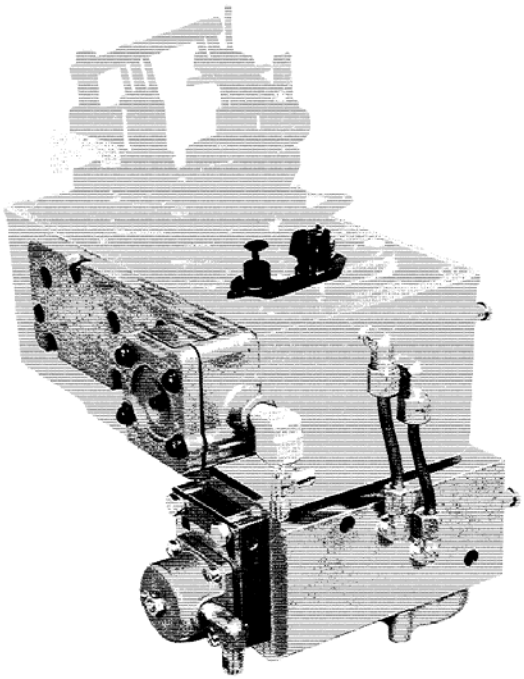
WOODWARD

Product Manual 36652
(Revision H)
Original Instructions



PG Automatic Safety Shutdowns and Alarms

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 Out-of-date translations are marked with ⚠.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

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

Purpose

This manual provides description, principles of operation, overhaul, and replacement parts information for:

1. Lube Oil Pressure Failure Shutdown and Alarm (includes single diaphragm and adjustable and non-adjustable differential diaphragm types).
2. Lube Oil Pressure Failure with Excessive Vacuum Shutdown and Alarm.
3. Water Pressure Failure Shutdown and Alarm.
4. Alarm without Shutdown.
5. Auto Reset for Lube Oil or Water Pressure Failure Shutdown and Alarm.
6. Starting Override for Lube Oil Pressure Failure Shutdown.

Description

The lube oil pressure failure and water pressure failure shutdown devices automatically shut down an engine and trip an alarm switch or trip an alarm only when oil or water pressures fall below a safe value. Most of these devices can be operated manually at the governor by pulling out the knob end of the shutdown plunger. The shutdown plunger end is not accessible on devices without manual operation.

An adjustable time delay feature allows a preset time to establish pressures when starting the engine. If pressures are not established within this time, the engine is shut down. A time delay accumulator is available which allows a longer starting time. An optional override device utilizes a starting booster air signal to prevent shutdown from low lube oil pressure during start-up.

IMPORTANT

The lube oil pressure shutdown device may be a single diaphragm or differential diaphragm type. The differential diaphragm type is generally used when engine oil pressure to cause shutdown is greater than 30 psig (207 kPa).

The lube oil pressure failure with excessive lube oil vacuum device provides the same protection functions as the oil pressure failure shutdown device. In addition, it shuts down an engine when excessive vacuum occurs in the intake line to the engine oil pump. It thus ensures that the volume of oil to the pump will not fall below a safe value while the engine is operating.

Once these shutdown devices have tripped, restarting the engine requires manual resetting. However, a self-resetting feature is available for both lube oil and water pressure failure shutdown systems. The auto-resetting features are also capable of reducing governor speed setting proportional to a temporary reduction in available lube oil or water pressure. It is especially useful on engines with pressure fluctuations that are not dangerous to the prime mover, but may trigger standard shutdown systems. A reduction in governor speed setting also reduces the load control balance point.

Chapter 2.
Principles of Operation

Introduction

The operation of shutdown system parts such as the bypass valve, time delay accumulator, and anti-blocking valve is similar in all shutdown systems. For brevity, their operation is described only as part of the single diaphragm lube oil pressure shutdown and alarm system.

Single Diaphragm Lube Oil Pressure Shutdown and Alarm

(See Figure 2-1)

Engine oil pressure is directed to the oil pressure diaphragm. The shutdown valve plunger is connected to the diaphragm which has three forces acting on it; load spring and engine oil pressures act to move it to the right, governor speed setting servo oil acts to move it to the left.

Normally, load spring and engine oil pressures hold the diaphragm and shutdown valve plunger to the right, permitting oil to the left of the shutdown piston to drain to sump. When engine lube oil pressure drops below a safe level, speed setting servo oil pressure (which is dependent on the speed setting and on the rate of the speed setting servo spring) overcomes the load spring and engine oil pressure forces and moves the diaphragm and shutdown valve plunger to the left. Governor pressure oil is directed around the shutdown valve plunger to the shutdown piston and moves it to the right. The shutdown piston moves the inner spring and shutdown plunger to the right. When the shutdown plunger moves sufficiently, it trips the alarm switch. In addition, oil trapped above the governor speed setting servo piston flows around the smaller diameter on the left end of the shutdown plunger and drains to sump. This action allows the speed setting servo piston to be forced up by the speed setting servo spring and the speeder spring. When the piston moves up sufficiently, the piston rod lifts the shutdown nuts and rod. The shutdown rod lifts the governor pilot valve plunger. When it is lifted above its centered position, oil trapped below the power piston drains to sump and the power piston moves to the fuel off position.

IMPORTANT **The shutdown plunger must be pushed back in to re-start the engine.**

Bypass Valve

(See Figure 2-1)

Governor pressure oil is supplied to the shutdown piston in one of two ways, depending on the speed setting. At rated speed settings, the bypass valve is moved down off its seat by the speed changing mechanism. Governor pressure oil passes directly to the shutdown piston and immediately initiates engine shutdown in the event of lube oil failure. See Figure 2-2 for the various types of speed changing mechanisms that operate the bypass valve.

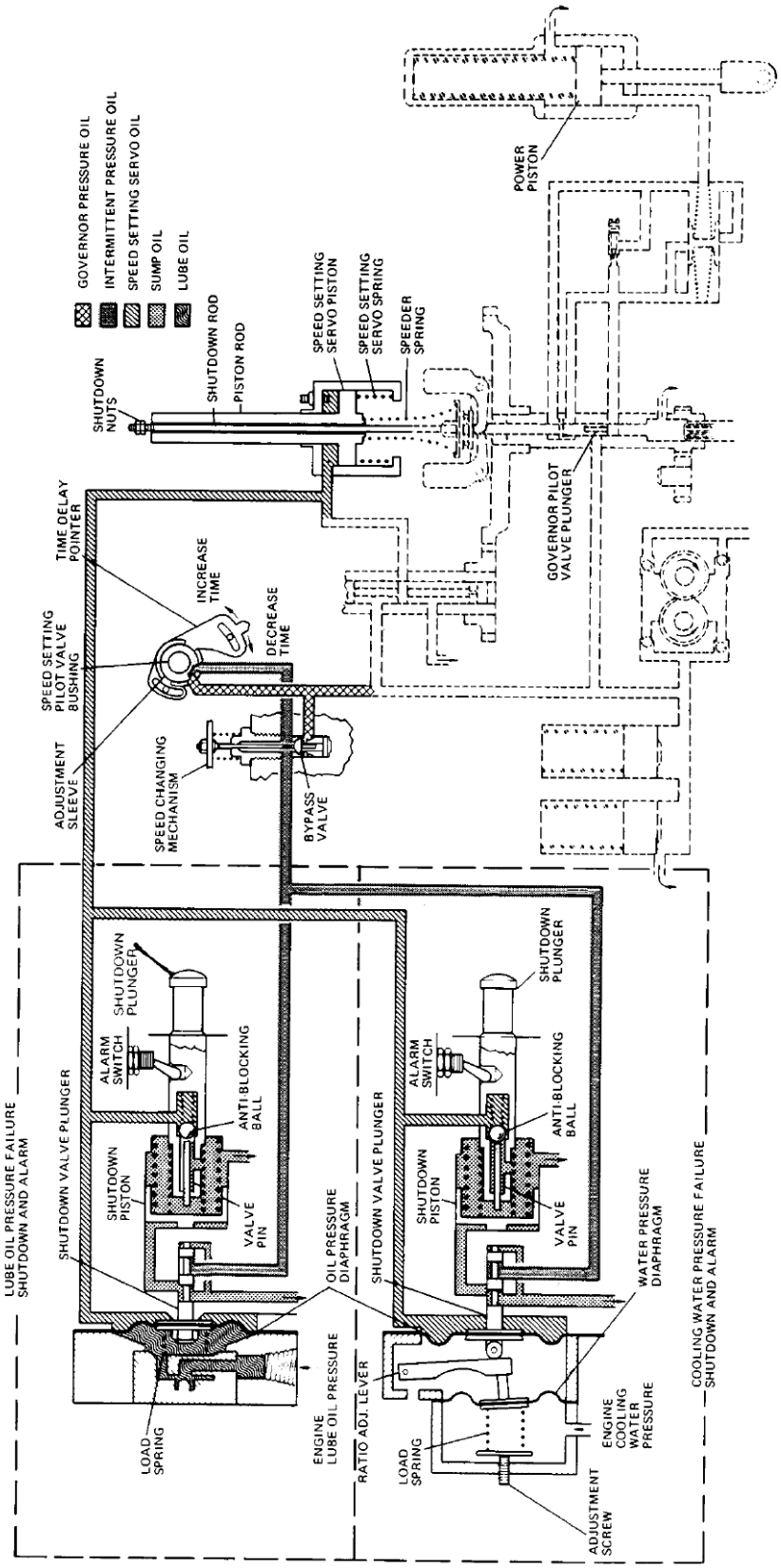


Figure 2-1. Single Diaphragm Lube Oil Pressure Shutdown and Water Pressure Shutdown Schematic

When starting and at idle speeds, the bypass valve is closed and governor pressure oil travels through an intermittent flow orifice in the rotating speed setting pilot valve bushing (Figure 2-1). With each rotation of the bushing, a slot in the bushing registers with an oil supply passage in the governor column and a hole in the adjustment sleeve. Thus, intermittent pressure oil is passed to the shutdown valve plunger. The adjustment sleeve may be turned (by readjusting the time delay pointer) so the cross-sectional area of the oil passage is increased or decreased. Thus, the volume of oil supplied with each rotation of the bushing is increased or decreased. Turning the pointer cw increases volume and decreases the time required to pass sufficient oil to initiate shutdown.

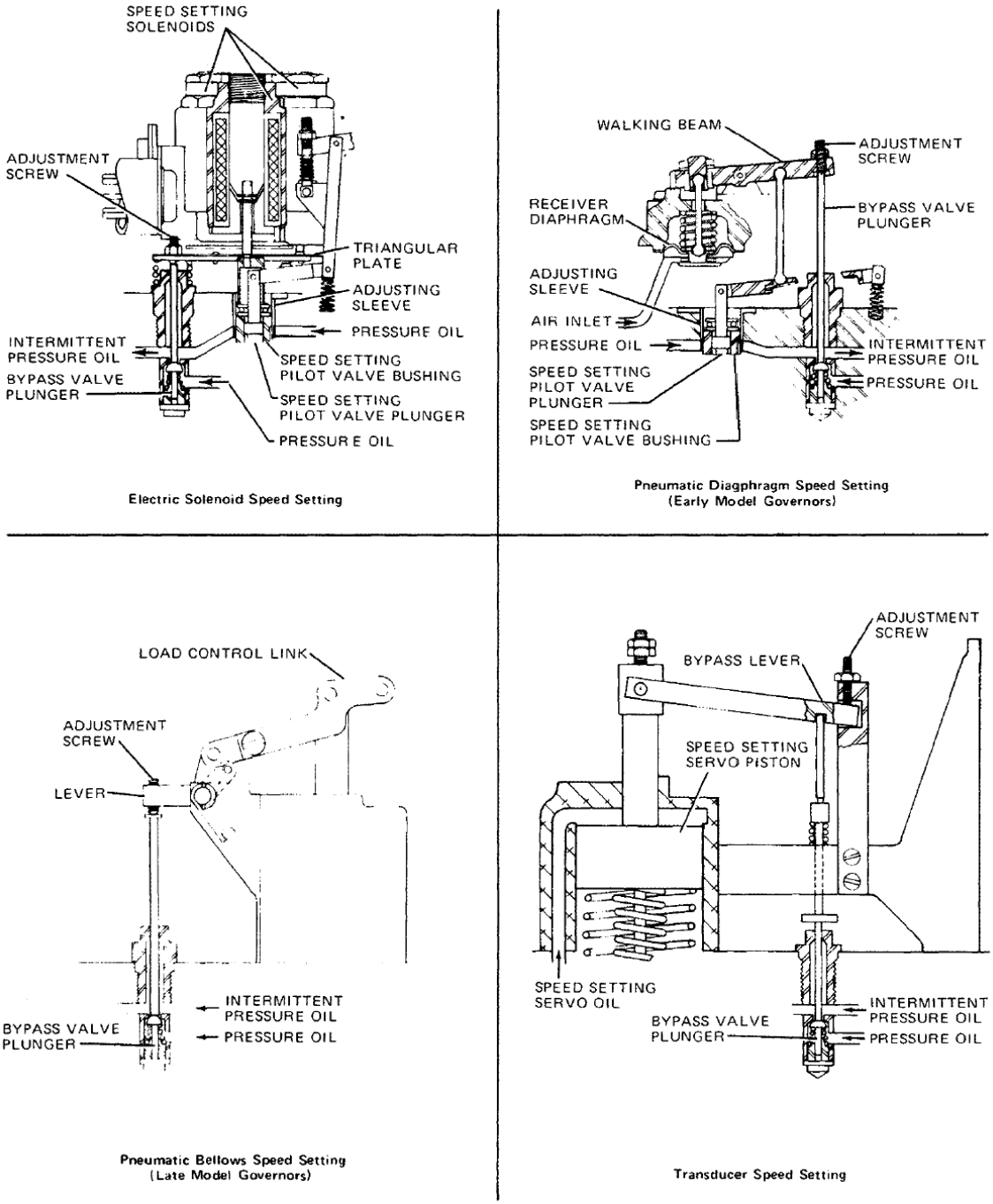


Figure 2-2. Bypass Valve Operation with Various Speed Changing Mechanisms

Time Delay Accumulator

(See Figure 2-3)

On applications where it is necessary to provide a shutdown time delay greater than 40 seconds in order to establish oil pressure during startup, the time delay accumulator is used. The time delay accumulator is connected to the intermittent oil supply. During startup while engine oil pressure is low, the shutdown valve plunger directs intermittent pressure oil to the shutdown piston and time delay accumulator. This condition normally causes the shutdown piston to move the inner spring and shutdown plunger right, toward shutdown position. The accumulator load spring, however, is lighter than the shutdown plunger inner spring and causes the accumulator piston to move up and store the intermittent pressure oil admitted to the shutdown system. When the piston reaches its stop additional intermittent pressure oil will then move the shutdown piston and plunger to shutdown.

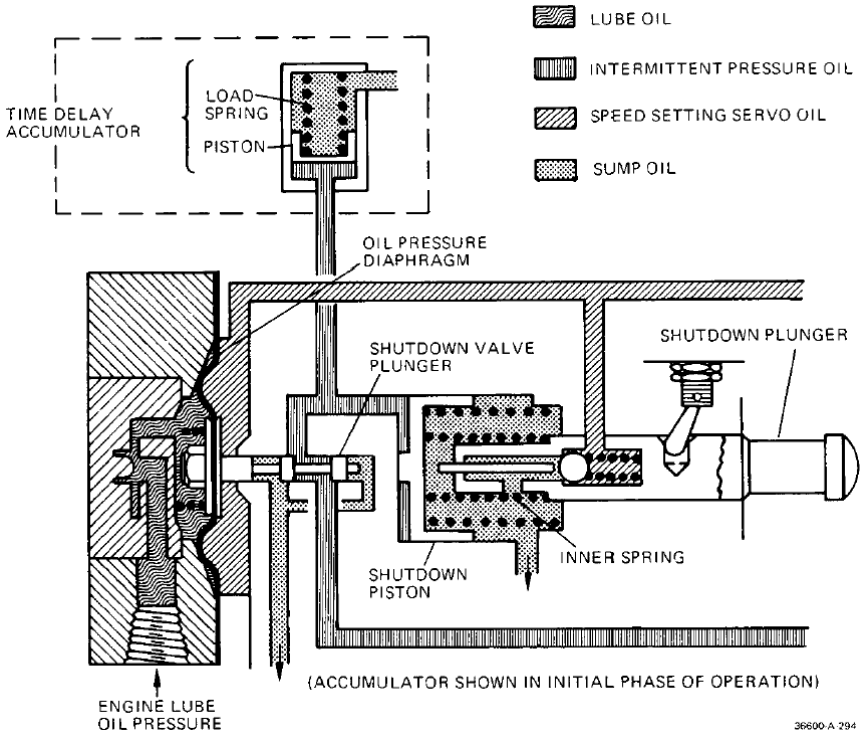


Figure 2-3. Accumulator Schematic

Ant/-Blocking Valve

(See Figure 2-1)

Blocking the shutdown device by holding the plunger in will stop the alarm, but not prevent the shutdown device from protecting the engine. The spring loaded anti-blocking ball in the shutdown plunger is normally held on its seat and has no effect on the operation of the shutdown device. If an attempt is made to run the engine with low oil pressure by holding the shutdown plunger in, the valve pin forces the ball off its seat. Oil trapped above the governor speed setting servo piston drains through—rather than around—the shutdown plunger and out to sump. Thus, the power piston moves to the fuel off position.

Water Pressure Failure Shutdown and Alarm

(See Figure 2-1)

The operation of this device is identical to the lube oil pressure failure device.

IMPORTANT

This device contains an adjustment screw and a ratio adjustment lever which control the water pressure required to initiate shutdown. Field adjustment of these items is not recommended. They may be adjusted at time of overhaul on a Woodward test stand, model 8909-001.

Differential Piston Lube Oil Pressure Failure Shutdown and Alarm

(See Figure 2-4)

The operation of this device is identical to the single diaphragm shutdown device. The differential piston allows a high engine lube oil pressure trip point without a corresponding increase in the speed setting servo oil pressure. The engine lube oil pressure required to initiate shutdown is increased, while the speed setting servo oil pressure is identical to that used with the single diaphragm shutdown device.

IMPORTANT

This device may contain an adjusting screw (Figure 2-6) which biases the lube oil pressure required to initiate shutdown. Field adjustment of the screw is not recommended. The screw may be adjusted at time of overhaul on a Wood-ward test stand, model 8909-001.

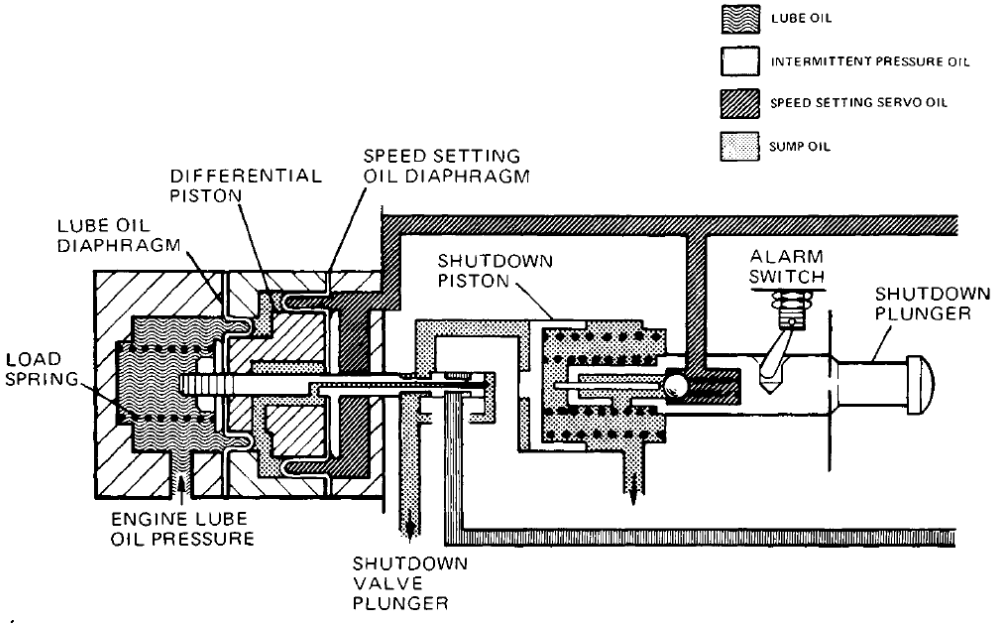


Figure 2-4. Differential Diaphragm Lube Oil Pressure Shutdown Schematic

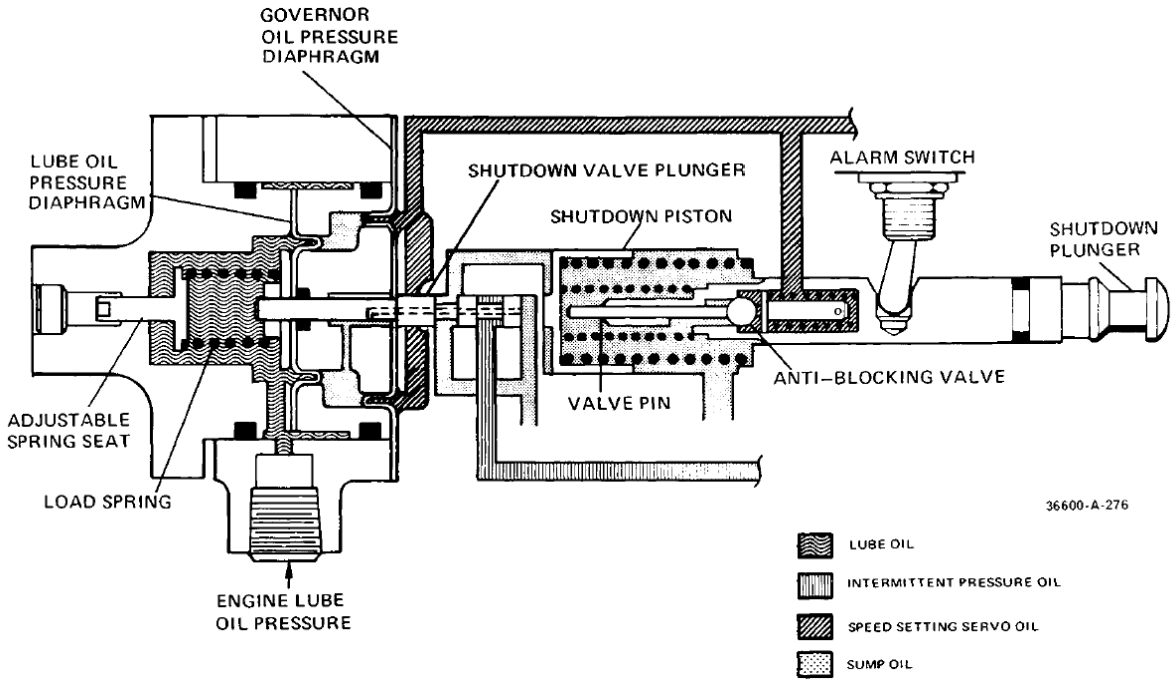


Figure 2-5. Differential Diaphragm Adjustable Lube Oil Shutdown Schematic

Lube Oil Pressure Failure with Excessive Vacuum Shutdown and Alarm

Shutdown due to Lube Oil Pressure Failure

The operation of the device when lube oil pressure failure occurs is identical to the single diaphragm shutdown device.

Shutdown due to Excessive Vacuum

(See Figure 2-6)

The vacuum diaphragm is connected to the inlet side of the oil pump. The vacuum ball valve separates the lube oil pressure and vacuum areas. Normally, the vacuum diaphragm spring holds the vacuum diaphragm to the left. Lube oil pressure holds the vacuum ball to the left against the vacuum seat. When vacuum increases to a value which pulls the vacuum diaphragm and adjustment screw to the right, the vacuum ball is forced off the vacuum seat and onto the pressure seat by the adjustment screw. This closes the engine lube oil pressure area and opens the oil pressure diaphragm area, reducing pressure on the left of the oil pressure diaphragm. Speed setting servo oil pressure forces this diaphragm and the shutdown valve plunger to the left and the engine is shut down in the same manner as when lube oil pressure failure occurs.

IMPORTANT

This device contains an adjusting screw (Figure 2-6) which controls the vacuum required to initiate shutdown. Field adjustment of the screw is not recommended. The screw may be adjusted at time of overhaul on a Woodward test stand, model 8909-001.

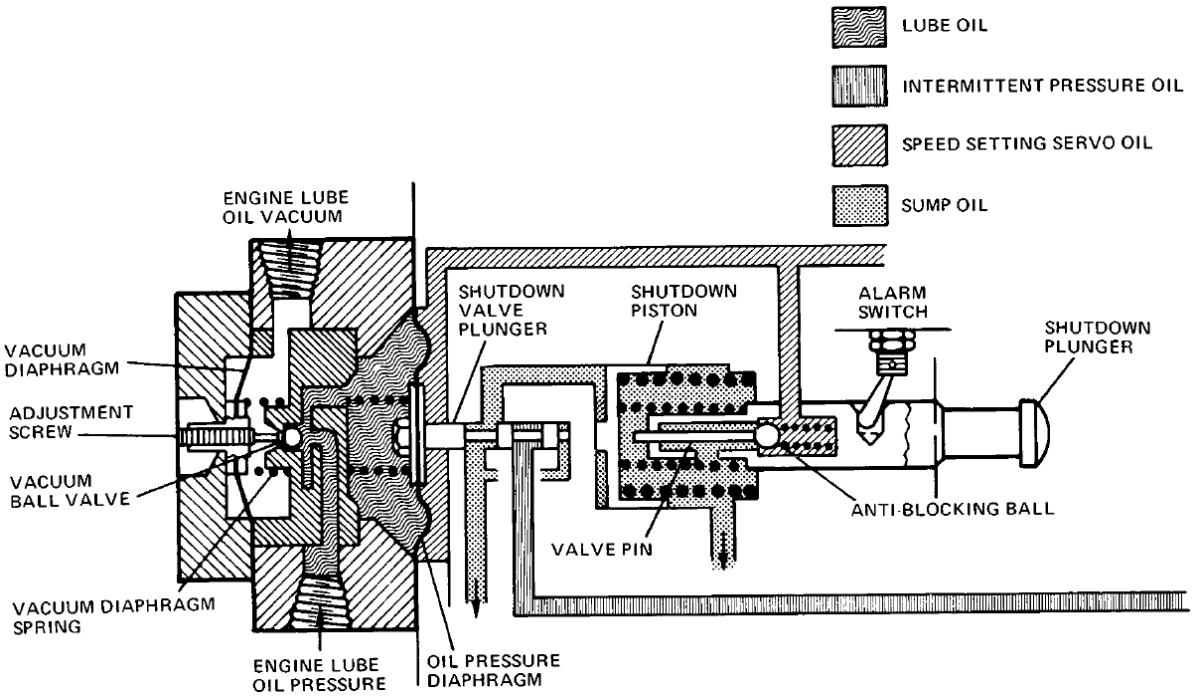


Figure 2-6. Lube Oil Pressure Failure with Excessive Vacuum Shutdown Schematic

Alarm without Shutdown

(See Figure 2-7)

The operation of this device is similar to the shutdown devices. Movement of the alarm plunger to the right trips the alarm switch but does not initiate engine shutdown. The device may be operated by low lube oil pressure, excessive lube oil vacuum, or low water pressure. It does not provide the anti-blocking features.

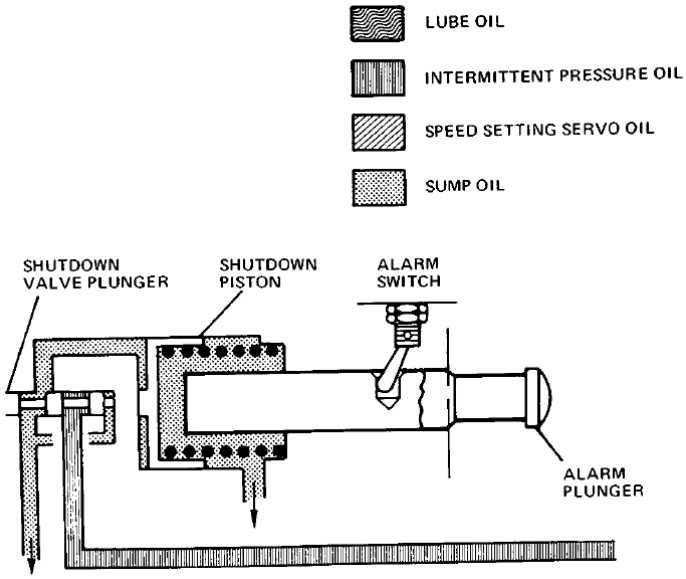


Figure 2-7. Alarm without Shutdown Schematic for Lube Oil or Water Pressure Failure

Auto-Reset for Lube Oil or Water Pressure Failure Shutdown and Alarm

(See Figure 2-8)

The auto-reset works identically for lube oil or water pressure failure shutdown systems. Normally, load spring and engine oil or water pressure forces hold the shutdown valve plunger to the right. When engine oil or water pressure drops below a safe limit, the shutdown valve plunger springs (and a similar spring for water shutdown device) and speed setting servo oil pressure forces overcome the forces of the load spring and engine oil or water pressure and move the shutdown plunger to the left. Governor oil pressure is then directed to the shutdown piston.

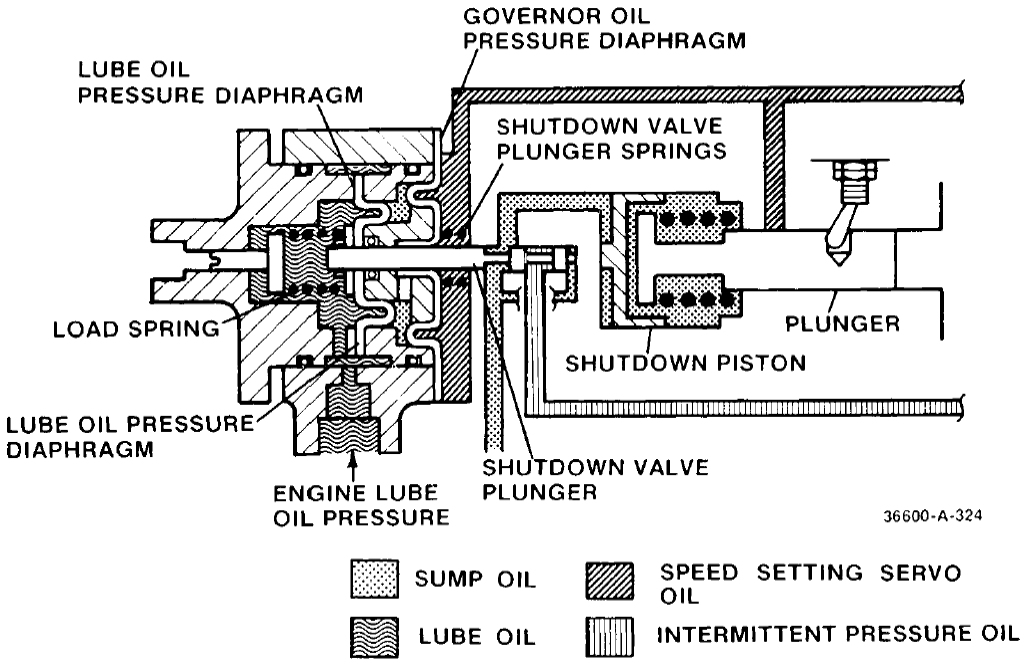


Figure 2-8. Auto-Reset for Lube Oil or Water Pressure Failure Shutdown and Alarm Schematic

When the shutdown plunger moves sufficiently, it closes an alarm switch which remains closed until the shutdown plunger is fully returned. As the shutdown plunger continues moving right, it opens a port around the shutdown plunger and vents speed setting servo oil to the sump. This causes the speed setting servo piston to travel upward, reducing the governor's speed setting (see Figure 2-1). The governor's speed setting mechanism will sense the change in speed setting and will direct supply oil to the speed setting servo. This enables set speed to be reestablished if engine oil pressure again rises above the safe operating schedule. If engine oil pressure lingers below the safe operating schedule, governor speed setting and load control balance will be reduced until a force balance occurs between the opposing forces acting on the shutdown valve plunger. In this mode, the shutdown valve plunger positions the shutdown plunger and regulates the governor's speed setting as a function of available engine oil pressure. The governor may surge while in this reduced pressure mode but the speed setting will remain below its original level. The shutdown valve plunger springs are designed to insure a full shutdown if engine oil pressure remains below the minimum safe pressure.

If a full shutdown occurs, the governor will not reset itself until internal pressure has bled to low pressures. This may not occur until several minutes after the governor's drive shaft has stopped turning. Because the shutdown plunger is not externally accessible, it is not possible to manually reset this system.

If the pressure failure shutdown system trips when attempting to start a cold engine, longer than usual time periods are required for the system to reset itself. This is due to the higher viscosity of cold oil and subsequently longer time period for internal pressures to bleed low enough for the system to reset. If this does occur, setting the governor's speed setting above idle to allow the oil behind the shutdown piston to go back through the bypass valve, will help considerably.

Starting Override for Lube Oil Pressure Failure Shutdown

(See Figure 2-9)

In some applications of governors with pneumatic bellows speed setting, the speed setting piston can overshoot during startup and open the bypass valve before lube oil pressure is established and shut down the engine. If it is not acceptable to increase the speed setting at which the bypass valve trips, then the starting override is used.

Operation of the lube oil pressure failure shutdown is normal except during engine start-up when the system is held in the non-shutdown position by admitting the air override signal. In this mode the override signal supplements the initially low lube oil pressure forces acting against speed setting servo oil pressure forces. The additional override forces prevent the differential diaphragm assembly and shutdown valve plunger from moving left, directing intermittent pressure oil to the shutdown piston, and causing shutdown. The duration of the override signal to establish lube oil pressure must be determined by the customer.

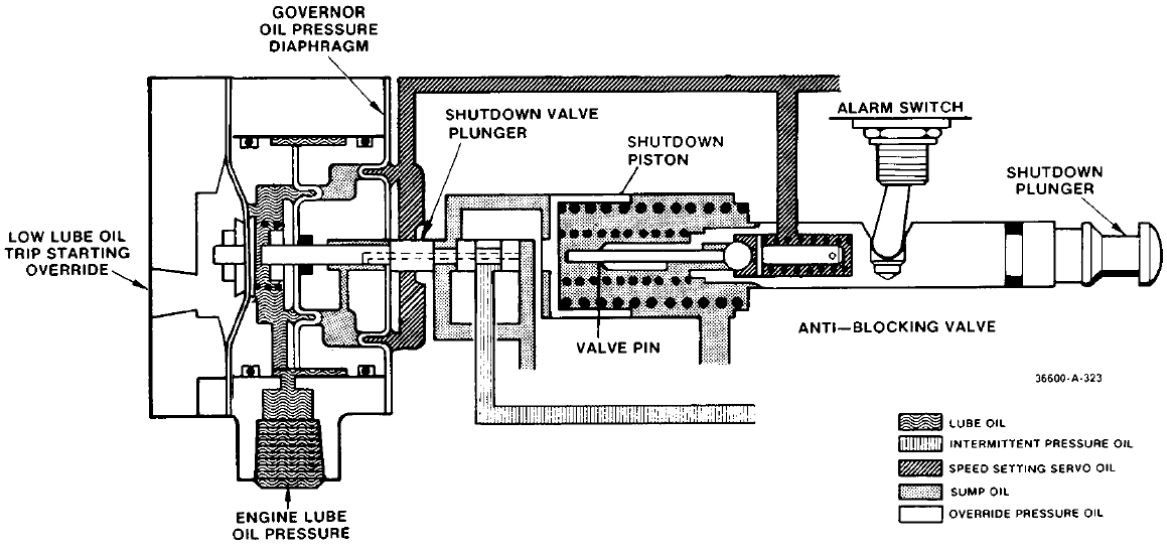


Figure 2-9. Starting Override for Lube Oil Pressure Failure Shutdown

Chapter 3.
Overhaul

Disassembly

1. Clean exterior surface.

2. Table 3-1 lists the figures and the device illustrated. Before disassembly of the water pressure failure shutdown (Figure 4-3), place a mark (use indelible ink) in the right hand corner junction of the lever block (237) and diaphragm plate (246). At reassembly, the halves of the mark must be aligned.

3. Discard all gaskets, preformed packings (O-rings), seals, and diaphragms in the process of disassembly.

Table 1. Illustrated Parts Breakdown Figures

Figure	Device Illustrated
3-1	Single Diaphragm Lube Oil Pressure Failure and Excessive Lube Oil Vacuum Shutdown Parts
3-2	Speed Changing Mechanisms and Alarm Switch Parts
3-3	Water Pressure Failure Shutdown and Alarm Parts
3-4	Differential Piston Lube Oil Pressure Failure Shutdown Parts
3-5	Accumulator Parts
3-6	Parts for Auto-Reset and Speed Reduction, Used with Single Diaphragm Lube Oil Pressure Failure and Excessive Lube Oil Vacuum Shutdown
3-7	Parts for Auto-Reset and Speed Reduction, Used with Water Pressure Failure Shutdown and Alarm Parts
3-8	Accumulator Parts (Latest Style)
3-9	Starting Override for Lube Oil Pressure Failure Shutdown and Alarm

Cleaning

1. Wash all parts, except needle bearings (244), ultrasonically or by agitation in cleaning solvent. Do not permit sealing surfaces to contact other parts or objects. Use a non-metallic brush or a jet of compressed air to clean slots and holes. Dry all parts after cleaning with a jet of clean, dry, compressed air.

2. Apply a light film of lubricating oil to all finely machined surfaces.

Inspection

Visually inspect all parts for damage or wear, paying particular attention to the following.

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

2. Screws, plugs, and internal threads must be free of corrosion, cracks, burred slots, and damaged threads.

3. Pistons and plungers must move freely in their bores.

Assembly

1. Replace gaskets, preformed packings (O-rings), seals, and diaphragms discarded during disassembly with new parts.

2. When assembling the water pressure failure shutdown (Figure 4-3), attach the ratio lever block (237) to the diaphragm plate (246) with the marks (marked at disassembly) aligned.

3. Install diaphragms so the elastomer contacts the oil and the fabric is on the side opposite the oil.

Adjustments

Mount the governor on a Woodward model 8909-001 test stand and make the necessary air, hydraulic, vacuum, and electrical connections.

Water Pressure Failure Shutdown Device

(See Figure 4-3)

1. Connect a regulated air supply to the water box (229).

2. Idle speed shutdown pressure adjustment: Adjust screw (231) to obtain the desired shutdown pressure. Turn it cw to raise the shutdown pressure.

3. Rated speed shutdown pressure adjustment:
   a. Loosen locking screws (234).
   b. Reposition the lever block (237) to obtain the desired shutdown pressure. Slide it upward to raise the shutdown pressure.
   c. Tighten looking screws.

4. A change made to the idle speed shutdown pressure affects the rated speed shutdown pressure and vice versa. It is therefore essential to check both shutdown pressures and readjust (if necessary) both adjustments when a change is made to one.

Differential Piston Lube Oil Pressure Failure Shutdown Device

(See Figure 4-4)

1. Remove diaphragm cap (313), then remove spring (314) and screw (316).

2. Press out plug (315).

3. Reinstall spring and screw in cap, then reinstall cap on governor.

4. Adjust screw (316) to obtain the desired shutdown pressure. Turn it ccw to increase shutdown pressure.

5. Reinstall plug (315).

Lube Oil Pressure Failure (with Excessive Vacuum) Device

(See Figure 4-1)

Adjust screw (62) to obtain the desired shutdown vacuum. Turn it ccw to increase the shutdown vacuum.

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.

Chapter 4.
Replacement Parts

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

- Governor model, serial number, and part number (shown on nameplate)
- Manual number (this is manual 36652)
- Part reference number as given in the parts list, figure number illustrating part, and name or description of the part

Parts List for Figure 3-1

Ref. No.	Part Name	Quantity
36652-1	Cover, bolt	2
36652-2	Washer	2
36652-3	Oil filler cup	1
36652-4	Cover	1
36652-5	Cover dowelling bushing	2
36652-6	Cover gasket	1
36652-7	Counterbalance spring (solenoid speed setting only)	1
36652-8	Nut, seal retainer	1
36652-9	Preformed packing	1
36652-10	Retainer sleeve	1
36652-11	Retainer spring	1
36652-12	Bypass valve body	1
36652-13	Roll pin	1
36652-14	Bypass valve plunger	1
36652-15	Bypass valve spring	1
36652-16	Bypass valve spring seat	1
36652-17	Preformed packing	1
36652-18	Screw, hex hd., 1/4-28 x 3/4 (MS35298-6)	1
36652-19	Bushing retainer spring	1
36652-20	Retainer spring collar	1
36652-21	Retainer spring washer	1
36652-22	Time delay pointer	1
36652-23	Adjustment sleeve	1
36652-24	Shutdown plunger tubing	1
36652-25	Preformed packing	1
36652-26	Shutdown plunger	1
36652-27	Anti-blocking ball spring	1
36652-28	Headed pin	1
36652-29	Anti-blocking ball	1
36652-30	Anti-blocking pin	1
36652-31	Anti-blocking ball seat	1
36652-32	Shutdown plunger spring	1
36652-33	Column assembly	1
36652-34	Piston spring	1
36652-35	Shutdown piston	1
36652-36	Valve bushing gasket	1
36652-37	Valve bushing	1
36652-38	Washer	1
36652-39	Screw, soc. hd., 1/4-28 x 3/8 (MS24678-20)	1
36652-40	Elbow, 9Q0, 1/4 NPT x 1/4 tube	AR
36652-41	Elbow, street, 1/4 NPT	AR
36652-42	Tee, 900, 1/4 NPT x 1/4 tube	AR
36652-43	Washer, split lock, 17/64 (MS35338-44)	14
36652-44	Screw, soc. hd., 1/4-28 x 1-1/2 (MS24678-26)	3
36652-45	Straight half-union, 1/4 NPT x 3/8 tube	AR
36652-46	Side plate	1
36652-47	Screw, soc. hd, 1/4-28 x 3/4 (MS24678-22)	7
36652-48	Side plate gasket	1
36652-49	Lube valve assembly	1
36652-50	Shutdown valve plunger	1
36652-51	Oil pressure diaphragm	1
36652-52	Diaphragm washer	1
36652-53	Nut, lock, thin, 10-32 (MS20364-1032)	1
36652-54	Load spring	1
36652-55	Lube valve body	1
36652-56	Preformed packing	AR
36652-57	Vacuum ball valve	1
36652-58	Vacuum ball seat	1
36652-59	Nut, special, 3/8-24	3
36652-60	Vacuum diaphragm spring	1
36652-61	Vacuum diaphragm holder	1
36652-62	Adjustment screw	1
36652-63	Vacuum diaphragm	1
36652-64	Vacuum diaphragm washer	1
36652-65	Vacuum diaphragm cap	1
36652-66	Screw, soc. hd., 1/4-28 x 2 (MS24678-28)	4
36652-71	Low oil pressure alarm plunger	1
36652-72	Shutdown piston stop	1

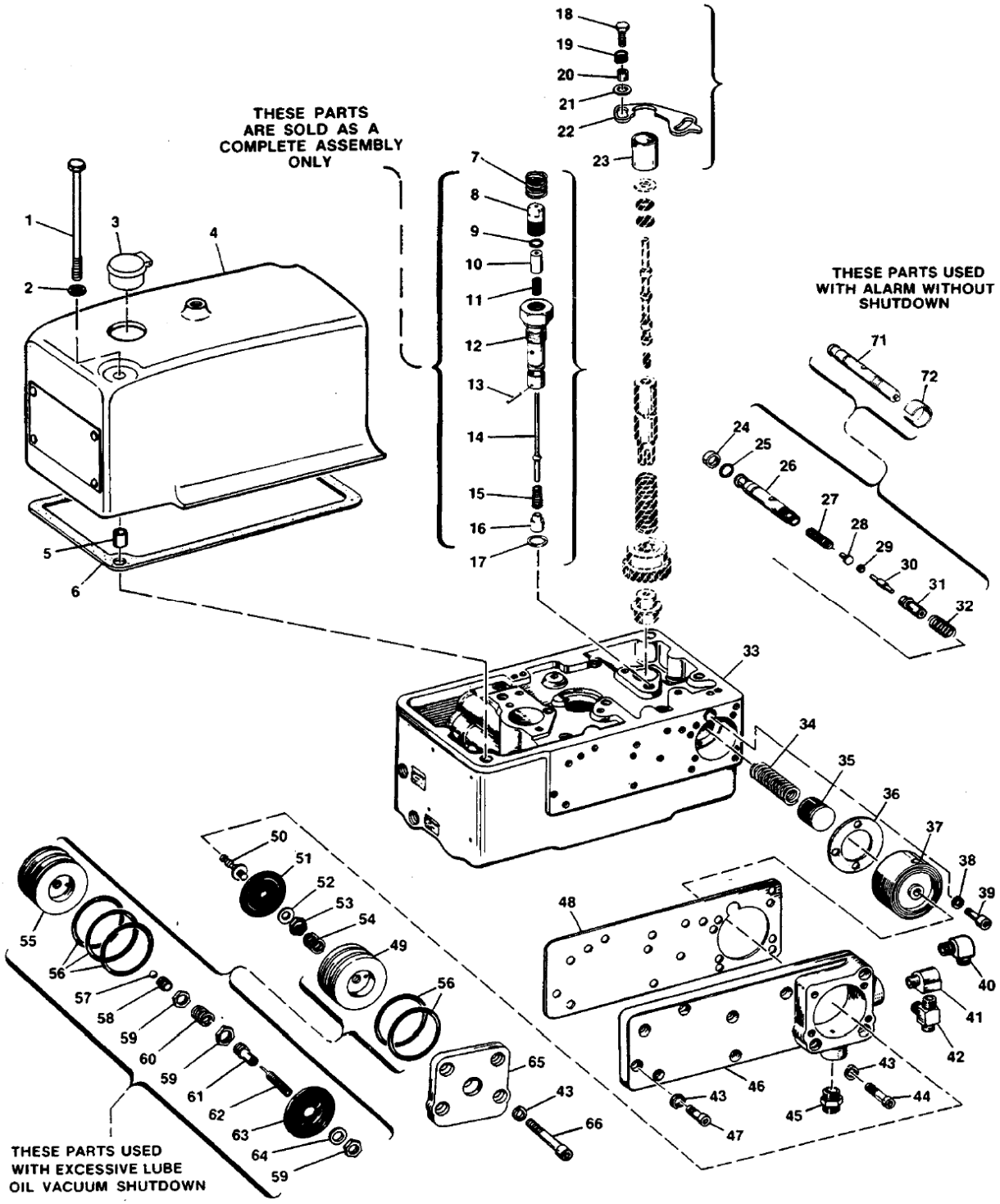
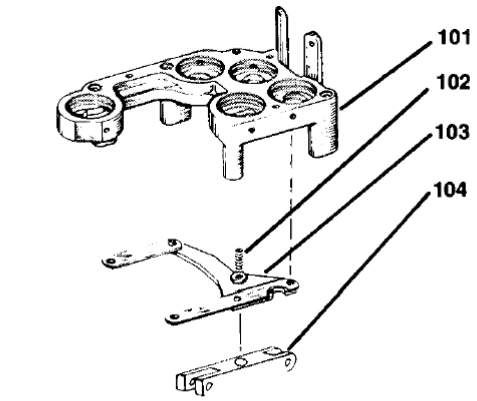


Figure 3-1. Single Diaphragm Lube Oil Pressure Failure and Excessive Lube Oil Vacuum Shutdown Parts

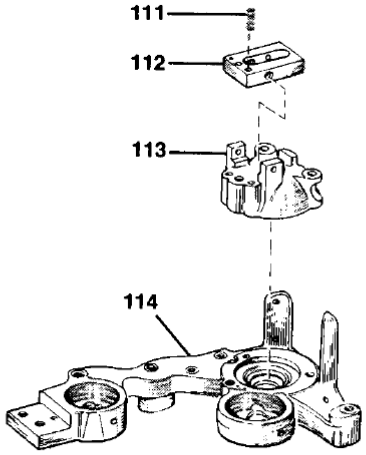
Parts List for Figure 3-2

Ref. No.	Part Name	Quantity
Electric Solenoid Speed Setting		
36652-101	Speed setting bracket (without switch bracket)	1
	Speed setting bracket (with switch bracket)	1
36652-102	Bypass adjustment screw	1
36652-103	Triangular plate assembly	1
36652-104	Floating lever (speed setting)	1
Pneumatic Diaphragm Speed Setting (Early Model Governors)		
36652-111	Set screw, soc. hd, 10-32 x 3/4	1
36652-112	Speed control lever	1
36652-113	Speed control bracket cap	1
36652-114	Speed setting bracket (without switch bracket)	1
	Speed setting bracket (with switch bracket)	1
Lube Oil Pressure Failure Alarm Switch		
36652-121	Screw, soc. hd. 10-32 x 2 1/4 (electric solenoid speed setting)	2
	10-32 x 1 3/4 (pneumatic diaphragm speed setting)	2
	10-32 x 2 1/8 (pneumatic bellows speed setting)	2
	10-32 x 2 1/8 (transducer speed setting)	2
36652-122	Washer, split lock, #10 (MS35338-43)	2
36652-123	Switch mounting bracket	1
36652-124	Switch bracket clamp plate	1
36652-125	Alarm switch	1

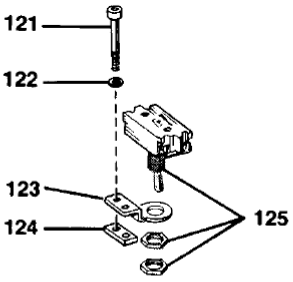
Ref. No.	Part Name	Quantity
Pneumatic Bellows Speed Setting (Late Model Governors)		
36652-131	Torsion spring	1
36652-132	Sleeve	1
36652-133	Sleeve	1
36652-134	Power cylinder	1
36652-135	Screw, flat hd., 10-32 x 1/2	1
36652-136	Load control link	1
36652-137	Load control link	1
36652-138	Nut, lock, thin, 10-32 (MS20364-1032)	1
36652-139	Link assembly	1
36652-140	Spacer	1
36652-141	Roll pin	1
36652-142	Set screw, soc. hd., 8-32 x 1/2	1
36652-143	Lever assembly	1
36652-144	Bypass pin	1
36652-145	Spring	1
36652-146	Speed control bracket	1
Transducer Speed Setting		
36652-151	Nut, hex, 6-32 (MS35649-262)	1
36652-152	Set screw, soc. hd., 6-32	1
36652-153	Bypass lever assembly	1
36652-154	Link	1
36652-155	Bushing	1
36652-156	Guide post assembly	1
36652-157	Washer	2
36652-158	Screw, 8-32 x 1/2	2
36652-159	Spring	1
36652-160	Speed control bracket	1
36652-161	Pin	1
36652-162	Pin assembly	1



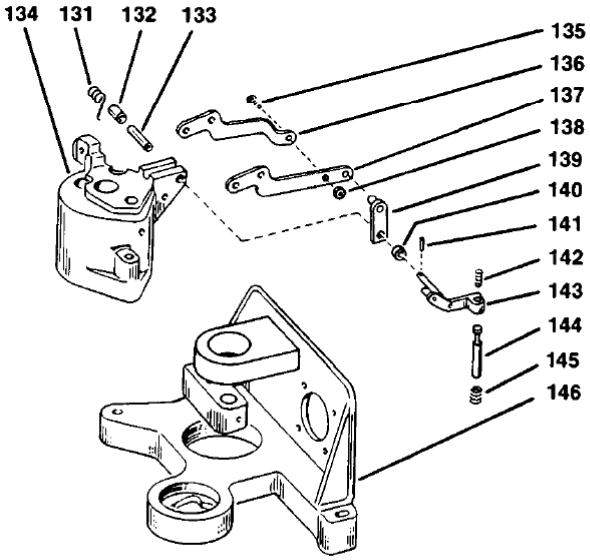
ELECTRIC SOLENOID SPEED SETTING



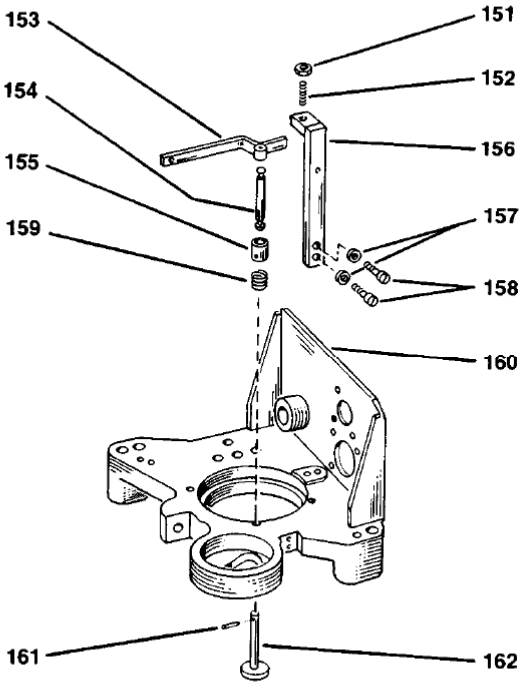
PNEUMATIC DIAPHRAGM SPEED SETTING
(EARLY MODEL GOVERNORS)



LUBE OIL PRESSURE FAILURE
ALARM SWITCH



PNEUMATIC BELLOWS SPEED SETTING
(EARLY MODEL GOVERNORS)



TRANSDUCER SPEED SETTING

36600-C-39

Figure 3-2. Time Delay Tripping Mechanisms and Alarm Switch Parts

Parts List for Figure 3-3

Ref. No.	Part Name	Quantity
36652-201	Copper tubing, 1/4 OD	2
36652-202	Elbow, 900	4
36652-203	Screw, soc. hd., 1/4-20 x 3 (MS24677-45)	2
36652-204	Washer, lock, high collar (MS51848)	6
36652-205	Preformed packing, 1/2 OD (NAS1593-012)	3
36652-206	Preformed packing, 3/8 OD (NAS1593-010)	2
36652-207	Wiring tube	1
36652-208	Buffer spring	1
36652-209	Sleeve	1
36652-210	Screw, fil. hd, 10-32 x 7/8 (MS35266-66)	2
36652-211	Washer, lock, #10 (MS35338-43)	6
36652-212	Switch cover	1
36652-213	Preformed packing, 2 3/4 OD (NAS1593-145)	1
36652-214	Screw, fil. hd., 6-32 x 3/8 (AN 503-6-6)	2
36652-215	Washer, lock, #6 (MS35338-41)	2
36652-216	Washer, plain, #6 (special)	2
36652-217	Alarm switch	1
36652-218	Switch plate	1
36652-219	Shutdown plunger	1
36652-220	Shutdown plunger tube	1
36652-221	Anti-blocking ball seat	1
36652-222	Anti-blocking ball pin	1
36652-223	Anti-blocking ball	1
36652-224	Headed pin (MS20392-2C19)	1
36652-225	Anti-blocking ball spring	1
36652-226	Nut, hex, drilled, 1/4-28	1
36652-227	Washer, plain, 1/4 (AN960-416L)	1
36652-228	Screw, fil. hd, 10-32 x 3/4	4
36652-229	Water box	1
36652-230	Roll pin, 1/16 x 7/16 (MS171435)	1
36652-231	Adjustment screw	1
36652-232	Spring retainer	1
36652-233	Load spring	1
36652-234	Screw, hex hd., 1/4-28 x 1 1/8 (MS35298-9)	2
36652-235	Washer, lock, 1/4 (MS35338-44)	2
36652-236	Clamp, strap	1
36652-237	Ratio lever block	1
36652-238	Nut, lock, 10-32 (MS20364-1032C)	1
36652-239	Diaphragm washer	1
36652-240	Diaphragm	2
36652-241	Straight pin	1
36652-242	Ratio lever	1
36652-243	Washer, plain, #8 (AN960-8L)	2
36652-244	Needle bearing	2
36652-245	Screw, fil. hd, 1/4-20x 3/4 (MS35267-81)	4
36652-246	Diaphragm plate	1
36652-247	Plunger end	1
36652-248	Straight pin	1
36652-249	Diaphragm washer	1
36652-250	Shutdown valve plunger	1
36652-251	Screw, soc. hd, 1/4-28 x 3/8 (MS24678-19)	1
36652-252	Washer, plain, #1/4 (special)	1
36652-253	Valve bushing	1
36652-254	Valve bushing gasket	1
36652-255	Shutdown piston	1
36652-256	Piston spring	1
36652-257	Plunger spring	1
36652-258	Shutdown case	1
36652-259	Power case	1
36652-260	Column	1
36652-261	Low water pressure alarm plunger	1
36652-262	Shutdown piston stop	1

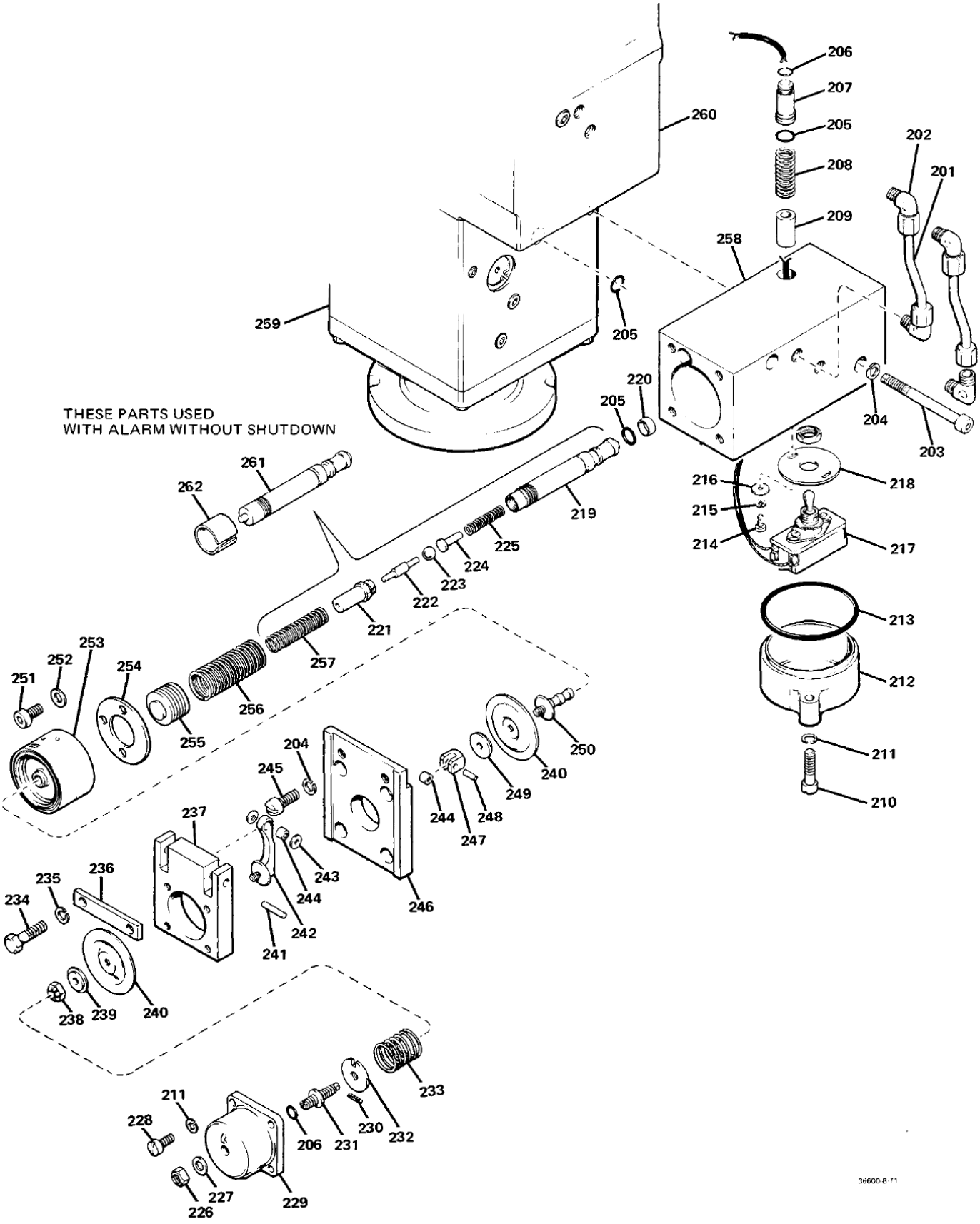


Figure 3-3. Water Pressure Failure Shutdown and Alarm Parts

Parts List for Figure 3-4

Ref. No.	Part Name	Quantity
36652-301	Spring seat	1
36652-302	Preformed packing, 2.012 OD (NAS1593-224)	AR
36652-303	Load spring	1
36652-304	Nut, hex, 10-32 (special)	1
36652-305	Diaphragm washer	1
36652-306	Diaphragm	1
36652-307	Bellofram spacer	1
36652-308	Preformed packing, 0.316 OD (NAS1593-008)	1
36652-309	Differential piston	1
36652-310	Diaphragm	1
36652-311	Shutdown valve plunger	1
36652-312	Valve bushing	1
36652-313	Diaphragm cap	1
36652-314	Load spring	1
36652-315	Plug	1
36652-316	Spring seat (adjustment screw)	1

For parts not shown, see Figures 3-1 and 3-2.

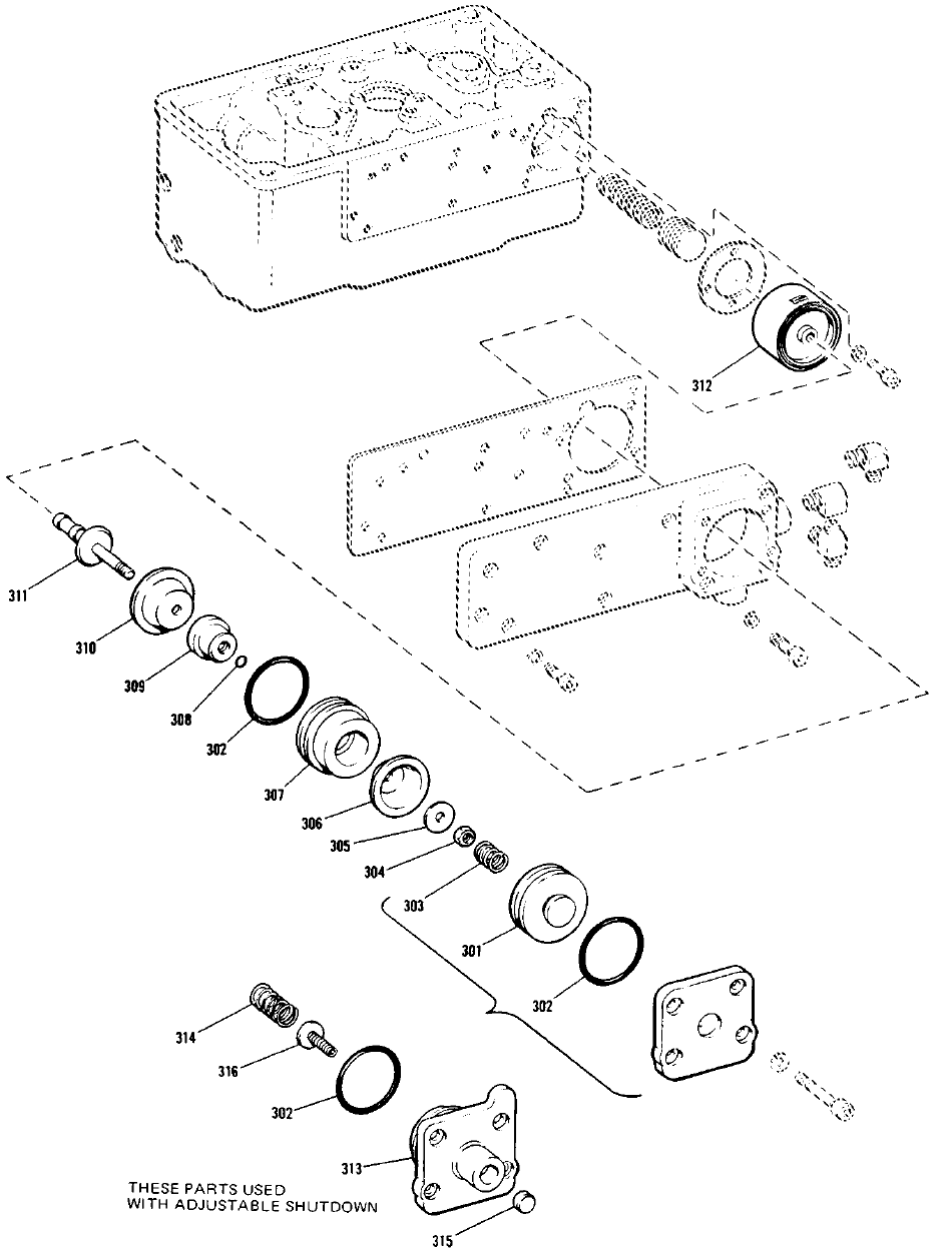


Figure 3-4. Differential Piston Lube Oil Pressure Failure Shutdown Parts

Parts List for Figure 3-5

Ref. No.	Part Name	Quantity
36652-401	Steel tubing, 1/4 OD	1
36652-402	Elbow, 90°	2
36652-403	Screw, fil. hd., 1/4-28 x 2 1/4 (MS35266-88)	4
36652-404	Washer, copper, 1/4 (MS15795-509)	4
36652-405	Accumulator gasket	1
36652-406	Screw, fil. hd., 10-32 x 3	4
36652-407	Nut, hex, 10-32 (Ms35650-302)	4
36652-408	Washer, lock, #10 (MS35338-43)	4
36652-409	Accumulator cover	1
36652-410	Accumulator cover gasket	2
36652-411	Accumulator cover	1
36652-412	Accumulator spring	1
36652-413	Accumulator piston	1
36652-414	Accumulator body	1

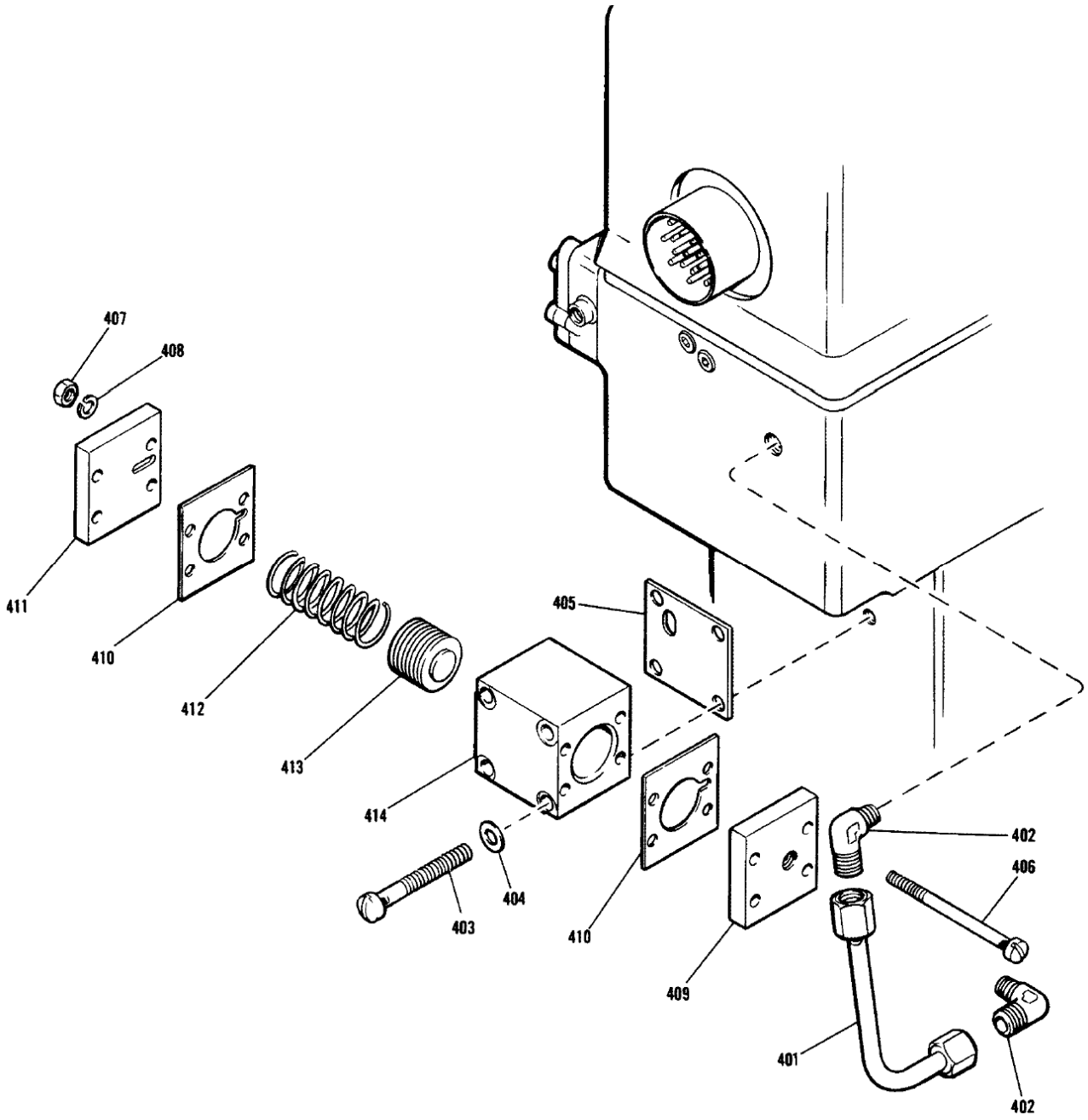


Figure 3-5. Accumulator Parts

Parts List for Figure 3-6

Ref. No.	Part Name	Quantity
36652-451	Oil failure piston spring	1
36652-452	Shutdown piston stop	1
36652-453	Shutdown plunger	1
36652-454	Bushing assy.	1
36652-455	Inner load spring	1
36652-456	Outer load spring	1
36652-457	Plug	1

IMPORTANT

Figure 3-6 is identical to Figure 3-1 except items 24 through 32, and 34 through 39, are replaced by items 451 through 457.

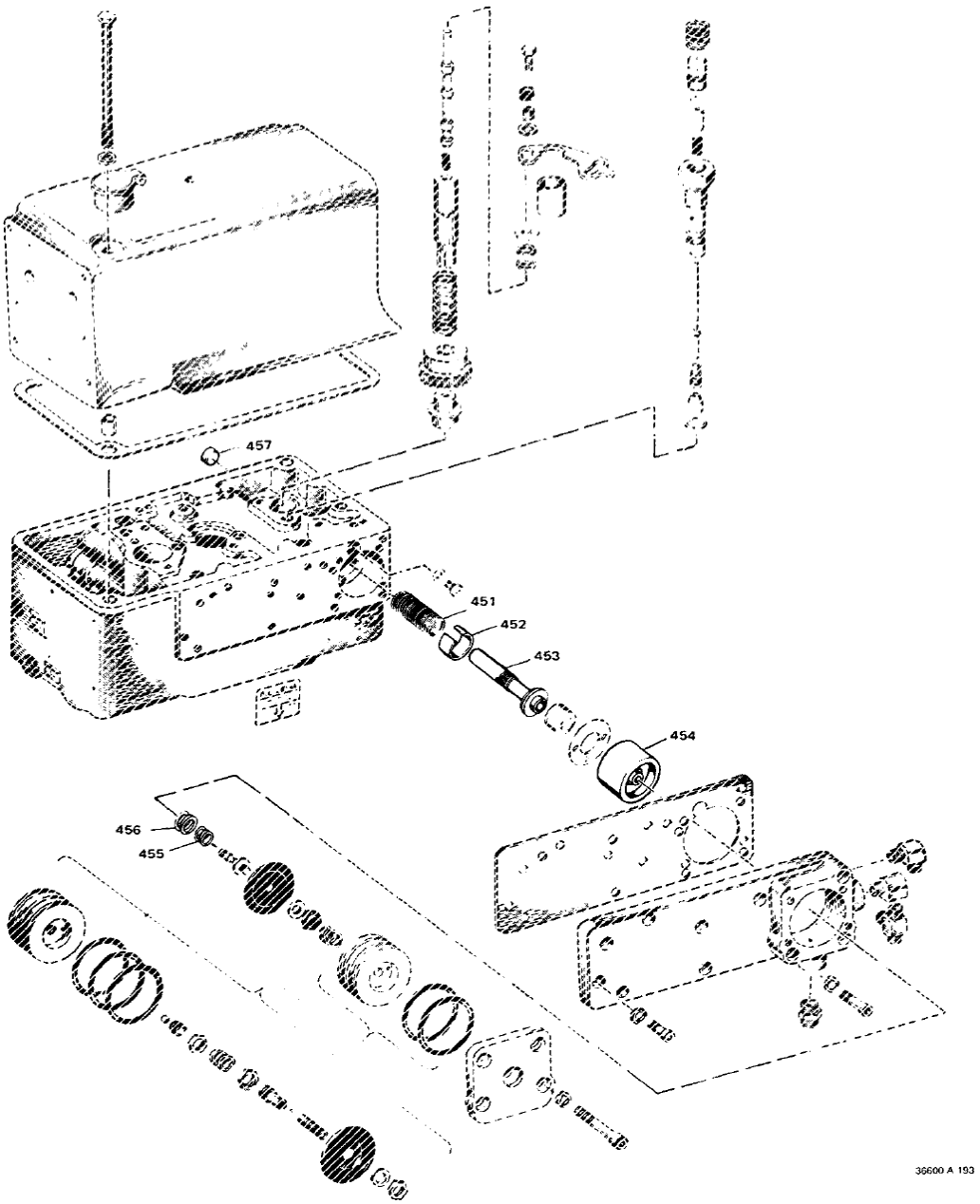


Figure 3-6. Parts for Auto-Reset and Speed Reduction, Used with Single Diaphragm Lube Oil Pressure Failure and Excessive Lube Oil Vacuum Shutdown

Parts List for Figure 3-7

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
36652-471	Water failure piston spring	1	36652-475	Outer load spring	1
36652-472	Shutdown piston stop	1	36652-476	Inner load spring	1
36652-473	Shutdown plunger	1	36652-477	Plug	1
36652-474	Valve bushing	1			

IMPORTANT

This figure is identical to Figure 3-3 except that one item 205 and item 220 are not used, that items 219 and 221 through 225, and items 253 and 257 are replaced by items 471 through 477.

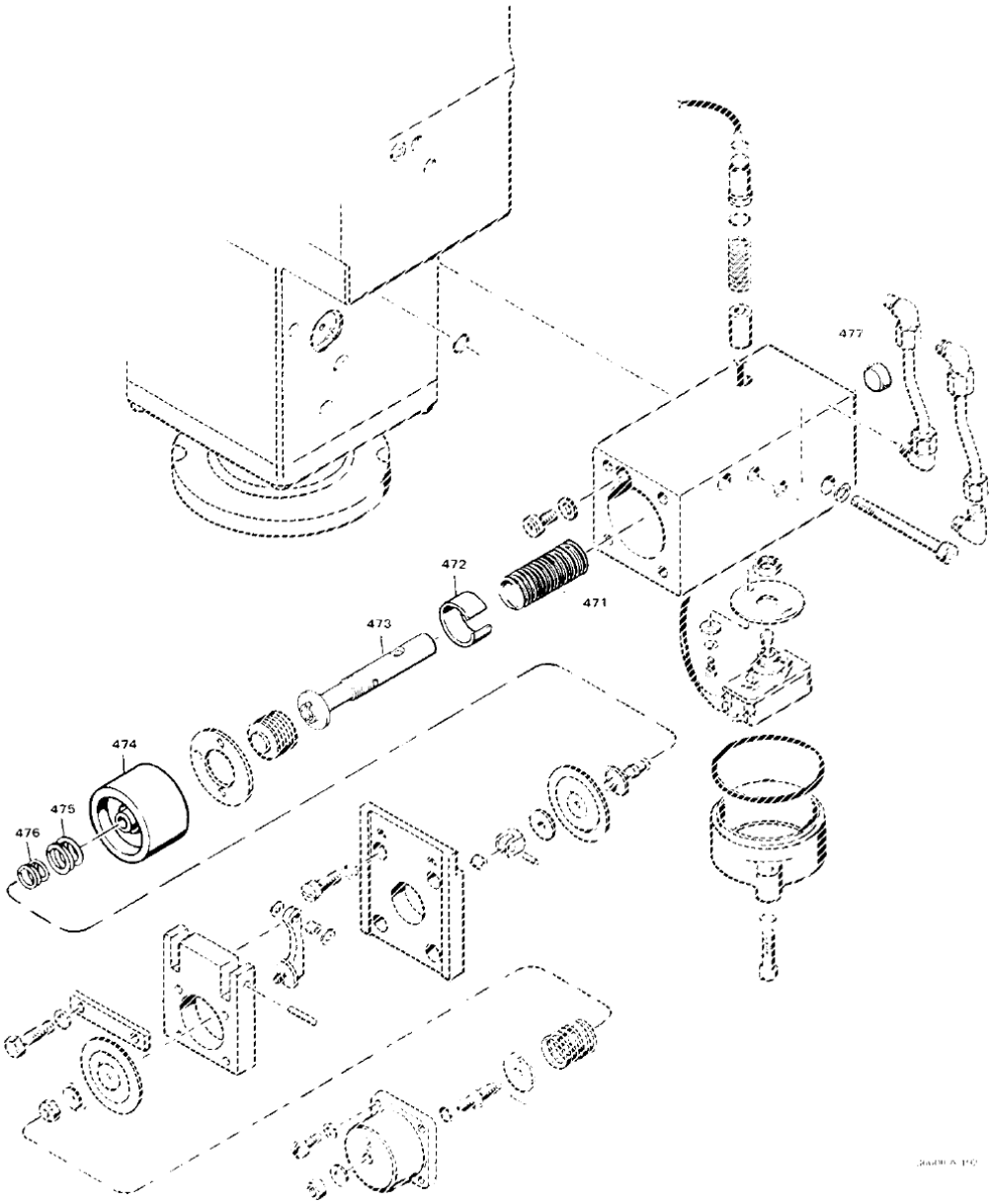


Figure 3-7. Parts for Auto-Reset and Speed Reduction, Used with Water Pressure Failure Shutdown and Alarm Parts

Parts List for Figure 3-8

Ref. No.	Part Name	Quantity
36652-491	Spring	1
36652-492	Piston	1
36652-493	Gasket	1
36652-494	Accumulator body	1
36652-495	Washer	4
36652-496	Screw	4
36652-497	90° elbow fitting	1
36652-498	Tube	1
36652-499	90° elbow fitting	1

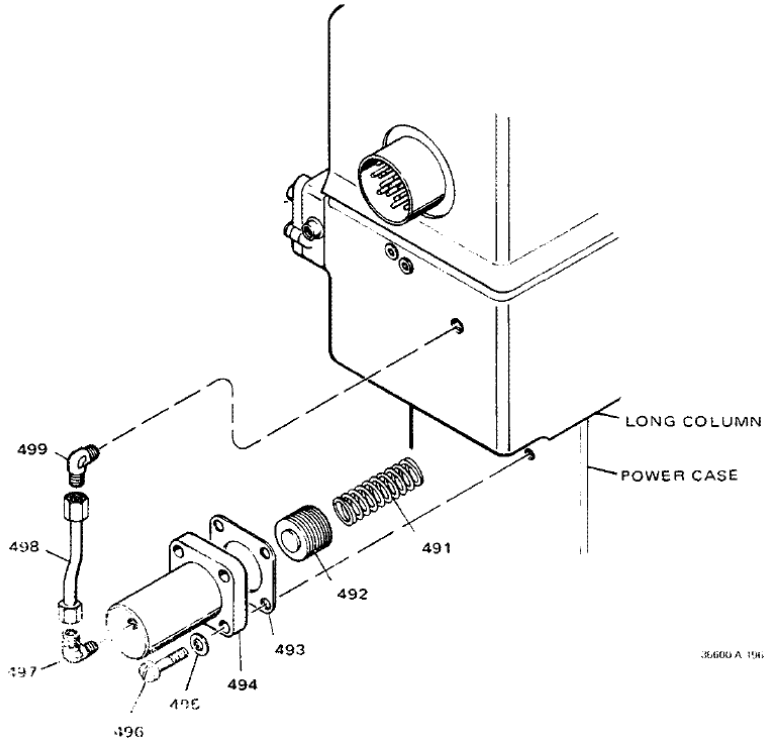


Figure 3-8. Accumulator Parts (Latest Style)

Parts List for Figure 3-9

Ref. No.	Part Name	Quantity
36652-501	Spacer washer, 0.128 ID x 0.120	2
36652-502	Stop nut, 10-32	1
36652-503	Pin	1
36652-504	Screw	1
36652-505	Spring	1
36652-506	Elastic nut, thin, 8-32	1
36652-507	Pivot assy.	1
36652-508	Link assy.	1
36652-509	Lever	1
36652-510	Straight pin 0.186 x 1.250	1
36652-511	Cotter pin, 0.062 x 0.375	2
36652-512	Spring	1
36652-513	Spacer	1
36652-514	Pin	1
36652-515	Packing ring, preformed 0.239 ID x 0.070	1
36652-516	Power piston assy	1
36652-517	Lockwasher 0.250	2
36652-518	Screw 0.250-28 x 1.375 hex. hd. cap	2
36652-519	Power cylinder assy	1
36652-520	Screw 10-32 x 1.250 soc. hd. set	1
36652-521	Link	1
36652-522	Lever	2
36652-523	Fulcrum	1

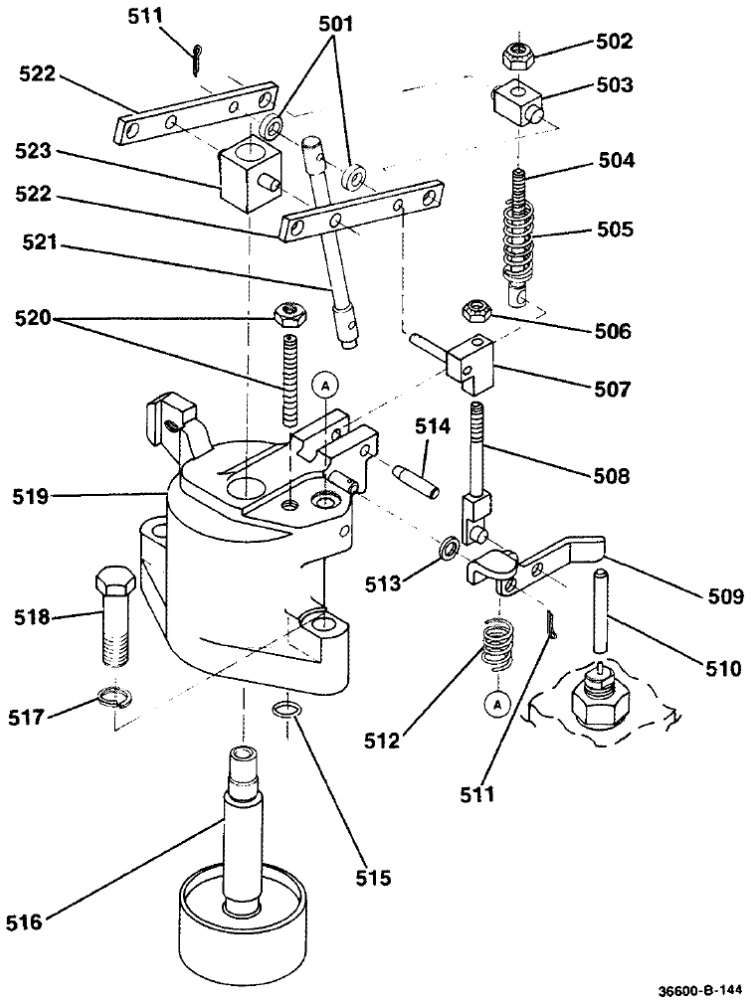


Figure 3-9. Pneumatic Bellows Speed Setting, PGG (Late Model Governors)

Parts List for Figure 3-10

Ref. No.	Part Name	Quantity
36652-551	Lever assy – pivot	1
36652-552	Link assy - bypass valve	1
36652-553	Ring - 0.094 ID Retaining	1
36652-554	Nut - 10-32 Kaylock	1
36652-555	Nut - 8-32 elastic hex thin	1
36652-556	Block - bypass adjusting	1
36652-557	Spring - bypass activating	1
36652-558	Rod - bypass actuating	1
36652-559	Screw - #8-32 x 1.000 soc. hd. cap	1
36652-560	Screw - 0.250 - 28 x 1.375 hex. hd. cap	1
36652-561	Washer - helical spring lock 0.250	2
36652-562	Plunger assy – droop	1
36652-563	Packing - preformed 0.239 ID x 0.070	1
36652-564	Piston assy - S.S. power w/ droop	1
36652-565	Cylinder assy - S.S. power	1
36652-566	Screw - 10-32 x 0.375 ph. rd. hd.	1
36652-567	Washer - 0.203 x 0.438 x 0.032 thick	1
36652-568	Scale - speed indicator	1
36652-569	Nut - 8-32 elastic hex	1
36652-570	Nut - 10-32 hex	2
36652-571	Valve assy – check	1
36652-572	Screw 10-32 1.750 set	1
36652-573	Pin – guide	1
36652-574	Screw assy - 8-32 stop	1
36652-575	Link - load control	1
36652-576	Screw - 10-32 0.500 soc. hd. cap	1
36652-577	Fulcrum assy - power piston	1
36652-578	Cap - droop plunger	1

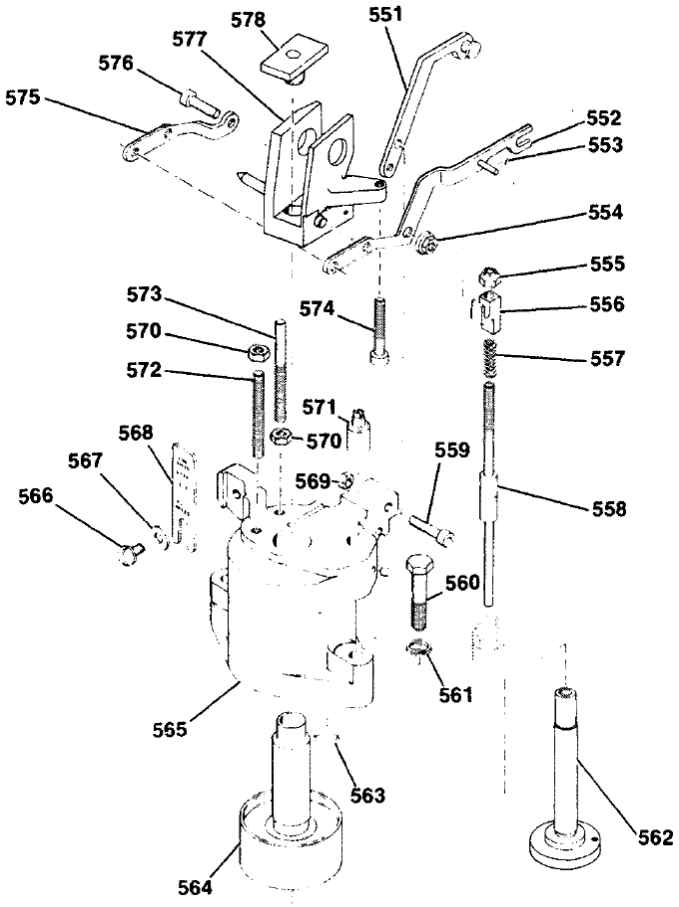


Figure 3-10. Pneumatic Bellows Speed Setting, PGA (Late Model Governors)

Parts List for Figure 3-11

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
36652-601	Valve bushing	1	36652-611	Load spring	1
36652-602	Shutdown valve plunger	1	36652-612	Diaphragm plate	1
36652-603	Diaphragm	1	36652-613	Diaphragm clamping plate	1
36652-604	Differential piston	1	36652-614	Diaphragm	1
36652-605	Preformed packing, 0.176 ID x 0.070	1	36652-615	Diaphragm washer	1
36652-606	Preformed packing, 1.734 ID x 0.139	2	36652-616	Nut, Kaylock, 10-32	1
36652-607	Bellofram spacer	1	36652-617	Diaphragm cap	1
36652-608	Diaphragm	1	36652-618	Elbow, 90° 1/8 NPT x 1/4 tube	1
36652-609	Seal plate	1	36652-619	Screw, soc hd, 1/4-28	3
36652-610	Nut, hex, 10-32 (special)	1	36652-620	Washer, split lock	3

For parts not shown, see Figure 3-1.

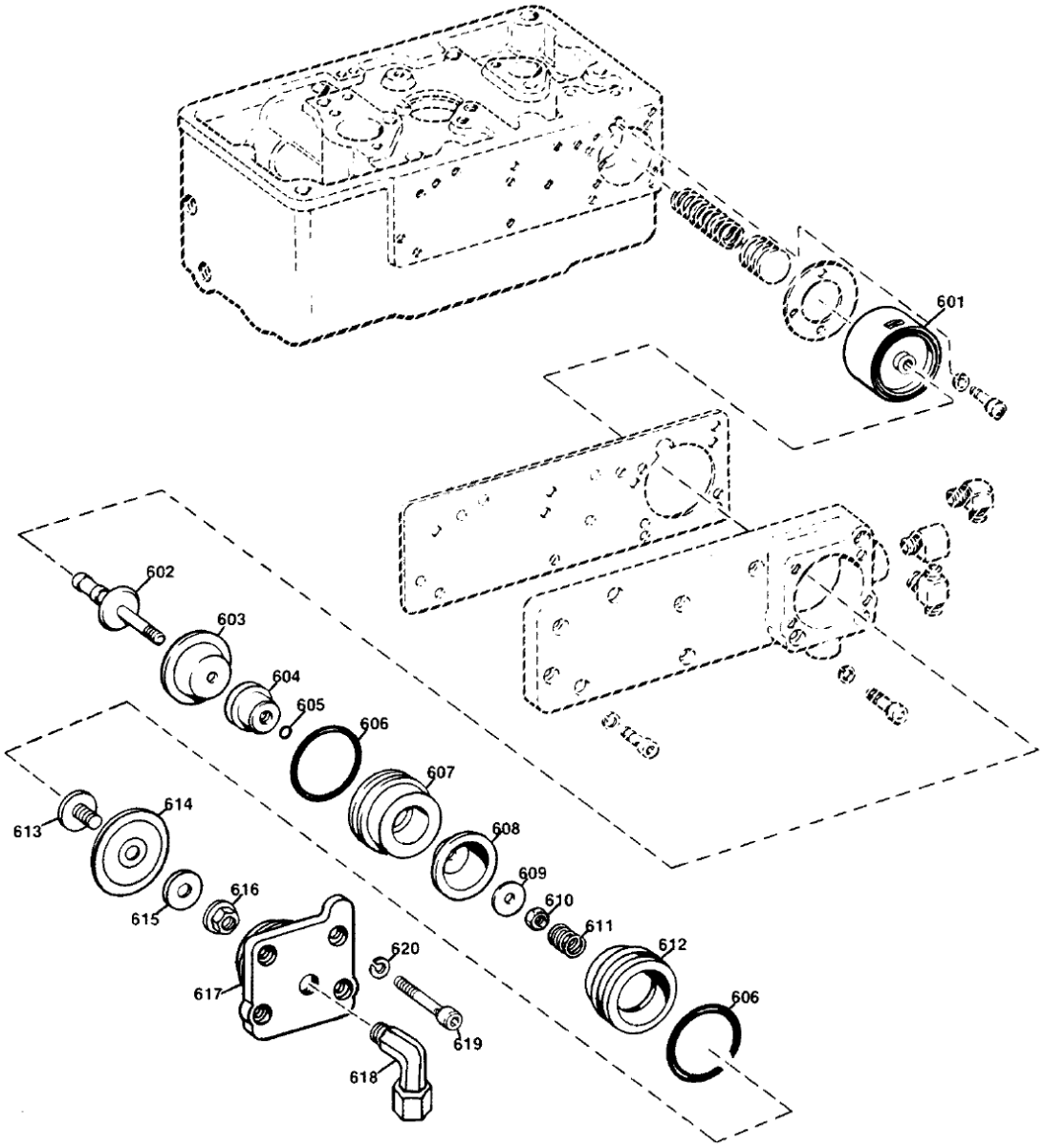


Figure 3-11. Starting Override for Lube Oil Pressure Failure Shutdown & Alarm

Chapter 5.
Product Support and Service Options

Product Support Options

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

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

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

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

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

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

Product Service Options

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

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

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

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

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

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

Returning Equipment for Repair

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

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

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

NOTICE

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

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

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

Contacting Woodward's Support Organization

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

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

Products Used In Electrical Power Systems

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

Products Used In Engine Systems

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

Products Used In Industrial Turbomachinery Systems

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

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

Technical Assistance

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

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

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

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

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

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 36652H.

B36652:H

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2012/11/Colorado