ANNEX B

WOODWARD UG8 GOVERNOR

INTRODUCTION

1. The UG8 is a mechanical-hydraulic governor for mechanical linking to fuel racks.

2. The maximum work output of the UG8 is 8 ft-lbs. over the full 42° travel of its output (terminal) shaft. The recommended travel of the output shaft is 28° which provides a useful work output of 5-3 ft-lbs.

3. Normally, the UG8 operates isochronously (constant speed) regardless of load on the engine, except during transient load conditions.

REGULATOR

4. The regulator comprises the following sub-assemblies and systems:

a. Oil pump

b. Accumulator.

c. Power piston.

d. Pilot valve system.

e. Ballhead system.

f. Compensation system.

g. Load limit control.

h. Synchronizer.

j. Speed droop.

OIL PUMP

5. The oil pump system is housed in the bottom of the controller. The controller is mounted directly to the base. The oil pump system consists of two gears and four check valves. One gear is part of the laminated drive. The rotating bushing is driven by the governor drive shaft which is driven by the engine. As the bushing rotates it rotates the laminated drive. The oil pump gears can be driven either clockwise or counter-clockwise. Oil flow is directed through the check valve system into the accumulator system.

ACCUMULATOR

6. The accumulator is also housed (two cylinders) in the controller. The accumulator consists of two spring loaded pistons. Oil is pumped into the cylinders and increased to 120 psi by the accumulator springs. If the oil pressure exceeds 120 psi, oil is released back to sump through a relief port in each cylinder. Oil flows from the accumulator through passages to the top of the power piston and to the pilot valve system.

POWER PISTON

7. The power piston (servo) is also housed in the controller. It is a differential type with oil pressure on both the top and bottom of the piston. The upper end of the power piston is connected to the terminal output) shaft through a power lever and link assembly. The bottom of the power piston has larger area than the top of the piston. Therefore less oil pressure is required on the bottom than on the top when the piston is stationary. If the oil pressure is the same on both the top and bottom of the piston, the piston is moved upward to rotate the terminal shaft in the increase fuel direction. The piston moves downward only when oil under the piston is released to sump. Oil to or from the bottom of the power piston is regulated by the pilot valve system.

PILOT VALVE SYSTEM

8. The pilot valve system is housed in the controller. It consists of the rotating bushing (mentioned previously), and the pilot valve plunger. The bushing IS rotated by the drive shaft and through this rotation, friction between the pilot valve plunger and bushing is reduced. The pilot valve plunger (PVP) has a control land that regulates oil flow through ports in the bushing. When the PVP is lowered high pressure oi1 flows to the bottom of the piston, raising the power piston. When the PVP is raised oi1 is released to sump from under the power piston. The higher pressure on the top of the piston forces the piston downward. When the PVP is in its centered position the control land covers the control port as shown in the schematic, Figure 6–B–1, and there is no movement of the power piston. The PVP movement is controlled by ballhead.

BALLHEAD SYSTEM

9. The ballhead system consists of a ballhead, flyweights, speeder spring, thrust bearing, speeder plug, and speeder rod. The ballhead is geared and is driven by the laminated drive. The flyweights are attached to the ballhead with pivot pins. A thrust bearing rides on the toes of the flyweights. The speeder spring is held in position on the thrust bearing by the speeder plug. As the ballhead rotates the flyweights pivot outward due to the centrifugal force. At the same time the speeder spring is forcing the thrust bearing downward on the flyweight toes. The downward force opposes the centrifugal force of the flyweights. Increasing the drive speed Increases the centrifugal force. Compressing the speeder spring with the speeder plug increases the downward force and in turn increases the governor speed setting. The engine must run faster to produce a higher centrifugal force to overcome the speeder spring force and rebalance the system. Speeder spring force or speed setting is controlled manually through the synchronizer (speed) adjusting knob. The governor is equipped with a speed adjusting motor so the speed setting may be controlled remotely.

COMPENSATION SYSTEM

10. Two pistons, an actuating and a receiving piston, along with a needle valve make up the compensation system. The actuating piston is linked to the terminal shaft by a compensation adjusting lever. Changing the fulcrum position allows the adjusting lever to control the amount of stroke available for the actuating compensating piston. The receiving piston is connected through a floating lever to the pilot valve plunger and the speeder rod. The needle valve controls the f low of oi1 between the oi1 sump and the actuating piston and receiving piston. Moving the actuating piston downward forces oil under the receiving piston. As the receiving piston is forced upward it lifts the PVP to close of the control port which stops the flow of oil to the bottom of the power piston.

LOAD LIMIT CONTROL

Do not manually force linkage to increase fuel without first turning the load limit control knob to maximum position (10).

11. The load limit control consists of an indicator disc geared to a load limit rack. The control knob is also attached to the load limit cam. Load is limited mechanically by positioning the load limit knob. When the load indicator reaches the preset point the PVP is lifted stopping any further increase of fuel. Engine shutdown is possible by turning the load limit control to zero. This turns the cam, forcing the load limit lever and shutdown strap downward. As the right end of the load limit shutdown lever is forced downward it pivots about its fulcrum and lifts the pilot valve plunger releasing oil from under the power servo.

SYNCHRONIZER

12. The synchronizer is the speed adjusting control and is used to change engine speed for a single unit. On engines paralleled with other units it is used to change engine load The upper knob, “SYNCHRONIZER”, is the control knob while the lower knob, “SYN. INDICATOR”, indicates the number of revolutions of the synchronizer control knob.

SPEED DROOP

13. Speed droop consists of a control knob, cam, and linkage which when preset, varies the compression of the speeder spring as the terminal shaft rotates. Increasing the fuel reduces speeder spring compression and in turn the governor setting. The unit gradually reduces its speed as load is applied and acts as a resistance to load changes when the unit is interconnected with other units either mechanically or electrically. Setting the speed droop control automatically divides and balances load between engines that are paralleled in an electrical system. Reducing droop to zero allows the unit to change load without changing speed. Normally, set zero droop on unit running alone. On interconnected units, set the least amount of droop possible to provide satisfactory load division. For AC generated units tied in with other units set droop sufficiently high (30 to 50 on dial) to prevent interchange of load between units. If one unit in the system has enough capacity, set its governor on zero droop and it will regulate the frequency of the engine system. If its capacity is not exceeded this unit will handle all load changes. Operate the SYNCHRONIZER, of the governor with zero droop, to adjust the system's frequency. Operate the SYNCHRONIZERS, of the governors that have speed droop, to distribute load between units.

TROUBLE SHOOTING

14. It is impossible to anticipate every kind of trouble that is encountered in the field. This bulletin covers most common troubles experienced. Poor governing may be due to faulty governor performance, or it may be due to the governor attempting to correct for faulty operation of the engine or the equipment driven. The effect of any auxiliary equipment on the overall control required of the governor must also be considered.

Oil

15. Keep the governor oil level between the lines on the oil level gauge glass with the unit operating. The correct oil level is ¾ to 1¼ inch below the top of the governor case. Dirty oil causes approximately 50% of all governor troubles. Use clean new or filtered oil. Containers should be perfectly clean. Oil contaminated with water breaks down rapidly, causing foaming and corrodes internal governor parts.

Compensating Adjustment and Needle Valve

16. The compensating adjustment and needle valve must be correctly adjusted with the governor controlling the engine, even though the compensation may have been previously adjusted at the factory or on governor test equipment. Although the governor may appear to operating satisfactorily because the unit runs at constant speed without load, the governor still may not be correctly adjusted. High overspeeds and low underspeeds, or slow return to speed, after a load change or speed setting change, are some of the results of an incorrect setting or the compensating adjustment and needle valve.

TROUBLE SHOOTING CHART

17. Use the chart to determine the probable causes of faulty operation, and to correct these troubles. Terms used in the chart are defined as follows:

a. **Hunt**. A rhythmic variation of speed which can be eliminated by blocking governor operation manually, but which will recur when returned to governor control

b. **Surge**. A rhythmic variation of speed, always of large magnitude, which can be eliminated by blocking governor action manually and which will not recur when returned to governor control, unless speed adjustment is changed of the load changes.

c. **Jiggle**. A high frequency vibration of the governor terminal shaft and fuel linkage. Do not confuse this with normal controlling action of the governor.

Preliminary Inspection

18. Governor troubles are usually revealed in speed variations of the engine, but it does not necessarily follow that such variations are caused by the governor. When improper speed variations appear, the following procedure should be performed:

1. Check the load to be sure the speed changes are not the result of load changes beyond the capacity of the prime mover.

2. Check engine operation to be sure all cylinders are firing properly and that the fuel injectors are in good operating condition and properly calibrated.

3. Check linkage between governor and fuel control to be sure there is no binding or excessive backlash.

4. Check setting of governor compensation adjustment and needle valve

5. The source of most troubles in any hydraulic governor stems from dirty oil. Grit and other Impurities can be introduced into the governor with the oil, or form when the oil begins to breakdown (oxidize) or become sludgy. The internal moving parts are continually lubricated by the oil within the unit. Valves, pistons and plungers will stick and even freeze' in their bores, due to grit and impurities in the oil. If this is the case erratic operation and poor response can be corrected (if wear is not excessive) by flushing the unit with fuel oil. The use of commercial solvents is not recommended as they may damage seals of gaskets. Change the oil and flush the governor twice a year if possible. Remove the drain plug and drain out the old oil. Flush the governor by filling it with fuel oil, and with the prime mover running at low speed, cycle the governor by opening the needle valve two or three turns. Let the governor hunt for a minute or two, then stop the engine and drain all the governor. Flush the governor once again. Refill the governor with oil. Restart the engine and reset the compensation adjustment and needle valve.

6. Check the drive to the governor for any evidence of mis-alignment, roughness, excessive backlash, etc.

Table 6–B–1 Trouble Shooting

TROUBLE	CAUSE	CORRECTION
1. Engine hunts or surges. Block the throttle, fuel racks or steam valve.	a. Compensation adjustments incorrect.	Adjust needle valve and compensation adjusting pointer.
	b. Dirty oil in governor-sludge.	Drain oil, clean governor and refill.
	c. Low oil level - low level permits air to enter.	Add oil to correct level on gauge glass. Check for leaks, especially at driveshaft.
	d. Foamy oil in governor caused by air in oil.	Drain oil. Refill.
	e. Lost motion in engine for fuel pumps.	Repair linkage and or linkage pumps.
	f. Binding in engine linkage or fuel pumps.	Repair and realign linkage and or pumps.
	g. Governor worn.	Return governor to factory.
	h. Low oil pressure. Normal operating pressure 120 psi.	Pump check valves are not seating. Return governor to factory to reseat valves.
	j. Engine misfiring.	Check pyrometer readings of each cylinder and make necessary repairs or adjustments. Bad fuel injector.
	k. Voltage regulator not operating properly.	Check voltage regulator.