COOLANT INHIBITOR CHART

Inhibitor or Inhibitor System	Corrosion Inhibitor Type	Inhibitor Compatability: Complete Inhibitor System	Inhibitor Compatability: Water	Inhibitor Compatability: Ethylene Glycol Base Antifreeze
Sodium chromate	Chromate	No	Yes	No
Potassium dichromate	Chromate	No	Yes	No
Perry filter elements:				
5020 (Type OS)	Chromate	Yes	Yes	No
S-453 (Spin-on)	Chromate	Yes	Yes	No
S-373 (Spin-on)	Non-chromate	Yes	Yes	Yes
5070 (Type OS)	# Non-chromate	Yes	Yes	Yes
S-473 (Spin-on)	# Non-chromate	Yes	Yes	Yes
Lenroc filter element	Non-chromate	Yes	Yes	Yes
Fleetguard filter elements:				
DCA (Canister)	Non-chromate	Yes	Yes	Yes
DCA (Spin-on)	Non-chromate	Yes	Yes	Yes
AC filter elements:				
DCA (Canister)	Non-chromate	Yes	Yes	Yes
DCA (Spin-on)	Non-chromate	Yes	Yes	Yes
Luber-Finer filter elements:				
LW-4739 (Canister)	Non-chromate	Yes	Yes	Yes
LFW-4744 (Spin-on)	Non-chromate	Yes	Yes	Yes
Nalcool 2000 (Liquid)	Non-chromate	Yes	Yes	Yes
Perry LP-20 (Liquid)	Non-chromate	Yes	Yes	Yes
Sy-Cool (Liquid)	Non-chromate	Yes	Yes	Yes
Lubercool (Liquid)	Non-chromate	Yes	Yes	Yes
DuBois Chemicals IWT-48 (Liquid)	Non-chromate	Yes	Yes	Yes
Norman Chemicals C15 (Liquid)	Non-chromate	Yes	Yes	Yes
Aqua-Tane (Liquid)	Non-chromate	Yes	Yes	Yes

Caution: Do not use methoxy propanol base antifreeze in Detroit Diesel engines

Fig. 3 - Coolant Inhibitor Chart

Bulk Inhibitor Additives

Commercially packaged inhibitor systems are available which can be added directly to the engine coolant or to bulk storage tanks containing coolant solution.

Both chromate and non-chromate systems are available and care should be taken regarding inhibitor compatability with other coolant constituents.

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

ANTIFREEZE

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

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

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

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

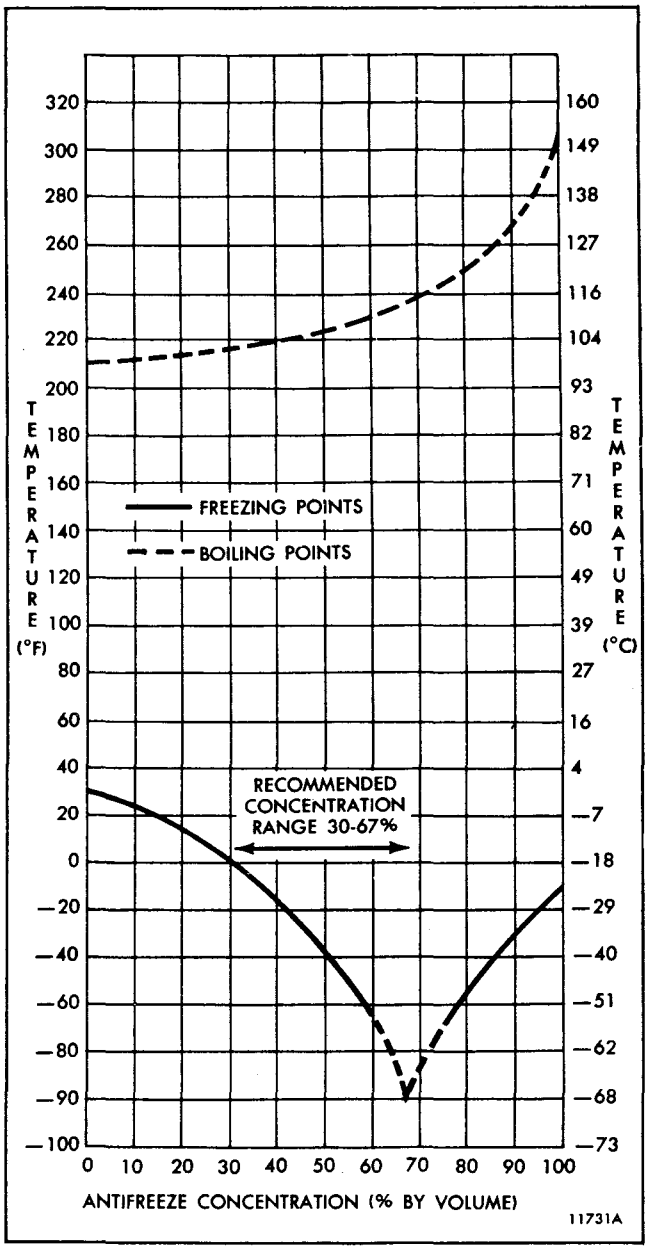


Fig. 4 - Coolant Freezing and Boiling Temperatures vs. Antifreeze Concentration (Sea Level)

Sealer Additives

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

GENERAL RECOMMENDATIONS

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

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

1. Always use a properly inhibited coolant.

2. Do not use soluble oil.

3. Maintain the prescribed inhibitor strength.

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

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

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

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

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

9. Do not mix ethylene glycol base antifreeze with methoxy propanol base antifreeze in the cooling system.

10. Do not use an antifreeze containing sealer additives.

11. Do not use methyl alcohol base antifreeze.

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

ENGINE TUNE-UP PROCEDURES

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

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

1. Limiting speed mechanical.

2. Variable speed mechanical.

3. Constant speed mechanical.

4. Hydraulic.

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

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

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

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

> **NOTE:** The exhaust valve bridges on the four valve cylinder head are adjusted at the time the cylinder head is installed on the engine and, until wear occurs, no further adjustment is required. When wear is evident, perform a complete valve bridge adjustment as outlined on the following page.

The tune-up procedures apply to the individual engines of multiple engine units as well as to the single engine units. However, the throttle linkage of multiple engine units must be adjusted after the individual engines have been tuned-up. Use a new valve rocker cover gasket after tune-up is completed.

Tune-Up Sequence for Mechanical Governor

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

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the governor gap.

4. Position the injector rack control levers.

5. Adjust the maximum no-load speed.

6. Adjust the idle speed.

7. Adjust the buffer screw.

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

9. Adjust the supplementary governing device, if used.

Tune-Up Sequence for Hydraulic Governor

1. Adjust the exhaust valve clearance.

2. Time the fuel injectors.

3. Adjust the fuel rod.

4. Position the injector rack control levers.

5. Adjust the load limit screw.

6. Compensation adjustment (PSG governors only).

7. Adjust the speed droop.

8. Adjust the maximum no-load speed.

EXHAUST VALVE CLEARANCE ADJUSTMENT

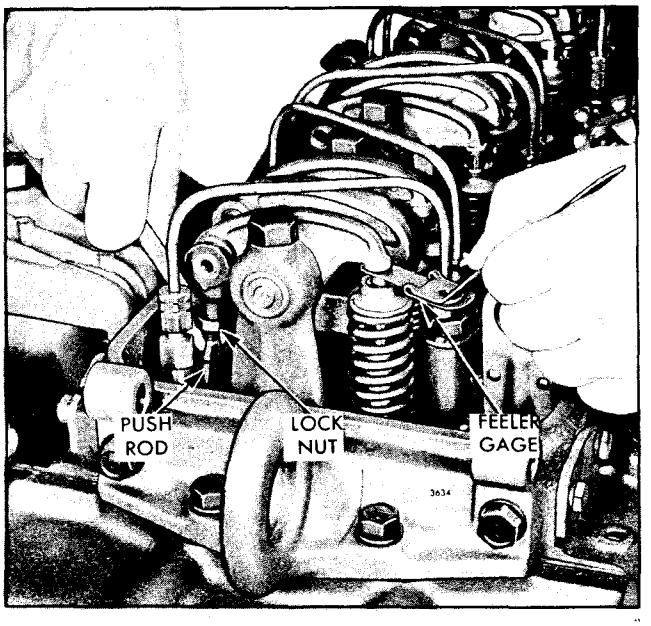


Fig. 1 - Adjusting Valve Clearance

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

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

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

ENGINES WITH TWO VALVE CYLINDER HEADS

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

Exhaust Valve Clearance Adjustment (Cold Engine)

1. Place the governor stop lever in the no-fuel position.

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

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

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

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

5. Place a .013 " feeler gage, tool J 9708, between the valve stem and the rocker arm (Fig. 1). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

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

7. Recheck the clearance. At this time, if the adjustment is correct, the .011 " feeler gage, J 9708, will pass freely between the valve stem and the rocker arm, but the .013 " feeler gage will not pass through.

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

Exhaust Valve Clearance Adjustment (Hot Engine)

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

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

ENGINES WITH FOUR VALVE CYLINDER HEADS

The exhaust valve bridges must be adjusted and the adjustment screws locked securely at the time the cylinder head is installed on the engine. Until wear occurs, no further adjustment is required on the exhaust valve bridges. When wear is evident, make the necessary adjustments as outlined.

Exhaust Valve Bridge Adjustment

1. Remove the loose dirt from the valve rocker cover and remove the cover. Remove the injector fuel pipes and the rocker arm retaining bolts. Move the rocker arms away from the exhaust valve bridges.

2. Remove the exhaust valve bridge (Fig. 2).

3. Place the bridge in a vice or holding fixture J 21772 and loosen the lock nut on the bridge adjusting screw.

> **NOTE:** Loosening or tightening the lock nut with the bridge in place may result in bending the bridge guide or the rear valve stem.

4. Install the bridge on the bridge guide.

5. While firmly pressing straight down on the pallet surface of the bridge, turn the adjusting screw clockwise until it just touches the valve stem. Then turn the screw an additional 1/8 to 1/4 turn clockwise and tighten the lock nut finger tight.

6. Remove the bridge and place it in a vise. Hold the screw from turning with a screw driver and tighten the lock nut on the adjustment screw. Complete the operation by tightening the lock nut with a torque wrench to 25 lb-ft (34 Nm), being sure that the screw does not turn.

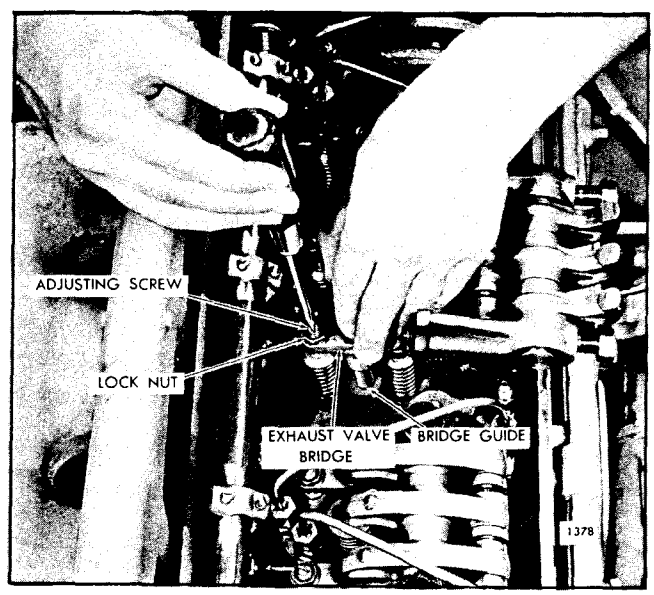


Fig. 2 - Valve Bridge Adjustment

7. Lubricate the bridge guide and bridge pilot with engine oil.

8. Reinstall the bridge in its original position.

9. Place a .0015 " feeler gage under each end of the bridge. When pressing down on the pallet surface of the bridge, both feeler gages must be tight. If both feeler gages are not tight, readjust the screw as outlined in Steps 5 and 6.

10. Adjust the remaining bridges as outlined above.

11. Swing the rocker arm assembly into position being sure the bridges are properly positioned on the rear valve stems. This precaution is necessary to prevent valve damage due to mislocated bridges.

12. Tighten the rocker bracket bolts to 90-100 lb-ft (122-136 Nm) torque.

13. Align the fuel pipes and connect them to the injectors and the fuel connectors. Use socket J 8932 to tighten the connectors to 12-15 lb-ft (16-20 Nm) torque.

> **NOTE:** Do not bend the fuel pipes and do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

Exhaust Valve Clearance Adjustment (Cold Engine)

Adjust the exhaust valve clearance at the push rod. *Do not disturb the exhaust valve bridge adjusting screw.*

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

1. Place the governor stop lever in the no-fuel position.

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

3. Rotate the crankshaft manually, or with the starting

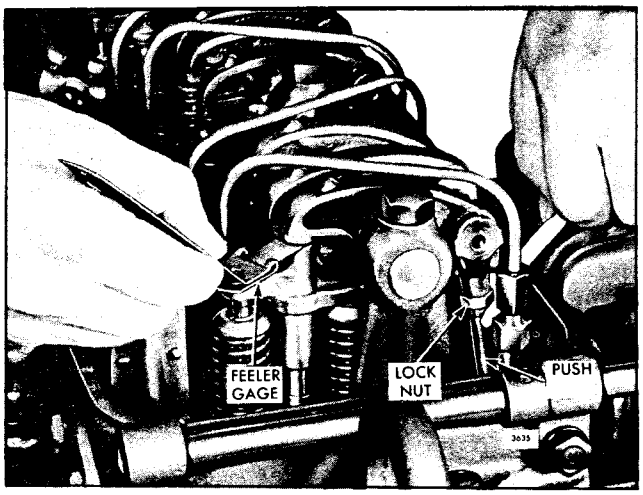


Fig. 3 - Adjusting Valve Clearance

motor, until the injector follower is fully depressed on the cylinder to be adjusted.

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

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

5. Place a .017 " feeler gage, J 9708, between the valve bridge and the valve rocker arm pallet (Fig. 3). Adjust the push rod to obtain a smooth "pull" on the feeler gage.

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

7. Recheck the clearance. At this time, if the adjustment is correct, the .015 " feeler gage will pass freely between the valve bridge and the rocker arm pallet but the .017 " feeler gage will not pass through.

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

Exhaust Valve Clearance Adjustment (Hot Engine)

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

1. With the engine at normal operating temperature (160-185 °F or 71-85 °C), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .013 " feeler gage will pass freely between the valve bridge and the rocker arm pallet, but the .015 " gage will not pass through. Adjust the push rod, if necessary.

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

TIMING FUEL INJECTOR

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

All of the injectors can be timed, in firing order sequence, during one full revolution of the crankshaft. Refer to the general specifications at the front of the manual for the engine firing order.

Use the proper timing gage as indicated in the following chart.

Time Fuel Injector

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

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

2. Rotate the crankshaft until the exhaust valves are fully depressed on the particular cylinder to be timed.

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

3. Place the small end of the injector timing gage in the hole provided in the top of the injector body, with the flat of the gage toward the injector follower (Fig. 4).

4. Loosen the push rod lock nut.

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

6. Hold the push rod and tighten the lock nut. Check the adjustment and, if necessary, re-adjust the push rod.

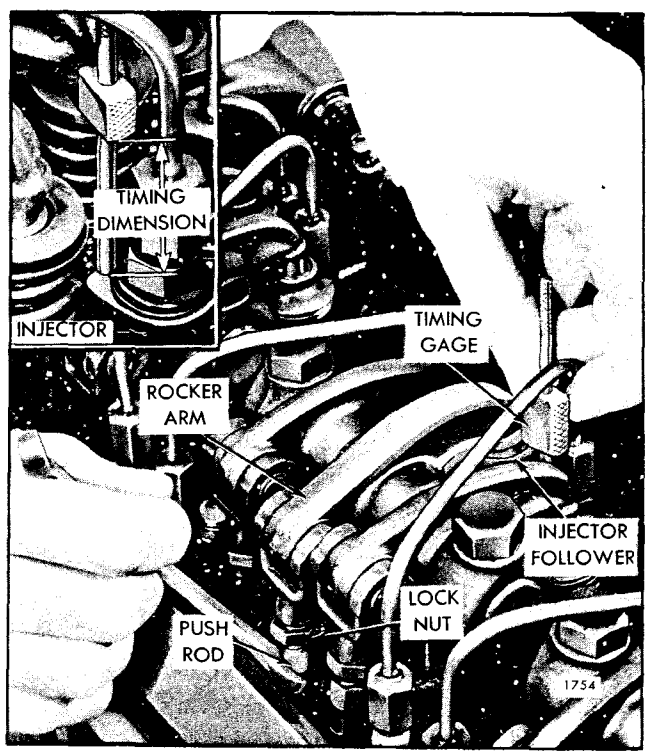


Fig. 4 - Timing Fuel Injector

Injector	Timing Dimension	Timing Gage	Camshaft Timing
GENERATOR SET APPLICATIONS			
All	1.460"	J 1853	Standard
ALL OTHER APPLICATIONS			
71N5	*1.460"	J 1853	*Standard
N55	*1.460"	J 1853	*Standard
N60	*1.460"	J 1853	*Standard
N65 (White Tag)	1.460"	J 1853	Standard
N65 Turbo (Brown Tag)	1.484"	J 1242	Standard
N65 Non-Turbo (Brown Tag)	**1.484"	J 1242	**Advanced
HN65	1.460"	J 1853	Standard
N70 Turbo	1.460"	J 1853	Standard
N70 Non-Turbo	1.460"	J 1853	Advanced
N75 Turbo	1.460"	J 1853	Standard
N80 Turbo	1.484"	J 1242	Standard
N80 Non-Turbo	**1.484"	J 1242	**Advanced
N90	1.460"	J 1853	

*Use 1.484" timing gage (J 1242) when engine has advanced camshaft timing. Correct to standard camshaft timing and 1.460" injector timing at first opportunity to be consistent with current production build.

**Use 1.460" timing gage (J 1853) when engine has standard camshaft timing. Correct to advanced camshaft timing and 1.484" injector timing at first opportunity.

NOTE: Advanced camshaft timing is indicated by "ADV—CAM—TIMING" stamped on lower right hand side of option plate.

INJECTOR TIMING GAGE CHART (Needle Valve)

7. Time the remaining injectors in the same manner as outlined in Steps 1 through 6.

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

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

The governor is mounted on the front end of the blower and is driven by the upper blower rotor.

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

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

Adjust Governor Gap (Single Weight Governor)

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

IMPORTANT: If the gap adjustment is to be made with the engine in the vehicle, it is suggested that the fan assembly be removed due to the closeness of the fan blades to the engine governor.

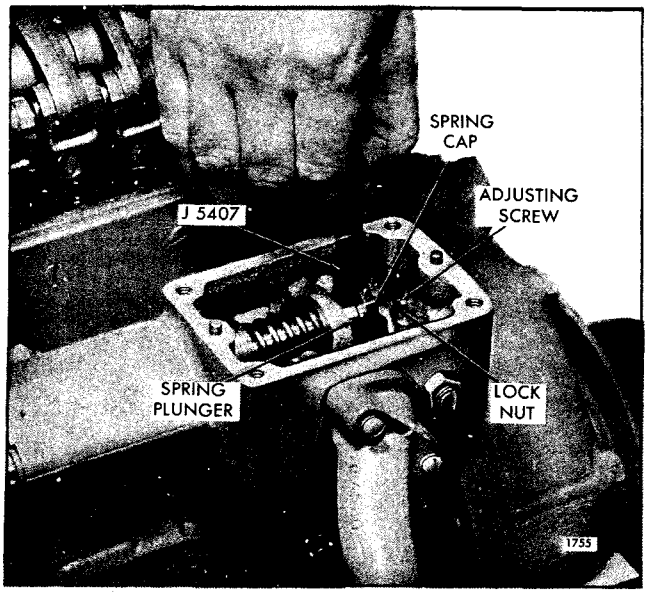


Fig. 1 - Adjusting Gap (Single Weight Governor)

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

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

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

NOTE: Current limiting speed governors used in turbocharged engines include a starting aid screw threaded into a boss on the governor housing.

IMPORTANT: EPA certified minimum idle speeds are 500 rpm for trucks and highway coaches and 400 rpm for city coaches.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker cover. Discard the gaskets.

5. Remove the fuel rod from the differential lever and the injector control tube lever.

6. Check the gap between the low-speed spring cap and the high-speed spring plunger with gage J 5407 (.170 ") as shown in Fig. 1.

7. If required, loosen the lock nut and turn the gap adjusting screw until a slight drag is felt on the gage.

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

9. Recheck the gap and readjust if necessary.

10. Install the fuel rod between the governor and injector control tube lever.

11. Use a new gasket and install the governor cover and lever assembly.

Adjust Governor Gap - Double-Weight Governor

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

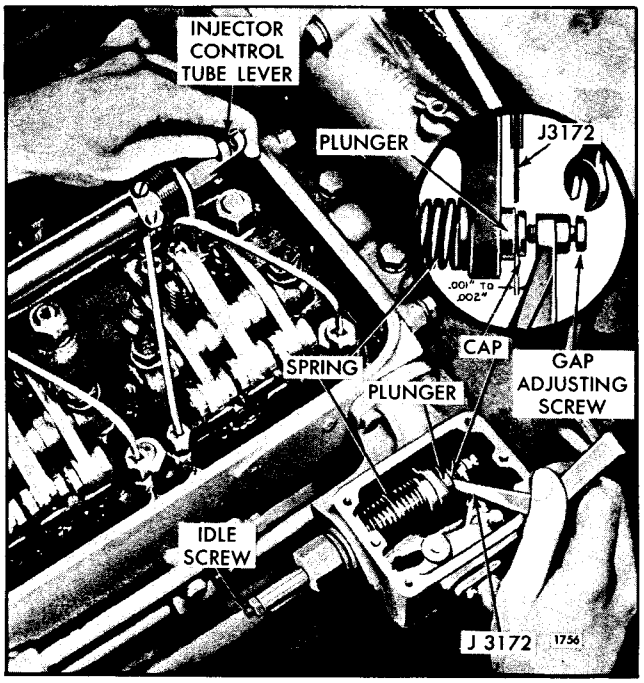


Fig. 2 - Adjusting Gap (Double-Weight Governor)

NOTE: If the governor gap adjustment is to be made with the engine in the vehicle, it is suggested that the fan assembly be removed due to the closeness of the fan blades to the engine governor.

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

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

3. Start the engine and loosen the idle speed adjusting screw lock nut and adjust the idle screw to obtain the desired engine idle speed (Fig. 2). Hold the screw and tighten the lock nut to hold the adjustment.

NOTE: Current limiting speed governors used in turbocharged engines include a starting aid screw threaded into a boss on the governor housing.

IMPORTANT: EPA certified minimum idle speeds are 500 rpm for trucks and highway coaches and 400 rpm for city coaches.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker cover. Discard the gaskets.

5. Remove the fuel rod from the differential lever and the injector control tube lever (Fig. 3).

6. Start and run the engine between 1100 and 1300 rpm by manual operation of the control tube lever.

NOTE: Do not overspeed the engine.

7. Check the gap between the low-speed spring cap and the high-speed spring plunger with a feeler gage as shown in Fig. 2. The gap should be .002 "-.004 ". If the gap setting is incorrect, reset the gap adjusting screw. If the setting is correct, the .002 "-.004 " 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.

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

9. Recheck the governor gap and readjust, if necessary.

10. Stop the engine and install the fuel rod between the differential lever and the control tube lever.

11. Use a new gasket and install the governor cover and lever assembly.

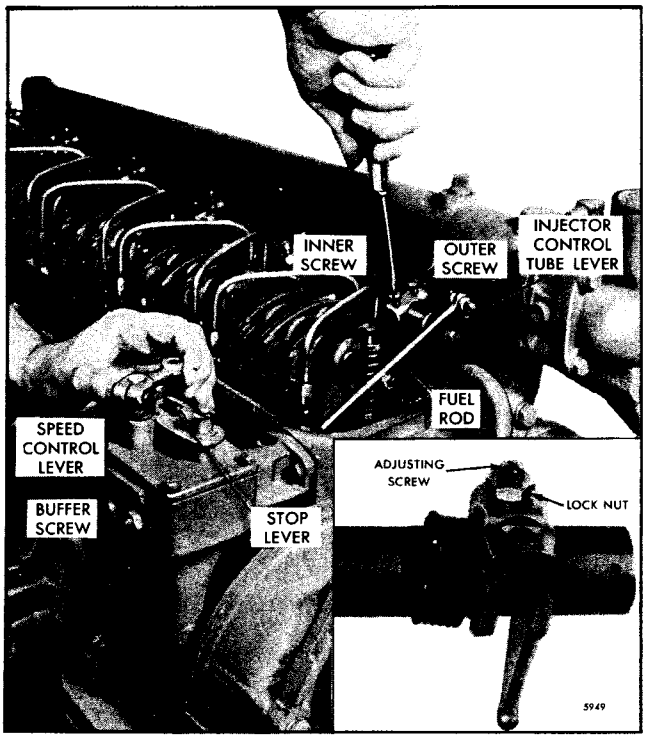


Fig. 3 - Positioning No. 1 Injector Rack Control Lever

Position Injector Rack Control Levers

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

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

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

1. Speed control lever at the maximum speed position.

2. Governor low-speed gap closed.

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

4. Injector racks in the full-fuel position.

> **NOTE:** When positioning the injector racks on an early engine equipped with a fuel modulator, be sure no interference is encountered from the fuel modulator. Loosen the fuel modulator lever ("U" bolt) and move the modulator lever along the injector control tube to avoid contact with the modulator cam or the adjacent cylinder head stud nut.

Adjust the No. 1 injector rack control lever (Fig. 3) first to establish a guide for adjusting the remaining injector rack control levers.

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

2. Turn the idle speed adjusting screw until there is no tension in the idle spring.

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

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

Injector racks must be adjusted so that the effort to move the throttle from the idle speed position to the maximum speed position is uniform. A sudden increase in effort can result from:

a. Injector racks adjusted too tight, not allowing the speed control lever to reach the end of its travel.

b. Binding of the fuel rod.

c. Failure to back out idle screw.

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

4. Loosen all of the inner and outer injector rack control lever adjusting screws or adjusting screw and lock nut. Be sure all of the control levers are free on the injector control tube.

> **NOTE:** On engines equipped with a yield link type fuel rod, attach a small "C" clamp at the shoulder of the rod to prevent the yield spring from compressing while adjusting the injector rack control levers.

5. Move the speed control lever to the maximum speed position; hold it in that position with light finger pressure.

a. On the spring-loaded injector control tube, tighten the adjusting screw of the No. 1 injector rack control lever until the injector rack clevis is observed to roll up or an increase in effort to turn the screwdriver is noted. Tighten the screw approximately 1/8 of a turn more and lock securely with the adjusting screw lock nut. This will place the No. 1 injector rack in the full fuel position.

b. On the two screw injector control tubes turn the inner adjusting screw of the No. 1 injector rack control lever down (Fig. 3) until a slight movement in the control tube lever is observed or a step-up in effort to turn the screw driver is noted. This will place the No. 1 injector rack in the full-fuel position. Turn down the the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

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

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

6. To be sure of the proper rack adjustment, hold the speed control lever in the maximum speed position

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

If the rack does not return to its original position, it is too loose. To correct this condition on current engines, loosen the lock nut and turn the adjusting screw clockwise a slight amount and retighten the lock nut. On former engines, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

The setting is too tight if, when moving the speed control lever from the idle speed position to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to the end of its travel.

To correct this condition on spring-load injector control tube engines, loosen the lock nut and turn the adjusting screw counterclockwise a slight amount and retighten the nut. On former engines, back out the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

7. To adjust the remaining injector rack control levers, remove the clevis pins from the fuel rod at the injector control tube levers, hold the left bank injector control racks in the full fuel position by means of the lever on the end of the control tube and proceed as follows.

On spring-loaded injector control tubes:

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

b. Verify the injector rack adjustment of No. 1 as outlined in Procedure 6. If No. 1 does not "spring" back upward, turn the No. 2 adjusting screw counterclockwise slightly until the No. 1 injector rack returns to its full fuel position and secure the adjusting screw lock nut. Verify proper injector rack adjustment for both No. 1 and No. 2 injectors. Turn clockwise or counterclockwise the No. 2 injector rack adjusting screw until both No. 1 and No. 2 injector racks are in the full fuel position when the lock nut is securely tightened.

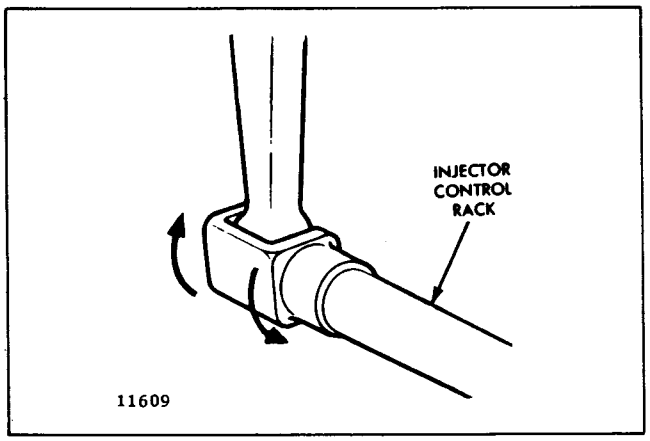


Fig. 4 - Checking Rotating Movement of Injctor Control Rack

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

On two screw injector control tubes:

a. Turn down the inner adjusting screw of the No. 2 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.

b. Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 injector rack control lever and tighten the outer adjusting screw.

c. When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

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

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

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

NOTE: Remove the "C" clamp from the fuel rod on units equipped with a yield link.

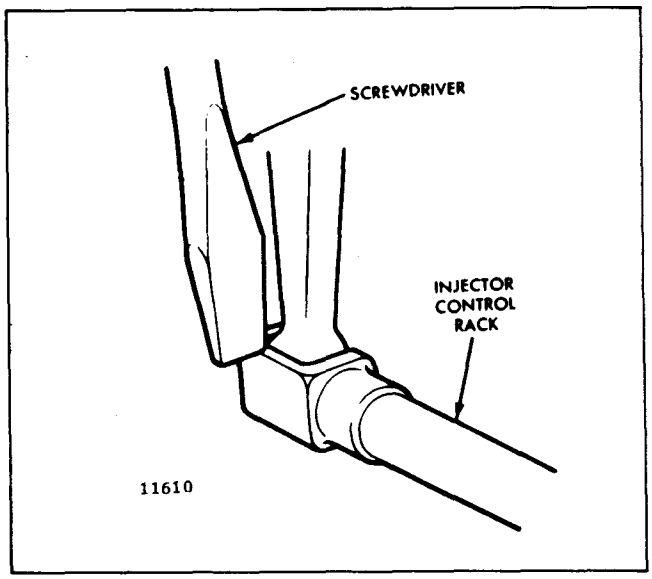


Fig. 5 - Checking Injector Control Rack "Spring"

11. On current turbocharged engines, adjust the external starting aid screw as follows:

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

b. Adjust the starting aid screw to obtain the required setting between the shoulder on the injector rack clevis and the injector body (Fig. 6). Select the proper gage and measure the setting at any convenient cylinder. When the starting aid screw is properly adjusted, the gage should have a small clearance of 1/64 " (.397 mm) in the space along the injector rack shaft between the rack clevis and the injector body.

c. After completing the adjustment, hold the starting aid screw and tighten the lock nut.

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

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

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

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

NOTE: Movement of the speed control lever is to take-up the clearance in the governor linkage. The injector rack clevis-to-body clearance can be increased by turning the starting aid screw farther in against the operating shaft lever or reduced by backing it out.

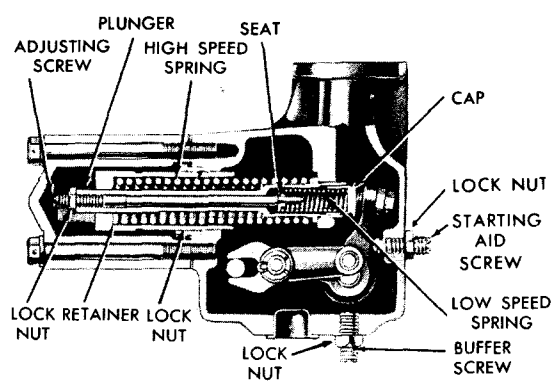
IMPORTANT: The starting aid screw will be ineffective if the speed control lever is advanced toward wide open throttle during start-up.

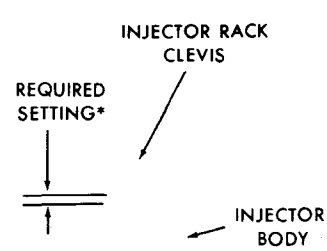
12. Use a new gasket and replace the valve rocker cover.

Adjust Maximum No-Load Engine Speed

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

1. Loosen the lock nut (Fig. 7) and back off the high-speed spring retainer approximately five turns.





INJECTOR	GAGE SETTING*	TOOL NUMBER
N65	.385"	J 24882
N70	.385"	J 24882
N75	.385"	J 24882
N80	.385"	J 24882
N90	.454"	J 23190
C65	.385"	J 24882

5664

Fig. 6 - Adjusting Starting Aid Screw (Current Turbocharged Engines)

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.

Adjust Idle Speed

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

1. Remove the spring housing to uncover the idle speed adjusting screw.

2. With the engine at normal operating temperature and with the buffer screw (Fig. 8) backed out to avoid contact with the differential lever, turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed.

NOTE: EPA certified minimum idle speeds are 500 rpm for trucks and highway coaches and 400 rpm for city coaches.

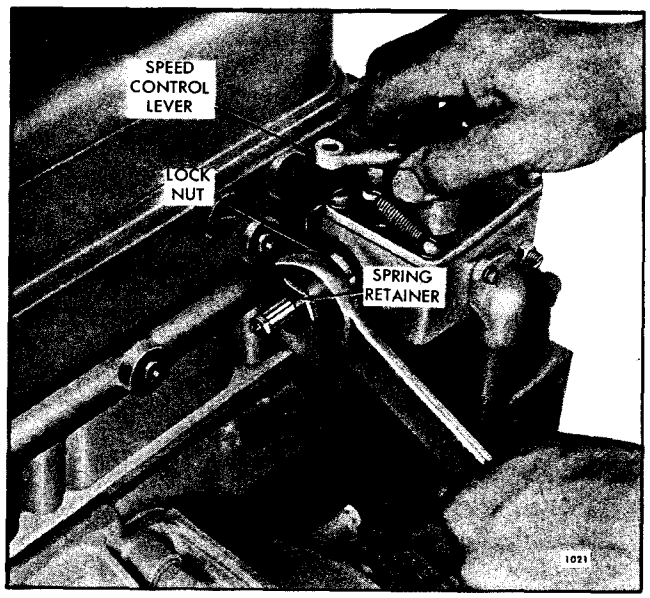


Fig. 7 - Adjusting Maximum No-Load Speed

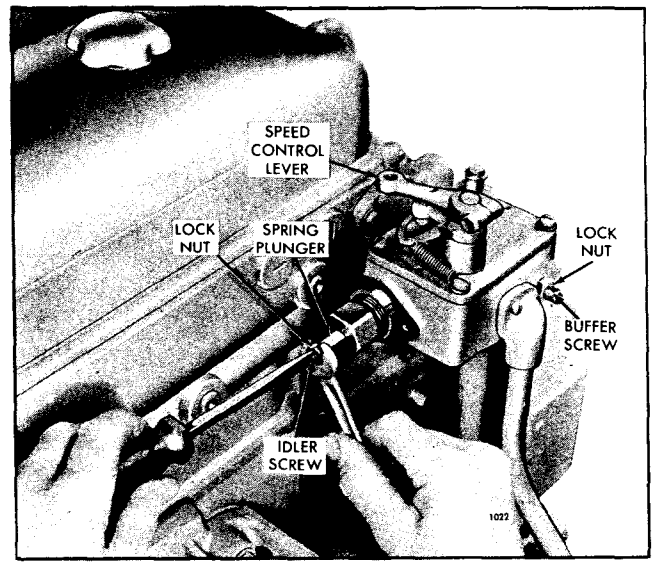


Fig. 8 - Adjusting Engine Idle Speed

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

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

Adjust Buffer Screw

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

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

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

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

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

LIMITING SPEED MECHANICAL GOVERNOR (DUAL RANGE) AND INJECTOR RACK CONTROL ADJUSTMENT

The governor is mounted on the front end of the blower and is driven by the upper blower rotor.

After adjusting the exhaust valves and timing the fuel injectors, adjust the limiting speed mechanical governor (dual range) and injector rack control levers.

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

Adjust Governor Gap

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

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

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

3. Start the engine and loosen the idle speed adjusting screw lock nut. Then adjust the idle screw to obtain the desired engine idle speed (Fig. 1). Hold the screw and tighten the lock nut to hold the adjustment.

NOTE: The recommended idle speed is 450 rpm, but may vary with special engine applications.

4. Stop the engine. Clean and remove the governor cover and lever assembly and the valve rocker cover. Discard the gasket.

5. Remove the fuel rod from the differential lever and the injector control tube lever.

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

NOTE: Do not overspeed the engine.

7. Check the gap between the low-speed spring cap and the high-speed spring plunger with a .0015 " feeler gage J 3172 as shown in Fig. 1. If the gap setting is incorrect, reset the gap adjusting screw.

If the setting is correct, the .0015 " movement can be seen by placing a few drops of oil into the governor

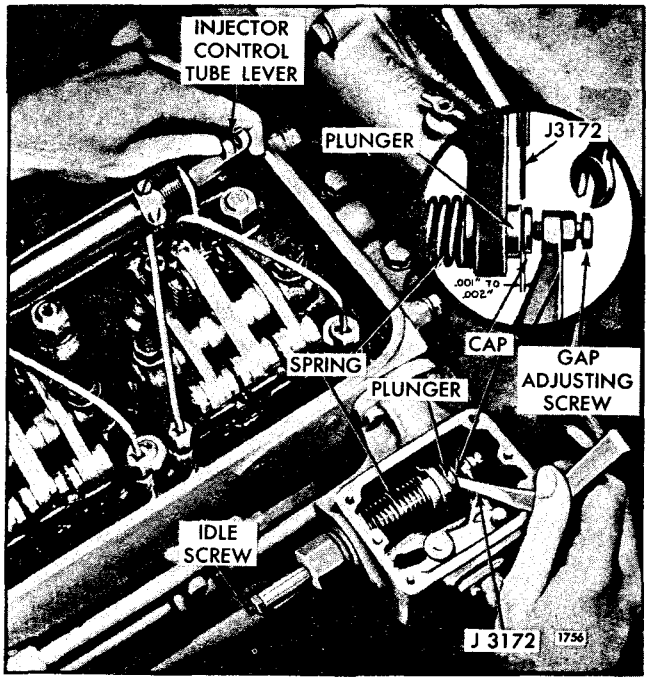


Fig. 1 - Adjusting Governor Gap

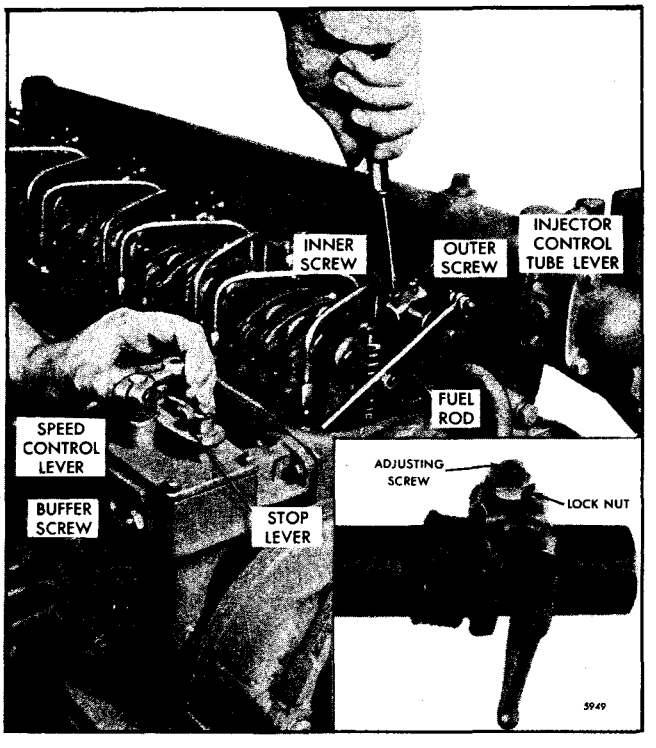


Fig. 2 - Positioning No. 1 Injector Rack Control Lever

gap and pressing a screw driver against the gap adjusting screw. Movement of the cap toward the plunger will force the oil from the gap in the form of a small bead.

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

9. Recheck the governor gap and readjust, if necessary

10. Stop the engine and install the fuel rod between the differential lever and the control tube lever.

11. Use a new gasket and install the governor cover and lever assembly.

Position Injector Rack Control Levers

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

1. Speed control lever at a maximum speed position.

2. Governor low-speed gap closed.

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

4. Injector racks in the full-fuel position.

Adjust the No. 1 injector rack control lever (Fig. 2) first to establish a guide for adjusting the remaining injector rack control levers.

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

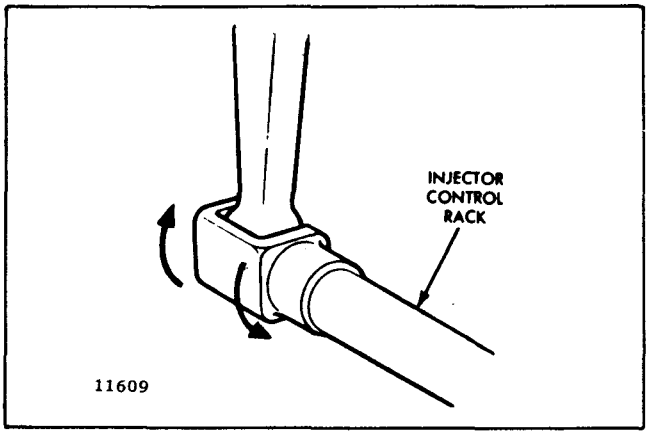


Fig. 3 - Checking Rotating Movement of Injector Control Rack

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

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

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

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

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

NOTE: On engines equipped with a yield link type fuel rod, attach a small "C" clamp at the shoulder of the rod to prevent the yield spring from compressing while adjusting the injector rack control levers.

5. Move the speed control lever to the maximum speed position as shown in Fig. 2. Hold the lever in that position with light finger pressure. Turn the inner adjusting screw on the No. 1 injector rack control lever down until a slight movement of the control tube is observed or a step-up in effort is noted. This will place the No. 1 injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms

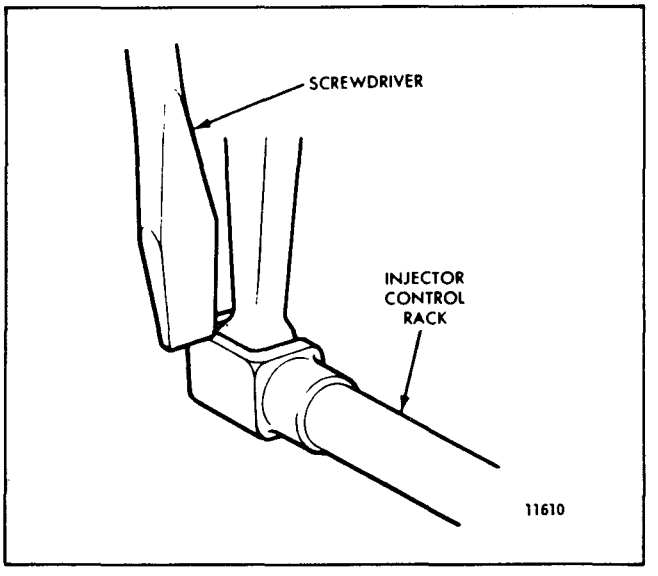


Fig. 4 - Checking Injector Control Rack Movement

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

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

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

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

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

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

7. To adjust the remaining injector rack control levers, remove the clevis pin from the fuel rod and the injector control tube lever and hold the injector control racks in the full-fuel position by means of the lever on the end of the control tube. Turn down the inner adjusting screw of the No. 2 injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

8. Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 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.

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

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

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

NOTE: Remove the "C" clamp from the fuel rod on units having a yield link.

Adjust Maximum No-Load Engine Speed

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

After positioning the injector rack control levers, set the maximum engine speeds.

NOTE: Be sure the buffer screw projects 5/8 " from the lock nut to prevent interference while adjusting the maximum no-load speeds.

With the spring housing assembly mounted on the governor, the piston and sleeve assembled with four .100 " shims and ten .010 " shims (Fig. 5) and the low maximum speed screw extending from the spring housing approximately 1-1/4 ", proceed as follows:

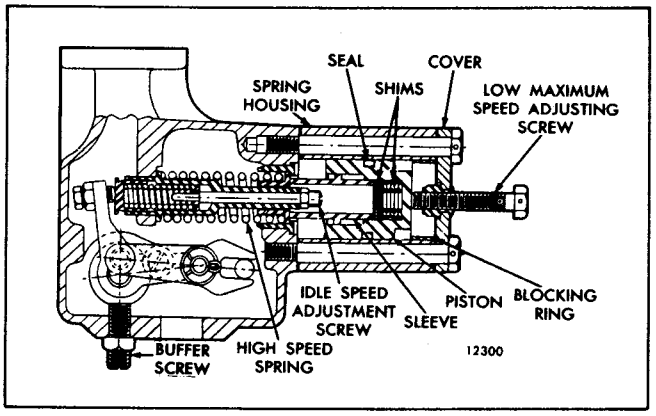


Fig. 5 - Dual Range Governor

NOTE: Do not apply air pressure to the governor until performing Step 1f.

1. Set the high maximum no-load speed.

a. Start the engine and position the speed control lever in the maximum speed position.

b. Turn the low maximum speed adjustment screw in until the high maximum speed desired is obtained.

c. Stop the engine and remove the spring housing assembly.

NOTE: Do not permit the seal ring on the piston to slide past the air inlet port, since the seal ring will be damaged.

d. Note the distance the piston is within the spring housing when it is against the low maximum speed screw, then remove the sleeve from the piston.

NOTE: When checking this distance, the piston should be held tight against the adjustment screw of the cover that is held in position, with its gasket, against the end of the spring housing.

e. Remove a quantity of shims, from the shims within the piston, equal to the distance noted in Step d.

f. Start the engine and position the engine speed control lever in the maximum speed position and apply air pressure to the governor and note the engine speed.

g. Remove the air pressure from the governor and stop the engine, then install or remove shims as required to obtain the correct high maximum no-load speed. Removing shims will decrease the engine speed and adding shims will increase the engine speed.

NOTE: Each .010 " shim removed or added will decrease or increase the engine speed approximately 10 rpm.

2. Set the low maximum no-load engine speed.

a. With air pressure removed, adjust the low maximum speed adjusting screw, with the speed control lever held in the maximum speed position, until the desired low maximum speed is obtained. Turn the screw in to increase or out to decrease the engine speed.

b. Recheck the engine speed and readjust if necessary.

3. Check both the high maximum and low maximum engine speeds. Make any adjustment that is necessary as outlined in Steps 1 and 2.

Adjust Idle Speed

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

1. Refer to Fig. 5 and remove the spring housing to uncover the idle speed adjusting screw.

2. With the engine at normal operating temperature and with the buffer screw (Fig. 5) backed out to avoid contact with the differential lever, turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed. The recommended idle speed is 450 rpm, but may vary with special engine applications.

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

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

Adjust Buffer Screw

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

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

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

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

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

LIMITING SPEED MECHANICAL GOVERNOR (Fast Idle Cylinder)

The limiting speed governor equipped with a fast idle air cylinder is used on vehicle engines where the engine powers both the vehicle and auxiliary equipment.

The fast idle system consists of a fast idle air cylinder installed in place of the buffer screw and a throttle locking air cylinder mounted on a bracket fastened to the governor cover (Fig. 1). An engine shutdown air cylinder, if used, is also mounted on the governor cover.

The fast idle air cylinder and the throttle locking air cylinder are actuated at the same time by air from a common air line. The engine shutdown air cylinder is connected to a separate air line.

The air supply for the fast idle air cylinder is usually controlled by an air valve actuated by an electric solenoid. The fast idle system should be installed so that it will function only when the parking brake system is in operation to make it tamper-proof.

The vehicle accelerator-to-governor throttle linkage is connected to a yield link so the operator cannot overcome the force of the air cylinder holding the speed control lever in the idle position while the engine is operating at the single fixed high idle speed.

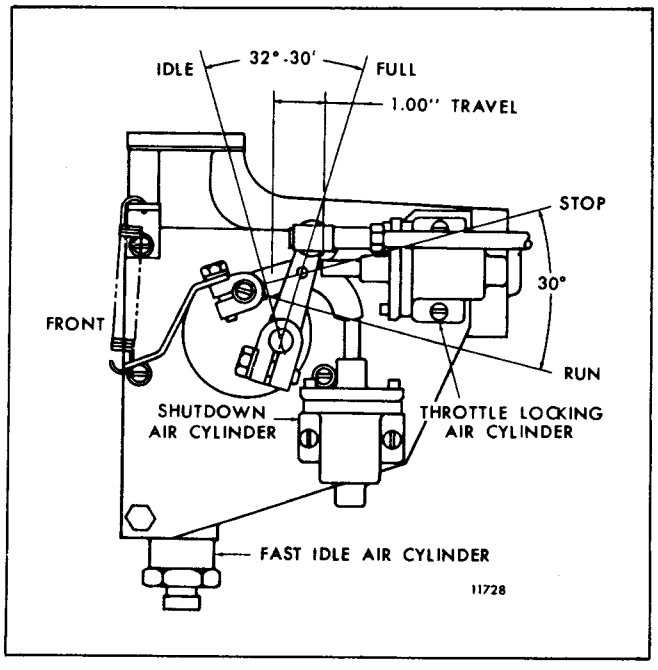


Fig. 1 - Governor with Fast Idle Cylinder

Operation

During highway operation, the governor functions as a limiting speed governor.

For operation of auxiliary equipment, the vehicle is stopped and the parking brake set. Then, with the engine running, the low speed switch is placed in the ON position. When the fast idle air cylinder is actuated, the force of the dual idle spring (Fig. 2) is added to the force of the governor low-speed spring, thus increasing the engine idle speed.

The governor now functions as a constant speed governor at the high idle speed setting, maintaining a near constant engine speed regardless of the load within the capacity of the engine. The fast idle system provides a single fixed high idle speed that is not adjustable, except by disassembling the fast idle air cylinder and changing the dual idle spring. As with all

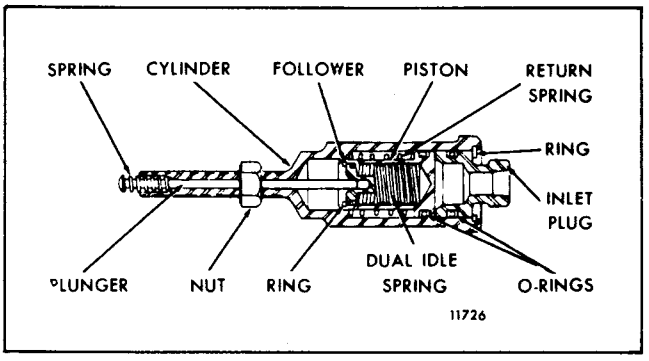


Fig. 2 - Fast Idle Air Cylinder

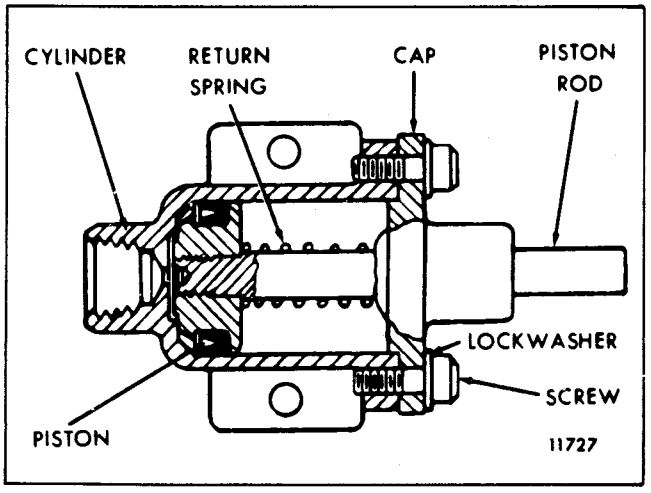


Fig. 3 - Throttle Locking Air Cylinder

mechanical governors, when load is applied, the engine speed will be determined by the governor droop.

Adjust Governor

Before adjusting the governor gap, back out the de-energized fast idle air cylinder until it will not interfere with the governor adjustments. After the normal idle speed setting is made, adjust the de-energized fast idle air cylinder as follows:

1. Turn in the fast idle cylinder assembly until an increase of idle speed is noted. The increase in idle speed should not exceed 15 rpm. Tighten the fast idle jam nut.

2. Lock the governor throttle in the idle position and apply full shop air pressure to the fast idle air cylinder. The engine idle speed must increase from 325 to 500 ± 50 rpm, depending on the original idle speed setting and fast idle spring used.

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

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

The single weight governor is mounted on the front of the blower and is driven by the upper blower rotor.

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

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

Adjust Governor Gap

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

1. Disconnect any linkage attached to the governor levers.

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

3. Remove the governor cover.

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

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

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

7. Secure the governor cover to the governor housing with three regular screws, one special screw and lock washers.

8. Hook the torsion retracting spring on the special cover screw and the stop lever (Fig. 2).

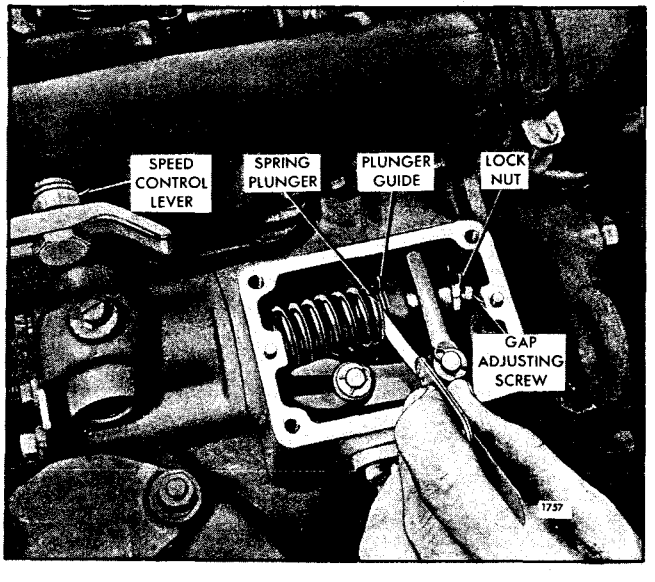


Fig. 1 - Adjusting Governor Gap

Position Injector Rack Control Levers

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

Certain engines use spring-loaded injector control tube assemblies which have a yield spring at each injector rack control lever and only one screw and lock nut to keep each injector rack properly positioned. Adjust the single screw and lock nut on each injector rack control lever the same as for the two screw rack control lever.

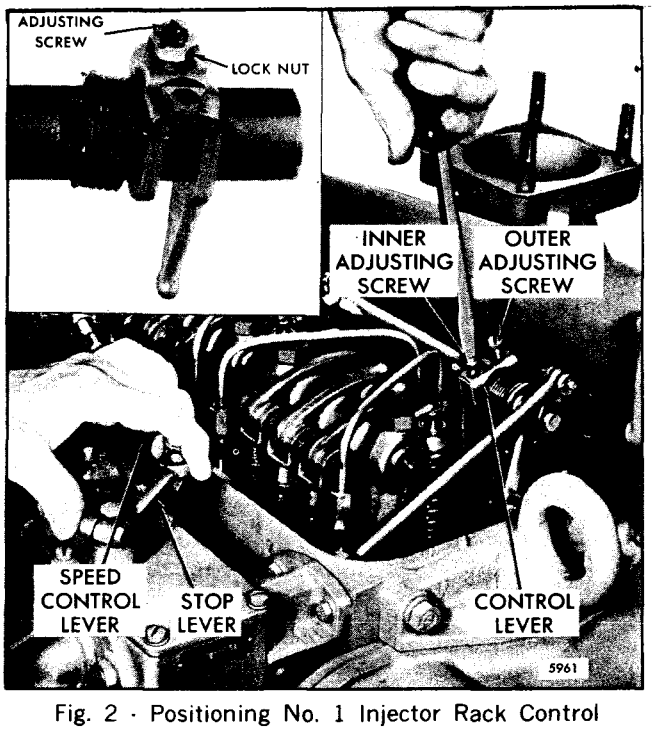


Fig. 2 - Positioning No. 1 Injector Rack Control Lever

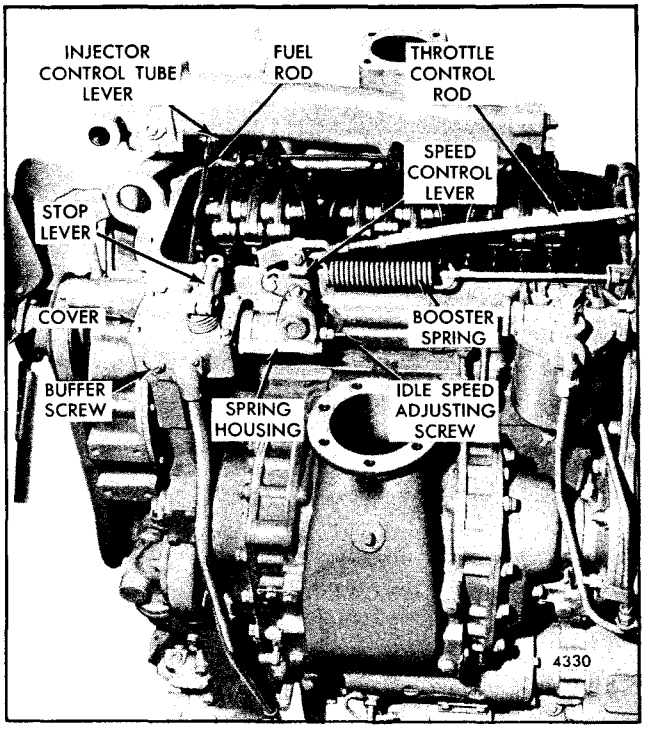


Fig. 3 - Buffer and Idle Speed Adjusting Screw

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

1. Speed control lever at the maximum speed position.

2. Stop lever in the RUN position.

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

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

> **NOTE:** The cross link equalizer spring must be removed from multiple engine units before performing the individual engine tune-up. See *Throttle Adjustment for Load Equalization on Twin or Quad Units with Variable Speed Mechanical Governors* for procedure on removing the cross link equalizer spring.

Adjust the No. 1 injector rack control lever (Fig. 2) first, to establish a guide for adjusting the remaining injector rack control levers.

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

2. Move the speed control lever to the full-fuel position.

3. Move the stop lever to the run position. Hold it in that position with light finger pressure. Turn the inner adjusting screw of the No. 1 injector rack control lever down until a step-up in effort is noted. This will place the No. 1 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.

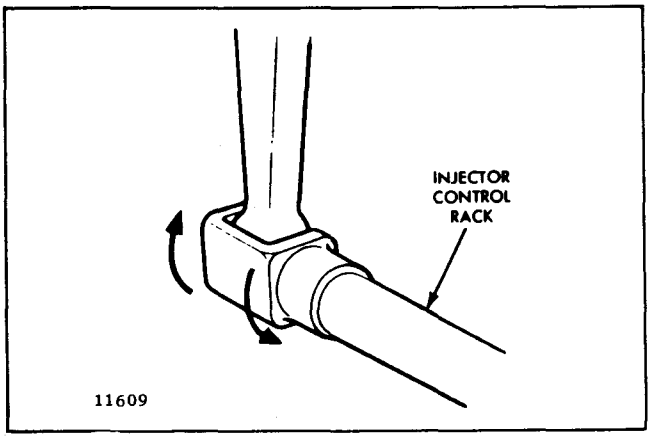


Fig. 4 - Checking Rotating Movement of Injector Control Rack

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

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

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

If the rack does not return to its original position, it is too loose. To correct, 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 as determined by the stop under the governor cover. This will result in a step-up in effort required to move the stop lever to the end of its travel. To correct

this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw.

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

6. Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the rack control lever while positioning the adjacent injector rack. If the rack of the No. 1 injector has become loose, back off the inner adjusting screw slightly on the adjacent injector control lever. Tighten the outer adjusting screw.

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

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

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

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

Adjust Maximum No-Load Speed

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

Full-Load Speed	Stops	Shims
1200 to 1425 rpm	2	Up to .325"
1426 to 1825 rpm	1	Up to .325"
1826 to 2100 rpm	0	Amount required to get necessary speed

TABLE 1 - TWO VALVE CYLINDER HEADS

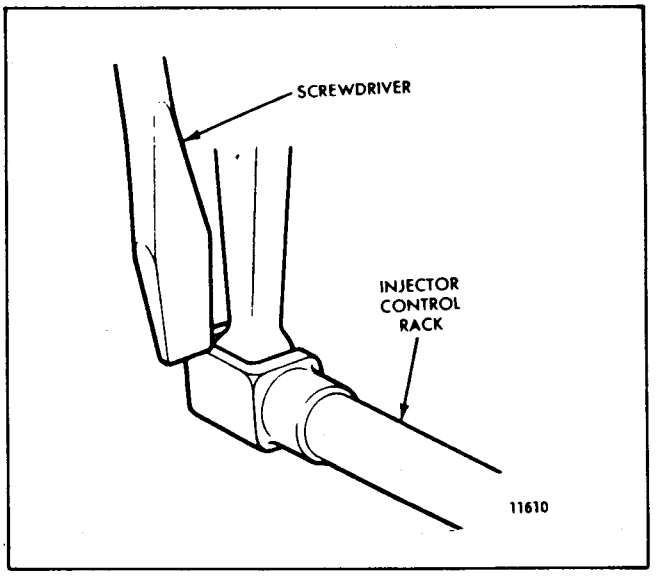


Fig. 5 - Checking Injector Control Rack Movement

Start the engine and, after normal operating temperature is reached, use an accurate tachometer to determine the maximum no-load speed of the engine. Then stop the engine and make the following adjustments, if required.

1. Refer to Fig. 3 and disconnect the booster spring.

2. Remove the variable speed spring housing and the variable speed spring plunger from inside the spring housing.

3. Refer to Table 1 and Fig. 6 and determine the stops or shims required for the desired full-load speed for engines with two valve cylinder heads. *A split stop can only be used with a solid stop.*

Refer to Table 2 and determine the stops or shims required for the desired full-load speeds for engines with four valve cylinder heads.

4. Install the variable speed spring plunger and housing and tighten the two bolts. Start the engine and recheck the maximum no-load speed.

Full-Load Speed	Stops	Shims
1450 to 1650 rpm	2	Amount required to get necessary speed
1651 to 2150 rpm	1	
2151 to 2300 rpm	0	

TABLE 2 - FOUR VALVE CYLINDER HEADS

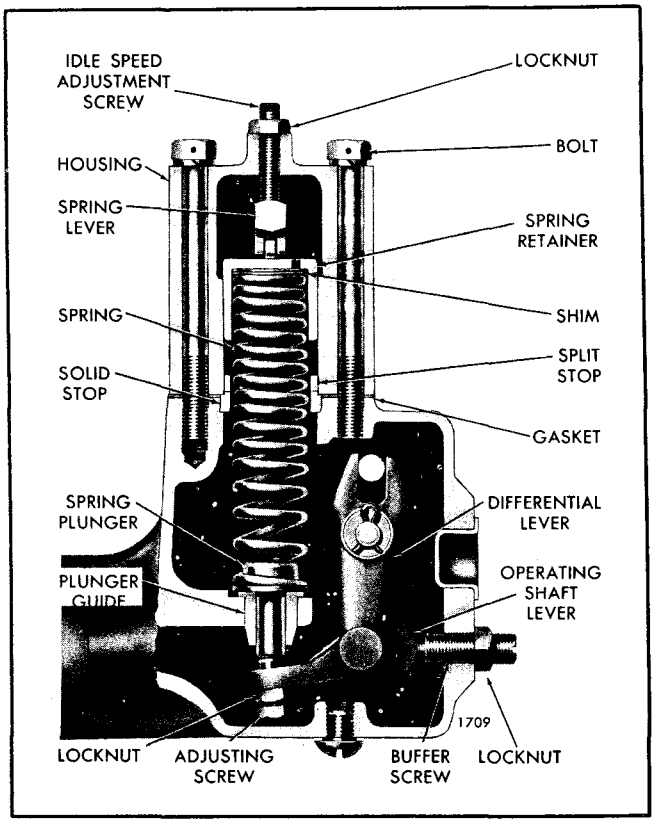


Fig. 6 - Location of Stops and Shims

5. If required, add shims to obtain the necessary operating speed. For each .001 " shim added, the operating speed will increase approximately 1 rpm.

IMPORTANT: If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of the governor shims, the governor gap should be rechecked.

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

If re-adjustment of the governor gap is required, the position of the injector racks must be rechecked.

Adjust Idle Speed

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

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

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

3. Loosen the lock nut and turn the idle speed adjusting screw until the engine is operating at approximately 15 rpm below the recommended idle speed. The recommended idle speed is 500-600 rpm, but may vary with special engine applications.

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

Adjust Buffer Screw.

With the idle speed set at approximately 15 rpm below the recommended idle speed, the buffer screw may be set as follows:

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

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

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

Adjust Booster Spring

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

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

2. Refer to Fig. 3 and loosen the booster spring retaining nut on the speed control lever. Loosen the nut and lock nut on the eye bolt at the opposite end of the booster spring.

3. Move the spring retaining bolt in the slot of the speed control lever until the center of the bolt is on or slightly over center toward the idle 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 point is reached where it will not return to idle. Then reduce the spring tension until the lever does not 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.

SUPPLEMENTARY GOVERNING DEVICE ADJUSTMENT

ENGINE LOAD LIMIT DEVICE

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

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

The load limit device is located between the No. 1 and No. 2 cylinders of a three cylinder engine, between the No. 2 and No. 3 cylinders of a four cylinder engine or between the No. 3 and No. 4 cylinders of a six cylinder engine.

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

Adjustment

After the engine tune-up is completed, make sure the load limit device is properly installed as shown in Fig. 1. Make sure the counterbores in the adjusting screw plate are up. The rocker arm shaft bracket bolts which fasten the adjusting screw plate to the brackets are tightened to 75-85 lb-ft (102-115 Nm) torque. All other rocker arm shaft bracket bolts are tightened to 90-100 lb-ft (122-136 Nm) torque. Then adjust the load limit device as follows:

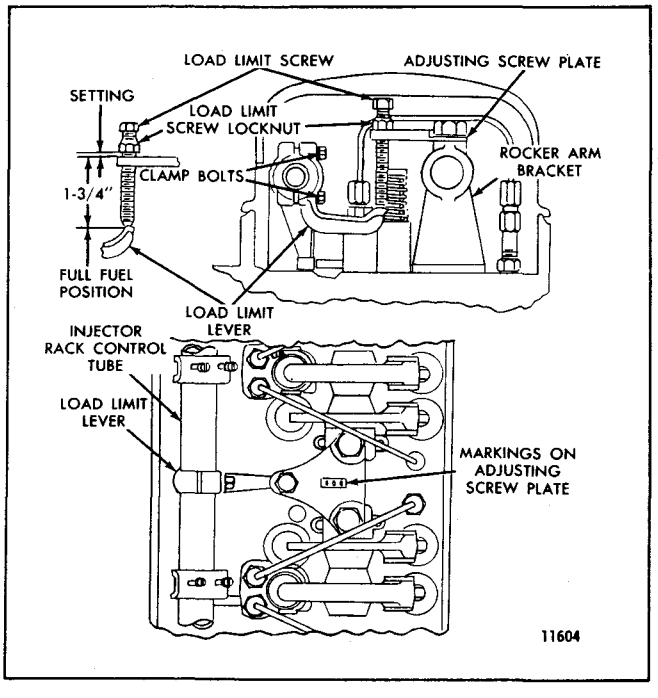


Fig. 1 - Engine Load Limit Device

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

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

3. With the screw out of the plate, adjust the load limit screw lock nut so the bottom of the lock nut is 1 3/4" from the bottom of the load limit screw (Fig. 1) for the initial setting.

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

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

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

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

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

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

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

POWER CONTROL DEVICE

The power control (torque limiting) device (Fig. 2) is used, on some engines, to limit the maximum horsepower output at the wheels without diminishing the performance at lower speeds where full power may be required. It limits the horsepower at, or just below, the normal full-load governed speed. These limiting characteristics are proportionately lessened as the engine speed is reduced and the horsepower required is reduced.

This device consists of an adjusting screw threaded into a plate mounted between two adjacent rocker arm shaft brackets and a spring attached to a clamp on the injector control tube.

NOTE: The rocker arm shaft bracket bolts that retain the adjusting screw plate are tightened to 75-85 lb-ft (102-115 Nm) torque. All other rocker arm shaft bracket bolts are tightened to 90-100 lb-ft (122-136 Nm) torque.

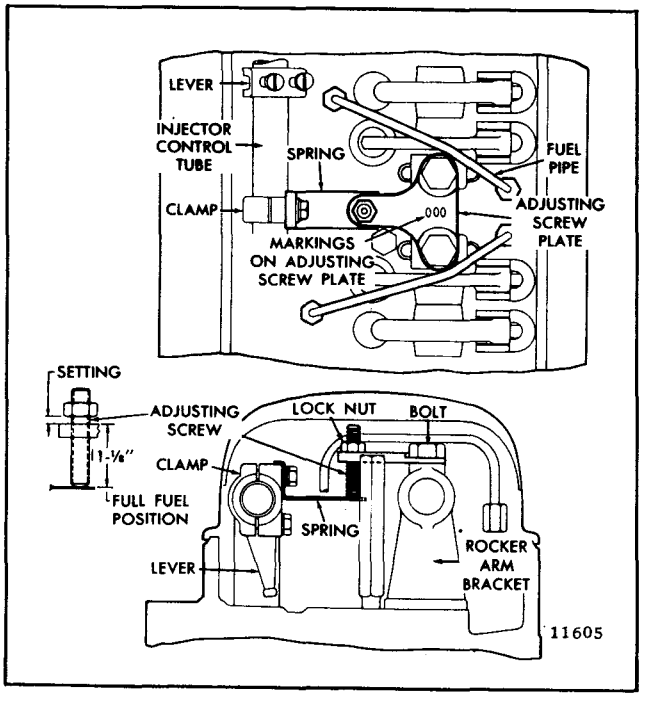


Fig. 2 - Power Control Device

The power control device is located between the No. 1 and No. 2 cylinders on a three-cylinder engine, between the No. 2 and No. 3 cylinders on a four-cylinder engine and between the No. 3 and No. 4 cylinders on a six-cylinder engine.

Adjustment

After the engine tune-up is completed, adjust the power control device as follows:

1. Place the vehicle on a chassis dynamometer and check the maximum wheel horsepower.

2. Loosen the power control spring attaching bolts. Then adjust the spring until it projects parallel to the cylinder head when the injector control racks are held in the full-fuel position. Tighten the spring attaching bolts to 7-9 lb-ft (10-12 Nm) torque to retain the adjustment.

3. Set the power control device, while holding the injector control racks in the full-fuel position, by turning the adjusting screw down (clockwise) until it just touches the spring and the lock nut is tight against the plate. Then release the injector control racks.

NOTE: Wipe the oil from the spring and the bottom of the adjusting screw so the point of contact can be seen readily.

4. Start the engine. Then, with the engine running at full governed speed, check the horsepower. If necessary, re-adjust the screw to obtain the specified horsepower. Turn the screw down to decrease the horsepower; turn the screw up to increase the horsepower. When the desired wheel horsepower is obtained, hold the screw from turning and tighten the lock nut.

NOTE: If a dynamometer is not available, back up the lock nut the distance stamped on the plate. Then turn the screw and lock nut down together until the lock nut *bottoms* on the plate. Hold the screw from turning and tighten the lock nut.

THROTTLE DELAY MECHANISM

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

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

A yield lever and spring assembly replaces the standard lever and pin assembly on the front end of the injector control tube.

Operation

Oil is supplied to a reservoir above the throttle delay cylinder through an orifice plug in the drilled oil passage in the rocker arm shaft bracket (Fig. 3). As the injector racks are moved toward the no-fuel position, free movement of the throttle delay piston is assured by air drawn into the cylinder through the ball check valve. Further movement of the piston uncovers an opening which permits oil from the reservoir to enter the cylinder and displace the air. When the engine is accelerated, movement of the injector racks toward the full-fuel position is momentarily retarded while the piston expels the oil from the cylinder through an orifice. To permit full accelerator travel, regardless of the retarded injector rack position, a spring loaded yield lever and spring assembly replaces the standard lever on the front end of the injector control tube.

Inspection

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

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

Adjustment

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

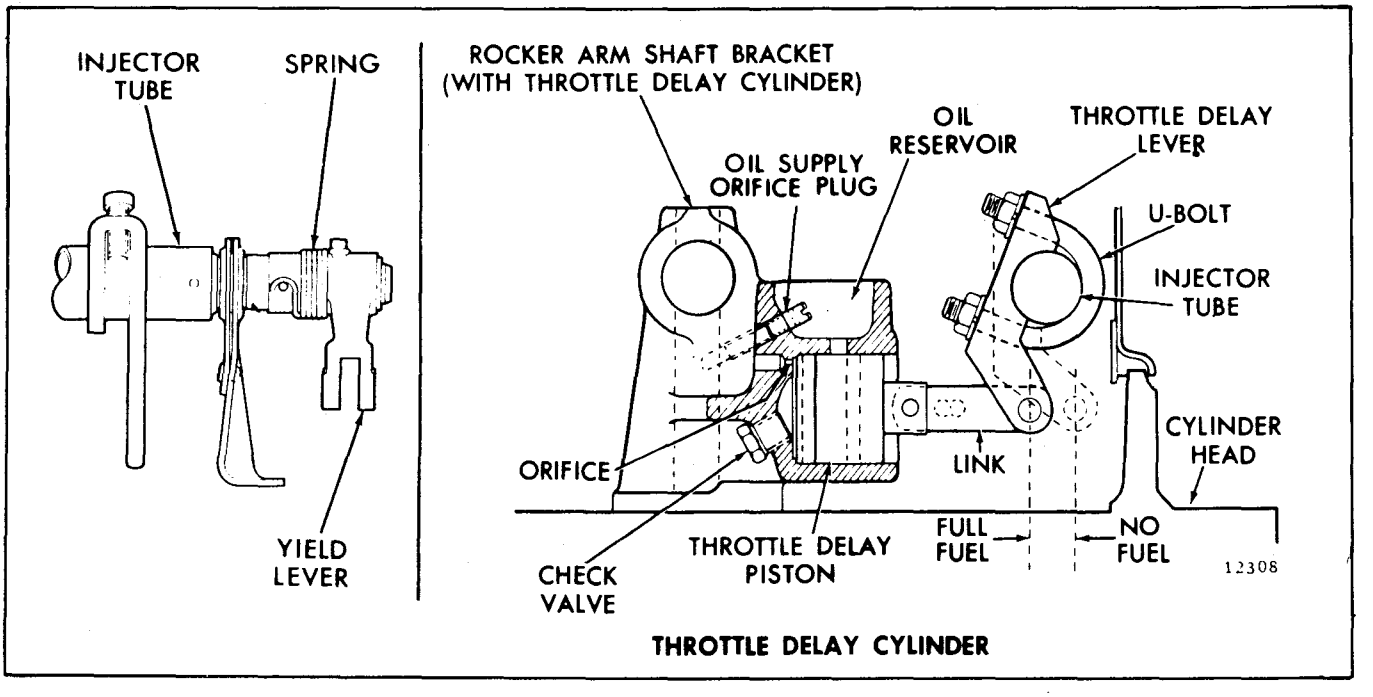


Fig. 3 - Throttle Delay Cylinder and Yield Link

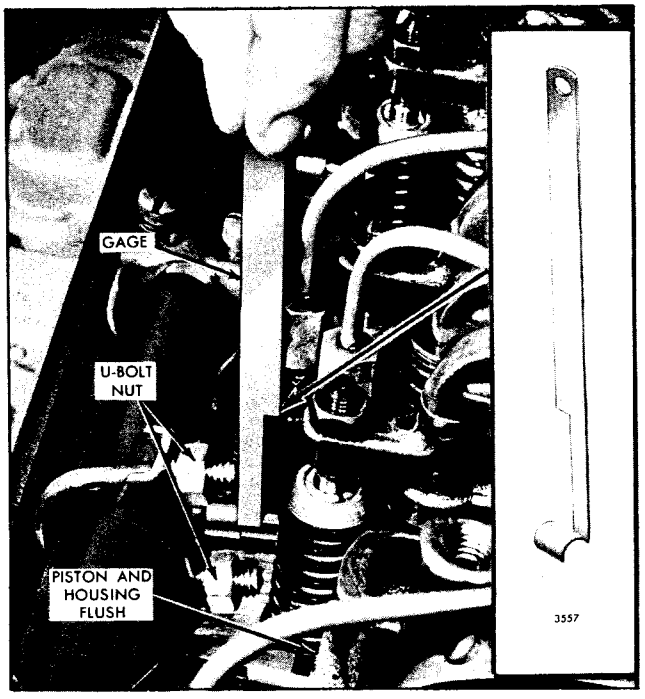


Fig. 4 - Adjusting Throttle Delay Cylinder

1. Refer to Fig. 4 and insert gage J 23190 (.454" setting) between the injector body and the shoulder on the injector rack. Then exert a light pressure on the injector control tube in the direction of full fuel.

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

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

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

FUEL SHUT-OFF AIR CYLINDER ASSEMBLY

An air cylinder (Fig. 5) is mounted at the rear of the cylinder head on some engines to move the injector fuel control racks to the no-fuel position to stop the engine. The air cylinder permits the use of a governor with a single control lever, eliminating the need of an off-on lever and the necessary operating linkage.

The use of the air cylinder on an engine with a limiting speed governor requires a yielding fuel control rod (Fig. 6). An engine equipped with an air cylinder and a fuel modulating governor (Figs. 7 and 8) does not require the yielding rod because the torsion spring within the governor will perform the same purpose.

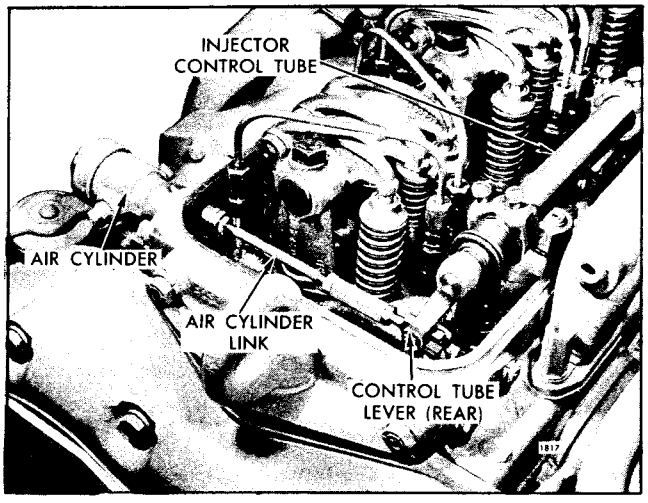


Fig. 5 - Air Cylinder Used with Limiting Speed Governor

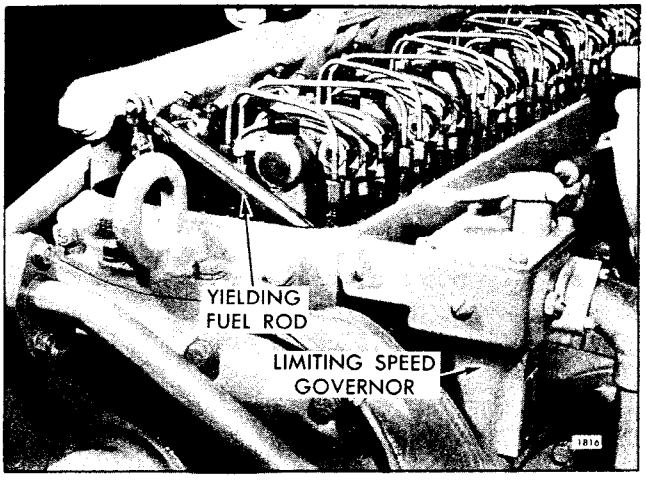


Fig. 6 - Yielding Fuel Rod Used with Limiting Speed Governor

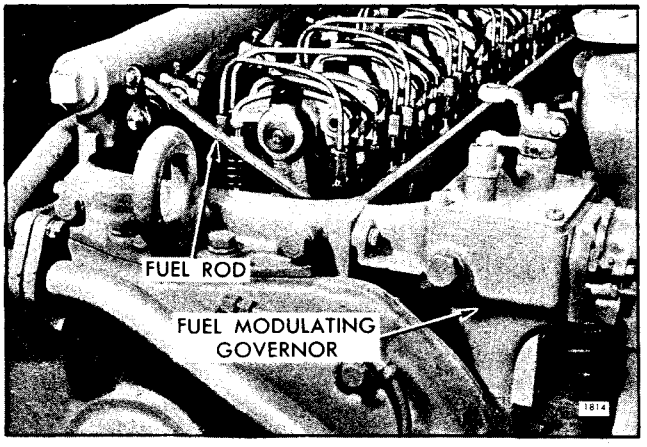


Fig. 7 - Standard Fuel Rod Used with Fuel Modulating Governor

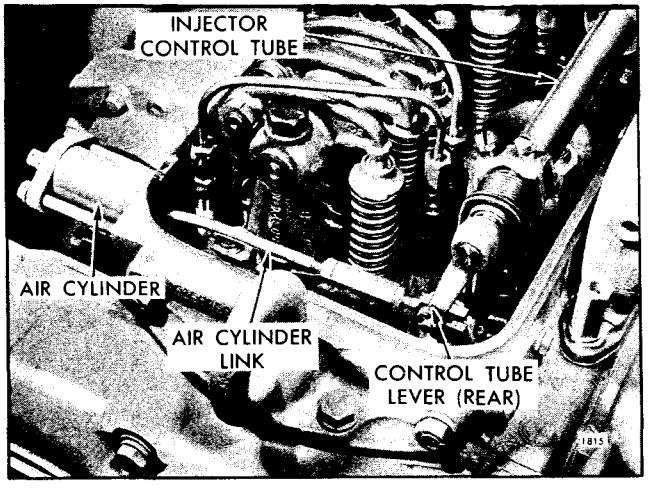


Fig. 8 - Air Cylinder Used with Fuel Modulating Governor

Operation

The fuel shut-off cylinder is actuated by air pressure. The air enters the cylinder and forces the piston forward, thus overcoming the tension of the air cylinder spring; the yielding fuel rod is used to move the injector fuel control racks to the no-fuel position, shutting the engine down. When the air pressure is released, the spring within the air cylinder moves the piston to the end of its travel away from the engine allowing the yielding rod to expand, moving the injector racks into the full-fuel position required for engine starting.

Adjust Air Cylinder Linkage

After completing adjustment of the governor, adjust the linkage between the fuel shut-off cylinder and the injector control tube lever as follows:

1. Place the governor speed control lever in the maximum speed position. Movement of the control lever will move the injector racks to the full-fuel position.

2. Loosen the lock nuts on the air cylinder link (Fig. 5) and lengthen the rod by turning the turnbuckle until the end of the slot contacts the pin in the end of the control tube lever. Then shorten the rod one complete turn of the turn buckle and tighten the lock nuts.

Adjusting the rod in this manner will permit the governor to move the injector control racks into the full-fuel position without coming to the end of the slot in the air cylinder link.

ADJUSTMENT OF MECHANICAL GOVERNOR SHUTDOWN SOLENOID

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

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

1. Remove the bolt connecting the rod end eye (variable speed governor) or the right angle clip (limiting speed governor) to the stop lever (Figs. 9 and 10). Align and clamp the lever to the shutdown shaft in such a way that, at its mid-travel position, it is perpendicular to the solenoid plunger. This assures that the linkage will travel as straight as possible. The solenoid plunger has available 1/2 " travel which is more than adequate to move the injector control racks from the full-fuel to the complete no-fuel position and shutdown will occur prior to attaining complete travel.

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

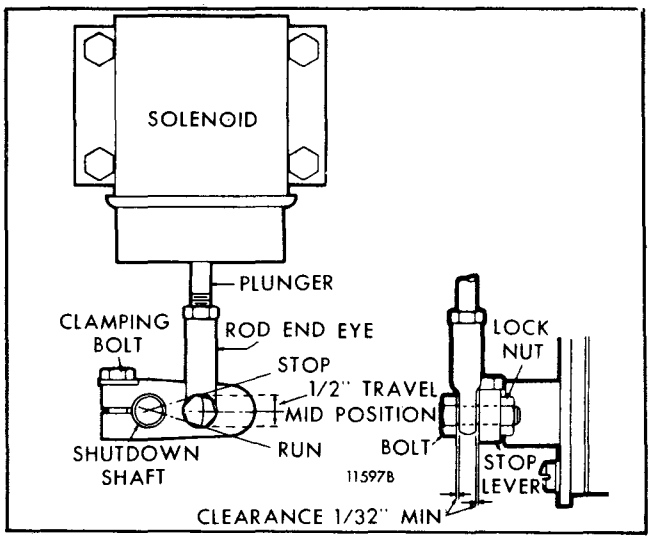


Fig. 9 - Typical Variable Speed Governor Lever Position

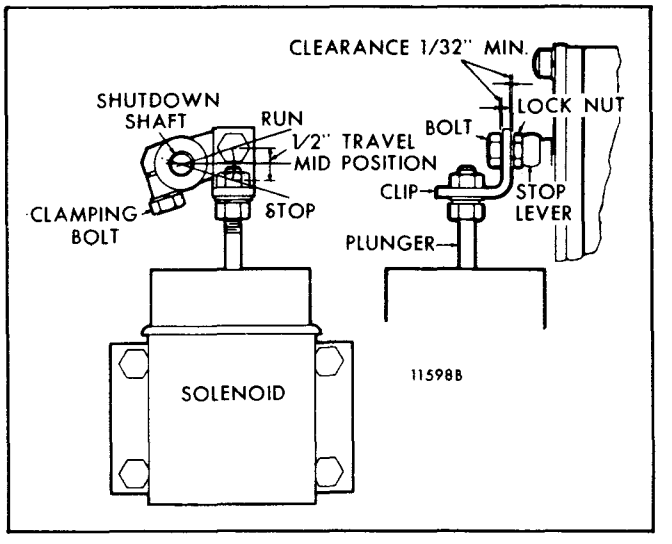


Fig. 10 - Typical Limiting Speed Governor Lever Position

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

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

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

HYDRAULIC SG GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

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

Adjust Fuel Rod

1. Remove the governor cover and the rocker cover (Fig. 2). Loosen all of the inner and outer adjusting screws. Make sure all of the control levers are free on the injector control tube.

2. Loosen the fuel rod lock nut (Fig. 1) and remove the fuel rod knob.

3. Turn the lock nut until 3/16 " of the fuel rod extends beyond the nut. Hold the lock nut in position with a wrench and install the fuel rod knob. Use a suitable wrench to tighten the knob against the lock nut.

Position Injector Rack Control Levers

After the fuel rod is properly adjusted, adjust the rack control levers as follows:

1. Turn the outer adjusting screw (Fig. 2) in until a slight movement of the injector control tube lever is observed. Then tighten the inner adjusting screw.

2. Pull the fuel rod out and check for 1/32 " to 1/16 " movement.

If the movement exceeds the distance specified, back off the inner adjusting screw approximately 1/8 of a turn and tighten the outer adjusting screw.

If the movement is less than the specified distance, back off the outer adjusting screw approximately 1/8 of a turn and tighten the inner adjusting screw.

3. Disconnect the fuel rod from the injector control tube lever.

4. Manually hold the No. 1 injector rack control lever in the full-fuel position and turn the inner adjusting screw (Fig. 2) into the No. 2 injector rack control lever 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.

NOTE: Overtightening the injector rack control lever adjusting screws can result in damage to the injector control tube. The recommended

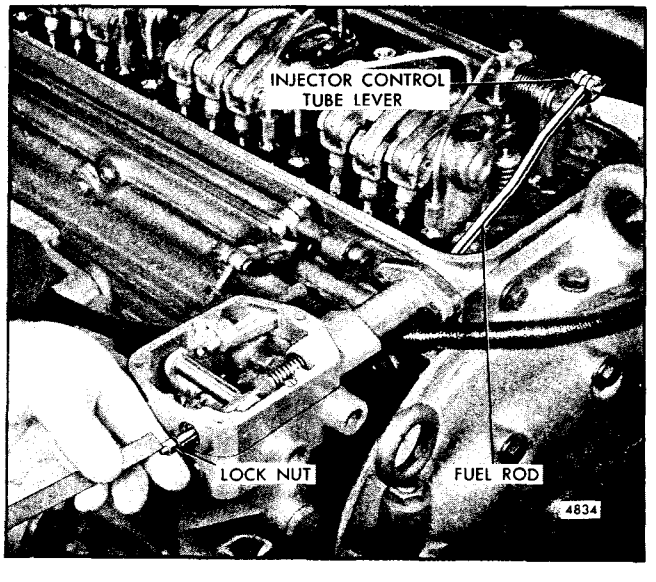


Fig. 1 - Adjusting Fuel Rod

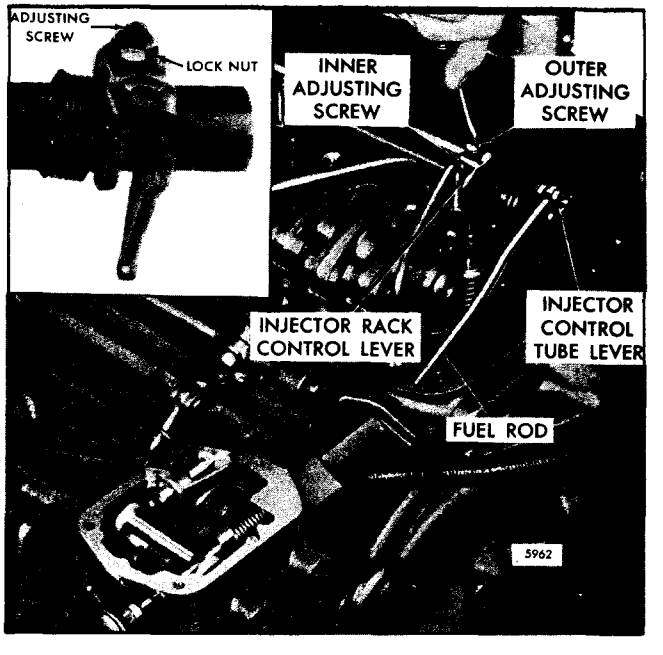


Fig. 2 - Positioning No. 1 Injector Rack Control Lever

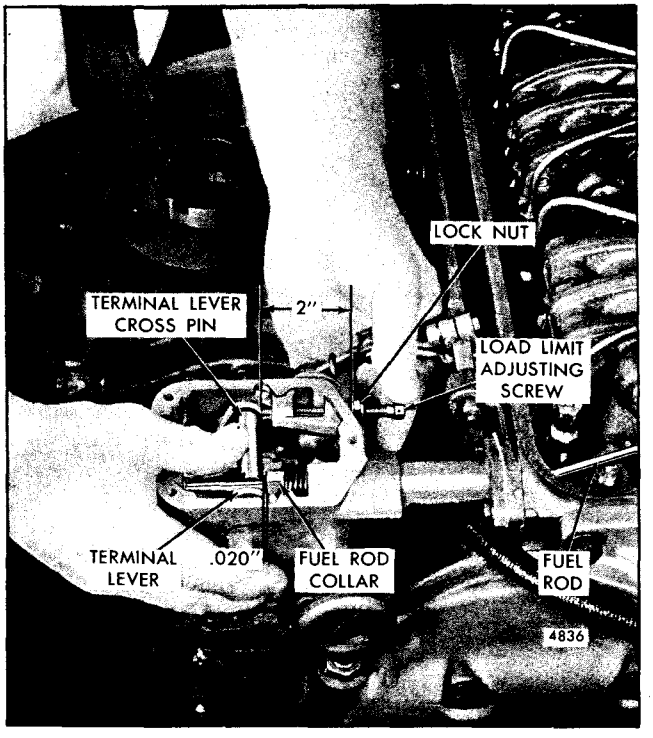


Fig. 3 - Adjusting Load Limit

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

5. Recheck the No. 1 injector fuel rack to make sure that it has remained snug on the ball end of the rack control lever while adjusting the No. 2 injector rack. If the rack of No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 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 the respective rack control levers.

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

When the settings are correct, the racks of all of the injectors must be snug on the ball end of the rack control levers when the control tube lever is held in the full-fuel position.

7. Reconnect the fuel rod to the injector control tube lever.

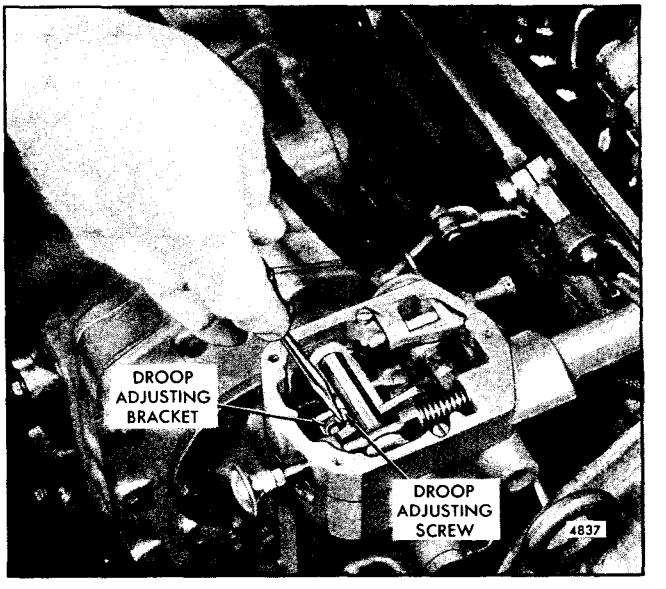


Fig. 4 - Adjusting Speed Droop

Adjust Load Limit

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been repositioned, the load limit screw should be re-adjusted.

With the injector rack control levers properly adjusted, the load limit may be set as follows:

1. Loosen the lock nut (Fig. 3) and adjust the load limit screw to obtain a distance of approximately 2 "

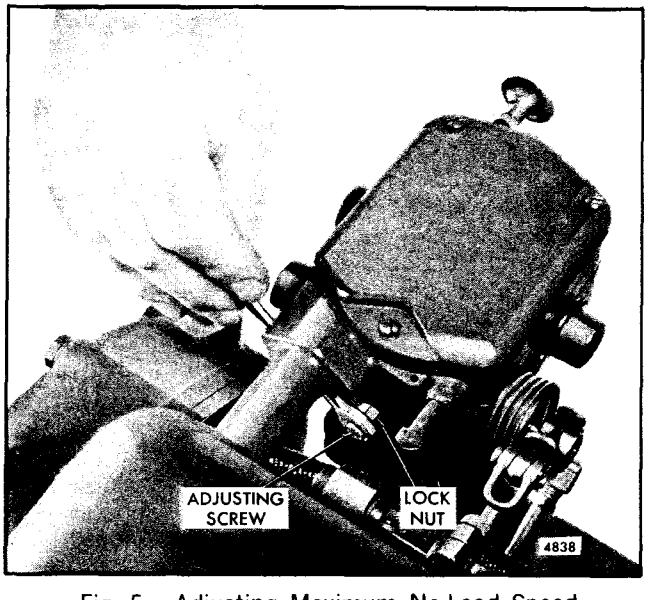


Fig. 5 - Adjusting Maximum No-Load Speed

from the outside face of the boss on the governor sub-cap to the end of the screw.

2. Place the fuel rod and terminal lever in the full-fuel position.

3. Turn the load limit screw until a .020 " space exists between the fuel rod collar and the terminal lever, then hold the screw and tighten the lock nut.

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 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.

Use an accurate tachometer to determine the engine speed.

When a full rated load on the unit is 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 operate it at approximately one-half the rated no-load speed until the lubricating oil has had an opportunity to warm-up.

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

2. Stop the engine and remove the governor cover.

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

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

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

TABLE 1

5. With the throttle in the RUN position, adjust the speed until the engine is operating at 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 has stabilized under no-load. If the speed droop is correct, the engine speed will be approximately 5% higher than the full-load speed.

If the speed droop is too high, stop the engine, loosen the screw again and move the speed droop adjusting bracket IN (toward the engine). Tighten the screw. To increase the speed droop, move the droop adjusting bracket OUT (away from the engine).

If the speed droop in the governors of power generator engines are not the same, the electrical load will not be equally divided when the generators are operated in parallel.

The speed droop bracket in the governor of each engine must be adjusted to obtain the desired variation between the engine no-load and full-load speeds shown in Table 1.

The recommended speed droop at full-load for power generator sets operating in parallel is 50 rpm (2-1/2 cycles) at 1000 and 1200 rpm. For generator sets operating at 1500 and 1800 rpm, the speed droop should be 75 rpm (2-1/2 cycles). The speed droop may be varied to suit the particular application.

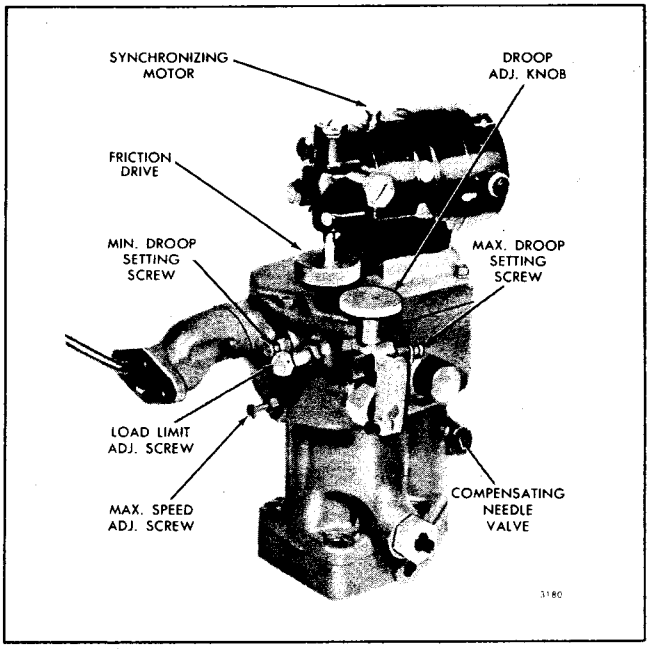


Fig. 6 - Typical Synchronizing Motor Mounting

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 the adjusting screw out three turns.

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

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

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

5. Install the governor cover.

Governors with Synchronizing Motor

Some hydraulic governors are equipped with a reversible synchronizing motor which is mounted on the governor cover (Fig. 6). This motor makes a close adjustment of the engine speed possible by remote control and is especially valuable for synchronizing two generators from a central control panel.

The motor is connected to the source of electrical supply through a two-way switch located on the control panel. When this switch is held in the desired position, the motor shaft turns the governor speed adjusting shaft by means of a reduction gear and slip coupling. The position of the switch determines the direction of rotation of the speed adjusting shaft. When the desired engine speed is indicated on a tachometer or frequency meter mounted on the control panel, the switch is placed in the "OFF" position.

> **NOTE:** If the switch is held in the "Lower Speed" position too long, the synchronizing motor will continue to lower the engine speed and the engine will ultimately stop. If the switch is held in the "Raise Speed" position too long the synchronizing motor will turn the speed adjusting shaft until it strikes the maximum speed adjusting screw. The clutch or slip coupling will slip and the motor will continue to run at a slightly reduced speed without affecting the governor after the shaft strikes the adjusting screw.

The adjustments on a governor equipped with a synchronizing motor are the same as on a governor without the motor. If the governor does not have an external droop setting screw (Fig. 6), the governor cover and motor assembly must be removed when the engine speed droop is set. Reinstall the governor cover and motor to check the speed droop.

HYDRAULIC WOODWARD PSG GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

Adjust engines with hydraulic governor assemblies after adjusting the exhaust valves and timing the fuel injectors as follows:

Adjust Fuel Rod

1. Remove the governor cover. Refer to Fig. 1 and loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the control levers are free on the injector control tube.

2. Loosen the fuel rod lock nut and remove the fuel rod knob.

3. Turn the lock nut to a position so that 13/16 " of the fuel rod extends beyond the nut. Install the fuel rod knob and tighten the lock nut.

Position Injector Rack Control Levers

With the fuel rod properly adjusted, the rack control levers may be adjusted as follows:

1. Turn the outer adjusting screw (Fig. 2) in until a slight movement of the injector control tube lever is observed. Tighten the inner adjusting screw.

2. Pull out on the fuel rod and check for 1/32 " to 1/16 " movement.

If the movement exceeds that specified, back off the inner adjusting screw approximately 1/8 of a turn and tighten the outer adjusting screw.

If the movement is less than that specified, back off the outer adjusting screw approximately 1/8 of a turn and tighten the inner adjusting screw.

3. Disconnect the fuel rod from the injector control tube lever.

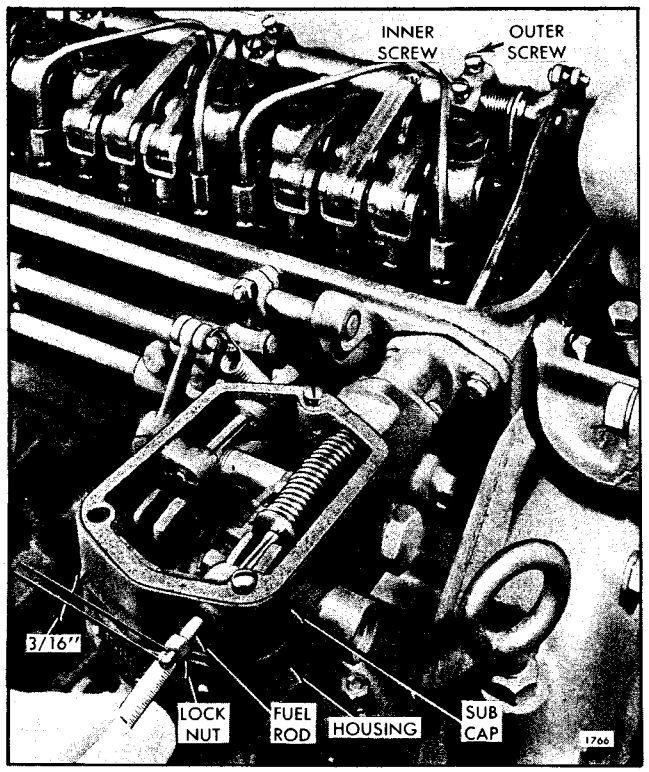


Fig. 1 - Adjusting Fuel Rod

4. Hold onto the clevis at the end of the injector control tube and position the No. 1 injector in the full-fuel position and turn down the inner adjusting screw of the No. 2 injector until the injector rack control lever for that injector contacts the injector body. This may be felt at the clevis end by a slight movement as contact is made.

Tighten the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

5. Make sure the rack remains snug on the pin of the rack control lever at the No. 1 injector.

If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw at the No. 2 injector rack control lever. Tighten the outer adjusting screw.

When the settings are correct, the rack of both injectors must be snug on the pin of their respective rack control levers.

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

When the settings are correct, the racks of all injectors must be snug on the pins of the rack control levers

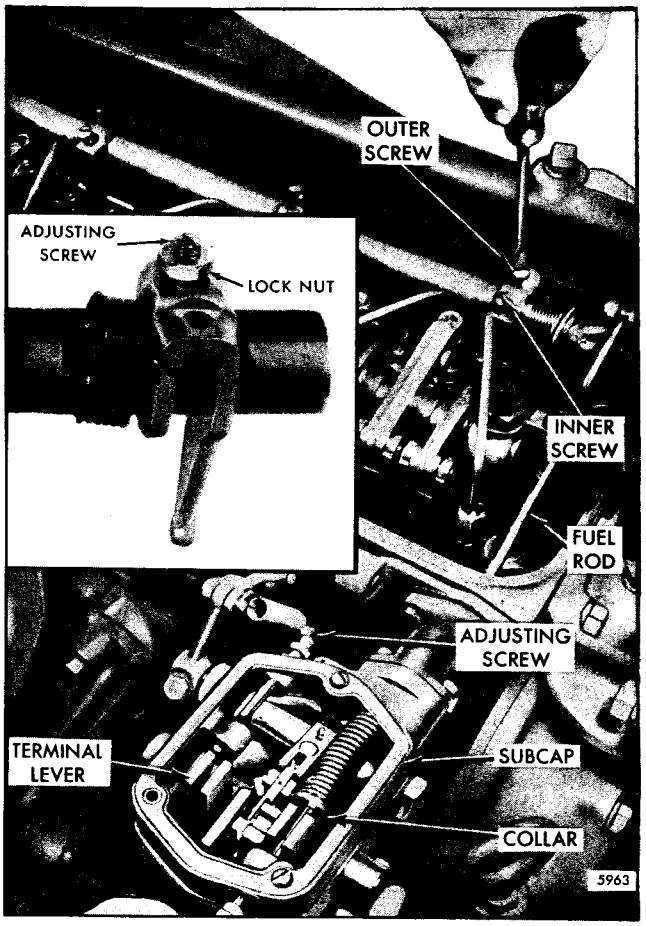


Fig. 2 - Positioning No. 1 Injector Rack

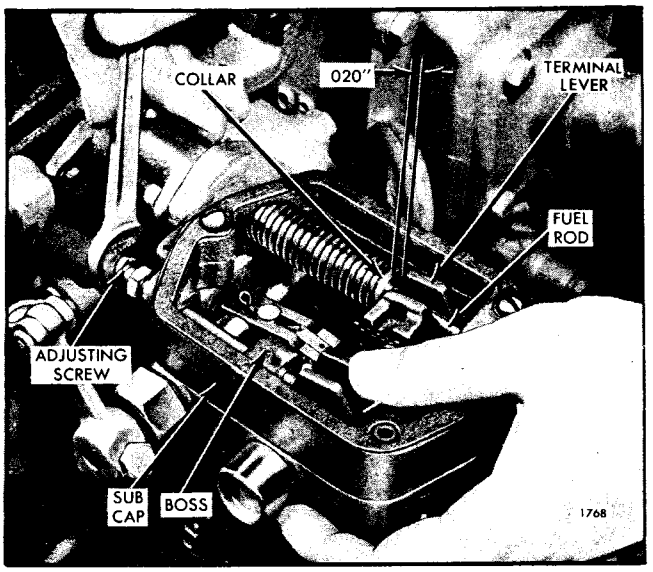


Fig. 3 - Setting Maximum Fuel Adjusting Screw (Load Limit)

when the control tube lever is held in the full-fuel position.

Adjust Load Limit

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been repositioned, the load limit screw should be adjusted.

With the injector rack control levers properly adjusted, the load limit may be set as follows:

1. Place the fuel rod and the terminal lever in the full-fuel position as shown in Fig. 3.

2. Loosen the lock nut and turn the adjusting screw until a .020 " space exists between the fuel rod collar and the terminal lever. Hold the screw and tighten the lock nut.

Compensation Adjustment

After the temperature of the engine and the oil supplied to the governor have reached their normal operating values, adjust the governor compensation without load on the engine as follows:

1. Open the compensating needle valve (Fig. 6) two or three turns with a screw driver and allow the engine to "hunt" or "surge" for about one-half minute to bleed trapped air from the governor oil passages.

2. Gradually close the needle valve until "hunting" just stops. Do not go beyond this position. Check the amount of needle valve opening by closing the valve completely, noting the amount required to close. Open the valve to the previously determined opening at which "hunting" stopped. Test the action by manually disturbing the engine speed. The engine should return promptly to the original steady speed with only a small overshoot. The correct needle valve setting will be between 1/8 and 1/2 turn open.

It is desirable to have as little compensation as possible. Closing the needle valve farther than necessary will make the governor slow to return to normal speed after a load change.

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 adjusted.

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

If a full rated load on the unit can be established, the fuel rod, injector control rack 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 oil increases.

2. With the engine stopped, remove the governor cover.

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

4. Refer to Fig. 4 and loosen the droop adjusting bolt. Move the bracket so that the bolt is midway between the ends of the slot in the bracket. Tighten the bolt. Be sure the bracket remains on the shoulder of the terminal lever.

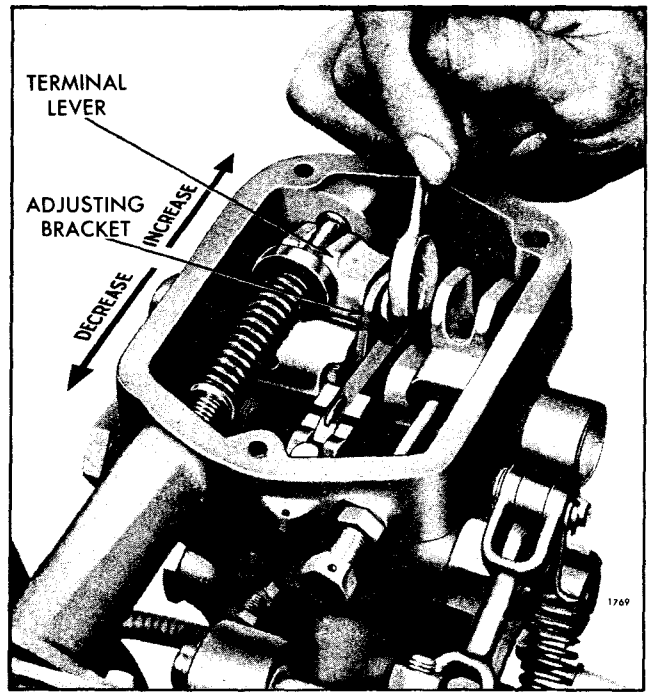


Fig. 4 - Adjusting Speed Droop

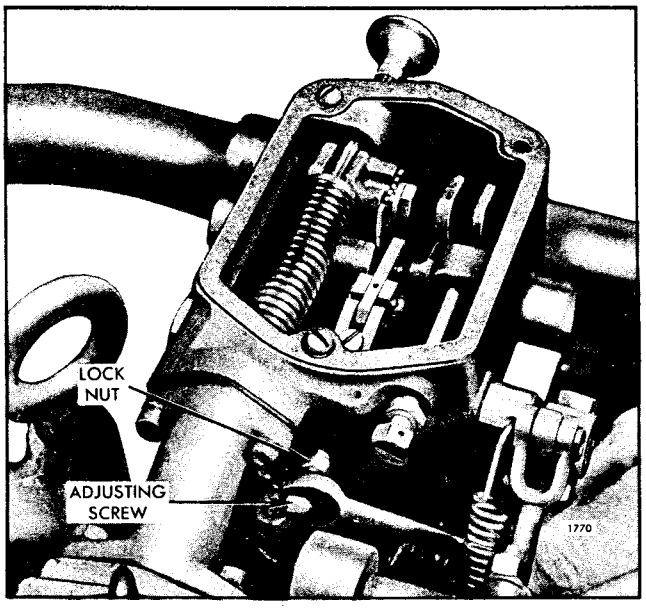


Fig. 5 - Setting Maximum Speed Adjusting Screw

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

TABLE 1

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 adjust the engine speed to the correct full-load speed.

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

If the speed droop is too high, stop the engine and again loosen the 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 should be identical, otherwise the electrical load will not be equally divided.

Adjust the speed droop bracket in each engine

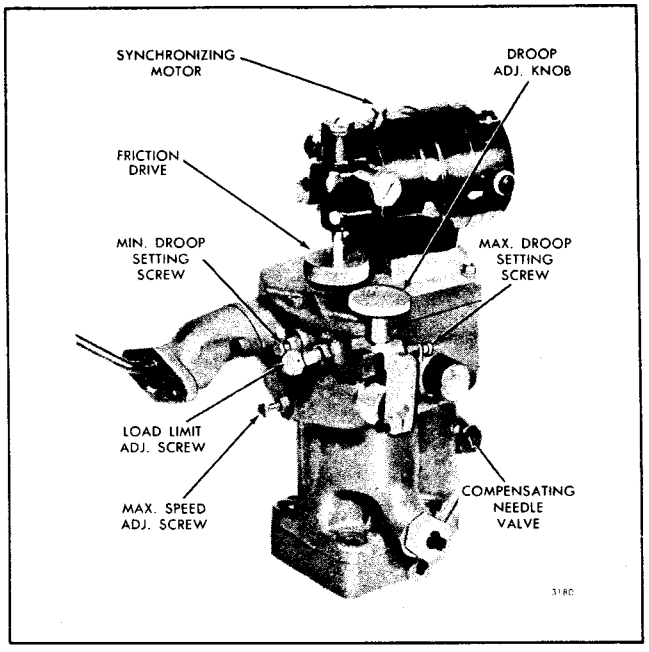


Fig. 6 - Typical Synchronizing Motor Mounting and Drive Assembly

governor to obtain the desired variation between the engine no-load and full-load speeds shown in Table 1.

The recommended speed droop of generator sets operating in parallel is 50 rpm (2 1/2 cycles) for units operating at 1000 and 1200 rpm and 75 rpm (2 1/2

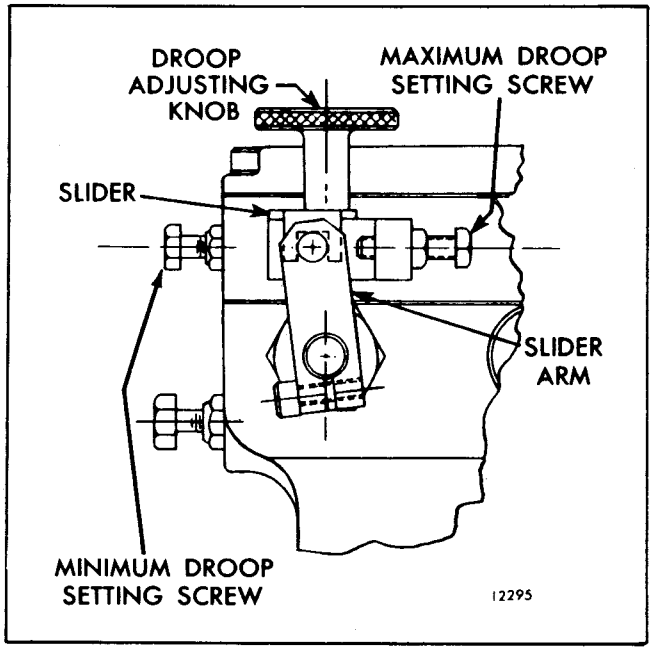


Fig. 7 - External Droop Control on PSG Isochronous Governor

cycles) for units operating at 1500 and 1800 rpm full load. This speed droop recommendation may be varied to suit the individual application.

A single engine unit equipped with an isochronous type hydraulic governor may operate at a constant frequency by setting the governor droop to zero. However, when operating generator sets in parallel, the governor of each unit must be set with an equal amount of droop for stable operation and proper division of the load.

If required, the zero droop setting may be carried out by performing Steps 1 through 7 as outlined, except adjust for zero droop instead of 3% to 5% as stated.

Adjust Maximum No-Load Speed

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

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

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

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

4. Hold the screw and tighten the lock nut. Install the governor cover.

Governors with Synchronizing Motor

On some hydraulic governors, a reversible electric synchronizing motor (Fig. 6) is mounted on the governor cover. This motor permits close adjustment of the engine speed by remote control. This feature is especially valuable when synchronizing two generators from a central control panel.

When the two-way control switch on the central control panel is closed by the operator, the motor shaft turns the governor speed adjusting shaft by means of the reduction gear and slip coupling. The direction of rotation (clockwise or counterclockwise) is dependent upon the position of the switch. When the desired engine speed is indicated on a tachometer or frequency meter on the panel, the operator returns the switch to the "OFF" position.

If the switch is held in the "Lower Speed" position too long, the synchronizing motor will continue to lower the engine speed until it ultimately shuts the engine down. Should the switch be held too long in the "Raise Speed" position, the motor will turn the governor shaft until the shaft strikes the maximum speed adjusting screw, after which the clutch will slip and the motor will continue to run at a slightly reduced speed without further effect.

The adjustments on the governor equipped with a synchronizing motor are the same as on units without a synchronizing motor. The synchronizing motor is used in place of the vernier throttle control knob to raise and lower the engine speed.

The governor cover and motor assembly must be removed when setting the engine droop. The desired engine speeds may be obtained by manually turning the worm drive while the cover is removed.

Governors with External Droop Control

Some PSG governors have an external adjustable droop control to enable droop adjustment without the removal of the governor cover. Units having a governor with this feature may be paralleled with another unit that is operating at constant frequency (zero droop). The incoming unit should have its droop bracket set in the maximum position while it is being paralleled and while operating in parallel. When it is desired to stop the unit operating at constant frequency, the load should be shifted to the incoming unit and its governor droop bracket moved to zero droop. The outgoing unit can then be adjusted to maximum droop, removed from the line and stopped. The incoming unit will now be carrying the load and operating at constant frequency (zero droop).

Adjustment of governor droop by the external adjustable droop control should be performed as follows:

1. Start the engine, and run it at approximately one-half the rated full-load speed until the lubricating oil temperature stabilizes.

2. Remove the load from the engine.

3. Back off the needle valve to release any air that may be trapped in the system. Turn the needle valve in slowly to reduce governor hunting. The correct needle valve setting will be between 1/8 and 1/2 turn open.

4. Back out the minimum and maximum droop setting screws.

5. Loosen the droop adjusting knob (Fig. 7) and move the slider all the way in toward the engine, and then tighten the knob.

6. Loosen the lock nut on the maximum speed

adjusting screw and turn the screw out until 5/8 " of the threads are exposed.

7. With the engine operating at the recommended full-load speed, apply the full rated load and re-check the engine speed. If required, re-adjust the engine to full-load speed by means of the synchronizing motor.

8. Remove the load and note the engine speed. If the zero droop setting is correct, the engine speed will remain constant. If the engine speed is higher, loosen the droop adjusting knob and set the slider to a reduced droop position.

9. When the desired minimum droop setting is reached, loosen the lock nut and turn the minimum droop setting screw inward until it contacts the droop linkage within the governor. This will be felt by a step-up of resistance while turning the adjusting screw. Lock the adjusting screw.

10. Loosen the droop adjusting knob and slide the droop bracket in a direction to increase the droop. Perform Steps 7 and 8 to check the droop until the desired maximum droop is attained.

11. When the desired maximum droop setting is reached, loosen the lock nut and turn the maximum droop setting screw inward until it contacts the droop slider arm. Lock the adjusting screw.

12. Recheck the minumum and maximum droop setting as outlined in Steps 7 and 8 and adjust the adjustment screws if necessary until the correct settings are attained.

13. Adjust the maximum no-load speed.

MECHANICAL OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT

A Pierce mechanical governor is used to maintain a near constant output shaft speed on engines equipped with a torque converter. The governor may be mounted at the front of the engine (Fig. 1) and driven by a flexible shaft from the converter output shaft, or may be mounted on the torque converter and gear driven from the output shaft (Fig. 2).

Lubrication for the direct driven governor is provided by an external oil line from the torque converter. The engine mounted governor is lubricated by engine oil contained within the governor housing. The governor sump is filled through the hinged cap oiler until the oil begins to drip out of the oil level hole. After filling, a plug is installed in the oil level hole to prevent leakage.

The output shaft governor is connected to the engine governor by control rods and levers (Figs. 1 and 2). The control rod end ball joints are sealed assemblies and do not require lubrication. However, the throttle control shaft bearings should be lubricated periodically with all purpose grease through the grease fittings. Other moving parts of the control linkage should be lubricated with engine oil.

The centrifugal force of the revolving output shaft governor flyweights is converted into linear motion which is transmitted through a riser, thrust bearing, operating fork, and rocker shaft to an external speed adjusting spring. The speed of the torque converter output shaft is governed by the tension of the speed adjusting spring. This spring tension is established by the operator when he moves the output shaft governor speed adjusting lever to the desired speed setting.

The engine governor operating lever is positioned by the operator to limit the maximum fuel input to the engine. For most purposes, such as drag line and shovel operation, the lever is advanced to its maximum position to permit the output shaft governor to obtain full power from the engine. The lever may be used as an overrule lever when performing such jobs as laying of structural steel. A spring is used to return the lever to the idle position. Travel of the governor operating lever is limited by a stop (bolt).

The engine governor throttle control lever is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever, yields to permit the governor operating lever to move the throttle control lever toward the idle position, regardless of the position of the output shaft governor lever. A slot in the underside of the governor cover

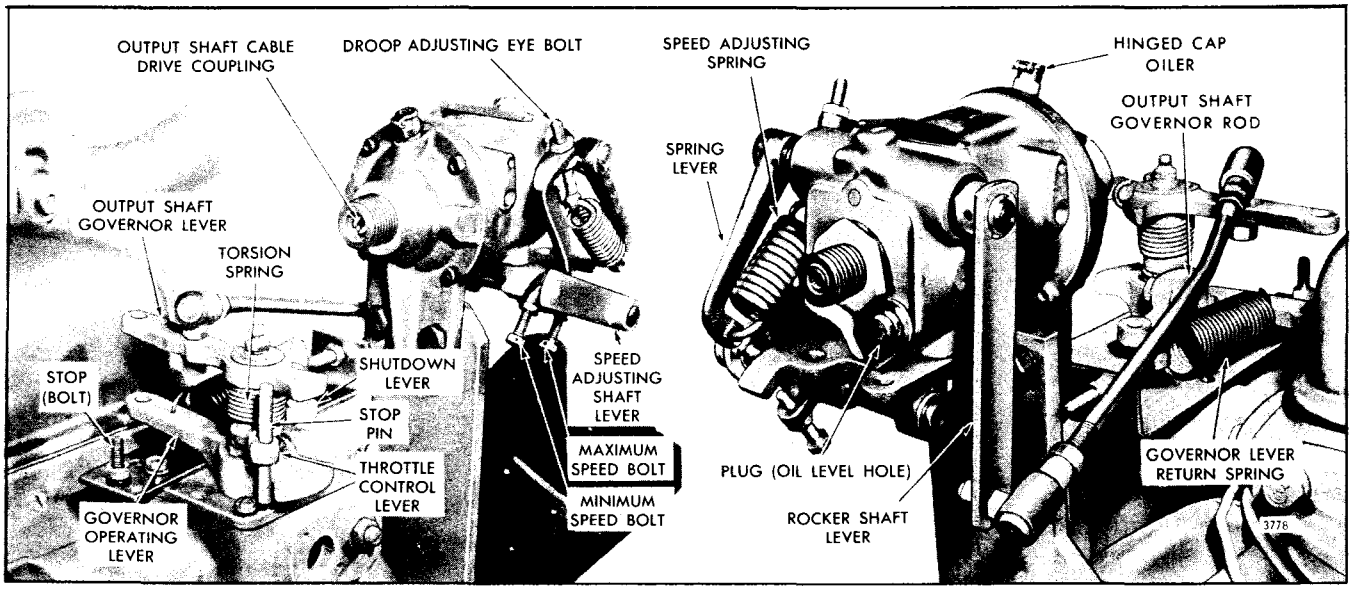


Fig. 1 - Flexible Shaft Driven Output Shaft Governor and Linkage

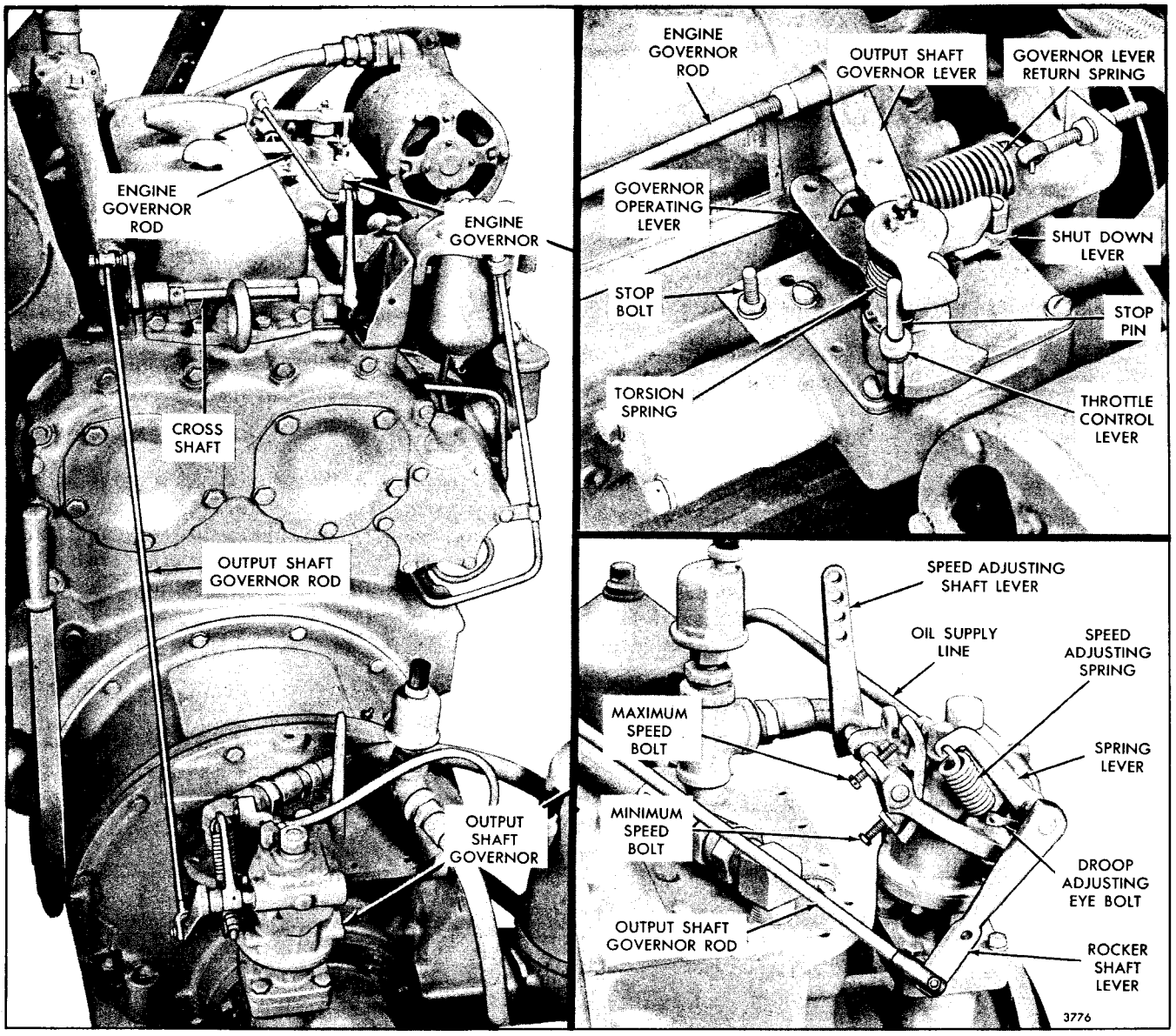


Fig. 2 - Gear Driven Output Shaft Governor and Linkage

hub limits the travel of the throttle control lever in both its maximum and minimum speed positions.

Movement of the output shaft governor speed adjusting lever is limited by the maximum and minimum speed adjusting bolts.

The engine shutdown lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shutdown lever is used to move the differential lever to the no-fuel position.

Operation

When the output shaft governor speed adjusting lever is advanced, the tension on the speed adjusting spring is increased. The force resulting from the increased spring tension is transmitted through the rocker shaft lever and control linkage to the throttle control lever which advances the injector racks. Engine speed increases, as a result of the increased fuel, until the output shaft governor weight force is sufficient to balance the increased spring tension. The weights then move against the spring and reduce the injector rack fuel setting to an amount sufficient to maintain the higher engine speed setting.

Should the operator move the speed adjusting shaft lever to a decreased speed position, the tension on the speed adjusting spring will decrease and the governor weights will overcome the spring tension and move the rocker shaft lever to a decreased fuel position. The engine speed will be reduced until the force of the output shaft governor weights equals the tension of the speed adjusting spring. The engine will then operate at the desired reduced engine speed.

When a load is applied to the unit, the output shaft slows down and the force exerted by the governor flyweights is reduced, allowing the spring to move the rocker shaft lever to an increased fuel position to provide sufficient power to equal the new load.

When the load on the unit is removed, the output shaft speed will increase and the force exerted by the governor flyweights will increase, overcoming the spring tension and moving the rocker shaft lever to a decreased fuel position to reduce the power to match the reduced load.

Tune-Up

Adjust the exhaust valve clearance, time the injectors and adjust the engine and output shaft governors as follows:

1. Adjust the exhaust valve clearance and time the fuel injectors.

2. Disconnect the output shaft governor rod and the linkage to the engine governor operating lever. Then adjust the engine governor as outlined under *Limiting Speed Mechanical Governor and Injector Rack Control Adjustment.*

> **NOTE:** Set the no-load engine speed to that specified on the engine option plate. The no-load speed varies with the converter used and the maximum output shaft speed setting.

3. Reconnect the linkage to the governor operating lever and check the total travel of the operating lever. The lever should move to the stop (bolt) in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

4. Move the governor operating lever to the maximum speed position (against the stop bolt).

5. Move the output shaft governor rocker shaft lever to the maximum fuel position and retain it by moving the speed adjusting lever to the full-speed position. Then move the output shaft governor lever and the throttle control lever together to the maximum speed position and retain them there.

> **NOTE:** This operation closes the low speed gap which may require more torque than is available from the torsion spring between the above two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

6. Adjust the flexible-shaft driven output shaft governor rod length until it will just slide into the inner hole of the output shaft governor lever (Fig. 1). Then increase the length of the rod until there is approximately .020 " clearance between the stop pin and the output shaft governor lever, and the bend in the rod is positioned as shown in Fig. 1. Tighten the adjustment.

To adjust the linkage between the output shaft governor (mounted on the torque converter) and the engine governor, loosen the output shaft governor rod clamping bolt in the ball joint in the rear cross shaft lever (Fig. 2). Next, move the output shaft governor rod until there is approximately .020 " clearance between the stop pin and the output shaft governor lever. Then tighten the clamping bolt securely.

> **NOTE:** The engine governor control rod is connected to the outer bolt hole in the output shaft governor lever on units equipped with a rear mounted output shaft governor.

7. Adjust the governor operating lever return spring by retaining the rocker shaft lever in the full-speed position and increasing the tension on the spring by adjusting the eyebolt and nuts, until the tension of the torsion spring is overcome and the throttle control lever is moved against its stop in the idle position.

8. Move the output shaft governor speed adjusting lever to the minimum speed position and start the engine.

9. Advance the output shaft governor speed adjusting lever to the desired maximum output shaft speed and adjust the maximum speed adjusting bolt to retain the lever.

10. Move the output shaft governor speed adjusting shaft lever to the desired minimum speed position and adjust the minimum speed adjusting bolt to retain the lever.

11. Recheck the output shaft maximum and minimum speeds and readjust the position of the speed adjusting bolts, if necessary.

12. To check the unit for stability as affected by governor speed droop, move the speed adjusting shaft lever, with the engine operating at no load, to the maximum speed position. Then move the output shaft

governor rod to cause a speed decrease of several hundred rpm. Release the rod and check for hunting when the governor returns the engine to the maximum speed setting. If the engine stabilizes in less than three surges, the droop may be set too high; if the engine does not stabilize in five surges, the droop may be set too low. Set the speed droop as follows:

a. If the engine hunts less than three surges, back off the inner speed adjusting spring eyebolt nut one full turn and tighten the outer nut one turn to retain the adjustment. If the engine hunts more than five surges, back off the outer speed adjusting spring eyebolt nut one full turn and tighten the inner nut one turn to retain the adjustment.

NOTE: The eye of the bolt must be in a horizontal plane to avoid twisting the spring.

b. Reset the maximum engine no-load speed, if necessary, as outlined in Steps 9 and 10.

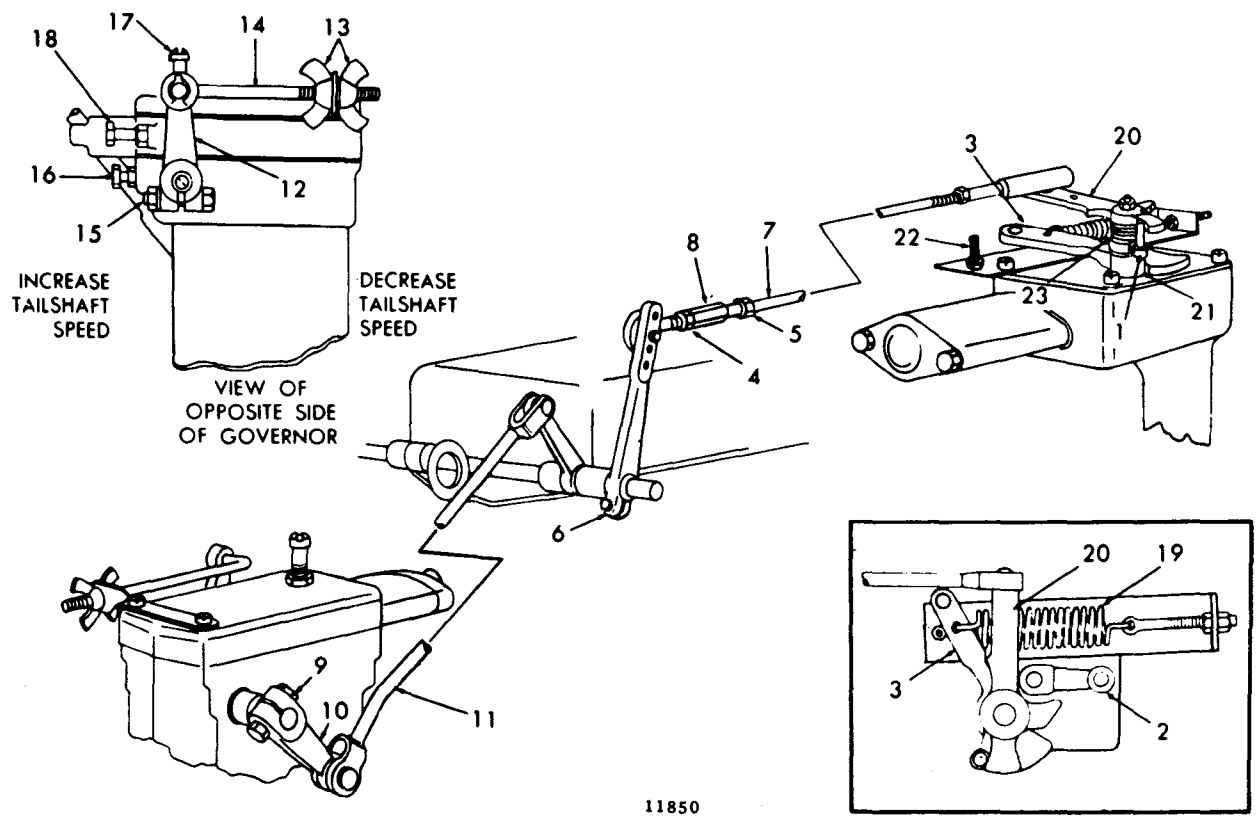
c. Recheck the speed droop. The engine speed should be stable when the governor droop is 7-1/2% to 10% of the full-load speed. For example, at an output shaft speed setting of 1800 rpm full load, the output shaft speed droop should be 150 to 200 rpm. Therefore, the no-load output shaft speed should be set at 1950 to 2000 rpm.

HYDRAULIC OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT

A hydraulic governor is used to maintain a near constant output shaft speed on engines equipped with a Series 500 or larger Torqmatic converter. The governor is mounted on the converter and gear driven from the output shaft.

The output shaft governor is connected to the engine governor by control rods and levers (Figs.1 and 2). The control rod end ball joints are sealed assemblies and do not require lubrication. However, the throttle control shaft bearings should be lubricated periodically with all purpose grease through the grease fittings. Other moving parts of the control linkage should be lubricated with engine oil.

In most applications, such as drag line and shovel operation, it is desirable to have the output shaft governor control the fuel input to maintain a relatively constant output shaft speed. The output shaft speed will be constant up to full power of the engine, except for the amount of governor droop. The speed setting of the engine governor must be sufficiently higher than the speed setting of the output shaft governor so the engine governor will not reduce the fuel input to the engine before full power is required by the output



1 Lever--Throttle Control
2 Lever--Shut Down
3 Lever--Governor Operating
4 Lock Nut--Turnbuckle
5 Lock Nut--Turnbuckle
6 Lever--Throttle Control Rear Cross-Shaft
7 Rod--Engine Governor
8 Turnbuckle
9 Bolt
10 Lever--Output Shaft Governor Control
11 Rod--Output Shaft Governor
12 Lever--Speed Control
13 Wing Nuts--Speed Adjusting
14 Link--Sliding
15 Bolt
16 Screw--Maximum Speed Limit Adjusting
17 Screw--Minimum Speed Limit Adjusting
18 Screw--Maximum Fuel Adjusting
19 Spring--Governor Lever Return
20 Lever--Output Shaft Governor
21 Pin--Stop
22 Bolt--Stop
23 Spring--Torsion

FIG. 1 - Hydraulic Output Shaft Governor and Linkage (Type A)

shaft governor. As load is applied to the output shaft, the output shaft speed will decrease gradually up to the amount of the output shaft governor droop at full load. At the same time, the engine speed will gradually increase until full load is reached.

In some types of operation, such as laying of structural steel, it is desirable to operate the unit with a very low output shaft speed. This speed could be so low that the output shaft governor ball head assembly would not actuate the governor pilot valve and spring seat assembly. In such applications, the engine governor operating lever (6), Fig. 1, or the remote throttle control lever (1), Fig. 2, used as an overrule lever, can be moved toward the idle speed position sufficiently to provide the desired low output shaft speed. Output shaft speeds down to zero can be obtained through this type of engine governor control. The engine governor would maintain control unless the output shaft speed increased to the speed setting of the output shaft governor.

Two types of governor control linkages are in use. The adjustment procedure for each type is outlined in the following paragraphs.

Adjustments (Type A - Fig. 1)

The engine governor throttle control lever (Fig. 1) is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever, yields to permit the governor operating lever to move the throttle control lever toward the idle position, regardless of the position of the output shaft governor control lever. A slot in the underside of the governor cover hub limits the travel of the throttle control lever in both the maximum and minimum speed positions.

The engine shutdown lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shutdown lever is used to move the differential lever to the no-fuel position.

The following linkage and governor adjustments should be made with the engine stopped, after the limiting speed engine governor has been adjusted as outlined under *Limiting Speed Mechanical Governor and Injector Rack Control Adjustment.*

1. Connect the linkage to the governor operating lever (Fig. 1) and check the total travel of the lever. The lever should move to the stop bolt in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

2. Move the governor operating lever to the maximum speed position (against the stop bolt).

3. Move the output shaft governor control lever to the full-fuel position and retain it by moving the speed control lever to the maximum speed position. Then move the output shaft governor lever (on the engine governor cover) and the throttle control lever together to the maximum speed position and retain them there.

> **NOTE:** This operation closes the low speed gap (in the engine governor) which may require more torque than is available from the torsion spring between the two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

4. To adjust the linkage between the output shaft governor and the engine governor, loosen the output shaft governor rod clamping bolt in the ball joint in the rear cross-shaft lever. Next, move the output shaft governor rod until there is approximately .020 " clearance between the stop pin and the output shaft governor lever. Then tighten the clamping bolt securely.

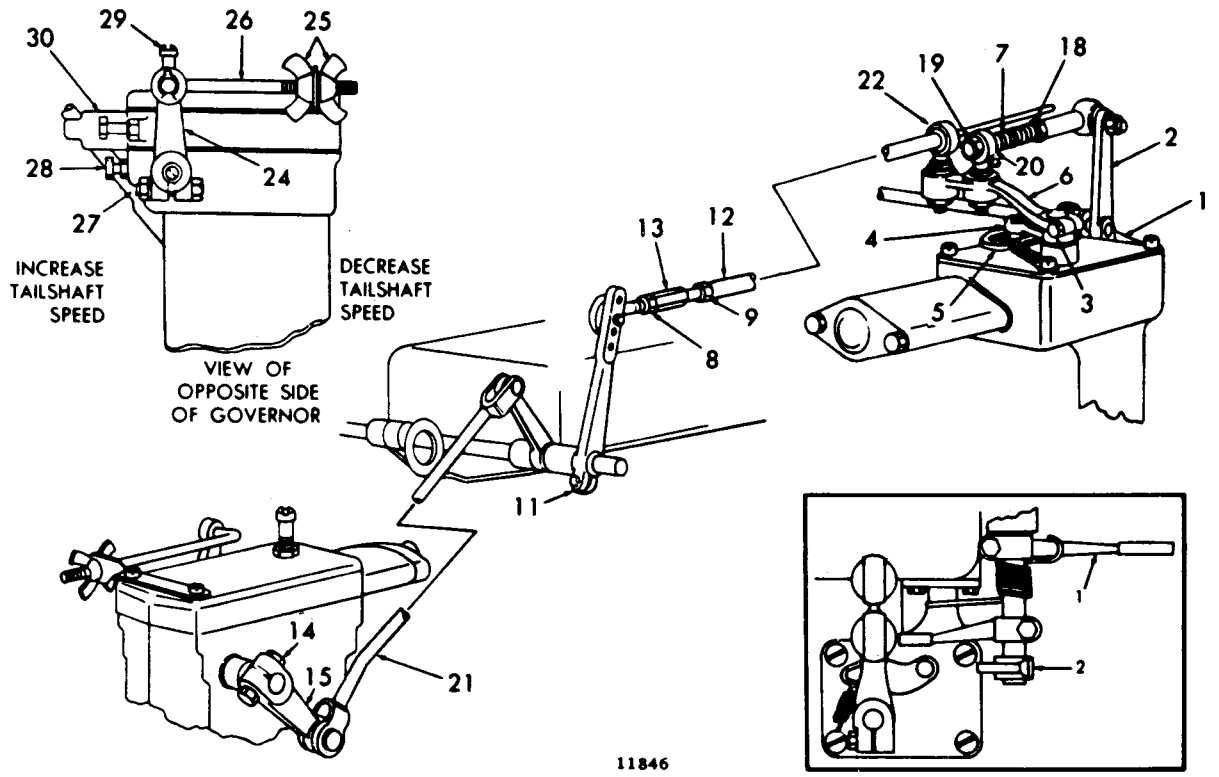
> **NOTE:** The engine governor control rod is connected to the outer bolt hole in the output shaft governor lever.

5. To adjust the governor operating lever return spring, retain the output shaft governor control lever in the full-fuel position and increase the tension on the spring by adjusting the eyebolt and lock nuts until the tension of the torsion spring is overcome and the throttle control lever is moved against the stop in the idle position.

Final Adjustments

Move the output shaft governor lever in the idle speed position and start the engine.

After the engine reaches normal operating temperature, advance the output shaft governor speed control lever to the maximum speed position and check the



1 Lever--Remote Throttle Control
2 Lever--Governor Throttle Control
3 Bolt
4 Lever--Governor Stop
5 Cam--Governor
6 Lever--Governor Speed Control
7 Spring--Repulsing
8 Lock Nut--Turnbuckle
9 Lock Nut--Turnbuckle
11 Lever--Throttle Control Rear Cross-Shaft
12 Rod--Throttle
13 Turnbuckle
14 Bolt
15 Lever--Output Shaft Governor Control
18 Lock Nut
19 Bolt--Spring
20 Bearing--Rod End
21 Rod--Throttle
22 Bearing--Rod End
24 Lever--Speed Control
25 Wing Nuts--Speed Adjusting
26 Link--Sliding
27 Bolt
28 Screw--Maximum Speed Limit Adjusting
29 Screw--Minimum Speed Limit Adjusting
30 Screw--Maximum Fuel Adjusting

Fig. 2 - Hydraulic Output Shaft Governor and Linkage (Type B)

Torqmatic converter output shaft speed. This speed will vary depending upon engine application.

If it is necessary to adjust the output shaft speed, loosen the wing nuts on the sliding link and move the speed control lever to increase or decrease the speed as needed.

The output shaft governor is driven through the converter and there is a high droop. Therefore, the no-load speed setting should be at least 150 rpm higher than the desired full-load speed setting. Tighten the wing nuts after completing the adjustment.

NOTE: Do not set the Torqmatic converter output shaft speed in excess of the speed specified by the equipment manufacturer, to prevent damage to the driven machinery.

It will be noted during engine operation that the minimum droop will vary between 150 and 175 rpm. If the droop requires adjustment, move the droop bracket (inside the output shaft governor) to decrease or increase the amount of droop.

NOTE: To compensate for the output shaft speed droop, the engine no-load speed must be set approximately 175 rpm above the required engine full-load speed.

Move the output shaft governor speed control lever to the idle speed position and adjust the idle speed by means of the minimum speed limit adjusting screw.

The maximum fuel adjusting screw and the maximum speed limit adjusting screw are not used and should be backed out to prevent interference.

Adjustments (Type B - Fig. 2)

The following linkage and governor adjustments should be made with the engine stopped and after the limiting speed engine governor has been adjusted as outlined under *Limiting Speed Mechanical Governor and Injector Rack Control Adjustment.*

1. Place the remote throttle control lever (1), Fig. 2, in the maximum speed position.

2. Move the governor speed control lever (6) and governor stop lever (4) into the "idle" notch in the governor cam (5). The repulsing spring (7) should be fully compressed when the stop lever reaches the "idle" notch of the governor cam.

If the repulsing spring is not fully compressed, loosen the bolt (3) in the governor speed control lever and move the lever until the spring is compressed.

If the repulsing spring becomes fully compressed before the governor stop lever reaches the "idle" notch in the governor cam, loosen the bolt (3) in the governor speed control lever and manually move the stop lever into the "idle" notch.

3. Hold the governor stop lever (4) halfway between the idle and maximum speed positions and loosen the lock nuts (8) and (9). Adjust the turnbuckle (13) so the rear cross-shaft lever (11) is vertical.

4. Loosen the bolt (14) and remove the output shaft governor control lever (15). Place the governor stop lever (4) into the idle position by moving the rear cross-shaft lever (11) and reinstall the output shaft governor control lever.

> **NOTE:** Move the rear cross-shaft lever (11) into the maximum speed position and check to see that there is no binding between the clevis on the end of the throttle rod (21) and the output shaft governor control lever (15).

5. Move the governor stop lever (4) into the maximum speed position in the governor cam (5) and check to see that there is 1/32 " to 1/16 " clearance between the rod end bearing (20) and the hex head of the spring bolt (19). If the clearance is not correct, loosen the lock nut and adjust the spring bolt.

6. Manually hold the governor stop lever (4) in the idle position. Loosen the lock nuts (8) and (9) and adjust the turnbuckle (13) until the shoulder on the throttle rod (12) just contacts the rod end bearing (22) and holds the stop lever in the idle position.

Final Adjustments

Place the remote throttle control lever (1) in the "mid-position", then start the engine. After the engine reaches normal operating temperature, place the remote throttle control lever in the maximum speed position and check the Torqmatic converter output shaft speed. This speed will vary depending upon engine application requirements.

If it is necessary to adjust the output shaft speed, loosen the wing nuts on the sliding link as needed and move the speed control lever to increase or decrease the speed.

The Torqmatic converter hydraulic output shaft governor is driven through the torque converter and there is a high droop. Therefore, the no-load setting should be at least 150 rpm higher than the desired full-load setting. Tighten the wing nuts after completing the adjustment.

> **NOTE:** Do not set the output shaft speed in excess of the speed specified by the equipment manufacturer, to prevent damage to the driven machinery.

During engine operation, it will be noted that the minimum droop will vary between 150 and 175 rpm. If the droop requires adjustment, move the droop bracket (inside the hydraulic output shaft governor) to decrease or increase the amount of droop.

> **NOTE:** To compensate for the output shaft speed droop, the engine no-load speed must be set approximately 175 rpm above the required engine full-load speed.

In the application of a hydraulic governor, the maximum fuel adjusting screw (30) and the maximum speed limit adjusting screw (28) are not used and therefore should be backed out to prevent any interference.

DUAL HYDRAULIC SGT GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

A dual hydraulic governor assembly is used with certain torque converter applications. This governor consists of two sets of flyweights and pilot valve assemblies that are interconnected to operate a single servo piston. One set of flyweights is driven by the engine. The other set is driven through a flexible shaft by the output shaft. The governor assembly used on a particular engine may have either single (Fig. 1) or dual (Fig. 3) speed control levers.

The control lever, on the single lever type governor, is attached to the output shaft governor speed adjustment shaft (Fig. 1). The engine governor and the output shaft governor speed adjusting shaft arms are linked together by a "slip-joint" link (Fig. 2).

On the single lever type governor, the control lever has two distinct arcs of travel. In the first arc of travel (used to obtain the desired engine speed), the control lever moves the engine governor speed adjusting shaft arm to a point between the engine idle and maximum speed positions. In the second arc of travel (used to set the desired output shaft speed, the pin located at the lower end of the output shaft governor speed adjusting shaft arm "picks-up" the output shaft governor floating lever assembly. The movement of the governor control lever in the second arc of travel is opposed by the "slip-joint" linkage spring.

The two lever control of the dual lever type governor assembly has one of the control levers attached to the engine governor speed adjusting shaft and is used to control the engine governor. The other control lever is attached to the output shaft governor speed adjusting shaft and controls the output shaft governor.

In both the single lever and dual lever type governors, oil is pumped through the engine governor pilot valve to the output shaft governor pilot valve and then to a single common servo piston. The servo piston operates a terminal lever which in turn controls the position of the fuel rod connected to the injector control tube lever.

Pull out the fuel rod knob (Figs. 1 and 3) when it is necessary to stop the engine.

Adjustments

The following linkage and governor adjustments should be made after the engine has reached normal operating temperature and has been stopped.

Check the injector racks, injector control tube and remote throttle control linkage for freedom of movement before adjusting the governor to make sure the adjustments are necessary.

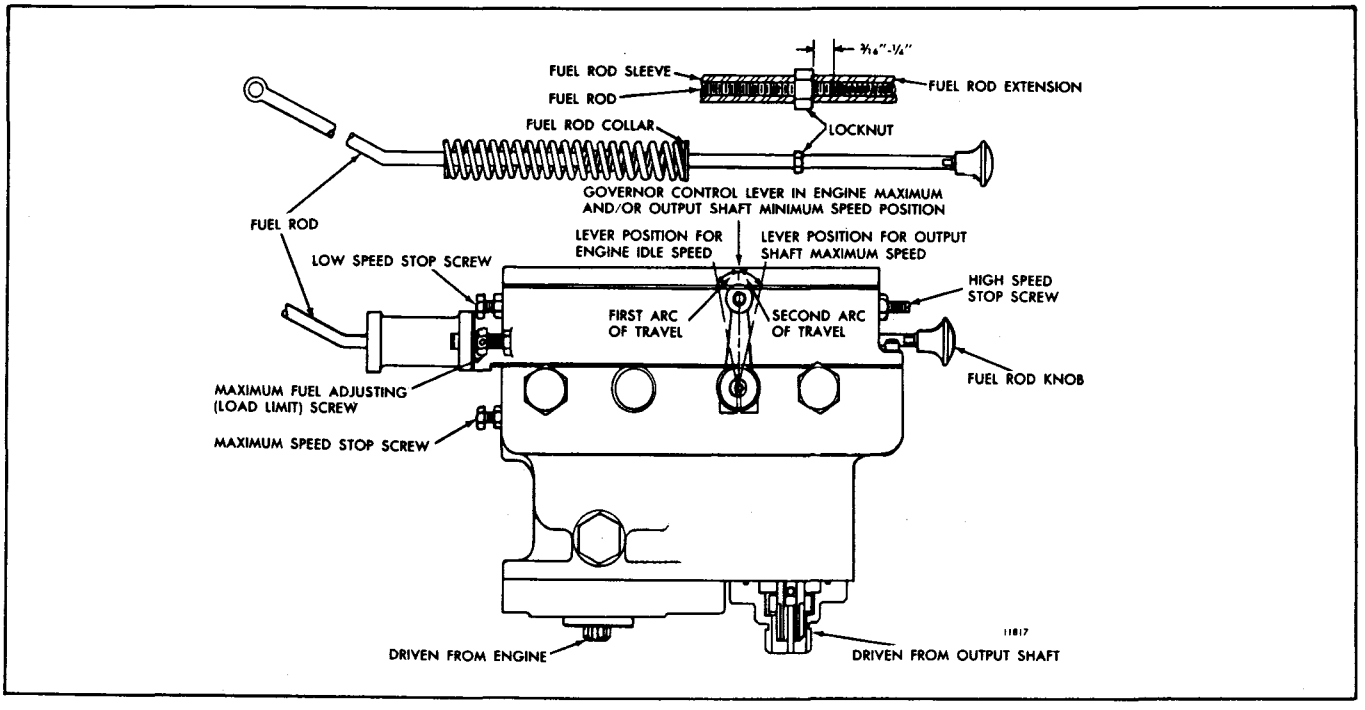


Fig. 1 - Single Lever Dual Hydraulic Governor

Adjust Fuel Rod (Engine Stopped)

1. Remove the valve rocker cover. Loosen all of the inner and outer injector rack control lever adjusting screws. Be sure all of the levers are free on the injector control tube.

2. Loosen the lock nut on the engine governor load limit adjusting screw (Fig. 1). Back the screw out until the end of the screw is flush with the face of the boss and tighten the lock nut.

3. Loosen the fuel rod lock nut and unscrew the shutdown knob and rod extension.

4. Turn the lock nut so 3/16" to 1/4" of the fuel rod extends beyond the nut.

5. Replace the fuel rod extension and knob and tighten the extension against the lock nut.

Position Injector Rack Control Levers

After the fuel rod is properly adjusted, adjust the injector rack control levers as follows:

1. Turn the outer adjusting screw of the No. 1 injector rack control lever in until a slight movement of the injector control tube lever is observed. Then tighten the inner adjusting screw.

2. Pull the fuel rod out and check for 1/16" movement.

If the movement exceeds the specified amount, back off the inner adjusting screw approximately 1/8 of a turn and tighten the outer adjusting screw.

If the movement is less than the specified amount, back off the outer adjusting screw approximately 1/8 of a turn and tighten the inner adjusting screw.

3. Remove the clevis pin and disconnect the fuel rod from the injector control tube lever.

4. Manually hold the No. 1 injector rack control lever in the full-fuel position and turn the inner adjusting screw into the No. 2 injector rack control lever 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.

5. Recheck the No. 1 injector rack to make sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector rack. If the rack of the No. 1 injector has become loose, back off the inner adjusting screw slightly on the No. 2 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.

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

6. Connect the fuel rod to the injector control tube

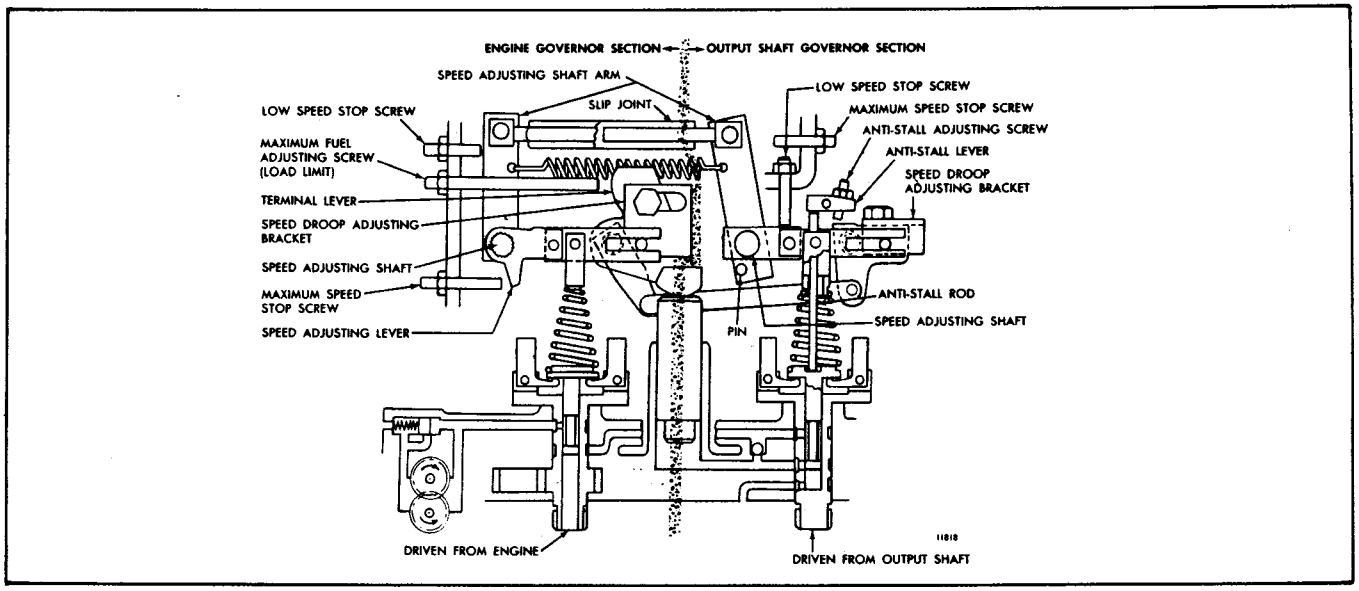


Fig. 2 - Schematic Diagram of Single Lever Dual Governor

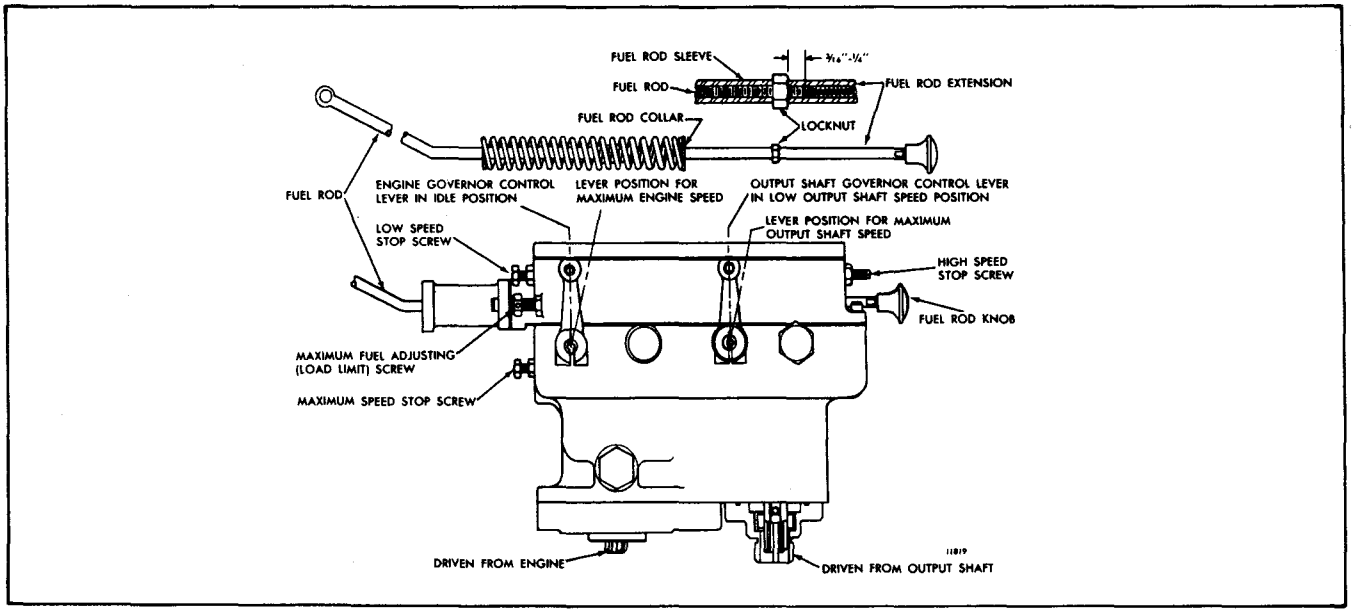


Fig. 3 - Two Lever Dual Hydraulic Governor

lever and replace the clevis pin; the clevis pin must rotate freely. Replace the valve rocker cover.

Adjust Load Limit

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been repositioned, the load limit screw should be adjusted.

With the injector rack control levers properly adjusted, the load limit may be set as follows:

1. Place the fuel rod and the terminal lever in the full-fuel position (some improvised method may be employed to hold the fuel rod in the full-fuel position).

2. Loosen the lock nut on the load limit adjusting screw. Turn the adjusting screw until a .020" gap exists between the terminal lever and the fuel rod collar. Hold the screw and tighten the lock nut.

Adjust Engine Governor

1. Loosen the lock nut and back out the output shaft governor maximum speed stop screw (Fig. 2) until it extends approximately 1" from the face of the lock nut when the nut is tight against the housing.

2. Back out the output shaft governor anti-stall adjusting screw until it projects 1/2" above the anti-stall lever.

3. Loosen the output shaft governor low speed stop screw lock nut and turn the screw until it projects 5/16" above the upper face of the lock nut when the nut is tight against the governor body.

4. Disconnect the output shaft governor flexible drive shaft at the governor.

5. Position the engine governor droop adjusting bracket so the adjusting screw is an equal distance from either end of the slot.

Adjust Engine Governor

1. Start and warm up the engine.

2. Loosen the lock nut on the engine governor maximum speed stop screw (Figs. 1 and 2) and back out the screw until it projects 5/8" from the face of the lock nut when the nut is tight against the governor body.

3. Position the engine governor control lever, using the remote throttle control, so that the engine is running at the specified maximum no-load speed shown on the unit name plate. Then turn the maximum speed stop screw in until it contacts the speed adjusting lever. Tighten the lock nut.

4. Loosen the lock nut on the engine governor low speed stop screw and turn the screw until it projects

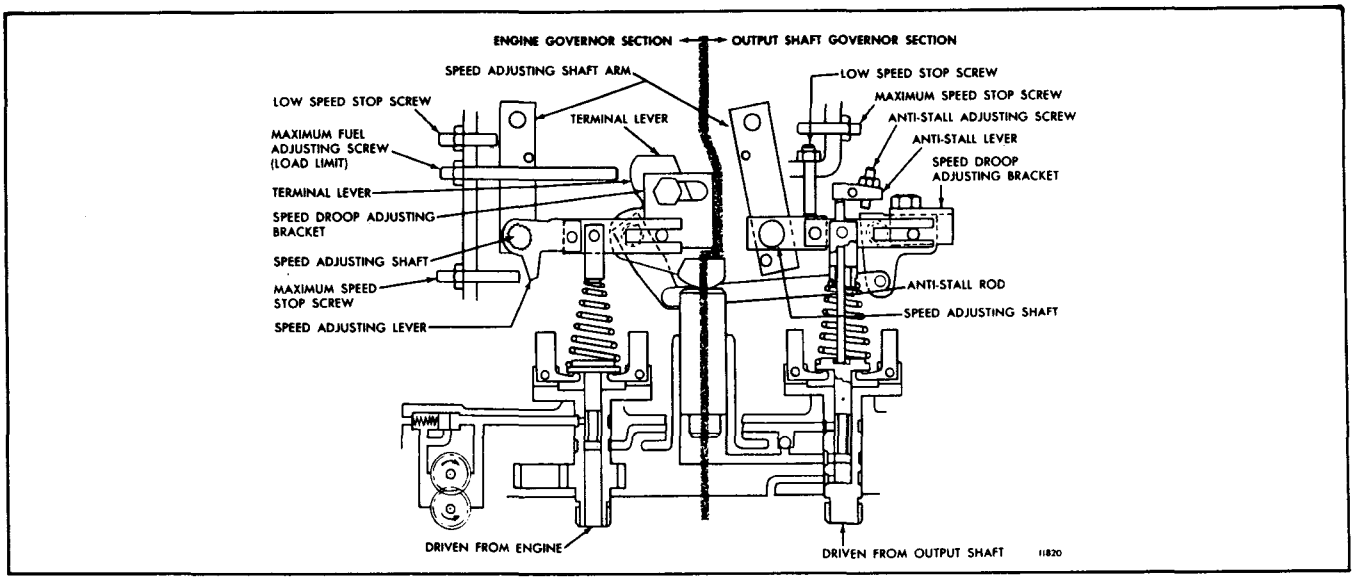


Fig. 4 - Schematic Diagram of Two Lever Dual Governor

3/4" from the governor body when the nut is tight against the governor body.

5. Position the engine governor speed control lever, using the remote throttle control, so the engine is running at the specified no-load idle speed. Then turn the low speed stop screw until it contacts the governor speed adjusting shaft arm. Tighten the lock nut.

NOTE: The idle speed should be 500 rpm or more.

6. Adjust the governor speed droop bracket, if necessary, to obtain the minimum droop to stabilize the engine.

NOTE: Droop is the difference or loss in rpm from maximum no-load speed to maximum full-load speed. An insufficient speed droop will cause "hunting" or "surging". A normally operating engine may surge three or four times before stabilizing.

Move the governor speed droop bracket toward the engine to decrease the speed droop and away from the engine to increase the speed droop. Stop the engine after making the necessary adjustments.

Adjust Output Shaft Governor

1. Reconnect the flexible drive shaft to the output shaft governor. Start the engine and make sure the ball head assembly of the output shaft governor is turning.

2. Adjust the output shaft governor speed droop bracket, if necessary, to stabilize the engine. Moving the bracket toward the engine decreases the droop and moving the bracket away from engine increases the amount of droop.

3. On single lever type governor assemblies, position the governor control lever, using the remote throttle control, in the output shaft minimum speed position.

On dual lever type governor assemblies, position the output shaft governor control lever, using the remote throttle control, in the low output shaft speed position (Fig. 3).

Dual governor assemblies with the "single" control lever incorporating the "slip-joint" linkage may have the linkage adjusted to provide a "lag" or "dwell" between the throttle position at which the no-load maximum engine speed is reached and the throttle position at which the output shaft speed begins to increase (as the governor control lever is moved toward the output shaft maximum speed position). This "lag" is usually governed by the type of application (or provided for the convenience of the operator) and permits movement of the control lever toward full output shaft position, for a short distance, without a corresponding change in output shaft speed. The "slip-joint" may be lengthened or shortened by loosening the lock nut and turning the turnbuckle until the desired adjustment is made. Lengthening the linkage will decrease and shortening the linkage will increase the "lag".

4. On single lever type governor assemblies, position the governor control lever, using the remote throttle control, so that the output shaft is running at the maximum speed desired (usually shown on one of the

unit name plates); then run in the output shaft governor maximum speed stop screw until it contacts the output shaft governor speed adjusting shaft arm. Tighten the lock nut.

On dual lever type governor assemblies, position the output shaft governor control lever, using the remote throttle control, so that the output shaft is running at the maximum speed desired (usually shown on one of the unit name plates). Then turn in the output shaft governor maximum speed stop screw until it contacts the output shaft governor speed adjusting shaft arm. Tighten the lock nut.

5. Loosen the output shaft governor low speed stop screw lock nut and back out the screw until the desired minimum output shaft no-load speed is obtained. Tighten the lock nut.

6. On single lever type governor assemblies, position the governor control lever, using the remote throttle control, in the minimum speed position. Then turn in the anti-stall screw (Fig. 2) until the anti-stall lever just contacts the anti-stall rod. This can be checked by lightly pressing the outer end of the anti-stall lever (side opposite screw) with a screw driver. The screw will be adjusted correctly when a slight increase in output shaft speed is noted when the lever is depressed slightly with a screw driver.

On dual lever type governor assemblies, position the output shaft governor control lever, using the remote throttle control, in the minimum speed position. Then turn in the anti-stall screw until the anti-stall lever just contacts the anti-stall rod. This can be checked by lightly pressing the outer end of the anti-stall lever (side opposite screw) with a screw driver. The screw will be adjusted correctly when a slight increase in output shaft speed is noted when the lever is depressed slightly with a screw driver.

7. Replace the governor cover.

THROTTLE ADJUSTMENTS FOR LOAD EQUALIZATION

TWIN AND QUAD UNITS

Each twin unit consists of two engines and each quad unit has four engines connected through clutches to a common gear box. The throttle adjustment is made so that each engine of a twin or quad unit will carry its share of the load. Throttle adjustments are divided into two groups, depending on the type of governor used, as follows:

1. Twin or quad units with limiting or variable speed mechanical governors.

2. Tandem twin marine units with variable speed mechanical governors.

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON TWIN OR QUAD UNITS WITH LIMITING SPEED MECHANICAL GOVERNORS

The tune-up of each engine is very important in the adjustment of twin and quad units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (8), Fig. 2, from the governor speed control levers (2) and perform a tune-up on each engine before adjusting the throttle control linkage. Then, with the engines stopped, proceed as follows:

1. Check the stop lever and the governor speed control lever and make sure the levers are in alignment. The upper one must be exactly over the lower. Loosen the bolt in the upper lever and adjust the lever if necessary.

2. Make sure that each throttle control lever is locked in place on the quadrant by the latch pin (Fig. 1).

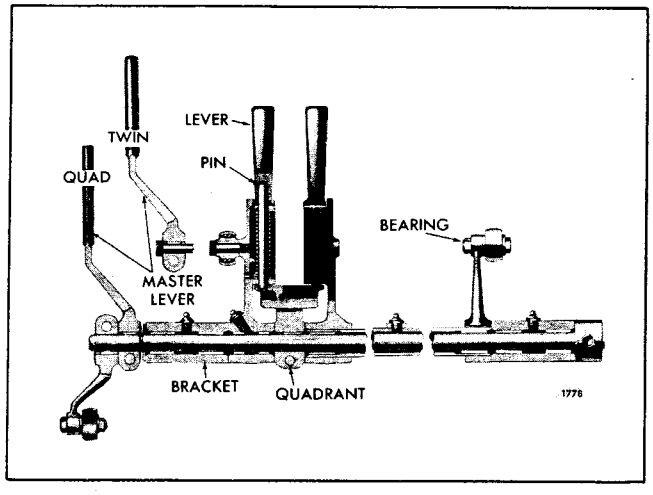


Fig. 1 - Throttle Control Cross Shaft Assembly Twin and Quad Units

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

4. Make sure the governor speed control lever is in the maximum speed position. The pin in the stop lever must be in contact with the end of the slot in the governor cam.

5. If the governor speed control lever is not in the maximum speed position, loosen the two lock nuts (7) and adjust the turnbuckles (4), Figs. 2 and 3.

6. Tighten the turnbuckle lock nuts and recheck the position of the governor speed control levers.

> **NOTE:** Use care when tightening the lock nuts to prevent misalignment of the rod end bearings (5), Figs. 2 and 3.

7. Disengage the clutches, place the master control lever in the idle speed position and start the engines.

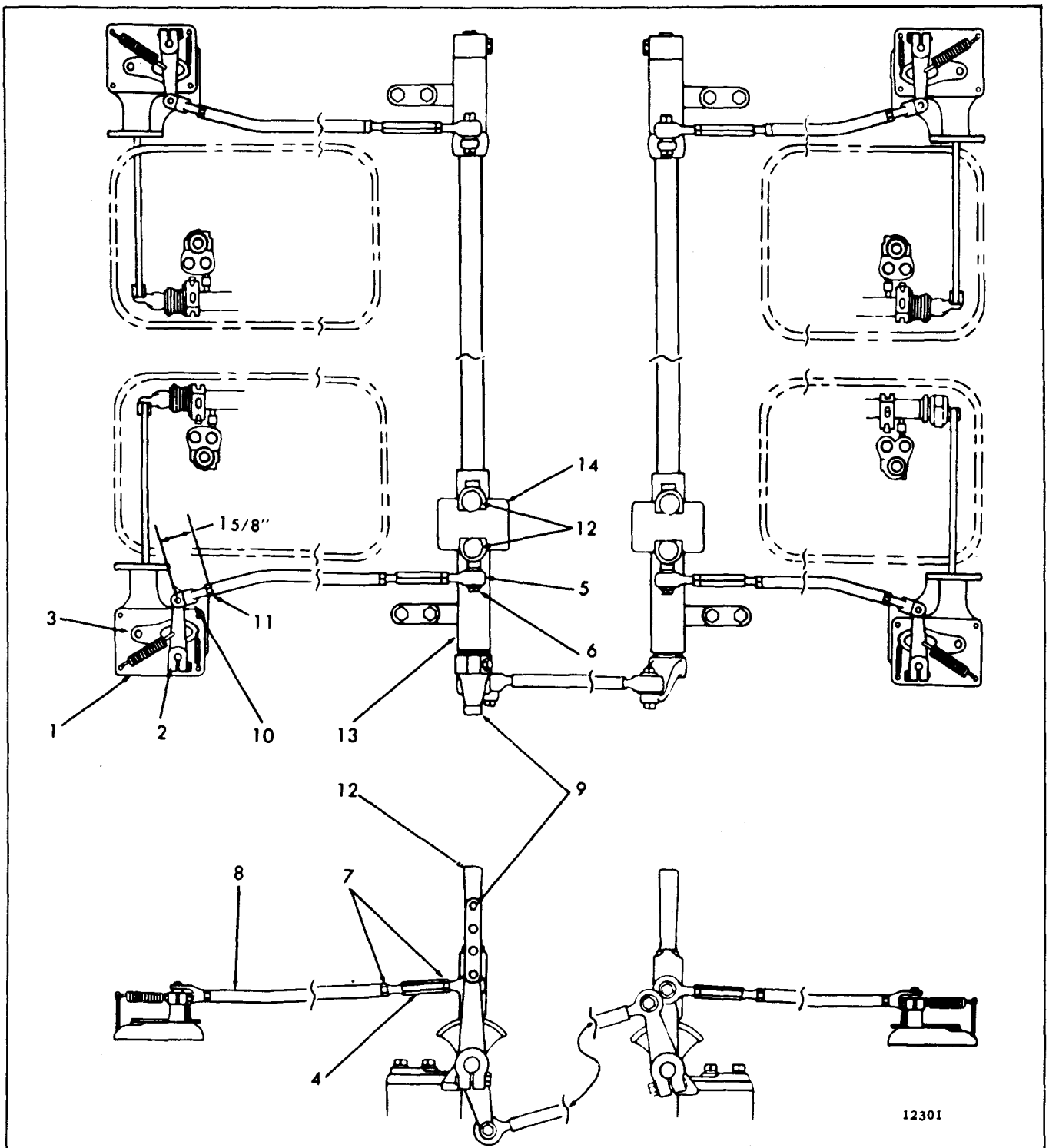
8. After the engines are warmed up, move the master control lever to the idle speed position and check the idle speed of each engine.

9. Move the master control lever to the maximum speed position and check the no-load speed of each engine.

10. Move the master control lever so the unit is operating at approximately 200 rpm below the normal no-load speed.

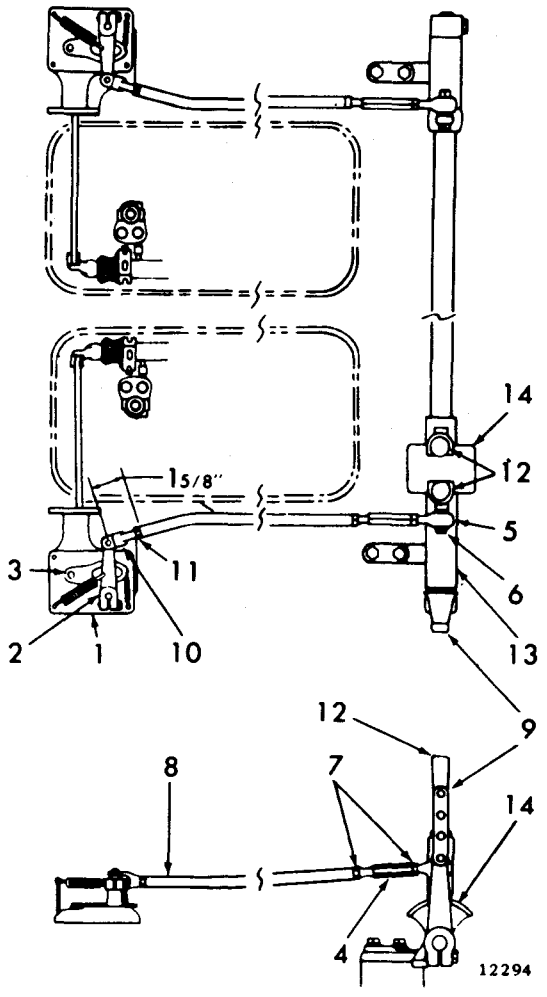
The engines in the unit should be running within 50 rpm of each other. Then check the unit in the same way at 400 rpm and again at 600 rpm below the no-load speed.

If this procedure does not bring the engines within correct synchronization, recheck each engine for poor compression, faulty injectors, low fuel pressure, or



1 Cover--Governor
2 Lever--Governor Speed Control
3 Cam--Governor
4 Turnbuckle
5 Bearing--Rod End
6 Bolt
7 Lock Nut--Turnbuckle
8 Rod--Throttle Control
9 Lever--Master Throttle Control
10 Clevis--Control Rod
11 Lock Nut--Clevis
12 Lever--Throttle Control
13 Bracket--Throttle Control Shaft
14 Quadrant--Throttle Control

Fig. 2 - Diagram of Throttle Control Linkage for Quad Units with Limiting Speed Mechanical Governors



1 Cover--Governor
2 Lever--Governor Speed Control
3 Cam--Governor
4 Turnbuckle
5 Bearing Rod End
6 Bolt
7 Lock Nut--Turnbuckle
8 Rod--Control
9 Lever--Master Throttle Control
10 Clevis--Control Rod
11 Lock Nut--Clevis
12 Lever--Throttle Control
13 Bracket--Throttle Control Shaft
14 Quadrant--Throttle Control

Fig. 3 - Diagram of Throttle Control Linkage for Twin Units With Limiting Speed Mechanical Governors

other conditions which may cause unsatisfactory engine operation.

11. Install the valve rocker covers.

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON SIDE-BY-SIDE TWIN OR QUAD UNITS USING VARIABLE SPEED GOVERNORS

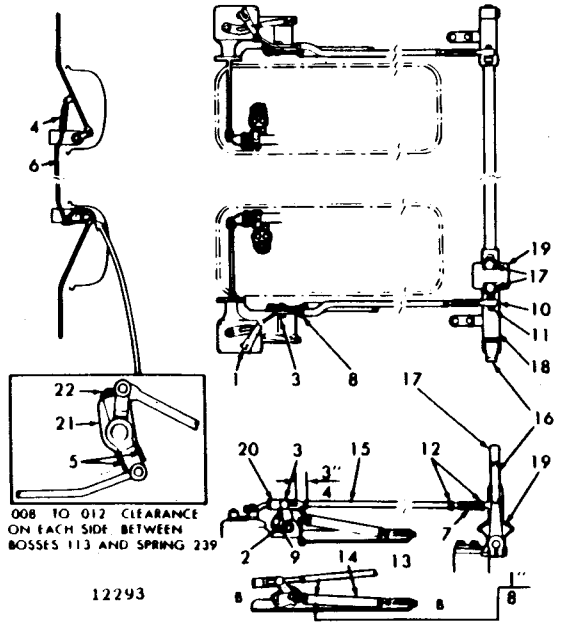
The tune-up of each engine is very important in the adjustment of twin and quad units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (15) from the governor speed control levers (2). On the side-by-side twin units, remove the cross link equalizer spring (21) from the cross link (6), Fig. 1. Loosen the screw (27) and remove the master control equalizer spring (3), Fig. 2, on quad units. Perform a tune-up on each engine before adjusting the throttle control linkage.

Then, with the engines stopped, proceed as follows:

1. Check the control rod end link (20), Fig. 1, on each engine. Make sure the bolt (3) is just touching the end of the link in the idle position.

2. Make sure that each throttle control lever is locked in place on the quadrant by the latch pin.



1 Lever - - Stop	13 Lock Nut--Throttle Booster Spring Adjusting
2 Lever--Speed Control	14 Spring--Throttle Booster
3 Bolt--Lever-to-Link	15 Rod--Throttle Control
4 Turnbuckle--Cross Link Equalizer	16 Lever--Master Throttle Control
5 Boss	17 Lever--Throttle Control
6 Link--Equalizer	18 Bracket--Throttle Control Shaft
7 Turnbuckle	19 Quadrant--Throttle Control
8 Lock Nut	20 Link--Control Rod End
9 Pin--Booster Spring	21 Spring--Link Equalizer
10 Bearing--Rod End	22 Screw--Equalizer Spring
11 Bolt	
12 Lock Nut--Turnbuckle	

Fig. 1 - Diagram of Throttle Control Linkage for Twin Units With Variable Speed Mechanical Governors

3. Move the master throttle control lever (16), Figs. 1 and 2, to the maximum speed position.

4. Make sure the governor speed control lever (2) is in the maximum speed position. The pin in the stop lever (1) must be in contact with the end of the slot in the governor cam (Fig. 1).

5. If the governor speed control lever is not in the maximum speed position, loosen the two lock nuts (12) and adjust the turnbuckles.

6. Tighten the turnbuckle lock nuts and recheck the position of the governor speed control levers.

NOTE: Use care when tightening the lock nuts to prevent misalignment of the rod end bearings (10), Fig. 1.

If it is necessary to adjust the booster spring (14), set the idle speed and proceed as follows:

a. Set the governor booster spring pin (9) 1/8 " below the over-center line B-B (Fig. 1).

b. Disengage the clutches and start each engine.

c. Release each governor speed control lever (1) individually from its maximum speed position and note its return to the idle position. The lever should return quickly.

d. Loosen the throttle booster spring retaining nut on the governor control lever (2). Then loosen the nut and lock nut on the throttle booster spring eyebolt.

e. Move the bolt as necessary in the slot of the lever to allow the speed control lever (2) to move from the maximum speed position to the idle position. Hold the bolt and tighten the spring retaining nut.

f. Turn the nut on the throttle booster spring eyebolt as necessary to allow the speed control lever to be moved to the maximum speed position with the least amount of effort.

7. Reconnect the throttle control rods (15) to the levers.

8. Set the gap between the end of link (20) and governor control lever (2) at 1/16 " to 1/8 " by adjusting the lever on its shaft. While setting the gap, the governor lever must be in the idle position and the forward end of the slot in link (20) must be in contact with the lever-to-link bolt (3).

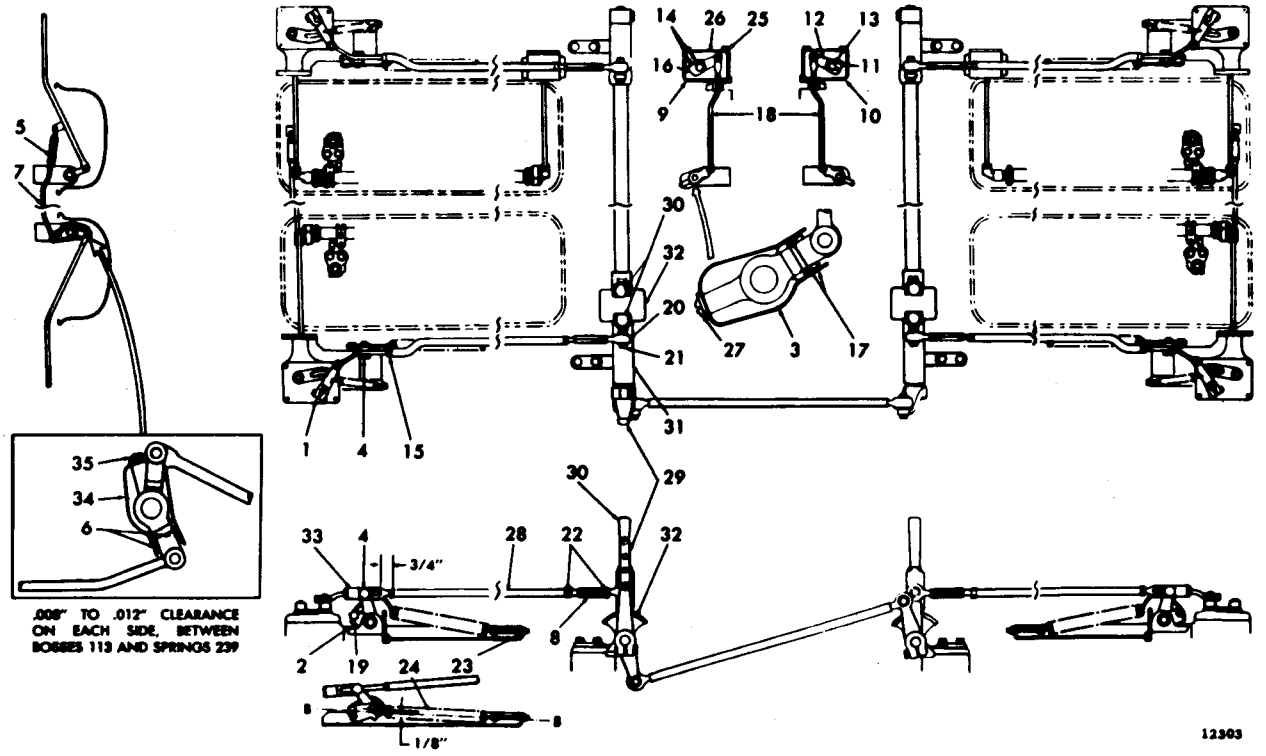
9. Secure the master throttle control lever (16) in the maximum speed position, then replace the link equalizer spring (21) and secure it with the screw (22).

10. Loosen the turnbuckle lock nuts (12).

Adjust the turnbuckle until there is equal clearance between each leg of the link equalizer spring and the lower boss, with approximately .010 " clearance on each side.

11. Tighten the turnbuckle lock nuts and recheck the clearance. Readjust them if necessary.

12. Lubricate the link joints of the equalizer linkage with a few drops of engine oil. Move the master throttle control lever (16) back and forth to check for binding in the equalizer. The equalizer link (6) must not rub inside the tube. Correct any binding that may exist.



1 Lever - - Stop
2 Lever--Speed Control
3 Spring--Master Control Equalizer
4 Bolt--Lever-to-Link
5 Turnbuckle--Cross Link Equalizer
6 Boss
7 Link--Equalizer
8 Turnbuckle
9 Housing--Master Control Equalizer
10 Housing--Master Equalizer
11 Bolt
12 Lever--Master Equalizer
13 Shaft--Equalizer
14 Screw--Adjusting
15 Lock Nut
16 Lever--Master Control Equalizer
17 Boss--Master Control Equalizer
18 Link--Master Control Equalizer
19 Pin--Booster Spring
20 Bearing--Rod End
21 Bolt
22 Lock Nut--Turnbuckle
23 Lock Nut--Booster Spring Adjusting
24 Spring--Throttle Booster
25 Bolt--Equalizer Housing
26 Cover--Equalizer Housing
27 Screw--Master Control Equalizer Spring
28 Rod--Throttle Control
29 Lever--Master Throttle Control
30 Lever--Throttle Control
31 Bracket--Throttle Control Shaft
32 Quadrant--Throttle Control
33 Link--Control Rod End
34 Spring--Link Equalizer
35 Screw--Equalizer Spring

Fig. 2 - Diagram of Throttle Control Linkage for Quad Units with Variable Speed Mechanical Governors

13. Disengage the clutches, then move the master throttle control lever (16) to the idle position and start the engines.

14. After the engines are warmed-up, move the master throttle control lever (16) to the idle position and check the idling speed.

The idling speed of the engines, without the equalizer spring (21), will probably be less than the idling speed of an engine which has the spring due to the expansion of the equalizer link (6). In such cases, remove the valve rocker covers and proceed with Step 15.

15. Loosen the turnbuckle lock nuts (12), and adjust the cross link equalizer turnbuckle (4) until both engines are idling at the same speed. The clearance between each leg of the link equalizer spring (21) and the lower bosses (5) should be equal.

16. Reinstall the valve rocker covers.

17. Start the engines, move the throttle control lever (16) to the maximum speed position and check the maximum no-load speed of each engine. The speed should be the same as previously set. If not, check for binding in the equalizer.

18. With the clutches still disengaged, move the master throttle control lever until the engines are running approximately 200 rpm lower than the maximum no-load speed.

19. With a hand tachometer, check the speed of the engines. They should be running within 25 rpm of each other.

20. If a difference of more than 25 rpm exists, check the tune-up of each engine. Then adjust the master control equalizer between the front and rear engine pairs in the quad unit (Fig. 2).

21. Remove the valve rocker covers.

22. Remove the bolts (25), covers (26) and gaskets from the master equalizer housings (9) and (10).

23. Loosen the bolt (11) until the master equalizer lever (12) swings freely on the equalizer shaft (13).

24. Turn the adjusting screws (14) until they are threaded equally into the master control equalizer lever (16) and are contacting the flats in the equalizer shaft. The adjusting screws should be fairly tight.

25. With each throttle control lever (30) latched to its quadrant (32), move and secure the master throttle control lever (29) in the maximum speed position.

26. Move the master control equalizer link (18) and adjust each leg of the equalizer spring (3) and each master control equalizer boss (17). The clearance should be approximately .010 " on each side.

27. Hold the master control equalizer link in this position and tighten the bolt (1) in the master equalizer lever(12).

28. Recheck the clearance between each leg of the equalizer spring and the lower bosses (17). Readjust them if necessary.

29. Install the valve rocker covers.

30. Place the master throttle control lever (29) in the idle position and start the engines.

31. Place the master throttle control lever as necessary to warm up the engines.

32. Move the master throttle control lever to the maximum speed position and check the maximum no-load speed on each engine.

33. Place the master throttle control lever in the idle position and check the idle speed of each engine.

The maximum no-load speed and the idle speed of each engine should be the same as previously set.

34. If the speeds are not as previously set, it will be necessary to readjust the master equalizer adjusting lever (16) with the adjusting screws (14).

35. After the adjustments have been satisfactorily completed, install the equalizer housing covers (26) and gaskets.

If this procedure does not bring the engines within the correct synchronization, check each engine for poor compression, faulty injectors, low fuel pressure, or other conditions which may cause unsatisfactory engine operation.

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON TANDEM TWIN UNITS

(VARIABLE SPEED MECHANICAL GOVERNORS)

The tandem twin unit throttle and reverse gear control arrangement is shown in Figs. 1 and 3 and the master throttle control and individual throttle lever assemblies are illustrated in Figs. 2 and 4.

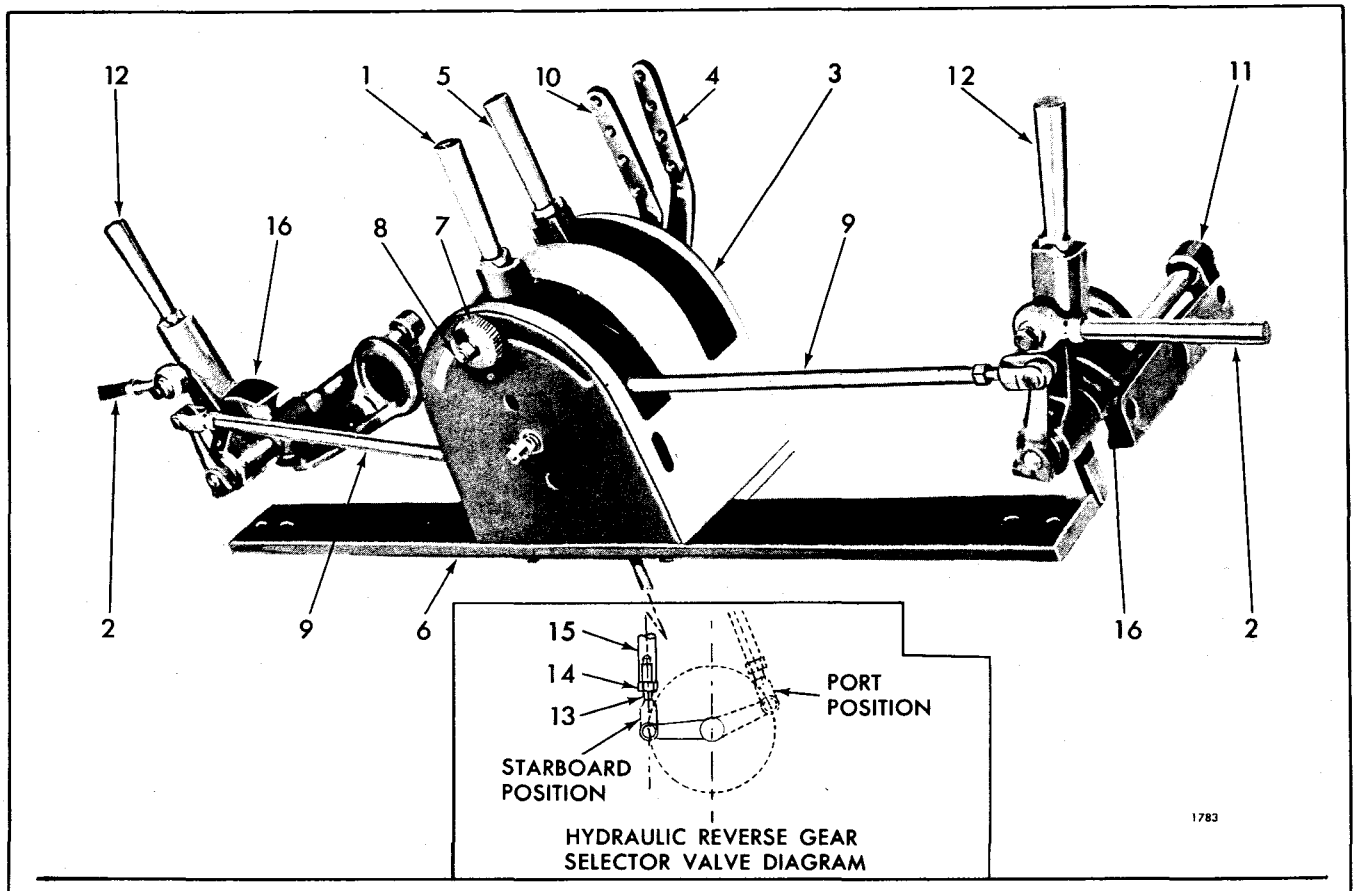
Master throttle levers and master reverse gear control levers are provided in both the engine room and pilot house, thus permitting operation of the propulsion unit at either location through this dual control arrangement.

The tune-up of each engine is very important in the adjustment of the twin units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (17) from the speed control levers (2), Fig. 3, and perform a tune-up on each engine before adjusting the throttle control linkage. Then, with engines stopped, proceed as follows:

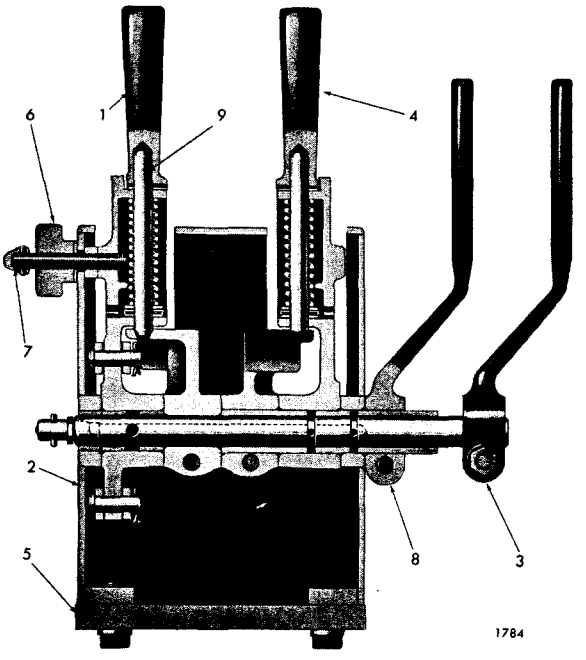
1. Remove any binding or excessive play from the clevis pins.

2. Move the master throttle lever (1) toward the full open position until the two clevis pins in the upper



1. Lever--Master Control Equalizer
2. Rod--Throttle Control
3. Housing--Master Throttle and Control Valve Lever
4. Lever--Master Throttle Remote Control
5. Lever--Master Remote Control Valve
6. Mounting Bracket--Control Housing
7. Nut--Master Hand Throttle Locking
8. Nut--Retaining
9. Rod--Master Throttle Control
10. Lever--Reverse Gear Control Valve (Remote Control)
11. Bracket--Engine Lifting
12. Lever--Throttle Control
13. Clevis--Valve Control Rod End
14. Lock Nut--Valve Control Rod
15. Rod--Valve Control
16. Quadrant--Throttle Control

Fig. 1 · Arrangement of Throttle Levers on a Tandem Twin Marine Unit



1 Lever--Master Control Equalizer
2 Housing--Master Throttle and Control Valve Lever
3 Lever--Master Throttle Remote Control
4 Lever--Master Remote Control Valve
5 Support--Throttle and Control Valve
6 Nut--Master Throttle Control Lever Locking
7 Nut--Retaining
8 Lever--Reverse Gear Control Valve (Remote Control)
9 Latch Pin--Throttle Control Lever

Fig. 2 - Master Throttle Assembly on a Tandem Twin Unit

and lower arms of the throttle lever shank are in a vertical straight line, as observed through the two holes on the side of the lever housing (2). Secure the throttle lever in this position with the knurled lock nut (6), Fig. 2.

3. Disconnect the master throttle control rods (22) from the cross shaft operating levers (25) of the "A" and "C" engines (Fig. 3).

4. Lock the throttle levers (24) to their quadrants (28) in a vertical position.

5. Loosen the clamp bolts on the throttle lever quadrants (28), if necessary, and set the cross shaft operating levers (25) vertically with the holes for the clevis pin on an imaginary line extending through the centers of the cross shafts and rod end bearings and between these centers. Retighten the clamp bolts on the quadrants.

6. Hold the throttle control levers (24) in a vertical position and adjust the master throttle control rods (22) with the clevises so the clevis pins will just slide into position through the holes in the clevises and levers (25). Install the cotter pins.

7. Loosen the knurled locking nut (20) and move the master throttle control lever (11) toward the full open position until the threaded locking stud is within 3/8" to 1/2" from the end of the slot in the housing (18). Then retighten the locking nut.

8. Adjust the length of the throttle control rods (17), with the turnbuckles (6), until the speed control levers (2) are fully open. Tighten the turnbuckle lock nuts.

CAUTION: Use care when tightening the turnbuckle lock nuts to prevent misalignment of the rod end bearings and to avoid damage to the bearing seal.

9. If all of the adjustments are correct, the speed of each engine will be the same when checked individually at maximum speed. Check the maximum speed of each engine as follows:

a. Disconnect the equalizer link at the master equalizer lever(8) on the "A" engine.

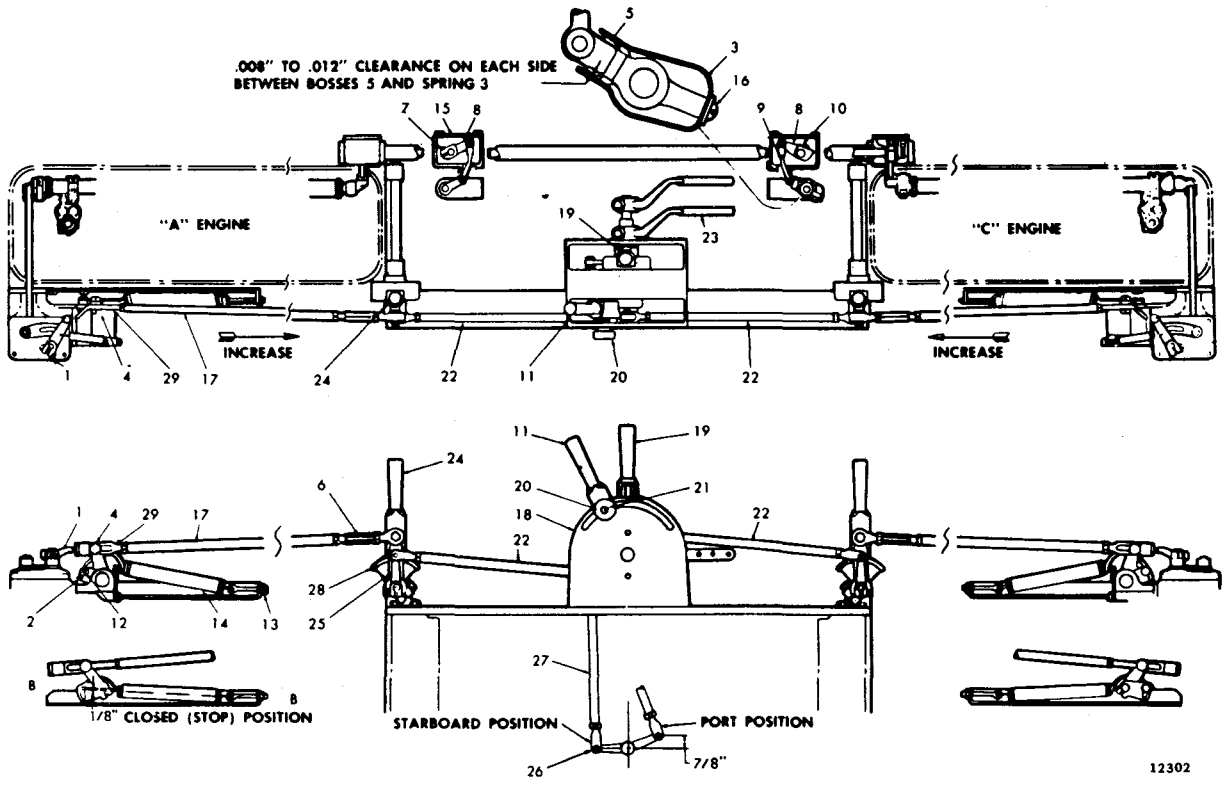
b. Warm up the engines, then run each engine at maximum speed and compare the speeds with the original maximum speed to check the proper length of the throttle control rod (17).

c. If the engine speeds are satisfactory, connect the equalizer link and install the cotter pin; if the speeds are unsatisfactory, readjust the control rods (17) as necessary.

10. With the master remote control valve lever (19) set in a vertical position, check the position of the remote reverse gear control valve lever (23). On a port propulsion unit, the center of the clevis pin hole in the valve lever will lie on a horizontal center line drawn through the center of the valve lever shaft (Fig. 3) and point forward. On a starboard propulsion unit, the clevis pin hole in the selector valve lever will point aft and lie 7/8" above the horizontal center line drawn through the center line of the valve lever shaft.

11. Adjust the equalizer levers so each engine will carry its share of the load as follows:

a. With the engines stopped, the master throttle control lever (11) in the full open position, and the equalizer links connected at the "A" and "C" engines, loosen the bolt (7) in the master equalizer lever (8) on the "A" engine so the lever can turn on the shaft.



1 Lever - - Stop
2 Lever--Speed Control
3 Spring--Equalizer
4 Bolt--Link
5 Boss--Master Equalizer
6 Turnbuckle
7 Bolt
8 Lever--Master Equalizer
9 Shaft--Equalizer
10 Screw--Adjusting
11 Lever--Master Control Equalizer
12 Pin--Booster Spring
13 Lock Nut--Booster Spring Adjusting
14 Spring--Throttle Booster
15 Cover--Equalizer Housing
16 Screw--Master Control Equalizer Spring
17 Rod--Throttle Control
18 Housing--Master Throttle and Control Valve Lever
19 Lever--Master Remote Control Valve
20 Nut--Master Throttle Control Lever Locking
21 Nut--Retaining
22 Rod--Master Throttle Control
23 Lever--Reverse Gear Control Valve (Remote Control)
24 Lever--Throttle Control
25 Lever--Throttle Control Cross Shaft
26 Clevis--Valve Control Rod End
27 Rod--Valve Control
28 Quadrant--Throttle Control
29 Link--Control Rod End

Fig. 3 - Diagram of Throttle Control Linkage for Tandem Twin Marine Unit with Variable Speed Governors

b. Set the two adjusting screws (10) in the master equalizer lever on the "C" engine the same height in the lever so the lever can be readjusted, if necessary.

c. Turn the master equalizer lever on the shaft until the free ends of the equalizer spring (3) are contacting -- without pressure -- the two bosses on the injector control tube lever and are an equal distance from the master equalizer bosses (3) on each side of the equalizer link lever. Maintain the clearance between the lever bosses and spring and tighten the bolt (7) in the master equalizer lever (8).

d. Recheck the clearance between the bosses and spring and if the clearance was changed while tightening the bolt, readjust the screws (10) and change the position of the lever until the clearance between the bosses and the spring is the same on both sides of the equalizer link lever.

e. With the clutches disengaged, place the throttle in the idle position and start the engines.

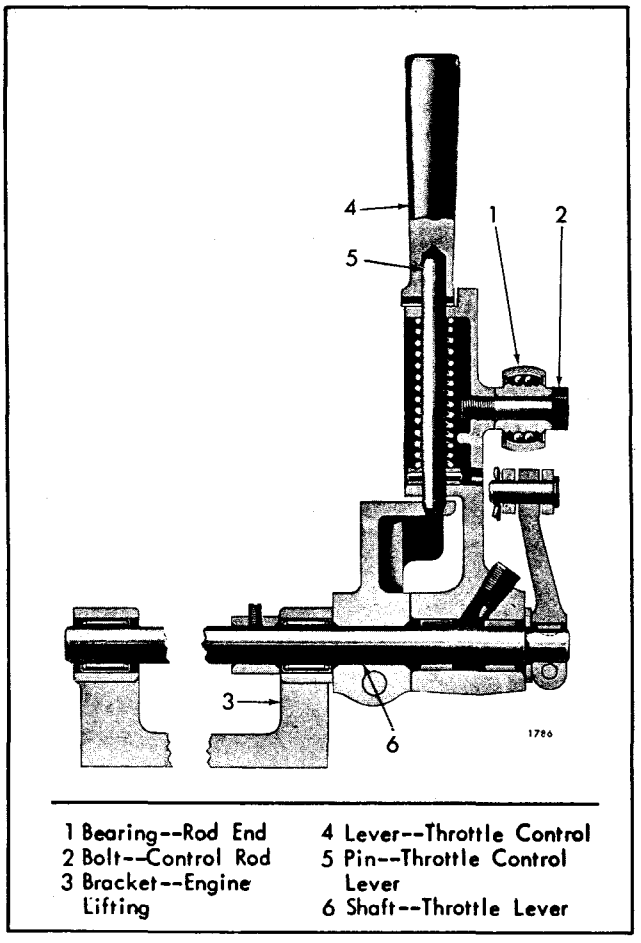


Fig. 4 - Individual Throttle Assembly on a Tandem Twin Unit

f. With the engines warmed up, the clutches still disengaged and the individual throttle levers (24) locked, move the master throttle lever (11) to the full open position and check the speed of each engine with an accurate tachometer. The speed of each engine should now be the same as the no-load top speed previously set on the individual engines.

g. Place the master throttle control lever in the idle position and check the speed of each engine.

If either the idle or maximum speed is not the same as that previously established on the individual engines, readjust the clearance between the master equalizer bosses (5) and the spring (3) as outlined in Steps 11c and 11d.

STORAGE

PREPARING ENGINE FOR STORAGE

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

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

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

TEMPORARY STORAGE (30 days or less)

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

1. Drain the engine crankcase.

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

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

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

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

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

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

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

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

EXTENDED STORAGE (more than 30 days)

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

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

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

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

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

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

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

7. Stop the engine.

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

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

10. Drain the engine fuel tank.

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

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

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

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

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

15. MARINE GEAR

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

b. Start and run the engine at 600 rpm for 10 minutes so that clean oil can coat all of the internal parts of the marine gear. Engage the clutches alternately to circulate clean oil through all of the moving parts.

16. TORQMATIC CONVERTER

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

b. Remove the drain plug and drain the converter.

c. Remove the filter element.

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

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

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

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

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

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

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

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

17. POWER TAKE-OFF

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

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

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

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

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

19. Drain the engine cooling system.

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

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

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

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

24. 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.

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

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

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

1. Reinstall the valve rocker cover.

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

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

4. Remove the rust preventive from the flywheel.

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

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

7. Fill the fuel tank with the 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, add a high boiling point type antifreeze solution to the cooling system (the antifreeze contains a rust inhibitor).

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 CONVERTER

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

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

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

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

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

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

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

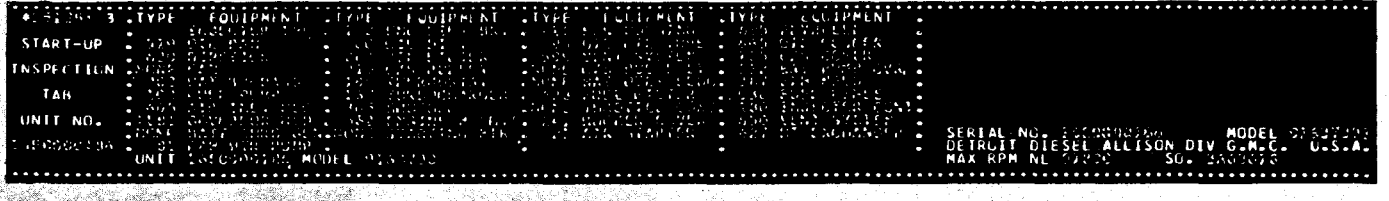
NOTE: Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.

BUILT-IN

PARTS BOOK

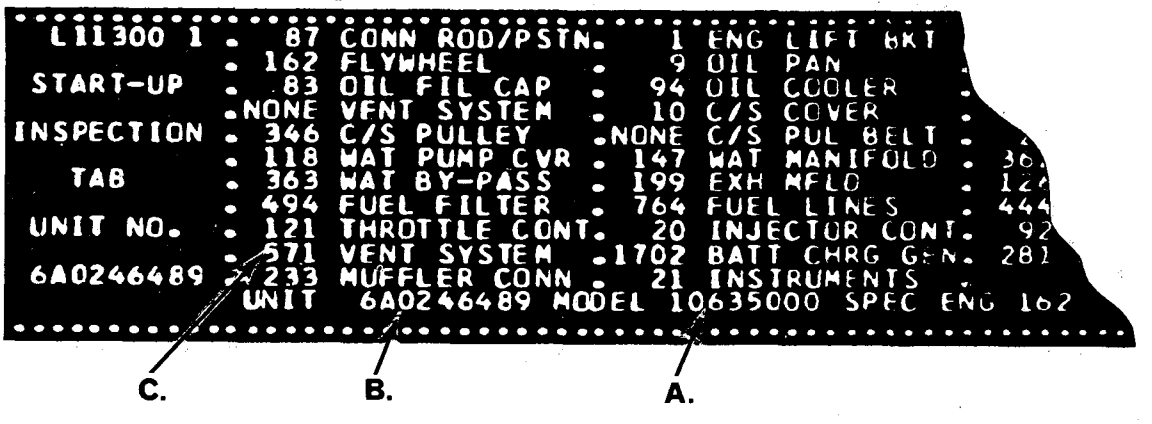
for

DETROIT DIESEL ENGINES



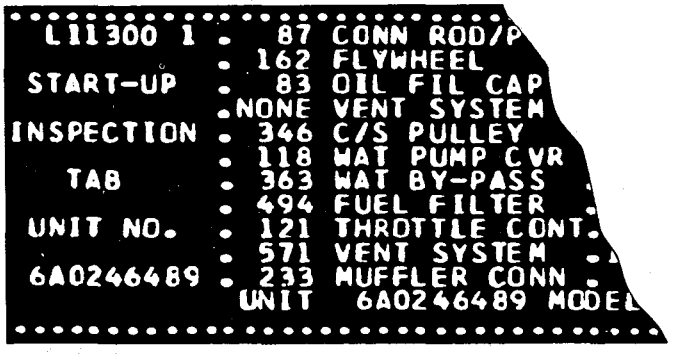
Progress in industry comes at a rapid pace. In order for the engine manufacturer to keep pace with progress he needs a versatile product for the many models and arrangements of accessories and mounting parts needed to suit a variety of equipment. In addition, engine refinements and improvements are constantly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

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

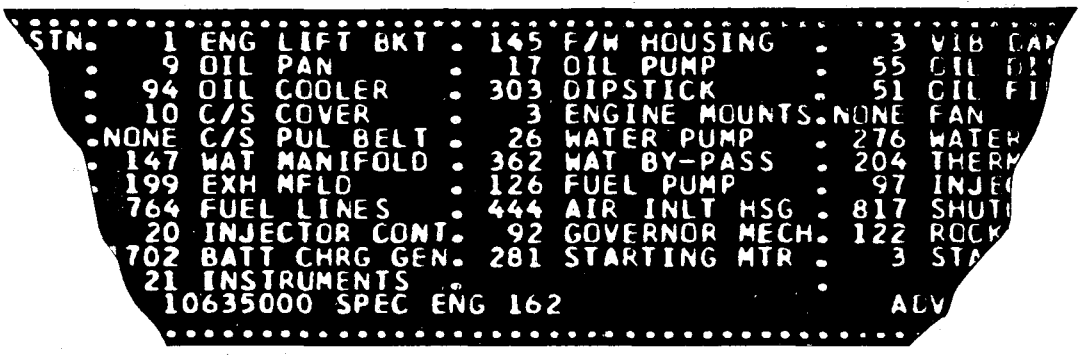


From that much information, the dealer with his complete records on all engine models, can completely interpret your parts requirements.

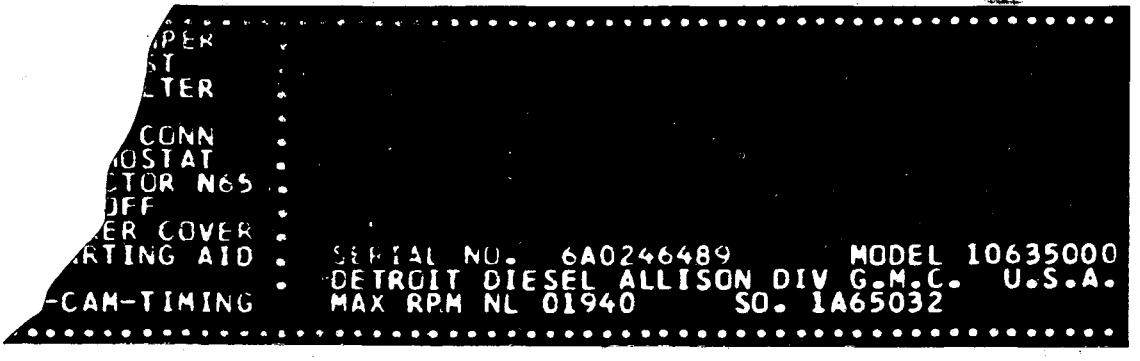
What is this "built-in" book? It is a photo etched aluminum plate that fits into a holding channel on the engine rocker cover.



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



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



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

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

GROUP NOMENCLATURE

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

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

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

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

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

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

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

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

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

10.0000 SHEET METAL
- 10.1000A Engine Hood

11.0000 ENGINE MOUNTING
- 11.1000A Engine Mounting and Base

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

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

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

DETROIT DIESEL 71 MPC 1064-7000 (RD)

STANDARD AND STANDARD OPTION EQUIPMENT

GROUP NAME	GROUP NO.	TYPE
CYLINDER BLOCK	1.1000	4
AIR BOX DRAINS	1.1000A	1
CYLINDER HEAD	1.2000	17
ENGINE LIFTER BRACKET	1.2000A	2
CRANKSHAFT	1.3000	4
CRANKSHAFT FRONT COVER	1.3000A	2
VIBRATION DAMPER REFER TO OPTION PLATE	1.3000B	NONE
CRANKSHAFT PULLEY	1.3000C	177
CRANKSHAFT PULLEY BELT	1.3000D	245
FLYWHEEL	1.4000A	170
FLYWHEEL HOUSING (SAE #1)	1.5000A	23
CONNECTING ROD AND PISTON	1.6000	101
CAMSHAFT AND GEAR TRAIN	1.7000	18
BALANCE WEIGHT COVER	1.7000A	25
VALVE OPERATING MECHANISM	1.8000	21
ROCKER COVER	1.8000A	122
FUEL INJECTOR N60	2.1000A	78
FUEL PUMP	2.2000	76
FUEL PUMP DRAIN	2.2000A	2
FUEL FILTER	2.3000A	273
FUEL MANIFOLD CONNECTIONS	2.4000	52

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

So, from the plate, give the dealer the

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

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