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: Ordinarily, adjustment is required when the governor has been repaired or replaced.

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 rpm (Fig. 8).

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

5. Shut the engine down and remove the governor cover.

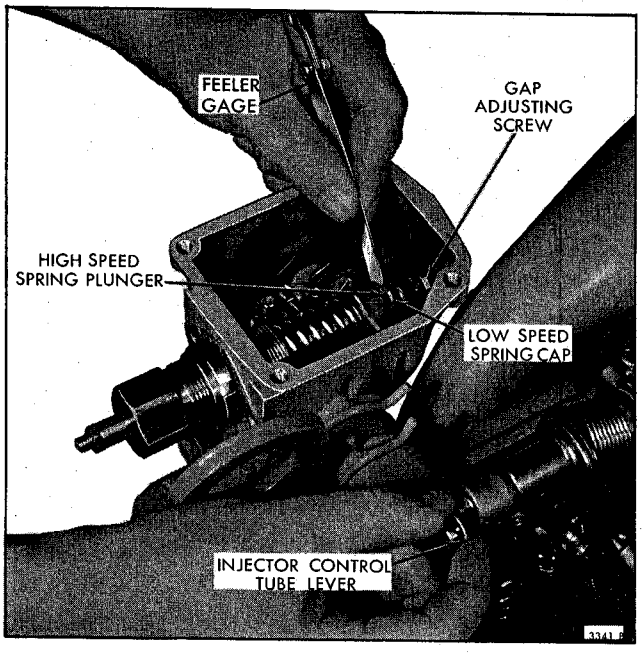


Fig. 4 - Adjusting Governor Gap

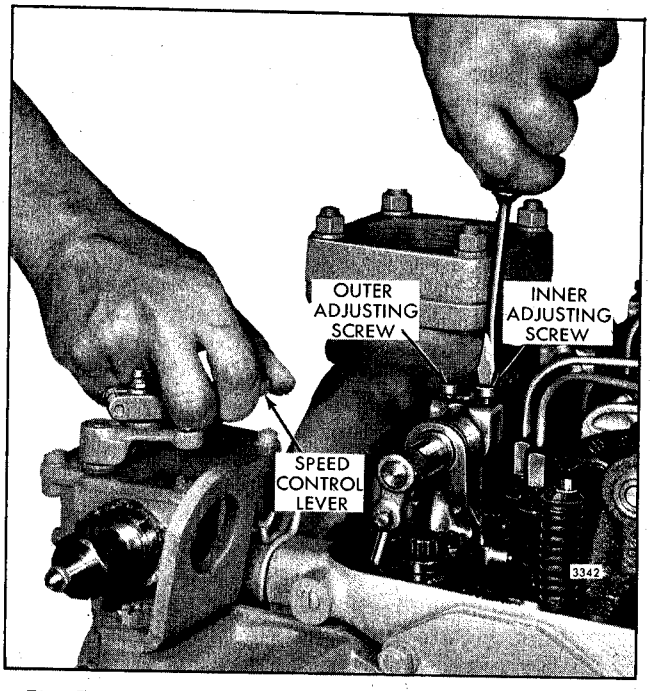


Fig. 5 - Positioning the Rear Injector Rack Control Lever

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 cap and the high speed spring plunger with a .0015" feeler gage. If gap setting is incorrect, reset the gap adjusting screw (Fig. 4).
8. 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.
9. 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:

Speed control lever at the maximum speed position.

Governor low speed gap closed.

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

Injector fuel control racks in the full-fuel position.

Adjust the rear injector rack control lever (Fig. 5) first to establish a guide for adjusting the remaining injector rack control levers.

1. Refer to Fig. 5, and disconnect any linkage attached to the speed control lever.

2. Loosen all 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. 5. 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 screws until they are tight.

   The above step 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, the following check should be performed.

   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.

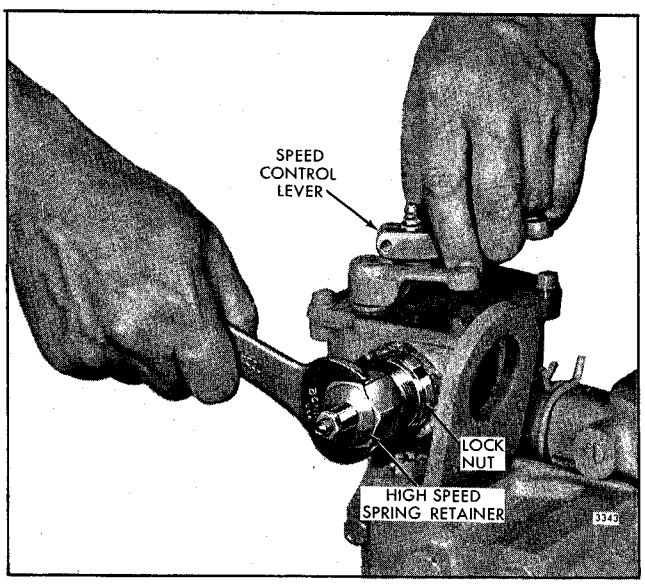


Fig. 6 - Adjusting Maximum No-Load Engine Speed

   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 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 slightly the inner adjusting screw 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 unit name plate, the maximum no-load speed may be set as follows:

TYPE A GOVERNOR SPRINGS (Fig. 7):

1. Loosen the lock nut and back off the high speed spring retainer approximately five turns (Fig. 6).

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. 7):

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.

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.

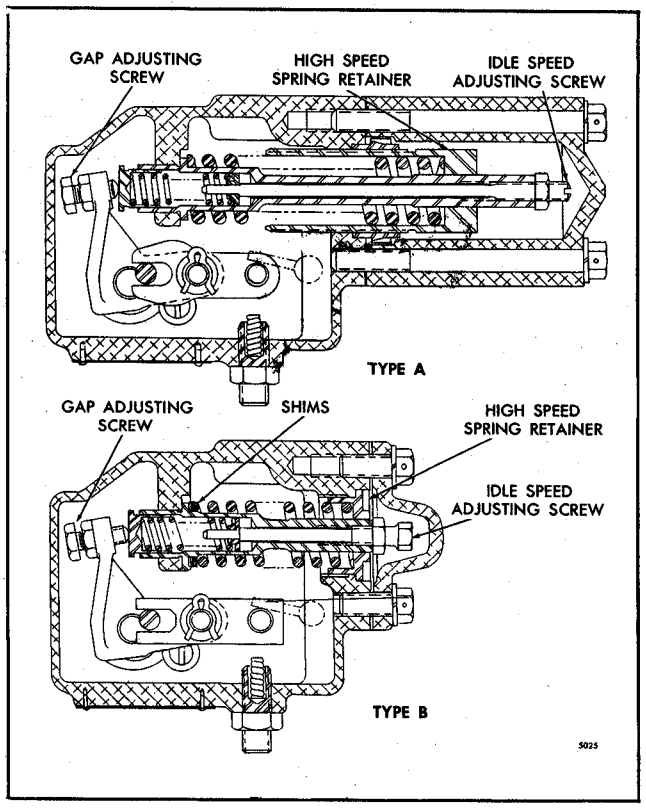


Fig. 7 - Governor Spring Assemblies

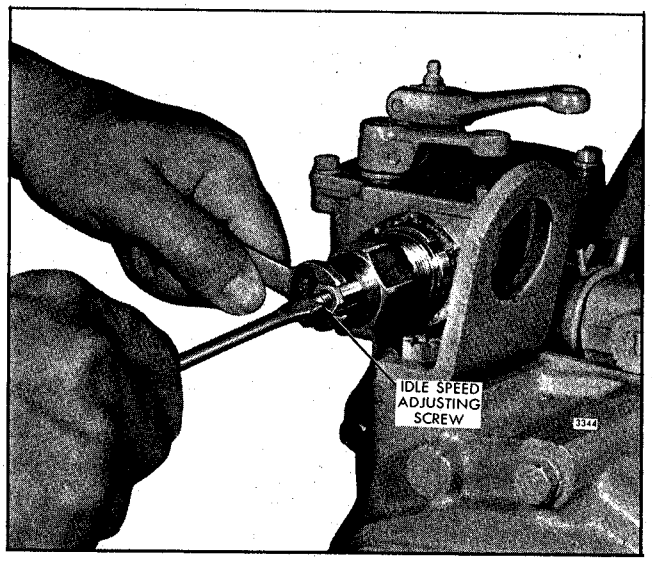


Fig. 8 - Adjusting Engine Idle Speed

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

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

   c. Replace the high speed spring on the high speed plunger and assemble the spring assembly into 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. 8) until the engine idles at the recommended idle speed.

   The recommended idle speed is 500 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.

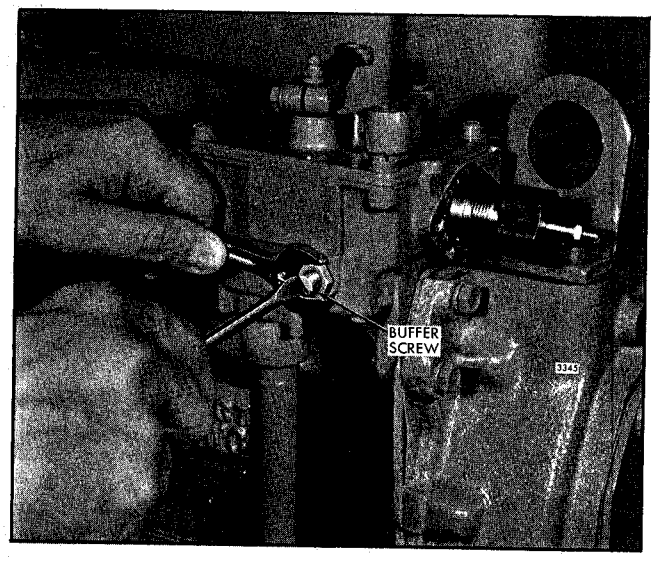


Fig. 9 - Adjusting the Buffer Screw

Adjust Buffer Screw

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

1. With the engine running at normal operating temperature, turn buffer screw in (Fig. 9) 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.

Load Limit Device

Engines may be equipped with a load limiting device on each cylinder head to reduce the maximum horsepower by reducing the fuel output. The device, illustrated in Fig. 9a, mechanically limits the travel of the injector racks and thereby the fuel output of the injectors.

Adjustment

After the engine tune-up is completed, it should be ascertained that the parts comprising the load limiting device are properly installed on the engine as shown in Fig. 9a. The load limiting device may then be adjusted as follows:

1. Loosen the load limit screw lock nut.

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 the bottom of the lock nut is 7/8" from the bottom of the load limit screw.

4. Loosen the load limit lever clamp bolts so 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 rack control tube in the full-fuel position and place the load limit lever against the bottom of the load limit screw. Then, tighten the load limit lever clamp bolts.

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

8. Hold the load limit screw to keep it from turning, then "set" the 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.

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

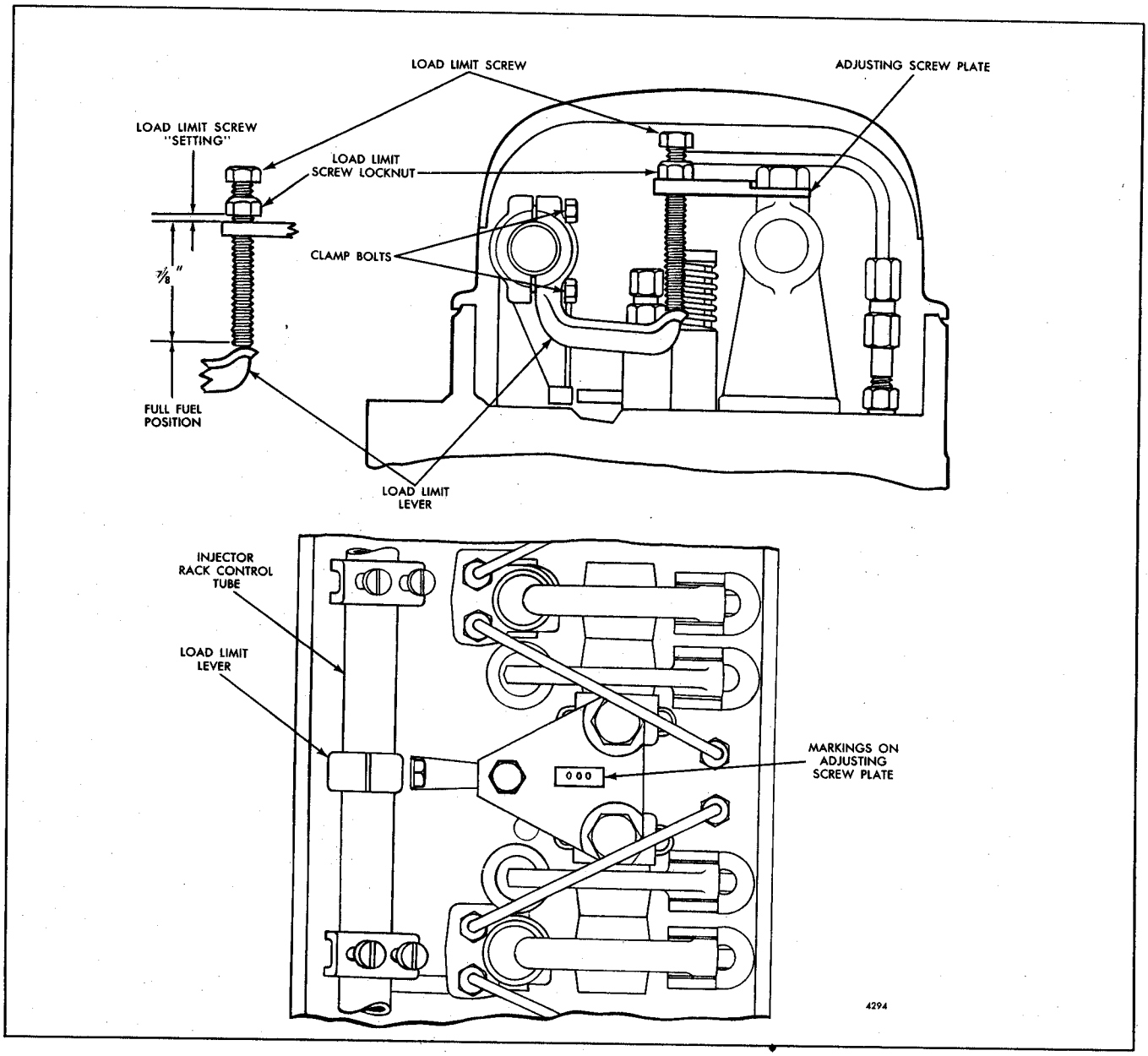


Fig. 9a – Engine Load Limiting Device

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT (V-Type Engines) 6V-53 ENGINE

The limiting speed mechanical governor assembly is mounted at the rear of the engine, between the flywheel housing and the blower (Fig. 10). The governor is driven by the right blower rotor drive gear. The left blower rotor drive gear is driven by a shaft, 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. 14).

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.

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

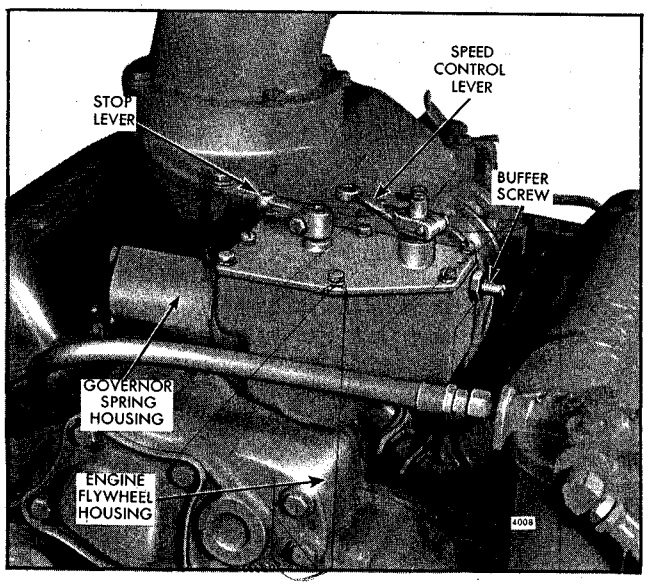


Fig. 10 - Limiting Speed Governor Mounting (6V Engine)

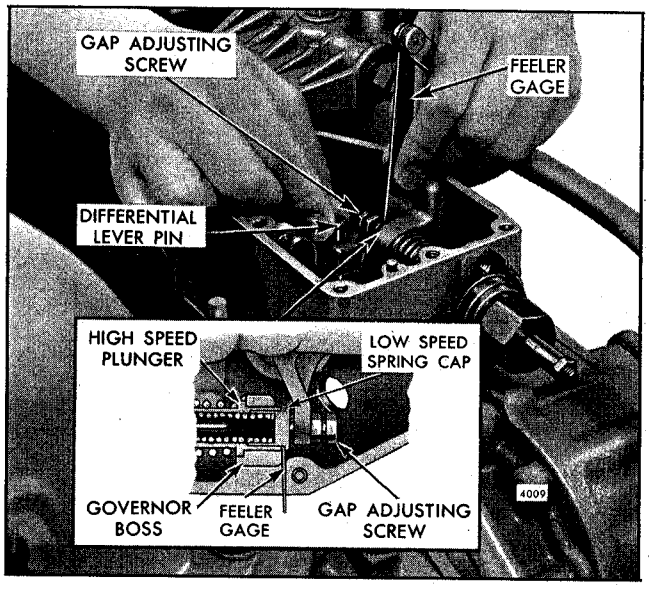


Fig. 11 - Checking Governor Gap

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then, adjust the idle screw (Fig. 15) 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. 11).

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

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

8. Recheck the gap and readjust if necessary.

9. Stop the engine and reinstall the governor cover.

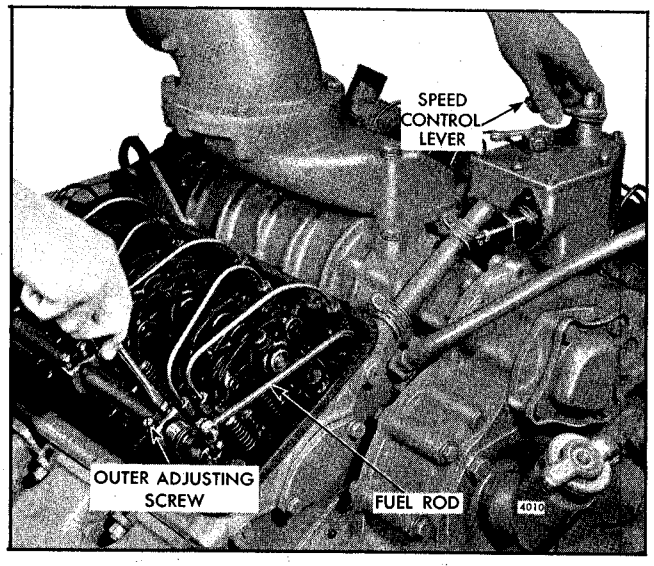


Fig. 12 - Positioning No. 3L Injector Rack Control Lever

Position Injector Rack Control Levers

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

Speed control lever at the maximum speed position.

Governor low speed gap closed.

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

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. 12) 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.

   The above step 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.

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 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 unit name plate, set the maximum no-load speed as outlined below.

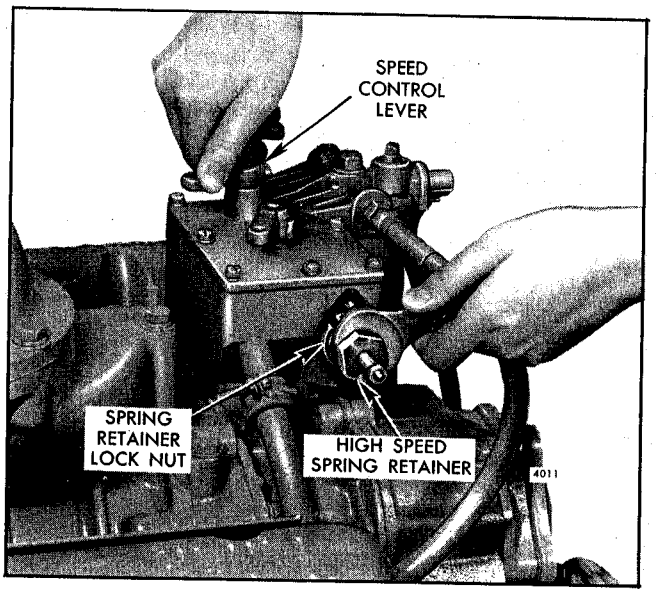


Fig. 13 - Adjusting Maximum No-Load Engine Speed

TYPE A GOVERNOR SPRINGS (Fig. 14):

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. 13) until the engine is operating at the recommended no-load speed. Use an accurate tachometer to accurately determine the engine speed. 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
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. 14):

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

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

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

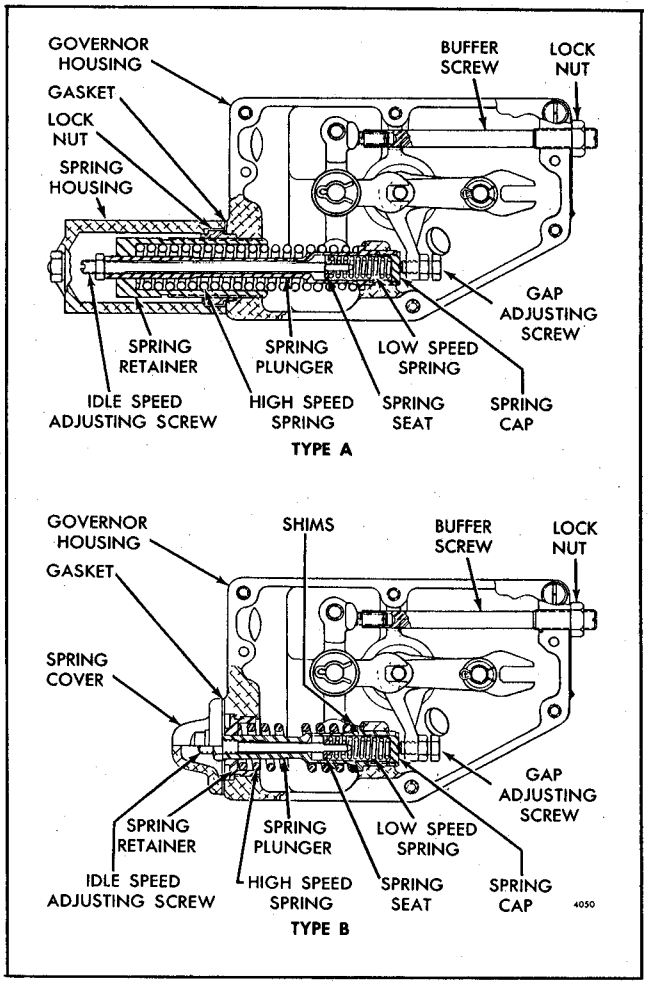


Fig. 14 - Governor Spring Assemblies

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. 15) until the engine idles at the recommended idle speed. The recommended idle speed is 500-600 rpm, but may vary with the engine application.

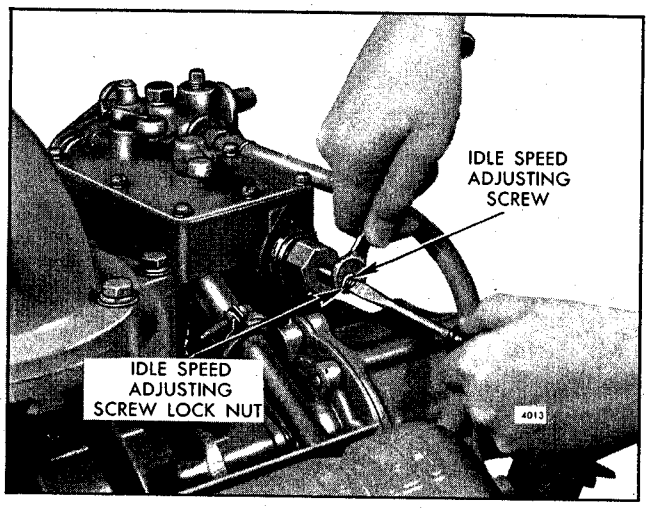


Fig. 15 - Adjusting Engine Idle Speed

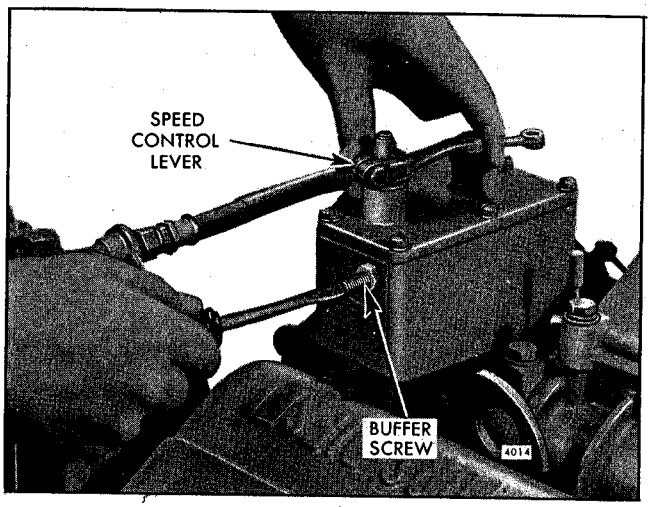


Fig. 16 - Adjusting Buffer Screw

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.
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. 16) 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.

8V-53 ENGINE

The limiting speed mechanical governor assembly is mounted on the front end of the blower (Fig. 17). The governor weight carrier shaft is attached to and driven by the left-hand helix rotor.

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.

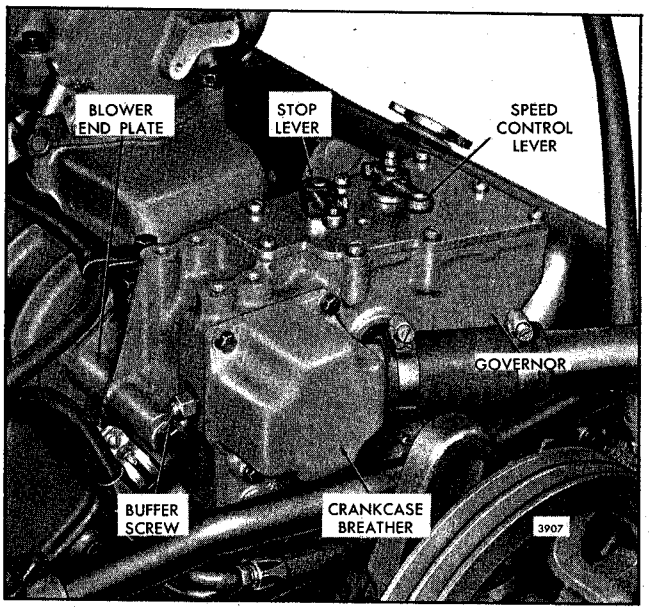


Fig. 17 - Limiting Speed Governor Mounting (8V Engine)

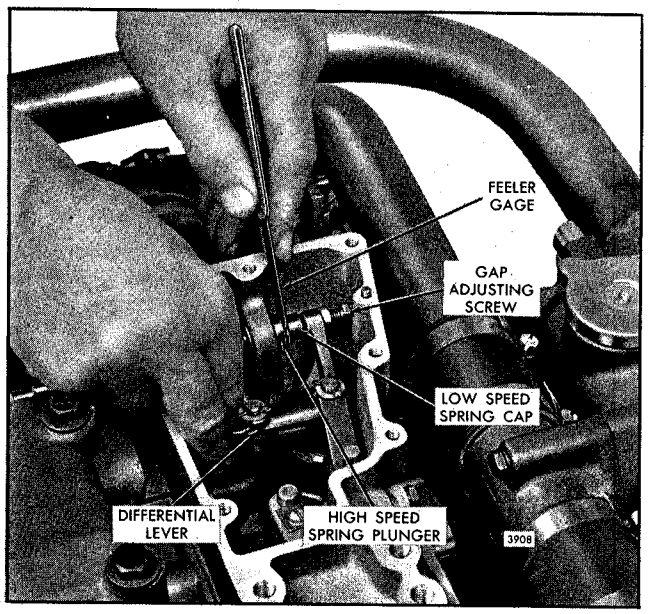


Fig. 18 - Checking Governor Gap

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. 21) 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. 18).
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:

Speed control lever at the maximum speed position.

Governor low speed gap closed.

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

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. 19) 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.

   The above step 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.

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 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.

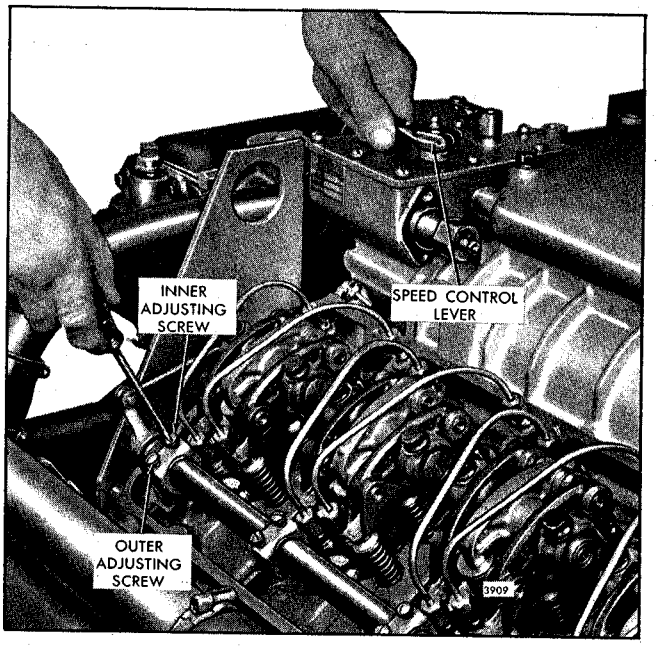


Fig. 19 - Positioning No. 1L Injector Rack Control Lever

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 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 unit 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.

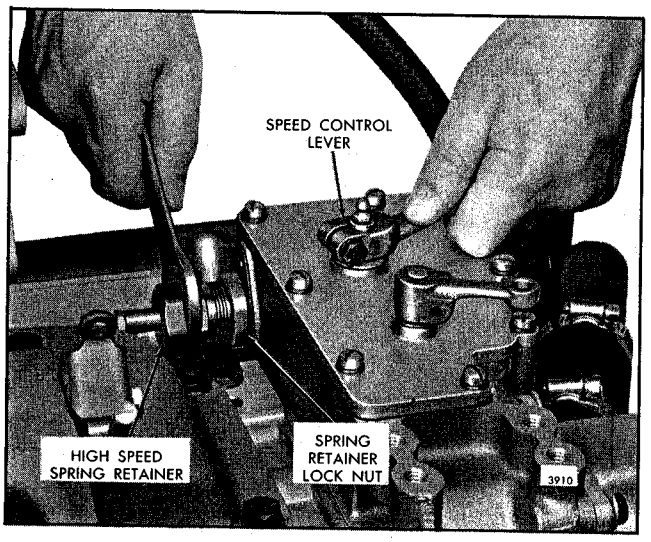


Fig. 20 - Adjusting Maximum No-Load Engine Speed

2. With the engine at operating temperature and no-load on the engine, place the speed control lever in the maximum speed position. Turn the high speed spring retainer in (Fig. 20) 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 full-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.

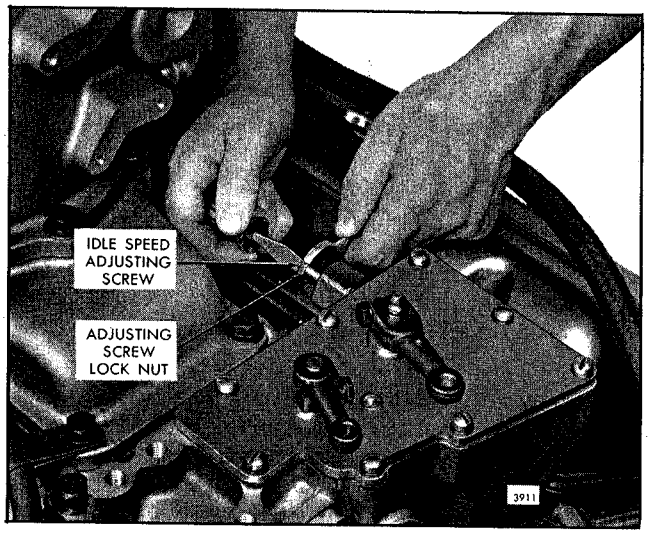


Fig. 21 - Adjusting Engine Idle Speed

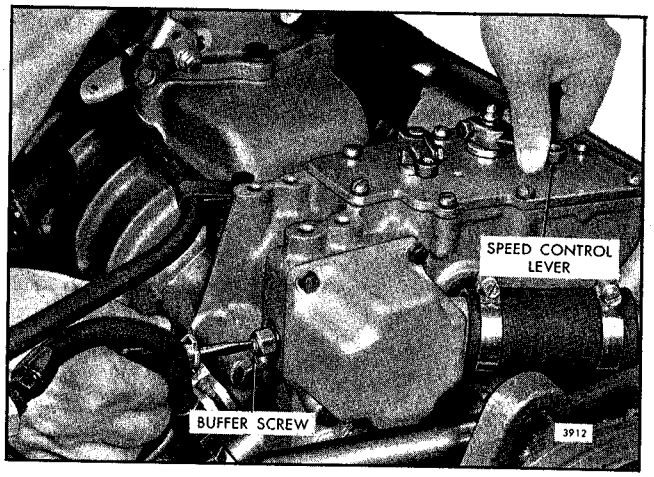


Fig. 22 - Adjusting Buffer Screw

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

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. 21) 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. 22) 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.

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.

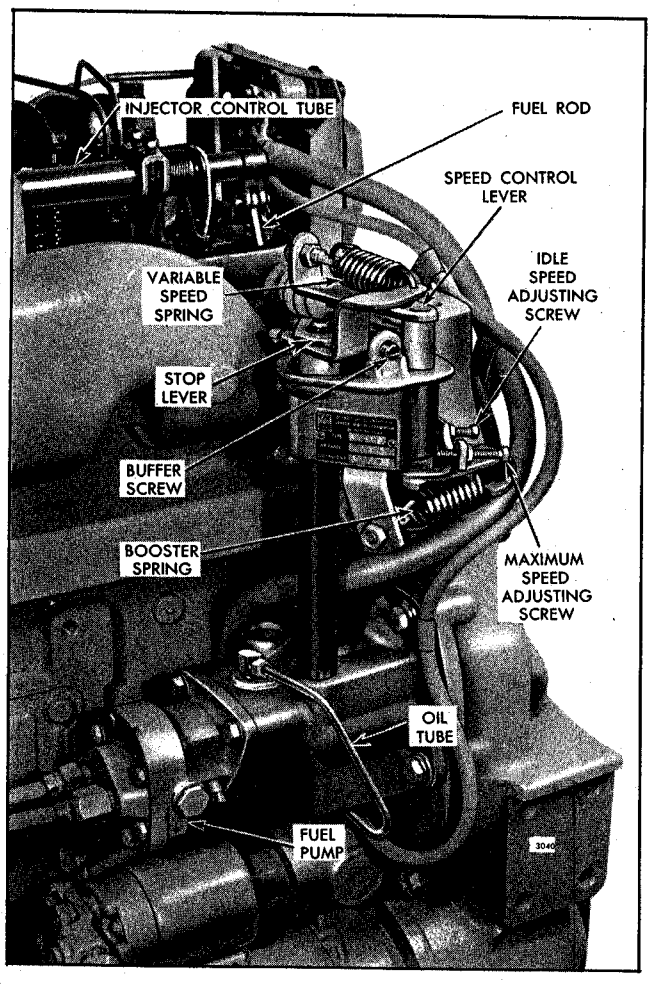


Fig. 1 - Variable Speed Open Linkage Governor Mounted on Engine

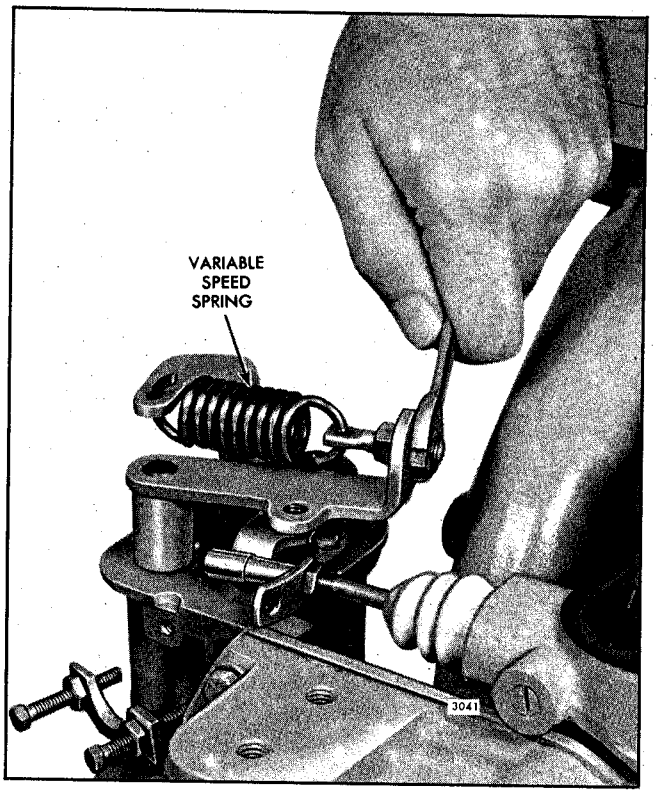


Fig. 2 - Adjusting Governor Spring Eye Bolt

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.

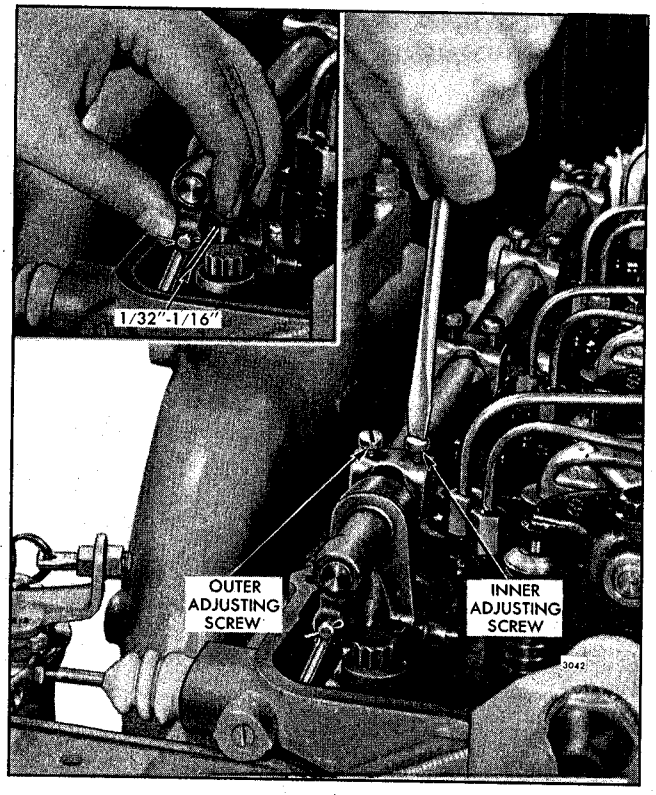


Fig. 3 - Adjusting Injector Rack Control Lever Adjusting Screws

2. Disconnect the fuel rod at the stop lever.

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

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

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

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

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.

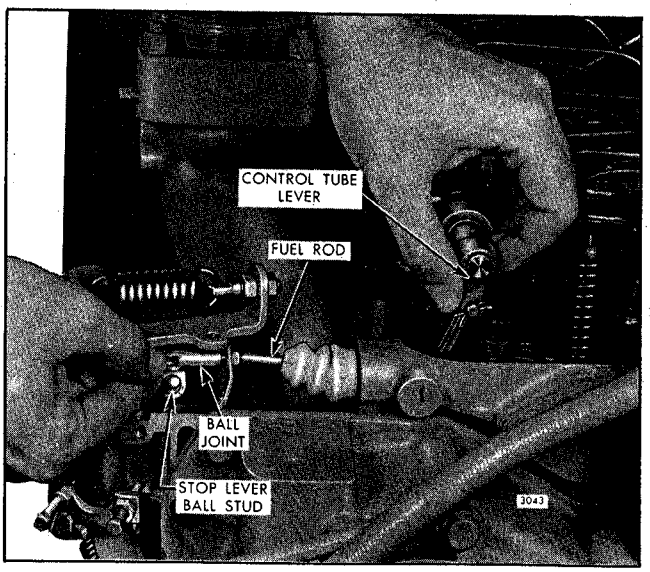


Fig. 4 - Adjusting Fuel Rod Length

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.

3. Hold the idle speed 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.

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 Buffer Screw

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

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

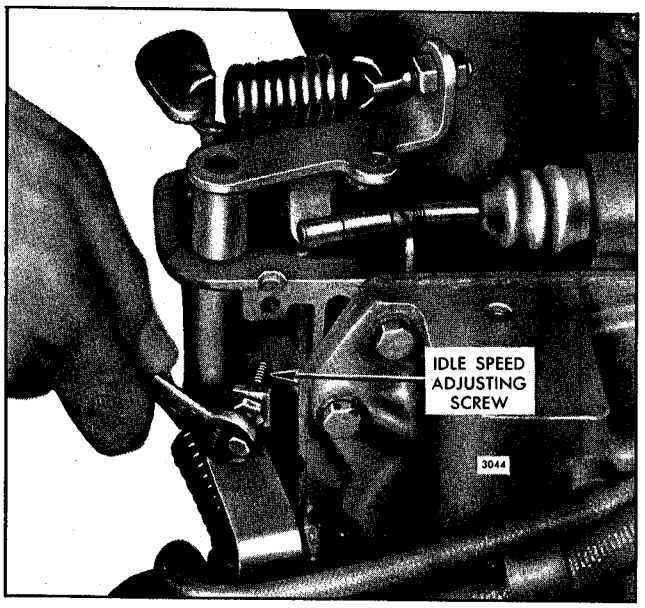


Fig. 5 - Adjusting Idle Speed

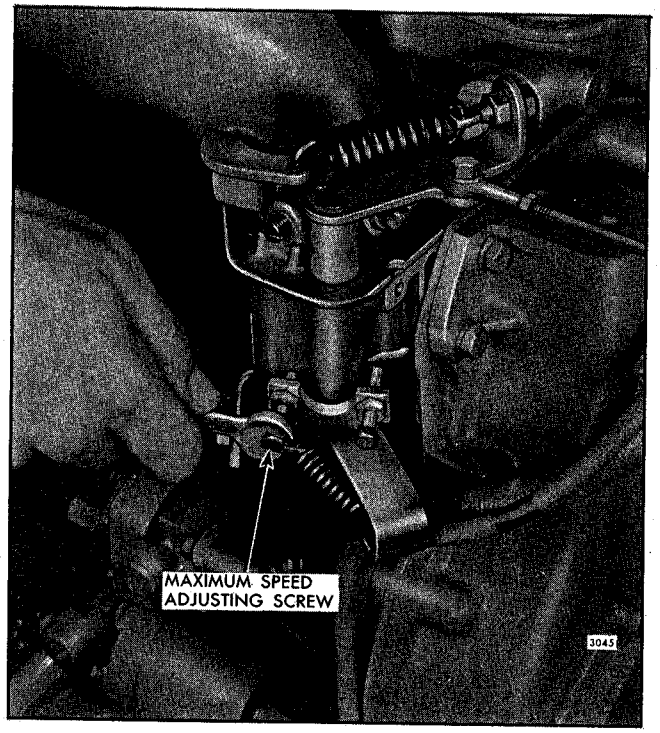


Fig. 6 - Adjusting Maximum No-Load Engine Speed

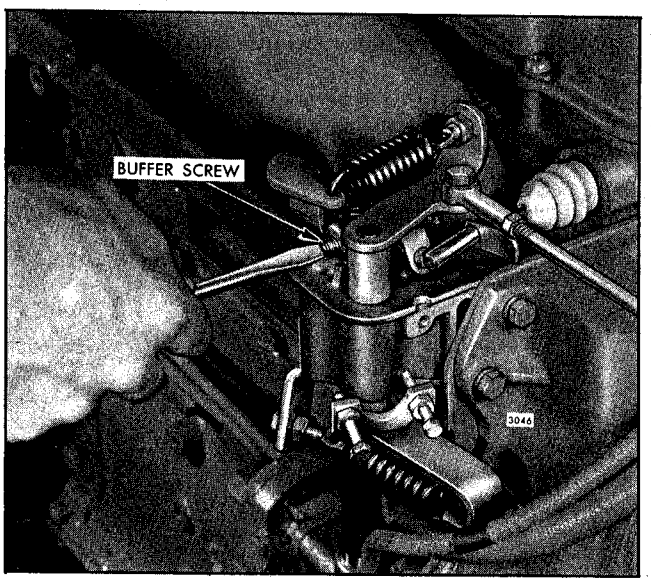


Fig. 7 - Adjusting Buffer Screw

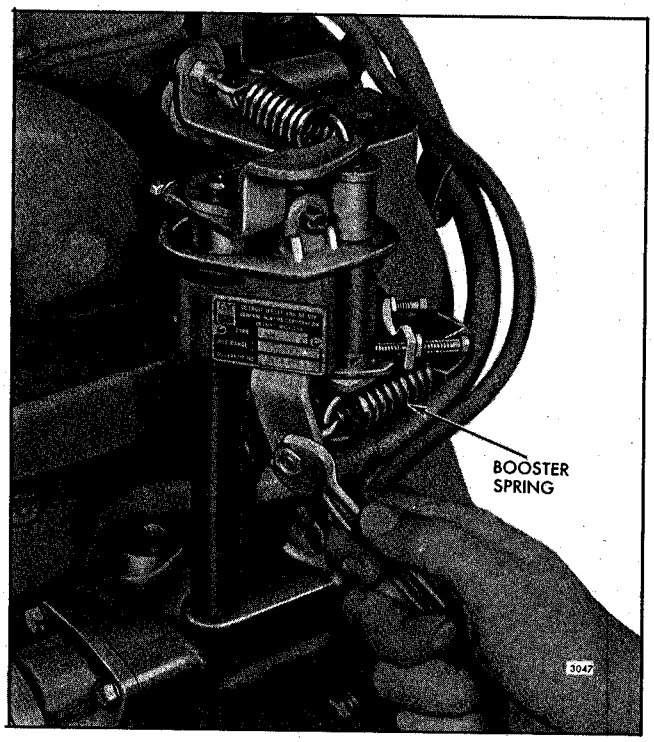


Fig. 8 - Adjusting Booster Spring

Adjust Governor Booster Spring

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

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

2. Reduce the tension on the booster spring, if not previously performed, to the minimum by backing off the outer lock nut (Fig. 8) until the end of the booster spring eye bolt is flush with the end of the nut.

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

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

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

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

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. 9. If required, loosen the lock nut and turn the gap adjusting screw in or out until a slight drag is noted on the feeler gage.
5. Hold the adjusting screw and tighten the lock nut. Check the gap and readjust if necessary.

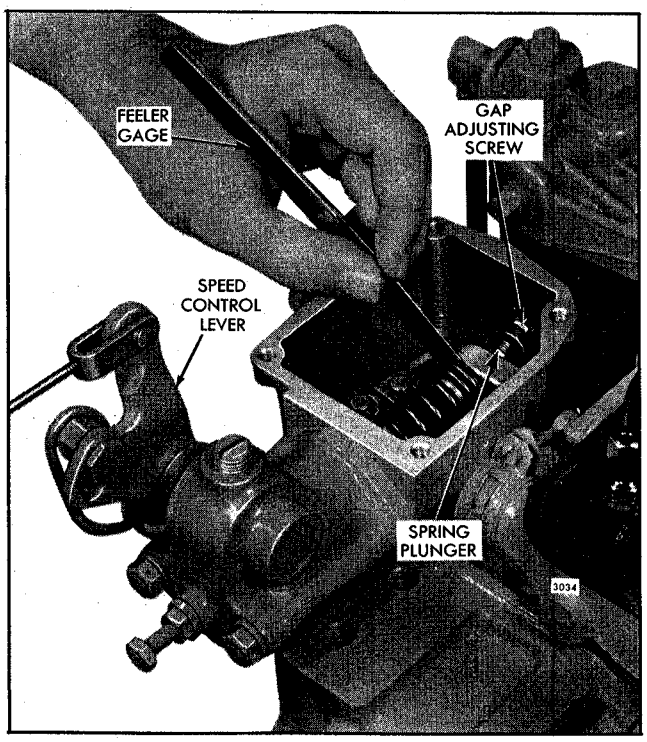


Fig. 9 - Adjusting Governor Gap

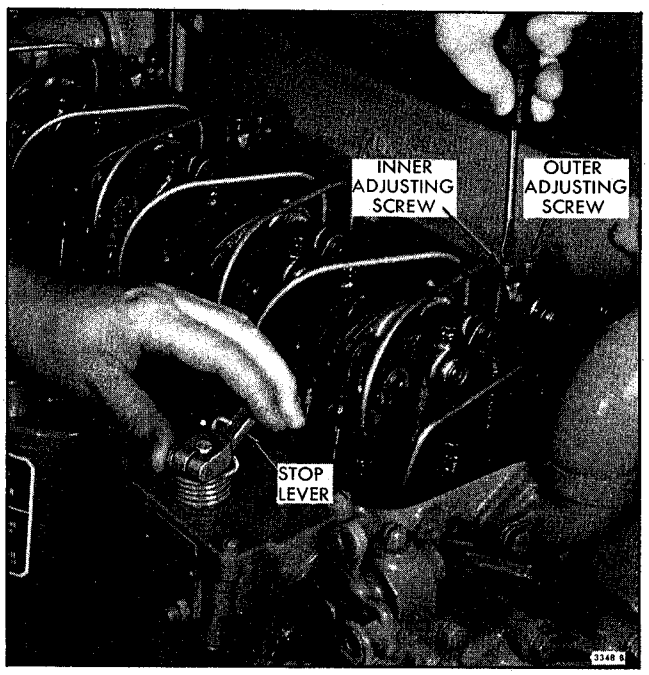


Fig. 10 - Positioning the Rear Injector Rack Control Lever

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. 13) 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. 10). 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.

   The above step 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.

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 I.

TABLE I
ENGINE SPEED DROOP

Full-Load RPM	Maximum Governor Droop - RPM	
	Engines with 2 Valves/Cylinder	Engines with 4 Valves/Cylinder
0-1200	125	125
1201-1400	135	135
1401-1600	145	145
1601-1800	155	155
1801-2000	165	165
2001-2200	175	175
2201-2400	-	185
2401-2600	-	195
2601-2800	-	205

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 2375 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. 14 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. 11).

TABLE II

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

4. Install the variable speed spring housing.

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.

NOTE 1: 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.

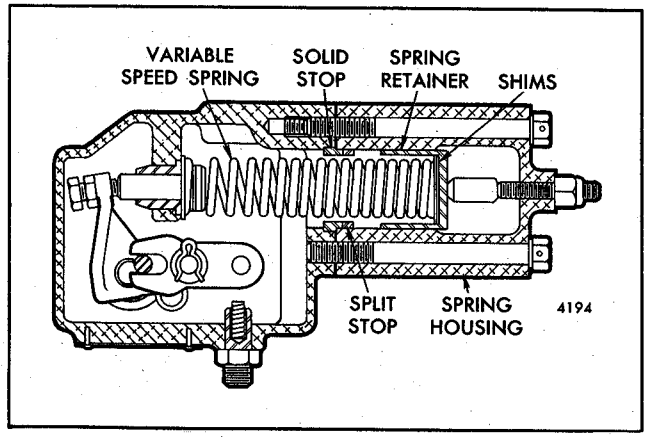


Fig. 11 - Location of Shims and Stops

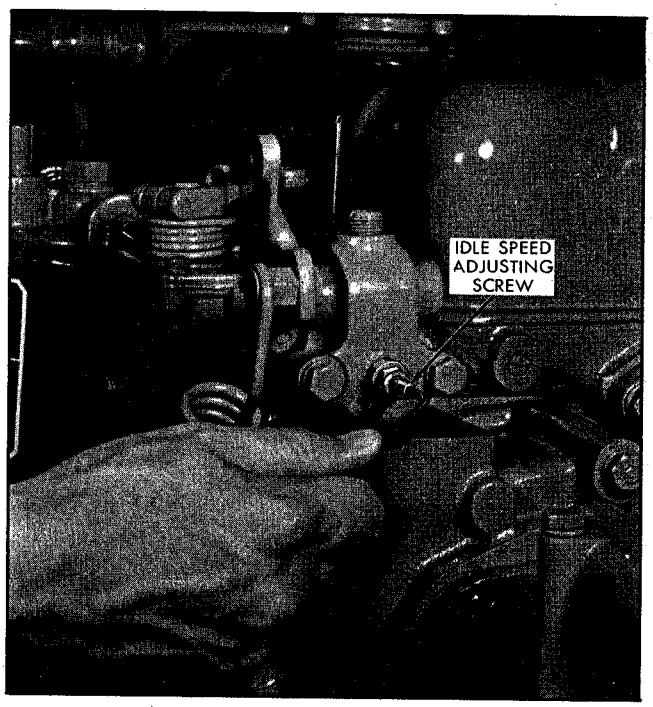


Fig. 12 - Adjusting Idle Speed

NOTE 2: 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. 12) 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:

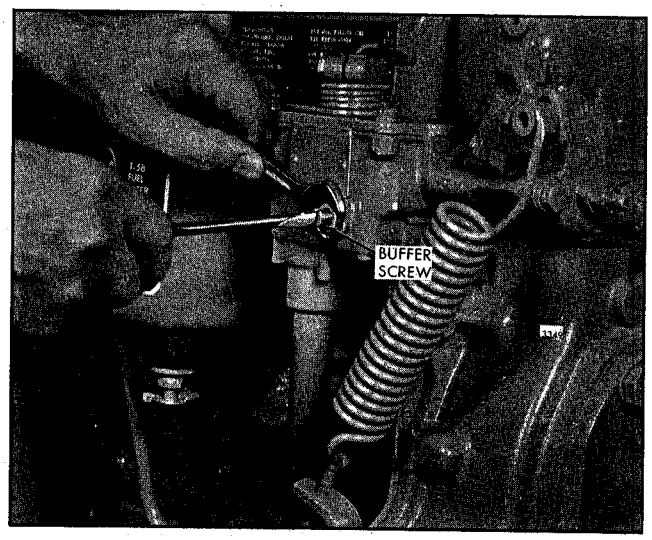


Fig. 13 - Adjusting Buffer Screw

1. With the engine running at idle speed, loosen the lock nut and turn the buffer screw in (Fig. 13) 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:

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

2. Refer to Fig. 14 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 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.

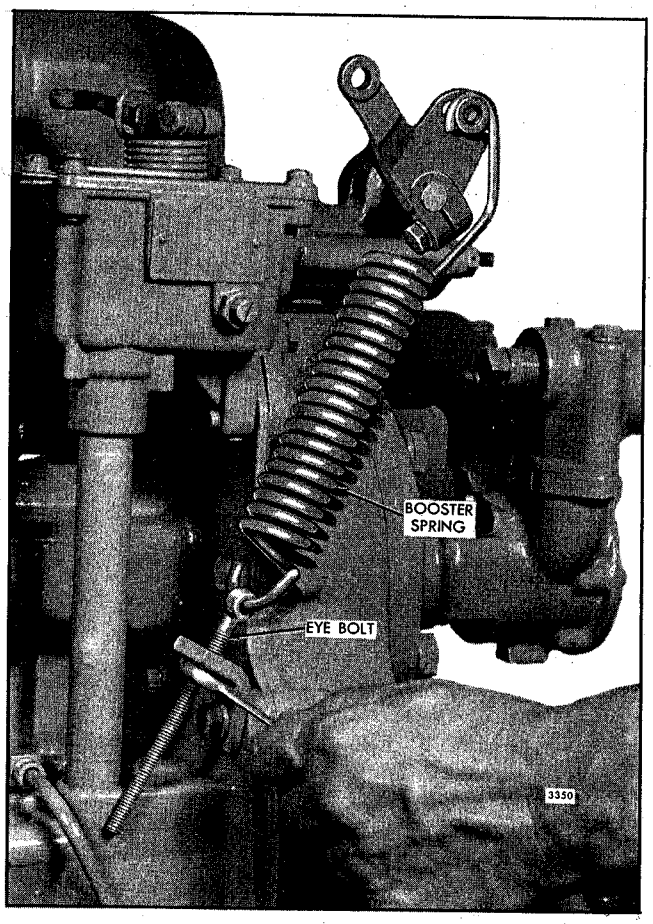


Fig. 14 - Adjusting Booster Spring

Load Limit Device

Engines may be equipped with a load limiting device, on each cylinder head to reduce the maximum horsepower by reducing the fuel output. This device, illustrated in Fig. 14a, mechanically limits the travel of the injector racks and thereby the fuel output of the injectors.

Adjustment

After the engine tune-up is completed, it should be ascertained that the parts comprising the load limiting device are properly installed on the engine as shown in Fig. 14a. The load limiting device may then be adjusted as follows:

1. Loosen the load limit screw lock nut.

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 the bottom of the lock nut is 7/8" from the bottom of the load limit screw.

4. Loosen the load limit lever clamp bolts so 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 rack control tube in the full-fuel position and place the load limit lever against the bottom of the load limit screw. Then, tighten the load limit lever clamp bolts.

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

8. Hold the load limit screw to keep it from turning, then "set" the 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.

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

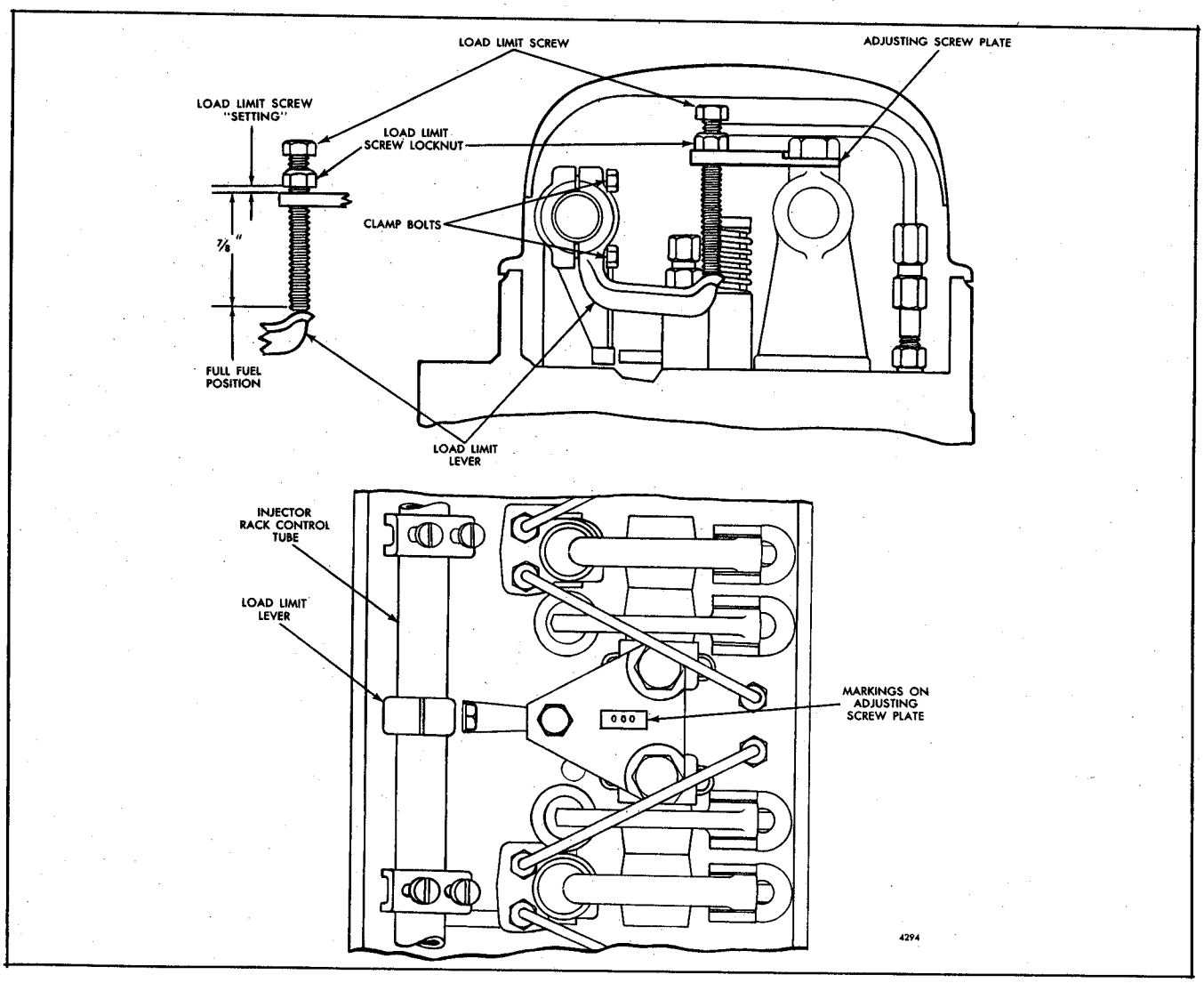


Fig. 14a - Engine Load Limiting Device

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT (V-TYPE ENGINE)

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. 15). 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. 16. 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.

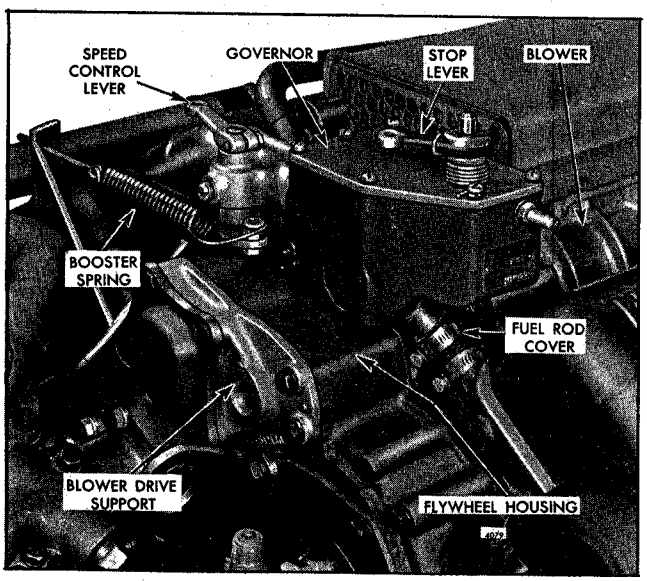


Fig. 15 - Variable Speed Governor Mounting

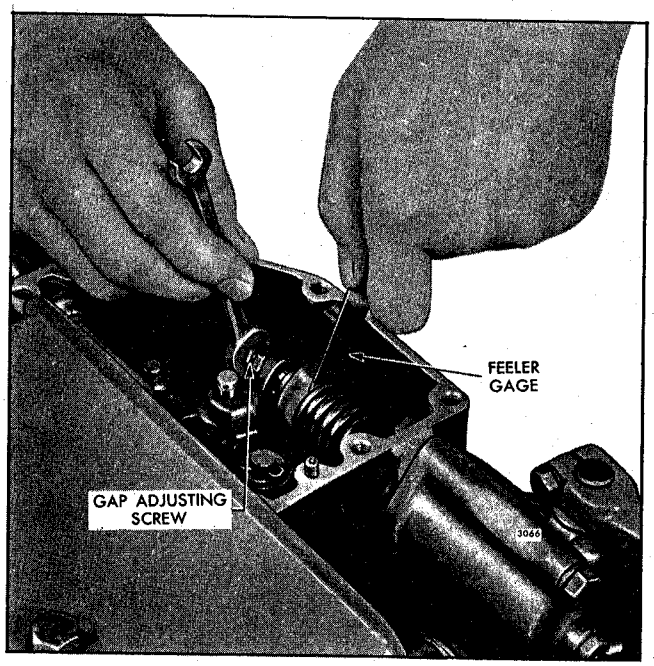


Fig. 16 - Adjusting Governor Gap

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

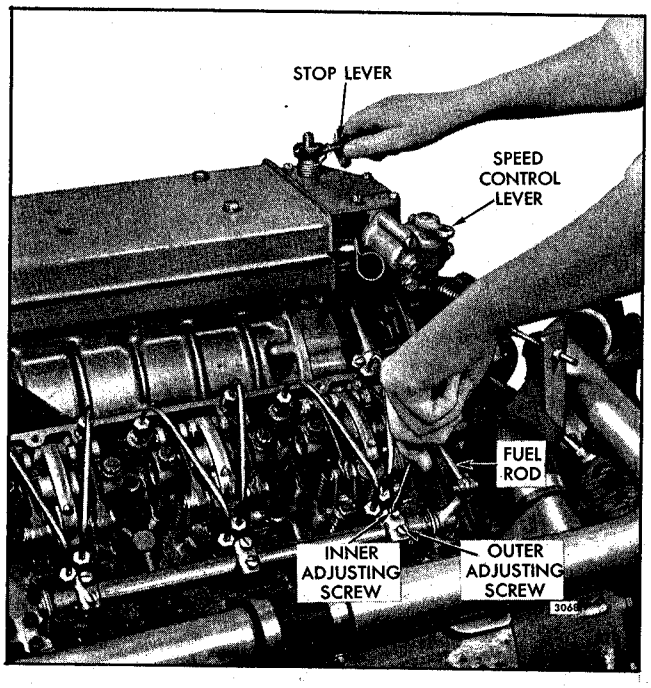


Fig. 17 - Positioning No. 3L Injector Rack Control Lever

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. 3L injector rack control lever down (Fig. 17) 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.

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

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.

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

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.

1. Refer to Fig. 21 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. 18).

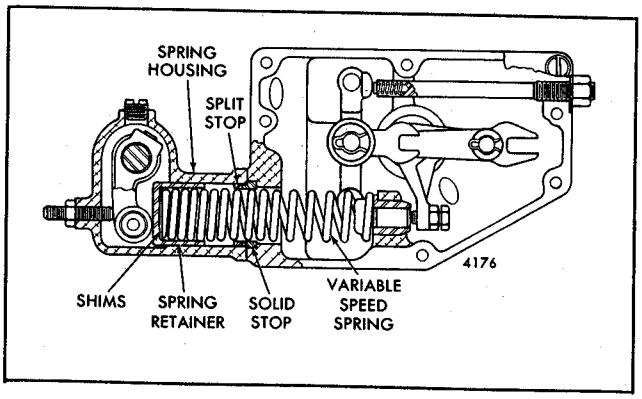


Fig. 18 - Location of Shims and Stops

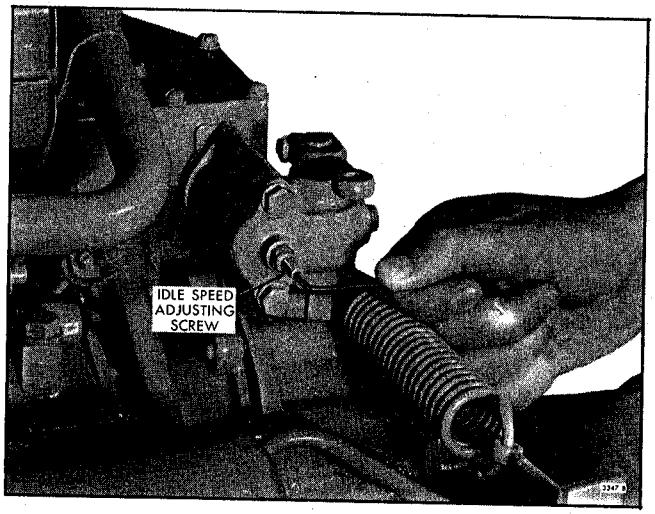


Fig. 19 - Adjusting Idle Speed

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

*Maximum amount of shims .325"

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.

NOTE 1: 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 2: 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:

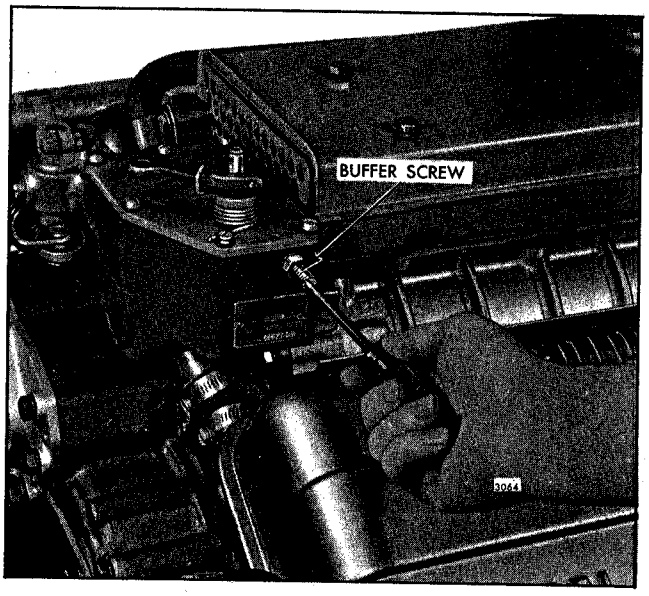


Fig. 20 - Adjusting Buffer Screw

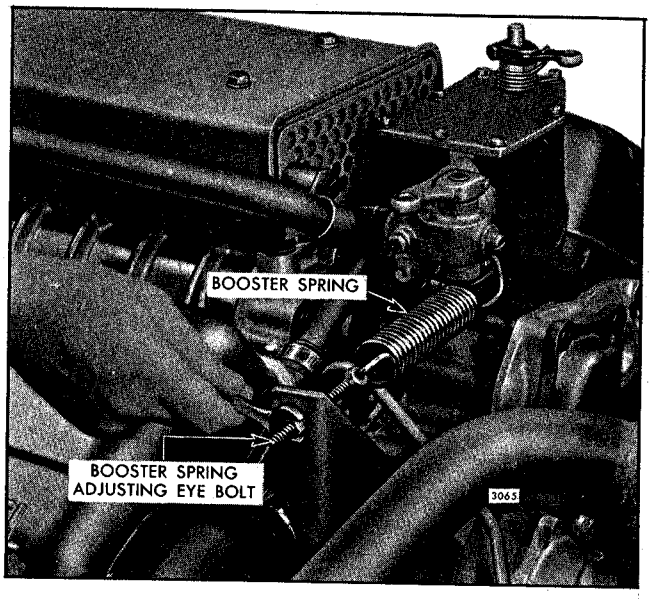


Fig. 21 - Adjusting Booster Spring

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. 19) 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. 20) so that it contacts the differential lever as lightly as possible and still eliminates engine roll.

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

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

Adjust Booster Spring

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

1. Refer to Fig. 21 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.

8V ENGINE

The variable speed mechanical governor assembly (Fig. 22) 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. 23. 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 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.

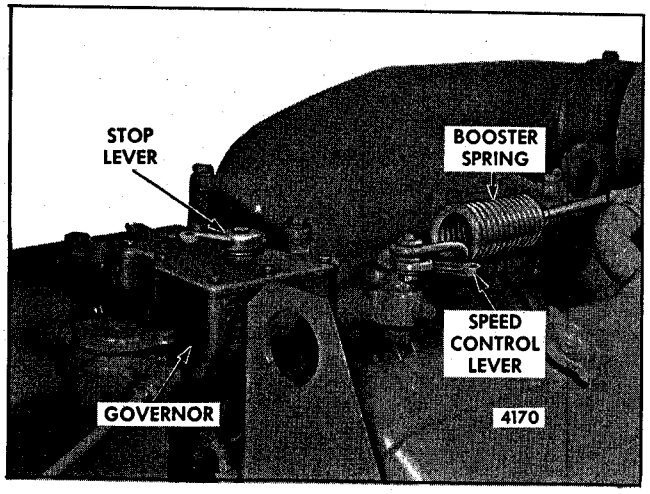


Fig. 22 - Variable Speed Governor Mounting

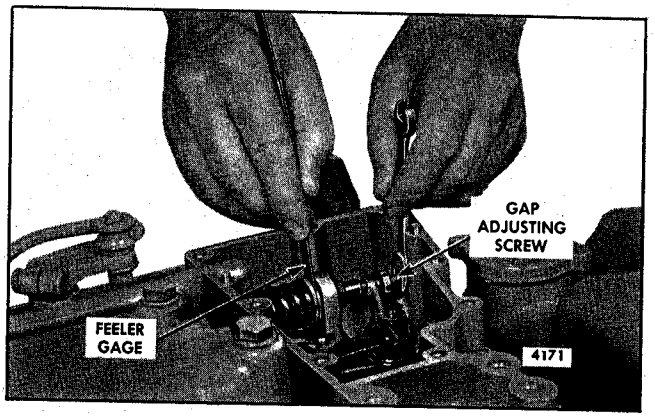


Fig. 23 - Adjusting Governor Gap

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. 24) 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 both the inner and outer adjusting screws.

   The above steps should result in placing the governor linkage and control tube in the

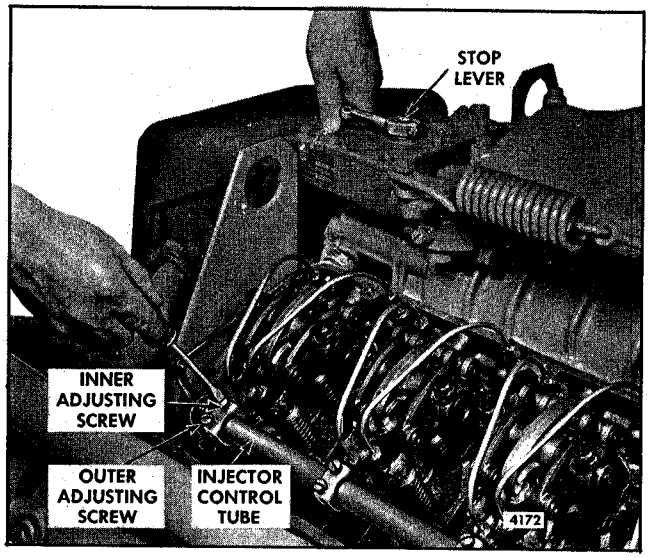


Fig. 24 - Positioning No. 1L Injector Rack Control Lever

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

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.

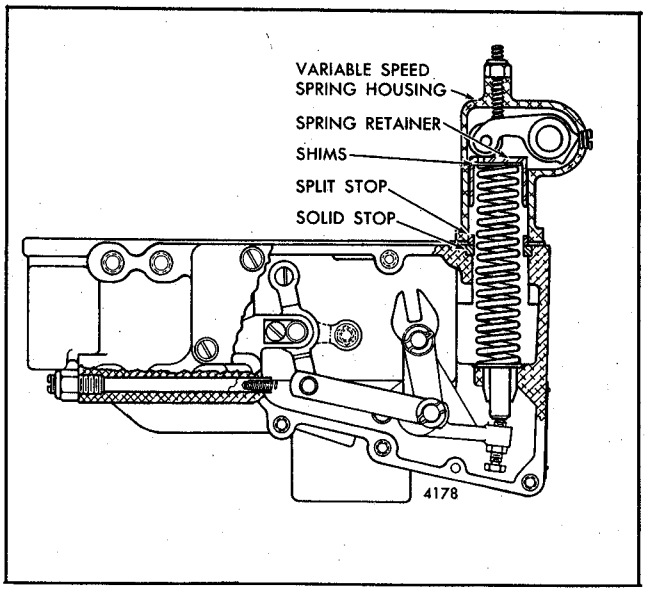


Fig. 25 - Location of Shims and Stops

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.

1. Refer to Fig. 28 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. 25).

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.

   NOTE 1: 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.

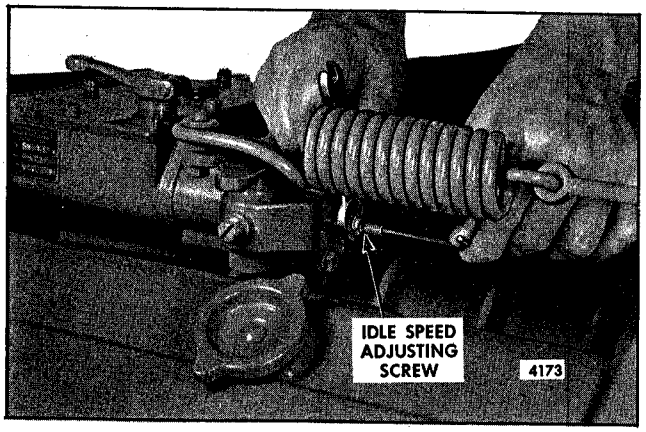


Fig. 26 - Adjusting Idle Speed

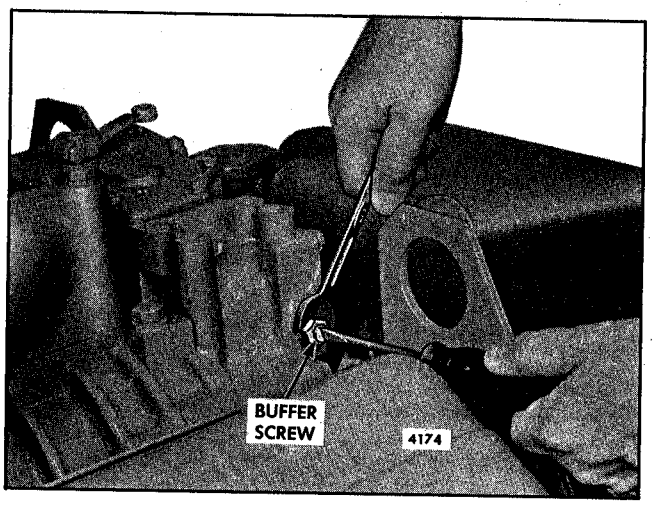


Fig. 27 - Adjusting Buffer Screw

NOTE 2: 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. 26) 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. 27) 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.

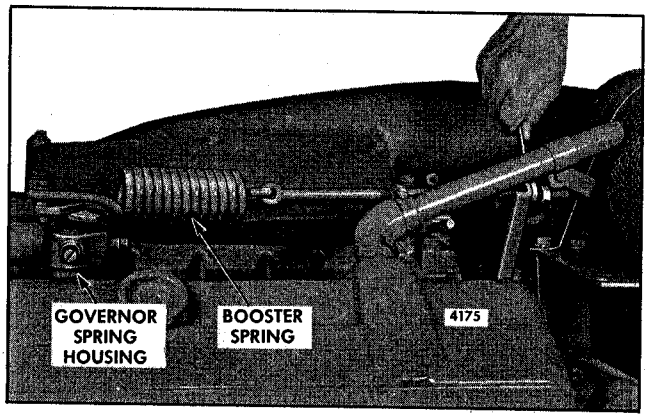


Fig. 28 - Adjusting Booster Spring

Adjust Booster Spring

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

1. Refer to Fig. 28 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.

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 bolt or the cylinder head casting (below the bolt) for at least 1/6" 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 1/6" clearance.

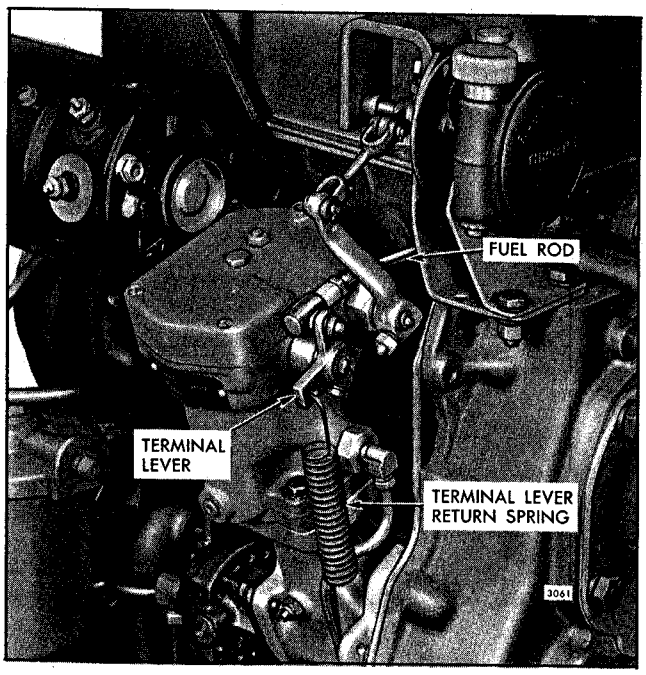


Fig. 1 - Hydraulic Governor Mounted on In-line Engine

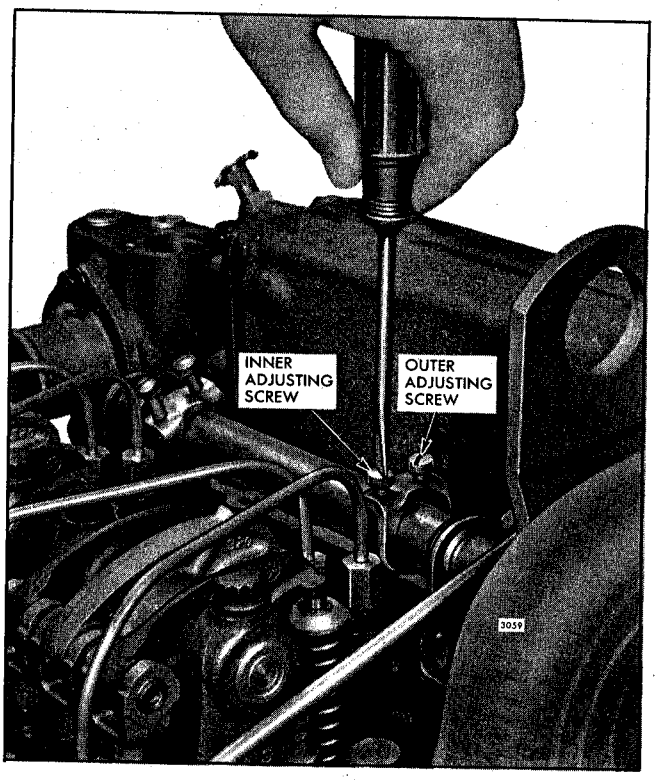


Fig. 2 - Adjusting Height of Rack Control Lever Adjusting Screws

2. Remove the governor terminal lever return spring.

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

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

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

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

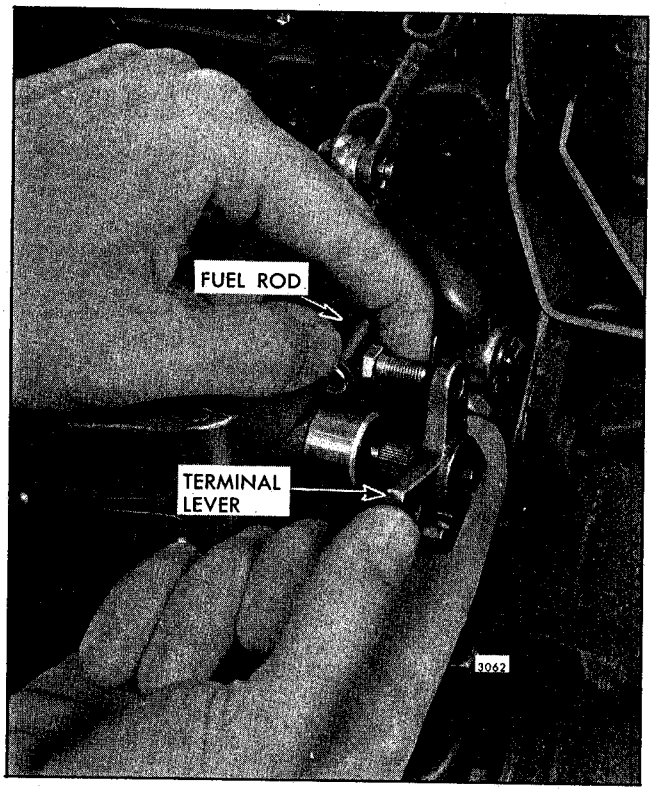


Fig. 3 - Adjusting Length of Fuel Rod

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 items 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 re-adjusted.

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

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

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

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

2. With engine stopped, 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

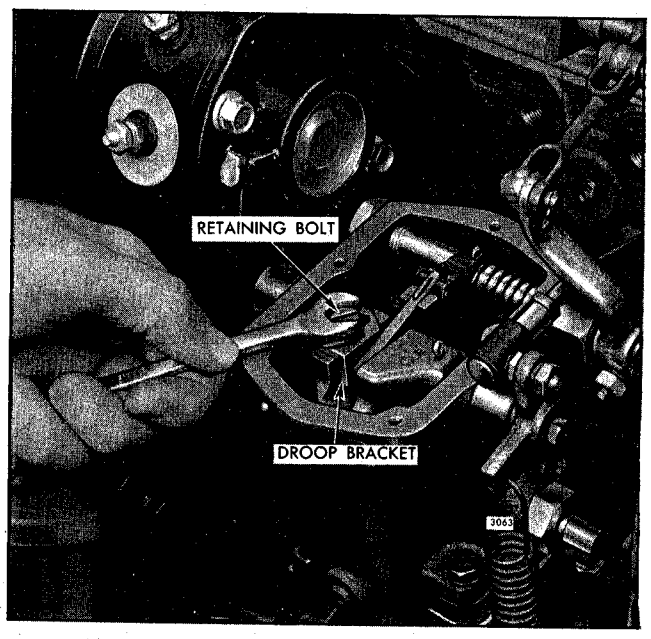


Fig. 4 - Adjusting Droop Bracket

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 stablizes 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 operating at 1000 and 12000 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 3 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.

Fig. 5 - Adjusting Maximum Engine Speed

HYDRAULIC GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT (6V ENGINE)

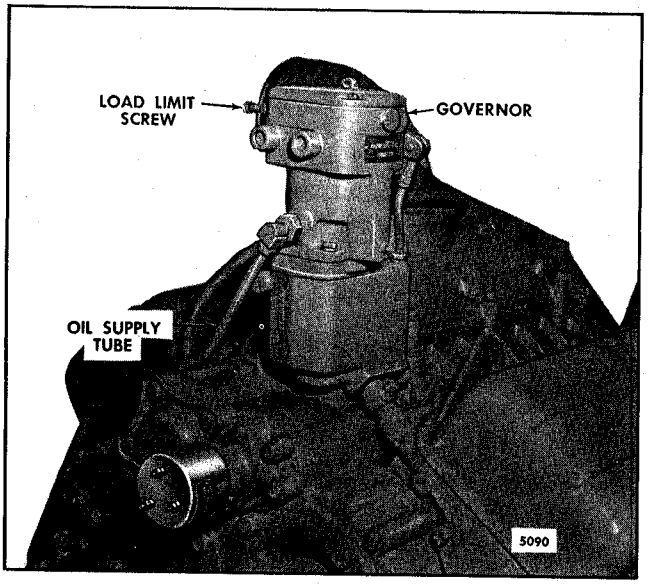


Fig. 6 - Hydraulic Governor Mounting (6V Engine)

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

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

1. Remove the 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 number 3 injector rack control levers on each bank to full-fuel.
6. Position the remaining rack control levers to the number 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. 6) 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.

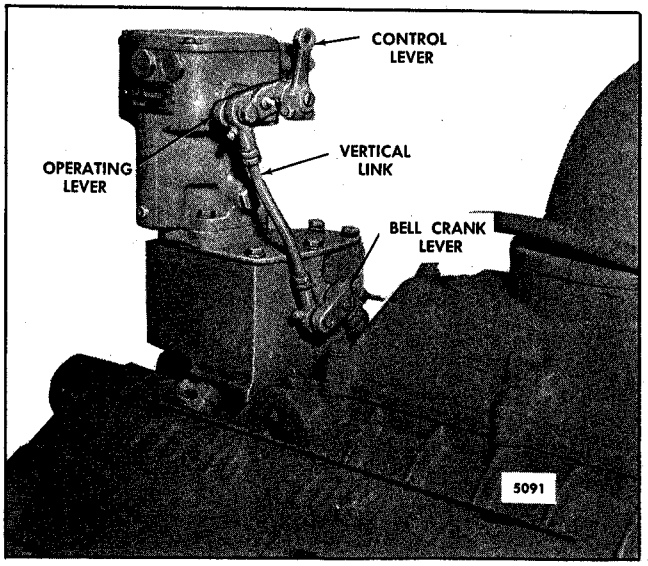


Fig. 7 - Hydraulic Governor Controls (6V Engine)

TROUBLE SHOOTING

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

Satisfactory engine operation depends primarily on:

1. The presence of 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 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 (.009" for the two valve, or .024" for the 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 not be any 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 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.

If installation of a new injector does not eliminate misfiring, check the compression pressures.

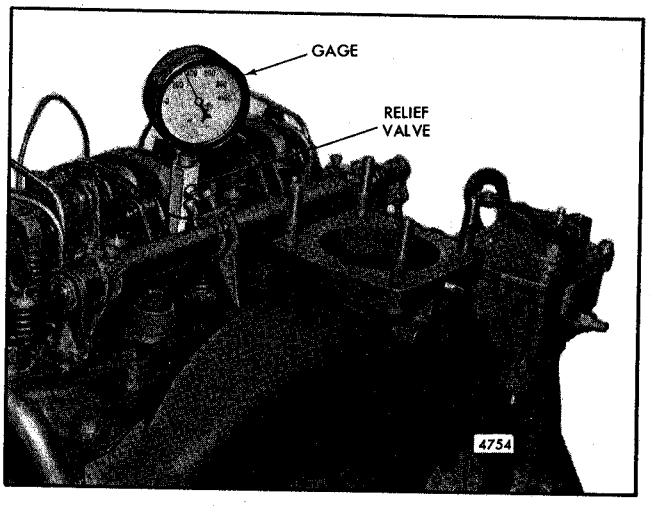


Fig. 1 - Checking Compression Pressure

Checking Compression Pressure

1. Start the engine and run at it approximately one-half rated load until normal operating temperature is reached.
2. With the engine stopped, remove the fuel pipes from the injector in cylinder No. 1 and the fuel connectors.
3. Remove the injector and install the adaptor and pressure gage from Diagnosis Kit J 9531-01 (Fig. 1).
4. Use a spare fuel pipe and fabricate a jumper connection between the fuel inlet and return passage to permit fuel to flow directly to the return passage.
5. Start the engine and run it at 600 rpm. Observe and record the compression pressure indicated on the gage.

   Do not crank the engine with the starting motor to check the 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

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" engine) at 600 rpm. In addition, the variation in compression pressures between cylinders of the engine must not exceed 25 psi at 600 rpm. For 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 operation of the engine. Nevertheless, the No. 3 cylinder compression pressure indicates that something unusual has occurred and that a localized pressure leak has developed.

Low cylinder pressures 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 inspect them by pressing 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 is 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 is run out of fuel inadvertently, there is a definite procedure to follow for restarting the engine. 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 engire fuel system. Remove the filter plug in the fuel filter cover and install the primer. Prime the system. Remove the primer and install the filter plug.

Fuel Flow Test

1. Disconnect the fuel return tube and hold the open end in a suitable container.
2. Start and run the engine at approximately 1200 rpm and measure the fuel flow from the return tube for one minute.

   At least .6 gallons of fuel should flow from the return tube per minute.
3. Be sure all tube connections between the fuel supply and the pump are tight so no air will be drawn into the fuel system; then, immerse the end of the fuel return tube into the fuel in the container. Air bubbles rising to the surface of the fuel will indicate a leak on the suction side of the pump.

Crankcase Pressure

The crankcase pressure indicates the amount of air that has passed between the oil control rings and the liner into the crankcase, most of which is clean air from the air box. A slight pressure in the crankcase is needed 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 maximum crankcase pressure is shown 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	.9	1.0
4-53	.5	—	.5	.9	1.0
6V-53	—	—	—	.9	1.0
8V-53	—	—	—	.9	1.0
*Engines with four valve cylinder head(s).					

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 the manometer in the engine diagnosis test kit J 9531 -01. The manometer should be connected to the oil level dipstick opening in the cylinder block. Check the readings obtained at various engine speeds with the specifications in the chart.

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 of efficiency of the blower. This means less air for scavenging which results in poor combustion and higher temperatures. The maximum exhaust back pressure (no-load) is shown in the following chart.

EXHAUST BACK PRESSURE (max. in inches of Mercury)					
Engine	Speed (rpm)				
	1800	2000	2200	2500*	2800*
2-53	1.3	1.7	—	—	—
3-53	1.3	—	2.1	2.7	2.7
4-53	1.3	—	2.1	2.7	2.7
6V-53	—	—	—	2.7	2.7
8V-53	—	—	—	2.7	2.7
*Engines with four valve cylinder head(s).					

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 the manometer in the engine diagnosis test kit, J 9531-01. The manometer or pressure gage is connected to the exhaust manifold by removing the 1/8" pipe plug which is provided for that purpose. 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 Exhaust Back Pressure 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 leaking end plate gaskets, a clogged blower air inlet screen.

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	—	8.6	8.0	9.3
4-53	5.5	—	8.6	8.0	9.3
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	—	6.2	4.8	6.1
4-53	3.8	—	6.2	4.8	6.1
6V-53	—	—	—	4.8	6.1
8V-53	—	—	—	4.8	6.1
*Engines with four valve cylinder head(s).					

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

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

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

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 as low as possible 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 water 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 the air cleaner and ducting 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 INTAKE RESTRICTIONS
(in 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	—	—	—	23.0	25.0
8V-53	—	—	—	23.0	25.0
Max. with clean air cleaner (oil bath or dry) with precleaner					
2-53	9.5	10.8	—	—	—
3-53	9.5	—	12.0	14.0	16.0
4-53	9.5	—	12.0	14.0	16.0
6V-53	—	—	—	14.0	16.0
8V-53	—	—	—	14.0	16.0
Max. with clean air cleaner (dry) no precleaner					
6V-53			7.3	8.7	10.0
8V-53			7.3	8.7	10.0

*Engines with four valve cylinder head(s).

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 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.

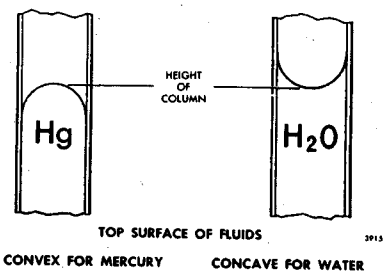


Fig. 2 - Comparison of Column Height for Mercury and Water Manometers

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

STORAGE

PREPARING ENGINE UNITS FOR STORAGE

When an engine unit 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, corrosion, and gumming in the fuel system. The parts requiring attention and the recommended preparations are given below.

An engine unit should be processed for storage as soon as possible after removal from operation. If an engine unit is not processed at the earliest possible opportunity and corrosion starts on the exposed metal surfaces, it will then be necessary to carefully and thoroughly remove the corrosion before applying a rust inhibitor.

Engine units should be stored in a building which is dry and may be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in storage areas.

TEMPORARY STORAGE (30 days or less)

Protect engine unit for a temporary period of time as outlined below:

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 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 anti-freeze 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 with fuel oil and dry it with air.
7. Seal all 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.

Engines prepared in this manner can be put into service in a short time by simply removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, gear box, and priming the raw water pump, if used.

EXTENDED STORAGE (30 days or more)

When an engine unit is to be removed from operation for an extended period of time, prepare the unit 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 where necessary to make sure they will be ready to operate when the engine is again placed in service.
5. Reinstall the injectors in the engine, time the injectors, 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 plug and completely drain the engine crankcase. Install new lubricating oil filter elements and gaskets.

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

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough Valvoline Oil Company "Tectyl 502-C" rust preventive compound, or its equivalent, to enable the engine to operate 15 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. Refer to Air System and service the air cleaner.

14. MARINE GEARS

    Drain the oil completely and refill with clean oil of the proper viscosity and grade as is recommended. Remove, clean or replace all strainers or filters. When performing Step 15, engage the clutches alternately to circulate clean oil through all moving parts.

15. Start and run the engine at 600 rpm for 5 minutes so that the clean oil can coat all of the internal parts of the engine.

    NOTE: The performance of this step is not necessary on torque converter units.

16. TORQMATIC CONVERTER

    a. Start the engine and let it run at idle speed until the temperature of the converter oil reaches 150°F.

    b. Remove the plug and drain the converter.

    c. Remove the filter.

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

    e. Reinstall the drain plug and the filter.

    f. Fill the unit 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 minumum of 1000 rpm. Engage the clutch, then stall the converter to raise the oil temperature to 225°F.

    CAUTION: Do not allow the 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

    Lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing, clutch release shaft, also the outboard bearing, if unit is so equipped, through the grease fittings with an all purpose grease such as Shell Alvania No. 2 or its equivalent.

    Remove the inspection hole cover on the clutch housing and lubricate the clutch release lever and pins with a hand oiler. To avoid getting oil on the clutch facing, do not over lubricate.

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

18. HYDROSTARTER SYSTEM

    a. Release the pressure in the hydrostarter system by opening the relief valve on the side of the hand pump.

    b. Drain all of the fluid from the system.

    c. Remove the filler cap at the top and the screen in the bottom of the reservoir.

    d. Flush the reservoir and clean the reservoir filler cap and screen.

    e. Clean the filter element in the line between the reservoir and the engine pump.

f. To provide maximum protection, use Lubriplate type 130-AA, or its equivalent, as directed below:

Fill the hand pump cam cavity under the boot with Lubriplate. Also apply Lubriplate to both ends of the cam retaining pin and to the area where the boot fits around the cam.

Fill the cavity under the air valve cover on the accumulator with Lubriplate.

Coat the starter motor internal clutch splines, shaft splines, yoke, tangs of the fork, spool of the overrunning clutch and the control shaft with Lubriplate.

Remove the plug from the starter control valve housing and withdraw the control valve. Apply Lubriplate on the control valve surface ahead of the front seal ring and behind the rear seal ring.

If a hydraulic remote control is used, do not remove the control valve. Apply the Lubriplate on the control valve ahead of the front seal ring only.

g. Saturate the wick in the starter drive housing with SAE 20 lubricating oil.

h. Refill the Hydrostarter system with SAE 10 or 20 lubricating oil. See Hydraulic Starting System for the filling and purging procedure. Then start the engine at least 10 times to circulate oil through the system.

NOTE: Leave some pressure in the system (at least 100 psi above the nitrogen precharge pressure).

19. Remove the valve rocker cover(s) from the engine and spray a thin film of Valvoline Oil Company "Tectyl 502-C" rust preventive compound, or its equivalent, on the injector operating mechanism, on the top of the cylinder head and on the underside of the valve rocker cover(s). This compound is soluble in the engine lubricating oil. Reinstall the valve rocker cover(s).

20. Apply a "non-friction" rust preventive compound, similar to Valvoline Oil Company "Tectyl No. 812", 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.

23. If the oil is drained, reinstall and tighten the drain plug.

24. 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.

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

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

27. 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.

28. 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.

Stored engines 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 TO SERVICE ENGINE UNITS WHICH HAVE BEEN IN EXTENDED STORAGE

1. Remove the valve rocker cover(s).

   Pour at least one-half gallon of the proper engine lubricating oil over the injector operating mechanism.

2. Reinstall the valve rocker cover(s).

3. Remove all covers and tape from 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. Remove the rust preventive from the flywheel.

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

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

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

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

9. Install and connect the battery.

10. Service the air cleaner as outlined under Air System.

11. POWER GENERATOR

    Prepare the generator for starting as outlined under Operating Instructions.

12. MARINE GEAR

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

13. TORQMATIC CONVERTERS

    a. Remove the tape from the breathers 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.

14. 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.

15. 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.

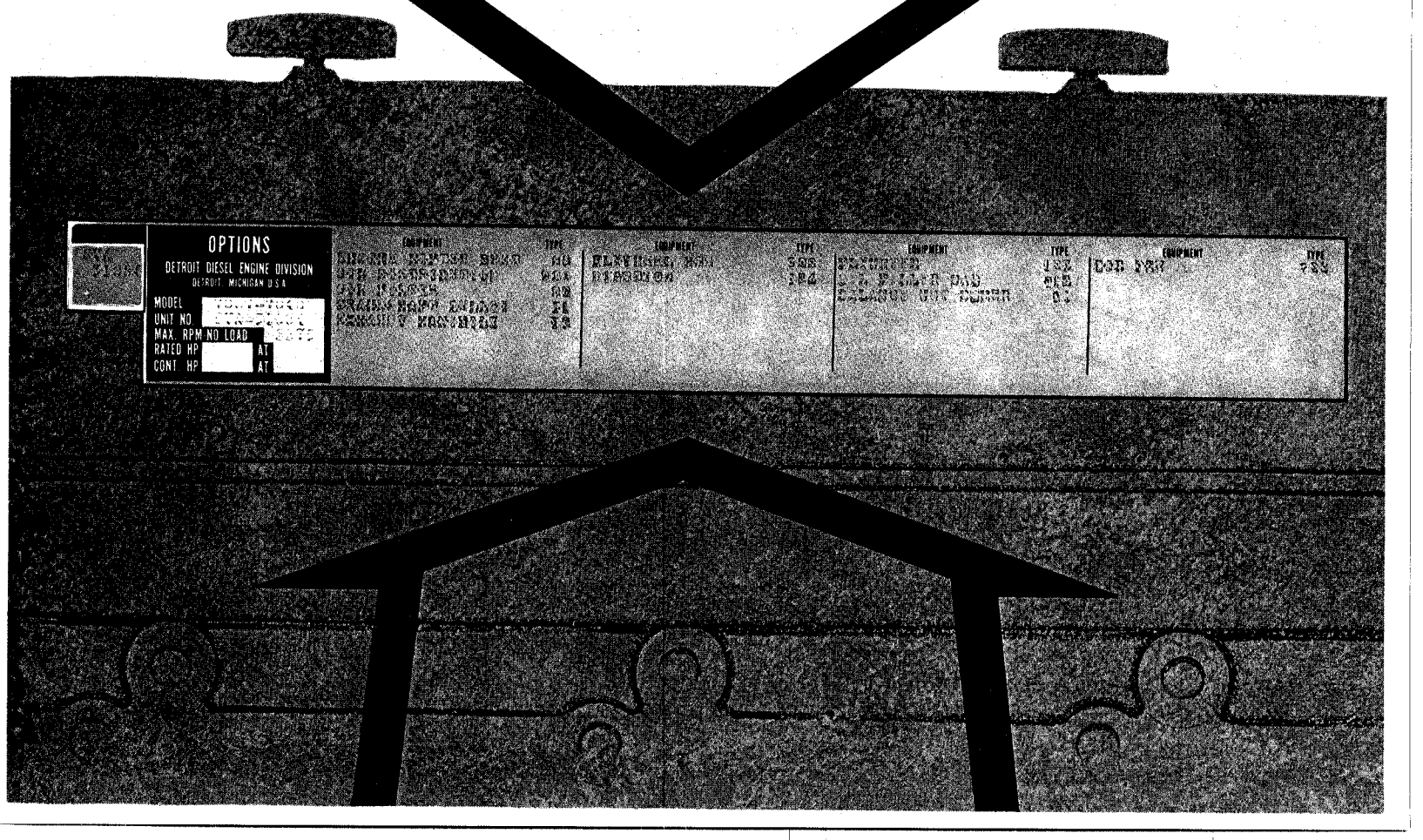
16. TURBOCHARGER

    Refer to the lubricating procedure outlined in Preparation for Starting Engine First Time.

17. 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.

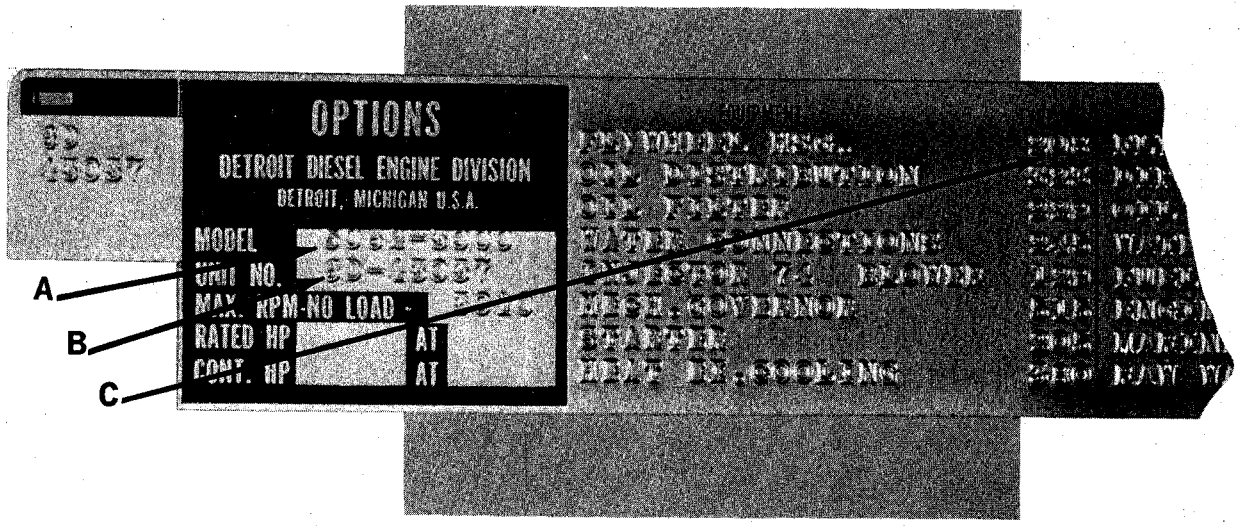
    NOTE: Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.

YOUR *BUILT-IN* PARTS BOOK



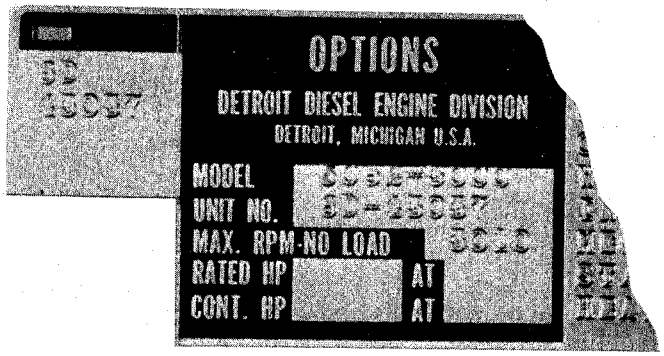
The various manufacturers serving the Industrial and Marine fields strive endlessly to improve, refine and expand the scope of their products to meet the growing needs of their respective markets. Accomplishment when it comes sometimes creates an expanded or entirely new role for the engine. In order for the engine manufacturer to keep pace with these changes that spell progress, he must offer a product that can be built into many arrangements of accessories and mounting parts to suit a variety of applications. In addition, his own product 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, if downtime results. What is the answer?—It is in Detroit Diesel's exclusive BUILT-IN PARTS BOOK which is furnished with each engine. It takes the form of an embossed "Option Plate" mounted on the rocker cover of the engine. With it, ordering parts becomes as simple as A, B, C. You have merely to provide the dealer with . . .

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

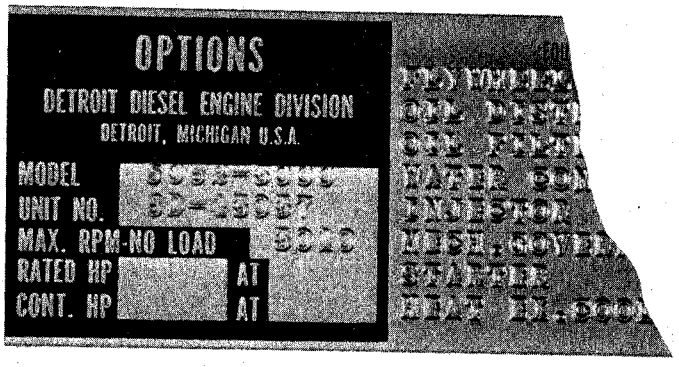


From that much information, the dealer with his complete master Parts Catalog of all engine models, can completely interpret the need or needs.

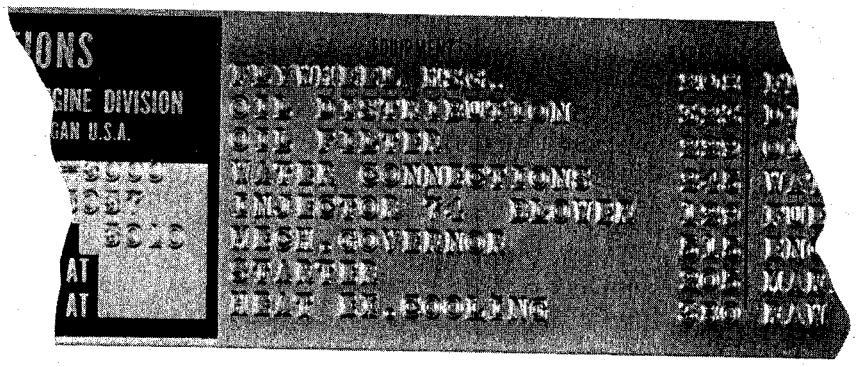
What is this "built-in" book? It is an anodized aluminum plate that fits into a holding channel on the engine rocker cover.



ON THE LEFT HAND SIDE of the plate, if applicable, is the Start-up Inspection Tab—scored for easy removal by the dealer when he has completed the inspection.



NEXT pertinent data on the model number, unit number, horsepower rating and the related governor settings.



THEN the equipment *description* and type number. The first is a brief description of the Option component. Opposite (right) this description is a *type number*. It is a number assigned to all the various serviced and attaching parts for that component.

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 dealer has a Master 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
- 3.5000A Turbocharger

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

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

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

7.0000 ELECTRICAL-INSTRUMENTS
- 7.1000A Battery Charging Generator
- 7.2000B Automatic Starting
- 7.3000A Starting Motor
- 7.4000A Instruments
- 7.4000B Tachometer Drive
- 7.4000C Shut-off or Alarm System
- 7.6000A 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.

NEXT he has in his Master Catalog a Model Index Page for each engine model. The Model Index Page lists all of the components for that model, including all of the type "Options".

5063-7200 (RC)

MODEL INDEX

STANDARD AND OPTIONAL EQUIPMENT

GROUP NAME	GROUP NO.	TYPE
Cylinder Block	1.1000	31
Air Box Drains (thru 6D-4948)	1.1000A	48
Air Box Drains (effective with 6D-4949)	1.1000A	62
Cylinder Head	1.2000	26
Engine Lifter Bracket	1.2000A	44
Crankshaft	1.3000	22
Crankshaft Front Cover	1.3000A	63
Crankshaft Pulley (2 grooves)	1.3000C	137
Crankshaft Pulley Belt	1.3000D	92
Flywheel (SAE #2) (Rockford 14" RT clutch)	1.4000A	376
Flywheel (SAE #3) (Rockford 14" TT clutch)	1.4000A	328
Flywheel Housing (SAE #2)	1.5000A	211
Flywheel Housing (SAE #3)	1.5000A	208
Connecting Rod and Piston	1.6000	35
Camshaft and Gear Train	1.7000	35
alve Operating Mechanism	1.8000	3
aker Cover (with oil filler in both covers)	1.8000A	
er Cover (with oil filler in one cover)	1.8000A	
lector (S40)	2.1000A	
or (S45)	2.1000A	

NOTE the "Optional" Engine Lifter Brackets, Crankshaft Pulley, Crankshaft Pulley Belts, Flywheels and Flywheel Housings. The full page from which this sample was taken lists some 60 line items. The Option Plate reflects which choice of options has been built into the engine. Listing all 60 items on the plate is needlessly cumbersome—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 and gasket inside. It is advisable to have your own personal record of these part numbers by filling in the chart provided below:

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

*Not Standard

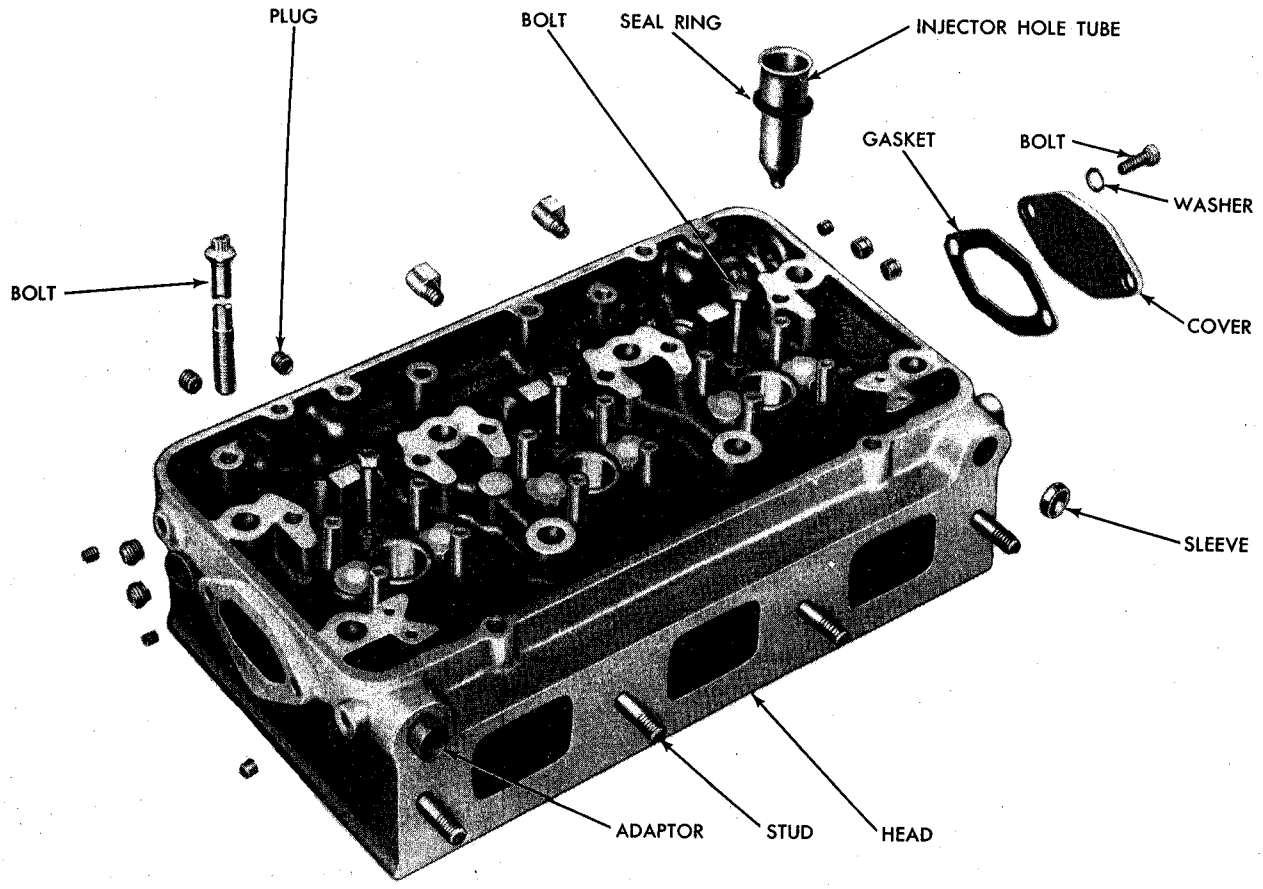
AIR CLEANER

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

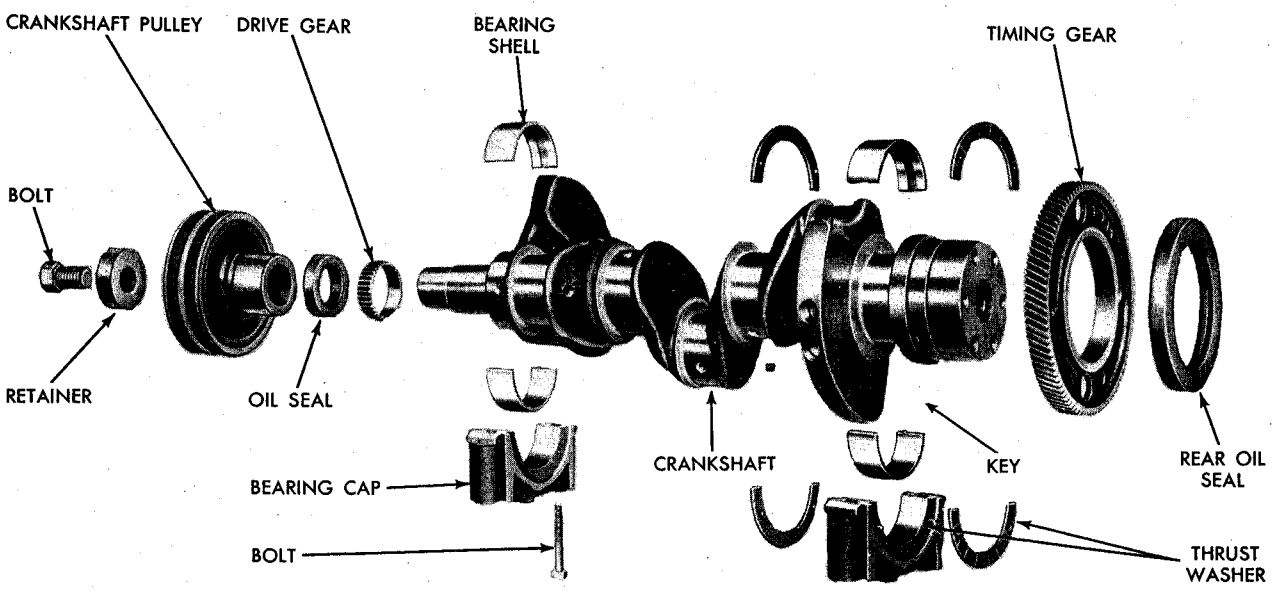
_____

_____

Wet type, indicate capacity_____qts.

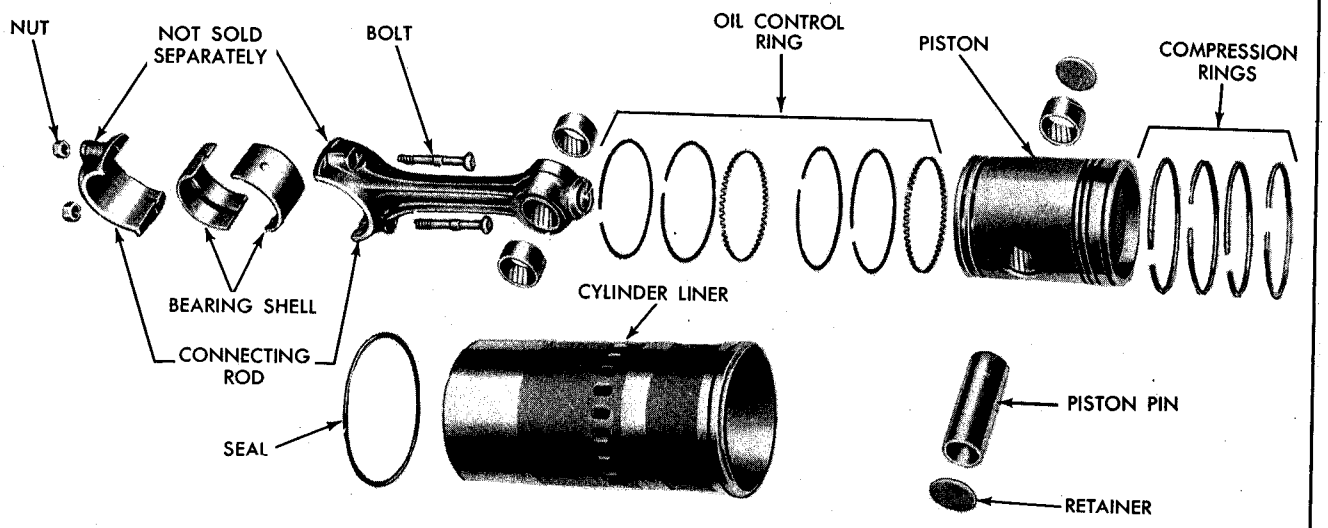


CYLINDER HEAD

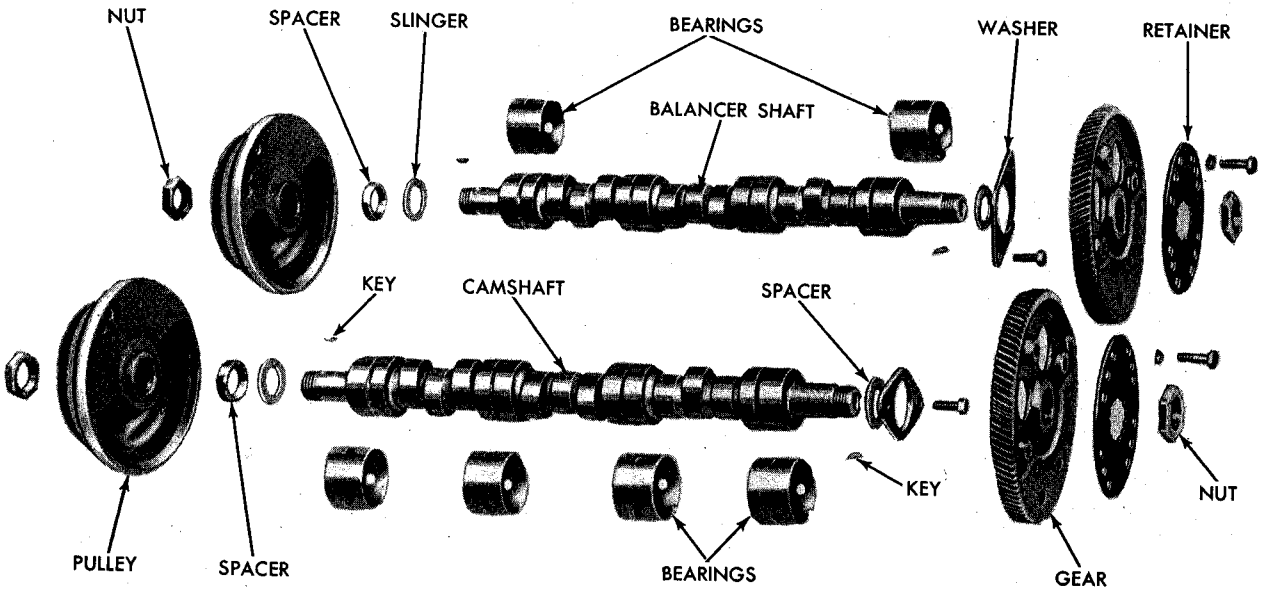


CRANKSHAFT

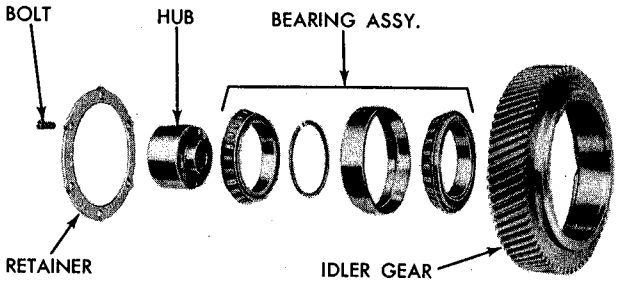
P 628



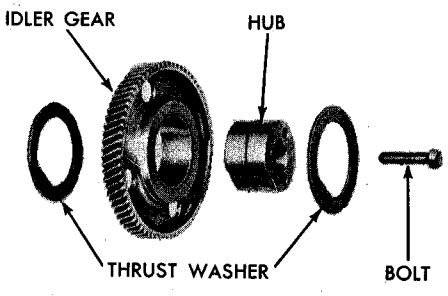
CONNECTING ROD, PISTON AND LINER



CAMSHAFT AND GEAR

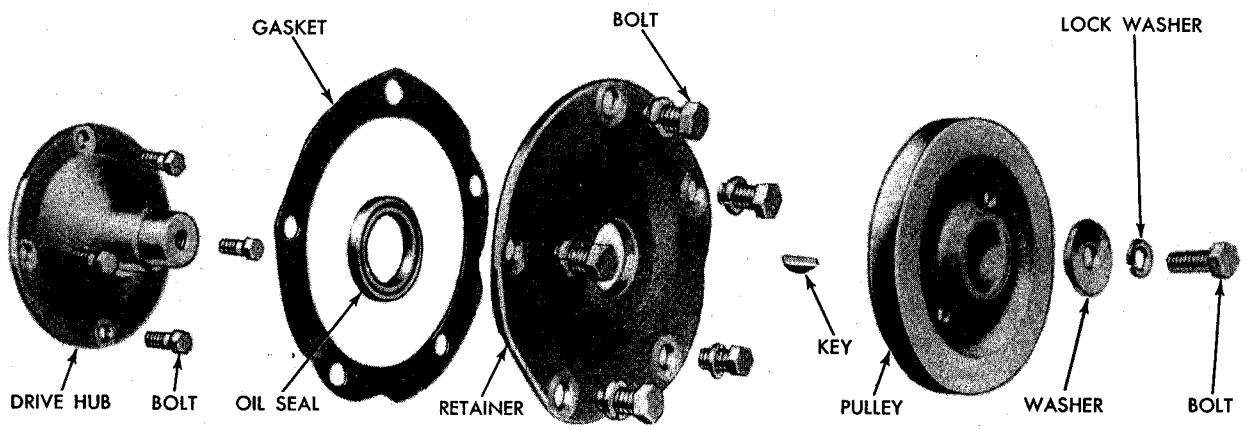


IDLER GEAR (8V-53)

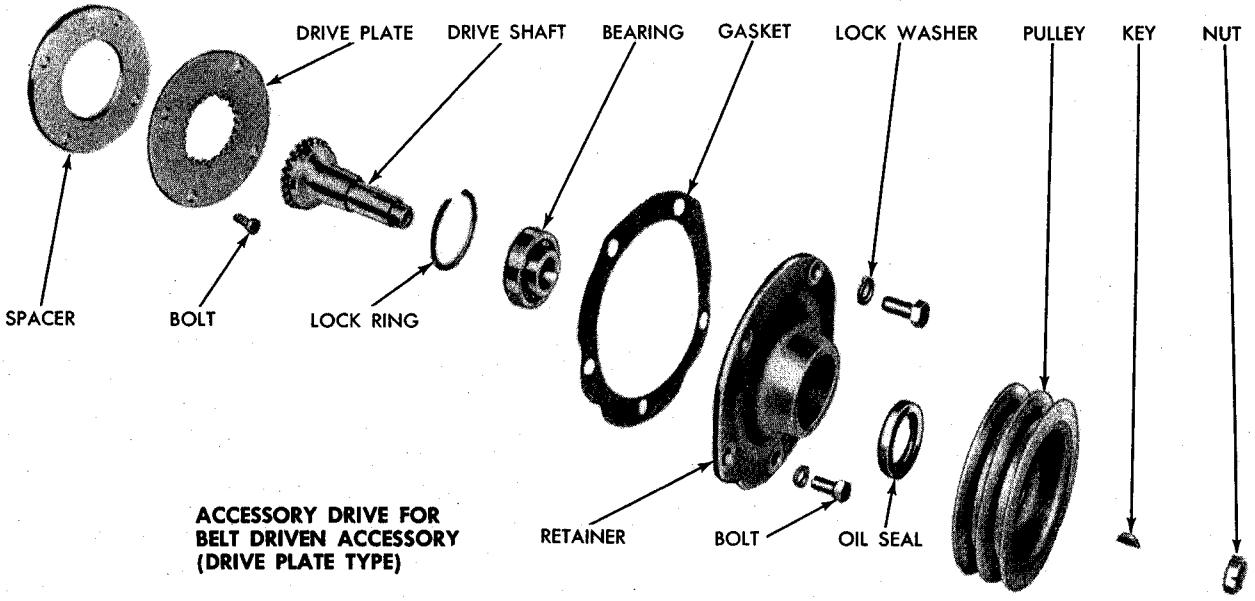


IDLER GEAR

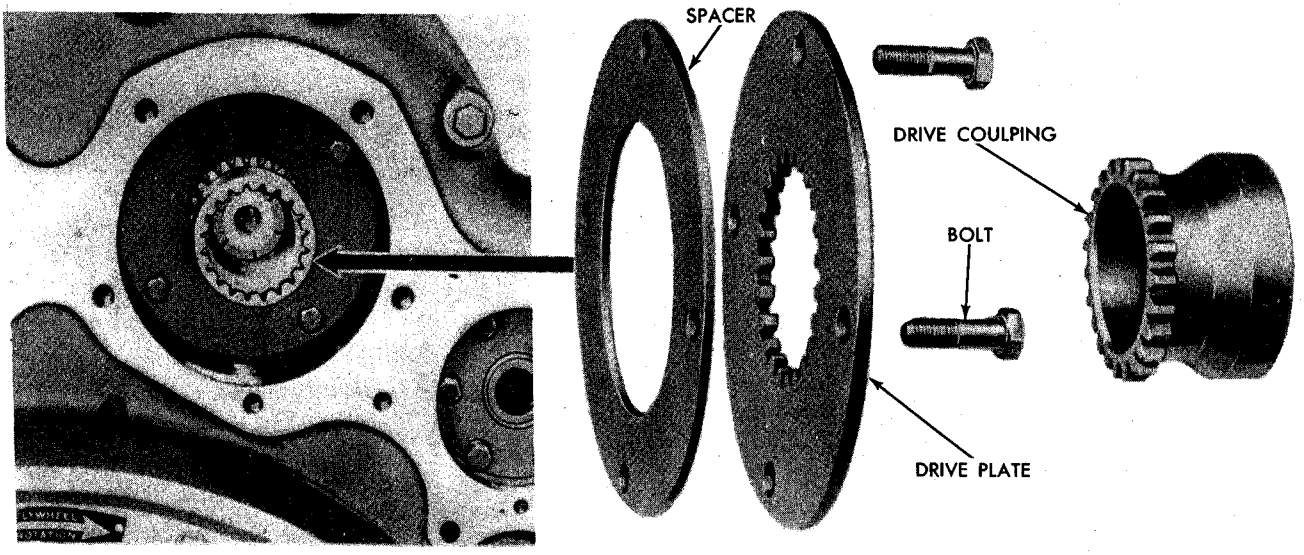
P 629



ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE HUB TYPE)

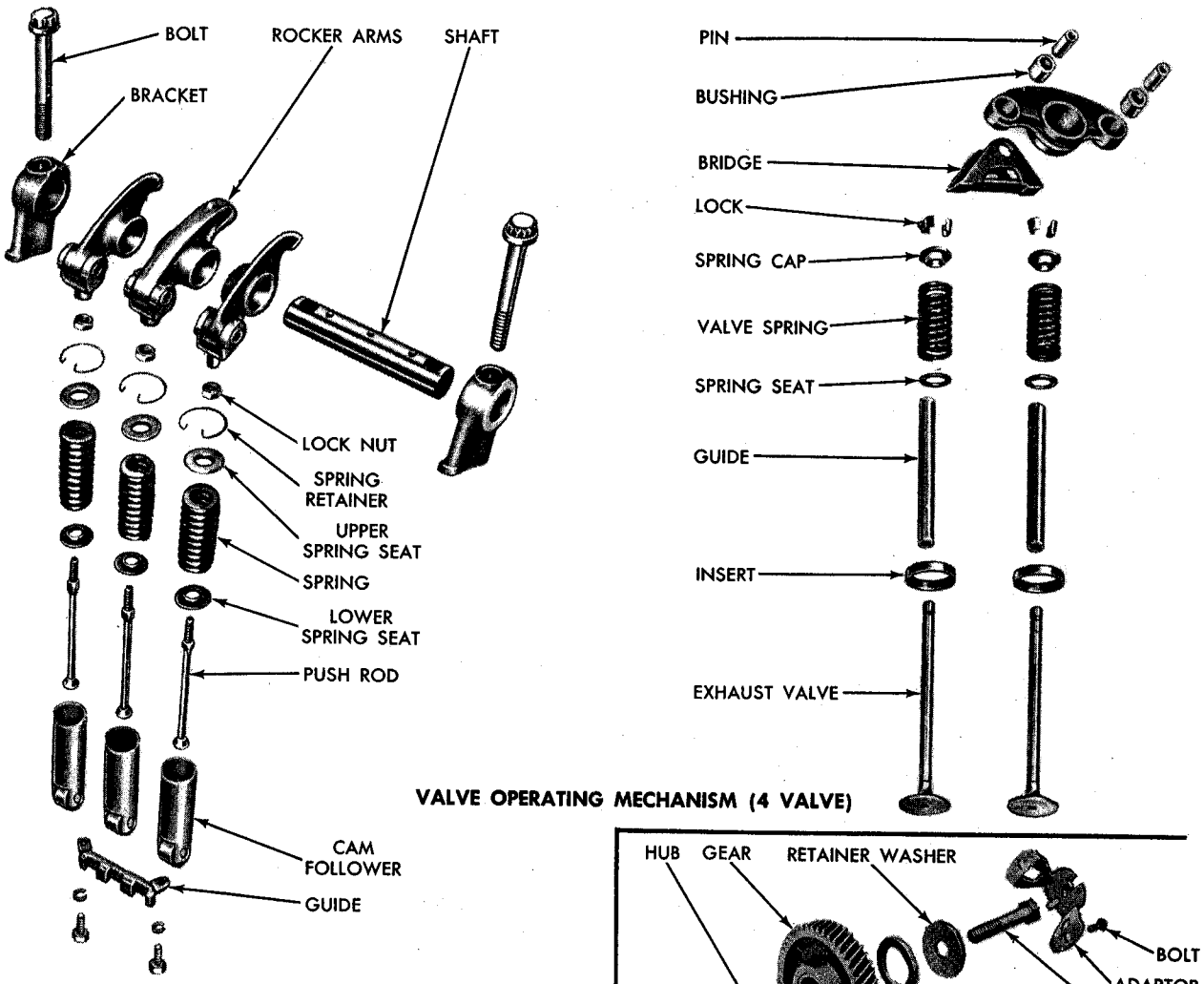


ACCESSORY DRIVE FOR BELT DRIVEN ACCESSORY (DRIVE PLATE TYPE)



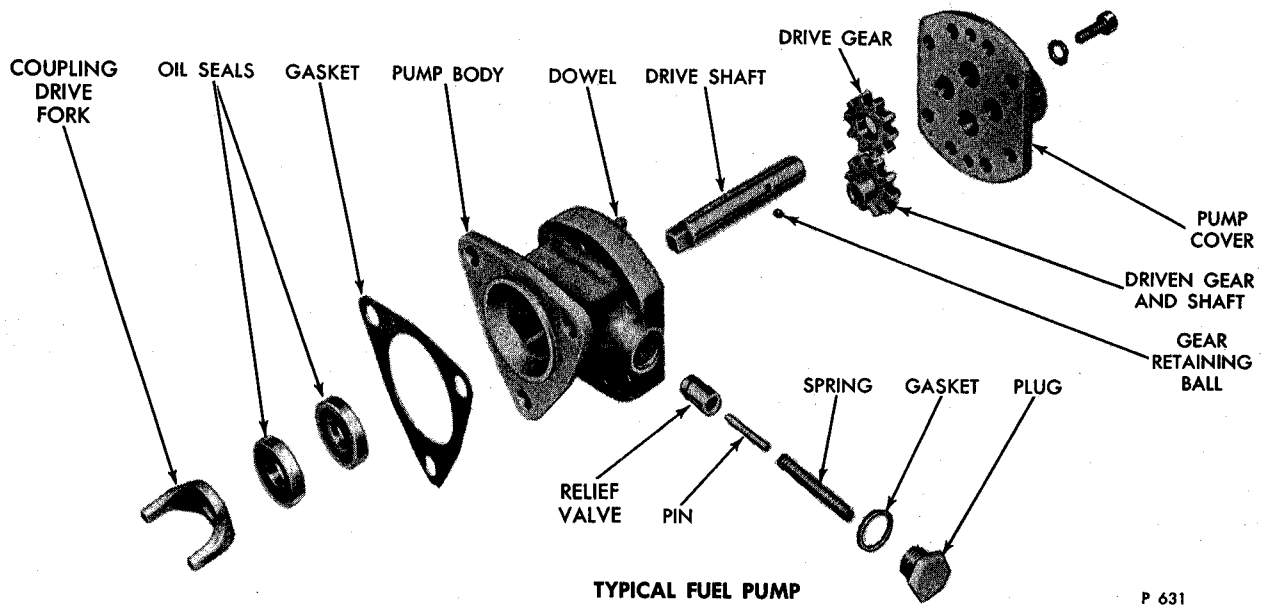
ACCESSORY DRIVE FOR DIRECT DRIVEN ACCESSORY (CAMSHAFT GEAR)

P 630



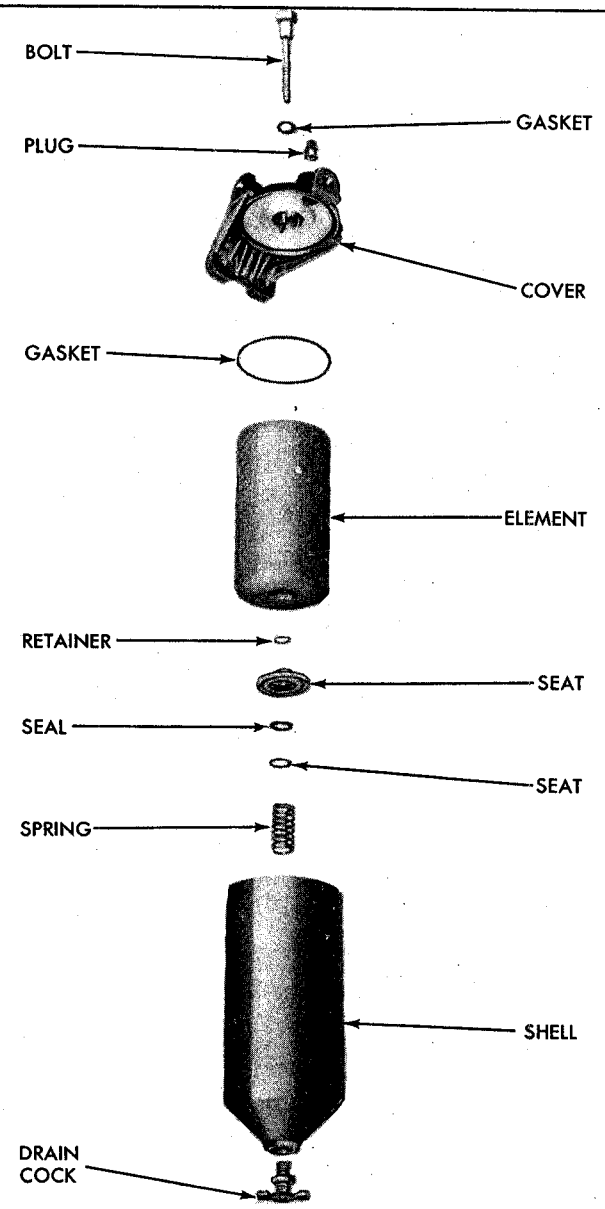
VALVE OPERATING MECHANISM (4 VALVE)

FUEL PUMP DRIVE (6V53)

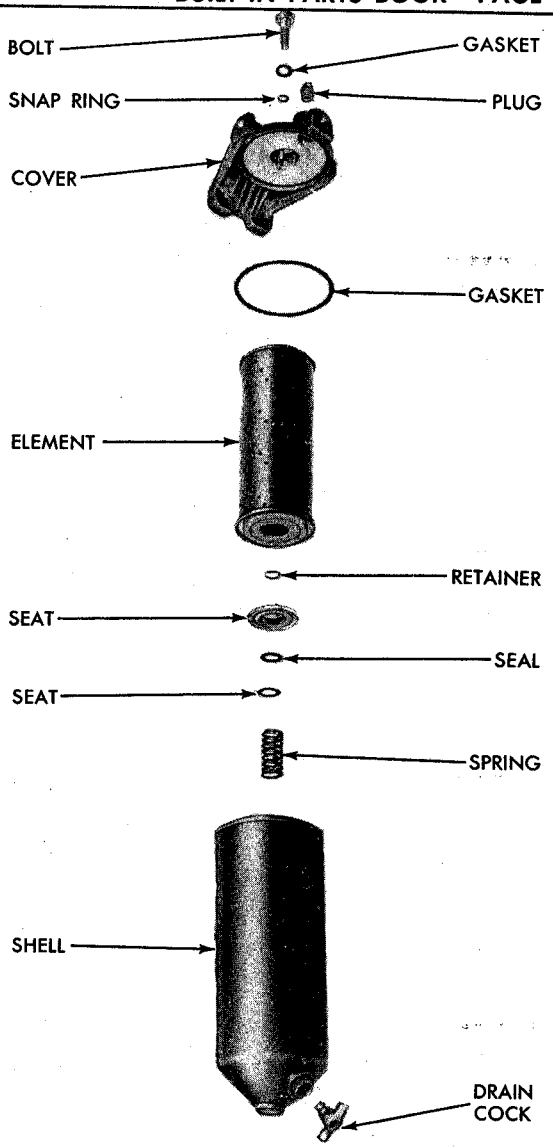


TYPICAL FUEL PUMP

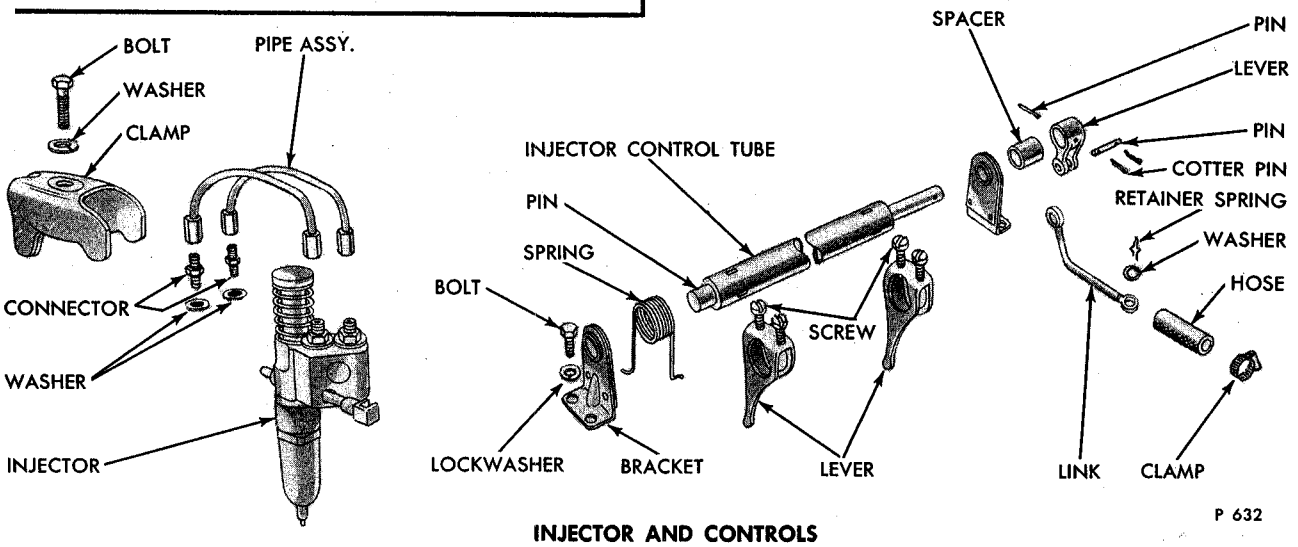
P 631



TYPICAL FUEL OIL STRAINER

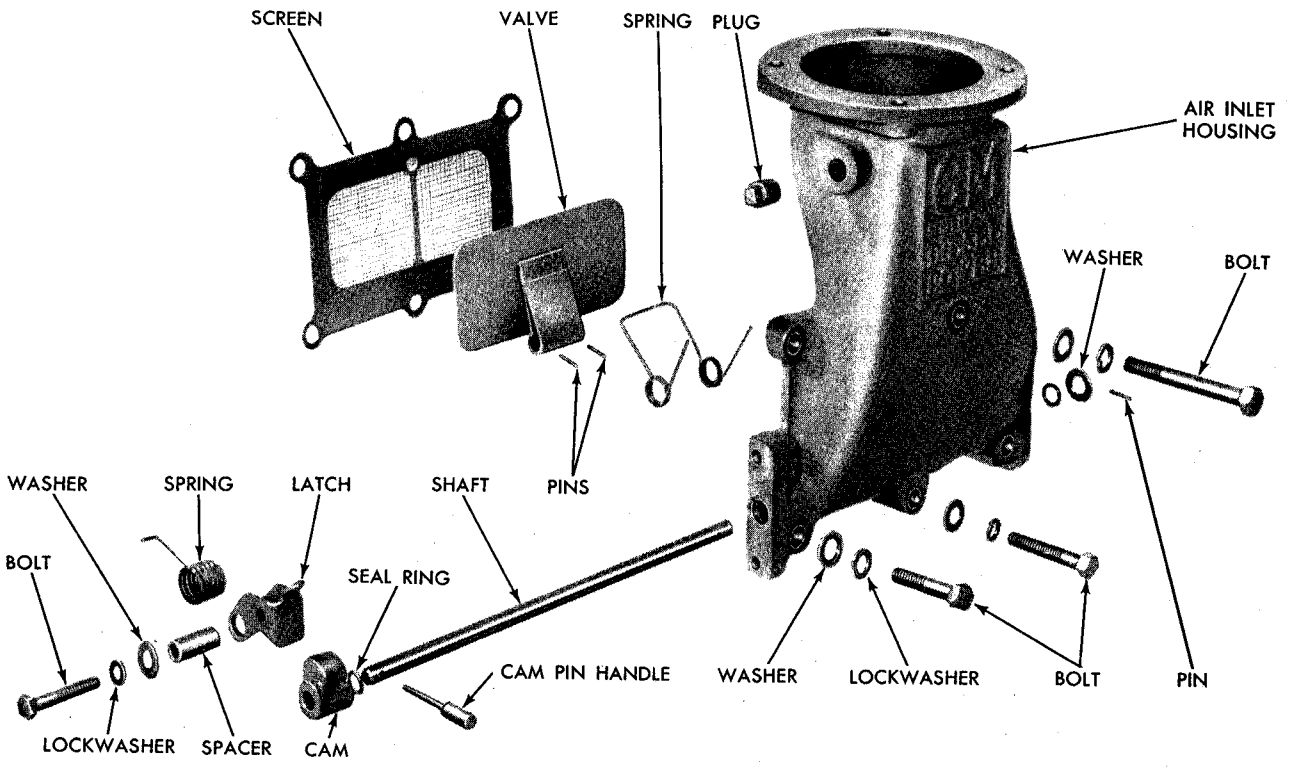


TYPICAL FUEL OIL FILTER

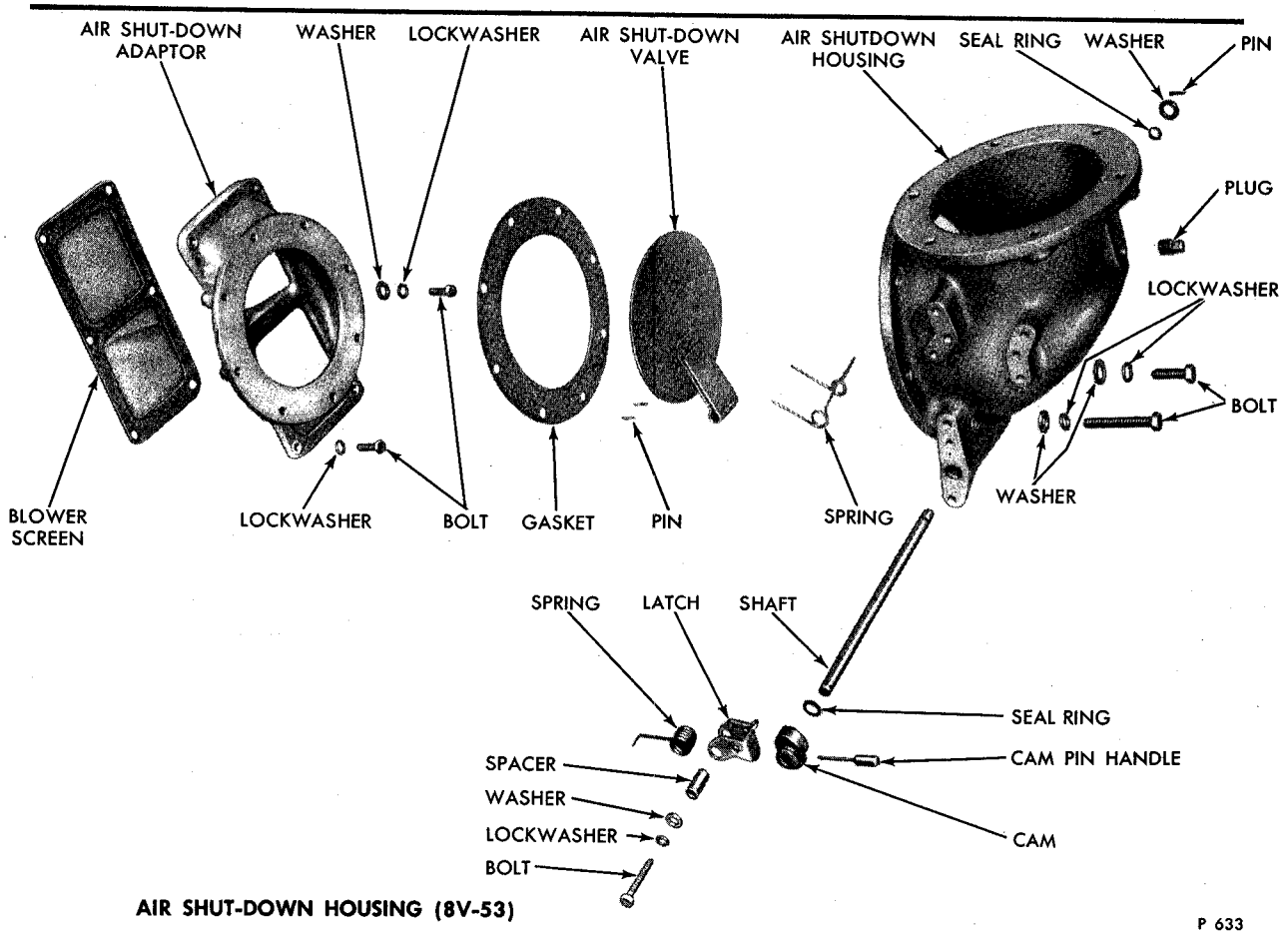


P 632

INJECTOR AND CONTROLS

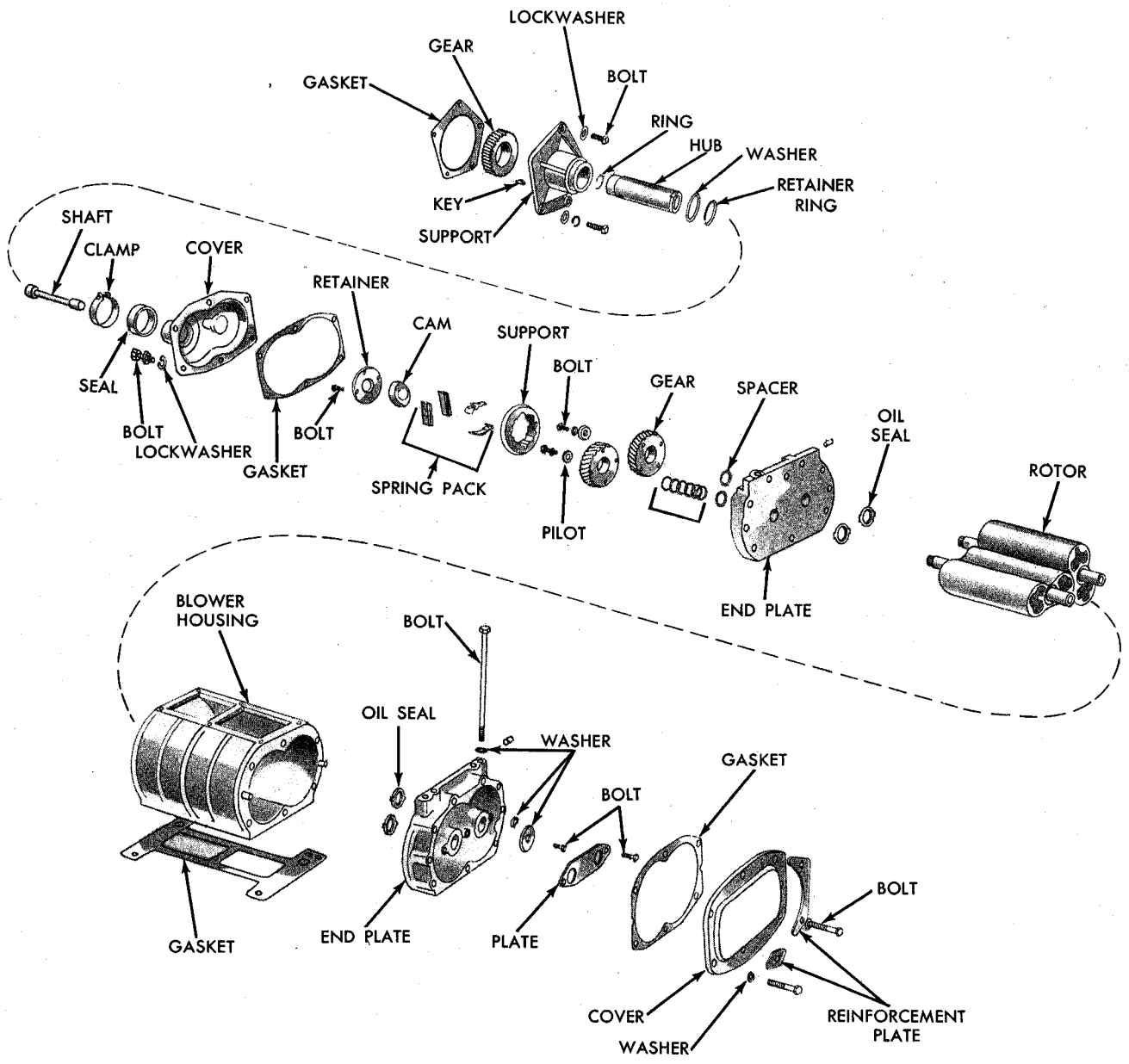


AIR SHUT-DOWN HOUSING



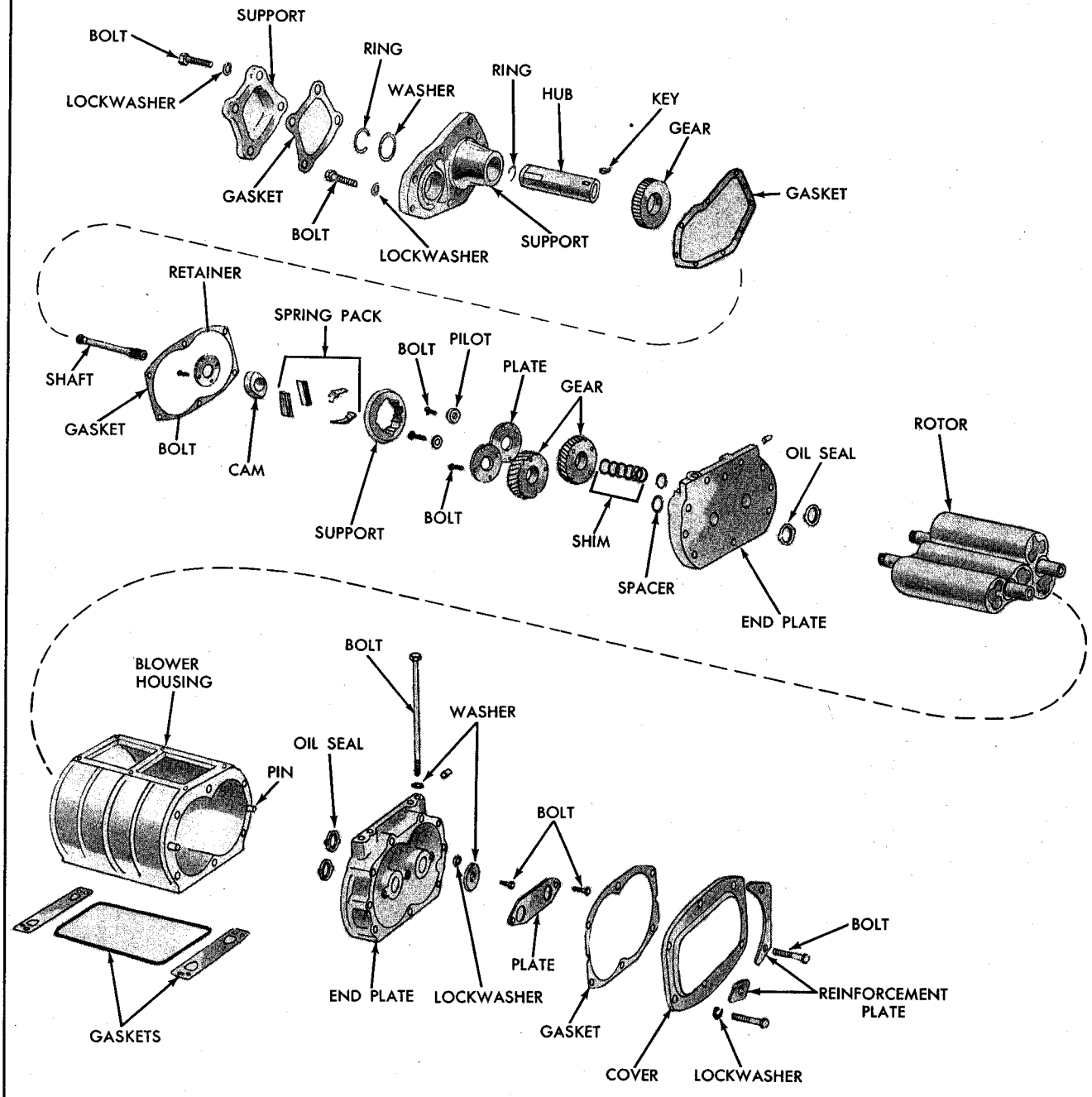
AIR SHUT-DOWN HOUSING (8V-53)

P 633



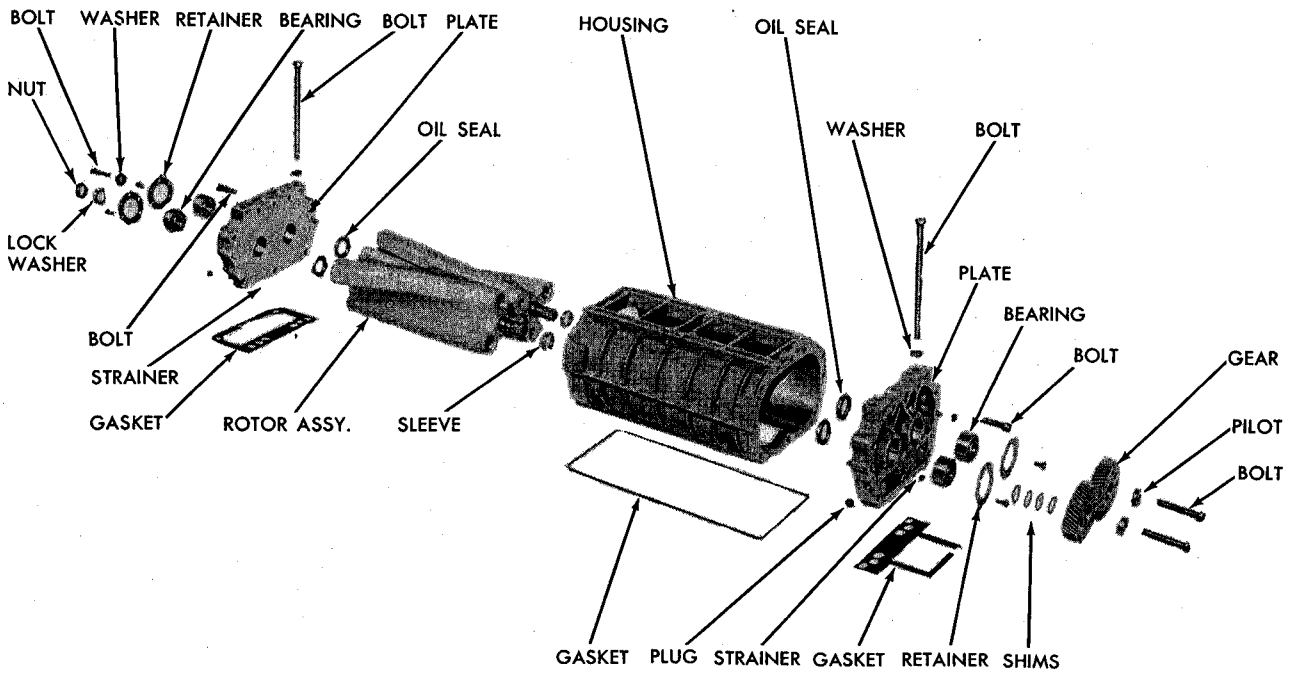
BLOWER ASSEMBLY AND DRIVE (4 CYL.)

P 634

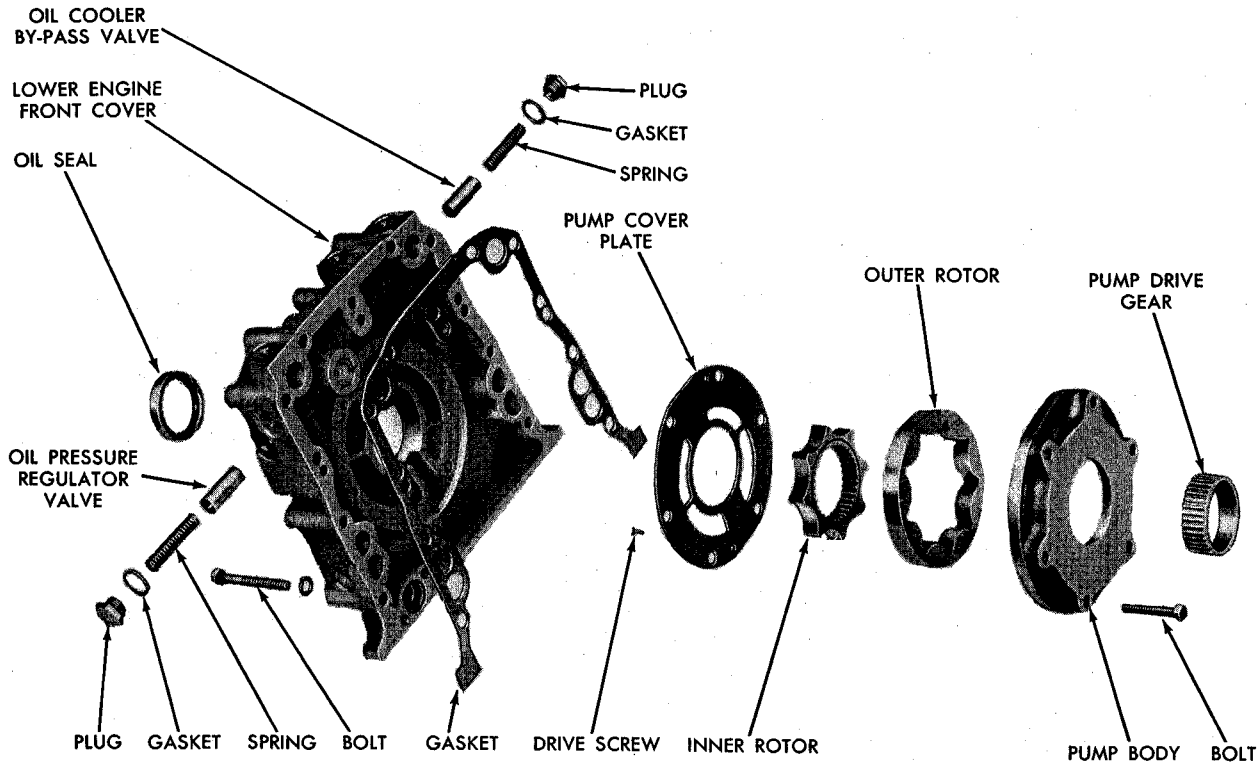


BLOWER ASSEMBLY AND DRIVE (6 CYL.)

P 635

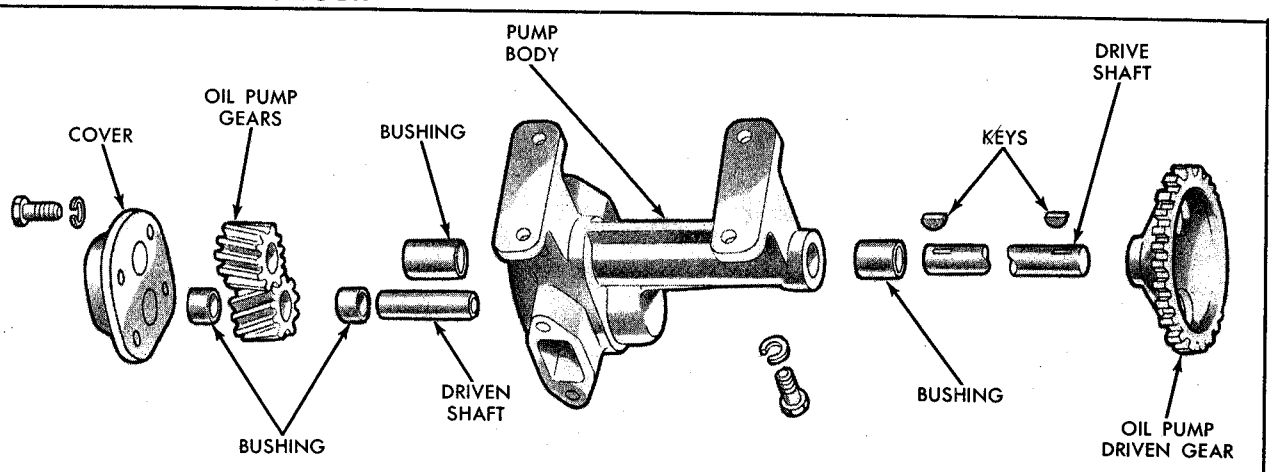


BLOWER ASSEMBLY (8 CYL.)

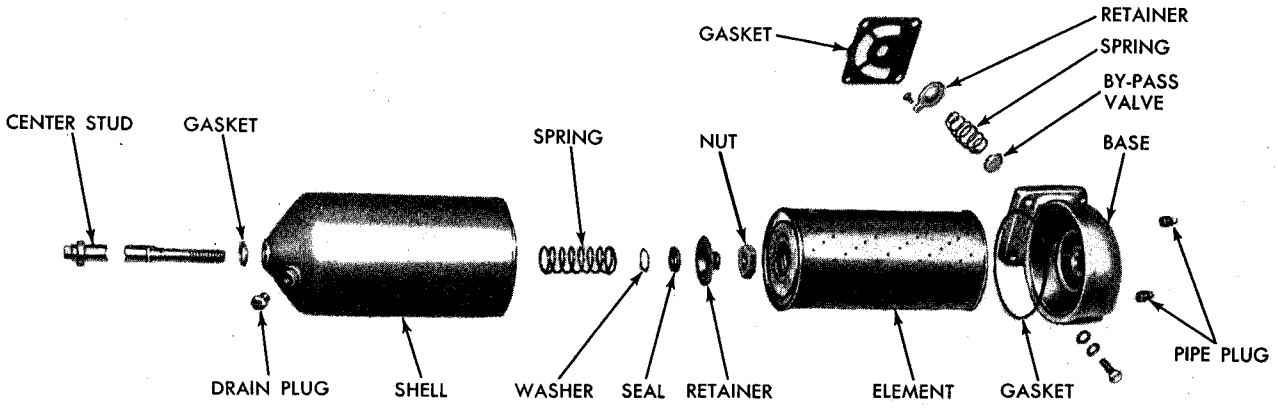


OIL PUMP AND REGULATOR

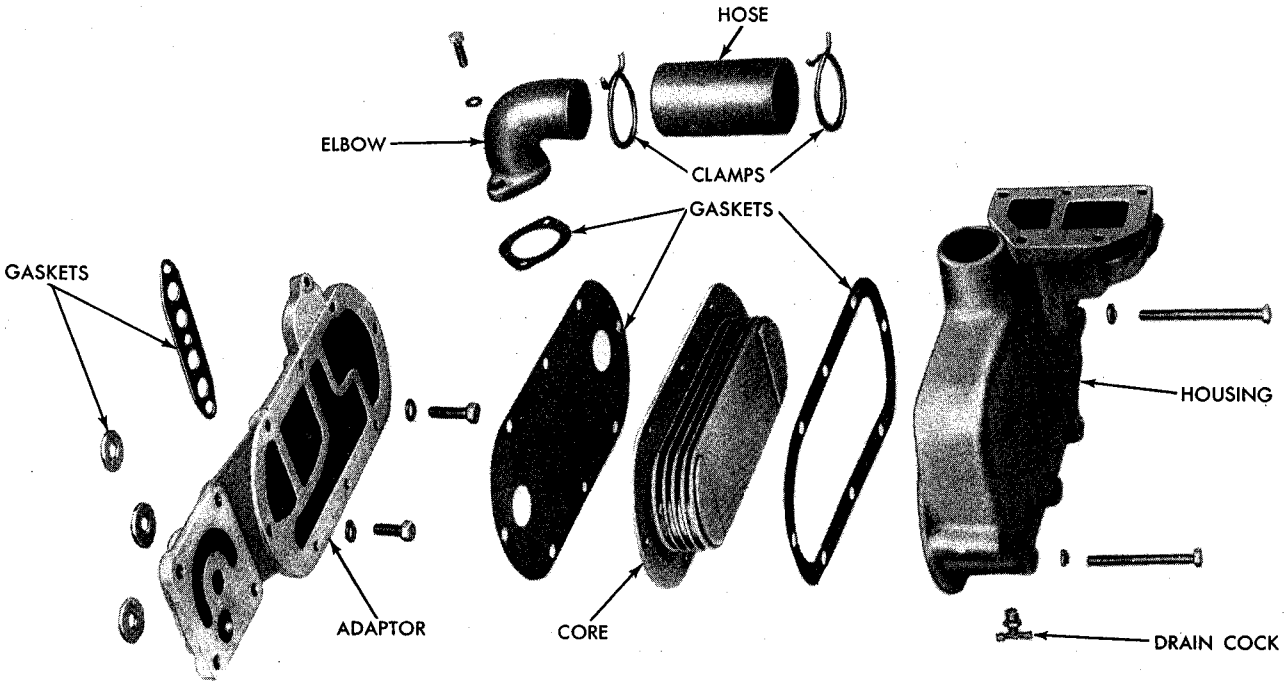
P 636



OIL PUMP (8V-53)

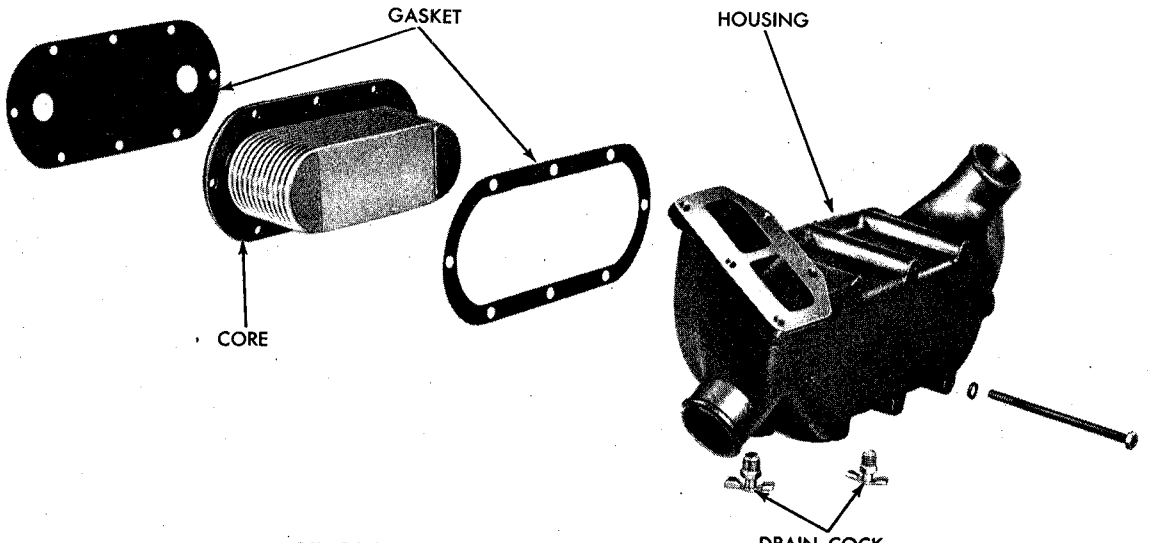


OIL FILTER

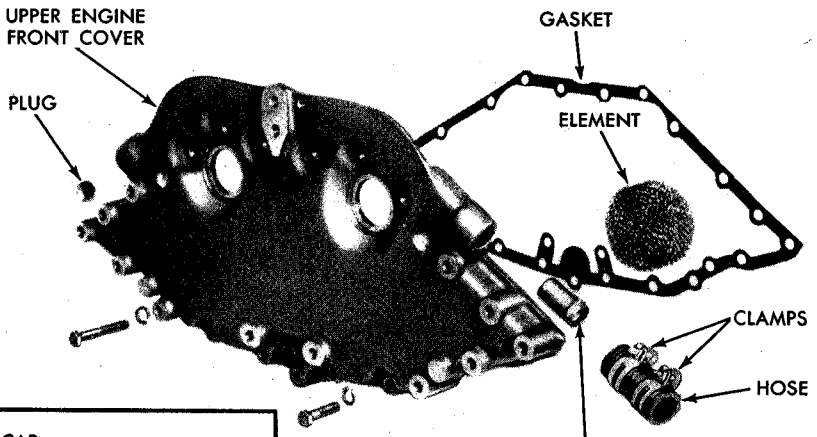


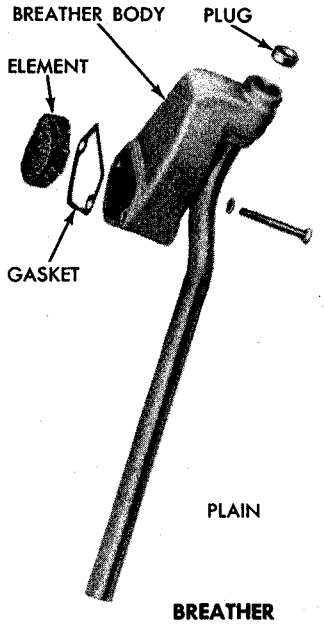
OIL COOLER

P 637

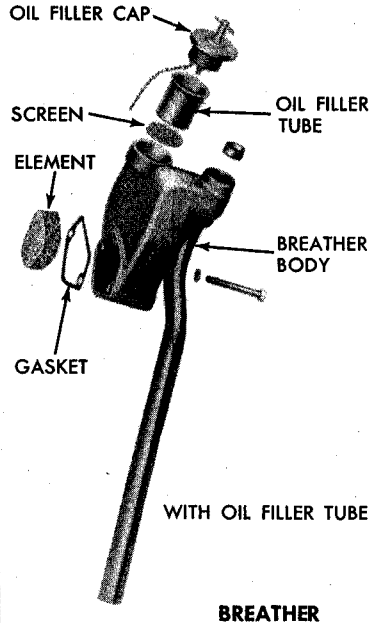


OIL COOLER (6 & 8V-53)

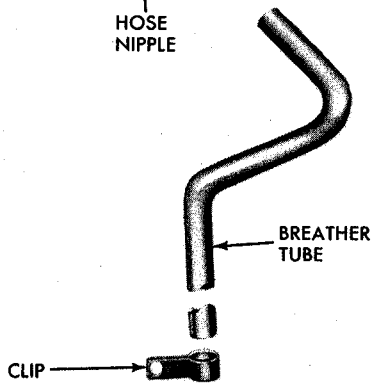




BREATHER

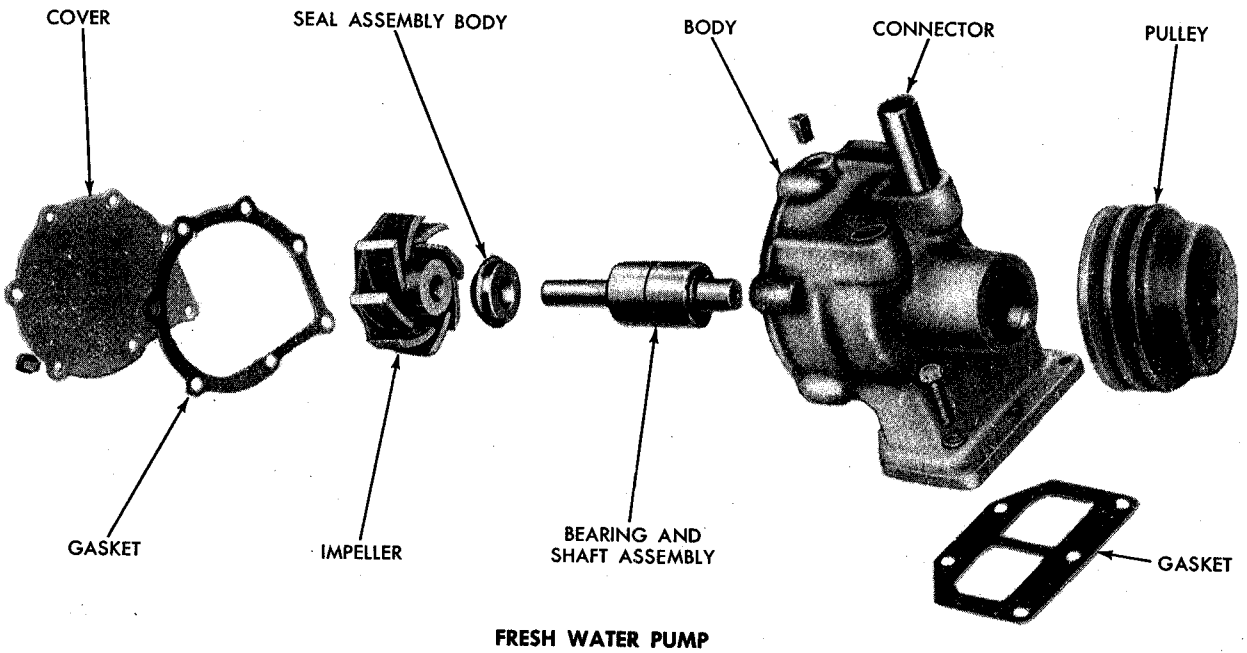


BREATHER

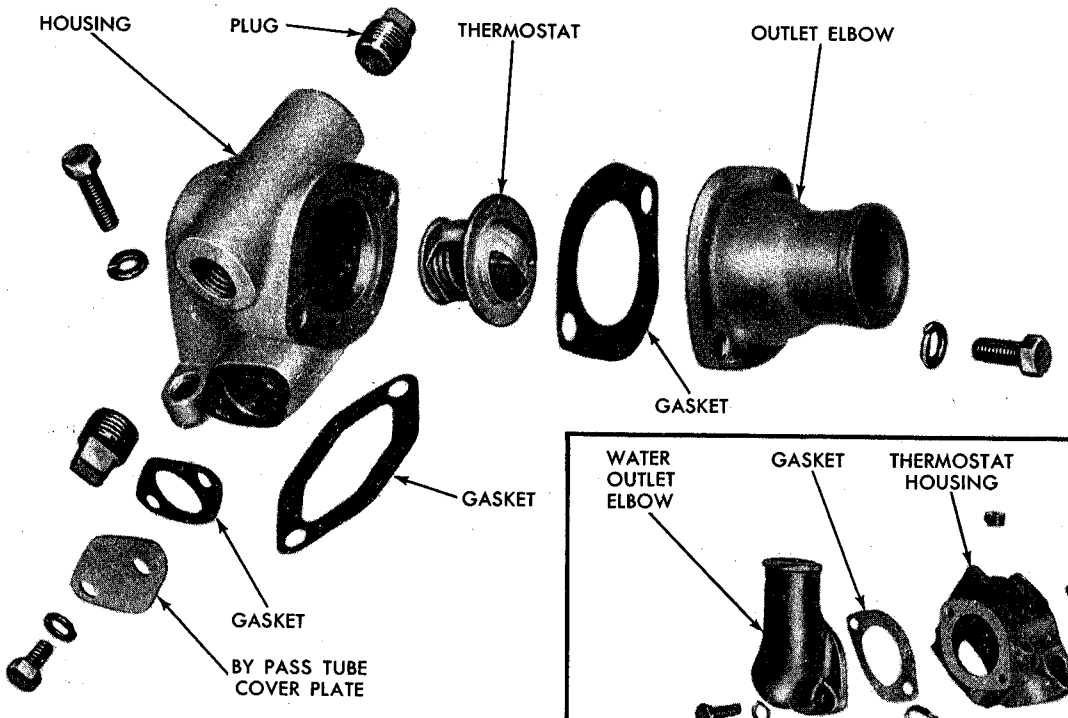


BREATHER (6 & 8V-53)

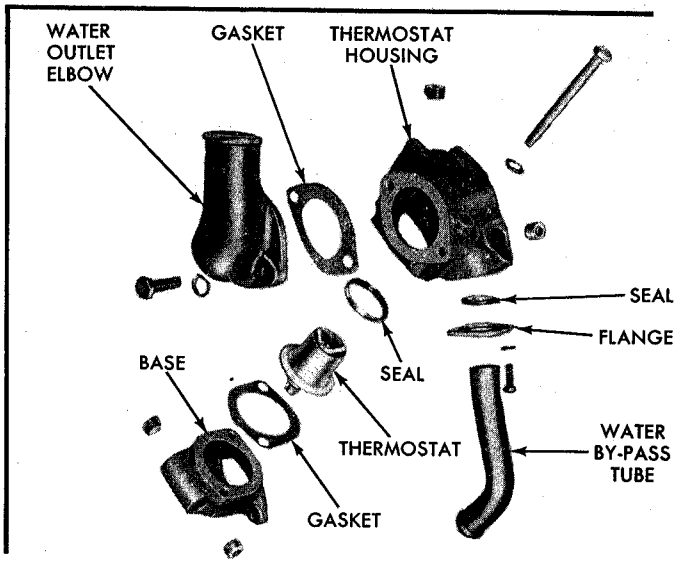
P 638



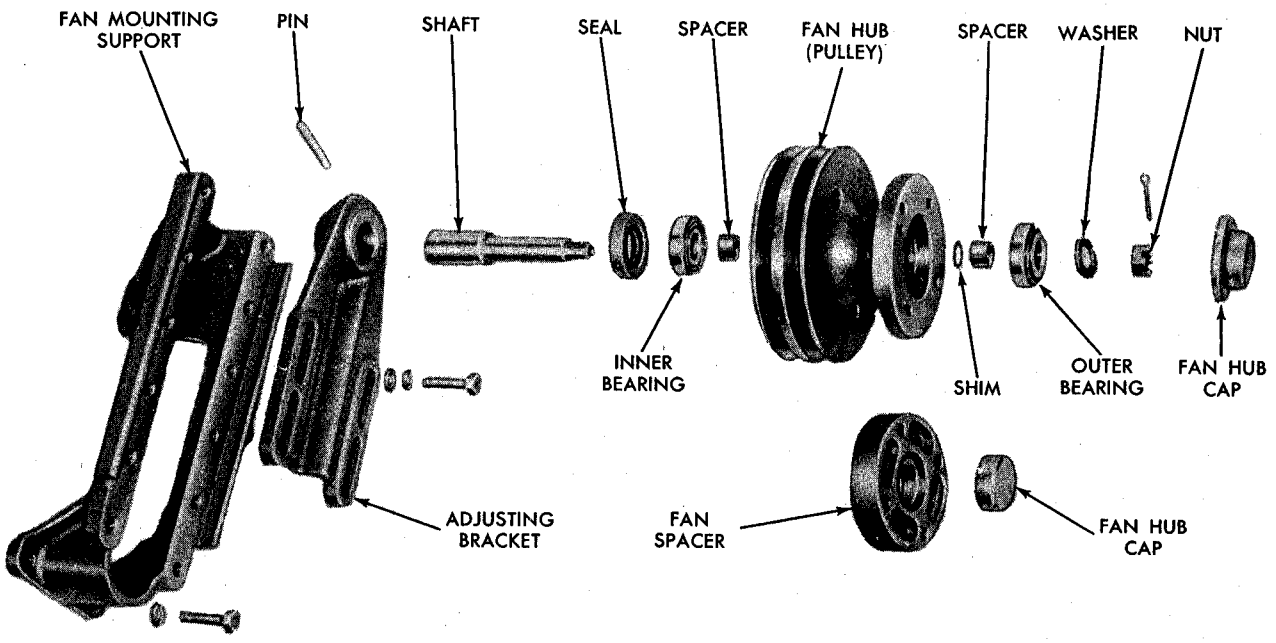
FRESH WATER PUMP



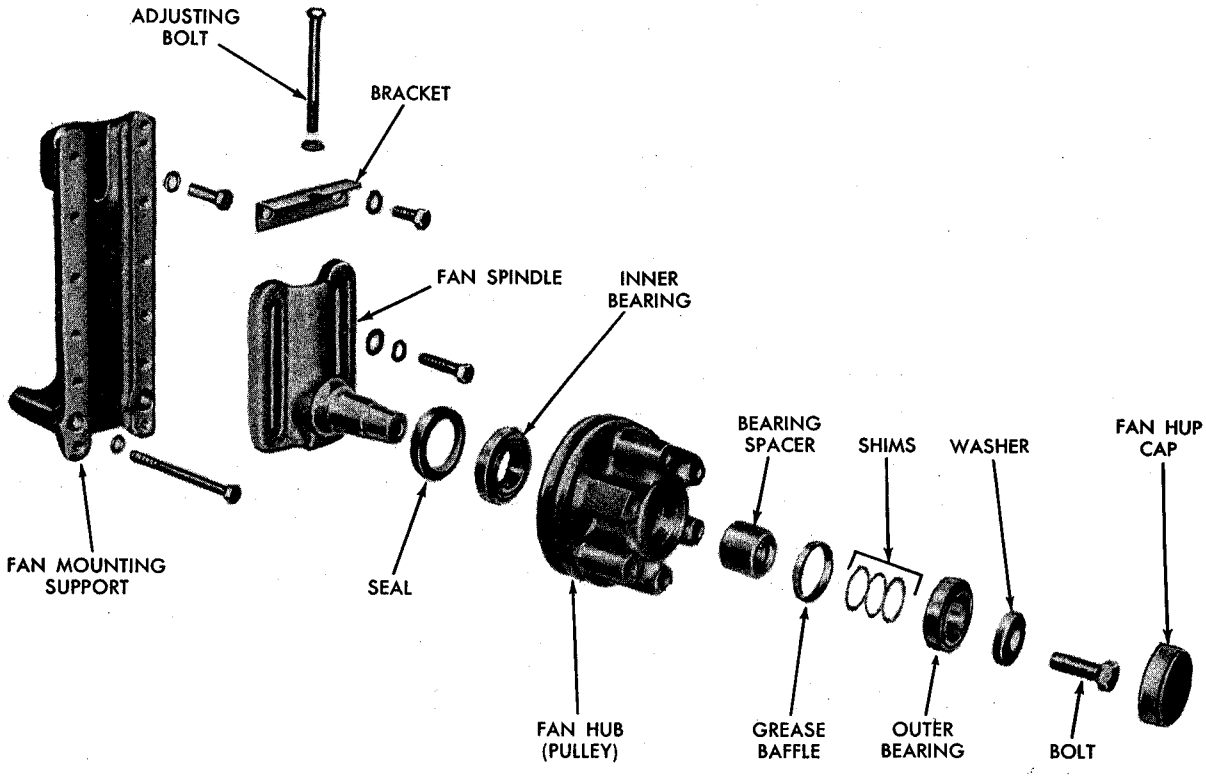
THERMOSTAT



THERMOSTAT (6 & 8V-53) P 639

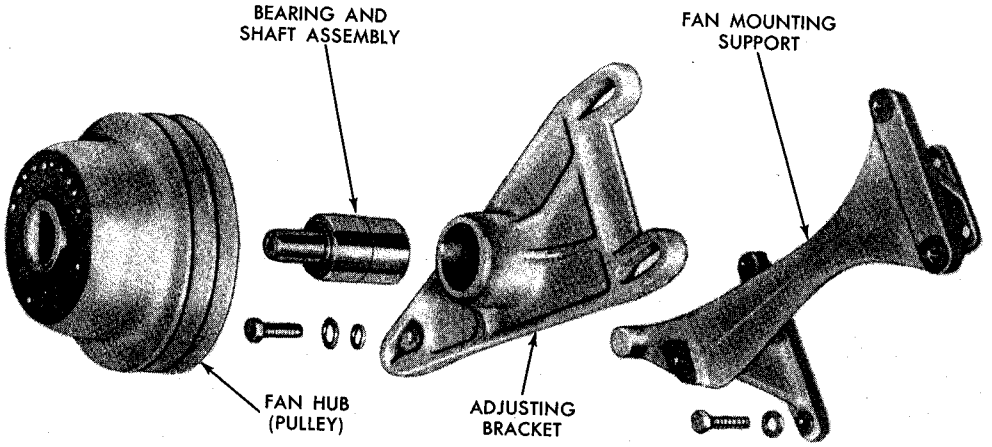


FAN MOUNT (6V-53)

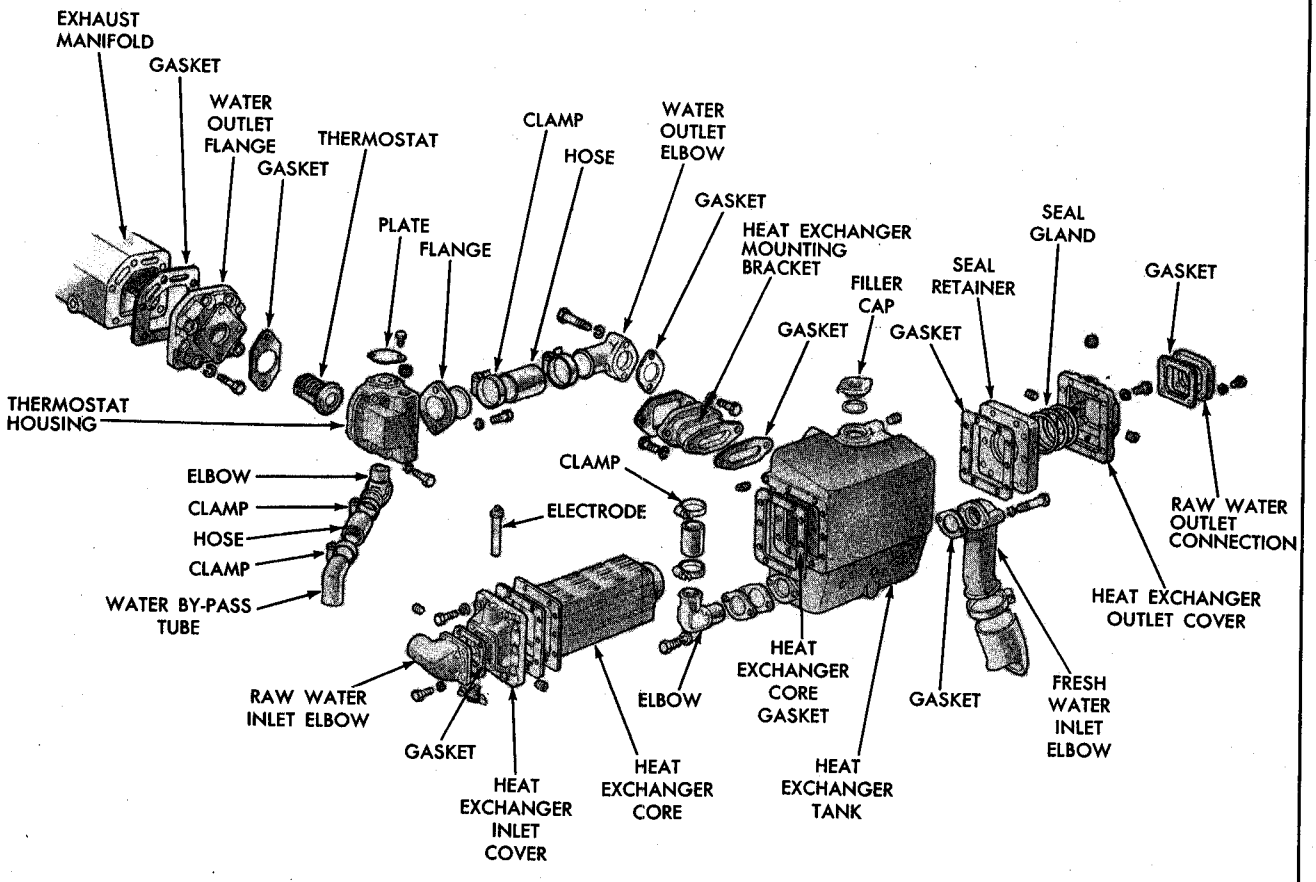


FAN MOUNT (8V-53)

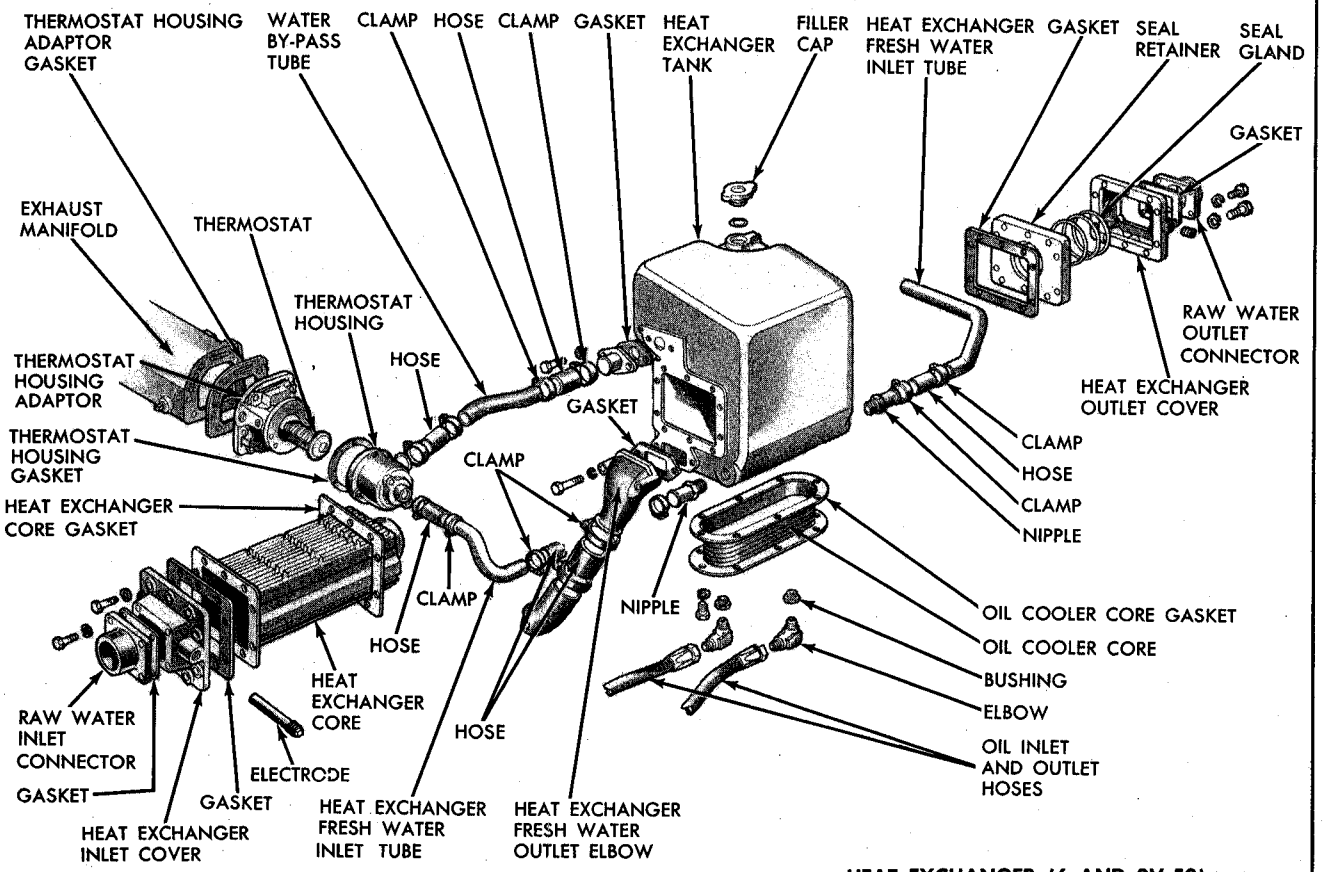
P 640



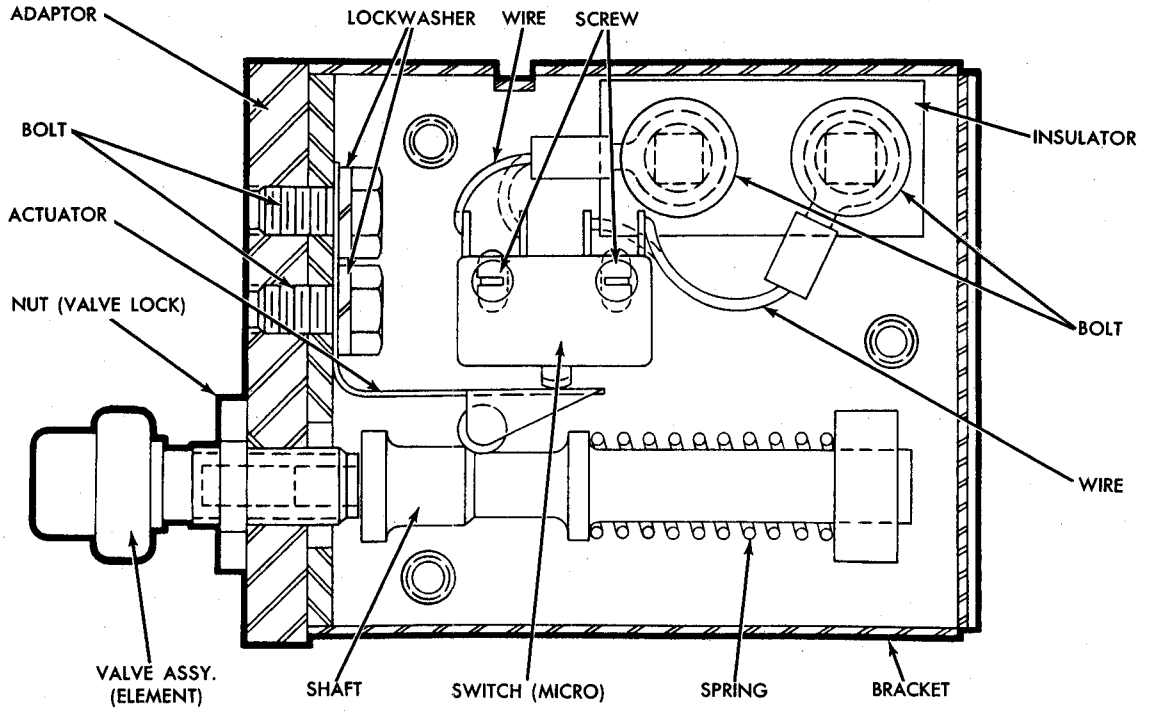
FAN MOUNT



HEAT EXCHANGER



HEAT EXCHANGER (6 AND 8V-53)



WATER TEMPERATURE SHUTDOWN SWITCH

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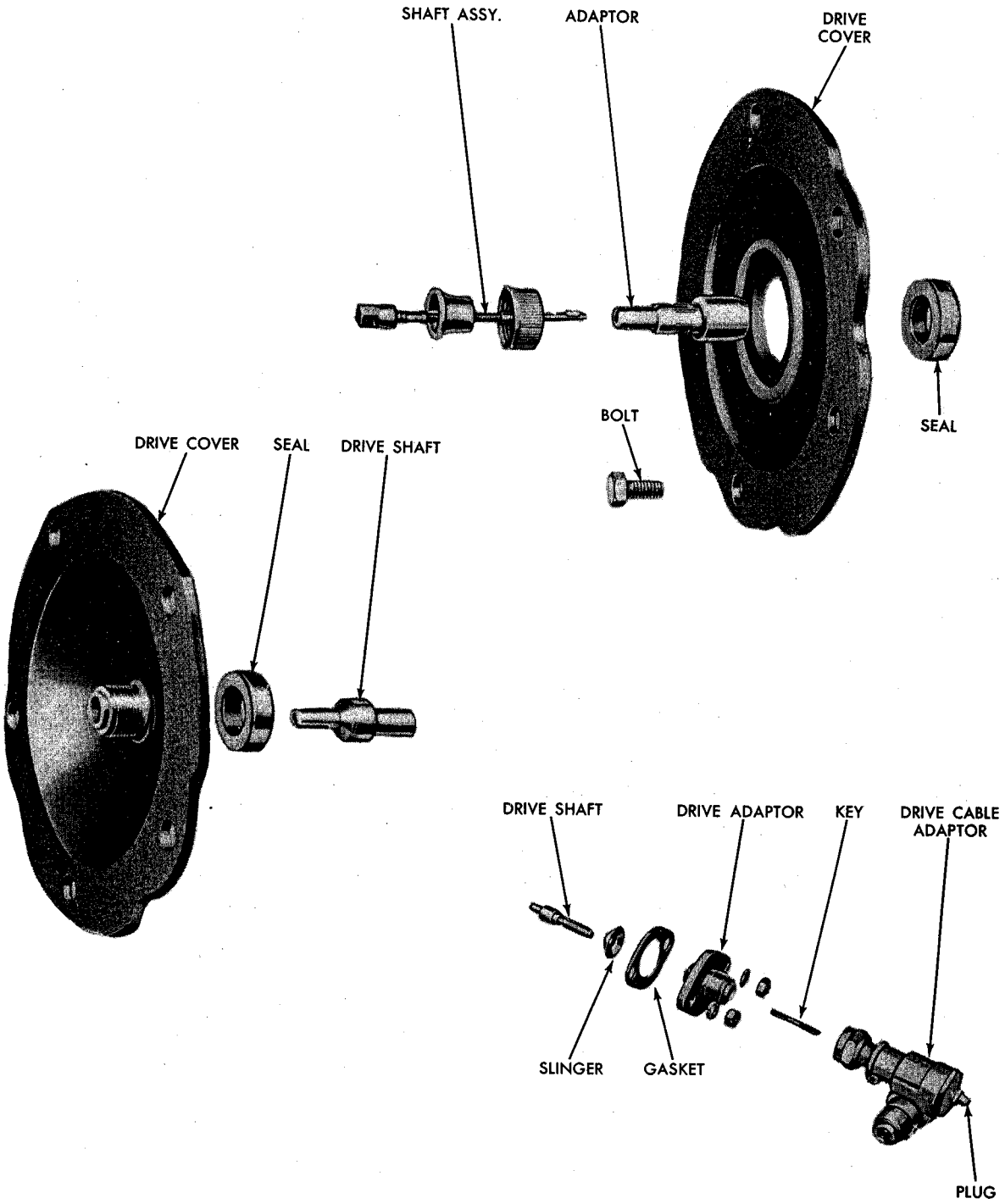
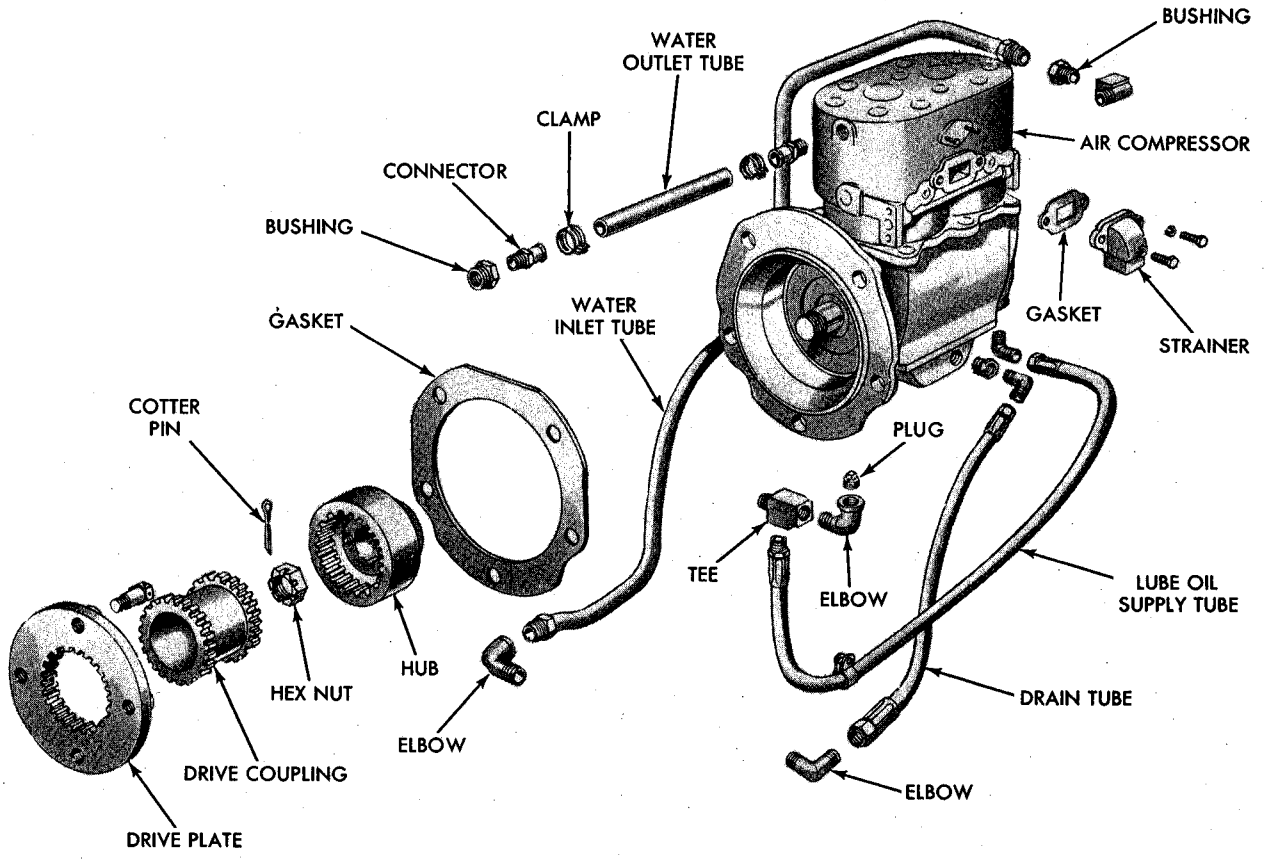
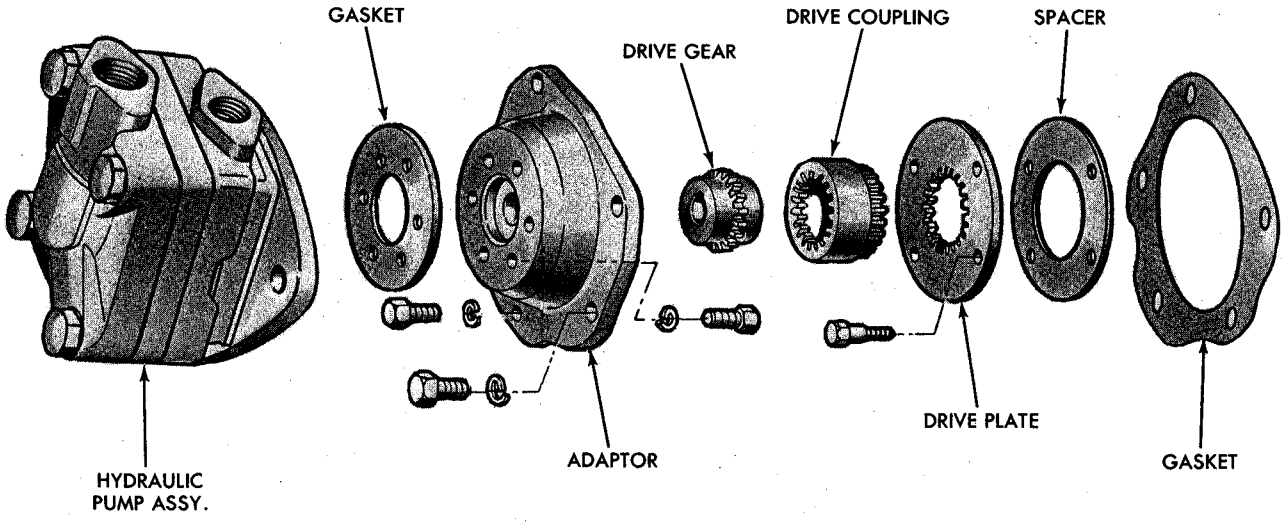


TACHOMETER DRIVE COVERS AND ADAPTORS



AIR COMPRESSOR AND DRIVE



HYDRAULIC PUMP AND DRIVE

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