ENGINE COOLANT

Engine coolant is considered as any solution which is circulated through the engine to provide the means for heat transfer from the different engine components. In general, water containing various materials in solution is used for this purpose.

The function of the coolant is basic to the design and to the successful operation of the engine. Therefore, coolant must be carefully selected and properly maintained.

COOLANT REQUIREMENTS

A suitable coolant solution must meet the following basic requirements:

1. Provide for adequate heat transfer.

2. Provide a corrosion resistant environment within the cooling system.

3. Prevent formation of scale or sludge deposits in the cooling system.

4. Be compatible with the cooling system hose and seal materials.

5. Provide adequate freeze protection during cold weather operation.

The first four requirements are satisfied by combining a suitable water with reliable inhibitors. When operating conditions dictate the need for freeze protection, a solution of suitable water and a permanent antifreeze containing adequate inhibitors will provide a satisfactory coolant.

WATER

Any water, whether of drinking quality or not, will produce a corrosive environment in the cooling system. Also, scale deposits may form on the internal surfaces of the cooling system due to the mineral content of the water. Therefore, water selected as a coolant must be properly treated with inhibitors to control corrosion and scale deposition.

To determine if a particular water is suitable for use as a coolant when properly inhibited, the following characteristics must be considered: the concentration of chlorides, sulfates, total hardness and dissolved solids. Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium present) causes deposits of scale. Total dissolved solids may cause scale deposits, sludge deposits, corrosion or a combination of these. Chlorides, sulfates, magnesium and calcium are among but not necessarily all the materials which make up dissolved solids. Water, within the limits specified in Tables 1 and 2 of Fig. 1, is satisfactory as an engine coolant when proper inhibitors are added.

CORROSION INHIBITORS

A corrosion inhibitor is a water soluble chemical compound which protects the metallic surfaces of the cooling system against corrosive attack. Some of the

TABLE 1

	PARTS PER MILLION	GRAINS PER GALLON
Chlorides (Maximum)	40	2.5
Sulfates (Maximum)	100	5.8
Total Dissolved Solids (Maximum)	340	20
Total Hardness (Maximum)	170	10

Refer to Table 2 for evaluation of water intended for use in a coolant solution.

TABLE 2

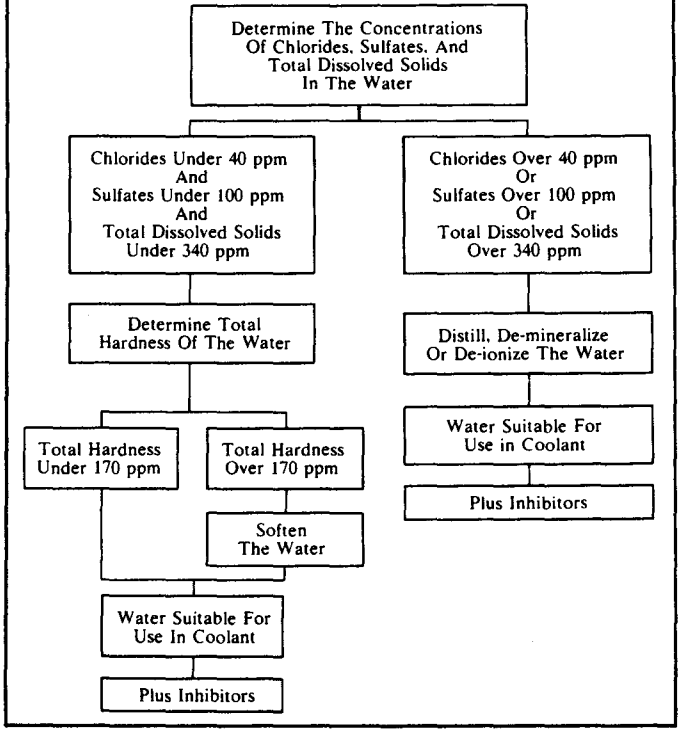

Fig. 1 - Water Characteristics

more commonly used corrosion inhibitors are chromates, borates, nitrates, nitrites and soluble oil. Depletion of all types of inhibitors occurs through normal operation. Therefore, strength levels must be maintained by the addition of inhibitors at prescribed intervals. Always follow the supplier's recommendations on inhibitor usage and handling.

Chromates

Sodium chromate and potassium dichromate are two of the best and most commonly used *water* system corrosion inhibitors. However, the restrictive use of these materials, due to ecology considerations, has deemphasized their use in favor of non-chromates. Care should be exercised in handling these materials due to their toxic nature.

Chromate inhibitors should *not* be used in permanent type antifreeze solutions. Chromium hydroxide, commonly called "green slime", can result from the use of chromate inhibitors with permanent type antifreeze. This material deposits on the cooling system passages, reducing the heat transfer rate (Fig. 2) and results in engine overheating. Engines which have operated with a chromate-inhibited water must be chemically cleaned before the addition of permanent antifreeze. A commercial heavy-duty descaler should be used in accordance with the manufacturer's recommendation for this purpose.

Soluble Oil

Soluble oil has been used as a corrosion inhibitor for many years. It has, however, required very close attention relative to the concentration level due to adverse effects on heat transfer if the concentration exceeds 1% by volume. For example: 1 1/4% of soluble oil in the cooling system increases fire deck temperature 6% and a 2 1/2% concentration raises fire deck temperature up to 15%. Soluble oil is *not* recommended as a corrosion inhibitor.

Non-chromates

Non-chromate inhibitors (borates, nitrates, nitrites, etc.) provide corrosion protection in the cooling system with the basic advantage that they can be used with either water or a water and permanent antifreeze solution.

INHIBITOR SYSTEMS

An inhibitor system (Fig. 3) is a combination of

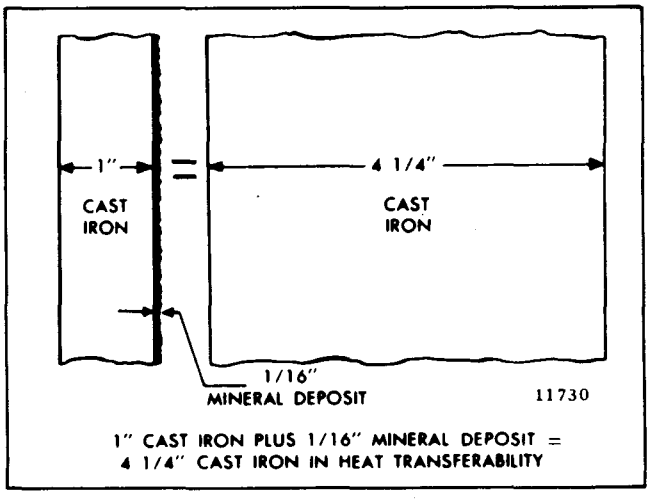

Fig. 2 - Heat Transfer Capacity

chemical compounds which provide corrosion protection, pH control and water softening ability. Corrosion protection is discussed under the heading *Corrosion Inhibitors.* The pH control is used to maintain an acid-free solution. The water softening ability deters formation of mineral deposits. Inhibitor systems are available in various forms such as coolant filter elements, liquid and dry bulk inhibitor additives, and as an integral part of permanent antifreeze.

Coolant Filter Elements

Replaceable elements are available with various chemical inhibitor systems. Compatibility of the element with other ingredients of the coolant solution cannot always be taken for granted.

Problems have developed from the use of the magnesium lower support plate used by some manufacturers in their coolant filters. The magnesium plate will be attacked by solutions which will not be detrimental to other metals in the cooling system. The dissolved magnesium will be deposited in the hottest zones of the engine where heat transfer is most critical. The use of an aluminum or zinc support plate in preference to magnesium is recommended to eliminate the potential of this type of deposit. High chloride coolants will have a detrimental effect on the water softening capabilities of systems using ion-exchange resins. Accumulations of calcium and magnesium ions removed from the coolant and held captive by the zeolite resin can be released into the coolant by a regenerative process caused by high chloride content solutions.

Inhibitor or Inhibitor System	Corrosion Inhibitor Type	Inhibitor Compatability			
		Complete Inhibitor System	Water	Ethylene Glycol Base Antifreeze	*Methoxy Propanol Base Antifreeze
Sodium chromate	Chromate	No	Yes	No	No
Potassium dichromate	Chromate	No	Yes	No	No
Perry filter elements:					
5020 (type OS)	Chromate	Yes	Yes	No	No
S-453 (Spin-on)	Chromate	Yes	Yes	No	No
5030 (type OS)	@Non-chromate	Yes	Yes	Yes	No
S-331 (Spin-on)	@Non-chromate	Yes	Yes	Yes	No
5070 (type OS)	# Non-chromate	Yes	Yes	Yes	No
S-473 (Spin-on)	# Non-chromate	Yes	Yes	Yes	No
Lenroc filter element	Non-chromate	Yes	Yes	Yes	No
Fleetguard filter elements:					
DCA (canister)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on) (Eth. Gly.)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on) (Meth. Prop.)	Non-chromate	Yes	No	No	Yes
AC filter elements:					
DCA (canister)	Non-chromate	Yes	Yes	Yes	No
DCA (Spin-on)	Non-chromate	Yes	Yes	Yes	No
Luber-Finer filter elements:					
LW-4739 (canister)	Non-chromate	Yes	Yes	Yes	No
LFW-4744 (spin-on)	Non-chromate	Yes	Yes	Yes	No
Nalcool 2000 (liquid)	Non-chromate	Yes	Yes	Yes	No
Perry LP-20 (liquid)	Non-chromate	Yes	Yes	Yes	No
Sy-Cool (liquid)	Non-chromate	Yes	Yes	Yes	No
Lubercool (liquid)	Non-chromate	Yes	Yes	Yes	No
Dowtherm cooling system conditioner	Non-chromate	Yes	Yes	Yes	Yes

*Dowtherm 209, or equivalent. @Perry "Year Around" formula. # Perry "Universal" formula.

Fig. 3 - Coolant Inhibitor Chart

Bulk Inhibitor Additives

Commercially packaged inhibitor systems are available which can be added directly to the engine coolant or to bulk storage tanks containing coolant solution. Both chromate and non-chromate systems are available and care should be taken regarding inhibitor compatibility with other coolant constituents.

Non-chromate inhibitor systems are recommended for use in Detroit Diesel engines. These systems can be used with either water or permanent antifreeze solutions and provide corrosion protection, pH control and water softening. Some non-chromate inhibitor systems offer the additional advantage of a simple on-site test to determine protection level and, since they are added directly to the coolant, require no additional hardware or plumbing.

All inhibitors become depleted through normal

operation and additional inhibitor must be added to the coolant at prescribed intervals to maintain original strength levels. Always follow the supplier's recommendations on inhibitor usage and handling.

NOTE: Methoxy propanol base permanent antifreeze (such as Dowtherm 209, or equivalent) must be re-inhibited only with compatible corrosion inhibitor systems.

ANTIFREEZE

When freeze protection is required, a permanent antifreeze must be used. An inhibitor system is included in this type of antifreeze and no additional inhibitors are required on initial fill if a minimum antifreeze concentration of 30% by volume is used. Solutions of less than 30% concentration do not provide sufficient corrosion protection. Concentrations over 67% adversely affect freeze protection and heat transfer rates (Fig. 4).

Methoxy propanol base antifreeze is not recommended for use in Detroit Diesel engines due to the presence of fluoroelastomer (Viton '0') seals in the cooling system. Before installing ethylene glycol base antifreeze in an engine previously operated with methoxy propanol, the entire cooling system should be drained, flushed with clean water and examined for rust, scale, contaminants, etc. If deposits are present, the cooling system must be chemically cleaned with a commercial grade heavy-duty de-scaler.

Ethylene glycol base antifreeze is recommended for use in Detroit Diesel engines. Methyl alcohol antifreeze is *not* recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point.

The inhibitors in permanent antifreeze should be replenished at approximately 500 hour or 20,000 mile intervals with a non-chromate inhibitor sytem. Commercially available inhibitor systems may be used to re-inhibit antifreeze solutions.

Sealer Additives

Several brands of permanent antifreeze are available with sealer additives. The specific type of sealer varies with the manufacturer. Antifreeze with sealer additives is *not recommended* for use in Detroit Diesel engines due to possible plugging throughout various areas of the cooling system.

GENERAL RECOMMENDATIONS

All Detroit Diesel engines incorporate pressurized cooling systems which normally operate at temperatures higher than non-pressurized systems. It is essential that these systems be kept clean and leak-free, that filler caps and pressure relief mechanisms be correctly installed at all times and that coolant levels be properly maintained.

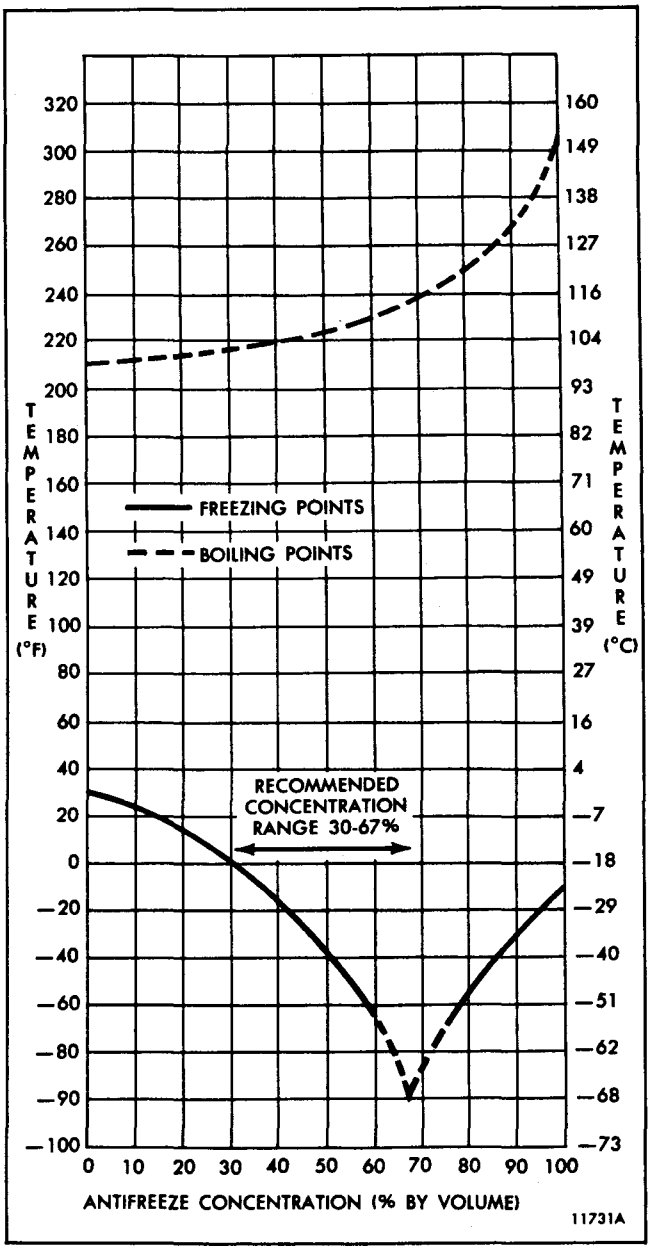

Fig. 4 - Coolant Freezing and Boiling Temperatures vs. Antifreeze Concentration (Sea Level)

WARNING: Use extreme care when removing a radiator pressure control cap from an engine. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding) from the hot liquid.

1. Always use a properly inhibited coolant.

2. Do not use soluble oil.

3. Maintain the prescribed inhibitor strength.

4. Always follow the manufacturer's recommendations on inhibitor usage and handling.

5. If freeze protection is required, always use a permanent antifreeze.

6. Re-inhibit antifreeze with a recommended non-chromate inhibitor system.

7. Do not use a chromate inhibitor with permanent antifreeze.

8. Do not use methoxy propanol base antifreeze in Detroit Diesel engines.

9. DO NOT mix ethylene glycol base antifreeze with methoxy propanol base antifreeze in the cooling system.

10. Do not use an antifreeze containing sealer additives.

11. Do not use methyl alcohol base antifreeze.

12. Use extreme care when removing the radiator pressure control cap.

ENGINE TUNE-UP PROCEDURES

There is no scheduled interval for performing an engine tune-up. As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustments in the valve and injector operating mechanisms, governor, etc. should only be required periodically to compensate for normal wear on parts.

Three types of governors are used. Since each governor has different characteristics, the tune-up procedure varies accordingly. The three types are:

1. Limiting speed mechanical.

2. Variable speed mechanical.

3. Hydraulic.

The mechanical engine governors are identified by a name plate attached to the governor housing. The letters D.W.-L.S. stamped on the name plate denote a double-weight limiting speed governor. A single-weight variable speed governor name plate is stamped S.W.-V.S.

Normally, when performing a tune-up on an engine in service, it is only necessary to check the various adjustments for a possible change in the settings. However, if the cylinder head, governor or injectors have been replaced or overhauled, then certain preliminary adjustments are required before the engine is started.

The preliminary adjustments consist of the first four items in the tune-up sequence. The procedures are the same except that the valve clearance is greater for a cold engine.

To tune-up an engine completely, all of the adjustments are made by following the applicable tune-up sequence given below after the engine has reached the normal operating temperature. Since the adjustments are normally made while the engine is stopped, it may be necessary to run the engine between adjustments to maintain normal operating temperature.

Tune-Up Sequence for Mechanical Governor

CAUTION: Before starting an engine after an engine speed control adjustment or after removal of the engine governor cover, the serviceman must determine that the injector racks move to the no-fuel position when the governor stop lever is placed in the stop position. Engine overspeed will result if the injector racks cannot be positioned at no fuel with the governor stop lever.

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the governor gap.

4. Position the injector rack control levers.

5. Adjust the maximum no-load speed.

6. Adjust the idle speed.

7. Adjust the buffer screw.

8. Adjust the throttle booster spring (variable speed governor only).

9. Adjust the supplementary governing device (if used).

Tune-Up Sequence for Hydraulic Governor

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the fuel rod.

4. Position the injector rack control levers.

5. Adjust the load limit screw.

6. Adjust the speed droop.

7. Adjust the maximum no-load speed.

NOTE: Use new valve rocker cover gasket(s) after each tune-up.

EXHAUST VALVE CLEARANCE ADJUSTMENT

The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine.

Insufficient valve clearance can result in loss of compression, misfiring cylinders, and eventually burned valve seats and valve seat inserts. Excessive valve clearance will result in noisy operation, especially in the low speed range.

Whenever the cylinder head is overhauled, the exhaust valves reconditioned or replaced, or the valve operating mechanism is replaced or disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will ensure a valve setting which is close enough to the specified clearance to prevent damage to the valves when the engine is started.

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to the *General Specifications* at the front of the manual for the engine firing order.

TWO VALVE CYLINDER HEADS

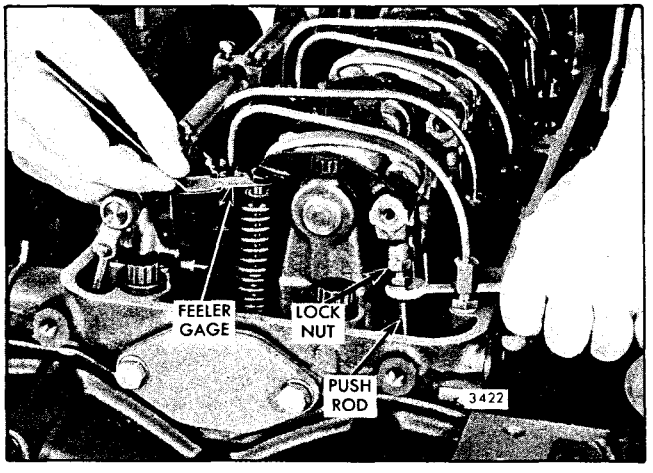

Fig. 1 - Adjusting Valve Clearance (Two-Valve Cylinder Head)

Cold Engine

1. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.

2. Remove the loose dirt from the valve rocker cover(s) and remove the cover(s).

3. Rotate the crankshaft, manually or with the starting motor, until the injector follower is fully depressed on the cylinder to be adjusted.

CAUTION: If a wrench is used on the crankshaft bolt, do not turn the engine in a left-hand direction of rotation as the bolt will be loosened.

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Place a .012" feeler gage, J 9708, between the valve stem and the rocker arm (Fig. 1). Adjust the push rod to obtain a smooth pull on the feeler gage.

6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

7. Recheck the clearance. At this time, if the adjustment is correct, the .010" gage will pass freely between the end of the valve stem and the rocker arm and the .012" gage will not pass through.

8. Check and adjust the remaining valves in the same manner as outlined above.

Hot Engine

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance, when running at full load, may become insufficient.

1. With the engine at normal operating temperature (160-185°F or 71-85°C), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .008" gage will pass freely between the end of the valve stem and the rocker arm and the .010" gage will not pass through. Readjust the push rod, if necessary.

2. After the exhaust valve clearance has been adjusted, check the fuel injector timing.

FOUR VALVE CYLINDER HEADS

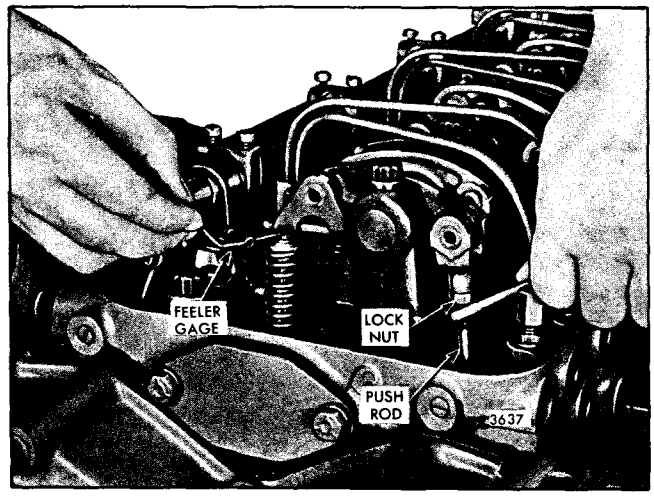

Fig. 2 - Adjusting Valve Clearance (Four-Valve Cylinder Head)

Cold Engine

1. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.

2. Remove the loose dirt from the valve rocker cover(s) and remove the cover(s).

3. Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

CAUTION: If a wrench is used on the crankshaft bolt, do not turn the engine in a left-hand direction of rotation as the bolt will be loosened.

4. Loosen the exhaust valve rocker arm push rod lock nut.

5. Place a .027" feeler gage, J 9708, between the end of one valve stem and the rocker arm bridge (Fig. 2). Adjust the push rod to obtain a smooth pull on the feeler gage.

6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

7. Recheck the clearance. At this time, if the adjustment is correct, the .025" gage will pass freely between the end of one valve stem and the rocker arm bridge and the .027" gage will not pass through. Readjust the push rod if necessary.

8. Check and adjust the remaining exhaust valves, in the same manner as above.

Hot Engine

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance, when running at full load, may become insufficient.

1. With the engine at normal operating temperature (160-185°F or 71-85°C), recheck the exhaust valve clearance with gage J 9708. At this time, if the valve clearance is correct, the .023" gage should pass freely between the end of one valve stem and the rocker arm bridge and the .025" feeler gage should not. Readjust the push rod, if necessary.

2. After the exhaust valve clearance has been adjusted, check the fuel injector timing.

TIMING FUEL INJECTOR

Injector	Timing Dimension	Tool Number
*35	1.508	J 8909
35	1.484	J 1242
40	1.484	J 1242
45	1.484	J 1242
S40	1.460	J 1853
S45	1.460	J 1853
S50	1.460	J 1853
L40	1.460	J 1853
N40	1.460	J 1853
N45	1.460	J 1853
N50	1.460	J 1853

*Reefer Car

To time a fuel injector properly, the injector follower must be adjusted to a definite height in relation to the injector body.

All of the injectors can be timed, in firing order sequence, during one full revolution of the crankshaft.

Time Fuel Injector

After the exhaust valve clearance has been adjusted, time the fuel injector as follows:

1. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.

2. Rotate the crankshaft, manually or with the starting motor, until the exhaust valves are fully depressed on the particular cylinder to be timed.

CAUTION: If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation or the bolt will be loosened.

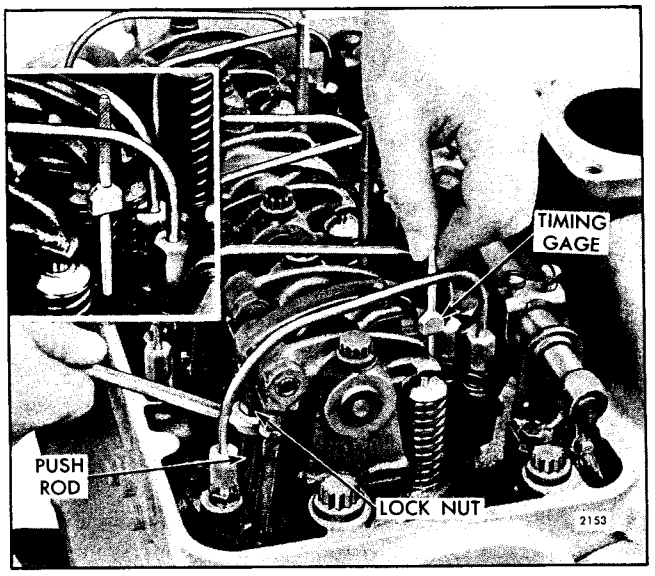

Fig. 3 - Timing Fuel Injector

3. Place the small end of the injector timing gage (see table for correct timing gage) in the hole provided in the top of the injector body, with the flat of the gage toward the injector follower as shown in Fig. 3.

4. Loosen the push rod lock nut.

5. Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

6. Hold the push rod and tighten the lock nut. Check the adjustment and readjust, if necessary.

7. Time the remaining injectors as outlined above.

8. If no further engine tune-up is required, use a new gasket(s) and install the valve rocker cover(s).

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINES

The double-weight limiting speed governor is mounted on the rear end plate of the engine and is driven by a gear that extends through the end plate and meshes with either the camshaft gear or the balance shaft gear, depending upon the engine model.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

NOTE: Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, re-connect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at operating temperature, adjust the governor gap as follows:

1. Remove the high-speed spring retainer cover.

2. Back out the buffer screw (Fig. 8) until it extends approximately 5/8" from the lock nut.

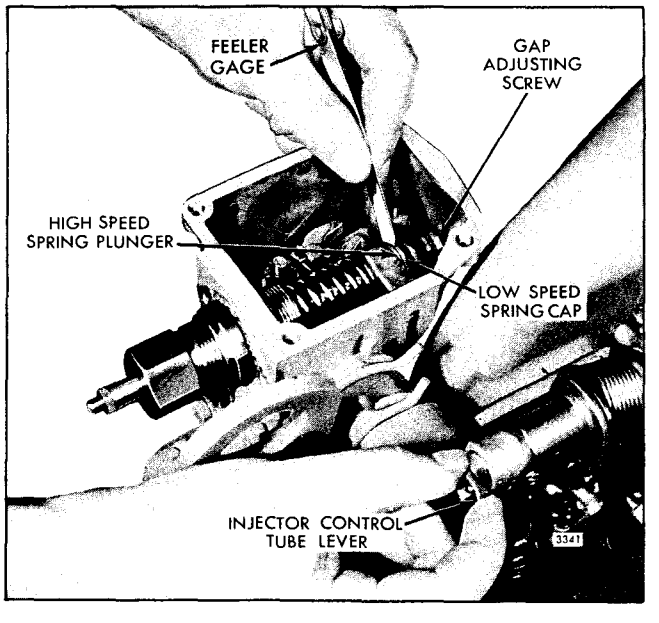

Fig. 1 - Adjusting Governor Gap

3. Start the engine and adjust the idle speed screw (Fig. 7) to obtain the desired engine idle speed. Hold the screw and tighten the lock nut to hold the adjustment.

NOTE: The recommended idle speed for non-EPA certified engines is 500-600 rpm, but may vary with special engine applications.

4. Stop the engine, clean and remove the governor cover and the valve rocker cover. Discard the gaskets.

5. Start and run the engine, between 800 and 1000 rpm by manual operation of the injector control tube lever.

CAUTION: Do not overspeed the engine.

6. Check the gap between the low-speed spring cap and the high-speed spring plunger with a .0015" feeler gage. If the gap setting is incorrect, reset the gap adjusting screw (Fig. 1). If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the governor gap and pressing a screw driver against the gap adjusting screw. Movement of

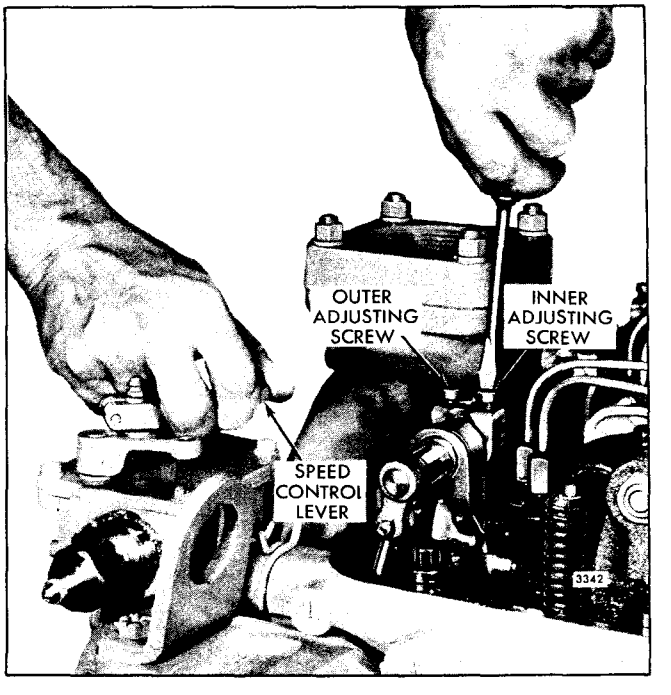

Fig. 2 - Positioning the Rear Injector Rack Control Lever

the cap toward the plunger will force the oil from the gap in the form of a small bead.

7. Hold the gap adjusting screw and tighten the lock nut.

8. Recheck the gap and readjust if necessary.

9. Stop the engine and, using a new gasket, install the governor cover. The governor cover should be placed on the housing with the pin of the speed control lever projecting into the slot of the differential lever.

10. Install the screws and lock washers finger tight. Pull the cover away from the engine and tighten the screws. This step will properly locate the cover on the governor housing.

Position Injector Rack Control Levers

The position of the injector racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load. Properly positioned injector rack control levers with the engine at full-load will result in the following:

1. Speed control lever at the full-fuel position.

2. Governor low-speed gap closed.

3. High-speed spring plunger on the seat in the governor control housing.

4. Injector racks in the full-fuel position.

Adjust the rear injector rack control lever first to establish a guide for adjusting the remaining injector rack control levers.

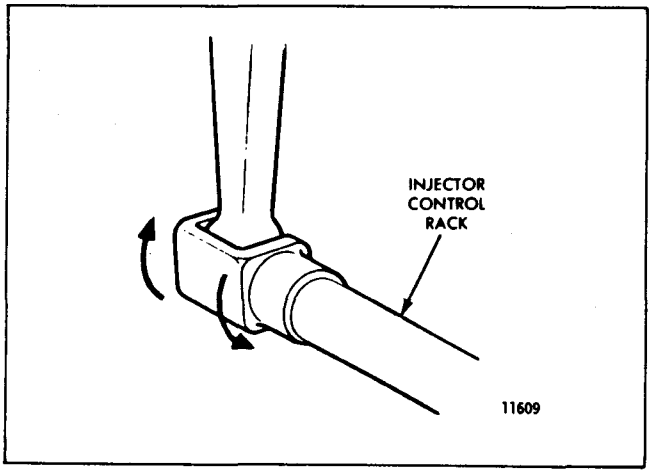

Fig. 3 - Checking Rotating Movement of Injector Control Rack

1. Disconnect any linkage attached to the speed control lever.

2. Turn the idle speed adjusting screw until 1/2" of the threads (12-14 threads) project from the lock nut, when the nut is against the high-speed plunger.

> **CAUTION:** A false fuel rack setting may result if the idle speed adjusting screw is not backed out as noted above.

> **NOTE:** This adjustment lowers the tension of the low-speed spring so it can be easily compressed. This permits closing the low speed gap without bending the fuel rods or causing the *yield mechanism springs to yield or stretch.*

3. Back out the buffer screw approximately 5/8", if it has not already been done.

4. Loosen all of the inner and outer injector rack control lever adjusting screws (Fig. 2). Be sure all of the levers are free on the injector control tube.

5. Move the speed control lever to the maximum speed position. Turn the inner adjusting screw down on the rear injector rack control lever until a step-up in effort is noted. This will place the rear injector rack in the full-fuel position. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube assembly in the

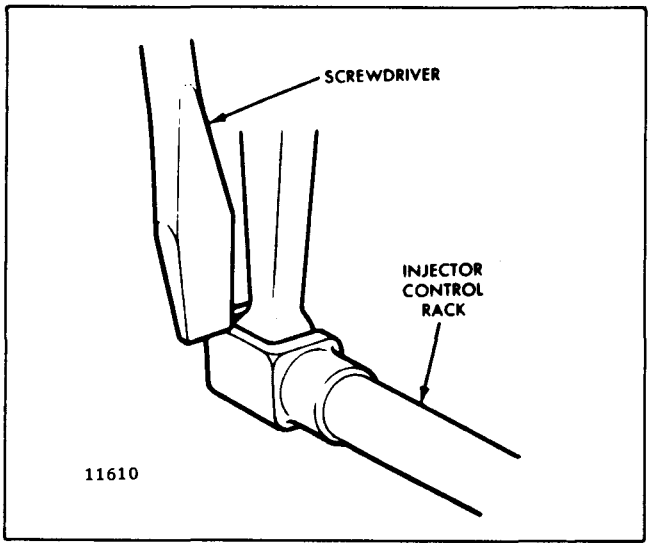

Fig. 4 - Checking Injector Rack "Spring"

same positions that they will attain while the engine is running at full-load.

6. To be sure of the proper rack adjustment, hold the speed control lever in the full-fuel position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 3) when the speed control lever is in the maximum speed position. Hold the speed control lever in the maximum speed position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 4) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the speed control lever from the no-speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

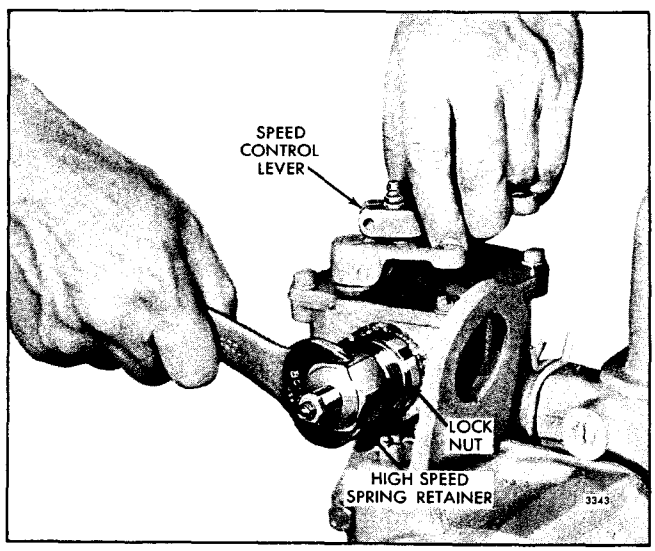

Fig. 5 - Adjusting Maximum No-Load Engine Speed (Type A)

IMPORTANT: The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full load.

7. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rod and the injector control tube lever, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube. Turn down the inner adjusting screw on the injector rack control lever of the adjacent injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

8. Recheck the rear injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while adjusting the adjacent injector. If the rack of the rear injector has become loose, back off the inner adjusting screw slightly on the adjacent injector rack control lever. Tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

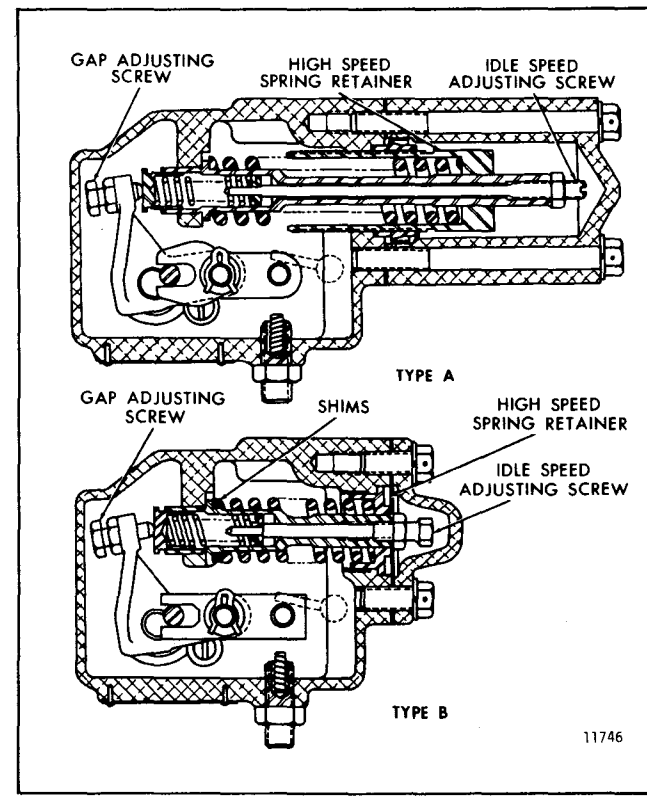

Fig. 6 - Governor Spring Assemblies

9. Position the remaining injector rack control levers as outlined in Steps 6 and 7.

10. Connect the fuel rod to the injector control tube lever.

11. Turn the idle speed adjusting screw in until it projects 3/16" from the lock nut to permit starting the engine. Tighten the lock nut.

12. Use a new gasket and replace the valve rocker cover.

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the engine option plate, set the maximum no-load speed as follows:

TYPE A GOVERNOR SPRINGS (Fig. 6):

1. Loosen the lock nut (Fig. 5) and back off the high-speed spring retainer approximately five turns.

2. With the engine at operating temperature and no-load on the engine, place the speed control lever in the full-fuel position. Turn the high-speed spring retainer IN until the engine is operating at the recommended no-load speed.

The best method of determining the engine speed is with an accurate tachometer.

3. Hold the high-speed spring retainer and tighten the lock nut.

TYPE B GOVERNOR SPRINGS (Fig. 6):

1. Start the engine and after it reaches normal operating temperature, remove the load from the engine.

2. Place the speed control lever in the maximum speed position and note the engine speed.

3. Stop the engine and, if necessary, adjust the no-load speed as follows:

a. Remove the high-speed spring retainer, high-speed spring and plunger.

CAUTION: To prevent the low-speed spring and cap from dropping into the governor, be careful not to jar the assembly while it is being removed.

b. Remove the high-speed spring from the high-speed spring plunger and add or remove shims (Fig. 6) as required to establish the desired engine no-load speed.

NOTE: For each .010" shim added, the engine speed will be increased approximately 10 rpm.

c. Install the high-speed spring on the plunger and install the spring assembly in the governor housing. Install the spring retainer in the governor housing and tighten it securely.

d. Start the engine and recheck the engine no-load speed. Repeat the procedure as necessary to establish the no-load speed.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. With the engine running at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (Fig. 7) until the engine is operating at approximately 15 rpm below the recommended idle speed.

NOTE: The recommended idle speed for non-EPA certified engines is 500-600 rpm, but may vary with special engine applications.

2. Hold the idle speed adjusting screw and tighten the lock nut.

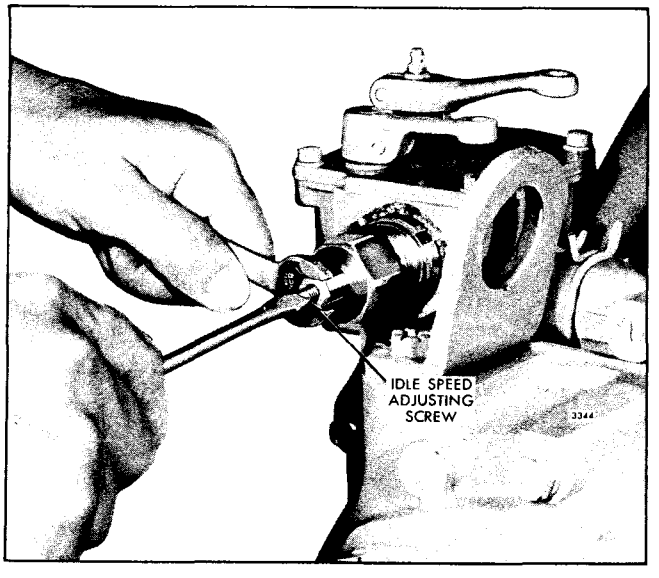

Fig. 7 - Adjusting Engine Idle Speed

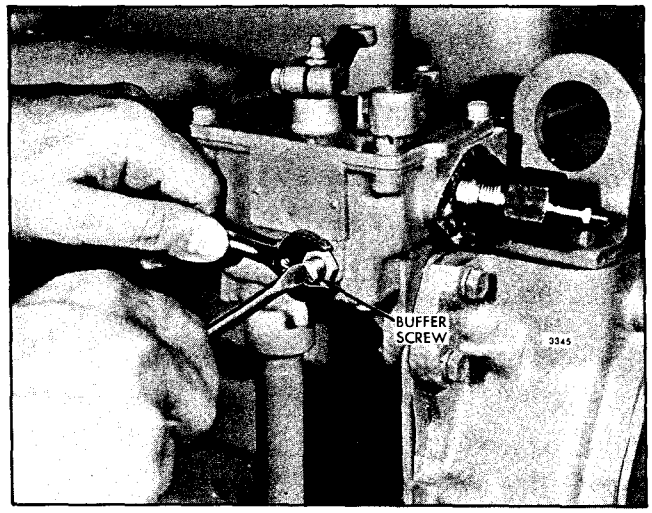

Fig. 8 - Adjusting Buffer Screw

3. Install the high-speed spring cover and tighten the two bolts.

Adjust Buffer Screw

With the idle speed properly set, adjust the buffer screw as follows:

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 8) so it contacts the differential lever as lightly as possible and still eliminates engine roll.

> **NOTE:** Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.

3. Hold the buffer screw and tighten the lock nut.

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6V-53 ENGINE

The limiting speed mechanical governor is mounted at the rear of the engine, between the flywheel housing and the blower (Fig. 1). The governor is driven by the right blower rotor drive gear. The left blower rotor drive gear is driven by a shaft, that passes through the governor housing, from the engine gear train. There are two types of limiting speed governor assemblies. The difference in the two governors is in the spring mechanism (Fig. 7). One has a long spring mechanism, the other has a short spring mechanism.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

NOTE: Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, re-connect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at operating temperature, adjust the governor gap as follows:

1. Remove the high-speed spring retainer cover.

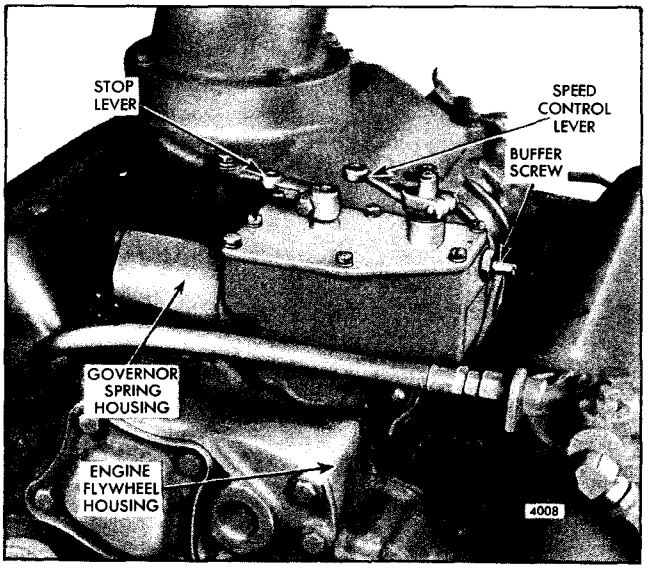

Fig. 1 - Limiting Speed Governor Mounting

2. Back out the buffer screw (Fig. 9) until it extends approximately 5/8" from the lock nut.

CAUTION: Do not back the buffer screw out beyond the limits given, or the control link lever may disengage the differential lever.

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then adjust the idle screw (Fig. 8) to obtain the desired engine idle speed. Hold the screw and tighten the lock nut to hold the adjustment.

NOTE: The recommended idle speed for non-EPA certified engines is 500-600 rpm, but may vary with special engine applications.

4. Stop the engine, clean and remove the governor cover and the valve rocker covers. Discard the gaskets.

5. Start and run the engine, between 800 and 1000 rpm, by manual operation of the differential lever.

CAUTION: Do not overspeed the engine.

6. Check the gap between the low-speed spring cap, and the high-speed spring plunger with a .0015" feeler gage. If the gap setting is incorrect, reset the gap

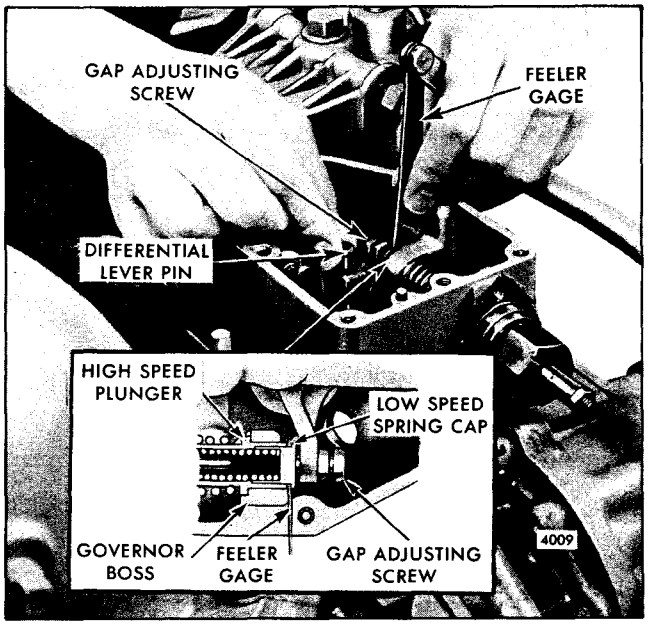

Fig. 2 - Adjusting Governor Gap

adjusting screw (Fig. 2). If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the governor gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.

7. Hold the gap adjusting screw and tighten the lock nut.

8. Recheck the gap and readjust if necessary.

9. Stop the engine and, using a new gasket, install the governor cover.

Position Injector Rack Control Levers

The position of the injector racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Properly positioned injector rack control levers with the engine at full-load will result in the following:

1. Speed control lever at the maximum speed position.

2. Governor low-speed gap closed.

3. High-speed spring plunger on the seat in the governor control housing.

4. Injector fuel control racks in the full-fuel position.

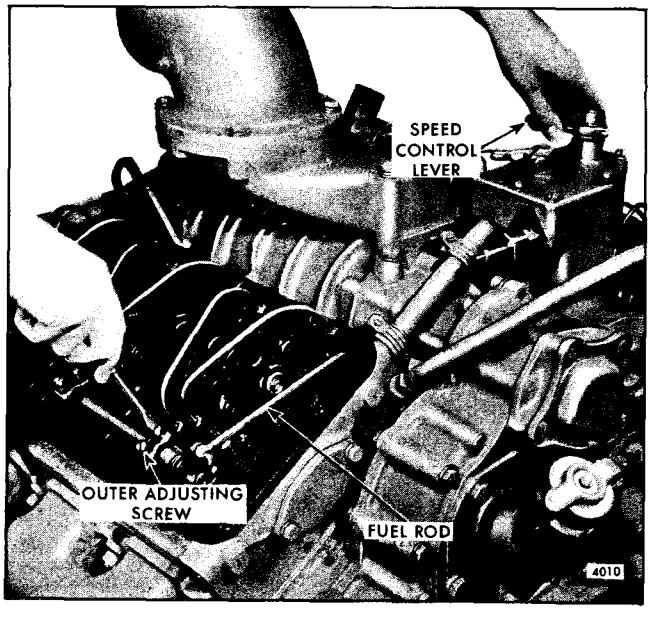

Fig. 3 - Positioning No. 3L Injector Rack Control Lever

The letters R or L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 3L injector rack control lever first to establish a guide for adjusting the remaining injector rack control levers.

1. Disconnect any linkage attached to the speed control lever.

2. Turn the idle speed adjusting screw until 1/2" of the threads (12-14 threads) project from the lock nut when the nut is against the high-speed plunger.

CAUTION: A false fuel rack setting may result if the idle speed adjusting screw is not backed out as noted above.

NOTE: This adjustment lowers the tension of the low-speed spring so it can be easily compressed. This permits closing the low speed gap without bending the fuel rods or causing the *yield mechanism springs to yield or stretch.*

3. Back out the buffer screw approximately 5/8", if it has not already been done.

4. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

5. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.

6. Move the speed control lever to the maximum speed position; hold it in that position with light finger pressure. Turn the inner adjusting screw on the

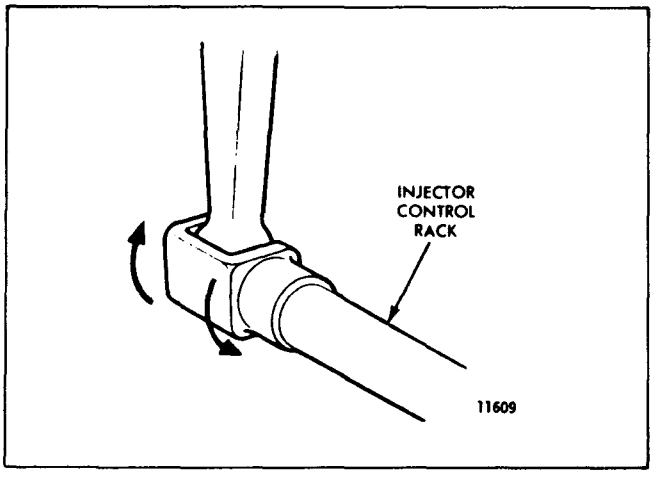

Fig. 4 - Checking Rotating Movement of Injector Control Rack

No. 3L injector rack control lever down as shown in Fig. 3 until a slight movement of the control tube lever is observed or a step-up in effort to turn the screw driver is noted. This will place the No. 3L injector in the full-fuel position. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

IMPORTANT: The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full-load.

7. To be sure of the proper rack adjustment, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 4) when the speed control lever is in the maximum speed position. Hold the speed control lever in the maximum speed position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 5) and when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

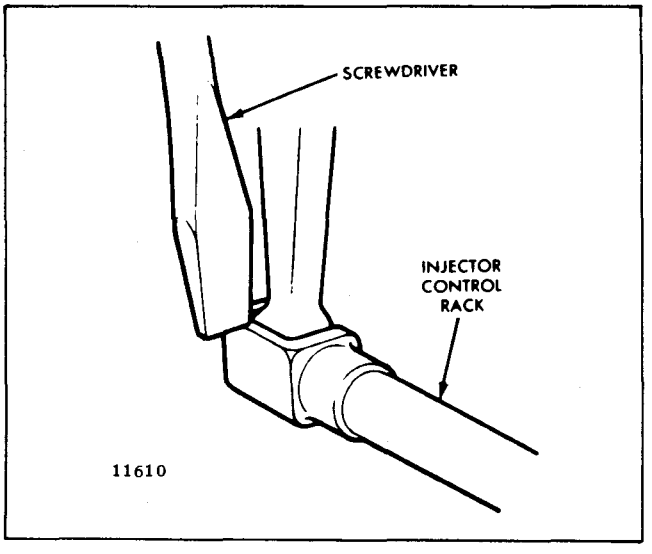

Fig. 5 - Checking Injector Control Rack "Spring"

The setting is too tight if, when moving the speed control lever from the no-speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

8. Remove the clevis pin from the fuel rod and the left bank injector control tube lever.

9. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the No. 3R injector rack control lever as previously outlined in Step 6 for the No. 3L injector rack control lever.

10. Insert the clevis pin in the fuel rod and the left cylinder bank injector control tube lever. Repeat the check on the 3L and 3R injector rack control levers as outlined in Step 7. Check for and eliminate any deflection which may occur at the bend in the fuel rod where it enters the cylinder head.

11. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube, and proceed as follows:

a. Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

b. Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

c. While still holding the control tube lever in the full-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in Step 7. Tighten the screws.

CAUTION: Once the No. 3L and No. 3R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.

NOTE: Overtightening of the injector rack control tube lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended

torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

12. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 7. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

13. Insert the clevis pin in the fuel rod and the injector control tube levers.

14. Turn the idle speed adjusting screw in until it projects 3/16" from the lock nut to permit starting the engine.

15. Use new gaskets and replace the valve rocker covers.

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the engine option plate, set the maximum no-load speed as follows:

TYPE A GOVERNOR SPRINGS (Fig. 7):

1. Loosen the lock nut with a spanner wrench and back off the high-speed spring retainer several turns. Then start the engine and increase the speed slowly. If the speed exceeds the required no-load speed before the speed control lever reaches the end of its travel, back off the spring retainer a few additional turns.

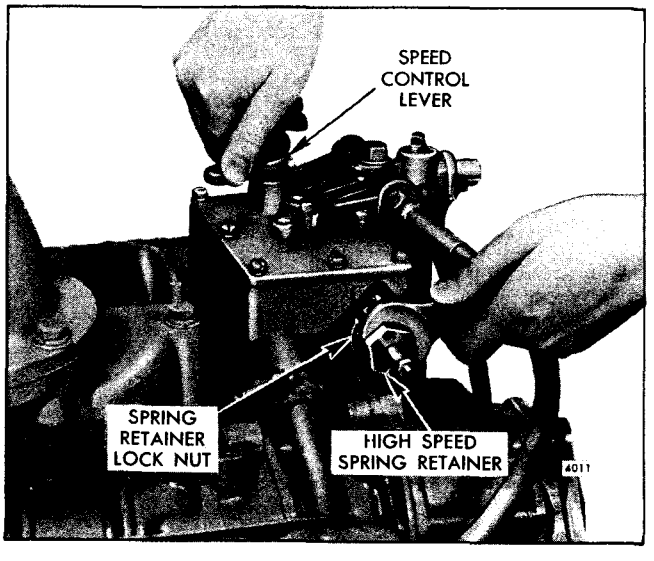

Fig. 6 - Adjusting Maximum No-Load Engine Speed

2. With the engine at operating temperature and no-load on the engine, place the speed control lever in the maximum speed position. Turn the high-speed spring retainer in (Fig. 6) until the engine is operating at the recommended no-load speed. Use an accurate hand tachometer to determine the engine speed. The maximum no-load speed varies with the full-load operating speed.

3. Hold the spring retainer and tighten the lock nut.

TYPE B GOVERNOR SPRINGS (Fig. 7):

1. Start the engine and after it reaches normal operating temperature, remove the load from the engine.

2. Place the speed control lever in the maximum speed position and note the engine speed.

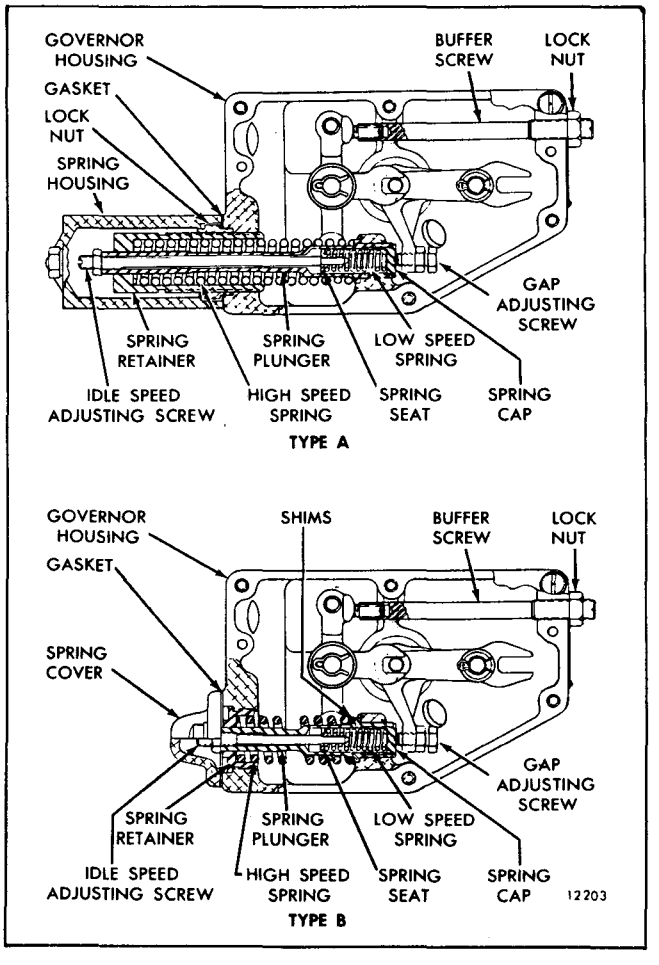

Fig. 7 - Governor Spring Assemblies

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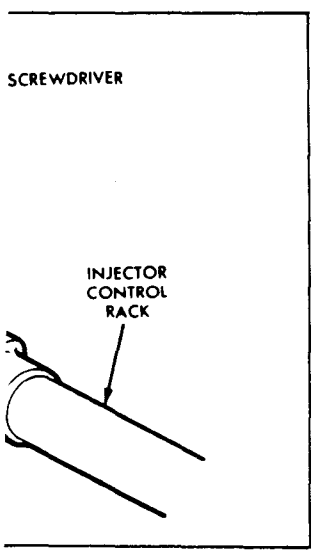

jector Control Rack
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adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the speed control lever from the no-speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

8. Remove the clevis pin from the fuel rod and the left bank injector control tube lever.

9. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the No. 3R injector rack control lever as previously outlined in Step 6 for the No. 3L injector rack control lever.

10. Insert the clevis pin in the fuel rod and the left cylinder bank injector control tube lever. Repeat the check on the 3L and 3R injector rack control levers as outlined in Step 7. Check for and eliminate any deflection which may occur at the bend in the fuel rod where it enters the cylinder head.

11. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube, and proceed as follows:

a. Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

b. Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

c. While still holding the control tube lever in the full-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in Step 7. Tighten the screws.

CAUTION: Once the No. 3L and No. 3R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.

NOTE: Overtightening of the injector rack control tube lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended

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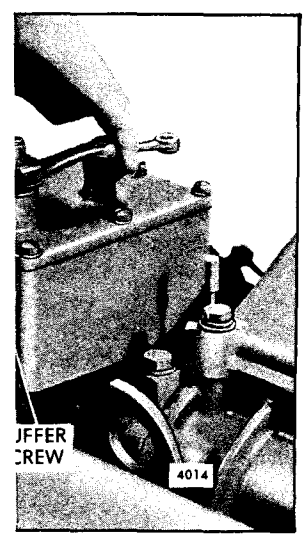


uffer Screw

VARIABLE SPEED MECHANICAL GOVERNOR (OPEN LINKAGE) AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINES

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor (Fig. 1) and the injector rack control levers.

Preliminary Governor Adjustments

1. Clean the governor linkage and lubricate the ball joints and bearing surfaces with clean engine oil.

2. Back out the buffer screw until it projects 9/16" from the boss on the control housing.

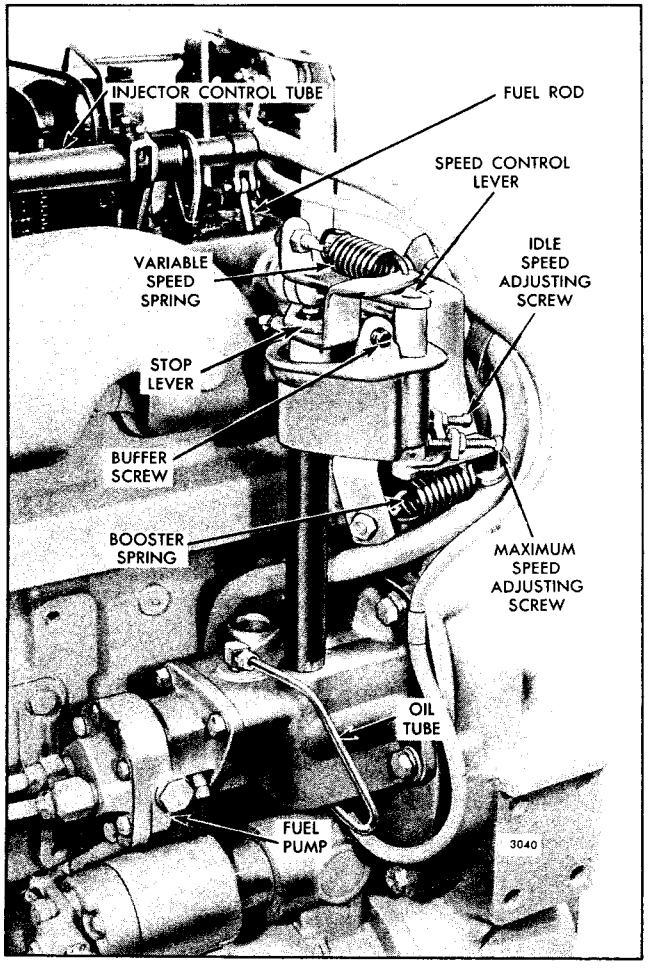


Fig. 1 - Variable Speed Open Linkage Governor Mounted on Engine

3. Back out the booster spring eye bolt until it is flush with the outer lock nut.

Adjust Variable Speed Spring Tension

1. Adjust the variable speed spring eye bolt until 1/8" of the threads project from the outer lock nut (Fig. 2).

2. Tighten both lock nuts to retain the adjustment.

NOTE: This setting of the eye bolt will produce approximately 7% droop in engine speed from no-load to full-load.

Position Injector Rack Control Levers

The position of the injector control racks must be correctly set in relation to the governor. Their position

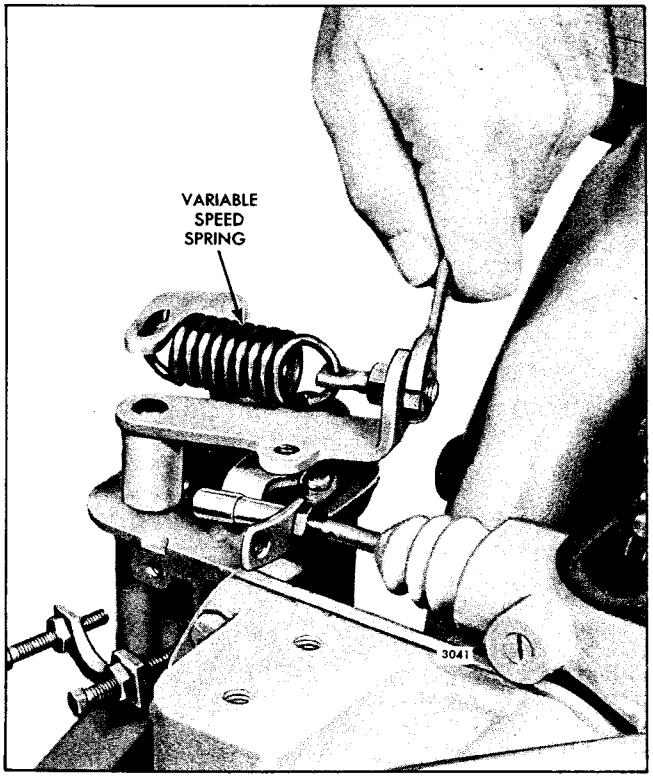


Fig. 2 - Adjusting Governor Spring Eye Bolt

determines the amount of fuel injected into each cylinder and ensures equal distribution of the load. Adjust the rear injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Clean and remove the valve rocker cover. Discard the gasket.

2. Disconnect the fuel rod at the stop lever.

3. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the injector rack control levers are free on the injector control tube.

4. Move the speed control lever to the maximum speed position.

5. Adjust the rear cylinder injector rack control lever adjusting screws (Fig. 3) until both screws are equal in height and tight on the injector control tube.

6. Move the rear injector control rack into the full-fuel position and note the clearance between the fuel rod and the cylinder head bolt. The clearance should be 1/32" or more. If necessary, readjust the injector rack adjusting screws until a clearance of at least 1/32" to 1/16" exists. Tighten the adjustment screws.

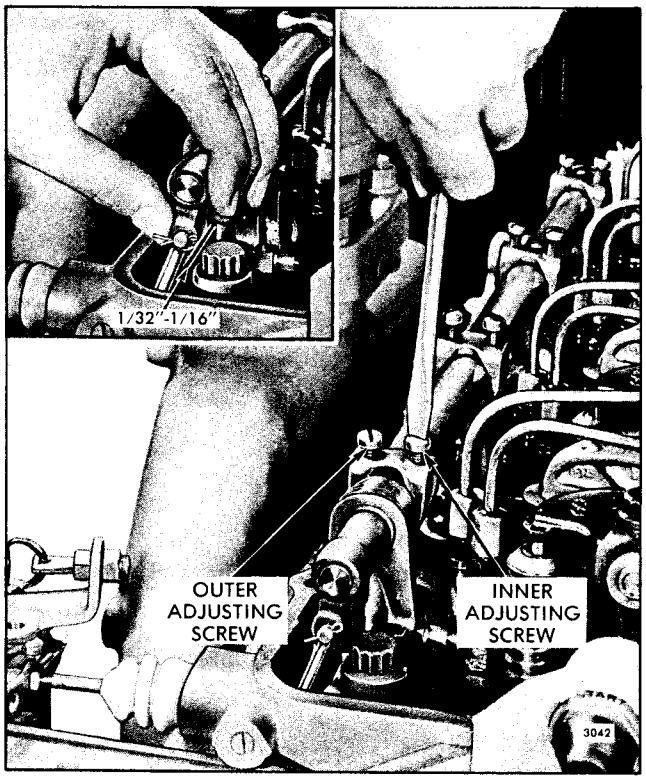


Fig. 3 - Adjusting Injector Rack Control Lever Adjusting Screws

7. Loosen the nut which locks the ball joint on the fuel rod. Hold the fuel rod in the full-fuel position and adjust the ball joint until it is aligned and will slide on the ball stud on the stop lever (Fig. 4). Position the shutdown cable clip and tighten the fuel rod lock nut to retain the adjustment.

8. Check the adjustment by pushing the fuel rod toward the engine and make sure the injector control rack is in the full-fuel position. If necessary, readjust the fuel rod.

9. Manually hold the rear injector rack in the full-fuel position, with the lever on the injector control tube, and turn the inner adjusting screw of the adjacent injector rack control lever down until the injector rack moves into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

10. Recheck the rear injector rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector rack. If the rack of the rear injector has become loose, back off the inner adjusting screw slightly on the adjacent injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

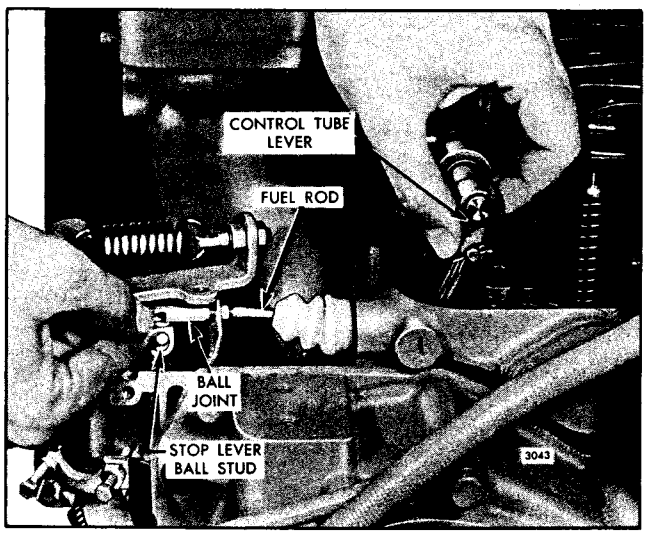


Fig. 4 - Adjusting Fuel Rod Length

11. Position the remaining injector rack control levers as outlined in Steps 9 and 10.

Adjust Maximum No-Load Speed

1. With the engine running, move the speed control lever to the maximum speed position. Use an accurate tachometer to determine the no-load speed of the engine.

NOTE: Do not overspeed the engine.

2. Loosen the lock nut and adjust the maximum speed adjusting screw (Fig. 5) until the required no-load speed is obtained.

3. Hold the adjusting screw and tighten the lock nut.

Adjust Engine Idle Speed

1. Make sure the stop lever is in the run position and place the speed control lever in the idle position.

2. With the engine running at normal operating temperature, loosen the lock nut and turn the idle speed adjusting screw (Fig. 6) until the engine idles at the recommended speed. The recommended idle speed is 500 rpm. However, the idle speed may vary with special engine applications.

3. Hold the idle speed adjusting screw and tighten the lock nut.

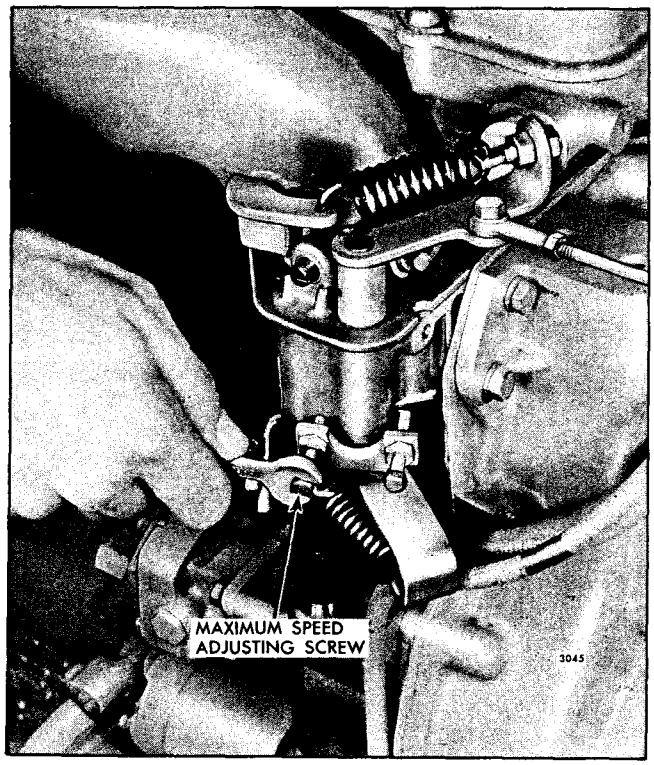


Fig. 5 - Adjusting Maximum No-Load Engine Speed

Adjust Buffer Screw

1. With the engine running at idle speed, turn the buffer screw in (Fig. 7) so that it contacts the stop lever as lightly as possible and still eliminates engine roll.

NOTE: Do not raise the engine idle speed more than 20 rpm with the buffer screw. Check the maximum no-load speed to make sure it has not increased over 25 rpm by the buffer screw setting.

Adjust Governor Booster Spring

The governor booster spring is used on some engines to reduce the force necessary to move the speed control lever from the idle speed position to the maximum speed position. Adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Reduce the tension on the booster spring, if not

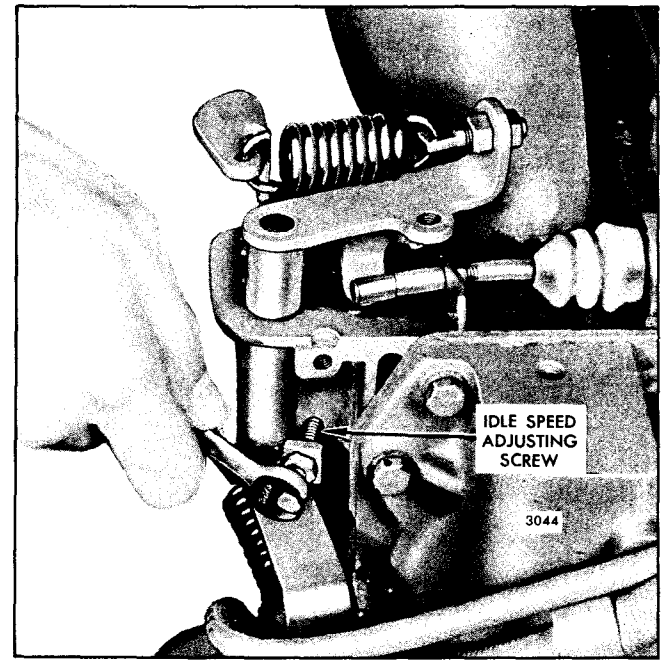


Fig. 6 - Adjusting Idle Speed

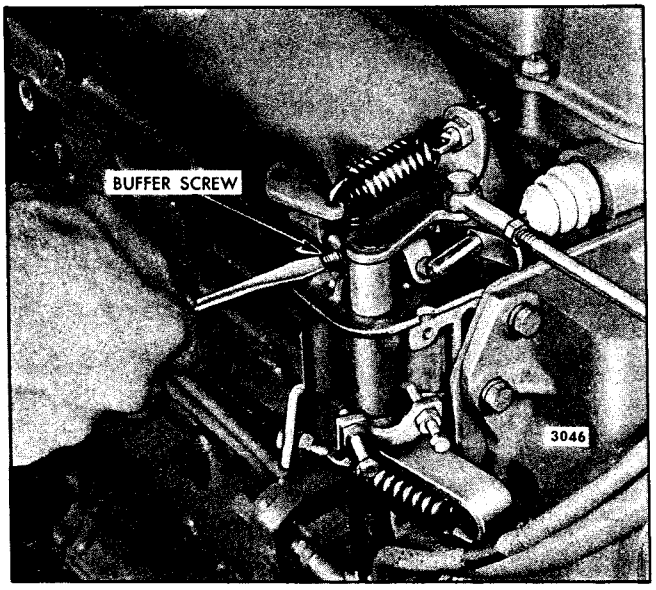


Fig. 7 - Adjusting Buffer Screw

previously performed, to the minimum by backing off the outer lock nut (Fig. 8) until the end of the booster spring eye bolt is flush with the end of the nut.

3. Adjust the eye bolt in the slot in the bracket so that an imaginary line through the booster spring will align with an imaginary center line through the speed control shaft. Secure the lock nuts on the eye bolt to retain the adjustment.

4. Move the speed control lever to the maximum speed position and note the force required. To reduce the force, back off the inner lock nut and tighten the outer lock nut to increase the tension on the booster spring.

NOTE: Before tightening the lock nuts, reposition the booster spring as in Step 3.

The setting is correct when the speed control lever can be moved from the idle speed position to the maximum speed position with a constant force, while the engine is running, and when released it will return to the idle speed position.

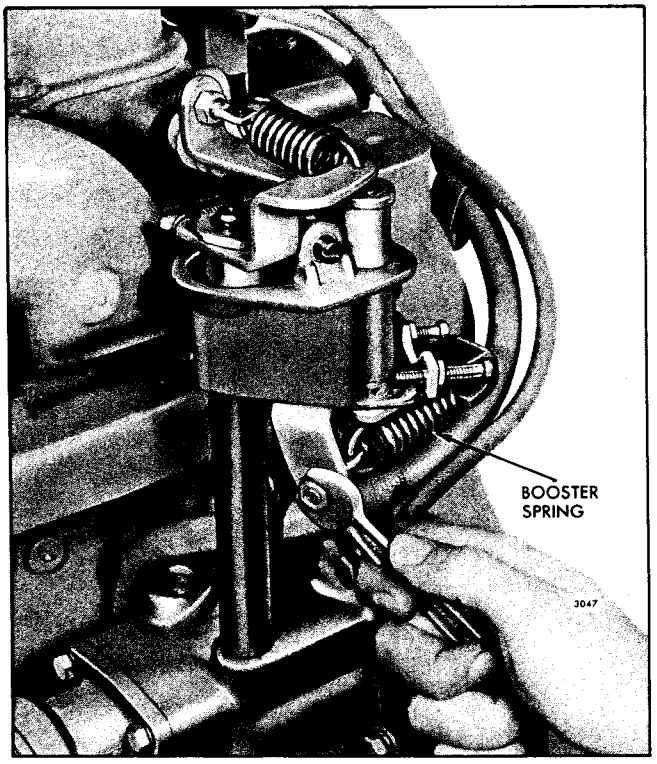


Fig. 8 - Adjusting Booster Spring

Adjust Engine Speed Droop

The adjustment of the spring tension as outlined under *Adjust Variable Speed Spring Tension* will result in approximately 7% droop from the maximum no-load speed to the full-load speed. This is the optimum droop setting for most applications. However, the droop may be changed as necessary for a particular engine application.

1. Lower the speed droop by increasing the spring tension.

2. Raise the speed droop by decreasing the spring tension.

NOTE: A change in the variable speed spring tension will change the maximum no-load speed and the engine idle speed which must also be readjusted.

VARIABLE SPEED MECHANICAL GOVERNOR (ENCLOSED LINKAGE) AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINES

The single-weight variable speed governor is mounted on the rear end plate of the engine and is driven by a gear that extends through the end plate and meshes with either the camshaft gear or the balance shaft gear, depending upon the engine model.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

NOTE: Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at operating temperature, adjust the governor gap as follows:

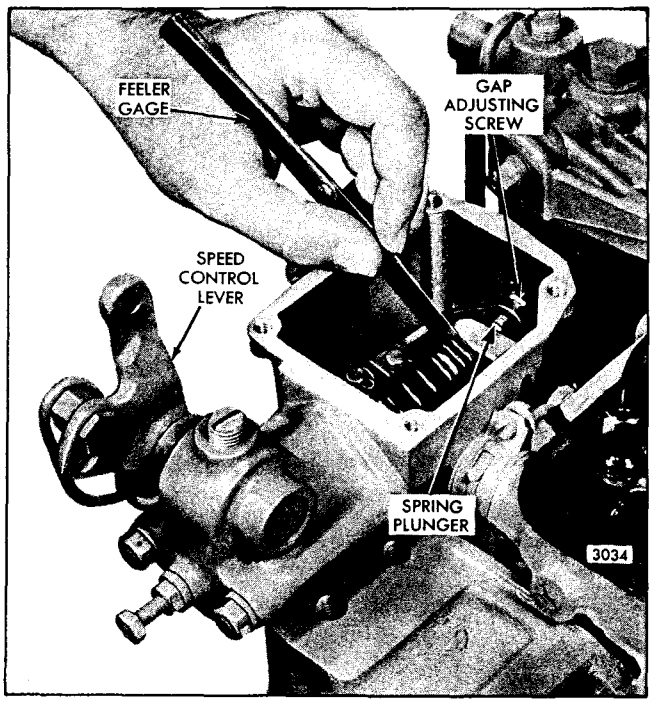


Fig. 1 - Checking Governor Gap

1. Disconnect any linkage attached to the governor levers.

2. Back out the buffer screw until it extends approximately 5/8" from the lock nut.

3. Clean and remove the governor cover and valve rocker cover. Discard the gaskets.

4. Place the speed control lever (Fig. 1) in the maximum speed position.

5. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 1. If required, loosen the lock nut and turn the gap adjusting screw in or out until a slight drag is noted on the feeler gage.

6. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

7. Use a new gasket and install the governor cover as follows:

a. Place the cover on the governor housing, with the

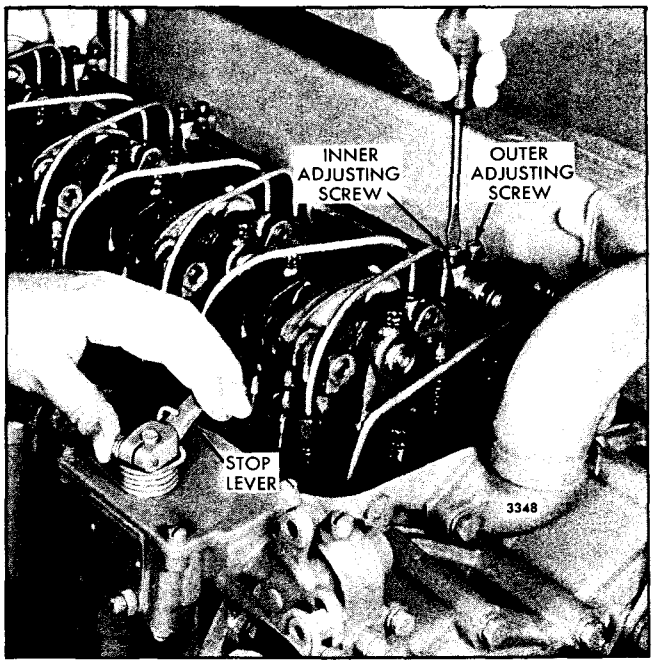


Fig. 2 - Positioning the Rear Injector Rack Control Lever

pin in the throttle shaft assembly entering the slot in the differential lever.

b. Install the four cover screws and lock washers finger tight.

c. Pull the cover assembly in a direction away from the engine, to take up the slack, and tighten the cover screws.

NOTE: This step is required since no dowels are used to locate the cover on the housing.

Position Injector Rack Control Levers

The position of the injector control rack levers must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load. Properly positioned injector control rack levers with the engine at full-load will result in the following:

1. Speed control lever at the maximum speed position.

2. Stop lever in the RUN position.

3. Injector fuel control racks in the full-fuel position.

Adjust the rear injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Loosen all of the inner and outer injector rack control lever adjusting screws (Fig. 2). Be sure all of the levers are free on the injector control tube.

2. Move the speed control lever to the maximum speed position.

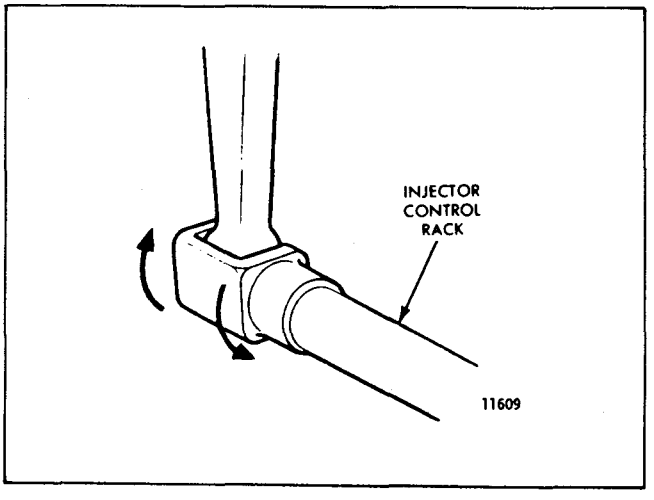


Fig. 3 - Checking Rotating Movement of Injector Control Rack

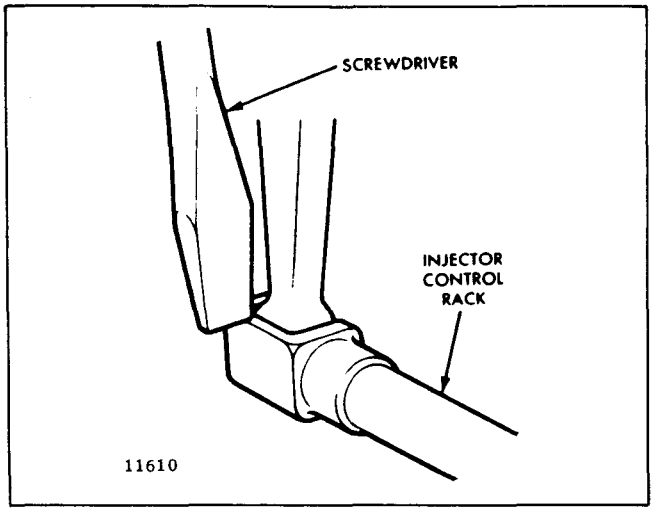


Fig. 4 - Checking Injector Control Rack "Spring"

3. Move the stop lever to the RUN position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the rear injector rack control lever down until a slight movement of the control tube is observed or a step-up in effort to turn the screw driver is noted. This will place the rear injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full load.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lbs** (3-4 Nm).

4. To be sure of proper rack adjustment, hold the stop lever in the RUN position and press down on the injector rack with a screw driver or finger tip and note "rotating" movement of the injector control rack (Fig. 3). Hold the stop lever in the RUN position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 4) and, when the pressure of the screw driver is released, the control rack should "spring" back upward.

If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the STOP to the RUN position, the injector rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort

required to move the stop lever to the RUN position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is found to be too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

5. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rod and the injector control tube lever, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube. Turn down the inner adjusting screw on the injector rack control lever of the adjacent injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

6. Recheck the rear injector rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector rack. If the rack of the rear injector has become loose, back off the inner adjusting screw slightly on the adjacent injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

7. Position the remaining injector rack control levers as outlined in Steps 4, 5 and 6.

8. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 4. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

9. Insert the clevis pin in the fuel rod and the injector control tube levers.

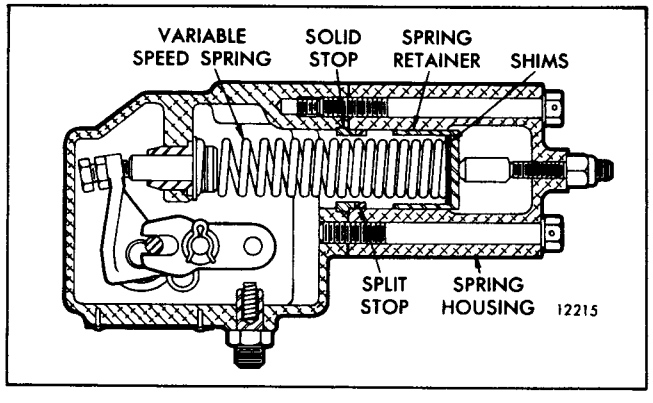


Fig. 5 - Locating of Shims and Stops

10. Use a new gasket and replace the valve rocker cover.

Adjust Maximum No-Load Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the option plate, the maximum no-load speed may be set as follows:

Start the engine and, after it reaches normal operating temperature, determine the maximum no-load speed of the engine with an accurate tachometer. Then stop the engine and make the following adjustments, if required.

1. Refer to Fig. 8 and disconnect the booster spring and the stop lever retracting spring.

2. Remove the variable speed spring housing and the variable speed spring retainer located inside of the housing.

3. Refer to Table 1 and determine the stops or shims required for the desired full-load speed. Do not use more than four thick and one thin shim. A split stop can only be used with a solid stop (Fig. 5).

4. Install the variable speed spring retainer and housing and tighten the two bolts.

5. Connect the booster spring and stop lever spring. Start the engine and recheck the maximum no-load speed.

6. If required, add shims to obtain the necessary operating speed. For each .001" in shims added, the operating speed will increase approximately 2 rpm.

IMPORTANT: If the maximum no-load speed is raised or lowered more than 50 rpm by the

Full Load Speed RPM	STOPS		SHIMS
	Solid Ring	Split Ring	
2575-2800	0	0	As Required
2101-2575	1	0	As Required
1701-2100	1	1	As Required
1200-1700	1	2	As Required

TABLE 1

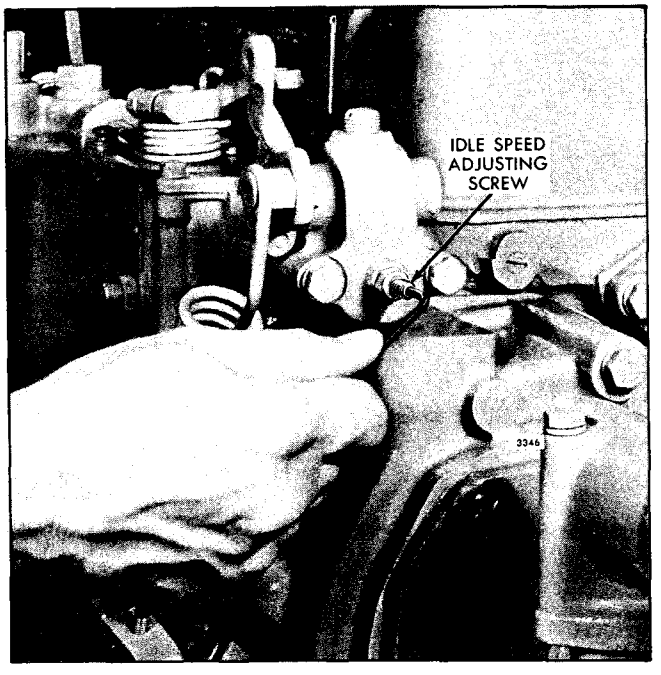


Fig. 6 - Adjusting Idle Speed

installation or removal of shims, recheck the governor gap. If readjustment of the governor gap is required, the position of the injector racks must be rechecked.

NOTE: Governor stops are used to limit the compression of the governor spring which determines the maximum speed of the engine.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. Place the stop lever in the RUN position and the speed control lever in the IDLE position.

2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.

3. Loosen the lock nut and turn the idle speed adjusting screw (Fig. 6) until the engine is operating at approximately 15 rpm below the recommended idle speed.

The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the lock nut.

Fig. 7 - Adjusting Buffer Screw

Adjust Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 7) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

NOTE: Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the lock nut.

Adjust Booster Spring

With the engine idle speed adjusted, adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Refer to Fig. 8 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the booster spring.

3. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginary line through the bolt, lever shaft and eye bolt. Hold the bolt and tighten the lock nut.

4. Start the engine and move the speed control lever to the maximum speed position and release it. The lever should return to the idle speed position. If it does not, reduce the tension on the booster spring. If it does, continue to increase the spring tension until the point is reached where it will not return to idle. Then reduce

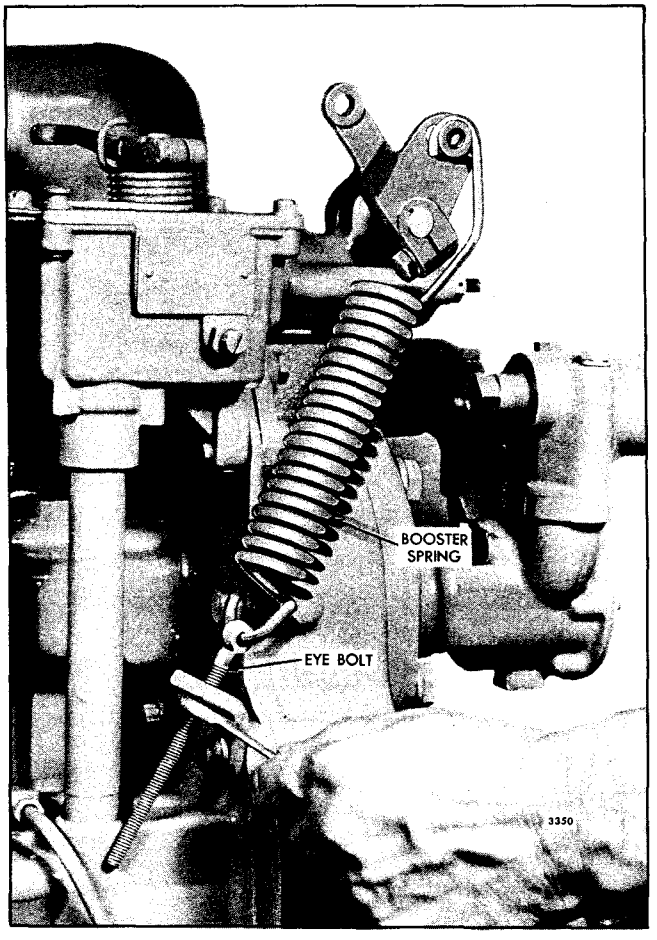


Fig. 8 - Adjusting Booster Spring

the spring tension until the lever does return to idle and tighten the lock nuts on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.

5. Connect the linkage to the governor levers.

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6V-53 ENGINE

The variable speed mechanical governor assembly is mounted at the rear of the 6V engine, between the flywheel housing and the blower (Fig. 1). The governor is driven by the right-hand blower rotor drive gear.

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and position the injector rack control levers.

> **NOTE:** Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Adjust Governor Gap

With the engine stopped and at normal operating temperature, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.

2. Back out the buffer screw until it extends approximately 5/8" from the lock nut.

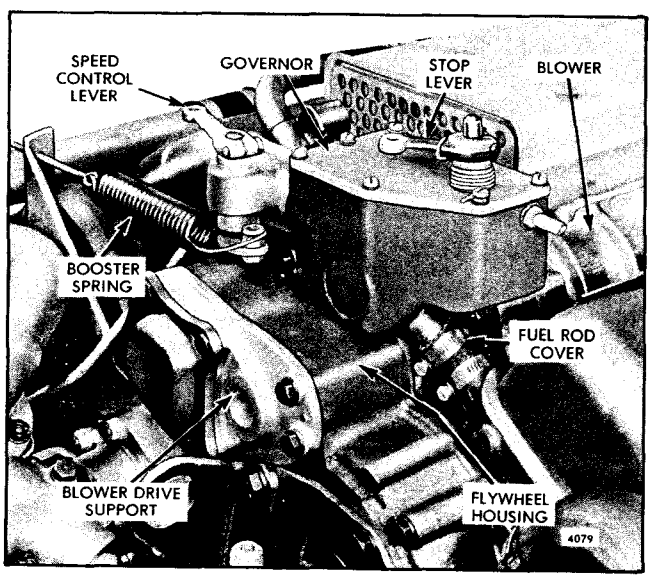


Fig. 1 - Variable Speed Governor Mounting

3. Clean and remove the governor cover and the valve rocker covers. Discard the gaskets.

4. Place the speed control lever in the maximum speed position.

5. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 2. If required, loosen the lock nut and turn the adjusting screw in or out until a slight drag is noted on the feeler gage.

6. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

7. Use a new gasket and install the governor cover.

Position Injector Rack Control Levers

The position of the injector control racks must be correctly set in relation to the governor. Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Properly positioned injector rack control levers with the engine at full-load will result in the following:

1. Speed control lever at the maximum speed position.

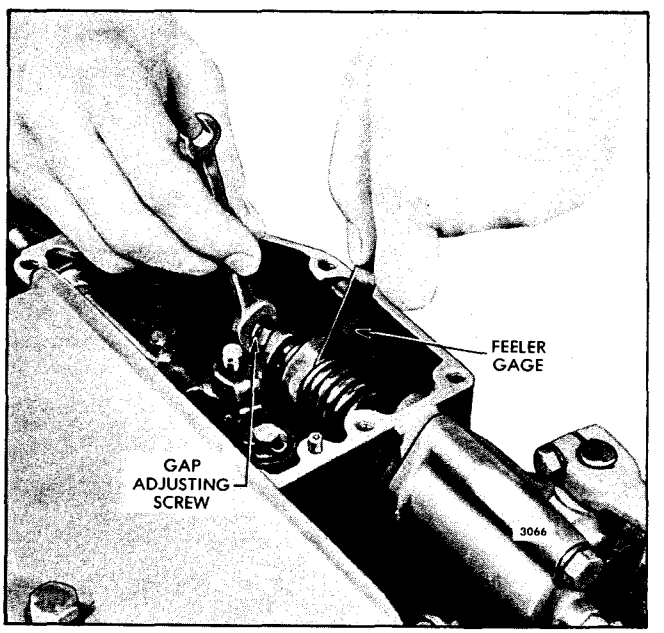


Fig. 2 - Adjusting Governor Gap

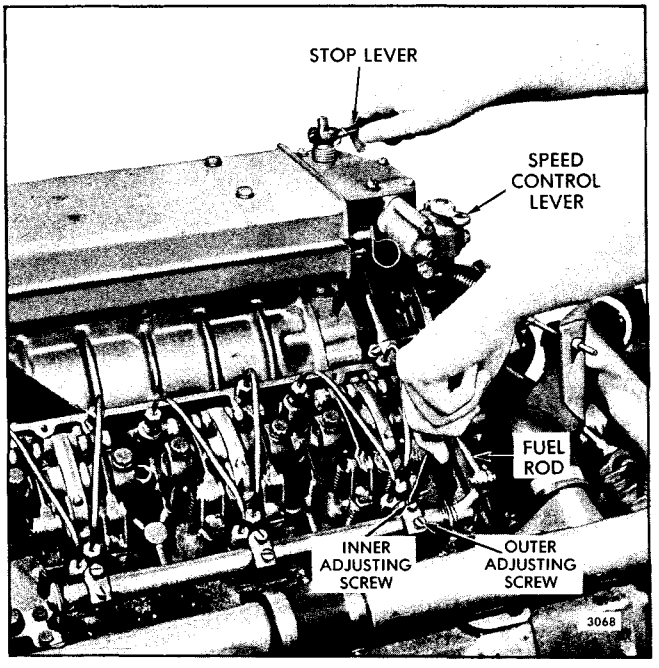


Fig. 3 - Positioning No. 3L Injector Rack Control Lever

2. Stop lever in the RUN position.

3. Injector fuel control racks in the full-fuel position.

The letters R or L indicate the injector location in the right or left cylinder bank, viewed from the rear of the engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust the No. 3L injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

2. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.

3. Move the speed control lever to the maximum speed position.

4. Move the stop lever to the *run* position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 3L injector rack control lever down (Fig. 3) until a slight movement of the control tube is observed, or a step-up in effort to turn the screw driver is noted. This will place the No. 3L injector rack in the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on

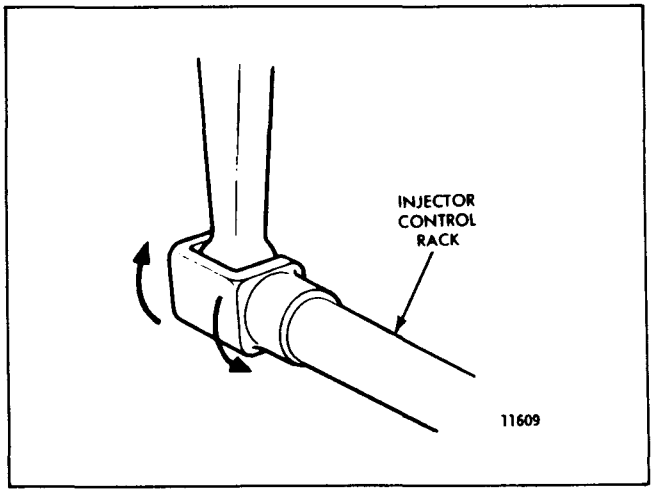


Fig. 4 - Checking Rotating Movement of Injector Control Rack

the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

NOTE: Overtightening the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 **in-lb** (3-4 Nm).

The above steps should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full load.

5. To be sure of proper rack adjustment, hold the stop

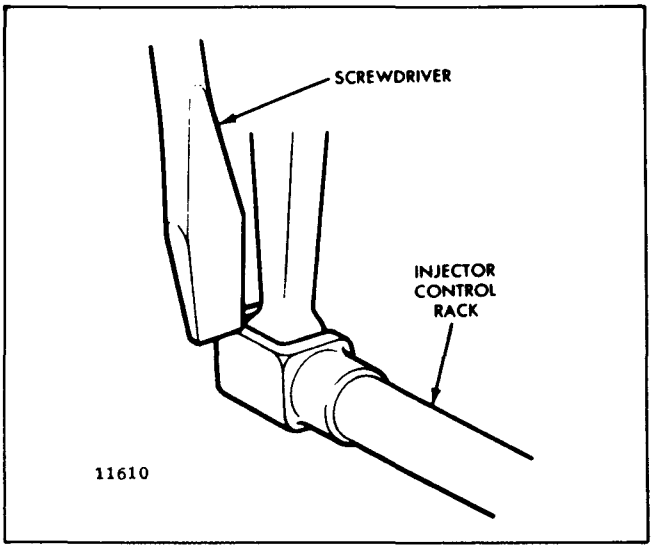


Fig. 5 - Checking Injector Control Rack "Spring"

lever in the *run* position and press down on the injector rack with a screw driver or finger tip and note the "rotating" movement of the injector control rack (Fig. 4). Hold the stop lever in the *run* position and, using a screw driver, press downward on the injector control rack. The rack should tilt downward (Fig. 5) and when the pressure of the screw driver is released, the control rack should "spring" back upward. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the *stop* to the *run* position, the injector rack becomes tight before the governor stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the *run* position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is found to be too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

6. Remove the clevis pin from the fuel rod and the left bank injector control tube lever.

7. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the No. 3R injector rack control lever as previously outlined in Step 4 for the No. 3L control lever.

8. Insert the clevis pin in the fuel rod and the left bank injector control tube lever. Repeat the check on the 3L and 3R injector rack control levers as outlined in Step 5. Check for and eliminate any deflection which may occur at the bend in the fuel rod where it enters the cylinder head.

9. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rods and the injector control tube levers, hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube and proceed as follows:

a. Turn down the inner adjusting screw of the injector rack control lever until the screw bottoms (injector control rack in the full-fuel position).

b. Turn down the outer adjusting screw of the injector rack control lever until it bottoms on the injector control tube.

c. While still holding the control tube lever in the full-fuel position, adjust the inner and outer adjusting screws to obtain the same condition as outlined in Step 5. Tighten the screws.

CAUTION: Once the No. 3L and No. 3R injector rack control levers are adjusted, do not try to alter their settings. All adjustments are made on the remaining control racks.

10. When all of the injector rack control levers are adjusted, recheck their settings. With the control tube lever in the full-fuel position, check each control rack as in Step 5. All of the control racks must have the same "spring" condition with the control tube lever in the full-fuel position.

11. Insert the clevis pin in the fuel rods and the injector control tube levers.

12. Use new gaskets and install the valve rocker covers.

Adjust Maximum No-Load Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the engine option plate, the maximum no-load speed may be set as follows:

Start the engine and after it reaches normal operating temperature, determine the maximum no-load speed of the engine with an accurate tachometer. Then stop the engine and make the following adjustments, if required.

1. Refer to Fig. 9 and disconnect the booster spring and the stop lever retracting spring.

2. Remove the variable speed spring housing and the spring retainer, located inside of the housing, from the governor housing.

3. Refer to Table 1 and determine the stops or shims required for the desired full-load speed. A split stop can only be used with a solid stop (Fig. 6).

4. Install the variable speed spring retainer and housing and tighten the two bolts.

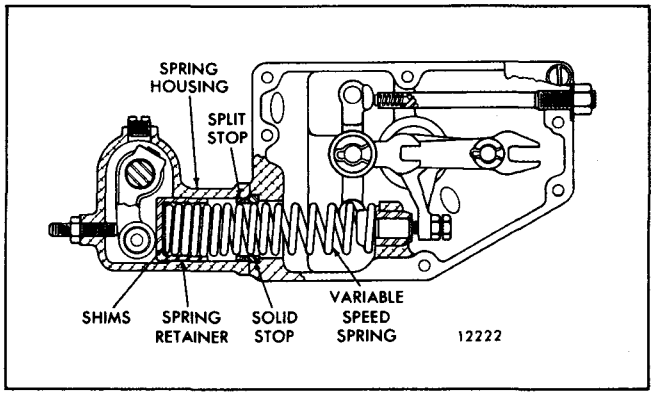


Fig. 6 - Location of Shims and Stops

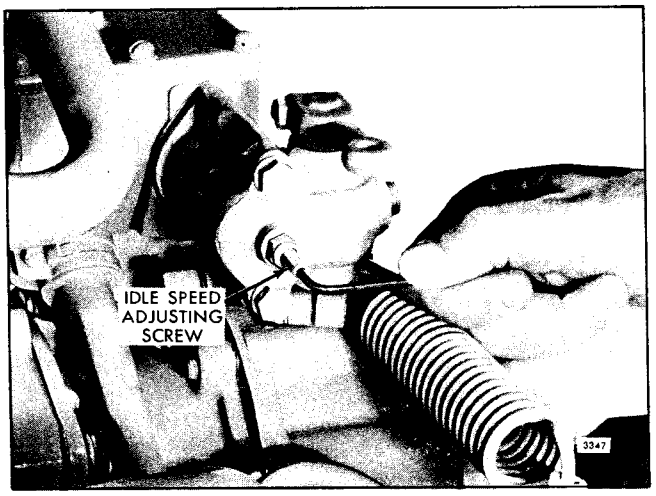


Fig. 7 - Adjusting Idle Speed

Full-Load Speed	Stops		Shims*
	Solid	Split	
1200-2100	1	1	As Required
2100-2500	1	0	As Required
2500-2800	0	0	As Required

*Maximum amount of shims .325"

TABLE 1

5. Connect the booster spring and the stop lever spring. Start the engine and recheck the maximum no-load speed.

6. If required, add shims to obtain the necessary operating speed. For each .001" in shims added, the operating speed will increase approximately 2 rpm.

IMPORTANT: If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of shims, recheck the governor gap. If readjustment of the governor gap is required, the position of the injector racks must be rechecked.

NOTE: Governor stops are used to limit the compression of the governor spring, which determines the maximum speed of the engine.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, adjust the idle speed as follows:

1. Place the stop lever in the *run* position and the speed control lever in the *idle* position.

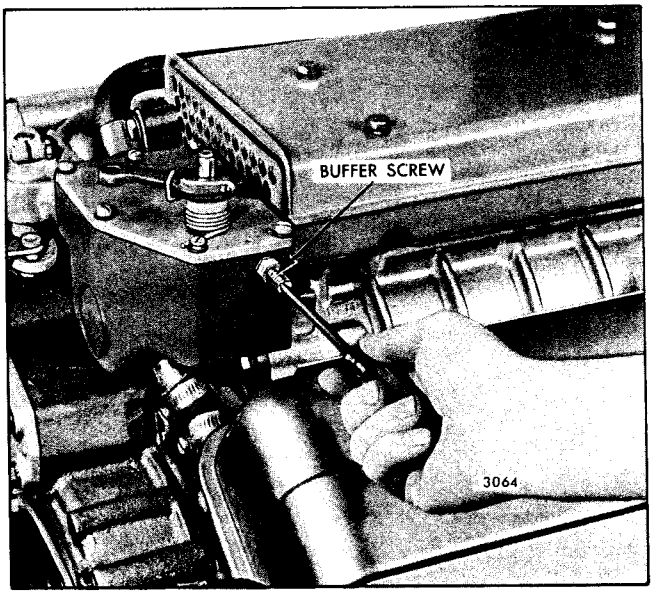


Fig. 8 - Adjusting Buffer Screw

2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.

3. Loosen the lock nut and turn the idle speed adjusting screw (Fig. 7) until the engine is operating at approximately 15 rpm below the recommended idle speed. The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 8) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

NOTE: Do not raise the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the lock nut.

Adjust Booster Spring

With the idle speed adjusted, adjust the booster spring as follows:

1. Move the speed control lever to the idle speed position.

2. Refer to Fig. 9 and loosen the booster spring

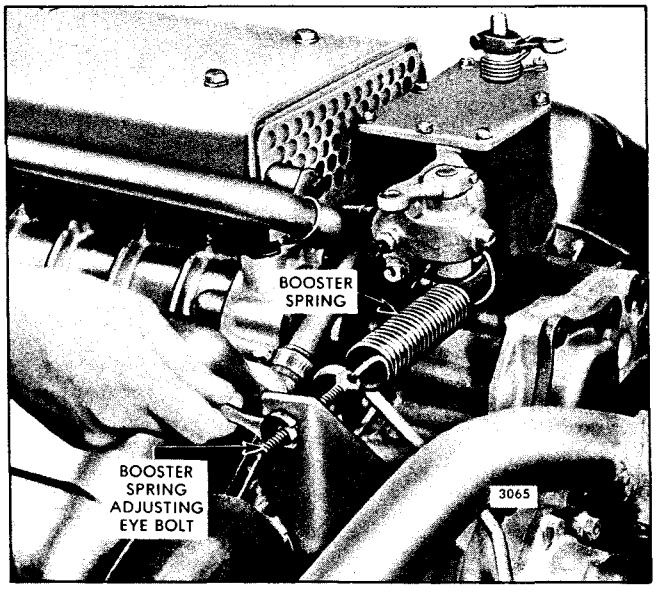


Fig. 9 - Adjusting Booster Spring

retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the booster spring.

3. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginary line through the bolt, lever shaft and eye bolt. Hold the bolt and tighten the lock nut.

4. Start the engine and move the speed control lever to the maximum speed position and release it. The speed control lever should return to the idle position. If it does not, reduce the tension on the booster spring. If the lever does return to the idle position, continue to increase the spring tension until the point is reached that it will not return to idle. Then reduce the tension until it does return to idle and tighten the lock nut on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.

5. Connect the linkage to the governor levers.

SUPPLEMENTARY GOVERNING DEVICE ADJUSTMENT

ENGINE LOAD LIMIT DEVICE

Engines with mechanical governors may be equipped with a load limit device (Fig. 1) to reduce the maximum horsepower.

This device consists of a load limit screw threaded into a plate mounted between two adjacent rocker arm shaft brackets and a load limit lever clamped to the injector control tube.

The load limit device is located between the No. 2 and No. 3 cylinders of a three or four cylinder engine or between the No. 1 and No. 2 cylinders of *each* cylinder head on a V-type engine. However, when valve rocker covers with a breather are used, the load limit device is installed between the No. 1 and No. 2 cylinders on in-line engines and between the No. 2 and No. 3 cylinders on V-type engines to avoid interference with the rocker cover baffles.

When properly adjusted for the maximum horsepower desired, this device limits the travel of the injector control racks and thereby the fuel output of the injectors.

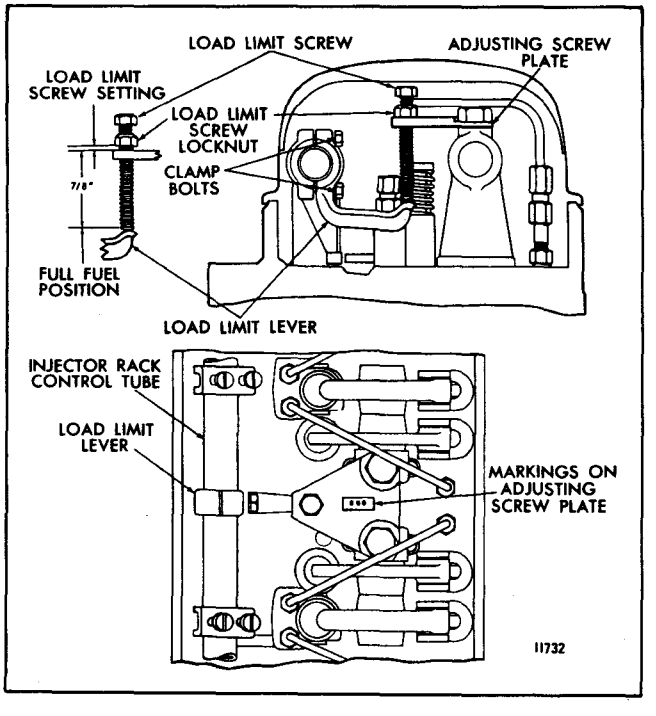


Fig. 1 - Engine Load Limit Device

Adjustment

After the engine tune-up is completed, make sure the load limit device is properly installed as shown in Fig. 1. Make sure the counterbores in the adjusting screw plate are up. The rocker arm shaft bracket bolts which fasten the adjusting screw plate to the brackets are tightened to 50-55 lb-ft (68-75 Nm) torque. Then adjust the load limit device, on each cylinder head, as follows:

1. Loosen the load limit screw lock nut and remove the screw.

2. Loosen the load limit lever clamp bolts so the lever is free to turn on the injector rack control tube.

3. With the screw out of the plate, adjust the load limit screw lock nut so the bottom of the lock nut is 7/8" from the bottom of the load limit screw (Fig. 1) for the initial setting.

4. Loosen the load limit lever clamp bolts so the lever is free to turn on the injector rack control tube.

4. Thread the load limit screw into the adjusting screw plate until the lock nut *bottoms* against the top of the plate.

5. Hold the injector rack control tube in the full-fuel position and place the load limit lever against the bottom of the load limit screw. Then tighten the load limit lever clamp bolts.

6. Check to ensure that the injector racks will just go into the full-fuel position -- readjust the load limit lever if necessary.

7. Hold the load limit screw to keep it from turning, then *set* the lock nut until the distance between the bottom of the lock nut and the top of the adjusting screw plate corresponds to the dimension (or number of turns) stamped on the plate. Each full turn of the screw equals .042", or .007" for each flat on the hexagon head.

> **NOTE:** If the plate is not stamped, adjust the load limit screw while operating the engine on a dynamometer test stand and note the number of turns required to obtain the desired horsepower. Then stamp the plate accordingly.

8. Thread the load limit screw into the plate until the lock nut *bottoms* against the top of the plate. Be sure the nut turns with the screw.

9. Hold the load limit screw to keep it from turning, then tighten the lock nut to secure the setting.

THROTTLE DELAY MECHANISM

The throttle delay mechanism is used to retard full-fuel injection when the engine is accelerated. This reduces exhaust smoke and also helps to improve fuel economy.

The throttle delay mechanism (Fig. 2) is installed between the No. 1 and No. 2 cylinders on three cylinder engines, between the No. 2 and No. 3 cylinders on four cylinder engines, or between the No. 1 and No. 2 cylinders on the right-bank cylinder head of V-type engines. It consists of a special rocker arm shaft bracket (which incorporates the throttle delay cylinder), a piston, throttle delay lever, connecting link, oil supply plug, ball check valve and U-bolt.

A yield lever and spring assembly replaces the standard lever and pin assembly on the rear end of the injector control tube on In-line engines (Fig. 3). A yield lever replaces the standard operating lever in the governor of the 6V-53 engine (Fig. 4).

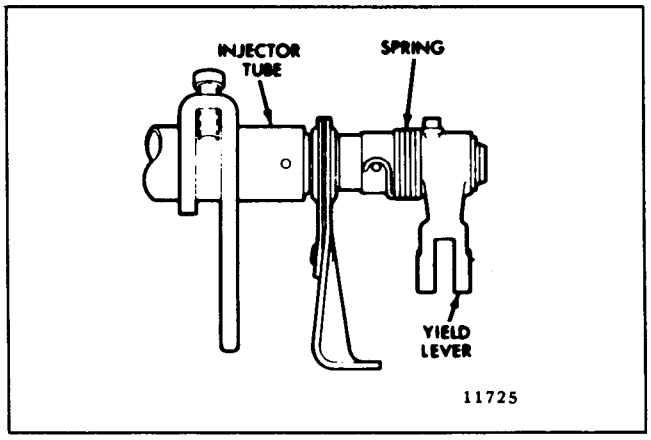


Fig. 3 - Throttle Delay Yield Lever (In-Line Engine)

Operation

Oil is supplied to a reservoir above the throttle delay cylinder through a special plug in the drilled oil passage in the rocker arm shaft bracket (Fig. 2). As the injector racks are moved toward the no-fuel position, free movement of the throttle delay piston is assured by air drawn into the cylinder through the ball check valve. Further movement of the piston uncovers an opening which permits oil from the reservoir to enter the cylinder and displace the air. When the engine is accelerated, movement of the injector racks toward the full-fuel position is momentarily retarded while the piston expels the oil from the cylinder through a .016" orifice. To permit full accelerator travel, regardless of the retarded injector rack position, a spring loaded yield lever or link assembly replaces the standard operating lever connecting link to the governor.

Inspection

When inspecting the throttle delay hydraulic cylinder, it is important that the check valve be inspected for wear. Replace the check valve if necessary.

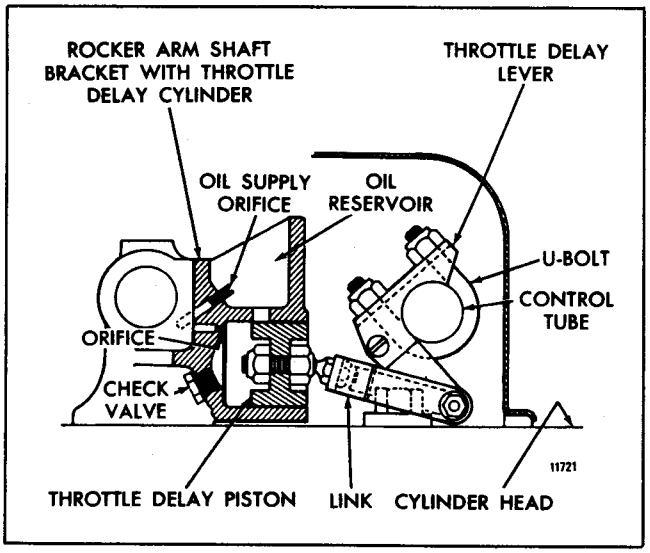


Fig. 2 - Throttle Delay Cylinder

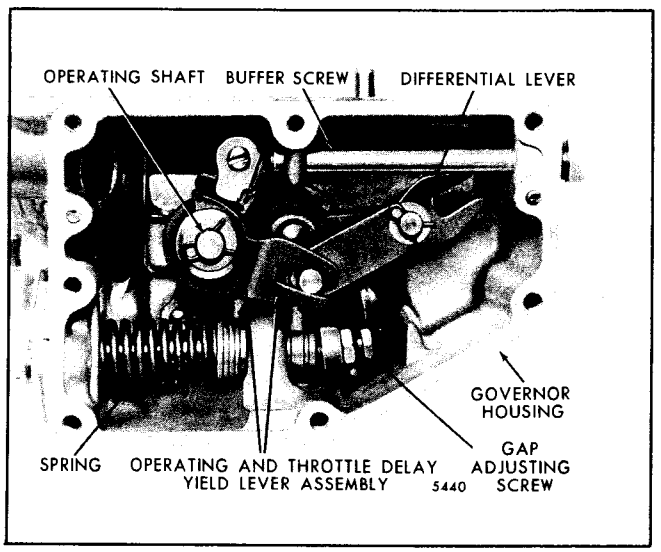


Fig. 4 - Throttle Delay Yield Lever (6V Engine)

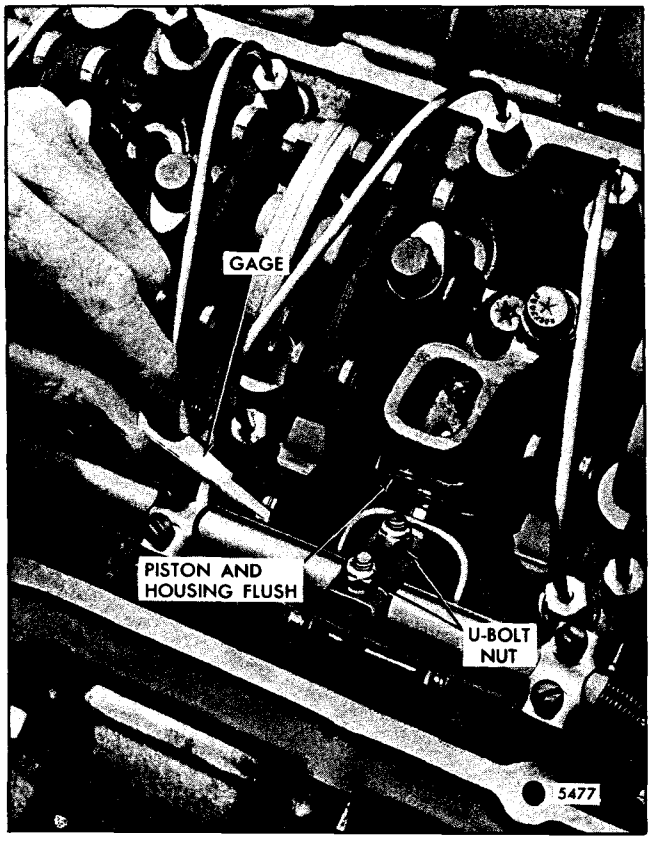


Fig. 5 - Adjusting Throttle Delay Cylinder

To inspect the check valve, fill the throttle delay cylinder with diesel fuel oil and watch for check valve leakage while moving the engine throttle from the idle position to the full fuel position.

Adjustment

Whenever the injector rack control levers are adjusted, disconnect the throttle delay mechanism by loosening the U-bolt which clamps the lever to the injector control tube. After the injector rack control levers have been positioned, the throttle delay mechanism must be re-adjusted. With the engine stopped, proceed as follows:

1. Refer to Fig. 5 and insert gage J 23190 (.454" setting) between the injector body and the shoulder on the injector rack. Then exert a light pressure on the injector control tube in the direction of full fuel.

2. Align the throttle delay piston so it is flush with the edge of the throttle delay cylinder.

3. Tighten the U-bolt on the injector control tube and remove the gage.

4. Move the injector rack from the no-fuel to full-fuel to make sure it does not bind.

ADJUSTMENT OF MECHANICAL GOVERNOR SHUTDOWN SOLENOID

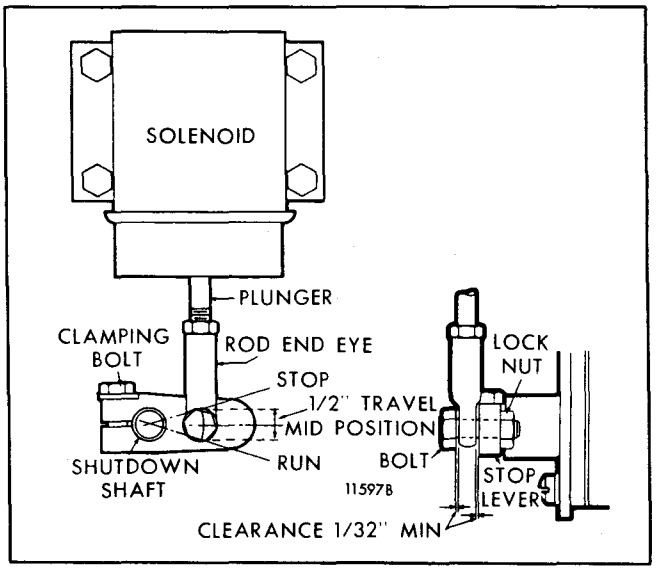


Fig. 6 – Typical Variable Speed Governor Lever Position

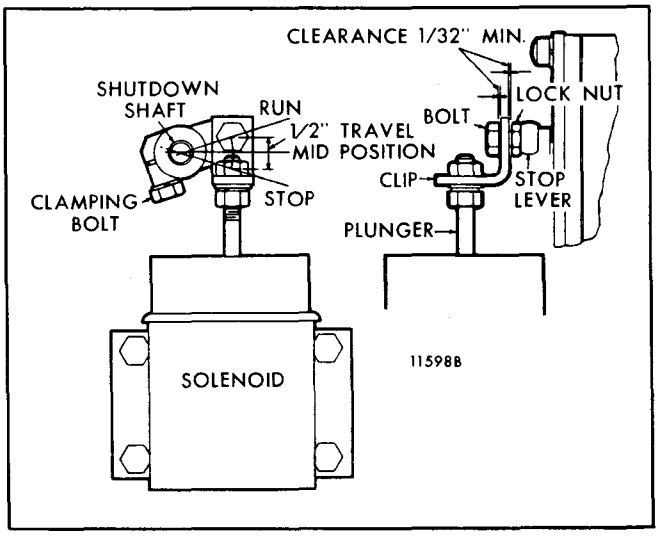


Fig. 7 – Typical Limiting Speed Governor Lever Position

When a governor shutdown solenoid is used on an engine equipped with a mechanical governor, the governor stop lever must be properly adjusted to match the shutdown solenoid plunger travel.

The solenoid plunger can be properly aligned to the governor stop lever as follows:

1. Remove the bolt connecting the rod end eye (variable speed governor), or the right angle clip (limiting speed governor) to the stop lever (Figs. 6 and 7). Align and clamp the lever to the shutdown shaft in such a way that, at its mid-travel position, it is perpendicular to the solenoid plunger. This assures that the linkage will travel as straight as possible. The solenoid plunger has available 1/2" travel which is more than adequate to move the injector control racks from the full-fuel to the complete no-fuel position and shutdown will occur prior to attaining complete travel.

2. With the stop lever in the *run* position, adjust the rod end eye or right angle clip for minimum engagement on the solenoid plunger when the connecting bolt is installed. The oversize hole in the eye or clip will thereby permit the solenoid to start closing the air gap, with a resultant build-up of pull-in force prior to initiating stop lever movement.

3. The bolt through the rod end eye or the right angle clip should be locked to the stop lever and adjusted to a height that will permit the eye or clip to float vertically. The clearance above and below the eye or clip and the bolt head should be approximately 1/32" minimum.

NOTE: The lock nut can be either on top of or below the stop lever.

4. Move the lever to the *stop* position and observe the plunger for any possible bind. If necessary, loosen the mounting bolts and realign the solenoid to provide free plunger motion.

HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINE

The hydraulic governor is mounted on the 3 and 4-53 engines as shown in Fig. 1. The terminal lever return spring and the fuel rod are attached to an external terminal shaft lever. The maximum fuel position of the governor load limit is determined by the internal governor terminal lever striking against a boss that projects from the governor cover.

Adjust engines having a hydraulic governor assembly after adjusting the exhaust valve clearance and timing the fuel injectors.

Adjust Fuel Rod and Injector Rack Control Levers

1. Adjust the inner and outer adjusting screws (Fig. 2) on the rear injector rack control lever until both screws are equal in height and tight on the control tube. Check the clearance between the fuel rod and the cylinder head casting (below the bolt) for at least 1/16" clearance when the injector rack is in the *full-fuel* position and the rack adjusting screws are tight. If the fuel rod contacts the bolt or cylinder head casting, readjust the screws to obtain the 1/16" clearance.

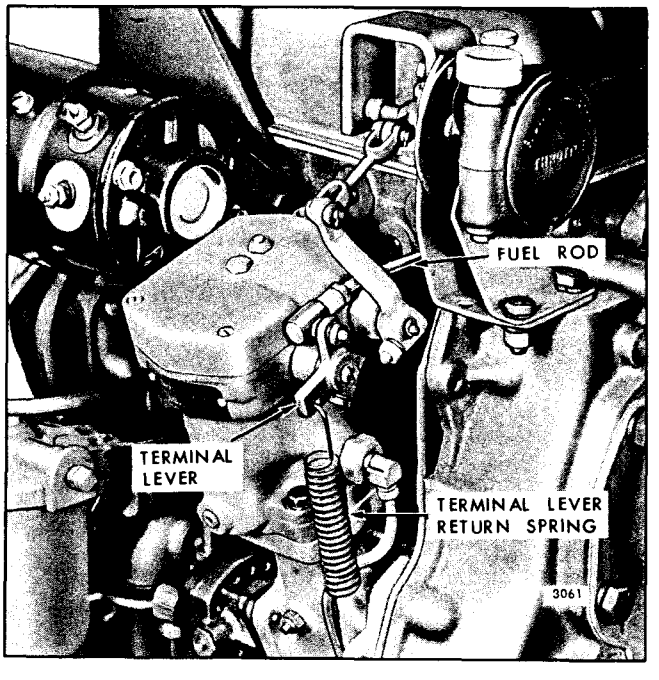


Fig. 1 – Hydraulic Governor Mounted on Engine

NOTE: Overtightening the injector rack control lever adjusting screws during installation or adjustment can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24–36 **in-lbs** (3–4 Nm).

2. Remove the governor terminal lever return spring.

3. Remove the fuel rod end bearing or ball joint from the terminal shaft lever and the terminal lever from the terminal shaft.

4. Place the terminal lever on the terminal shaft so that the hole for attaching the fuel rod end bearing or ball joint is in line vertically above the terminal lever shaft at one half the arc of travel. Do not tighten the clamping bolt.

5. Hold the injector rack control tube and the terminal lever in the *full-fuel* position and adjust the length of the fuel rod until the end bearing or ball joint will slide freely into the hole of the terminal lever as shown in Fig. 3. Tighten the lock nut to retain the ball

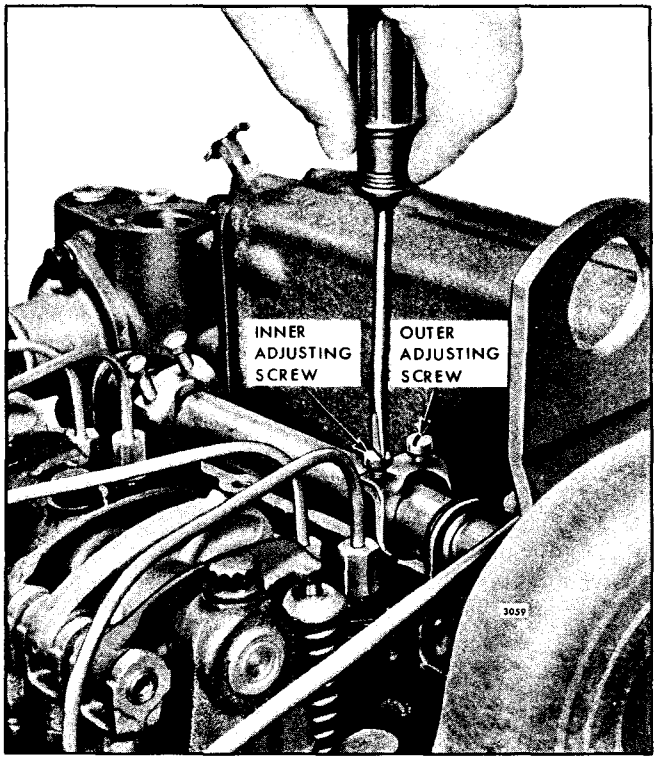


Fig. 2 – Adjusting Height of Rack Control Lever Adjusting Screws

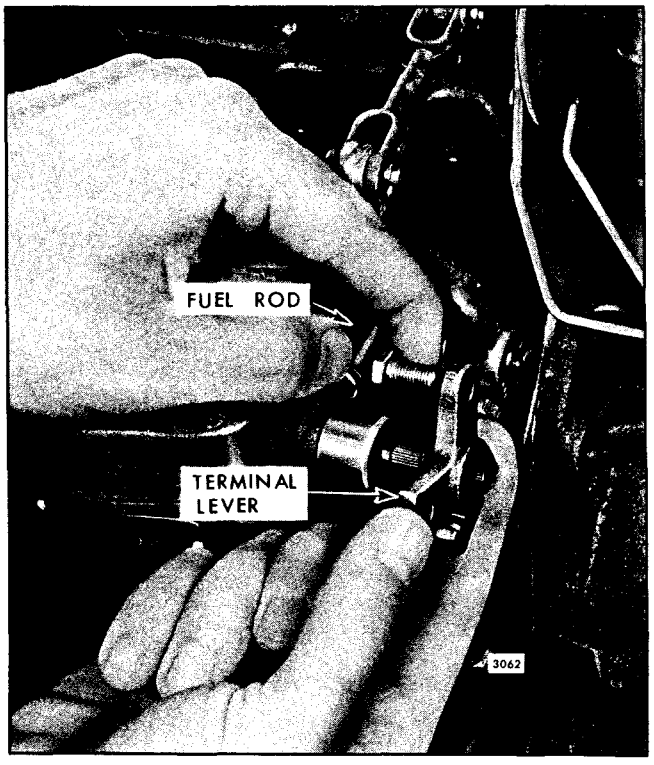


Fig. 3 – Adjusting Length of Fuel Rod

joint or end bearing and the terminal lever clamping bolt securely.

NOTE: It will be necessary to slide the terminal lever partially off of the shaft to attach the fuel rod end bearing or ball joint to the terminal lever.

6. Hold the terminal lever in the *full-fuel* position and loosen the inner adjusting screw 1/8 of a turn and tighten the outer adjusting screw 1/8 of a turn to retain the adjustment. This is done to prevent the governor from bottoming the injector racks, since there is no load limit screw on this governor.

7. Remove the clevis pin between the fuel rod and the injector control tube lever.

NOTE: Cover the cylinder head oil drain back hole, located under the control lever, when removing the fuel rod clevis pin to prevent its loss and possible damage to the engine.

8. Manually hold the rear injector in the *full-fuel* position and turn down the inner rack control lever adjusting screw of the adjacent injector until the injector rack of the adjacent injector has moved into the *full-fuel* position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the

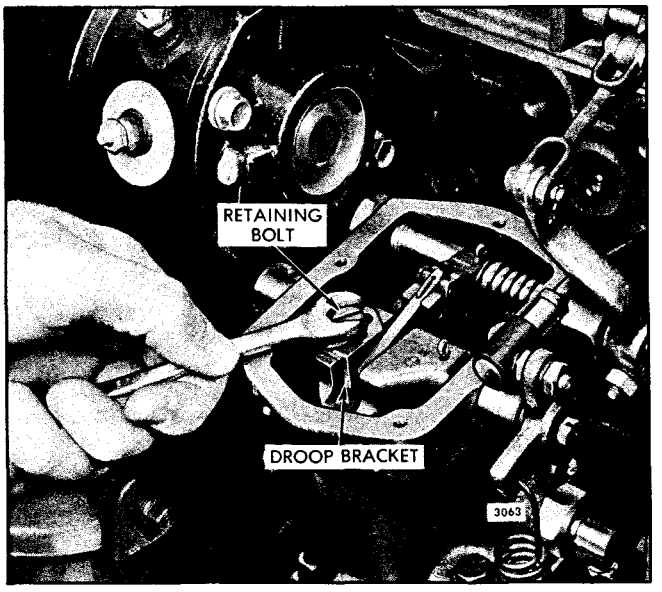


Fig. 4 – Adjusting Droop Bracket

injector control tube. Then alternately tighten both the inner and outer rack control lever adjusting screws.

9. Recheck the rear injector fuel rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector. If the rack of the rear injector has become loose, back off slightly on the inner adjusting screw on the adjacent injector rack control lever. Tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

10. Position the remaining rack control levers as outlined in Steps 8 and 9.

11. Insert the clevis pin between the fuel rod and the injector control tube lever.

12. Install the terminal lever return spring.

Adjust Speed Droop

The purpose of adjusting the speed droop is to establish a definite engine speed at no load with a given speed at rated full load.

The governor droop is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs, the speed droop should be readjusted.

The best method of determining the engine speed is with an accurate hand tachometer.

Full Load	No-Load
50 cycles 1000 rpm	52.5 cycles 1050 rpm
60 cycles 1200 rpm	62.5 cycles 1250 rpm
50 cycles 1500 rpm	52.5 cycles 1575 rpm
60 cycles 1800 rpm	62.5 cycles 1875 rpm

TABLE 1

If a full-rated load can be established on the engine and the fuel rod, injector rack control levers and load limit have been adjusted, the speed droop may be adjusted as follows:

1. Start the engine and run it at approximately one-half the rated no-load speed until the lubricating oil temperature stabilizes.

> **NOTE:** When the engine lubricating oil is cold, the governor regulation may be erratic. The regulation should become increasingly stable as the temperature of the lubricating oil increases.

2. Stop the engine and remove the governor cover. Discard the gasket.

3. Loosen the lock nut and back off the maximum speed adjusting screw (Fig. 5) approximately 5/8".

4. Refer to Fig. 4 and loosen the droop adjusting bolt. Move the droop bracket so that the bolt is midway between the ends of the slot in the bracket. Tighten the bolt.

5. With the throttle in the *run* position, adjust the engine speed until the engine is operating at 3% to 5% above the recommended full-load speed.

6. Apply the full-rated load on the engine and re-adjust the engine speed to the correct full-load speed.

7. Remove the rated load and note the engine speed after the speed stabilizes under no-load. If the speed droop is correct, the engine speed will be approximately 3% to 5% higher than the full-load speed.

If the speed droop is too high, stop the engine and again loosen the droop bracket retaining bolt and move the droop adjusting bracket *in* toward the engine. Tighten the bolt. To increase the speed droop, move the droop adjusting bracket *out,* away from the engine.

The speed droop in governors which control engines driving generators in parallel must be identical, otherwise, the electrical load will not be equally divided.

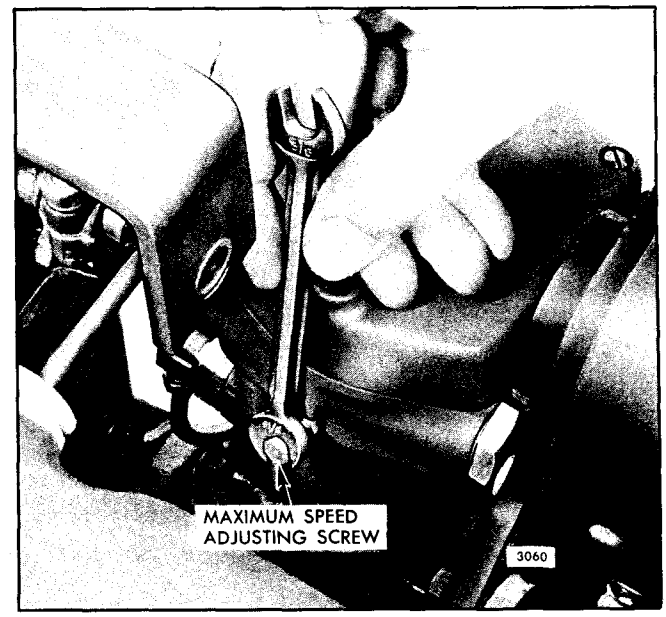


Fig. 5 - Adjusting Maximum Engine Speed

Adjust the speed droop bracket in each engine governor to obtain the desired variation between the engine no-load and full-load speeds shown in Table 1.

The recommended speed droop of generator sets operating in parallel is 50 rpm (2-1/2 cycles) for units operating at 1000 and 1200 rpm and 75 rpm (2-1/2 cycles) for units operating at 1500 rpm and 1800 rpm full load. This speed droop recommendation may be varied to suit the individual application.

Adjust Maximum No-Load Speed

With the speed droop properly adjusted, set the maximum no-load speed as follows:

1. Loosen the maximum speed adjusting screw lock nut and back out the maximum speed adjusting screw three turns.

2. With the engine operating at no-load, adjust the engine speed until the engine is operating at approximately 8% higher than the rated full-load speed.

3. Turn the maximum speed adjusting screw (Fig. 5) in lightly until contact is felt with the linkage in the governor.

4. Hold the maximum speed adjusting screw and tighten the lock nut.

5. Use a new gasket and install the governor cover.

HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6V–53 ENGINE

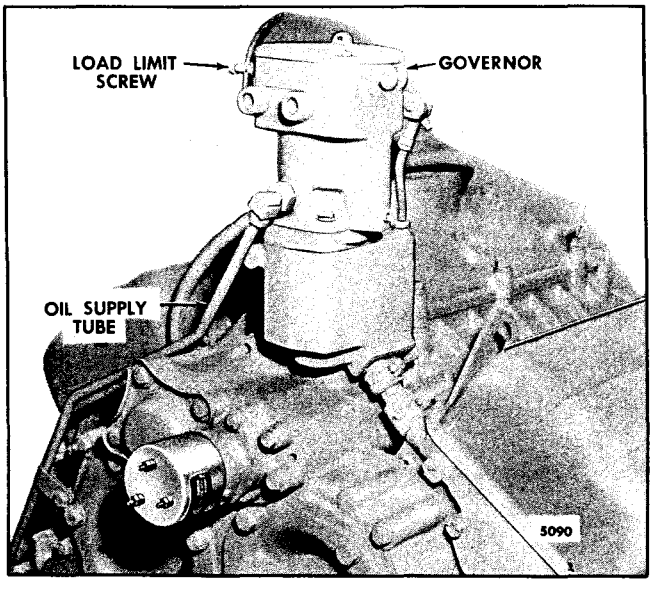


Fig. 1 – Hydraulic Governor Mounting

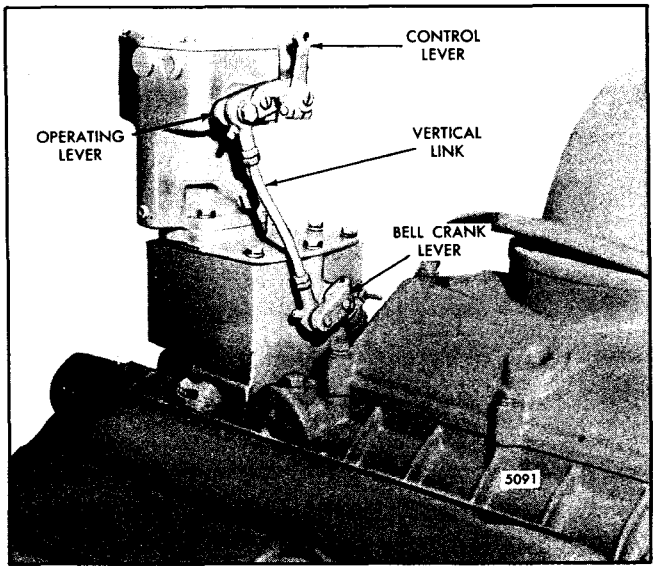


Fig. 2 – Hydraulic Governor Controls

The hydraulic governor is mounted between the blower and the rear end plate as shown in Fig. 1. The vertical control link assembly is attached to the governor operating lever and the bell crank lever on the governor drive housing (Fig. 2).

After adjusting the exhaust valves and timing the fuel injectors, adjust the governor as follows:

1. Disconnect the vertical control link assembly from the governor operating lever.

2. Loosen all of the injector rack control lever adjusting screws.

3. While holding the bell crank lever (on the governor drive housing) in a horizontal position (full–fuel), set the No. 3 injector rack control levers on each bank to full–fuel.

4. Position the remaining rack control levers to the No. 3 control levers.

5. Remove the governor cover. Discard the gasket.

6. To determine the full–fuel position of the terminal lever, adjust the load limit screw to obtain a distance of 2″ from the outside face of the boss on the governor sub–cap to the end of the screw.

7. Adjust the operating lever (on the governor) so that it is horizontal, or slightly below (as close as the serrations on the shaft will permit) when the shaft is rotated to the full–fuel position, or clockwise when viewed from the front of the engine.

8. Loosen the lock nut and adjust the length of the vertical link assembly, attached to the bell crank lever, to match the full–fuel position of the governor operating lever and the injector rack control levers. This length should be approximately 6–5/16″. Tighten the lock nut.

9. With the governor operating lever held in the *full–fuel* position, turn the load limit screw ((Fig. 1) inward until the injector racks just loosen on the ball end of the control levers, to prevent the injector racks from bottoming.

10. Release the governor operating lever and hold the adjusting screw while tightening the lock nut.

11. Use new gaskets and install the governor cover and the valve rocker covers.

STORAGE

PREPARING ENGINE FOR STORAGE

When an engine is to be stored or removed from operation for a period of time, special precautions should be taken to protect the interior and exterior of the engine, transmission and other parts from rust accumulation and corrosion. The parts requiring attention and the recommended preparations are given below.

It will be necessary to remove all rust or corrosion completely from any exposed part before applying a rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

The engine should be stored in a building which is dry and can be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in the storage area.

TEMPORARY STORAGE (30 days or less)

To protect an engine for a temporary period of time, proceed as follows:

1. Drain the engine crankcase.

2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.

3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

> **NOTE:** Do not drain the fuel system or the crankcase after this run.

4. Check the air cleaner and service it, if necessary, as outlined under *Air System.*

5. If freezing weather is expected during the storage period, add a high boiling point type antifreeze solution in accordance with the manufacturer's recommendations. Drain the raw water system and leave the drain cocks open.

6. Clean the entire exterior of the engine (except the electrical system) with fuel oil and dry it with air.

7. Seal all of the engine openings. The material used for this purpose must be waterproof, vaporproof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

An engine prepared in this manner can be returned to service in a short time by removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, transmission, and priming the raw water pump, if used.

EXTENDED STORAGE (30 days or more)

When an engine is to be removed from operation for an extended period of time, prepare it as follows:

1. Drain and thoroughly flush the cooling system with clean, soft water.

2. Refill the cooling system with clean, soft water.

3. Add a rust inhibitor to the cooling system (refer to *Corrosion Inhibitor* under *Cooling System).*

4. Remove, check and recondition the injectors, if necessary, to make sure they will be ready to operate when the engine is restored to service.

5. Reinstall the injectors in the engine, time them, and adjust the valve clearance.

6. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160–185 ° F or 71–85 ° C).

7. Stop the engine.

8. Remove the drain plug and completely drain the engine crankcase. Reinstall and tighten the drain plug. Install new lubricating oil filter elements and gaskets.

9. Fill the crankcase to the proper level with a 30-weight preservative lubricating oil MIL-L-21260, Grade 2 (P10), or equivalent.

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough rust preventive fuel oil such as American Oil Diesel Run-In Fuel (LF

4089), Mobil 4Y17, or equivalent, to enable the engine to operate 10 minutes.

12. Drain the fuel filter and strainer. Remove the retaining bolts, shells and elements. Discard the used elements and gaskets. Wash the shells in clean fuel oil and insert new elements. Fill the cavity between the element and shell about two-thirds full of the same rust preventive compound as used in the fuel tank and reinstall the shell.

13. Operate the engine for 10 minutes to circulate the rust preventive throughout the engine.

14. Refer to *Air System* and service the air cleaner.

15. MARINE GEAR

a. Drain the oil completely and refill with clean oil of the proper viscosity and grade as is recommended. Remove, clean or replace the strainer and replace the filter element.

b. Start and run the engine at 600 rpm for 5 minutes so that clean oil can coat all of the internal parts of the marine gear. Engage the clutches alternately to circulate clean oil through all of the moving parts.

16. TORQMATIC CONVERTER

a. Start the engine and operate it until the temperature of the converter oil reaches 150° F (66° C).

b. Remove the drain plug and drain the converter.

c. Remove the filter element.

d. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter. *Due to lack of lubrication, do not exceed the 20 second limit.*

e. Install the drain plug and a new filter element.

f. Fill the converter to the proper operating level with a commercial preservative oil which meets Government specifications MIL-L-21260, Grade 1. Oil of this type is available from the major oil companies.

g. Start the engine and operate the converter for at least 10 minutes at a minimum of 1000 rpm. Engage the clutch; then stall the converter to raise the oil temperature to 225° F (107° C).

CAUTION: Do not allow the oil temperature to exceed 225° F (107° C). If the unit does not have a temperature gage, *do not stall the converter for more than thirty seconds.*

h. Stop the engine and permit the converter to cool to a temperature suitable to touch.

i. Seal all of the exposed openings and the breather with moisture proof tape.

j. Coat all exposed, unpainted surfaces with preservative grease. Position all of the controls for minimum exposure and coat them with grease. The external shafts, flanges and seals should also be coated with grease.

17. POWER TAKE-OFF

a. With an all purpose grease such as Shell Alvania No. 2, or equivalent, lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing, clutch release shaft, and the outboard bearings (if so equipped).

b. Remove the inspection hole cover on the clutch housing and lubricate the clutch release lever and link pins with a hand oiler. Avoid getting oil on the clutch facing.

c. If the unit is equipped with a reduction gear, drain and flush the gear box with light engine oil. If the unit is equipped with a filter, clean the shell and replace the filter element. Refill the gear box to the proper level with the oil grade indicated on the name plate.

18. TURBOCHARGER

The turbocharger bearings are lubricated by pressure through the external oil line leading from the engine cylinder block while performing the previous operations above and no further attention is required. However, the turbocharger air inlet and turbine outlet connections should be sealed off with moisture-resistant tape.

19. HYDROSTARTER SYSTEM

Refer to *Hydraulic Starting System* in the section on *Engine Equipment* for the lubrication and preventive maintenance procedure.

20. Apply a *non-friction* rust preventive compound, to all exposed parts. If it is convenient, apply the rust preventive compound to the engine flywheel. If not, disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

CAUTION: Do not apply oil, grease or any wax base compound to the flywheel. The cast iron will absorb these substances which can "sweat" out during operation and cause the clutch to slip.

21. Drain the engine cooling system.

22. The oil may be drained from the engine crankcase if so desired. If the oil is drained, reinstall and tighten the drain plug.

23. Remove and clean the battery and battery cables with a baking soda solution and rinse them with fresh water. Do not allow the soda solution to enter the battery. Add distilled water to the electrolyte, if necessary, and fully charge the battery. Store the battery in a cool (never below 32 ° F or 0 ° C) dry place. Keep the battery fully charged and check the level and the specific gravity of the electrolyte regularly.

24. Insert heavy paper strips between the pulleys and belts to prevent sticking.

25. Seal all of the openings in the engine, including the exhaust outlet, with moisture resistant tape. Use cardboard, plywood or metal covers where practical.

26. Clean and dry the exterior painted surfaces of the engine. Spray the surfaces with a suitable liquid automobile body wax, a synthetic resin varnish or a rust preventive compound.

27. Cover the engine with a good weather-resistant tarpaulin or other cover if it must be stored outdoors. A clear plastic cover is recommended for indoor storage.

The stored engine should be inspected periodically. If there are any indications of rust or corrosion, corrective steps must be taken to prevent damage to the engine parts. Perform a complete inspection at the end of one year and apply additional treatment as required.

PROCEDURE FOR RESTORING AN ENGINE TO SERVICE WHICH HAS BEEN IN EXTENDED STORAGE

1. Remove the covers and tape from all of the openings of the engine, fuel tank, and electrical equipment. *Do not overlook the exhaust outlet.*

2. Wash the exterior of the engine with fuel oil to remove the rust preventive.

3. Remove the rust preventive from the flywheel.

4. Remove the paper strips from between the pulleys and the belts.

5. Remove the drain plug and drain the preservative oil from the crankcase. Re-install the drain plug. Then refer to *Lubrication System* in the *Operating Instructions* and fill the crankcase to the proper level with the recommended grade of lubricating oil.

6. Fill the fuel tank with the fuel specified under *Diesel Fuel Oil Specifications.*

7. Close all of the drain cocks and fill the engine cooling system with clean soft water and a rust inhibitor. If the engine is to be exposed to freezing temperatures, add a high boiling point type antifreeze solution to the cooling system (the antifreeze contains a rust inhibitor).

8. Install and connect the battery.

9. Service the air cleaner as outlined under *Air System.*

10. POWER GENERATOR

Prepare the generator for starting as outlined under *Operating Instructions.*

11. MARINE GEAR

Check the Marine gear; refill it to the proper level, as necessary, with the correct grade of lubricating oil.

12. TORQMATIC CONVERTER

a. Remove the tape from the breather and all of the openings.

b. Remove all of the preservative grease with a suitable solvent.

c. Start the engine and operate the unit until the temperature reaches 150 ° F (66 ° C). Drain the preservative oil and remove the filter. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter.

CAUTION: A Torqmatic converter containing preservative oil should only be operated enough to bring the oil temperature up to 150 ° F (66 ° C).

d. Install the drain plug and a new filter element.

e. Refill the converter with the oil that is recommended under *Lubrication and Preventive Maintenance.*

13. POWER TAKE-OFF

Remove the inspection hole cover and inspect the clutch release lever and link pins and the bearing ends of the clutch release shaft. Apply engine oil sparingly, if necessary, to these areas.

14. HYDROSTARTER

a. Open the relief valve on the side of the hand pump and release the pressure in the system.

b. Refer to the filling and purging procedures outlined in *Hydraulic Starting System.* Then, drain, refill and purge the hydrostarter system.

15. TURBOCHARGER

Remove the covers from the turbocharger air inlet and turbine outlet connections. Refer to the lubricating procedure outlined in *Preparation for Starting Engine First Time.*

16. After all of the preparations have been completed, start the engine. The small amount of rust preventive compound which remains in the fuel system will cause a smoky exhaust for a few minutes.

NOTE: Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.

BUILT-IN

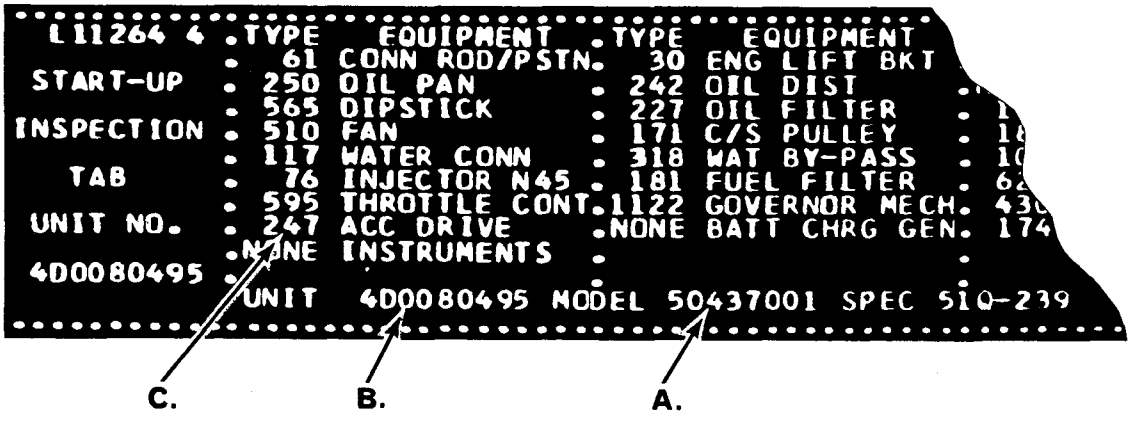
PARTS BOOK

for

DETROIT DIESEL ENGINES

Progress in industry comes at a rapid pace. In order for the engine manufacturer to keep pace with progress he needs a versatile product for the many models and arrangements of accessories and mounting parts needed to suit a variety of equipment. In addition, engine refinements and improvements are constantly being introduced. All of this dynamic action must be documented so that the equipment can be serviced if and when it's needed. It is fully documented in the manufacturer's plant and in dealer Parts Departments with Master Files and adequate supporting records. But, what about YOU the user of this equipment? You have neither the time nor the inclination to ferret out specific part number data. What is the answer? – It is Detroit Diesel's exclusive BUILT-IN PARTS BOOK which is furnished with each engine. It takes the form of an "Option Plate" mounted on the rocker cover of the engine. With it, ordering parts becomes as simple as A, B, C. You have merely to provide the Dealer with . . .

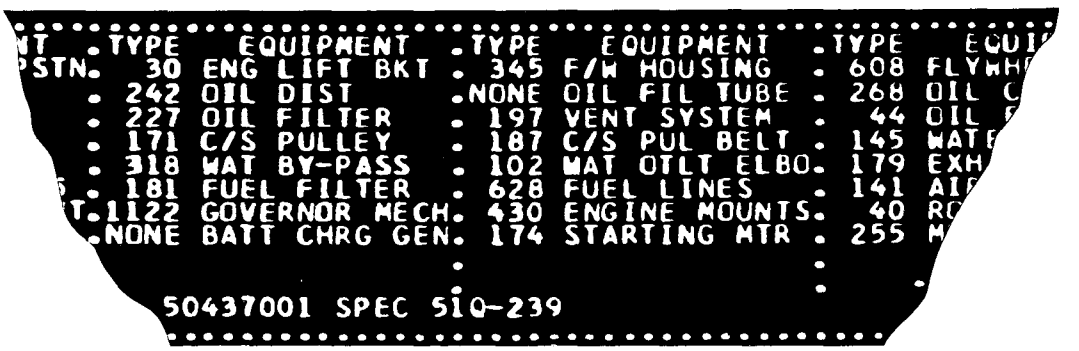
A. The "Model" number **B.** The "UNIT" number **C.** The "TYPE" number



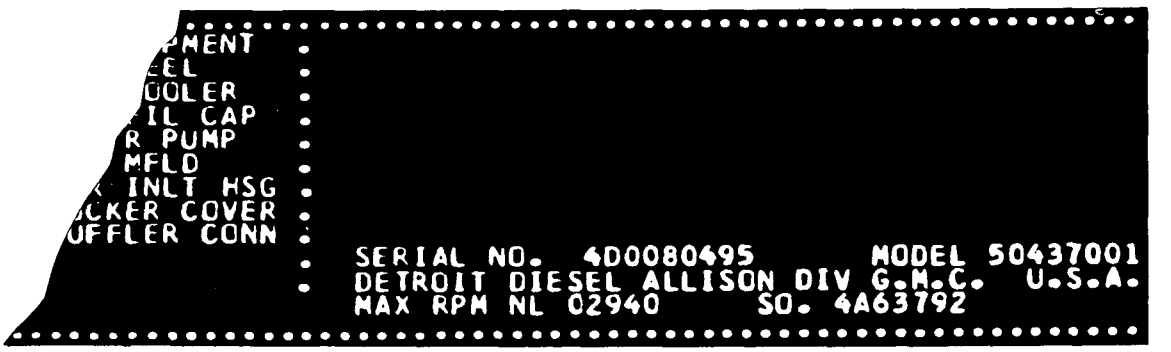
From that much information, the dealer with his complete records on all engine models, can completely interpret your parts requirements.

What is this "built-in" book? It is a photo etched aluminum plate that fits into a holding channel on the engine rocker cover.

ON THE LEFT SIDE of the plate is the Start-up Inspection Tab which is removed by the dealer when he has completed the inspection.



NEXT is the type number and the equipment description. On the left is the type number. The type number designates all service parts applicable to the equipment. On the right is a brief description of the equipment.



ON THE RIGHT SIDE of the plate is shown the model number, serial number and the related governor setting.

All engine components are divided into groups of functionally related parts. A complete listing of the twelve major groups and their many sub-groups is shown below.

GROUP NOMENCLATURE

1.0000 ENGINE (less major assemblies)
- 1.1000 Cylinder Block
- 1.1000A Air Box Drains
- 1.2000 Cylinder Head
- 1.2000A Engine Lifter Bracket
- 1.3000 Crankshaft
- 1.3000A Crankshaft Front Cover
- 1.3000B Vibration Damper
- 1.3000C Crankshaft Pulley
- 1.3000D Crankshaft Pulley Belt
- 1.4000A Flywheel
- 1.5000A Flywheel Housing
- 1.5000B Flywheel Housing Adaptor
- 1.6000 Connecting Rod and Piston
- 1.7000 Camshaft and Gear Train
- 1.7000A Balance Weight Cover
- 1.7000B Accessory Drive
- 1.8000 Valve and Injector Operating Mechanism
- 1.8000A Rocker Cover

2.0000 FUEL SYSTEM
- 2.1000A Fuel Injector
- 2.2000 Fuel Pump
- 2.2000A Fuel Pump Drain
- 2.3000A Fuel Filter
- 2.4000 Fuel Manifold and/or Connections
- 2.5000A Fuel Lines
- 2.6000A Fuel Tank
- 2.7000A Mechanical Governor
- 2.8000A Hydraulic Governor
- 2.9000 Injector Controls
- 2.9000A Throttle Controls

3.0000 AIR SYSTEM
- 3.1000A Air Cleaner and/or Adaptor
- 3.2000A Air Silencer
- 3.3000A Air Inlet Housing
- 3.4000 Blower
- 3.4000A Blower Drive Shaft
- 3.5000A Turbocharger

4.0000 LUBRICATING SYSTEM
- 4.1000A Oil Pump
- 4.1000B Oil Distribution System
- 4.1000C Oil Pressure Regulator
- 4.2000A Oil Filter
- 4.3000A Oil Filter Lines
- 4.4000A Oil Cooler
- 4.5000A Oil Filler
- 4.6000A Dipstick
- 4.7000A Oil Pan
- 4.8000A Ventilating System

5.0000 COOLING SYSTEM
- 5.1000 Fresh Water Pump
- 5.1000A Fresh Water Pump Cover
- 5.2000A Water Outlet Manifold and/or Elbow
- 5.2000B Thermostat
- 5.2000C Water By-pass Tube
- 5.3000A Radiator
- 5.3000B Water Connections
- 5.4000A Fan
- 5.4000B Fan Shroud
- 5.5000A Heat Exchanger or Keel Cooling
- 5.6000A Raw Water Pump
- 5.7000A Water Filter

6.0000 EXHAUST SYSTEM
- 6.1000A Exhaust Manifold
- 6.2000A Exhaust Muffler and/or Connections

7.0000 ELECTRICAL-INSTRUMENTS
- 7.1000A Battery Charging Generator
- 7.2000B Automatic Starting
- 7.3000A Starting Motor
- 7.4000A Instruments
- 7.4000B Tachometer Drive
- 7.4000C Shut-off or Alarm System
- 7.5000A Power Generator
- 7.6000A Control Cabinet
- 7.7000A Wiring Harness
- 7.8000A Air Heater

8.0000 POWER TAKE-OFF
- 8.1000A Power Take-off and/or Clutch
- 8.3000A Torque Converter
- 8.3000B Transmission Lines

9.0000 TRANSMISSION AND PROPULSION
- 9.1000A Hydraulic Marine Gear
- 9.3000A Power Transfer Gear
- 9.4000 Transmission-Highway
- 9.7000 Transmission-Off-highway

10.0000 SHEET METAL
- 10.1000A Engine Hood

11.0000 ENGINE MOUNTING
- 11.1000A Engine Mounting and Base

12.0000 MISCELLANEOUS
- 12.2000A Bilge Pump
- 12.3000A Vacuum Pump
- 12.4000A Air Compressor
- 12.5000A Hydraulic Pump
- 12.6000A Gasoline Starter
- 12.6000B Air Starter
- 12.6000C Cold Weather Starting Aid
- 12.6000D Hydraulic Starter
- 12.6000E Hydraulic Starter Accessories

Within each of these sub-groups, various designs of similar equipment are categorized as "Types" and identified by a Type Number.

The Distributor/Dealer has an Index for each engine model. The Index lists all of the "Standard" and "Standard Option" equipment for that model.

DETROIT DIESEL 53 MPC 5063-5000 (RA)

STANDARD AND STANDARD OPTION EQUIPMENT

GROUP NAME	GROUP NO.	TYPE
CYLINDER BLOCK	1.1000	31
AIR BOX DRAINS	1.1000A	62
CYLINDER HEAD (4 VALVE)	1.2000	26
ENGINE LIFTER BRACKET	1.2000A	44
CRANKSHAFT	1.3000	44
CRANKSHAFT FRONT COVER	1.3000A	65
CRANKSHAFT PULLEY (2 GROOVES)	1.3000C	171
CRANKSHAFT PULLEY BELT	1.3000D	121
FLYWHEEL	1.4000A	328
FLYWHEEL HOUSING (SAE #3)	1.5000A	350
CONNECTING ROD AND PISTON	1.6000	68
CAMSHAFT AND GEAR TRAIN	1.7000	35
VALVE OPERATING MECHANISM	1.8000	33
ROCKER COVER	1.8000A	64
FUEL INJECTOR N50	2.1000A	74
FUEL PUMP	2.2000	73
FUEL FILTER	2.3000A	358
FUEL MANIFOLD CONNECTIONS	2.4000	48
FUEL LINES	2.5000A	786
GOVERNOR—MECHANICAL	2.7000A	514

NOTE The Distributor/Dealer uses his model index to interpret the standard equipment. The plate, therefore, lists only the non-standard or choice items.

So, from the plate, give the dealer the

A—Model No._____
B—Unit No. _____
***C—Type No.** _____

*(If not shown, indicate "NONE". The dealer knows the "standard" for the model).

FOR READY REFERENCE, Transfer the information on the Option Plate to this record.

MODEL NO._____ **UNIT NO.**_____

EQUIPMENT	TYPE	EQUIPMENT	TYPE	EQUIPMENT	TYPE
Engine Base		Water Bypass Tube		Battery Chrg. Generator	
Engine Lifter Brkt.		Thermostat		Starter	
Flywheel Housing		Water Filter		Hyd. Starter Acces.	
Vibration Damper		Exhaust Manifold		Starting Aid	
Flywheel		Air Cleaner or Silencer		Marine Gear	
Flywheel Hsg. Adptr.		Fuel Pump		Torque Converter	
Oil Pan		Injector		Torque Converter Lines	
Oil Pump		Blower		Muffler & Conn.	
Oil Distribution		Blower Drive Shaft		Engine Hood	
Dipstick		Fuel Filter		Wiring Harness	
Oil Pan Drain Tube		Fuel Lines		Instruments	
Oil Filler Tube or Cap		Air Inlet Housing		Tach. Drive	
Oil Cooler		Alarm or Shutoff		Radiator	
Oil Filter		Overspeed Governor		Heat Ex. or Keel Cooling	
Oil Lines		Throttle Controls		Raw Water Pump	
Ventilating System		Injector Controls		Power Generator	
Crankshaft Cover		Governor Mech or Hyd		Control Cabinet	
Balance Wgt. Cover		Engine Mounts		Cylinder Head	
Fan		Power Take-off		Conn Rod & Piston	
Crankshaft Pulley		Hydraulic Pump		Valve Mechanism	
Crankshaft Pulley Belt		Air Compressor		Fuel Manifold Conn	
Fan Shroud		Camshaft & Gear Train			
Water Connections		Rocker Cover			
Water Pump Cover		Accessory Drive			
Water Manifold					

OTHER USEFUL INFORMATION:

Each fuel and lube oil filter on your engine has a decal giving the service package part number for the element. It is advisable to have your own personal record of these part numbers by filling in the chart provided below:

TYPE	LOCATION	PACKAGE PART NO.
Fuel Strainer		
Fuel Filter		
Lube Oil Filter Full-Flo		
Lube Oil Filter By-Pass*		

*Not Standard

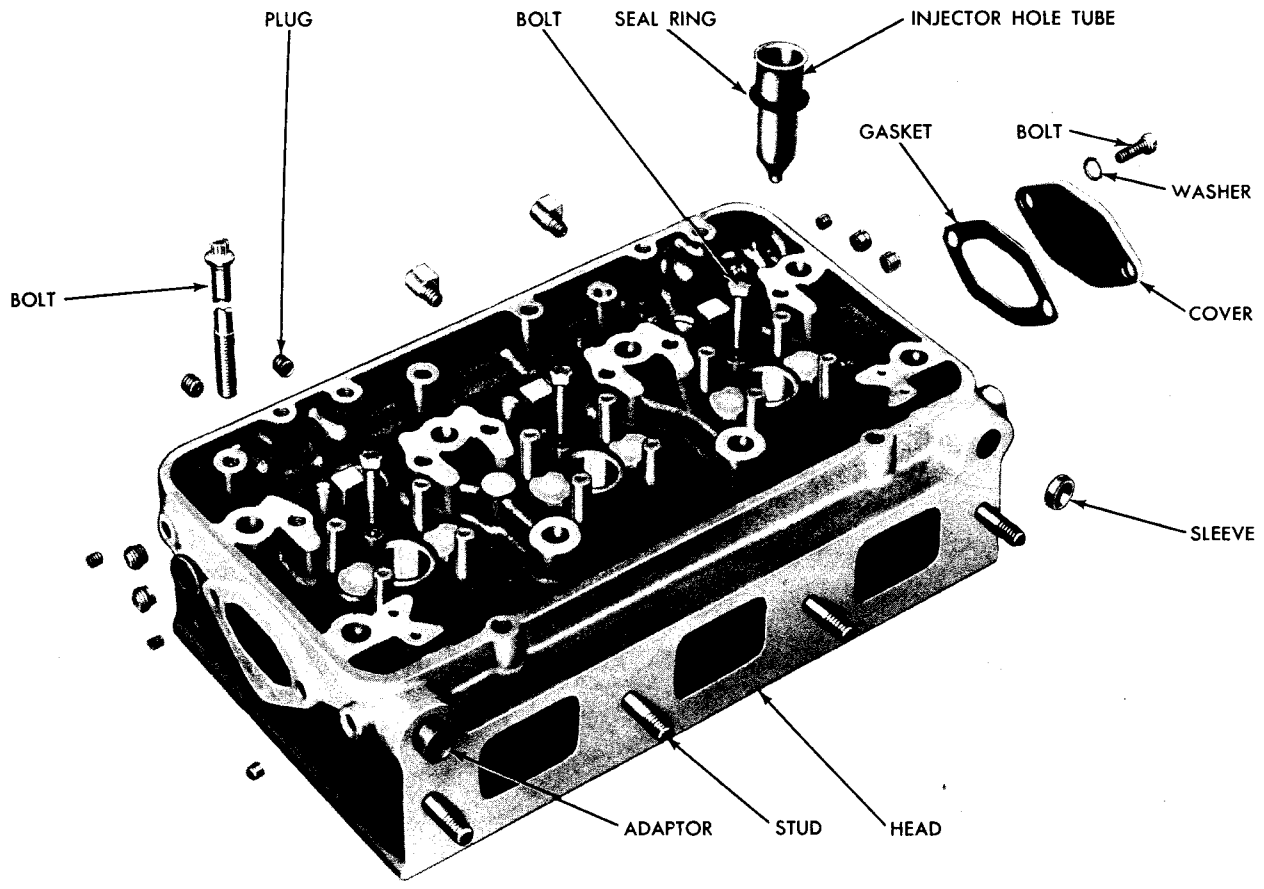
AIR CLEANER

If dry-type, indicate make and number of filter element:

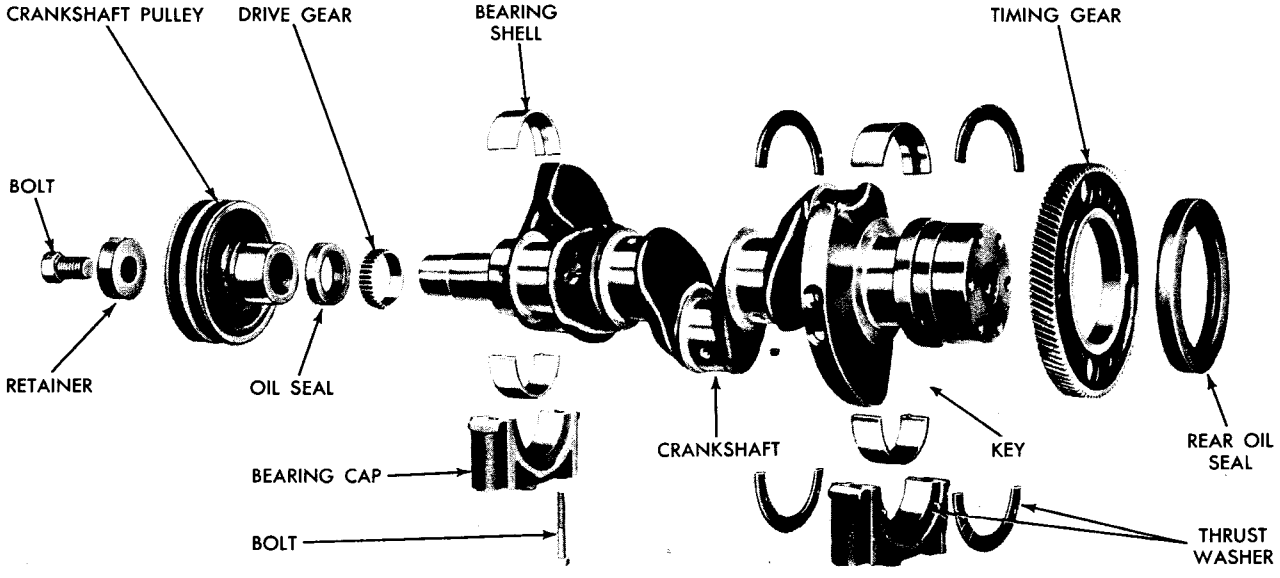
_____

_____

Wet type, indicate capacity_____qts.

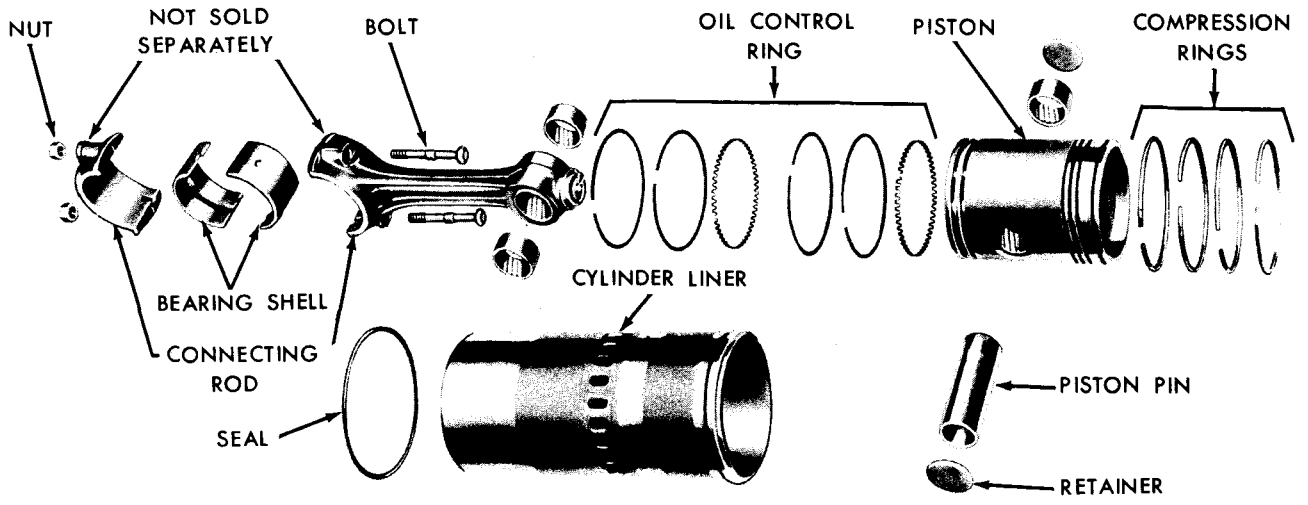


CYLINDER HEAD

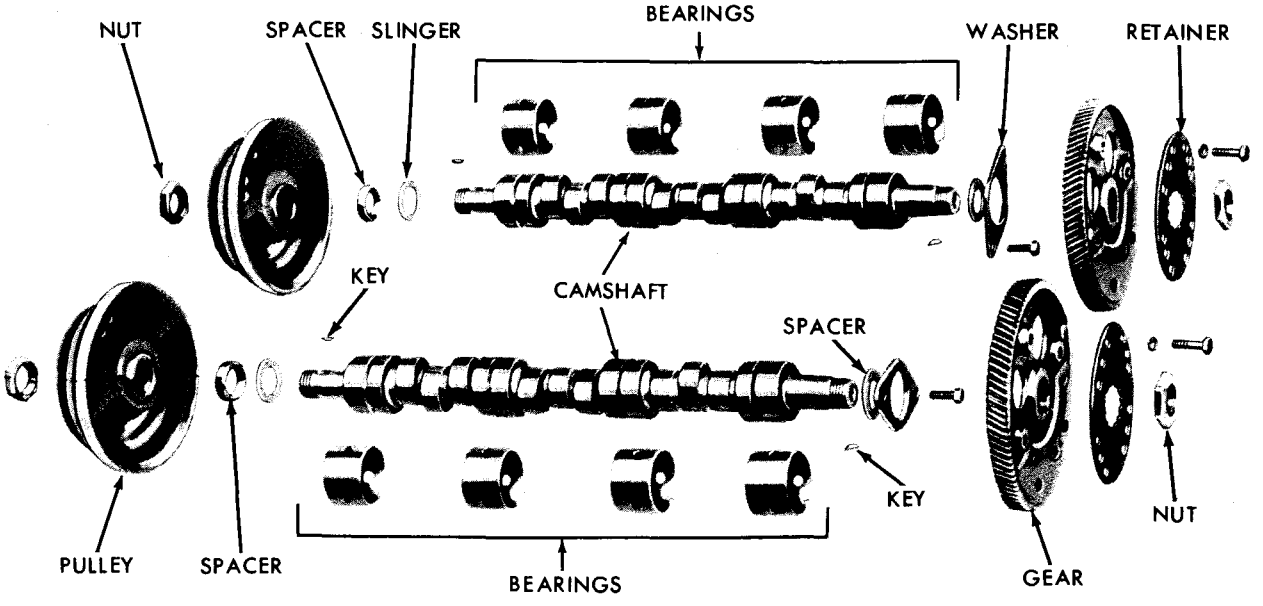


CRANKSHAFT

P 628

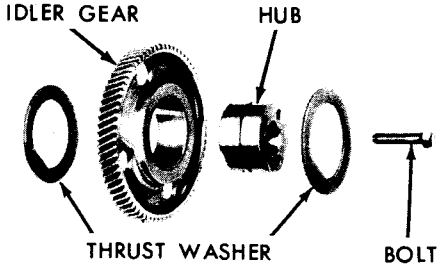


CONNECTING ROD, PISTON AND LINER

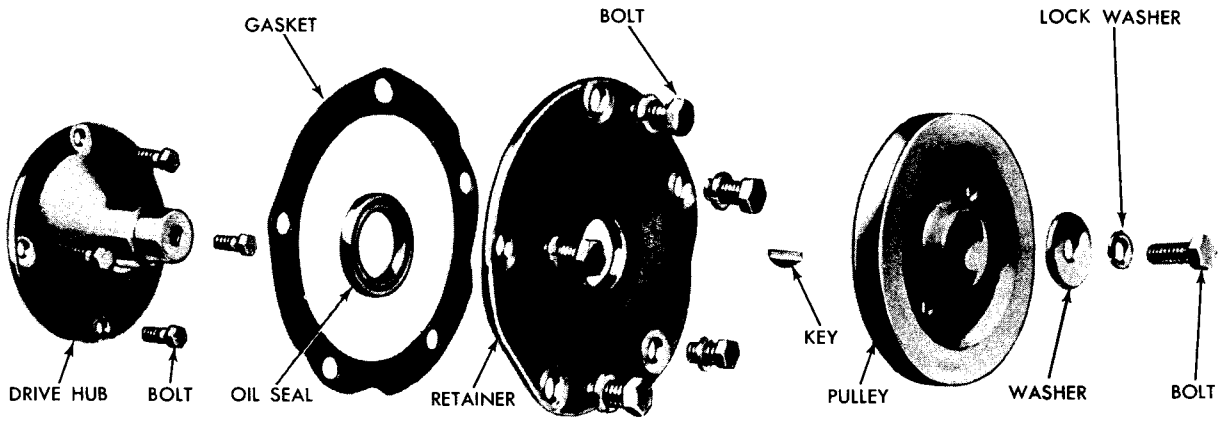


CAMSHAFT AND GEAR (V-ENGINE)

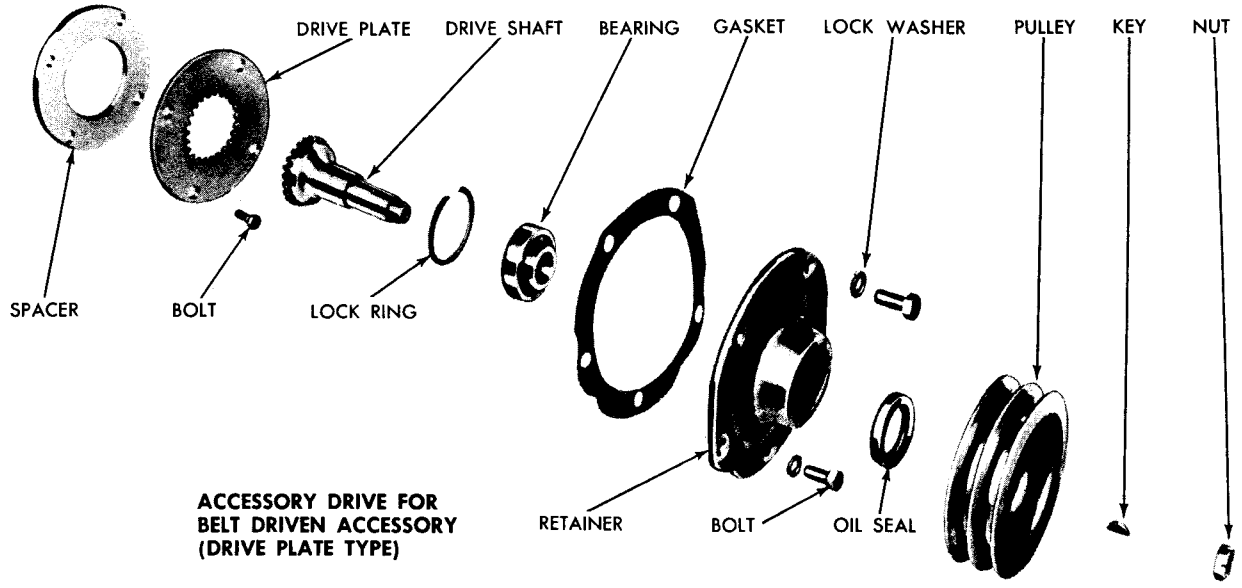
P 629



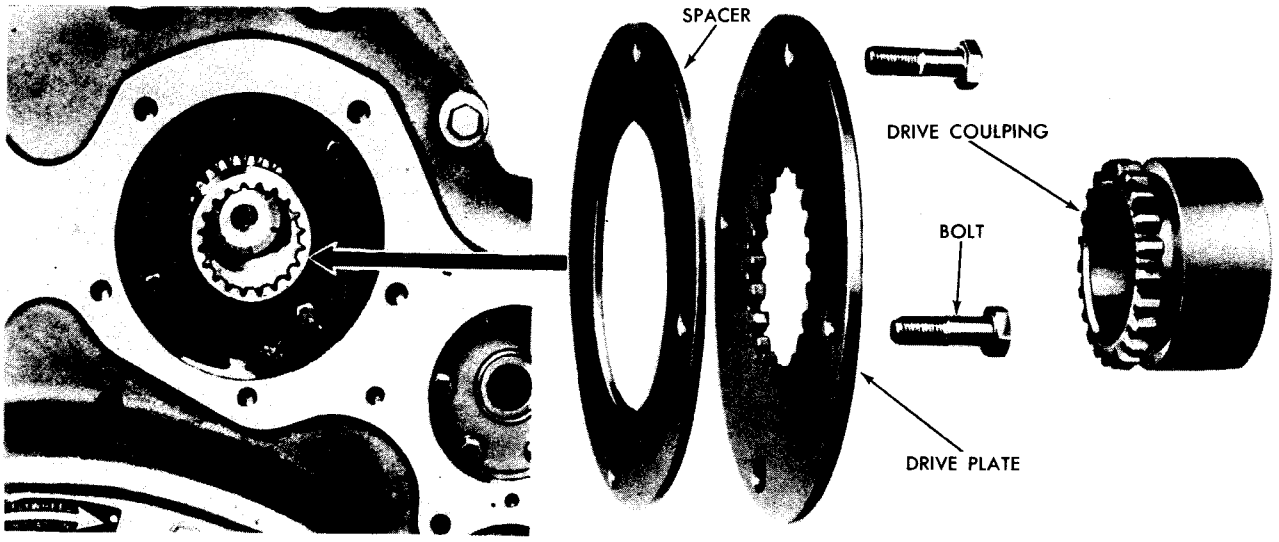
IDLER GEAR



ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE HUB TYPE)

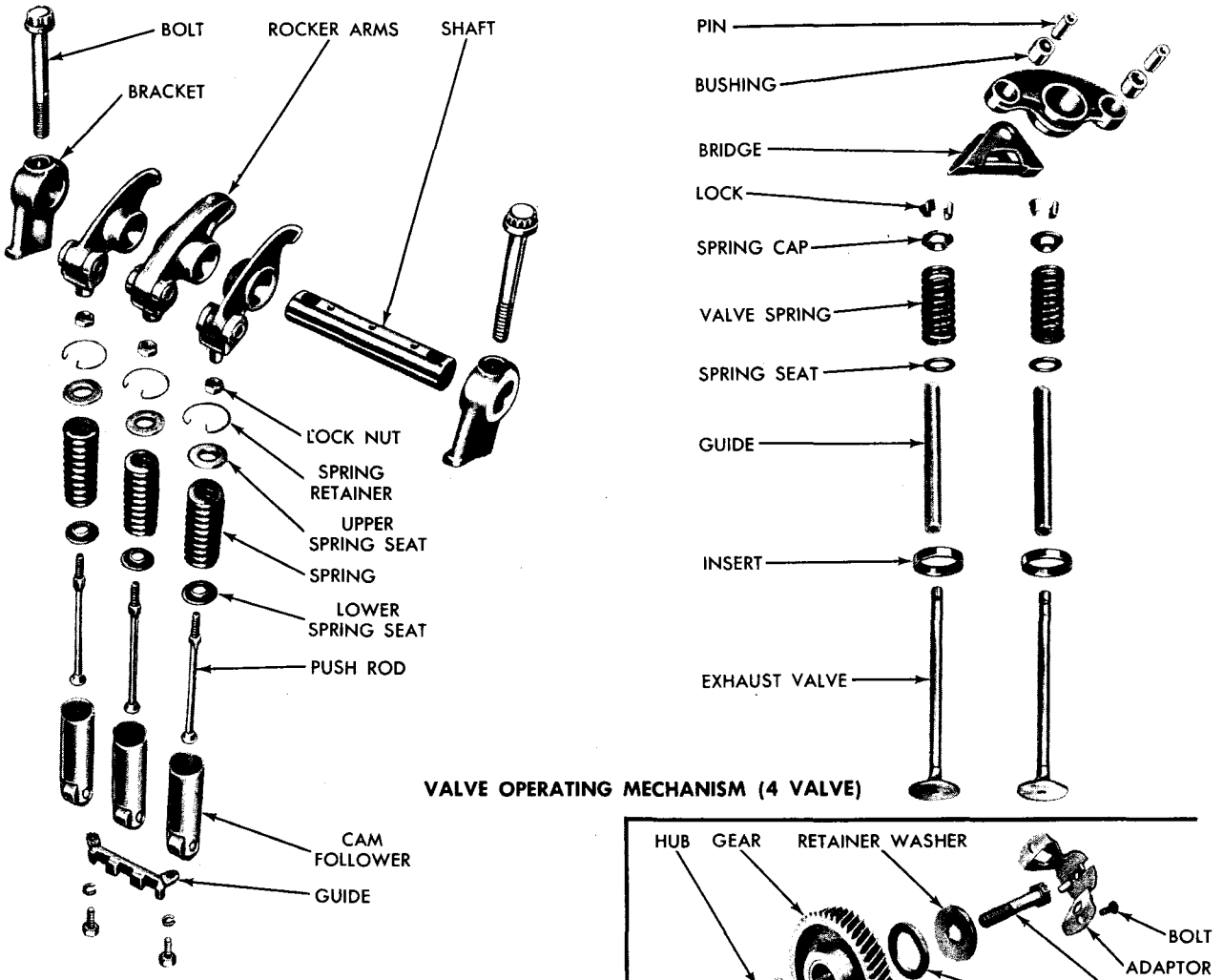


ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE PLATE TYPE)



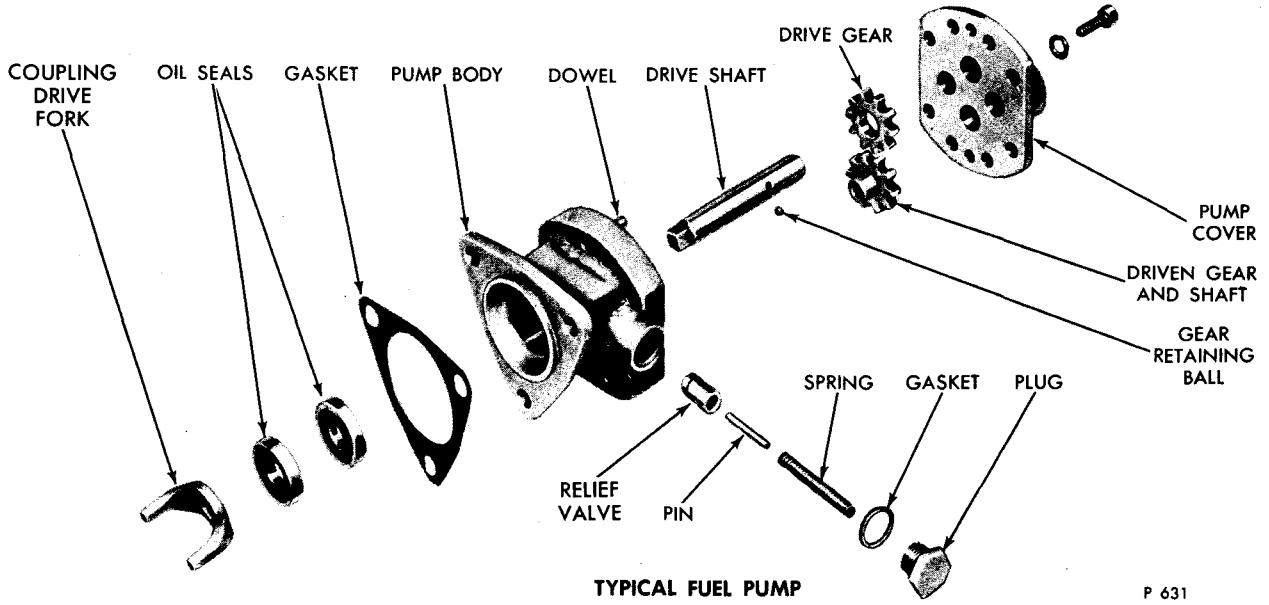
ACCESSORY DRIVE FOR DIRECT DRIVEN ACCESSORY (CAMSHAFT GEAR)

P 630



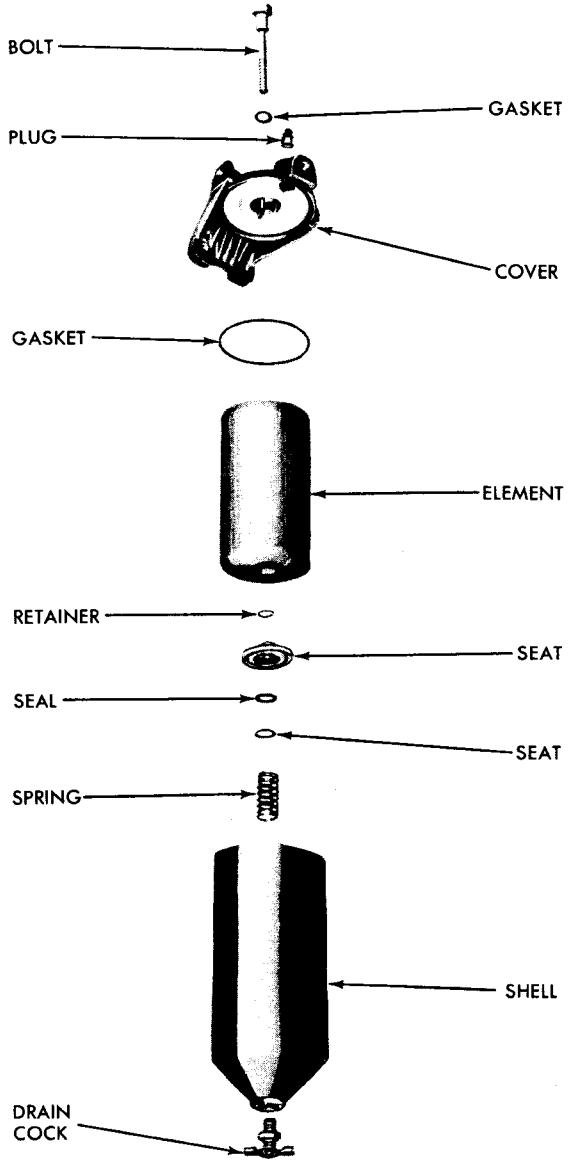
VALVE OPERATING MECHANISM (4 VALVE)

FUEL PUMP DRIVE (6V53)

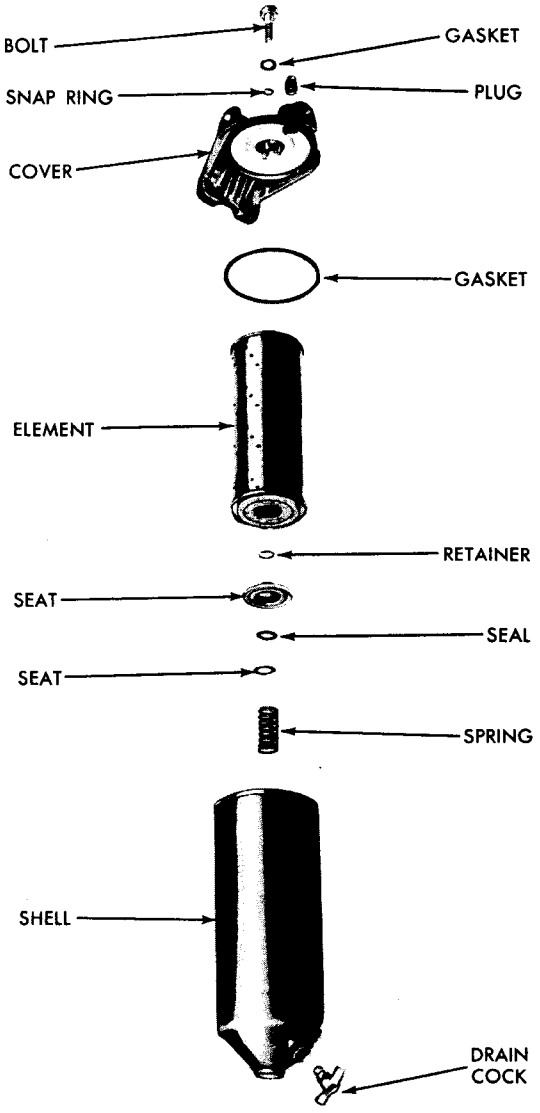


TYPICAL FUEL PUMP

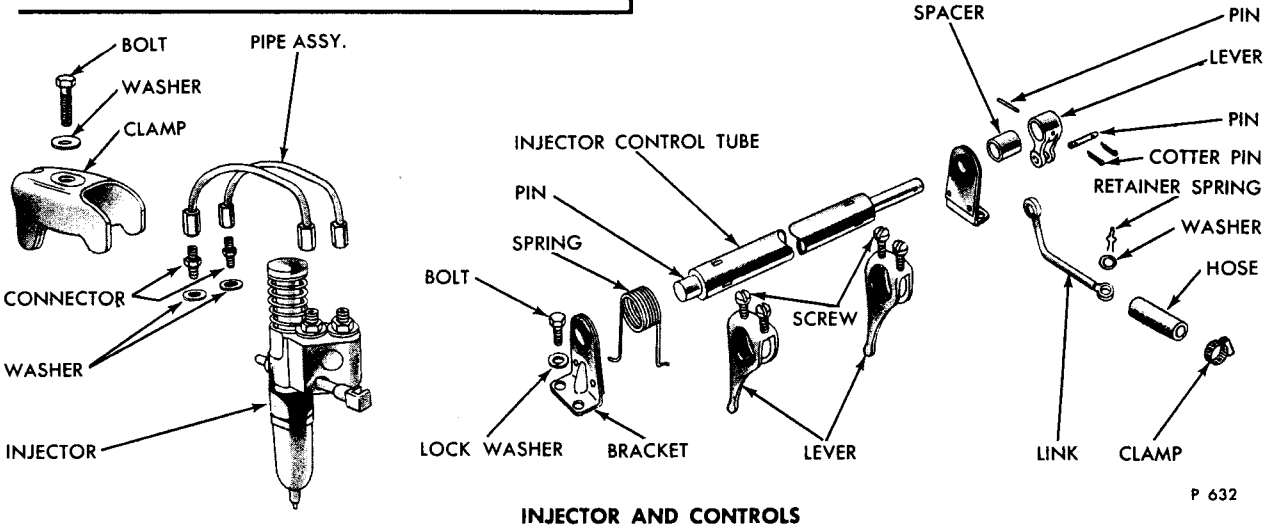
P 631



TYPICAL FUEL OIL STRAINER

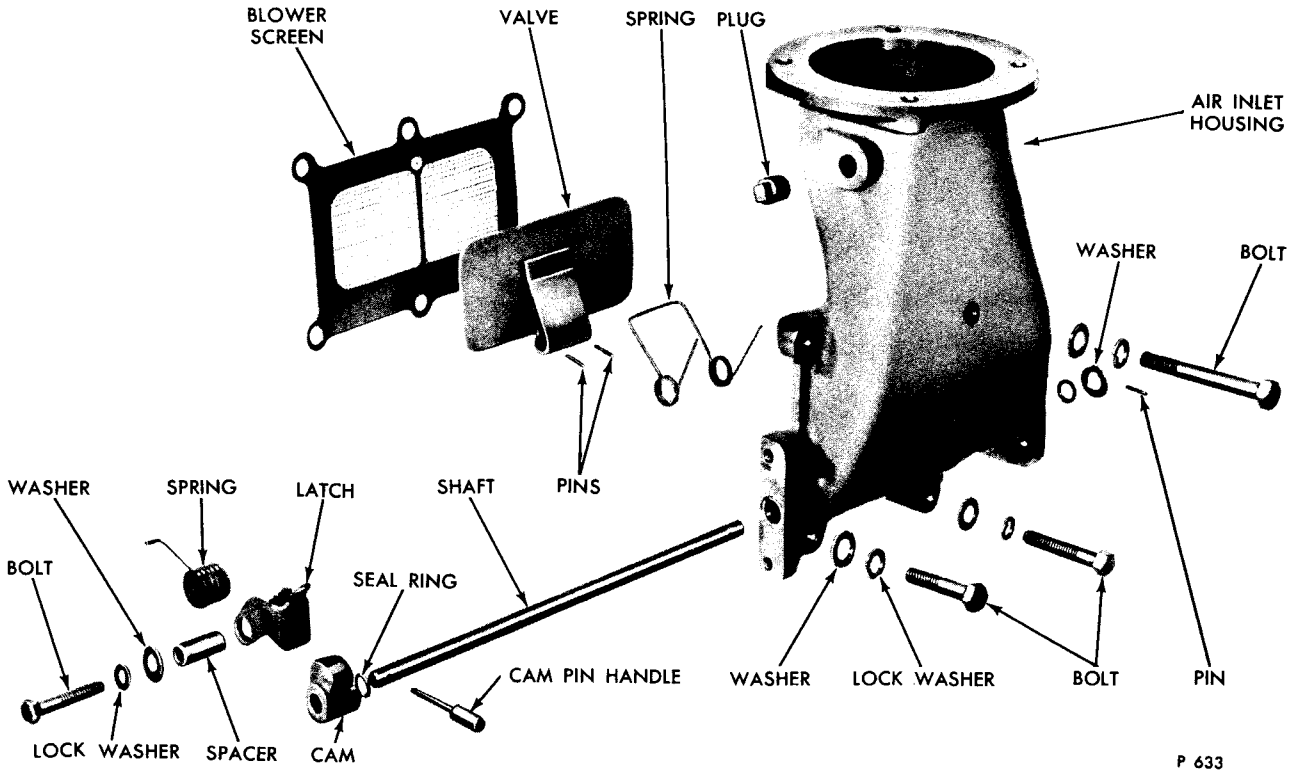


TYPICAL FUEL OIL FILTER

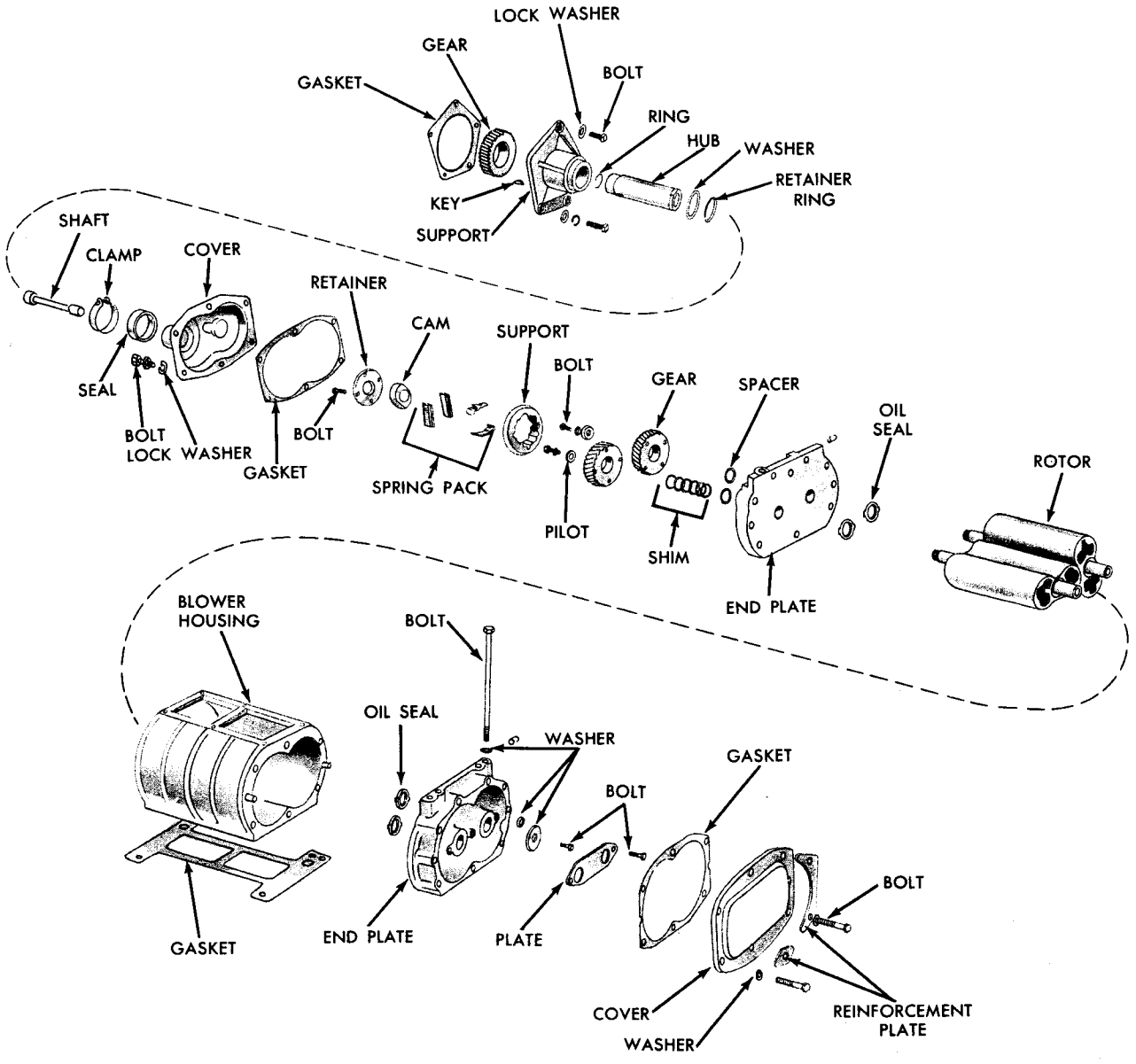


P 632

INJECTOR AND CONTROLS

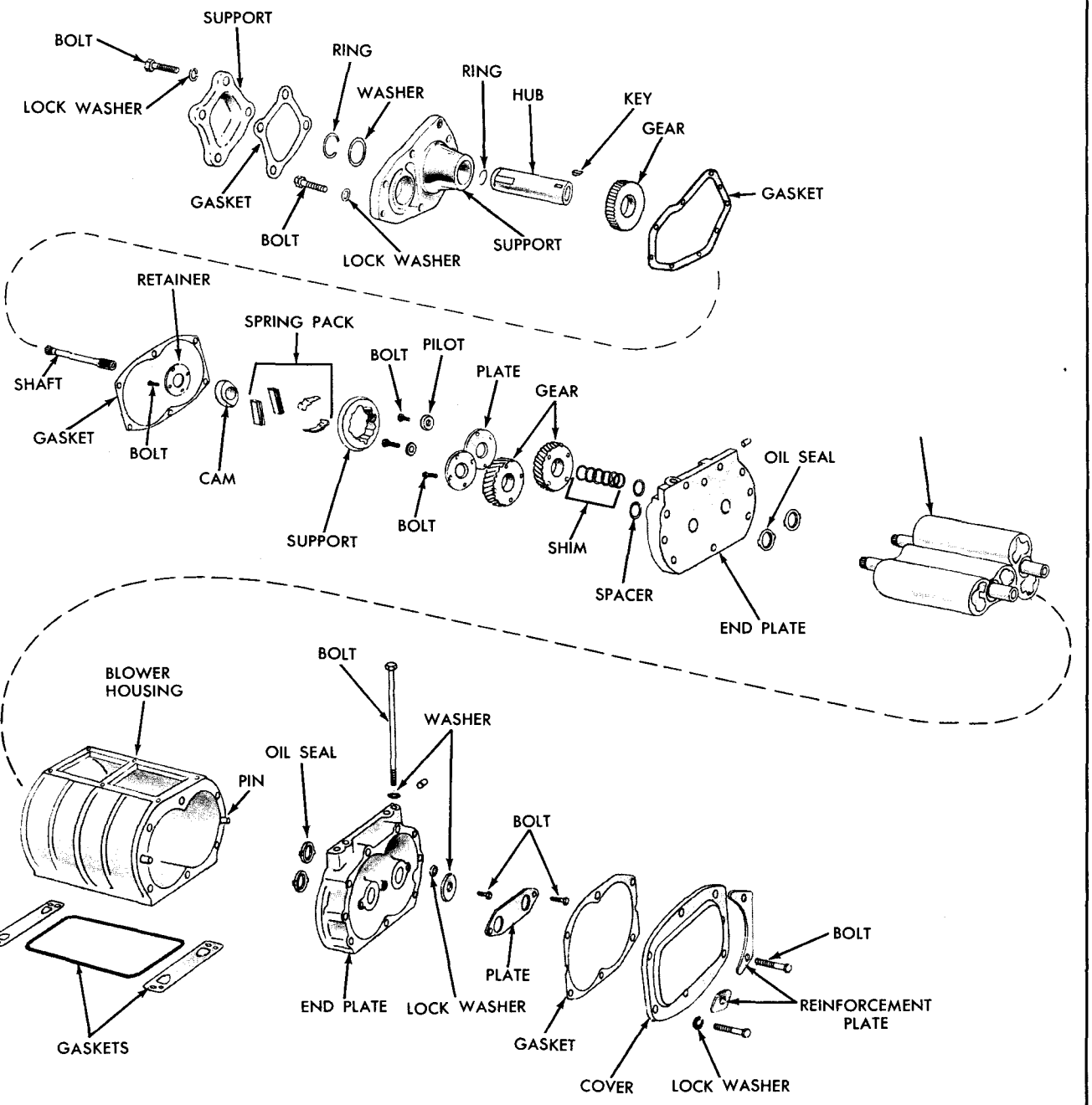


AIR SHUT-DOWN HOUSING



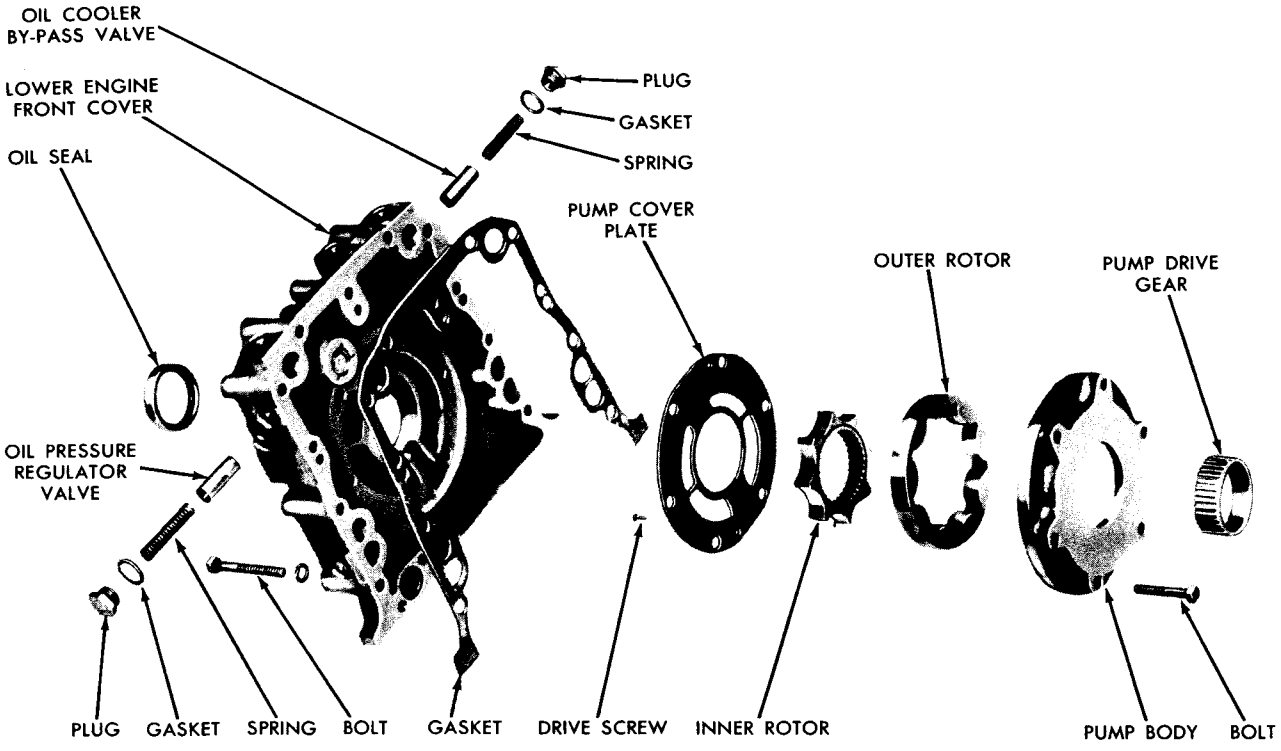
P 634

BLOWER ASSEMBLY AND DRIVE (4 CYL.)



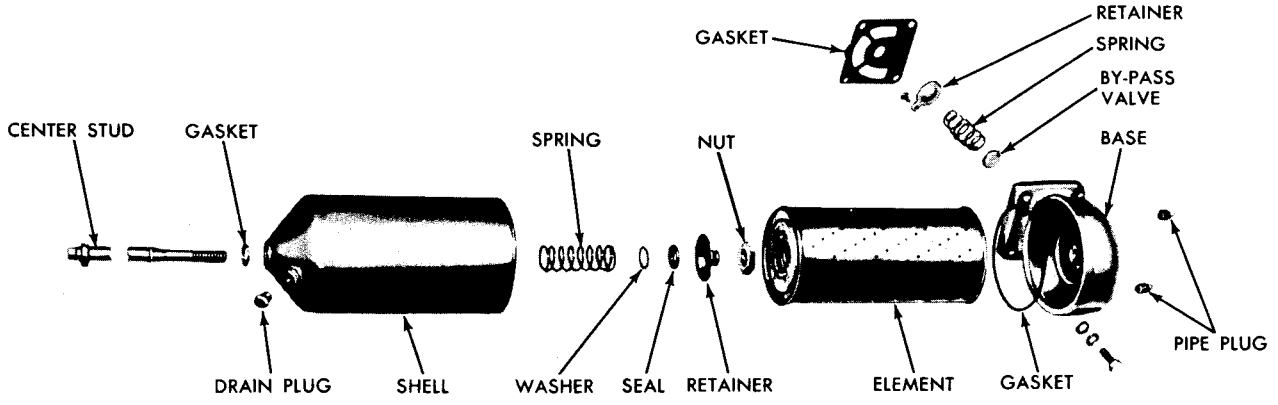
BLOWER ASSEMBLY AND DRIVE (6 CYL.)

P 635

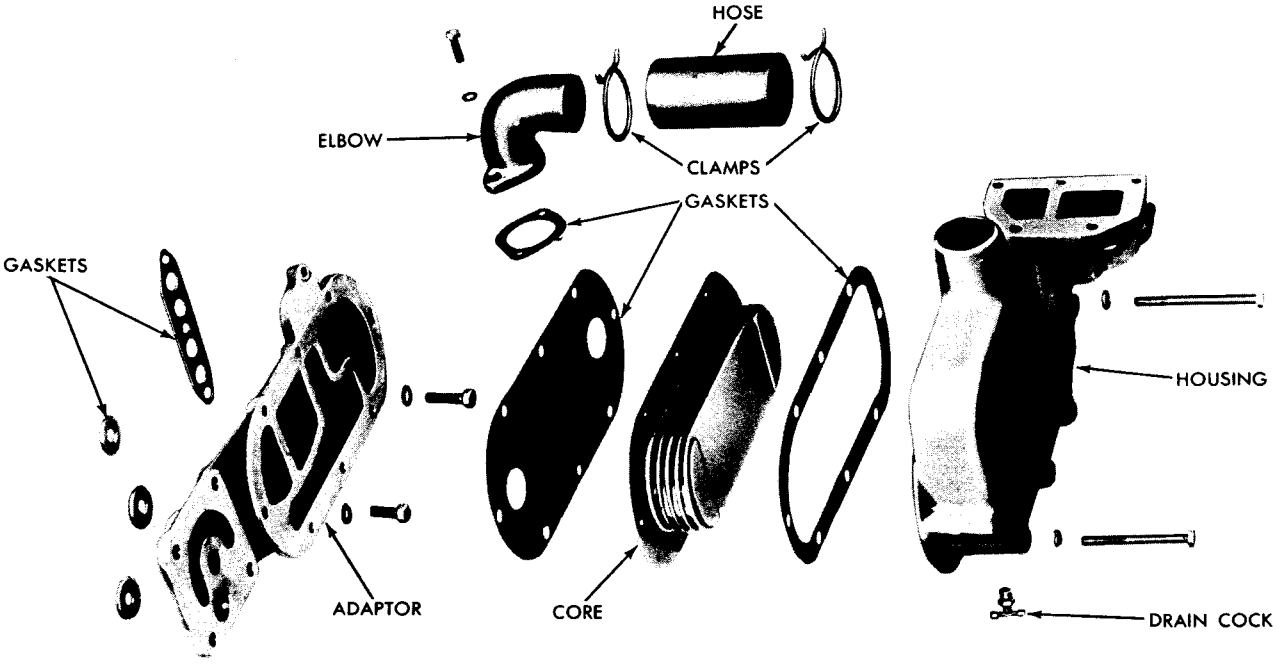


OIL PUMP AND REGULATOR

P 636

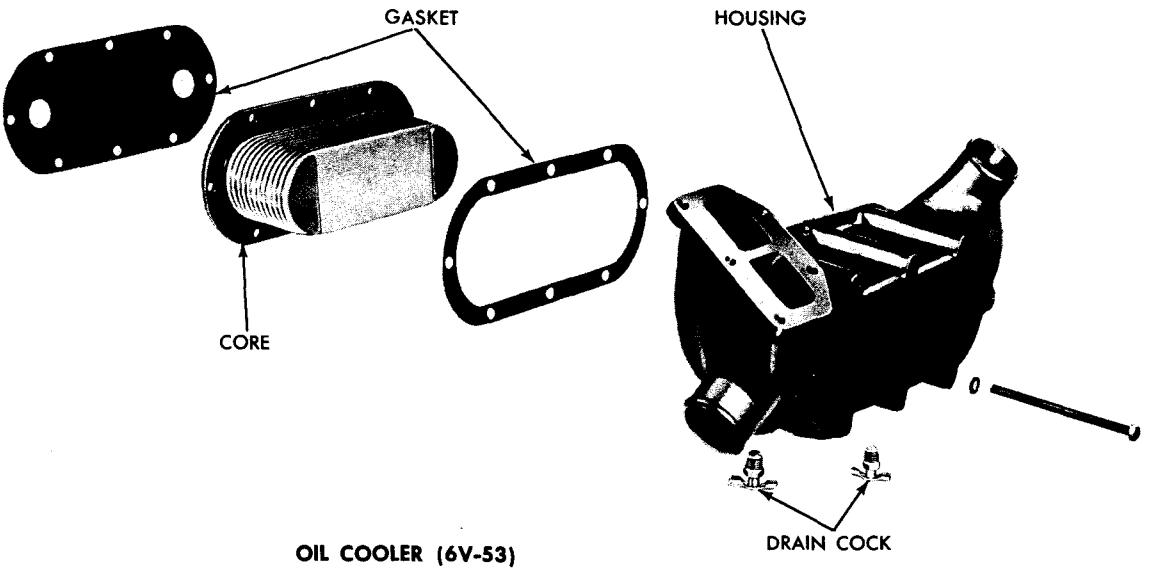


OIL FILTER

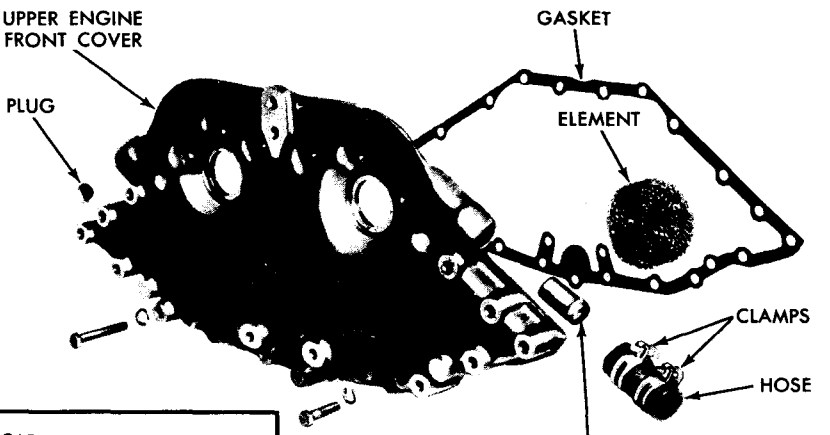


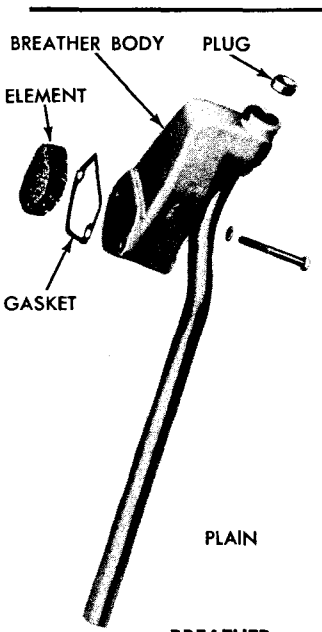
OIL COOLER

P 637

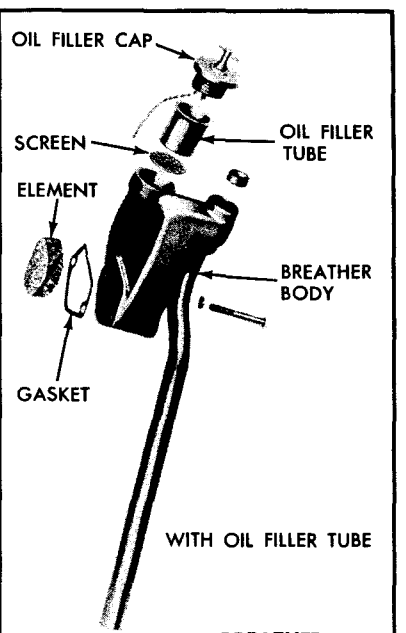


OIL COOLER (6V-53)

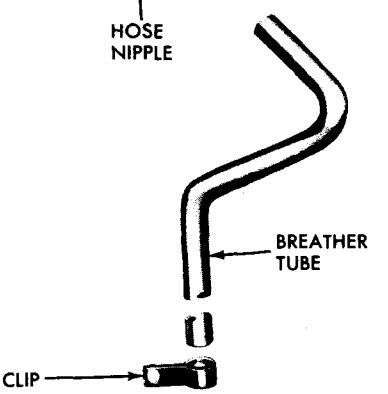




BREATHER

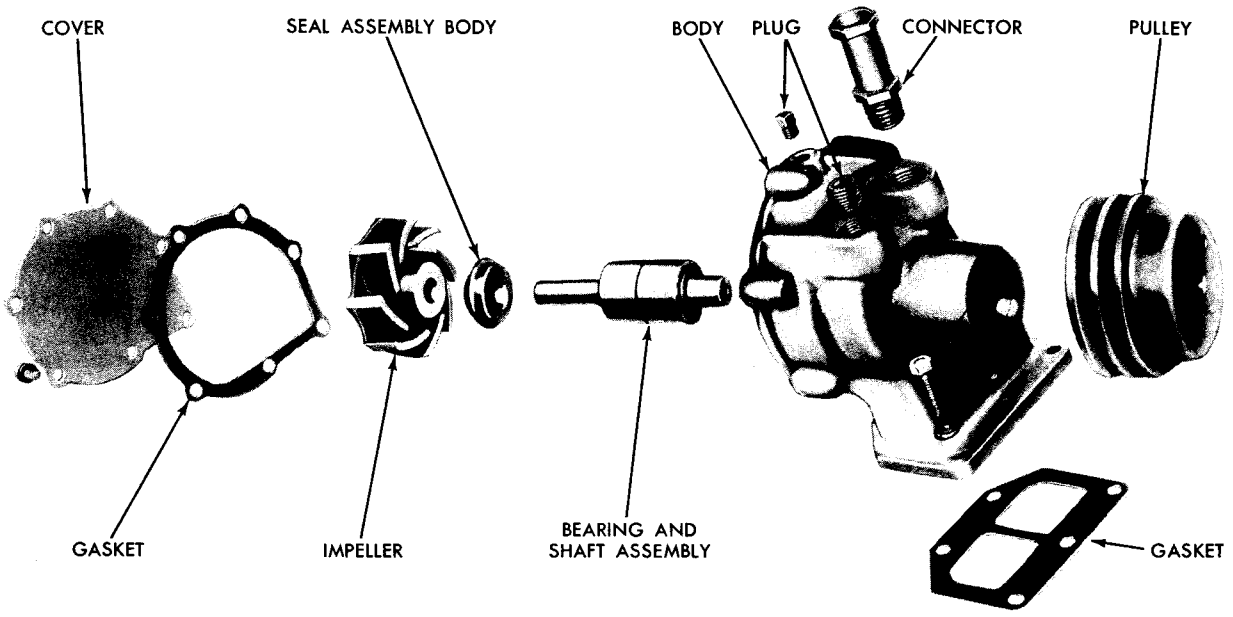


BREATHER

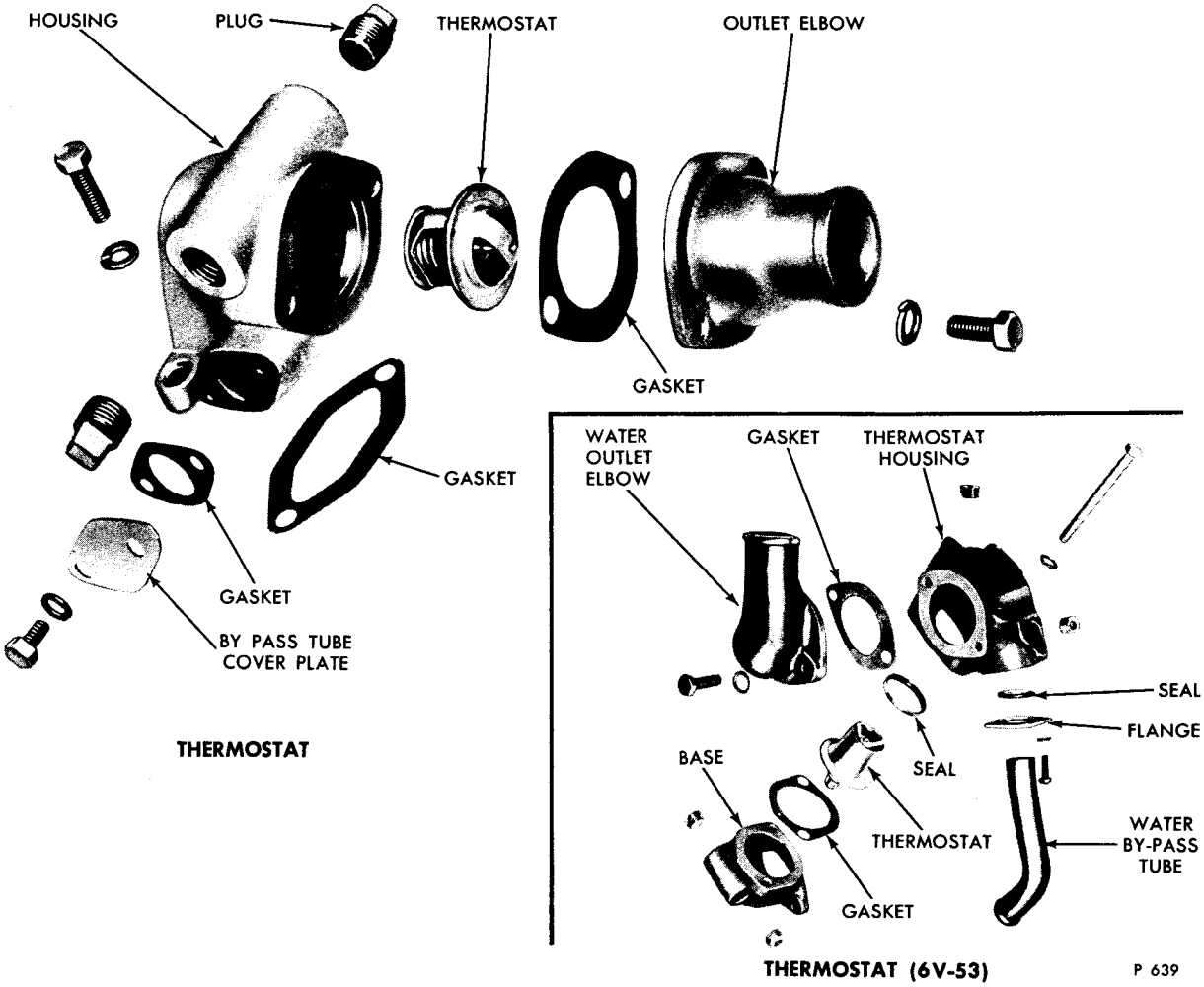


BREATHER (6V-53)

P 638

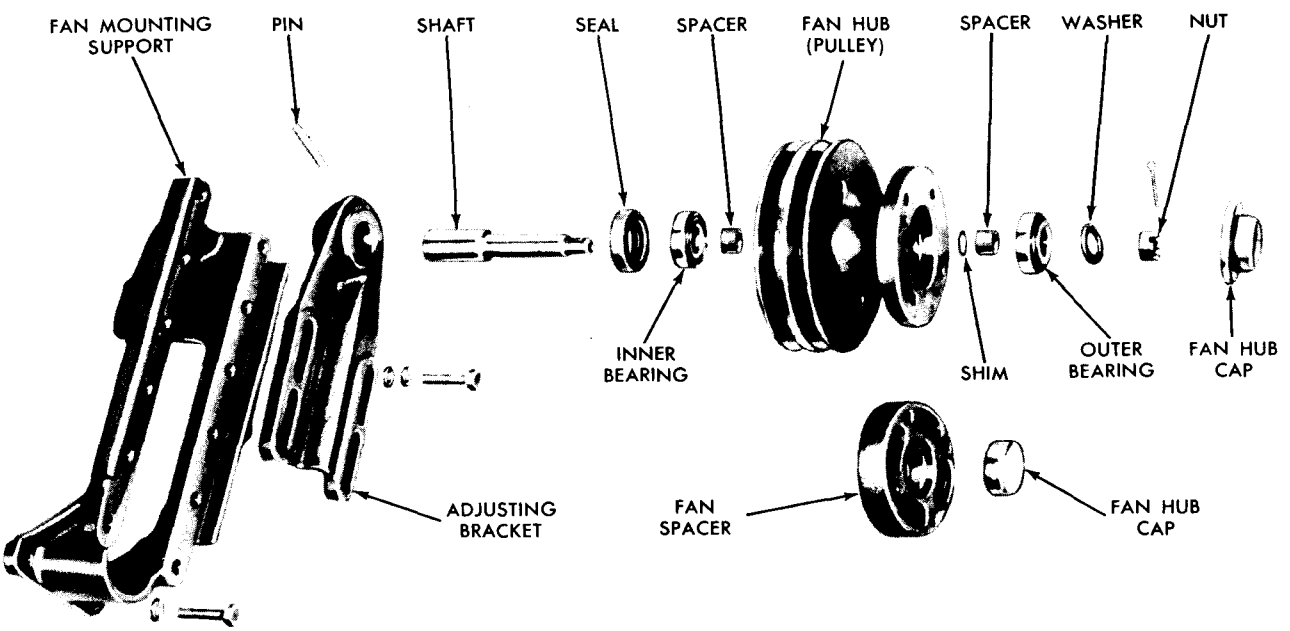


FRESH WATER PUMP



THERMOSTAT

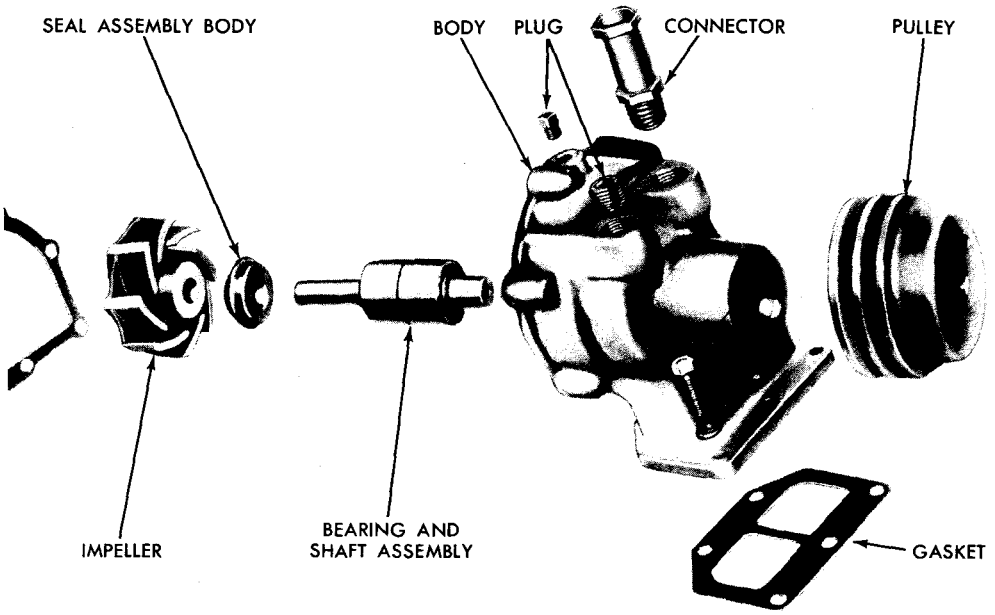
THERMOSTAT (6V-53) P 639



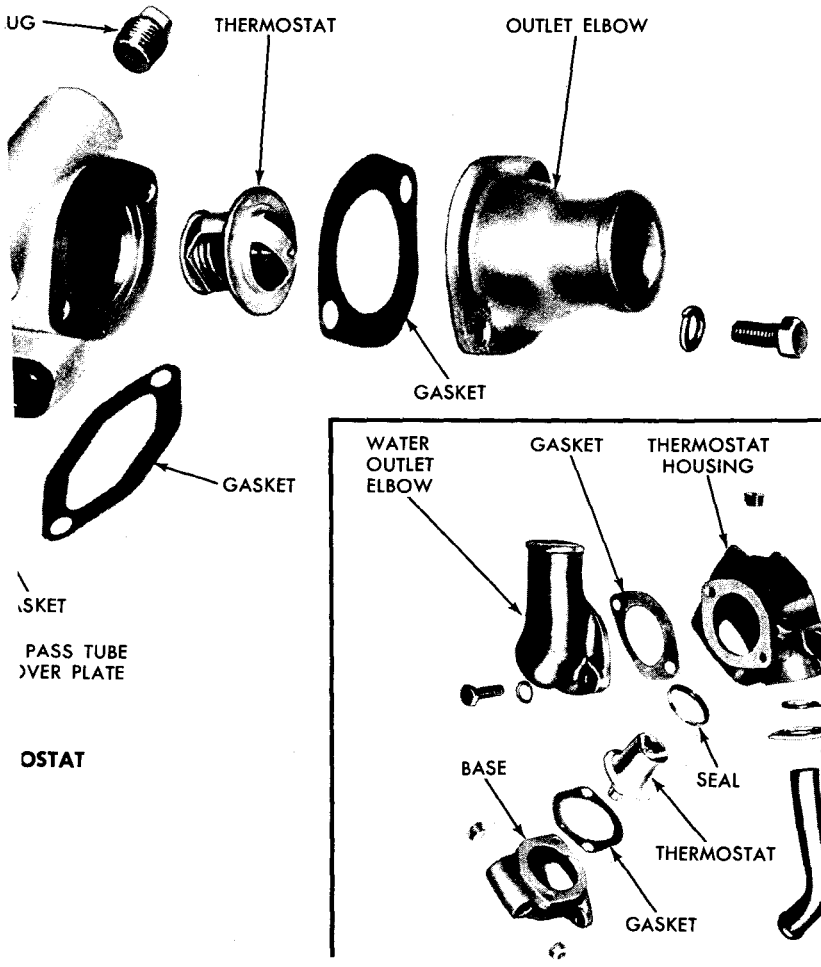
FAN MOUNT (6V-53)

P 640

ETROIT DIESEL



FRESH WATER PUMP



THERMOSTAT (6V-53) P 639

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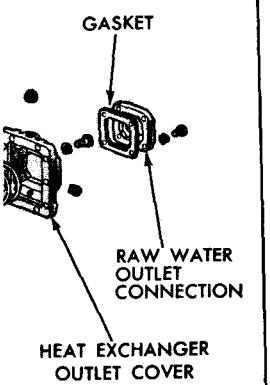
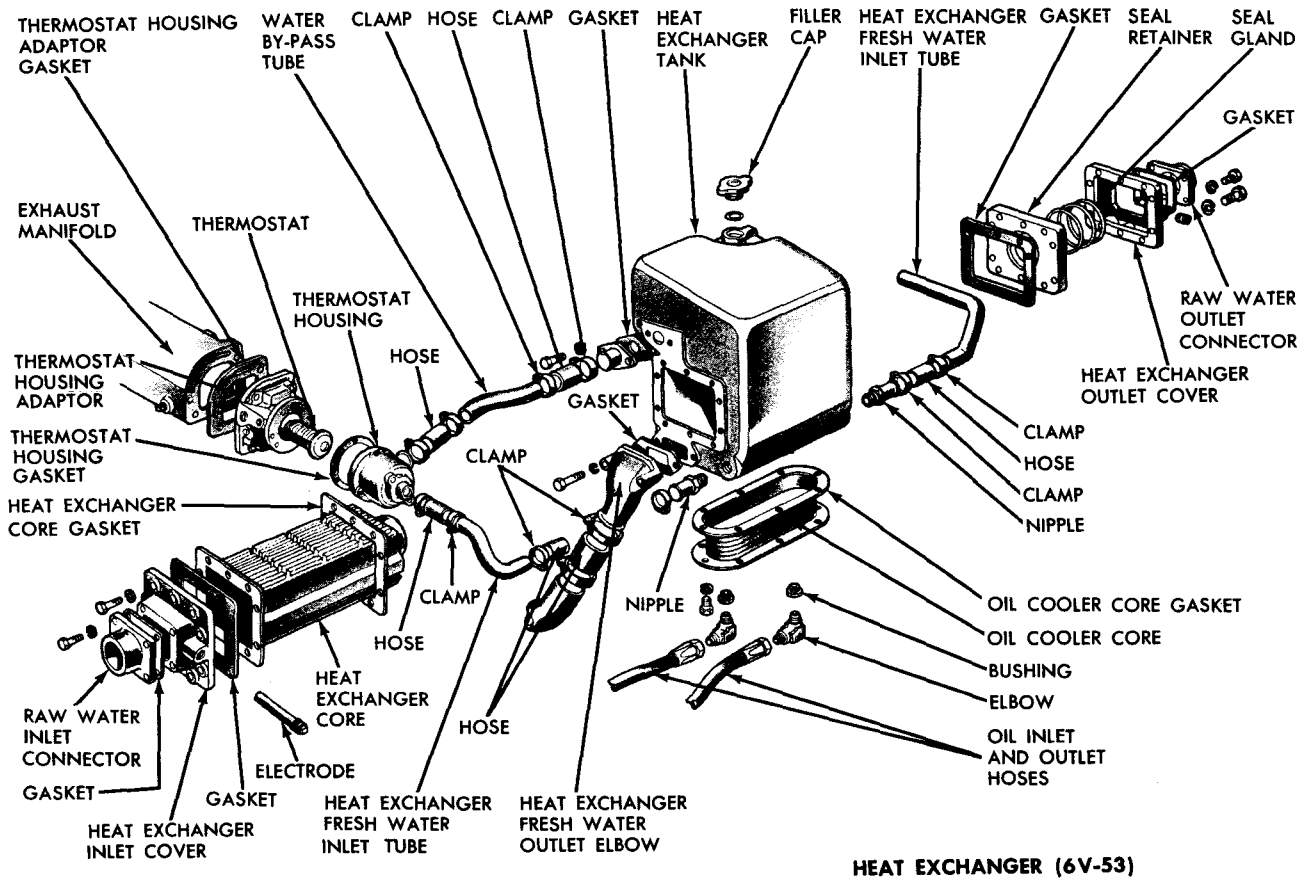
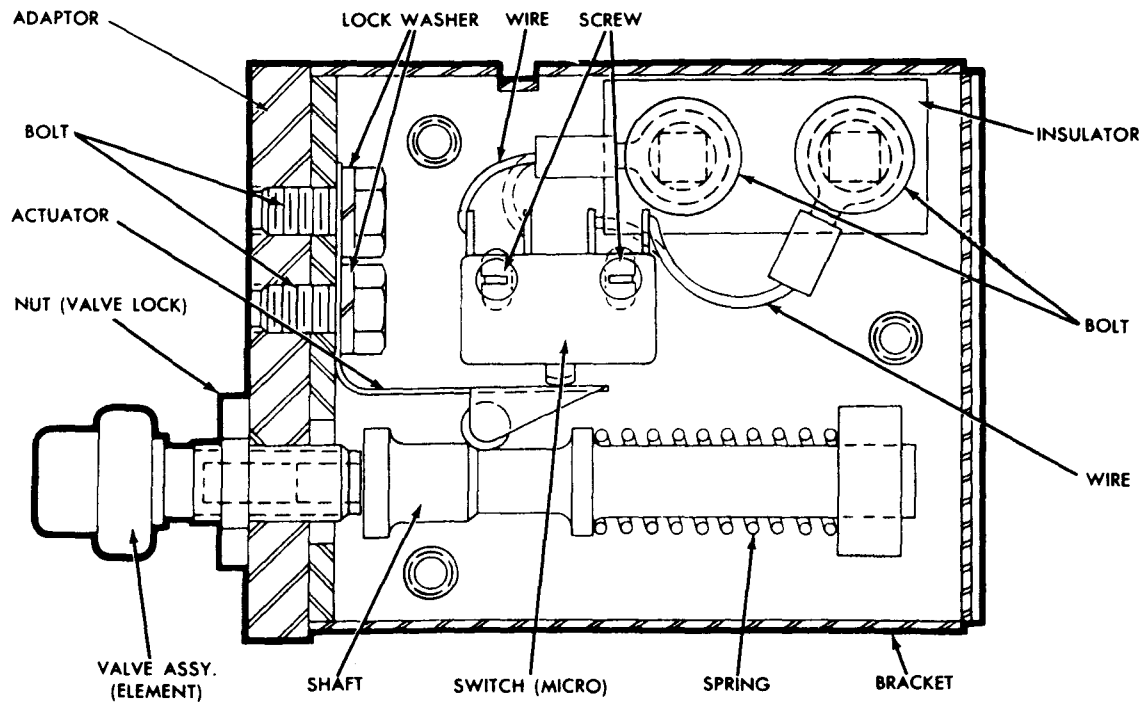


FRESH
WATER
INLET
ELBOW

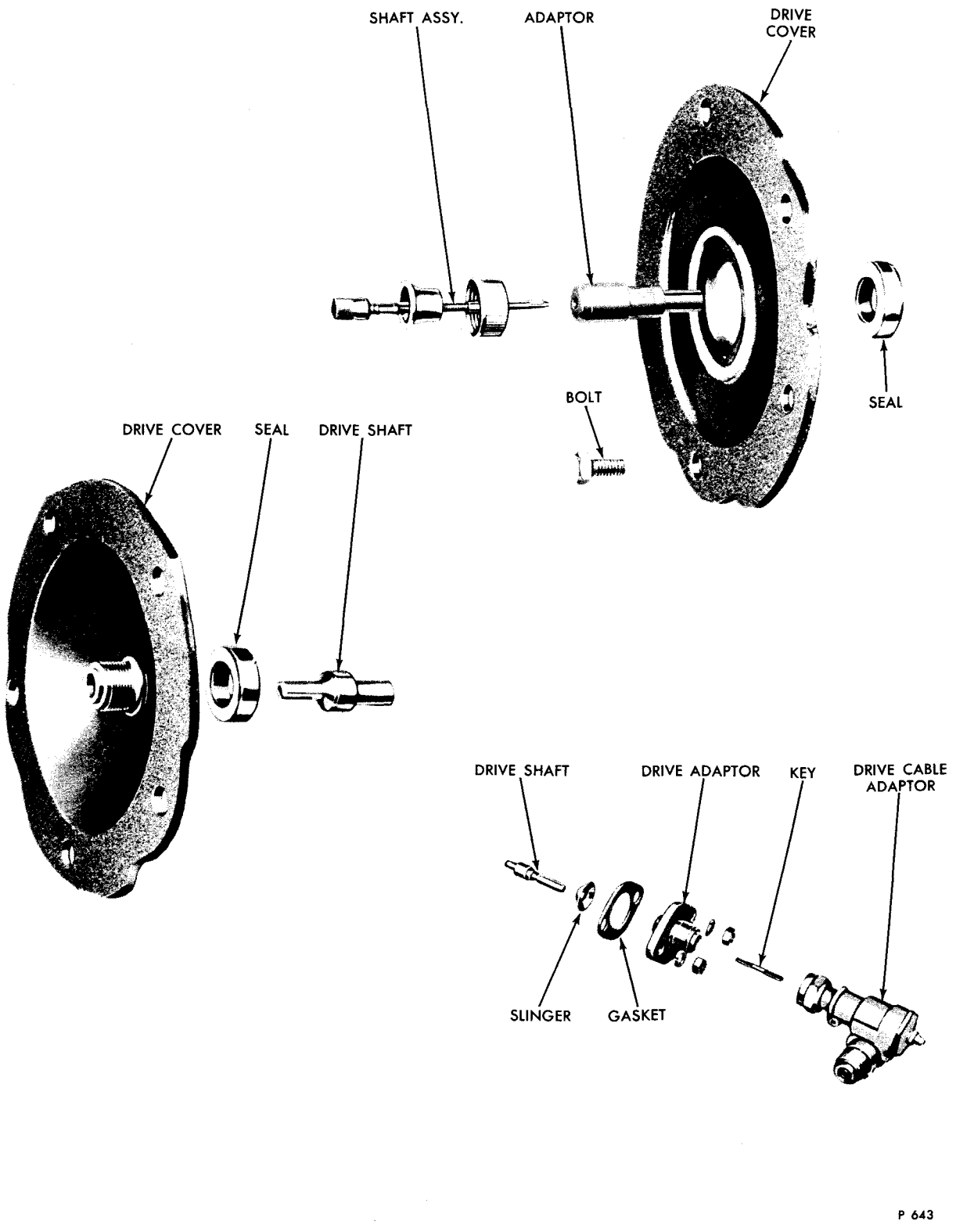
P 641



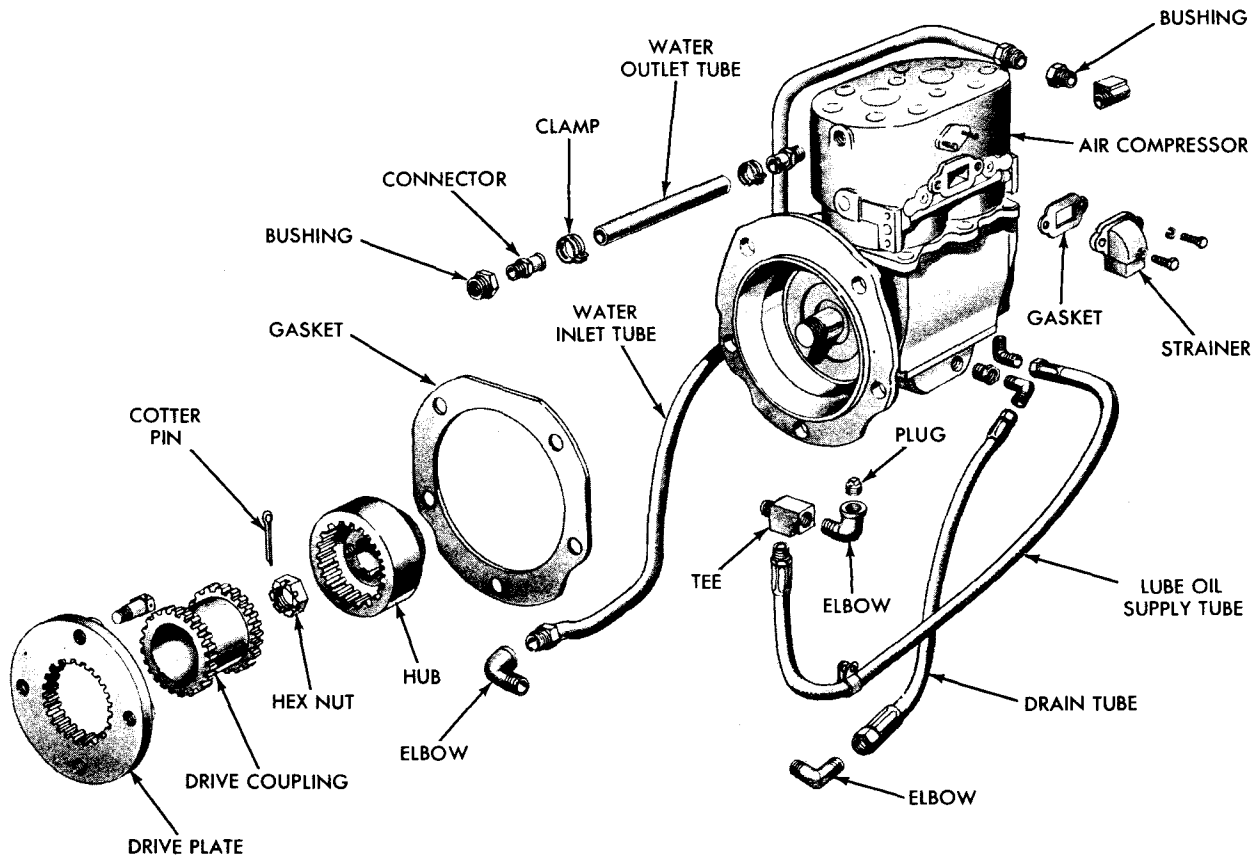
HEAT EXCHANGER (6V-53)



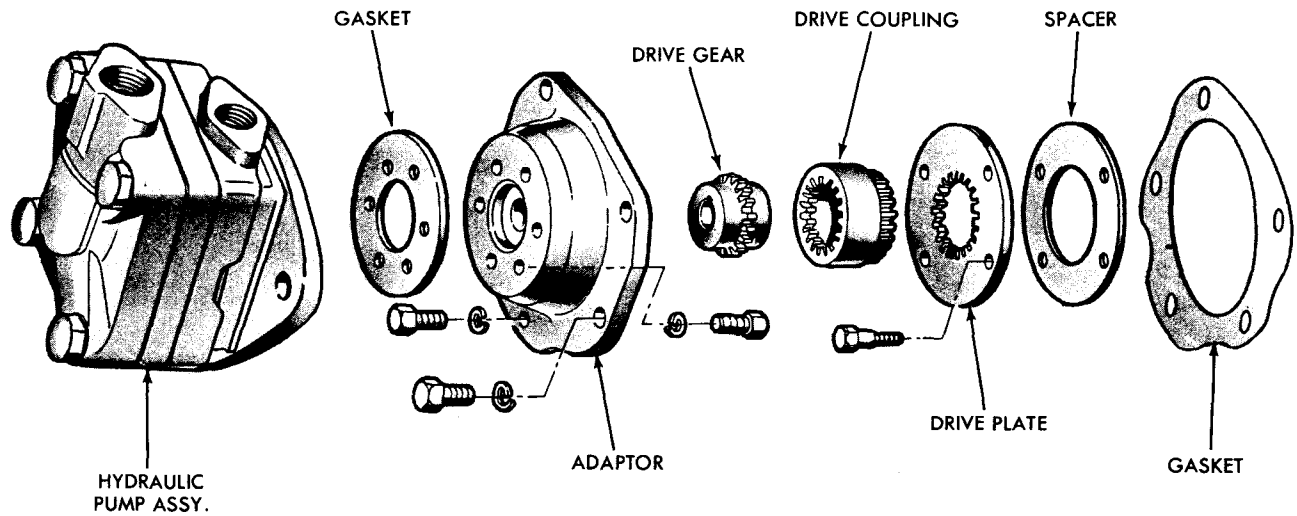
WATER TEMPERATURE SHUTDOWN SWITCH 12734



TACHOMETER DRIVE COVERS AND ADAPTORS



AIR COMPRESSOR AND DRIVE



HYDRAULIC PUMP AND DRIVE

P 644

OWNER ASSISTANCE

The satisfaction and goodwill of the owners of Detroit Diesel engines are of primary concern to the Detroit Diesel Allison Division, its distributors and their dealers.

As an owner of a Detroit Diesel engine, you have a complete network of over 2300 Detroit Diesel Allison Distributors and Dealers in the U.S. and Canada, plus many outlets worldwide that are prepared and anxious to meet your parts and service needs:

Expert service by trained personnel.

Emergency service 24 hours a day.

Complete parts support, including reliabilt components.

Sales teams to help determine your power requirements.

Product information and literature.

We recognize, however, that despite the best intentions of everyone concerned, misunderstandings may occur. Normally, any such situation that arises in connection with the sale, operation or service of your engine will be handled by the distributor or dealer in your area (check the Yellow Pages for the Detroit Diesel Allison Service Outlet nearest you).

To further assure your complete satisfaction, we have developed the following three-step procedure to be followed in the event you have a problem that has not been handled satisfactorily.

Step One - **Discuss your problem with a member of management from the distributorship or dealership.** Frequently, complaints are the result of a breakdown in communication and can quickly be resolved by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. If your problem originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement.

Step Two - When it appears that your problem cannot readily be resolved at the distributor level without additional assistance, **contact the Detroit Diesel Allison Regional Office nearest you** listed below:

Eastern Region
Suite 202
10 Parsonage Road
Edison, New Jersey 08817
Phone: (201) 246-5074
Regional Manager: S. F. Zappia
Service Manager: D. P. Friedrich

Southeastern Region
5730 Glenridge Drive, N.E.
Atlanta, Georgia 30328
Phone: (404) 252-3310
Regional Manager: L. R. Kirby
Service Manager: B. D. Robison, Jr.

Great Lakes Region
Garrison Place
19855 Outer Drive
Dearborn, Michigan 48124
Phone: (313) 565-0411
Regional Manager: A. W. Christy
Service Manager: R. Schwaller

Midwestern Region
Suite 618
2021 Spring Road
Oak Brook, Illinois 60521
Phone: (312) 654-6619
Regional Manager: C. O. Zimmerman
Service Manager: T. F. Chope

Southwestern Region
Suite 130
2655 Villa Creek Drive
Dallas, Texas 75234
Phone: (214) 241-7721
Regional Manager: F. A. Skells
Service Manager: W. C. Kaphengst

Northwestern Region
Suite 250
20380 Town Center Lane
Cupertino, California 95014
Phone: (408) 255-7700
Regional Manager: W. C. Edwards
Service Manager: J. P. Miles

Western Region
Suite 823
Crocker Bank Building
15760 Ventura Blvd.
Encino, California 91436
Phone: (213) 981-7300
Regional Manager: G. J. Dunneback
Service Manager: W. K. Clark, Jr.

Prior to this call, have the following information available:

- Name and location of distributor or dealer.
- Type and make of equipment.
- Engine model and serial number.
- Engine delivery date and accumulated miles or hours of operation.
- Nature of problem.
- Chronological summary of unit's history.

Step Three - If you are still not satisfied, **present the entire matter in writing or by phone to the Home Office:**

Diesel Operations - J. E. Fisher, Manager Customer Services, Detroit Diesel Allison, 13400 W. Outer Drive, Detroit, Michigan 48228, Phone (313) 592-5608.

Canada Operations - E. A. Kobe, Manager of Product Service, Diesel Division, General Motors of Canada, Ltd., P.O. Box 5990, 847 Highbury Avenue, London, Ontario N6A 4L6, Phone (519) 455-7110.

If at this point your problem is still not resolved to your satisfaction, call or write J. P. Lewis, Manager, Diesel Engine Service, Diesel Operations (313) 592-7279; D. F. Downham, Sales Manager, Diesel Operations (313) 592-7276.

When contacting the Regional or Home Office, please keep in mind that ultimately your problem will likely be resolved at the distributorship or dealership utilizing their facilities, equipment and personnel. Therefore, it is suggested that you follow the above steps in sequence when experiencing a problem.

ALPHABETICAL INDEX

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DETROIT DIESEL

Page

Detroit Diesel Allison
Division of General Motors Corporation

ENGLISH TO METRIC CONVERSIONS

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
AREA		
$Inch^2$	645.2	$millimetres^2$ (mm^2)
	6.45	$centimetres^2$ (cm^2)
$Foot^2$	0.092 9	$metres^2$ (m^2)
$Yard^2$	0.836 1	$metres^2$
VOLUME		
$Inch^3$	16 387.	mm^3
	16.387	cm^3
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
$Yard^3$	0.764 6	$metres^3$ (m^3)
MASS		
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons

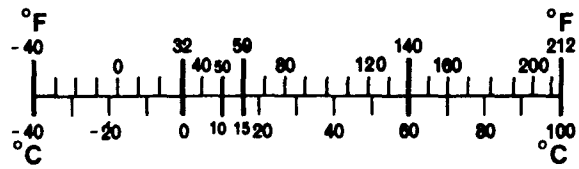
Multiply	by	to get equivalent number of:
ACCELERATION		
$Foot/sec^2$	0.304 8	$metre/sec^2$ (m/s^2)
$Inch/sec^2$	0.025 4	$metre/sec^2$
TORQUE		
Pound-inch	0.112 98	newton-metres (N·m)
Pound-foot	1.355 8	newton-metres
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Inches of water	0.249 1	kilopascals
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3.6×10^6 or 3 600 000	joules (J = one W·s)
LIGHT		
Footcandle	10.76 4	$lumens/metre^2$ (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
VELOCITY		
Miles/hour	1.609 3	kilometres/hr (km/h)

Degree (angle) 0.017 5 radians (rad)
Ounce (mass)-inch (balancing) 720.077 8 milligram-metre (mg·m)

TEMPERATURE

$°F = \frac{9}{5}(°C) + 32$

$°C = \frac{5}{9}(°F - 32)$



USE CONVERSION TABLES LIKE THIS:

13 hp = ? kW Read across the 10 line to the 3 column. Read 9.7 kW

POWER – HORSEPOWER TO KILOWATTS

(1 hp = 0.7456999 kW)

hp	0	1	2	3	4	5	6	7	8	9
	kW	kW	kW	kW	kW	kW	kW	kW	kW	
0		0.75	1.49	2.24	2.98	3.73	4.47	5.22	5.9	
10	7.5	8.2	8.9	9.7	10.4	11.2	11.9	12.7		
20	14.9	15.7	16.4	17.2	17.9	18.6	19.4	20		
30	22.4	23.1	23.9	24.6	25.4	26.1				
40										

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