WOODWARD

Product Manual 82340
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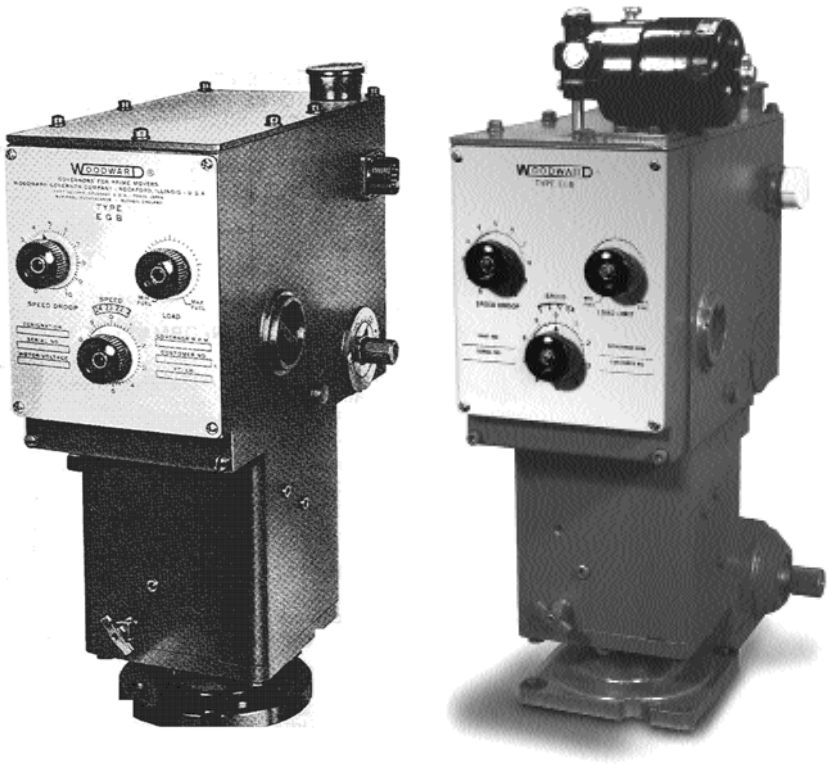
Original Instructions



EGB-Proportional Governor/Actuator with Hydraulic Amplifier Systems

EGB-10P/-13P/-29P/-35P/-50P/-58P

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 Out-of-date translations are marked with ⚠.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.

Manual 82340

Contents

Illustrations and Tables

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.

Chapter 1.
General Information

Introduction

This manual provides description, operation, installation, adjustment and replacement parts information for the proportional EGB governor/actuators with hydraulic amplification systems (EGB-10P/-13P/-35P/-29P/-50P/-58P; referred to in general as an EGB-P). Certain optional auxiliary features which may be used with the actuator are included in this manual.

Description

The EGB-P is an electrically controlled, proportional output actuator with an integral backup mechanical (centrifugal) governor. It is normally used with a Woodward integrating electric control unit to form a complete governing system.

When operating on the electrical side, 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 required of the fuel or steam control to maintain the desired prime mover speed under varying conditions of load.

Applications

EGB proportional actuators are normally used on units which must continue to operate, even if the electrical governor fails. The combination of an electrically powered actuator and a mechanical ballhead governor in the same unit provides an extra aspect of reliability for control systems which must provide emergency service.

Proportional actuators are also particularly suited for use with prime movers operating in tandem to drive a common mechanical load. In these applications, a single electric control can be used for two or more proportional actuators connected in series with the output of the electrical control unit. With each actuator receiving the same current signal, the output shafts will take the same angular position and direct the same amount of fuel or steam to each prime mover. Because the EGB has droop built into the mechanical governor section it can operate these tandem units should the electrical control signal fail for any reason.

Two Controls

The EGB-P governor/actuator (Figure 1-1) is, in effect, two controls in one; an electric actuator and a mechanical governor, each independently capable of positioning the output or terminal shaft.

During normal operation, the electric section controls fuel or steam to the prime mover. The mechanical governor controls the prime mover during starting and also functions as a backup governor to prevent runaway should the electric control system fail in such a manner to call for maximum fuel. The speed of the mechanical governor is set slightly higher than the electrical governor and should the speed of the controlled unit reach this level the mechanical governor will assume and maintain control of the prime mover.

An EGB-P unit operating with droop will have the mechanical side set about five percent higher than the electrical side. If the unit is not using droop, the mechanical side may be set only one or two percent higher than the electrical side.

With standard confirmation (direct acting), the EGB-P output servo will go to minimum position should the electric control signal fail to zero volts. The EGB-P may be installed with a “reverse acting” control which will call for maximum fuel should the electric signal fail to zero volts causing the continued operation of the controlled unit by the mechanical governor side starting when the engine speed increases to the speed setting of the mechanical control.

⚠WARNING

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

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

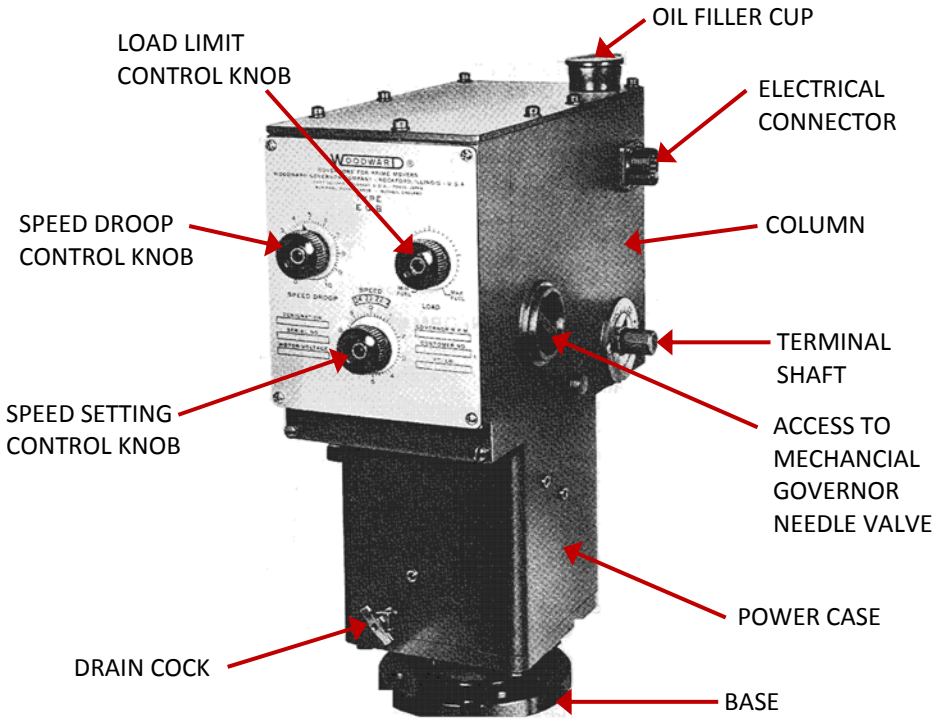

Figure 1-1a. EGB-10/13/35/50 Governor/Actuator

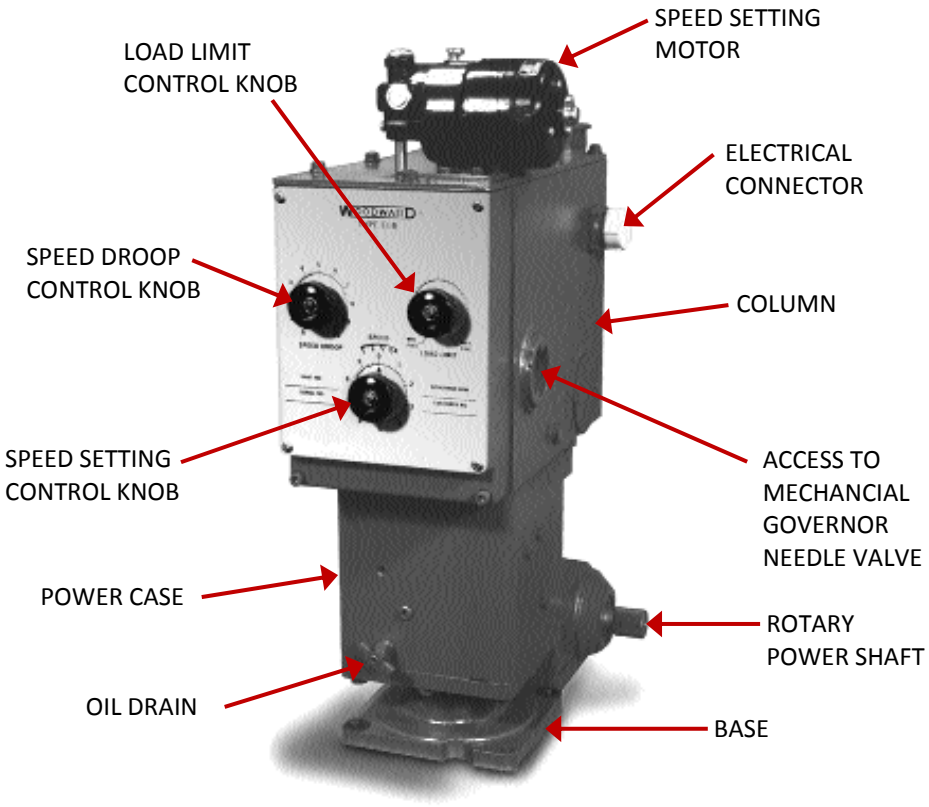

Figure 1-1b. EGB-29/58 Governor/Actuator

The operating element of the electric section of the actuator is an electro-hydraulic transducer. The transducer consists of a solenoid attached to the pilot valve plunger controlling oil flow to and from the power piston (see Figure 4-1).

The solenoid responds to the output of an electric control unit and moves the pilot valve plunger up or down. Through connecting linkage the servo piston moves the terminal (output) shaft of the actuator. The engine or turbine fuel linkage attaches to the actuator shaft.

Specifications

All EGB proportional actuators and governors described in this manual operate in identical fashion.

EGB-10, 13, 35, and 50 models provide operating power through a terminal shaft located in the aluminum column. The work capacities are related to the amount of hydraulic pressure available to the power cylinder.

The EGB-29 and 58 models operate with a power cylinder which has its own terminal shaft as part of the power cylinder. The EGB-29 and 58 are identical except for the difference in internal hydraulic pressures.

Table 1-1. EGB Rated Work Capacity

Governor/ Actuator	Maximum Work Capacity	Useful Work Capacity *	Stalled Torque Rating	Oil Pump
EGB-10P	11 J / 8 ft-lb	7.3 J / 5.4 ft-lb	14.2 N•m / 10.5 lb-ft	690 kPa / 100 psi
EGB-13P	14.2 J / 10.5 ft-lb	9.5 J / 7 ft-lb	19 N•m / 14 lb-ft	896 kPa / 130 psi
EGB-35P	38 J / 28 ft-lb	26 J / 19 ft-lb	49 N•m / 36 lb-ft	2.4 MPa / 350 psi
EGB-50P	54 J / 40 ft-lb	50 J / 37 ft-lb	71 N•m / 52 lb-ft	3.4 MPa / 500 psi
EGB-29P	39 J / 29 ft-lb	27 J / 20 ft-lb	75 N•m / 55 lb-ft	690 kPa / 100 psi
EGB-58P	71 J / 52 ft-lb	47 J / 35 ft-lb	134 N•m / 99 lb-ft	1.6 MPa / 230 psi

***** Useful Work Capacity is the actual work available for 2/3 of max travel and references the travel that should be used between no load and full load positions on the actuator. Equal travel beyond min and max load positions should be used.

WARNING

It is important to regularly check the high speed stop on the speed setting knob. The operation of the electrical actuator will not be affected should this setting be changed to a higher speed. Should the speed setting knob be changed to a higher speed, and should the electric actuator or electric control fail In such a way as to call for maximum fuel a dangerous overspeed could occur.

Auxiliary Features (optional)

A brief description of the various optional auxiliary features which may be used, either alone or in combination, is given in the following paragraphs.

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. The motor is mounted externally on top of the actuator (see Figure 1-2) 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 can be provided 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 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 Woodward manual 03505, *Speed Adjusting Synchronizing Motor*, for maintenance and parts information.

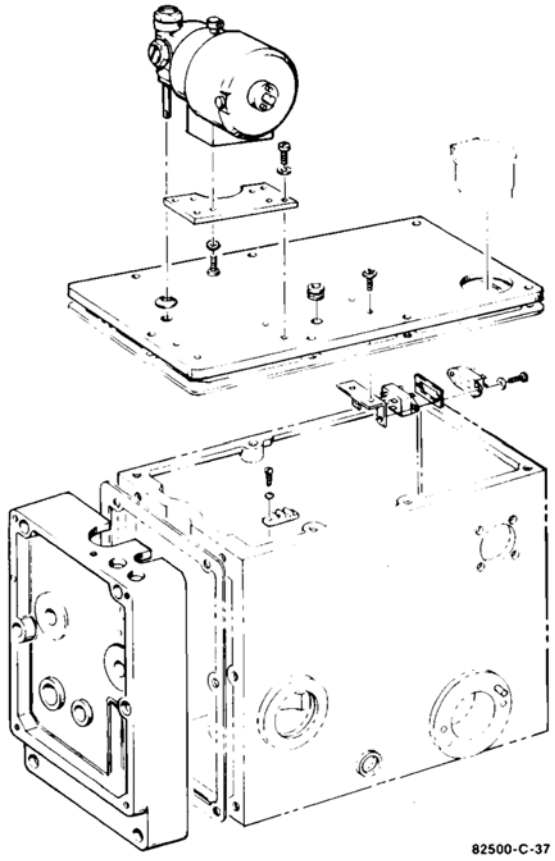

Figure 1-2. EGB Speed Setting Motor

Shutdown Solenoid

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.

The solenoid is mounted internally within the actuator column (see Figure 1-3). 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 minimum fuel position. (Reference Figure 4-2 Schematic View of Relay Valve Plunger and Shutdown Solenoid.)

⚠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 control.**

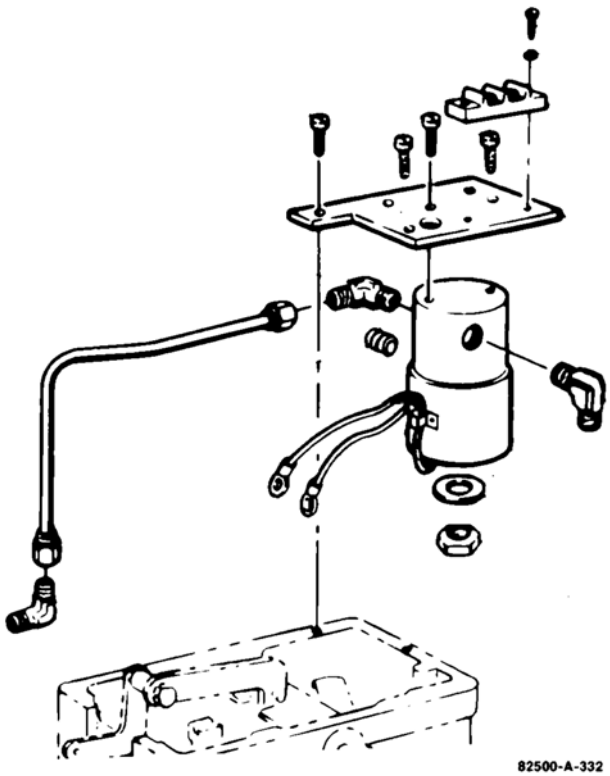

Figure 1-3. EGB Shutdown Solenoid

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 actuator pilot valve downward. The oil pressure generated at cranking speed will then cause the actuator output shaft to move in the increase direction so the prime mover can be started. The device is mounted on the actuator cover directly over the electric actuator pilot valve (see Figure 1-4) and is designed for use with air pressures in a range of 690 kPa to 1.7 MPa (100 to 240 psi). A starting device is not needed on reverse acting units.

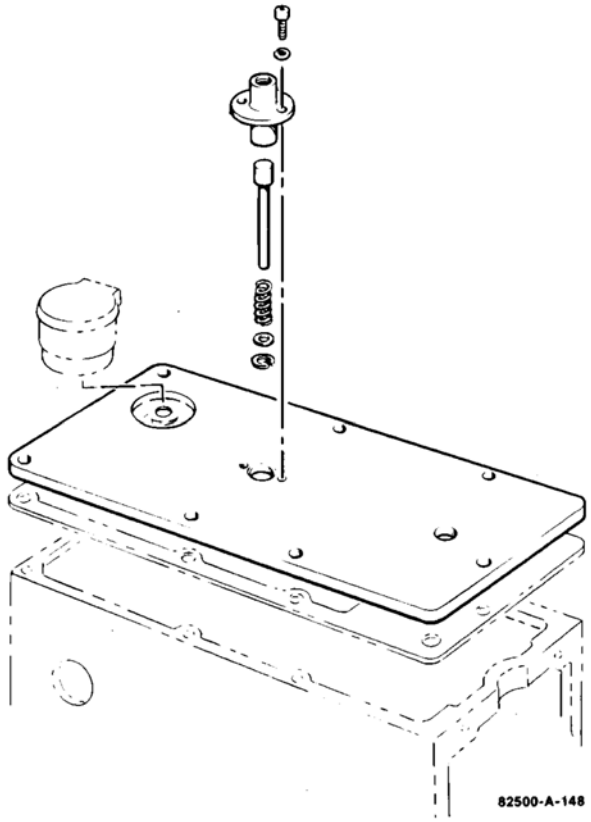

Figure 1-4. Pneumatic Starting

Manual Starting Device

Installations which lack an electric or air pressure signal when the prime mover, which is controlled by the governor is not running, can be fitted with a simple Manual Starting Device. The starting device is a plunger with a spring return mounted in the governor/actuator cover directly over the actuator pilot valve plunger. When the starting plunger is pushed down on the actuator pilot valve plunger the oil pressure generated at cranking speed will cause the terminal shaft to move in the increase direction so the prime mover can be started under control of the mechanical governor side of the EGB-P. A starting device is not needed on reverse acting units.

Spring Driven Oil-Damped Ballhead

A spring driven-oil damped flyweight head is available for use in EGB-P 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.

Mode Switch

A mode switch may be installed on the EGB-P governor/actuator to provide a visual indication if the electrical actuator or the mechanical governor is controlling. The installation consists of a micro switch actuated by the mechanical governor side of the control when the mechanical side is inactive. The switch assembly is mounted on top of the sub-governor case.

References

The publications listed below are available on Woodward's website (www.woodward.com).

Manual 03505	Speed Adjusting Synchronizing Motor
Manual 25071	Oils for Hydraulic Controls
Prod. Spec. 82543	EGB-10P/-13P/-35P/-50P Governor/Actuator
Prod. Spec. 82483	EGB-29P/-58P Governor/Actuator
Prod. Spec. 82489	EGB Mode Switch Assembly
App. Note 50516	Governor Linkage for Butterfly Throttle Valves

Additional Information

For help in selecting optional accessories for the governor, or if field conversion of the governor actuator is necessary, contact Woodward (see Chapter 7).

Chapter 2.
Installation

Locating Actuator

Refer to Figure 2-2, 2-3, or 2-5 for complete physical dimensions of the actuator. 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 in 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. Only a minimum of force can be used when installing a coupling or gear on the drive shaft.

If the governor/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 on 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., when transmitted to the actuator will adversely affect actuator operation and result in erratic governing.

EGB-10, 13, 35, and 50

The linkage between the actuator output shaft and fuel or steam control should be adjusted to use a minimum of 30 degrees (2/3 of the 45 degrees of travel available) of the actuator output shaft travel from the rated speed, no-load position, to the rated speed, full-load, position. 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.

Recommendations for linkage from the prime mover manufacturer should be used when available.

EGB-29 and 58

The linkage between the actuator output shaft and fuel or steam control should be adjusted to use a minimum of 20 degrees (2/3 of the 30 degrees of travel available) of the actuator output shaft travel from the rated speed, no-load position, to the rated speed, full-load, position. 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.

Recommendations for linkage from the prime mover manufacturer should be used when available.

Actuator Linkage

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 terminal shaft movement.

Strict linearity of terminal shaft travel versus load is not required. Linkage must be arranged to give the degree of linearity necessary to obtain steady-state and transient performance. Should the unit be controlling a non-linear fuel or steam valve a non-linear linkage must be used (see Woodward Application Note 50516, *Governor Linkage for Butterfly Throttle Valves*).

Linkage to the fuel control should be arranged to allow the minimum fuel stop on the prime mover to provide the minimum stop for the governor. The maximum fuel stop on the governor should provide the maximum fuel stop for the prime mover.

⚠WARNING

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

Oil Specifications

In general, the oil used in the prime mover will be satisfactory for use in the governor.

The governor/actuator oil supply is self contained. Sump capacity is 1.4 L (1.5 qt US / 1.25 qt imp.). When an empty governor is filled, add oil until it drains out the vent hole in the sight glass. This should require about 1.4 L (47 oz) of oil. Immediately after starting and with the engine running, check the oil level in the sight glass. If the oil level is above the sight glass line, oil should be drained. If the oil level is below the line, add new, clean oil to bring the level up.

IMPORTANT

When an oil cooler or starting booster is used, additional oil will be required depending on the size of the cooler or booster and the length of the lines connecting it to the governor.

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. Refer to Woodward manual 25071, *Oils for Hydraulic Controls*, 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 to 300 SUS at normal operating temperatures. Only oils of the grade specified for a particular temperature range should be used.

Figure 2-1 shows the viscosity of oils at the different operating temperatures. Operating the governor with oil which does not fall in the acceptable operating range on the chart can cause erratic governor operation and possible damage to the governor.

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.

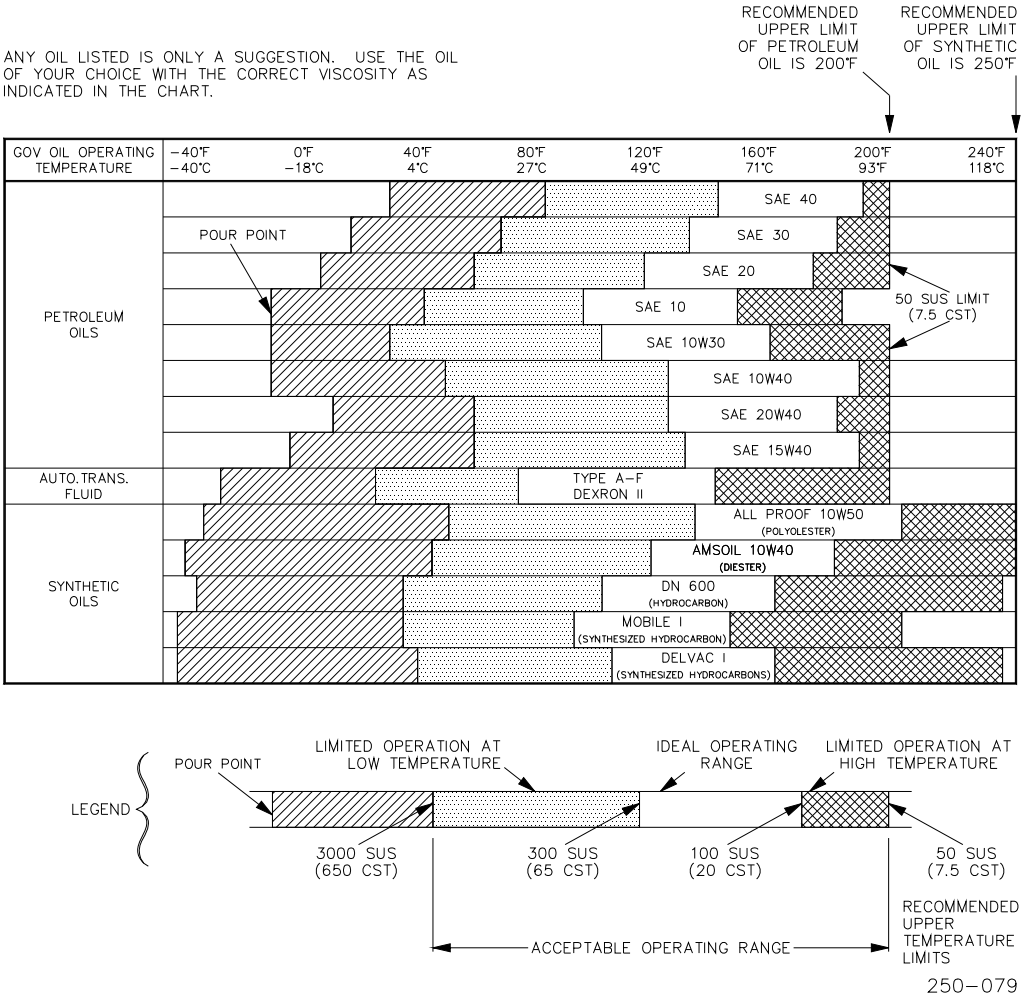

Figure 2-1. Oil Viscosity Chart

Electrical Connections

The EGB-P is normally provided with a 10-pin electrical connection located on the column. Other connectors available include 19-pin, 14-pin, and 8-pin styles. In all styles of connectors the A pin is normally connected to the positive electrical control lead with the negative lead from the control connected with the B pin. The other pins are open for use of the numerous auxiliary features which may be added to the unit. A plant wiring diagram should include the information which fits the individual EGB-P.

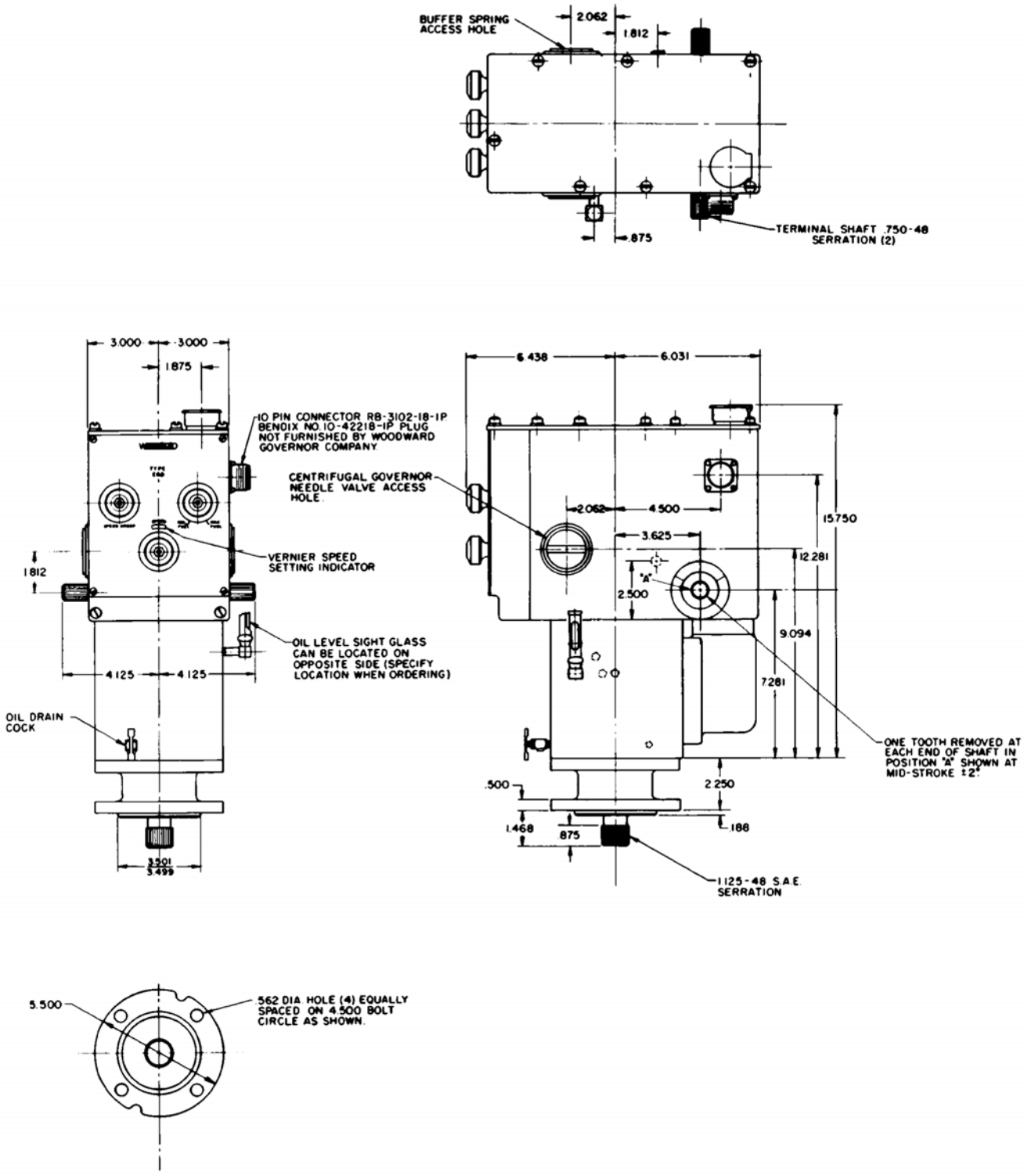

Figure 2-2. EGB-10P and 13P Exterior Dimensions

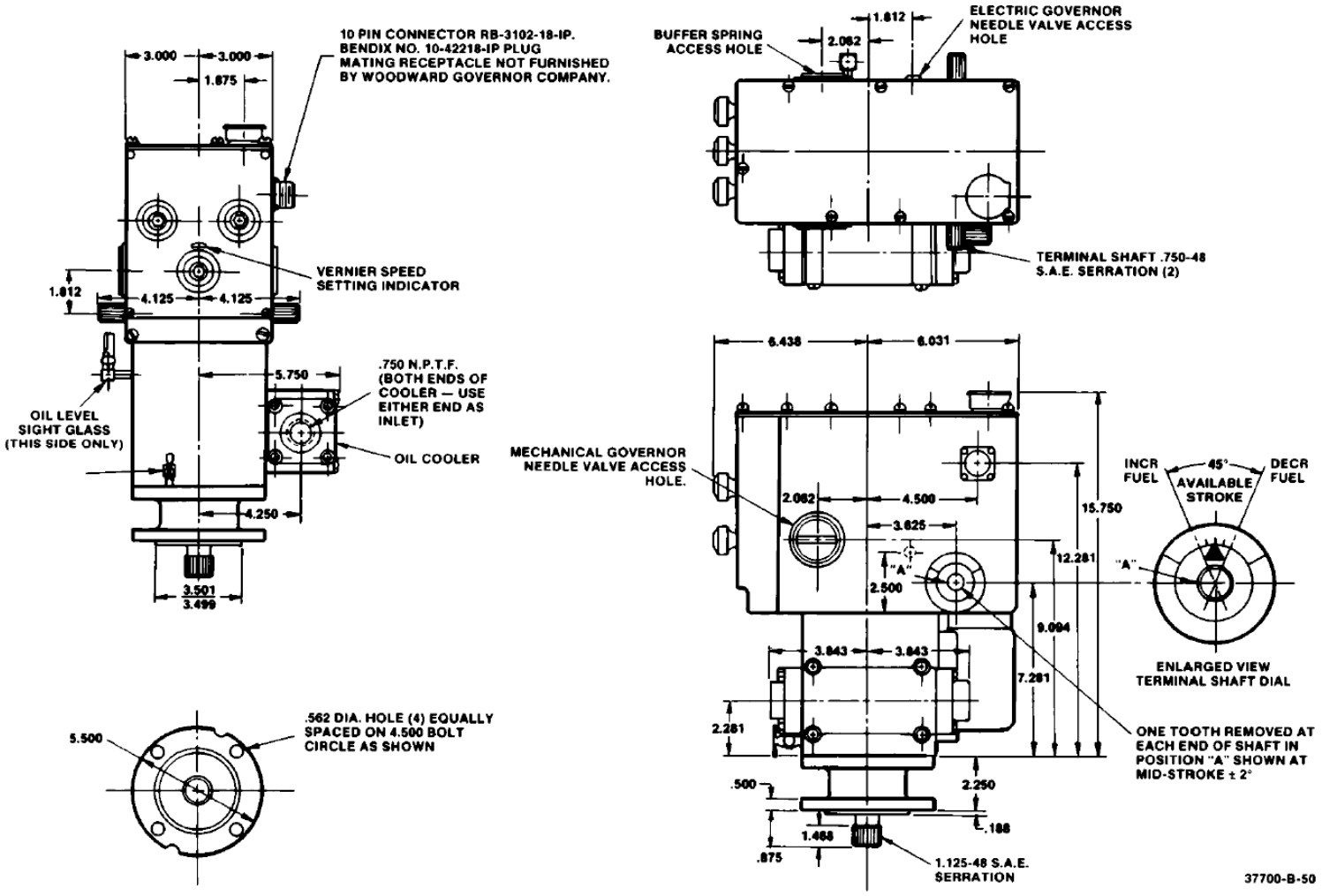

Figure 2-3. EGB-35P and 50P Exterior Dimensions

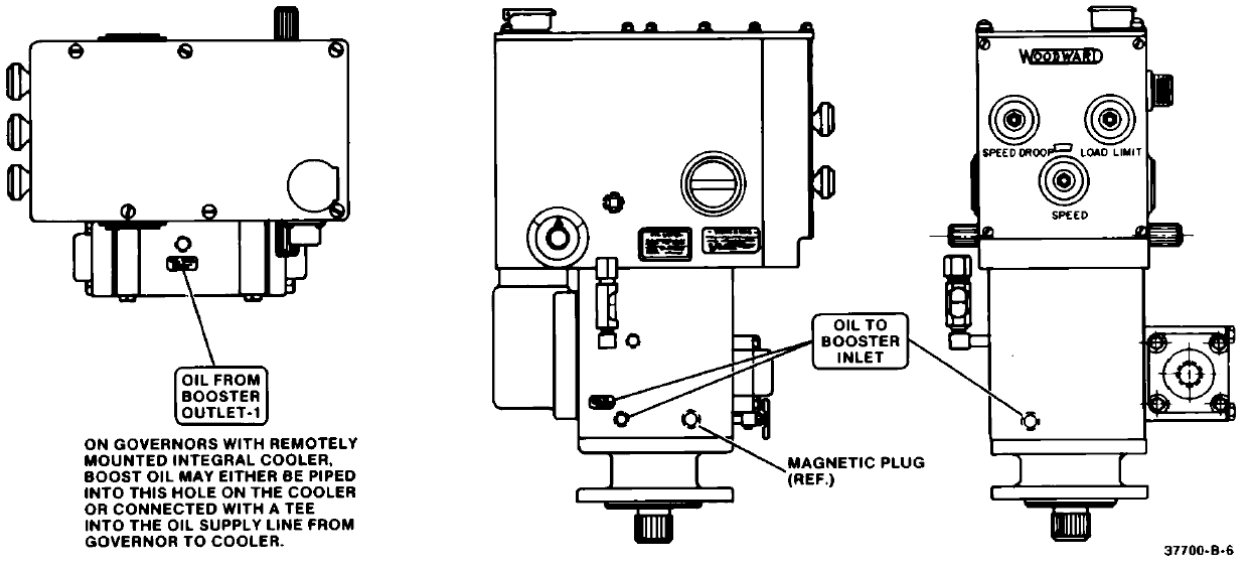

Figure 2-4. EGB-35P and 50P Booster Connections

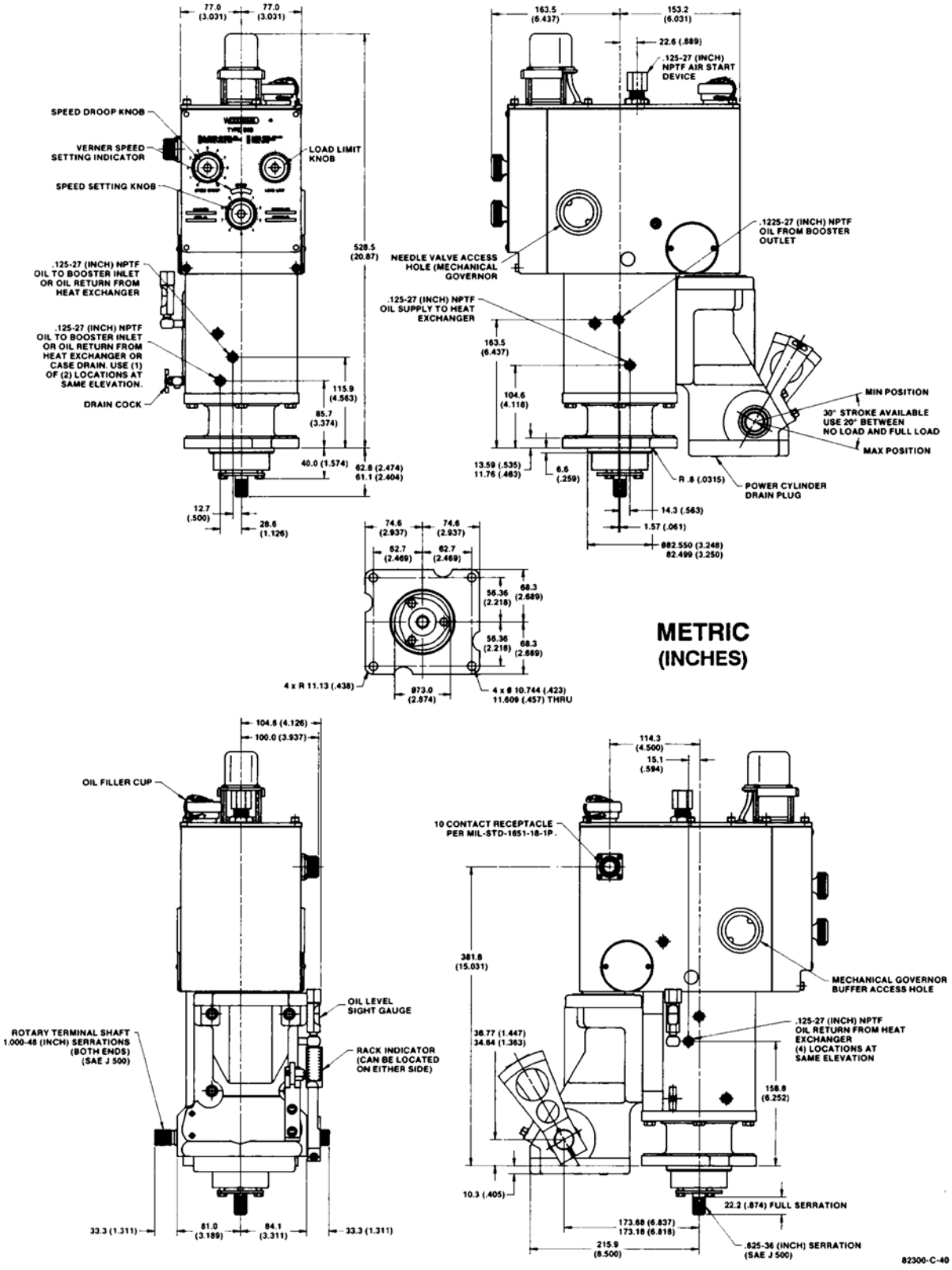

Figure 2-5. EGB-29P and 58P Exterior Dimensions

Chapter 3.
Prime Mover Operation

Normal Start-up Procedure

Whenever starting the prime mover the electric governor pilot valve must be moved 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.

⚠WARNING

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

Because of the higher oil pressures within the EGB-35 and EGB-50 actuators, they require a 0.7 kW (1 hp) drive to rotate the actuator drive shaft at 1000 rpm under normal operating conditions.

⚠WARNING

Overcurrent to the actuator (12 volts or more applied to actuator terminals) can cause a calibration shift of the actuator toward maximum fuel. The calibration shift can cause engine overspeed and resulting damage to the engine and possible personal injury or loss of life. SHOULD AN OVERCURRENT OCCUR, EVEN WHILE THE ENGINE IS SHUT DOWN, DO NOT USE THE ACTUATOR UNTIL IT HAS BEEN TESTED OFF THE ENGINE TO THE ACTUATOR SPECIFICATIONS.

Normally a battery or other independent power supply is used to provide power to the electrical control unit and 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 or manual 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 9 V battery may be connected across pins A(+) and B(–) of the actuator receptacle to provide the necessary electrical signal for starting. This method may also be used in the event of control unit failure or loss of electrical power to force the electric governor to assume a simulated overspeed condition and to permit continued operation of the prime mover under control of the mechanical governor in the actuator.

⚠WARNING

It is important to regularly check the high speed stop on the speed setting knob. The operation of the electrical actuator will not be affected should this setting be changed to a higher speed. Should the speed setting knob be changed to a higher speed, and should the electric actuator or electric control fall in such a way as to call for maximum fuel a dangerous overspeed could occur.

Should the EGB-P be equipped with a reverse-acting actuator, the electrical actuator will move to the increase fuel or steam direction automatically should the electric signal be interrupted and no voltage will be required for starting.

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 the applicable manual.

Starting the Engine

Instructions furnished by the prime mover manufacturer or installer should be carefully followed at any time the unit is started. The operator should be prepared to manually control the unit until the governor has proven that it is functioning.

Prior to start-up over-speed controls should be checked to assure they are functioning.

Operating Control Adjustments

Three operating control knobs are located on the front panel of the EGB-P Governor/Actuator (see Figure 1-1).

1. Speed setting control knob, used to set the speed at which the mechanical governor will control.

2. Speed droop control knob, used to permit load division and parallel operation of the prime mover controlled by the mechanical governor.

3. Load limit control knob, used to limit maximum prime mover load whether the actuator is controlled by the electric or mechanical governor. The load limit sets the maximum governor fuel level position.

Mechanical Governor 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 mechanical governor needle valve (see Figure 2-2) 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 chapter of the EGB-P has no external operating adjustment.

Terminal Shaft Travel Adjustment

IMPORTANT

The following preliminary operating adjustments are for the mechanical governor section only and are required only after repair or overhaul. Preferably the adjustments should be made only on a governor test stand with the mechanical governor controlling.

The drive shaft must be rotating to make the following adjustments. Do not attempt these adjustments when connected with the engine unless experienced and trained. Make sure the overspeed protection, separate from the governor, is operating and dependable.

Turn the load limit control knob fully clockwise. Turn screw (23, Figure 6-9) ccw until the control knob can be rotated 1/8 turn ccw before the load limit strap (24, Figure 6-9) begins to rise. Again turn the control knob fully clockwise.

Adjust screw (85, Figure 6-9) to permit full travel of the terminal shaft (from minimum fuel to maximum fuel positions as shown on the fuel indicator (part 152, Figure 6-11). Turn screw ccw to lengthen the terminal shaft travel in the maximum fuel direction.

Load Limit Adjustment

Turn the load limit control knob fully cw.

With the actuator running and the terminal shaft just at the end of its travel in the maximum fuel direction, turn screw (23, Figure 6-9) cw until the terminal shaft just starts to move in the minimum direction. Then turn the screw ccw ¼ turn.

Turn the load limit control knob ccw until the terminal shaft is at the midpoint of its travel (as shown by fuel indicator). Loosen nut (12) and position pointer disk (14) at “5”. Tighten nut to lock pointer in position.

Speed Droop Adjustment

⚠WARNING

The Internal speed droop adjustment should be made on a governor test stand. The adjustment should not be attempted on the engine unless It is absolutely necessary. The adjustment procedure can make the engine overspeed with possible personal injury, loss of life, or damage to equipment.

If the governor/actuator has been disassembled, reset the droop linkage to zero. Perform steps one through seven to completely recalibrate the droop linkage. Perform steps four through seven for a normal procedure of setting droop.

Perform steps 1 through 3 with the engine not running and the governor/actuator cover removed. For steps four through seven replace the cover and operate the engine unloaded.

1. Set the speed droop knob all the way ccw to zero droop.

2. Place a dial indicator on top of speeder spring (245, Figure 6-12).

3. Manually lift up power piston (295) and check the dial indicator for movement. Zero to plus .003 movement indicates “0” droop. The speeder spring should not move down when the power piston is raised.

If there is not zero droop, reposition link (63, Figure 6-9) until the pin in the link is on the same axis as the pivot pins (208, Figure 6-12).

Some units are equipped with an eccentric pivot pin (62, Figure 6-9) and some just a plain pivot pin. If pin (62) is an eccentric turn it until it is in the center of its movement.

IMPORTANT

Do not release the tension on crank (68) while screw (65) is loose.

Loosen screw (65) and manually move link (63) until its pin lines up on an axis above pivot pins (208). Tighten screw (65). If pin (62) is an eccentric, make fine adjustments by loosening the nut and turning the eccentric until “0” droop is obtained. Remove the dial indicator.

⚠WARNING

Before starting the engine, make sure the high speed stop has not slipped and the mechanical governor is within the normal operating range. A mechanical governor set at too high a speed can allow engine overspeed with possible personal injury, loss of life, or damage to equipment.

4. Operate the engine unloaded. Be sure the speed droop control knob is all the way ccw on zero droop.

5. Increase the electronic control speed until the mechanical governor controls the prime mover.

6. With the mechanical governor controlling adjust the mechanical governor speed setting knob to 60 Hz.

7. Load the prime mover to maximum.

8. Check for zero droop by watching the frequency meter which should not vary from 60 Hz. If the frequency meter does vary, shutdown the prime mover, check and adjust for zero droop as in steps 1 through 3. If the frequency meter does not vary from 60 Hz. the mechanical governor is set at zero droop.

9. Once zero droop is attained, unload the prime mover.

10. Turn the droop knob to about 3 on the dial.

11. Load the prime mover to maximum and check the frequency meter. Droop should be at three percent. The frequency meter should read 58.2 Hz.

12. If droop is not correct, unload the prime mover.

13. Turn the droop knob cw to increase droop or ccw to decrease droop as required to obtain 3 percent droop.

14. Set the speed to 60 Hz. and load the prime mover to maximum. Check the droop.

15. Continue the adjustments until three percent droop is attained.

16. Adjust the speed setting knob until the frequency meter reads 62.5 to 63 Hz.

17. Adjust the electronic control to 60 Hz.

The mechanical governor is now set with the correct amount of droop. The mechanical governor speed is also set, just high enough that it will not interfere with the electric actuator which is now in control of the prime mover.

Speed Setting Stop Adjustment

Remove dial plate (8, Figure 6-9). Remove speed setting control knob (13) and pointer disc (14). Loosen three screws (15). Put control knob back on speed adjusting shaft (43).

⚠WARNING

It is important to regularly check the high speed stop on the speed setting knob. The operation of the electrical actuator will not be affected should this setting be changed to a higher speed. Should the speed setting knob be changed to a higher speed, and should the electric actuator or electric control fail in such a way as to call for maximum fuel a dangerous overspeed could occur.

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

Rotate dial stop 19 farthest from the control knob until it is about even with low speed stop. Tighten three screws (15).

Turn speed setting control knob cw until specified high speed is reached. (This speed is usually about 5 per cent above rated speed.)

Loosen three screws (15) rotate dial stop (19) farthest from the knob until it is against stop.

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

Turn control knob to low speed setting. Remove knob. Put pointer disc (14) on shaft assembly so the pointer is at the top or “0” position. When properly set the “0” on the speed setting dial behind the dial plate, the “0” on the dial plate and the pointer should all be aligned at low speed. Put control knob back on and tighten nut (12).

Magnet Adjustment (Centering Pilot Valve Plunger)

The following adjustments are best made on a test stand. Actuator adjustments can be extremely difficult on the engine. The actuator drive must be rotating at operating speed while making these adjustments.

WARNING

When blocking governor output or operating the hand throttle, the system is not under governor control, and extreme caution must be taken to prevent overspeed. Do not attempt if overspeed device is not functioning.

Initial adjustment of the actuator consists of physically centering the magnet (240, Figure 6-12) between the coils of the transducer assembly 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 balanced load division when the actuator is used in tandem (droop) applications. In applications where load division is not a factor, centering is not critical and the centering screw need only be backed out 1-1/4 to 1-3/4 turns after bottoming, to provide acceptable operating characteristics.

Center the magnet (pilot valve plunger) as follows:

1. Connect the test circuit to the terminal block (the Jones plug inside the governor case) on the actuator as shown in Figure 3-1. Set the test switch to OFF. Remove the fuel linkage to engine or test stand.

IMPORTANT

The test circuit must be connected to the Jones plug inside the governor case, not to the actuator receptacle on the outside of the case. The only electrical test possible from the outside terminal plug is to check continuity of the circuit through the transducer coils. Note Figure 5-I, actuator wiring diagrams, that circuits are jumped between the Jones plug and the receptacle. The test circuit must operate with these circuits open.

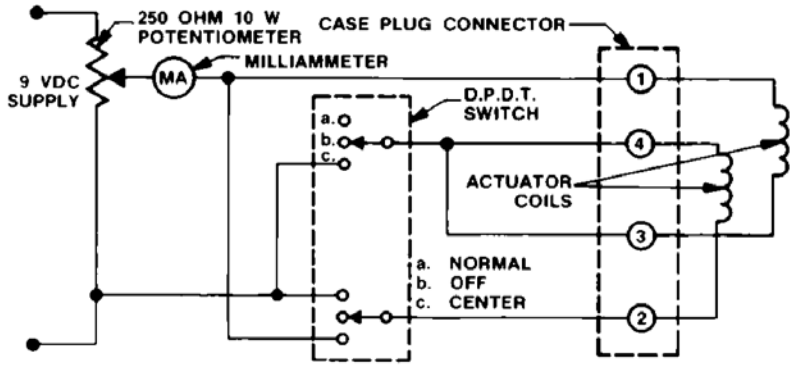

Figure 3-1. EGB Electrical Test Circuit

2. Install a protractor (one is provided on the inside back cover of this manual) 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 position on the protractor. The total output shaft travel should be 30 degrees if the shaft is part of the power cylinder and 45 degrees if the shaft is located in the aluminum column.

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 6-4), and engage the pilot valve centering screw. Slowly turn the centering screw in until it gently bottoms, then turn it out 1-1/4 to 1-3/4 turns to establish an initial starting position.

4. Set the test switch to CENTER and adjust the potentiometer to 400 mA on the milliammeter. Set the test switch to OFF.

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 to increase fuel or ccw to move the shaft to decrease fuel. Note the exact position of the shaft for future reference.

6. Set the test switch to CENTER and observe the output shaft for rotation. 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 the test switch to OFF.

7. If the output shaft movement was to increase fuel, turn the pilot valve centering screw cw a small amount using the 7/64-inch Allen wrench. If the movement was to decrease fuel, 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 the test switch is moved from OFF to CENTER.

9. Set the test switch to OFF and turn the potentiometer full ccw (decrease).

Output Shaft Travel

Adjust the travel of the actuator output shaft as follows:

Direct Acting Units

1. Set the test switch to normal. Adjust the potentiometer for minimum current according to the test specification.

2. Using a 1/2-inch Allen wrench, turn the output lever adjustable spring seat ccw until the actuator is at its minimum position, then turn the seat cw until the shaft moves 1 to 2 degrees from its minimum position.

3. Adjust the potentiometer for the maximum specification current. The output shaft should move an additional 40 (±1/2) in the increase fuel direction if the unit has the terminal shaft in the column. If the terminal shaft is in the power cylinder the output shaft should move an additional 27 (±1/2) degrees in the increase fuel direction. Change the actuator adjustments until these values are achieved.

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

5. Disconnect the test circuit and the oil supply line if used. Remove the protractor. Refer to Chapter 2, and attach the fuel linkage to the engine.

Reverse Acting Units

1. Set the test switch to NORMAL. Adjust the potentiometer for maximum current according to the test specification.

2. Using a 1/8-inch Allen wrench, turn the adjustable spring seat cw until the actuator output level is at its maximum position, then turn the seat ccw until the shaft moves 2–3 degrees from its maximum position.

3. Adjust the potentiometer for the maximum specification current. The output shaft should move an additional 40 (±1/2) degrees in the decrease direction if the output shaft is in the column. The output shaft should move an additional 27 (±1/2) degrees if the output shaft is in the power cylinder. Change the actuator adjustments until these values are achieved.

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

5. Disconnect the test circuit and the oil supply line, if used. Remove the protractor.

Friction Clutch Adjustment

To prevent speed setting changes because of engine vibrations, a friction drive (items 30 to 36, Figure 6-9) is installed in the speed setting mechanical drive of the EGB-P Governor/Actuator.

The friction drive must be tight enough to avoid a speed setting change due to vibrations and to permit the speed setting motor, if used, to turn the speed setting gear.

If the friction drive is to tight, the speed setting (synchronizer) knob can not be turned manually.

To adjust the friction on the friction drive, remove the governor cover (5), then the retaining ring (30) on the friction drive using a No. 1 Truarc pliers. Do not let the friction drive cover (31) fall into the governor.

Place a torque wrench in the slots in top of the friction drive case (34) and check the torque of the friction drive and set it at 0.2 to 0.3 N·m (1.5 to 2.5 lb-in) with manual speed setting or 0.5 to 0.6 N·m (4.5 to 5.5 lb-in) with speed setting motor. To increase friction, turn the nut on the shaft cw while holding the speed setting knob. To decrease friction, turn the nut ccw.

Reassemble the friction drive and replace cover (5) on the Governor/Actuator.

Chapter 4.
Principles of Operation

Introduction

The EGB-P governor/actuator (see Figures 4-1 and 4-2) consists of three distinct but interconnected sections: (1) an electric actuator section; (2) a mechanical governor section; (3) a hydraulic amplifier section which amplifies the force output of the other two sections through a power cylinder which provides the hydraulic power needed to position the output shaft. The amplifier section also provides a source of pressure oil for that section and for the power cylinder.

The only difference in the operation of the EGB units is in the hydraulic amplifier and power cylinder section.

Spring scale in the amplifier section is varied for the different EGB-P units, with stronger springs used to provide additional hydraulic pressure which in turn produces additional work force from otherwise identical governor/actuators.

The two types of power cylinders work in exactly the same way. The EGB-10 or 13 power cylinder moves the terminal lever and the attached terminal shaft directly. (see Figure 4-2.)

In the EGB-29, 35, 50, and 58 units, the power cylinder is attached to the feedback lever in the column and to the terminal shaft in the lower part of the power cylinder housing (see Figure 4-1).

In either case, the power cylinder is a differential servo, moving down when there is less oil pressure on the bottom of the cylinder than on the top and moving up when equal pressure is exerted against both the top and bottom surfaces.

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

Direct/Reverse Acting

Two types of electrical controls are used with the EGB-P actuators. Direct acting controls provide the electric actuator with increased electrical signals as more fuel is needed by the prime mover. This type of control will cause the governor to go to minimum terminal shaft position in case of loss of the electrical signal.

If the unit is provided with a reverse acting electrical control, a loss of electric signal will cause the electrical actuator to go to maximum position, allowing the mechanical governor section to take control of the prime mover and operation to continue at a rate only slightly higher than under electric control.

The descriptions in this section apply to both direct and reverse acting units.

Hydraulic Amplifier Section

The EGB-P governor/actuator contains two separate hydraulic circuits. Each circuit utilizes the oil of a common sump. The relay oil pump (see Figure 4-1 or 4-2) provides pressure oil required by the amplifier section. The actuator drive shaft, driven at a speed proportionate to engine speed, rotates the pump drive gear and rotating bushing. Oil from sump is transported from the supply side to the pressure side around the outside of the two gears. The meshing gears then have little space between the teeth to move oil from the pressure side back to the supply side of the pump.

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 provides a reservoir of pressure oil and also a relief valve to limit maximum pressure in the hydraulic circuit.

In most EGB units, the arrangement of the four check valves on the suction and discharge sides of the oil pump permits the actuator drive shaft to rotate in either direction without any changes to the governor. Were the pump gears to rotate in directions opposite those shown the open check valves would close and the closed check valves would open.

Some units are made with plugs in the hydraulic system rather than check valves. This provides an extra safety against starting an engine backwards.

The relay servo piston is connected 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 and the terminal lever and linkage position. In the EGB-29P through 58P models, linkage from the relay servo piston moves the terminal lever in the same manner as that employed in the EGB-10P and 13P.

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 (the 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 force is in the direction to push the piston up and increase fuel.

Loading piston and attached output nut position, as set by either the electrical actuator or mechanical governor section, controls the movement of the relay valve plunger. If the actuator is directed to decrease fuel the loading piston will move down.

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 relay terminal lever). The relay valve plunger is thus lifted above center and the servo piston rotates the terminal shaft in the decrease fuel direction.

As the relay terminal lever rotates in the decrease fuel direction the screw in the left end of the lever is raised. This permits the oil pressure on 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 dashpot 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. With pressure oil on both sides of the piston it will move in the downward direction.) As the relay valve plunger reaches a centered position, flow of oil from under the relay servo piston stops, thereby stopping the terminal shaft.

If 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 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 servo piston and pushes the piston up. The terminal shaft rotates in the increase fuel direction. As the relay 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, lifting the relay valve plunger back to a centered position and stopping further movement of the terminal shaft.

Electric Actuator Section

During the normal mode of operation the electric actuator (see Figure 4-1) will be controlling and the mechanical governor power piston will be at the top of its stroke.

Pressure oil for the electrical 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 used is relatively small, no accumulator is required. The sub-governor oil pump operates the same way as the relay oil pump.

The electric actuator pilot valve plunger controls the flow of oil to and from its power piston. The pilot valve plunger is connected to a magnet which is spring-suspended in the field of a two-coil polarized solenoid. An output signal from an electric control unit is applied to the polarized coil and produces a force, proportionate to the current in the coil, which tends to drive the magnet and pilot valve plunger down. A combination of the restoring spring and centering spring force tends always to raise the magnet and center the pilot valve plunger. 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). This occurs only when the plunger position is exactly proportional to the amount of electric signal. With the pilot valve plunger centered, 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), an unbalanced force results. The combination of the restoring spring and centering spring force, now relatively greater, raises the pilot valve plunger. Oil under the electric actuator power piston is thus connected to sump. The oil pressure constantly applied to the upper side of the loading piston now forces the pistons down as the floating lever pivots about its connection to the mechanical governor power piston. The loading piston causes the amplifier section to rotate the terminal shaft in the “decrease” direction.

As the electric governor 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 increased and applies pressure to lower the pilot valve plunger. The loading piston and electric actuator power piston move down until the increase in restoring spring force is sufficient to offset the increased force in an upward direction 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.

The position of the actuator shaft is always proportional to the electric input signal to the actuator. If the electric input signal increases, the pilot valve plunger will be lowered, pressure oil will flow to the underside of the power piston and push the piston up; the loading piston will be raised, rotating the terminal shaft in the “increase” direction. At the same time, the upward movement of the power piston, acting through the restoring levers, decreases the restoring spring force so the pilot valve plunger will re-center to stop movement of the terminal shaft.

Mechanical Governor Section

The mechanical governor (see Figure 4-1) 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 power piston. If the plunger is centered, no oil flows through the pilot valve and the 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. There is one speed at which the centrifugal force of the flyweights is equal and opposite to the speeder spring force. At this speed the pilot valve is centered.

With the speed setting of the mechanical governor set slightly higher than the electric actuator, the centrifugal force of the rotating flyweights is not sufficient to lift the pilot valve plunger to its centered position. Consequently, with the electric actuator controlling, pressure oil is continually directed to the underside of the mechanical governor power piston to hold it up against its stop. With the actuator running on-speed with the mechanical governor controlling, the pilot valve plunger is centered. (This can only occur if the electrical actuator calls for a speed higher than the speed setting of the mechanical governor.) If a load is added to the engine and governor speeds decrease the pilot valve plunger is lowered by the speeder spring force which is greater than the lessened centrifugal force of the flyweights.

Pressure oil flows to the buffer piston and moves it toward 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 fuel needs for the new load.

The movement of the buffer piston toward the power 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, causes 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 difference of pressure produces a force which acts to push the pilot valve plunger back to its centered position.

When the terminal shaft has been rotated far enough to satisfy the new fuel requirement, the force of the pressure differential on the compensation land plus the centrifugal force of the rotating flyweights will have re-centered the pilot valve plunger. Even though engine speed is not yet completely back to normal, servo piston and terminal shaft movement is stopped. The continued increase of speed to normal results in continued increase in centrifugal force developed by the rotating flyweights. This increase of speed to normal does not cause the flyweights to lift the pilot valve plunger above center because the leakage of oil 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.

With equalization of pressure through the needle valve, 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 power 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 close the pilot valve ports while speed decreases to normal.

The speed at which the mechanical governor controls the engine is determined by the loading or compression of the speeder spring which opposes the centrifugal force of the flyweights.

Dial readings on the front panel indicating speed setting of the mechanical governor are for reference only. Readings may vary from governor to governor for similar speed settings.

Speed Droop

Speed droop is used in mechanical governors to automatically divide and 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-P mechanical governor 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 power piston droop setting and speeder spring scale. If the pivot pin connecting the speed droop floating lever to the speed adjusting lever linkage is on the same centerline as the speed droop lever pivot arm, there is no change in speeder spring forces as the power 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 power piston movement.

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

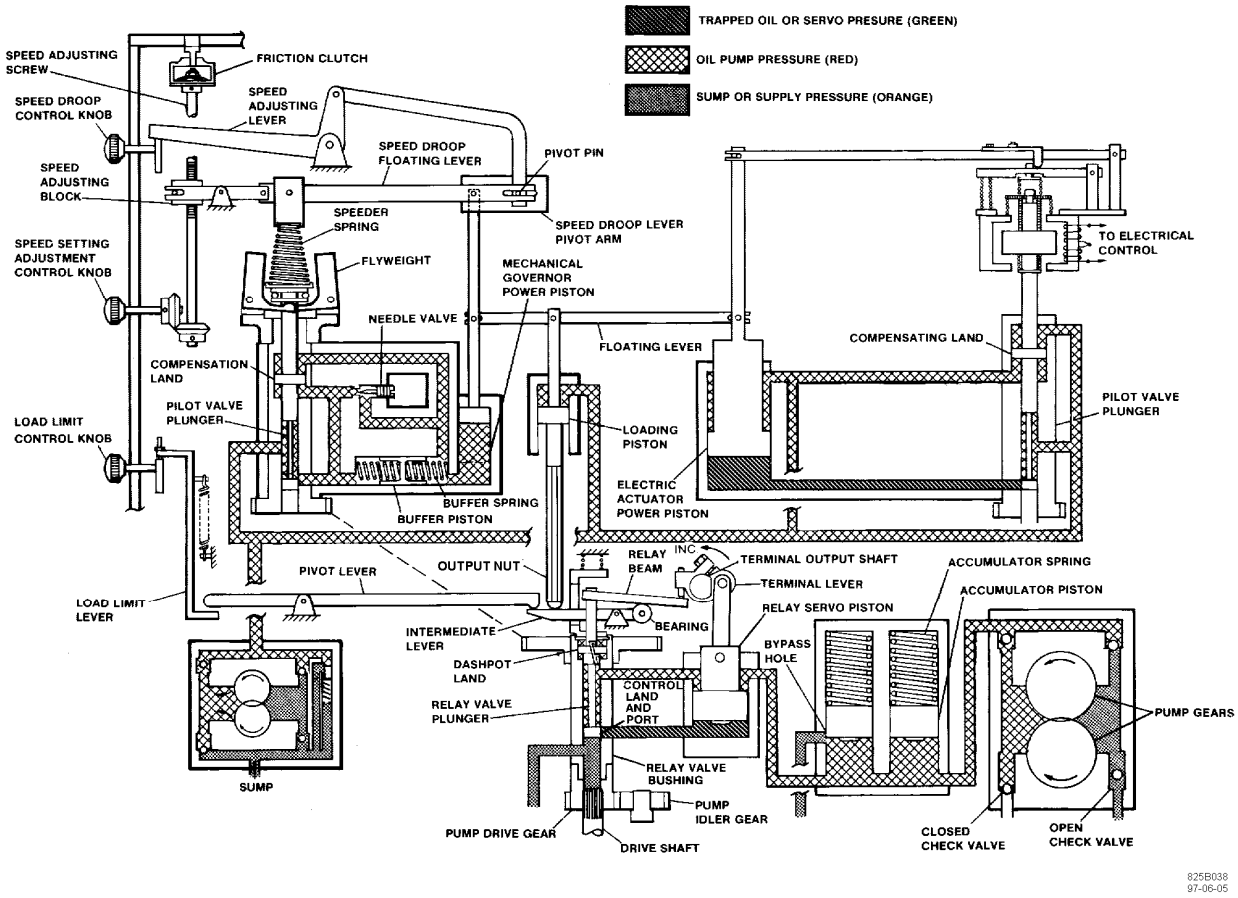

Figure 4-1a. EGB-10P and 13P Schematic

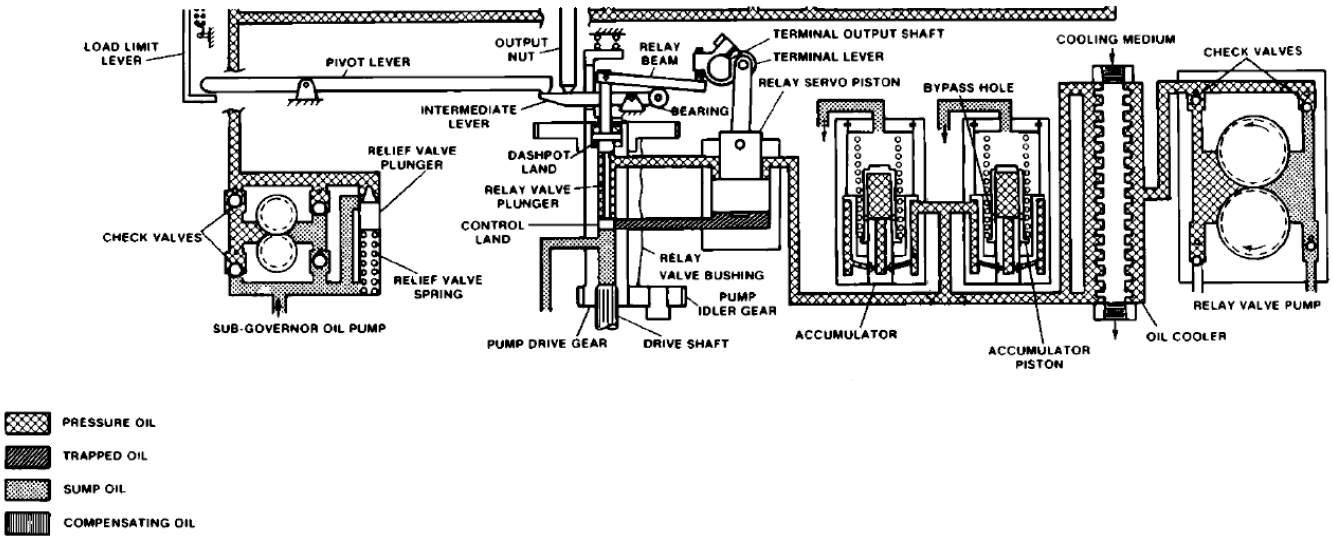

Figure 4-1b. EGB-35P and 50P Schematic

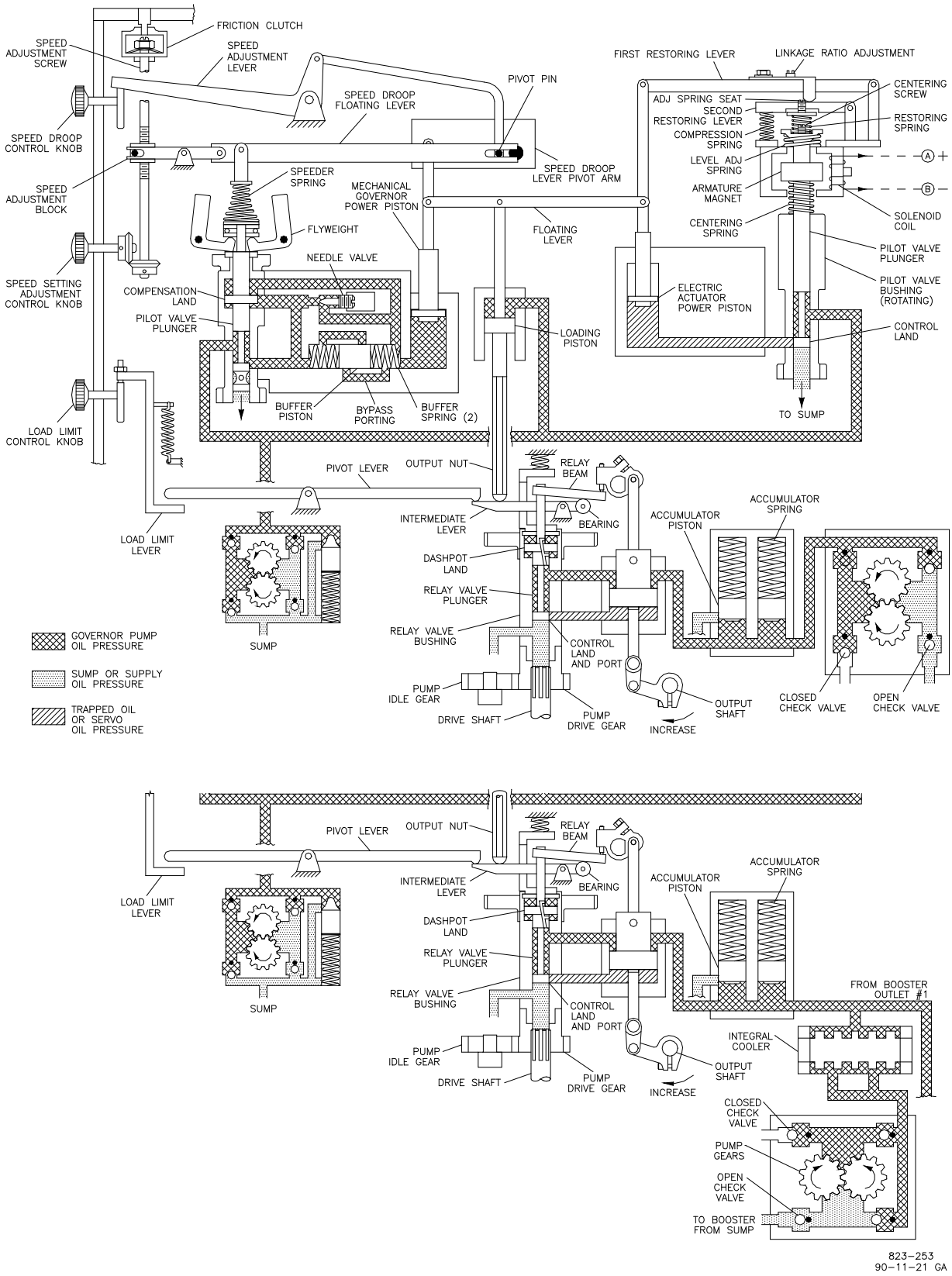

Figure 4-1c. EGB-29P and 58P Schematic

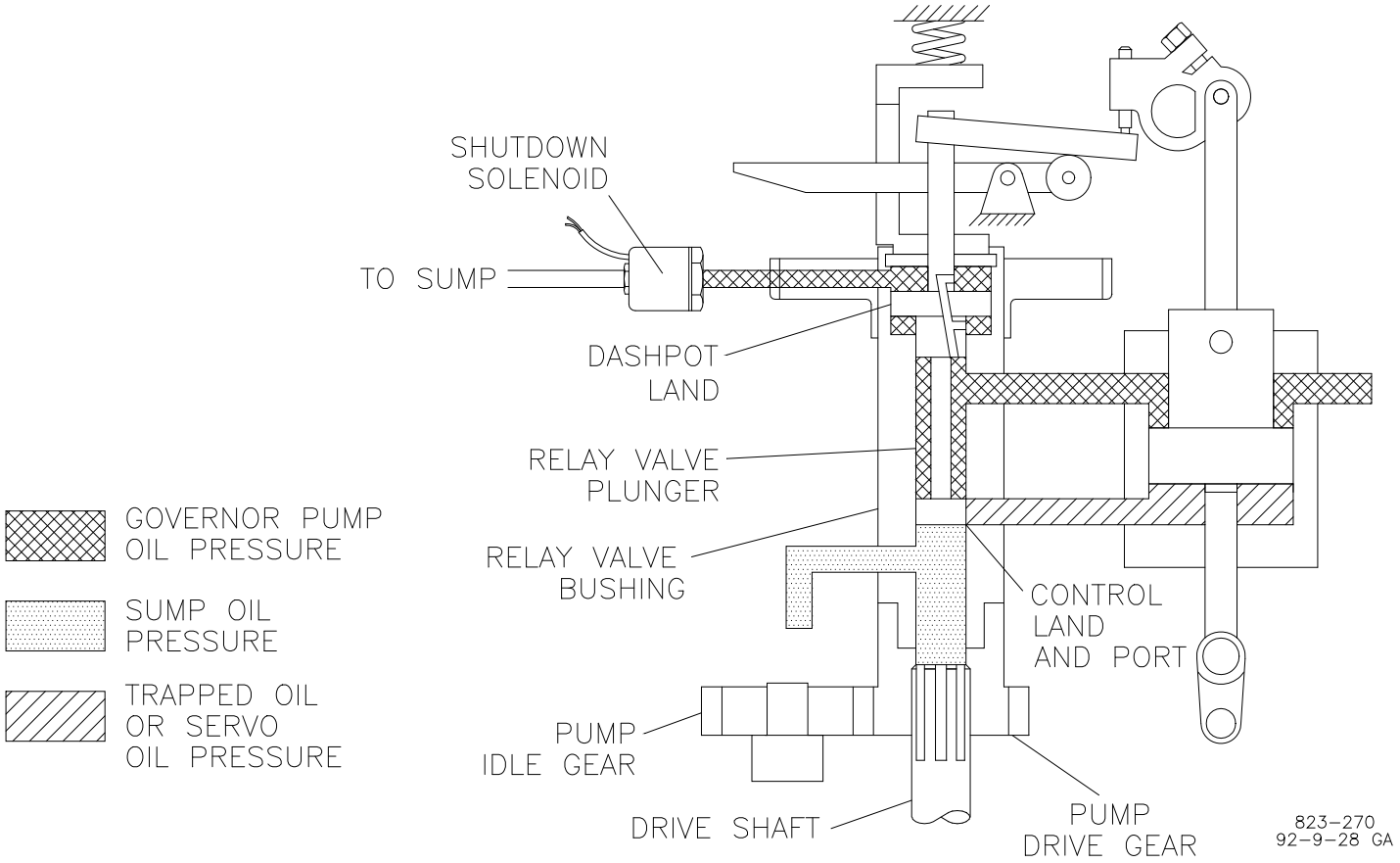

Figure 4-2. Schematic View of Relay Valve Plunger with Shutdown Solenoid
(see Shutdown Solenoid explanation in Chapter 1)

Chapter 5.
Maintenance

Troubleshooting

WARNING

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

IMPORTANT

Adjustments of the governor/actuator are included in Chapter 3 of this manual.

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. Trouble shoot to localize a problem before attempting disassembly and repair. When improper speed variations appear, the following procedure should be performed.

1. Check carefully the speed set for the mechanical side of the governor/ actuator. If the mechanical speed setting is lower than the electrical setting the mechanical side will control the engine or turbine with slightly different control results than if the electrical side is controlling. The side with the lowest speed set will provide the control of the output shaft. It is important that the speed set points of the two side be far enough apart to prevent interference between the two sides. The difference between the speed set of the two sides must be considerably more for governors operating in the droop mode than for those being used isochronously. If the controlling sides interfere with each other totally unstable operation can occur.

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

3. If the actuator is on an engine, check the operation to be sure all cylinders are firing properly and the injectors are in good operating condition. If the actuator is on a turbine check the steam valves for proper operation.

4. Check the operating linkage between the actuator and the prime mover to make certain there is no binding or lost motion. Linkage between the governor-actuator and prime mover is often a problem associated with governing systems. The linkage must be firm and properly adjusted. Check the linkage for unexpected wear.

5. Check for steam or fuel supply pressure changes.

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

7. With the actuator controls set for normal operation, check the voltage input to the actuator.

8. Lower the mechanical governor speed setting until it controls the speed. Raise the electronic actuator speed setting to maximum. If the unit is now stable the problem is probably in the electronic control. If the unit is still unstable the cause can be either the actuator, the linkage or the prime mover.

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

10. Return the unit to electric control.

11. If the unit is still unstable replace either the actuator or the electronic control to pinpoint the problem area.

⚠WARNING

It is important to regularly check the high speed stop on the speed setting knob. The operation of the electrical actuator will not be affected should this setting be changed to a higher speed. Should the speed setting knob be changed to a higher speed, and should the electric actuator or electric control fall in such a way as to call for maximum fuel a dangerous overspeed could occur.

Governor Oil Maintenance

Contaminants and foreign matter in the governor oil are the greatest source of governor troubles. Use only new or filtered oil. Be sure that all containers used for governor oil storage are clean since grit and other impurities can be introduced into the governor in new oil. Foaming or the formation of sludge may occur if the oil is allowed to break down or oxidize. This results in excessive wearing of plungers, bushings, gears, etc., or may cause parts to stick or seize.

Whenever governor control problems are encountered, the first corrective step should be to carefully check the oil condition and oil level. If the oil is not in new and perfect condition, drain the governor while hot. Flush with kerosene and refill with the proper grade and type of oil. To refill the governor, add 1.9 L (2 qt US / 1.7 qt imp.) of new oil. After operating for about 30 minutes, again drain the governor and refill with 1.9 L (2 qt US / 1.7 qt imp.) of new, clean oil of the proper type and weight. After starting operation, check that the oil level is correct. Drain off excess oil or add new, clean oil to the proper level. A completely dry governor will hold about 2.4 L (2.5 qt US / 2.1 qt imp.) of oil.

Should the oil level be too high it should be drained until it appears in the center of the sight glass.

IMPORTANT

Most problems which appear to be caused by the electrical actuator or mechanical governor included in the EGB-P unit are traced to either oil condition or linkage from the unit to the engine or turbine being controlled. Prior to disassembly the oil should be checked carefully and changed if any doubt exists on the condition. The linkage to the engine or turbine should be carefully inspected for binding or looseness.

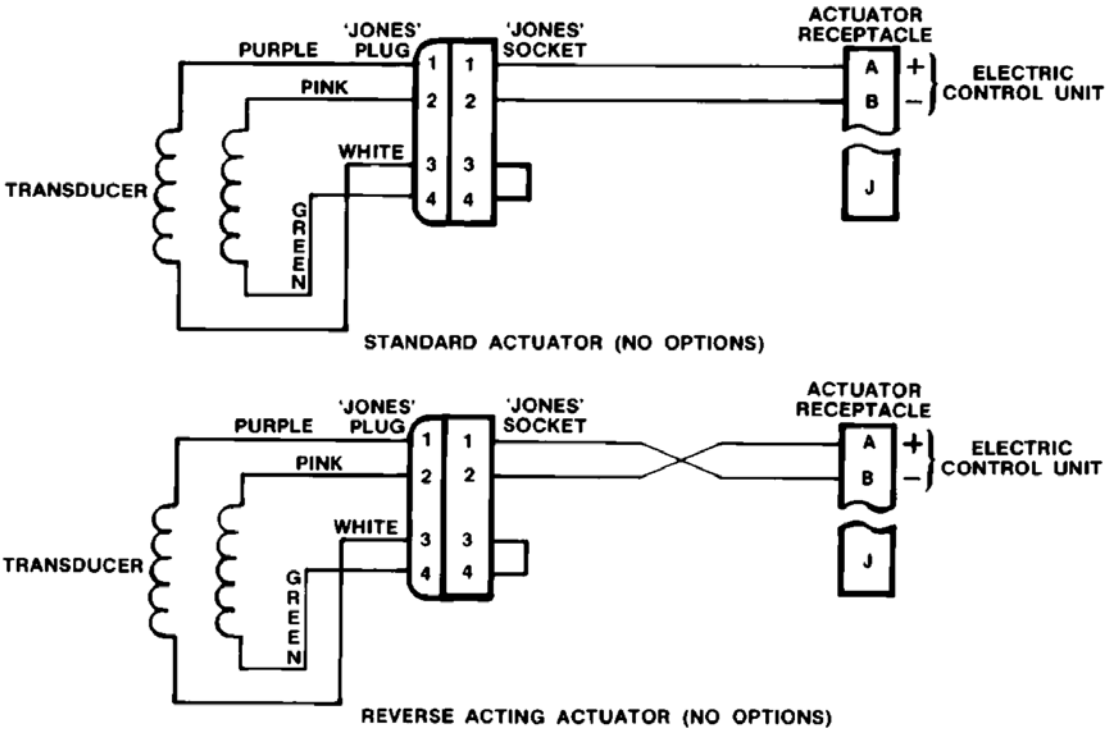

Figure 5-1. Typical Schematic Wiring Diagram of Governor/Actuator

Chapter 6.
Replacement Parts

Parts Information

When ordering replacement parts, include the following information:

- Governor serial number and part shown on the nameplate
- Manual number (this is manual 82340)
- Parts reference number and part name from parts list

⚠WARNING

Injury may result If compressed springs are released suddenly. Use the proper equipment to remove springs and spring covers.

Parts List for Figure 6-1

Ref. No.	Part Name	Quantity
82340-1	Screw, fil. hd., 1/4-28 x 5/8	7
82340-2	Lockwasher, split, 1/4 ID	7
82340-3	Clutch pin	1
82340-4	Oil cup	1
82340-5	Cover	1
82340-6	Cover gasket	1
82340-7	Screw, binder hd., Phillips, 8-32 x 3/8	4
82340-8	Dial and name plate	1
82340-9	Screw, fil hd., 1/4-28 x 1.750	6
82340-10	Lockwasher, split, 1/4 ID x 0.35 OD x 5/64 thk.	6
82340-11	Panel Gasket	1
82340-12	Locknut, thin 1/4-20	3
82340-13	Knob	3
82340-14	Pointer Disk	3
82340-15	Screw, flat hd., 10-32 x 3/8	3
82340-16	Dial locating plate	1
82340-17	Speed setting dial	1
82340-18	Spacer	2
82340-19	Dial Stop	2
82340-20	Load limit spring	1
82340-21	Locknut, thin 10-32	1
82340-22	Screw, soc. hd. cap. special 10-32 x 1	.1
82340-23	82340-23 Set Screw, soc. hd., oval pt., 6-32 x 5/8	1
82340-24	Load limit strap assembly	1
82340-25	Locknut, thin, 3/8-24	2
82340-26	Spring washer	2
82340-27	Speed droop cam	1
82340-28	Load limit cam	1
82340-29	Roll pin, 3/32 x 1/2	1
82340-30	Retaining ring, internal	1
82340-31	Friction drive cover	1
82340-32	Locknut, thin, 1/4-28	1
82340-33	Friction drive spring	1
82340-34	Friction drive case	1
82340-35	Roll pin, 3/32 x 1/2	1
82340-36	Friction drive plate	1
82340-37	Speed adjusting nut	1
82340-38	Friction drive shaft	1
82340-39	Speed adjusting level gear	1
82340-40	Plain washer, 21/64 ID x 5/8 OD x .050 to .052 thick	1
82340-41	Retaining ring, external	1
82340-42	Dial stop gear	1
82340-43	Speed adjusting shaft	1
82340-44	Roll pin 1/16 x 1/2	1
82340-45	Intermediate gear	1
82340-46	Roll pin, 5/32 x 5/8	1
82340-47	Pinion	1
82340-48	Plug	1
82340-49	Pinion bushing	1
82340-50	Shaft bushing	1
82340-51	Screw bushing (upper)	1
82340-52	Screw bushing (lower)	1
82340-53	Screw, rd. hd., 6-32 x 1/2	2
82340-54	Lockwasher, split, No. 6	2
82340-55	Locating pin	2
82340-56	Dial panel	1
82340-57	Lock nut, 5/16-24	1
82340-58	Screw, .312-24 x 2.500	1
82340-59	Lockwasher, split, 5/16 ID	1
82340-60	Spring	1
82340-61	Lock nut, thin, 10-32	2
82340-62	Pivot pin	1
82340-63	Speed droop link	1
82340-64	Spacer	2
82340-65	Screw, soc. hd. cap, 10-32 x 5/8	1
82340-66	Lockwasher, split, No. 10	1
82340-67	Speed droop cam lever	1
82340-68	Speed droop crank	1
82340-69	Spring pin	1
82340-70	Gasket	1
82340-71	Screw, fil. hd., 6-32 x 7/16	4
82340-72	Lockwasher, split, No. 6	4
82340-73	Electrical connector receptacle	1
82340-74	Receptacle gasket	1
82340-75	Not used	
82340-76	Terminal shaft pin	1
82340-77	Screw, hex hd. cap. 5/16-24 x 1	5
82340-78	Lockwasher, split, 5/16 ID	5
82340-79	Retaining ring, external	2
82340-80	Pointer disk	2
82340-81	Oil seal	2
82340-82	Roller bearing	2
82340-83	Terminal shaft (output)	1
82340-84	Terminal lever	1
82340-84A	Pin retainer bracket	1
82340-85	Setscrew, slotted hd., rd. point 5/16-24 x 1 5/32	1
82340-86	Screw, truss hd., 6-32 x 1/4	4
82340-87	Dial plate, R. H.	1
82340-88	Dial plate, L, H.	1
82340-89	Barrel plug	2
82340-90	Plug, sq. hd. pipe, 1/4-18 NPTF	1
82340-91	Oil level decal	2
82340-92	Locating Pin	1
82340-93	Stud, 5/16-18 x 5/16-24 x 2	1
82340-94	Column	1

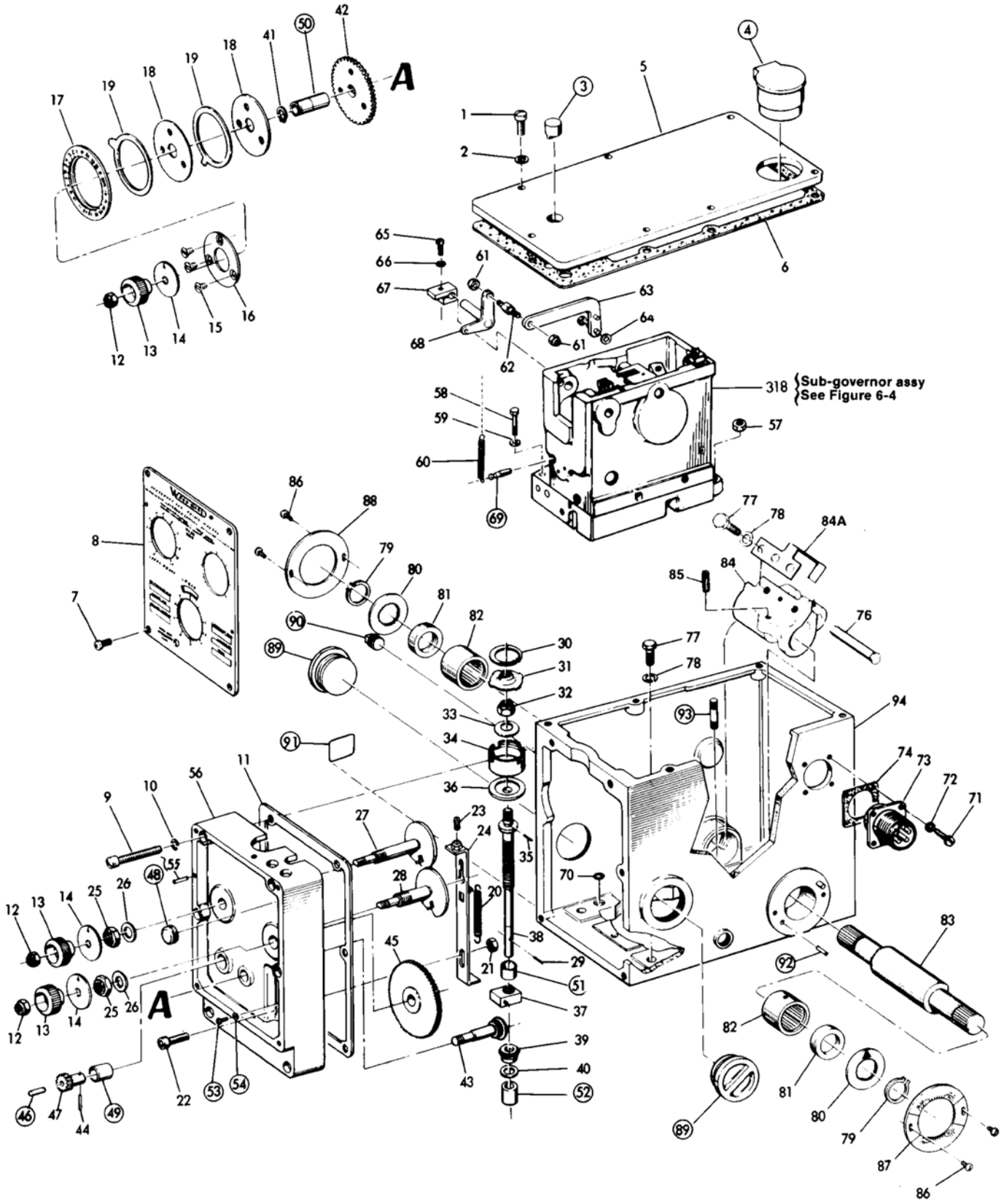

Figure 6-1. Column Assembly Parts, EGB-10P/-13P/-35P/-50P

Parts List For Figure 6-2

Ref. No.	Part Name	Quantity
82340-101	Pinion	1
82340-102	Bearing retainer assembly	2
82340-103	Washer, soft copper, 5/8 OD x 7/16 ID 1/32 thick	2
82340-104	Roller pin	1
82340-105	Roller	1
82340-106	Intermediate lever and shaft	1
82340-107	Pivot pin	1
82340-108	Relay beam	1
82340-109	Spring	1
82340-110	Roll pin, 1/8 x 7/16	1
82340-111	Bushing retainer	1
82340-112	Retaining ring, internal	1
82340-113	Intermediate Relay valve bushing	1
82340-114	Intermediate Relay valve plunger	1
82340-115	Intermediate Relay valve gear	1
82340-116	Gasket	1
82340-117	Preformed packing	1
82340-118	Ring, power cylinder seal	1
82340-119	Spring, seal compression	1
82340-120	Not used	
82340-121	Screw, soc. hd. cap, 3/8-16 x 1	4
82340-122	Lockwasher, split, 3/8 ID	4
82340-123	Not used	
82340-124	Retaining ring, internal	1
82340-125	Power cylinder bushing	1
82340-126	Piston pin	1
82340-127	Piston rod	1
82340-128	Power piston	1
82340-129	Power cylinder	1
82340-130	Not used	
82340-131	Not used	
82340-132	Gasket	1
82340-133 to –165	Not used	
82340-166	Retaining ring	2
82340-167	Spring seat	2
82340-168	Accumulator spring, inner	2
82340-169	Accumulator spring, outer	2
82340-170	Locating pin	1
82340-171	Preformed packing	1
82340-172	Plug, soc. hd. pipe, 1/8-27	as req'd
82340-173	Magnetic plug	1
82340-174	Locating pin	1
82340-175	Pipe plug, 1/16, Soc. Hd.	as req'd
82340-176	Power case	1
82340-177	Drain cock, 1/8-27	1
82340-178	Locating Pin	2
82340-179	Oil gauge assembly	1
82340-180	Street elbow, 1/8 pipe thread	1
82340-181	Check valve assembly, short body	2
82340-182	Check valve assembly, long body	2
82340-183	Accumulator piston	2
82340-184	Idler gear stud	1
82340-185	Idler gear	1
82340-186	Retaining ring, internal	2
82340-187	Drive gear	1
82340-188	Oil seal ring	1
82340-189	Taper pin, number 5	2
82340-190	Base	1
82340-191	Washer, split lock	8
82340-192	Screw, hex head cap	8
82340-193	Gasket, retaining	1
82340-194	Oil seal	1
82340-195	Oil seal retainer	1
82340-196	Drive shaft	1
82340-197	Bearing assembly	1
82340-198	Retaining ting	1
82340-199	Bearing retainer	1
82340-200	Retainer screw	3
82340-200A	Lock wire	as req'd

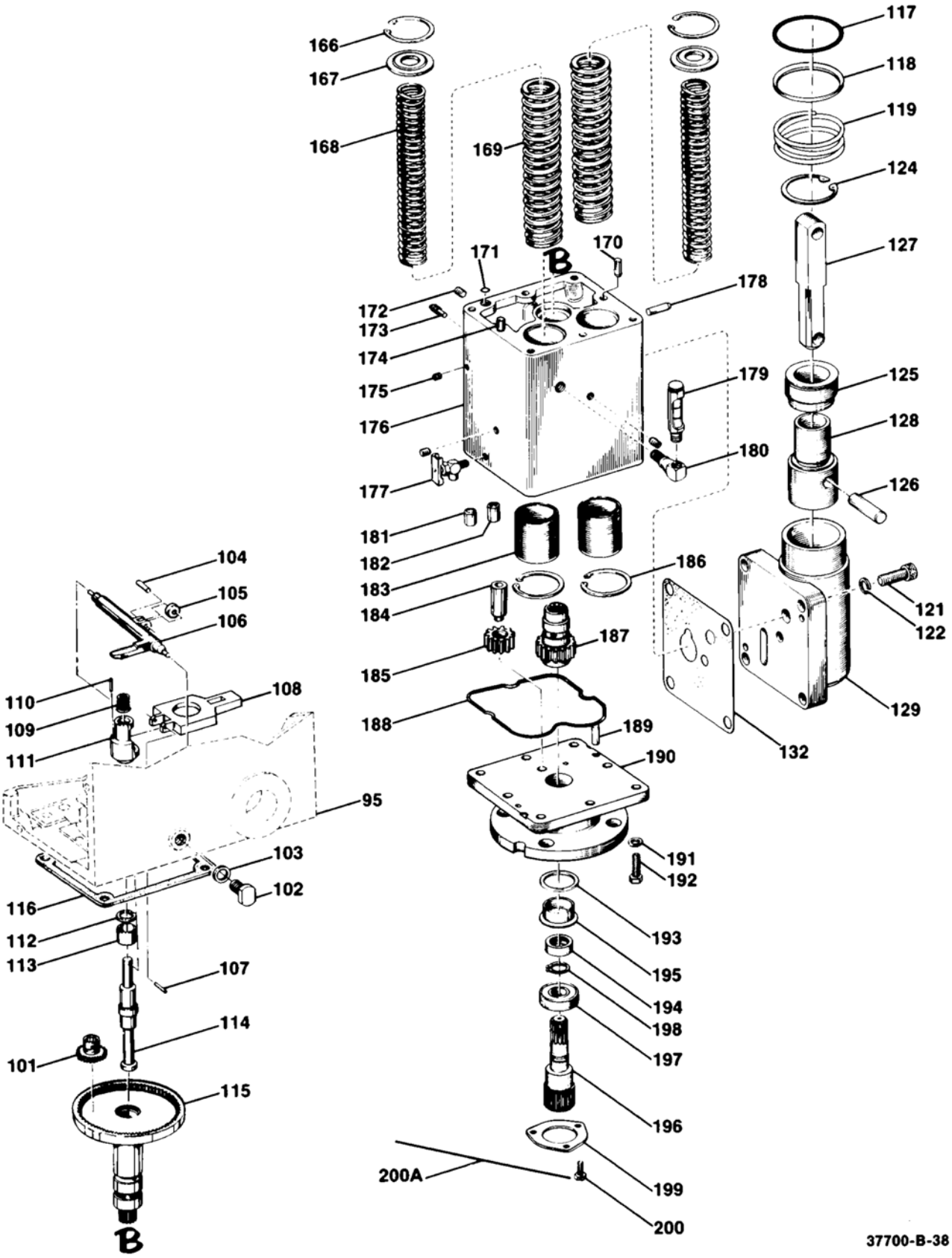

Figure 6-2. Power Case and Power Piston, EGB-10P/-13P

Parts List For Figure 6-3

Ref. No.	Part Name	Quantity
82340-201	Screw, rd. hd., w/captive lockwasher, 6- 32 x 1/2	2
82340-202	Electrical connector receptacle	1
82340-203	Spacer plate	1
82340-204	Electrical connector plug	1
82340-205	Cotter pin 1/16 x 3/8	4
82340-206	Headed pin, drilled	1
82340-207	Retaining ring, internal	2
82340-208	Pivot pin	2
82340-209	Speed droop pivot lever	1
82340-210	Cotter pin, 1/32 x 3/8	2
82340-211	Straight pin, drilled	1
82340-212	Locknut, thin, 1/4-28	1
82340-213	Speed adjusting lever	2
82340-214	Spacer	1
82340-215	Lever post	1
82340-216	Floating lever	2
82340-217	Headed pin, drilled	1
82340-218	Screw, hex. hd. cap 10-32 x 1/2	2
82340-219	Lockwasher, No. 10	2
82340-220	Plain washer, 13/64 ID x 3/8 OD x 3/64 thk.	2
82340-221	Clamping plate	1
82340-222	Eccentric ratio adjustment pin	1
82340-223	Restoring lever	1
82340-224	Straight pin	1
82340-225	Jam nut, 1/4-28	1
82340-226	Adjustable spring seat	1
82340-227	Transducer lever	1
82340-228	Load spring	1
82340-229	Screw, soc. hd. cap, self-lock, 6-32 x 3/8	1
82340-230	Restoring spring assembly	1
82340-231	Cotter pin, 1/32 x 1/4	1
82340-232	Retainer sleeve	1
82340-233	Needle bearing	1
82340-234	Bearing pin	1
82340-235	Screw, soc. hd. cap, 10-32 x 1.875	2
82340-236	Lockwasher, split, No. 10	2
82340-237	Clamp bracket	1
82340-238	Roll pin, 1/16 x 1/4	1
82340-239	Transducer cover	1
82340-240	Magnet	1
82340-241	Flat washer, al., 7/32 ID x 7/16 OD x 1/32	1
82340-242	Transducer assembly	1
82340-243	Temperature compensation ring	1
82340-244	Magnet spring	1
82340-245	Speeder spring assembly	1
82340-246	Plunger nut, 1/4-28	1
82340-247	Speeder spring seat	1
82340-248	Thrust bearing	1
82340-249	Retaining ring, external	1
82340-250	Retaining ring, spiral	1
82340-251	Flyweight pin	2
82340-252	Flyweight assembly	2
82340-253	Flyweight head	1
82340-254	Headed pin, drilled	1
82340-255	Headed pin, drilled	1
82340-256	Servo link (Mechanical)	1
82340-257	Piston pin	1
82340-258	Retaining ring, internal, beryllium copper	1
82340-259	Buffer plug	1
82340-260	Preformed packing, .625 OD	1
82340-261	Buffer spring	2
82340-262	Buffer piston	1
82340-263	Retaining ring, internal	1
82340-264	Plug	1
82340-265	Preformed packing, .816 OD	1
82340-266	Plug	1
82340-267	Preformed packing, .316 OD	2
82340-268	Needle valve (Compensation)	1
82340-269	Screw, soc. hd. cap, 10-32 x 2.125	3
82340-270	Screw, soc. hd. cap, 10-32 x 7/8	1
82340-271	Screw, soc. hd. cap, 10-32 x 1.375	3
82340-272	Screw, soc. hd. cap, 10-32 x 1/2	3
82340-273	Lockwasher, split, No. 10	10
82340-274	Relief valve spring	1
82340-275	Relief valve plunger	1
82340-276	Relief valve spacer	1
82340-277	Relief valve sleeve	1
82340-278	Reformed packing, 1.062 OD	1
82340-279	Pivot pin	1
82340-280	Load limit lever	1
82340-281	Check valve assembly	4
82340-282	Taper pin, No. 2	2
82340-283	Plug	1
82340-284	Guide pin	1
82340-285	Sub-governor base	1
82340-286	Idler gear	1
82340-287	Pilot valve bushing (mechanical)	1
82340-288	Retaining ring, internal	1
82340-289	Pilot valve plunger (mechanical)	1
82340-290	Compensating bushing (mechanical)	1
82340-291	Pilot valve bushing (electrical)	1
82340-292	Retaining ring, internal	1
82340-293	Pilot valve plunger (electrical)	1
82340-294	Compensating bushing (electrical)	1
82340-295	Servo piston (mechanical)	1
82340-296	Plug	1
82340-297 through 300 Not used		
82340-301	Plain washer, .203 ID x .281 OD x .035-045 thick	1
82340-302	Straight pin	1
82340-303	Servo link (electrical)	1
82340-304	Pivot pin	1
82340-305A	Servo piston (electrical)	1
82340-305B	Stop	1
82340-305C	Retaining ring	1
82340-306	Link pin, grooved	1
82340-307	Floating lever	1
82340-308	Retaining ring	1
82340-309	Output nut	1
82340-310	Nut, hex., 1/4-28	1
82340-311	Pivot	1
82340-312	Pivot link	1
82340-313	Loading piston	1
82340-314	Lever post bushing	1
82340-315	Plug, soc. hd. pipe, 1/8 NPTF	as req'd
82340-316	Plug, soc. hd. pipe, 1/16-27 NPTF	as req'd
82340-317	Idler gear stud	1
82340-318	Sub-governor case	1

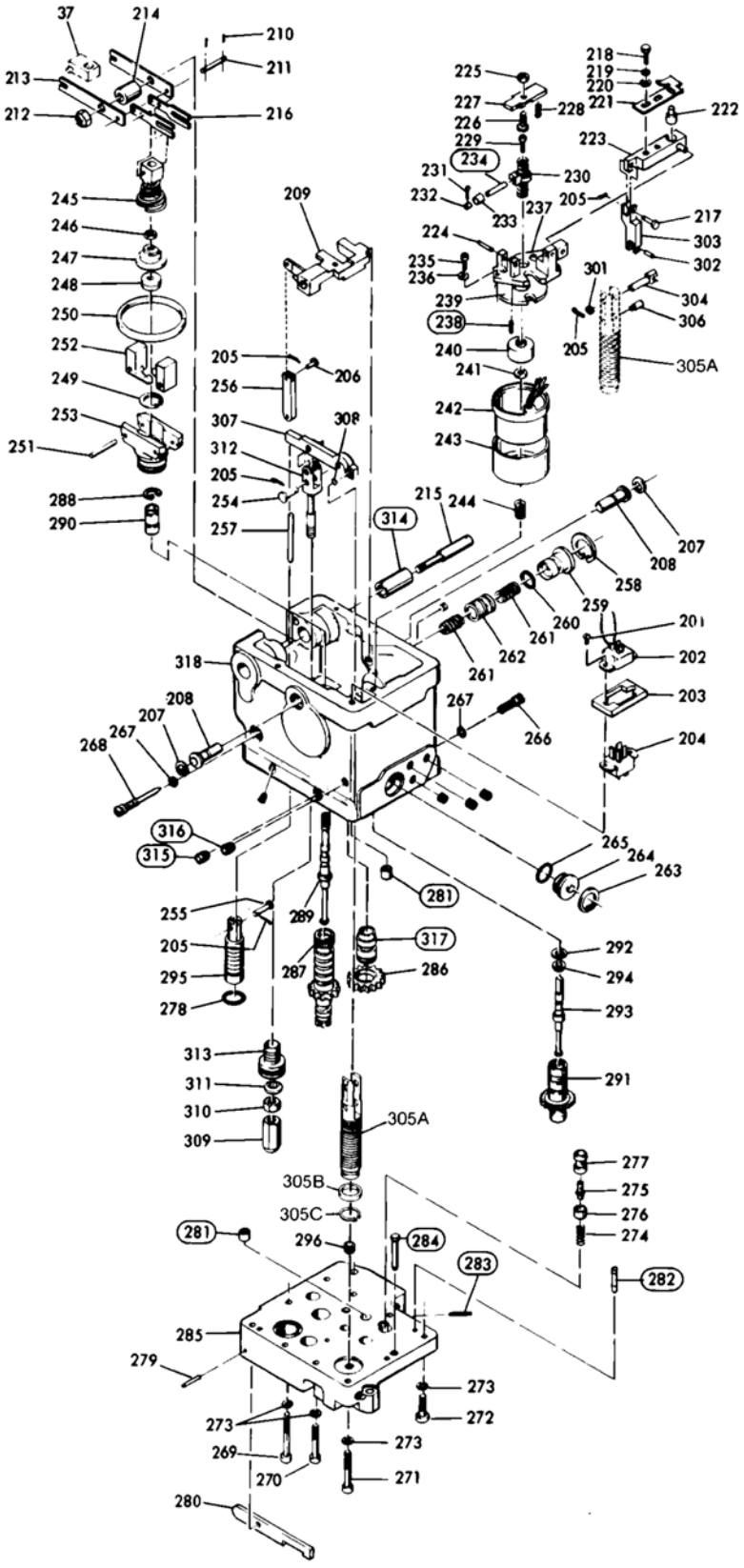

Figure 6-3. Sub-Governor Parts, EGB-10P/-13P/-35P/-50P

Parts List for Figure 6-4

Ref. No.	Part Name	Quantity
37712-301	Snap Ring	2
37712-302	Spring Seat	2
37712-303	Accumulator Spring (Small)	2
37712-304	Accumulator Spring (Large)	2
37712-305	Power Case Assembly	1
37712-306	O-ring	1
37712-307	O-ring	1
37712-308	O-ring	1
37712-309	Plug	1
37712-310	O-ring	1
37712-311	Accumulator Piston	2
37712-312	Accumulator Plug	2
37712-313	Accumulator Plug Flange	2
37712-314	Snap Ring	2
37712-315	Idler Gear Stud	1
37712-316	Idler Gear Assembly	1
37712-317	Needle Bearing	2
37712-318	Drive Gear	1
37712-319	Base	1
37712-320	Hex Hd. Cap Screw (1/4-20x3/4”)	8
37712-321	Shakeproof Washer (1/4”)	8
37712-322	End Cap	2
37712-323	Not Used	
37712-324	O-ring	2
37712-325	O-ring	2
37712-326	Body	1
37712-327	Hex Hd. Cap Screw (5/16-18x31/4”)	4
37712-328	Lock Washer (5/16”)	4
37712-329	O-ring	3
37712-330	Heat Exchanger inner Tubing	1
37712-331	Heat Exchanger Outer Tubing	1
37712-332	Heat Exchanger Tube (new design)	1

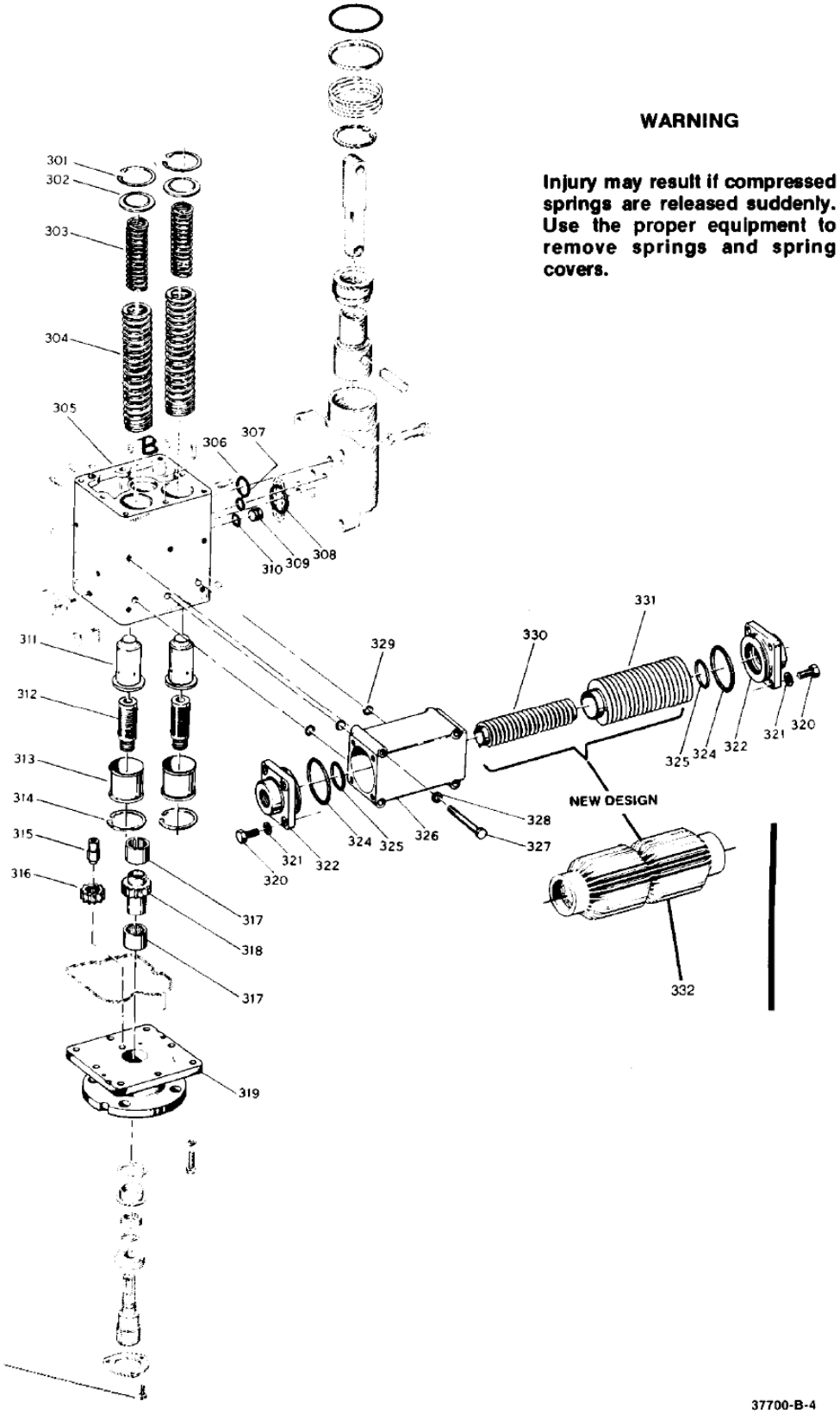

Figure 6-4. Power Case and Oil Cooler, EGB-35P/-50P

Parts List For Figure 6-5

Ref. No.	Part Name	Quantity
82340-401	Screw, rd. hd., 6-32 X 5/8	2
82340-402	Lockwasher, split, No. 6	2
82340-403	Electrical connector socket (Jones)	1
82340-404	Spacer plate	1
82340-405	Electrical connector plug (Jones)	1
82340-406	Screw, rd. hd. w/captive lockwasher, 6-32 X 1/2	2
82340-407	Mounting bracket	1
82340-408	Grommet	1
82340-409	Screw, fil. hd., 10-32 X 1/2	4
82340-410	Lockwasher, split, No. 10	4
82340-411	Screw, flat csk. hd., 820 10-32 X 3/8	4
82340-412	Not used	
82340-413	Motor mounting bracket	1
82340-414	Sealspring	1
82340-415	Speed setting motor (see manual 03505)	1
62340-416	Cover	1
82340-417	Screw, soc. hd., cap, 6-32 X 1/2	2
82340-418	Lockwasher, split, No. 6	2
82340-419	Screw, fil. hd., 8-32 X 1/4	1

Ref. No.	Part Name	Quantity
82340-420	Lockwasher, external tooth, No. 8	1
82340-421	Clamp, cable	1
82340-422	Screw, rd. hd., 2-56 X 3/8	4
82340-423	Lockwasher, split, No. 2	4
82340-424	Microswitch, SPOT	2
82340-425	Insulator	2
82340-426	Cotter pin, 1/32 X 1/4	1
82340-427	Washer, No. 4	1
82340-428	Actuator arm	1
82340-429	Screw hex. hd. cap, full thd.,8-32X7/8	2
82340-430	Nut, hex., 8-32	2
82340-431	Pin	1
82340-432	Mounting plate	1
82340-433	Terminal lug, crimp type	4
82340-434	Grommet	1
82340-435	Dial panel	1
82340-436	Screw, fil. hd., 6-32 X 1/2	2
82340-437	Lockwasher, internal tooth, No. 6	2
82340-438	Terminal block, 3 term	1
	Terminal block, 4 term	1

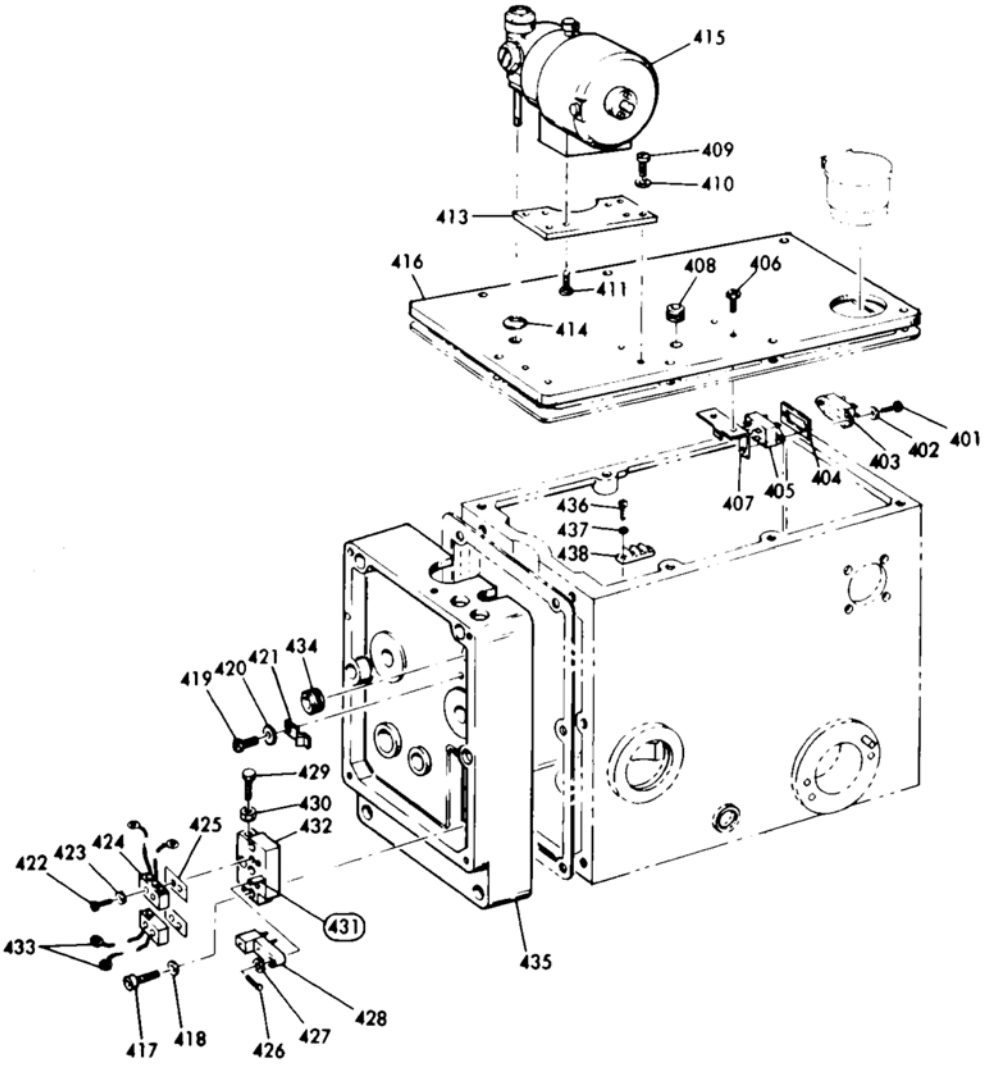

Figure 6-5. Speed Setting Motor (optional)

Parts List For Figure 6-6

Ref. No.	Part Name	Quantity
82340-501	Bleeder bolt	1
82340-502	Flat washer, copper, 21/64 ID x 17/32 OD x 1/32 thk.	2
82340-503	Screw, fil., hd., drilled, 10-32 x 1/2	4
82340-504	Copper tube, 1/4 OD	1
82340-505	Elbow, 90°, 1/4 tube x 1/8 NPT (with nut and sleeve)	3
82340-505A	Pipe plug	1
82340-506	Banjo fitting	1
82340-507	Solenoid valve	1
82340-508	Not used	

Ref. No.	Part Name	Quantity
82340-509	Terminal lug, insulated	2
82340-510	Screw, fil. hd., 6-32 x 1/2	2
82340-511	Lockwasher, internal tooth, No. 6	2
82340-512	Terminal block, 2 terminal	1
82340-513	Solenoid mounting bracket	1
82340-514	Preformed packing, 0.531 OD	1
82340-514a	Seal, .364 OD	1
82340-514b	Gasket, .438 OD	1
82340-515	Column	1
82340-516	Power case	1
82340-517	Nut, 1/2-20	1

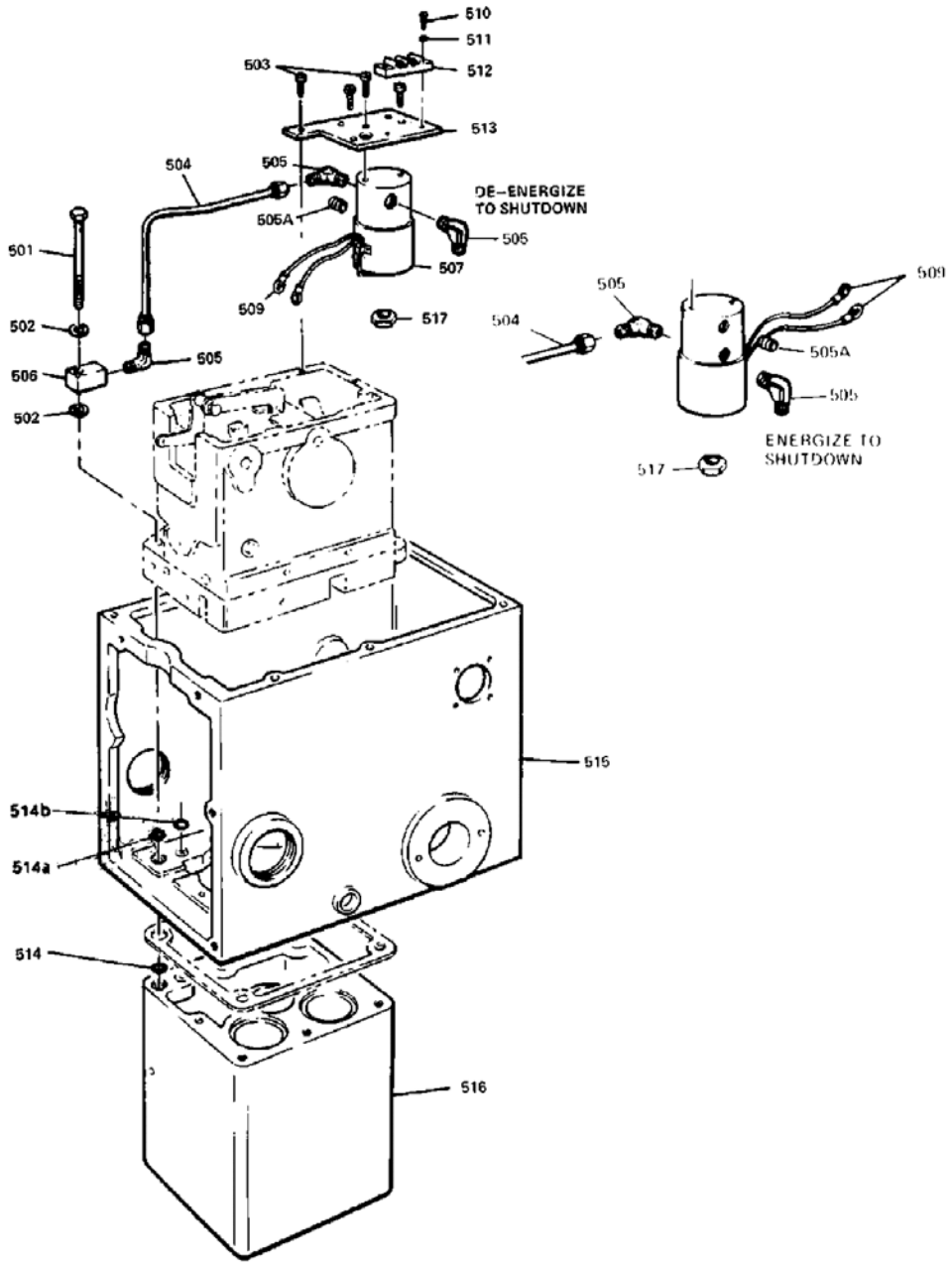

Figure 6-6. Solenoid Shutdown (optional)

Parts List For Figure 6-7

Ref. No.	Part Name	Quantity
	Pneumatic Starting Device Parts	
82340-601	Screw, soc. hd. cap. 10-32 x 1/2	2
82340-602	Lockwasher, split, No. 10	2
82340-603	Retaining ring, internal	1
82340-604	Plain washer, 17/64 ID x 13/32 OD x 1/32 thk	1
82340-605	Plunger spring	1
82340-606	Plunger	1
82340-607	Air cylinder	1
82340-608	Cover	1

Ref. No.	Part Name	Quantity
	Manual Starting Device Parts	
82340-611	Knob assembly	1
82340-612	Pin, .096 x 1.000, roll	1
82340-613	Spring, manual override loading	1
82340-614	O-Ring, .176 ID x .070	1
82340-615	Pin, .094 dia x .625, s.s.	1
82340-616	Shaft, manual override	1
82340-617	Sleeve, manual override	1
82340-618	Nut, 3/4-32 jam	1
82340-619	Cover, manual override	1

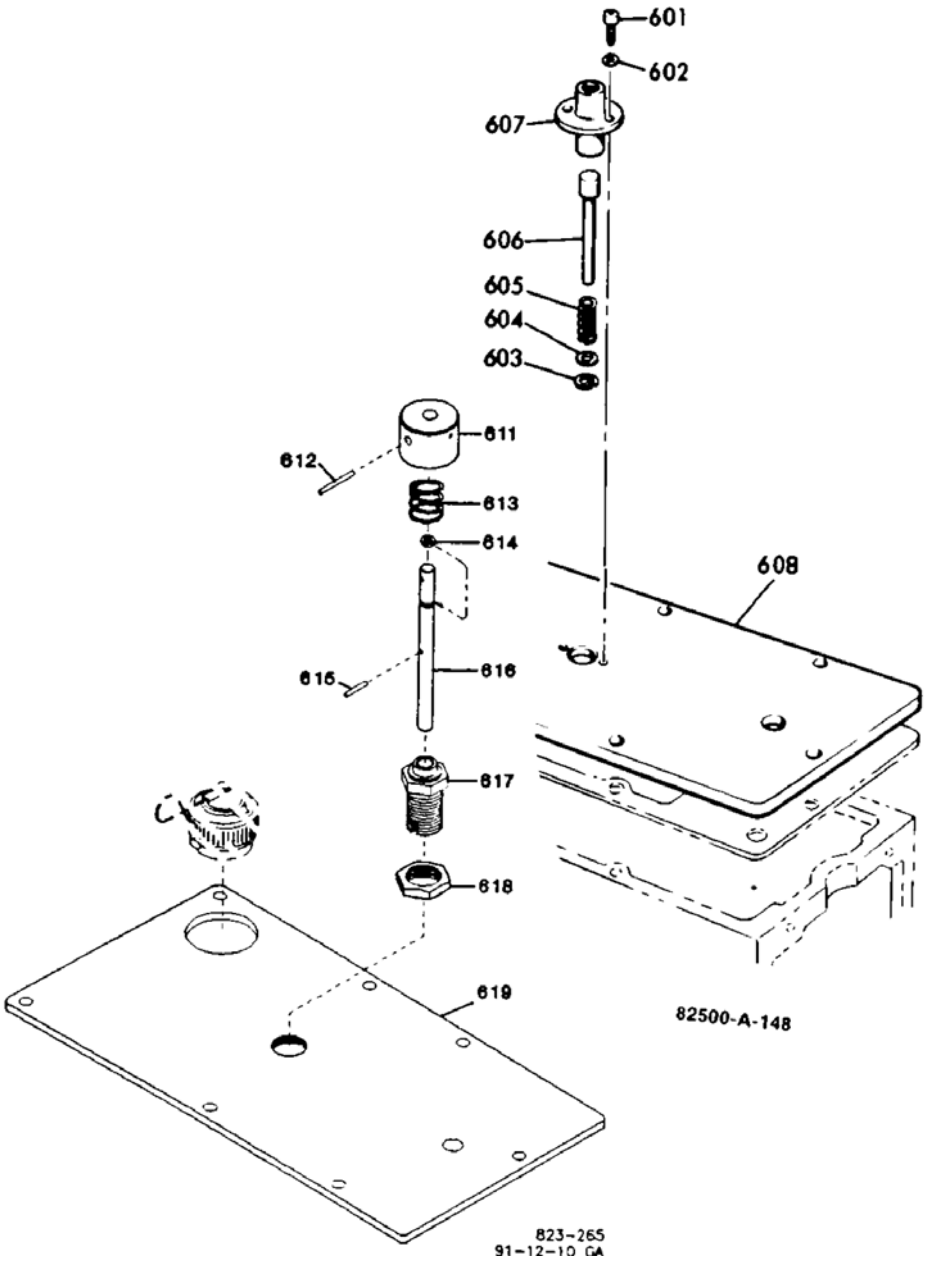

Figure 6-7. Optional Starting Devices

Parts List For Figure 6-8

Ref. No.	Part Name	Quantity
82340-701	Ballarm pin	2
82340-702	Ballarm assembly	2
82340-703	Ballhead	1
82340-704	Torsion spring	1
82340-705	Ball bearing	1
82340-706	Ballhead drive cup	1
82340-707	Ballhead cover	1

*–These parts are furnished only as a complete assembly.

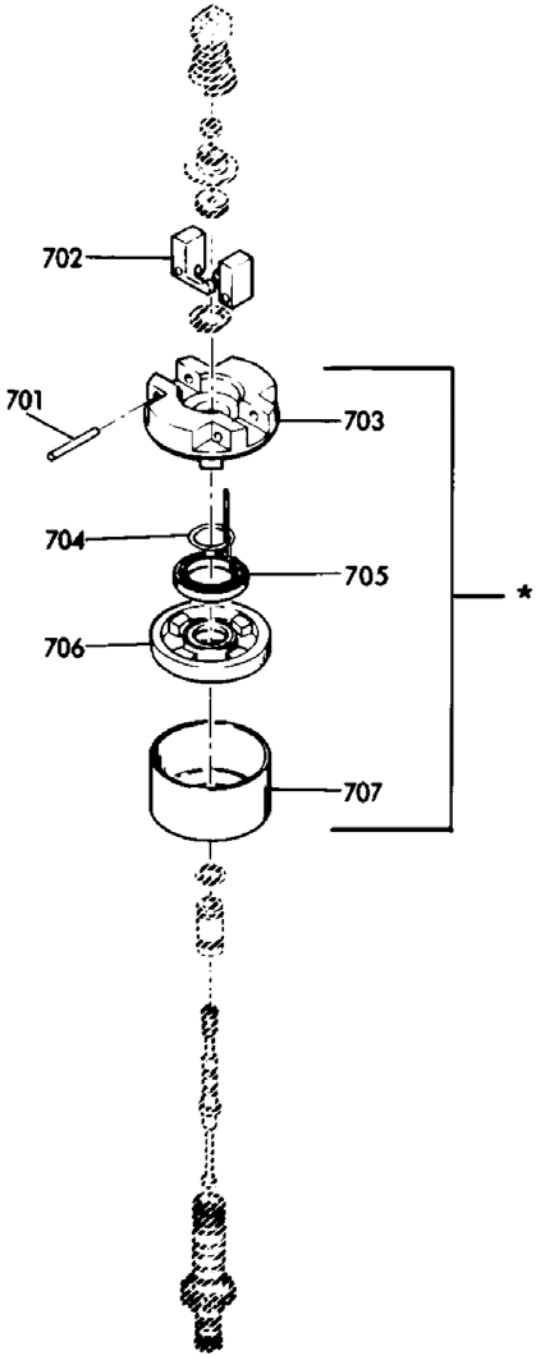

Figure 6-8. Spring Driven Ballhead (optional)

Parts List for Figure 6-9

Ref. No.	Part Name	Quantity
82340-1	Screw, fil. hd., 1/4-28 x 5/8	7
82340-2	Lockwasher, split, 1/4 ID	7
82340-3	Clutch pin	1
82340-4	Oil cup	1
82340-5	Cover	1
82340-6	Cover gasket	1
82340-7	Screw, binder hd., Phillips, 8-32 x 3/8	4
82340-8	Dial and name plate	1
82340-9	Screw, fil hd., 1/4-28 x 1.750	6
82340-10	Lockwasher, split, 1/4 ID x 0.35 OD x 5/64 thk.	6
82340-11	Panel gasket	1
82340-12	Locknut, thin 1/4-20	3
82340-13	Knob	3
82340-14	Pointer disk	3
82340-15	Screw, flat hd., 10-32 x 3/8	3
82340-16	Dial locating plate	1
82340-17	Speed setting dial	1
82340-18	Spacer	2
82340-19	Dial stop	2
82340-20	Load limit spring	1
82340-21	Locknut, thin 10-32	1
82340-22	Screw, soc. hd. cap. special 10-32 x 1	1
82340-23	Set Screw, soc. hd., oval pt., 6-32 x 5/8	1
82340-24	Load limit strap assembly	1
82340-25	Locknut, thin, 3/8-24	2
82340-26	Spring washer	2
82340-27	Speed droop cam	1
82340-28	Load limit cam	1
82340-29	Roll pin, 3/32 x 1/2	1
82340-30	Retaining ring, internal	1
82340-31	Friction drive cover	1
82340-32	Locknut, thin, 1/4-28	1
82340-33	Friction drive spring	1
82340-34	Friction drive case	1
82340-35	Roll pin, 3/32 x 1/2	1
82340-36	Friction drive plate	1
82340-37	Speed adjusting nut	1
82340-38	Friction drive shaft	1
82340-39	Speed adjusting level gear	1
82340-40	Plain washer, 21/64 ID x 5/8 OD x .050 to .052 thick	1
82340-41	Retaining ring, external	1
82340-42	Dial stop gear	1
82340-43	Speed adjusting shaft	1
82340-44	Roll pin 1/16 x 1/2	1
82340-45	Intermediate gear	1
82340-46	Roll pin, 5/32 x 5/8	1
82340-47	Pinion	1
82340-48	Plug	1
82340-49	Pinion bushing	1
82340-50	Shaft bushing	1
82340-51	Screw bushing (upper)	1
82340-52	Screw bushing (lower)	1
82340-53	Screw, rd. hd., 6-32 x 1/2	2
82340-54	Lockwasher, split, No. 6	2
82340-55	Locating pin	2
82340-56	Dial panel	1
82340-57	Lock nut, 5/16-24	1
82340-58	Screw, .312-24 x 2.500	1
82340-59	Lockwasher, split, 5/16 ID	1
82340-60	Spring	1
82340-61	Lock nut, thin, 10-32	2
82340-62	Pivot pin	1
82340-63	Speed droop link	1
82340-64	Spacer	2
82340-65	Screw, soc. hd. cap, 10-32 x 5/8	1
82340-66	Lockwasher, split, No. 10	1
82340-67	Speed droop cam lever	1
82340-68	Speed droop crank	1
82340-69	Spring pin	1
82340-70	Gasket	1
82340-71	Screw, fil. hd., 6-32 x 7/16	4
82340-72	Lockwasher, split, No. 6	4
82340-73	Electrical connector receptacle	1
82340-74	Receptacle gasket	1
82340-75	Not used	
82340-76	Terminal shaft pin	1
82340-77	Screw, hex hd. cap. 5/16-24 x 1	5
82340-78	Lockwasher, split, 5/16 ID	5
82340-79	Not used	
82340-80	Not used	
82340-81	Oil seal	2
82340-82	Roller bearing	2
82340-83A	Terminal shaft (output)	1
82340-84	Terminal lever	1
82340-84A	Pin retainer bracket	1
82340-85	Setscrew, slotted hd., rd. point 5/16-24 x 1.156	1
82340-86	Screw, truss hd., 6-32 x 1/4	4
82340-87A	Cover	2
82340-88	Not used	
82340-89	Barrel plug	2
82340-90	Plug, sq. hd. pipe, 1/4-18 NPTF	1
82340-91	Oil level decal	2
82340-92	Not used	
82340-93	Stud, 5/16-18 x 5/16-24 x 2	1
82340-94	Column	1

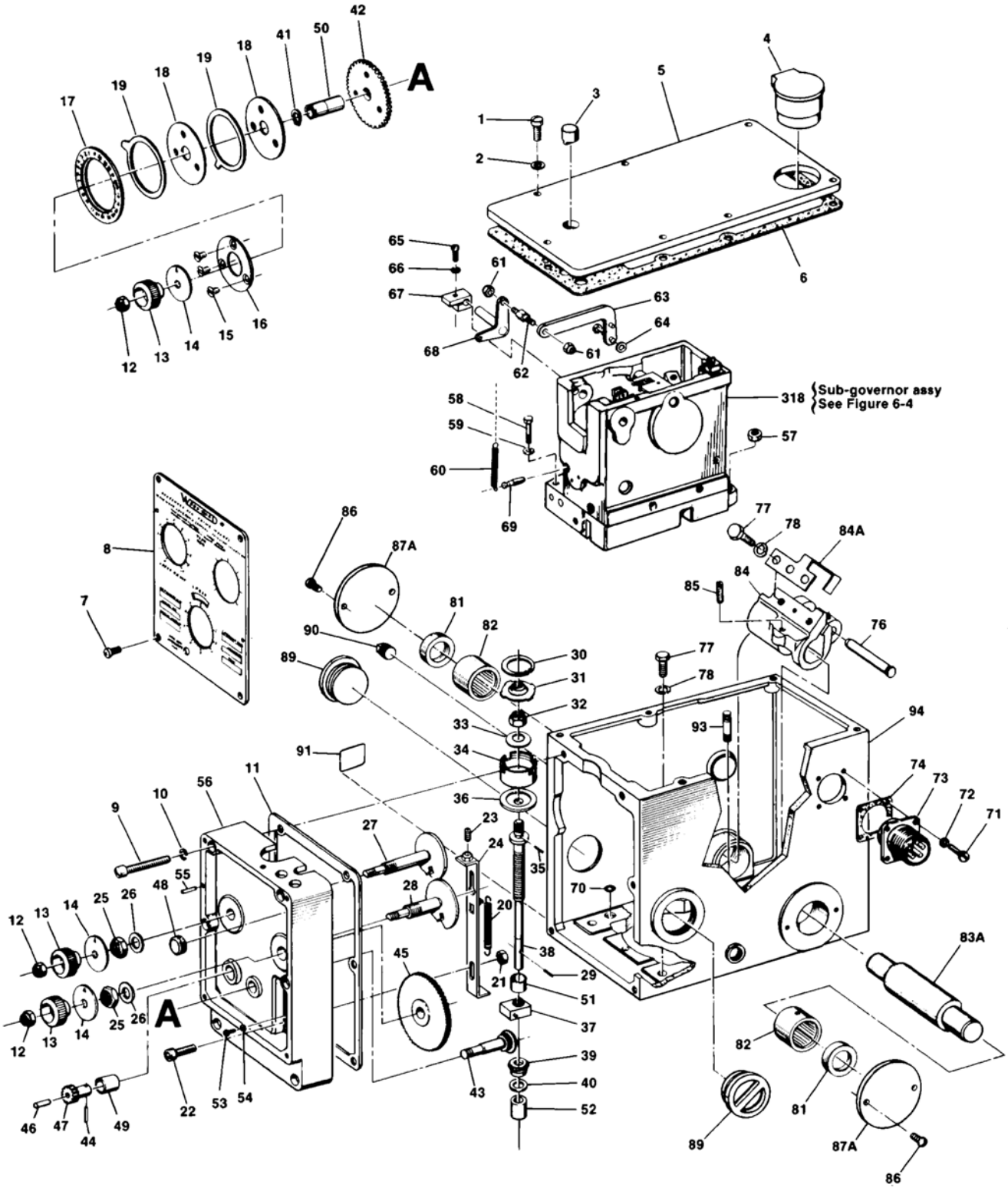

Figure 6-9. Column Assembly Parts, EGB-29P/-58P

Parts List for Figure 6-10

Ref. No.	Part Name	Quantity
82340-801	Pinion	1
82340-802	Bearing retainer assembly	2
82340-803	Washer, soft copper, 5/8 OD x 7/16 ID 1/32 thick	2
82340-804	Roller pin	1
82340-805	Roller	1
82340-806	Intermediate lever and shaft	1
82340-807	Pivot pin	1
82340-808	Relay beam	1
82340-809	Spring	1
82340-810	Roll pin, 1/8 x 7/16	1
82340-811	Bushing retainer	1
82340-812	Retaining ring, internal	1
82340-813	Intermediate relay valve bushing	1
82340-814	Intermediate Relay valve plunger	1
82340-815	Intermediate Relay valve gear	1
82340-816	Gasket	1
82340-817	Retaining ring	2
82340-818	Spring seat	2
82340-819	Accumulator spring, inner	2
82340-820	Accumulator spring, outer	2
82340-821	Locating pin	1
82340-822	Preformed packing	1
82340-823	Plug, soc. hd. pipe, 1/8-27	as req'd
82340-824	Magnetic Plug	1
82340-825	Locating Pin	1
82340-826	Pipe Plug, 1/16, Soc. Hd.	as req'd
82340-827	Power case	1
82340-828	Drain cock, 1/8-27	1
82340-829	Locating pin	2
82340-830	Oil gauge assembly	1
82340-831	Street elbow, 1/8 pipe thread	1
82340-832	Check valve assembly, short body	2
82340-833	Check Valve Assembly, long body	2
82340-834	Accumulator Piston	2
82340-835	Idler gear stud	1
82340-836	Idler gear	1
82340-837	Retaining ring, internal	2
82340-838	Drive gear	1
82340-839	Oil seal ring	1
82340-840	Taper pin, number 5	2
82340-841	Base	1
82340-842	Washer, split lock	8
82340-843	Screw, hex head cap	8
82340-844	Gasket, retaining	1
82340-845	Oil seal	1
82340-846	Oil seal retainer	1
82340-847	Drive shaft	1
82340-848	Bearing assembly	1
82340-849	Retaining ring	1
82340-850	Bearing retainer	1
82340-851	Retainer screw	3
82340-852	Lockwire	as req'd

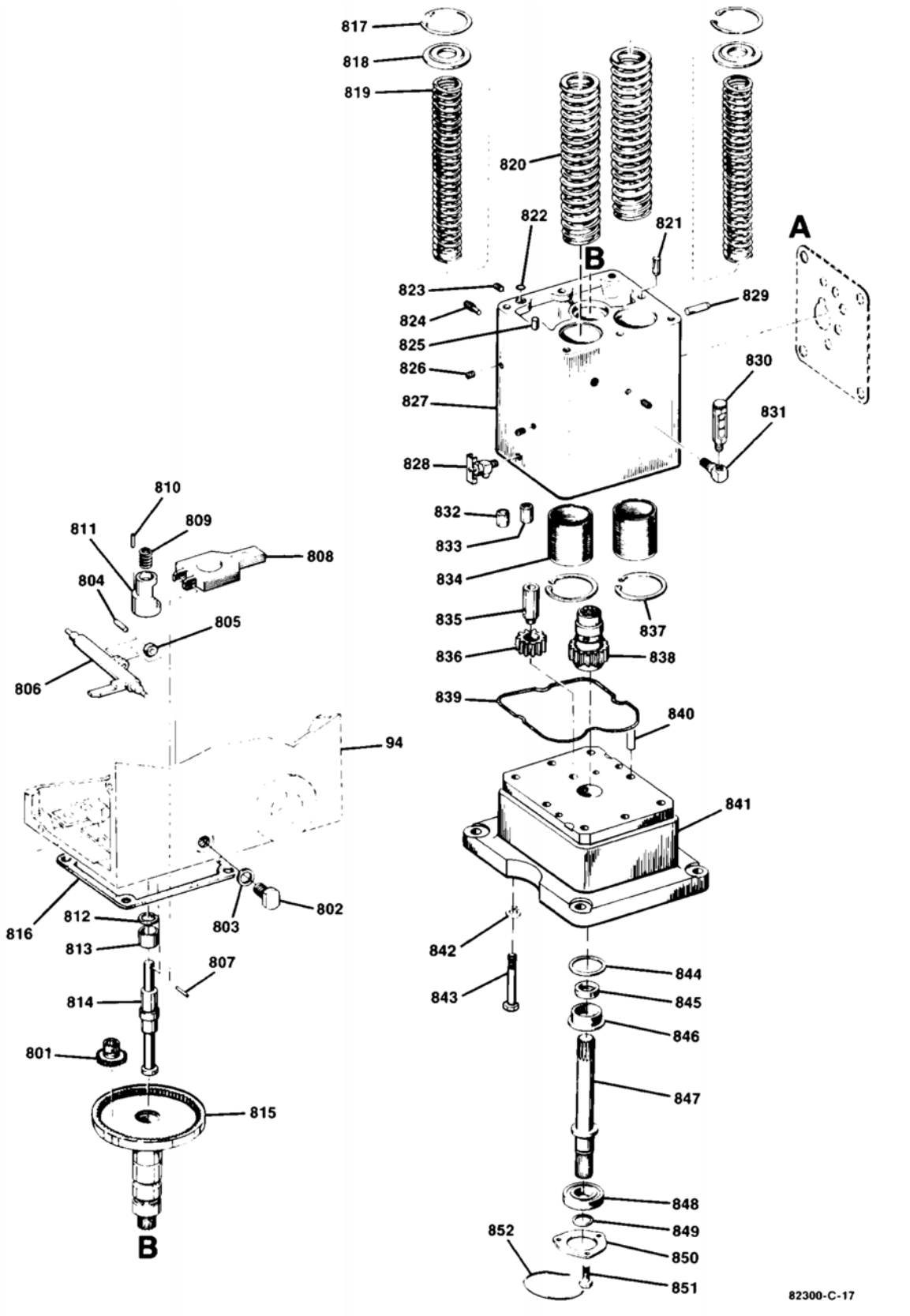

Figure 6-10. Power Case and Base, EGB-29P/-58P

Parts List for Figure 6-11

Ref. No.	Part Name	Quantity
82340-350	Preformed packing	1
82340-351	Ring, power cylinder seal	1
82340-352	Spring, seal compression	1
82340-353	Screw, .312-24 x .750 soc. hd. cap	6
82340-354	Washer, .312 hi collar lock	6
82340-355	Power cylinder head	1
82340-356	Preformed packing, 2.800 ID	1
82340-357	Power piston	1
82340-358	Washer, .375 hi collar lock	4
82340-359	Screw, .375-16 socket hd.	4
82340-360	Link	1
82340-361	Pin	1
82340-362	Ring, snap	1
82340-363	Gasket	1
82340-133	Power cylinder housing	1
82340-134	Oil seal	2
82340-135	Bushings, terminal shaft	2
82340-136	Terminal shaft	2
82340-137	Packing, preformed, .351 IDx.072	1
82340-138	Piston rod pin	1
82340-139	Link, power piston	2
82340-140	Ring, external retaining	2

Ref. No.	Part Name	Quantity
82340-141	Nut, .438-20 elastic hex, thin	1
82340-142	Pin, power lever	1
82340-143	Lever, power	1
82340-144	Washer,.312 hi collar lock	2
82340-145	Screw, .312-18 x 1, soc hd. cap	2
82340-146	Gasket	1
82340-147	Cover	1
82340-148	Washer, .250 ID hi collar lock	8
82340-149	Screw, .250-28 x .875 soc. hd. cap	8
82340-150	Plug, .438-20 UNF 2A, hollow hex	1
82340-151	Screw, drive	2
82340-152	Scale, terminal shaft	1
82340-153	Lever, rack dial	1
82340-154	Screw, .250-28 x 1 socket cap	1
82340-155	Washer, .250 ID hi collar lock	1
82340-156	Screw	1
82340-157	Washer, No. 8, spring lock	1
82340-158	Washer, .174 x .375 x .032	1
82340-159	Pointer bracket casting	1
82340-160	Pointer	1
82340-161	Screw, .250-28 x I Soc Hd. cap	2
82340-162	Washer, .250 helical spring lock	2

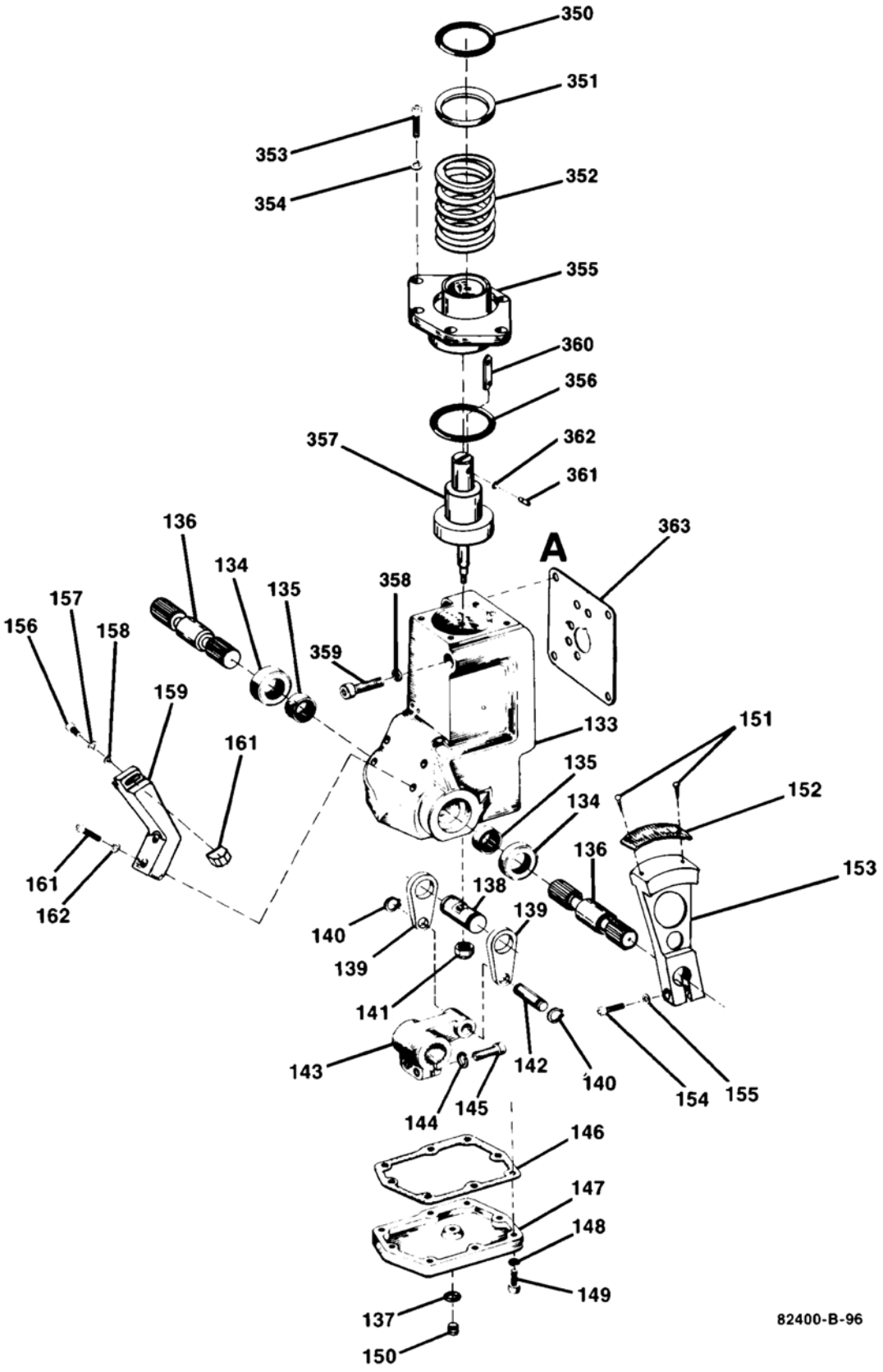

Figure 6-11. Power Cylinder, EGB-29P/-58P

Parts List for Figure 6-12

Ref. No.	Part Name	Quantity
82340-201	Screw, rd. hd., w/captive lockwasher, 6-32 x 1/2	2
82340-202	Electrical connector receptacle	1
82340-203	Spacer plate	1
82340-204	Electrical connector plug	1
82340-205	Cotter pin 1/16 x 3/8	4
82340-206	Headed pin, drilled	1
82340-207	Retaining ring, internal	2
82340-208	Pivot pin	2
82340-209	Speed droop pivot lever	1
82340-210	Cotter pin, 1/32 x 3/8	2
82340-211	Straight pin, drilled	1
82340-212	Locknut, thin, 1/4-28	1
82340-213	Speed adjusting lever	2
82340-214	Spacer	1
82340-215	Lever post	1
82340-216	Floating lever	2
82340-217	Headed pin, drilled	1
82340-218	Screw, hex. hd. cap 10-32 x 1/2	2
82340-219	Lockwasher, No. 10	2
82340-220	Plain washer, 13/64 ID x 3/8 OD x 3/64 thk.	2
82340-221	Clamping plate	1
82340-222	Eccentric ratio adjustment pin	1
82340-223	Restoring lever	1
82340-224	Straight pin	1
82340-225	Jam nut, 1/4-28	1
82340-226	Adjustable spring seat	1
82340-227	Transducer lever	1
82340-228	Load spring	1
82340-229	Screw, soc. hd. cap, self-lock, 6-32 x 3/8	1
82340-230	Restoring spring assembly	1
82340-231	Cotter pin, 1/32 x 1/4	1
82340-232	Retainer sleeve	1
82340-233	Needle bearing	1
82340-234	Bearing pin	1
82340-235	Screw, soc. hd. cap, 10-32 x 1.875	2
82340-236	Lockwasher, split, No. 10	2
82340-237	Clamp bracket	1
82340-238	Roll pin, 1/16 x 1/4	1
82340-239	Transducer cover	1
82340-240	Magnet	1
82340-241	Flat washer, al., 7/32 ID x 7/16 OD x 1/32	1
82340-242	Transducer assembly	1
82340-243	Temperature compensation ring	1
82340-244	Magnet spring	1
82340-245	Speeder spring assembly	1
82340-246	Plunger nut, 1/4-28	1
82340-247	Speeder spring seat	1
82340-248	Thrust bearing	1
82340-249	Retaining ring, external	1
82340-250	Retaining ring, spiral	1
82340-251	Flyweight pin	2
82340-252	Flyweight assembly	2
82340-253	Flyweight head	1
82340-254	Headed pin, drilled	1
82340-255	Headed pin, drilled	1
82340-256	Servo link (mechanical)	1
82340-257	Piston pin	1
82340-258	Retaining ring, internal, beryllium copper	1
82340-259	Buffer plug	1
82340-260	Preformed packing, .625 OD	1
82340-261	Buffer spring	2
82340-262	Buffer piston	1
82340-263	Retaining ring, internal	1
82340-264	Plug	1
82340-265	Preformed packing, .816 OD	1
82340-266	Plug	1
82340-267	Preformed packing, .316 OD	2
82340-268	Needle valve (Compensation)	1
82340-269	Screw, soc. hd. cap, 10-32 x 2.125	3
82340-270	Screw, soc. hd. cap, 10-32 x 7/8	1
82340-271	Screw, soc. hd. cap, 10-32x 1.375	3
82340-272	Screw, soc. hd. cap, 10-32 x 1/2	3
82340-273	Lockwasher, split, No. 10	10
82340-274	Relief valve spring	1
82340-275	Relief valve plunger	1
82340-276	Relief valve spacer	1
82340-277	Relief valve sleeve	1
82340-278	Reformed packing, 1.062 OD	1
82340-279	Pivot pin	1
82340-280	Load limit lever	1
82340-281	Check valve assembly	4
82340-282	Taper pin, No. 2	2
82340-283	Plug	1
82340-284	Guide pin	1
82340-285	Sub-governor base	1
82340-286	Idler gear	1
82340-287	Pilot valve bushing (mechanical)	1
82340-288	Retaining ring, internal	1
82340-289	Pilot valve plunger (Mechanical)	1
82340-290	Compensating bushing (mechanical)	1
82340-291	Pilot valve bushing (electrical)	1
82340-292	Retaining ring, internal	1
82340-293	Pilot valve plunger (electrical)	1
82340-294	Compensating bushing	1
82340-295	Servo piston (mechanical)	1
82340-296	Plug	1
82340-297 through 300 Not used		
82340-301	Plain washer, .203 ID x.281 OD x.035-.045 thick	1
82340-302	Straight pin	1
82340-303	Servo link (electrical)	1
82340-304	Pivot pin	1
82340-305A	Servo piston (electrical)	1
82340-305B	Stop	1
82340-305C	Retaining ring	1
82340-306	Link pin, grooved	1
82340-307	Floating lever	1
82340-308	Retaining ring	1
82340-309	Output nut	1
82340-310	Nut, hex, 1/4-28	1
82340-311	Pivot	1
82340-312	Pivot link	1
82340-313	Loading piston	1
82340-314	Lever post bushing	1
82340-315	Plug, soc, hd. pipe 1/8 NPTF	as req'd
82340-316	Plug, soc. hd. pipe, 1/16-27 NPTF	as req'd
82340-317	Idler gear stud	1
82340-318	Sub-governor case	1

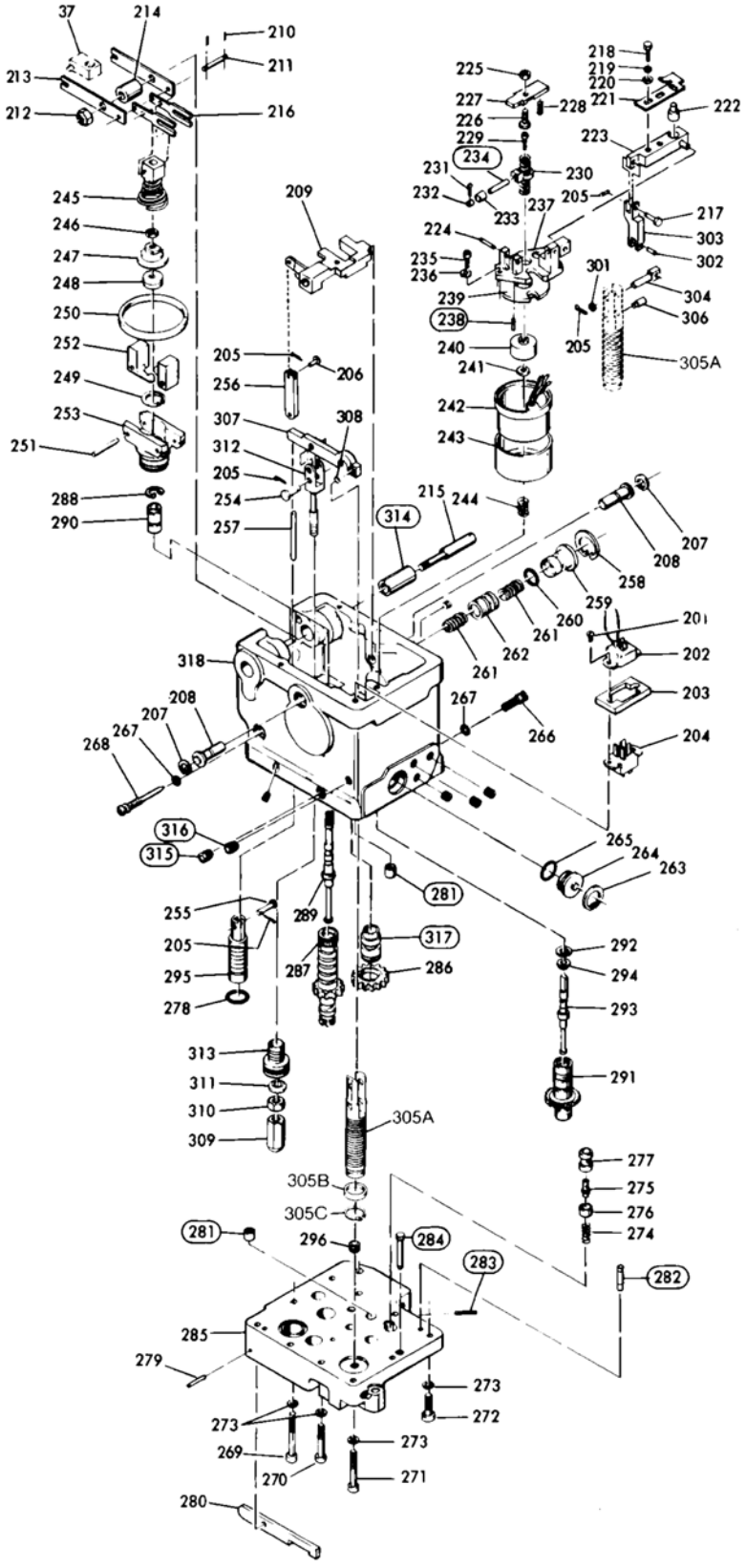

Figure 6-12. Sub-Governor Parts, EGB-29P/-58P

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.

Revision History

Changes in Revision F—

- Updated titles in Figures 6-1, 6-3, & 6-9 to clarify which EGBs are shown
- Removed old Figure 6-5 (information is in Figure 6-3)

Changes in Revision E—

- Added descriptions of EGB-35P and EGB-50P

Changes in Revision D—

- Improved Output Shaft Travel adjustment procedures (page 19)
- Removed references to non-existent EGB-22P version

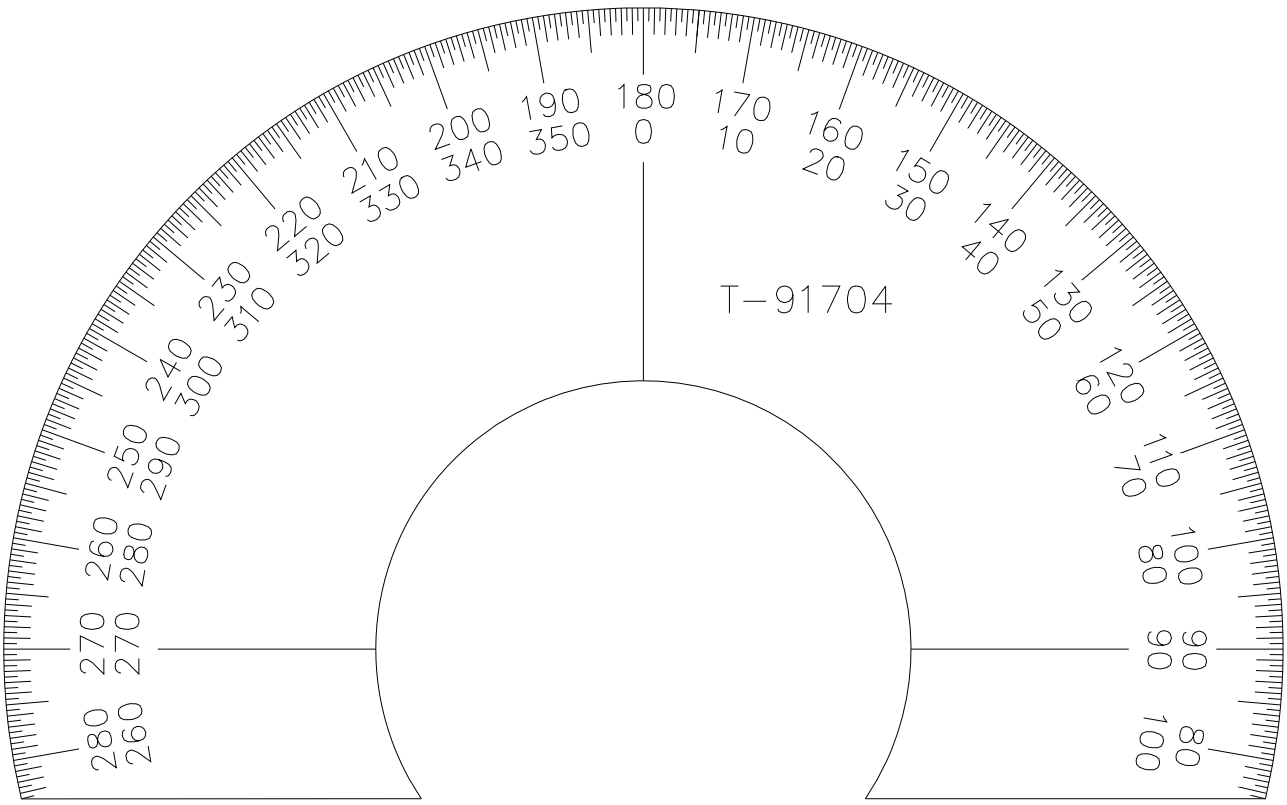

Figure A. Protractor

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 82340F.

B82340:F

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