

**SIEMENS-ALLIS**

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**INSTRUCTION  
BOOK**

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**PNEU-DRAULIC OPERATOR**  
**Type PH-33T-5**

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**INDEX TO  
INSTRUCTION BOOK BWX-6788-1  
COVERING PH-33T-5  
"PNEU-DRAULIC" OPERATOR**

<b>CONTENTS</b>	<b>SECTION</b>	<b>PAGE NO.</b>
LIST OF ILLUSTRATIONS	32	1
PRECAUTIONS	33	1,2
GENERAL	34	1
INTRODUCTION		1
RECEIVING		1
STORAGE		1
INSTALLATION		1,2
DESCRIPTION	35	1
FLUID SYSTEM		1
HYDRAULIC FLUID		1
HYDRAULIC POWER UNIT		2
CONTROL VALVE		3
POWER CYLINDER		3
ACCUMULATOR		3,4
OPTIONAL GAUGING & PRECHARGING DEVICE		4
ACCUMULATOR PRECHARGE		5,6,7
FITTINGS		7
HYDRAULIC TUBING		7
AUXILIARY CONTROL EQUIPMENT	36	1
Q-9 AUXILIARY SWITCH		1
LATCH CHECK SWITCH		1
PRESSURE SWITCHES		2
MOTOR SWITCH (63M)		2
ALARM SWITCH (63A)		2
LOCKOUT SWITCH (63C)		2
ANTI-PUMP RELAY (52Y)		3
LIMIT SWITCH (52aa)		3
HAND TRIPPING		3
HEATER		3
OPERATIONS COUNTER		3
HIGH SPEED AUXILIARY SWITCH		3
OPERATION	37	1
CLOSING, MECHANICAL SEQUENCE		1
CLOSING, ELECTRICAL SEQUENCE		1
FULL SPEED, CLOSING MANUAL OPERATION		2
OPENING, MECHANICAL SEQUENCE		2
OPENING, ELECTRICAL SEQUENCE		2

# ILLUSTRATIONS FOR TYPE PH-33T-5 "PNEU-DRAULIC" OPERATOR

FIG. NO.	DESCRIPTION	DRAWING NO.
1	Typical "Pneu-Draulic" Operator	
2	Typical "Pneu-Draulic" Operator Fluid System	72-410-318-401
3	Typical "Pneu-Draulic" Cylinder & Valve Assembly	72-410-027-401
3A	Typical Pilot Valve	71-401-767-401
3B	Typical 52aa Limit Switch	72-211-360-401
4	Typical Operator Mechanism with Adjustment Settings	72-210-526-402
4A	Typical Operating Mechanism Linkage	72-210-534-402
4C	Typical Trip Mechanism	72-210-535
6	Typical Hydraulic Power Unit	72-410-316-401
6A	Typical Manifold Block Assembly	72-310-470-402
6B	Typical Hydraulic Pump	72-310-407-402
7	Typical Pressure Switch Assembly	71-303-468-401
8	Typical Auxiliary Switch	71-301-078-401
9	Typical Elementary Connection Diagram	72-310-405-401
13A	Typical Accumulator Charging & Gauging Assembly	71-118-793-401
13C	Typical Hydraulic Accumulator Assembly	72-410-202-401
13D	Nitrogen Cylinder Gas Valve Outlet Conn.	72-211-356-401
14	Typical Temperature /Pressure Curve	71-300-972-401
15	Typical Type "T" Latch Check Switch	72-210-567-401
16	Assembly Instructions for Ermeto Fittings	72-110-146-401
17	Assembly Instructions for Lenz Fittings	71-111-339-401
18	High Speed Auxiliary Switch	72-210-571-402

# **PNEU-DRAULIC OPERATOR**

## **GENERAL**

### **INTRODUCTION**

The instructions included in this book are to aid you in obtaining longer and more economical service from your Siemens-Allis equipment. The successful operation of this equipment is dependent upon proper installation and care as well as proper design and manufacture. By distributing this information to your operators and engineers you can assure proper installation and operation resulting in better service and lower maintenance cost.

### **RECEIVING**

Each operator and its associated apparatus has been carefully checked, inspected, and packed at the factory by workmen experienced in the proper handling of electrical equipment. Immediately upon receipt of this equipment remove all packing traces and examine parts, checking them against the packing list, carefully noting any damage incurred in transit. If damage is disclosed, a damage claim should be filed at once with the transportation company. In addition, Siemens-Allis should be notified.

The hydraulic system is shipped filled with oil at zero pressure. The system should be inspected for leaks when received and pressure raised to operating pressure to check high pressure fittings.

### **STORAGE**

When this apparatus is to be stored for any length of time, a location should be selected which is clean, dry and not exposed to possible corrosive gases or mechanical injury. All machined surfaces should be slushed to prevent corrosion. Particular care should be taken to protect insulating parts which might absorb moisture. All conduit openings should be sealed. A periodic inspection schedule should be set up for the protection of this stored equipment. The hydraulic oil supplied is a rust inhibitive oil; therefore, no precautions are necessary for storage with regards to the hydraulic system.

The operating mechanism housing is weatherproof. However, to prevent corrosion due to moisture condensation within the cabinet, the space heaters furnished should be energized as soon as possible even to the extent of using temporary wiring.

### **INSTALLATION**

#### **REMOVAL OF BLOCKING AND PUTTING BREAKER INTO OPEN POSITION**

As received, the breaker operating mechanism will be braced in the closed position and for a breaker shipped with bushings installed there may be bracing or strapping within each tank.

First carefully remove any bracing or strapping from inside the tanks leaving the operating mechanism braced as a safety precaution. Then carefully remove the blocking from the operator.

10. To avoid false accumulator precharge readings, a minimum waiting period of 10 minutes is necessary, after either adding nitrogen to separator bag or draining system pressure to zero PSI, before taking readings.

See Section 35 for complete instructions.

11. When performing test electrical trip-free operations, the trip coil should be energized through the main breaker contacts.

**NOTE**

*If conditions necessitate energization of the trip coil through the "A" stage of the auxiliary switch, the "A" stage should be adjusted to make at the breaker contact position. This results in an accurate simulation of actual conditions existant when the breaker is closed against a fault while in service.*

The operator is designed to perform satisfactorily under electrical trip-free conditions. However, if the "A" stage is not readjusted, the breaker load is released so early in the operator stroke that the unexpended kinetic energy of the closing cylinder, instead of being absorbed in a normal manner by the breaker load, must be absorbed by the operator. This, unnecessarily, creates conditions which can only have adverse affect on the life of the operator.

12. To avoid damage to lift rods and breaker mechanisms, do not trip operating mechanism before filling breaker tanks and shock absorbers with oil. To open breaker slowly, block release latch (473 Fig. 4C) in position to prevent accidental spillout. Install maintenance closing device and jack ram roll (413) up off prop latch (416). Block prop latch (413) out of way and using slotted handle of hydraulic jack open release valve of jack slightly and allow breaker load to open operating mechanism slowly. Control speed of opening by adjusting position of release valve on hydraulic jack as required.



**DANGER**



*Keep hands free of the breaker while the operator or jack is descending.*

13. When checking out operator run down, do not operate more than two operations below lock-out pressure.

Operating at too low a pressure creates the possibility of the breaker stalling in a partially closed position due to running out of hydraulic fluid in the accumulator.

## DESCRIPTION

The Type PH-33T-5 "PNEU-DRAULIC OPERATORS" is designed for use with outdoor oil circuit breakers. This unit includes a mechanically trip-free operating mechanism, a high speed tripping device, and a "PNEU-DRAULIC" system for closing power. The operating mechanism and all associated equipment, is located within the operator housing fastened to the front of the leading breaker tank.

### FLUID SYSTEM (Ref. Fig. 1 & 2)

The "PNEU-DRAULIC" fluid system stores oil in the accumulator at high pressure and in sufficient quantity to supply the necessary power required for satisfactory operation or operations of the hydraulic cylinder.

Hydraulic fluid in the reservoir flows at atmospheric pressure through a submerged filter to the power pump.

Raising of system pressure requires the pressure bleed valve to be in the closed position (handle turned clockwise). Pressure may then be raised by operation of the power pump. Hydraulic fluid flows from the power pump through check valve "B" into the accumulator where it is stored under pressure for use on demand. A pressure relief valve is incorporated in the system to prevent the possibility of excessive pressure arising during power pump operation.

A hand pump is available, as an optional accessory, to manually raise the system pressure for emergency power operations.

During operation, high pressure oil flows from the accumulator through the control valve as described under "OPERATION" and is exhausted back to the reservoir at the completion of the work cycle.

### HYDRAULIC FLUID (Ref. Fig. 2)

Outdoor oil circuit breakers, due to seasonal and even day-to-day weather conditions, are subject to a wide range of ambient temperature conditions. To provide proper lubricity for the protection of moving parts, and maintain proper fluid viscosity to provide reliable operating characteristics over the full range of these ambient temperature conditions, the fluid must have a high viscosity index.

To provide these properties the "PNEU-DRAULIC" system is furnished with a hydraulic fluid compounded in accordance with MIL-H-5606 specifications. This is a petroleum base fluid which contains inhibitors to minimize oxidation (sludging), corrosion, foaming, and also contains an anti-wear agent. This is a nearly constant viscosity fluid with a viscosity index of 232, a pour point of -75 degrees F., a flash point of 205 degrees F. Its viscosity is 77 SSU at 100 degrees F. and 601 SSU at 0 degrees F. This is a red fluid.

The following are hydraulic fluids which meet this specification. These are compatible with each other and may be used as required.

The Texas Company "TEXACO AIRCRAFT HYDRAULIC OIL "AA"  
Humble Oil & Refining Company "ESSO UNIVIS J-43"  
Mobil Oil Company "MOBIL AERO HYDRAULIC OIL HFA"

The breaker should now be "slow opened" using the maintenance closing device. Do not disturb the trip latch. Put the maintenance closing device in place and pump it up until the load is removed from the operator prop latch. The prop latch can now be pried out from under the toggle roll and the breaker let out slowly against the maintenance closing device.



**DANGER**



***KEEP HANDS FREE OF THE BREAKER WHILE THE OPERATOR OR JACK IS DESCENDING.***

***When using the maintenance closing device on breakers with pneudraulic operators, the accumulator pressure must be at zero and the pressure bleed valve between accumulator and oil reservoir must be left open.***

### **CONTROL VALVE (Ref. Fig. 3 & 3A)**

The hydraulic control valve is a solenoid controlled, pilot operated normally closed, three — y directional control valve of the ball poppet type. High carbon chrome alloy steel balls in combination with conical seats are utilized to provide positive metal-to-metal poppet seating. Poppet seats are pressure sealed and self cleaning, therefore, not susceptible to fine dirt particles.

Being an integral part of the power cylinder assembly, the main control valve body serves a dual purpose, also acting as the cylinder base.

Actuation of the control valve may be initiated electrically or manually as described under "OPERATION."

### **POWER CYLINDER (Ref. Fig. 3)**

The power cylinder of the "PNEU-DRAULIC" operator is a high speed double acting cylinder specifically designed for circuit breaker application.

Operation of the power cylinder during normal operation is accomplished by pressure acting on the large differential area existing between the upper and lower faces of piston (332). The upper section of the cylinder being directly connected to the accumulator, is exposed to full system pressure at all times providing fast positive resetting of the ram.

"O" Rings are used for all static seals and "Quad" rings or Polypak Rings in conjunction with anti-extrusion back-up washers for all dynamic seals.

Wiper rings are provided on both upper ram (330) and lower ram (322) to prevent the entrance of any contaminating particles which might otherwise damage seals.

### **ACCUMULATOR (Ref. Fig. 2 & 13C)**

The accumulator is a high pressure storage chamber in which the potential energy of incompressible oil under high pressure is stored against the dynamic force of a compressible gas, in this case oil pumped or dry nitrogen. The accumulator consists of a steel alloy shell (1351), a special XN-1206 high density Buna N separator bag (1352) incorporating an integrally molded high pressure gas valve (1367) and an oil port assembly (1363).

The high pressure gas valve, (1367) located at the upper end of the accumulator is used for the introduction of gas precharge pressure into the separator bag. A special high pressure, spring loaded pressure seated valve core (1356) is provided to protect against loss of this precharge. As an added precaution, an additional seal is provided through the use of a valve guard (1353) and dyna-seal washer (1354) assembly. Before installing valve guard and dyna-seal, carefully check valve core (1356) for leakage and lubricate dyna-seal washer (1354) lightly with white petroleum or vaseline. CAUTION: Do not overtighten valve guard. After installing hand tight, snug up lightly with wrench to compress resilient portion of dyna-seal washer.

The poppet valve (1364), located in the oil discharge port, is used to prevent extrusion of the separator bag through the port when system fluid is at zero pressure. Since the accumulator has been previously precharged with nitrogen gas at a predetermined pressure, fluid must initially enter at precharge pressure.

Introduction of fluid at a pressure above gas precharge pressure causes the poppet valve (1364) to be lifted open as the relatively incompressible fluid compresses the nitrogen in the separator bag, thereby filling the shell with an oil volume equal to the reduction in volume of gas due to — increased pressure. With system under pressure, the separator bag floats in a state of equilibrium, acting only to separate two mediums at equal pressure.



## HYDRAULIC POWER UNIT (Ref. Fig. 6, 6A & 6B)

The hydraulic power unit consists of a motor driven hydraulic pump mounted inside of a reservoir, an integrally mounted pressure relief valve, and check valve.

The reservoir (656), with a total capacity of 8 gallons, provides sufficient working volume to charge the hydraulic system and the accumulator to the required pressure and provide an adequate volume to compensate for temperature changes.

A column type fluid level sight gauge (655) is provided on the front of the reservoir. Proper fill level, with system pressure at 0 PSI, is indicated by arrows located 5 inches below the top of the reservoir. Hydraulic fluid should be visible in the lower end of the sight gauge at all times.

### CAUTION

*BEFORE ADDING ADDITIONAL FLUID TO RESERVOIR, SYSTEM MUST BE BLED TO ZERO. (FAILURE TO HEED THIS WARNING MAY RESULT IN OVERFILLING OF RESERVOIR CAUSING LOSS OF EXPANSION SPACE, AND OVERFLOW OF FLUID WHEN SYSTEMS IS LATER BLED TO ZERO.)*

The entire unit can be removed by disconnecting the piping and removing four mounting bolts, or the reservoir may be dropped for inspection or service without draining the system by removal of the six reservoir mounting bolts.

This hydraulic power unit uses a piston type pump (663). This pump (663) is flange mounted on a pump extension (641) which places the pump in a totally submerged position under all operating conditions. The pump and motor shafts are connected through flexible couplings (639 & 665) and pump shaft extension (640). All shaft connections are keyed.

A replaceable twenty five micron filter element (660) is installed at the suction inlet of the pump and is secured in place by stud (642).

This hydraulic power unit is also equipped with an auxilliary filter element (659) and suction line (657) for use with an optional accessory hand pump.

The relief valve (630) is adjustable within a range of 1000 PSI to 3300 PSI. The slotted adjusting screw (635 Fig. 6E) is located on the front face of the manifold assembly and is accessible by removal of hexagonal cap (636). Adjusting screw (635) is turned clockwise to raise, or counter-clockwise to lower the relief valve pressure setting. (Cracking pressure is set 300 PSI above normal operating pressure.) After completion of adjustment, replace hexagonal cap (636) after making sure the seal ring (634) is in place.

The reservoir filler cap (652) is mounted on top of reservoir (656) at the manifold (653) and has a 40 micron filter element which removes foreign particles from the outside air as the reservoir breathes during changes of oil level.

A check valve (617) is mounted within the manifold (603). When an optional accessory hand pump is used in the system, this check valve is placed between the hand pump and the hydraulic system. It serves to isolate and protect the hand pump from system pressure surges.

## ACCUMULATOR PRECHARGE - GENERAL

Accumulator Precharge Pressure may be readily and properly checked without the use of an auxiliary gauging device, or an auxiliary gauging device (Fig. 13A) can be used.

### TO CHECK ACCUMULATORS PRECHARGE (Without Auxiliary Gauging Device)

1. Open pressure bleed valve and drain system pressure to zero PSI.
2. Allow system to set at zero pressure for a minimum of 10 minutes:

#### NOTE

*It is essential to allow the system to stabilize at zero pressure, as removal of the fluid causes the nitrogen gas to expand and create an initial drop of temperature resulting in a false pressure reading.*

3. Refer to operator nameplate for recommended precharge pressure.

#### NOTE

*Precharge pressure specified is given at an average ambient temperature of 70°F. Indicated gauge pressure will change with variations in temperature.*

4. Record current ambient temperature.
5. Refer to Fig. 14. From temperature value recorded in Step 4, draw a vertical line upward to intersect the proper precharge curve determined in Step 3. From this point of intersection, draw a horizontal line and read corrected precharge pressure at vertical edge of chart. This value is the required precharge pressure under the current ambient temperature conditions. Record this value for later use.

### EXAMPLES

Specified precharge pressure (at 70 degrees F) is 2000 PSI.

- A. Ambient temperature at time of reading is 30 degrees F. Normal corrected precharge pressure reading will be 1847 PSI.
  - B. Ambient temperature at time of reading is 90 degrees F. Normal corrected precharge pressure reading will be 2076 PSI.
6. Close pressure bleed valve.
  7. With control valve in normal position, raise system pressure from zero with power pump. The system pressure gauge needle will rise rapidly to precharge pressure then level off and slowly rise above.

Compare this indicated pressure reading with the temperature corrected value determined in Step 5. Indicated pressure reading should agree with the temperature corrected value within plus or minus 100 PSI.

If the precharge pressure, indicated on the pressure gauge, exceeds 150 PSI below the corrected precharge pressure value determined in Step 5 it will be necessary to add nitrogen and restore precharge pressure to the corrected value.

Due to the natural process of osmosis (the slow diffusion of gas through the pores of the separator bag), it is possible to experience a slight decrease in the precharge pressure. This diffused gas will become entrapped in the upper section of the accumulator shell. **Upon bleeding system pressure to zero, this free gas may be discharged through the reservoir filler-breather cap.** This is a normal condition and not an indication of a damaged or ruptured separator bag.

The accumulator separator bag is precharged with "dry nitrogen gas" to the pressure specified on the operator nameplate. To avoid false accumulator precharge readings, a minimum waiting period of 10 minutes is necessary, after either adding nitrogen to separator bag or draining system pressure to zero PSI, before taking readings.

During the addition of nitrogen, compression of the gas in the accumulator separator bag is adiabatic and follows Boyle's Law. As precharge pressure is raised, the temperature of the gas goes up resulting in an initial false high pressure reading unless waiting period, to allow gas temperature and pressure to stabilize and drop to ambient, is observed.

### OPTIONAL GAUGING AND PRECHARGING DEVICE (Ref. Fig. 13A & 13D)

An optional gauging head assembly and charging hose assembly is available.

The gauging head assembly consists of a gas chuck (1312), a bleeder valve (1313), a gas charging (tank) valve (1304) and pressure gauge (1303) mounted into an adapter (1310) which is mounted directly on the gas valve of the accumulator.

The charging hose assembly (1302) is used to connect the gauging head assembly (1301) to the nitrogen bottle. It consists of a 10 foot hose (1306) with a swivel connector (1305) at one end and a gland nut assembly (1308) and (1309) at the other.

#### NOTE

*Ref. Fig. 13D*

*Several changes have been made in the ASAB57.1 and The Compressed Gas Association CGA-B96 standards in designated oil pumped dry nitrogen gas valve outlet connections. The earlier CGA-550 valve outlet connection standard was briefly replaced by the CGA-590 connection which was later replaced by the CGA-580 connection as their latest standard.*

*Optional charging hose assemblies are furnished with a mating gland nipple and gland nut to match up with the latest CGA-580 nitrogen cylinder gas valve outlet connection.*

#### NOTE

*Request CGA identification of the N<sub>2</sub> outlet connection when ordering cylinders. If the cylinder outlet does not match the hose connector, request the required CGA adapter.*

Refer to Fig. 13D showing details of the three different CGA valve outlet connections involved for a visual identification of the correct CGA adapter if required.

If the local gas supplier has changed over completely to the latest CGA-580 nitrogen gas valve outlet connection, older charging hose assemblies can be updated by simply replacing the present gland nipple (1308) and gland nut (1309) with a new CGA-583 nipple and CGA-584 gland nut available from the gas supplier.

18. Close valve on nitrogen bottle securely. Remove charging hose assembly (1302) quickly. A slight release of pressure will be evident when hose assembly is removed. This is caused by nitrogen which was trapped in hose and does not affect accumulator precharge.
19. With gauging head assembly (1301) still in position, wait approximately one hour, if possible, for temperature of nitrogen precharge to adjust to ambient conditions. If indicated precharge is too high, decrease gradually through bleeder valve (1313).

**NOTE**

*It is essential that the  $N_2$  precharge temperature be allowed to stabilize. Compression of the gas causes an initial temperature rise resulting in a false pressure reading.*

20. Turn bar handle (1311) counterclockwise allowing valve core to reset. Remove gauging head (1301). Check for leakage by placing a few drops of oil in accumulator gas valve.
21. Lubricate dyna-seal washer (1354) lightly with vaseline and replace valve guard (1353). After installing hand tight, snug up lightly with wrench to compress resilient portion of dyna-seal.

**CAUTION**

**DO NOT OVERTIGHTEN**

**FITTINGS (Ref. Fig. 16 & 17)**

The hydraulic tube fittings used throughout this system are of the flareless tube type requiring no special tools for assembly.

Where possible, tube fittings which incorporate the new SAE straight thread with "O-Ring" seal, at the port assembly, are used. Where components are not available with the new style ports, fittings with standard "Dry-Seal" pipe threads are used.

Tube fittings used throughout the hydraulic system are Weatherhead "ERMETO" 700 series with but two exceptions. Tube fittings (3001 & 309, Fig. 3) on cylinder by-pass tube are Lenz Company "A" series per Fig. 17.

**HYDRAULIC TUBING**

Cold drawn, soft annealed, low carbon steel hydraulic tubing conforming to the J.I.C. Hydraulic Standards for Industrial Equipment is used throughout the hydraulic system. The outside diameter of this tubing is cadmium plated to resist corrosion.

## TO CHECK ACCUMULATOR PRECHARGE (With Auxiliary Gauging Device)

8. Follow procedure outlined in Steps 1 through 5.
9. To install the gauging head assembly (1301), retract valve core depressor shaft in gas chuck (1312) by turning bar handle (1311) counter-clockwise until it stops rotating. Mount swivel of gas chuck on accumulator gas valve stem, compressing gasket in swivel to prevent gas leakage.
10. Check precharge pressure by turning bar handle (1311) clockwise until shaft depresses valve core in gas valve of accumulator. Read pre-charge pressure on gauge (1303). Compare this pressure reading with temperature corrected value determined in Step 5.
11. If precharge pressure is at required level, turn bar handle (1311) counter-clockwise allowing valve core to reseat. Remove gauging head assembly (1301). Lubricate dyna-seal washer lightly with vaseline and replace valve guard.
12. If precharge pressure is low, leave gauging head assembly in place with valve core (1356) depressed as in step 10 and proceed to "To Precharge Accumulator."

## TO PRECHARGE ACCUMULATOR (Ref Fig. 13A & 13C)

### NOTE

*System Pressure must be at 0 PSI and pressure bleed down valve in its' open position.*

### CAUTION

*Only dry nitrogen is acceptable for charging the accumulator.*

13. Remove valve guard (1353) and dyna-seal washer (1354) from accumulator gas valve using wrench on both guard (1353) and lock nut (1355) immediately below.

### CAUTION

*Failure to use two wrenches can result in damage to the separator bag.*

14. Install gauging head assembly (1301) per step 9 and depress valve core (1356) per step 10.
15. Attach Swivel Connector (1305) of Charging Hose Assembly (1302) to Tank Valve Assembly (1304) and hand tighten sufficiently to produce a leak-proof joint.
16. Attach Gland Nut (1309) to Valve Connection at top of Nitrogen Bottle.
17. Proceed to inflate accumulator bladder to a value approximately 200 psi above the required **temperature corrected pressure** determined in step 5. By opening valve on nitrogen bottle slowly, losing valve occasionally to allow needle on pressure gauge (1303) to settle in position, thus recording the gas precharge pressure in the accumulator. (This indicated pressure will decrease slightly as temperature adjustments take place.)

### CAUTION

*Exercise care if the accumulator is at low N<sub>2</sub> pressure of 25 psi or less. Crack the cylinder valve slowly and admit gas in small increments. A pressure regulator may be used to check the flow rate of high pressure gas.*

## **PRESSURE SWITCHES (Ref. Fig. 7A)**

Pressure switches furnished with this operator are of the Bourdon tube type and utilize a micro switch as the electrical switching element.

The Barksdale Pressure Switch (Fig. 7A) adjusting screw has a built in locking device and requires no separate locking screw.

### **MOTOR SWITCH (63M)**

An automatic motor-control pressure switch is provided and so set that it starts the power pump when system pressure drops to a predetermined value and stops the pump when normal operating pressure has been restored.

Adjusting screw (3) is used to set the switch to open at normal operating pressure. Adjustment is to be made on rising pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

### **ALARM SWITCH (63A)**

A low pressure alarm switch is provided which is arranged to operate a bell alarm or annunciator if, for any reason, the pressure drops below a predetermined value. 63A switch is normally open and is operated by the same Bourdon tube as 63C switch.

Adjustment screw (4) is used to set the switch to close at alarm pressure. Adjustment is to be made on falling pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

### **LOCKOUT SWITCH (63C)**

An automatic lockout pressure switch is provided and so set that when the pressure drops below a predetermined value the switch contacts open, rendering the closing circuit inoperative and when sufficient pressure has been restored the switch contacts reclose. This eliminates the possibility of starting a closing operation when pressure is too low to complete the operation.

Adjustment screw (4) is used to set the switch to open at lockout pressure. Adjustment is to be made on falling pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

### **ANTI-PUMP RELAY - 52Y (Ref. Fig. 3, 3A & 9)**

Once the closing solenoid (364) has tripped the pilot latch (368), the pilot springs (370) take over to mechanically actuate the pilot valve. As the actuating bar (359) moves upward, it raises the pilot reset arm (374) which directly actuates the arm of limit switch (3001) closing 52aa contacts.

As the 52aa contacts are closed, the anti-pump relay (52Y) is energized. The normally closed contact (52Y1) is opened de-energizing the closing solenoid (52C) allowing the solenoid armature (363) to return to its normal de-energized position in sufficient time for the pilot latch (368) to be reset.

The normally open contact (52Y2) closes, establishing an anti-pump circuit through the 52Y2 contact maintaining the (52Y1) contact in the open position as long as the closing switch (01C) is held in the closed position, thus preventing re-energization of the closing solenoid (52C) and subsequent pumping.

## AUXILIARY CONTROL EQUIPMENT

### Q-9 AUXILIARY SWITCH (Ref. Fig. 8)

This operator is supplied with a 10-stage Q-9 Auxiliary switch as standard equipment. This switch is mounted on the back panel of the operator housing and is connected to the output shaft of the operator through an adjustable linkage.

Each rotor contact (818) may be readily set to function as an "a" or "b" stage as required, or may be adjusted to intermediate settings in steps of  $22\frac{1}{2}$  degrees.

To adjust the "making" or "breaking" point of any stage:

- a. Using a pair of needle nose pliers, press the rotor contact (818) sideways against rotor contact spring (802). This disengages pin on driving hub (817) from rotor contact (818).
- b. Move rotor contact (818) in the desired "advanced" or "retarded" direction as desired. Release pressure against rotor contact spring and allow locking pin to re-engage rotor contact as new position.

The drive linkage is normally adjusted to provide a 90 degree rotation of rotor contacts (818). This adjustment is made by changing the projection height of the threaded eye end used at the operator output shaft.

Fine adjustment of rotor contact position relative to breaker "full open" or "full close" position, is made by changing the length of the connecting rod by adjusting position of threaded yoke end provided for this purpose.

#### NOTE

*The last two adjustments change the position of all stages simultaneously.*

When auxiliary switches are furnished, on special order only, with the number of stages greater than standard, a second switch assembly is provided immediately below the standard unit. Both switch assemblies are linked together with an adjustable connection.

Adjustment of both units is identical with that described above with one exception. Fine adjustment of the added unit is made by adjusting position of the threaded yoke end provided on the interconnecting linkage.

### LATCH CHECK SWITCH (Ref. Fig. 15)

The latch check switch mounted on the side of the operator frame is used for a dual function.

1. It is used to prevent the operator from attempting to close the breaker if the trip-free mechanism is not recoupled.
2. The switch has an adjustable timing head attached that allows the closing of the switch contacts to be delayed so that the reclosing time of the breaker may be varied from minimum to approximately 60 cycles.

## **OPERATION**

### **CLOSING, MECHANICAL SEQUENCE (Ref. Fig. 3, 3A, 4, 4A)**

Before the operating mechanism may be electrically or manually operated for high speed closing of the circuit breaker, the hydraulic system should be at normal operating pressure.

Armature (363) of closing solenoid (364) must be in the solenoid de-energized position, and pilot latch (368) in the latched position as shown, allowing fluid pressure to build up above the piston (332) in cylinder (329) and tube (311). When fluid pressure is raised to normal operating pressure, the system is then ready for "power" operation.

Operation of the control switch energizes the pilot valve closing solenoid (364) causing armature (363) to push pilot latch (368) off latch roll (367) allowing pilot springs (370) to raise actuating bar (359) and plunger (354) thereby seating pilot exhaust ball (353). Pilot valve high pressure ball (350) is simultaneously lifted from its seat through the action of push rod (351) allowing fluid at full system pressure to flow to pilot piston chamber causing pilot piston (335) to shift horizontally seating main control valve exhaust ball (334). Simultaneously through push rod (318), main control valve high pressure ball (317) is lifted from its seat allowing fluid at full system pressure to flow into lower chamber forcing piston (332) and ram (330) upward.

Through the action of the ram (330) on RAM roll (413) the toggle joint is raised until the prop latch (416) drops under the RAM roll (413), latching the toggle joint in the closed position. During the upward travel of the toggle joint, toggle links (413 & 430) working through the output crank (425) rotate crank clockwise on shaft (423) to close circuit breaker through operating rod which is attached to end of output crank (425). Overtravel of RAM roll (413), and RAM roll shaft (414) is checked by resilient overtravel stop (401) through the absorption of the kinetic energy of toggle links (413 & 430).

Near the end of the piston's closing stroke, disc (324) attached to the lower end of lower ram (322) actuates the pilot reset arm (374) forcing actuating bar (359) downward compressing pilot spring (370) and allowing spring (361) to reset pilot latch (368).

As actuating bar (359) is moved downward, plunger (354) is moved downward by plunger reset spring (355) allowing pilot valve balls (350 & 353) to return to their normal position as shown. Exhausting of high pressure fluid behind pilot piston (335) allows spring (316) to return main control valve high pressure ball (317) to its seat and lift main control valve exhaust ball (334) from its seat thereby connecting lower chamber to reservoir. With high pressure ball (317) seated, high pressure fluid on top of piston (332) forces piston and ram (330) downward exhausting fluid under piston (332) to reservoir.

### **CLOSING - ELECTRICAL SEQUENCE (Ref. Fig. 3A & 9)**

With the accumulator at full operating pressure, the closing of the breaker is initiated by the closing of control switch contacts (O1C) to energize the closing solenoid (52C) through the contacts of recloser cut-off switch (69), low pressure lock out switch (63C), auxiliary switch (52b), latch check switch (52LC) and anti-pump relay contact (52Y1).

Once the closing solenoid (52C) is energized, the (52aa) switch is mechanically actuated energizing the anti-pump relay (52Y) opening the normally closed (52Y1) contact and de-energizing the closing solenoid (52C).

The normally open contact (52Y2) closes, establishing an anti-pump circuit through the (52Y) coil maintaining the (52Y1) contact in the open position as long as the closing switch (O1C) is held in closed position, thus preventing re-energization of the closing solenoid (52C) and subsequent pumping.



## **PRESSURE SWITCHES (Ref. Fig. 7A)**

Pressure switches furnished with this operator are of the Bourdon tube type and utilize a micro switch as the electrical switching element.

The Barksdale Pressure Switch (Fig. 7A) adjusting screw has a built in locking device and requires no separate locking screw.

### **MOTOR SWITCH (63M)**

An automatic motor-control pressure switch is provided and so set that it starts the power pump when system pressure drops to a predetermined value and stops the pump when normal operating pressure has been restored.

Adjusting screw (3) is used to set the switch to open at normal operating pressure. Adjustment is to be made on rising pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

### **ALARM SWITCH (63A)**

A low pressure alarm switch is provided which is arranged to operate a bell alarm or annunciator if for any reason, the pressure drops below a predetermined value. 63A switch is normally open and operated by the same Bourdon tube as 63C switch.

Adjustment screw (4) is used to set the switch to close at alarm pressure. Adjustment is to be made on falling pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

### **LOCKOUT SWITCH (63C)**

An automatic lockout pressure switch is provided and so set that when the pressure drops below a predetermined value the switch contacts open, rendering the closing circuit inoperative and when sufficient pressure has been restored the switch contacts reclose. This eliminates the possibility of starting a closing operation when pressure is too low to complete the operation.

Adjustment screw (4) is used to set the switch to open at lockout pressure. Adjustment is to be made on falling pressure.

**REFER TO OPERATOR NAMEPLATE FOR PROPER SETTING.**

## **ANTI-PUMP RELAY - 52Y (Ref. Fig. 3, 3A & 9)**

Once the closing solenoid (364) has tripped the pilot latch (368), the pilot springs (370) take over to mechanically actuate the pilot valve. As the actuating bar (359) moves upward, it raises the pilot reset arm (374) which directly actuates the arm of limit switch (3001) closing 52aa contacts.

As the 52aa contacts are closed, the anti-pump relay (52Y) is energized. The normally closed contact (52Y1) is opened de-energizing the closing solenoid (52C) allowing the solenoid armature (363) to return to its normal de-energized position in sufficient time for the pilot latch (368) to be reset.

The normally open contact (52Y2) closes, establishing an anti-pump circuit through the 52Y coil maintaining the (52Y1) contact in the open position as long as the closing switch (O1C) is held in the closed position, thus preventing re-energization of the closing solenoid (52C) and subsequent pumping.

## AUXILIARY CONTROL EQUIPMENT

### Q-9 AUXILIARY SWITCH (Ref. Fig. 8)

This operator is supplied with a 10-stage Q-9 Auxiliary switch as standard equipment. This switch is mounted on the back panel of the operator housing and is connected to the output shaft of the operator through an adjustable linkage.

Each rotor contact (818) may be readily set to function as an "a" or "b" stage as required, or may be adjusted to intermediate settings in steps of  $22\frac{1}{2}$  degrees.

To adjust the "making" or "breaking" point of any stage:

- a. Using a pair of needle nose pliers, press the rotor contact (818) sideways against rotor contact spring (802). This disengages pin on driving hub (817) from rotor contact (818).
- b. Move rotor contact (818) in the desired "advanced" or "retarded" direction as desired. Release pressure against rotor contact spring and allow locking pin to re-engage rotor contact as new position.

The drive linkage is normally adjusted to provide a 90 degree rotation of rotor contacts (818). This adjustment is made by changing the projection height of the threaded eye end used at the operator output shaft.

Fine adjustment of rotor contact position relative to breaker "full open" or "full close" position, is made by changing the length of the connecting rod by adjusting position of threaded yoke end provided for this purpose.

#### NOTE

*The last two adjustments change the position of all stages simultaneously.*

When auxiliary switches are furnished, on special order only, with the number of stages greater than standard, a second switch assembly is provided immediately below the standard unit. Both switch assemblies are linked together with an adjustable connection.

Adjustment of both units is identical with that described above with one exception. Fine adjustment of the added unit is made by adjusting position of the threaded yoke end provided on the interconnecting linkage.

### LATCH CHECK SWITCH (Ref. Fig. 15)

The latch check switch mounted on the side of the operator frame is used for a dual function.

1. It is used to prevent the operator from attempting to close the breaker if the trip-free mechanism is not recoupled.
2. The switch has an adjustable timing head attached that allows the closing of the switch contacts to be delayed so that the reclosing time of the breaker may be varied from minimum to approximately 60 cycles.

### **LIMIT SWITCH - 52aa (Refer Fig. 3B)**

This switch is mechanically actuated by the pilot reset arm (374) during a breaker closing operation. Its function is to provide position sequential control of the 52Y relay and establish the anti-pump circuit.

Reset of the 52aa switch occurs at the completion of the breaker closing stroke along with the reset of the pilot latch (368).

### **HAND TRIPPING**

A hand tripping device is provided which will permit tripping of the circuit breaker from the outside of operator cabinet by mechanical means and open the reclosing circuit through a cut-off switch at the same time. This prevents a reclosing of the circuit breaker upon a manual tripping of breaker by this device.

Releasing of hand trip device will restore mechanism to non-trip position. The cut-off switch, however, remains in open circuit position until it is reset manually.

### **HEATER**

Within the operator cabinet is a heating element continuously energized without a thermostat. Its purpose is to reduce inside condensation by maintaining a higher temperature within the cabinet than outside it.

### **OPERATIONS COUNTER**

The standard operations counter furnished is electrically operated and is normally connected to the closing circuit.

An optional mechanically actuated operations counter is available to provide count on trip.

### **HIGH SPEED AUXILIARY SWITCH (Ref. to Fig. 18)**

The high speed auxiliary switch (when furnished) is located on the right side of the operating mechanism, and to the rear.

It is normally a two pole switch and is designed for contact actuation during the initial opening stroke of the breaker. It is furnished either one pole contact normally open and one pole contact normally closed, or both poles either contacts normally open or normally closed, according to the user's requirements.

The contact actuation may be timed by rotating cams (1809) and (1811) about pivot pin (1808) after which clamp bolt (1806) is securely tightened.

Vertical setting "M" is  $.031 \pm .010$  and is obtained by adding or removing washers (1802) between bracket (1801) and contact assembly (1803).

Thus through the contacts of reclosing relay (79), lockout switch (63C), auxiliary switch (52b), timed latch check switch (52LC), and anti-pump contact (52Y1) the closing solenoid (52C) is energized quickly reclose the breaker as described under **CLOSING, MECHANICAL SEQUENCE**. The retrieving action of the mechanism is such that the operator mechanism has been retrieved before the breaker reaches its full open position. Therefore, high speed reclosing is dependent upon the adjustment of the timed latch check switch (52LC) and not the auxiliary switch (52b) as is usual. The auxiliary switch is in the closing circuit only to prevent the operator ram from damaging the linkage if it is already latched in the breaker closed position.

Due to the high speed return of piston and ram to normal position, the trip-free linkage quickly retrieves again to allow a second high speed reclosure of the mechanism if required. The number of successive high speed reclosures is limited only by the number of operations available from the storage capacity of the accumulator and the setting of the lock-out switch.

### **MANUAL OPERATION FOR MAINTENANCE (Ref. Fig. 2 & 3)**

(Before proceeding, see Section 40 for installation and operation of maintenance closing device).



**DANGER**



*Do not use the closing device with breaker energized or control power connected, or when the PNEU-DRAULIC operator system bleed valve is closed. System pressure must be at 0 PSI.*

Open D.C. Control Power Switch.

Drop system pressure to zero by opening pressure bleed valve in line between control valve and reservoir. To avoid foaming, pressure drop should be accomplished in small increments allowing a slight pause between drops. Leave pressure bleed valve in open position.

**CAUTION**

*Block release latch (Fig. 4C, IT 473) in position while working on breaker in closed position to prevent accidental tripping.*

Install maintenance closing device.

Close breaker to full closed, or desired position by operation of hydraulic jack.

To open breaker slowly, open bleed valve on hydraulic jack slightly, allowing mechanism to open. If mechanism is latched closed, raise ram roll shaft (414) to uppermost position by additional operation of hydraulic jack. Block prop latch (416) out of way and open bleed valve on hydraulic jack slightly. This allows the force exerted by the breaker load, through the operator linkage, to force ram (330) downward to the open position. To insure that the ram is fully reset, pressure is required in the hydraulic system.

## FULL SPEED CLOSING, MANUAL OPERATION (Ref. Fig. 3A)

The closing operations previously described, were for power closing through the energization of closing solenoid (364).

To provide for manual full speed closing, with hydraulic system at normal operating pressure, a mechanically trip-free manual operating device is provided.

To close breaker manually, lift manual lever (388) slightly upward to clear stop in bracket (393) and pull forward. Lever, through rotation about pin (392), will contact pin extension of pilot latch (368) causing pilot latch to rotate and release latch roll (367) initiating a closing sequence identical with that described under **CLOSING, MECHANICAL SEQUENCE**.

Release of manual lever (388) allows lever reset spring (394) to return manual lever to its normal position.

### CAUTION

*Do not operate the manual close lever if the system pressure is below the lockout value.*

## OPENING - MECHANICAL SEQUENCE (Ref. Fig. 3, 4, 4A & 4C)

Normal opening is a function requiring the breaker to be closed, all mechanisms at rest and with the ram roll shaft (414) held up by prop latch (416) under ram roll (413), and the piston (331) and ram (331) in their normal down or reset position.

The operator trip solenoid (476) when energized by control switch or fault responsive relays, forces trip pin (474) to the left causing release latch (473) to rotate counter-clockwise. Rotation of release latch (473) permits the breaker load to force trip latch (492) off trip latch roll (407) which releases trip toggle crank (410) to rotate counter-clockwise. This motion allows ram roll (413) to be forced to the left and drop off prop latch (416). When the ram roll is free to move downward, under the influence of operator reset springs (427), output crank (425) is rotated counter-clockwise by the breaker load. In addition to ram roll shaft (413) moving to the down (open) position, the collapse of toggle links (415 & 430) causes the trip toggle crank (410) to rotate clockwise until the trip latch roll (407) returns to its stop (411). This is immediately followed by the reset of latches (492) and (473). The operator is now relatched and in the open position and is ready to be closed.

## OPENING, ELECTRICAL SEQUENCE (Ref. Fig. 9)

Opening of the breaker is initiated by the closing of the control switch (01T) which energizes the trip coil (52T) through the auxiliary switch contacts (52a). Early in the opening stroke, the auxiliary switch contacts (52a) open, cutting off the current to the trip coil (52T).

## RECLOSING

With the circuit breaker closed and carrying its normal load, assume that the line to which it is connected is suddenly subjected to a fault. The operator trip circuit will become energized through the action of the fault responsive relays, thereby opening the circuit breaker as described under "OPENING". In the process of opening the operator mechanism, trip toggle crank (410) is rotated counter-clockwise causing cam (1510) attached to toggle crank to open the latch check switch. The opening of the latch check switch prevents energization of the pilot valve solenoid coil (365, Figure 3A) until the mechanism is fully retrieved. When the mechanism is fully retrieved, the latch check contacts close after the timing head times out and the circuit is completed permitting a breaker closing operation.

## ADJUSTMENTS

### GENERAL

All of the mechanism has been checked, adjusted, and tested before leaving the factory. However, it is advisable to check the following to be sure that no changes have occurred during the shipping and handling of this equipment.

All preliminary inspection should be made using the maintenance closing device for operation of breaker. Electrical operation should not be attempted until adjustments have been checked and final inspection made.



**DANGER**



**KEEP HANDS FREE OF THE BREAKER WHILE THE OPERATOR OR JACK IS DESCENDING.**

*When using the maintenance closing device on breakers with pneudraulic operators, the accumulator pressure must be at zero and the pressure bleed valve between accumulator and oil reservoir must be left open.*

### OPERATOR MECHANISM ADJUSTMENT SETTINGS

Refer to Figure 4 for tabular listing of all settings. For specific instructions on how to obtain these values, refer to the adjustment procedure table following.

SETTING	MECHANISM ADJUSTMENT PROCEDURE	REFERENCE FIGURE
NOTE: *	Settings A, B, C, D, E and F must be made in the sequence specified below and with the operator in the open position	
	With trip solenoid armature solidly against its pole head and trip pin (item 474) solidly against the armature: (tripped position)	4C
*A	Add or remove shims, (item 475) to provide a latch release clearance (Setting "A") of $.050 \pm .010$	4C
*B	Adjust stop screw, (item 481) to make setting "B" $.020 \pm .010$ when "A" is $.050$ as described above	4C
With release latch (473) in the reset or engaged position		
*C	Adjust stop screw (480) to make overlap of release latch to face of trip latch (492) $.062 + .031, -.000$ (Setting "C")	4C
*D	Gap of $.031 + .010$ (Setting "D") must be provided between pin (474) and release latch (473). To adjust add or remove shims (489)	4C
*E	With trip latch (492) solidly against stop screw (482) and release latch in engaged position, adjust screw (482) to provide a $.016 + .016, -.000$ gap between prop latch and release latch (Setting "E")	4C
F	With trip latch roll (407) resting on trip toggle stop screw (411) adjust screw to provide a clearance between roll (407) and trip latch (492, Figure 4C) of $.010 + .010, -.000$ (Setting "F") then tighten locking nuts securely	4A

If mechanism should be accidentally tripped while closing breaker, remove hydraulic jack. Close pressure bleed valve and lower ram by operating either hand or power pump. After mechanism has reset, open pressure bleed valve, replace hydraulic jack and proceed as before.

After manual operation as described, the following steps must be followed:

1. Remove maintenance closing device and store in a safe place. Electrical operation should never be performed with hydraulic jack in place.
2. Remove any blocking behind prop latch (416).
3. Close pressure bleed valve.

The system is now ready to raise pressure for power operation.

After system pressure has built up to a value greater than pre-charge, reconnect D.C. Control Power.

## PILOT VALVE ADJUSTMENTS (Ref. Fig. 3 & 3A)

### NOTE

*Pilot valve adjustments are made with the pilot latch (368) in latched position and in the order of K, L, and H. If performed carefully, adjustment K can be checked with the system at normal operating pressure. The equipment is factory-adjusted and normally should require no field adjustment.*

### Pushrod Gap Adjustment K

The setting of the pushrod gap (adjustment K in Figure 3A) regulates the free travel of pushrod (351), to ensure proper seating of the pilot pressure ball (350).

The distance of free travel can be checked by measuring the gap between the plunger (354) and actuator bar (359). Proceed as follows:

1. Insert the blade of a small screwdriver in the special groove provided for this purpose at the lower end of plunger (354).



**DANGER**



*Exercise care when performing the check with the system under pressure. Keep clear of the pilot reset arm and avoid unseating the pilot pressure ball, as otherwise the control valve will actuate and operate the breaker.*

2. Carefully raise the plunger until the resistance of the seated pressure ball can be felt. Do not force the ball from its seat.
3. Use a feeler gauge to measure the gap between plunger and actuating bar. The measurement should be 1/16, plus 1/32 and minus 0 inches.

In case adjustment is necessary, the pilot valve closing mechanism portion can be raised or lowered by adding or removing spacers 366. These spacers are open-sided for easy removal or insertion.

### Static Overtravel Adjustment L

To check the overtravel of the pilot reset arm (adjustment L in Figure 3A), the maintenance closing device must be used.

1. Disconnect control power and let down hydraulic pressure by opening the system bleed valve.
2. Install the maintenance closing device (Refer to Section 40).
3. Jack up the ram to the upper limit of stroke. Do not attempt to force the ram past the upper limit.
4. Measure the gap between the face of pilot latch (368) and latch roll (367). The overtravel measurement should be 0.060,  $\pm$  0.020 inches.

Adjustment can be made by changing the position of disc 324 through the relocation of spacers above or below the disc, as required. Do not remove any of the spacers. (323 or 3012)



<b>NOTE:</b> <b>**</b>	Settings G and HH must be made in sequence and with the operator in the closed position	
With ram 339 of Pneu-Draulic cylinder jacked to maximum height:		
<b>**G</b>	<p>Add or remove adjusting washers (304) to obtain a latch clearance (Setting "G") of <math>.030 + .030 - .000</math></p> <p>The ram cap (303) is threaded into the top end of the ram (330). Locking is provided by the wedging action of the tapered locking plug (346) against the split lower section of the ram cap. To remove the ram cap (303) for adding or subtracting of adjusting washers (304), secure the ram (330) from turning by use of a strap wrench or pin. Using a <math>\frac{3}{8}</math>" square key stock as a wrench, loosen the locking plug (346) to release wedging action by turning clockwise. With a pin or strap wrench, remove the ram cap (303) by turning it clockwise. Add or subtract the required number of adjusting washers (304) and replace the ram cap. Tighten the ram cap by turning it clockwise and lock in position by tightening the tapered locking plug (346) in a counter-clockwise direction.</p>	<p>4</p> <p>3</p>
With ram roll 413 resting on prop latch 416		
<b>**HH</b>	Add or remove spacer plates (404) to obtain a roll clearance (Setting "HH") of $.10 \pm .02$	4A
<b>I</b>	With breaker in open position, add or remove shim plates under breaker shock absorber to obtain a roll clearance (Setting "I") of $.005$ to $.313$	See Brkr. Instr. Book

## SUMMARY OF PILOT VALVE ADJUSTMENTS.

See Text following for greater detail of adjustment procedures.

ADJUSTMENT	MEASUREMENT	METHOD OF ADJUSTMENT	REFERENCE FIGURE
K	<b>PUSH ROD</b> $+ .030$ $.060 - .000$	Changing Number of Spacers between Pilot Valve and Bracket	3A
L	<b>STATIC OVERTRAVEL</b> $.060 \quad .020$	Changing Position of Disc on Lower Ram	3A
H	<b>DYNAMIC OVERTRAVEL</b> $.060 \quad .020$	Adjustment Nut	3A
52aa Limit Switch	Contacts Open	Rotation of Switch	3B

## MAINTENANCE CLOSING DEVICE

This maintenance closing device supplied for this operator consists of a support on which is placed a closing jack.

To install this maintenance closing device, insert four studs through holes in support plate and screw to full depth of thread engagement in tapped holes provided on the lower surface of the main valve body. Adjust studs to provide proper levelling of support plate to insure each stud is taking its share of the load. The hydraulic jack may then be placed in position, care being taken to see that the jack plunger is centered with lower ram (322) of operating cylinder (Fig. 3).

The jack is equipped with a pressure release valve which should be closed before attempting to close the operator. This valve may be operated by means of the operating handle which has one end slotted for this purpose.

To operate the maintenance closing device, the operating handle is inserted in the hydraulic jack and the operator may then be closed as required. Prop latch (416, Fig. 4A) is in plain view and can be checked easily in the latched position.

Refer to Section 37 Manual Operation for Maintenance.

### CAUTION

*Always remove maintenance closing device and store in a safe place before operating breaker electrically. This will prevent any possibility of damage to equipment from device working off its supports during successive breaker operations.*

### CAUTION

*System pressure must be at zero and pressure bleed valve (Ref. Fig. 2) must be left in the open position during the jacking operation.*

## OIL

Check oil if jack fails to raise to full height. Lower ram completely. Cautiously remove filler screw on side of jack cylinder. Jack will take correct amount of oil while in this position. Use only oil recommended by jack manufacturer.



### DANGER



*Do not use the closing device with breaker energized or control power connected, or when the PNEU-DRAULIC operator system bleed valve is closed. System pressure must be at 0 PSI.*

**CAUTION**

*To avoid damage to the threaded end of stud (326), a clearance of 1/16, plus 1/16 and minus 0 inches, must be maintained between the end of the stud and the lower face of cap (325). This dimension is shown in Figure 3.*

**CAUTION**

*To prevent loosening and loss of adjustment, threads of cap 325 and stud 326 must be treated with Loctite Primer "T" and Loctite Grade 242 Sealant.*

### **Dynamic Overtravel Adjustment H**

The dynamic overtravel distance (adjustment H in the Figure 3A) is the clearance between stop tube 380 and actuating bar 359. To check and adjust the clearance, proceed as follows:

1. Install the maintenance closing device.
2. Jack up the ram to the limit of stroke. Do not attempt to force the ram past the upper limit.
3. Check the distance between the stop tube and upper washer. The measurement should be  $0.060 \pm 0.020$  inches.
4. Adjust the nut 372 as necessary to obtain the required clearance.

### **52aa Limit Switch Adjustment (Ref. Fig. 3B)**

The limit switch (Figure 3B) should not require re-adjustment. However, to check switch for proper operation after completion of adjustment "H" & "L" with ram still raised to the upper limits of its stroke:

1. Block prop latch out of the way.
2. With pilot latch 368 held in the tripped position, open pressure bleed valve on hydraulic jack slightly and allow breaker to open slowly until disc on lower ram is clear of pilot reset arm (374). At this position, contacts of limit switch (3001) should be closed with approximately .06 of overtravel of limit switch arm (3003) without arm striking switch case.
3. Jack breaker back toward closed position until pilot latch just snaps back into its reset position. At this position, contacts of limit switch should be open.

If the limit switch needs re-adjustment for proper switching sequence:

4. Repeat step 2 and loosen screw (3006).
5. Rotate limit switch around pivot screw "A" (3005) until switch contacts close. Then provide .06 overtravel of limit switch arm without arm hitting switch case.
6. Tighten screw (3006) to lock switch in position.
7. Repeat step 3.

## MAINTENANCE

### GENERAL

Upon the proper operation and maintenance of the oil circuit breaker depends the safety of the operators and the successful functioning of the connected apparatus; therefore, the operator must have regular, systematic, and thorough inspection.

Be sure that the operator and breaker are disconnected from all electric power before inspecting or repairing. Make sure that the pressure bleed valve is opened to bleed pressure to zero before working on breaker or operating mechanism.



**DANGER**



*Secure the operator against accidental tripping: Insert a wedge in the trip latch adjacent to its stop. Block the end of the large crank in the operator mechanism to the frame.*

### LUBRICATION

All Operators should have regular, systematic, and thorough inspection, and all bearing surfaces should be lubricated with a good quality, light, non-gumming lubricating oil (Artic Oil "C"), having a pour point below -40 degrees Fahrenheit.

### CONNECTIONS

Check all mechanical and electrical connections for tightness.

### ACCUMULATOR PRECHARGE

Accumulator precharge should be checked periodically referring to Figure 14 for temperature correction factor. Indicated factory settings were made at an average factory ambient temperature of plus 70°C. Variations from this ambient temperature will be reflected in precharge pressure values. See Section 35 for proper method of checking accumulator precharge.

If the precharge has dropped below its rated value (considering temperature factor) it should be recharged immediately. See Section 35 for proper method of precharging accumulator.

Check operator nameplate for proper precharge and pressure switch settings.

### FLUID LEVEL

Check fluid level in reservoir and replenish as necessary using hydraulic fluid to MIL-H-5606 specs. See Section 35 "HYDRAULIC FLUID" for list of approved hydraulic fluids.

### PRESSURE GAUGE

A Bourdon tube type pressure gauge is furnished to indicate hydraulic system pressure. This gauge is furnished with a restrictor to protect gauge against pressure surges, and a recalibrator to correct reading should it get out of adjustment.

Since accumulators are used in this hydraulic system, on bleeding system pressure to 0 psi, pressure will drop gradually until the precharge level is reached. At this point, however, due to the relative incompressibility of the hydraulic fluid the pressure will drop suddenly to 0 psi. As a result of this sudden drop in pressure, gauge needle may get out of calibration and not register exactly at 0 psi.

To readjust needle for proper reading, remove rim and gauge glass. Turn recalibrator screw, in dial face, in the opposite direction to which the needle should move until the needle stands at the proper zero position. Replace gauge glass and rim.

Pressure gauge is now properly recalibrated and will read correctly at all positions.

## **FINAL INSTALLING INSPECTION**

### **LUBRICATION**

This equipment should not be operated until the protective film of grease and any dirt accumulated in transit has been completely removed from all latch faces, latch rolls, and cylinder rams. Latch faces and latch rolls should then be covered with a light film of clean, good quality, light non-gumming lubricating oil having a pour point below -40 degrees Fahrenheit.

### **ADJUSTMENTS**

All operator adjustments should be checked in accordance with Section 38.

### **CONNECTIONS**

Check all mechanical and electrical connections for tightness. Examine hydraulic system for signs of leaks.

### **RESERVOIR**

With system at 0 PSI, check fluid level.

### **ACCUMULATOR PRECHARGE**

Refer to operator nameplate for proper precharge pressure. Check in accordance with Section 35.

### **WIRING**

Inspect all insulation on wiring and see that no damage has resulted during the process of installing the breaker.

Test the wiring for possible grounds or short circuits.

Make sure that all current carrying parts outside the oil circuit breaker have an adequate current carrying capacity and are correctly insulated in accordance with standard practice.

### **PRESSURE SWITCHES**

Refer to operator nameplate for proper setting. See Section 36 for adjusting instructions.

## **REPLACEMENT PARTS**

### **GENERAL**

When ordering replacement parts for a Siemens-Allis Oil Circuit Breaker Operator, it is very important to give complete information. This information should include:

1. Breaker serial number. (On breaker & operator name plates)
2. Type of Operator. (On operator name plate)
3. Type of breaker.
4. Rated amperes of breaker.
5. Rated voltage of breaker.
6. Description of Part — Use Instruction book description in so far as possible.
7. Operator Instruction Book number (On Breaker Nameplate)
8. Reference number.
9. Number of pieces required.

While the operator can be identified by the serial number alone, all additional information that is given will serve as a check to be certain that the part of parts furnished are correct for the operator in question. Without this serial number Siemens-Allis cannot be sure of the correct identity of desired parts.

If any doubt exists as to the instruction book reference number or the description, a dimensioned sketch of the desired part will help to properly identify it.

Siemens-Allis recommends that a supply of repair parts be kept on hand so that emergency repairs can be made without waiting for shipment of parts from the factory. A list of recommended spare parts is sent with the breaker.

Before removing any part to be replaced, observe its function and adjustment. This usually saves adjustment time during its installation.

## **HYDRAULIC TUBE CONNECTIONS**

Where possible, tube fittings which incorporate the new SAE Straight Thread with "O-Ring" seal at the port assembly are used. Where components are not available with SAE ports, fittings with "DRY-SEAL" pipe threads are used.

All "DRY-SEAL" connections have been treated with "Loctite Hydraulic Sealant" to provide leak free joints.

"Loctite Hydraulic Sealant" is an anerobic compound which forms a hard, solid resin bond in the threaded joint.

If for any reason these threaded joints are disturbed, the sealant bond is destroyed. The matching components of that must then be re-treated with "Loctite" primer and hydraulic sealant.

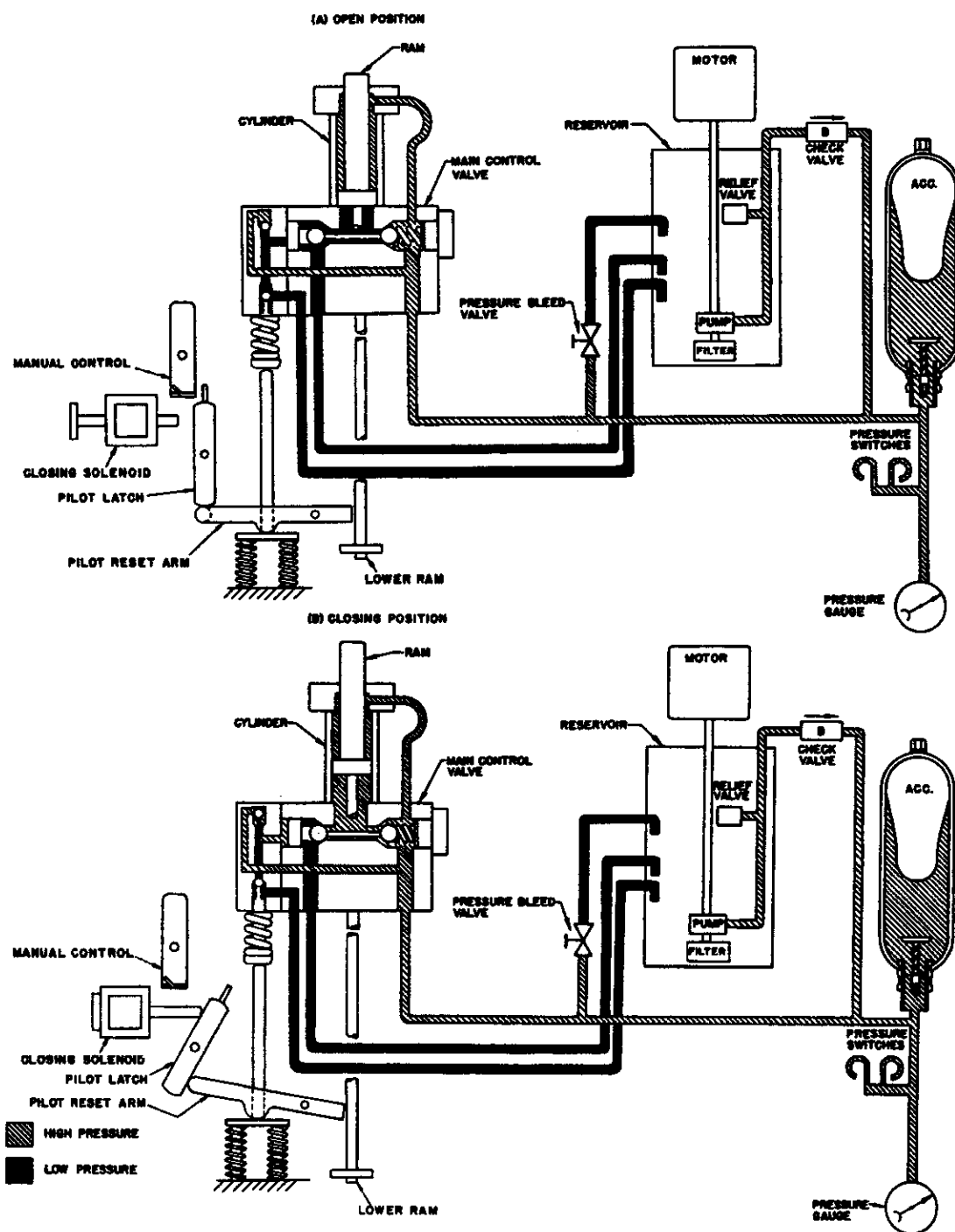


FIG. 2  
TYPICAL "PNEU-DRAULIC" OPERATOR  
FLUID SYSTEM

AUG. 9, 1977

72-410-318-401



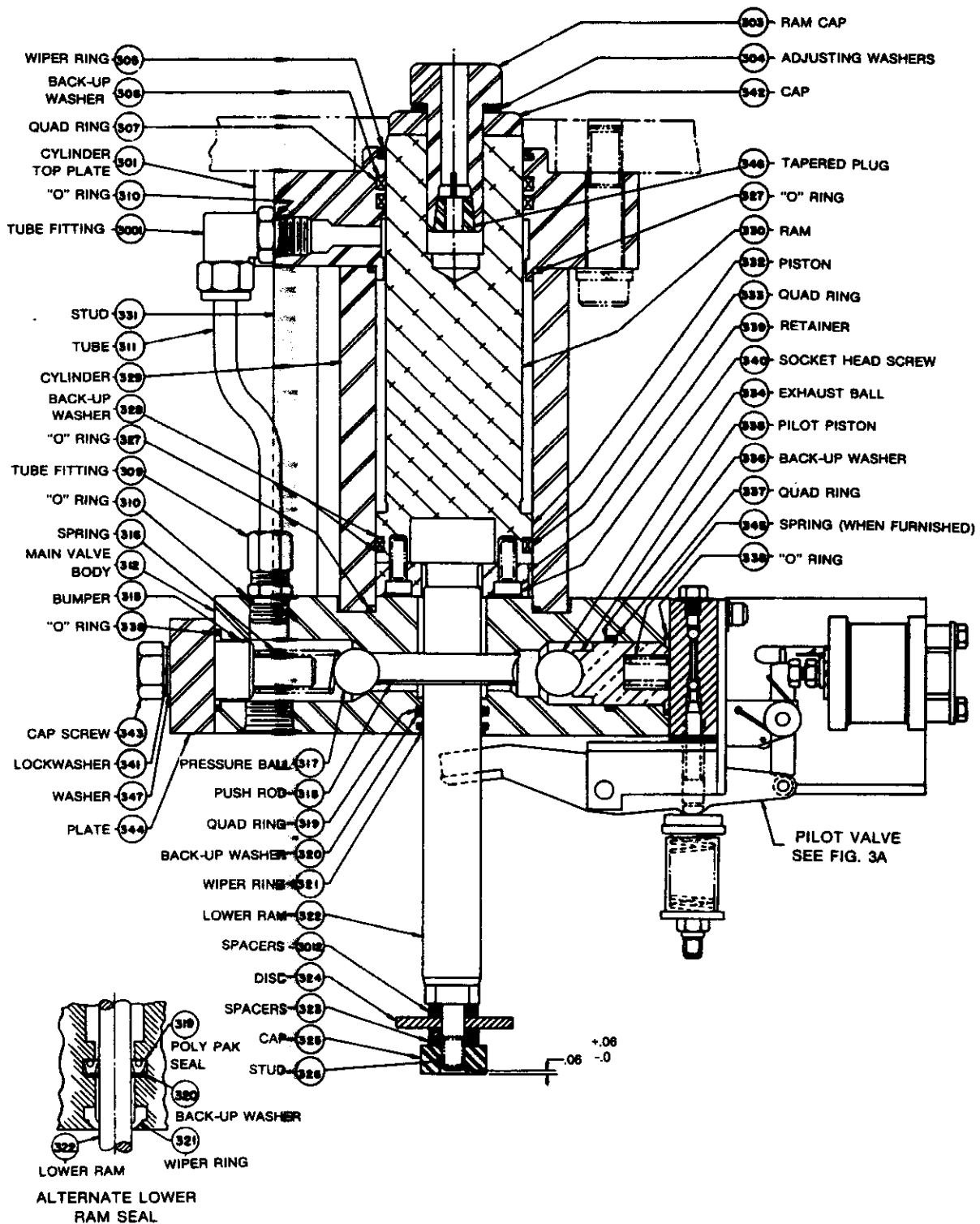


FIG. 3  
 TYPICAL "PNEU-DRAULIC" CYLINDER  
 AND VALVE ASSEMBLY

MAY 5, 1971

72-410-027-401

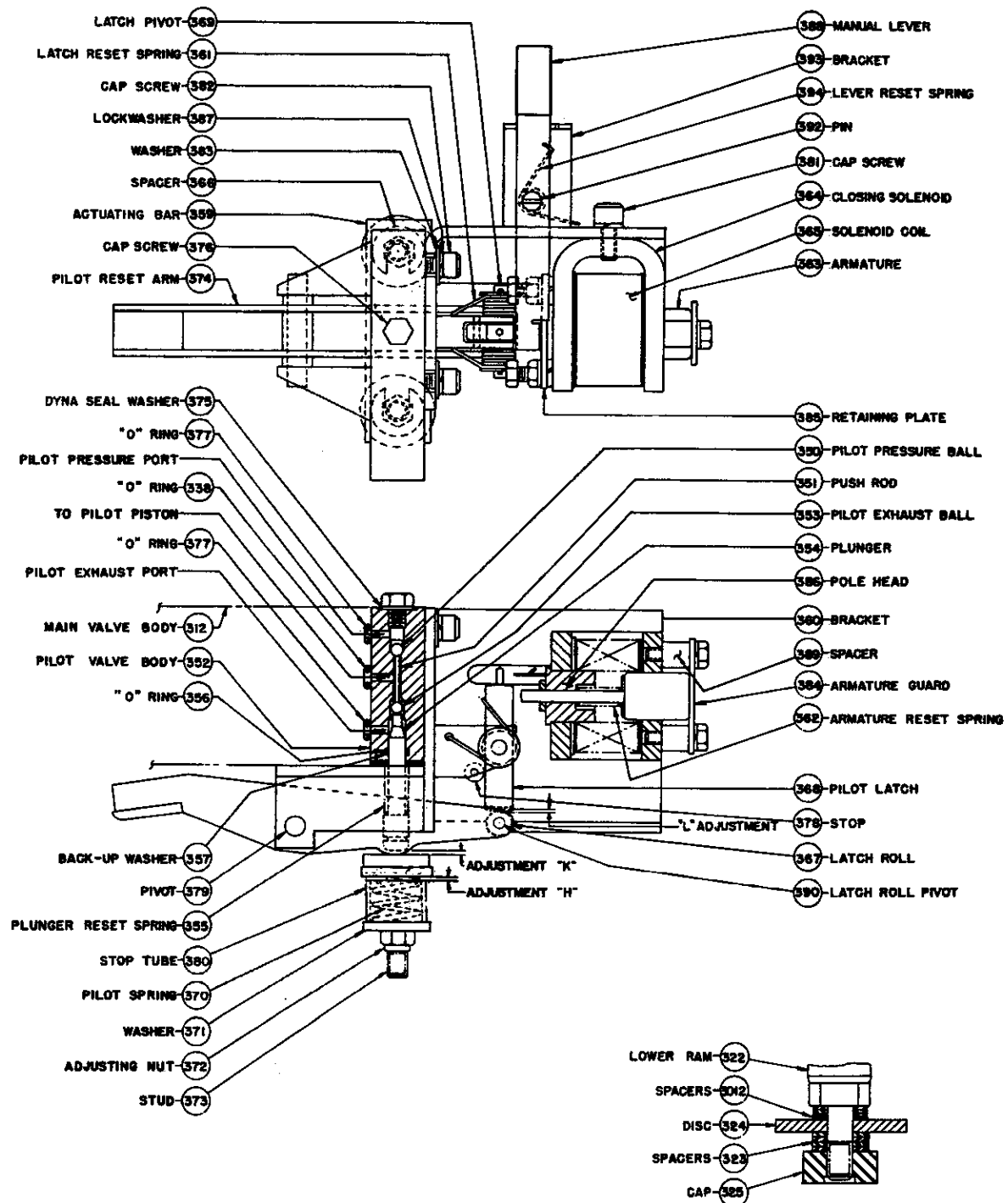


FIG. 3A  
TYPICAL PILOT VALVE

JUNE 14, 1965

71-401-767-401

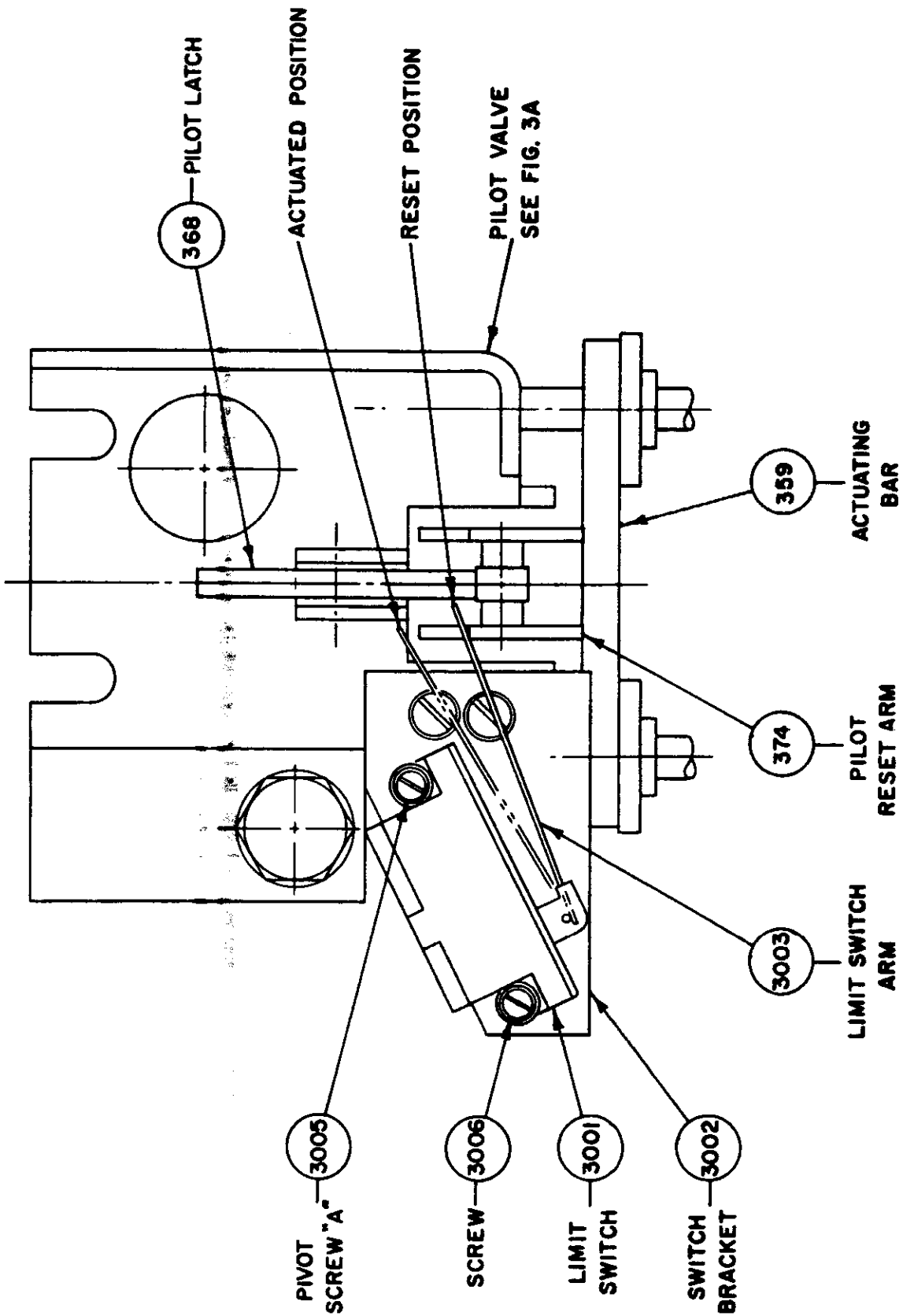
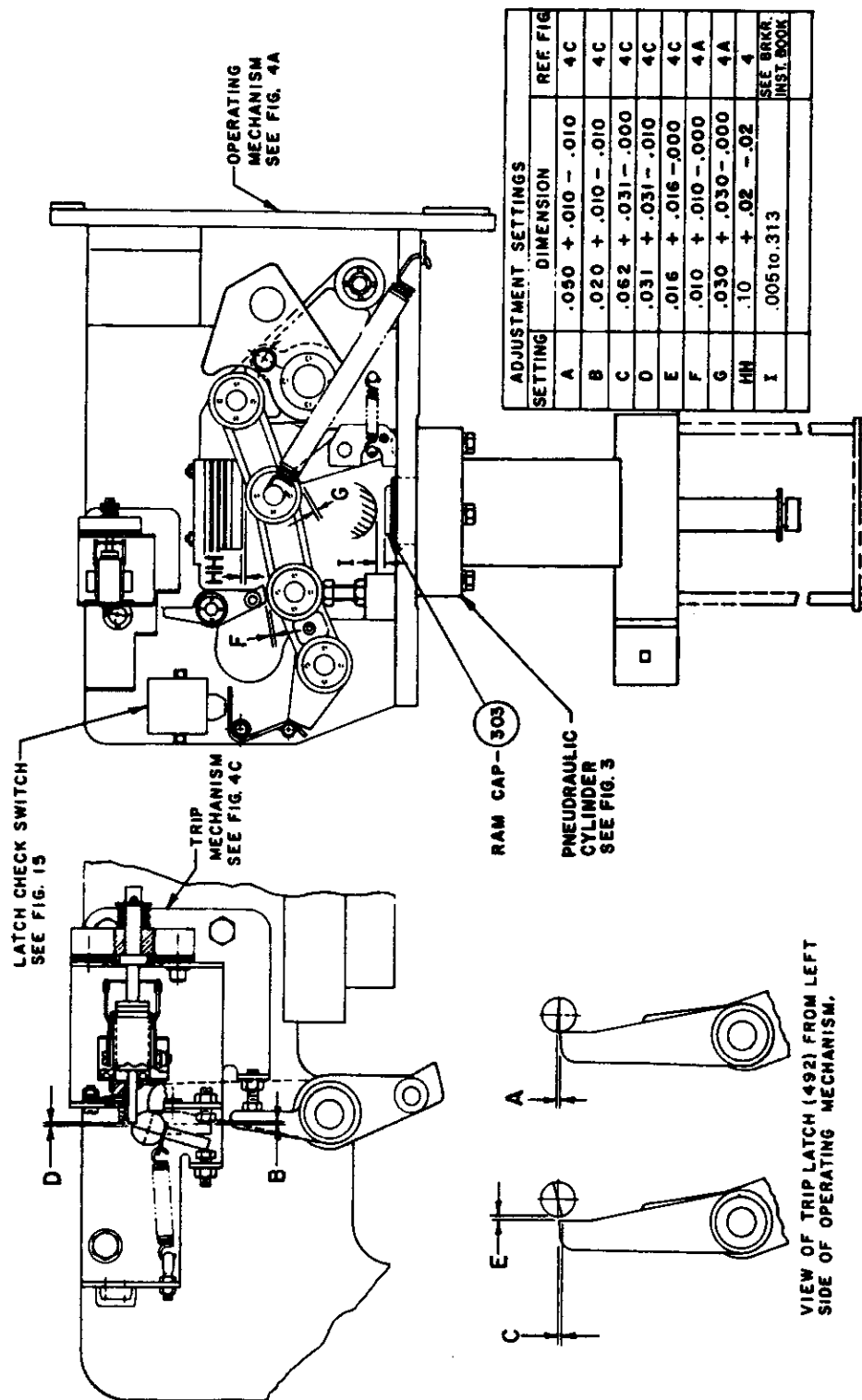


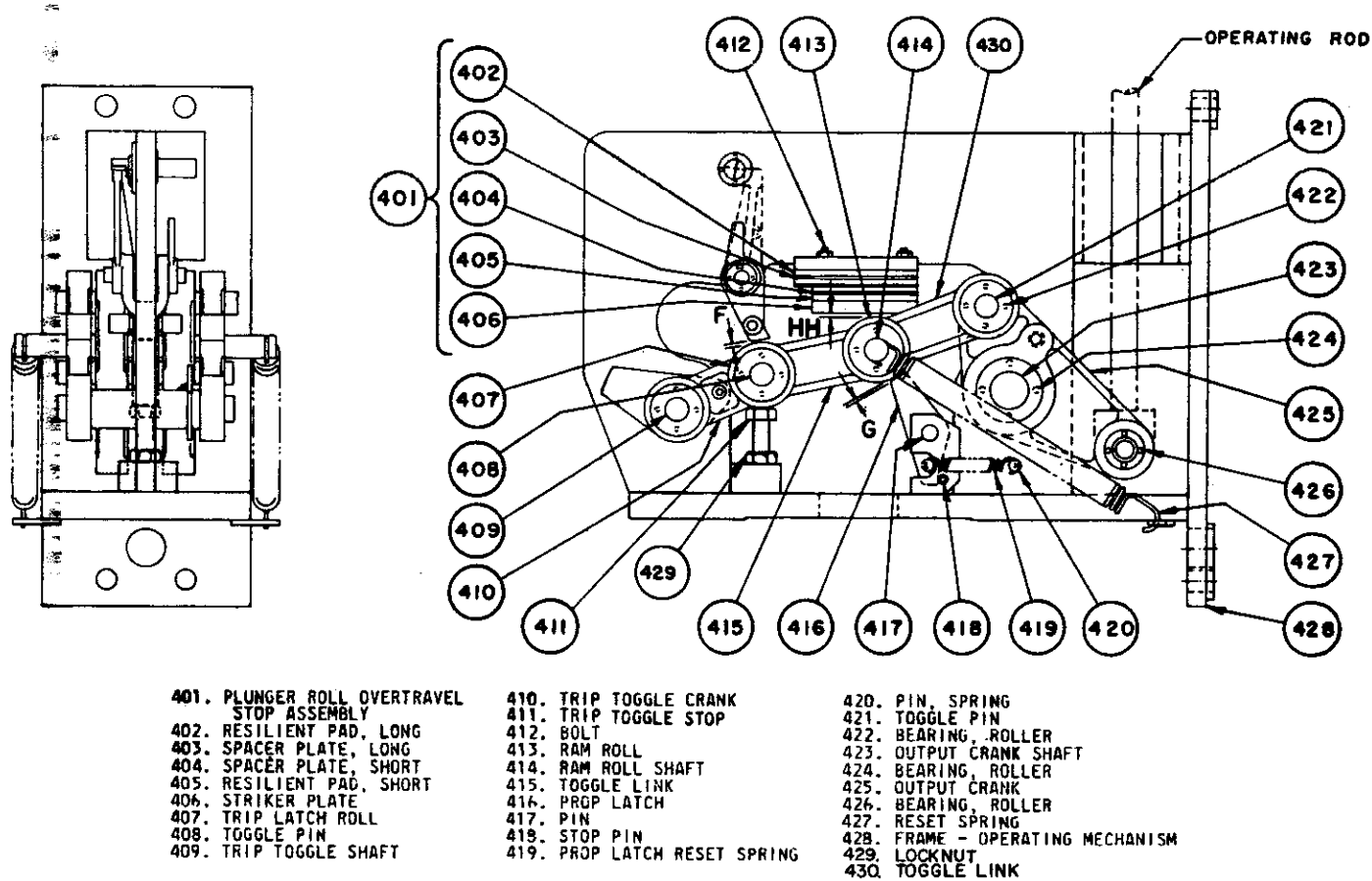
FIG. 3B  
 TYPICAL 52aa LIMIT SWITCH



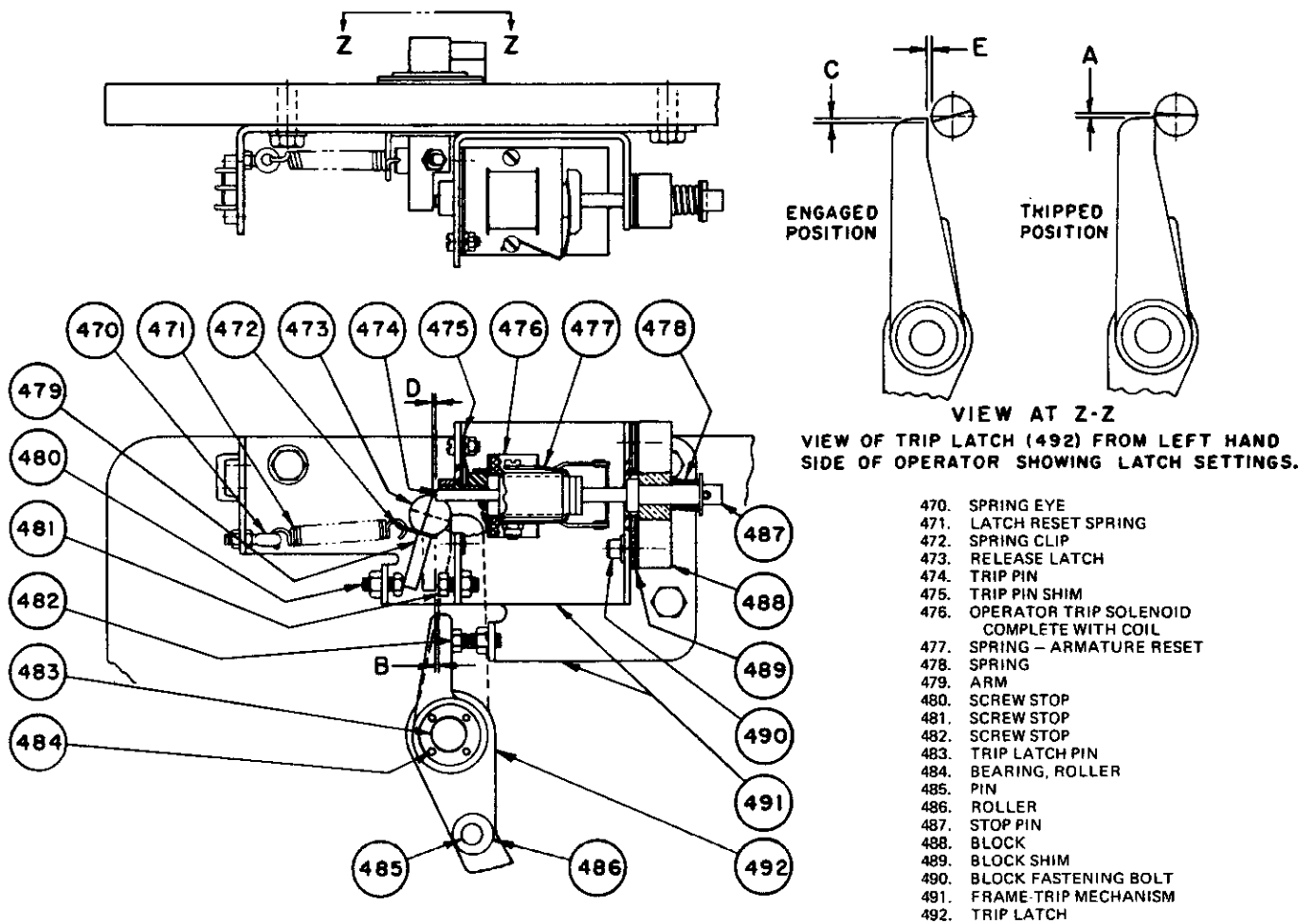
**FIG. 4**  
TYPICAL OPERATOR MECHANISM  
WITH ADJUSTMENT SETTINGS

AUG. 4, 1977

72-210-526-402



**FIG. 4A**  
 TYPICAL OPERATING MECHANISM LINKAGE  
 AUG. 4, 1977 72-210-534-402



**FIG. 4C**  
**TYPICAL TYPE "T" TRIP MECHANISM**  
AUGUST 23, 1967 72-210-535-401

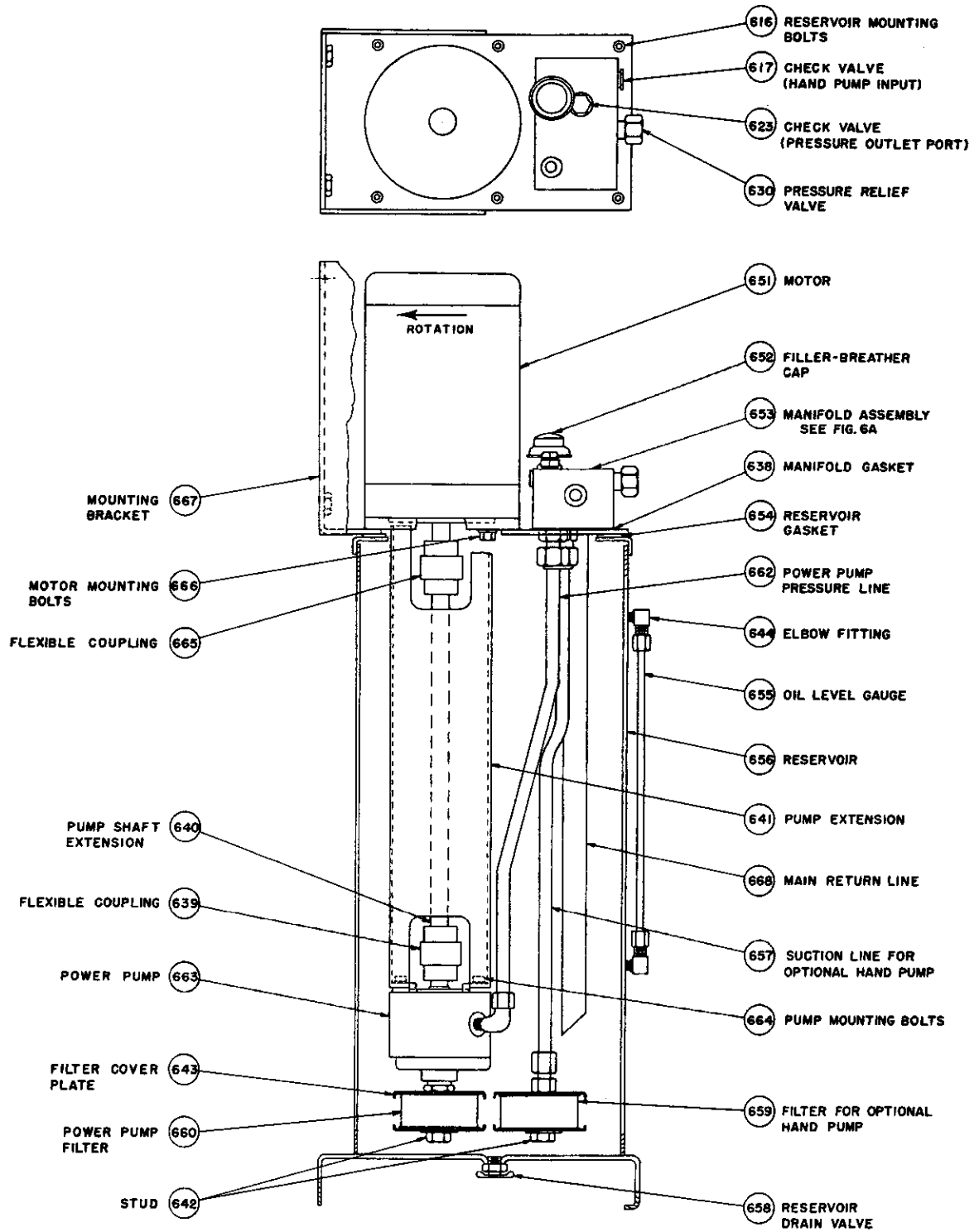
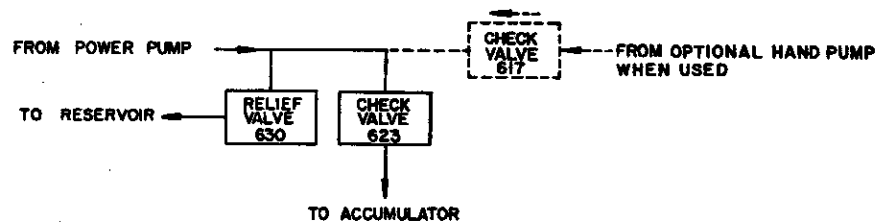
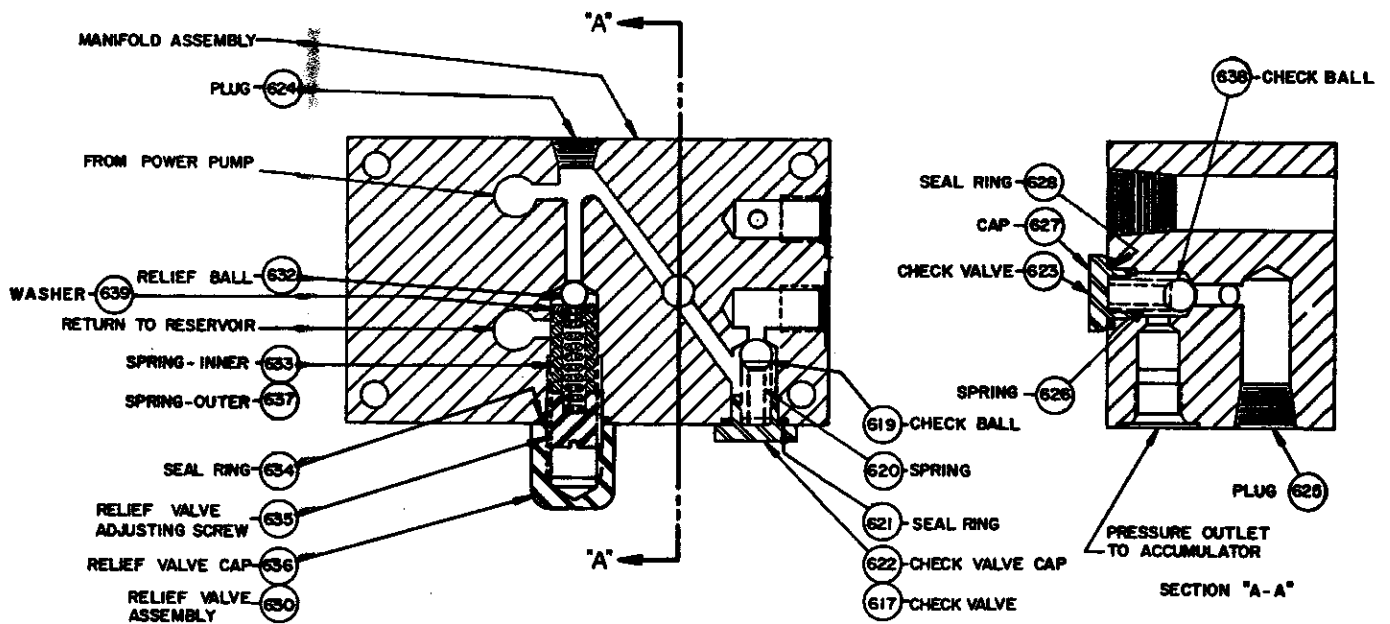


FIG. 6  
 TYPICAL HYDRAULIC POWER UNIT

AUG. 4, 1977

72-410-316-401



FLOW DIAGRAM

FIG. 6A  
TYPICAL MANIFOLD BLOCK ASSEMBLY

AUG. 4, 1977

72-310-470-402



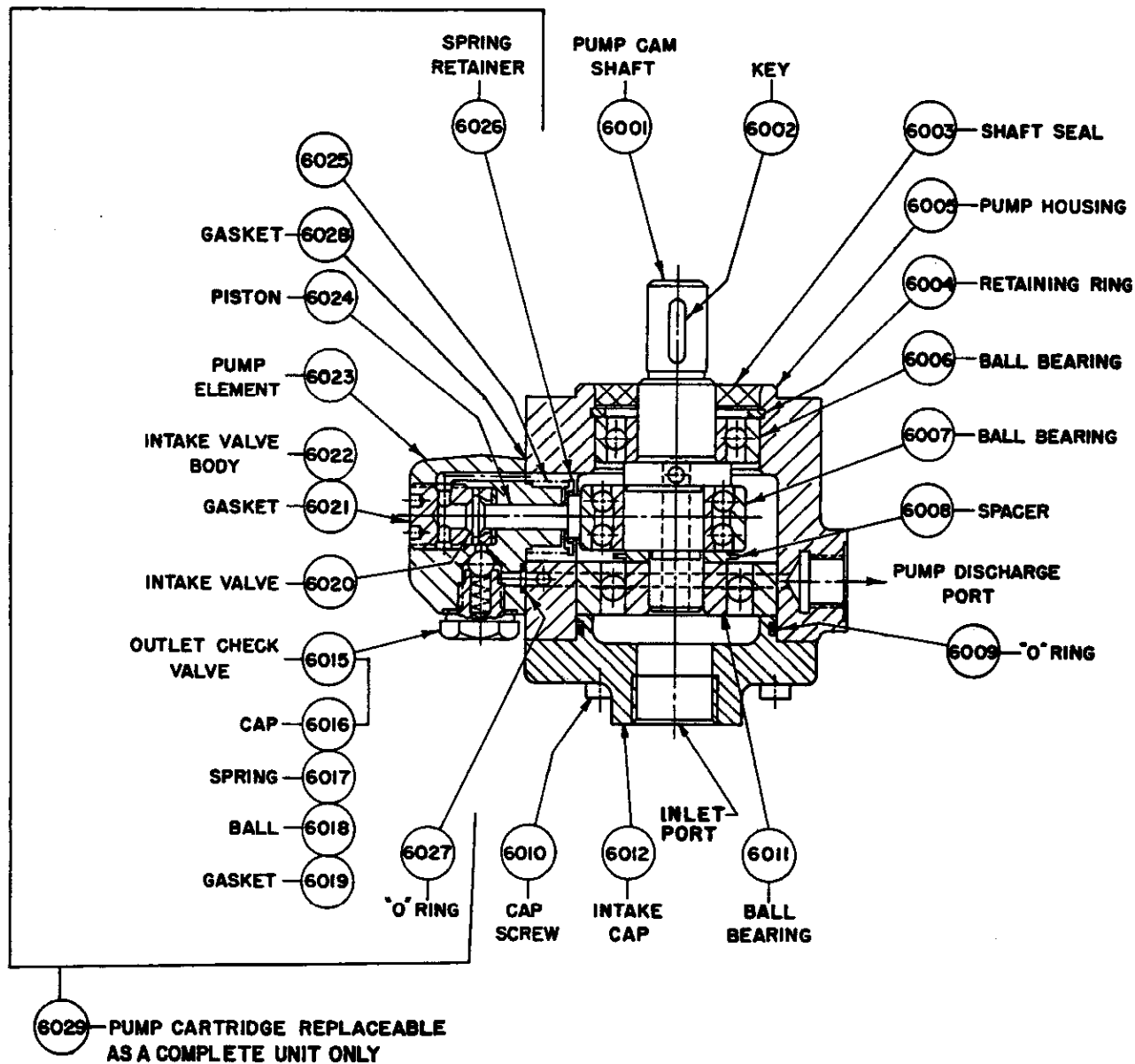


FIG. 6B  
TYPICAL HYDRAULIC PUMP

AUG. 4, 1977

72-310-407-402

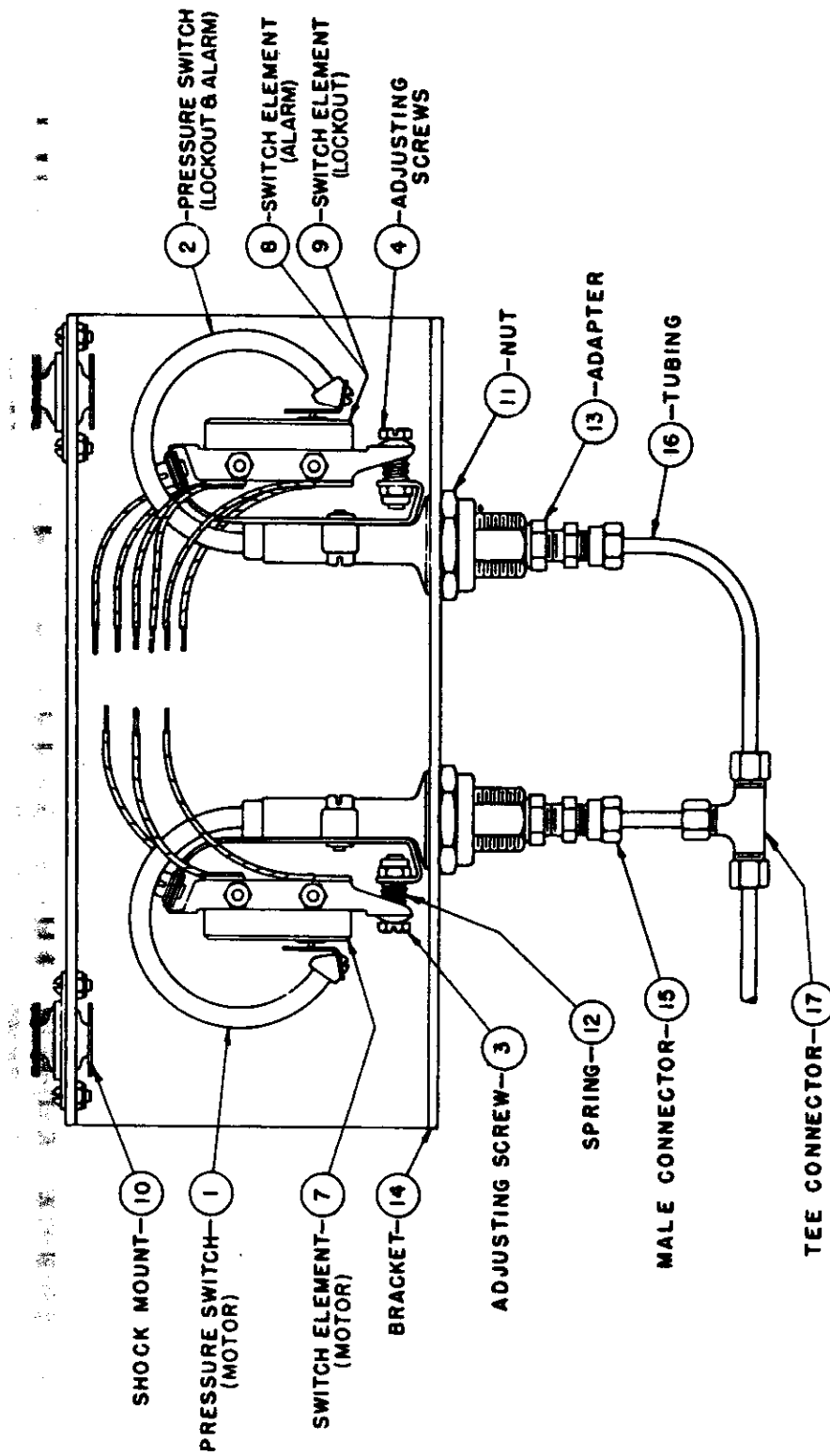


FIG. 7A

TYPICAL PRESSURE SWITCH ASSEMBLY

JULY 29, 1964

71-303-468-401

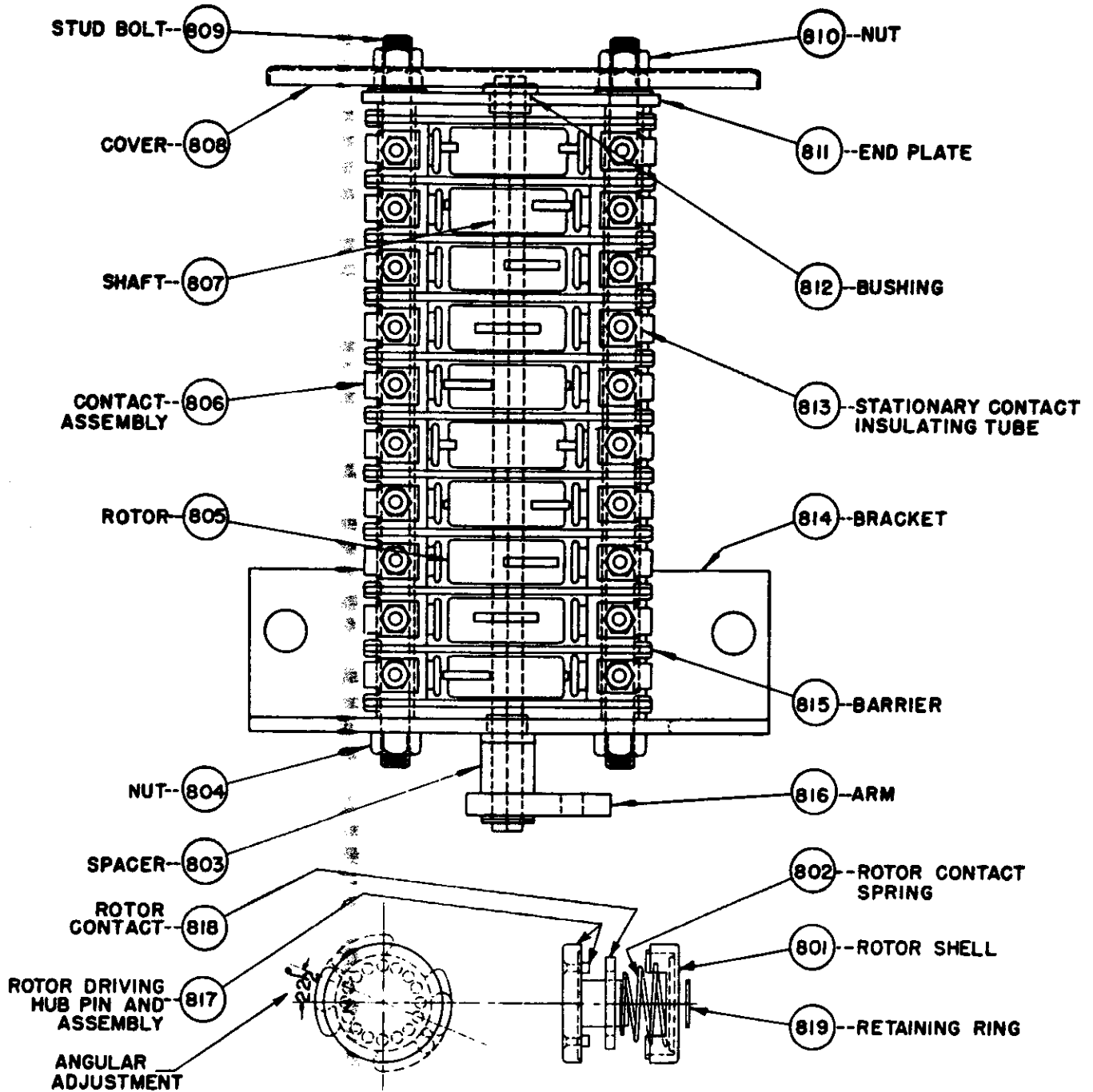
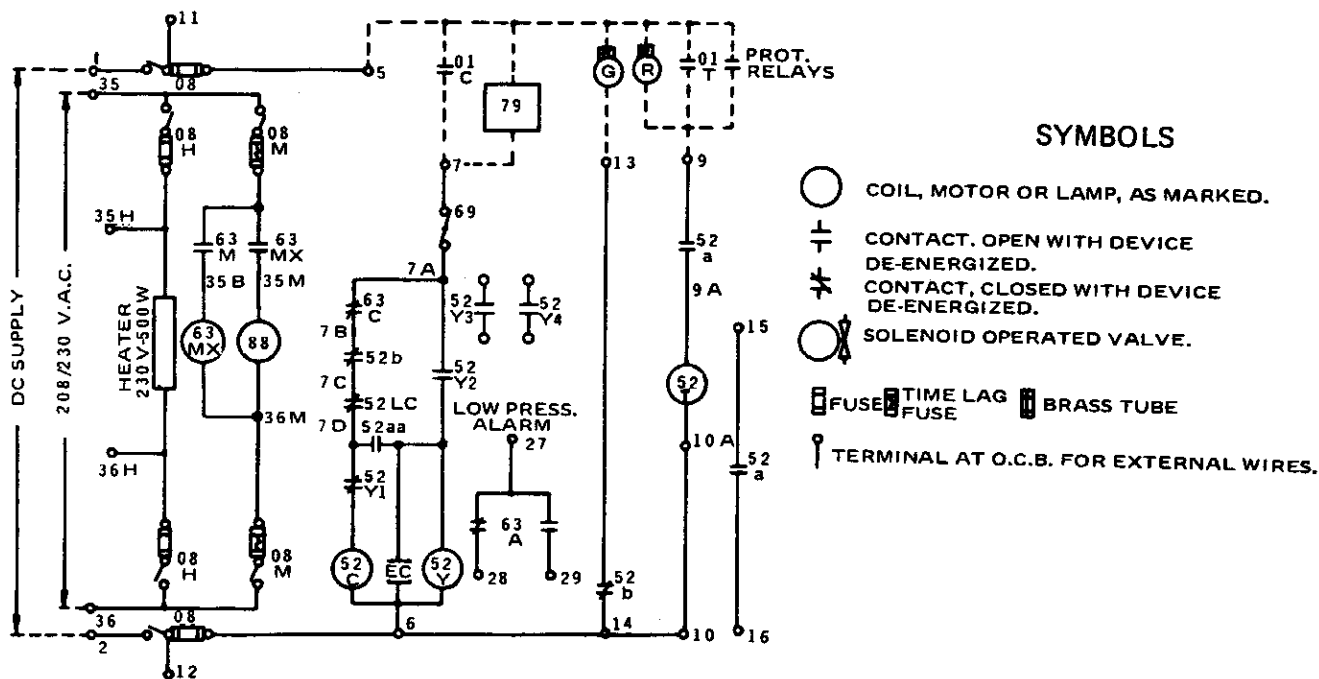


FIG. 8  
TYPICAL AUXILIARY SWITCH

FEB. 17, 1956

71-301-078-401



### DEVICE NUMBER EXPLANATION

01	CIRCUIT BREAKER CONTROL SWITCH.
08	CONTROL POWER SWITCH OR AIR CIRCUIT BREAKER.
08M	COMPRESSOR MOTOR POWER SWITCH OR AIR CIRCUIT BREAKER.
08H	HEATER POWER SWITCH OR AIR CIRCUIT BREAKER.
23	THERMOSTAT
25	SYNCHRONIZING DEVICE.
27	A.C. UNDERVOLTAGE RELAY.
29	ISOLATING CIRCUIT BREAKER, CONTACTOR, OR SWITCH.
43	TRANSFER DEVICE.
51	A.C. OVERCURRENT RELAY.
52	OIL CIRCUIT BREAKER (O.C.B.)
52a	O.C.B. AUX. SW. - OPEN WHEN BREAKER IS OPEN.
52b	O.C.B. AUX. SW. - CLOSED WHEN BREAKER IS OPEN.
52aa	OPERATOR LIMIT SWITCH - CLOSING WHEN PILOT VALVE OPERATES AND OPENS WHEN PILOT VALVES RESETS.
52C	OPERATING SOLENOID RELEASE COIL FOR SPRING LOADED PILOT VALVE MECHANICALLY RESET BY HYDRAULIC MOTOR RAM.
52LC	LATCH CHECK SWITCH - CLOSED ONLY WHEN O.C.B. IS LATCHED TO OPERATOR AND EQUIPPED WITH ADJUSTABLE TIME DELAY ON CLOSING USED FOR SETTING RECLOSING TIME FROM MINIMUM TO 60 CYCLES MAXIMUM.
52Y	ANTI-PUMP RELAY.
52T	TRIP COIL OF O.C.B.
63A	PRESSURE SWITCH - LOW PRESSURE ALARM.
63C	PRESSURE SWITCH - LOCKOUT - PREVENTS OPERATION AT LOW PRESSURE.
63M	PRESSURE SWITCH - ACTS AS PRESSURE REGULATOR.
63MX	AUX. RELAY FOR 63M.
67	POWER DIRECTIONAL RELAY.
69	CLOSING CUT OFF SWITCH - OPENED BY HAND TRIP LEVER, MANUALLY RESET.
79	A.C. RECLOSING RELAY.
87	DIFFERENTIAL CURRENT RELAY.
88	AUXILIARY MOTOR OR MOTOR GENERATOR.
EC	ELECTRIC COUNTER NORMALLY CONNECTED TO COUNT CLOSING OPERATIONS.

### NOTES:

- ALL EQUIPMENT SHOWN WITH O.C.B. OPEN, COILS DE-ENERGIZED, AND FLUID SYSTEM AT NORMAL OPERATING PRESSURE.
- EQUIPMENT FURNISHED BY SIEMENS-ALLIS WILL BE AS SPECIFIED ON ORDER OR CONTRACT AND DOES NOT NECESSARILY INCLUDE ALL DEVICES SHOWN HERE TO MAKE DIAGRAM COMPLETE.
- ALL GROUNDS BY PURCHASER.
- TIMED LATCH CHECK SWITCH TRANSFERS IMMEDIATELY ON O.C.B. TRIP ADJUSTABLE RESET FOR SETTING RECLOSING TIME FROM MINIMUM TO 60 CYCLES MAXIMUM.

FIG. 9

TYPICAL ELEMENTARY CONNECTION DIAGRAM

APRIL 27, 1976

72-310-405-401

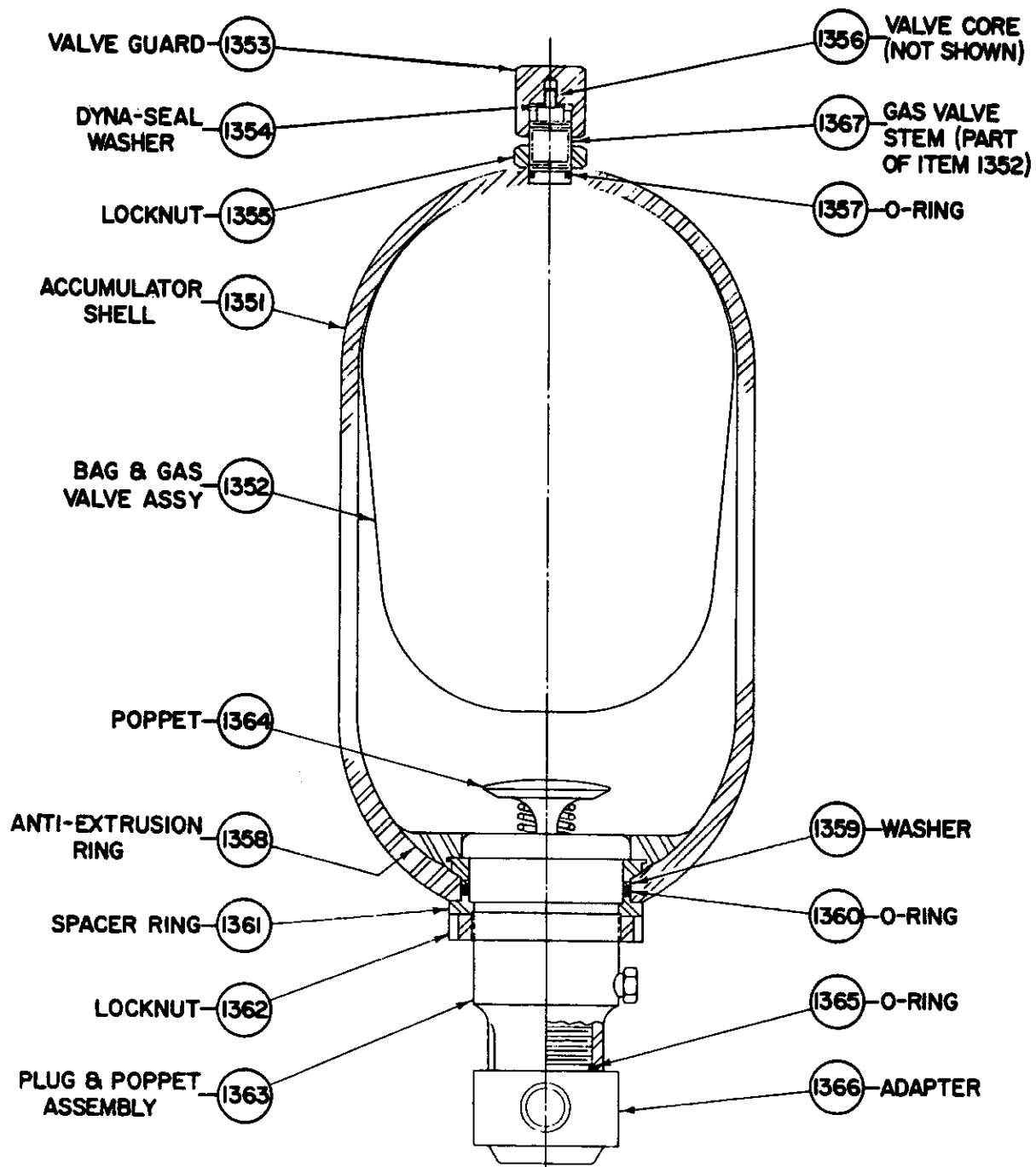
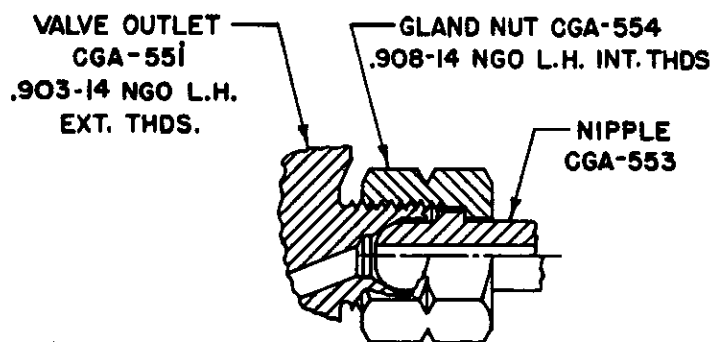


FIG. 13C

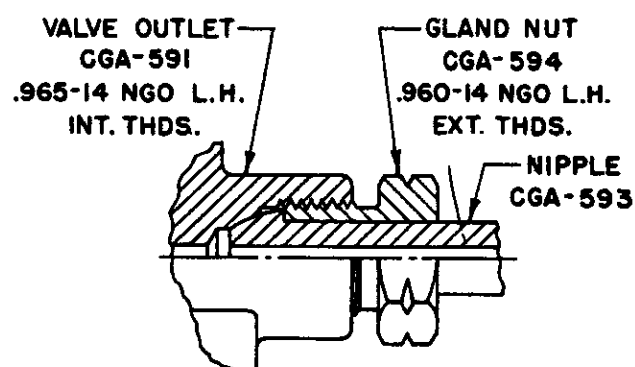
TYPICAL HYDRAULIC ACCUMULATOR ASSEMBLY

JUNE 18, 1971

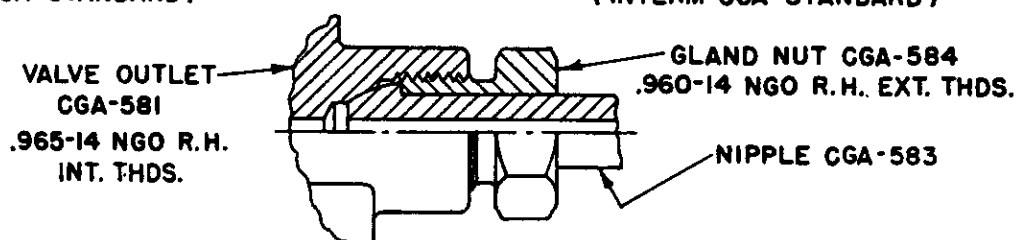
72-410-202



**CGA-550 STD NITROGEN CYLINDER  
VALVE OUTLET CONNECTION  
(OLD CGA STANDARD)**

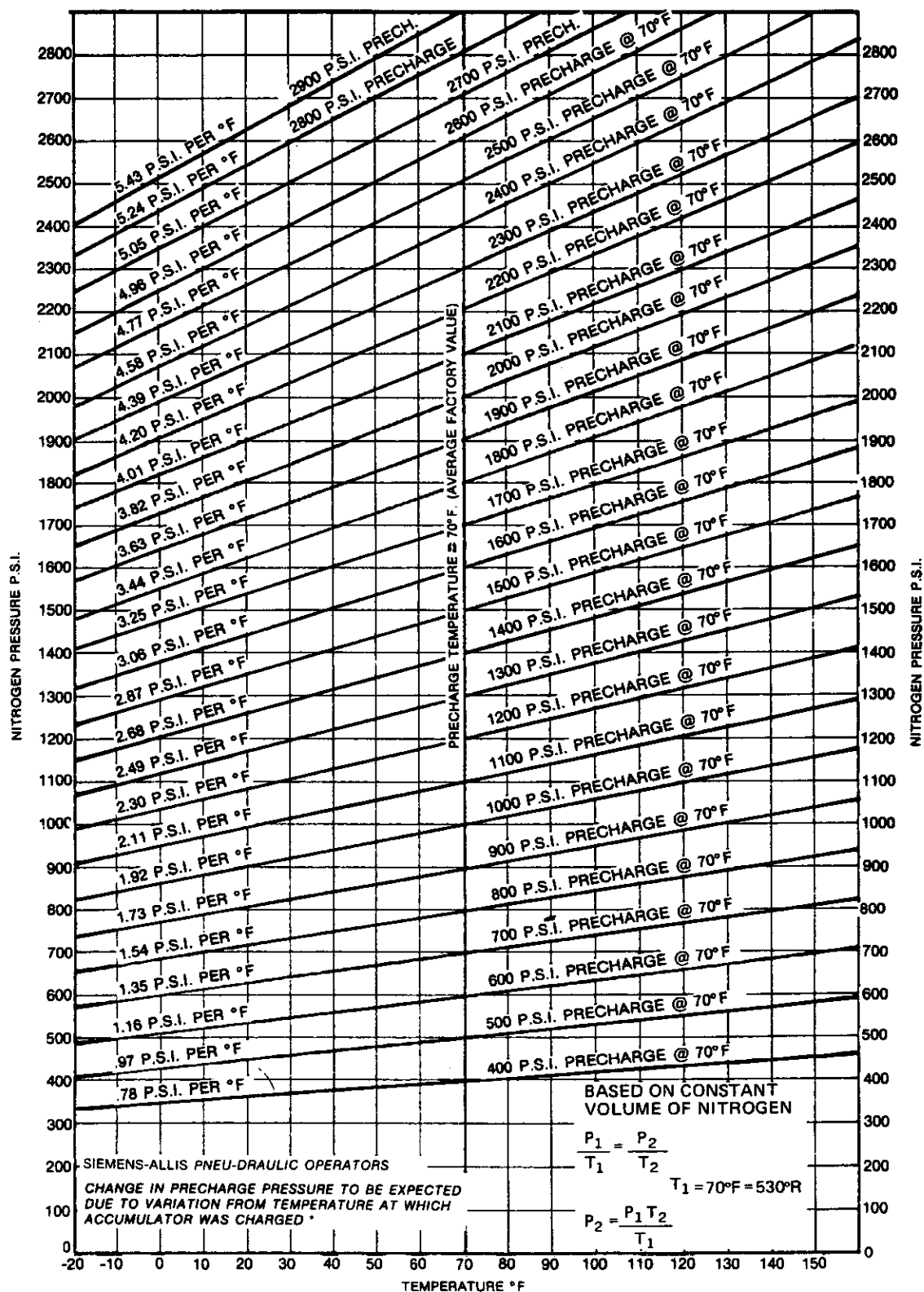


**CGA-590 STD NITROGEN CYLINDER  
VALVE OUTLET CONNECTION  
(INTERM CGA STANDARD)**



**CGA-580 STD NITROGEN CYLINDER  
VALVE OUTLET CONNECTION  
(PRESENT CGA STANDARD)**

**FIG. 13D**  
**NITROGEN CYLINDER GAS VALVE  
OUTLET CONNECTION**



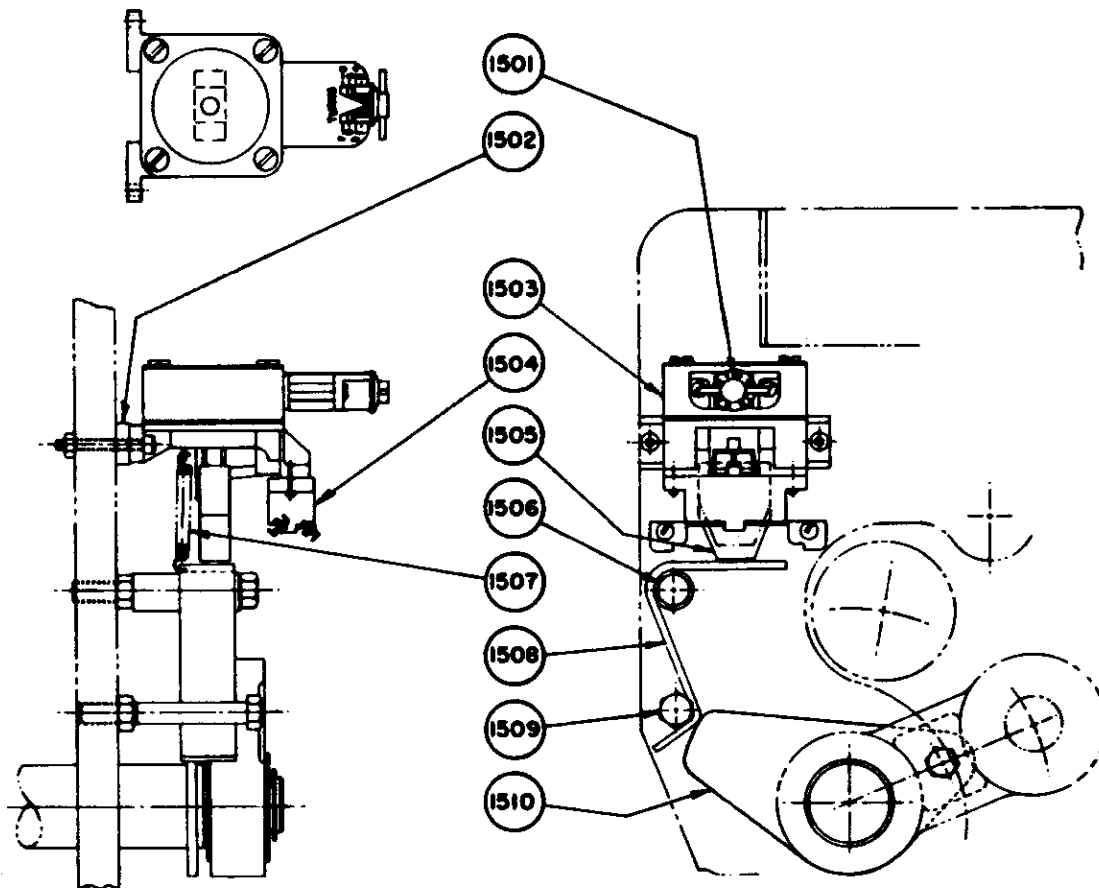
\*CAUTION: - SEE ACCUMULATOR SECTION

FIG. 14

TYPICAL TEMPERATURE/PRESSURE CURVE

OCT. 24, 1974

71-300-972-401



- 1501. TIMING HEAD ADJUST. KNOB
- 1502. RESILIENT SPACER
- 1503. TIMING HEAD
- 1504. SWITCH
- 1505. BLOCK
- 1506. LEVER PIVOT BOLT
- 1507. SPRING
- 1508. LEVER
- 1509. LEVER STOP BOLT
- 1510. CAM

**FIG. 15**

TYPICAL TYPE "T" LATCH CHECK SWITCH

OCT. 24, 1967

72-210-567-401



# ASSEMBLY INSTRUCTIONS FOR ERMETO® FLARELESS FITTINGS



The Recommended Assembly Procedure for Ermeto Flareless Fittings consists of two separate and distinct operations:

- ① **PRESETTING** This operation pertains to initial assembly of the sleeve and nut to the tubing.
- ② **INSTALLATION** This operation pertains to final assembly of the sleeve, nut and tubing to the fitting.

## PRESETTING

- ① The Weatherhead Company recommends that all Ermeto flareless fittings be preset by one of the three following methods:

**A. Presetting Machine:** This method is for production line assemblies.

**B. Hand Preset Tools:** This method is to be used when production line equipment is not available.

**C. Preset in Fitting:** This method should be employed only when impractical to use a presetting machine or hand Preset Tools.

② Presetting with Presetting Machine: Consult instruction manual supplied with machine for preset procedure.

③ Presetting with Hand Preset Tools:

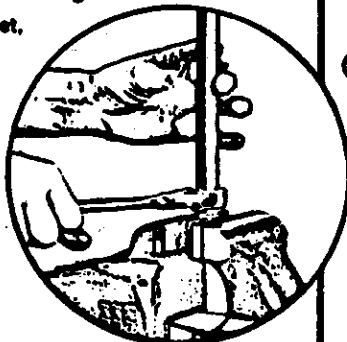
**A.** Follow procedures illustrated at right:

**B.** For checks of proper preset, refer to Figure 11 on next page.

④ Presetting with Fitting: Follow same procedures as when presetting with hand preset tool.

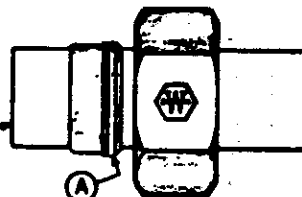


**WEATHERHEAD**  
**ERMETO® Flareless Tube Fittings**

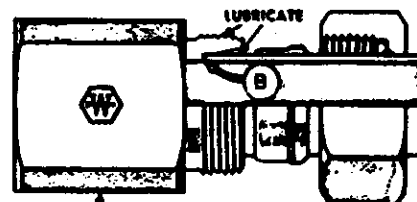


- ② Slide nut and then sleeve on tube. Be sure that sleeve is not on backwards. Head of sleeve "A" must be toward nut.

REASONABLY SQUARE

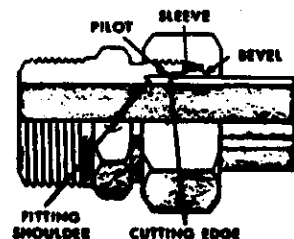


- ③ Insert tube into presetting tool or fitting. Be sure that tube is bottomed on fitting shoulder at point "B". Lubricate with good grade of lubricant.



PRESETTING TOOL

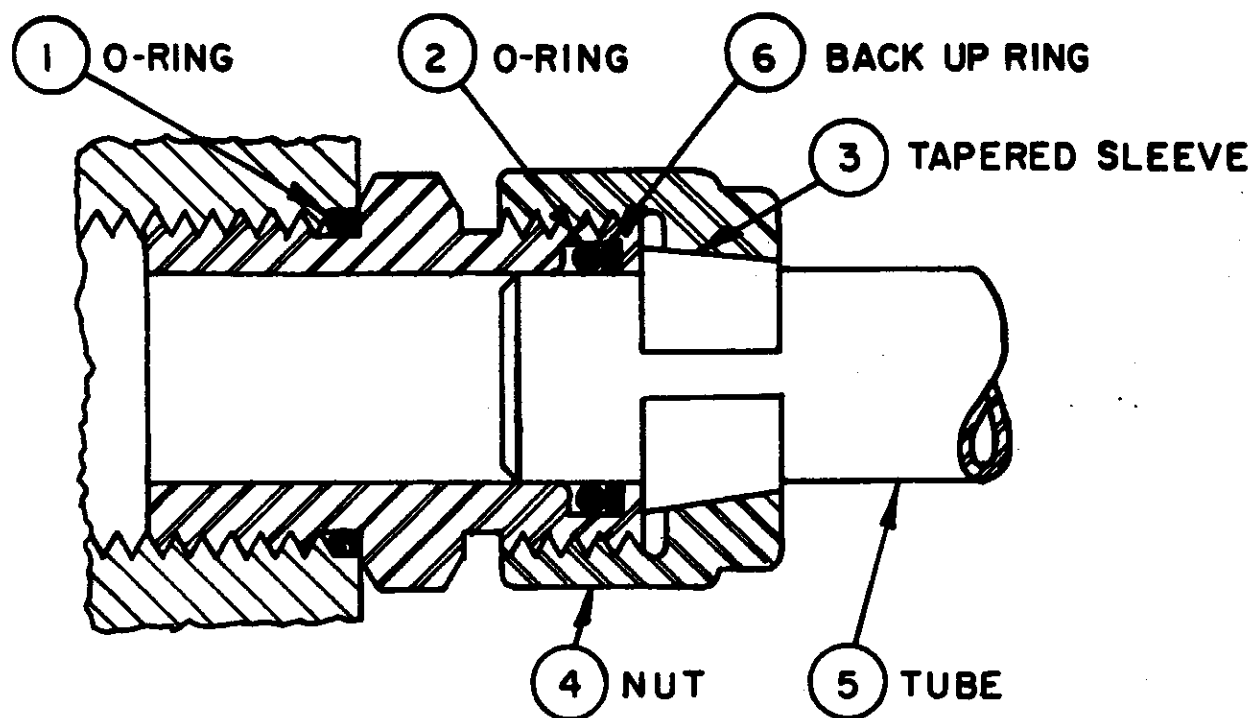
- ④ Turn nut slowly with wrench while turning tube with other hand. When sleeve grips the tube, that is, when the tube can no longer be turned by hand — STOP — and note position of wrench. This is the "Ring Grip" point.



- ⑤ Tighten nut an additional number of turns past "ring-grip" point as shown in Figure 1 on next page.

FIG. 16

ASSEMBLY INSTRUCTIONS FOR  
ERMETO FITTINGS



**HOW APPLIED:-**

1. LUBRICATE "O" RINGS (ITEMS 1 & 2) LIGHTLY WITH PETROLEUM JELLY (VASELINE) TO PREVENT DAMAGE DURING INSTALLATION.
2. INSTALL FITTING IN PLACE AND TIGHTEN WITH WRENCH.
3. CHAMFER END OF HYDRAULIC TUBING AND REMOVE ALL BURRS. THOROUGHLY CLEAN TUBING OF ALL CHIPS AND ANY OTHER FOREIGN MATTER.
4. REMOVE NUT AND SPLIT TAPERED SLEEVE (ITEMS 4 & 3) FROM FITTING.
5. SLIDE THE NUT AND SPLIT TAPERED SLEEVE (ITEMS 4 & 3) ON THE TUBING WITH LARGE END OF TAPERED SLEEVE FACING THE FITTING.
6. INSERT THE TUBING INTO BODY OF FITTING WITH TUBING END WELL PAST "O" RING (ITEM 2). SLIDE TAPERED SLEEVE UP AGAINST FITTING. TIGHTEN NUT (ITEM 4) HAND TIGHT. THEN, TIGHTEN NUT WITH WRENCH UNTIL SMALL END OF TAPERED SLEEVE (ITEM 3) IS OBSERVED TO BE FLUSH WITH FACE OF NUT OR PROTRUDING A MAXIMUM OF  $1/64$ .

FIG. 17  
ASSEMBLY INSTRUCTIONS FOR  
LENZ FITTINGS

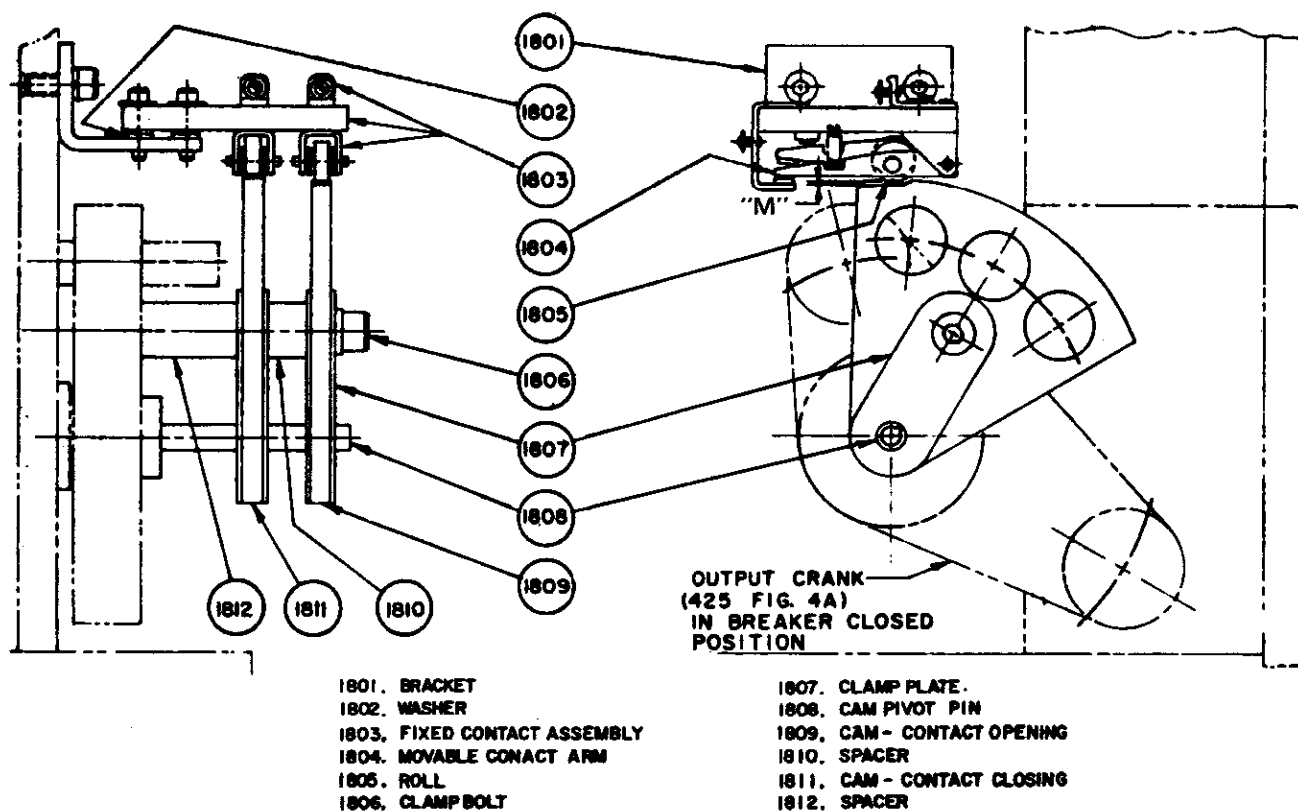


FIG. 18  
 HIGH SPEED AUXILIARY SWITCH

AUG. 4, 1977

72-210-571-402

## RECOMMENDED SPARE PARTS LIST

**TYPE** BZ0-145-63KA-6 **AMPERES** 2000/2500/3000 **VOLTS** 145KV **SERIAL NO.**

**ORDER NO.**

**CUSTOMERS ORDER NO.**

**CUSTOMER** PH33T-5

**DATE** 8/22/77

INSTRUCTION BOOK NO.	REF. NO.	DESCRIPTION	DWG. OR CODE NO.	RECOMMENDED FOR STOCK	
				1-5 BKRS	5 OR MORE
BWX-6789	201	BUSHING	SPECIFY MAKE & COLOR	2	3
	205	LIFT ROD	72-211-267-502	1	2
	207	CONTACT ROD	72-111-898-003	6	12
	210	ROD GUIDE	71-200-867-519	1	2
	216	OVERTRAVEL STOP	71-116-025-503	1	1
	218	OIL GAUGE	72-211-151-002	1	1
	225	SHOCK ABSORBER	71-200-866-503	1	1
	242	GASKET (MANHOLE)	72-112-789-001	6	12
	245	INTERRUPTING DEVICE	72-410-221-509	1	2
	250	GASKET (BUSHING)	71-208-242-002	6	12
	304	RESISTOR	72-211-188-501	1	2
	308	CONTACT ASSEMBLY	72-211-413-502	6	12
	345	SHELL	72-410-190-001	1	2
	346	BAFFLE ASSEMBLY	72-211-190-501	6	12
	349	DEFLECTOR	72-112-276-001	6	12
	353	WASHER	71-029-122-006	12	24
	359	TUBE	72-112-262-001	6	12
	365	WASHER	72-110-713-002	12	24
	</				

## RECOMMENDED SPARE PARTS LIST

**TYPE** BZO-145-63KA-6 **AMPERES** 2000/2500/3000 **VOLTS** 145KV **SERIAL NO.**

**ORDER NO.****CUSTOMERS ORDER NO.**

**CUSTOMER** PH33T-5

**DATE** 8/22/77

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## ISSUE

02