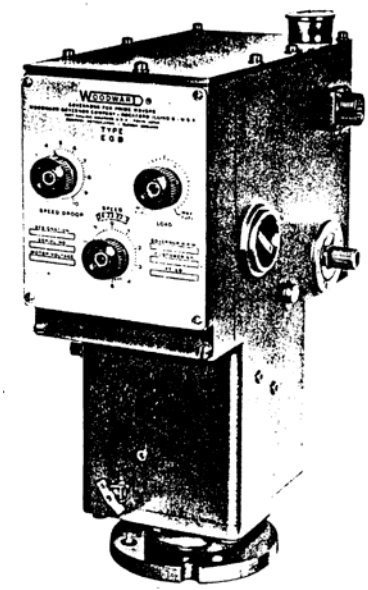
WOODWARD

Product Manual 82558
(Revision A)
Original Instructions



EGB-10PLS Hydraulic 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

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

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Proper Use

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

Translated Publications

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

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 Out-of-date translations are marked with ⚠.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

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Important Definitions

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

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

⚠WARNING

Overspeed / Overtemperature / Overpressure

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

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

⚠WARNING

Personal Protective Equipment

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

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

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

⚠WARNING

Start-up

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

⚠WARNING

Automotive Applications

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

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

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

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

Follow these precautions when working with or near the control.

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

Chapter 1.
General Information

Introduction

This manual provides description, operation, installation, adjustment, overhaul, and replacement parts information for the EGB-10PLS Hydraulic Actuator and certain optional auxiliary features which may be used with the actuator. This manual, together with manual 37712, also provides coverage for the EGB-35PLS and EGB-50PLS Hydraulic Actuators, which are basically identical to the EGB-10PLS with minor modification to permit greater work outputs.

Description

The EGB-10PLS is a electric, proportional output actuator with an integral backup mechanical (centrifugal) governor. It is normally used with the Woodward 2301 load sensing electric control unit to form a complete governing system. This system is superior to other similar systems in the 2301 electric governor series in that it provides a faster response to prime mover transient conditions and thereby improves the performance of the complete governing system.

A proportional actuator is one in which the actuator terminal (output) shaft assumes a position in direct proportion to the magnitude of the electrical output signal from the electric control unit. The magnitude of the input signal to the actuator is determined by the position of the fuel or steam control required to maintain the desired prime mover speed under varying conditions of load. Although proportional actuators (or governors) can be used in the same type of service as other models of actuators, they are particularly suited for use with prime movers operating in tandem to drive a common mechanical load. In such application, a single electric control unit can be used for two or more proportional actuators connected in series with the control unit's output. With each actuator receiving the same current signal, their output shafts will take the same angular position and direct the same amount of fuel or steam to each prime mover.

The EGB-10PLS actuator (Figure 1-1) is, in effect, two governors in one: an electric governor and a mechanical governor, each independently capable of positioning the output shaft. During normal operation, the electric governor controls fuel or steam to the prime mover. The mechanical governor may control the prime mover during starting and also function as a backup governor to prevent runaway should the electric control unit fail and call for maximum fuel or steam. The speed of the mechanical governor is set approximately 5% higher than the electrical governor; when the speed reaches the level of the mechanical governor, this chapter will assume and maintain control of the prime mover. Speed can be reduced, if desired, by lowering the speed setting of the mechanical governor. Should the electric signal be interrupted or should the electric control unit fail and call for a decrease in fuel or steam, the prime mover will shut down.

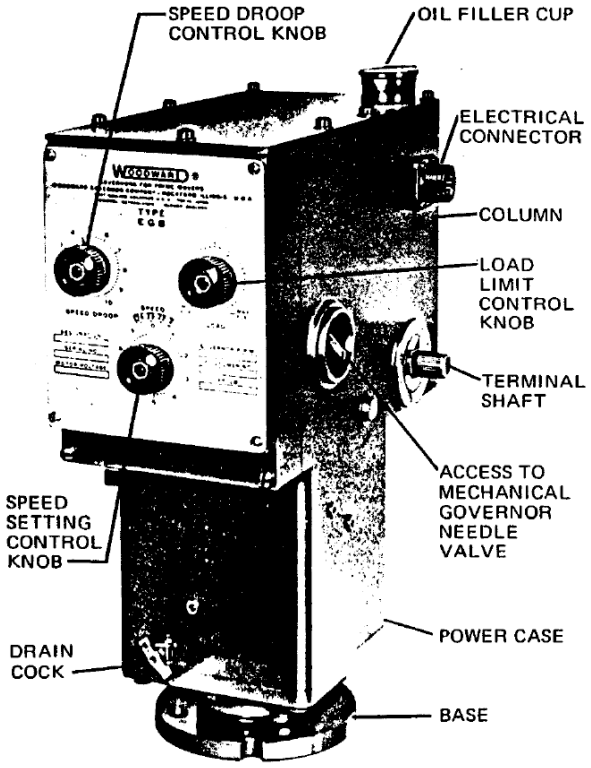


Figure 1-1. EGB-10PLS Hydraulic Actuator

As is the case with a governor of any type, the prime mover should be equipped with a separate overspeed device to prevent runaway.

The essential element of the electric section of the actuator is an electro-hydraulic transducer which directs pressure oil to and from the power piston which actuates the fuel or steam control mechanism. The transducer consists of a solenoid to which is attached the pilot valve plunger, controlling oil flow to and from the servo piston. The solenoid responds to the output of an electric control unit and, in so doing, moves the pilot valve plunger. Through connecting linkage, the servo piston moves the terminal (output) 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, the linkage should be arranged to give the same degree of linearity afforded conventional speed sensing governors to obtain optimum steady-state and transient performance.

Specifications

Outline dimensions:	See Figure 6-8
Drive rotation:	Omni-directional (cw or ccw) or uni-directional
Drive speed:	900–1100 rpm at rated prime mover speed
Power requirement:	0.5 hp (373 W) at 1000 rpm and normal operating temperature
Hydraulic fluid:	Lubricating oil
Viscosity range:	100–200 cSt (min 50 to max 1000 cSt for wide range applications)
Supply:	Self-contained sump
Sump Capacity:	1.5 US qt (1.4 L)

Output

Useful work capacity:	7.5 ft-lb (10.2 J)
Stalled work capacity:	10.0 ft-lb (13.6 J)
Stalled torque rating:	13.0 lb-ft (17.6 N·m)
Angular output shaft travel:	45°

Auxiliary Features (Optional)

A brief description of the various optional auxiliary features which may be used, either singly or in combination, is given in the following paragraphs. Replacement parts information will be found in Chapter 6 of this manual.

Speed Setting Motor

The speed setting motor permits changes in the speed setting of the mechanical governor section to be made from a remote location and is normally used when remote starting of the prime mover is required. The motor is mounted externally on top of the actuator (see Figure 6-4) with its output shaft connected to the manual speed adjusting screw through a friction clutch. The clutch allows speed setting changes to be made either remotely via the speed setting motor or at the actuator via the manual speed setting control knob.

Two limit switches may be installed when the speed setting motor is used. The switches are actuated by the dial stops on the manual speed adjusting mechanism and may be connected in such fashion as to limit the speed setting motor travel at the desired minimum or maximum speeds or to provide a remote visual indication when the minimum or maximum speed setting has been attained. The motor is of the split field, series wound, reversible type and is available for use with all standard voltages. Refer to manual 03505 for maintenance and parts information.

Shutdown Solenoid

The shutdown solenoid is used in applications where automatic shutdown of the prime mover is desired in the event of loss of lubricating oil pressure, excessive operating temperatures, loss of vacuum, etc. The solenoid is mounted internally within the actuator column (see Figure 6-5). It is connected via tubing and internal passageways to the upper side of the dashpot land on the relay valve plunger in the hydraulic amplifier section of the actuator. When the solenoid is energized, oil pressure on the upper side of the dashpot land is dumped. This allows the oil pressure acting on the under side of the dashpot land to raise the relay valve plunger which, in turn, dumps the trapped oil under the power piston. The oil pressure acting on top of the power piston then forces the piston to move to the shutdown position.

Pneumatic Starting Device

The pneumatic starting device is used in applications where the electric control unit is unable to provide a signal to the actuator for starting the prime mover. This would be the case in installations where the electric control unit is dependent upon a frequency signal or upon the generator being driven for its power and thus would not emit a signal until the generator was excited. The starting device is a simple air operated plunger with spring return which is used to push the electric governor pilot valve downward. The oil pressure generated at cranking speed will then cause the actuator output shaft to move in the increase direction so that the prime mover can be started. The device is mounted on the actuator cover directly over the electric governor pilot valve (see Figure 6-6) and is designed for use with air pressures within a range of 80–240 psi (552–1655 kPa).

Spring Driven Ballhead

A spring driven flyweight head is available for use in EGB-10PLS actuators where it is necessary to dampen undesirable torsional vibrations transmitted through or from the prime mover accessory drive to the speed sensing flyweight head of the mechanical governor (see Figure 6-7).

Chapter 2.
Installation

Introduction

Refer to Figure 6-8 for complete physical dimensions of the actuator and to manual 36693 for dimensions of the various bases. Adequate clearance must be provided for installation and removal, and for access to the drain cock and oil filler cup.

Take particular care to mount the actuator squarely with respect to the prime mover accessory drive pad and to the interconnecting linkage from the fuel or steam control. A gasket should be used between the actuator base and drive pad.

NOTICE

Do not drop or rest the actuator on its drive shaft, or drive a coupling or gear on or off the shaft as damage to the shaft oil seal or other parts may occur.

If the actuator has a splined drive shaft, make certain the actuator shaft slips into the prime mover accessory drive coupling freely enough to drop into place of its own weight.

If a keyed type actuator drive shaft is used, the gear placed in the shaft must be checked for proper backlash with its mating drive gear. There should be neither excessive backlash nor binding. Vibration or other irregularities caused by uneven gear teeth, shaft run-out, etc. and transmitted to the actuator will adversely affect actuator operation and result in erratic governing.

The linkage between the actuator output shaft and fuel or steam control should be adjusted to use a minimum of 27° of the actuator output shaft travel from the rated speed no-load position to the rated speed full-load position. The linkage must operate freely with a minimum of backlash. If there is a collapsible member in the linkage, it must not yield during normal governing action or under conditions of rapid output shaft movement.

⚠WARNING

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

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

Oil Specifications

Proper selection of the oil used in the actuator is necessary to realize best governor performance and maximum service life. The oil should have a minimum tendency to foam or retain air, form sludge, or deposit varnish. It should protect actuator parts from corrosion and not be detrimental to oil seals or paint. Synthetic oils are not usually recommended. Refer to Woodward manual 25071 for more complete information on selection of oils for use in hydraulic actuators (governors).

The oil selected should have a high viscosity index, within the range of 100–200 centistokes at normal operating temperatures. Only oils of the grade specified for a particular operating temperature range should be used. The same oil as used in the prime mover may be used in the actuator if it meets the above requirements.

NOTICE

Oil contamination is the major cause of actuator troubles. Use only new oil or filtered oil. Containers used for filling the actuator must be clean and should be rinsed with a light grade of the same oil before use.

Prime Mover Operation

Whenever starting the prime mover, an electrical signal must be provided to the actuator so that the electric governor pilot valve will move in the increase fuel or steam direction. This allows the oil pressure generated at cranking speed to rotate the output shaft and open the fuel or steam control sufficiently to start the prime mover. When a battery or other independent power supply is available to provide power to the electrical control unit, the control unit will transmit a signal in the range of 8 to 9 Vdc to the actuator for starting. If a source of electrical power is not available, the actuator may be equipped with a pneumatic starting device (refer to Chapter 1). Where neither a source of electric or pneumatic power is available or in the event of electrical control unit failure, a 6 Vdc battery may be connected across pins A(+) and B(–) of the actuator receptacle to provide the necessary electrical signal for starting. After the unit is started and the electric control system is powered, the external electrical source must be removed for operation in the electric governor mode. In the event of control unit failure or loss of electrical power, an external electric source may be used to force the electric governor to assume a simulated overload condition and permit continued operation of the prime mover under control of the mechanical governor in the actuator.

Prior to starting the prime mover for the first time after installation of a new or overhauled actuator, perform an operational checkout of the electrical control unit in accordance with applicable manual.

Chapter 3.
Principles of Operation

Introduction

The EGB-10PLS hydraulic actuator (see Figure 3-1) consists of three distinct but interconnected sections: (1) an electric governor section; (2) a mechanical governor section; and (3) a hydraulic amplifier section which amplifies the force output of the other two sections. The amplifier section also provides a source of pressure oil for that section.

The three sections are interconnected through the loading piston. The loading piston position determines the actuator output shaft position. Either the electric or mechanical governor section can control the position of the loading piston.

Hydraulic Amplifier Section

The EGB-10PLS actuator contains two separate hydraulic circuits. Each circuit utilizes the oil of a common sump within the actuator. The relay valve oil pump (see Figure 3-1) provides pressure oil required by the amplifier section. The actuator drive shaft, driven at a speed proportional to engine speed, rotates the pump drive gear and rotating bushing. Pressure oil forces the accumulator pistons up, opposing the downward force of the accumulator springs. When the pistons move up sufficiently, one piston uncovers a bypass hole through which excess oil is returned to sump. The accumulator thus not only provides a reservoir for pressure oil but acts also as a relief valve to limit maximum pressure in the hydraulic circuit.

The arrangement of the four check valves on the suction and discharge sides of the oil pump permits the actuator drive shaft to be rotated in either direction without any changes being made in or to the governor. The direction of pump rotation does not affect the oil pressure system or actuator operation. Were the pump gears rotated in directions opposite those shown in Figure 3-1, the open check valves would be closed and the closed check valves open.

The relay servo piston is connected through the terminal lever to the actuator terminal (output) shaft. The terminal shaft position establishes the fuel rack, fuel valve, or steam valve opening. The relay servo piston position establishes the terminal shaft position.

The relay valve plunger in the rotating bushing controls the flow of oil to and from the underside of the relay servo piston. If the plunger is “centered” in the bushing (its control land exactly covers the control port in the rotating bushing), no oil flows to or from the piston. Pressure oil continually urges the piston down in the direction to decrease engine fuel. However, the piston cannot move down to decrease fuel unless the oil trapped between the underside of the piston and the relay valve plunger control land can escape to sump. This trapped oil can escape only if the relay valve plunger is raised. If the relay valve plunger is lowered, pressure oil is directed to the underside of the piston as well as to the upper side of the piston. Because the pressure acts upon a greater area on the lower side of the piston, the resulting net force is in the direction to push the piston up to increase fuel.

The relay valve plunger movement is controlled by the output nut attached to the loading piston. Assume that with the relay valve plunger centered, the loading piston and output nut move down. As will be seen, either the electric governor section or the mechanical governor section is capable of controlling the loading piston position. This downward movement of the piston and nut pushes the left end of the intermediate lever down. As the right end of the intermediate lever moves up, the left end of the relay beam is raised (the beam pivots about the screw in the end of the terminal lever). The relay valve plunger is thus lifted above center and the servo piston acting through the terminal lever rotates the terminal shaft in the decrease fuel direction.

As the terminal lever rotates the terminal shaft to decrease fuel, the screw in the left end of the lever is raised. This permits the oil pressure atop the dashpot land to push the relay plunger down, pivoting the relay beam about the bearing in the right end of the intermediate lever. (The dash pot land is, in effect, a “differential piston” with the area on the upper side of the land greater than the area on the lower side. The oil pressure continually acting on both sides of the land produces a net force in the downward direction.) As the relay valve plunger reaches its centered position, flow of oil from under the relay servo piston is stopped, thereby stopping the terminal shaft movement.

Assume now that, with the relay valve plunger centered, the loading piston and output nut move up. Oil pressure on the upper side of the dashpot land now pushes the relay plunger down. At the same time, the right end of the intermediate lever is pushed down thereby keeping the left end of the lever in contact with the output nut.

With the relay valve plunger below center, pressure oil flows to the lower side of the relay servo piston and pushes the piston up. The terminal lever rotates the shaft in the increase fuel direction. As the terminal lever rotates, the screw in the end of the lever pushes the right end of the relay beam down. The relay beam pivots about the roller bearing in the right end of the intermediate lever, thus lifting the relay valve plunger back to its centered position and stopping further movement of the terminal shaft.

Electric Governor Section

During the normal mode of operation of the actuator the electric governor (see Figure 3-1) will be controlling and the servo piston of the mechanical governor will be at the top of its stroke (refer to mechanical governor section).

Pressure oil for the electric and mechanical governor sections is provided by the sub-governor oil pump. The pump relief valve plunger, acting against the relief valve spring maintains the oil pressure required in these sections. Because the oil volume required in these sections is relatively small, no accumulator is required. The sub-governor oil pump operates the same way as the relay oil pump.

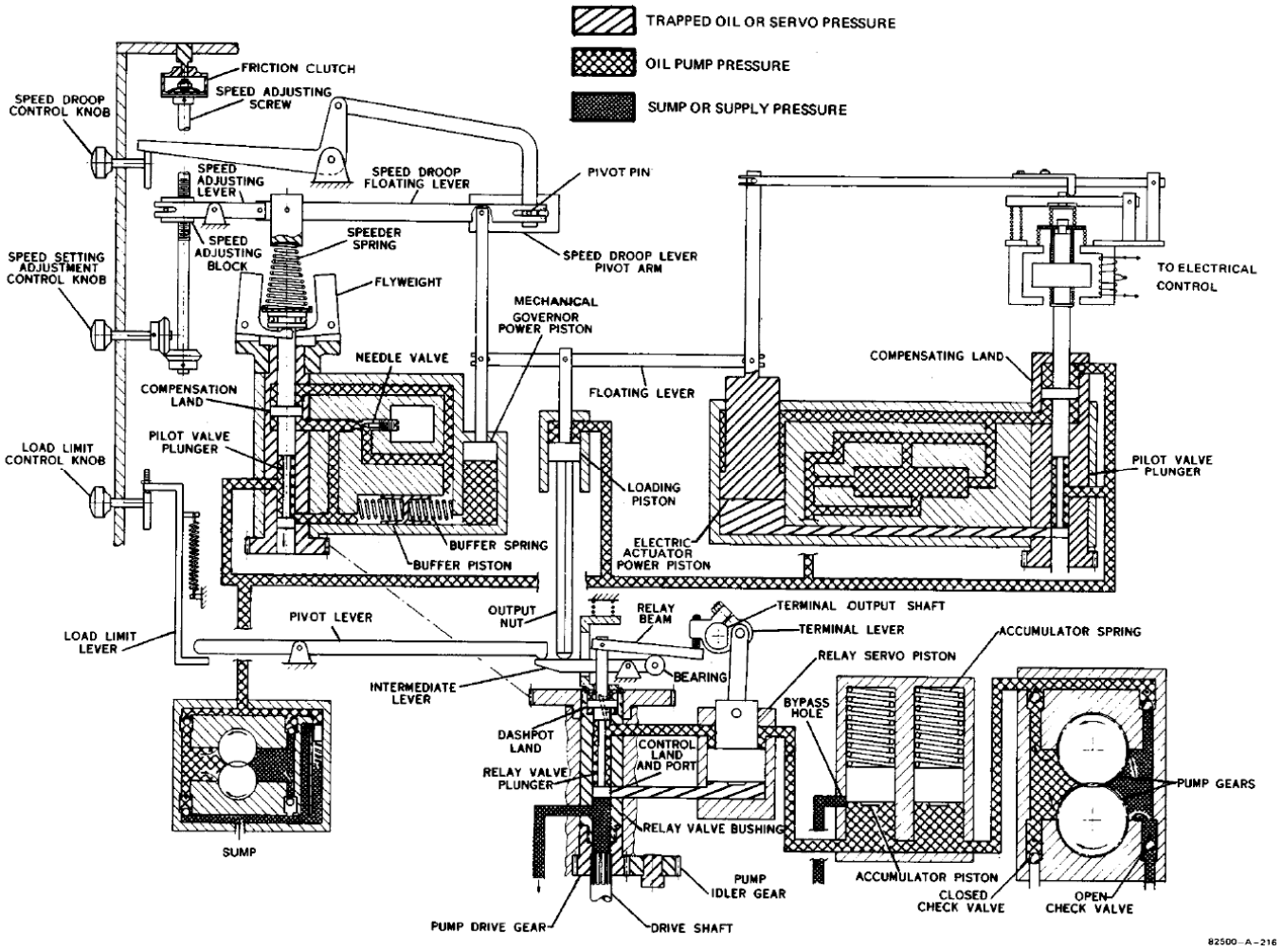


Figure 3-1. Schematic Diagram of EGB-10PLS Hydraulic Actuator

The electric governor pilot valve plunger controls the flow of oil to and from its servo piston. The position of the pilot valve plunger is controlled by a two-coil polarized solenoid, a permanent magnet, a centering spring, and a restoring spring. The magnet is attached to the pilot valve plunger and is suspended within the magnetic field of the solenoid by the centering spring and the restoring spring. The force of the centering spring acts to move the magnet (and plunger) in the decrease fuel direction (up). The force of the restoring spring and the magnetic field of the solenoid act to move the magnet (and plunger) in the increase fuel direction (down). When the actuator is running under steady-state conditions, these opposing forces are equal and the pilot valve plunger is centered (the control land of the plunger exactly covers the control port in the pilot valve bushing). With the pilot valve plunger centered, no oil other than leakage make-up flows to or from the servo piston.

When the signal from the electric control decreases (due .to a decreased load and resultant increase in engine or turbine speed, or a decrease in speed setting) an unbalanced force results. The force of the magnetic field of the solenoid decreases. The centering spring force therefore becomes relatively greater, and the magnet and pilot valve plunger are forced up. Oil under the electric governor servo piston is thus connected to sump. The oil pressure on the upper side of the electric governor servo piston forces the piston and floating lever down. The floating lever pivots at the connection to the mechanical governor servo piston and forces the loading piston down. The downward movement of the loading piston causes the terminal shaft to rotate in the “decrease” direction.

As the electric governor servo 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 and lowers the pilot valve plunger. The loading piston and electric governor servo piston move down until the increase in restoring spring force is sufficient to offset the decreased magnetic force resulting from the decrease in the 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.

When the signal from the electric control increases (due to an increased load and resultant decrease in engine or turbine speed, or an increase in speed setting) an unbalanced force results. The force of the magnetic field of the solenoid increases. The centering spring force therefore becomes relatively smaller, and the magnet and pilot valve plunger are forced down. Pressure oil is then directed to the underside of the electric governor servo piston, and forces the piston and floating lever up. The floating lever pivots at the connection to the mechanical governor servo piston and raises the loading piston. The upward movement of the loading piston causes the terminal shaft to rotate in the “increase” direction. At the same time, the upward movement of the electric governor servo piston, acting through the restoring levers, decreases restoring spring force so that the pilot valve plunger can be re-centered to stop the movement of the terminal shaft.

Load and Speed Sensing Coils

Under steady-state conditions, the sum of the voltages across the load and speed sensing coils is at some stable value (Figure 3-2). The magnetic field intensity of the solenoid is therefore stable, the pilot valve plunger remains centered, and fuel flow remains at a constant rate. When the electric control unit senses a change in load, a signal voltage is sent to the load sensing coil which causes a sudden rise (or fall) in the voltage across the coil (Figure 3-3). The magnitude of the signal voltage is dependent on and is in direct proportion to the magnitude of the load change. The sudden voltage rise (or fall) across the coil causes a sudden rise (or fall) in the magnetic field intensity of the solenoid. The change in magnetic field intensity causes the pilot valve plunger to move, which, in turn, increases or decreases fuel flow. The voltage across the load sensing coil then stabilizes at some new level which is in proportion to the new load. The speed sensing coil receives a signal voltage from the electric control unit. This signal modifies the magnetic field intensity to trim out the final position of the pilot valve plunger and rate of fuel flow as a function of speed.

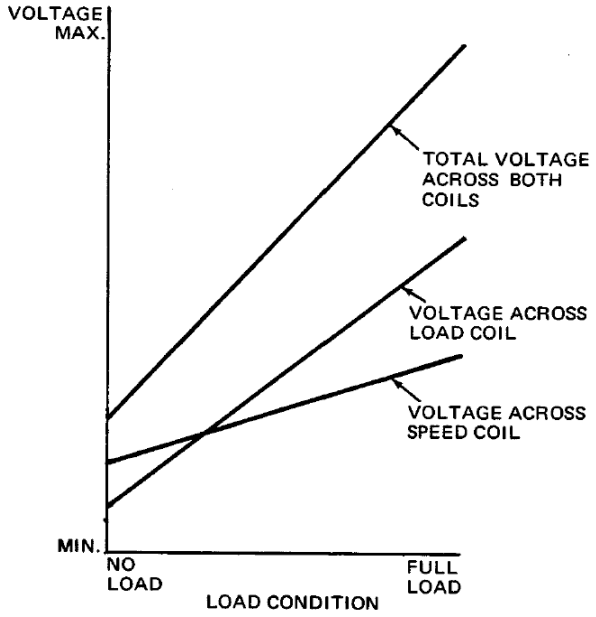
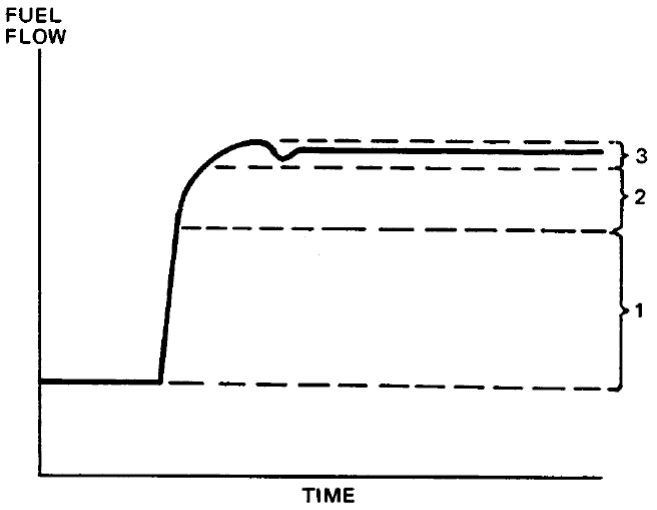


Figure 3-2. Coil Voltage vs Load Condition (typical)



1. Voltage across load sensing coil jumps, resulting in an increase in fuel flow.
2. Voltage across load sensing coil (and hence fuel flow) begins to stabilize.
3. Voltage across speed sensing coil rises and stabilizes, thus trimming out the final rate of fuel flow.

Figure 3-3. Fuel Flow vs Time

Mechanical Governor Section

The mechanical governor (see Figure 3-1) controls the prime mover during starting and also functions as a backup governor to prevent runaway should the electric control unit fail and call for maximum fuel or steam. The mechanical governor pilot valve plunger controls the flow of oil to its servo piston. If the plunger is centered, no oil flows through the pilot valve and the servo 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 flyweights is translated into an upward force which attempts to raise the plunger. With the pilot valve centered, there is but 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 mechanical governor set slightly higher than the electric governor, the centrifugal force of the rotating flyweights is not sufficient to lift the pilot valve plunger to its centered position. Consequently, with the electric governor controlling, pressure oil is continually directed to the underside of the mechanical governor servo piston to hold it up against its stop. It is for this reason that the servo piston of the mechanical governor is up against its stop when the electric governor is controlling. With the actuator running on-speed with the mechanical 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 now 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 servo piston.

The oil displaced by the buffer piston forces the servo 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 servo piston partially relieves the compression of the left buffer spring and increases the compression of the right buffer spring. The force of the right buffer spring tending to resist this movement results in a slightly higher oil pressure on the left side 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.

The speed error signal will cause the terminal shaft to move in an increase fuel position. As the speed approaches the governor set point, the speed error becomes less and the compensation force plus the flyweight force will center the pilot valve prior to reaching the set speed point. The compensation force is then slowly dissipated by bleeding pressure through the needle valve allowing the pilot valve to move to change fuel flow slowly until the speeder spring force and flyweight force are equal. At this time the speed setting is satisfied and the buffer piston is centered.

With the pressures above and below the compensation land equalized, the buffer springs return the buffer piston to its normal, central position. Were the engine load to decrease, the resultant increase in governor speed would cause 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 would be connected to sump. The loading piston, continually being urged downward by oil pressure from the sub-governor pump, would move down and force the servo piston down. The movement would reduce the fuel to meet the new requirement. Again, differential pressure across the compensation land would assist in re-centering the pilot valve plunger, and allow the speed to slowly decrease to normal through the needle valve bleed action.

Speed droop is used in mechanical governors to balance load between engines or turbines driving the same shaft or paralleled in an electrical system. (Speed droop is defined as the decrease in governor speed as its output connection to the engine fuel linkage moves in an increase direction. How far the governor speed decreases for a given stroke, determines the amount of droop.) Speed droop is incorporated in the EGB-10PLS actuator through linkage which varies the loading on the speeder spring as a function of the servo piston position. The change in speeder spring force for a given movement of the servo piston is determined by the servo piston and speeder spring. If the pin is on the same centerline as the speed droop lever pivot arm, there is no change in speeder spring force as the servo piston moves and the mechanical governor responds 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 servo piston movement.

Chapter 4. Adjustments

Operating Control Adjustments

Three operating control knobs are located on the front panel of the EGB-10PLS hydraulic actuator (see Figure 1-1):

- Speed setting control knob; used to set the speed at which the mechanical governor will control
- Speed droop control knob, used to permit load division and parallel operation of actuators controlled by the mechanical governor
- Load limit control knob, used to limit maximum prime mover load whether the actuator is controlled by the electric or mechanical governor

Mechanical Governor Compensation Needle Valve Adjustment

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 compensation needle valve (see Figure 1-1) until the actuator hunts or surges. 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 closed tight.

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 governor section of the actuator does not require compensation adjustments. Compensation is taken care of electrically in the control unit.

IMPORTANT

The following preliminary operating adjustments are for the mechanical governor section only and should not ordinarily be required except after repair or overhaul. The adjustments should be made preferably on a governor test stand with the mechanical governor controlling.

Terminal Shaft Travel Adjustment

Turn the load limit control knob fully clockwise. Turn screw (23, Figure 6-1) counterclockwise until the control knob can be rotated 1/8 turn counterclockwise before the load limit strap (24) begins to rise. Again turn the control knob fully clockwise.

Adjust screw (85) to permit full travel of the terminal shaft (from minimum fuel to maximum fuel positions as shown on the fuel indicating dial plate, 87 or 88). Turn screw counterclockwise to lengthen the terminal shaft travel in the maximum fuel direction.

Load Limit Adjustment

Turn the load limit control knob fully clockwise.

With the actuator running and the terminal shaft just at the end of its travel in the maximum fuel direction, turn screw (23, Figure 6-1) clockwise until the terminal shaft just starts to move in the minimum fuel direction. Then turn the screw counterclockwise 1/4 turn.

Turn the load limit control knob counterclockwise until the terminal shaft is at the mid-point of its travel (as shown by fuel indicating dial plate). Loosen nut (12) and position pointer disk (14) at “5”; tighten nut to lock pointer in position.

Speed Droop Adjustment

The speed droop cam lever (67, Figure 6-1) must be positioned so that, with the speed droop control knob turned fully counterclockwise, there is no change in speed as the actuator terminal shaft rotates from just off its minimum to just short of its maximum fuel position.

IMPORTANT

Pivot pin (62) is an eccentric. For minor changes in droop, loosen lock nut (61) and rotate pin (62) to obtain the correct droop setting. If more adjustment is required, adjust lever (67).

If speed decreases as the terminal shaft moves from minimum to maximum positions, the cam lever must be lowered. If speed increases as the terminal shaft moves from minimum to maximum positions, raise the cam lever. Follow the procedure outlined below to move the cam lever.

1. To lower the cam lever: Rest a screwdriver against the bowed rib in the front edge of the column to push the upper end of speed droop crank (68) back slightly. While holding the crank in this position, loosen socket head screw (65) allowing spring (60) to pull the cam lever (67) down; while still holding the crank in position with the screwdriver, tighten screw (65) to lock the cam lever in the new position.

NOTICE

Do not release the tension on the crank while screw is loose.

2. To raise the cam lever: Rest a screwdriver against the bowed rib in the front edge of the column to hold the upper end of the speed droop crank in the same position while loosening screw. While still retaining control of crank movement by means of the screwdriver, allow spring (60) to move the upper end of the crank forward slightly. Hold the crank in the new position while tightening screw.

NOTICE

Do not allow the spring to move the crank except as allowed by the screwdriver.

Speed Setting Stop Adjustment

Remove dial plate (8, Figure 6-1). Remove speed setting control knob (13) and pointer disk (14). Loosen three screws (15). Put control knob back on speed adjusting shaft (43).

Turn speed setting control knob counterclockwise until specified low speed is reached. Rotate dial stop (19) nearest the control knob counterclockwise unit it reaches stop pin (46). Be sure actuator terminal shaft is not at the end of its travel when low speed is reached.

Position speed setting dial plate to have “0” at the 12 o’clock position.

Now turn control knob clockwise until specified maximum speed setting is reached. Rotate the dial stop furthest from the control knob clockwise until it touches the stop pin. Be sure actuator terminal shaft is not at the end of its travel when high speed is reached.

Tighten screws (15). Recheck speed settings; readjust stops, as necessary.

Turn control knob to low speed setting. Remove knobs. Put pointer disk (14) on shaft assembly so that pointer is at the 12 o’clock position. Put control knob back on and tighten nut (12).

Magnet Adjustment (Centering Pilot Valve Plunger)

Initial adjustment of the actuator consists of physically centering the magnet (240, Figure 6-3) between the coils of the solenoid when the control land on the pilot valve plunger is centered over the control port in the pilot valve bushing. This minimizes the effect of temperature drift when changes occur in the operating temperature of the actuator and provides a more equal load division when the actuator is used in parallel isochronous applications. In applications where the unit is not operating in parallel, centering is not critical and the centering screw (229) need only be backed out 1 to 1 1/4 turns after bottoming to provide acceptable operating characteristics.

Center the magnet (pilot valve plunger) as follows:

1. Connect the test circuit to the receptacle on the actuator as shown in Figure 4-1. Set SW1 to OFF.

2. Install a protractor over the actuator output shaft and secure in position. Install the actuator output lever, if not already in place, for use as an indicator. Rotate the output shaft over its full range of travel. Note or mark the minimum and maximum shaft positions on the protractor. The total output shaft travel should be 42–45 degrees.

3. Insert a 7/64-inch Allen wrench through the clearance hole in the transducer lever, through the hollow center of the adjustable spring seat (226, Figure 6-3), and engage the pilot valve centering screw (229). Turn the centering screw in until it bottoms, then turn out 1 to 1-1/4 turns to establish an initial starting position.

4. Set SW1 to ON and SW2 to CENTER, then adjust the potentiometer for 400 mA on the milliammeter. Set SW1 to OFF.

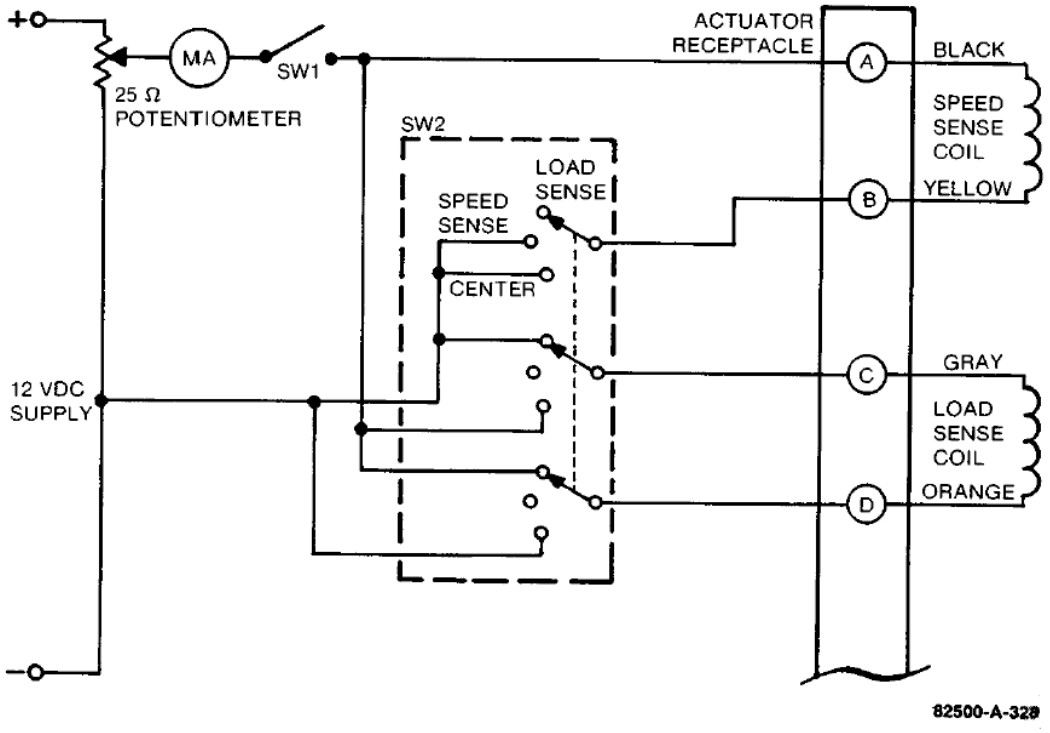


Figure 4-1. Actuator Adjustment Test Circuit

5. Insert a 1/8-inch Allen wrench through the clearance hole in the stop screw plate and engage the adjustable spring seat. Center the output shaft at the approximate midpoint of its travel. Turn the seat cw to move the shaft cw (increase) or ccw to move the shaft ccw (decrease). Note the exact position of the shaft for future reference.

6. Set SW1 to ON and SW2 to CENTER and observe the output shaft for rotation. If necessary, readjust the potentiometer for 400 mA. If the output shaft remains stationary, the magnet (pilot valve plunger) is centered and no further centering adjustments are required. If the output shaft moves to another position, note the direction of movement and then set SW1 to OFF.

7. If the output shaft movement was cw, turn the pilot valve centering screw cw a small amount using the 7/64.inch Allen wrench. If the movement was ccw, turn the centering screw ccw. The output shaft will assume a new position after making an adjustment to the centering screw. Note the new position of the shaft for reference if further adjustment is required.

8. Repeat steps 6 and 7 until a point is found at which no movement of the output shaft occurs when SW1 is moved from OFF to ON when SW2 is set at CENTER.

9. Set SW1 to OFF and turn the potentiometer fully ccw (decrease).

NOTICE

Do not exceed 200 mA from this step on.

Adjust the travel of the output shaft as follows:

1. Set SW1 to ON and SW2 to LOAD SENSE. Adjust the potentiometer for minimum current according to the test specification.

2. Using a 1/8-inch Allen wrench, turn the adjustable spring seat ccw until the actuator output lever is at its minimum position, then turn the seat cw until the output shaft rotates to the minimum position (as indicated on the protractor) according to the test specification.

3. Adjust the potentiometer for the maximum specification current. The output shaft should rotate in the cw (increase) direction the additional number of degrees (as indicated on the protractor) according to the test specification. To decrease travel, shift the clamping plate so the pivot pin moves toward the output shaft. To increase travel, shift the clamping plate so the pivot pin moves away from the output shaft.

4. Repeat the adjustments at minimum and maximum current alternately until no further adjustment is required at either point.

5. Set SW2 to SPEED SENSE and adjust the potentiometer for minimum current according to the test specification. The output shaft should rotate to the minimum position (as indicated on the protractor) according to the test specification.

6. Adjust the potentiometer for the maximum specification current. The output shaft should rotate to the maximum position (as indicated on the protractor) according to the test specification.

Chapter 5. Maintenance

Troubleshooting

When troubles occur in the governing system, the general location of the fault can be readily isolated to the hydraulic actuator or to the electric control unit by connecting the test circuit shown in Figure 4-1 to the actuator. Set SW2 to LOAD SENSE and operate the actuator by varying the position of the potentiometer; then set SW2 to SPEED SENSE and again operate the actuator by varying the potentiometer. If operation of the actuator appears to be satisfactory, the trouble is in the electric control unit.

Actuator faults are usually revealed in speed variations of the prime mover, but it does not necessarily follow that all such speed variations indicate actuator faults. Therefore, when improper speed variations appear, the following procedures 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 actuator is on an engine, check the engine to be sure that all cylinders are firing properly and that the injectors are in good operating condition. If the actuator is on a turbine, check the steam valves for proper operation.

3. Check the operating linkage between the actuator and the prime mover to make certain there is no binding or lost motion.

4. Check for steam or fuel gas pressure changes.

5. Check the voltage regulator for proper operation, as applicable.

6. With the actuator controls set for normal operation, check the voltage input to the actuator. (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 actuator or in the prime mover drive to the actuator.

The source of most troubles in any hydraulic actuator or governor stems from dirty oil, foaming oil, or the formation of sludge. The moving parts within the actuator are continually lubricated by the oil within the actuator. Thus, grit and other impurities will cause excessive wear of valves, pistons, and plungers, and can cause these parts to stick and even “freeze” in their bores.

In many instances erratic operation and poor repeatability can be corrected by flushing the unit with fuel oil or kerosene while cycling the actuator using the test circuit shown in Figure 4-1. The use of commercial solvents is not recommended as they may damage seals or gaskets.

If the speed variation of the actuator is erratic but small, excessive backlash or a tight meshing of the gears driving the actuator may be the cause. If the speed variation is erratic and large and cannot be corrected by adjustments the actuator should be repaired and/or replaced.

A typical electrical schematic diagram of the hydraulic actuator is shown in Figure 5-1.

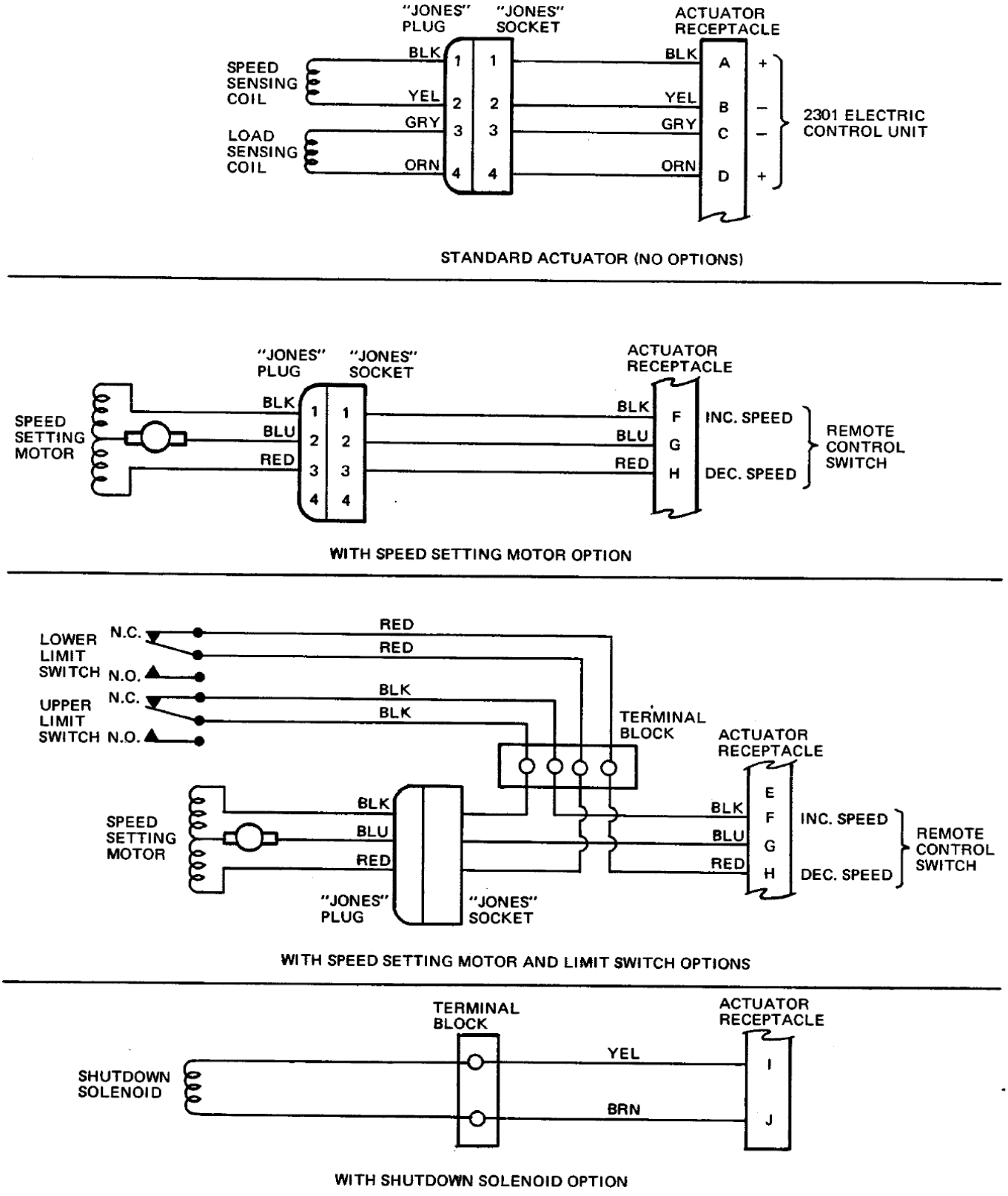


Figure 5-1. Schematic Wiring Diagram of Hydraulic Actuator (typical)

Lubrication

The oil used in the actuator should be clean and free of foreign particles (refer to oil specifications, Chapter 2) 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 break down or darken.

Disassembly

Complete disassembly of the actuator is not recommended if the necessary test equipment is not available for accomplishing the required recalibration (electrically centering) and adjustments following reassembly. If this equipment is lacking, do not alter the position of the pilot valve centering screw (229. Figure 6-3).

Disassemble the unit following the general sequence of index numbers assigned in Figures 6-1 through 6-3, giving special attention to the following. Circled index numbers do not require further disassembly unless repair or replacement of parts is required.

1. Clean exterior surfaces of actuator with clean cloth moistened with cleaning solvent.

2. Discard all gaskets, O-rings, seals, retaining rings, etc., removed during the process of disassembly.

3. Remove cover screws (1, Figure 6-1) and washers (2). Lift off cover (5) and gasket (6).

4. Remove dial plate screws (7) and dial plate (8).

5. Remove dial panel screws (9) and washers (10).

6. Pull dial panel (56) forward to remove dial panel assembly (12 thru 52). Remove gasket (11).

7. Remove screws (201, Figure 6-3). Separate connector receptacle (202), spacer plate (203), and connector plug (204).

8. Lift sub-governor case (318, Figure 6-3) and components assembled to and within the case (60 thru 69 and 201 thru 318).

NOTICE **Ensure that pinion (101, Figure 6-2) does not drop out when sub-governor is removed.**

9. Remove pinion (101).

10. Remove shaft bearing retainer assemblies (102) and washers (103). Take out shaft assembly (106) with bearing (105) and pin (104) attached.

11. Lift out relay beam (108), relay valve plunger (114), and assembled parts (107, 109, 110 thru 113).

12. Loosen set screw (75, figure 9). Remove terminal shaft pin (76).

13. Remove three screws (77) and washers (78). Lift off column (94) and assembled column components (items, 73, 83. 84, etc.). Remove gasket (116, Figure 6-2).

14. Lift out relay valve bushing/gear assembly (115).

15. Remove screws (121) and washers (122) to detach the relay power cylinder (129) and its assembled components. Remove gasket (123).

NOTICE **Ensure that idler gear (134) and drive gear (135) do not fall when the base is removed.**

16. Remove screws (130) and washers (131). Remove base (144) and seal ring (133). Remove gears (134 and 135).

17. Remove screws (136) and retainer (137).

18. Take out drive shaft (140) with bearing (139) and retaining ring (138) attached.

19. Remove oil seal retainer (141), oil seal (143), and gasket (142).

Power Case Disassembly

1. Place power case (162, Figure 6-2) in an arbor press or small drill press (end of case with idler gear stud (f56) to be “down”). Place a rod against spring seat (149) to compress accumulator springs (150 and 151) to permit removal of retaining ring (148) (see Figure 5-2A).

2. Slowly relieve compression of springs. Remove spring seat (149), springs (150 and 151), and accumulator piston (152).

3. Invert power case (162) and remove lower retaining ring (148).

4. If necessary to remove check valve assembly (154), proceed as follows: Press ball through and out of check valve case. Use a 1/4-28 tap to put a thread on the inside of the valve case. Then, using a 1/4-28 bolt with a small plate as a jack, pull the valve case out of the power case (see Figure 5-2B).

5. If necessary to remove check valve assembly (155), proceed as follows: Pry the retainer plate from the check valve assembly and remove the spring and check ball. Use a 1/4-28 tap to thread the inside of the valve case. Then use a 1/4-28 bolt and plate to pull the valve case out of the power case.

Column Disassembly

1. Loosen two screws (77, Figure 6-1) in terminal lever (84). Turn a No. 10-24 screw into the tapped hole between the screws to relieve slightly the “clamping” effect of the terminal lever about the terminal shaft (83).

2. Remove retaining snap ring (79) from one end of terminal shaft.

3. Using a soft (rubber, plastic, etc.) hammer on the end of the terminal shaft from which the ring was removed, drive out the bearing (82) and oil seal (81) on the opposite side of the column.

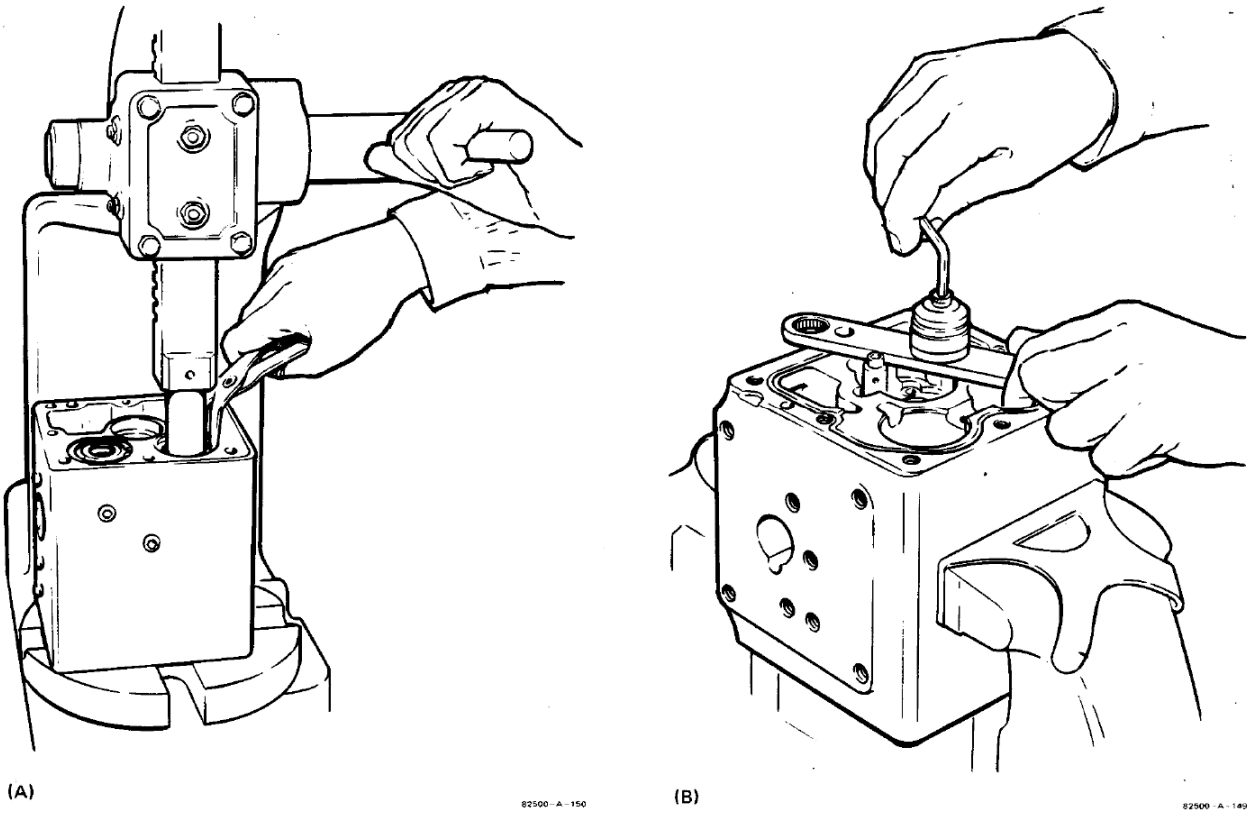


Figure 5-2. Power Case Disassembly

Sub-Governor Disassembly

1. Remove cotter pin (205, Figure 6-3) and pin (206). Remove retaining rings (207) and pivot pins (208). Take out droop lever (209).

2. Remove spring (60, Figure 6-1). Loosen screw (65) and slide lever (67) off speed droop crank (68).

3. Remove nut (61) and pivot pin (62). Remove speed droop crank.

4. Remove link assembly (63) and spacers (64).

5. Remove cotter pin (210, Figure 6-3) and pin (211). Remove nut (212), levers (213), and spacer (214). Take out lever post (215).

6. Remove floating levers (216).

7. Remove cotter pin (205) and pin (217). Remove screw (218) and washers (219, 220) from restoring lever (223). Lift out eccentric pin (222).

NOTICE

It is virtually impossible to re-center the armature magnet—and hence, pilot valve plunger—without the use of special equipment. Unless such equipment is available, it is recommended that no attempt be made to service the electric governor section of the actuator.

8. Remove nut (225) and spring seat (226). Remove lever (227) and spring (228).

9. Remove screw (229) from pilot valve plunger (293). Lift out spring assembly (230).

10. Remove screw (235) and washer (236). Lift out bracket (237) and cover (239).

11. Lift out temperature compensating ring (243) and transducer assembly (242). Magnet assembly (240) will come out with transducer assembly.

12. Remove washer (241) and spring (244).

13. Separate the speeder spring (245) from the spring seat (247) by “leaning” the spring in the direction of the open end of the bottom coil while at the same time “unscrewing” the spring from the seat. (Note: Use special wrench—Woodward tool 370109—to hold the seat while loosening spring). Remove spring and upper spring seat assembly.

14. While holding the spring seat loosen and remove nut (246). Remove spring collar (247) and thrust bearing (248).

15. Remove retaining ring (249). Lift off flyweight head assembly (250, 259, 252, 253). Disassemble flyweight head assembly by first removing retaining ring (250).

16. Remove pins (254, 255, 205). Remove link (256). Lift “free” end of lever (307) and tip case to allow piston pin (257) to slide out.

17. Remove retaining ring (258) to gain access to centrifugal governor buffer parts (259, 260, 261, and 262).

18. Remove retaining ring (263) to gain access to other parts (264, 265).

19. Remove plug (266) and O-rings (267).

20. Turn case (318) upside down and remove base screws (269, 270, 271, 272) and washers (273). Lift off base (285) and remove spring (274), relief valve plunger (275), spacer (276), and sleeve (277).

NOTICE

Be careful that none of the gears or other parts are pulled from the case and fall when the base is taken off.

21. Remove idler gear (286).

22. Remove centrifugal governor pilot valve bushing (287) with pilot valve plunger (289) inside. Take out retaining ring (288) to remove compensating bushing (290) and pilot valve plunger.

23. Remove electric governor pilot valve bushing (291) with pilot valve plunger (293) inside. Take out retaining ring (292) to remove compensating bushing (294) and pilot valve plunger.

24. Remove the O-ring (278). Remove servo piston assembly (295).

25. Remove plug (296), O-ring (298), and spring washer (297). Remove servo piston sleeve (299) and O-ring (300).

    Remove servo piston assembly (305) with floating lever (307) attached. Drive out pin (306) to separate lever and piston assembly. Be careful that retaining ring (308) is not lost when pin is driven out.

26. Remove output nut (309) and jam nut (310). Take off pivot (311) and remove loading piston (313). Remove pivot link (312).

Cleaning

Wash all parts ultrasonically or by agitation while immersed in cleaning solvent. Do not permit highly polished sealing or mating surfaces to contact other objects. Use nonmetallic brush or jet of compressed air to clean slots and holes. Dry all parts after cleaning with jet of clean, dry air.

Inspection

1. Visually inspect all parts for evidence of wear, corrosion, pitting, deep scoring, nicks, cracks, or other damage.

2. Inspect all bearings in accordance with standard practice. Replace bearings where there is any detectable roughness or stickiness or any pitting, scoring, galling or brinelling of needles or races.

3. Mating surfaces must be free of nicks, burrs, cracks or other damage.

4. Screws, threaded plugs and inserts must be free of corrosion, cracks, burred slots, rounded flats, or damaged threads.

5. All moving and actuating parts must move freely without excessive play.

6. All surfaces and fluid passages must be free of foreign matter.

Repair or Replacement

1. Repair of small parts of this unit is impractical and shall generally be limited to removal of nicks and burrs from mating flanges, replacement of bearings, and light burnishing of mating parts.

NOTICE **Handle critical parts with extreme care so that mating edges and surfaces are not damaged. Sharp edges must be maintained.**

2. Replace damaged thread inserts in accordance with standard practice.

3. Polish slightly corroded areas with a fine grit abrasive cloth or paper and oil.

Reassembly

Reassemble actuator assembly parts in reverse order of index numbers in Figures 6-1 through 6-3. Ensure no foreign matter is present on the parts. Follow the special instruction given below.

IMPORTANT

A dust-free work area is recommended for reassembly if acceptable overhaul results are to be obtained.

1. When installing O-rings over threaded surfaces, use appropriate size thimble or tape threaded area to prevent damage to O-rings.

2. Obtain new gaskets, O-rings, seals, retaining rings or clips, etc., to replace those discarded during disassembly.

NOTICE

Count out only required number of small parts such as screws, washers, retaining rings or clips, etc., before proceeding with operation at hand. When a sufficient number of parts is not available, missing part(s) must be located before performing next operation. If part(s) cannot be located, it is essential to disassemble unit as necessary to ensure that missing part has not fallen into an internal cavity. Any parts in assembly which are not properly secured or in place can readily cause jamming and render unit inoperative.

Sub-Governor

1. Install servo piston assembly (305, Figure 6-3). Sleeve (299) not yet installed. Place retaining ring (308) in counterbore around pin hole in floating lever (307). Fit lever into slot of piston assembly and install pin (306); tapered end of pin should be inserted in piston hole furthest from the retaining ring; press pin in until retaining ring slips into groove in pin.

2. Install servo piston assembly (295) and servo pin (257).

3. Attach pivot link (312) to floating lever using pins (254 and 205). Fit free end of lever over servo pin while at the same time slipping the pivot link into the bore in the case for the loading piston (313). Now put loading piston, pivot (311), and jam nut (310) onto the threaded end of the pivot link; jam nut should be just started onto the thread.

4. Install piston sleeve (299) and O-ring (300).

5. Use pins (255 and 205) to attach servo link (256) to servo piston assembly (295).

6. Lay the sub-governor case on its side. Lift up on the floating lever to raise the servo pistons (295 and 305) to the upper end of their strokes. While holding the floating lever up, thread the jam nut (310) up onto the pivot link until piston (295) just begins to move down; then back the nut off 1/8 turn. Lock the nut in position using output nut (309).

7. After installing the mechanical governor pilot valve plunger (289), compensating bushing (290), the flyweight head and other components including items 246 thru 253, the pilot valve plunger must be centered.

   Proceed in this manner:

   a. Be sure the lock nut (246) is not locked tight against the spring seat (247).

   b. With one hand holding the bottom end of the pilot valve bushing (257) up into the case, use the other hand to push down on the pilot valve plunger (289). Pushing down on the plunger will move the flyweights to the innermost position.

      Look through the metering port (the hole below the gear) in the bushing to observe the position of the pilot valve plunger control land with respect to the port in the bushing (see Figure 5-3A).

   c. Holding the pilot valve plunger down against the flyweight toes, move the flyweights outward as far as they will go, and check the amount of port opening now appearing below the edge of the control land of the plunger (see Figure 5-3B).

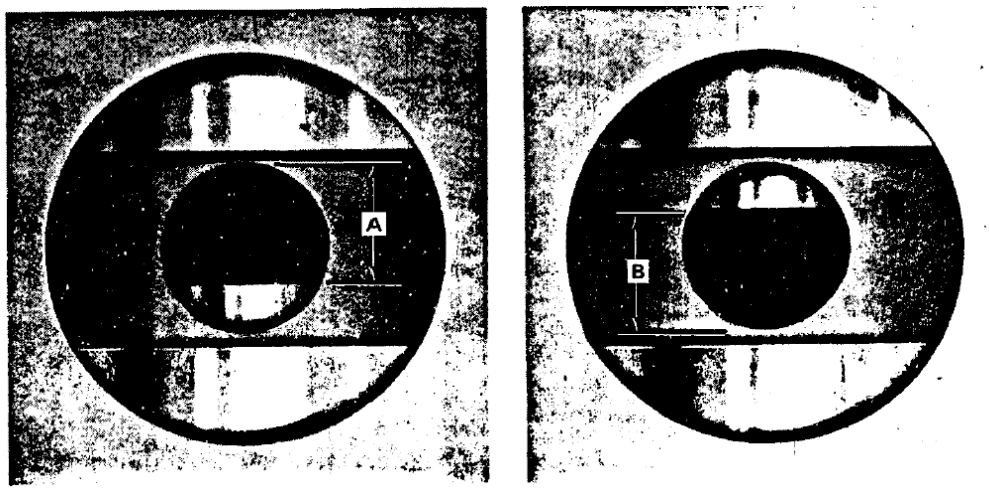


Figure 5-3. Pilot Valve Plunger Centering

   d. The amount of port opening with the fly-weights at extreme inner and outer positions should be equal.

   e. If the pilot valve plunger is too low, hold the spring seat stationary, and turn the pilot valve counterclockwise to raise it. If the pilot valve plunger is too high, hold the spring seat and turn the pilot valve clockwise to lower it.

   f. When the pilot valve appears to be centered, tighten the lock nut down on the spring seat, re-check the valve setting.

8. Be sure that the base (285) and case (318) are properly aligned so that the idler gear assembly (286) and pilot valve bushings (287 and 291) turn freely. Before tightening the base screws, slip pinion (101, figure 10) onto pilot valve bushing (287) and use it to turn the bushing to see that the base and case are properly aligned. After tightening the base screws, recheck the alignment once again.

   If the pilot valve bushing does not rotate freely, loosen the base screws slightly and tap the edge of the base with a soft (plastic, rubber, etc.) hammer to shift it about until the bushing turns freely. Tighten screws and recheck.

9. Each end of the speeder spring must be securely attached to its mating part.

Chapter 6.
Parts Information

When ordering actuator replacement parts, it is essential that the following information be given:

- Actuator serial number and part number on nameplate
- Manual number (this is manual 82558)
- Part reference number as given in part list, name of part, or description of part

The illustrated parts breakdown (Figures 6-1 through 6-3) illustrates and lists all parts for the EGB-10PLS actuator assembly. Index numbers are assigned in disassembly sequence. Circled index numbers indicate items which do not require further disassembly unless repair or replacement of the part is required.

Optional equipment available for use with the actuator assembly is shown in the parts breakdown in Figures 6-4 through 6-7.

Parts List for Figure 6-1

Ref. No.	Part Name	Quantity
82558-1	Screw, fil. hd., 1/4-28 x 5/8 (MS35266-80)	7
82558-2	Lockwasher, split, 1/4-28 ID (MS35338-44)	7
82558-3	Clutch pin	1
82558-4	Oil cup	1
82558-5	Cover	1
82558-6	Cover gasket	1
82558-7	Screw, binder hd., Phillips, 8-32 x 3/8	4
82558-8	Dial and name plate	1
82558-9	Screw, fil hd., 1/4-28 x 1-3/4 (MS35266-86)	6
82558-10	Lockwasher, split, 1/4 ID x 0.35 OD x 5/64 thk.	6
82558-11	Panel gasket	1
82558-12	Locknut, thin, 1/4-20	3
82558-13	Knob	3
82558-14	Pointer disk	3
82558-15	Screw, flat hd., 10-32 x 3/8 (MS24583-53)	3
82558-16	Dial locating plate	1
82558-17	Speed setting dial	1
82558-18	Spacer	3
82558-19	Dial stop	2
82558-20	Load limit spring	1
82558-21	Locknut, thin, 10-32 (MS21083N3)	1
82558-22	Screw, soc. hd. cap, special, 10-32 x 1	1
82558-23	Setscrew, soc. hd., oval pt., 6-32 x 5/8	1
82558-24	Load limit strap assembly	1
82558-25	Locknut, thin, 3/8-24 (MS21083N6)	2
82558-26	Spring washer	2
82558-27	Speed droop cam	1
82558-28	Load limit cam	1
82558-29	Roll pin, 3/32 x 1/2 (MS9048-069)	1
82558-30	Retaining ring, internal (MS16625-1100)	1
82558-31	Friction drive cover	1
82558-32	Locknut, thin, 1/4-28 (MS21083N4)	1
82558-33	Friction drive spring	1
82558-34	Friction drive case	1
82558-35	Roll pin, 3/32 x 1/2 (MS9048-069)	1
82558-36	Friction drive plate	1
82558-37	Speed adjusting nut	1
82558-38	Speed adjusting screw	1
82558-39	Speed adjusting bevel gear	1
82558-40	Plain washer, 21/64 ID x 5/8 00 x 0.050-0.052 thk.	1
82558-41	Retaining ring, external (MS16624-1043)	1
82558-42	Dial stop gear	1
82558-43	Speed adjusting shaft	1
82558-44	Roll pin, 1/16 x 1/2 (MS9048-007)	1
82558-45	Intermediate gear	1
82558-46	Roll pin, 5/32 x 5/8 (MS9048-133)	1
82558-47	Pinion	1
82558-48	Plug	1
82558-49	Pinion bushing	1
82558-50	Shaft bushing	1
82558-51	Screw bushing (Upper)	1
82558-52	Screw bushing (Lower)	1
82558-53	Screw, rd. hd., 6-32 x 1/2	2
82558-54	Lockwasher, split, No. 6 (MS35338-41)	2
82558-55	Locating pin	2
82558-56	Dial panel	1

Ref. No.	Part Name	Quantity
82558-57	Lock nut, 5/16-24 (MS21044N5)	1
82558-58	Screw, hex. hd. cap., 5/16-24 x 2-1/2 (MS9072642)	1
82558-59	Lockwasher, split, 5/16 ID (MS35338-45)	1
82558-60	Spring	1
82558-61	Lock nut, thin, 10-32 (MS21083N3)	2
82558-62	Pivot pin	1
82558-63	Speed droop link	1
82558-64	Spacer	2
82558-65	Screw, soc. hd. cap, 10-32 x 5/8	1
82558-66	Lockwasher, split, No. 10 (MS35338-43)	1
82558-67	Speed droop cam lever	1
82558-68	Speed droop crank	1
82558-69	Spring pin	1
82558-70	Gasket	1
82558-71	Screw, fil hd., 6-32 x 7/16 (MS35265.29)	4
82558-72	Lockwasher, split, No. 6 (MS35338-4 1)	4
82558-73	Electrical connector receptacle (MS3102A18-1P)	1
82558-74	Receptacle gasket	1
82558-75	Setscrew, half-dog Pt., soc. hd., 6-32 x 5/16	1
82558-76	Terminal shaft pin	1
82558-77	Screw, hex. hd. cap, 5/16-24 x 1 (MS90726-34)	6
82558-78	Lockwasher, split, 5/16 ID (MS35338-45)	6
82558-79	Retaining ring, external (MS16624-1075)	2
82558-80	Pointer disc	2
82558-81	Oil seal	2
82558-82	Roller bearing	2
82558-83	Terminal (Output) shaft	1
82558-84	Terminal lever	1
82558-85	Setscrew, slotted hd., rd. point, 5/16-24 x 1-5/32	1
82558-86	Screw, truss hd., 6-32 x 1/4	4
82558-87	Dial plate, RH	1
82558-88	Dial plate, LH	1
82558-89	Barrel plug	2
82558-90	Plug, sq. hd. pipe, 1/4-18 NPTF (MS20913.25)	1
82558-91	Oil level decal	2
82558-92	Locating pin	2
82558-93	Stud, 5/16-18 x 5/16-24 x 2	1
82558-94	Column	1

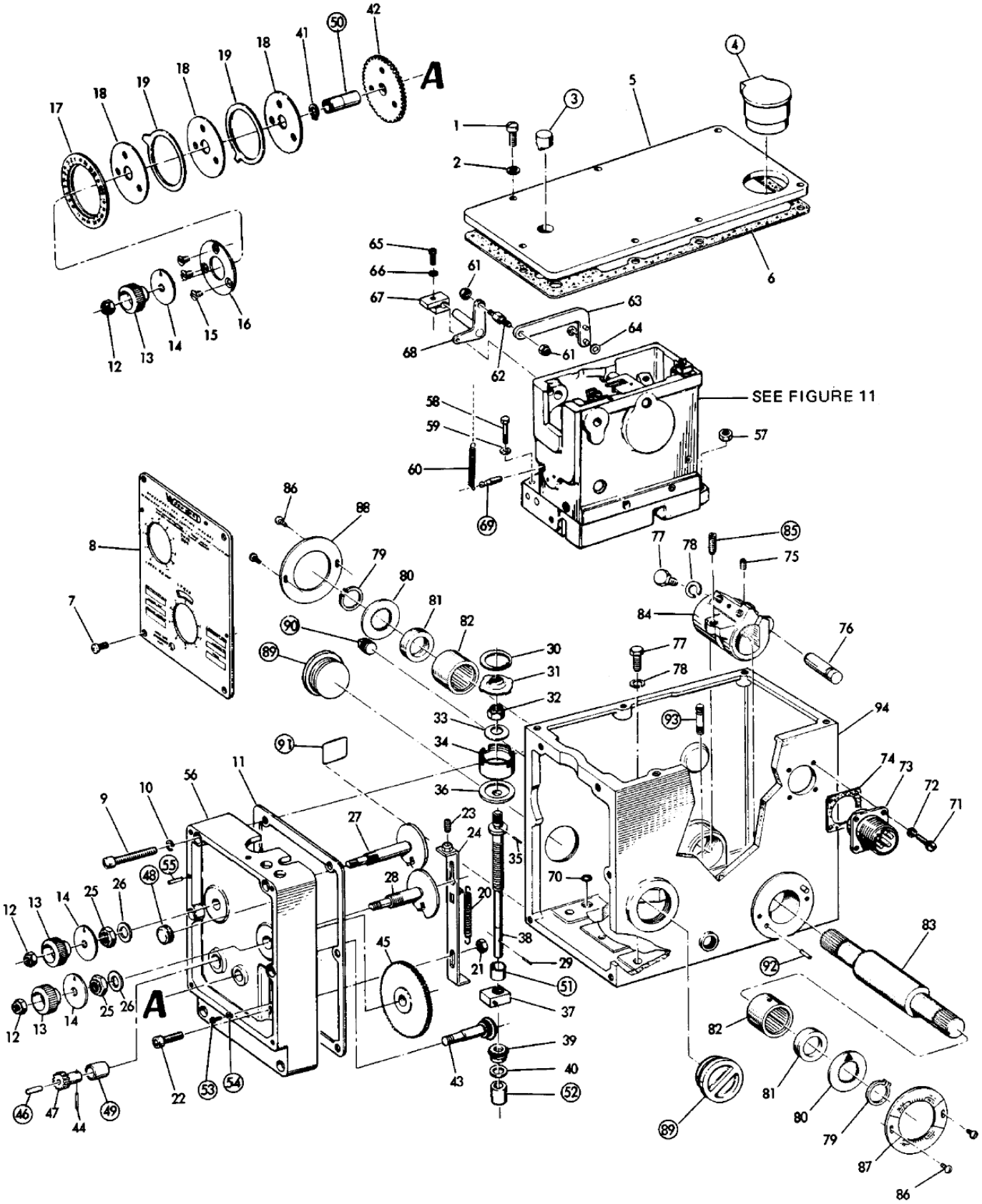


Figure 6-1. Hydraulic Actuator (Column)

Parts List for Figure 6-2

Ref. No.	Part Name	Quantity
82558-101	Pinion	1
82558-102	Bearing retainer assembly	2
82558-103	Washer, soft copper, 5/8 OD x 7/16 ID 1/32 thk.	2
82558-104	Roller pin	1
82558-105	Roller	1
82558-106	Intermediate lever and shaft	1
82558-107	Pivot pin	1
82558-108	Relay beam	1
82558-109	Spring	1
82558-110	Roll pin, 1/8 x 7/16 (MS171525)	1
82558-111	Bushing retainer	1
82558-112	Retaining ring, internal (MS16625-1075)	1
82558-113	Relay valve bushing	1
82558-114	Relay valve plunger	1
82558-115	Relay valve gear	1
82558-116	Case gasket	1
82558-117	Preformed packing, 2.500 OD (NAS1593-228)	1
82558-118	Seal ring	1
82558-119	Seal spring	1
82558-120	Gasket	1
82558-121	Screw, soc. hd. cap, 3/8-16 x 1 (MS24667-66)	4
82558-122	Lockwasher, split, 3/8 ID (MS51848-46)	4
82558-123	Gasket	1
82558-124	Retaining ring, internal (MS16625-1193)	1
82558-125	Power cylinder plug	1
82558-126	Piston pin	1
82558-127	Piston rod	1
82558-128	Power piston	1
82558-129	Power cylinder	1
82558-130	Screw, hex. hd. cap, 5/16-18 x 1 (MS90725-34) (Standard Base) Screw, hex. hd. cap, 5/16-18 x 4.1/4 (MS90725-49) (Alternate Base)	8 8
82558-131	Lockwasher, split, 5/16 ID (MS35338-45)	8
82558-132	Taper pin, No. 5	2
82558-133	Oil seal ring	1
82558-134	Idler gear	1
82558-135	Drive gear	1
82558-136	Screw, hex, hd. cap, 1/4-28 x 5/8 (MS51096-5)	3
82558-137	Bearing retainer	1
82558-138	Retaining ring, external (MS16624-1066)	1
82558-139	Ball bearing (AFBMA 17BCO2xPP)	1
82558-140	Drive shaft	1
82558-141	Oil seal retainer	1
82558-142	Retainer gasket	1
82558-143	Oil seal	1
82558-144	Base (Standard)	1
82558-145	Oil gauge assembly	1
82558-146	Street elbow, 1/8 NPTF	1
82558-147	Drain cock, 1/8 NPTF	1
82558-148	Retaining ring, internal (MS16625-1175)	4
82558-149	Spring seat	2
82558-150	Accumulator spring (Small)	2
82558-151	Accumulator spring (Large)	2
82558-152	Accumulator piston	2
82558-153	Magnetic plug	1
82558-154	Check valve assembly (Short body)	2
82558-155	Check valve assembly (Long body)	2
82558-156	Idler gear stud	1
82558-157	Plug, soc. hd. pipe, 1/8-27 NPTF (AN932-2)	as req'd
82558-158	Plug, soc. hd. pipe, 1/16-27 NPTF (AN932S1)	as req'd
82558-159	Locating pin	1
82558-160	Locating pin	2
82558-161	Locating pin	1
82558-162	Power case	1

Parts List for Figure 6-3

Ref. No.	Part Name	Quantity
82558-201	Screw, rd. hd., w/captive lockwasher 6-32 x 1/2	2
82558-202	Electrical connector receptacle	1
82558-203	Spacer plate	1
82558-204	Electrical connector plug	1
82558-205	Cotter pin, 1/16 x 3/8 (MS24665-130)	4
82558-206	Headed pin, drilled	1
82558-207	Retaining ring, internal (MS16625-1050)	2
82558-208	Pivot pin	2
82558-209	Speed droop pivot lever	1
82558-210	Cotter pin, 1/32 x 3/8 (MS24665-3)	2
82556-211	Straight pin, drilled	1
82558-212	Locknut, thin, 1/4-28 (MS21083N4)	1
82558-213	Speed adjusting lever	2
82558-214	Spacer	1
82558-215	Lever post	1
82558-216	Floating lever	2
82558-217	Headed pin, drilled	1
82558-218	Screw, hex. hd. cap, 10-32 x 1/2 (MS9518-06)	2
82558-219	Lockwasher, No. 10 (MS35338-43)	2
82558-220	Plain washer, 13/64 ID x 3/8 OD x 3/64 thk.	2
82558-221	Clamping plate	1
82558-222	Eccentric ratio adjustment pin	1
82558-223	Restoring lever	1
82558-224	Straight pin	1
82558-225	Jam nut, 1/4-28	1
82558-226	Adjustable spring seat	1

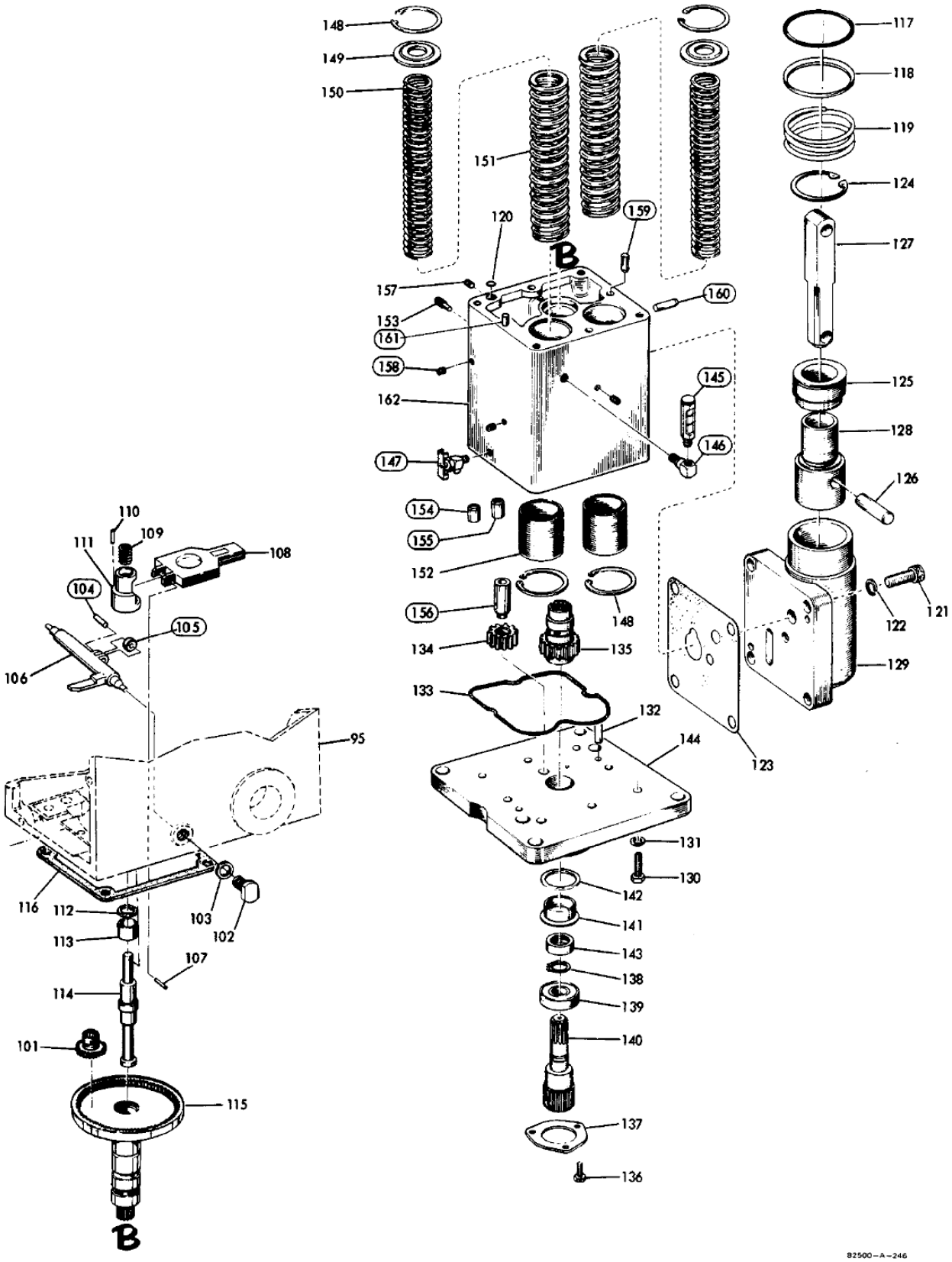


Figure 6-2. Hydraulic Actuator (Power Case)

Parts List for Figure 6-3 (cont.)

Ref. No.	Part Name	Quantity
82558-227	Transducer lever	1
82558-228	Load spring	1
82558-229	Screw, soc. hd. cap, self-locking,\ 6-32 x 3/8	1
82558-230	Restoring spring assembly	1
82558-231	Cotter pin, 1/32 x 1/4 (MS9245-01)	1
82558-232	Retainer sleeve	1
82558-233	Needle bearing	1
82558-234	Bearing pin	1
82558-235	Screw, soc. hd. cap, 10-32 x 1-7/8	2
82558-236	Lockwasher, split, No. 10 (MS35338-43)	2
82556-237	Clamp bracket	1
82558-238	Roll pin, 1/16 x 1/4 (MS1 71432)	1
82558-239	Transducer cover	1
82558-240	Magnet	1
82558-241	Fiat washer, al., 7/32 ID x 7/16 OD x 1/32 thk.	1
82558-242	Transducer assembly	1
82558-243	Temperature compensation ring	1
82558-244	Magnet spring	1
82558-245	Speeder spring assembly	1
82558-246	Plunger nut, 1/4-28	1
82558-247	Speeder spring seat	1
82558-248	Thrust bearing	1
82558-249	Retaining ring, external (MS16624-1062)	1
82558-250	Retaining ring, spiral	1
82558-251	Flyweight pin	2
82558-252	Flyweight assembly	2
82558-253	Flyweight head	1
82558-254	Headed pin, drilled	1
82558-255	Headed pin, drilled	1
82558-256	Servo link (Mechanical)	1
82558-257	Piston pin	1
82558-258	Retaining ring, internal, beryllium copper	1
82558-259	Buffer plug	1
82558-260	Preformed packing, 0.625 00 (NA51593-111)	1
82556-261	Buffer spring	2
82558-262	Buffer piston	1
82558-263	Retaining ring, internal (MS16625-1087)	1
82558-264	Plug	1
82558-265	Preformed packing, 0.816 CD (NA51593-017)	1
82558-266	Plug	1
82558-267	Preformed packing, 0.316 CD (NAS 1593-008)	2
82558-268	Needle valve (Compensation)	1
82558-269	Screw, soc. hd. cap, 10-32 x 1-1/8	3
82558-270	Screw, soc. hd. cap, 10-32 x 7/8 (MS24678-13)	1
82558-271	Screw, soc. hd. cap, 10-32 x 1-3/8	3
82558-272	Screw, soc. hd. cap, 10-32 x 1/2 (MS24678-10)	3
82558-273	Lockwasher, split, No. 10 (MS35338-43)	10
82558-274	Relief valve spring	1
82558-275	Relief valve plunger	1
82558-276	Relief valve spacer	1
82558-277	Relief valve sleeve	1
82558-278	Preformed packing, 1.062 CD (NAS1593-021)	1
82558-279	Pivot pin	1
82558-280	Load limit lever	1
82558-281	Check valve assembly	4
82558-282	Taper pin, No. 2	2
82558-283	Plug	1
82558-284	Guide pin	1
82558-285	Sub-governor base	1
82558-286	Idler gear	1
82558-287	Pilot valve bushing (Mechanical)	1
82558-288	Retaining ring, internal (MS16625-1043)	1
82558-289	Pivot valve plunger (Mechanical)	1
82558-290	Compensating bushing (Mechanical)	1
82558-291	Pilot valve bushing (Electric)	1
82558-292	Retaining ring, internal (MS16625-1050)	1
82558-293	Pilot valve plunger (Electric)	1
82558-294	Compensating bushing (Electric)	1
82558-295	Servo piston (Mechanical)	1
82558-296	Plug	1
82558-297	Spring washer	1
82558-298	Preformed packing, 0.316 CD (NA51593-008)	1
82558-299	Load sensing servo sleeve	1
82558-300	Preformed packing, 1.004 CD (NA51593-020)	1
82558-301	Plain washer, 0.203 ID x 0.281 00 x 0.035-0.040 thk.	1
82558-302	Straight pin	1
82558-303	Servo link (Electric)	1
82558-304	Pivot pin	1
82558-305	Servo piston (Electric)	1
82558-306	Link pin, grooved	1
82558-307	Floating lever	1
82558-308	Retaining ring	1
82558-309	Output nut	1
82558-310	Nut, hex., 1/4-28 (MS35650-3252)	1
82558-311	Pivot	1
82558-312	Pivot link	1
82558-313	Loading piston	1
82558-314	Lever post bushing	1
82558-315	Plug, soc. hd. pipe, 1/8-27 NPTF (AN932-2)	as req'd
82558-316	Plug, soc. hd. pipe, 1/16-27 NPTF (AN93251)	as req'd
82558-317	Idler gear stud	1
82558-318	Sub-governor case	1

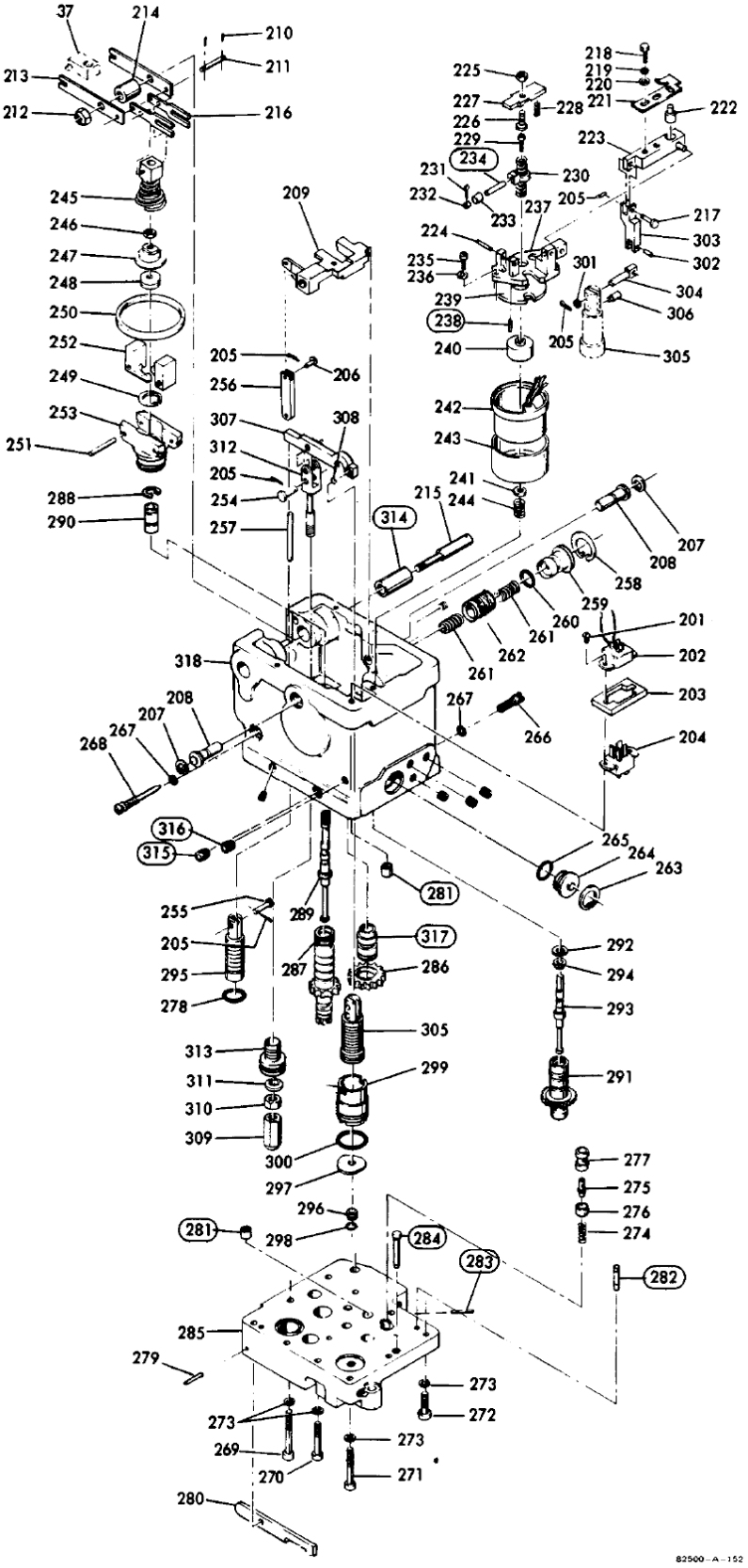


Figure 6-3. Hydraulic Actuator (Sub-governor)

Parts List for Figure 6-4

Ref. No.	Part Name ..... Quantity
82558-401	Screw, rd. hd., 6-32 x 5/8 2
82558-402	Lockwasher, split, No. 6 (MS35338-41) 2
82558-403	Electrical connector socket (“Jones”) .. 1
82558-404	Spacer plate 1
82558-405	Electrical connector plug (“Jones”) 1
82558-406	Screw, rd. hd., w/captive lockwasher, 6-32 x 1/2 2
82558-407	Mounting bracket 1
82558-408	Grommet 1
82558-409	Screw, fil. hd., 10-32 x 1/2 (AN502-10.8) 4
82558-410	Lockwasher, split. No. 10 (MS35338-43) 4
82558-411	Screw, flit csk. hd., 820, 10-32 x 3/8 (MS24583-53) 4
82558-412	Lockwasher, ext. tooth, csk., No. 10 (AN936C10) 4
82558-413	Motor mounting bracket 1
82558-414	Seal spring 1
82558-415	Speed setting motor (see manual 03505) 1
82558-416	Cover 1
82558-417	Screw, soc. hd. cap., 6-32 x 1/2 (MS24677-8) 2
82558-418	Lockwasher, split, No. 6 (MS35338-41) 2
82558-419	Screw, fil. hd., 8-32 x 1/4 (MS35265-41) 1
82558-420	Lockwasher, external tooth, No. 8 (AN936B8) 1
82558-421	Clamp, cable 1
82558-422	Screw, rd. hd., 2-56 x 3/8 4
82558-423	Lockwasher, split, No. 2 (MS35338-39) 4
82558-424	Microswitch, SPDT 2
82558-425	Insulator 2
82558-426	Cotter pin, 1/32 x 1/4 (MS9245-01) 1
82558-427	Washer, No. 4 (MS27183-4) 1
82558-428	Actuator arm 1
82558-429	Screw, hex. hd. cap, full thd., 8-32 x 7/8 2
82558-430	Nut, hex., 8-32 2
82558-431	Pin 1
82558-432	Mounting plate 1
82558-433	Terminal lug, crimp type 4
82558-434	Grommet 1
82558-435	Dial panel 1
82558-436	Screw, fil. hd., 6-32 x 1/2 (MS35265-30) 2
82558-437	Lockwasher, internal tooth, No. 6 (MS35333-37) 2
82558-438	Terminal block, 3 term. 1
	Terminal block, 4 term. 1

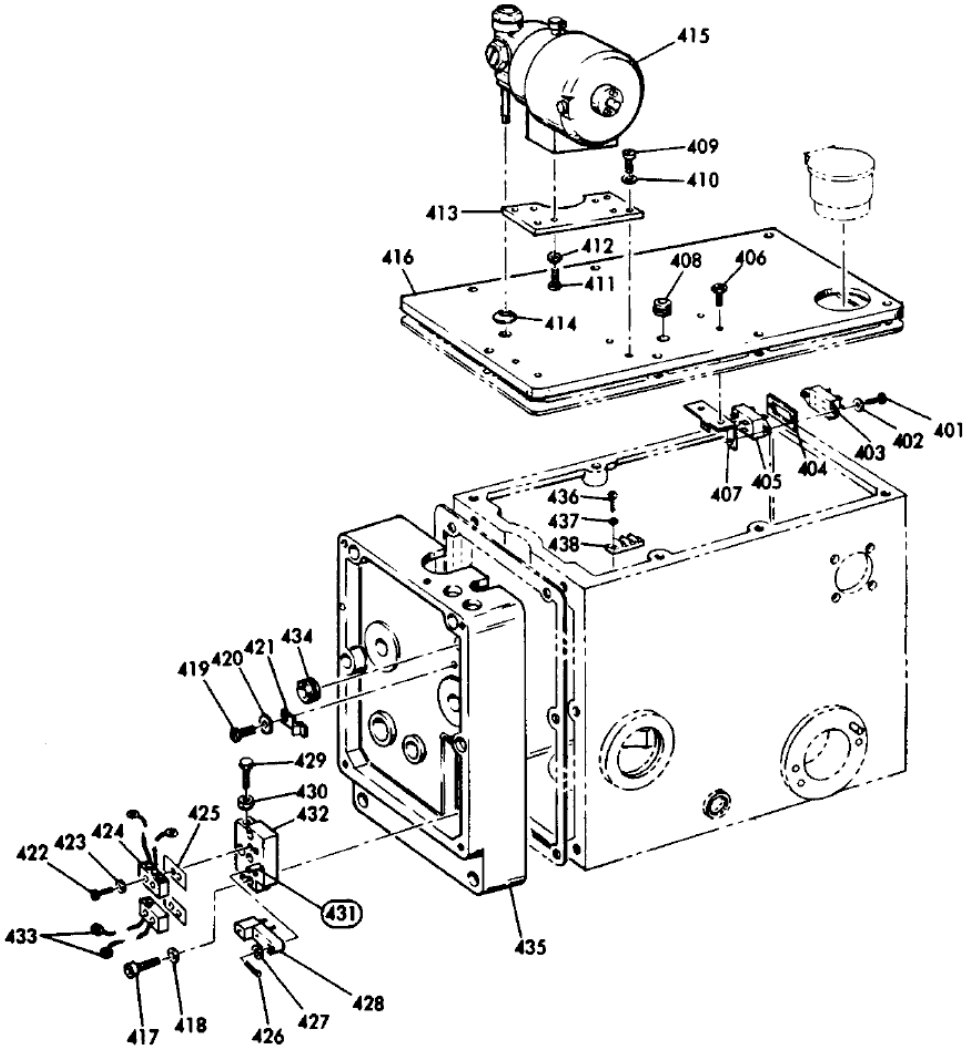


Figure 6-4. Speed Setting Motor (Optional)

Parts List for Figure 6-5

Ref. No.	Part Name	Quantity
82558-501	Bleeder bolt	1
82558-502	Flat washer, copper, 21/64 ID x 17/32 OD x 1/32 thk.	2
82558-503	Screw, fil. hd., drilled, 10-32 x 1/2 (AN502-10-8)	4
82558-504	Copper tube, 1/4 OD	1
82558-505	Elbow, 900, 1/4 tube x 1/8 NPT (with nut and sleeve)	2
82558-506	Banjo fitting	1
82558-507	Solenoid valve	1
82558-508	Lockwasher, internal tooth, 1/2 ID (MS35333-44)	1
82558-509	Terminal lug, insulated (MS25036-102)	2
82558-510	Screw, fil. hd., 6-32 x 1/2 (MS35265-30)	2
82558-511	Lockwasher, internal tooth, No. 6 (MS35333-37)	2
82558-512	Terminal block, 2 term.	1
82558-513	Solenoid mounting bracket	1
82558-514	Preformed packing, 0.504 OD (NAS1593-012)	2
82558-515	Column	1
82558-516	Power case	1
82558-517	Nut	1

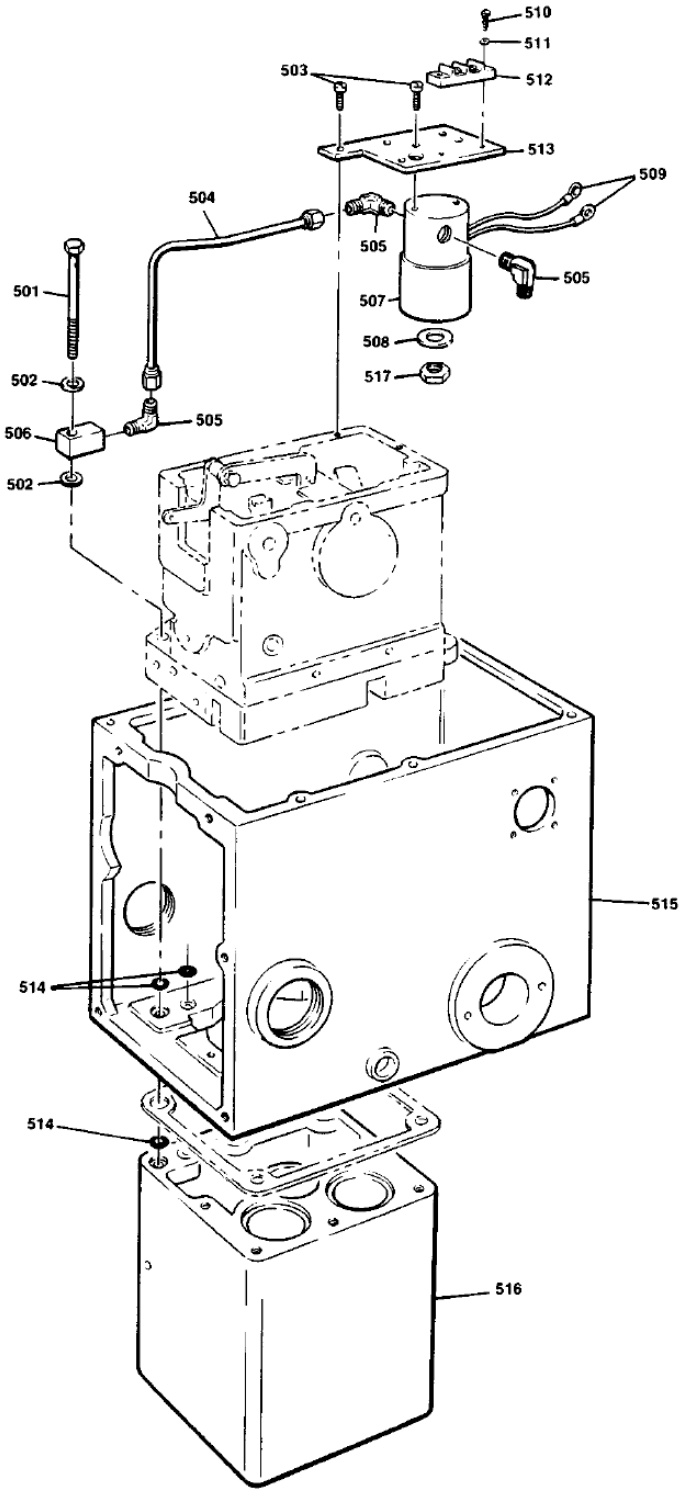


Figure 6-5. Solenoid Shutdown (Optional)

Parts List for Figure 6-6

Ref. No.	Part Name ..... Quantity
82558-601	Screw, soc. hd. cap, 10-32 x 1/2 (MS24678-10) 2
82558-602	Lockwasher, split, No. 10 (MS35338-43) 2
82558-603	Retaining ring, internal (MS16625-1043) 1
82558-604	Plain washer, 17/64 ID x 13/32 OD x 1/32 thk. 1
82558-605	Plunger spring 1
82558-606	Plunger 1
82558-607	Air cylinder 1
82558-608	Cover 1

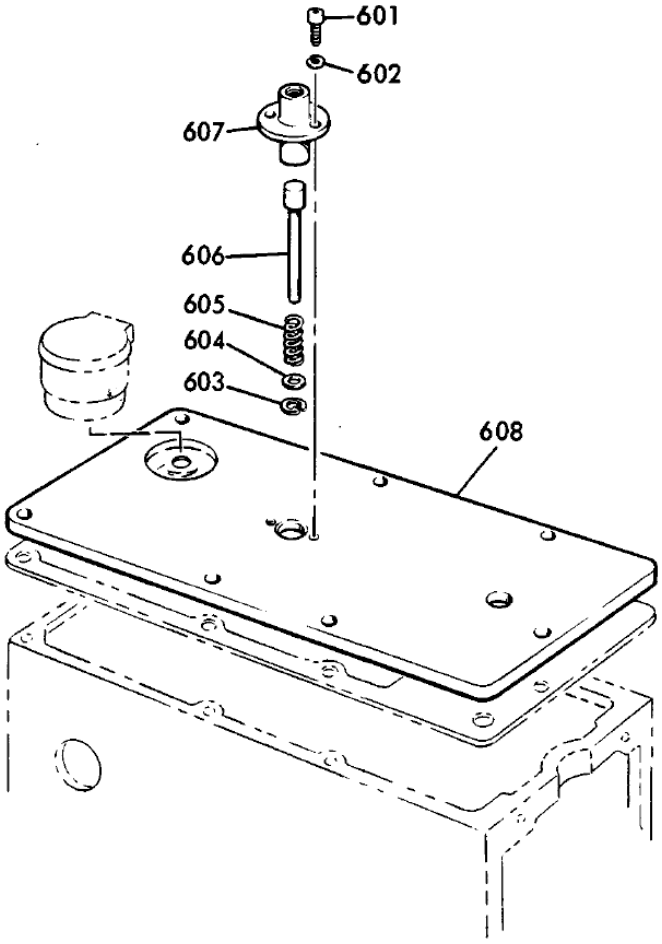


Figure 6-6. Pneumatic Starting Device (Optional)

Parts List for Figure 6-7

Ref. No.	Part Name ..... Quantity
82558-701	Ballarm pin 2
82558-702	Ballarm assembly.....2
82558-703	Ballhead 1
82558-704	Torsion spring 1
82558-705	Ball bearing 1
82558-706	Ballhead drive cup.....1
82558-707	Ballhead cover 1

IMPORTANT **This is sold as an assembled unit only.**

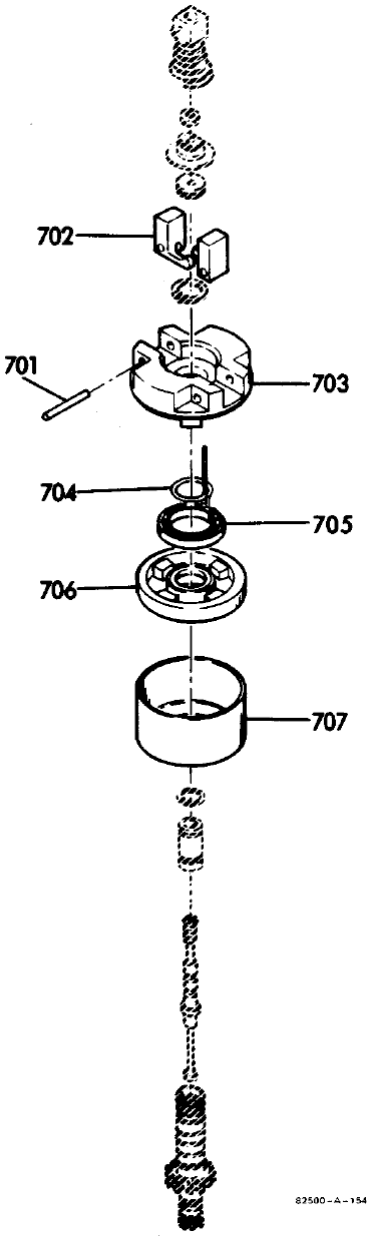


Figure 6-7. Spring Driven Oil Damped Ballhead (Optional)
[sold as an assembled unit only]

Chapter 7.
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

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

Products Used In Engine Systems

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

Products Used In Industrial Turbomachinery Systems

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

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

Technical Assistance

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

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

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

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

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

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 82558A.

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Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

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

2012/11/Colorado