and shaft as an assembly.

If the rocker arm assemblies have been disassembled for cleaning, inspection, or replacement, refer to Figure 49 and 50 for proper reassembly.

**b. Installation**

**NOTE:** The right and left rocker arms must be installed on rocker shaft, as shown in Figure 49. The stamped arrow on rocker shaft must be on top and the arrow must point toward the push rod socket of the rocker arm. This is necessary to provide proper lubrication to the rocker assemblies. The two wide brackets must be installed with the oil feed grooves facing the push rod side of rocker arm, as shown in Figures 49 and 50.

Install the rocker arms, brackets, and shaft assembly.

**NOTE:** Use extreme care in tightening the bolts so

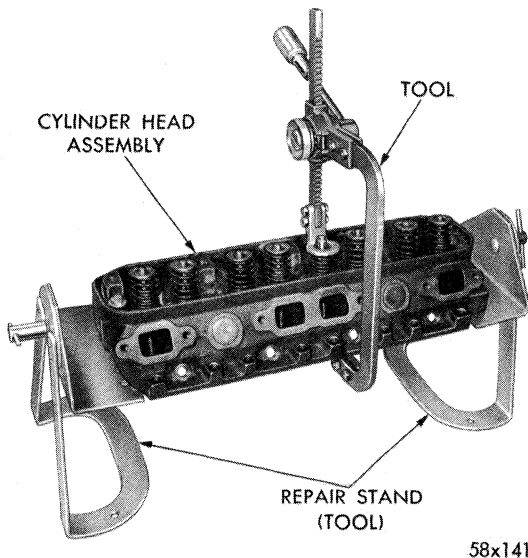


Fig. 51 — Compressing Valve Spring

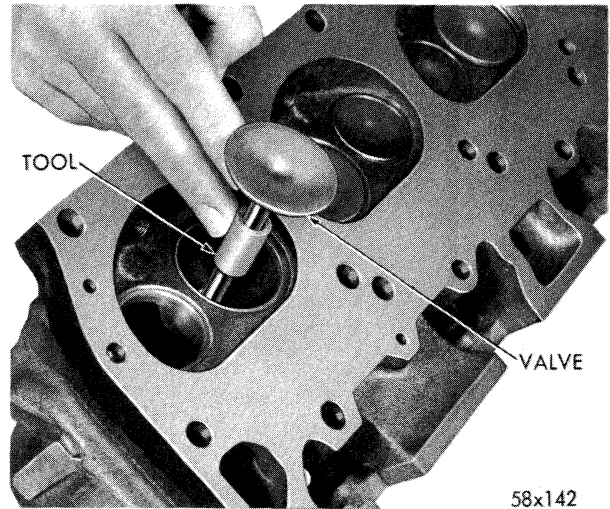


Fig. 52 — Using Sleeve Tool in Checking Wear

that tappets have time to bleed down to their operating length. Bulged tappet bodies, bent push rods and permanent noisy operation may result if the tappets are forced down too rapidly.

Tighten the bolts to 30 foot-pounds torque.

**VALVES AND VALVE SPRINGS**

Valves are arranged in-line in the cylinder heads and inclined 30° outward from vertical. Intake and exhaust valves operate in guides that are integral with the heads.

**a. Removal**

With the cylinder head removed, compress valve springs using Tool C-3422, as shown in Figure 51.

Remove the valve retaining locks, valve spring retainers, valve stem cup seals and valve springs. Remove the burrs from valve stem lock grooves to prevent damage to the valve guide when valves are removed.

**b. Valve Inspection**

Clean the valves thoroughly, and discard burned, warped and cracked valves. Measure valve stems for wear. Intake valve stem diameter should measure .372 to .373 inch and exhaust valve stem diameter should measure .371 to .372 inch. If the wear exceeds .002 inch, replace the valve. Remove carbon and varnish deposits from the inside of valve guides with cleaner, Tool C-756.

Measure the valve stem guide clearance as follows: Install sleeve Tool C-3026 over the valve stem, as shown in Figure 52, and install valve.

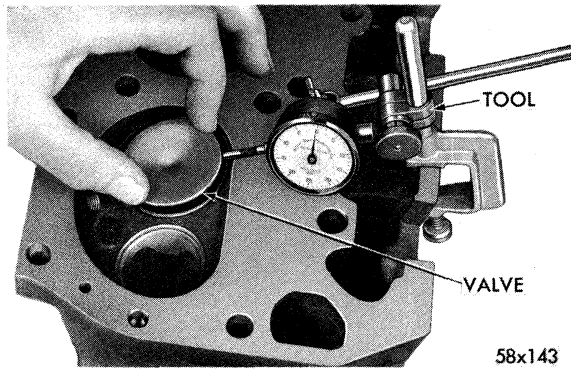


Fig. 53 — Measuring Guide Wear

The special sleeve places the valve at the correct height for checking with a dial indicator. Attach the dial indicator Tool C-3339 to cylinder head and set it at right angle of the valve stem being measured (Fig. 53).

Move valve to and from the indicator. The total dial indicator reading should not exceed .010 inch on intake valves, and .014 inch on exhaust valves. Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

Service valves with oversize stems are available in .005, .015 and .030 inch oversizes. Reamers to accommodate the oversize valve stem are as follows: Reamer Tool C-3433 (.379 to .380 inch) Reamer Tool C-3427 (.404 to .405 inch). Slowly turn reamer by hand and clean guide thoroughly before installing new valve.

**CAUTION**

**Do not attempt to ream the valve guides from standard directly to .030 inch. Use step procedure of .005,**

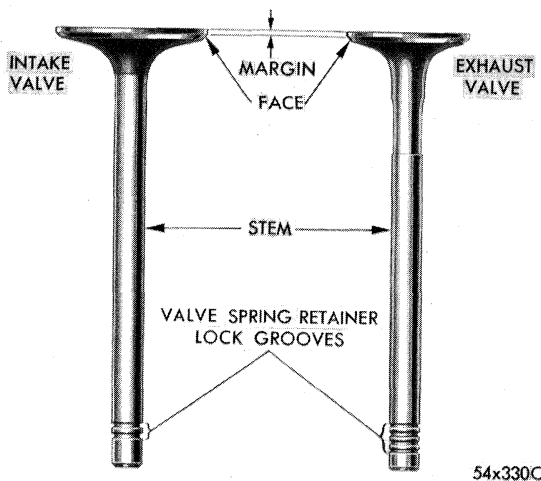


Fig. 54 — Intake and Exhaust Valve

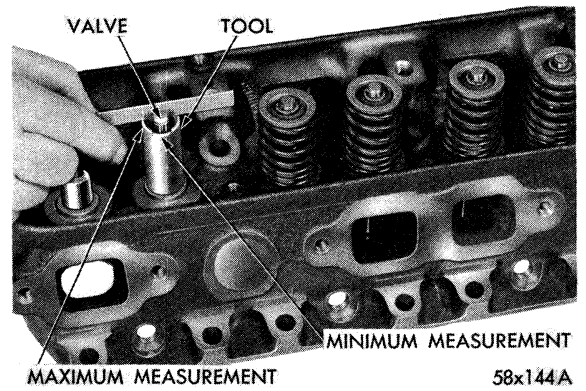


Fig. 55 — Measuring Valve Stem Length

**.015 and .030 inch so the valve guides may be reamed true in relation to the valve seat.**

**c. Refacing valves and valve seats**

The intake and exhaust valve faces have a 45° degree angle. Always inspect the remaining margin after the valves are refaced (Fig. 54). Valves with less than 3/64 inch margin should be discarded.

The angle of both valve and seat should be identical. When refacing the valve seats with Tool MTH-80, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained. Measure the concentricity of valve seat using a dial indicator. The total runout should not exceed .002 inch (total indicator reading). When the seat is properly positioned, the width of intake seats should be 1/16 to 3/32 inch. The width of exhaust seats should be 3/64 to 1/16 inch.

When the valves and seats are reground, the position of the valve in the cylinder head is changed, shortening the operating length of hydraulic tappet. This means that the plunger is operating closer to its bottomed position, and less clearance is available for thermal expansion of valve mechanism during

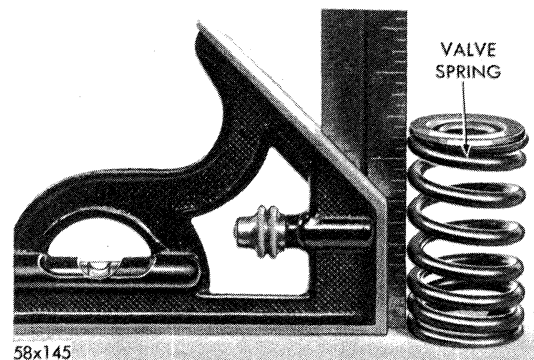


Fig. 56 — Checking Valve Spring Squariness

high speed driving. The design of the valve mechanism includes a safety factor to allow for a limited amount of wear, and the refacing of valves and seats.

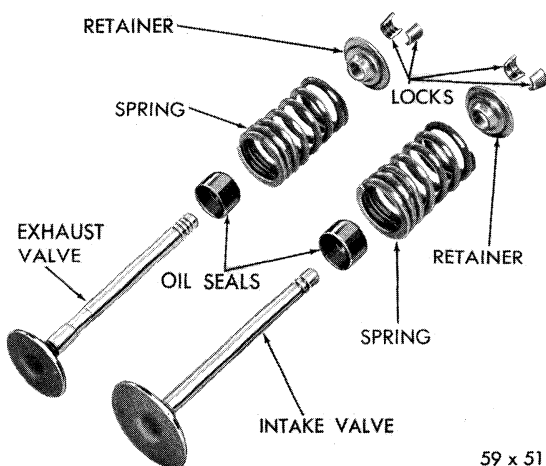
To insure that the limits have not been exceeded, the dimension from valve spring seat in head to valve tip should be measured with Gauge, Tool C-3648, as shown in Figure 55.

The end of the cylindrical gauge and the bottom of slotted area represent the maximum and minimum allowable extension of valve stem tip beyond the spring seat. If the tip exceeds maximum, grind the stem tip to within gauge limits. Clean tappets if tip grinding is required.

**d. Testing Valve Springs**

Whenever the valves have been removed for inspection, reconditioning or replacement, the valve springs should be tested. To test a spring, first determine the length at which the spring is to be tested. As an example, the compressed length of the spring to be tested is 1-15/32 inches. Turn the table of Tool C-647 until surface is in line with the 1-15/32 inch mark on the threaded stud and the zero mark to the front. Place spring over stud on table and lift the compressing lever to set the tone device. Pull on torque wrench until a ping is heard. Take the reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at the test length. Fractional measurements are indicated on the table for finer adjustments. The valve springs should test 183 to 202 lbs. when compressed to 1-15/32 inch. Discard springs that do not meet these specifications.

Inspect each valve spring for squareness with a



59 x 51

Fig. 57 — Valve Assembly

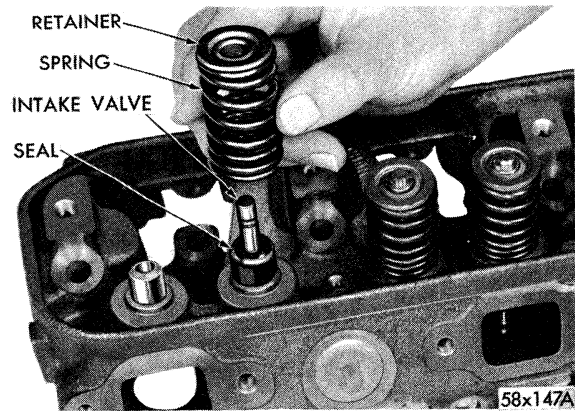


Fig. 58 — Installing Valves and Cup Seals

steel square and surface plate, as shown in Figure 56.

If the spring is more than 1/16 inch out of square, install a new spring.

**e. Installation**

Coat the valve stems with lubricating oil and insert them in position in cylinder head. Install the cup seals on intake and exhaust valve stems and over valve guides, as shown in Figure 57 and 58 and install valve springs and retainers.

Compress the valve springs with Tool C-3422. Install locks and release tool.

**NOTE:** If the valves and/or seats are reground, measure the installed height of springs. Make sure measurement is taken from the bottom of the spring seat in cylinder head to the bottom surface of spring retainer. (If spacers are installed, measure from the top of spacer.) If height is greater than 1-57/64 inches, install a 1/16 inch spacer in head counter-bore to bring spring height back to normal 1-53/64 to 1-57/64 inch.

**HYDRAULIC TAPPETS**

**α. Preliminary to Checking Hydraulic Tappets**

Before disassembling any part of engine to correct tappet noise, read the oil pressure at gauge and check the oil level in the oil pan. The pressure should be between 45 and 70 pounds at 2000 rpm. The oil level in the pan should never be above "full" mark on dip stick, or below "add oil" mark. Either of these two conditions could be responsible for noisy tappets.

**Oil Level Too High** — If oil level is above "full" mark on dip-stick, it is possible for the connecting

rods to dip into oil while the engine is running and create foam. Foam in the oil pan would be fed to the hydraulic tappets by the oil pump causing them to go flat and allowing the valves to seat noisily.

**Oil Level Too Low** — Low oil level may allow the oil pump to take in air which, when fed to tappets, causes them to lose length and allows the valves to seat noisily. Any leaks on intake side of the pump through which air can be drawn will create the same tappet action. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, the engine should be operated at fast idle for sufficient time to allow all of air inside of tappets to be bled out.

### b. Tappet Noises

To determine the source of tappet noise, operate the engine at idle with the cylinder head covers removed. Feel each valve spring or rocker arm to detect the noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

**NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on valve spring. Inspect rocker arm push rod sockets and push rod ends for wear. If noise is not appreciably reduced, it can be assumed the noise is in the tappet.**

Valve tappet noise ranges from a light noise to a heavy click. A light noise is usually caused by exces-

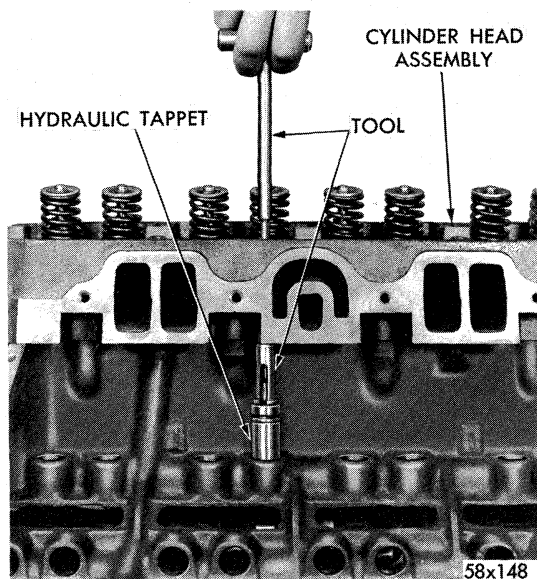


Fig. 59 — Removing Tappet

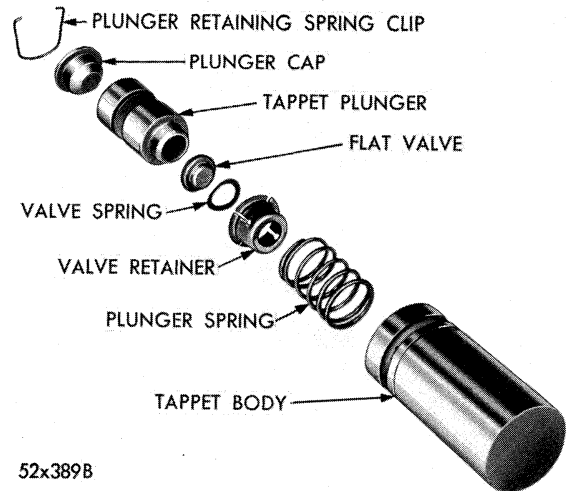


Fig. 60 — Hydraulic Tappet Assembly

sive leakdown around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and tappet body, causing plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between valve stem and rocker arm as valve closes. In either case, the tappet assembly should be removed for inspection and cleaning.

### c. Removal of Tappets

Tappets can be removed without removing the intake manifold by following this recommended procedure: remove the cylinder head covers. Remove rocker arms and shaft assembly. Remove the push rods and place them in their respective holes in Tool C-3068. Slide puller Tool C-3661 through push rod opening in cylinder head and seat tool firmly in the head of tappet. Pull tappet out of bore with a twisting motion, as shown in Figure 59.

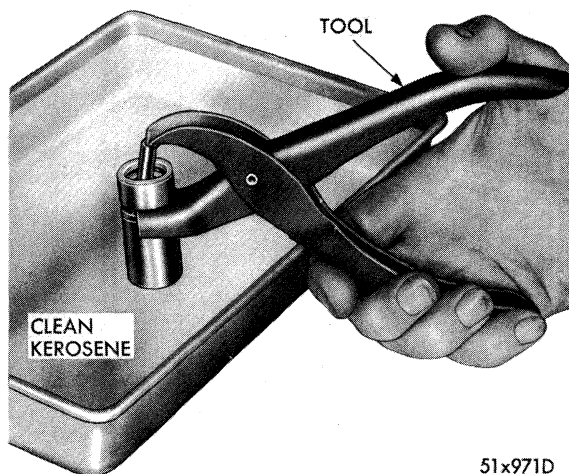
If all tappets are to be removed, remove the hydraulic tappets and place them in their respective holes in tappet and push rod holder, Tool C-3068. This will insure installation of the tappets in their original locations.

**NOTE: A diamond shaped marking stamped on the engine numbering pad indicates that all tappet bodies are .008 inch oversize, see Figure 84.**

### CAUTION

**Do not disassemble a tappet on a dirty work bench. The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tap-**





51x971D

Fig. 61 — Testing Tappet

pet at a time to avoid mixing of parts. Mixed parts are not compatible.

**d. Disassembly (Fig. 60)**

Pry out plunger retainer spring clip. Clean the varnish deposits from the inside of tappet body above the plunger cap. Invert the tappet body and remove plunger cap, plunger, flat check valve, check valve spring, check valve retainer and plunger spring. Separate the plunger, check valve retainer and check valve spring. Place all parts in their respective place in the tappet holder Tool C-3068.

**e. Cleaning and Assembly**

Clean all tappet parts in a solvent that will remove all varnish and carbon. Replace the tappets that are unfit for further service with new assemblies. Assemble the tappets, as shown in Figure 56.

**f. Inspection**

If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize, using Tool C-3028. If plunger shows signs of scoring or wear and valve is pitted, or if the valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.

**g. Testing**

Fill a pan with clean kerosene. Remove cap from plunger and completely submerge the tappet in an upright position.

Allow tappet to fill with kerosene, remove tappet, and replace the cap. Hold the tappet in an upright position and insert the lower jaw of pliers, Tool C-

3160, in the groove of tappet body (Fig. 61).

Engage jaw of pliers with top of the tappet plunger. Check leakdown by compressing pliers. If plunger collapses almost instantly as pressure is applied, disassemble tappet, clean and test again. If the tappet still does not operate satisfactorily after cleaning, install a new tappet assembly.

**h. Installation**

Lubricate the tappets. Install tappets and push rods in their original positions. Install the rocker arm and shaft assembly. Start and operate the engine. Warm up to normal operating temperature.

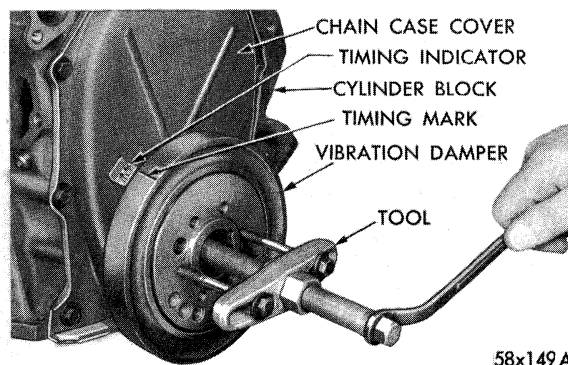
**NOTE: To prevent damage to valve mechanism, the engine must not be run above fast idle until all of hydraulic tappets have filled with oil and have become quiet.**

**CHECKING VALVE TIMING**

Turn crankshaft until the No. 1 exhaust valve is full open and the No. 1 piston is on TDC.

Insert a 1/4 inch spacer between the rocker arm pad and the stem tip of the No. 1 intake valve (second valve on the left bank). Install a dial indicator so that the plunger contacts the valve spring retainer as nearly perpendicular as possible. Allow the spring load to bleed the tappet down giving in effect a solid tappet. Zero the indicator.

Turn the crankshaft clockwise (normal running direction) until intake valve has lifted .013 inch. The timing on the timing indicator, located on the chain case cover, should read from 10° BTDC to 2° ATDC. If the reading is not within the specified limits: Check the sprocket index marks, inspect the timing chain for wear, and check the accuracy of the DC mark on the timing indicator. Turn crankshaft counter-clockwise until the valve is closed and remove the spacer.



58x149A

Fig. 62 — Removing Vibration Damper Assembly

**CAUTION**

Do not turn crankshaft any further clockwise as the valve spring might bottom and result in serious damage.

**TIMING SPROCKETS AND CHAIN**

The timing chain has 50 links of  $\frac{1}{2}$  inch pitch and is  $\frac{7}{8}$  inch wide. Chain stretch is reduced because of fewer joints to wear.

**a. Removal**

Drain the cooling system. Remove the radiator and water pump assembly. Remove the bolt holding vibration damper on crankshaft. Remove two of the pulley bolts, install Tool C-3033, and pull the damper assembly off the end of crankshaft, as shown in Figure 62.

Remove the chain cover and gasket. Slide the crankshaft oil slinger off end of crankshaft. Remove the camshaft sprocket attaching bolt. Remove timing chain with crankshaft and camshaft sprockets.

**b. Installation**

Place both the camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores. Place the timing chain around both sprockets. Turn the crankshaft and camshaft to line up with the keyway location in crankshaft sprocket and the dowel holes in the camshaft sprocket. Lift the sprockets and chain, (keep sprockets tight against the chain in position as described). Slide both sprockets evenly over their respective shafts. Use a straight edge to check alignment of the timing marks (Fig. 63). Install the washer and

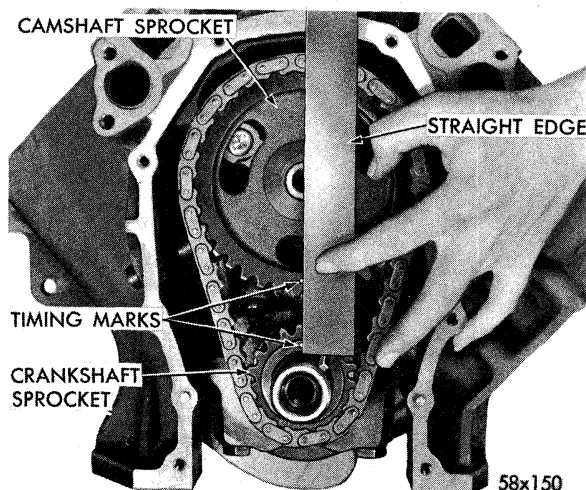


Fig. 63 — Alignment of Timing Marks

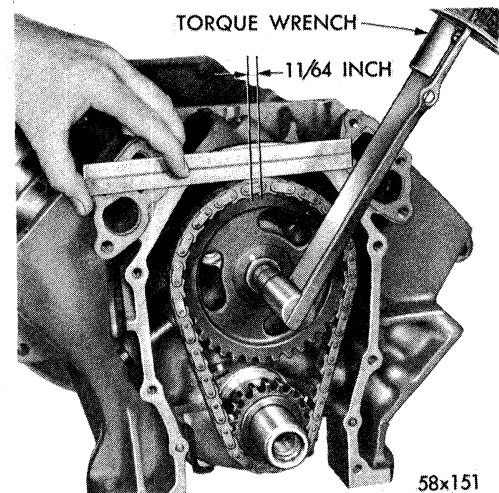


Fig. 64 — Measuring Chain Stretch

camshaft sprocket bolt and tighten to 35 foot-pounds torque.

**c. Checking Timing Chain for Stretch**

Place a scale next to timing chain so that any movement of the chain may be measured. Place a torque wrench and socket over the camshaft sprocket attaching bolt and apply torque in the direction of crankshaft rotation to take up the slack; 30 foot-pounds torque (with cylinder heads installed) or 15 foot-pounds torque (cylinder heads removed). Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed), and note the amount of chain movement, as shown in Figure 64. Install a new timing chain, if its movement exceeds  $\frac{11}{64}$  inch.

**NOTE:** With a torque applied to camshaft sprocket bolt, the crankshaft should not be permitted to move. It may be necessary to block the crankshaft to prevent rotation.

If chain is satisfactory, slide the crankshaft oil slinger over shaft and up against the sprocket (flange away from sprocket.)

**TIMING CHAIN CASE COVER OIL SEAL REPLACEMENT****a. Removal**

Position puller screw of Tool C-3506 through case cover, the inside of case cover up. Position the puller blocks directly opposite each other, and force the angular lip between neoprene and flange of the seal retainer. Place washer and nut on puller screw.

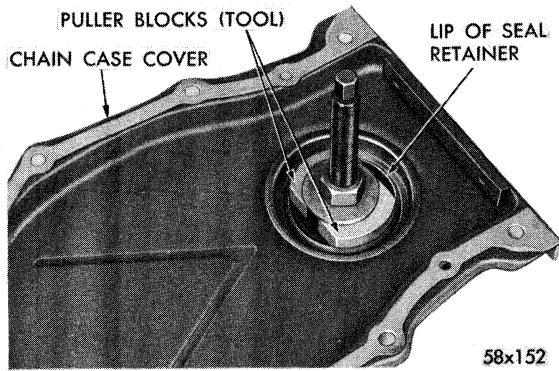


Fig. 65 — Puller Blocks Expanded to Pulling Position

Tighten the nut as tight as possible by hand, forcing blocks into gap to a point of distorting the seal retainer lip (Fig. 65). This is important (puller is only positioned at this point). Place sleeve over the retainer and place removing and installing plate into sleeve. Place the flat washer and nut on puller screw. Hold the center screw and tighten lock nut to remove seal (Fig. 66).

**b. Installation of Oil Seal**

Insert puller screw through removing and installing plate so that the thin shoulder will be facing up.

Insert puller screw with plate through the seal opening (inside of chain case cover facing up). Place the seal in cover opening, with neoprene down. Place the seal installing plate into the new seal, with protective recess toward lip of seal retainer (Fig. 67). Install the flat washer and nut on puller screw, hold screw and tighten the nut (Fig. 68).

The seal is properly installed when neoprene is tight against the face of cover. Try to insert a .0015 inch feeler gauge between neoprene and cover (Fig. 69). If the seal is installed properly, the feeler gauge cannot be inserted.

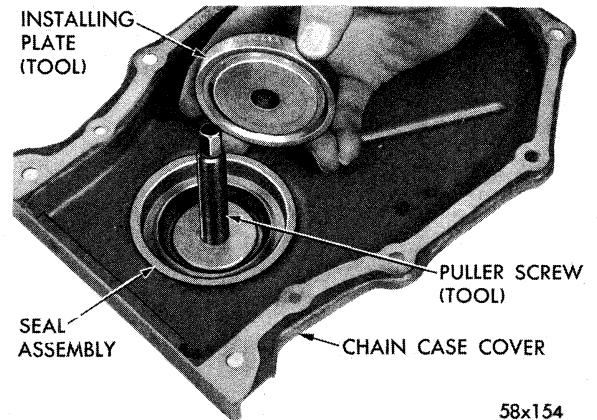


Fig. 67 — Positioning Installer Plate on New Seal

**NOTE: It is normal to find particles of neoprene collected between the seal retainer and crankshaft oil slinger after the seal has been in operation.**

**c. Installing Chain Case Cover**

Be sure the mating surfaces of chain case cover and cylinder block are clean and free from burrs. Using

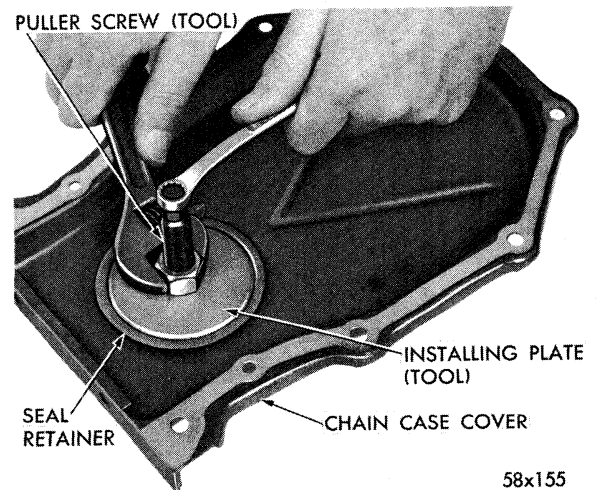


Fig. 68 — Installing New Seal

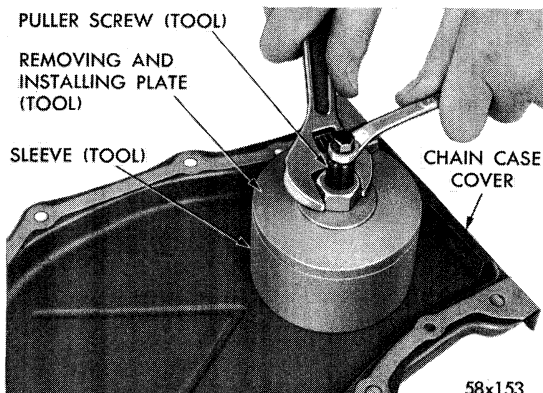


Fig. 66 — Removing Oil Seal

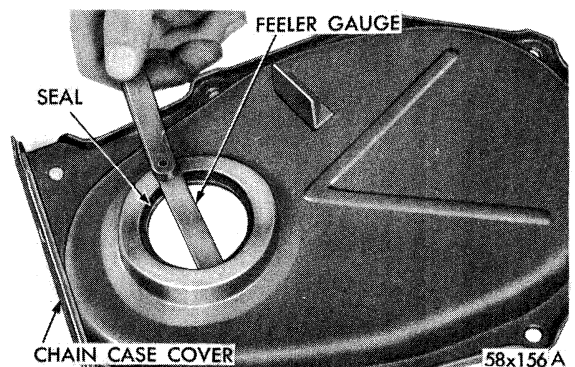


Fig. 69 — Checking Seal for Proper Seating

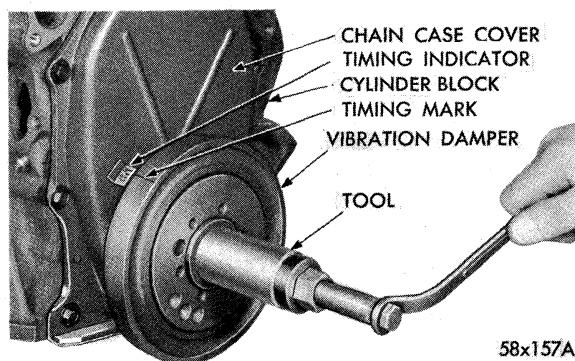


Fig. 70 — Installing Vibration Damper Assembly

a new gasket slide the chain case cover over the locating dowels and tighten bolts to 15 foot-pounds torque.

#### d. Installing Vibration Damper

Place the damper hub key in slot in crankshaft, and slide hub on crankshaft. Place the installing tool, part of Puller set Tool C-3033 in position and press damper hub on the crankshaft (Fig. 70). Slide the pulley over the shaft and attach with bolts and lock-washers. Tighten the bolts to 15 foot-pounds torque. Install damper hub retainer washer and bolts. Tighten to 135 foot-pounds torque.

### CAMSHAFT

The camshaft has an integral oil pump and distributor drive gear and fuel pump eccentric, as shown in Figure 71.

Rearward camshaft thrust is taken by the rear face of the cast iron camshaft sprocket hub, bearing directly on the front of the cylinder block, eliminating the need for a thrust plate. The helical oil pump and distributor drive gear and the camshaft lobe taper both tend to produce only a rearward thrust.

#### Removal

With the tappets and timing sprockets removed, remove distributor and lift out oil pump and distribu-

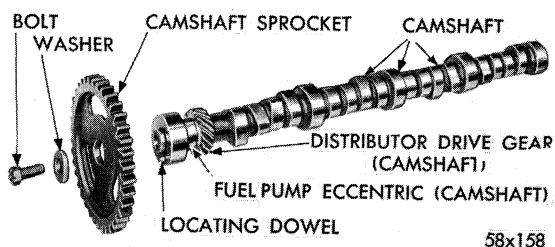


Fig. 71 — Camshaft and Sprocket Assembly

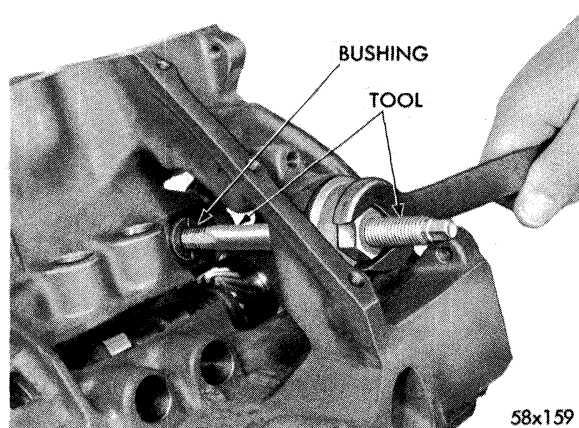


Fig. 72 — Removing Distributor Drive Shaft Bushing

tor drive shaft. Remove the fuel pump to allow the push rod to drop away from the cam eccentric. Remove the camshaft being careful not to damage the cam bearings with the cam lobes.

### DISTRIBUTOR DRIVE SHAFT BUSHINGS

#### a. Removal

Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained (Fig. 72). Hold the puller screw and tighten puller nut until bushing is removed.

#### b. Installation

Slide new bushing over burnishing end of Tool C-3053 and insert the tool and bushing into bore, as shown in Figure 73.

Drive bushing and tool into position, using a soft hammer. As the burnisher is pulled through bushing by tightening puller nut, the bushing is expanded tight in block and burnished to correct size, as shown in Figure 74. **DO NOT REAM THIS BUSHING.**

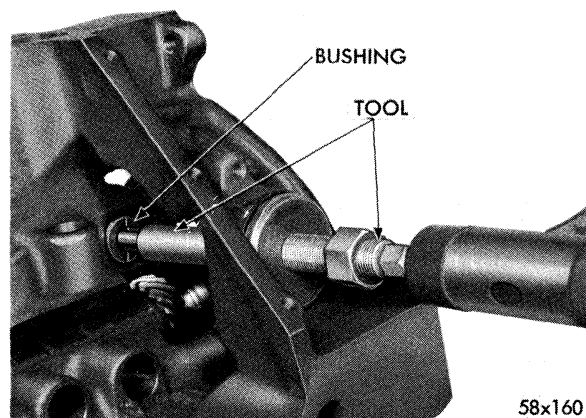


Fig. 73 — Installing Distributor Drive Shaft Bushing

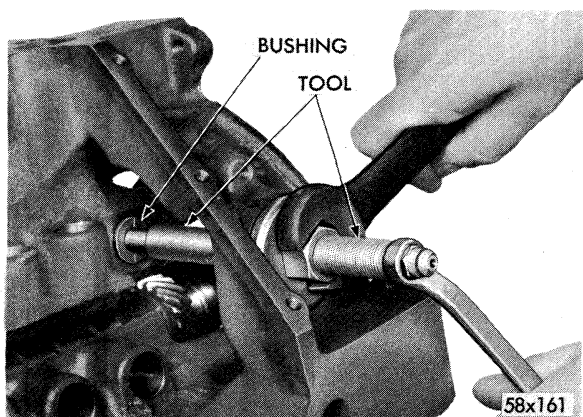


Fig. 74 — Burnishing Distributor Drive Shaft Bushing

**c. Camshaft Installation**

Lubricate the camshaft lobes and camshaft bearing journals and insert the camshaft to within 2 inches of its final position in the cylinder block. Modify Tool C-3509 by grinding off the index lug holding upper arm on the tool and rotate arm 180°. Install Tool C-3509 in place of distributor drive gear and shaft, as shown in Figure 75. Hold the tool in position with distributor lock plate screw. This tool will restrict the camshaft from being pushed in too far and prevent knocking out the welch plug in the rear of the cylinder block. **The tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

**NOTE: Whenever an engine has been rebuilt and a new camshaft and/or new tappets have been installed, one quart of factory recommended oil additive should be added to the engine oil to aid in break-in. The oil mixture should be left in the engine for a minimum of 500 miles. Drain the oil mixture at the next normal oil change.**

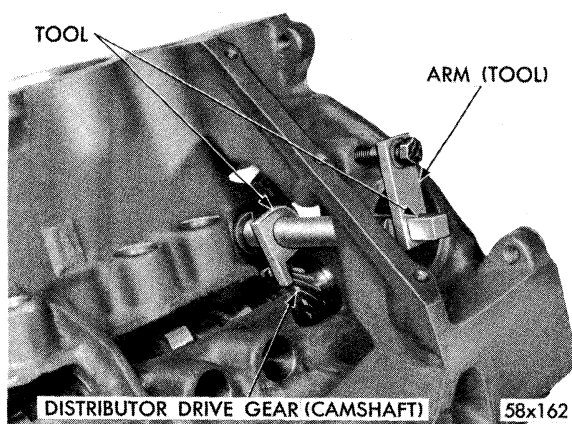


Fig. 75 — Camshaft Holding Tool

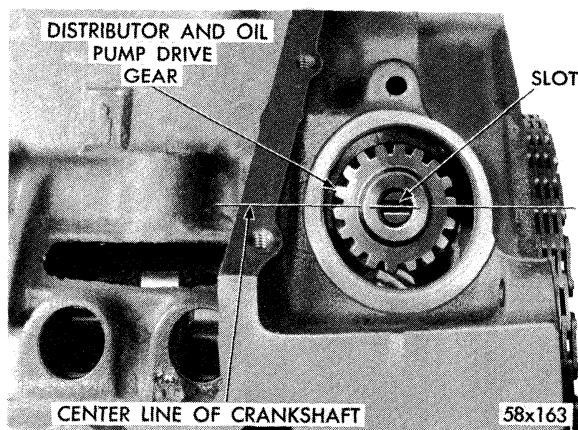


Fig. 76 — Distributor Drive Gear Installation

**NOTE: Whenever the camshaft is replaced, all of the tappet faces must be inspected for crown with a straight edge. If any negative crown (dish) is observed, the tappet must be replaced.**

**d. Distributor (Basic) Timing**

Before installing the distributor and oil pump drive shaft, time engine as follows: Rotate the crankshaft until No. 1 cylinder is at top dead center on firing stroke. When in this position, the straight line on the vibration damper should be under (DC) on the timing indicator. Coat shaft and drive gear with engine oil. Install the shaft so that after the gear spirals into place, it will index with oil pump shaft, so that the slot in top of drive gear will be parallel with center line of crankshaft as shown in Figure 76.

**e. Installation of Distributor**

Hold distributor over the mounting pad on cylinder block with the vacuum chamber pointing toward the center of engine. Turn the rotor until it points forward and to the approximate location of the No. 1 tower terminal in the distributor cap. Place distributor gasket in position. Lower distributor and en-

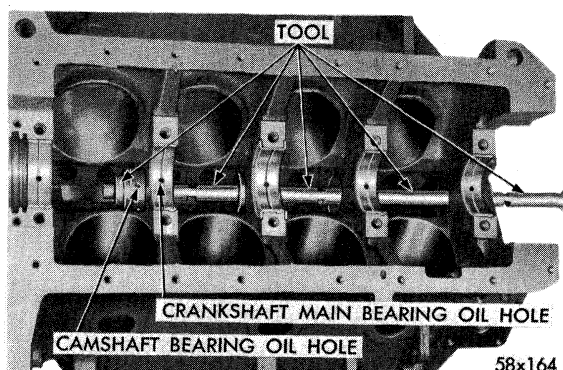


Fig. 77 — Removing Camshaft Bearing

gage shaft in slot of distributor drive shaft gear. Turn distributor clockwise until the breaker contacts are just separating and install hold down clamp.

### REMOVAL AND INSTALLATION OF CAMSHAFT BEARINGS (Engine Removed from Car)

#### a. Removal

With the engine completely disassembled, drive out the rear cam bearing welch plug. Install proper size adapters and horse shoe washers (part of Tool C-3132A) at back of each bearing shell to be removed and drive out the bearing shells.

#### b. Installation

Install the new camshaft bearings with Tool C-3132-A by sliding the new camshaft bearing shell over the proper adapter. Position bearing in the tool. Install horse shoe lock and by reversing removal procedure, carefully drive bearing shell into place, as shown in Figure 77. Install remaining shells in like manner.

**NOTE: Install the No. 1 camshaft bearing 1/32" inward from front face of the cylinder block.**

The oil holes in camshaft bearings and cylinder block must be in exact alignment to insure proper lubrication (Fig. 77).

Camshaft bearing index can be checked after installation by inserting a pencil flashlight in the bearing shell. The camshaft bearing oil hole should be perfectly aligned with the drilled oil passage from the main bearing. Another oil hole in the camshaft bearings should be visible by looking down on the left bank oil hole above and between No. 6 and No. 8 cylinders to No. 4 camshaft bearing and on the right bank above and between No. 5 and 7 cylinders to No. 4 camshaft bearings. If the camshaft bearing shell oil holes are not in exact alignment, remove and reinstall them correctly. Use Tool C-897 to install a new welch plug at the rear of camshaft. **Be sure this plug does not leak.**

### CYLINDER BLOCK

The cylinder block is of the deep block design which eliminates the need for a torque converter housing adapter plate. Its sides extend three inches below the crankshaft centerline.

#### Cleaning and Inspection

Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking. If new core hole

plugs are installed, coat the edges of plug and core hole with a suitable sealer and drive plugs in place with driver, Tool C-897. Examine block for cracks or fractures. Remove the top ridge of cylinder bores with a reliable ridge reamer before removing the pistons from cylinder block. **Be sure to keep the tops of pistons covered during this operation.**

**NOTE: Pistons and connecting rods must be removed from the top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so each connecting rod is centered in the cylinder bore.**

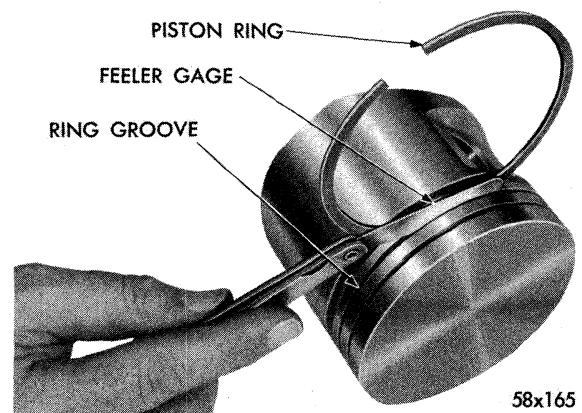
Remove connecting rod cap. Install Tool C-3221 on one connecting rod bolt and protector over the other bolt and push each piston and rod assembly out of the cylinder bore. After removal, install bearing cap on mating rod.

#### a. Checking Cylinder Bores

The cylinder bores should be checked for out-of-round and taper with Tool CM-119. If the cylinder bores show more than .005 inch out-of-round or a taper of more than .010 inch the cylinder block should be rebored and honed, and new pistons and rings fitted.

#### b. Honing Cylinder Bores

To remove light scoring, scuffing, or scratches from the cylinder walls, use Tool C-823. Usually a few strokes will clean up a bore and maintain the required limits. The cylinder walls should be deglazed, using cylinder surfacing hone Tool C-3501 equipped with 280 grit stones, prior to installation of the new rings or to smooth down the cylinder walls after rough honing. A satisfactory finish can be obtained by



58x165

Fig. 78 — Measuring Piston Ring Clearance

giving each cylinder wall 20 strokes in 20 seconds with the hone so that a cross hatch pattern will be obtained.

After honing, it is necessary that the block be cleaned again to remove all traces of abrasives, and to prevent excessive wear of engine parts. **The hone may be safely used for removal of metal up to .005 inch and as high as .010 to .015 inch by an experienced operator.**

**CAUTION**

**Be sure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and water be used with a brush and then thoroughly dried. If this is impossible, use SAE 10 engine oil and CLEAN cloth. When the bore can be wiped with a clean white cloth and be withdrawn clean, the bore is clean.**

**c. Cylinder Walls**

Cylinder walls which are badly scored, scuffed, scratched, or worn beyond specified limits should be rebored. Whatever type of boring equipment is used, boring operation should be closely coordinated with the fitting of pistons and rings in order that specified clearance may be maintained.

**d. Fitting Pistons**

The piston and cylinder wall must be clean and dry. The specified clearance between the piston and the cylinder wall is .0005 to .0010 inch.

The piston diameter should be measured at the top of skirt 90° to the piston pin axis. The cylinder bores on used engines should be measured halfway down the cylinder bore and transverse to the engine crankshaft centerline.

**NOTE: Pistons and cylinder bores should be measured at normal room temperature 70° F.**

All service pistons include pins, and are available in standard and the following oversizes, .005, .020 and .040 inch.

**e. Fitting Rings**

Measure the piston ring gap about two (2) inches from bottom of cylinder bore in which it is to be fitted. (An inverted piston can be used to push the rings down to insure positioning rings squarely in the cylinder wall before measuring.) Insert the feeler stock in gap (Fig. 78).

The ring gap should be between .013 to .025 inch.

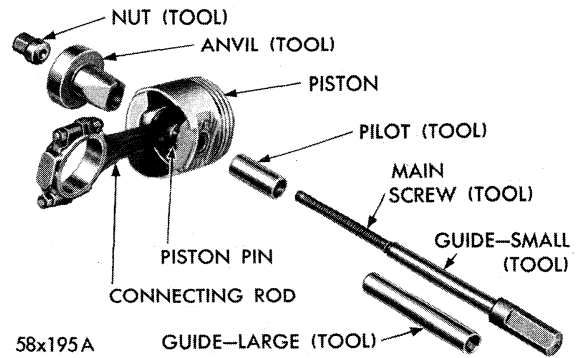


Fig. 79 — Tool Arrangement of Removing Piston Pin

This measurement is the same for all rings. Measure the side clearance between piston ring and ring land. The clearance should be .0015 to .003 inch for the top compression ring, .001 to .0025 inch for the intermediate ring, and .001 to .003 for the oil control ring. Starting with the oil ring expander, place expander ring in the lower ring groove and install oil control ring. Install the compression rings in middle and top grooves. Use ring installer, Tool C-3629 for the MC-1 and MC-2 engine and Tool C-3628 for the MC-3 and MY-1 engine.

**NOTE: Be sure the mark "Top" on each compression ring is to the top of piston when the ring is installed.**

**REMOVAL OF PISTON PIN**

Arrange Tool C-3624 parts for the removal of piston pin, as shown in Figure 79. Install pilot on the main screw. Install the screw through piston pin. Install anvil over the threaded end of the main screw with small end of anvil against the piston boss.

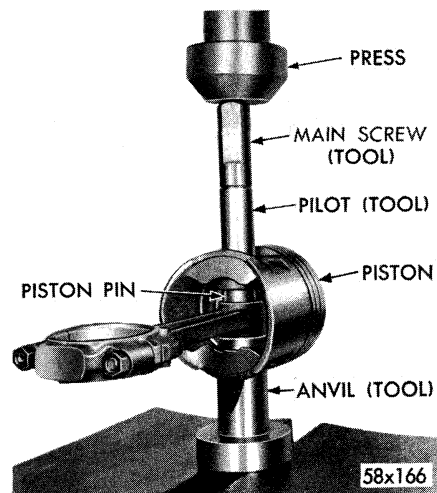
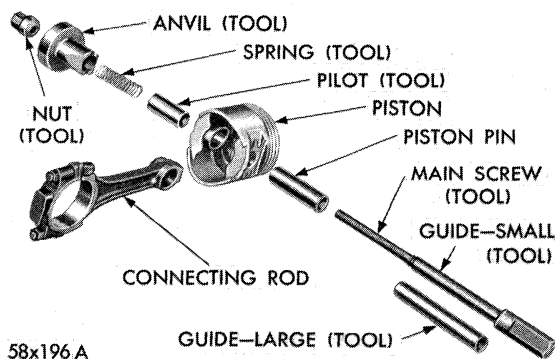


Fig. 80 — Removing Piston Pin



58x196A

Fig. 81 — Tool Arrangement for Installing Piston Pin

**NOTE:** Be sure spring is removed from the anvil.

Install nut loosely on the main screw and place the assembly on a press, as shown in Figure 80. Press the piston pin out of connecting rod.

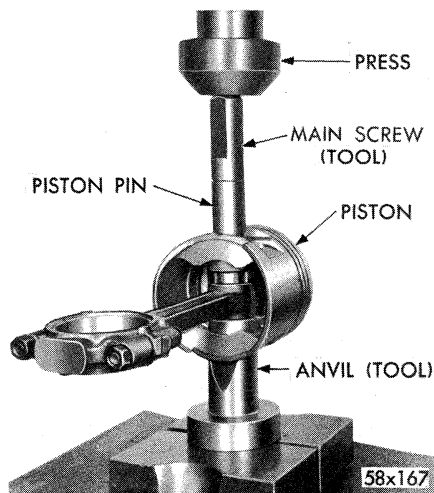
**NOTE:** When the pin falls free from connecting rod, stop the press to prevent damage to bottom of the anvil.

Remove the tool from the piston.

**INSTALLATION OF PISTON PIN**

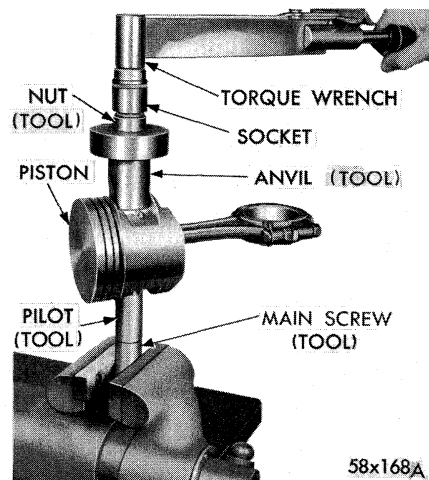
Check the piston pin fit in the piston. It should be a sliding fit in the piston at 70°F. Piston pins are supplied in standard sizes only. Lubricate piston pin holes in the piston and connecting rod.

Arrange the tool parts for installation of piston pin, as shown in Figure 81. Install the spring inside the pilot and install the spring and pilot in the anvil. Install the piston pin over main screw. Place piston, with "front" up, over pilot so that the pilot extends



58x167

Fig. 82 — Installing Piston Pin



58x168A

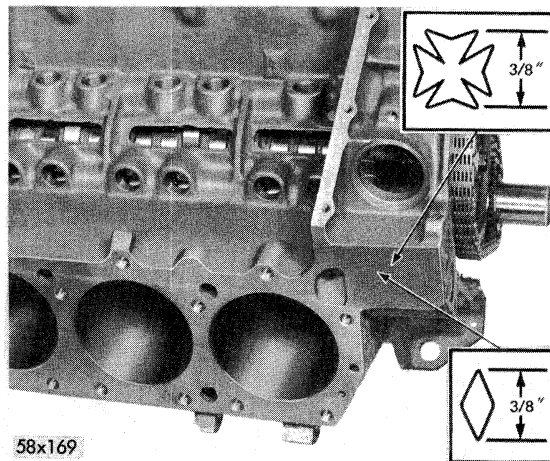
Fig. 83 — Testing Fit on Piston Pin in Connecting Rod

through the piston pin hole. Position connecting rod over the pilot which extends through the piston hole.

**NOTE:** Assemble rods to pistons of the right cylinder bank (2, 4, 6, and 8) with the indent on the piston head opposite to the larger chamfer on the large bore end of connecting rod. Assemble the rods to pistons of the left cylinder bank (1, 3, 5, and 7) with the indent on the piston head on the same side as the large chamfer on the large bore end of connecting rod.

Install the main screw and piston pin in the piston, as shown in Figure 81.

Install the nut on puller screw to hold assembly together. Place assembly on a press, as shown in Figure 82. Press in the piston pin until piston pin bottoms on the pilot properly positioning the pin in the connecting rod. Remove the tool and arrange tool parts and piston assembly in the same manner, as shown in Figure 79.



58x169

Fig. 84 — External Identification



Place the assembly in a vise, as shown in Figure 83.

Attach the torque wrench to nut and check torque up to 15 foot-pounds torque. If the connecting rod moves downward on piston pin, reject this connecting rod and piston pin combination. Obtain a connecting rod with proper small end bore diameter and repeat the installation and checking procedure.

If connecting rod does not move under 15 foot-pounds torque, the piston pin and connecting rod interference is satisfactory, the tool may be removed.

**CONNECTING RODS**

**IMPORTANT**

A Maltese Cross stamped on the engine numbering pad (Fig. 84) indicates that engine is equipped with a crankshaft which has one or more connecting rods and main bearing journals finished .001 inch undersize. The position of the undersize journal or journals will be stamped on machined surface of No. 3 counterweight (Fig. 85).

Connecting rod journals will be identified by the letter "R" and main bearing journals by the letter "M." Thus "M-1" indicates that No. 1 main bearing is .001 inch undersize.

**INSTALLING CONNECTING ROD BEARINGS**

**NOTE: Fit all rods on one bank until completed. Do not alternate from one bank to another, because when the rods are assembled to pistons correctly, they are not interchangeable from one bank to another.**

Each bearing cap has a small "V" groove across the parting face. When installing the lower bearing shell, make certain that the "V" groove in shell is in line with "V" groove in cap. This allows lubrication of the cylinder wall. The bearing shells should always be installed so that small formed tang fits into ma-

chined grooves of rods. The side play should be from .009 to .017 inch (two rods).

Limits of taper or out-of-round on any crankshaft journals should be held to .001 inch. Bearings are available in .001, .002, .003, .010 and .012 inch undersize.

**NOTE: Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.**

**CHECKING THE CONNECTING ROD BEARING CLEARANCE (PLASTIGAGE METHOD)**

Connecting rod bearing clearance measurements can be made by the use of Plastigage with the engine in the chassis. After removing the connecting rod cap, wipe off the oil from the journal and inserts. Place the Plastigage on bearing parallel with crankshaft. Reinstall the cap and tighten attaching nuts alternately to specified torque.

Remove cap and measure the width of the compressed material with the graduated scale to determine the bearing clearance. Allowable clearance is from .0005 to .0015 inches. If taper of the compressed material is evident, measure with the graduated scale. If the taper appears to exceed .005 inch, the journal should be checked with micrometers.

**INSTALLING PISTON AND CONNECTING ROD ASSEMBLY IN CYLINDER BLOCK**

Before installing the pistons, rods, and rod assemblies in bore, be sure that compression ring gaps are diametrically opposite one another and not in line with oil ring gap. The oil ring expander gap should be toward the outside of the "V" of the engine. The oil ring gap should be turned toward the inside of the "V" of engine. Immerse the piston head and rings in clean engine oil, slide the ring compressor, Tool C-385, over the piston and tighten with the special wrench (part of Tool C-385). Be sure the position of rings does not change during this operation. Screw the connecting rod bolt protector (part of Tool C-3221) on one rod bolt, and insert the rod and piston into cylinder bore.

**NOTE: Rotate the crankshaft so that connecting rod journal is on center of the cylinder bore.**

Attach the puller part of Tool C-3221 on the other bolt, and guide the rod over the crankshaft journal, as shown in Figure 86.

Tap piston down in the cylinder bore, using the

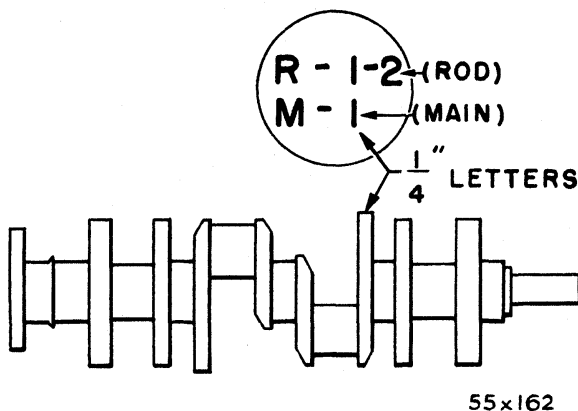


Fig. 85 — Internal Identification

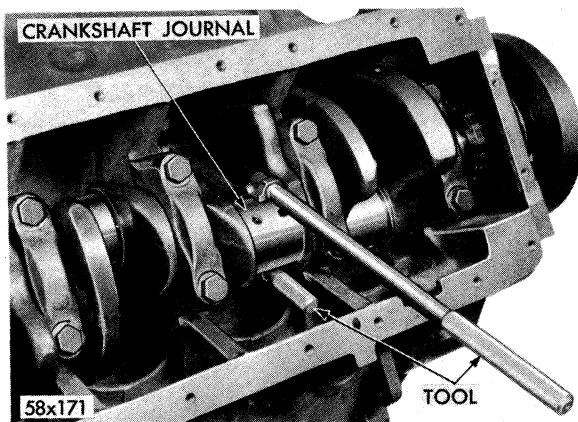


Fig. 86 — Removing and Installing Connecting Rod

handle of a hammer. At the same time, guide connecting rod into position on crankshaft journal. The notch or groove on the top of the piston must be pointing toward front of the engine and the larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet. Install the rod caps, tighten nuts to 45 foot-pounds torque.

**CRANKSHAFT MAIN JOURNALS**

The crankshaft journals should be checked for excessive wear, taper and scoring. Journal grinding should not exceed .012 inch under the standard journal diameter. DO NOT grind the thrust faces of No. 3 main bearing. DO NOT nick the crankpin or main bearing fillets. After regrinding, remove the rough edges from crankshaft oil holes and clean out all oil passages.

**CRANKSHAFT MAIN BEARINGS**

The lower main bearing halves of 1, 2, 4 and 5 numbers are interchangeable, as shown in Figure 87. The

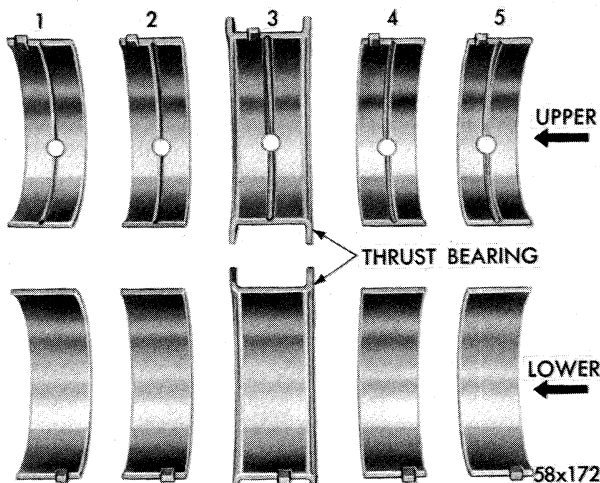


Fig. 87 — Main Bearing Identification

upper main bearing halves of 1, 2, 4 and 5 numbers are interchangeable. Upper and lower bearing halves are not interchangeable because the upper bearing is grooved and the lower is not.

The upper and lower No. 3 bearing halves are flanged to carry the crankshaft thrust loads and are not interchangeable with any other bearing halves in the engine.

**NOTE: Bearings that are not badly worn or pitted must be reinstalled in the same position.**

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Bearing shells are available in standard and the following undersizes: .001, .002, .003, .010 and .012 inch. Never install an undersize bearing shell that will reduce the clearance below specifications.

**REMOVAL AND INSTALLATION OF THE MAIN BEARINGS**

**a. Removal**

Remove the oil pan and mark bearing caps before removal. Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Fig. 88) into the oil hole of crankshaft. Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

**Checking the Main Bearing Clearance**

Plastigage Method. Use the same technique as described in "Checking the Connecting Rod Bearing Clearance."

**CAUTION**

If bearings are measured with the engine in the chas-

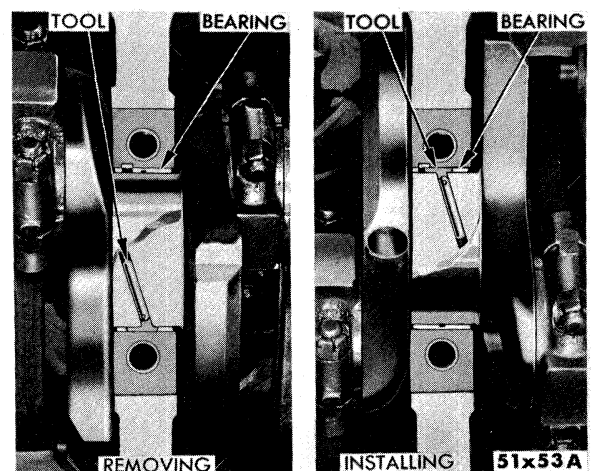


Fig. 88 — Removing and Installing Main Bearing Upper Shell

sis, the crankshaft must be supported in order to take up clearance between the upper bearing insert and the crankshaft journal. This can be done by snugging bearing caps of the adjacent bearings with .005 to .015 inch cardboard between lower bearing shell and journal. Use extreme caution when this is done to avoid unnecessary strain on the crankshaft or bearings, or false reading may be obtained. Do not rotate crankshaft while plastigage is installed. Be sure to remove cardboard before reinstalling oil pan.

It is permissible to use one .001 inch undersize bearing shell with one standard bearing shell or one .002 inch bearing shell. Always use the smaller diameter bearing half as the upper. Never use a new bearing with a used bearing and never use an upper bearing half more than .001 inch smaller than the lower bearing half.

**b. Installation of the Upper Main Bearing**

**NOTE:** When installing a new upper bearing shell, slightly chamfer the sharp edge from the plain side.

Start bearing in place, and insert Tool C-3059 into the oil hole of crankshaft (Fig. 88). Slowly rotate the crankshaft counter-clockwise sliding the bearing into position. After all bearings have been fitted, tighten all caps to 85 foot-pounds torque. The crankshaft end play should be .002 to .007 inch.

**OIL PAN (ALL MODELS)**

**a. Removal**

Drain the oil and remove dipstick. Disconnect the steering linkage from steering arm to allow the steering linkage to be lowered. On single exhaust system, the exhaust crossover pipe must be removed. Be sure the rest of exhaust system is sufficiently supported. It may be necessary to pull the brake line located across the crossmember slightly forward to allow enough clearance for pan removal. Remove oil pan attaching bolts and lower the oil pan on MC-1 only. Disconnect throttle linkage at transmission and at carburetor. Rotate the crankshaft until the centerline of the front counterweight is in the 10 o'clock position. Remove the front engine mounting nuts and raise the engine one inch. Remove the oil pan.

**b. Installation**

**NOTE:** Check the alignment of the oil strainer. The bottom of strainer must be on a horizontal plane machined surface of the cylinder block. The foot of strainer should touch bottom of the oil pan. Clean pan thoroughly and install new gasket, oil pan and

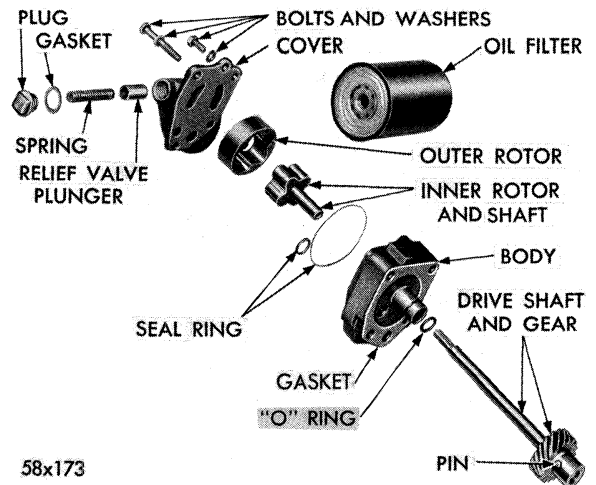


Fig. 89 — Oil Pump and Filter Assembly

attaching bolts. Tighten bolts to 15 foot-pounds torque. Lower the engine and install front engine mounting nuts and tighten to 85 foot-pounds torque.

Connect exhaust pipes (if removed) and steering, throttle and carburetor linkage. Refer to Transmission Section in this manual. Refill the crankcase.

**OIL PUMP**

**a. Removal**

Remove oil pump attaching bolts and remove pump and filter assembly from bottom side of the engine.

**b. Disassembly**

Remove the filter base and oil seal ring. Remove pump rotor and shaft and lift out the outer pump rotor. Remove oil pressure relief valve plug and lift out spring and plunger (Fig. 89).

**c. Inspection and Repair**

Clean all parts thoroughly. The mating face of oil

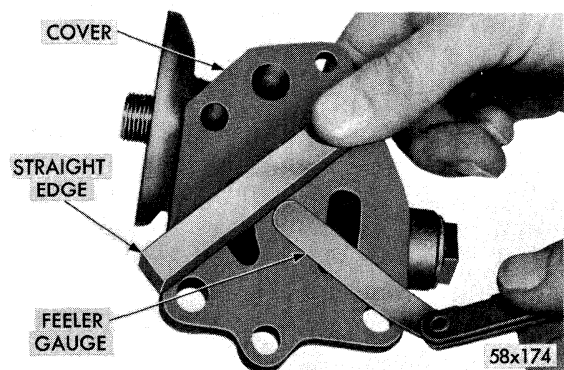
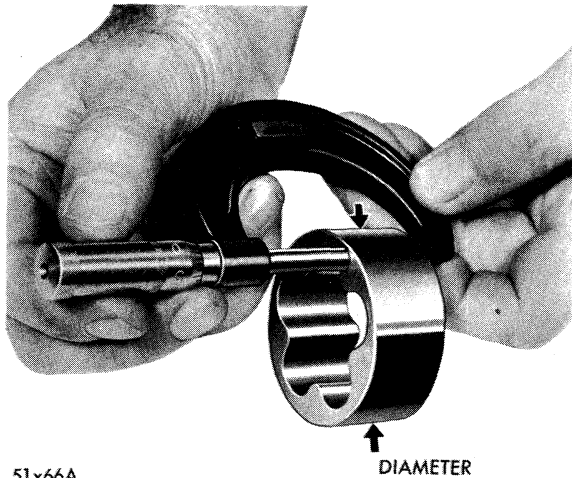


Fig. 90 — Checking Oil Pump Cover Flatness



51x66A

DIAMETER

Fig. 91 — Measuring Outer Rotor Thickness

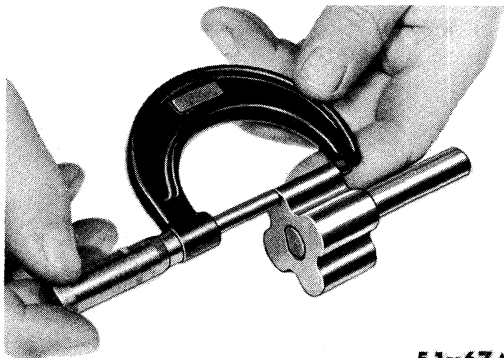
pump cover should be smooth. Replace cover if it is scratched or grooved.

Lay a straight edge across the oil pump cover surface (Fig. 90). If a .0015 inch feeler gauge can be inserted between the cover and straight edge, the cover should be replaced. If outer rotor length measures less than .943 inch (Fig. 91), and diameter less than 2.469 inches, replace outer rotor.

If the pump inner rotor length measures less than .943 inch (Fig. 92) a new pump rotor should be installed.

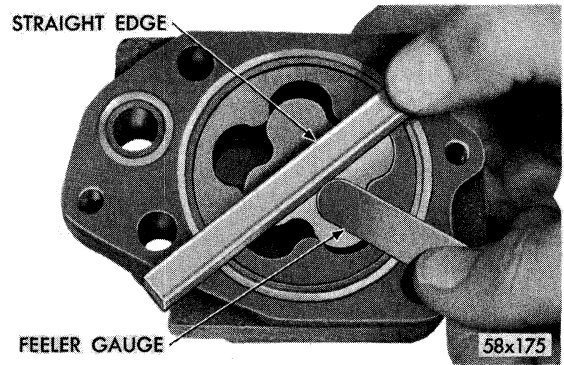
Slide outer rotor and inner rotor into pump body and place a straight edge across the face (between the bolt holes), as shown in Figure 93.

If a feeler gauge of more than .004 inch can be inserted between rotors and straight edge, replace pump body. Remove pump inner rotor and shaft leaving the outer rotor in pump cavity. Press the outer rotor body to one side with fingers and measure the clearance between outer rotor and pump body (Fig. 94). If measurement is more than .012



51x67A

Fig. 92 — Measuring Inner Rotor Thickness



58x175

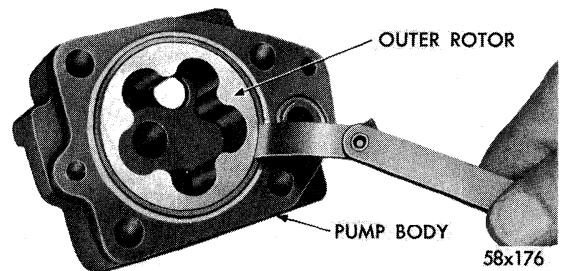
Fig. 93 — Measuring Clearance over Rotors

inch replace the oil pump body. If clearance between inner rotor and outer rotor (Fig. 95) is more than .010 inch, replace the inner and outer rotors.

Check the oil pump relief valve plunger for scoring and for free operation in its bore. If the plunger is scored, replace the plunger. The spring should conform to specifications on chart. If, for any reason, the spring has to be replaced, the same color spring should be used. An exception is where oil pressure is either above or below specifications. **When assembling oil pump, be sure to use new oil seal rings between filter base and body.** Tighten the attaching bolts to 35 foot-pounds torque.

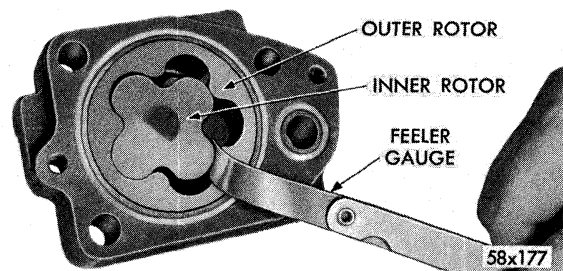
**Installation**

Install the oil pump on engine.



58x176

Fig. 94 — Measuring Outer Rotor Clearance



58x177

Fig. 95 — Measuring Clearance Between Rotors

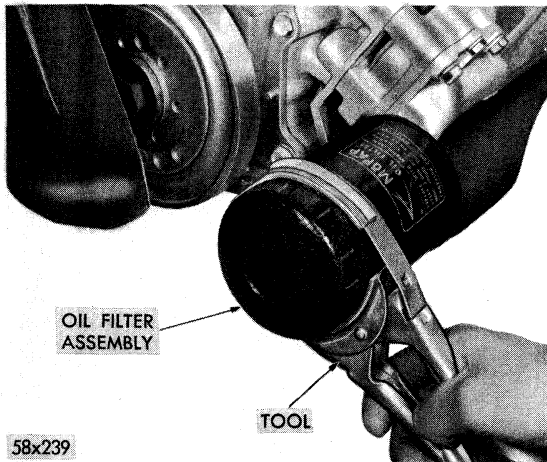


Fig. 96 — Removing Oil Filter with Tool

**RELIEF VALVE SPRING CHART**

Color	Free Length	Loaded Length	Compression Pounds
Gray (Lt.) . . . . .	2.19	1.60	11.85 to 12.85
Red (Std.) . . . . .	2.29	1.60	14.85 to 15.85
Brown (Hvy.) . . . . .	2.39	1.60	17.9 to 18.9

**REMOVAL AND INSTALLATION OF OIL FILTER**

The oil filter should be replaced every 5,000 miles to coincide with an engine oil change as follows:

Use care so as not to damage transmission oil cooler lines. Using Tool C-3654, unscrew the filter from base on bottom side on engine and discard. Wipe the base clean. Screw new filter on base, as shown in Figure 96, until gasket on filter contacts base. Tighten 1/2 turn more by hand. Start engine and check for leaks.

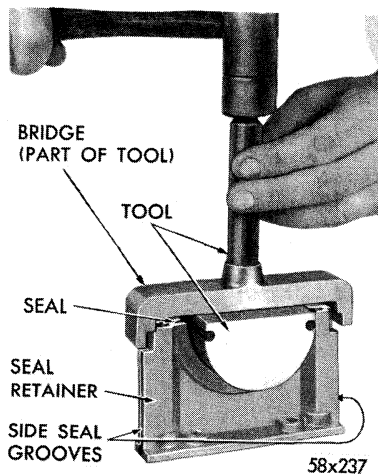


Fig. 97 — Installing Rear Main Bearing Lower Oil Seal

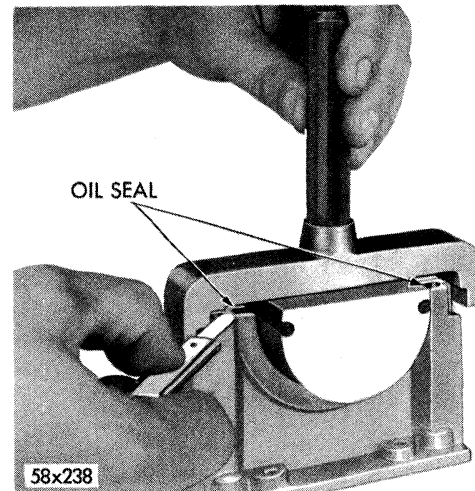


Fig. 98 — Trimming Rear Main Bearing Lower Oil Seal

**REPLACEMENT OF THE REAR MAIN BEARING OIL SEAL (Crankshaft Removed)**

Remove Allen screws and seal retainer. Install a new rear main bearing oil seal in the cylinder block so that both ends protrude. Tap seal down into position, using Tool C-3625 until the tool is seated in bearing bore. Hold tool in this position and cut off portion of seal that extends above the block on both sides.

**NOTE:** Be sure the bridge is removed from tool.

Install a new seal in the seal retainer so that the ends protrude (Fig. 97). Install bridge on tool and tap the seal down into position with Tool C-3625 until tool is seated. Trim off the portion of the seal that protrudes above the cap (Fig. 98). Install the two side seals in grooves in seal retainer. Install seal retainer and tighten screws to 30 foot-pounds torque.

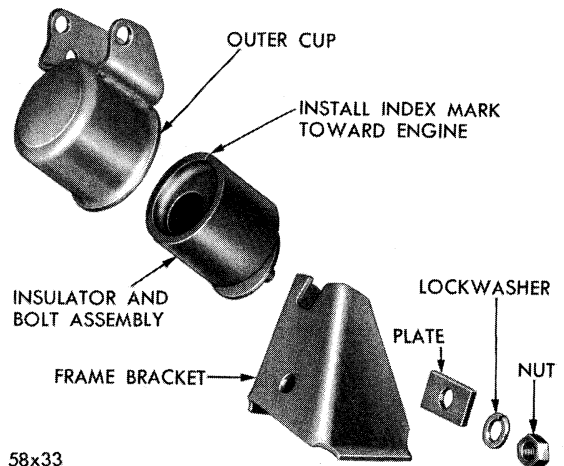


Fig. 99 — Right Front Engine Support

**FRONT ENGINE MOUNTS**

**a. Removal**

Disconnect throttle linkage at transmission and at carburetor. Remove the nuts, washers, plates from front engine mounts and raise the engine sufficiently enough to remove the insulator and stud assembly.

**b. Installation**

Install the insulator and stud assembly with the index mark on the insulator facing toward the engine, as shown in Figure 99.

Lower the engine aligning the stud with the slots in frame brackets.

**CAUTION**

Be sure the insulator stud does not interfere with the bottom of the slot in the frame bracket.

Install plates, washers and nuts. Neutralize the engine, and tighten nuts to 85 foot-pounds torque. Connect throttle linkage to transmission and to carburetor. Refer to Transmission Section in this manual for adjustment.

## Section VIII

# FUEL AND EXHAUST SYSTEM

## DATA AND SPECIFICATIONS

Model	MC-1
<b>FUEL PUMP</b>	
Make.....	Carter
Model.....	M-2769S
Type.....	Mechanical
Driven By.....	Camshaft
Pump Pressure (pounds).....	5 to 7
<b>CARBURETOR</b>	
Type.....	Dual Throat Downdraft
Model.....	BBD-2795S-2872S
<b>ADJUSTMENTS</b>	
Idle Mixture (both screws).....	One full turn open
Idle Speed.....	500 rpm
Fast Idle.....	.017"
Fast Idle Cam.....	On Index
Choke Unloader.....	1/4 inch
Accelerator Pump Travel.....	1 in. + or - 1/64
Float Setting.....	9/32 + or - 1/64
<b>CHOKE</b>	
Control.....	Cross over type
Setting.....	On Index
Fast Idle Speed Setting.....	1375 to 1425 rpm

Model	MC-2, MC-3 and MY-1
<b>FUEL PUMP</b>	
Make.....	Carter
Model.....	M-2769S
Type.....	Mechanical
Driven By.....	Camshaft
Pump Pressure (pounds).....	5 to 7