

Section 1.7 DIESEL ENGINE GOVERNORS

Introduction

Unlike automotive engines and many industrial engines, the operating speed of AC generator engines must be held constant. Operation at a constant speed is required to ensure correct AC voltage and frequency output from the generator.

Diesel engines are equipped with a mechanical engine governor which is usually part of the fuel injection pump. The governor must (a) maintain a fairly constant speed when the engine is running at no-load, and (b) must not permit excessive rpm droop when heavy loads are applied.

The following general rules apply to generators that utilize a mechanical engine governor:

- On units rated 60 Hertz, the mechanical governor is generally factory adjusted to maintain a 62 Hertz AC frequency at no-load. When electrical loads equal to the unit's full rated wattage/amperage capacity are applied, engine speed should not droop below about 58 Hertz.

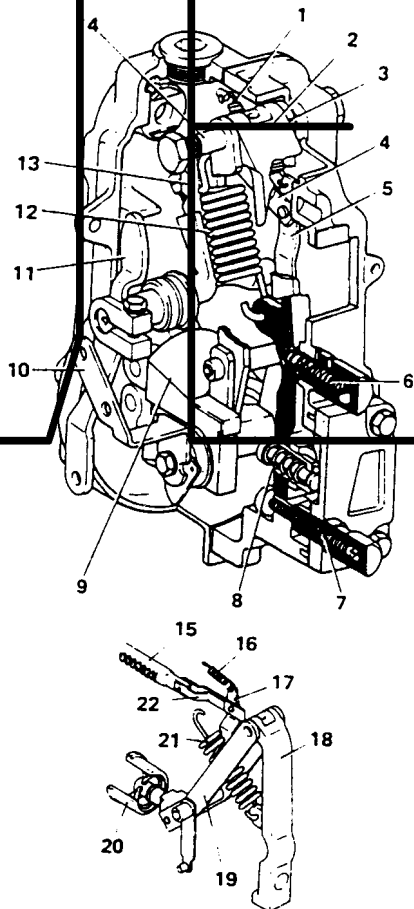
- On units rated 50 Hertz, the governor is factory set to maintain approximately 51 Hertz at no-load. When electrical loads equal to the unit's full rated wattage/amperage capacity are applied, engine speed should not droop below about 49 Hertz.

A Typical Injection Pump Governor

See Figure 1 below. The governor assembly shown is used on Generac's 4.0 liter diesel engine. The Generac 6.4 and 13.3 liter diesel engines are equipped with governors that are very similar. Governor operation is based on spring tension (Item 12 and 21) versus centrifugal force acting on a flyweight (Item 9).

Governor movement acts on a control rod (Item 15) which, in turn, adjusts a control sleeve in the injection pump. Control sleeve movement increases or decreases fuel flow to the fuel injection nozzles and to the engine combustion chambers.

Governor shown is for the 4.0 liter diesel engine. Governors on 6.4 and 13.3 liter engines are similar.



ITEM	NOMENCLATURE
1	Start Spring
2	Tension Lever
3	Guide Lever
4	Shackle Assembly
5	Control Lever
6	Idle Spring
7	Full Load Adjustment
8	Adapter Spring
9	Flyweight Assembly
10	Stop Lever
11	Adjusting Lever
12	Speed Control Spring
13	Swivelling Lever
14	Lever Support Shaft
15	Control Rod
16	Start Spring
17	Control Lever
18	Tension Lever
19	Guide Lever
20	Governor Sleeve
21	Speed Control Spring
22	Shackle

Figure 1. Typical Injection Pump Governor

A Typical Injection Pump Governor (Continued)

Governor action may be briefly described as follows:

- Spring force acts on the control rod (Item 15) which moves axially to impart a radial motion to the control sleeve (Item 20). Fuel flow and engine speed increase.
- As engine speed increases, centrifugal force acts on the flyweight assembly (Item 9) tending to move the flyweights outward in opposition to spring force.
- When centrifugal force acting on the flyweights is sufficient to overcome spring force, the control rod is moved in the opposite direction. Fuel flow and engine speed will then decrease.
- As engine speed decreases a point is reached where spring force is greater than centrifugal force. The control rod will then move to increase fuel flow and engine speed.
- The governing action is a series of very small cyclic increases and decreases in engine speed as the system attempts to reach a point where centrifugal and spring force are balanced.

From the above, it is apparent that governed speed can be established by adjusting the tension of the spring (Item 12). Some other adjustment parameters are also provided.

Adjustments Familiarization

See Figure 2. A typical diesel governor provides the following adjustments:

1. Full load adjust screw.
2. Stop adjust screw.
3. Maximum speed screw.
4. Governor adjust screw.
5. Idling subspring.
6. Stop lever.

FULL LOAD ADJUST SCREW:

Use the full load adjust screw (Item 1) to eliminate excessive rpm and frequency droop when electrical loads are applied to the generator. If generator AC frequency drops too low when the unit's rated maximum load is applied, remove the cap and turn the adjust screw in (clockwise) to increase control rod travel. The following apply:

1. With unit running at its correct no-load frequency, apply electrical load to the unit's rated capacity.
2. With the load applied, turn the adjust screw in (clockwise) to increase frequency. Then, turn the adjust screw out (counterclockwise) until frequency starts to drop off. Finally, turn the adjust screw in (clockwise) to recover frequency. Full-load frequency should be 59-60 Hz (never below 58 Hz).

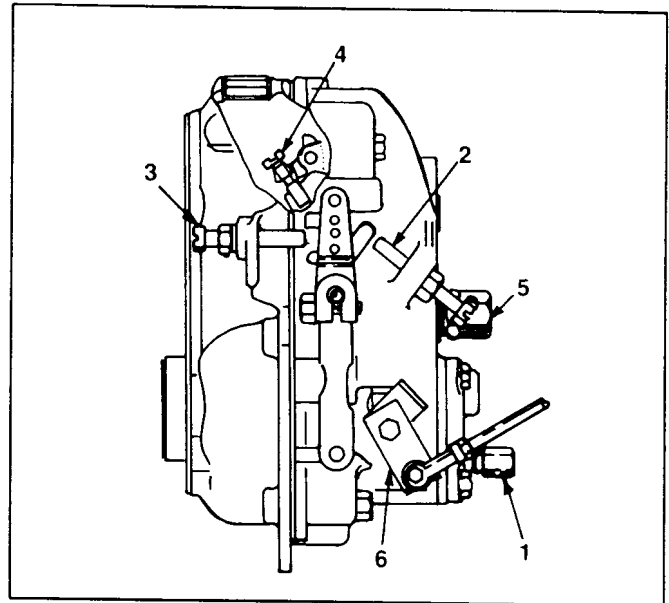


Figure 2. Adjustments on a Typical Governor

STOP ADJUST SCREW:

Use this adjust screw to establish a governed no-load speed equal to the rated no-load speed and AC frequency of the unit. Other times the stop adjust screw will be turned are:

- Prior to adjusting the governor adjust screw (Item 4).
- When setting the speed/frequency at which overspeed shutdown will occur.

MAXIMUM SPEED SCREW:

Adjustment of the maximum speed screw (Item 3) should not be required. One exception to this rule is when the screw must be backed out during adjustment of overspeed shutdown.

GOVERNOR ADJUST SCREW:

Adjustment of this adjust screw (Item 4) is normally required only on new replacement fuel injection pumps.

Adjust the screw with the engine shut down, as follows:

1. Remove plug at top of governor housing.
2. Back the full load adjust screw (Item 1) all the way out (counterclockwise).
3. Move the stop lever (Item 6) to the right (shutdown position) to allow adjustment of the governor adjust screw. Turn the governor adjust screw in (clockwise) for better and more stable governing.

NOTE: On the Generac 4.0 liter diesel engine, it will be necessary to remove the engine intake adapter to gain access to the governor adjust screw.

Adjustments Familiarization (Continued)

NOTE: The GOVERNOR ADJUST SCREW (Item 4) is adjusted by counting the number of "clicks" as the screw is turned. There is no hard and fast rule as to the number of clicks that will provide optimum, stable governing. After adjustment, start the engine and let it run at the unit's rated no-load speed. If governing is unstable, shut engine down and adjust the governor adjust screw (Item 4) in (clockwise) one or two clicks. Restart the engine, let it run at rated speed and check again for unstable governing. If governing is unstable, shut down and adjust screw in (clockwise) one or two more clicks. Continue this process until stable governing is obtained. If governing is stable at no-load, but instability occurs when partial load is applied, turn the screw out (counterclockwise) to eliminate the problem.

IDLING SUBSPRING:

Idle speed is increased by turning the idling sub-spring screw (Item 5) in (clockwise). Adjustment of the screw should never be required in the field. If the screw is turned in (clockwise) too far, maximum governed rpm will be changed.

STOP LEVER:

An electrically actuated fuel solenoid (FS) is connected to the stop lever (Item 6). When the stop lever is moved to its right, fuel flow is terminated and shut-down will occur.

Proper adjustment of the fuel solenoid linkage to the stop lever is critical since positive fuel shutoff must occur when the electrical solenoid is de-energized. Conversely, when the fuel solenoid energizes, fuel flow must be positively turned on.

Governor Adjustment

GENERAL:

The following covers governor adjustment procedures for 4.0, 6.4 and 13.3 liter diesel engines. All of the procedures may or may not be required when adjusting the governor.

BLEEDING THE FUEL SYSTEM:

If engine fuel system parts have been removed and replaced, or removed and reinstalled, bleeding of air from the system may be required. Air in the fuel system will result in hard starting and rough, unstable operation.

GOVERNOR ADJUSTMENT PROCEDURES:

1. Start the engine, let it warm up for a few minutes at no-load.
2. See Figure 2. With engine running at no-load, turn the STOP ADJUST SCREW (Item 2) to obtain correct no-load AC frequency (62 Hz on units rated 60 Hz).

IF ENGINE SPEED IS ERRATIC OR HUNTING OCCURS, GO TO STEP 3; IF NOT ERRATIC, STEP 4.

3. If hunting or erratic operation occur at no-load governed speed, adjust the GOVERNOR ADJUST SCREW (Item 4) as follows:

- a. Stop the engine.
- b. Turn the STOP ADJUST SCREW (Item 2) all the way out.
- c. At top of governor housing, remove the plug to gain access to the GOVERNOR ADJUST SCREW (Item 4).

NOTE: On the Generac 4.0 liter engine, removal of the engine air intake adapter may be required to allow room for adjustment.

- d. Hold the STOP LEVER (Item 6) all the way to its right. Then, insert a screwdriver into the access hole and turn the GOVERNOR ADJUST SCREW (Item 4) in about four (4) clicks.
- e. Install and tighten the plug into the access hole.
- f. Turn the STOP ADJUST SCREW (Item 2) back to its original setting.
- g. Restart the engine and let it warm up. If hunting or erratic operation is still present, repeat Steps 4(a) through 4(f). Then, restart engine and check for hunting and erratic operation at no-load.

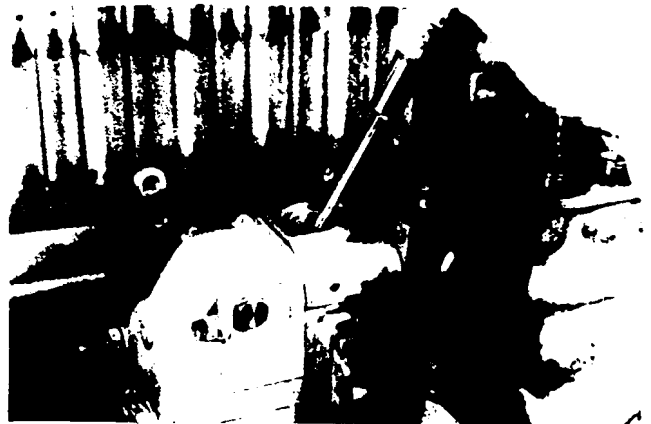


Figure 3. Adjustment of Governor Adjust Screw

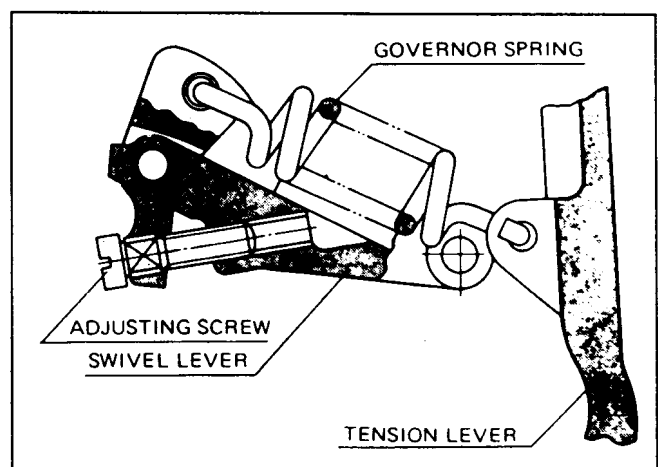


Figure 4. The Governor Adjust Screw

Governor Adjustment (Continued)

- h. Repeat Steps 3(a) through 3(h) until no further hunting or erratic operation is noted. Then, readjust the STOP ADJUST SCREW (Item 2) to correct no-load AC frequency and go on to Step 4.
4. With engine running at correct rated no-load speed (frequency), apply a light electrical load in increments. Start at about 10% of rated wattage/amperage capacity. Then, increase to 20%, 30%, 40% and 50% of rated load, one increment at a time. If hunting or erratic operation occurs under light electrical loading, it will be necessary to readjust the GOVERNOR ADJUST SCREW (Item 4) as follows:
- Shut the engine down.
 - Turn the STOP ADJUST SCREW (Item 2) all the way out.
 - Remove the plug at top of governor housing to gain access to the GOVERNOR ADJUST SCREW (Item 4).
 - Hold the STOP LEVER (Item 6) all the way to its right. Then, turn the GOVERNOR ADJUST SCREW (Item 4) out one (1) click.
 - Install and tighten plug into access hole.
 - Turn the STOP ADJUST SCREW (Item 2) back to its original setting.
 - Restart the engine, let it run at no-load.
 - If necessary, reset the STOP ADJUST SCREW (Item 2) to obtain correct governed no-load speed.
 - Apply light electrical loads in increments as stated in Step 4 above. If hunting or erratic operation still occur under light loading, repeat Steps 4(a) through 4(f).
 - Continue the above process until no further hunting or erratic operation is noted under light electrical loading.
5. With engine running at correct rated no-load frequency, apply electrical loads equal to 100% of the unit's rated wattage/amperage capacity.
- With unit running at full rated load, check the AC frequency reading. Reading should not be less than about 59-60 Hertz.
 - If reading is about 59-60 Hertz at full rated load, no further adjustment is required.
 - If the reading is less than 58 Hertz at full rated load, go on to Step 6.
6. If AC frequency at full rated load is low, adjust the FULL LOAD ADJUST SCREW (Item 1) as follows:
- Remove the cap from the ADJUST SCREW.
 - With engine running and full rated load applied, turn the FULL LOAD ADJUST SCREW (Item 1) in (clockwise) until speed increases as close to 60 Hertz as possible. Then, back the SCREW out until frequency starts to drop off. Finally, turn the SCREW (Item 1) back in until frequency recovers.
 - When the engine is running at its best frequency under full rated load, install the cap over the FULL LOAD ADJUST SCREW.

NOTE: The frequency obtained at full rated load should be as close as possible to the unit's rated frequency (50 or 60 Hertz). However, the maximum frequency obtainable will depend on the specific engine. It is desirable to operate as close as possible to rated frequency (50 or 60 Hertz). Frequency under full rated load should not be less than 58 Hertz (units rated 60 Hertz) or 49 Hertz (units rated 50 Hertz).