LIMITING SPEED MECHANICAL GOVERNOR

INJECTOR RACK CONTROL ADJUSTMENT - IN-LINE ENGINES

The 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 gap and position the injector rack control levers.

Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. On turbocharged engines, the fuel (air box) modulator lever and roller assembly must be positioned free from cam contact. 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:

1. Remove the governor high-speed spring retainer cover.

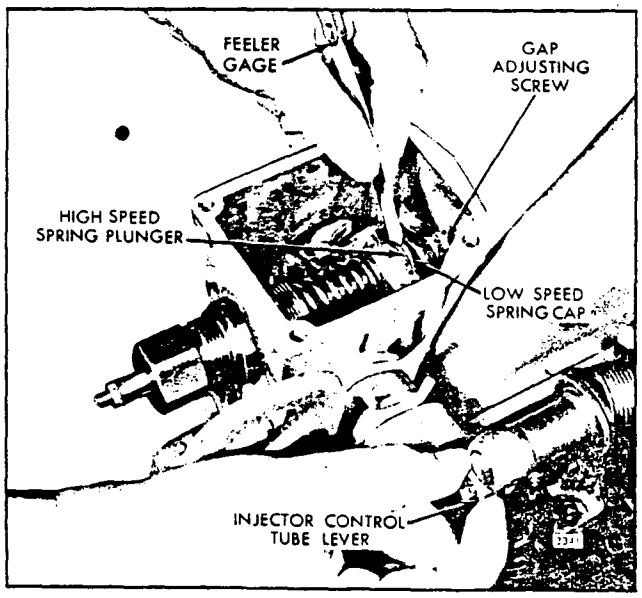


Fig. 1 - Adjusting Governor Gap

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

3. Start the engine and loosen the idle speed adjusting screw locknut (Fig. 7). Then, adjust the idle speed screw to obtain the desired engine idle speed. The recommended idle speed is 500-600 rpm, but may vary with special engine applications. Hold the screw and tighten the locknut to hold the adjustment. Governors used in turbocharged engines include a starting aid screw and locknut threaded into the governor gap adjusting screw.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker cover (if not already done). Discard the gaskets.

5. Start and run the engine between 1,100 and 1,300 rpm by manual operation of the differential lever. Do not overspeed the engine.

6. Check the gap between the low-speed spring cap and the high-speed spring plunger with a feeler gage (Fig. 1). The gap should be .002"-.004". If the gap setting is incorrect, reset the gap adjusting screw.

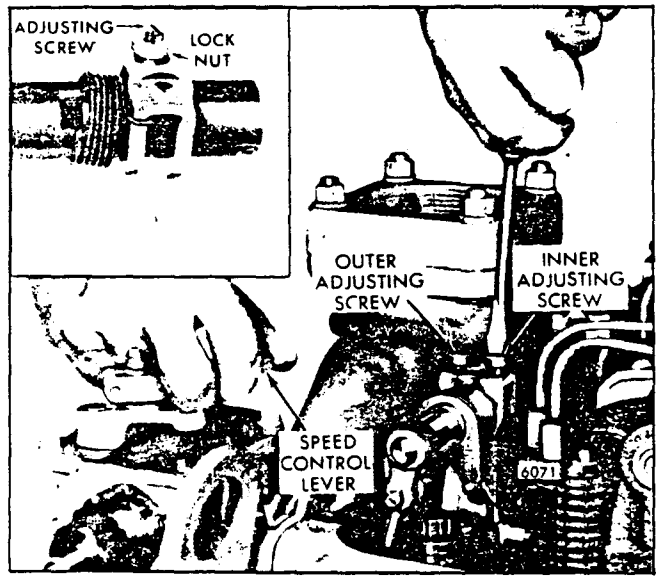


Fig. 2 - Positioning the Rear Injector Rack Control Lever

7. On governors without the starting aid screw, hold the gap adjusting screw and tighten the locknut.

8. Recheck the gap with the engine operating between 1,100 and 1,300 rpm and readjust, if necessary.

9. Stop the engine and, using a new gasket, install the governor cover on non-turbocharged engines. 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. 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.

Do not install the governor cover and lever assembly at this time on turbocharged engines as they include an internal starting aid screw and locknut.

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 racks in the *full-fuel* position.

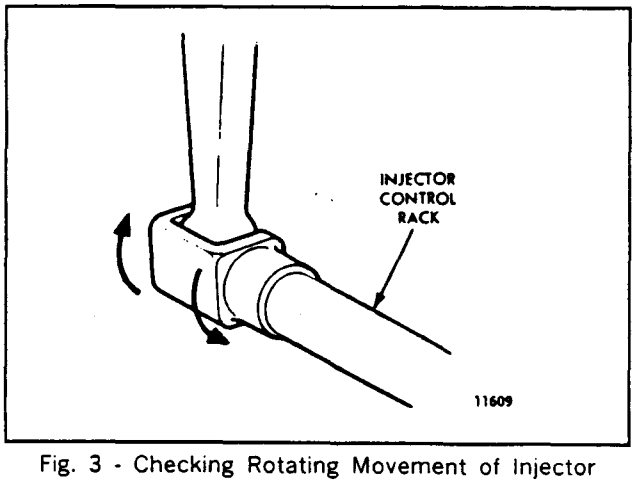


Fig. 3 - Checking Rotating Movement of Injector Control Rack

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

1. Disconnect the 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 locknut, when the nut is against the high-speed plunger. 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.* A false fuel rack setting may result if the idle speed adjusting screw is not backed out as noted above.

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

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

5. Move the speed control lever to the *full-fuel* position and hold it in that position with light finger pressure. Tighten the adjusting screw of the rear injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Tighten the screw approximately 1/8 of a turn more and lock securely with the adjusting screw locknut. This will place the rear injector rack in the *full-fuel* position.

NOTE: Overtightening of the injector rack control lever adjusting screws during installation

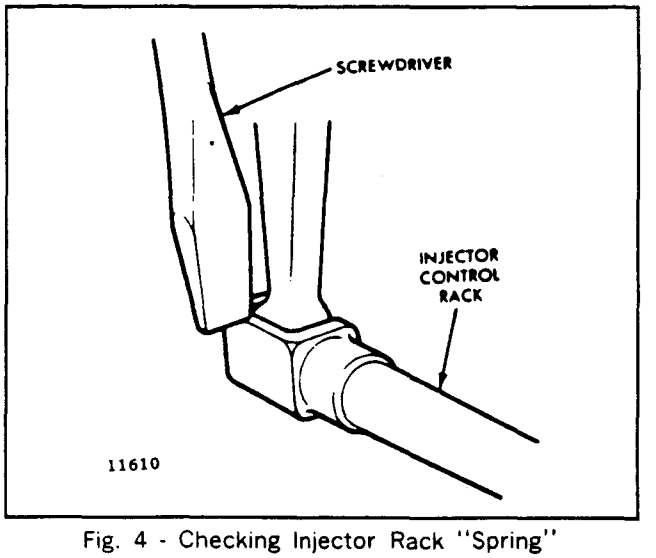


Fig. 4 - Checking Injector Rack "Spring"

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

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.

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 screwdriver or finger tip and note the "rotating" movement of the injector control rack when the speed control lever is in the *maximum speed* position (Fig. 3). Hold the speed control lever in the *maximum speed* position and, using a screwdriver, press downward on the injector control rack. The rack should tilt downward and when the pressure of the screwdriver is released, the control rack should "spring" back upward (Fig. 4).

If the rack does not return to its original position, it is too loose. To correct this condition, loosen the locknut and turn the adjusting screw clockwise a slight amount and retighten the locknut.

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, loosen the locknut and turn the adjusting screw counterclockwise a slight amount and retighten the locknut.

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 and proceed as follows:

a. Tighten the adjusting screw of the injector rack control lever adjacent to the rear injector until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Securely lock the adjusting screw locknut.

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 **lb-in** (3-4 Nm).

b. Verify the rear injector rack adjustment, as outlined in Step 7. If it does not "spring" back upward, turn the adjacent injector rack adjusting screw counterclockwise slightly until the rear injector rack returns to its *full-fuel* position and secure the adjusting screw locknut. Verify proper injector rack adjustment for both the rear and the adjacent injector. Turn clockwise or counterclockwise the adjacent injector rack adjusting screw until both the rear and the adjacent injector racks are in the *full-fuel* position when the locknut is securely tightened.

c. Adjust the remaining injectors using the proceedures outlined in Step "b", always verifying proper injector rack adjustment.

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

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

10. On **turbocharged engines** adjust the internal starting aid screw, as follows:

The starting aid screw has a locknut and the gap adjusting screw has a self locking patch.

a. Install a cutaway governor cover assembly, on the governor housing (Fig. 5).

b. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle* position.

c. Hold the gap adjusting screw to keep it from turning and adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the counter bore in the injector body (Fig. 5). Move the gage back and forth along the injector rack until a clearance of 1/64" is noted. The setting is measured at any convenient cylinder. Tighten the locknut on the starting aid screw sufficiently to prevent oil leakage as well as to hold the adjusting screw setting.

d. Check the injector rack clevis-to-body clearance after performing the following:

1. Position the stop lever in the *run* posiition.

2. Move the speed control lever from the *idle* position to the *maximum speed* position.

3. Return the speed control lever to the *idle* position.

Movement of the governor speed control lever is to take up clearance in the governor linkage. The clevis-to-body clearance can be increased by backing out the starting aid screw or reduced by turning it farther into the gap adjustment screw.

e. Start the engine and recheck the running gap (.0015") and, if necessary, reset it and reposition the injector racks. Then, stop the engine.

f. Remove the cutaway governor cover assembly.

g. Affix a new gasket to the top of the governor housing. Place the governor cover assembly on the governor housing with the pin in the throttle control shaft assembly in the slot of the differential lever and the dowel pins in the housing in the dowel pin holes of the cover. Tighten the screws.

CAUTION: Before starting an engine after an engine speed control adjustment, or after removal of the engine governor cover and lever assembly, the technician 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. An overspeeding engine can result in engine damage which could cause personal injury.

11. Use a new gasket and reinstall 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. 7):

1. Loosen the locknut with a spanner wrench and back off the high-speed spring retainer approximately five turns (Fig. 6). 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.

2. With the engine running 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. 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 high-speed spring retainer and tighten the locknut.

TYPE B GOVERNOR SPRINGS (Fig. 7):

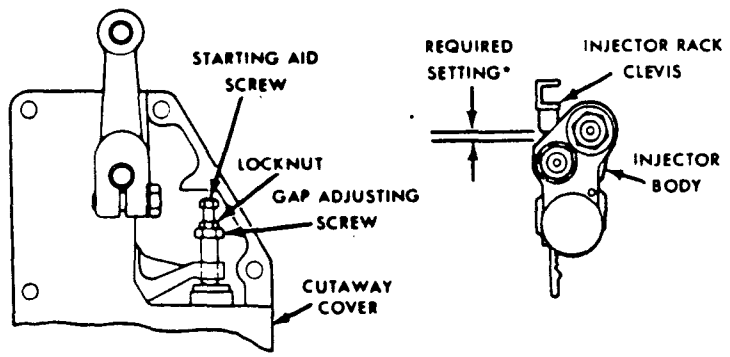
1. Start the engine and after it reaches normal operating temperature, remove the load from the engine.

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

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

a. Remove the high-speed spring retainer with tool J 5895 and withdraw the high-speed spring and plunger assembly. 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 as required to establish the desired engine no-load



INJECTOR	GAGE SETTING*	TOOL NUMBER
5A55	.345"	J 24889
5A60	.345"	J 24889
N55	.345"	J 24889
N60	.345"	J 24889
N65	.385"	J 24882
N70	.385"	J 24882
M60	.345"	J 24889
M70	.385"	J 24882

L-5870

Fig. 5 - Starting Aid Screw Adjustment

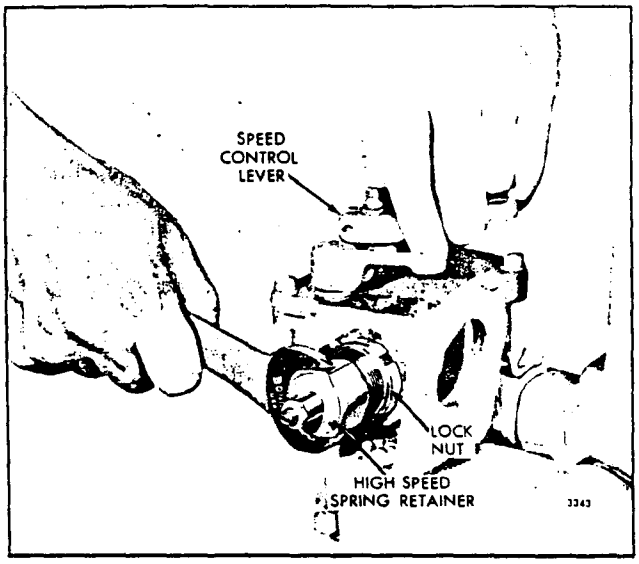


Fig. 6 - Adjusting Maximum No-Load Engine Speed (Type A)

speed (Fig. 7). For each .010" shim added, the engine speed will be increased approximately 10 rpm.

c. Install the high-speed spring on the high-speed spring 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 steps above as necessary to establish the no-load speed.

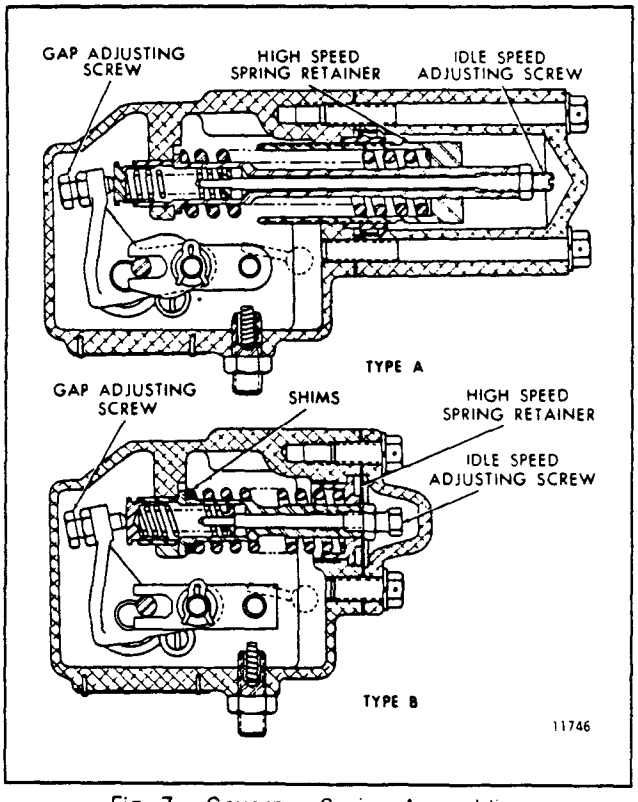


Fig. 7 - Governor Spring Assemblies

Adjust Idle Speed

With the maximum no-load speed properly set, 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 until the engine is operating at approximately 15 rpm below the recommended idle speed (Fig. 8). The recommended idle speed is 500-600 rpm, but may vary with special engine applications.

2. Hold the idle speed adjusting screw and tighten the locknut.

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

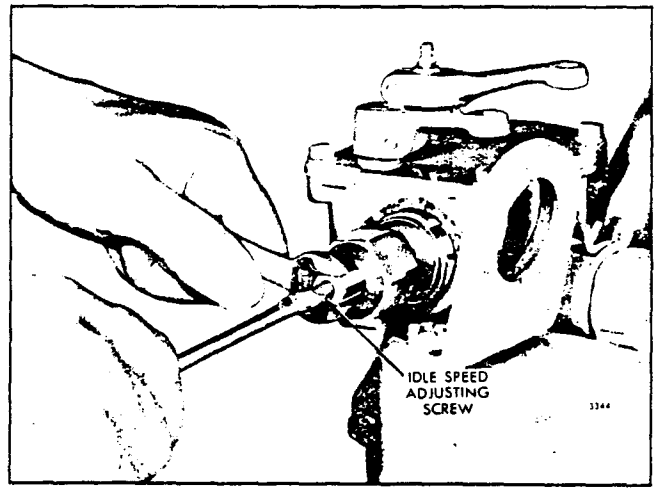


Fig. 8 - Adjusting Engine Idle Speed

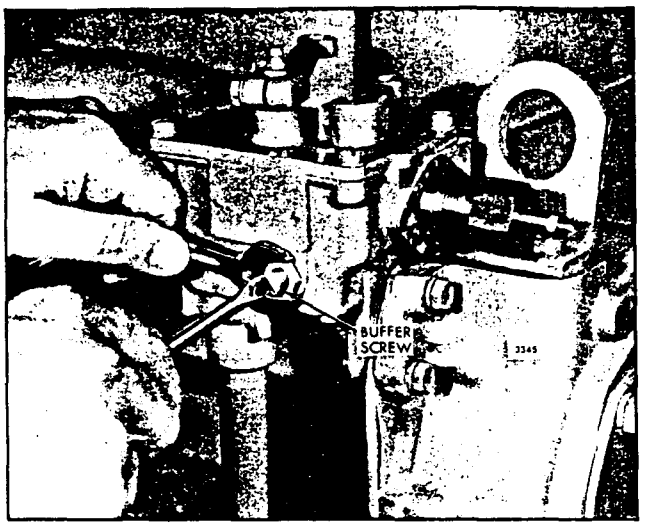


Fig. 9 - Adjusting Buffer Screw

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, loosen the locknut and turn the buffer screw IN so that it contacts the differential lever as lightly as possible and still eliminates engine roll (Fig. 9). 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 locknut.

If the engine is equipped with a supplementary governing device, adjust it at this time.

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. 10). 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. 14). One has a long spring mechanism, the other has a short spring mechanism.

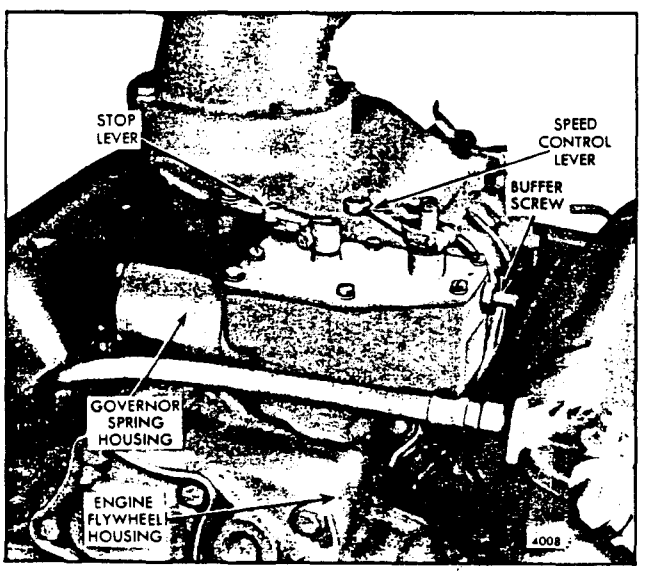


Fig. 10 - Limiting Speed Governor Mounting

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

Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. On turbocharged engines, the fuel (air box) modulator lever and roller assembly must be positioned free from cam contact. 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. Remove the high-speed spring retainer cover.

2. Back out the buffer screw until it extends approximately 5/8" from the locknut (Fig. 16). 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 locknut. Then, adjust the idle screw to obtain the desired engine idle speed (Fig. 14). The recommended idle speed is 500-600 rpm, but may vary with special engine applications. Hold the screw and tighten the locknut to hold the adjustment. Governors used in

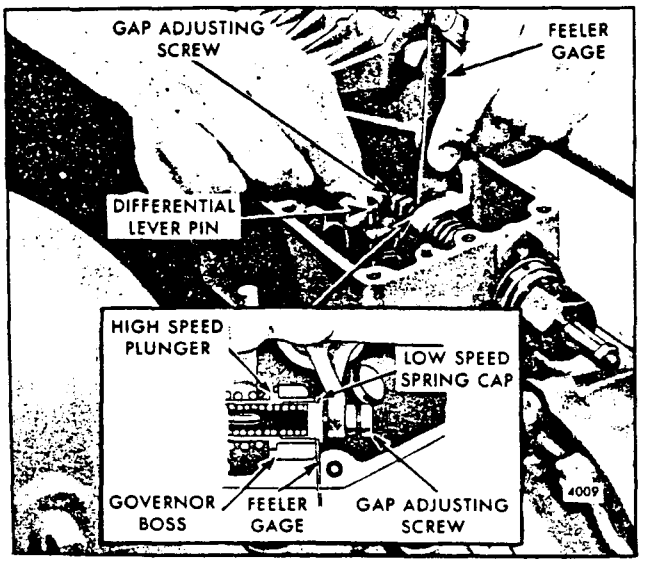


Fig. 11 - Adjusting Governor Gap

turbocharged engines include a starting aid screw and locknut threaded into the governor gap adjusting screw.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker covers (if not already done). Discard the gaskets.

5. Start and run the engine between 1,100 and 1,300 rpm by manual operation of the differential lever. Do not overspeed the engine.

6. Check the gap between the low-speed spring cap and the high-speed spring plunger with a feeler gage (Fig. 11). The gap should be .002"-.004". If the gap setting is incorrect, reset the gap adjusting screw.

7. On governors without the starting aid screw, hold the gap adjusting screw and tighten the locknut.

8. Recheck the gap with the engine operating between 1,100 and 1,300 rpm and readjust, if necessary.

9. Stop the engine and, using a new gasket, reinstall the governor cover. Do not install the governor cover and lever assembly at this time on turbocharged engines as they include an internal starting aid screw and locknut.

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:

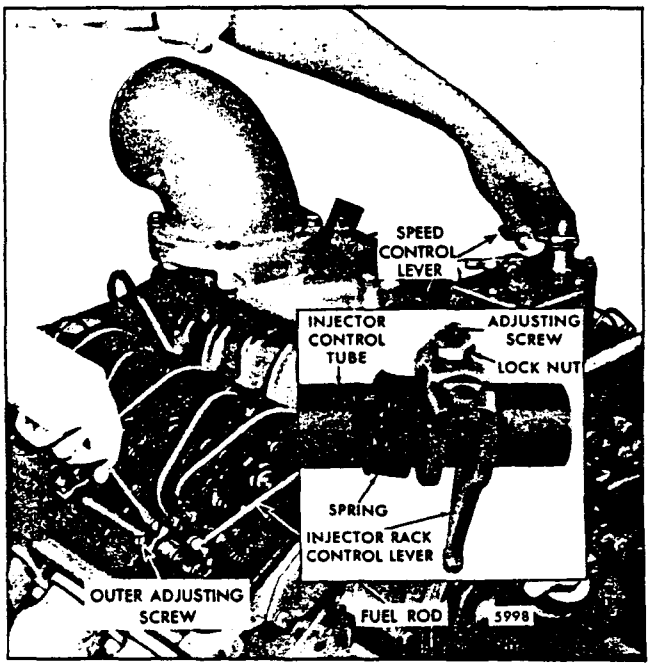


Fig. 12 - Positioning No. 3L Injector Rack Control Lever

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.

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 the 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 locknut when the nut is against the high-speed plunger. 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.* A false fuel rack setting may result if the idle speed adjusting screw is not backed out as above.

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

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.ll of the adjusting screws and locknuts on ır control tubes. Be sure all of the injector levers are free on the injector control tubes.

ɜ speed control lever to the *maximum speed* ɜ hold it in that position with light finger ighten the adjusting screw of the No. 3L k control lever until the injector rack clevis to roll up or an increase in effort to turn the is noted. Tighten the screw approximately rn more and lock securely with the adjusting ıut. This will place the No. 3L injector rack *fuel* position.

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

step should result in placing the governor ɜ control tube assembly in the same position vill attain while the engine is running at full

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ɜ the clevis pin from the fuel rod and the left tor 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 bank injector control tube lever. Repeat the check on the No. 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. Tighten the adjusting screw of the No. 2L injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Securely lock the adjusting screw locknut.

   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 **lb-ft** (3-4 Nm).

b. Verify the injector rack adjustment of No. 3L as outlined in Step 7. If No. 3L does not "spring" back upward, turn the No. 2L adjusting screw counterclockwise slightly until the No. 3L injector rack returns to its *full-fuel* position and secure the adjusting screw locknut. Verify proper injector rack adjustment for both No. 3L and No. 2L injectors. Turn clockwise or counterclockwise the No. 2L injector rack adjusting screw until both No. 3L and No. 2L injector racks are in the *full-fuel* position when the locknut is securely tightened.

c. Adjust the remaining injectors using the procedures outlined in Step"b" always varifying proper injector rack adjustment.

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.

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 locknut to permit starting the engine.

15. On **turbocharged engines** adjust the internal starting aid screw, as follows:

The starting aid screw has a locknut and the gap adjusting screw has a self locking patch.

a. Install a cutaway governor cover assembly, on the governor housing (Fig. 5).

b. With the engine *stopped*, place the governor stop lever in the *run* position and the speed control lever in the *idle* position.

c. Hold the gap adjusting screw to keep it from turning and adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the counter bore in the injector body (Fig. 5). Move the gage back and forth along the injector rack until a clearance of 1/64" is noted. The setting is measured at the No. 3R injector rack clevis. Tighten the locknut on the starting aid screw sufficiently to prevent oil leakage as well as to hold the adjusting screw setting.

d. Check the injector rack clevis-to-body clearance after performing the following:

1. Position the stop lever in the *run* position.

2. Move the speed control lever from the *idle* position to the *maximum speed* position.

3. Return the speed control lever to the *idle* position.

Movement of the governor speed control lever is to take up clearances in the governor linkage. The clevis-to-body clearance can be increased by backing out the starting aid screw or reduced by turning it farther into the gap adjustment screw.

e. Start the engine and recheck the running gap (.0015") and, if necessary, reset it and reposition the injector racks. Then, stop the engine.

f. Remove the cutaway governor cover assembly.

g. Affix a new gasket to the top of the governor housing. Place the governor cover assembly on the governor housing with the pin in the throttle control shaft assembly in the slot of the differential lever and the dowel pins in the housing in the dowel pin holes of the cover. Tighten the screws.

CAUTION: Before starting an engine after an engine speed control adjustment, or after removal of the engine governor cover and lever assembly, the technician 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. An overspeeding engine can result in engine damage which could cause personal injury.

16. Use new gaskets and reinstall 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. 14):

1. Loosen the locknut 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.

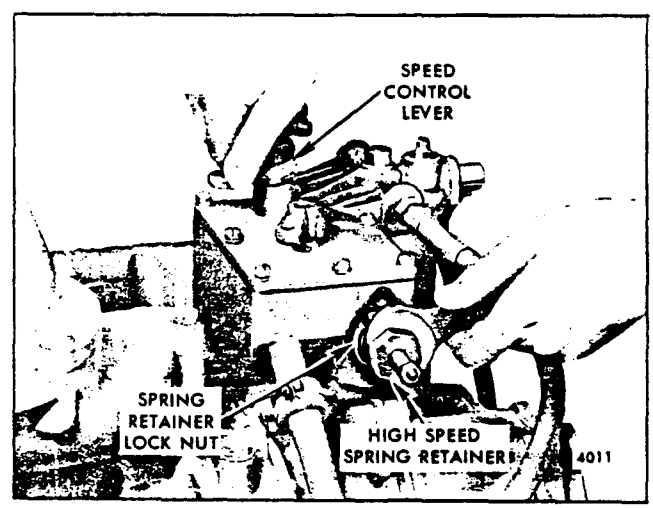


Fig. 13 - Adjusting Maximum No-Load Engine Speed

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. 13) 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 high-speed spring retainer and tighten the locknut.

TYPE B GOVERNOR SPRINGS (Fig. 14):

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.

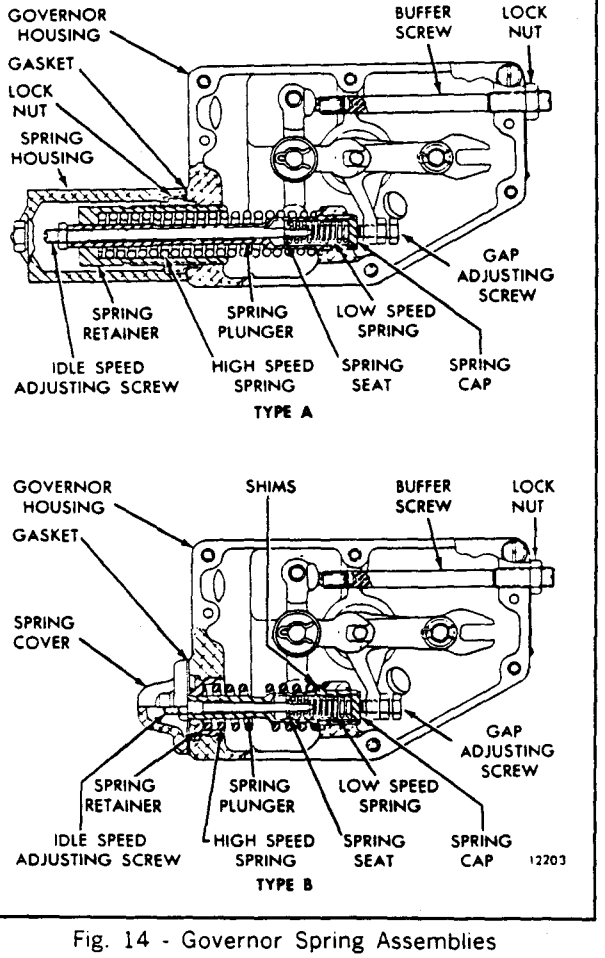


Fig. 14 - Governor Spring Assemblies

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

a. Remove the high-speed spring retainer with tool J 5895 and withdraw the high-speed spring and plunger assembly. 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 as required to establish the desired engine no-load speed. For each .010" in shims added, the engine speed will be increased approximately 10 rpm.

c. Install the high-speed spring on the high-speed spring plunger and install the spring assembly in the governor housing. Install the spring retainer in the governor housing and tighten it securely. The maximum no-load speed varies with the full-load operating speed desired (Table 1).

Full Load RPM	Maximum Governor Droop RPM
2401-2600	150
2601-2800	140

TABLE 1 - Engine Speed Droop

If the full-load speed is to be 2,800 rpm, then the no-load speed setting should be 2,940 rpm (2,800 +140 rpm) to ensure the governor will move the injector racks into the *full-fuel* position at the desired full-load speed.

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

Adjust Idle Speed

With the maximum no-load speed properly set, 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 until the engine is operating at

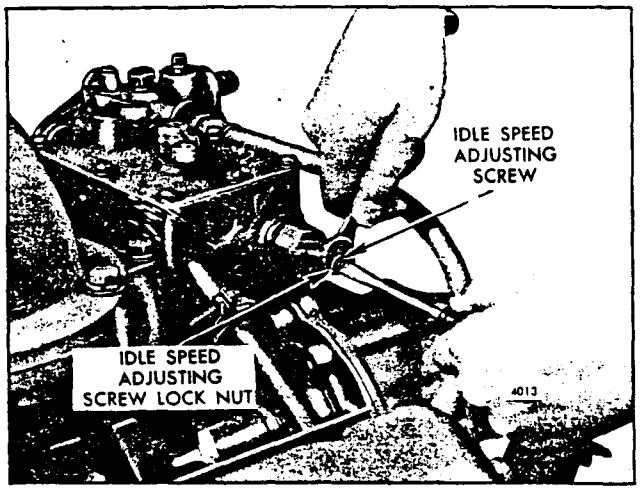


Fig. 15 - Adjusting Engine Idle Speed

approximately 15 rpm below the recommended idle speed (Fig. 15). The recommended idle speed is 500-600 rpm, but may vary with special engine applications.

If the engine has a tendency to stall during deceleration, install a new buffer screw. The current buffer screw uses a heavier spring and restricts the travel of the differential lever to the *off (no-fuel)* position.

2. Hold the idle speed adjusting screw and tighten the locknut.

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

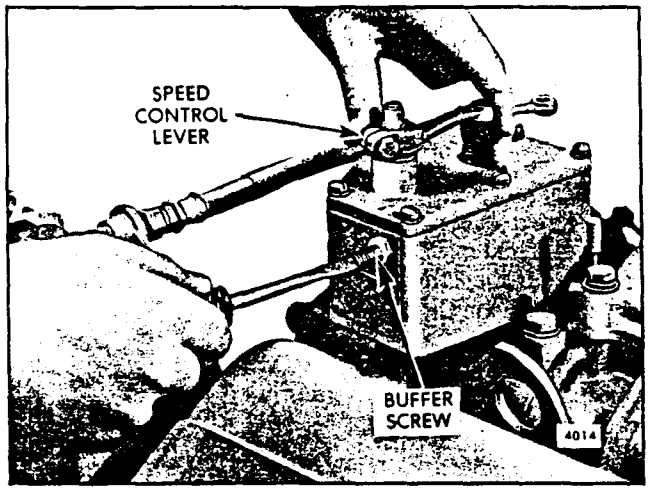


Fig. 16 - Adjusting Buffer Screw

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, loosen the locknut and turn the buffer screw IN so it contacts the differential lever as lightly as possible and still eliminate engine roll (Fig. 16). 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 locknut.

If the engine is equipped with a supplementary governing device, adjust it at this time.

VARIABLE SPEED MECHANICAL GOVERNOR

INJECTOR RACK CONTROL ADJUSTMENT - IN-LINE ENGINES (OPEN LINKAGE)

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 the injector rack control levers (Fig. 1).

Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. On turbocharged engines, the fuel (air box) modulator lever and roller assembly must be positioned free from cam contact. After the adjustments are completed, reconnect and adjust the supplementary governing device.

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.

3. Back out the booster spring eyebolt until it is flush with the outer locknut.

Adjust Variable Speed Spring Tension

1. Adjust the variable speed spring eyebolt until 1/8" of the threads project from the outer locknut (Fig. 2). This setting of the eyebolt will produce approximately 7% droop in engine speed from no load to full load.

2. Tighten both locknuts to retain the adjustment.

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. 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 injector rack control lever adjusting screws and locknuts. 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. 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

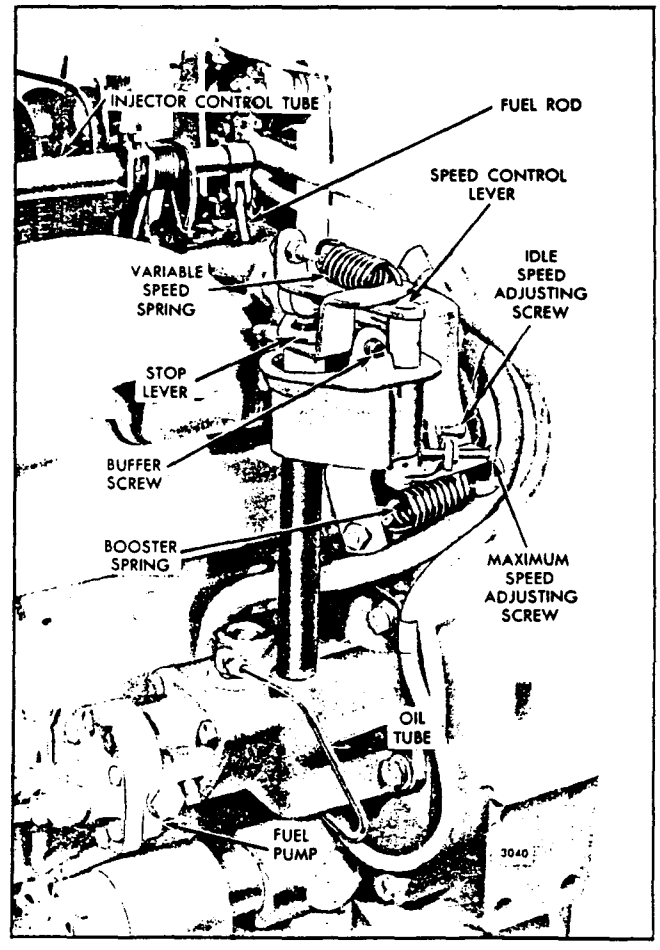


Fig. 1 - Variable Speed Open Linkage Governor Mounted on Engine

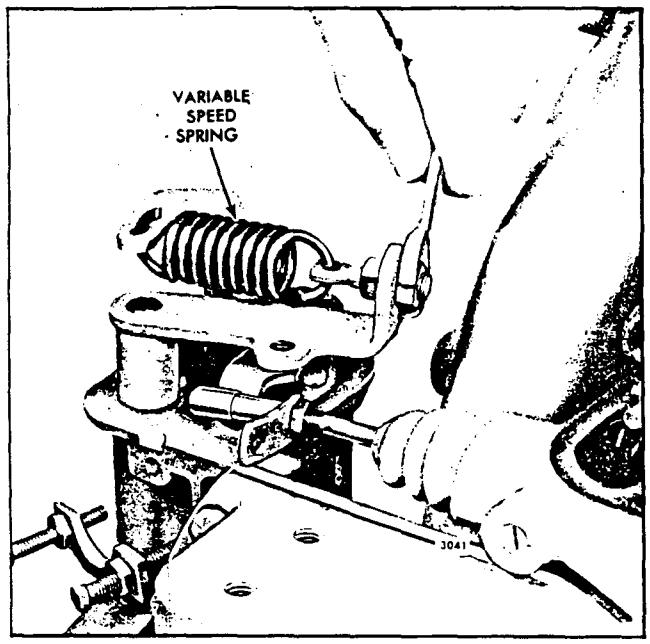


Fig. 2 - Adjusting Governor Spring Eyebolt

1/16" exists. Tighten the adjusting screw and locknut (Fig. 3).

6. 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 locknut to retain the adjustment.

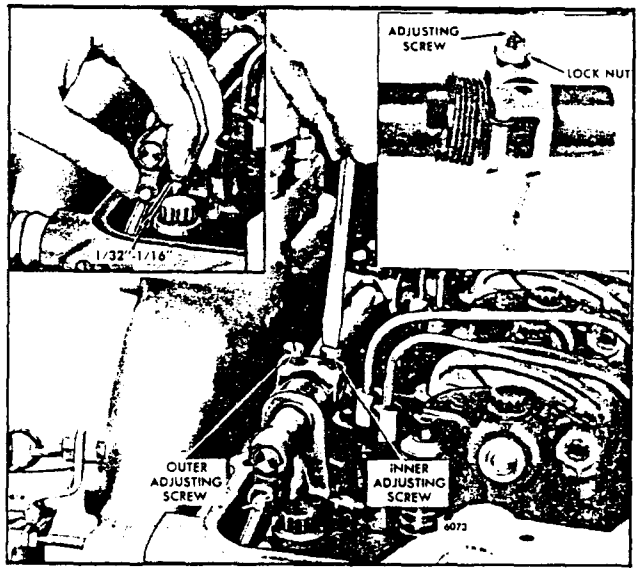


Fig. 3 - Adjusting Injector Rack Control Lever Adjusting Screws

7. 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. On units having the governor on the opposite side of the control rack, be sure the control rack lever will not contact the rocker cover.

8. Manually hold the rear injector rack in the *full-fuel* position with the lever on the injector control tube. Turn the adjusting screw of the adjacent injector rack control lever until the injector rack moves into the *full-fuel* position. Turn the adjusting screw until a slight roll-up on the injector rack clevis is observed or an increase in effort to turn the screwdriver is noted, then securely lock the adjusting screw locknut.

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 **lb-in** (3-4 Nm).

9. 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 adjusting screw slightly on the adjacent injector rack control lever. When the settings are correct, the racks of all injectors must be snug on the ball end of their respective control levers.

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

CAUTION: Before starting an engine after an engine speed control adjustment or after removal of the engine governor cover and lever assembly, the technician must determine that the injector racks move to the *no-fuel* position when the

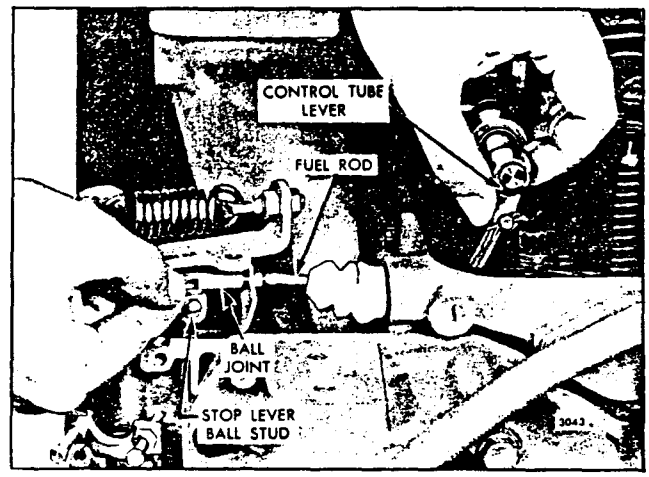


Fig. 4 - Adjusting Fuel Rod Length

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. An overspeeding engine can result in engine damage which could cause personal injury.

11. Use a new gasket and reinstall the valve rocker cover.

Adjust Maximum No-Load Speed

1. With the engine running, move the speed control lever to the *maximum speed* position. Do not overspeed the engine. Use an accurate tachometer to determine the no-load speed of the engine.

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

3. Hold the adjusting screw and tighten the locknut.

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 locknut and turn the idle speed adjusting screw until the engine idles at the recommended speed (Fig. 6). 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 locknut.

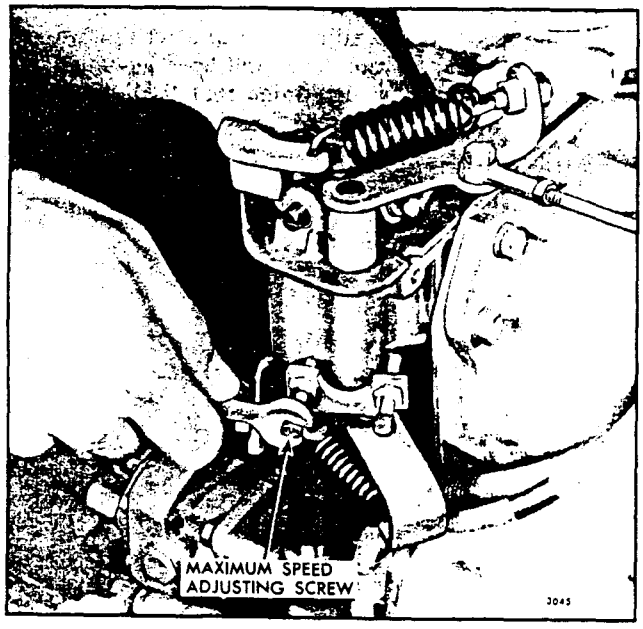


Fig. 5 - Adjusting Maximum No-Load Engine Speed

Adjust Buffer Screw

With the engine running at idle speed, turn the buffer screw in so that it contacts the stop lever as lightly as possible and still eliminates engine roll (Fig. 7).. 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 previously performed, to the minimum by backing off the outer locknut until the end of the booster spring eyebolt is flush with the end of the nut (Fig. 8).

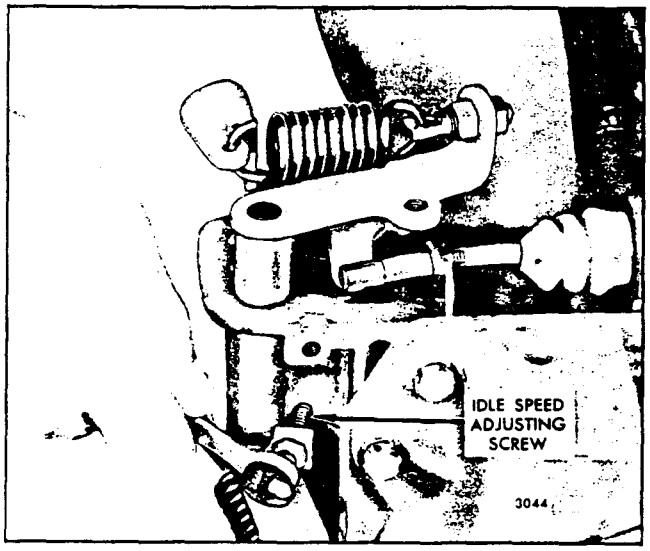


Fig. 6 - Adjusting Idle Speed

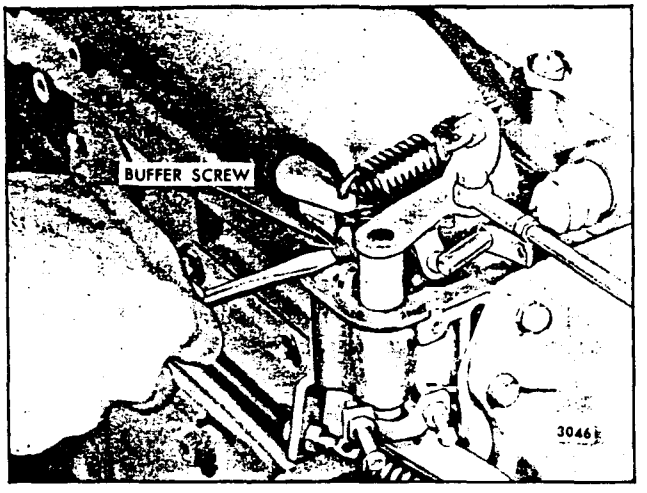


Fig. 7 - Adjusting Buffer Screw

3. Adjust the eyebolt 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 locknuts on the eyebolt 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 locknut and tighten the outer locknut to increase the tension on the booster spring. Before tightening the locknuts, 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.

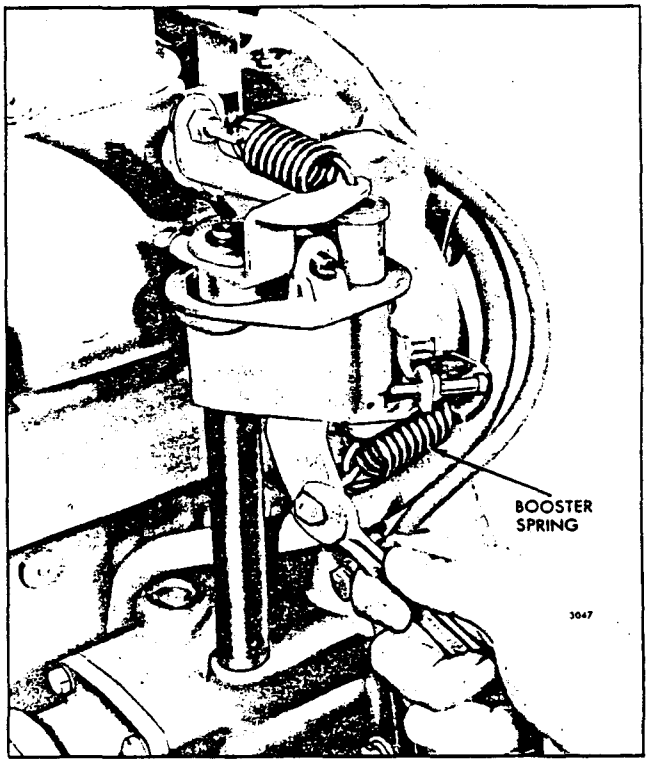


Fig. 8 - Adjusting Booster Spring

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.

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.

If the engine is equipped with a supplementary governing device, adjust it at this time.

INJECTOR RACK CONTROL ADJUSTMENT - IN-LINE ENGINES (ENCLOSED LINKAGE)

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.

Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. On turbocharged engines, the fuel (air box) modulator lever and roller assembly must be positioned free from cam contact. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Back out the external starting aid screw.

Adjust Governor Gap

With the engine stopped and at 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 locknut.

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

4. Place the speed control lever in the *maximum speed* position (Fig. 9).

5. Insert a .006" feeler gage between the spring plunger and the plunger guide (Fig. 9). If required, loosen the locknut 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 locknut. Check the gap and readjust, if necessary.

7. Use a new gasket and reinstall the governor cover. Place the cover on the governor housing, with the pin in the throttle shaft assembly entering the slot in the differential lever. Install the four cover screws and lock washers finger tight. Pull the cover assembly in a direction away from the engine, to take up the slack, and tighten the cover screws. 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.

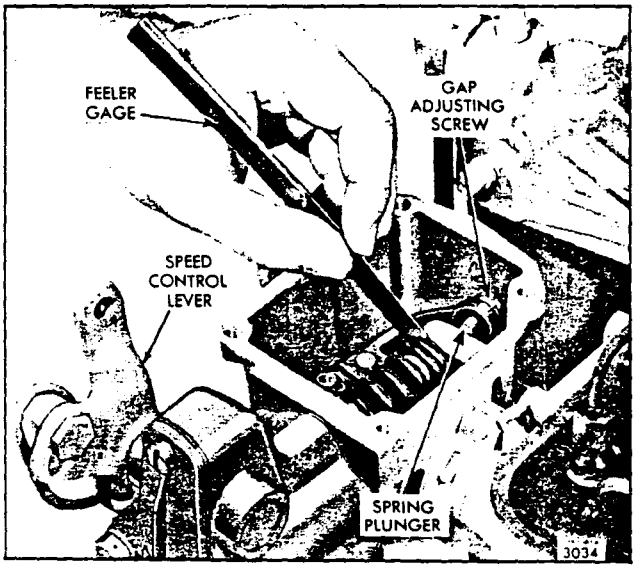


Fig. 9 - Checking Governor Gap

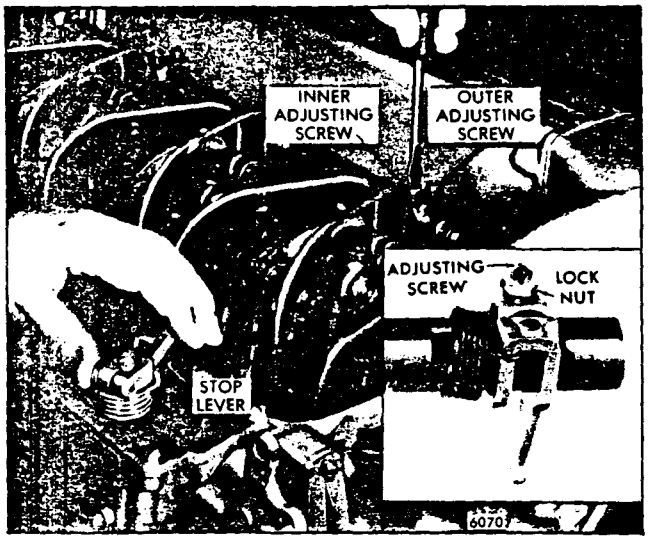


Fig. 10 - Positioning the Rear Injector Rack Control Lever

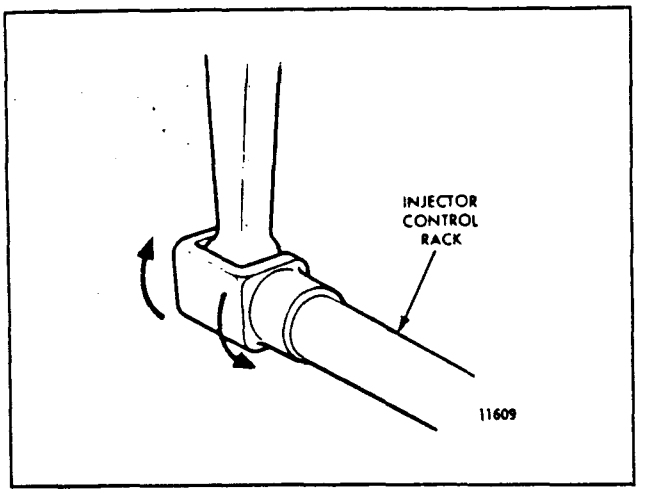


Fig. 11 - Checking Rotating Movement of Injector Control Rack

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 injector rack control lever adjusting screws and locknuts (Fig. 10). Be sure all of the levers are free on the injector control tube.

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

3. Move the stop lever to the *run* position and hold it in that position with light finger pressure. Tighten the adjusting screw of the rear injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Tighten the screw spproximately 1/8 of a turn more and lock securely with the adjusting screw locknut. This will place the rear injector rack in the *full-fuel* position.

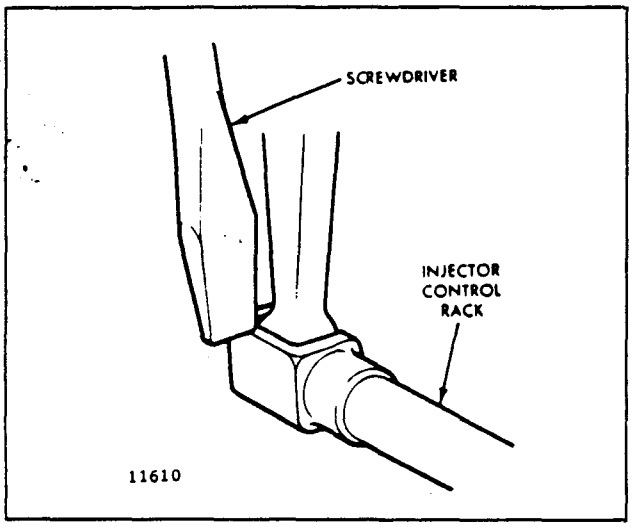


Fig. 12 - Checking Injector Control Rack "Spring"

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 **lb-in** (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 screwdriver or finger tip and note "rotating" movement of the injector control rack (Fig. 11). Hold the stop lever in the *run* position and, using a screwdriver, press downward on the injector control rack. The rack should tilt downward and, when the pressure of the screwdriver is released, the control rack should "spring" back upward (Fig. 12).

If the rack does not return to its original position, it is too loose. To correct this condition, loosen the locknut and turn the adjusting screw clockwise a slight amount and retighten the locknut.

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, loosen the locknut and turn the adjusting screw counterclockwise a slight amount and retighten the locknut.

5. Manually hold the rear injector control rack in the *full-fuel* position with the lever on the injector control tube and proceed as follows:

a. Tighten the adjusting screw of the adjacent injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted.

b. Securely lock the adjusting screw locknut.

> **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 **lb-in** (3-4 Nm).

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, turn the adjusting screw counterclockwise slightly until the rear injector rack returns to its *full-fuel* position and secure the adjusting screw and locknut.

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.

CAUTION: Before starting an engine after an engine speed control adjustment or after removal of the engine governor cover and lever assembly, the technician 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. An overspeeding engine can result in engine damage which could cause personal injury.

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

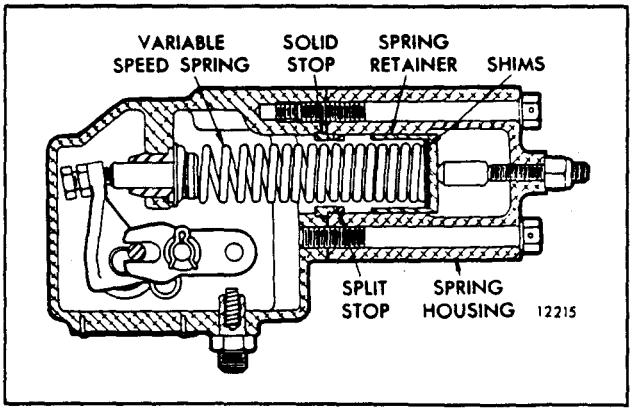


Fig. 13 - Locating of Shims and Stops

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:

1. Refer to Fig. 16 and disconnect the booster spring and the stop lever retracting spring.

2. Remove the two attaching bolts and withdraw 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 (Fig. 13). Do not use more than four thick and one thin shim. *A split stop can only be used with a solid stop (Fig. 13).*

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

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. 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.

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

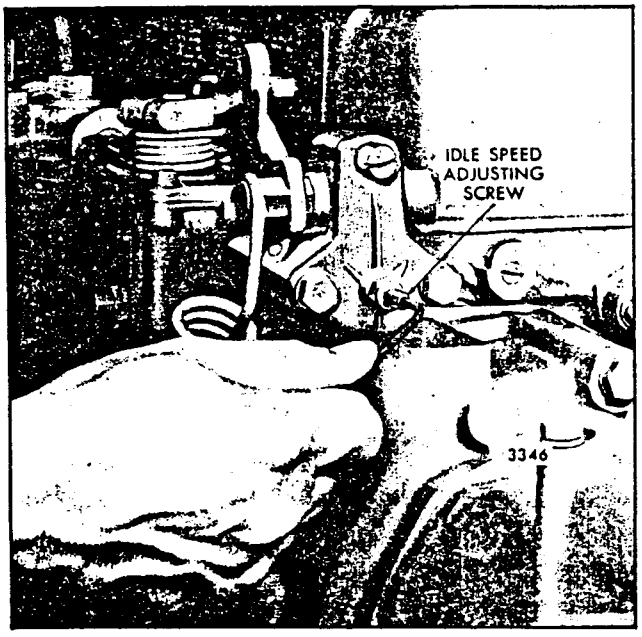


Fig. 14 - Adjusting Idle Speed

Adjust Idle Speed

With the maximum no-load speed properly set, 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 locknut and turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed (Fig. 14). The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the locknut.

Adjust Buffer Screw

1. With the engine running at normal operating temperature, turn the buffer screw in so that it contacts the differential lever as lightly as possible and still eliminates engine roll (Fig. 15). Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the locknut.

Fig. 15 - Adjusting Buffer Screw

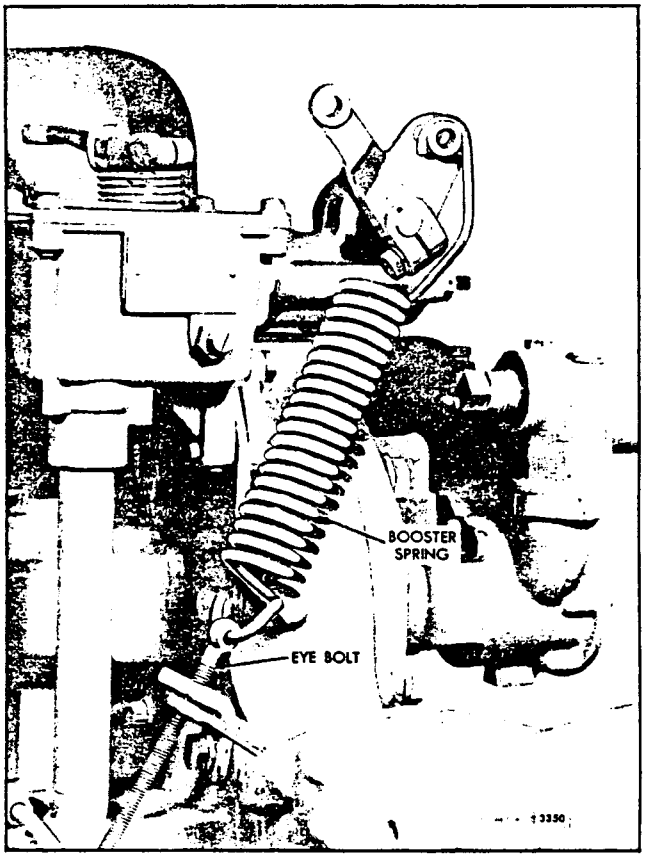


Fig. 16 - Adjusting Booster Spring

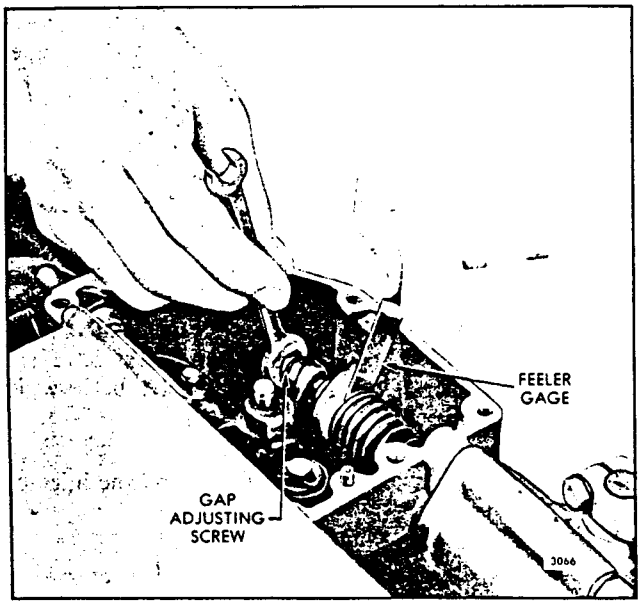


Fig. 18 - Adjusting Governor Gap

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:

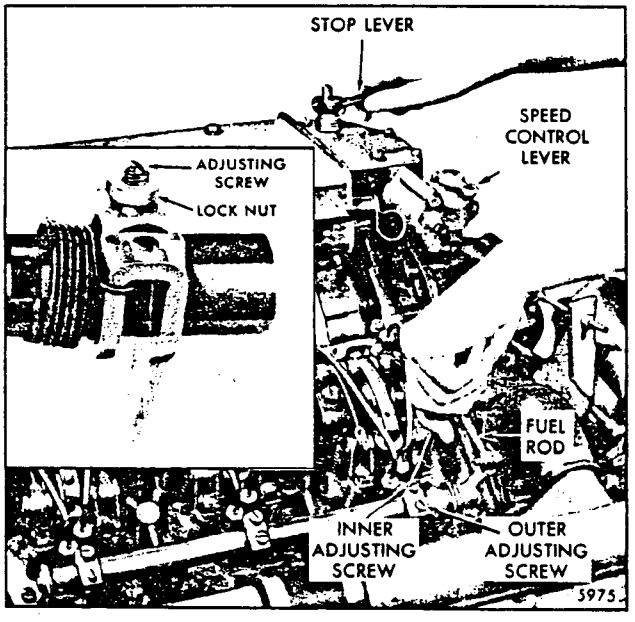


Fig. 19 - Positioning No. 3L Injector Rack Control Lever

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.

The letters "R" or "L" indicate the injector location in the right or left cylinder bank as 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 injector rack control lever adjusting screws and locknuts 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. Tighten the adjusting screw of the No. 3L injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted (Fig. 19). Tighten the screw spproximately 1/8 of a turn more and lock securely with the adjusting screw locknut. This will place the No. 3L injector rack in the *full-fuel* position.

> **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 **lb-in** (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 lever in the *run* position and press down on the injector rack with a screwdriver or finger tip and note the "rotating" movement of the injector control rack (Fig. 11). Hold the stop lever in the *run* position and, using a screwdriver, press downward on the injector control rack. The rack should tilt downward and when the pressure of the screwdriver is released, the control rack should "spring" back upward (Fig. 12).

If the rack does not return to its original position, it is too loose. To correct this condition, loosen the locknut and turn the adjusting screw clockwise a slight amount and retighten the locknut.

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, loosen the locknut and turn the adjusting screw counterclockwise a slight amount and retighten the locknut.

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 No. 3L and No. 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. Tighten the adjusting screw of the No. 2L injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Securely lock the adjusting screw locknut.

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 **lb-ft** (3-4 Nm).

b. Verify the injector rack adjustment of No. 3L as outlined in Step 7. If No. 3L does not "spring" back upward, turn the No. 2L adjusting screw counterclockwise slightly until the No. 3L injector rack returns to its *full-fuel* position and secure the adjusting screw locknut. Verify proper injector rack adjustment for both No. 3L and No. 2L injectors. Turn clockwise or counterclockwise the No. 2L injector rack adjusting screw until both No. 3L and No. 2L injector racks are in the *full-fuel* position when the locknut is securely tightened.

c. Adjust the remaining injectors using the procedures outlined in Step "b" always varifying proper injector rack adjustment.

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.

CAUTION: Before starting an engine after an engine speed control adjustment, or after removal of the engine governor cover and lever assembly, the technician 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. An overspeeding engine can result in engine damage which could cause personal injury.

12. Use new gaskets and reinstall 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. 23 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.

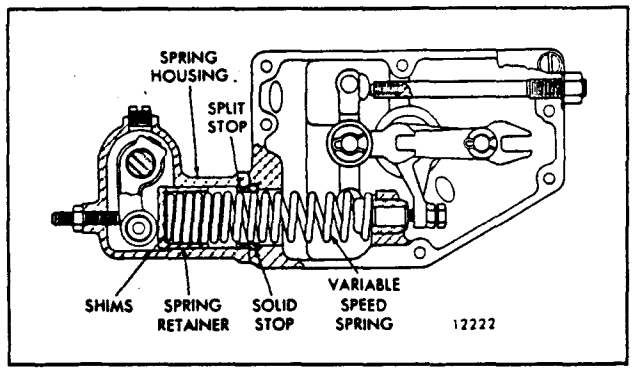


Fig. 20 - Location of Shims and Stops

3. Refer to Table 2 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. 20).

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 2

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

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

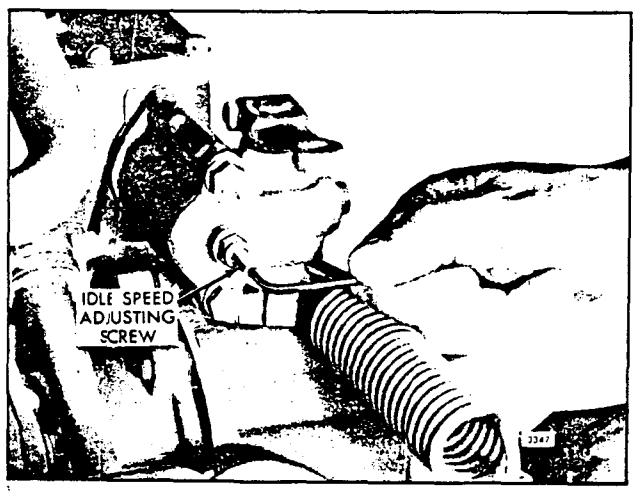


Fig. 21 - Adjusting Idle Speed

Adjust Idle Speed

With the maximum no-load speed properly set, 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 locknut and turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed (Fig. 21). The recommended idle speed is 550 rpm, but may vary with special engine applications.

4. Hold the idle speed adjusting screw and tighten the locknut.

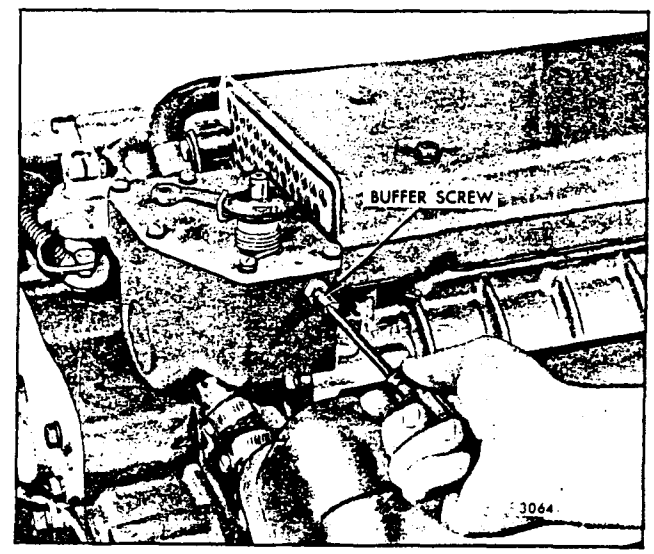


Fig. 22 - Adjusting Buffer Screw

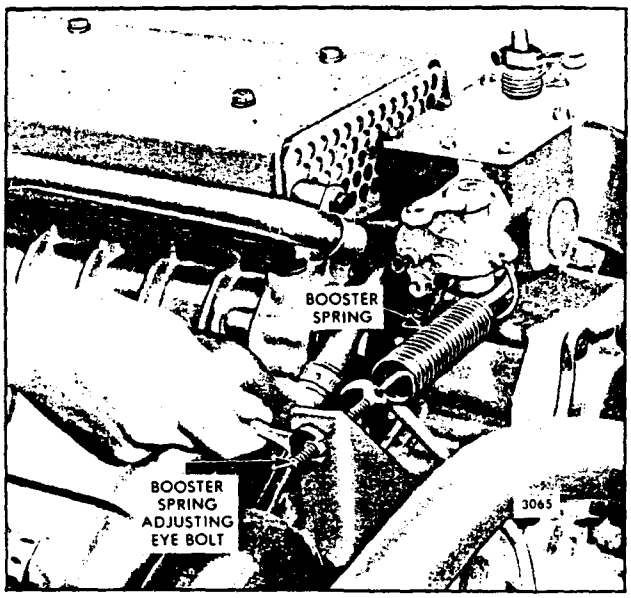


Fig. 23 - Adjusting Booster Spring

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, turn the buffer screw in so that it contacts the differential lever as lightly as possible and still eliminates engine roll (Fig. 22). Do not raise the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the locknut.

Adjust Booster Spring

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

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

2. Refer to Fig. 23 and loosen the booster spring retaining nut on the speed control lever. Loosen the locknuts on the eyebolt 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 center of the bolt, lever shaft and eyebolt. Hold the bolt and tighten the locknut.

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 speed* 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 where it will not return to idle. Then, reduce the spring tension until the lever does return to idle and tighten the locknut on the eyebolt. This setting will result in the minimum force required to operate the speed control lever.

5. Connect the linkage to the governor levers.

If the engine is equipped with a supplementory governing device, adjust it at this time.

HYDRAULIC GOVERNOR

INJECTOR RACK CONTROL ADJUSTMENT - IN-LINE ENGINE

The hydraulic governor is mounted on the 3-53 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 the a hydraulic governor after adjusting the exhaust valve clearance and timing the fuel injectors.

Before proceeding with the governor and injector rack adjustments, disconnect any supplementary governing device. On turbocharged engines, the fuel (air box) modulator lever and roller assembly must be positioned free from cam contact. After the adjustments are completed, reconnect and adjust the supplementary governing device.

Adjust Fuel Rod and Injector Rack Control Levers

1. Adjust the adjusting screws and locknuts on the rear injector rack control lever to a *central* or *middle* position (Fig. 2).

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 **lb-in** (3-4 Nm).

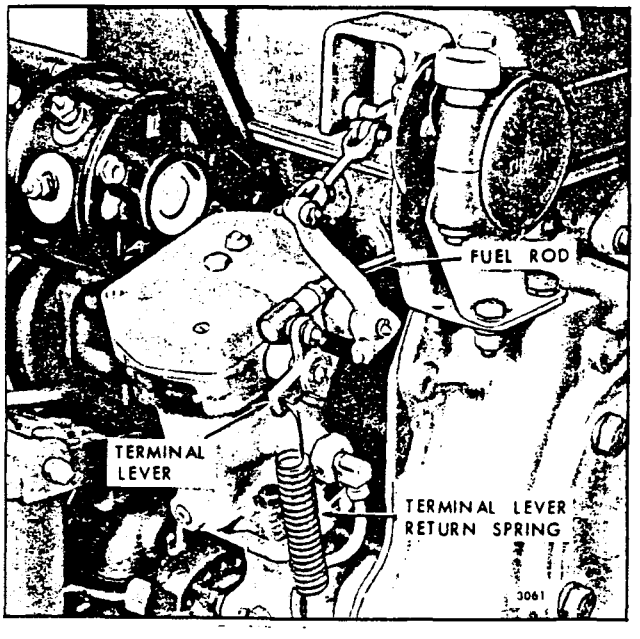


Fig. 1 - Hydraulic Governor Mounted on Engine

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.

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

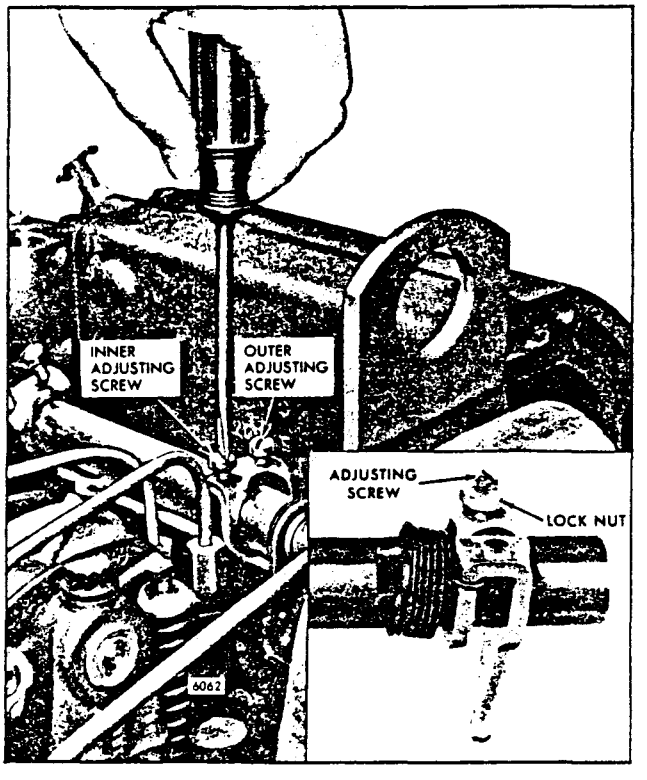


Fig. 2 - Adjusting Height of Rack Control Lever Adjusting Screws

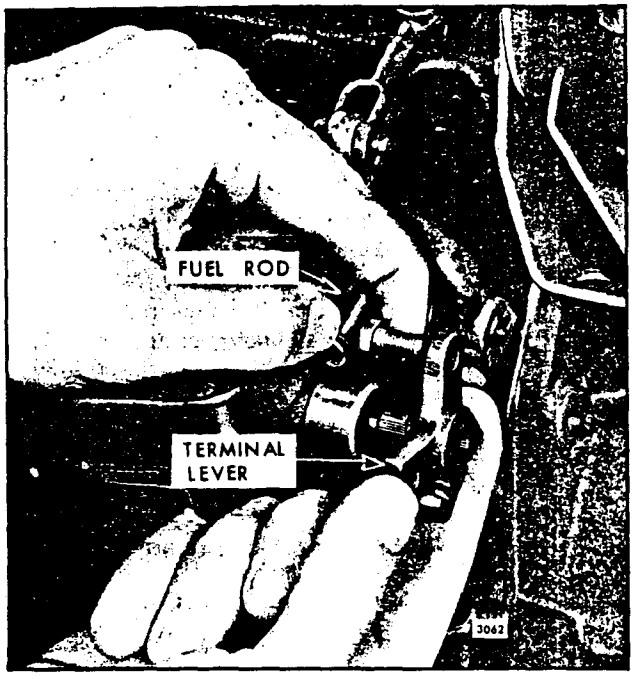


Fig. 3 - Adjusting Length of Fuel Rod

at one half the arc of travel. Do not tighten the clamping bolt.

5. Hold both 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 (Fig. 3). Tighten the locknut to retain the ball joint or end bearing and the terminal lever clamping bolt securely. 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. Remove the clevis pin between the fuel rod and the injector control tube lever. 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.

7. Manually hold the rear injector in the *full-fuel* position with the lever on the injector control tube. Turn the adjusting screw of the rear injector rack control lever until the injector rack moves into the *full-fuel* position.

Turn the adjusting screw until a slight roll-up on the injector rack clevis is observed or an increase in effort to turn the screwdriver is noted, then securely lock the adjusting screw locknut.

8. Recheck the rear injector fuel rack to be sure that it has remained snug on the ball end of the rack control

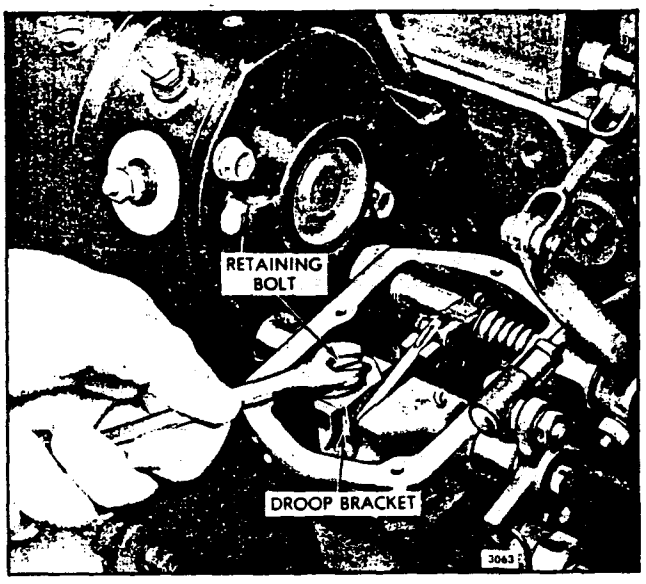


Fig. 4 - Adjusting Droop Bracket

lever while adjusting the adjacent injector. If the rack of the rear injector has become loose, back off slightly on the adjusting screw on the adjacent injector rack control lever. When the settings are correct, the racks of all injectors must be snug on the ball end of their respective rack control levers.

9. Position the remaining rack control levers as outlined in Steps 7 and 8.

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

11. On governors that have the load limit screw in the governor cover hold the terminal lever in the *full-fuel* position and adjust the load limit screw enough to cause the injector racks to just become loose on the control tube levers. This will allow the terminal lever to reach full travel before the injector racks bottom.

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.

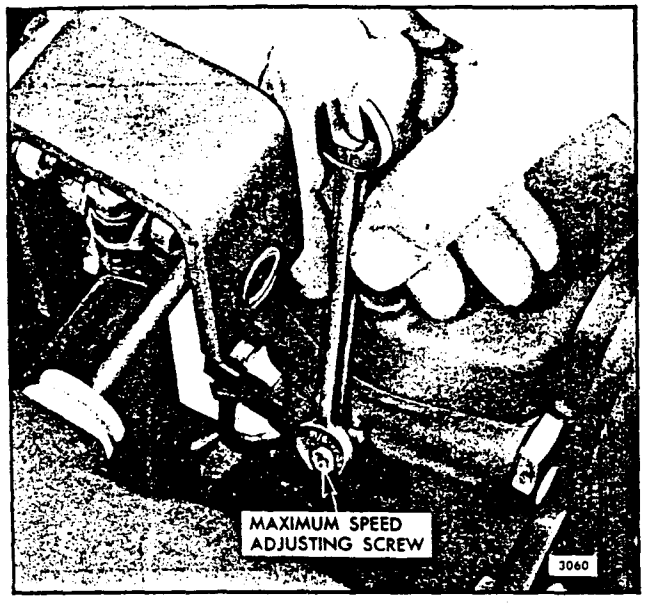


Fig. 5 - Adjusting Maximum Engine Speed

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. 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 locknut and back off the maximum speed adjusting screw approximately 5/8" (Fig. 5).

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 readjust 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.

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

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

The recommended speed droop of generator sets operating in parallel is 50 rpm (2-1/2 cycles) for units operating at 1,000 and 1,200 rpm and 75 rpm (2-1/2 cycles) for units operating at 1,500 rpm and 1,800 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 locknut 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 in lightly until contact is felt with the linkage in the governor (Fig. 5).

4. Hold the maximum speed adjusting screw and tighten the locknut.

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

INJECTOR RACK CONTROL ADJUSTMENT - 6V-53 ENGINE

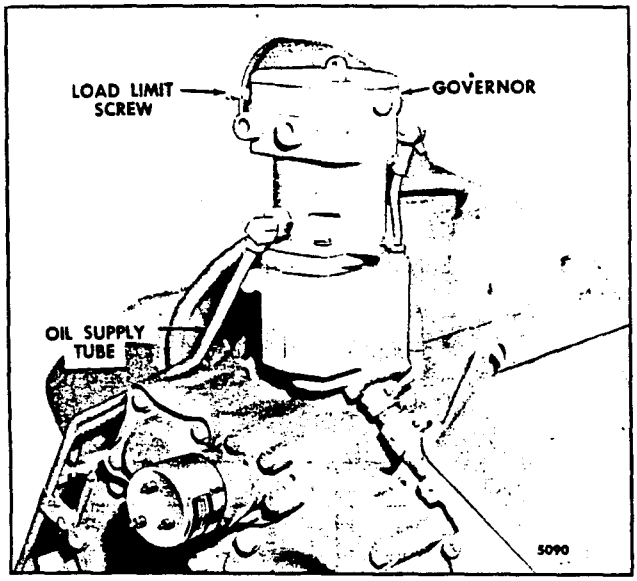


Fig. 6 - Hydraulic Governor Mounting

The hydraulic governor is mounted between the blower and the rear end plate (Fig. 6). The vertical control link assembly is attached to the governor operating lever and the bell crank lever on the governor drive housing (Fig. 7).

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 and locknuts.

3. While holding the bell crank lever on the governor drive housing in a *horizontal (full-fuel)* position 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.

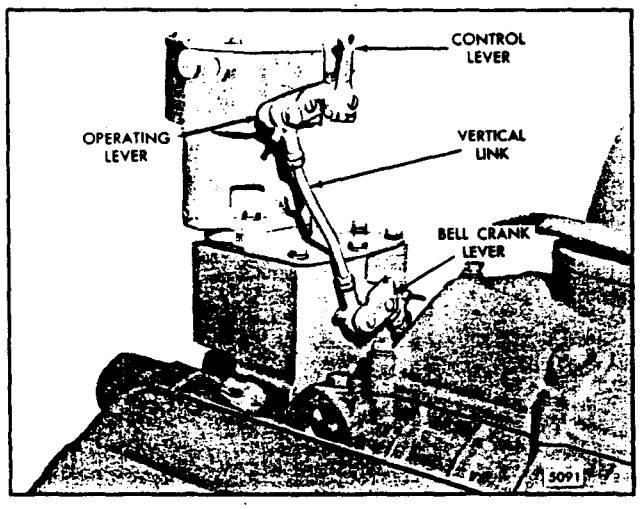


Fig. 7 - Hydraulic Governor Controls

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 subcap 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 locknut 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 locknut.

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 locknut.

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

SUPPLEMENTARY GOVERNING DEVICE

ENGINE LOAD LIMIT DEVICE ADJUSTMENT

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

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.

Adjustment

After the engine tune-up is completed, make sure the load limit device is properly installed (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:

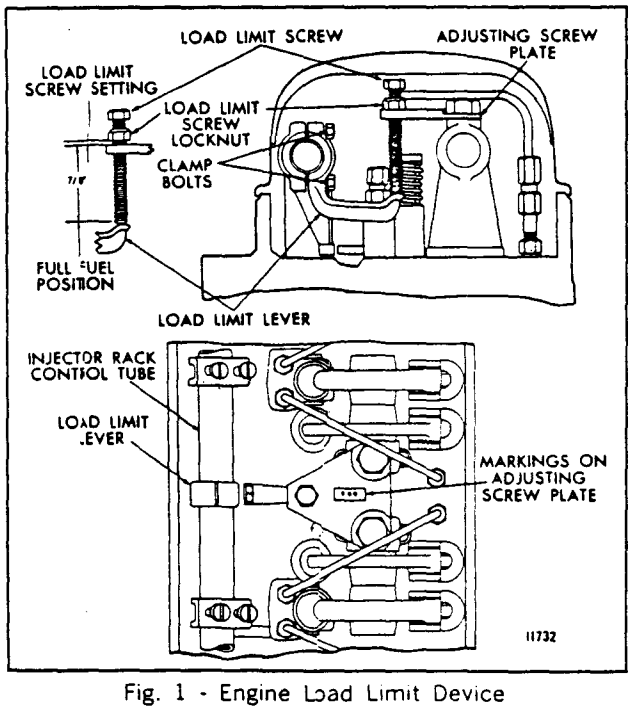


Fig. 1 - Engine Load Limit Device

1. Loosen the load limit screw locknut 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 locknut so the bottom of the locknut is 7/8" from the bottom of the load limit screw for the initial setting (Fig. 1).

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

5. Thread the load limit screw into the adjusting screw plate until the locknut *bottoms* against the top of the plate.

6. 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.

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

8. Hold the load limit screw to keep it from turning, then *set* the locknut until the distance between the bottom of the locknut 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.

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

10. Hold the load limit screw to keep it from turning, then tighten the locknut to secure the setting.

THROTTLE DELAY MECHANISM ADJUSTMENT

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.

Install the throttle delay lever assembly on the injector control tube with the legs inward (Fig. 2). A backward installation (legs outward) can result in a binding condition between the lever and the valve cover and possible loss of injector fuel control. Adjust the lever to obtain a leg width of 1.43" ±.03" (Fig. 3) to prevent binding.

Adjust the current throttle delay lever assembly by loosening or tightening the screw and nut in the lever to obtain a width of 1.43" ±.03" between the lever legs (Fig. 3). This dimension is required to prevent the lever from binding with the link.

A yield lever and spring assembly replaces the standard lever and pin assembly on the rear end of the injector

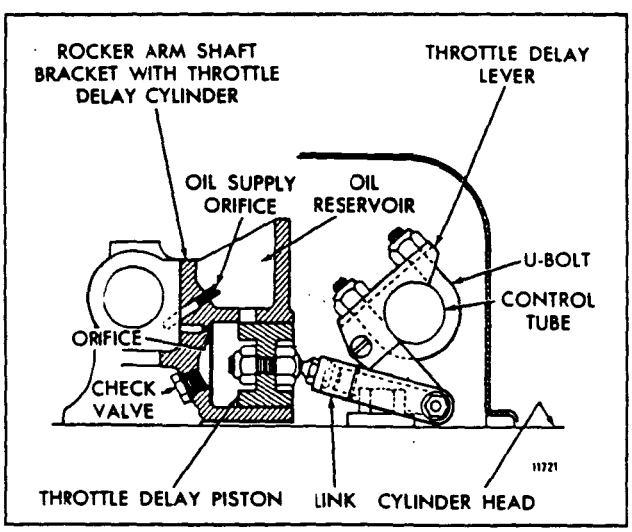


Fig. 2 - Throttle Delay Cylinder

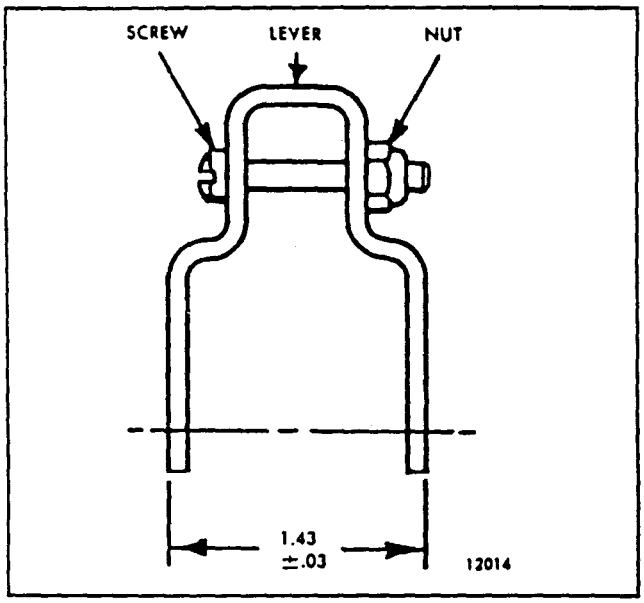


Fig. 3 - Throttle Delay Lever Assembly

control tube on In-line engines (Fig. 4). A yield lever replaces the standard operating lever in the governor of the 6V-53 engine (Fig. 5).

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.

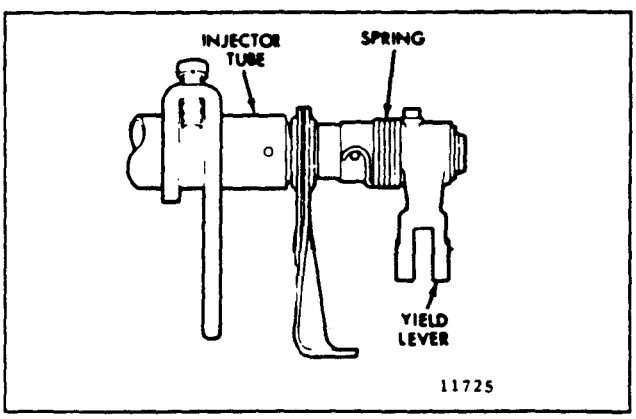


Fig. 4 - Throttle Delay Yield Lever (In-Line Engine)

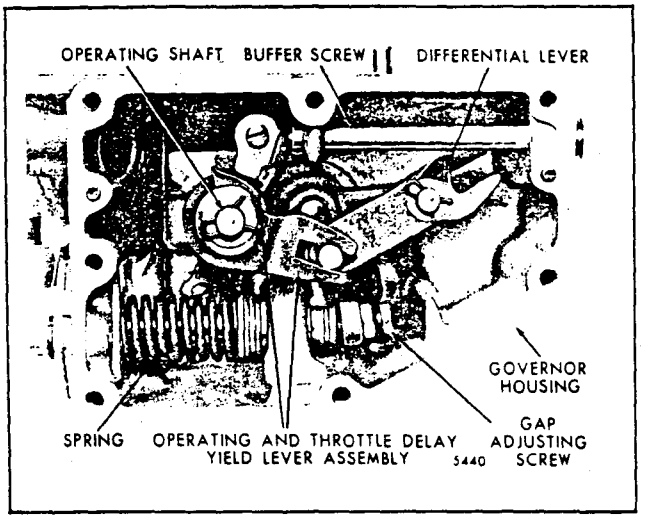


Fig. 5 - Throttle Delay Yield Lever (6V Engine)

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

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. If more than a drop of leakage occurs, replace the check valve.

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

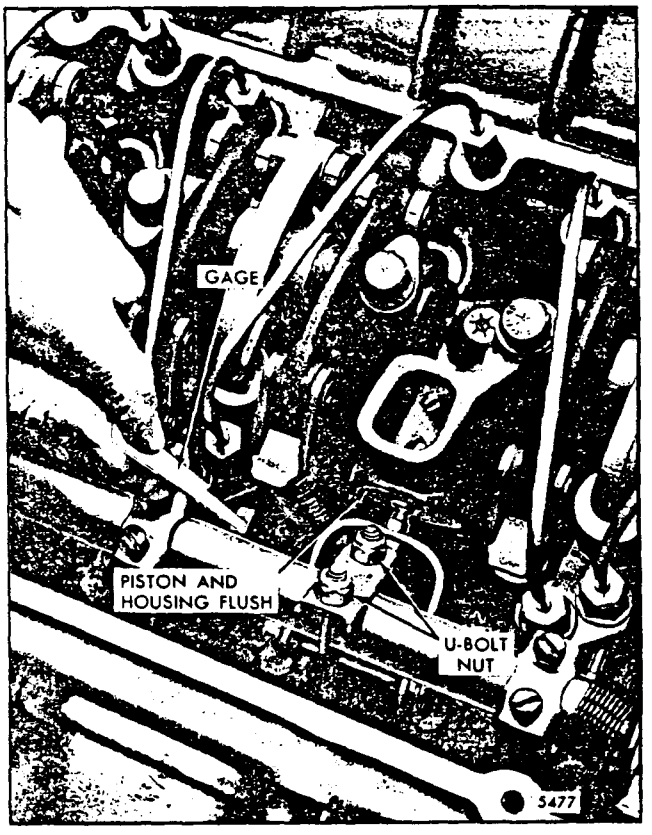


Fig. 6 - Adjusting Throttle Delay Cylinder

positioned, the throttle delay mechanism must be readjusted. With the engine stopped, proceed as follows:

1. Refer to Fig. 6 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 the *full-fuel* position to make sure it does not bind.

MECHANICAL GOVERNOR SHUTDOWN SOLENOID ADJUSTMENT

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. 7 and 8). 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

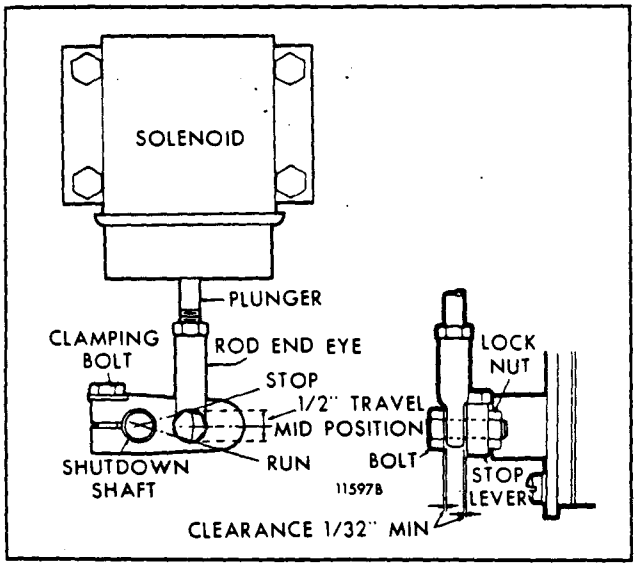


Fig. 7 - Typical Variable Speed Governor Lever Position

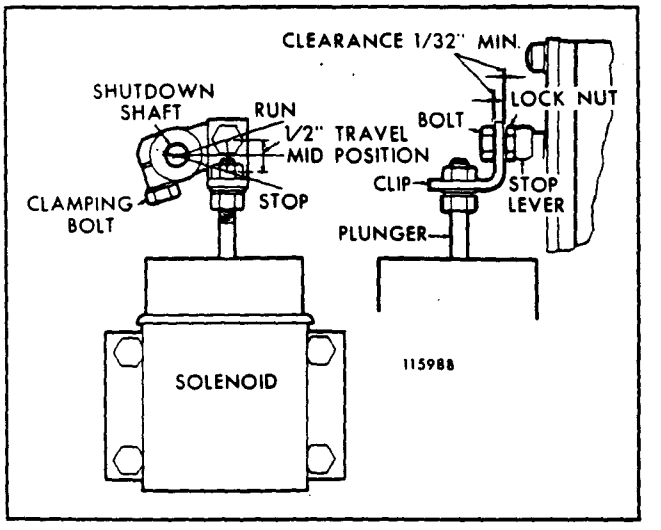


Fig. 8 - Typical Limiting Speed Governor Lever Position

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. The locknut can be either on tip 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.

FUEL MODULATOR ADJUSTMENT

The fuel modulator (Fig. 9), used on turbocharged engines, maintains the proper fuel to air ratio in the lower speed ranges where the mechanical governor would normally act to provide maximum injector output. It operates in such a manner that, although the engine throttle may be moved into the *full-speed* position, the injector racks cannot advance to the *full-fuel* position until the turbine speed is sufficient to provide proper combustion.

The fuel modulator will reduce exhaust smoke and also will help to improve fuel economy. The modulator mechanism is installed between the No. 1 and No. 2 cylinders.

A fuel modulator consists of a cast housing containing a cylinder, piston, cam and calibrated spring mounted on the cylinder head (see Table 1). A lever and roller which controls the injector rack is connected to the injector control tube. Tubes run from the air box to the housing to supply pressure to actuate the piston.

The modulator tells the fuel system how much fuel the engine can efficiently use based on air box pressure.

FUEL MODULATING SPRING IDENTIFICATION

COLOR CODE	LOAD	RATE
Pink Stripe	5.61 ± 1.5 Lbs. @ 1.125 Length	6.00 Lbs. Per Inch.
Green Stripe	26.9 ± 1.34 Lbs. @ .65 Length	18.25 Lbs. Per Inch.
None	28.25 ± 1.4 Lbs. @ .65 Length	16.25 Lbs. Per Inch.

TABLE 1

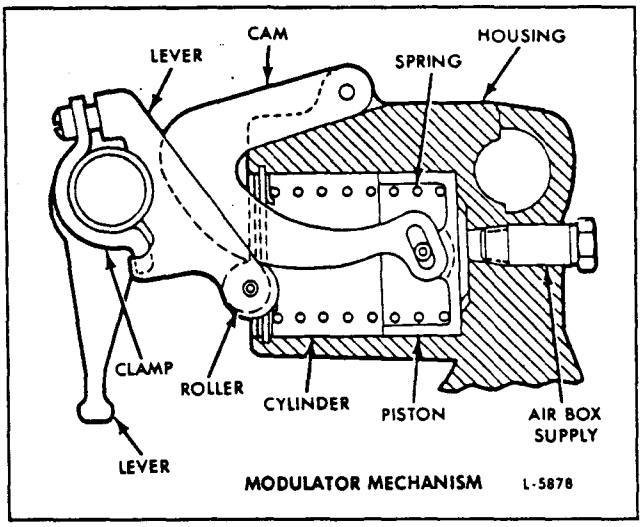


Fig. 9 - Typical Fuel Modulator Assembly

Increased air box pressure forces the piston and cam out of the cylinder bore allowing the rack to move toward full fuel. The spring is calibrated to the individual engine model air box pressure characteristics.

Whenever the fuel injector rack control levers are adjusted, the fuel (air box) modulator lever and roller assembly must first be positioned free of cam contact. This is done by loosening the clamp screw.

Inspection

At major repair or overhaul, inspect the roller and piston outer diameter and the cylinder bore inner diameter for wear. Also, inspect the operating surface, the lever roller, the roller pins at the cam pivot and the cam attachement to the piston.

The piston outer diamter must not be less than 1.6555" and the cylinder bore inner diameter must not be more than 1.6605".

Adjust Fuel Modulator

After completing the injector rack control lever and governor adjustment, adjust the fuel modulator, with the engine stopped, as follows:

1. Insert the proper gage between the injector body and the shoulder on the injector rack (See Table 2).

TOOL NO.	DIM.	USAGE
J28779	.365	4-53T Truck/5A55 injectors.
J28779	.365	4-53T Truck/5A60 injectors except California
J28779	.365	6V-53T Marine/5N65 injectors.
J9509	.404	4-53T Truck/5A60 injectors California only.
J9509	.404	4-53T Truck/N65 injectors.

TABLE 2

2. Position the governor speed control lever in the *maximum* speed position and the governor run stop lever in the *run* position.

3. Rotate the air box modulator lever assembly and clamp on the injector control tube until the lever roller contacts the modulator cam with sufficient force to take up the pin clearance.

4. Check to make sure only the roller contacts the cam and not the lever stamping. Tighten the lever and clamp screw.

5. Remove the gage from between the injector body and the shoulder on the injector rack.

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 1,200 rpm and no load. 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* - Section 2.

5. If freezing weather is expected during the storage period, add an ethylene glycol base 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 compressed 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 (more than 30 days)

1. Drain the cooling system and flush with clean, soft water. Refill with clean, soft water and add a rust inhibitor to the cooling system (refer to *Corrosion Inhibitor* under *Coolant Specifications* - Section 5).

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

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

4. Circulate the coolant by operating the engine until normal operating temperature is reached.

5. Stop the engine.

6. Drain the engine crankcase, then reinstall and tighten the drain plug. Install new lubricating oil filter elements and gaskets.

7. Fill the crankcase to the proper level with a 30-weight preservative lubricating oil MIL-L-21260C, Grade 2.

8. Drain the engine fuel tank. Refill with enough clean No. 1 diesel fuel or pure kerosene to permit the engine to operate for about ten minutes. If it isn't convenient to drain the fuel tank (i.e., marine) use a separate portable supply of the recommended fuel.

NOTE: If engines in vehicles or marine units are stored where condensation of water in the fuel tank may be a problem add pure, waterless isopropyl alcohol (isopropanol) to the fuel at a ratio of one pint to 125 gallons of fuel, or .010%

by volume. Where biological contamination of fuel may be a problem, add a biocide such as Biobor JF, or equivalent, to the fuel. When using a biocide, follow the manufacutrer's concentration recommendations.

9. Drain and disassemble the fuel filter and strainer. Discard the used elements and gaskets. Fill the cavity between the element and shell with No. 1 diesel fuel or pure kerosene, and reinstall on the engine. If spin-on fuel filters and strainers are used, discard the used cartridges, fill the new ones with No. 1 diesel fuel or pure kerosene and reinstall on the engine.

10. Operate the engine for five minutes to circulate the clean fuel oil throughout the engine.

11. Refer to *Air System* in Section 2 and service the air cleaner.

12. MARINE GEAR

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

The performance of Step b is not necessary on torque converter units.

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

13. TORQMATIC CONVERTER

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

b. Stop the engine, remove the converter drain plug and drain the converter.

c. Remove the filter element.

d. Start the engine and stall the converter for **twenty seconds** at 1,000 rpm to scavenge the oil from the converter. *Due to lack of lubrication, do not exceed the twenty (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-21260C, Grade 2. Oil of this type is available from the major oil companies.

g. Start the engine and operate the converter for at least ten minutes at a minimum of 1,000 rpm. Engage the clutch, then stall the converter to raise the oil temperature to 225° F (107° C). 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 then **thirty (30) seconds.**

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

i. Seal the breather and all of the exposed openings 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.

14. POWER TAKEOFF

a. Use an all purpose grease such as Shell Alvania No. 2, or equivalent, and 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 the gear box and flush 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 grade of oil indicated on the name plate.

15. TURBOCHARGER

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

16. Apply a *non-friction* rust preventive compound to all exposed parts. If 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.

NOTE: 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.

17. Drain the engine cooling system.

18. Drain the preservative oil from the engine crankcase. Reinstall and tighten the drain plug.

19. Remove and clean the battery and battery cables with a baking soda-water 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.

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

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

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

23. Protect the engine with a good weather-resistant tarpaulin and store it under cover, preferably in a dry building which can be heated during the winter months.

Detroit Diesel Allison does not recommend the outdoor storage of engines (or transmissions). Nevertheless, DDA recognizes that in some cases outdoor storage may be unavoidable. If units must be kept out-of-doors, follow the preparation and storage instructions already given. Protect units with quality, weather-resistant tarpaulins (or other suitable covers) arranged to provide air circulation.

> **NOTE:** *Do not use plastic sheeting for outdoor storage.* Plastic is fine for indoor storage. When used outdoors, however, enough moisture can condense on the inside of the plastic to rust ferrous metal surfaces and pit aluminum surfaces. If a unit is stored outside for any extended period of time, severe corrosion damage can result.

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. Reinstall the drain plug. Then, refer to *Lubrication System* in the *Operating Instructions* (Section 4) and fill the crankcase to the proper level, using a pressure prelubricator, with the recommended grade of lubricating oil.

6. Fill the fuel tank with the fuel specified under *Fuel Specifications* in Section 5.

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, fill the cooling system with an ethylene glycol base antifreeze solution (see *Coolant Specifications* in Section 5).

8. Install and connect the battery.

9. Service the air cleaner as outlined under *Air System* in Section 2.

10. POWER GENERATOR

Prepare the generator for starting as outlined under *Operating Instructions* in Section 4.

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 (20) seconds** at 1,000 rpm to scavenge the oil from the

converter. 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* in Section 5.

13. POWER TAKEOFF

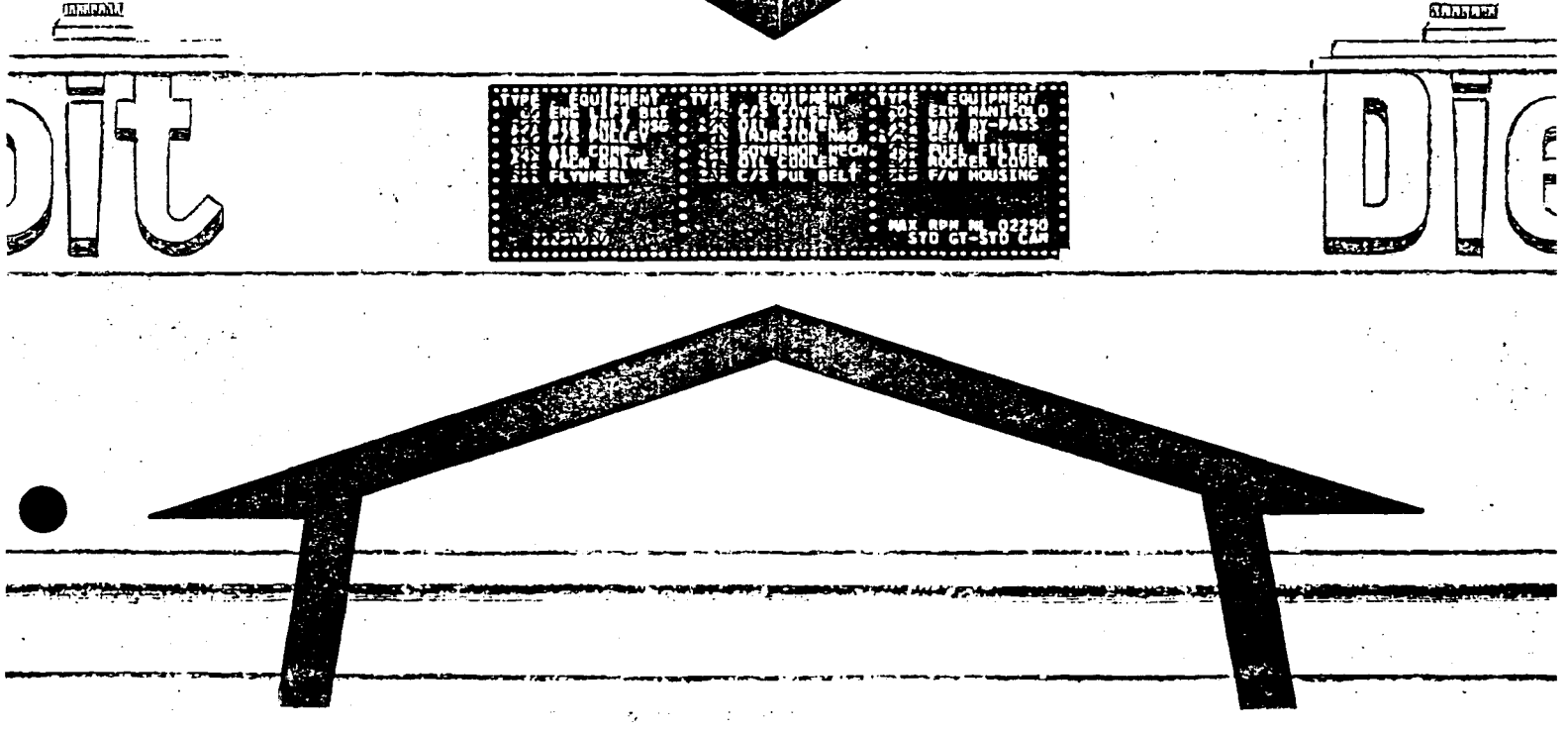
Remove the inspection hole cover and inspect the clutch release lever and link pins and the bearing ends of the clutch release shaft. Apply engine oil sparingly, if necessary, to these areas.

14. 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* in Section 4.

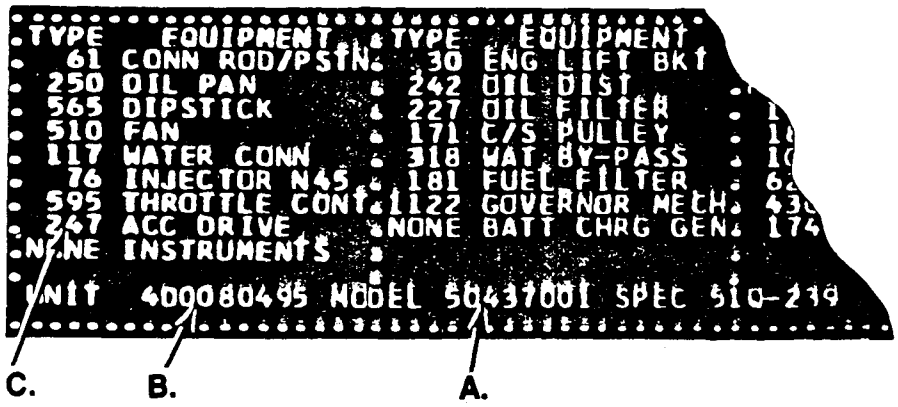
15. Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up. After all of the preparations have been completed, start the engine. The small amount of rust preventive compound which remains in in the fuel system will cause a smoky exhaust for a few minutes.

BUILT-IN
PARTS BOOK
for
DETROIT DIESEL
ENGINES



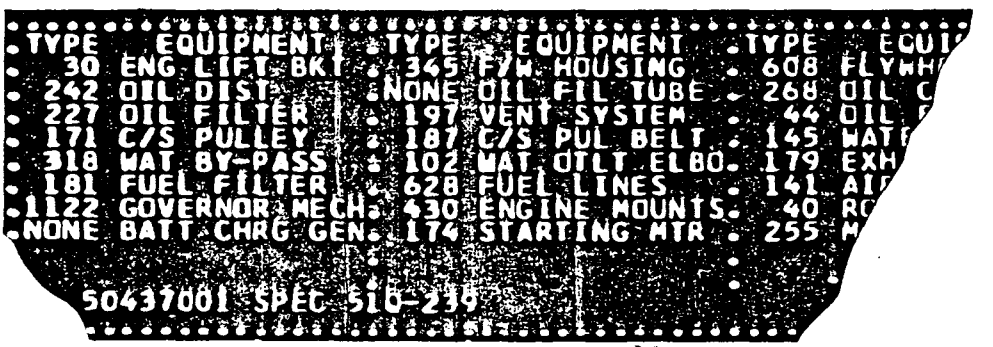
Progress in industry comes at a rapid pace. In order for the engine manufacturer to keep pace with progress he needs a versatile product for the many models and arrangements of accessories and mounting parts needed to suit a variety of equipment. In addition, engine refinements and improvements are constantly 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 option plate that fits into a holding channel on the engine rocker cover.



SHOWN IN COLUMNS, the type numbers and equipment descriptions represent specific groups of functionally related parts installed on the engine as optional equipment. The components making up these groups are found in the parts catalog microfiche under the "type" number of the appropriate equipment category.

The engine unit and model numbers appear at the bottom of the plate, as shown on the preceding page, along with the governed maximum rpm, no-load setting, and engine timing.

All engine components are divided into groups of functionally related parts. A complete listing of the twelve major groups and their many subgroups 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 subgroups, 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

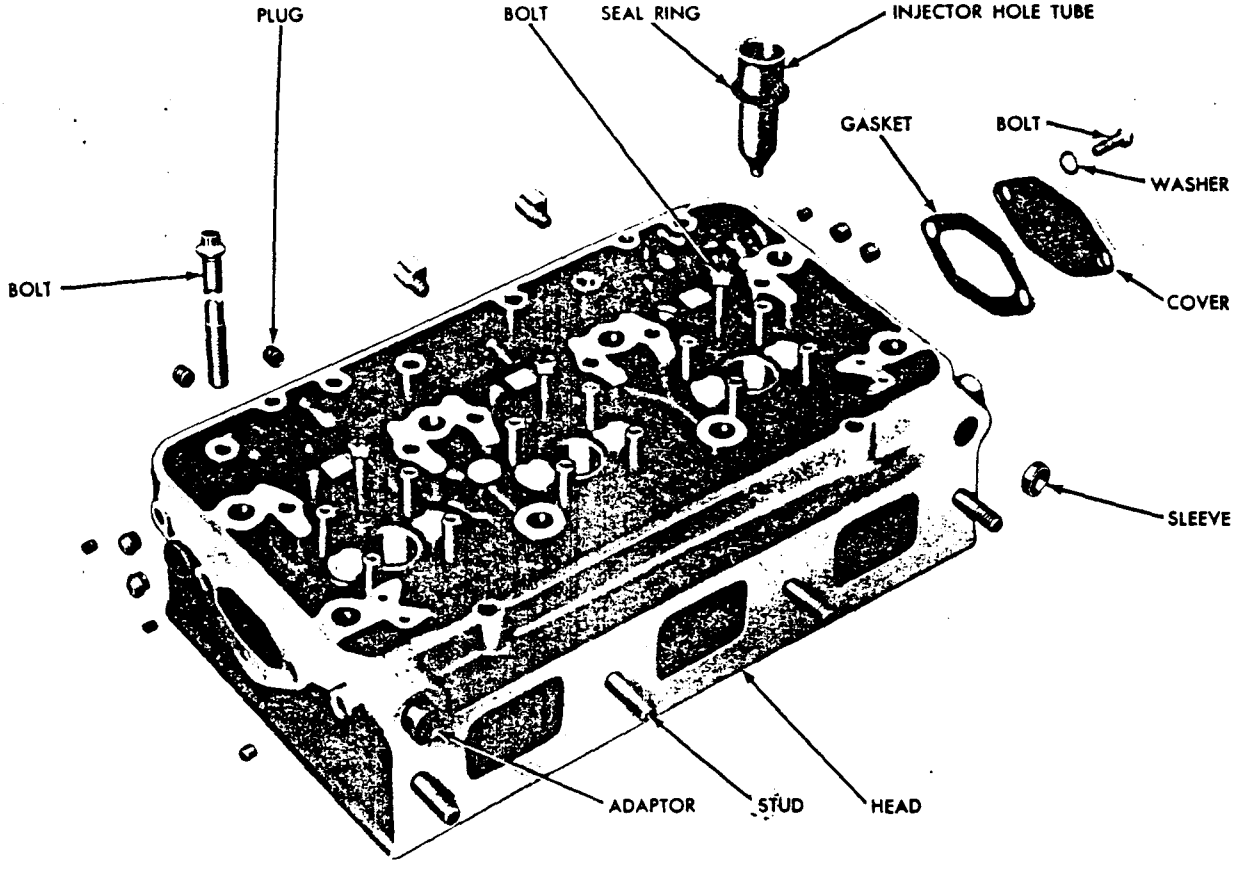
AIR CLEANER

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

_____

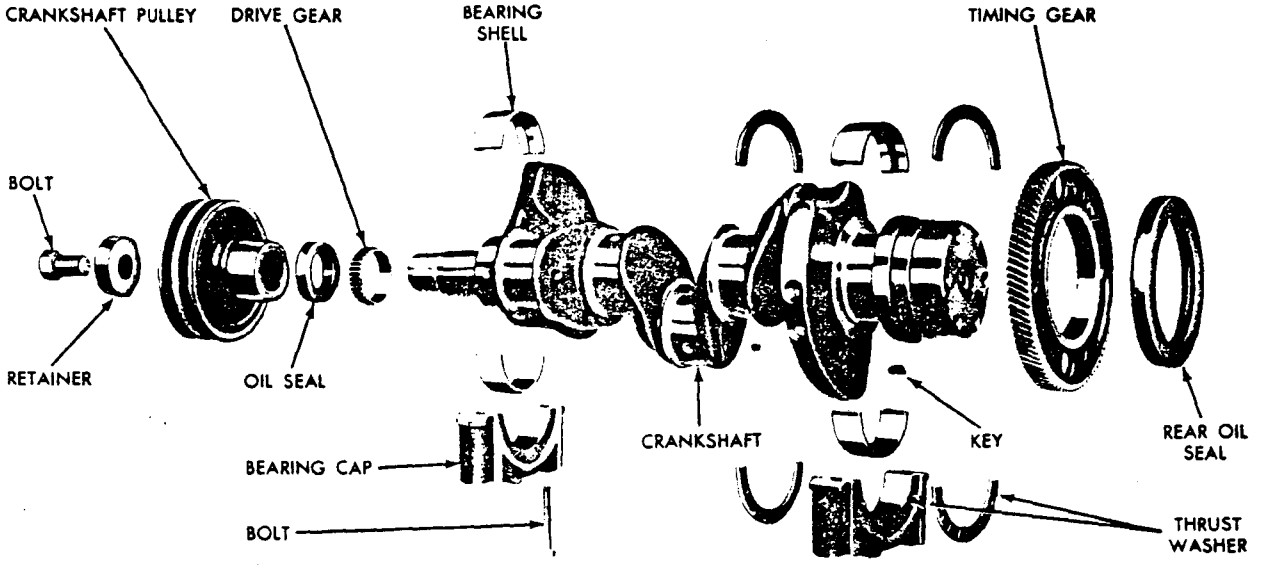
_____

Wet type, indicate capacity_____qts.

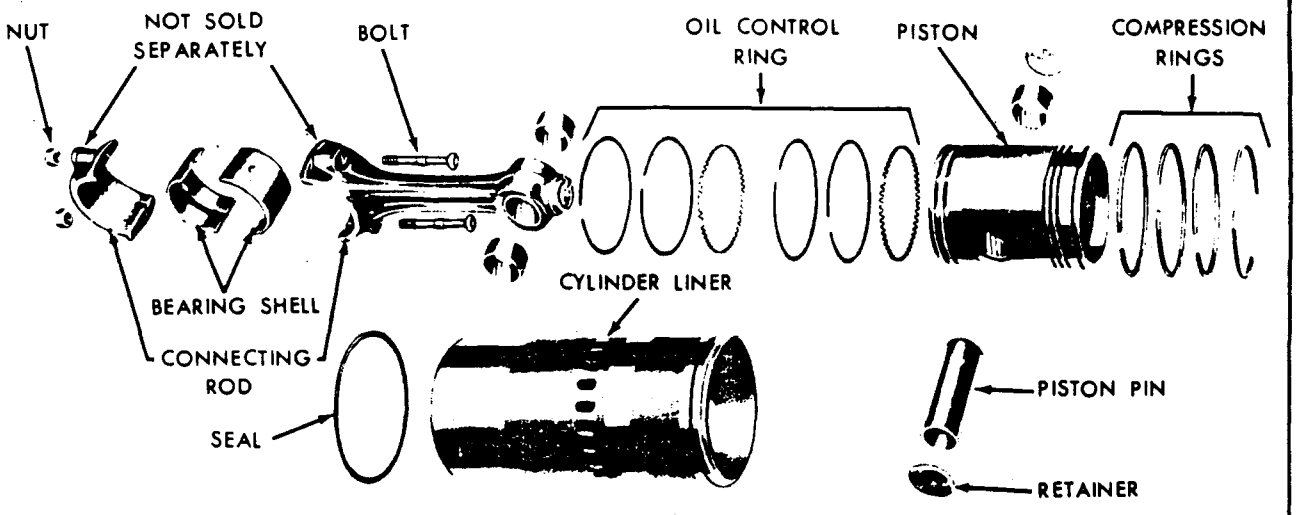


CYLINDER HEAD

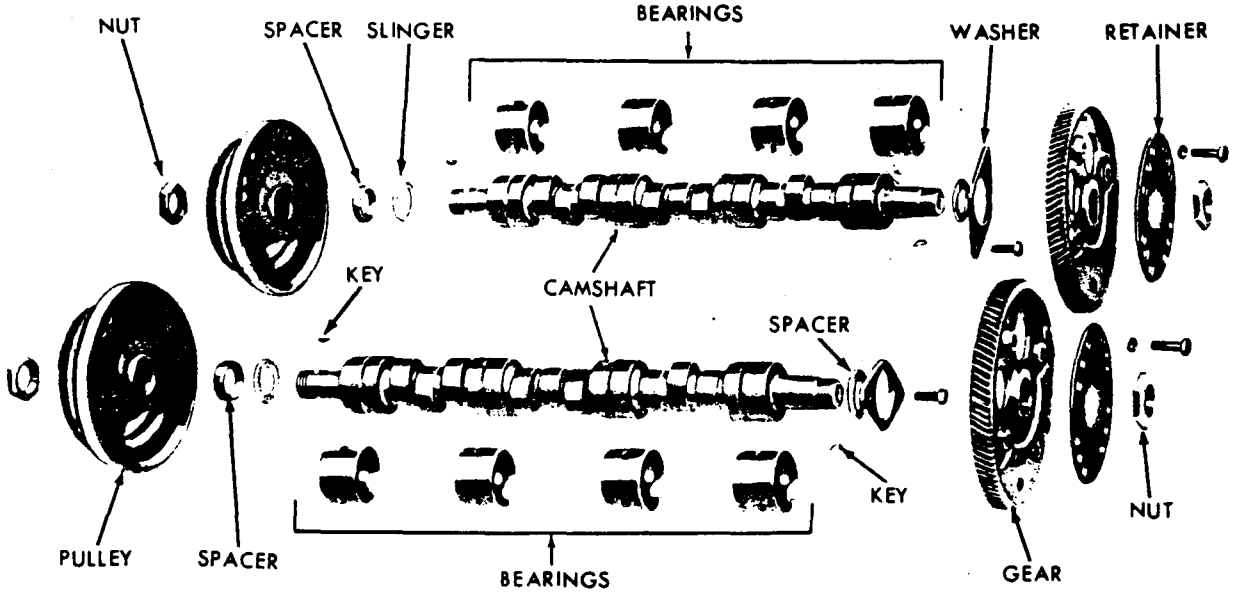
P 628



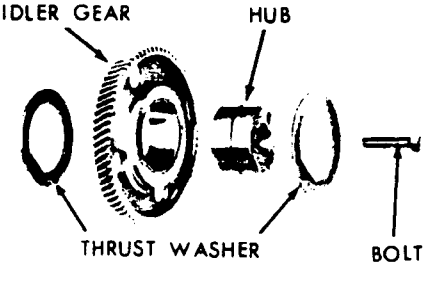
CRANKSHAFT



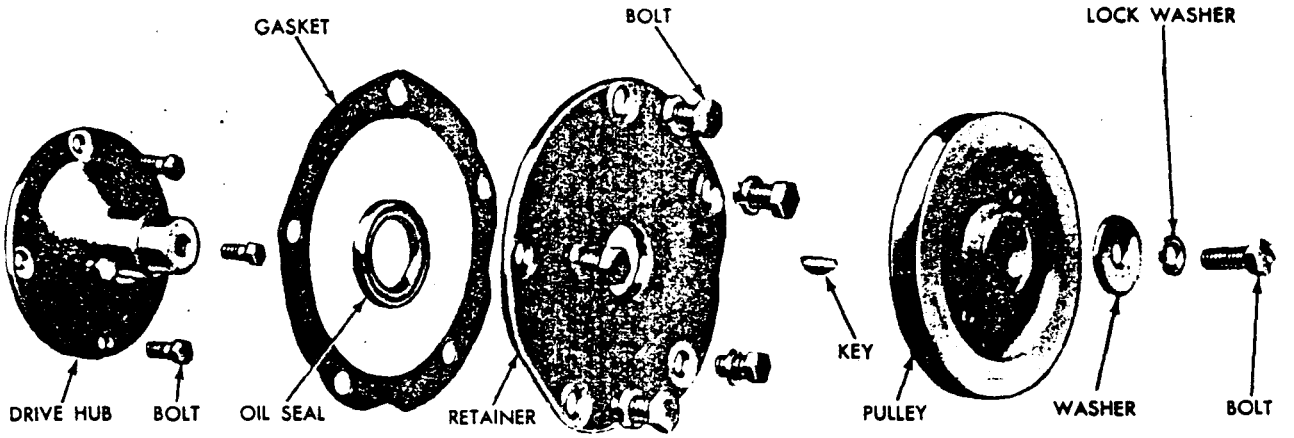
CONNECTING ROD, PISTON AND LINER



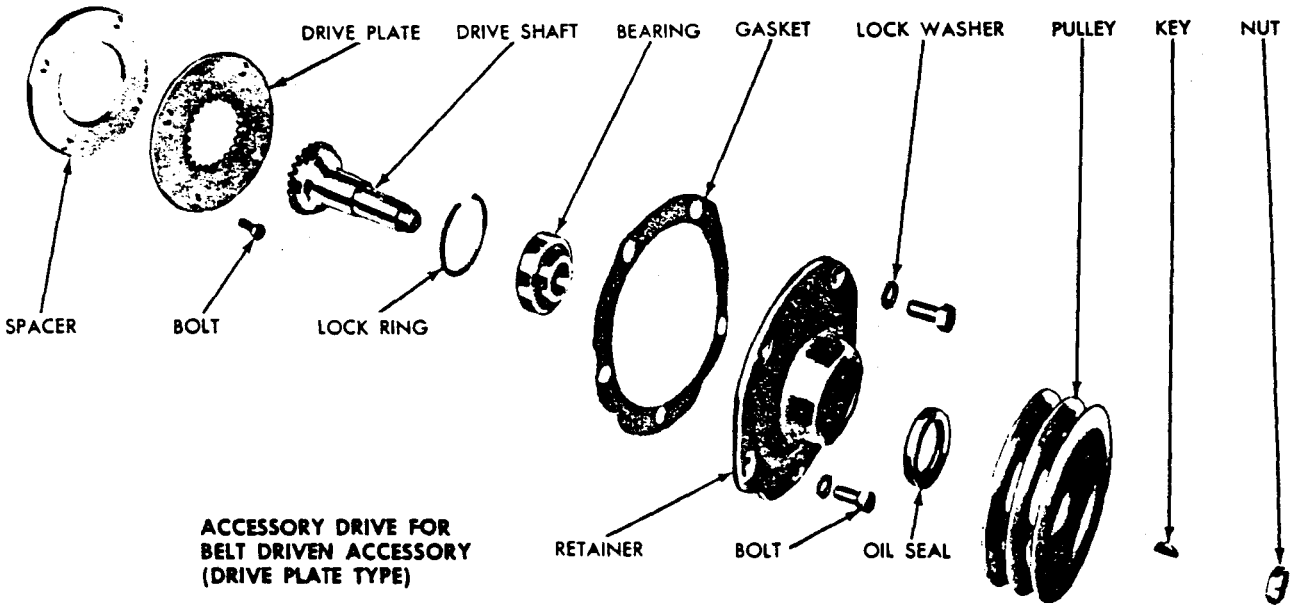
CAMSHAFT AND GEAR (V-ENGINE) P 629



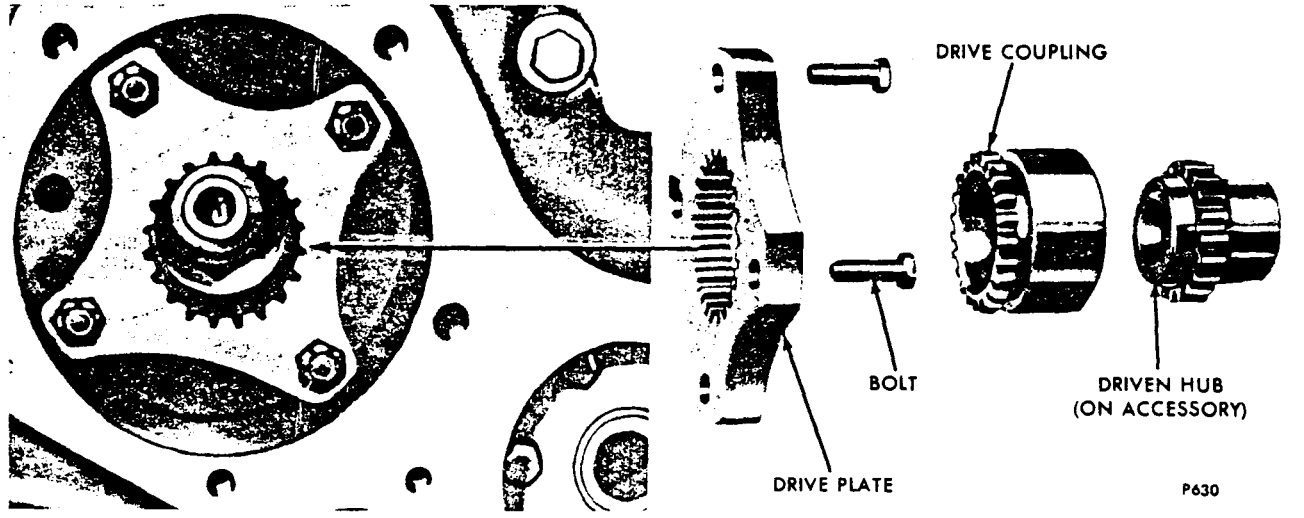
IDLER GEAR



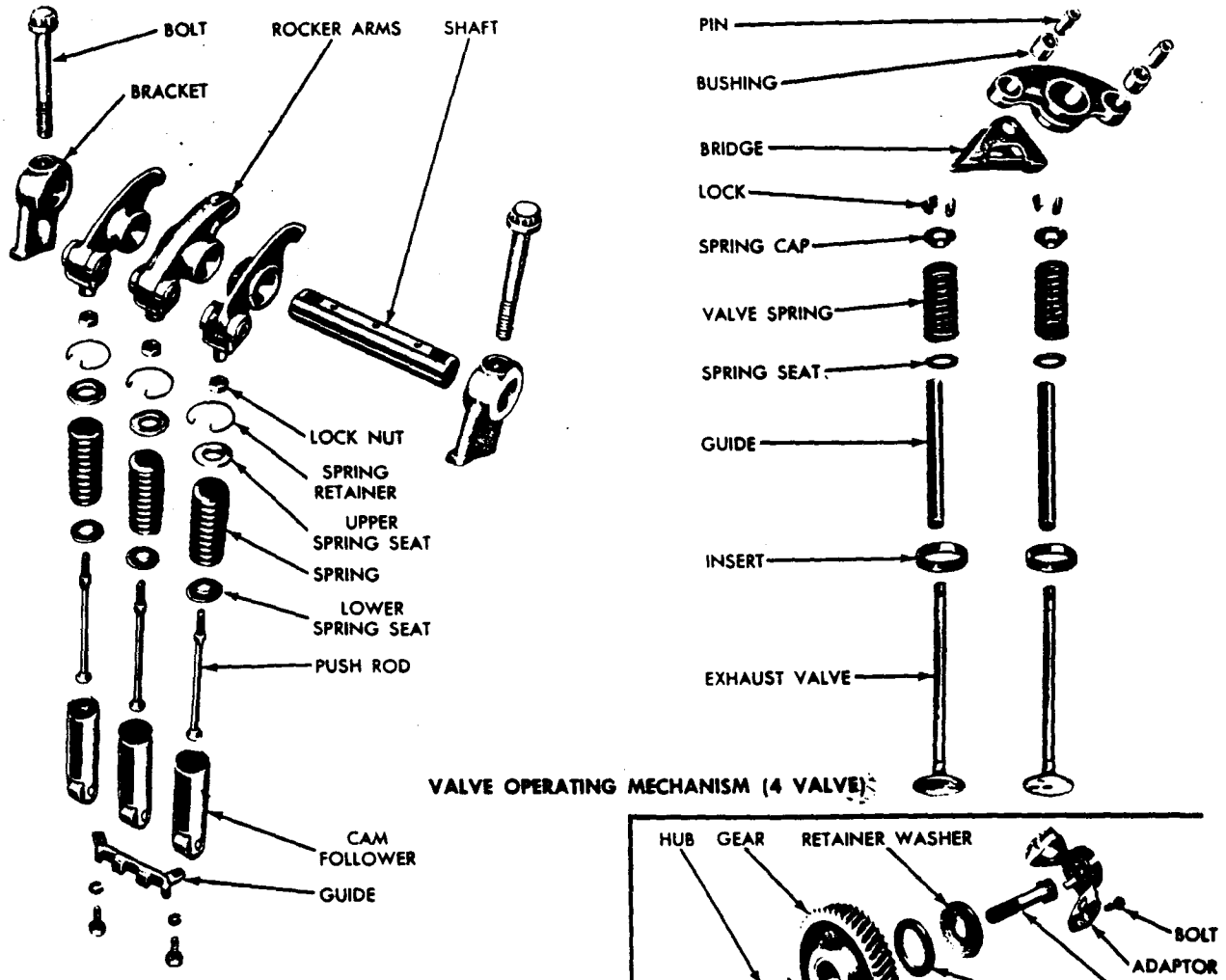
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE HUB TYPE)



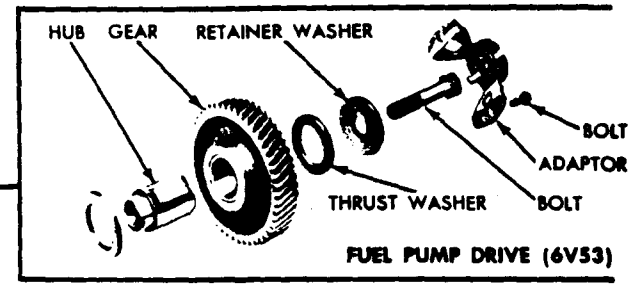
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE PLATE TYPE)



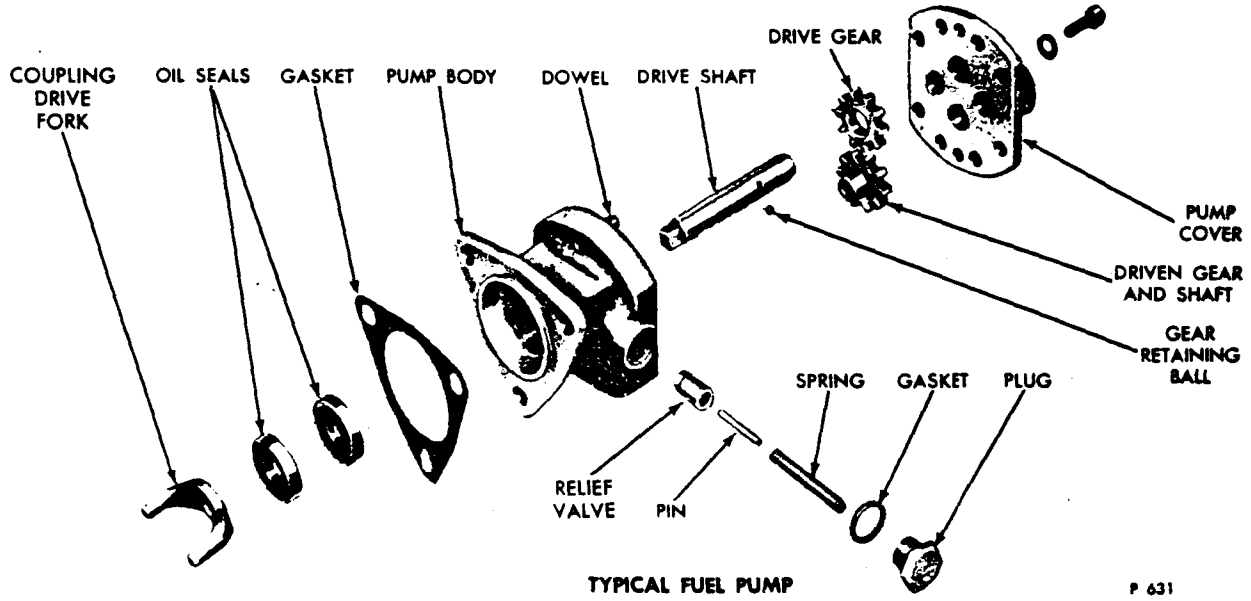
ACCESSORY DRIVE FOR DIRECT DRIVEN ACCESSORY (CAMSHAFT GEAR)



VALVE OPERATING MECHANISM (4 VALVE)

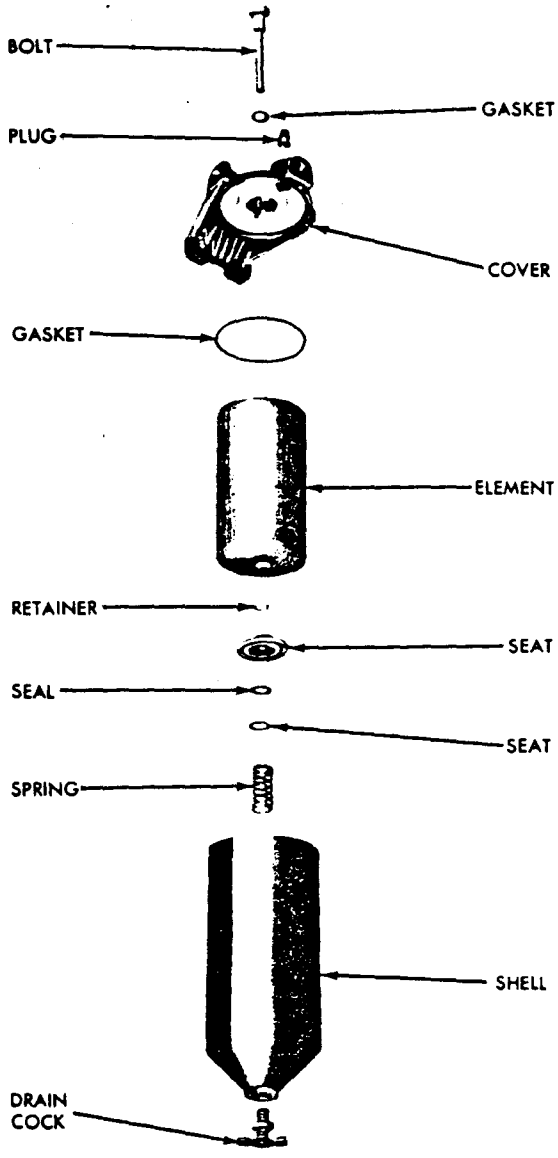


FUEL PUMP DRIVE (6V53)

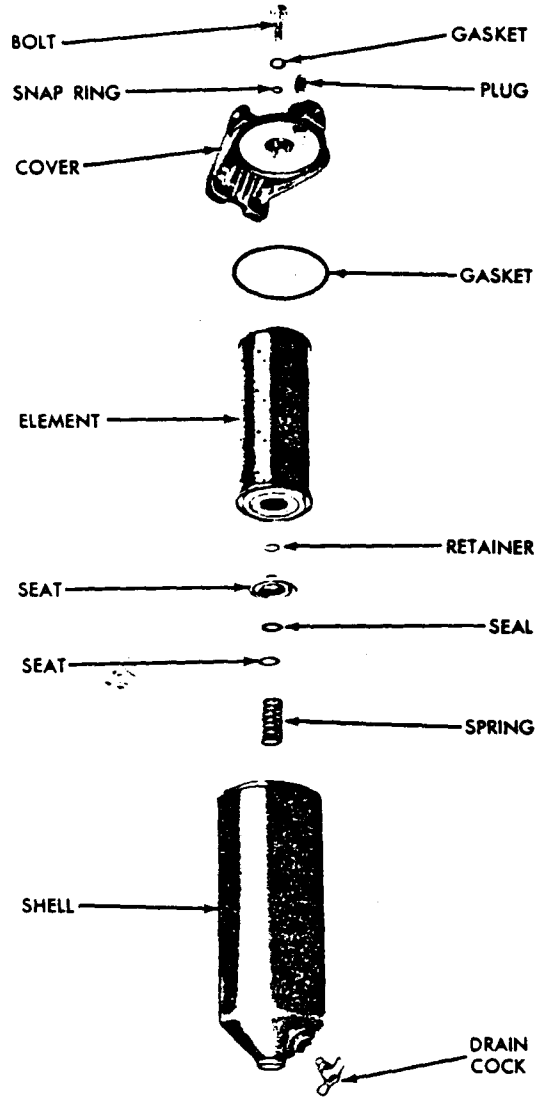


TYPICAL FUEL PUMP

P 631

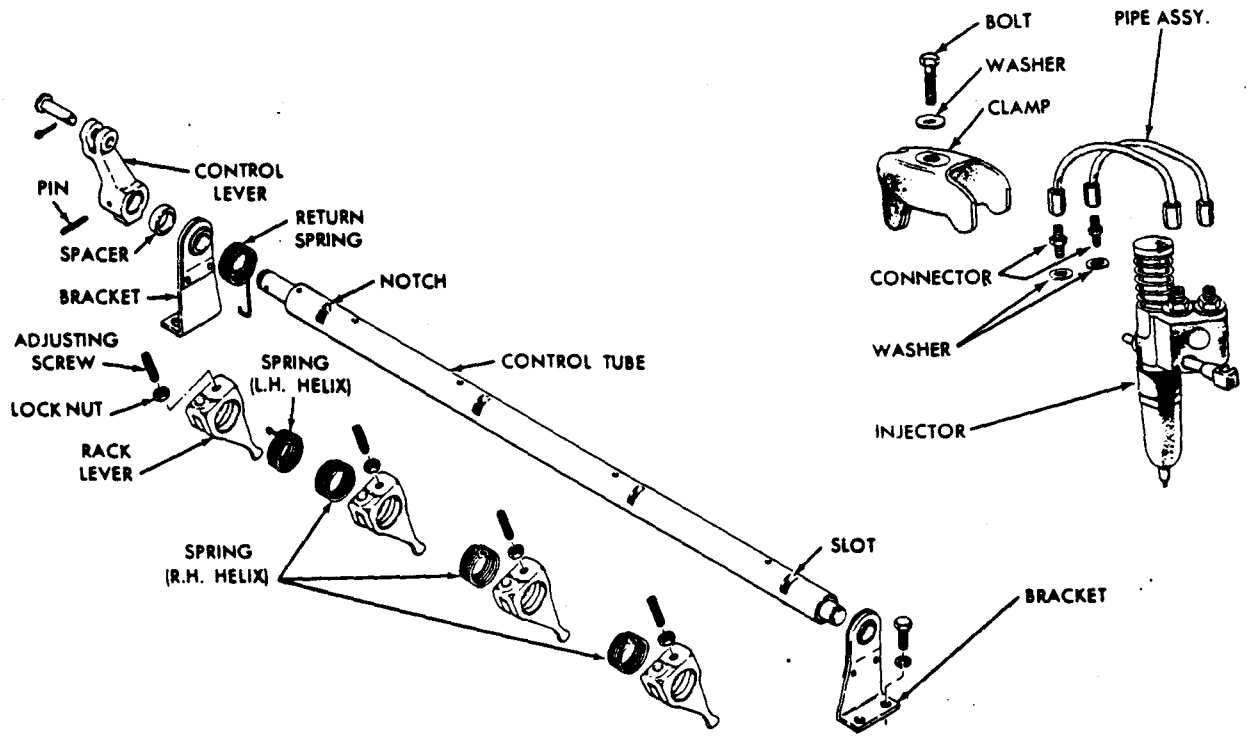


TYPICAL FUEL OIL STRAINER

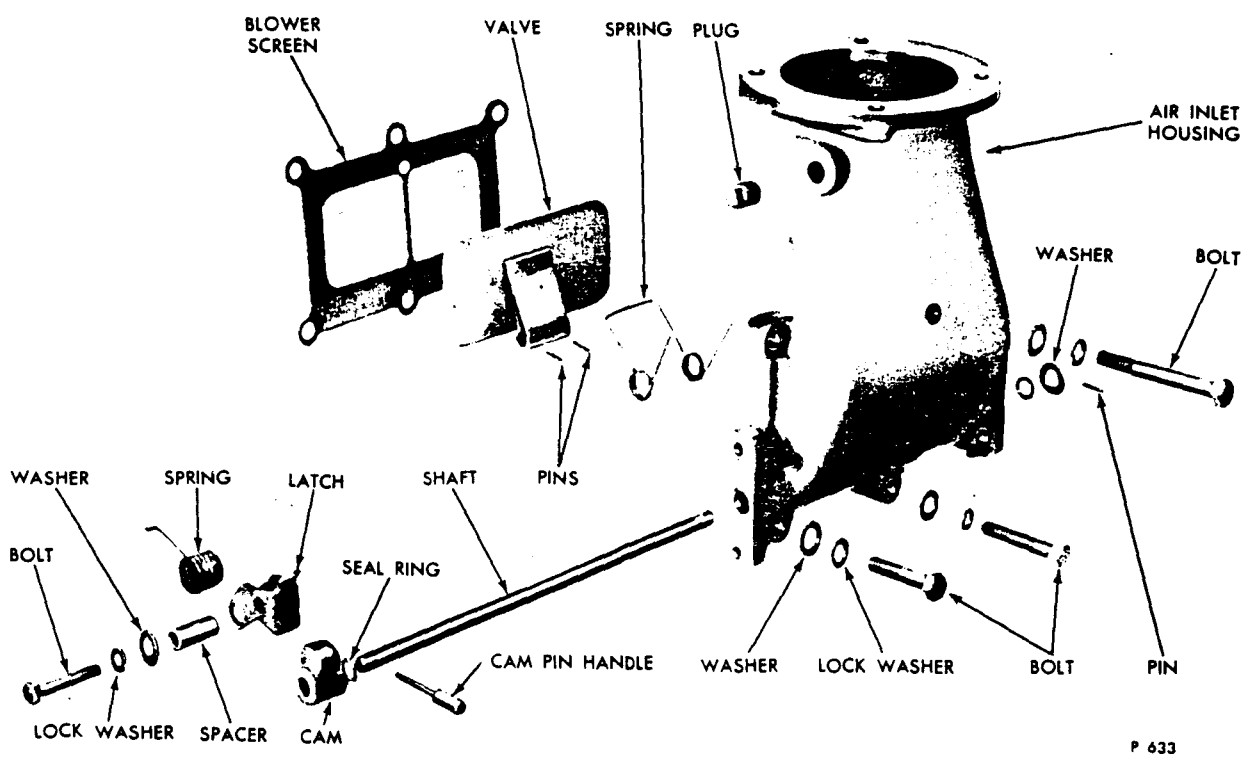


TYPICAL FUEL OIL FILTER

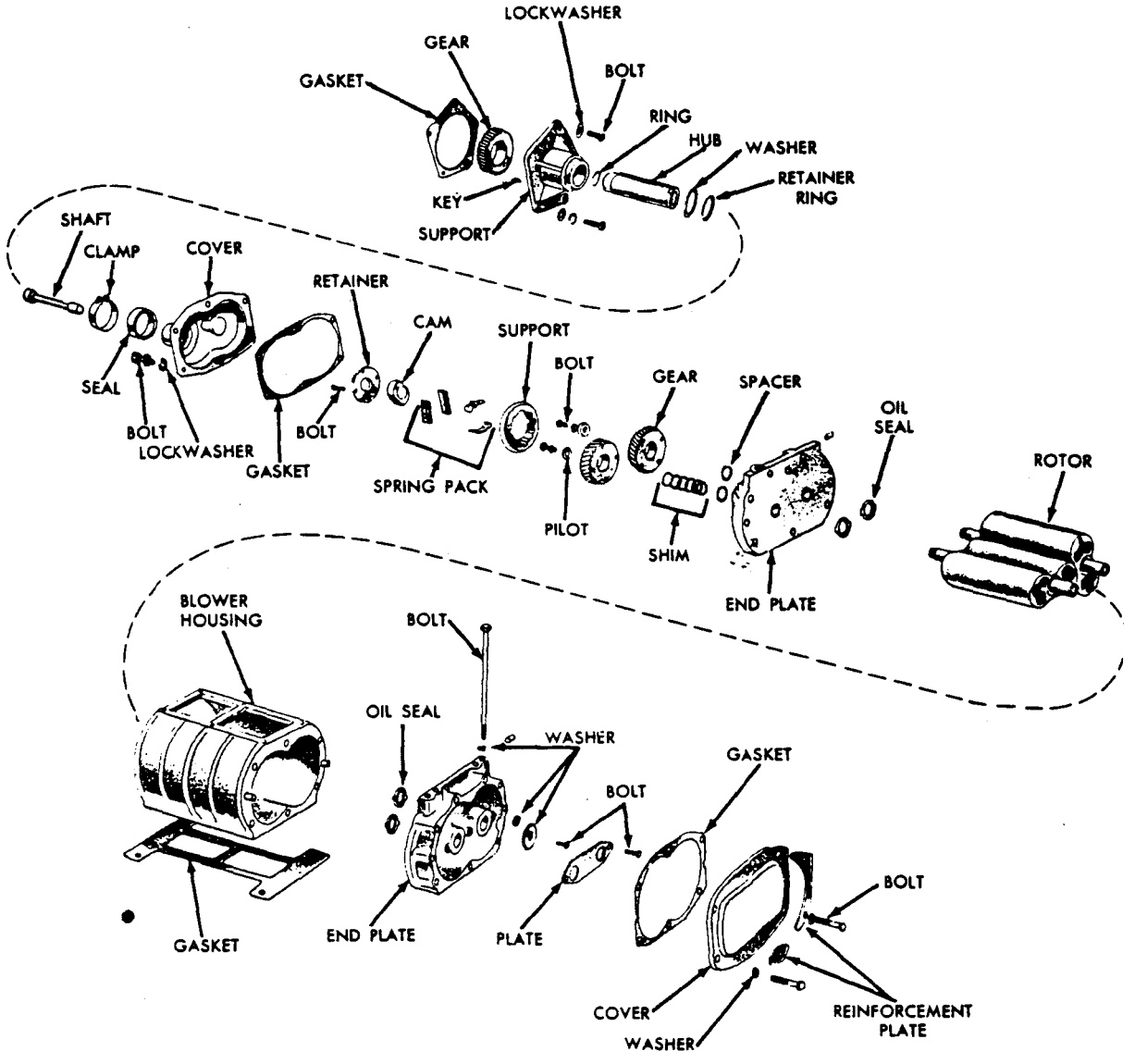
P 632



INJECTOR AND CONTROLS

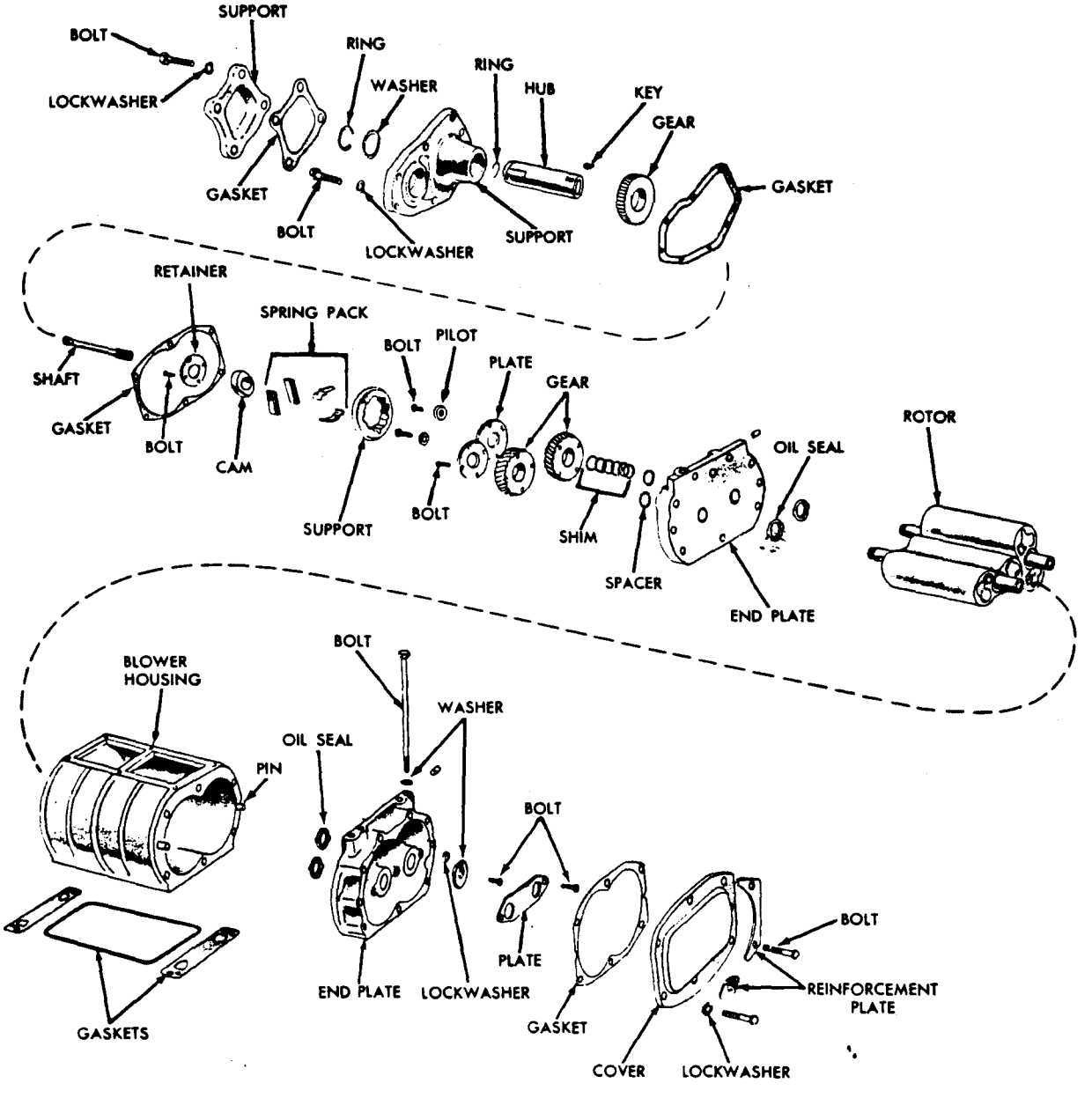


AIR SHUTDOWN HOUSING



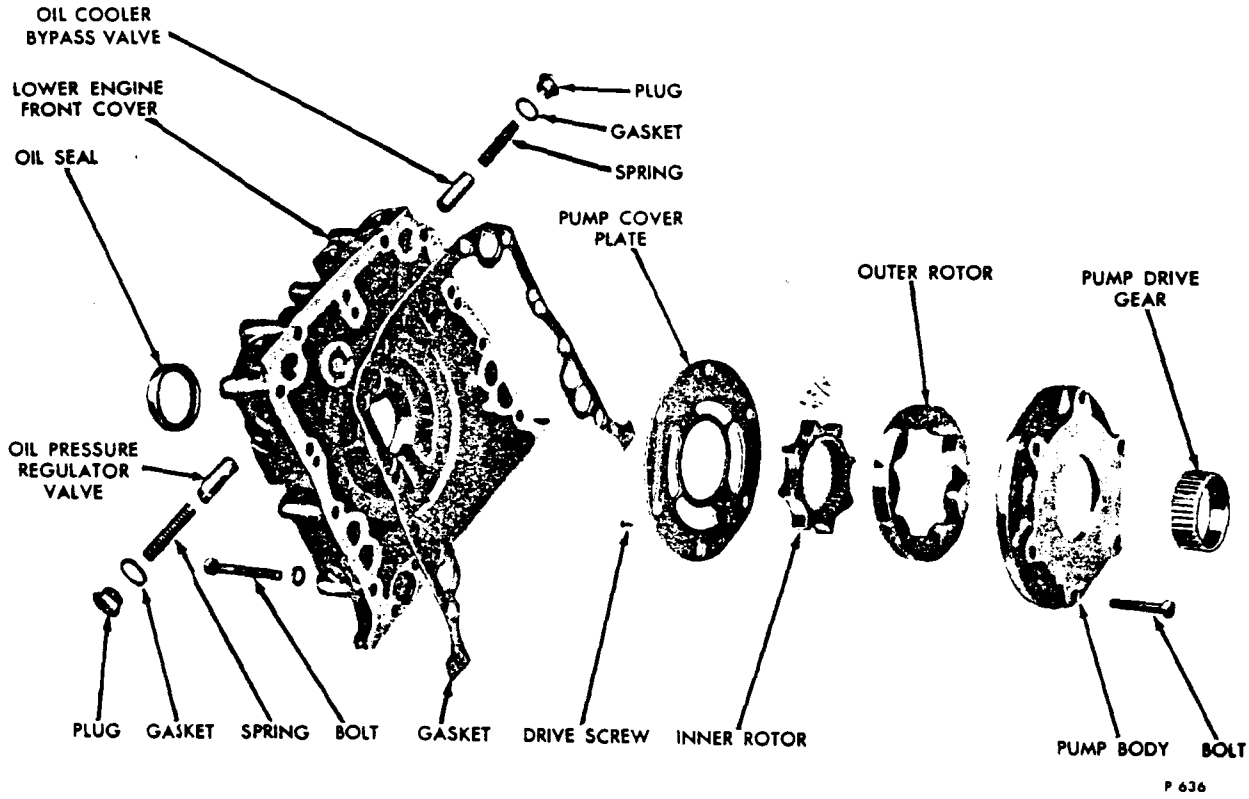
P 634

BLOWER ASSEMBLY AND DRIVE
(4 CYL.)

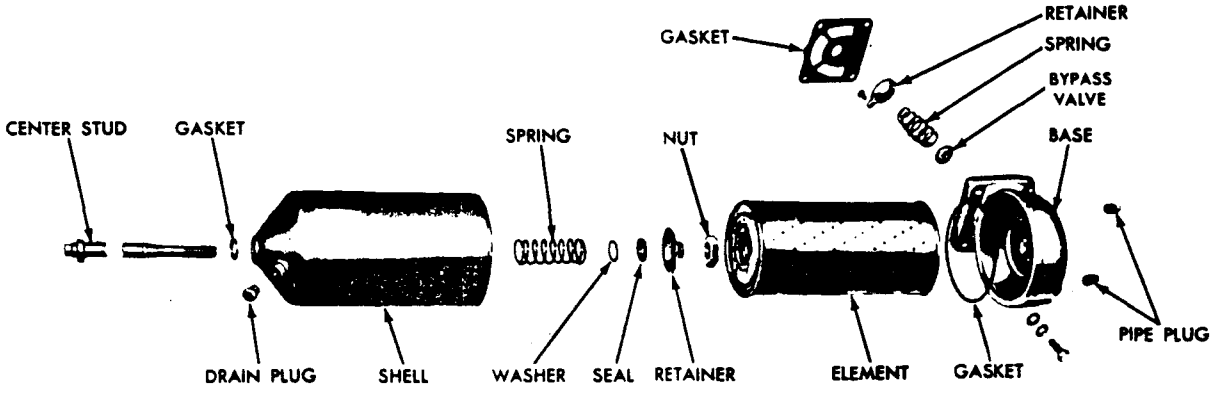


BLOWER ASSEMBLY AND DRIVE (6 CYL.)

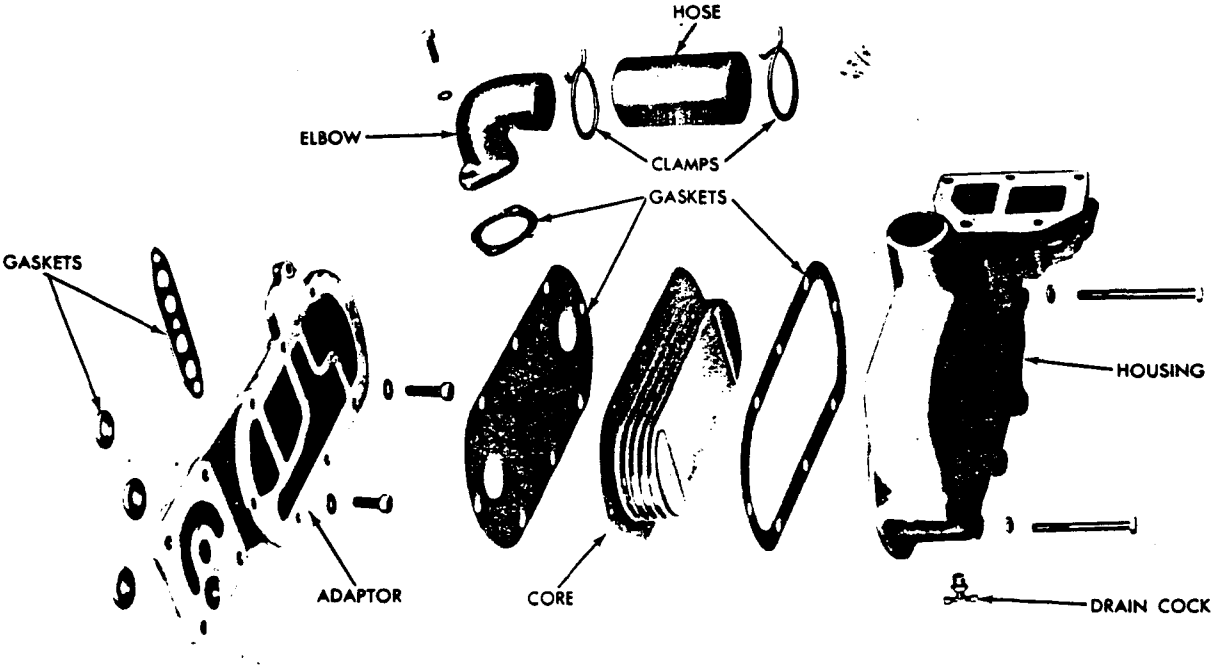
P 635



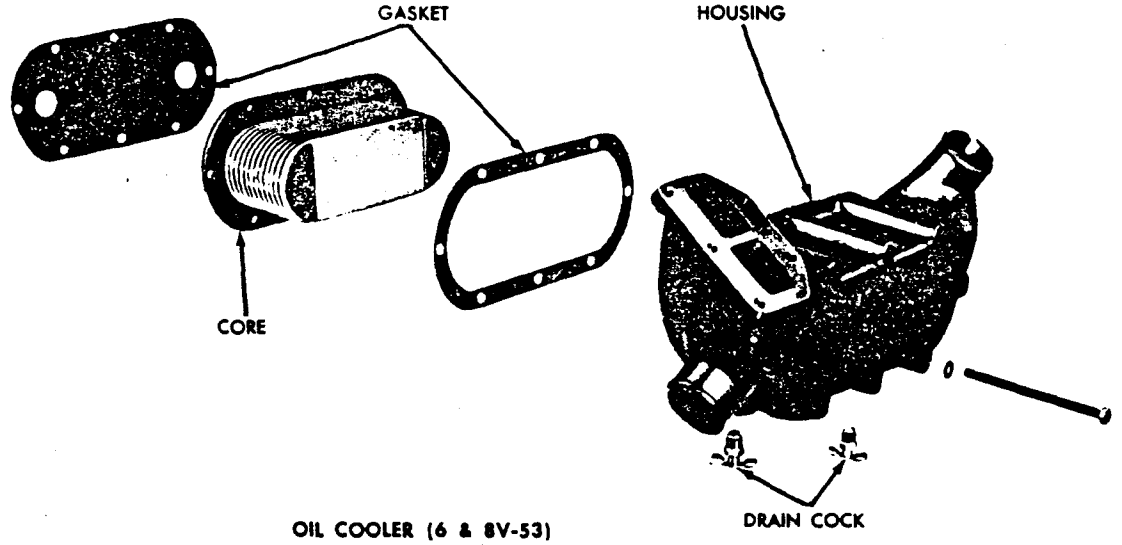
OIL PUMP AND REGULATOR



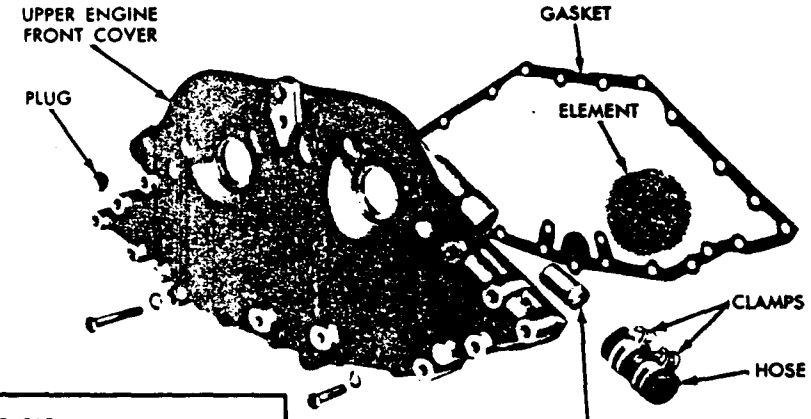
OIL FILTER

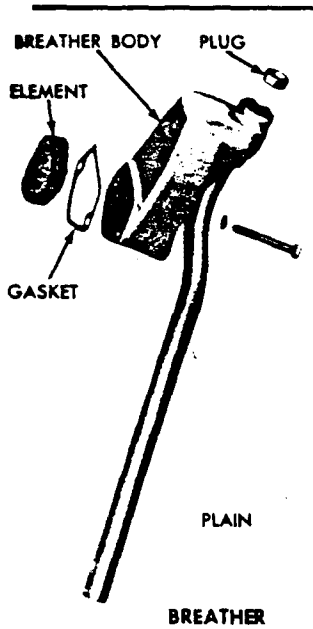


P 637

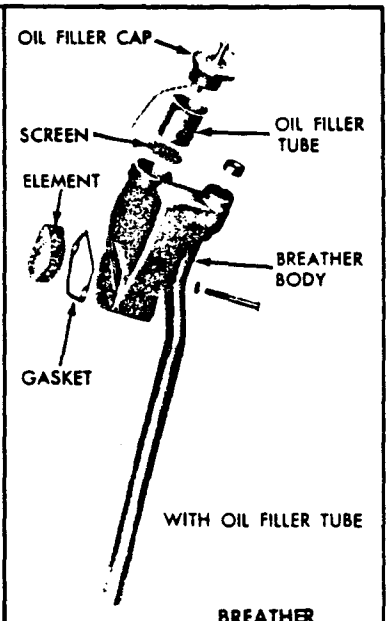


OIL COOLER (6 & 8V-53)

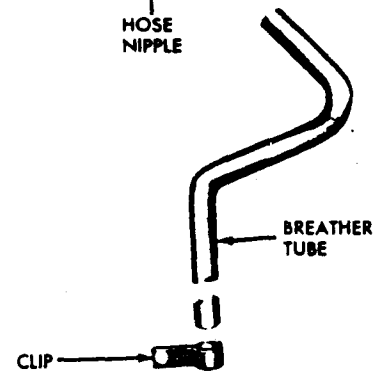




BREATHER

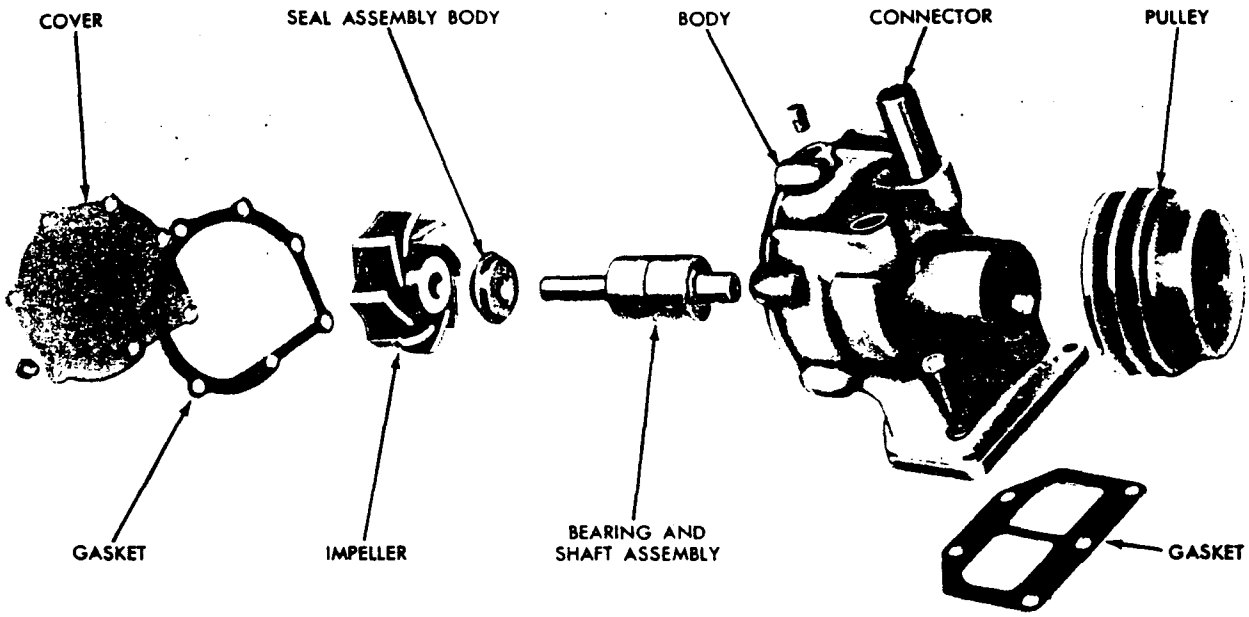


BREATHER

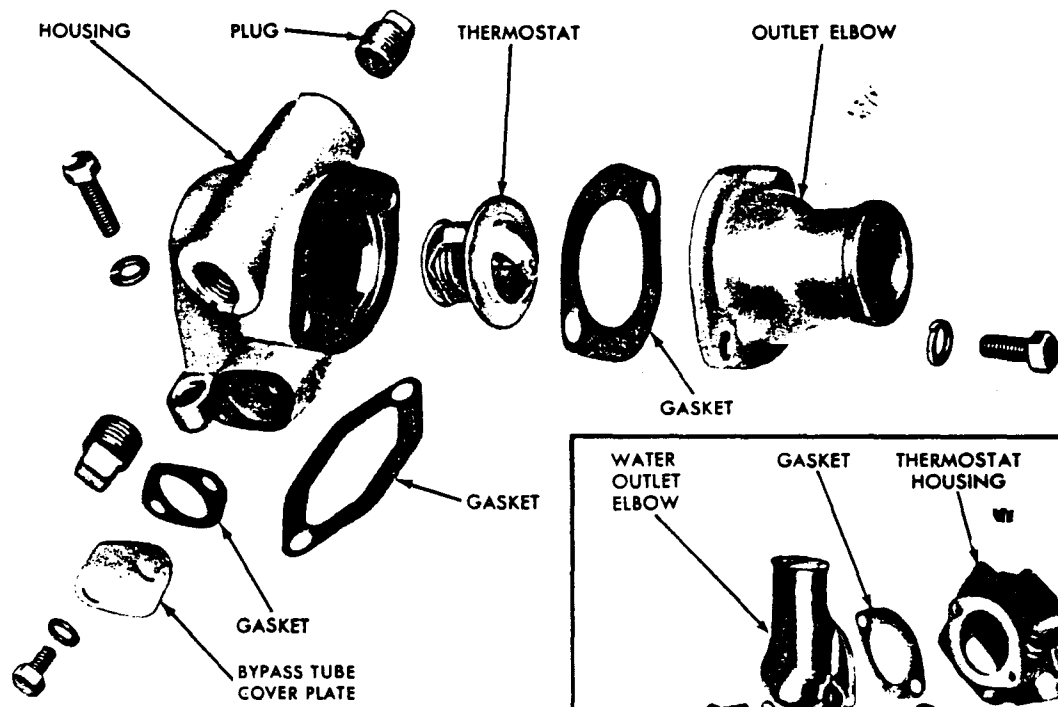


BREATHER (6 & 8V-53)

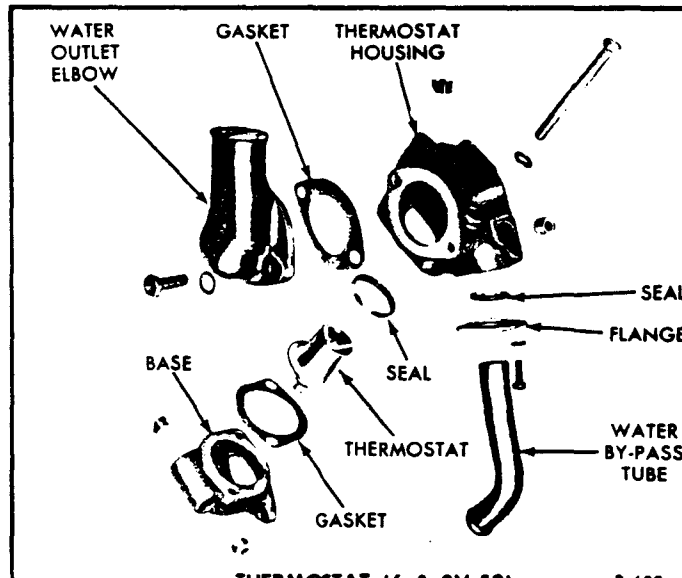
P 638



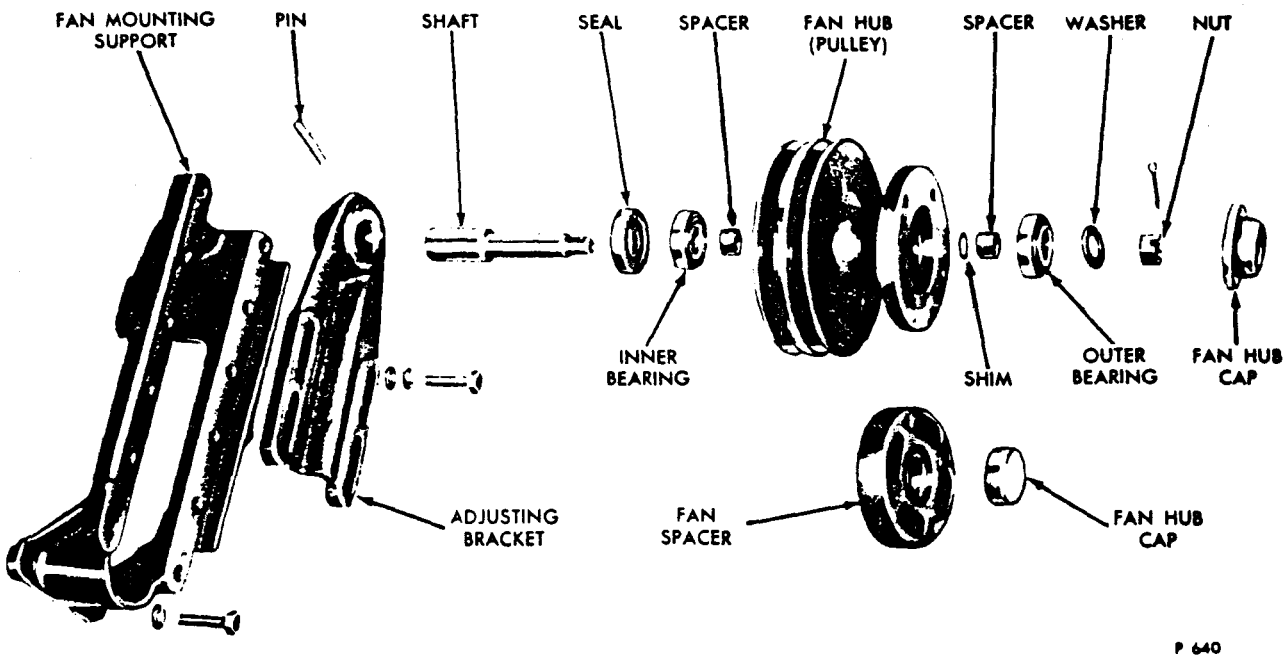
FRESH WATER PUMP



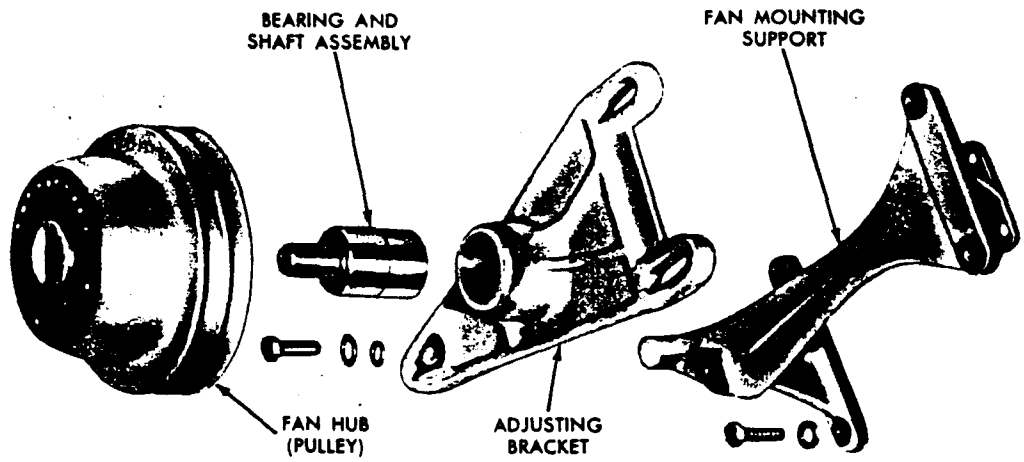
THERMOSTAT



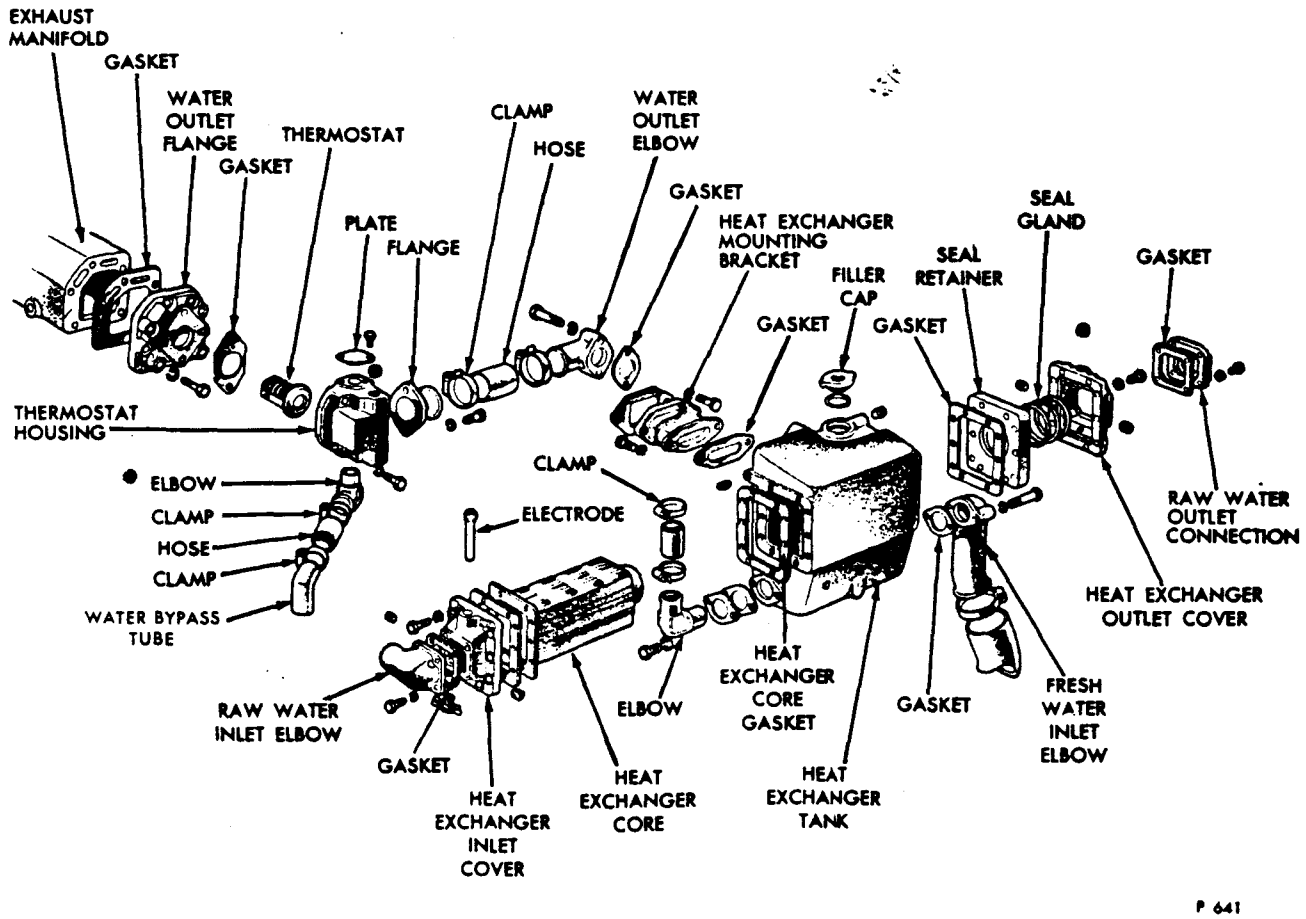
THERMOSTAT (6 & 8V-53) P 639



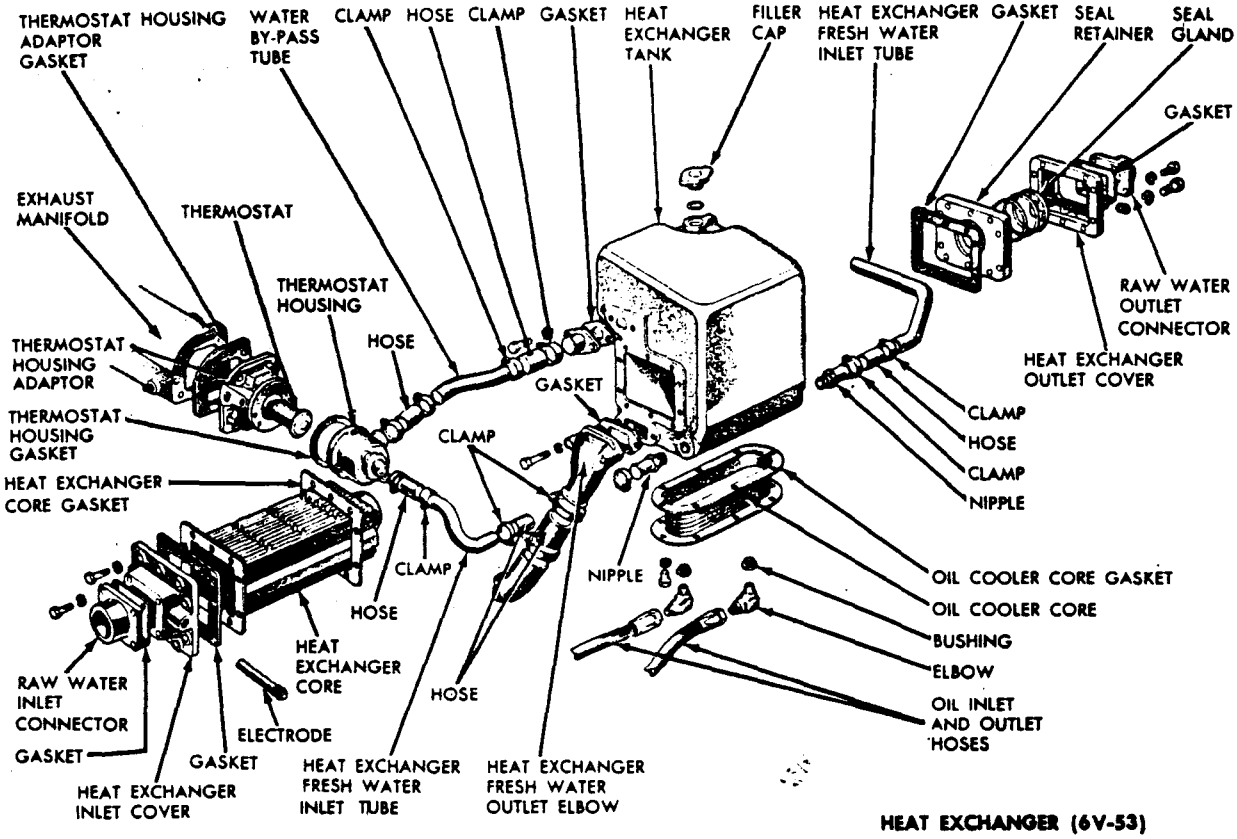
FAN MOUNT (6V-53)



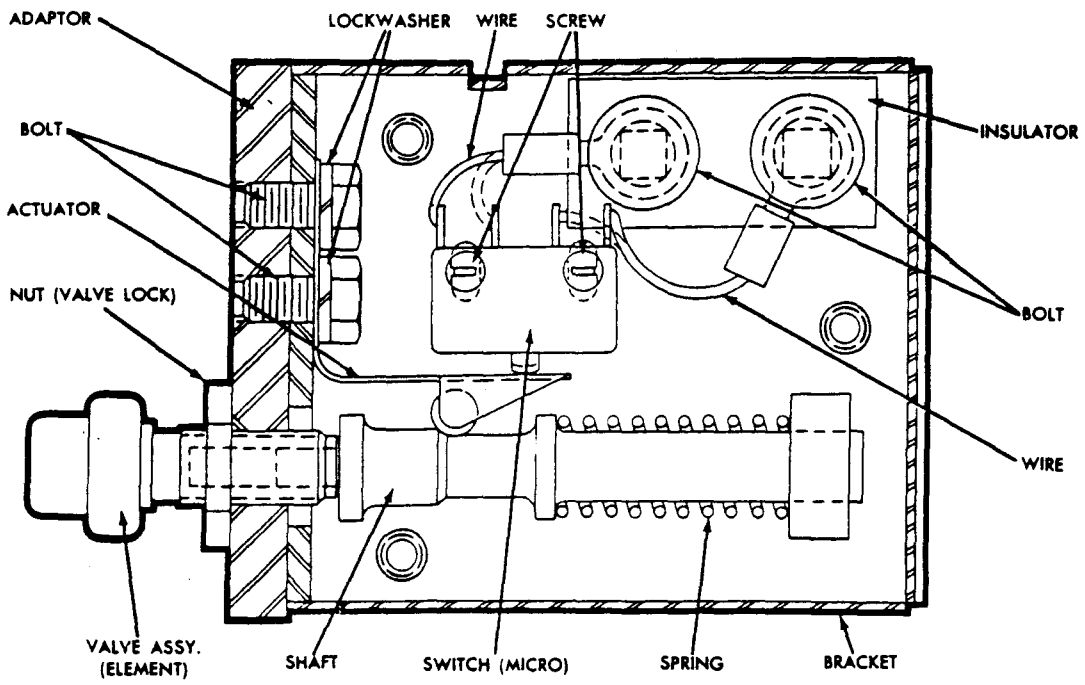
FAN MOUNT



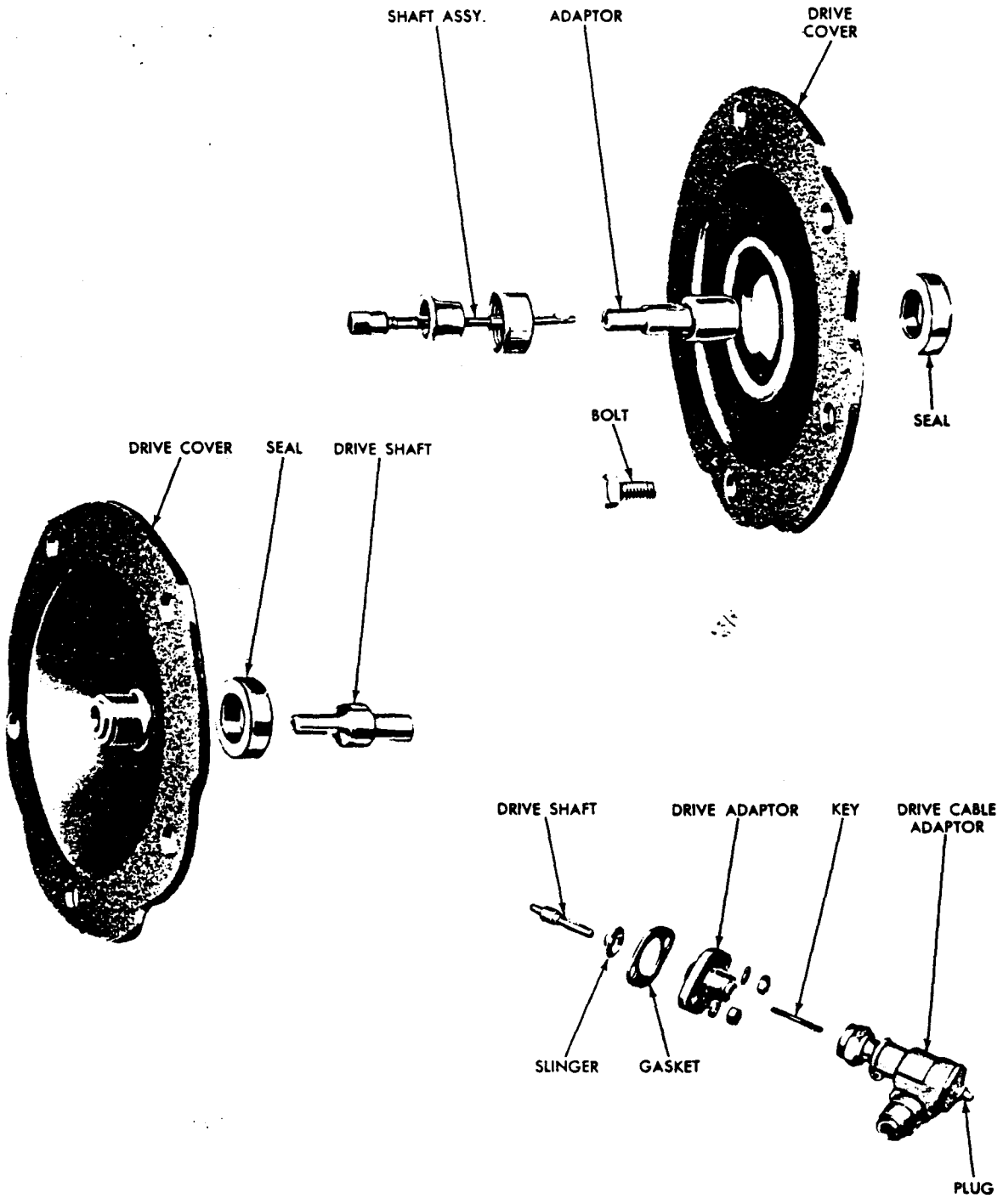
HEAT EXCHANGER



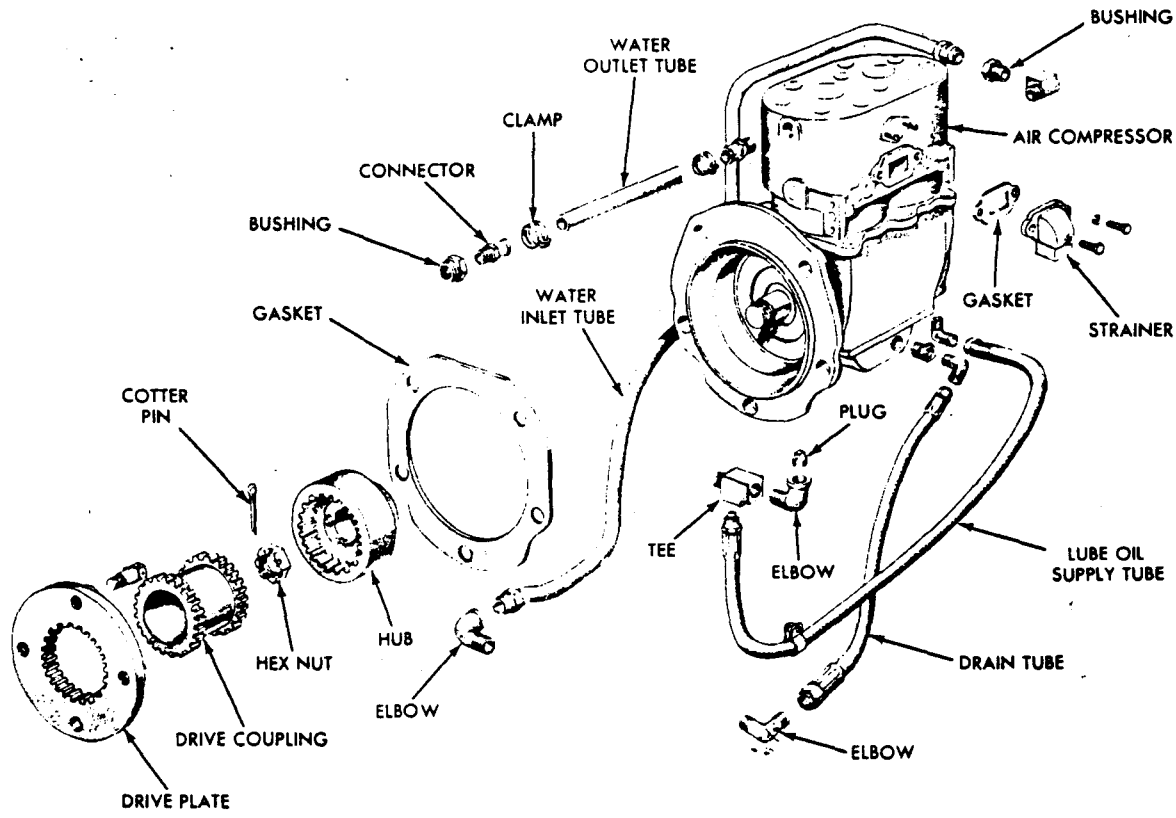
HEAT EXCHANGER (6V-53)



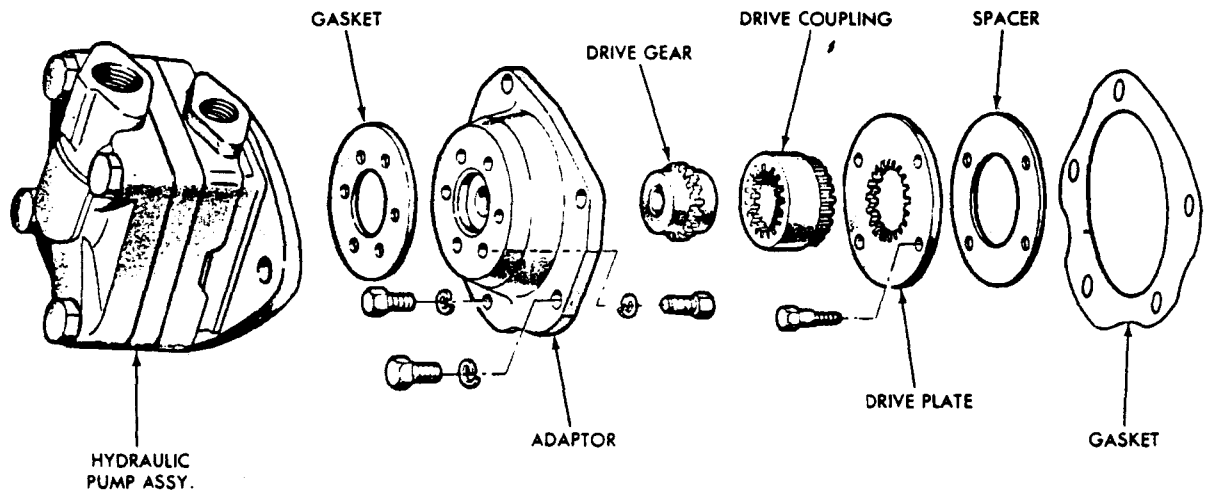
WATER TEMPERATURE SHUTDOWN SWITCH P 642



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 Detroit Diesel Allison and its authorized service outlets. 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 authorized service outlets 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 authorized service outlet.** 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 responsible Detroit Diesel Allison Regional Office in your area** listed below:

Eastern Region
9 Sylvan Way
P.O. Box 3001
Parsippany, New Jersey 07054, U.S.A.
Phone: (201) 993-4046

Great Lakes Region
Suite 365 - New Center One
3031 W. Grand Blvd.
Detroit, Michigan 48202, U.S.A.
Phone: (313) 556-5800

Southwestern Region
General Motors Bldg.
130 E. Carpenter Freeway
Irving, Texas 75062, U.S.A.
Phone: (214) 659-5070

Latin America Region
Detroit Diesel Allison
Gables Center - Suite 321
95 Merrick Way
Coral Gables, Florida 33144, U.S.A.
Phone: (305) 446-4900

Pacific Region
Detroit Diesel Allison
Div. of GM Overseas Corp.
Princes Highway, P.O. Box 163
Dandenong, Victoria 3175
Australia
Phone: 03-792-01111

Southeastern Region
5730 Glenridge Drive, N.E.
Atlanta, Georgia 30328, U.S.A.
Phone: (404) 252-3640

Midwestern Region
475 Alexis R. Shuman Blvd.
Naperville, Illinois 60566, U.S.A.
Phone: (312) 961-6750

Western Region
Suite 2700
39465 Paseo Padre Parkway
Fremont, California 94538, U.S.A.
Phone: (415) 498-5200

Canada
Diesel Division - GM of Canada Ltd.
P.O. Box 5990
London, Ontario N6A 4L6, Canada
Phone: (519) 452-5000
Telex: 064-5850

European Region
Detroit Diesel Allison - Europe
GM Nederland BV
Parmentierplein 1, 3088 GN Rotterdam
Mail: P.O. Box 5061
3008 AB Rotterdam, Netherlands
Phone: (31) 10-29-0000

Asia Region
Detroit Diesel Allison
Div. of GM Overseas Dist. Corp.
15 Benoi Sector
Jurong Town
Singapore 2262
Phone: 265-4697

Middle East/Africa Region
Detroit Diesel Allison
Atrina Center, 11th Floor
32 Kifissias Avenue
Paradissos, Amaroussion
GR151 10 Athens, Greece
Phone: (30) 1-6833-100 thru 6833-119

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 **Product Headquarters:**

Diesel Operations - Manager Customer Services, Detroit Diesel Allison, 13400 W. Outer Drive, Detroit, Michigan 48239, Phone (313) 592-5608.

The inclusion of all pertinent information will assist the product headquarters in expediting the handling of the matter. If an additional review by the product headquarters of all the facts involved indicates that some further action can be taken, the Regional Office will be so instructed.

If at this point your problem is still not resolved to your satisfaction, call or write:

Manager, Diesel Engine Service, Detroit Diesel Allison, 13400 W. Outer Drive, Detroit, Michigan 48239, U.S.A., Phone: (313)592-7279.

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

Your purchase of a Detroit Diesel Allison product is greatly appreciated, and it is our sincere desire to assure complete satisfaction.