

EXHAUST VALVE CLEARANCE ADJUSTMENT

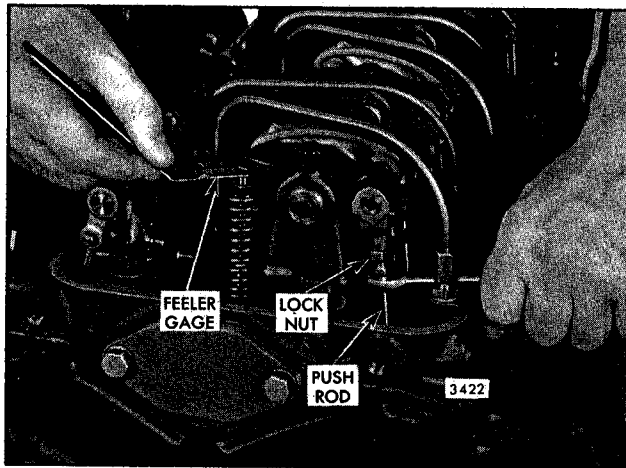


Fig. 1 - Adjusting Valve Clearance (Two-Valve Cylinder Head)

The correct exhaust valve clearance at normal engine operating temperature is important for smooth,

efficient operation of the engine.

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

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

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

TWO VALVE CYLINDER HEADS

Cold Engine

1. Clean the loose dirt from the exterior of the engine and remove the valve rocker cover(s).
2. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.
3. Rotate the crankshaft, manually or with the starting motor, until the injector follower is fully depressed on the cylinder to be adjusted.

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

4. Loosen the push rod lock nut.
5. Place a .012" feeler gage, J 9708, between the valve stem and the rocker arm (Fig. 1). Adjust the push rod to obtain a smooth pull on the feeler gage.
6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

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

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

Hot Engine

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

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

Use new gaskets when installing the valve rocker cover(s).

FOUR VALVE CYLINDER HEADS

Cold Engine

1. Clean the loose dirt from the exterior of the engine and remove the valve rocker cover(s).
2. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.
3. Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

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

4. Loosen the push rod lock nut.
5. Place a .027" feeler gage, J 9708, between the end of one valve stem and the rocker arm bridge (Fig. 2). Adjust the push rod to obtain a smooth pull on the feeler gage.
6. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.
7. Recheck the clearance. At this time, if the adjustment is correct, the .025" gage will pass freely between the end of one valve stem and the rocker arm bridge and the .027" gage will not pass through. Readjust the push rod if necessary.

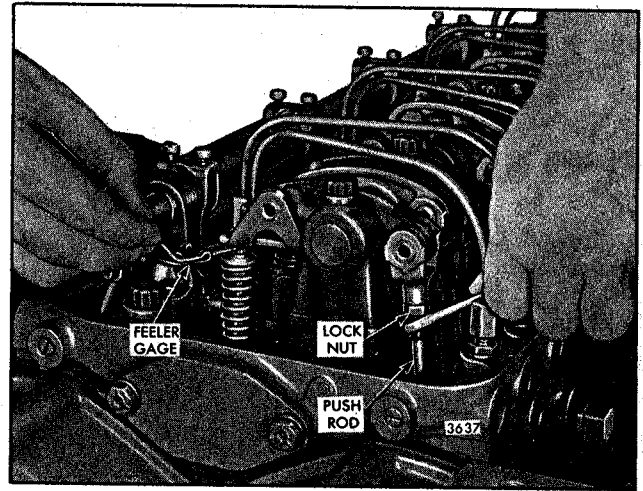


Fig. 2 - Adjusting Valve Clearance (Four-Valve Cylinder Head)

Hot Engine

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

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

Use new gaskets when installing the valve rocker cover(s).

TIMING FUEL INJECTOR

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

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

Time Fuel Injector

1. Clean the loose dirt from the exterior of the engine and remove the valve rocker cover(s).
2. Place the speed control lever in the *idle* speed position. If a stop lever is provided, secure it in the *no-fuel* position.
3. Rotate the crankshaft, manually or with the starting motor, until the exhaust valves are fully depressed on the particular cylinder to be timed.

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

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

*Reefer Car

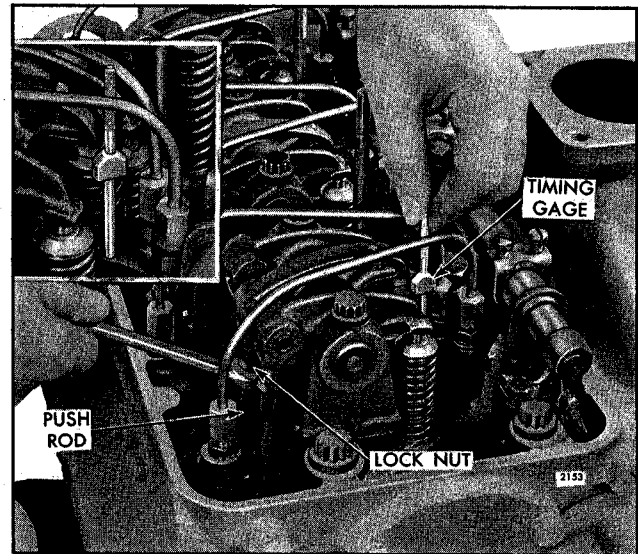


Fig. 3 - Timing Fuel Injector

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

5. Loosen the push rod lock nut.

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

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

8. Time the remaining injectors as outlined above.

9. Use new gaskets when installing the valve rocker cover(s).

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINES

After timing the fuel injectors and adjusting the exhaust valves, adjust an engine with a limiting speed mechanical governor as follows:

NOTE: Loosen the load limit lever for the load limiting device, if the engine is so equipped, before proceeding with the governor adjustment.

Adjust Governor Gap

With the engine at operating temperature, the governor gap may be adjusted as follows:

1. Remove the high speed spring retainer cover.
2. Back out the buffer screw until it extends 5/8" beyond the governor housing.
3. Remove the valve rocker cover.
4. Start the engine and adjust the idle speed screw to obtain an idle speed of 500-600 rpm (Fig. 5).

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

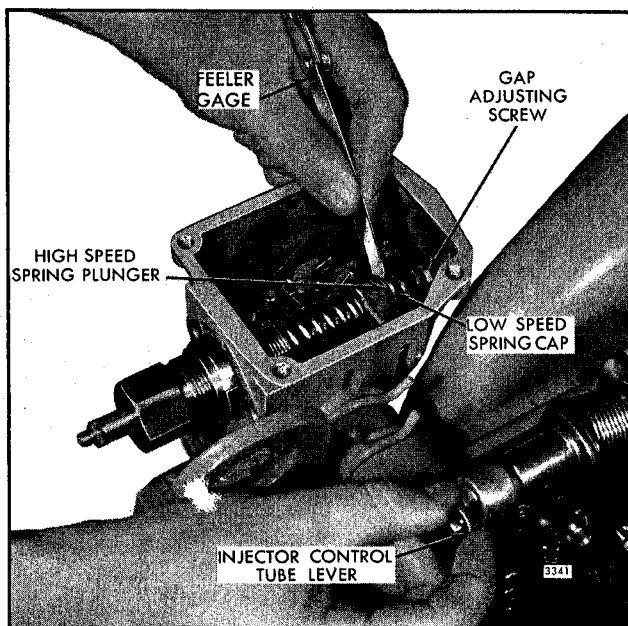


Fig. 1 - Adjusting Governor Gap

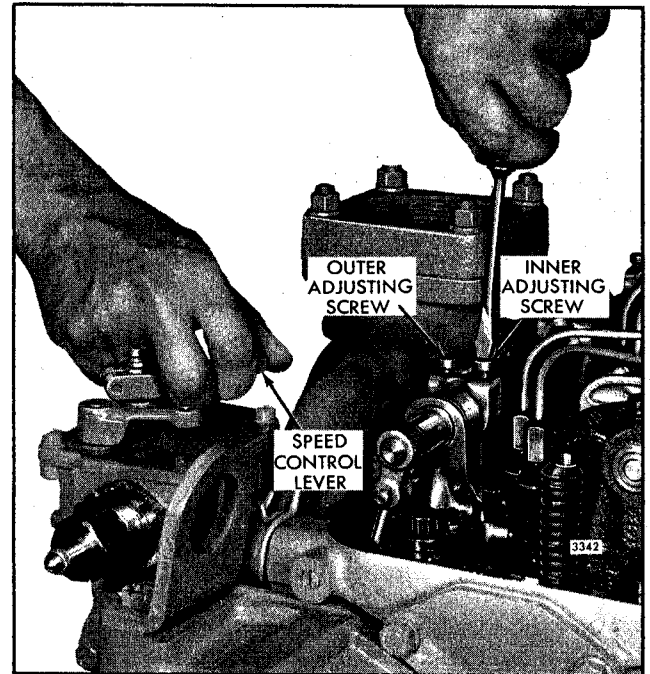


Fig. 2 - Positioning the Rear Injector Rack Control Lever

5. Shut the engine down and remove the governor cover.
6. Start the engine and control the speed manually by operating the injector control tube lever. Engine speed should be between 800 and 1000 rpm.
7. Check the gap between the low speed spring cap and the high speed spring plunger with a .0015" feeler gage. If the gap setting is incorrect, reset the gap adjusting screw (Fig. 1). If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.
8. Hold the gap adjusting screw and tighten the lock nut.
9. Recheck the gap and readjust, if necessary.
10. Install the governor cover. The governor cover should be placed on the housing with the pin of the speed control lever projecting into the slot of the differential lever.

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

Position Injector Rack Control Levers

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

1. Speed control lever at the maximum speed position.
2. Governor low speed gap closed.
3. High speed spring plunger on the seat in the governor control housing.
4. Injector fuel control racks in the *full-fuel* position.

Adjust the rear injector rack control lever (Fig. 2) first to establish a guide for adjusting the remaining injector rack control levers.

1. Disconnect any linkage attached to the speed control lever.
2. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all injector rack control levers are free on the injector control tube.
3. Move the speed control lever to the *full-fuel* position as shown in Fig. 2. Turn the inner adjusting screw down on the rear injector rack control lever until a step-up in effort to turn the screw driver is noted. This will place the rear injector rack in the *full-fuel* position. Turn down the outer adjusting screw until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting

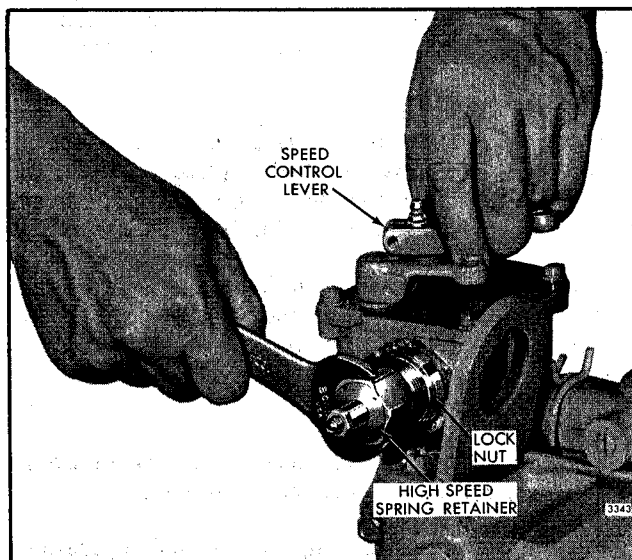


Fig. 3 - Adjusting Maximum No-Load Engine Speed

screws until they are tight. This should result in placing the governor linkage and the control tube assembly in the same positions that they will attain while the engine is running at *full load*.

4. To be sure of proper rack adjustment, hold the speed control lever in the *full-fuel* position. Press down on the injector rack with a screw driver or finger tip, causing the rack to rotate, and release the rack.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

The setting is sufficiently tight if the injector rack returns to its original position. If the rack does not return to its original position, it is too loose. To correct, back off the outer adjusting screw slightly and tighten the inner adjusting screw.

The setting is too tight if, when moving the speed control lever from the idle speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (stop under the governor cover). This will result in a step-up in effort to move the speed control lever to its maximum speed position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

5. Manually hold the rear injector rack control lever in the *full-fuel* position. Turn down the inner adjusting screw on the injector rack control lever of the adjacent injector until the injector rack has moved into the *full-fuel* position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws until they are tight..

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

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

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 name plate, the maximum no-load speed may be set as follows:

TYPE A GOVERNOR SPRINGS (Fig. 4):

1. Loosen the lock nut and back off the high speed spring retainer approximately five turns.(Fig. 3).
2. With the engine at operating temperature and no-load on the engine, place the speed control lever in the *full-fuel* position. Turn the high speed spring retainer **IN** until the engine is operating at the recommended no-load speed. The best method of determining the engine speed is with an accurate tachometer.
3. Hold the high speed spring retainer and tighten the lock nut.

TYPE B GOVERNOR SPRINGS (Fig. 4):

1. Start the engine and, after it reaches normal operating temperature, remove the load from the engine.
2. Place the engine speed control lever in the *full-fuel* position and note the engine speed.

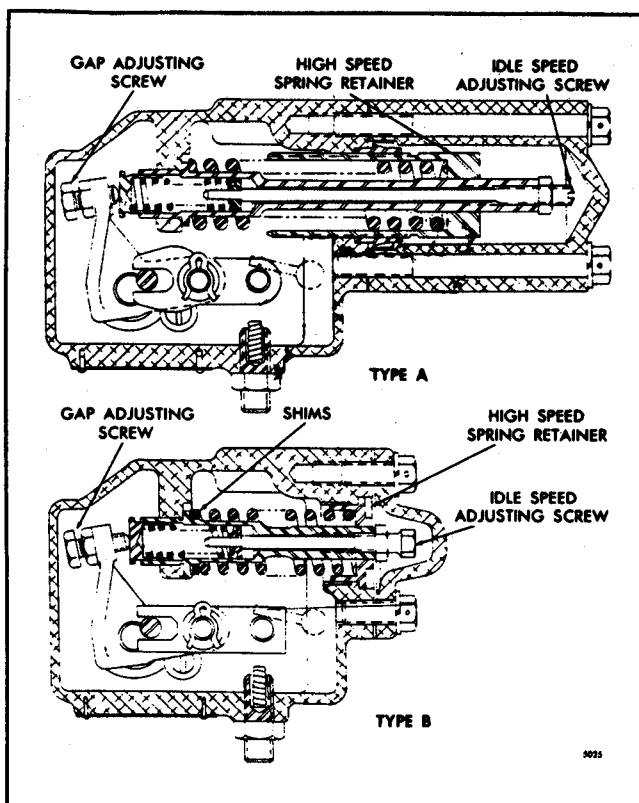


Fig. 4 - Governor Spring Assemblies

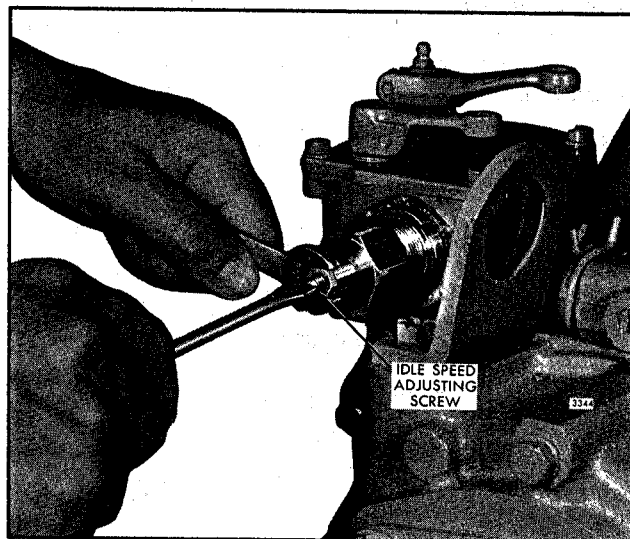


Fig. 5 - Adjusting Engine Idle Speed

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

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

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

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

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

- c. Replace 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 Steps a, b and c as is necessary to establish the no-load speed.

Adjust Idle Speed

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

1. With the engine running at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (Fig. 5) until the engine idles at

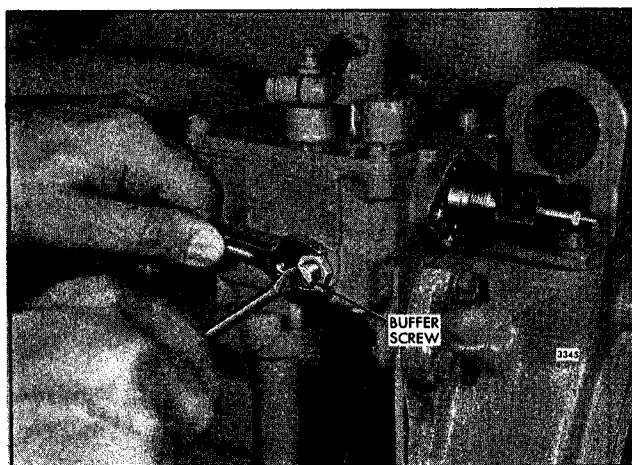


Fig. 6 - Adjusting the Buffer Screw

the recommended idle speed. 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 lock nut.

3. Install the high speed spring retainer cover.

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 6) so that it contacts the differential lever as lightly as possible and still eliminates the engine roll.

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

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

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

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

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The limiting speed mechanical governor assembly is mounted at the rear of the engine, between the flywheel housing and the blower (Fig. 1). The governor is driven by the right blower rotor drive gear. The left blower rotor drive gear is driven by a shaft, which passes through the governor housing, from the engine gear train. There are two types of limiting speed governor assemblies. One type is generally used in industrial applications and the other is generally used in vehicles. The only difference between the governors is in the spring mechanism (Fig. 5).

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

Adjust Governor Gap

With the engine at operating temperature, set the governor gap as follows:

1. With the engine stopped remove the two bolts and withdraw the governor high speed spring retainer cover.
2. Back out the buffer screw until it extends $9/16"$ to $5/8"$ from the surface of the governor housing.

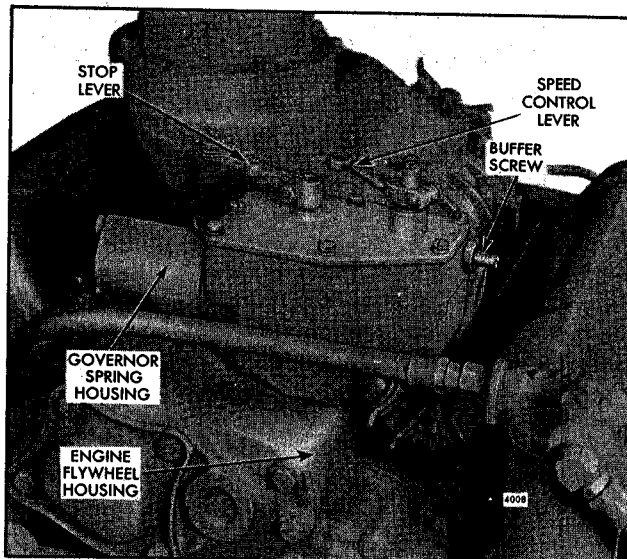


Fig. 1 - Limiting Speed Governor Mounting

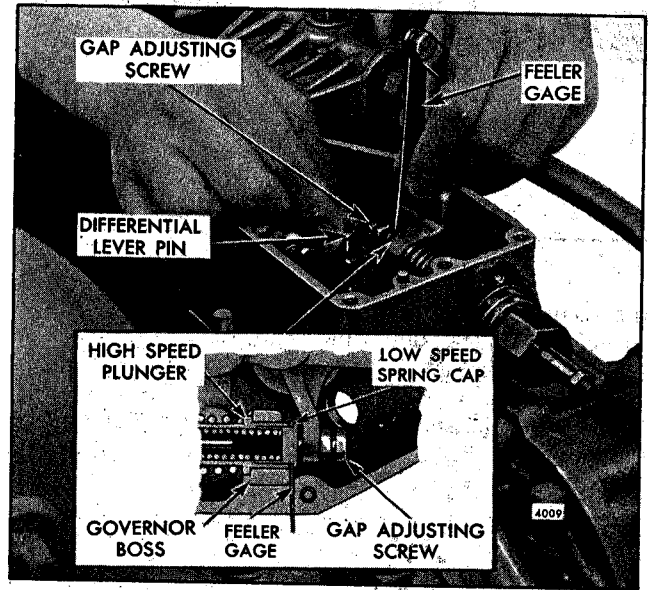


Fig. 2 - Checking Governor Gap

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

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then, adjust the idle screw (Fig. 6) to obtain the desired engine idle speed.
4. Stop the engine and remove the governor cover and the engine valve rocker covers. Discard the gaskets.
5. Start and run the engine, between 800 and 1000 rpm, by manual operation of the differential lever.

CAUTION: Do not overspeed the engine.

6. Check the gap between the low speed spring cap and the high speed spring plunger with a .0015" feeler gage. If the gap setting is incorrect, reset the gap adjusting screw (Fig. 2). If the setting is correct, the .0015" movement can be seen by placing a few drops of oil into the governor gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.

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

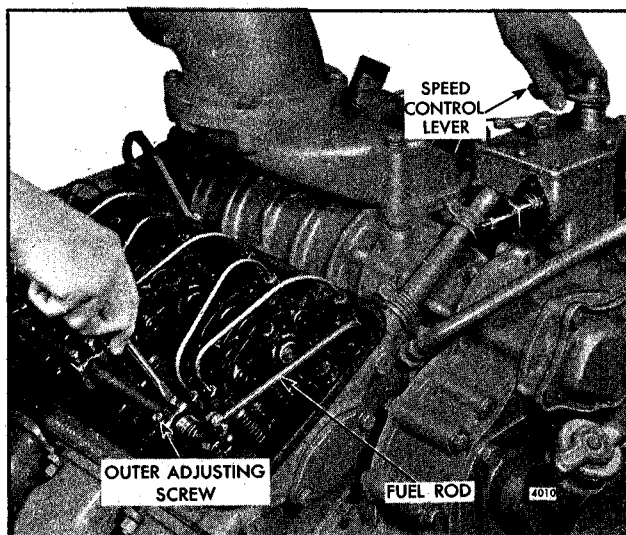


Fig. 3 - Positioning No. 3L Injector Rack Control Lever

8. Recheck the gap and readjust if necessary.
9. Stop the engine and reinstall the governor cover.

Position Injector Rack Control Levers

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

1. Speed control lever at the maximum speed position.
2. Governor low speed gap closed.
3. High speed spring plunger on the seat in the governor control housing.
4. Injector fuel control racks in the full-fuel position.

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

1. Disconnect the linkage attached to the speed control lever.
2. Turn the idle speed adjusting screw until about 1/2" of the screw projects from the lock nut.

NOTE: This adjustment lowers the tension of the low speed spring so it can be compressed, while closing the low speed gap, without bending the fuel rods.

3. If not already done, back out the buffer screw as outlined in Step 2 under *Adjust Governor Gap*.
4. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.

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

6. Move the speed control lever to the maximum speed position with light finger pressure. Turn the inner adjusting screw of the No. 3L injector rack control lever down (Fig. 3) until a slight movement of the control tube lever is observed or a step-up in effort to turn the screw driver is noted. This will place the No. 3L injector in the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube assembly in the same positions they will attain while the engine is running at full-load.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

7. To be sure the control lever is properly adjusted, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the rack returns to its original position. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the speed control lever from the idle speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to its maximum speed position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

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

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

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

11. Manually hold the No. 3L injector rack in the *full-fuel* position with the lever on the injector control tube, and turn the inner adjusting screw of the No. 2L injector rack control lever down until the injector rack of the No. 2L injector has moved into the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

12. Recheck the No. 3L injector rack to be sure it has remained snug on the ball end of the rack control lever while positioning the No. 2L injector rack. If the rack of the No. 3L injector has become loose, back off the inner adjusting screw slightly on the No. 2L injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

13. Position the No. 1L injector rack control lever as outlined in Steps 11 and 12.

14. Position No. 2R and 1R injector racks as outlined above for the left cylinder bank.

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

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

Adjust Maximum No-Load Engine Speed

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

TYPE A GOVERNOR SPRINGS (Fig. 5):

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

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. 4) until the engine is operating at the recommended no-load speed. Use an accurate tachometer to determine the engine speed. The maximum no-load speed varies with the full-load

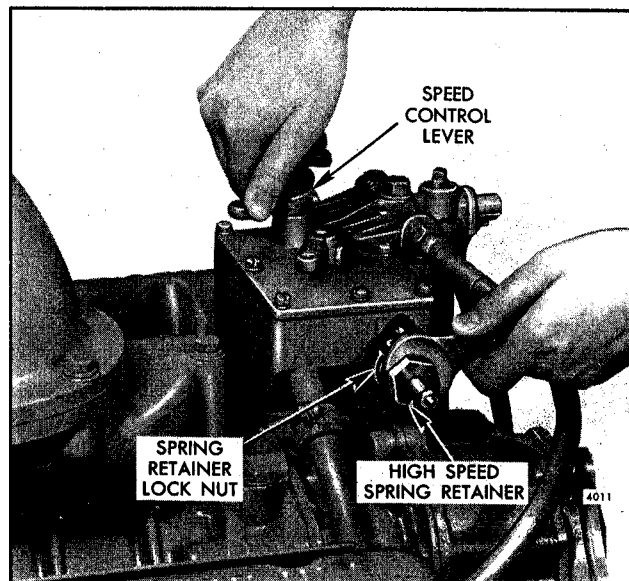


Fig. 4 - Adjusting Maximum No-Load Engine Speed

operating speed desired as shown in the following table.

Engine Speed Droop

Full-Load RPM	Maximum Governor Droop-RPM
0-1200	200
1201-1400	175
1401-1600	150
1601-1800	160
1801-2000	170
2001-2200	180
2201-2400	190
2401-2600	200
2601-2800	210

EXAMPLE: If the *full-load* speed is to be 2600 rpm, then the *no-load* speed setting should be 2800 rpm to ensure the governor will move the injector racks into the full-fuel position at the desired full-load speed.

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

TYPE B GOVERNOR SPRINGS (Fig. 5):

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:

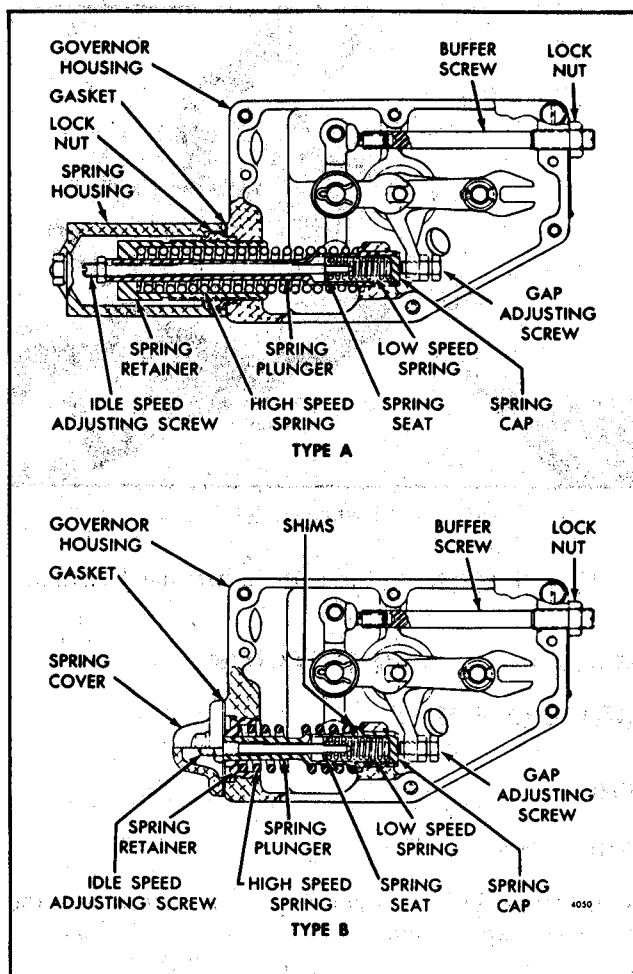


Fig. 5 - Governor Spring Assemblies

- a. Remove the high speed spring retainer with tool J 5895 and withdraw the high speed spring and plunger assembly.

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

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

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

- c. Replace the high speed spring on the plunger and install the spring assembly in the governor housing. Tighten the spring retainer securely. The maximum no-load speed varies with the full-load

operating speed desired as shown in the following table.

Engine Speed Droop

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

EXAMPLE: If the *full-load* speed is to be 2800 rpm, then the *no-load* speed setting should be 2940 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 adjusted, adjust the idle speed as follows:

1. With the engine running at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (Fig. 6) until the engine idles at the recommended idle speed. The recommended idle speed is 500-600 rpm, but may vary with the engine application.

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 screw and tighten the lock nut.

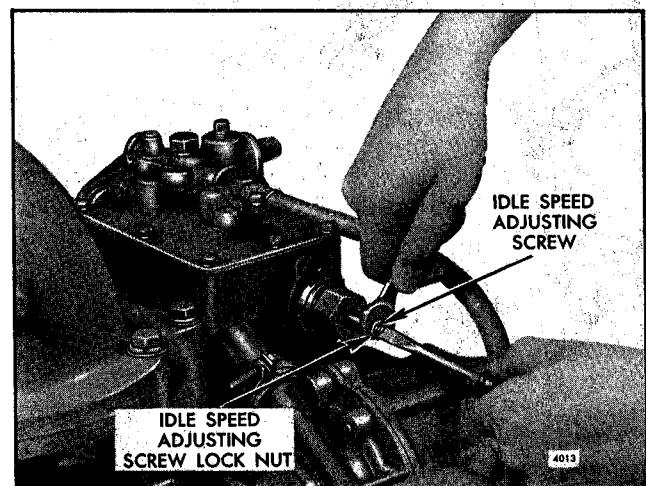


Fig. 6 - Adjusting Engine Idle Speed

3. Install the high speed spring retainer cover.

Adjust Buffer Screw

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

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

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

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

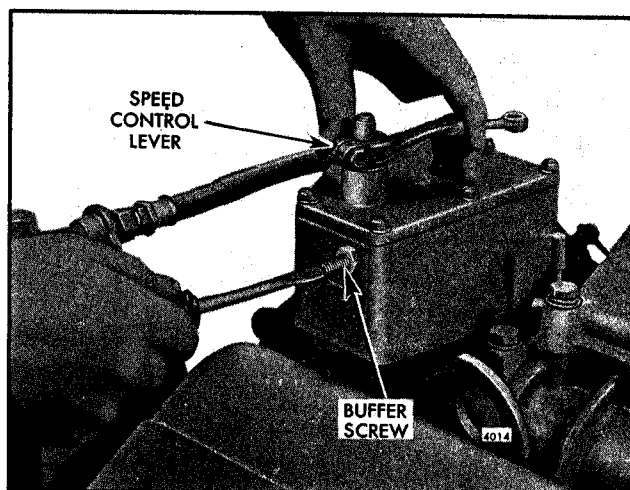


Fig. 7 - Adjusting Buffer Screw

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

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

8V-53 ENGINE

The limiting speed mechanical governor assembly is mounted on the front end of the blower (Fig. 1). The governor weight carrier shaft is attached to and driven by the left-hand helix blower rotor.

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

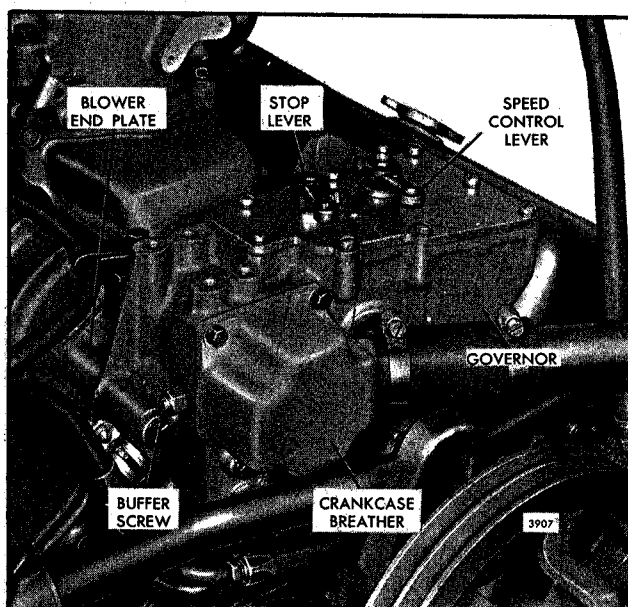


Fig. 1 - Limiting Speed Governor Mounting

Adjust Governor Gap

With the engine at operating temperature, set the governor gap as follows:

1. With the engine stopped, remove the two bolts and withdraw the governor high speed spring retainer cover.
2. Back out the buffer screw until it extends $9/16''$ to $5/8''$ from the surface of the governor housing.

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

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then, adjust the idle screw (Fig. 5) to obtain the desired engine idle speed.
4. Stop the engine and remove the governor cover and the engine valve rocker covers. Discard the gaskets.
5. Start and run the engine, between 800 and 1000 rpm, by manual operation of the differential lever.

CAUTION: Do not overspeed the engine.

6. Check the gap between the low speed spring cap and the high speed spring plunger with a .0015"

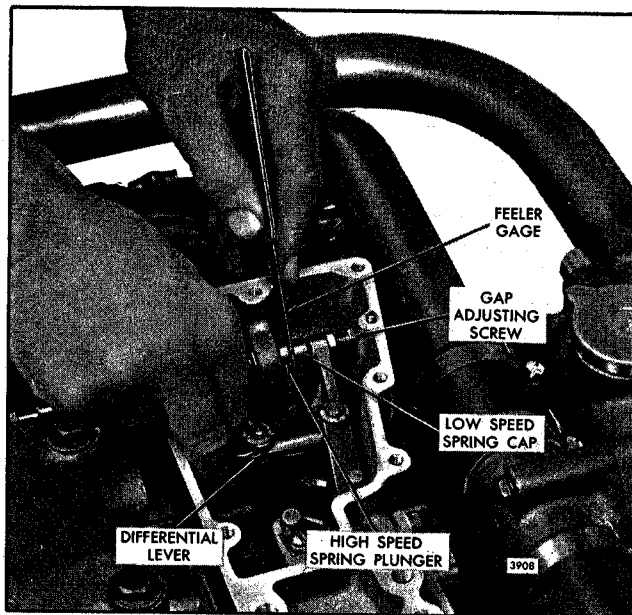


Fig. 2 - Checking Governor Gap

feeler gage. If the gap setting is incorrect, reset the gap adjusting screw (Fig. 2).

7. Hold the gap adjusting screw and tighten the lock nut.
8. Recheck the gap and readjust if necessary.
9. Stop the engine and reinstall the governor cover.

Position Injector Rack Control Levers

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

1. Speed control lever at the maximum speed position.
2. Governor low speed gap closed.
3. High speed spring plunger on the seat in the governor control housing.
4. Injector fuel control racks in the full-fuel position.

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. 1L injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Disconnect the linkage attached to the speed control lever.
2. Turn the idle speed adjusting screw until about 1/2" of the screw projects from the lock nut.

NOTE: This adjustment lowers the tension of the low speed spring so it can be compressed,

while closing the low speed gap, without bending the fuel rods.

3. If not already done, back out the buffer screw as outlined in Step 2 under *Adjust Governor Gap*.
4. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.
5. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.
6. Move the speed control lever to the maximum speed position; hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 1L injector rack control lever down (Fig. 3) until a slight movement of the control tube lever is observed or a step-up in effort to turn the screw driver is noted. This will place the No. 1L injector in the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube assembly in the same positions they will attain while the engine is running at full-load.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

7. To be sure the control lever is properly adjusted, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the rack returns to its original position. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the speed control lever from the idle speed to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to its maximum speed position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

8. Remove the clevis pin from the fuel rod and the left bank injector control tube lever.
9. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the No. 1R injector rack control lever as previously outlined in Step 6 for the No. 1L injector rack control lever.

10. Insert the clevis pin in the fuel rod and the left cylinder bank injector control tube lever. Repeat the check on the 1L and 1R 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. Manually hold the No. 1L injector rack in the *full-fuel* position, with the lever on the injector control tube, and turn the inner adjusting screw of the No. 2L injector rack control lever down until the injector rack of the No. 2L injector has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

12. Recheck the No. 1L injector rack to be sure it has remained snug on the ball end of the rack control lever while positioning the No. 2L injector rack. If the rack of the No. 1L injector has become loose, back off the inner adjusting screw slightly on the No. 2L injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

13. Position the No. 3L and 4L injector rack control levers as outlined in Steps 11 and 12.

14. Position the No. 2R, 3R and 4R injector rack control levers as outlined above for the left cylinder bank.

15. Turn the idle speed adjusting screw in until it

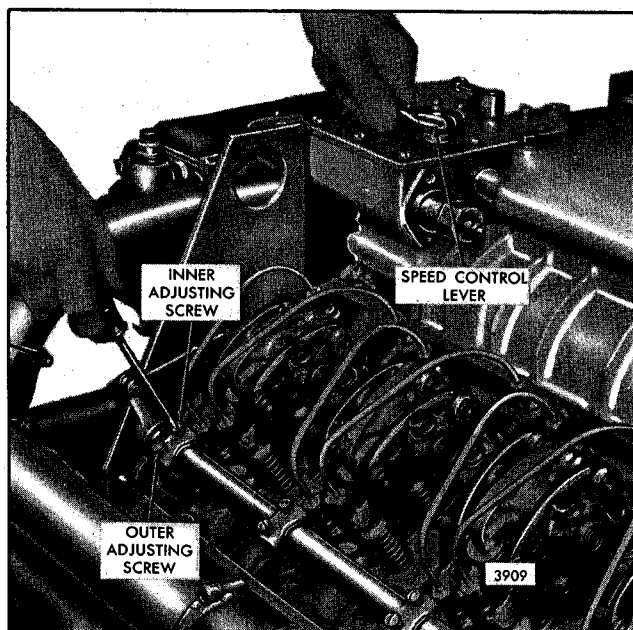


Fig. 3 - Positioning No. 1L Injector Rack Control Lever

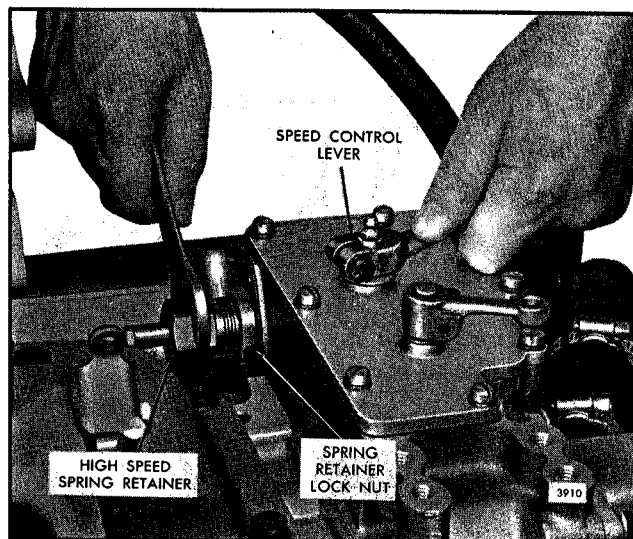


Fig. 4 - Adjusting Maximum No-Load Engine Speed

projects 3/16" from the lock nut to permit starting of the engine.

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

Adjust Maximum No-Load Engine Speed

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

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

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. 4) until the engine is operating at the recommended no-load speed. Use an accurate tachometer to determine the engine speed. The recommended speed droop is 150 rpm for governors with a speed range of 2500-2800 rpm.

EXAMPLE: If the full-load speed is to be 2800 rpm, then the no-load speed setting should be 2950 rpm to ensure the governor will move the injector racks into the full-fuel position at the desired full-load speed.

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

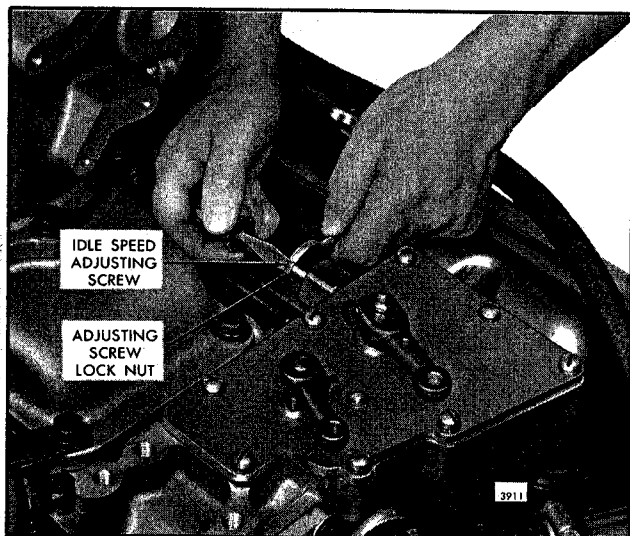


Fig. 5 - Adjusting Engine Idle Speed

Adjust Idle Speed

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

1. With the engine running at normal operating temperature and with the buffer screw backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (Fig. 5) until the engine idles at the recommended idle speed. The recommended idle speed is 400-600 rpm, but may vary with the engine application.
2. Hold the idle screw and tighten the lock nut.
3. Install the high speed spring retainer cover.

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, turn the buffer screw in (Fig. 6) so it contacts the differential lever as lightly as possible and still eliminates the engine roll.

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

2. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.
3. Hold the buffer screw and tighten the lock nut to retain the adjustment.

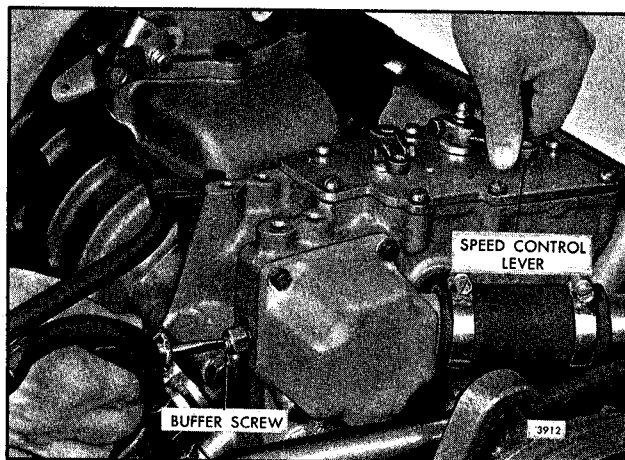


Fig. 6 - Adjusting Buffer Screw

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

IN-LINE ENGINES

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

Preliminary Governor Adjustments

1. Clean the governor linkage and lubricate the ball joints and bearing surfaces with clean engine oil.
2. Back out the buffer screw until it projects $9/16"$ from the boss on the control housing.
3. Back out the booster spring eye bolt until it is flush with the outer lock nut.

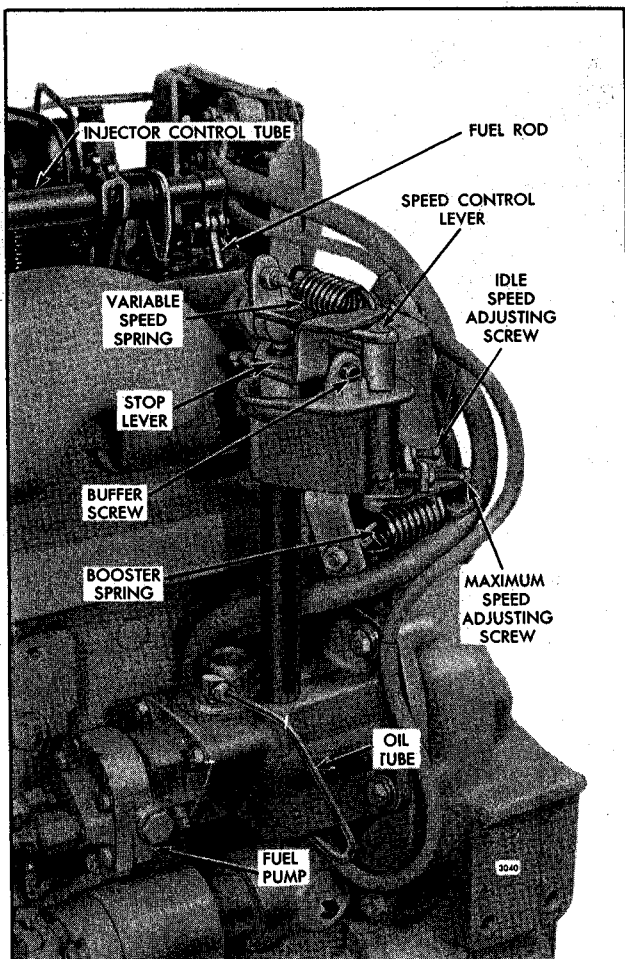


Fig. 1 - Governor Mounted on Engine

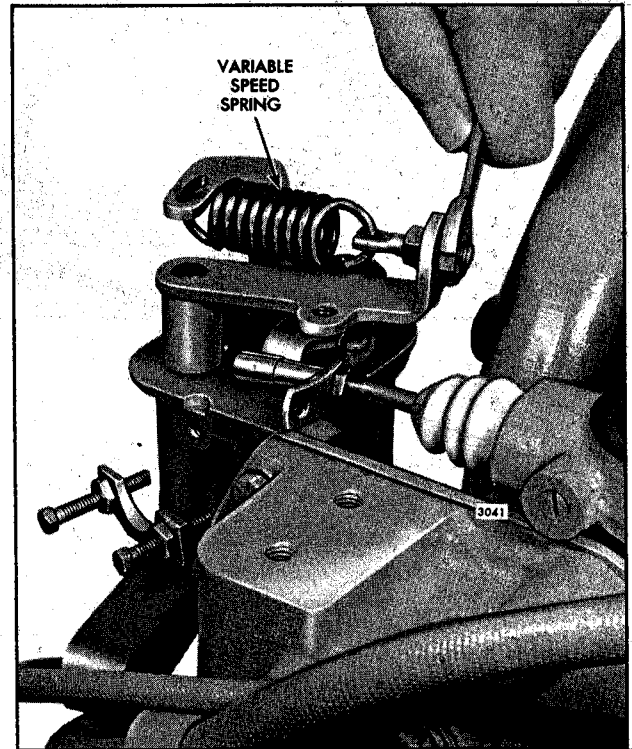


Fig. 2 - Adjusting Governor Spring Eye Bolt

Adjust Variable Speed Spring Tension

1. Adjust the variable speed spring eye bolt until $1/8"$ of the threads project from the outer lock nut (Fig. 2).
2. Tighten both lock nuts to retain the adjustment.

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

Position Injector Rack Control Levers

The position of the injector control racks must be correctly set in relation to the governor. Their position 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. Remove the valve rocker cover.
2. Disconnect the fuel rod at the stop lever.

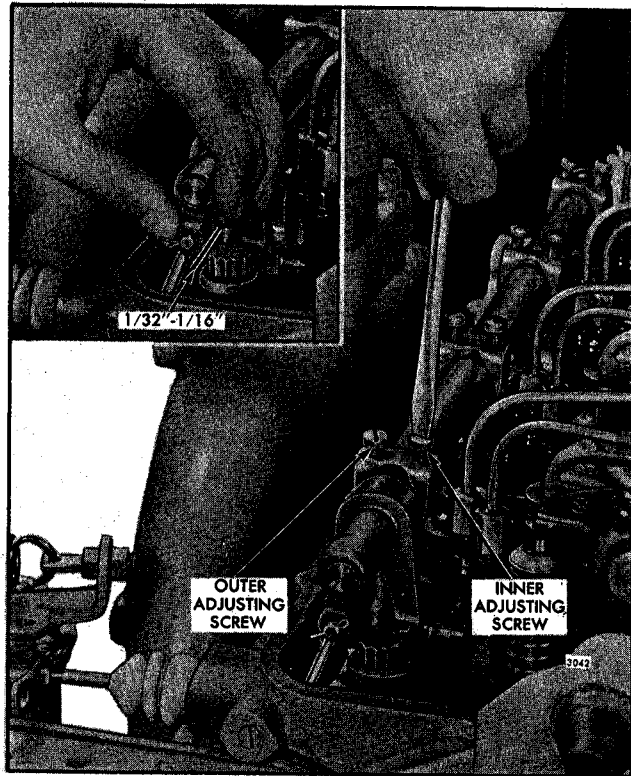


Fig. 3 - Adjusting Injector Rack Control Lever Adjusting Screws

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

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

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

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

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

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

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

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

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

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

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 operating, loosen the lock nut and turn the idle speed adjusting screw (Fig. 5) in or out until the engine idles at the recommended speed. The recommended idle speed is 500 rpm for engines operating up to 2500 rpm or 550 rpm for engines operating up to 3000 rpm. However, the idle speed may vary with special engine applications.

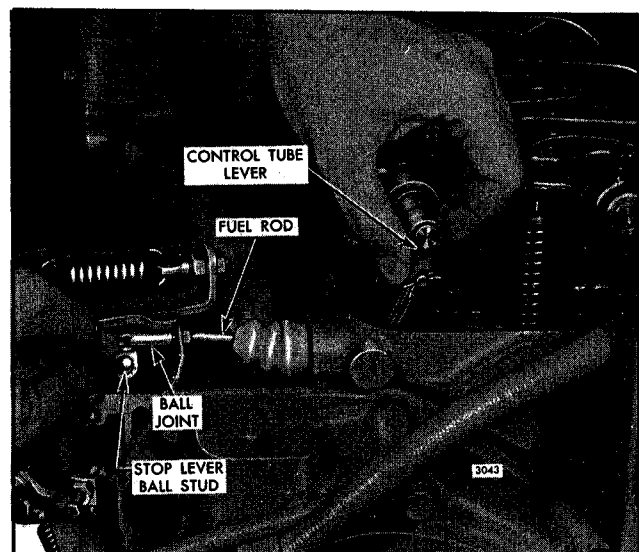


Fig. 4 - Adjusting Fuel Rod Length

3. Hold the idle speed adjusting screw and tighten the lock nut.
2. Loosen the lock nut and adjust the maximum speed adjusting screw (Fig. 6) until the required no-load speed is obtained.
3. Hold the adjusting screw and tighten the lock nut.

Adjust Maximum No-Load Speed

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

NOTE: Do not overspeed the engine.

Adjust Buffer Screw

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

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

Adjust Governor Booster Spring

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

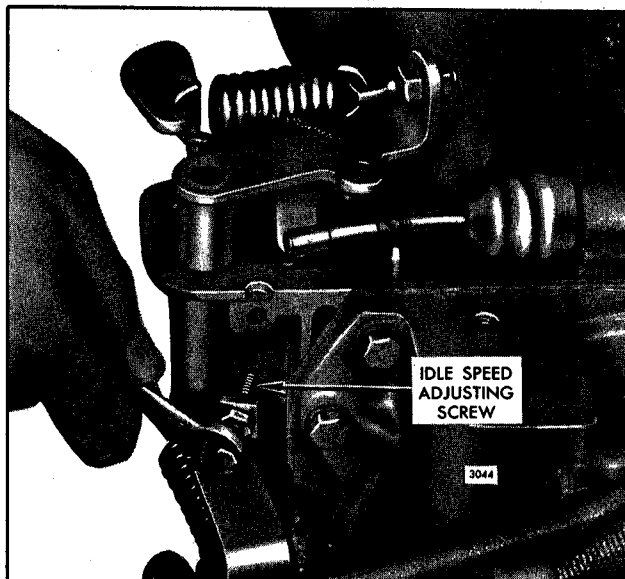


Fig. 5 - Adjusting Idle Speed

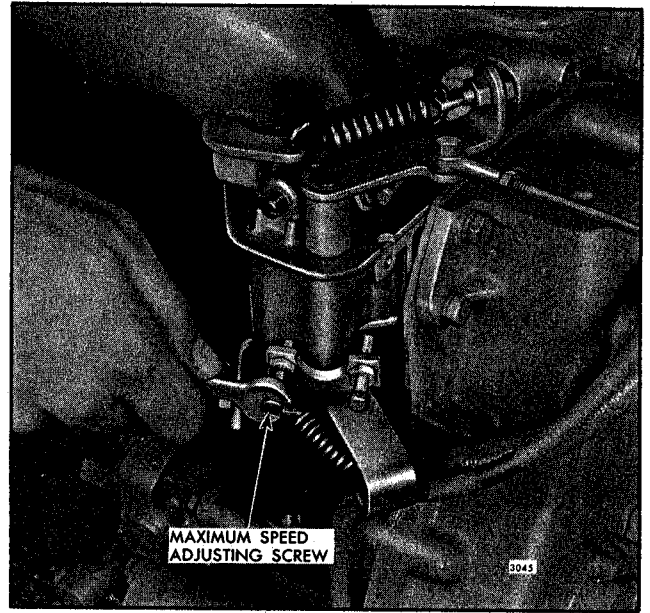


Fig. 6 - Adjusting Maximum No-Load Engine Speed

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 lock nut (Fig. 8) until the end of the booster spring eye bolt is flush with the end of the nut.
3. Adjust the eye bolt in the slot in the bracket so that an imaginary line through the booster spring will align with an imaginary center line through the speed control shaft. Secure the lock nuts on the eye bolt to retain the adjustment.

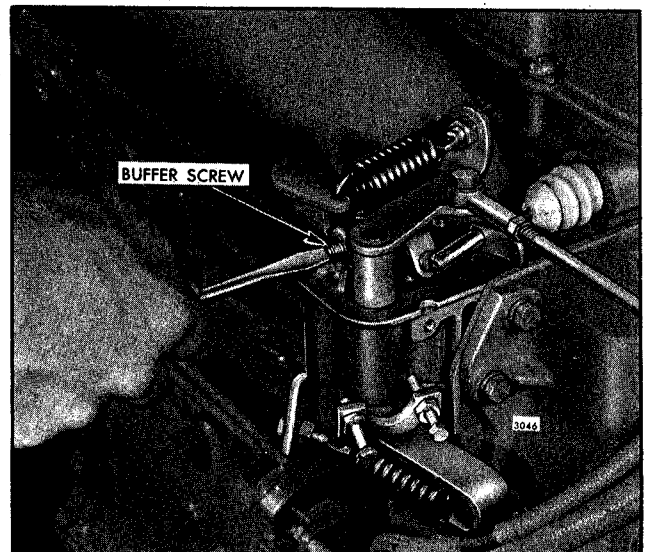


Fig. 7 - Adjusting Buffer Screw

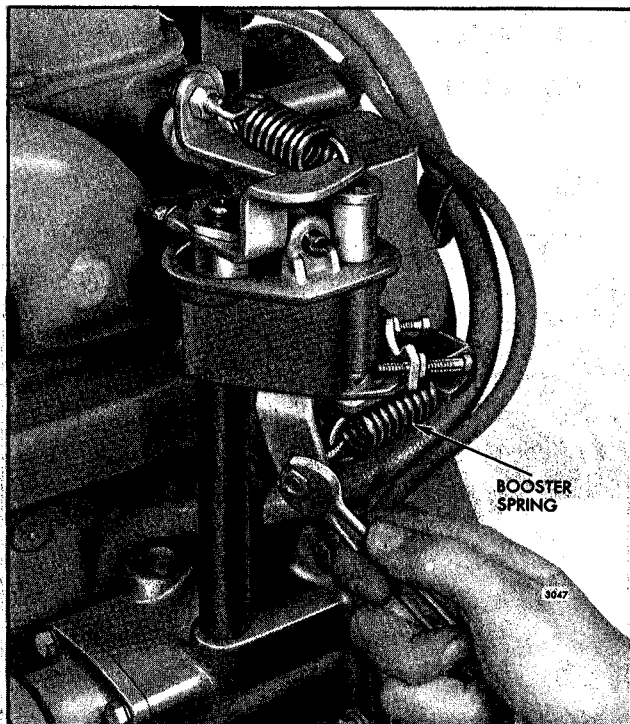


Fig. 8 - Adjusting Booster Spring

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

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

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

Adjust Engine Speed Droop

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

1. Lower the speed droop by increasing the spring tension.
2. Raise the speed droop by decreasing the spring tension.

Note, however, that a change in the variable speed spring tension will change the engine idle speed and maximum no-load speed, which must also be readjusted.

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

IN-LINE ENGINES

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

NOTE: Loosen the load limit lever for the load limiting device, if the engine is so equipped, before proceeding with the governor adjustment.

Adjust Governor Gap

With the engine stopped, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.
2. Remove the governor cover.
3. Place the speed control lever in the maximum speed position.
4. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 1. If required, loosen the lock nut and turn the gap

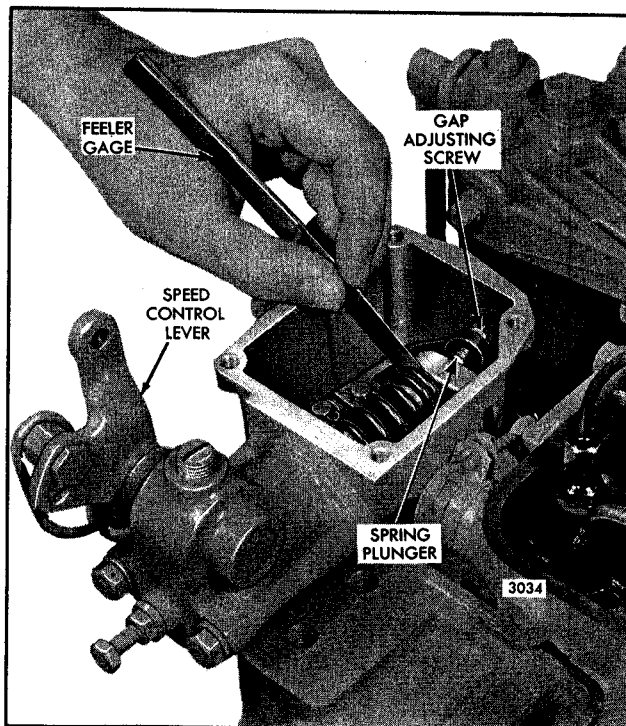


Fig. 1 - Adjusting Governor Gap

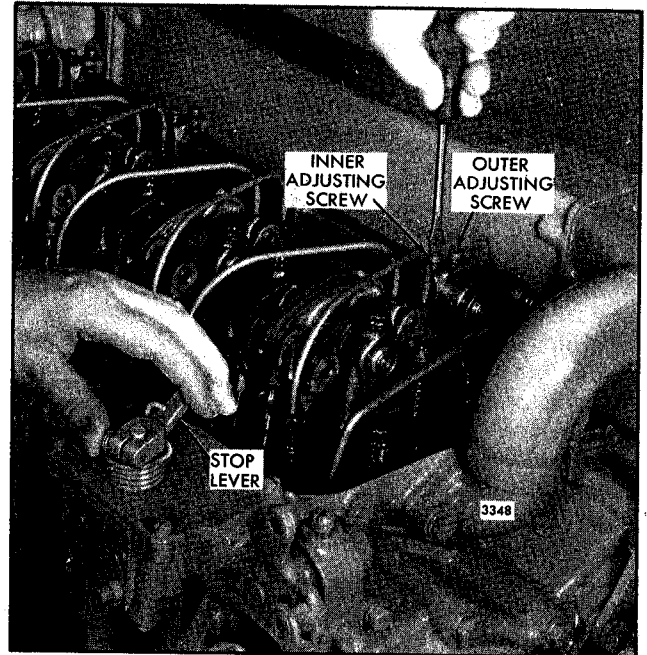


Fig. 2 - Positioning the Rear Injector Rack Control Lever

adjusting screw in or out until a slight drag is noted on the feeler gage.

5. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.
6. Install the governor cover as follows:

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

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

Position Injector Rack Control Levers

The position of the injector control 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. Loosen the lock nut and back the buffer screw (Fig. 5) out approximately 5/8".

2. Remove the valve rocker cover.

3. Loosen all of the inner and outer injector rack control lever adjusting screws (Fig. 2). 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 stop lever to the **run** position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the rear injector rack control lever down until a slight movement of the control tube is observed or a step-up in effort to turn the screw driver is noted. This will place the rear injector rack in the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full-load.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

6. To be sure the control lever is properly adjusted, hold the stop lever in the **run** position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the rack returns to its original position when the pressure is released. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the **stop** to the **run** position, the injector rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the **run** position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is found to be too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

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

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

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

9. Position the remaining injector rack control levers as outlined in Steps 6, 7 and 8.

Adjust Maximum No-Load Speed

The maximum no-load speed varies with the full-load operating speed desired as shown in Table 1.

TABLE I
ENGINE SPEED DROOP

Full-Load RPM	Maximum Governor Droop - RPM	
	Engines with 2 Valves/Cylinder	Engines with 4 Valves/Cylinder
0-1200	220	220
1201-1400	220	220
1401-1600	205	205
1601-1800	185	185
1801-2000	175	175
2001-2200	160	160
2201-2400	-	145
2401-2600	-	140
2601-2800	-	140

EXAMPLE: If the full-load speed is to be 2200 rpm and the engine has four exhaust valves per cylinder, then the no-load speed setting should be 2360 rpm to ensure the governor will move the injector racks into the full-fuel position at the desired full-load speed.

Use an accurate tachometer to determine the maximum no-load speed of the engine; then make the following adjustments, if required.

1. Refer to Fig. 6 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 II 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. 3).
4. Install the variable speed spring housing.

TABLE II

Full-Load Speed	Stops		Shims
	Solid	Split	
<u>Two Valve Head Engines</u>			
1200-1400	1	2	As Required
1401-1800	1	1	As Required
1801-2350	1	0	As Required
2351-2200	0	0	As Required
<u>Four Valve Head Engines</u>			
1200-1575	1	2	As Required
1576-2025	1	1	As Required
2026-2625	1	0	As Required
2626-2800	0	0	As Required

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

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

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

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

Adjust Idle Speed

After the maximum no-load speed has been set, adjust the idle speed as follows:

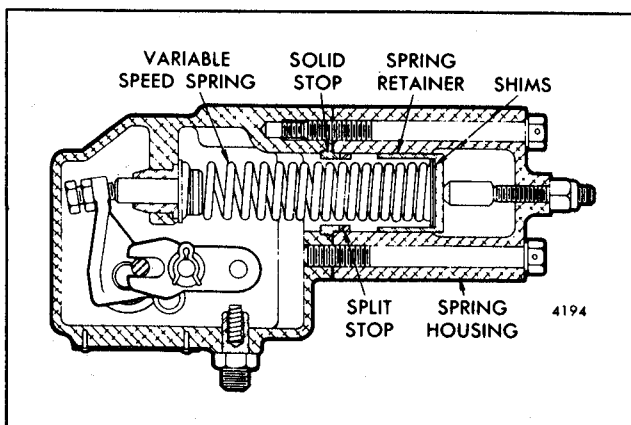


Fig. 3 - Location of Shims and Stops

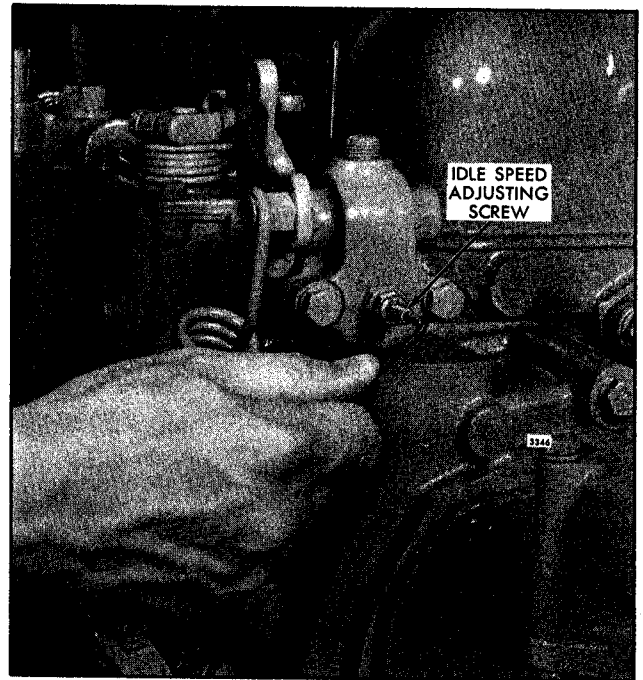


Fig. 4 - Adjusting Idle Speed

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

2. With the engine operating, loosen the lock nut and turn the idle speed adjusting screw (Fig. 4) in or out until the engine idles at the recommended speed. The recommended idle speed is 500 rpm for engines operating up to 2500 rpm or 550 rpm for engines operating at higher speeds. However, the idle speed may vary with special engine applications.

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

Adjust Buffer Screw

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

1. With the engine running at idle speed, loosen the lock nut and turn the buffer screw in (Fig. 5) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

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

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

Adjust Booster Spring

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

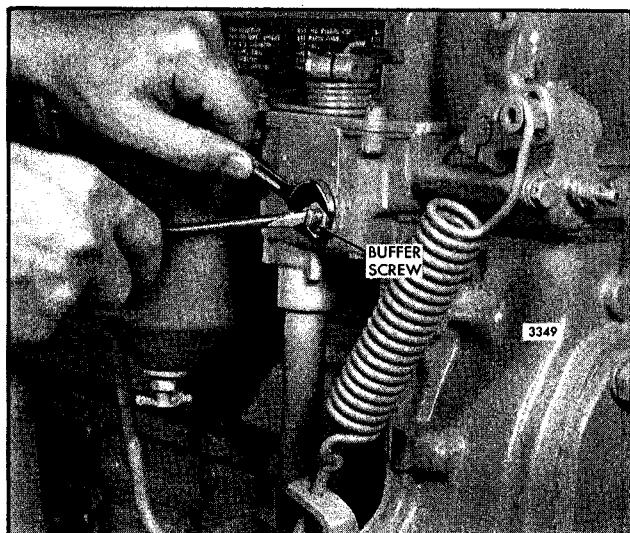


Fig. 5 - Adjusting Buffer Screw

1. Move the speed control lever to the idle speed position.
2. Refer to Fig. 6 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the opposite end of the spring.
3. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center (toward the idle speed position) of an imaginary line through the bolt, lever shaft and eye bolt. Hold the bolt and tighten the lock nut.
4. Start the engine and move the speed control lever to the maximum speed position and release it. The lever

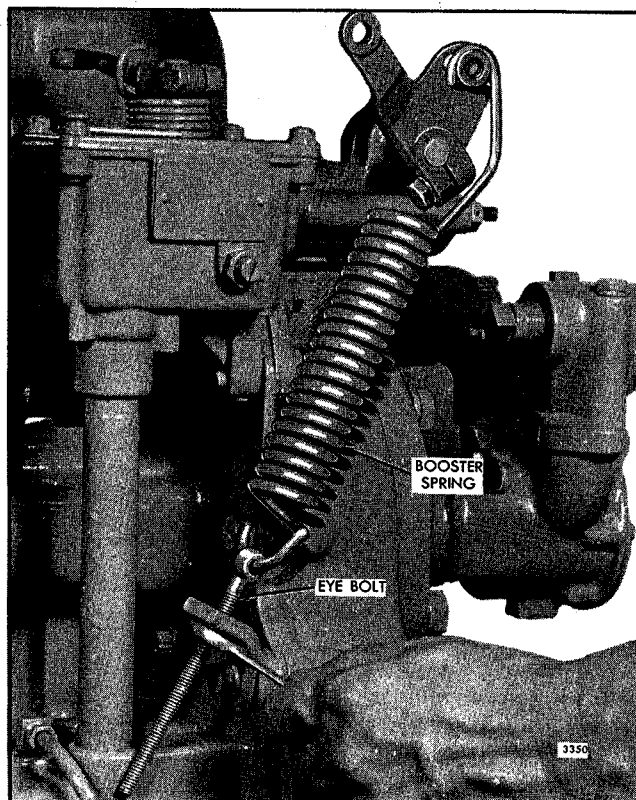


Fig. 6 - Adjusting Booster Spring

should return to the idle speed position. If it does not, reduce the booster spring tension. If it does, 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 lock nuts on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6V ENGINE

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

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

Adjust Governor Gap

With the engine stopped, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.
2. Remove the governor cover.
3. Place the speed control lever in the maximum speed position.
4. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 2. If required, loosen the lock nut and turn the adjusting screw in or out until a slight drag is noted on the feeler gage.
5. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

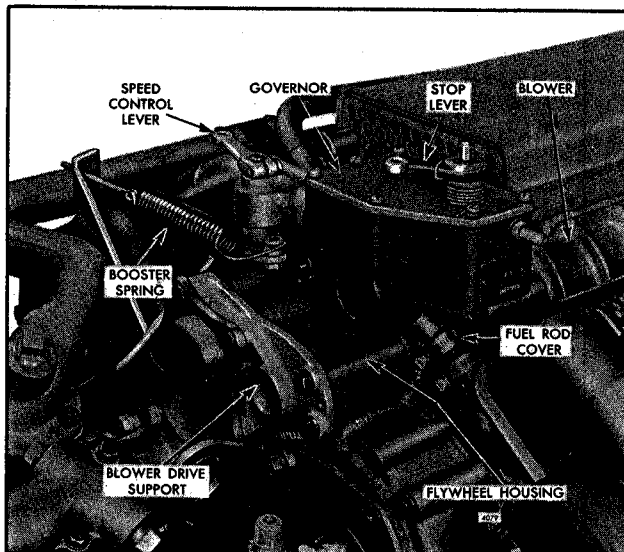


Fig. 1 - Variable Speed Governor Mounting

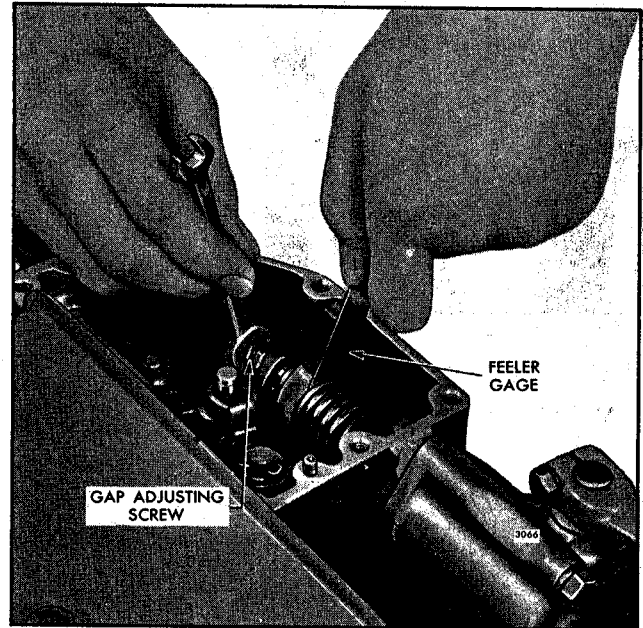


Fig. 2 - Adjusting Governor Gap

6. Install the governor cover.

Position Injector Rack Control Levers

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

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

1. Loosen the lock nut and back out the buffer screw approximately 3/4".
2. Remove the valve rocker covers.
3. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.
4. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.

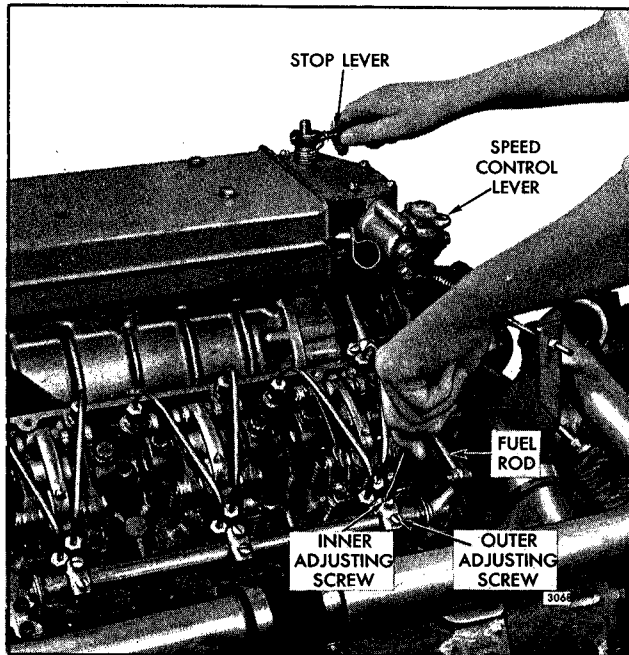


Fig. 3 - Positioning No. 3L Injector Rack Control Lever

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

6. Move the stop lever to the **run** position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 3L injector rack control lever down (Fig. 3) until a slight movement of the control tube is observed, or a step up in effort to turn the screw driver is noted. This will place the No. 3L injector rack in the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full load.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

7. To be sure the control lever is properly adjusted, hold the stop lever in the **run** position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the rack returns to its original position. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the **stop** to the **run** position, the injector rack becomes tight before the governor stop lever reaches the end of its travel. This will result in a step-

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

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

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

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

11. Manually hold the No. 3L injector rack in the *full-fuel* position, with the lever on the injector control tube, and turn the inner adjusting screw of the No. 2L injector rack control lever down until the injector rack of No. 2L injector has moved into the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

12. Recheck the No. 3L injector rack to be sure that it has remained snug on the ball end of the rack control lever while positioning the No. 2L injector rack. If the rack of the No. 3L injector has become loose, back off the inner adjusting screw slightly on No. 2L injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

13. Position the 1L injector rack control lever as outlined in Steps 11 and 12.

14. Position the No. 2R and 1R injector rack control levers as outlined above for the left cylinder bank in Steps 11 through 13.

15. Install the valve rocker covers.

Adjust Maximum No-Load Speed

The maximum no-load speed varies the full-load operating speed desired, as shown in the following chart.

EXAMPLE: If the full-load speed is to be 2200 rpm, then the no-load speed setting should be 2355 rpm to ensure the governor will move the injector racks into the full-fuel position at the desired full-load speed.

Use an accurate tachometer to determine the maximum no-load speed of the engine; then, make the following adjustments, if required.

ENGINE SPEED DROOP

Full-Load RPM	Max. Speed Droop RPM
0-1200	230
1201-1400	185
1401-1600	140
1601-1800	* 145
1801-2000	* 150
2001-2200	* 155
2201-2400	* 160
2401-2600	* 165
2601-2800	* 170

*Droop 175 rpm for two-spring governor.

1. Refer to Fig. 7 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 the table below 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. 4).

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"

4. Install the variable speed spring housing and recheck the maximum no-load speed.
5. If required, add shims to obtain the necessary operating speed. For each .001" in shims added, the operating speed will increase approximately 2 rpm.

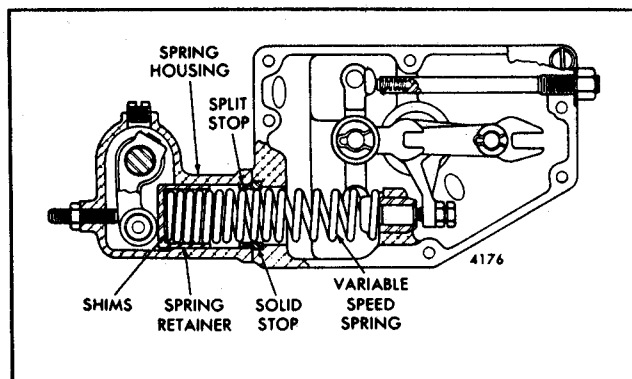


Fig. 4 - Location of Shims and Stops

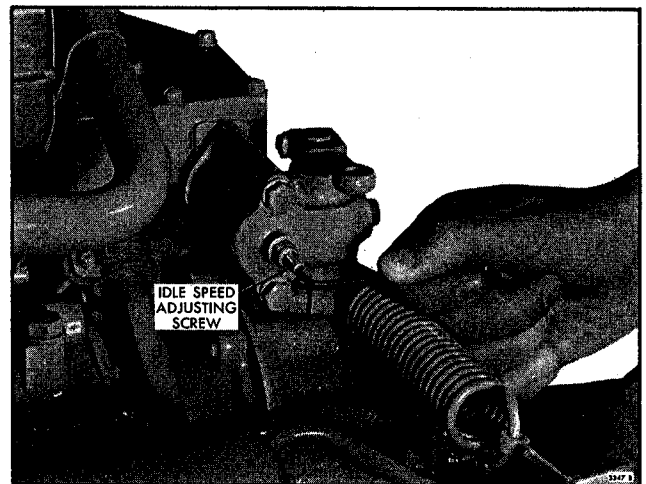


Fig. 5 - Adjusting Idle Speed

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

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

Adjust Idle Speed

After the maximum no-load speed has been 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 operating, loosen the lock nut and turn the idle speed adjusting screw (Fig. 5) in or out until the engine idles at the recommended idle speed. The recommended idle speed is 550 rpm, but may vary with special engine applications.
3. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Buffer Screw

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

1. With the engine running at idle speed, turn the buffer screw in (Fig. 6) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

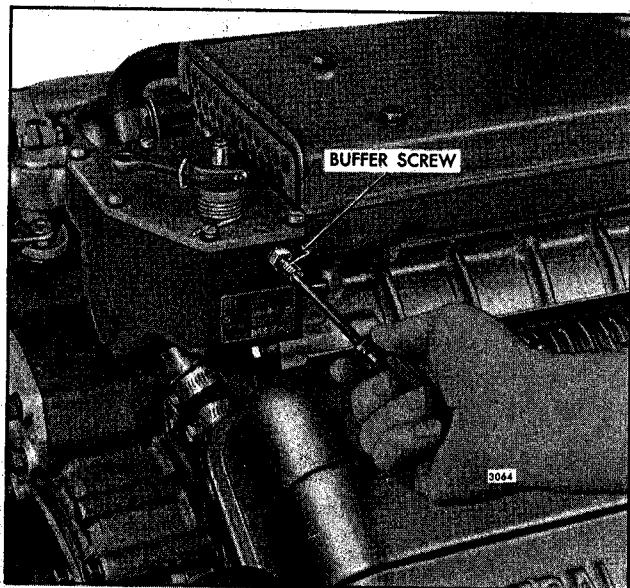


Fig. 6 - Adjusting Buffer Screw

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

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

Adjust Booster Spring

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

1. Refer to Fig. 7 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the other end of the spring.
2. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on an

imaginary line through the center of the bolt, lever shaft, and eye bolt. Hold the bolt and tighten the lock nut.

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

4. Connect the linkage to the governor levers.

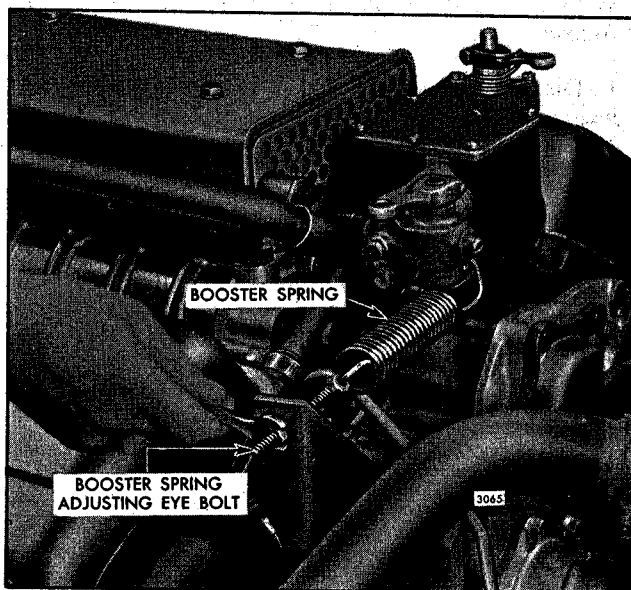


Fig. 7 - Adjusting Booster Spring

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

8V ENGINE

The variable speed mechanical governor assembly (Fig. 1) is mounted at the front end of the 8V engine. After adjusting the exhaust valves and timing the fuel injectors, adjust the governor and the injector rack control levers.

Adjust Governor Gap

With the engine stopped, adjust the governor gap as follows:

1. Disconnect any linkage attached to the governor levers.
2. Remove the governor cover.
3. Place the speed control lever in the maximum speed position.
4. Insert a .006" feeler gage between the spring plunger and the plunger guide as shown in Fig. 2. If required, loosen the lock nut and turn the adjusting screw in or out until a slight drag is noted on the feeler gage.
5. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust, if necessary.
6. Install the governor cover.

Position Injector Rack Control Levers

The position of the injector control racks must be

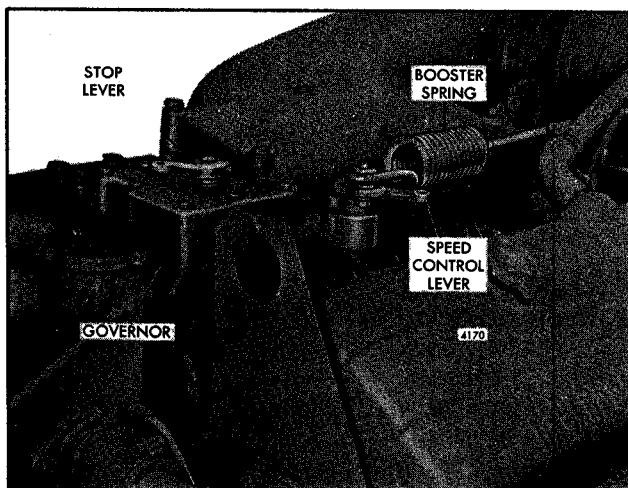


Fig. 1 - Variable Speed Governor Mounting

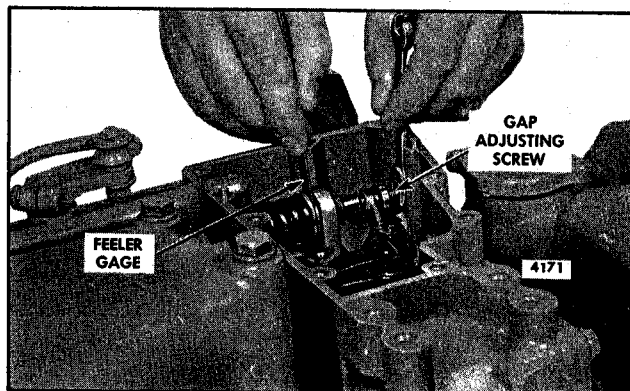


Fig. 2 - Adjusting Governor Gap

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.

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. 1L injector rack control lever first to establish a guide for adjusting the remaining levers.

1. Loosen the lock nut and back out the buffer screw approximately 3/4".
2. Remove the valve rocker covers.
3. Remove the clevis pin from the fuel rod and the right cylinder bank injector control tube lever.
4. Loosen all of the inner and outer injector rack control lever adjusting screws on both injector control tubes. Be sure all of the injector rack control levers are free on the injector control tubes.
5. Move the speed control lever to the maximum speed position.
6. Move the stop lever to the **run** position and hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 1L injector rack control lever down (Fig. 3) until a slight movement of the control tube is observed, or a step-up in effort to turn the screw driver is noted. This will place the No. 1L injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten

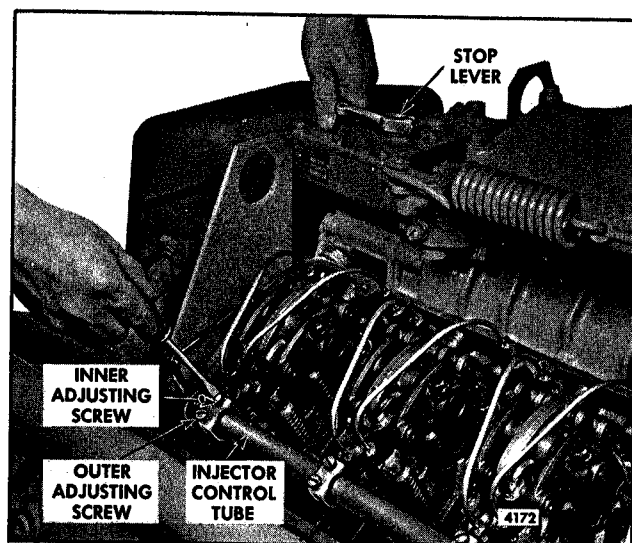


Fig. 3 - Positioning No. 1L Injector Rack Control Lever

both the inner and outer adjusting screws. This should result in placing the governor linkage and control tube in the respective positions that they will attain while the engine is running at full-load.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

7. To be sure the control lever is properly adjusted, hold the stop lever in the **run** position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the rack returns to its original position. If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the stop lever from the **stop** to the **run** position, the injector rack becomes tight before the stop lever reaches the end of its travel. This will result in a step-up in effort required to move the stop lever to the **run** position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If the rack is found to be too tight, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

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

9. Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the No. 1R injector rack control lever as previously outlined in Step 6 for the No. 1L control lever.

10. Insert the clevis pin in the fuel rod and the left bank injector control tube lever. Repeat the check on the 1L and 1R 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. Manually hold the No. 1L injector rack in the *full-fuel* position, with the lever on the injector control tube, and turn the inner adjusting screw of the No. 2L injector rack control lever down until the No. 2L injector rack moves into the *full-fuel* position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

12. Recheck the No. 1L injector rack to be sure that it has remained snug on the ball end of the rack control lever while positioning the No. 2L injector rack. If the rack of the No. 1L injector has become loose, back off the inner adjusting screw slightly on the No. 2L injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective control levers.

13. Position the No. 3L and No. 4L injector rack control levers as outlined in Steps 11 and 12.

14. Position the No. 2R, 3R and 4R injector rack control levers as outlined for the left cylinder bank in Steps 11 through 13.

15. Install the valve rocker covers.

Adjust Maximum No-Load Speed

The maximum no-load speed must not exceed 150 rpm above the full-load speed of 2500-2800 rpm. Use an accurate tachometer to determine the maximum no-load speed of the engine; then, make the following adjustments, if required.

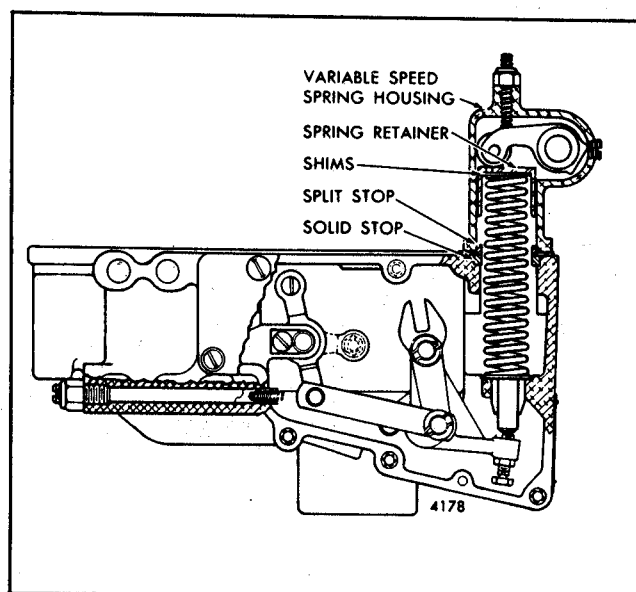


Fig. 4 - Location of Shims and Stops

1. Refer to Fig. 7 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 spring retainer located inside of the housing.
3. Refer to the table below 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. 4).

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"

4. Install the variable speed spring housing and recheck the maximum no-load speed.
5. If required, add shims to obtain the necessary operating speed. For each .001" in shims added, the speed will increase approximately 2 rpm.

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

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

Adjust Idle Speed

After the maximum no-load speed has been set, adjust the idle speed as follows:

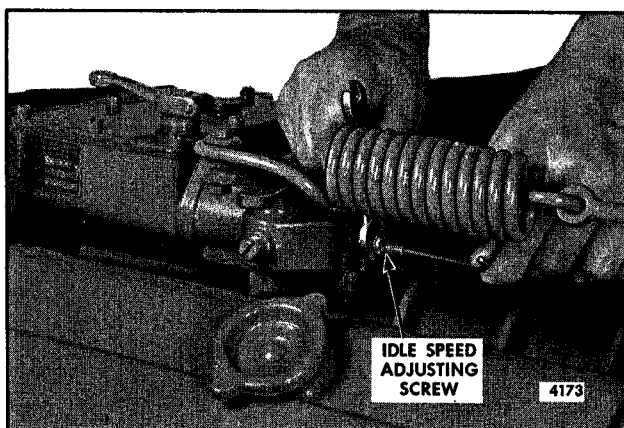


Fig. 5 - Adjusting Idle Speed

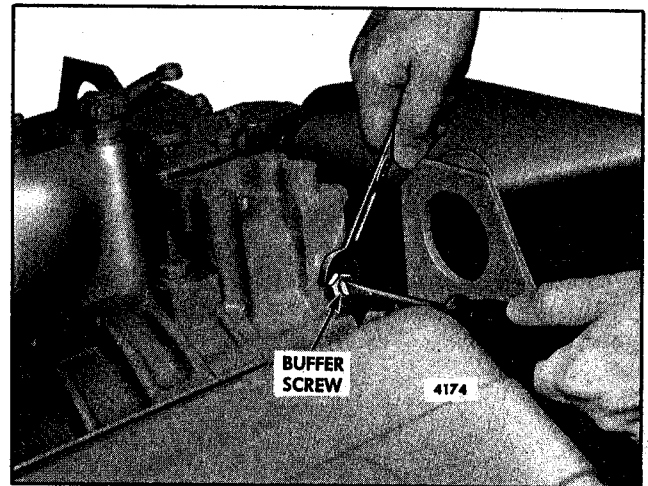


Fig. 6 - Adjusting Buffer Screw

1. Place the stop lever in the **run** position and the speed control lever in the **idle** position.
2. With the engine operating, loosen the lock nut and turn the idle speed adjusting screw (Fig. 5) in or out until the engine idles at 600 rpm.
3. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Buffer Screw

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

1. With the engine running at idle speed, turn the buffer screw in (Fig. 6) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

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

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

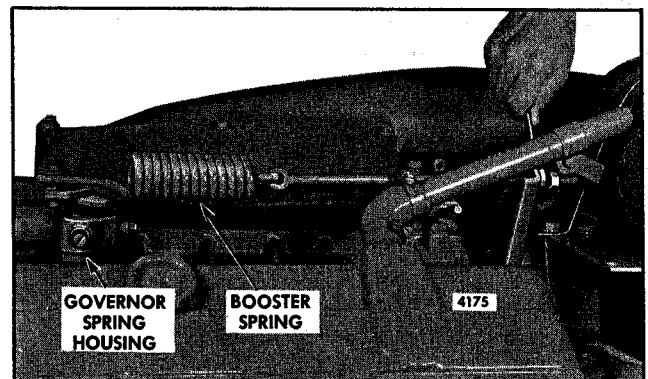


Fig. 7 - Adjusting Booster Spring

Adjust Booster Spring

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

1. Refer to Fig. 7 and loosen the booster spring retaining nut on the speed control lever. Loosen the lock nuts on the eye bolt at the other end of the spring.
 2. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on an imaginary line through the center of the bolt, lever shaft, and eye bolt. Hold the bolt and tighten the lock nut.
 3. Start the engine and move the speed control lever to the maximum speed position and release it. The speed control lever should return to the idle position. If it does not, reduce the tension on the booster spring. If the lever does return to the idle position, continue to increase the spring tension until the lever does not return to idle. Then, reduce the tension until it does return to idle and tighten the lock nut on the eye bolt. This setting will result in the minimum force required to operate the speed control lever.
 4. Connect the linkage to the governor levers.
-

SUPPLEMENTARY GOVERNING DEVICE ADJUSTMENT

Engines with mechanical governors may be equipped with any one of a number of governing devices.

After completing adjustment of the engine governor and repositioning the injector rack controls, adjust the particular governing device.

ENGINE LOAD LIMITING DEVICE

1. Loosen the load limit screw lock nut (Fig. 1).
2. Back the load limit screw out of the adjusting screw plate until approximately 1" of the screw is below the plate.
3. Adjust the load limit screw lock nut so that the bottom of the lock nut is 1 3/4" from the bottom of the load limit screw.
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 lock nut "bottoms" against the top of the plate.
6. Hold the injector control tube in the full-fuel position and place the load limit lever against the load limit lever clamp bolts.
7. Check to ensure the injector racks will just go into the full-fuel position--readjust the load limit, if necessary.
8. Hold the load limit screw to keep it from turning, then "set" the lock nut until the distance between the bottom of the lock nut and the top of the adjusting screw plate corresponds to the markings on the adjusting screw plate.
9. Thread the load limit screw into the plate until the lock nut "bottoms" against the top of the plate.

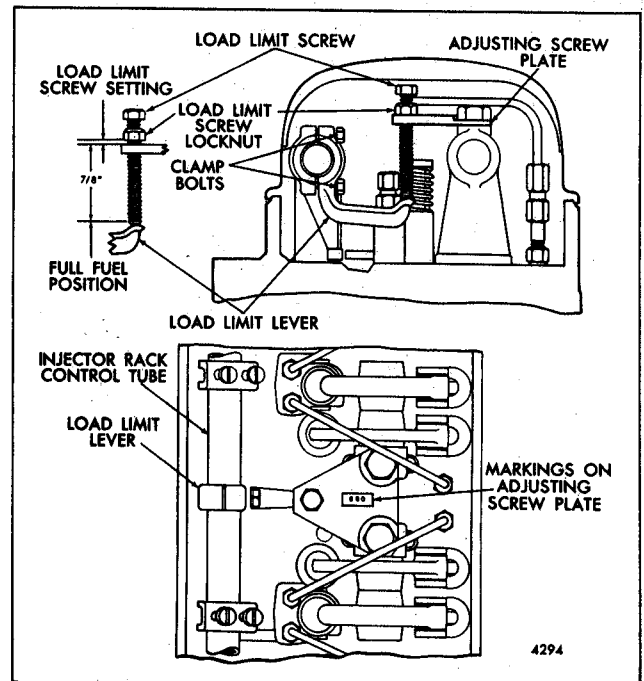


Fig. 1 - Load Limiting Device Mounted on 71 Engine

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

Occasionally it may be necessary to vary the "setting" very slightly in accordance with the actual performance required of the engine.

THROTTLE DELAY CYLINDER

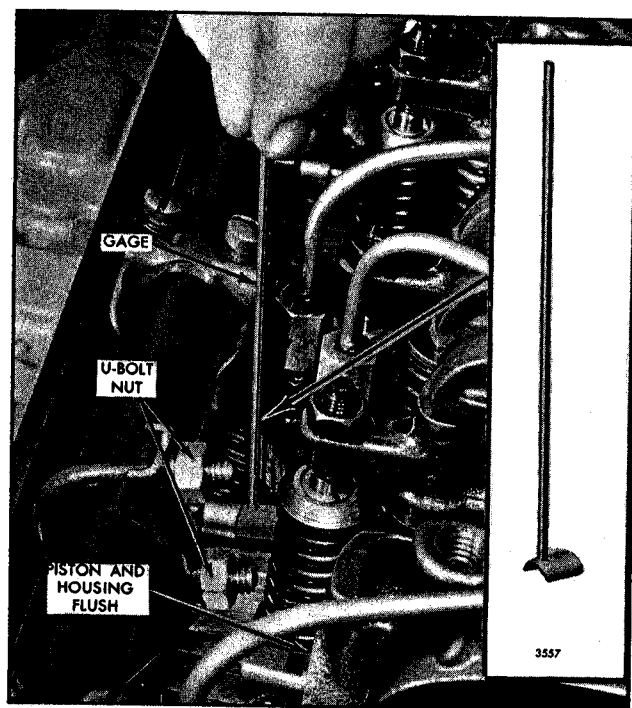


Fig. 2 - Adjusting Throttle Delay Cylinder

Whenever the injector rack control levers are adjusted, the throttle delay cylinder must first be taken out of adjustment. After the injector rack control levers have been positioned, the throttle delay cylinder must be readjusted. With the engine stopped, proceed as follows:

1. Loosen the U-bolt which clamps the throttle delay lever to the injector control tube.
2. Insert gage J 23190 between the injector body and the shoulder on the injector rack (Fig. 2). The gage is .454" wide. Then exert a light pressure on the injector control tube in the direction of full-fuel.
3. Align the piston so it is flush with the edge of the throttle delay cylinder.
4. Tighten the U-bolt and remove the gage.
5. Rotate the injector control rack to be sure it does not bind.

DUAL IDLE SPEED CYLINDER (Vehicle Engines)

Before adjusting the governor gap, the de-energized dual idle speed cylinder must be screwed outward until it will not interfere with the governor adjustments. After the idle speed setting is made, the de-energized dual idle speed cylinder must be adjusted the same as for the standard buffer screw.

1. With the engine running at normal operating temperature, turn the dual idle speed cylinder in so that it contacts the differential lever as lightly as possible and still eliminates the engine roll.

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

2. Hold the cylinder and tighten the lock nut.
3. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the cylinder until the increase is less than 25 rpm.

The throttle locking air cylinder is adjusted on its mounting bracket so it will lock the throttle in the idle position when it is activated, but will not limit the throttle movement when it is not activated.

HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

IN-LINE ENGINE

The hydraulic governor is mounted on the 2, 3 and 4-53 engines as shown in Fig. 1. The terminal lever return spring and the fuel rod are attached to an external terminal shaft lever. The maximum fuel position of the governor load limit is determined by the internal governor terminal lever striking against a boss that projects from the governor cover.

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

Adjust Fuel Rod and Injector Rack Control Levers

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

2. Remove the governor terminal lever return spring.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to

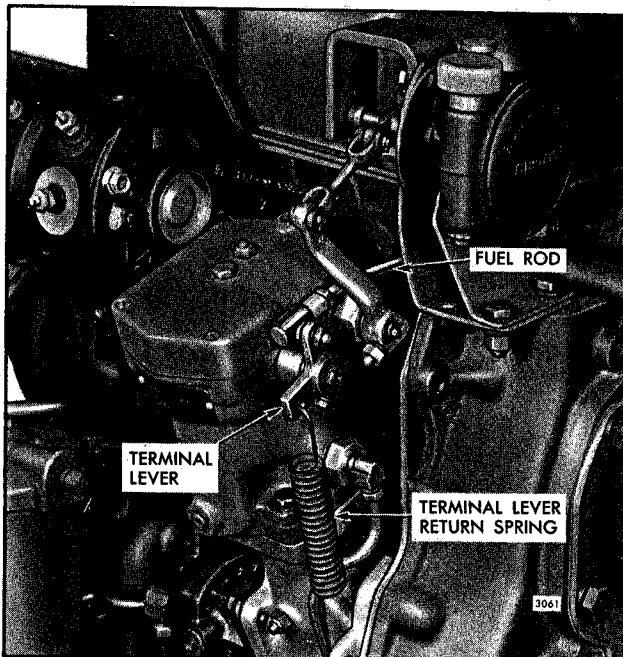


Fig. 1 - Hydraulic Governor Mounted on Engine

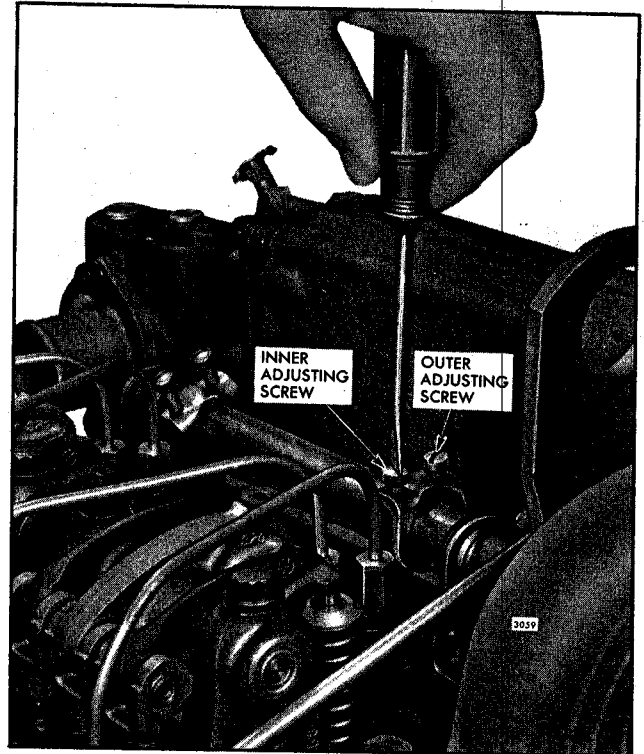


Fig. 2 - Adjusting Height of Rack Control Lever Adjusting Screws

the injector control tube. The recommended torque of the adjusting screws is 24-36 in-lb.

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

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

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

NOTE: It will be necessary to slide the terminal lever partially off of the shaft to attach the fuel

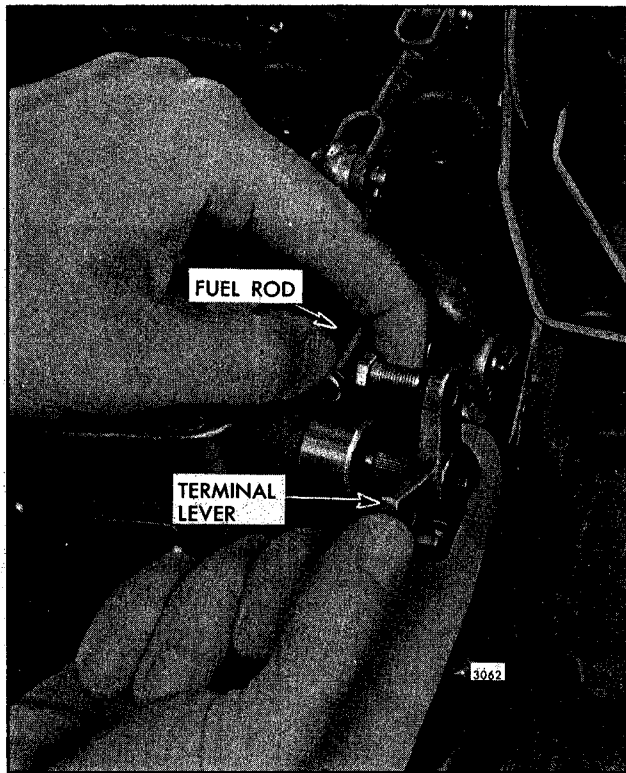


Fig. 3 - Adjusting Length of Fuel Rod

rod end bearing or ball joint to the terminal lever.

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

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

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

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

9. Recheck the rear injector fuel rack to be sure that it has remained snug on the ball end of the rack control lever while adjusting the adjacent injector. If the rack

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

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

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

12. Install the terminal lever return spring.

Adjust Speed Droop

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

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

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

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.

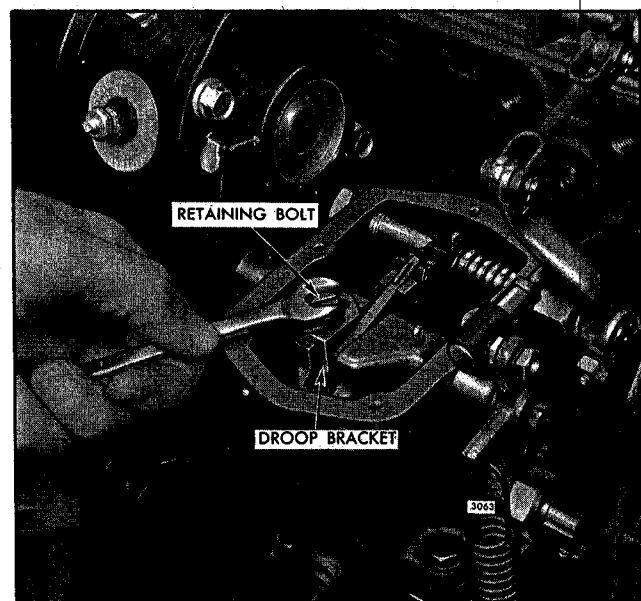


Fig. 4 - Adjusting Droop Bracket

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

2. Stop the engine and remove the governor cover.
3. Loosen the lock nut and back off the maximum speed adjusting screw (Fig. 5) approximately $5/8"$.
4. Refer to Fig. 4 and loosen the droop adjusting bolt. Move the droop bracket so that the bolt is midway between the ends of the slot in the bracket. Tighten the bolt.
5. With the throttle in the **run** position, adjust the engine speed until the engine is operating at 3% to 5% above the recommended full-load speed.
6. Apply the full-rated load on the engine and re-adjust the engine speed to the correct full-load speed.
7. Remove the rated load and note the engine speed after the speed stabilizes under no-load. If the speed droop is correct, the engine speed will be approximately 3% to 5% higher than the full-load speed.

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

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

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

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

The recommended speed droop of generator sets operating in parallel is 50 rpm (2-1/2 cycles) for units

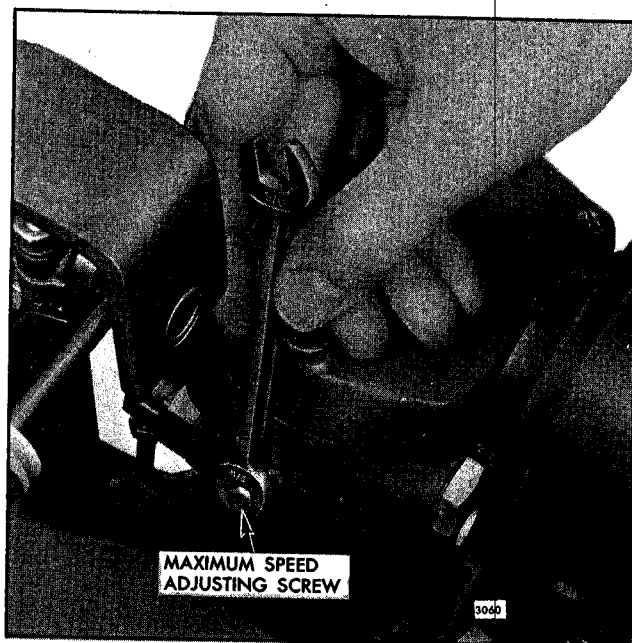


Fig. 5 - Adjusting Maximum Engine Speed

operating at 1000 and 1200 rpm and 75 rpm (2-1/2 cycles) for units operating at 1500 rpm and 1800 rpm full load. This speed droop recommendation may be varied to suit the individual application.

8. Install the governor cover.

Adjust Maximum No-Load Speed

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

1. Loosen the maximum speed adjusting screw lock nut and back out the maximum speed adjusting screw three turns.
2. With the engine operating at no-load, adjust the engine speed until the engine is operating at approximately 8% higher than the rated full-load speed.
3. Turn the maximum speed adjusting screw (Fig. 5) in lightly until contact is felt with the linkage in the governor.
4. Hold the maximum speed adjusting screw and tighten the lock nut.

HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

6V ENGINE

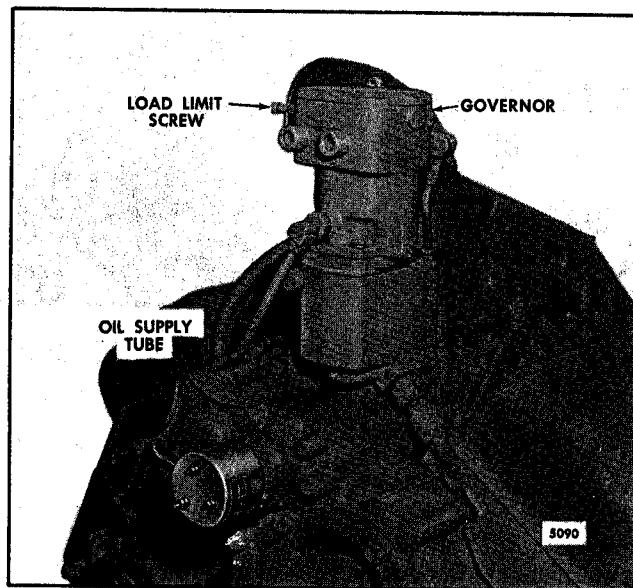


Fig. 1 - Hydraulic Governor Mounting

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

Perform the following adjustment on a 6V engine that incorporates a hydraulic governor.

1. Remove the valve rocker covers.
2. Adjust the exhaust valve clearance and time the fuel injectors.
3. Disconnect the vertical control link assembly from the governor operating lever.
4. Loosen all of the injector rack control lever adjusting screws.
5. While holding the bell crank lever (on the governor drive housing) in a horizontal position (full-fuel), set the No. 3 injector rack control levers on each bank to full-fuel.
6. Position the remaining rack control levers to the No. 3 control levers.
7. Remove the governor cover.

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

9. 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.

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

11. 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.

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

13. Install the governor cover.

14. Install the rocker covers.

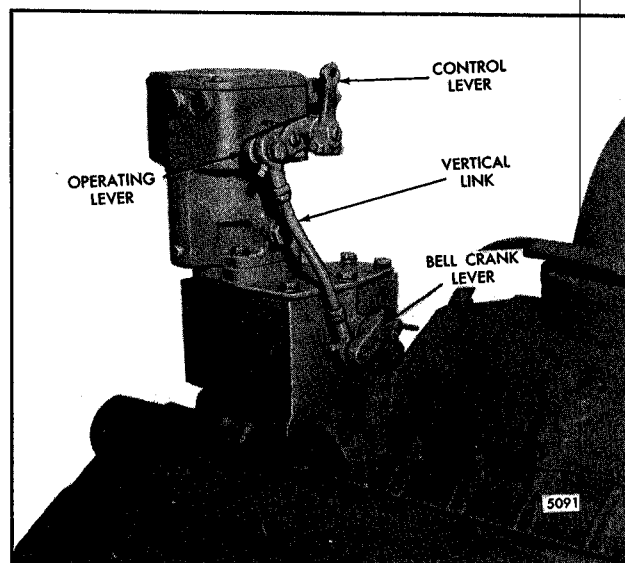


Fig. 2 - Hydraulic Governor Controls

TROUBLE SHOOTING

Certain abnormal conditions which sometimes interfere with satisfactory engine operation, together with methods of determining the cause of such conditions, are covered on the following pages.

Satisfactory engine operation depends primarily on:

1. An adequate supply of air compressed to a sufficiently high compression pressure.
2. The injection of the proper amount of fuel at the right time.

Lack of power, uneven running, excessive vibration, stalling at idle speed, and hard starting may be caused by either low compression, faulty fuel injection in one or more cylinders, or lack of sufficient air.

Since proper compression, fuel injection and the proper amount of air are important to good engine performance, detailed procedures for their investigation are given as follows:

Locating a Misfiring Cylinder

1. Start the engine and run it at part load until it reaches normal operating temperature.
2. Stop the engine and remove the valve rocker cover(s). Discard the gasket(s).
3. Check the valve clearance. The clearance should be .009" (two valve cylinder head) or .024" (four valve cylinder head).
4. Start the engine and hold an injector follower down with a screw driver to prevent operation of the injector. If the cylinder has been misfiring, there will be no noticeable difference in the sound and operation of the engine. If the cylinder has been firing properly, there will be a noticeable difference in the sound and operation when the injector follower is held down. This is similar to short-circuiting a spark plug in a gasoline engine.
5. If the cylinder is firing properly, repeat the procedure on the other cylinders until the faulty one has been located.
6. Provided that the injector operating mechanism of the faulty cylinder is functioning satisfactorily, remove the fuel injector and install a new one by performing the removal and installation procedure outlined in *Fuel System*.
7. If installation of a new injector does not eliminate misfiring, check the compression pressure.

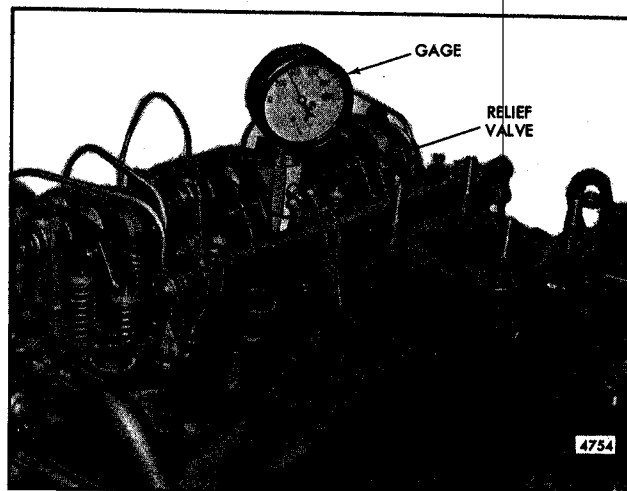


Fig. 1 - Checking Compression Pressure

Checking Compression Pressure

Compression pressure is affected by altitude as follows:

Minimum Compression Pressure, psi		Altitude, Feet Above Sea Level
Std. Engine	"N" Engine	
430	540	0
400	500	2,500
370	465	5,000
340	430	7,500
315	395	10,000

Check the compression pressure as follows:

1. Start the engine and run it at approximately one-half rated load until normal operating temperature is reached.
2. Stop the engine and remove the fuel pipes from the No. 1 injector and the fuel connectors.
3. Remove the injector and install adaptor J 7915-02 and pressure gage and hose assembly J 6992 (Fig. 1).
4. Use a spare fuel pipe and fabricate a jumper connection between the fuel inlet and return fuel connectors to permit fuel to flow directly to the fuel return manifold.
5. Start the engine and run it at 600 rpm. Observe and record the compression pressure indicated on the gage.

NOTE: Do not crank the engine with the starting motor to check the compression pressure.

6. Perform Steps 2 through 5 on each cylinder. The compression pressure in any one cylinder should not

be less than 430 psi (540 psi for "N" engines) at 600 rpm. In addition, the variation in compression pressures between cylinders of the engine must not exceed 25 psi at 600 rpm.

EXAMPLE: If the compression pressure readings were as shown in the following table, it would be evident that No. 3 cylinder should be examined and the cause of the low compression pressure be determined and corrected.

Cylinder	Gage Reading*
1	525 psi
2	520 psi
3	485 psi
4	515 psi

*The above pressures are for an engine operating at an altitude near sea level.

Note that all of the cylinder pressures are above the low limit for satisfactory engine operation. Nevertheless, the No. 3 cylinder compression pressure indicates that something unusual has occurred and that a localized pressure leak has developed.

Low compression pressure may result from any one of several causes:

- A. Piston rings may be stuck or broken. To determine the condition of the rings, remove the air box cover and press on the compression rings with a blunt tool. A broken or stuck compression ring will not have a "spring like" action.
- B. Compression pressure may be leaking past the cylinder head gasket, valve seats, injector tubes, or through a hole in the piston.

Engine Out of Fuel

The problem in restarting the engine after it has run out of fuel stems from the fact that after the fuel is exhausted from the fuel tank, fuel is then pumped from the primary fuel strainer and sometimes partially removed from the secondary fuel filter before the fuel supply becomes insufficient to sustain engine firing. Consequently, these components must be refilled with fuel and the fuel pipes rid of air in order for the system to provide adequate fuel for the injectors.

When an engine has run out of fuel, there is a definite procedure to follow for restarting it. The procedure is outlined below:

1. Fill the fuel tank with the recommended grade of fuel oil. If only partial filling of the tank is possible, add a minimum of ten gallons of fuel.

2. Remove the fuel strainer shell and element from the strainer cover and fill the shell with fuel oil. Install the shell and element.

3. Remove and fill the fuel filter shell and element with fuel oil as in Step 2.

4. Start the engine. Check the filter and strainer for leaks.

NOTE: In some instances, it may be necessary to remove a valve rocker cover and loosen a fuel pipe nut in order to bleed trapped air from the fuel system. Be sure the fuel pipe is retightened securely before replacing the rocker cover.

Primer J 5956 may be used to prime the engine fuel system. Remove the filler plug in the fuel filter cover and install the primer. Prime the system. Remove the primer and install the filler plug.

Fuel Flow Test

1. Disconnect the fuel return hose from the fitting at the fuel tank and hold the open end in a suitable container.

2. Start and run the engine at 1200 rpm and measure the fuel flow for a period of one minute. At least .6 gallon of fuel should flow from the fuel return hose per minute.

3. Immerse the end of the fuel return hose in the fuel in the container. Air bubbles rising to the surface of the fuel will indicate air being drawn into the fuel system on the suction side of the pump.

If air is present, tighten all fuel line connections between the fuel tank and the fuel pump.

If the fuel flow fails to meet the amount specified, the fuel strainer, filter, or pump should be serviced.

Crankcase Pressure

The crankcase pressure indicates the amount of air passing between the oil control rings and the cylinder liner into the crankcase, most of which is clean air from the air box. A slight pressure in the crankcase is desirable to prevent the entrance of dust. A loss of engine lubricating oil through the breather tube, crankcase ventilator, or dipstick hole in the cylinder block is indicative of excessive crankcase pressure.

The causes of high crankcase pressure may be traced to excessive blow-by due to worn piston rings, a hole or crack in a piston crown, loose piston pin retainers,

worn blower oil seals, defective blower, cylinder head or end plate gaskets, or excessive exhaust back pressure. Also, the breather tube or crankcase ventilator should be checked for obstructions.

The crankcase pressure may be checked with a manometer connected to the oil level dipstick opening in the cylinder block. Check the readings obtained at various engine speeds with the specifications in the following chart.

CRANKCASE PRESSURE (max. in inches of water)					
Engine	Speed (rpm)				
	1800	2000	2200	2500*	2800*
2-53	.5	.5	—	—	—
3-53	.5	.5	.5	.9	1.0
4-53	.5	.5	.5	.9	1.0
4-53T	—	—	—	1.0	—
6V-53	—	—	—	.9	1.0
8V-53	—	—	—	.9	1.0

*Engines with four valve cylinder head(s).

Exhaust Back Pressure

A slight pressure in the exhaust system is normal. However, excessive exhaust back pressure seriously affects engine operation. It may cause an increase in the air box pressure with a resultant loss in the efficiency of the blower. This means less air for scavenging, which results in poor combustion and higher temperatures.

Causes of high exhaust back pressure are usually a result of an inadequate or improper type of muffler, an exhaust pipe which is too long or too small in diameter, an excessive number of sharp bends in the exhaust system, or obstructions such as excessive carbon formation or foreign matter in the exhaust system.

The exhaust back pressure, measured in inches of mercury, may be checked with a manometer, or pressure gage, connected to the exhaust manifold.

EXHAUST BACK PRESSURE (max. in inches of Mercury)					
Engine	No-Load Speed (rpm)				
	1800	2000	2200	2500*	2800*
2-53	1.3	1.7	—	—	—
3-53	1.3	1.7	2.1	2.7	2.7†
4-53	1.3	1.7	2.1	2.7	2.7†
4-53T	—	—	—	1.8	—
6V-53	—	—	—	2.7	2.7†
8V-53	—	—	—	2.7	2.7†

*Engines with four valve cylinder head(s).

†3.8 for Marine engines.

Remove the 1/8" pipe plug, which is provided for that purpose, from the manifold. If there is no opening provided, one can be made by drilling an 11/32" hole in the exhaust manifold companion flange and tapping a 1/8" pipe thread.

Check the readings obtained at various speeds (no load) with the specifications in the chart.

Air Box Pressure

Proper air box pressure is required to maintain sufficient air for combustion and scavenging of the burned gases. Low air box pressure is caused by a high air inlet restriction, damaged blower rotors, an air leak from the air box (such as a leaking end plate gasket), or a clogged blower air inlet screen.

Lack of power or black or grey exhaust smoke are indications of low air box pressure.

To check the air box pressure, connect a manometer to an air box drain tube.

Check the readings obtained at various speeds with the specifications in the following chart.

AIR BOX PRESSURE (min. in inches of Mercury)					
Max. Exhaust Back Pressure (Full Load)					
Engine	Speed (rpm)				
	1800	2000	2200	2500*	2800*
2-53	5.7	7.2	—	—	—
3-53	5.5	6.9	8.6	8.0	9.3
4-53	5.5	6.9	8.6	8.0	9.3
4-53T	—	—	—	33.5	—
6V-53	—	—	—	8.0	9.3
8V-53	—	—	—	8.0	9.3
(Zero Exhaust Back Pressure)					
2-53	4.1	5.2	—	—	—
3-53	3.8	4.9	6.2	4.8	6.1
4-53	3.8	4.9	6.2	4.8	6.1
4-53T	—	—	—	31.5	—
6V-53	—	—	—	4.8	6.1
8V-53	—	—	—	4.8	6.1

*Engines with four valve cylinder head(s).

Air Inlet Restriction

Excessive restriction of the air inlet will affect the flow of air to the cylinders and result in poor combustion and lack of power. Consequently, the restriction must be kept to a minimum considering the size and capacity of the air cleaner. An obstruction in the air inlet system or dirty or damaged air cleaners will result in a high blower inlet restriction.

The air inlet restriction may be checked with a manometer connected to a fitting in the air intake ducting located 2" above the air inlet housing. When practicability prevents the insertion of a fitting at this point, the manometer may be connected to the engine air inlet housing. The restriction at this point should be checked at a specific engine speed. Then, the air cleaner and ducting should be removed from the air inlet housing and the engine again operated at the same speed while noting the manometer reading.

The difference between the two readings, with and without the air cleaner and ducting, is the actual restriction caused by the air cleaner and ducting.

Check the normal air intake vacuum at various speeds (at no-load) and compare the results with the following chart:

AIR INLET RESTRICTION (inches of water)					
Engine	Speed (rpm)				
	1800	2000	2200	2500*	2800*
Max. with dirty air cleaner (oil bath or dry)					
2-53	13.4	16.0	—	—	—
3-53	13.4	—	18.8	23.0	25.0
4-53	13.4	—	18.8	23.0	25.0
6V-53	—	—	18.8	23.0	25.0
8V-53	—	—	18.8	23.0	25.0
Max. with clean air cleaner (oil bath)					
2-53	9.5	10.8	—	—	—
3-53	9.5	10.8	12.0	14.0	16.0
4-53	9.5	10.8	12.0	14.0	16.0
6V-53	—	—	12.0	14.0	16.0
8V-53	—	—	12.0	14.0	16.0
Max. with clean air cleaner (Dry with precleaner)					
2-53	6.8	10.8	—	—	—
3-53	6.8	10.8	12.0	—	—
4-53	6.8	10.8	12.0	—	—
Max. with clean air cleaner (Dry less precleaner)					
2-53	5.5	6.5	—	—	—
3-53	5.5	6.5	7.4	8.7	10.0
4-53	5.5	6.5	7.4	8.7	10.0
6V-53	—	—	7.4	8.7	10.0
8V-53	—	—	7.4	8.7	10.0
Max. with air silencer (full load)					
4-53T	—	—	—	20.0	—

*Engines with four valve cylinder heads.

PROPER USE OF MANOMETER

The U-tube manometer is a primary measuring device indicating pressure or vacuum by the difference in the height of two columns of fluid.

Connect the manometer to the source of pressure, vacuum, or differential pressure. When the pressure is imposed, add the number of inches one column of fluid travels up to the amount the other column travels down to obtain the pressure (or vacuum) reading.

The height of a column of mercury is read differently than that of a column of water. Mercury does not wet the inside surface; therefore, the top of the column has a *convex* meniscus (shape). Water wets the surface and therefore has a *concave* meniscus. A mercury column is read by sighting horizontally between the top of the convex mercury surface (Fig. 2) and the scale. A water manometer is read by sighting

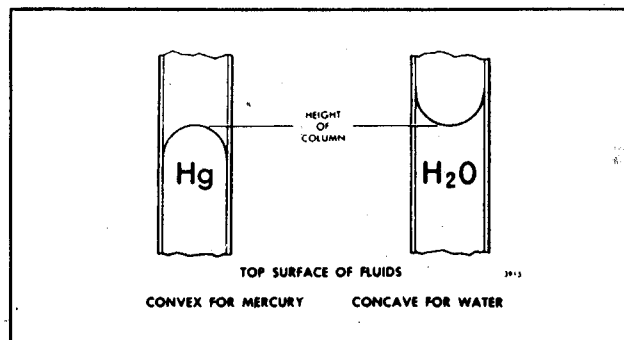


Fig. 2 - Comparison of Column Height for Mercury and Water Manometers

horizontally between the bottom of the concave water surface and the scale.

Should one column of fluid travel further than the

other column, due to minor variations in the inside diameter of the tube or to the pressure imposed, the accuracy of the reading obtained is not impaired.

The manometer reading may be converted into other units of measurement by use of the pressure conversion chart.

PRESSURE CONVERSION CHART

1" water	=	.0735" mercury
1" water	=	.0361 psi
1" mercury	=	.491 psi
1" mercury	=	13.6" water
1 psi	=	27.7" water
1 psi	=	2.036" mercury

ENGINE ELECTRICAL GENERATING SYSTEM

Whenever trouble is indicated in the engine electrical generating system, the following quick checks can be made to assist in localizing the cause.

A fully charged battery and low charging rate indicates normal generator-regulator operation.

A low battery and high charging rate indicates normal generator-regulator operation.

A fully charged battery and high charging rate condition usually indicates the voltage regulator is set

too high or is not limiting the generator output. A high charging rate to a fully charged battery will damage the battery and other electrical components.

A low battery and low or no charging rate condition could be caused by: Loose connections or damaged wiring, defective battery or generator, generator not or improperly polarized, and defective regulator or improper regulator setting.

Contact an authorized *Detroit Diesel Service Outlet* if more information is needed.

STORAGE

PREPARING ENGINE FOR STORAGE

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

It will be necessary to remove all rust or corrosion completely from any exposed part before applying a

rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

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

TEMPORARY STORAGE (30 days or less)

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

1. Drain the engine crankcase.
2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.
3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

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

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

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

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

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

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

EXTENDED STORAGE (30 days or more)

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

1. Drain and thoroughly flush the cooling system with clean, soft water.
2. Refill the cooling system with clean, soft water.
3. Add a rust inhibitor to the cooling system (refer to *Corrosion Inhibitor* under *Cooling System*).
4. Remove, check and recondition the injectors, if necessary, to make sure they will be ready to operate when the engine is restored to service.
5. Reinstall the injectors in the engine, time them, and adjust the valve clearance.

6. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160°F. to 185°F.).

7. Stop the engine.

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

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

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough rust preventive fuel oil such as American Oil Diesel Run-In Fuel (LF 4089), Mobil 4Y17, or equivalent, to enable the engine to operate 10 minutes.

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

13. Operate the engine for 5 minutes to circulate the rust preventive throughout the engine.

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

15. MARINE GEAR

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

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

16. TORQMATIC CONVERTER

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

b. Remove the drain plug and drain the converter.

c. Remove the filter element.

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

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

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

g. Start the engine and operate the converter for at least 5 minutes at a minimum of 1000 rpm. Engage the clutch; then stall the converter to raise the oil temperature to 225°F.

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

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

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

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

17. POWER TAKE-OFF

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

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

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

18. TURBOCHARGER

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

19. HYDROSTARTER SYSTEM

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

20. Apply a *non-friction* rust preventive compound, to all exposed parts. If it is convenient, apply the rust preventive compound to the engine flywheel. If not,

disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

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

21. Drain the engine cooling system.

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

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

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

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

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

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

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

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

1. Remove the valve rocker cover(s) and pour at least one-half gallon of oil, of the same grade as used in the crankcase, over the rocker arms and push rods.

2. Reinstall the valve rocker cover(s).

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

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

5. Remove the rust preventive from the flywheel.

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

7. Check the crankcase oil level. Fill the crankcase to the proper level with the heavy-duty lubricating oil recommended under *Lubricating Oil Specifications*.

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

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

solution to the cooling system (the antifreeze contains a rust inhibitor).

10. Install and connect the battery.

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

12. POWER GENERATOR

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

13. MARINE GEAR

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

14. 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. Drain the preservative

oil and remove the filter. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter.

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

- 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*.

15. POWER TAKE-OFF

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

16. HYDROSTARTER

- a. Open the relief valve on the side of the hand pump and release the pressure in the system.
- b. Refer to the filling and purging procedures outlined in *Hydraulic Starting System*. Then, drain, refill and purge the Hydrostarter system.

17. 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*.

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

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

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 from a book that may or may not have the latest detailed part number information. Mistakes can be annoying—and sometimes costly. 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

L11264 4		TYPE	EQUIPMENT	TYPE	EQUIPMENT
START-UP	61	CONN ROD/PSTN.	30	ENG LIFT BKT	
INSPECTION	250	OIL PAN	242	OIL DIST	
TAB	565	DIPSTICK	227	OIL FILTER	
UNIT NO.	510	FAN	171	C/S PULLEY	
	117	WATER CONN	318	WAT BY-PASS	
	76	INJECTOR N45	181	FUEL FILTER	
	595	THROTTLE CONT.	1122	GOVERNOR MECH.	
	247	ACC DRIVE	NONE	BATT CHRG GEN.	
	NONE	INSTRUMENTS			
4D0080495					
	UNIT	4D0080495	MODEL	50437001	SPEC 51Q-239

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

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

```

.....
L11264 4 .TYPE EQUIPME
START-UP . 61 CONN ROD/P
          . 250 OIL PAN
          . 565 DIPSTICK
INSPECTION . 510 FAN
          . 117 WATER CONN
          . 76 INJECTOR N4
          . 595 THROTTLE CON
UNIT NO. . 247 ACC DRIVE
4D0080495 .NONE INSTRUMENTS
          UNIT 4D0080495 MODEL
.....

```

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

```

.....
TYPE EQUIPMENT .TYPE EQUIPMENT .TYPE EQUIP
STN. 30 ENG LIFT BKT . 345 F/W HOUSING . 608 FLYWH
      . 242 OIL DIST .NONE OIL FIL TUBE . 268 OIL C
      . 227 OIL FILTER . 197 VENT SYSTEM . 44 OIL F
      . 171 C/S PULLEY . 187 C/S PUL BELT . 145 WAT
      . 318 WAT BY-PASS . 102 WAT OTLT ELBO. 179 EXH
      . 181 FUEL FILTER . 628 FUEL LINES . 141 AIR
      . 1122 GOVERNOR MECH. 430 ENGINE MOUNTS. 40 RO
      .NONE BATT CHRG GEN. 174 STARTING MTR. 255 M
.....
50437001 SPEC 51Q-239
.....

```

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

```

.....
EQUIPMENT
COOLER
OIL CAP
R PUMP
MFLD
INLT HSG
ROCKER COVER
OFFLER CONN
.....
SERIAL NO. 4D0080495 MODEL 50437001
DETROIT DIESEL ALLISON DIV G.M.C. U.S.A.
MAX RPM NL 02940 SO. 4A63792
.....

```

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

WHAT'S THE REAL ADVANTAGE?

The system completely eliminates the possibility of your selecting a wrong part number, or one that may have been superseded. The reason is that although individual part numbers may change, the Model, Unit No. and Type do not—so interpretation is positive.

Your Distributor/Dealer has a Parts Catalog of all engine models from which he determines the exact part number of each item on each engine. In his catalog, all engine components are divided into the groups of functionally related parts. A complete listing of the twelve major groups and their many sub-groups is shown below.

GROUP NOMENCLATURE

1.0000 ENGINE (less major assemblies)

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

2.0000 FUEL SYSTEM

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

3.0000 AIR SYSTEM

- 3.1000A Air Cleaner and/or Adaptor
- 3.2000A Air Silencer
- 3.3000A Air Inlet Housing
- 3.4000 Blower
- 3.4000A Blower Drive Shaft
- 3.6000A 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
- 4.8000A 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 Torque Converter Lines

9.0000 TRANSMISSION AND PROPULSION

- 9.1000A Hydraulic Marine Gear
- 9.3000A Power Transfer Gear
- 9.4000 Transmission-Highway
- 9.7000 Transmission-Off-highway

10.0000 SHEET METAL

- 10.1000A Engine Hood

11.0000 ENGINE MOUNTING

- 11.1000A Engine Mounting and Base

12.0000 MISCELLANEOUS

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

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

The Distributor/Dealer has in his Parts Catalog a Model Index Page for each engine model. The Model Index Page lists all of the "Standard" and "Standard Option" equipment for that model.

DETROIT DIESEL 53		5063 5000 (RA)	
STANDARD AND STANDARD OPTION EQUIPMENT			
	GROUP NAME	GROUP NO.	TYPE
Cylinder Block		1000	31
Air Box Drains		1000A	32
Cylinder Head (4 valve)		2000	26
Engine Lifter Bracket		2000A	34
Crankshaft		1500	24
Crankshaft Front Cover		1500A	35
Crankshaft Pulley (2 grooves)		3000C	171
Crankshaft Pulley Belt		3000D	121
Flywheel (SAE #1)		1000A	312
Flywheel Housing (SAE #2)		1500A	350
Connecting Rod and Piston		1000	30
Camshaft and Gear Train		1000	127
Valve Operating Mechanism		1000	33
Rockers Cover (with oil filter and one cover)		1000A	32
Fuel Injector VSO		2000A	34
Fuel Pump (3/8" inlet) (mounted on 1 Bank camshaft)		2000	73
Fuel Filter		2000A	155
Fuel Manifold Connections		1000	28
Fuel Lines		2000A	786
Governor Mechanical		2000A	513

NOTE The option plate reflects which choice of options has been built into the engine. The Distributor/Dealer uses his model index to interpret the standard equipment. The plate, therefore, lists only the non-standard or choice items.

So, 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, Record 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 bears a decal giving the service package part number for the element. It is advisable to have your own personal record of these part numbers by filling in the chart provided below:

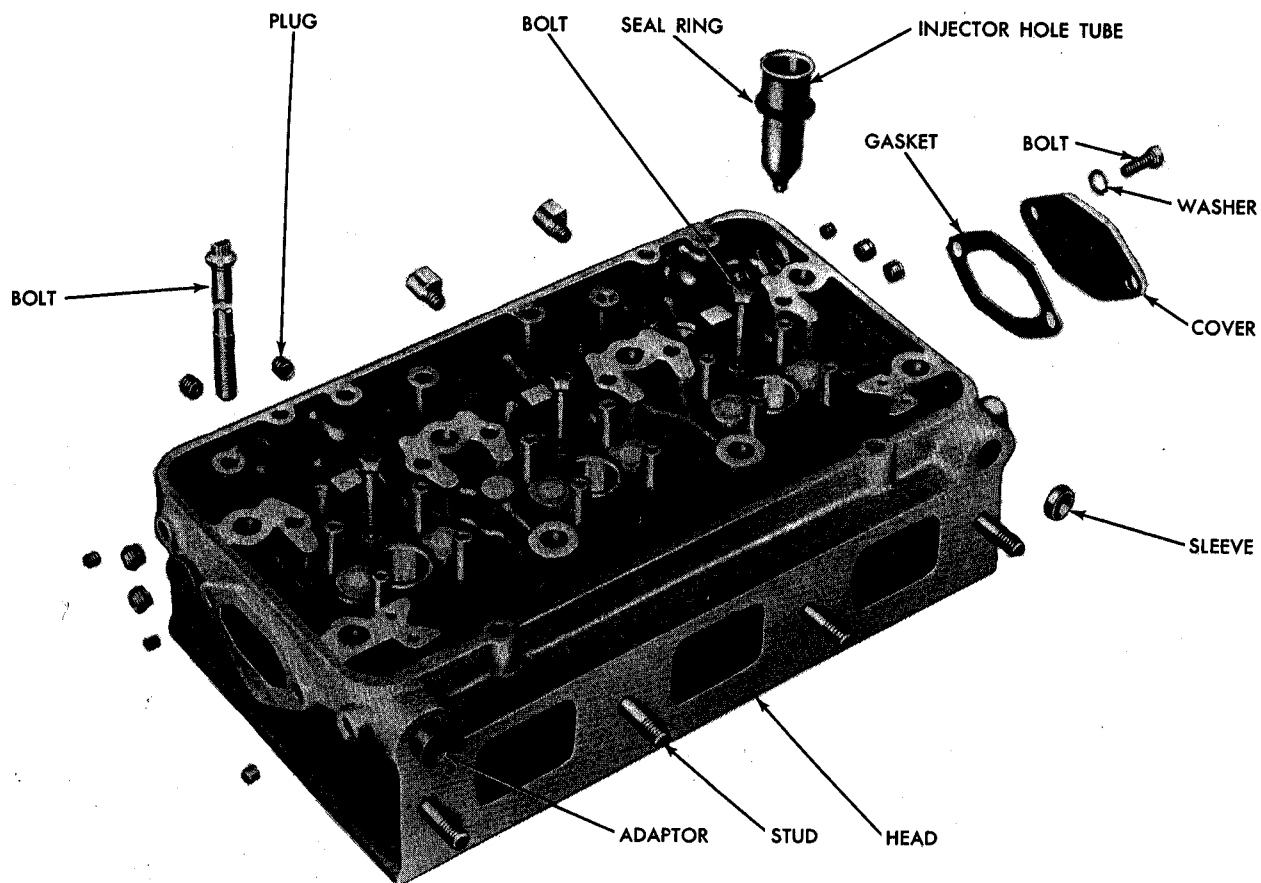
TYPE	LOCATION	PACKAGE PART NO.
Fuel Strainer		
Fuel Filter		
Lube Oil Filter Full-Flo		
Lube Oil Filter By-Pass*		

*Not Standard

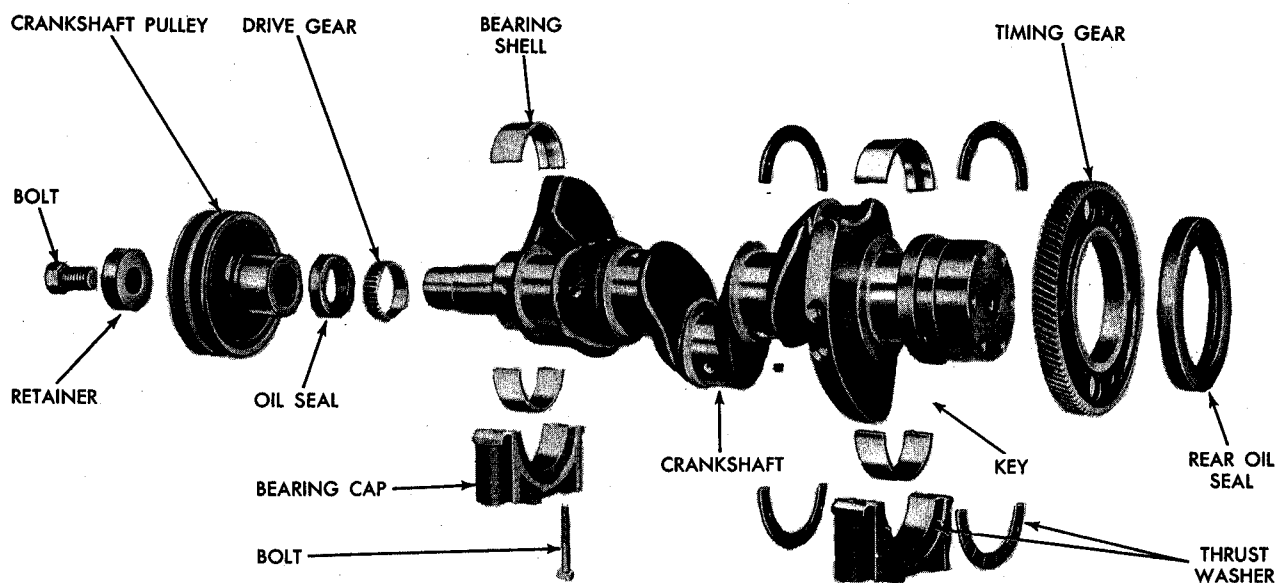
AIR CLEANER

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

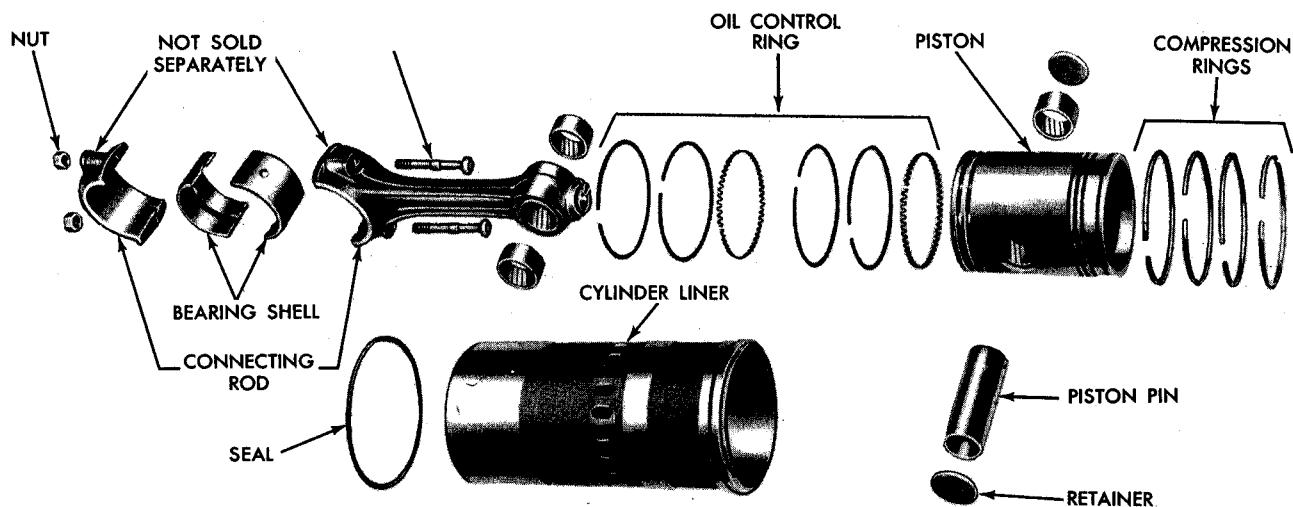
Wet type, indicate capacity _____ qts.



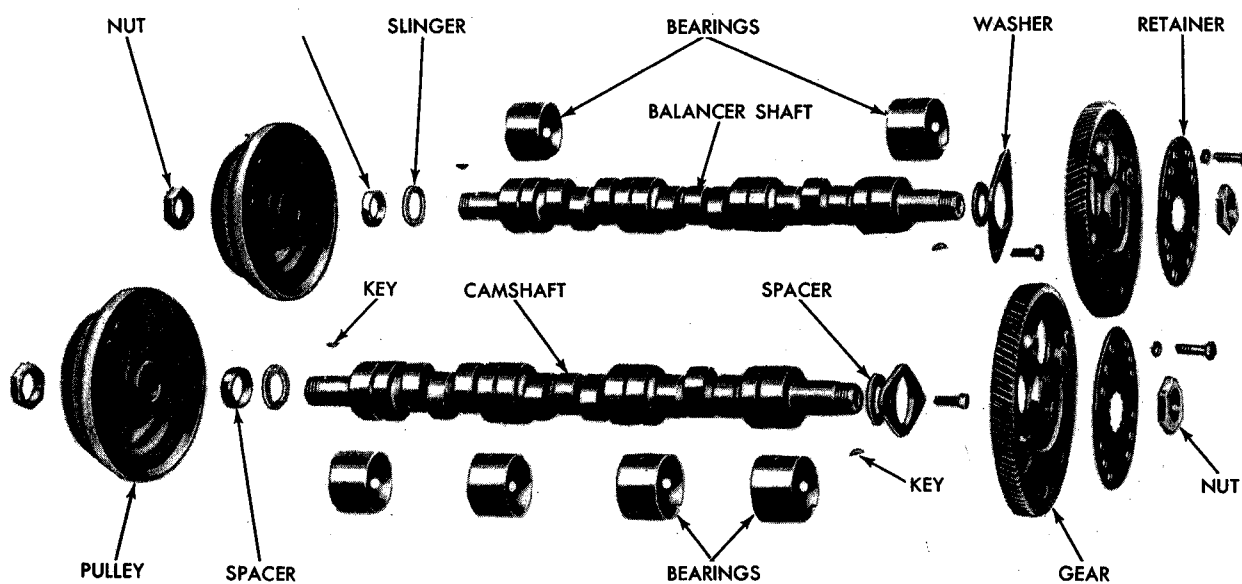
CYLINDER HEAD



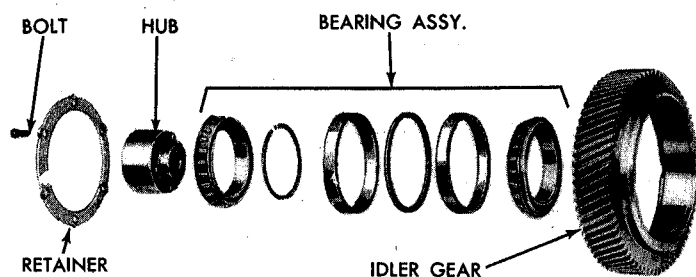
CRANKSHAFT



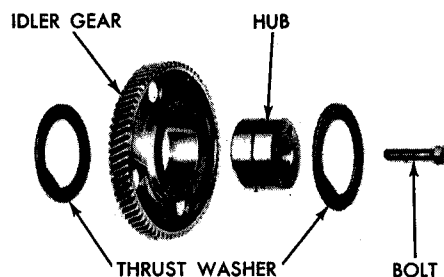
CONNECTING ROD, PISTON AND LINER



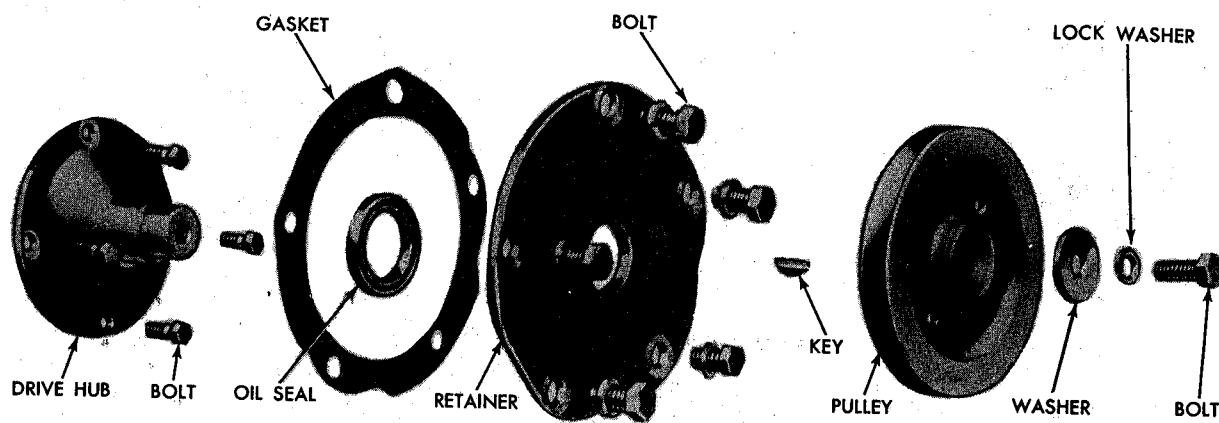
CAMSHAFT AND GEAR



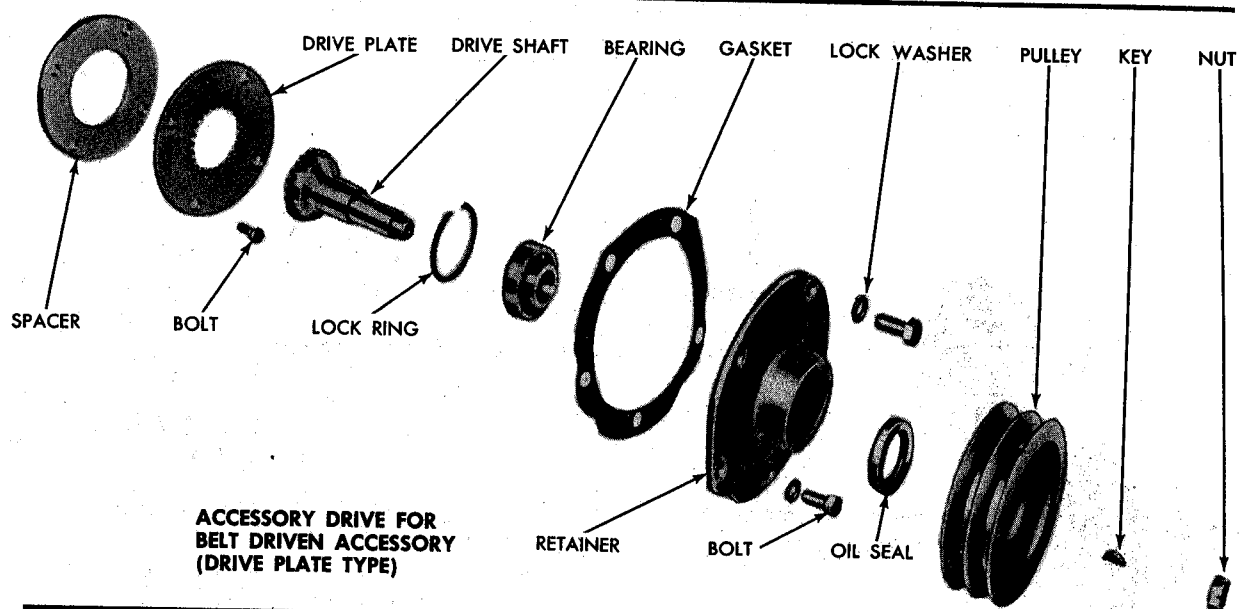
IDLER GEAR (8V-53)



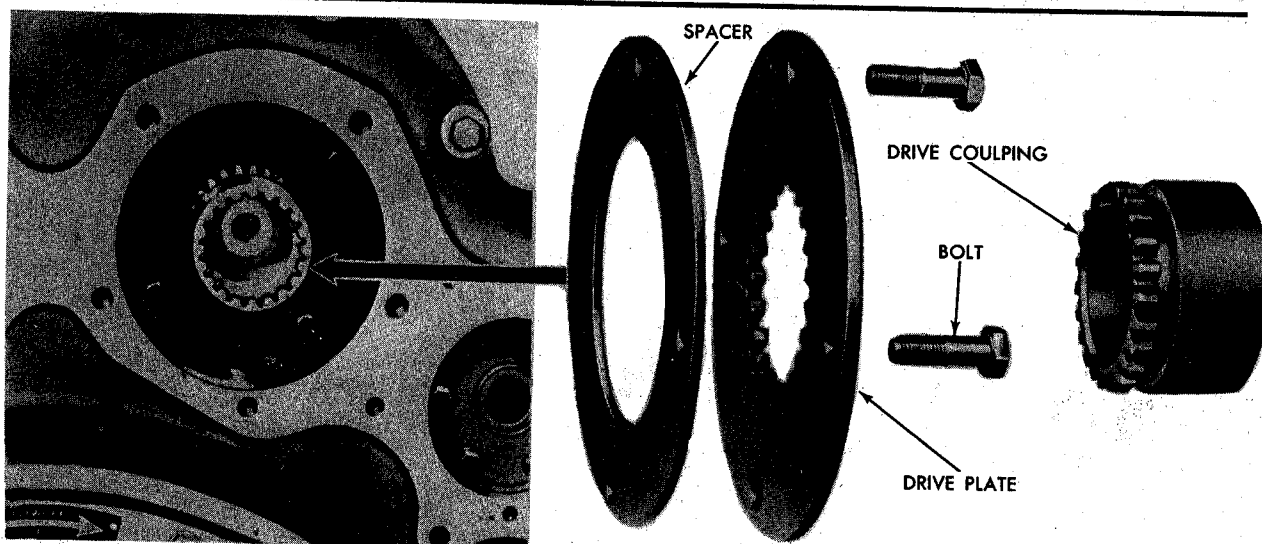
IDLER GEAR



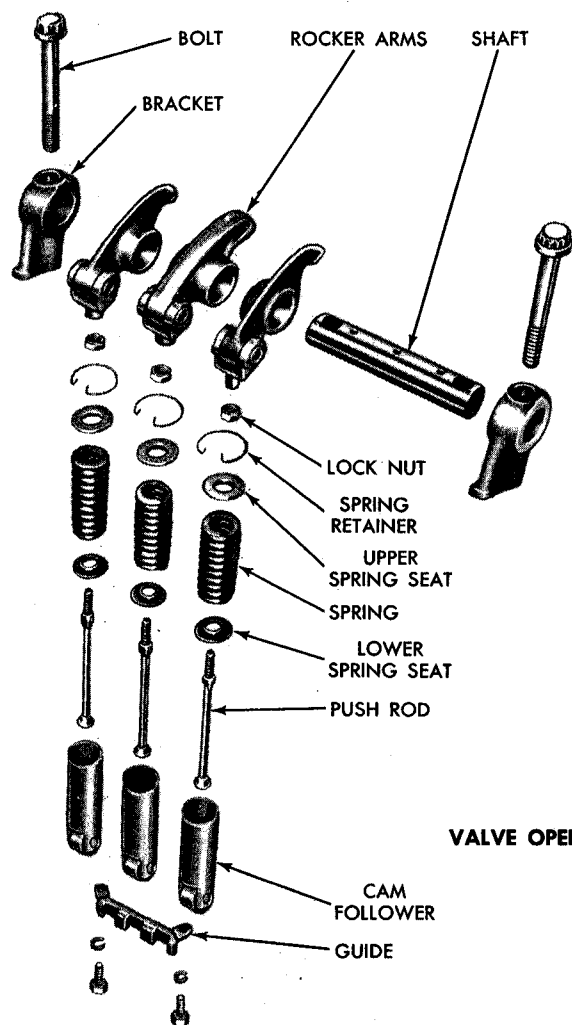
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE HUB TYPE)



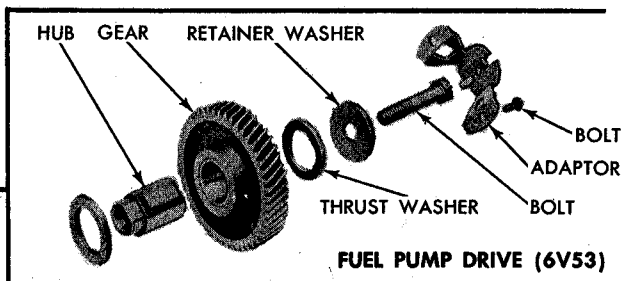
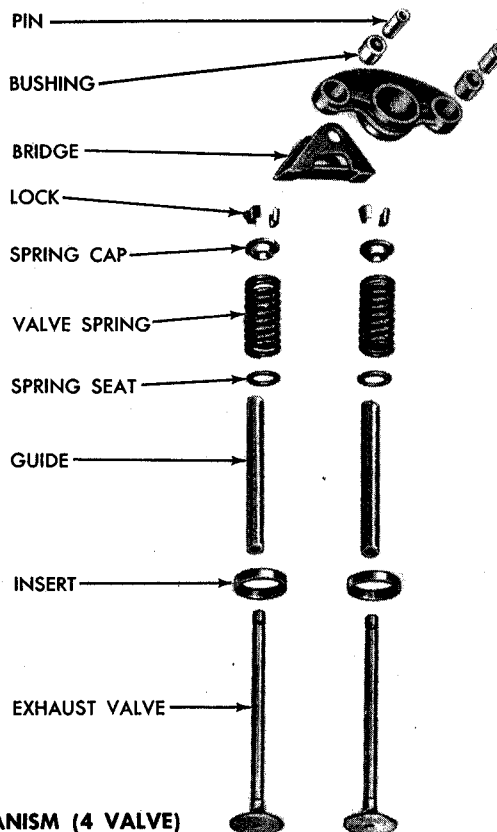
ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE PLATE TYPE)



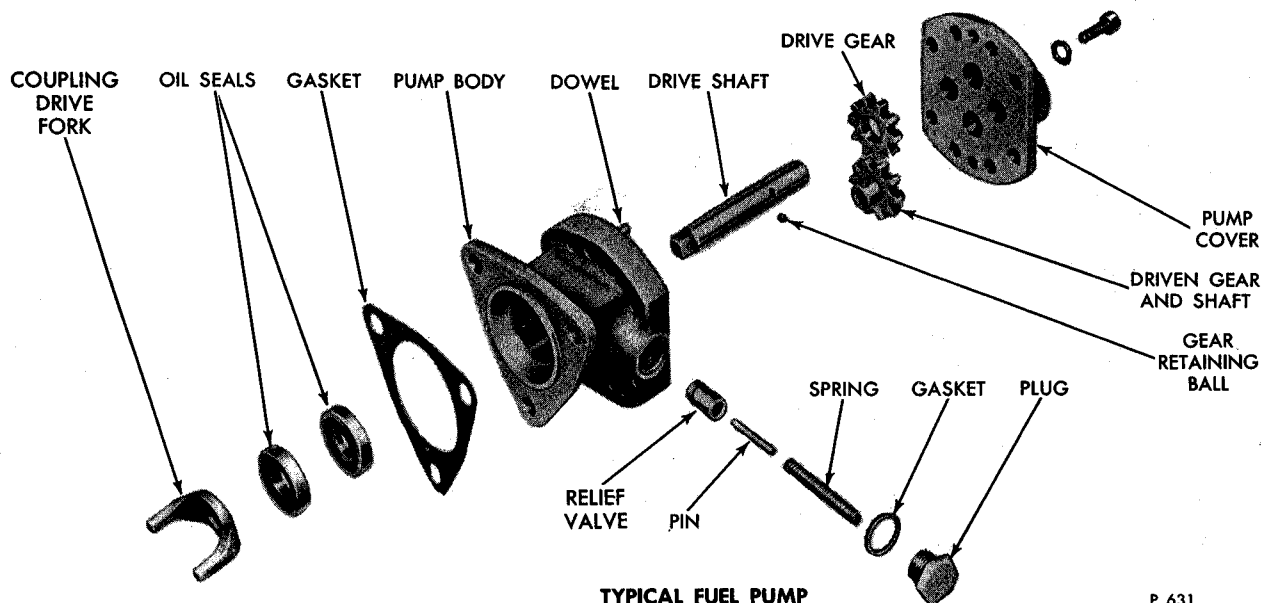
ACCESSORY DRIVE FOR DIRECT DRIVEN ACCESSORY (CAMSHAFT GEAR)



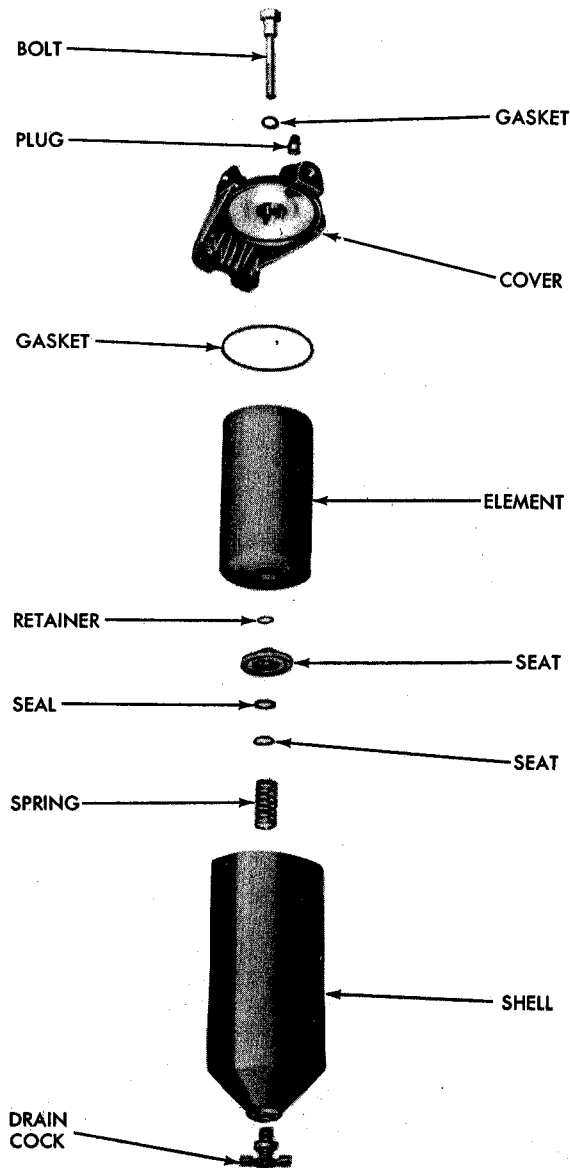
VALVE OPERATING MECHANISM (4 VALVE)



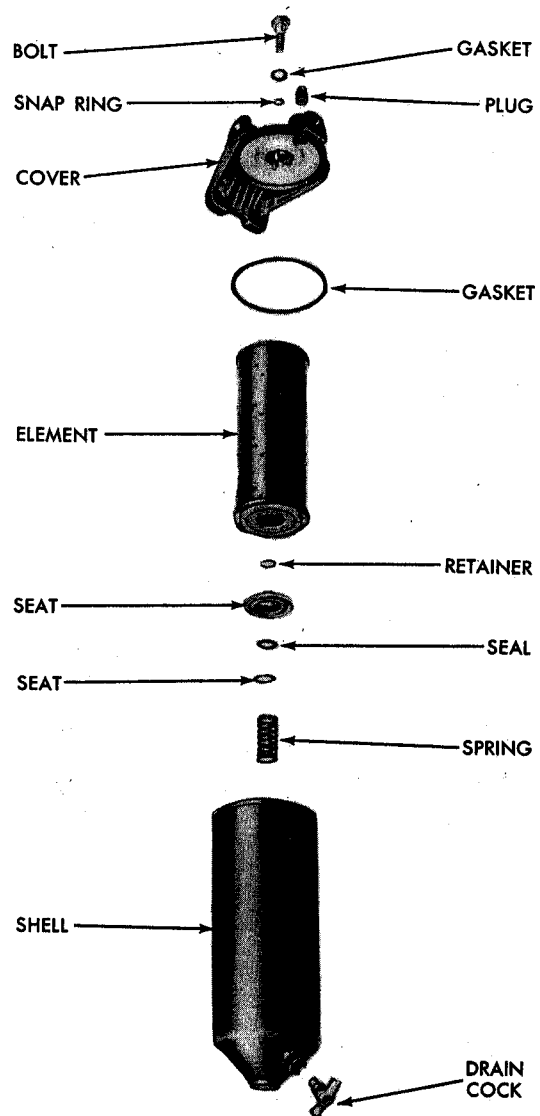
FUEL PUMP DRIVE (6V53)



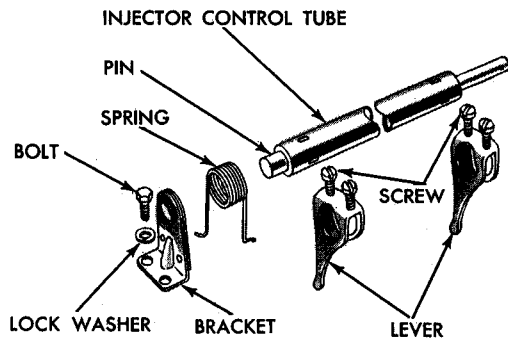
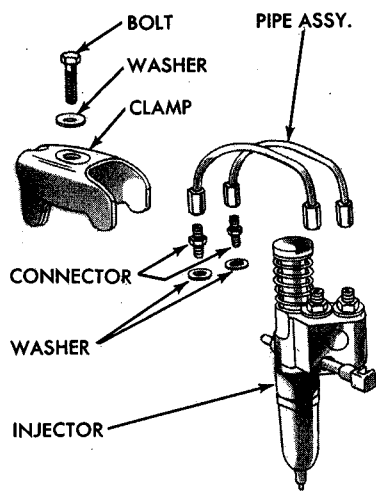
TYPICAL FUEL PUMP



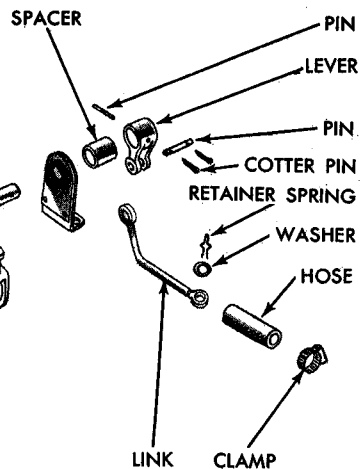
TYPICAL FUEL OIL STRAINER

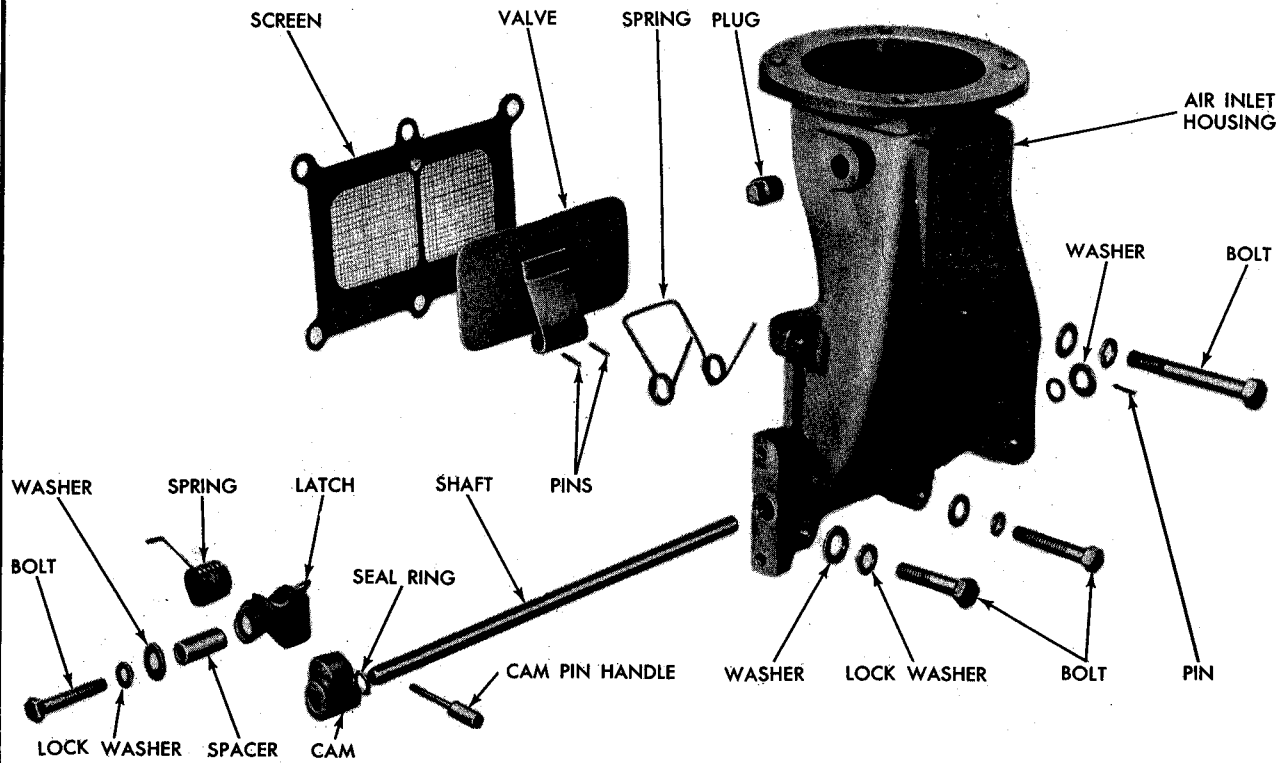


TYPICAL FUEL OIL FILTER

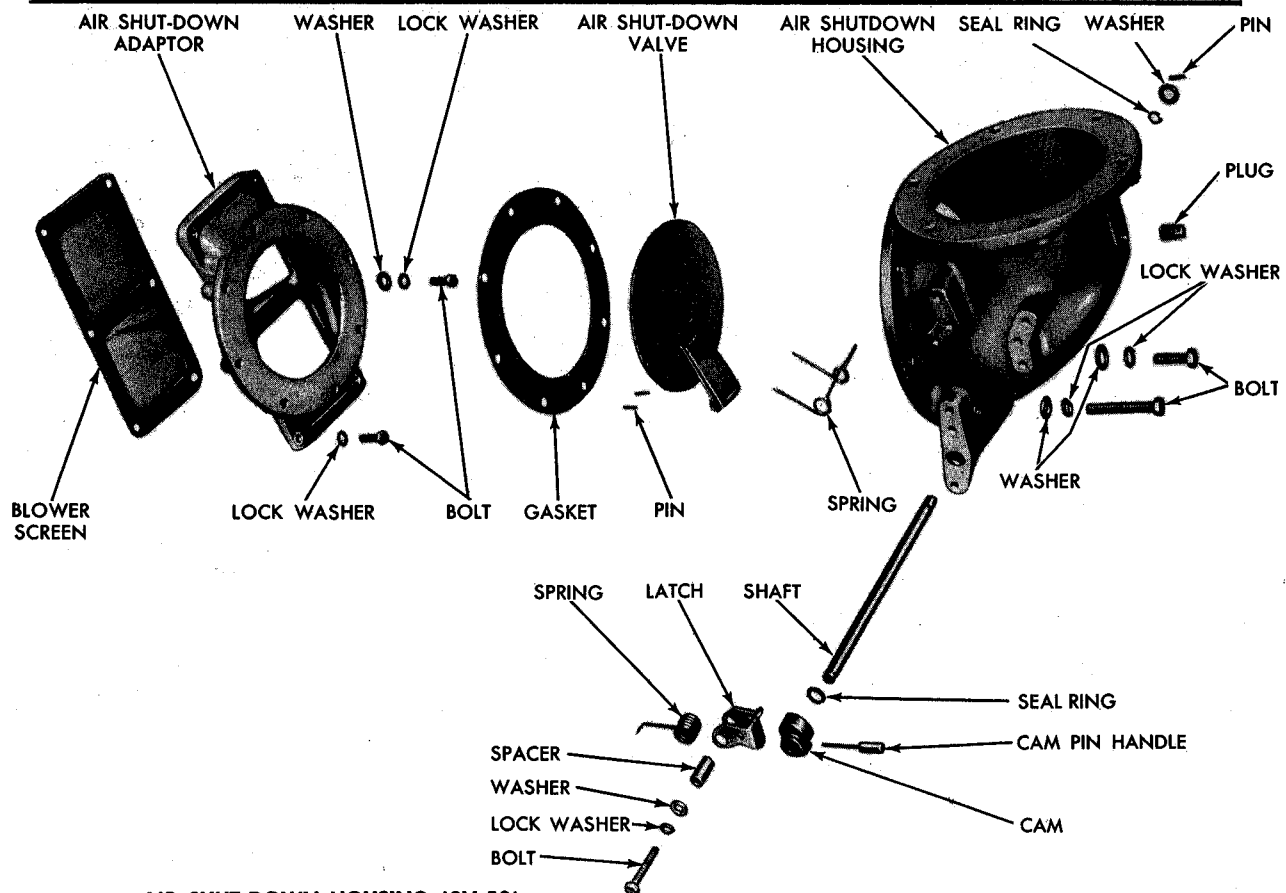


INJECTOR AND CONTROLS

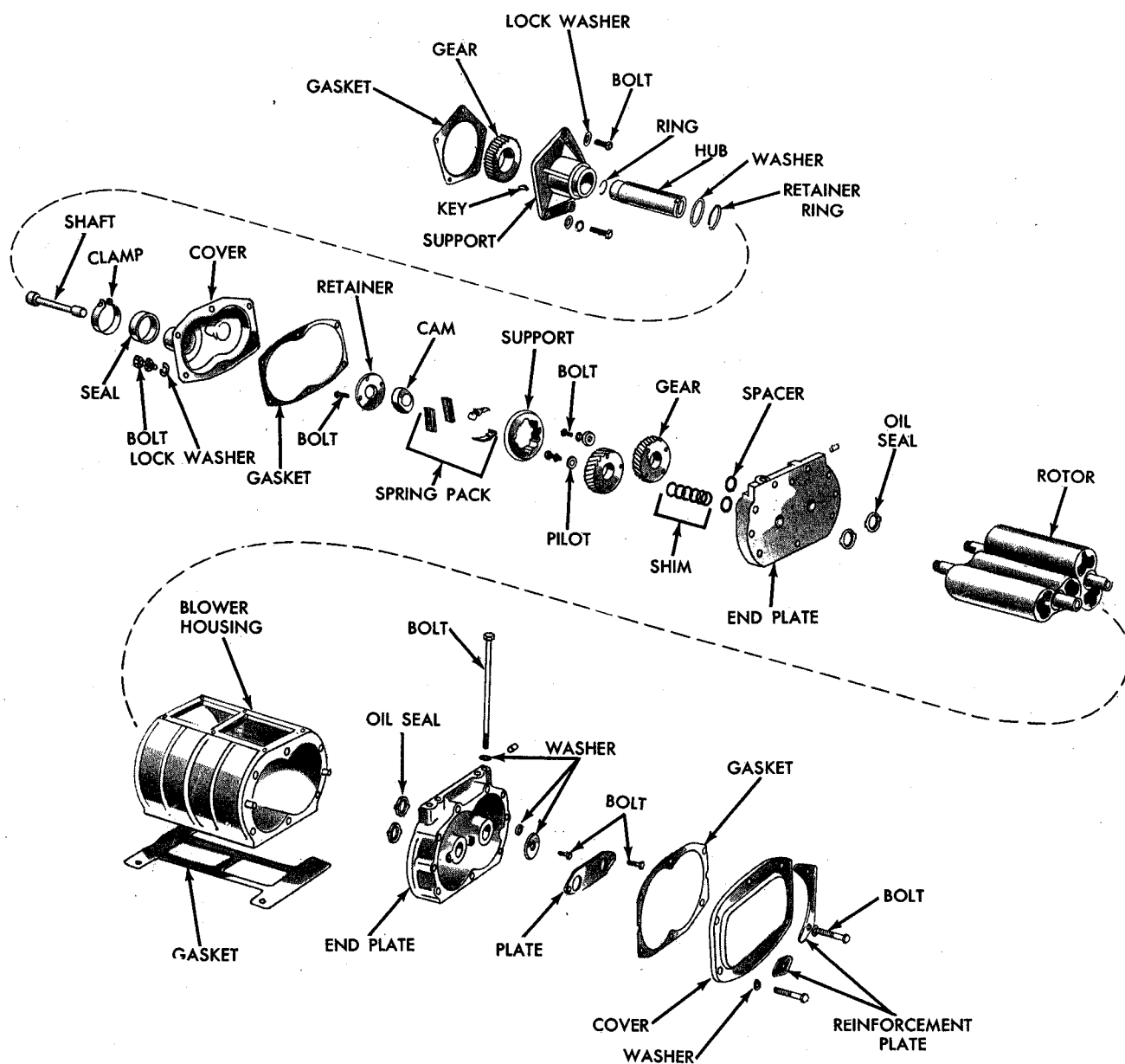




AIR SHUT-DOWN HOUSING

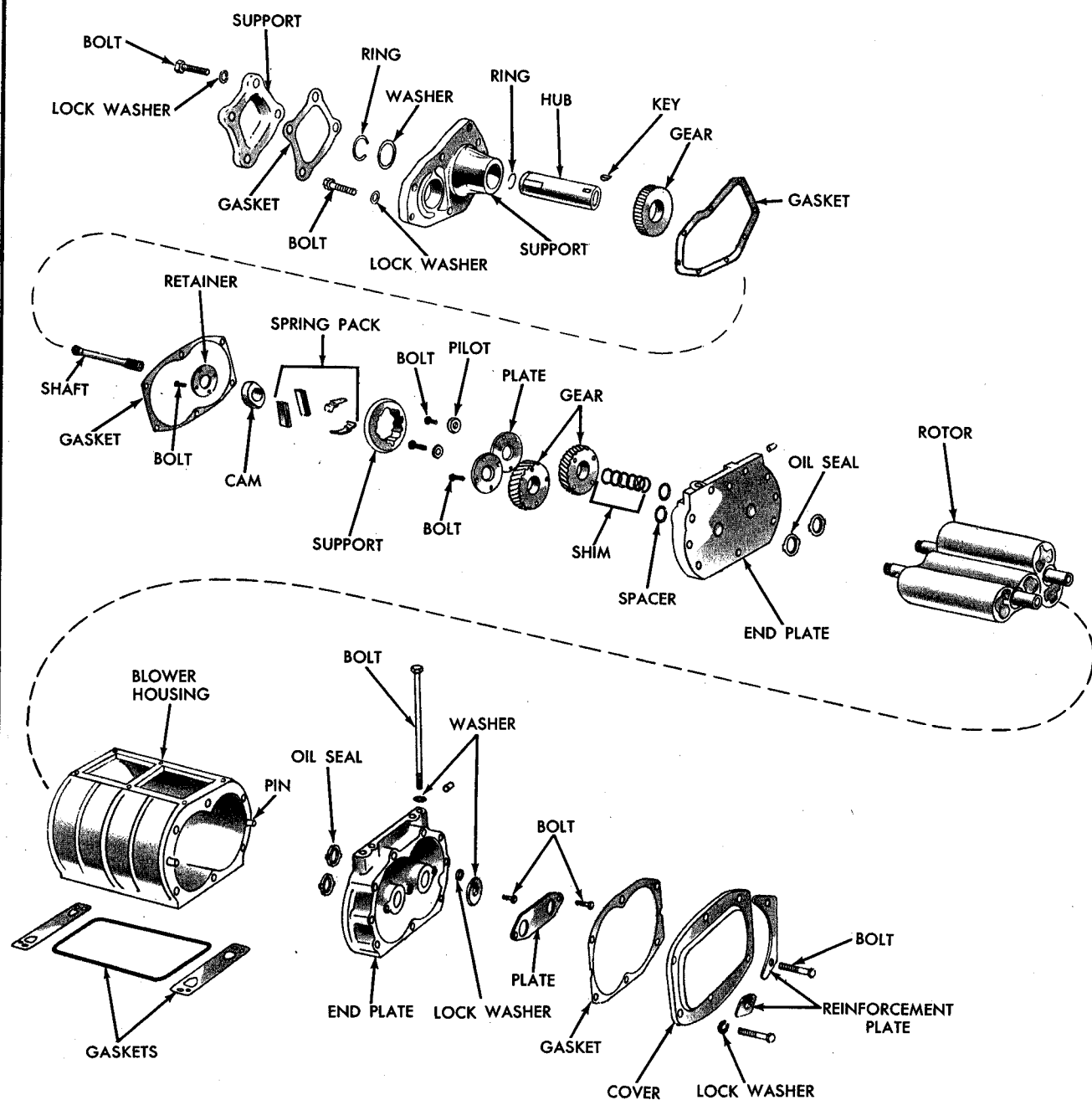


AIR SHUT-DOWN HOUSING (8V-53)

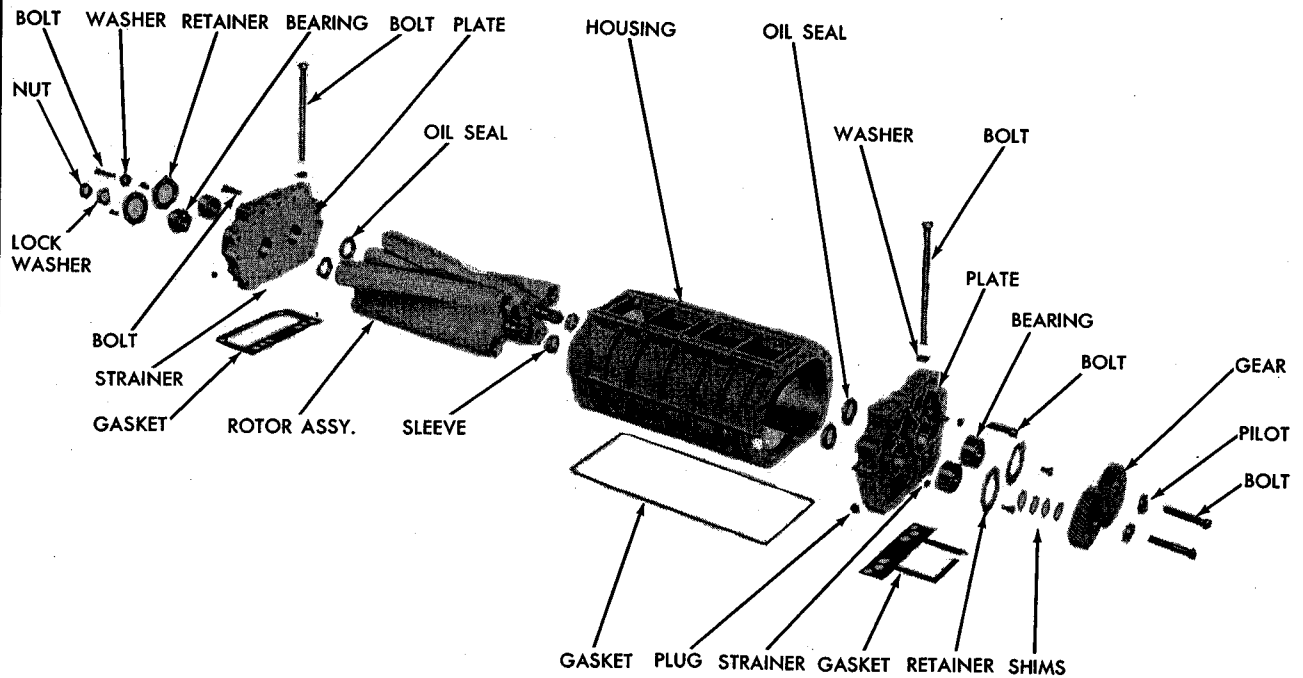
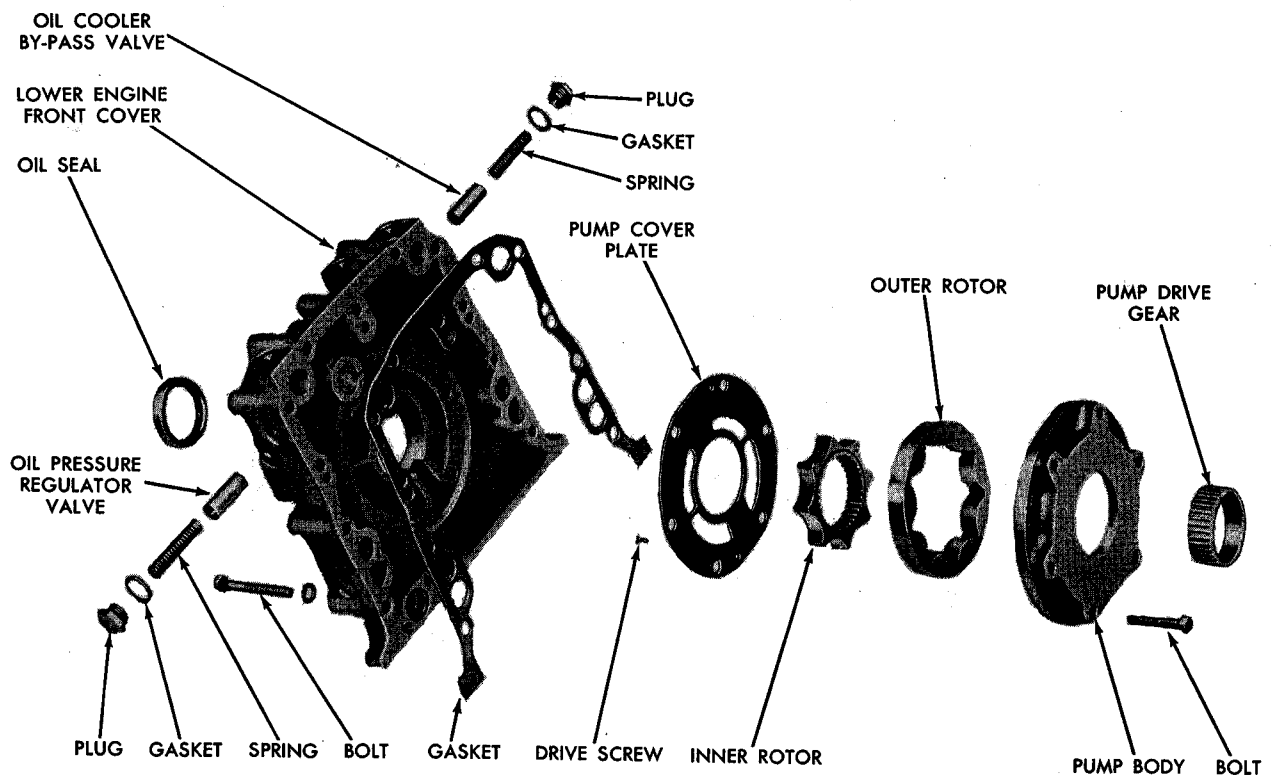


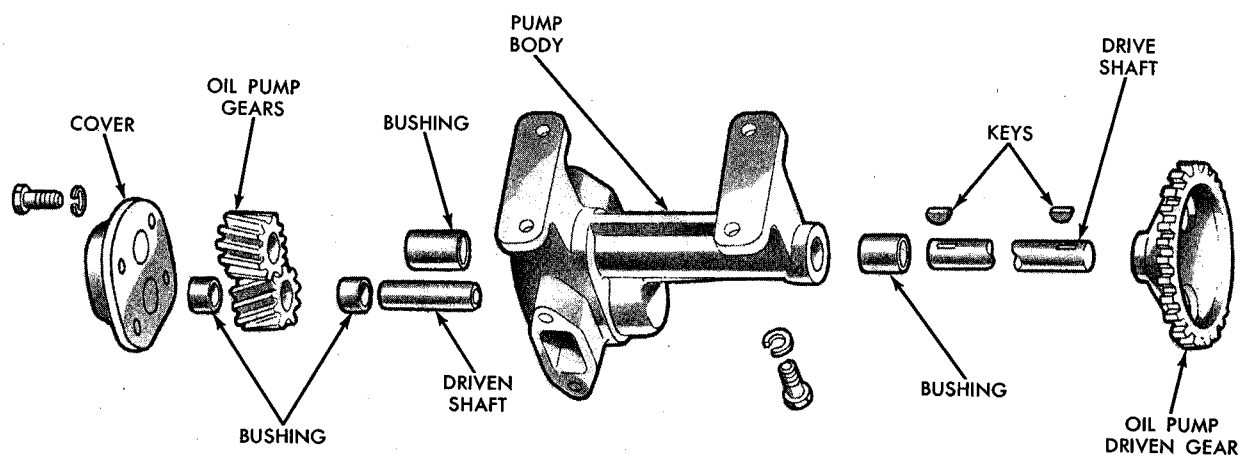
**BLOWER ASSEMBLY AND DRIVE
(4 CYL.)**

P 634

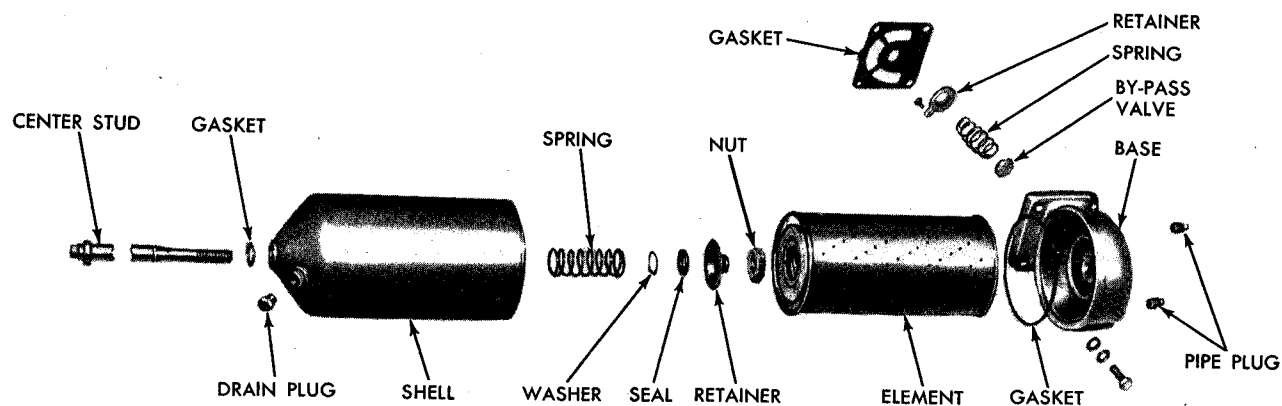


BLOWER ASSEMBLY AND DRIVE (6 CYL.)

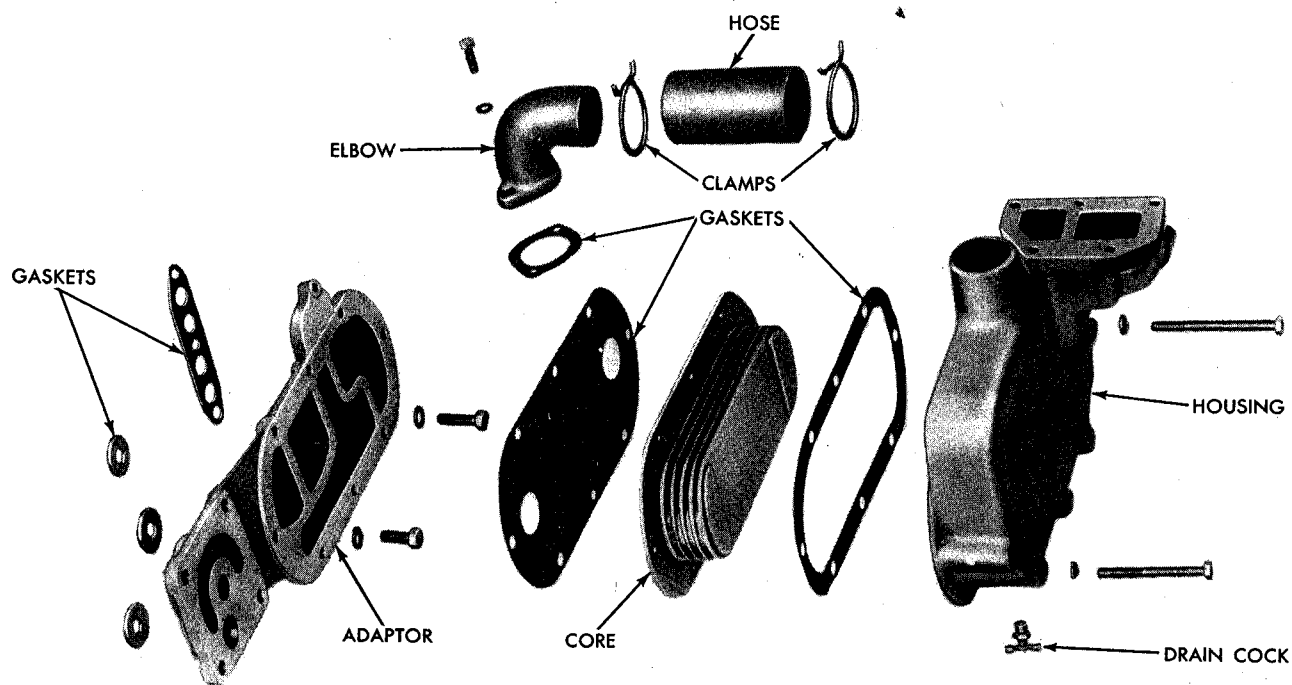
**BLOWER ASSEMBLY (8 CYL.)****OIL PUMP AND REGULATOR**



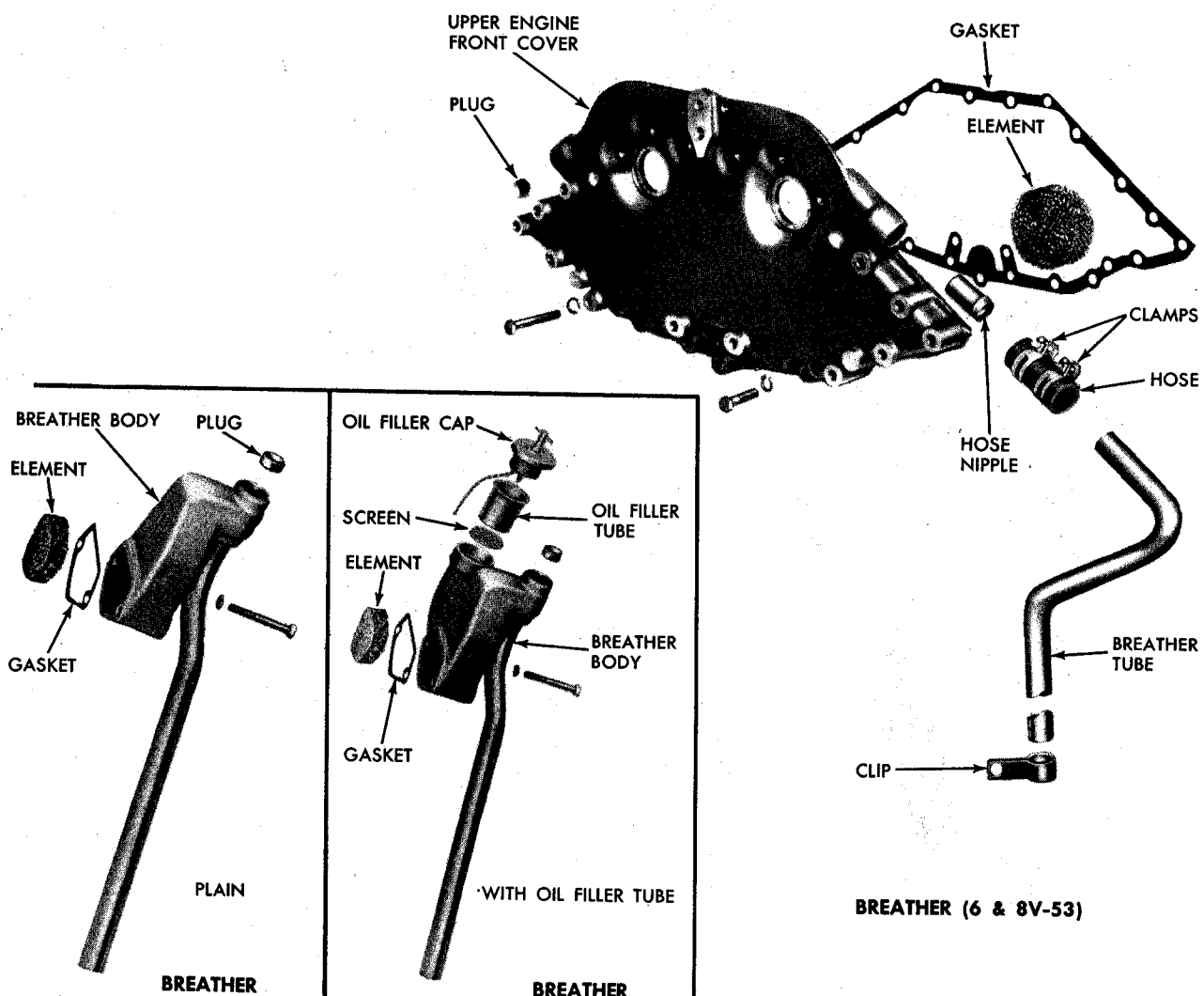
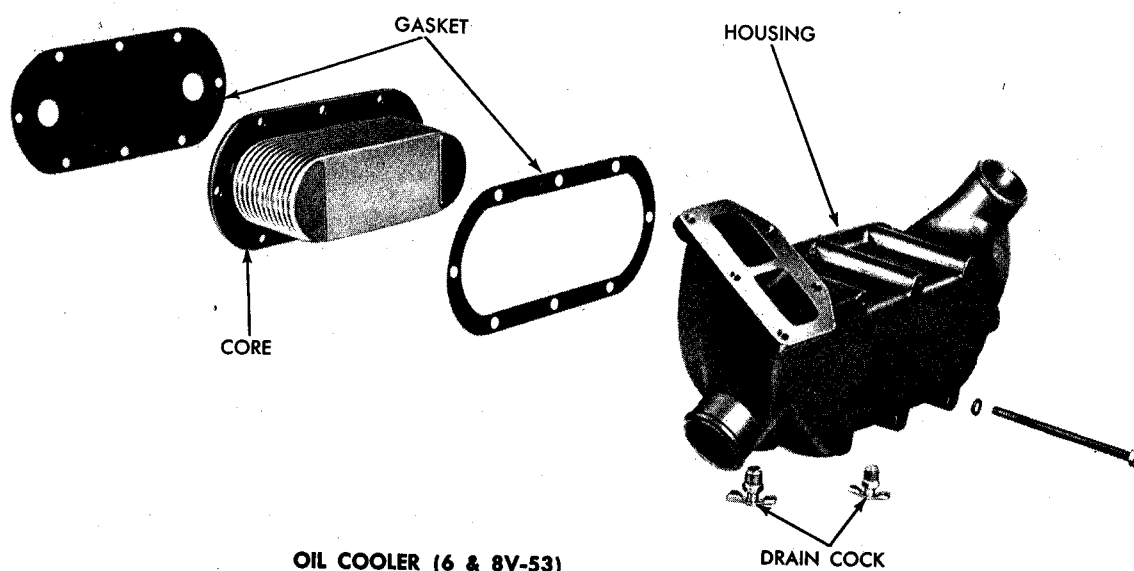
OIL PUMP (8V-53)

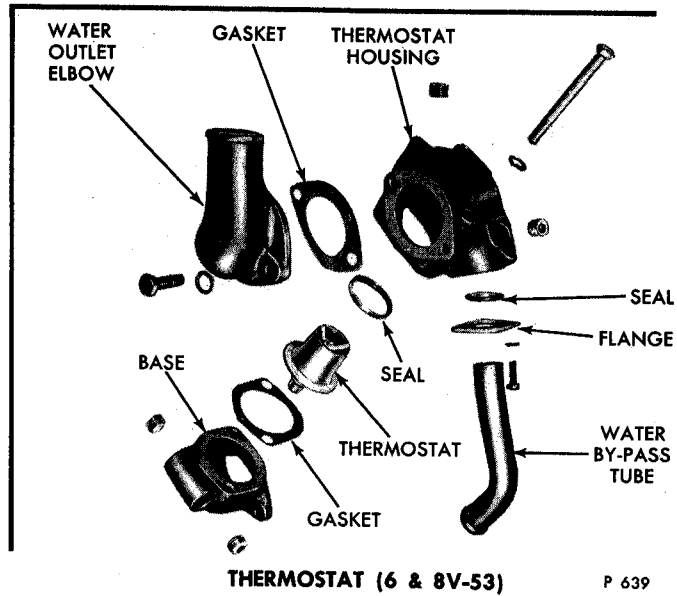
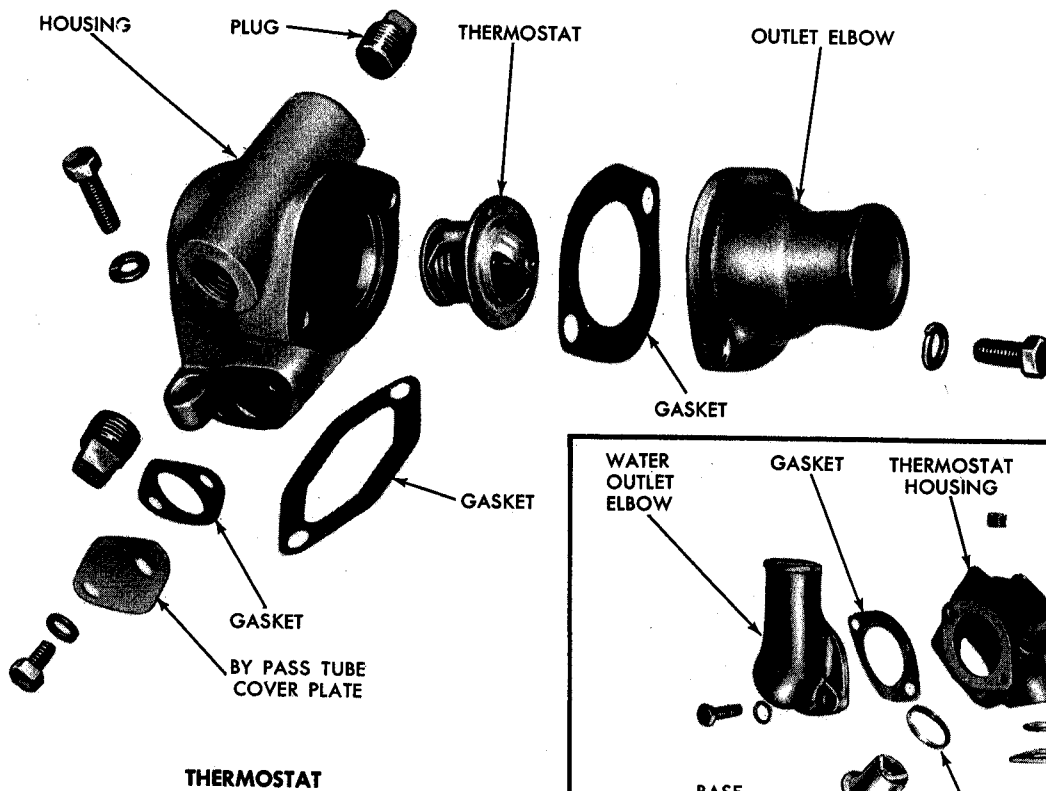
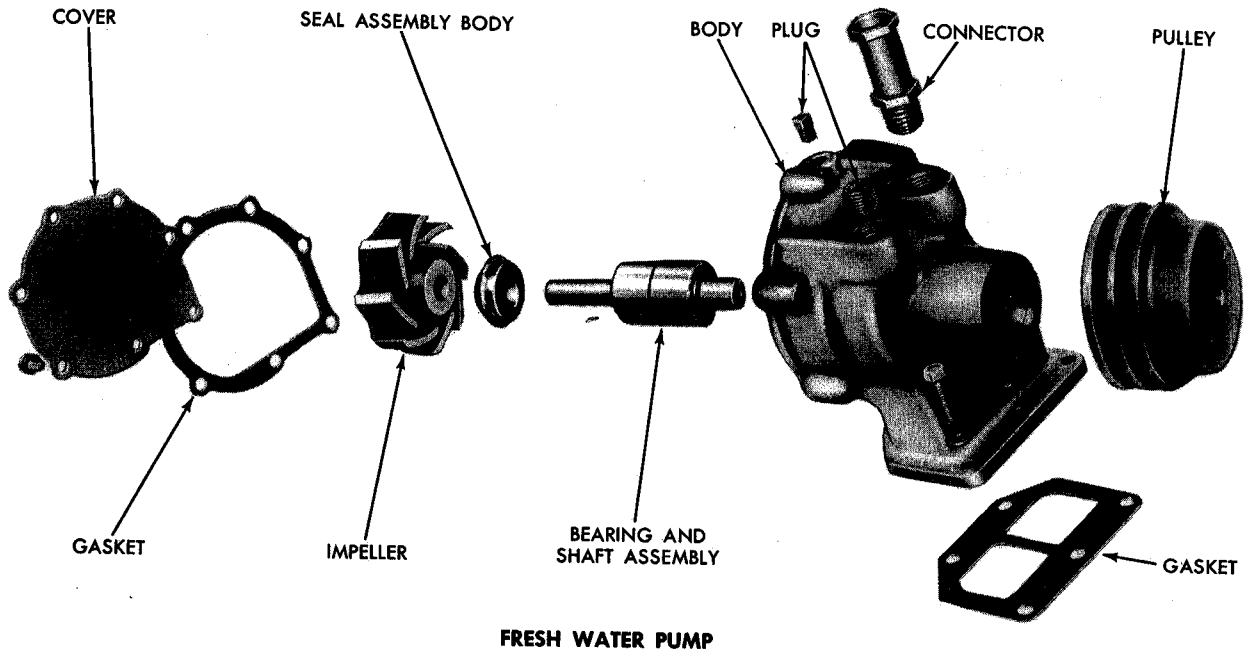


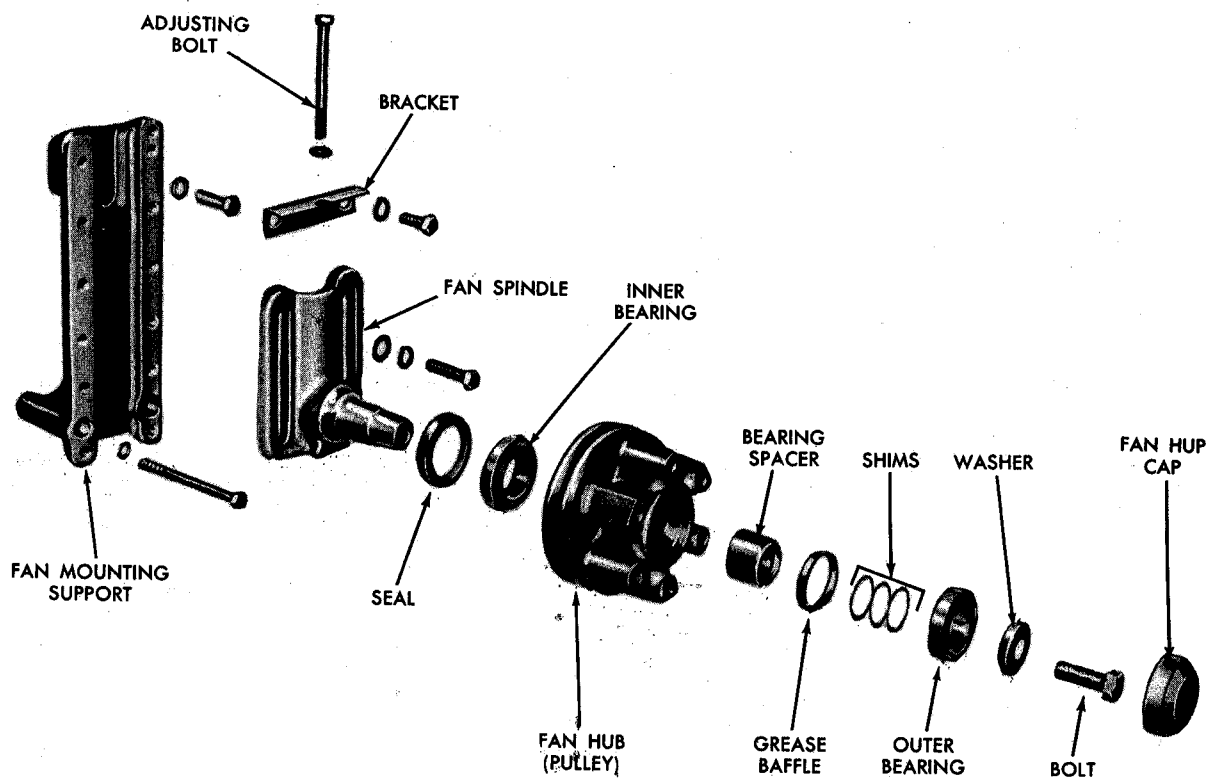
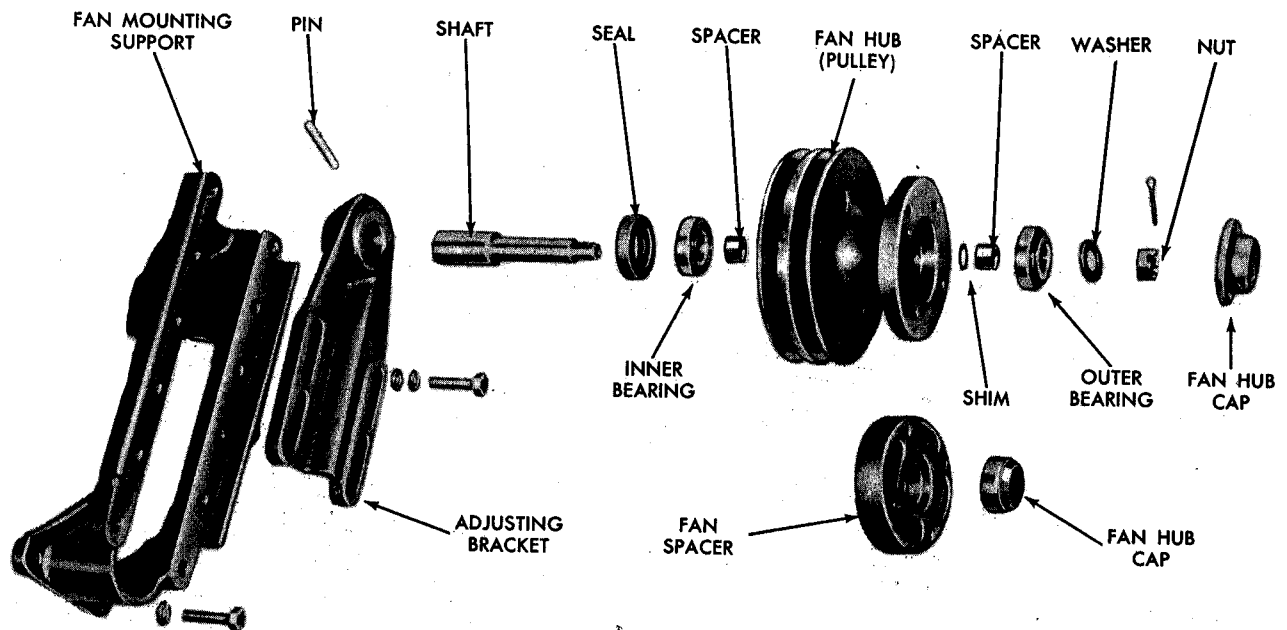
OIL FILTER

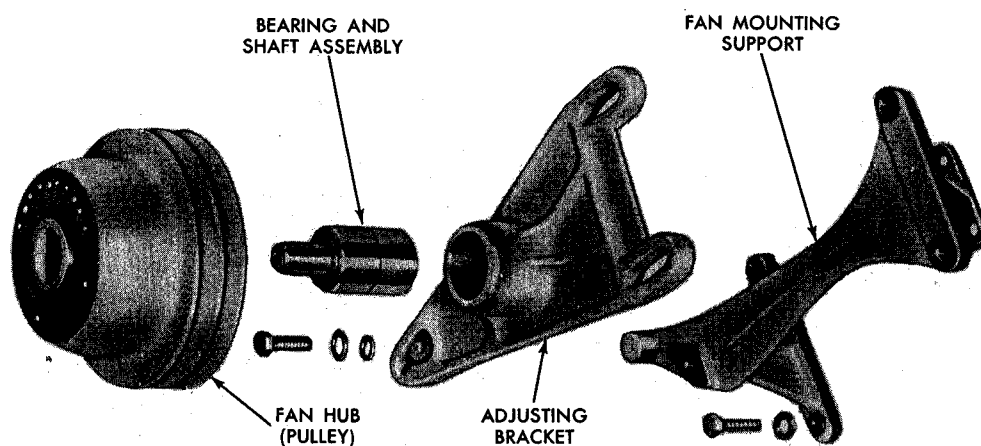
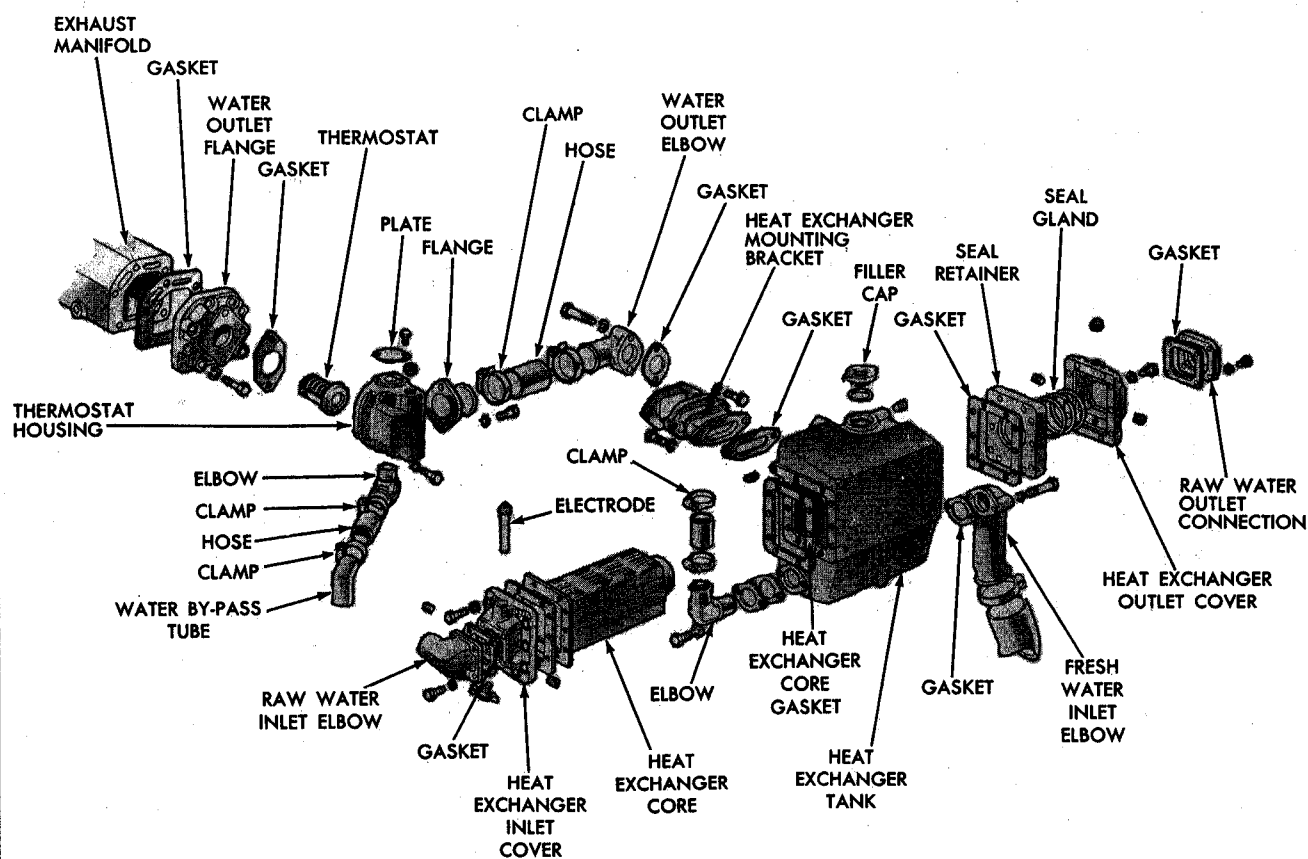


OIL COOLER

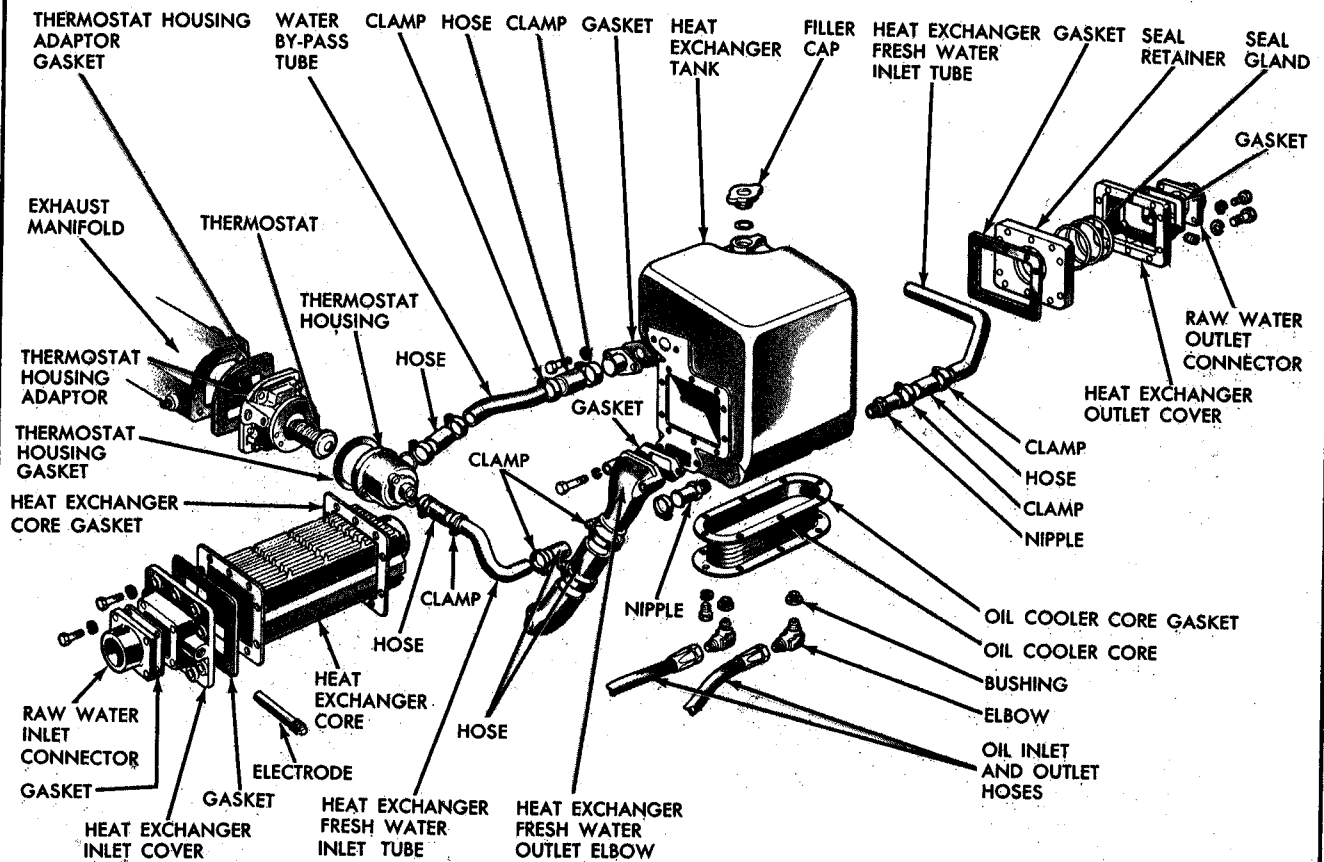




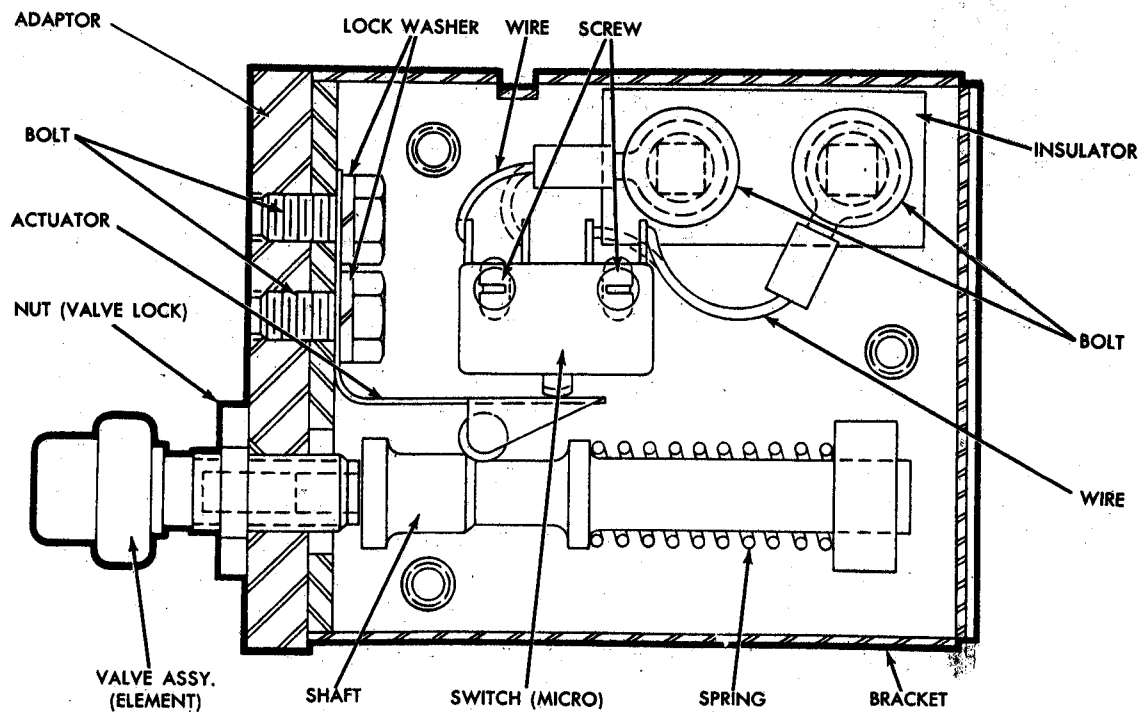


**FAN MOUNT**

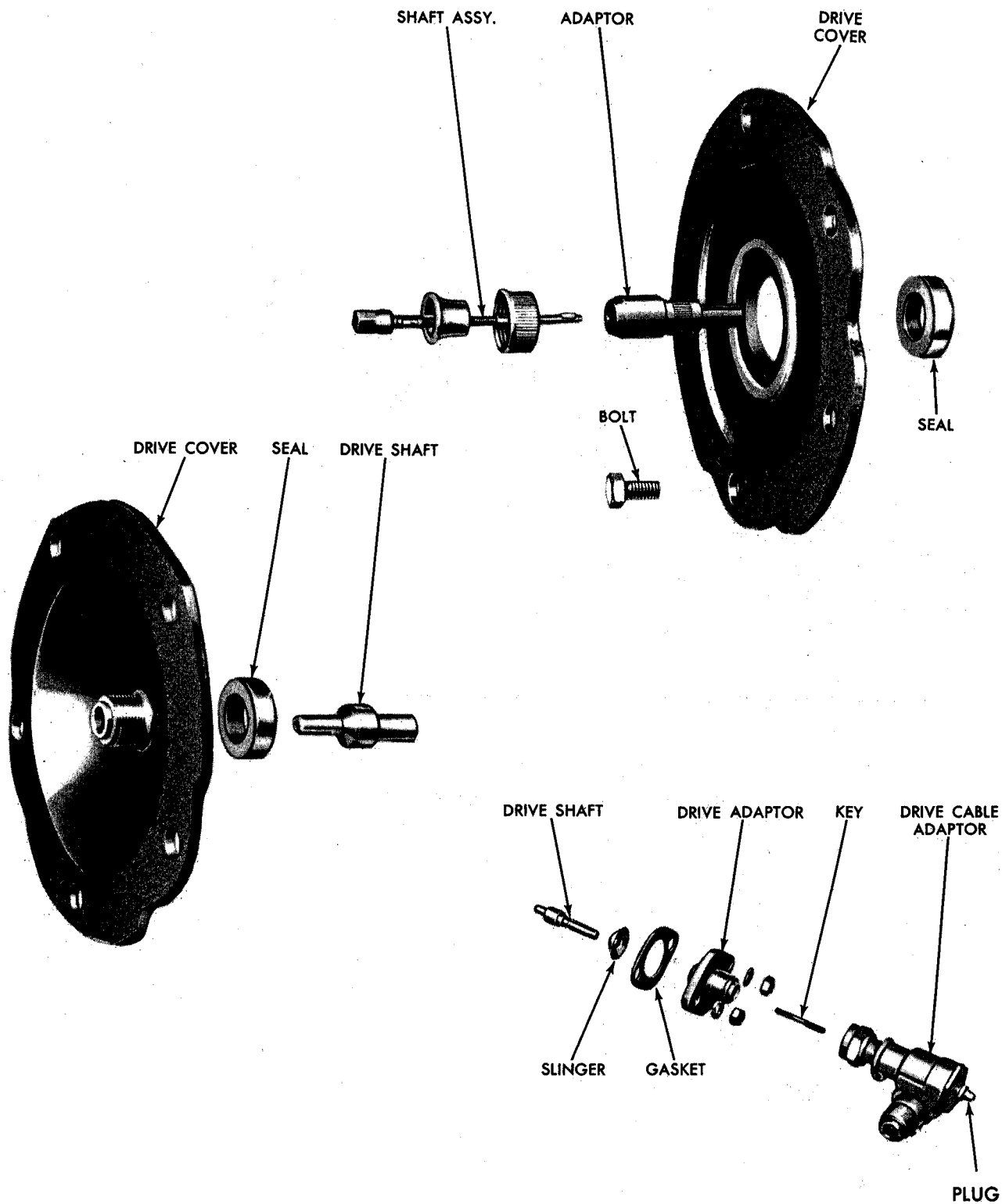
HEAT EXCHANGER



HEAT EXCHANGER (6 AND 8V-53)

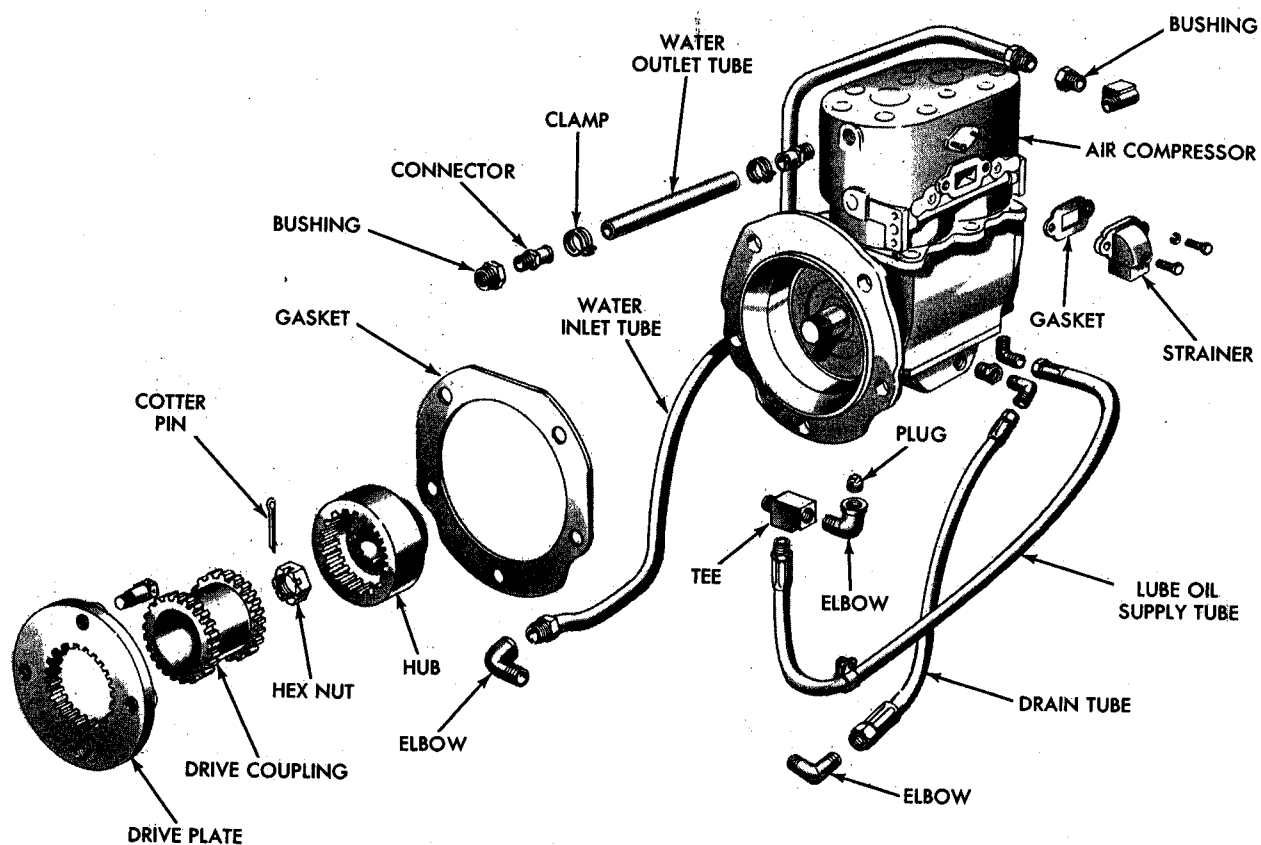


WATER TEMPERATURE SHUTDOWN SWITCH

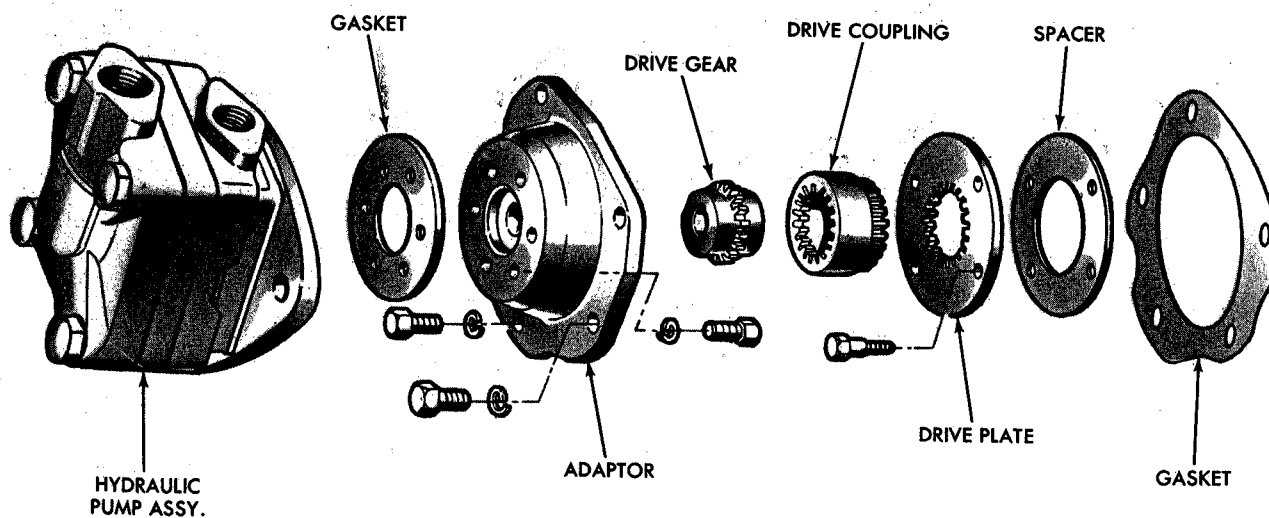


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TACHOMETER DRIVE COVERS AND ADAPTORS



AIR COMPRESSOR AND DRIVE



HYDRAULIC PUMP AND DRIVE

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