



EGB-1P and EGB-2P
Governor/Actuator

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

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The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.



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.



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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 Out-of-date translations are marked with .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.

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Warnings and Notices

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.

Regulatory Compliance

North American Compliance:

These listings are limited only to those EGB2P Governors bearing the CSA identification.

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, & D, T4 at 93 °C ambient. For use in Canada and the United States. CSA 1987834.

Special Conditions for Safe Use:

Wiring must be in accordance with North American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Field wiring must be suitable for at least 125 °C.

Connect ground terminal to earth ground.

Chapter 1.

General Information

Introduction

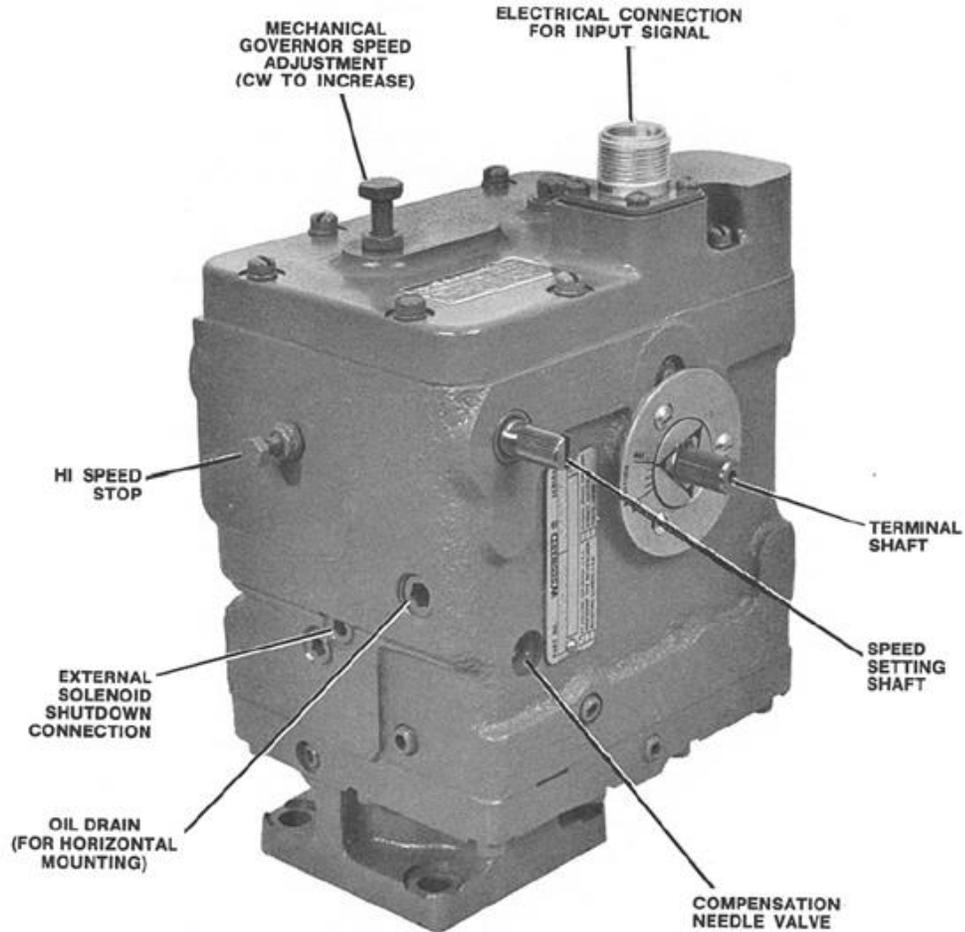


Figure 1-1. EGB-2P Governor/Actuator

This manual provides description, installation, operation, adjustments, maintenance, auxiliary devices and replacement parts information for the EGB-2P Governor/Actuator.

The EGB-1P is used in high performance applications requiring fast acting responses with lower work output. The EGB-1P has the same mounting pad, drive shaft and terminal shaft configuration as the EGB-2P. Internal parts are also identical except for the power piston. The EGB-1P uses a smaller size power piston (see Figures 5-16a and 7-1).

Information given in this manual regarding the EGB-2P also applies to the EGB-1P.

The EGB-2P and -1P actuators are proportional electro-hydraulic actuators combined with isochronous or droop mechanical-hydraulic governors. Both actuators have 32 degrees of maximum output shaft travel. Recommended travel from the no load to the full load position is 2/3 of full actuator travel.

See Figure 1-2 for a graphic representation of maximum work capacity for the actuator, and related actuator output shaft travel information.

A description of the EGB-2P governor/actuator is given in this chapter. This information includes general information about the system, the available adjustments, and the different arrangements available.

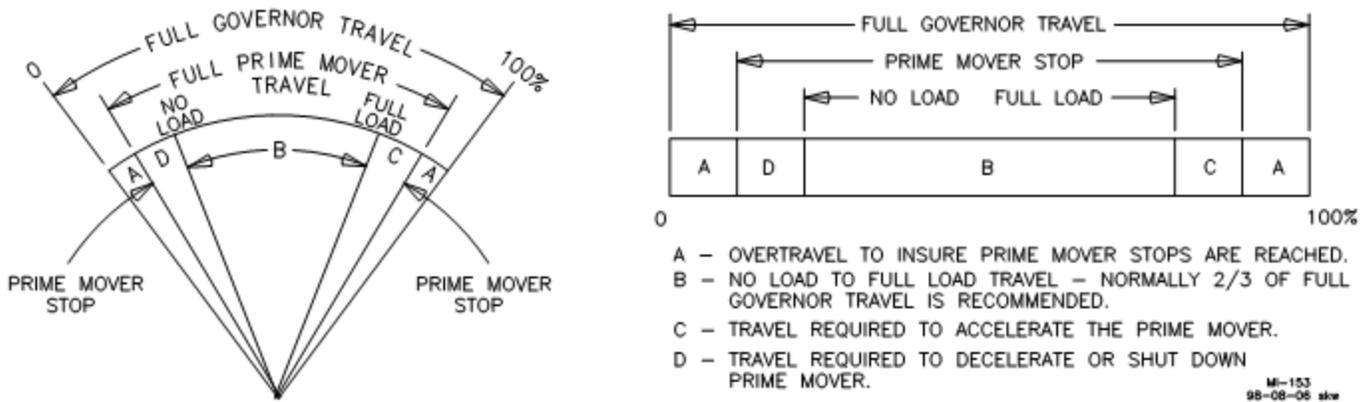


Figure 1-2. EGB-2P and -1P Work Output

Description

Governor/Actuator

The EGB-2P is a proportional actuator with a mechanical backup governor. The proportional actuator's terminal (output) shaft position is directly proportional to the magnitude of the output signal from the electronic control unit. The uses and functions of a proportional actuator are different and distinct from integrating types of EG actuators. The EGB-2P actuator must be used with the Woodward 2301 or 2500 integrating electronic control to form a complete governing system. By comparison, the EGB-2C is an integrating actuator with the companion EGA control box being basically a proportional amplifier.

While proportional actuators can be used in the same type of service as other actuator models, they are particularly well suited to engines operating in tandem to drive a common load. In such installations, one electric control can be used for two proportional actuators wired in series with the control's output, to furnish the same input signal to each actuator. Since each actuator receives the same signal, their output shafts take the same position and give each engine the same fuel.

Externally, the EGB-2P is similar in size and appearance to the EGB-2C actuator. Internally, each has two sections: an electric actuator section and a mechanical governor section. The mechanical governor section acts as a backup governor in the event of failure of the electric control. The electric actuator section is different in function and construction. The actuator section of the EGB-2P includes feedback linkage from its power piston to its pilot valve to give the proportional feature to the actuator.

The proportional actuator requires a continuous electric input signal (in contrast to the nominally zero input signal under steady-state conditions for integrating type actuators). Woodward electronic controls are used to furnish the control input signal for the proportional actuator. The exact control used depends on the operating scheme of the installation. Control assemblies are available to sense speed, frequency, load, and other combinations.

The essential element of the actuator section of the EGB-2P is an electro-hydraulic transducer which directs pressure oil to and from the power piston to actuate the fuel or steam control mechanism. The transducer consists of a solenoid attached to the pilot valve plunger to control oil flow to and from the power piston. The solenoid responds to the given output of the electric control, and, in so doing, moves the pilot valve plunger down directing oil to the power piston. Through connecting linkage, the power piston moves the terminal shaft of the actuator. The engine or turbine fuel linkage attaches to the actuator terminal shaft.

While strict linearity of terminal shaft travel versus load is not required, we recommend that the linkage be arranged to give the same degree for linearity afforded conventional speed sensing governors.

The mechanical governor section has three operating adjustments. Once set, these adjustments do not usually require further adjustment.

1. Speed setting; an external adjustment Used to set the speed at which the mechanical governor will control.
2. Speed droop; an internal adjustment used to permit parallel operation of units controlled by the mechanical governor.
3. Needle valve; an external adjustment used to stabilize the mechanical governor. See Figure 1-4 for adjustment location.

The actuator section of the EGB-2P has no external operating adjustments.

The actuator uses oil from the engine lubricating system or from a separate sump (not furnished by Woodward). It does not have a self-contained sump.

EGB-2P governor/actuators are available with the terminal shaft extending from either or both sides of the case. They can be furnished with the speed adjusting shaft (for the mechanical governor section) extending on either side. However, most units use a speed adjusting screw in the top cover and omit the speed adjusting shaft entirely.

Direct and Reverse Acting Types

EGB-2P actuators are available in either the direct or the reverse acting type.

The direct acting actuator operates with electronic controls which produce an increasing positive voltage to the actuator as fuel increase is required. Pin A is positive and pin B in actuator receptacle is negative, see Figure 5-28. The terminal shaft of the direct acting actuator goes to shutdown on loss of control voltage and thus provides a failsafe feature. However, mechanical governing control will not start on its own, operator intervention is needed, and one of three ways must be used to operate the actuator:

1. A 9 to 12 V battery placed across A (+) & B (-). (See Figure 5-28.)

2. A pneumatic start device, using an 80 to 240 psi (550 to 1650 kPa) air signal. (See Auxiliary Devices, Chapter 6.)
3. A manual override device, by pushing and turning a knob mounted on top of the EGB-2P. (See Auxiliary Devices, Chapter 6.)

All three methods hold the actuator pilot valve below center to keep the actuator piston in its full up position as needed to obtain mechanical governor control.

When using a reverse acting actuator, none of the above is needed as a loss of control voltage causes the actuator to go to maximum fuel.

The reverse acting actuator operates with electronic controls which produce a decreasing positive voltage to the actuator as a fuel increase is required. Pin A is positive and pin B is negative in the actuator receptacle, see Figure 5-28. The terminal shaft of the reverse acting actuator goes to maximum fuel on loss of control voltage. The transfer from electrical actuator operation to mechanical governor operation takes place on its own. This is not meant to imply that an automatic operational transfer will take place (same speed setting, same load sharing capability).

IMPORTANT

To change a direct acting actuator to a reverse acting actuator or vice versa, the actuator calibration must be changed as well as the internal wiring polarity.

Speed Droop

Speed droop is adjustable (internally) between zero and twelve percent. Maximum amount of droop is reduced if terminal shaft travel is shortened. Speed droop permits load division between two or more engines driving generators operating in parallel or driving a common load on a single shaft. If the engine is operated alone the governor may be set for zero droop (isochronous operation).

Parallel engine-generator units should have droop set sufficiently high to prevent the units from interchanging load. If one unit in the plant or system has enough capacity, its governor may be set on zero droop to provide isochronous operation. By maintaining constant speed, this unit regulates the frequency of the entire system. Isochronous operation permits this unit to absorb all load changes within the limits of its capacity and also control frequency if its capacity is not exceeded.

The system frequency is adjusted by changing the speed setting of the governor operating isochronously. Load distribution between units is accomplished by changing the speed setting of the governor(s) having speed droop.

External Solenoid Shutdown

Since no governor mounted shutdown device is available for this small actuator/governor, it is common practice to apply an external solenoid for shutdown. The solenoid allows the governor control oil to drain to the prime mover oil sump and thus create a shutdown.

Two factors are of primary importance in utilizing external solenoid shutdowns. First is the location of the solenoid. Figure 1-3 following shows the proper connection. Once a suitable connection is decided, the solenoid must be connected with tubing runs as short as possible. The solenoid must also be mounted below the governor and oriented so that it does not fill with air. Air trapped by the tubing causes governor instability.

The second consideration is solenoid size. The solenoid and all connected tubing must pass enough flow to ensure that the governor moves to minimum position and remains there. Shutdown of the EGB-2P Governor/Actuator is accomplished by draining oil from the increase fuel side of the compensating land on the actuator pilot valve. This forces the pilot valve to drain control oil to move the power piston to minimum fuel. Since this is a restricted flow, the solenoid for the EGB-2P must flow 0.6 US gal/min (2.3 L/min) with a maximum pressure drop of 10 psi (69 kPa). Therefore, different flow capabilities are required depending on rated governor speed.

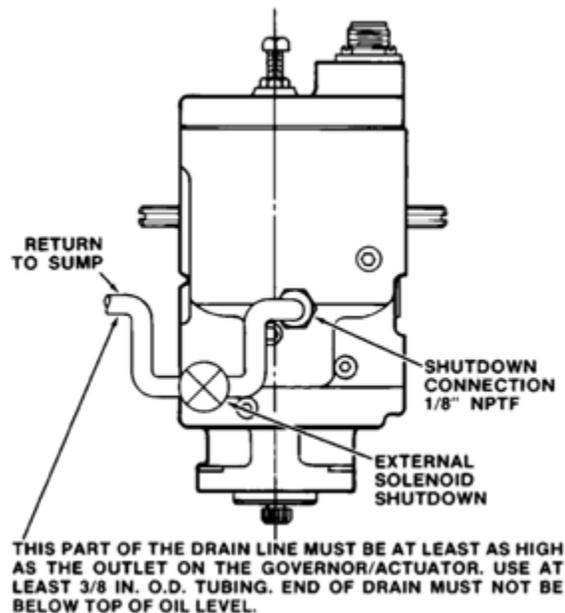


Figure 1-3. Solenoid Shutdown Connection

The shutdown solenoid can be used for normal shutdown and/or as a backup to the safety shutdown system. The engine, turbine, or other type of Prime Mover should be equipped with safety systems entirely separate from the governor. However, the safety system may be interfaced with the shutdown solenoid to cause the governor or actuator to go to minimum during safety systems shutdown. As with all safety shutdowns, proper operation should be confirmed periodically. See the prime mover manufacturer's instructions.



WARNING

The shutdown solenoid must not be used as an overspeed protective device. Overspeed protection must come from a unit completely separate from the EGB-2P or -1P control.

Chapter 2. Installation Procedures

General Installation

Using a gasket between the base of the unit and the mounting pad, mount the governor/actuator unit on the mounting pad. Square the unit with the engine linkage and in line with the drive. Fit the splined drive shaft into the drive with a free, slip fit; no tightness is permitted. The unit must fit the mounting pad of its own weight without any force being applied. Also, be sure there is a free discharge of oil through the drive shaft bore and annulus within the base mounting pilot. The drain must be a free flowing gravity drain with no back pressure. Keep the end of the overboard drain line above the sump oil level.

IMPORTANT

The gasket must allow passage of supply oil when oil is supplied through the base. The gasket must also allow for free discharge of oil.

Terminal shaft angular travel is approximately 32 degrees. Design and adjust the fuel linkage to use approximately 21° of the terminal shaft travel from no-load to full-load. Adjustment of the fuel linkage must provide for the control of fuel from "OFF" to "FULL FUEL" within the limits of the actuator output travel. The engine linkage must not bind and backlash must be minimal. If there is a collapsible member in the linkage, it must not yield when unit moves the linkage rapidly. Relation between engine torque output and terminal shaft travel must be approximately linear.

IMPORTANT

If the installation must be changed from vertical to horizontal, or vice versa, a plug must be added or removed, and a new calibration is needed. Return the unit to Woodward for calibration.

Linkage Adjustment

Maximum and minimum lines on the terminal shaft dial plate (136 on Figure 7-1) indicate the limits of terminal shaft travel during normal operation (approximately 32°). The pointer (138) is pre-set at the factory and should not be moved.

Notice that the EGB-2P has excess travel in the decrease fuel direction when the prime mover is not running.

WARNING

Do not use the physical minimum stop of governor terminal shaft to align fuel linkage since this position will not be reached when operating. Instead, set the linkage so the prime mover's fuel control is at its minimum fuel position when the EGB-2P pointer is just above the minimum fuel mark on the dial.

Electrical Connections

The EGB-2P is provided with a 2-pin electrical connection Bendix “RB” 2 Pole, No. 10-42212-3P. The mating plug may be a two pole, Straight plug, MS-3106A12S-3S. See Figure 5-28, EGB-2P Governor/Actuator Wiring Diagrams, for direct acting and reverse acting electrical connections.

Normal input current range is 20 to 160 mA. Maximum allowable current is 200 mA during normal operation and 400 mA during centering operation. (For information on centering operation, see Chapter 4, Adjustments.)

Governor/Actuator Drive

The actuator’s flyweight head is driven directly from the engine by the governor/actuator drive. For best results, operate the unit in the range of 2600 to 4000 rpm at normal operating speed. One-third horsepower is required to drive it at 3600 rpm at normal operating conditions.

A smooth drive is important to prevent false speed change signals to the governor flyweights. Attempting to correct for these changes, results in a continual vibration of the actuator terminal shaft and engine fuel linkage.

Normally, drive shaft rotation can be in either direction without making any changes in the unit. Check for correct direction of rotation before actually driving the unit.

Operating temperature range for the governor/actuator is 0 to 200 °F (–18 to +93 °C) (with proper viscosity oil).

Oil Supply

Connect a 3/8 inch O.D. tubing oil line from the oil supply to either of the two 1/8 inch pipe tapped inlet holes of the unit. A minimum of 5 psi (34 kPa) oil pressure is required at the unit end of the line. Maximum supply pressure is 50 psi (345 kPa). If a separate sump is used (rather than engine lubricating oil), the distance the mechanical governor must lift the oil should not exceed 12 inches (30 cm), and a foot valve with a capacity of 2 US gal/min (7.6 L/min) must be used. Operating oil pressure is 300 to 350 psi (2068 to 2413 kPa) plus supply oil pressure. (Maximum supply oil pressure is 50 psi [345 kPa].)

When oil from the engine lube system is used, install a 2 US gal/min (7.6 L/min), 20 to 25 μ m filter in the oil supply line. Oil supply to the governor/actuator can be either through a supply hole in the actuator case, or through an oil inlet in the actuator base, depending upon the option selected. See Figure 1-4, Outline Drawing. Filter is not supplied by Woodward.



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.



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.

Use an oil depending on operating temperature for the governor (see Table 2-1).

IMPORTANT

Primary concern is for the oil properties in the governor.

Use the information given in Tables 2-1 and 2-2 as a guide in the selection of a suitable lubricating/ hydraulic oil. Oil grade selection is based on the operating temperature range of the actuator. Also, use this information to aid in recognizing and correcting common problems associated with oil used in products manufactured by Woodward.

For applications where the actuator shares the oil supply with the engine, use the oil recommended by the engine manufacturer.

Actuator oil is both a lubricating oil and a hydraulic oil, It must have a viscosity index that allows it to perform over the operating temperature range and it must have the proper blending of additives that cause it to remain stable and predictable over this range.

Actuator oil must be compatible with seal materials (nitrile, polyacrylic, and fluorocarbon). Many automotive and gas engine oils, industrial lubricating oils, and other oils of mineral or synthetic origin meet these requirements. Woodward actuators are designed to give stable operation with most oils with the viscosity, at the operating temperature, between 50 and 3000 SUS (Saybolt Universal Seconds). At the normal operating temperature, the viscosity should be between 100 to 300 SUS. Poor actuator response or instability may be an indication that the oil viscosity is outside this range.

Excessive component wear or seizure in an actuator indicates the possibility of:

1. Insufficient lubrication caused by:
 - a. An oil that flows slowly when it is cold, especially during start-up.
 - b. An oil line with restrictions caused by either obstructions within or bends in the line (for external supply actuators only).
 - c. No oil in the actuator.
2. Contaminated oil caused by:
 - a. Dirty oil containers.
 - b. An actuator exposed to heating up and cooling down cycles, which creates condensation of water in the oil.
3. Oil not suitable for the operating conditions caused by:
 - a. Changes in ambient temperature.
 - b. An improper oil level which creates foamy, aerated oil.

Operating an actuator continuously beyond the high limit temperature of the oil will result in oil oxidation. This is identified by varnish or sludge deposits on the actuator parts. To reduce oil oxidation, lower the actuator operating temperature with a heat exchanger or other means, or change to an oil more oxidation resistant at the operating temperature.

**WARNING**

A loss of stable governor control and possible engine overspeed may result if the viscosity exceeds the 50 to 3000 SUS range.

Specific oil viscosity recommendations are given on the Oil Chart (Table 2-1). Select a readily available good brand of oil, either mineral or synthetic, and continue using that same brand. Do NOT mix the different classes of oils. Oil that meets the API (American Petroleum Institute) engine service classification in either the “S” group or the “C” group, starting with “SA” or “CA” through “SF” and “CD” is suitable for actuator service. Oils meeting performance requirements of the following specifications are also suitable: US MIL-L-2104A, MIL-L-2104B, MIL-L-2104C, MIL-L-46152, MIL-L-46152A, MIL-L-46152B, MIL-L-45199B.

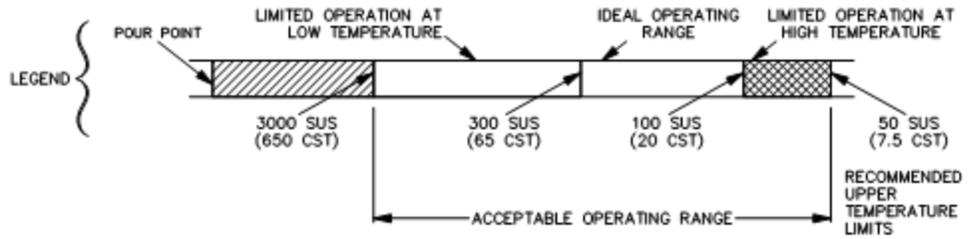
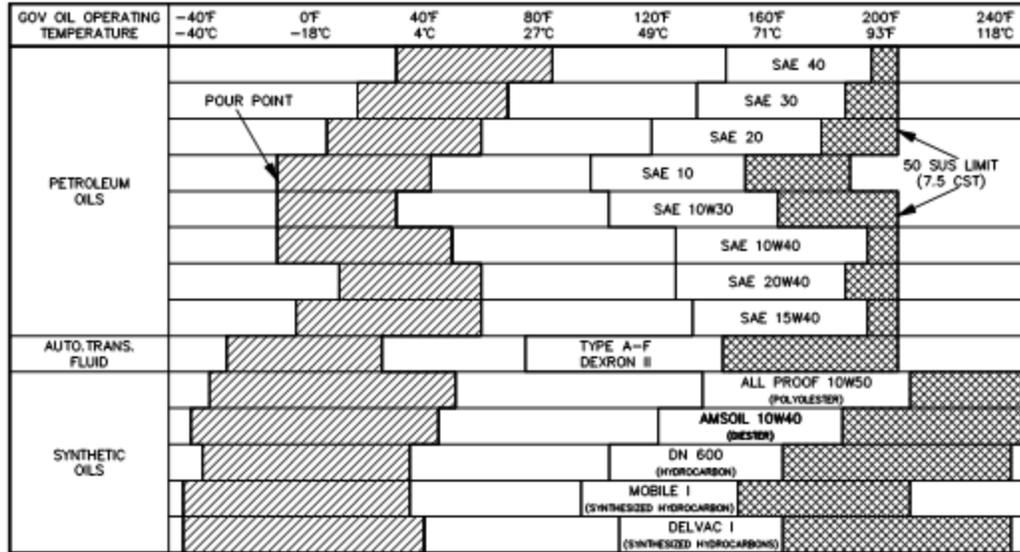
Be sure engine oil is kept clean and free from contamination. Dirty or contaminated engine oil can cause poor governing control, erratic operation, and excessive actuator/governor wear.

Any persistent or reoccurring oil problems should be referred to a qualified oil specialist for solution.

The recommended continuous operating temperature of the oil is 140 to 200 °F (60 to 93 °C). The ambient temperature limits are –20 to +200 °F (–30 to +93 °C). Measure the temperature of the actuator on the outside lower part of the case. The actual oil temperature will be slightly warmer, by approximately 10 °F (6 °C).

ANY OIL LISTED IS ONLY A SUGGESTION. USE THE OIL OF YOUR CHOICE WITH THE CORRECT VISCOSITY AS INDICATED IN THE CHART.

RECOMMENDED UPPER LIMIT OF PETROLEUM OIL IS 200°F
 RECOMMENDED UPPER LIMIT OF SYNTHETIC OIL IS 250°F



250-079

Table 2-1. Oil Chart

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

250-087
97-11-04 skw

Table 2-2. Viscosity Comparisons

Chapter 3.

Principles of Operation

Introduction

This chapter provides information concerning the functional operation of the EGB-2P. The schematic arrangement of the EGB-2P is shown in Figure 3-1 with parts in relative positions assumed during normal operation. Oil enters the unit through either of the two inlet holes in the side of the base. The oil passes from the suction to the pressure side of the pump. After filling the oil passages, the pump builds up the oil pressure. When the pressure is great enough to overcome the relief valve spring force and push the relief valve plunger back to uncover the bypass hole, the oil recirculates through the pump.

Rotation of the pump in the opposite direction from that shown in Figure 3-1, closes the open check valves and opens the closed check valves.

The loading piston positions the terminal shaft. Constant oil pressure is applied to the upper side of the loading piston always tending to move it in the “decrease fuel” direction. Either the governor power piston or the actuator power piston can move the loading piston in the “increase fuel” direction since the effective area on which the control oil pressure acts is greater on the power piston than on the loading piston.

In the event of an electric failure, the direct acting actuator goes to minimum fuel and thus provides a failsafe feature. However, mechanical governing control will not start on its own. The operator must intervene and use one of two ways to cause the actuator to become operative again.



Be sure the mechanical governor can control the prime mover speed before the operator causes the actuator to become operative again.

Turning the speed-setting screw clockwise on the mechanical governor increases speed setting and turning the speed-setting screw counterclockwise (anti-clockwise) decreases speed setting.

After adjusting the speed-setting screw to ensure that the mechanical governor will control the prime mover speed, use one of the two following methods to cause the actuator to become operative again:

1. If the actuator is equipped with a manual override knob on the cover (see Chapter 6), push the override knob down and turn it to the right to lock out the actuator control.
2. If the actuator is not equipped with a manual override knob, place a 9 volt battery across actuator terminals A (+) and B (-). See Figure 5-28.

When using a reverse acting actuator, none of the above is needed, as a loss of control voltage causes the actuator to go to maximum fuel and mechanical governing control starts on its own.

Actuator Control

During normal operation the actuator is controlling. At this time the mechanical governor power piston is at the top of its stroke (for reasons to be discussed later).

The actuators' pilot-valve plunger controls the flow of oil to and from its power piston. The pilot-valve plunger is connected to an armature magnet which is spring-suspended in the field of a two-coil polarized solenoid. The output signal from the electric control is applied to the polarized coil, and produces a force, proportional to the current in the coil. Position of the actuator shaft is proportional to the electric input signal to the actuator.

When the unit is running under steady state conditions, the compression spring force, the restoring spring force and magnetic forces always balance, and the pilot-valve plunger is "centered". The control land of the plunger covers the control port in the pilot-valve bushing and no oil flows to or from the power piston.

If the signal from the electric control decreases (due to an increase in engine or turbine speed or a decrease in unit speed setting), the compression spring force, now relatively greater, raises the pilot-valve plunger. Oil under the actuator power piston drains to sump. The oil pressure constantly applied to the upper side of the loading piston now forces both pistons down and the floating lever pivots about its connection to the mechanical governor power piston. The terminal shaft rotates in the "decrease fuel" (or steam) direction as the pistons move down.

As the actuator power piston moves down, it lowers the left end of the first restoring lever. The clamping plate, attached to the first restoring lever, pushes down on the second restoring lever. The loading on the restoring spring is thereby increased. The loading piston and actuator power piston move down until the increase in restoring spring force is sufficient to offset the increased force resulting from the decreased electric signal. When the pilot-valve plunger is pushed back to its centered position, movement of the power piston, loading piston, and terminal shaft stop.

If the signal from the electric control increases, (due to a decrease in engine or turbine speed or an increase in unit speed setting), it creates similar movements in the opposite directions. The pilot-valve plunger lowers, allowing pressure oil to flow to the underside of the power piston and push the piston up. The loading piston raises, rotating the terminal shaft in the "increase fuel" (or steam) direction. At the same time, the upward movement of the power piston acting through the restoring levers, decreases the restoring spring force, re-centers the pilot-valve plunger, and stops movement of the terminal shaft.

Governor Control

The governor pilot-valve plunger controls the flow of oil to its power piston. If the plunger is centered, no oil flows through the pilot valve and the power piston is stationary. The greater of two opposing forces moves the pilot-valve plunger: the speeder spring force tends to push it down, the centrifugal force developed by the rotating flyweight is translated into an upward force which attempts to raise the plunger. With the pilot valve centered, there is one speed at which the centrifugal force of the flyweights is equal and opposite to the speeder spring force.

With the speed setting of the governor set slightly higher than the actuator, the centrifugal force of the rotating flyweights is not sufficient to lift the pilot-valve plunger to its centered position. Consequently, with the actuator controlling, pressure oil is continually directed to the underside of the governor power piston to hold it up against its stop. It is for this reason that the power piston of the governor is up against its stop when the actuator is controlling.

With the unit running on-speed with the governor controlling, the pilot-valve plunger is centered. If a load is added to the engine, the engine and governor speeds decrease. The pilot-valve plunger is lowered by the speeder spring force which is now greater than the centrifugal force of the flyweights. Pressure oil flows to the buffer piston and moves it towards the power piston.

The oil displaced by the buffer piston forces the power piston upward; the loading piston is raised, and the terminal shaft rotated in the direction to provide the additional fuel needed for the new load.

The movement of the buffer piston towards the power piston partially relieves the compression of the left hand buffer spring and increases the compression of the right hand buffer spring. The force of the right hand buffer spring tending to resist this movement results in a slightly higher oil pressure on the left of the buffer piston than on the right. The pressure on the left of the buffer piston is transmitted to the underside of the compensation land of the pilot-valve plunger; the pressure on the right of the buffer piston is fed to the upper side of the compensation land. The difference in pressures on the two sides of the compensation land produces a force which acts to push the pilot-valve plunger back to its centered position.

When the terminal shaft has rotated far enough to satisfy the new fuel requirement, the pilot valve re-centers. This is due to the differential force on the compensation land plus the centrifugal force of the rotating flyweights, even though the engine speed has not returned completely to normal. Power piston and terminal shaft movement stops. The continued increase of speed to normal increases the centrifugal force developed by the rotating flyweights. However, this increase of speed to normal does not cause the flyweights to lift the pilot-valve plunger above center. Oil leakage through the needle valve orifice equalizes the pressure above and below the compensation land at a rate proportional to the return of the engine speed to normal. Consequently, as the centrifugal force increases, the compensating force decreases.

With the pressures above and below the compensation land equalized, the buffer springs return the buffer piston to its normal, centered position.

When engine load decreases, the resultant increase in governor speed causes the flyweights to move outward and raise the pilot-valve plunger. With the pilot-valve plunger raised, the area to the left of the buffer piston is connected to sump. The loading piston, which is continually urged downward by oil pressure from the governor pump, moves down and forces the governor power piston down. The movement reduces the fuel to meet the new requirement. Again, differential pressure across the compensation land assists in re-centering the pilot-valve plunger.

By-pass ports are provided in the buffer cylinder to facilitate large corrective movements of the power piston. A large increase or decrease in the speed setting of the governor, or a large increase or decrease of load on the engine, will require a correspondingly large movement of the power piston to make the necessary correction to the fuel setting. Under such conditions, the buffer piston will move only far enough to the left or right to effect an opening at the bypass port (pressure or drain). Oil will then flow directly to or from the power cylinder through the bypass port without further increasing the differential oil pressure force existing on the compensating land.

The speed at which the governor controls the engine is determined by the loading or compression of the speeder spring which opposes the centrifugal force of the flyweights. The standard EGB-2P has a speed adjusting screw in the top cover as shown in Figure 3-1.

Speed Droop

Speed droop is used in governors to divide and balance load between engines or turbines driving the same common load or driving generators paralleled in an electrical system.

Speed droop is defined as the decrease in speed taking place when the governor output shaft moves from the minimum to the maximum position in response to a load increase. It 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 can cause instability in governor operation.

Not enough or too much droop can also cause faulty governor operation. Not enough droop can cause instability in the form of hunting, surging or difficulty in load sharing. Too much droop can result in large speed undershoots and overshoots upon speed setting or load changes. It can also at times result in an output shaft jiggle on some types of governors.

Using an example where governor speed is 3000 rpm at no load and 2800 rpm at full load, droop can be calculated with the formula:

$$\begin{aligned} \% \text{ Droop} &= \frac{\text{No load speed} - \text{Full load speed}}{\text{Full load speed}} \times 100 \\ &= \frac{3000 \text{ rpm} - 2800 \text{ rpm}}{2800 \text{ rpm}} \times 100 \\ &= \frac{200}{2800} \times 100 = 7\% \end{aligned}$$

If the decrease in speed is greater than 200 rpm, droop greater than 7% is shown by the governor! actuator. If the decrease in speed is less than 200 rpm, droop less than 7% is shown by the governor/actuator.

Remember that the amount of speed droop depends also upon how much governor terminal shaft or tail rod travel is used.

IMPORTANT

If the EGB-2P output shaft does not use the full 21° of available travel from “NO LOAD” to “FULL LOAD”, droop will also be reduced proportionately.

As a result, the maximum droop that can be obtained depends also on the adjustment of the fuel linkage between the governor and the prime mover, as this adjustment determines how much output shaft travel is used between no load and full load.

Speed droop is provided in the EGB-2P through linkage which varies the loading on the speeder spring as a function of the power piston position. The change in speeder spring force for a given movement of the power piston is determined by the position of the adjustable pin in the linkage between the power piston and speeder spring. If the pin is on the same centerline as the speed droop lever pivot is, there is no change in speeder spring force as the power piston moves and the governor operates as an isochronous (constant speed) control. The further the adjustable pin is moved away from the pivot arm centerline, the greater is the change in compression of the speeder spring for a given power piston movement.

With the unit operating under the electric control, the speed droop feature is, in effect, inoperative. During such operation, the governor power piston remains in the maximum position for all engine or turbine loads (except possibly momentarily during transients). Therefore, the speed droop linkage does not alter the speeder spring compression when the actuator is controlling.

In a conventional droop linkage arrangement, droop is thought of as a decrease in speed with an increase in load, (expressed as a percentage of rated speed).

However in the EGB-2P droop linkage arrangement, full droop effect can take place without an increase in load. It can take full effect for example, when the actuator is going from governor control to actuator control because the ballhead power piston moves to the maximum up position. This gives maximum droop effect which lowers the mechanical speed set point, to a point which can be lower than the electrical speed setting.

For this reason interference between the mechanical governor and electrical actuator can occur. To eliminate interference, droop can be reduced to zero, or the speed difference between the governor and the actuator can be increased by setting the mechanical governor speed 3 to 5% higher than the electrical actuator speed.

This eliminates interference between the governor and the actuator and allows the actuator to control in most cases.

If the droop setting is quite large or if only a small amount of travel is used from no load to full load, the speed difference between the mechanical governor and the actuator may have to be increased above 5%.

Chapter 4. Adjustments

Introduction

This chapter includes procedures for making adjustments normally made at the factory for each particular unit and they are only required after it is repaired or overhauled. These adjustments are preferably made with the unit on a test stand.

IMPORTANT

Item numbers shown in parenthesis indicate parts as shown in the exploded view, Figure 7-1.

Recommended Tools

These tools and the equipment listed may be purchased from Woodward.

Part No.	Name
8909-051	Test Stand
8909-041	Centering Box
8959-042	Electronic Counter Kit
370109	Pilot Valve Wrench
8995-054*	Ballhead Cover Removal Tool
8995-005*	Ballhead Assembly Tool
224007	Gear

* Only necessary for those governors using dampened ballheads

Preliminary Adjustments

1. Mount unit on test stand and connect oil inlet, pump pressure and drain connections. A minimum oil pressure of 5 psi (34 kPa) at a temperature of 140 to 150 °F (60 to 66 °C) is required. Connect the governor terminal shaft to the test stand speed control link.

If a test specification sheet is desired for the EGB-2P being tested, contact Woodward at one of the locations listed on the back cover of this manual.

2. Drive the unit in the normal direction of rotation.
3. Check pump pressure at 2000 rpm. It must be 300 to 350 psi (2068 to 2413 kPa) plus supply oil pressure. (Maximum supply oil pressure is 50 psi [345 kPa].)
4. Remove cover and use adapter plate shown in Figure 4-1, to hold speed adjustment screw.
5. Insert a 7/64 inch Allen wrench through the hollow center of the adjustable spring seat (90), and engage the centering screw (97). Turn the centering screw clockwise until it bottoms GENTLY. Back it off two and a half turns to establish an initial starting position.

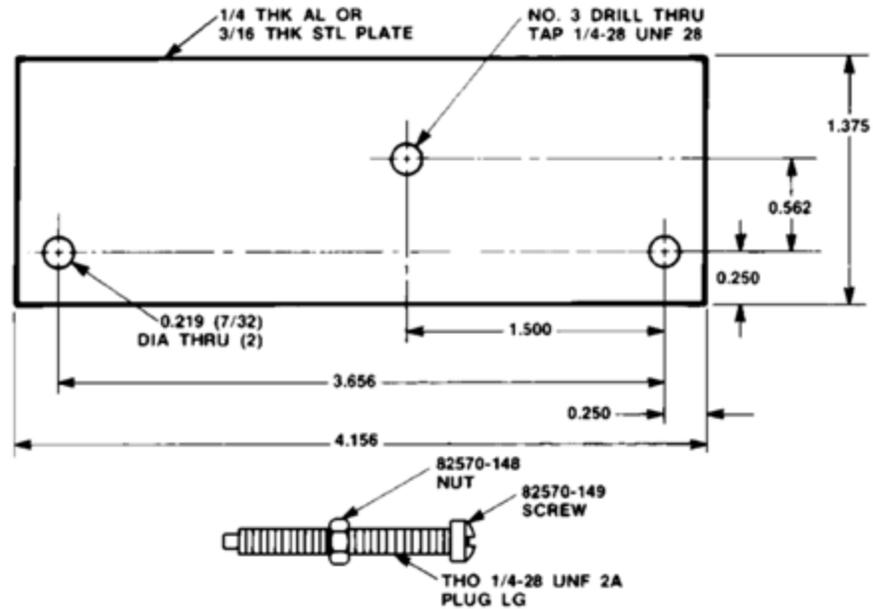


Figure 4-1. Speed Setting Adapter Plate

6. Make sure to align the pointer with the maximum position on the dial plate by rotating the terminal shaft in the full increase fuel direction. (Both ballhead and electric power pistons in full up position—the mechanical governor underspeeded and the electric actuator pilot valve below center.)



WARNING This is important since the unit will either not control or become unstable below minimum. Checking the dial plate and pointer position ensures that the unit is operating in its correct range.

7. Check governor section for leaks, hunting, drifting and oil pressure.

Governor Needle Valve Setting

When starting the engine for the first time, it is necessary to eliminate any air which may be trapped in the actuator passages. With the mechanical governor controlling, air may be eliminated in the following manner: Open the mechanical governor needle valve (18) until the actuator hunts. After a half minute, gradually close the needle valve until the engine speed just settles out.

Closing the needle valve further than necessary will make the actuator slow to return to normal speed after a load change. The needle valve should never be tightly closed.

Test the action by manually disturbing the speed of the actuator. The actuator should return to its original, steady-state, speed with only a small overshoot or undershoot.

The electric actuator section of the EGB-2P has no external operating adjustment.

Speed Droop Adjustment

Speed droop is adjustable internally. The speed droop bracket (116 on Figure 7-1) is clamped to the speed droop lever with a set screw. A pin on the droop bracket carries the floating lever (120). When this pin is aligned with the droop lever shaft the droop will be zero. Speed droop is normally set in the range of 3 to 4%.

If speed droop setting needs to be changed, use the following procedure:

1. Adjust the unit's speed using the speed adjustment screw until the desired rated speed is obtained.
2. Simulate an underspeed condition until the terminal shaft travels to a position just short (1° to 2°) of maximum line on the dial plate. For greater accuracy, cut the protractor printed on the inside back cover of this manual, following the protractor outline. Fasten the protractor to the EGB-2P and attach a wire pointer to the output shaft.

Readjust the speed setting screw if necessary to obtain terminal shaft position at the required speed.

3. Simulate an overspeed condition until the terminal shaft travels to a position just short (1° to 2°) of the minimum line on the dial plate. At this point the speed should rise by the amount of droop percentage. If the speed droop needs to be increased, move the droop bracket towards the flyweights. Move the droop bracket away from the flyweights to decrease droop.
4. Repeat steps 2 and 3 above until the correct droop is obtained. Remember that Maximum speed adjustment must be reset each time droop is readjusted.

Centering Pilot Valve Plunger

1. Adjust speed adjusting screw on the adapter plate until governor is at least 5 to 6% above steady-state speed. This eliminates interference between the mechanical governor and the actuator and allows the electric actuator to control.
2. Disconnect test stand linkage from terminal shaft and install a protractor to read the terminal shaft position between minimum and maximum.
3. Back out actuator pilot valve centering screw (97) 2 and a half turns after bottoming very carefully against spring. Use a $7/64$ inch Allen wrench. Refer to preliminary adjustments, step 5.
4. Set test circuit (Figure 4-2) to OFF and connect to transducer plug on actuator case.
5. Connect a 9 Vdc power source to test circuit. Set test circuit to CENTER.
6. Adjust test circuit potentiometer to 400 mA then set switch to OFF.
7. Adjust spring seat screw (90) with a $1/8$ inch Allen wrench until terminal shaft rotates approximately to its mid-point of travel. Turn seat (90) clockwise to move terminal shaft towards maximum fuel and counterclockwise to move it towards minimum fuel.

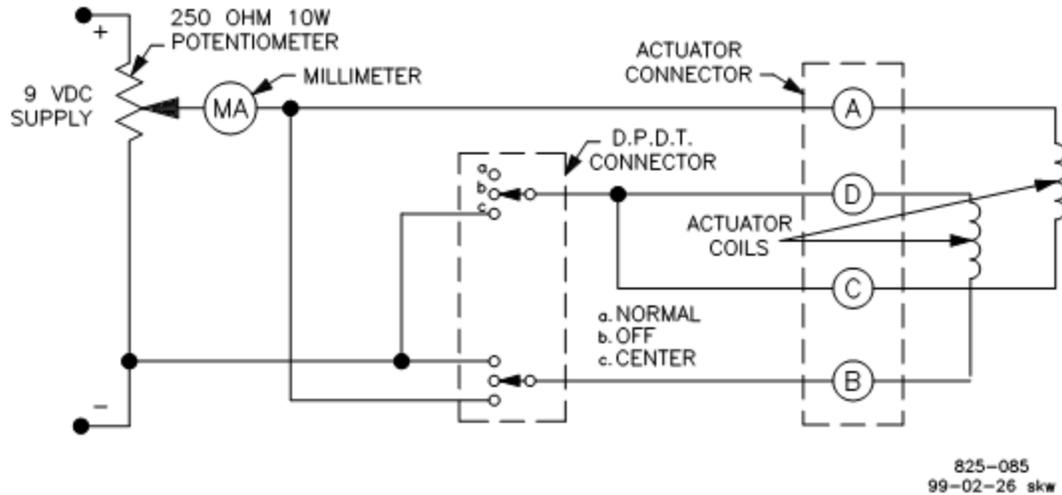


Figure 4-2. Actuator Test Circuit

8. Set test circuit to CENTER. Observe and note direction and position of terminal shaft movement.
 - A. If terminal shaft moves to another position set test circuit of OFF.
 - (1) For movement towards increase fuel turn pilot valve centering screw (97) slightly clockwise.
 - (2) For a movement towards decrease fuel turn screw (97) slightly counterclockwise.
 - (3) Note the new position for reference in case more adjustment is needed.
 - (4) Repeat steps 8.A.1. and 3. or 8.A.2 and 3. until no movement of the terminal shaft occurs when the test circuit is moved from OFF to CENTER. Continue on to step 9 and calibrate terminal shaft.
 - B. If terminal shaft did not move from its original position, the pilot valve plunger is centered. Continue on to step 9 and calibrate terminal shaft.
9. Turn test circuit to OFF and set potentiometer to zero mA.

NOTICE

Do not exceed 200 mA during remainder of test to prevent damage to the magnetic properties of the magnet.

10. Set test circuit switch to NORMAL.
11. Adjust potentiometer to 20 mA or to Min value signal (see Specification sheet for EGB-2P).
12. Turn spring seat (90) counterclockwise until actuator terminal shaft moves to minimum position on dial. Turn seat (90) clockwise until shaft moves 1 to 2° toward maximum.

13. Adjust potentiometer for 160 mA or to Max. value signal (see Specification sheet for EGB-2P). Terminal shaft movement should be an additional 29° ($\pm 0.5^\circ$) towards maximum.
14. If adjustment is necessary, loosen screws (105) slightly and turn eccentric pin (95) in restoring lever (93) as required to shift position of ratio adjustment clamping plate (102).

Move ratio adjustment plate (102) towards piston link (78) to decrease terminal shaft travel and away from piston link (78) to increase shaft travel.
15. Repeat maximum and minimum mA adjustments until terminal shaft travels correct distance and steps 12, 13 and 14 are satisfied.
16. Shut off test stand. Disconnect test circuit. Remove speed setting adapter plate and replace it with cover. Be sure speed setting screws protrude the same distance below edge of case, or that the mechanical governor's speed is sufficiently high to prevent interference with actuator portion.

Speed Adjustment

The speed adjustment can be done on the test stand or with the unit installed on the engine, It must be done with the unit's cover installed and fastened to the unit.

General Information

Three arrangements for setting the speed of the mechanical governor section of the unit are available.

1. A single speed adjustment screw.
2. A combination of high and low speed stop set screws and a speed adjusting shaft.
3. An electric motor and high speed stop set screw.

As seen in the schematic diagram, Figure 3-1, a speed adjustment changes the speeder spring force. The balance point of the opposing speeder spring force to the centrifugal force of the fly-weights determines the speed setting.

1. Figure 3-1, shows the speed adjustment screw. Turn the adjustment screw clockwise to increase the speed and counterclockwise to decrease speed.
2. Figure 7-1, the exploded view, shows the speed adjusting shaft (126), and the high (13) and low (149) speed stop screws. Set the high to low speed range with the stop screws. Use the speed adjusting shaft to change speeds between these preset ranges. Speed may be changed remotely with the speed adjusting shaft and the proper connections.
3. Units equipped with an electric motor for speed adjustment may have a high speed stop screw. Adjust this screw to establish a high speed stop. The motor can then be used to control the speed setting remotely. This motor is a split field universal motor which drives the speed adjusting shaft through a worm and gear with a friction clutch to protect the motor if the adjustment is run against the stop.

Setting Maximum Speed

Adjust the unit's speed using the speed adjustment screw, speed adjusting shaft or speed setting motor until the desired rated speed is obtained.

If droop is used, simulate an underspeed condition until the terminal shaft travels to a position just short (1° to 2°) of maximum line on the dial plate. Readjust the speed setting screw if necessary to obtain terminal shaft position at the required speed.

If zero droop is used, maximum speed can be set at any terminal shaft position between maximum and minimum fuel positions.

Remember that maximum speed must be reset each time droop is readjusted.

Adjustments after Tests

When actually operating, set the mechanical governor section at approximately 5% higher than the actuator section. This normally allows the actuator to control without interference from the mechanical governor.

The greater the percentage of droop set in the mechanical governor, the higher the mechanical governor speed must be set to avoid interference between the mechanical governor and the electric actuator.

If only a small amount of travel is used from No load to Full load with droop, the speed difference between the mechanical governor and the electric actuator may have to be increased above 5%.

Chapter 5.

Maintenance

Introduction

This chapter includes information for troubleshooting, disassembly, parts check, assembly, and lubrication. In addition to the basic tools, the speed setting adapter plate (Figure 4-1), the actuator test circuit (Figure 4-2), and the pilot valve wrench (Figure 5-1) will be necessary to disassemble, repair, and assemble the unit. See Chapter 4 for a list of recommended tools.

Since these units vary somewhat depending on the individual requirements, one type of unit is used for disassembly and another type for assembly. Study the unit carefully during disassembly for ease in reassembly. The exploded view (Figure 7-1) is referred to for disassembly. The unit used in Figure 7-1 has a solid ballhead, speed adjusting shaft and high and low speed stop screws. The figures in this chapter, referred to for assembly, are of a unit with a spring and oil damped ballhead, a low speed stop screw and stub speed adjustment shaft.

During reassembly replace all packings, gaskets, seals, retaining rings and cotter pins removed during disassembly. Cleanliness and careful handling of all parts is important.

Troubleshooting

If trouble occurs in the governing system, the general location of the fault can be readily isolated to the actuator or to the electric control unit by connecting the test circuit shown in Figure 4-2 to the actuator. Set the switch to NORMAL and operate the actuator by varying the position of the potentiometer. If operation of the actuator appears to be satisfactory, the trouble is in the electric control unit.

Governor/Actuator faults are usually revealed in speed variations of the prime mover, but it does not necessarily follow that all such speed variations indicate such faults. Therefore, when improper speed variations appear, the following procedure should be performed:

1. Check the load to be sure that the speed changes observed are not the result of load changes beyond the capacity of the prime mover.
2. If the unit is controlling an engine, check the engine operation to be sure that all cylinders are firing properly and that the injectors are in good operating condition. If the unit is controlling a turbine, check the steam valves for proper operation.
3. Check the operating linkage between the unit and the prime mover to make certain there is no binding or lost motion.
4. Check for steam or fuel pressure changes.
5. Check the voltage regulator for proper operation, as applicable.
6. With the electric controls set for normal operation, check the voltage input to the unit. (Refer to the applicable manual for troubleshooting the electric control unit.)

If neither load nor prime mover irregularities are found to be the cause of the speed variation, the cause may be either in the unit or in the drive from the prime mover.

The source of most troubles in any hydraulic actuator or governor stems from dirty oil. Grit and other impurities can be introduced into the governor/actuator with the oil, or form when the oil begins to breakdown (oxidize) or become sludgy. The internal moving parts are continually lubricated by the oil within the unit. Valves, pistons and plungers will stick and even “freeze” in their bores, due to excessive wear caused by grit and impurities in the oil. If this is the case, erratic operation and poor response can often be corrected by flushing the unit with fuel oil or Kerosene, using the test circuit shown in Figure 4-2 to cycle it. The use of commercial solvents is not recommended as they may damage seals or gaskets.

If the speed variation of the unit is erratic but small, excessive backlash or a tight meshing of the gears driving the unit may be the cause. If the speed variation is erratic and large and cannot be corrected by adjustments, repair or replace the unit.

Removing the EGB-2P

1. Disconnect electrical plug on actuator, and hydraulic tubing connections.
2. Before removing terminal shaft, mark both shaft and lever so they may be easily reinstalled at their original positions.
3. Remove the four stud nuts holding the actuator to the mounting pad and lift the actuator off. Remove the gasket between the actuator and actuator mounting pad.

NOTICE

Use care in handling and resting of the governor/actuator. Do not strike or rest the actuator on its drive shaft as damage may result to drive shaft, oil seal, bearing, or Internal parts or surfaces. Set the governor/actuator on wooden blocks to protect the drive shaft.

4. Do not remove or disturb the position of screws, levers, etc., which function as adjustments; nor disassemble the various linkages further than required to effect removal unless replacement is necessary.
5. Do not remove press-fit parts such as bearings, locating (dowel) pins, oil pump, check valves, pivot pins, etc., unless replacement is necessary or removal is required for disassembly of other parts.

NOTICE

Handle critical parts with extreme care. Keep them separated so mating edges and surfaces are not damaged. Sharp edges of plunger lands, piston grooves, metering ports, etc., must be maintained. Rounded edges, nicks or other damage to such edges will result in excessive Internal leakage and decreased control sensitivity.

Disassembly

Do not disassemble the unit or its various sub-assemblies any further than necessary.

1. Remove screws (153), cover (151) and gasket (150).
2. Remove pins (124) from speeder spring assembly, pin (121) from floating lever (120) and take out floating lever.
3. Remove pin (128) and tapered plug (129). Do not damage shaft bushing (125), or bore.
4. Drive speed adjusting shaft (126) toward opposite side of case to knock out the oil seal (130).
5. Remove speed adjusting shaft (126), speed adjusting lever (123), bushings (125) only if replacement is necessary, and spacer (127).
6. Remove speed droop lever pin (131) connecting speed droop lever (112) and piston link (36).
7. Remove retaining rings (139) and both dial plates (136 and 140) from the case.
8. Remove retaining ring (115), pull out pivot pin (114) and take out speed droop lever (112).

IMPORTANT

If the speed droop bracket is removed, mark its position on the speed droop lever for ease in reassembly.

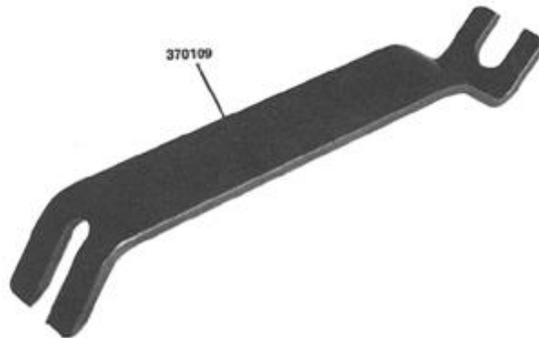


Figure 5-1. Pilot Valve Wrench

9. Use pilot valve wrench 370109, Figure 5-1, and place it between speeder spring (74) coils on spring seat (69). Disengage spring from its seat. Hold seat with wrench and bend spring towards open end of bottom coil. At the same time turn spring to disengage coil from seat lip.
10. Remove taper pin (111) from terminal lever (29) using a 10-32 nut and two washers from the cover as a puller.

11. Remove screw (110) and retaining ring (108) from terminal shaft (107) and pull shaft from case. Remove bushings (106) only if replacement is necessary, oil seal (134) and felt washer (135) from both sides of the case.
12. Remove screws (133) that attach plug (132) to case. Do not disconnect plug from solenoid leads.
13. Remove pin (100) and disconnect restoring lever (93) from piston link (78).
14. Remove pin (96) from transducer bracket (84). Lift out transducer lever (91), spring seat (90) and spring (101).

IMPORTANT

If spring seat is to be removed from transducer lever, measure and record projection of seat above top of transducer lever for ease in reassembly.

15. Remove screw (97) and restoring spring assembly (85) including attached parts (86) through (89).
16. Remove screws and washers (99 and 98) and lift out transducer bracket assembly (84, 93, 95, and 102 through 105).

IMPORTANT

If ratio adjustment plate (102) is removed, mark its position on restoring lever (93) so it can be replaced in the same position.

17. Lift out temperature compensation ring (79), solenoid (80), washer (81), magnet (82) and cover (83) as a unit. Do not remove spring (49) from pilot valve plunger.
18. Remove pivot pin (75) and piston link (78).
19. Hold spring seat (69) with pilot valve wrench and remove nut (70).
20. Remove spring seat (69) while holding pilot valve plunger (42) stationary.
21. Remove thrust bearing (68).
22. Remove retaining ring (67) from bushing (41) and lift flyweight assembly (63 through 67) out of case.
23. Disassemble ring (66) and flyweights (64) from flyweight head (63).
24. Remove needle valve and packing (1 and 17).
25. Remove plug and packing (11 and 10).
26. Remove retaining ring (16) and pull out buffer cap (15) with smooth jaw pliers. Remove packing (14).
27. Remove retaining ring (9) and buffer system (5 through 8). Thread a base bolt into plug (8) to ease removal.
28. Turn actuator over on its top with base up and remove drive coupling (154).
29. Remove screws and washers (73 and 72). Place two screwdrivers into the slots provided on each side of the base. Carefully work base off by twisting and prying to free taper pins and remove base. When separating the base from case be careful of parts falling out and becoming damaged.

30. Remove oil seal (61), packing (62), plug (56), and packing (55).
31. Remove relief valve parts (51) through (54).
32. Remove rotating bushing (41), pilot valve plunger (42) compensation bushing (43) and retaining ring (44) from case.
33. Remove idler gear (60).
34. Remove bushing (45), pilot valve plunger (46) and retaining ring (48).
35. Disengage magnet spring (49) from pilot valve plunger (46) and remove compensating bushing (47).
36. Remove cotter pin (25), pin (37) and push power piston (34) out of case from top.
37. Remove pushrod (35).
38. Remove nut (33) and pivot washer (32), and push linkage return piston (31) out of case from top. Count number of turns when removing the nut for reassembly.
39. Lift free end of floating lever (21) and turn it to a position where pin (20) can be driven out.
40. Remove floating lever (21) terminal lever (29), terminal lever link (26) and pivot link (23).
41. Remove snap ring (22).
42. Remove power piston (19) through top of case.
43. Pull piston sleeve (59) out of case using a hook-shaped tool.

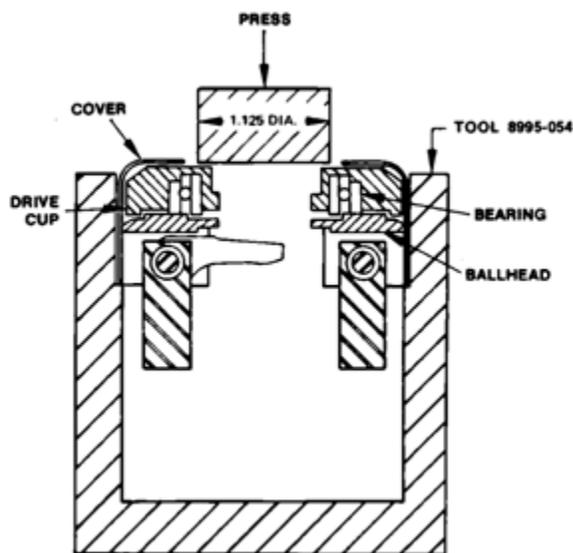


Figure 5-2. Ballhead Disassembly

44. Use an arbor press and Woodward tool 8995-054 to disassemble the ballhead. See Figure 5-2. Press the drive cup and ballhead out of the cover. Disassemble the drive cup, ballhead, bearing and flyweights. Note which side of the bearing is "up" in the drive cup and reassemble it with the same side up.

Parts Check

Check all parts for wear, cracks, nicks, corrosion, or other damage. Check threads and serrations for tooth damage. Check the electrical connector for cracks or damage and wiring connections for breaks. Check all bearings for wear and damage.

Replace flyweights if there are worn areas on the toes. Insert flyweight pins in the flyweights and check for brinelling (wear pockets), looseness, or stickiness. At the same time check the flyweight bearings. Replace both flyweights together if either one is damaged.

Power pistons, buffer pistons, pilot valve bushings and rotating bushings must have sharp edges on all lands.

Replacement is necessary if any nicks, roundness or other damage is found.

Assembly

Lubricate all packings with petrolatum. Lubricate all seals and metal parts before installation. Numbers on callouts of figures are the same as numbers on Figure 7-1 for cross-reference.

1. Install all pipe plugs in case and base per exploded view Figure 7-1.
2. Install check valves in the case bottom and base as shown in Figure 5-3.

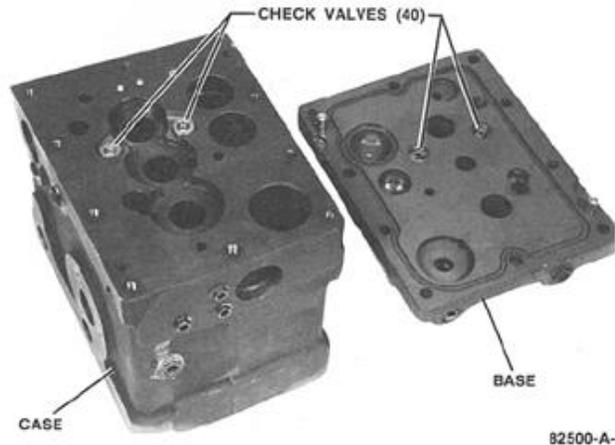


Figure 5-3. Check Valve Installation

3. Assemble floating lever and speed adjusting lever as shown in Figure 5-4 Parts Layout and Figure 5-5 Subassembly.

IMPORTANT

Speeder spring assembly is shown in Figures 5-4 and 5-5 for reference only. See step (32) for speeder spring assembly.

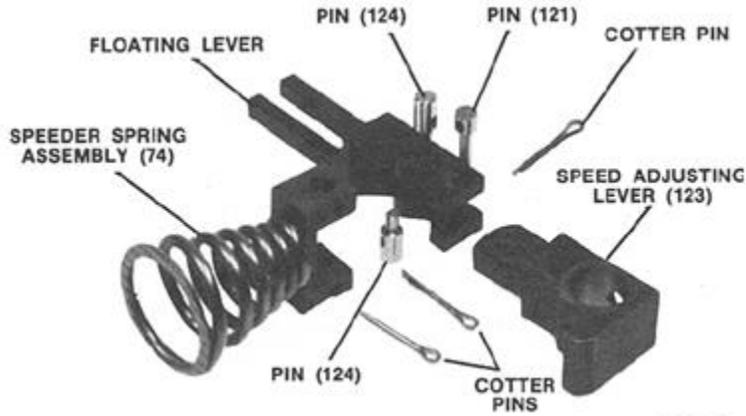


Figure 5-4. Speeder Spring Parts Layout

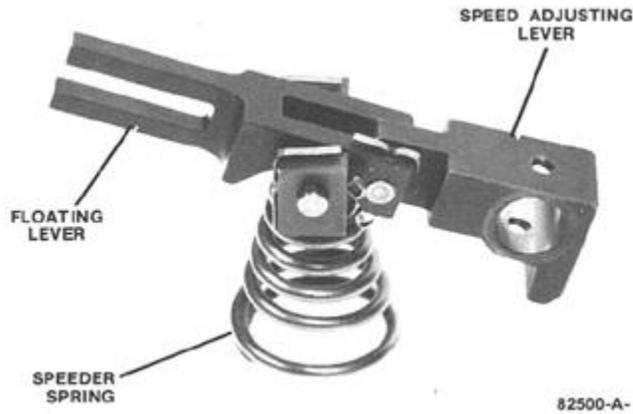


Figure 5-5. Speeder Spring Subassembly

4. Assemble mechanical governor pilot valve bushing, pilot valve plunger, compensating bushing, and retaining ring, Figure 5-6.

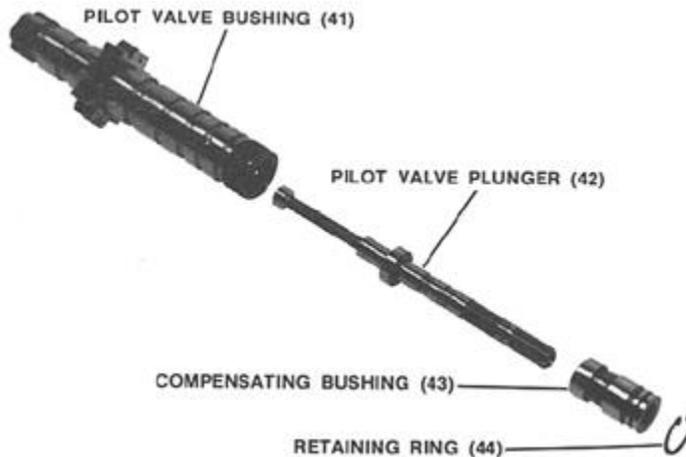


Figure 5-6. Mechanical Governor Pilot Valve Assembly

5. Assemble actuator pilot valve bushing, pilot valve plunger, compensating bushing, magnet adjusting spring and retaining ring.

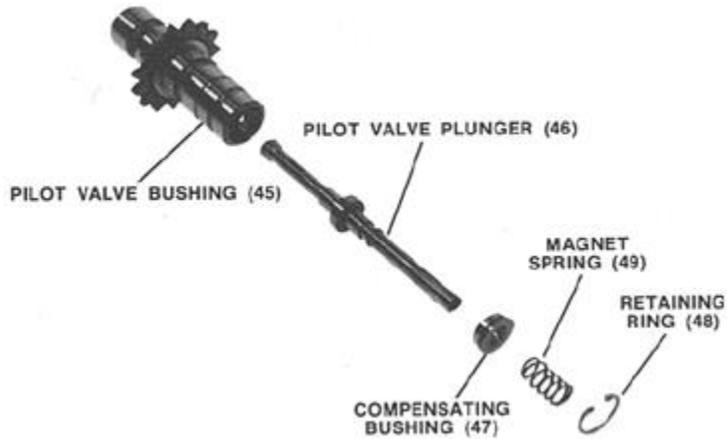


Figure 5-7. Actuator Pilot Valve Assembly

6. Assemble clamp bracket (84), restoring spring assembly (85 to 89), transducer lever (91), restoring lever (93), eccentric pin (95), adjustable spring seat (90), and pilot valve plunger nut (92) per Figure 5-8 Parts Layout and Figure 5-9 Subassembly.

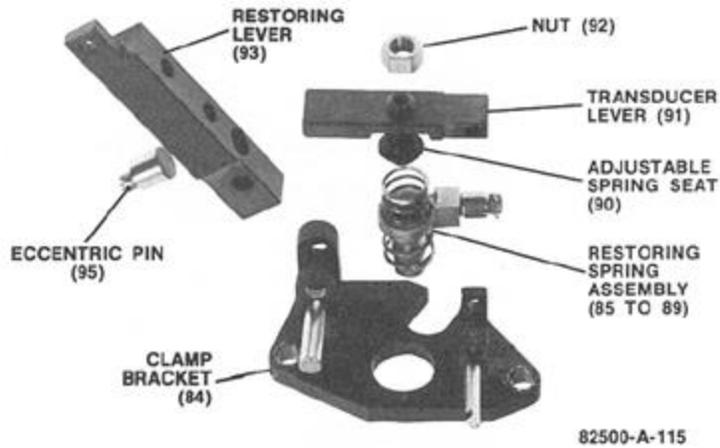


Figure 5-8. Clamp Bracket Parts Layout

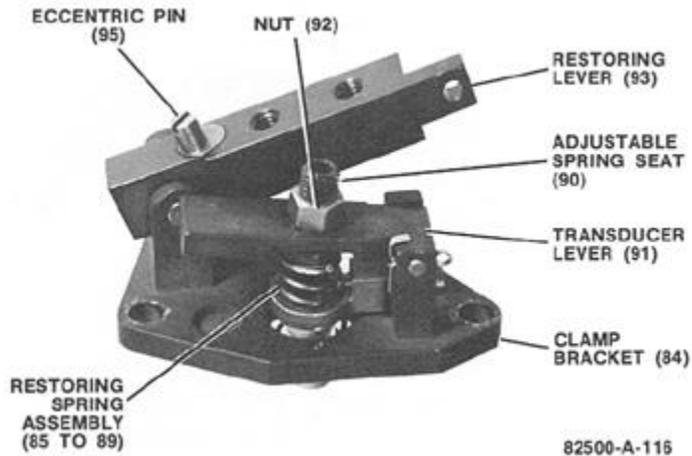


Figure 5-9. Clamp Bracket Subassembly

7. Assemble ballhead assembly in the order shown in Figure 5-10. This is a spring and oil damped ballhead. The spring is located in the ballhead with its tang end protruding out towards the drive cup. Place the bearing (lubricated) in drive cup with the red die side up. Position the tang end of spring over slot in inner hub of drive cup and assemble ballhead to drive cup. Assemble flyweights and pins in ballhead.
8. Use an arbor press and Woodward tool 8995-005 and press the cover in place on the ballhead as shown in Figure 5-11. The cover lip should be flush with the edge of the ballhead. Be sure flyweight pivot pins are centered when replacing cover.
9. Check the ballhead flyweights for freedom of movement. They should pivot freely. Also, twist the ballhead slightly with your fingers to check if the spring tang is engaged. The ballhead should spring back when released.

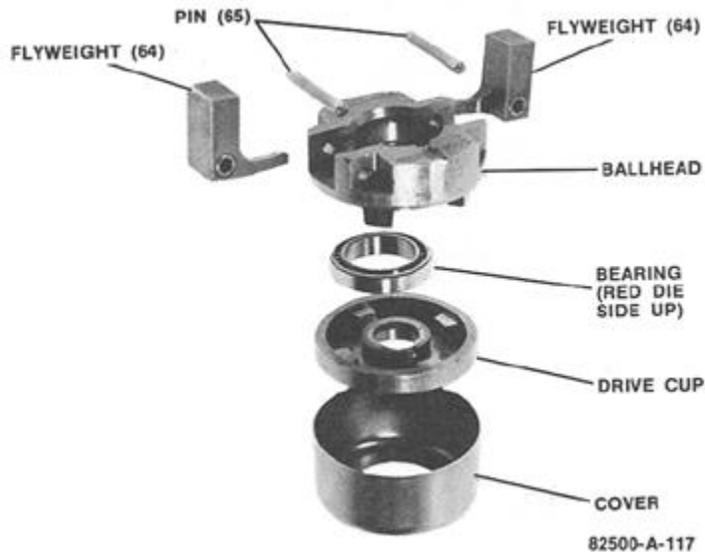


Figure 5-10. Ballhead Parts Layout

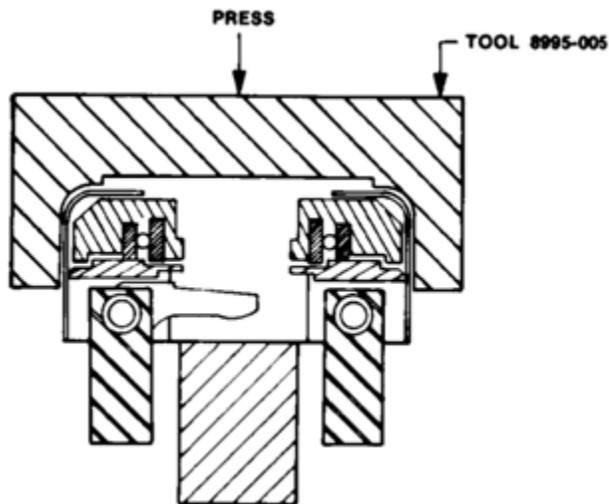


Figure 5-11. Ballhead Cover Assembly

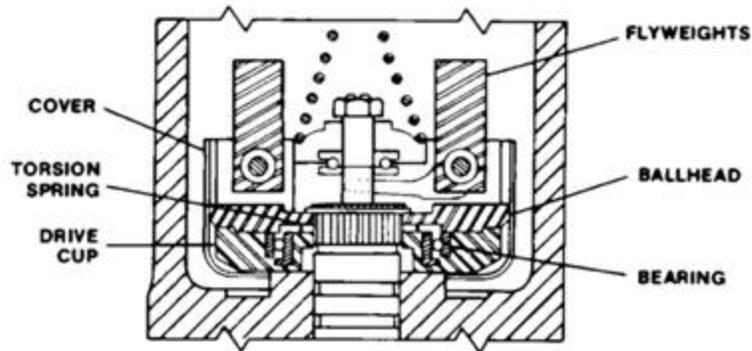


Figure 5-12. Ballhead Assembly

10. See Figure 5-13.
 - A. Assemble packing (14), buffer cap (15), and retaining ring (16) in the case.
 - B. Assemble packing (10) and screw plug (11) in case.
 - C. Assemble spring (5), buffer piston (6), spring (5), packing (7), buffer plug (8), and retaining ring (9) in case.

IMPORTANT

Insert buffer piston (6) into case correctly with cup end out.

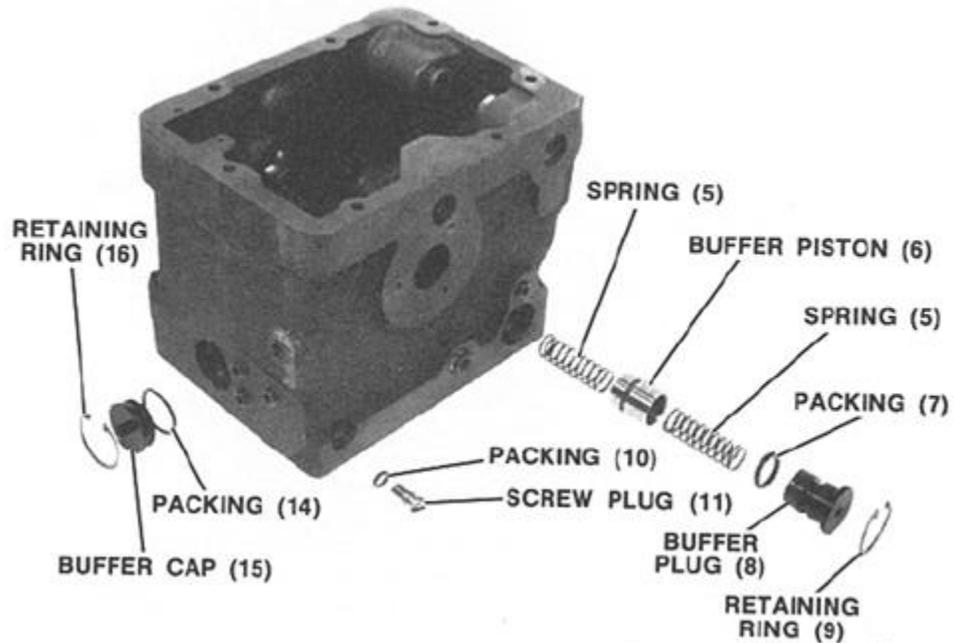


Figure 5-13. Buffer System Parts Layout

11. Assemble needle valve in case (Figure 5-14).

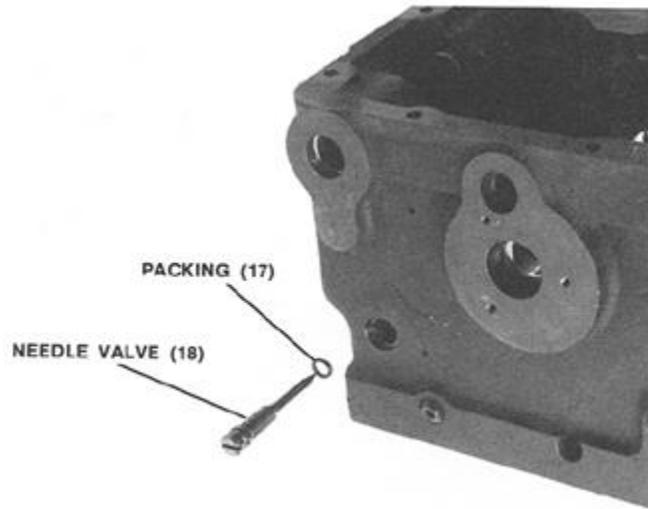


Figure 5-14. Needle Valve Assembly

12. See Figure 5-15.
- A. Assemble power piston (19) and floating lever (21) with pin (20) and snap ring (22).
 - B. Assemble pivot link (23) and terminal lever link with pin (27), and fasten together with roll pin (28).
 - C. Assemble terminal lever (29) to terminal lever link (26) with pin (30).
 - D. Assemble pivot pin (75) to (78) with straight pin (77).

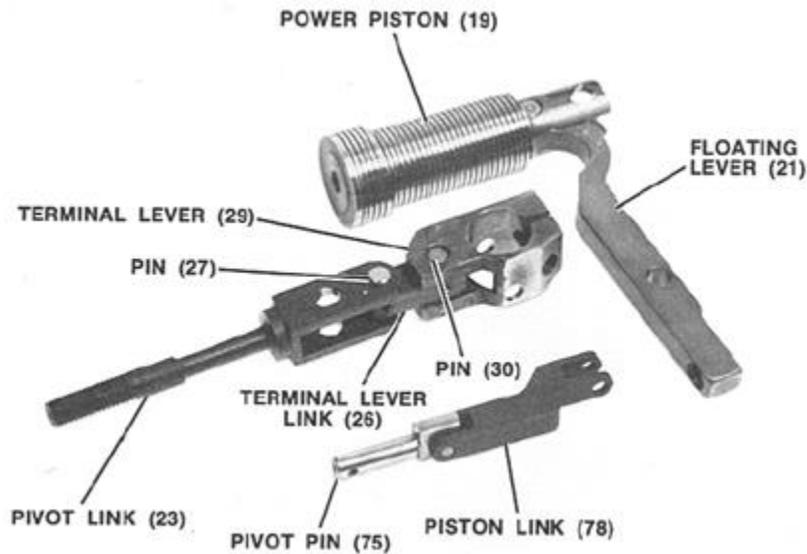


Figure 5-15. Parts Layout, Pistons and Levers

13. Insert power piston (19) and floating lever (21) assembly into case per Figure 5-16.

There are two sizes of power pistons. Figure 5-16 shows the large size power piston (19) which is installed from the outside of the case. Figures 5-16a shows the small size power piston (19A) which is installed from the inside of the actuator case. The small size power piston is used on the EGB-1P only. If the small size piston is to be installed, be sure to slip the collar and the snap ring onto the end of the small piston, after it has been installed in the case.

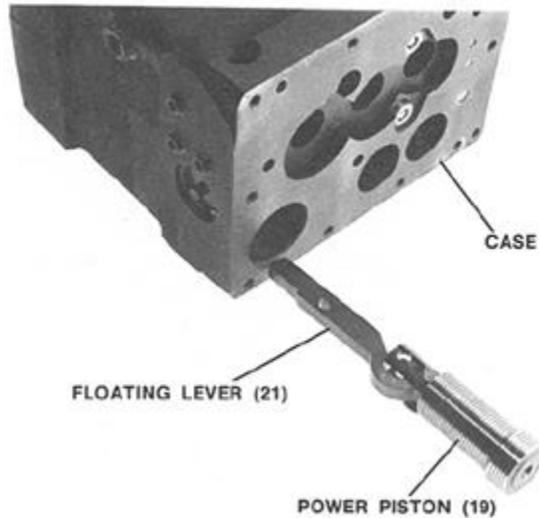


Figure 5-16. Power Piston Assembly (Large Size Piston)

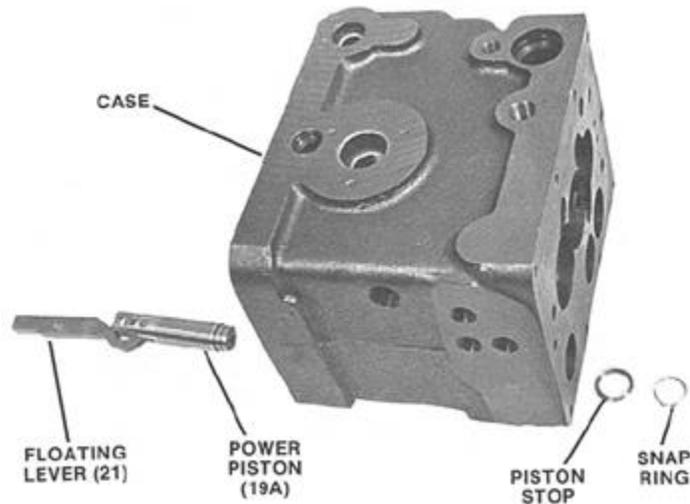


Figure 5-16a. Power Piston Assembly (Small Size Piston)

14. Insert terminal lever (29), terminal lever link (26), and pivot link (23) into the case (Figure 5-17). Insert floating lever (21) through the slot in pivot link (23). Fasten together with pin (24) and secure with a cotter pin.
15. Insert piston link (78) and pivot pin (75) into top hole in power piston. Secure with washer (76) and a cotter pin. See Figure 5-17.

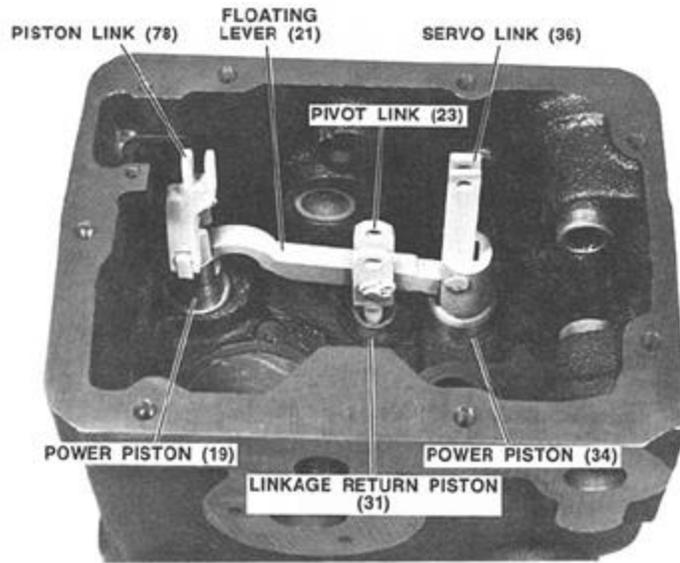


Figure 5-17. Power Piston Linkage Assembly

16. Refer to Figures 5-18 and 5-19.
 - A. Insert pin (35) into power piston (34). Place this assembly in case.
 - B. Attach solid end of piston link (36) to power piston (34) with headed pin (37), and secure with a cotter pin.
 - C. Place piston (31), pivot washer (32), and elastic stop nut (33) into the case as shown. Thread nut (33) onto pivot link (23) nine to nine and a half turns.
 - D. Remove all play in the piston linkage assembly according to the following instructions:
 - (1) First tighten elastic nut (33) until a rocking motion is obtained when pushing alternately on pistons (19) & (34) in a teeter-totter motion. See Figure 5-17a.

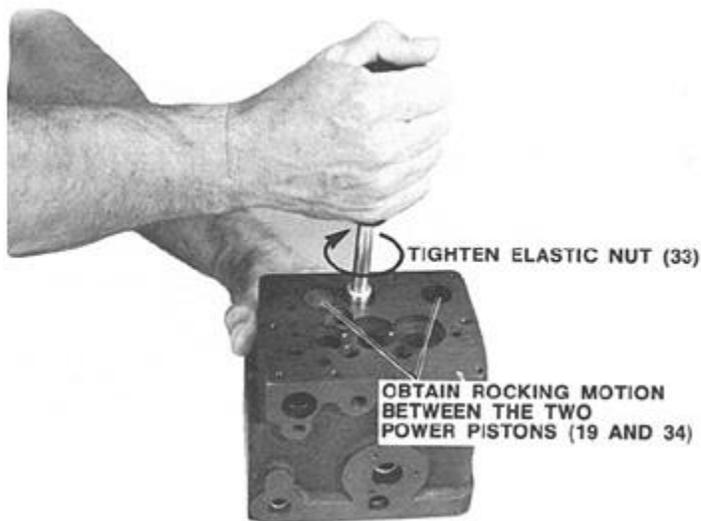


Figure 5-17a. Obtaining Rocking Motion In Power Pistons

- (2) Apply pressure on elastic nut (33) with index finger and raise both pistons (19) & (34) with inside hand. See Figure 5-17b. Remove inside hand quickly to allow piston linkage assembly to drop sharply in order to remove all stickiness and insure proper seating. Repeat this step three or four times. See Figure 5-17c.

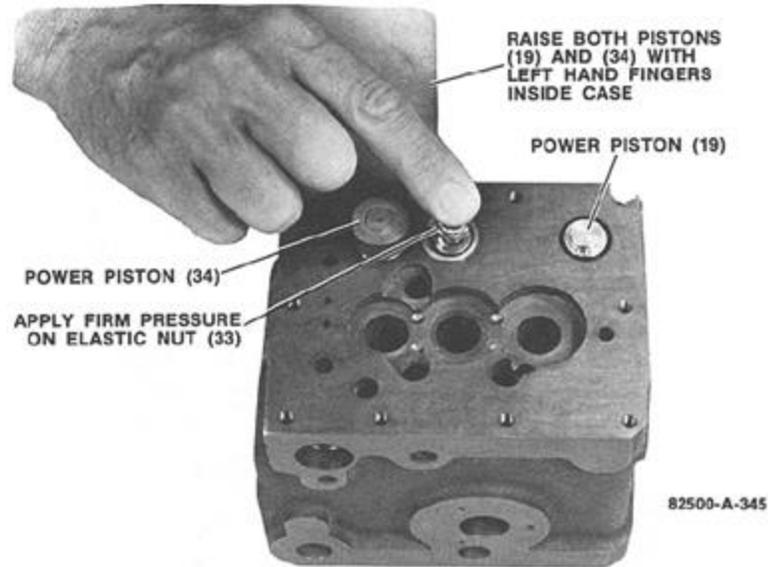


Figure 5-17b. Raising Power Pistons

IMPORTANT

Make sure the piston linkage assembly is hanging free and is not hanging up anywhere inside the actuator case.

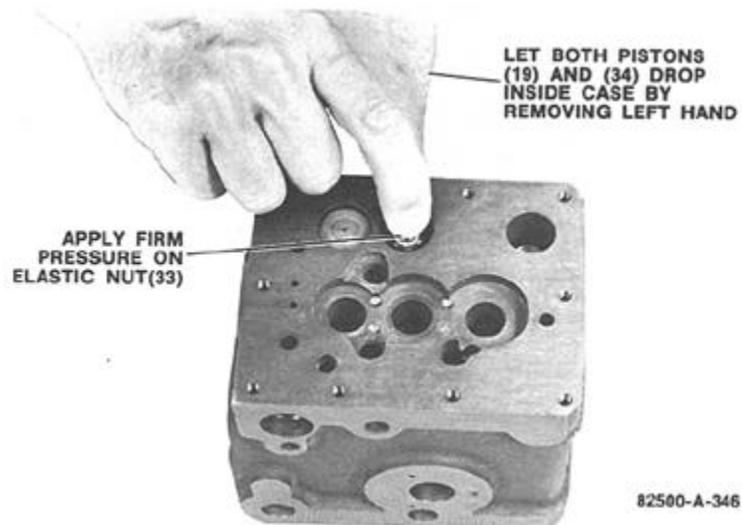


Figure 5-17c. Dropping Power Pistons

- (3) Fit speed handle to elastic nut (33) and holding speed handle with firm pressure, start turning elastic nut (33) counterclockwise 1/4 of a turn or so at a time to remove play in the piston linkage assembly. Remove speed wrench each time while maintaining firm pressure with the finger on the elastic nut, to see how much play has been removed by pushing alternately on pistons (19) & (34) as in step (1) above. See Figure 5-17d. Each time this step is repeated, turn elastic nut (33) counterclockwise in progressively smaller amounts as the amount of play in the piston linkage assembly decreases. See Figure 5-17e. When nearing complete removal of play in the piston linkage assembly, turn the elastic nut (33) counterclockwise only one degree at a time until all play has been removed.

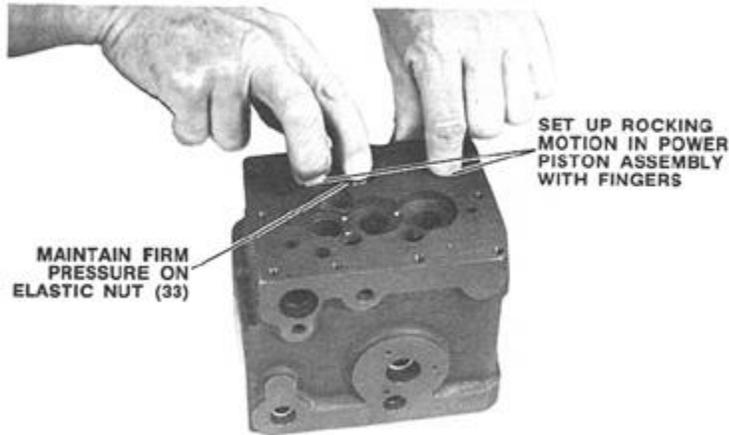


Figure 5-17d. Removing Play in Power Piston Assembly

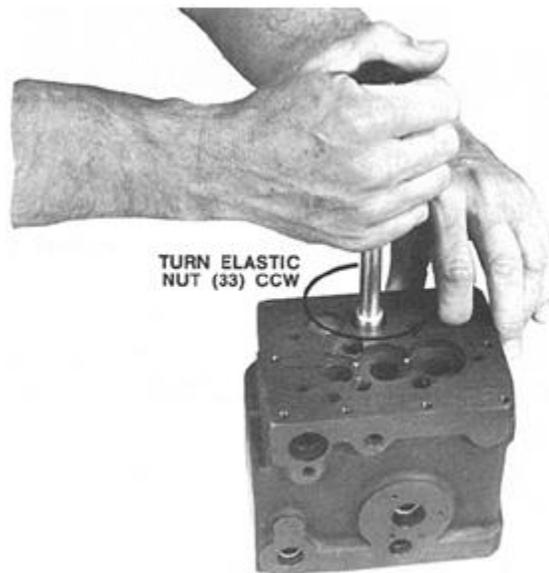


Figure 5-17e. Removing Play in Assembly

- (4) If play is left in the piston linkage assembly, sluggish operation of the actuator will result. Optimum adjustment is just at the point where all play is removed. Do not turn elastic nut (33) counterclockwise beyond that point or minimum to maximum travel of the actuator output shaft will be shortened.

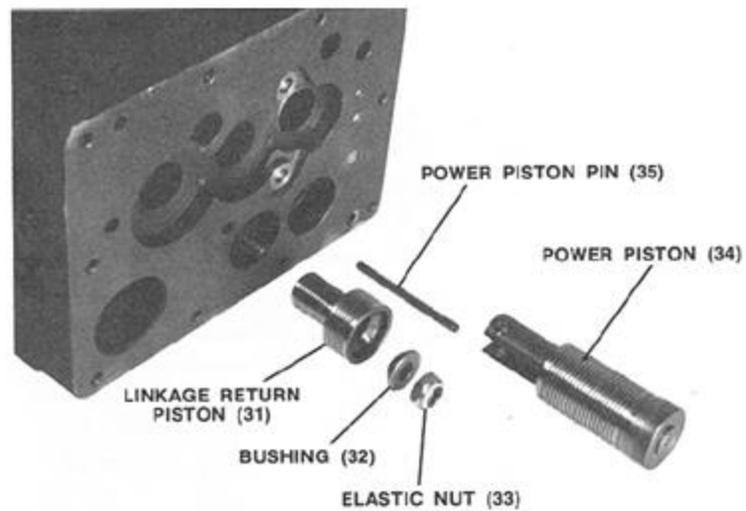


Figure 5-18. Piston Placement

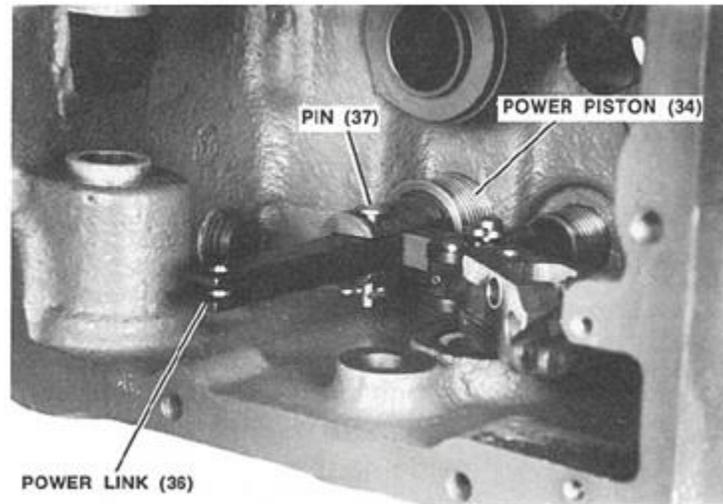


Figure 5-19. Piston Link Assembly

17. Refer to Figure 5-20 and place packing (62) in base. Lubricate and put packing (55) on plug (56) and push into base. Put bowed spring washer (57) (concave side up) in place on top of plug (56) in base.

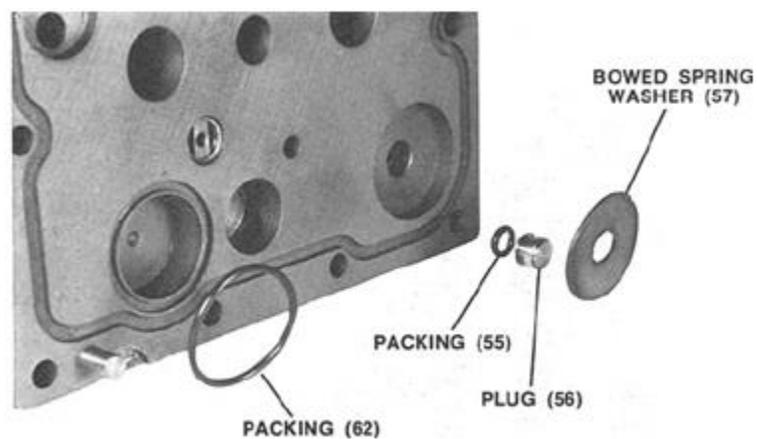


Figure 5-20. Base and Parts

18. Refer to Figure 5-21.

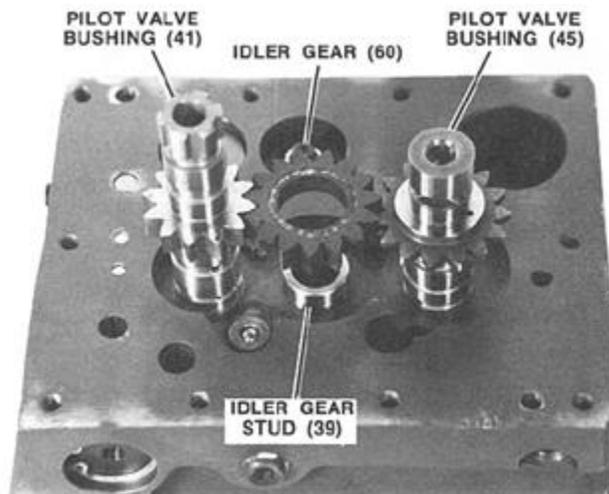


Figure 5-21. Bushing Assemblies

- A. If idler gear stud (39) has been removed, although this should not be necessary, press it into case until its end is just below face surface.
- B. Insert pilot valve bushing assemblies (41) and (45) and idler gear (60) into case as shown. Gears should all mesh.

19. Refer to Figure 5-22.

Lubricate packing (58) and place it on piston sleeve (59) and insert sleeve into case.

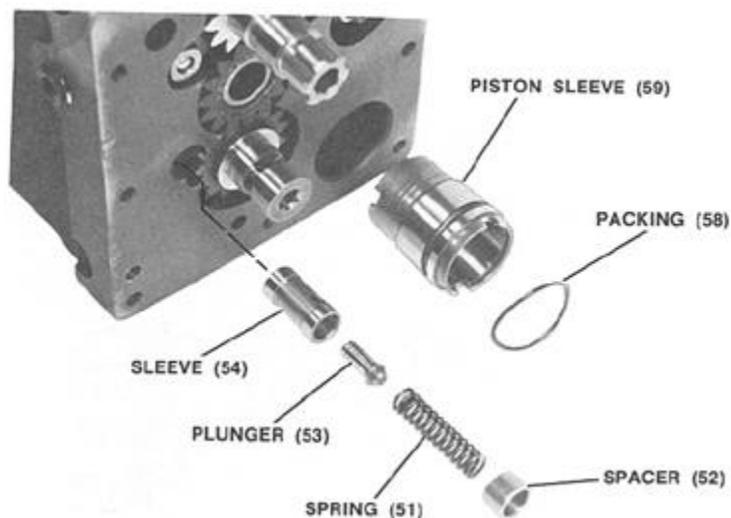


Figure 5-22. Relief Valve & Piston Sleeve Assembly

20. Place ballhead assembly in case on pilot valve plunger (42). Secure with retaining ring (67).

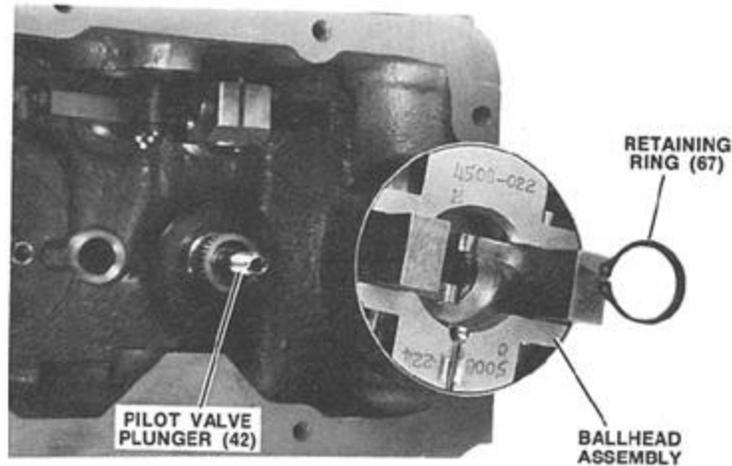


Figure 5-23. Ballhead Assembly

21. Install thrust bearing (68) (race1 bearing, race), speeder spring seat (69) on pilot valve plunger (42) and secure with nut (70). Do not tighten nut (70).
22. Check centering of pilot valve plunger by holding the pilot valve bushing with one hand and pushing on the flyweight toes with the other to lower the pilot valve plunger (PVP) as far as possible. Check distance "A". Pivot flyweights out as far as possible and check distance "B". Distance "A" must equal distance "B" when flyweights have been moved from their extreme inward to their extreme outward position, as nearly as can be determined by visual observation. See Figure 5-25.

If the PVP is too low, use pilot valve wrench (Figure 5-1) to hold spring seat (69) stationary, and turn PVP counterclockwise to raise it. If the PVP is too high, hold spring seat and turn PVP clockwise to lower it.

When pilot valve plunger is centered tighten nut (70) to 70 lb-in. See Figure 5-24.

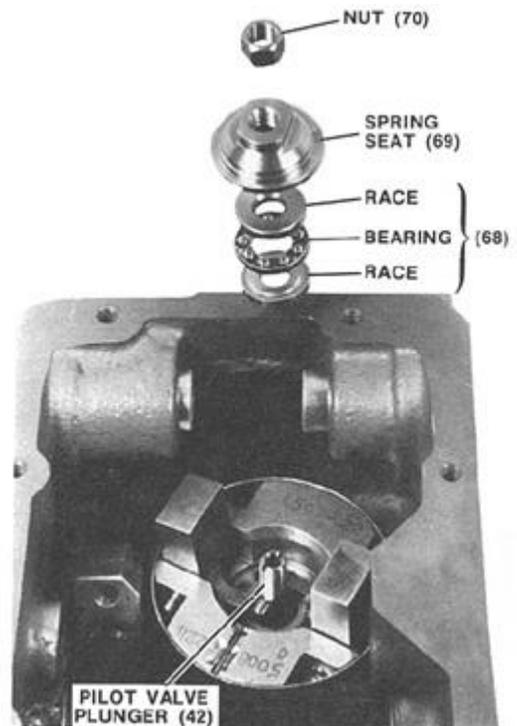


Figure 5-24. Thrust Bearing & Spring Seat Assembly

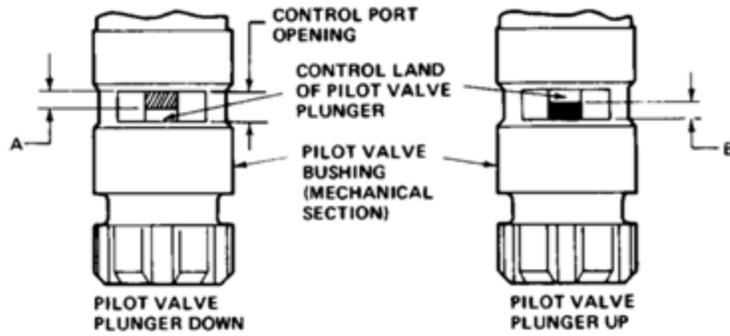


Figure 5-25. Centering Pilot Valve Plunger

23. Refer to Figure 5-22.

Insert sleeve (54), plunger (53), spring (51), and spacer (52) into case.

Lubricate base oil seal (61) and place it in groove on base. Assemble base to case and secure it with lock washers (72) and screws (73). See Figure 5-26. Check bushing rotation for freeness before tightening screws (73).

24. Assemble transducer cup (79), transducer (80), washer (81), magnet (82), and coil cover (83). See Figure 5-27. Note that plug (132) is attached to the transducer.

Figure 5-28 shows the electrical schematic diagram of the hydraulic actuator.

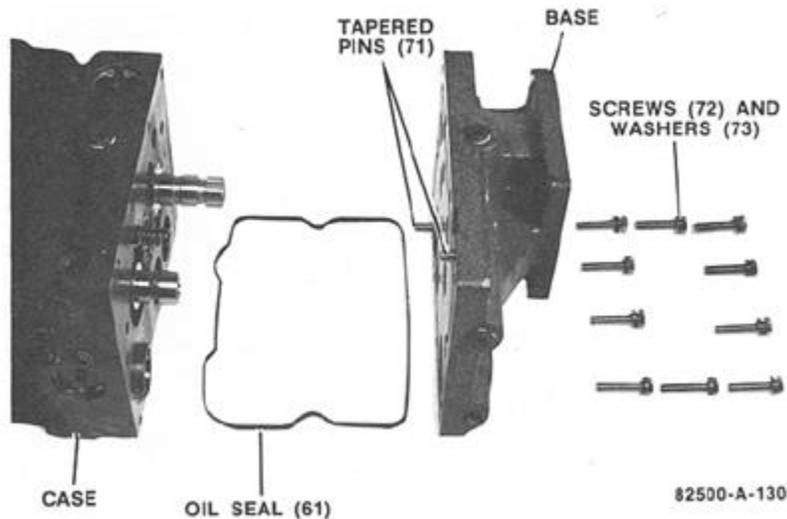


Figure 5-26. Base Assembly

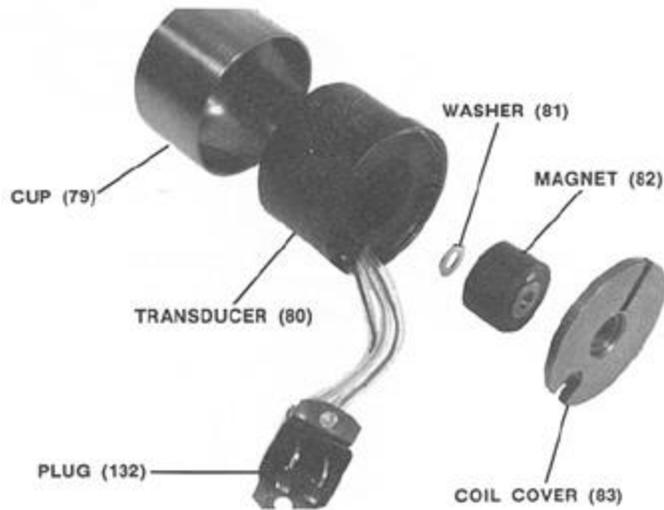


Figure 5-27. Transducer Parts Assembly

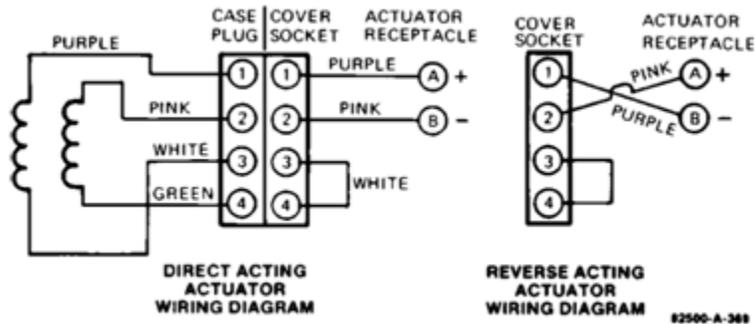


Figure 5-28. EGB-2P Diagram

25. Install transducer assembly on pilot valve plunger (46) and attach plug (132) to case with screws (133). Be sure connections of plug (132) match the connections in cover.
26. Install clamp bracket assembly (Figure 5-9) and secure with screws (99). Note guide pin to slot position Figure 5-31. Insert centering screw (97) through hollow center of adjustable spring seat. Bottom centering screw to prevent binding when plate (102) is installed. Final adjustment is made later. See Figure 5-30.
27. Insert transducer compression spring (101) in position and pivot the transducer lever over to lie on top of the spring. Attach plate (102) to restoring lever with screws (105) and washers (103 and 104). See Figure 5-31. Connect restoring lever to piston link (78) using headed pin (100) and cotter pin (157). Transducer clamp bracket may require realignment to remove binding in this joint.

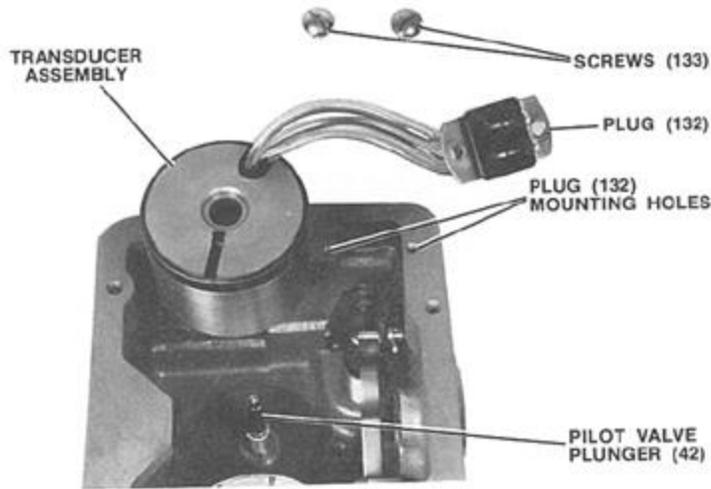


Figure 5-29. Plug & Transducer Installation

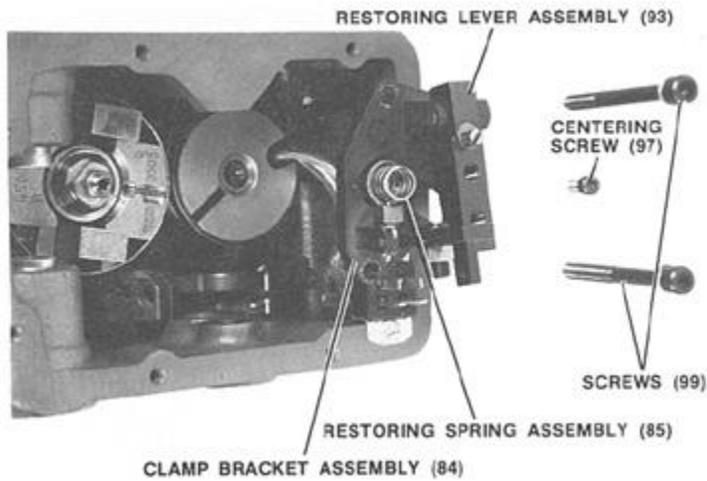


Figure 5-30. Clamp Bracket Assembly

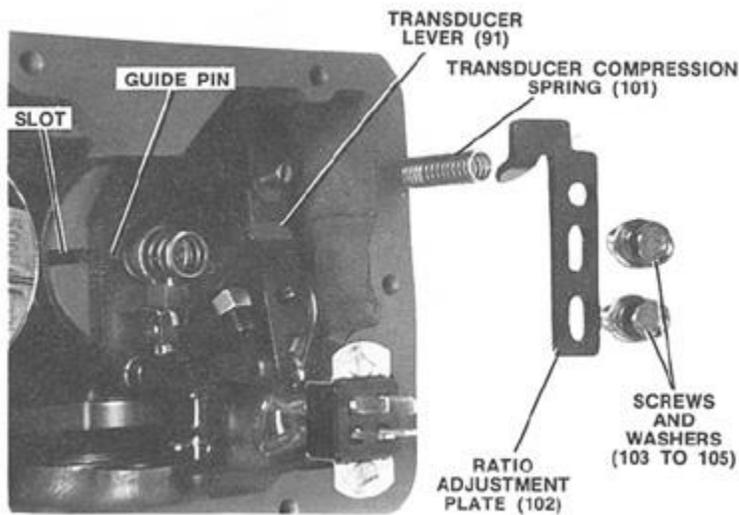


Figure 5-31. Transducer Compression Spring & Ratio Adjustment Plate

28. Insert terminal shaft (107) through side of case (Figure 5-32) and through terminal lever (29). Secure with retaining ring (108). When inserting shaft, tapered hole in shaft must align with hole in terminal lever. Insert tapered pin (111) into hole tight enough for alignment and thread screw (110) with washer (109) into terminal lever and tighten. Tap taper pin in until it is tight.

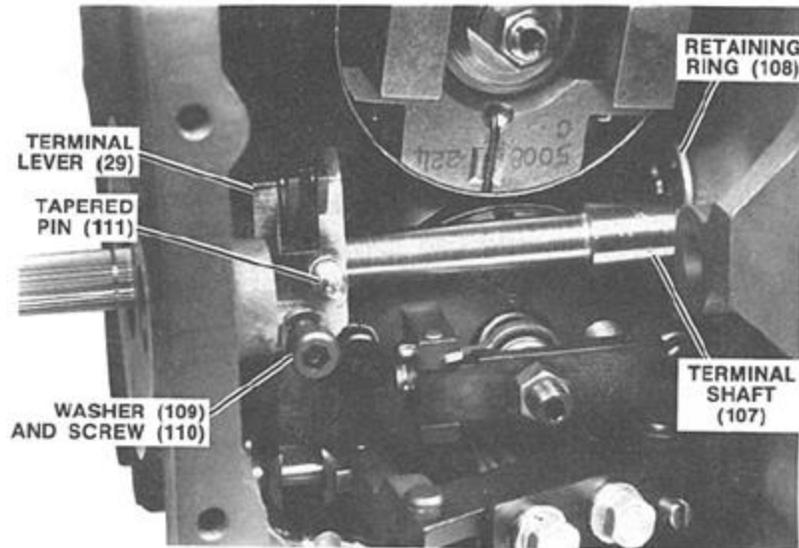


Figure 5-32. Terminal Shaft Installation

29. Assemble speed droop adjustment bracket (116) on speed droop lever (112) with screw and washers (117, 118 and 119). Connect the speed droop lever to the servo link (36) using headed pin (131) and cotter pin (25).

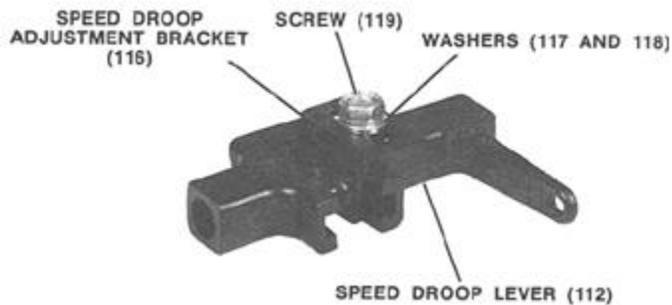


Figure 5-33. Speed Droop Lever

30. Lubricate packings (113) and place on pivot pins (114). Place speed droop lever assembly in the case in line with hole above terminal shaft (107). Insert pivot pins (114) through holes into speed droop lever. Secure pivot pins with retaining rings (115).

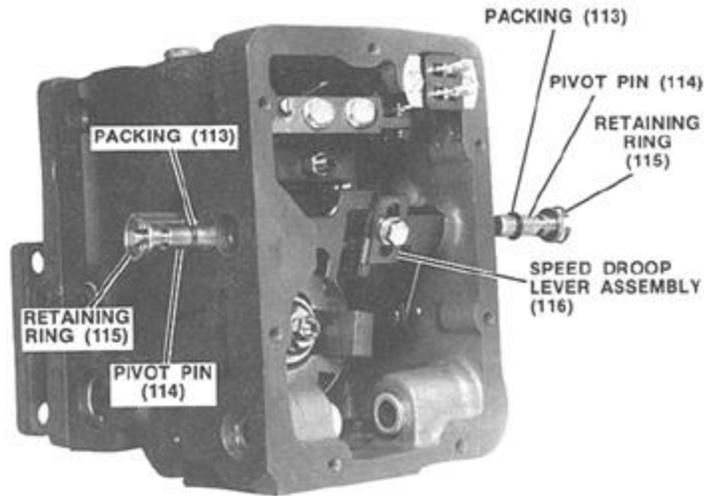


Figure 5-34. Speed Droop Lever Assembly

31. Attach dial plates (136 and 140) with screws (137). See Figure 5-35. Place oil seal (134, cup towards case) on terminal shaft using seal installing tools T94157. Turn terminal shaft to maximum position. Place pointers (138) on terminal shaft with pointer pointing at max., and secure them in place with retaining ring (139). Adjust dial plate (136) until max. line and pointer are aligned.

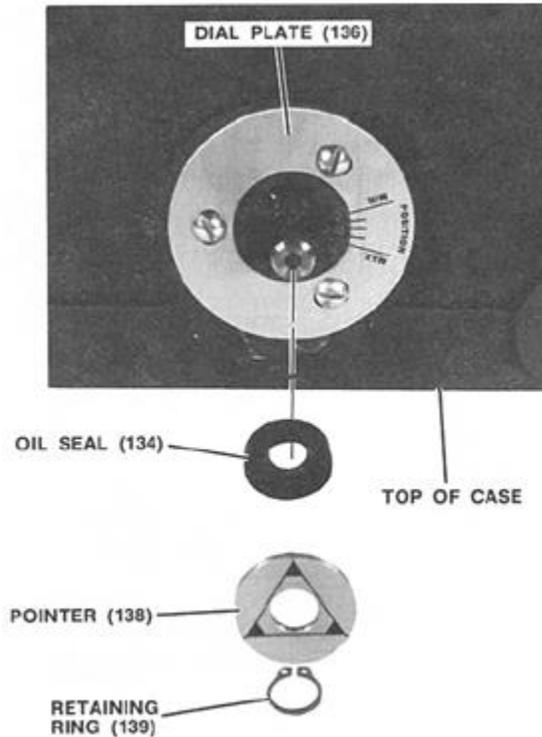


Figure 5-35. Dial Plate & Seal Assembly

32. Place speeder spring assembly (74) on top of ballhead assembly. Press down and twist the spring clockwise to seat the spring on spring seat (69).

33. Insert speed adjusting shaft (126) through case, through speed adjusting lever (123), spacer (127) and into hole on opposite side of case. Figure 5-36 shows an actuator equipped with a stub shaft. Stub shafts require tapered plugs as shown on each side of case. Keep 0.005 to 0.010 inch clearance between bushing (125) and speed adjusting lever (123), and bushing (125) and spacer (127).

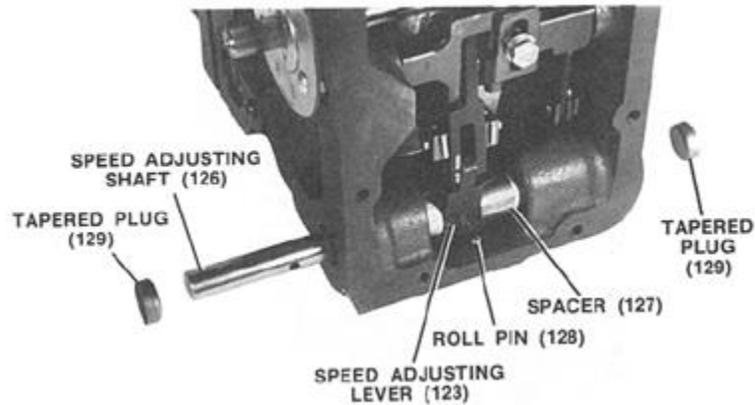


Figure 5-36. Speed Adjusting Shaft Assembly

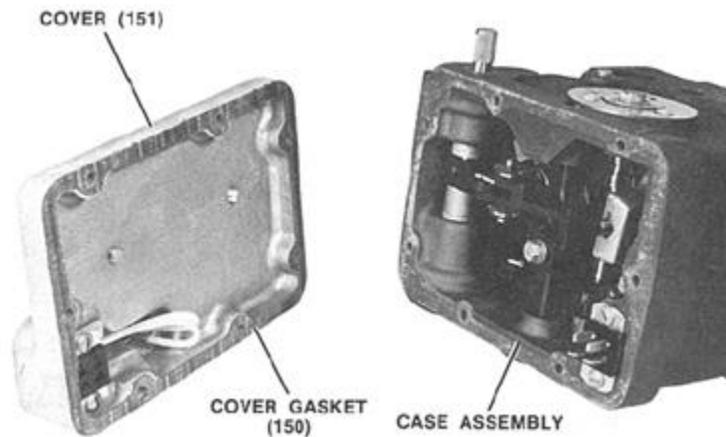


Figure 5-37. Cover Assembly

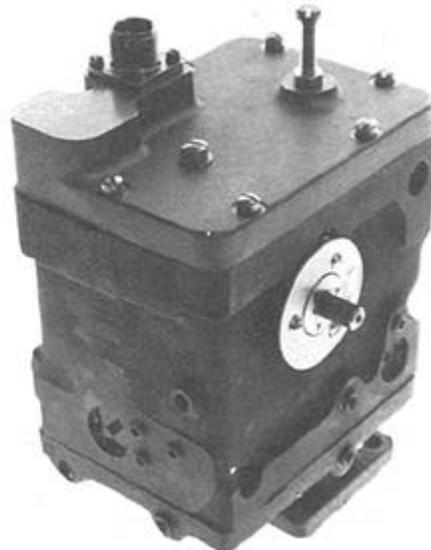


Figure 5-38. Final Assembly

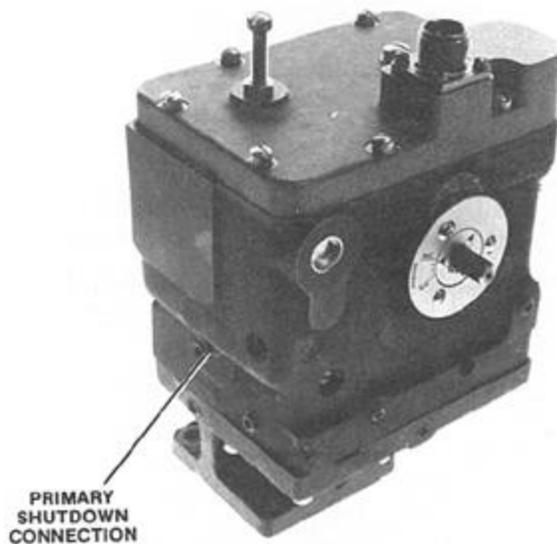


Figure 5-39. Final Assembly

34. Install cover (151) and gasket (150) on case with bolts and washers (152 and 153).

Manual Override Assembly (optional)

Assemble the manual override in the order shown in Figure 5-40. To hold the assembly together compress the assembly and insert pin (159) through knob (158) and through the top of shaft (165). Assemble the unit into the case top.

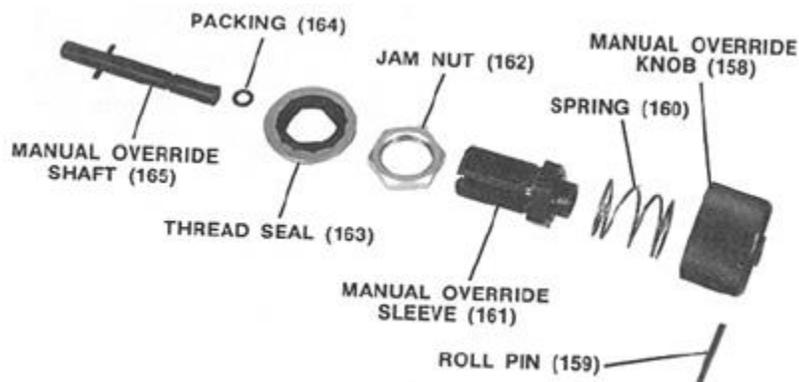


Figure 5-40. Manual Override Parts Layout

To adjust the manual override:

- A. Set the mechanical governor to maximum speed.
- B. Disconnect the electrical power if applicable.
- C. Push down and turn the manual override knob and lock it in its latched position.

- D. Thread the sleeve (161) of the completed assembly down until the terminal shaft is at maximum position.
- E. Tighten jam nut (162) against the cover to lock the assembly in place.
- F. Unlatch the manual override. The terminal shaft should move back to minimum position.
- G. Connect the power supply to the actuator. The manual override should not interfere with the actuator operation in its unlatched position.

Lubrication

Refer to Chapter 2 for the type of oil used in the actuator. The oil used in the actuator should be clean and free of foreign particles to obtain maximum performance from the actuator. Under favorable conditions, the oil may be used for six months or longer without changing. Change oil immediately when it starts to breakdown or darken.

Chapter 6. Auxiliary Devices

Introduction

The following is a brief description of the auxiliary devices available for the EGB-2P Governor/Actuator.

Manual and Pneumatic Overrides for Actuator

The manual and pneumatic overrides provide a means of moving the actuators pilot valve to the full fuel position on the direct acting EGB-2P actuator when control voltage is not available or has failed. (See Chapter 1, Direct and Reverse Acting Types). The unit may then be started on the mechanical backup governor. These overrides are not needed on the reverse acting EGB-2P since this type actuator goes to maximum fuel on loss of control voltage. (See Chapter 1.) The pneumatic device accepts air pressures within the range of 80 to 240 psi (552 to 1655 kPa). See Figure 7-1 for an exploded view of the parts.



Before using the override device, be sure the mechanical governor can control the prime mover speed.

Spring Driven Ballhead

A spring driven flyweight head is available to filter undesirable torsional vibrations transmitted from the engine drive to the centrifugal speed sensing flyweight head.

Magnetic Pickup

The EGB-2P is available with a Magnetic Pickup (MPU) which provides an electrical reading of the ballhead speed. The MPU may be used to control an electronic governor or for other purposes.

The Magnetic Pickup may be installed in either the side or the end of the EGB.

Units with a MPU are equipped with a special solid-drive ballhead that incorporates a 30-tooth gear. The MPU generates a frequency from the gear. The frequency in Hz is one-half of the governor drive speed in rpm. (The electronic governor is selected on a basis of speed in Hz.)

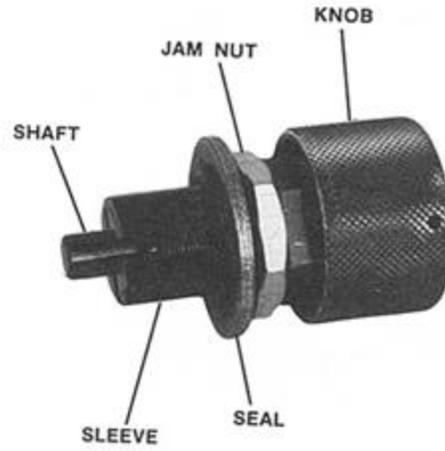


Figure 6-1. Manual Override Assembly

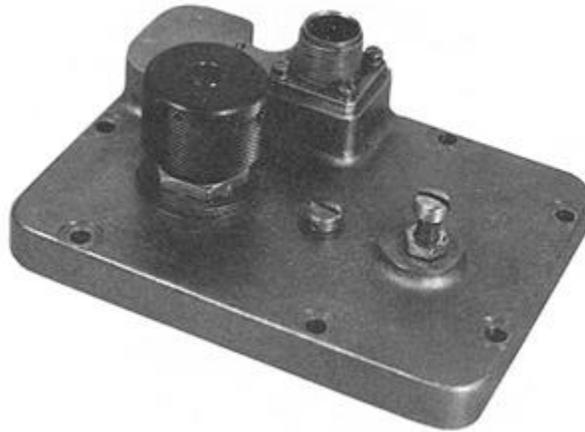


Figure 6-2. Cover with Manual Override

Chapter 7.

Replacement Parts

Introduction

This chapter provides replacement parts information for the EGB-2P Governor/Actuator. An illustrated parts breakdown shows all replaceable parts of the governor/actuator.

The parts breakdown (Figure 7-1) illustrates and lists all the replaceable parts for the EGB-2P Actuator. The numbers assigned are used as reference numbers and are not specific Woodward part numbers. Woodward will determine the exact part number for your particular actuator.

When ordering replacement parts, it is essential to include the following information:

- Actuator serial number and part number shown on nameplate
- Manual number (this is manual 82570)
- Parts reference number in parts list and description of part or part name

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
82570-1	EG-82P case.....	1	82570-38	NOT USED	
82570-2	Soc. hd. pipe plug, .250-18	2	82570-39	Idler gear stud.....	1
82570-3	Pipe plug .125-27 NPTF	4	82570-40	Check valve	4
82570-4	Soc. hd. pipe plug 1/16 NPTF	11	82570-41	Pilot valve bushing	1
82570-5	Buffer spring.....	2	82570-42	Pilot valve plunger	1
82570-6	Buffer piston.....	1	82570-43	Compensating bushing	1
82570-7	Packing, .625 O.D.	1	82570-44	Retaining ring, .438 I.D.	1
82570-8	Buffer plug.....	1	82570-45	Pilot valve bushing	1
82570-9	Retaining ring, .901 O.D.....	1	82570-46	Pilot valve plunger	1
82570-10	Packing, .070 x .316 O.D.	1	82570-47	Compensating bushing	1
82570-11	Screw plug	1	82570-48	Retaining ring.....	1
82570-12	Jam nut	1	82570-49	Magnet spring	1
82570-13	Hex. hd. screw	1	82570-50	Governor base	1
82570-14	Packing, .070 x .816 O.D.	1	82570-51	Relief valve spring	1
82570-15	Buffer cap.....	1	82570-52	Relief valve spacer	1
82570-16	Retaining ring	1	82570-53	Relief valve plunger	1
82570-17	Packing, .070 x .316 O.D.	1	82570-54	Relief valve sleeve.....	1
82570-18	Needle valve	1	82570-55	Packing, .070 x .316	1
82570-19	Power piston (large size).....	1	82570-56	Plug	1
82570-19A	Power piston (Small size) EGB-1P only.	1	82570-57	Bowed spring washer	1
82570-20	Pin.....	1	82570-58	Packing, .070 x 1.004 O.D.	1
82570-21	Floating lever.....	1	82570-59	Load sensing power piston sleeve.....	1
82570-22	Snap ring, .172 I.D.	1	82570-60	Idler gear	1
82570-23	Pivot link.....	1	82570-61	Base oil seal ring	1
82570-24	Lever fulcrum pin.....	1	82570-62	Packing, .070 x 1 .062 O.D.	1
82570-25	Cotter pin, .060 x .375.....	3	82570-63	Ballhead.....	1
82570-26	Terminal lever link.....	1	82570-64	Ballarm	2
82570-27	Pivot pin	1	82570-65	Straight pin.....	2
82570-28	Roll pin	2	82570-66	Spirolox ring, 2.062 I.D.	1
82570-29	Terminal lever	1	82570-67	Retaining ring, .579 I.D.	1
82570-30	Pivot pin	1	82570-68	Thrust bearing.....	1
82570-31	Linkage return piston.....	1	82570-69	Spring seat.....	1
82570-32	Pivot washer.....	1	82570-70	Pilot valve plunger nut	1
82570-33	Elastic stop nut, .250-28.....	1	82570-71	Taper pin, #2.....	2
82570-34	Power piston	1	82570-72	Lock washer, #10.....	10
82570-35	Straight pin	1	82570-73	Hex hd. screw, 10-32 x .875	10
82570-36	Servo link	1	82570-74	Speeder spring	1
82570-37	Drilled headed pin	1	82570-75	Pivot pin.....	1

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
82570-76	Washer .281 O.D.	1	82570-126	Speed adjusting shaft	1
82570-77	Straight pin	1	82570-127	Spacer	1
82570-78	Piston link	1	82570-128	Roll pin, .135 O.D. x .500	1
82570-79	Transducer temp. comp. cup	1	82570-129	Tapered plug, 9/16	1
82570-80	Transducer solenoid	1	82570-130	Oil seal, .568 O.D.	1
82570-81	Washer, .223 I.D.	1	82570-131	Drilled headed pin	1
82570-82	Magnet	1	82570-132	4 pin plug	1
82570-83	Coil cover	1	82570-133	Fillister screw, 6-32 x .375	2
82570-84	Transducer clamp bracket	1	82570-134	Seal .755 O.D.	2
82570-85	Restoring spring assembly	1	82570-135	NOT USED	
82570-86	Straight drilled pin	1	82570-136	L.H. dial plate	1
82570-87	Needle bearing	1	82570-137	Nylok truss screw	6
82570-88	Bearing retainer sleeve	1	82570-138	Load indication pointer	2
82570-89	Cotter pin, .030 x .250	2	82570-139	Retaining ring	2
82570-90	Adjustable spring seat	1	82570-140	R.H. dial plate	1
82570-91	Transducer lever	1	82570-141	Copper washer, 265 I.D.	1
82570-92	Pilot valve plunger nut	1	82570-142	Vent screw	1
82570-93	Restoring lever	1	82570-143	Bendix 2 pin receptacle	1
82570-94	Pin, .1877 x .750	1	82570-144	Lock washer	4
82570-95	Eccentric pin	1	82570-145	Fill. hd. screw, 6-32 x .375	4
82570-96	Drilled straight pin	1	82570-146	4 pin socket	1
82570-97	Soc. hd. Nylok screw, 6-32 x .375	1	82570-147	Fill. hd. screw, 6-32 x .375	2
82570-98	Lock washer, #10	2	82570-148	Jam nut	1
82570-99	Socket screw, 10-32 x 1.875	2	82570-149	Low speed stop screw	1
82570-100	Drilled headed pin	1	82570-150	Cover gasket	1
82570-101	Transducer compression spring	1	82570-151	Governor cover	1
82570-102	Ratio adjustment plate	1	82570-152	Lock washer, 10	7
82570-103	Washer, .203 I.D. x .380 O.D.	2	82570-153	Fillister screw, 10-32 x 1	7
82570-104	Lock washer, #10	2	82570-154	Drive coupling	1
82570-105	Cap screw, 10-32 x .500	2	82570-155	Nameplate	1
82570-106	Oilite bushing, .689 O.D.	2	82570-156	Drive screw, 2 x .125	2
82570-107	Terminal shaft	1	82570-157	Cotter pin .060 x .375	2
82570-108	Retaining ring, .392 I.D.	1	82570-158	Manual override knob	1
82570-109	Lock washer, #10	1	82570-159	Roll pin, .094 x 1.000	1
82570-110	Soc. hd. cap screw, 10-32 x .625	1	82570-160	Spring	1
82570-111	Taper pin	1	82570-161	Manual override sleeve	1
82570-112	Speed droop lever	1	82570-162	Jam nut, .750-32	1
82570-113	Packing, .070 x .316 O.D.	2	82570-163	Thread seal	1
82570-114	Speed droop pivot pin	2	82570-164	Packing .176 I.D. x .070	1
82570-115	Retaining ring	2	82570-165	Manual override shaft	1
82570-116	Speed droop adjusting bracket	1	82570-166	Cover	1
82570-117	Washer, .203 I.D. x .380 O.D.	1	82570-167	Adjustable air start cylinder	1
82570-118	Lock washer, #10	1	82570-168	Jam nut .750-32	1
82570-119	Cap screw, 10-32 x .500	1	82570-169	Plunger	1
82570-120	Floating lever	1	82570-170	Spring	1
82570-121	Pivot pin	1	82570-171	Washer	1
82570-122	Cotter pin, .060 x .625	3	82570-172	Retaining ring	1
82570-123	Speed adjusting lever	1	82570-173	Idle gear stud plug (used in horizontal installation only)	1
82570-124	Pivot pin	2			
82570-125	Oilite bushing, .376 O.D.	2			

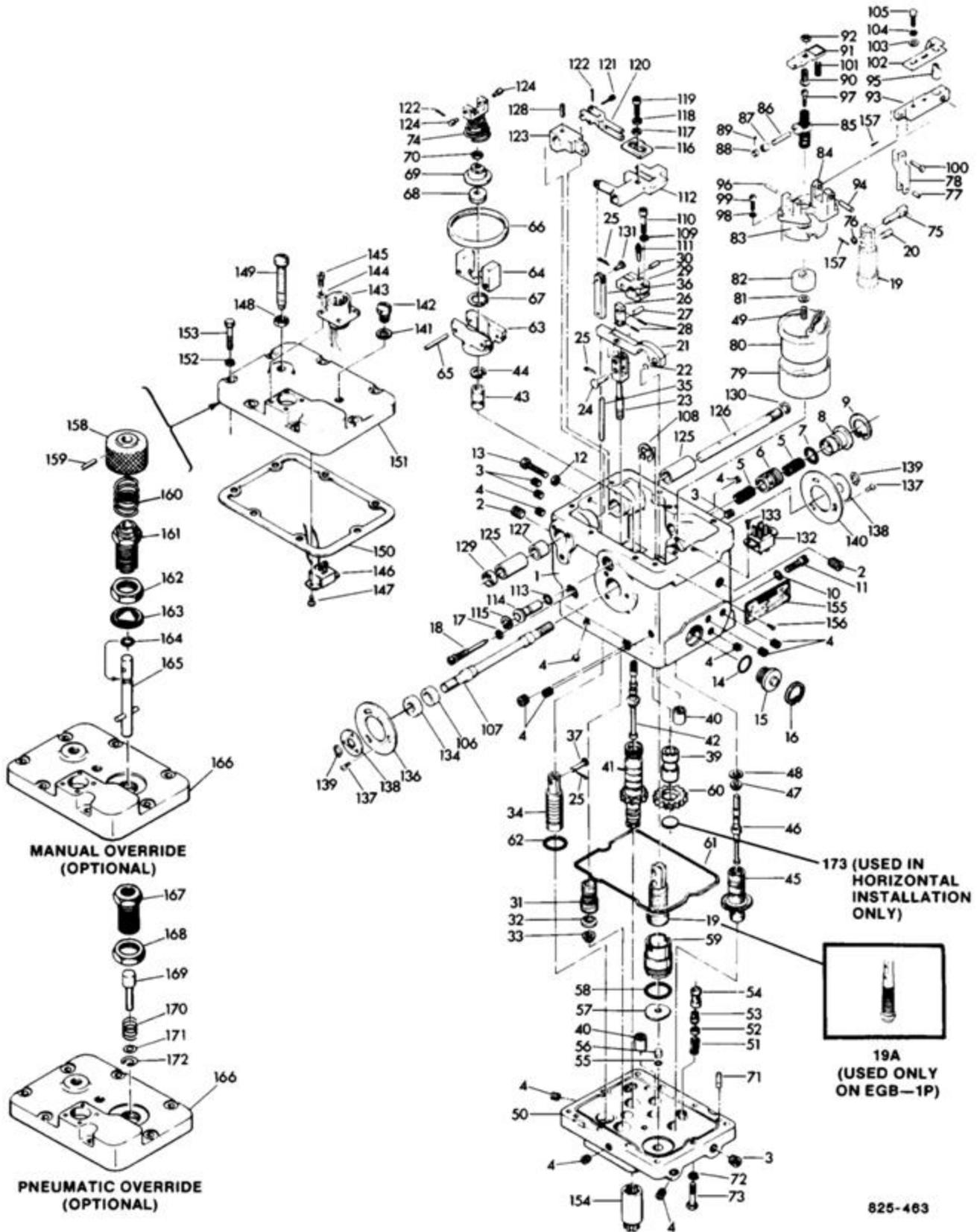


Figure 7-1. EGB-2P Exploded View

Chapter 8.

Product Support and Service Options

Product Support Options

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		Products Used in Engine Systems		Products Used in Industrial Turbomachinery Systems	
Facility	Phone Number	Facility	Phone Number	Facility	Phone Number
Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727	China	+86 (512) 6762 6727	China	+86 (512) 6762 6727
Germany:		Germany	+49 (711) 78954-510	India	+91 (124) 4399500
Kempen	+49 (0) 21 52 14 51	India	+91 (124) 4399500	Japan	+81 (43) 213-2191
Stuttgart	+49 (711) 78954-510	Japan	+81 (43) 213-2191	Korea	+82 (51) 636-7080
India	+91 (124) 4399500	Korea	+82 (51) 636-7080	The Netherlands	+31 (23) 5661111
Japan	+81 (43) 213-2191	The Netherlands	+31 (23) 5661111	Poland	+48 12 295 13 00
Korea	+82 (51) 636-7080	United States	+1 (970) 482-5811	United States	+1 (970) 482-5811
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 _____

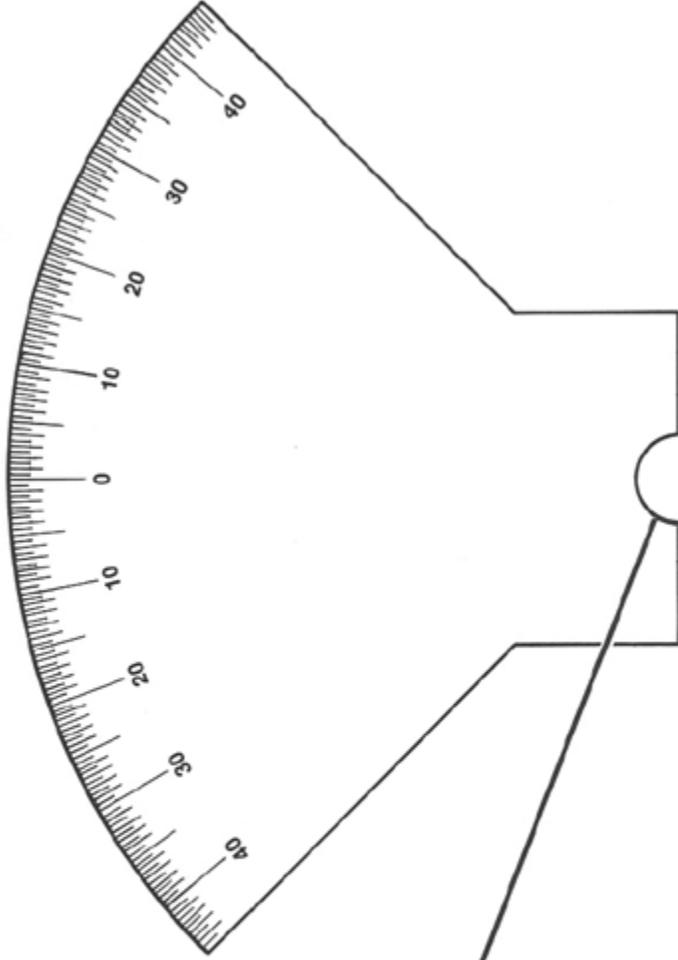
Control Description or Governor Type _____

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.



**CUT HERE
FOR EGB-2P**

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **82570L**.



PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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