Chrysler

M-SERIES
8-CYLINDER

Marine
ENGINES

MODELS M-318A, M-318B, M-318C, M-383, M-413

MAINTENANCE MANUAL

81-770-7522

Poly318.com Note:

I purchased a clean copy of the 1962 factory marine engine maintenance manual and scanned it into a PDF for free download. While the manual focuses on marine applications, there is also good information and procedures for automotive A-block 318, B383, and RB413 engines. I also offer two factory services manuals for automotive A-block engines for free download.

The Marine Division produced the A318 "Chrysler Sea V" from 1959 - around 1962 and the early "M318A" from 1960 - 1961 before the 1962 design. While this manual does not cover 1959 - 1961 marine A-block 318 engines, most of the information and procedures apply to 1959 - 1961 engines. I have a 1956 - 1961 A-block factory service manual for free download that is a good supplement for this marine manual when working on 1959 - 1961 marine A-block engines.

The A-block 318 models on the cover refer to the Fury line of engines that I identify below. The engines originally had a unique valve-cover decal for each model. Of note, the Marine Division offered a Fury 235 HP engine (the most powerful factory marine A318 engine), but the model was not offered in 1962. Use the Fury 210 HP procedures for the Fury 235 HP engine.

M318A: Fury 190 HP
M318B: Fury 195 HP
M318C: Fury 210 HP

FOREWORD

This Maintenance Manual contains complete description and detailed information regarding the operation and maintenance of the Chrysler Marine Engines, Models M-318A, M-318B, M-318C, M-383 and M-413. (Figs 1, 2, and 3.)

Even though long life and dependability are built into the Chrysler Marine Engines, satsfactory performance depends upon intelligent maintenance and a thorough understanding of the various parts that make the complete unit.

Before maintenance operations are attempted, a thorough study of this manual is recommended.

Whenever communications with the factory are necessary, the engine type and serial number should be furnished complete for the proper identification of the particular unit.

IMPORTANT

Before ordering parts, read the following information carefully.

Orders for parts should be placed with the nearest authorized Chrysler Marine Engine Center or Dealer who 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 Marine Engine Dealer, a card addressed to the Chrysler Corporation, Marine Engine Division, 12200 E. Jefferson, Detroit 15, Michigan, will bring you his name and address promptly.

Ordering parts from the exploded views is a very simple operation, and requires but three steps. First and MOST IMPORTANT is the proper identification of the engine. Always mention the Model and serial number of your engine when ordering parts or carrying on correspondence regarding it. Include all letters and numerals exactly as stamped on the brass name plate attached to the engine as shown in Fig. 6. Second—the quantity desired and name of part should be shown. It is not only necessary to show the noun name, but the name of the assembly to which the part belongs should also be shown. For instance, instead of mentioning Gasket 10-08-3, mention Oil Pump Gasket 10-08-3. With some parts, such as pistons, it is necessary to specify whether standard or oversize are needed. Third—the Part Type Code number should be shown complete with hyphens, just as it appears on the illustration with the name of the part.

QUICK REFERENCE INDEX *To use: Bend manual back to expose black spots on pages of 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
MARINE ENGINE
MAINTENANCE
MANUAL

M-SERIES
8-CYLINDER
MARINE ENGINES
MODELS M-318A, M-318B, M-318C, M-383 and M-413

This Maintenance Manual is compiled as a reference and guide to provide the service men with the proper adjustments and repair procedures for servicing the new Chrysler Marine Engines.

The service tools referred to in this Manual are available through the Miller Manufacturing Company, 17640 Grand River Avenue, Detroit 27, Michigan, U.S.A. unless otherwise specified.

Extra copies of this Manual are available at $4.00 net each plus any local taxes, under Part Number 81-770-7522. Order from Chrysler Corporation, Marine Engine Division, P.O. Box 1836, Detroit 31, Michigan, U.S.A.

Chrysler Corporation
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DETROIT, MICHIGAN, U. S. A.

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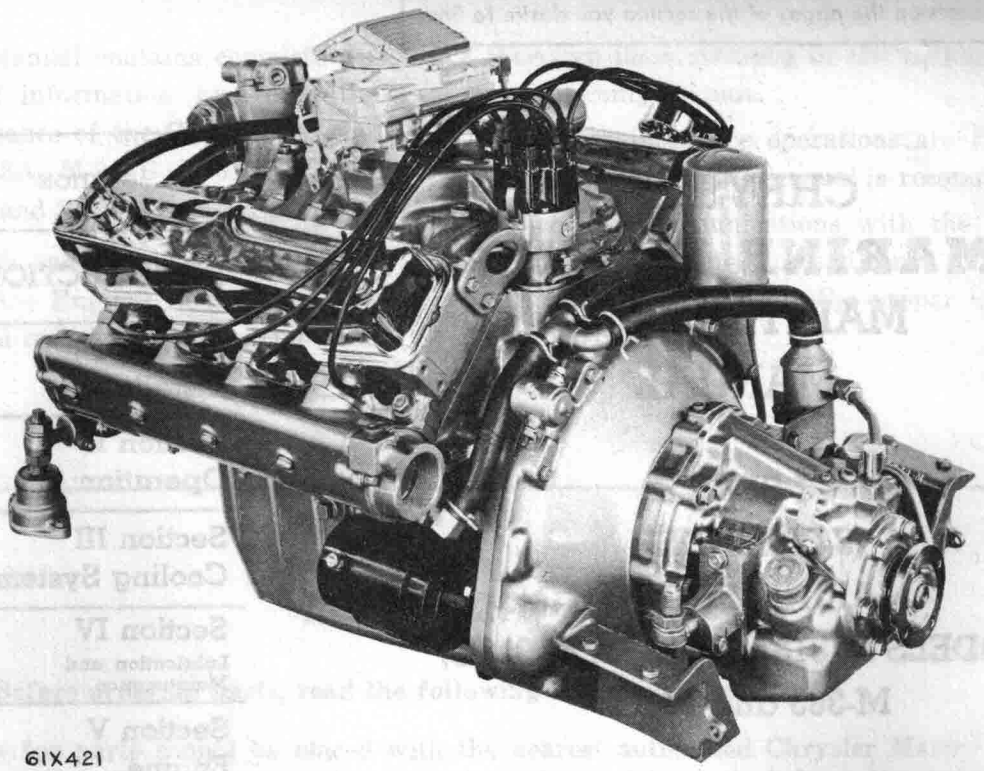


Fig. 1—Left Side View of Model M-318A Marine Engine

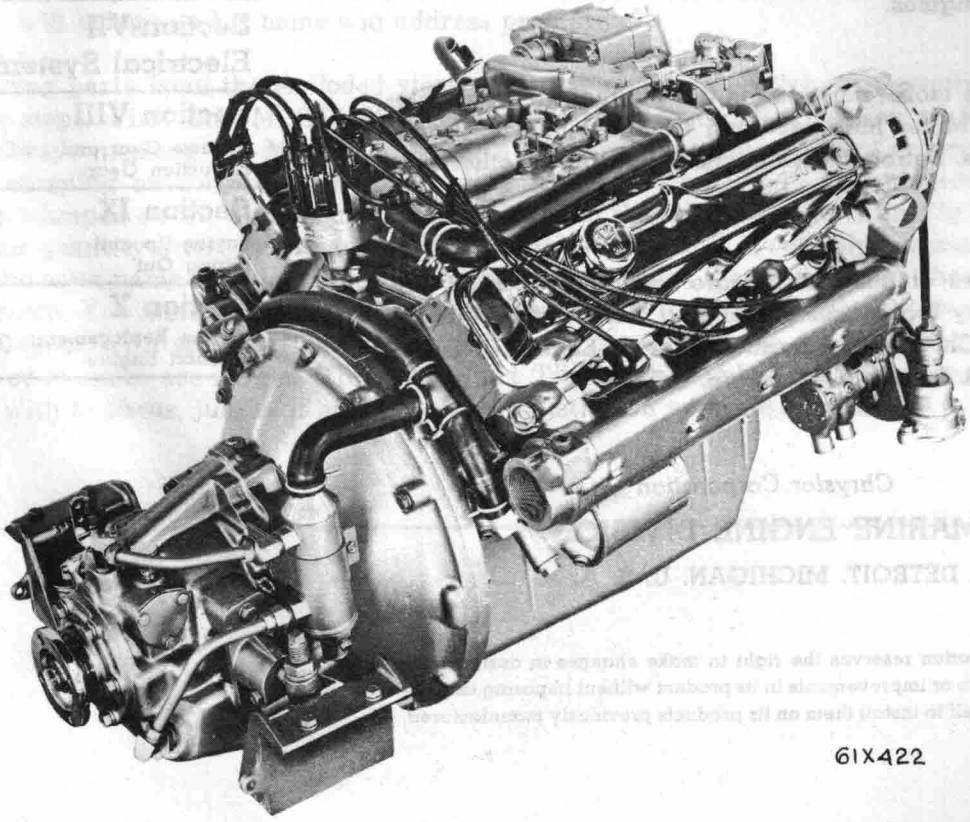


Fig. 2—Right Side View of Model M-318C Marine Engine

INTRODUCTION

POWER CURVES

The power curves (Figures 4 and 5) show the torque and horsepower for all engine speeds on Models M-318A, M-318B, and M-318C covering a range from 190 horsepower to a maximum of 210 horsepower @ 4000 rpm and on models M-383 and M-413, from 200 horsepower to a maximum of 280 horsepower @ 4000 rpm.

IDENTIFICATION

A brass name plate, as shown in Figure 6, is attached to the rear of the engine, showing the model symbol, type and serial number of the engine. Reading from left to right on the name plate, the first item is the model symbol, M-413, which indicates that the engine is a Chrysler Marine Model M-413 Series.

After the model symbol are four blank spaces followed by letters which indicate rotation of the engine. If for example, the letter "L" is shown the "L" is for a left hand rotation engine and the letter "R" is for a right hand rotation engine. Engine rotation is determined when viewing the front of the engine.

The next markings indicate the type of equipment assembled to the engine such as straight drive reduction gear, etc. Following this code the serial number appears. In any event, should you have to identify the engine, all information on the plate should be given.

SERVICE BULLETINS

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

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

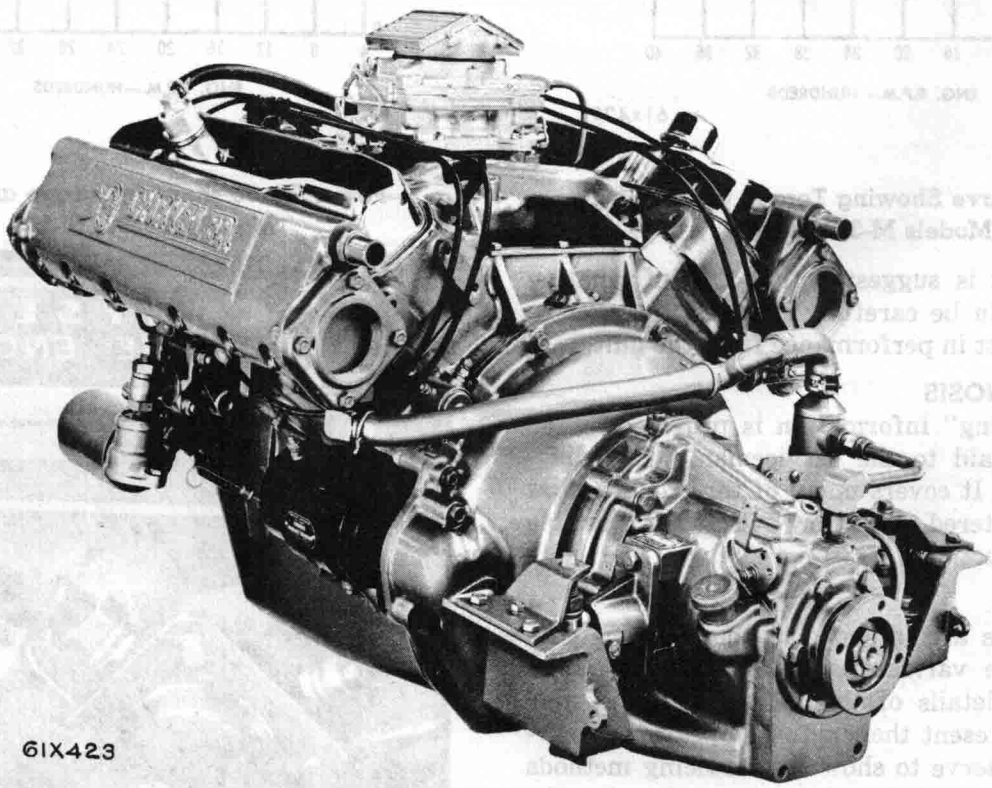


Fig. 3–Left Side View of Model M-413 Marine Engine

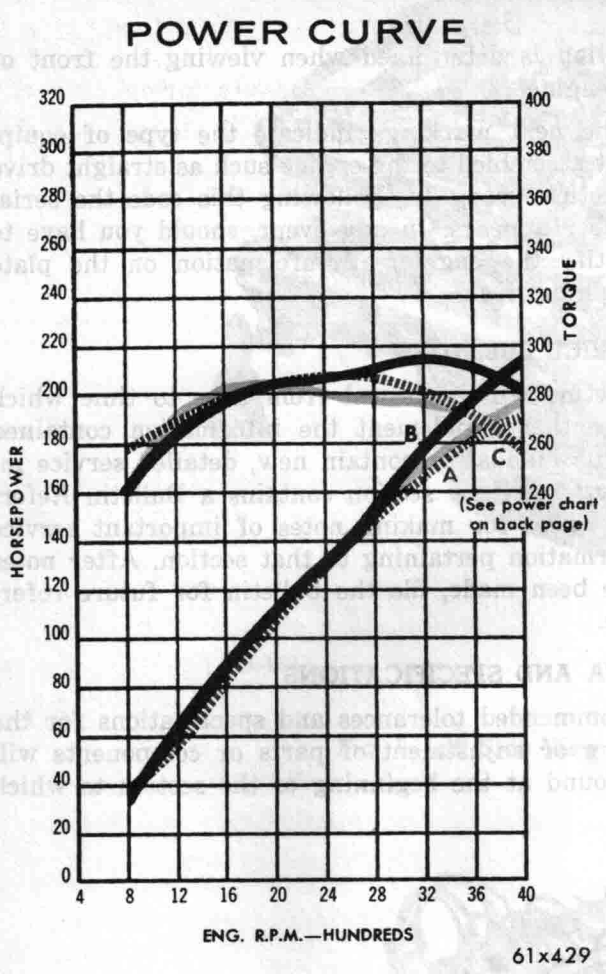


Fig. 4–Power Curve Showing Torque and Horsepower Models M-318A, B, C

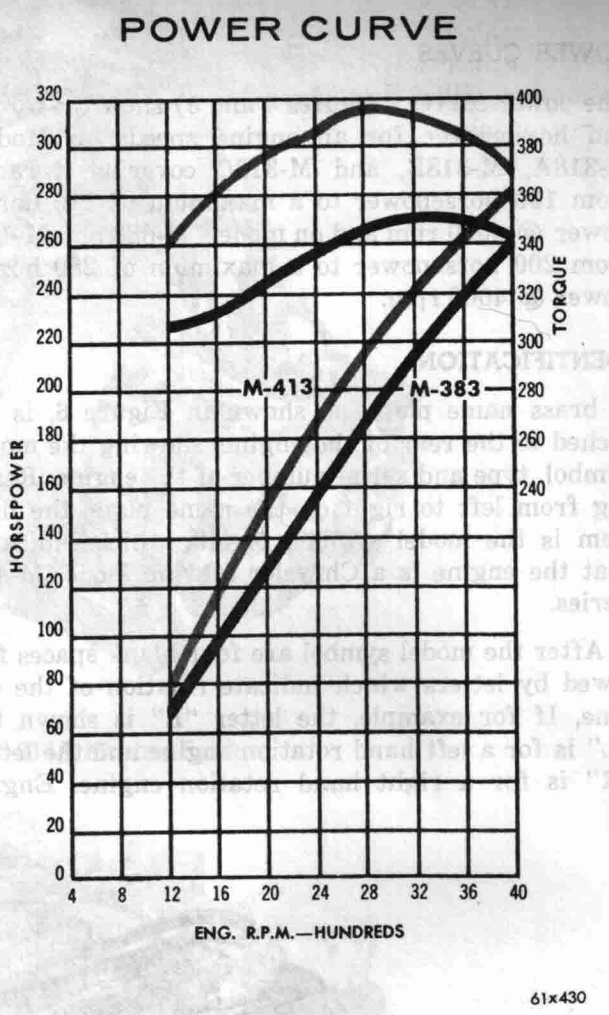


Fig. 5–Power Curve showing Torque and Horsepower Models M-383, M-413

they pertain. It is suggested that the information contained therein be carefully followed in order to obtain the utmost in performance from the unit.

SERVICE DIAGNOSIS

"Trouble Shooting" information is provided in 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 and corrections.

ILLUSTRATIONS

The illustrations are intended to show typical construction of the various parts. In some instances the shapes or details of the parts illustrated may not exactly represent their actual appearance, however, they will serve to show the servicing methods explained or help to indentify parts performing the same function.

Fig. 6–Engine Model and Serial Number Plate

MODIFICATIONS

Slight modifications in design as dictated by field experience or desire to improve the unit, or changes of materials due to inability to procure those originally specified may become necessary. Such changes in design will be obvious and, wherever possible, parts or assemblies will be interchangeable with original design.

SERVICE TOOLS

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

Section I

INSTALLATION

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION I

INSTALLATION

INSPECTION OF SHIPMENT

The M-Series Marine engines are carefully inspected, tested and adjusted before shipment from the factory.

Immediately upon delivery, the engine should be inspected for damage and shortage and comparison with the carrier's receipt. Before acceptance, note on the receipt, the condition of the engine. File a claim with the transportation company as soon as the extent of the damage can be evaluated.

PREPARATION FOR INSTALLATION

The installation of all equipment should conform to the designer's blue prints and specifications, particularly with regard to brand name, model, weight and location of heavy equipment. Any substitution or change of location should be approved by the designer.

When an installation is being made: whereby the M-Series engine replaces an engine of different make, or a Chrysler engine of different size and weight, the designer should specify the location of the new engine.

The location of the center of gravity (Figs. 1, 2, 3, 4 and 5) should be marked on the sides of the engine before the engine is placed in the hull.

Engines which have been delayed in transit or have been in storage during humid damp weather, should be inspected for internal rusting, particularly on cylinder walls, valves, etc.

ENGINE ALIGNMENT

The engine should be placed on the engine bed to bring the center of gravity mark in perpendicular alignment above the designer's specified location on the longitudinal stringers. After rechecking, scribe the engine bed around the engine mounting pads. In case the engine must be moved at any time, the scribed marks can be used in relocating it. Install ½ inch through bolts but do not tighten until the engine has been aligned to the propeller shaft.

The coupling flanges on the reverse gear shaft and on the propeller shaft must be parallel within .002 inch. With a .002 inch feeler gauge held against the reverse gear flange, bring the propeller shaft flange into contact with the gauge to produce a slight drag feel as the gauge is withdrawn and inserted. The same feel at four locations corresponding to twelve, three, six, and nine o'clock must be obtained. A difference in feel at the three and nine o'clock positions indicates that the rear engine supports should be moved toward the tight side. A difference in feel at the six and twelve o'clock positions indicates that the rear supports should be raised to increase the drag at the six o'clock position, or that the front supports should be raised to increase the drag at the 12 o'clock position. A uniform drag feel must be obtained after tightening the through bolts. Also, the center gravity markings must be in perpendicular alignment after tightening the through bolts securely.

Cover the contact surfaces of both flanges with a thin film of water-proof grease. Install the coupling bolts and tighten securely.

COOLING SYSTEM INSTALLATION

The M-Series engine water connection sizes are as follows:

Water pump inlet	1″ ID hose
Overboard outlets	3/4″ pipe tap
By-pass outlet	1″ pipe tap

The designer may specify iron pipe, seamless drawn annealed copper pipe or rubber hose for the cooling system and a sea-cock. The water scoop, sea-cock, the pipe and the tee above the pipe should be 1 inch ID. One side of tee should carry a shut-off valve with a one-inch pipe tap outlet, to conform to the size of the thermostat by-pass (middle) outlet to which it is to be connected. The opposite side of the tee should be 1 inch ID and connected to the water pump intake pipe. If iron pipe or copper pipe is used, rubber (steam) hose should also be used in this line for vibration control. The two ¾ inch pipe tap connections above the thermostat should be connected to the exhaust pipes close to the manifold flanges.

EXHAUST SYSTEM INSTALLATION

Two types of exhaust pipe flanges are available. One type is tapped for the 2½ inch on Models M-383 and M-413 (inside) pipe, for use with iron pipe. The other is 2 inch on Models M-318A, B and C which is not threaded and can be used when copper exhaust lines are specified.

In general, the exhaust pipes which are connected

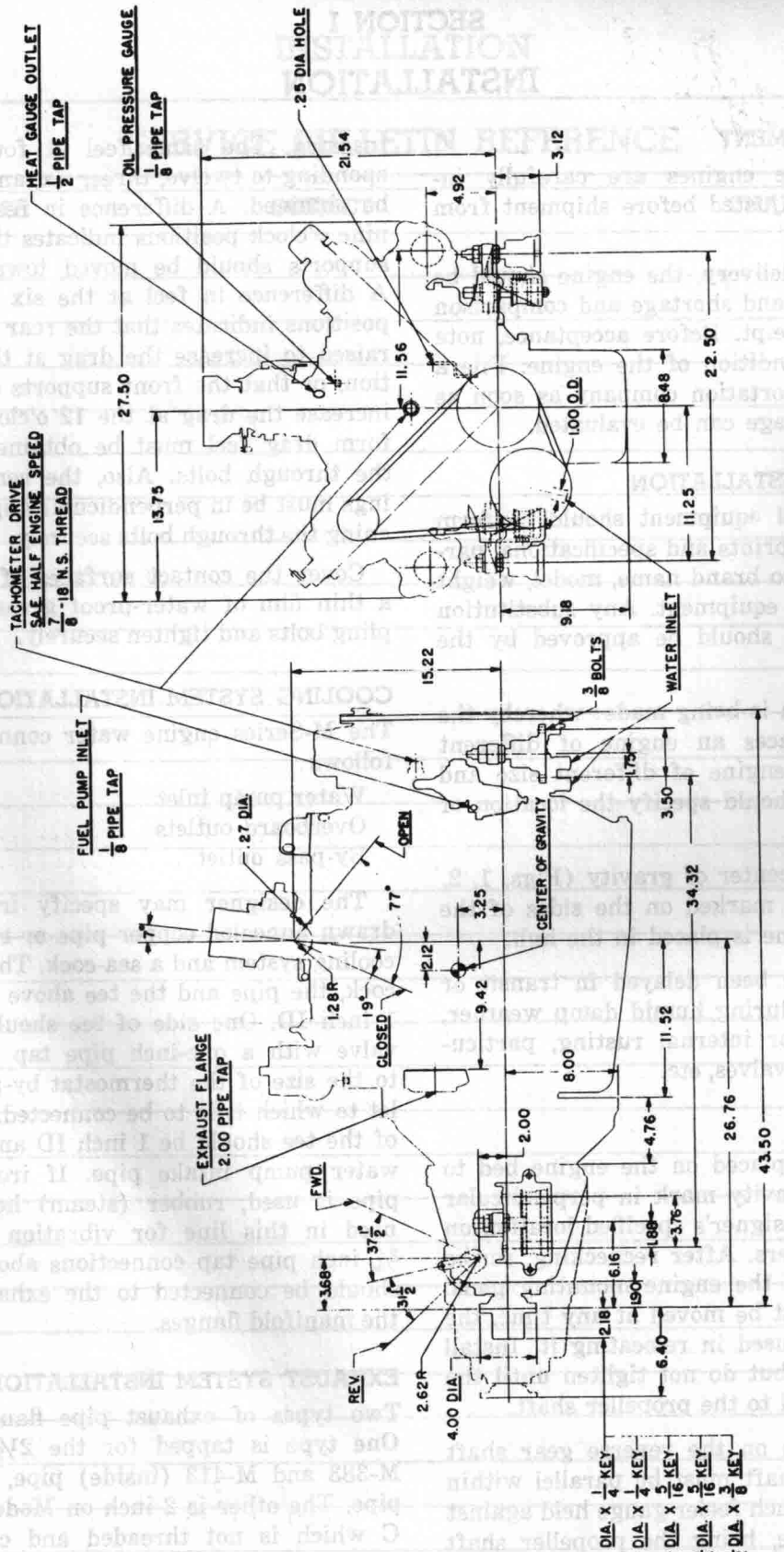


Fig. 1—Installation Diagram Straight Drive Model M-318A

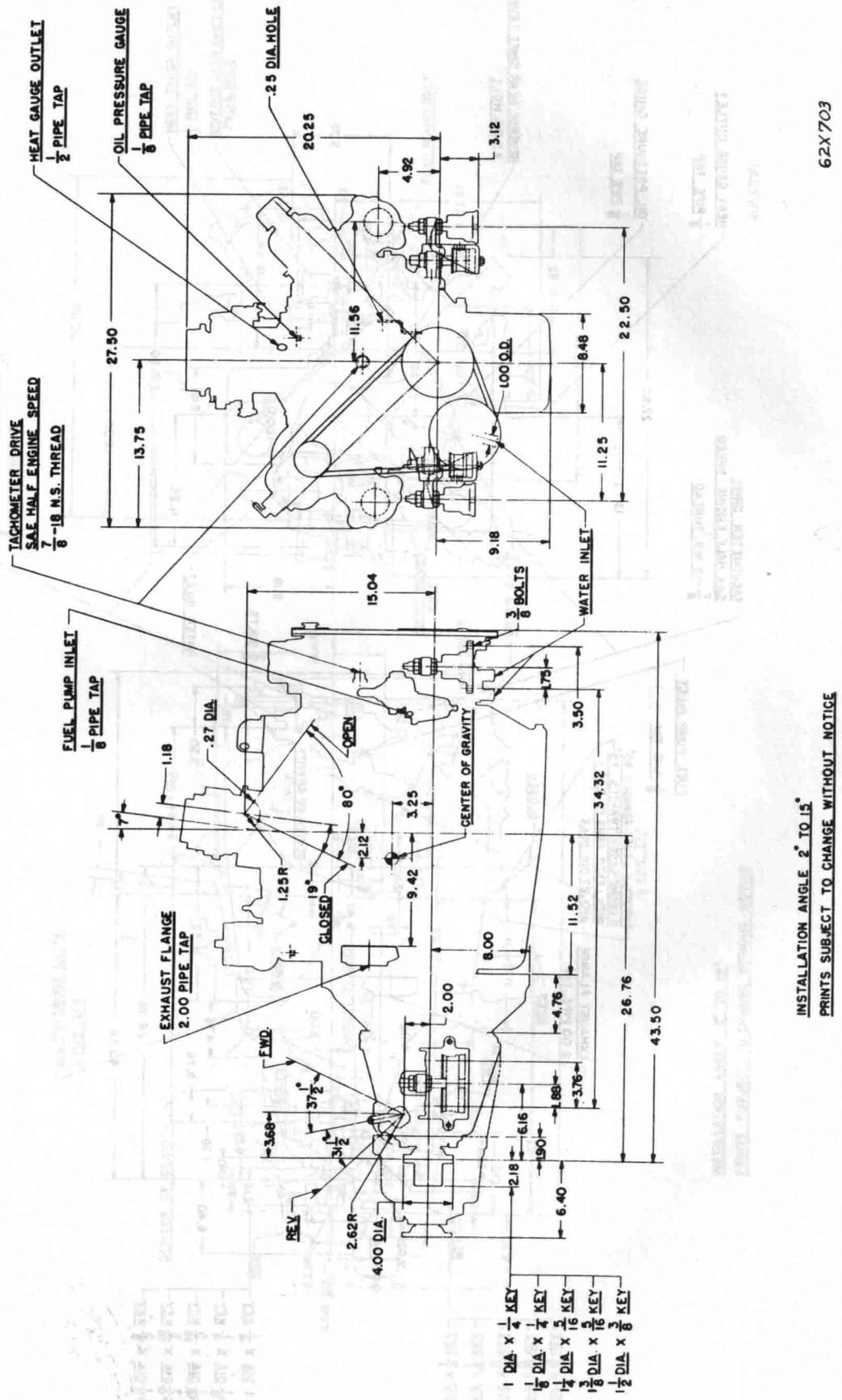


Fig. 2–Installation Diagram Straight Drive Model M-318B

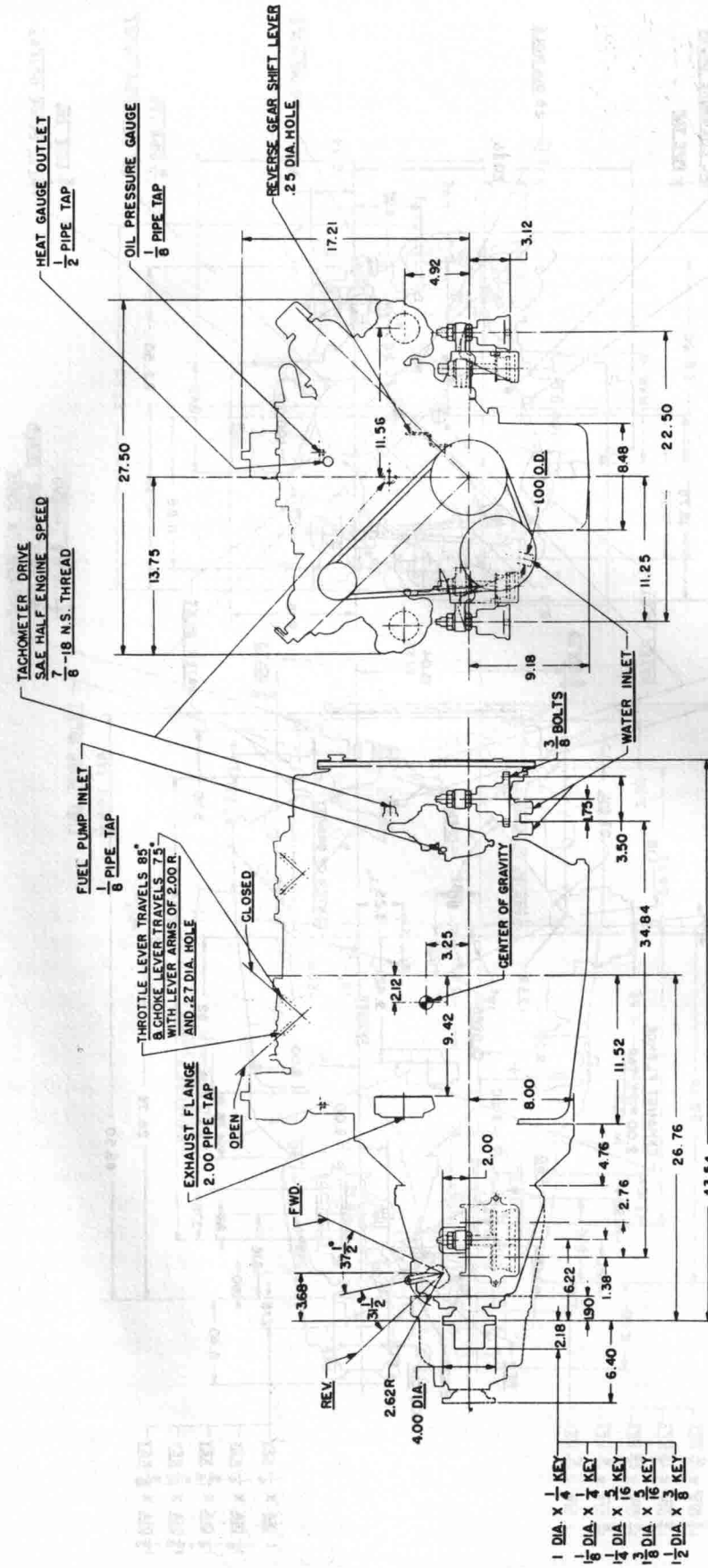


Fig. 3—Installation Diagram Straight Drive Model M-318C

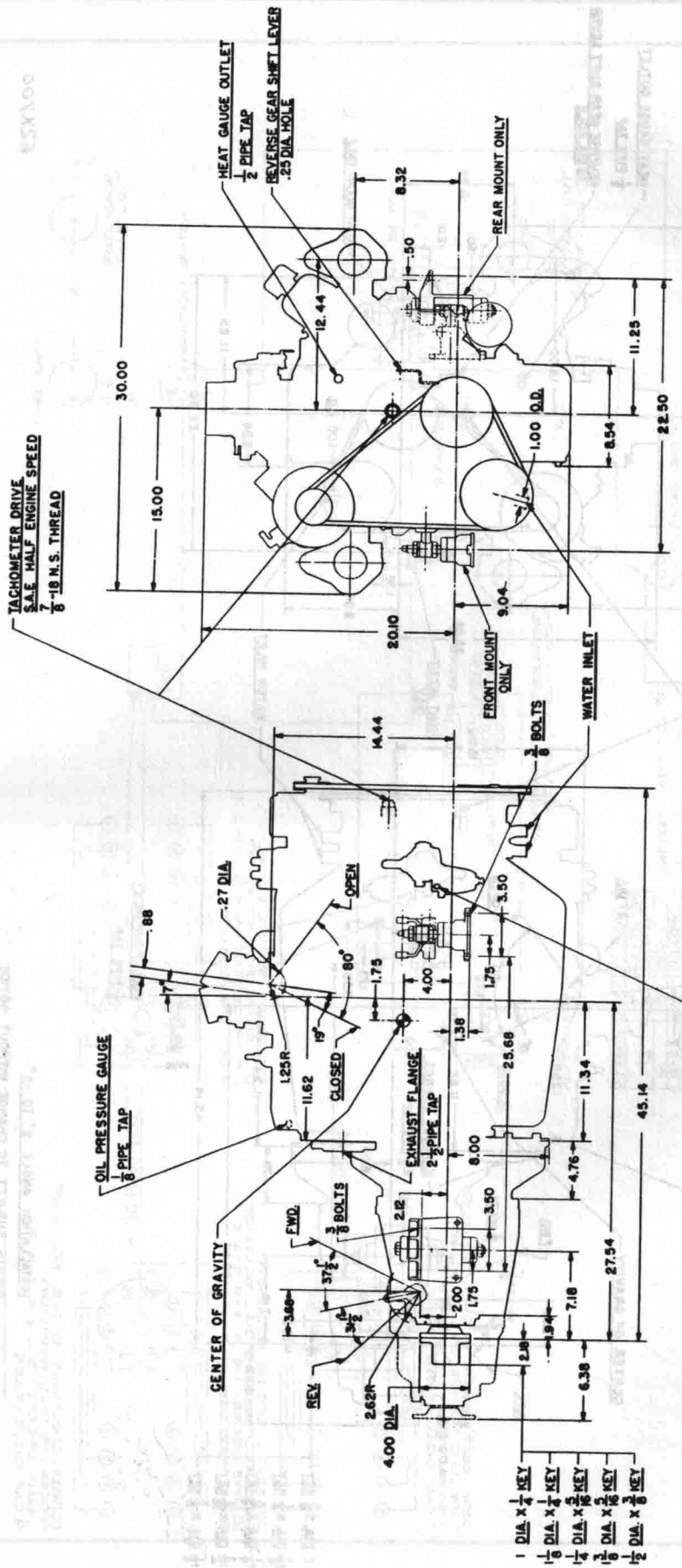


Fig. 4–Installation Diagram Straight Drive Model M-383

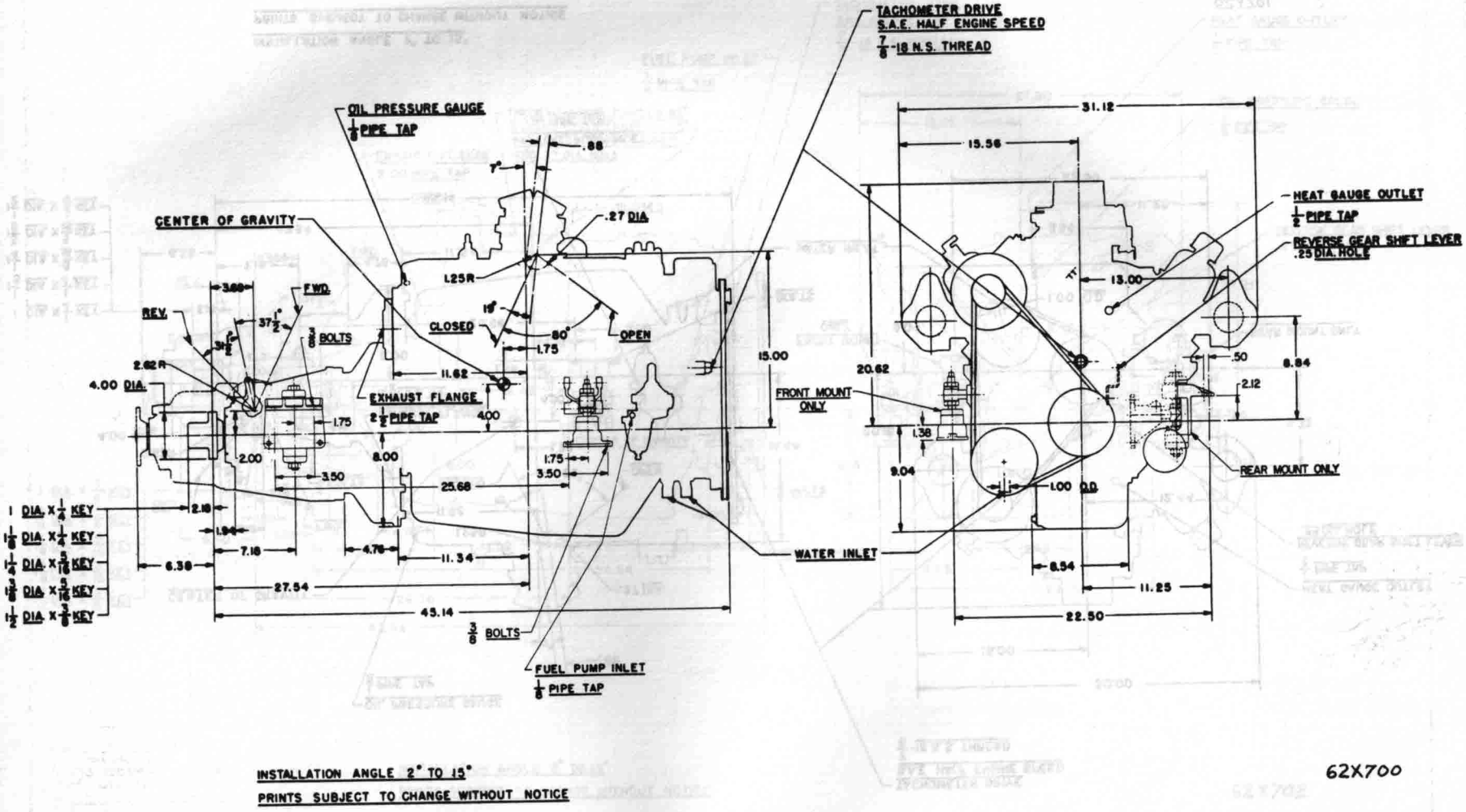
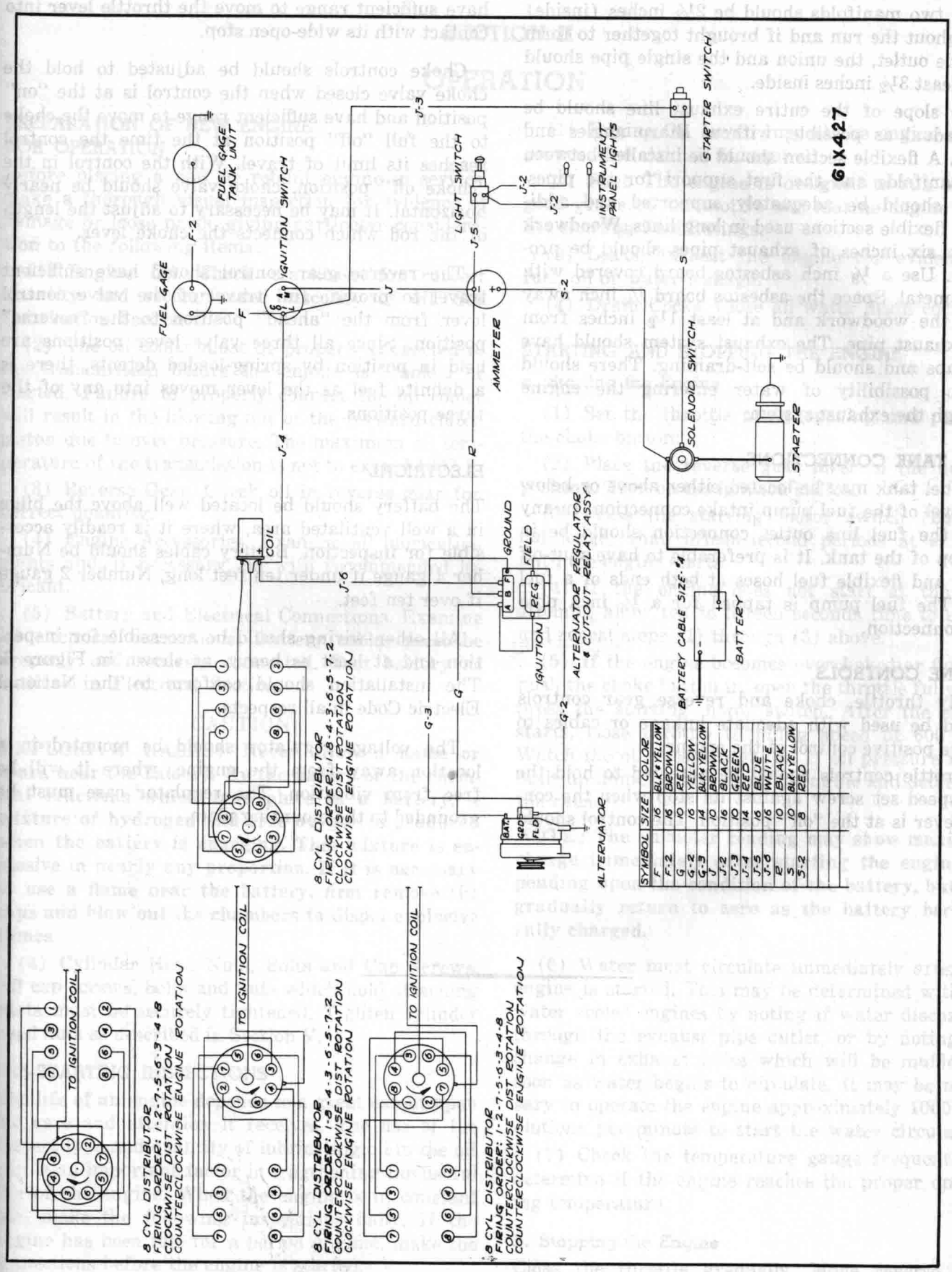


Fig. 5—Installation Diagram Straight Drive Model M-413



SYMBOL	SIZE	COLOR
F	16	BLK-YELLOW
F-2	16	BROWN
G	10	RED
G-2	16	YELLOW
G-3	14	BLK-YELLOW
J	10	BROWN
J-2	16	BLACK
J-3	10	GREEN
J-4	14	RED
J-5	16	BLUE
J-6	16	WHITE
2	10	BLACK
S	10	BLK-YELLOW
S-2	8	RED

Fig. 6—Wiring Diagram 12 Volt System Negative Ground

to the two manifolds should be 2½ inches (inside) throughout the run and if brought together to form a single outlet, the union and the single pipe should be at least 3½ inches inside.

The slope of the entire exhaust line should be as gradual as possible, without sharp angles and bends. A flexible section should be installed between the manifolds and the first support for the pipes. Lines should be adequately supported and additional flexible sections used in long lines. Woodwork within six inches of exhaust pipes should be protected. Use a ⅛ inch asbestos board covered with sheet metal. Space the asbestos board ¼ inch away from the woodwork and at least 1½ inches from the exhaust pipe. The exhaust system should have no traps and should be self-draining. There should be no possibility of water entering the engine through the exhaust system.

FUEL TANK CONNECTIONS

The fuel tank may be located either above or below the level of the fuel pump intake connection. In any case, the fuel line outlet connection should be in the top of the tank. It is preferable to have shut-off cocks and flexible fuel hoses at both ends of a fuel line. The fuel pump is tapped for a ⅛ inch pipe tap connection.

ENGINE CONTROLS

Sturdy throttle, choke and reverse gear controls should be used with adequate linkage or cables to assure positive control of the engine.

Throttle controls should be adjusted to hold the idle speed set screw against its stop when the control lever is at the "off" position. The control should have sufficient range to move the throttle lever into contact with its wide-open stop.

Choke controls should be adjusted to hold the choke valve closed when the control is at the "on" position and have sufficient range to move the choke to the full "off" position at the time the control reaches its limit of travel. With the control in the "choke off" position, choke valve should be nearly horizontal. It may be necessary to adjust the length of the rod which connects the choke lever.

The reverse gear control should have sufficient travel to provide full travel of the valve control lever from the "ahead" position to the "reverse" position. Since all three valve lever positions are held in position by spring-loaded detents, there is a definite feel as the lever moves into any of the three positions.

ELECTRICAL

The battery should be located well above the bilge in a well ventilated area, where it is readily accessible for inspection. Battery cables should be Number 4 gauge if under ten feet long, Number 2 gauge if over ten feet.

All other wiring should be accessible for inspection and at least as heavy, as shown in Figure 6. The installation should conform to the National Electric Code in all respects.

The voltage regulator should be mounted in a location away from the engine, where it will be free from vibration. The regulator case must be grounded to the mounting plate.

SECTION II

OPERATION

PREPARATION OF NEW ENGINE FOR OPERATION

Before placing a new or rebuilt engine in service, make a thorough visual inspection for evidence of damage or loose parts, giving particular consideration to the following items:

(1) Engine Oil. Check crankcase for correct quantity and recommended viscosity of oil. See Lubrication Section.

(2) The oil cooler must be properly connected to the transmission before the engine is cranked or started. Failure to properly connect the oil cooler will result in the blowing out of the forward clutch piston due to over pressure. The maximum oil temperature of the transmission is not to exceed 190° F.

(3) Reverse Gear. Check oil in reverse gear for correct quantity.

(4) Engine Accessories. Examine all lubrication points and, if necessary, fill with recommended lubricant.

(5) Battery and Electrical Connections. Examine all electrical connections. Battery cables must be properly and securely connected. Test battery as outlined in Electrical Section.

CAUTION

EXPLOSIVE GASES: Never allow a flame or spark near the battery. By the nature of the chemical reactions which take place in a battery, a mixture of hydrogen and free oxygen is produced when the battery is charging. This mixture is explosive in nearly any proportion. If it is necessary to use a flame near the battery, first remove the caps and blow out the chambers to dispel explosive fumes.

(4) Cylinder Head Nuts, Bolts and Cap Screws. All cap screws, bolts and nuts which hold attaching parts must be securely tightened. Tighten cylinder head nuts as described in Section V.

PRE-STARTING INSPECTIONS

The life of an engine depends to a great extent upon the care and attention it receives. The use of the correct type and quantity of lubricating oil in the oil pan is an important factor in lengthening the useful life of the engine. When the engine is in constant use, make the following inspections daily. If the engine has been idle for a period of time, make the inspections before the engine is started.

(1) Engine Oil Level. Inspect the engine oil for proper level. Add oil as required.

(2) Fuel. The engine is designed to run on any good grade of automotive and marine engine fuels. See chart on Fuel Ratings.

(3) Leaks, Inspect the engine for evidence of fuel, oil or water leakage.

(4) Drain Cocks. Close all water drain cocks.

STARTING AND STOPPING THE ENGINE

a. Starting the Engine

(1) Set the throttle at ⅓ opening and pull out the choke button.

(2) Place the reverse gear lever in the neutral position. Turn on the ignition switch.

(3) Press the starting motor switch (but for not longer than fifteen-second periods at a time) until the engine starts.

(4) If the engine does not start at the first attempt, allow ten to fifteen seconds time to elapse and repeat steps (1) through (3) above.

(5) If the engine becomes overchoked or flooded, push the choke button in, open the throttle fully, and press the starting motor switch. After the engine starts, close throttle to idling speed of 600 rpm. Watch the oil pressure gauge. If oil pressure is not built up immediately, stop the engine and determine the cause.

NOTE: The ammeter reading may show maximum charge immediately after starting the engine depending upon the condition of the battery, but will gradually return to zero as the battery becomes fully charged.

(6) Water must circulate immediately after the engine is started. This may be determined with sea water cooled engines by noting if water discharges through the exhaust pipe outlet, or by noting the change in exhaust noise which will be muffled as soon as water begins to circulate. It may be necessary to operate the engine approximately 1000 revolutions per minute to start the water circulating.

(7) Check the temperature gauge frequently to determine if the engine reaches the proper operating temperature.

b. Stopping the Engine

Close the throttle gradually. Move reverse gear

lever in neutral position. Allow the engine to run at idling speed for approximately fifteen to twenty seconds. With the throttle closed, turn off the ignition. This procedure will prevent kick back and the drawing of steam vapor from the exhaust pipe into the combustion chambers.

OPERATING PRECAUTIONS

a. Warm-up Period

After starting a cold engine, operate at a speed slightly faster than idle (approximate 800 revolutions per minute) for a few minutes to allow it to warm up before placing in service. Allow the engine to reach normal operating temperature before placing it under full load. This will allow the oil to warm and reach the bearing surfaces, and reduce the possibility of scoring and premature wear of internal engine parts.

b. Oil Pressure

With the engine running at 2800 revolutions per minute, oil gallery temperature from 140 to 180 degrees, and the water at normal operating temperature, the oil pressure should be 40 to 65 pounds, providing there is no escape of oil from some point in the system. As bearings wear and increased clearance allows more than the normal amount of oil to escape, there will be a drop in pressure, particularly at idling speed.

As the filter becomes clogged, the pressure increases until it reaches a maximum of approximately 15 psi at which time a by-pass valve opens and allows some of the oil to pass around the oil filter. In an oil filter which has become partially clogged, the oil pressure of the engine will drop as much as 15 pounds under the pressure obtained with a new filter element. This is no cause for alarm but merely indicates that the filter element should be replaced to maintain continued full-flow oil filtration.

c. Reverse and Reduction Gear

The reverse gear is self-contained and is independent of the engine oil pressure system.

Pressured oil for the operation of the reverse gear is provided by an oil pump mounted inside of the reverse gear. The oil pump is driven continuously by the engine.

The pressurized oil is delivered from the oil pump to the control valve and then to the forward or reverse piston, depending upon the control valve setting.

A relief valve maintains the oil at a constant pressure. The pressurized oil will be approximately 120-145 psi at engine speeds over 1000 rpm.

The pressure will be as low as 85 psi at idle speeds. Due to variances in the relief valves, pressures slightly above or below these values may be encountered.

When shifting the control valve to the forward position, the pressured oil is directed to the multiple disc clutch piston. This clamps the multiple disc clutch, which turns the propeller shaft in the right hand direction or in the same direction as the engine is turning.

When shifting the control valve to the reverse position, the pressured oil is directed to the reverse piston, which clamps the planetary reverse gear train, which turns the propeller shaft in the left hand direction or in the opposite direction as the engine is turning.

When the control valve is in the neutral position, the pressured oil is stopped from entering either the multiple disc clutch piston or the reverse band piston.

d. Water Temperature

The thermostats will automatically control the water temperature from 130 to 140 degrees. If water temperature exceeds 180 degrees, stop the engine and check the water circulation system.

e. Ignition System

Keep all units of the ignition system clean and properly adjusted. (See Section VII, Electrical System.)

f. Fuel System

Keep the fuel tank, fuel lines and filters clean. Use clean fuel of the proper grade.

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) Adjust valve tappet clearance to recommended setting.

(2) Adjust ignition timing if necessary.

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

(4) Adjust idle mixture and idle speed.

Operate a new engine below ¾ throttle for the first 8 to 10 hours. This will allow the bearings to seat in properly. The breaking-in period will also enable the operator to become acquainted with the controls and action of the engine.

"M" SERIES ENGINE FUEL RATINGS, ENGINE ROTATION AND ADJUSTMENTS

MODEL	M-318A	M-318B	M-318C	M-383	M-413
FUEL GRADE	82 Oct. Minimum (Motor Method)	85 Oct. Minimum (Motor Method)	80 Oct. Minimum (Motor Method)	83 Oct. Minimum (Motor Method)	84 Oct. Minimum (Motor Method)

The V-8 Marine Engines will operate satisfactorily on good quality regular grade fuels. There are differences in the minimum quality fuels that the engines can tolerate and this information is intended as a guide. All M-Series engines will operate satisfactorily on fuels of better anti-knock quality. The fuel octane numbers shown are motor method ratings and are not the more commonly expressed (and higher number) research method ratings. So called Marine White gasolines of sufficient octane requirements are also satisfactory.

SPARK PLUG MAKE & MODEL	Autolite AT-42 or equivalent	Autolite AT-42 or equivalent	Autolite AT-42 or equivalent	Autolite AT-42 or equivalent	Autolite AT-42 or equivalent
SPARK PLUG GAP. (ins.)	.035	.035	.035	.035	.035
BREAKER POINT GAP. (ins.)	.014-.019	.014-.019	.014-.019	.014-.019	.014-.019
IGN. TIMING	12½° B.T.C.	12½° B.T.C.	12½° B.T.C.	5° B.T.C.	5° B.T.C.
FIRING ORDER	R.H. ROTATION 1-8-4-3-6-5-7-2 L.H. ROTATION 1-2-7-5-6-3-4-8	R.H. ROTATION 1-8-4-3-6-5-7-2 L.H. ROTATION 1-2-7-5-6-3-4-8	R.H. ROTATION 1-8-4-3-6-5-7-2 L.H. ROTATION 1-2-7-5-6-3-4-8	R.H. ROTATION 1-8-4-3-6-5-7-2 L.H. ROTATION 1-2-7-5-6-3-4-8	R.H. ROTATION 1-8-4-3-6-5-7-2 L.H. ROTATION 1-2-7-5-6-3-4-8

The engine rotation that is stamped on the M-Series engine serial number plates, refer to the rotation of the crankshaft when facing the front of the engine. The No. 1 cylinder is the front cylinder on the right hand side of the engine when facing the front of the engine.

PROPELLER ROTATION: When viewing the reverse gear end of the engine, the left hand rotation engine would turn a right hand propeller and the right hand rotation engine would turn a left hand propeller. The exception to this rule is an engine equipped with a 1.91 to 1 reduction gear. This gear incorporates a mechanical reversing feature which results in the propeller shaft turning in the opposite direction of engine rotation.

	M-318A	M-318B	M-318C	M-383	M-413
TAPPET CLEARANCE					
INTAKE	.012″	.012″	.012″	.015″	.015″
EXHAUST	.022″	.022″	.022″	.026″	.026″

After 25 hours of operation the tappet adjustments should be made with the engine at normal operating temperature. Adjustments at 50 hour intervals thereafter will result in the owner having an engine at the peak of operating efficiency. See Adjustments in this manual for service procedures.

POLARITY BATTERY GROUND	Negative only	Negative only	Negative only	Negative only	Negative only

Section III

COOLING SYSTEM

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION III

COOLING SYSTEM

DATA AND SPECIFICATIONS

WATER PUMP

Make	Jabsco-Sherwood
Type	Dual Impeller
Drive	Belt
Method of Packing	Permanent type water seal (None adjustable)

THERMOSTAT

Make	Dole
Starts to Open	137°F. to 142°F.
Fully Open	162°

TIGHTENING REFERENCE

Part Name	Foot Pounds Torque
Water Pump Assembly Attaching Screw	30

SECTION III

COOLING SYSTEM

DESCRIPTION (FIGS. 1 AND 2)

The belt driven water pump located at the left side of the timing gear case, is actually two pumps in one, since two flexible rubber impellers on one shaft have a common housing or body. The corrosion-resistant bronze housing provides a separate inlet and a separate outlet for each impeller (Fig. 3). The water pump has one permanent lip-type water seal which requires no periodic adjustment, lubrication or servicing (except in lay-up).

The pump shaft is supported in a pre-lubricated housing, and is protected by a lip-type seal. An open portion of the housing, between the bearing and the impellers, precludes the possibility of water reaching the bearing from the impeller portion of the water pump body.

The dual inlets are fitted with an elbow which permits a single connection from the sea cock. The bypass connection is a part of this elbow which will further simplify the installation. If the water pump

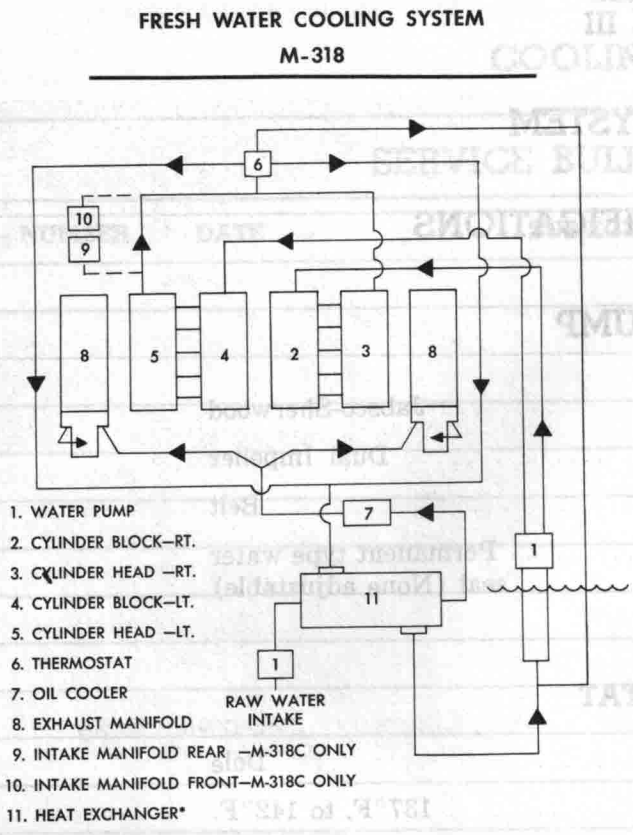


Fig. 1—Cooling System Using Heat Exchanger

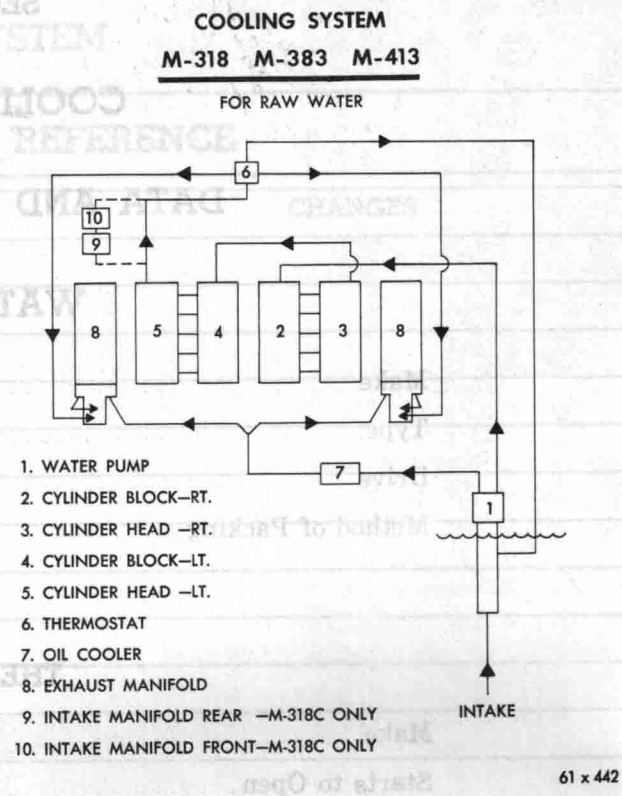


Fig. 2—Cooling System Water Circulation

inlet is to be above the water line, straight hoses can be attached between the pump inlet and the elbow so that the bypass connections will be below the water line. The water circulation from one side of the water pump supplies water to the reverse gear oil cooler, both exhaust manifolds and then overboard thru the exhaust lines. This overboard water provides very cool exhaust and a minimum of steaming.

The water from the other section of the water pump passes through the engine right cylinder block, right cylinder head, the left cylinder block, the left cylinder head, the intake manifold and the thermostat housing in that order. From the thermostat housing, the water flows either through the bypass (Fig. 4) or past the thermostat and overboard depending on the engine cooling demand.

A single bellows type thermostat is used. Since the thermostat is affected by exhaust system back pressure, the control temperature will vary from approximately 125°F. to 140°F. at full throttle. The control system is designed to operate with an exhaust back pressure of 4 psi (Pounds per Square inch). If the exhaust back pressure should exceed this, a lower temperature thermostat may be substituted to bring the top temperature to the desired level. This thermostat will reduce the idle temperature a proportionate amount. For extreme service in salt water, an adapter will be available incorporating the heavy duty thermostat and housing. This feature is available as optional equipment at extra cost.

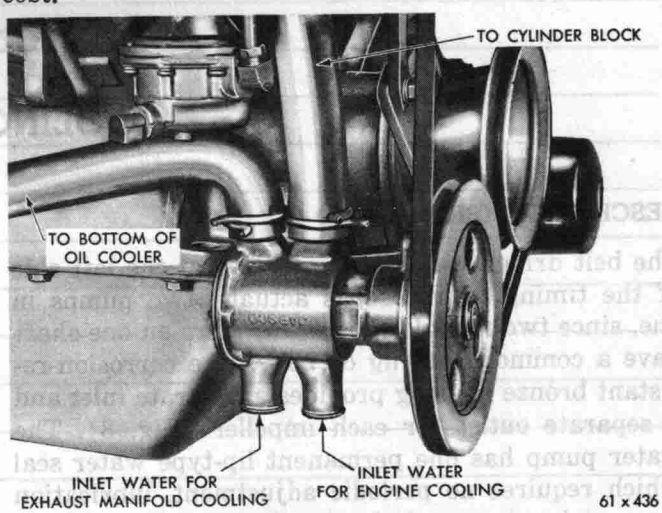


Fig. 3—Water Pump Connections

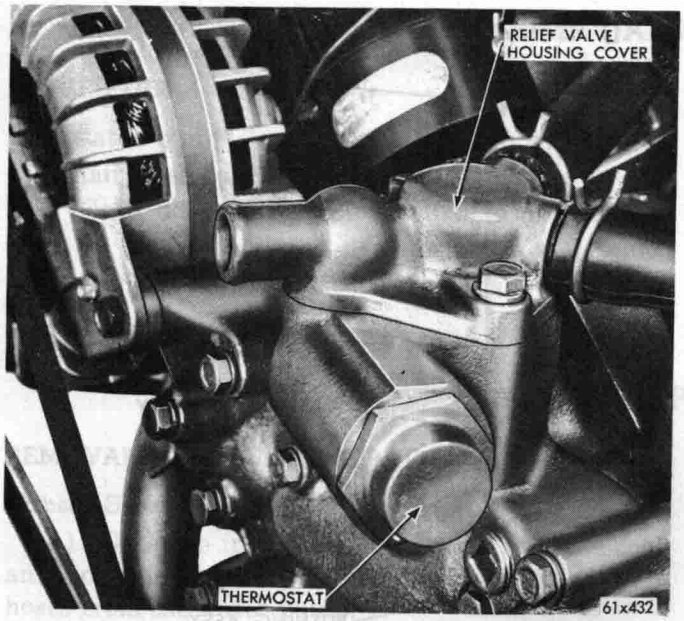


Fig. 4–Location of Thermostat and Pressure Relief Valve

The overboard plumbing consists of a hose from the water pump to the reverse gear oil cooler and then to a tee at the rear end of the engine dividing the water flow side for side. The water is then directed to the low end of each exhaust manifold thru the manifold to the upper manifold outlets and into the exhaust elbows and overboard from the elbow on Models M-318A, M-318B and M-318C. On Models M-383 and M-413 there are no thru passages from the manifold to the elbow, therefore there is external piping from the manifold outlet to the exhaust elbow outlet.

The cooling of the engine is accomplished by a hose which runs from the water pump to the right bank inlet. From the right cylinder head a hose connects the flow of water to the left cylinder bank on Models M-318A, M-318B and M-318C (cored passages on M-383 and M-413). A hose is run from the thermostat housing bypass to the bypass connection on the water pump inlet elbow and from the thermostat connections one hose runs to each exhaust elbow. The last two hoses are required for high speed operation when much cooling water passes the thermostat. Because of exhaust system back pressure, the hoses must not be teed into the same connections as the manifold overboard water. The cooling system on these engines therefore, makes for a highly efficient operation.

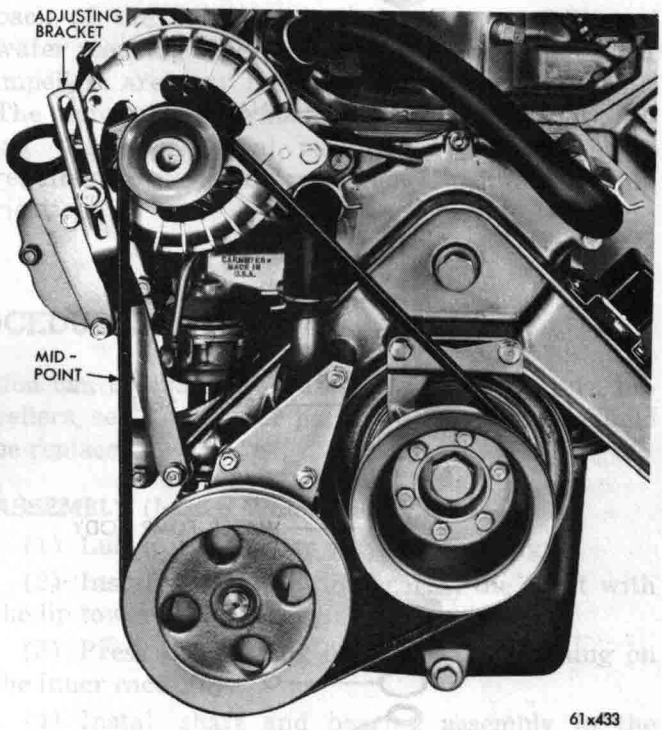


Fig. 5–Belt Deflection Method

PROPER BELT TENSION

Satisfactory performance of the belt driven accessories depends on the maintenance of the proper belt tension. If the specified tensions are not maintained, belt slippage may cause engine overheating, reduced alternator charging rates, and greatly reduced belt life. To avoid any such adverse effects, the following service procedures should be followed:

The belt can be tightened by measuring the deflection of the belt at the mid-point between two pulleys under a five-pound push or pull. A small spring scale can be used to establish the five-pound load. See Figure 5 for correct location at which to measure deflection.

To adjust the belt, loosen the mounting bolt, and use a bar to apply tension to the belt being careful not to damage the accessory. Tighten the mounting bolt and check the deflection. It may be necessary to repeat this procedure several times to establish the correct tension.

Any belt that has operated for a minimum of a half-hour is considered a "belt in use".

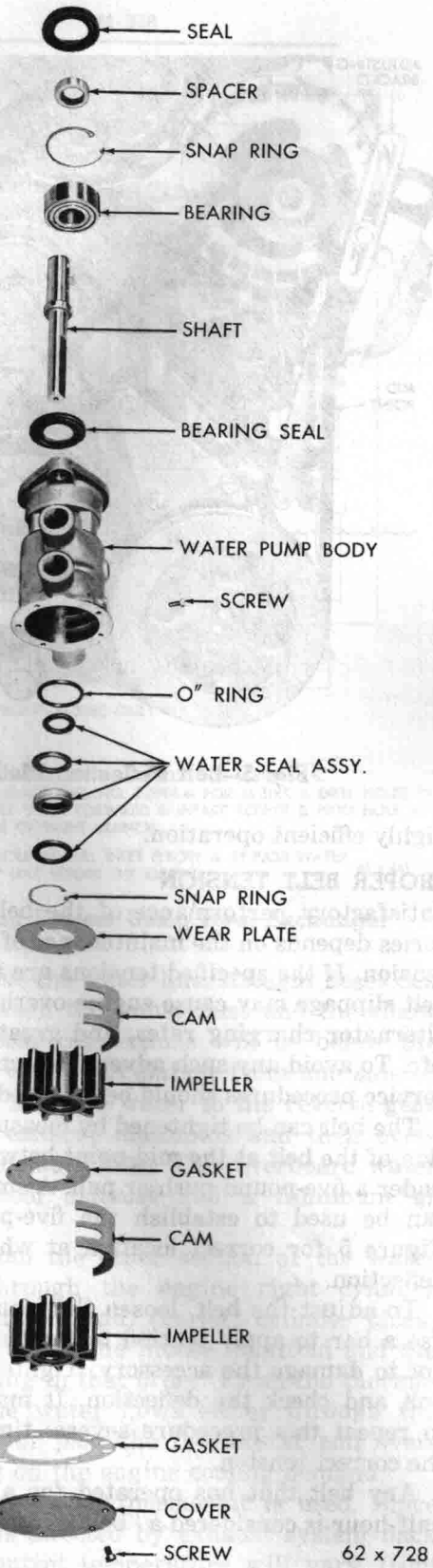


Fig. 6—Jabsco Water Pump (Disassembled View)

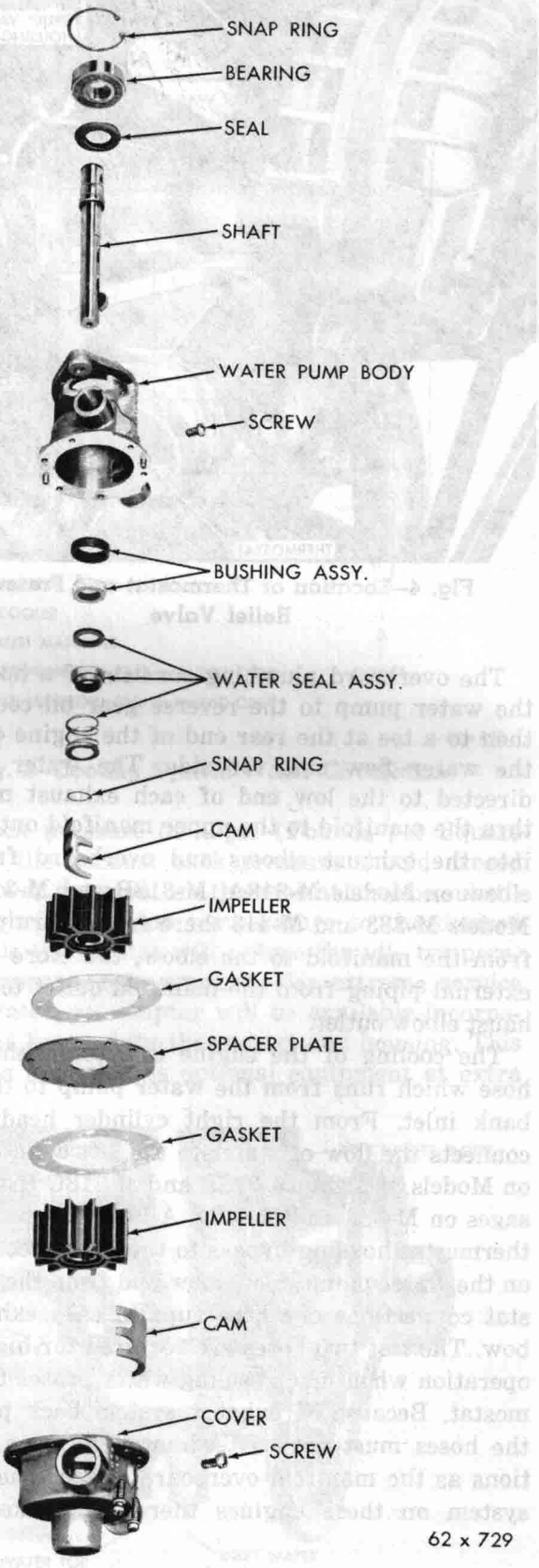


Fig. 7—Sherwood Water Pump (Disassembled View)

WATER PUMP (JABSCO AND SHERWOOD)

DESCRIPTION

The water pump, located at the lower left rear of the chain case cover, is actually two pumps in one. The pump body is corrosion-resistant bronze. The shaft is supported by a pre-lubricated and sealed ball bearing. An open section of the pump body, back of the bearing, precludes the possibility of water reaching the bearing. The two flexible rubber impellers are very resistant to abrasion and wear. The pump uses a permanent type water seal, replacing the conventional packing gland. The pump requires no periodic servicing, adjustment or lubrication.

SERVICE PROCEDURES

REMOVAL OF WATER PUMP (Figs 6 and 7)

(Jabsco-Sherwood)

(1) Close the intake sea cock and drain the coolant from the engine by removing the intake (lower) hoses from the water pump.

(2) Remove both outlet hoses.

(3) Remove pump mounting bolts and remove the pump assembly.

DISASSEMBLY (Fig. 6) Jabsco Water Pump

(1) Remove the end cover screws, cover and gasket.

(2) Grasp outboard impeller with water pump pliers and remove the impeller from the shaft. (Fig. 6). In difficult cases and when reconditioning pump it may be necessary to press the shaft assembly out of the body by performing Step (6) through Step (8).

(3) Remove the first cam and dowel assembly and the first wear plate.

(4) Remove the inboard impeller, cam and dowel assembly and second wear plate.

(5) Remove the snap ring using Tool C-760.

(6) Use a small hooked wire between the shaft and the following parts to remove: seal spacer washer, seal, seal spacer washer, slinger washer and the "O" ring in the body.

(7) Remove the pulley from the shaft.

(8) Remove woodruff key, spacer, and the bearing snap ring using snap ring pliers Tool C-760.

(9) Press the shaft and bearing assembly out of body toward the drive end. Remove the bearing seal from body.

(10) Press the bearing off the shaft, supporting the bearing inner race only.

c. Inspection

Clean all parts thoroughly. Inspect body and shaft for excessive wear or damage. Minor shaft wear in the water seal area is permissible since the seal position can be changed in assembly. Worn or torn impellers, seals and other parts of like material should be replaced.

ASSEMBLY (Jabsco Water Pump)

(1) Lubricate all parts when assembling.

(2) Install the bearing oil seal on the shaft with the lip toward the bearing.

(3) Press the bearing on the shaft, pressing on the inner race only.

(4) Install shaft and bearing assembly in the pump body, pressing on the outer race only.

(5) Install the bearing snap ring with the beveled side away from the bearing.

(6) Install the spacer.

(7) Install "O" ring in pump body. See (Fig. 6).

(8) Install slinger washer and one seal spacer. If a new seal position is desired, install both seal spacer washers.

(9) Install water seal with lip toward impellers.

(10) Install the snap ring.

(11) Position a wear plate in the pump body with the slot in line with the cam screw holes.

(12) Install a cam with dowels seated in wear plate and install cam screw securely.

(13) Install an impeller. Turn the shaft in the direction of normal rotation, making sure that the impeller blades are trailing over the cam area.

(14) Install the second wear plate with the slot in line with the cam screw hole.

(15) Install the cam with dowels seated in wear plate and install cam screw securely.

(16) Install the second impeller. Turn the shaft in the direction of normal rotation, making sure that the impeller blades are trailing over the cam area.

(17) Position gasket over cam and install end cover, tightening screws securely.

REMOVAL OF IMPELLERS (Fig. 7)

(Sherwood Water Pump)

(1) Remove the cover retaining screws.

(2) Slip the rear cover off the shaft. The *rear* impeller will be retained in the cover and can be lifted out by hand.

(3) Remove spacer plate and gaskets. This will expose the *front* impeller.

(4) Using 2 pairs of pliers grasp 2 vanes 180° apart and pull straight off shaft.

INSTALLATION OF IMPELLERS

(Sherwood Water Pump)

(1) The neoprene impeller is a slip fit over the drive shaft and key. First wet impeller or grease housing bore, then with screwing motion slip impeller in until it engages drive key, then push straight in.

(2) Install gasket and spacer plate.

(3) Place rear impeller into rear cover.

(4) Install gasket on rear cover.

(5) Slip impeller and cover assembly over the shaft and into position.

(6) Tighten unit together with 6 screws.

NOTE: Do not remove drive shaft from pump when changing impellers. The mechanical seal and ceramic seat provide the ultimate in sealing efficiency. If the mating lapped surfaces are even disturbed it is advisable to replace the seal.

DISASSEMBLY (Sherwood Water Pump)

(1) Remove impellers. See Paragraph "Removing Impellers".

(2) Remove the pulley and pulley drive key from shaft.

(3) Press the shaft through the ball bearing, pressing from the drive pulley end. The shaft will carry the mechanical seal and seat. The ball bearing and slinger will be retained in the housing.

(4) Slip rubber slinger through the housing drain slot.

(5) Remove ball bearing, retaining ring and press the ball bearing out of the housing.

(6) To remove graphitar bushing use hack saw or chisel, being careful not to harm housing bore.

(7) Due to complete disassembly it is recommended that a new mechanical seal ring retainer and seal be installed, therefore, remove seal retaining ring, seal and seat from shaft.

INSPECTION

Clean all parts thoroughly. Inspect body and shaft for excessive wear or damage. Minor shaft wear in the water seal area is permissible since the seal position can be changed in assembly. Worn or torn impellers, seals and other parts of like material should be replaced.

ASSEMBLY

(1) If graphitar bushing is removed lightly press in new bushing.

(2) Using fingers only, press the ceramic seat into its cavity in the housing. Wipe clean.

(3) Assemble the ball bearing and rubber slinger into position on the shaft. The bearing should be shouldered against the shaft collar.

(4) Slip the shaft and bearing assembly into the housing and press the ball bearing into place.

(5) Install ball bearing retaining ring to lock unit in housing.

(6) Clean mechanical seal faces, coat with light oil and slip the seal down the shaft and into position against the seal face. Lock in place with the shaft seal retaining ring.

(7) Position impeller drive keys in the shaft and tap or press into place. The inner key may be reached thru the housing ports.

(8) Replace impellers as outlined previously.

(9) Replace drive pulley key and drive pulley on shaft. Lock pulley in place with snap ring.

INSTALLATION ON THE ENGINE

(Jabsco and Sherwood)

(1) Install the water pump on mounting bracket and tighten bolts to 30 foot-pounds torque.

(2) Connect the intake and outlet hoses.

(3) Install the pulley on the shaft.

(4) Open the intake sea cock, start and run engine at idle speed to fill cooling system.

SERVICE DIAGNOSIS

ENGINE OVERHEATING

Possible Causes:

(a) Excessive sludge in crankcase.

(b) Water pump inlet restricted.

(c) Improper pump operation.

(d) Improper circulation of air.

Remedies:

(a) Drain lubricating oil from engine. Refill to required level with light flushing oil. Operate engine at slow speed for approximately 15-20 minutes. Drain and refill case with correct grade of oil. In severe cases, remove oil pan and clean by hand.

(b) Remove inlet pipe and check for obstruction.
(c) Follow steps for disassembly and inspection.
(d) Obstructions must not hinder normal circulation of air around engine.

ENGINE RUNS TOO COLD

Possible Causes:

(a) Inoperative thermostat.
(b) Inaccurate temperature gauge.

Remedies:

(a) Inspect thermostat for damage to bellows that would cause it to remain in closed position. Check for obstruction in by-pass line.
(b) Make necessary inspection and checks as outlined by gauge manufacturer.

INTERNAL LEAKAGE

Possible Causes:

(a) Warped cylinder head.
(b) Blown cylinder head gasket.
(c) Cracked cylinder wall.
(d) Loose cylinder head bolts.
(e) Cracked valve port.
(f) Sand holes or porous condition.
(g) Porous condition around distributor hole in cylinder block.
(h) Cracked block in valve chamber.

Remedies:

(a) Replace cylinder head and gasket. Draw down bolts to the required torque. See Engine Section.
(b) Replace gasket.
(c) Replace cylinder block, as described in Engine Section.
(d) Tighten cylinder head bolts to required torque as illustrated in Engine Section.
(e) Weld crack in valve port or replace cylinder block, as described in Engine Section.
(f) Weld sand holes or replace cylinder block, as outlined in Engine Section.
(g) A porous condition in the cylinder block may be corrected by the use of a good sealing compound.
(h) Replace cylinder block, as described in Engine Section.

Section IV

LUBRICATION AND MAINTENANCE

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION IV

LUBRICATION AND MAINTENANCE

SELECTION OF LUBRICANT

The type of service for which an engine oil is intended is usually designated by the letters MS, MM, or ML on the container. These are service classifications established by the API (American Petroleum Institute). This system does not replace the SAE (Society of Automotive Engineers) grade number of the oil which indicates the viscosity or consistency of the oil recommended.

For best performance and engine protection, the Chrysler Corporation recommends that the operator select:

1. An oil which conforms to the requirements of API classification "For Service MS".

2. An oil of proper SAE grade number in accordance with the recommendations for the anticipated temperature shown in the following table:

Anticipated Temperature Range	Recommended Viscosity Grade No.	Recommended Multi-Viscosity Oils
Above +32°F.	SAE 30	SAE 20W-40
As low as +10°F.	SAE 20W	SAE 20W-40 SAE 10W-30 SAE 10W-20
As low as −10°F.	SAE 10W	SAE 10W-30 SAE 10W-20 SAE 5W-20
Below −10°F.	SAE 5W	SAE 5W-20

Chrysler Corporation does not recommend the use of any lubricant which does not have an SAE designation and an MS service classification on the container.

BREAK-IN PERIOD

All Marine engines are delivered from the factory filled with a good grade of engine oil. This oil is provided to aid the initial engine break-in and should be retained for the first 25 hours of operation.

If necessary to add oil during the break-in period, use a good grade of engine oil having the appropriate SAE viscosity grade, as listed on the temperature viscosity chart under "Selection of Lubricant".

FULL-FLOW OIL FILTER

The full-flow filter cleans the oil as it comes from the oil pump. It is so constructed and installed that it is impossible for the supply of oil to be cut off to the engine even though the filter becomes clogged. If the filter becomes clogged, the oil will not be filtered but will be pumped to the working parts of the engine at reduced pressure through the safety by-pass valve in the top of the filter body. When the filter is operating properly, oil pressure indicated on the oil pressure gauge should be 45 to 65 pounds at operating speeds. If this pressure drops to 35 pounds, the engine oil level may be low or, the filter element may be clogged and should be changed.

ENGINE OIL FILTER ("SCREW ON" TYPE)

The "Screw on, throw-away" full flow sealed filter unit should be replaced every 100 hours of operation. (Fig. 1.)

It is only necessary to unscrew the filter from the base by hand and discard. Wipe the base clean and screw on a new filter until the gasket on filter contacts the base. Tighten at least ½ turn more, as no tools are necessary. Run engine to check for leaks. Add oil to bring level to full mark on the dip stick.

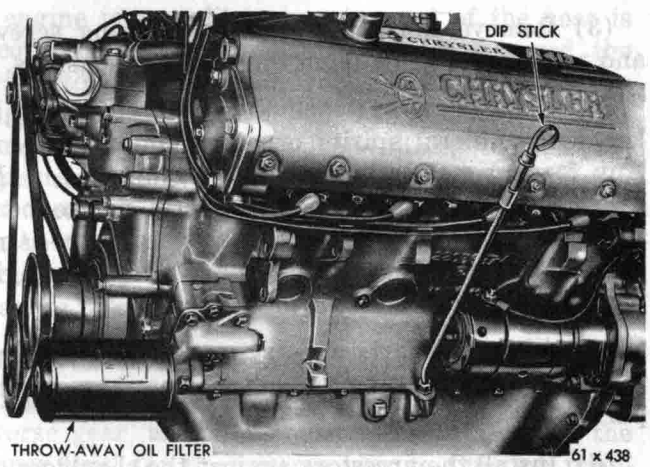


Fig. 1—Oil Filter (Throw Away Type) Model M-413

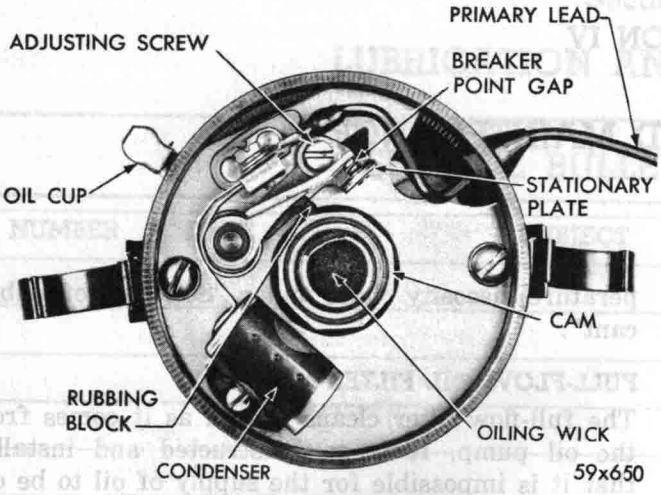


Fig. 2–Distributor Lubrication

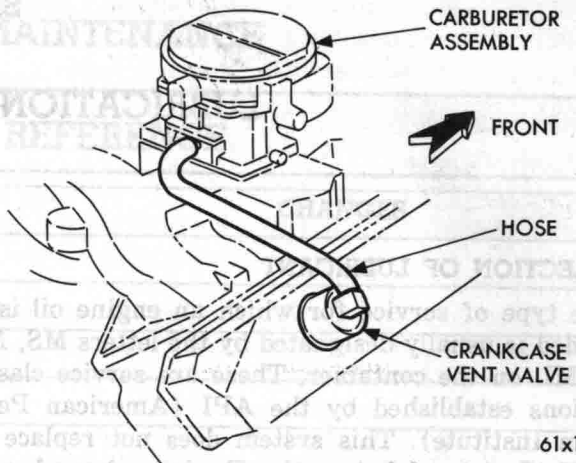


Fig. 3–Closed Crankcase Vent System (2 Barrel Carburetor) (Typical)

DISTRIBUTOR

(1) Add 3 to 5 drops of SAE 10W oil to the oiler on the outside of distributor base. (Fig. 2.)

(2) Lubricate the felt pad under the rotor in the top of the distributor cam with 3 to 5 drops of SAE 10W oil.

(3) Wipe old grease from surface of the breaker cam. Apply a light film of new distributor cam lubricant number 1473595. **Do not over-lubricate, keep oil and grease away from the breaker points.**

FLAME ARRESTORS

Flame arrestors should be clean and dry at all times.

To clean flame arrestors:

(1) Remove the engine ventilation outlet pipes.

(2) Loosen the flame arrestor clamp bolts and remove the assemblies from the carburetors. Take the arrestors and vent pipes ashore.

(3) Remove the grid retainer attaching screws and remove the grids from the arrestor housings.

(4) Clean all parts including the vent pipes in kerosene, mineral spirits or other similar solvent. Any foreign matter between the cooling fins in the grid must be removed, being careful not to bend the fins. The grids are clean only when there is no varnish-like material on the fins and a uniform light pattern is visible through the grid.

(5) After the parts are dry, assemble the arrestors, without painting or lubricating any of the parts.

(6) Install the arrestors against the shoulders on the carburetors. Tighten the clamp bolts.

(7) Install the engine ventilation outlet pipes, bringing the ends of pipes close to the flame arrestors. Tighten attaching bolts securely.

CLOSED CRANKCASE VENTILATION SYSTEM

The chemical composition of any fuel mixture changes when it is burned in a combustion chamber. The greater proportion of this is water in the form of vapor, and a few other mineral elements released by combustion process. A very small proportion of these chemicals may find their way into other parts of the engine through the necessary tolerances between valves and valve guides and between piston rings and cylinder walls. A very effective system for disposing of these chemicals, vapors, and fumes, before they cool sufficiently to change to a fluid state, is incorporated in all Marine engines.

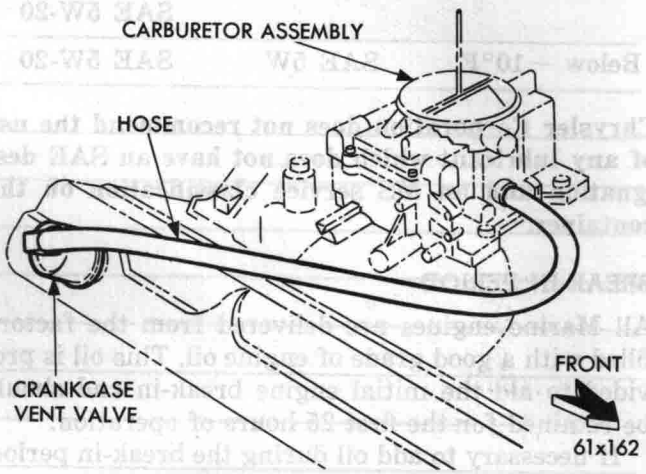


Fig. 4–Closed Crankcase Vent System (4 Barrel Carburetor) (Typical)

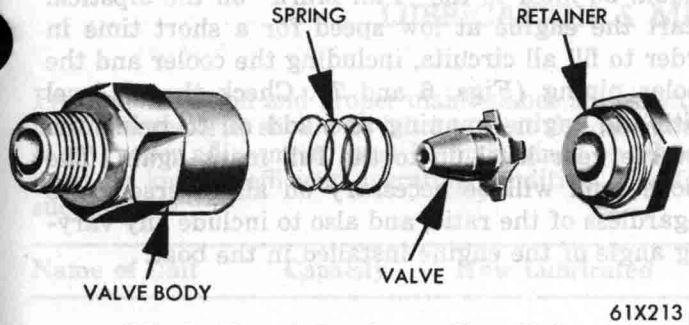


Fig. 5—Closed Crankcase Vent Valve (Disassembled View)

This is accomplished by a ventilation valve installed in the outlet vent cap on the cylinder head cover, and a ventilator hose (capable of withstanding 20 inches of vacuum), connected between the outlet vent cap and the carburetor throttle body. The function of the valve is to regulate the flow of crankcase ventilation at various throttle positions. (Figs. 3 and 4).

The system will operate effectively as long as normal maintenance is applied. The valve and ventilator hose are subject to fouling with sludge and carbon formation due to the nature of the materials carried by the ventilating system, and should be cleaned periodically.

Removal

The ventilation valve should be inspected and cleaned at the lay-up period and after every 100 hours of operation as follows:

Remove the valve and cap assembly from the cylinder head cover and detach from the hose. Remove the valve from the cap (Fig. 5). Soak the valve in Carburetor Cleaner, and blow out with compressed air. If the valve has been properly cleaned, the shuttle valve will click when the unit is shaken, and the outlet passage should be clean. If the valve is badly plugged and cannot be cleaned by this procedure, it will be necessary to disassemble the valve and thoroughly clean all elements. If the valve is disassembled, great care should be taken not to stretch the spring and to reassemble the pieces in the proper order. **Note: The free height of this spring is $\frac{9}{16}$".**

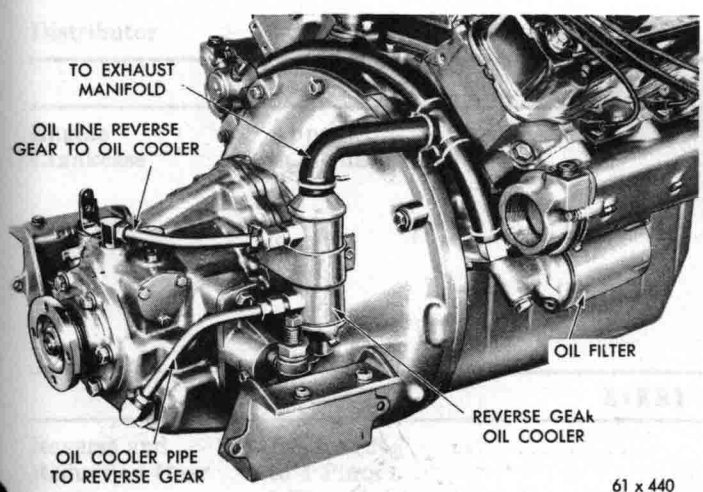


Fig. 6—Reverse Gear Oil Cooler Connections (Model M-318C)

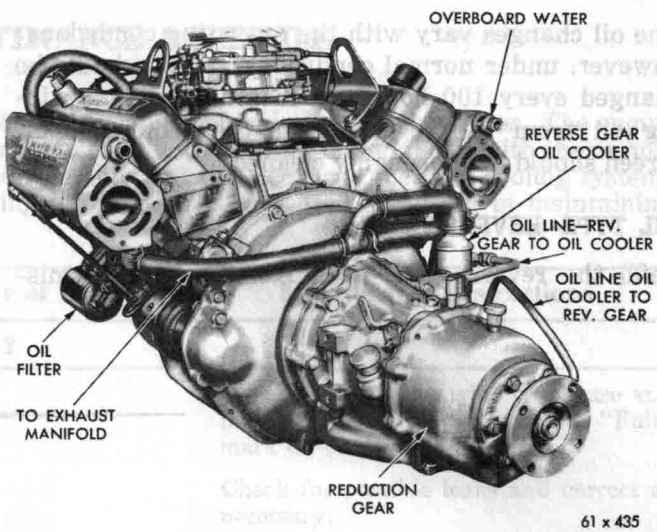


Fig. 7—Reverse Gear Oil Cooler Connections (Model M-413)

Installation

While the ventilation valve and cap assembly are removed for cleaning, put a finger over the open end of the ventilator hose hole and have the engine started. If the ventilator hose and carburetor passages are open and operating normally a strong suction will be felt and there will be a large change in engine idle quality when the end of the hose is uncovered. If these conditions are not observed, the carburetor passages and/or ventilator hose are plugged and must be cleaned. The carburetor should be removed from the engine and the ventilation passages cleaned by dipping the lower part of the carburetor in the cleaner. A pipe cleaner or wire can be used to aid cleaning the passages. It is not necessary to disassemble the carburetor for this cleaning operation.

OIL LEVEL—REVERSE GEAR

Using the dipstick, check the oil periodically in the reverse gear, as the oil must be maintained at the proper level for the reverse gear to function properly. (Figs. 6 and 7.)

OIL CHANGE–REVERSE GEAR

The oil changes vary with the operating conditions; however, under normal conditions, the oil should be changed every 100 hours, or seasonal. After draining oil from the reverse gear the removable oil screen should be thoroughly cleaned.

OIL TYPE–REVERSE GEAR

Refill the reverse gear with Automatic Transmission Fluid Type "A" Suffix "A" oil. The reverse gear should be filled to the "Full Mark" on the dipstick. Start the engine at low speed for a short time in order to fill all circuits, including the cooler and the cooler piping (Figs. 6 and 7). Check the oil level with the engine running and add oil to bring the reverse gear level up to the full mark again. The above refill will be necessary on all reverse gears regardless of the ratio, and also to include any varying angle of the engine installed in the boat.

LUBRICATION & MAINTENANCE SCHEDULE

Proper lubrication and proper maintenance are essential for efficient and economical engine operation. The engine and its accessories should be lubricated at the designated time intervals with the best material and with the utmost care. Proper adjustment must be maintained on the engine assembly and the electrical, fuel and cooling systems must be kept in efficient operating condition. The following information is presented as an aid in maintaining such service

Name of Unit	Capacity	How Lubricated	Type of Lubricant	Maintenance Instructions
		DAILY		
Oil Level Indicator	.....	.....	.....	Check oil level in engine crankcase and maintain to or slightly below "Full" mark on oil level indicator.
Oil and Fuel Lines	.....	.....	.....	Check for possible leaks and correct as necessary.
Fuel Tank	.....	.....	.....	Check quantity of fuel in tank and add fuel as required.
Cooling System	.....	.....	.....	Check for possible leaks and correct as necessary. Also pump out any bilge water that might have accumulated in bottom of boat.
		EVERY 25 HOURS		
Reverse Gear Control Linkage	Few Drops	Oil Can	Light Engine Oil	Every 25 hours of operation.
Reverse Gear	.....	.....	.....	Check oil level in reverse gear to full mark on oil level indicator.
Battery	.....	.....	.....	Check condition of battery. Proper fluid gravity is 1.260 + .015 temperature compensated. If reading is lower than 1.220 the battery should be removed and recharged. Check level of water in battery and maintain at ⅜ inch above plates.
Shaft Bearings	.....	.....	.....	Check condition of propeller shaft stuffing box and any inboard shaft bearings if used.
Distributor	5 Drops	Oil Cup	Engine Oil SAE 30	
		EVERY 50 HOURS		
Engine Crankcase	Approx. 7 to 8 Quarts	.....	Engine Oil: Above 32° F. Use SAE 30; Below 32° F. Use SAE 20-W	Remove engine oil from crankcase with pump and refill with clean oil. Change oil when engine is hot, as the oil will drain down into the engine pan more readily and carry off foreign material and sediment more completely. Capacity of crankcase depends on type of reduction gears used and angle of engine installation.
		EVERY 100 HOURS		
Reverse and Reduction Gear	Approx. 3½ to 4 Pints 1 Pint for Red. Gear	.....	Automatic Transmission Fluid Type "A" Suffix "A"	The reduction gear has one oil drain plug and the reverse gear housing has one drain plug. Draining and Refilling—Remove oil filler plug. Place 2 qt. capacity container under

LUBRICATION AND MAINTENANCE SCHEDULE–Continued

Name of Unit	Capacity	How Lubricated	Type of Lubricant	Maintenance Instructions
EVERY 100 HOURS (Continued)				
				drain plug. Unscrew drain plug, reach into the opening with a suitable tool and remove the strainer assembly. Allow oil to drain. Clean strainer assembly and reassemble into the oil pan. Replace the drain plugs and tighten. Pour 1 qt. of Automatic Transmission Fluid Type "A" into the oil pan. Start the engine and allow to idle until operating temperature is attained. Check fluid level with engine shut-off. Add sufficient fluid to bring the level to "Full" mark on the dipstick.
Fuel Filter	.....	.....	.....	Install a new filter every 100 hours of operation.
Oil Filter	.....	.....	.....	Replace filter element.
Flame Arrestors	.....	.....	.....	Remove flame arrestors and wash out with a suitable solvent and dry thoroughly before installation.
Clutch and Reverse Gear	.....	.....	.....	Check adjustment of clutch and reverse gear.
Fuel Pump	.....	.....	.....	Remove fuel filter from fuel pump to carburetor tube and clean thoroughly.
EVERY 250 HOURS				
Distributor Wick	2 or 3 Drops	Remove distributor cap and rotor and oil wick in center of cam	Engine Oil SAE 10W	Apply cam lubricant MoPar Part No. 1473595 to rubbing block.
Distributor Contact	.....	.....	.....	Clean and adjust contact points on distributor. Adjust gap to .014-.019 inch.
Spark Plugs	.....	.....	.....	Clean and adjust. Set gap at .035 inch.
Ignition Timing	.....	.....	.....	Check ignition timing. Reset to 12½° B.T.D.C. for Models M-318A, B, C and 5° B.T.D.C. for M-383 and M-413 Engines.
Carburetor	.....	.....	.....	Check carburetor adjustment.
Wiring	.....	.....	.....	Inspect all wiring for loose connections or worn insulation. Clean battery terminals with soda solution and coat with vaseline or grease.
Valve Tappets	.....	.....	.....	Check valve tappet adjustment.
Engine	.....	.....	.....	Clean exterior thoroughly.
EVERY 500 HOURS				
Compression	.....	.....	.....	Check compression. See your Chrysler Marine Engine Center.

SECTION V

ENGINE

DATA AND SPECIFICATIONS

	M-318A, B, C	M-383	M-413
MODEL			
Displacement (Cubic Inch)	318	383	413
Type	90°V	90°V	90°V
Bore	3.91″	4.25″	4.19″
Stroke	3.31″	3.375″	3.750″
Compression Ratio	8.25:1	8.0:1	8.0:1
Comp. Pressure @ 150 R.P.M. (Plugs Removed wide open throttle	150-180 P.S.I.	150-180 P.S.I.	150-180 P.S.I.
Firing Order Clockwise Engine Rotation (Marked "R" on name plate)	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2
C/Clockwise Engine Rotation (Marked "L" on name plate)	1-2-7-5-6-3-4-8	1-2-7-5-6-3-4-8	1-2-7-5-6-3-4-8
CRANKSHAFT AND BEARINGS			
Type	Fully Counter Balanced	Fully Counter Balanced	Fully Counter Balanced
Bearings	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt
Main Bearing Journal Diameter	2.4995″-2.5005″	2.6245″-2.6255″	2.7495″-2.7505″
Connecting Rod Journal Diameter	2.124″-2.125″	2.374″-2.375″	2.374″-2.375″
Max. Out of Round Permissible	.001″	.001″	.001″
Number of Main Bearings	5	5	5
Clearance Desired	.0005″-.0015″	.0005″-.0015″	.0005″-.0015″
End Play	.002″-.007″	.002″-.007″	.002″-.007″
Thrust Taken by	No. 3 Main	No. 3 Main	No. 3 Main
Interchangeability of Bearings (Upper)	1, 2, 4, 5	1, 2, 4, 5	1, 2, 4, 5
(Lower)	1, 2, 4, 5	1, 2, 4, 5	1, 2, 4, 5
CONNECTING RODS AND BEARINGS			
Type	Forged "I" Beam	Forged "I" Beam	Forged "I" Beam
Length (Rod)	6.123″	6.356″-6.360″	6.766″-6.770″
Bearings (Type)	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt
Diameter	2.126″	2.376″	2.376″
Length	.842″	.927″	.927″
Clearance Desired	.0005″-.0015″	.0005″-.0015″	.0005″-.0015″
Max. Allowable Before Reconditioning	.0025″	.0025″	.0025″
Side Clearance	.006″-.014″	.009″-.017″	.009″-.017″
Bearings for Service	Std. .001″, .002″, .003″, .010″, .012″	Std. .001″, .002″, .003″, .010″, .012″	Std. .001″, .002″, .003″, .010″, .012″
Piston Pin Diameter	.9842″	1.0925″-1.0928″	1.0925″-1.0928″
CONNECTING ROD BUSHING			
Type	Steel Backed Bronze	None	None
Diameter	.9842″-.9843″	None	None
Length	1.20″	None	None

ENGINE

DATA AND SPECIFICATIONS CONT'D

	M-318A, B, C	M-383	M-413
CAMSHAFT			
Drive	Chain	Chain	Chain
Bearings (Type)	Steel Backed Babbitt	Steel Backed Babbitt	Steel Backed Babbitt
Number	5	5	5
End Play	.002″-.006″	—	—
Thrust Taken by	Thrust Plate	Cyl. Block	Cyl. Block
Bearing Clearance	.001″-.003″	.001″-.003″	.001″-.003″
Max. Allowable Before Recond.	.005″	.005″	.005″
Bearing Journal (Diameter) No. 1	1.998″-1.999″	1.998″-1.999″	1.998″-1.999″
2	1.982″-1.983″	1.982″-1.983″	1.982″-1.983″
3	1.967″-1.968″	1.967″-1.968″	1.967″-1.968″
4	1.951″-1.952″	1.951″-1.952″	1.951″-1.952″
5	1.5605″-1.5615″	1.748″-1.749″	1.748″-1.749″
Bearings (Diameter) No. 1	2.000″-2.001″	2.000″-2.001″	2.000″-2.001″
2	1.984″-1.985″	1.984″-1.985″	1.984″-1.985″
3	1.969″-1.970″	1.969″-1.970″	1.969″-1.970″
4	1.953″-1.954″	1.953″-1.954″	1.953″-1.954″
5	1.5625″-1.5635″	1.750″-1.751″	1.750″-1.751″
TIMING CHAIN			
Number of Links	68	50	50
Pitch	.375″	.50″	.50″
Width	1.02″	.88″	.88″
TAPPETS			
Type	Mechanical	Mechanical	Mechanical
Clearance in Block	.0005″-.0018″	.0005″-.0018″	.0005″-.0018″
Body Diameter	.9040″-.9045″	.9040″-.9045″	.9040″-.9045″
Tappet Adjustment (Intake)	.012″	.015″	.015″
(Exhaust)	.022″	.026″	.026″
PISTONS			
Type	Conformatic with Steel Band and Horizontal Slot	Horizontal Slot w/Steel Strut	Horizontal Slot w/Steel Strut
Material	Aluminum	Aluminum	Aluminum
Land Clearance	.0219″-.084″	.031″-.037″	.031″-.037″
Clearance at Top of Skirt	.0005″-.0015″	.0005″-.0010″	.0005″-.0010″
Length (Overall)	3.21″	3.84″	3.96″
Ring Groove Width—No. 1	.0795″-.0805″	.220″	.216″
2	.0795″-.0805″	.220″	.216″
3	.1875″-.1890″	.208″	.206″
PISTON PINS			
Type	Full Floating	Press Fit	Press Fit
Diameter	.9842″	1.0935″-1.0937″	1.0935″-1.0937″
Length	2.995″	3.555″-3.575″	3.555″-3.575″
Clearance in Piston	.0″-.0005″	.00045″-.00075″	.00045″-.00075″
End Play	.004″-.026″	—	—
Clearance in Rod	.0001″-.0004″	.0007″-.0012″	.0007″-.0012″
Pins for Service	Std. .003″, .008″ O.S.	Std.	Std.

ENGINE

DATA AND SPECIFICATIONS CONT'D

	M-318A, B, C	M-383	M-413
PISTON RINGS			
Number of Rings	3	3	3
Compression	2	2	2
Width of Rings (Comp.)	.0775″-.0780″	.0775″-.0780″	.0775″-.0780″
(Oil)	.1860″-.1865″	.1860″-.1865″	.1860″-.1865″
Piston Ring Gap (All)	.010″-.020″	.013″-.025″	.013″-.025″
Side Clearance (Comp.—Upper)	.0015″-.0030″	.0015″-.0030″	.0015″-.0030″
(Intermediate)	.0015″-.0030″	.0015″-.0030″	.0015″-.0030″
(Oil) (Service)	.0010″-.0030″	.0010″-.0030″	.0010″-.0030″
VALVES (Intake)			
Length	4.51″	4.79″	4.79″
Head Diameter	1.844″	2.08″	2.08″
Stem (Type)	Solid	Solid	Solid
Stem Diameter	.372″-.373″	.372″-.373″	.372″-.373″
Stem to Guide Clearance	.004″	.001″-.003″	.001″-.003″
Max. Allowable Before Reconditioning	.004″	.004″	.004″
Valve Face Angle	45°	45°	45°
Adjustment	Rocker Arm Screw	Rocker Arm Screw	Rocker Arm Screw
VALVES (Exhaust)			
Length	4.45″	4.79″	4.79″
Head Diameter	1.563″	1.60″	1.60″
Stem (Type)	Solid	Solid	Solid
Stem Diameter	.371″-.372″	.371″-.372″	.371″-.372″
Stem to Guide Clearance	.002″-.004″	.002″	.002″
Max. Allowable Before Reconditioning	.006″	.006″	.006″
Valve Face Angle	45°	45°	45°
Adjustment	Rocker Arm Screw	Rocker Arm Screw	Rocker Arm Screw
VALVE SPRINGS			
Number	16	16	16
Load When Compressed to (Valve Closed)	$1\frac{11}{16}$″ @ 78-88 lbs.	$1\frac{55}{64}$″ @ 95-105 lbs.	$1\frac{55}{64}$″ @ 95-105 lbs.
Load When Compressed to (Valve Open)	$1\frac{5}{16}$″ @ 170-184 lbs.	$1\frac{15}{32}$″ @ 187-203 lbs.	$1\frac{15}{32}$″ @ 187-203 lbs.
Corrosion Protection	Cadmium Plated	Cadmium Plated	Cadmium Plated
CYLINDER BLOCK			
Cylinder Bore (Standard)	3.910″-3.912″	4.2495″-4.2515″	4.1870″-4.1890″
Cylinder Bore Out of Round (Max. Allowable Before Reconditioning	.005″	.005″	.005″
Cylinder Bore Taper (Max. Allowable Before Reconditioning	.010″	.010″	.010″
Reconditioning Working Limits (For Taper and Out-of-Round)	.001″	.001″	.001″
Max. Allowable Oversize (Cylinder Bores)	.040″	.040″	.040″
Tappet Bore Diameter	.9050″-.9058″	.9050″-.9058″	.9050″-.9058″
Distributor Lower Drive Shaft Bushing (Press Fit in Block)	.0005″-.0040″	.0005″-.0040″	.0005″-.0040″
Ream to	.4865″-.4880″	.4865″-.4880″	.4865″-.4880″
Shaft to Bushing Clearance	.0007″-.0027″	.0007″-.0027″	.0007″-.0027″
CYLINDER HEAD			
Combustion Chamber	Polyspherical Type	Wedge Type	Wedge Type
Valve Seat Run-Out (Max.)	.002″	.002″	.002″
Intake Valve Seat Angle	45°	45°	45°
Seat Width	.060″-.085″	.060″-.085″	.060″-.085″
Exhaust Valve Seat Angle	45°	45°	45°
Seat Width	.040″-.060″	.040″-.060″	.040″-.060″

ENGINE

DATA AND SPECIFICATIONS CONT'D

	M-318A, B, C	M-383	M-413
ENGINE LUBRICATION			
Pump (Type)	Rotary	Rotary	Rotary
Capacity	*8 Qts. at 7° Angle	*7 Qts. at 7° Angle	*7 Qts. at 7° Angle
Pump Drive	Camshaft	Camshaft	Camshaft
Operating Pressure @ 2000 R.P.M.	45-65 P.S.I.	45-65 P.S.I.	45-65 P.S.I.
Pressure Drop Resulting from Clogged Filter	7-9 Lbs.	7-9 Lbs.	7-9 Lbs.
* When filter is replaced Add 1 qt.			
OIL PUMP—INSPECTION LIMITS FOR REPLACEMENT			
Filter Base Surface	.0015 inch or more	.0015 inch or more	.0015 inch or more
Outer Rotor Length	.998 inch or less	.943 inch or less	.943 inch or less
Outer Rotor Diameter	2.244 inch or less	2.469 inch or less	2.469 inch or less
Inner Rotor Length	.998 inch or less	.942 inch or less	.942 inch or less
Clearance Over Rotor—Outer	.004 inch or more	.004 inch or more	.004 inch or more
Inner	.004 inch or more	.005 inch or more	.005 inch or more
Outer Rotor Clearance	.012 inch or more	.012 inch or more	.012 inch or more
Tip Clearance Between Rotors	.012 inch or more	.010 inch or more	.010 inch or more

TOOL LIST

C-119	Cylinder Bore Gauge
C-385	Ring Compressor
C-445	Box Wrench
C-647	Spring Tester
C-690	Spring Scale
C-741	Reamer—Valve Guide
C-756	Cleaner—Valve Guide
C-771	Tool—Flywheel Turning
C-823	#500 Hone—Cylinder
C-897	Driver—Welsh Plug
C-3005	Wrench—Torque 100 Ft. Lbs.
C-3012	Reamer—Ridge
C-3025	Sleeve—Valve Guide Wear
C-3026	Sleeve Valve Guide Wear
C-3027	Aligning tool, Oil Pump Drive Gear
C-3028	Reamer
C-3033	Puller—Installer Front End
C-3049	Reamer
C-3052	Puller
C-3053	Installer
C-3054	Socket
C-3059	Bearing Remover
C-3065	Gauge—Cylinder Compression
C-3068	Holder
C-3132A	Bearing Remover Camshaft
C-3221	Piston Remover
C-3339	Dial Indicator
C-3422	Valve Spring Compressor
C-3427	Reamer—.030″ Oversize
C-3430	Reamer—.015″ Oversize
C-3433	Reamer—.005″ Oversize
C-3436	Gauge—Valve Stem Length
C-3466	Plate—Engine Lifting
C-3495	Ring Installer
C-3501	Hone Cylinder
C-3506	Remover & Installer
C-3509	Installer—Camshaft Gear
C-3511	Oil Seal Installer
C-3625	Oil Seal Installer
C-3626	Fixture—Cylinder Head
C-3648	Gauge—Valve Stem Length
C-3671	Ring Installer
C-3673	Ring Installer

SECTION V

ENGINE

Models M-318A, M-318B, M-318C

The 318 cubic inch V-8 engine is a 90 degree type unit with polyspherical combustion chambers and inclined valves in the cylinder heads. The engine is equipped with mechanical tappets.

A Maltese Cross stamped on the engine numbering pad 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 is stamped on the machined surface of a counter weight. Connecting rod journals are 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. A diamond-shaped marking stamped on engine numbering pad indicates that tappet bodies are .008 inch oversize.

SERVICE PROCEDURES

MINOR TUNE-UP (All Models)

A periodic engine tune up will assure maximum engine performance and fuel economy.

(1) Check battery specific gravity, add water if necessary and clean and tighten battery connections.

(2) Clean and adjust the spark plugs (.035 inch gap). Tighten to 30 foot-pounds torque with Tool C-3054.

(3) Adjust the distributor contact points (.015 to .018 inch gap). Install new points if necessary.

(4) Check the distributor cap for cracks and corrosion. Inspect the rotor, rotor spring and plunger. Inspect the distributor to spark plug wires for brittle, cracked or frayed insulation. Inspect small lead wires for tightness, or damaged insulation.

(5) Reset the ignition timing.

(6) Tighten the carburetor flange nuts to 7 foot-pounds torque.

(7) Set carburetor idle mixture adjustment for maximum vacuum. Adjust the throttle stop screw so engine idles 550 to 600 rpm in neutral.

MAJOR TUNE-UP (All Models)

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

(1) Tighten the manifold nuts.

(2) Test the cylinder compression. The compression should not vary more than 20 pounds between cylinders.

(3) Test the coil, and condenser. Inspect the primary and secondary wires.

(4) Every 100 hours remove and disassemble flame arrester and clean in solvent. Flame arrester must be dry when reassembled and installed.

(5) Test fuel pump for pressure and vacuum. Refer to Fuel Section and Specifications.

(6) Adjust the carburetor.

(7) Run engine as a final check.

CYLINDER HEAD ASSEMBLY

a. Removal

(1) Drain cooling system. Remove carburetor flame arrester, fuel line from pump and carburetor, and the alternator.

(2) Disconnect throttle linkage at carburetor, distributor cap, coil wires, heat indicator sending unit wire, water hoses at engine.

(3) Remove spark plugs and cables, engine ventilating system.

(4) Remove intake manifold attaching bolts and remove manifold, carburetor and coil as an assembly.

(5) Remove exhaust manifolds.

(6) Remove cylinder head covers.

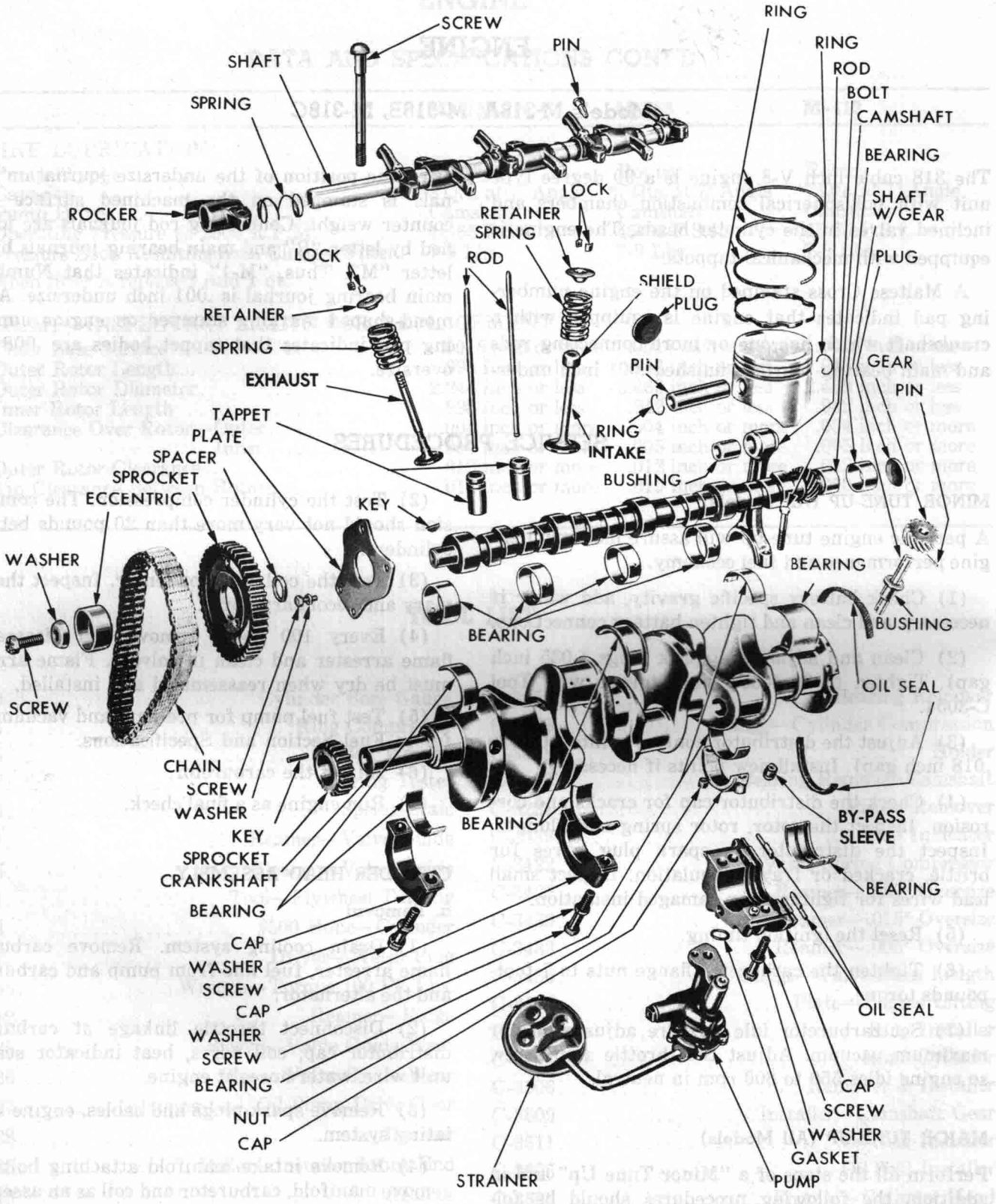


Fig. 1—Engine Internal Parts

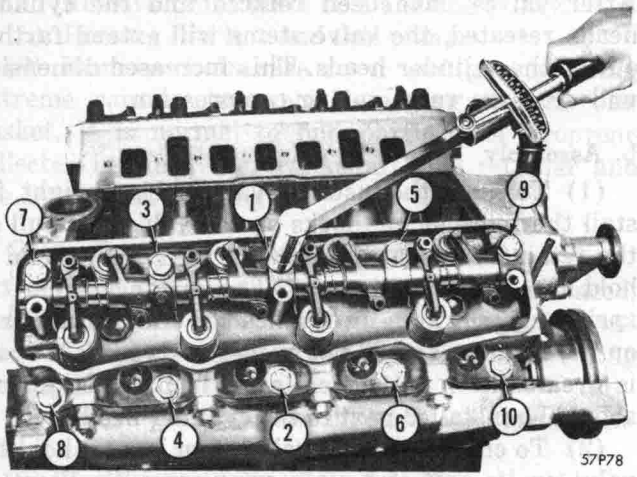


Fig. 2—Cylinder Head Tightening Sequence

(7) Remove head bolts and remove cylinder head and push rods.

(8) Place cylinder heads in holding fixtures, Tool C-3626.

(9) Remove lock plug, rocker shaft and arms from rocker shaft struts.

b. Installation

A check of the accuracy of the timing marks at the front of the engine can be made before the left cylinder head is installed. (The valve timing can be checked after the engine has been run.)

(1) Mount a dial indicator so that the indicator will read the exact maximum upward travel of the piston (T.D.C.).

(2) With the dial indicator at its highest reading, the straight line on the pulley (vibration damper) should be in line with the "O" stamp on the timing indicator. If the calibration is not correct, relocate

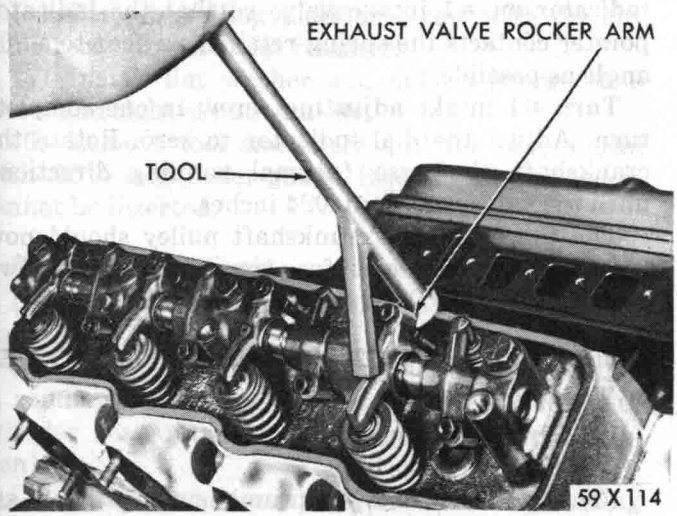


Fig. 3—Compressing Exhaust Valve Spring

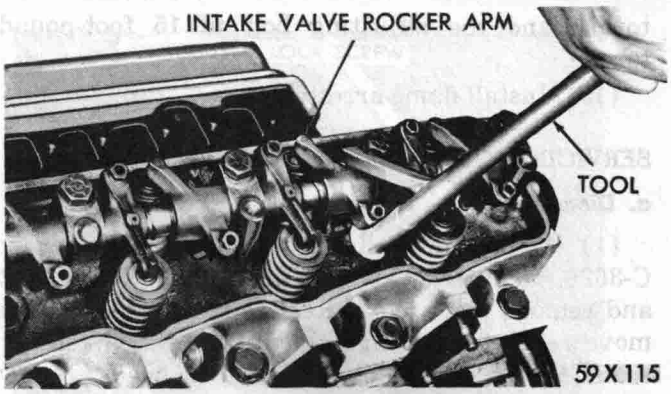


Fig. 4—Compressing Intake Valve Spring

T.D.C. position on the damper. See Paragraph "Checking the Valve Timing" for the method of timing.

(3) Coat new cylinder head gaskets with a suitable sealer and place gaskets on the cylinder block.

(4) Slide rocker shaft into bore of strut and at same time engage intake rocker arm. Install spring and engage the exhaust rocker arm. Install remainder of rocker arms in the same sequence. Make sure that rocker shaft head bolt grooves line up with head bolt holes in rocker shaft strut. The plug hole in strut must also line up with hole in rocker shaft. Tap in new rocker shaft plug.

(5) Remove cylinder heads from holding fixtures, Tool C-3626 and place heads on engine.

(6) Install and tighten all bolts on each head in sequence (Fig. 2). Retighten in the same sequence to 85 foot-pounds torque.

(7) Install push rods with small ends in tappets. When using Tool C-3695 (Fig. 3 and 4), rocker arm valve spring compressor, to position large end of push rod under rocker arm, **make certain low point of camshaft lobe is under tappet.**

(8) Install new intake manifold gaskets and seals.

(9) Install intake manifold, with coil and carburetor, tighten manifold to 30 foot-pounds torque.

(10) Using new cylinder head cover gaskets, install covers. Tighten bolts to 40 inch-pounds torque. Install engine ventilating system.

(11) Install spark plugs with new gaskets. Tighten to 30 foot-pounds torque.

(12) Install exhaust manifolds, with new gaskets, tightening to 30 foot-pounds torque.

(13) Connect throttle linkage, install distributor cap and connect cables, coil wires, heat indicator sending unit wire and water hoses.

(14) Install fuel line, alternator and belts. Tighten alternator bracket bolts to 50 foot-pounds torque and mounting nut to 20 foot-pounds torque. Tighten adjusting strap mounting bolt to 30 foot-pounds

torque and the adjusting bolt to 15 foot-pounds torque.

(15) Install flame arrestor.

SERVICING CYLINDER HEAD ASSEMBLIES

a. Disassembly

(1) With cylinder heads in holding fixtures Tool C-3626, compress valve springs using Tool C-3422 and remove valve locks. Release compressor and remove retainers, springs and intake valve stem cup seals. If valves do not slide out of heads, remove burrs from lock grooves to prevent damage to guides. Place valves in a numbered rack.

(2) Clean valves thoroughly and discard burned, warped or cracked valves.

(3) Measure valve stems. Intake should measure from .372 to .373 inch, exhaust from .371 to .372 inch.

(4) Clean cylinder heads thoroughly. Use Tool C-756 to clean valve guides.

(5) Test valve guides for wear. Install sleeve, Tool C-3025 on intake valve and C-3026 on exhaust valve over valve stem to hold valve at working height in head. Attach dial indicator, having stem at right angle with edge of valve. Move valve to and from indicator. Total movement should not exceed .008 inch on intake valves and .014 inch on exhaust valves. If tolerance is excessive, ream guides and install valves with oversize stems. Reamer Tool C-3433 will ream guides for .005 inch oversize valve stems; Tool C-3430 for .015 inch oversize valve stem; Tool C-3427 for .30 inch oversize. Turn reamer by hand, and clean guides thoroughly when finished. Use .005 reamer first and, if necessary, the .015 inch, then the .030 inch so the guides remain true in relation to the seat.

(6) Reface valves to 45°, dressing the stone before refacing each valve. Discard valves having less than $\frac{3}{64}$ inch margin remaining after grinding.

(7) When refacing valve seats, the correct size pilot must be used and the correct size stone of proper grit should be dressed to 45° before grinding each seat. A true and complete surface must be obtained. Check the seat with dial indicator. Total runout should not exceed .002 inch.

(8) Check the valve seat with Prussian Blue to determine where the valve contacts the seat. If this contact surface is not properly centralized, the seat should be relocated by using a 20° stone at the top, or a 60° stone at the bottom, whichever is necessary. When the seat is properly positioned, the width of intake valve seats should be from $\frac{1}{16}$ inch to $\frac{3}{32}$ inch; exhaust valve seats from $\frac{3}{64}$ inch to $\frac{1}{16}$ inch.

After valves have been refaced and the cylinder heads reseated, the valve stems will extend farther out of the cylinder heads. This increased dimension will decrease valve spring compression.

b. Assembly

(1) To check the installed valve spring height, install the retainer and locks on the valve and pull on the retainer, to seat the locks in the retainer and to hold the valve on its seat. The distance from the spring contact area on the head to the contact area on the retainer should not exceed $1\frac{11}{16}$ inch. If space is greater than $1\frac{11}{16}$ inch, a $\frac{1}{16}$ inch spring spacer should be installed next to the cylinder head.

(2) To check installed valve stem length, hold the valve on its seat and place gauge over the stem. If valve stem extends above the gauge, grind the end of stem to fall between maximum and minimum.

Whenever valves have been removed, the valve springs should be tested. Check springs for squareness. If a spring is more than $\frac{1}{16}$ inch out of square, install a new spring. Test spring tension with Tool C-647. Spring tension should be from 170 to 184 pounds when compressed to $1\frac{5}{16}$ inches and from 78 to 88 pounds when compressed to $1\frac{11}{16}$ inches.

Lubricate valve stems and insert in head. Install new seals on intake valve stems with lip of seal contacting cylinder head. Place springs and retainers over valve stems. Use Tool C-3422 to compress springs and install valve locks.

CHECKING VALVE TIMING

Check the accuracy of the TDC mark on the pulley (vibration damper) by bringing the number one piston to TDC by means of an indicator placed in the spark plug opening.

Rotate the crankshaft until #6 exhaust valve is closing and #6 intake valve is opening. Install a dial indicator on #1 intake valve so that the indicator pointer contacts the spring retainer as near to a 90° angle as possible.

Turn #1 intake adjusting screw in one complete turn. Adjust the dial indicator to zero. Rotate the crankshaft clockwise (normal running direction) until the valve has lifted .024 inches.

The timing of the crankshaft pulley should now read from 10 degrees before top dead center to two degrees after top dead center. Readjust lash.

TIMING CHAIN, COVER, OIL SEAL AND SPROCKET

a. Timing Chain Case Cover Removal

(1) Drain cooling system.

(2) Remove drive belts.

(3) Remove water pump and housing as an assembly.

(4) Remove crankshaft bolt and the pulley.

(5) Remove fuel line and fuel pump.

(6) Remove chain case cover and gasket, using extreme caution to avoid damaging the oil pan gasket. It is normal to find particles of neoprene collected between the crankshaft seal retainer and the crankshaft oil slinger.

b. Chain Case Cover Oil Seal Removal

If the chain case cover oil seal needs to be replaced, use Tool C-3506 as follows: Refer to the 383-413 cubic inch engine section for illustrations covering the application of the tool.

(1) Insert puller screw through seal toward inside of cover.

(2) Position angular lip of both puller blocks under the flanges of the seal retainer and with the blocks directly opposite each other. In this position the blocks will be leaning against the screw.

(3) Place washer and the nut on puller screw. As nut is tightened and the blocks move down the shaft, the lips will be forced outward under the seal retainer. The nut must be tight. The tool is only positioned at this time.

(4) Place tool sleeve over seal retainer. Place removing and installing plate into sleeve. Place washer and nut on puller screw. Tighten nut to remove seal retainer.

c. Installing Chain Case Cover Oil Seal

To install a seal, use Tool C-3506 as follows:

(1) Place removing and installing plate on puller screw with the thick shoulder up.

(2) Insert puller screw through seal opening toward inside of cover.

(3) Place seal in recess in cover with neoprene section down (retainer section up). Make certain seal is centered.

(4) Place installing plate on screw with the circular recess toward seal retainer.

(5) Install flat washer and nut on screw. Hold screw and tighten nut securely.

(6) Remove tool and check seal for proper seat with .0015 inch feeler gauge. Seal is seated if gauge cannot be inserted.

d. Testing Timing Chain

(1) Block crankshaft from moving in either direction.

(2) Apply 15 foot-pounds torque to camshaft bolt in counter-clockwise direction (30 foot-pounds with cylinder heads installed and engine under compression).

(3) Place a scale next to chain and take reading of chain position. Hold scale in same position.

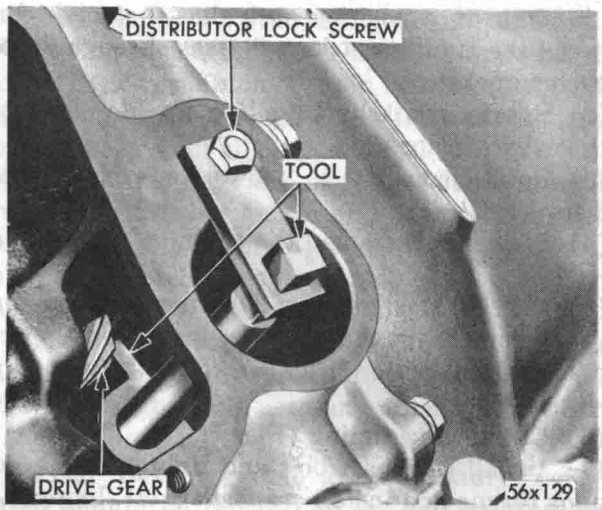


Fig. 5—Camshaft Holding Tool

(4) Apply 15 foot-pounds torque to camshaft bolt in clockwise direction (30 foot-pounds torque with cylinder heads installed).

(5) Read scale for amount of chain movement. Replace chain if movement exceeds $\frac{3}{16}$". If removal of the chain is necessary, remove the crankshaft oil slinger and the camshaft sprocket bolt. Slide both sprockets and the chain off as an assembly.

e. Installing Timing Chain

When installing the timing chain, use Tool C-3509 to prevent the camshaft from contacting the welch plug in the rear of the engine block. Remove the distributor and the oil pump-distributor drive gear. Locate tool against rear side of cam gear and attach the tool with distributor retainer plate bolt (Fig. 5).

(1) Place chain on bench and locate both sprock-

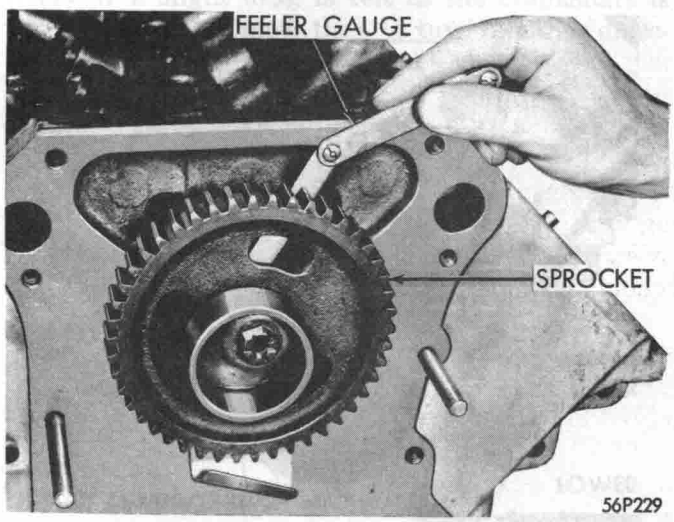


Fig. 6—Measuring Camshaft End Play

ets in chain in a position such that a straight line between the timing marks will pass through center of each sprocket.

(2) Rotate crankshaft to line up key in shaft with keyway in sprocket.

(3) Rotate camshaft to line up keyways in shaft and sprocket.

(4) Slide sprockets and the chain on shafts as an assembly.

(5) Check camshaft for .002 to .006 inch end play. If not within these limits, install new spacer and/or thrust plate (Fig. 6). Install fuel pump eccentric.

(6) Check valve timing (Fig. 7).

(7) Install camshaft bolt and tighten to 35 foot-pounds torque and install crankshaft oil slinger.

(8) Install chain cover with new gaskets and tighten bolts to 15 foot-pounds torque. Use extreme caution to avoid the oil pan gasket.

(9) Install fuel pump and fuel lines.

(10) Install crankshaft pulley, washer and bolt. Tighten bolt to 135 foot-pounds torque.

(11) Install water pump and housing assembly. Tighten bolts to 30 foot-pounds torque.

(12) Install drive belts, hoses and close drains.

(13) With timing indicator on T.D.C., install distributor drive gear with slot pointing to the first intake manifold bolt on the left side of engine (Fig. 8).

CAMSHAFT AND TAPPETS

a. Removing Camshaft

(1) Remove mechanical tappets from the tappet bore (Fig. 9). Place push rods and tappets in their respective places in Tool C-3068 since each part should be replaced in its original location.

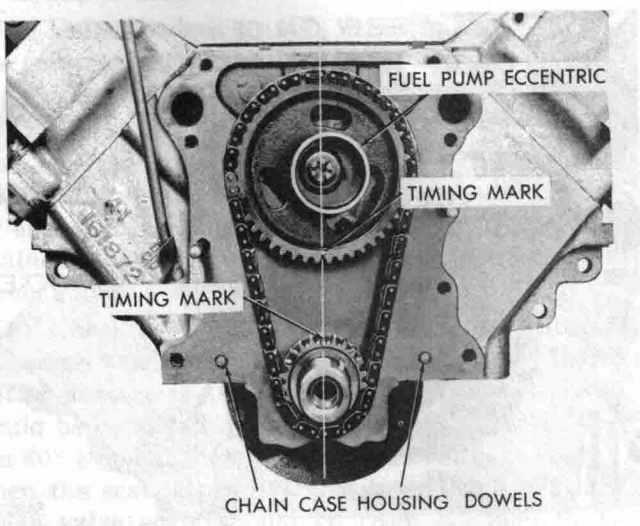


Fig. 7—Timing Marks

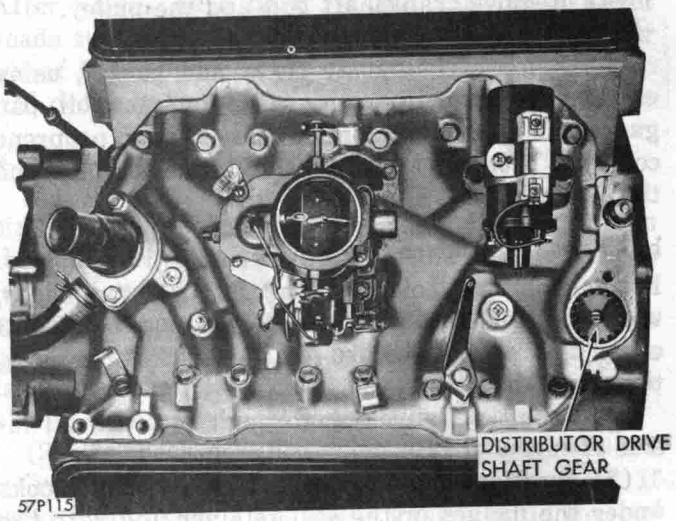


Fig. 8—Position of Distributor Drive Shaft

(2) To remove the camshaft, remove all tappets and remove the timing chain and sprockets.

(3) Remove the distributor and the oil pump distributor drive gear.

(4) Remove the camshaft. Use care to avoid damaging the camshaft bearings while removing or replacing the camshaft. Camshaft bearing replacement will be found under Paragraph "Cylinder Block'.

b. Installing Camshaft

(1) Lubricate the cam lobes and bearing journals before inserting the camshaft.

(2) Install Tool C-3509 with tongue back of distributor drive gear (Fig. 5).

(3) Push camshaft into final position.

(4) Keep tool in place until sprockets and chain have been installed. Complete installation as de-

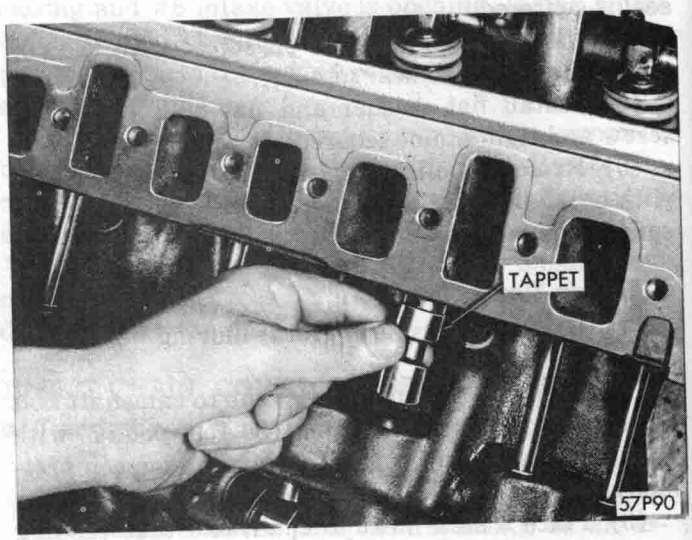


Fig. 9—Removing Mechanical Tappet

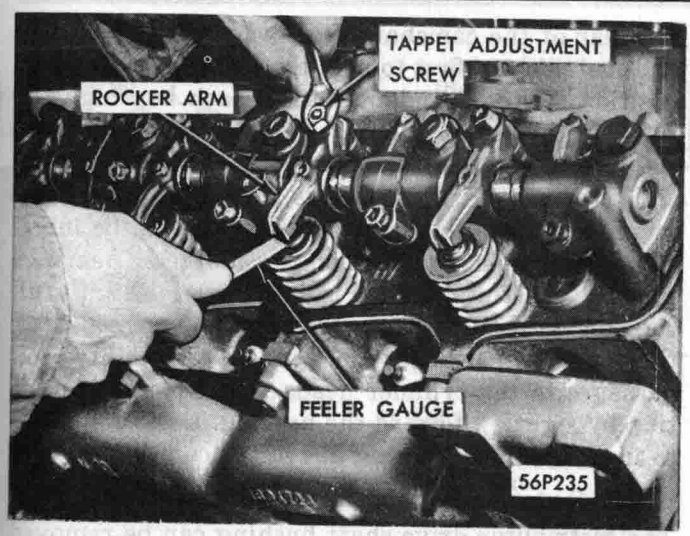


Fig. 10—Adjusting Mechanical Tappets

scribed in Paragraph "Timing Chain and Sprockets"

MECHANICAL TAPPET ADJUSTMENT

Mechanical tappet adjustments should be made after engine reaches normal operating temperature. Adjust intake rocker arms to have .012 inches clearance and the exhaust rocker arms to have .022 inches clearance (Fig. 10). The adjustment is made at the self-locking rocker arm adjusting screw. The screw should have a minimum of 3 foot-pounds tension as it is turned. If less than this, replace the adjustment screw and if necessary, the rocker arm.

CRANKSHAFT AND BEARINGS

Precision type bearings require careful handling. Do not touch or wipe a bearing when it is dry. When cleaning with a suitable solvent, use only a light finger pressure. When necessary to dry a bearing, use air pressure only.

a. Crankshaft Bearing Removal

With the engine in repair stand C-3167 and the cylinder heads, oil pan, and timing chain removed:

(1) Check and mark all bearing caps as necessary for proper location.

(2) Use ridge reamer Tool C-3012 to remove ridge at top of any cylinder bore.

(3) Remove oil strainer, tube and pump.

(4) Remove all connecting rod and piston assemblies, one at a time, using Tool C-3221 on one connecting rod bolt and the short portion of tool on the other bolt. Install cap on rod as soon as removed.

(5) Remove main bearing caps and crankshaft.

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to .001 inch. Journal grinding should not exceed .012 inch under the standard journal diameter. Do **NOT** grind thrust faces of Number 3 main bearing. Do **NOT** nick crankpin or main bearing fillets. After regrinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

The bearing caps are not interchangeable. The lower main bearing halves of 1, 2, and 4 are interchangeable. The upper main bearing halves of 1, 2, and 4 are interchangeable. Upper and lower bearing halves are NOT interchangeable.

The upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are **NOT** interchangeable with any other bearing halves in the engine (Fig. 11).

NOTE: Bearings that are not badly worn or pitted should be reinstalled in their original position.

b. Crankshaft Bearing Installation

(1) Install upper half of a new rear main bearing oil seal using Tool C-3511. Seal is seated when tool bottoms in main bearing bore. Hold seal in place with tool while trimming ends of seal flush with block.

(2) Install upper half of all main bearings with tangs of bearings in grooves in block and lubricate the bearings.

(3) Position crankshaft in the block.

(4) Smooth the edges of a ½ x ¾ inch piece of soft copper or brass shim stock, .001 inch thickness.

(5) Lubricate the main bearing journals and position the shim stock across the center main journal.

(6) Install bearing in center main bearing cap, bearing tang in groove in cap, lubricate bearing and seat cap on block. Tighten bolts to 85 foot-pounds torque.

(7) If a slight drag is felt as the crankshaft is turned (moved no more than ¼ turn in either direc-

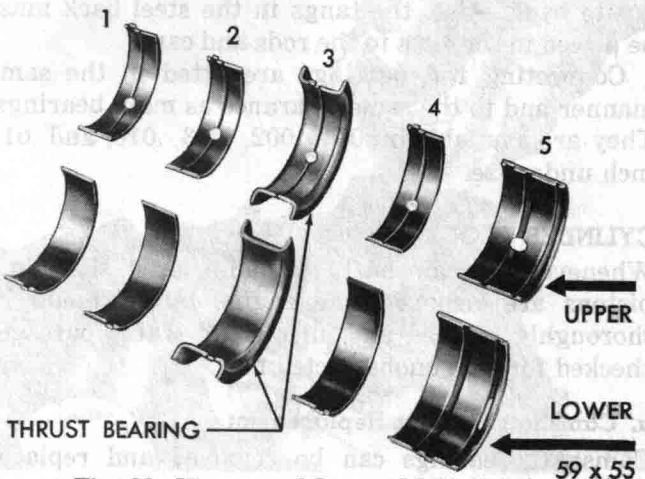


Fig. 11—Upper and Lower Main Bearings

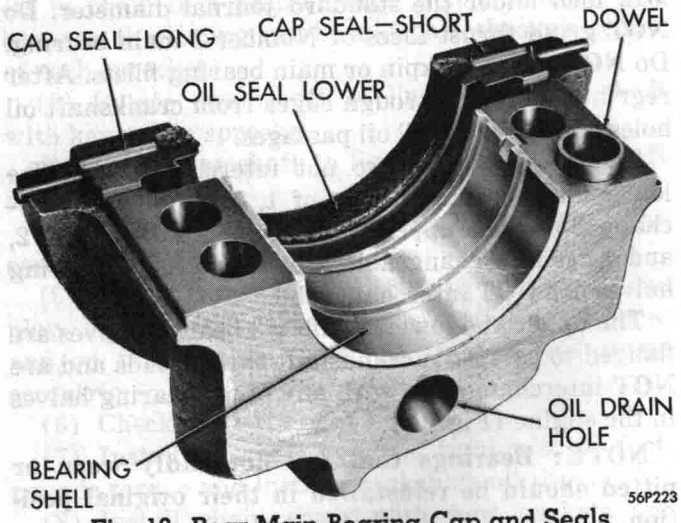


Fig. 12—Rear Main Bearing Cap and Seals

tion), the clearance is .001 inch or less and is considered satisfactory. If, however, no drag is felt, or the crankshaft cannot be rotated, the bearing is either too large or too small and should be replaced with the correct size.

(8) Check crankshaft end play to .002-.007 inch. If end play is less than .002" or more than .007", install a new Number 3 main bearing.

(9) Fit the remaining bearings in same manner.

10) Install new rear main bearing oil seal in the cap with Tool C-3511.

(11) Hold seal in place with tool and trim ends of seal flush with cap.

(12) Install bearing shell and cap seals (Fig. 12).

c. Checking Connecting Rod Bearings

Connecting rod bearings caps have a small "V" groove across the parting face. When installing a lower bearing, the "V" groove of the bearing must be placed on the "V" groove side of the cap. This provides lubrication of the cylinder wall in the opposite bank. Also, the tangs in the steel back must be placed in the slots in the rods and caps.

Connecting rod bearings are fitted in the same manner and to the same clearance as main bearings. They are available in .001, .002, .003, .010, and .012 inch undersize.

CYLINDER BLOCK

Whenever the camshaft, oil pump, crankshaft and pistons are removed, the engine block should be thoroughly cleaned and all oil and water passages checked for full, unobstructed flow.

a. Camshaft Bearing Replacement

Camshaft bearings can be removed and replaced with Tool C-3132 after removing the welch plug at the rear of the camshaft. Remove end bearings last and install them first to hold the tool in a centralized position. Select an adapter to fit each bearing. For removal, have the adapter shoulder and horseshoe retainer to the rear of the bearing. For installation, the shoulder and horseshoe is forward of the bearing. When installing bearings, they should be lubricated before placing them on the adapters. Bearings must be carefully aligned to bring oil holes into full register with oil passages from main bearings. Also, the Number 4 bearing must index with the two oil passages to the cylinder heads. Check bearing position by sighting toward the bearing. Use Tool C-897 to install new welch plug at rear of camshaft.

b. Distributor Drive Shaft Bushing Replacement

The distributor drive shaft bushing can be removed by threading Tool C-3052 into the bushing until a tight fit is obtained. Hold puller screw and tighten nut to remove bushing. To install, place new bushing on Tool C-3053 and insert tool and bushing. Drive bushing into position. As tool is removed by tightening nut the burnisher will wedge the bushing in the block and also burnish it to correct size. DO NOT REAM THIS BUSHING.

c. Cylinder Walls

Cylinder walls which are badly scored, scuffed, scratched, or worn more than .005 inch out-of-round or .010 inch taper should be rebored and new pistons and rings fitted. Tool C-119 is used in checking cylinder walls for out-of-round and taper. Micrometer measurement for size is to be taken half way down the bore and crosswise to the engine. Cylinder walls not requiring reboring should be resurfaced with Tool C-3501 using 280 grit stones. This tool can also be used after rough honing. Desirable cross hatch pattern is obtained by operating at 20 strokes in 20 seconds. This treatment can also be used to eliminate minor surface scratches and irregularities.

CAUTION

Be sure all abrasives are removed from engine parts. Use hot water and soap with a brisk scrubbing and thorough drying. Lacking soap and water, clean SAE 10 engine oil and clean cloths may be used. Cylinder walls are clean when a clean white cloth remains clean after wiping the cylinder walls. Coat cylinder walls with oil immediately after drying.

PISTONS

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures,

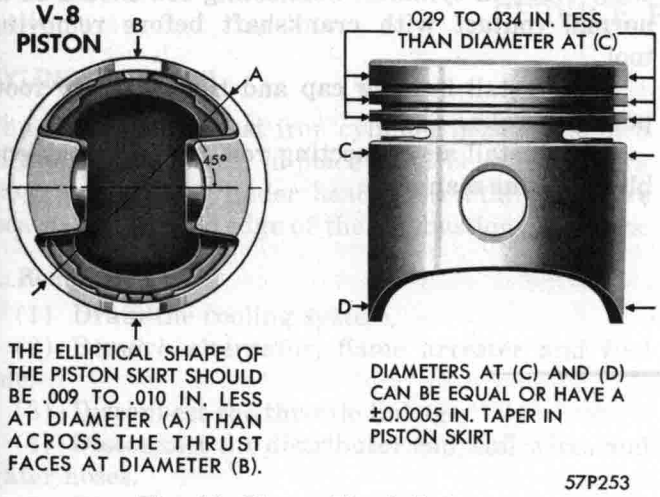


Fig. 13—Piston Check Points

expansion forces the pin bosses away from each other, thus causing the piston to assume a more nearly round shape. It is important that pistons be checked for taper and elliptical shape before they are fitted into the cylinder bore. (See Fig. 13).

a. Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize to maintain piston balance. For cylinder bores which have been honed or rebored, pistons are available in standard and the following oversizes: .005, .020, .040 inch.

b. Piston Fitting

Piston fitting should be done at normal room temperature, 70°F. Use a spring scale and a strip of ½ inch wide feeler stock .0015 inch thickness. The feeler stock should be long enough to extend into the cylinder bore to the full length of piston travel. **Cylinder bore and piston must be clean.**

(1) Coat the cylinder bore lightly with SAE 10W engine oil. Insert the piston in the bore upside down with the feeler stock between the thrust face of the piston and the cylinder wall.

(2) Hold the piston and draw the feeler stock straight out, with the spring scale.

(3) The amount of pull required should be from 5 to 10 pounds (Fig. 14).

c. Piston Pins

(1) With new pistons and new pins at room temperature, 70°F., the pin should be a tight thumb push fit in the piston and connecting rod. Replacement is necessary if there is excessive clearance between the pin and the piston. Ream piston and connecting rod to next oversize. New Pistons are supplied with properly fitted pins.

(2) Assemble pistons and rods for the left hand cylinder bank (1-3-5-7) with piston boss marked "Front" and indent on piston head on the same side as the large chamfer on large end of connecting rod. Assemble pistons and rods to be used in the right cylinder bank (2-4-6-8) with "Front" and indent opposite the large chamfer in the connecting rod.

d. Piston Rings

Measure the piston ring gap about 2 inches from the bottom of the cylinder bore in which it is to be used. (An inverted piston can be used to push the rings down into position. This will insure the rings being exactly square with the cylinder wall before measuring).

(1) Insert feeler stock in gap. The ring gap should be from .010 inch to .020 inch.

(2) Insert ring in the piston groove in which it will be installed. Insert feeler stock between the ring and ring land and roll ring around piston. Clearance should be uniform and for compression rings, from .0015 inch to .003 inch; and for oil rings from .001 inch to .003 inch.

(3) Use ring installing Tool C-3495. When installing piston rings, place expander in lower ring groove with ends toward the outside of "V" of engine. Install oil control ring over expander.

(4) Install compression rings with side marked "TOP" up.

(5) Position oil control ring gap in line with oil hole in connecting rod. Position the gap in compression rings opposite each other, with neither in line with the oil control ring gap.

(6) Immerse piston in clean oil, position compressor C-385 over the rings and tighten securely.

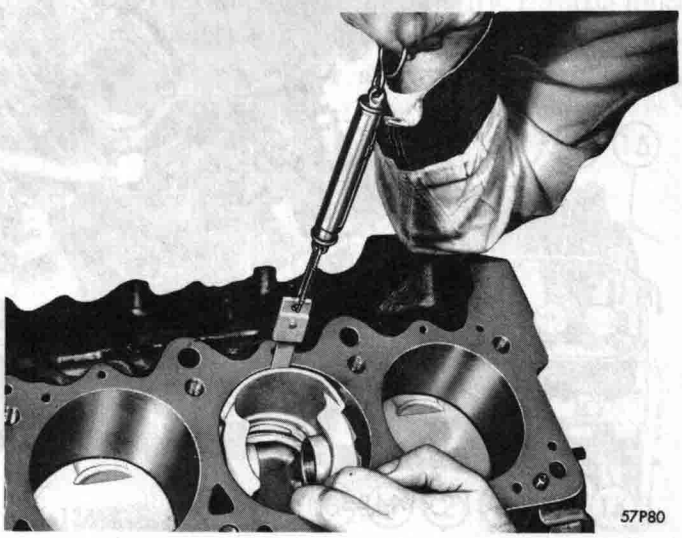


Fig. 14—Fitting Piston in Cylinder Bore

(7) Remove connecting rod bearing cap and install both parts of Tool C-3221 on rod cap bolts.

(8) Lubricate cylinder wall and insert piston in cylinder. Lubricate crankshaft journal.

(9) Guide connecting rod into position on crankshaft journal while pulling on long portion of tool to enter rings in cylinder. Connecting rod should be in normal contact with crankshaft before removing tool.

(10) Install bearing cap and tighten to 45 foot-pounds torque.

(11) Install all connecting rod and piston assemblies in same manner.

MODELS M-383, M-413

There are two basic V-8 engines (Fig. 15) used for the various models and have the same basic design. The engines differ only in the piston displacement, bore diameter, power output and carburetor equipment. All engines are equipped with valve in head, having a wedge shaped combustion chamber of 8:0 to 1 compression ratio. All engines use regular fuel. A periodic engine tune-up will assure maximum engine performance and fuel economy. Refer to the Engine Tune-up as outlined under the M-318 cubic inch engines.

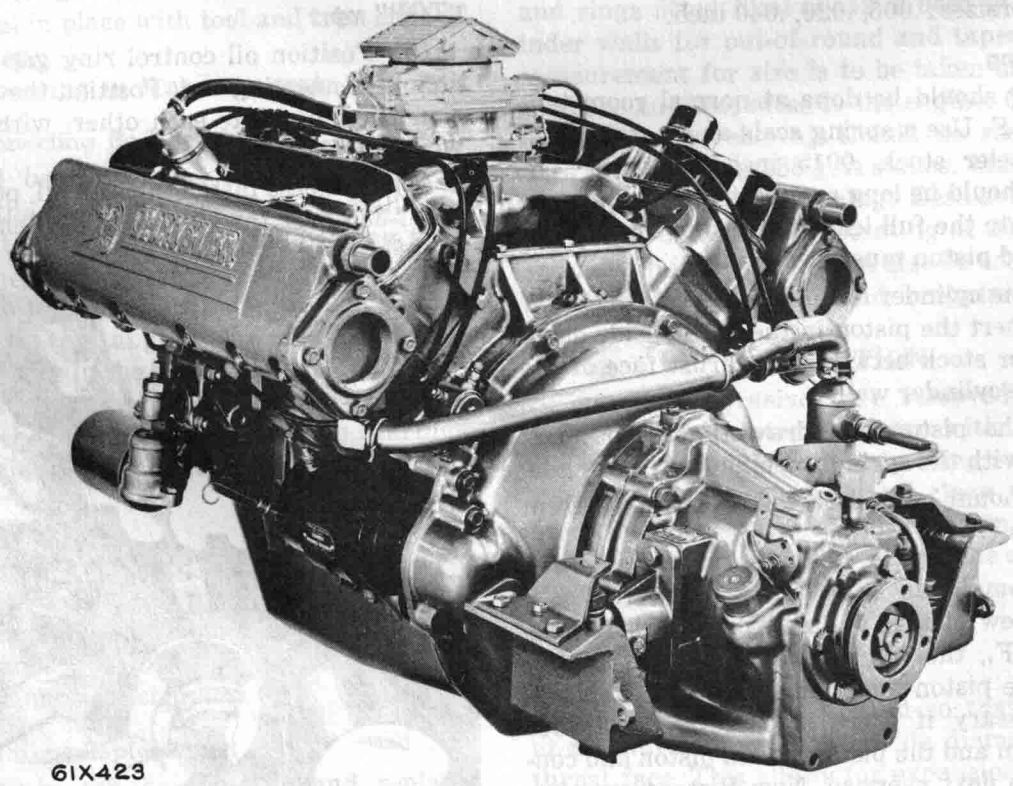


Fig. 15—Side View of Model M-413 Marine Engine

SERVICE PROCEDURES

CYLINDER HEADS

The chrome alloy cast iron cylinder heads as shown in Figure 16 are held in place by 17 bolts. The spark plugs enter the cylinder head horizontally and are located at the wide edge of the combustion chambers.

a. Removal

(1) Drain the cooling system.

(2) Remove alternator, flame arrester and fuel line.

(3) Disconnect the throttle linkage.

(4) Disconnect the distributor cap, coil wires and water hoses.

(5) Disconnect the heat indicator sending unit wire.

(6) Remove spark plugs located under the manifolds.

(7) Remove the intake manifold, ignition coil and carburetor as an assembly.

(8) Remove the tappet chamber cover.

(9) Remove cylinder head covers and gaskets.

(10) Remove exhaust manifolds.

(11) Remove the rocker arms and shaft assembly.

(12) Remove the push rods and place them in their respective slots in holder Tool C-3068.

(13) Remove the 17 head bolts from each cylinder head and remove cylinder heads.

(14) Place cylinder head in holding fixture Tool C-3626.

b. Installation

(1) Clean the gasket surfaces of cylinder block and cylinder head.

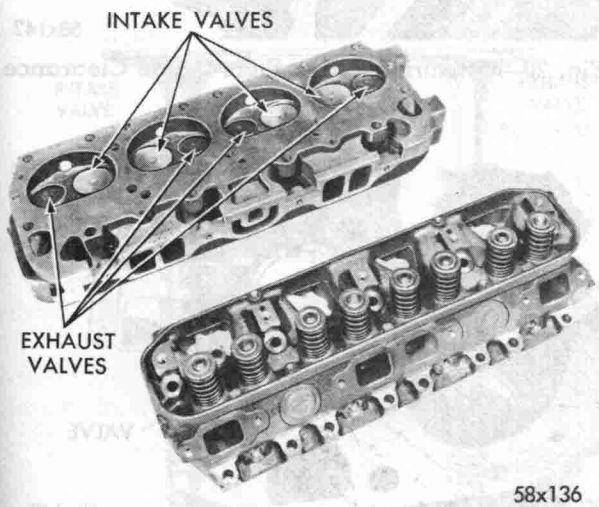


Fig. 16—Cylinder Heads

(2) Check all surfaces with a straightedge if there is any reason to suspect leakage.

(3) Coat the new gaskets with MoPar number 1122893 sealer. Install the gaskets and cylinder heads.

(4) Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 70 foot-pounds torque in sequence, as shown in Figure 17.

Repeat the procedure, retightening all head bolts to 70 foot-pounds torque.

(5) Inspect push rods and replace worn or bent rods.

(6) Install push rods with the small ends in tappets maintaining alignment using rod, as shown in Figure 18.

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

(8) Place the new cylinder head cover gaskets in position and install cylinder head covers. Tighten the nuts to 40 inch-pounds torque.

(9) Install exhaust manifolds and tighten the nuts to 30 foot-pounds torque.

(10) Adjust spark plugs to .035 inch gap and install the plugs, and tighten to 30 foot-pounds torque with Tool C-3054.

(11) Install the tappet chamber cover and tighten end bolts to 9 foot-pounds torque.

(12) Install intake manifold, carburetor and ignition coil as an assembly and tighten manifold bolts to 50 foot-pounds torque.

(13) Install the distributor cap. Connect the coil wire, heat indicator sending unit wire, throttle linkage, spark plug cables and insulators.

(14) Install alternator and drive belts. Tighten

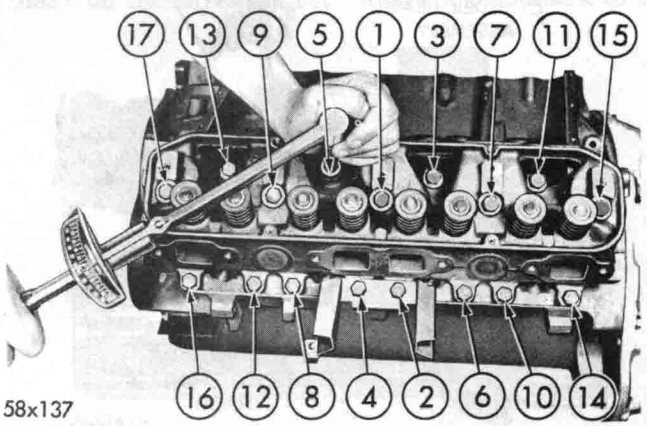


Fig. 17—Cylinder Head Tightening Sequence

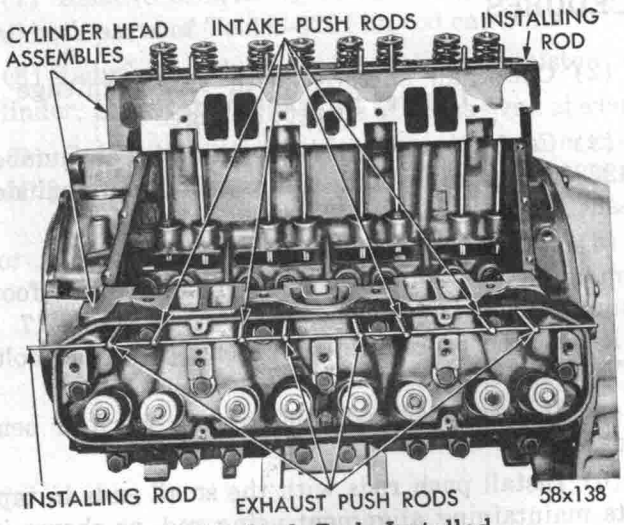


Fig. 18—Push Rods Installed

alternator bracket bolts to 30 foot-pounds, and alternator mounting nut to 20 foot-pounds torque.

(15) Install the fuel line and flame arrester.

VALVES AND SPRINGS

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

a. Removal

(1) With the cylinder head removed, compress valve springs using Tool C-3422, as shown in Figure 19.

(2) Remove the valve retaining locks, valve spring retainers, valve stem cup seals and valve springs.

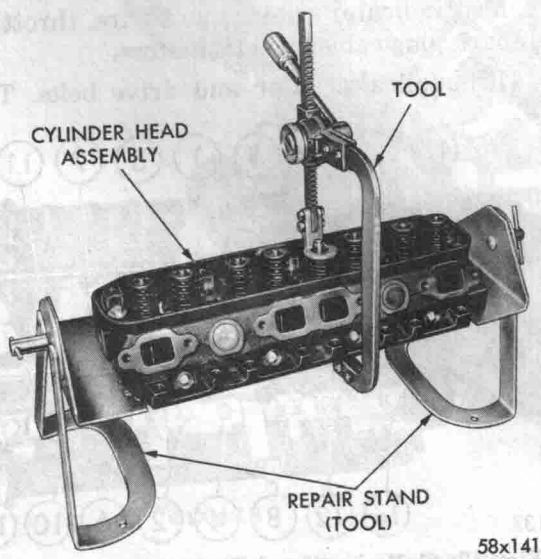


Fig. 19—Compressing Valve Spring

(3) Remove the burrs from the valve stem lock grooves to prevent damage to the valve guide when valves are removed.

b. Valve Inspection

(1) Clean the valves thoroughly, and discard burned, warped and cracked valves.

(2) Measure valve stems for wear. New intake valve stem diameter should measure .375 to .373 inch and exhaust valve stem diameter should measure .371 to .372 inch. If the wear exceeds .002 inch, replace the valve.

(3) Remove carbon and varnish deposits from the inside of valve guides with cleaner, Tool C-756.

(4) Measure the valve stem guide clearance as follows: Install sleeve Tool C-3026 over the valve stem as shown in Figure 20 and install valve.

(5) The special sleeve places the valve at the correct height for checking with a dial indicator. Attach the dial indicator Tool C-3339 to cylinder head and set it at right angle of the valve stem being measured (Fig. 21).

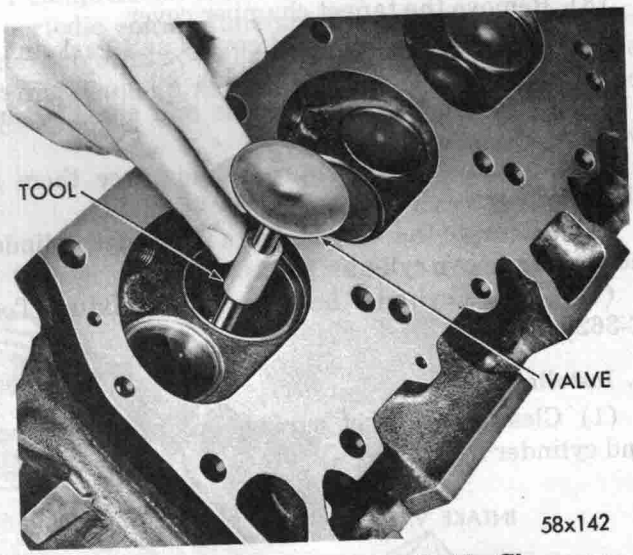


Fig. 20—Measuring Valve Stem Guide Clearance

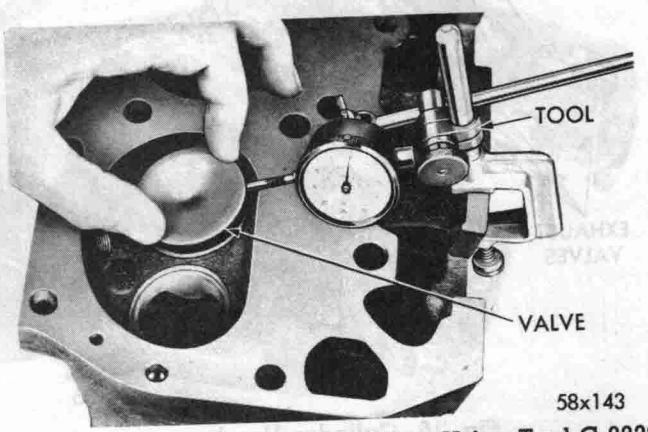


Fig. 21—Measuring Guide Wear Using Tool C-3339

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

(7) Service valves with oversize stems are available in .005, .015 and .030 inch oversizes. Reamers to accommodate the oversize valve stem are as follows: Reamer Tool C-3433 (.379 to .380 inch). Reamer Tool C-3430 (.389 to .390 inch). Reamer Tool C-3427 (.404 to .405 inch).

(8) Slowly turn reamer by hand and clean guide thoroughly before installing new valve **Do not attempt to ream the 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 the valve seat.**

c. Refacing Valves and Valve Seats

The intake and exhaust valve faces have a 45 degree angle. Always inspect the remaining margin after the valves are refaced (Fig. 22). Valves with less than $\frac{3}{64}$ inch margin should be discarded.

(1) The angle of both valve and seat should be identical. When refacing the valve seats it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using a dial indicator. The total runout should not exceed .002 inch (total indicator reading). When the seat is properly positioned, the width of intake seats should be $\frac{1}{16}$ to $\frac{3}{32}$ inch. The width of exhaust seats should be $\frac{3}{64}$ to $\frac{1}{16}$ inch.

(3) When the valves and seats are reground, the position of the valve in the cylinder head is changed,

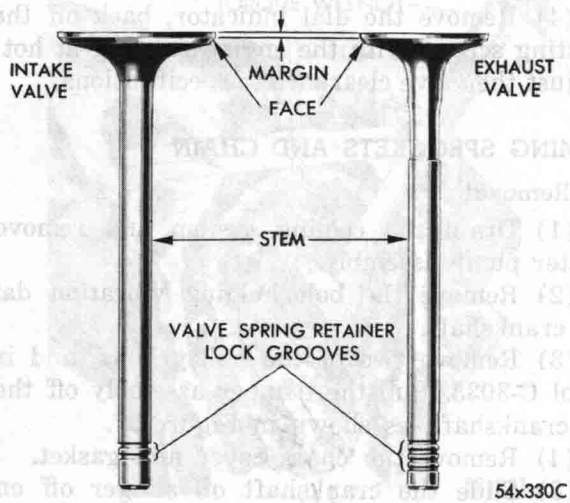


Fig. 22—Intake and Exhaust Valve Faces

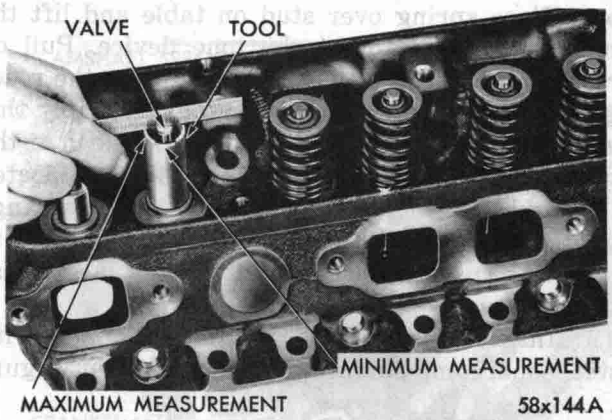


Fig. 23—Measuring Valve Stem Length Using Tool C-3648

shortening the operating length of the push rod.

(4) The design of the valve mechanism includes a safety factor to allow for a limited amount of wear, and the refacing of valves and seats.

(5) To insure that the limits have not been exceeded, the dimension from valve spring seat in head to valve tip should be measured with Gauge, Tool C-3648, as shown in Figure 23.

(6) The end of the cylindrical gauge and the bottom of slotted area represent the maximum and minimum allowable extension of valve stem tip beyond the spring seat.

(7) If the tip exceeds maximum, grind the stem tip to within gauge limits.

d. Testing Valve Springs

(1) Whenever the valves have been removed for inspection, reconditioning or replacement, the valve springs should be tested. To test a spring, first determine the length at which the spring is to be tested. As an example, the compressed length of the spring to be tested is $1\frac{15}{32}$ inches. Turn the table of Tool C-647 until surface is in line with the $1\frac{15}{32}$ inch mark on the threaded stud and the zero mark to the

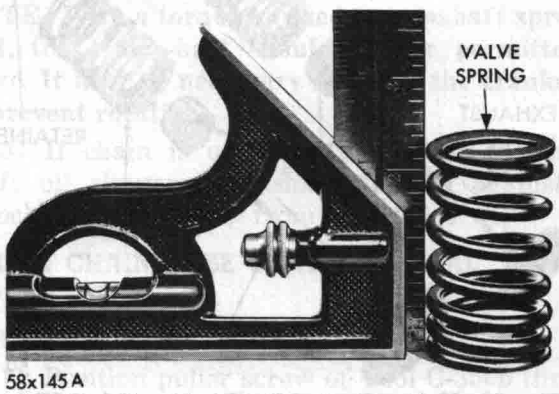


Fig. 24—Checking Valve Spring Squareness

front. Place spring over stud on table and lift the compressing lever to set the tone device. Pull on torque wrench until a ping is heard. Take the reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at the test length. Fractional measurements are indicated on the table for finer adjustments. The valve springs should test 187 to 203 pounds when compressed to $1\frac{15}{32}$ inch. Discard springs that do not meet these specifications.

(2) Inspect each valve spring for squareness with a steel square and surface plate, as shown in Figure 24.

(3) If the spring is more than $\frac{1}{16}$ inch out of square, install a new spring.

e. Installation

(1) Coat the valve stems with lubricating oil and insert them in position in cylinder head.

(2) Install the cup seals on intake and exhaust valve stems and over valve guides, as shown in Figures 25 and 26 and install valve springs and retainers.

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

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

MECHANICAL TAPPET ADJUSTMENT

(1) Operate the engine until normal operating

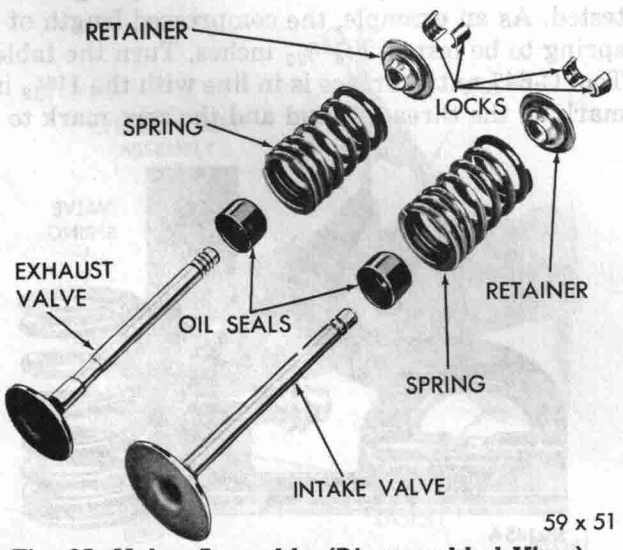


Fig. 25—Valve Assembly (Disassembled View)

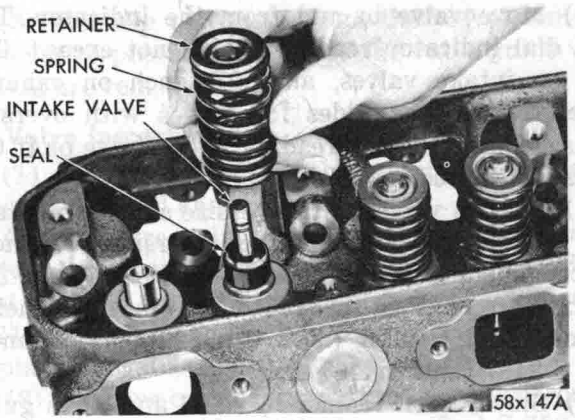


Fig. 26—Installing Valve and Cup Seals

temperature (approximately 180 degrees water temperature) has been reached.

(2) With the engine running at hot idle, adjust the intake rocker arms to .015 inch clearance and the exhaust rocker arms to .026 inch clearance.

VALVE TIMING (Right and Left Hand Rotation)

(1) Rotate the crankshaft until the #6 exhaust valve is closing and the #6 intake valve is opening. Turn the #1 intake (2nd valve on left bank) rocker arm adjusting screw down to zero clearance, plus ½ turn. Install a dial indicator so the indicator pointer contacts the retainer as near to 90 degrees angle as possible. Adjust the dial indicator to zero.

(2) Turn the crankshaft in the normal running direction until the valve has lifted .069 inch. The timing pointer should read from 5 degrees B.T.D.C. to 7 degrees A.T.D.C.

(3) If th reading is not within the above specified limits: Note the sprocket index marks. Inspect the timing chain for wear. Determine the accuracy of the D.C. mark on the vibration damper.

(4) Remove the dial indicator, back off the adjusting screw; with the engine running at hot idle, adjust the valve clearance to specifications.

TIMING SPROCKETS AND CHAIN

a. Removal

(1) Drain the cooling system and remove the water pump assembly.

(2) Remove the bolt holding vibration damper on crankshaft.

(3) Remove two of the pulley bolts, and install Tool C-3033. Pull the damper assembly off the end of crankshaft, as shown in Figure 27.

(4) Remove the chain cover and gasket.

(5) Slide the crankshaft oil slinger off end of crankshaft.

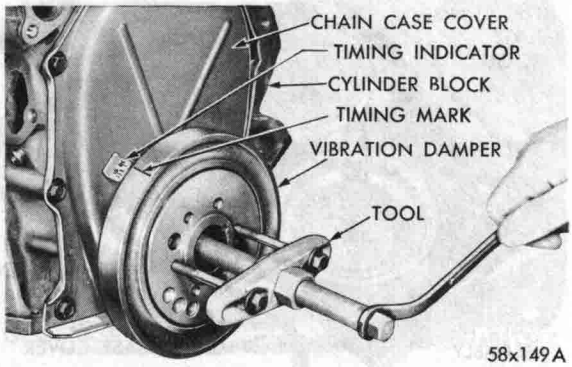


Fig. 27–Removing Vibration Damper Assembly Using Tool C-3033

(6) Remove the camshaft sprocket attaching bolt.

(7) Remove timing chain with crankshaft and camshaft sprockets.

b. Installation

(1) Place both the camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(2) When installing the timing chain use Tool C-3509 to prevent the camshaft from contacting the rear welch plug in the rear of the engine block.

(3) Place the timing chain around both sprockets.

(4) Turn the crankshaft and camshaft to line up with the keyway location in crankshaft sprocket and the dowel holes in the camshaft sprocket.

(5) Lift the sprockets and chain (keep sprockets tight against the chain in position as described).

(6) Slide both sprockets evenly over their respective shafts.

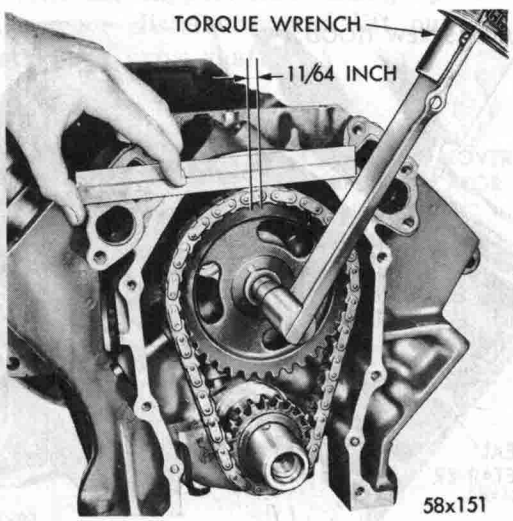


Fig. 28–Measuring Chain Stretch

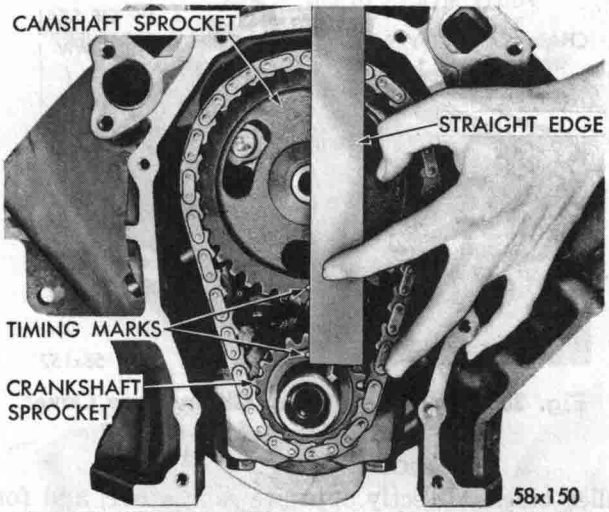


Fig. 29–Checking Alignment of Timing Marks Using a Straightedge

(7) Use a straightedge to check alignment of the timing marks (Fig. 28).

(8) Install the washer and camshaft sprocket bolt and tighten to 35 foot-pounds torque.

c. Checking Timing Chain for Stretch

(1) Place a scale next to timing chain so that any movement of the chain may be measured.

(2) Place a torque wrench and socket over the camshaft sprocket attaching bolt and apply torque in the direction of crankshaft rotation to take up the slack; 30 foot-pounds torque (with cylinder head installed) or 15 foot-pounds torque (cylinder heads removed).

(3) Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed), and note the amount of chain movement, as shown in Figure 29.

(4) Install a new timing chain, if its movement exceeds $^{11}/_{64}$ inch.

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

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

TIMING CHAIN CASE COVER OIL SEAL REPLACEMENT

a. Removal

(1) Position puller screw of Tool C-3506 through case cover, the inside of case cover up. Position the

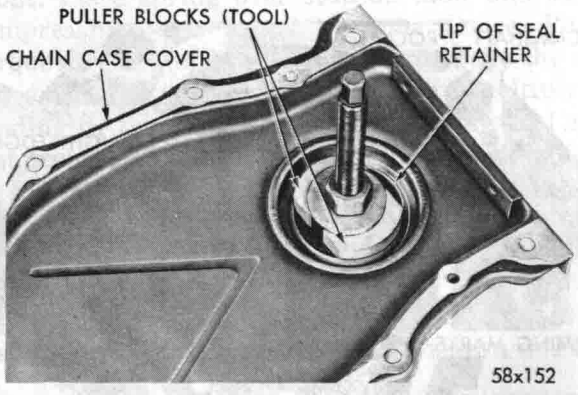


Fig. 30–Removing Timing Chain Case Cover Oil Seal Using Tool C-3506

puller blocks directly opposite each other, and force the angular lip between neoprene and flange of the seal retainer.

(2) Place washer and nut on puller screw. Tighten the nut as tight as possible by hand, forcing blocks into gap to a point of distorting the seal retainer lip (Fig. 30). This is important (puller is only positioned at this point.)

(3) Place sleeve over the retainer and place removing and installing plate into sleeve.

(4) Place the flat washer and nut on puller screw. Hold the center screw and tighten lock nut to remove seal (Fig. 31).

b. Installation of Oil Seal

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

(2) Insert puller screw with plate through the seal opening (inside of chain case cover facing up).

(3) Place the seal in cover opening, with neoprene down. Place the seal installing plate into the

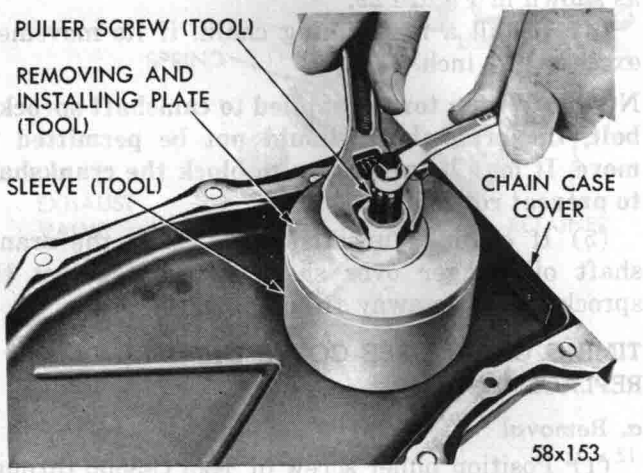


Fig. 31–Removing Oil Seal

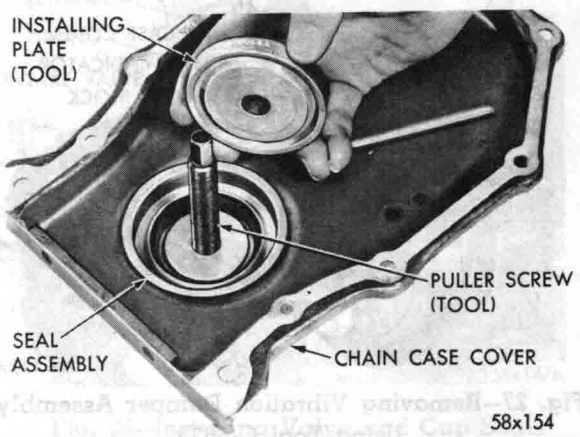


Fig. 32–Positioning Installer Plate on New Seal

new seal, with protective recess toward lip of seal retainer (Fig. 32).

(4) Install the flat washer and nut on puller screw, hold screw and tighten the nut (Fig. 33).

(5) The seal is properly installed when neoprene is tight against the face of cover. Try to insert a .0015 feeler gauge between neoprene and cover (Fig. 34). If the seal is installed properly, the feeler gauge cannot be inserted. **It is normal to find particles of neoprene collected between the seal retainer and crankshaft oil slinger after the seal has been in operation.**

c. Installing Chain Case Cover

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

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

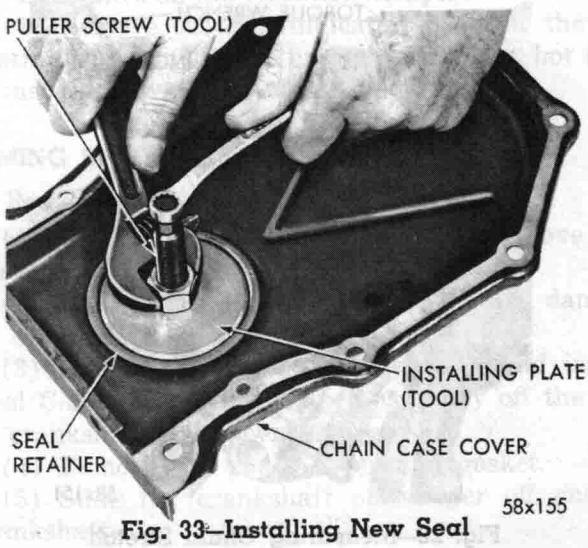


Fig. 33–Installing New Seal

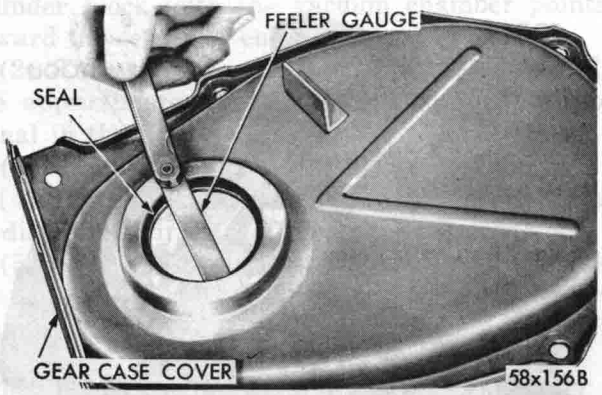


Fig. 34—Checking Seal for Proper Seating

d. Installing Vibration Damper

(1) Install the damper hub key in slot in crankshaft, and slide hub on crankshaft.

(2) Place the installing tool, part of Puller set Tool C-3033 in position and press damper hub on the crankshaft (Fig. 35).

(3) Slide the pulley over the shaft and attach with bolts and lockwashers.

(4) Tighten the bolts to 15 foot-pounds torque.

(5) Install damper hub retainer washer and bolts. Tighten to 135 foot-pounds torque.

CAMSHAFT REMOVAL

The camshaft has an integral oil pump and distributor drive gear and fuel pump eccentric, as shown in Figure 36.

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

(1) With the tappets and timing sprockets removed, remove distributor and lift out oil pump and distributor drive shaft.

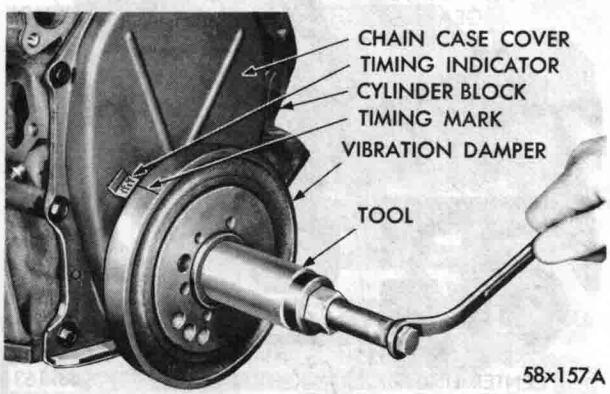


Fig. 35—Installing Vibration Damper Assembly

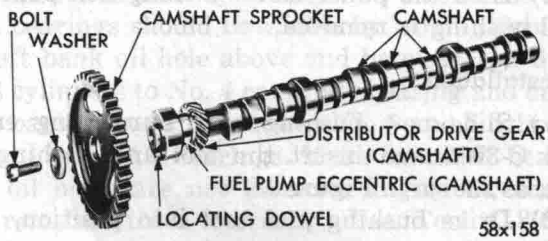


Fig. 36—Camshaft and Sprocket Assembly (Disassembled View)

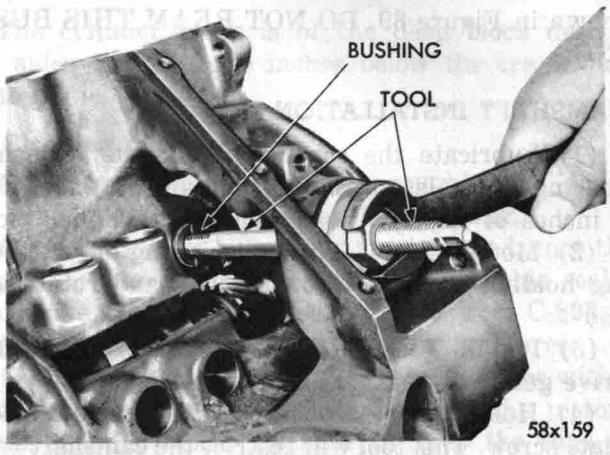


Fig. 37—Removing Distributor Drive Shaft Bushing

(2) Remove the fuel pump to allow the push rod to drop away from the cam eccentric.

(3) Remove the camshaft being careful not to damage the cam bearings with the cam lobes.

DISTRIBUTOR DRIVE SHAFT BUSHINGS

a. Removal

(1) Insert Tool C-3052 into old bushing and

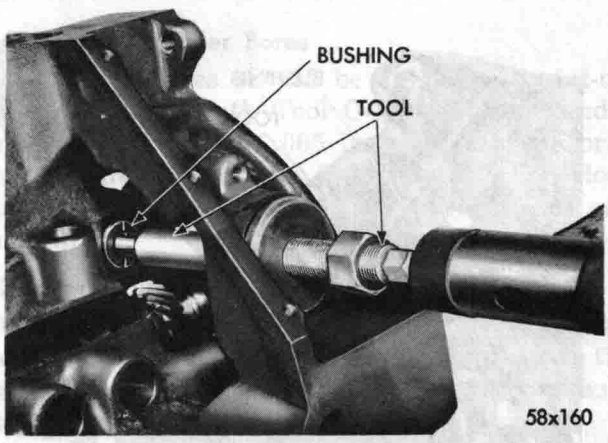


Fig. 38—Installing Distributor Drive Shaft Bushing Using Tool C-3053

thread down until a tight fit is obtained (Fig. 37).

(2) Hold the puller screw and tighten puller nut until bushing is removed.

b. Installation

(1) Slide new bushing over burnishing end of Tool C-3053 and insert the tool and bushing into bore, as shown in Figure 38.

(2) Drive bushing and tool into position, using soft hammer.

(3) As the burnisher is pulled through bushing by tightening puller nut, the bushing is expanded tight in block and burnished to correct size, as shown in Figure 39. DO NOT REAM THIS BUSHING.

CAMSHAFT INSTALLATION

(1) Lubricate the camshaft lobes and camshaft bearing journals and insert the camshaft to within 2 inches of its final position in the cylinder block.

(2) Modify Tool C-3509 by grinding off the index lug holding upper arm on the tool and rotate arm 180°.

(3) Install Tool C-3509 in place of distributor drive gear and shaft, as shown in Figure 40.

(4) Hold the tool in position with distributor lock plate screw. This tool will restrict the camshaft from being pushed in too far and prevent knocking out the welch plug in the rear of the cylinder block. **The tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

NOTE: Whenever an engine has been rebuilt and a new camshaft and/or new tappets have been installed, one quart of factory recommended oil additive MoPar part number 1879406 should be added to the engine oil to aid in break-in. The oil mixture should be left in the engine for a minimum of 25 hours. Drain the oil mixture at the next normal oil change.

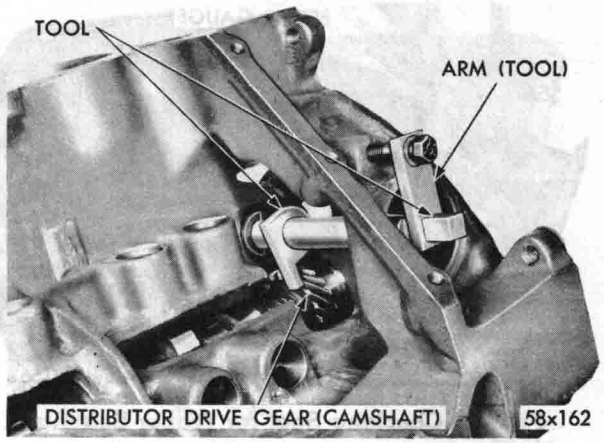


Fig. 40—Camshaft Holding Tool C-3509

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

a. Distributor Timing

Before installing the distributor and oil pump drive shaft, time engine as follows:

(1) Rotate the crankshaft until No. 1 cylinder is at top dead center on firing stroke.

(2) When in this position, the straight line on the vibration damper should be under (DC) on the timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after the gear spirals into place, it will index with oil pump shaft, so that the slot in top of drive gear will be parallel with center line of crankshaft as shown in Figure 41.

b. Installation of Distributor

(1) Hold distributor over the mounting pad on

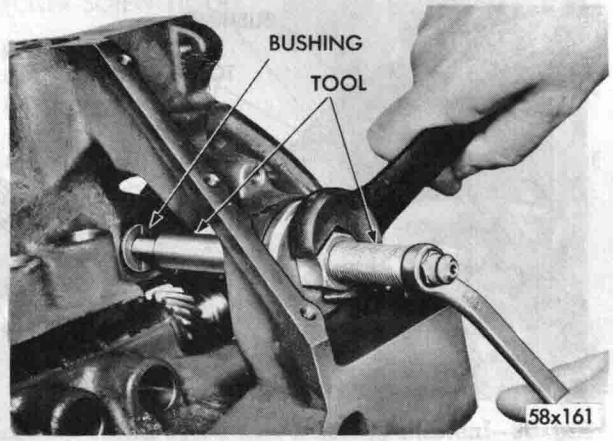


Fig. 39—Burnishing Distributor Drive Shaft Bushing

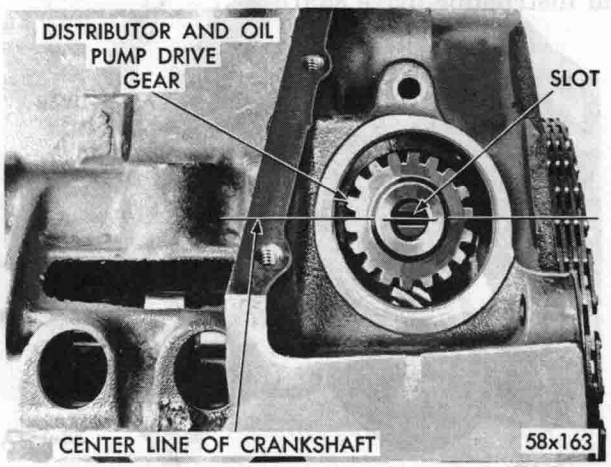


Fig. 41—Distributor Drive Gear Installed

cylinder block with the vacuum chamber pointing toward the center of engine.

(2) Turn the rotor until it points forward and to the approximate location of the No. 1 tower terminal in the distributor cap.

(3) Place distributor gasket in position.

(4) Lower distributor and engage shaft in slot of distributor drive shaft gear.

(5) Turn distributor clockwise until the breaker contacts are just separating and install hold down clamp.

REMOVAL AND INSTALLATION OF CAMSHAFT BEARINGS (Engine Removed)

a. Removal

(1) With the engine completely disassembled, drive out the rear cam bearing welch plug.

(2) Install proper size adapters and horse shoe washers (part of Tool C-2132A) at back of each bearing shell to be removed and drive out the bearing shells.

b. Installation

(1) Install the new camshaft bearings with Tool C-2132A by sliding the new camshaft bearing shell over the proper adapter.

(2) Position bearing in the tool. Install horse shoe lock and by reversing removal procedure, carefully drive bearing shell into place, as shown in Figure 28.

(3) Install remaining shells in like manner.

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

The oil holes in camshaft bearings and cylinder block must be in exact alignment to insure proper lubrication (Fig. 42).

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

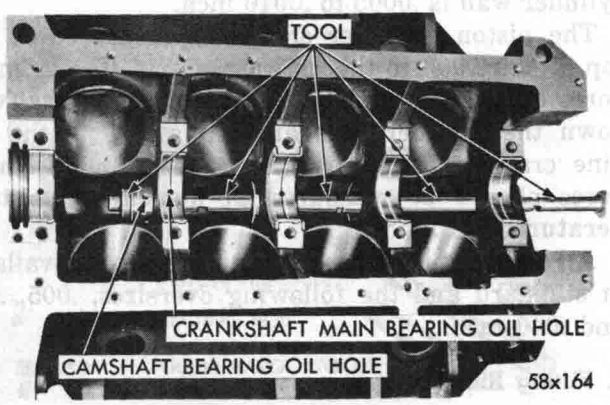


Fig. 42—Removing Camshaft Bearing

CYLINDER BLOCK

The cylinder block is of the deep block design. Its sides extend three inches below the crankshaft center line.

a. Cleaning and Inspection

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core hole plugs are installed, coat the edges of plug and core hole with a suitable sealer and drive plugs in place with driver, Tool C-897.

(3) Examine block for cracks or fractures.

(4) Remove the top ridge of cylinder bores with a reliable ridge reamer before removing the pistons from cylinder block. **Be sure to keep the tops of pistons covered during this operation.**

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

(1) Remove connecting rod cap.

(2) Install Tool C-3221 on one connecting rod bolt and protector over the other bolt and push each piston and rod assembly out of the cylinder bore.

(3) After removal, install bearing cap on mating rod.

b. Checking Cylinder Bores

The cylinder bores should be checked for out-of-round and taper with Tool C-119. If the 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 honed, and new pistons and rings fitted.

c. Honing Cylinder Bores

NOTE: Before honing, stuff plenty of clean rags under the bores, over the crankshaft to keep the abrasive materials from entering the crankshaft area.

(1) To remove light scoring, scuffing, or scratches, from the cylinder walls, use Tool C-823.

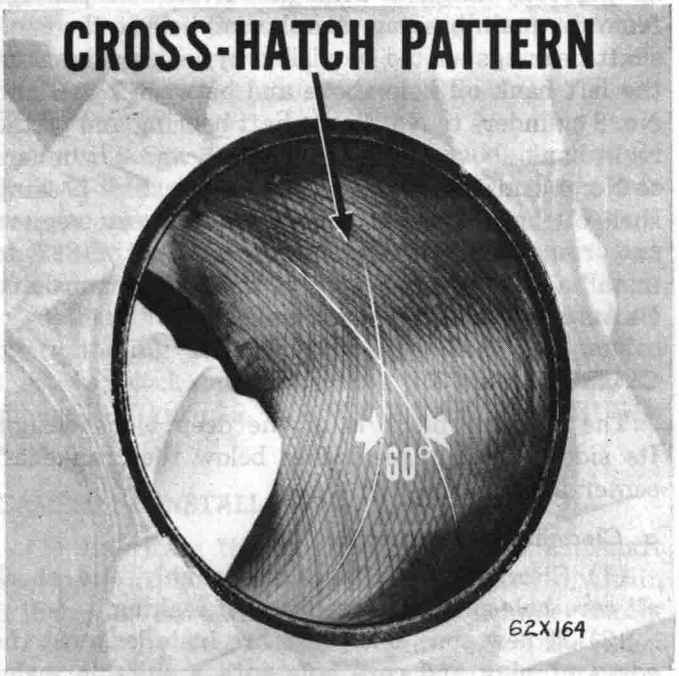


Fig. 43—Cross Patch Pattern

Usually a few strokes will clean up a bore and maintain the required limits.

(2) The cylinder walls should be deglazed, using cylinder surfacing hone Tool C-3501 equipped with 280 grit stones, prior to installation of the new rings or to smooth down the cylinder walls after rough honing.

(3) A satisfactory finish can be obtained by giving each cylinder wall 20 strokes in 20 seconds with the hone so that a cross hatch pattern will be obtained (Fig. 43).

(4) After honing, it is necessary that the block be cleaned again to remove all traces of abrasives, and to prevent excessive wear of engine parts.

(5) The hone may be safely used for removal of metal up to .005 inch and as high as .010 to .015 inch by an experienced operator.

CAUTION

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

d. Cylinder Walls

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

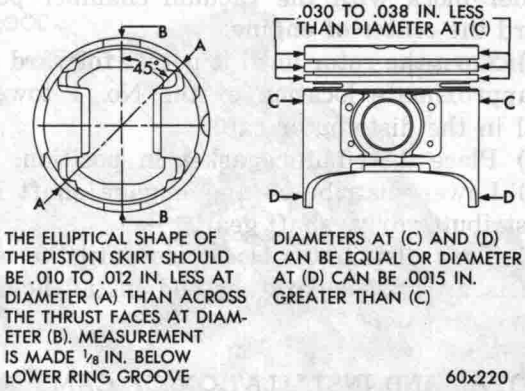


Fig. 44—Piston Dimensions

PISTONS

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus, causing the piston to assume a more nearly round shape. It is important that pistons be checked for taper and elliptical shape before they are fitted into the cylinder bore. (See Fig. 44).

a. Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize to maintain piston balance. For cylinder bores which have been honed or rebored, pistons are available in standard and the following oversizes: .005, .020, .040 inch.

b. Fitting Pistons

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

The piston diameter should be measured at the top of skirt 90° to the piston pin axis. The cylinder bores on used engines should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line. **Pistons and cylinder bores should be measured at normal room temperature 70°F.**

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

c. Fitting Rings

(1) Measure the piston ring gap about two (2)

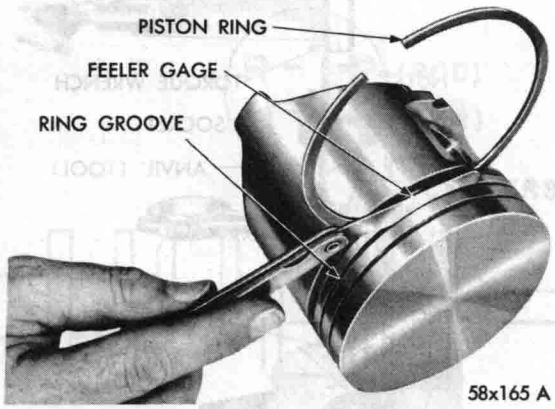


Fig. 45—Measuring Piston Ring Clearance

inches from bottom of cylinder bore in which it is to be fitted. (An inverted piston can be used to push the rings down to insure positioning rings squarely in the cylinder wall before measuring.)

(2) Insert the feeler stock in gap. The ring gap should be between .013 to .025 inch. This measurement is the same for all rings.

(3) Measure the side clearance between piston ring and ring land (Fig. 45). The clearance should be .0015 to .003 inch for the top compression ring and the intermediate ring, and .001 to .003 inch for the oil control ring.

(4) Starting with the oil ring expander, place expander ring in the lower ring groove and install oil control ring.

(5) Install the compression rings in the middle and top grooves. Use ring installer Tool C-3673 for the 383 cubic inch engine and Tool C-3671 for the 413 cubic inch engine.

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

PISTON PINS

a. Removal

(1) Arrange Tool C-3684 parts for the removal

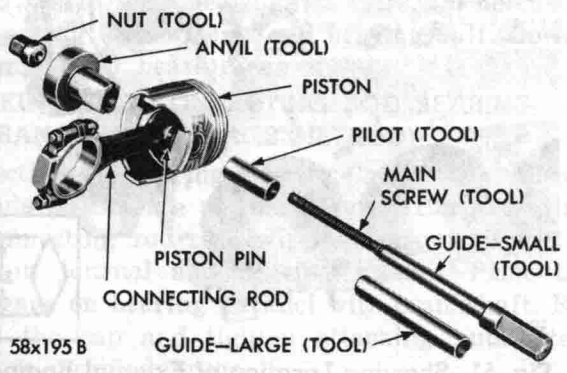


Fig. 46—Removing Piston Pin Using Tool C-3624

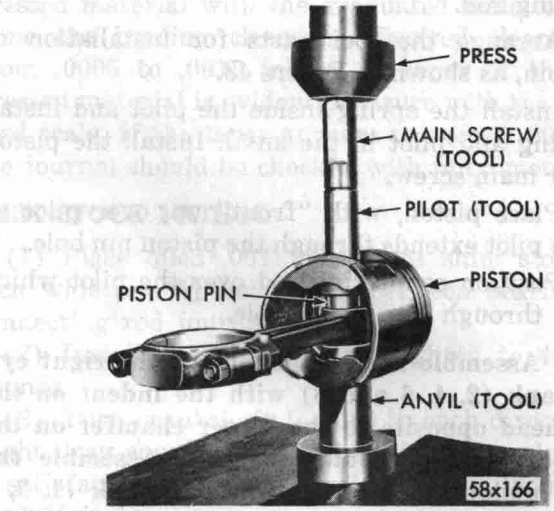


Fig. 47—Removing Piston Pin from Connecting Rod

of piston pin, as shown in Figure 46.

(2) Install pilot on the main screw.

(3) Install the screw through the piston pin.

(4) Install anvil over the threaded end of the main screw with small end of anvil against the piston boss. **Be sure spring is removed from the anvil.**

(5) Install nut loosely on the main screw and place the assembly on a press, as shown in Figure 47.

(6) Press the piston pin out of connecting rod. **When the pin falls free from connecting rod, stop the press to prevent damage to bottom of the anvil.**

(7) Remove the tool from the piston.

b. Installation

(1) Check the piston pin fit in the piston. It should be a sliding fit in the piston at 70° F. Piston pins are supplied in standard sizes only.

(2) Lubricate piston pin holes in the piston and

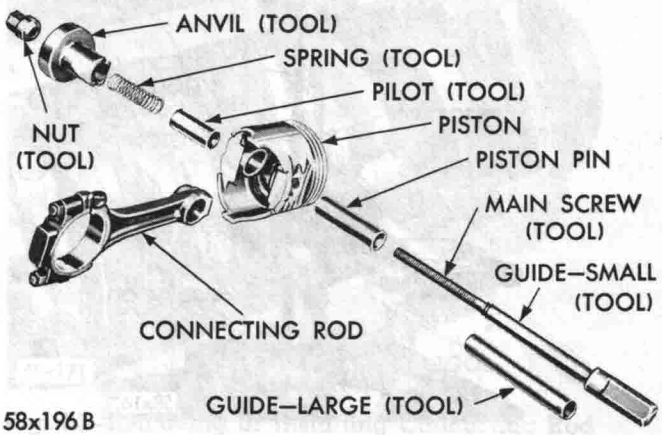


Fig. 48—Installing Piston Pin Using Tool C-3624

connecting rod.

(3) Arrange the tool parts for installation of piston pin, as shown in Figure 48.

(4) Install the spring inside the pilot and install the spring and pilot in the anvil. Install the piston pin over main screw.

(5) Place piston, with "front" up, over pilot so that the pilot extends through the piston pin hole.

(6) Position connecting rod over the pilot which extends through the piston hole.

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

(7) Install the main screw and piston pin in the piston, as shown in Figure 48.

(8) Install the nut on puller screw to hold assembly together. Place assembly on a press, as shown in Figure 49.

(9) Press in the piston pin until piston pin bottoms on the pilot properly positioning the pin in the connecting rod.

(10) Remove the tool and arrange tool parts and piston assembly in the same manner, as shown in Figure 46.

(11) Place the assembly in a vise, as shown in Figure 50.

(12) Attach the torque wrench to nut and check torque up to 15 foot-pounds torque. If the connecting rod moves downward on piston pin, reject this connecting rod and piston pin combination. Obtain

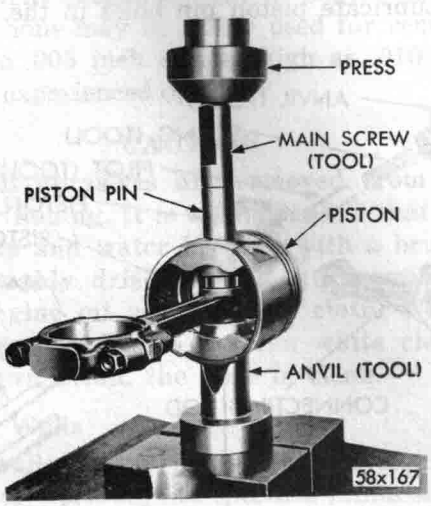


Fig. 49–Installing Piston Pin in Connecting Rod

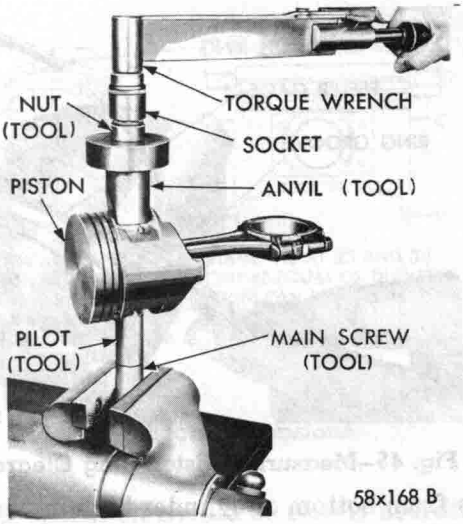


Fig. 50–Testing Fit with Pin in Connecting Rod

a connecting rod with proper small end bore diameter and repeat the installation and checking procedure.

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

CONNECTING RODS

IMPORTANT

A Maltese Cross stamped on the engine numbering pad (Fig. 51) indicates that engine is equipped with a crankshaft which has one or more connecting rods and/or main bearing journal finished .001 inch oversize. The position of the undersize journal or journals is stamped on machined surface of No. 3 counterweight Fig. 52).

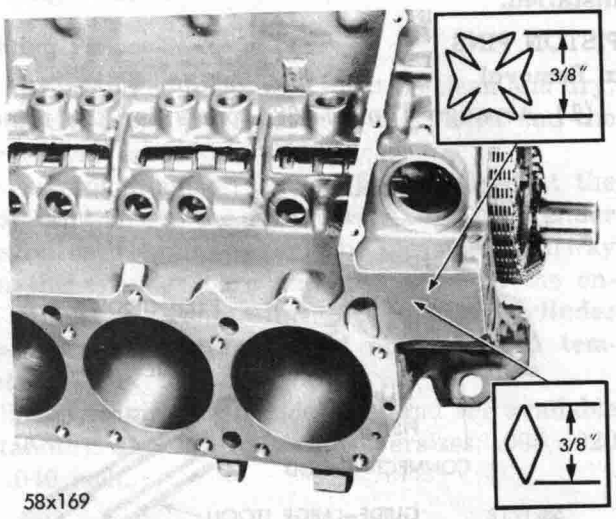


Fig. 51–Showing Location of External Engine Numbering Pad

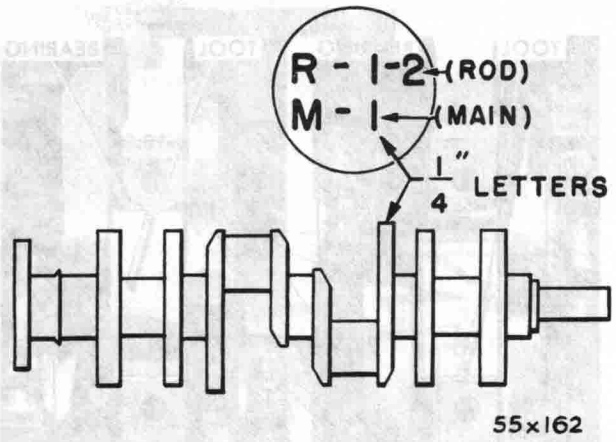


Fig. 52—Showing Location of Internal Location of No. 3 Counterweight

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

INSTALLATION OF CONNECTING ROD BEARINGS

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

Each bearing cap has a small "V" groove across the parting face. When installing the lower bearing shell, make certain that the "V" groove in shell is in line with "V" groove in cap. This allows lubrication of the cylinder wall. The bearings should always be installed so that small formed tang fits into machined grooves of rods. The end clearance should be from .009 to .017 inch (two rods).

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

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

CHECKING THE CONNECTING ROD BEARING CLEARANCE (PLASTIGAGE METHOD)

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

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

SHIM STOCK METHOD

(1) Place oiled .001 inch brass shim stock (½ inch wide and ¾ inch long) between bearing and connecting rod journal.

(2) Install bearing cap and tighten to 45 foot-pounds.

(3) Turn crankshaft ¼ turn in each direction. A slight drag should be felt which indicates clearance is satisfactory. The correct clearance is from .0005 to .0015 inch.

(4) The side clearance should be from .009 to .017 inch (two rods).

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY IN CYLINDER BLOCK

(1) Before installing the pistons, rods, and rod assemblies in bore, be sure that compression ring gaps are diametrically opposite one another and not in line with oil ring gap.

(2) The oil ring expander should be toward the outside of the "V" of the engine. The oil ring gap should be turned toward the inside of the "V" of engine.

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, Tool C-385, over the piston and tighten with the special wrench (part of Tool C-385).

(4) Be sure the position of rings does not change during this operation. Screw the connecting rod bolt protector (part of Tool C-3221) on one rod bolt, and insert the rod and piston into cylinder bore.

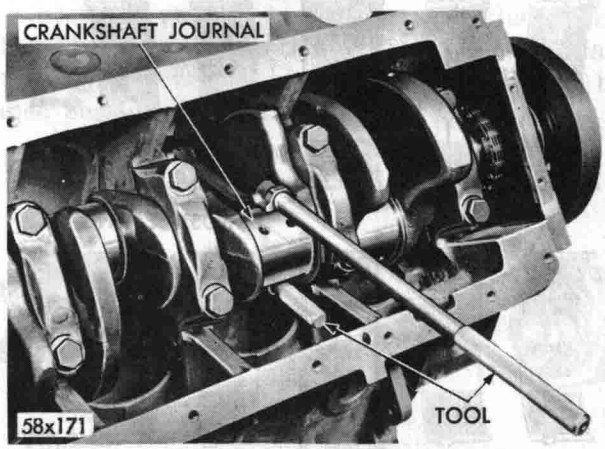


Fig. 53—Removing or Installing Connecting Rod Using Tool C-3221

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

(5) Attach the puller part of Tool C-3221 on the other bolt, and guide the rod over the crankshaft journal, as shown in Figure 53.

(6) Tap piston down in the cylinder bore, using the handle of a hammer. At the same time, guide connecting rod into piston on crankshaft journal.

(7) The notch or groove on the top of the piston must be pointing toward front of the engine and the larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install the rod caps, tighten nuts to 45 foot-pounds torque.

CRANKSHAFT MAIN JOURNALS

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

CRANKSHAFT MAIN BEARINGS

The lower main bearing halves of 1, 2, 4 and 5 numbers are interchangeable, as shown in Figure 54. The upper main bearing halves of 1, 2, 4 and 5 numbers are interchangeable. Upper and lower bearing halves are not interchangeable because the upper bearing is grooved and the lower is not.

The upper and lower No. 3 bearing halves are flanged to carry the crankshaft thrust loads and are not interchangeable with any other bearing halves in the engine. **Bearings that are not badly worn or pitted must be reinstalled in the same position.**

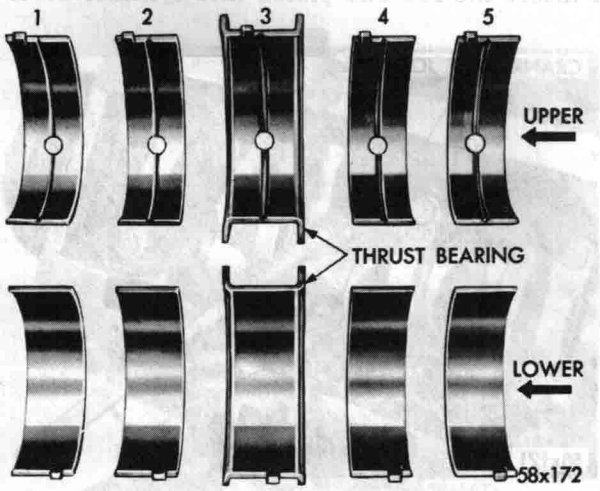


Fig. 54—Upper and Lower Main Bearings

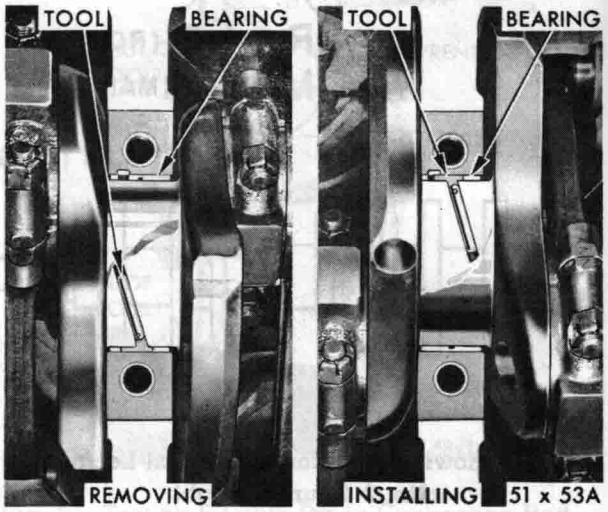


Fig. 55—Removing or Installing Main Bearing Upper Shell

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

MAIN BEARINGS

a. Removal

(1) Remove the oil pan and mark bearing caps before removal.

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Figure 55) into the oil hole of crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing.

b. Checking Main Bearing Clearance

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

It is permissible to use one .001 inch undersize bearing shell with one standard bearing shell, or one .002 inch undersize bearing shell with one .001 inch undersize shell. Always use the smaller diameter bearing half as the upper. Do not use a new bearing with a used bearing and never use an upper bearing half more than .001 inch smaller than the lower bearing half.

c. Installation of Upper Main Bearing

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

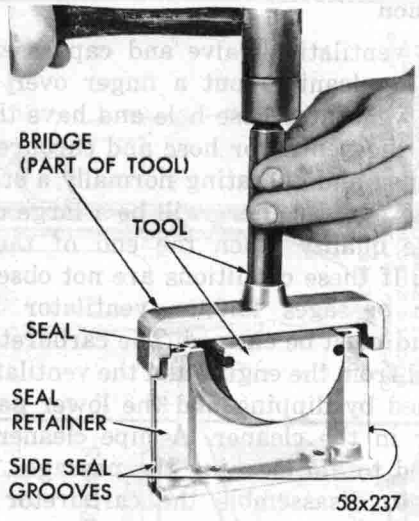


Fig. 56–Installing Rear Main Bearing Lower Oil Seal

(1) Lubricate the bearing. Start bearing in place, and insert Tool C-3059 into the oil hole of crankshaft (Fig. 55).

(2) Slowly rotate the crankshaft counter-clockwise sliding the bearing into position.

(3) After all bearings have been fitted, tighten all caps to 85 foot-pounds torque. The crankshaft end clearance at #3 main bearing should be .002 to .007 inch.

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

a. Installation–Upper

(1) Install a new rear main bearing oil seal in the cylinder block so that both ends protrude.

(2) Tap seal down into position, using Tool C-3625 with bridge removed until the tool is seated in bearing bore.

(3) Hold tool in this position and cut off portion of seal that extends above the block on both sides.

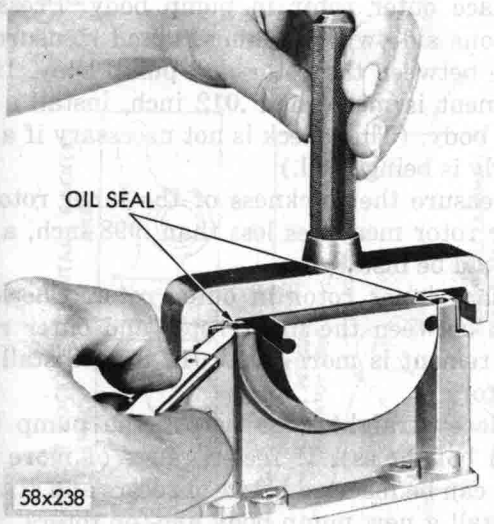


Fig. 57–Trimming Rear Main Bearing Lower Oil Seal

b. Installation–Lower

(1) Install a new seal in the seal retainer so that the ends protrude, (Fig. 56).

(2) Install bridge on tool and tap the seal down into position with Tool C-3625 until tool is seated.

(3) Trim off the portion of the seal that protrudes above the cap (Fig. 57).

(4) Install the two side seals in grooves in seal retainer.

(5) Install seal retainer and tighten screws to 30 foot-pounds torque.

CLOSED CRANKCASE VENTILATION SYSTEM

The chemical composition of any fuel mixture changes when it is burned in a combustion chamber. The greater proportion of this is water in the form of vapor, and a few other mineral elements released by combustion process. A very small proportion of these chemicals may find their way into other parts of the engine through the necessary tolerances between valves and valve guides and between piston rings and cylinder walls. A very effective system for disposing of these chemicals, vapors, and fumes, before they cool sufficiently to change to a fluid state, is incorporated in all Marine engines.

This is accomplished by a ventilation valve installed in the outlet vent cap on the cylinder head cover, and a ventilator hose (capable of withstanding 20 inches of vacuum), connected between the outlet vent cap and the carburetor throttle body. The function of the valve is to regulate the flow of crankcase ventilation at various throttle positions.

The system will operate effectively as long as normal maintenance is applied. The valve and ventilator hose are subject to fouling with sludge and carbon formation due to the nature of the materials carried by the ventilating system, and should be cleaned periodically.

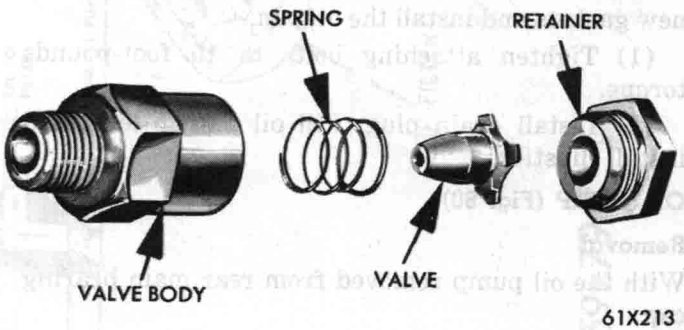


Fig. 58–Crankcase Vent Valve (Exploded View)

a. Removal (Fig. 58)

The ventilation valve should be inspected and cleaned at the lay-up period and after every 100 hours of operation as follows:

Remove the valve and cap assembly from the cylinder cover and detach from the hose. Remove the valve from the cap. Soak the valve in Carburetor Cleaner, and blow out with compressed air. If the valve has been properly cleaned, the shuttle valve will click when the unit is shaken, and the outlet passage should be clean. If the valve is badly plugged and cannot be cleaned by this procedure, it will be necessary to disassemble the valve and thoroughly clean all elements. If the valve is disassembled, great care should be taken not to stretch the spring and to ressemble the pieces in the proper order. **Note: The free height of this spring is 9/16".**

b. Installation

While the ventilation valve and cap assembly are removed for cleaning, put a finger over the open end of the ventilator hose hole and have the engine started. If the ventilator hose and carburetor passages are open and operating normally a strong suction will be felt and there will be a large change in engine idle quality when the end of the hose is uncovered. If these conditions are not observed, the carburetor passages and/or ventilator hose are plugged and must be cleaned. The carburetor should be removed from the engine and the ventilation passages cleaned by dipping and the lower part of the carburetor in the cleaner. A pipe cleaner or wire can be used to aid cleaning the passages. It is not necessary to disassemble the carburetor for this cleaning operation.

ENGINE OILING SYSTEM

MODELS M-318A, M-318B, M-318C

The engine oiling system consists of a rotor type oil pump and a shunt type oil filter. Oil is forced by the oil pump to a series of oil passages in the engine, as shown in Figure 59.

OIL PAN

a. Removal

(1) Remove dipstick and drain oil. Leave plug out.

(2) Remove oil pan attaching bolts and remove the oil pan.

b. Installation

Clean the oil strainer and check it for alignment. The bottom of the strainer must be parallel with the lower, machined surface of the engine block. Use new gaskets and install the oil pan.

(1) Tighten attaching bolts to 15 foot-pounds torque.

(2) Install drain plug. Fill oil pan to level and install dipstick.

OIL PUMP (Fig. 60)

Removal

With the oil pump removed from rear main bearing cap:

(1) Remove oil pressure relief valve plug carefully as it is under spring pressure. Remove spring and valve.

(2) Remove cover screws and remove cover.

(3) Remove inner and outer rotors.

(4) Clean all parts thoroughly.

(5) Measure the diameter and thickness of the outer rotor. If the rotor measures less than .998 inch and the diameter less than 2.244 inches, install a new rotor.

(6) Place outer rotor in pump body. Press the rotor to one side with the fingers and measure the clearance between the rotor and pump body. If the measurement is more than .012 inch, install a new oil pump body. (This check is not necessary if a new pump body is being used.)

(7) Measure the thickness of the inner rotor. If the inner rotor measures less than .998 inch, a new rotor should be installed.

(8) Place inner rotor in outer rotor. Check the clearance between the inner rotor and outer rotor. If measurement is more than .012 inch, install new pump rotors.

(9) Place straight edge across the pump body (between bolt holes). If feeler gauge of more than .004 inch can be inserted between rotors and straight edge, install a new pump body and/or rotors.

(10) The mating face of the oil pump should be

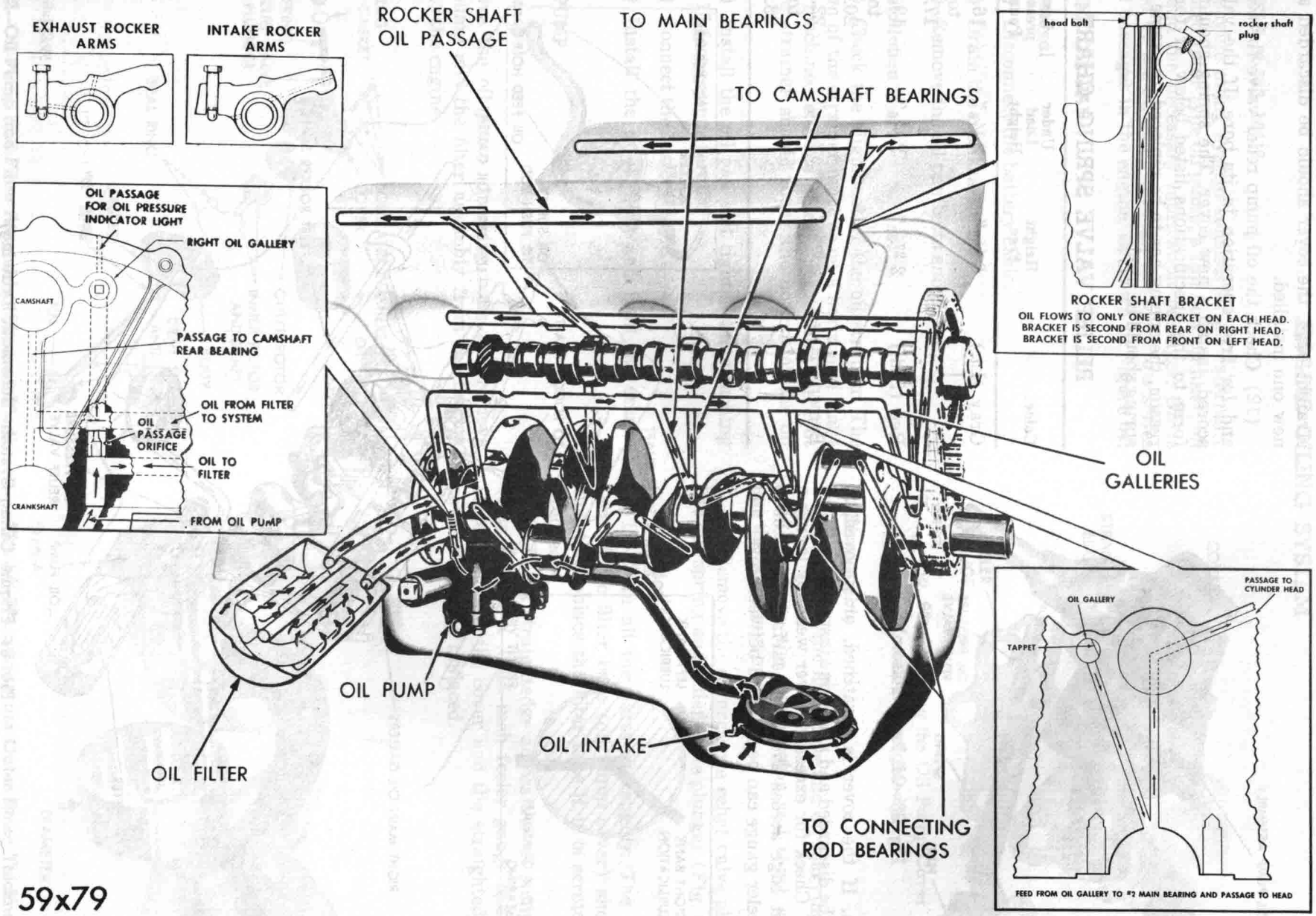


Fig. 59—Engine Oiling System (318 Cu. In. Engine)

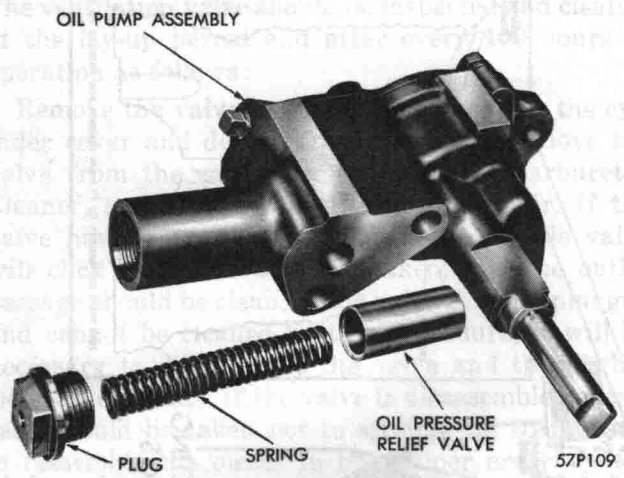


Fig. 60—Oil Pump Assembly

smooth. If the cover is scratched, or grooved, it should be discarded and a new one installed.

(11) Check for excessive cover wear, by laying a straight edge across the cover surface. If a .0015 inch feeler gauge can be inserted between cover and straight edge, the cover should be discarded and a new one installed.

(12) Check the oil pump relief valve for scoring and for free operation in its bore. If the valve is scored, install a new cover. The spring should conform to the specifications listed below. If for any reason, the spring has to be replaced, the same color spring should be used.

RELIEF VALVE SPRING CHART

Color	Height Free	Under Load Height	Compression Pounds
Gray (Lt.)	3 1/32"	2 1/16"	16.1 to 17.1
Red (Std.)	2 27/32"	2 1/16"	19.5 to 20.5
Brown (Hvy.)	2 31/32"	2 1/16"	22.9 to 23.9

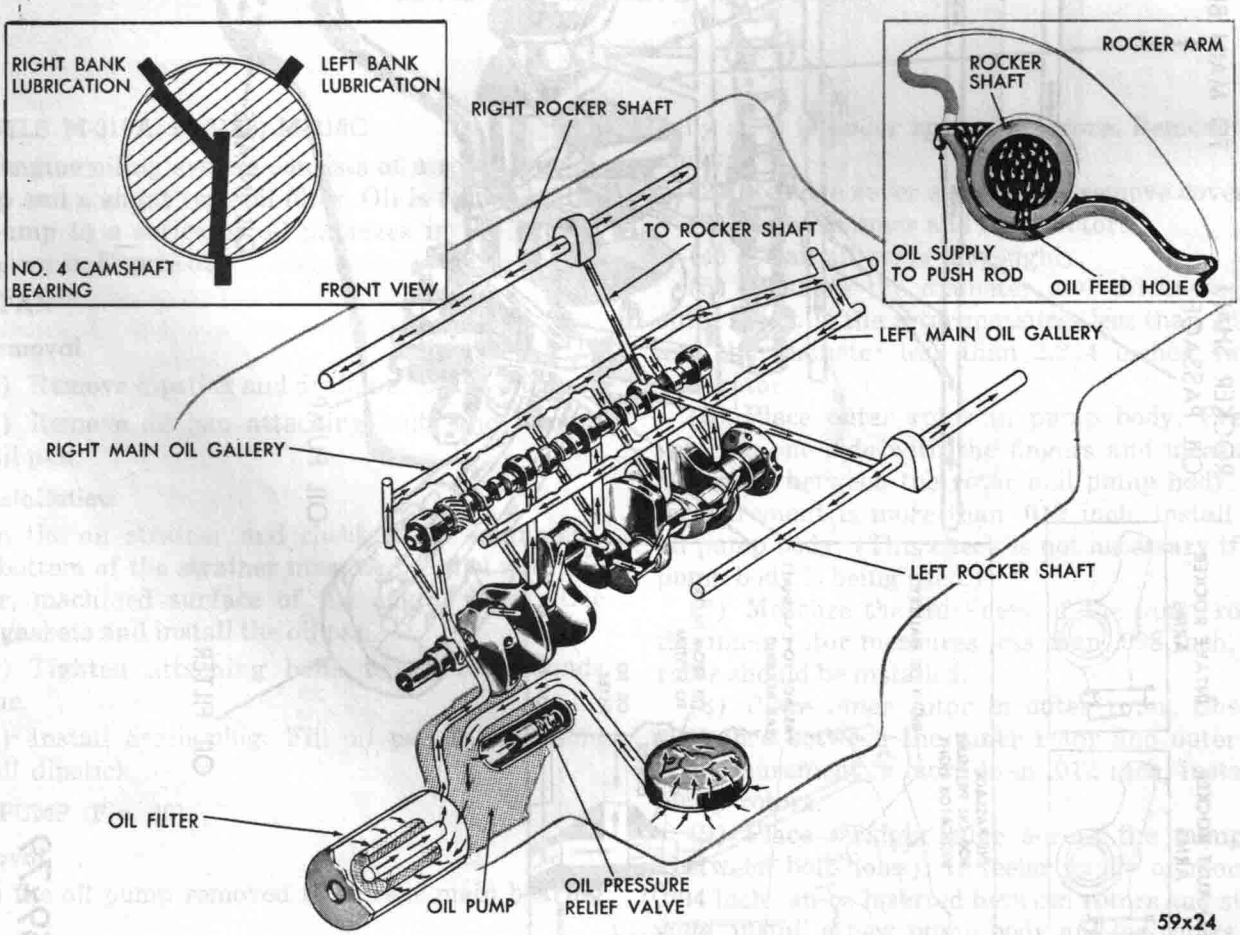


Fig. 61—Engine Oiling System (Schematic Drawing)

ENGINE OILING SYSTEM

MODELS M-383, M413

The engine oiling system consists of an externally mounted rotor type oil pump, a full flow oil filter, oil pan and the necessary lubrication passages. Oil is forced by the oil pump through the filter to a series of oil passages in the engine, as shown in Figure 61.

ENGINE OIL PAN

a. Removal

(1) Disconnect the battery cable.

(2) Drain the crankcase oil.

(3) Remove the oil pan bolts and oil pan.

b. Installation

(1) Check the alignment of the oil strainer. The bottom of the strainer must be on a horizontal plane with machined surface of cylinder block. The foot of the strainer should touch the bottom of the oil pan.

(2) Install the oil pan and tighten the attaching bolts 15 foot-pounds torque.

(3) Connect the battery cable.

(4) Install the drain plug and refill the crankcase.

OIL PUMP

a. Removal

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

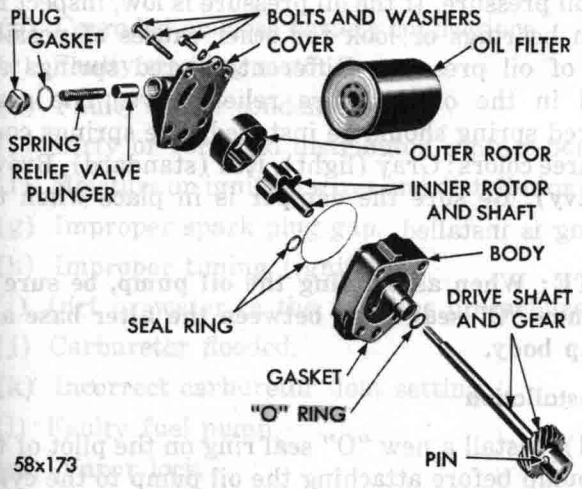


Fig. 62–Oil Pump and Filter Assembly (Disassembled)

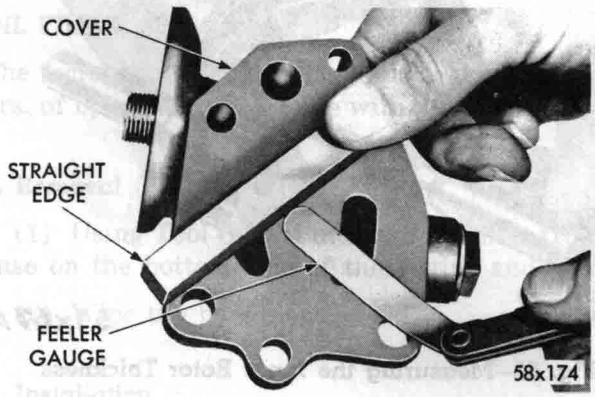


Fig. 63–Checking the Oil Pump Cover with a Straightedge

b. Disassembly

(1) Remove the filter base and oil seal ring.

(2) Remove the pump rotor and shaft and lift out the outer pump rotor.

(3) Remove the oil pressure relief valve plug and lift out spring and relief valve plunger (Fig. 62).

c. Inspection

(1) Clean all the parts thoroughly. The mating face of the filter base (oil pump cover) should be smooth. Replace the filter base if it is scratched or grooved.

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

Fig. 64–Measuring the Outer Rotor Thickness

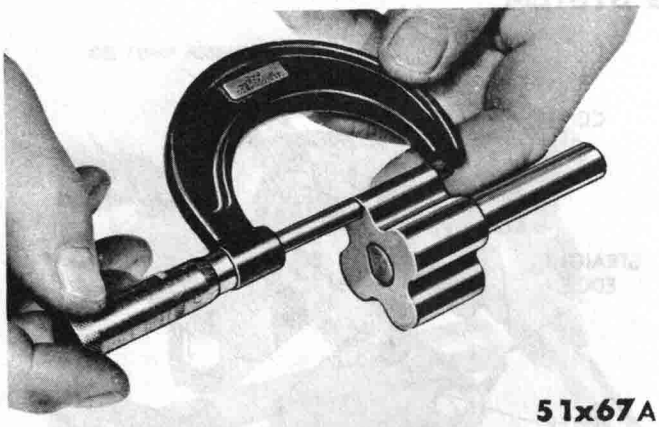


Fig. 65—Measuring the Inner Rotor Thickness

(3) If the outer rotor length measures less than .943 inch (Fig. 64) and the diameter less than 2.469 inches, replace the outer rotor.

(4) If the inner rotor length measures less than .943 inch (Fig. 65), a new inner rotor should be installed.

(5) Slide the outer rotor and inner rotor into the pump body and place a straightedge across the face (between the bolt holes), as shown in Figure 66.

(6) If a feeler gauge of more than .004 inch can be inserted between the rotor and straightedge replace the rotor.

(7) Remove the inner rotor and shaft leaving the outer rotor in the pump cavity.

(8) Press the outer rotor body to one side with the fingers and measure the clearance between the outer rotor and the pump body (Fig. 67).

(9) If the measurement is more than .012 inch, replace the oil pump body.

(10) If the top clearance between the inner and

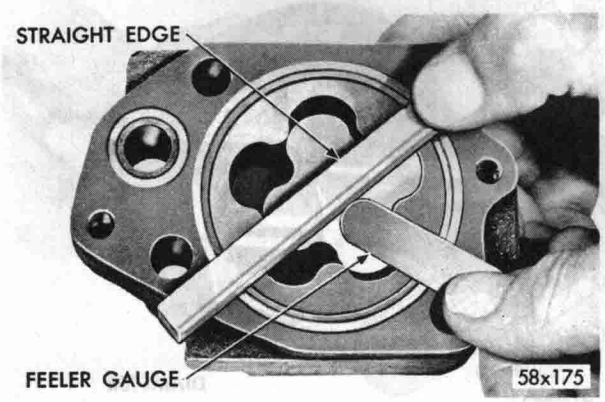


Fig. 66—Measuring the Clearance Over Rotors

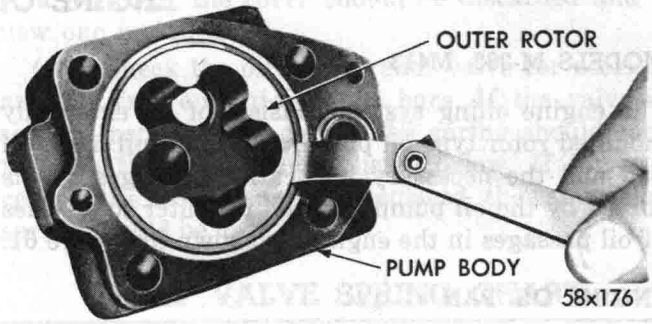


Fig. 67—Measuring the Outer Rotor Clearance

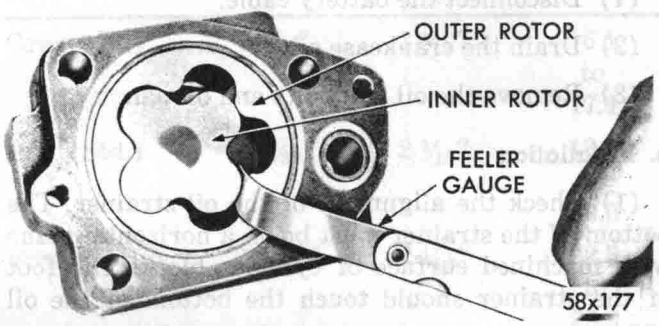


Fig. 68—Measuring the Clearance Between Rotors

outer rotor (Fig. 68) is more than .010 inch, replace the inner and outer rotors.

d. Servicing Oil Pressure Relief Valve

Inspect the relief valve plunger, spring and damper. If the plunger is scratched, remove the scratches by polishing, or install a new filter base assembly which includes the plunger. If the old plunger is to be reinstalled, clean it and flush out the bore with engine oil.

If the spring is to be replaced, use a new one of the same type. Do not use a heavier spring to raise the oil pressure. If the oil pressure is low, inspect for worn bearings or look for other causes of possible loss of oil pressure. Different colored springs are used in the oil pressure relief valve. The same colored spring should be installed. The springs come in three colors: Gray (light), Red (standard), Brown (heavy). Be sure the damper is in place when the spring is installed.

NOTE: When assembling the oil pump, be sure to use new "O" seal rings between the filter base and pump body.

e. Installation

(1) Install a new "O" seal ring on the pilot of the oil pump before attaching the oil pump to the cylinder block.

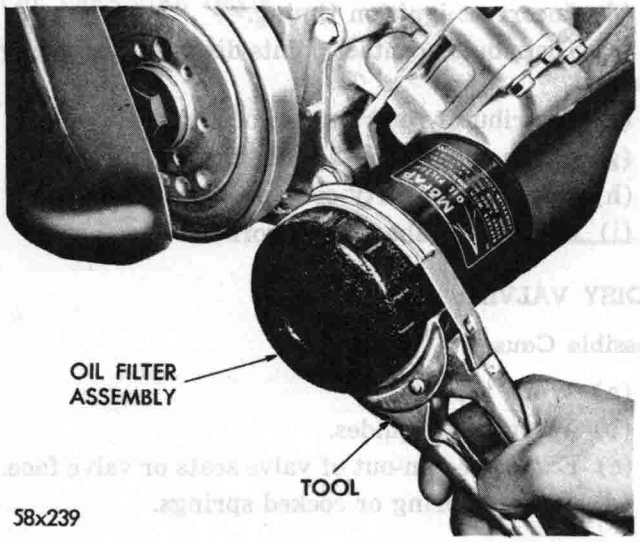


Fig. 69–Removing or Installing the Oil Filter (Typical)

(2) Install the oil pump on the engine, using a new gasket on the engine and tighten the attaching bolts to 35 foot-pounds torque.

(3) Install the oil filter element.

OIL FILTER REPLACEMENT

The "screw-on" oil filter should be replaced every 100 hrs. of operation to coincide with an oil change.

a. Removal (Fig. 69)

(1) Using Tool C-3654 unscrew the filter from the base on the bottom side of the engine and discard.

(2) Wipe the base clean.

b. Installation

(1) Install the "screw-on" oil filter by hand, finger tight. **Do not use the tool.**

(2) Tighten **½ turn only** by hand. Check the engine oil level and add oil. Start the engine and check for leaks.

SERVICE DIAGNOSIS

ENGINE WILL NOT START

Possible Causes:

(a) Weak battery.
(b) Corroded or loose battery connections.
(c) Faulty starting motor.
(d) Faulty coil or condenser.
(e) Dirty or corroded distributor contact points.
(f) Moisture on ignition wires and distributor cap.
(g) Improper spark plug gap.
(h) Improper timing (ignition).
(i) Dirt or water in the fuel line or carburetor.
(j) Carburetor flooded.
(k) Incorrect carburetor float setting.
(l) Faulty fuel pump.
(m) Vapor lock.
(n) Faulty ignition cables.

ENGINE STALLS

Possible Causes:

(a) Idle speed set too low.
(b) Idle mixture too lean or too rich.
(c) Incorrect carburetor float setting.
(d) Improper choke adjustment.
(e) Leak in intake manifold. Check intake manifold gasket.
(f) Faulty coil or condenser.
(g) Distributor contact points dirty, burned or improperly gapped.
(h) Distributor rotor burned or cracked.
(i) Faulty ignition wiring.

ENGINE HAS LOSS OF POWER

Possible Causes:

(a) Incorrect ignition timing.

(b) Defective coil or condenser.
(c) Distributor rotor burned or cracked.
(d) Excessive play in distributor shaft.
(e) Worn distributor cam.
(f) Dirty or incorrectly gapped spark plugs.
(g) Dirt or water in fuel line or carburetor.
(h) Improper carburetor float level.
(i) Defective fuel pump.
(j) Incorrect valve timing.
(k) Blown cylinder head gasket.
(l) Low compression.
(m) Burned, warped or pitted valves.
(n) Faulty ignition cables.

ENGINE MISSES WHILE IDLING

Possible Causes:

(a) Dirty or incorrectly gapped spark plugs.
(b) Broken or loose ignition wires.
(c) Burned or pitted contact points.
(d) Faulty coil or condenser.
(e) Weak battery.
(f) Distributor cap cracked.
(g) Distributor rotor burned or cracked.
(h) Moisture on ignition wires, distributor cap or spark plugs.
(i) Excessive play in distributor shaft.
(j) Burned, warped, or pitted valves.
(k) Incorrect carburetor idle adjustment.
(l) Incorrect carburetor float level.
(m) Low compression.

ENGINE MISSES ON ACCELERATION

Possible Causes:

(a) Distributor contact points dirty or improperly gapped.
(b) Coil or condenser defective.
(c) Spark plugs dirty or gap too great.
(d) Incorrect ignition timing.
(e) Dirt in carburetor.
(f) Burned, warped, or pitted valves.
(g) Acceleration pump in carburetor faulty.

ENGINE MISSES AT HIGH SPEED

Possible Causes:

(a) Dirt or water in fuel line or carburetor.
(b) Dirty jets in carburetor.
(c) Defective coil or condenser.
(d) Incorrect ignition timing.
(e) Distributor contact points dirty or incorrectly gapped.
(f) Distributor rotor burned or cracked.
(g) Excessive play in distributor shaft.
(h) Spark plugs dirty or gap set too wide.
(i) Distributor shaft cam worn.

NOISY VALVES

Possible Causes:

(a) Worn tappets.
(b) Worn valve guides.
(c) Excessive run-out of valve seats or valve face.
(d) Broken spring or cocked springs.

CONNECTING ROD NOISE

Possible Causes:

(a) Low oil pressure.
(b) Insufficient oil supply.
(c) Thin or diluted oil.
(d) Misaligned connecting rods.
(e) Excessive bearing clearance.
(f) Crankpin journals out-of-round.

MAIN BEARING NOISE

Possible Causes:

(a) Low oil pressure.
(b) Insufficient oil supply.
(c) Thin or diluted oil.
(d) Loose flywheel.
(e) Excessive bearing clearance.
(f) Excessive end play.
(g) Crankshaft journals out-of-round.
(h) Sprung crankshaft.
(i) Loose vibration damper or pulley.

OIL PUMPING AT RINGS

Possible Causes:

(a) Worn, scuffed or broken rings.
(b) Incorrect ring size.
(c) Out-of-round rings.
(d) Rings fitted too tight in grooves.
(e) Carbon in oil ring slots.
(f) Insufficient tension in rings.
(g) Rings stuck.
(h) Rings upside down on pistons.

OIL PRESSURE DROP

Possible Causes:

(a) Low oil level.
(b) Clogged oil filter.
(c) Worn parts in oil pump.
(d) Excessive bearing clearance.
(e) Thin or diluted oil.
(f) Oil pump relief valve stuck.
(g) Oil pump suction tube not aligned or bent.

SECTION VI

FUEL SYSTEM

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION VI

FUEL SYSTEM

DATA AND SPECIFICATIONS

BBD SERIES CARBURETOR

CARBURETOR	
Type	Ball and Ball Dual Throat
Model	BBD-3212S
BORE	1 7/16"
VENTURI	1 3/16"
MAIN METERING JET	
Standard	#120—206S
One Size Lean	#120—215S
Two Sizes Lean	#120—214S
ADJUSTMENTS	
Float Setting (at center of floats)	15/64"
Accelerator Pump (top of plunger rod to bowl cover)	1 1/8" ± 1/64"
Fast Idle (1375 to 1245 rpm)	.015"
Choke Unloader (wide open kick)	1/4"
Idle Mixture (both screws)	1 full turn open ± 1/2
Idle Speed	500 rpm
CHOKE	
Type	Well Automatic
Control	Thermostatic Coil Spring
Setting	on index

AFB SERIES CARBURETOR

AFB CARBURETOR	
Type	4 Barrel Downdraft
Model	AFB-3213S
THROTTLE BORE	
Primary	1 7/16"
Secondary	1 7/16"
MAIN VENTURI	
Primary	1 3/16"
Secondary	1 3/16"
MAIN JET	
Primary	.089"
Secondary	.061"

AFB SERIES CARBURETOR CONT'D

STEP-UP ROD (2 Stage)	
Standard	16-75
1 Size Lean	16-42
2 Sizes Lean	16-39
ADJUSTMENTS	
Accelerator Pump (top of plunger to air horn)	17/64"
Choke Unloader	1/4"
Fast Idle Speed (rpm)	1800
Idle Speed (rpm)	500
Secondary Throttle Lever Adjustment	3/8"
Secondary Throttle Lockout Adjustment	.020"
Float Setting	7/32"
Float Drop	9/16"
Idle Mixture (both screws open)	1½ Turns
CHOKE	
Control	Thermostatic Coil Spring
Type	Well
Setting	2 Notches Rich

AFB SERIES CARBURETOR (WITH AUTOMATIC TRANSMISSION)

CARBURETOR	
Type	4 Barrel Downdraft
Model (automatic transmission)	AFB-3214S
THROTTLE BORE	
Primary	17/16"
Secondary	19/16"
MAIN VENTURI	
Primary	13/16"
Secondary	15/16"
LOW SPEED JET	
Primary	No. 67-.032" No. 67-.035"
ADJUSTMENTS	
Accelerator Pump Setting (top of plunger to air horn)	7/16"
Choke Unloader (wide open kick)	1/4"
Fast Idle Adjustment	.020"
Fast Idle Speed (rpm)	1775-1825
Idle Speed Adjustment (rpm)	500
Secondary Throttle Lever Adjustment	19/64"
Secondary Throttle Lock-Out Adjustment	.020"
Float Setting (gasket to top of floats)	7/32"
Float Drop	3/4"
Idle Mixture (both screws-turns open)	1-2
Automatic Choke Unit Setting	2 Notches Rich

DATA AND SPECIFICATIONS

YH SERIES CARBURETOR

Make	Carter
Type	Horizontal
Model	YH-2911S
Nominal Size	1¼ SAE—3 Bolt
ADJUSTMENTS	
Idle Mixture	¾ to 1½ Turns Open
Idle Speed	500-550 rpm
Accelerator Pump Rod	One Hold Only—No Adj.
Pump Stroke	No Adj.
Float Setting	9/16″
CHOKE	
Control	Manual

FUEL PUMP

Model	M-318 A, B, C	M-383, M-413
Make	Carter	Carter
Fuel Pump Model	M-2504S	M-2769S
Chrysler Part No.	1736073	2125600
Type	Diaphragm	Diaphragm
Driven by	Camshaft	Camshaft
Pump Pressure, lbs.	6 to 7	3½ to 5

SPECIAL TOOLS

C-3225	Repair Stand
C-3400	Repair Stand
C-3411	Pressure Gauge
T109-22	Bending Tool
T109-29	Wire Gauge (.020″ and .030″) (Fast Idle)
T109-31	Gauge ¼″ (Choke Unloader)
T109-41	Bending Tool (Fast Idle End Unloader)
T109-43	Plug Remover
T109-44	Fast Idle Wire Gauge—.015 inch
T109-58	Screw driver Bit
T109-59	Screw driver Bit
T109-106	Float Gauge (7/32″)
T109-126	Float Gauge (9/32″)
T109-200	Wire Gauge (.010″ and .012″) (Fast Idle)
T109-213	Bending Tool
T109-230	Float Gauge—9/32 inch
T109-287S	Elevating Legs

SECTION VI

FUEL SYSTEM

BBD SERIES CARBURETOR

Model BBD 3212S

SERVICING THE CARBURETOR

Often, the carburetor is blamed for a great variety of trouble which is classed as "POOR ENGINE PERFORMANCE." Therefore, be definitely sure that the trouble is not located elsewhere before disassembling the carburetor.

When overhauling the carburetor, several items of importance should be observed to assure a good job:

(1) The carburetor must be completely disassembled.

(2) All parts should be cleaned in a suitable solvent then inspected for damage or wear.

(3) Use air pressure only, to clean the various orifices or channels.

(4) Replace questionable parts with NEW ONES. When checking parts removed from the carburetor, it is at times difficult to be sure they are satisfactory for further service. It is therefore recommended that in such case, NEW parts be installed.

SERVICE PROCEDURES

DISASSEMBLING THE CARBURETOR

To disassemble the carburetor for cleaning or overhaul, refer to Figure 1, and proceed as follows:

(1) Place the carburetor assembly on repair block Tool C-3225.

(2) Remove the hairpin clips and disengage the

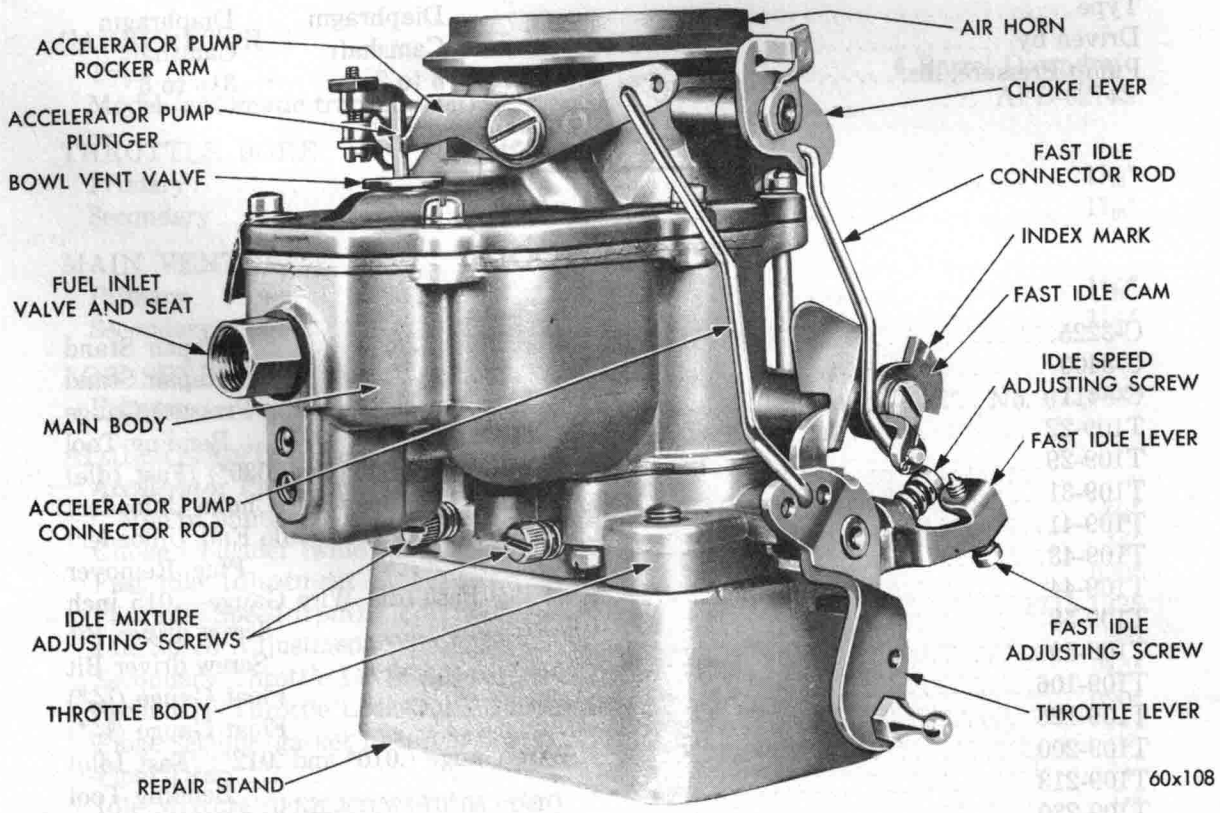


Fig. 1—Carburetor Identification

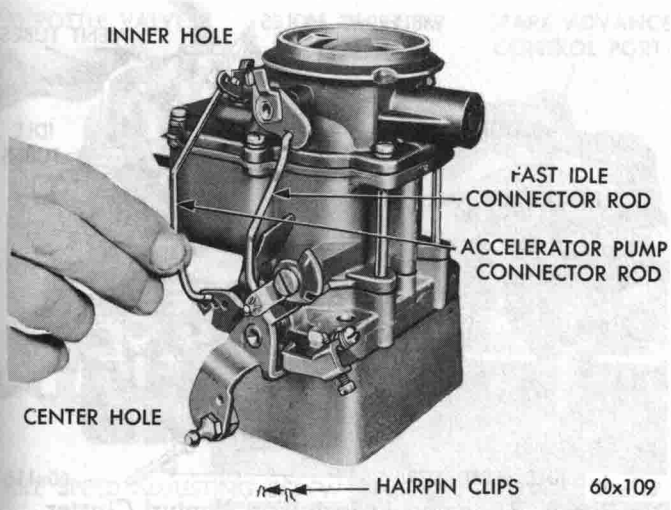


Fig. 2—Removing or Installing Accelerator Pump Rod

accelerator pump operating rod, as shown in Figure 2.

(3) Remove the hairpin clip and disengage the fast idle connector rod from the fast idle cam and choke lever, as shown in Figure 3.

(4) Remove the air horn retaining screws and lift air horn straight up and away from main body, as shown in Figure 4. Discard the gasket.

(5) Disengage the accelerator pump plunger from the rocker arm by pushing up on the bottom of plunger and sliding plunger shaft off hook, as shown in Figure 5. Slide plunger out of air horn and remove the bowl vent valve, spring seat and spring.

If the old plunger can be used again, or if a new plunger is to be installed, place the plunger in a jar of clean gasoline or kerosene to prevent the leather from drying out.

(6) Remove the fuel inlet needle valve, seat and

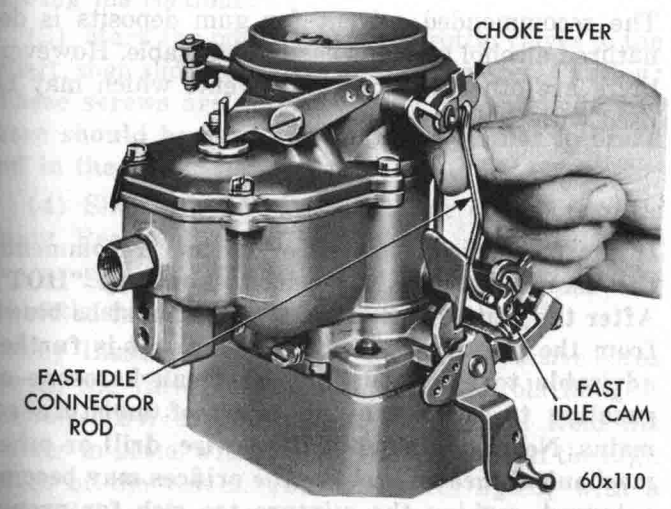


Fig. 3—Removing or Installing Fast Idle Connector Rod

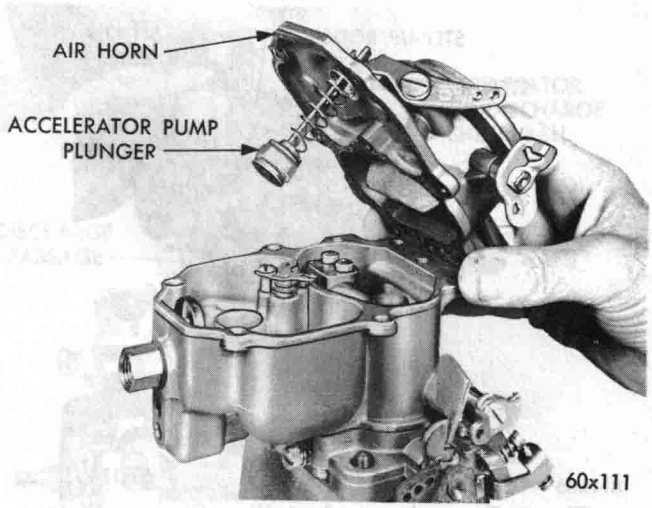


Fig. 4—Removing or Installing Air Horn

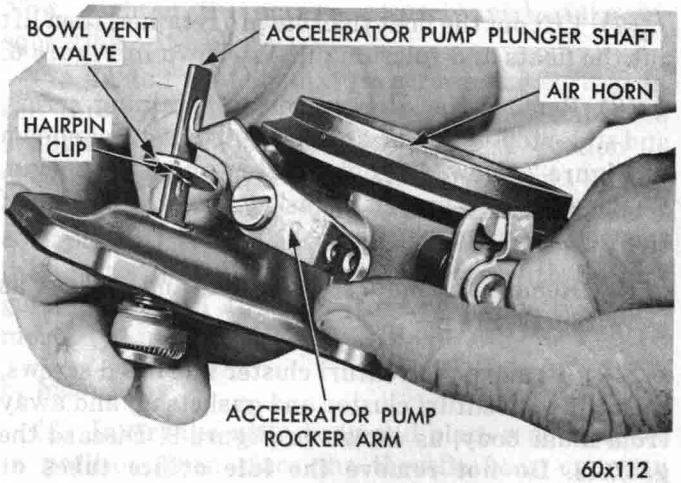


Fig. 5—Removing or Installing Accelerator Pump Plunger

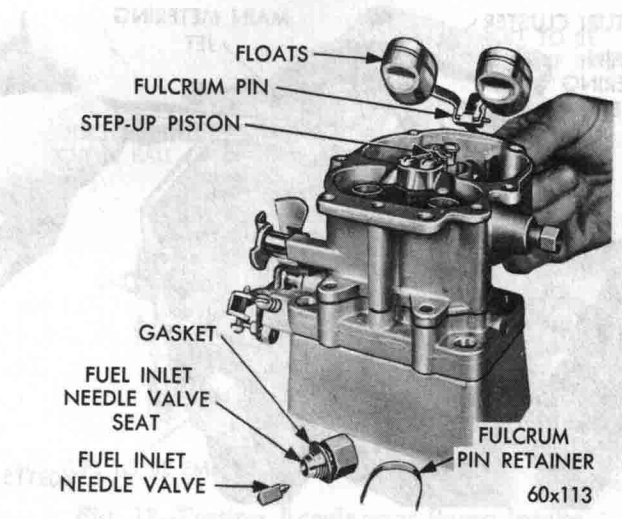


Fig. 6—Removing or Installing Float

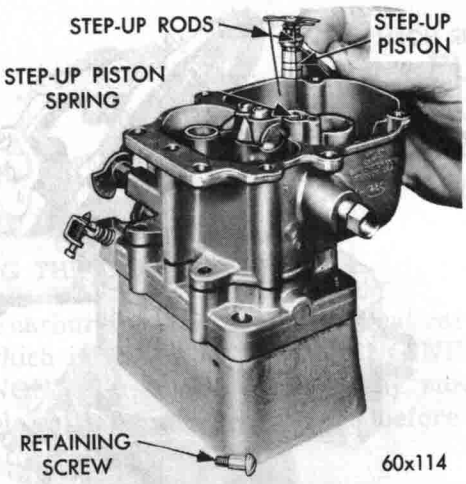


Fig. 7—Removing or Installing Step-up Piston

gasket from the main body.

(7) Lift out the float fulcrum pin retainer, then lift out the floats and fulcrum pin, as shown in Figure 6.

(8) Remove the step-up piston retaining screw, and slide step-up piston and rods out of well, as shown in Figure 7. Now, lift out the step-up piston spring. Remove the step-up piston gasket from the bottom of the well.

(9) Remove the main steering jets and gaskets, as shown in Figure 8.

(10) Remove the venturi cluster idle bleed screws, then lift the venturi cluster and gaskets up and away from main body, as shown in Figure 9. Discard the gaskets. **Do not remove the idle orifice tubes or main vent tubes from the cluster.** They can be cleaned in a solvent and dried with compressed air.

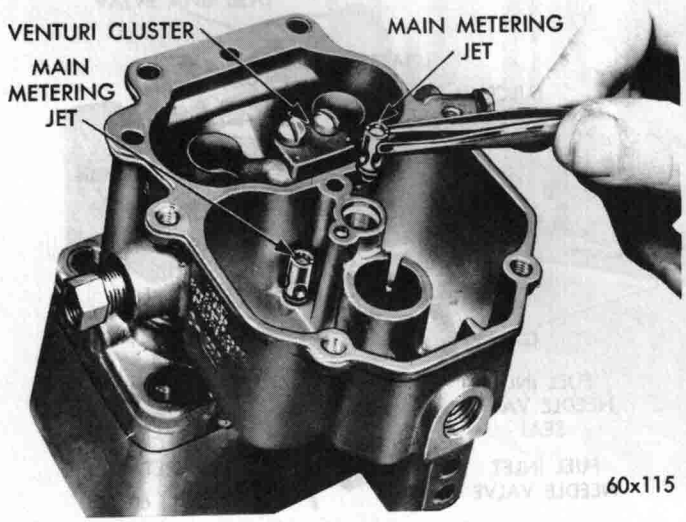


Fig. 8—Removing or Installing Main Metering Jets

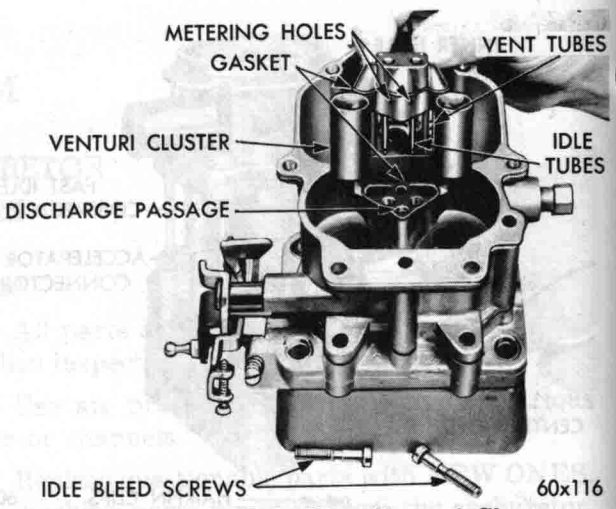


Fig. 9—Removing or Installing Venturi Cluster

(11) Invert the carburetor and drop out the accelerator pump discharge check ball.

(12) Remove the idle mixture adjusting screws and springs from the throttle body.

(13) Remove the screws that attach the throttle body to the main body. Separate the bodies and discard the gasket.

The carburetor now has been disassembled into three main units, namely, the air horn, main body and throttle body and the component parts of each disassembled as far as necessary for cleaning and inspection.

It is usually not advisable to remove the throttle shaft or valves from the throttle body, unless wear or damage necessitates the installation of new parts.

CLEANING CARBURETOR PARTS

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

IMPORTANT:

If the commercial solvent or cleaner recommends the use of water as a rinse, it should be "HOT". After the rinsing, all trace 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. Never clean jets with a wire, drill or other mechanical means, because the orifices may become enlarged, making the mixture too rich for proper performance.

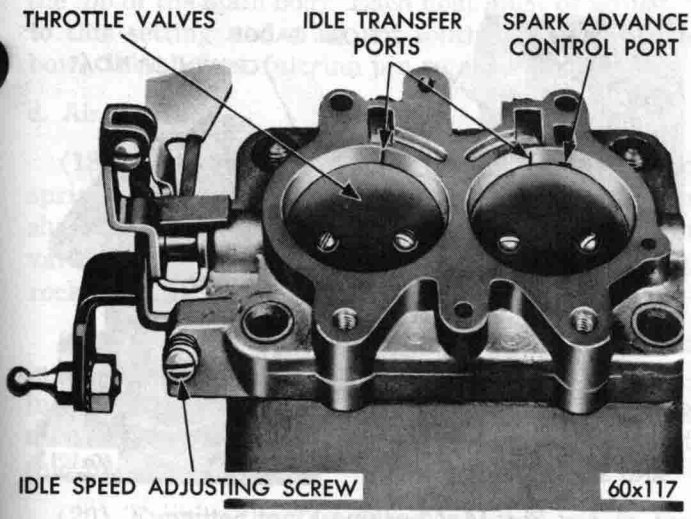


Fig. 10—Ports in Relation to Throttle Valves

INSPECTION AND REASSEMBLY

a. Throttle Body

(1) Check the throttle shaft for excessive wear in the throttle body. (If wear is extreme, it is recommended that the throttle body assembly be replaced rather than installing a new shaft in the old body).

During manufacture, the location of the idle transfer port and the spark advance control ports to the throttle valve, is carefully established for one particular assembly. (See Fig. 10).

If a new shaft should be installed in an old, worn throttle body, it would be very unlikely that the original relationship of the ports to the valves would be obtained. Changing the relationship of the valves to the ports would adversely affect normal engine operation. However, if it has been determined that a new shaft or valves is to be installed, adhere to the following instructions:

(2) Mark the position of the throttle valves to the shaft, then slide the valves out of the bores. **Caution: These screws are staked on the opposite side and care should be used at removal so as not to break off in the shaft.**

(4) Slide the throttle shaft out of the throttle body. Remove the fast idle speed screw lever.

(5) Slide the fast idle speed screw lever over new throttle shaft and insert into throttle body.

(6) Install throttle valves in their respective bores (with the valve numbers toward manifold flange). Install **NEW** screws but do not tighten. Hold the valves in place, with the fingers pressing on the high sides of the valves. Tap the valves lightly with a screwdriver to seat valves in the throttle bores.

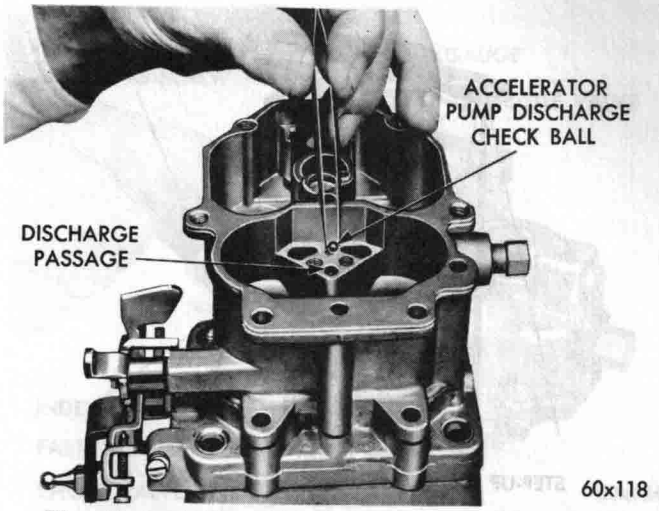


Fig. 11—Installing Accelerator Pump Discharge Check Ball

Now, tighten the screws securely and stake by squeezing with pliers.

(7) Install the idle mixture screws and springs in the throttle body. (The tapered portion must be straight and smooth. If the tapered portion is grooved or ridged, new idle mixture screws should be installed to insure having correct idle mixture control). **DO NOT USE A SCREWDRIVER.** Turn the screws **lightly** against their seats with the fingers. Back off 1 full turn for approximate adjustment.

b. Main Body

(8) Invert the main body and place a new gasket in position, then place the throttle body on main body and align. Install screws and tighten securely.

(9) Install the accelerator pump discharge check ball in the discharge passage, as shown in Figure 11.

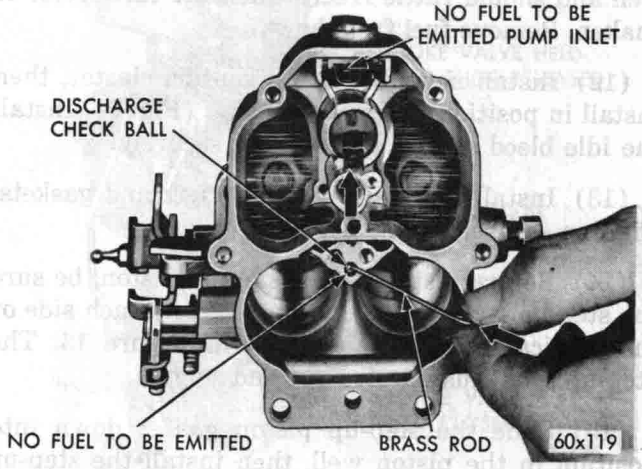


Fig. 12—Testing Accelerator Pump Intake and Discharge Check Balls

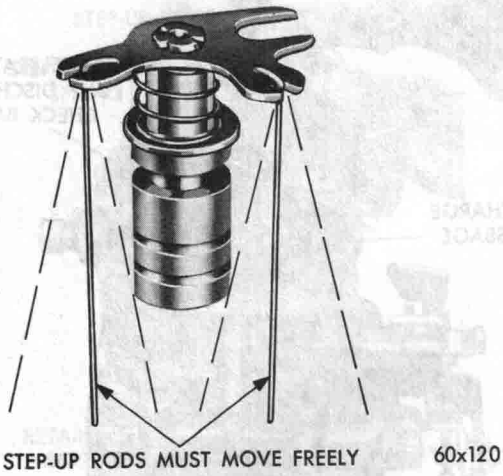


Fig. 13—Step-up Rod Free Play

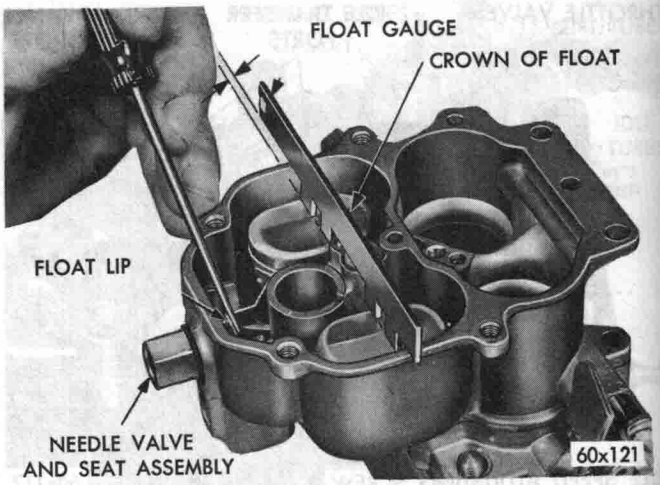


Fig. 14—Checking Float Setting

To check the accelerator pump system; fuel inlet and discharge balls, proceed as follows:

(10) Pour clean gasoline into the carburetor bowl, approximately ½ inch deep. Remove the pump plunger from the jar of gasoline and slide down into the pump cylinder. Raise the plunger and press lightly on the plunger shaft to expel air from the pump passage.

(11) Using a small clean brass rod, hold the discharge check ball down firmly on its seat. Again raise the plunger and press downward. No fuel should be emitted from either the intake or discharge passage, as shown in Figure 12.

If any fuel does emit from either passage, it indicates the presence of dirt or a damaged check ball. Clean the passage again and repeat test. If leakage is still evident, install a new check ball. The fuel inlet check ball is located at the bottom of the plunger well and should rattle freely when the carburetor is shaken. Remove fuel from bowl.

(12) Install new gaskets on venturi cluster, then install in position in the main body. (Fig. 9). Install the idle bleed screws and tighten securely.

(13) Install the main metering jets and gaskets, Tighten securely. (Fig. 8).

(14) Before installing the step-up piston, be sure the step-up rods are able to move freely each side of the vertical position, as shown in Figure 13. The step-up rods must be straight and smooth.

(15) Slide the step-up piston gasket down into position in the piston well, then install the step-up piston spring and step-up piston and rods. Carefully guide the step-up rods into the main metering jets. (Refer to Figure 7). Install retaining screw and tighten securely.

A step-up piston stuck in the **UP** position will cause a rich mixture at part throttle, whereas a piston stuck in the **DOWN** position will cause a lean mixture at wide open throttle and poor acceleration.

c. Checking Float Setting

Install the floats and fulcrum pin, then proceed as follows:

(16) Assemble the fuel inlet needle valve, seat and gasket, then insert in position in the main body. Tighten securely. (If the needle valve is ridged or badly worn, install a new needle valve and seat assembly.)

(17) Using Tool T109-230 or a "T" scale, check the float setting, as shown in Figure 14. There should be 9/32" from the top of the crown of each float to

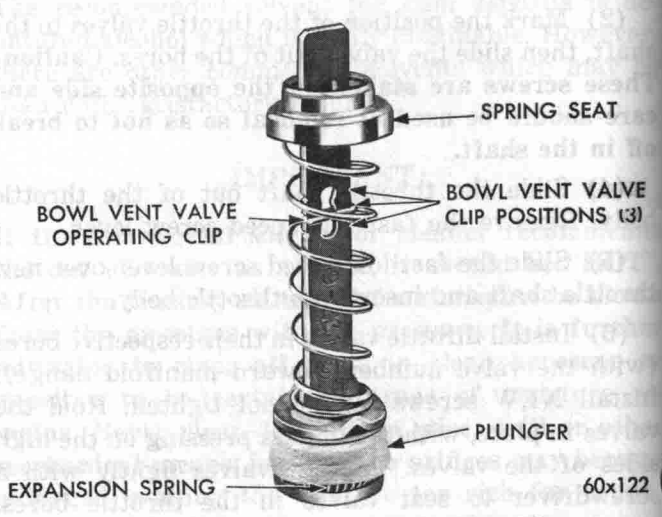


Fig. 15—Accelerator Pump Assembly

the top of the main body. Each float must be adjusted to this setting and must not touch the sides of the bowl. Install float fulcrum pin retainer.

d. Air Horn

(18) Assemble the pump plunger, spring and spring seat, as shown in Figure 15. Slide plunger shaft through opening in air horn. Install bowl vent valve over plunger shaft, then engage with pump rocker arm (Refer to Fig. 5).

(19) Place a new gasket on the main body, then install the air horn. (Refer to Fig. 4). Install attaching screws and tighten securely. (When installing air horn, be sure the leather on the plunger does not fold back).

(20) Engage the fast idle connector rod in the choke lever and fast idle cam. Secure with hairpin clip. (Refer to Fig. 3).

(21) Engage the accelerator pump operating rod in the outer hole in the rocker arm and in the center hole in the throttle lever. (Refer to Fig. 2). Install clips to secure.

CARBURETOR ADJUSTMENTS

It is very important that the following adjustments be made on a reconditioned carburetor, and in the sequence listed:

a. Accelerator Pump

(1) Back off the idle speed adjusting screw. Open the choke valve so that the throttle valves can be completely seated in the bores. Be sure that pump connector rod is in the center hole of the throttle lever.

(2) Close the throttle valves tightly. Now, measure the distance between the top of the air horn and the end of the plunger shaft, as shown in Figure 16. This measurement should be $1\frac{1}{8}$ + or − $\frac{1}{64}$ inch.

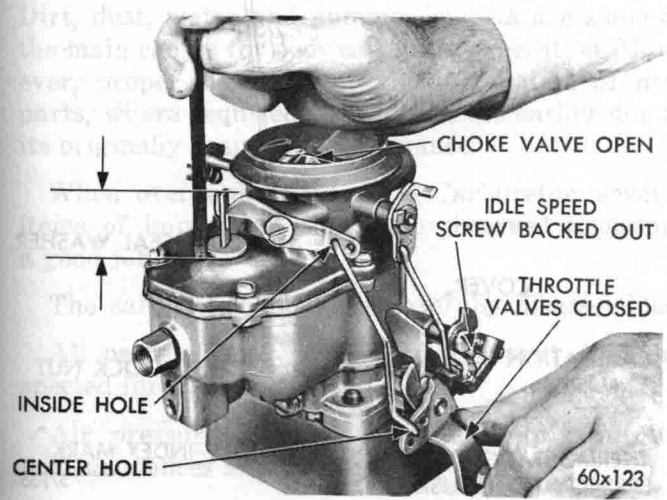


Fig. 16—Measuring Accelerator Pump Travel

(3) To adjust pump travel, bend the pump connector rod, using Tool T109-213, at the lower angle of rod, until correct travel has been obtained.

b. Fast Idle Adjustment

(1) Open the throttle valves and hold the choke valve in the fully closed position. Close the throttle valves. This will position the fast idle cam to the fast idle position.

(2) Hold in this position, then invert the carburetor. Slide wire gauge Tool T109-44 (.015) between the throttle valves and the bore (side opposite ports). Tighten the fast idle adjusting screw until a slight drag is felt as a gauge is being withdrawn, as shown in Figure 17.

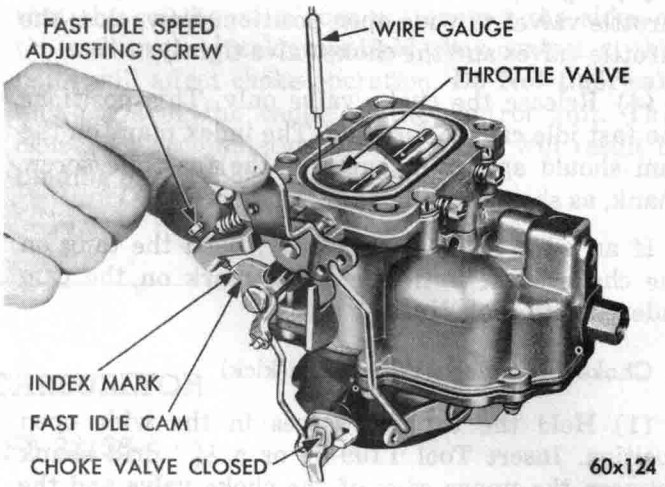


Fig. 17—Checking Fast Idle Setting

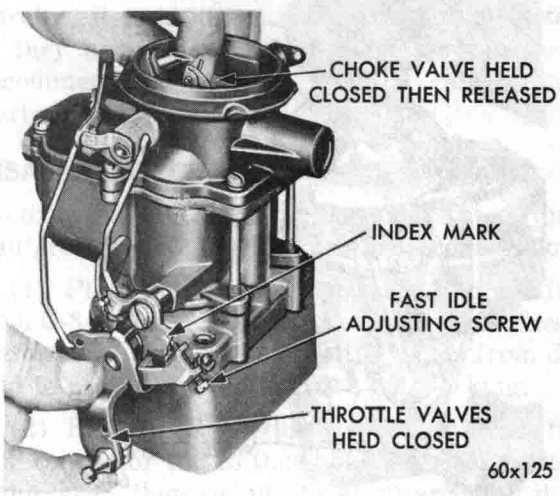


Fig. 18—Fast Idle Index Mark Aligned

(3) Again, invert the carburetor and open the throttle valves to wide open position. Now, close the throttle valves and the choke valve tightly.

(4) Release the choke valve only. This positions the fast idle cam to fast idle. The index mark on the cam should split the center of the fast idle screw shank, as shown in Figure 18.

If an adjustment is necessary, bend the tang on the choke shaft until the index mark on the cam indexes with the adjusting screw.

c. Choke Unloaded (Wide open kick)

(1) Hold the throttle valves in the wide open position. Insert Tool T109-31 or a ¼" drill shank between the upper edge of the choke valve and the inner wall of the air horn, as shown in Figure 19.

(2) If no drag is felt, or if too much drag is apparent, bend the unloader tang on the throttle lever, until correct clearance has been obtained.

d. Bowl Vent Adjustment

(1) With the throttle valves held closed, it should be possible to insert a .060 inch drill shank between the bowl vent valve and the air horn, as shown in Figure 20.

(2) If an adjustment is to be made, bend the accelerator pump rod at the lower angle until correct clearance has been obtained.

If the pump rod is installed in either the long or short stroke hole, it will be necessary to move the hair pin clip (directly under the bowl vent valve) either up or down to compensate for the change in order to obtain correct bowl vent clearance.

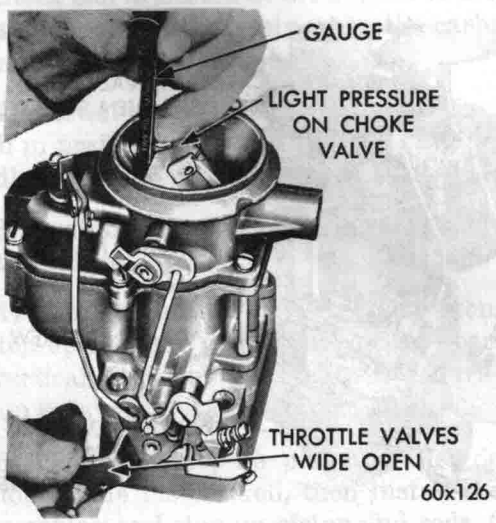


Fig. 19—Checking Choke Unloader Setting

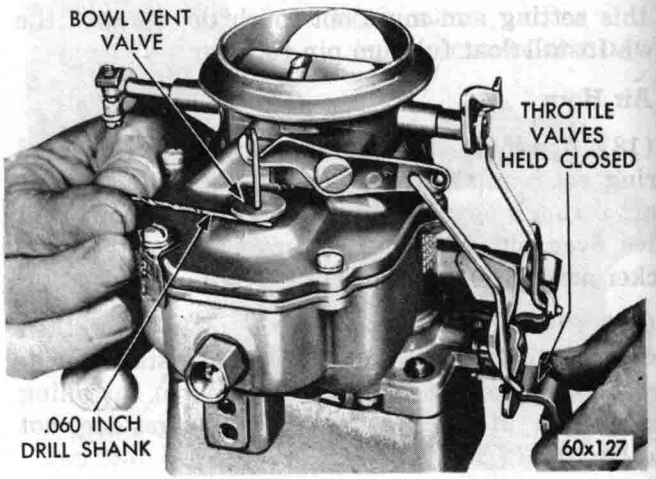


Fig. 20—Checking Bowl Vent Opening

e. Idle Speed Adjustment

The idle speed adjustment is made after the carburetor has been installed on the engine.

(1) With the throttle valves closed and the choke valve wide open (engine at normal operating temperature) adjust the idle screw to 500 R.P.M., using a tachometer.

(2) Adjust the idle mixture screws until the engine operates smoothly, then recheck the tachometer and again adjust the idle screw to give the correct engine R.P.M.

AUTOMATIC CHOKE—WELL TYPE

To function properly, it is important that all parts be clean and move freely. Other than an occasional cleaning, the choke requires no servicing. However,

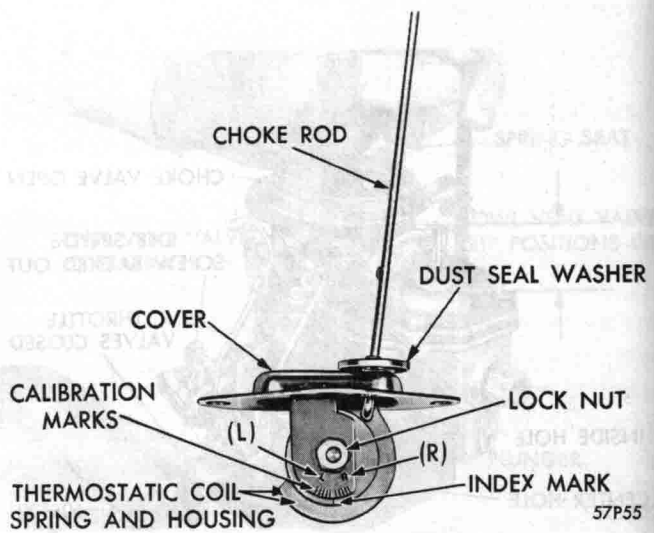


Fig. 21—Well Type Automatic Choke Unit

it is very important that the choke control unit work freely in the well and at the choke shaft. Move the choke rod up and down to check for free movement on the pivot. If the unit binds, a new choke unit should be installed. **THE WELL TYPE CHOKE UNIT, is serviced as an assembly. Do not attempt to repair.** (See Fig. 21).

When installing the well type choke unit be certain that the coil housing does not contact the sides of the well in the intake manifold. Any contact at this point will affect choke operation. **Do Not Lubricate** any parts of the choke or the control unit. This causes an accumulation of dirt which will result in binding of the choke mechanism.

AFB SERIES CARBURETOR

MODEL AFB 3213S

The AFB (aluminum four barrel) carburetor contains many features, some of which are the locations for the step-up rods and pistons. The step-up rods, pistons and springs are accessible for service without removing the air horn or the carburetor from the engine. The venturi assemblies (primary and secondary) are replaceable and contain many of the calibration points for both the high and low speed system. One fuel bowl feeds both the primary and secondary nozzles on the right side while the other fuel bowl takes care of the primary and secondary nozzles on the left side. This provides improved performance and acceleration.

All the major castings of the carburetor are aluminum, with the throttle body cast integral with the main body. This allows an overall height reduction in the carburetor. The section containing the accelerator pump is termed the primary side of the carburetor. The rear section is the secondary. The five conventional systems used in previous four barrel carburetors are also used in this unit. The five conventional systems are, two float systems, two low speed systems, (primary side only) two high speed systems, one accelerator pump system and one automatic choke control system.

SERVICE PROCEDURES

SERVICING THE CARBURETOR

Dirt, dust, water and gummy deposits are some of the main causes for poor carburetor operation. However, proper cleaning and the installation of new parts, where required, will return the carburetor to its originally designed performance.

When overhauling the AFB Carburetor, several items of importance should be observed to assure a good job.

The carburetor should be carefully disassembled.

All parts cleaned in a suitable solvent, then inspected for wear or damage.

Air pressure only should be used to clean the various orifices and channels.

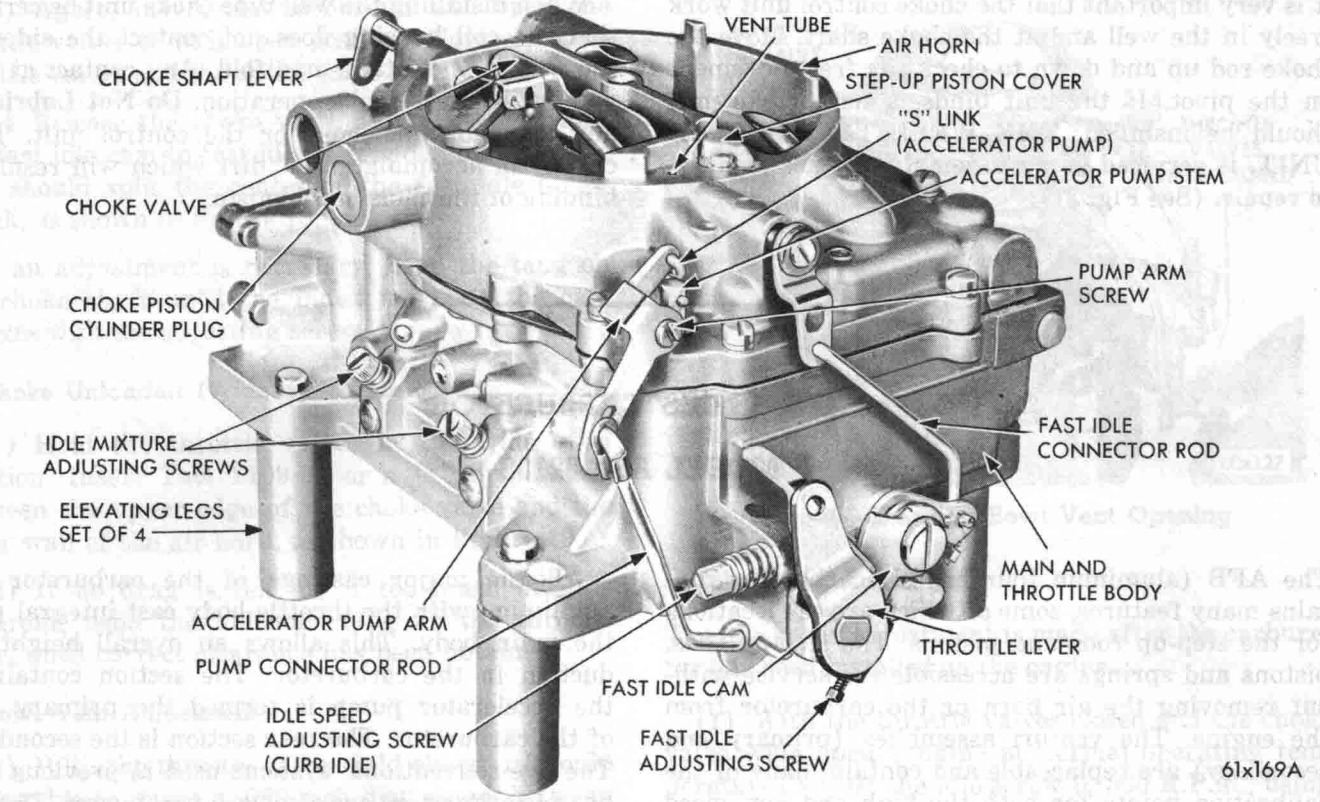
Questionable parts should be replaced with new ones. When inspecting parts removed from the carburetor, it is at times rather difficult to determine if they are satisfactory for further service. It is recommended therefore, in such cases, that **new** parts be installed.

DISASSEMBLING THE CARBURETOR

To disassemble the carburetor for cleaning or overhaul, refer to Figure 22, then proceed as follows:

(1) Place the carburetor assembly on repair stand Tool C-3400 or T-109-287S elevating legs. These tools are used to protect the throttle valves from damage and to provide a suitable base for working.

(2) Remove the hairpin clip that attaches the fast idle connector rod to the choke lever. Disengage rod from lever, then swing rod at an arc until it can be disengaged from the fast idle cam.



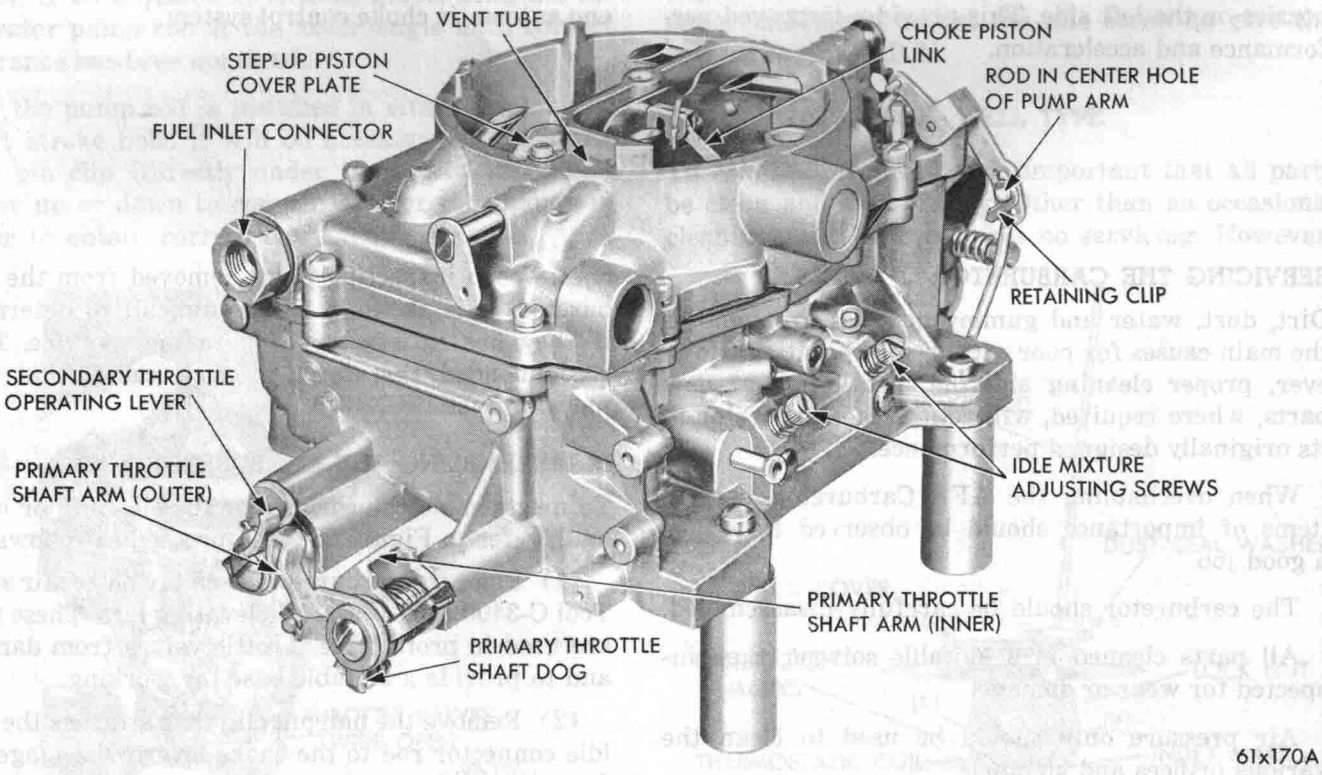


Fig. 22—Carburetor Assembly (AFB Series)

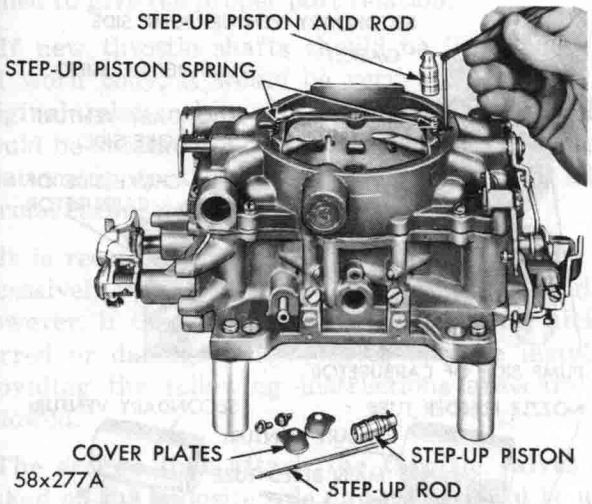


Fig. 23—Removing or Installing Step-Up Pistons and Rods

(3) Remove the clevis clip that holds the throttle connector rod in the center hole of the accelerator pump arm. Remove the hairpin clip that attaches the lower end of rod in the primary throttle shaft lever. Disengage rod from arm and lever, then remove from carburetor.

(4) Remove the screws attaching the step-up piston and rod cover plates. **Hold cover down with a finger to prevent the piston and rods from flying out.** Lift off the plates and slide the step-up pistons and rods out of the air horn, as shown in Figure 23. Remove the step-up piston springs.

(5) Remove the ten screws that attach the air horn to the main body. (1 screw in hole in air horn.) Lift air horn straight up and away from the main body. **When removing air horn, use care so as not to bend or damage the floats.** Remove the accelerator pump, plunger lower spring from the pump cylinder.

a. Disassembling the Air Horn

Place the air horn in an inverted position on the bench (to protect the floats) then proceed to disassemble as follows:

(1) Using a suitable Tool, remove the float fulcrum pins, (left and right) then lift the floats up and out of bosses on air horn. **It is suggested that the float on the pump side be marked so that the floats can be re-installed in their respective positions.**

(2) Remove the two needle valves from their respective seats, after marking the one on the pump side for identification. Using a wide blade screwdriver, remove the needle valve seats. Be sure each needle valve is returned to its original seat at reassembly.

(3) Remove the spring clip that holds the throttle connector rod in the center hole of the pump arm. Remove the pump arm pivot screw and lift off the pump arm, at the same time, disengage the link from the arm and the pump stem. Slide the accelerator pump plunger and spring out of the air horn. Remove gasket.

(4) Place the accelerator pump plunger in a jar of clean gasoline or kerosene, to prevent the leather from drying out.

(5) Remove the fuel inlet fitting and filter screen from the air horn.

(6) Using a prick punch, pierce the welsh plug and remove it from the end of choke piston cylinder. Remove cotter pin that attaches the piston link to the choke valve lever. Slide choke piston and link out of cylinder.

b. Main Body Disassembly

(1) Remove the screws that attach the accelerator pump jet housing to the main body. Lift out the jet housing and gasket, as shown in Figure 24. Discard the gasket. Now, invert the main body and drop out the discharge check needle from the discharge passage.

(2) Using Tool T109-58, remove the main metering jets (primary side), as shown in Figure 25. **The primary and secondary main metering jets are not interchangeable. It is very important that these jets be installed in their respective locations in the main body at reassembly.**

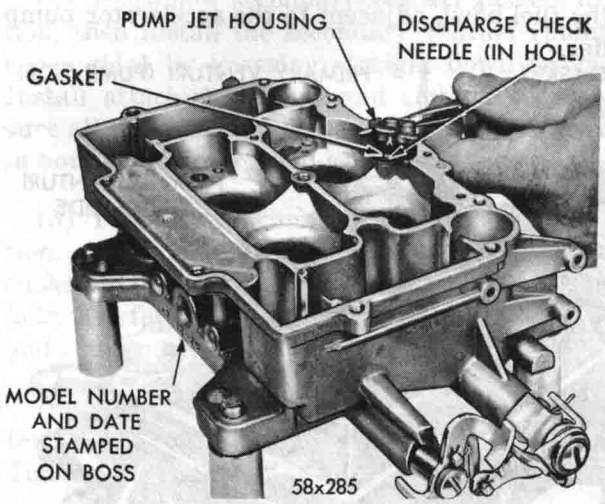


Fig. 24—Removing or Installing Accelerator Pump Jet Housing

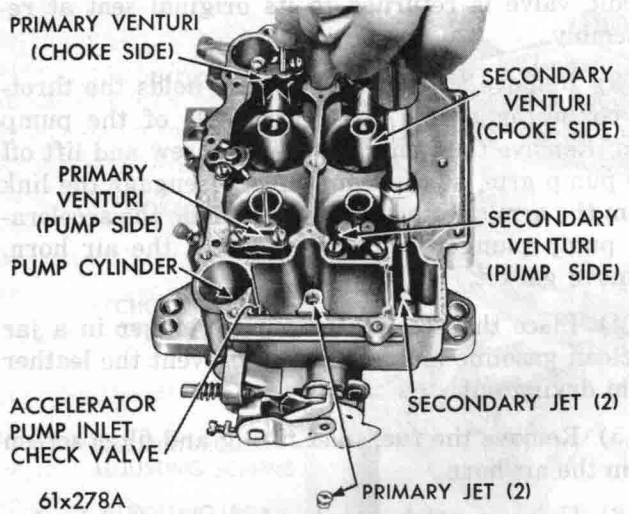


Fig. 25—Removing or Installing Main Metering Jets

(3) Again using Tool T109-58, remove the main metering jets (secondary side), as shown in Figure 25.

(4) Remove the screws that attach the primary venturi (choke and pump side) to the main body. Lift the venturi straight up and away from the main body, as shown in Figure 26. Discard the gaskets.

The venturi assemblies are not interchangeable, side for side and must be reinstalled in their original locations at reassembly.

(5) Remove the screws that attach the secondary venturi (choke and pump side) to the main body. Lift the secondary venturi assemblies straight up and away from the body, as shown in Figure 27.

(6) Using Tool T109-59, screw driver bit, remove the accelerator pump intake check valve located inside the fuel bowl, adjacent to the accelerator pump cylinder.

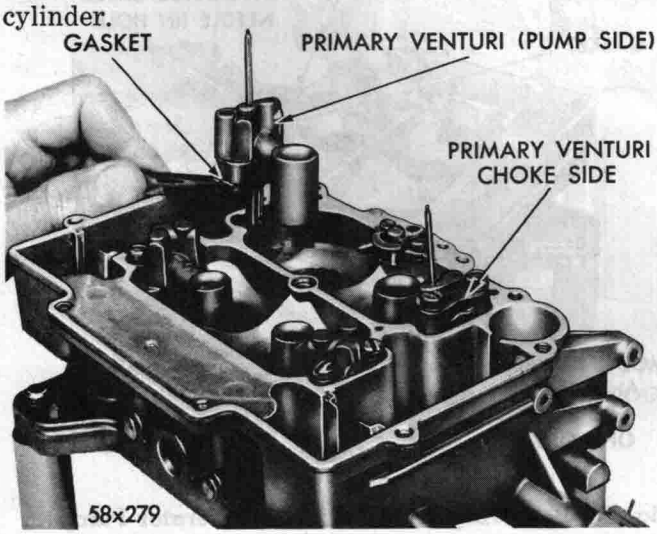


Fig. 26—Removing or Installing Primary Venturi

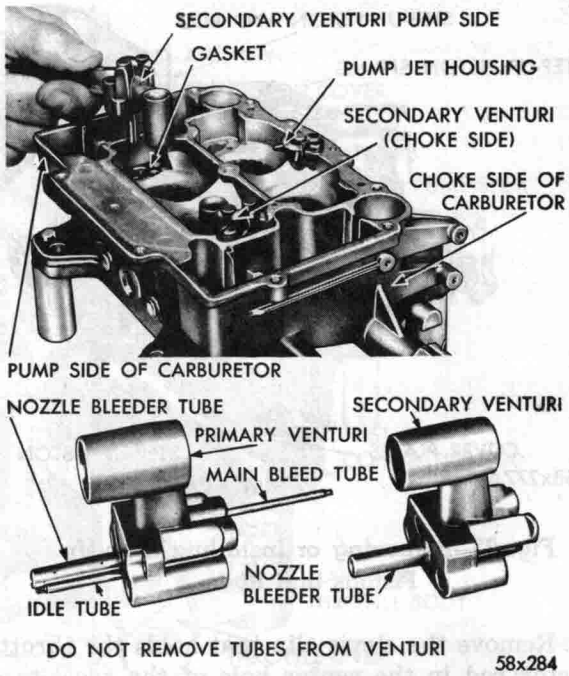


Fig. 27—Removing or Installing Secondary Venturi

(7) Remove the two idle mixture adjusting screws and springs from the throttle body portion of the main casting.

The carburetor now has been disassembled into two units, namely the air horn and the main and throttle body casting. The component parts of each have been disassembled as far as necessary for cleaning and inspection.

It is usually not advisable to remove the throttle shafts or valves, unless wear or damage necessitates the installation of new parts. During the manufacture of the carburetor, the location of the idle transfer ports and the idle discharge ports to the valve is carefully established for one particular assembly, as shown in Figure 28. The valves are

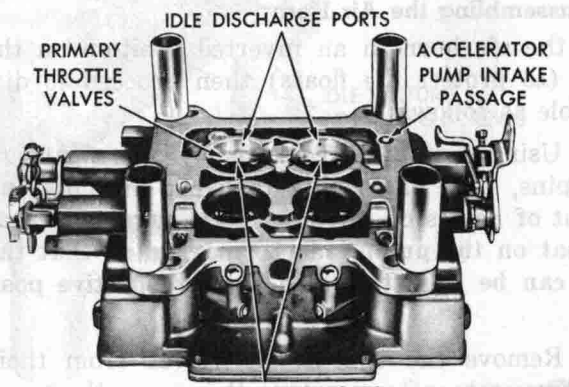


Fig. 28—Ports in Relation to Throttle Valves

milled to give the proper port relation.

If new throttle shafts should be installed in an old worn body, it would be very unlikely that the original relationship of these ports to the valves would be obtained. A very slight change in the port relationship to the valves would adversely affect normal carburetor operation.

It is recommended that if the throttle shafts are excessively worn, that a new carburetor be installed, However, if the throttle valves have become nicked, burred or damaged, new valves may be installed, providing the following instructions are carefully followed.

The screws that attach the throttle valves are staked on the opposite side and care should be used in removal so as not to break the screws in the throttle shaft. Remove the staked portion of the screws with a file.

Remove the screws that attach the primary throttle valves to the throttle shaft and slide valve (or valves) out of the bores.

Remove the screws that attach the secondary throttle valves to the throttle shaft and slide valve (or valves) out of bores.

The primary valves and secondary valves are not interchangeable and should be kept separate in order that each may be returned to its respective bore. (See Fig. 29).

CLEANING CARBURETOR PARTS

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

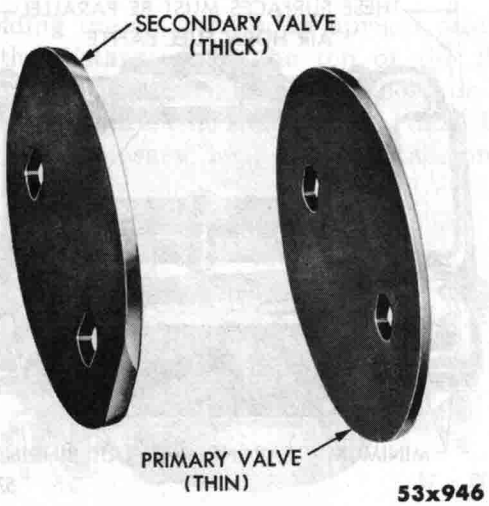


Fig. 29—Throttle Valve Identification

IMPORTANT:

If the commercial solvent or cleaner recommends the use of a water rinse, it should be "HOT." After rinsing, all trace 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. Never clean jets with a wire, drill or other mechanical means, because the orifices may become enlarged, making the mixture too rich for proper performance.

INSPECTION AND REASSEMBLY

(1) Slide the primary throttle valve (or valves) into their respective bores, install new screws, but do not tighten. Be sure the idle speed adjusting screw is backed out. Hold the valves in place with fingers. (Fingers pressing on the high side of valves.)

(2) Tap the valves lightly in this position, tighten screws securely. Stake screws by squeezing with pliers.

(3) Install the two idle mixture adjusting screws and springs in the throttle body portion of the casting. The tapered portion must be straight and smooth. If the tapered portion is grooved or ridged, a new idle mixture adjusting screw should be installed to insure having correct idle mixture control. **Do not use a screw driver.** The adjustment should be made with the fingers. Turn the idle mixture adjusting screws lightly against their seats, then back off one full turn for an approximate adjustment.

(4) Place new secondary venturi gaskets in position, then install the secondary venturi (pump and choke side) by lowering straight down on gaskets. Install attaching screws and tighten securely. **Be sure all the metering holes and vent tubes are clean, in both the primary and secondary venturi.**

(5) Place new primary venturi gaskets in position, then install the primary vinturi (pump and choke side) by lowering straight down on the gaskets. (Refer to Fig. 26.) Install attaching screws and tighten securely.

(6) Install the primary and secondary main metering jets, using Tool T109-58. (Refer to Fig. 25.) Tighten jets securely.

(7) Install the accelerator pump intake check ball using Tool T-109-59.

a. Accelerator Pump Test

(1) Pour clean gasoline into the carburetor bowl (approximately ½ inch deep). Remove the accelerator pump plunger from the jar of gasoline. Flex the leather several times, then slide into the pump cylinder.

(2) Install the accelerator pump discharge check needle in the discharge passage. Raise the pump plunger and press lightly on the plunger shaft to expel air from the pump passages. Using a small clean brass rod, hold the discharge check needle firmly on its seat. Again raise the plunger and press downward. No fuel should be emitted from either the intake or discharge passage.

(3) If fuel does emit from the intake passage, disassemble the intake check ball and reclean the passage. Fuel leakage at the discharge check needle indicates the presence of dirt or a damaged check needle. Clean again and then install a new check needle. Retest for leakage.

(4) If either the intake check assembly or discharge check needle leaks after above test and service fix, attempt to reseat as follows:

b. Intake Check Ball

Remove the intake check assembly from the throttle body. Install a new check assembly, then retest as described previously.

c. Discharge Check Needle

(1) With the discharge check needle installed, insert a piece of drill rod down on the needle. Lightly tap the drill rod with a hammer to form a new seat. Remove and discard old needle and install a new one. Retest as described previously. If the service fix does not correct the condition, a new carburetor will have to be installed

(2) Install the accelerator pump discharge check needle, jet housing and gasket. Install housing and attaching screws. Tighten screws securely.

(3) Press down on the accelerator pump plunger shaft, and as the plunger is being depressed, a clear straight stream should emit from each jet. If the streams are not identical, (if either one is diverted or restricted) a new accelerator pump jet housing should be installed. After test, pour the gasoline from the carburetor bowl and remove pump plunger.

d. Assembling the Air Horn

(1) Slide the fuel inlet screen into the fuel line fitting, then install fitting in air horn. Tighten securely.

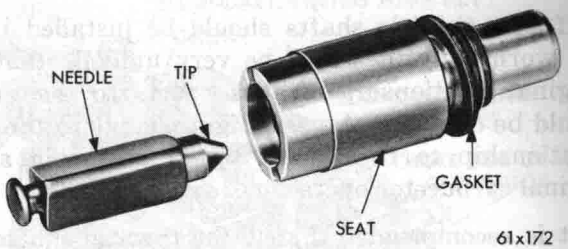


Fig. 30—Synthetic Rubber Tipped Fuel Inlet Needle, Seat and Gasket

(2) Check to see if the leather on the accelerator pump plunger is hard, cracked or worn. If any sign of wear or deterioration is evident, install a new plunger assembly.

(3) When reassembling, make sure the large diameter of the pivot screw enters the hole in the pump arm and that the shoulder on the screw has not pinched the pump arm.

The carburetors are equipped with synthetic rubber tipped fuel inlet needles, as shown in Figure 30. The needle tip is a rubber material which is not affected by gasoline and is stable over a wide range of temperatures. The tip is flexible enough to make a good seal on the needle seat, and to give increased resistance to flooding.

The use of the new inlet needles requires that care be used when making float adjustments. Avoid applying any pressure on the floats which might compress the tip of the fuel inlet needles. **The tip can be compressed sufficiently to cause a false setting which will affect correct level of fuel in the bowl.**

(4) Place a new air horn to main body gasket in

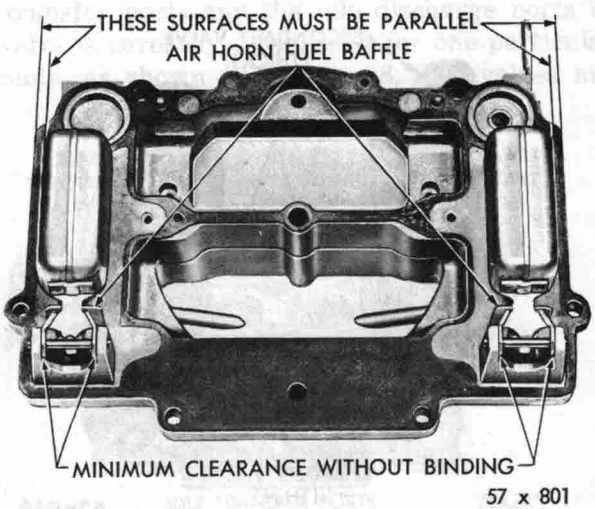


Fig. 31—Checking Float Alignment

position on the air horn, then install the float needle valve seats. (Be sure each needle seat and needle is reinstalled in its original position.)

(5) Slide the right and left floats into position in the air horn, then install the float fulclum pins. **(Be sure the marked float is installed on the pump side of the air horn.)**

(6) After the floats have been installed, check the float alignment, level and drop settings as follows:

e. Float Alignment Setting

(1) Sight down the side of each float shell to determine if the side of the float is parallel to the outer edge of the air horn casting, as shown in Figure 31.

(2) If the sides of the float are not in alignment with the edge of casting, bend the float lever by applying pressure to the end of the float shell with the fingers while supporting the float lever with the thumb. **To avoid damage to the float, apply only enough pressure to bend the float lever.**

f. Float Level Setting

(1) With the air horn inverted, the air horn gasket in place and the float needle seated, slide float gauge (refer to specifications) between the top of the float (at outer end) and the air horn gasket, as shown in Figure 32. Float should just touch gauge.

(2) Check the other float in the same manner. If an adjustment is necessary, bend the float arm using Tool T109-22, until correct clearance has been obtained. After bending arm, recheck the float alignment.

g. Float Drop Setting

(1) Holding the air horn in an upright position, measure the distance from the top of the floats (outer end) to the air horn gasket, as shown in Figure 33. This measurement should be $\frac{9}{16}$ inch. If an adjustment is necessary, bend the stop tabs on the

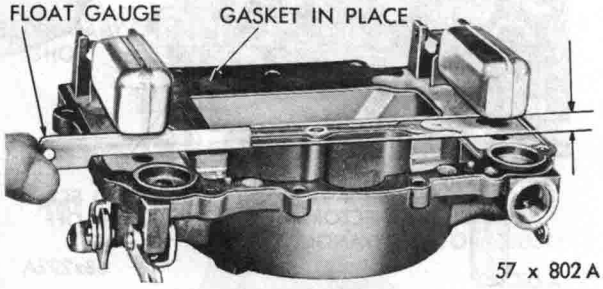


Fig. 32—Checking Float Height

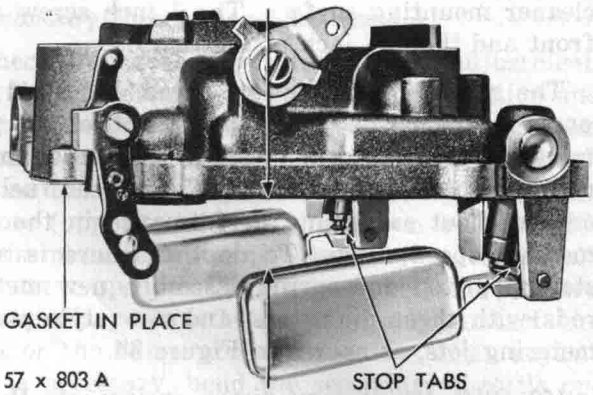


Fig. 33—Checking Float Drop

float levers until the correct drop setting has been obtained. Bend the tab toward the needle seat to lessen the drop, or away from the seat to increase the drop.

(2) After the floats have been checked and adjusted, continue to assemble the carburetor as follows:

(3) Place the accelerator pump plunger lower spring in the pump cylinder, then lower the air horn carefully down on the main body. Care must be taken to center the small brass main bleed tubes so that they will pass through the holes in the air horn without being damaged. **Be sure the fuel baffles on the air horn, slide down in front, (bowl side) of the float chamber baffles, or the air horn will not index correctly with the main body and can cause the floats to hang up. Be sure the leather on the plunger does not curl or wrinkle. Accelerator pump operation will be affected if this precaution is not observed.**

(4) Install the 10 air horn attaching screws and tighten securely. (The two long screws should be installed in the holes that are located at the air

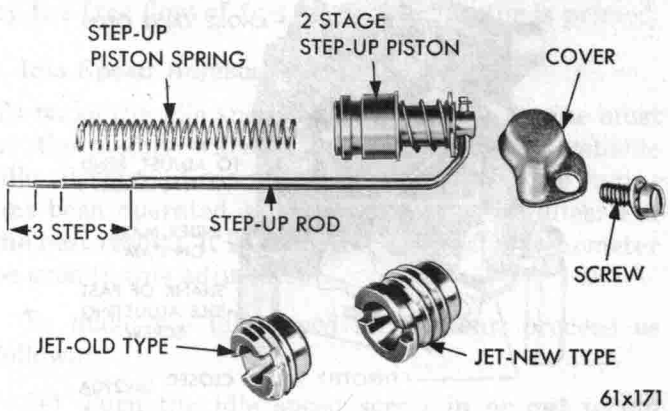


Fig. 34—Step-Up Piston, Rod and Jet

cleaner mounting surface. The 1 inch screw at the front and the 1½ inch at the rear).

The change from the low speed, best fuel economy, to the richer wide open throttle full power mixtures is now accomplished in two steps. This has made it possible to secure best low speed fuel economy without sacrificing performance in the intermediate speed range. To do this, there is a new step-up piston and spring assembly, new metering rods with three diameters, and new style primary metering jets, as shown in Figure 34.

(5) Slide the step-up piston spring into the piston cylinders, followed by the step-up pistons and step-up rods. Install the cover plates and attaching screws while holding the step-up pistons down in position. Tighten screws securely.

(6) Slide the choke piston into its cylinder in the air horn, guiding the link into the slot in the choke valve lever. Align hole, then install attaching cotter pin. Place a new welsh plug over cylinder opening and secure by rapping with a hammer. Check the fit of the choke valve in air horn. The valve should be evenly spaced on all sides. Loosen screws and reposition if necessary.

(7) Engage the throttle connector rod with the primary throttle shaft lever, then install hairpin clip. Install clevis clip to the rod and pump arm.

(8) Engage the lower end of the fast idle connector rod with the fast idle cam, then swing in an arc to lock in cam. Slide other end of rod into the choke shaft lever and secure with hairpin clip.

CARBURETOR ADJUSTMENTS

The following adjustments should be made with the carburetor on the bench for ease of working, and, should be made in the following order:

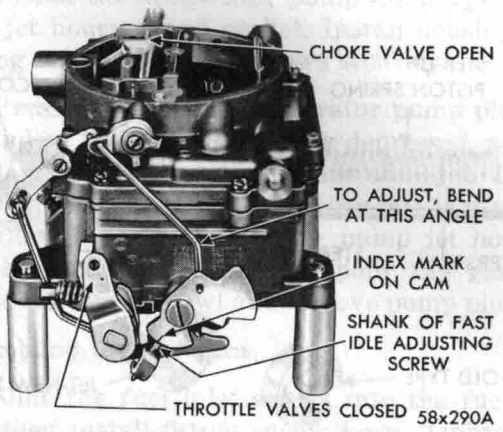


Fig. 35—Fast Idle Cam Indexing

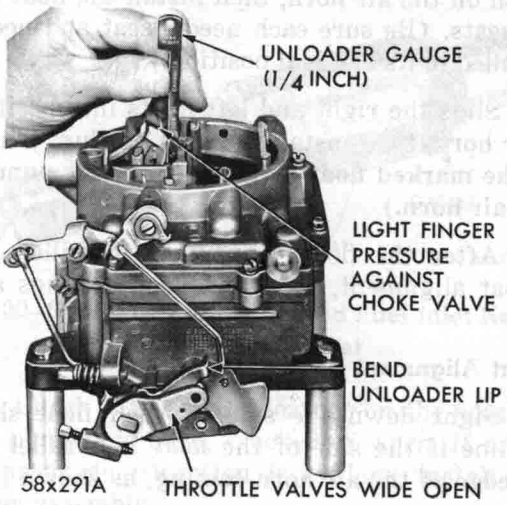


Fig. 36—Checking Choke Unloader (wide open kick)

a. Fast Idle Adjustment (On the Bench)

Open the throttle valves to wide open positions. Close the choke valve tightly and then close the throttle valves. Release the choke valve.

This will position the fast idle cam to fast idle. The index mark on the cam should split the center of the fast idle adjusting screw, as shown in Figure 35. If an adjustment is necessary, bend the fast idle connector rod at the angle, using Tool T109-213, until the index mark on the cam indexes the fast idle adjusting screw.

b. Choke Unloader Adjustment

With the throttle valves in the wide open position, it should be possible to insert Tool T109-31 (¼ inch) gauge between the upper edge of the choke valve and the inner wall of the air horn, as shown in Figure 36.

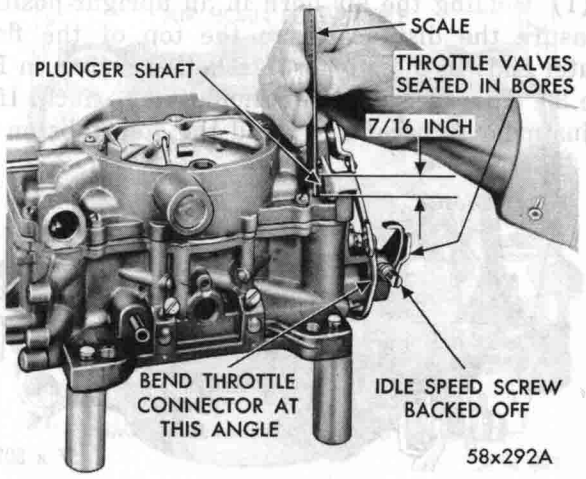


Fig. 37—Checking Accelerator Pump Travel

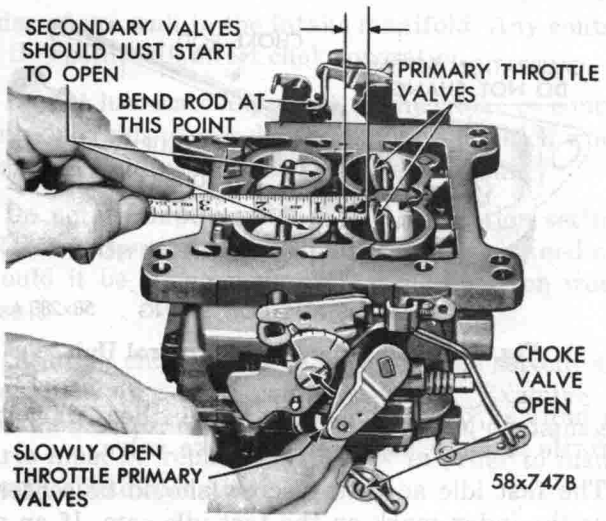


Fig. 38—Checking Secondary Throttle Opening

If an adjustment is necessary, bend the unloader lip on the throttle shaft lever, using Tool T109-41, until correct opening has been obtained.

c. Accelerator Pump Adjustment

Move the choke valve to wide open position, to release the fast idle cam. Back off the idle speed adjusting screw until the throttle valves are seated in the bores.

Measure the distance from the top of the air horn to the top of the plunger shaft, using a "T" scale, as shown in Figure 37. This distance should be $^{17}/_{64}$ inch.

If an adjustment is necessary, bend the throttle connector rod at the lower angle, using Tool T109-213, until correct travel has been obtained.

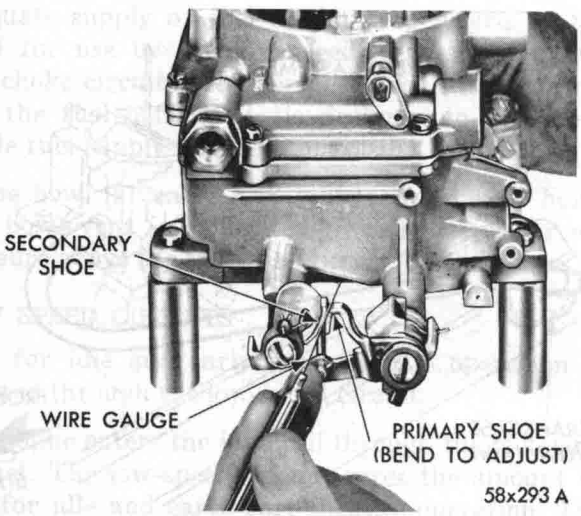


Fig. 39—Checking Clearance Between Closing Shoes

d. Secondary Throttle Lever Adjustment

To check the secondary throttle lever adjustment, block the choke valve in the wide open position and invert the carburetor. Slowly open the primary throttle valves until it is possible to measure $^{19}/_{64}$ inch between the lower edge of the primary valve and the bore (opposite idle port) as shown in Figure 38. At this measurement, the secondary valves should just start to open. The stop lugs on both the primary and secondary throttle levers should contact the bosses on the flange at the same time. If an adjustment is necessary, bend the secondary throttle operating rod at the angle, using Tool T109-213, until correct adjustment has been obtained. At wide open throttle, the primary and secondary throttle valves should reach the full vertical position.

With the primary and secondary throttle valves in the tightly closed position, it should be possible to insert Tool T109-20 (.20") wire gauge, between the positive closing shoes on the secondary throttle levers, as shown in Figure 39.

If an adjustment is necessary, bend the shoe on the secondary throttle lever, using Tool T109-22, until correct clearance has been obtained.

e. Secondary Throttle Lock-Out Adjustment

Crack the throttle valves, then manually open and close the choke valve. The tang on the secondary throttle lever should freely engage in the notch of the lockout dog.

If an adjustment is necessary, bend the tang on the secondary throttle lever, until engagement has been made. Use Tool T109-22 for this operation.

After adjustments have been made, reinstall carburetor on engine, using a new gasket.

It is suggested that the carburetor bowl be filled with clean gasoline. This will help prevent dirt that is trapped in the fuel system, from being dislodged by the free flow of fuel, as the carburetor is primed.

f. Idle Speed Adjustment

To make the idle speed adjustment, the engine must be thoroughly warmed up. A much more reliable idle adjustment can usually be obtained if the engine has been operated a minimum of five minutes. For the best results, it is recommended that a tachometer be used in this adjustment.

To make the idle speed adjustment, proceed as follows:

(1) Turn the idle speed screw **in** or **out** to obtain 500 r.p.m. Be sure the choke valve is fully open

and that the fast idle adjusting screw is not contacting the fast idle cam.

(2) Turn each idle mixture screw to obtain the highest r.p.m. While making the adjustment, carefully watch the tachometer and notice that the speed can be decreased by turning the screws in either direction from the setting that gave the highest r.p.m. reading.

(3) Readjust to 500 r.p.m. with the idle speed screw.

(4) Turn each idle mixture adjusting screw in the clockwise direction (leaner) until there is a slight drop in r.p.m. Now, turn each screw out, counter-clockwise (richer) just enough to regain the lost r.p.m.

This procedure will assure that the idle has been set to the leanest possible mixture for smooth idle.

This setting is very important!

Since the correct speed was originally set using the speed screw, the speed obtained after finding the leanest smooth idle setting will probably be too fast.

(5) Readjust the speed screw to obtain correct idle speed. Repeat steps 2 and 4 above if necessary.

After the proper idle speed has been obtained, move the sliding link to the rear, against the stop, and tighten the nut securely.

g. Fast Idle Speed Adjustment (On the Engine)

To set the fast idle speed, connect a tachometer, then proceed as follows:

(1) With the engine not running, open the throttle halfway, close the choke valve, then allow the throttle to close. Release the choke valve.

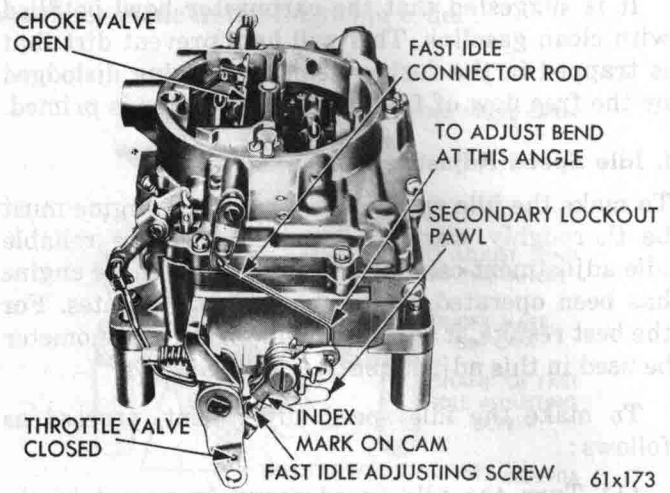


Fig. 40—Fast Idle Cam Indexing

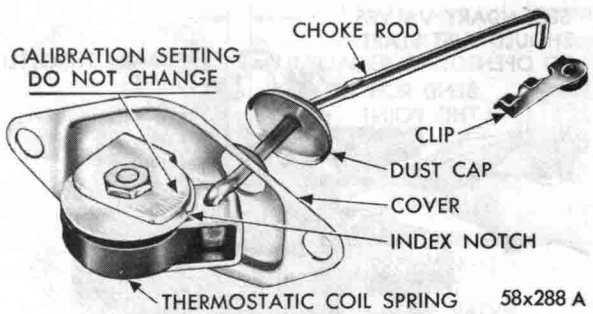


Fig. 41—Well Type Choke Control Unit

The fast idle adjusting screw should be centered over the index mark on the fast idle cam. If an adjustment is necessary, bend the fast idle rod at the angle, using Tool T109-213, to secure proper position of the fast idle cam. (See Fig. 40.)

(2) With the engine running and warmed up, turn the fast idle adjusting screw in or out to the specified r.p.m., as shown in the Specifications.

AUTOMATIC CHOKE (Well Type)

To function properly, it is important that all parts be clean and move freely. Other than the occasional cleaning the automatic choke control requires no servicing. However, it is very important that the choke control unit works freely at the thermostatic coil spring housing and at the choke shaft. Move the choke rod up and down to check free movement of the coil housing on the pivot. If unit binds, a new unit should be installed. The Well Type Choke Control Unit **is serviced only as a complete unit. Do not attempt to repair.** (See Fig. 41.)

When installing the well type choke unit, make certain that the coil housing does not contact the

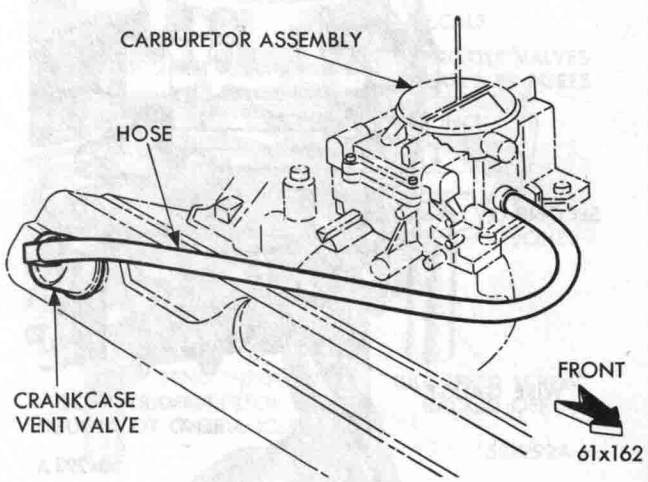


Fig. 42—Closed Crankcase Vent System

sides of the wall in the intake manifold. Any contact at this point will affect choke operation.

Do not lubricate any parts of the choke or control unit since this causes dirt accumulation which would result in binding of the choke mechanism.

Do not attempt to change the calibration setting. (Refer to specifications.) This is predetermined and should it be changed, improper choke action would result.

Clean all choke parts using a suitable solvent and then blow dry with compressed air. Examine all choke parts for wear or damage. Worn or damaged parts must be replaced with new in order to insure proper choke operation.

CLOSED CRANKCASE VENT SYSTEM

The closed crankcase ventilator valve is located in the crankcase vent tube cap and is connected to the carburetor throttle body via a rubber tube. (See Fig. 42.)

The function of the valve is to regulate the flow of unburned hydrocarbons from the crankcase and return them to the intake manifold. From here they enter the combustion chamber and then exit via the exhaust system as completely burned exhaust products.

For servicing procedures of this system, refer to the Engine section of this Manual.

YH SERIES CARBURETOR

Model YH-2911S

The Carter carburetor Model YH-2911S is a low silhouette horizontal-draft carburetor consisting of a cast iron throttle body with three-bolt mounting, and the main body incorporates a manual control choke and bowl cover (Figs. 43, 44, 45).

It has five (5) conventional circuits as have been used in previous carburetors. They are as follows:

FLOAT CIRCUITS

The purpose of the float circuit is to maintain an adequate supply of fuel at the proper level in the bowl for use by the low-speed, high-speed, pump and choke circuits. The spring loaded intake needle and the fuel baffle plate is designed to provide a stable fuel supply under all operating conditions.

The bowl is vented to the inside of the air horn. The bowl vent is calibrated to provide proper air pressure above the fuel at all times.

LOW SPEED CIRCUITS

Fuel for idle and early part throttle operation is metered through the low-speed circuit.

Gasoline enters the idle well through the metering rod jet. The low-speed jet measures the amount of fuel for idle and early part throttle operation. The air by-pass, economizer, and air bleed are carefully calibrated and serve to break up the liquid fuel and mix it with air as it moves through the passage to the idle port and idle adjustment screw port. Turning the idle adjustment screw toward its seat reduces the quantity of fuel mixture supplied by the idle circuit.

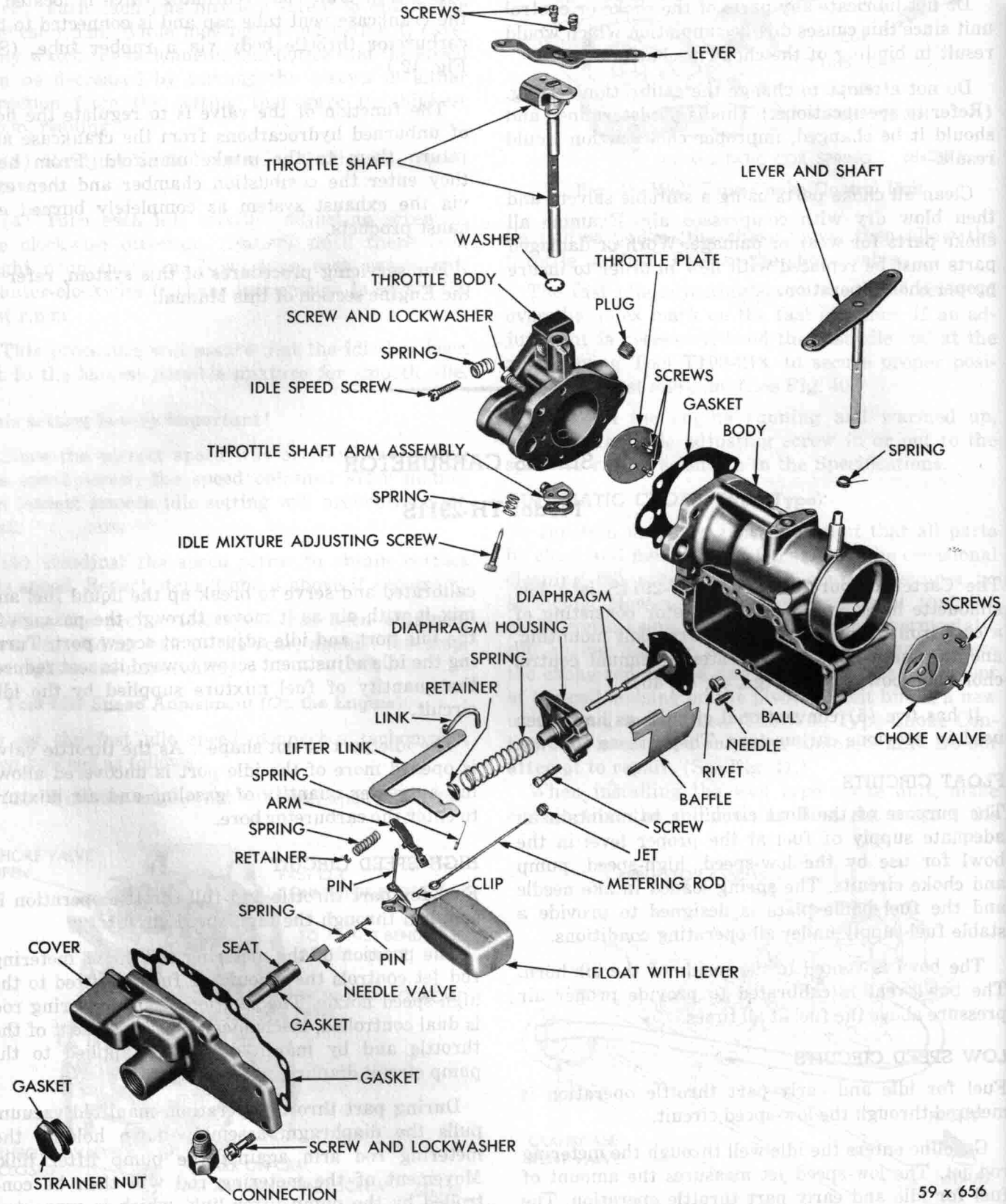
The idle port is slot shaped. As the throttle valve is opened more of the idle port is uncovered allowing a greater quantity of gasoline and air mixture to enter the carburetor bore.

HIGH SPEED CIRCUIT

Fuel for part throttle and full throttle operation is supplied through the high-speed circuit.

The position of the metering rod in the metering rod jet controls the amount of fuel admitted to the high-speed nozzle. The position of the metering rod is dual controlled, mechanically, by movement of the throttle and by manifold vacuum applied to the pump circuit diaphragm.

During part throttle operation, manifold vacuum pulls the diaphragm assembly down holding the metering rod arm against the pump lifter link. Movement of the metering rod will then be controlled by the pump lifter link, which is connected to the throttle shaft. This is true at all times that



59 x 656

Fig. 43–Carburetor Model YH-2911S (Exploded View)

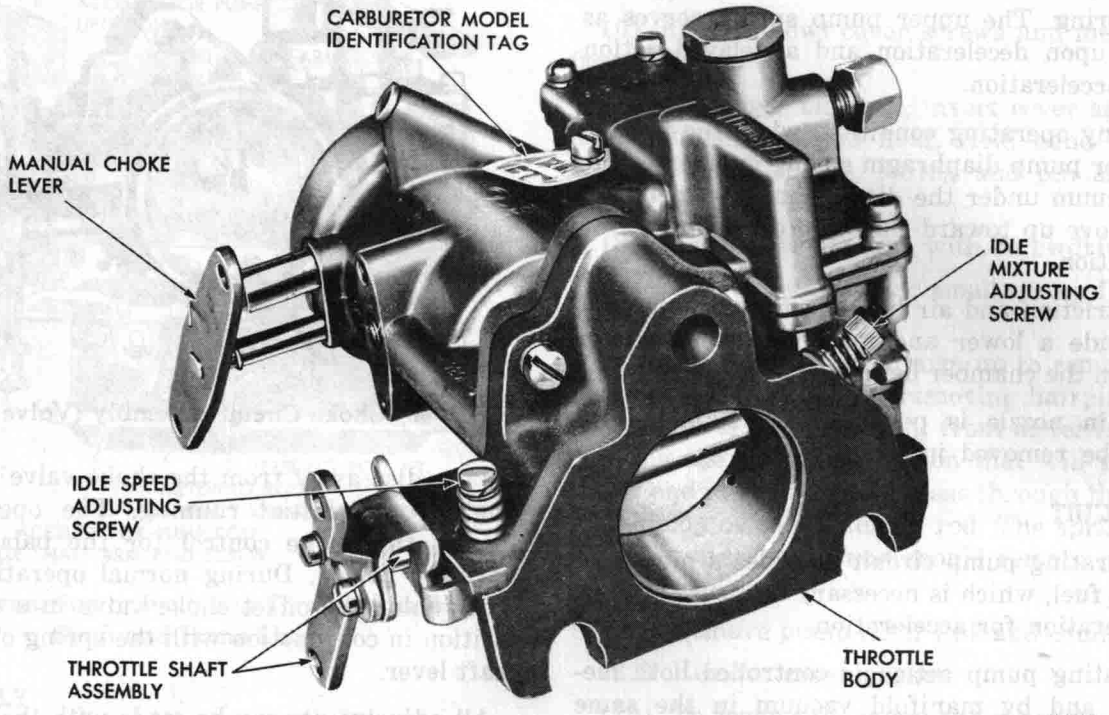


Fig. 44—Marine Engine Carburetor Model YH-2911S (Left Side)

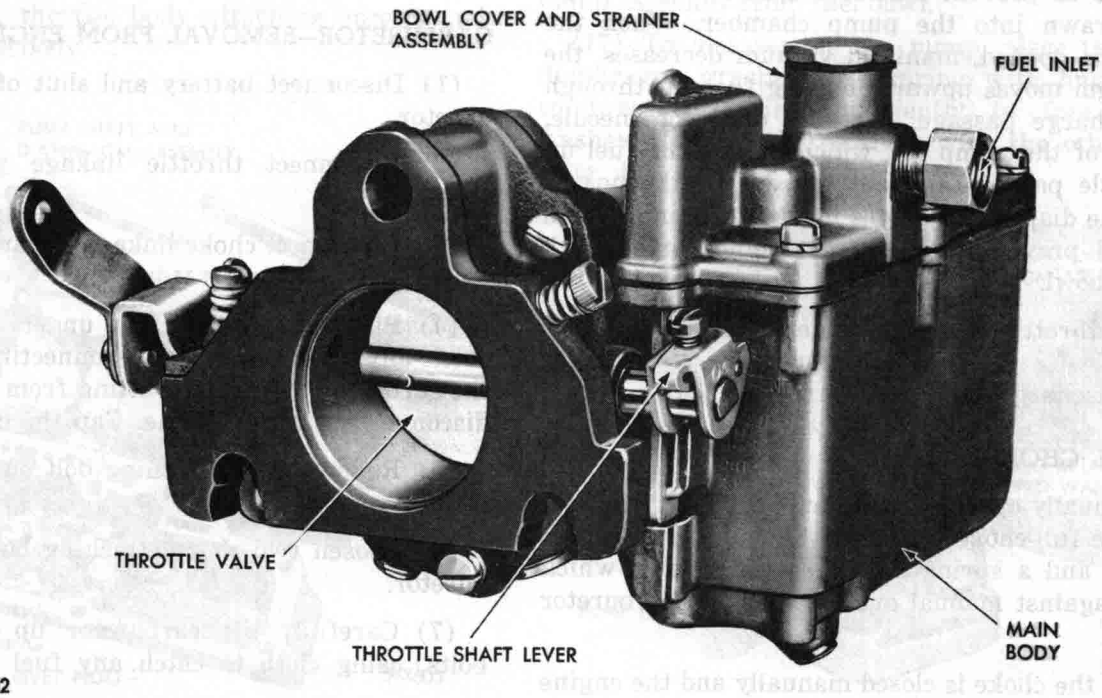


Fig. 45—Marine Engine Carburetor Model YH-2911S (Right Side)

the vacuum under the diaphragm is strong enough to overcome the tension of the lower pump diaphragm spring. The upper pump spring serves as a bumper upon deceleration and a delayed action spring on acceleration.

Under any operating condition, when the tension of the lower pump diaphragm spring overcomes the pull of vacuum under the diaphragm, the metering rod will move up toward the wide open throttle or power position.

The restriction and air bleed in the vacuum passage, provide a lower and more uniform vacuum condition in the chamber below the diaphragm.

The main nozzle is permanently installed and must not be removed in service.

PUMP CIRCUIT

The accelerating pump circuit provides a measured amount of fuel, which is necessary to insure smooth engine operation for acceleration.

Accelerating pump action is controlled both mechanically and by manifold vacuum in the same manner as the metering rod. Manifold vacuum is applied to the underside of the diaphragm at all times the engine is in operation. When the throttle is closed, the diaphragm moves downward and fuel is drawn into the pump fuel chamber through the intake ball check. The discharge needle is seated at this time to prevent fuel from the nozzle passage being drawn into the pump chamber. When the throttle is opened, manifold vacuum decreases, the diaphragm moves upward, forcing fuel out through the discharge passage, past the discharge needle, and out of the pump jet, which directs the fuel up the nozzle passage and out the end of the nozzle. When the diaphragm moves upward, the intake ball is closed preventing fuel from being forced back into the bowl.

If the throttle is opened suddenly, the upper pump spring being compressed, results in a smoother pump discharge of longer duration.

MANUAL CHOKE CIRCUIT

The manually-operated choke circuit (Fig. 46) provides the full-choke necessary for quick cold engine starting and a spring-loaded partial release which guards against manual overchoking and carburetor flooding.

When the choke is closed manually and the engine started, air velocity against the spring loaded disc on the choke valve overcomes spring pressure, moving the disc away from the choke valve and admitting air for initial running. The operator then adjusts the choke control for the balance of the warm-up period. During normal operation, air velocity holds the offset choke valve in a full release position in conjunction with the spring on the choke shaft lever.

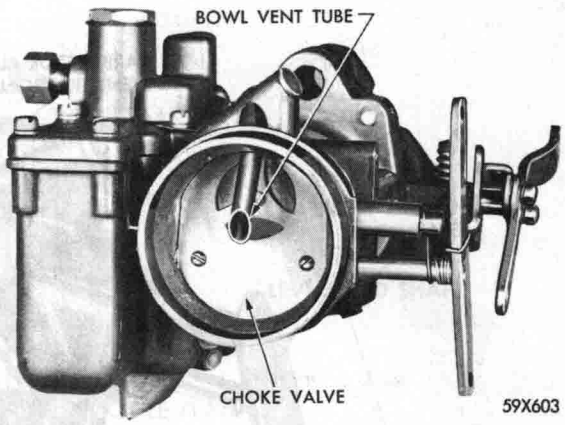


Fig. 46—Choke Circuit Assembly (Valve Closed)

All adjustments can be made with the carburetor on the engine. However, when a carburetor has been in service for a sufficient length of time, that internal adjustments are necessary, the carburetor should first be removed, disassembled and cleaned since any foreign matter could make on-engine adjustments ineffective.

CARBURETOR—REMOVAL FROM ENGINE

(1) Disconnect battery and shut off fuel to carburetor.

(2) Disconnect throttle linkage at carburetor throttle lever.

(3) Disconnect choke linkage at carburetor choke lever.

(4) Place absorbent cloth under carburetor to catch any spillage before disconnecting fuel line at the carburetor. Hold inlet fitting from turning while disconnecting the fuel line. Cap the open fuel line.

(5) Remove long attaching bolt on top of carburetor.

(6) Loosen two short attaching bolts under carburetor.

(7) Carefully lift carburetor up off attaching bolts, using cloth to catch any fuel spillage.

(8) Remove the carburetor and absorbent cloth from the ship before draining the carburetor.

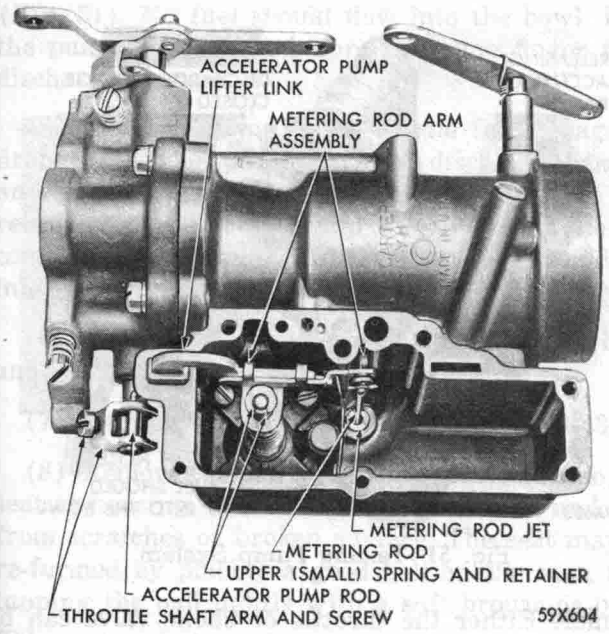


Fig. 47–Removing or Installing Throttle Arm from Shaft and Pump Link

DISASSEMBLY

(1) Remove and disassemble flame arrestor.

(2) Remove idle mixture screw from throttle body.

(3) Loosen throttle arm attaching screw and remove arm from shaft and pump link (Fig. 47).

(4) Remove throttle body attaching screws and remove throttle body.

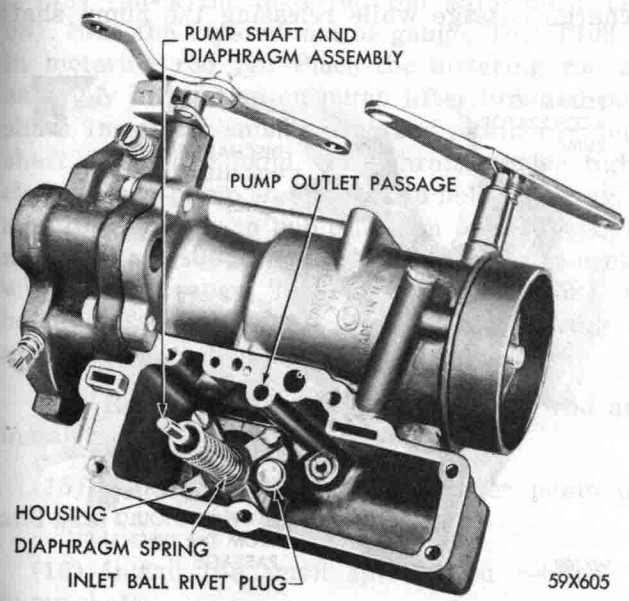


Fig. 48–Removing or Installing Pump Shaft Outlet Needle also Pump Fuel Bowl

(5) Remove bowl strainer nut, gasket and gauge assembly.

(6) Remove bowl cover screws and metal identification tag.

(7) Lift cover off bowl, invert cover and remove float retainer pin and float. Hold hand under the cover to catch needle, spring and pin as cover is turned upright.

(8) Remove needle seat with screwdriver.

(9) Remove retainer and small spring from pump shaft (Fig. 47).

(10) Lift metering rod arm up to remove metering rod. Separate rod by removing hairpin clip, unhooking lever end of spring from metering rod and rotating the rod to a position that will permit the upper end of the spring to pass through the opening in the loop of the metering rod. The spring is part of the arm assembly and should remain in the arm assembly.

(11) Remove pump lifter link and connector link.

(12) Remove cover gasket.

(13) To remove the pump outlet needle, hold hand under bowl as carburetor is inverted. Catch needle as it falls from outlet passage (Fig. 48).

(14) Remove the bowl baffle plate.

(15) Remove the metering jet.

(16) Remove the pump housing screws and lift pump assembly from fuel bowl.

(17) To disassemble the pump, place thumb on diaphragm, grasping the spring with fingers and compressing spring sufficiently to free cupped washer. Remove the retainer with the other hand (Fig. 49).

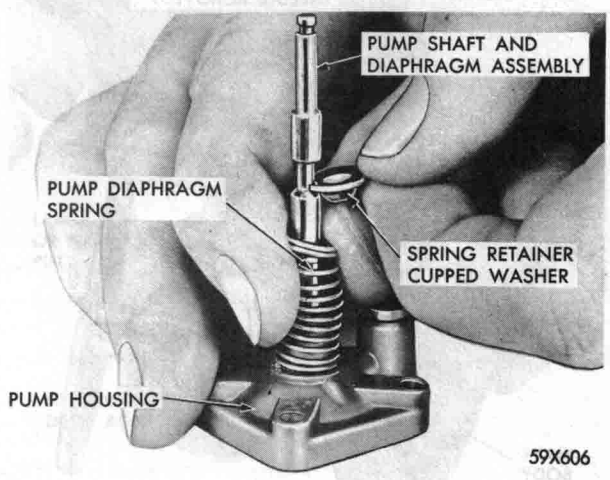


Fig. 49–Removing or Installing Pump Diaphragm Spring Assembly

CLEANING AND INSPECTION

(1) Clean the pump diaphragm with soft dry cloth. The diaphragm should be without holes, cracks or torn edges.

(2) All metallic parts, including the flame arrestor, may be cleaned in kerosene, mineral spirits or other good fluid. Use compressed air for blowing cleaning fluid out of passages.

(3) Check all passages in the main body, throttle body, pump housing and bowl cover for being free of obstructions. Do not clean passages with wire or other solid objects. In case of blockage, removal of the lead plugs may be necessary to blow out the foreign matter. A gray, granular corrosion on die castings is an indication that the sealing treatment has been broken or worn off the casting. Such castings should be replaced. Float should be air tight and free from dents.

The pump outlet needle and the idle mixture screw should have a full, undamaged seating surface on their cone-shaped end. The pump inlet ball should be free and should rattle when shaking the pump housing.

The metering jet should show no wear and the metering rod should be straight and true.

(4) Inspect the throttle bore for excessive shaft bore wear. Replace the assembly rather than installing a new shaft in the worn body. Check the throttle plate positioning with the throttle held tightly closed. A thin but uniform light is permissible between the plate and bore.

(5) Check the choke for full closing in the same manner. Either the throttle or choke valve can be repositioned by loosening the attaching screws, positioning the valve and tightening the screws.

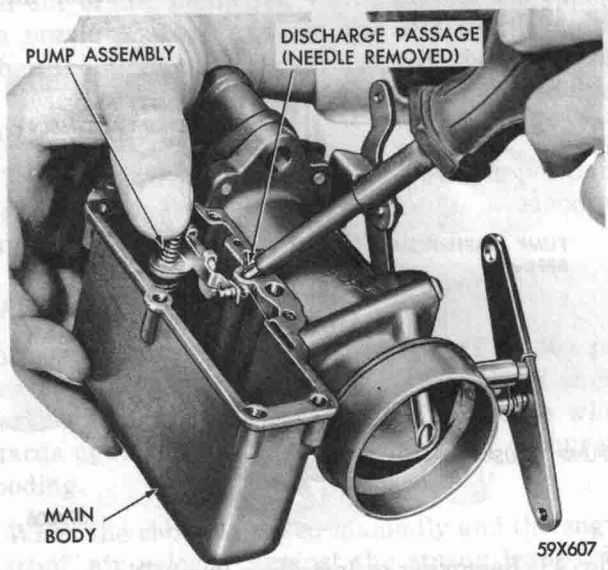


Fig. 50—Filling Pump Circuit with Fuel

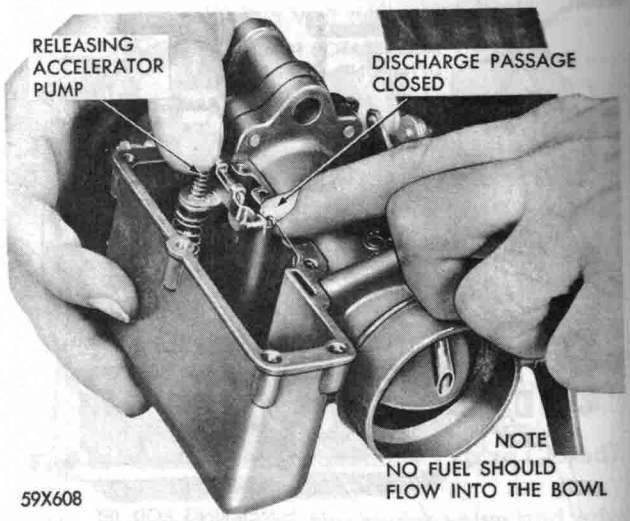


Fig. 51—Testing Pump System

ASSEMBLY

(1) Install the throttle body on throat-and-bowl body.

(2) Place the pump housing and large spring on pump shaft. Compress spring sufficiently to install spring retainer (Fig. 49).

(3) Align the pump housing and diaphragm and insert screws through housing and diaphragm.

(4) Test the pump inlet ball for leakage by holding pump down with one hand, filling pump circuit with fuel (Fig. 50), then holding a finger over the discharge passage while releasing the pump shaft

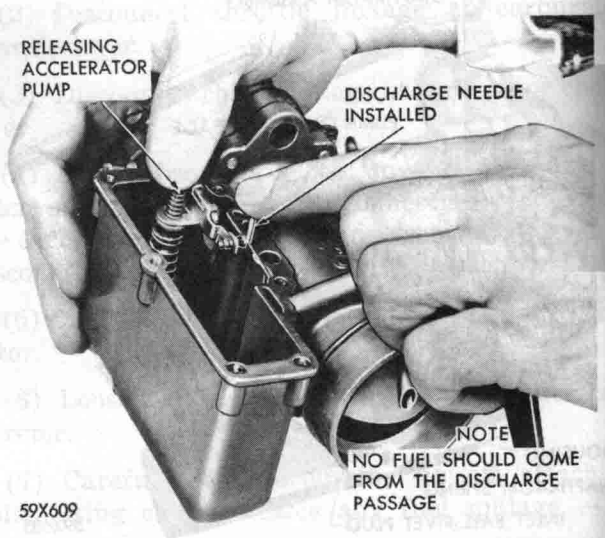


Fig. 52—Holding Needle on its seat and Releasing Pressure on Pump Shaft

(Fig. 51). No fuel should flow into the bowl. Hold the pump shaft down before removing finger from discharge passage.

(5) Test the pump outlet needle for leakage by dropping needle, point down, in discharge passage and holding needle on its seat with a small rod and releasing pressure on pump shaft. No fuel should come from discharge passage (Fig. 52). Should the inlet leak in Step 4 above:

(6) Remove the pump assembly from fuel bowl and disassemble.

(7) Remove the inlet ball plug (Tool T109-43).

(8) Remove the ball and inspect ball and also ball seat in housing. The ball should be smooth and free from scratches or broken surface. The seat may be re-formed by placing a good ball on the seat, then tapping the ball lightly with a soft bronze or brass rod.

The outlet needle seat may be re-formed by tapping the needle in a like manner. Install the pump and re-test. Then continue the assembly.

(9) Install the metering jet.

(10) Install the bowl cover gasket on bowl.

(11) Install the pump lifter link and connector link.

(12) Install the throttle arm on throttle shaft, guiding the pump connector link through the arm. Tighten attaching screw.

(13) Check the metering rod adjustment (Fig. 53). Seat the tapered end of gauge, Tool T109-104 in metering rod jet. Place the metering rod arm assembly in position on pump lifter link and pump shaft. Install the small spring and retainer on pump shaft. With one hand, hold throttle valve tightly closed. Push pump shaft down to hold metering rod arm in contact with pump link on pump shaft. The metering rod support pin should be in tight contact with top of gauge, Tool T109-104 (Fig. 52). Use bending Tool T109-22 to adjust the metering rod arm (section on pump shaft).

(14) Remove gauge tool and metering rod arm, install metering rod on arm.

(15) Install the arm assembly over pump link and shaft.

(16) Install the small spring and retainer on pump shaft.

(17) Install the inlet needle seat in bowl cover.

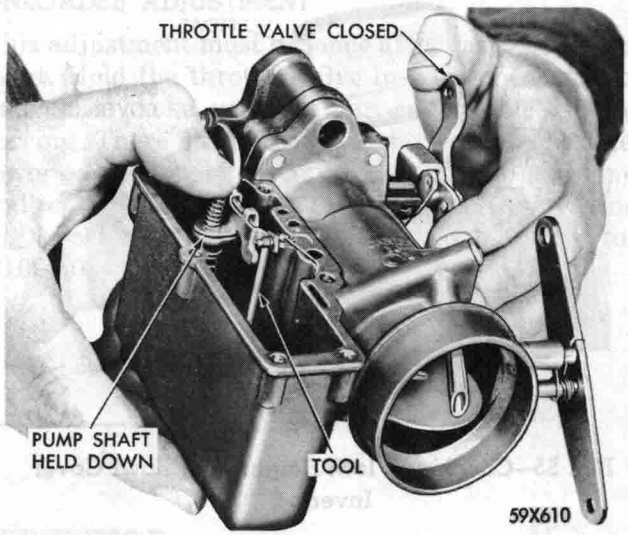


Fig. 53—Checking Metering Rod Adjustment

(18) Install the needle valve, spring and pin in seat.

(19) Install the float, inserting pin from inlet side of cover (Fig. 54).

(20) Check the float height with cover inverted and only the weight of the float on the inlet needle pin (Fig. 55). Hold cover level at eye height. The distance from cover to top of float should be $\frac{9}{16}$ inch (gauge Tool T109-84). Adjust by bending float lever. Do not hold float shell while bending the lever.

(21) Check the float drop with cover upright (Fig. 56). Distance from the bottom of the float at free end to the bowl cover should be $2\frac{7}{16}$" + or − $\frac{1}{16}$". Adjust by bending tab on float arm back of needle seat.

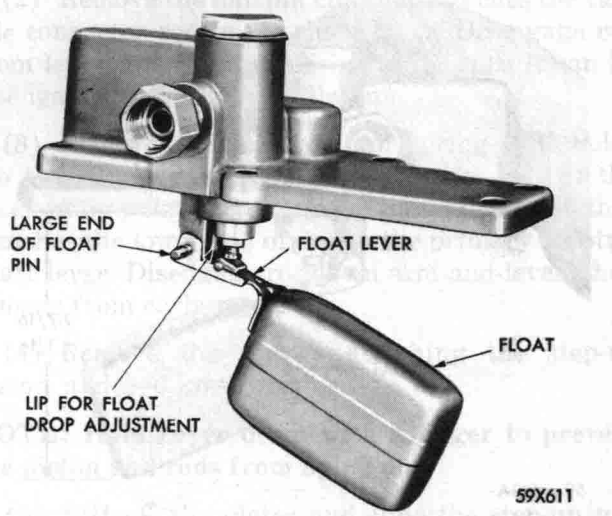


Fig. 54—Removing or Installing Float

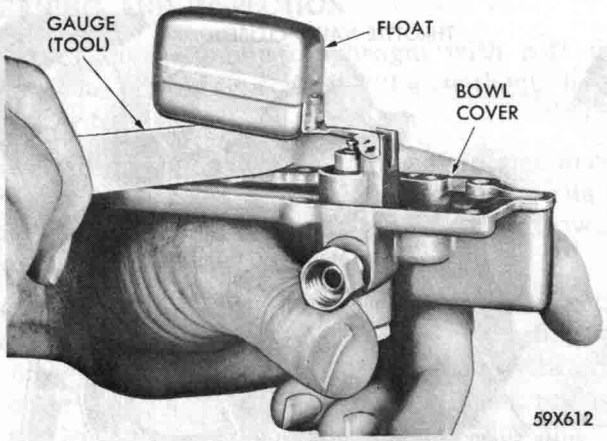


Fig. 55—Checking Float Height with Bowl Cover Inverted

(22) Install the cover on bowl with metal identification tag under screw on throat side of bowl.

(23) Install the bowl strainer nut, gasket and gauge assembly.

(24) Install idle mixture screw in throttle body.

(25) Assemble flame arrestor and attach to carburetor air horn.

INSTALLATION OF ENGINE

(1) Place the carburetor on the two lower attaching bolts. Install upper bolt and tighten all three to 25 foot-pounds torque.

(2) Remove the cap and connect fuel line, holding the fitting while tightening.

(3) Check the length of throttle linkage while holding throttle closed. Linkage should enter hole in throttle lever without force. Connect the linkage.

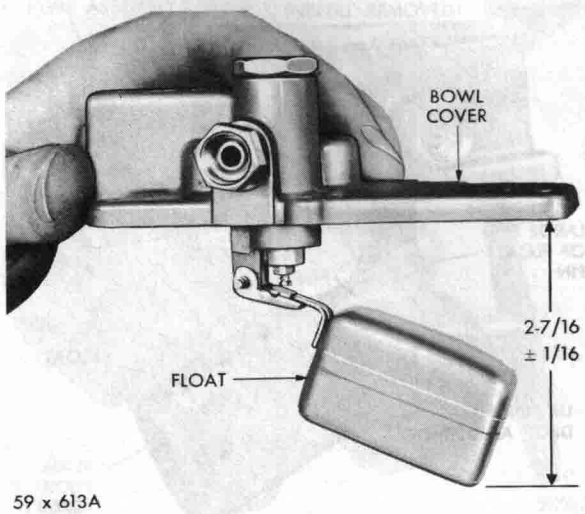


Fig. 56—Checking Float Drop with Bowl Cover Upright

(4) Check the length of choke linkage while holding choke closed. The linkage should enter the choke lever without force. Connect the linkage.

(5) Start the engine and allow it to run long enough to reach normal operating temperature before adjusting idle. Adjust the idle mixture screw to produce highest idle rpm. Then, adjust idle speed screw to produce 500 rpm. Re-adjust the mixture screw to produce smooth idle at this rpm.

CARBURETOR ADJUSTMENT

FLOAT ADJUSTMENT

With the gasket removed, bowl cover assembly inverted and float resting on pin in seated needle, the distance from the bowl cover to the top of float should be $\frac{9}{16}$ inch (gauge T109-84). Do not depress float lip against spring loaded pin in needle, but let float rest on its own weight. Adjust by bending float lever. The float setting must be checked with bowl cover held at eye height in a level position.

FLOAT DROP

With the bowl cover assembly held in upright position, the distance between bottom of float (at free end) and bowl cover should be $2\frac{7}{16}$ + or $-\frac{1}{16}$. Adjust by bending stop tab on float arm.

METERING ROD ADJUSTMENT

This adjustment is important and should be checked each time the carburetor is reassembled. Insert gauge (Tool T109-104) in place of metering rod, seating tapered end of gauge in metering rod jet. Hold gauge vertical to insure seating in jet. With throttle valve tightly closed, press down on diaphragm shaft until metering rod arm contacts lifter link at diaphragm stem. With diaphragm shaft held in this position, metering rod pin must rest lightly on metering rod gauge. To adjust, bend metering rod arm. Use bending Tool T109-22.

ACCELERATING PUMP

If acceleration is not satisfactory, remove pump housing, intake rivet plug and ball check. Examine diaphragm for wear or damage. Be sure intake check ball and discharge check needle seats are not clogged with lint or foreign matter. Intake ball check and discharge needle must seat, as a leak at these points will result in poor acceleration. Inspect and replace all worn parts, clean and blow out all passages with compressed air. Pump jet is permanently installed, do not remove.

FAST IDLE ADJUSTMENT

With thermostatic coil housing, gasket and baffle plate removed, partially open throttle, close choke valve and then close throttle valve. This will allow the fast idle cam to revolve to fast idle position. With choke valve held tightly closed and slight tension on throttle lever, there should be .015" (gauge T109-44) clearance between throttle valve and bore of carburetor (side opposite idle port). Adjust by bending connector link at lower angle.

UNLOADER ADJUSTMENT

This adjustment must be made after fast idle adjustment. Hold the throttle valve in wide open position and close choke valve as far as possible without forcing. There should be 5/8 inch clearance between lower edge of choke valve (vent tube side) and inner wall of air horn (gauge T109-85). Adjust by bending choke shaft unloader arm (use bending tool T109-105).

AFB SERIES CARBURETOR
MODEL AFB 3214S

The new AFB (aluminum four barrel) carburetor contains many new features, some of which are a new location for the step-up rods and pistons. The step-up rods, pistons and springs are accessible for service without removing the air horn, or the carburetor from the engine.

The venturi assemblies (primary and secondary) are replaceable and contain many of the calibration points for both the high and low speed system. One fuel bowl feeds both the primary and secondary nozzles on the right side while the other fuel bowl takes care of the primary and secondary nozzles on the left side. This provides improved performance and acceleration.

All the major castings of the carburetor are aluminum, with the throttle body cast integral with the main body. This allows an overall height reduction in the carburetor. The section containing the accelerator pump is termed the primary side of the carburetor. The rear section is the secondary.

The five conventional systems are two float systems, two low speed systems (primary side only), two high speed systems, one accelerator pump system and one automatic choke control system.

SERVICING THE CARBURETOR

Dirt, dust, water and gummy deposits are some of the main causes for poor carburetor operation. However, proper cleaning and the installation of new parts, where required, will return the carburetor to its originally designed performance.

When overhauling the AFB carburetor, several items of importance should be observed to assure a good job.

The carburetor should be carefully disassembled and all parts should be cleaned in a suitable solvent and inspected for wear or damage.

Air pressure only should be used to clean the various orifices and channels. Replace questionable parts with new ones.

DISASSEMBLING THE AFB CARBURETOR (Fig. 57)

(1) Place the carburetor assembly on repair stand Tool C-3400 or T109-287S elevating legs.

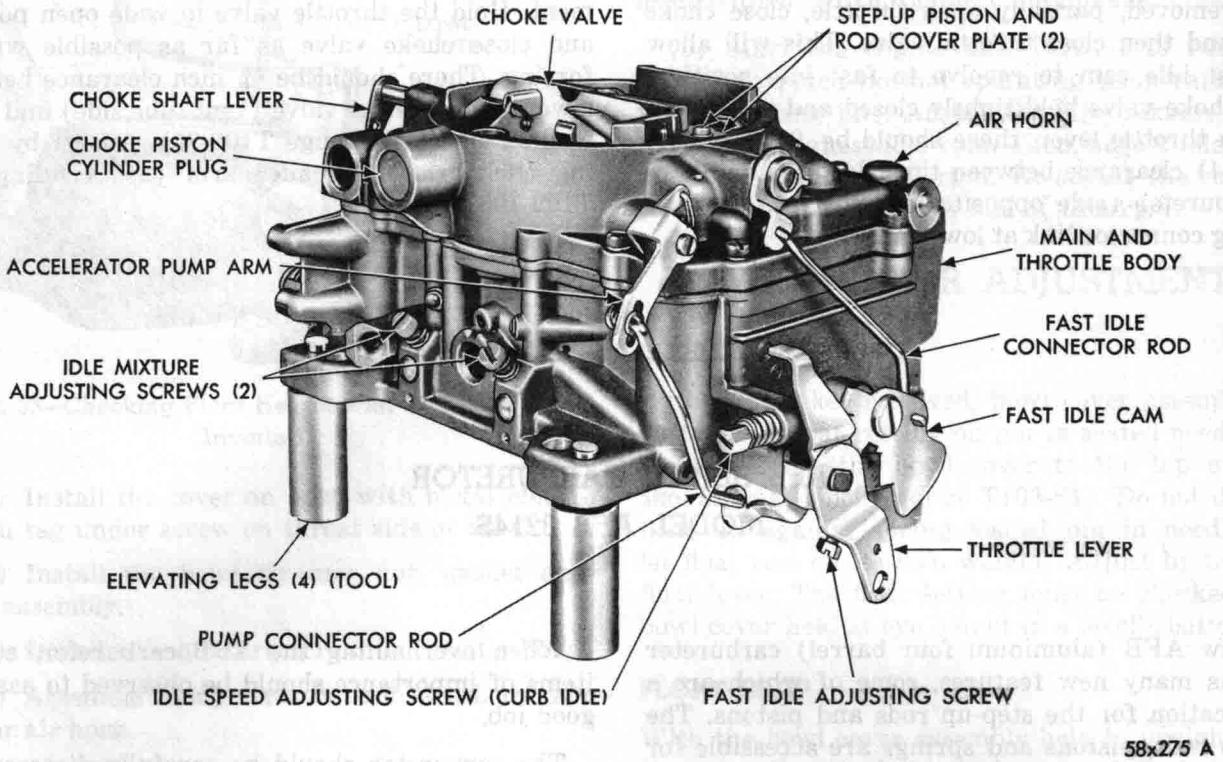
(2) Remove the hairpin clip that attaches the fast idle connector rod to the choke lever. Disengage rod from lever, then swing rod in an arc until it can be disengaged from the fast idle cam.

(3) Remove the retainer and spring that holds the throttle connector rod in the center hole of the accelerator pump arm. Remove the hairpin clip that attaches the lower end of rod in the primary throttle shaft lever. Disengage rod from arm and lever, then remove from carburetor.

(4) Remove the screws attaching the step-up piston and rod cover plates.

NOTE: Hold cover down with a finger to prevent the piston and rods from flying out.

(5) Lift off the plates and slide the step-up pistons and rods out of the air horn, as shown in Figure



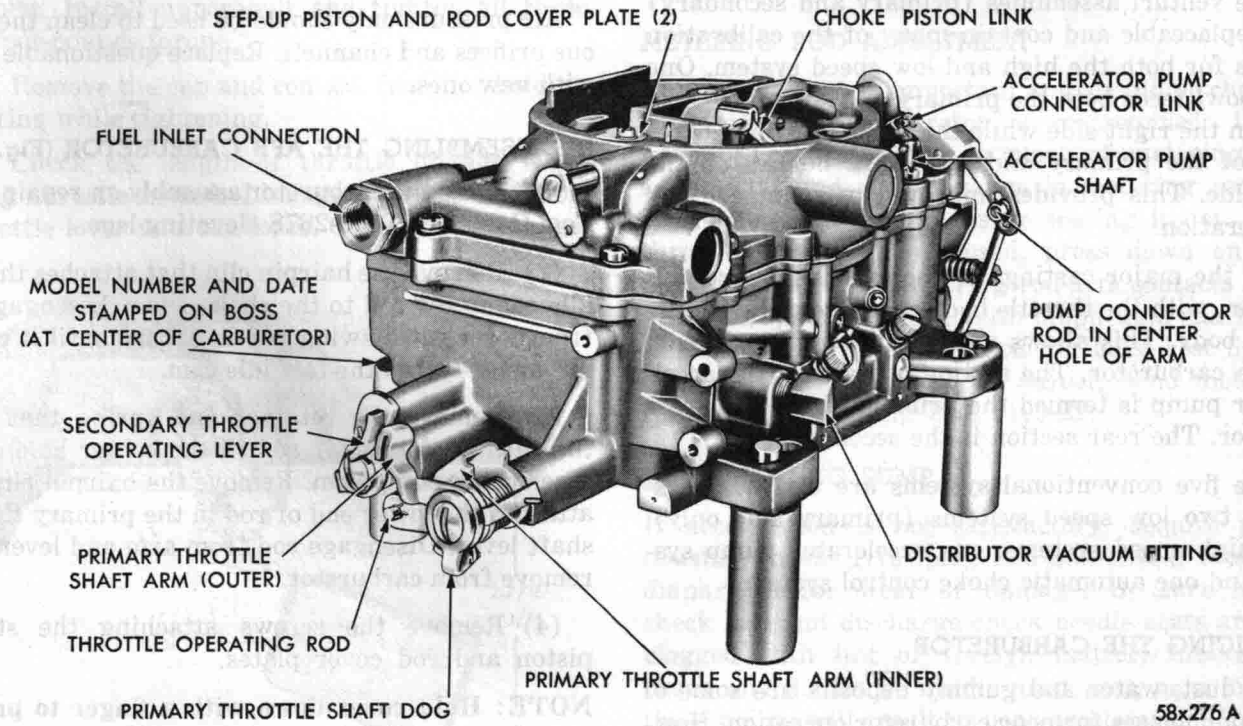


Fig. 57—Carburetor Assembly

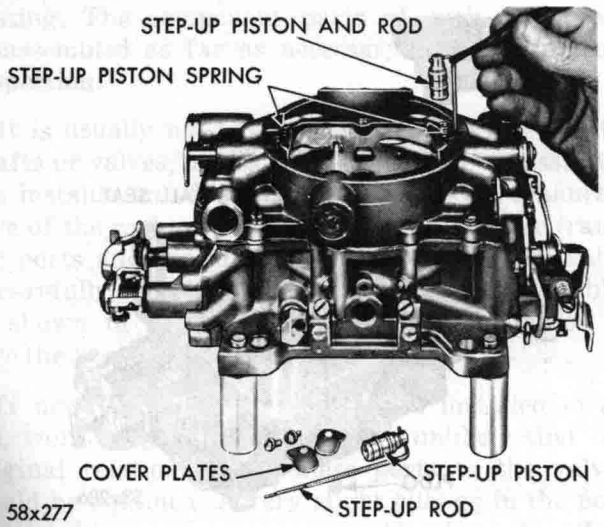


Fig. 58–Removing or Installing Step-Up Pistons and Rods

58. Remove the step-up piston springs.

(6) Remove the ten screws that attach the air horn to the main body (1 screw in hole in air horn). Lift air horn straight up and away from the main body.

NOTE: When removing air horn, use care so as not to bend or damage the floats.

(7) Remove the accelerator pump plunger lower spring from the pump cylinder.

a. Disassembling the Air Horn

Place the air horn in an inverted position on the bench (to protect the floats).

(1) Using a suitable tool, remove the float fulcrum pins (left and right) and lift the floats up and out of bosses on air horn.

NOTE: It is suggested that the float on the pump side be marked so that the floats can be re-installed in their respective positions.

(2) Remove the two needle valves from their respective seats, after marking the one on the pump side for identification. Using a wide blade screwdriver, remove the needle valve seats. Be sure each needle valve is returned to its original seat at reassembly.

(3) Remove the hairpin clip that holds the accelerator pump connector link in the pump arm and plunger shaft. Disengage link from pump arm and shaft. Slide the accelerator pump plunger and spring out of the air horn. Remove the air horn to main body gasket and discard.

(4) Place the accelerator pump plunger in a jar of clean gasoline or kerosene, to prevent the leather from drying out.

(5) Remove the fuel inlet fitting and filter screen from the air horn.

(6) Using a prick punch, pierce the welch plug and remove it from the end of choke piston cylinder. Remove cotter pin that attaches the piston link to the choke valve lever. Slide choke piston and link out of cylinder.

b. Main Body Disassembly

(1) Remove the screws that attach the accelerator pump jet housing to the main body. Lift out the jet housing and gasket, as shown in Figure 59. Discard the gasket. Invert the main body and drop out the discharge check needle from the discharge passage.

(2) Using Tool T109-58, remove the main metering jets (primary side), as shown in Figure 60.

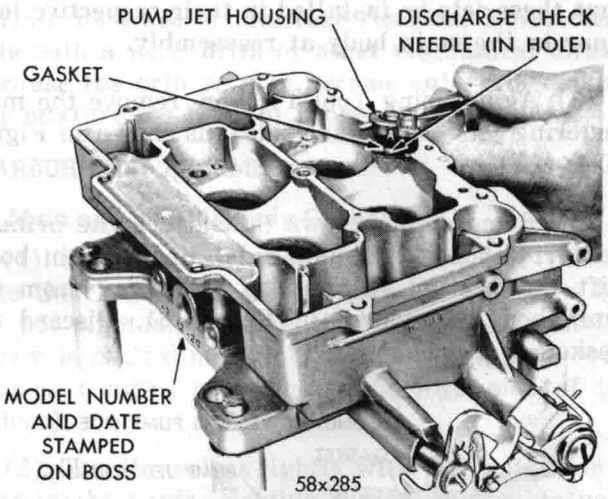


Fig. 59–Removing or Installing Accelerator Pump Jet Housing

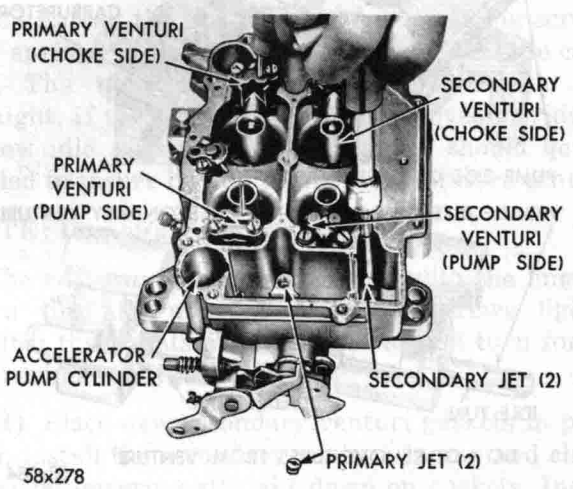


Fig. 60–Removing or Installing Main Metering Jets

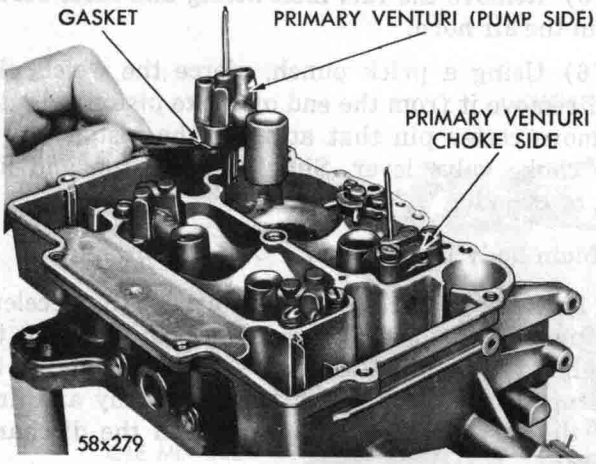


Fig. 61—Removing or Installing Primary Venturi

NOTE: The primary and secondary main metering jets are not interchangeable. It is very important that these jets be installed in their respective locations in the main body at reassembly.

(3) Again using Tool T109-58, remove the main metering jets (secondary side), as shown in Figure 60.

(4) Remove the screws that attach the primary venturi (choke and pump side) to the main body. Lift the venturi straight up and away from the main body, as shown in Figure 61. Discard the gaskets.

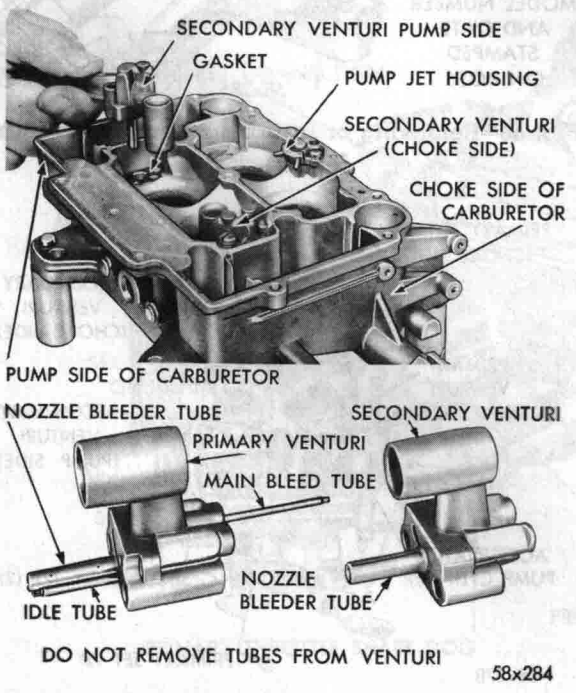


Fig. 62—Removing or Installing Secondary Venturi

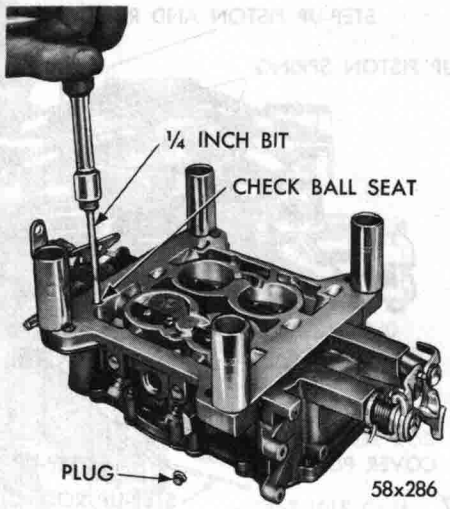


Fig. 63—Removing or Installing Accelerator Pump Intake Check Ball Seat

NOTE: The venturi assemblies are not interchangeable, side for side and must be re-installed in their original location at reassembly.

(5) Remove the screws that attach the secondary venturi (choke and pump side) to the main body. Lift the secondary venturi assemblies straight up and away from the body, as shown in Figure 62.

(6) Invert the main and throttle body casting, and remove the accelerator pump intake check ball plug. Using Tool T109-59, screwdriver bit, remove the check ball seat, as shown in Figure 63. Again invert the body casting and drop out the intake check ball.

(7) Remove the two idle mixture adjusting screws and springs from the throttle body portion of the main casting.

The carburetor now has been disassembled into two units, the air horn and main and throttle body

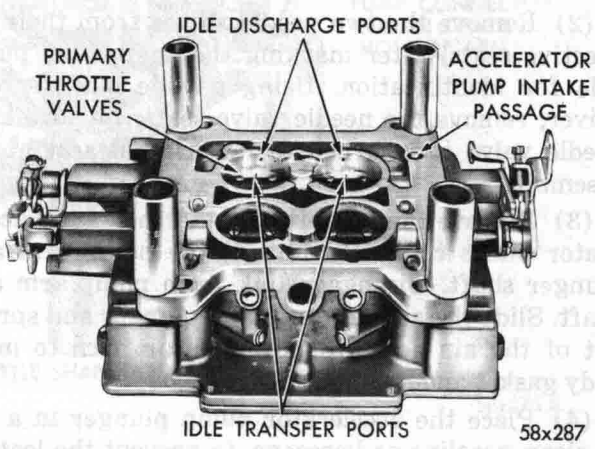


Fig. 64—Ports in Relation to Throttle Valves

casting. The component parts of each have been disassembled as far as necessary for cleaning and inspection.

It is usually not advisable to remove the throttle shafts or valves, unless wear or damage necessitates the installation of new parts. During the manufacture of the carburetor, the location of the idle transfer ports and the idle discharge ports to the valve is carefully established for one particular assembly, as shown in Figure 64. The valves are milled to give the proper port relation.

If new throttle shafts should be installed in an old, worn body, it would be very unlikely that the original relationship of these ports to the valves would be obtained. A very slight change in the port relationship to the valves would adversely affect normal carburetor operation.

It is recommended that if the throttle shafts are excessively worn, that a new carburetor be installed. If the throttle valves, however, have become nicked, burred or damaged, new valves may be installed, providing the following instructions are carefully followed.

NOTE: The screws that attach the throttle valves are staked on the opposite side and care should be used in removal so as not to break the screws in the throttle shaft. Remove the staked portion of the screws with a file.

Remove the screws that attach the primary throttle valves to the throttle shaft and slide valve (or valves) out of the bores.

Remove the screws that attach the secondary throttle valves to the throttle shaft and slide valve (or valves) out of bores.

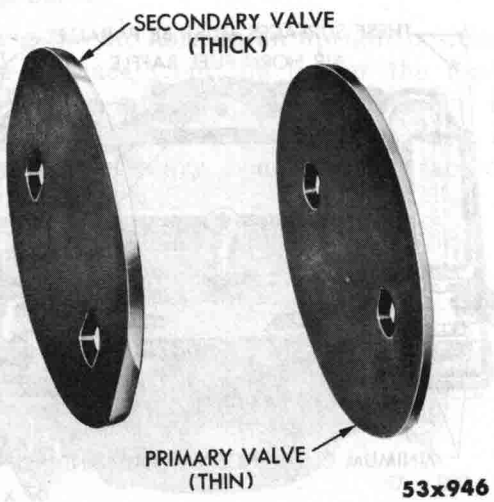


Fig. 65—Throttle Valve Identification

The primary valves and secondary valves are not interchangeable and should be kept separate in order that each may be returned to its respective bore. (See Fig. 65.)

c. Cleaning and Inspection

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

IMPORTANT

If the commercial solvent or cleaner recommends the use of a water rinse, it should be "HOT." After rinsing, all trace 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. Never clean jets with a wire, drill, or other mechanical means, because the orifices may become enlarged, making the mixture too rich for proper performance.

CARBURETOR ASSEMBLY

a. Main and Throttle Body Casting

(1) Slide the primary throttle valve (or valves) into their respective bores, install new screws, but do not tighten. Be sure the idle speed adjusting screw is backed out. Hold the valves in place with fingers (fingers pressing on the high side of the valves).

(2) Tap the valves lightly with a screwdriver to seat in the bores. Holding the valves in this position, tighten the screws securely. Stake screws by squeezing with pliers.

(3) Install the two idle mixture adjusting screws and springs in the throttle body portion of the casting. The tapered portion must be smooth and straight. If the tapered portion is grooved or ridged, a new idle mixture adjusting screw should be installed to insure having correct idle mixture control.

NOTE: Do not use a screwdriver.

The adjustment should be made with the fingers. Turn the idle mixture adjusting screws lightly against their seats and back off one full turn for an approximate adjustment.

(4) Place new secondary venturi gaskets in position, install the secondary venturi (pump and choke side) by lowering straight down on gaskets. Install attaching screws and tighten securely.

NOTE: Be sure all the metering holes and vent tubes are clean, in both the primary and secondary venturi.

(5) Place new primary venturi gaskets in position, then install the primary venturi (pump and choke side) by lowering straight down on the gaskets. (See Fig. 61.) Install attaching screws and tighten securely.

(6) Install the primary and secondary main metering jets, using Tool T109-58. (See Fig. 60.) Tighten jets securely.

(7) Invert the carburetor and install the accelerator pump intake check ball. Install seat and tighten securely, using Tool T109-59 (Fig. 63). Install screw plug and tighten securely.

b. Accelerator Pump Test

(1) Pour clean gasoline into the carburetor bowl (approximately ½ inch deep). Remove the accelerator pump plunger from the jar of gasoline. Flex the leather several times, then slide onto the pump cylinder.

(2) Install the accelerator pump discharge check needle in the discharge passage. Raise the pump plunger and press lightly on the plunger shaft to expel air from the pump passages. Using a small clean brass rod, hold the discharge check needle firmly on its seat. Again raise the plunger and press downward. No fuel should be emitted from either the intake or discharge passage.

(3) If fuel does emit from the intake passage, disassemble the intake check ball and reclean the passage. Fuel leakage at the discharge check needle indicates the presence of dirt or a damaged check needle. Clean again and then install a new check needle. Retest for leakage.

(4) If either the intake check ball or discharge check needle leaks after above test and service fix, attempt to reseat as follows:

c. Intake Check Ball

Remove the screw plug, gasket, ball seat and ball from the bottom of the throttle body flange. Install a new ball and ball seat. Install screw plug and new gasket and retest as described previously.

d. Discharge Check Needle

(1) With the discharge check needle installed, insert a piece of drill rod down on the needle. Lightly tap the drill rod with a hammer to form a new seat. Remove and discard old needle and install a new one. Retest as described previously. If the service fix does not correct the condition, a new carburetor must be installed.

(2) Install the accelerator pump discharge check needle, jet housing and gasket. Install housing and attaching screws. Tighten screws securely.

(3) Press down on the accelerator pump plunger shaft and as the plunger is being depressed, a clear straight stream should emit from each jet. If the streams are identical (if either one is diverted or restricted) a new accelerator pump jet housing should be installed. After test, pour the gasoline from the carburetor bowl and remove pump plunger.

e. Air Horn Assembly

(1) Slide the fuel inlet screen into the fuel line fitting, then install fitting in air horn. Tighten securely.

(2) Check to see if the leather on the accelerator pump plunger is hard, cracked or worn. If any sign of wear or deterioration is evident, install a new plunger assembly.

(3) Slide the accelerator plunger into air horn, and install the accelerator pump link. Install the retaining hairpin clip to secure.

(4) Place a new air horn to main body gasket in position on the air horn and install the float needle valve seats. (Be sure each needle seat and needle is reinstalled in its original position.)

(5) Slide the right and left floats into position in the air horn and install the float fulcrum pins.

NOTE: Be sure the marked float is installed on the pump side of the air horn.

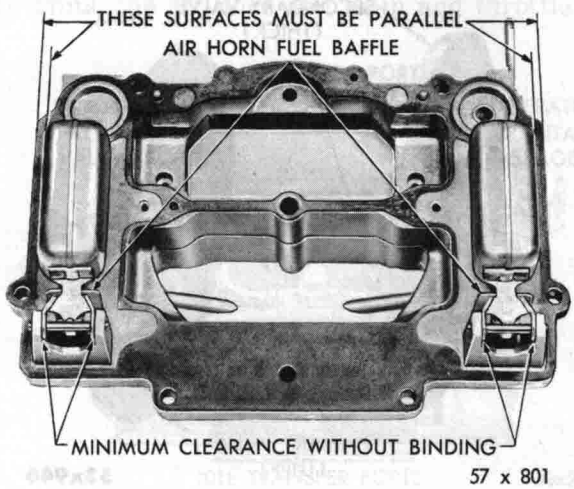


Fig. 66–Checking Float Alignment

(6) After the floats have been installed, check the float alignment, level and drop settings as follows:

f. Float Alignment Setting

(1) Sight down the side of each float shell to determine if the side of the float is parallel to the outer edge of the air horn casting, as shown in Figure 66.

(2) If the sides of the float are not in alignment with the edge of casting, bend the float lever by applying pressure to the end of the float shell with the fingers while supporting the float lever with the thumb.

NOTE: To avoid damage to the float, apply only enough pressure to bend the float lever.

(3) After aligning the floats, remove as much clearance as possible between the arms of the float lever and the lugs on the air horn. To do this, bend the float lever. The arms of the float lever should be parallel as possible to the inner surfaces of the lugs or the casting.

g. Float Level Setting

(1) With the air horn inverted, the air horn gasket in place and the float needle seated, slide float gauge Tool T109-106 ($\frac{7}{32}$") between the top of the float **(at outer end)** and the air horn gasket, as shown in Figure 67. Float should just touch gauge.

(2) Check the other float in the same manner. If an adjustment is necessary, bend the float arm using Tool T109-22, until correct clearance has been obtained. After bending arm, recheck the float alignment.

h. Float Drop Setting

(1) Holding the air horn in an upright position, measure the distance from the top of the floats (outer end) to the air horn gasket, as shown in Figure 68. This measurement should be $\frac{3}{4}$ inch. If an adjustment is necessary, bend the stop tabs on

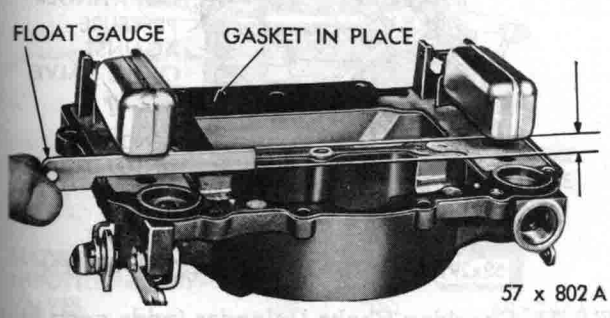


Fig. 67—Checking Float Height

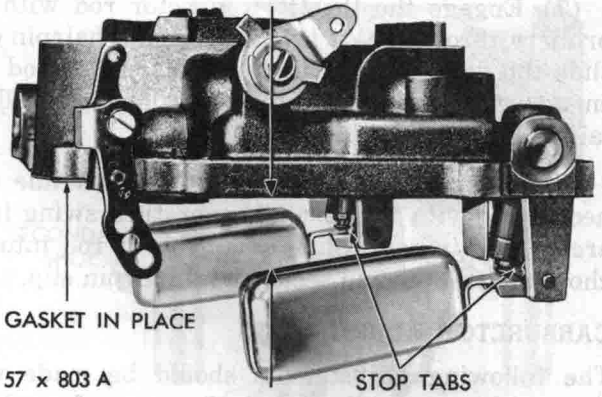


Fig. 68—Checking Float Drop

the float levers until the correct drop setting has been obtained. Bend the tab towards the needle seat to lessen the drop, or away from the seat to increase the drop.

(2) After the floats have been checked and adjusted, continue to assemble the carburetor as follows:

(3) Place the accelerator pump plunger lower spring in the pump cylinder, then lower the air horn carefully down on the main body.

CAUTION

Be sure the fuel baffles on the air horn, slide down in front (bowl side) of the float chamber baffles, or the air horn will not index correctly with the main body and can cause the floats to hang up. Be sure the leather on the plunger does not curl or wrinkle. Accelerator pump operation will be affected if this precaution is not observed.

(4) Install the (10) air horn attaching screws and tighten securely. (The two long screws should be installed in the holes that are located at the air cleaner mounting surface. The 1 inch screw at the front and the 1½ inch at the rear.)

(5) Slide the step-up piston springs into the piston cylinders, followed by the step-up pistons and step-up rods. Install the cover plates and attaching screws while holding the step-up pistons down in position. Tighten screws securely.

(6) Slide the choke piston into its cylinder in the air horn, guiding the link into the slot in the choke valve lever. Align hole, then install attaching cotter pin. Place a new welch plug over cylinder opening and secure by rapping with a hammer. Check the fit of the choke valve in air horn. The valve should be evenly spaced on all sides. Loosen screws and reposition if necessary.

(7) Engage the throttle connector rod with the primary throttle shaft lever and install hairpin clip. slide the flat washer over the other end of rod and engage with the accelerator pump arm. Install retainer spring and retainer securely.

(8) Engage the lower end of the fast idle connector rod with the fast idle cam, then swing in an arc to lock in cam. Slide other end of rod into the choke shaft lever and secure with hairpin clip.

CARBURETOR ADJUSTMENTS

The following adjustments should be made with the carburetor on the bench for ease of working, and should be made in the following order:

a. Fast Idle Adjustment

(1) With the choke valve held tightly closed and carburetor inverted, tighten the fast idle adjusting screw (on the high step of the fast idle cam) until wire gauge Tool T109-29 (.020 inch) can be inserted between the primary throttle valve and the bore (side opposite idle port), as shown in Figure 69. The index mark on the fast idle cam should be in direct line with the fast idle screw shank.

(2) Invert the carburetor and open the throttle valves to wide open position. Close the choke valve tightly and then close the throttle valves. Release the choke valve. This will position the fast idle cam to fast idle. The index mark on the cam should split the center of the fast idle adjusting screw, as shown in Figure 70.

(3) If an adjustment is necessary, bend the fast idle connector rod at the angle, using Tool T109-213, until the index mark on the cam indexes the fast idle adjusting screw.

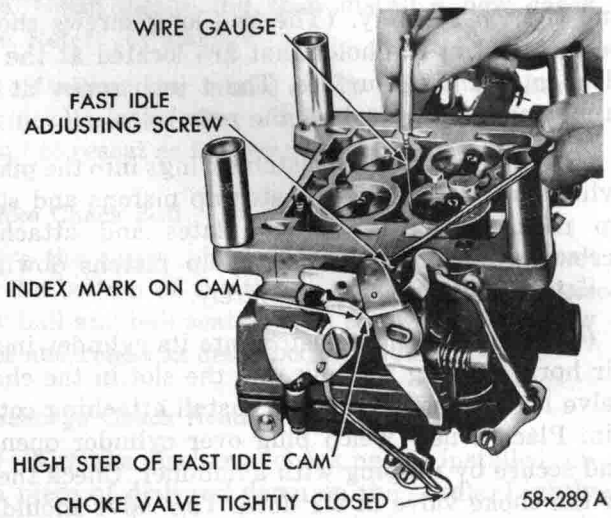


Fig. 69—Checking Fast Idle Adjustment

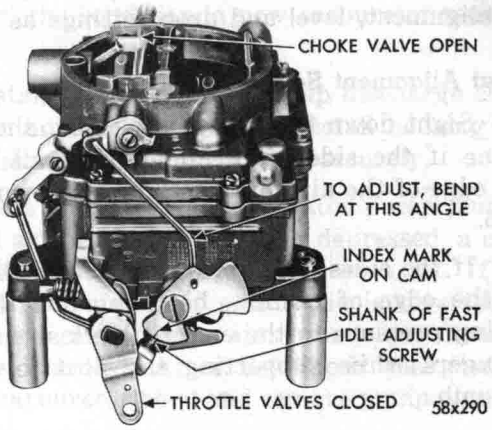


Fig. 70—Fast Idle Cam Indexing

b. Choke Unloader Adjustment

(1) With the throttle valves in the wide open position, it should be possible to insert Tool T109-31 (¼ inch) gauge between the upper edge of the choke valve and the inner wall of the air horn, as shown in Figure 71.

(2) If an adjustment is necessary, bend the unloader lip on the throttle shaft lever, using Tool T109-41, until correct opening has been obtained.

c. Accelerator Pump Adjustment

(1) Move the choke valve to wide open position, to release the fast idle cam. Back off the idle speed adjusting screw until the throttle valves are seated in the bores.

(2) Measure the distance from the top of the air horn to the top of the plunger shaft, using a "T" scale as shown in Figure 72. This distance should be 7/16 inch.

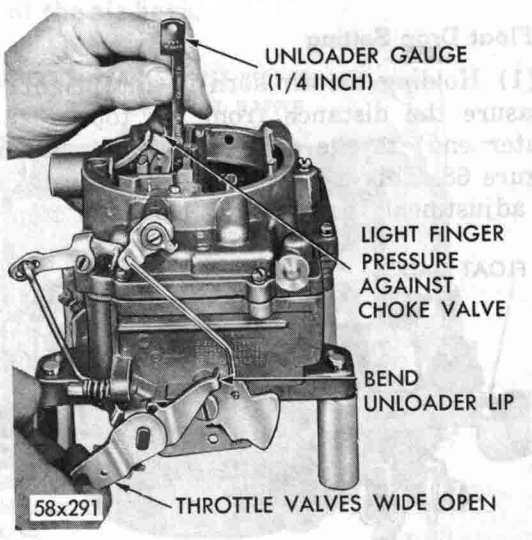


Fig. 71—Checking Choke Unloader (wide open kick) Adjustment

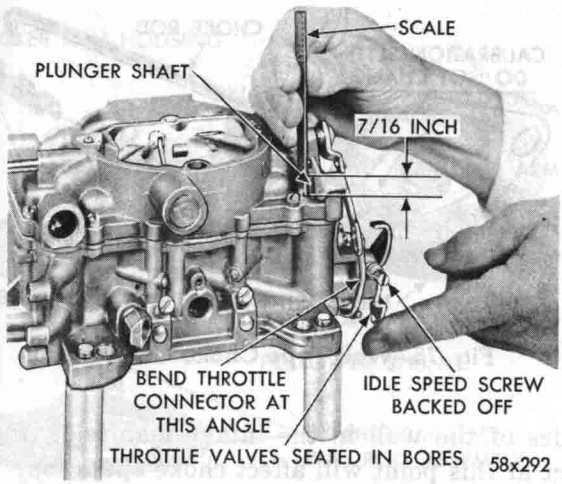


Fig. 72—Checking Accelerator Pump Travel

(3) If an adjustment is necessary, bend the throttle connector rod at the lower angle, using Tool T109-213, until correct travel has been obtained.

d. Secondary Throttle Lever Adjustment

(1) To check the secondary throttle lever adjustment, block the choke valve in the wide open position and invert the carburetor.

(2) Slowly open the primary throttle valves until it is possible to measure $^{19}/_{64}$ inch between the lower edge of the primary valve and the bore (opposite idle port) as shown in Figure 73. At this measurement, the secondary valves should just start to open.

(3) The stop lugs on both the primary and secondary throttle levers should contact the bosses on the flange at the same time.

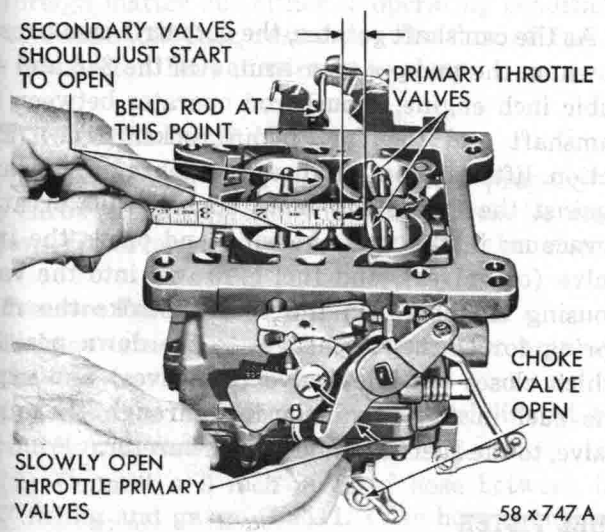


Fig. 73—Checking Secondary Throttle Opening

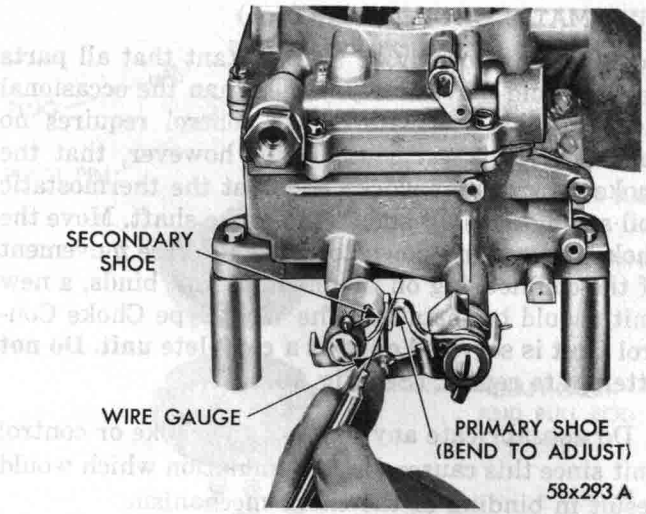


Fig. 74—Checking Clearance Between Closing Shoes

(4) If an adjustment is necessary, bend the secondary throttle operating rod at the angle, using Tool T109-213, until correct adjustment has been obtained.

(5) At wide open throttle, the primary and secondary throttle valves should reach the full vertical position.

(6) With the primary and secondary throttle valves in the tightly closed position, it should be possible to insert Tool T109-29 (.020 inch) wire gauge, between the positive closing shoes on the secondary throttle levers, as shown in Figure 74.

(7) If an adjustment is necessary, bend the shoe on the secondary throttle lever, using Tool T109-22, until correct clearance has been obtained.

e. Secondary Throttle Lock-Out Adjustment

(1) Crack the throttle valves, than manually open and close the choke valve. The tang on the secondary throttle lever should freely engage in the notch of the lock-out dog.

(2) If an adjustment is necessary, bend the tang on the secondary throttle lever, until engagement has been made. Use Tool T109-22 for this operation.

(3) After adjustments have been made, reinstall carburetor on engine, using a new gasket.

(4) It is suggested that the carburetor bowl be filled with clean gasoline. This will help prevent dirt that is trapped in the fuel system from being dislodged by the free flow of fuel, as the carburetor is primed.

AUTOMATIC CHOKE (Well Type)

To function properly, it is important that all parts be clean and move freely. Other than the occasional cleaning, the automatic choke control requires no servicing. It is very important, however, that the choke control unit works freely at the thermostatic coil spring housing and at the choke shaft. Move the choke rod up and down to check for free movement of the coil housing on the pivot. If unit binds, a new unit should be installed. The Well Type Choke Control Unit **is serviced only as a complete unit. Do not attempt to repair.** (See Fig. 75.)

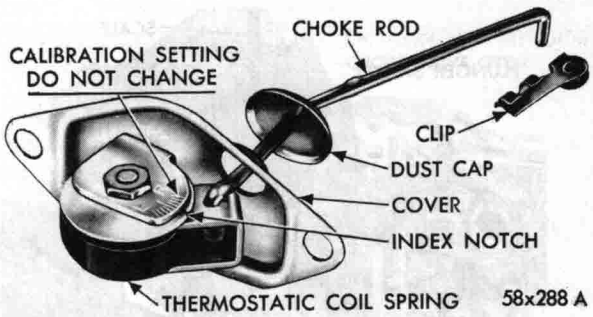


Fig. 75—Well Type Choke Control Unit

Do not lubricate any parts of the choke or control unit since this causes dirt accumulation which would result in binding of the choke mechanism.

Do not attempt to change the calibration setting. (Refer to specifications.) This is pre-determined and should it be changed, improper choke action would result.

Clean all choke parts using a suitable solvent and then blow dry with compressed air. Examine all choke parts for wear or damage. Worn or damaged parts must be replaced with new in order to insure proper choke operation.

When installing the well type choke unit, make certain that the coil housing does not contact the sides of the wall in the intake manifold. Any contact at this point will affect choke operation.

IDLE SPEED ADJUSTMENT

The idle speed adjustment is made after the carburetor has been installed on the engine.

(1) With the throttle valves closed and the choke valve wide open (engine at normal operating temperature), adjust the idle screw at 500 rpm using a tachometer.

(2) Adjust the idle mixture screws until the engine operates smoothly, then recheck the tachometer and again adjust the idle screw to give the correct engine rpm.

FUEL PUMP

Two different models of fuel pumps are used in production. (Figs. 76 and 77.) The same basic design applies to both models. The service procedures for testing, disassembly, overhaul, cleaning and reassembly of these pumps are the same. However, slight modifications do exist and will be covered in the text wherever they appear. For detailed information, refer to specifications.

SERVICING THE FUEL PUMP

The fuel pumps are driven by an eccentric cam cast integral with the camshaft and a short push rod in the M-383 and M-413 cubic inch engines, or by a pressed steel eccentric cam mounted on the camshaft sprocket in the M-318A, B, and C cubic inch engines.

As the camshaft rotates, the eccentric cam presses down on the pump rocker arm. (On the 383 and 413 cubic inch engine, a push rod operates between the camshaft and the fuel pump rocker arm.) This action lifts the pull rod and diaphragm upwards against the fuel pump main spring, thus creating a vacuum in the valve housing and opens the inlet valve (or valves), and fuel is drawn into the valve housing chamber. On the return stroke the main spring forces the diaphragm to the **down** position, which closes the inlet valve (or valves) and expels the fuel in the valve housing through the outlet valve, to the fuel filter and the carburetor.

FUEL FILTER

The fuel filter (All Models) should be changed every

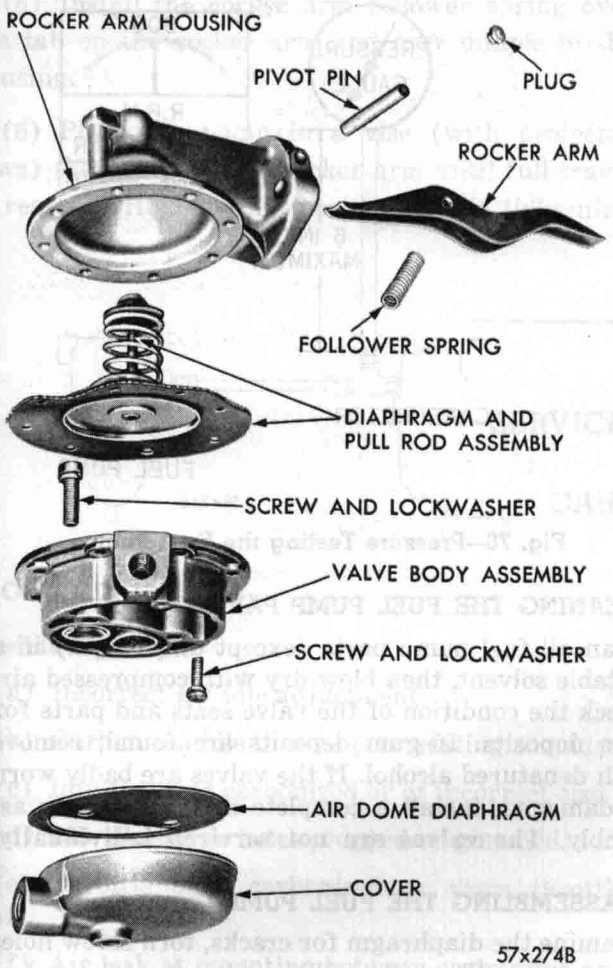


Fig. 76—Fuel Pump Assembly (Exploded View) M-2504S

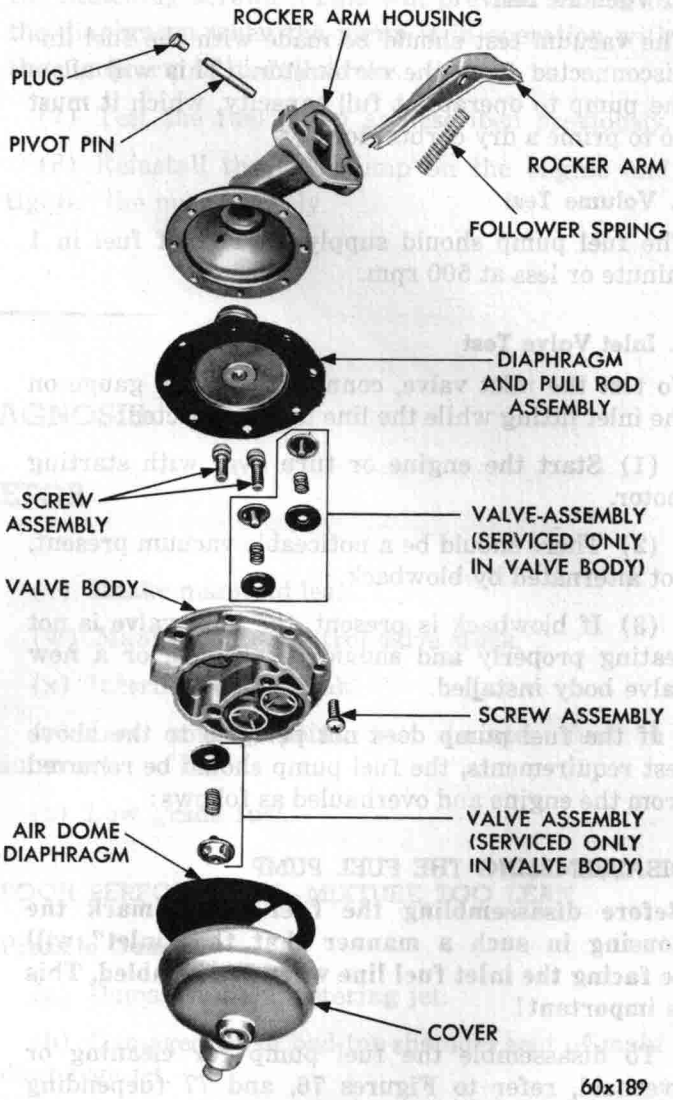


Fig. 77—Fuel Pump Assembly (Exploded View) M-2769S

100 hours of operation. Loss of performance may occur if the filter traps an unusually large quantity of foreign matter due either to operating conditions or contaminated fuel, restricting the flow of fuel to the carburetor. **Do not attempt to clean.**

TESTING FUEL PUMP (On Engine)

If the fuel pump fails to supply fuel properly to the carburetor, the following tests should be made before removing the fuel pump from the engine.

a. Pressure Test

If leakage is not apparent, test pump for pressure, as follows:

(1) Insert a "T" fitting in the fuel line at the carburetor, as shown in Figure 78.

(2) Connect a 6 inch piece of hose between the "T" fitting and gauge C-3411. (The hose should not exceed 6 inches. A longer hose may collect fuel and the additional weight of the fuel would be added to the pressure of the pump and result in an inaccurate reading.)

(3) Vent the pump for a few seconds (this relieves the air trapped in the fuel chamber). If this is not done, the pump will not operate at full capacity and low pressure reading will result.

(4) Connect a tachometer, then start the engine and run at 500 rpm. The reading should be from 3½ to 5 psi on Models M-383 and 413, and 6 to 7 psi on Models M-318 A, B, C, and remain constant or return to zero very, very slowly when the engine is stopped. An instant drop to zero indicates a leaky outlet valve. If the pressure is too low a weak diaphragm main spring, or improper assembly of the diaphragm may be the cause. If the pressure is to high, the main spring is too strong.

b. Vacuum Test

The vacuum test should be made with the fuel line disconnected from the carburetor. (This will allow the pump to operate at full capacity, which it must do to prime a dry carburetor.)

c. Volume Test

The fuel pump should supply 1 quart of fuel in 1 minute or less at 500 rpm.

d. Inlet Valve Test

To test the inlet valve, connect a vacuum gauge on the inlet fitting while the line is disconnected;

(1) Start the engine or turn over with starting motor.

(2) There should be a noticeable vacuum present, not alternated by blowback.

(3) If blowback is present, the inlet valve is not seating properly and should be cleaned, or a new valve body installed.

If the fuel pump does not perform to the above test requirements, the fuel pump should be removed from the engine and overhauled as follows:

DISASSEMBLING THE FUEL PUMP

Before disassembling the fuel pump, mark the housing in such a manner that the "inlet" will be facing the inlet fuel line when reassembled. This is important!

To disassemble the fuel pump for cleaning or overhaul, refer to Figures 76, and 77 (depending on Model of pump being worked on).

(1) Remove the pivot pin plug, using Tool T-109-43.

(2) Disengage the rocker arm follower spring from the rocker arm and rocker arm housing.

(3) Turn the pump on its side (pivot pin hole down) and rap gently to remove the pivot pin.

(4) Disengage the rocker arm from the diaphragm pull rod, by sliding rocker arm out of housing.

(5) Remove the screws that attach the valve body to the rocker arm housing. Separate the valve body and rocker arm housings, and lift out the diaphragm and pull rod assembly.

(6) Remove the screws that attach the valve body to the valve housing cover. Separate cover and valve body and remove the outlet airdome diaphragm.

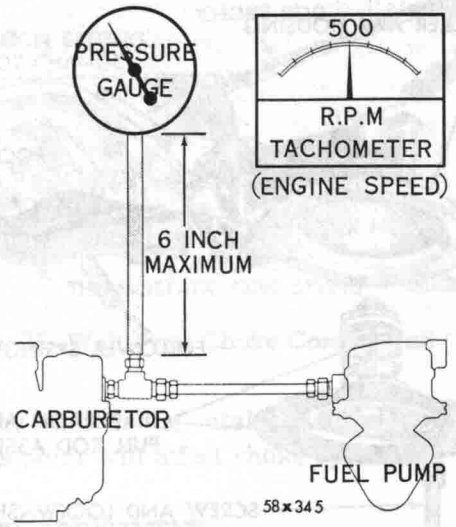


Fig. 78—Pressure Testing the Fuel Pump

CLEANING THE FUEL PUMP PARTS

Clean all fuel pump parts (except diaphragm) in a suitable solvent, then blow dry with compressed air. Check the condition of the valve seats and parts for gum deposits. If gum deposits are found, remove with denatured alcohol. If the valves are badly worn or damaged, install a complete new valve body assembly. **The valves are not serviced individually.**

REASSEMBLING THE FUEL PUMP

Examine the diaphragm for cracks, torn screw holes or ruptures. Check the rubber oil seal on the end of the pull rod for deterioration. Check the outlet air dome diaphragm for cracks or deterioration. Check the rocker arm for scoring or galling on the camshaft eccentric (push rod on 383 and 413 cubic inch engine) bearing surface.

(1) Place the airdome diaphragm in position on the valve body.

(2) Align the scribe marks on the cover and the valve body, then install attaching screws. Tighten securely.

(3) Slide the diaphragm pull rod up into the rocker arm housing. Place the valve body in position on the diaphragm with the scribe marks aligned. (Be sure the holes in the diaphragm, rocker arm housing and valve bodies are aligned.) Compress the unit together, then install the attaching screws, but **do not tighten. Never use shellac or any other adhesive on the diaphragm.**

(4) Slide the rocker arm into the housing and engage the diaphragm pull rod. Align the pivot pin holes in the arm with those in the housing, then install pivot pin. Install new plug and drive in securely.

(5) Install the rocker arm follower spring over the tab on the rocker arm and over dimple in the housing.

(6) Place the pump in a vise (with protector jaws) then push on the rocker arm until full travel is reached. Hold in this position, while tightening the attaching screws. (This will prevent tearing of the diaphragm when the pump is in operation with the pump arm in its full stroke.

(7) Test the fuel pump as described previously.

(8) Reinstall the fuel pump on the engine and tighten the nuts securely.

SERVICE DIAGNOSIS

CARBURETOR

POOR IDLING

Possible Causes:

(a) Incorrect air idle adjustment.

(b) Carbonized idle tube or poor seating shoulder.

(c) Idle air bleed carbonized or of incorrect size.

(d) Idle discharge holes plugged or gummed.

(e) Throttle body carbonized or worn throttle shaft.

(f) Air leak at mounting between carburetor and manifold.

(g) Damaged or worn idle needle.

(h) Incorrect fuel or float level.

(i) Choke does not completely open.

(j) Loose main body to throttle body screws.

(k) Carburetor icing.

(l) Distributor advance vacuum leak.

(m) Loose distributor base plate bearing.

(n) Corroded wire ends or distributor towers.

(o) Incorrect distributor point gap.

(p) Fouled spark plugs.

(q) Incorrect ignition timing.

(r) Incorrect spark plug gap.

(s) Overheated spark plugs.

(t) Incorrect valve timing.

(u) Compression not within limits.

(v) Intake manifold leak.

(w) Manifold heat control valve stuck.

(x) Internal coolant leak.

(y) Low boiling point fuel (winter fuel in summer).

(z) Low grade fuel.

POOR PERFORMANCE—MIXTURE TOO LEAN

Possible Causes:

(a) Damaged main metering jet.

(b) Damaged tip or bad top shoulder seat of main discharge jet.

(c) Vacuum piston worn or stuck.

(d) Incorrect fuel or float level.

(e) Automatic choke not operating properly.

(f) Incorrect fuel pump pressure.

POOR PERFORMANCE—MIXTURE TOO RICH

Possible Causes:

(a) Restricted air cleaner.

(b) Excessive fuel pump pressure.

(c) High float or fuel level.

(d) Damaged needle and seat.

(e) Leaking float.

(f) Worn main metering jet.

(g) Sticking choke.

EXCESSIVE FUEL CONSUMPTION

Possible Causes:

(a) Overloading engine.

(b) Cruising in high winds.

(c) Unnecessary use of accelerator.

(d) Sticky choke

(e) Incorrect ignition timing.

(f) Incorrect distributor advance.

(g) Incorrect valve timing.

(h) High fuel level in carburetor.

(i) Stuck manifold heat control valve.

(j) Detonation or pre-ignition.

(k) Fouled spark plugs.

(l) Low engine compression.

(m) Worn camshaft lobes.

(n) Sticking valves.

(o) Elevation and atmospheric conditions.

(p) Restricted exhaust system.

(q) Operating at excessive speeds.

CABURETOR FLOODS OR LEAKS

Possible Causes:

(a) Cracked body.

(b) Defective body gaskets.

(c) High float or fuel level.

(d) Worn needle valve and seat.

(e) Leaking float.

(f) Excessive fuel pump pressure.

NOTE: Presence of fuel dye around carburetor gaskets does not necessarily denote a leak or a flooding condition. Tighten air horn attaching screws securely to correct.

POOR ACCELERATION

Possible Causes:

(a) Step-up piston stuck in down position (lean mixture at wide open throttle).

(b) Accelerator pump piston (or plunger) leather too hard, worn or loose on stem.

(c) Faulty acceleration pump discharge ball.

(d) Accelerator pump inlet check ball faulty.

(e) Incorrect fuel or float level.

(f) Worn accelerator pump and throttle linkage.

(g) Automatic choke not operating properly.

(h) Carburetor gummed up.

(i) Faulty coil.

(j) Loose distributor base plate bearing.

(k) Distributor not advancing properly.

(l) Incorrect ignition timing.

(m) Incorrect spark plug gap.

(n) Fouled spark plugs.

(o) Overheated spark plugs.

(p) Manifold heat control valve stuck.

(q) Low fuel pump pressure or vacuum.

(r) Compression not up to specifications.

(s) Incorrect valve timing.

(t) Low grade of fuel.

(u) Detonation or pre-ignition.

FUEL PUMP

FUEL PUMP LEAKS (Fuel)

Possible Causes:

(a) Loose housing screws.

(b) Worn, ruptured or torn diaphragm.

(c) Loose diaphragm mounting plates.

(d) Loose inlet or outlet line fittings.

FUEL PUMP LEAKS (Oil)

Possible Causes:

(a) Cracked or deteriorated pull rod oil seal.

(b) Loose rocker arm pivot pin.

(c) Loose pump mounting bolts.

(d) Defective pump to block gasket.

INSUFFICIENT FUEL DELIVERY

Possible Causes:

(a) Vent in tank filler neck restricted. (This will also cause collapsed fuel tank.)

(b) Leaks in fuel line or fittings.

(c) Dirt or restriction in fuel tank.

(d) Worn, ruptured or torn diaphragm.

(e) Frozen gas lines.

(f) Improperly seating valves.

(g) Vapor lock.

(h) Weak main spring.

(i) Incorrect fuel pump.

(j) Restricted fuel filter.

FUEL PUMP NOISE

Possible Causes:

(a) Loose mounting bolts.

(b) Scored or worn rocker arm.

(c) Weak or broken rocker arm spring.

SECTION VII

ELECTRICAL SYSTEM

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION VII

ELECTRICAL SYSTEM

DATA AND SPECIFICATIONS

STARTING MOTOR
MODELS M-318A, B, C

Chrysler Number	1889295	1889774
Auto-Lite Number	MDU-7001	MDU-6010
Type Drive	Bendix	Bendix
Rotation	Clockwise	Counter-Clockwise
Voltage	12 Volts	12 Volts
Number of Fields	3	3
Number of Poles	3	3
Brushes	4	4
Spring Tension	31 to 47 Ounces	31 to 47 Ounces
Armature End Play	.005″ Minimum	.005″ Minimum
Free Running Test		
Voltage	11	11
Amperage Draw	50 Amperes Minimum	50 Amperes Minimum
Minimum Speed	5500 R.P.M.	5500 R.P.M.
Stall Torque Test		
Torque Foot-Pounds	9.0	9.0
Voltage	5	5
Amperage Draw	355	355
Pinion to Housing Clearance	.052″ to .204″ (Including End Play)	.052″ to .204″ (Including End Play)

STARTING MOTOR
MODELS M-383 and M-413

Chrysler Number	1889297	2095509
Auto-Lite Number	MDT-7001	MDT-7010
Type Drive	Bendix	Bendix
Rotation	Clockwise	Counter-Clockwise
Voltage	12 Volts	12 Volts
Number of Fields	4	4
Number of Poles	4	4
Brushes	4	4

STARTING MOTOR (Continued)
MODELS M-383 and M-413

Spring Tension	31 to 47 Ounces	31 to 47 Ounces
Armature End Play	.005″ Minimum	.005″ Minimum
Free Running Test		
Voltage	11	11
Amperage Draw	58 Amperes Minimum	58 Amperes Minimum
Minimum Speed	3800 R.P.M.	3800 R.P.M.
Stall Torque Test		
Torque Foot-Pounds	8.5	8.5
Voltage	4	4
Amperage Draw	350	350
Pinion to Housing Clearance	.052″ to .204″ (Including End Play)	.052″ to .204″ (Including End Play)

ALTERNATOR

DATA AND SPECIFICATIONS

Models M-318 A-B-C, M-383 and M-413

Rated Output	35 Amperes
Voltage	12 Volts
Brushes	2
Capacitor	
Inside Capacitor	.158 microfarad minimum
Outside Capacitor	.5 microfarad minimum (so equipped)
Field Coil Draw	2.3 amperes minimum to 2.7 amperes maximum at 12 volts, rotating alternator by hand; or 3.00 amperes minimum to 3.50 amperes maximum at 15 volts at 70 degrees Fahrenheit, alternator operating at 750 rpm.
Current Output (Minimum) at 15 volts; 1250 Engine RPM (Plus or Minus 3 amperes allowed)	34.5 Amperes

ALTERNATOR VOLTAGE REGULATOR

Alternator Voltage Regulator and Relay	2098140
Regulator Number	2095700
Relay	2095946
Volts	12
Ground Polarity	Negative
Point Gap	.015 inch plus or minus .001 inch
Air Gap	.048 to .052 inch

Measure gap with gauge back of stop. Contacts close with .052 inch gauge installed. Contacts open with .048 inch gauge installed.

Temperature in Degrees	20°	93°	117°	140°	163°
Minimum Setting	13.7 to	13.6 to	13.5 to	13.4 to	13.3 to
Maximum Setting	14.3	14.2	14.1	14.0	13.9

DATA AND SPECIFICATIONS

IGNITION SYSTEM
MODELS M-318A, B, C

DISTRIBUTOR	
Chrysler Part No.	2095900
Auto-Lite Part No.	IBM-4109
Engine Model Usage	318
Advance (Centrifugal) Automatic (Distributor Degrees at Distributor RPM)	0° @ 275 to 425 0° to 7.5° @ 425 6° to 8° @ 550
Breaker Point Gap	.014″-.019″
Dwell Angle	27-32°
Breaker Arm Spring Tension	17 to 21.5 ounces
Timing	12½° BTDC
Condenser Capacity	.25-.285 mfd.
Shaft Side Play	.000″-.004″*
Shaft End Play (After Assembly)	.003″-.010″
Distributor Rotation	Clockwise
SPARK PLUGS	AT-42
Size	14 MM
Gap	.035 inch
Firing Order—Counter-Clockwise Engine Rotation	1-2-7-5-6-3-4-8
Clockwise Engine Rotation	1-8-4-3-6-5-7-2
COIL	Chrysler—Auto-Lite 2095338 200578
Primary Resistance @ 70-80° F	3.9 to 4.2 ohms
Secondary Resistance @ 70-80° F	9400 to 11700 ohms

* When distributor is new or after rebuilding (new bushings and/or shaft installed). Service wear tolerance should not exceed .006 inch.

IGNITION SYSTEM
MODEL M-383

DISTRIBUTOR	
Chrysler Part No.	1889370
Auto-Lite Part No.	IBM-4108
Engine Model Usage	383 cu. in.
Advance (Centrifugal) Automatic (Distributor Degrees at Distributor RPM)	0° @ 300 to 400 0° to 4½° @ 400 11° to 13° @ 700
Breaker Point Gap	.014″-.019″

IGNITION SYSTEM (Continued)
MODEL M-383

Dwell Angle	27-32°
Breaker Arm Spring Tension	17 to 21.5 ounces
Timing	5° BTDC
Condenser Capacity	.25-.285 mfd.
Shaft Side Play	.000-.004″*
Shaft End Play (After Assembly)	.003-.010″
Distributor Rotation	Counter-Clockwise
SPARK PLUGS	AT-42
Size	14MM
Gap	.035 inch
Firing Order—	
Clockwise Engine Rotation	1-8-4-3-6-5-7-2
Counter-Clockwise Engine Rotation	1-2-7-5-6-3-4-8
COIL	Chrysler—Auto-Lite
	2095338 200578
Primary Resistance @ 70-80°F	3.9 to 4.2 ohms
Secondary Resistance @ 70-80° F	9400 to 11700 ohms

* When distributor is new or after rebuilding (new bushings and/or shaft installed). Service wear tolerance should not exceed .006 inch.

IGNITION SYSTEM
MODEL M-413

DISTRIBUTOR	
Chrysler Part No	2098085
Auto-Lite Part No	IBM-4108A
Engine Model Usage	413 cu. in.
Advance (Centrifugal) Automatic (Distributor Degrees at Distributor RPM)	0° @ 300 to 400
	0° to 4½° @ 400
	11° to 13° @ 700
Breaker Point Gap	0.14″-.019″
Dwell Angle	27-32°
Breaker Arm Spring Tension	17 to 21.5 ounces
Timing	5° BTDC
Condenser Capacity	.25-.285 mfd.
Shaft Side Play	.000-.004″*
Shaft End Play (After Assembly)	.003-.010″
Distributor Rotation	Counter-Clockwise
SPARK PLUGS	AT-42
Size	14MM
Gap	.035 inch
Firing Order—Clockwise Engine Rotation	1-8-4-3-6-5-7-2
Counter-Clockwise Engine Rotation	1-2-7-5-6-3-4-8
COIL	Chrysler—Auto-Lite
	2095338 200578
Primary Resistance @ 70-80° F	3.9 to 4.2 ohms
Secondary Resistance @ 70-80°F	9400 to 11700 ohms

* When distributor is new or after rebuilding (new bushings and/or shaft installed). Service wear tolerance should not exceed .006 inch.

ALTERNATOR

SPECIAL TOOLS

C-744	Test Lamp
C-828	Voltage Regulator Tool Kit (Insulate the Bending Tool)
SP-3374	Adapters—Bearing Remover
SP-3380	Remover Rectifier
SP-3381	Installer Rectifier End Housing Bearing
SP-3383	Support—Bearing Remover
C-3615	Remover Pulley
C-3769	Installer Drive End Housing Bearing
C-3770	Remover—Rectifier End Housing Bearing
C-3771	Support Bearing Remover
C-3772	Installer Rectifier
C-3829	Alternator Diode Tester
C-3900	Slip Ring Installer Tool

SECTION VII

ELECTRICAL SYSTEM

BATTERY

BATTERY VISUAL INSPECTION

(1) Protect the paint finish with covers.

(2) Inspect the battery carrier for damage caused by loss of acid from the battery.

(3) Remove the battery hold-down clamp and clean the top of battery with clean warm water and baking soda. Scrub areas with a stiff bristle brush being careful not to scatter corrosion residue with the bristles. Finally wipe off with a cloth moistened with ammonia or baking soda in water.

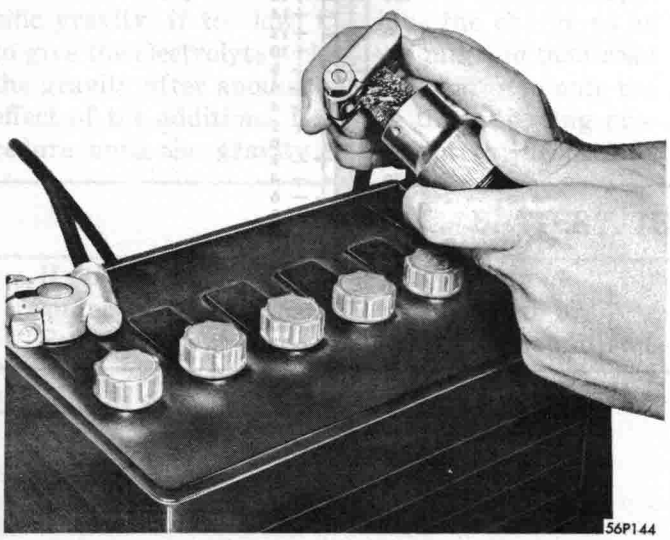


Fig. 1—Cleaning Inside of Cable Clamp

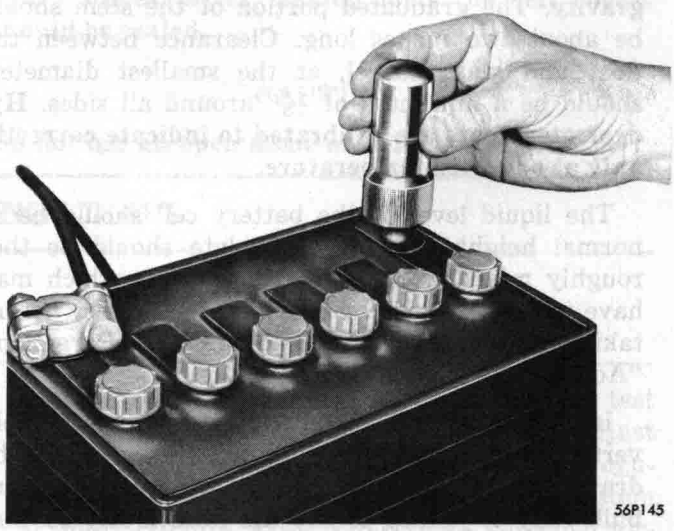


Fig. 2—Cleaning Outside of Battery Post

CAUTION

Keep cleaning solution out of battery cells to eliminate weakening the electrolyte.

(4) Inspect the cables. Replace damaged or frayed cables.

(5) Inspect the terminal posts to see that they are not deformed or broken. Clean the tapered battery terminals and the inside surfaces of the clamp terminals with the terminal cleaning tool as shown in Figures 1 and 2.

(6) Examine the battery for cracks in case, raised cells. Inspect sealing compound for leaks. Reseal as necessary.

(7) Tighten the battery hold-down screw nuts to 3 foot-pounds torque.

(8) **Observe the polarity of the terminals of battery to be sure the battery is not reversed** and connect the cable clamps to the battery posts and tighten securely. Coat all connections with light mineral grease or petrolatum.

(9) If the electrolyte level is low, fill to recommended level with mineral-free water.

SPECIFIC GRAVITY TEST

A hydrometer is used to measure the specific gravity of the electrolyte in the battery cells. This gives an indication of how much unused sulphuric acid remains in the solution.

A hydrometer should be graduated to read from 1.160 to 1.320, in graduations of .005 specific gravity. The graduated markings should be not less than $\frac{1}{16}$ inch apart and accurate to within .002 specific gravity. The graduated portion of the stem should be about two inches long. Clearance between the float and glass barrel, at the smallest diameter, should be a minimum of $\frac{1}{8}$" around all sides. **Hydrometer floats are calibrated to indicate correctly only at one fixed temperature.**

The liquid level of the battery cell should be at normal height and the electrolyte should be thoroughly mixed with any battery water which may have just been added by charging the battery before taking any hydrometer readings. See Paragraph "Adjustment of Acid Gravity."

In reading a hydrometer, the barrel must be held vertically and just the right amount of fluid be drawn up into the gauge barrel with the pressure bulb fully expanded to lift the float freely so that it does not touch the sides, top or bottom of the barrel. Take a reading with eye on level with liquid in barrel **DO NOT TILT** hydrometer.

The specific gravity of the battery electrolyte varies not only with the quantity of acid in solution but also with temperature. As temperature increases, the volume of the electrolyte expands and the specific gravity is reduced. As temperature drops, the electrolyte contracts and specific gravity increases.

Specific gravity variations caused by temperatures must be considered in an analysis of the battery, otherwise specific gravity readings will not give a true indication of the state of charge.

Use a battery thermometer of the mercury-in-glass type, having a scale reading as high as 125° F and designed for not over a 1-inch bulb immersion. A suitable dairy type thermometer may prove satisfactory for the purpose.

Draw electrolyte in and out of the hydrometer barrel several times to bring the temperature of the hydrometer float to that of the acid in the cell and then measure the electrolyte temperature in the cell.

The temperature correction amounts to .004 specific gravity points for each 10 degrees Fahrenheit change in temperature. A hydrometer reading of a cell with electrolyte above 80 degrees Fahrenheit

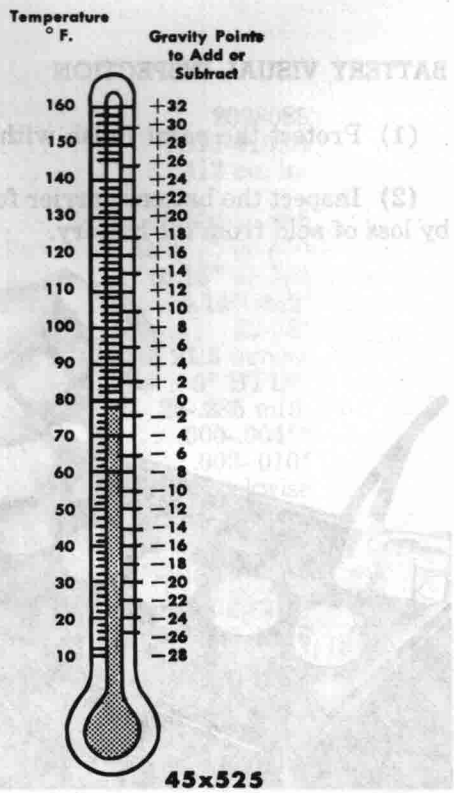


Fig. 3–Hydrometer Reading Correction Chart

will be less than a reading with electrolyte at 80 degrees Fahrenheit. The opposite holds true where the temperature of the electrolyte is below 80 degrees Fahrenheit. Readings must be corrected to 80 degrees Fahrenheit. Refer to Figure 3 and examples one and two as follows:

Example 1 –

Hydrometer Reading	1.260
Acid Temperature	20 degrees Fahrenheit
Subtract Specific Gravity	.024
Correct Specific Gravity is	1.236

Example 2 –

Hydometer Reading	1.255
Acid Temperature	100 degrees Fahrenheit
Add Specific Gravity	.008
Corrected Specific Gravity is	1.263

A fully charged battery has a specific gravity reading of 1.260 plus .015 minus .005 (all batteries for use in temperate climates).

ADJUSTMENT OF ACID GRAVITY

Hydrometer floats usually are not calibrated below about 1.160 specific gravity and cannot indicate the condition of a battery in a very low state of charge. Therefore, it may be necessary to give the battery several hours charge before a hydrometer reading will indicate that the battery is taking a charge.

If the specific gravity of all cells are not within 15 points of the specified value, corrected to 80° F, at the end of a full charge, remove some of the electrolyte with the hydrometer and add a like amount of distilled water to reduce the gravity if too high, or add 1.400 Specific Gravity acid to raise the specific gravity, if too low. Continue the charge so as to give the electrolyte a chance to mix and then read the gravity after another hour of charge to note the effect of the additions. Continue this adjusting procedure until the gravity is brought to the desired value by charging for one hour after each adjustment.

Never adjust the specific gravity of any battery cell which does not gas freely on charge. Unless electrolyte has been lost through spilling or leaking, it should not be necessary to add acid to a battery during its life. Acid should never be added unless one is certain that the cell will not come up to normal gravity by continued charging. Always make the temperature correction for hydrometer readings, as warm electrolyte will read low and this might be mistaken for failure of the battery to rise normally in gravity. It could also be falsely concluded that the battery would not take a full charge.

VOLTAGE TESTS

NOTE: Freshly charged batteries may have a "surface charge" which causes high and inaccurate readings unless properly dissipated.

To make battery test, contact the meter prods (Tool MT-379) to proper cell terminals (red to positive, black to negative), using caution not to connect across more than one cell. The point of prod will have to be pushed through sealing compound to make contact with buried link for each cell reading.

The individual cell readings should not vary more than .05 volt between any two cells. A battery varying more than .05 volt between any two cells should be *recharged* and "high rate discharge tester" used to test battery before discarding the battery as unsuitable for use.

NOTE: The cell connectors are not exposed, therefore it will be necessary to pierce the cell covers to contact the connector straps to obtain individual cell voltages. After making tests the cell covers should be sealed.

CAUTION

Do not use an open flame near the battery.

BATTERY TESTING CHART

Hydrometer Test (Corrected to 80°F.) See Paragraph 2	State of Charge or Battery Condition	Correction
Less than 1.220 Sp. Gr.	Battery low	Recharge battery. Give high rate Discharge test for capacity. If cells test O.K., recharge and adjust gravity of all cells uniformly. Test voltage regulator setting. Thoroughly test the electrical system for short circuits, loose connections, corroded terminals, etc.

BATTERY TESTING CHART (Continued)

Cells show more than 25 points (.025 Specific Gravity) variation.	a. Short circuit in low cell b. Loss of electrolyte by leakage or excessive overcharge c. Improper addition of acid d. Natural or premature failure e. Cracked case	Try to recharge battery. See "Charging the Battery". See "Adjustment of Acid Gravity". Test battery for capacity. Install new battery if necessary.

Open Circuit Voltage Test	State of Charge or Battery Condition	Correction
Cells showing more than 1.220 Specific Gravity.	Satisfactory	No correction required if variation among cells is not over .05 volts. If variation is more than .05 volt, recharge. Give high rate discharge capacity test, if cells test O.K., adjust gravity of all cells uniformly.
Cells showing less than 1.220 specific gravity, but not more than .05 volts variation.	Questionable	Recharge battery. Give high rate discharge test for capacity. If cells test O.K., recharge and adjust gravity of all cells uniformly. Test voltage regulator setting. Thoroughly test the electrical system for short circuits, loose connections, corroded terminals, etc.
Cells showing more than .05 volts variation.	a. Short circuit in low cell b. Loss of electrolyte by leakage or excessive overcharge c. Improper addition of acid or "Dopes" d. Natural or premature failure e. Cracked case	Recharge battery. See "Charging the Battery".

Cranking Test	State of Charge or Battery Condition	Correction
If the voltage drop is more than 0.2 volts (2/10) between the starting motor cable and the engine ground while cranking, look for:	Poor contact between cable terminal and the engine ground or between cable clamp terminal and battery post or starter switch contacts. Frayed, corroded or broken cable.	Locate the high resistance: Repair or replace as necessary.
While operating the starting motor, ignition "OFF" check the voltage of all cells. If the voltage varies more than 0.15 volt between cells, look for:	Faulty cell or cells	Compare voltage readings with hydrometer reading – low voltage is usually accompanied by low gravity. Try to recharge the battery. See "Charging the Battery".

HIGH RATE DISCHARGE TEST OF BATTERY CAPACITY

Satisfactory capacity tests can be made only when battery equals or exceeds 1.220 specific gravity at 80 degrees Fahrenheit. If reading is below 1.220, the battery should be slow charged until fully charged in order to secure proper test results.

TEST PROCEDURE

(1) Turn control knob of battery starter tester to the **OFF** position.

(2) Turn voltmeter selector switch to the 16 volt position.

(3) Connect test ammeter and voltmeter positive leads to battery negative terminal and ammeter and voltmeter negative leads to battery positive terminal (Fig. 4).

NOTE: The Voltmeter clips must contact the battery posts or cable clamps and not the ammeter clips.

(4) Turn control knob clockwise until ammeter reading is equal to three times the ampere hour rating of the battery (180 amperes for a 60 ampere hour battery).

(5) Maintain load for 15 seconds, voltmeter should read 9.5 volts or more, which will indicate battery has good output capacity.

(6) Turn control knob to the OFF position.

CHARGING THE BATTERY

If voltage in "High Rate Discharge Test" was under 9.5 volt, the battery should be test charged to determine whether the battery can be satisfactorily charged.

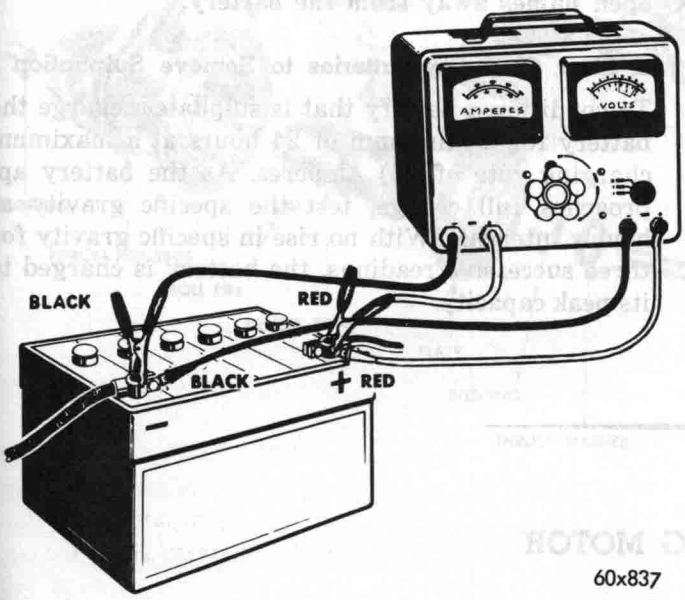


Fig. 4—High Rate Discharge Test

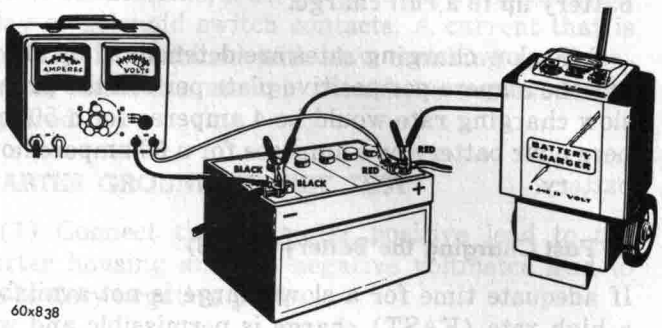


Fig. 5—Three Minute Charge Test

a. Three Minute Charge Test (Fig. 5)

NOTE: This test should not be used if battery temperature is below 60 degrees F.

(1) Connect (positive +) charger lead to the battery positive terminal and (negative −) lead to battery negative terminal.

(2) Trip the power switch to **ON** position. Turn charger timer switch past "three minutes" then back to "three minutes."

(3) Adjust the charge switch to the highest possible rate not exceeding 40 amperes.

(4) When the timer switch cuts off at end of 3 minutes, turn back to fast charge.

(5) Use the 4 volt scale of the battery starter tester voltmeter and quickly measure the voltage across each cell while the battery is being fast charged. A faulty cell or cells will be detected by a cell voltage variation of more than .1 volt.

(6) If cell voltages are even within .1 volt, use 16 volt scale of battery starter tester and measure total voltage of battery posts while battery is being fast charged. If total voltage during charge exceeds 15.5 volts, the battery is sulphated and should be cycled and slow-charged until specific gravity reaches 1.260. (See "Slowing Charging".)

If the specific gravity remains constant after testing battery at one hour intervals for three hours, the battery is at its highest state of charge.

(7) Make another capacity test. If the capacity test does not meet specifications, replace the battery.

NOTE: A slow charge is preferrable to bring the battery up to a full charge.

Safe slow charging rates are determined by allowing one ampere per positive plate per cell the proper slow charging rate would be 4 amperes for a 50 ampere hour battery or 5 amperes for a 60 ampere hour battery.

b. Fast Charging the Battery (Fig. 6)

If adequate time for a slow charge is not available, a high rate (FAST) charge is permissible and will give a sufficient charge in one hour enabling the battery and alternator to continue to carry the electrical load.

Connect the positive (+) charger lead to the battery positive terminal and the negative (−) charger lead to the battery negative terminal.

CAUTION

The battery can be damaged beyond repair unless the following precautions are taken:

(1) The battery electrolyte temperature must **NEVER** exceed 125 degrees Fahrenheit.

If this temperature is reached, the battery should be cooled by reducing the charging rate or remove the battery from the circuit.

(2) As the batteries approach full charge the electrolyte in each cell will begin to gas or bubble. Excessive gassing must not be allowed.

(3) Do not fast charge longer than one hour.

The battery is fully-charged when three successive hourly hydrometer readings show no rise in specific gravity. Remember to use the temperature correction when checking specific gravity.

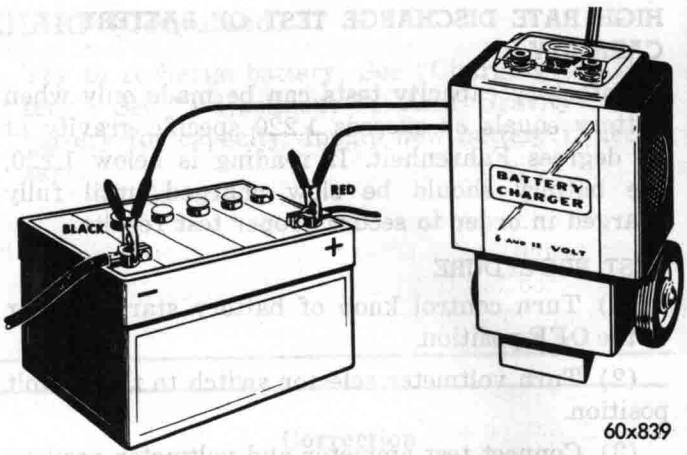


Fig. 6–Fast Charging the Battery

If the battery does not show a significant change in specific gravity after one hour of "FAST" charge, the slow charge method should be used.

NOTE: The manufacturers of high rate charging equipment generally outline the precautions and some models have thermostatic temperature limiting and time limiting controls.

WARNING

When batteries are being charged an explosive gas mixture forms beneath the cover of each cell. Do not smoke near batteries on charge or which have recently been charged. Do not break live circuits at the terminals of the batteries on charge. A spark will occur where the live circuit is broken. Keep all open flames away from the battery.

c. Slow Charging Batteries to Remove Sulphation

To condition a battery that is sulphated, charge the battery for a minimum of 24 hours at a maximum charging rate of (4) amperes. As the battery approaches full charge, test the specific gravity at hourly intervals. With no rise in specific gravity for three successive readings, the battery is charged to its peak capacity.

STARTING MOTOR

The starting motor is of the 12 volt type with a Bendix starter drive.

SERVICE PROCEDURES

TESTING STARTER CURRENT RESISTANCE AND CURRENT DRAW

(1) Test the battery electrolyte specific gravity. Specific gravity should be 1.220 or above temperature corrected to 80°F. If the battery specific gravity is below 1.220, recharge the battery to full charge before proceeding with test.

(2) Disconnect the positive battery lead from battery terminal post. Connect an 0 to 300 scale ammeter between the disconnected lead and the battery terminal post.

(3) Connect a test voltmeter with 10 volt scale division between the battery positive post and the starter switch terminal at the starter solenoid.

(4) Crank the engine and observe the readings on the voltmeter and ammeter. The voltage should not exceed .12 volt per 100 amperes of current. A reading of voltage that exceeds .12 volt per 100 amperes indicates there is high resistance caused from loose circuit connections, a defective cable, burned starter relay or solenoid switch contacts. A current that is high and is combined with slow cranking speed, indicates that the starter should be removed and repaired.

STARTER GROUND CIRCUIT TEST

(1) Connect the voltmeter positive lead to the starter housing and the negative voltmeter lead to the battery negative post.

(2) Crank the engine with a remote control starter switch and observe the voltmeter reading. The voltmeter reading should not exceed .2 volt. A reading of .2 volt or less indicates voltage in the

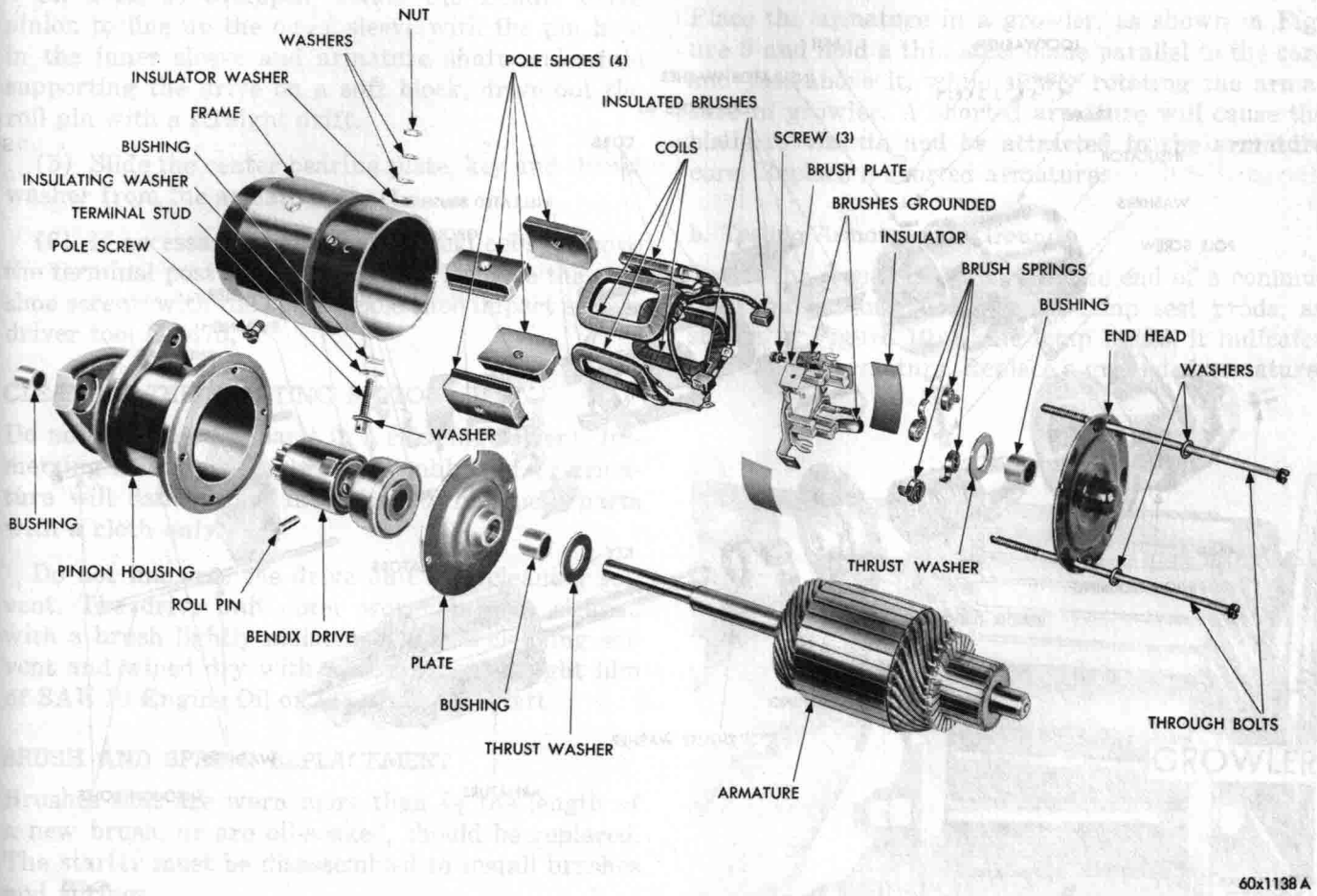


Fig. 7–Starting Motor (Disassembled)

ground cable and connections is normal. If the voltmeter reading is more than .2 volt, it indicates excessive voltage loss in the starter ground circuit. Make the following tests to isolate the point of excessive voltage loss. Repeating the test at each connection.

(a) Starter drive housing.

(b) Cable terminal at the engine.

(c) Cable clamp at the battery.

A small change will occur each time a normal portion of the circuit is removed from the test. A definite change in the voltmeter reading indicates that the last part eliminated in the test is at fault.

Maximum allowable voltage loss is as follows:

Battery ground cable	.2 volt
Engine ground circuit	.1 volt
Each connection	.0 volt

REMOVING THE STARTING MOTOR

(1) Disconnect the ground cable at battery.

(2) Remove the starter cable at starter.

(3) Remove the bolts attaching the starter to the flywheel housing and remove the starter motor from beneath the engine. Remove the starter motor to cylinder block seal (if so equipped).

TESTING THE STARTING MOTOR (Bench Test)

a. Free Running Test

Place the starting motor in vise and connect a fully-charged, 12 volt battery to starter as follows:

Connect a test ammeter (100 ampere scale) and carbon pile rheostat in series with the battery positive post and starter terminal. Connect a voltmeter (15 volt scale) across the starter. Rotate the carbon pile to the full-resistance position. Connect the battery cable from the battery negative post to the starter frame. Adjust rheostat on battery starter tester until battery voltage shown on voltmeter reads 11 volts. The current draw should be as shown in specifications.

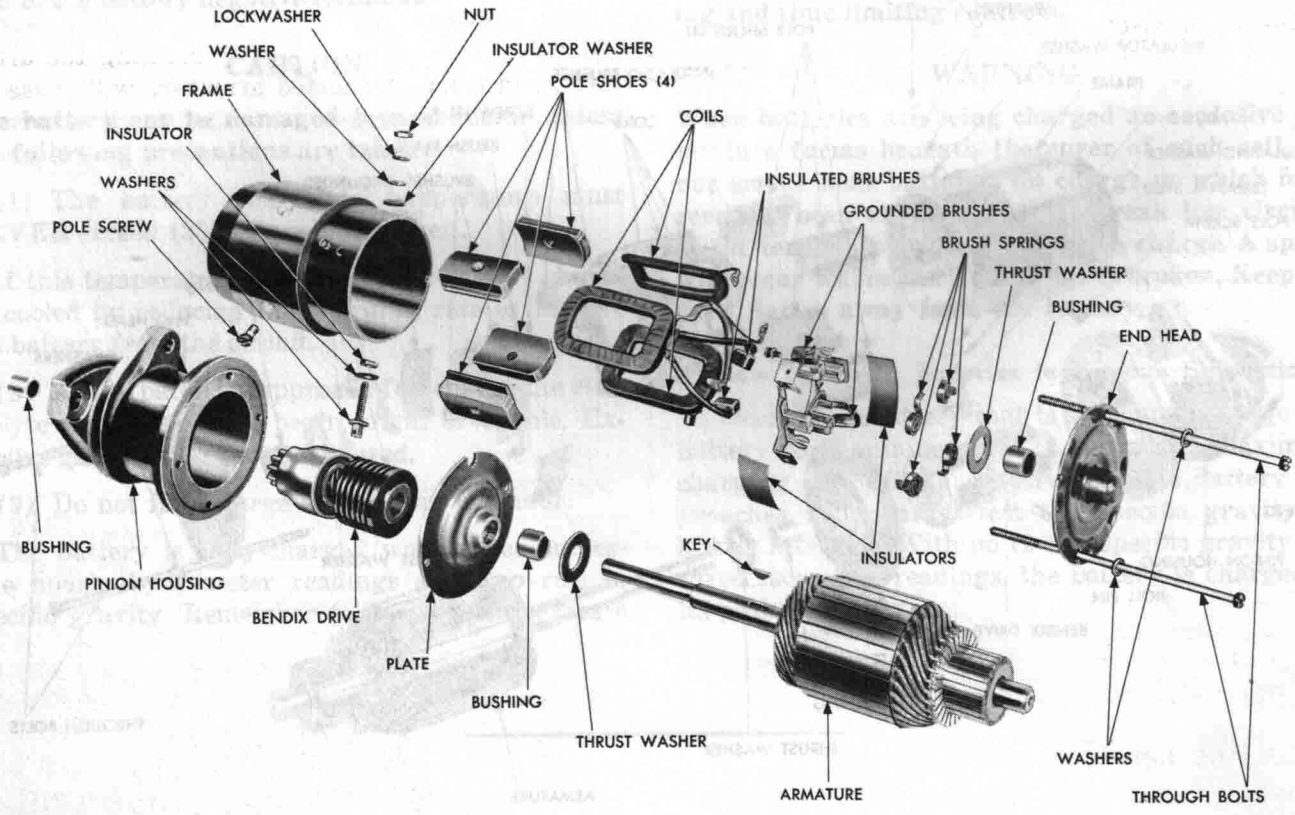


Fig. 8–Starting Motor (Disassembled)

b. Stall Test

Install starting motor in test bench. Follow instructions of test equipment manufacturer and check stall torque of starter against specifications.

DISASSEMBLING THE STARTING MOTOR

To disassemble the starting motor, refer to Figures 7 and 8 then proceed as follows:

(1) Remove the through bolts and tap the commutator end frame from the field frame.

(2) Remove the three screws attaching the brush ring to the starter frame, disconnect the field lead wire at the brush ring; disengage the brushes from the holders and carefully slide the brush ring out of the housing.

(3) Remove the three screws attaching center plate to pinion housing and remove the pinion housing.

(4) Tap the drive assembly from the armature shaft.

On units so equipped, rotate the Bendix drive pinion to line up the outer sleeve with the pin hole in the inner sleeve and armature shaft and while supporting the drive on a soft block, drive out the roll pin with a straight drift.

(5) Slide the center bearing plate, key and thrust washer from the armature shaft.

(6) If necessary to replace the field coils, remove the terminal post nut and washers. Remove the pole shoe screws with the special pole shoe impact screwdriver tool C-3475.

CLEANING THE STARTING MOTOR

Do not immerse the parts in a cleaning solvent. Immersing field frame and coil assembly and/or armature will damage the insulation. Wipe these parts with a cloth **only.**

Do not immerse the drive unit in a cleaning solvent. The drive unit outer worm may be cleaned with a brush lightly moistened with a cleaning solvent and wiped dry with a cloth. Place a light film of SAE 10 Engine Oil on the armature shaft.

BRUSH AND SPRING REPLACEMENT

Brushes that are worn more than ½ the length of a new brush, or are oil-soaked, should be replaced. The starter must be disassembled to install brushes and springs.

Brushes that are soldered to the field coils can be replaced after removing the field coils from the field frame. Always mark one end of the field frame and the pole shoes before removal so they can be installed in their original position and direction.

The two brushes that have the ground terminal riveted under the brush holder should have the lead unsoldered and the terminal unclamped. Insert the new brush lead to its full depth in the terminal and clamp tightly. Solder to make a strong, low resistance connection using a high temperature solder and a rosin flux. DO NOT use acid core solder as corrosion will occur.

Measure the brush spring tension with a spring scale hooked under the spring near the end. Pull the scale on a line parallel to the edge of the brush and take a reading just as the spring end leaves the brush. Adjust the tension by bending the brush spring at the point where it is clamped to the brush holder.

TESTING THE ARMATURE

a. Testing the Armature for Short Circuit

Place the armature in a growler, as shown in Figure 9 and hold a thin steel blade parallel to the core and just above it, while slowly rotating the armature in growler. A shorted armature will cause the blade to vibrate and be attracted to the armature core. Replace a shorted armature.

b. Testing Armature for Ground

Touch the armature shaft and the end of a commutator bar with a pair of test lamp test prods, as shown in Figure 10. If the lamp lights, it indicates a grounded armature. Replace a grounded armature.

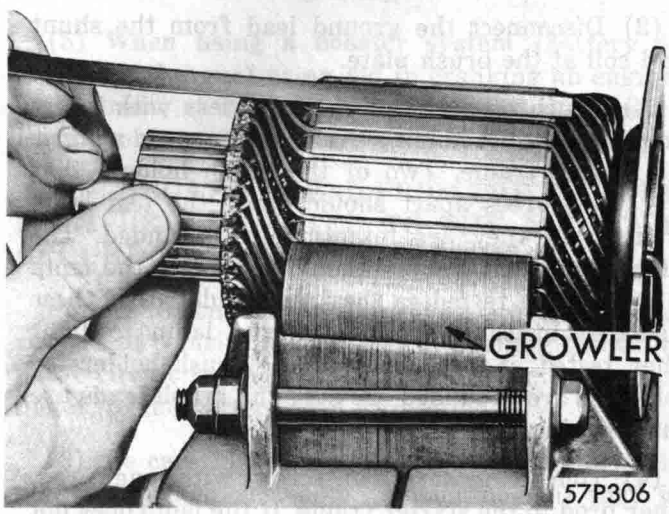


Fig. 9—Testing Armature for Short

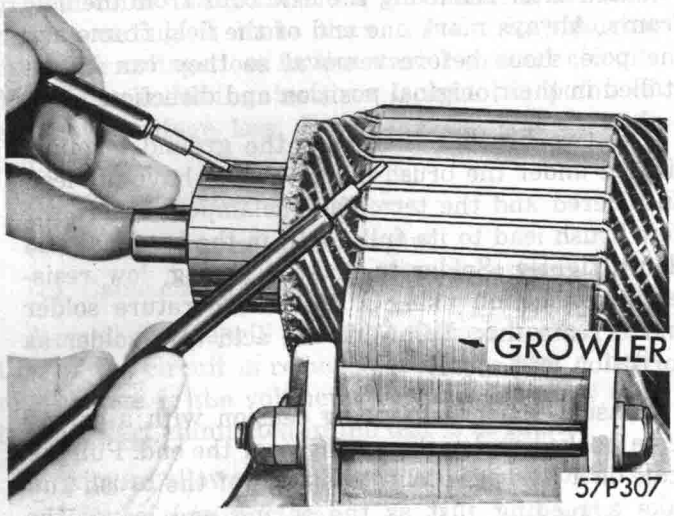


Fig. 10—Testing Armature for Ground

c. Testing Commutator Runout, Refacing and Undercutting

Place the armature in a pair of "V" blocks and check run-out with a dial indicator. Check both the shaft and commutator. A bent shaft requires replacement of the armature. When the commutator runout exceeds .003 inch, the commutator should be refaced. Remove only sufficient metal to provide a smooth, even surface. After the commutator is refaced; undercut the insulation between the bars to a depth of $\frac{1}{32}$ inch. Undercut the insulation square and the full width of the groove, and polish commutator with 00 sandpaper to remove all burrs.

TESTING THE FIELD COILS FOR GROUND

(1) For this test re-install brush ring assembly into the starter frame.

(2) Disconnect the ground lead from the shunt field coil at the brush plate.

(3) Touch each of the brush holders with a test lamp prod, while holding the other test prod against the starter frame. Two of the brush holders that are 180 degrees apart should cause the test lamp to light, as they are intentionally grounded. The other two brush holders should not cause the lamp to light when tested as they are insulated. If these insulated brush holders cause the lamp to light when tested, it indicates that the brush holders or field coils are grounded. **Be sure the brush leads are not touching the field frame.**

(4) Touch the terminal screw with one prod, other prod to the starter frame. If the lamp does not light, field coils are O.K. If the lamp lights, inspect terminal insulation. If insulation is in good condition replace grounded field coils. Test the shunt field coils for continuity and for any ground, then reconnect the ground lead. Replace the brush plate assembly if the holders are grounded.

FIELD COIL REPLACEMENT

A pole shoe screwdriver should be used to remove and install field coils to prevent damage to the pole shoe screws and for proper tightening. Pole shoes that are loose may cause the armature core to rub the pole shoes. This will decrease the starter efficiency and damage the armature core.

BUSHINGS REPLACEMENT

Inspect the armature shaft bearing surfaces and bushings for wear by placing the armature core in a vise equipped with soft jaws. Do not squeeze tightly. Try the commutator end frame, the drive end frame, and armature support bushings for wear by placing them on the armature shaft and checking for side play. Replace the commutator end frame assembly if bushing is worn. Also, replace the drive end bushing if it is worn. The bushing should be well soaked in SAE 10W engine oil before it is installed.

ASSEMBLING THE STARTING MOTOR

(1) Refer to Figures 7 and 8 and apply a light film of oil to the Oilite bushings and to all bearing surfaces.

(2) Install the intermediate thrust washer, intermediate bearing and plate and starter drive key (so equipped).

(3) Slide the starting motor drive assembly on armature shaft.

On units so equipped, slide the starter drive on the armature shaft, align the holes in the drive with the hole in the armature shaft and install the retainer pin.

(4) Install the pinion housing on the armature and install intermediate bearing plate attaching screws.

(5) Install the brush ring and the three self-locking screws.

(6) Connect the field lead wire at brush ring.

(7) Install the armature and drive assembly, sliding assembly into field frame until end of commutator touches brushes. While holding armature against the brushes with slight pressure, push

brushes up and allow them to rest on edges of commutator. When all brushes are seated on commutator, slide armature and pinion housing assembly into place. **Make sure the drive end frame is positioned on the locating pins.**

(8) Position the two insulators.

(9) Install the rear thrust washer and commutator end head. **Make sure that the slots in the intermediate bearing and the commutator end head line up with the indexing pins and notch in the frame.**

(10) Install the through bolts and tighten them securely.

INSTALLING THE STARTING MOTOR

(1) Before installing the starter, be sure the starting motor and flywheel mounting surfaces are free of dirt and oil. These surfaces must be clean to make good electrical contact.

(2) Install the starting motor to cylinder block removable seal (if so equipped).

(3) Install the starting motor assembly.

(4) Tighten the attaching bolts securely.

(5) Attach solenoid switch wire to the starter terminal.

(6) Install the battery ground cable and test operation of starter for proper engine cranking.

ALTERNATOR

ALTERNATOR SYSTEM PRECAUTIONS

The following list of precautions has been prepared to assist you in avoiding damage to the alternator system that might accidentally occur when either working on or around this system.

(1) Never short circuit either the alternator field terminal or the field terminal at the regulator to ground. Short circuiting either of these terminals with the ignition switch in the "ON" position may cause the fuse to be blown and could also damage the regulator.

(2) Never short circuit the alternator "Bat" terminal to ground. When the ignition key is in the "ON" position, this terminal is directly connected to the battery. A short circuit to ground at this terminal can burn the insulation from the wiring in the harness.

To prevent an accidental short circuit of the alternator "Bat" terminal, it is recommended that the terminal post and terminal be wrapped with friction or rubber tape on early production engines. A rubber boot is now being used on present production alternators.

(3) Never under any circumstance install a battery backwards. Installing a battery backwards will result in damage to the alternator (diode) rectifiers and the insulation on the charging system wiring harness. A battery that is installed backwards creates a dead short circuit through the (diode) rectifiers. The battery negative post is the ground post and must be connected to the ground cable attached to the engine.

(4) When charging a battery connected in the electrical system, it is essential that the charger be connected properly to the battery with respect to polarity. Positive (+) charger lead to the positive (+) battery post and the negative (−) lead to the grounded negative (−) battery post. If this is not done the wiring between the alternator and the battery may be burnt and possibly the diode rectifiers. A safe procedure is to disconnect the battery ground cable before connecting charger.

(5) **When using a booster system** (battery or high rate charger) as an aid in cranking an engine, use **extreme caution, to be** certain that the booster leads are properly connected.

THE NEGATIVE LEAD FROM THE BOOSTER MUST BE CONNECTED TO THE NEGATIVE GROUND POST OF THE BATTERY.

Failure to connect the booster leads properly with respect to polarity, may result in burning the alternator circuit wiring from the alternator to the ammeter, to the battery feed connection.

(6) Be careful not to spill oil into the alternator air vents when servicing the engine. Oil that is spilled into the alternator may get on the slip rings and cause output failure.

(7) It is essential that the regulator base has a good ground connection. The voltage coil in the regulator grounds to the base. Without a good ground connection there can be no regulation.

(8) Always turn the ignition switch off when working on the regulator. Such as when adjusting the spring tension to change the voltage setting. The field circuit is connected to the battery through the ignition switch. Turning the switch off will prevent damage to the regulator in case a tool accidentally contacts between the armature and the base.

(9) All wiring connections in both the field circuit and the charging circuit must be clean and tight.

ALTERNATOR

CONSTRUCTION AND OPERATION

The alternator (Fig. 11) is fundamentally an A.C. current generator, with six (6) built-in silicon rectifiers, that convert the A.C. current into D.C. current. D.C. current is available at the "output" "BAT" terminal. A voltage regulator (Fig. 12) is used in the field circuit to limit the output voltage. An alternator cutout relay assembly is inserted in the system located between the output stud on the alternator and the hot lead from the battery. The cutout relay is an off-on switch that opens the circuit from the battery to the alternator when the ignition circuit is opened (ignition key off).

The main components of the alternator are the rotor, the stator, the rectifiers and the two end shields and the drive pulley. (See Fig. 13.)

ROTOR

The rotor (Fig. 14) consists of a circular field coil, encased by two end pole pieces, each having six protruding fingers spaced 60 degrees apart. In assembly, the six protruding fingers (of each end pole piece) are alternately spaced providing twelve poles. Since the end pole pieces have different polarity, this in effect provides a (12) twelve-pole rotating electro-magnet.

The ends of the field coil winding are threaded through a hole drilled in the side of the rotor shaft, then through the shaft and rotor sleeve and are soldered to the slip rings at the rear end of the rotor shaft. The field coil is externally excited by means of battery current. The battery current is supplied to the field coil winding through the ignition switch, the voltage regulator, the brushes and the slip rings.

STATOR

The stator or armature (Fig. 15) consists of an internally-slotted laminated stationary armature having three separate sets of windings. One end of each of the windings is connected to a common

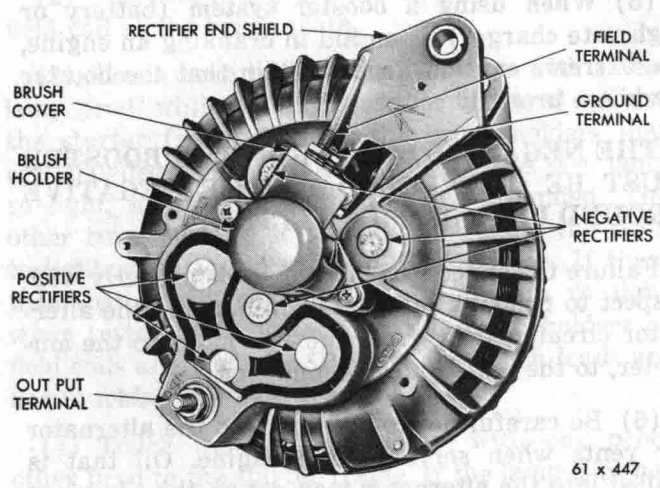


Fig. 11—Alternator Assembly

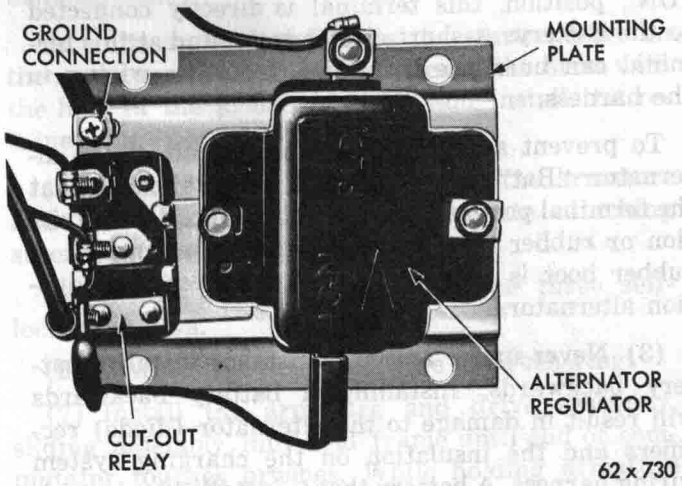


Fig. 12—Voltage Regulator and Cut Out Relay

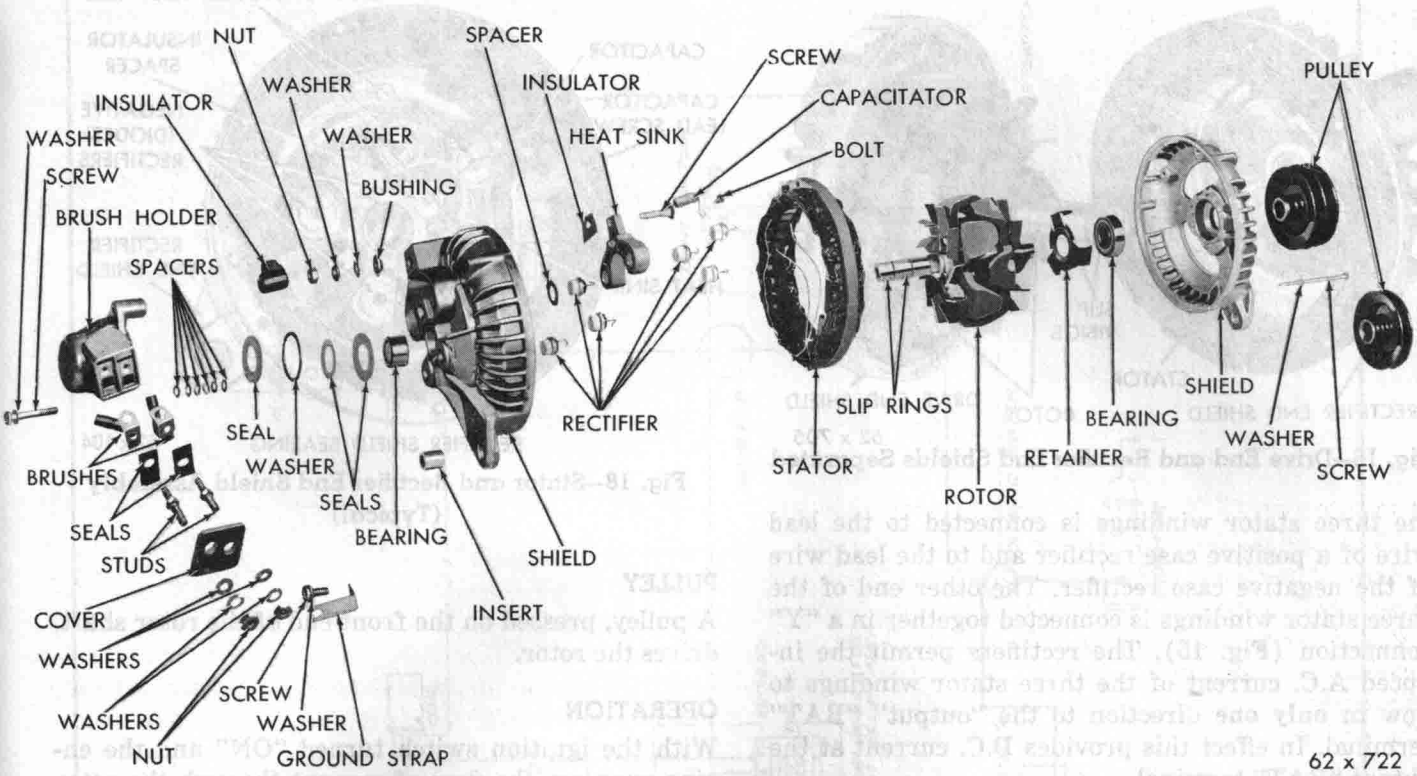


Fig. 13—Alternator Disassembled View

"Y" connection. The other end of each winding is connected to two rectifiers.

RECTIFIERS

In order to convert the induced A.C. current in the stator windings into usable D.C. current, six (6) silicon (diode) rectifiers are used (Fig. 11 and 18). Three of the rectifiers have positive polarity cases, and are pressed into an insulated die cast aluminum holder called a "heat sink". The heat sink is electrically insulated and is large enough to absorb the heat from the positive case rectifiers. The heat sink contains the "output" "BAT" terminal. Three of the rectifiers have "negative" polarity cases, and are pressed into the rear die cast aluminum end shield, providing a ground in the circuit.

The silicon rectifiers have a very high resistance to current flow in one direction, and very low resistance in the opposite direction. One end of each of

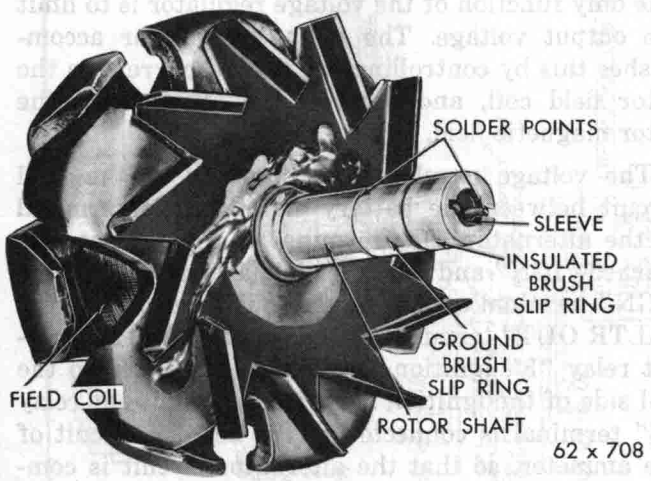


Fig. 14—Alternator Rotor Assy.

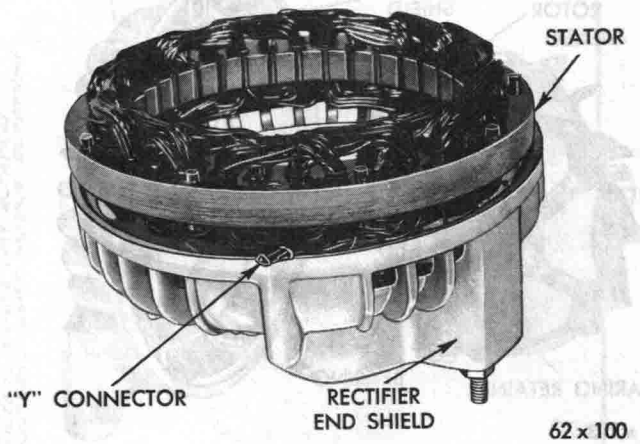


Fig. 15—Stator and End Shield Separated to Expose "Y" Connector

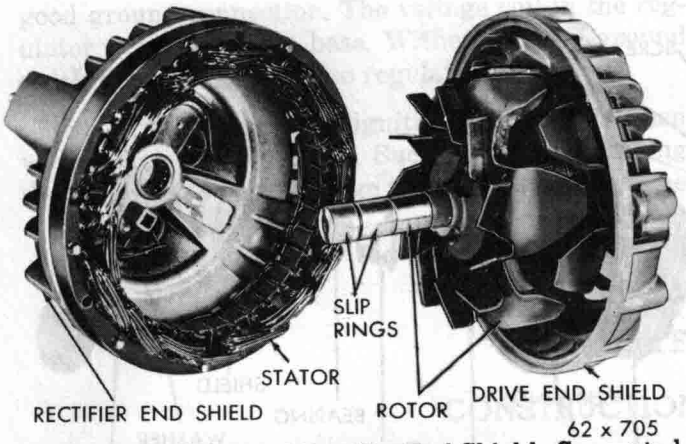


Fig. 16—Drive End and Rectifier End Shields Separated

the three stator windings is connected to the lead wire of a positive case rectifier and to the lead wire of the negative case rectifier. The other end of the three stator windings is connected together in a "Y" connection (Fig. 15). The rectifiers permit the induced A.C. current of the three stator windings to flow in **only one** direction to the "output" "BAT" terminal. In effect this provides D.C. current at the output "BAT" terminal.

END HOUSINGS

The two die cast aluminum end shields (Fig. 16) support and contain the internal parts. The housings are vented at both ends and around the circumference. Two centrifugal fans on the rotor shaft force cool air through the alternator. The rotor shaft is supported on the front end by a pre-lubricated ball bearing (Fig. 17). The rear end of the rotor shaft is supported by a pre-lubricated needle roller bearing (Fig. 18).

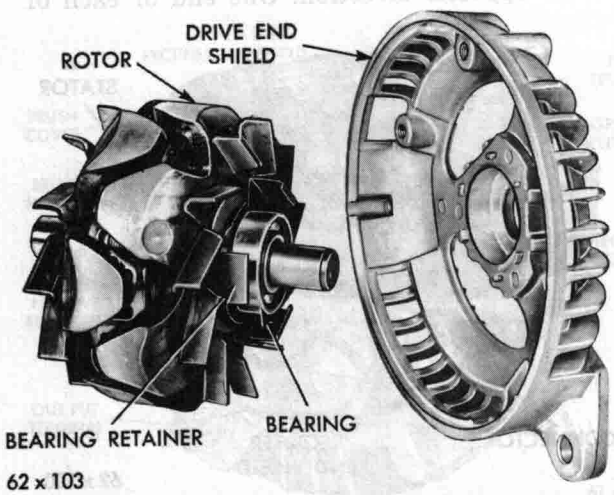


Fig. 17—Rotor and Bearing Separated from Drive End Shield

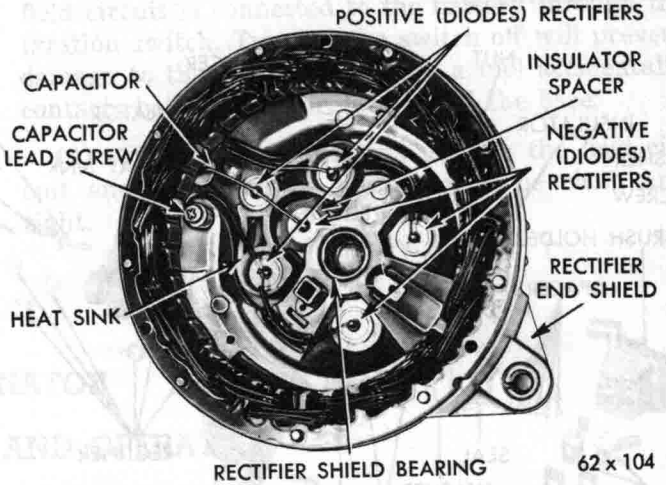


Fig. 18—Stator and Rectifier End Shield Assembly (Typical)

PULLEY

A pulley, pressed on the front end of the rotor shaft, drives the rotor.

OPERATION

With the ignition switch turned "ON" and the engine running, the flow of current through the rotor field coil winding energizes a twelve-pole rotating electromagnet. The rotation of the rotor will cause the stator windings to cut the magnetic lines of force of the rotor. This induces an A.C. current voltage, in the stator windings. The silicon rectifiers convert the (A.C.) alternating current to (D.C.) direct current at the output terminal, to carry the electrical load and charge the battery. The silicon rectifiers prevent the battery from discharging through the alternator.

VOLTAGE REGULATOR

The only function of the voltage regulator is to limit the output voltage. The voltage regulator accomplishes this by controlling the flow of current in the rotor field coil, and controls the strength of the rotor magnetic field.

The voltage regulator is connected in the field circuit between the battery and the field terminal of the alternator. One terminal of the regulator is marked "IGN" and the other is marked "FLD". The "IGN" terminal of the regulator is connected to the "ALTR OUT" terminal of the cutout relay. The cut-out relay "F" ignition terminal is connected to the coil side of the ignition switch and the cut-out relay "B" terminal is connected to the battery circuit of the ammeter, so that the alternator circuit is completed only when the ignition switch is closed "ON". Refer to (Fig. 19) Wiring Diagram.

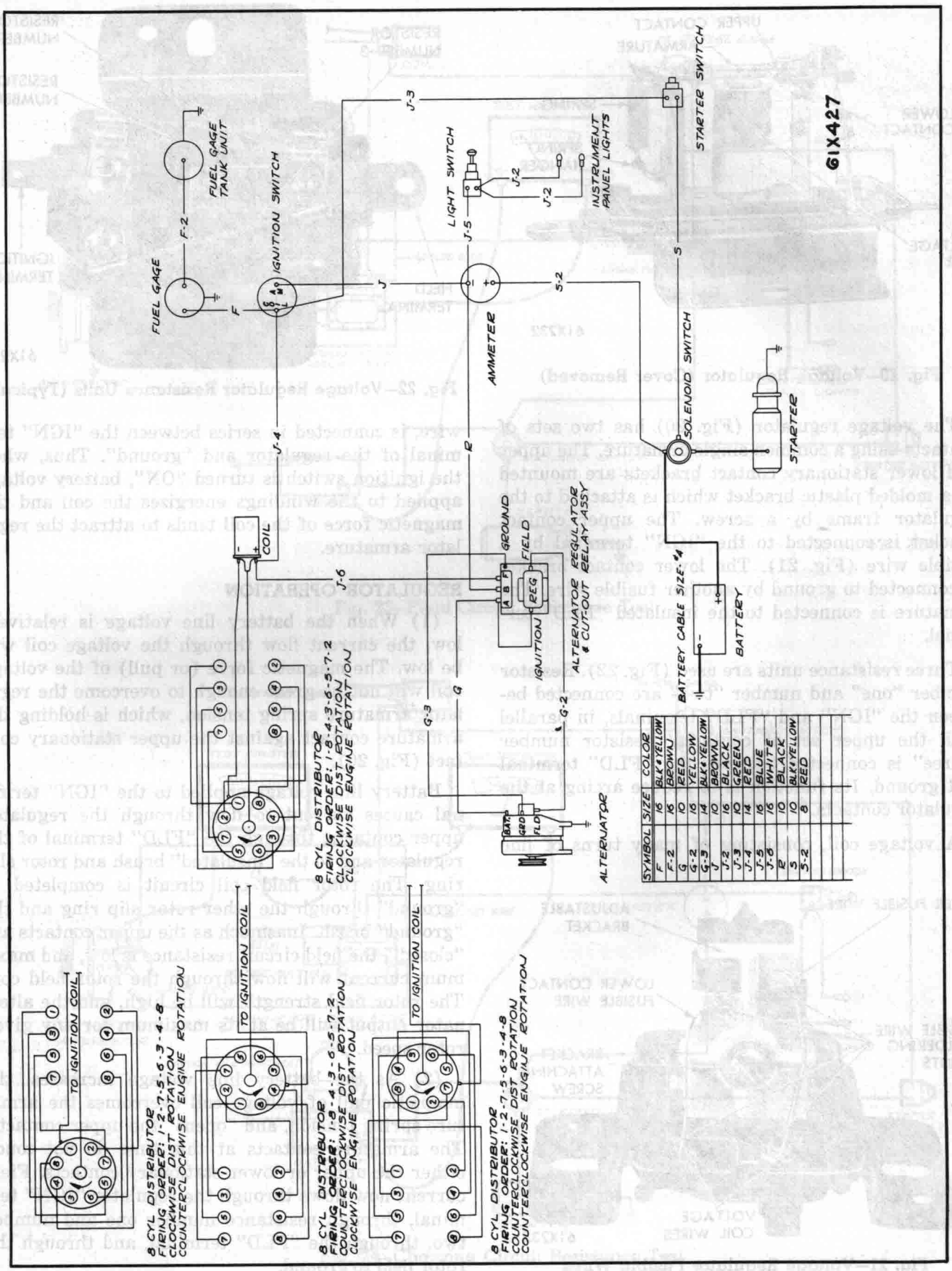


Fig. 19—Wiring Diagram

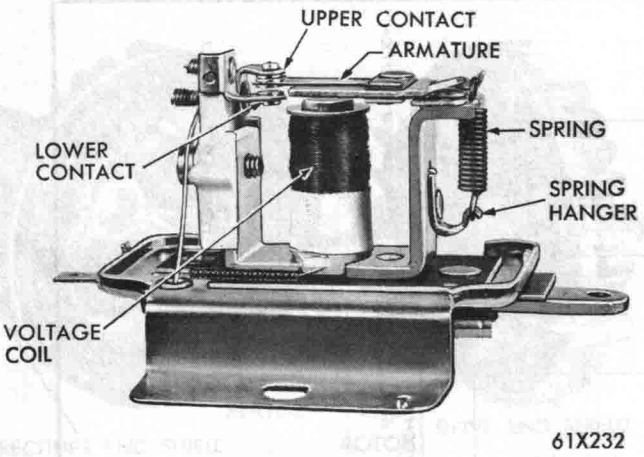


Fig. 20—Voltage Regulator (Cover Removed)

The voltage regulator (Fig. 20) has two sets of contacts using a common single armature. The upper and lower stationary contact brackets are mounted on a molded plastic bracket which is attached to the regulator frame by a screw. The upper contact bracket is connected to the "IGN" terminal by a fusible wire (Fig. 21). The lower contact bracket is connected to ground by another fusible wire. The armature is connected to the insulated "FLD" terminal.

Three resistance units are used (Fig. 22). Resistor number "one" and number "two" are connected between the "IGN" and "FLD" terminals, in parallel with the upper set of contacts. Resistor number "three" is connected between the "FLD" terminal and ground. Its function is to reduce arcing at the regulator contacts.

A voltage coil, consisting of many turns of fine wire, is connected in series between the "IGN" terminal of the regulator and "ground". Thus, when the ignition switch is turned "ON", battery voltage applied to the windings energizes the coil and the magnetic force of the coil tends to attract the regulator armature.

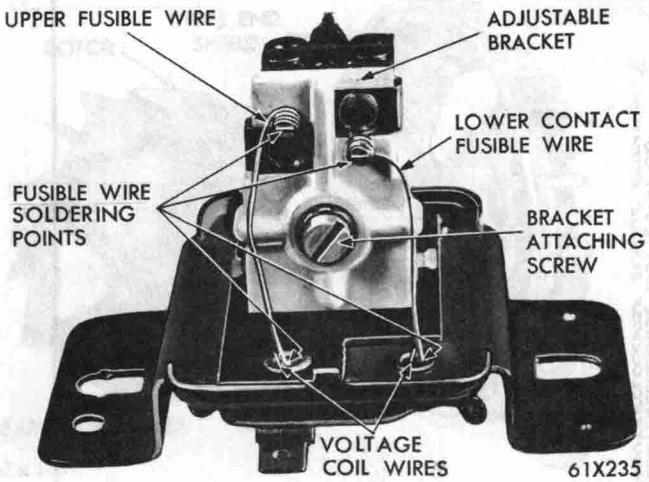


Fig. 21—Voltage Regulator Fusible Wires

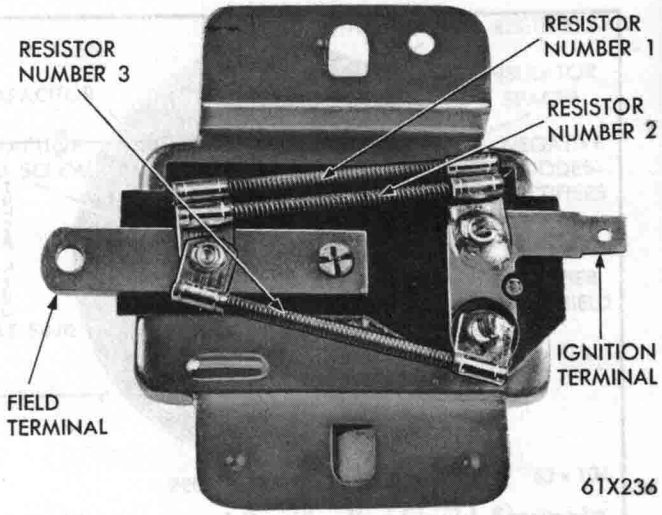


Fig. 22—Voltage Regulator Resistance Units (Typical)

REGULATOR OPERATION

(1) When the battery line voltage is relatively low, the current flow through the voltage coil will be low. The magnetic force (or pull) of the voltage coil will not be great enough to overcome the regulator armature spring tension, which is holding the armature contact against the upper stationary contact (Fig. 20).

Battery line voltage applied to the "IGN" terminal causes current to flow through the regulator upper contacts, through the "FLD" terminal of the regulator and to the "insulated" brush and rotor slip ring. The rotor field coil circuit is completed to "ground" through the other rotor slip ring and the "ground" brush. Inasmuch as the upper contacts are "closed", the field circuit resistance is low, and maximum current will flow through the rotor field coil. The rotor field strength will be high, and the alternator output will be at its maximum for any given rotor speed.

(2) As the battery line voltage increases, the magnetic pull of voltage coil overcomes the armature spring tension, and "opens" the upper contacts. The armature contacts at this time do not touch either the upper or lower stationary contacts. Field current now flows through the regulator "IGN" terminal, through resistance number one and number two, through the "FLD" terminal, and through the rotor field to ground.

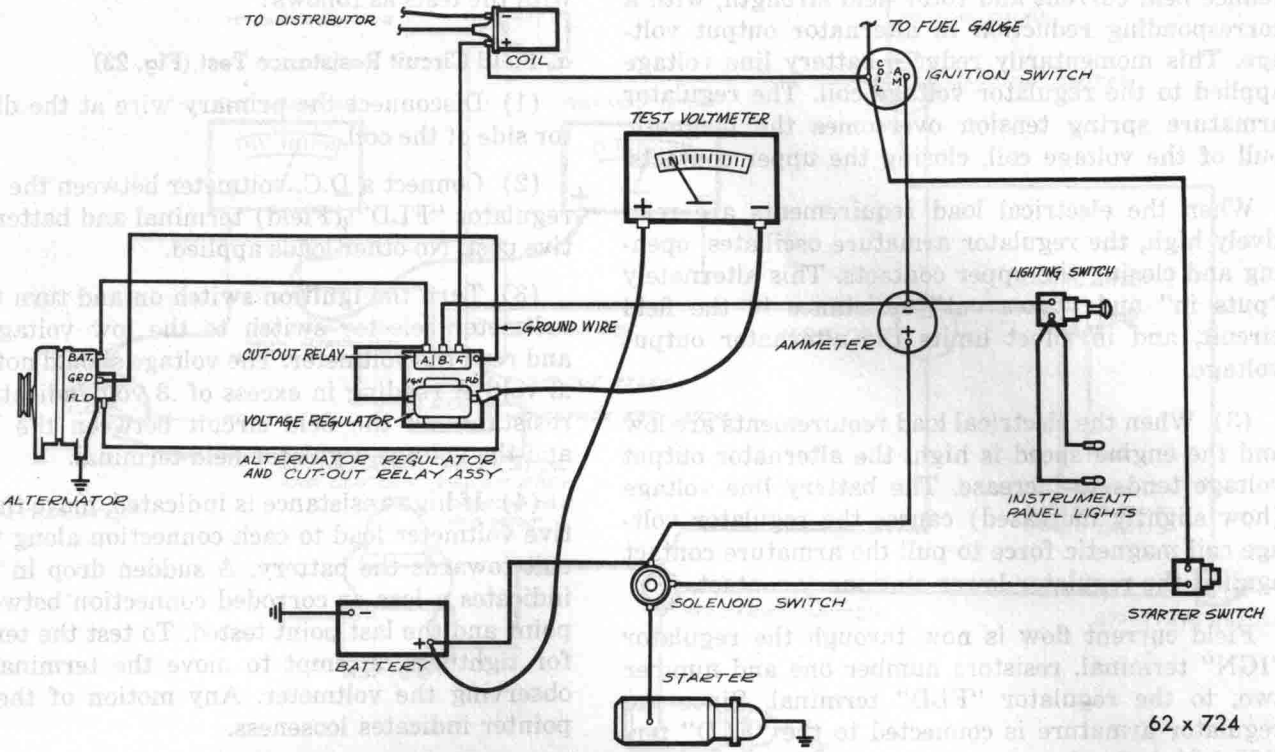


Fig. 23—Field Circuit Resistance Test

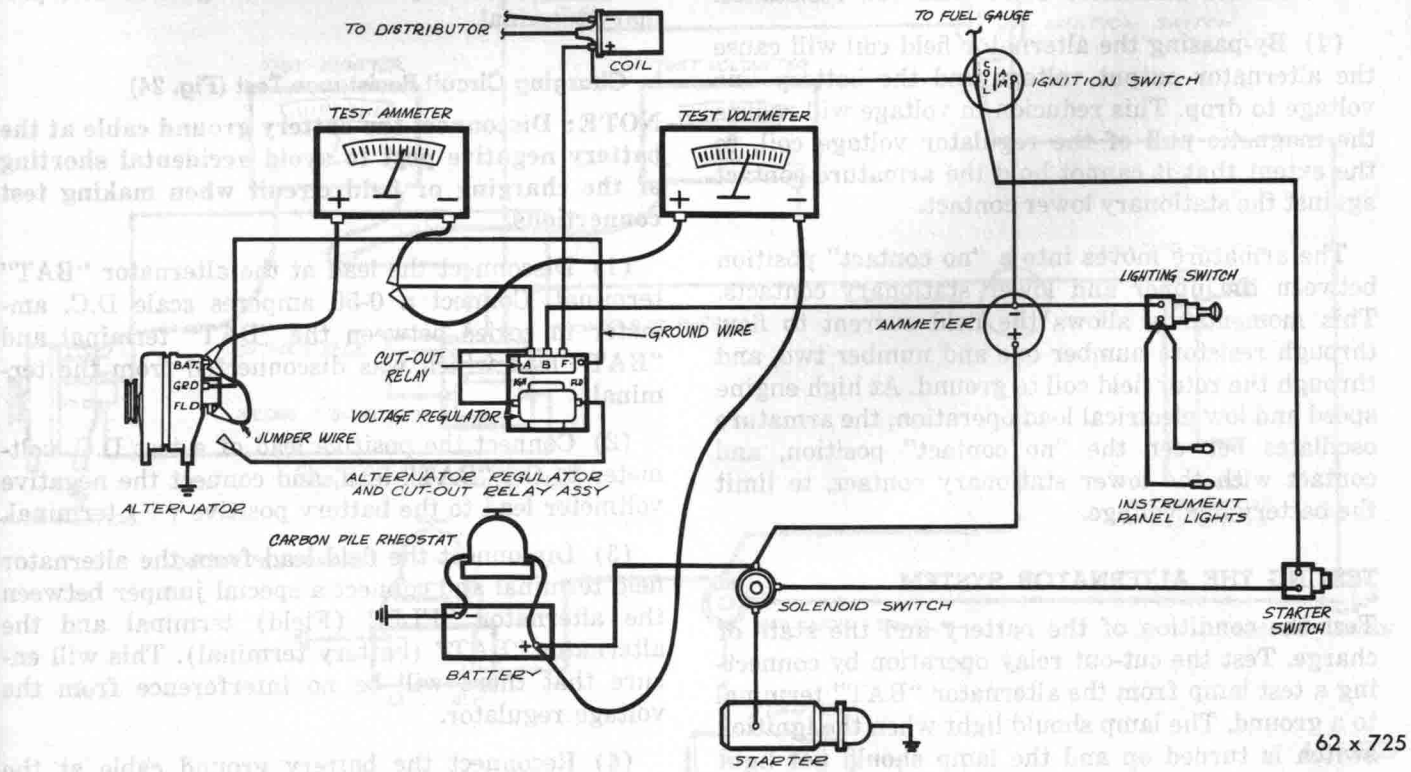


Fig. 24—Charging Circuit Resistance Test

The two resistors in series with the field circuit, reduce field current and rotor field strength, with a corresponding reduction in alternator output voltage. This momentarily reduces battery line voltage applied to the regulator voltage coil. The regulator armature spring tension overcomes the magnetic pull of the voltage coil, closing the upper contacts.

When the electrical load requirements are relatively high, the regulator armature oscillates, opening and closing the upper contacts. This alternately "puts in" and "takes out" resistance in the field circuit, and in effect limits the alternator output voltage.

(3) When the electrical load requirements are low and the engine speed is high, the alternator output voltage tends to increase. The battery line voltage (how slightly increased) causes the regulator voltage coil magnetic force to pull the armature contact against the regulator lower stationary contact.

Field current flow is now through the regulator "IGN" terminal, resistors number one and number two, to the regulator "FLD" terminal. Since the regulator armature is connected to the "FLD" terminal and the lower contacts are closed, current flows through the regulator armature to the movable contact and thence through the lower contact to ground. This is because the resistance to ground is less than the alternator rotor field coil resistance.

(4) By-passing the alternator field coil will cause the alternator output voltage and the battery line voltage to drop. This reducion in voltage will reduce the magnetic pull of the regulator voltage coil, to the extent that it cannot hold the armature contact against the stationary lower contact.

The armature moves into a "no contact" position between the upper and lower stationary contacts. This momentarily allows the field current to flow through resistors number one and number two, and through the rotor field coil to ground. At high engine speed and low electrical load operation, the armature oscillates between the "no contact" position, and contact with the lower stationary contact, to limit the battery line voltage.

TESTING THE ALTERNATOR SYSTEM

Test the condition of the battery and the state of charge. Test the cut-out relay operation by connecting a test lamp from the alternator "BAT" terminal to a ground. The lamp should light when the ignition switch is turned on and the lamp should not light when the ignition switch is turned off. With the battery in good condition and fully charged, proceed with the tests as follows:

a. Field Circuit Resistance Test (Fig. 23)

(1) Disconnect the primary wire at the distributor side of the coil.

(2) Connect a D.C. voltmeter between the voltage regulator "FLD" (Field) terminal and battery positive post. No other loads applied.

(3) Turn the ignition switch on and turn the test voltmeter selector switch to the low voltage scale and read the voltmeter. The voltage should not exceed .3 volt. A reading in excess of .3 volt indicates high resistance in the field circuit between the battery and the voltage regulator field terminal.

(4) If high resistance is indicated, move the negative voltmeter lead to each connection along the circuit towards the battery. A sudden drop in voltage indicates a loss or corroded connection between the point and the last point tested. To test the terminals for tightness, attempt to move the terminal while observing the voltmeter. Any motion of the meter pointer indicates looseness.

NOTE: Excessive resistance in the regulator wiring circuit will cause fluctuations in the ammeter.

(5) Turn ignition switch off and reconnect the distributor primary wire at the ignition coil primary terminal.

b. Charging Circuit Resistance Test (Fig. 24)

NOTE: Disconnect the battery ground cable at the battery negative post to avoid accidental shorting of the charging or field circuit when making test connections.

(1) Disconnect the lead at the alternator "BAT" terminal. Connect a 0-50 amperes scale D.C. ammeter in series between the "BAT" terminal and "BAT" lead which was disconnected from the terminal.

(2) Connect the positive lead of a test D.C. voltmeter to the "BAT" lead, and connect the negative voltmeter lead to the battery positive (+) terminal.

(3) Disconnect the field lead from the alternator field terminal and connect a special jumper between the alternator "FLD" (Field) terminal and the alternator "BAT" (battery terminal). This will ensure that there will be no interference from the voltage regulator.

(4) Reconnect the battery ground cable at the battery negative terminal.

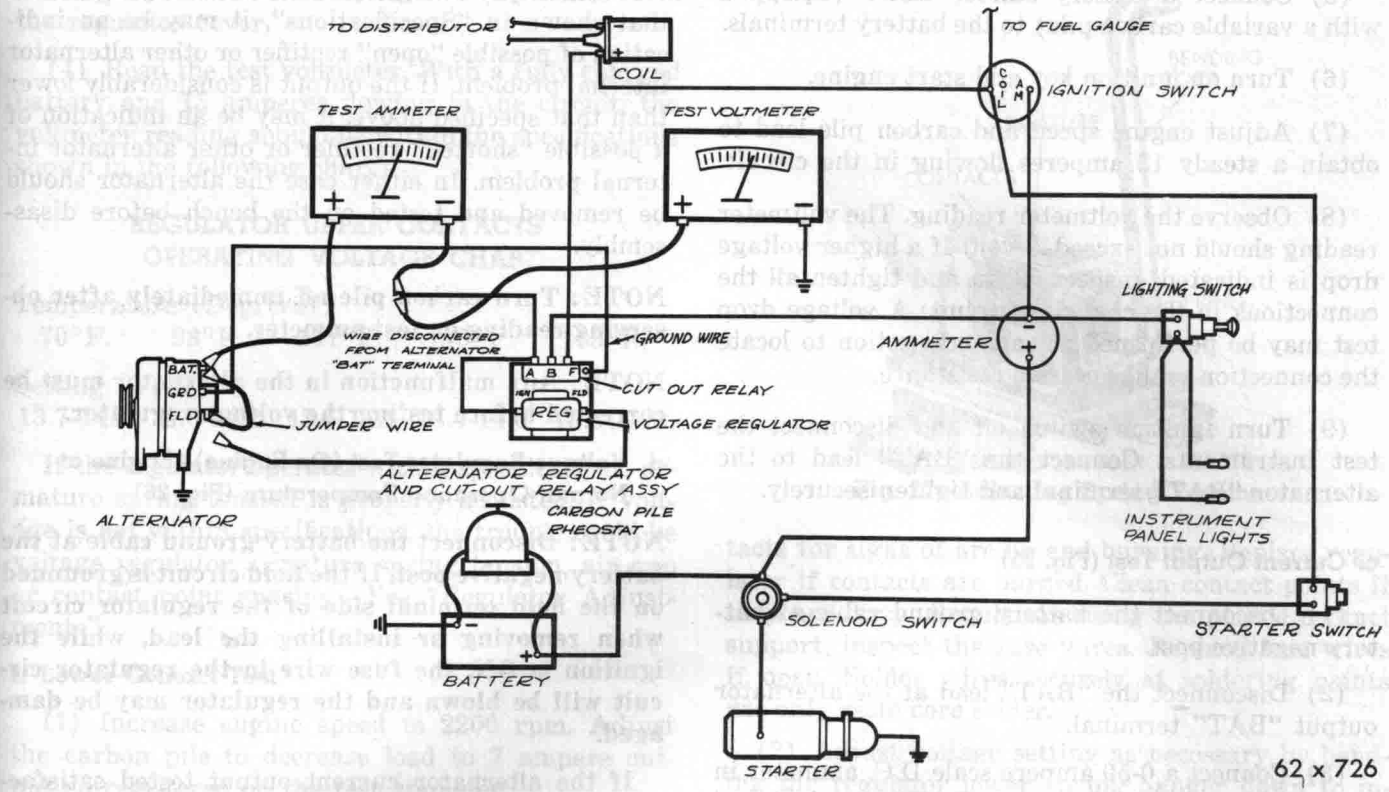


Fig. 25—Current Output Test

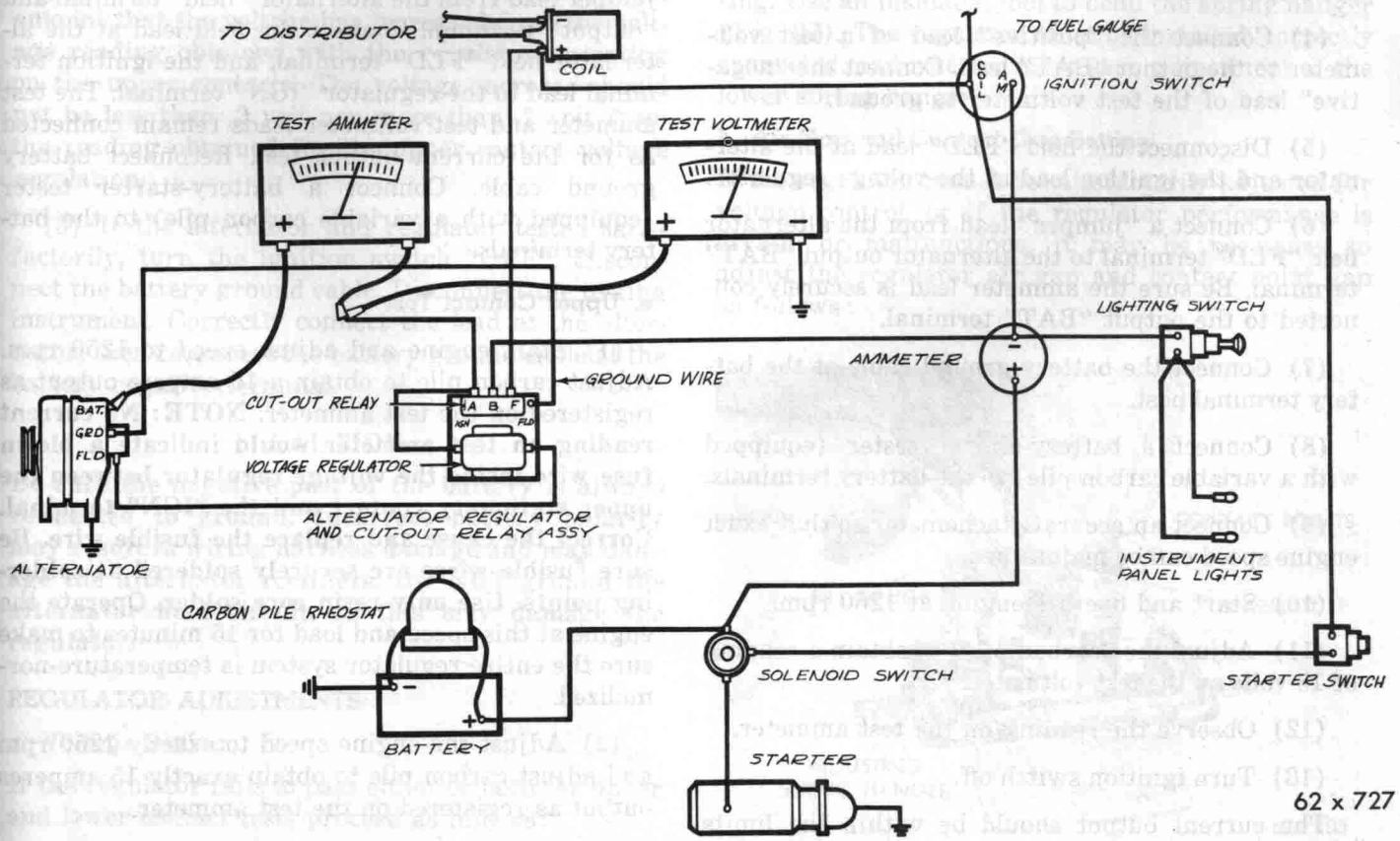


Fig. 26—Voltage Regulator Test

(5) Connect a battery starter tester (equipped with a variable carbon pile) to the battery terminals.

(6) Turn on ignition key and start engine.

(7) Adjust engine speed and carbon pile load to obtain a steady 12 amperes flowing in the circuit.

(8) Observe the voltmeter reading. The voltmeter reading should not exceed .3 volt. If a higher voltage drop is indicated, inspect, clean and tighten all the connections in the charging circuit. A voltage drop test may be performed at each connection to locate the connection with excessive resistance.

(9) Turn ignition switch off and disconnect the test instruments. Connect the "BAT" lead to the alternator "BAT" terminal and tighten securely.

c. Current Output Test (Fig. 25)

(1) Disconnect the battery ground cable at battery negative post.

(2) Disconnect the "BAT" lead at the alternator output "BAT" terminal.

(3) Connect a 0-50 ampere scale D.C. ammeter in series between the alternator "BAT" terminal and the disconnected "BAT" lead.

(4) Connect the "positive" lead of a test voltmeter to the output "BAT" lead. Connect the "negative" lead of the test voltmeter to ground.

(5) Disconnect the field "FLD" lead at the alternator and the ignition lead at the voltage regulator.

(6) Connect a "jumper" lead from the alternator field "FLD" terminal to the alternator output "BAT" terminal. Be sure the ammeter lead is securely connected to the output "BAT" terminal.

(7) Connect the battery ground cable at the battery terminal post.

(8) Connect a battery-starter tester (equipped with a variable carbon pile) to the battery terminals.

(9) Connect an accurate tachometer so that exact engine speed can be maintained.

(10) Start and operate engine at 1250 rpm.

(11) Adjust the "carbon pile" to obtain a reading of 15 volts on the test voltmeter.

(12) Observe the reading on the test ammeter.

(13) Turn ignition switch off.

The current output should be within the limits shown in "Specifications".

If the output is slightly less (5 to 7 amperes) than that shown in "Specifications", it may be an indication of possible "open" rectifier or other alternator internal problem. If the output is considerably lower than that specified above, it may be an indication of a possible "shorted" rectifier or other alternator internal problem. In either case the alternator should be removed and tested on the bench before disassembly.

NOTE: Turn carbon pile off immediately after observing reading on test ammeter.

NOTE: Any malfunction in the alternator must be corrected before testing the voltage regulator.

d. Voltage Regulator Test (On Engine)—Engine at Normal Operating Temperature (Fig. 26)

NOTE: Disconnect the battery ground cable at the battery negative post. If the field circuit is grounded on the field terminal side of the regulator circuit when removing or installing the lead, while the ignition is ON, the fuse wire in the regulator circuit will be blown and the regulator may be damaged.

If the alternator current output tested satisfactorily; turn off the ignition switch and remove the jumper lead from the alternator "field" terminal and "output" terminal. Connect the field lead at the alternator field "FLD" terminal, and the ignition terminal lead to the regulator "IGN" terminal. The test ammeter and test voltmeter leads remain connected as for the current output test. Reconnect battery ground cable. Connect a battery-starter tester (equipped with a variable carbon pile) to the battery terminals.

e. Upper Contact Test

(1) Start engine and adjust speed to 1250 rpm. Adjust carbon pile to obtain a 15 ampere output as registered on the test ammeter. **NOTE: No current reading on test ammeter would indicate a blown fuse wire inside the voltage regulator between the upper stationary contact and the "IGN" terminal. Correct the cause and replace the fusible wire. Be sure fusible wires are securely soldered at soldering points. Use only resin core solder.** Operate the engine at this speed and load for 15 minutes to make sure the entire regulator system is temperature-normalized.

(2) Adjust the engine speed to exactly 1250 rpm and adjust carbon pile to obtain exactly 15 amperes output as registered on the test ammeter.

(3) Measure the temperature at the regulator by

holding a reliable thermometer two (2) inches from the regulator cover.

(4) Read the test voltmeter. With a fully charged battery and 15 amperes flowing in the circuit, the voltmeter reading should be within the specifications shown in the following chart:

REGULATOR UPPER CONTACTS OPERATING VOLTAGE CHART

Temperature (Degrees):				
70°F.	93°F.	117°F.	140°F.	163°F.
Setting (Volts):				
13.7-14.3	13.6-14.2	13.5-14.1	13.4-14.0	13.3-13.9

If the regulator operates within specifications, armature spring tension is properly adjusted. If voltage is not within specifications, the trouble could be voltage regulator armature spring tension, air gap or contact point spacing – See "Regulator Adjustments".

f. Lower Contact Test

(1) Increase engine speed to 2200 rpm. Adjust the carbon pile to decrease load to 7 ampere output as registered on the test ammeter.

(2) Read the test voltmeter and note the exact amount that the voltage has increased from the voltage reading obtained with the regulator operating on the upper contacts. The voltage increase should not be less than .2 volt nor more than .7 volt from the reading obtained for the upper contact voltage regulation.

(3) If the alternator and regulator tested satisfactorily, turn the ignition switch "OFF". Disconnect the battery ground cable. Disconnect the testing instrument. Correctly connect the lead at the alternator, then reconnect the battery ground cable at the battery negative terminal.

CAUTION

Be sure the negative post of the battery is always connected to ground. Incorrect battery polarity may result in wiring harness damage and may damage the alternator rectifiers. DO NOT ground the alternator field circuit, as this may damage the regulator.

REGULATOR ADJUSTMENTS

a. Voltage Setting

If the regulator fails to pass either or both the upper and lower contact tests proceed as follows:

(1) Remove the regulator cover. Inspect the contacts for signs of arcing and burning. Replace regulator if contacts are burned. Clean contact points if they are dirty. Regulators using the plastic contact support, inspect the fuse wires. Replace fuse wires if open. Solder wires securely at soldering points use **only** resin core solder.

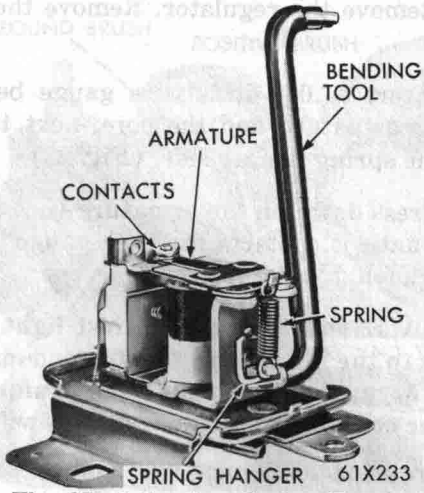


Fig. 27—Adjusting Spring Tension

(2) Adjust voltage setting as necessary by bending the regulator lower spring hanger **down** to **increase** voltage setting, **up** to **decrease** voltage setting. Use an insulated tool to bend the spring hanger (Fig. 27). The regulator must be installed, correctly connected, and retested after each adjustment of the lower spring hanger.

b. Air Gap and Contact Gap Setting

If the regulator cannot be satisfactorily adjusted for voltage control, or if the regulator performance is erratic or malfunctions, it may be necessary to adjust the regulator air gap and contact point gap as follows:

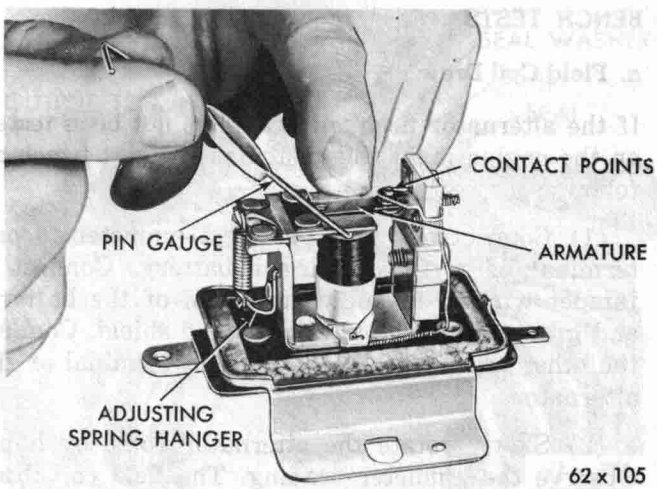


Fig. 28—Checking Air Gap

(1) Remove the regulator. Remove the regulator cover.

(2) Insert a .048 inch wire gauge between the regulator armature and the core, next to the stop pin on the spring hanger side. (Fig. 28).

(3) Press down on the **armature** (not the contact spring) until it contacts the wire gauge. The upper contacts should just "open".

NOTE: A 12 volt battery and test light connected in series to the "IGN" and "FLD" terminals may be used to accurately determine the contact opening. When the contacts open, the test light will go "dim".

(4) Insert a .052 inch wire gauge between the armature and the core, next to the stop pin on the spring hanger side.

(5) Press down the armature until it contacts the wire gauge. The contacts should remain "closed", and the test light should remain "bright".

(6) If adjustment is required, adjust the air gap by loosening the screw and moving the stationary contact bracket; make sure the air gap is checked with attaching screw fully tightened. Remeasure the air gap as described in step 2, 3, 4 and 5.

(7) Remove the wire gauge from under the armature. Measure the lower contact gap with a feeler gauge. The lower contact gap should be .012 to .016 inch. Adjust the lower contact gap by bending the lower stationary contact bracket.

(8) Install the regulator cover. Install the regulator. The voltage setting must be rechecked on the engine after installation of the regulator.

SERVICE PROCEDURES

ALTERNATOR

Removal

If the alternator performance does not meet current output specification limits, it will have to be removed and disassembled for further test and servicing.

(1) Disconnect the battery ground cable at the battery.

(2) Disconnect the alternator output "BAT" and field "FLD" leads and disconnect ground wire.

(3) Remove the alternator from the engine.

BENCH TESTS

a. Field Coil Draw

If the alternator field coil draw has not been tested on the engine it may be tested on the test bench as follows:

(1) Connect one lead of a test ammeter to one terminal of a fully charged battery. Connect a jumper wire to the other terminal of the battery, and ground it to the alternator end shield. Connect the other ammeter lead to the field terminal of the alternator.

(2) Slowly rotate the alternator rotor by hand. Observe the ammeter reading. The field coil draw should be 2.3 amperes to 2.7 amperes at 12 volts.

NOTE: A low rotor coil draw is an indication of high resistance in the field coil circuit. (brushes, slip rings, or rotor coil). A higher rotor coil draw indicates a possible shorted rotor coil or a grounded rotor.

b. Testing Alternator Internal Field Circuit for Ground

(1) To test the internal field circuit for a ground, remove the ground brush. See "Disassembly operation (1)". Do not remove positive brush terminal stud or positive brush. Touch one test prod from a 110 volt test lamp to the alternator insulated brush terminal and the remaining test prod to the end shield. If the rotor assembly or positive brush is not grounded, the lamp will not light.

(2) If the lamp lights, remove the insulated brush assembly, plastic brush holder, brush holder seals. (See "Disassembly Operation (2)") and separate the end shields by removing the three through bolts.

(3) Again test by placing one of the test prods to a slip ring and the remaining test prod to the end shield. If the lamp lights, the rotor assembly is grounded and requires replacement. If the lamp does not light after removing the positive brush and separating the end shields, the cause of the ground at the first ground test was that the positive brush is grounded.

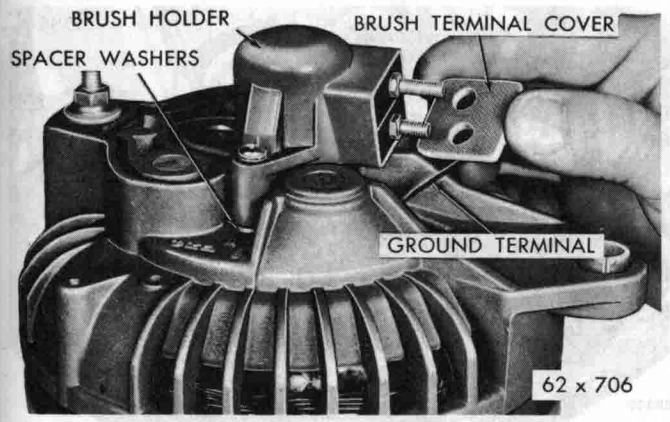


Fig. 29—Removing or Installing Brush Terminal Cover

c. Disassembly

To prevent possible damage to the brush assemblies, they should be removed before proceeding with the disassembly of the alternator. The brushes are mounted in a plastic holder that positions the brushes vertically against the slip rings on the rectifier end of the rotor shaft.

(1) Remove the retaining stud nut, lockwasher, brush terminal cover (Fig. 29), sealing washers (Fig. 30), terminal studs and brushes (Fig. 31).

(2) Remove the plastic brush holder attaching screws, brush holder (Fig. 32), and spacer washers. Keep spacer washers separated for each attaching screw to insure proper spacing at assembly. Carefully remove the brush cover seals (Fig. 33).

CAUTION

The stator is laminated, do not burr the stator or end shield.

(3) Remove the through bolts and carefully pry between the stator and drive end shield with the blade of a screwdriver (Fig. 34). Carefully separate the drive end shield, pulley and rotor assembly away from the stator and rectifier shield assembly.

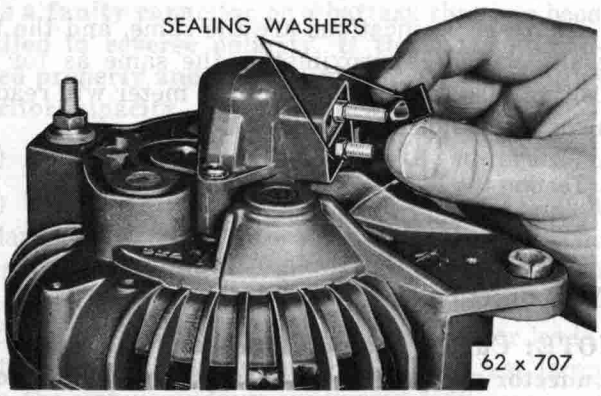


Fig. 30—Removing or Installing Sealing Washers

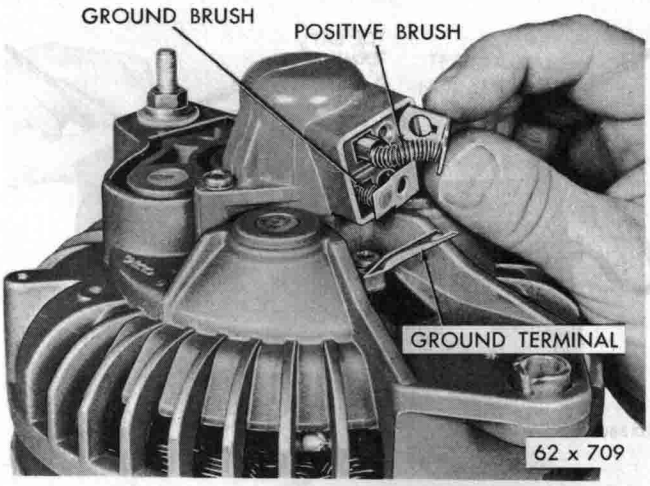


Fig. 31—Removing or Installing Brushes

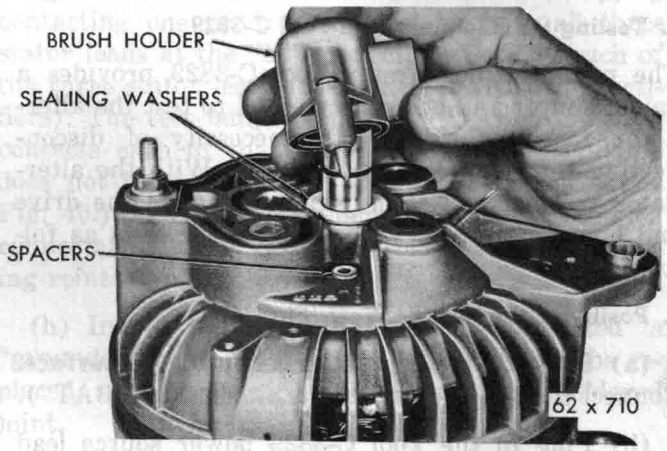


Fig. 32—Removing or Installing Brush Holder

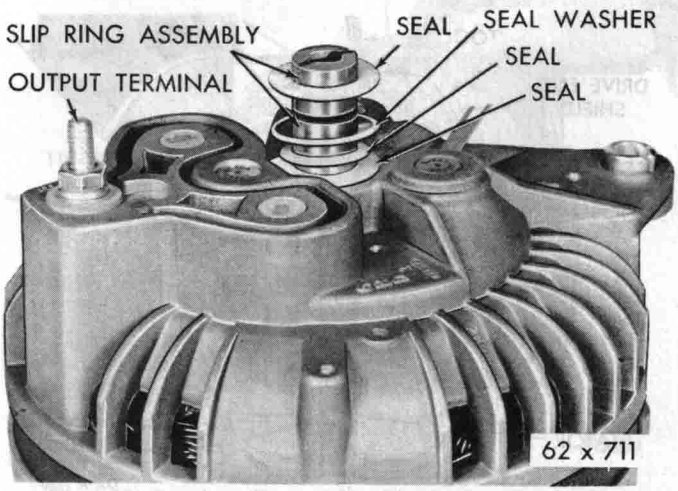


Fig. 33—Brush Holder Seal Arrangement

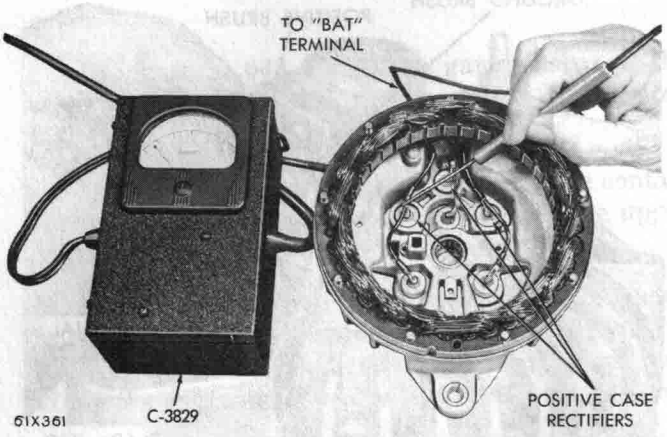


Fig. 34—Separating Drive End Shield from Stator (Typical)

d. Testing the Rectifiers with Tool C-3829

The new Rectifier Tester Tool C-3829 provides a quick, simple and accurate method to test the alternator rectifiers without the necessity of disconnecting the soldered rectifier leads. With the alternator rectifier end shield separated from the drive end housing proceed with the rectifier tests as follows:

e. Positive Case Rectifier Test (Fig. 35)

(a) Place the alternator on an insulated surface. Connect the test lead clip to the alternator ("BAT").

(b) Plug in the Tool C-3829 power source lead into a 110 volt A.C. power supply. Touch the exposed bare metal connections of each of the positive case rectifiers, with the test prod.

CAUTION

Do not break the sealing around the rectifier lead wire, or on the inner end of the rectifier. The sealing material is for protection against corrosion. Always touch the test prod to the exposed metal connection nearest the rectifier.

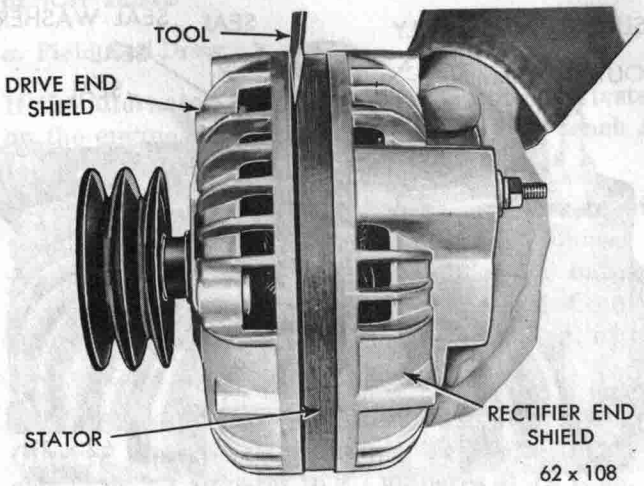


Fig. 35—Testing Positive Rectifiers

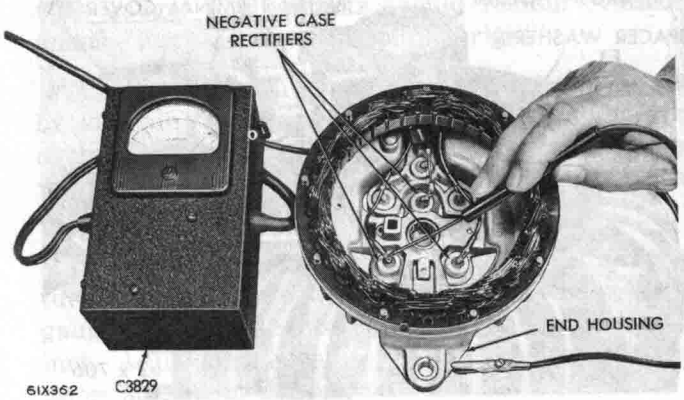


Fig. 36—Testing Negative Rectifiers

The meter reading for satisfactory rectifiers will be 1¾ amperes or more. The reading should be approximately the same for the three rectifiers.

When two rectifiers are good and one rectifier is shorted, the reading taken at the good rectifiers will be low, and reading at the shorted rectifier will be zero. Disconnect the lead to the rectifier reading zero and retest. The reading of the good rectifiers will now be within the satisfactory range.

When one rectifier is open it will read approximately one ampere, and the two good rectifiers will read within the satisfactory range.

f. Negative Case Rectifier Test (Fig. 36)

(a) Connect the test lead clip to the rectifier end housing.

(b) Touch the exposed connection of each of the negative case rectifiers with the test prod.

The test specifications are the same, and the test results will be approximately the same as for the positive case rectifiers, except the meter will read on the opposite side of the scale.

g. Testing the Rectifiers and Stator (without Tool C-3829)

(a) Separate the three (3) stator leads at the "Y" connection. (See Fig. 37.)

NOTE: Cut the stator connections as close to the connector as possible because they will have to be soldered together again. If they are cut too short

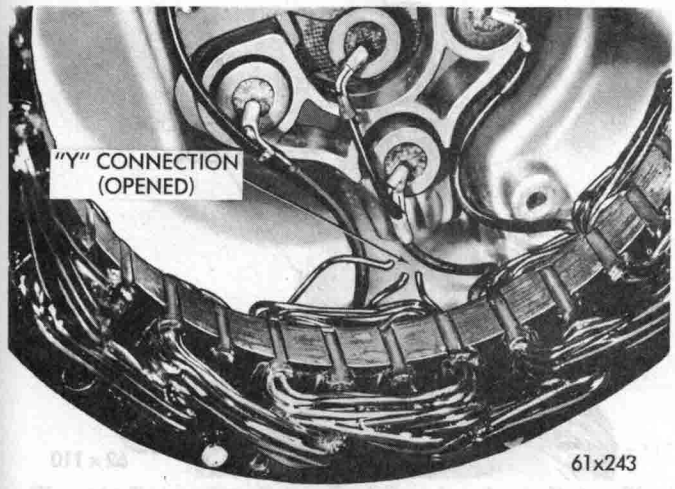


Fig. 37—"Y" Connector Opened and Stator Leads Separated

it may be difficult to get them together again for soldering.

(b) Test the rectifiers with a 12 volt battery and a test lamp equipped with a number 67 bulb (4 candle power) by connecting one side of test lamp to the positive battery post. The other side of the test lamp to a test probe with the other test probe connected to the negative battery post.

(c) Contact the outer case of the rectifier with one probe and the other probe to the wire in the center of the rectifier. (See Fig. 38.)

(d) Reverse the probes, moving the probe from the rectifier outer case to the rectifier wire, and the probe from the rectifier wire to the rectifier outer case.

If the test lamp "lights" in one direction but does "not light" in the other direction, the rectifier is satisfactory. If lamp lights in "both directions", the **rectifier** is "shorted". If the test lamp does "not light" in either direction, the rectifier is "open".

NOTE: The usual cause of an open or blown rectifier is a faulty capacitor or a battery that has been installed in reverse polarity. If the battery is installed properly and the rectifiers are open, test the capacitor capacity—See "Specifications".

(e) Disconnect the rectifiers from the stator leads.

(f) Test the stator for grounds using a 110 volt test lamp (Fig. 39). Use wood slats to insulate the stator from the rectifier shield. Contact one prod of the test lamp to the stator pole frame, and contact the other prod to each of the three stator leads. The test lamp should "not light". If the test lamp lights, the stator windings are "grounded".

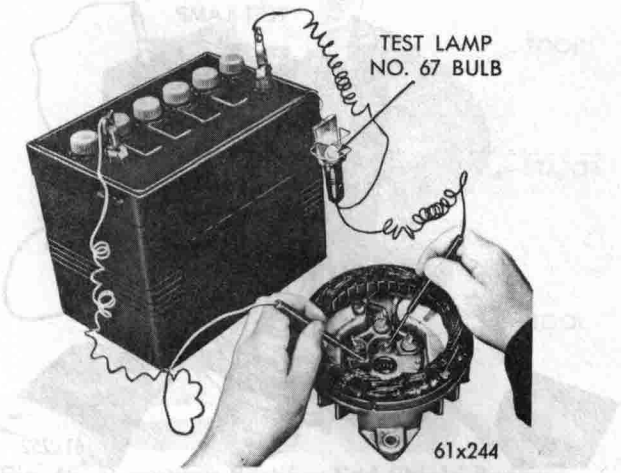


Fig. 38—Testing Rectifiers with Test Lamp (Typical)

(g) Test the stator windings for continuity, by contacting one prod of the test lamp to all three stator leads at the "Y" connection. Contact each of the three stator leads (disconnected from the rectifiers). The test lamp should "light" when the prod contacts each of the three leads. If the test lamp does not light the stator winding is "open". (See Fig. 40.) After test, resolder the wires at the "Y" connector. Use only resin core solder. After resoldering reinstall plastic sleeve.

(h) Install a new stator if the one tested is "grounded" or "open." If the rectifiers must be replaced, unsolder the rectifier wire at the soldered joint.

NOTE: Three rectifiers are pressed into the heat sink and three in the end shield. When removing the rectifiers, it is necessary to support the end shield and/or heat sink to prevent damage to these castings.

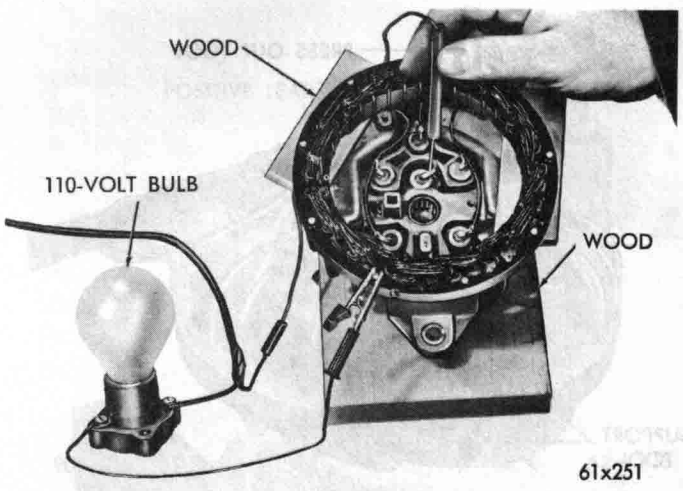


Fig. 39—Testing Stator for Grounds (Typical)

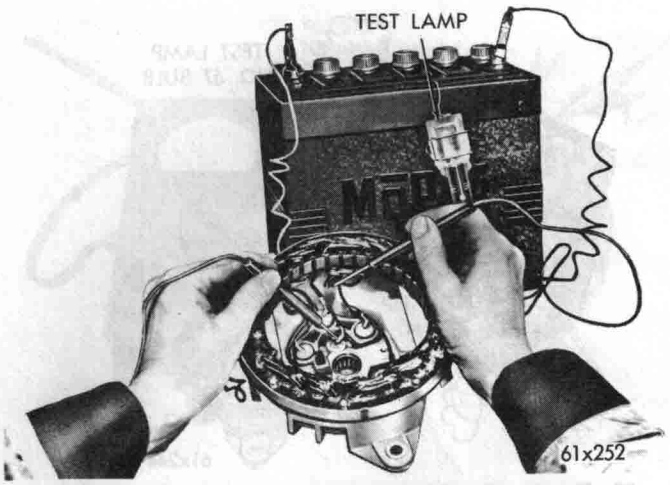


Fig. 40—Testing Stator Windings for Continuity

(i) Support the rectifier shield on Tool C-3771 welded to a support plate.

NOTE: This tool is cut-away and slotted to fit over the wires and around the bosses in the shield. Make sure that the bore of the tool completely surrounds the rectifier, then press the rectifier out of the shield using a suitable press-out tool (Fig. 41).

(4) The pulley is an interference fit on the rotor shaft. Remove the pulley with puller Tool C-3615 and special adapters SP-3002 (Fig. 42).

(5) Pry the drive end bearing spring retainer from the end shield with a screwdriver (Fig. 43).

(6) Support the end shield and tap the rotor shaft with a plastic hammer to separate the rotor and bearing from the end shield.

If the drive end bearing is to be replaced, always use a new bearing.

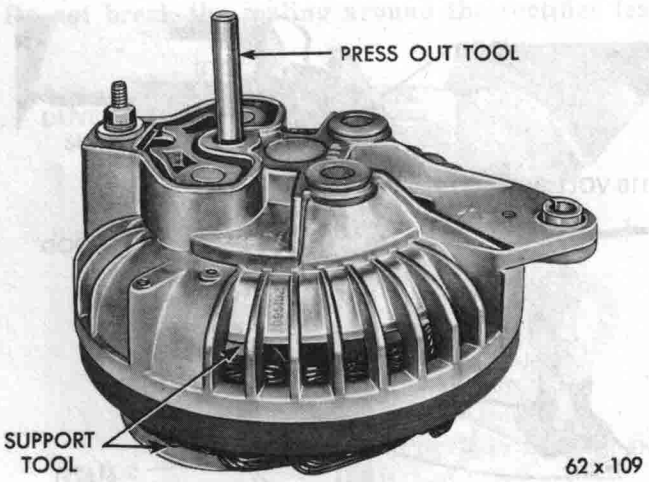


Fig. 41—Removing a Rectifier (Typical)

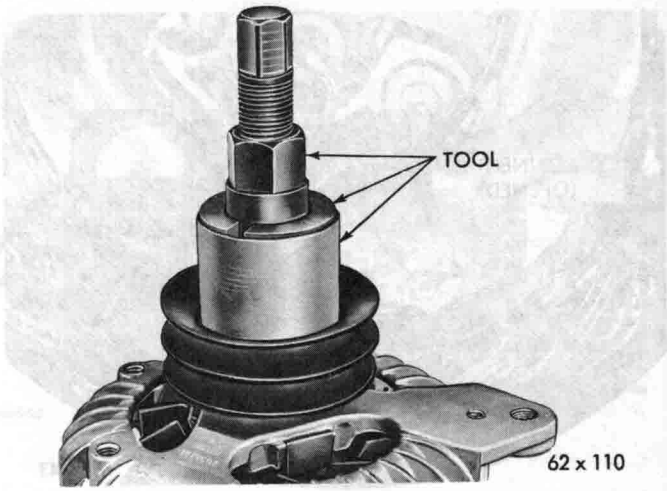


Fig. 42—Removing Pulley (Typical)

NOTE: The new bearing is lubricated with a predetermined amount of special lubricant and does not require additional lubrication.

(7) The drive end ball bearing is an interference fit with the rotor shaft. Remove the bearing with puller Tool C-3615 and adapters as follows:

(a) Support rotor so that slip rings will not be damaged.

(b) Position the center screw to Tool C-3615 on rotor shaft.

(c) Place the thin lower end of the adapters SP-3375 under the bearing equally spaced and the upper end of the adapters around the center screw.

(d) Hold the adapters and center screw in position with the tool sleeve.

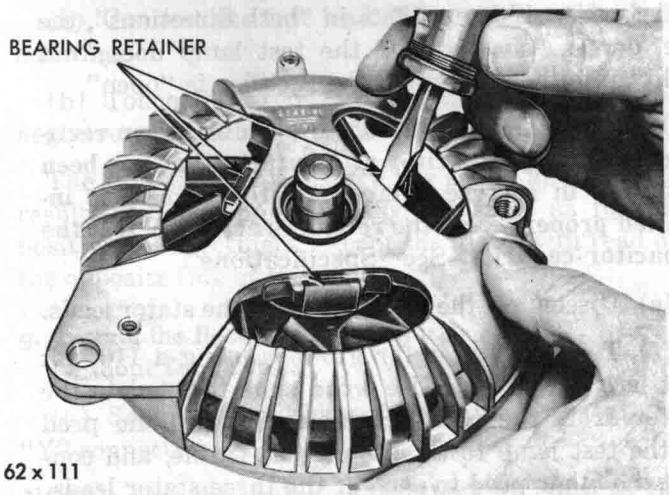


Fig. 43—Disengaging Bearing Retainer from the End Shield

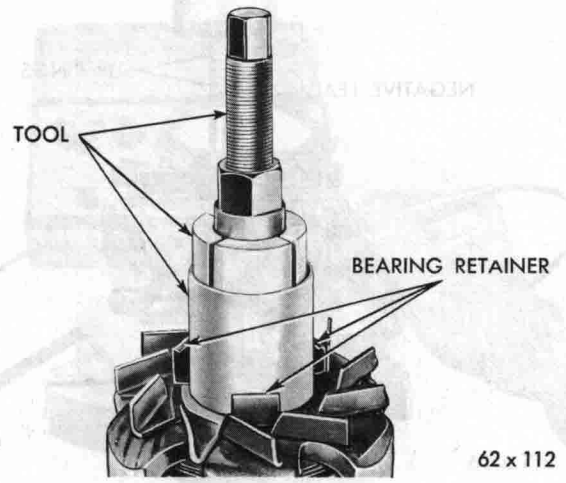


Fig. 44—Removing Drive End Bearing from Rotor Shaft

CAUTION

Tool sleeve must bottom on bearing, otherwise, adapters may be damaged.

(e) Turning center screw while holding the outer body of tool (Fig. 44) will withdraw the bearing from the rotor shaft.

(8) Remove the D.C. output terminal nuts and washers and remove terminal screw and inside capacitor (on units so equipped).

NOTE: The heat sink is also held in place by the terminal screw.

(9) Remove the insulator (Fig. 45).

(10) The needle roller bearing in the rectifier end shield is a press fit. If it is necessary to replace the needle bearing, support the shield with Tool SP-3383 when pressing the bearing out with Tool C-3770 (Fig. 46).

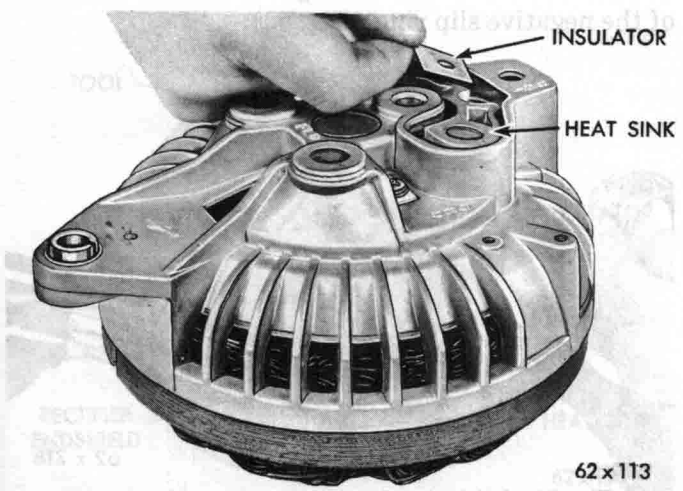


Fig. 45—Removing or Installing Heat Sink Insulator

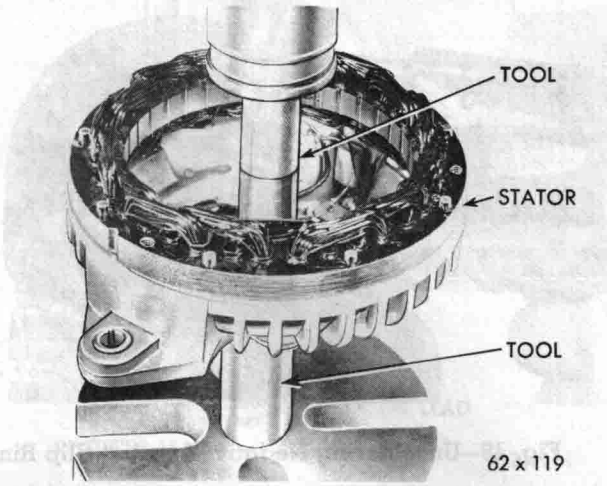


Fig. 46—Removing Rectifier End Shield Bearing

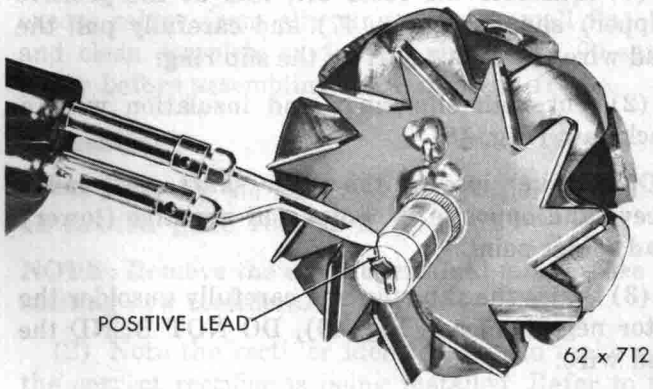


Fig. 47—Unsoldering Positive Lead at Slip Ring

NOTE: The new bearing is prelubricated and no additional lubricant should be added, as an excessive amount of lubricant will contaminate the slip rings and cause premature brush and rotor failures.

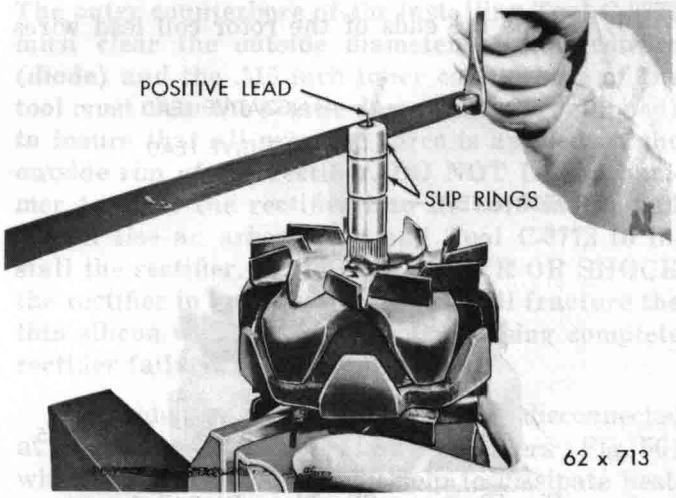


Fig. 48—Cutting Slip Rings for Removal

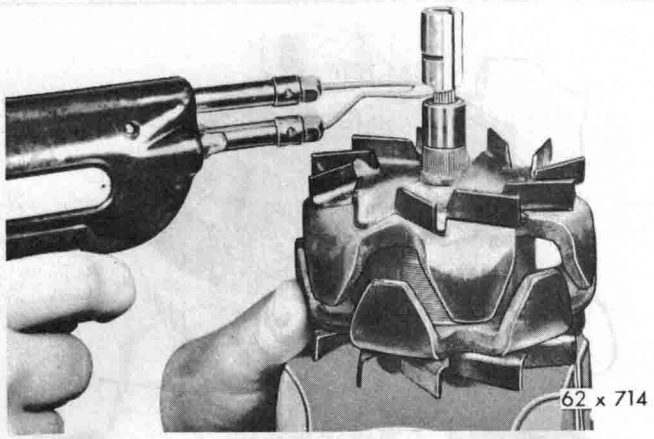


Fig. 49—Unsoldering Negative Lead at Slip Ring

REPLACING SLIP RINGS

(1) Unsolder the rotor coil lead at the positive (upper) slip ring (Fig. 47) and carefully pull the lead wire up and away from the slip ring.

(2) Cut both slip rings and insulation with a hack saw (Fig. 48).

NOTE: Cut close to the rotor shaft steel inner sleeve and opposite the rotor coil negative (lower) lead solder point.

(3) Raise the slip ring and carefully unsolder the rotor negative lead (Fig. 49). DO NOT BEND the lead wire.

CAUTION

If the lead wires are broken the complete rotor must be replaced.

(4) Remove the old slip rings and clean away dirt and particles of the old slip ring from the rotor (Fig. 50).

(5) Scrape the ends of the rotor coil lead wires clean for good electrical contact.

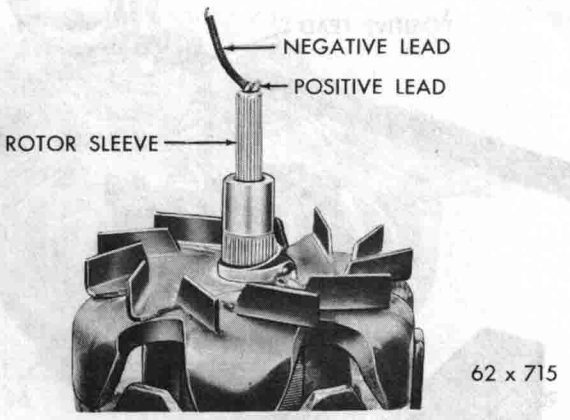


Fig. 50—Rotor—Slip Rings Removed

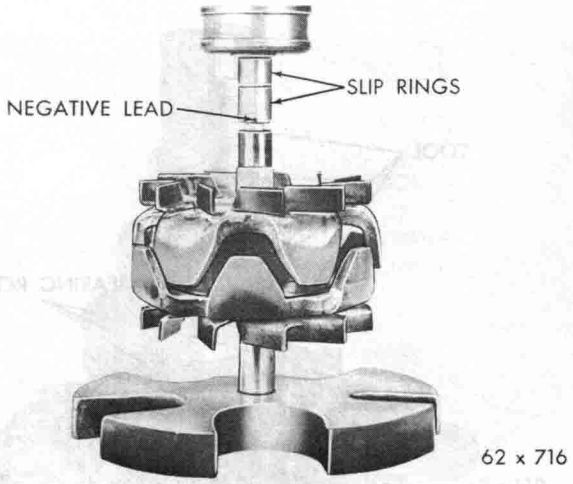


Fig. 51—Pressing Slip Rings on Rotor Sleeve

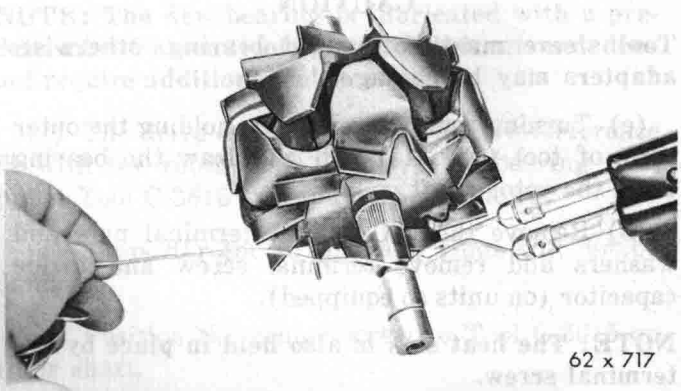


Fig. 52—Soldering Negative Lead to Slip Ring

(6) Carefully press the new slip ring assembly on the rotor sleeve to within ⅛ inch of the rotor shaft (Fig. 51).

(7) Resolder rotor coil negative lead into the slot of the negative slip ring (Fig. 52).

Fig. 53—Soldering Positive Lead to Slip Ring

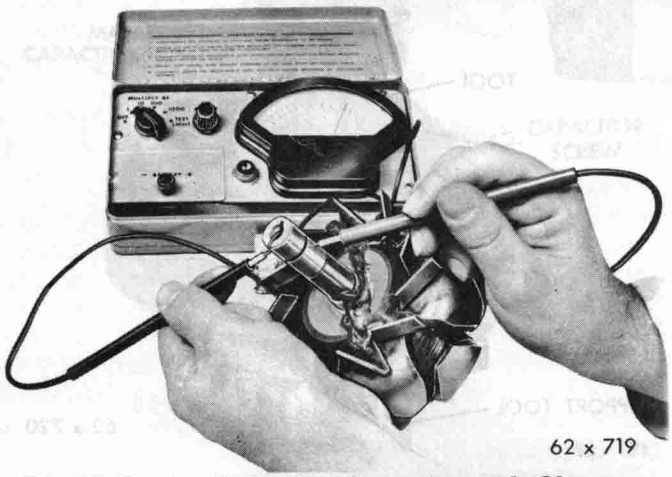


Fig. 54—Testing Soldering Operation with Ohmeter

(8) Press the slip ring assembly down carefully until the slip ring insulation bottoms against the rotor shaft.

(9) Resolder the rotor coil positive lead in the groove of the positive slip ring (Fig. 53). Use resin core solder.

(10) Test soldering operation with ohmmeter, to check resistance one prod to negative slip ring, other prod to positive slip ring (Fig. 54). Reading should be 3.8 to 4.2 ohms. If resistance exceeds 4.2 ohms the leads are not securely soldered

(11) Test each slip ring for ground with a 110 volt test lamp by touching one test lead prod to the rotor pole shoe and remaining prod to each ring. Test lamp should not light. If lamp lights, slip rings are shorted to ground, possibly due to grounding insulated field lead when installing the slip rings.

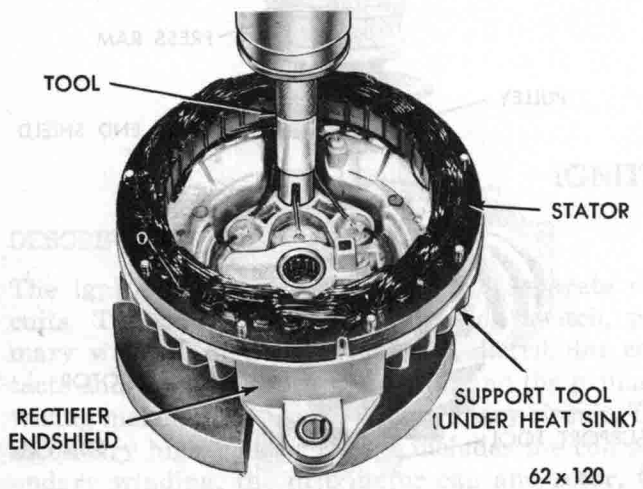


Fig. 55—Installing A Rectifier

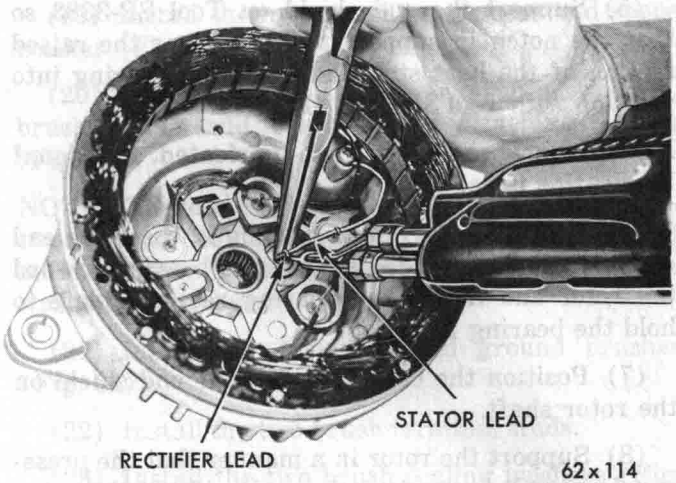


Fig. 56—Soldering Rectifier and Stator Leads

(12) If rotor is not grounded, carefully clean excess solder from slip ring with a small fine file and clean complete surface of rings with 00 sandpaper before assembling rotor into end frame.

Assembly

(1) Support the heat sink or rectifier end shield on circular plate Tool SP-3377.

NOTE: Remove the output terminal nuts before installing new rectifiers.

(2) Note the rectifier identification to make sure the correct rectifier is being installed. Refer to the MoPar Parts List at the Chrysler Engine Centers for rectifier identification.

(3) Start the new rectifier into the casting squarely and press the rectifier into the casting with Tool C-3772 (Fig. 55).

CAUTION

The outer counterbore of the installing Tool C-3772 must clear the outside diameter of the rectifier (diode) and the .515 inch inner counterbore of the tool must clear the plastic dome (units so equipped) to insure that all pressing force is applied on the outside rim of the rectifier. DO NOT USE a hammer to start the rectifier into its bore in the end shield. Use an arbor press and Tool C-3772 to install the rectifier. DO NOT HAMMER OR SHOCK the rectifier in any manner as this will fracture the thin silicon wafer in the rectifier causing complete rectifier failure.

(4) Solder the wire lead to the wires disconnected at removal. Hold the wire lead with pliers (Fig. 56) while soldering it. This will help to dissipate heat, protecting the rectifier.

(5) Support the end shield on Tool SP-3383 so that the notch in support tool will clear the raised section of the heat sink and press the bearing into position with Tool SP-3381 (Fig 57).

NOTE: New bearings are pre-lubricated, additional lubrication is not required.

(6) Insert the drive end bearing in the drive end shield with the shielded side of the bearing toward the rotor and install the bearing retainer plate to hold the bearing in place.

(7) Position the bearing and drive end shield on the rotor shaft.

(8) Support the rotor in a manner that the pressing force will be against the underside of the rotor (Fig. 58). (A heavy commercial type pipe 2 inches outside diameter, 1½ inches inside diameter and three inches long, notched out to clear the rotor lead wires.) Press the bearing and shield into position on the rotor shaft with an arbor press and Tool C-3769 (Fig. 48).

(9) Snap the bearing retainer in the notches provided in the end shield.

CAUTION

Make sure that the bearing is installed squarely at installation: otherwise, damage to the bearing will result. Press the bearing on the rotor shaft until the bearing contacts the shoulder on the rotor shaft.

(10) Install the pulley on the rotor shaft. The shaft of the rotor must be supported in a manner so that all pressing force is on the pulley hub and underside of rotor not on end of rotor shaft. (Marine engines only.) DO NOT support rotor on slip ring

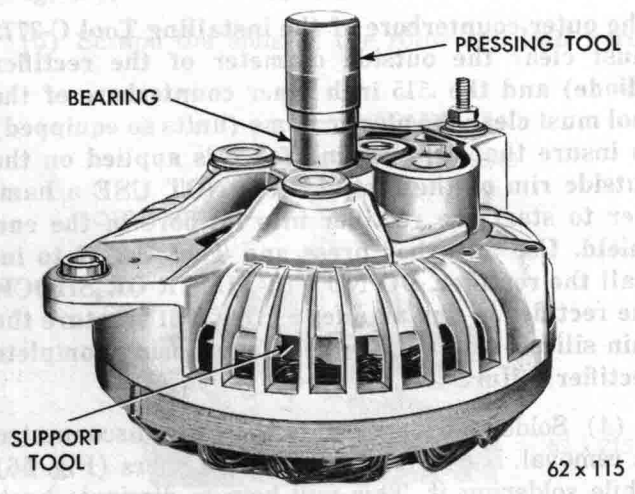


Fig. 57—Installing Rectifier End Shield Bearing

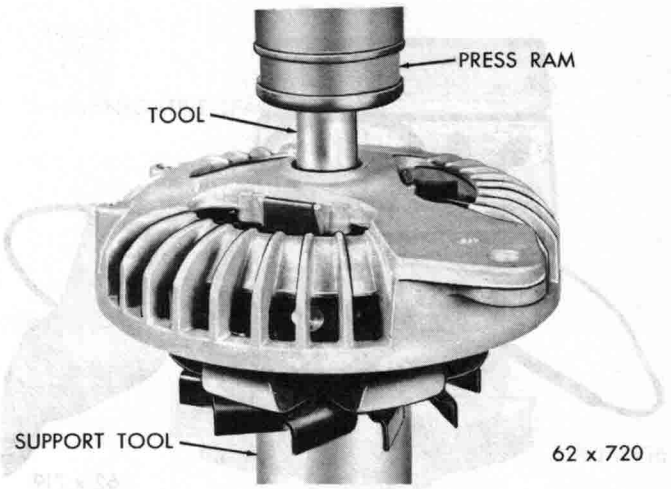


Fig. 58—Installing Drive End Shield and Bearing

end of shaft as this would damage the slip rings and inner sleeve.

NOTE: Make sure support tool is positioned so that notches in support tool clear the rotor lead wires (Fig. 59). Do not exceed 6800 pounds pressure. Press the pulley on the rotor shaft until the pulley contacts the inner race of the drive end bearings.

(11) Where the alternators have the capacitor mounted internally; make sure the heat sink insulator is in place.

(12) Install the output terminal screw with capacitor attached through the heat sink and end shield (Fig. 60).

(13) Install the insulating washers, lockwashers and lock nuts.

(14) Make sure the heat sink and insulator are in position and tighten the lock nut.

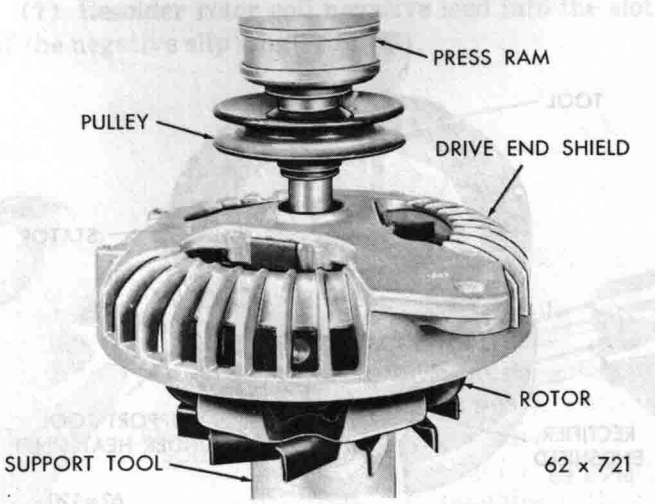


Fig. 59—Installing Alternator Pulley

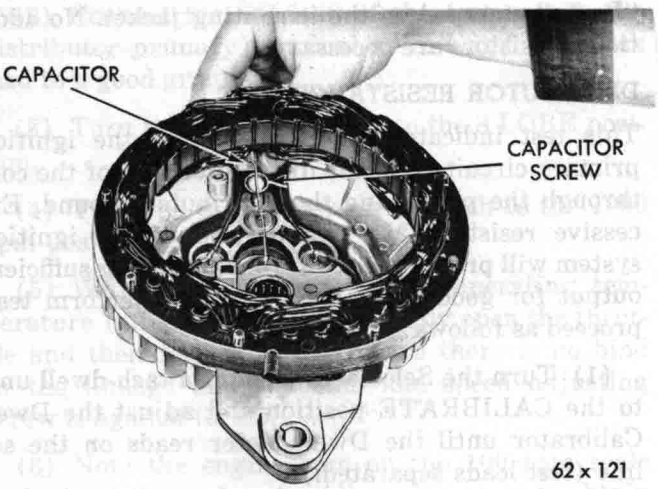


Fig. 60–Installing Inside Capacitor

(15) Position the stator on the rectifier end shield.

(16) Position the rotor end shield assembly on the stator and rectifier end shield. Align the through bolt holes in the stator, rectifier end shield and drive end shield.

(17) Compress the stator and both end shields by hand and install the through bolts, washers and nuts.

(18) Rotate the pulley slowly by hand to be sure that the rotor fans do not hit the rectifiers, capacitor lead, and stator connectors.

(19) Install the nylon sealing washers and space washer (Fig 33).

(20) Install the brush holder spacer washers, brush holder and brush holder attaching screws (Fig. 32).

NOTE: There must be between .000 to .015 gap between brush holder legs and end shield (Fig. 32) before tightening brush holder screws. Use spacer washers as necessary.

(21) Install the insulated and ground brushes (Fig. 31).

(22) Install the two brush terminal studs.

(23) Install the two brush sealing washers (Fig. 30).

(24) Install the brush cover (Fig. 29).

(25) Install the brush ground strap, terminal washers and terminal nuts.

(26) Install the alternator and adjust the drive belts.

(27) Connect the output "BAT" and field "FLD" leads and connect the ground wire.

(28) Connect the battery ground cable.

(29) Start and operate the engine, and observe the alternator operation.

(30) Test the current output and regulator voltage setting, if necessary.

IGNITION SYSTEM

DESCRIPTION

The ignition system consists of two separate circuits. The battery, ammeter, ignition switch, primary winding of the ignition coil, distributor contacts and condenser, engine ground and the primary wiring make up the low voltage primary circuit. The secondary high voltage circuit includes the coil secondary winding, the distributor cap and rotor, the spark plug cables, the spark plugs and to a ground.

OPERATION

In operation, a primary current flows from the battery, through the ammeter, ignition switch and to the coil primary winding, then to ground through the distributor contacts. When the contacts open, the magnetic field produced by the current in the coil primary winding collapses. This collapsing field induces a very high voltage in the secondary windings, which is carried by the high tension wire to the

center terminal of the distributor cap. The rotor connects this center terminal to one of the cap terminals which in turn is connected to the proper spark plug. The spark produced by this high tension current ignites the fuel in that cylinder. This process is repeated for every power stroke of the engine. This requires moving parts to operate at high speeds and electrical parts to perform their function with maximum efficiency.

TESTING WITH SECONDARY CIRCUIT

The coil to distributor cap cable and the spark plug cables should make good, clean contact at the ignition coil, the distributor cap towers and on the spark plugs. Cable terminals that are loose or are not inserted all the way into the towers or on the plugs will corrode the terminals as well as cause carbon tracking of the coil or cap towers.

The ignition coil tower, if oily or dirty, should be wiped clean and inspected for cracks, carbon tracking or oil leaks. Replace the coil if faulty.

To prevent hard starting in wet weather, thoroughly wash the cap in a **weak** solution of liquid soap or detergent in warm water, at not more than 500 hour intervals. Do not use a concentrated solution or soak the cap in the solution. Scrub the inner surfaces with a stiff bristle nylon brush to clean between the ribs and the crevices. Rinse well in hot water, shake out excess of water and dry thoroughly. Do not use compressed air to dry or blow out the water. Carefully inspect for cracks or carbon tracking on the inner or outer surfaces. Replace the cap if faulty.

The insulation of the coil cables and spark plug cables can deteriorate with usage. Leakage to ground and between the wires will occur, resulting in hard starting and inefficient engine operation. Old, cracked, or damaged wires should be replaced. The secondary cables, cap and rotor should be tested, using Tool C-3296. This tester provides high voltage which is sufficient for testing secondary insulation.

On engines equipped with the resistance type wire, check for an open circuit, loose terminals or high resistance. Replace the cable if resistance is more than 50,000 ohms. Replace the cable if the terminal has pulled off.

NOTE: To remove the wire always grasp the boot at the end of the wire and rotate the boot slightly to break the adhesion between it and the spark plug insulator.

Resistance type wire is identified by the word "Radio" stamped on the insulating jacket. No additional resistors are necessary.

DISTRIBUTOR RESISTANCE TEST

This test indicates the resistance of the ignition primary circuit from the distributor side of the coil, through the points and the distributor ground. Excessive resistance in this portion of the ignition system will prevent the coil from producing sufficient output for good over-all ignition. To perform test, proceed as follows:

(1) Turn the Selector Switch of a tach-dwell unit to the CALIBRATE position and adjust the Dwell Calibrator until the Dwell Meter reads on the set line (test leads separated.)

(2) Leave Selector Switch in the CALIBRATE position, connect the tach-dwell red lead to the distributor terminal of coil and the black lead to a good ground.

(3) Turn ingition switch "ON". Observe dwell meter reading. Meter pointer should be well within the black zero or outside of black bar, crank engine with starter until the meter pointer moves as far to right as possible. (This will indicate that breaker points are closed.) A reading now within the black indicates a normal distributor primary circuit.

If reading is outside the black bar, high resistance is present in the distributor primary circuit.

(4) Remove test lead from the distributor terminal of coil and connect to the following points:

(a) Distributor primary terminal (outside)

(b) Distributor primary terminal (inside)

(c) Breaker point terminal bracket (insulated bracket)

(d) Ground side of contact points.

(e) Distributor housing.

(5) Repeat test at each connection until a noticeable change occurs in the meter reading. If a poor connection or faulty lead is indicated, clean, tighten or replace as necessary and repeat test (3).

If faulty contact points are indicated, remove the distributor for complete inspection, service, testing and calibration.

IDLE RPM TEST

Test procedures are as follows:

(1) Turn the Selector Switch to the CALIBRATE position and adjust Dwell Calibrator until the Dwell Meter reads on the set line (test leads separated).

(2) Connect the red lead of the test unit to the distributor primary terminal at coil and the black lead to a good ground.

(3) Turn the Selector Switch to the 8 LOBE position.

(4) Turn the tachometer rpm switch to the 1000 rpm position.

(5) With the engine at normal operating temperature (off fast idle), momentarily open the throttle and then release to make sure there is no bind in the linkage and that the idle speed adjusting screw is against its stop.

(6) Note the engine rpm on the 100 rpm scale and adjust the carburetor idle speed screw to obtain 550 engine rpm.

DISTRIBUTOR POINT DWELL

The degrees of distributor dwell are the degrees of rotation through which the breaker points remain closed. This is also commonly referred to as "dwell angle" or "cam angle".

Correct distributor point dwell is essential for good ignition performance and contact point life.

Test procedures are as follows:

(1) Connect the Tach-Dwell test unit red lead to the distributor terminal of the coil and the black lead to a good ground.

(2) Turn the Selector Switch to the 8 LOBE position.

(3) Start the engine and operate at 550 rpm.

(4) Observe the dwell meter reading. If the dwell reading is within "Specifications", the point gap, cam rubbing block and breaker arm are all in satisfactory condition.

If the dwell reading is not within specifications, the point gap is incorrect. This can be due to incorrect initial setting, excessive point material erosion, a worn rubbing block, or worn bushings.

DWELL VARIATION

This test indicates the mechanical condition of the distributor. Excessive wear in distributor mechanical parts cause dwell variations which will affect ignition timing.

Test procedures are as follows:

(1) With the engine at idle speed, and with the test leads connected as in Paragraph "Distributor Point Dwell Test", turn the test Tachometer rpm switch to the 5000 rpm position.

(2) Slowly increase the engine speed to 1500 rpm, then slowly reduce to idle speed while observing the dwell meter reading.

If the dwell reading varies more than 2 degrees from the initial reading between idle speed and 1500 rpm, probable wear in the distributor shaft, bushings or breaker plate is indicated. Remove the distributor for complete inspection and testing on a reliable distributor tester.

IMPORTANT

Dwell and gap of the points must both be within their specified tolerance at the same time. If this cannot be accomplished, it is probable that wrong points are installed, or the distributor shaft may be bent.

IGNITION TIMING

To obtain maximum engine performance, the distributor must be correctly positioned on the engine to give proper ignition timing.

The ignition timing test will indicate the timing of the spark at No. 1 cylinder at idle (only).

Test procedures are as follows:

(1) Connect the secondary lead of the Power Timing Light to the number 1 spark plug, red primary lead to positive terminal of the battery and the black primary lead to the negative battery terminal.

NOTE: Do not puncture the wires, boots or nipples with test probes. Always use adapters. Puncturing spark plug wires with a probe will damage the wires. The probe can separate the conductor of linen cord impregnated with carbon (on units so equipped) and cause high resistance. In addition breaking the rubber insulation may permit secondary current to arc to ground.

(2) Start the engine and set idle to 475-500 rpm, engine at normal operating temperature.

(3) Use a timing light to observe position of timing mark on crankshaft damper or timing gear cover and check against specifications.

(4) Loosen the distributor hold-down clamp screw and rotate the distributor housing so that crankshaft damper mark aligns with the specified BTC mark on timing plate. Refer to "Specifications". (Moving distributor housing counter-clockwise advances the ignition timing and clockwise retards the timing.)

(5) Tighten the distributor hold-down clamp screw after timing has been set and recheck timing adjustment with a Power Timing Light.

DISTRIBUTOR REMOVAL

(1) Disconnect the primary lead wire at coil.

(2) Unfasten the distributor cap retaining clips and lift off the distributor cap.

(3) Scribe a mark on the edge of the distributor housing to indicate the position of rotor as reference when reinstalling the distributor.

(4) Remove the distributor hold-down clamp screw and clamp and carefully lift the distributor from the engine.

SHAFT AND BUSHING WEAR TEST

(1) Remove the distributor rotor.

(2) Disconnect the primary lead wire at the distributor terminal.

(3) Clamp the distributor housing lightly in a vise equipped with soft jaws and attach the dial indicator to the body of the distributor with the indicator plunger arm resting against the movable breaker arm at the rubbing block and with the rubbing block of the breaker arm on the highest point of the cam lobe (Fig. 61).

(4) Place one end of a wire loop around the top of the distributor shaft. Hook a spring scale in the other end of the wire loop and pull on a line with the plunger of the indicator gauge. Be sure the wire loop on shaft end is down on the shaft to insure a straight pull and also that the wire loop does not interfere with the indicator or holding bracket. Apply a five pound pull and read the movement of the plunger on the indicator dial. (Be sure the rubbing block of breaker arm is on the highest point of the cam lobe during this test). If the plunger movement reaches or exceeds .006 inch, replace the bushing and/or distributor shaft, see Paragraph "Disassembly of the Distributor".

DISASSEMBLY OF THE DISTRIBUTOR (Fig. 62)

(1) Remove distributor rotor.

(2) Remove the primary lead wire and rubber grommet as an assembly. Push the grommet towards the inside of distributor to remove. Do not pull on the wire.

(3) Remove the two screws and lockwashers attaching the breaker plate to the housing and lift out the breaker plate, points and condenser as an assembly.

(4) Remove the oil wick from the distributor cam (Fig. 63).

(5) Remove the spring clip from the oil well in cam and remove the cam and yoke assembly and spacer.

(6) If the side play reaches or exceeds .006 inch in Paragraph "Shaft and Bushing Wear Test", replace bushings and/or distributor shaft as follows:

(a) Remove the distributor drive collar retaining pin and slide the collar off the end of the shaft.

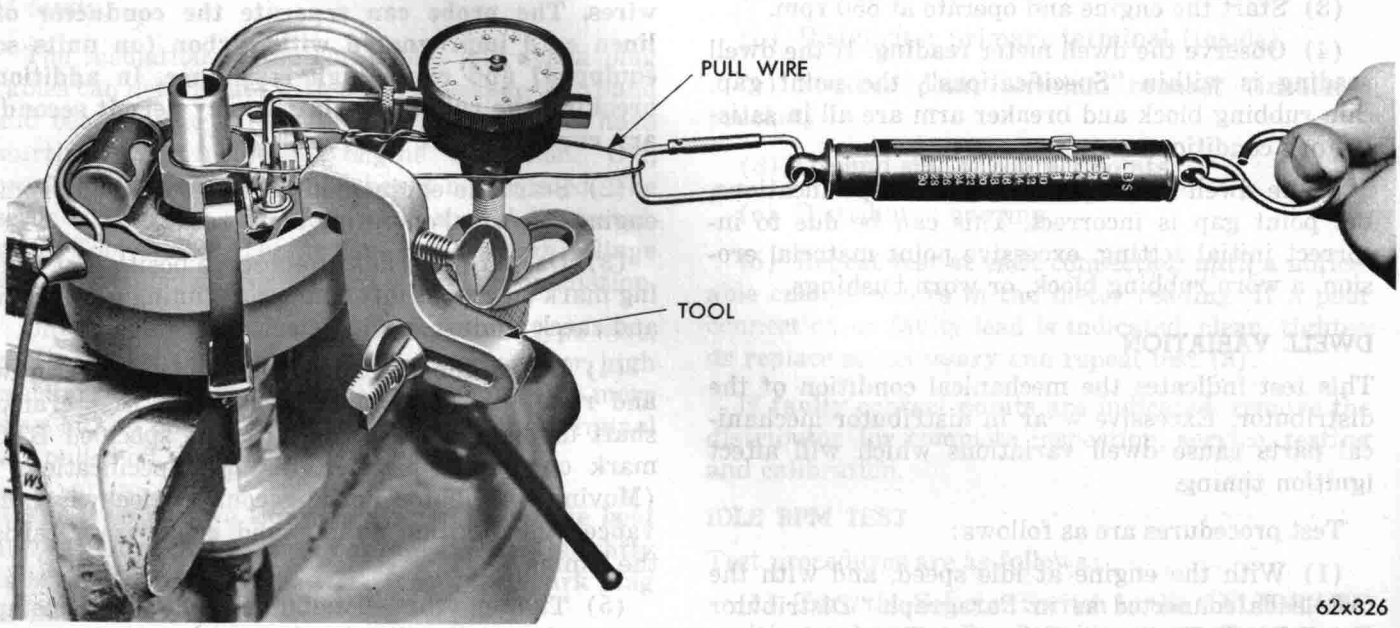


Fig. 61–Shaft and Bushing Wear Test

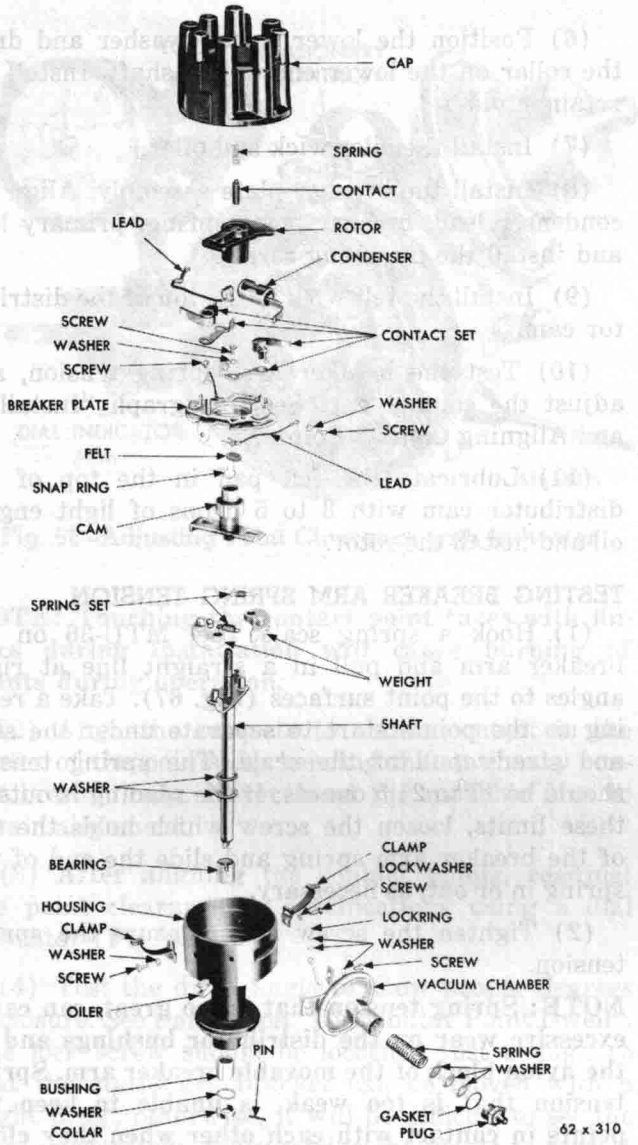


Fig. 62—Distributor—(Disassembled View—AutoLite)

(b) Use a fine file to clean the burrs from around the pin hole in the shaft and remove the lower thrust washer.

(c) Push the shaft up and remove it through the top of the distributor body. Remove the upper thrust washers.

(d) Remove the shaft oiler and lift out the oiler wick.

(e) Place the housing in an arbor press and press out the upper and lower bushings from the bottom of the housing using Driver Tool C-3041.

(f) Soak the new bushings in light engine oil for approximately 15 minutes.

(g) Position the new upper bushing with the hole in the bushing **up** and in line with oil hole in housing, then press the bushing into the distributor housing with Tool C-3041 and the tool adapter (Fig. 64). The bushing will measure .094 inch below the top of housing bore. Invert the housing and install the other bushing (Fig. 65) flush with the face of the distributor base.

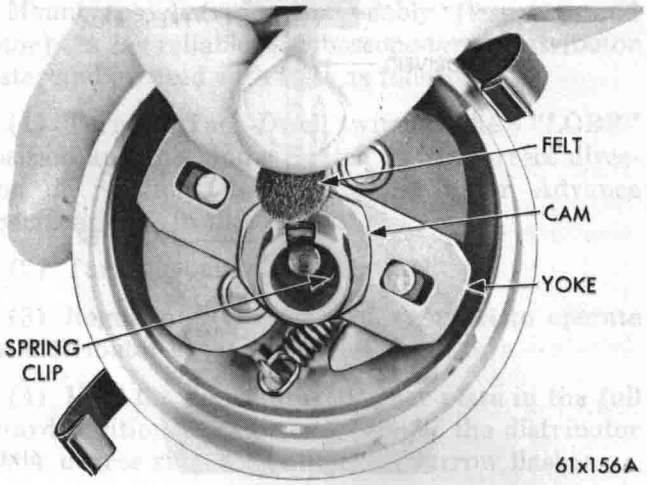


Fig. 63—Removing or Installing Cam Felt Wick

(h) Insert a $\frac{3}{32}$ inch rod through the housing oiler hole to see if the hole in the bushing indexes with the oiler hole in the housing. If the rod cannot be inserted through the housing and the bushing, drill a $\frac{1}{8}$" hole through the upper bushing by drilling through the oil wick hole. Remove burrs caused by the drilling operation and blow the chips out of the oil hole.

(i) Install the burnishing tool part of C-3041 tool set and force the burnisher through both the bushings (Fig. 66). The correct bushing inside diameter is .4995 to .5000 inch.

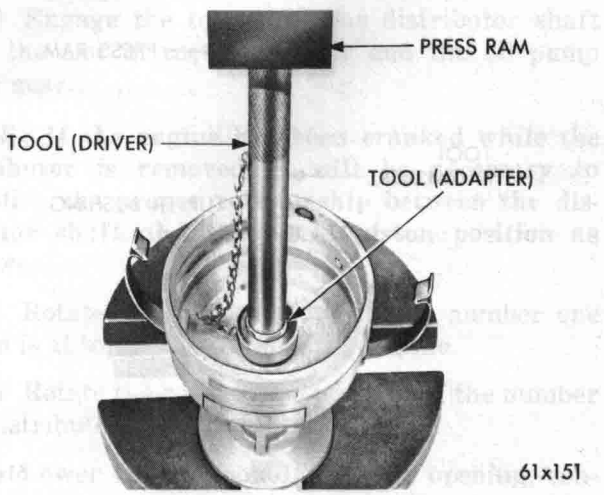


Fig. 64—Installing Distributor Housing Upper Bushing

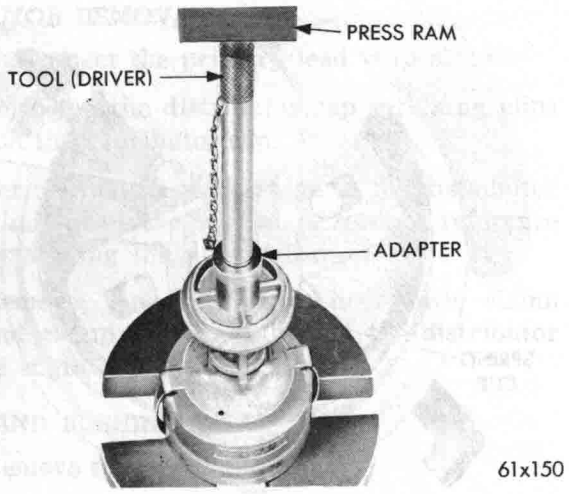


Fig. 65—Installing Distributor Housing Lower Bushing

ASSEMBLING THE DISTRIBUTOR

(1) Check operation of centrifugal weight and inspect the weight springs for distortion. Lubricate the governor weights.

(2) Inspect all bearing surfaces and pivot pins for roughness, binding or excessive looseness.

(3) Install the cam spacer, chamfered end down on the distributor shaft.

(4) Slide the cam and yoke on the distributor shaft, engage the weight lugs with the slots in the yoke. Install the cam retaining spring clip. Be sure it is properly seated in the groove of the distributor shaft.

(5) Lubricate and install the upper thrust washers. Position the washers on the distributor shaft and slide the shaft into the distributor body.

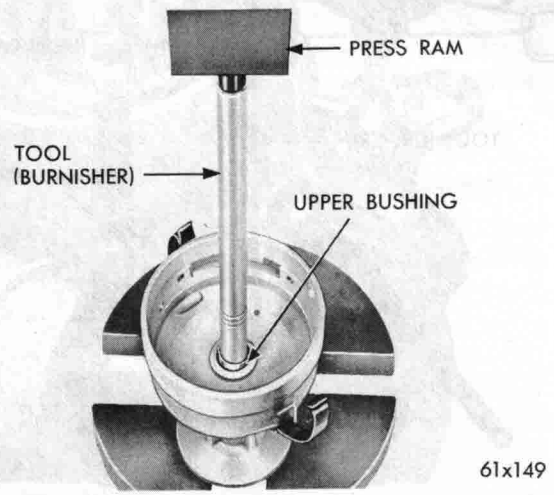


Fig. 66—Burnishing Distributor Housing Bushings

(6) Position the lower thrust washer and drive the collar on the lower end of the shaft. Install the retainer pin.

(7) Install the oiler wick and oiler.

(8) Install the breaker plate assembly. Align the condenser lead, breaker point spring, primary lead and install the attaching screws.

(9) Install the felt wick in the top of the distributor cam.

(10) Test the breaker arm spring tension, and adjust the contact gap. See Paragraph "Installing and Aligning Contact Points".

(11) Lubricate the felt pad in the top of the distributor cam with 3 to 5 drops of light engine oil and install the rotor.

TESTING BREAKER ARM SPRING TENSION

(1) Hook a spring scale Tool MTU-36 on the breaker arm and pull in a straight line at right angles to the point surfaces (Fig. 67). Take a reading as the points start to separate under the slow and steady pull of the scale. The spring tension should be 17 to 21.5 ounces. If the reading is outside these limits, loosen the screw which holds the end of the breaker arm spring and slide the end of the spring in or out, as necessary.

(2) Tighten the screw and measure the spring tension.

NOTE: Spring tension that is too great, can cause excessive wear on the distributor bushings and on the nylon block of the movable breaker arm. Spring tension that is too weak, is unable to keep the points in contact with each other when they close. This is particularly true as engine speed is increased, causing high-speed misfiring.

INSTALLING AND ALIGNING CONTACT POINTS

(1) Remove the old contact points and install a new set.

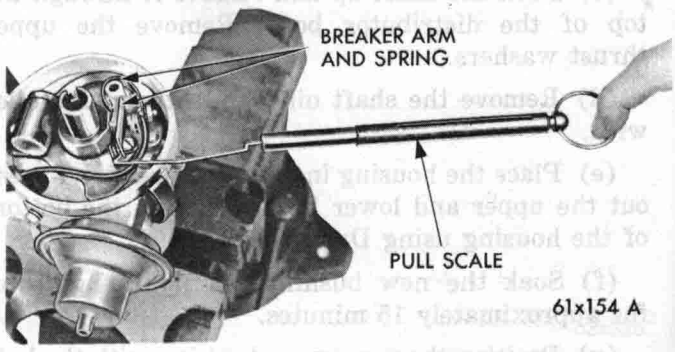


Fig. 67—Testing Breaker Arm Spring Tension

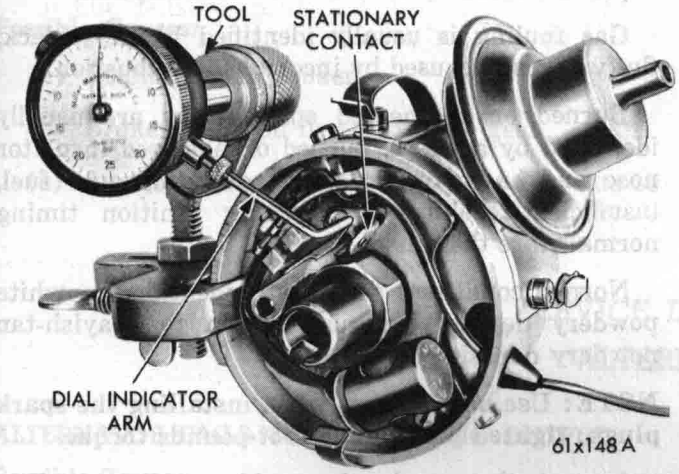


Fig. 68—Adjusting Point Clearance with Indicator

NOTE: Touching the contact point faces with fingers during installation will cause burning of points during operation.

(2) Align the contacts to obtain contact in the center of the points, by bending the stationary contact bracket only. **Never bend** the movable arm to obtain alignment.

(3) After aligning the contact points, readjust the point clearance to specifications using a dial indicator (Fig. 68).

(4) Test the dwell angle to show proper degrees of closure. See Paragraph "Distributor Point Dwell". The lock screw should be loosened just enough so that the stationary bracket can be moved with a slight drag; otherwise, it will be difficult to set the points accurately. After setting the points to correct the gap, tighten the lock screw.

DISTRIBUTOR LUBRICATION

(1) Add 3 to 5 drops of SAE 10W oil to the oiler on the outside of the distributor base.

(2) Lubricate the felt pad under the rotor in the top of the distributor cam with 3 to 5 drops of SAE 10W oil.

(3) Wipe old grease from surface of the breaker cam. Apply a light but positive film of new distributor cam lubricant number 1473595. **Do not overlubricate, keep oil and grease away from the breaker points.**

TESTING DISTRIBUTOR ADVANCE

Centrifugal Advance Curve

Note the model number of the distributor and refer to the specifications before making this test.

Mount the distributor assembly (less cap and rotor) in a reliable stroboscope-type distributor tester and proceed with tests as follows:

(1) Turn the Tach-Dwell switch to the 8 "LOBE" position and the Motor Switch to the correct direction of rotation. Refer to "Distributor Advance Specifications" in this Manual.

(2) Turn the battery switch "ON".

(3) Regulate the tester speed control to operate the distributor at 200 distributor rpm.

(4) Hold the distributor breaker plate in the full retard position and align the "0" of the distributor tester degree ring with any of the arrow flashes.

(5) Adjust the tester speed control to operate the distributor at speeds called for under "Specifications" and observe arrow flashes opposite tester degree ring to determine degrees of advance.

(6) If the advance is not according to specifications, corrections can be made by bending the spring tabs on the cam yoke to increase or decrease the spring tension. The governor spring tabs can be reached through the access hole at the breaker plate. Rotate the shaft until the proper spring and tab line up with the access holes. Insert a screwdriver blade through the access hole and bend the spring tab toward the distributor cam to decrease spring tension and advance the spark, or away from the distributor cam to increase the spring tension and retard the spark.

INSTALLATION OF DISTRIBUTOR

(1) Position the distributor on the engine. Align the rotor with the scribe marks previously scribed on the distributor housing.

(2) Engage the tongue of the distributor shaft with the slot in the distributor and the oil pump drive gear.

NOTE: If the engine has been cranked while the distributor is removed, it will be necessary to establish the proper relationship between the distributor shaft and the No. 1 piston position as follows:

(3) Rotate the crankshaft until the number one piston is at top of the compression stroke.

(4) Rotate the rotor to the position of the number one distributor cap terminal.

(5) Lower the distributor into the opening, connect the primary lead and install the distributor cap. Make sure all high tension wires "snap" firmly in

the cap towers. Install the distributor hold-down clamp screw. Tighten the screw finger tight.

(6) Attach the primary lead to the coil.

(7) Connect the secondary lead of a Power Timing Light to the No. 1 spark plug (using proper adapter). Connect the red primary lead to the positive terminal of the battery and the black primary lead to the negative battery terminal.

(8) Start and operate the engine at 475-500 rpm. Rotate the distributor housing so that the specified timing mark and the pointer are in alignment. (Moving the distributor housing against the shaft rotation advances the timing and with the shaft rotation retards the timing.)

(9) Tighten the distributor clamp screw after the timing has been set and recheck the timing adjustment with a Power Timing Light.

(10) If the timing is correct, remove the timing light from the engine.

SPARK PLUGS

Cleaning and Inspection

Remove the spark plugs. Examine the firing ends of the plugs for evidence of oil fouling, gas fouling, burned or overheating conditions. Clean, resharpen electrode edges by filing and reset the gaps to .035 inch.

Oil fouling is usually identified by wet, sludgy deposits caused by excessive oil consumption.

Gas fouling is usually identified by dry, black, fluffy deposits caused by incomplete combustion.

Burned or overheated spark plugs are usually identified by a white, burned or blistered insulator nose and badly burned electrodes. Improper fuel, insufficient cooling or improper ignition timing normally are the cause.

Normal conditions are usually identified by white powdery deposits or rusty-brown to grayish-tan powdery deposits.

NOTE: Use new gaskets when installing the spark plugs; tighten plugs to 30 foot-pounds torque.

Inspect the spark plug cables, coil secondary (high tension) cable, nipples and covers for hardening, cracks and wear. Always use the neoprene insulating nipples whenever it becomes necessary to replace high tension cables or nipples. Inspect for loose terminals.

IGNITION COIL

Inspect the coil for external leaks and arcing. Always make two tests when testing the coil. One when the coil is cold, the other after the coil has been warmed up.

Test the coil according to the coil tester Manufacturer's instructions. Test the coil primary resistance. Test the coil secondary resistance. Replace any coil that does not meet specifications.

SERVICE DIAGNOSIS
STARTING MOTOR

STARTER FAILS TO OPERATE

Possible Causes:

(a) Weak battery or dead cell in battery.

(b) Faulty ignition switch.

(c) Loose or corroded battery cable terminals.

(d) Open circuit, (wire between ignition-starter switch and ignition terminal on solenoid.

(e) Faulty starter drive unit.

(f) Faulty solenoid switch.

(g) Faulty starter motor.

(h) Armature shaft sheared.

STARTER FAILS AND LIGHTS DIM

Possible Causes:

(a) Weak battery or dead cell in battery.

(b) Loose or corroded battery cable terminals.

(c) Internal ground in windings.

(d) Grounded starter fields.

(e) Armature rubbing on pole shoes.

STARTER TURNS, BUT PINION DOES NOT ENGAGE

Possible Causes:

(a) Bendix spring broken.

(b) Broken teeth on flywheel drive gear.

(c) Armature shaft rusted, dirty or dry, due to lack of lubrication.

STARTER PINION LOCKS

Possible Causes:

(a) Starter mounting bolts loose.

(b) Armature shaft bent.

SERVICE DIAGNOSIS
ALTERNATOR

ALTERNATOR FAILS TO CHARGE (NO OUTPUT)

Possible Causes:

(a) Blown fusible wire in voltage regulator.

(b) Alternator drive belt loose.

(c) Worn brushes and/or slip rings.

(d) Sticking brushes.

(e) Open field circuit.

(f) Open charging circuit.

(g) Open circuit in stator windings.

(h) Open rectifiers.

(i) Alternator cutout relay not operating (so equipped).

LOW, UNSTEADY CHARGING RATE

Possible Causes:

(a) Alternator drive belt loose.

(b) High resistance at battery terminals.

(c) High resistance in the charging circuit.

(d) Open stator winding.

LOW OUTPUT AND A LOW BATTERY

Possible Causes:

(a) High resistance in the charging circuit.

(b) Low regulator setting.

(c) Shorted rectifier. Open rectifier.

(d) Grounded stator windings.

EXCESSIVE CHARGING RATE TO A FULLY CHARGED BATTERY

Possible Causes:

(a) Regulator set too high.

(b) Regulator contacts stuck.

(c) Regulator voltage winding open.

(d) Regulator base improperly grounded.

(e) High resistance in field coil.

REGULATOR CONTACTS BURNED

Possible Cause:

(a) Incorrect fuse wire or grounded field connection on alternator or regulator.

REGULATOR CONTACT POINTS STUCK

Possible Cause:

(a) Poor ground connection between the alternator and the regulator.

NOISY ALTERNATOR

Possible Causes:

(a) Alternator mounting loose.

(b) Worn or frayed drive belt.

(c) Worn bearings.

(d) Interference between rotor fan and stator leads or rectifiers.

(e) Rotor or rotor fan damaged.

(f) Open or shorted rectifier.

(g) Open or shorted winding in the stator.

EXCESSIVE AMMETER FLUCTUATION

Possible Cause:

(a) High resistance in the field circuit to the alternator or an improperly set voltage regulator.

SERVICE DIAGNOSIS
IGNITION SYSTEM

BURNED OR PITTED DISTRIBUTOR POINTS

(a) Dirt or oil on points.

(b) Points misaligned or gap set too small.

(c) Poor ground circuit for points or condenser.

(d) Rubbing block worn resulting in improper point opening.

(e) Wrong condenser or faulty condenser.

(f) Alternator regulator setting too high.

(g) Bushing or distributor shaft worn resulting in improper point opening.

(h) Touching contacts with fingers during installation.

IGNITION COIL FAILURE

(a) Internal flashover.

(b) Coil case or tower cracked.

(c) Oil leak at tower.

(d) Coil tower carbon-tracked.

CONDENSER FAILURE

(a) Condenser intermittently open or shorted.

FOULED SPARK PLUGS

(a) Carburetor mixture over-rich.

(b) Excessive oil consumption.

(c) Improper plug heat range.

(d) Improper gap adjustment.

(e) Lack of an anti fouling additive (phosphorous) in gasoline.

BURNED SPARK PLUGS

(a) Plugs loose in cylinder head.

(b) Carburetor mixture too lean.

(c) Improper plug heat range.

(d) Improper ignition timing.

(d) Leaking head gasket or cracked cylinder head.

SECTION VIII

REVERSE GEAR AND REDUCTION GEAR

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

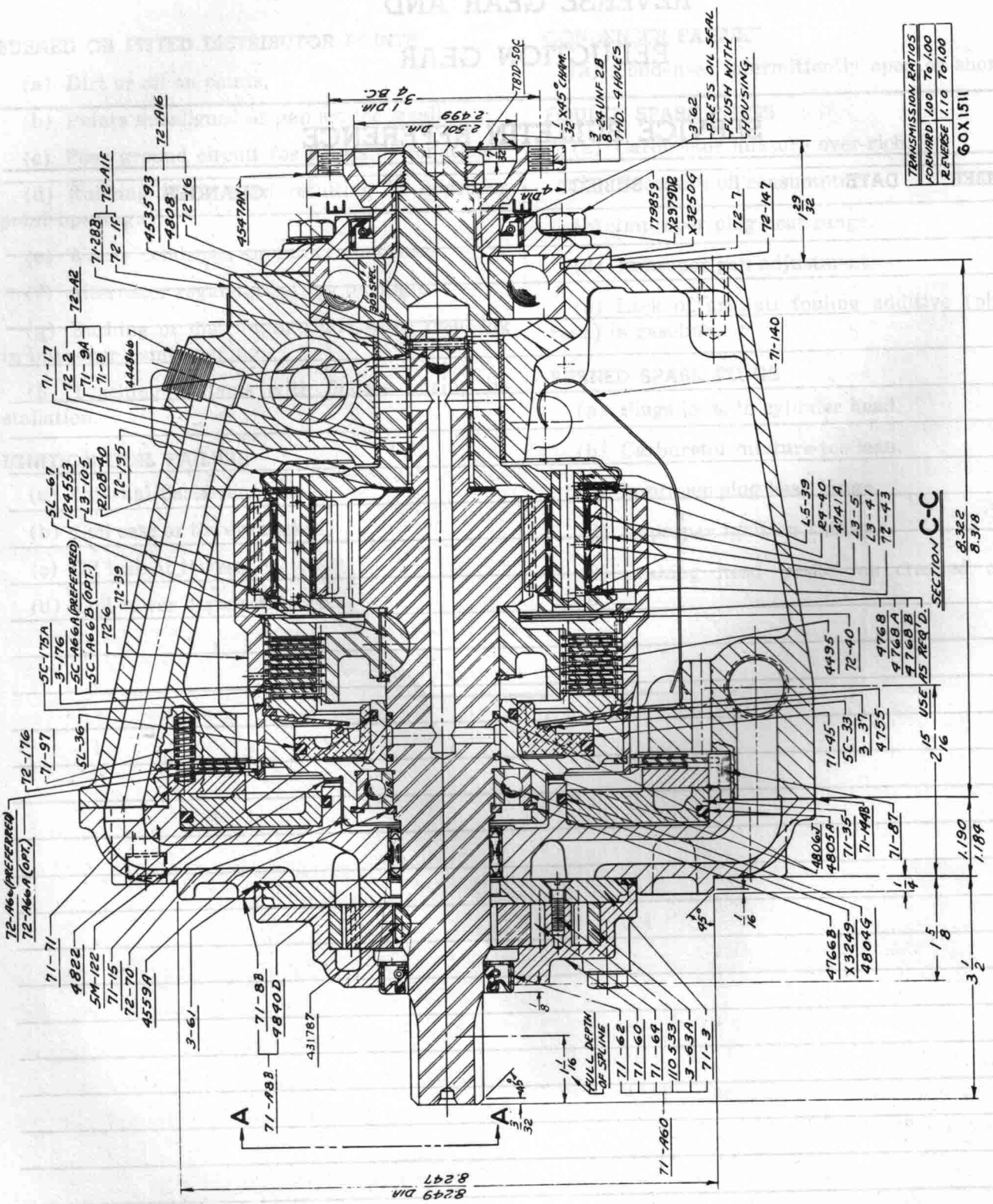


Fig. 1—Reverse Gear (Straight Drive) (Schematic Drawing) Model 72

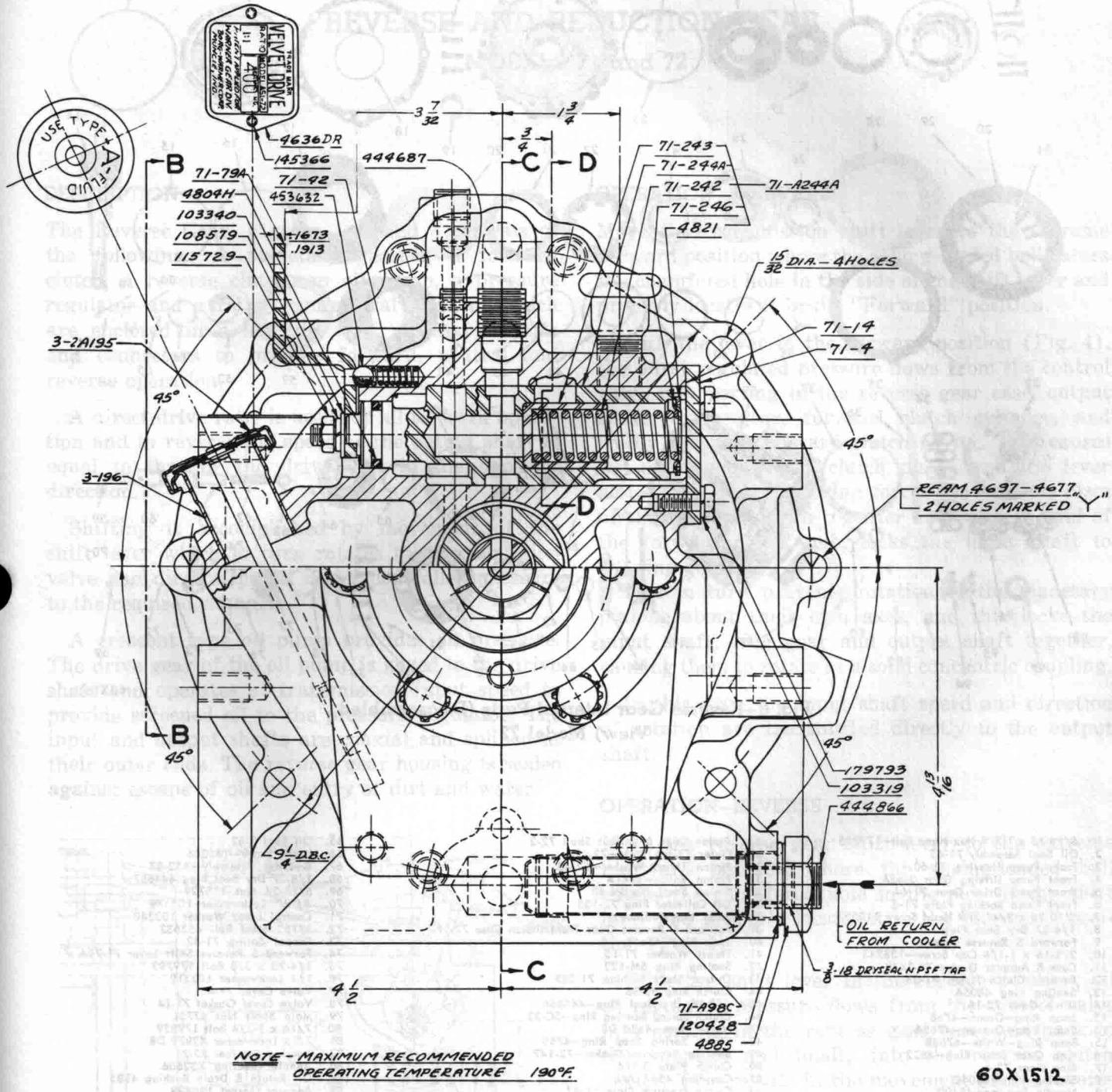


Fig. 2—Rear View and Cross Section of Reverse Gear (Schematic View) Model 72

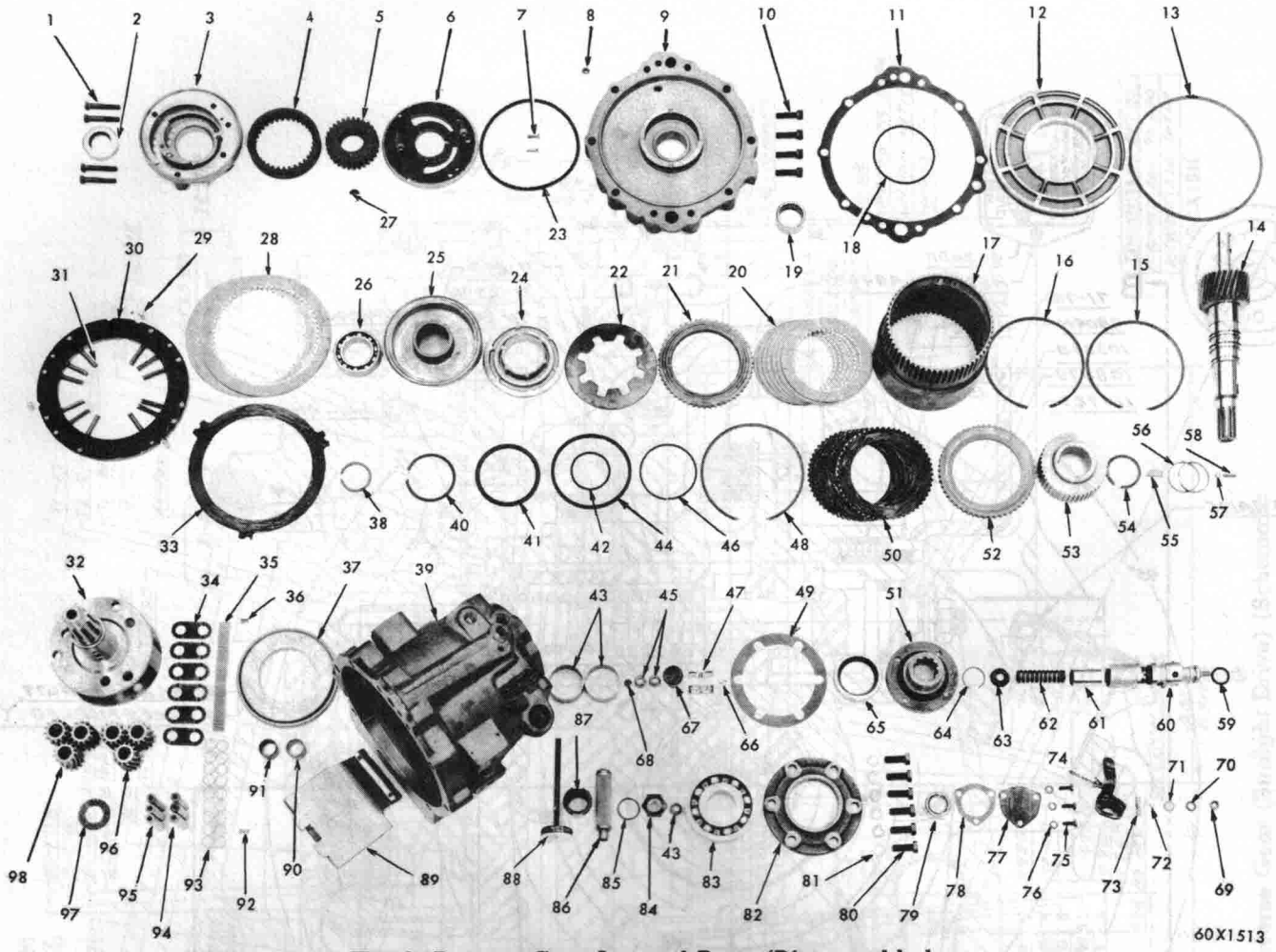


Fig. 3—Reverse Gear Internal Parts (Disassembled View) Model 72

1. 5/16-18 x 1-7/8 Hex Head Bolt—179825
2. Oil Seal Assembly 71-62
3. Front Pump Housing 71-60
4. Front Pump Driving Gear 3-63A
5. Front Pump Drive Gear 71-64
6. Front Pump Backing Plate 71-3
7. #10-24 x 3/4" Flat Head Screw 110533
8. 1/4-27 Dry Seal Plug
9. Forward & Reverse Adapter
10. 3/8-16 x 1-1/4 Cap Screw—138243
11. Case & Adapter Gasket 71-144B
12. Reverse Clutch Piston 71-35
13. Sealing Ring 4805A
14. Drive Gear 72-16
15. Snap Ring—Green—4768
15. Snap Ring—Orange—4768A
15. Snap Ring—White—4768B
16. Ring Gear Snap Ring—4822
17. Ring Gear 72-6
18. Sealing Ring—4804G
19. Needle Bearing—4840D
20. Clutch Inner Plate Assy—5C—A66A
21. Clutch Pressure Plate 5C—175A
22. Clutch Spring 3-37
23. Front Pump Gasket 3-61
24. Forward Clutch Piston 71-45
25. Forward Clutch Cylinder 72-70
26. Annular Bearing—X3249
27. Woodruff Key—431787
28. Reverse Clutch Plate Assy.—72-A66
29. Dowel Pin 71-87
30. Reverse Clutch Pressure Plate 71-71
31. Pressure Plate Spring 71-97
32. Pinion Cage & Output Shaft 72-2
33. Outer Clutch Plate—72-176
34. Pinion Thrust Washer—72-43
35. Pinion Roller—4741A
36. Pinion Shaft Pin R4-40
37. Oil Collector Ring 72-135
38. Snap Ring—4559A
39. Forward & Reverse Gear Transmission Case 72-1F
40. Snap Ring—4766B
41. Thrust Washer 71-15
42. Sealing Ring 5M-122
43. Output Shaft Bushing 71-28B
44. Clutch Ring 5L-36
45. 3/8-18 Dry Seal Plug—444866
46. Clutch Spring Bearing Ring—5C-33
47. Name Plate—4636 DR
48. Clutch Spring Snap Ring—4755
49. Bearing Retainer Gasket—72-147
50. Clutch Plate 3-176
51. Coupling 4547 AN
52. Clutch Pressure Plate 5L-67
53. Forward Clutch Hub 72-40
54. Snap Ring 4495
55. Woodruff Key 124553
56. Sealing Ring 48065
57. 3/8" Steel Ball 453593
58. Roll Pin—4808
59. "O" Ring 4804H
60. Forward & Reverse Gear Transmission Valve 71-244A
61. Pressure Regulator Valve 71-243
62. Valve Spring 71-242
63. Valve Spring Retainer—71-246
64. Snap Ring—4821
65. Oil Seal 3-62
66. Drive Screw—145366
67. Breather Assembly—A52-87
68. 1/8-27 Dry Seal Plug 444687
69. 5/16-24 Nut 115729
70. 5/16" Lockwasher 108579
71. Control Lever Washer 103340
72. 5/16" Steel Ball 453632
73. Poppet Spring 71-42
74. Forward & Reverse Shift Lever 71-79A
75. 1/4-20 x 5/8 Bolt 179793
76. 1/4 Lockwasher 103319
77. Valve Cover 71-4
78. Valve Cover Gasket 71-14
79. Main Shaft Nut 4775L
80. 7/16 x 1-1/4 Bolt 179859
81. 7/16 Lockwasher X2979 DR
82. Bearing Retainer 72-7
83. Annular Bearing X32506
84. Oil Return & Drain Bushing 4885
85. Annular Gasket 120428
86. Oil Strainer Assembly 71-A98C
87. Oil Filler Tube 3-196
88. Oil Filler Cap & Dip Stick Assy. 3-2A195
89. Baffle 71-140
90. Main Drive Gear & Bushing 71-9A
91. Main Drive Gear Bushing 71-9
92. Pinion Shaft Pin R10 B-40
93. Pinion Bearing Spacer L3-41
94. Pinion Shaft L5-39
95. Pinion Shaft 72-39
96. Pinion L.H. L3-5
97. Clutch Hub Thrust Washer
98. Pinion R.H. L3-105

SECTION VIII

REVERSE AND REDUCTION GEAR

MODELS 71 and 72

DESCRIPTION

The Reverse Gear, Figures 1, 2 and 3 consists of the following: A planetary gearset, a forward clutch, a reverse clutch, an oil pump, a pressure regulator and a rotary control valve, all of which are enclosed in a housing with necessary shafts and connectors to provide forward, neutral and reverse operation.

A direct drive ratio is used for all forward operation and in reverse the speed of the output shaft is equal to that of the drive, but in the opposite direction.

Shifting is accomplished by movement of the shift lever which in turn rotates the transmission valve and directs the oil under controlled pressure to the required channels.

A crescent type oil pump provides oil pressure. The drive gear of the oil pump is keyed to the drive shaft and operates at transmission input speed to provide screened oil to the pressure regulator. The input and output shafts are coaxial and splined at their outer ends. The reverse gear housing is sealed against escape of oil and entry of dirt and water.

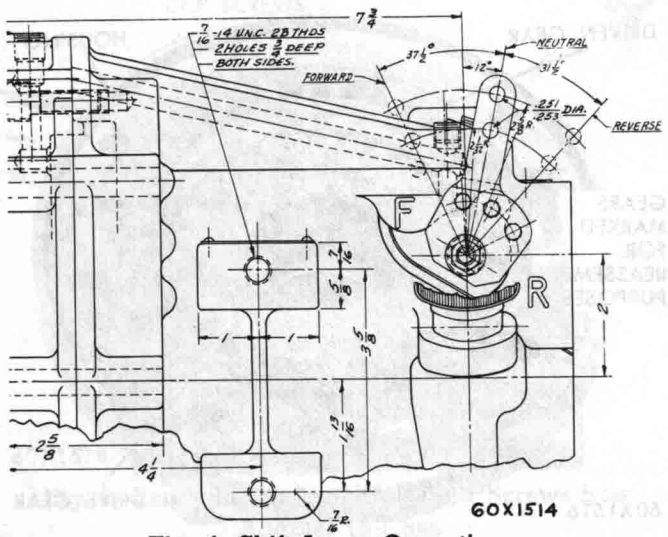


Fig. 4–Shift Lever Operations

OPERATION–FORWARD

Move the transmission shift lever to the extreme forward position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "Forward" position.

With the lever in the forward position (Fig. 4), the oil at regulated pressure flows from the control valve into porting in the reverse gear case, output shaft, drive gear, forward clutch cylinder, and finally into one forward clutch cavity. This causes the movement of the clutch piston and the lever action of the clutch spring forces the multiple discs of the forward clutch together and, with the aid of the forward clutch hub, locks the input shaft to the ring gear.

This in turn prevents rotation of the planetary pinions about their own axes, and this locks the input shaft, ring gear and output shaft together, causing them to rotate as a solid concentric coupling.

In this way, the input shaft speed and direction of rotation are transmitted directly to the output shaft.

OPERATION–REVERSE

Move the reverse gear shift lever to the extreme rearward position where the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "Reverse" position (Fig. 4).

With the shift lever in the reverse position, oil at regulated pressure flows from the control valve into porting in the reverse gear case, and back to the adapter, and finally into the reverse clutch cavity. This results in the movement of the reverse clutch piston and the reverse clutch pressure plate which locks the reverse clutch plate to the reverse gear case. The stationary reverse clutch plate, through splined connectors, prevents rotation of the ring gear.

With the ring gear held and the sun gear rotating

at input speed, the pinions of the compound planetary gearset are free to rotate about their own axes and reverse the directions of rotation of the pinion carrier and output shaft.

OPERATION–NEUTRAL

With the shift lever in the Neutral position, the spring-loaded ball enters the chamfered hole in the side of the shift lever and properly locates it in the "Neutral" position (Fig. 4).

OIL CHANGE

Under normal operating conditions, the oil should be changed every 100 hours.

OIL TYPE

When refilling the reverse gear, use Automatic Transmission Fluid Type "A" Suffix "A" having approximately 2 quart capacity.

SERVICE PROCEDURES

DISASSEMBLY AND INSPECTION OF REVERSE GEAR

With reverse gear removed from engine, remove the filler cap which is located below the shift lever on rear left side of reverse gear case. Turn cap counter-clockwise and lift.

Remove drain cap, as shown in Figure 5 and reach into the opening with a suitable tool to remove the strainer assembly. Allow oil to drain.

Stand the reverse gear assembly on the rear face of coupling.

Remove four front oil pump attaching bolts, and place a protective covering over splines to prevent damage to seal lip, and lift pump assembly squarely up and over the protruding input shaft.

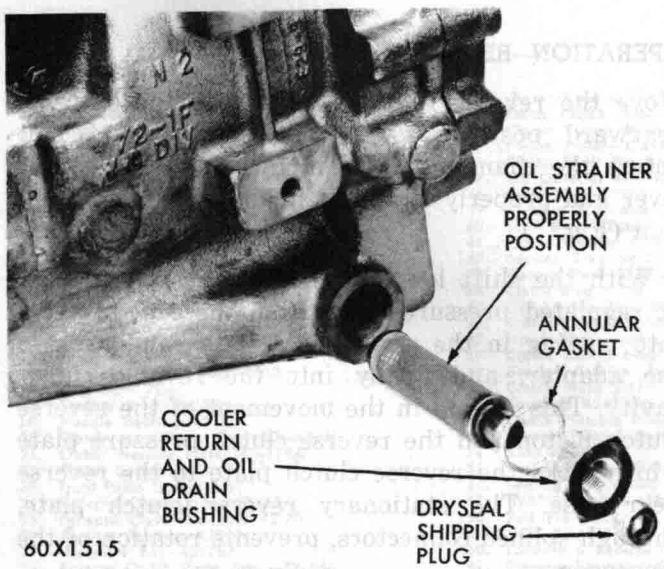


Fig. 5–Installation of Oil Strainer, Cooler, Return Bushing and Dry Seal Plug (Model 72 only)

Remove the front oil pump gasket and woodruff key.

Remove two flat head screws.

Lift backing plate and the oil pump gears (Fig. 6). Inspect the backing plate, drive gear, driven gear, oil pump housing and the oil seal for wear.

NOTE: Mark gears to identify them for proper mesh and for relocation of gear face during assembly.

Remove three bolts, lockwashers, valve cover and gasket.

Remove shift lever by removing the nut, lockwasher, control lever washer, shift lever, steel ball and poppet spring.

Tap on exposed threaded shaft with a rubber mallet upon which the shift lever was mounted and

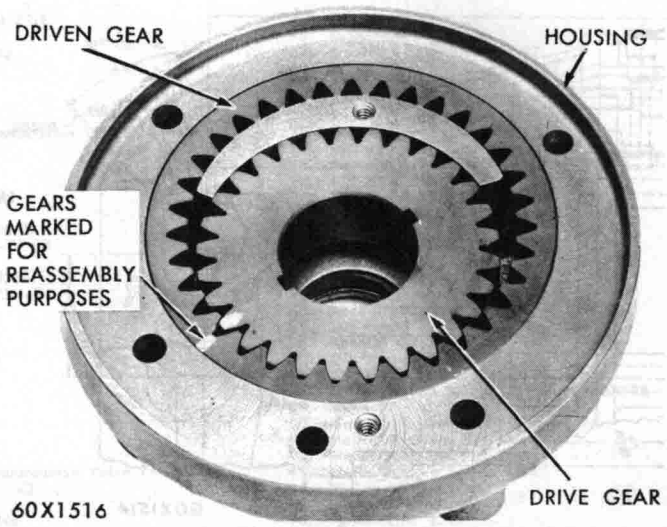


Fig. 6–Oil Pump Gears Correctly Installed

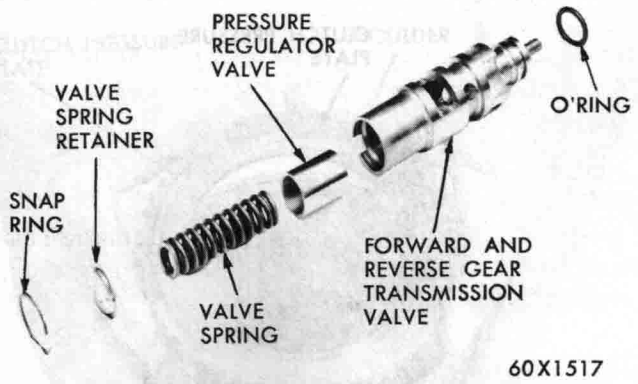


Fig. 7—Valve and Spring Assembly (Disassembled View)

pull valve and spring assembly out of gear case from right side.

Install valve and spring assembly in a suitable holder and using an arbor press, depress the valve spring retainer and valve spring until snap ring is free. Remove snap ring, valve spring retainer, valve spring, pressure regulator valve and "O" ring, as shown in Figure 7.

Remove four cap screws, as shown in Figure 8. Lift the adapter and reverse clutch piston. If necessary, tap the adapter with a soft hammer to remove.

CAUTION

The reverse clutch pressure plate may stick momentarily to the reverse clutch piston. To avoid damage, prevent pressure plate from dropping.

Hold piston, as shown in Figure 9, and force compressed air into reverse clutch cavity, and the piston will blow itself out.

Remove sealing rings, from the adapter and reverse clutch piston.

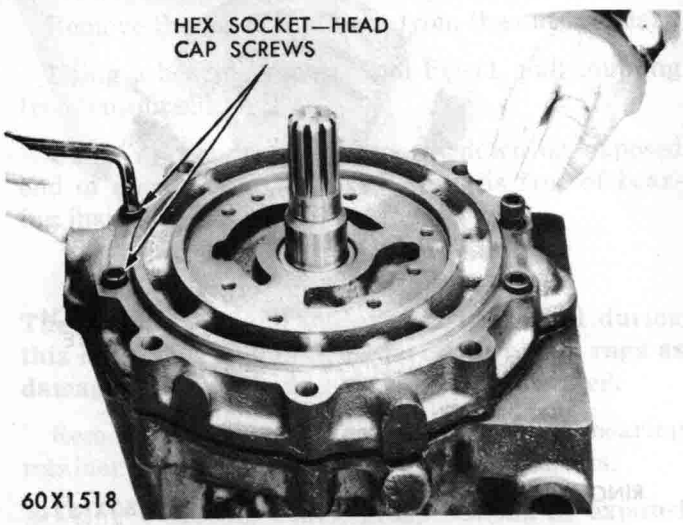


Fig. 8—Removing or Installing Four Screws from Adapter to Case

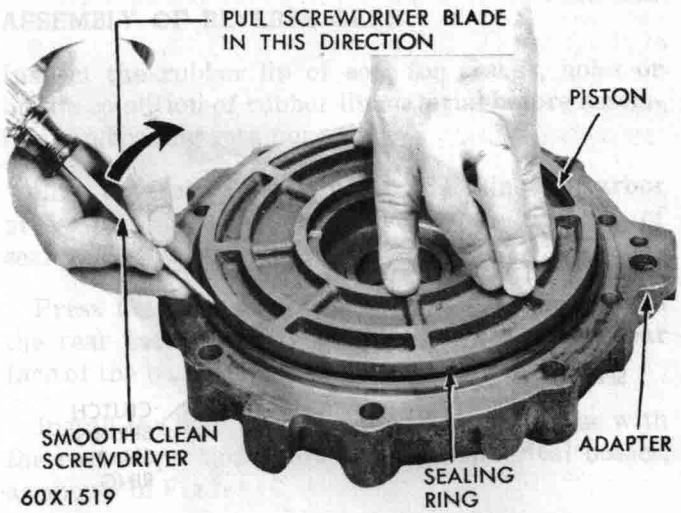


Fig. 9—Removing Reverse Clutch Piston from Adapter

Remove the thrust washer.

Remove clutch pressure plate (Fig. 10).

Remove the 12 pressure plate springs and the three dowel pins.

Lift the exposed end of the input gear straight up. The drive gear and clutch assembly will also come out.

Stand drive gear and clutch assembly in a suitable fixture and remove snap rings.

Remove the front end of the drive gear by tapping

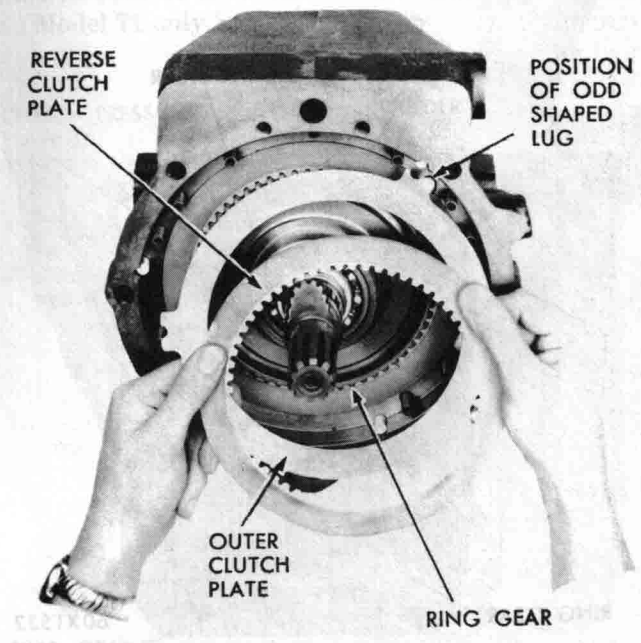


Fig. 10—Removing Reverse Clutch Pressure Plate

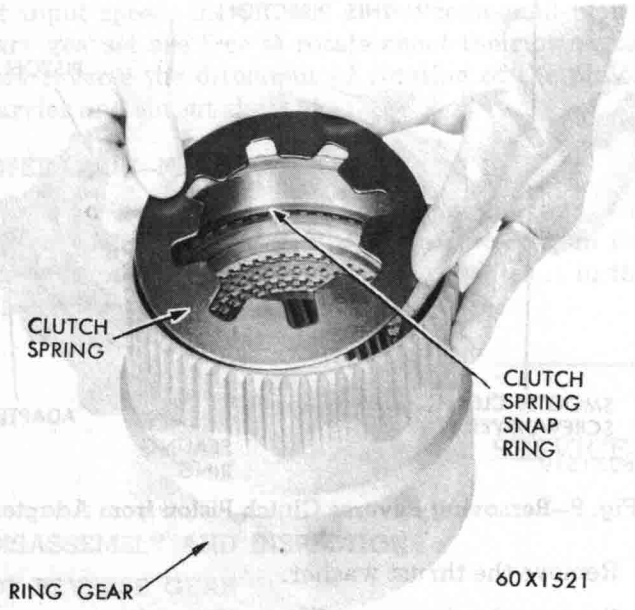


Fig. 11–Removing or Installing Clutch Spring

with a soft hammer. The drive gear and forward clutch hub will pass through the ring gear and forward clutch assembly and come out of the rear end of the ring gear.

Tap the bearing out with a soft blunt tool and remove the snap ring.

Hold the ring gear straight up and tap the exposed face of forward clutch hub inside of ring gear. The forward clutch hub will move forward and disassemble out of front of ring gear.

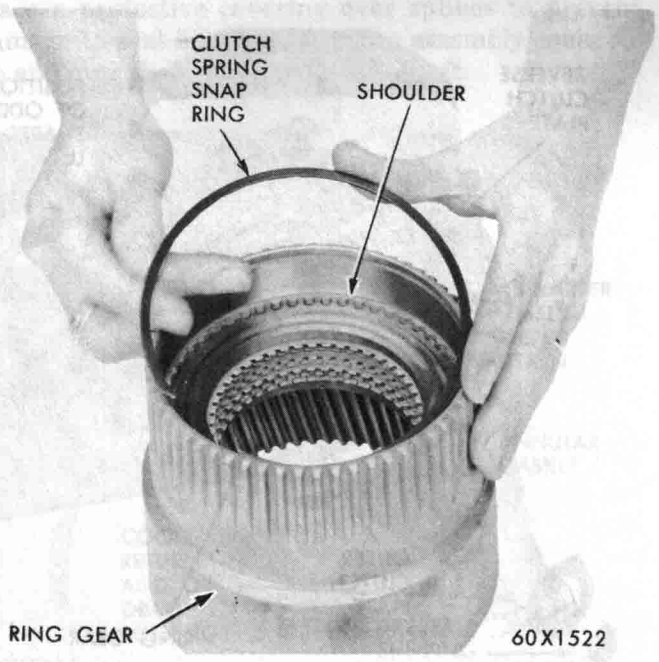


Fig. 12–Removing or Installing Clutch Spring Snap Ring

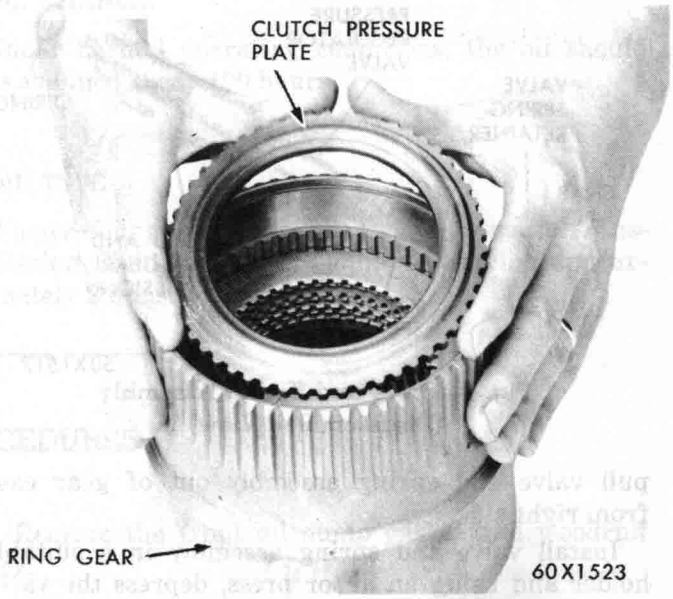


Fig. 13–Removing or Installing Clutch Pressure Plate

Remove the clutch spring, as shown in Figure 11.

Remove the clutch spring snap ring, as shown in Figure 12.

Remove the clutch pressure plate, as shown in Figure 13.

Remove seven clutch inner plates and six clutch plates, as shown in Figure 14.

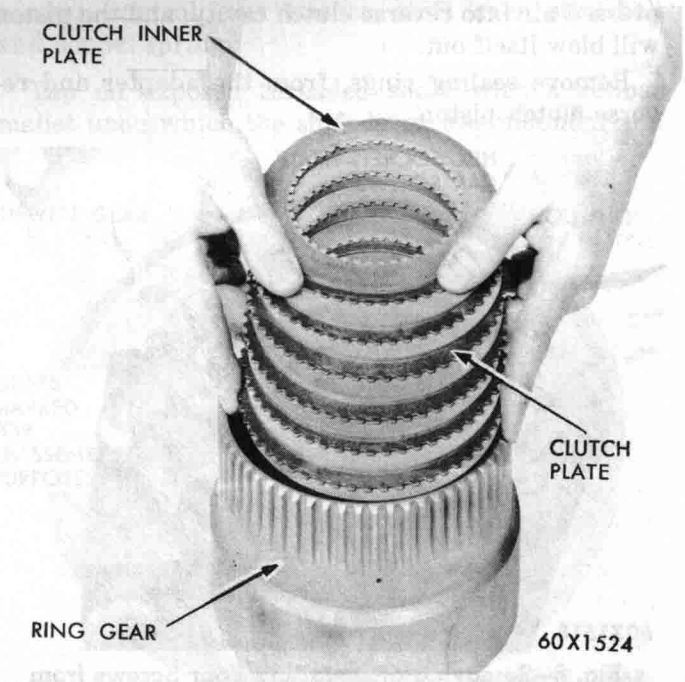


Fig. 14–Removing or Installing Forward Clutch Plates

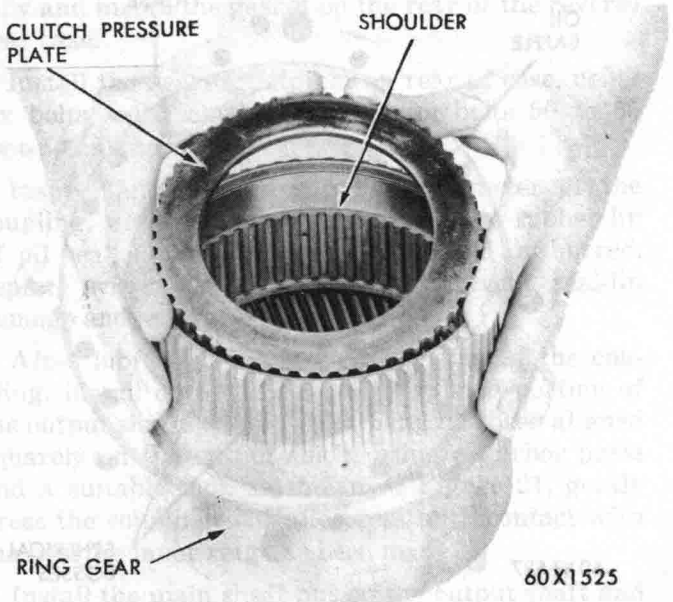


Fig. 15–Removing or Installing Clutch Pressure Plate

Remove the clutch pressure plate from the shoulder at the bottom of the internal splines. Note its position so that at reassembly, it can be installed correctly (Fig. 15).

Remove the forward clutch piston from the forward clutch cylinder by applying compressed air to clutch cavity through two holes in inside diameter of forward clutch cylinder.

Remove the sealing ring from the forward clutch cylinder.

Remove the clutch spring bearing ring from the forward clutch piston. Also remove the clutch ring.

Remove the main shaft nut from the output shaft.

Using a bearing puller, Tool PO-11, pull coupling from output shaft.

Using an arbor press, depress down on exposed end of output shaft until the shaft is free of bearing inside diameter.

CAUTION

The pinion cage and output shaft will fall during this operation. Protect the parts with shop rags as damage will result if parts are not protected.

Remove six bolts and lockwashers from bearing retainer and remove the retainer and gaskets.

Using a bearing puller, grasp bearing by exposed groove in outside diameter and carefully pull bearing from case.

ASSEMBLY OF REVERSE GEAR

Inspect the rubber lip of seal for cracks, holes or brittle condition of rubber lip material before assembling in bearing retainer.

Line up front face of bearing retainer on arbor press. Install oil seal squarely in place with lip of seal in the proper location.

Press the oil seal into the bearing retainer until the rear face of the oil seal is flush with the rear face of the bearing retainer.

Install the baffle inside the reverse gear case with the curved portion below the cast spherical bosses, as shown in Figure 16.

Position the front end of the baffle so that the center of the baffle rests on top of the boss at the front center of the case, and the turned down corners of the baffle are located below the cast spherical bosses at the front of the gear case (Fig. 16).

Insert the baffle through the large bore at the front of the reverse gear, with the "V" notch of the baffle toward the front, as shown in Figure 17. A slight circular compression of the baffle will be required to insert through the bore (Model 71 only.)

After inserting the baffle through the bore in the case, press down at the center of the baffle toward the bottom of the case, until the bosses provided on both sides of the case are hooked in the slots provided in both ends of the baffle, as shown in Figure 18 (Model 71 only.)

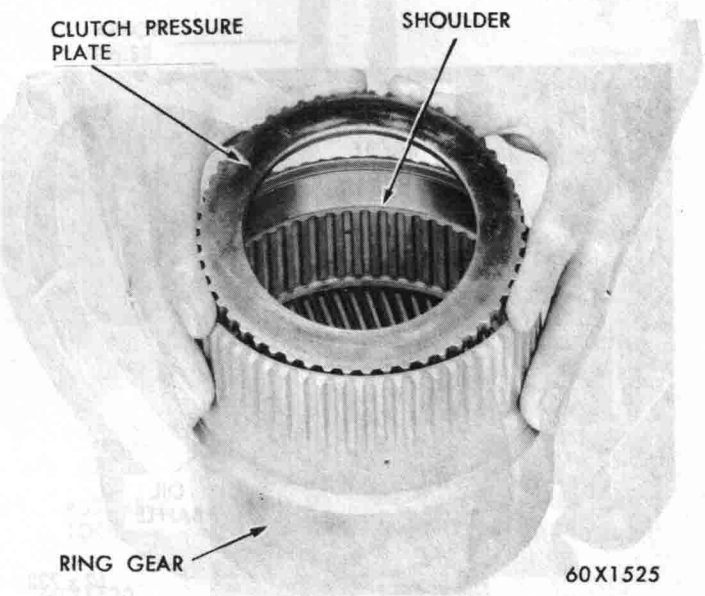


Fig. 16–Removing or Installing the Oil Baffle

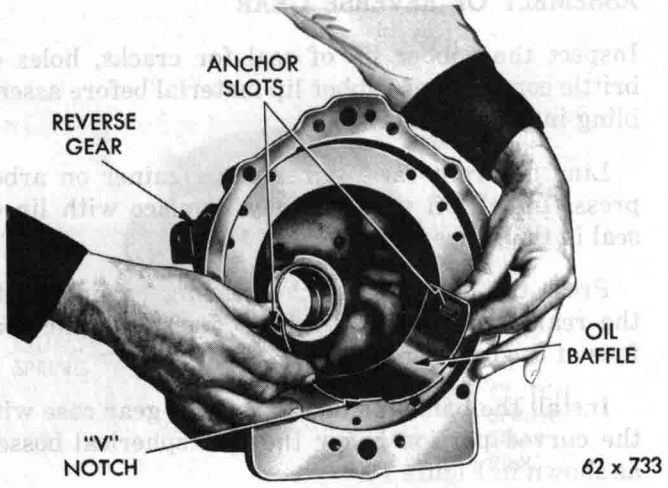


Fig. 17–Installing Model 71B Oil Baffle

Snap the baffle into position by lifting up on the curved portion, so that the two large holes are located firmly on the spherical bosses at the rear of the gear case, as shown in Figure 19.

Place the pinion cage and output shaft assembly on a 5 inch diameter by 2⅞ inch long assembly tool, which in turn is mounted on an arbor press.

Install the reverse gear case over the pinion cage and output shaft assembly so gear case rests squarely on arbor press table which is supporting assembly tool.

Inspect the bearing bore for possible dirt, burrs, scored or damaged balls and races, and for loose or cracked ball retainer. Replace the bearing if damage is detected.

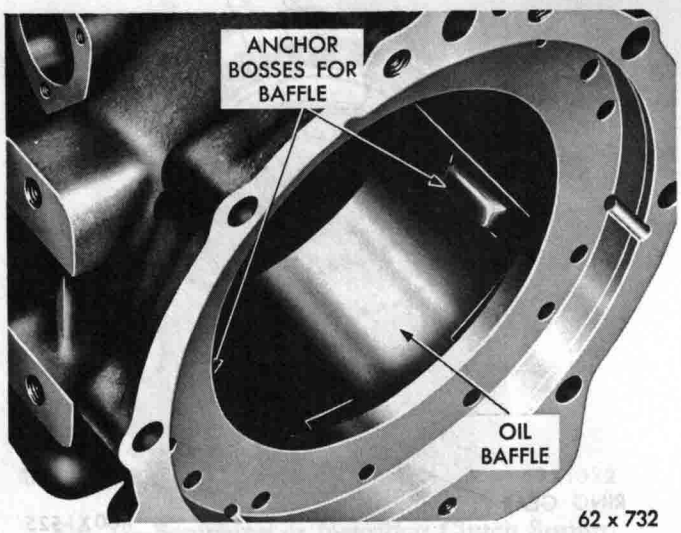


Fig. 18–Model 71B Oil Baffle Properly Installed

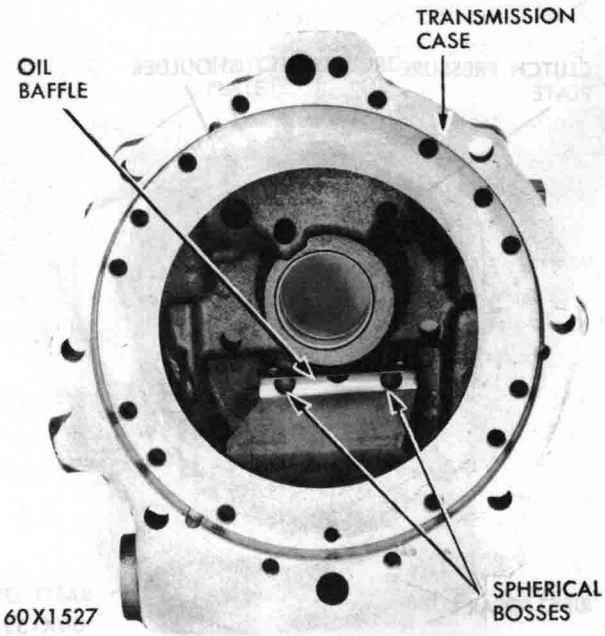


Fig. 19–Oil Baffle Snapped into Position

If dirt is present, wash bearing until clean and lubricate with Automatic Transmission Fluid, Type "A" Suffix "A" before assembly.

Install the bearing with the groove on the outside diameter located toward the rear of the reverse gear case. Install bearing over the projecting output shaft and squarely in the bearing bore.

Using an assembly tool, as shown in Figure 20, and an arbor press, depress bearing down until seated against shaft or case shoulder.

NOTE: The above tool should be designed to press evenly on the bearing outer and inner rings.

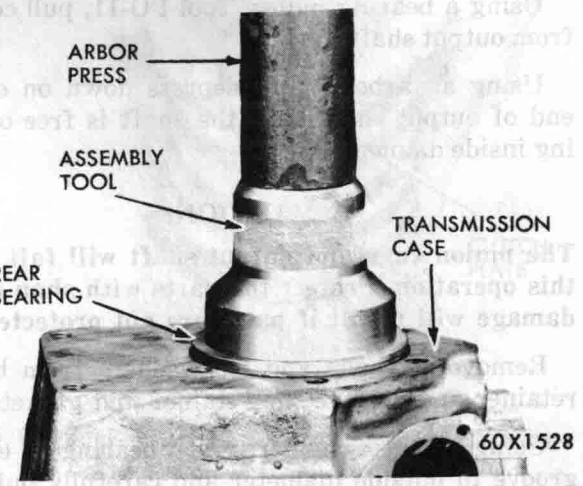


Fig. 20–Rear Bearing Pressed into Reverse Gear Case

Coat the bearing retainer gasket with petroleum jelly and install the gasket on the rear of the reverse gear case.

Install the bearing retainer on rear of case, using six bolts and lockwashers. Tighten bolts 50 to 55 foot-pounds torque.

Inspect and lubricate the hub diameter of the coupling, which runs in contact with the rubber lip of oil seal. If this surface is scratched or burred, replace with a new coupling to prevent seal-lip damage and eventual oil leakage.

After lubricating the splined portion of the coupling, install onto the externally splined portion of the output shaft. When the coupling has been aligned squarely on the output shaft, using an arbor press and a suitable tool, as shown in Figure 21, gently press the coupling with the press until contact with the bearing inner ring has been made.

Install the main shaft nut on the output shaft and tighten 90 to 140 foot-pounds torque.

NOTE: The inner ring of bearing will contact with the shoulder on the output shaft: therefore, eliminate any end play in the coupling and output shaft combination.

Place the ring gear on a clean work bench with the external teeth up, as shown in Figure 17.

Make sure that all dirt and/or solid particles are removed from the shoulder inside the gear formed by the top of the internal helical gear.

Install the clutch pressure plate in the ring gear, as shown in Figure 15.

NOTE: The pressure plate is firmly and squarely seated on the shoulder at the bottom of the internal splines to complete installation.

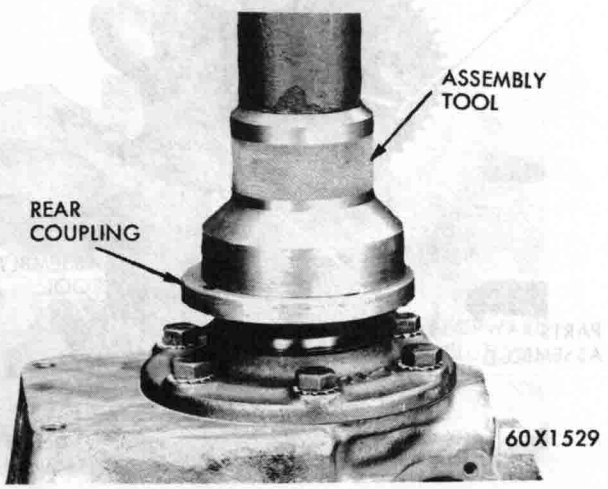


Fig. 21–Installing Rear Coupling Using an Arbor Press

Install a clutch inner plate and a clutch plate in that order until all have been installed. There are seven clutch inner plates and six clutch plates.

NOTE: All plates must be lubricated before assembly (Fig. 14).

Install the clutch pressure plate with the flat face down in contact with clutch plate, as shown in Figure 13.

Install the clutch spring snap ring on the internal shoulder provided by the top of the internal splines (Fig. 12). Be sure the snap ring is squarely and firmly seated on the shoulder.

CAUTION

It is important that the snap rings be properly identified according to "Free Diameter" and the thickness before assembly into the Reverse Gear. The "Clutch Spring Snap Ring" is .090" to .093" thick and has a "Free Diameter" of $5\frac{19}{32}$" + $\frac{1}{16}$". If the correct snap ring is not installed Reverse Gear will fail. (All models.)

Install the clutch spring with the concave side down in the ring gear (Fig. 11). Make sure the clutch spring is seated firmly and squarely on top of the clutch snap ring.

Inspect the inside diameter of the forward clutch piston having contact with the sealing ring. Remove all burrs or scratches and lubricate before assembly.

Install on the forward clutch piston the clutch

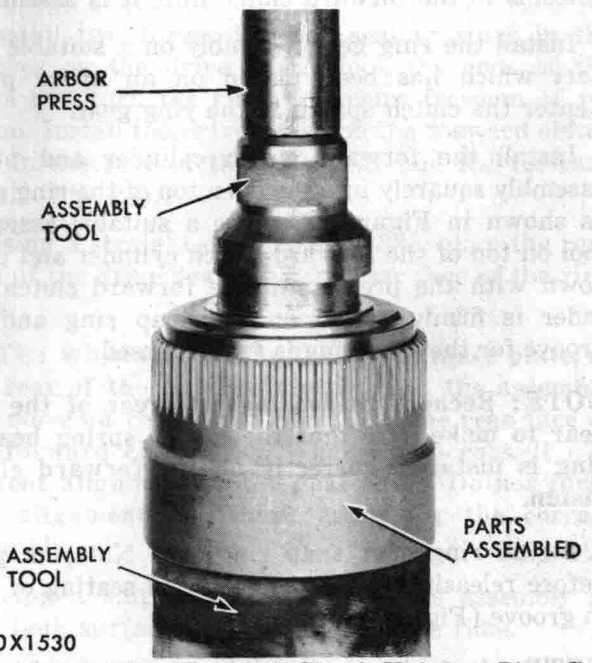


Fig. 22–Installing Forward Clutch Hub into Ring Gear

Fig. 23–Installing Ring Gear Snap Ring

spring bearing ring, and a lubricated clutch ring.

Install in the forward clutch cylinder a well lubricated sealing ring. Lubricate the entire forward clutch cylinder before continuing assembly.

Install the forward clutch piston squarely on the assembled forward clutch hub. Press the clutch piston into the forward clutch hub. Do not hammer or pound this assembly together as when the piston bottoms in the forward clutch hub, it is assembled.

Install the ring gear assembly on a suitable support which has been placed on an arbor press. Center the clutch spring in the ring gear.

Install the forward clutch cylinder and piston assembly squarely into the open top of the ring gear, as shown in Figure 22. Place a suitable assembly tool on top of the forward clutch cylinder and press down with the press until the forward clutch cylinder is firmly seated on the snap ring and the groove for the snap ring is fully exposed.

NOTE: Recheck by looking into rear of the ring gear to make sure that the clutch spring bearing ring is installed correctly on the forward clutch piston.

Install ring gear snap ring (see Note) in place before releasing press to insure full seating of ring in groove (Fig. 23).

NOTE: It is important that the snap rings be properly identified according to "Free Diameter" and thickness before assembly into the reverse gear. The snap ring referred to as the "Ring Gear Snap Ring" is .074 to .078" thick with a "Free Diameter" of 5⅞ inch + 1/16".

Install the forward clutch and ring gear assembly on an arbor press with the assembly supported on the face of the ring gear, as shown in Figure 24.

Install a suitable assembly tool in the press to apply force on the clutch pressure plate, compressing the clutch plates and the clutch pressure plate against the clutch snap ring (Fig. 24).

NOTE: The clearance between the clutch pressure plate and the shoulder of the snap ring groove in the ring gear assembly can be measured with a feeler gauge.

Select a snap ring to obtain the proper clearance of .056 to .086 inches (Fig. 25). (Model 72 only.)

NOTE: The snap ring referred to as the "Selective Snap Ring" is variable in thickness and has a "Free Diameter of 5⅞" + 1/16". The ring gear is color coded for thickness as follows: Green–.050" to .054 ; Orange–.074" to .078"; White–.096" to .100". (Model 72 only.)

Install the forward clutch hub on a suitable support placed on an arbor press, as shown in Figure 26.

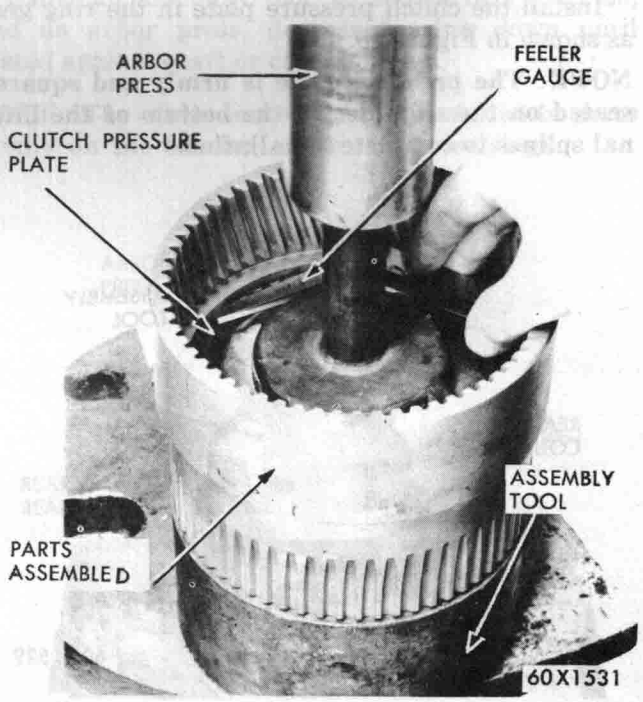


Fig. 24–Measuring Gap for Selecting Snap Ring

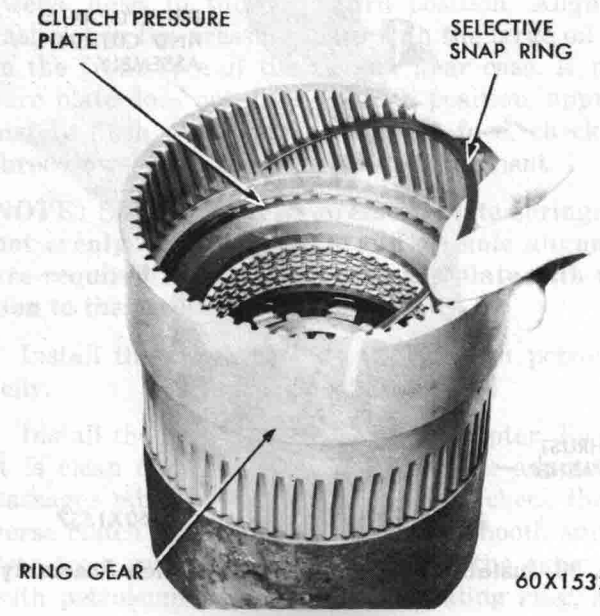


Fig. 25–Installing Selective Snap Ring (Model 72 only)

Install a woodruff key in the keyway on the drive gear (Fig. 26).

Lubricate the outside diameter of the drive gear on the area which pressed into the forward clutch hub.

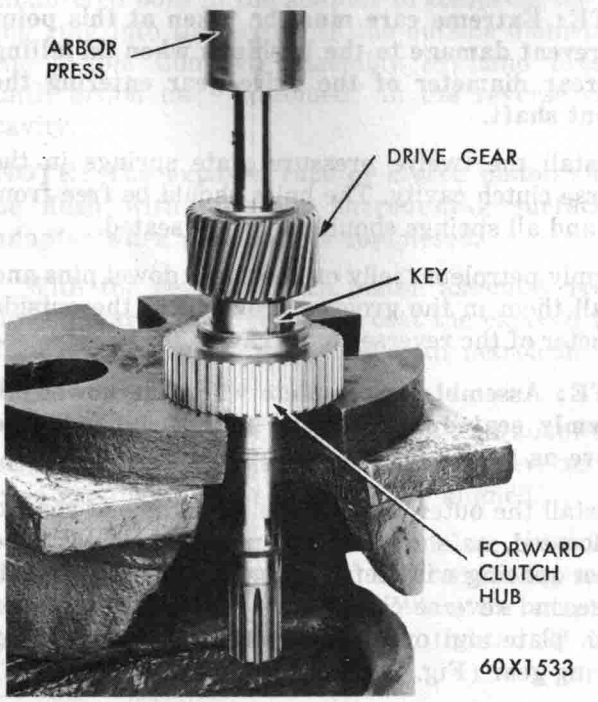


Fig. 26–Installing Drive Gear into Forward Clutch Hub

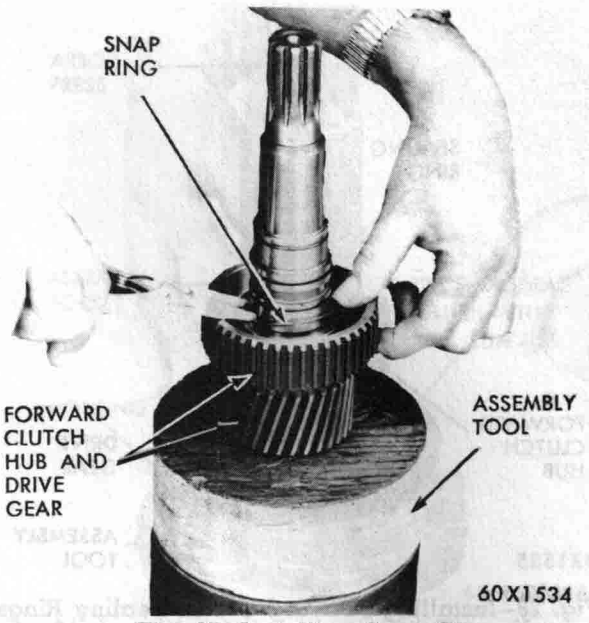


Fig. 27–Installing Snap Ring

Install the drive gear and woodruff key squarely into the forward clutch hub, being careful to align the key with the mating keyway in the forward clutch hub (Fig. 26). Press the drive gear into the forward clutch hub until the gear "bottoms" on the face of the forward clutch hub and groove for the snap ring is fully uncovered.

Invert the drive gear clutch hub and install a snap ring in the groove provided (Fig 27). Tap ring with a soft hammer to insure full seating in the groove after assembly.

Install two forward clutch sealing rings in the grooves on the drive gear. Hook the ends of the rings and turn the rings to insure freedom of rotation. Install the drive gear and the forward clutch hub in the rear of the ring gear and the forward clutch (Fig. 28).

Using a straight edge Tool C-3335, align the rear face of the drive gear with the rear face of the ring gear.

NOTE: When assembling the clutch inner plate, at the rear of the forward clutch pack, the assembly can move off center and hook over the rear face of the forward clutch hub. When this occurs, it will prevent alignment of the gear faces. Do not force this alignment but check again for the correct assembly.

Using a suitable fixture, align the assembly so that both surfaces contact at the same time.

Install aligned parts and assembly tool in place on

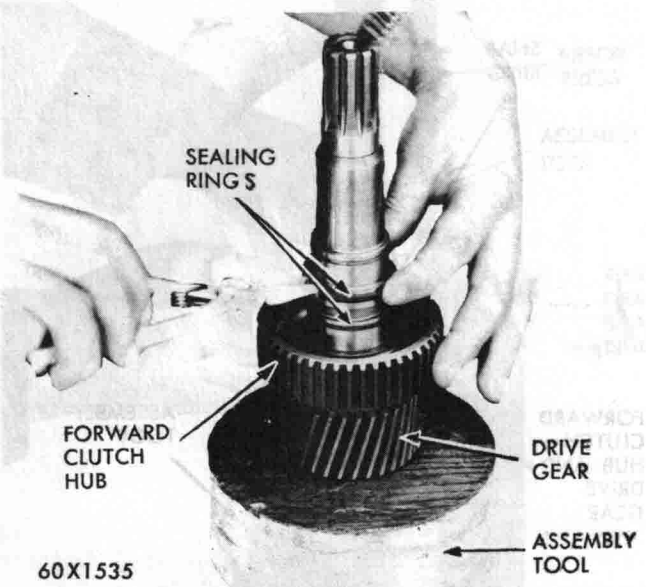


Fig. 28–Installing Forward Clutch Sealing Rings on Drive Gear

arbor press. Install bearing over protruding drive gear and securely into bore at front of forward clutch cylinder. Press bearing down with press until bearing is fully seated on shoulder and snap ring grooves in front of bearing are exposed.

Install snap ring on drive gear.

Install snap ring on forward clutch cylinder.

Place the assembled reverse gear case with the rear face of coupling in an upright position on a clean work bench.

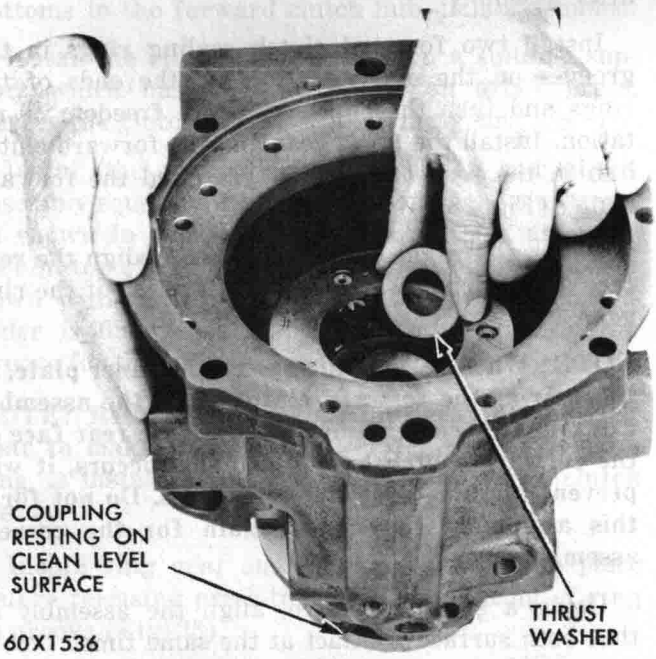


Fig. 29–Installing Thrust Washer into the Pinion Cage

Fig. 30–Installing Drive Gear and Clutch Assembly

Install a thrust washer covered with petroleum jelly into the pinion cage and output shaft assembly, as shown in Figure 29.

NOTE: Center the washer carefully over bore provided for rear of drive gear.

Lubricate the rear end of the drive gear and check center position of the thrust washer. Install the drive gear and clutch assembly into the case and pinion cage and output shaft assembly, as shown in Figure 30.

NOTE: Extreme care must be taken at this point to prevent damage to the bushings when installing the rear diameter of the drive gear entering the output shaft.

Install the twelve pressure plate springs in the reverse clutch cavity. The holes should be free from dirt and all springs should be firmly seated.

Apply petroleum jelly on the three dowel pins and install them in the grooves provided at the outside diameter of the reverse clutch cavity.

NOTE: Assembly is complete when the dowel pin is firmly seated on end and placed out into the groove as far as groove contour will permit.

Install the outer clutch plate with the odd shaped lug located, as shown in Figure 10, to obtain the proper spacing with reference to the springs. Install the second reverse clutch plate on top of the outer clutch plate and over the exposed splined teeth of the ring gear (Fig. 10).

Install the reverse clutch pressure plate with the

twelve holes in the downward position. Align the cast slot in the pressure plate with the large oil hole in the front face of the reverse gear case. If pressure plate does not drop down in position, approximately flush with gear case front face, check the three dowel pins for possible misalignment.

NOTE: Since the twelve pressure plate springs are not evenly spaced, the slot and oil hole alignment are required to locate the pressure plate with relation to the pressure plate springs.

Install the thrust washer coated with petroleum jelly.

Install the needle bearing in the adapter. Be sure it is clean and free from damage. The adapter oil passages must be free from dirt and check the reverse clutch cavity outer wall for a smooth surface free from scratches and burrs. Coat the outer wall with petroleum jelly. Install the sealing ring, after coating with petroleum jelly.

Install sealing ring coated with petroleum jelly on the reverse clutch piston assembly. Make sure the inside diameter of the reverse clutch piston has a smooth clean surface free from scratches and burrs, and coat generously with petroleum jelly.

Install the reverse clutch piston on the adapter. Press down on reverse clutch piston while pulling a smooth clean screwdriver blade around the exposed portion of the sealing ring. This will aid the chamfered bore in the adapter to compress the sealing ring into the groove in the outside diameter of the piston. Complete assembly by hand pressure until piston has "bottomed" in the reverse clutch cavity.

NOTE: The exposed face of clutch piston should be flush with adjacent surrounding surface on adapter when assembly is completed.

With the reverse clutch piston assembly resting on the rear face of coupling, coat the exposed front face of the reverse gear case with petroleum jelly and install the gasket.

Install the reverse clutch piston and adapter assembly on top of the input gear and reverse gear case making sure the oil holes are aligned.

With the adapter squarely in place, install the four cap screws and washers. Tighten the cap screws evenly and check for binding. When the adapter is pulled down as far as possible, tighten 28 to 30 foot-pounds torque.

Assemble the oil pump parts, and check for the following: scoring in gear pockets, crescent, backing plate and gear faces, dents and burrs on both faces of backing plate, oil seal lip for brittle condition, cracks and cuts, oil seal outside diameter for dents or scratches, gear teeth for burrs.

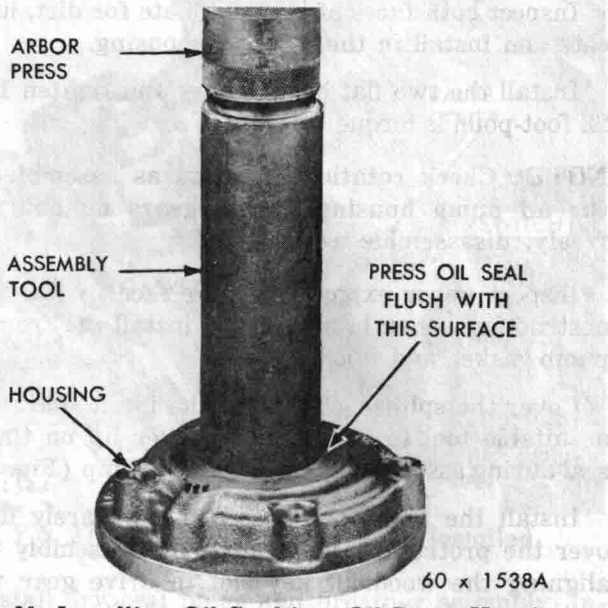


Fig. 31–Installing Oil Seal into Oil Pump Housing (All Models)

Install the oil seal in the oil pump housing, squarely into bore provided with lip in position.

Using an arbor press and a suitable tool to fit the oil seal, press seal into oil pump housing until front face of oil seal is flush with the front face of the oil pump housing (Fig. 31).

Install the lubricated driven and drive gears into the oil pump housing, lubricated with Automatic Transmission Fluid Type "A" Suffix "A" with reassembly identification marks matched, as shown in Figure 6.

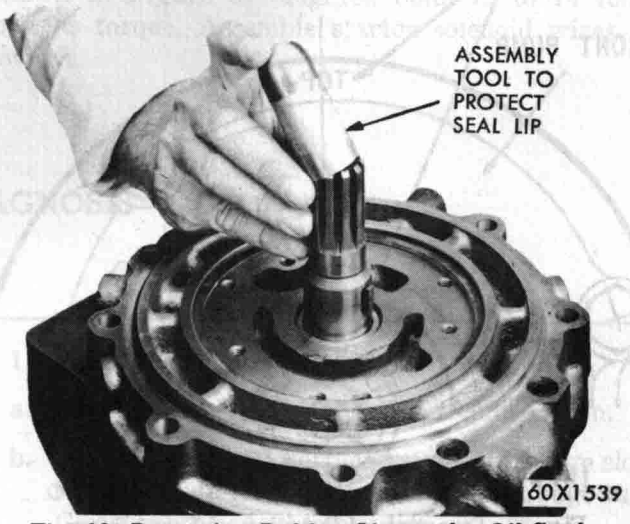


Fig. 32–Protecting Rubber Lip on the Oil Seal

Inspect both faces of backing plate for dirt, lubricate and install in the oil pump housing.

Install the two flat head screws and tighten 17 to 22 foot-pounds torque.

NOTE: Check rotation of gears as assembled in the oil pump housing and if gears do not turn freely, disassemble and inspect.

Inspect upper exposed adapter face for dirt and obstructions, then lubricate and install the front oil pump gasket, and woodruff key.

Cover the splined portion of the input shaft with a suitable tool to protect the rubber lip on the oil seal during assembly of the front oil pump (Fig. 32).

Install the front pump assembly squarely down over the protruding input shaft and assembly tool, aligning the woodruff key slot in drive gear with mating woodruff key on the input shaft.

Line up the pump mounting bolt holes and direction of rotation arrow, depending on direction of input rotation (Fig. 33). Check for freedom of rotation of pump gears in housing.

Remove tool and install bolts. Tighten bolts evenly 17 to 22 foot-pounds torque.

Note the exploded view of the valve and spring assembly. Install the valve spring into the hollow portion of the pressure regulator valve. The concave portion of the valve spring retainer faces the valve spring and the valve spring is installed into the concave portion of the valve spring retainer.

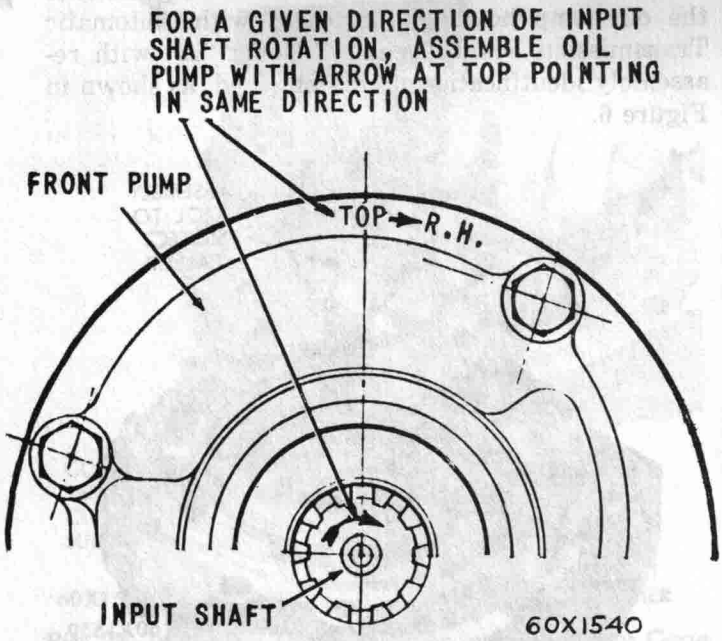


Fig. 33—Direction of Rotation of Front Pump

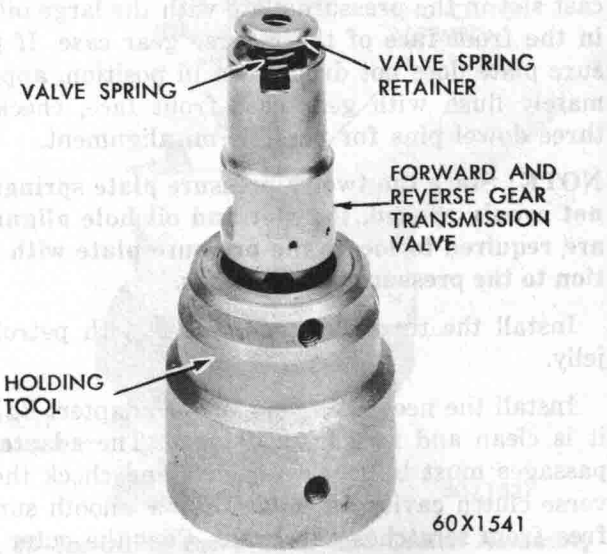


Fig. 34—Mounting Valve and Spring Assembly in Holding Tool

Check the pressure regulator valve and the bore in the forward and reverse gear valve for dirt and burrs. Place the assembly in a suitable holding tool, as shown in Figure 34.

Using an arbor press and a suitable tool, press squarely down on the exposed convexed top of the valve spring retainer, until the groove for the snap ring is fully exposed. Install snap ring.

Install the valve and spring assembly into the opening provided high on the right rear side of the reverse gear case, threaded end first, and when the valve and spring assembly "bottoms" against the shoulder in the case, assembly is completed.

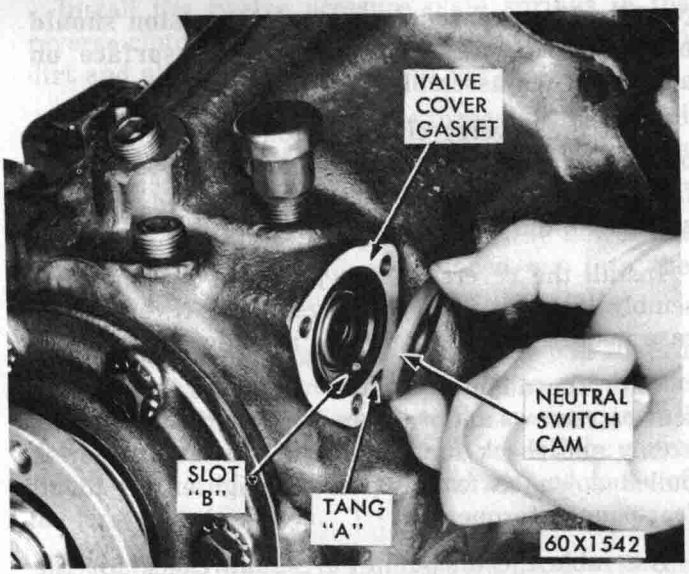


Fig. 35—Installing Gasket and Cam

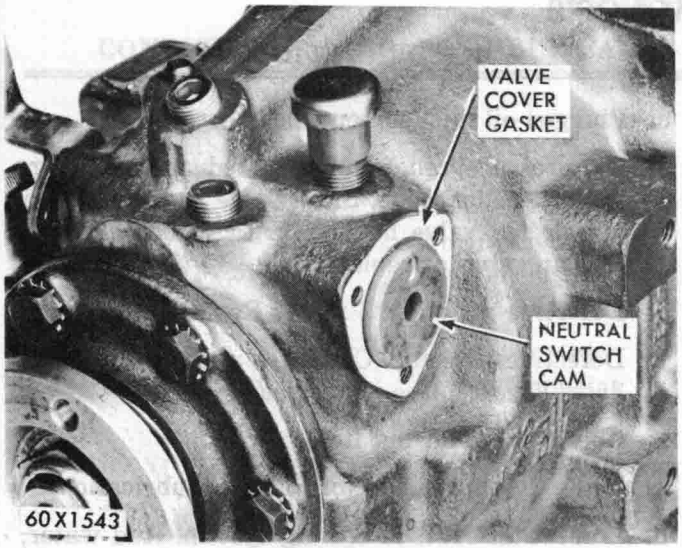


Fig. 36–Neutral Switch Cam in Correct Position

Install the valve cover gasket, valve cover, lockwashers and bolts. Tighten 12 to 14 foot-pounds torque.

Check the position of the threaded end of the valve, so that the flat portion is toward the bottom following the assembly of the lever. (Fig. 7).

Install shift lever and parts. Tighten nut 12 to 16 foot-pounds torque. Rotate the lever through forward, neutral and reverse positions. This should require no more than finger tip effort. If valve binds in rotation, remove and inspect.

Install the oil strainer into the tapped hole provided in the lower right side of the reverse gear case. The end of the oil strainer containing the ring will be approximately ½ inch inside the finished face of the tapped drain hole when assembly is completed. Mount the annular gasket on the oil drain cap and screw cap into drain hole. Tighten 28 to 30 foot-pounds torque.

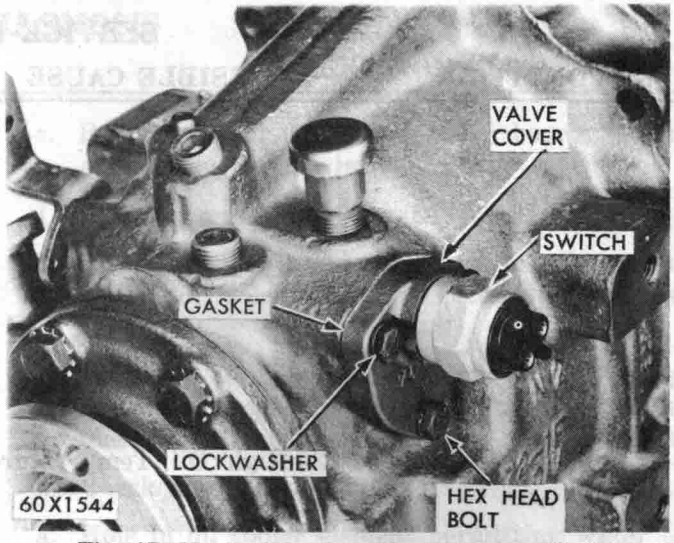


Fig. 37–Neutral Switch Correctly Installed

Install dry seal plugs and breather assembly. Install oil filler cap and dip stick assembly in tube provided on rear left side of reverse gear case. Push down on filler cap and dip stick until assembly "bottoms" on tube then turn cap to right to tighten.

In order to install the neutral switch (optional equipment) the valve cover and gasket must be removed. Discard valve cover gasket bolts and lockwashers.

With shift lever in neutral, install gasket and switch cam. Align tang "A" on cam with slot "B" in valve, as shown in Figure 35.

Switch cam is properly installed, as shown in Figure 36.

Install switch and valve cover with switch between two upper screws in gear box. Use 3 bolts and lockwashers provided in neutral switch kit, as shown in Figure 37. Tighten bolts 12 to 14 foot-pounds torque. Assemble starter solenoid wires to switch.

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Gear Inoperative–Drive shaft does not rotate with selector valve in forward or reverse	1. Low oil pressure.	1. Check the following items: a. Low oil supply. Add oil, refer to lubrication. b. Faulty oil gauge. Replace gauge. Oil gauge slow to register, air or obstruction in oil gauge line. Clean and bleed oil gauge line.

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
		c. Plugged oil inlet screen. Clean screen.
		d. Oil pressure relief valve scored and sticking. Remove relief valve. Clean valve and valve bore in selector valve housing with crocus cloth to free up valve, or replace.
		e. Defective piston seal rings. Replace seal rings.
		f. Defective oil pump. Check for wear and sheared drive key. Replace if necessary.
	2. High Oil Temperature.	2. Check the following items:
		a. Low oil supply. Add oil, refer to lubrication.
		b. Low water level in cooling system. Add water, and check for leaks.
		c. Clogged or dirty oil cooler element. Remove and clean oil cooler element.
	3. Failure of planetary assembly.	3. Remove the reverse planetary assembly, and check for defective or damaged parts. Replace planetary assembly if necessary.
	4. Failure of reduction gear.	4. Remove reduction gear and planetary assembly and check for defective or damaged parts. Replace defective or damaged parts.
	5. Failure of reduction gear input shaft outer bushings.	5. Worn and misalignment of oil holes in bushings with oil holes in gear housing. If worn excesssively or bushings are out of alignment, replace bushings.
Gear Dragging	1. Defective forward or reverse clutch plates.	1. Forward and reverse clutch plates warped and sticking. Remove clutch plates and replace.
	2. Defective forward or reverse clutch piston release springs.	2. Forward and reverse clutch piston release springs broken or weak. Replace springs.
	3. Binding in reverse planetary assembly.	3. Check the following items:
		a. Bearings and gears worn excessively in planetary assembly. Replace planetary assembly.
		b. Input shaft bearing worn excessively, causing misalignment of input shaft. Replace necessary parts.
	4. Binding in reduction gear.	4. Check the following items:
		a. Bearings and gears worn excessively in planetary assembly. Replace planetary assembly.
		b. Bushings in reduction gear input shaft and drive shaft worn excessively causing misalignment of input and drive shaft. Replace necessary parts.

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
		c. Reduction gear drive shaft roller bearing worn excessively, replace bearing.
Gear Slipping or slow to engage–with selector valve in forward or reverse position	1. Low oil pressure.	1. Low oil pressure, see Chart 1, Item 1.
	2. Worn forward or reverse clutch plates.	2. Remove forward and reverse clutch plates and check for wear. If worn excessively replace clutch plates.
Internal and External Leaks	1. Excessive oil in flywheel housing.	1. Defective reverse gear oil pump oil seal, pump to adaptor gasket or loose oil pump bolts. Replace oil seal and gasket. Tighten oil pump bolts.
	2. Water in lubricating oil or oil in cooling water.	2. Check the following items: a. Hole in oil cooler element permitting water to seep into oil compartment, or oil seeping into the engine cooling system due to the oil pressure being greater than the water pressure. Replace oil cooler element. b. Oil cooler gaskets damaged. Replace oil cooler gaskets.
	3. Oil on exterior of marine gear unit.	3. Check the following items: a. Reverse gear housing adaptor, reduction gear adaptor, reduction gear housing and bearing retainer gaskets damaged. b. Defective selector valve "O" seal ring. Replace seal ring. c. Defective reduction gear drive shaft bearing retainer oil seal. Replace oil seal. d. Loose reverse gear to oil cooler supply and return oil tube fittings. Tighten all fittings.

REDUCTION GEAR ASSEMBLY

DESCRIPTION

The 1.523 reduction gear operates with any reverse gear.

The reduction gear consists of a planetary gear set which reduces the rpm put into the unit by a 1.523 to 1 ratio and is always engaged.

The direction of rotation of the output shaft of the reduction gear is the same as the engine rotation:

Lubrication pressure is supplied by the oil pump in the reverse gear.

Lubricating oil is transferred from the reduction gear to the reverse gear by gravity and jet flow.

REMOVAL (Fig. 38)

(1) With the reverse and reduction gear housing removed from the engine, and on a clean work bench, remove the bolts and lockwashers, holding (Fig. 39) the reverse and reduction gear housing together. Remove the reduction gear, as shown in Figure 40.

(2) Remove the six lock bolts and lockwashers through access holes, as shown in Figure 41. Remove the reduction adapter, ring gear, input gear and bearing, as shown in Figure 42.

(3) Support the reduction unit adapter on a clean flat surface on an arbor press. Remove the snap ring as shown in Figure 43. Using a suitable

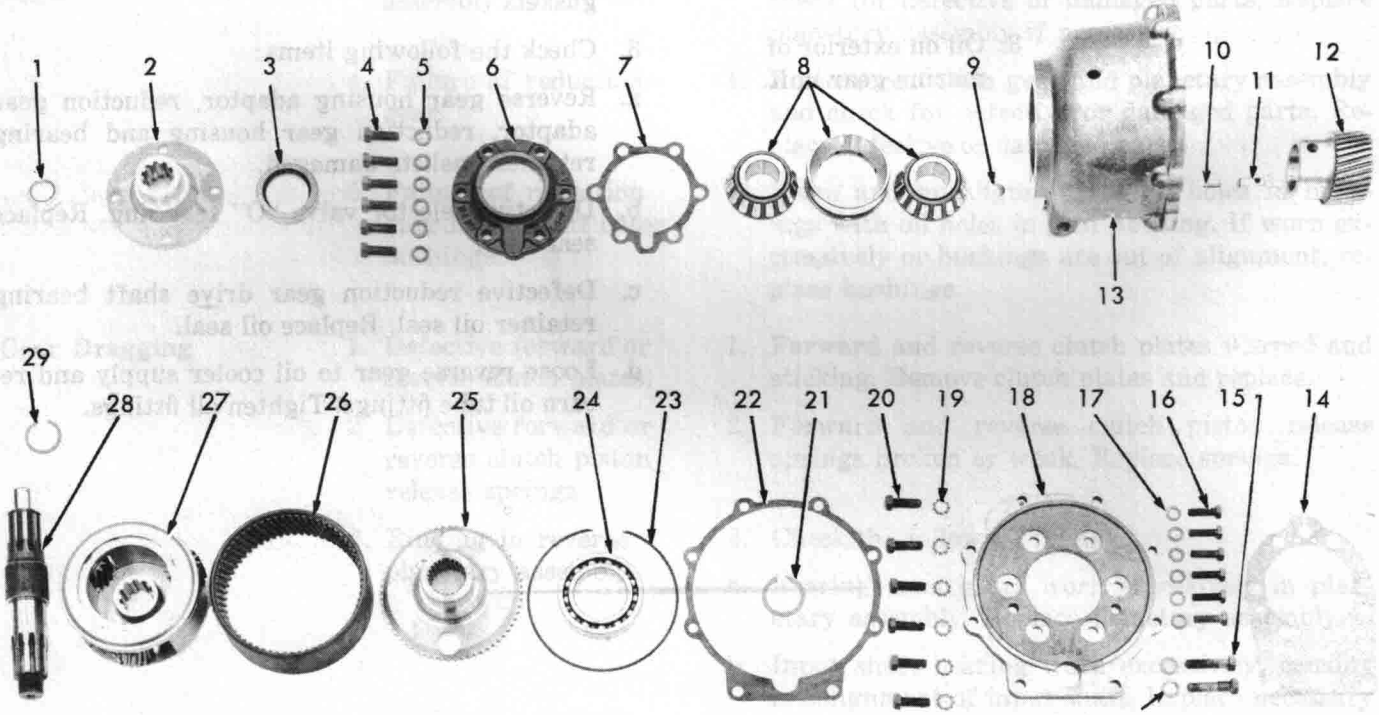


Fig. 38–Reduction Assembly (Exploded View)

1. Main Shaft Nut T87D-50C
2. Coupling 4547 AN
3. Oil Seal Assembly 3-62
4. 6–7/16-14 x 1-1/4 Bolt 179860
5. 8–7/16 Lockwasher 103322
6. Bearing Retainer L4-7
7. Bearing Retainer Gasket L4-147
8. Bearing X3372
9. 5/8 Expansion Plug–103891
10. Roll Pin–4808
11. Pinion Cage Drive Pin–L4-151
12. Sun Gear–L4-4
13. Reduction Housing L4-1
14. Reduction Unit Adapter Gasket–Front L4-145
15. 2–7/16-14 x 1-3/4 Bolt 179864
16. 6–3/8 Lockwasher 103321
17. 6–3/8-16 x 1-1/8 Bolt 179840
18. Reduction Unit Adapter L4-8
19. 6–7/16 Lockwasher
20. 6–Lock bolt 4853
21. Snap Ring 4766
22. Reduction Housing Adapter Gasket–Rear L4-145
23. Snap Ring 4576D
24. Bearing X3248
25. Input Gear L4-16
26. Ring Gear L3-6
27. Pinion Cage Assy. L4-A150
28. Main Shaft L4-2
29. Snap Ring 4734

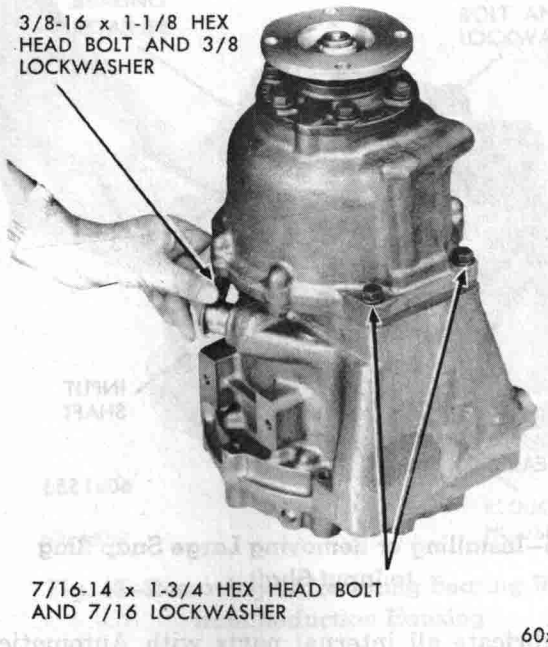


Fig. 39—Installing Reduction Unit to Reverse Gear

tool press the bearing off by applying pressure on the small diameter of the input gear, as shown in Figure 44.

(4) Remove the large snap ring and separate the ring gear from the input gear, as shown in Figure 45.

(5) Remove the main shaft nut and coupling, as shown in Figure 46.

(6) Remove the six bolts and lockwashers and remove the bearing retainer, as shown in Figure 47.

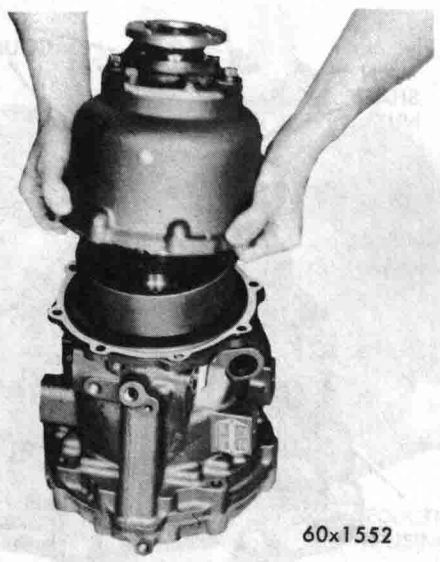


Fig. 40—Assembling Reduction Unit to Reverse Gear

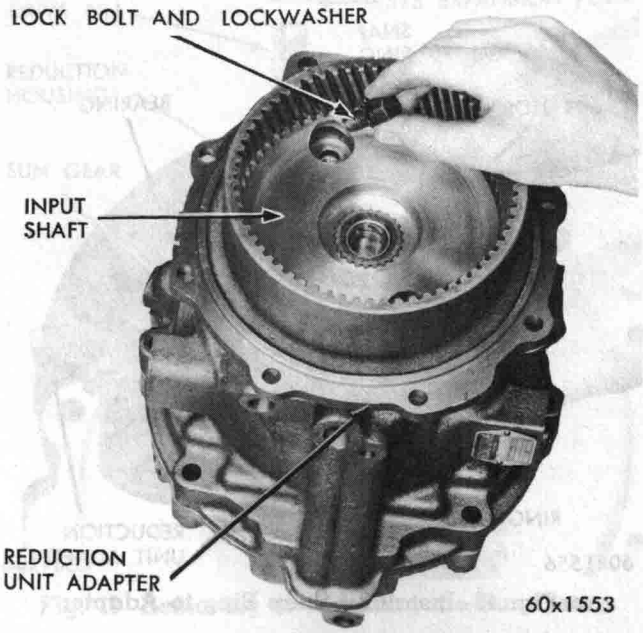


Fig. 41—Installing Reduction Adapter to Reverse Gear

(7) Remove the rear inner race of the bearing from the housing, as shown in Figure 48.

(8) Using an arbor press place the reduction housing on an arbor press supported on the rear face, being careful not to drop the main shaft. Press the outer race of the bearing out of the reduction housing by applying force to the main shaft being careful not to drop the parts when they are free of the housing.

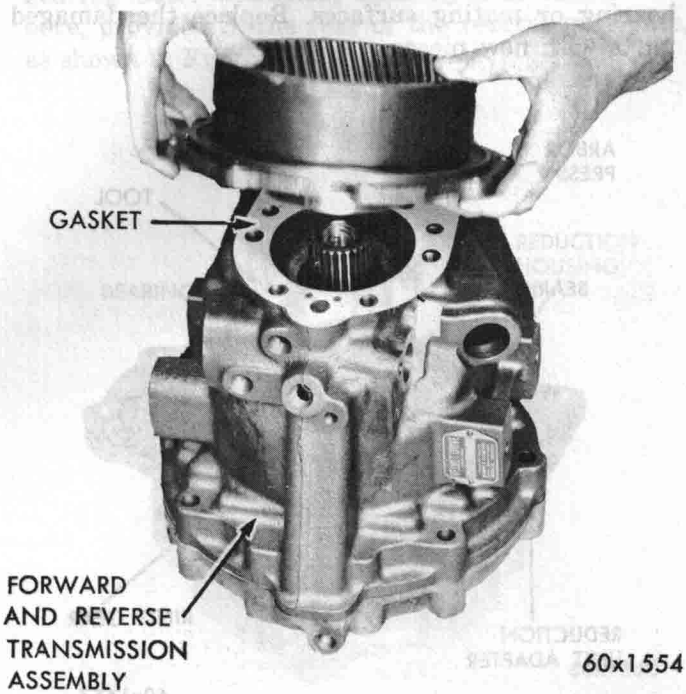


Fig. 42—Installing Gasket and Adapter to Reverse Gear

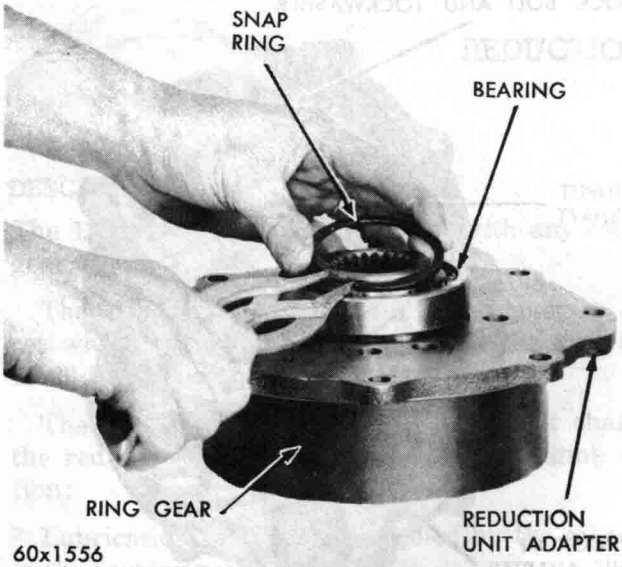


Fig. 43—Installing Snap Ring to Adapter

(9) Using a suitable punch driving from the rear of the housing, punch the roll pin out of the pinion cage drive.

(10) Remove the pinion cage drive pin and sun gear, as shown in Figure 49.

CLEANING AND INSPECTION

(1) Clean all parts thoroughly.

(2) Inspect all parts for damage and wear to bearing or mating surfaces. Replace the damaged parts with new pieces.

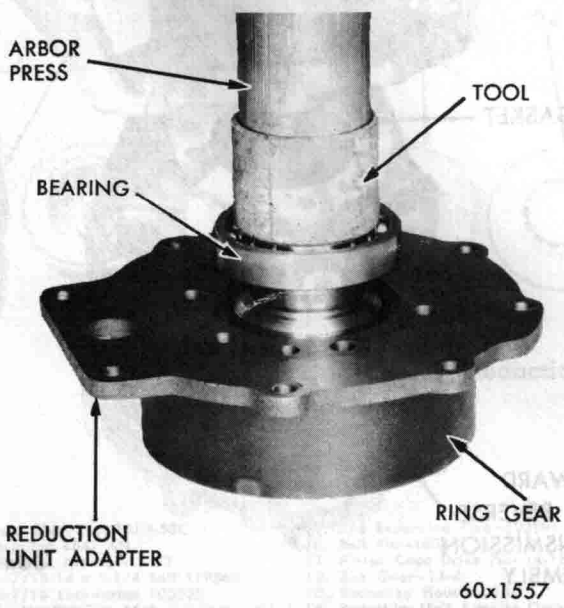


Fig. 44—Installing Bearing to Reduction Unit Adapter

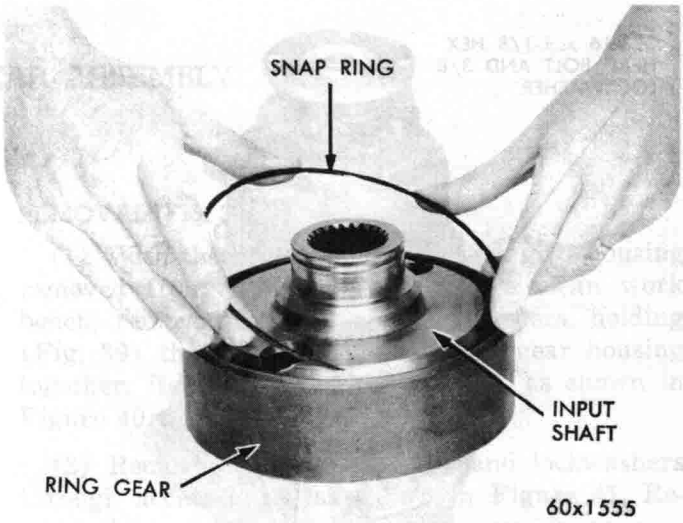


Fig. 45—Installing or Removing Large Snap Ring to Input Shaft

(3) Lubricate all internal parts with Automatic Transmission Fluid Type "A" Suffix "A", before assembly.

(4) Always install new gaskets, seals rings and oil seals when assembling gaskets, may be coated with petroleum jelly for easier assembly.

(5) Use a lint free cloth such as nylon for wiping parts, because lint from wiping cloths can cause erratic operation of the pressure regulating system.

(6) When assembling oil seals and bearings, use a suitable tool and a squarely aligned arbor press. Do not pound bearings or oil seals during assembly.

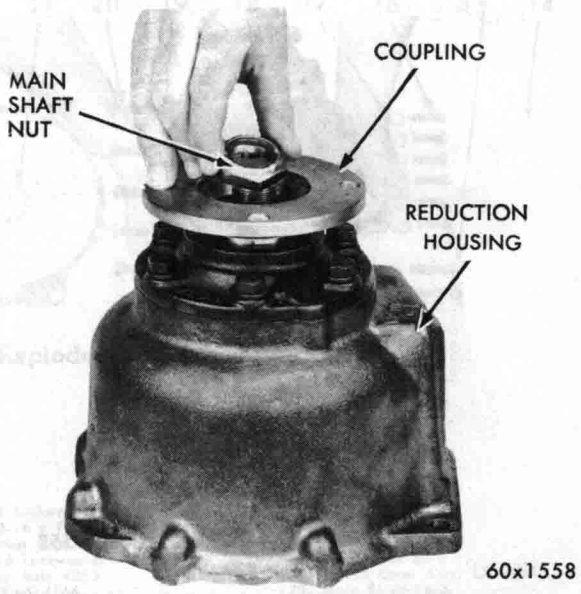


Fig. 46—Removing or Installing Main Shaft Nut

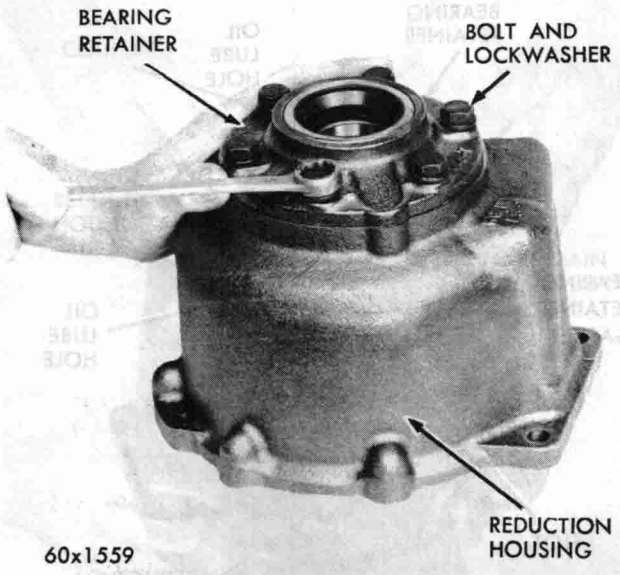


Fig. 47–Removing or Installing Bearing Retainer from Reduction Housing

ASSEMBLY

Install the ring gear on the input shaft and assemble the large snap ring firmly in place, as shown in Figure 45.

Place the ring gear and input shaft on an arbor press with the ring gear supported on the rear face. Position the adapter on the input shaft, lubricate the bearing inside diameter and using a suitable tool locating on the bearing inner ring, press the bearing down firmly, against the shoulder of the input shaft, as shown in Figure 44.

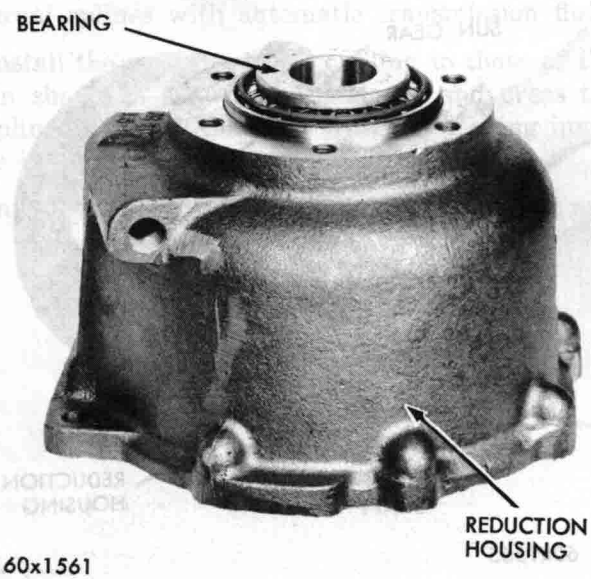


Fig. 48–Installing Rear Inner Bearing Race

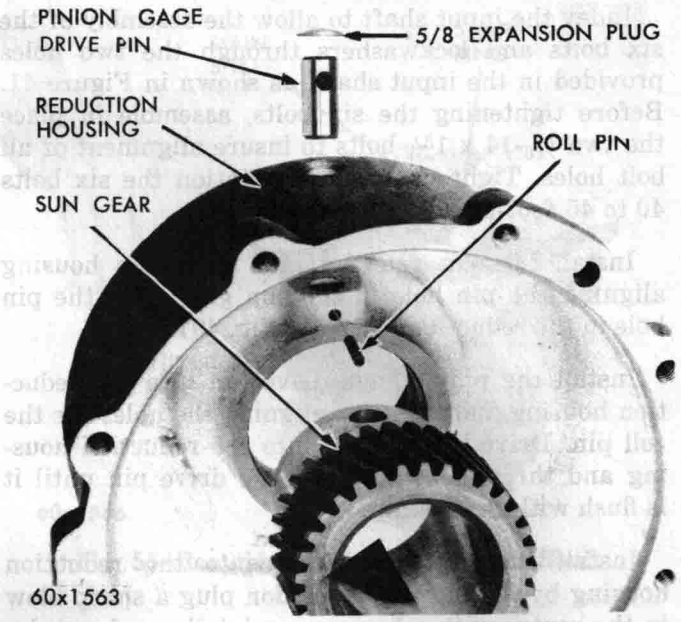


Fig. 49–Removing or Installing the Sun Gear

Install the snap ring into the groove, as shown in Figure 43.

Install the reduction adapter gasket front on the rear of the reverse gear case, as shown in Figure 42. Gasket may be coated with petroleum jelly for easier assembly.

Install the reduction unit adapter assembly with the input shaft splines engaging the splined outside diameter of the reverse gear output shaft and the bearing outer diameter, squarely started into the bore, provided in the rear of the reverse gear case, as shown in Figure 42.

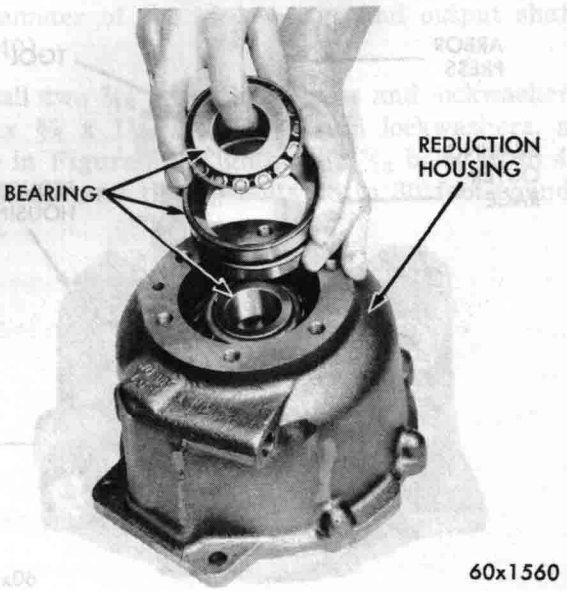


Fig. 50–Removing or Installing Bearing

Index the input shaft to allow the assembly of the six bolts and lockwashers through the two holes provided in the input shaft, as shown in Figure 41. Before tightening the six bolts, assemble in place the two $\frac{7}{16}$-14 x $1\frac{3}{4}$ bolts to insure alignment of all bolt holes. Tighten evenly in rotation the six bolts 40 to 45 foot-pounds torque.

Install the sun gear into the reduction housing aligning the pin hole in the sun gear with the pin hole in the reduction housing (Fig. 49).

Install the pinion cage drive pin into the reduction housing and sun gear aligning the holes for the roll pin. Drive the roll pin into the reduction housing and through the pinion cage drive pin until it is flush with the casting.

Install the expansion plug into the reduction housing by hitting the expansion plug a sharp blow in the center with a hammer and dull punch swedging it firmly into the bore.

Install the reduction housing on an arbor press resting the front face on a clean surface. Figure 50 shows the bearings to be installed.

Inspect bearing for match marks and match them in the assembly that follows. Install the first row of the tapered bearing so that the inner ring rests against the shoulder in the reduction housing.

Lubricate the outer diameter of the outer ring with automatic transmission fluid and press it into the reduction housing, using a suitable tool, as shown in Figure 51, until the outer race is seated firmly against the shoulder in the reduction housing.

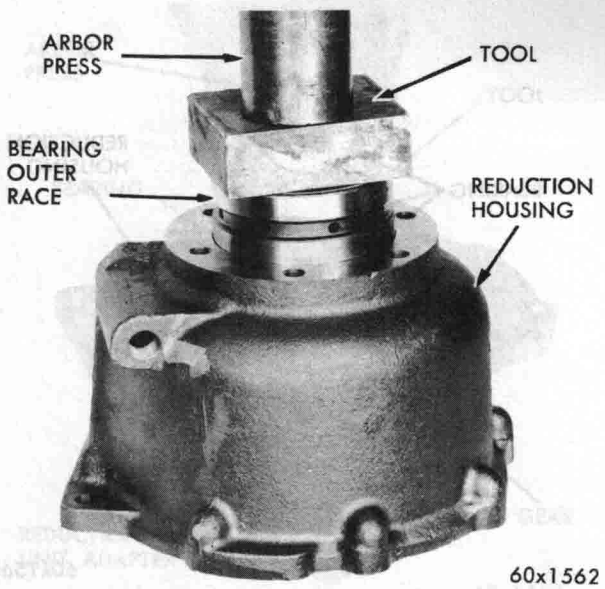


Fig. 51—Installing Outer Bearing Race

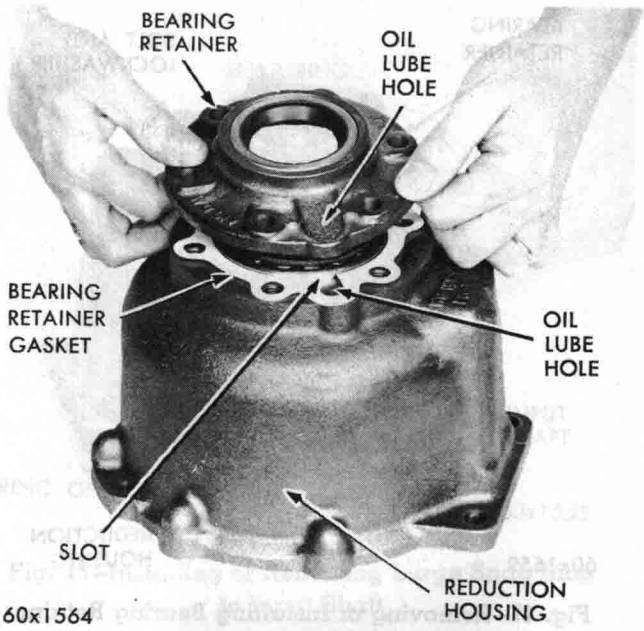


Fig. 52—Removing or Installing Bearing Retainer and Gasket

Install the rear row of the tapered bearing into the outer race, as shown in Figure 49.

Install the bearing retainer gasket on the reduction housing aligning the slot with the oil lube hole, as shown in Figure 52. The gasket may be coated with petroleum jelly for easier assembly.

Inspect the rubber lip of the oil seal for cuts, cracks or other damage which might cause leakage and replace if necessary. Align the oil lube holes when installing the bearing retainer on to the reduction housing, as shown in Figure 52.

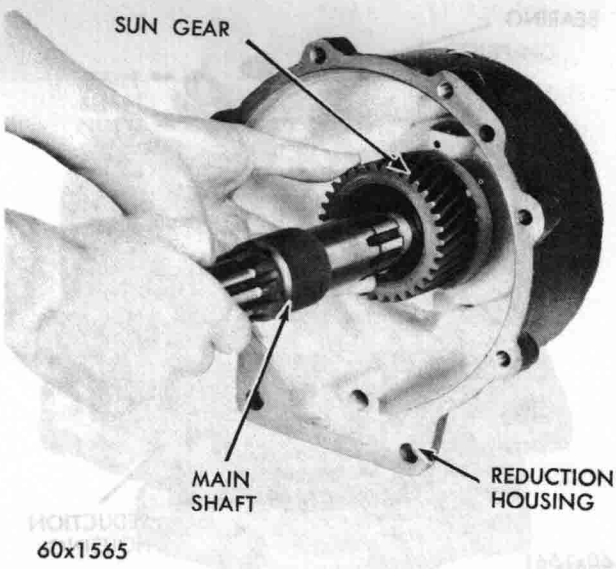


Fig. 53—Removing or Installing the Main Shaft

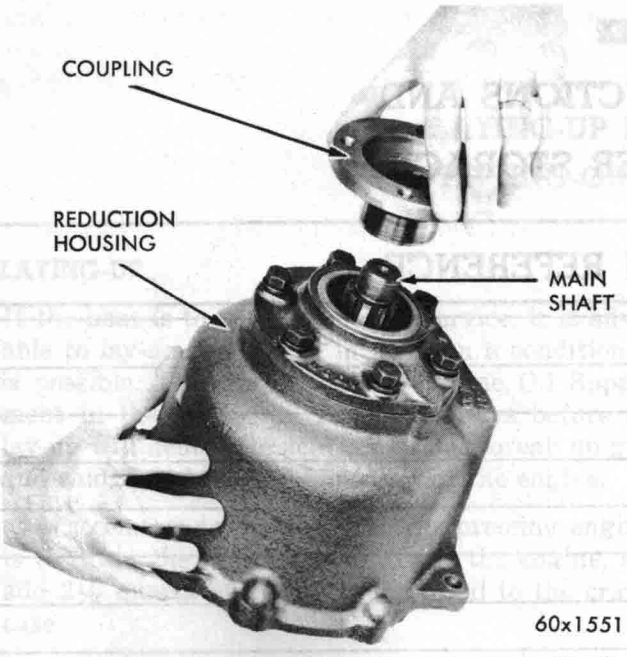


Fig. 54—Removing or Installing the Main Shaft Coupling

Install the six bolts and tighten 50 to 55 foot-pounds torque, as shown in Figure 47.

Install the main shaft through the sun gear into the bearing, as shown in Figure 53. **Do not use force or arbor press** as the main shaft may be pulled fully into the bearing by using of the main shaft nut.

Inspect the coupling sealing diameter to make sure there are no burrs or sharp edges which might damage the seal or prevent proper sealing. Replace if damaged. Lubricate the sealing diameter and the internal splines with automatic transmission fluid.

Install the splines of the coupling to those of the main shaft, as shown in Figure 54 and press the coupling down until contact with the bearing inner race is made.

Install the main shaft nut on the main shaft and tighten 150 to 200 foot-pounds torque (Fig. 48).

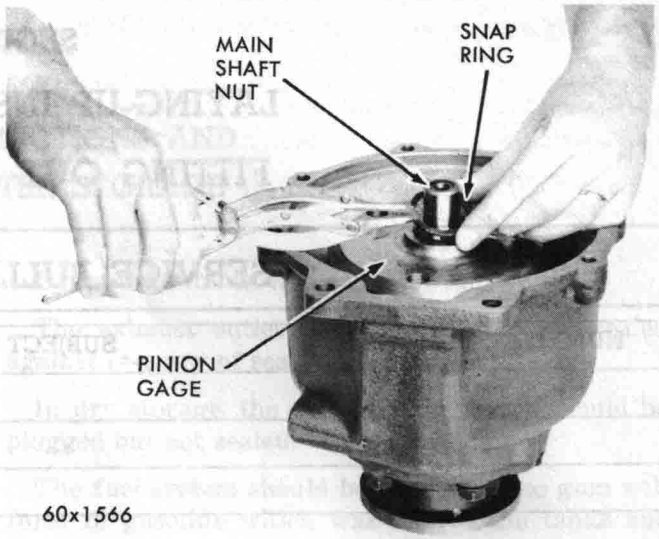


Fig. 55—Removing or Installing Main Shaft Snap Ring

Install the splines of the pinion cage with the splines of the main shaft until the pinion cage is seated against the shoulder on the main shaft.

Install the snap ring firmly into the groove on the main shaft to hold the pinion cage, as shown in Figure 55.

Support the reverse gear with the adaptor assembly on the front face on a clean flat surface or block.

Install the reduction gear assembly by meshing the pinion gears into the ring gear and engaging the pilot diameter of the main shaft into the bushing diameter of the pinion cage and output shaft (Fig. 40).

Install two $\frac{7}{16}$ x $1\frac{3}{4}$ head bolts and lockwashers and six $\frac{3}{8}$ x $1\frac{1}{8}$ head bolts and lockwashers, as shown in Figure 39. Tighten the $\frac{7}{16}$ bolts 40 to 45 foot-pounds and the $\frac{3}{8}$ bolts 28 to 30 foot-pounds torque.

SECTION IX

LAYING-UP INSTRUCTIONS AND FITTING OUT AFTER STORAGE

SERVICE BULLETIN REFERENCE

NUMBER	DATE	SUBJECT	CHANGES

SECTION IX

LAYING-UP INSTRUCTIONS AND FITTING-OUT AFTER STORAGE

LAYING-UP

If the boat is to be taken out of service, it is advisable to lay-up the engine in as clean a condition as is possible. The use of MoPar Engine Oil Supplement in the engine oil for a few days before the lay-up will neutralize acid conditions, break up gum and sludge and clean the interior of the engine.

A recommended method for rustproofing engines is to drain the lubricating oil from the engine, and add 2½ quarts of rust preventive oil to the crankcase.

Remove the flame arrestors. Run the engine at fast idle speed. Pour about ½ pint of rust preventive oil through each carburetor air intake, until the engine stalls. Pour approximately an ounce (two tablespoons) of rust proofing oil into each cylinder through the spark plug holes. Press the starter button to distribute the oil over the cylinder walls. Replace the spark plugs, finger tight. Drain the rust preventive oil from the crankcase. The engine should not be operated again that season.

The engine cooling system should be completely drained (in wet storage, close the sea cock first).

Drain the water pump by removing the cover.

NOTE: The water pump has two rubber impellers. If the rubber impellers are allowed to stay in the water pump during the lay-up period they will become "set" and will not function properly in further use. It is recommended that the impellers be removed from the pump. Refer to the Cooling Section in this manual.

Open the drain plugs and make certain that they remain open for complete drainage. Remove the thermostat and housing. Blockage at these locations is an indication of sediment that should be flushed from the engine block immediately before it dries out and hardens.

Pressure flush the cooling system with fresh water or in extreme cases, in combination with air pressure.

NOTE: It is best to flush with fresh water if the engine was used in salt water.

Drain the exhaust line at its lowest point.

The exhaust outlet should be adequately sealed against re-entry of sea water for wet storage.

In dry storage, the exhaust pipe outlet should be plugged but not sealed.

The fuel system should be drained since gum will form in gasoline which was left in the tanks and carburetor. Remove the flame arrestors. Drain the fuel as follows:

CAUTION

Avoid spilling any fuel if possible as preparation should be made to mop up the fuel immediately.

(1) Siphon the fuel from the gas tanks.

(2) Disconnect both fuel lines from the fuel pump. Blow the fuel back into the tank.

(3) Remove the screws from both carburetor bowl covers and using a suction bulb, remove the fuel from the bowls. Blow the fuel from the fuel pump line into the bowls. Dispose of wiping cloths immediately.

(4) Install the bowl covers and reconnect the fuel lines.

(5) Reinstall the flame arrestors and cover to prevent entry of dirt.

The electrical equipment should be removed as follows:

Remove the alternator

Remove the starter

Remove the distributor and all wires

Remove the battery and provide adequate storage and recharging facilities ashore.

Have the distributor checked before storing it ashore in a dry, dust free place.

Cover all openings to prevent foreign matter falling into the engine.

Lubricate all linkage connections to prevent rust.

Disconnect the propeller shaft. Inspect the flange

mating surfaces, and coat the surfaces with oil or grease.

Drain the bilge completely and provide maximum ventilation during the storage.

Cover the engine loosely with a tarpaulin or water-proof cover to protect it from dust, water or snow. The covering should not fit too tightly. Good ventilation discourages condensation and rust.

FITTING-OUT

In the foregoing lay-up procedure, the engine was sealed against the entrance of dust and other foreign matter. A visual inspection will determine the effectiveness of the seals as they are removed for installation of the various units.

Clean the engine before installing any of the units. Install the cooling system drain plugs if they were removed and reinstall the water pump impellers and cover using a new gasket if necessary.

Refill the engine with five quarts of oil, using the proper SAE viscosity grade and for service "MS" only on the container. The oil filter should be changed at this time therefore add an extra quart to compensate for the filter. Add 4½ pints transmission automotive fluid, Type "A" Suffix "A" to the reverse gear and reduction gear (3½ for reverse gear only). Reinstall the units, distributor, starter, etc. Use care in handling the "radio" spark plug wires. Apply pressure only at the terminals.

Install the battery. Clean the battery posts and cable connectors to a bright finish and after attaching the cables, apply a thin film of grease on the top of the connections.

Connect all parts of the fuel system, using new gaskets if necessary, under the carburetor float bowl covers. Clean and install the flame arrestors and the engine ventilation pipes.

Clean the reverse gear and the propeller shaft flanges. Align the engine to the shaft within .002 inch before attaching the propeller shaft. The alignment should be rechecked after the hull has been in the water for a sufficient length of time to assume its normal shape. Replace packing in packing glands if adjusting nuts are near their limit of travel.

Fill the cooling system before installing the thermostat housing. Operate all controls to see that they move freely and that they are properly adjusted and lubricated. After the boat has been placed in the water, check the sea cock for ease of operation.

After refueling, prime the carburetor through the inlet screen and start the engine. Observe the instruments for normal readings. Check the exhaust outlet for the water discharge. While the engine is warming up, check the gauges for smooth operation, and check the cooling system for leaks.

The engine should be tested for proper operation at the dock and a trial run should be made only after the propeller shaft alignment has been rechecked.

SECTION X

THE MARINE REPLACEMENT ENGINE

DESCRIPTION

The Chrysler Marine Replacement Engine consists of the following assemblies and parts.

1. Cylinder block
2. Pistons and rings assembly
3. Cylinder heads and covers
4. Crankshaft, bearings, bearing caps, and rear seal
5. Connecting rods with pins and bearings
6. Camshaft and bearings
7. Intake and exhaust valves
8. Valve springs
9. Tappets and push rods
10. Chain case cover, timing chain and sprocket
11. Oil pump

The Chrysler Marine Short Engine consists of the following assemblies and parts.

1. Cylinder block
2. Pistons and rings assembly
4. Crankshaft and bearings and caps and rear seal
5. Connecting rods with bearings and piston pins
6. Camshaft and bearings.
7. Tappets
8. Timing chain and sprocket
9. Oil pump

Both right and left rotation models are available. The reverse gear drive gear is also supplied as a factory installed extra cost optional item.

The Marine Replacement Engine is a non-dynamometer tested engine. It is recommended that prior to installation the engine be run in a test stand for a period of time. A thorough check should be made for oil and water leaks, as well as any necessary adjustments to assure proper functioning of the engine before it is installed.

To secure satisfactory performance, it may be necessary that some or all of the accessories, removed from the original engine, be reconditioned before being installed on the new base engine. These accessory assemblies may have seen a great deal of service and are usually in need of attention. All or some of the units or accessories may have to be replaced or serviced.

OPERATION PROCEDURES

The following units will require examination and perhaps reconditioning. Refer to the various sections in this manual for more complete information.

ALTERNATOR AND STARTING MOTORS

Inspection should be made of the starter armature, commutator and brushes; alternator slip rings and brushes; units should be thoroughly cleaned and any worn or damaged parts replaced. See "Electrical Section for Service Procedures."

DISTRIBUTOR

A complete inspection should be made of the governor weights, springs and condenser. New points should be installed, if necessary, and properly spaced from .014 to .019 inch clearance. A few drops of oil should be put on the cam sleeve felt wick. The rotor should be examined and cleaned and the distributor cap checked for cracks. Lubricate cam with a light film of 1473595 lubricant.

SPARK PLUGS

All spark plugs should be replaced, adjust gap to .035 inch.

BATTERY

A thorough test of the battery condition should be made. A fully charged battery is usually required to start a new engine. Inspect the terminals for corrosion and tightness.

COIL AND VOLTAGE REGULATOR

A check of the efficiency of both the coil and voltage regulator is necessary. Inspection and adjustment is outlined in the Electrical Section.

WIRING

All exposed wiring should be inspected and replaced if found to be oil soaked or deteriorated.

MANIFOLDS

Before installing the manifolds, remove all carbon, gum, or other foreign substance in the ports. This will prevent restrictions which cause loss of power. It has been found necessary, in some instances, to sandblast the ports of the intake manifold to remove gum accumulations.

OIL LINES

All oil lines should be cleaned internally and externally before attaching to the new engine.

CARBURETOR

The carburetors should be disassembled and thoroughly cleaned inside and out to remove gum or other residue. To remove gum or residue, a suitable commercial solvent such as denatured alcohol, acetone, or butyl cellosolve should be used. Examine the float level for proper height setting.

FUEL PUMP

The fuel pump strainer, bowl and screen should be thoroughly cleaned and the diaphragm checked before assembling.

THERMOSTATS

Before installing the thermostats, test their operation in hot water.

Although all Marine Replacement and Short Engines, less accessories, are thoroughly inspected at the factory, it is essential that proper care and attention be given the new units especially during the break-in period.

The importance of proper operation and maintenance must not be overlooked. A new Operating Instructions Book will be supplied with each new Marine Replacement and Short Engine since all of the operating and break-in instructions contained in this booklet are applicable and essential to efficient operation.

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