Chrysler

MAINTENANCE MANUAL

D-16703

QUICK REFERENCE INDEX: *To use, bend manual back to expose black spots on pages of the various sections. By means of the index arrows on this page, locate the corresponding black spots on the pages of the section you desire to find.*

CHRYSLER MAINTENANCE MANUAL

V-8 CYLINDER CHRYSLER INDUSTRIAL ENGINES

MODELS IND. 52, 53, 54, 56, 56A, SERIES POWER UNITS AND ENGINE ASSEMBLIES

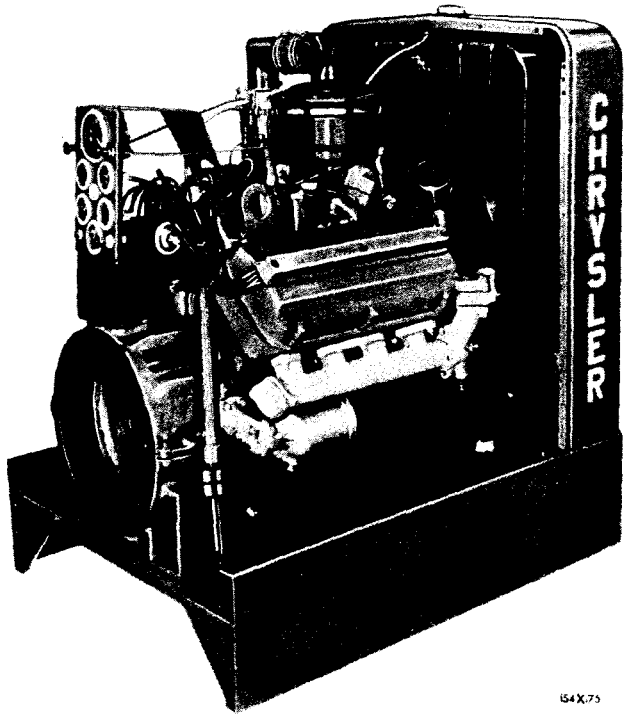
All Tools referred to in this Manual are available through the Miller Mfg. Co., 17640 Grand River, Detroit 27, Michigan, U.S.A.

Extra copies of this Manual are available at $3.00 each under Part Number D-16703. Order direct from the Industrial Engine Division.

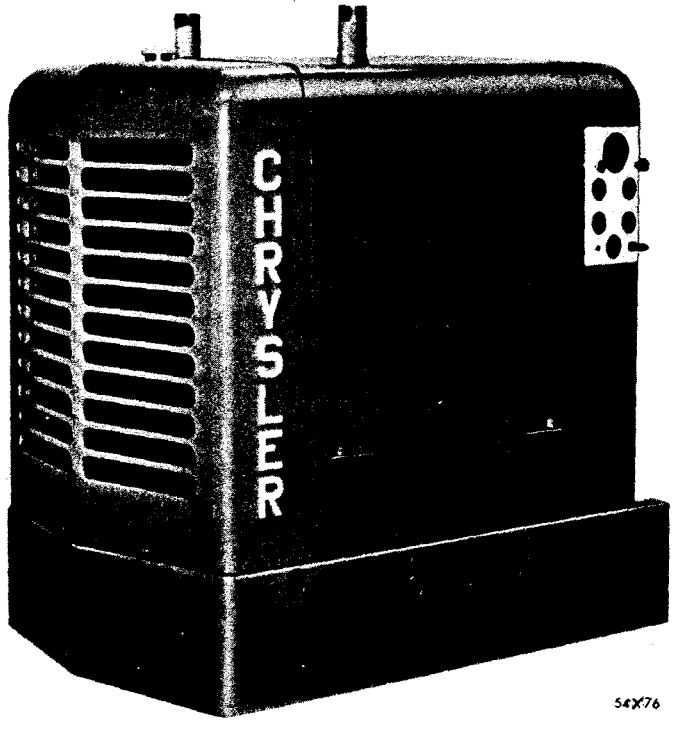
CHRYSLER CORPORATION
INDUSTRIAL ENGINE DIVISION
7700 RUSSELL STREET
DETROIT 11, MICHIGAN, U. S. A.

Litho in U.S.A.
5M—SD & TO—8-58

D-16703



Open Power Unit



Closed Power Unit

Fig. 1 — V-8 Industrial Engine Power Units

GENERAL PRECAUTIONS

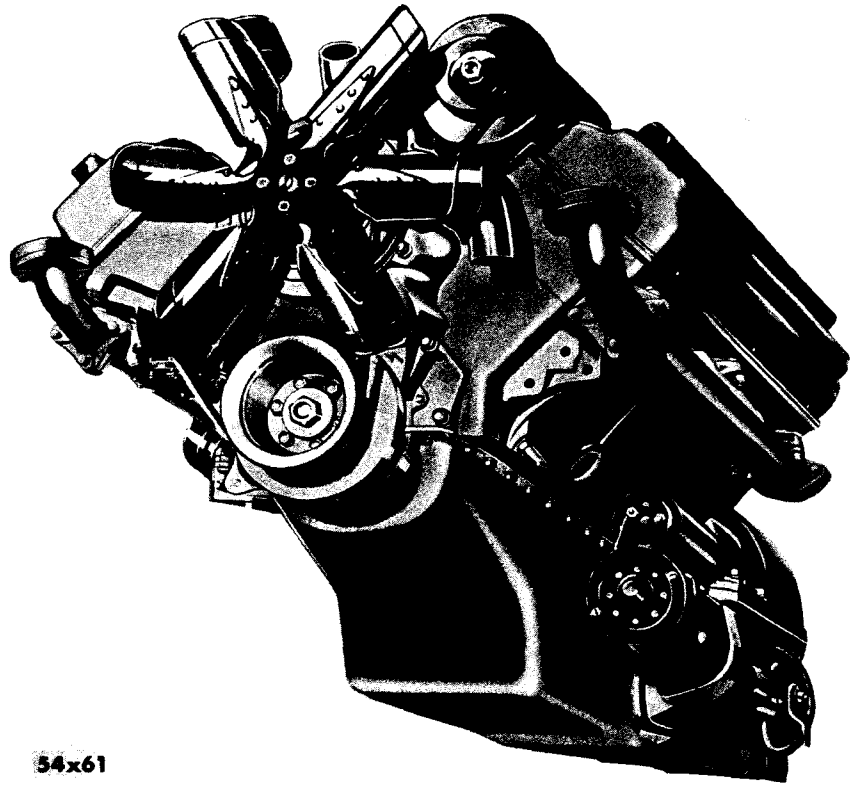
When starting a cold engine (whether new or not), avoid unnecessary acceleration during the warm-up period. Keep the throttle at little more than idling speed until normal operating temperature is indicated on the temperature gauge. This simple precaution will assure long life of the engine and maximum efficiency of operation.

It is good practice not to operate a new or rebuilt engine at more than ¾ throttle for the first 8 to 10 hours. This low speed will permit the bearings to seat properly, and will allow the operator to familiarize himself with the controls and performance of the engine.

After a hard run, let the engine idle for a few minutes before turning off the ignition. This will prevent the engine from kicking back and drawing in vapors from the exhaust.

In cool, wet weather, keep the fuel tank as full as possible at all times. This prevents the entry of moisture-laden air and helps to keep condensation out of the fuel system.

Make frequent checks on the instruments and gauges while operating the engine. Trouble is indicated beforehand by unusual readings. In most instances, proper interpretation of the gauges, together with prompt action in making some slight adjustment will forestall difficulty.



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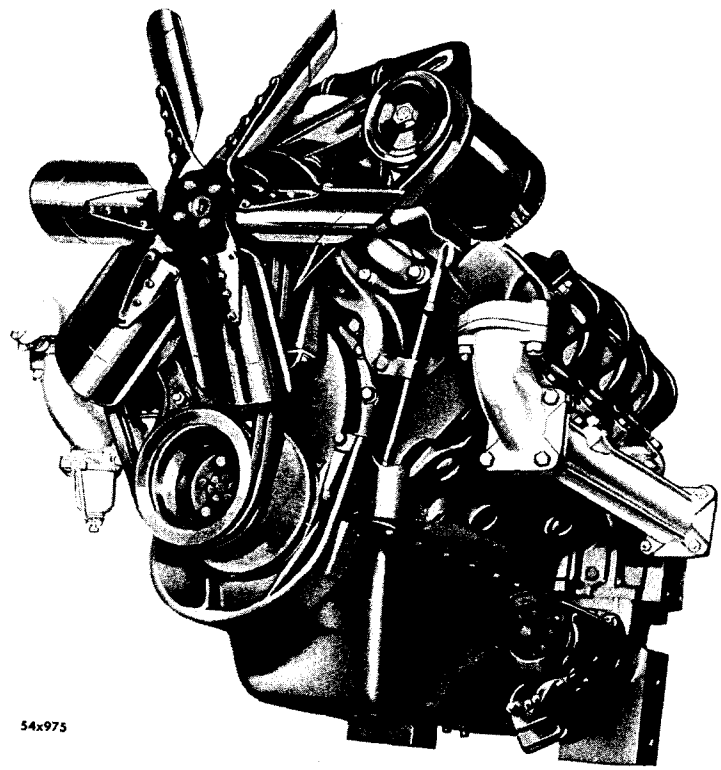

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Fig. 2 — V-8 Industrial Engine Assemblies

Section I
GENERAL INFORMATION

1. UNIT APPLICATION

Chrysler 8—Cylinder Industrial Engines, Models IND. 52, 53, 54, 56 and 56A are supplied in various types (Fig. 1 and 2) for use as power units for Farm Combines, Irrigation Pumps, Power Cranes, Aircraft handling equipment, Deepwell Turbine irrigation pumps, Airport crash trucks, Motor generator sets, Mobile air conditioner and Ground power units with many other industrial applications.

When an engine is modified for various adaptations, with a particular combination of accessories, it is designated by a separate model and type number. These engine models and types have been designated so that they may be readily identified in determining the service parts requirements, or when additional accessories are required for various adaptations.

2. ENGINE IDENTIFICATION

A brass name plate is attached beneath the distributor on the cylinder block, as shown in Figure 3, showing the model symbol, type, and serial number of the engine.

3. SERVICE TOOLS

The service tools referred to in this Manual, or their equivalent are necessary for efficient servicing of the Chrysler Industrial Engines. All tools listed are available through the Miller Manufacturing Company, 17640 Grand River Avenue, Detroit 27, Michigan, U.S.A.

NOTE

The number stamped on the front of the cylinder block just back of the water pump is a manufacturing code and should not be used for the purpose of identification.

4. SERVICE BULLETINS

Bulletins will be issued from time to time and will either supplement the information contained in this manual or contain new, detailed service instructions. Each section contains a

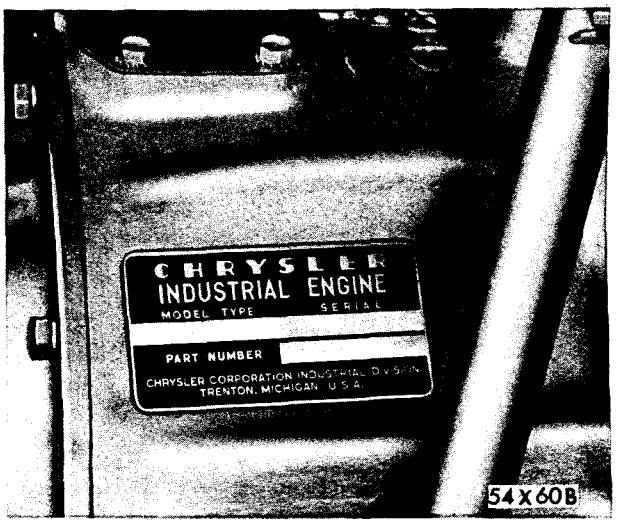

Fig. 3 — Engine Identification Name Plate

Bulletin Reference sheet for making notes of important service information pertaining to that section. After notes have been made file the bulletin for future reference.

5. DATA AND SPECIFICATIONS

Recommended tolerances and specifications for the fitting or adjustment of parts or components will be found at the beginning of the section to which they pertain. It is suggested that the information contained therein, be carefully followed in order to obtain the utmost in performance from the unit.

6. SERVICE DIAGNOSIS

"Trouble Shooting" information is provided in most of the sections as an aid to the serviceman, when diagnosing troubles. It covers many of the troubles that may be encountered, together with their possible causes.

7. ORDERING PARTS

Most **IMPORTANT** in ordering parts is the proper identification of the engine. **ALWAYS** mention the Model, Type and Serial Number. (Sample: Model Ind. 56A type 442, Serial Number 1273.) This information is stamped

on the identification plate (Fig. 3) and should be mentioned in all parts orders or communications.

The arrowed numbers appearing on many of the illustrations shown in this manual are NOT part numbers. They are "Part Type Codes" used by authorized Chrysler Industrial Engine Dealers and the MOPAR Motors Parts Corporation in identifying the individual parts. The part names and part type code number are included with the illustrations in order to facilitate the ordering of parts by use of the part name and part type code number, since part numbers are not included in this book.

Orders for parts should be placed with the nearest authorized Chrysler Industrial Engine Dealer. Authorized Chrysler Industrial Engine Dealers are in possession of complete parts information and can, in most instances, promptly supply your parts requirements from their inventory. If you do not know your nearest Chrysler Industrial Engine Dealer, a card addressed to the Chrysler Corporation, Industrial Engine Division, 7700 Russell St., Detroit 11, Michigan will bring you his name and address promptly.

8. OPERATION

Before placing a new engine in service, make a thorough inspection for evidence of damage or loose parts. Particular attention should be given to the nuts and bolts which hold the attaching parts.

The life of an engine depends to a great extent, upon careful and frequent inspection as an assurance that all units are adequately lubricated and maintained. When the engine is in constant use, make the inspections daily. If the engine has been idle for a period of time, make the inspections before the engine is started.

NOTE

Follow items 1 through 7, when preparing to start a new unit. Only those items indicated with an asterisk (*) pertain to routine starting.

a. Preparation for Starting Engine

(1) Close all drain cocks in the cooling system. Remove radiator cap (if engine is so equipped) and fill radiator with clean soft water to approximately ¾ inch of the filler neck. In weather below 32 degrees F., use a reliable anti-freeze.

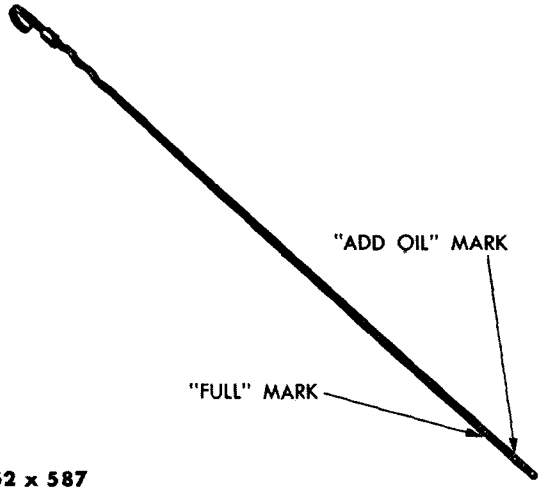

Fig. 4 — Engine Oil Indicator (Dip Stick)

(2) Check condition of the storage battery. The electrolyte liquid in the battery must be at least ⅜ inch above the plates. Check all electrical connections for tightness.

*(3) Check the oil level in the crankcase by means of oil level indicator shown in Figure 4. The oil level indicator has two markings: "Full" and "Add Oil." If the oil level is between the "Full" and "Add Oil" marks, it will not be necessary to add oil. If the oil level is even with, or drops slightly below the "Add Oil" mark, not more than one quart of oil should be added.

*(4) Fill fuel tank with regular grade gasoline, and open valves (if used) in the fuel lines.

*(5) Refer to the Lubrication and Maintenance Schedule, Section IX, and lubricate as required.

(6) Remove obstacles that would interfere with free rotation of moving parts. Clear away all tools or other potential obstructions.

(7) Check electrical connections against the wiring diagram.

b. Starting the Engine (Fig. 5)

(1) Turn counter-clockwise to unlock and pull the throttle to ⅓ open position and pull out choke button (if not equipped with an automatic choke).

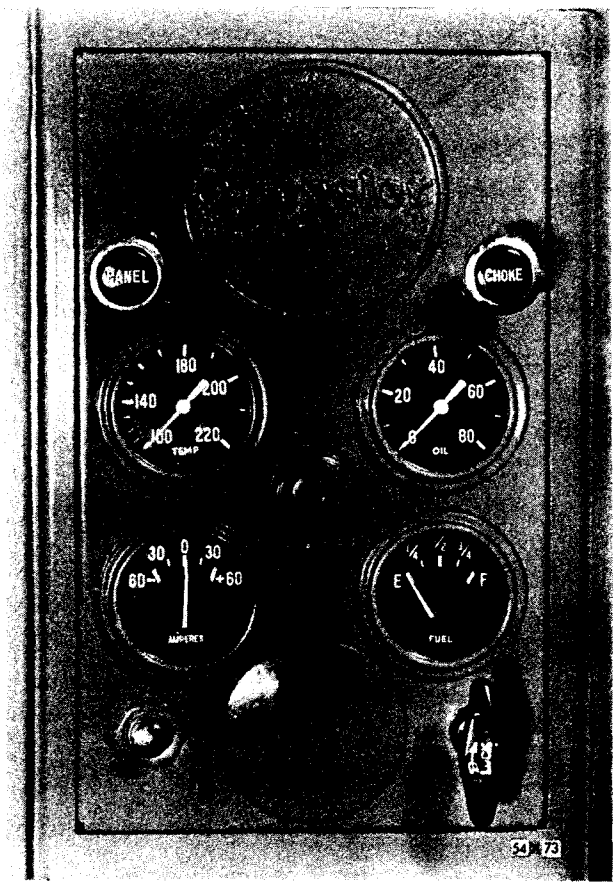

Fig. 5 — Typical Instrument Panel

(2) Disengage clutch (if so equipped) and turn on the ignition switch.

(3) Engage the starter button.

(4) Immediately after engine starts, observe the oil pressure gauge at instrument panel. If no pressure shows on the gauge after 10 to 15 seconds, stop the engine and check the lubrication system.

If the engine becomes overchoked or flooded open the throttle fully and press the starter button. After the engine starts, close the throttle to obtain the desired engine speed.

c. Stopping the Engine (Fig. 5)

(1) Close the throttle gradually and disengage the clutch (if so equipped).

(2) Allow the engine to run at idling speed for a few minutes. Close throttle, turn off the ignition.

(3) Check and replenish oil in the crankcase —if necessary.

(4) Check the amount of fuel in the fuel tank and replenish as required.

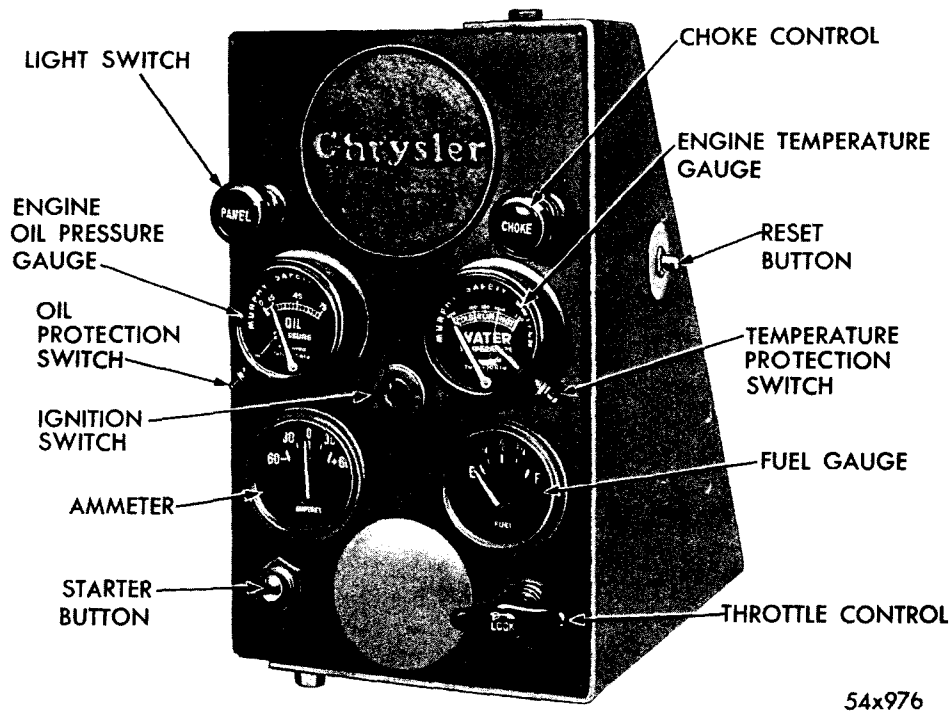

Fig. 6 — Temperature and Oil Pressure Protection Switches Instrument Panel (Optional)

d. Temperature and Oil Pressure Protection Switches (Fig. 6)

In the event of high water temperature or low oil pressure, the switches will stop the engine. In order to start the engine equipped with the above switches, the Manual Reset Button, as shown in Figure 6 must be held in until the oil pressure has been built up sufficiently to deactivate the oil safety switch.

9. OPERATING PRECAUTIONS

a. Warm-up Period

After starting a cold engine, operate at a speed slightly faster than idle (approximately 700 rpm) for a few minutes to allow the engine to reach normal operating temperature before placing under full load. This is done to allow the oil to warm up and reach the bearing surfaces, thus reducing the possibility of scoring and premature wear of internal engine parts.

b. Oil Pressure

With the engine turning at approximately 2,000 rpm and the water temperature at 160 degrees F., the oil pressure should be from 45 to 55 pounds, providing there is no unusual escape of oil from some point in the system. As bearings wear and the increased clearance allows more than the normal amount of oil to escape there will be a drop in pressure shown on the gauge, particularly at idling speed.

When the oil filter is operating properly, oil pressure on the gauge should be 45 to 55 pounds. If this pressure drops to 35 pounds, the filter element may be plugged and should be changed.

c. Water Temperature

A thermostat is used to retard the circulation of water in the cooling system until the water has reached a predetermined temperature, thereby permitting faster warm-up of the engine. When operating in hot climates, the maximum reading shown on the water temperature gauge should not exceed 100 degrees F. above the prevailing atmospheric temperature.

CAUTION

Do not operate the engine with the thermostat removed, as excessive sludge formations will form in the crankcase as a result of the engine running too cool to dissipate the fumes in the crankcase.

d. Ignition System

Keep the units of the ignition system clean and properly adjusted.

e. Fuel System

Keep the fuel tank, lines and filters clean. Use a good grade of fuel at all times.

f. Cooling System

Do not fill the cooling system when the engine is overheated. Allow the engine to cool before adding water or anti-freeze to prevent cracking the cylinder block or head. Use a good grade of anti-freeze during cold weather.

10. BREAKING IN A NEW OR REBUILT ENGINE

For peak performance and economical operation, the following adjustments should be made on a new or rebuilt engine after one hour of operation:

(1) Tighten cylinder heads while engine is hot.

(2) Adjust ignition timing—if necessary.

(3) Lubricate water pump.

(4) Oil governor and set to required engine speed. Use a tachometer.

(5) Inspect for fuel, oil or water leaks.

(6) Adjust idle mixture and idle speed on the carburetor.

11. STORING THE ENGINE

When the engine is to be stored or removed from operation, for an extended period of time, special precautions should be taken to protect the engine against rust accumulation, corrosion of the bearing and mating surfaces within the engine and a gumming condition in the fuel system. To properly store an engine the following instructions should be followed:

(1) Drain lubricating oil from engine.

Add 2½ quarts of Rust Preventive Lubricant, (as manufactured by a reliable oil company) to the crankcase.

(2) Drain cooling system and add MOPAR Rust Resistor. Fill with clean water.

(3) Run engine at idle speed for 3 or 4 minutes. This will allow the MOPAR Rust Resistor to coat the radiator (if so equipped) and engine water jackets with a protective film and the Rust Proofing Oil to be distributed throughout the internal parts of the engine.

NOTE

If unable to run the engine under its own power, turn it over several times with the starter until Rust Proofing Oil has been thoroughly distributed.

(4) Remove the top of the air cleaner. Run the engine at approximately 1,000 rpm, and pour ½ pint of Rust Preventive Oil through the carburetor air intake. Shut off engine as soon as the ½ pint of Rust Preventive Oil has been drawn into the combustion chamber.

(5) Drain the Rust Proofing Oil from the crankcase.

(6) Remove the spark plugs and pour 1 ounce of Rust Preventive Oil into each spark plug hole. Turn the engine over 4 or 5 times with the starter. Reinstall the spark plugs.

(7) Drain the cooling system at the radiator and cylinder block.

(8) Drain the fuel system tank, fuel pump, filter and carburetor. Operate the carburetor throttle lever several times to empty the accelerator pump system.

(9) Remove the carburetor air cleaner, the oil filler cap air cleaner and the outlet ventilator pipe air cleaner. Seal the openings with masking or adhesive tape. Seal the exhaust outlet opening in the exhaust manifold or exhaust pipe.

(10) Change the element in the oil filter and clean out the filter housings.

(11) Replenish the water in the storage battery to ⅜ inch above the plates. Recharge, if necessary, and store in a cool dry place.

(12) Protect the engine with a waterproof cover if exposed to the weather.

(13) Make periodic inspections to determine condition of engine and seals.

Section II

ENGINE

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

ENGINE

MODELS IND. 52, 53, 54, 56, 56A
DATA AND SPECIFICATIONS

MODELS	*IND. 52*	*IND. 53*	*IND. 54*	*IND. 56*	*IND. 56A*
ENGINE					
Type	90° V	90° V	90° V	90° V	90° V
Valve Arrangement	In Heads Single Rocker Shaft	Single Rocker Shaft	Double Rocker Shaft	Double Rocker Shaft	Double Rocker Shaft
Number of Cylinders	8	8	8	8	8
Bore	3.625	3.63	3.63	3.81	3.94
Stroke	3.250	3.80	3.80	3.63	3.63
Piston Displacement (cu. in.)	270 cu. in.	315 cu. in.	315 cu. in.	331 cu. in.	354 cu. in.
Taxable Horsepower (AMA)	42.2	42.16	42.16	46.51	49.6
Compression Ratio	8 to 1	7 to 1	7.5 to 1	8.5 to 1	7.5 to 1
Maximum Brake Horsepower (continuous)					140 @ 3000 RPM
Compression Pressure at 150 RPM (plugs removed) Wide Open Throttle	90 to 155 lbs.	120 to 160 lbs.	120 to 155 lbs.	140 to 170 lbs.	120 to 140 lbs.
Maximum Variation Between Cylinders (any one engine)	15 lbs.	15 lbs.	15 lbs.	15 lbs.	15 lbs.
Firing Order	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2
CYLINDER NUMBERING—					
(As viewed from Drive End of Engine)					
Left Bank	1-3-5-7	1-3-5-7	1-3-5-7	1-3-5-7	1-3-5-7
Right Bank	2-4-6-8	2-4-6-8	2-4-6-8	2-4-6-8	2-4-6-8
ENGINE WEIGHT					
Approximate Weight of Engine (dry) (Will vary with equipment)	718 lbs.	760 lbs.	760 lbs.	732 lbs.	718 lbs.
CRANKSHAFT					
Type	Fully Counter-Balanced	Fully Counter-Balanced	Fully Counter-Balanced	Fully Counter-Balanced	Fully Counter-Balanced
Bearings	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt	Tri-Metal

ENGINE—(Contd.)

MODELS	IND. 52	IND. 53	IND. 54	IND. 56	IND. 56A
Number Main Bearings	5	5	5	5	5
Diametral Clearance (desired)	.0005-.0015	.0005-.0015	.0005-.0015	.0005-.0015	.0015-.0025
Maximum Allowable Before Reconditioning	.0025	.0025	.0025	.0025	.0035
End Play	.002-.007 in.	.002-.007 in.	.002-.007 in.	.002-.007 in.	.002-.007 in.
Maximum Allowable Before Reconditioning	.010	.010	.010	.010	.010
Thrust Taken by	No. 3 Main Bearing	No. 3 Main Bearing	No. 3 Main Bearing	No. 3 Main Bearing	No. 3 Main Bearing
Interchangeability of Bearings	Upper & Lower Nos. 1-2-4 Upper & Lower No. 3 Upper & Lower No. 5 Not Interchangeable	Upper & Lower Nos. 1-2-4 Upper & Lower No. 3 Upper & Lower No. 5 Not Interchangeable	Upper & Lower Nos. 1-2-4 Upper & Lower No. 3 Upper & Lower No. 5 Not Interchangeable	Upper & Lower Nos. 1-2-4 Upper & Lower No. 3 Upper & Lower No. 5 Not Interchangeable	Upper & Lower Nos. 1-2-4 Upper & Lower No. 3 Upper & Lower No. 5 Not Interchangeable
BEARING SIZES (Diameter and Length)					
No. 1	2 3/8 x 27/32"	2.5 x 27/32"	2.5 x 27/32"	2.5 x .90"	2.5 x .90"
No. 2	2 3/8 x 27/32"	2.5 x 27/32"	2.5 x 27/32"	2.5 x .90"	2.5 x .90"
No. 3	2 3/8 x 27/32"	2.5 x 27/32"	2.5 x 27/32"	2.5 x 1.15"	2.5 x 1.15"
No. 4	2 3/8 x 27/32"	2.5 x 27/32"	2.5 x 27/32"	2.5 x .90"	2.5 x .90"
No. 5	2 3/8 x 1 9/16"	2.5 x 1 9/16"	2.5 x 1 9/16"	2.5 x 1.62"	2.5 x 1.62"
MAIN BEARINGS (Service) Available in Standard and the Following Undersizes:					
No. 1	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"
No. 2	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"
No. 3	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"
No. 4	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"
No. 5	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"	.001, .002, .003, .010, .012"

ENGINE—(Contd.)

MAIN BEARING JOURNALS					
Diameter	2.3745-2.3755″	2.4995-2.5005″	2.4995-2.5005″	2.4995-2.5005″	2.4995-2.5005″
Maximum Allowable Out-of-Round	.001″	.001″	.001″	.001″	.001″
Maximum Allowable Taper	.001″	.001″	.001″	.001″	.001″
Center Bearing Run-Out (total indicator reading) When Supported at Front and Rear	.002″	.002″	.002″	.002″	.002″
CRANKPIN JOURNALS					
Diameter	1.9365-1.9375″	2.249-2.250″	2.249-2.250″	2.249-2.250″	2.249-2.250″
Length		1.650-1.674″	1.650-1.674″		1.838-1.872″
Maximum Allowable Out-of-Round	.001″	.001″	.001″	.001″	.001″
Maximum Allowable Taper	.001″	.0005″	.0005″	.0005″	.0005″
CONNECTING RODS AND BEARINGS					
Type	Forged "I" Beam	Forged "I" Beam	Forged "I" Beam	Drop Forged "I" Beam	Drop Forged "I" Beam
Lenght, Center to Center	5.9335-5.9375″	6.616-6.620″	6.616-6.620″	6.621-6.625″	6.621-6.625″
Weight (less bearings shell)	600 Grams	680 Grams	680 Grams	713-717 Grams	713-717 Grams
Bearings (Material)	Steel Backed Babbitt	Bi-Metal	Bi-Metal	Tri-Metal	Tri-Metal
Diameter and Length	$1\frac{15}{16}$ x $\frac{13}{16}$″	2.25 x .811″	2.25 x .811″	2.25 x .90″	2.25 x .90″
Radial Clearance Desired	.0005-.0015″	.0010-.0020″	.0010-.0020″	.001-.002″	.001-.002″
Maximum Allowable Before Reconditioning	.0025″	.0025″	.0025″	.0025″	.0025″
Side Clearance	.006-.014″	.006-.014″	.006-.014″	.006-.014″	.006-.014″
Bearings for Service (Standard)	.001, .002, .003, .010, .012″ US	.001, .002, .003, .010, .012″ US	.001, .002, .003, .010, .012″ US	.001, .002, .003, .010, .012″ US	.001, .002, .003, .010, .012″ US
CONNECTING ROD BUSHING					
Type	Steel Backed Bronze	Steel Backed Bronze	Steel Backed Bronze	Steel Backed Bronze	Steel Backed Bronze
Number	8	8	8	8	8
Diameter and Length	$\frac{55}{64}$ x $1\frac{1}{8}$″	.922 x 1.12″	.922 x 1.12″	.9843 to .9846 x $1\frac{1}{4}$″	.984 x 1.18″
Interchangeability	All	All	All	All	All
Clearance	.0001-.0004″ (Selective)	.0010-.0020″ (Selective)	.0010-.0020″ (Selective)	.0001-.0004″ (Selective)	.0001-.0004″ (Selective)

ENGINE—(Contd.)

MODELS	IND. 52	IND. 53	IND. 54	IND. 56	IND. 56A
CAMSHAFT					
Drive	Chain	Chain	Chain	Chain	Chain
Bearings	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt
Number	5	5	5	5	5
Thrust Taken by	Thrust Plate	Thrust Plate	Thrust Plate	Thrust Plate	Thrust Plate
End Play	.002-.006″	.002-.007″	.002-.007″	.002-.006″	.002-.006″
Maximum Allowable Before Reconditioning	.010″	.010″	.010″	.010″	.010″
Radial Clearance	.001-.003″	.001-.003″	.001-.003″	.001-.003″	.001-.003″
Maximum Allowable Before Reconditioning	.005″	.005″	.005″	.005″	.005″
Valve Lift—Intake	.378″	.388″	.388″	.375″	.388″
Valve Lift—Exhaust	.361″	.388″	.388″	.361″	.388″
CAMSHAFT BEARING JOURNALS					
Diameter and Length—No. 1	1.998 -1.999 x 7/8″	2 x .875″	2 x .875″	1.998 -1.999 x 15/16″	1.998 -1.999 x 15/16″
No. 2	1.982 -1.983 x 3/4″	1.98 x .75″	1.98 x .75″	1.998 -1.999 x 3/4″	1.998 -1.999 x 3/4″
No. 3	1.967 -1.968 x 3/4″	1.96 x .75″	1.96 x .75″	1.998 -1.999 x 3/4″	1.998 -1.999 x 3/4″
No. 4	1.951 -1.952 x 3/4″	1.95 x .75″	1.95 x .75″	1.998 -1.999 x 3/4″	1.998 -1.999 x 3/4″
No. 5	1.4355-1.4365x 15/16″	1.43 x 15/16″	1.43 x 15/16″	1.4355-1.4365x 29/32″	1.4355-1.4365x 29/32″
CAMSHAFT BEARINGS					
Diameter and Length (after reaming)—No. 1	2 x 7/8″	2 x 7/8″	2 x 7/8″	2.000 -2.001 x 15/16″	2.000 -2.001 x 15/16″
No. 2	1 63/64 x 3/4″	1 63/64 x 3/4″	1 63/64 x 3/4″	2.000 -2.001 x 13/16″	2.000 -2.001 x 13/16″
No. 3	1 31/32 x 3/4″	1 31/32 x 3/4″	1 31/32 x 3/4″	2.000 -2.001 x 13/16″	2.000 -2.001 x 13/16″
No. 4	1 61/64 x 3/4″	1 61/64 x 3/4″	1 61/64 x 3/4″	2.000 -2.001 x 13/16″	2.000 -2.001 x 13/16″
No. 5	1 1/16 x 7/8″	1 1/16 x 7/8″	1 1/16 x 7/8″	1.4375-1.4385x 29/32″	1.4375-1.4385x 29/32″
CAMSHAFT CHAIN					
Adjustment	None	None	None	None	None
Number of Links	68	68	68	68	68
Pitch	.375″	.375″	.375″	.375″	.375″
Width	1/8″	1/8″	1/8″	1/8″	1/8″
TAPPETS					
Type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Clearance in Block	.0005-.0015″	.0005-.0015″	.0005-.0015″	.0005-.0015″	.0005-.0015″
Body Diameter	.9040-.9045″	.9040-.9045″	.9040-.9045″	.9040-.9045″	.9040-.9045″

ENGINE—(Contd.)

Clearance Between Valve Stem and Rocker Arm (Dry)	.060-.210"	.060-.210"	.060-.210"	.060-.210"	.060-.210"
Tappets for Service	Std. .001, .008, .030" OS	Std. .001, .008, .030" OS	Std. .001, .008, .030" OS	Std. .001, .008, .030" OS	Std. .001, .008, .030" OS
PISTONS					
Type	Thermal Controlled by Steel Band	Thermal Controlled by Steel Band	Thermal Controlled by Steel Band	Thermal Controlled by Steel Strut	Thermal Controlled by Steel Strut
Material	Aluminum Alloy Tin Coated	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy Tin Coated	Aluminum Alloy Tin Coated
Clearance in Bore (pounds pull with .0015" x ½" feeler stock)	5-10 lbs. Pull	5-10 lbs. Pull	5-10 lbs. Pull	5-12 lbs. Pull	5-12 lbs. Pull
Land Clearance (diametral)	.027-.033"	.027-.033"	.027-.032"	.027-.032"	.027-.032"
Clearance (Top of Skirt)	.0005-.0015"	.0005-.0015"	.0005-.0015"	.0005-.0015"	.0005-.0015"
Weight (Standard through .060" oversize)	457-461 Grams	516 Grams	516 Grams	595 Grams	646 Grams
Piston Length (overall)	3 7/32"	3.31"	3.31"	3.55"	3.82"
Ring Groove Width—Upper	.0795-.0805"	.0795-.0885"	.0795-.0805"	.080 -.081"	.080 -.081"
Intermediate	.0790-.0800"	.0790-.0800"	.0790-.0800"	.080 -.081"	.080 -.081"
Lower	.1875-.1890"	.1875-.1890"	.1875-.1890"	.1875-.1885"	.1875-.1885"
Pistons for Service	Std. .005, .020, .030, .040, .060" OS	Std. .005, .020, .040, .060" OS	Std. .005, .020, .040, .060" OS	Std. .005, .020, .040, .060" OS	Std. .005, .020, .040, .060" OS
PISTON PINS					
Type	Floating	Floating	Floating	Floating	Floating
Diameter and Length	.8591-.8593 x 2.880-2.890"	.9216-.9218 x 3.060-.3070"	.9216-.9218 x 3.060-3.070"	.9841-.9843 x 3.140-3.150"	.9841-.9843 x 3.140-3.150"
Clearance in Piston (thumb Press at 70° F)	.0000-.0005"	.0000-.0005"	.0000-.0005"	.0000-.0005"	.0000-.0005"
End Play	.003-.029"	.003-.029"	.003-.029"	.004-.026"	.004-.026"
Clearance in Rod (selective)	.0001-.0004"	.0001-.0004"	.0001-.0004"	.0001-.0004"	.0001-.0004"
Piston Pins for Service	Std. .003, .008" OS	Std. .003, .008" OS	Std. .003, .008" OS	Std. .003, .008" OS	Std. .003, .008" OS
PISTON RINGS					
Number of Rings per Piston	3	3	3	3	3
Compression	2	2	2	2	2
Oil with Expander	1	1	1	1	1
Piston Ring Gap	.010-.020"	.010-.020"	.010-.020"	.010-.020"	.010-.020"
Ring Side Clearance—Upper	.0015-.0030"	.0015-.0030"	.0015-.0030"	.0015-.0030"	.0015-.0030"
Intermediate	.0010-.0025"	.0010-.0025"	.0010-.0025"	.0020-.0035"	.0020-.0035"
Lower	.0010-.0030"	.001-.003"	.001-.003"	.0010-.0025"	.0010-.0025"

ENGINE—(Contd.)

MODELS	IND. 52	IND. 53	IND. 54	IND. 56	IND. 56A
VALVES—Intake					
Material	Silicon-Chromium Steel	Silicon-Chromium Steel	Silicon-Chromium Steel	Silicon-Chromium Steel	Silicon-Chromium Steel
Head Diameter	1 23/32"	1.839-1.849"	1.75"	1 13/16"	2"
Length (to top of valve face)	4 1/4"	4.301-4.316"	4.80"	4 25/32"	5 1/32"
Stem Diameter (Standard)	.372-.373"	.372-.373"	.372-.373"	.372-.373"	.372-.373"
Stem to Guide Clearance	.001-.003"	.001-.003"	.001-.003"	.001-.003"	.001-.003"
Face Angle	45°	45°	45°	45°	45°
Adjustment	None	None	None	None	None
Lift	.378"	.388"	.388"	.375"	.388"
VALVES—Exhaust					
Material	XCR-Stellite	XCR-Stellite	Silicrome-XB	Nitrided Chrome Nickel Steel	Nitrogen Treated Manganese Chrome Nickel Steel
Head Diameter	1.47"	1.464-1.474"	1.406"	1.75"	1.75"
Length (to top of valve face)	4.167"	4.254-4.269"	4.70"	5 1/32"	5 1/32"
Stem Diameter	.371-.372"	.371-.372"	.433-.434"	.371-.372"	.371-.372"
Stem to Guide Clearance	.002-.004"	.002-.004"	.002-.004"	.002-.004"	.002-.004"
Face Angle	45°	45°	45°	45°	45°
Adjustment	None	None	None	None	None
Lift	.361"	.388"	.388"	.361"	.388"
VALVE SPRINGS—Outer					
Number	16	16	16	16	16
Free Length	1 15/16"	1 7/8"	1 7/8"	2"	2"
Free Length (Rotator Equipped)	—	—	—	1 7/8"	1 7/8"
Load When Compressed to 1 11/16" (valve closed)	38-43 lbs.	38-43 lbs.	38-43 lbs.	38-43 lbs.	38-43 lbs.
Load When Compressed to 1 13/64" (rotator equipped—valve closed)	38-43 lbs.	38-43 lbs.	38-43 lbs.	38-43 lbs.	38-43 lbs.
Load When Compressed to 1 5/16" (valve open)	100-110 lbs.	100-110 lbs.	100-110 lbs.	100-110 lbs.	100-110 lbs.
Load When Compressed to 1 13/64" (rotator equipped—valve open)	100-110 lbs.	100-110 lbs.	100-110 lbs.	100-110 lbs.	100-110 lbs.
Assemble with Closed Coils Toward	—	—	—	Head	Head
Valve Spring I.D.	—	—	—	.990-1.010"	.990-1.010"

ENGINE—(Contd.)

VALVE SPRINGS—Inner					
Number	16	16	16	16	16
Free Length	1 29/32″	1.81″	1.81″	1.81″	2 1/64″
Free Length (Rotator Equipped)	—	—	—	—	1 29/32″
Load When Compressed to 1 9/16″ (valve closed)	20-23 lbs.	20-23 lbs.	20-23 lbs.	20-23 lbs.	20-23 lbs.
Load When Compressed to 1 29/64″ (rotator equipped—valve closed)	20-23 lbs.	20-23 lbs.	20-23 lbs.	20-23 lbs.	20-23 lbs.
Load When Compressed to 1 3/16″ (valve open)	40-45 lbs.	40-45 lbs.	40-45 lbs.	40-45 lbs.	40-45 lbs.
Load When Compressed to 1 5/64″ (rotator equipped—valve open)	40-45 lbs.	40-45 lbs.	40-45 lbs.	40-45 lbs.	40-45 lbs.
Valve Spring Inside Diameter	—	—	—	—	.690-.710″
Maximum Allowance Out-Of-Plumb	1/16	1/16″	1/16″	1/16″	1/16″
CYLINDER HEADS					
Number Used	2	2	2	2	2
Combustion Chamber (type)	Polyspherical	Polyspherical	Polyspherical	Hemispherical	Hemispherical
Valve Seat Run-out (maximum)	.002″	.002″	.002″	.002″	.002″
Valve Seat Out-of-Round	.0005″	.0005″	.0005″	.0005″	.0005″
Intake Valve Seat Angle	45°	45°	45°	45°	45°
Seat Width (finished)	.060-.085″	.060-.085″	.060-.085″	.040-.060″	.060-.085″
Exhaust Valve Seat Angle	45°	45°	45°	45°	45°
Seat Width (finished)	.040-.060″	.040-.060″	.040-.060″	.040-.060″	.040-.060″
Cylinder Head Gasket (thickness)	.055″	—	—	.024″	.020″
VALVE GUIDES					
Type	Cast in Head Integral	Cast in Head Integral	Cast Iron	Cast Iron	Cast Iron
Ream for Next Oversize Valve Stem	.374″ Standard .379, .389, .404″ OS	.374″ Standard .379, .389, .404″ OS	.374″ Standard .379, .389, .404″ OS	.374″ Standard .379, .389, .404″ OS	.374″ Standard .379, .389, .404″ OS
ROCKER SHAFT ASSEMBLY					
Clearance Between Rocker Arm and Shaft	.001-.002″	.001-.002″	.0014-.0027″	.0014-.0027″	.0014-.0027″
Clearance Between Rocker Shaft and Bracket	.007-.0027″	.007-.0027″	.0012-.0022″	.0012-.0022″	.0012-.0022″
Clearance Between Valve Stem and Rocker Arm Tip (Dry Lash Tappet Drained)	.060-.210″	.060-.210″	.060-.210″	.060-.210″	.060-.210″

SPECIAL TOOLS

Tool Number	*Tool Name*
C-119	Indicator—Cylinder Bore
C-385	Compressor—Piston Ring
C-425	Vacuum Gauge
C-455	Wrench—Starting Motor Flange Nut
C-647	Tester—Clutch and Valve Spring
C-690	Scale and Gauge—Piston Fitting
C-741	Reamer—Solid Valve Guide
C-756	Cleaner—Valve Guide
C-863	Timing Light—6 and 12 Volt
C-897	Driver—Welch Plug Installer
C-3005	Wrench—Torque 100 Foot-Pounds (Sensory Type)
C-3012	Reamer—Cylinder Bore Ridge
C-3024	Tool—Rocker Arm and Spring Compressor
C-3025	Sleeve—Guide Wear Measuring—Intake
C-3026	Sleeve—Guide Wear Measuring—Exhaust
C-3028	Reamer Set—Valve Tappet
C-3033	Puller Set—Damper, Sprocket, Crank Gear
C-3038	Fixtures—Cylinder Head Holding (56)
C-3046	Tool—Piston Ring Installer (52 & 53)
C-3049	Reamer—Piston Pin Line (.980 to 1.030)
C-3052	Remover—Distributor Shaft Bushing
C-3053	Driver and Burnisher—Distributor Drive Shaft Bushing
C-3054	Wrench—Spark Plug
C-3059	Tool—Main Bearing Upper Shell
C-3061	Gauge—Valve Stem Length (56)
C-3065	Gauge—Cylinder Compression
C-3066	Connector—Timing Light
C-3068	Rack—Hydraulic Tappet
C-3075	Gauge—Top Dead Center (56)
C-3132	Puller and Installer—Camshaft Bearing
C-3151	Driver—Welch Plug Installing
C-3160	Pliers—Hydraulic Tappet Leakdown Checking
C-3167	Stand—Engine Repair
C-3168	Adapter—Engine Repair Stand
C-3216	Puller—Hydraulic Tappet
C-3221	Tool—Piston and Connecting Rod Assembly
C-3339	Dial Indicator Set
C-3419	Wrench—Distributor Lock Plate
C-3422	Compressor—Valve Spring (56)
C-3427	Reamer—Valve Guide (.404 to .405 inch)
C-3428	Compressor—Valve Spring (52 & 53)
C-3430	Reamer—Valve Guide (.389 to .390 inch) (52 & 53)
C-3433	Reamer—Valve Guide (.379 to .380 inch) (52 & 53)
C-3436	Gauge—Valve Stem Length (52 & 53)
C-3466	Plate—Engine Lifting
C-3491	Connecting Rod Aligner
C-3495	Tool—Piston Ring Installer (56)
C-3501	Cylinder Bore Deglazing Hone
C-3506	Removing and Installing Tool—Chain Case Cover Oil Seal
C-3509	Tool—Camshaft Holding
C-3511	Tool—Rear Main Bearing Seal Installing
DD-883	Driver—Valve Guide

TIGHTENING REFERENCE

Part Name	*Foot-Pounds Torque*
CAMSHAFT SPROCKET HUB SCREW	35
CAMSHAFT SPROCKET HUB THRUST PLATE BOLT	15
CARBURETOR TO MANIFOLD STUD NUT	15
CHAIN CASE COVER BOLT	15
CLUTCH HOUSING BOLT (small)	30
CLUTCH HOUSING BOLT (large)	45
CLUTCH HOUSING PAN BOLT	15
CONNECTING ROD BEARING CAP BOLT NUT	45
CYLINDER HEAD BOLT	85
DISTRIBUTOR CLAMP BOLT	15
EXHAUST MANIFOLD STUD NUT	25
EXHAUST PIPE FLANGE BOLT NUT	40
FAN BLADE BOLT	15
FLYWHEEL HOUSING TO CYLINDER BLOCK BOLT	50
FUEL PUMP BOLT	30
GENERATOR ADJUSTING STRAP BOLT	15
GENERATOR ADJUSTING STRAP MOUNTING BOLT	30
GENERATOR BRACKET BOLT	50
GENERATOR MOUNTING BOLT	20
INTAKE MANIFOLD BOLT	30
MAIN BEARING CAP BOLT	85
OIL FILTER BOLT	25
OIL PAN BOLT	15
OIL PAN DRAIN PLUG	35
OIL PUMP COVER BOLT	10
OIL PUMP MOUNTING BOLT	35
SPARK PLUGS	30
CRANKSHAFT PULLEY HUB BOLT	135
WATER OUTLET ELBOW BOLT	30
WATER PUMP BODY BOLT	30
WATER PUMP HOUSING BOLT	30

	Inch-Pounds Torque
CRANKCASE VENTILATOR OUTLET PIPE BOLT	15
MANIFOLD HEAT CONTROL COUNTERWEIGHT BOLT	50
ROCKER COVER STUD NUT	30
ROCKER COVER BOLT	30
TAPPET CHAMBER COVER BOLT	50
IGNITION CABLE COVER BOLT	85

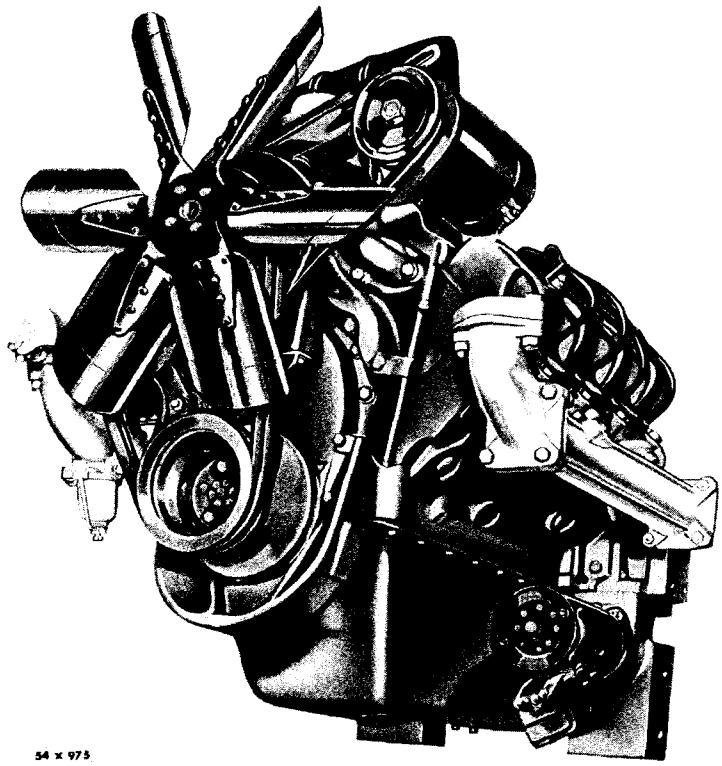

Fig. 1 — Chrysler Industrial Model 52 Engine

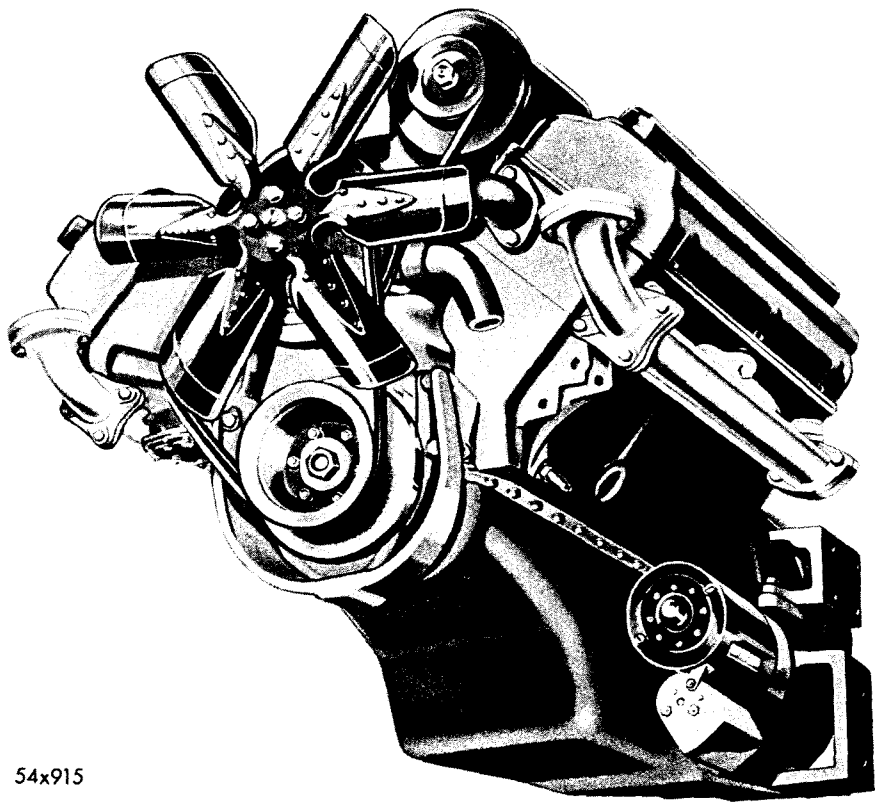

Fig. 2 — Chrysler Industrial Model 56 A Engine

Section II

ENGINE

MODELS IND. 52, 53, 54, 56, 56A

1. GENERAL INFORMATION

Engine Model Ind. 52 has a piston displacement of 270 cubic inches and is a Single Rocker Shaft Design. (Fig. 1.)

Engine Models Ind. 53 and 54 have a piston displacement of 315 cubic inches with a Single and Double Rocker Shaft Design, respectively.

Engine Models Ind. 56 has a piston displacement of 331 cubic inches and Model 56A has a piston displacement of 354 cubic inches, and both engines have Double Rocker Shafts. (Fig. 2 and 3.)

The service procedures for all Model V-8 Engines are similar.

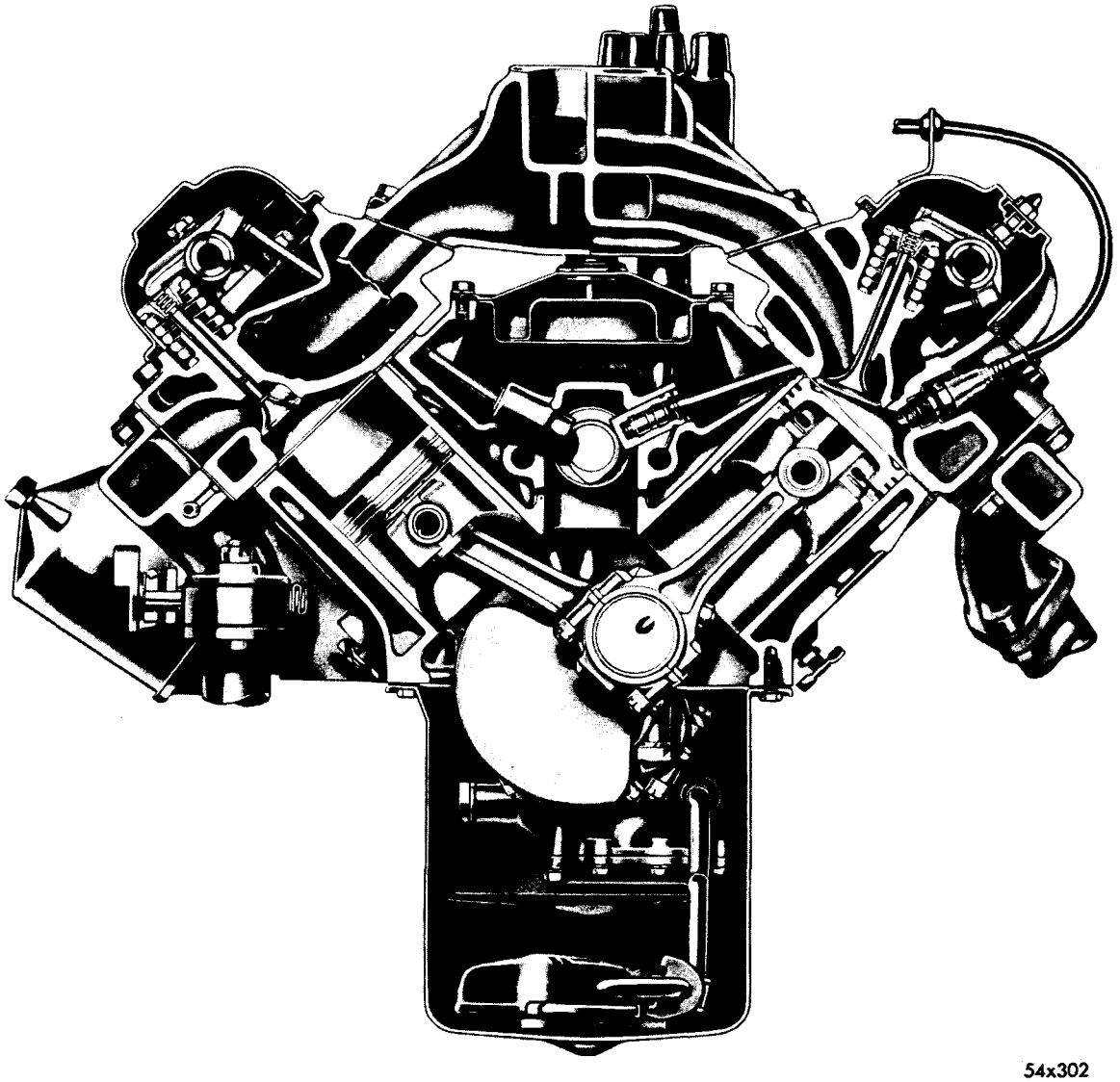

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Fig. 3 — Engine (End Sectional View)

2. NEW ENGINES IN STORAGE

Lack of proper storage preparation on engines which are not delivered immediately will result in the formation of rust on the operating parts of the engines. Such rust formation can, of course, cause excessive piston ring wear, stuck valves, excessive valve guide wear, sticking rocker arms, etc.

Conditions produced by this rust and the lack of storage preparation can result in extreme customer dissatisfaction, needless service expense, and also shorter engine life. It is therefore recommended that engines not being delivered immediately, be prepared for storage in the following manner to protect against internal rusting.

Storage — (Up to 30 days)

(1) Add 1 quart of special rust preventive oil to five gallons of gasoline in the fuel tank.

(2) Run the engine on this mixture for five minutes at approximately 1000 rpm.

(No additional treatment will be required.)

Storage — (Over 30 days)

Storage for over thirty days when the engine will not be started during the storage period:

(1) Add 1 quart of special rust preventive oil to each five gallons of gasoline in the tank.

(2) Run the engine on this mixture for five minutes at approximately 1000 rpm.

(3) Drain the fuel tank and operate the engine until the carburetor runs dry.

The purpose of this operation is to aid in preventing the carburetor from being contaminated with gums that normally form in the gasoline as a direct result of its prolonged exposure to the oxygen in the air.

Failure to take this precaution generally results in carburetor flat spots and general owner dissatisfaction with the operation of the engine.

(4) Remove the spark plugs and pour two ounces of special rust preventive oil into each cylinder. Turn the engine through several revolutions with the starter to distribute the rust preventive oil on the cylinder walls and pistons. Replace the spark plugs.

(5) In addition, remove the rocker covers and spray the rocker arms, shafts, valve springs, push rods and valve stems with the special rust preventive oil. *Be sure and use dry air and a clean spray gun.*

Storage — (90 days and over)

For engines to be stored more than ninety days, treat as described above. In addition, drain the cooling system and gas tank, then tag the engine accordingly so that it will not be started until the coolant has been replaced.

The special rust preventive oil to be used, as described in the above paragraphs, should conform to U.S.A. specifications 2-126. The oil may be obtained by this designation through most reputable oil refiners.

3. ENGINE—Description

All models are 90° V-8, with lateral valves in the heads. The power plant is mounted at four points in live rubber to prevent sound or vibration.

4. CYLINDER BLOCK

The cylinders are completely encircled by full length water jackets. Cool water from the pump circulates through the cylinder heads, around the exhaust valve into the cylinder heads. The coolant then circulates through the cylinder heads, around the exhaust valve ports and into the return passages of the pump housing, thence to the thermostat for return to the radiator, for recirculation, until the thermostat opens. (See Figure 7.)

Drilled passages in the block and cylinder heads carry lubricating oil from the pump to all moving parts of the engine.

The Industrial Engine, as shown in Figure 1 and 2 is a 90 degree, V-8 type, and the cylinder block and crankcase are cast integrally, along with transverse members, which support five main bearings. It is pressure lubricated by a rotary type oil pump, driven by the lower distributor drive shaft. Drilled passages in cylinder block and cylinder heads, permit lubricating oil to circulate from the oil pump, to all moving parts of the engine. The crankshaft is a steel drop forging, and static and dynamic balance is achieved by the use of six counterweights,

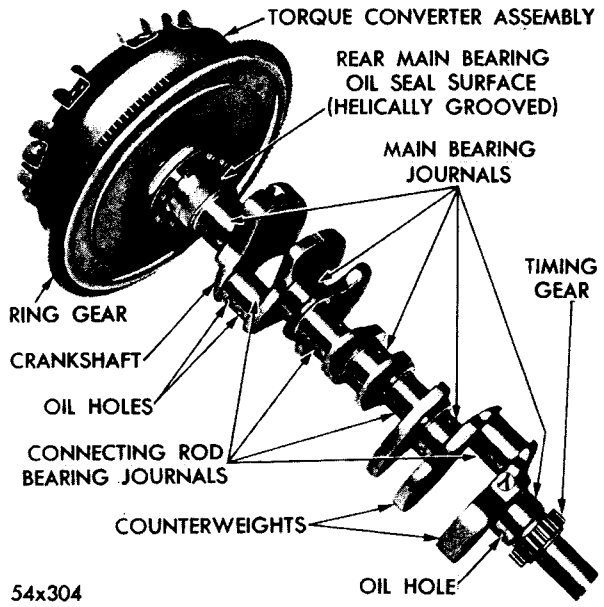


Fig. 4 — Crankshaft and Torque Converter Assembly

as shown in Figure 4. End thrust is taken by the Number 3 main bearing. Hydraulic tappets are used in the engine, and the camshaft is chain driven.

5. CRANKSHAFT

The static and dynamic balance of the crankshaft has been achieved by the use of six counterweights, and the end thrust is taken by the number three main bearing. The crankshaft is drilled for full pressure lubrication to the main and connecting rod bearings. A portion of the rear main bearing journal carries a diagonal knurled surface, extending completely around the journal. This knurled surface, shown in Figure 8, in conjunction with the rear main bearing oil seal, helps to eliminate the possibility of oil leakage at this point.

6. CAMSHAFT AND VALVE MECHANISM

The camshaft is supported by five replaceable steel-backed bearing shells and is driven by a short, sturdy, silent timing chain. A spiral gear cast integrally with the camshaft, meshes with a gear and stub shaft which drives the distributor and oil pump. The eccentric which drives the fuel pump is mounted on the camshaft timing gear. A special ramp or quieting curve on each cam, rapidly and quietly opens and closes the valves, providing maximum duration of full opening and insures positive valve action at all speeds.

The hydraulic tappets (standard equipment on all engines) automatically compensate for variations in the operating mechanism, resulting from temperature changes or wear. The hydraulic tappet provides zero (0) clearance in the operating mechanism from the camlobe surface to the push rods, rocker arms and valve stems. The hydraulic tappets are included in the valve mechanism to eliminate service adjustments and to insure quiet valve operation. If necessary, the tappet assemblies can be removed from the engine to facilitate service.

The exhaust and intake rocker arms oscillate on two hollow steel shafts (one on each head), supported by brackets on the cylinder heads. The rocker arms float in lubricating oil supplied under metered oil pressure through two special drilled passages from the number two and number four camshaft bearing bores. The oil flows into the drilled rocker cover studs and thence into the rocker shafts. The rocker arms are prevented from excessive lateral movement along the shafts by a series of spacer springs, as shown in Figure 18.

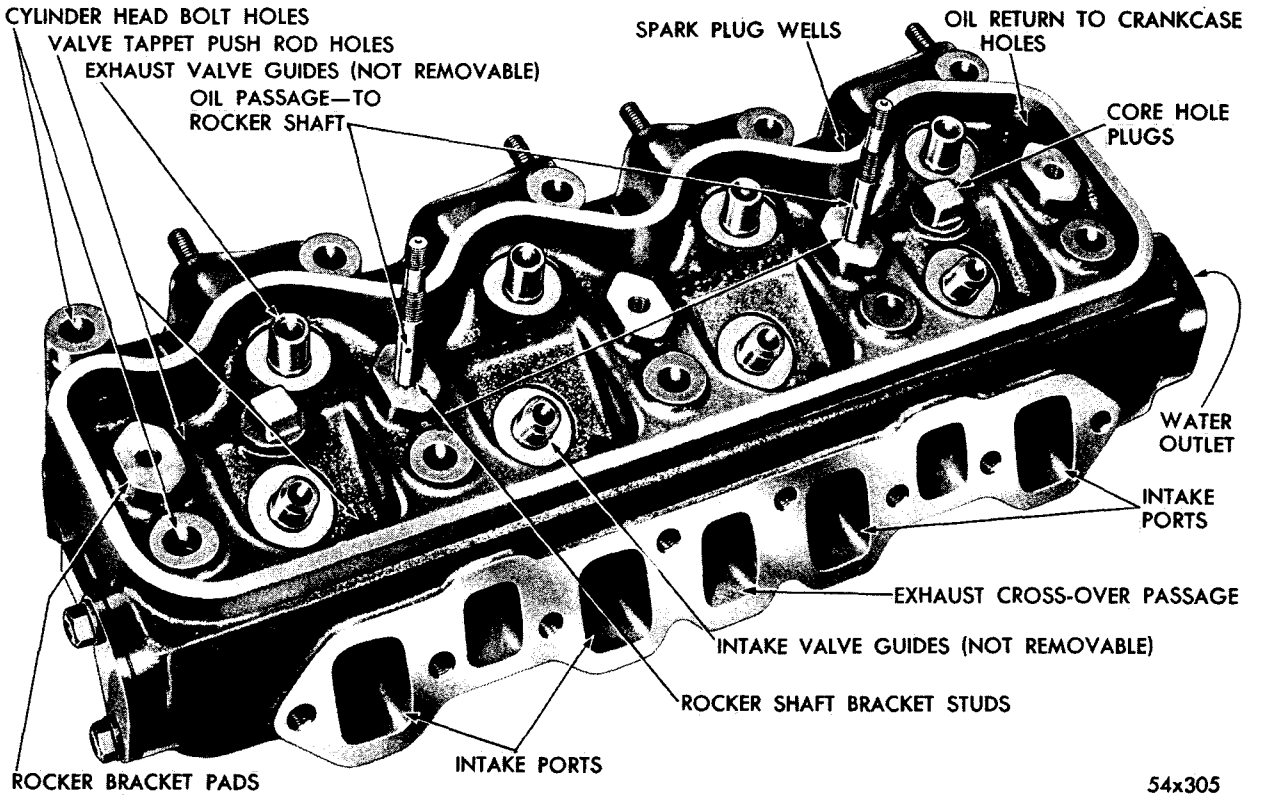
7. CYLINDER HEADS

The single rocker shaft engine cylinder heads have polyspherical combustion chambers, as shown in Figure 5, and the double rocker shaft engine cylinder heads are equipped with hemispherical type combustion chambers, as shown in Figure 6. The water passages in the heads are large and well designed to carry ample coolant over the combustion chamber wall and around the integral valve guide bosses and valve seats. The lower operating temperatures which result, indicate a marked increase in valve life which is a growing problem in many a high output engine.

Special oil drain holes in the heads return the liberated lubricating oil from the rocker arms and shafts back to the oil pan for redistribution.

8. PISTONS, RINGS AND CONNECTING RODS

Aluminum alloy, steel belt, elliptical turned pistons are used in the single rocker shaft engine. The piston skirts are relieved diagonally below the piston pin boss to allow clearance between piston and crankshaft counterweights, when the pistons are at the bottom of travel. The expansion and contraction is controlled by the



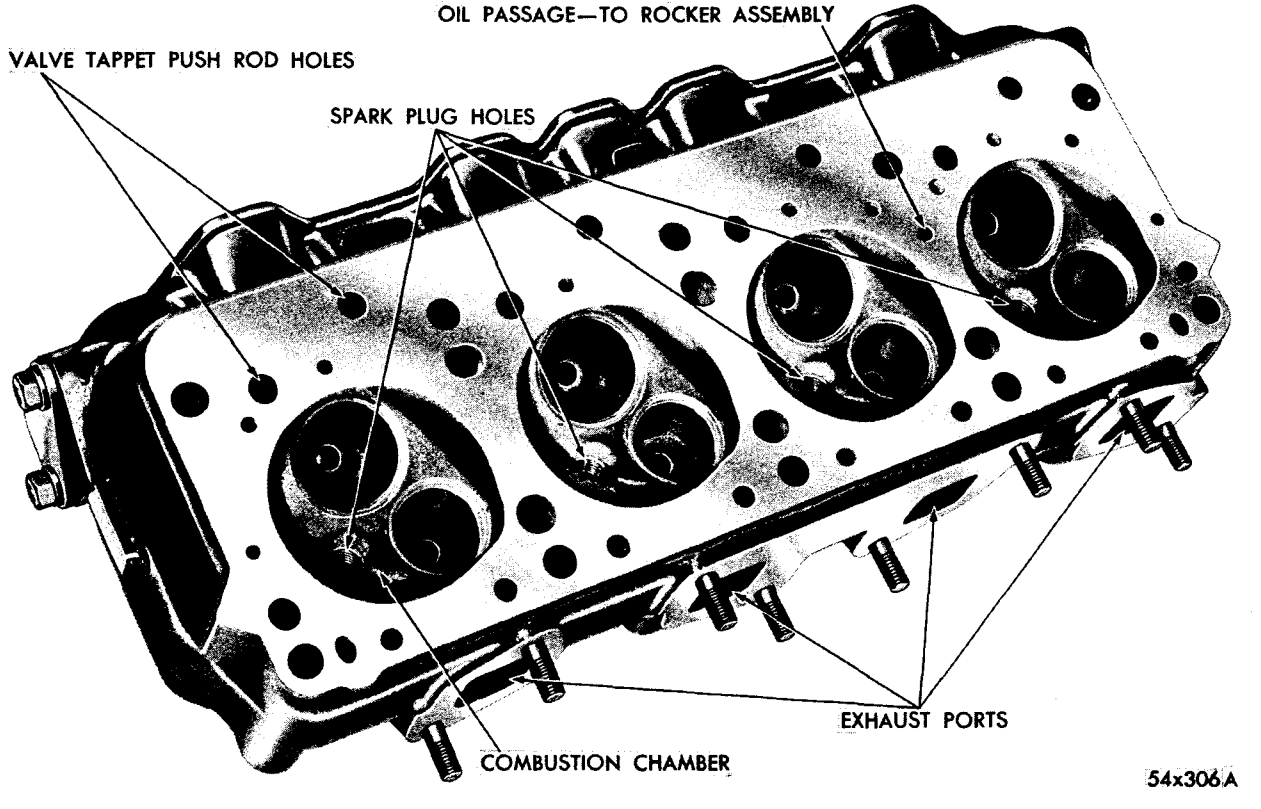


Fig. 5 — Single Rocker Shaft Cylinder Head

steel belt in such manner that a more nearly constant clearance is maintained between the piston and cylinder wall. Consequently, the pistons can be correctly fitted to minimum clearance and this clearance maintained whether the engine is idle or in operation. All piston and rod assemblies must be removed and installed through the top of each bank.

Two tin coated compression and one oil ring with an expander are fitted to seal the compression and control the oil. The oil ring is locked in position with the gap up, by the expander spring to further control oil during idle or shutdown operation.

The piston pins are full floating and retained by two snap rings which fit in recessed grooves in the piston boss.

The connecting rods are made of drop-forged, heat-treated carbon steel, and forged to an "I" section with a closed hub at the upper end and a separate cap on the lower. Each bearing shell and connecting rod cap has a small "v" groove across the cap-to-rod mating surface (on one side only). This "v" groove permits lubrication of the opposite cylinder wall. All main and connecting rod bearing shells are of the replaceable, steel backed babbitt type and require no reaming for fitting.

9. ENGINE LUBRICATION

The single rocker shaft engines are pressure lubricated by means of a rotary type oil pump. The pump is driven by the lower distributor drive shaft and draws oil through a screen lo-

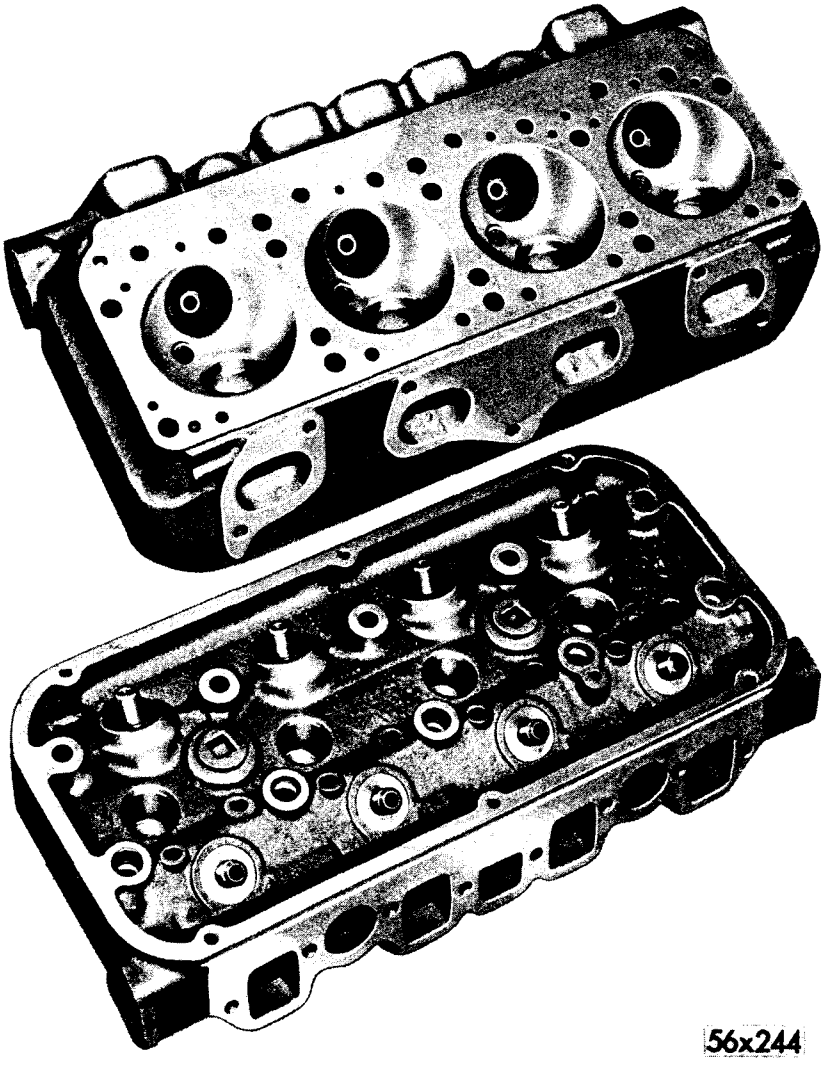
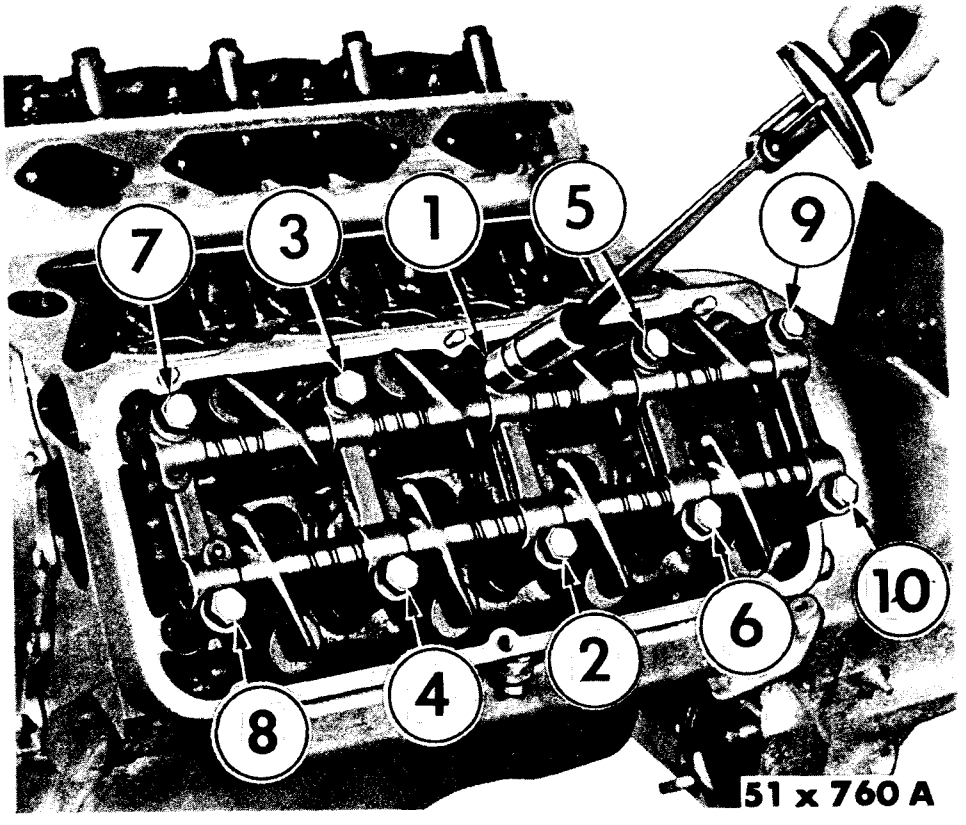


Fig. 6 — Double Rocker Shaft Cylinder Head



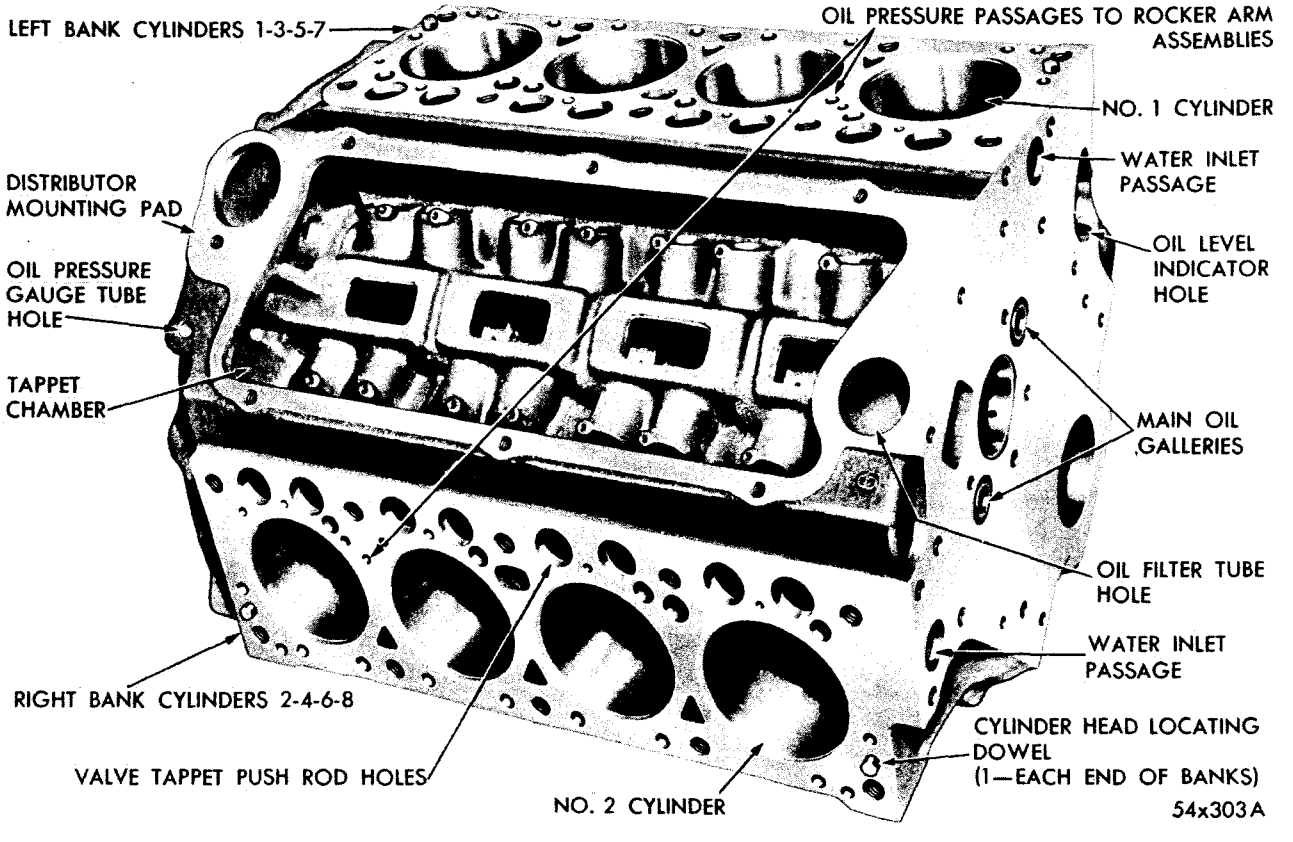


Fig. 7 — Cylinder Block

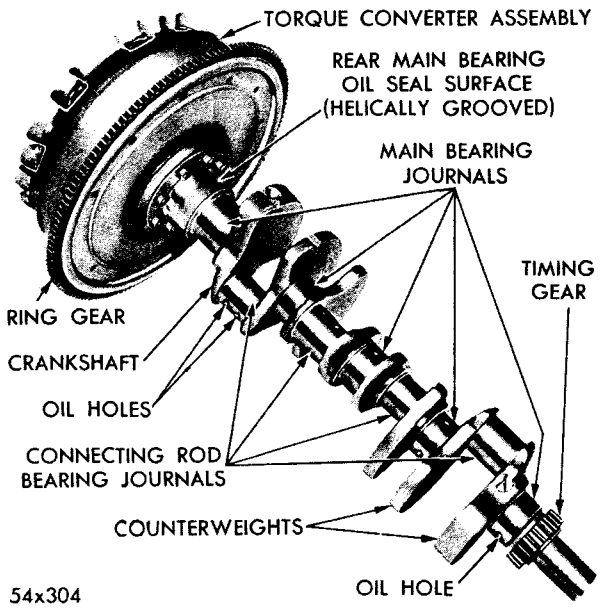


Fig. 8 — Crankshaft and Torque Converter Assembly

cated in the deep sump at the front of the oil pan.

Lubricating oil is drawn from the top of the crankcase oil supply by means of a floating strainer, and is forced through drilled oil passages to the oil filter and then to the main oil gallery in the right hand cylinder bank. The oil then travels to all main and connecting rod bearings, as well as to the camshaft bearings, hydraulic tappets, timing gears and chain. The oil then circulates across number one main bearing and into the left hand cylinder bank oil gallery. Drilled passages from both oil galleries supply each hydraulic tappet with lubricating oil. (See Figure 9 for oil flow through the engine.)

A drilled passage from the number two and four camshaft bearings, allows a metered amount of oil to be forced to the corresponding right and left bank drilled rocker cover retain-

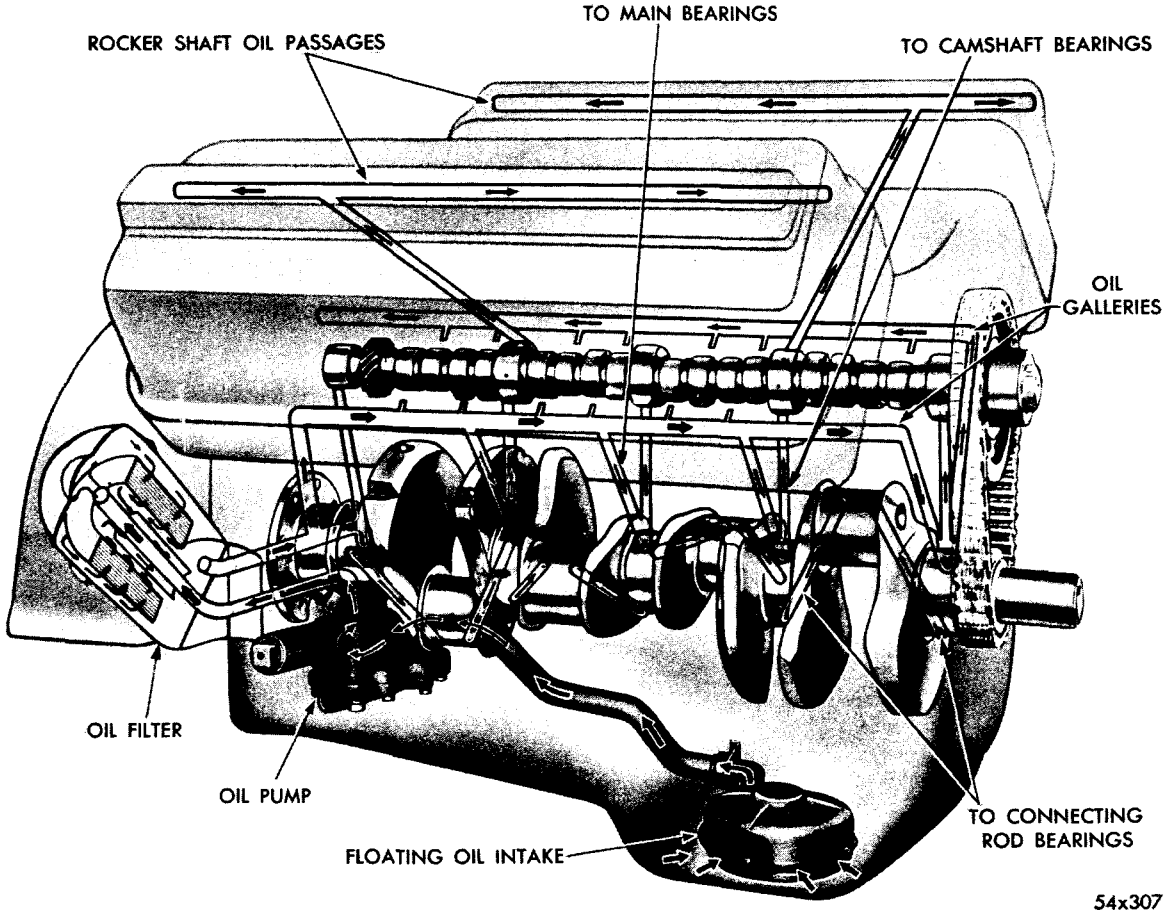


Fig. 9 — Flow of Oil Through the Engine

ing stud. The oil then flows into the steel rocker shafts and out through drilled holes and grooves in the shafts to the rocker arms. Special drilled passages in the rocker arms carry the oil to small orifices in the rocker arms. Oil is liberated directly to the push rod ends of both rocker arms, as shown in Figure 12, and to the valve tip end of the intake rocker arm only. The exhaust valve tip end is fed by gravity from a hole in rocker arm bushing.

Thus, oil is supplied to the valve operating mechanism, but only in spurts. When the lubricating oil hole in the camshaft journal is in alignment with the passages leading to the rocker shaft, oil is momentarily supplied under pressure to these working parts.

A spring loaded pressure relief valve, integral with the oil pump, controls the pump pressures.

ENGINE TUNE-UP

10. MINOR TUNE-UP

The following procedures are provided as a guide which should be followed when attempting minor engine repairs or a complete engine overhaul.

Clean and adjust spark plugs (.035 inch gap). Adjust or replace distributor contact points (.015 to .018 inch gap). Check distributor cap for cracks and corrosion. Inspect rotor, rotor spring and plunger. Inspect distributor to spark plug wires for cracks. Inspect small lead wires for tightness, breakage, or damaged insulation. Check for excessive play in distributor vacuum advance plate bearing. Reset ignition timing. Check battery specific gravity and clean and tighten battery connections. Check starter amperage draw. Inspect fan belt, and check adjustment. Clean and oil the air cleaner. Tighten carburetor flange nuts. Set carburetor idle mixture adjustment. Adjust throttle stop screw so engine idles at 450 to 500 r.p.m. Tighten cylinder head bolts and manifold nuts, as shown in Figures 10 and 11. Cylinder head bolts should be tightened while engine is at normal operating temperature.

Service procedures for removal, inspection, repair and installation of engine components are provided in this section. In this way, information can be followed for specific operation, or for complete engine overhaul.

11. MAJOR TUNE-UP

A periodic engine tune-up will assure maximum engine performance and fuel economy. The following test should be made when a complete engine analysis is being made during a Major Tune-Up. In addition, perform all steps of a "Minor Tune-Up."

Make a compression test. The compression should not vary more than 15 pounds between cylinders. Refer to "Specifications" for com-

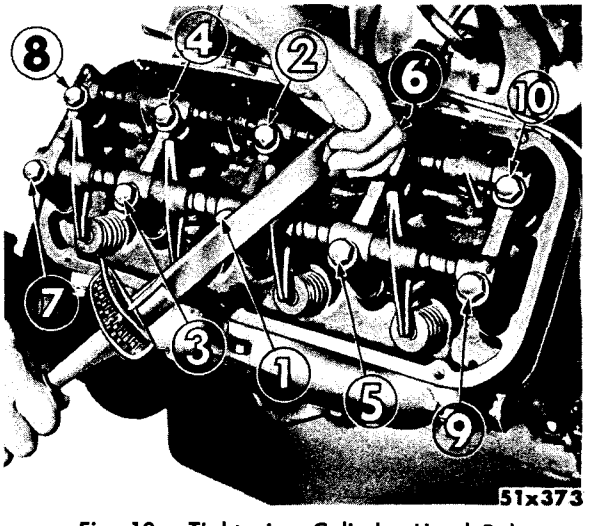


Fig. 10 — Tightening Cylinder Head Bolts Double Rocker Shafts

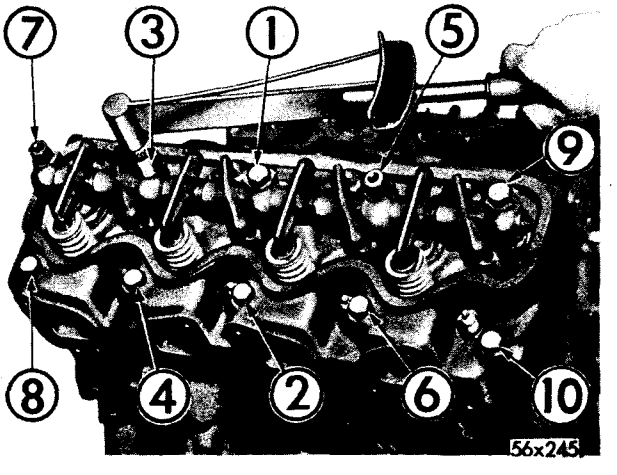


Fig. 11 — Tightening Cylinder Head Bolts Single Rocker Shafts

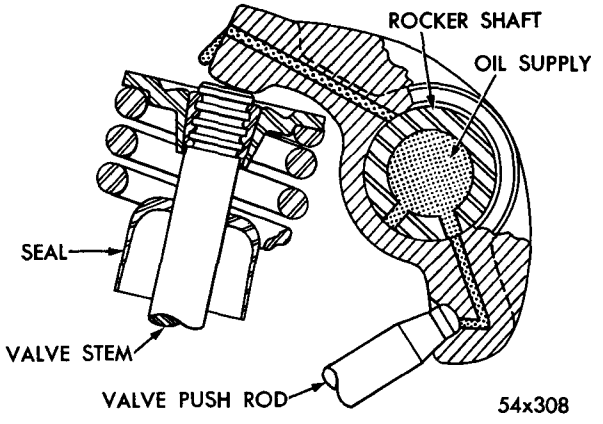


Fig. 12 — Intake Rocker Arm Lubrication

pression pressures. Check coil and condenser and inspect primary and secondary wires. Test fuel pump for pressure and vacuum, and adjust carburetor. Refer to Fuel System, Section III, "Carburetor Adjustments." Check combustion analysis. Clean and re-oil the air cleaner.

12. SERVICING THE V-8 ENGINES

The following disassembly procedures are presented as a guide, to be followed when completely overhauling the V-8 engines. Time and labor can be saved by mounting the engine and clutch housing (if so equipped) in repair stand C-3167. Because of the stand's unusual design, the engine can be rotated (360°) to the most convenient working position.

In addition to the service procedure for overhauling the engine, special instructions are given to cover the different operations required for cleaning, inspection and servicing the various components before assembly.

13. REMOVAL OF CYLINDER HEADS

Drain cooling system. Remove generator adjusting strap and generator.

Remove carburetor air cleaner and fuel line between carburetor and fuel pump. Disconnect accelerator linkage at carburetor throttle lever. Remove vacuum control tube at carburetor and distributor. Disconnect coil wires. Remove heat indicator sending unit wire. Remove oil level indicator (dip stick). Remove air tube between automatic choke and exhaust manifold. Remove bolts attaching water pump housing to cylinder heads and loosen remaining water pump housing bolts to allow sufficient forward movement to facilitate installation of cylinder head to water pump gaskets.

Remove ignition cable cover and disengage insulators from spark plugs. Use a thin wall socket, or Tool C-3054 to remove spark plugs and tubes. Remove cylinder head covers and gaskets. Remove intake manifold, ignition coil and carburetor as an assembly. Disconnect exhaust pipes at manifold flanges.

Remove bolts that attach rocker arm support brackets to cylinder head and block, and pull rocker assemblies and bolts directly away from heads.

CAUTION

The rocker arm assembly attaching bolts also hold cylinder heads to block. When these bolts are removed, cylinder heads are loose and are held by two dowel pins only.

Remove push rods and place them in their respective slots in Holder Tool C-3068.

Lift off cylinder head and place into holding fixture Tool C-3209 for single rocker shaft or Tool C-3133 for double rocker shaft to prevent damage to machined surfaces. Remove exhaust manifold and gasket, if cylinder head is to be replaced.

14. INSTALLATION OF CYLINDER HEADS

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

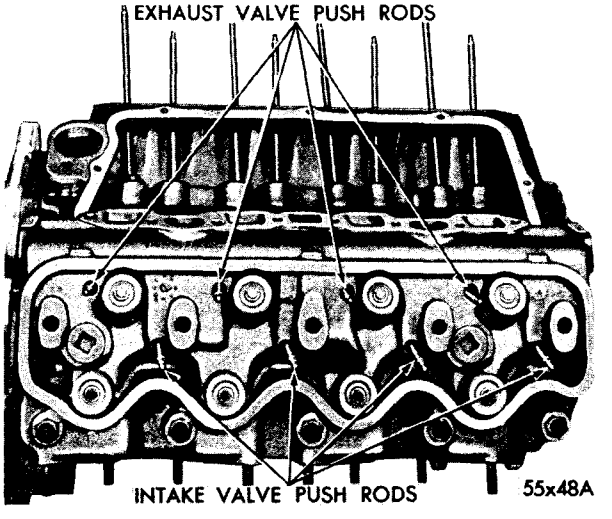


Fig. 13 — Push Rods Installed

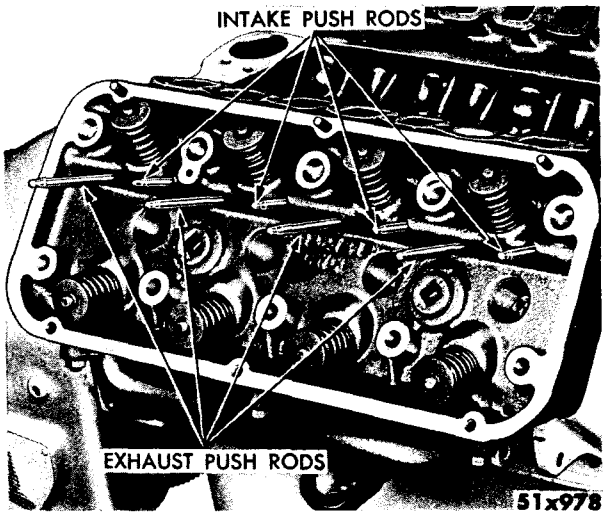


Fig. 14 — Push Rods Installed

Install exhaust manifold gasket and manifold on cylinder heads. Install cylinder heads and *new* cylinder head gaskets. Coat gaskets with a suitable sealer. Install push rods as shown in Figures 13, 14 and 15. Insert cylinder head bolts into rocker arm support brackets, and place rocker arm assemblies in position on head, lining up all push rods to their respective rocker arms. Starting at top center, tighten all cylinder head bolts to 85 foot-pounds torque, in sequence shown in Figures 10 and 11.

Place *new* valve tappet cover gaskets in position, and install tappet cover. Tighten bolts to 50 inch-pounds torque. Install crankcase breather tube on tappet cover and insert oil level indicator (dip stick) tube into position.

Install *new* cylinder head cover gasket and

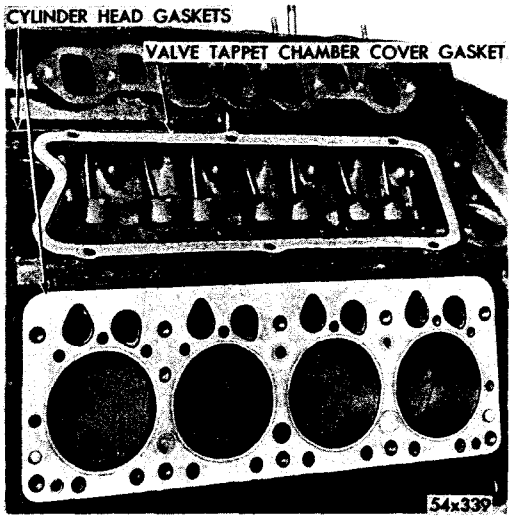


Fig. 15 — Cylinder Head Gasket Installed

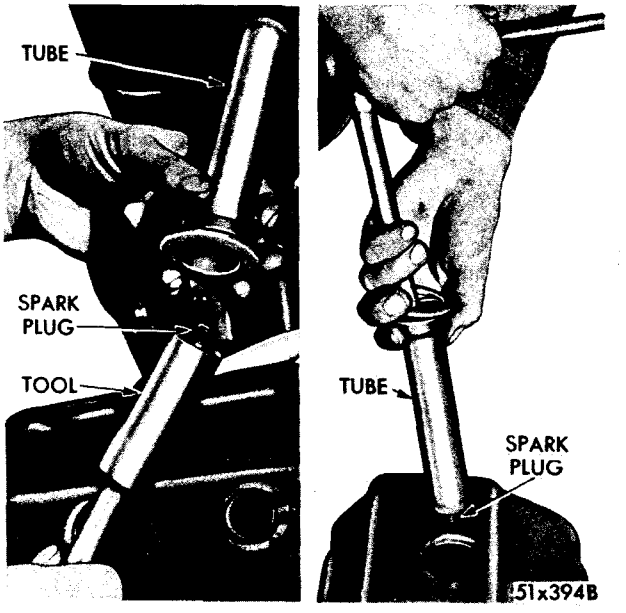


Fig. 16 — Installing Spark Plugs

install cover. Tighten nuts and bolts to 30 inch-pounds torque. On Models 56 and 56A engines slide spark plug tube seals over tubes, and install in position in heads. Check spark plugs for .035 inch gap and install plugs, being careful not to drop them on electrodes as this would cause gap setting to be altered. Tighten spark plugs with Tool C-3054 to 30 foot-pounds torque. Install *new* intake manifold gaskets and manifold. Tighten bolts to 30 foot-pounds torque. (Fig. 16).

NOTE

When installing intake manifold, insert short bolts in holes on extreme ends of manifold.

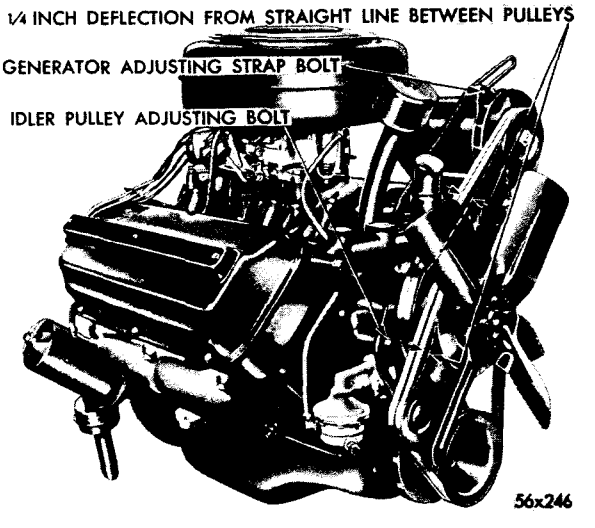


Fig. 17 — Adjustment of Fan Belts

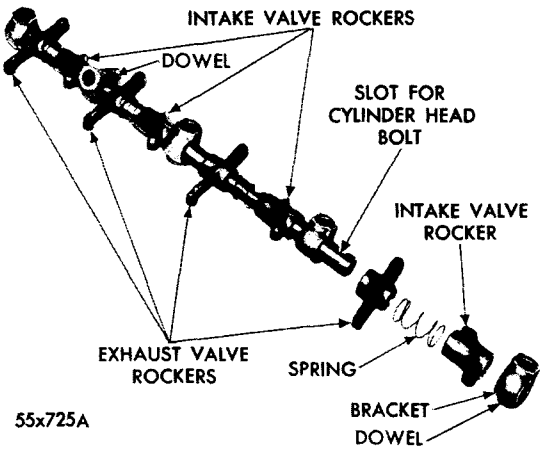


Fig. 18 — Single Rocker Shaft Assembly (Disassembled View)

Install distributor cap coil wire, spark plug cables and insulators. On Models 56 and 56A Engines place spark plug tube seal retainers in position and install spark plug covers, after carefully arranging spark plug cables. Tighten screws securely.

Install generator and adjusting strap bolt. Tighten bolts to 15 foot-pounds torque.

NOTE

When adjusting fan and generator belts, obtain enough slack so that belts may be depressed, as shown in Figure 17. When dual belts are used, both belts should have equal tension.

15. REMOVAL OF ROCKER ARMS AND SHAFT ASSEMBLY

a. Removal

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

CAUTION

With bolts removed, the cylinder heads are only held in position by two locating dowel pins on Models 56A.

If rocker arm assemblies have been disassembled for cleaning, inspection or replacement, refer to Figures 18 and 19 for proper reassembly.

NOTE

On 56 and 56A engines rocker shafts are stamped "IN" for intake and "EX" for exhaust. The intake rocker arms are shorter than exhaust rocker arms.

16. INSTALLATION OF ROCKER ARM AND SHAFT ASSEMBLY

Install push rods as shown in Figures 13 and 14. The push rods should be properly positioned in rocker arm and tappets. Position rocker arm assemblies and install cylinder head bolts. Tighten bolts 85 foot-pounds torque in sequence shown in Figures 10 and 11.

17. REMOVAL OF VALVES AND VALVE SPRINGS

With cylinder head removed, compress valve springs with Tool C-3428 (single rocker shaft).

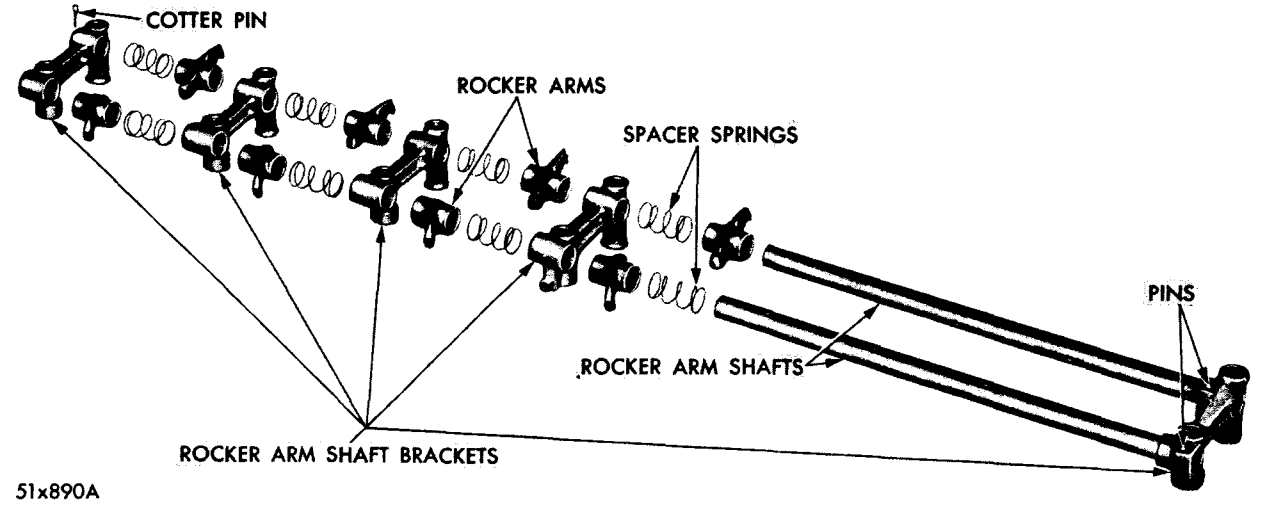


Fig. 19 — Double Shaft Assembly (Disassembled View)

Tool C-3023 (double rocker shaft) and remove valve retaining locks, valve spring retainers, valve stem cup seals (intake valves only) and valve springs. *Remove burrs from valve stem lock grooves to prevent damage to valve guide when valves are removed.*

18. VALVE INSPECTION

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

NOTE

On Single Rocker Shaft Engines, the valve guides are cast integrally with the cylinder head. Service valves with oversize stems are available for these engines.

Check valve stem to guide clearance as follows:

Install sleeve, Tool C-3025, over intake valve stem, and sleeve Tool C-3026 on exhaust valve stem (Fig. 20) and install valves. These special sleeves place valve at working height for easy checking with a dial indicator. Attach dial indicator Tool C-3339 to cylinder head and set it at right angle to edge of valve being checked (Fig. 21). Move valve to and from indicator. The total dial indicator reading should not exceed .008 in. on intake valves, or .014 inch on exhaust valves. If readings exceed the above

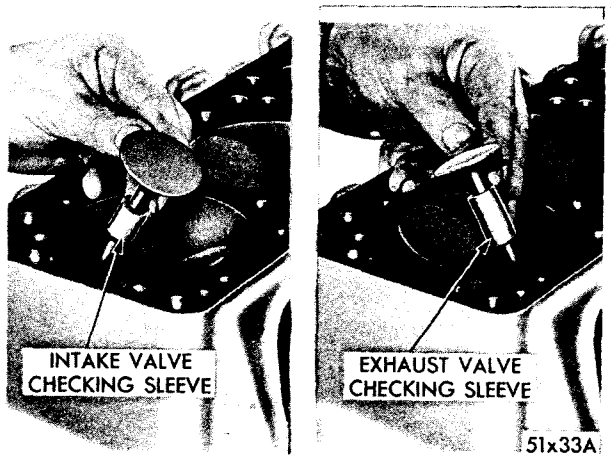


Fig. 20 — Installing Sleeves To Check Guide Clearance (Typical)

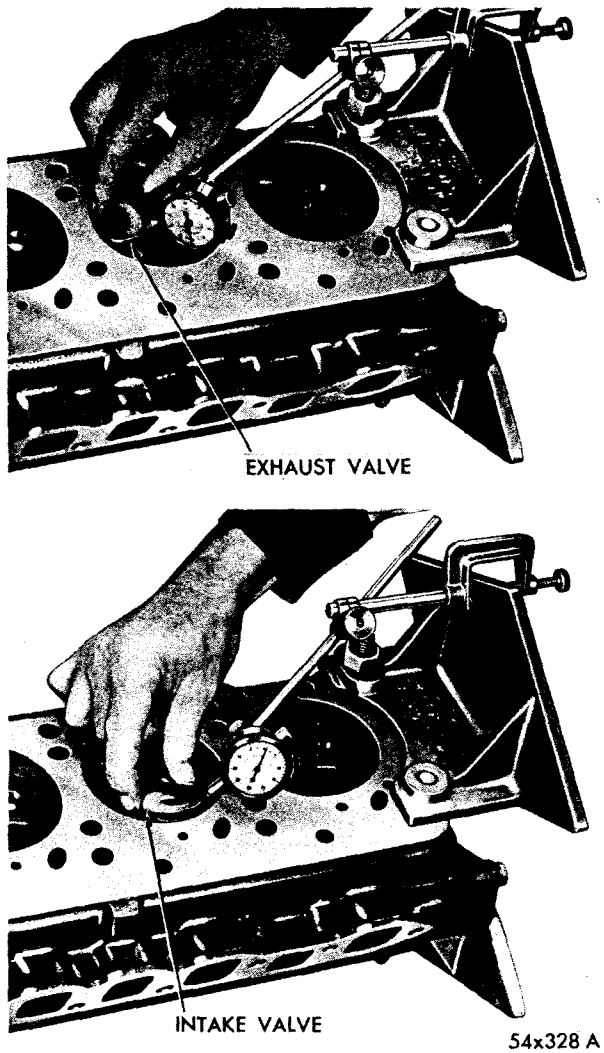


Fig. 21 — Checking Valve Guide Clearance (Typical)

tolerances, install new valve guides on the double rocker shaft engines, or ream guides for oversize valves on the single rocker shaft engines, to next oversize (if other than standard).

19. REMOVAL AND INSTALLATION OF VALVE GUIDES

Drive out guides through top of cylinder heads with Tool C-3150. Install as follows: Turn cylinder head with combustion chamber facing up. Drive valve guides into position with a suitable driver to dimensions shown in Figure 22. After new valve guides have been installed, ream each guide from .374 to .375 inch with Tool C-741. Valves with oversize stems are available in .005, .015, and .030 inch. Reamers to accommodate

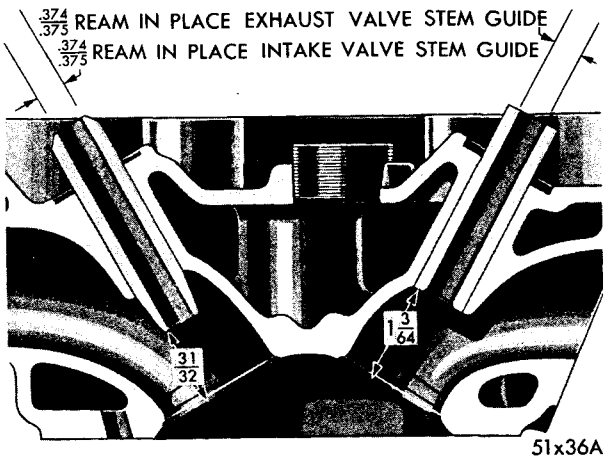


Fig. 22 — Exhaust and Intake Valve Guides Installed in Head

the oversize valve stems are as follows. Reamer Tool C-3433 (.379 to .380 inch), Reamer Tool C-3430 (.389 to .390 inch) and 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 valve guides from standard directly to .030 inch. Use step procedure of .005, .015, and .030 inch so the valve guides may be reamed true in relation to valve seat.

20. REFACING VALVES AND VALVE SEATS

The intake and exhaust valves are faced to a 45 degree angle. When refacing valve always check remaining margin (Fig. 23). Valve with less than 3/64 inch margin should be discarded.

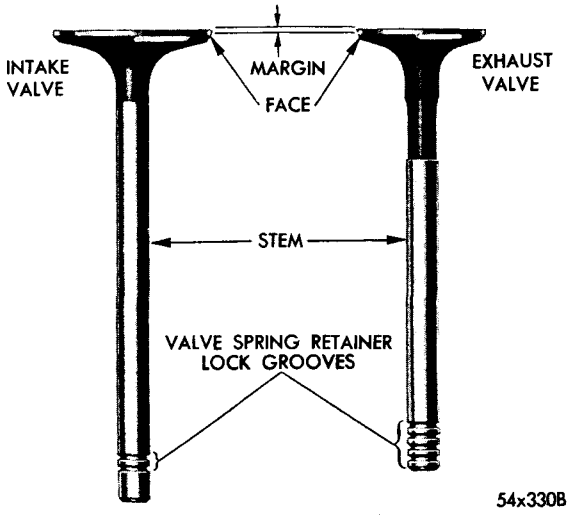


Fig. 23 — Intake and Exhaust Valve Nomenclature

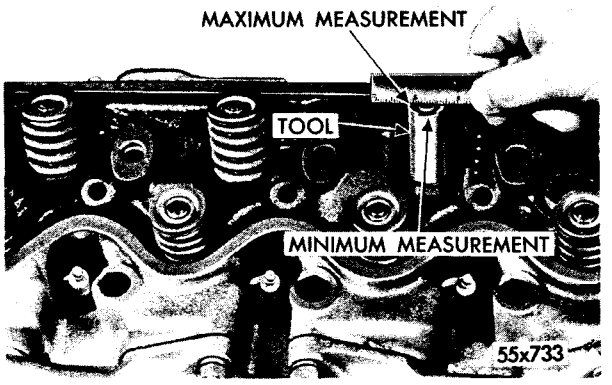


Fig. 24 — Checking Valve Stem Position (Single Rocker Engine)

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

When valves and seats are reground, the position of valve in head is changed, shortening operating length of hydraulic tappet. This means that plunger is operating closer to its bottomed position, and less clearance is available for thermal expansion of valve mechanism during high speed driving. Design of plunger travel includes a safety factor for normal wear and refacing of valves and seats. The dimension from valve spring seat in head to valve tip should be checked with Gauge Tool C-3436 for Single Rocker

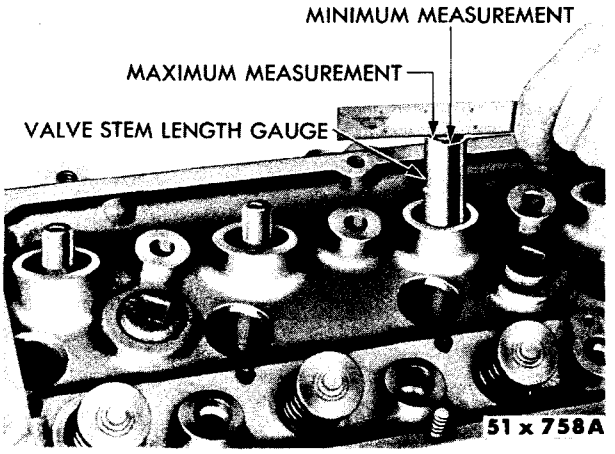


Fig. 25 — Checking Valve Stem Position (Double Rocker Engine)

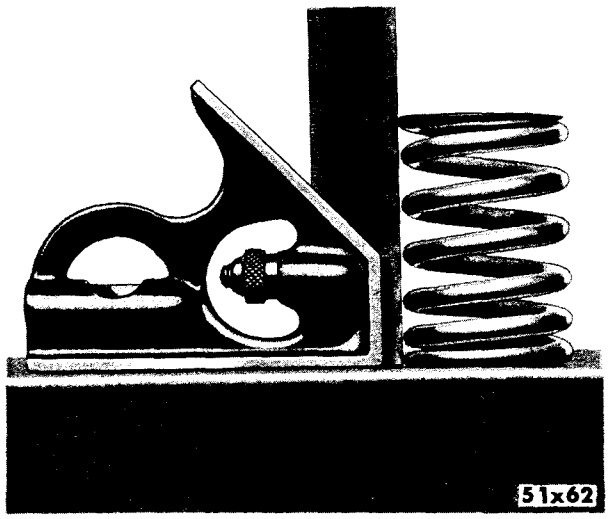


Fig. 26 — Checking Valve Spring for Squareness

Engines and Gauge Tool C-3061 for Double Rocker Engines, (Figs. 24 and 25).

The end of cylindrical gauge and bottom of slotted area represent maximum and minimum allowable extension of valve stem tip beyond spring seat. If tip exceeds maximum, grind to approach, but do not go below minimum allowable on gauge.

21. TESTING VALVE SPRINGS

Whenever valve springs are removed they should be tested with spring tester Tool C-647. Attach torque wrench, check tension and multiply reading by 2. See Data and Specifications for readings. Discard springs that do not meet these specifications.

Check each spring for squareness with a steel square and surface plate (Fig. 26). If spring is more than $\frac{1}{16}$ inch out of square, install new spring.

22. INSTALLING VALVES AND VALVE SPRINGS

Coat intake valve stems with lubricating oil and insert in position in cylinder head. Install cup seals on intake valve stems and over valve guides (Figs. 27 and 28), and install valve springs and retainers. Compress valve springs with Tool C-3422. Install locks and release tool.

NOTE

If valves and/or seats are reground, check the installed height of springs. Make sure measurement is taken from full depth of counterbore in cylinder head to top surface of spring retainer. (If spacers are installed measure from top of spacer). If height is 1 23/32 inches or greater, install a 1/16 inch spacer (Part No. 1400482) in head counterbore to bring spring height back to normal 1 5/8 to 1 11/16 inch.

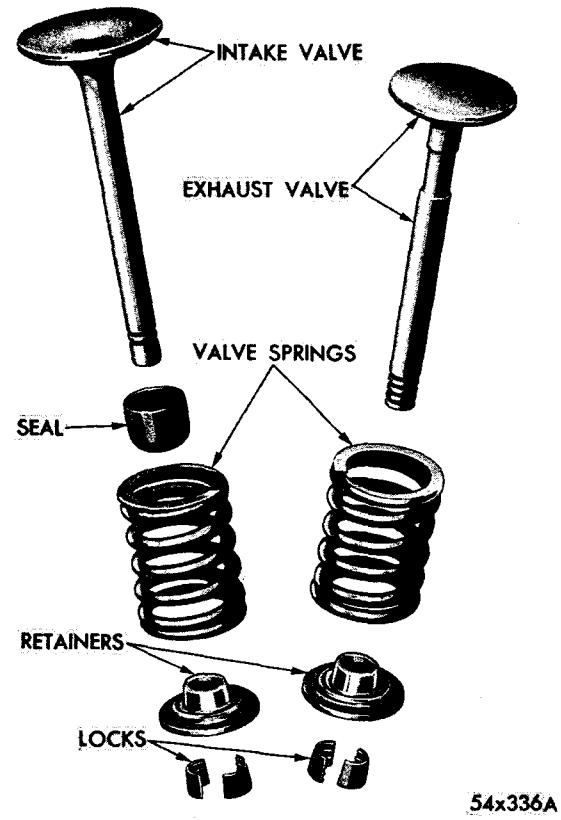


Fig. 27 — Valves, Springs, Seals and Retainer (Disassembled View)

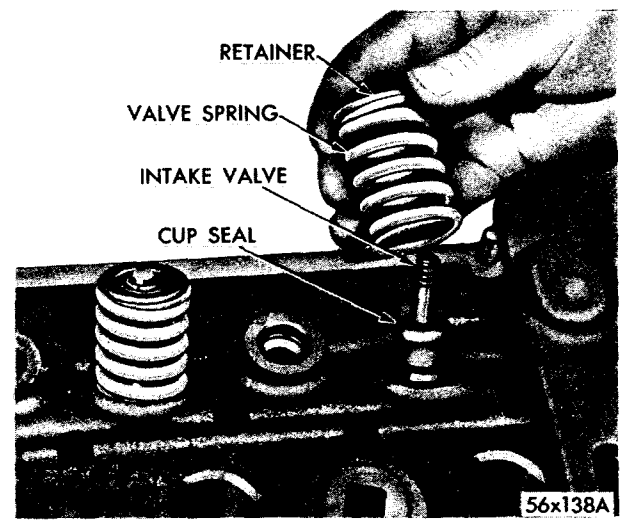


Fig. 28 — Installing Intake Valves and Cup Seals

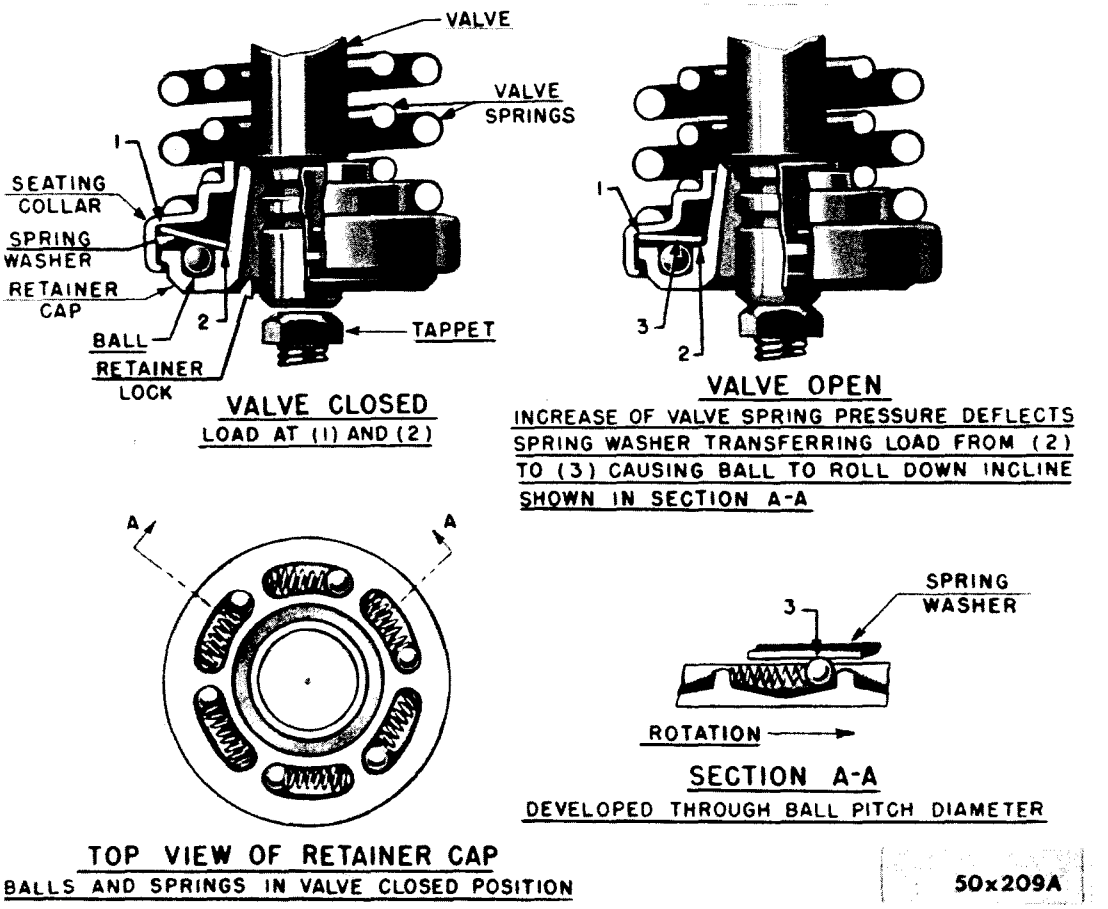


Fig. 29 — Exhaust Valve Rotator Operation

NOTE

The exhaust valves of many Chrysler Industrial Engines are equipped with valve rotators (Figure 29) which assure positive rotation of the valves and prolong valve life.

The rotator unit, as shown in Figure 29, called Roto-Cap, is installed in place of the conventional type valve spring retainer. The pressure of the valve spring against the seat holds the upper portion (collar) of the rotator stationary. The lower portion (retainer cap) of the rotator is held securely to the valve stem by regular valve locks. As the valve is opened, pressure is applied to the spring washer. This pressure forces the ball bearings down the inclined races, causing a counter-clockwise motion on the retainer cap which, in turn, rotates the exhaust valve. When the valve is closed, pressure on the spring is released. The ball springs then return the bearings up the inclined races to their original positions.

The valve rotators are not serviced. In cases of excessive wear, sticking, or other damage, replace the complete unit. As Roto-Cap valve rotators are thicker than the conventional valve spring retainers it is necessary that shorter springs be used with them. Springs, in this case, should be $\frac{7}{64}$ inch shorter in length than standard. See Data and Specifications.

Each spring should be checked for squareness. This can be done with a steel square and surface plate. Stand each spring and the square on end on the surface plate and slide the spring up to the square. Gradually revolve the spring, while at the same time noticing the space between the top coil of the spring and the square. Th trueness of the spring should not exceed $\frac{1}{16}$ inch out-of-square. If the spring is more than $\frac{1}{16}$ inch out-of-square, install new spring.

When assembling valve springs the closed coils must be toward the cylinder head.

If valves and/or seats are reground, check

the installed height of the springs. If the height is $1\frac{11}{16}$ inch or greater, install a $\frac{1}{16}$ inch spacer (Part No. 1400482) in the head counterbore to bring the spring height back to nominal $1\frac{5}{8}$ to $1\frac{11}{16}$ inches.

23. HYDRAULIC TAPPETS

a. Preliminary to Checking Hydraulic Tappets

Before disassembling any part of engine to check for tappet noise, check oil pressure at gauge and oil level in oil pan. The pressure should be between 40 to 65 pounds at 2,000 r.p.m. The oil level in pan should never be above "full" mark on dip stick, nor below "add oil" mark. Either of 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 the connecting rods can dip into oil when engine is running and create foaming. This foam is fed to the hydraulic tappets by the oil pump, causing them to go flat and allowing valves to seat noisily.

Oil Level Too Low—Low oil level may allow pump to take in air which, when fed to tappets, causes them to lose length and allows valves to seat noisily. Any leaks on intake side of 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 run at fast idle for sufficient time to allow all of the air inside of tappets to be worked out.

b. Tappet Noises

To determine source of tappet noise run engine at idle with cylinder head covers removed. Feel each rocker arm to detect the noisy tappet.

NOTE

Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise, in all probability, will be dampened by applying side thrust on valve spring. If noise is not appreciably reduced, it can then be assumed the noise is in the tappet.

Valve tappet noise can be separated into two types, light noise and heavy noise. A light noise is usually caused by excessive leakdown around the unit plunger, or by plunger partially sticking in cylinder. A heavy noise is caused either by a valve not seating, or by foreign particles becoming wedged between plunger and tappet body, causing plunger to stick in down position. This heavy noise will be further evidenced by clearance between valve stem and rocker arm as valve closes. A tappet causing light noise can be determined by pushing down on push rod end of rocker arm. The noise will become more audible and, if push rod end of rocker arm is held down long enough, the intensity of noise may increase. In either instance, the unit assembly should be removed for further inspection and cleaning.

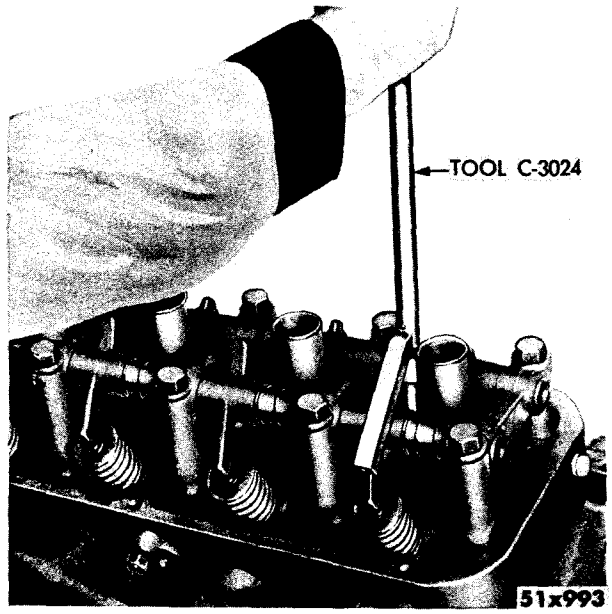


Fig. 30 — Compressing Valve Spring

c. Removal of Tappets (with Rocker Arms in Position)

NOTE

If all of tappets are to be removed, it will be advisable to remove rocker arms and shaft. If only one or two tappets are to be removed, proceed as follows:

Install valve spring compression Tool C-3024, over rocker arm (Fig. 30) so heel of tool rests on valve stem side. Make certain valve is seated and tappet body is resting on low point of camshaft lobe. Refer to Paragraph 28 "Locating the Low Point of Camshaft Lobe In Conjunc-

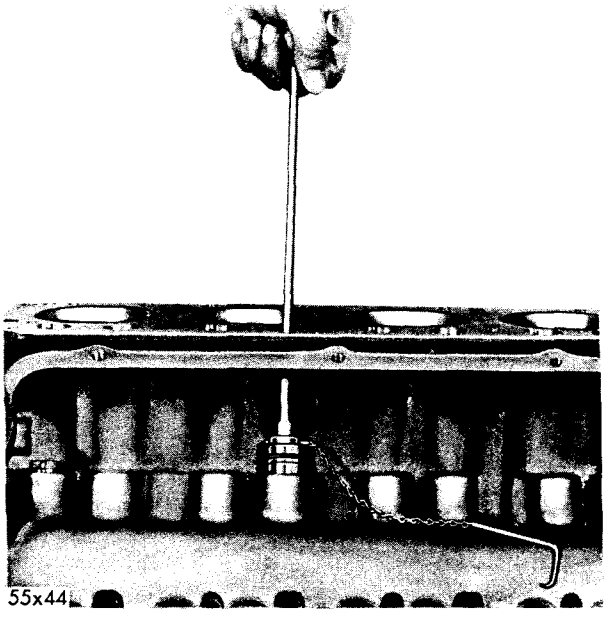


Fig. 31 — Removing Tappet (With Varnish Build-Up)

tion With Valve Tappet Face." Using handle of tool for leverage, compress valve springs sufficiently to raise rocker arm above push rod. While holding rocker arm in this position, slide rocker arm to one side along the tube.

IMPORTANT

To avoid damage to valves, be sure that piston head is well below top of travel before compressing valve springs.

Drain cooling system below level of intake manifold. Remove carburetor air cleaner. Disconnect coil wires and wire from heat indicator sending unit. Disconnect carburetor heat tube at the integral choke. Remove intake manifold, carburetor and coil as an assembly. Remove tappet chamber cover and gasket.

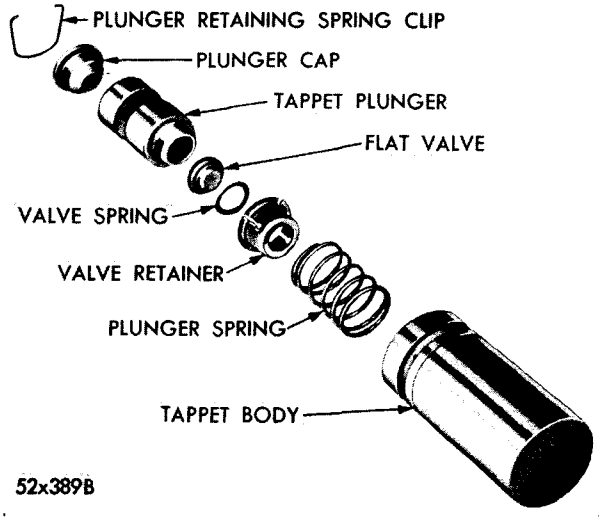


Fig. 32 — Hydraulic Tappet (Disassembled View)

Remove the rocker arms and shaft assemblies. Remove the push rods and place them in their respective holes in Tool C-3068. Slide the puller portion of Tool C-3631 through the cylinder head push rod holes and into the cap of tappet. Insert puller pin and remove tappet with a twisting motion (Fig. 31).

If all tappets are to be removed, remove hydraulic tappets and place them in their respective holes in Tappet and Push Rod Holder, Tool C-3068. This will insure installation of tappets in their original locations.

NOTE

Do not disassemble a tappet in dirty surroundings or 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 tappet at a time to avoid mixing parts. Mixed parts are not usable.

d. Disassembly

Refer to Figure 32 and proceed as follows. Pry out plunger retainer spring clip. Clean varnish deposits from inside of tappet body above plunger cap. Invert tappet body and remove plunger cap, plunger, flat check valve, check valve spring, check valve retainer, and plunger spring. Separate plunger, check valve retainer, and check valve spring. Place all parts in their respective place in tappet holder. Tool C-3068.

e. Cleaning and Assembly

Clean all tappet parts in a solvent that will remove all varnish and carbon. Replace tappets that are unfit for further service. Refer to Figure 32 and assemble tappets, as shown.

f. Inspection

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

g. Testing

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

Allow tappet to fill with kerosene, remove tappet, and relace cap. Hold tappet in an upright position and insert the lower jaw of pliers, Tool C-3160, in groove of tappet body (Fig. 33).

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

h. Installation

After work has been completed on tappet, install tappet and push rod in their original bores. Position rocker arm so it is partially seated on valve stem. Install valve spring compressor tool and compress valve spring until rocker arm can be positioned over push rod. Remove tool and install tappet chamber cover. Install intake manifold, carburetor and coil. Connect items which were disconnected during removal, refill cooling system, start engine, and 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 become quiet.

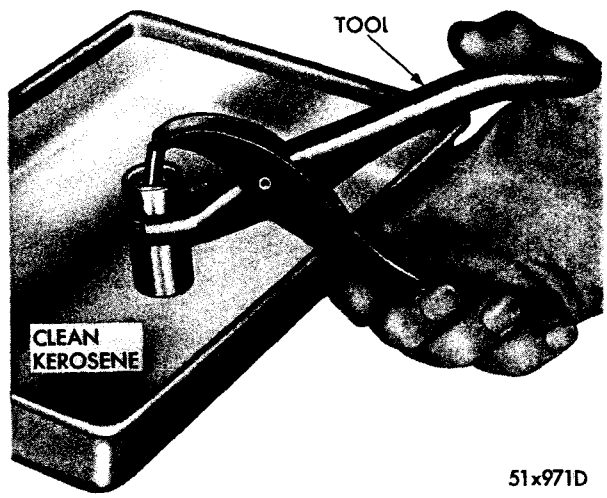


Fig. 33 — Testing the Hydraulic Tappet (Typical)

24. CHECKING VALVE TIMING (MODELS IND. 52, 54, 56 AND 56A).

Check the accuracy of the Top Dead Center (TDC) mark on the damper by bringing Number 1 piston to (TDC) by means of an indicator placed in the spark plug opening. Turn crankshaft until Number 1 exhaust valve is full open. Insert a .210 inch spacer between rocker arm and stem of Number 1 intake valve. This can be done by prying between rocker and valve spring seat with a large screwdriver.

Install a dial indicator on Number 1 intake valve so that pointer contacts valve spring retainer as nearly at a right angle as possible. Wait until seat stops moving. This indicates that oil has bled out of hydraulic tappet and plunger has bottomed, giving, in effect, a solid tappet.

Set dial indicator on zero and turn crankshaft clockwise, (normal running direction) until dial indicator shows that valve has lifted as shown in the following chart.

IND. 52	IND. 54
.020" Intake	.015" Intake
IND. 56	IND. 56A
.020" Intake	.033" Intake

The timing on the vibration damper should now read from 5 degrees before Top Dead Center BTDC to 7 degrees after Top Dead Center ATDC.

After valve timing has been checked, turn crankshaft counter-clockwise until tappet is back down to valve closed position. Remove the .210 inch spacer from between the rocker arm valve stem.

Checking Valve Timing (Model IND. 53)

Check the accuracy of the TDC mark on the damper by bringing the Number 1 piston to TDC by means of an indicator placed in the spark plug opening.

Rotate the crankshaft clockwise (normal running direction) until Number 1 intake is fully open. Install a dial indicator on Number

1 Exhaust valve so that the indicator pointer contacts the spring retainer as near to a 90° angle as possible.

Insert a 1 4 inch spacer between the rocker arm and the stem of Number 1 Exhaust valve. Allow the spring load to bleed the tappet down giving, in effect, a solid tappet.

Reset the dial indicator to zero. Rotate the crankshaft counter-clockwise (opposite to normal running direction) until the exhaust valve has lifted .096 inch.

The timing marks should now read from 12 degrees before TDC to Top Dead Center. If the reading is over the specified limits, check the timing gear marks and timing chain wear.

After the timing has been checked turn the crankshaft clockwise (normal running direction) until the tappet is back down to the valve closed position. Remove the .210 inch spacer from between the rocker arm and valve stem.

CAUTION

Under no condition should crankshaft be turned further in clockwise direction, as spacer might cause valve spring to bottom and damage valve operating mechanism.

25. LOCATING LOW POINT OF CAMSHAFT IN CONJUNCTION WITH VALVE TAPPET FACE (CYLINDER HEAD INSTALLED)

Remove distributor cap, noting position of rotor for Number 1 and Number 6 cylinders. Set timing mark ("DC") on vibration damper to pointer. With rotor at Number 1 firing position, the following tappets will be on low side of cam lobe.

2—Intake	7—Intake
2—Exhaust	8—Intake
4—Exhaust	8—Exhaust

NOTE

To remove Number 1 intake and exhaust tappet, rotate the crankshaft ¼ turn clockwise from above position.

With rotor at Number 6 firing position, the following tappets will be on low side of cam lobe:

3—Intake	5—Intake
3—Exhaust	5—Exhaust
4—Intake	7—Exhaust

NOTE

To remove Number 6 intake and exhaust tappet, rotate crankshaft ¼ turn clockwise from above position.

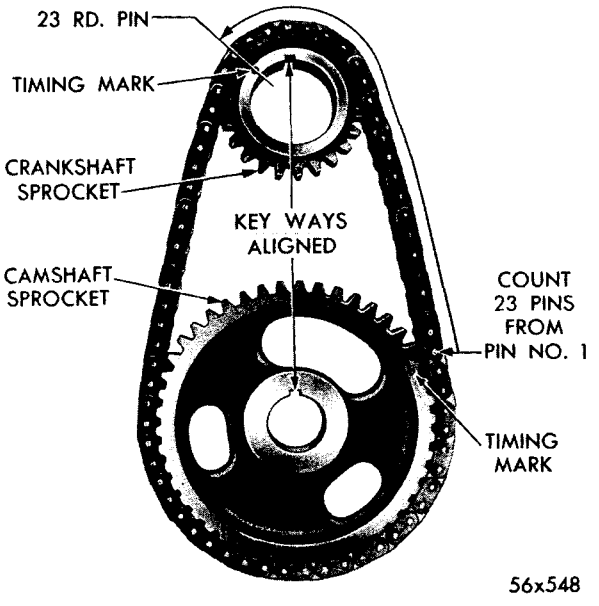


Fig. 34 — Positioning Sprockets in Chain

26. REMOVAL OF TIMING SPROCKETS AND CHAIN

Remove radiatior and water pump. See Coding System, Section IV.

Remove bolt and flatwasher holding vibration damper on crankshaft. Remove two of the damper bolts, install Tool C-3033, and pull damper assembly off end of crankshaft. Remove chain cover and gasket.

Slide crankshaft oil slinger off end of crankshaft. Remove fuel pump eccentric attaching bolt, cup washer and eccentric. Remove timing chain, with crankshaft and camshaft sprockets as an assembly.

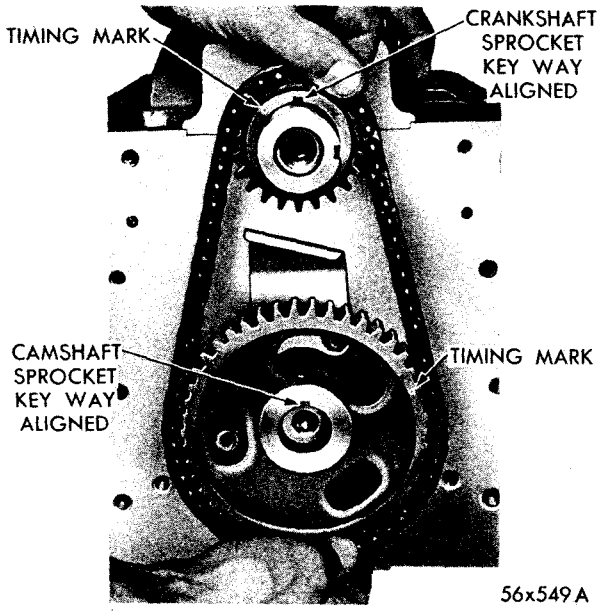


Fig. 35 — Installing Timing Sprockets and Chain (Engine Shown in Repair Stand)

27. INSTALLATION OF TIMING GEARS AND CHAIN

a. Installation

Insert camshaft and crankshaft Woodruff keys in their respective slots, and rotate shafts so that both keys are directly up and on an imaginary centerline through both shafts.

Place both camshaft gear and crankshaft gear on bench, with keyway slots up and aligned (Fig. 34). Place timing chain around camshaft gear so that camshaft gear timing mark tooth is between links of chain. Slide crankshaft gear into chain so that slot at timing mark (between teeth) is in direct line with *twenty-third* timing chain pin.

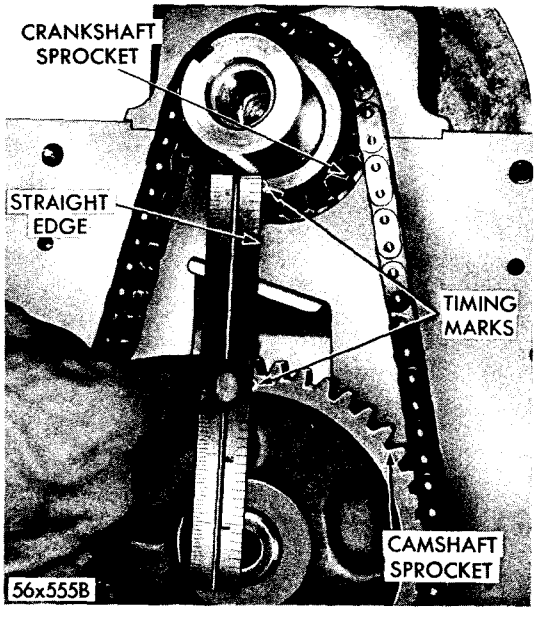


Fig. 36 — Checking Alignment of Timing Marks

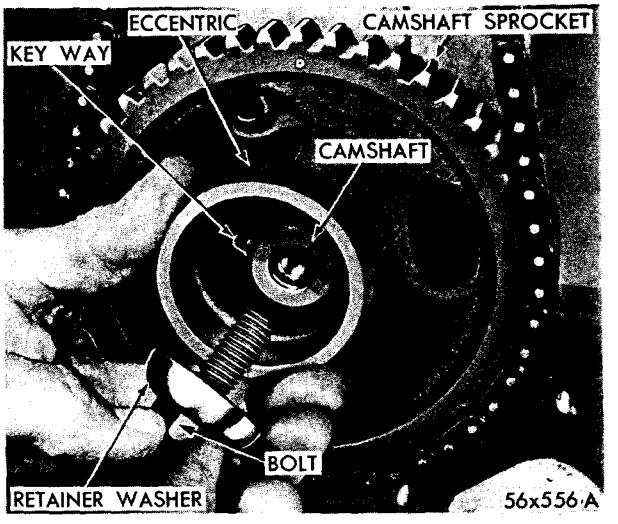


Fig. 37 — Installing Fuel Pump Eccentric

Lift gears and chain (keep gears tight in position as described), slide both gears evenly over their respective shafts (Fig. 35), and push gears over keyways. See "Paragraph 35, Camshaft Installation."

Rotate engine until timing marks on gears are on exact imaginary centerline through both camshaft and crankshaft. Use straightedge for this check. (Fig. 36.)

Slide fuel pump eccentric over camshaft against gear (Fig. 37). *Be sure slot in eccentric*

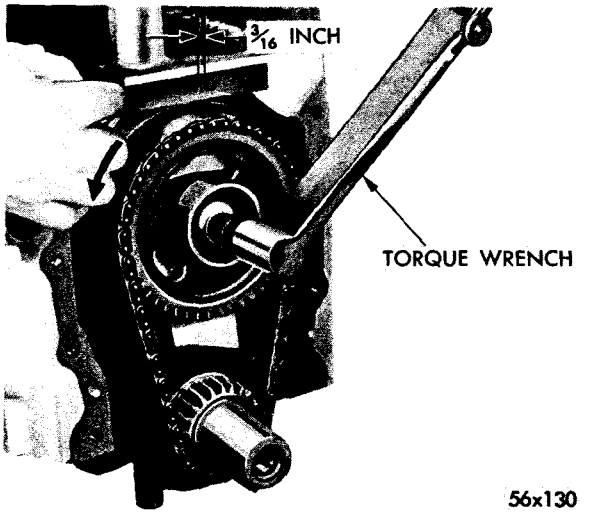


Fig. 38 — Measuring Timing Chain Stretch (Typical)

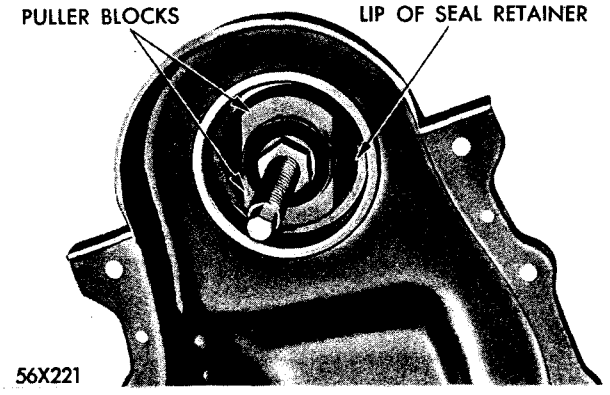


Fig. 39 — Puller Blocks Expanded to Correct Pulling Position

lines up with top of protruding camshaft gear key. Install cup washer and bolt and tighten 35 foot-pounds torque.

b. Checking Timing Chain for Stretch

Place a scale next to timing chain so that any movement of chain may be measured. Place a torque wrench and socket over camshaft gear attaching bolt and apply torque in direction of crankshaft rotation to take up slack 30 foot-pounds torque (with cylinder heads installed) and 15 foot-pounds torque (heads removed). Holding scale with dimensional reading even with edge of a chain link, apply torque in reverse direction 25 foot-pounds (with cylinder heads installed) and 15 foot-pounds (heads removed), and note the amount of chain rotation (Fig. 38). Install new timing chain, if its movement is greater than $\frac{3}{16}$ inch.

NOTE

With a torque applied to camshaft gear bolt, the crankshaft should not move. If there is any movement, however, the crankshaft should be blocked to prevent rotation.

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

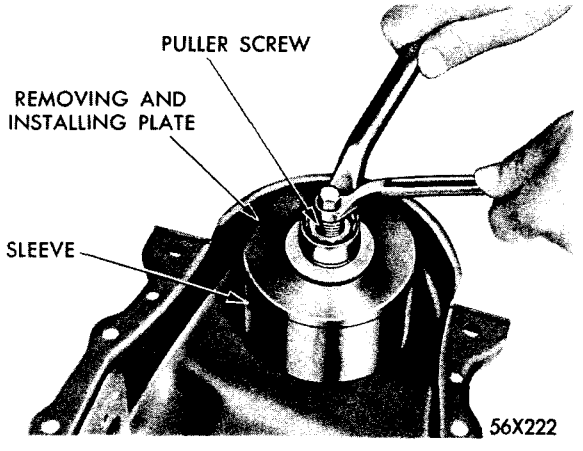


Fig. 40 — Removing Oil Seal

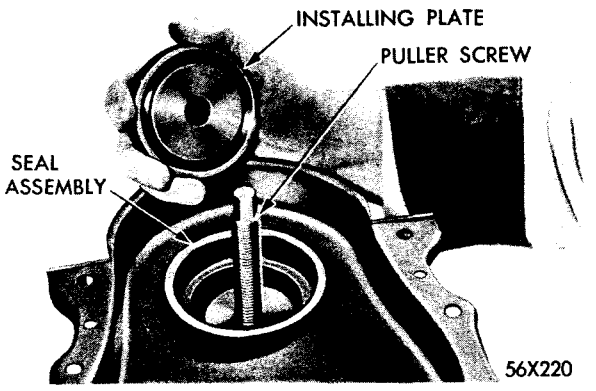


Fig. 41 — Positioning the Installer Plate on New Seal

28. TIMING CHAIN CASE COVER OIL SEAL REPLACEMENT

a. Removing Oil Seal

Position puller screw of Tool C-3506 through case cover, with inside of case cover up. Position puller blocks directly opposite each other, and force angular lip between neoprene and flange of seal retainer. Place washer and nut on puller screw. Tighten nut as tight as possible by hand, forcing blocks into gap to point of distorting seal retainer lip (Fig. 39). *THIS IS IMPORTANT!* (Puller is only positioned at this point.) Place sleeve over seal retainer and place removing and installing plate into sleeve. Place flatwasher and nut on puller screw. Hold center screw and tighten lock nut to remove seal (Fig. 40).

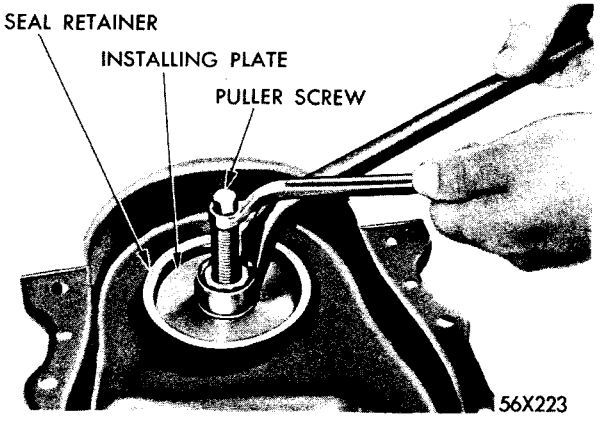


Fig. 42 — Installing New Seal

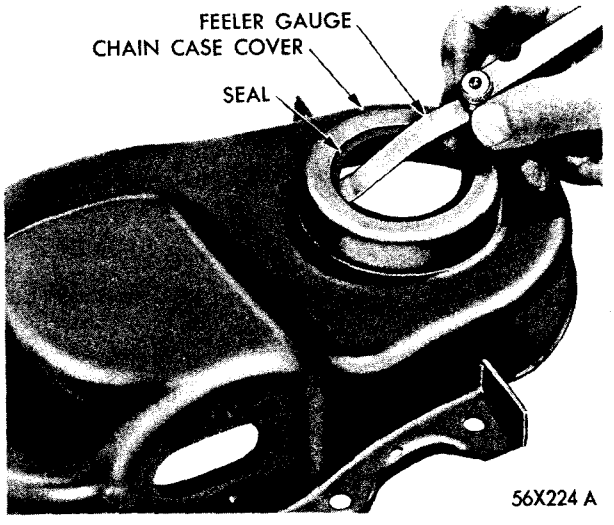


Fig. 43 — Checking to Make Sure Seal is Properly Seated

b. Installing Oil Seal

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

NOTE

Always have thin shoulder up with stamped case cover, and thick shoulder up with a cast iron case cover.

Insert puller screw with plate through seal opening (inside of chain case over facing up). Place seal in cover opening, with neoprene down. Place seal installing plate into the new seal, with protective recess toward lip of seal retainer (Fig. 41). Install flatwasher and nut on puller screw, hold screw, and tighten nut (Fig. 42).

Seal is properly installed when neoprene is tight against face of cover. Try to insert a .0015 inch feeler gauge between neoprene and cover (Fig. 43). If seal is installed properly, the feeler gauge cannot be inserted.

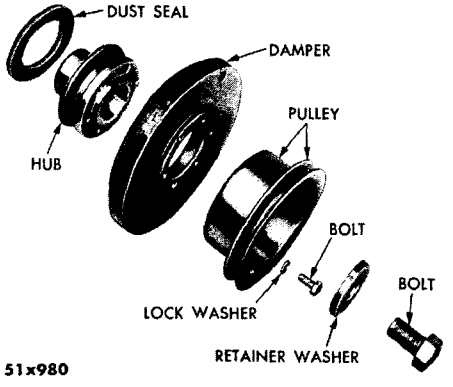


Fig. 44 — Vibration Damper Assembly (Disassembled View)

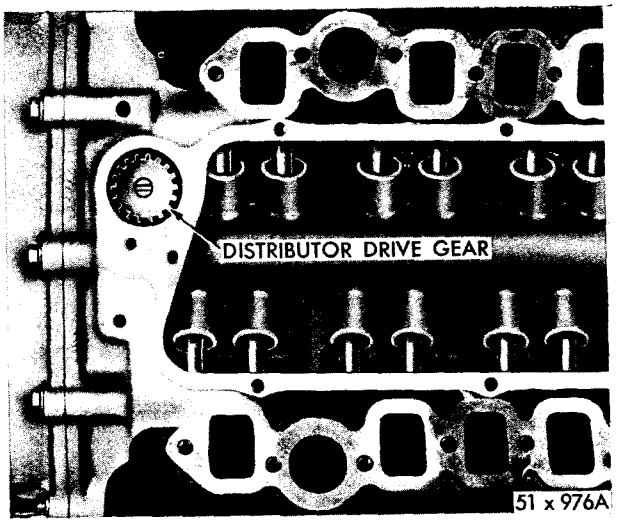


Fig. 45 — Distributor Drive Gear Installation

NOTE

It is normal to find particles of neoprene collected between the seal retainer and crankshaft oil slinger.

c. Installing Chain Case Cover

Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs. Use a *new* gasket, slide chain case cover over locating dowels and tighten bolts to 15 foot-pounds torque.

29. INSTALLING VIBRATION DAMPER

Refer to Figure 44 and proceed as follows.

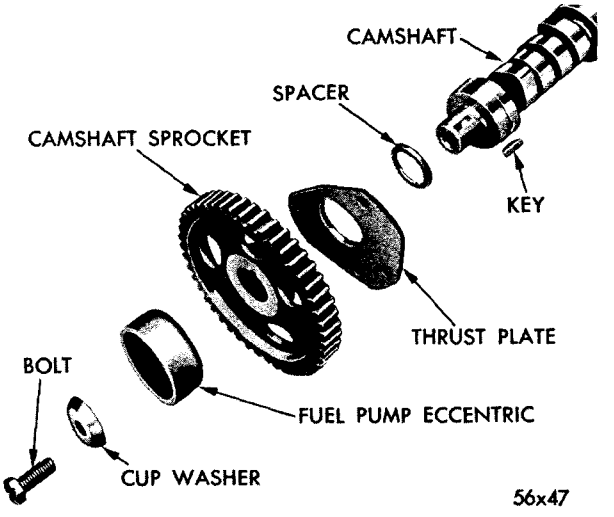


Fig. 46 — Camshaft Drive Parts (Disassembled View)

Place damper hub key in slot in crankshaft and position dust seal in hub. Slide hub and seal on crankshaft. Place installing tool (part of Puller set C-3033) in position and press damper hub on crankshaft. Slide damper and pulley over shaft and secure with bolts and lockwashers. Tighten bolts 15 foot-pounds torque. Install damper hub retainer washer and bolt. Tighten 135 foot-pounds torque.

30. CAMSHAFT REMOVAL

With intake manifold, tappet cover, push rods, tappets and timing gears removed, remove distributor. Lift out distributor drive gear and stub shaft, (Fig. 45). Remove camshaft thrust plate attaching bolts and oil trough, (Fig. 46). Withdraw camshaft and spacer, *being careful not to damage the cam bearings with the cam lobes.*

31. REMOVAL AND INSTALLATION OF DISTRIBUTOR DRIVE SHAFT BUSHING

a. Removal (Camshaft Removed)

Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained, (Fig. 47). Hold puller screw and tighten puller nut until bushing is removed.

b. Installation

Slide new bushing over burnishing end of Tool C-3053 and insert tool and bushing into bore.

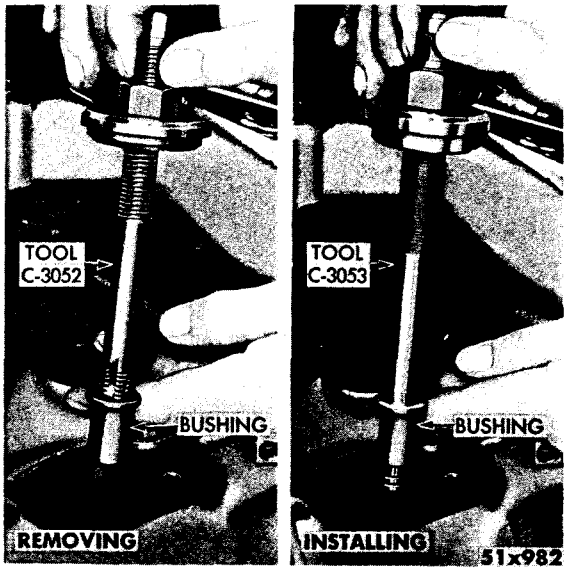


Fig. 47 — Removing and Installing the Distributor Drive Shaft Bushing

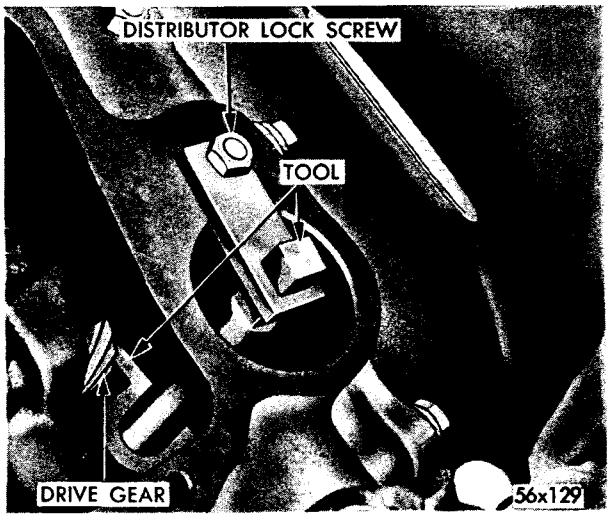


Fig. 48 — Camshaft Holding Tool C-3509

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

32. CAMSHAFT INSTALLATION

Install Tool C-3509 in place of distributor drive gear, and stub shaft (Fig. 48). Hold 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, *and should remain installed until camshaft and crankshaft sprockets and timing chain have been installed.*

Lubricate camshaft bearing journals and install camshaft, *being careful not to damage cam bearings with the cam lobes.*

Install thrust plate spacer (chamfered side toward camshaft fillet). Install thrust plate and oil trough; tighten screws 15 foot-pounds torque.

Check difference in thickness between spacer and thrust plate. The spacer should be thicker than thrust plate to extent that camshaft must have an end play of .002 to .006 inch.

NOTE

Whenever an engine has been rebuilt and a new camshaft and/or new tappets have been installed, one quart of MOPAR Oil Additive should be added to the engine oil to aid break-in. The oil mixture should be left in the engine for a minimum of 10 hrs. However, it is not

necessary to drain the mixture before normal oil change is required, nor is it necessary to use the oil additive at subsequent oil changes.

33. DISTRIBUTOR (BASIC) TIMING

Before installing the distributor drive shaft and gear, it will be necessary to time engine as follows: Rotate crankshaft until Number 1 cylinder is at top dead center (check with Tool C-3075). When in this position, the pointer on chain case cover should be over ("DC") on vibration damper. Position oil pump shaft so that it lines up with slot in drive gear. Coat shaft of drive gear with engine oil. Install so that, after gear spirals into place, it will index with oil pump shaft, and slot in top of drive gear will be parallel with centerline of crankcase (Fig. 45).

34. INSTALLATION OF DISTRIBUTOR

Hold distributor over mounting pad on cylinder block with vacuum chamber pointing toward right hand cylinder bank. Turn rotor until it points forward and to approximate location of Number 1 tower in distributor cap. Turn rotor counter-clockwise until breaker contacts are just separating. Place distributor oil seal ring in position. Lower distributor and engage shaft in slot of distributor drive shaft gear while holding rotor in position.

35. REMOVAL AND INSTALLATION OF CAMSHAFT BEARINGS

a. Removal

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

b. Installation

Install new camshaft bearings with Tool C-3132 by sliding new rear camshaft bearing shell over proper size adapter. Position bearing in tool (Fig. 49). Install horseshoe lock and, by reversing removal procedure, carefully drive bearing shell into place. Install remaining shells in like manner.

The oil holes in camshaft bearings and cylinder block must be in exact alignment to insure proper lubrication. (Fig. 49.) Camshaft bearing index can be checked after installation by inserting a pencil flashlight in bearing shell. The complete circumference of camshaft bearing hole should be visible by looking through main bearing drilled oil passage. If camshaft bearing shell oil hole is not in exact alignment, remove, and reinstall.

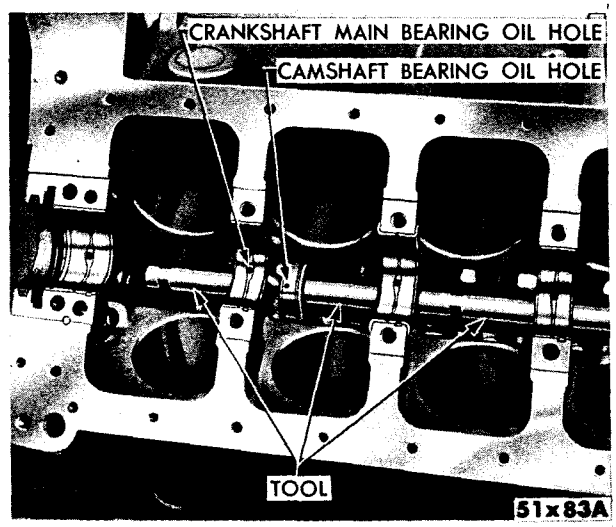


Fig. 49 — Installing Camshaft Bearing Shells—Tool C-3034

Use Tool C-897 to install a new Welch plug at rear of camshaft. Be sure this plug does not leak.

36. CYLINDER BLOCK

Clean cylinder block thoroughly, check all core hole plugs for evidence of leaking. If new core hole plugs are installed; coat edges of plug and core hole with a suitable sealer and drive plugs in place with driver, Tool C-897. Examine block for minute cracks or fractures. Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. *Be sure to keep tops of piston 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 engine, rotate crankshaft so each connecting rod is centered in cylinder bore and proceed as follows:

Remove connecting rod cap and bearing shells.

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

a. Checking Cylinder Bores

The cylinder bores should be checked for out-of-round and taper with Tool CM-119. If cylinder bores show more than .005 inch out-of-round or a taper of more than .020 inch, the cylinder block should be rebored and new pistons and rings fitted.

b. Honing Cylinder Bores

To remove light scoring, scuffing, or scratches from cylinder walls, use Honing Tool C-823. *The crankshaft, bearings and internal parts should be protected during honing and boring operations.* Usually one or two "passes" with a hone will clean up a bore and still maintain required limits.

If cylinder bores are found to be satisfactory in respect to taper and out-of-round and new rings are to be installed, use Cylinder Surfacing Hone Tool C-3501 with 280 grit stones for deglazing bores. This will facilitate in the break-in of new rings.

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

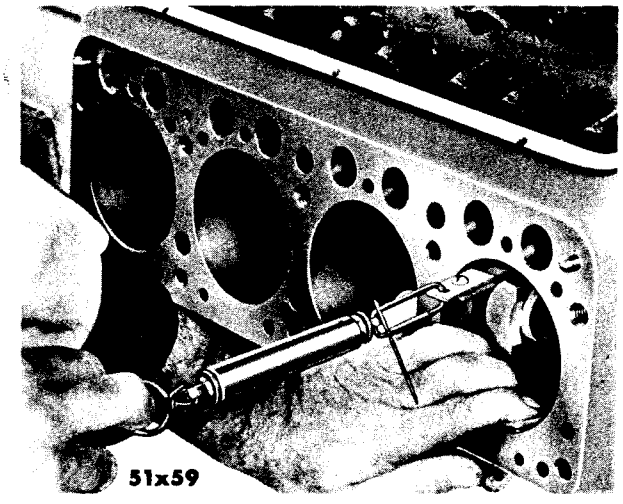


Fig. 50 — Fitting Piston to Cylinder Bore (Typical)

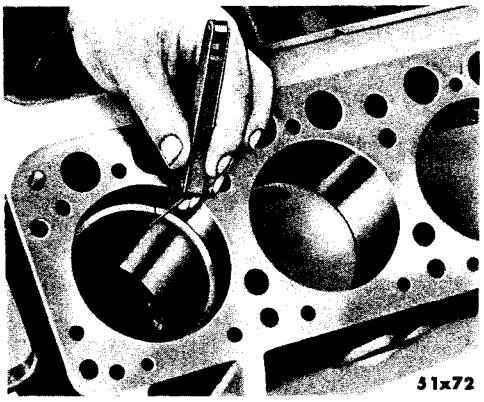


Fig. 51 — Checking Ring Gap in Cylinder Bore (Typical)

use SAE No. 10 oil and CLEAN rags. When the bore can be wiped with a clean white rag and be withdrawn clean, the bore is clean.

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 specifications may be maintained.

c. Fitting Pistons

The piston and cylinder wall must be clean and dry. Coat the bore very lightly with SAE 10W Engine Oil. The recommended clearance between the thrust face of piston and cylinder wall is .0005 to .0015 inch. Check clearance with a .002 inch feeler stock ½ inch wide on spring scale Tool C-690, by inserting piston in bore, upside down, with feeler stock between thrust face of piston and cylinder wall. Hold piston and draw the feeler stock straight out with spring scale (Fig. 50). The amount of pull required to withdraw the feeler stock should be from 8 to 12 pounds.

NOTE

Piston fitting should be done at normal room temperature, 70° F.

All service pistons include piston pins and retaining rings and are avaliable in standard and the following oversizes, .005, .020, .040 and .060 inch.

d. Fitting Rings

Measure piston ring gap about two (2) inches

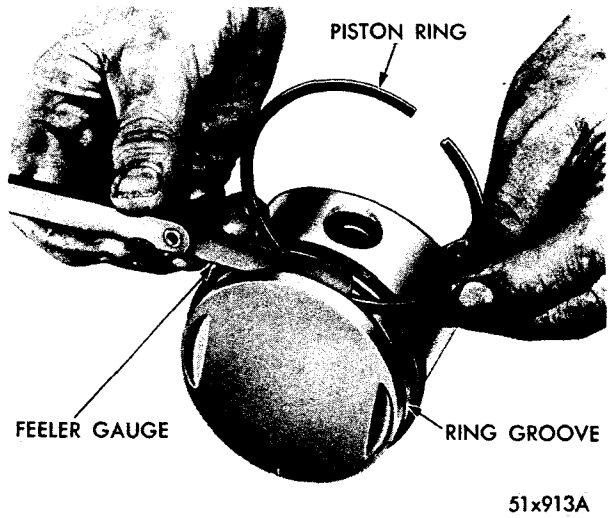


Fig. 52 — Checking Piston Ring Side Clearance (Typical)

from bottom of cylinder bore in which it is to be fitted. (An inverted piston can be used to push the rings down to position.) This will insure positioning rings exactly square with cylinder wall before measuring.

Insert feeler stock in gap (Fig. 51). The ring gap should be between .010 to .020 inch. This measurement is the same for all rings.

Measure clearance between piston ring and ring groove (Fig. 52). The clearance should be .0015 to .0030 inch for top compression ring, .001 to .0025 inch for intermediate ring, and .001 to .003 inch for oil control ring.

Starting with oil ring expander, place expander ring in lower ring groove and install oil control ring. Install compression rings, in top and middle grooves. Use ring installer, Tool C-3418.

Fig. 53 — Fitting Piston Pins in Connecting Rod

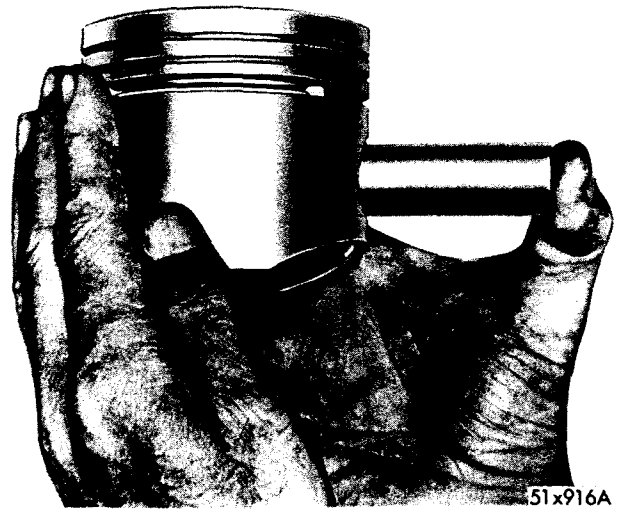


Fig. 54 — Fitting Piston Pins in Piston (Typical)

NOTE

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

e. Fitting Pins

The piston pin should be a tight thumb press fit in connecting rod (Fig. 53) and in piston (Fig. 54) at normal room temperature, 70° F.

If proper fit cannot be obtained with standard pins, ream piston and connecting rod, and install oversize piston pins. Piston pins are supplied in standard and the following oversizes: .003 and .008 inch.

Assemble pistons to rods on right cylinder bank (2, 4, 6 and 8), with the indent on piston head opposite to the larger chamfer on large

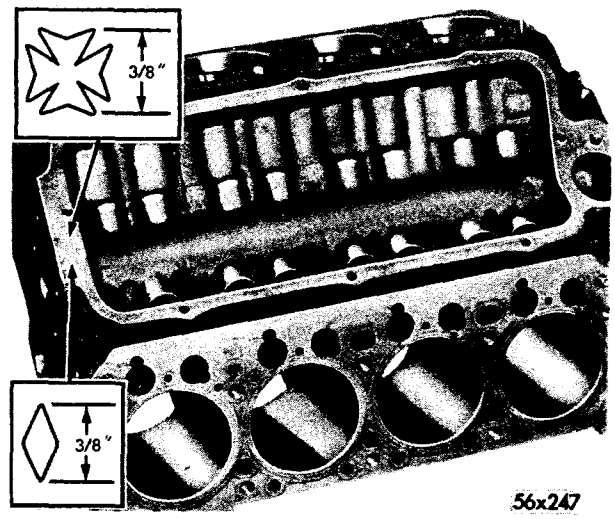


Fig. 55 — External Identification (Parts Other Than Standard Size)

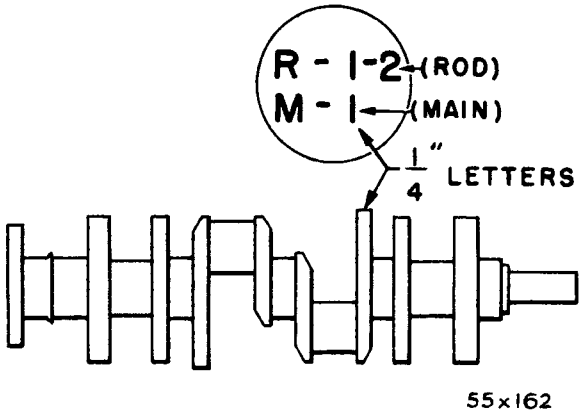


Fig. 56 — Internal Identification (Parts Other Than Standard Size)

end of connecting rod. Assemble pistons to rods on left cylinder bank (1, 3, 5 and 7), with the indent on the piston head on the same side as the larger chamfer on large end of the connecting rod.

37. CONNECTING RODS

IMPORTANT

A Maltese Cross stamped on the engine numbering pad (Fig. 55) 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 Number 3 counter-weight (Fig. 56). Connecting rod journals will be identified by letter "R" and main bearing journals by the letter "M". Thus, "M-1" indicates that number 1 main bearing journal is .001 inch undersize. Also, a diamond-shaped marking stamped on engine numbering pad indicates that all tappet bodies are .008 inch oversize. (See Figure 55.)

38. CHECKING CONNECTING ROD ALIGNMENT

Check for Bend—Install connecting rod and piston in fixture (connecting rod bearing removed), as shown in Figure 57, A.

The top of piston should be flush with tool. If clearance is more than .002 inch, piston and connecting rod should be disassembled and rod checked, as shown in Figure 58. Straighten a bent rod or install a new one.

Check for Twist—With connecting rod and piston assembly, installed in fixture Tool C-841, tilt the piston (B, Fig. 57). If clearance is more than .002 inch, piston and connecting rod should be disassembled and rod checked as shown in Figure 58.

39. INSTALLING CONNECTING ROD BEARINGS

Fit connecting rods to crankshaft (Fig. 59) without inserting piston and rod in cylinder bore, eliminating any possible drag that might be caused between piston and cylinder wall.

NOTE

Fit all rods of one bank until completed. Do not alternate from one bank to another, be-

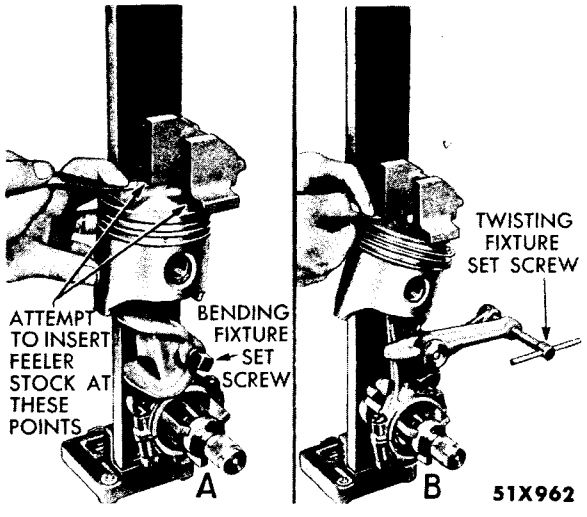


Fig. 57 — Checking Connecting Rod and Piston for Alignment

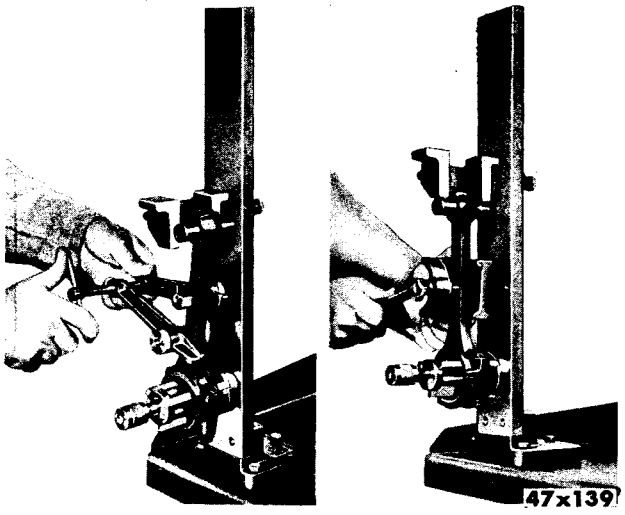


Fig. 58 — Checking Connecting Rod for Bind or Twist

cause, when 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 "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 machined grooves of rods.

Limits of taper or out-of-round on any crankshaft journal should be held to .001 inch. Undersize bearings are serviced in .001, .002, .003, .010, and .012.

40. CHECKING CONNECTING ROD BEARING CLEARANCE

The correct connecting rod bearing shell clearance is from .0005 to .0015 inch. Place a piece of oiled .001 inch feeler stock (½ inch wide and ¾ inch long) between bearing shell and crankshaft journal. Make sure shim edges are smooth. Install bearing cap and tighten cap to 45 foot-pounds torque.

NOTE

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

Move connecting rod and piston from side to side (Fig. 59). A slight drag should be felt as rod is moved. This will indicate that clearance is .001 inch or less which is satisfactory. If connecting rod is difficult to move, the bearing shell is too small and should be replaced with the correct size. Make sure that tangs on bearing inserts fit grooves in connecting rods and caps. The side play should be from .006 to .014 inch (two rods).

41. INSTALLING PISTON AND CONNECTING ROD ASSEMBLY IN CYLINDER BLOCK

Before installing 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 "V" of engine. The oil ring gap should be turned toward the inside of the "V" of engine.

Immerse piston head and rings in clean engine oil, slide ring compressor, Tool C-385, over piston, and tighten with special wrench (part of Tool C-385). Be sure position of rings does not change during this operation.

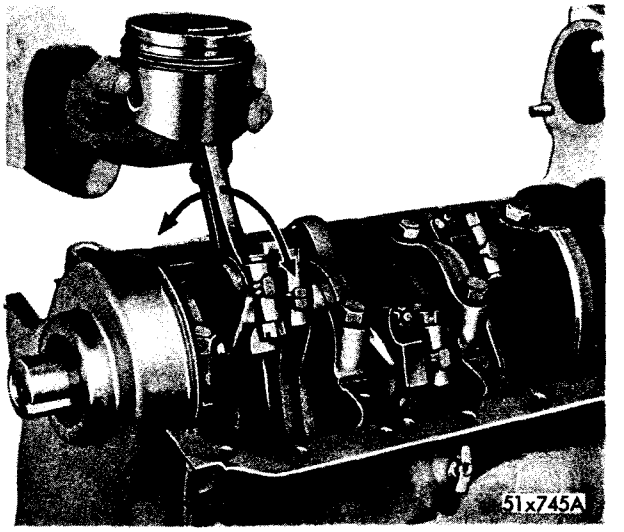


Fig. 59 — Checking Connecting Rod Bearing Clearance (Typical)

Screw connecting rod bolt protector (part of Tool C-3221) on one rod bolt, and insert rod and piston into cylinder bore. Attach puller part of Tool C-3221 on the other bolt, and guide the rod over crankshaft journal.

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

42. CRANKSHAFT

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 thrust faces of No. 3 main bearing. After regrinding remove rough edges from crankshaft oil holes and clean out all oil passages.

43. CRANKSHAFT BEARINGS

The halves of Number 1, 2 and 4 bearings are interchangeable (the bearing caps are not interchangeable and should be marked at removal to insure correct reassembly. Number 3 bearing, which controls the crankshaft end thrust, is not interchangeable with the others. The upper and

lower halves, however, of Number 3 bearing are interchangeable. Number 5 bearing halves are not interchangeable.

IMPORTANT

A Maltese Cross stamped on the engine numbering pad (Fig. 55) indicates that engine is equipped with a crankshaft which has one or more connecting rod and main bearing journals finished, .001 inch undersize. The position of undersize journal or journals will be stamped on machined surface of Number 3 counterweight (Fig. 56). Connecting rod journals will be identified by letter "R" and main bearing journals by letter "M". Thus, "M-1" indicates that Number 1 main bearing journal is .001 inch undersize.

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.

44. REMOVAL AND INSTALLATION OF MAIN BEARINGS (CRANKSHAFT IN ENGINE)

a. Removal

Remove 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. 60) in oil hole of crankshaft. Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

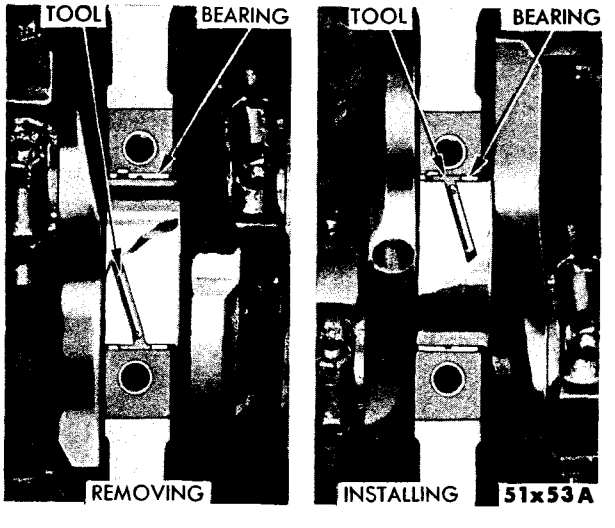


Fig. 60 — Removing and Installing Main Bearing Upper Shell

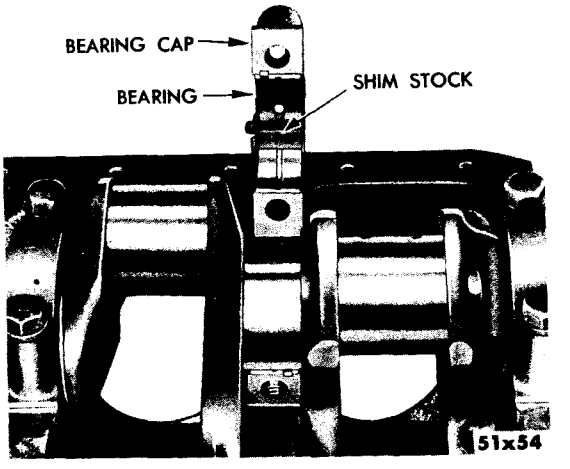


Fig. 61 — Checking Main Bearing Clearance with Shim Stock

b. Checking Bearing Clearance

Remove spark plugs to relieve compression. Check each bearing separately, *do not* loosen the other bearing caps.

Install bearing shell in cap and place a piece of oiled, .001 inch feeler stock (½ inch wide and 1 inch long) between bearing and crankshaft journal (Fig. 61). Install and tighten bearing cap bolts to 85 foot-pounds torque.

If a slight drag is felt as crankshaft is rotated, the clearance is .001 inch or less, and is considered satisfactory. If crankshaft cannot be rotated, the bearing is too small and should be replaced with the correct size.

If no drag is evident reduce clearance with undersize bearing inserts until a slight drag is felt with a .001 inch shim in place between bearing shell and crankshaft journal. *It is permissible to use a .001 inch undersize bearing with a standard bearing or a .002 inch bearing. Always use the smaller diameter bearing half as the upper housing half. Never use a new bearing with used bearing and never use an upper bearing half more than .001 inch smaller than the lower bearing half.*

c. Installation

NOTE

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

Start bearing in place, and insert Tool C-3059 in oil hole of crankshaft (Fig. 60). Slowly rotate the crankshaft counter-clockwise, sliding

bearing into position.

After all bearings have been fitted, tighten Number 3 (center) main bearing first, and work alternately to both ends. Tighten all caps to 85 foot-pounds torque.

Crankshaft end play should be .002 to .007 inch.

45. REMOVAL AND INSTALLATION OF OIL PAN

a. Removal

Drain oil and remove dip stick. Remove bolts that hold pan to cylinder block and remove pan.

b. Installation

Clean pan thoroughly and install new seals and gaskets. *End seals should be bottomed in their grooves and retained by crimping.* Ends of seals should extend approximately $\frac{1}{32}$ inch higher than the attaching face of oil pan to insure proper sealing. Tighten bolts evenly to 15 foot-pounds torque. Refill crankcase. See Lubrication, Section IX.

46. OIL PUMP

a. Removal

Remove oil pan, oil pump attaching bolts and remove pump by pulling straight down.

b. Disassembly

Refer to Figure 62 and proceed as follows: Remove the cotter pin, holding oil strainer to oil pump cover. Remove oil pump cover and oil seal ring. Remove pump rotor and shaft, and lift out pump rotor body. Remove oil pressure relief valve plug, and lift out spring and plunger.

c. Inspection and Repair

Wash all parts thoroughly. The mating face of oil pump cover should be smooth. Replace cover, if it is scratched or grooved.

Lay a straightedge across cover surface (Fig. 63). If a .0015 inch feeler gauge can be inserted between cover and straightedge, the cover should be replaced.

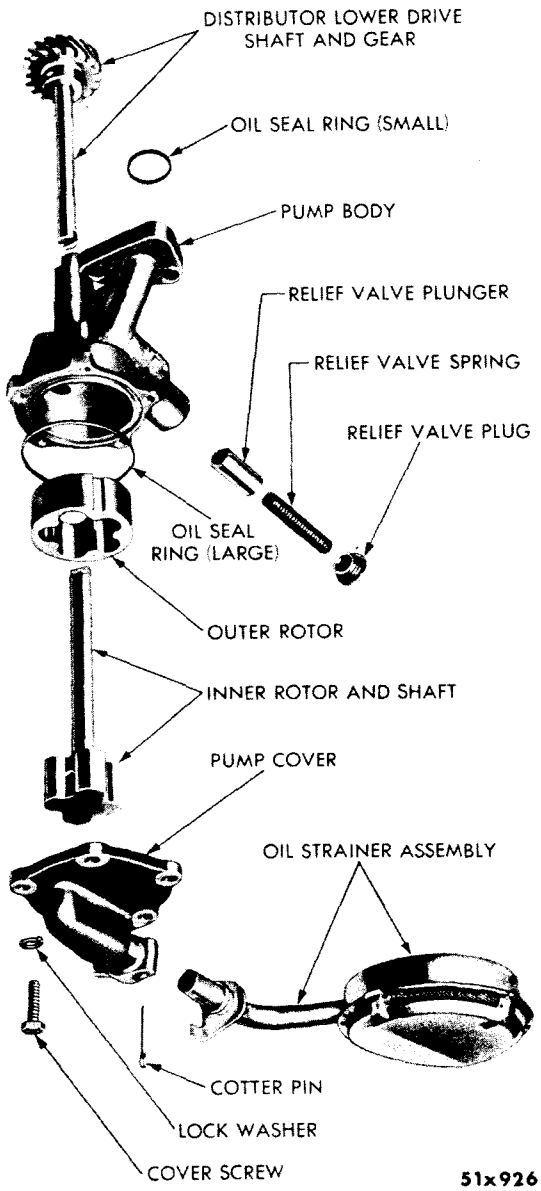


Fig. 62 — Oil Pump (Disassembled View) (Typical)

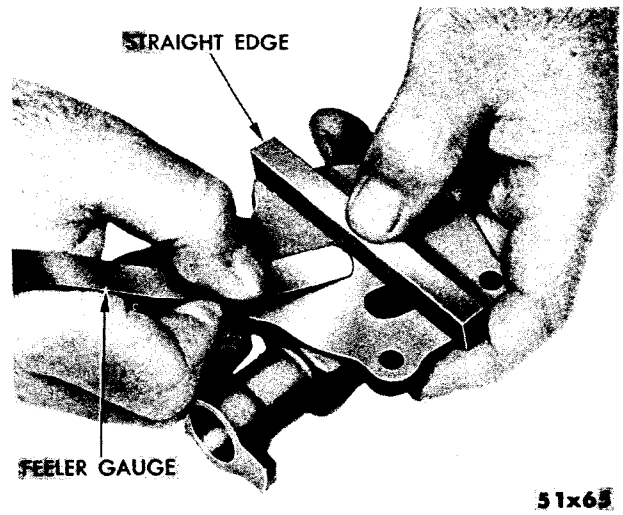


Fig. 63 — Checking Oil Pump Cover

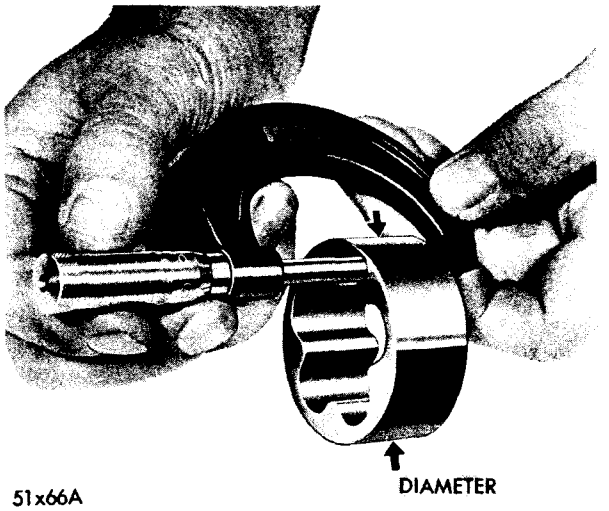


Fig. 64 — Measuring Thickness of Rotor Body

If rotor body measures less than .998 inch (Fig. 64) and diameter less than 2.244 inches, replace rotor body.

If pump rotor measures less than .998 inch (Fig. 65) a new pump rotor should be installed. Slide rotor body and rotor into pump body and place a straightedge across face (between bolt holes), as shown in Figure 66. If a feeler gauge or more than .004 inch can be inserted between rotors and straightedge, replace pump body.

Remove pump rotor and shaft, leaving rotor body in pump cavity. Press rotor body to one side with fingers and measure clearance between rotor and pump bodies, (Fig. 67). If measurement is more than .012 inch, replace oil pump body.

If clearance between pump rotor and rotor body (Fig. 68) is more than .010 inch, replace pump rotor and rotor body.

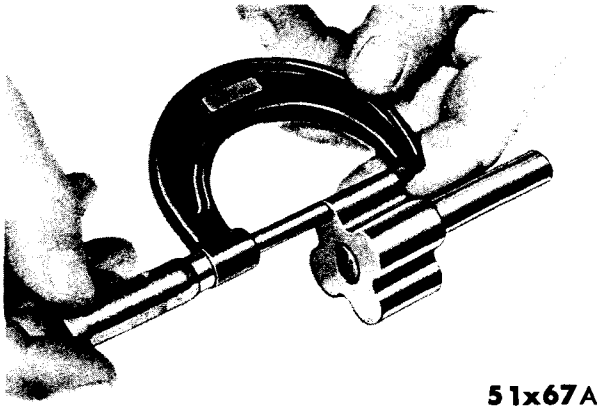


Fig. 65 — Measuring Thickness of Pump Rotor

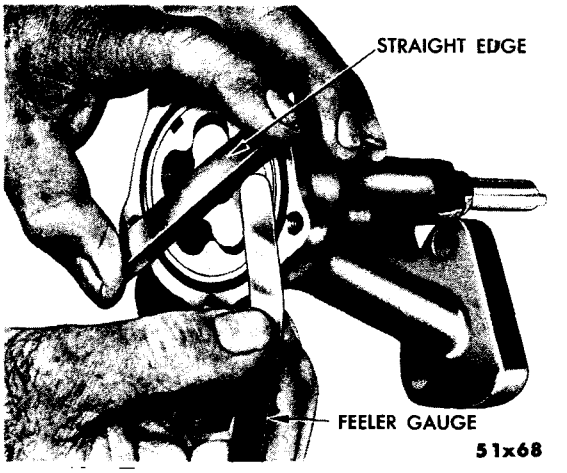


Fig. 66 — Measuring Clearance Over Pump Rotors

Check oil pump relief valve plunger for scoring and for free operation in its bore. If plunger is scored, replace plunger.

When assembling oil pump, be sure to use a new oil seal ring between cover and body. Tighten cover bolts to 10 foot-pounds torque. Prime the oil pump.

RELIEF VALVE SPRING CHART

Color	Free Height	Under-Load Height	Tension Pounds
Gray (Lt.)	3 1/32 inch	2 1/16 inch	16.1 to 17.1
Red (Std.)	2 27/32 inch	2 1/16 inch	19.5 to 20.5
Brown (Hvy.)	2 31/32 inch	2 1/16 inch	22.0 to 23.9

Unscrew plug and remove relief valve spring and plunger (Fig. 62). Clean all parts thoroughly.

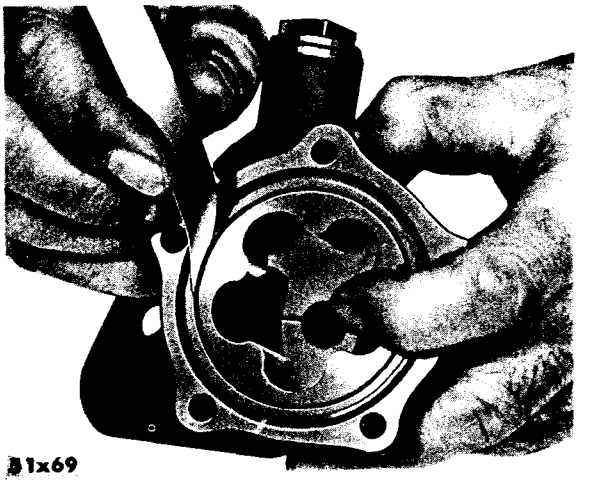


Fig. 67 — Measuring Clearance Between Rotor Body and Pump Body

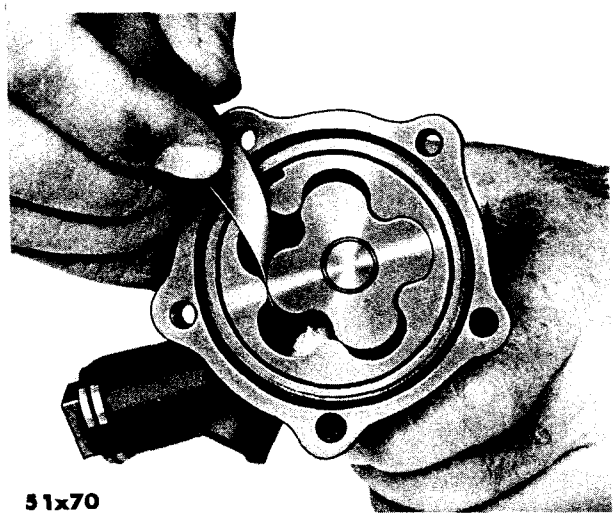


Fig. 68 — Measuring Clearance between Pump Rotors

If plunger shows signs of scoring or binds in bore, install a new plunger, and test spring. 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.

e. Installation

Install strainer on end of suction tube and secure with a cotter pin. Install suction tube into pump body.

Make sure pump guide sleeve is in position in rear main bearing cap and install oil pump, suction tube, and strainer to rear main bearing cap. Align drive slot in pump shaft with distributor lower drive shaft. Tighten mounting bolts to 33 foot-pounds torque.

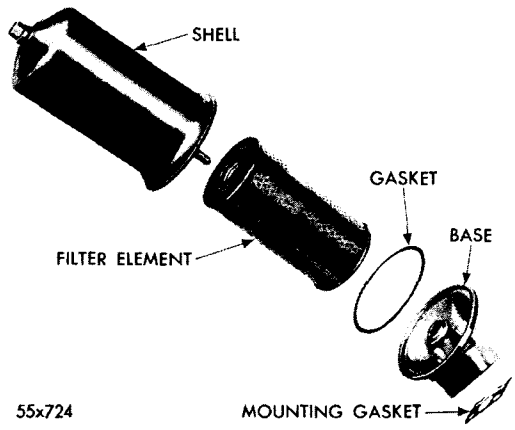


Fig. 69 — Full Flow Type Oil Filter (Disassembled View)

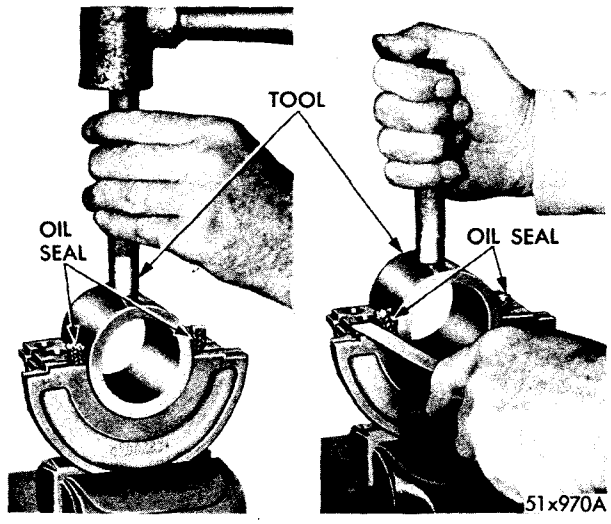


Fig. 70 — Installing Rear Main Bearing Oil Seal

After oil pump has been installed, check alignment of strainer. The bottom of strainer must be on a horizontal plane with machined surface of cylinder block.

47. REMOVAL AND INSTALLATION OF OIL FILTER

Remove the shell retaining center bolt and lift off outer shell and gasket (Fig. 69). Remove filter element. Remove filter base attaching bolts and filter base if necessary.

Use new gaskets, reinstall filter base and new filter element. Install outer shell and tighten center bolt securely.

48. REPLACEMENT OF REAR MAIN BEARING OIL SEAL (CRANKSHAFT REMOVED)

Remove old oil seals from cylinder block and bearing cap. Install a new rear main bearing oil seal in block so that both ends protrude. Tap seal down into position with Tool C-3511, until tool is seated in bearing bore. Hold tool in this position, and cut off portion of seal that extends above block on both sides.

Install a new seal in bearing cap (bearing shell removed) so that the ends protrude (Fig. 70). Tap seal down into position with Tool C-3511 (left-hand view, until tool is seated. Trim off portion of seal that protrudes above cap (right-hand view). Install two cap side seals in grooves in cap. Care should be used when installing these seals as they are *NOT* interchangeable. The seal with the longer body should be installed on the oil filter side of the block. Seals incorrectly installed will cause an oil leak.

Section III

FUEL SYSTEM, GOVERNORS AND LIQUID PROPANE GAS

DATA AND SPECIFICATIONS

MODELS	*IND. 52, 53, 54, 56 and 56A*
FUEL PUMP	
Make	Carter
Model	M 961 S
Type	Mechanical Diaphragm
Driven By	Camshaft
Pump Pressure (pounds)	6 to 7
CARBURETOR	
Model	*AAVP-2
Type	Stromberg—2 Barrel
Flange Size	1¼ SAE
Throttle Bores	1 7/16 Inches
Venturi	1⅛ Inches
Main Metering Jet	Stromberg Part No. P-22660 #55 Drill
Power By-Pass Jet	(2)—#58 Drill
Accelerating Pump Capacity	18-22 C.C. per 10 Strokes
Idle Adjustment Setting	Set Idle Needle Valve 1½ Turns Off Seat
Idle Adjustment Speed Screw	1½ Turns Open
Float Setting	Use Tool T-24971—Set Top of Float Lever with Vertical Guide on Tool
Choke	Manual

*NOTE: When ordering repair kits for the Stromberg Carburetor include the Carburetor Code Number stamped on the air horn assembly. The code number for Model AAVP-2 is 4-122A.

SPECIAL TOOLS

FUEL PUMP

C-483	Gauge
T-109-43	Rivet Extractor

CARBURETOR

73609	Grip Handle
73602	Socket Wrench ½"
73605	Wrench—Float Adjustment
73598	Screw Driver—Main Discharge Plug
73642	Tool—Inserting Clip
73606	Jet Wrench—Metering
73608	Remover—Main Jet
73627	Screen—Forming Tool
73652	Gauge—Float Lever

Section III
FUEL SYSTEM, GOVERNORS AND LIQUID PROPANE GAS

FUEL PUMP

1. DESCRIPTION

Carter fuel pump number M 961 S is used on all industrial models (Fig. 1). Acceleration, fuel economy, power output, and quick starting in all kinds of weather, are dependent upon the proper functioning of the fuel pump.

The fuel pump is driven by an eccentric on the camshaft, which actuates the rocker arm. This action lifts the pull rod and diaphragm assembly upwards against main spring, thus creating a vacuum in the valve housing, which opens the inlet valve and fuel is drawn into valve housing chamber from the fuel tank.

On the return stroke of rocker arm, the main spring pressure forces the diaphragm to down position, which expels fuel in valve chamber through outlet valve, to carburetor.

When carburetor float chamber is filled with fuel, the float in carburetor shuts off the needle valve, creating pressure in fuel pump chamber. This pressure holds fuel pump diaphragm upward against spring pressure until the carburetor requires more fuel.

As the engine consumes fuel the float level in the carburetor bowl drops and needle valve opens to admit fuel into float chamber, this releases the pump pressure and starts the

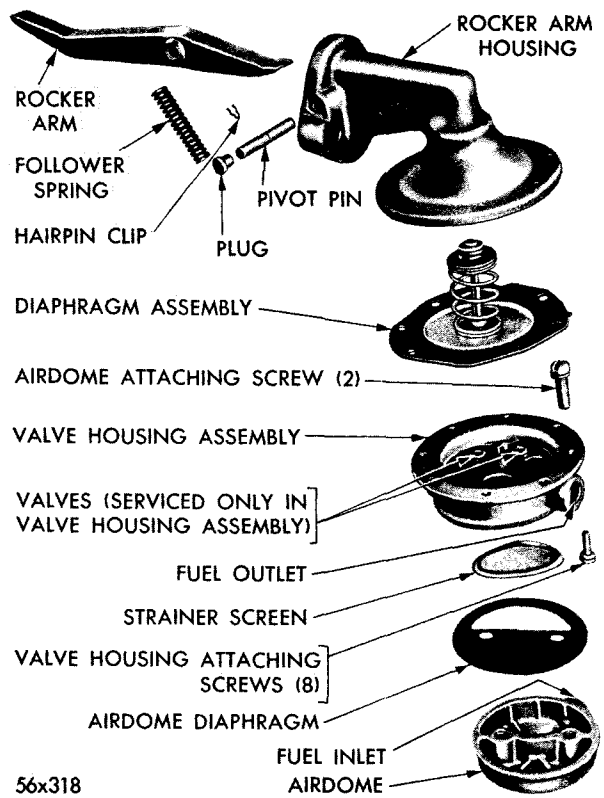


Fig. 1 — Fuel Pump (Exploded View Model M 961 S)

pumping cycle again. Actually, change in float level is negligible.

2. TESTING FUEL PUMP (On Car)

If fuel pump fails to pump fuel to carburetor, following checks should be made to determine cause of failure before removing fuel pump from car.

a. Fuel Lines

Make certain that fuel lines are not blocked and that fittings are tight. Check flexible hoses for cracks or deterioration which would cause leakage or retard flow of fuel to fuel pump.

b. Fuel Pump Breather Hole

Check for gasoline or oil leakage at fuel pump breather hole. A gasoline leak at this point indicates a defective diaphragm. An oil leak at this point indicates presence of a deteriorated or damaged oil seal on the diaphragm pull rod. In either case, the diaphragm assembly should be replaced.

c. Fuel Pump Pressure

If leakage is not apparent at fuel pump breather hole, test fuel pump pressure by inserting "T" fitting into fuel line at carburetor. Connect pressure gauge, Tool C-483, to "T" fitting and check fuel pump pressure while rotating the engine.

Fuel pump pressure should be from 6 to 7 pounds. This pressure should remain constant, or return to zero very, very slowly when engine is stopped. An instant drop to zero on the testing gauge indicates that outlet valve is leaking. Inlet and outlet valves are not serviceable. If necessary, replace the complete valve housing assembly.

If the Pressure Is Too Low—A weak diaphragm main spring, or improper assembly of diaphragm, may be the cause.

3. INLET VALVES

To test the inlet valves for proper functioning, disconnect fuel line to fuel pump and start engine, or turn engine with starting motor. Place finger over inlet fitting of fuel pump while engine is turning. There should be a noticeable suction—not alternated by blow-back—at this point. If blow-back is present, one or both inlet valves are not seating properly. The inlet and outlet valves are not serviceable. If necessary, replace the complete valve housing assembly.

Additional Checks

Check for leakage at fuel pump diaphragm which might be caused by loose mounting screws. Check fuel pump mounting bolts to insure that no oil leakage exists around mounting flange. If fuel pump fails to operate satisfactorily, disconnect fuel pump inlet and outlet lines and remove fuel pump assembly from engine. Service as outlined in Paragraph 4.

SERVICE PROCEDURES

4. SERVICING THE FUEL PUMP

Should it become necessary to disassemble the fuel pump for installation of new parts, refer to Figure 1, and proceed as follows:

Before disassembling the fuel pump, mark housings and air dome in such a manner that they may be reassembled with inlet and outlet fitting holes in correct location.

Remove rocker arm follower spring by prying up and over dimple in housing. Remove pivot pin plug, using plug removing Tool T-109-43. Remove hairpin clip from groove in pivot pin. Remove pin and slide rocker arm out of rocker arm housing.

Remove screws that hold valve housing to rocker arm housing. Separate housings and remove diaphragm assembly. Remove screws that attach air dome to valve housing. Separate dome from housing.

5. CLEANING AND INSPECTION

Clean all parts (except diaphragms) in solvent, then blow dry with compressed air. Examine diaphragm for cracks, torn screw holes or ruptures. Check condition of rubber oil seal on pull rod. If deteriorated, install new diaphragm and pull rod assembly. Check strainer screen in bottom of valve housing. If corroded or clogged, install new screen. Check rocker arm for wear or scoring on portion that contacts eccentric on camshaft. If arm is scored or worn, install new rocker arm.

The component parts of inlet and outlet valves are not available for service. If new valves are required, install new valve housing assembly.

6. ASSEMBLING THE FUEL PUMP

To reassemble fuel pump, refer to Figure 1, proceed as follows:

NOTE

When reassembling the fuel pump do not use shellac or other adhesive on the diaphragm.

Install strainer screen in position in valve body. Place rubber diaphragm over air dome with the cut-out portion over strainer. (Be sure the inlet fitting hole is in correct position under cut-out in diaphragm). Install screws and tighten securely.

Place diaphragm assembly over valve body, then align screw holes. Lower rocker arm housing down on diaphragm. Align screw holes. Check for positioning marks. Compress slightly and tighten screws alternately. Install rocker arm with slot directly under pull rod washer and gasket. Slide pivot pin through housing and lever until centered. Install hairpin clip and plug. Place end of follower spring over tang in lever, compress slightly and slide over dimple in housing.

SERVICE DIAGNOSIS

7. FUEL PUMP LEAKS—FUEL

a. Tighten loose housing screws.

b. Install new diaphragm.

c. Tighten loose inlet or outlet fuel fittings.

8. FUEL PUMP LEAKS—OIL

a. Install new diaphragm.

b. Tighten fuel pump mounting bolts.

c. Install new pump to block gasket.

9. INSUFFICIENT FUEL DELIVERY

a. Tighten fuel line fittings.

b. Install new diaphragm.

c. Thaw out frozen fuel lines.

d. Install new valve body.

e. Install correct fuel pump.

10. FUEL PUMP NOISE

a. Tighten fuel pump mounting bolts.

b. Install new rocker arm.

c. Install new rocker arm follower spring.

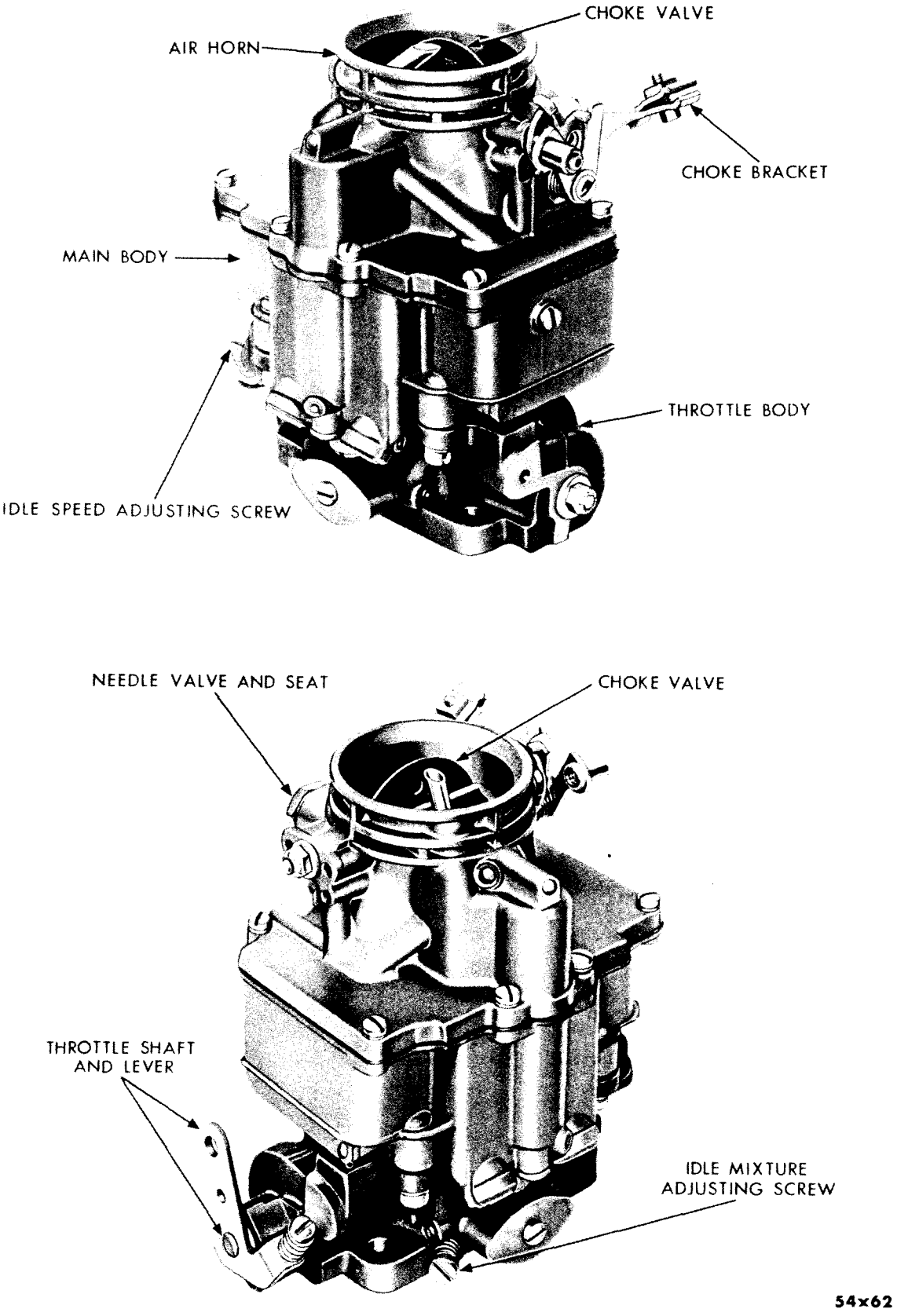


Fig. 2 — Stromberg Carburetor (Model AAVP-2)

CARBURETOR

STROMBERG MODEL AAVP-2
(With Vacuum Accelerating Pump)

11. DESCRIPTION AND OPERATION

NOTE

When ordering repair kits for the Stromberg Carburetor include the carburetor code number stamped on the air horn assembly. Code number is 4-122A.

The Stromberg AAVP-2 (Fig. 2) Carburetor is a double-barrel downdraft type with each barrel having its own idle system (with adjustable needle), main metering system and throttle valve, as shown in Figure 3. The idle system and main metering systems are supplemented by the float system, the accelerating system and the power system. The function of each system is described as follows:

a. The Float System (refer to Fig. 4)

The function of the float system is to maintain a constant level of fuel in the float chambers at all times and under all conditions of operation. Fuel enters the carburetor at the fuel inlet, flows through the float needle valve and seat and into the float chambers.

When the fuel reaches a given level, the floats shut-off the fuel supply at the needle valve. The float chambers are vented internally by a vent tube which connects the float chambers with the air horn.

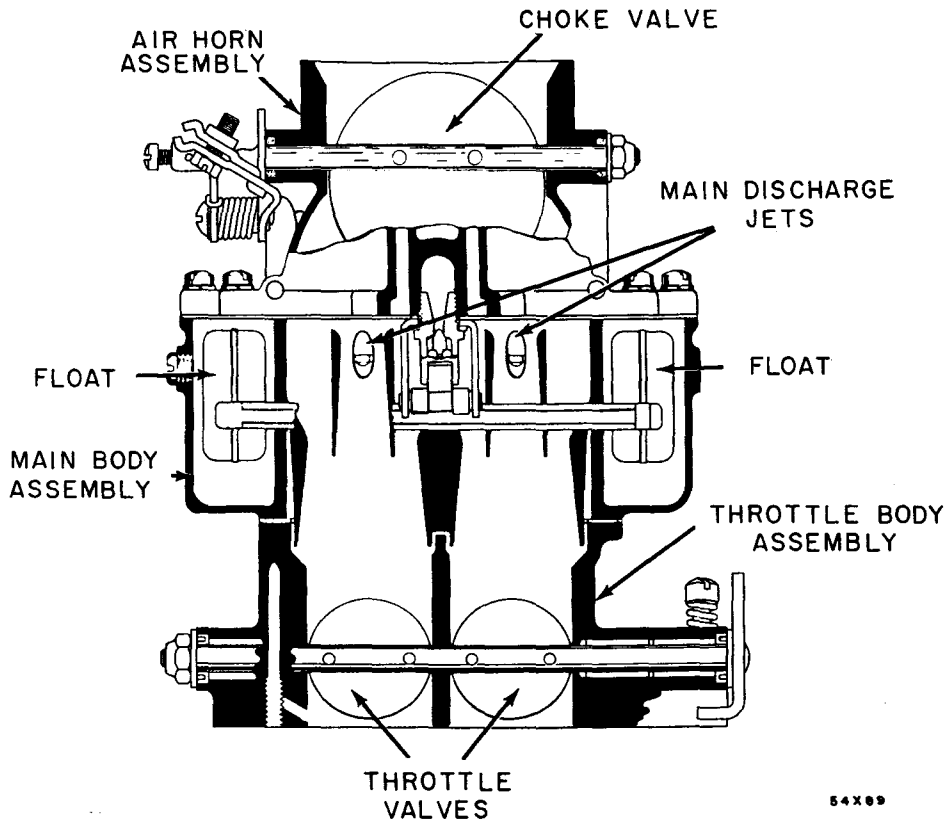


Fig. 3 — Stromberg Carburetor (Sectional View)

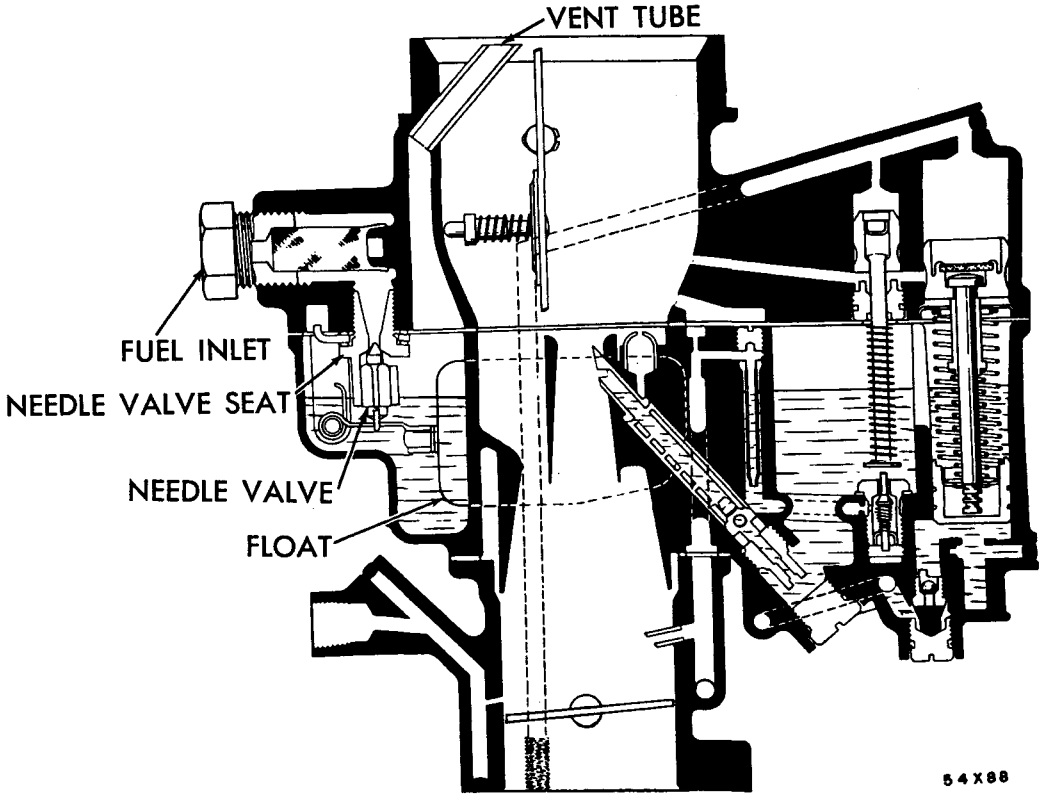


Fig. 4 — Float System

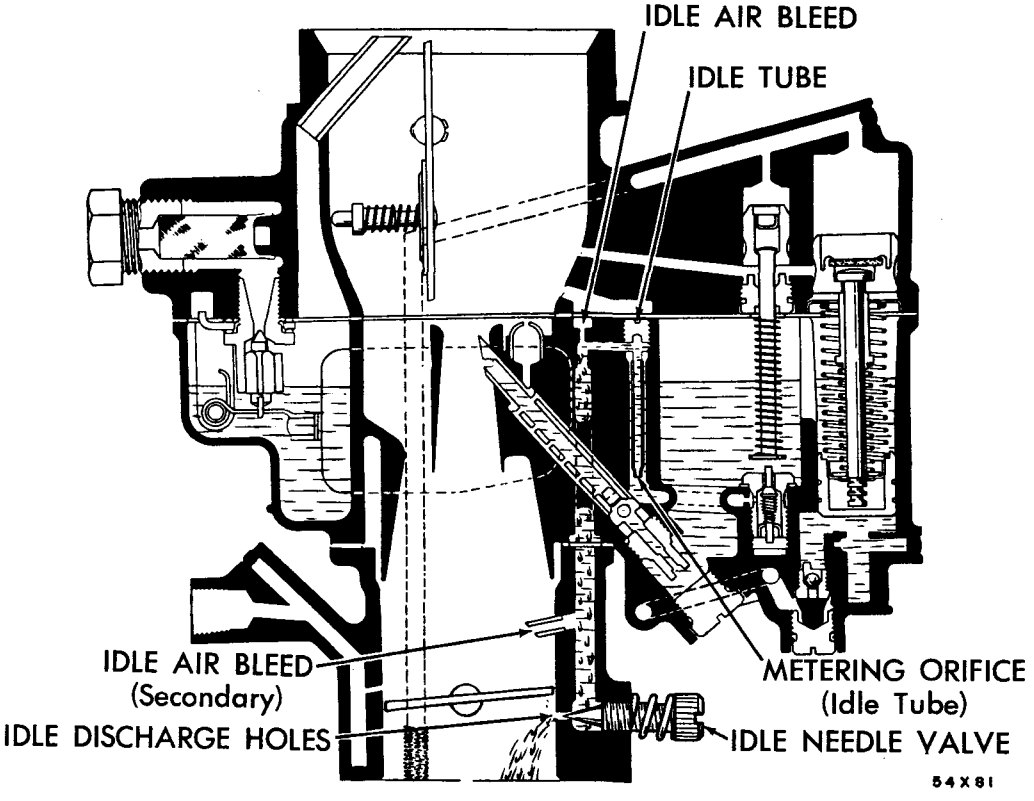


Fig. 5 — Idle System

b. The Idle System

With the throttle valves closed, as shown in Figure 5, and the engine running at slow idle speed, fuel from the float chambers is metered into the idle tubes through an orifice at the base of each idle tube. The air taken in through the idle air bleed holes mixes with the fuel at the top of the idle tubes.

The mixture of air and fuel flows down the channels where it is mixed with additional air entering through the secondary idle air bleeds. The mixture is discharged at the lower idle discharge holes. The quantity of fuel discharged is controlled by adjustable idle needle valves. As the throttle valves are opened slightly, the air-fuel mixture is also discharged from the upper idle discharge holes to supply the additional fuel required for increased engine speed.

c. Main Metering System

The main metering system controls the flow of fuel during the intermediate or part throttle range of operation. With the throttle valves in a partially open position, as shown in Figure 6, fuel flows from the float chambers through the main metering jets and enters the main discharge jets where it is mixed with air taken in through the high speed air bleeders.

This mixture of air and fuel is then discharged into the air stream through the auxiliary venturi tubes. The main body and main discharge jets are so designed that should vapor bubbles form in the fuel in the main discharge system, due to high temperatures, the vapor bubbles will collect in the outside channels surrounding the main discharge jets, rise and vaporize in the domes of the high speed bleeders, thus preventing "percolation."

d. Power System

The power system is incorporated into the carburetor to provide a richer mixture for maximum power and high speed operation. The extra fuel for power is supplied by a vacuum controlled power piston which automatically operates the power by-pass jet in accordance with throttle opening.

Intake manifold vacuum is maintained above the vacuum piston through a vacuum channel which leads to the manifold flange of the car-

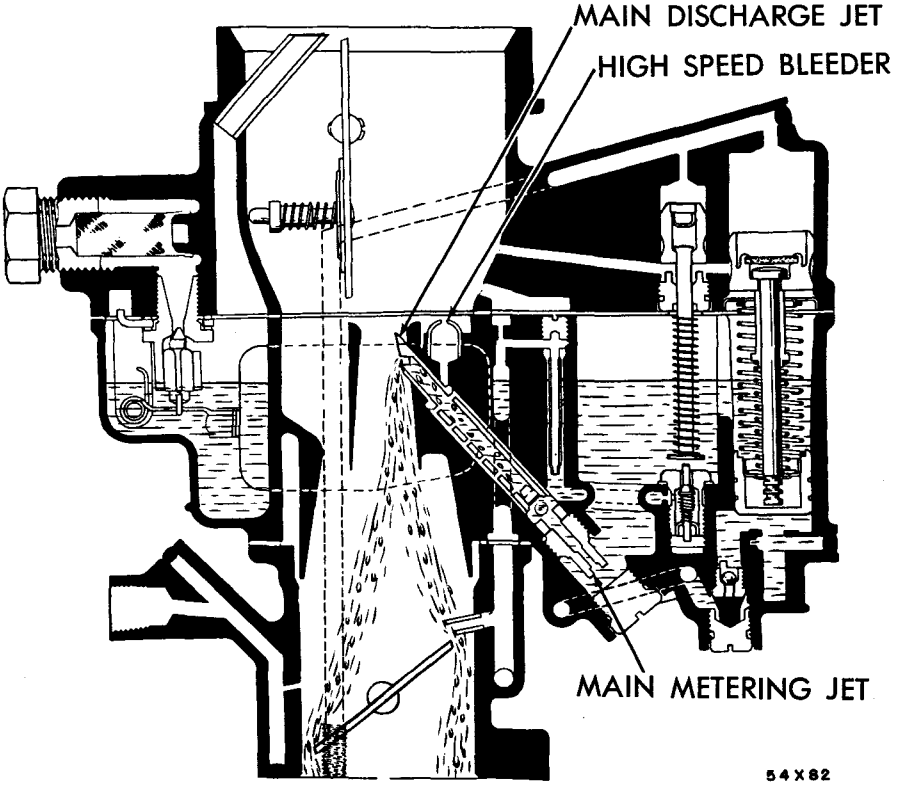


Fig. 6 — Main Metering System

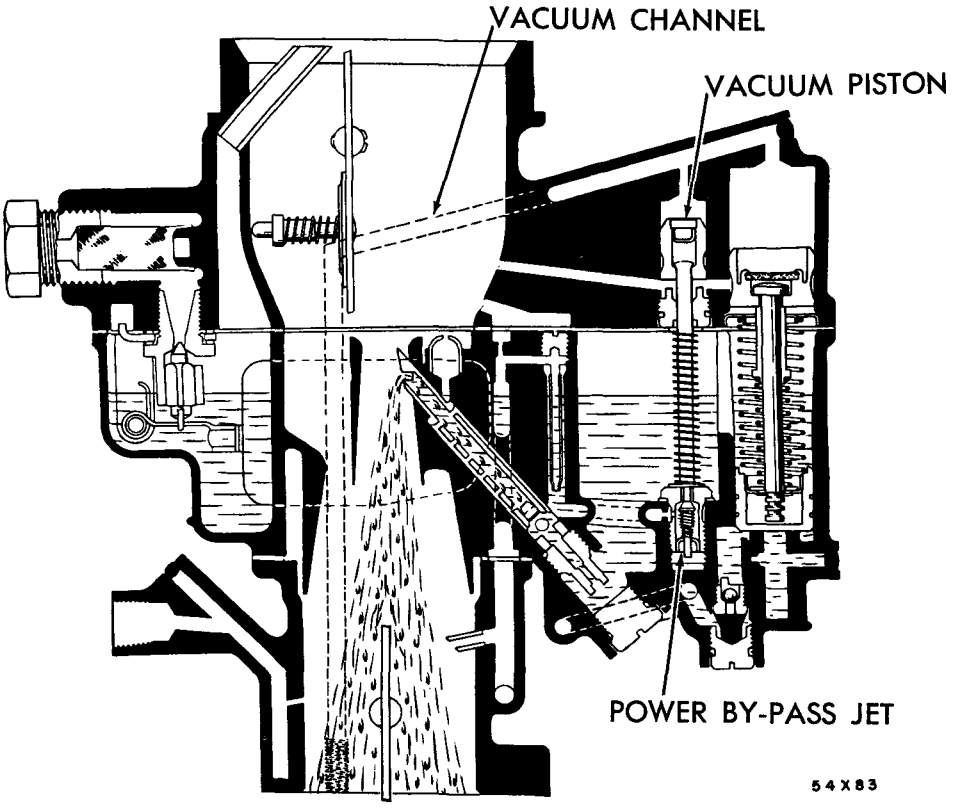


Fig. 7 — Power System

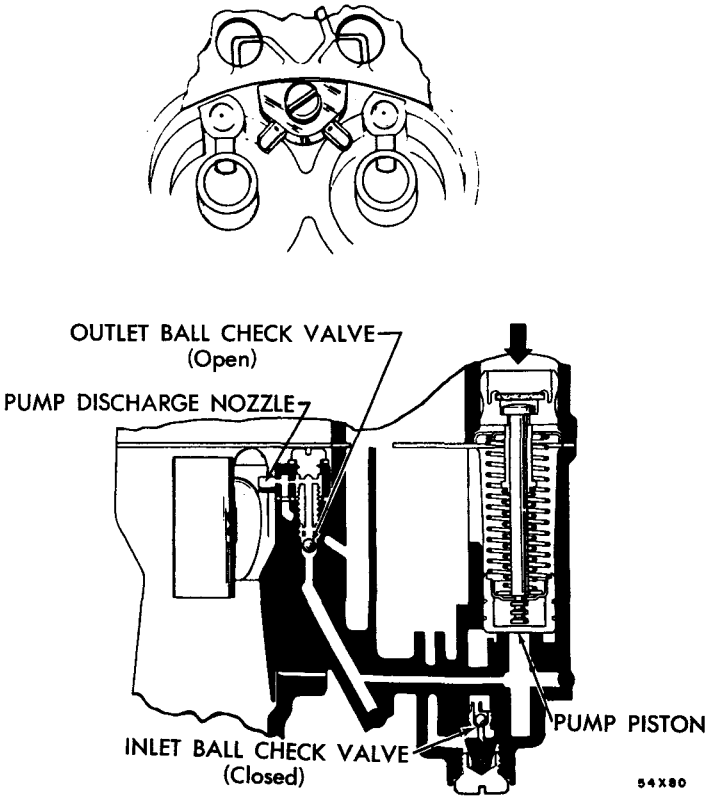


Fig. 8 — Accelerating System (Pump Piston "Down") (AAVP-2 Carburetor)

buretor, as shown in Figure 7. During partial throttle operation, the vacuum above the vacuum piston is sufficient to overrule the compression spring and hold the piston in the "UP" position.

When the throttle valves are opened to the point where the manifold vacuum drops to approximately four to five inches of mercury, the compression spring then moves the piston "DOWN" to open the power by-pass jet and meter additional fuel into the main metering system.

e. Accelerating System

To insure a smooth uninterrupted flow of power for acceleration, additional fuel must be metered into the engine. This is accomplished through the use of an accelerating pump which is operated by vacuum.

As the throttle valves are opened, the accelerating pump piston is moved "DOWN" either by a pump lever or by a drop in vacuum above the piston to close the inlet ball check valve and force a metered quantity of extra fuel through the outlet ball check valve and pump discharge nozzle into the air stream, as shown in Figure 8.

With the return of the accelerating pump lever to the released position or the return to normal engine vacuum, the outlet ball check valve "CLOSES" while the inlet ball check valve "REOPENS", thus permitting fuel from the float chamber to enter and refill the accelerating pump cylinder, as shown in Figure 9.

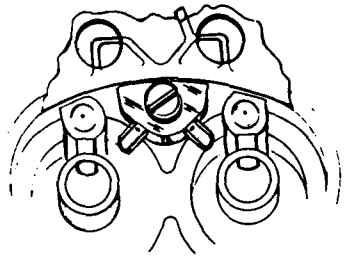
NOTE

The AAVP-2 carburetor is supplied by the carburetor manufacturer with a hollow screw in the mouth of the vacuum channel. When the carburetor is used with a governor this screw must be in the passage to block off the connection between the throat and the vacuum passage. When not used with a governor this screw must be removed.

The following service procedures cover the disassembly, assembly, cleaning and inspection of the Stromberg carburetor.

12. DISASSEMBLY

Disassembly consists of separating the carbur-



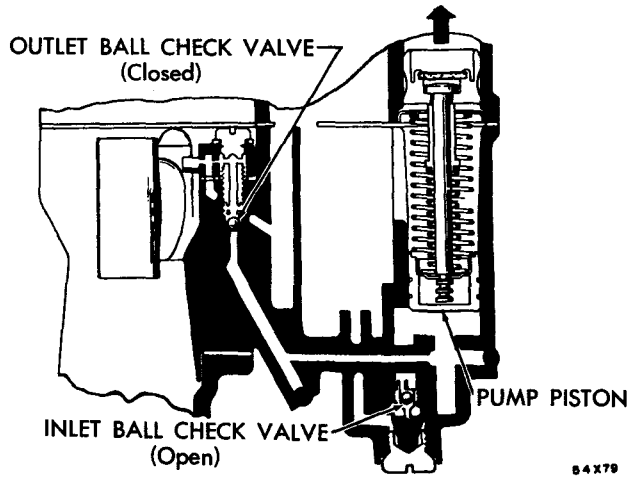


Fig. 9 — Accelerating System (Pump Piston "Up") (AAVP-2 Carburetor)

etor into its three basic groups, namely: the air horn, main body and the throttle body, and also the disassembly of each.

Refer to Figure 13 and proceed as follows: remove air horn attaching screws (8) and air horn. Remove throttle body attaching screws (4). Lift off main body assembly. The carburetor has now been separated into its three basic groups.

13. AIR HORN

With air horn assembly inverted and resting on air horn flange, as shown in inset in Figure 10, press out float fulcrum pin. Remove float with needle valve, clip and air horn gasket. Remove needle valve seat, gaskets and float hanger (use socket Tool 73602 with socket handle Tool 73609.

Remove vacuum power piston (use Tool 73605 for screw type). For staked type use 1" block of wood and small end wrench to pry vacuum power piston straight up and out of air horn. Remove gasoline inlet fitting and strainer. Remove all lead, ball plugs.

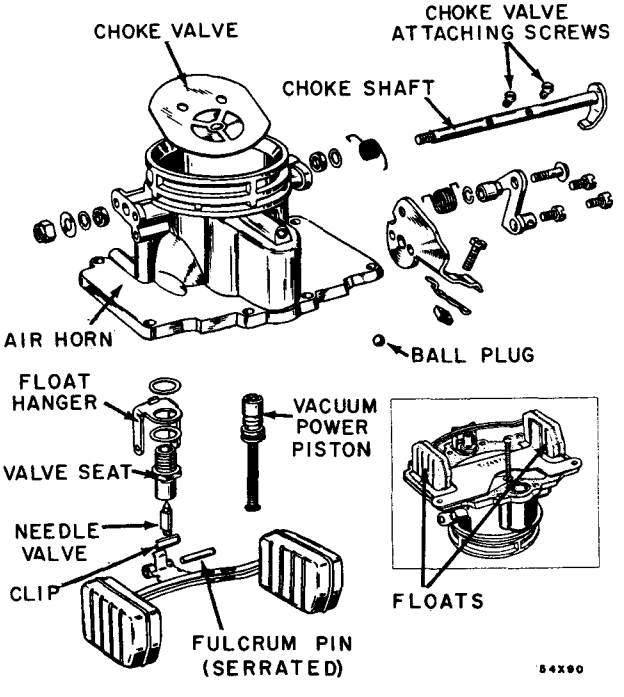


Fig. 10 — Air Horn Assembly (Disassembled View)

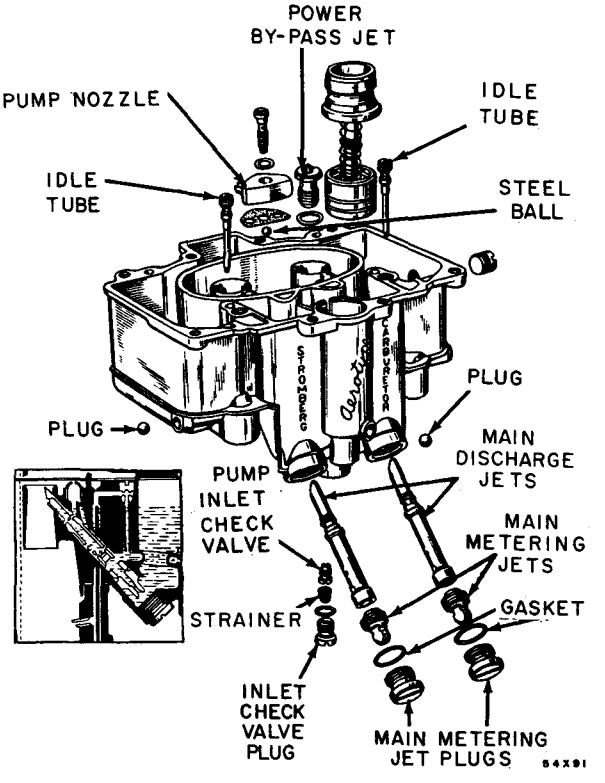


Fig. 11 — Main Body Assembly (Disassembled View)

14. MAIN BODY (Refer to Fig. 11)

Remove pump inlet check valve plug, main metering jet plugs and gaskets (use Tool 73598 and handle). Remove check valve strainer retainer ring (use plunger part of Tool 73642). Remove pump inlet check valve. Remove main metering jets (use Tool 73606 and handle). Remove main discharge jets (use jet remover Tool 73608). Remove idle tubes, and pump discharge nozzle, gasket and steel ball. Remove power by-pass jet and gasket.

15. THROTTLE BODY (Refer to Fig. 12)

Remove idle needle valves and springs. Scribe throttle valves along stem and mark valves and body for location of valves in body. Remove throttle attaching screws, and throttle valves. Remove throttle shaft and lever assembly.

16. CLEANING AND INSPECTION

The recommended solvent for gum deposits is denatured alcohol, which is easily obtainable. There are other commercial solvents, however, which may be used with satisfactory results.

NOTE

If the commercial solvent or cleaner recommends the use of water as a rinse, it should be "HOT". After rinsing, all traces of water must be blown from the passages with air pressure. It is further advisable to rinse all parts in clean kerosene or gasoline to be certain no trace of moisture remains.

A soft brush should be used to remove gum and carbon deposits while the parts are soaking in the solvent. After cleaning, all parts should be rinsed in clean solvent and all passages blown out with compressed air.

Thoroughly clean all metal parts. Blow out tubes and channels with air pressure. Inspect housing for damage, excessive wear, burrs or warpage.

NOTE

Never clean jets with a wire, drill or other mechanical means as the orifices may become enlarged, making the mixture too rich for proper performance.

17. ASSEMBLY

a. Throttle Body

Refer to Figure 12 and assemble throttle stop spring and throttle stop screws. Insert throttle shaft in throttle body and assemble throttle valves in same position and barrel they were removed from. Align to scribe marks and assemble throttle attaching screws. DO NOT TIGHTEN. Close throttle and align valves for best closing. Tighten screws.

b. Main Body (Refer to Fig. 11)

Replace drive plugs and lead ball plugs.* Install new power by-pass jet and gasket. Install new steel ball in center (threaded) passage of pump channel. Assemble new gasket, pump nozzle screw, and gasket. Install new idle tubes. Place new lead gaskets on main discharge jets and assemble jets into main body.

NOTE

Align jets, as shown in insert of Figure 11.

Assemble new main metering jets, using Tool 73606. Place new gaskets on main metering jet plugs and assemble plugs in main body. Assemble new pump inlet check valve. On carburetors (where used) assemble pump inlet screen and retainer clip using Tool 73642.

Place new strainer in Tool 73627 and assemble strainer in inlet check passage. Place gasket on inlet check valve plug and assemble plug. Securely tighten main metering jet plugs and inlet check valve plug.

c. Air Horn (Refer to Fig. 10)

Replace lead ball plugs.* Insert strainer in gasoline fitting and assemble in air horn. Assemble choke shaft, choke valve and attaching screws. Close choke valve and align valve for best closing, before tightening screws.

*During assembly operations lead plugs should be replaced with new plugs furnished as part of specific carburetor repair kits. Refer to Data and Specifications.

NOTE

Choke shaft should be free in all positions of travel.

Install vacuum power piston, using Tool 73605. Attach pump lever to air horn using washer and screw (screw has left hand treads). Assemble float hanger, new gaskets and new needle valve seat (use Tool 73602 and handle). Place air horn gasket on air horn. Attach new needle valve to float arm by means of clip. Attach

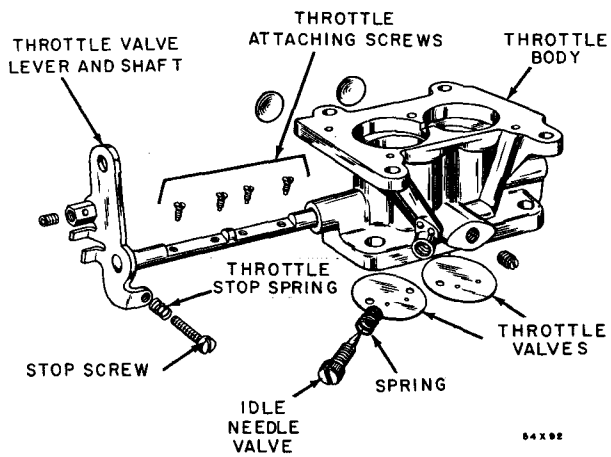


Fig. 12 — Throttle Body Assembly (Disassembled View)

float to float hanger arm by means of serrated pin. For float adjustment, use Tool 73652.

18. ASSEMBLING THE BASIC GROUPS (Refer to Fig. 13)

Place new main body gasket on throttle body. Assemble main body to throttle body. Securely tighten main body attaching screws and lockwashers.

Align air horn gasket with air horn and guide pump and power pistons into main body. Assemble air horn attaching screws (8) and lockwashers.

Reinstall carburetor on engine, using a new gasket.

Idle adjusting needle set 1½ turns open and set the idle speed screw 1½ turns open. Start engine and make final mixture and speed adjustment to 450-500 rpm engine speed.

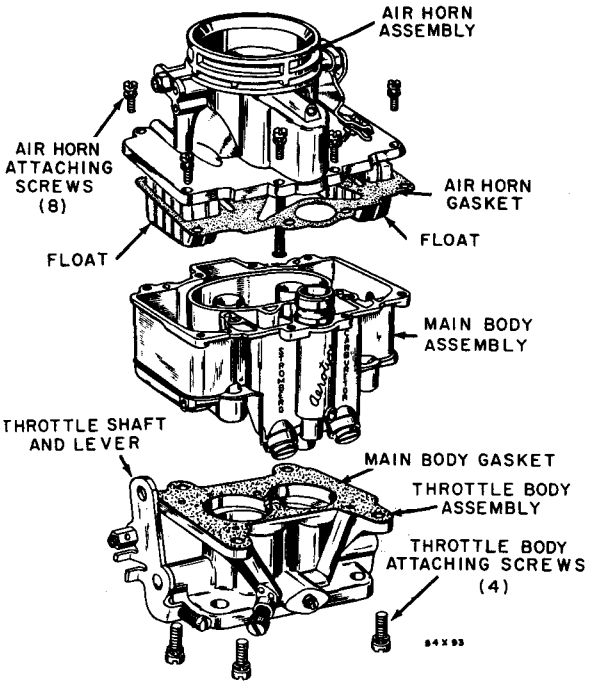


Fig. 13 — Three Main Groups (Disassembled View)

GOVERNORS

19. DESCRIPTION AND OPERATION (Velocity Type (King-Seeley))

With the velocity type governor, as shown in Figure 14, the engine speed is governed by the throttle valve which is closed by the force of the velocity of the fuel-air mixture as it passes through the governor. An accurately calibrated spring system attached to the governor throttle shaft opposes the velocity force and controls the position of the throttle valve and the maximum speed of the engine. When in proper operating condition, the governor does not affect engine performance below the speed at which it begins to control, and does not affect fuel consumption.

20. ADJUSTING THE VELOCITY TYPE (King-Seeley) GOVERNOR

NOTE

Leakage of manifold, carburetor or interconnector gaskets must be corrected before carburetor or governor can be properly set.

It may be apparent after a long period of operation that the governor has become sluggish and is not as responsive as when it was originally

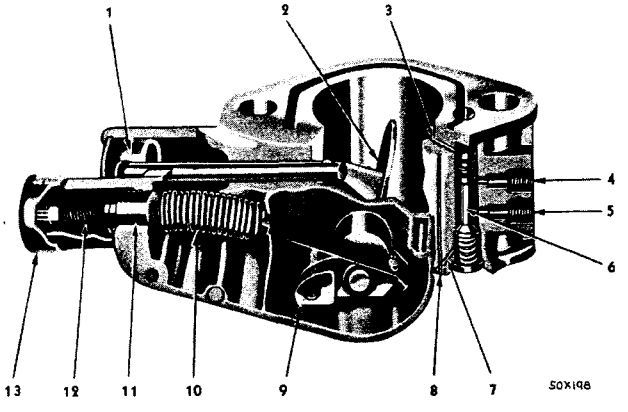


Fig. 14 — Typical King-Seeley Governor (Sectional View)

1 — Non-cheating stabilizer piston
2 — Throttle valve
3 — Passage to transfer valve chamber
4 — Carburetor vacuum connection (not used)
5 — Ignition distributor vacuum connection (not used)
6 — Vacuum transfer valve plunger
7 — Vacuum passage
8 — Vacuum by-pass passage
9 — Can and valve shaft assembly
10 — Control spring and ribbon assembly
11 — Calibrating nut
12 — Adjusting screw
13 — Adjusting screw cap assembly

installed. Such sluggishness is most generally caused by deposits of carbon and gum on the valve shaft and bearings, stabilizer piston rod or cylinder. The remedy for this condition, is to remove the governor and soak it in a cleaning solvent that will remove the carbon and gum deposits. It is always recommended that a governor not functioning properly be soaked in cleaning solvent before any adjustments or repairs are attempted, because in many cases, satisfactory performance can be restored in this manner. Before attempting any adjustment or recalibration of the governor, run the engine until normal operating temperature is reached. Manifold vacuum at sea level, should be approximately 16 inches with engine running at full throttle no-load (governor operating), and at least 17 inches at idling speed, with an allowable reduction for altitude.

21. ADJUSTING FOR SPEED
(Fig. 15) (King-Seeley)

For a HIGHER speed, turn adjusting cap (13) counter-clockwise or to the left; for LOWER speeds, turn adjusting cap clockwise or to the right.

CAUTION

Turn the speed adjusting cap in ¼ turns to obtain desired speed. Do not exceed 3800 rpm during the setting process.

When a more sensitive regulation is desired, or if the governor is too sensitive and inclined to surge at full throttle, correct as follows by means of the calibrating nut (11). (Fig. 14.)

a. Sensitivity Adjustment

If the governor is too sensitive or has a tendency to surge, place the hollow wrench (1) in position on the calibrating nut (11) and insert the special adjusting wrench (2) through the hollow wrench into the adjusting screw and turn the screw clockwise one turn (Figure 16).

With the hollow wrench in the slot of the calibrating nut, turn the nut clockwise about

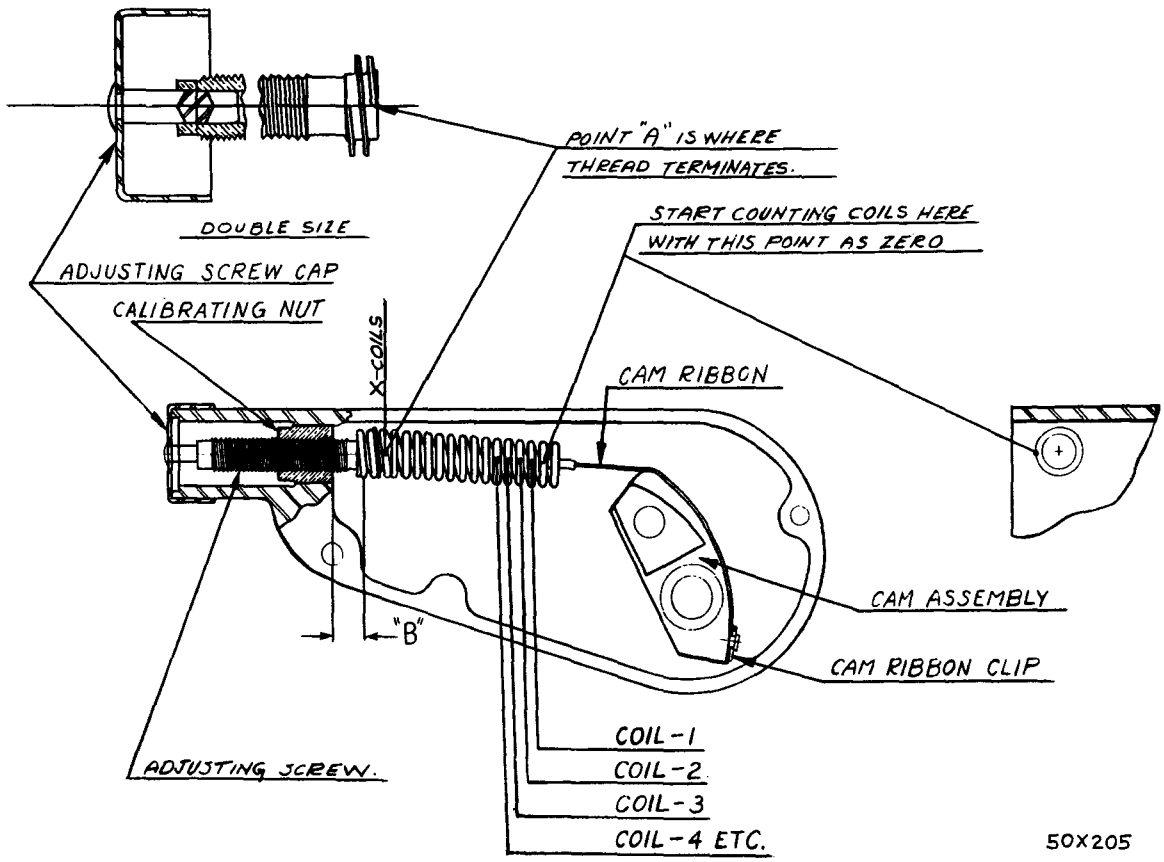


Fig. 15 — Control Spring Calibration Detail

¼ of a turn. When this adjustment is made the adjusting screw must be held from turning.

Continue this adjustment until the surge is eliminated. However, engines operate most efficiently when the governor is adjusted to the point which just barely eliminates the surge at full throttle.

b. Reaction Adjustment

If the governor is slow acting and does not open promptly when a load is applied at the governed speed or cut off promptly at maximum speed, turn the adjusting screw counter-clockwise one turn and while holding the screw in the new position, turn the calibrating nut counter-clockwise ¼ of a turn. Repeat this procedure until the desired regulation is obtained. However, when making this adjustment, it is best to continue until an actual surge is produced, and then, just eliminate the surge.

When the adjustment is completed, tap lightly on the end of the hollow wrench so that the calibrating nut will be properly seated and re-check speed.

The stock numbers of the special wrenches (Figure 16) are as follows:

A-24283 (Item 1 Fig. 16).
A-25264 (Item 2 Fig. 16).

These wrenches can be obtained from the King-Seeley Corporation, Ann Arbor, Michigan.

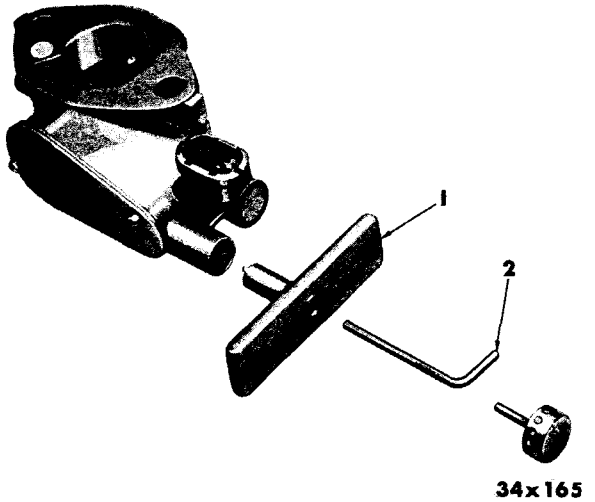


Fig. 16 — King-Seeley Governor Adjusting Wrenches

1 — Hollow wrench—A-24283 2 — Hex wrench—A-25

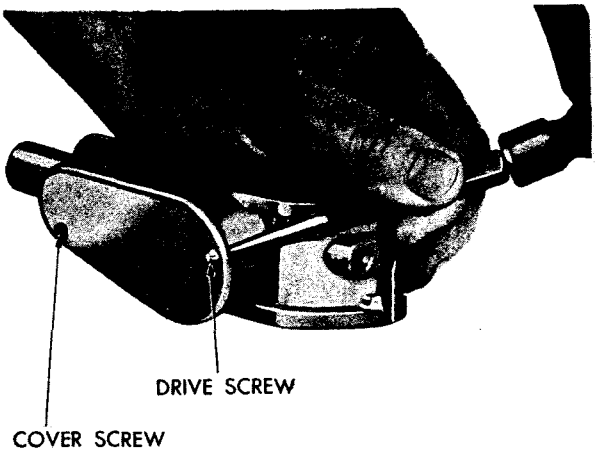


Fig. 17 — Removing Governor Housing Cover

c. Calibration

If the control spring should for any reason be disengaged from the adjusting screw, or the relationship of the adjusting screw and calibrating nut changed by someone not familiar with the governor, it will be necessary to go over the complete calibration for the particular governor to insure efficient control.

Remove seal and adjusting screw cap (13). (Fig. 14.) Remove cover screw and force out the drive screw as indicated on Figure 17. Do not use a screw driver or similar tool, as it will result in damage to the housing or cover. When the drive screw is out far enough so that side cutting pliers can be applied under the screw head, turn the screw out counter-clockwise.

Position the adjusting screw in the spring until the open coils correspond to the number indicated on the "Calibration Specification" sheets for the particular governor, and it may in some cases be necessary to move the calibrating nut several turns to provide sufficient space between the end of the spring and governor housing to obtain the correct number of open coils.

Referring to Figure 15, the active coils of the control spring end where the spring contacts the thread of the adjusting screw at point "A." Each turn of the adjusting screw adds or subtracts one coil. As an example: To obtain 10¼ coils turn the adjusting screw until there are 10 active coils between zero point and point "A," and then add ¼ coil by turning