WOODWARD

Product Manual 03039
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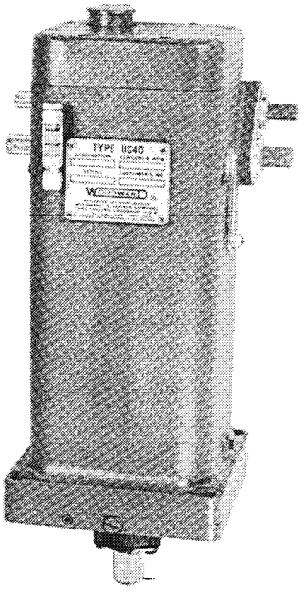
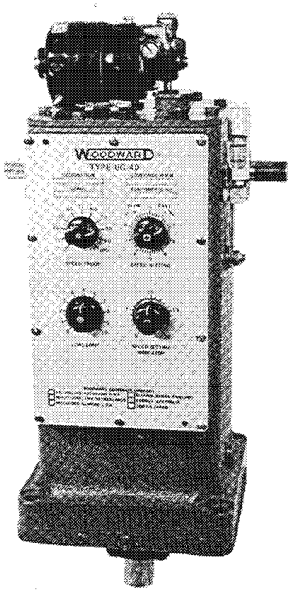
Original Instructions





UG-40 Dial and Lever Governors

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Manual 03039

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Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Chapter 1.
General Information

Description

The UG-40 governor is a mechanical-hydraulic speed governor for controlling diesel, dual fuel, or gas engines and steam turbines driving alternators, dc generators, pumps, compressors, or marine propellers.

The maximum work output of the UG-40 is 50 ft-lb (67 J) when using the full 38-degree travel of the terminal shaft. Useful work capacity is 2/3 or 33 ft-lb (45 J) using 25 degrees of terminal-shaft travel. The useful travel of the output shaft is limited by the need to allow sufficient overtravel at each end so the governor can create a shutdown and also give maximum fuel when required. The terminal shaft Is mechanically linked to the fuel system.

⚠WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

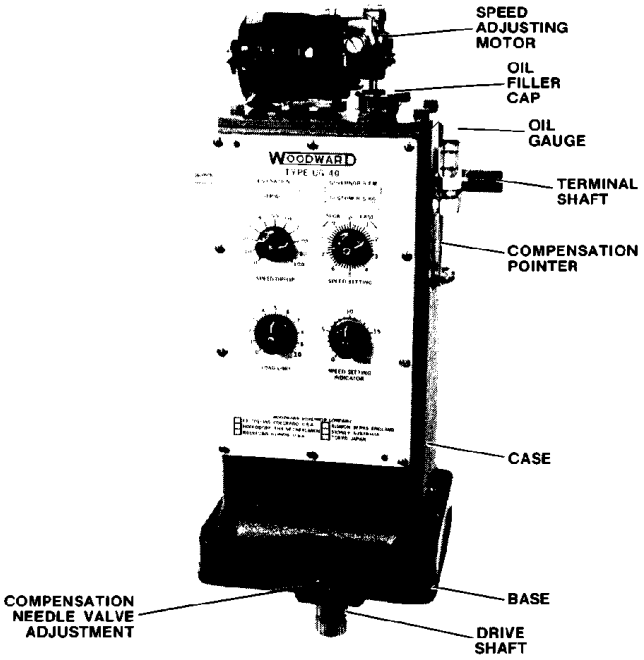

Figure 1-1. UG-40 Dial Governor

A proportional governor, the UG-40 Dial has an externally adjustable speed droop (knob) with 0 to 14% at 1000 rpm and 38 degrees terminal-shaft travel. The governor provides 0 to 17% droop at 800 rpm and 38 degrees of terminal-shaft travel. A reduction in the amount of terminal-shaft travel used causes a corresponding reduction in the amount of droop available.

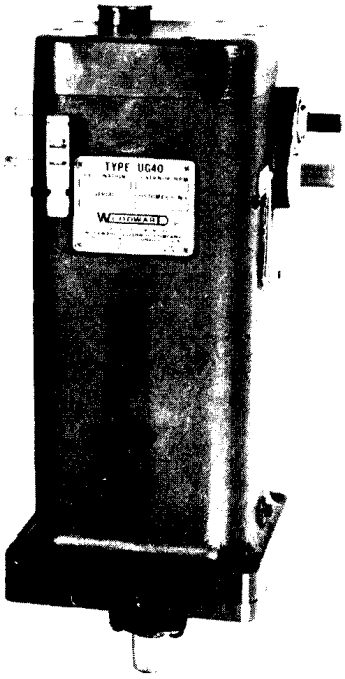

Figure 1-2. UG-40 Lever Governor

Droop is available for the Lever governor. Lever governor droop is internally adjustable at 0 to 7.5% at 1000 rpm and 0 to 9.5% at 800 rpm. Both figures assume 38 degrees of terminal shaft travel,

A load-limit control Is a standard feature on the UG-40 Dial governor. It limits the amount of fuel supplied by restricting the travel of the governor output shaft. An indicator dial shows the setting of governor-output-shaft limit position. The load-limit control may also be used for shutting down the engine, turbine, or other type of prime mover by turning it to zero. Load limit is available on the lever governor as a factory option.

References

Manual 03013, Shutdown Solenoid for UG Governors
Manual 03016, Low Lube Oil Pressure Shutdown for UG Governors
Manual 03019, Auxiliary Devices for UG-40 Governors Used in Marine Service
Manual 03026, Synchronizer Motor (Permanent Magnet) for UG Governors
Manual 03027, Synchronizer/Stepping Speed Adjustment Motors for UG Governors
Product Spec. 03030, UG-40 Governor
Manual 03045, UG-8 Speed Adjusting Devices
Manual 03505, Speed Adjusting (Synchronizing) Motor Parts and Lubrication Guide
Manual 25071, Oils for Hydraulic Controls
Manual 25075, Commercial Preservation and Packaging for Storage of Mechanical-Hydraulic Controls
Manual 36052, Magnetic Speed Pickup for PG, UG-8 and UG-40 Governors
Manual 36684, Booster Servomotor

Chapter 2.
Installation

Introduction

Use care while handling and installing the UG-40. Be particularly careful to avoid striking the governor drive shaft, output shafts, and the speed setting shaft. Abuse can damage seals and Internal parts. Do not rest the governor on its drive shaft.

⚠WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

Receiving

When you receive your UG-40 governor, it will be bolted to a wood platform in a vertical position. After testing the governor at the factory, it is drained of oil. This leaves a light film of oil covering the internal parts, preventing rust. No internal cleaning is required before installation.

Some drive shafts are sprayed with a light film of oil while others (depending on customer requirements) are covered with a soft seal. Before installation, remove the soft seal with a rag saturated with mineral spirits.

Storage

If a governor Is to be stored for any period of time. refer to Woodward manual 25075: *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*.

Mounting Requirements

1. Make sure the drive shaft rotates freely.
2. Select the correct length of coupling between the governor and the prime mover drive.
3. Mount the governor squarely on the mounting pad.
4. Make sure that force is not required when installing the governor drive shaft.
5. See Figures 2-1 and 2-2 (Outline Drawing), for mounting hole sizes and governor dimensions.

6. Make sure the coupling to the governor drive shaft rotates freely, but without backlash. Incorrect alignment of the governor shaft to the coupling, or not enough clearance between any of the parts, can result in excessive wear and/or seizure of parts. It can also cause an undesirable high frequency vibration or "jiggle" in the governor output shaft.

   Rough gear teeth, a bent shaft, bad bearings, or a shaft out of round can cause vibrations which cause jiggle in the governor shaft. This jiggle will often cause undesirable control conditions.

7. Mount the governor on the engine drive pad. If the engine drive pad is at an angle (from 0 degrees to 45 degrees maximum), the UG-40 must be installed with the front panel in the upper position. Use a gasket between the governor and the engine drive pad.

   Be sure there is adequate space available around the governor to provide easy access for installing the control linkage, filling the governor with oil, and adjusting the speed and compensation systems. See the outline drawings (Figures 2-1 and 2-2) for mounting hole sizes and governor dimensions.

The recommended rated speed range for the governor drive is 350 to 1050 rpm. Higher speeds are possible with internal gear changes. The drive power requirement is 1/2 hp (373 W) at normal speed and operating temperature. The UG-40 governor may be driven either clockwise or counterclockwise.

Operating temperature range for the UG-40 governor is –20 to +210 °F (–29 to +99 °C) with proper viscosity oil.

Linkage Attachments

Adjustment of the fuel linkage must provide for control of fuel from "OFF" to "FULL FUEL" within the limits of the 38 degrees of governor-output-shaft travel. It must also provide for approximately 25 degrees output-shaft travel between "NO LOAD" and "FULL LOAD".

NOTICE

Be sure to allow sufficient overtravel at each end so the governor can create a shutdown and also give maximum fuel when required. Overloading can cause engine damage if the governor cannot set maximum fuel.

Attach the fuel-rack linkage to the governor output shaft. There must be no lost motion or binding in this linkage. Adequate locking methods must be employed on the linkage connections.

A linear-linkage arrangement is used in applications where the governor-output-shaft positioning is directly proportional to the torque output of the prime mover. Thus, the governor-output-shaft travel will be directly proportional to the torque output of the prime mover.

In applications where a governor is controlling a butterfly valve, as on a gas engine, a linear linkage may not work. A non-linear linkage arrangement may be required.

For more information on non-linear linkage, see Woodward Application Note 50516, *Governor Linkage for Butterfly Throttle Valves*.

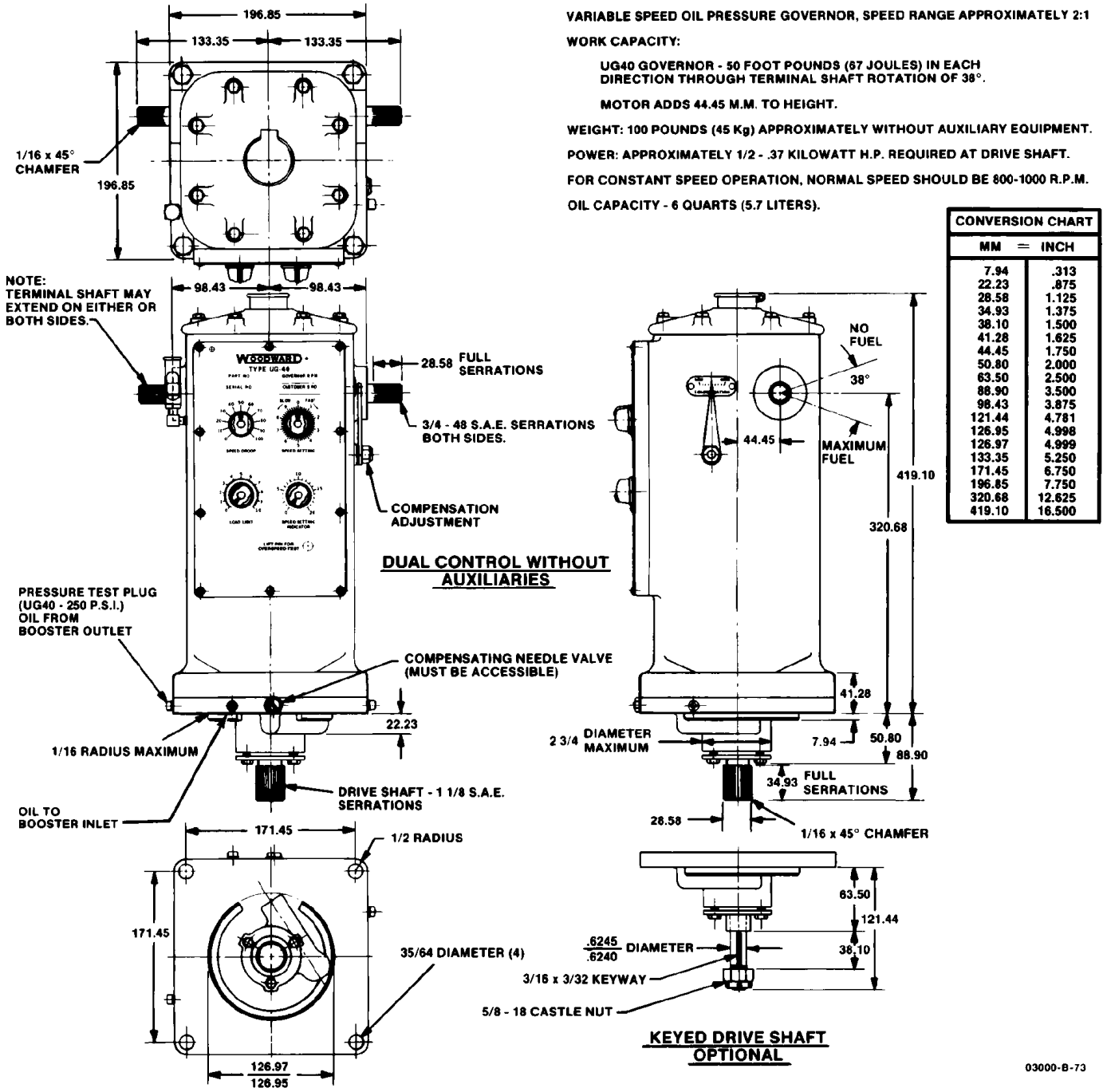

Figure 2-1. Outline Drawing of Dial Type Governor

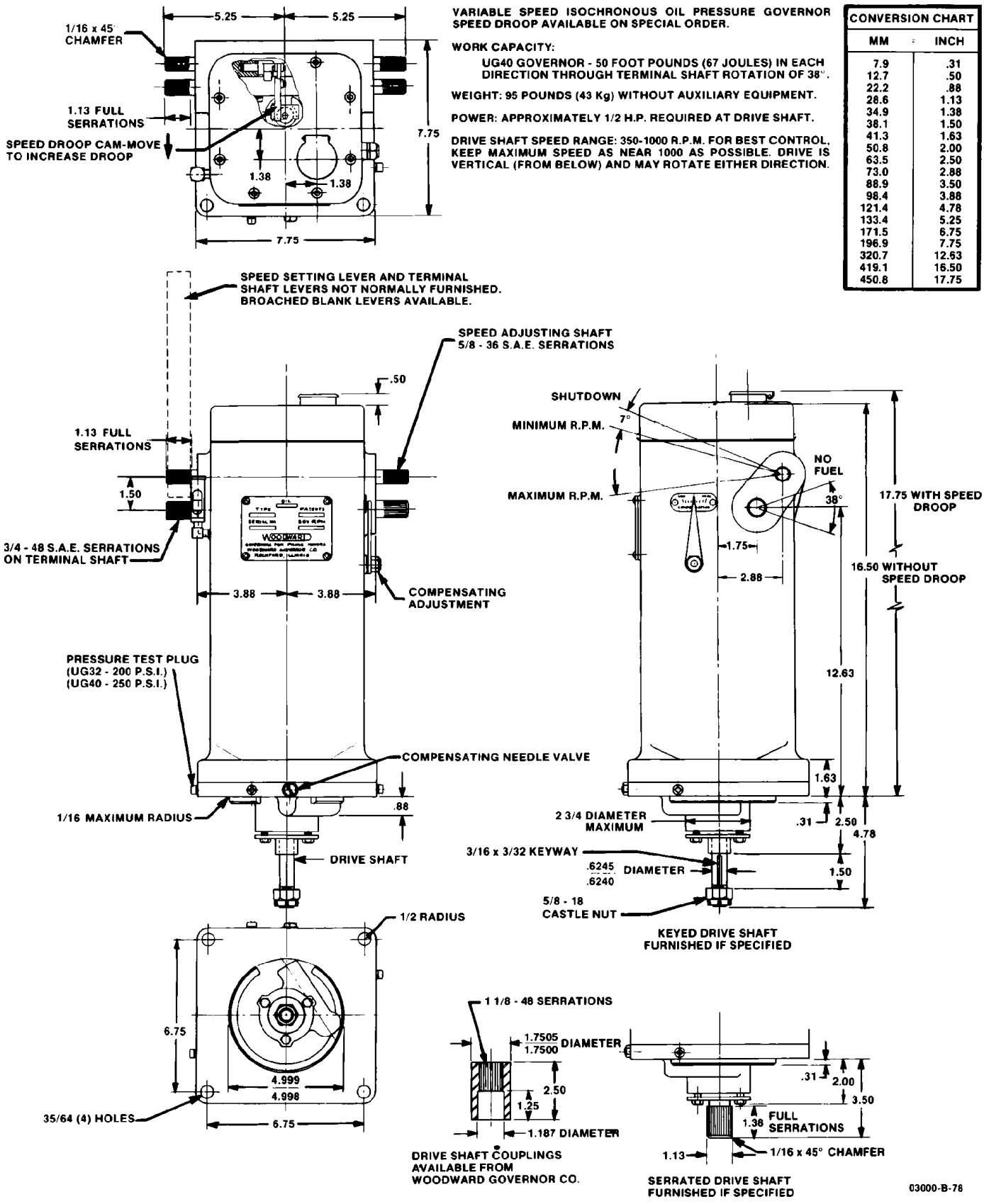

Figure 2-2. Outline Drawing of Lever Type Governor

Oil Supply

The recommended continuous operating temperature of the oil is 140 to 200 °F (60 to 93 °C). The ambient temperature limits are –20 to +210 °F (–29 to +99 °C). Contact Woodward if the temperature is beyond these limits.

IMPORTANT **The primary concern when selecting a governor oil is to provide the best possible hydraulic fluid properties within the governor.**

Measure the temperature of the governor on the outside, lower part, of the case, The actual oil temperature will be slightly warmer, by approximately 10 °F (6 °C).

Use SAE 10 to 50 oil depending on operating temperature for the governor (see Table 2-1). Fill the governor with approximately 6 US qt (5.7 L) of oil to the mark on the oil-sight glass. Add oil if necessary after the engine is started and the governor is at operating temperature.

Oil Maintenance

Regular oil maintenance will prolong the life and the reliability of a governor.

Use clean containers and pouring spouts when filling the governor. Partially used cans of oil must not be used. The UG-40 does not have a filter system, and oil must be clean when added.

Dirt, water, or chemicals introduced into the oil will contaminate the oil. Water, even in trace amounts, can contribute to early bearing failure or it can form oxides which cause failure of internal moving parts.

Formation of varnish on internal parts is an indication that operating temperatures are too high for the oil being used. Varnish is an oil contaminant. It can prevent the free motion of small pistons and valves which are machined to very close tolerances.

Sludge formation in a governor is a complex mixture of water, carbon, and oxidized oil. Sludge is a contaminant and is not soluble in oil. Sludge is controlled by either increasing the governor operating temperature, changing the oil more often, or by changing the type of oil (see Table 2-1).

Once an oil has been selected (see Table 2-1), do not use a different type or class of oil when adding oil to the governor. Continue using the same type or class of oil. If the type or class of oil needs to be changed, shut down the engine, turbine, or other type of prime mover, drain the governor while it is hot, flush with the new oil selected, and refill to the mark on the oil sight glass with the new type or class of oil.

Condition of the Oil

Conditions such as operating temperature, hostile environment (dirt, moisture, or chemical contamination). or anything that may change the composition of the oil or shorten its useful life, must be taken into account when determining the frequency of oil changes.

In general, change the oil If:

- The oil looks different than when it was new.
- The oil feels gritty when rubbed between your fingers.
- The oil smells different than when it was new.
- The oil has been contaminated by water, sludge, varnish, or any other contaminant.
- The oil viscosity has changed: increased or decreased.
- Excessive wear of parts occurs.
- Governor operating temperatures have changed, bringing oil viscosity outside ideal operating conditions.

Oil Change Frequency

Length of service between oil changes is greatly influenced by a number of factors including operating temperature, contamination, condensation, and the type of oil being used.

When a governor is put into service, the type of oil should be carefully selected. Then the condition should be checked weekly. After the first three months of careful observation of the oil condition, to make sure that the selection was proper for the particular installation, check the oil monthly to be sure the condition does not deteriorate. Annual oil change is recommended to assure maximum governor life. If the oil used is properly selected and carefully monitored, this period may be extended to a length of time not to exceed two years. Some environments are particularly destructive to oil and the year between changes cannot be attained. Whatever the time period, oil must be changed for new oil whenever the oil in the governor becomes dirty or contaminated.

Many governors operate efficiently on the same grade and type of oil used in the prime mover being controlled. Because of convenience and availability, this selection is recommended if the oil falls within the operation range of the governor. Do not use used oil from the prime mover in the governor. Use only new, clean oil in the governor and use care that the oil is contaminated while it is being installed in the governor.

To Change the Oil

Preferred Method

1. Remove the governor from its drive pad. Remove the cover and invert the entire governor.

IMPORTANT

Mark lever positions on the terminal shaft and on the speed adjusting shaft of a lever-type governor before removing the governor. Also keep compression on the speeder spring when inverting the lever type governor to prevent the ballhead from being dislodged and the gear from being disengaged. The friction drive cover of some dial type governors may fall out if not held in by a snap ring, but other parts of the governor will not come out unless intentionally disassembled.

2. Flush thoroughly with clean, light-grade fuel oil to remove any foreign matter.

3. Drain thoroughly and refill with clean governor oil, Follow the above procedure whenever the governor is removed from the prime mover.

Alternate Method
If it is not possible to shut down long enough to remove the governor from the prime mover, proceed as follows:

1. While the governor is hot and shut down (not operating), remove the oil drain plug (next to the needle valve adjustment cover on the front of the governor base) and drain the oil from the governor.

WARNING

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

2. Replace the oil drain plug and fill the governor with clean, light-grade fuel oil. Open the needle valve two or three turns and run the prime mover for about 30 seconds, then shut down the prime mover.

3. Remove the oil drain plug and drain the fuel oil and foreign matter. Replace the oil drain plug.

4. Refill the governor with the specified governor oil.

5. Adjust the needle valve as described in Compensation Adjustments (Chapter 4), and replace the compensating-needle-valve plug.

6. To ensure that all fuel oil is drained, repeat items 1, 4, and 5 after operating the unit about 30 minutes.

Oil Viscosity

Table 2-1 shows the viscosity of oil at different operating temperatures.

Viscosity represents the resistance of oil to flow. Oil pours freely when viscosity is low (SAE 10) and pours slowly when viscosity is high (SAE 50).

“Pour point” temperature Indicates the lowest temperature at which the oil will just flow to the pumps, bearings, and internal parts of the governor. In Table 2-1, the pour point (low temperature) is shown on the left and the high temperature at which the performance of the oil begins to deteriorate is on the right. Oil pour point must be below the lowest expected starting temperature.

The low-temperature limit shows an oil viscosity of 3000 Saybolt Universal Seconds (SUS). The governor will operate at temperatures near the pour point of the oil but governor operation will be sluggish and unresponsive. Only limited operation should be attempted at temperatures which will cause oil to fall below 300 SUS.

WARNING

Operation of the governor at a temperature lower than the pour point of the oil will cause damage to the governor and could create life-threatening overspeed by the prime mover.

The high-temperature limit shows an oil viscosity of 50 SUS. The governor will operate at temperatures near the high temperature limit, but governor operation can become unstable if the oil is too thin.

⚠WARNING

The governor could be unable to prevent life-threatening overspeed by the prime mover if it is operated at an excessively high temperature. Operation of the governor at a temperature above the recommended high-temperature limit of the oil could cause damage to the governor from oil deposits or fire.

Best governor operation is obtained with an oil viscosity between 100 and 300 SUS.

Adding or changing oil of one type or class to another class without thoroughly flushing the governor can cause operational problems including foaming and sludge formation, resulting in sluggish and unresponsive governor operation.

Not only is governor life greatly influenced by the use of clean and properly selected oil, but operation is also directly affected. Oil condition and type should be the first item checked when any governor problem develops.

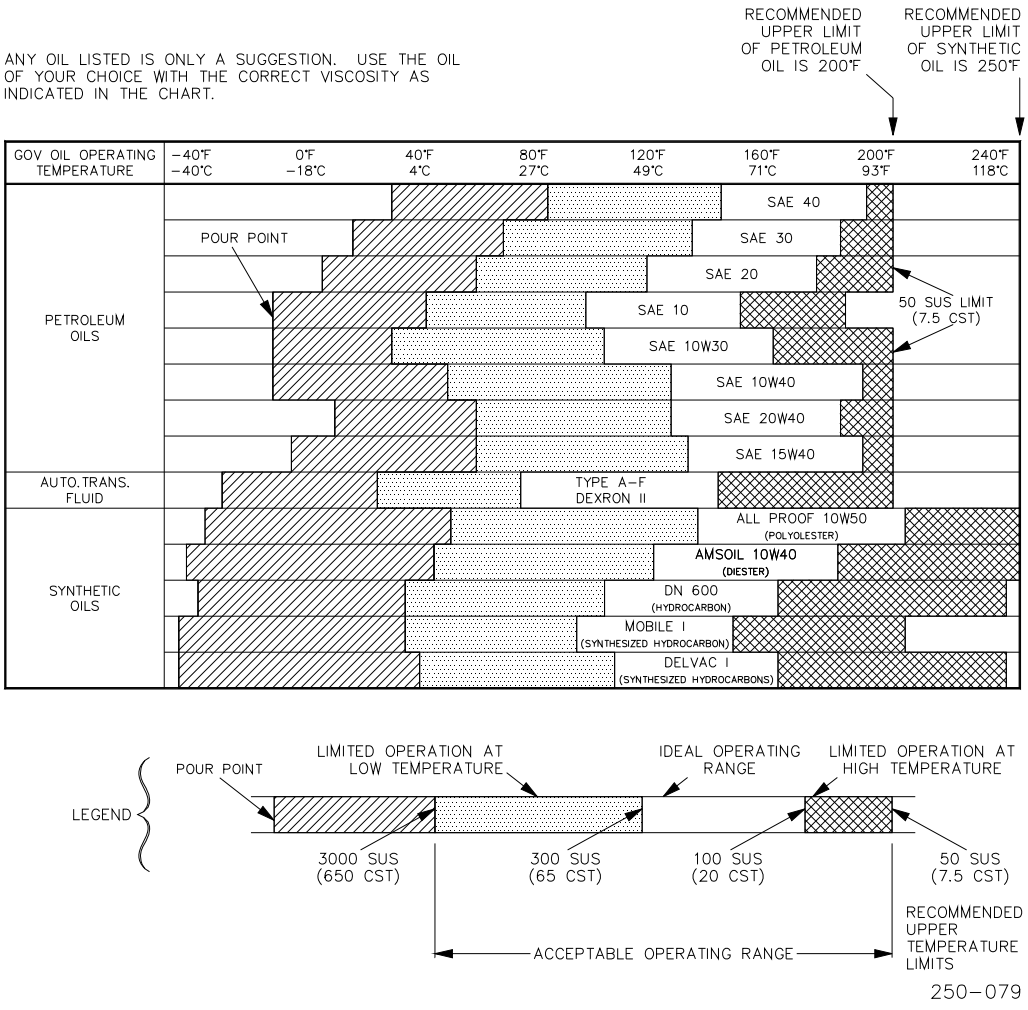

Table 2-1. Viscosity and Operating Temperature of Oils

VISCOSITY COMPARISONS				
CENTISTOKES (CST, CS, OR CTS)	SAYBOLT UNIVERSAL SECONDS (SUS) NOMINAL AT 100 DEGREES F	SAE MOTOR (APPROXIMATE)	SAE GEAR (APPROXIMATE)	ISO
15	80	5W		15
22	106	5W		22
32	151	10W	75	32
46	214	10	75	46
68	310	20	80	68
100	463	30	80	100
150	696	40	85	150
220	1020	50	90	220
320	1483	60	115	320
460	2133	70	140	460

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Table 2-2. Equivalent Viscosities for Lubricating Oils

Chapter 3.
Principles of Operation

Introduction

Basic UG-40 operation is similar for both dial and lever types. The only difference is in the method of setting speed and speed droop. Auxiliary devices provide different functions, but do not alter the basic operation of the governor.

Schematic diagrams of the UG-40 Lever and UG-40 Dial governor in this section provide a visual means of understanding the operation of the governor. The schematic diagrams do not show any auxiliary equipment.

Component Description

The schematic for the UG-40 Lever governor is less complicated than that for the Dial governor. For that reason, the following description refers to Figure 3-1. The Lever governor does not include load limit, speed droop, and shutdown features which are standard on the Dial governor. Most of these features may be included as options on the Lever governor, although they may not function in the same manner as on the Dial governor. Figure 3-3 is a schematic of the Dial governor. Unique features of the Dial governor are also explained in this section.

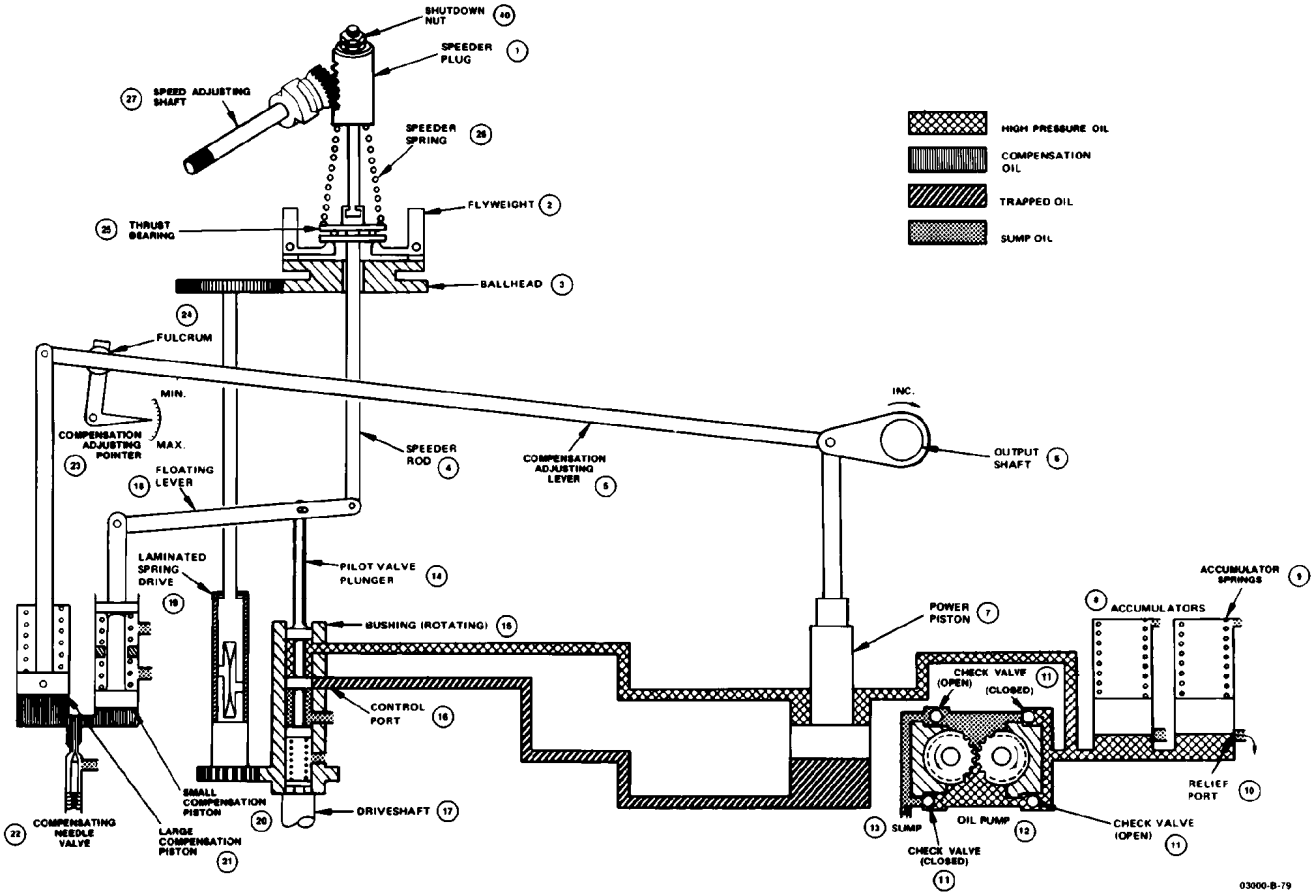

Figure 3-1. Lever Governor Schematic

Oil Pump

The oil pump (12, Figure 3-1) provides oil pressure for the governor. The pump gets oil from the self-contained sump (13). Four check valves (11) allow the positive displacement gear pump to operate either clockwise or counterclockwise. One pump gear is part of the rotating bushing (15) and the other is part of the laminated drive (19). The rotating bushing is driven by the governor drive shaft (17) which is driven by the prime mover. As the bushing rotates, it drives the laminated drive. Oil from sump is directed through the check valve system (11) into the accumulator system (8). Some units have positive direction plugs in the pump system to prevent unintentional reverse operation of the controlled device.

Accumulator

The accumulator (8, Figure 3-1) stores pressure oil for operation of the governor and also acts as a relief valve to control oil pressure in the governor.

As pressure oil is pumped into the accumulator, the two spring-loaded pistons raise until extra oil is released to sump through relief ports (10). The spring load on the accumulator pistons provides a constant pressure of 250 psi (1724 kPa) within the operating sections of the governor.

Oil flows from the accumulator through passages to the top of the power piston (7) and to the pilot-valve system (14 and 15).

Power Piston

The power piston (7) provides the movement which rotates the governor output shaft to new increase- or decrease-fuel positions.

The power piston (servo) Is a differential type with oil pressure on both sides. The upper side of the piston is connected to the governor output shaft (6) through a power lever and link assembly.

The lower side of the power piston has a larger area than the top of the piston. Therefore, less oil pressure is required on the bottom than on the top to hold the piston stationary. If the oil pressure is the same on both the top and bottom of the piston, the piston moves upward and rotates the terminal shaft in the increase-fuel direction. The piston moves down 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

The pilot-valve system (14 and 15, Figure 3-1) controls the flow of oil to and from the bottom of the power piston.

The pilot-valve system includes the rotating bushing (15) and the pilot-valve plunger (14).

The bushing is rotated by the drive shaft (17), and, through this rotation friction between the pilot-valve plunger (PVP) and the bushing is reduced. The PVP has a control land that regulates oil flow through ports in the bushing.

When the PVP is lowered, high-pressure oil flows under the power piston, raising It. When the PVP is raised, oil is released to sump from under the power piston allowing higher pressure on the top surface to lower it. When the PVP is lowered, pressure oil flows to the bottom of the power piston, causing it to rise. When the PVP Is in its centered position, the control land covers the control port, as shown in the schematic, and there is no movement of the power piston. PVP movement is controlled by the ballhead system (3) and the small-and large-compensation pistons (20 and 21).

Ballhead System

The ballhead system senses speed of the prime mover in reference to the governor speed setting and causes pilot valve movement when the reference speed and actual speed are not equal.

The ballhead system consists of a ballhead (3, Figure 3-1), flyweights (2), speeder spring (26), thrust bearing (25), speeder plug (1) and speeder rod (4). The geared ballhead is driven by the laminated drive (19). The flyweights are attached to the ballhead with pivot pins. A thrust bearing rides on the toes of the flyweights. The speeder rod is connected to the thrust bearing. The speeder spring is held against the thrust bearing by the speeder plug. As the ballhead rotates, the flyweights pivot outward due to centrifugal force. As the flyweights pivot out, the flyweight toes lift the thrust bearing against the speeder spring until spring force equals centrifugal force. At steady-state speed, the flyweights are at a middle position, centrifugal force is exactly equal to speeder-spring force, and the speeder rod has positioned the pilot-valve plunger in the central position so no oil is moving in the control system. If centrifugal force changes due to a change in engine speed, the speeder rod causes corresponding movement of the pilot valve.

Governor speed Is set by changing the compression of the speeder spring. If the speeder-spring compression is increased, the ballhead must rotate faster to center the pilot valve. If spring compression is lessened, so is the speed setting of the governor.

Speeder-spring force in the Lever governor is controlled manually through the speed-adjusting shaft (27, Figure 3-1). The Dial governor controls speeder-spring force with the speed-setting knob (30, Figure 3-3).

Compensation System

The compensation system provides governor stability and allows the governor to provide steady-state speed control.

When correctly adjusted, the compensation system effectively regulates the return to equilibrium rate of the pilot valve plunger. This reduces engine excursions while the new fuel level is found.

A large-compensation piston (21, Figure 3-1) small-compensation piston (20), a floating lever (18), and a compensation-adjusting lever (5), with an attached adjustable fulcrum (24), make up the compensation system.

The compensation system introduces a temporary readjustment of speed setting when the output shaft moves to produce a stabilizing speed droop characteristic to governor control. The compensation effect is slowly dissipated through the needle valve, allowing a return to the original speed-setting value.

The large-compensation piston is linked to the output shaft (6) by a compensation-adjusting lever (5). A pivotable fulcrum (24) rides on the adjusting lever. Changing the fulcrum position allows the adjusting lever to alter the amount of stroke available for the actuating compensating piston.

The small-compensation piston (20) is connected through a floating lever to the pilot-valve plunger and the speeder rod.

Moving the large-compensation piston down forces oil under the small-compensation piston. As the small-compensation piston is forced up, it lifts the PVP to close off the control port, which stops the flow of oil to the bottom of the power piston. The needle valve (22) controls the flow of oil between the oil sump and the large-compensation piston and the small-compensation piston.

IMPORTANT

Compensation must be properly adjusted to the particular engine and load to provide stable operation. (See Chapter 4, Compensation Adjustments.)

Speed Droop

The UG-40 Lever governor may be equipped at the factory with a speed-droop assembly (see Figure 3-2). The Dial governor has built-in droop and a droop-setting knob on the control panel (35, 37, and 39, Figure 3-3).

Speed droop allows load division among two or more prime movers operating in parallel or connected to a single shaft. Speed droop is the decrease in speed taking place when the output shaft moves from the minimum-to the maximum-fuel position in response to a load increase. Droop is expressed as a percentage of rated speed.

If, instead of a decrease in speed, an increase takes place, the governor is showing a negative droop. Negative droop will cause instability in a governor.

Not enough or too much droop will cause faulty governor operation. Not enough droop can cause instability in the form of hunting, surging, or difficulty in response to a load change. Too much droop can result in slow governor response in picking up or dropping off a load.

Using an example where the governor speed is 1000 rpm at no load and 950 rpm at full load, droop can be calculated with the formula:

DROOP = (No load speed – Full load speed) / (Full load speed)

DROOP = (1000 rpm – 950 rpm) / (950 rpm) = 5.26% droop

The speed droop is usually expressed as the percent change in speed setting for the full servo stroke referred to the maximum fuel speed setting.

IMPORTANT

If the output shaft does not use the full 38 degrees of available travel from “No Load” to “Full Load,” droop will be reduced proportionately. For example: 25 degrees is 66 percent of 38 degrees, which would provide 33 rpm droop or 3.5 percent droop.

As the governor output shaft moves to increase fuel, the speeder-spring compression Is reduced, which reduces the governor speed setting. The unit starts reducing its speed as load is applied.

When the governor output shaft moves to decrease fuel, the speeder-spring compression is increased, which increases the governor speed setting. The unit starts increasing its speed as load is decreased.

The change of governor speed setting when load is increased or decreased helps the governor resist a load change when the unit is connected mechanically with other units. See Figure 3-2.

IMPORTANT **If the governor output shaft does not use the full 38 degrees of available travel from "NO LOAD" to "FULL LOAD, "droop will also be reduced proportionally.**

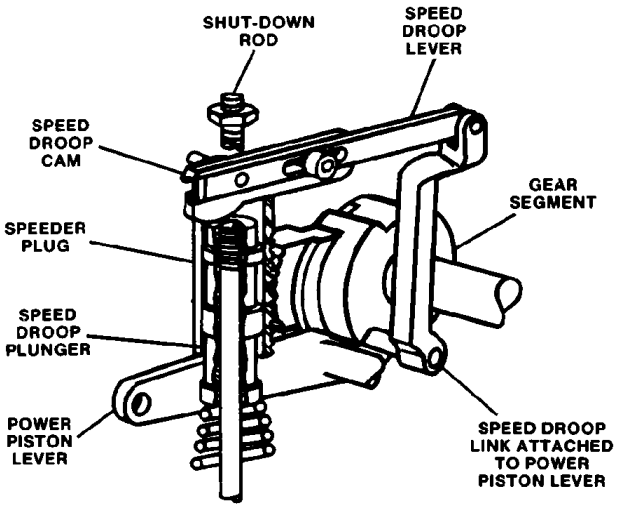

Figure 3-2. Lever Governor Speed Droop Assembly

Lever Governor Droop

The Lever governor speed-droop assembly (Figure 3-2) consists of a speed-droop-lever assembly, a speed-droop cam, and a speed-droop-link assembly which, when set, changes the compression of the speeder spring as the governor output shaft rotates.

Dial Governor Droop

Speed droop In the Dial governor (Figure 3-3) is set with the speed-droop-adjustment knob on the control panel. This adjustment (39) moves the sliding fulcrum (37) and changes the lever ratio of the speed droop lever to the output shaft and speeder plug. The position of the speed-droop lever (36) is positioned as a function of the output shaft (6).

Marks on the droop-adjustment scale on the dial panel are reference numbers only, and do not represent droop percentages. Thus the 100 mark does not represent 100 percent droop, it represents the maximum droop percentage available on that particular governor.

Sharing Loads

Reducing droop to zero allows the unit to change load without changing speed. Normally, set zero droop on units running alone. On connected units, set the least amount of droop possible to provide satisfactory load division.

For ac-generating units tied in with other units, set droop sufficiently high to prevent interchange of load among units. If one unit in the system has enough capacity, set its governor on zero droop and it will regulate the frequency of the prime-mover system. If its capacity is not exceeded, this unit will handle all load changes.

Set the speed of the governor with zero droop to adjust the frequency of the system. Set the speed of the governors that have speed droop to distribute load among units.

Shutdown Rod

The UG-40 Lever governor may be equipped with a shutdown rod to provide automatic or remote shutdown of the engine. The shutdown rod is not used to provide overspeed protection because it still relies on governor-produced hydraulic pressures.

The shutdown rod Is connected to the pilot-valve plunger through the speeder rod and one end of the floating lever. When the shutdown rod is lifted, the pilot-valve plunger is also raised, uncovering the control port in the pilot-valve bushing. This permits oil under the power piston to flow to sump. Oil pressure on top of the power cylinder forces the power piston down to zero fuel position. If linkage to the engine is correctly adjusted, the engine will shut down.

A number of actuating devices are available to install with the shutdown rod to provide automatic or remote shutdown of the engine. These devices allow shutdown without disturbing the lever-speed setting.

The shutdown rod will also provide shutdown of the governor through the speed-setting lever, when an adjustment nut on the rod is set above the speeder plug. This use of the shutdown rod operates as follows:

When the throttle is moved toward the shutdown position, the speeder plug rises, contacting the nut on the shutdown rod. Further movement lifts the shutdown rod, causing shutdown as previously explained. This use can provide shutdown at a predetermined speed setting rather than having to move the lever-speed setting clear to minimum-fuel position.

The UG-40 Dial Governor

Operation of the UG-40 Dial governor is identical to that of the UG-40 Lever governor just described, with the exceptions that speed droop, which may be changed by a dial setting, is incorporated in all UG-40 Dial governors, and all UG-40 Dial governors have load-limit control.

Load-Limit Control

The purpose of the load-limit control (31, 32, 33, 34, and 35 in Figure 3-3) is to hydraulically and mechanically limit the load that can be placed on the engine by restricting the travel of the output shaft in the increase-fuel direction. Consequently, the amount of fuel supplied to the engine Is limited.

The load-limit control may also be used for shutting down the engine by turning the knob to zero.

NOTICE

Forcing the prime-mover linkage to increase fuel without first turning the load-limit control knob to maximum position can cause damage to governor parts or a change in governor speed setting.

The load-limit control consists of an indicator disc geared to a load-limit rack. The rack is connected to the power piston and to the shutdown linkage. When the piston moves toward maximum fuel, the indicator dial on the control panel moves to indicate the load position. 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 pilot-valve plunger is lifted (nulled), stopping any further increase in fuel.

Turning the load-limit control to zero, to shut down the engine, turns the cam, forcing the load-limit (shutdown) lever and shutdown strap down. As the right end of the load-limit (shutdown) lever is forced down, it pivots about its fulcrum and lifts the pilot-valve plunger, releasing oil from under the power piston. Pressure oil acting on top of the power piston forces it down, rotating the output shaft to minimum fuel and causing the prime mover to shut down.

Synchronizer

The speed-adjusting control for the UG-40 Dial governor is used to change engine speed for a single unit. On engines in parallel with other units, it is used to change engine load.

The upper knob, called “Speed Setting Knob” on most models, is the speed-control knob.

The lower knob, “Speed Setting Indicator,” has no function of its own, but provides an indicator disc which shows the number of revolutions of the speed-setting-control knob.

Operation of UG-40 Governor

Refer to Figure 3-1 with this text to better understand the operation of the UG-40 governor. This schematic diagram is of a basic design and does not include any auxiliary equipment. Figure 3-3 is the basic Dial governor schematic and includes the speed-setting additions which are not on the UG-40 Lever governor.

This description is based on speed changes resulting from load changes. The same sequence of governor movements would occur if the governor speed setting were changed by repositioning the speed control.

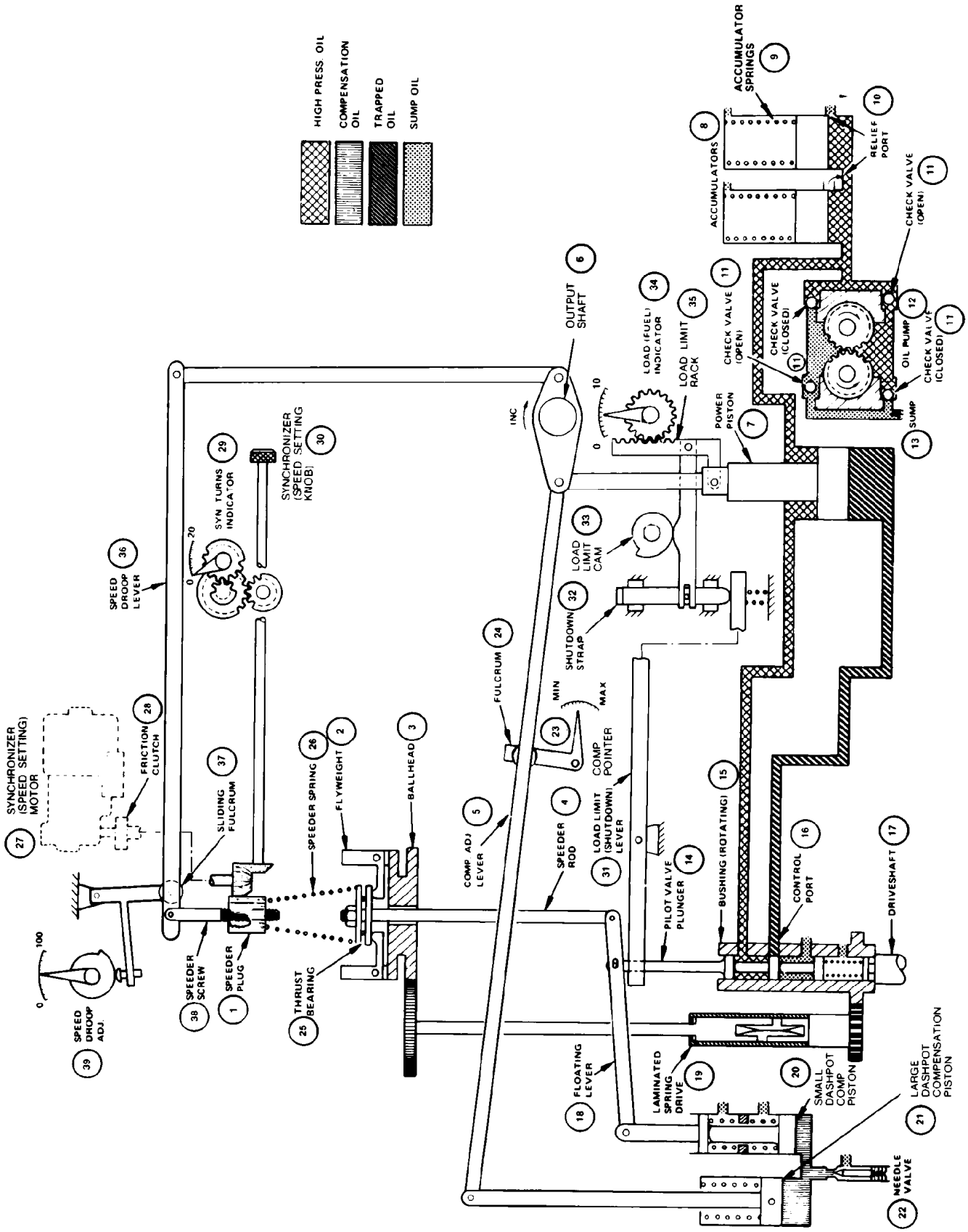

Figure 3-3. UG-40 Dial Governor Schematic

Decrease in Load

Assume the prime mover is running “on-speed.” The flyweights are in a vertical position for normal, steady-state operation. The control land of the pilot-valve plunger (14) is centered over the control port. As a result, there is no movement of the power piston (7) and no movement of the governor output shaft (6).

A decrease in load will create an increase in speed if the same fuel setting is maintained. This decrease in load will thus cause the following sequence of movements within the governor:

1. As speed increases, the centrifugal force of the flyweights (2) increases, overcoming the opposing speeder-spring force.

2. The flyweights tip outward, raising the speeder rod 14) and the right end of the floating lever (18).

3. This raises the pilot valve plunger (14), opening the control port in the rotating bushing (15). Oil is released from the bottom of the power piston (7) to sump.

4. The pressure oil acting on the top side of the power piston forces it down and rotates the output shaft (6) in the decrease-fuel direction.

5. Linkage from the output shaft lowers the compensation-adjusting lever (5) which pivots at the fulcrum (24) lifting up the large-compensation piston (21).

6. Suction is thus applied to the chamber of the small-compensation piston (20), lowering the left end of the floating lever.

7. The pilot-valve plunger is lowered, closing off the control port.

8. As sump oil flows through the needle valve (22) from the sump into the compensation-piston assembly, the small-dashpot-compensation piston is returned to its normal centered position by the compensation spring at the same rate as the speeder rod.

9. This keeps the pilot-valve plunger in its centered position, with the control land covering the control port in the pilot-valve bushing.

10. Output shaft and power-piston movement is stopped in the new decrease-fuel position required to run the prime mover at the selected speed setting with the decrease in load.

Increase in Load

With the prime mover running on-speed, the flyweights in a vertical position and the pilot-valve plunger centered, an increase in load will cause a decrease in speed. This decrease in speed due to a load increase will generate the following sequence of governor movements:

1. As speed decreases, the centrifugal force of the flyweights decreases and the opposing speeder-spring force is now greater than the centrifugal force of the flyweights.

2. The flyweights tip inward, lowering the speeder rod and the right end of the floating lever.

3. This lowers the pilot-valve plunger, opening the control port in the rotating bushing. Pressure oil is released through the control port to the bottom side of the power piston.

4. The pressure oil, acting on the greater area of the bottom side of the power piston, compared to the smaller area being influenced by pressure oil on the upper side, forces the power piston up and rotates the output shaft in the increase-fuel direction.

5. Linkage from the output shaft raises the compensation-adjusting lever which pivots at the fulcrum, lowering the large-compensation piston.

6. Pressure oil is applied to the chamber of the small-compensation piston, raising the left end of the floating lever.

7. The pilot-valve plunger is raised in turn, closing off the control port.

8. As sump oil flows through the needle valve from the dashpot-compensation-piston assembly, the small-compensation piston is returned to its normal centered position by the compensation spring at the same rate as the speeder rod. This keeps the pilot-valve plunger in its centered position.

9. This keeps the control port in the pilot-valve bushing covered by the land on the pilot-valve plunger.

10. The output-shaft and power-piston movement is stopped in the new increase-fuel position required to run the prime mover at the selected speed setting with the increase in load.

In either case, a decrease or an increase in load, compensation (amount of movement of the large-compensation piston) Is controlled by the compensation adjustment (the fulcrum position).

The rate at which the small-compensation piston is returned to normal is controlled by the needle-valve adjustment which regulates the amount of flow in the compensation area.

When correctly adjusted, the compensation system effectively regulates the amount of fuel necessary to bring the engine to the required output to adjust to a change in load or to a speed-setting change.

Chapter 4.
Operation and Adjustments

Initial Operation of a New Governor

⚠WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

Before initial operation of the UG-40, be sure all previous installation steps have been successfully accomplished and all linkages are secure and properly arranged and attached (see Chapter , Installation Procedures). Read all of this chapter.

Fill the governor with oil to the top mark on the oil sight glass (6 US qt/5.7 L). Close the needle valve carefully (clockwise) using a Phillips screwdriver. After the needle valve is seated, open it 1/2 to 3/4 of a turn. Loosen the nut holding the compensation-adjusting pointer enough to move the pointer, and set the pointer in the middle of the scale. Tighten the nut.

If replacing a governor, the initial compensation setting can be that of the governor just removed.

Use the prime-mover manufacturer's instructions to start the engine.

Adjustments

Normally, the only adjustments for putting a new governor into service include bleeding trapped air and adjusting compensation to obtain satisfactory stability and response. Other operating adjustments were made during factory testing in accordance with the prime-mover manufacturer's specifications and should not require further adjustment. Speed droop, high- and low-speed stops, and shutdown nut(s) adjustments are given in the "Test Procedures on the Engine" in this chapter.

IMPORTANT

Do not attempt internal adjustment of the governor unless you are thoroughly familiar with the proper procedure.

⚠WARNING

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

Compensation Adjustments

The needle valve and the adjusting pointer are the adjustable parts of the compensation system. Their settings directly affect governor stability.

Compensation must be properly adjusted to the particular engine and load to provide stable operation. When the engine, turbine, or other type of prime mover is started for the first time after the governor has been filled with oil, the governor may be stable at constant speed, yet need adjustment. High overspeeds and underspeeds after load changes, or slow return to normal speed indicate the need for compensation adjustment.

IMPORTANT **Maximum compensation settings generally provide stable steady-state operation but result in greater off-speeds on load changes.**

After the oil in the governor has reached Its normal operating temperature, make the following compensation adjustments without load on the prime mover to be certain the governor gives optimum control. See Figure 1-1 for location of the adjustment parts.

1, To bleed trapped air from the governor oil passages, first loosen the nut holding the compensation-adjusting pointer enough to set the pointer slits in the extreme upward position for maximum compensation.

Next, remove the needle-valve-access plug and open the needle valve two turns counterclockwise. Use a Phillips screwdriver to avoid damage to the threads inside the bore and to the needle valve.

Damage to the threads or to the needle valve may cause the needle valve to be difficult to adjust. This may affect response.

There are two screwdriver slots in the needle valve, a shallow slot and a deep slot, located at right angle to each other. The deeper slot is used to expand the head of the needle valve and increase friction to prevent vibrations from changing the needle-valve setting.

IMPORTANT **If a plain screwdriver must be used, be sure to use the shallow slot of the needle valve.**

Allow the prime mover to hunt for approximately 30 seconds to bleed trapped air from the governor oil passages.

2. Loosen the nut holding the compensation pointer just enough to lower the pointer as far as it will go for minimum compensation. Tighten the nut again.

IMPORTANT **The objective of the compensation-adjustment procedure is to find the particular settings for the needle valve and the compensation adjustment pointer at which the engine, turbine or other type of prime mover will return quickly to speed (needle-valve adjustment) after a speed disturbance with only a slight overshoot or undershoot (compensation-pointer adjustment).**

3. Gradually close the needle valve until hunting just stops. It hunting does not stop, open the needle valve one turn and move the compensation pointer up by one mark on the front-panel-indicator scale. Again, gradually close the needle valve until hunting stops.

If hunting does not stop, set the needle valve 1/4 turn open and repeat, setting the compensation pointer up by one mark. Retest the governor until hunting stops.

4. From this setting, open the needle valve one turn and manually disturb the governor fuel setting. Gradually close the needle valve until the governor returns to speed with only a small overshoot or undershoot and the needle valve is between 3/8 and 3/4 turns open.

Compensation adjustment determines off-speed. Needle valve adjustment determines recovery time.

IMPORTANT

For most responsive governor control, use as little compensation as possible. Too much compensation causes excessive speed overshoots and undershoots upon load changes.

Closing the needle valve more than indicated makes the governor slow to return to normal speed after a load change.

Opening the needle valve more than indicated decreases governor stability and can cause hunting.

Once the needle-valve adjustment is correct, it is not necessary to change the setting except for large, permanent changes in temperature or other conditions which affect viscosity of the oil being used in the governor.

When the adjustment is correct, tighten the compensation-pointer nut and reinstall the needle-valve-access plug with a copper washer. The plug and the washer will stop oil seepage around the needle valve.

Initial Operation for a Repaired or Reassembled Governor

After disassembly or repair, it is very important to test the governor on a test stand. If a test stand is not available, testing of the governor can be done on the engine.

⚠WARNING

If testing of the governor is done on the engine, the operator must manually control engine speed until it is proven that the governor will go to minimum position and cause the fuel valve to go to minimum position. Engine overspeed could occur if the governor is unable to move the fuel control to minimum. This could destroy the engine and endanger the life of the operator.

Before operating a repaired governor for the first time, check that all installation steps have been correctly completed (see Chapter 2, Installation Procedures). Also read all of this chapter.

Attach a serration wrench to the speed-setting shaft to manually control engine speed.

If accurate tests and adjustments are to be made, it is best to use a test stand. It is difficult to make accurate tests when the governor is mounted on an engine. Contact Woodward for a copy of the test specifications for each governor designation.

The tools listed in Table 4-1 are optional, and while not absolutely necessary, make repair and testing easier and quicker. The pressure gauge, however, is always needed to check operating oil pressure.

Test Procedures on the Engine

These adjustments and test procedures are provided for the particular type of governor being tested. Procedures are listed in entirety for testing the UG-40 Dial governor, the UG-40 Lever governor without droop, and the UG-40 Lever governor with droop. Follow the procedures that fit the governor being tested.

UG-40 Dial Governor

Before installation, be sure speed droop is not negative. To check droop, first set the speed-droop-control knob to zero. Remove the cover and speed-setting motor, if so equipped.

IMPORTANT **This procedure must be done before the governor is filled with oil.**

1. Put a dial indicator (tool 8995-037) on the governor with the indicator rod touching the top of the speed-setting gear. The speed-setting gear adjusts pressure on the speeder spring as it threads up or down on the speeder screw.

2. Place the serration wrench on the governor output shaft.

3. Rotate the governor output shaft from minimum-to maximum-fuel position and check the dial indicator.

4. No movement of the indicator is zero droop. If movement is negative, or greater than 0.002 inch (0.05 mm), positive adjustment is needed.

   To adjust, loosen locknut (200), Figure 6-4, and turn screw (198). Turn the screw counterclockwise if the indicator reads more than 0.002 inch (0.05 mm) positive, and clockwise if the indicator shows a negative reading.

   When zero droop is obtained (0.002 inch/0.05 mm or less positive indicator reading), retighten locknut (200).

   Check the adjustment again by moving the governor output shaft from minimum-to maximum-fuel position. Droop can be zero or positive, it must not be negative. Check the final droop setting with the governor operating on the prime mover as shown in “Test Procedures” in this chapter.

⚠WARNING **An untested governor can cause overspeed, capable of endangering life and destroying the prime mover. Before starting the engine under control of a new, repaired, or otherwise unproven governor, make sure all installation steps outlined in Chapter 2 of this manual have been followed. Then read and follow all of the directions in this chapter.**

Dial Governor Test Procedures

1. Remove one of the three pipe plugs in the base of the governor and attach a pressure gauge with capacity in excess of 250 psi (1724 kPa). Any of the three pipe plugs not located on the same side as the needle valve will provide a pressure-check location.

2. Install the governor on a test stand or on the engine pad. Do not force the drive shaft. See Chapter 2, Installation Procedures.

3. Fill the governor with 6 US qt (5.7 L) of the proper grade and weight of oil (see Chapter 2, Oil Supply). The oil level must be to the mark on the oil sight glass.

⚠WARNING

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

4. It the governor is tested on the engine, start the prime mover according to instructions from the manufacturer.

5, Make sure the governor has 225 to 275 psi (1551 to 1896 kPa) oil pressure at normal operating speed.

6. Close the needle valve and open it just enough to cause a small hunt. Use a Phillips screwdriver. Its plain screwdriver must be used, make sure to use only the shallow slot of the needle valve to avoid damage to the threads inside the bore and to the needle valve.

   Let the prime mover hunt for about 30 seconds to remove trapped air from the governor oil passages.

7. Close the needle valve and open it again 1/2 turn. If the governor continues to hunt, repeat step 6. If repetition of these steps does not provide steady governor operation, check that negative droop has not been set on the governor.

8. Adjust the compensation system. See Compensation Adjustments in this chapter.

9. While the engine is running, recheck the governor for zero droop. Turn the speed droop knob to zero and run the governor at normal operating speed without load. Then load the engine to near “full load.” Speed must be within 0 to minus 3 rpm. Should the governor have negative droop, the engine will hunt and surge at full load.

10. If adjustment Is needed to bring about 0 droop, follow the procedure already established before the governor was mounted on the test stand or engine.

11. To prevent speed-setting changes because of engine vibrations, a friction drive is installed in the speed-setting mechanical drive to the UG-40 governor.

    If the friction drive is too tight, the speed-setting knob can no longer be turned manually. Check the torque of the friction-drive cover (152) and set it at 4.5 to 5 lb-in (0.5 to 0.6 N·m), with the speed-setting motor and about 2 lb-in (0.2 N·m) with manual speed setting only.

    To adjust the friction on the friction drive, first remove the governor cover, then the retaining ring on the friction drive using Number 1 Truarc pliers. Do not let the cover or the spring fall into the governor as the friction-drive cover is under spring compression. To increase friction, turn nut (154) on the shaft clockwise while holding the speed-setting knob. To decrease friction, turn the nut counterclockwise.

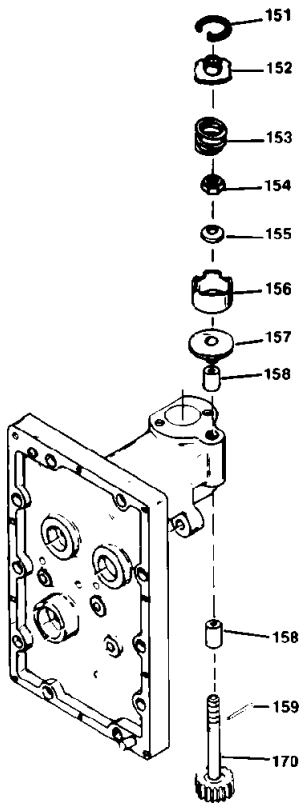

Figure 4-1. Friction Clutch

12. Reassemble the friction drive.

13. Set the maximum- and/or minimum-speed limit on the governor. This adjustment can also be made with the prime mover running. To make the adjustment, first remove the governor dial plate. Turn the speed-setting knob clockwise to increase the speed setting of the governor to its specified maximum plus 10 rpm.

    If the friction drive slips before reaching the required high-speed setting, mark the intermediate and the speed-setting-indicator gears, disengage the speed-setting gear, and index it one tooth counterclockwise to allow a higher speed setting, and engage the gear again.

    Re-engage the synchronizer-indicator gear with the high-speed-stop pin and engage the intermediate gear to prevent further increase in speed. The high-speed-stop pin is the pin closest to the gear center.

    On governors equipped with an electric-speed-adjusting motor, be sure the motor can run the governor up to its maximum speed stop and down to its minimum speed. Reset torque on the friction drive, if necessary.

    On governors equipped with a two-position high-speed stop (overspeed test device), set the overspeed test speed as described above, then the lever catch will provide the normal high speed stop for the governor. If necessary, set the high speed stop to the lever engaged position and then disengage the lever and advance to the normal high speed stop position to achieve the overspeed test speed.

14. To set the minimum-speed limit, turn the speed-setting knob counterclockwise to decrease the speed setting of the governor to the minimum-speed position.

15. Set the synchronizer-indicator-dial-panel pointer at zero.

16. Position the synchronizer-indicator knob about 1/16” (1.6 mm) from the surface of the dial. This prevents the knob from binding the synchronizer system gear train.

17. On governors equipped with limit switches, operate the governor at the required high and low speed to verify correct positioning of the cams that operate the switches. Adjust the cams by loosening the screws and turning the cams on the shaft. Tighten the screws again.

18. On governors equipped with solenoid shutdown, please refer to Woodward manual 03013 for setup procedures.

19. Turn the load-limit knob to zero. The load-limit indicator must move to zero. The governor-output shaft will move to its minimum-fuel position. Reset the load-limit knob to maximum load.

20. Shut down the engine. Remove the pressure gauge and install a 1/8 inch socket pipe plug. Apply a pipe sealer to the threads and torque to 90 in-lb (10 N·m).

21. Install the governor cover and dial plate.

UG-40 Lever with Droop Parts Test

Adjustment of the speed-stop levers and final check of droop lever and cam adjustments must be made only while the prime mover being controlled is operating Ins single unit configuration. Test requires loading of the prime mover. Adjust the governor to use as little droop as possible, yet obtain satisfactory control.

IMPORTANT

On paralleled generator sets or other applications where maximum loading is difficult, observation of governor behavior may be the best way to check droop operation. Preset the droop cam to provide about 0.010” (0.25 mm) rise in the speeder plug between minimum- and maximum-fuel locations of the governor-output shaft. This can be measured with the governor empty of oil and not on the engine mounting pad. Set a dial indicator on top of the speeder plug and rotate the output shaft. Note carefully which way the cam is moved on the lever, as final adjustment will probably have to be made with the governor running on the engine or test stand.

1. Remove a pipe plug in the base of the governor and attach a pressure gauge with capacity in excess of 250 psi (1724 kPa). Any of the pipe plugs not located on the same side as the needle valve will provide a pressure-check location.

2. Install the governor on a test stand or on the engine pad. Take care that the drive shaft is not damaged (see Chapter 2, Installation Procedures).

3. Fill the governor with 6 US qt (5.7 L) of the proper type and weight oil. The oil level must be to the mark on the oil sight glass.

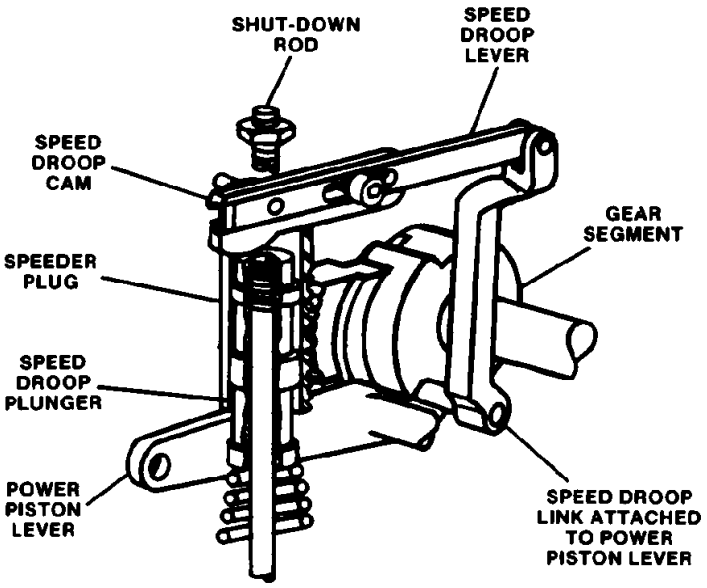

Figure 4-2. Lever Governor Droop Cam

4. Set the compensation-adjusting pointer at mid-point on the pointer scale.

5. If the governor is tested on the engine start the prime mover according to the instructions from the manufacturer, then run the governor until it is at operating temperature.

⚠WARNING

The operator must manually control engine speed until it is proven that the governor will go to minimum position and cause the fuel valve to go to minimum position. Engine overspeed could occur if the governor is unable to move the fuel control to minimum. This could destroy the engine and endanger the life of the operator.

6. Check that the governor has 225 to 275 psi (1551 to 1896 kPa) oil pressure at normal operating speed.

7. Close the needle valve and open it just enough to cause a small hunt. Use a Phillips screwdriver. if a plain screwdriver must be used, make sure to use only the shallow slot of the needle valve to avoid damage to the thread inside the bore and to the needle valve.

   Let the prime mover hunt for about 30 seconds to bleed trapped air from the governor oil passages.

8. Close the needle valve and open it again 1/2 turn. If the governor continues to hunt, repeat step 7.

9. Adjust the compensation system. See Compensation Adjustments in this chapter.

10. Adjustment of the droop lever and cam affect the speed settings. For this reason, droop must be checked and adjusted before the high- and low-speed stop settings are made.

11. Determine the amount of droop desired for the particular application and determine the high speed desired in no-load and full-load conditions.

12. With the governor running at the desired speed under no-load conditions, apply full load and observe the decrease in speed which takes place. If no-load speed is 945 rpm and 5 percent droop is desired, the full-load speed should be 900 rpm.

13. If the speed decrease is greater than the desired amount, then droop should be decreased and the droop cam should be moved a little toward the speed-adjusting shaft. If the speed decrease is less than the desired amount, then droop should be increased and the droop cam should be moved a little away from the speed-adjusting shaft. To move the cam, slightly loosen the screw holding the cam to the lever and tap the cam in the right direction.

    Once the droop adjustment Is correct, tighten the droop screw and set the high- and low-speed stops.

14. If shutdown is not required, lock the shutdown nuts together at the top of the shutdown rod. If a self-locking nut is used, thread it onto the shutdown rod until 1/4 inch (6 mm) of threads is above the nut.

    To set the nut(s) for shutdown operation, adjust the low-speed-stop screw to allow 10 degrees rotation of the speed-adjusting shaft below the minimum-speed setting. Thread the nut down on the top of the speeder plug to obtain shutdown at 5 degrees below minimum-speed setting. Lock the nut in place.

15. With the governor running at the high speed setting, turn in the speed-setting screw until it just touches the speed-setting gear (see Figure 6-7 for location). Set the lock nut. Turn the speed-setting lever to the low speed desired and set the low-speed screw (the upper screw or the screw in the cover depending on the model.)

16. Shut down the engine. Remove the pressure gauge and install a 1/8” socket-pipe plug. Apply a pipe sealer to the threads and torque pipe plug to 90 lb-in (10 N·m).

UG-40 Lever Governor without Droop Test

1. Remove a pipe plug from the base and attach a pressure gauge capable of measuring In excess of 250 psi (1724 kPa). Pressure may be checked from any of the three positions on the base not on the same side as the needle valve.

2. Install the governor on a test stand or on the engine pad (see Chapter 2, Installation Procedures). Do not damage the drive shaft.

3. Fill the governor with 6 US qt (5.7 L) of oil (see Chapter 2, Oil Supply) for the proper selection of oil. The oil level must be to the mark on the oil sight glass.

4. Set the compensation-adjusting pointer at the mid-point on the pointer scale.

⚠WARNING

The operator must manually control engine speed until it is proven that the governor will go to minimum position and cause the fuel valve to go to minimum position, Engine overspeed could occur if the governor is unable to move the fuel control to minimum. This could destroy the engine and endanger the life of the operator.

5. If the governor is tested on the engine, start the prime mover according to instructions from the manufacturer. Run the governor until it is at operating temperature.

6. Check that the governor has 225 to 275 psi (1551 to 1896 kPa) oil pressure at normal operating speed.

7. Close the needle valve and open it just enough to cause a small hunt. Use a Phillips screwdriver. If a plain screwdriver must be used, make sure to use only the shallow slot of the needle valve to avoid damage to the threads inside the bore and to the needle valve.

   Damage to the threads or to the needle valve will make adjustment difficult.

   Let the prime mover hunt for about 30 seconds to bleed trapped air from the governor oil passages.

8. Close the needle valve and open it again 1/2 turn. If the governor continues to hunt, repeat step 7.

9. Adjust the compensation system. See Compensation Adjustments in this chapter.

10. Move the speed-setting shaft to obtain the specified high speed. Set the speed-setting-stop screw to limit speed at this point (see Figure 6-7 for location).

11. Move the speed-setting shaft to the specified low-speed setting. Set the low-speed-stop screw (the upper screw in the back of the case or the screw in the cover) and lock with the nut.

12. If shutdown is not required, lock the shutdown nuts together at the top of the shutdown rod. If a self-locking nut is used, thread it onto the shutdown rod until 1/4 inch of threads is above the nut.

    To set the nut(s) for shutdown operation, adjust the low-speed-stop screw to allow 10 degrees rotation of the speed-adjusting shaft below the minimum-speed setting. Thread the nut down on the top of the speeder plug to obtain shutdown at five degrees below the minimum-speed setting. Lock the nut in place.

13. Shut down the engine. Remove the pressure gauge and install a 1/8 inch socket pipe plug. Apply a pipe sealer to the threads and torque the pipe plug to 90 in-lb (10 N·m).

Test Completion

When adjustments are complete, replace the front panel and governor cover. Shutdown auxiliary devices require installation, adjusting, and testing described In the applicable manuals before governor installation is complete.

Table 4-1. Test Stand Tools

Tool Description	Woodward Number	Application
Hydraulic Test Stand	205975, air drive; 8909-094 electric drive or equivalent	Engine simulator. Drives governor, supplies pressure oil. Includes gauges for testing.
Electronic Counter and Frequency Pickup		Indicates governor drive speed. Must have an output of at least 60 Hz per revolution, on a one-second time base. Must indicate speed to within ±1 rpm. Readouts of display time must not exceed 5 seconds.
Pressure Gauge (gauge to above 275 psi/1900 kPa)		To check governor oil pressure.
Dial Indicator	8995-037	To check and adjust droop setting. 0.000 inch (0.00 mm) reading.

Chapter 5. Troubleshooting

It is Impossible to anticipate every kind of trouble that is encountered in the field. This manual covers the most common troubles experienced. Poor governing can be due to faulty governor performance, or it can be due to the governor attempting to correct for faulty operation of the engine or the equipment driven. Also, consider the effect of auxiliary equipment on the overall control required of the governor.

Use the troubleshooting chart on the following pages to determine the probable causes of faulty operation and to correct these troubles.

Governor troubles are usually revealed In speed variations of the engine, but it does not necessarily mean that such variations are caused by the governor. When improper speed variations appear, perform the following procedures:

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

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

3. Check for binding or excessive backlash in the linkage to the fuel or steam control.

4. Check the setting of the governor compensation and needle valve.

5. The source of most troubles In hydraulic governors stems from oil conditions. Refer to oil supply and oil maintenance information in Chapter 2 of this manual and the oil selection table (Table 2-1).

6. Check the drive to the governor for any evidence of misalignment, roughness, or excessive backlash.

The troubleshooting table (Table 5-1) provides a number of hints on the location and solution of governing troubles.

Table 5-1. Troubleshooting

Trouble	Cause	Correction
1. Engine hunts or surges.	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 drive shaft.
	D. Foamy oil In governor—caused by air in oil.	Drain oil. Refill.
	E. Lost motion in engine linkage or fuel pumps.	Repair linkage and/or pumps.
	F. Binding in engine linkage or fuel pumps.	Repair and realign linkage and/or pumps.
	G. Fuel won't shut off or can't get full fuel, or both.	Change level length or position on governor terminal shaft until proper travel is attained (lever not usually provided by Woodward).
	H. Spring on yield linkage to fuel racks is too weak.	Install heavier spring.
	I. Low oil pressure. Normal operating pressure 250 psi (1724 kPa). Pump check valves are not seating.	Return governor to factory for adjustment.
	J. Voltage regulator not operating properly.	Check voltage regulator.
	K. Non-linear relationship between governor travel and horsepower output of the engine.	Adjust linkage from governor to valve to obtain linear relationship between governor travel and engine output.
	L. Load limit indicator binding on panel. Load limit shaft bent.	Replace damaged panel or load limit shaft.
2. Engine does not start or starts too slowly.	A. Cranking speed too low.	May be necessary to use a booster servomotor to open governor's power piston.
	B. Booster servomotor (If used) not functioning properly.	Check action of automatic air starting valve, air lines, and oil lines.
	C. Low oil pressure in governor.	Pump check valves inoperative. Return governor to factory for repair.
	D. Load limit knob limits fuel.	Set knob at 10.
	E. Solenoid shutdown not adjusted properly.	Readjust solenoid.
3. Jiggle at governor terminal shaft.	A. Rough drive, either the engine or the governor.	Inspect drive mechanism: a. Check alignment of gears. b. Inspect for rough gear teeth, eccentric gears, or excessive backlash In gear train. c. Check gear keys and nuts or set screws holding drive gears to shafts. d. Tighten chain between crankshaft and camshaft (if used). e. Check engine vibration damper (it used).
	B. Governor is not aligned properly.	Loosen mounting screws, disconnect linkage and rotate the governor back and forth about 90° on its mounting pad to align the drive shaft with its coupling. Tighten mounting screws.
	C. Failure of flexible drive in flyweight head. Ballhead frequency incorrect.	Return governor to factory to remove, disassemble, and clean flyweight head parts. Inspect centering spring.

IMPORTANT

The keyed drive can be a source of trouble because of its installation problems which include:

1. **Inherent side loading transmitted to the governor drive shaft from the bevel gear drive.**
2. **Shimming required to obtain proper mesh without binding or excessive backlash.**
3. **Necessity of checking the gear mesh and re-shimming as necessary each time the governor is changed. There is a danger that this check will be overlooked when a new governor is installed.**

If it is necessary to use a keyed drive, the gears used should be precision gears. When the governor is installed, the backlash must be checked and the gear shimmed so that there is no binding and the backlash is not too great. Refer to the prime mover manufacturer's specification for proper backlash.

Serrated drives offer few problems:

- **Concentricity of the drive shaft to drive coupling valve must be maintained;**
- **Coupling should be as long as possible to permit greater flexibility and a longer wear life.**

Trouble	Cause	Correction
4. Engine overspeeds when started.	A. Governor too slow.	Reduce compensation and open up needle valve.
	B. Speed setting too high.	Lower speed setting.
	C. Too much fuel.	Reduce booster stroke if booster is used. Limit fuel with load limit knob.
	D. Governor does not shut fuel pumps down completely.	Check that when governor is at zero, racks are at zero.
	E. Pilot-valve not centered.	Return governor to factory for adjustment.
	F. Low governor oil pressure.	Return governor to factory for adjustment.
5. Engine is slow to respond to a speed change or a load change.	A. Compensation adjustments incorrect.	Readjust compensating needle valve. Open further if possible. Compensation pointer may be too far toward maximum.
	B. Governor Is not sensitive in measuring speed change (deadband).	Sludge in governor. Clean governor. Friction or wear on flyweight toes. Return to factory for repair.
	C. Low oil pressure in governor.	Return governor to factory to Inspect pump and check valves if oil pressure Is low.
	D. Pilot valve not centered.	Return governor to factory for pilot valve adjustment.
	E. Engine may be overloaded.	Reduce load. Check load Indicator position.
	F. Restricted fuel supply.	Clean fuel supply filters.
	G. Load limit knob set to restrict fuel.	Increase load limit setting.
6. Engine unable to reach full load.	A. Governor at end of its stroke and fuel racks will not open far enough.	Adjust engine to governor fuel linkage.
	B. Governor at end of its stroke.	Adjust fuel pump stops.
	C. Low output from supercharger.	Clean or replace blower.
	D. Restricted fuel supply.	Clean fuel supply filters. Gas pressure low. Gas with different calorific value.

Trouble	Cause	Correction
7. Load does not divide properly on interconnect ed engines.	A. Speed settings of the governors are not the same.	Adjust speed setting so both engines have the same load.
	B. Speed droop adjustment incorrect.	Readjust droop to divide load properly. Increase droop to resist picking up (or dropping off) load. Reduce droop to increase picking up (or dropping off) load.
	C. Speed droop shaft vibrating out of position.	Return governor to factory so the tension on the speed droop friction spring can be increased.
8. System hunts In parallel. Single engine is stable.	A. Insufficient droop.	Increase droop.
	B. Insufficient generator damping.	Check with generator manufacturer.
	C. Resonance between frequency of installation and engine.	Check with engine or alternator manufacturer. Changing characteristics of governor may help. Check with Woodward.
9. Speed setting motor cannot change governor speed.	A. Friction clutch is slipping.	Adjust clutch as indicated in Chapter 2.
	B. Worn gears or gears binding.	Send governor to factory for repair.
10. Engine speed changes slowly over a period of time.	A. Engine vibration rotates speed setting motor armature.	Send speed setting motor to factory for installation of friction loading kit.

Chapter 6.
Replacement Parts

When ordering replacement parts, include the following information:

- Governor serial number and part number shown on nameplate
- Manual number (this is manual 03039)
- Parts reference number in parts list and description of part or part name

Parts for Figure 6-1

Ref. No.	Part Name	Quantity
03039-1	Ballhead bracket	1
03039-2	Screw, 0.312-24 x 0.750	2
03039-3	Shakeproof washer, 0.312	3
03039-4	Spring	2
03039-5	Accumulator cylinder	2
03039-6	Accumulator piston	2
03039-7	Dashpot spring	1
03039-8	Large dashpot link	1
03039-9	Large compensation piston	1
03039-10	Pin	1
03039-11	Shakeproof washer	1
03039-12	Screw, 0.375-24 x 1.500	1
03039-13	Plug 0.125-27	3
03039-14	Retaining ring	1
03039-15	Washer	1
03039-16	Retaining sleeve	1
03039-17	Roll pin, 0.125 dia. x 0.750	1
03039-18	Cotter pin, 0.062 dia x 0.625 long	1
03039-19	Ballhead gear driver	1
03039-20	Spring drive lamination	12
03039-21	Pump driven gear	1
03039-22	Check valve	2
03039-23	Seal strip	1
03039-24	Pilot valve bushing	1
03039-25	Pilot valve spring seat	1
03039-26	Pilot valve spring	1
03039-27	Nut	1
03039-28	Hex nut, 0.250-28	1
03039-29	Piston collar	1
03039-30	Compensating spring	1
03039-31	Spring seat	1
03039-32	Small compensation piston	1
03039-33	Power piston	1
03039-34	Pin	1
03039-35	Controlet	1
03039-36	Washer	1
03039-37	Torsion spring	1
03039-38	Cotter pin, 0.031 dia. x 0.375 long	1
03039-39	Dashpot cover	1
03039-40	Lever	1
03039-41	Pin	1
03039-42	Ph. rd. hd. screw, 10-32 x 0.500	2
03039-43	Shakeproof washer	2
03039-44	Pilot valve plunger	1
03039-45	Cotter pin 0.062 dia x 1.250 long	1
03039-46	Pin	1
03039-47	Floating lever	1
03039-48	Power link	1
03039-49	Pin	2
03039-50	Cotter pin 0.062 dia x 1.250 long	2
03039-51	Drive gear	1
03039-52	Hex hd. cap screw, 0.312-24 x 4.000	1
03039-53	Dowell Pin	2
03039-54 to 70		Not used

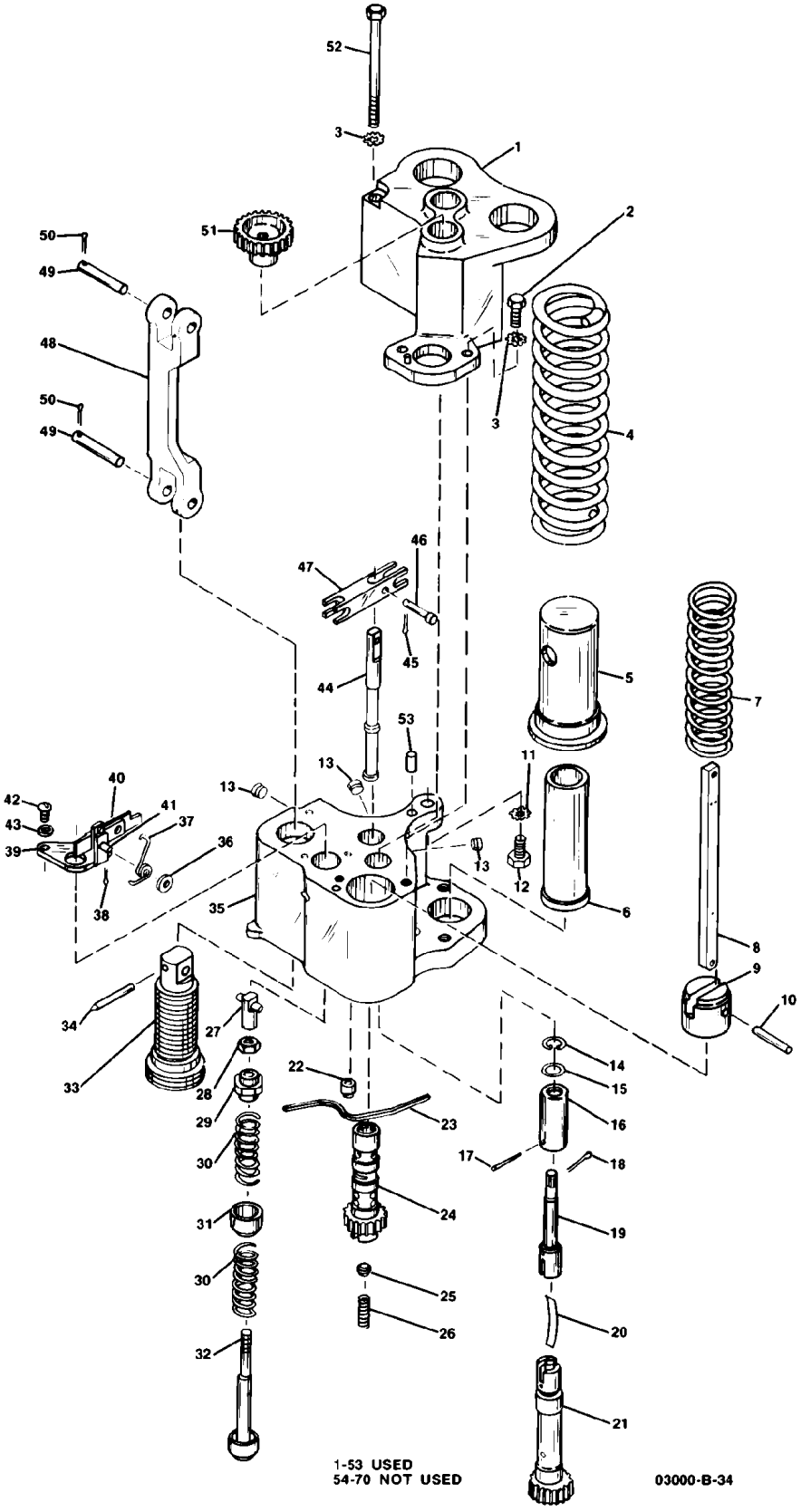

Figure 6-1. UG-40 Controlet Parts Illustration

Parts for Figure 6-2

Ref. No.	Part Name	Quantity
03039-71	Speed droop lever	1
03039-72	Cotter pin, 0.062 x 0.500 long	3
03039-73	Pin	1
03039-74	Speeder screw pin	1
03039-75	Speeder screw	1
03039-76	Speeder gear	1
03039-77	Speeder spring	1
03039-78	Lock nut, 0.250-28	1
03039-79	Thrust bearing	1
03039-80	Speeder rod spring	1
03039-81	Ballhead cover	1
03039-82	Flyweight pin	2
03039-83	Spring driven oil damped ballhead	1
03039-84	Needle bearing	4
03039-85	Flyweight	2
03039-86	Roll pin	4
03039-87	Ball bearing	1
03039-88	Torsion spring	1
03039-89	Ballhead assy	1
03039-90	Speeder rod	1
03039-91 to 100		Not used

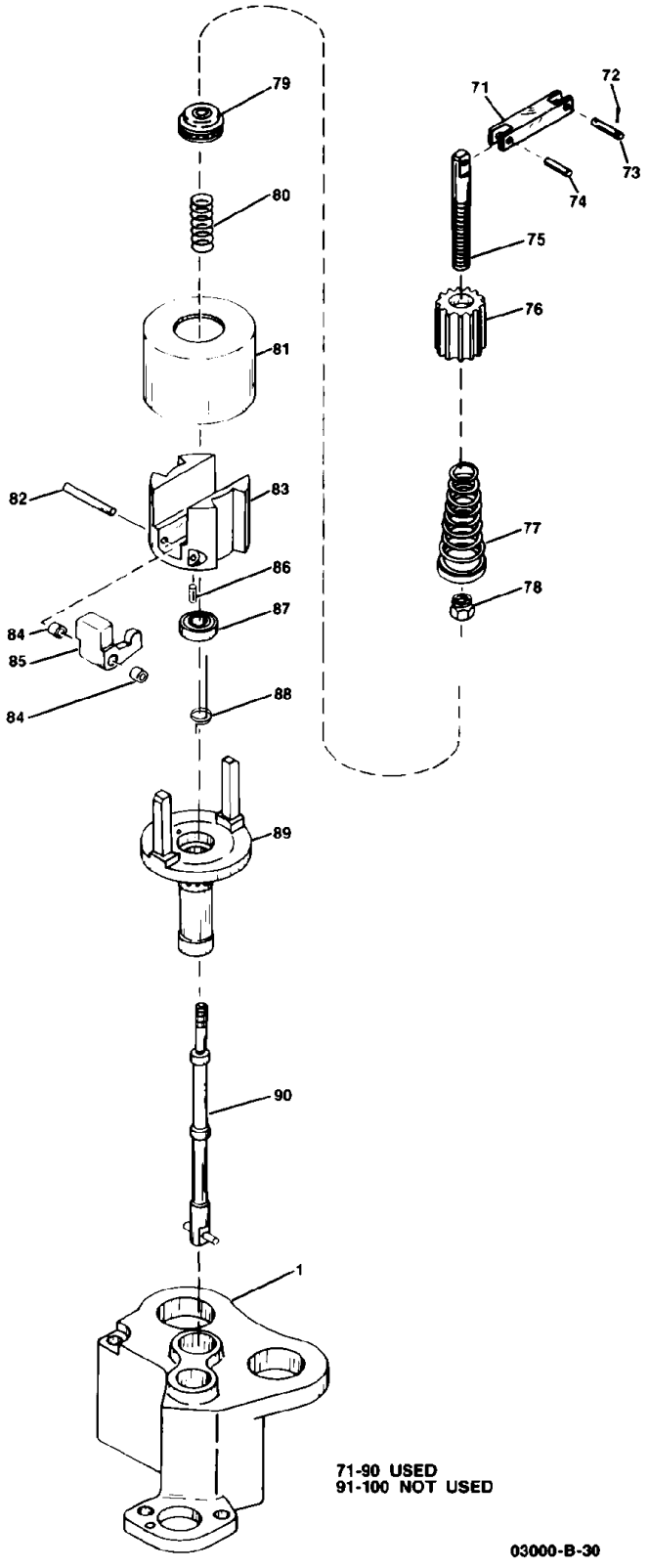

Figure 6-2. UG-40 Ballhead Parts Illustration

Parts for Figure 6-3

Ref. No.	Part Name	Quantity
03039-101	Base	1
03039-102	Dowel pin	4
03039-103	Check valve	2
03039-104	Plug, 0.125-27	4
03039-105	Plug, 0.250-18	1
03039-106	Compensating screw	1
03039-107	Washer, 0.328 x 0.531 x 0.031	1
03039-108	Plug, 0.312-24	1
03039-109	Washer, 0.376-381 x 0.625 x 0.031	13
03039-110	Screw, 0.375-24 x 0.875	13
03039-111	Gasket	1
03039-112	Oil seal retainer	1
03039-113	Oil seal	1
03039-114	Ball bearing	1
03039-115	Bearing retainer	1
03039-116	Screw, 0.250-28 x 0.625	3
03039-117	Drive shaft	1
03039-118	Key, 3/16 sq x 1.250 L	1
03039-119	Drive shaft adapter	1
03039-120	Retaining ring	1
03039-121	Cotter pin	1
03039-122	Nut	1
03039-123	Spacer	1
03039-124	Key, 3/16 sq x 1.250	1
03039-125	Drive shaft	1
03039-126	Lock wire (not shown)	AR
03039-127 to 150		Not used

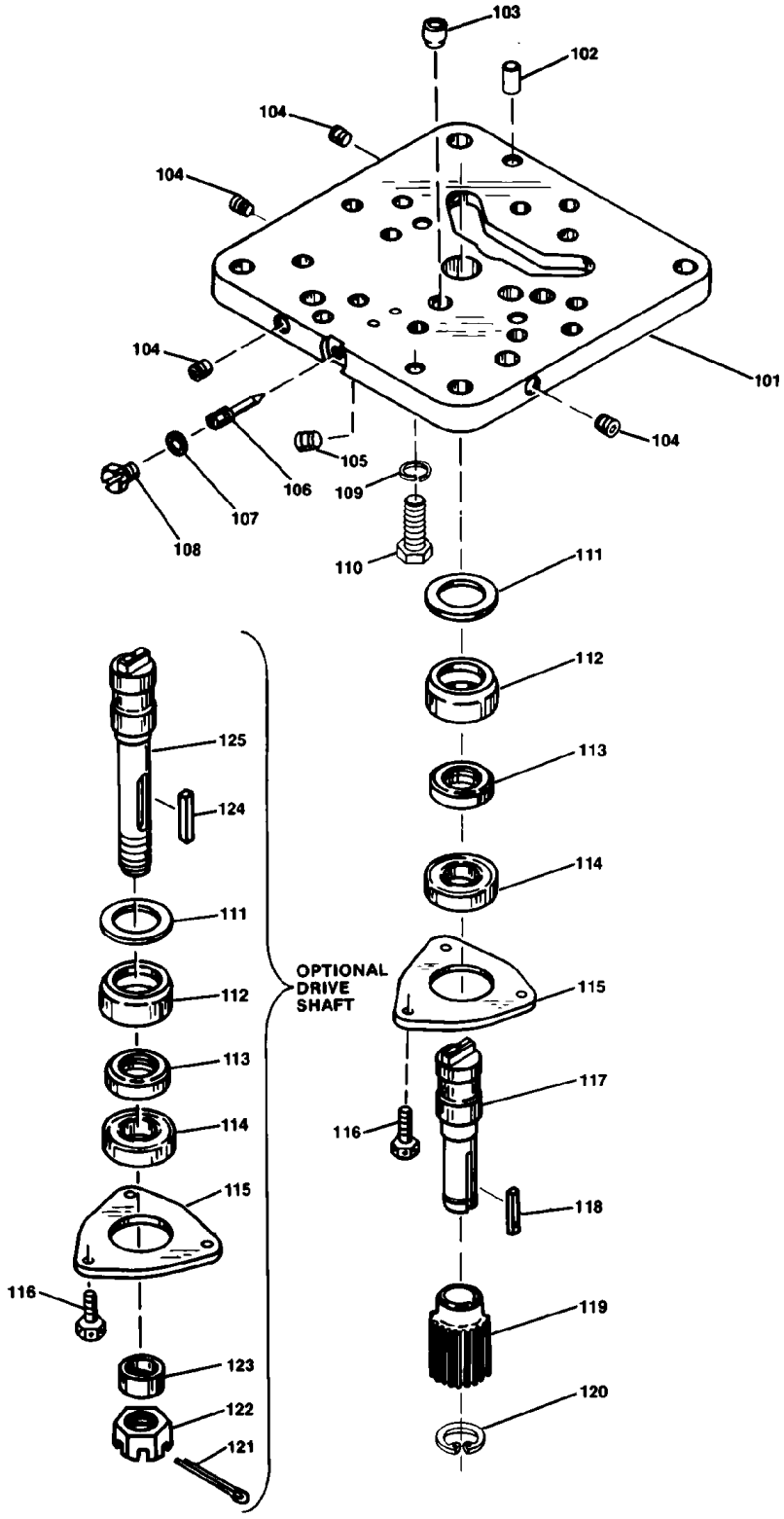

Figure 6-3. UG-40 Base Parts Illustration

Parts for Figure 6-4

Ref. No.	Part Name	Quantity
03039-151	Retaining ring	1
03039-152	Friction drive cover	1
03039-153	Spring	1
03039-154	Elastic HFX nut, 0.250-28	1
03039-155	Friction drive spring	1
03039-156	Friction drive case	1
03039-157	Drive plate	1
03039-158	Needle bearing	4
03039-159	Roll pin, 0.094 dia. x 0.500 L	2
03039-160	Speed droop cam	1
03039-161	Spring	1
03039-162	Pin	1
03039-163	Load limit cam	1
03039-164	Oilite bushing	2
03039-165	Gear	1
03039-166	Rack assy	1
03039-167	O-ring, 0.239 ID x 0.070	1
03039-168	Roll pin, 0.062 D x 0.500 L	1
03039-169	Gear	1
03039-170	Speed setting adjustment shaft	1
03039-171	Strap assy	1
03039-172	Pin	4
03039-173	Roll pin, 0.062 D x 0.625 L	3
03039-174	Soc. hd. screw, 8-32 x 0.312	4
03039-175	Knob	3
03039-176	Spring	1
03039-177	Washer, 0.365 OD	1
03039-178	Knob	1
03039-179	Load indicator pointer	1
03039-180	Indicator pointer	1
03039-181	Ph. pan hd. screw, 8-32 x 0.375	10
03039-182	Dial plate	1
03039-183	Shaft	1
03039-184	Oil seal	2
03039-185	Speed droop collar	1
03039-186	Oil seal	1
03039-187	Pin	1
03039-188	Pin	1
03039-189	Reduction gear	1
03039-190	Indicator shaft	1
03039-191	Gear	1
03039-192	Pin	1
03039-192A	Overspeed test catch	1
03039-192B	Overspeed test catch pin	1
03039-193	Spring clip	1
03039-194	Ph. hd. screw, 10-32 x 0.625	10
03039-195	Lock Washer, No. 10	10
03039-196	Roll pin. 0.188 D x 0.500 L	2
03039-197	Panel	1
03039-198	Screw	1
03039-199	Speed droop adjusting lever	1
03039-200	Nut	1
03039-201	Screw	1
03039-202	Speed droop spring	1
03039-203	Washer, 0.328 x 0.562 x 0.032 thick	1
03039-204	Cotter pin, 0.062 D x 0.625 L	1
03039-205	Fulcrum	1
03039-206	Ph. pan hd. screw, 8-32 x 0.375	2
03039-207	Shakeproof washer	2
03039-208	Guide	1
03039-209	Washer	2
03039-210	Lever	1
03039-211	Screw	2
03039-212	Plate	1
03039-213	Set screw 6-32	1
03039-214	Cover-friction	1
03039-215	Friction disc	1
03039-216	Washer 0.750 OD	1
03039-217	Friction washer spring	1
03039-218	Screw-speed adjust	1

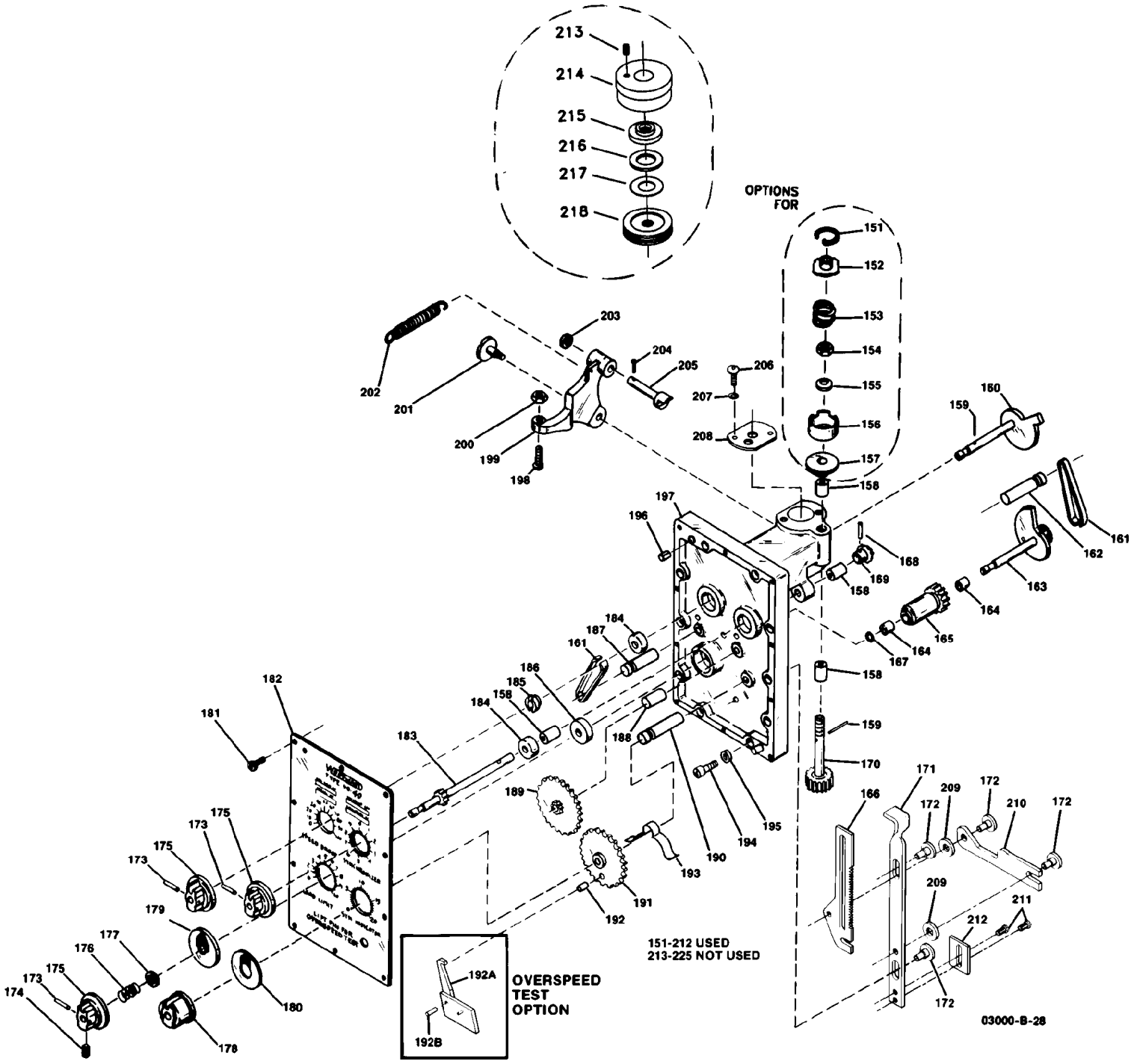

Figure 6-4. UG-40 Front Panel Parts Illustration

Parts for Figure 6-5

Ref. No.	Part Name	Quantity
03039-226	Case	1
03039-227	Roller bearing	2
03039-228	Oil seal	2
03039-229	Terminal shaft	1
03039-230	Cotter pin, 0.094 D x 1.25 L	1
03039-231	Pipe plug	1
03039-232	Elastic nut, 0.312-24	1
03039-233	Washer, 0.328 x 0.562 x 0.064 thick	1
03039-234	Compensation pointer	1
03039-235	Washer, 0.453 x 0.750 x 0.032 thick	1
03039-236	Drive screw	2
03039-237	Compensation plate	1
03039-238	Pin, .0187 OD x 0.750	2
03039-239	O-ring, 0.301 ID x 0.070	1
03039-240	Compensation lever	1
03039-241	Fulcrum	1
03039-242	Elbow	1
03039-243	Oil gauge	1
03039-244	Slide block	1
03039-245	Compensation link	1
03039-246	Pin	1
03039-247	Cotter pin, 0.062 D x 0.875 L	1
03039-248	Compensating lever	1
03039-249	Taper pin, No. 5 x 2.000	1
03039-250	Spacer	1
03039-251	Pin	1
03039-252	Power lever	1
03039-253	Lock washer, 0.375 ID	1
03039-254	Sock hd. cap screw, 0.375-24 x 1.250	1
03039-255	Pin	1
03039-256	Cotter pin	1
03039-257	Droop link	1
03039-258 to 275		Not used

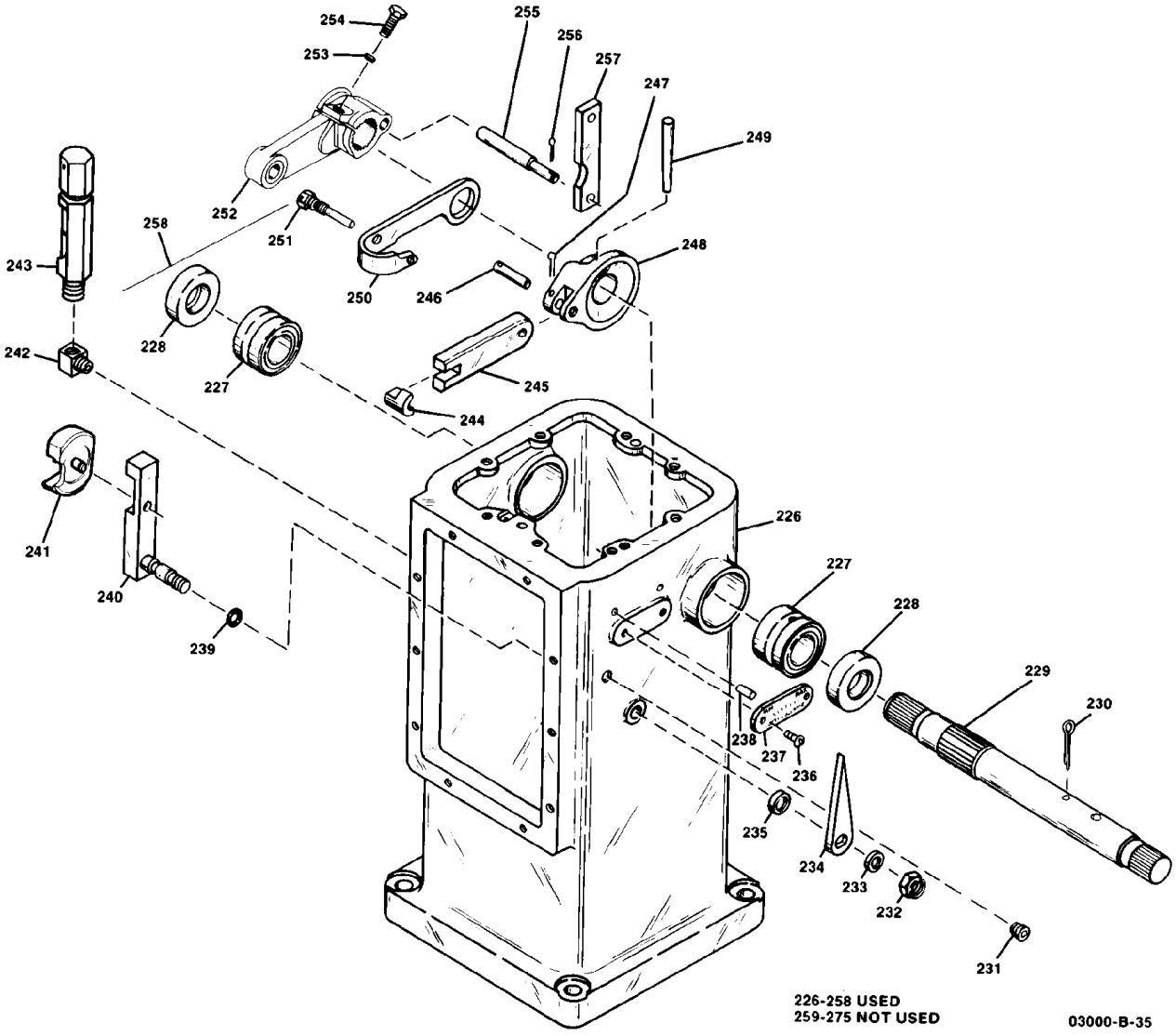

Figure 6-5. UG-40 Case Parts Illustration

Parts for Figure 6-6

Ref. No.	Part Name	Quantity
03039-276	Motor assy	1
03039-277	Motor seal spring	1
03039-278	Bracket	1
03039-279	Fil. hd. screw, 8-32 x 0.438	4
03039-280	Shakeproof washer, 8	4
03039-281	Ph. fl. hd. screw, 10-32 x 0.375	4
03039-282	Lock washer, 0.250	8
03039-283	Hex hd. cap screw, 0.250-28 x 1.000	8
03039-284	Cover	1
03039-285	Oil cup	1
03039-286	Cover gasket	1
03039-287	Gasket (base)	1
03039-288	Panel gasket	1
03039-289	Oil cup	1
03039-290	Cover	1
03039-291	Loktite adhesive TL242	AR

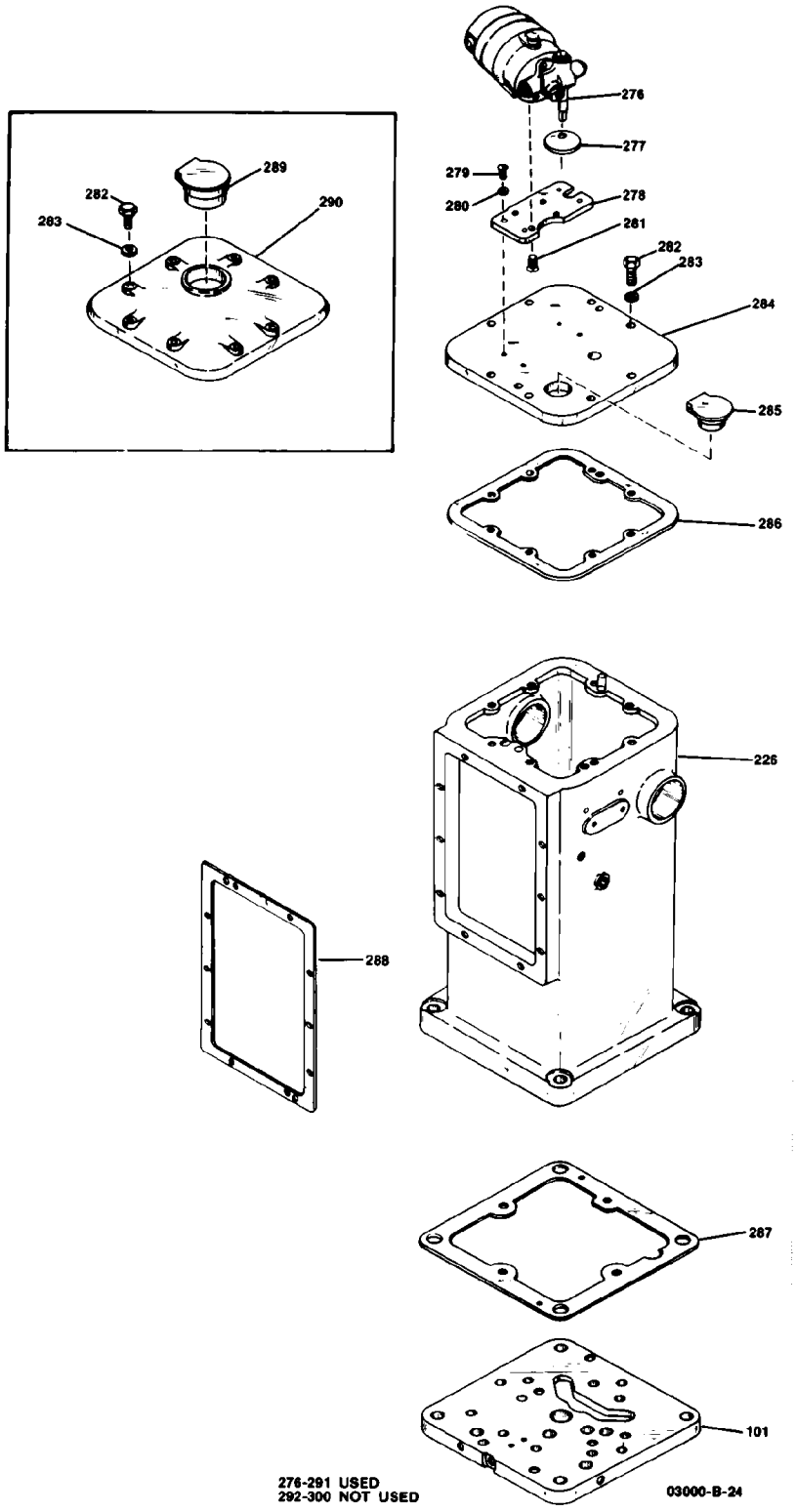

Figure 6-6. UG-40 Dial Cover Parts Illustration

Parts for Figure 6-7

Ref. No.	Part Name	Quantity
03039-301	Oil cap	1
03039-302	Low speed stop screw	1
03039-303	Nut hex, 0.312 x 18	1
03039-304	Hex head screw	8
03039-305	Hi-collar lock washer	8
03039-306	Cover	1
03039-307	Gasket, cover to case	1
03039-308	Gear segment, speed set	1
03039-309	Compensating lever stop pin	1
03039-310	High speed stop screw	1
03039-311	Lock nut	1
03039-312	Washer	1
03039-312A	Bushing	1
03039-313	Control shaft bushing	2
03039-314	Oil seal	2
03039-315	Roller bearing	2
03039-316	Oil seat	2
03039-317	Cotter pin, 3/32 x 1 inch	2
03039-318	Control shaft	1
03039-319	Terminal shaft	1
03039-320	Cotter pin, 3/32 x 1-1/4 inch	1
03039-321	Compensating pointer indicator plate	1
03039-322	Drive screw	2
03039-323	Oil sight gauge	1
03039-323A	Oil gauge fitting	1
03039-324	Compensating lever	1
03039-325	O-ring	1
03039-326	Compensating adjusting lever	1
03039-327	Compensating adjusting fulcrum	1
03039-328	Compensating adjusting link	1
03039-329	Slide block	1
03039-330	Taper pin, number 5	1
03039-331	Cotter pin. 0.082 x 0.812	1
03039-332	Compensating lever link pin	1
03039-333	Pipe plug, 0.125 NPTF	4
03039-334	Flat washer	1
03039-335	Compensating adjusting pointer	1
03039-336	Flat washer	1
03039-337	Elastic stop nut, 0.312-24	1
03039-338	Case	1
03039-339	Spacer link	1
03039-340	Compensating link pin	1
03039-341	Lock wire	1
03039-342	Power lever	1
03039-343	Hex head bolt	1
03039-343A	Lock washer	1
03039-344	Shutdown rod	1
03039-345	Bushing	1
03039-346	Speeder plug	1
03039-347	Cotter pin, 0.062 x 0.812	2
03039-348	Drilled pin, 0.249 x .0312	1
03039-349	Shutdown nut, 8-32	1
03039-350	Speed droop cam	1
03039-351	Speed droop lever	1
03039-352	Flat washer	1
03039-353	Shakeproof washer, No. 10	3
03039-354	Hex head screw, 10-32 x 0.375	1
03039-355	Cotter pin	1
03039-356	Speed droop link pin	1
03039-357	Speed droop link	1
03039-358	Link pin	1
03039-359	Cotter pin	1
03039-360	Flat washer	1
03039-361	Lock nut	1
03039-362	Cotter pin	1
03039-363	Retaining ring	1
03039-364	Nut. 8-32	2
03039-365	Speeder plug	1
03039-366	Speeder spring	1
03039-367	Pilot valve plunger nut	1
03039-368	Cotter pin	1
03039-369	Shutdown rod	1
03039-370	Speeder rod	1
03039-371	Spacer	1
03039-372	Low speed stop	1
03039-373	High speed stop	1
03039-374	Set screw, 0.250-28 x 1.500	1
03039-375	Nut, 0.250 -28, hex	1
03039-376	Speeder adjusting gear segment	1
03039-377	Gasket, case to base	1
03039-378	0.375-24 stud	1
03039-379	Phillips binding head screw	12
03039-380	Pipe plug	1
03039-381	Nameplate	1
03039-382	Shaft scale (left, right)	2
03039-383	Round head 6-32 screw	4
03039-384	Terminal shaft Indicator disk	2
03039-385	Speed adj indicator disk	2
03039-386	Set screw (10-32)	2

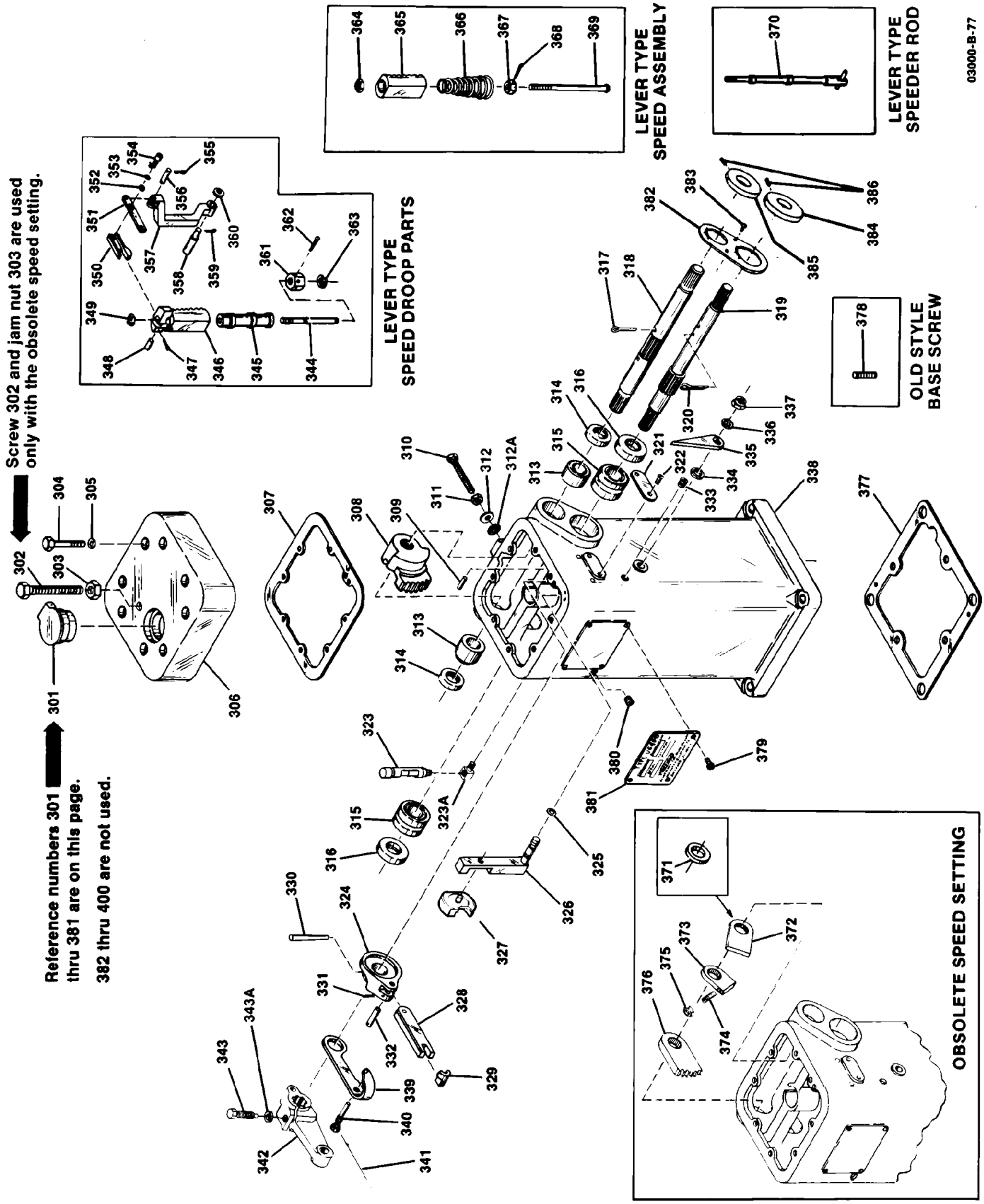

Figure 6-7. UG-40 Lever Case Parts Illustration

Chapter 7.
Product Support and Service Options

Product Support Options

IMPORTANT **UG governors have the same overhaul interval as the prime mover.**

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Revision History

Changes in Revision C—

- Added overhaul interval information to Chapter 7

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 03039C.

B03039:C

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as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.