SECTION XII

PILOT VALVE, PILOT VALVE LINKAGE, SETTING INJECTOR RACK AND LINKAGE

A. DESCRIPTION

1. Pilot Valve

The pilot valve is a device for controlling the flow of oil to the vane motor of the load regulator.

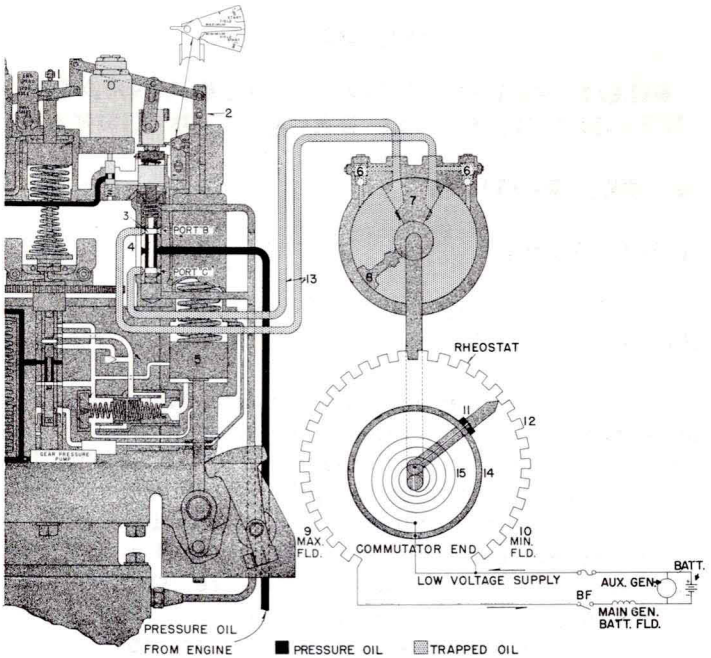
Electro-hydraulic and pneumatic-hydraulic governors have the pilot valve embodied in the governor housing as shown in partial governor section, Fig. 12-1. The normal operation of the pilot valve depends on the action of the governor. If fuel supply is correct for engine speed, the pilot valve is balanced and prevents oil flow to the load regulator. If there is an unbalance in fuel supply and speed setting, the pilot valve permits oil flow to the load regulator so a generator load correction may be made to resume speed and fuel balance. However, when the ORS solenoid is energized the pilot valve is raised, making the load regulator move to minimum field position.

2. Pilot Valve Linkage

The pilot valve linkage is the same on the electro-hydraulic and pneumatic-hydraulic governors. It consists of a horizontal floating link, Fig. 12-4, vertical slide link, eccentric adjustment, clevis and holding screw, which connects the pilot valve plunger to the floating link.

3. Injector Linkage

The injector linkage, Fig. 12-2, consists of the mechanical arrangement which permits all injector racks



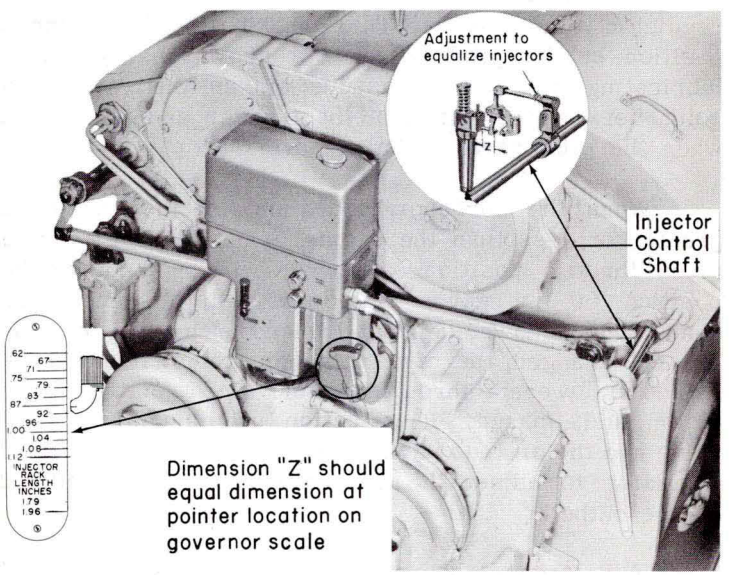
LEGEND

1. Speeder Spring Piston Extension
2. Power Piston Tailrod
3. Pilot Valve Plunger
4. Pilot Valve Bushing
5. Power Piston
6. Internal Check Valve
7. Vane Stop
8. Vane
9. 8 O'clock Position
10. 4 O'clock Position
11. Brushholder And Arm
12. Load Regulator Resistance
13. Oil Lines
14. Slip Ring
15. Spring Shunt

"O" Overriding Solenoid

Fig. 12-1 - Schematic Load Regulator and Pilot Valve Arrangement

to be positioned simultaneously by the governor fuel control lever. Parts of this linkage are: two injector control rods, one of which is adjustable and connecting fuel lever on governor to the injector control shafts. The injector control shafts, one for each bank, extend the length of the cylinder bank under the cylinder head cover frame. At each cylinder location a lever is pinned to the control shaft. A micrometer adjustable link connects the control shaft lever to a bracketed lever mounted on each cylinder head, one end of which saddles the ball at the end of the injector rack. As the governor fuel lever is moved, each injector rack is also moved proportionally.



Injector Linkage
Fig. 12-2

B. OPERATION

1. Pilot Valve

The pilot valve in conjunction with the load regulator requires each cylinder to assume a predetermined load for each throttle position, within the limits of the load regulator range of action, by controlling the loading of the main generator through the battery field.

Fig. 12-1 shows a partial governor section through the pilot valve and associated parts. When engine output is correct for a certain throttle position, the lands of the pilot valve plunger close ports "B" and "C" in the pilot valve bushing. In this position of the plunger no oil can flow through the ports to or from the load regulator vane motor. This position is the balanced position of the pilot valve. As shown in Fig. 12-1, lubricating oil under pressure enters the valve at a point between the lands of the plunger and is trapped when the pilot valve is balanced.

When the horsepower demand on the engine is greater or less than the engine is set to develop at a given throttle position, a change will be made in the position of the governor power piston to meet the changed horsepower demand. Since the throttle position has not changed, the pilot valve plunger will either be raised or lowered, through the movement of the power piston and linkage. This action unbalances the pilot valve and the oil thus permitted to flow causes the load regulator to adjust the generator load to the desired engine output.

If the engine is overloaded, the power piston will move upward to increase fuel. This action raises the pilot valve plunger, opening port "B" with its upper land. Oil under pressure can then flow through port "B" to the vane motor of the load regulator. This causes the load regulator movement to reduce main

generator output by increasing the electrical resistance of the battery field circuit. As the vane rotates it pushes oil ahead of it through the oil line port "C" of the pilot valve and thence to the engine oil sump. As the load on the engine is reduced, the power piston and pilot valve plunger move downward to normal position. The pilot valve plunger again closes both ports "B" and "C."

The operation of the pilot valve for an underload on the engine is opposite that given for an overload, again adjusting generator load to permit the engine to assume its proper load for a certain throttle position, within the range of action of the load regulator.

The movement or timing of the vane or brushholder of the load regulator is automatically controlled by orifices and slots in port "C," or lower port of the pilot valve bushings, as oil from the regulator must return through port "C" when oil to regulator leaves through port "B" or when oil to regulator passes through port "C." The slot and orifices in the pilot valve bushing lower port are designed to provide for a definite load regulator movement or timing. (See Table A, Section XI for the timing of the currently used pilot valve bushings.)

The pilot valve may be set either for maximum or minimum field starting. In maximum field, port "C" is open to operating pressure when starting; in minimum field, port "B" is open to oil pressure when starting. An additional setting is used on all current locomotives, known as modified maximum field start. With modified maximum field start, the pilot valve is set for maximum field, but through the action of the over-riding solenoid when energized, the pilot valve is positioned in minimum field position. Immediately after de-energizing of the over-riding solenoid, the pilot valve assumes the position as originally set, maximum field. See "Over-Riding Solenoid," Section XI. Provision is also made to allow oil to circulate through the system with the

engine in idle. This keeps warm oil in the system, improving the operation of the mechanism.

With the pilot valve set for minimum field position an unbalanced condition exists for the first several throttle positions, until the greater proportional movement of the speeder spring piston to the power piston allows the pilot valve plunger to assume balanced position. With maximum field start, the greater movement of the power piston in the first throttle position will lift the plunger to the balanced position.

C. MAINTENANCE

1. Setting Injector Rack

Before attempting to set injector racks, all racks and linkage should be checked for binding, sticking or wear which would affect operation of the parts.

To test injector racks of both banks, operate the injector control shaft hand lever. To check each bank separately, remove clevis pins from end of injector control rod ends. Each bank control shaft may then be checked. If required, each individual injector rack may be isolated from its control shaft for checking. (See Section X for remedy for sticking injectors.) Properly reassemble after checking.

The injector racks on the 567C engine are set as follows:

a. Injector racks on 567C engines should be set at a rack length of 1.00" with the governor pointer opposite the 1.00" mark on the governor terminal shaft scale.

b. Using governor tailrod jack, Fig. 12-4, raise tailrod until the 1.00" mark on scale is opposite the pointer on the governor. Do not force tailrod excessively as it may be broken in tension.

c. Rack setting gauge 8244899 is used to set the injector fuel rack. (This gauge replaces prior used injector rack setting gauge 8195904.)

Gauge 8244899 is made up of a body, indicator plate, multiplying lever-pointer and handle. Application of the gauge is shown in Fig. 12-3. In use, the injector fuel rack enters the gauge body and contacts the lever-pointer end, while the gauge is held against the injector. The injector link adjusting nut, Fig. 12-3, is turned to move the injector rack and position the gauge pointer at the center mark, which indicates that the injector rack is out of the injector one inch (1"). Calibration block 8244900 is inserted fully into the gauge body in place of the injector rack to check pointer accuracy. Pointer position is correct if at the center mark with the calibration block in place in the gauge.

d. Using two 7/8" open end wrenches, hold the injector micrometer adjusting nut and loosen the locknut, Fig. 12-3.

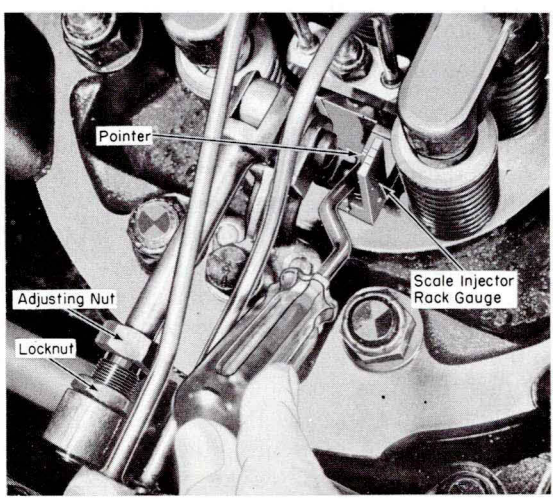
Place the injector rack setting gauge 8244899 over the injector rack and hold the gauge firmly against the injector body and check gauge pointer position. If pointer is on "L" side of gauge, the rack is out too far. Move micrometer adjusting nut to place pointer on the "S" side of scale, then bring rack out so pointer mark and scale mark line up at the center position. Hold this position and tighten the micrometer adjustment locknut. By bringing the pointer to the "S" side of scale, then lining up pointer, when adjusting all racks, will assure the rack backlash is taken up in the same direction. Set and check all injectors using this procedure.

NOTE: In the event injector rack setting gauge 8244899 is not available, the injector racks may be set by positioning governor pointer opposite 1.00" mark on terminal shaft scale and adjusting the injector rack so that 1.00" scribe mark on the rack is just visible, or rack gauge 8107751 if available may be used.

Replaced gauge 8195904 also had its pointer checked using a 1" gauge block and its pointer reset if required. However, this gauge is held to the injector by a magnet. Rack length was set by moving the fuel rack until gauge pointer was at the center mark of this gauge.

2. Setting Pilot Valve Linkage

Before setting the pilot valve, the injector linkage, injector racks and engine speeds should be properly



Injector Rack Gauge Application
Fig. 12-3

set. The governor engine speed scale must agree with the engine speed at idle and full speed positions or be re-set or re-marked to agree. If any change is made in the engine speed setting at anytime, the pilot valve should be checked for correct setting.

Also, the pilot valve scale should be checked that balance position agrees with actual pilot valve balance. Release the end of the floating link, and with the engine running, raise the floating link to position the pilot valve plunger so load regulator brush arm does not move when it is between maximum and minimum field positions. In this position of the pilot valve plunger, the pilot valve scale should indicate "0" or balance position. If the scale does not correspond with actual balance, the scale must be relocated or re-marked or pilot valve disc re-located to be correct.

Once the pilot valve is properly set, it should not be changed to correct engine output until all other conditions are investigated. A partial list of probable causes of low output are:

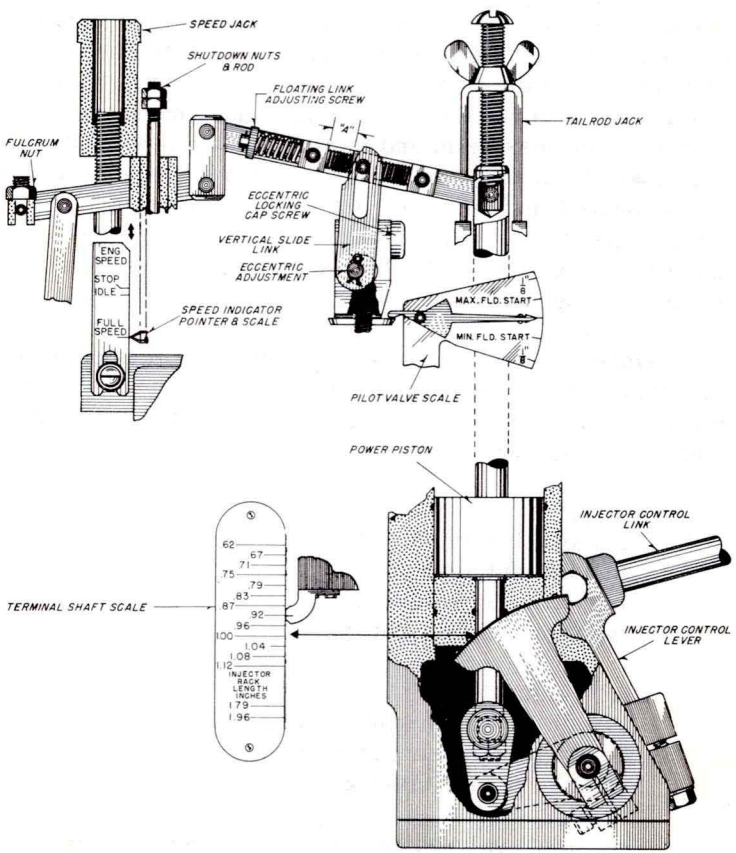
Engine:
- Inoperative injectors
- Insufficient fuel
- Incorrect injector timing
- Incorrect speed setting

Electrical:
- Power contactors not energized
- Broken or loose connections
- Interlocks not making contact

The pilot valve linkage is the same on electro-hydraulic and pneumatic-hydraulic governors. It consists of a horizontal adjustable floating link and a vertical slide with an eccentric for adjustment as shown in Fig. 12-4. Changing the location of the movable block (dimension "A") varies the total travel of the pilot valve

plunger, while changing the eccentric raises or lowers the plunger.

The pilot valve is set by making the following adjustments with the engine shut down:



Schematic Pilot Valve Linkage
567C Engine Governor
Fig. 12-4

a1. Check terminal shaft scale, with engine dead and governor power piston all the way down, that pointer indicates 1.96.

a2. Set dimension "A" of the floating link, Fig. 12-4, for the specific engine speed and full load injector rack length as given in Table "A" for the engine being set. Dimension "A" is approximately 45/64" for maximum field start for a 16-567C engine having .96 full load injector rack length and full speed of 835 RPM.

NOTE: Maximum field start setting (modified maximum field start with ORS energized or other) is standard on all locomotives; except Models E3, 6, 7, FT and F2.

b1. Position terminal shaft scale, using tailrod jack, until pointer is opposite full load rack length of engine being set.

b2. Using governor speed jack, position pointer on speed scale to full engine speed.

TABLE "A"

Full Load Injector Rack Setting	Full Engine Speed RPM	Type Of Start	Pilot Valve Idle Unbalance Direction	Amount	Dimension "A" (Approx.)
.83	800	Max. Fld.	Below	.040"	31/64"
*.83	800	Min. Fld.	Above	.040"	17/64"
.87	800	Max. Fld.	Below	.040"	17/32"
*.87	800	Min. Fld.	Above	.040"	5/16"
.87	835	Max. Fld.	Below	.040"	9/16"
.92	835	Max. Fld.	Below	.040"	21/32"
.96	835	Max. Fld.	Below	.040"	45/64"
1.00	800	Max. Fld.	Below	.040"	47/64"
*1.00	800	Min. Fld.	Above	.040"	15/32"
1.00	835	Max. Fld.	Below	.040"	49/64"
1.04	835	Max. Fld	Below	.040"	13/16"

*Comparable full load injector rack lengths of 567C engines replacing other 567 series engines operating at 800 RPM, using injector 5227852 are as follows:

.83 full load injector rack length = 5/16" power piston gap
.87 full load injector rack length = 11/32" power piston gap
1.00 full load injector rack length = 7/16" power piston gap

b3. Pointer on pilot valve scale must show balance with b1 and b2 settings. If not, loosen eccentric lock screw and adjust eccentric to bring pilot valve plunger scale pointer to "0" balance position and re-lock. (The pilot valve must be positioned at "0" or balance at full load and speed on all engines.)

c1. Position governor speed scale pointer to idle speed, and terminal shaft pointer opposite 1.79. Pilot valve scale pointer should indicate maximum field start (or minimum field) depending on the dimension "A" setting; maximum field start with dimension given under a2.

NOTE: Some early governors have 1.70 mark on the terminal shaft scale, which should be re-marked 1.79. Mark location is correct.

c2. If pilot valve scale pointer is "below" the "maximum or minimum" field mark, dimension "A" should be lengthened; if "above" the respective mark, dimension "A" should be shortened. On this correction adjust dimension "A" one half (1/2) required, then return to full speed and full load rack length and adjust pilot valve pointer to "0" or balance position with eccentric (b1, 2 and 3 adjustments).

Recheck settings at idle engine speed and 1.79 rack length and if further adjustment is required, repeat above procedure until pilot valve scale pointer indicates correctly at idle speed and 1.79 settings and "0" or balance at full speed and full load injector rack length.