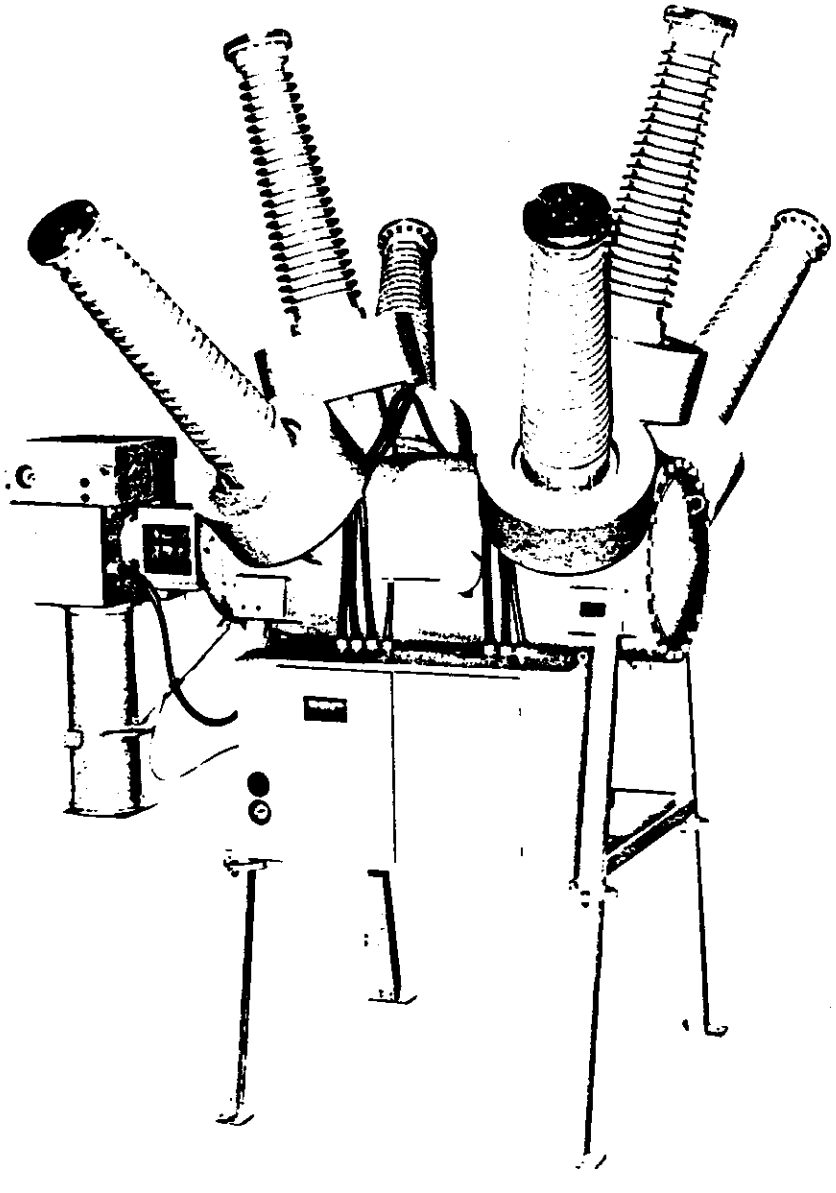
ASEA BROWN BOVERI

Installation/Maintenance Instructions

SF_6 Power Circuit Breaker

SF_6 Single Pressure (Puffer)
Outdoor Power Circuit Breaker

121 PA 40 16/20/30 B
145 PA 40 16/20/30 B



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INSTALLATION & MAINTENANCE NOTES

BREAKER SERIAL NUMBER _____

LOCATION _____

This installation/Maintenance Instruction Book 1B 6.4.1.7-1C consists of 64 pages. Should you desire the complete document, please order directly from the Marketing Department, ASEA Brown Boveri, 125 Theobold Ave., Greensburg, PA 15601.

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PART I
INTRODUCTION

1.0 INTRODUCTION AND GENERAL DESCRIPTION

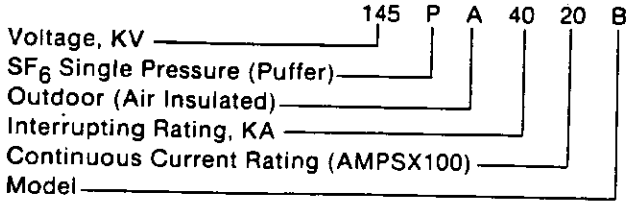
1.1 Scope

These General Operating Instructions apply to SF_6 puffer power circuit breaker types:

121PA40-16B
121PA40-20B
121PA40-30B

145PA40-16B
145PA40-20B
145PA40-30B

1.2 Explanation of Type Designation



1.3 Operating Instructions and Commissioning Documents

The technical information contained in this manual is intended to describe the general operation and maintenance of a typical circuit breaker. Specific information concerning individual circuit breakers is supplied with the unit. If additional information is desired by purchaser concerning installation, operation or maintenance of this particular equipment contact the local ASEA Brown Boveri representative.

2.0 GENERAL DESCRIPTION

The modern high speed circuit breaker is an essential component in present day high voltage transmission systems; depended upon for both routine switching operations and the critical task of high current fault protection. It should not be subjected to duties in excess of nameplate ratings unless agreed upon at time of purchase. The breaker is designed in accordance with the latest NEMA and ANSI Standards for outdoor high voltage circuit breakers.

The circuit breaker consists of a horizontally mounted, cylindrical, steel tank containing three current carrying phases. Entrance bushings extend through the top of the tank at each end. Interrupters, one per phase, are mounted on insulated supports within the tank. The tank, on extension legs, supports the hydraulic operating mechanism at one end. A weatherproof cabinet, containing control components is mounted beside the tank between the supporting legs. Current transformers are located around the outside of the entrance bushing supporting flanges and are enclosed in suitable weather shields.

The single pressure circuit breaker uses sulfer hexafluoride gas (SF_6) as both the interrupting and insulating media. The pressure differential required for arc interruption is provided by the "puffer" action of th interrupters during the opening stroke. The hydraul operator supplies power to open and close the circu breaker on command.

3.0 COMPONENT FUNCTION AND DESCRIPTION

3.1 Tank 13001

The tank 13001 is designed and constructed to me the ASME Boiler and Pressure Vessel Code for Unfire Pressure Vessels, Division 1 - Section VIII. The carbo steel tank consists of a flanged cylinder with pressu heads at both ends. The tank contains a rupture dis 13046 as protection against excessive internal pre sures.

3.2 Entrance Bushings 13040

The bushings 13040 consist of a glazed porcelain ca mented to aluminum flanges with a thru-rod attache to the top flange and the bottom flange mounted to th tank. The bottom of the thru-rod is connected to th interrupter with flexible jumpers. A bushing terminal mounted on the top flange. The gas in the tank com municates freely with the bushing cavity.

3.3 Current Transformers (CT's)

Each bushing may be equipped with any combinatio of up to three ring-type, toroidally wound, fully dis tributed metering CT's or multi-ratio relaying CT's c standard ANSI ratios and accuracies. CT secondar leads are run through conduits from each bushing int the control cabinet where each CT is terminated at a point short circuiting terminal block, providing a excellent location for selecting the desired ratios.

Linear couplers can be installed together with or i lieu of CT's. Their design mounting and wiring is sim ilar to that of CT's.

3.4 Interrupters 17000

The interrupter assembly extinguishes the arc gener ated during the opening operation and transfers loa current when the breaker is in the closed position.

3.4.1 *Main Current Path*

The main current path (Fig. 2, 4, 5, 8-10) through the breaker is described as entering from the mechanism end of the breaker and out the opposite end. The current enters bushing 13040 through its terminal 13047 flange 13038, thru-rod 13042, then into interrupter through flexible shunts 17110.

The shunts direct the current flow into the adapter flange of the support tube assembly 17010, to the puffer piston assembly 17099, through the multi-lam contact 17150, to the puffer cylinder 17105. The path continues through puffer cylinder to contact ring 17106, across continuous current contact fingers 17057, through stationary adapter support 17053 through shunts into opposite bushing.

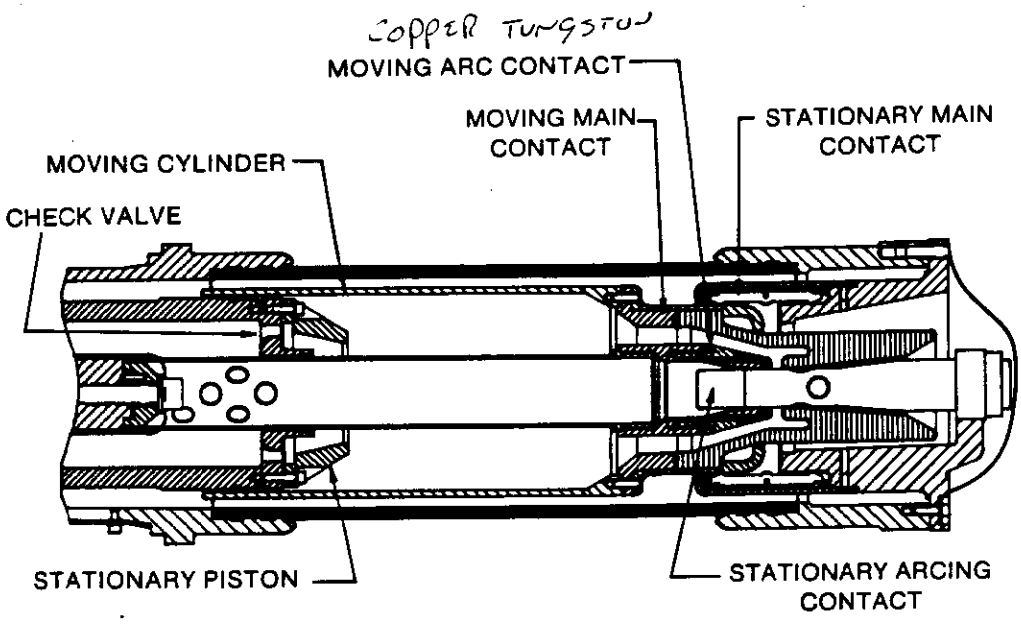


FIG. A
CLOSED

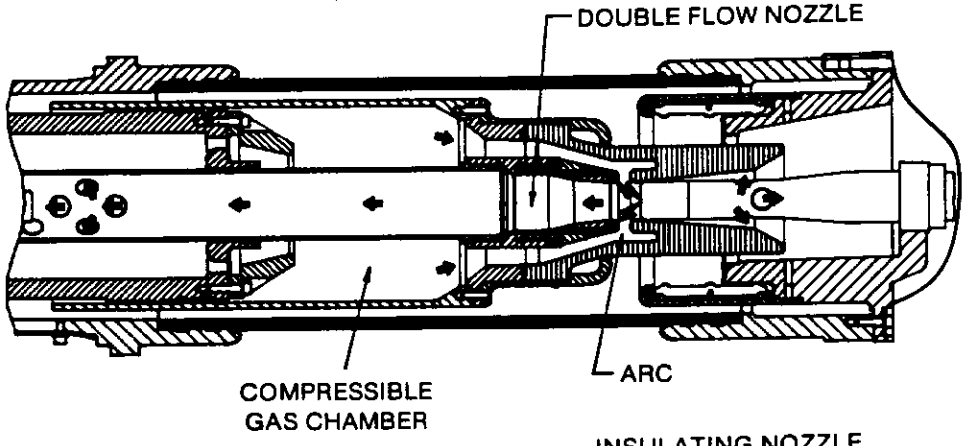


FIG. B
INTERRUPTION

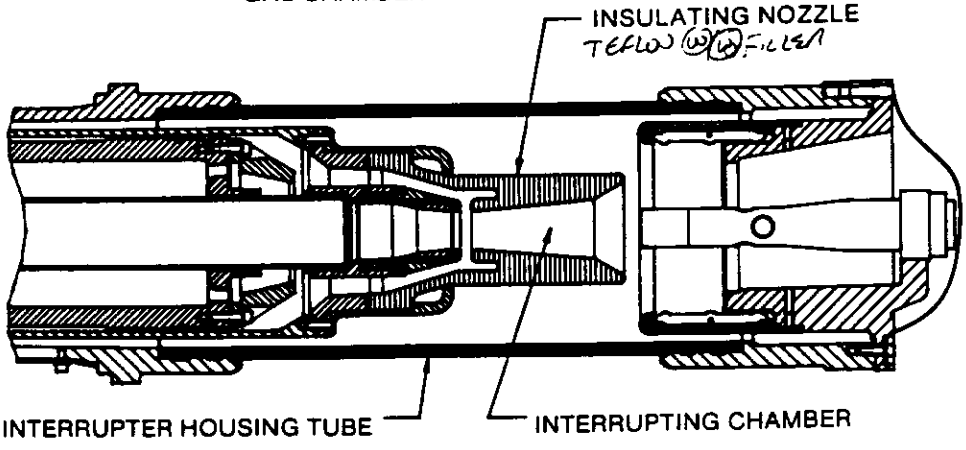


FIG. C
OPEN

3.4.2 *Interrupter Operating Principle*

The operating dynamics of the single pressure breaker are illustrated in Figures A, B and C by isolating three instantaneous contact positions during an opening stroke.

a. Closed Position
In the closed position both the main continuous current carrying and arcing contacts are fully engaged. The movable cylinder is in a position with respect to the stationary piston to contain a maximum volume of compressible SF_6 gas. This gas was drawn into the cylinder through check valve 17131 during the previous closing stroke.

b. Interruption
As the breaker starts its opening stroke the volume of the compressible gas chamber is reduced. This action increases the gas pressure in the cylinder. Simultaneously the main continuous current contacts separate, followed by separation of the arcing contacts. Compressed gas now flows from the cylinder through the arcing zone, elongating and cooling the arc in preparation for an effective extinguishing of the current flow at the next current zero. Gas flow continues after arc extinguishment due to compression in the puffer cylinder.

c. Open Position
The breaker opening operation continues to the end of its stroke. The gas flow during this portion of the stroke cleanses all arc products from the arcing zone. Contact separation now provides full rated dielectric capability and the breaker stands prepared for its next closing operation.

d. Interrupter Closing Operation
When closing, the arcing contacts are closed before the main contacts of the continuous current path. Any resultant striking arc is confined to the arcing contacts by shielding of the teflon nozzles 17102 and 17103. Due to the movement of the puffer cylinder, the compression space increases and fills with SF_6 gas by way of check valve 17131 located in the piston. (See Fig. 5, 9, & 10).

3.5 **Operating Mechanism Interrupter Connection**

The hydraulic operating mechanism 16000 operates the interrupters 17000 by direct connection to the driving rod 16140 extending from hydraulic actuator 16020. This driving rod 16140 is connected to the pull rod assembly 13025 by coupling 16143, (Fig. 2 & 3) located in the transition housing 13120. Pull rod assembly 13025, (Fig. 11) is in turn connected to the three interrupters, one per phase, by the adapter 13097. The adapter 13097 is connected to the three interrupters by means of the actuating tubes which drive the moving contact assemblies.

The pull rod assembly contains the gas seals which permit a leak-free transfer of mechanical power into the tank. Dynamic seals 13093 prevent gas leakage during the closing and opening strokes. Static seals 13087 then provide a gas tight seal when the breaker is in the open or closed position, (Fig. 3 and 11).

3.6 **Hydraulic Operating Mechanism - 16000 (Fig. 17-21**

The hydraulic mechanism 16000 operates the inte
rupters. It receives operating commands from t
electrical control system and transfers them to line
mechanical motion of sufficient energy to close
open the circuit breaker. Following are descriptio
and functions of major components of the hydrau
system:

3.6.1 *Oil Pump - 16062 and 16063*

The oil pump, 16062, transfers oil from the reserv
16030 to the hydraulic accumulator 16010 and th
compresses the nitrogen under the floating piston
the accumulator. Pump motor 16063 drives the pu
16062.

3.6.2 *Oil Pressure Switch - 16130*

Oil pressure switch 16130 monitors the hydraulic sy
tem and provides commands for various controls
pre-set levels:

- Maintains the static pressure level of the hydrau
system between 4750 and 4950 psig (32.7 and 34
MPa).
- Provides a low pressure alarm if the oil pressure fal
below 4500 psig (31.0 MPa).
- Blocks closing operation if oil pressure falls belo
4100 psig (28.3 MPa).
- Blocks opening operation if oil pressure falls belo
3850 psig (26.5 MPa).

3.6.3 *Pressure Limiting Valve - 16067*

The pressure limiting valve 16067 connects the hig
pressure hydraulic circuit to the low pressure circuit
the oil pressure rises too high. The excessively hig
pressure can occur if the pump 16062 is not switche
off at the right time or if the hydraulic accumulat
16010 is subjected to rapid heating, e.g. due to sola
radiation. The valve opens at 5590 psig (38.5 MPa) an
closes when the pressure falls to 5080 psig (35.0 MPa

3.6.4 *Manual Relief Valve - 16068*

The manual relief valve 16068 is used to deliberatel
reduce the oil pressure. It connects the high pressur
circuits to the low pressure circuit.

3.6.5 *Drain Valve - 16066*

The drain valve 16066 is used to remove hydraulic flui
from the oil reservoir.

3.6.6 *Check Valves - 16064 and 16065*

Check valves 16064 and 16065 block the return of o
from the high pressure circuit into the low pressur
circuit. The check valves also protect the power suppl
equipment from pressure pulses.

3.6.7 *Orifice - 16069*

The orifice 16069 protects the pressure limiting valv
16067 from responding unnecessarily due to pressur
pulses.

3.6.8 *Pressure Gauge - 16071*
Gauge 16071 monitors and displays the pressure in the high pressure circuits of the hydraulic system.

3.6.9 *Filter - 16061*
Filter 16061 removes impurities from the oil as it circulates through the hydraulic system.

3.6.10 *Orifices - 16077, 16134, 16136*
Orifices 16077, 16134 and 16136 protect the pressure switch 16130 and pressure gauge 16071 from pressure pulses.

3.6.11 *Oil Tank - 16030*
The oil tank 16030 serves as a reservoir in the low pressure system. Oil is stored there until it can be pumped back into the high pressure system. Oil stored in the reservoir under air pressure at 22 psig (122 kPa). The sealed low pressure system eliminates moisture and its effects from the hydraulic system.

3.6.12 *Low Pressure Safety Valve - 16035*
Low pressure safety valve 16035 protects the low pressure system from excessive pressures due to over filling. The valve vents to atmosphere at 58 psig (400 kPa) and reseals when the pressure drops to 40 psig (280 kPa).

3.6.13 *Solenoid Valves - 16044, 16045*
These valves operate in response to the close coil (CC, 16044) and trip coils (TC, 16045) to direct hydraulic fluid to and from the changeover valves (16042, 16043).

3.6.14 *Parallel Changeover Valves - 16042, 16043*
The parallel changeover valves 16042 and 16043 amplify and direct the hydraulic command output of the solenoid valves to operate the main hydraulic actuator 16020.

3.6.15 *Hydraulic Actuator - 16020*
The hydraulic actuator 16020 is mechanically linked to the interrupter assemblies and provides the power to close and open the circuit breaker.

3.6.16 *Hydraulic Accumulator - 16010*
The hydraulic accumulator 16010 stores the energy required for successive operations. The accumulator is divided into oil space and nitrogen space by a floating piston. The nitrogen space, the energy storage medium, is precharged to 3250 psig (22.5 MPa). A heater with a self contained thermostat insures adequate nitrogen pressure at the lower end of the breaker ambient temperature range.

3.6.17 *Various Orifices*
The Various Orifices - 16047, 16048, 16049, 16135
- Orifice 16135
  Adjustable orifice 16135 controls the closing speed of the circuit breaker by controlling the rate that oil flows into the closing side of the hydraulic cylinder during the closing stroke.
- Orifice 16048
  Adjustable orifice 16048 controls the opening speed of the circuit breaker by metering the rate at which hydraulic oil is expelled from the closing side of the hydraulic cylinder to the oil reservoir during the opening stroke.
- Orifices 16047, 16049
  The two orifices 16047 and 16049 adjusts the dead-time (the time contacts are closed during a close-open operation), by controlling the rate which hydraulic oil enters and leaves the closing side of the changeover valves 16042 and 16043 during the close and opening strokes of the circuit breaker.

3.6.18 *Service Connection - 16137*
The capped non-leaking pressure connection is a convenient point to attach a master gauge for calibration.

3.6.19 *Operating Mechanism Condensation Heater - H5*
A continuously energized heater is located in the operating mechanism to prevent condensation.

3.6.20 *Manual Trip - (Fig.19)*
When specified, a manual trip device is supplied with the circuit breaker. It is located in the operating mechanism and when operated manually trips the breaker locking out the closing circuit until the mechanism is reset. The manual trip system is designed to accept a Kirk Key Interlock which can be supplied.

3.6.21 *Dual Trip*
The standard circuit breaker is supplied with two trip assemblies 16044 and 16045, either of which is capable of independently tripping the breaker.

3.7 **Transition Housing - 13120**
The transition housing 13120 contains the mechanical coupling between the hydraulic operating mechanism and the interrupter assemblies. It also houses the mechanical operation counter, close-open indicator, auxiliary switch linkage and travel recorder connection point. The chamber is sealed and heated to prevent the window to view the counter and position indicator from fogging due to moisture condensation.

3.8 *Control Cabinet - 16001*
The weatherproof control cabinet contains the components required to control circuit breaker operation and is a convenient point for all customer connections. Contained in the cabinet are all electrical controls, auxiliary switches, gas pressure switch and gauge, CT short circuiting blocks, condensation heaters, and ground bar. The cabinet has two access doors and a cable entry to provide customer access.

3.8.1 *Density Monitor - 13170*
The SF_6 gas monitoring system utilizes a temperature compensated pressure switch 13170 located in the

control cabinet to monitor SF_6 gas density in the circuit breaker. The four adjustable set point assemblies contain spring packages which compensate for temperature variation and allow the switch to respond to changes in gas density.

Nominal pressure of SF_6 gas in the circuit breaker is 87 psig at 70°F (600 kPa at 21°C) and pressure switch contact 63-2C closes when gas pressure falls below 76 psig at 70°F (525 kPa at 21°C) to actuate the low pressure alarm. If SF_6 gas pressure continues to fall below 72 psig at 70°F (500 kPa at 21°C) minimum interruption pressure, contacts 63-2B1 and 63-2B2 close to energize 63AX and 63BX relays which block breaker operation. If the SF_6 gas pressure should fall below 55 psig at 70°F (380 kPa at 21°C) the dielectric alarm, contact 63-2A, will close signalling that dielectric strength is starting to deteriorate. See Fig. 22 for chart showing gas pressures and pressure switch actuation points for all temperatures within design range.

4.0 DESCRIPTION OF ELECTRICAL OPERATION

4.1 DC Control

The following conditions are required to close the circuit breaker electrically.

4.1.1 All specified remote control connections including rated control voltages must be made.

4.1.2 Sufficient hydraulic and gas pressures must exist in the operating mechanism and tank.

4.1.3 The circuit breaker must be in the open position.

4.1.4 With the above conditions met the breaker can be closed by momentary operation of the control switch (CS/C) or a remote contact closure.

The above action energizes the X-Relay which seals itself in and operates the close coil (CC) which opens the solenoid valve 16044. Hydraulic fluid flows through the solenoid valve and fills the close side of changeover valves 16042 and 16043. The changeover valves move from the open to closed position. The changeover valves in the closed position permit pressurized hydraulic fluid into the depressurized side of the hydraulic actuator 16020. The hydraulic action of the actuator closes the main contacts. As the circuit breaker closes the Y-Relay is energized by an auxiliary switch contact (a), resetting the X-Relay and close solenoid valve. The Y-Relay will remain energized through its seal-in contact as long as the control switch or relaying is activated thus providing the antipumping action.

Movement of the hydraulic actuator and changeover valves from their open to closed positions occurs in spite of the fact that equal pressure exists on both sides of the pistons. This is due to the fact that the close side piston surface area is significantly larger than the open side piston surface area and the resultant unbalanced force translates into motion which closes the valve or actuator.

4.1.5 Once closed, the circuit breaker can be opened b momentary operation of the control switch (CS/T) or remote relay operation. This operation energizes th trip coil (TC) which opens solenoid valve 16045 whic rapidly drains hydraulic fluid from the close side of th changeover valves to the reservoir. The changeove valves move to the open position permitting the hy draulic fluid in the close side of the hydraulic actuatc to also drain to the reservoir and the actuator opens th circuit breaker due to the continuously pressurize side of the actuator. As the breaker opens the auxiliar switch, (a) contacts opens, degenerizing the trip co and permitting solenoid valve 16045 to reset.

4.1.6 Additional auxiliary relays operate to block contr circuit functions when the hydraulic or gas pressur are below required minimums.

63AX—Trip block relay, operates at 3850 psig (26. MPa) hydraulic pressure or 72 psig (500kPa) ga pressure.

63BX—Close block relay, operates at 4100 psi (28.3 MPa) hydraulic pressure and 72 psig (5C kPa) gas pressure.

4.2 AC Control

The pump motor, condensation heaters, accumulatic heater, tank heater, and space heaters are supplied b an auxiliary AC source.

4.2.1 Pump Motor & Nitrogen Alarm

The pump motor 16063 is controlled by contactor 42- which utilizes hydraulic pressure switch 16130 cor tacts 63-IX and 63-IY to maintain the hydraulic syste pressure between 4750 psig (32.7 MPa) and 4950 ps (34.1 MPa). The pump motor is protected by kni switch 8-2 and overload 49 in the contactor.

A running time meter is provided to accumula pump operating time.

A nitrogen alarm circuit is also provided. The energ required for stored operations is contained in the nitr gen space of the accumulator. The alarm circuit inc rectly monitors the nitrogen pressure by measurir the time required for the hydraulic system to recove from 4750 to 4950 psig. Timer (T), monitors the 63N relay for 5 seconds each time the contactor is ene gized. If the system recovers within 5 seconds, a indication of loss of nitrogen, the alarm relay 63NX w operate.

4.2.2 Heaters

Heaters H1 & H2 are continuously energized conde sation heaters located in the control cabinet. H3 ar H4, also in the control cabinet, are controlled by the mostat 23-1.

Heater H5 is a continuously energized condensatic heater in the operating mechanism.

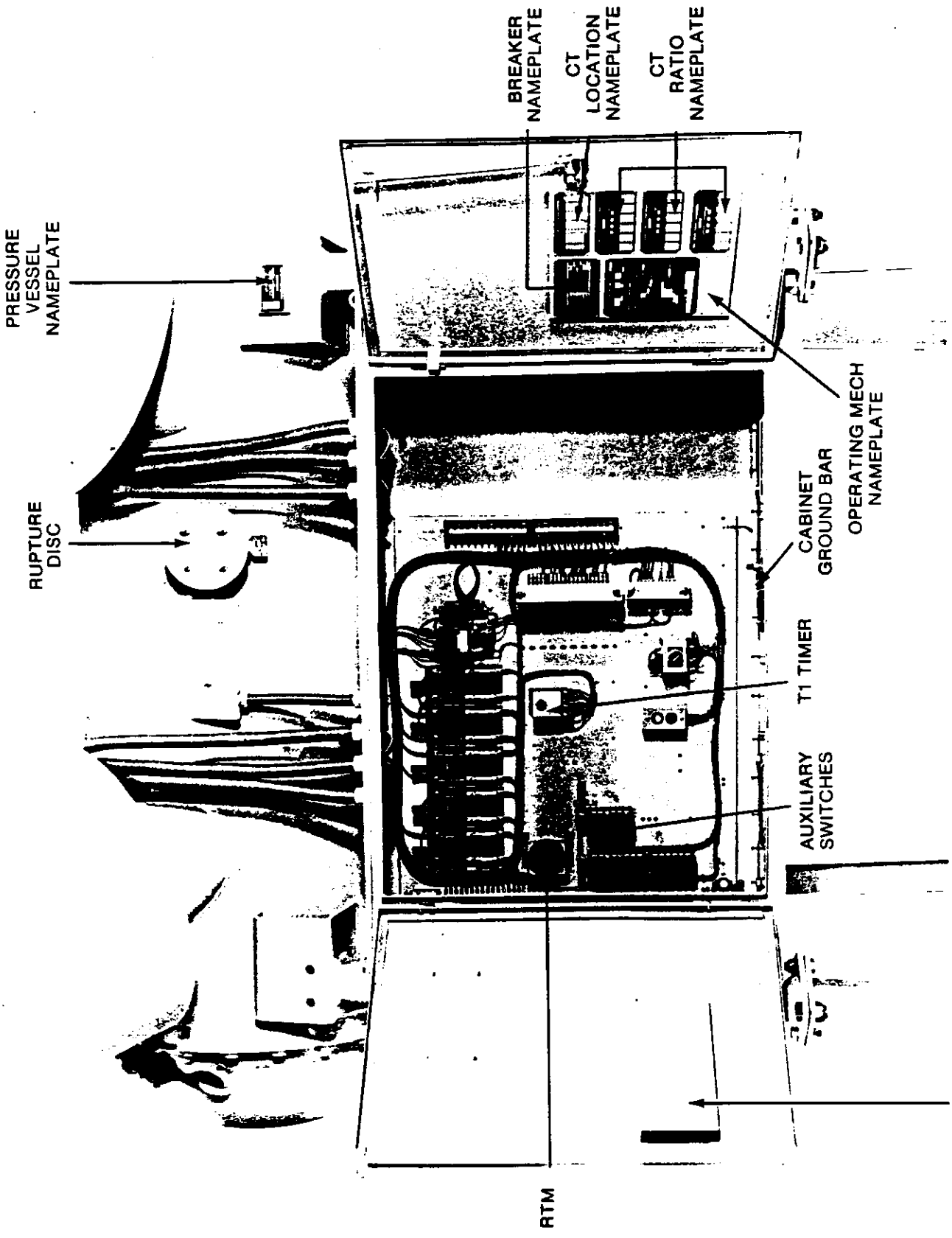
H6, the accumulator heater, is controlled by a se contained thermostat.

Tank heater, H7, is supplied when the expected ambient temperature is below -22°F (-30°C).

Transition house heater, H8, is energized continuously.

4.2.3 **Tank Heater - Fig. 38**

A tank heater H7, to prevent gas liquification, is supplied with circuit breakers expected to operate in areas where the minimum ambient falls below -22°F (-30°C). The silicon rubber heater, attached to the tank wall, is energized by thermostat 23-3 when the tank temperature falls below -10°F (-23°C). Cycling rate of the heater is controlled by thermostat 23-4.


BREAKER NAMEPLATE
CT LOCATION NAMEPLATE
CT RATIO NAMEPLATE
PRESSURE VESSEL NAMEPLATE
OPERATING MECH NAMEPLATE
RUPTURE DISC
CABINET GROUND BAR
T1 TIMER
AUXILIARY SWITCHES
INSTRUCTION BOOK HOLDER
RTM
CONTROL CABINET

PART II
RECEIVING, HANDLING, STORING AND ERECTION

1.0 RECEIVING

When the circuit breaker reaches its destination, the purchaser should check the material actually received against the shipping list to be certain all parts have been received. This will avoid delays in installation. If damage is found or suspected, a claim should be filed immediately with the transportation company and the local ASEA Brown Boveri representative should be notified.

2.0 HANDLING

The breaker is shipped complete except for extension legs and bushing top terminals which are shipped separately and must be attached in the field.

A crane with a lifting capacity of seven tons will be the most efficient means of handling the circuit breaker. Lifting lugs are provided for this purpose. See Fig. 25-26 for lifting arrangement.

3.0 STORING

If the circuit breaker is not installed immediately, facilities should be arranged to prevent damage during storage. The breaker can be stored indoors or outdoors.

The breaker is filled with a partial charge of SF_6 gas when shipped and is ready for service or storage.

If tank has been opened and storage is contemplated, replace desiccant bag and purge the moist atmosphere by evacuating the tank to 1.0 millimeter of mercury and hold for approximately 15 minutes to inspect for leaks. SF_6 gas should then be admitted to the breaker to a pressure of approximately 5 psig (34.5 kPa) and maintained during the storage period. If the above is impractical, fill the breaker twice with dry nitrogen to approximately 25 psig (172 kPa) and drain to atmosphere. Then again fill the breaker to 5 psig (34.5 kPa) with dry nitrogen and maintain during storage period.*

Protection from moisture and corrosion for the operating mechanism and control cabinet may be accomplished by closing the housings and energizing the space heaters provided. If energizing the space heaters is impractical, similar protection may be obtained by use of silica-gel, activated alumina, or other dehydrating agents.

Spare parts should be kept sealed and stored in a dry room to minimize the possibility of moisture damage.

* THIS DRY NITROGEN MUST BE REMOVED FROM THE BREAKER TANK PRIOR TO FILLING THE BREAKER WITH SF_6 DURING COMMISSIONING.

4.0 ERECTION OF THE BREAKER

4.1 Preparation for Installation

4.1.1 Supplied with breaker:
- Breaker assembly
- Field assembly kit
- Service kit
- Instruction manual

4.1.2 Other items:
- Traveling crane, 7 ton capacity
- Slings
- Spirit level
- Ladders
- Cleaning liquids
- Lint-free cleaning cloths

4.2 Lifting

Lift the breaker with the lifting arrangement shown in Fig. 25-26; and while suspended, attach leg extensions 13048 as shown with hardware supplied. Place breaker on its foundation pad, the unit does not require precise leveling, a spirit level on the horizontal bracing will suffice. Grout or shim under the breakers foot pads and bolt to foundation.

4.3 Grounding

The circuit breaker structure should be permanently grounded. Two NEMA grounding pads 13024 are provided, welded to the front and rear of the structure base. A ground terminal located in the center rear of the control cabinet must also be grounded.

The ground cable should be able to carry the available fault current at the breaker location for the maximum duration of the protection scheme.

4.4 Installation of Bushing Top Terminals

See Fig. 27. Apply Alnox Grease (ED 4.1.3318) on the raised diameter of the bushing flange and wire brush the bushing flange with grease in place. Add more grease to area and bolt terminal in place, torque screws to 38 Ft. Lbs. (52 Nm). Seal around each screw head with Silastic (ED 4.1.3190). Remove the excess grease from around the terminal, clean with solvent, then seal around terminal with Silastic.

4.5 **Commissioning**

The breaker has been adjusted and tested at the factory and is shipped completely assembled except for the leg extensions and bushing terminals. The breaker contains a partial charge of SF_6 gas and the full amount of desiccant thus eliminating the necessity of opening the breaker before commissioning. The hydraulic system is completely charged.

Once the breaker has been assembled completely and all electrical connections made, the breaker is ready for final commissioning which should be made in the following sequence:

4.5.1 *Control and Secondary Wiring*

Control and auxiliary equipment in the circuit breaker have been wired, adjusted and tested at the factory. Terminals are provided for power and control connections. Refer to Wiring Diagram for external connections and to mechanism nameplate for control voltages and pressures.

Use control and power wiring of adequate size to maintain voltages at breaker terminals within ANSI Standard ranges.

Conduits for external control wiring may be terminated at the removable plate located in the bottom of the control housing. All conduits should be properly sealed at the cabinet to prevent moisture and dirt from entering.

4.5.2 *Current Transformers*

Current transformer, relaying and metering, have been installed at the factory and wired to short circuiting terminal blocks in the control cabinet. Nameplates on the inside of the cabinet door indicate location, accuracy and ratio of the current transformers.

4.5.3 *Pole Resistance Measurement*

Perform the voltage drop measurement on each phase. The maximum reading bushing terminal to bushing terminal should not exceed 130 micro ohms using a 100 amp meter. If any phase exceeds this value it will have to be investigated and corrected. See Maintenance Section, Part IV of this book for gas evacuation, disassembly and instructions concerning the current path.

4.5.4 *Filling the circuit breaker with SF_6 Gas*

Complete the filling of the circuit breaker tank with SF_6 gas to 87 psig (600 kPa) at 70° F. When filling with SF_6 gas, take note and compensate for temperature variation as shown in Fig. 22.

The properties of the gas used in the breaker must meet the specification for sulfur hexafloride according to ASTM D2472-71.

An in-line dryer-filter may be used when filling the breaker with gas to bring the moisture content of the gas down to the specified level for the breaker. This precaution is not normally required when filling the breaker from a bottle supplied by the gas manufacturer or when using a gas cart which contains a dryer-filter unit. The dryer-filter can be obtained from ASEA Brown Boveri.

The two suggested methods of filling a circuit breaker are directly from a bottle or from a gas service cart as shown in Fig. 28 and 29.

A. Filling An Unopened Breaker From a Gas Bottle

Filling from a gas bottle should only be done if the breaker has not been opened and a positive pressure of approximately 5 psig (34.5 kPa) at 70° F remains in the tank. The recommended method for filling an unopened breaker with SF_6 gas from a gas bottle is through the use of an optional gas fill kit 13135. The kit is connected as shown in Figure 30. The line should be purged of any moisture and the pressure regulator should set according to the temperature compensated pressure chart shown in Figure 22A and 22B. Approximately 250 lbs. (113.5 kg) by weight will be required. Gas from two bottles will be required to fill the breaker and usable gas will remain in the last bottle after the breaker is filled. When filling during cold ambients the cylinder may be placed in hot water to convert the liquid SF_6 in the cylinder to a gas. See Section V for limitations on heating the SF_6 gas cylinder.

An unopened breaker may be filled from a gas bottle also through the vacuum and fill valve 13070 located on the bottom of the breaker tank (see Figure 29). However, a suitable means of regulating the pressure must be provided by the purchaser for the safety of maintenance and other personnel. The line must be purged and the breaker must be filled according to the temperature compensated chart shown in Figure 22A and 22B.

B. Filling An Unopened Breaker From A Gas Service Unit

Connect the flexible hose of the gas service unit to the breaker vacuum and fill valve 13070 (See Fig. 29) and start vacuum pump to remove air from hose and dryer. When vacuum gauge reads 1.0 mm Hg., open the vacuum valve on the tank. Fill breaker as described in "A" above.

C. Servicing An Opened Breaker

If a breaker has been opened, a means to attach a vacuum pump to the vacuum-fill valve must be arranged. Most gas service units contain built-in vacuum pumps. After closing breaker tank a vacuum is pulled down to 1.0 mm Hg. absolute measured with a vacuum gauge connected to sampling valve 13133. Vacuum should be held for 15 minutes to eliminate moisture. The breaker can then be filled from cylinders or a gas service unit as described above. A vacuum pump is required each time a breaker is opened.

Use temperature gauge, if supplied, in control cabinet to determine gas system temperature for determining gas fill pressure. If temperature gauge was not supplied, measure ambient temperature with a separate thermometer.

Allow gas pressure and temperature to stabilize for 15 minutes and recheck before removing filling apparatus.

During the filling process, it is good practice to check the gas density monitor settings as shown on mechanism nameplate or Wiring Diagram. Note that the gas pressure is rising when filling the breaker and the density settings are set on falling pressures, therefore, the reset points on rising pressure are approximately 3 psig above the indicated set points.

NOTE: ALL MPa PRESSURES ARE GAUGE

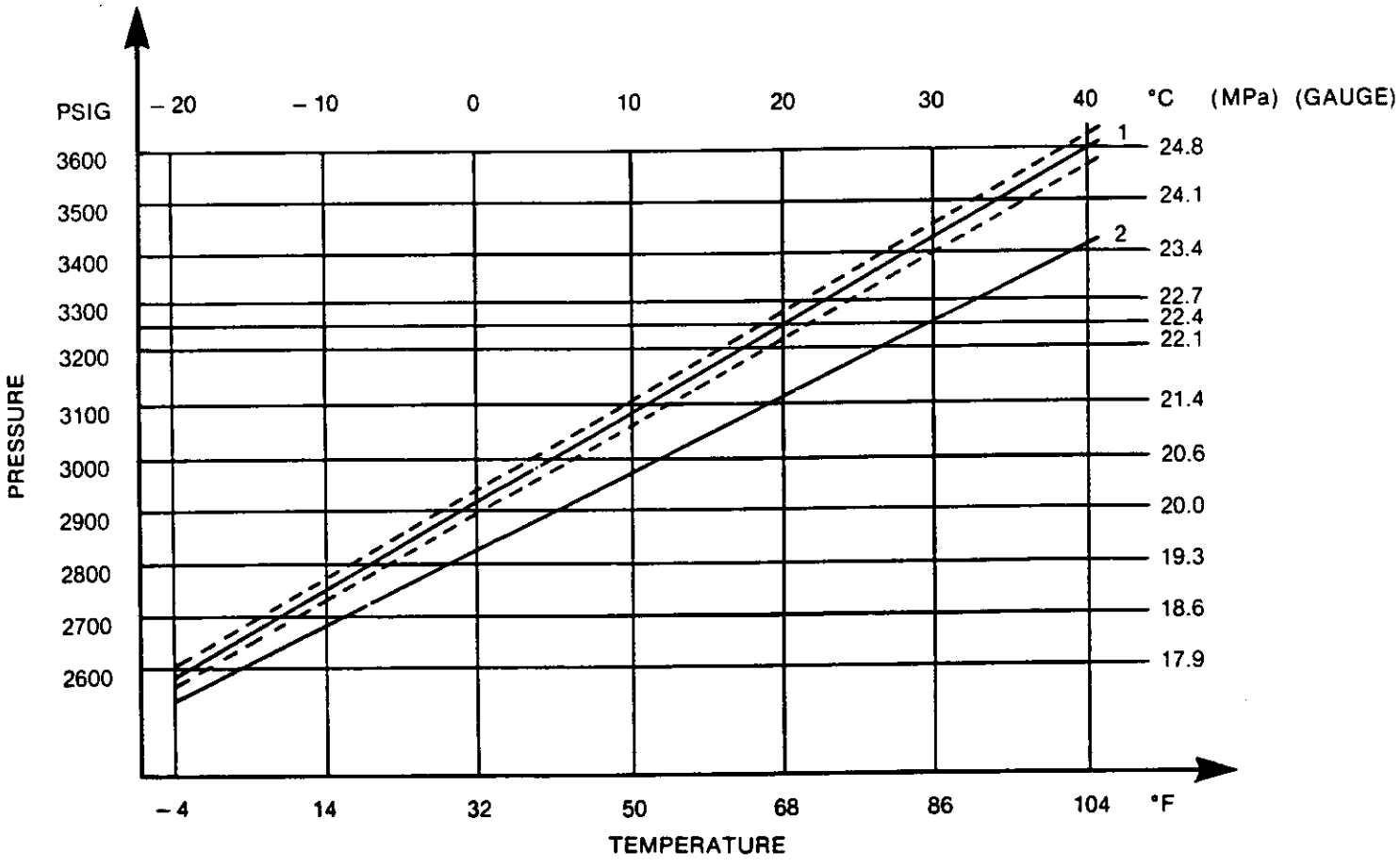


FIG. D
ACCUMULATOR PRE-CHARGE CHART

Pre-load pressure of nitrogen in the hydraulic accumulator 16010 plotted against temperature (t)

1. Pre-load pressure in the initial state of the accumulator 16010 with scatter band (shown dotted).
2. Minimum permissible pre-load pressure for operation.

4.6 **Moisture Measurement**

Moisture measurement may be taken after gas filling to check moisture content of gas used to fill breaker and should be taken 24 hours later after system moisture has stabilized.

Reliable moisture measurements require attention to cleanliness and prescribed procedure, particular as it applies to excluding moisture contamination from analyzer instrument and its connection. The tubing used to connect the instrument to the sampling valve (13133), Fig. 15, must be stainless steel and should be capped immediately after use to keep out moisture. It is important that the recommendations of the instrument supplier be followed carefully.

Moisture content of SF_6 or N_2 can be analyzed with Meeco Electrolytic Analyzer, Beckman Instrument Moisture Analyzer or equivalent.

The maximum moisture content to be expected from gas cylinders are:

SF_6 - Dew Point of -50°F (-45°C) or 63 PPM (by volume)

*N_2 - Dew Point of -78°F (-55°C) or 20 PPM (by volume)

*Used only for storage when SF_6 gas is not available.

The maximum permissible moisture level permitted in the circuit breaker is 100 PPM (by volume).

4.7 **Leak Testing**

With SF_6 leak detector test all threaded and gasketed connections with particular attention to the following points:

1. Tube connectors and fittings to pressure gauge 16001, gas density monitor 13170, sampling valve 13133, rupture disk 13046 and vacuum-fill valve 13070. (Fig. 12-16)
2. Bushing Flanges 13040 (Fig. 4)
3. Tank End Enclosures 13051 and 13110 (Fig. 2)
4. Operating Rod Static Seals 13087 with breaker open and closed. (Fig. 3 and 11).

4.8 **Hydraulic System Check**

The circuit breaker is shipped with a completely charged hydraulic system. Check the oil level in the reservoir with the hydraulic system at zero psig. The oil level should be visible in the top sight glass. When the hydraulic system is fully pressurized, 4950 psig (34.1 MPa), the oil level should be visible in the lower sight glass. Refer to Section IV, Para. 3.4-5 for instructions on adding hydraulic oil, if required.

Before pressurizing the hydraulic system check see that pressure gauge is at zero psig and that manu by-pass valve 16068 is closed. Energize pump circu and allow pump to pressurize system. The pressu rises rapidly until the nitrogen pre-load pressure reached and then continues to increase at a slow rate. At the moment the rate of rise changes, stop th motor and note the pressure. It should read 3250 ps (22.4 MPa) at 70°F or as indicated in Figure D. This the nitrogen precharge pressure in the accumulato Turn motor on and allow system to continue to rise nominal pressure 4950 psig (34.1 MPa).

Check hydraulic pressure switch settings by turnir off voltage to pump motor and bleeding the syste slowly through the manual by-pass valve 16088 ar verifying the pressure settings are per wiring diagra or nameplate values, adjust as necessary.

4.9 **Functional Testing**

Functional tests can only be performed on a circu breaker with normal gas and hydraulic pressure Carry out several close and open operations permittir the hydraulic pump to recover as necessary. Use th secondary trip circuit (if supplied) to perform sever trip operations.

Oscillograph records of typical open, close, clos open and reclose operations may be taken to veri proper operation. Breakers that fall within the tole ances given in Fig's. 31 and 32 are functioning pro erly. Those units not meeting this criteria will requi investigation discussed in Part III, Trouble Shooting

Optional time distance curves are shown in Fig. 3 34 for those desiring to perform these tests.

After completion of functional testing, the circu breaker may be placed in service.

PART III
TROUBLESHOOTING

.0 **Troubleshooting**

The circuit breaker is designed for unattended operation controlled from a remote center, therefore, both the hydraulic and SF_6 gas systems are continuously monitored and will provide alarms when either system deteriorates to marginal pressures and will disable circuit breaker operation when either system drops below minimum operating pressures.

1.1 **SF_6 Gas Pressure Alarm**

If the SF_6 gas pressure alarm (63-2C) is activated, check the gas pressure gauge remembering to adjust indicated pressure for temperature (See Fig. 22) and refill as required.

If frequent refilling is required check for gas leaks. Locate the leaks and seal them. The maximum acceptable leak rate is one percent per year.

1.2 **Hydraulic Oil Pressure Alarm**

A hydraulic oil pressure alarm is indication that the hydraulic system is starting to deteriorate. However, it is normal for this alarm to occur momentarily after rapid multiple operations. The alarm will reset after the pump has had time to recharge the system.

The following items should be checked to isolate trouble in the hydraulic system.

a. Check pressure gauge if pressure is below 4750 psig (32.8 MPa). The pump should be running and the hydraulic system recovering. If pump is not running check motor, electrical system, and hydraulic pressure switch.
b. If pump is running but hydraulic system is not recovering, check oil level, manual shutoff valve 16068, pump coupling, or pump.
c. If pump is running but hydraulic pressure is zero, a hydraulic short circuit has developed. The following items can cause short circuits:
   1. Changeover valves 16042, 16043 out of synchronization. This is generally caused by operating the circuit breaker below 3850 psig (26.5 MPa) during maintenance or test.
   2. Improper shimming of the solenoid operator atop the solenoid valves 16044, 16045 or 16046. This can occur after trip or close coil replacement.
   3. A major seal or check valve in the hydraulic block has malfunctioned causing an internal leak.
   4. Manual relief valve 16068, or bypass valve 16067 leaking.

It is normal for the pump to start up several times a day. If a breaker is not operated, up to 10 start ups a day may be regarded as acceptable.

The number of pump start ups on several different circuit breakers subjected to the same duty may vary significantly. For example, 10 start ups per day may occur for one breaker and one start up in two days for another. The difference does not represent an alarming irregularity.

A large increase in pump operating time indicates an internal leak. This can be deduced by logging the running time meter over a period of days or weeks. Variation in ambient temperature can also alter the number of pump operations on a circuit breaker.

Oozing of oil from threaded joints in the pipe lines, hoses, or other hydraulic couplings does not necessarily indicate a faulty seal. If a threaded joint is dripping, it should be tightened as soon as operating conditions permit the hydraulic system to be depressurized.

1.3 **Breaker Closing and Opening at Erratic Speeds**

Usually a sign that air pockets exist in the high pressure hydraulic system. Pull vacuum on hydraulic system per Para. 3.4.2, Section IV.

1.4 **Heaters**

Condensation heaters H1, H2, H5 and H8 are on continuously and should be warm to the touch. At high ambient temperatures it will be necessary to short thermostat 23-1 in order to check space heaters H3 and H4. Accumulator heater H6 can be checked by temporarily shorting terminal 155 to terminal 47. This shorts out thermostat 23-2. Remove short after test.

1.5 **Circuit Breaker Timing**

The oscillograph timing charts as shown in Fig. 31, 32 provide breaker timing information. The following problems can occur:

a. Problem:
   Contact parting or closing too slow.
   Cause:
   1. Terminal voltage at the trip or close coils too low.
   2. The puffer piston 17099 or puffer cylinder 17105 may be contaminated with arc products producing excessive friction.
   3. The contact lubrication may be contaminated with arc products producing excessive friction.
   4. The hydraulic pressure gauge is not calibrated and all corresponding pressure switch settings are too low.
b. Problem:
   Breaker pole spread is too great.
   Cause:
   1. Usually a result of excessive erosion on arcing contacts 17051 and 17104 particularly when single phase faults are interrupted (Fig. 8 & 10).

1.6 **Control System**

If the control system fails:
Check the power supply.
Check all terminals for firm correct connections.

1.7 **Current Transformers**

a. Problem:
   Inaccurate or erratic readings of all current trans-

formers on a single bushing.
Cause:
1. The lipseal 13011 between the CT platform and cover is not in place or the gap insulation is not maintained (see Fig. 2, Det. M).

1.8 **Low Nitrogen Alarm**
Nitrogen loss can be the result of either accumulator heater (H6) failure in cold ambient or a gas leak in the accumulator. The accumulator can be recharged in the field (see Fig. 50).

TABLE 1

MAINTENANCE TABLE

Inspection	Monthly Inspection	Yearly Inspection	Contact Inspection	Major Inspection
Conditions/Reason	or at walk - rounds or routine shut downs	or on the occasion of a contact inspection or a major inspection	10 yrs. or permitted number of operations given in Table 2	Every second contact inspection
Functions which have to be checked and parts which have to be inspected/replaced.				
Interrupter				
Fixed contact rod 17104	-	-	replace[1]	replace
Contact cage ass'y. 17060	-	-	"	"
Puffer piston - assembly 17099	-	-	inspect[2]	inspect
Puffer cylinder 17105	-	-	"	"
Contact ring 17106	-	-	replace	replace
Insulating nozzle 17103	-	-	"	"
Auxiliary nozzle 17102	-	-	"	"
Locking spring 17134	-	-	"	"
Multi-Lam contact 17150	-	-	"	inspect
Operating Mechanism				
Oil level	check[3]	check	check	check
Hydraulic pressure	"	"	"	"
Running time meter	"	"	"	"
Pressure gauge 16071	-	"	"	"
Pre-load pressure in hydraulic accumulator 16010	-	"	"	"
Pressure switch 16130	-	"	"	"
Hydraulic oil	-	"	examine[4]	"
Breaker Pole				
All removed sealing rings	-	-	replace	replace
SF_6 gas pressure	-	check	check	check
Density monitor 13170	-	"	"	"
Moisture content	-	"	"	"
Bushings	-	-	"	"
Timing	-	-	"	"
Micro ohms	-	-	"	"

1 Replace—Replace the part when it reaches the permissible number of operations. If after the inspection period of 10 years the parts are in very good condition (e.g. if there have been very few or no operations), the parts need not be replaced. (*See Table 2)*

2 Inspect— Inspect the part and, if necessary, replace it. Replacement of the part is not necessary if there is very little or no wear on the areas prone to wear and the silverplating is not damaged.

3 Check— Carry out a comparison of the nominal and actual values (settings, readings).

4 Examine— Perform an oil analysis and evaluate the further useability of the hydraulic oil. See para. 3.8, part IV.

PART IV
MAINTENANCE

1.1 **Maintenance Frequency**
Table 1 provides a complete list of maintenance checkpoints and suggested inspection frequency.

1.2 **Contact Replacement**
Stationary and moving contacts are designed to withstand a great number of low load switching operations without maintenance and a fewer number of operations as the switching load increases. Table 2 lists the number of permissible load operations before contact inspection is required.

TABLE 2

SWITCHING CURRENT kA	Up to 3	5	10	20	30	40
Permissible number of operations	2000	1000	280	65	30	16

1.3 **Disassembly Procedures**
It is possible to inspect and replace contacts of the circuit breaker by removing only the rear cover 13051, end opposite operating mechanism. However, to remove an interrupter assembly it will be necessary to remove both end covers. Both disassembly procedures are described below.

1.4 **General Cleanliness**
The major insulating components are subjected to high electrical stresses and, therefore, cleanliness of the component surfaces is extremely important.

Care is taken at the factory during interrupter assembly and field assembly of these parts must also be done in a clean, dry environment. Not only is dirt harmful but also the residue left from sweaty hands and atmospheric moisture. Therefore, handling of parts with bare hands, especially insulating surfaces should be kept to a minimum and must be wiped down with cleaning solvent. Equally stringent cleanliness requirements apply to the hydraulic system. The hydraulic components must be kept free of dirt and moisture.

1.5 **Lubrication**
Circuit breakers must be lubricated only where required and with lubrication specified.

Apply a thin coat of grease (4.1.3388) to the following contact surfaces during assembly:
- Guide 17151
- Inner Surface of Puffer Cylinder 17105
- Contact Fingers in Finger Cage 17160
- Contact Ring 17106

These surfaces will be identified on the corresponding drawing as indicated in Para. 2.9.

All the moving parts of the hydraulic mechanism are immersed in oil and need no lubrication.

1.6 **Locking**
There is a tendency for the impact loading which the circuit breaker experiences during each operation to loosen threaded connections. Therefore, all critical joints require that Loctite be applied. Clean threads in blind holes if they can be adequately dried afterwards. Apply Loctite sparingly to the outermost edges of the thread. Two small drops are enough even for large threads.

Joints locked with Loctite can usually be unfastened with proper wrenches. In cases of difficulty, the joint can be loosened by heating the joint to 150°C. Be careful not to damage materials which are sensitive to heat such as insulation or sealing components.

Particular care is required with the locking of current carrying connections. If used improperly, Loctite will fill the space between the contact areas and cause a high resistance joint. For this reason apply Loctite only where specified. See Para. 2.10.

1.7 **Seals**
When disassembly makes it necessary to remove end cover or bushing sealing rings which have been in service for a number of years, it is advisable to replace them, although, the sealing rings are reusable. Seals may be cleaned with soap in lukewarm water or, if necessary, kerosene or pure washing benzine. Volatile mineral oil products or solvents are not acceptable.

Never clean seals with abrasives even if they are very fine.

Allow to dry at room temperature.

Before use, check that the seals are flexible and that there are no cracks.

CAUTION: CAUTION: CAUTION: CAUTION:

It is not advisable to leave the breaker tank open overnight. Reinstall the end covers with a few bolts.

2.0 REMOVING A BREAKER FROM SERVICE

2.1 **Preparation for Maintenance**

WARNING: WARNING: WARNING: WARNING:

Before any work commences, the breaker must be isolated from the high voltage network and the bushing terminals grounded. The correct order of necessary procedures is determined by the particular characteristics of the installation in question.

2.2 **Gas Handling Safety Precaution**

Precautions to be observed when handling SF_6 gas and toxic by-products of arcing.

Toxic decomposition products are formed when arcing occurs. This gray dust may lightly coat the tank interior if the breaker has experienced several heavy fault interruptions. This powder should be carefully removed, if present, by vacuuming or wiping down the tank and interrupters with ethanol.

2.3 **Removing SF_6 Gas From Breaker**

Before an internal inspection of the breaker can be made, it is necessary to evacuate the SF_6 gas and store it. It is not economical to exhaust this gas to the atmosphere. A gas service unit should be available for this purpose.

After reading instructions and becoming familiar with the gas service unit check to see if the unit is purged of air and that the SF_6 gas already contained in the unit is of good quality. Connect the flexible hose from the unit to the breaker vacuum-fill valve 13170. Evacuate the hose from the gas service unit. Fully open vacuum-fill valve and let the high pressure gas flow from the breaker to the service unit. When the gas in the breaker and the service unit has equalized, turn on the compressor and follow service unit instructions step-by-step until a vacuum of about 2 mm Hg. is reached, then close all valves on service unit. Close vacuum-fill valve. Remove hose from vacuum-fill valve. Slowly open vacuum-fill valve 13070 releasing the vacuum in the breaker. End covers may now be removed.

2.4 **Opening the Breaker**

After vacuum is broken, it is recommended that the tank be opened and cleaned immediately. A mask with air supply approved for breathing, gloves, and protective clothing should be worn to clean the tank.

2.5 **Removing Desiccant**

A desiccant bag is installed in every circuit breaker. I purpose is to remove chemically active produc formed during arcing and to control the residu moisture.

Used desiccant bags should be discarded. Regene ation for purposes of reuse, although possible, is n recommended. Use precautions described in Para. 2 above when removing bags.

It is recommended that the desiccant bag be r placed each time the breaker is opened for inspectic or maintenance. The new bag should be installe immediately prior to sealing the breaker.

2.6 **Replacing Desiccant**

Desiccant bags are shipped in a hermetically seale reinforced aluminum bag to prevent contaminatic due to atmospheric moisture. The date of manufactu is marked on the outer bag. It is recommended th bags over two years old not be used in the breaker.

When ready to install the desiccant bag open th outer bag at one end. Be careful, if using a knife c scissors, not to damage the inner bag. Immediate check the small moisture indicator tag included in th bag. The indicator dot on the tag should be blue. If it not blue, the outer bag must have been damaged, th bag is useless, and must be discarded.

The protective outer bag is sealed under vacuur and the "tight-fit" usually indicates this. However, i very warm ambient temperature, the molecular siev gives off air it has absorbed. This may cause the oute bag to expand and look like a pillow. This does nc necessarily indicate that the desiccant is ineffective.

2.7 **Contact Inspection and Replacement**

For contact inspection and replacement, it is necessar to remove only the tank rear cover 13051 from the tan 13001 at cap screws 13052 after following instruction in Para's. 2.1-2.6 above (See Fig. 2, 42 and 43).

Refer to Fig. 2, 5-7.

Remove the shield 17021 and exhaust assembl 17120 at cap screws 17118. Remove the rear flexibl bushing shunts by removing bushing terminal scre 17111 and interrupter screw 17140. Remove stationar contact assembly 17101 complete (Fig's. 5 and 8) a screws 17124 from this assembly remove fixed contac rod 17051 at nut 17055. Insert assembly tool 13207 int contact assemblies inside diameter to maintain pos tion of contact fingers 17057. Finger cage assembl 17060 may now be removed at screws 17054.

The moving contact can now be exposed by removing contact ring 17106 along with nozzle 17103 at screws 17133 (Fig. 10). Remove auxiliary nozzle 17102 and moving arcing contact 17104 by first installing contact wrench onto the rear of the tank in holes that permit the insertion of the tool in the desired interrupter (Fig. 35). Then slide tube assembly 13201 so that studs 13202 are inserted into the vacant holes in flange 17098 (Fig. 10). Lock tube 13201 by clamp 13204 with screws 13203. The spider 13206 and the tube 13201 must be securely locked to prevent rotation of the moving contact assembly 17100. Fit center tube assembly 13205 over the flats on auxiliary nozzle 17102. Rotate counterclockwise to remove nozzle 17102 and moving arcing contact 17104 (Note: Considerable force is required).

2.8 **Removing Interrupters**

To remove interrupters for expanded maintenance, omit Para. 2.7 and follow procedure outlined below:

a) To gain access to the front end of the breaker it is necessary to remove the operating mechanism swinging it out of the way by means of a hinged maintenance device (Fig. 36).

b) With breaker in closed position disengage the mechanism driving rod 16140 (Fig. 3), from the breaker's pull rod assembly 13025. This is accomplished by removing the covers 13021 and 13022 (Fig. 2), then releasing the crank drive plate 16141 at screw 16142.

c) Remove the drive plate 16141 at screws 16145 and 16142, then the coupling 16143 at screws 16144 from the mechanism drive rod 16140 and breaker pull rod assembly 13025. Disengage the seal plate 13054 from the front end enclosure 13110 at the screws 13055. When screws 13055 are loose, tap their heads with a mallet to release the seal plate if it is stuck to the end enclosure 13110.

d) Attach front hinged maintenance device 13229 per Fig. 36A and detailed instructions Fig. 36B.

e) If hinged maintenance device is not available the front end may be lifted away from the tank using a crane after disconnecting electrical circuits and auxiliary switch drive linkage at the control cabinet.

f) Loosen the screws 17111 from bushing terminals to release the shunts 17110. Remove shield 17021 and exhaust assembly 17120 at cap screws 17118 (Fig. 5-7).

g) Install interrupter removal tool 13230 under interrupter to be removed (Fig. 37). Adjust jacks so that the cradles support the interrupter weight. Remove bolts 13195 securing interrupter to support plate. Roll interrupter to rear of tank and remove. Remove the remaining interrupters in same manner.

h) Do not lift on pull rod assembly 13025 as it may damage the operating rods 17090, pull rod assembly 13025 should be removed at this time by removing screws 13026 (Fig. 2 and 11).

NOTE: Use spanner wrench 13281 in the holes in the metal end of the insulating actuating rod 17090 to prevent torquing the rod.

In the event the interrupter removal tool 13230 is not available, the interrupters can be removed one at a time manually out the rear of the breaker after disconnecting the pull rod assembly 13025 and actuating rod 17090 at screw 13026, then removing nuts 13195 (Fig. 2).

i) Removing the interrupters 17000 should be arranged so that maintenance can be accomplished in a dust and moisture free environment, preferably indoors. Overnight storage of insulation components should be done in sealed plastic bags.

j) Remove the interrupters 17000 from the interrupter support 13050 at nuts 13195 (Fig. 2).

k) Disassemble stationary contact assembly 17101 as previously described in Para. 2.7 above.

l) Remove shields 17020 at screws 17123 (Fig. 6). Remove shunt connectors 17110 at screws 17140.

m) Disassemble the interrupter tube assembly 17050 at screws 17138. Remove puffer piston assembly 17099 and moving contact assembly 17100 as a unit by removing screws 17136 (Fig. 5).

n) Disconnect the insulating actuating rod 17090 from the moving contact assembly 17100 with spanner wrench 13400 inserted through one of the slots in the support 17154 (Figs. 5, 9 & 10) and engaging one of the holes in the metal end fitting of the insulating actuating rod. With the extension wrench 13401 remove screw 17115.

NOTE: Lock the insulating actuating rod at the hole adjacent to screw 17175 to prevent excessive torque on rod.

The puffer piston assembly 17099 and the moving contact assembly 17100 can now be separated.

o) Disassemble the moving contact assembly 17100 at screws 17133 and 17132. Use holding tool 13228 to disassemble nozzle assembly 17102 which allows removal of moving arcing contact 17104. This requires considerable force (Fig. 10 Det. A).

p) The puffer piston, assembly 17099, is disassembled by removing screws 17155. This will allow access to check valve 17131.

NOTE: The breaker cannot function unless this valve is in place and operating properly.

2.9 **Breaker Assembly**

Assembly takes place in the opposite order to that described in Para. 2.1-2.8 above.

Observe cleanliness, lubrication, and torquing requirements. Clean insulators with ethanol before installation and handle only when wearing polythene gloves. General torque specifications can be found in Table 3.

2.10 **Lubrication and Locking Instructions**

Triangular flags △ are used on the assembly drawings to provide lubricating and locking instructions.

- Conducting aluminum surface. See △1 below
- Lubricate areas of contact as described. See △2 △3 △4
- Lock threaded joints with loctite as described. See △5 △6 △7

△1 Use Alnox grease ED 4.1.3318 on the conducting aluminum surface of the bushing top flange. Wire brush—add a little more Alnox grease and bolt on terminal 13047 (see Fig. 27).

△2 Coat metallic sliding surfaces with a very light coat of lubricant "Alvania" ED 4.1.3388.

△3 Coat the flange surfaces indicated from the sealing "O" ring outward to the outside diameter of the flange with a light coat of silicone grease (Dow Corning #33) ED 4.1.3315. Lubricate indicated pin or bearing with Dow Corning #33 ED 4.1.3315.

△4 Polish with a lint-free cloth, then apply a light coat of Molycote Spray (Dow Corning #321) ED 4.1.3387.

△5 Apply Loctite Grade 222, ED 4.1.3034.1 to thread of fastener and a light coat of petroleum to the bearing surface of the fasteners and torque to the value in Table 3. (light grade Loctite).

△6 Apply Loctite Grade 242 ED 4.1.3034.2 to thread of fastener and a light coat of petroleum to the bearing surface. Torque to value in Table 3 (medium grade Loctite).

△7 Apply Loctite Grade 262 ED 4.1.3034.3 to the thread of fastener and a light coat of petroleum to the bearing surface of the fastener. Torque to the value in Table 3 (high grade Loctite).

△8 Align slots.

When assembly is complete, inspect tank to insure that all bolts are tight, corona shields are in place, and that all internal components are clean. Add desiccant 13194 per Para. 2.6. Close and seal tank immediately. Process breaker per Part II Para. 4.5.4. After gassing breaker carry out the functional tests as outlined in Part II before putting breaker in service.

2.11 **General Notes**

Contact penetration checks or adjustments are not required, there is no need or provisions for this adjustment.

The breaker speed has been set at the factory and field adjustment is not normally necessary.

NOTE: Torque auxiliary nozzle 17102 to 110-145 Ft. Lbs (145-195 NM). Use a torque spanner.

3.0 MAINTENANCE OF OPERATING MECHANISM

3.1 **Oil Level**

An unusual drop in oil level without a corresponding external leak is an indication of internal trouble. If nitrogen is escaping from the accumulator, the accumulator will store more oil for a given pressure. Check accumulator pre-load pressure.

TABLE 3
BOLT TORQUE TABLE IN FT-LB/NM

Thread size	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20
Through bolt with nut	4.4 / 6	8 / 11	13.3 / 18	19 / 26	37 / 51	65 / 89	104 / 141	158 / 215	217 / 295	309 / 420
Bolt in internal thread	2.6 / 3.5	4.4 / 6	7.7 / 10	11 / 15	22 / 30	30 / 52	61 / 83	93 / 127	127 / 173	180 / 245

3.2 **Pipe Joints**

If individual pipes are removed from the operating mechanism, be aware that small quantities of oil may remain in the pipes. The dismantled pipes and openings in the system must be sealed immediately after disassembly to protect from contamination.

Visually inspect threaded joints for leaks. Tighten the joints only if they are leaking. Oozing of oil from the joints does not necessarily indicate a failure of the seal. If a joint is dripping, equalize the hydraulic system, then tighten the joint.

When tightening or loosening threaded joints, hold the fixed part with a spanner while unscrewing the removable sleeve nut with another spanner.

Do not undo threaded male connectors which are screwed into hydraulic components, only tighten them. Before tightening the male connector in a threaded joint, slacken the sleeve nut so as not to distort the pipe.

When assembling pipes, oil may fill the space between the nut on the threaded joint and the pipe. This oil needs several days to escape and may falsely indicate that there is still a defect in the seal. It suffices to wipe the joint thoroughly until the oil has disappeared.

3.3 **Draining Hydraulic Oil**

Oil may be drained from the oil reservoir 16130 by first releasing the pressure in the oil tank by loosening the pressure relief valve 16035, on top of the mechanism, then opening drain valve 16066. Store oil in a clean, dry container.

3.4 **Filling with Hydraulic Oil**

The oil used in the hydraulic system should be per ED 4.1.3326. The fluid should be clean and free of moisture.

If the oil level is low but not to the point where air has been pumped into the high pressure system the level can be brought back to normal by adding oil per 3.4.1 below.

If the high pressure system has been contaminated with air it will have to be purged before filling with oil per 3.4.2.

3.4.1 **Adding Oil**

Fill the oil reservoir through the pressure relief valve 16035 port. Fill the reservoir until the oil level is in the middle of the upper sight glass. Start the pump and allow the pressure to stabilize at 4950 psig (34.1 MPa). Oil level should be visible in bottom sight glass. Allow pump to pressurize system to 5500 psig (38 MPa) by manually holding contactor 42-1 in or momentarily shorting terminals 42 and 44. Again fill reservoir until oil level is visible in bottom sight glass. Install pressure relief valve 16035 and tighten securely. Bleed hydraulic system down to 4950 psig (34.1 MPa).

3.4.2 **Purging Hydraulic System**

Drain hydraulic system of oil through drain valve 16066. Check that pressure relief valve 16035 is in place. Connect vacuum pump, vacuum gauge and valving per Fig. 18. Close valve B and open valves A and 16066. Pull vacuum down to 10 mm Hg absolute. Add a quart of oil to system by closing valve A and opening valve B. Again pull a vacuum down to 10 mm. Add oil until visible in top sight glass. Continue filling per Para. 3.4.1.

3.5 **General Hydraulic System Operating Instructions**

Due to the charging process when generating the working pressure, the compressed nitrogen in the hydraulic accumulator heats up and cooling occurs after the pump is switched off. As a result the achieved pressure falls and this may cause an automatic restart of the pump. The system should stabilize within 15 minutes.

Never operate the breaker with the hydraulic pressure below 3850 psig (26.7 MPa). When equalizing the hydraulic system, always open the cut-off valve slightly to ensure a slow equalization of pressure.

3.6 **Pressure Gauge Check**

Compare pressure gauge 16071 with master pressure gauge. Master pressure gauge may be connected to the hydraulic system service port, the difference must not exceed 70 psig (480 kPa).

3.7 **Hydraulic Pressure Switch**

Check hydraulic pressure switch 16130 against the hydraulic pressure gauge. If set points per operating mechanism nameplate does not agree with pressure gauge and gauge has been checked per Para. 3.7 above, then the set points must be adjusted. To adjust the relevant element, proceed as follows:

Bleed hydraulic system with manual relief valve 16068 to prescribed pressure. Connect a test clamp to electrical contacts of pressure switch element. Rotate the cam 16050 in direction of monitor until the monitor lamp lights. Hold the cam 16050 in this position and tighten the nut 16051 by hand. Carefully tighten nut 16051 with spanner and adjust width screw 16054 for 0.1 to 0.2 mm (see Fig. 39).

Check set point by building up pressure and bleeding it off several times. Readjust, if necessary. Once satisfied, carefully fold over the locking plate 16136 and press it against the flat on nut 16051, but do not hit it with a heavy object.

Tighten nut 16051 with spanner wrench only when pressure switch is pressurized.

3.8 **Hydraulic Oil and Service Life**

The oil used in the hydraulic system is subject to the aging process even under no-load use. Examination of the oil is therefore necessary every ten years. The conditions of the oil is to be judged by its appearance.

Increased water content causes turbidity of usually clear oil. Oil samples should be analyzed by independent laboratories for determining continued use or changeout.

4.0 **Rupture Disk Replacement**

Each breaker is shipped with a 2 inch reverse buckling rupture disk installed. Replacement will only be necessary if the disk ruptures due to an internal fault or if the disk develops a gas leak around the seals.

Clamping of the disk between the mounting flanges will cause a permanent deformation in the shape of a circle in the flat portion of the disk. Once a disk has been installed it should not be disturbed. If the disk is removed for any reason, the disk must be replaced with a new one.

Improper installation and particularly uneven tightening of the clamping studs can cause a reduction in rupture pressure below the guaranteed accuracy range. The following procedure should be used to install disks (see Fig. 12).

4.0.1 Inspect the flanges and disk for signs of accidental damage, particularly in the sealing and clamping area. Also check the teflon coating on the disk for damage. Check to see that disk and flanges are correct, "BS & B."

4.0.2 Apply a very thin coat of Dow Corning #33 grease ED 4.1.3315 to the unpainted sealing surfaces of both flanges for corrosion protection.

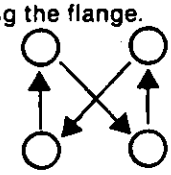
4.0.3 Insert the four M16 studs in the holes of the weldneck flange and screw on the backside nuts using Loctite 242, ED 4.1.3034.

4.0.4 Place the disk on the stationary flange with its tab at the cutout on the flange and the spherical bulge inward toward breaker tank. Place the loose flange on the four studs, apply Loctite Grade 242 ED 4.1.3034 to the studs where disk clamping nuts will be located after tightening. Lubricate the bearing surfaces of the four nuts with amber petrolatum, ED 4.1.3325, and install them loosely. Immediately proceed to next step.

4.0.5 Tighten the four clamping nuts to the proper torque.

4.0.6 Press the loose flange by hand against the stationar flange so that it rests evenly on the sealing surface an then finger tighten the four nuts gradually in a diagon cross pattern without tilting the flange.

Tightening Pattern



4.0.7 Set torque wrench to 15 ft. lbs. (20 Nm). Tighten nu in the diagonal cross pattern gradually so that at lea two runs through the pattern is required before th first nut reaches the preset torque. Bring all four nu up to the preset torque.

4.0.8 Set torque wrench to 30 ft. lbs. (40 Nm). Torque th nuts to the final value using procedure in 4.0.7.

4.0.9 Set torque wrench to final value of 45 ft. lbs. (61 Nm Raise nuts to final torque value using procedure 4.0.7.

4.1 **INSTALLING OF THE PROTECTIVE COVER**

4.1.1 Although the critical phase of the disk installations now complete, the protective cover is to be installe with caution, so that the disk assembly will not b disturbed.

4.1.2 Place the spacers and the cover on the four studs. Us Loctite Grade 222 ED 4.1.3034 on the end of the stuc and a light coat of amber petrolatum ED 4.1.3325 o the bearing surface of the nuts.

4.1.3 Set torque wrench to 40 ft. lbs. (54 Nm) and tighten a four nuts.

PART V
EQUIPMENT, SPARE PARTS, AND MAINTENANCE MATERIAL

1.0 GENERAL

Various equipment, material, and spare parts are required to maintain a circuit breaker throughout its expected life.

2.0 EQUIPMENT

2.1 Vacuum Pump

A 100 CFM vacuum pump is recommended, but if a smaller size is available, it will be satisfactory. However, the pump-down time will take longer.

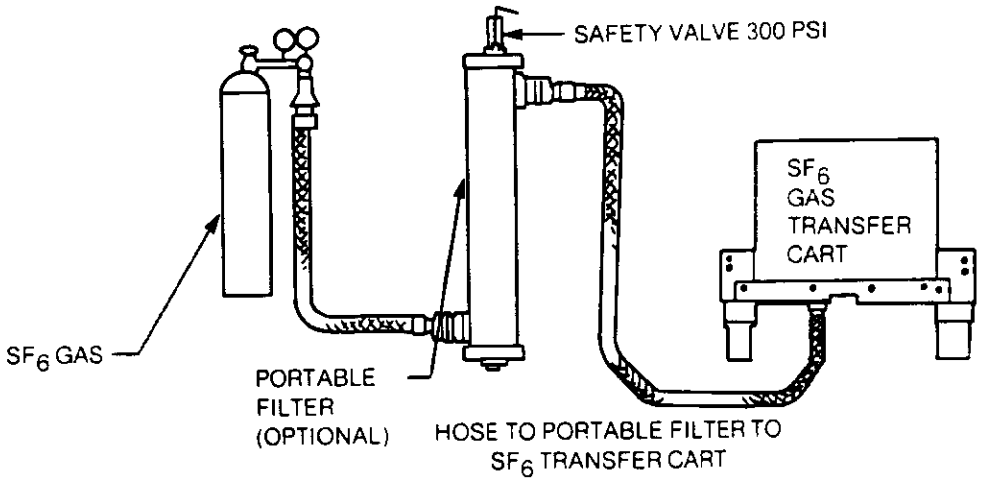
2.2 Vacuum Gauge

An accurate portable vacuum gauge must be used. Stokes Electrical gauges, Model TB-3, 4, or 5, or equivalent are suitable.

2.3 Portable Filter Assembly

An in-line portable filter may be used each time the breaker is filled or emptied of SF_6 gas. The filter removes arc products and moisture from the gas, which in turn protects the compressor and vacuum pump from damage. Place filter in the line between the breaker vacuum fill valve 13070 and the SF_6 gas service cart or gas bottles. A filter as shown in Figure 29 or similar functional design, utilizing 13X molecular sieve can be used. The filter is to be positioned vertically when in use so that gas can be forced to flow through the desiccant and cannot find a short path over the surface. Care must be taken to insure that liquid SF_6 will not enter the portable filter or breaker. The 13X molecular sieve must be replaced after passing approximately 3500 pounds of gas through the filter.

Filling Instructions. Stand unit upright and remove pipe plug at bottom end of unit, letting the desiccant out and discard it. Check the plug and clean the threads thoroughly. Apply the teflon tape and Rector Seal #2 to pipe plug and replace the plug. Filling the unit with desiccant should be performed quickly to reduce the time which the molecular sieve and the interior of the column are exposed to the atmosphere (perform indoors if possible). Pour the desiccant from the shipping container directly into the filter using a funnel. Fill the unit to about 1" from the top. Install top pipe plug as soon as filter is filled. If hoses are not connected to unit, always have the flared cap in place to protect the threads and seal from atmosphere.

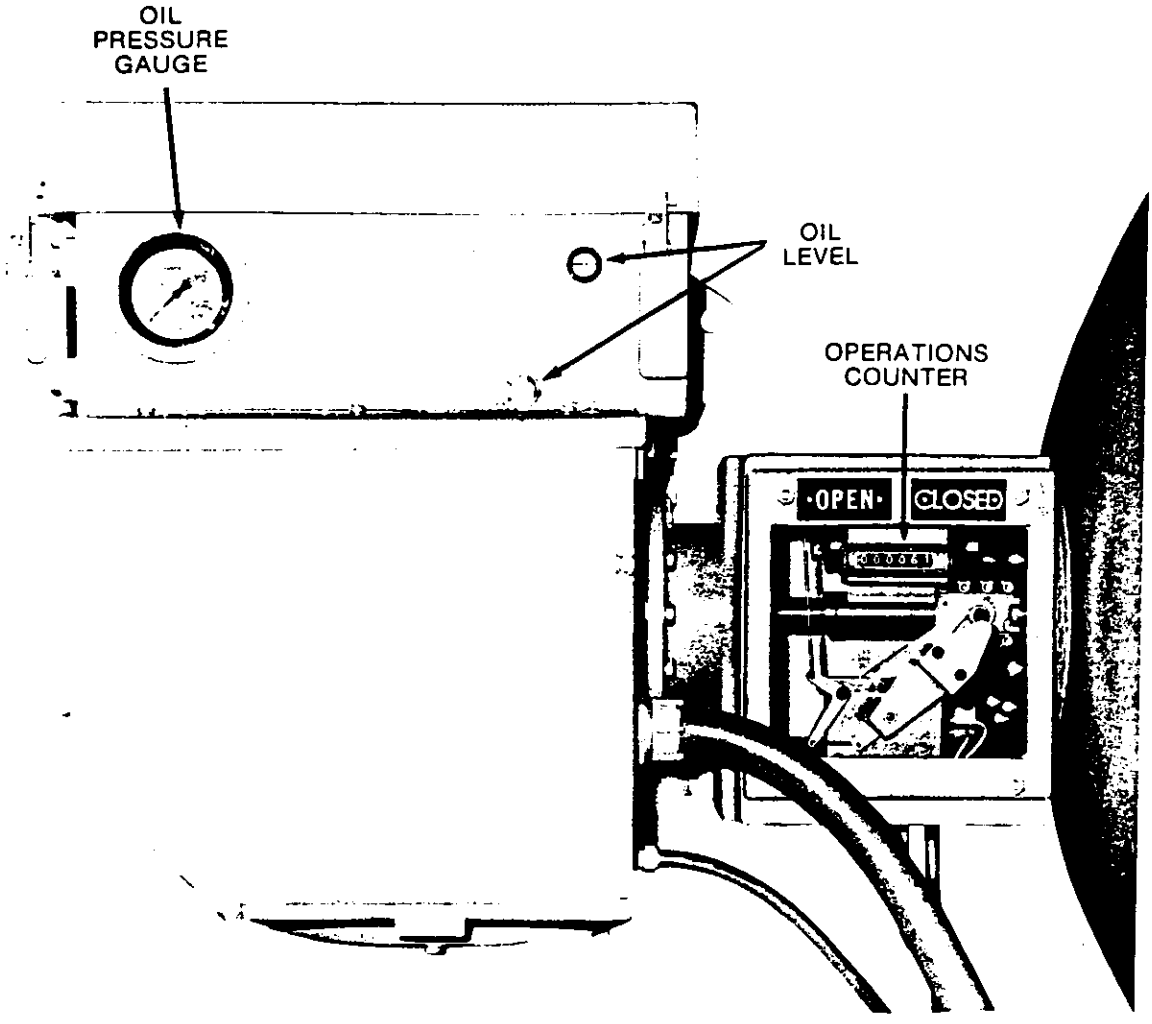


Optional:
Hose Assemblies (Airoquip Mfg.)

ITEM	QTY.	PART NO.	DESCRIPTION
*	1	042L017-76	Hose, 6 Ft. Airoquip #1503-20-72
*	1	042L017-77	Hose, 10 Ft. Airoquip #1503-20-120"

FIG. E

NOTE:
*Airoquip Hose has #411-20 J.I.C. swivel (female 1-1/4", 37° Flare) at both ends.



HYDRAULIC OPERATOR
AND TRANSITION HOUSING

2.4 **Hose Assemblies**
It is recommended that a short, large diameter hose (e.g. 10 feet or less by 1¼ inch I.D. hose) be connected between the breaker and the vacuum pump.

2.5 **Gas Service Transfer Cart**
Gas service unit (gas transfer cart) should include compressor, vacuum pump, active filters, and storage capacity of 300-500 lbs. of gas.

SUGGESTED SOURCES
Limco Corporation
Gravis Point Road
Glenn Cove, NY 11542

Penwalt Stokes Corporation
5500 Tabor Road
Philadelphia, PA 19120

Dilo-Gesellschaft Probst & Co. KG
D-8943 Babenhausen/West Germany
Frundberg Strasse 36

2.6 **Gas Cylinder Regulator (for size "A" cylinders)**
Air Products and Chemical, Inc., single stage regulator, delivery pressure range 1-180 psig. Code number E11-4-N515F. Connection ¼" NPT

2.7 **Leak Detector**
SUGGESTED SOURCES
Halogen Leaktector, Code 23-7023
Bacharach Instrument Company
625 Alpha Drive
Pittsburgh, PA 15238

Ultrasonic Translater - Delcon #4918A
Delcon Div. of Hewlett - Packard Co.
Mountain View, CA

Gas Leak Detector
Calgon Corporation
Pittsburgh, PA 15730

2.8 **Moisture Analyzer**
SUGGESTED SOURCES
Electrolytic Moisture Analyzer (MEECO)
Manufacturing Engineering and Equipment Corp.
250 Titus Avenue
Warrington, PA 18976

Trace Moisture Analyzer
Beckman Bulletin #4101
Beckman Process Instrument Div.
Fullerton, CA 92634

2.9 **Timing Devices**
a. Oscillograph
b. Mechanical Timetravel Recorder (if desired, not mandatory)

2.10 **Microhm Measurement Equipment**
Ductor 100 amp micrometer or equivalent.

3.0 TOOLS & EQUIPMENT FOR INSTALLATION AND MAINTENANCE

The intent of this list is to inform the purchaser of a suggested set of tools and equipment to have available when installing or maintaining the breaker. Most of the tools listed are normally carried by a mechanic, and most of those listed can be substituted by any tool which will perform the same function.

3.1 **Common Tools**
1 Impact Wrench
1 Impact Socket, ⅞" Bolt
1 Impact Adapter
1 Torque Wrench - 10 to 150 Ft. Lbs.
1 Torque Wrench - 10 to 600 Ft. Lbs.
1 Set - Box End Open Wrenches
5.5-7-8-10-13-17-19-24mm
1 Socket Wrench
1 Set Sockets - 5.5-7-8-10-13-17-19-24mm
1 Socket Wrenches (Allen)
1.5-2.5-3-4-5-6-10-12-14mm
2 Slings, Nylon 2" Wide X 8 Ft. Long
1 Portable Vacuum Cleaner

3.2 **Special Tools**
Special tools not normally available except through ASEA Brown Boveri are listed below. Those marked required are necessary to perform routine maintenance on a breaker and are supplied (one set per order) with the breaker. Optional tools, although not necessary, save time, effort and cut down on the lifting equipment required to maintain a breaker.

Code #	Description	Fig. #	Req.	Opt.
13200	Tool Instl. Arc Contact	35	X	
13269	Maint. Device, Manual Oper.	44	X	
13207	Tool Assy., Stat. Contact	48	X	
13228	Tool, Holder Exhaust Tube	46	X	
13400	Wrench, Spanner, Pull Rod	47	X	
13281	Wrench, Spanner, Pull Rod	47	X	
13401	Tool, Extension, Pull Rod	48	X	
13229	Hinge Instl., Front Maint.	36		X
13279	Hinge Instl., Rear Maint.	42, 43		X
13278	Sling Assy.	26		X
13230	Interrupter Removal Tool	37		X

4.0 MAINTENANCE MATERIAL

4.1 **Sulfur Hexafloride**
Manufactured per ASTM D2472-71. Shipped as liquid gas in steel cylinders containing 100-110 lbs. of gas. Each consignment is provided with a test certificate. Each cylinder has a serial number and a date of delivery.

4.2 **Hydraulic Oil (BBEL ED 4.1.3326)**
Exxon Univis J13
Areo-Shell-Fluid 4

4.3 **Lubricating Grease (BBEL ED 4.1.3388)**
Alvania No. 2
Shell Oil Company

4.4 **Cleaning Materials, Ethanol and Chlorothene**

4.5 **Loctite #222, #242, #262**

4.6 **Alnox Grease (BBEL ED 4.1.3318)**

4.7 **Silicon Grease, Dow Corning #33, (BBEL ED 4.1.3315)**

4.8 **Molycote Spray, Dow Corning #321 (BBEL ED 4.1.3387)**

4.9 **Amber Petrolatum (BBEL ED 4.1.3325)**

4.10 **Cleaning Fluid, Denatured Alcohol.**

5.0 **RENEWAL PARTS**

Sufficient renewal parts should be carried in stock to enable prompt replacement of worn or damaged parts. Careful planning for a stock of such parts will minimize service interruptions caused by equipment breakdown and will ultimately save time and expense.

The number of renewal parts which should be maintained is dependent on conditions of operations and past experience. When continuous operation is of primary importance, more renewal parts should be stocked, the amount being dependent upon severity of service and the time required to secure replacements. It is recommended that subassemblies be stocked for use as spares. A recommended renewal parts list is contained in Table 4.

Renewal parts may not always be identical to the original parts, since revisions may occur which improve the product. The parts which are furnished, however, will be interchangeable.

Standard hardware items are not listed and it is suggested that these items be purchased locally to save time and expense. Where hardware is of a special nature or where standard hardware is specifically requested, it will be provided.

A parts order of low monetary value will be invoiced at minimum billing rate at the time of shipment.

When ordering renewal parts, or for information concerning service or repair of parts, contact the nearest sales office of ASEA Brown Boveri. It is important that the following information be obtained from breaker nameplate and instruction book to properly identify the parts.

1. Breaker Serial Number
2. Breaker Type Designation
3. Figure & Part Number
4. Part Description
5. Quantity Required

All parts are shipped F.O.B. point of shipment, freight not allowed. ASEA Brown Boveri will establish method and routing of shipment. Standard carriers are rail or truck.

Customer may specify method and route of shipment, but in doing so obligates himself for the additional expense incurred. Shipment may also be sent by air or parcel post.

5.1 **STORAGE INSTRUCTIONS**

5.1.1 Carefully handle parts sealed in plastic bags (plastic bags must be intact) and remove bag immediately prior to installation.

5.1.2 Store rubber parts in cool dry place. Protect from light and sun.

5.1.3 Unsuitable storage produces accelerated aging of seals. The following rules permit spare seals to be stored for several years without deterioration:

a. Environmental temperature between 40° F and 70° F (4° C and 21° C).
b. Storage area away from water condensation or high humidity.
c Closed atmosphere in a suitable packing to reduce the oxidizing effects of air.
d. Store away from effects of ozone; equipment or machines which produce sparks or arcs.
e. Avoid contamination with fluids, oils, and fats; or contact with metals (copper, iron, manganese and their alloys), rubber of other grades, and plastics.
f. Store seals ("O" rings) flat with no stress, pressure, deformation or bending.

6.0 **GAS HANDLING**

Only properly instructed personnel should handle SF_6 and N_2 cylinders.

Check moisture content of N_2 and SF_6 gas cylinders. The maximum moisture content should be:

N_2 Dewpoint of -68° F (-55° C) or 20 ppm (by volume)
SF_6 Dewpoint of -50° F (-46° C) or 63 ppm (by volume)

6.1 **Cylinder Fittings**

N_2 (cylinder size "A", 9" x 55") OPTIONAL FOR LEAK TESTING OR STORAGE ONLY.

Standard industrial type cylinders which are color coded olive for easy identification, cylinder pressure connection is 0.965" diameter, 14 threads/ inch, national standard right hand. Cylinder adapter for connection is a CGA580 nipple and hexagon nut.

SF_6 (cylinder size "A", 9" x 55")

Standard industrial type cylinders which are color

coded silver with green top for easy identification. Cylinder pressure connection is 0.945" diameter, 14 threads/inch, national standard left hand. Cylinder adapter for connection is a CGA590 nipple and hexagon nut.

6.2 **Heating Cylinders**

SF_6 cylinders should only be heated when necessary to transfer the gas from the cylinders to the service cart or to the breaker. The following methods can be used:

6.2.1 Use portable electric heater, or two approximately 6" wide band heaters. Clamp band heater on SF_6 cylinder, such that one heater is near the bottom and the other 12 to 15 inches from bottom of cylinder.

6.2.2 Another means of heating cylinder to transfer gas in cold weather is to immerse the cylinder in a drum with 20 gallons of water and heat the water with a portable gas or electric heater.

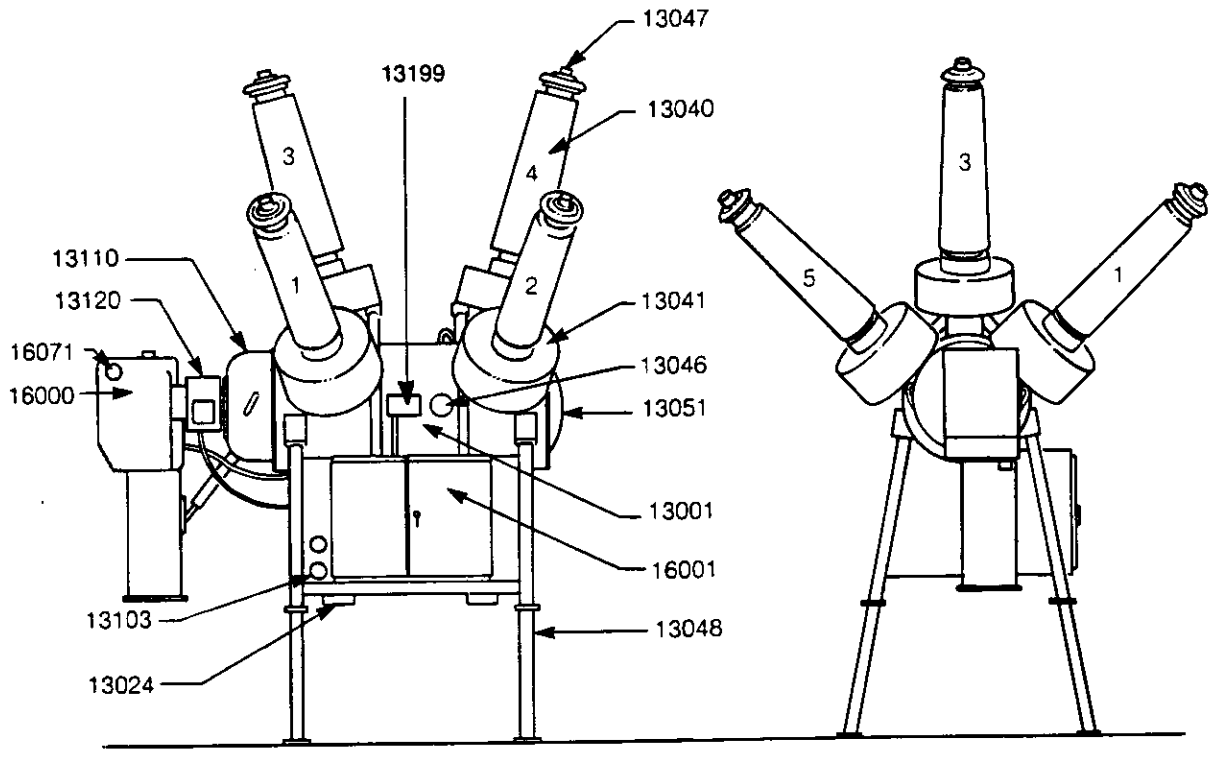
WARNING WARNING WARNING WARNING

Energize heaters only when transfering gas. Do not allow cylinder temperature to exceed 130°F (54°C). Use 300 psig safety relief valve in line between cylinder and gas cart or breaker.

TABLE 4
RENEWAL PARTS LIST

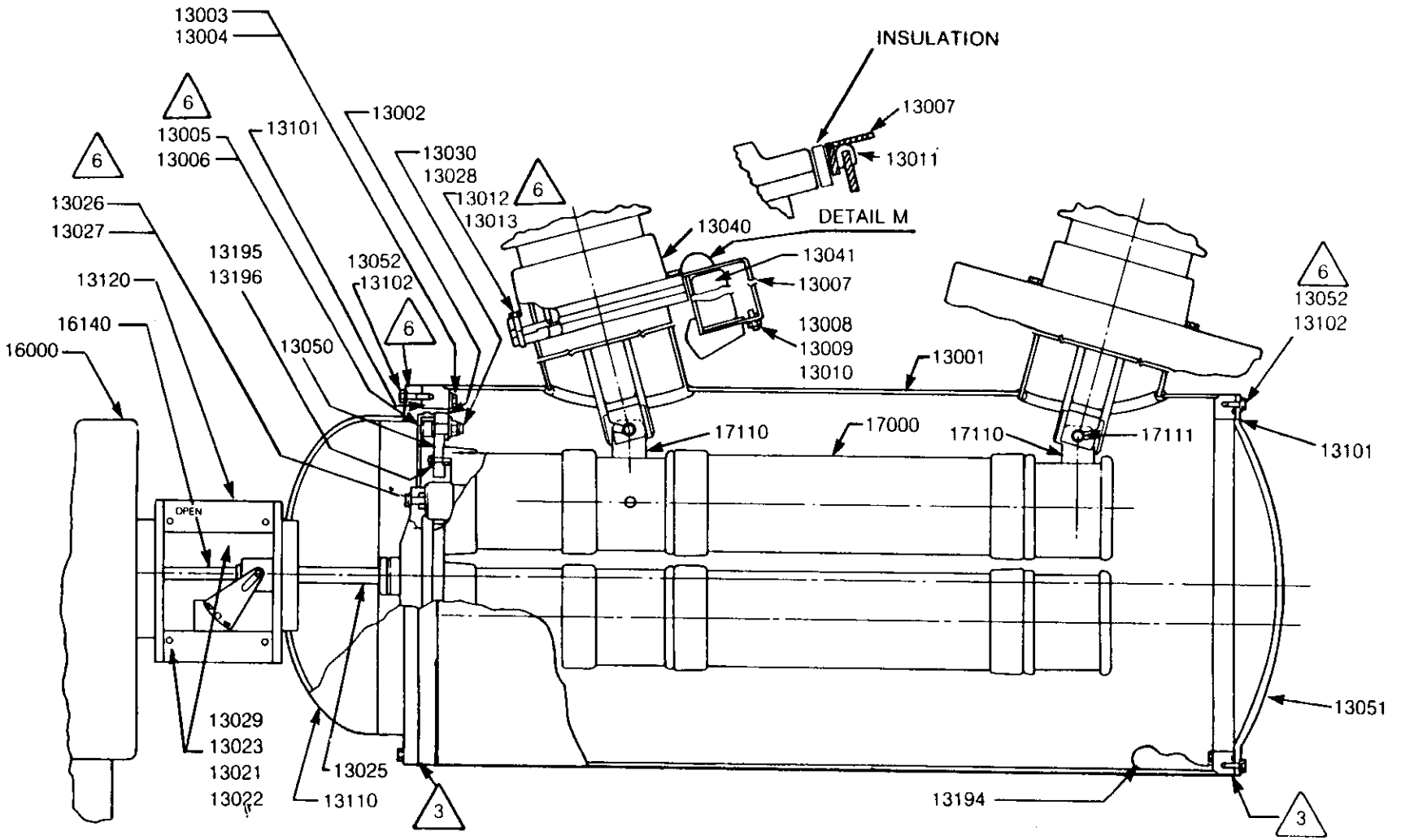
Component Description	Quantity Breaker	Figure No.	Code No.	Part Number
"O" ring, tank ends	2	2	13101	674A010-01
Seal, static	2	11	13087	HAGT446996-P2
"O" ring, pressure plate	1	3	16150	674A010-04
"O" ring, transition housing	1	3	16151	674A006-57
Desiccant bag, inside tank	1	2	13194	109A164-01
Auxiliary nozzle	3	10	17102	HATH407703-R1
Insulating nozzle	3	10	17103	HAGT341398-P1
Contact ring	3	10	17106	HAGT342356-P1
Moving arcing contact	3	10	17104	HATH407689-R1
Puffer cylinder	3	10	17105	HAGT342285-R2
Stationary arcing contact	3	8	17051	HAGT341286-R12
Continuous current contact finger	240	8	17057	HAGT445476-R1
Contact, multi-lam	3	9	17050	HAGS301276-P17
"O" ring, contact	3	10	17135	674A006-66
"O" ring, bushing lower flange	6	4	13031	674A010-03
"O" ring, bushing upper flange	6	4	13037	674A010-04
"O" ring, bushing pocket	6	4	13032	674A010-03
Seal ring, dynamic	1	11	13092	HAGT446963-P4
Seal ring, combination	1	11	13093	HAGT446964-P4
"O" ring, vacuum fill valve	1	13	13071	674A015-01
Rupture disk	1	12	13046	366B054-02
Solenoid valve	3	17	16044,45,46	GPFX30004P1
Changeover valve	2	17	16042,43	GPFX730015P1
Trip and close coil (TC, CC) 125VDC	3	17	16044,45,46	*GPFM730003-P125
Motor 230VAC, 1ϕ	1	17	16063	*GPHL730093P25
Pump	1	17	16062	GPFM730035P1
Oil filter	1	17	16061	HAGS400561P1
Oil pressure gauge	1	17	16071	458A023-01
Accumulator heater (H-6) 230VAC	1	17	16015	*495B205-03
Oper. mech. heater (H-5) 230VAC	1	17	16016	*495A209-01
Gas pressure gauge	1	14	13103	458A022-02
Density monitor	1	14	13170	894B301-01
Heater, Transition Housing (H8) 230VAC	2	3	16192	767A022-44
Heater, cabinet (H1-H4) 230VAC	4			*495B147-03
Relay X, Y, AX, BX 125VDC	4			*762A081-07
Relay NX 230VAC	1			*762A075-02
Heater, tank (H-7) 230VAC	1			*495B155-03
Thermostat (cab heater, 23-1)	1			923A007-01
Thermostat (tank heater, 23-3)	1			302A003-04
Motor starter (42-1) 230VAC	1			*866A010-02
Tank heater contactor (42-2) 230VAC	1			*866A018-02
Relay DX-DC 125VDC				762A095-02

*For voltages other than indicated, consult factory for part number.



13001	TANK
13024	GROUND PADS
13040	ENTRANCE BUSHINGS
13041	CURRENT TRANSFORMERS
13046	RUPTURE DISC
13047	TERMINAL
13048	LEG EXTENSIONS
13051	TANK COVER (REAR)
13103	PRESSURE GAUGE GAS
13110	FRONT TANK ENCLOSURE
13120	TRANSITION HOUSING
13199	TEMPERATURE BULB HOUSING
16000	OPERATING MECHANISM
16001	CONTROL HOUSING
16071	PRESSURE GAUGE OIL

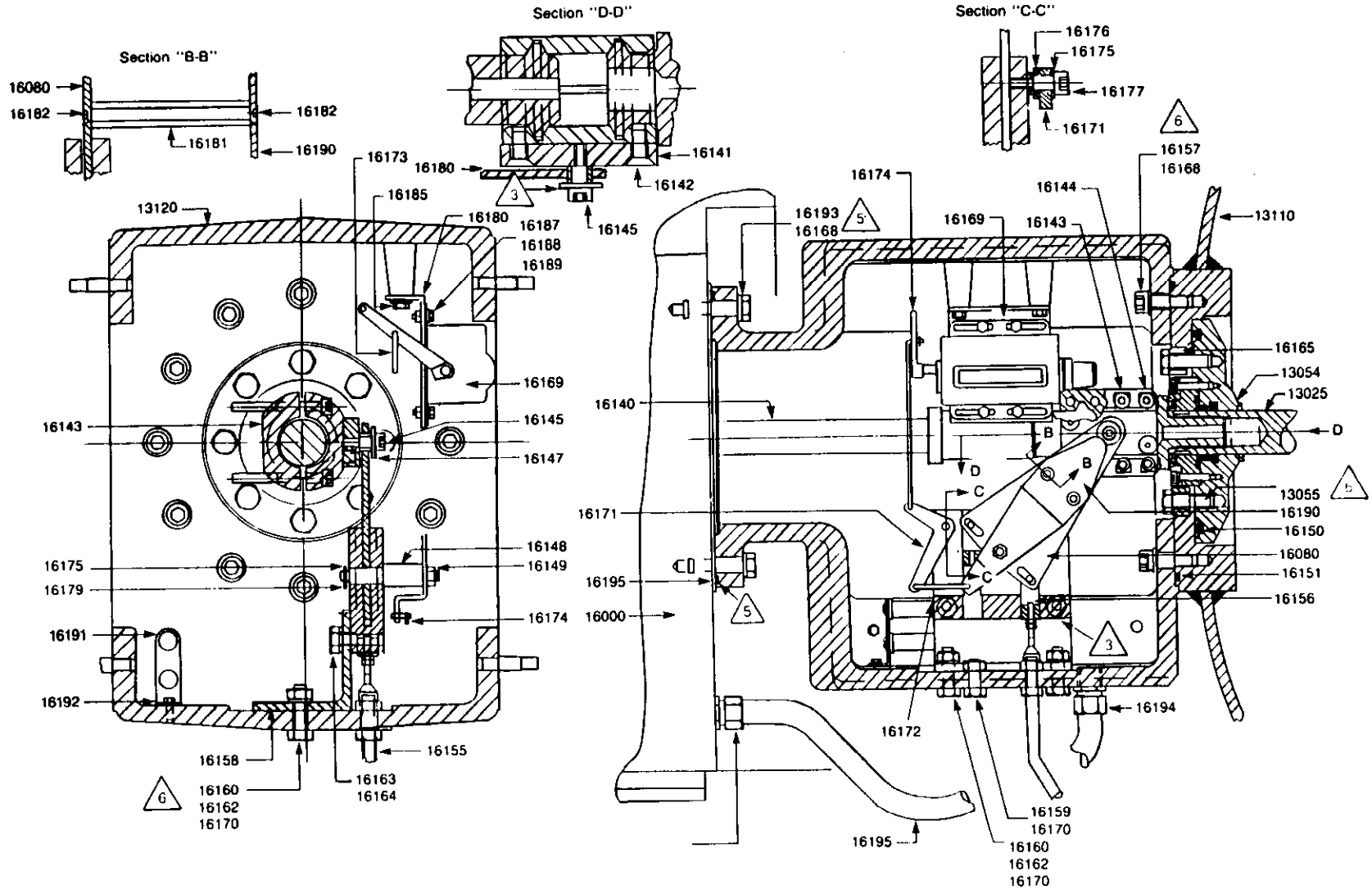
FIG. 1
13000 CIRCUIT BREAKER



13001	TANK	13011	GASKET	13029	LOCK WASHER	13120	TRANSITION HOUSING ASSEMBLY
13002	PLATE	13012	SCREW	13030	NUT	13140	DRIVING ROD
13003	SCREW	13013	WASHER	13040	ENTRANCE BUSHING	13194	DESICCANT BAG
13004	WASHER	13021	FRONT COVER ASSEMBLY	13041	CURRENT TRANSFORMER	13195	NUT
13005	SCREW	13022	REAR COVER ASSEMBLY	13050	INTERRUPTER SUPPORT	13196	WASHER
13006	WASHER	13023	NUT	13051	TANK COVER REAR	16000	OPERATING MECHANISM
13007	TRANSFORMER HOUSING	13025	PULL ROD ASSEMBLY	13052	SCREW	16140	DRIVING ROD
13008	NUT	13026	SCREW	13101	"O" RING	17000	INTERRUPTER ASSEMBLY
13009	WASHER	13027	WASHER	13102	WASHER	17110	SHUNT CONNECTOR
13010	WASHER	13028	WASHER	13110	TANK ENCLOSURE FRONT	17111	SCREW

△ SEE PAGE 17

FIG. 2

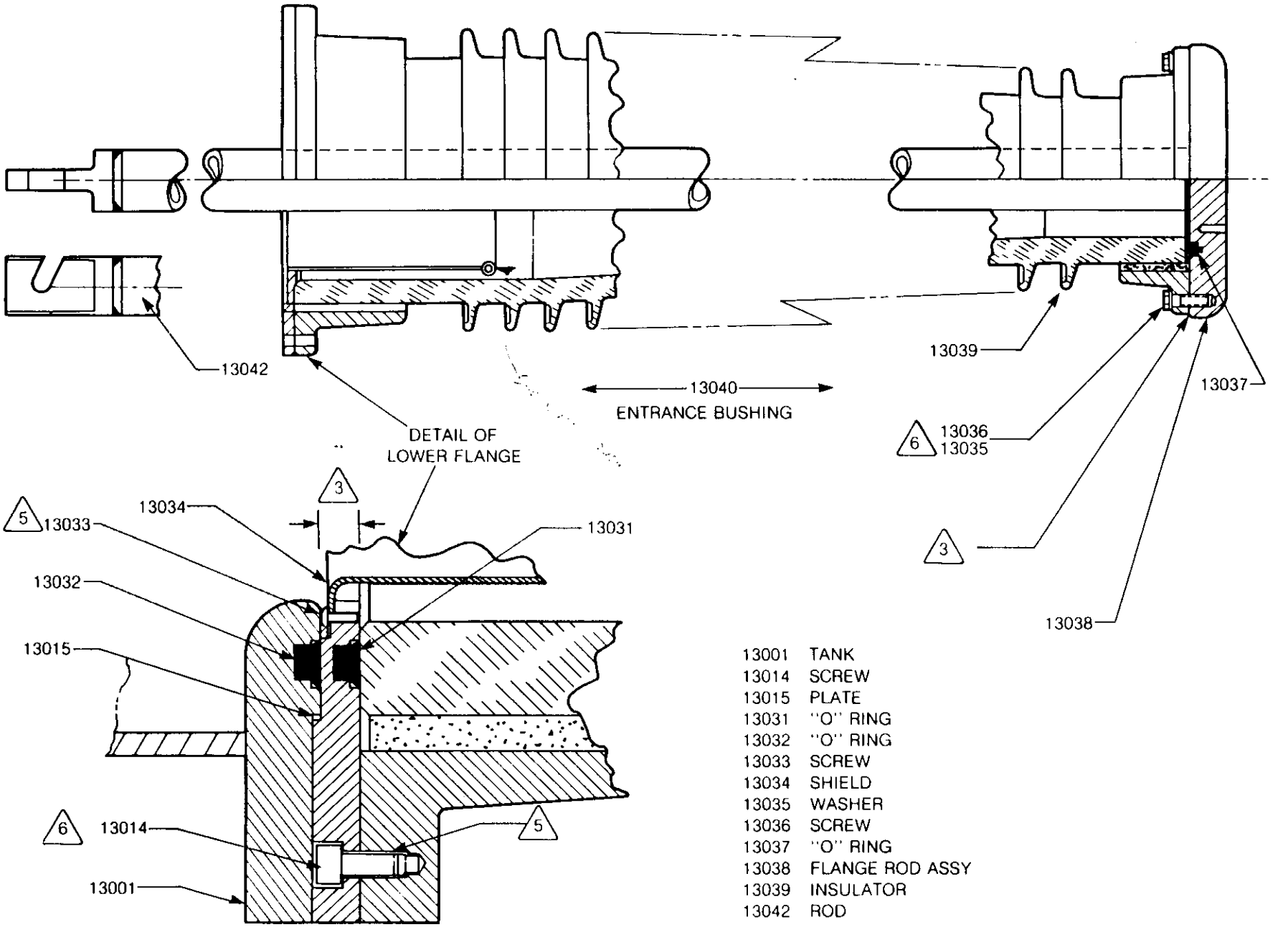


13025	PULL ROD ASSEMBLY	16144	SCREW	16157	BOLT	16169	OPER. COUNTER	16182	SCREW
13054	SEAL PLATE	16145	SHOULDER BOLT	16158	BRACKET	16170	NUT	16185	SCREW
13055	BOLT	16147	BUSHING	16159	BOLT	16171	LEVER	16186	LOCK, WASHER
13110	FRONT TANK HEAD	16148	PIN	16160	BOLT	16172	CONN. ROD	16187	NUT
13120	TRANSITION HSG.	16149	NUT	16162	WASHER	16173	CONN. ROD	16188	LOCK, WASHER
16000	OPERATING MECH.	16150	"O" RING	16163	BOLT	16174	COTTER PIN	16189	SCREW
16080	AUX. SW. DRIVE LEVER	16151	"O" RING	16164	WASHER	16175	WASHER	16190	OPEN, CLOSE INDICATOR
16140	HYDRAULIC DRIVE ROD	16152	ROD END	16165	CLAMPING RING	16176	WASHER	16191	HEATER
16141	LEVER DRIVE PLATE	16153	LEVER BLOCK ASS'Y	16166	WASHER	16177	SHOULDER SCREW	16192	SCREW
16142	SCREW	16155	SWITCH CABLE	16168	WASHER	16179	COTTER PIN	16193	BOLT
16143	COUPLING	16156	CLEVIS			16180	BRACKET	16194	CONDUIT FITTING
						16181	SPACER	16195	CONDUIT

△SEE PAGE 17

FIG. 3

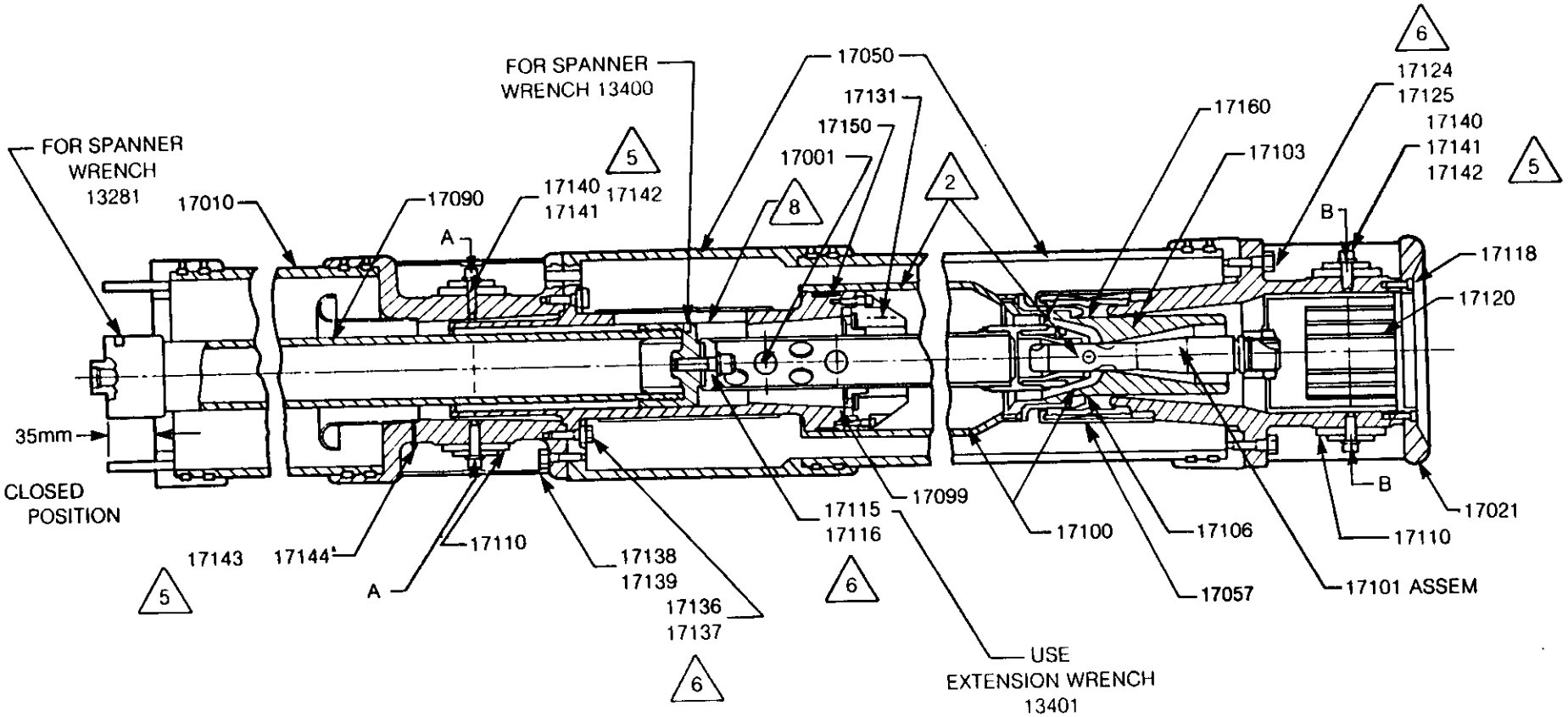
13120 TRANSITION HOUSING ASSEMBLY



13001	TANK
13014	SCREW
13015	PLATE
13031	"O" RING
13032	"O" RING
13033	SCREW
13034	SHIELD
13035	WASHER
13036	SCREW
13037	"O" RING
13038	FLANGE ROD ASSY
13039	INSULATOR
13042	ROD

△SEE PAGE 17

FIG. 4

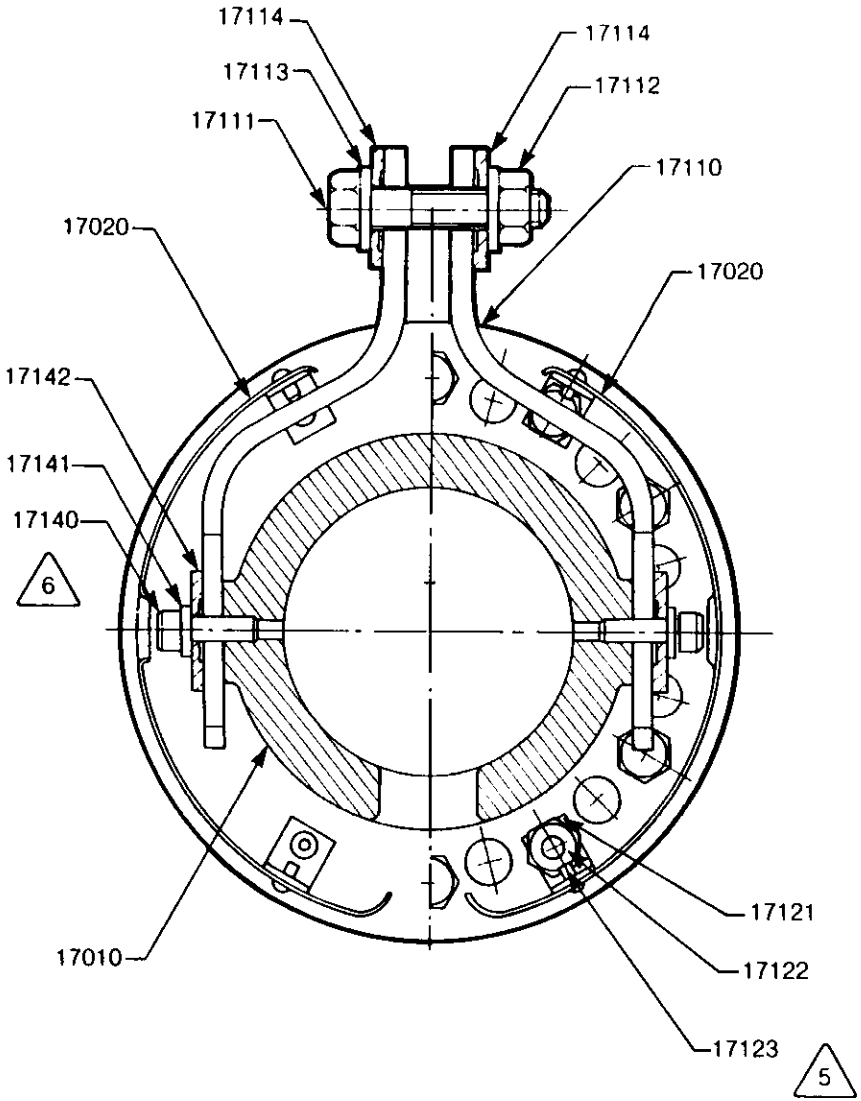


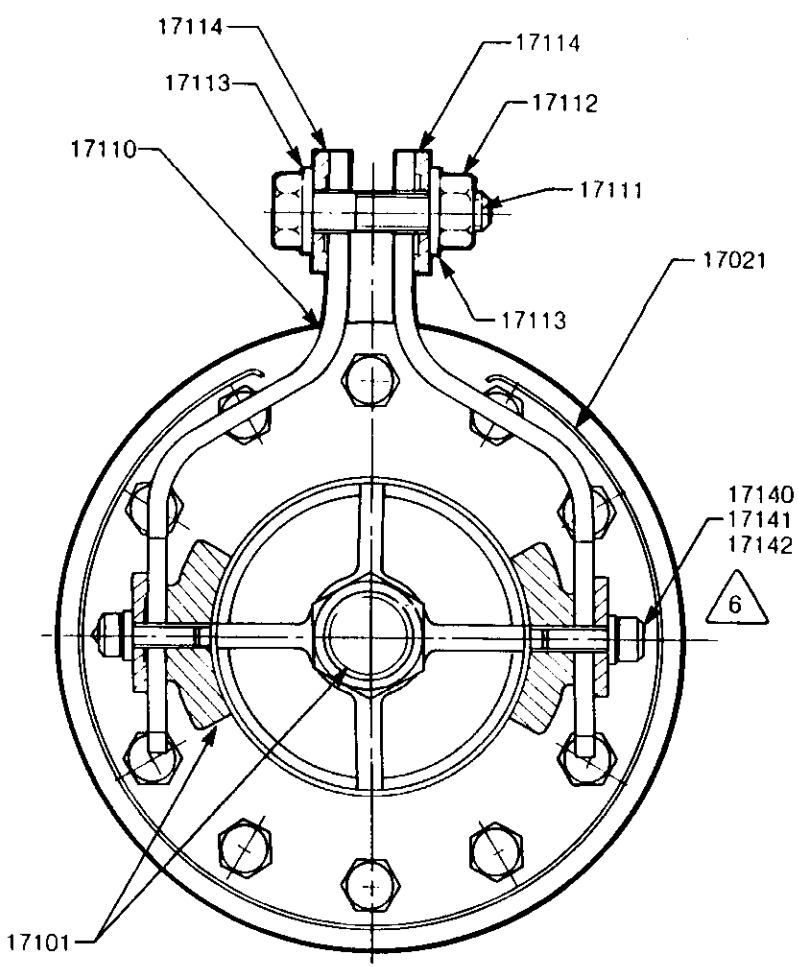
17001	ACTUATING TUBE	17101	STANDARD CONTACT ASSEMBLY	17115	SCREW	17138	SCREW
17010	SUPPORT TUBE ASSEMBLY	17103	INSULATING NOZZLE	17116	WASHER	17139	WASHER
17021	END SHIELD	17106	CONTACT RING	17120	EXHAUST ASSEMBLY	17140	SCREW
17050	INTERRUPTER TUBE ASSEMBLY	17110	SHUNT CONNECTOR	17124	SCREW	17141	WASHER
17057	CONTACT FINGER	17118	SCREW	17125	WASHER	17142	WASHER
17090	INSULATING ACTUATING ROD	17131	CHECK VALVE	17136	SCREW	17143	SCREW
17099	PUFFER PISTON ASSEMBLY	17160	CONTACT CAGE ASSEMBLY	17137	WASHER	17144	NUT
17100	MOVING CONTACT ASSEMBLY					17150	MULTI LAM CONTACT

FIG. 5

17000 INTERRUPTER ASSEMBLY
SEE FIGS. 6, 7, 8, 9, & 10 FOR DETAILS

△SEE PAGE 17





17010	**SUPPORT TUBE ASSEMBLY**	17111	SCREW	17121	CLIP	17140	SCREW
17020	**END SHIELD**	17112	NUT	17122	SCREW	17141	WASHER
17021	END SHIELD	17113	WASHER	17123	SCREW	17142	WASHER
17101	STATIONARY CONTACT ASSEMBLY	17114	WASHER				
17110	SHUNT CONNECTOR						

FIG. 6

FIG. 7

SEE PAGE 17

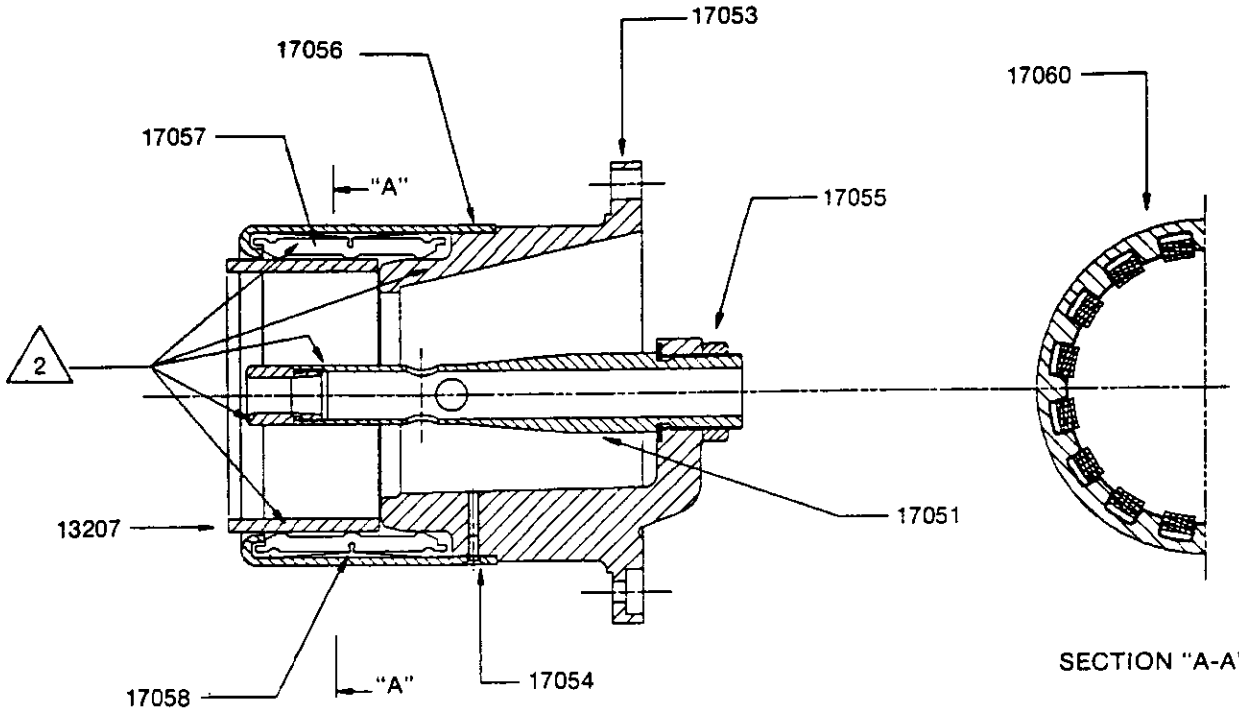
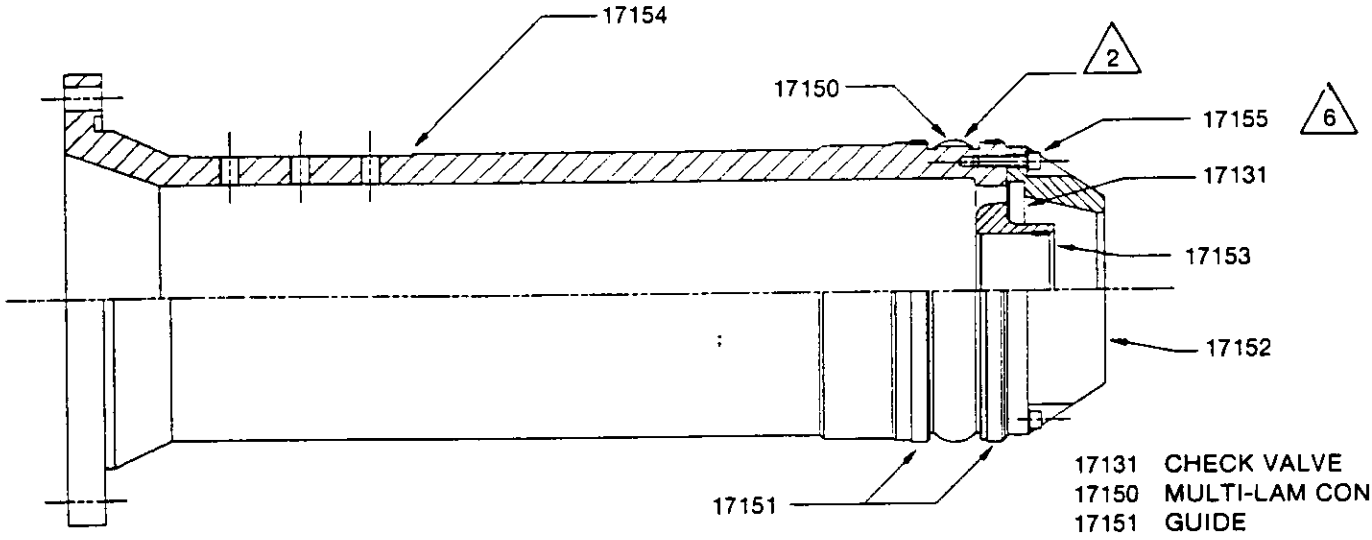


FIG. 8
17101 STATIONARY CONTACT ASSY.

13207 SPECIAL TOOL
17051 ARCING CONTACT
17053 SUPPORT
17054 SCREW
17055 NUT
17056 HOUSING CONTACT
17057 CONTACT FINGER
17058 SPRING
7060 CONTACT CAGE ASSEMBLY



17131 CHECK VALVE
17150 MULTI-LAM CONTACT
17151 GUIDE
17152 RETAINER
17153 GUIDE
17154 SUPPORT
17155 SCREW

FIG. 9
17099 PUFFER PISTON ASSEMBLY

△SEE PAGE 17

13228	HOLDING TOOL
17001	ACTUATING TUBE
17098	FLANGE
17102	AUXILIARY NOZZLE
17103	INSULATING NOZZLE
17104	MOVING ARCING CONTACT
17105	PUFFER CYLINDER
17106	CONTACT RING
17132	SCREW
17133	SCREW
17135	"O" RING

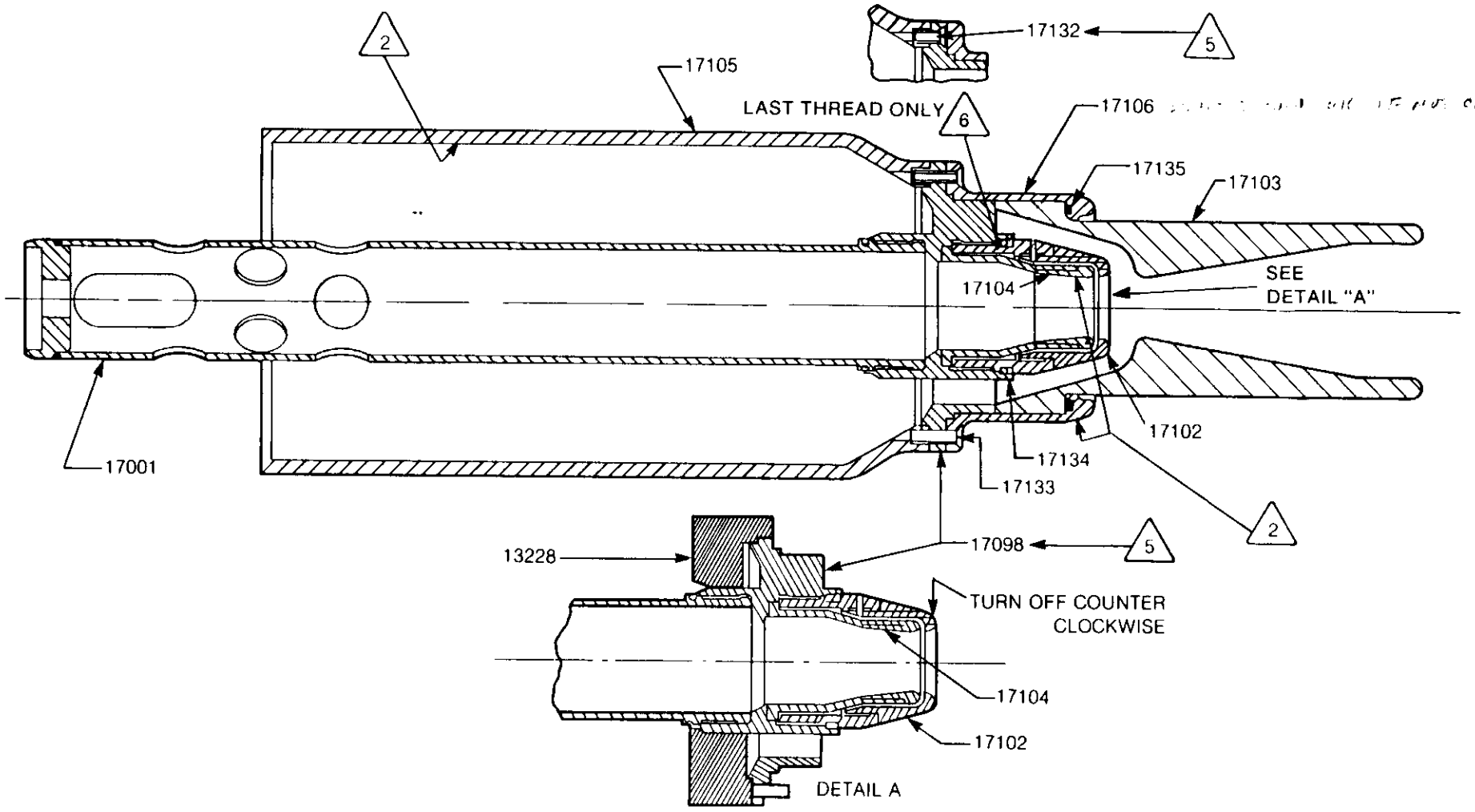
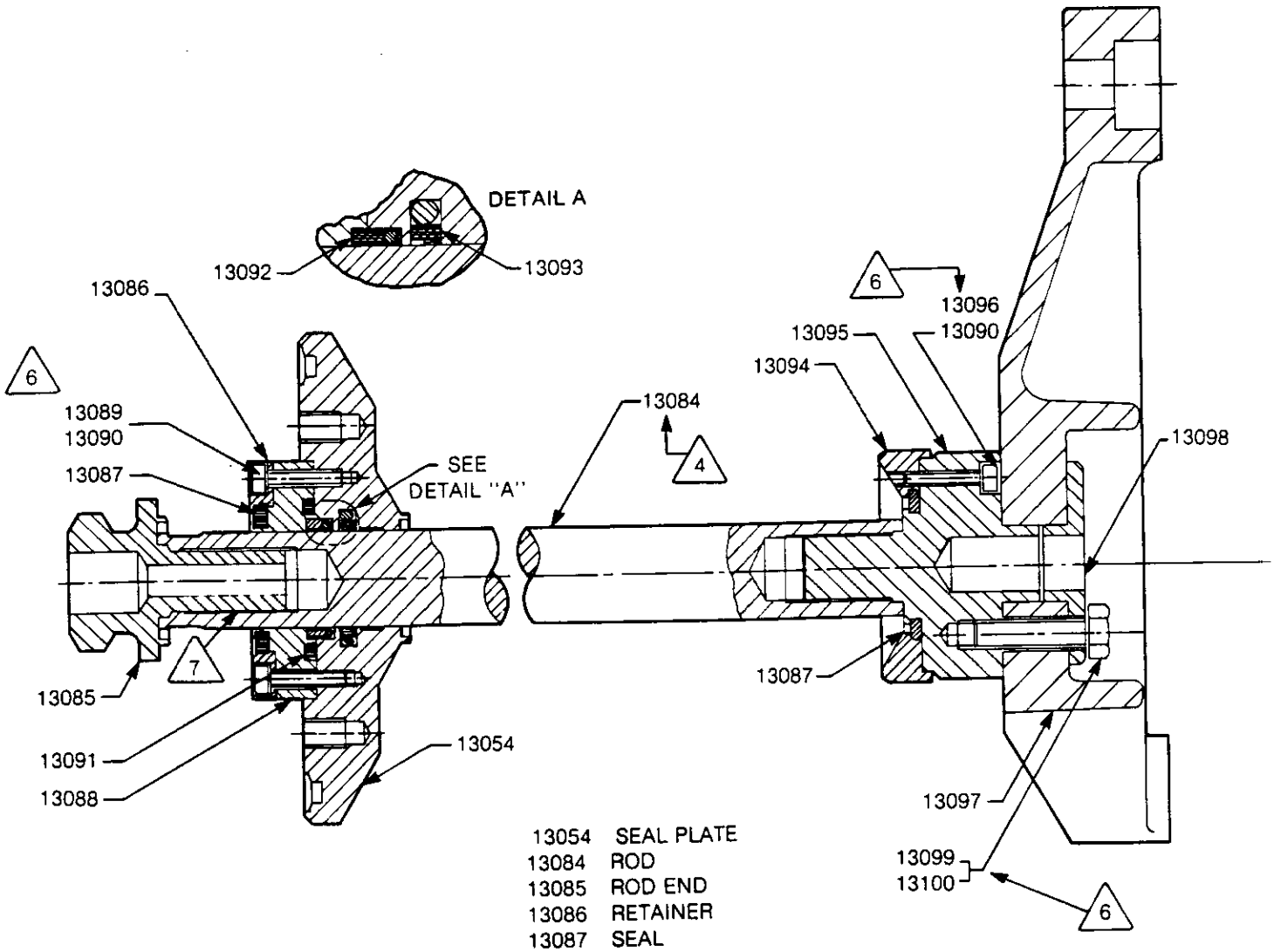


FIG. 10
17100 MOVING CONTACT ASSEMBLY

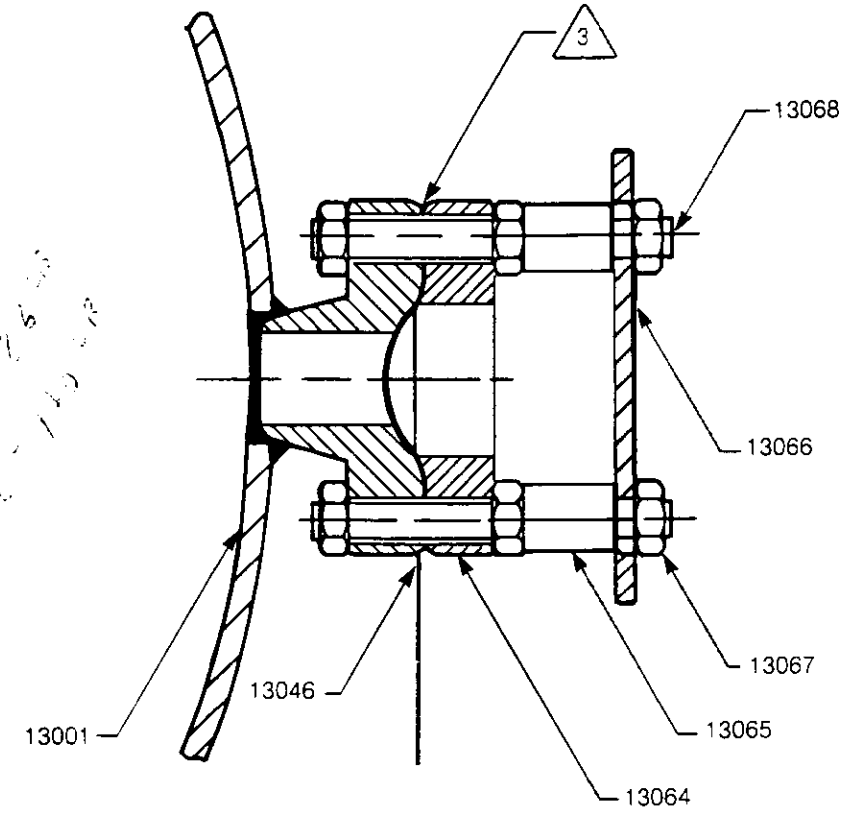
△SEE PAGE 17



13054	SEAL PLATE
13084	ROD
13085	ROD END
13086	RETAINER
13087	SEAL
13088	FLANGE
13089	SCREW
13090	WASHER
13091	"O" RING
13092	SEAL RING
13093	SEAL RING COMBINATION
13094	SEAL RETAINER
13095	ROD END
13096	SCREW
13097	ADAPTER
13098	FLANGE
13099	SCREW
13100	WASHER

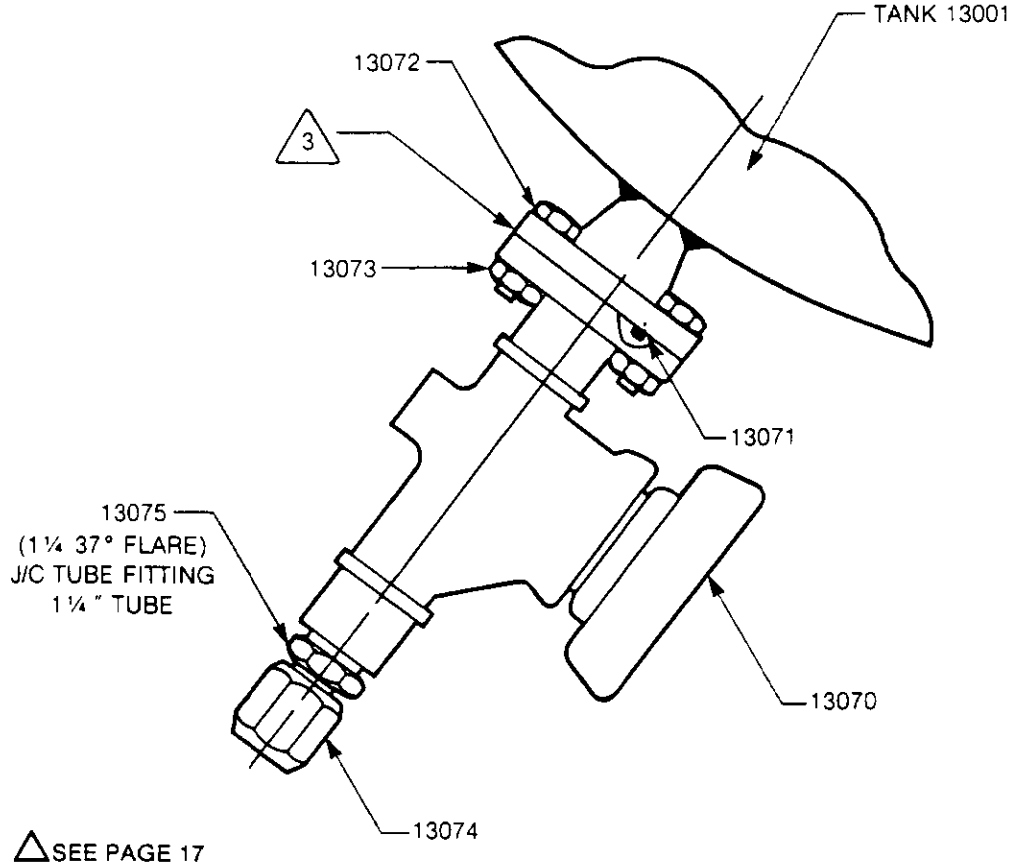
FIG. 11
13025 PULL ROD ASSY.

△SEE PAGE 17



13001 TANK
13046 RUPTURE DISC
13064 RETAINER
13065 SPACER
13066 COVER
13067 NUT
13068 STUD

FIG. 12
RUPTURE DISC ASSEMBLY



13001 TANK
13070 VACUUM AND FILL VALVE
13071 "O" RING
13072 SCREW
13073 NUT
13074 CAP
13075 FITTING

FIG. 13
VACUUM AND FILL VALVE

△SEE PAGE 17

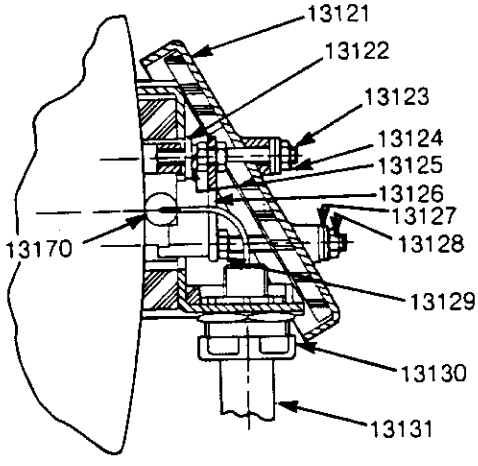


FIG. 14
GAS DENSITY MONITOR
BULB MOUNTING

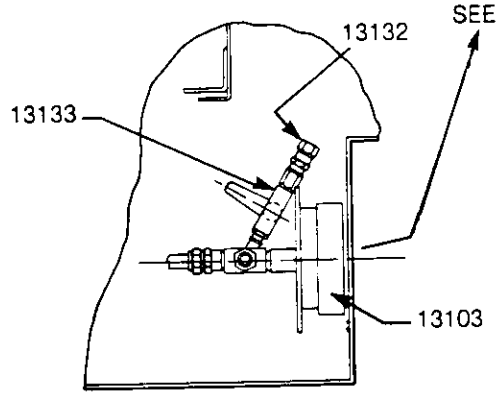


FIG. 15
MOISTURE SAMPLING VALVE

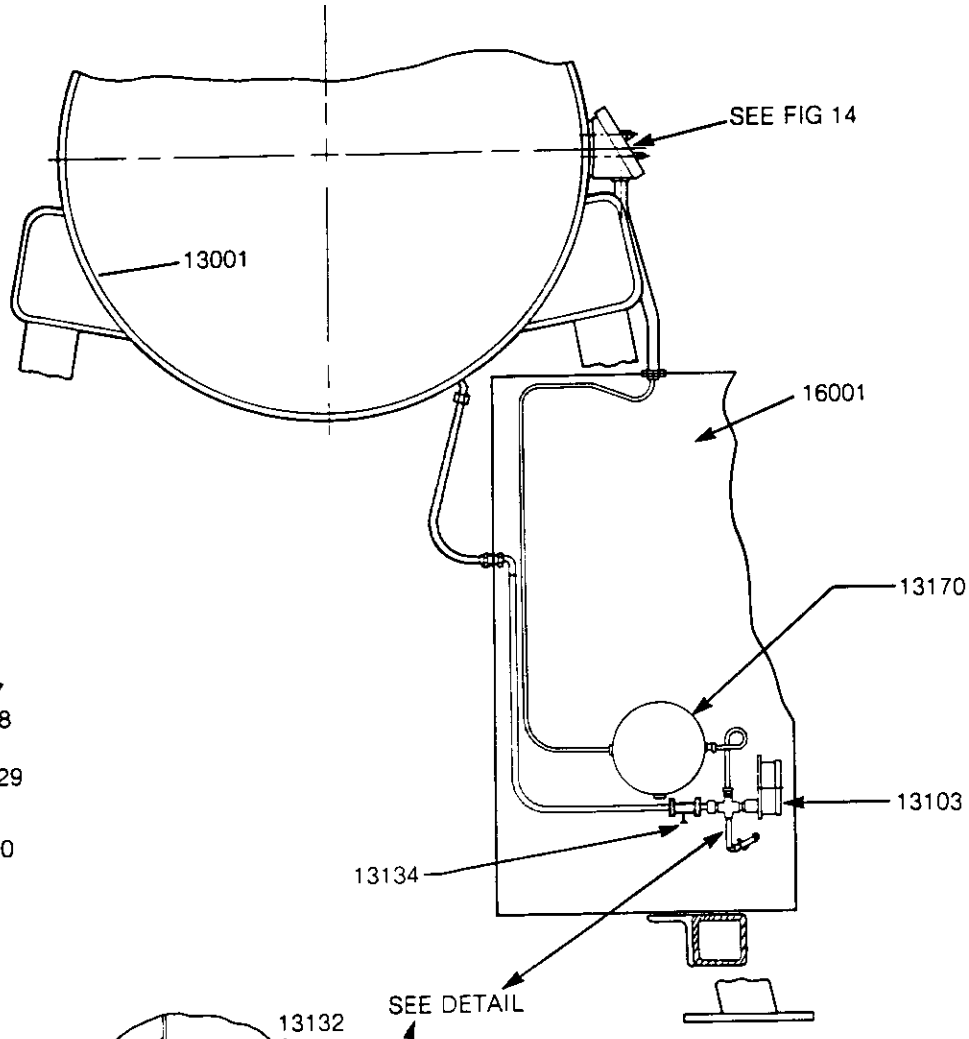


FIG. 16
GAS DENSITY AND PRESSURE GAUGE

13001	TANK
13103	PRESSURE GAUGE GAS
13121	COVER ASSEMBLY
13122	WASHER
13123	THREADED ROD
13124	NUT
13125	WASHER
13126	PLATE
13127	RUBBER WASHER
13128	WASHER
13129	NUT
13130	CONDUIT FITTING
13131	CONDUIT
13132	FITTING CAP
13133	SAMPLING VALVE
13134	ISOLATION VALVE
13170	DENSITY MONITOR
16001	CONTROL HOUSING

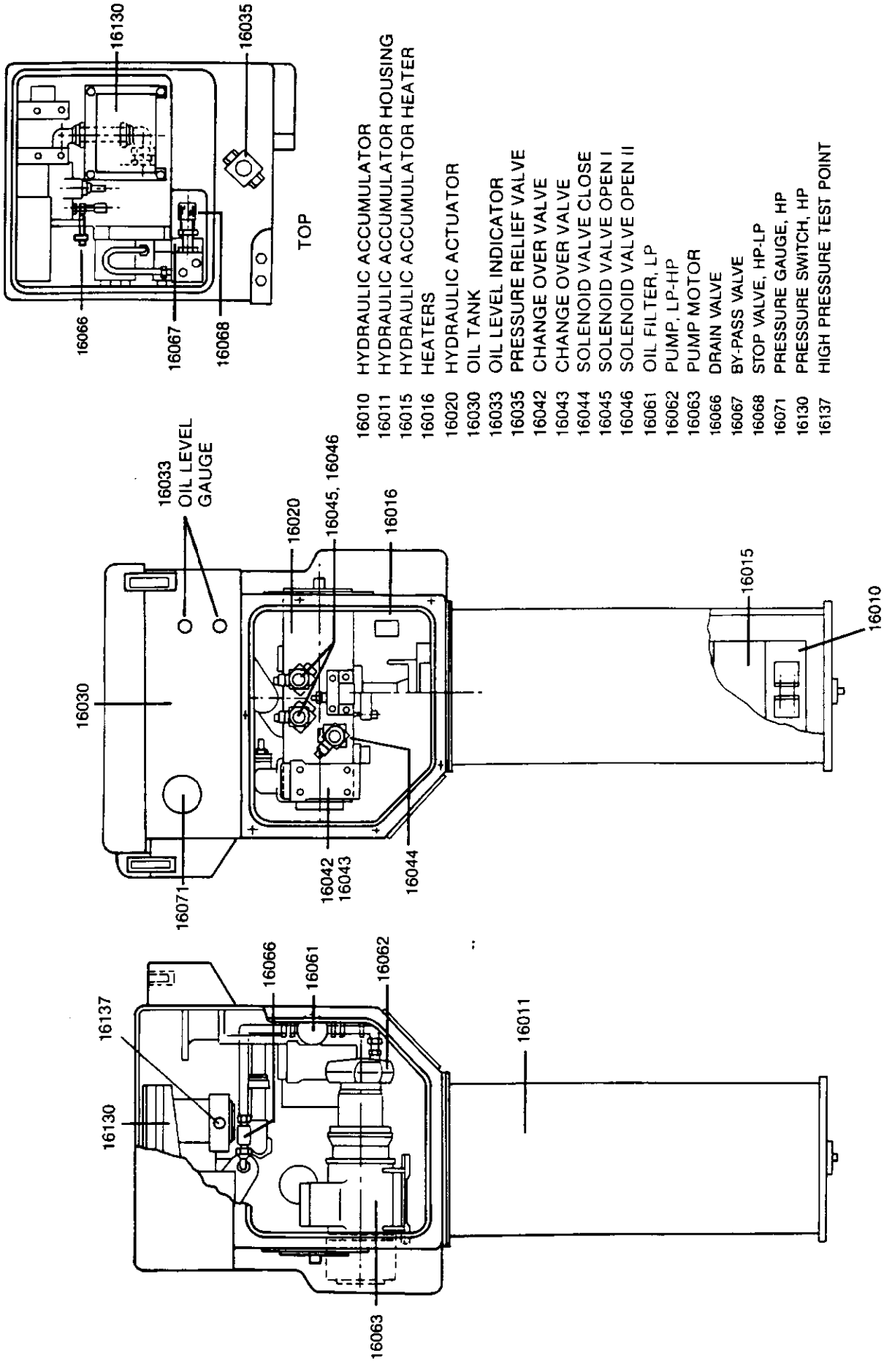


FIG. 17
16000 OPERATING MECHANISM

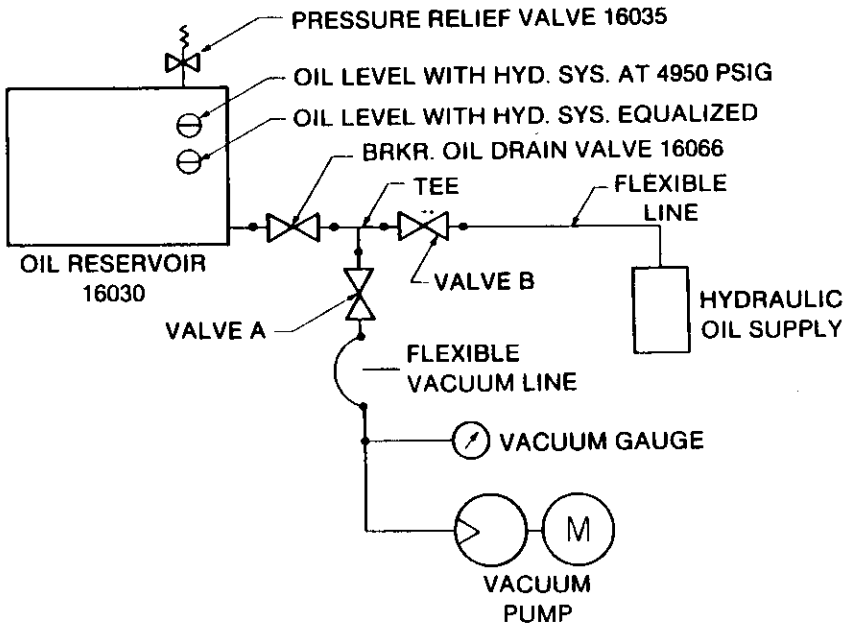


FIG. 18
HYDRAULIC SYSTEM
PURGING SCHEME

16010 ACCUMULATOR
16020 HYDRAULIC ACTUATOR
16042 CHANGEOVER VALVE
16045 SOLENOID VALVE, OPEN

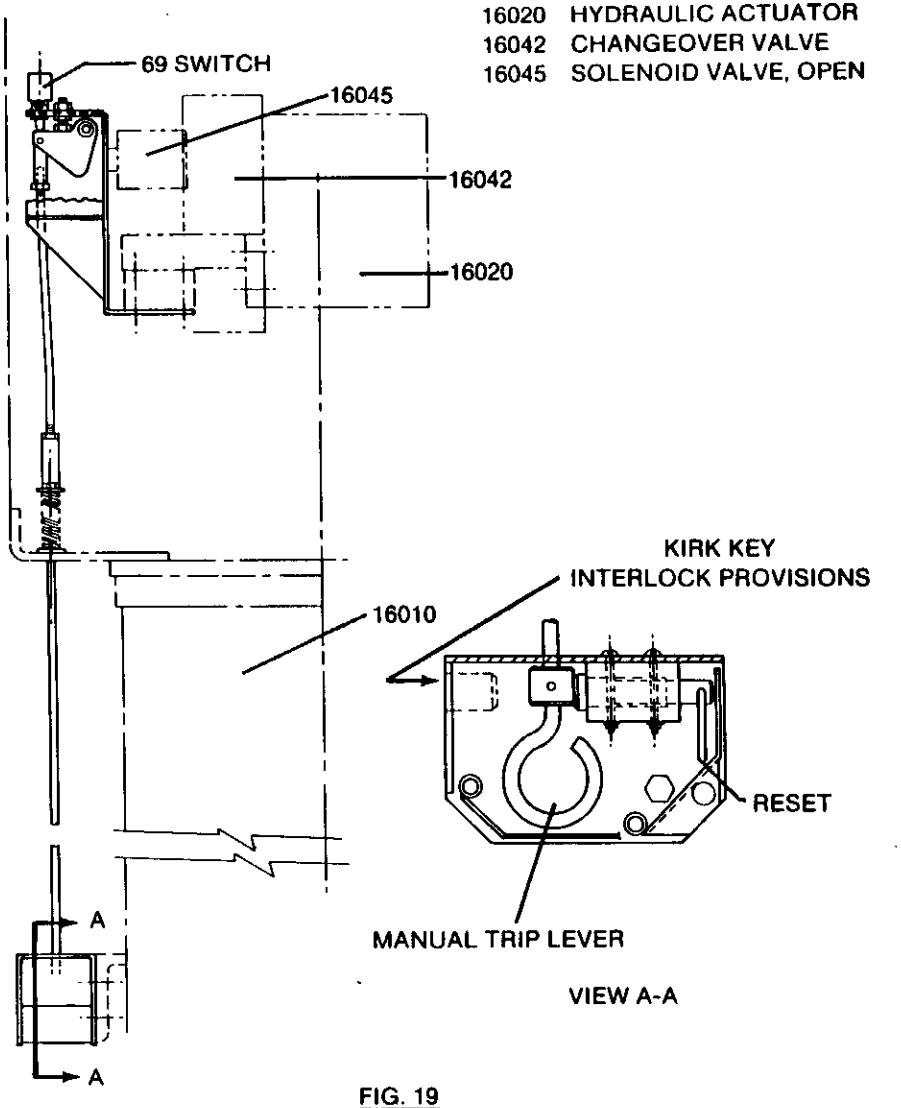


FIG. 19
MANUAL TRIP

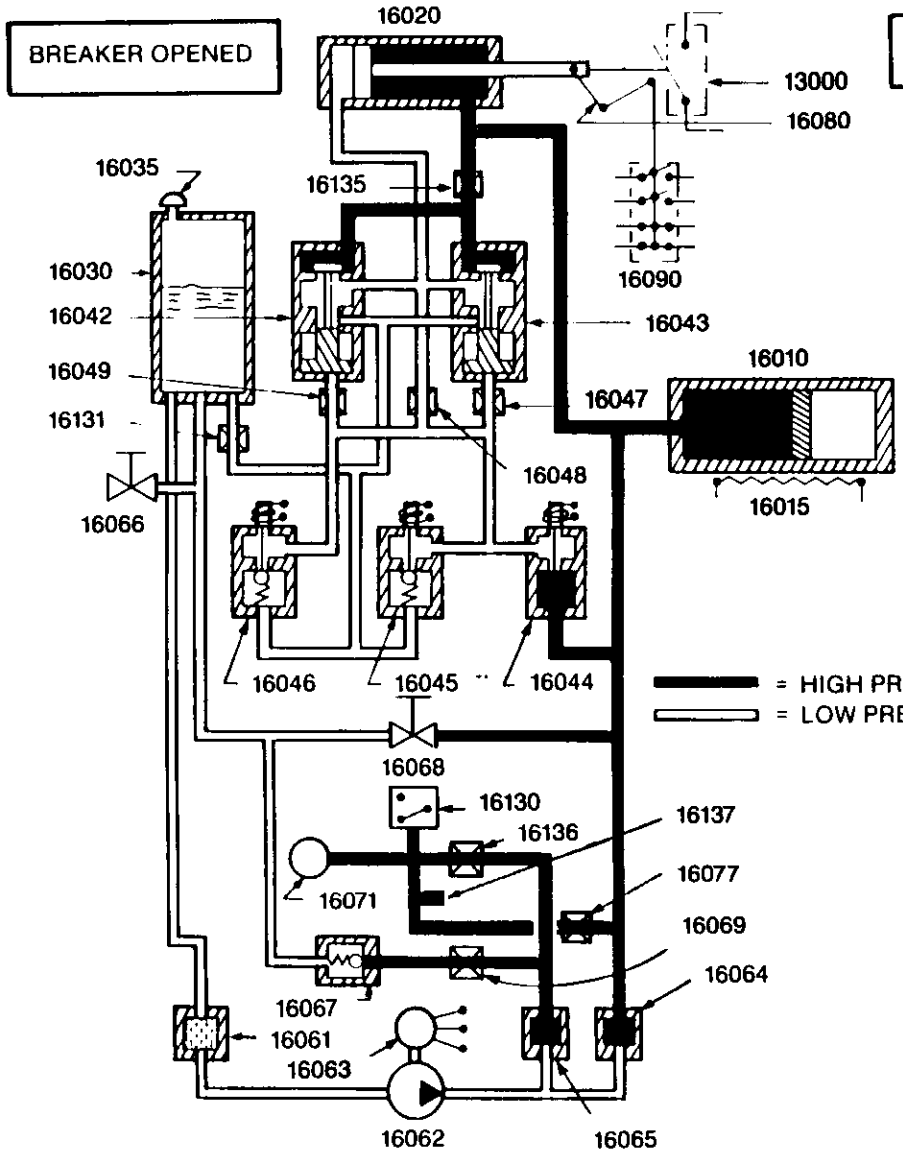


FIG. 20
HYDRAULIC SCHEMATIC
BREAKER OPEN

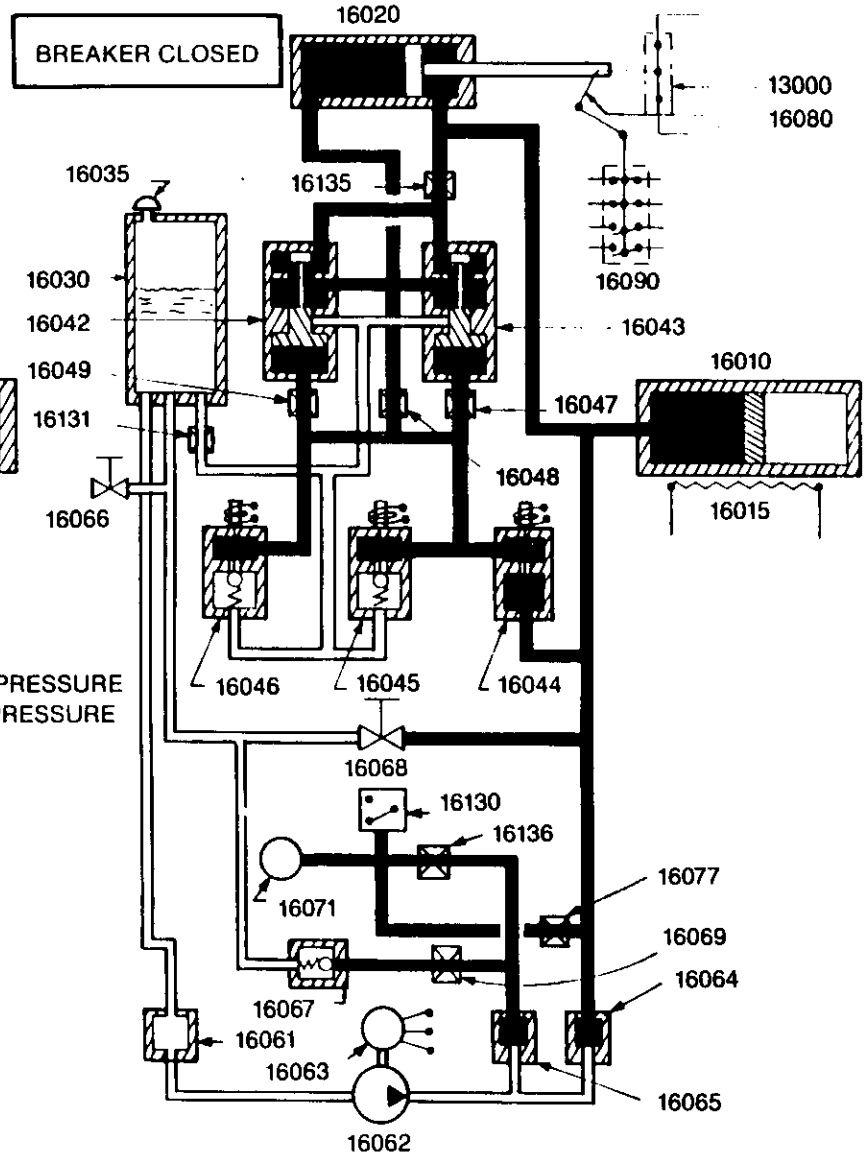
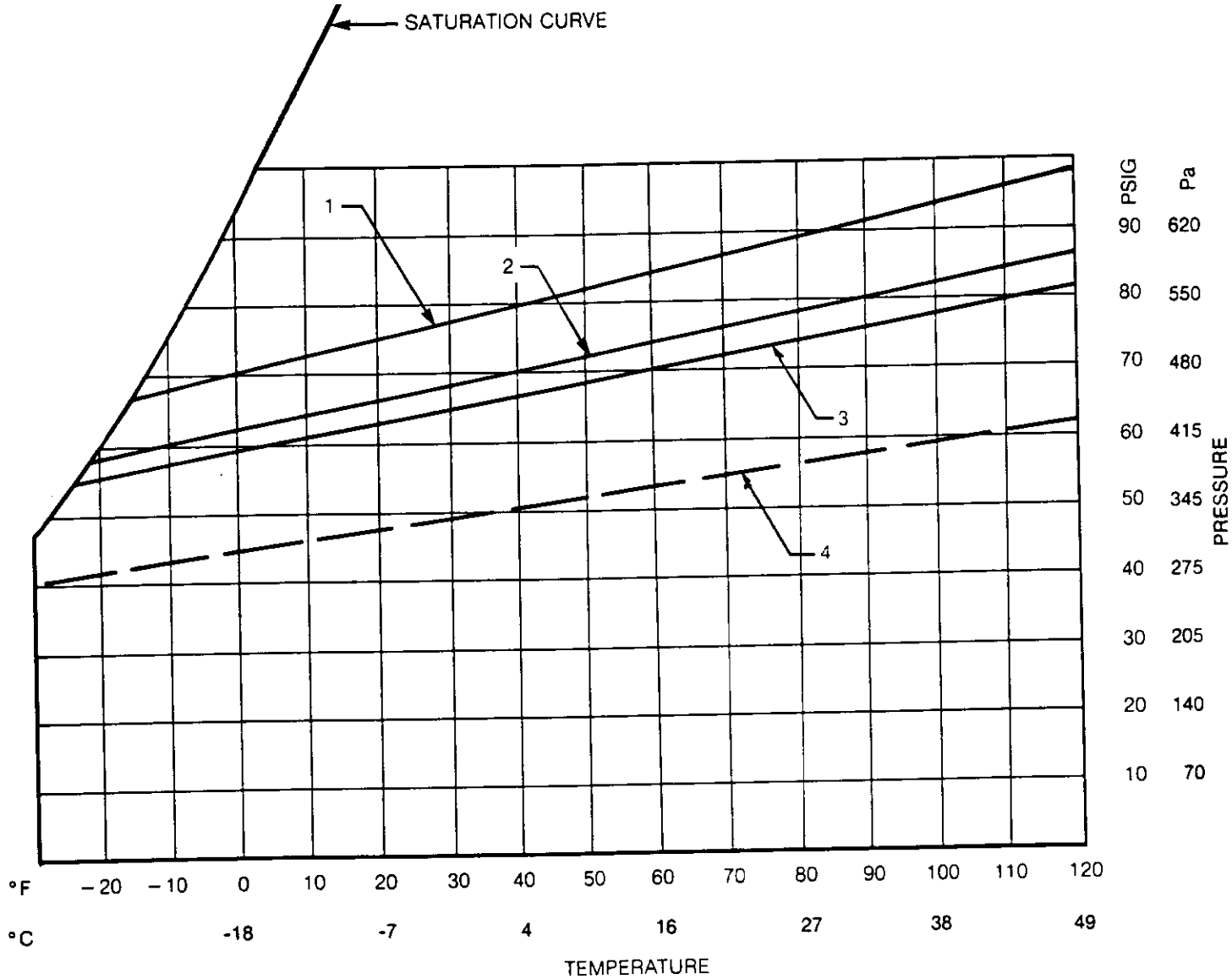


FIG. 21
HYDRAULIC SCHEMATIC
BREAKER CLOSED

13000 CIRCUIT BREAKER
16010 HYDRAULIC ACCUMULATOR
16015 ACCUMULATOR HEATER
16020 HYDRAULIC ACTUATOR
16030 OIL TANK (RESERVOIR)
16035 PRESSURE RELIEF VALVE
16042 CHANGEOVER AMPLIFIER VALVE
16043 CHANGEOVER AMPLIFIER VALVE
16044 SOLENOID VALVE, CLOSE
16045 SOLENOID VALVE, OPEN
16046 SOLENOID VALVE, OPEN
16047 ORIFICE
16048 ORIFICE
16049 ORIFICE
16061 OIL FILTER
16062 OIL PUMP
16063 PUMP MOTOR
16064 NON RETURN VALVE
16065 NON RETURN VALVE
16066 DRAIN VALVE
16067 BY-PASS VALVE
16068 MANUAL RELIEF VALVE
16069 ORIFICE
16071 PRESSURE GAUGE
16077 ORIFICE
16080 AUXILIARY SWITCH LINKAGE
16090 AUXILIARY SWITCH
16130 PRESSURE SWITCH
16131 ORIFICE
16134 ORIFICE
16135 ORIFICE
16136 ORIFICE
16137 ORIFICE

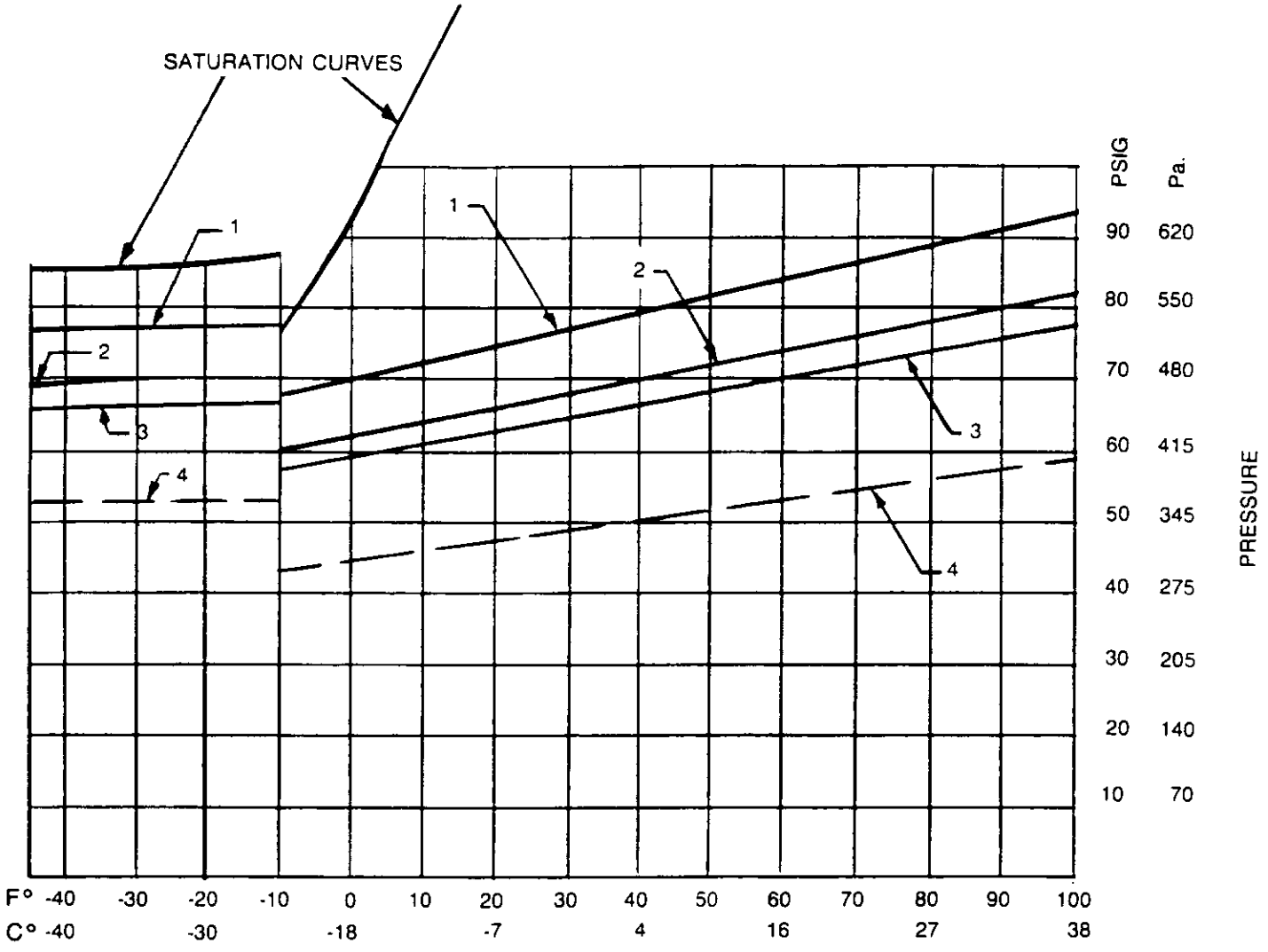


STANDARD BREAKER, WITHOUT TANK HEATER H7

DENSITY MONITOR CALIBRATION CURVE

1. NORMAL FILLING PRESURE PSIG OR KPa
2. LOW PRESSURE ALARM (CONTACT 63-2C CLOSES)
3. LOW PRESSURE BREAKER OPERATION BLOCK (CONTACT 63-2B1 AND 63-2B2 CLOSE)
4. DIELECTRIC LOW PRESSURE ALARM (CONTACT 63-2A CLOSES)
   READ ALL PRESSURES ON THE PRESSURE GAUGE 13103 FIG. 16 LOCATED IN THE CONTROL HOUSING 16001

FIG. 22A



TANK HEATER H7 ENERGIZED

TEMPERATURE

(LOW TEMPERATURE:BREAKER, WITH TANK HEATER)

DENSITY MONITOR CALIBRATION CURVE

1. NORMAL FILLING PRESSURE PSIG OR KPa
2. LOW PRESSURE ALARM (CONTACT 63-2C CLOSES)
3. LOW PRESSURE BREAKER OPERATION BLOCK (CONTACT 63-21B1 AND 63-2B2 CLOSE)
4. DIELECTRIC LOW PRESSURE ALARM (CONTACT 63-2A CLOSES)
   READ ALL PRESSURES ON THE PRESSURE GAUGE 13103 FIG. 16 LOCATED IN THE CONTROL HOUSING 16001

FIG. 22B

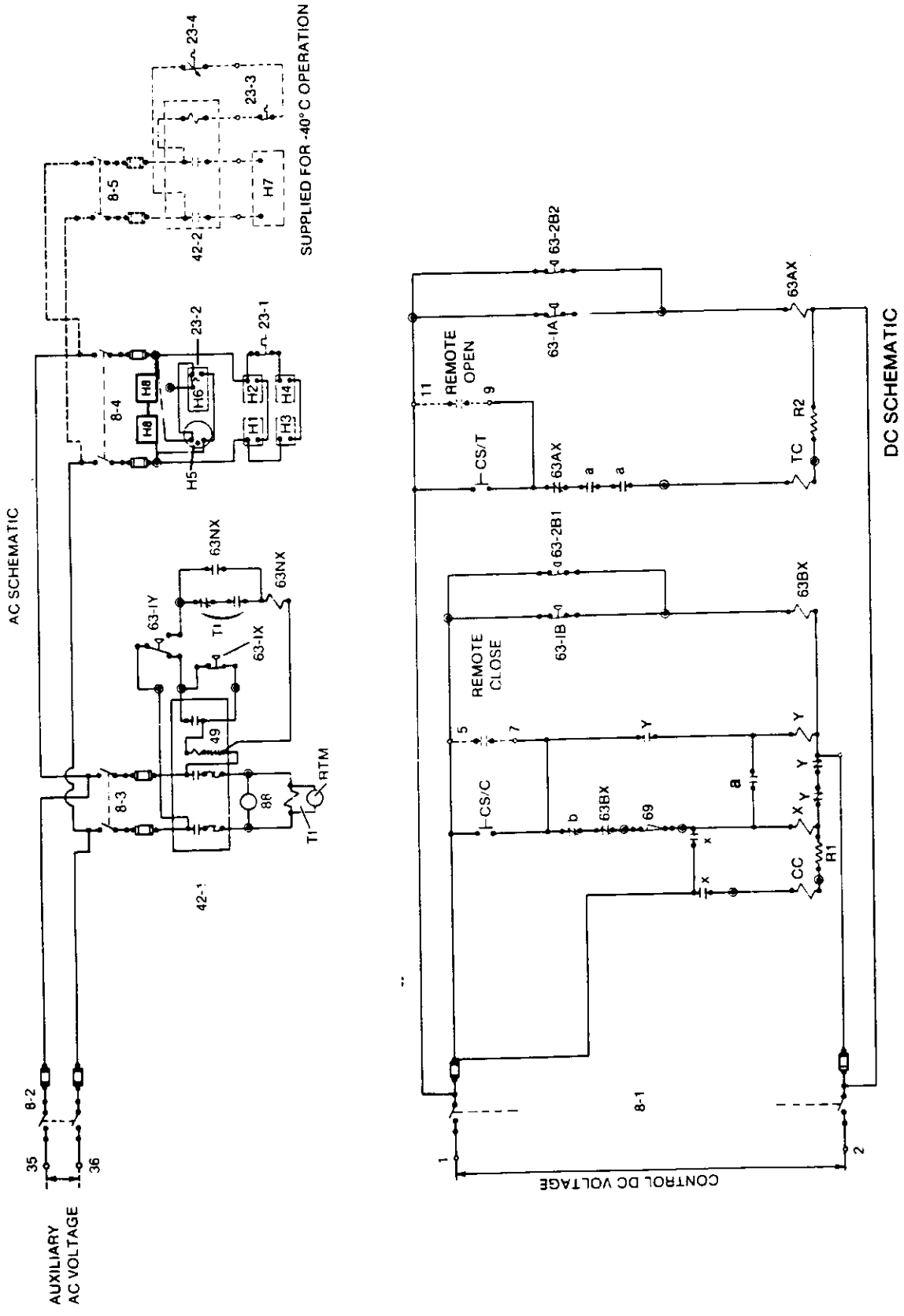
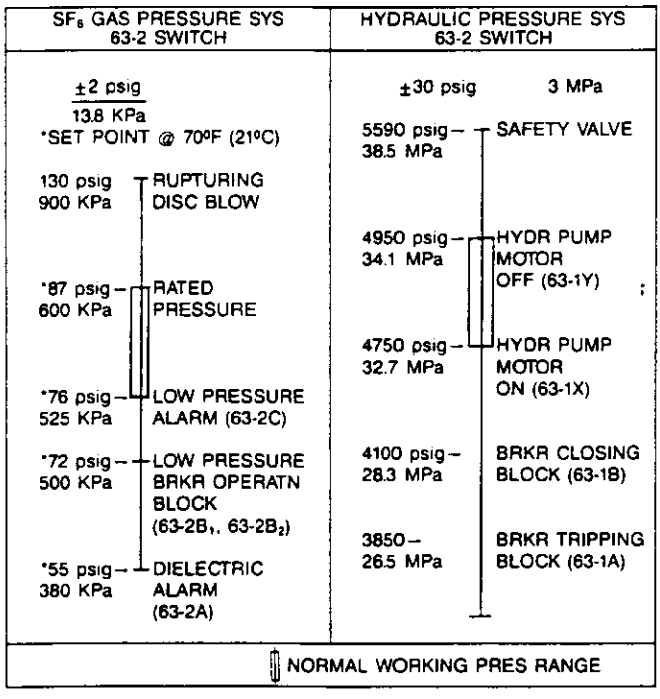


FIG. 23
TYPICAL SCHEMATICS

8-1	CONTROL PWR SWITCH, DC
8-4	MAIN POWER SWITCH, AC
8-5	HYDRAULIC PUMP MOTOR POWER SWITCH, AC
8-6	MECHANISM HEATER POWER SUPPLY
8-7	TANK HEATER POWER SUPPLY
23-1	THERMOSTAT, CONTROL HOUSE HEATERS
23-2	ACCUMULATOR MECHANISM HEATER THERMOSTAT
23-3	TANK HEATING SYS THERMOSTAT
23-4	TANK HEATER INTERNAL THERMOSTAT
42-1	STARTER, HYDRAULIC PUMP MOTOR
42-2	CONTACTOR TANK HEATER SYS
63-1	HYDRAULIC PRESSURE SWITCH
63-2	SF_6 GAS PRESSURE SWITCH
63AX	TRIP BLOCK AUXILIARY RELAY
63BX	CLOSE BLOCK AUXILIARY RELAY
63NX	LOW NITROGEN PRESS ALARM AUX RELAY
88	MOTOR, HYDRAULIC PUMP
ASW	AUXILIARY SWITCH ASSEMBLY
a or b	AUXILIARY SWITCH CONTACT
CC	CLOSING COIL
CS	CONTROL SWITCH
FU	FUSE
H1 to H4	HEATERS, CONTROL HOUSING
H5	HEATERS, OPERATING MECHANISM
H6	HEATER ACCUMULATOR
H7	HIGH PRESSURE TANK HEATER
H8	TRANSITION HOUSE HEATER
R1, R2	DROPPING RESISTOR
RTM	RUNNING TIME METER
TC	TRIP COIL
X	CLOSING RELAY
Y	ANTI-PUMP RELAY
—●—	DEVICE TERMINAL
—○—	TERMINAL CUSTOMER
—⊙—	TERMINAL INTERCONNECTION

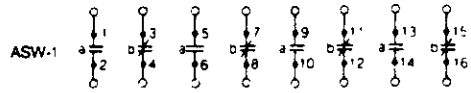
HEATER WATTAGE AT 240 VAC

HEATER	WATTS
H-1, H-2	75 W (EA)
H-3, H-4	75 W (EA)
H-5	140 W
H-6	275 W
H-7	4000 W
H-8	20 W

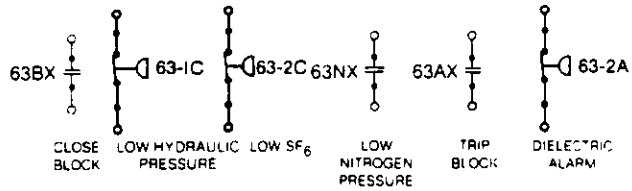


		OPERATING RANGE
23-1	CONTROL HOUSE HEATERS (H3, H4)	ON AT +55ºF ±2ºF OFF AT +70ºF ±2ºF
23-2	ACCUMULATOR MECHANISM HEATER (H6)	ON AT +35ºF ±2ºF OFF AT +50ºF ±2ºF
23-3	TANK HEATING SYSTEM (H-7)	ON AT -15ºF OFF AT -10ºF ±2ºF
23-4	TANK HEATER INTERNAL THERMOSTAT (H-7)	ON AT +90ºF OFF AT +100ºF ±9F

SPARE AUXILIARY SWITCH CONTACTS



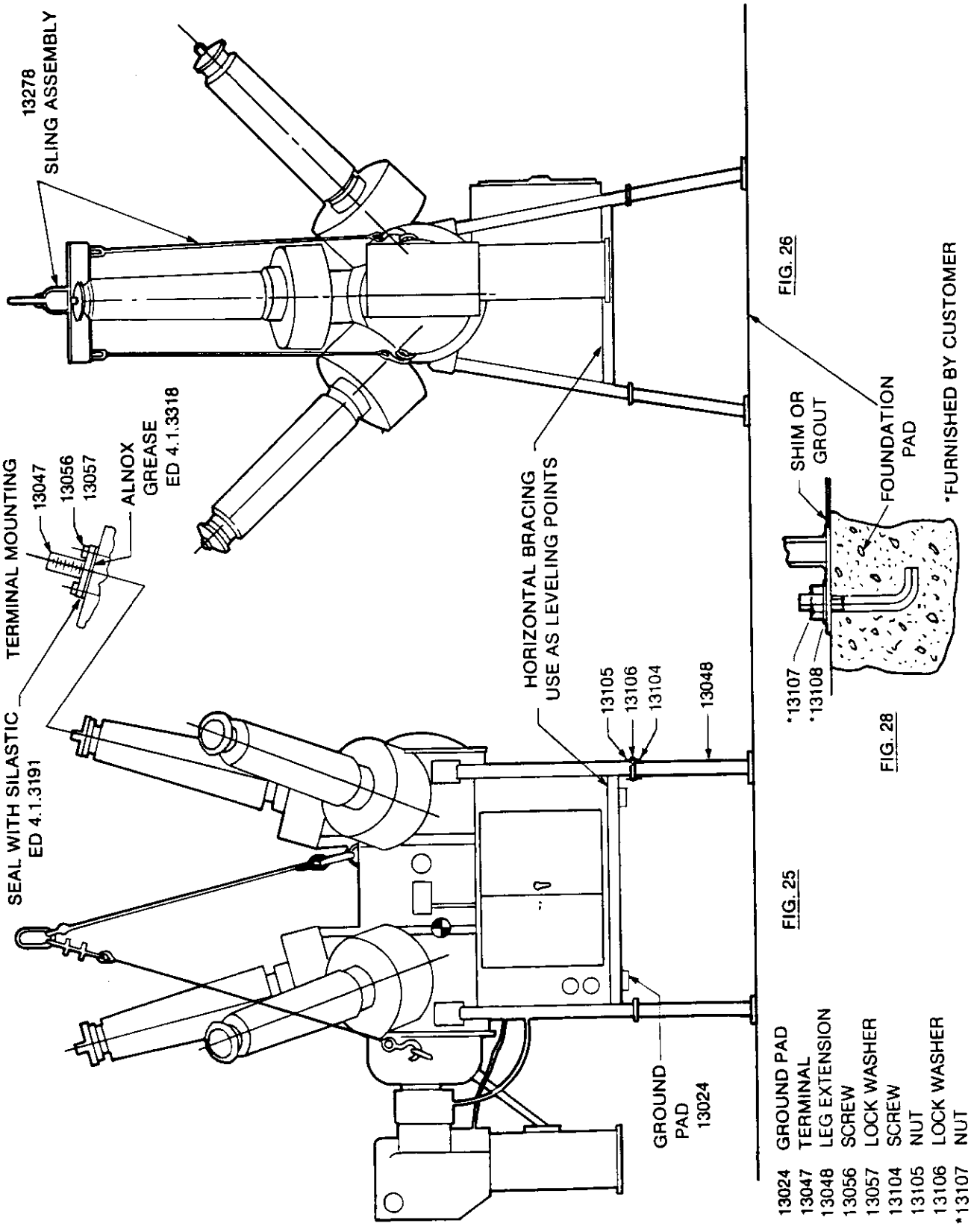
ALARM CONTACTS



NOTES:

1. DIAGRAMS SHOW BREAKER IN "OPEN" POSITION WITH ALL DEVICES SHOWN IN "OFF" OR DE-ENERGIZED CONDITION WITH LOW PRESSURE.
2. THE GROUND SYMBOLS ( ) INDICATE CONNECTION TO THE GROUND BAR IN THE CONTROL HOUSING. **WARNING:** IT IS IM-PERATURE TO ESTABLISH GROUND INTEGRITY WITH THE AC SOURCE PRIOR TO TESTING OR ENERGIZING BREAKER.
3. UNLESS OTHERWISE SPECIFIED, MINIMUM WIRE SIZE IS #14 AWG.
4. THERE ARE 8 SPARE AUXILIARY SWITCH CONTACTS. EACH CONTACT IS MECHANICALLY REVERSIBLE FROM a TO b OR b TO a.
5. DASH LINES IN SCHEMATICS IDENTIFY DEVICES AND WIRING PROVIDED BY CUSTOMER.
6. CIRCUIT BREAKERS ARE THERMO-MAGNETIC TYPE.

FIG. 24
SCHEMATIC WIRING DIAGRAM
CODE


13278
SLING ASSEMBLY
FIG. 27
TERMINAL MOUNTING
13047
13056
13057
ALNOX
GREASE
ED 4.1.3318
SEAL WITH SILASTIC
ED 4.1.3191
HORIZONTAL BRACING
USE AS LEVELING POINTS
13105
13106
13104
13048
GROUND
PAD
13024
FIG. 25
FIG. 26
SHIM OR
GROUT
FOUNDATION
PAD
*FURNISHED BY CUSTOMER
*13107
*13108
FIG. 28
13024 GROUND PAD
13047 TERMINAL
13048 LEG EXTENSION
13056 SCREW
13057 LOCK WASHER
13104 SCREW
13105 NUT
13106 LOCK WASHER
*13107 NUT
*13108 WASHER
13278 SLING ASSEMBLY

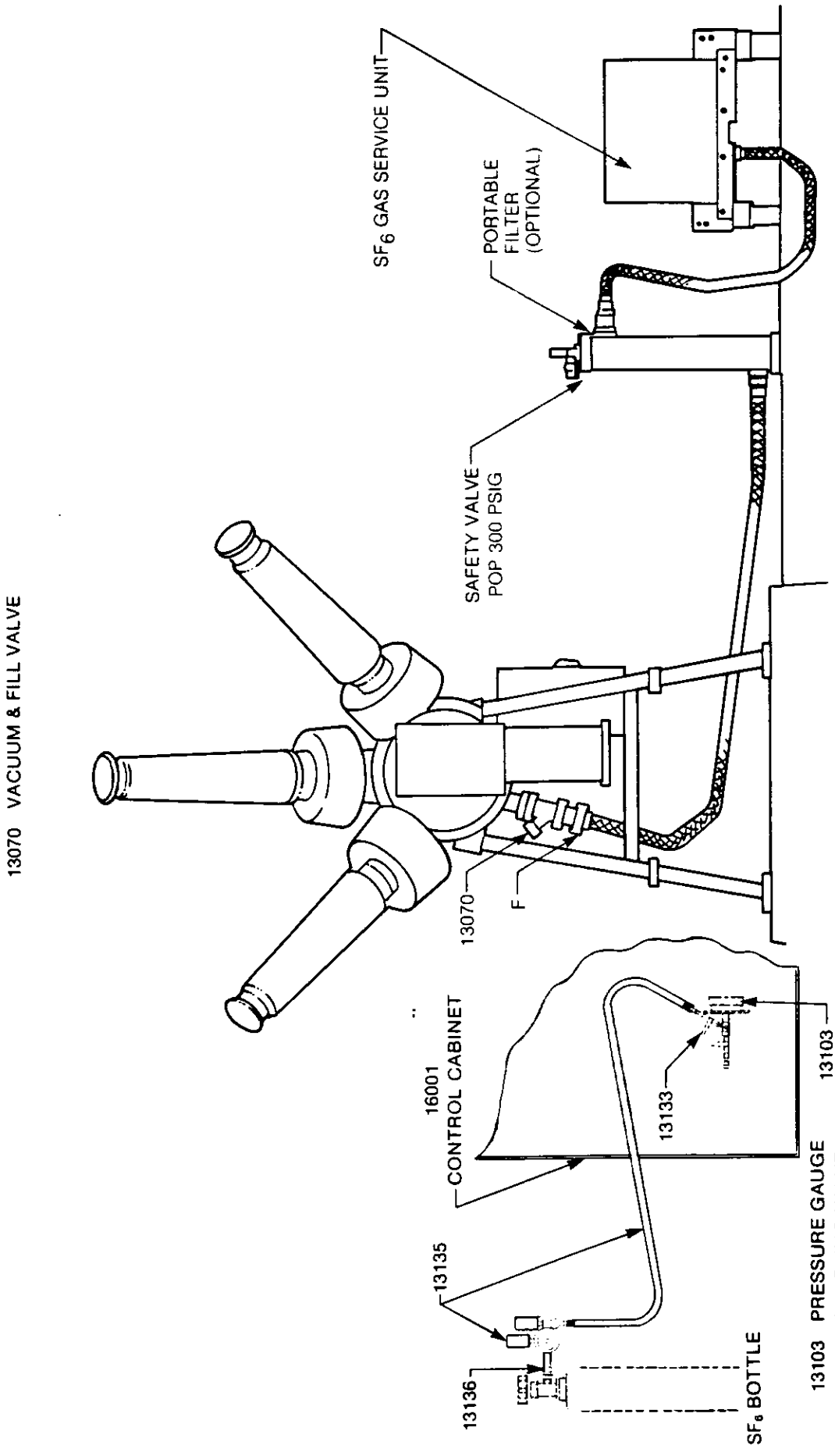


FIG. 30
FILLING THE BREAKER
FROM AN SF_6 CYLINDER

FIG. 29
FILLING THE BREAKER
FROM AN SF_6 GAS CART

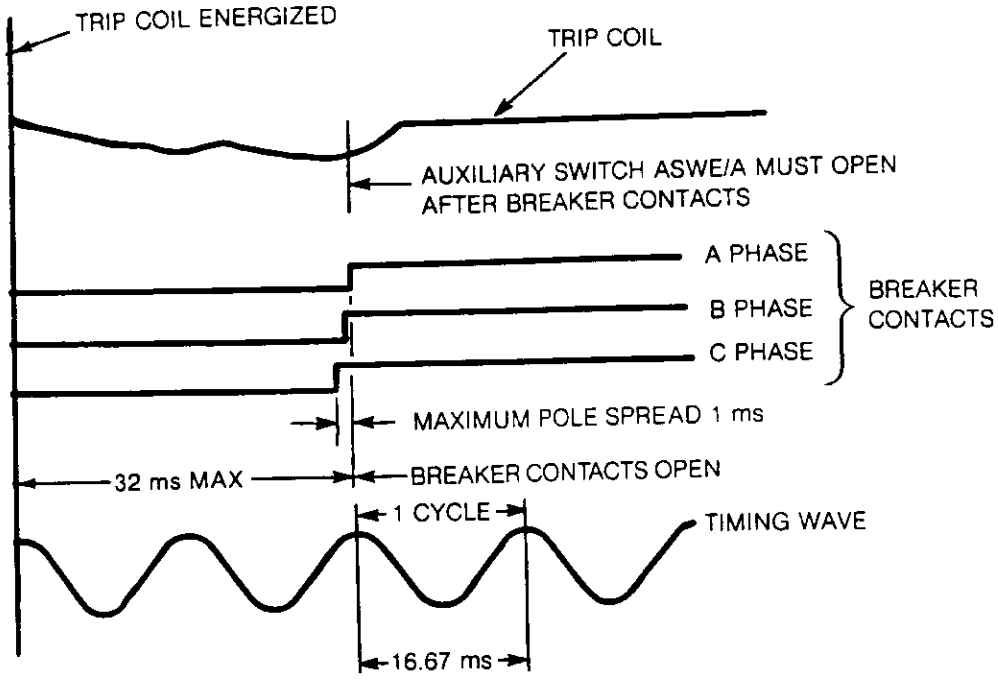


FIG. 31
OPEN OPERATION

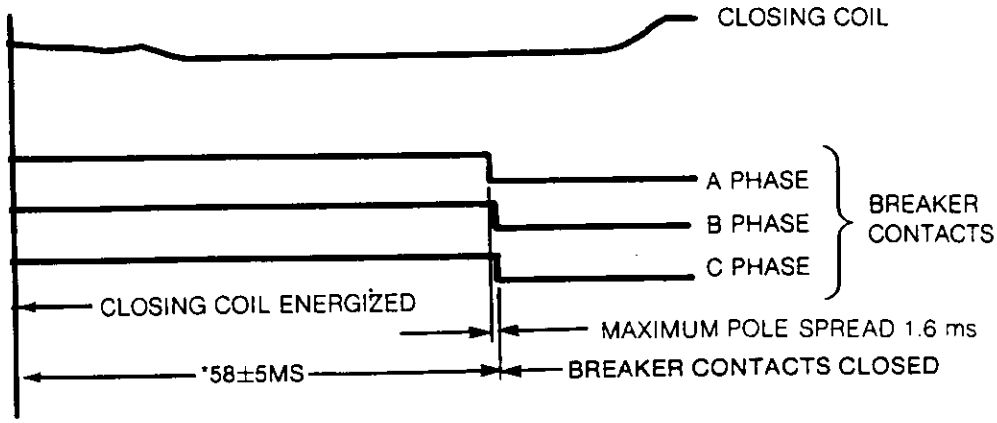


FIG. 32
CLOSE OPERATION

ALL MEASUREMENTS AT RATED PRESSURES AND VOLTAGE
*DOES NOT INCLUDE AUXILIARY RELAY TIME

TYPICAL TIME DISTANCE CURVES TAKEN AT NORMAL
HYDRAULIC AND GAS PRESSURES MEASURED FROM THE
MOTION OF CLEVIS 16156 (SEE FIGURE 3)
THREAD SIZE IN THE CLEVIS IS M5 (5mm)

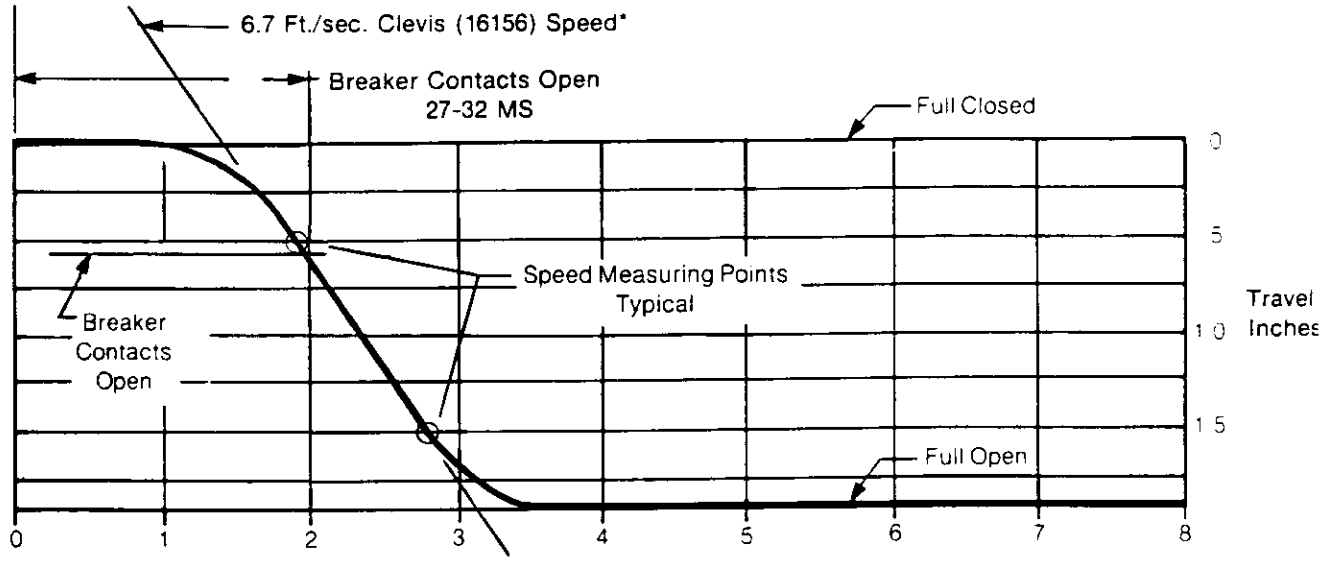
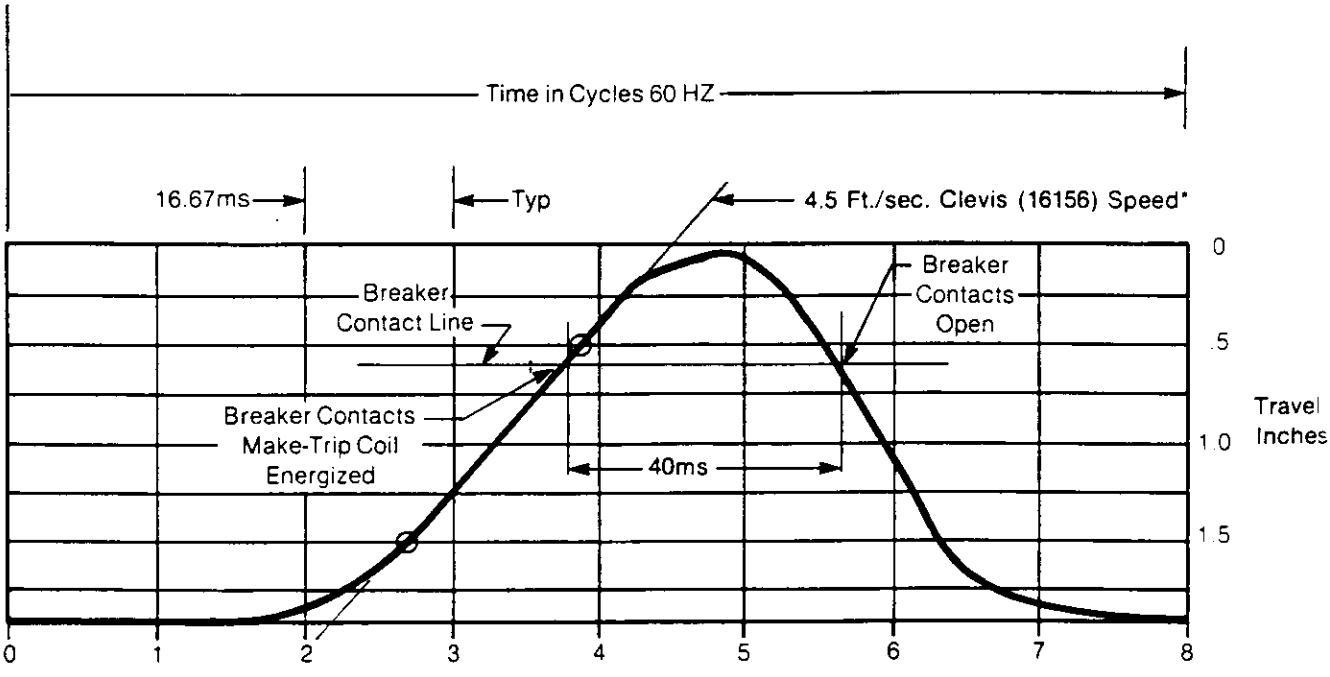
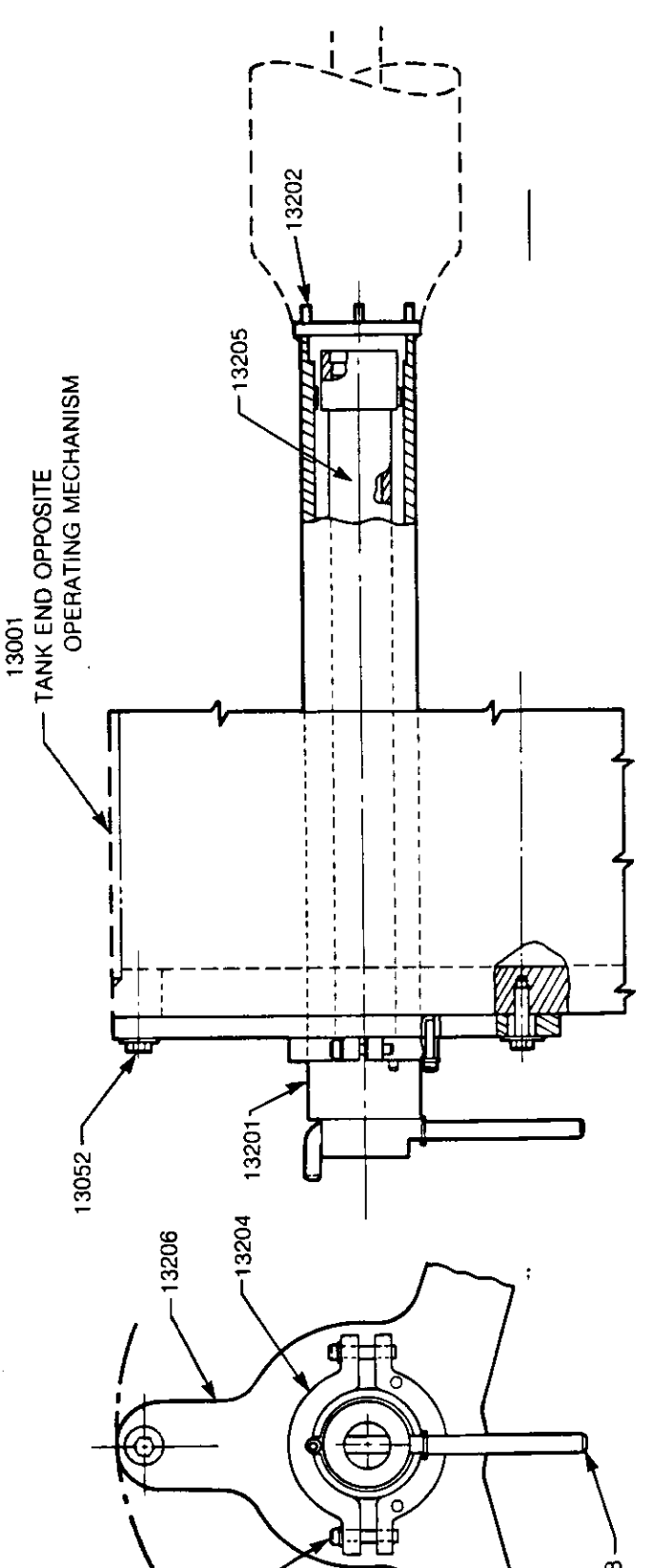


FIG. 33
OPEN



*BREAKER CONTACT SPEED OR TRAVEL = (CLEVIS SPEED OR TRAVEL) X (4)

FIG. 34
CLOSE OPEN



13001 TANK
13052 SCREWS
13201 TUBE ASSEMBLY
13202 STUDS
13203 SCREWS
13204 CLAMP
13205 CENTER TUBE ASSEMBLY
13206 SPIDER
13208 HANDLE

FIG. 35
13200 CONTACT WRENCH

13053	SCREW	13223	SCREW
13110	TANK END COVER, FRONT		
13210	SCREW SPECIAL	13225	SCREW
13211	HINGE ROD	13226	JAM SCREW
13212	SOCKET HOLE	13250	COMPRESSION ROD
13213	SUPPORT BRACKET	13251	JAM NUT
13214	SUPPORT BRACKET	13252	JACK STUD
13215	SCREW	13253	WASHER
13216	SCREW	13254	WASHER
13219	SCREW	13255	NUT
13220	JACK SCREW	13256	NUT
13221	SUPPORT BRACKET	16000	OPERATING MECH.
13222	BRACKET	16146	PLATE

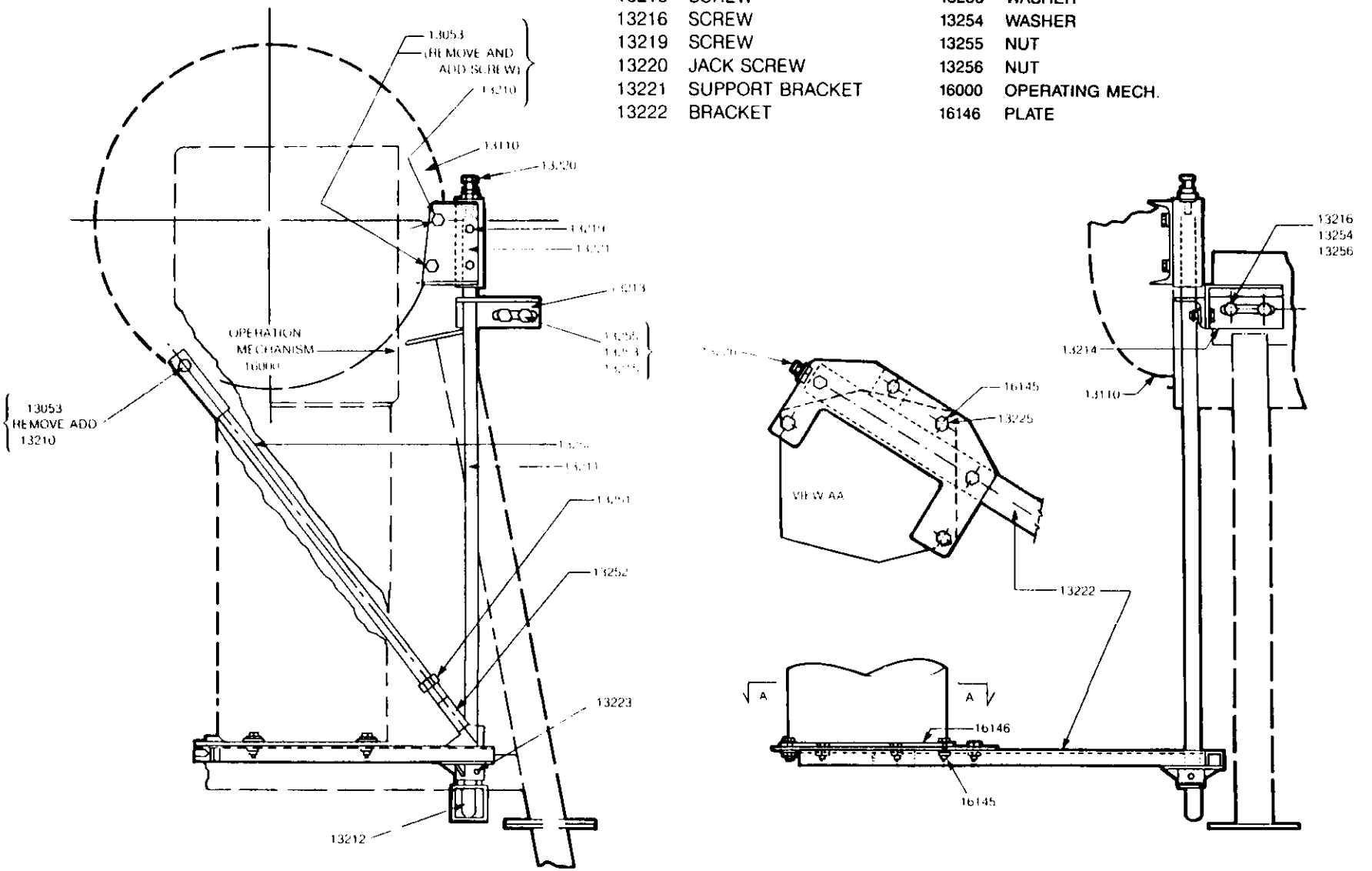


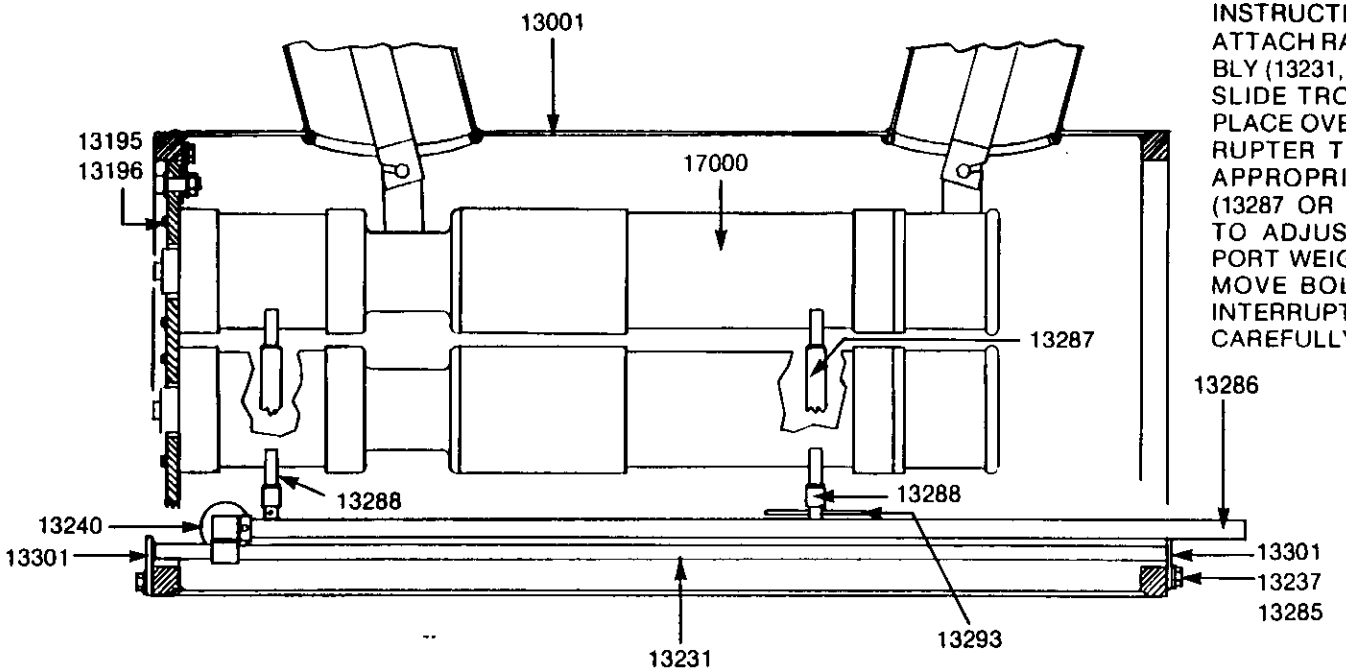
FIG. 36

13229 HINGED MAINTENANCE DEVICE

Front Hinge Installation

Before installing front hinge assembly 13229 the following preparations must be made. Deenergize high voltage connections, open adjacent disconnect switches and ground bushing terminals. Deenergize AC and DC control circuits. Remove all SF_6 gas from breaker. Disconnect operating rod 16140 at coupling 16143 in transition housing 13120. Attach hinge in following manner:

1. Attach support brackets, 13213 and 13214, using hardware specified.
2. Set retaining block 13230 in place on tank brace 13212. Insert hinge rod 13211 through bracket 13213, through spacers 13217 and 13218, through collar 13279, and through retaining block 13230 into tank brace 13212.
3. Attach bracket 13222 to bottom of transition housing 13120 using specified hardware.
4. Attach compression rods 13246 and 13300 to bracket 13222 using specified hardware. Complete the assembly of the brace from the transition housing to tank brace by inserting jack stud 13252 into rod 13246 and retaining block 13230.
5. Attach compression rod 13301 to collar 13279 using specified hardware. Assemble short brace by screwing rod 13280 into compression rods 13300 and 13301.
6. Slip hinge 13221 on hinge rod 13211. Remove the two tank bolts 13053 which line up with holes in hinge. Screw in screws 13210 tighten jam screws 13219.
7. Remove appropriate tank screw 13053 and attach long brace using screw 13210. Complete long brace by attaching jack stud 13252 to compression rod 13250 and retaining block 13230.
8. Adjust braces to exert force on front cover by adjusting jack studs 13252 and rod 13280. Adjust jack screw for tight fit.
9. Remove the remaining screws in the front cover taking care when removing the last screws. Adjust jack studs 13252 and rod 13280 to take up any slack.
10. Gently swing operating mechanism and front cover open to expose front end of tank.

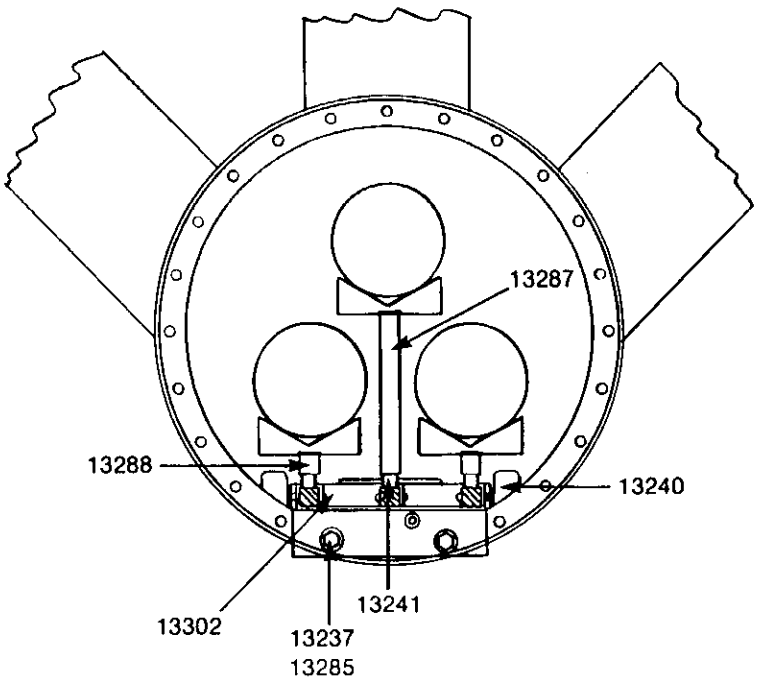


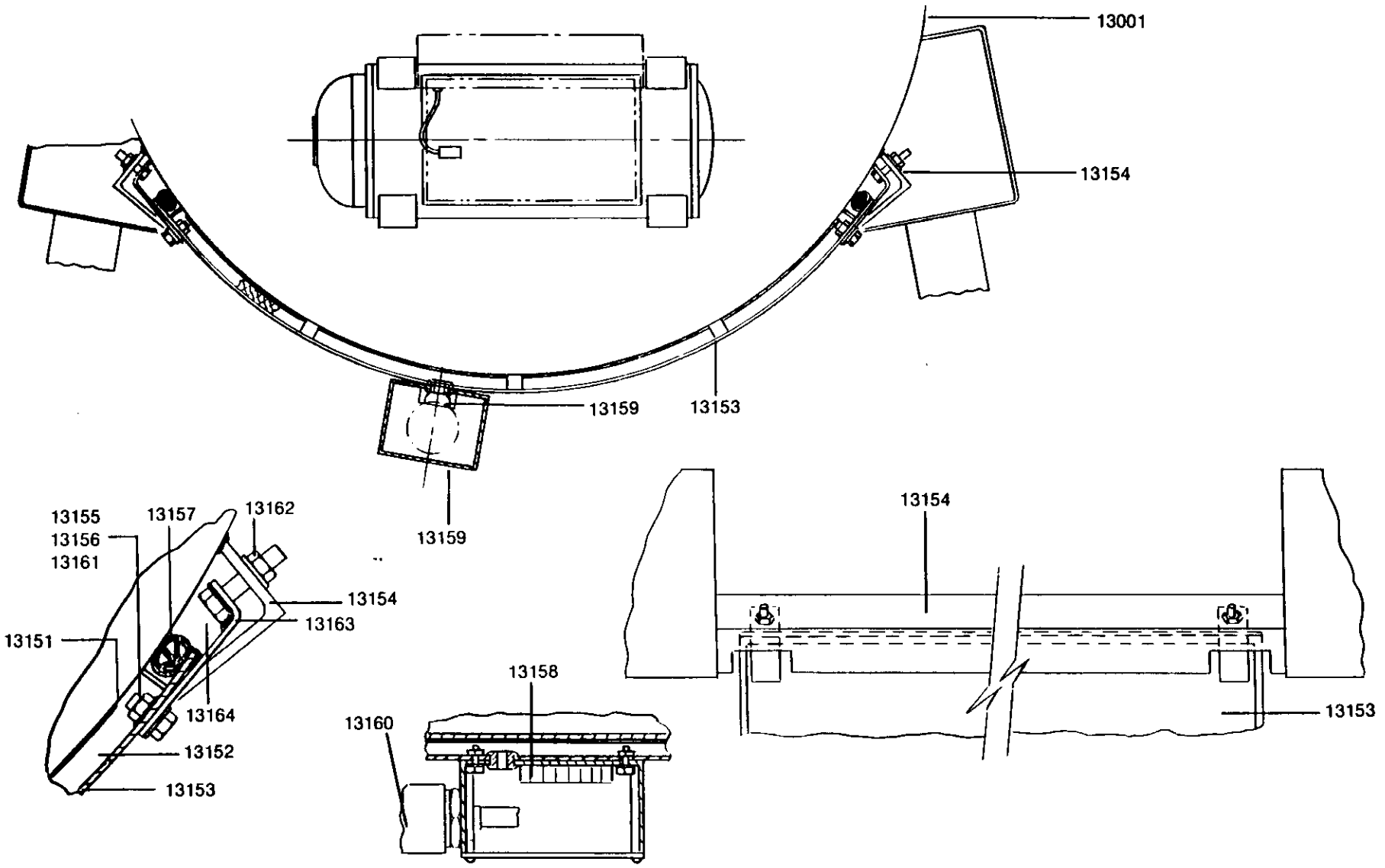
INSTRUCTIONS

ATTACH RAIL AND END PLATE ASSEMBLY (13231, 13301) TO TANK AS SHOWN. SLIDE TROLLEY ASSEMBLY 13286 IN PLACE OVER RAIL AND UNDER INTERRUPTER TO BE REMOVED. INSTALL APPROPRIATE CRADLE SUPPORTS (13287 OR 13288). USE HANDLE 13293 TO ADJUST JACK SCREW TO SUPPORT WEIGHT OF INTERRUPTER. REMOVE BOLTS 13195. GENTLY PULL INTERRUPTER TO REAR OF TANK AND CAREFULLY REMOVE.

13001	TANK
13195	BOLT
13196	WASHER
13231	RAIL ASSEMBLY
13237	BOLT
13240	ROLLER
13241	JACK SCREW
13285	WASHER
13286	TROLLEY ASSEMBLY
13287	CRADLE SUPPORT, LONG
13288	CRADLE SUPPORT, SHORT
13293	HANDLE FOR SCREW JACK
13301	END PLATE
13302	CROSS BRACE
17000	INTERRUPTER ASSEMBLY

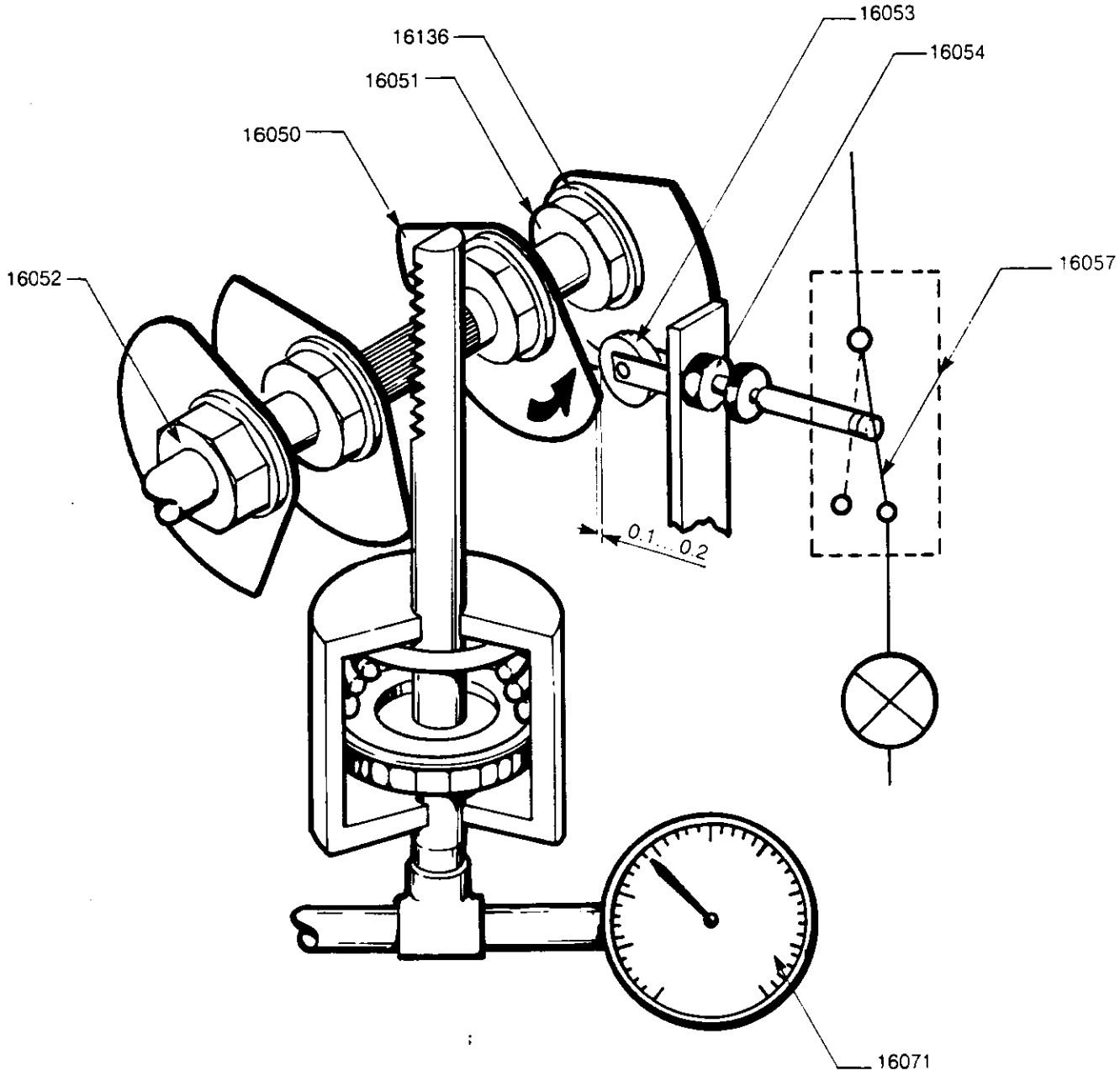
13230 INTERRUPTER REMOVAL TOOL FIG. 37





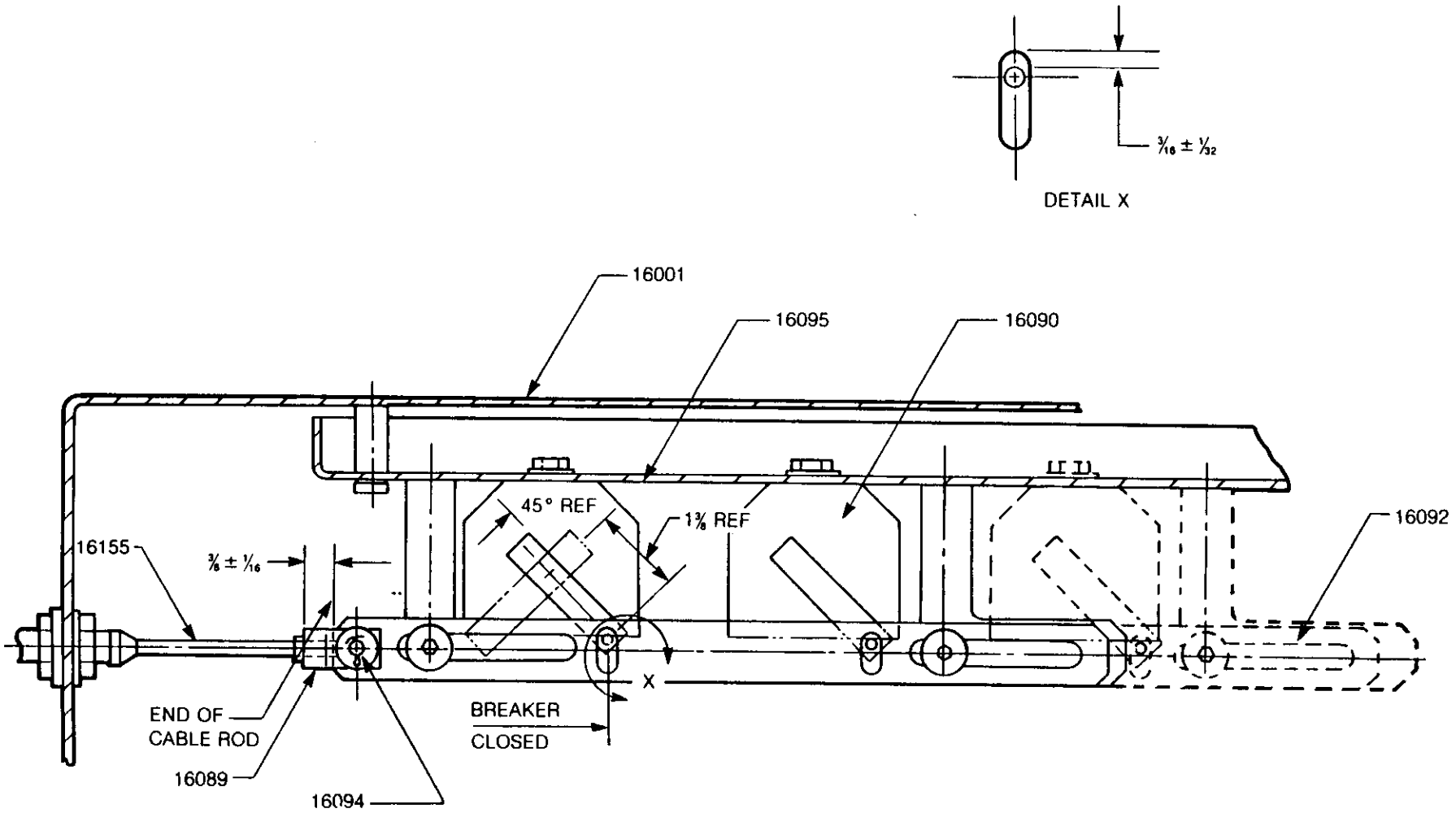
13001	TANK ASSY.	13157	GASKET
13151	TANK HEATER	13158	TERMINAL BLOCK
13152	INSULATION	13159	JUNCTION BOX
13153	COVER	13160	FLEXIBLE CONDUIT
13154	SUPPORT	13161	NUT
13155	BOLT	13162	NUT
13156	WASHER	13163	CLAMP
		13164	BOLT

FIG. 38 13150 TANK HEATER ASSEMBLY



16050 CAM
16051 NUT
16052 NUT
16053 CONTACT ROLLER
16054 SCREW
16057 MICRO SWITCH
16071 PRESSURE GAUGE
16136 LOCKING PLATE

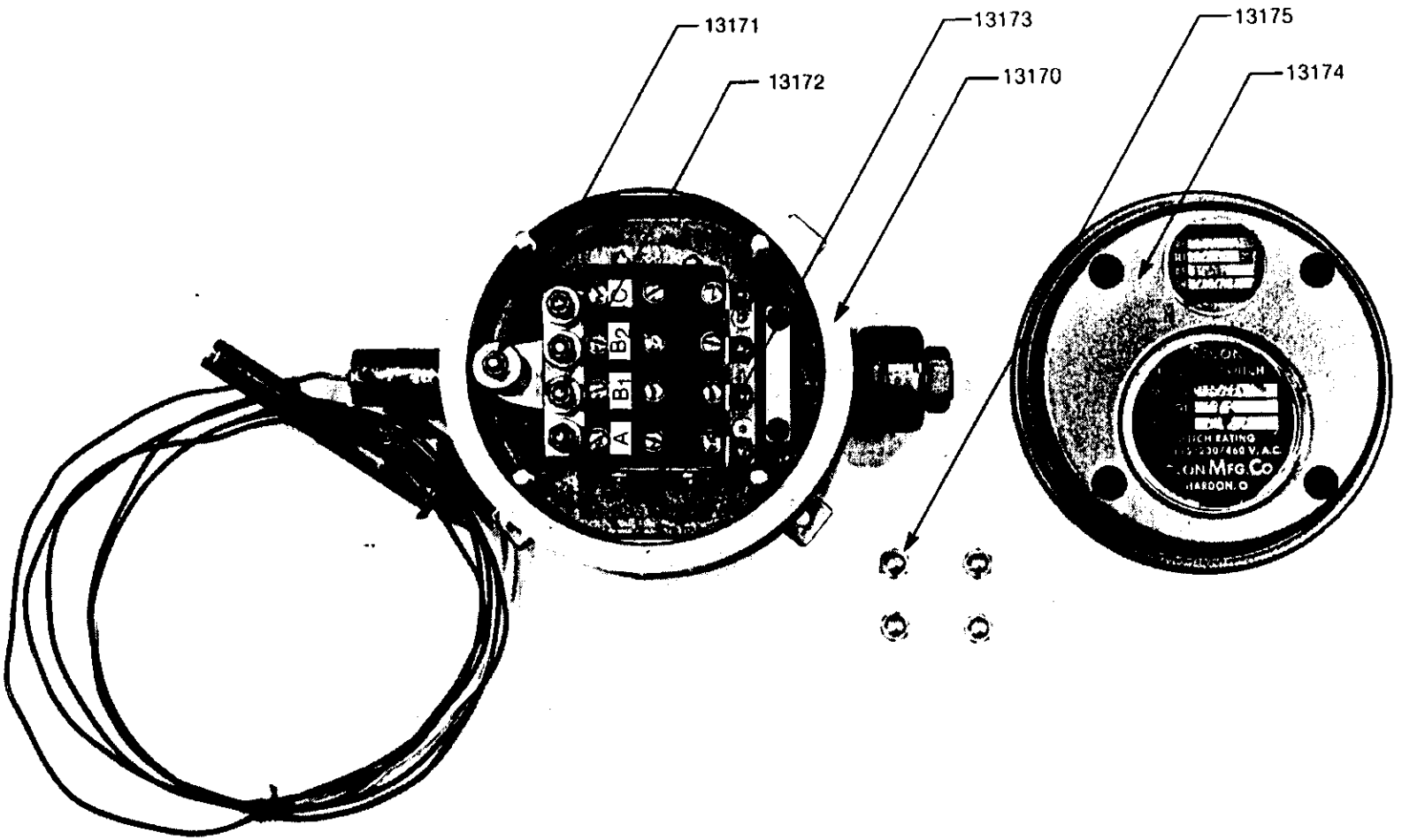
FIG. 39
16130 ADJUSTING PRESSURE SWITCH



16001	CONTROL HOUSING	16094	PIN
16089	ROD END	16095	CONTROL PANEL
16090	AUXILIARY SWITCH	16155	AUXILIARY SWITCH DRIVE LINKAGE
16092	LINK SLOTTED		

FIG. 40
16090 AUXILIARY SWITCH ASSEMBLY

NOTE: FOR AUXILIARY SWITCH ADJUSTMENT
SEE INSTRUCTION MANUAL.



SET EACH SWITCH TO THE PRESSURE INDICATED WIRING DIAGRAM OR NAMEPLATE WITH THE PRESSURE OF EACH SWITCH ADJUSTED TO COMPENSATE FOR THE GAS TEMPERATURE AS CHARTED ON FIG. 22. ADJUSTING NUT 13171 IS USED TO BRING ALL SWITCHES WITHIN THE DESIRED PRESSURE RANGE. ADJUSTING NUTS 13172 ARE USED TO SET ITS ASSOCIATED SWITCH AT THE DESIRED PRESSURE LEVEL. THE SWITCHES HAVE BEEN ADJUSTED AND TESTED AT THE FACTORY. NORMALLY ONLY A FIELD CHECK SHOULD BE NECESSARY.

13170	GAS DENSITY MONITOR	13173	SWITCH
13171	ADJUSTING NUT MASTER	13174	COVER
13172	ADJUSTING NUT	13175	COVER NUTS

FIG. 41

GAS DENSITY MONITOR ADJUSTMENT

13001	TANK	13261	JAM SCREW
13051	TANK COVER REAR	13262	SCREW
13210	SPECIAL SCREWS	13263	NUT
13252	SCREW	13264	WASHER
13257	SCREW	13265	STATIONARY HINGE
13258	WASHER	13266	MOVING HINGE
13259	NUT	13267	JAM SCREW
13260	WASHER	13268	TANK LEG BRACKET

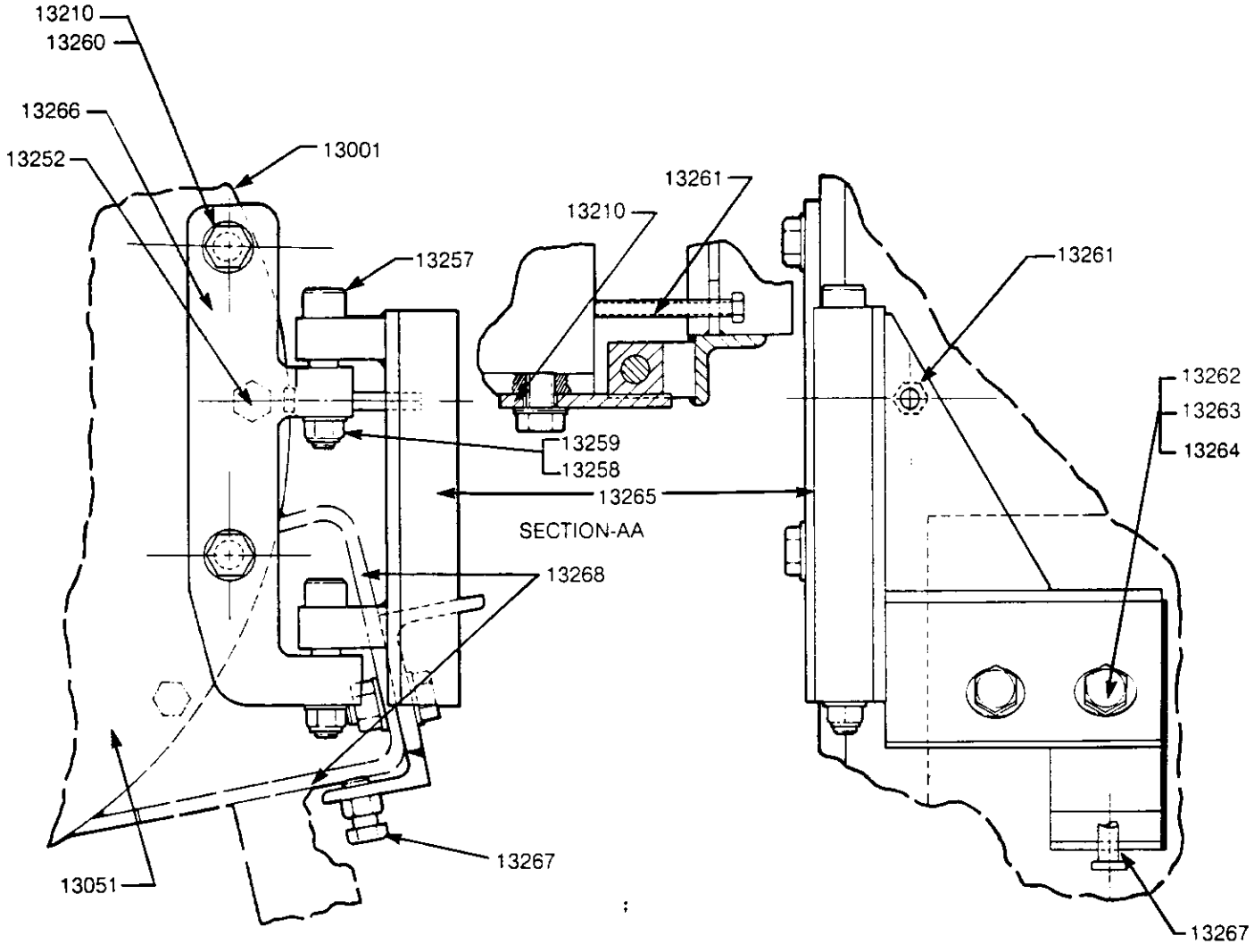


FIG. 42

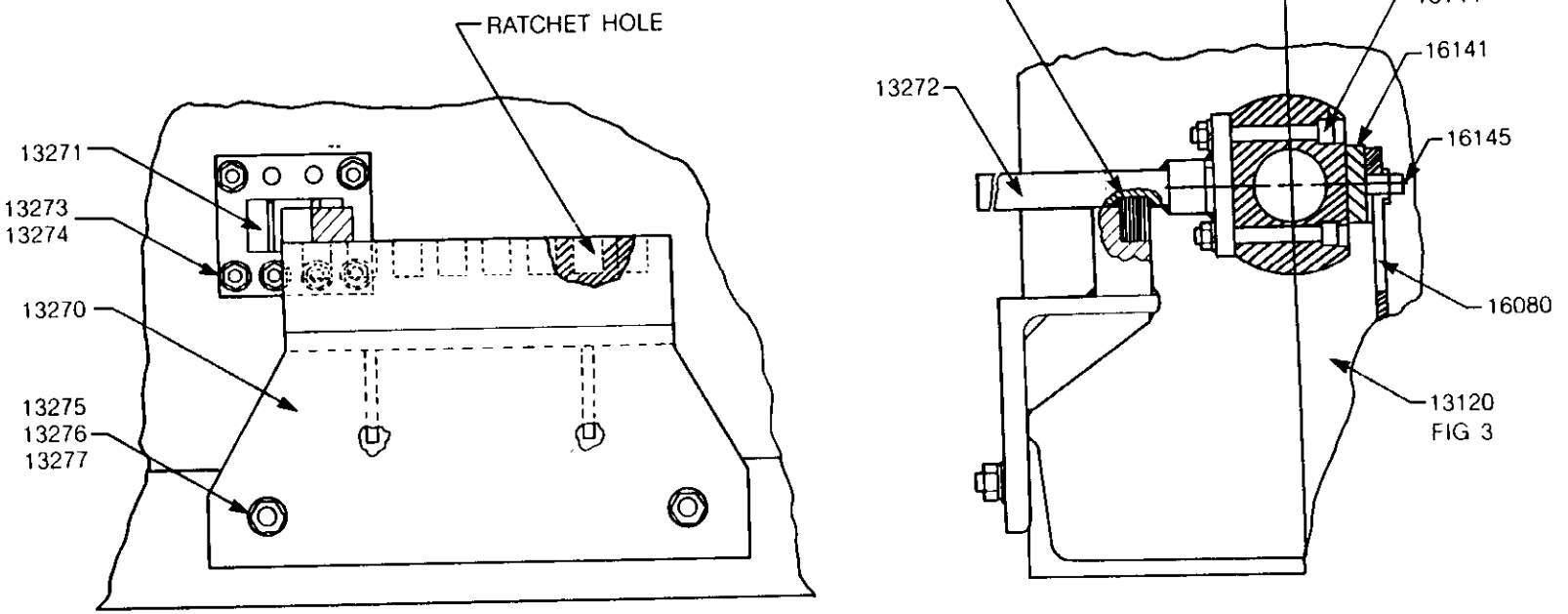
FIG. 43

13279 HINGE FOR TANK
COVER REAR

ASSEMBLY INSTRUCTIONS

(1) NO GAS PRESSURE IN THE TANK.
(2) REMOVE THE THREE ADJACENT SCREWS 13252 AS SHOWN IN FIG. 42.
(3) WITH THE HINGES 13265 AND 13266 CONNECTED AT SCREWS 13257, ATTACH THE ASSEMBLY TO THE TANK COVER 13051 WITH SPECIAL SCREWS 13210 AND WASHERS 13260, THEN IN TURN TO THE TANK LEG BRACKET WITH SCREWS NUTS WASHERS 13262-13263-13264 RESPECTIVELY.
(4) TIGHTEN SCREWS 13210 AND 13262 THEN POSITION JAM SCREW 13267 JUST "SNUG" AGAINST THE TANK LEG BRACKET 13268. TIGHTEN JAM SCREW 13261 "FINGER" TIGHT AGAINST THE TANK SHELL 13001. TIGHTEN THE NUTS 13259 TO SUPPORT THE WEIGHT OF THE TANK COVER 13051.
(5) REMOVE THE REMAINING SCREW 13250 FROM THE TANK COVER THEN SWING COVER OPEN.

13025 PULL ROD ASSEMBLY
13120 TRANSITION HOUSING ASSEMBLY
13270 BRACKET
13271 SOCKET BRACKET
13272 LEVER
13273 NUT
13274 WASHER
13275 NUT
13276 WASHER
13277 WASHER
16080 LEVER
16140 DRIVING ROD
16141 CRANK DRIVE PLATE
16143 COUPLING
16144 SCREWS
16145 SCREW



TO OPERATE THE BREAKER MANUALLY (SLOW OPEN OR CLOSE) OPEN THE MANUAL RELIEF VALVE 16068 (FIG. 17). TO REDUCE THE OIL PRESSURE IN THE OPERATING MECHANISM TO 0 PSIG (0 MPa) REMOVE THE REAR COVER ASSEMBLY 13022 (FIG. 2). INSTALL THE SOCKET BRACKET 13271 ON THE EXTRA LONG SCREWS 16144 WITH WASHERS 13274 AND NUTS 13273. INSTALL THE BRACKET 13270 ON THE STUDS WITH NUTS 13275 WASHERS 13276 AND 13277. INSERT THE LEVER BETWEEN THE LUGS ON THE SOCKET BRACKET 13271 AND IN TURN THE LEVER PIN INTO RATCHET HOLE. WITH THE LEVER CAM THE BREAKER OPEN OR CLOSED MOVING THE LEVER PIN FROM RATCHET HOLE TO RATCHET HOLE AFTER EACH STROKE.

FIG. 44

13269 MANUAL OPERATING DEVICE

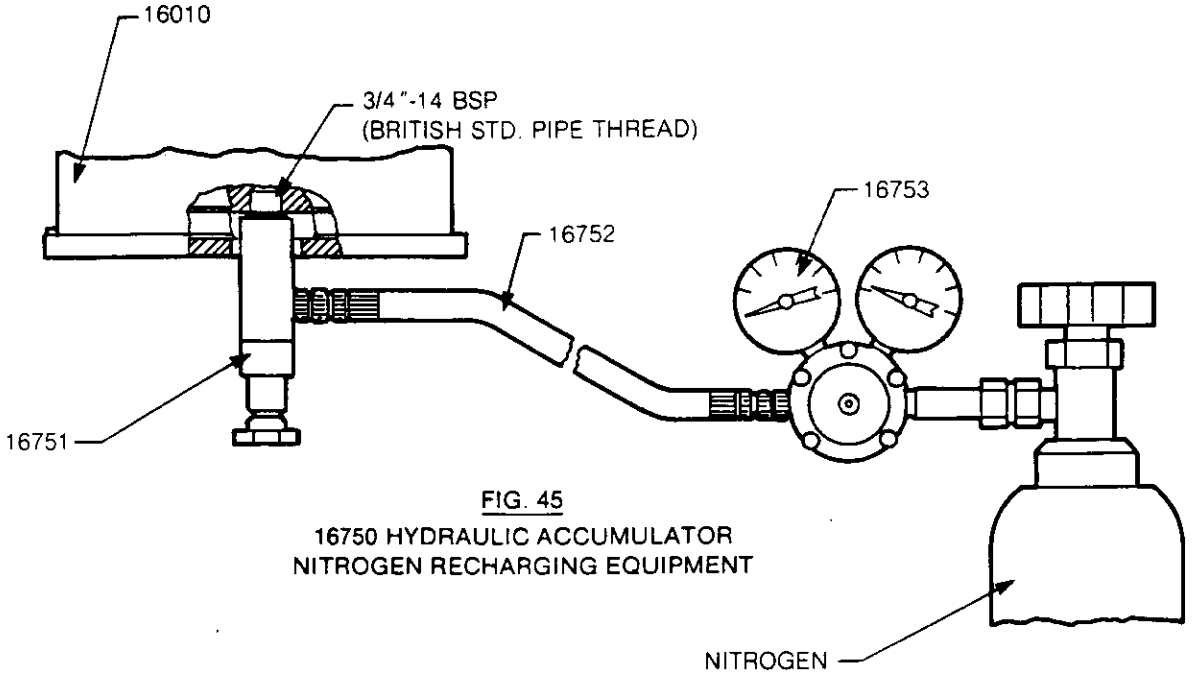


FIG. 45
16750 HYDRAULIC ACCUMULATOR
NITROGEN RECHARGING EQUIPMENT

16010 HYDRAULIC ACCUMULATOR
16751 VALVE
16752 HOSE
16753 REGULATOR

FILLING INSTRUCTIONS

LOW NITROGEN PRESSURE IN A NEW ACCUMULATOR INDICATES THAT THE UNIT WOULD HAVE TO BE REPLACED. ACCUMULATORS WITH A EXTENDED SERVICE PERIOD CAN BE RECHARGED WITH NITROGEN.

- REMOVE THE PLUG FROM THE BOTTOM OF THE ACCUMULATOR
- THE STEM OF THE VALVE MUST BE EXTENDED OUTWARD AT THE HANDLE END
- INSERT VALVE AND TIGHTEN — CONNECT HOSE BETWEEN REGULATOR AND THE VALVE. DO NOT TIGHTEN VALVE END OF HOSE. PURGE HOSE OF AIR WITH NITROGEN. TIGHTEN HOSE. SCREW VALVE STEM INWARD AT THE VALVE HANDLE. CHARGE ACCUMULATOR FROM THE NITROGEN BOTTLE.

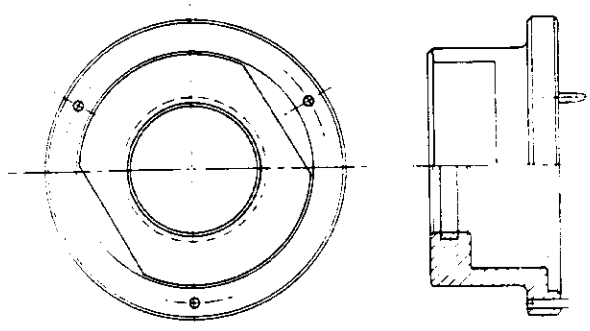
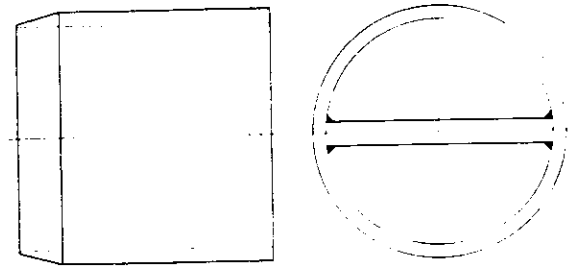
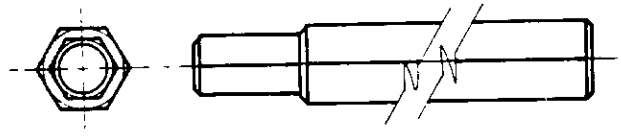


FIG. 46
13228 TOOL-EXHAUST TUBE HOLDER



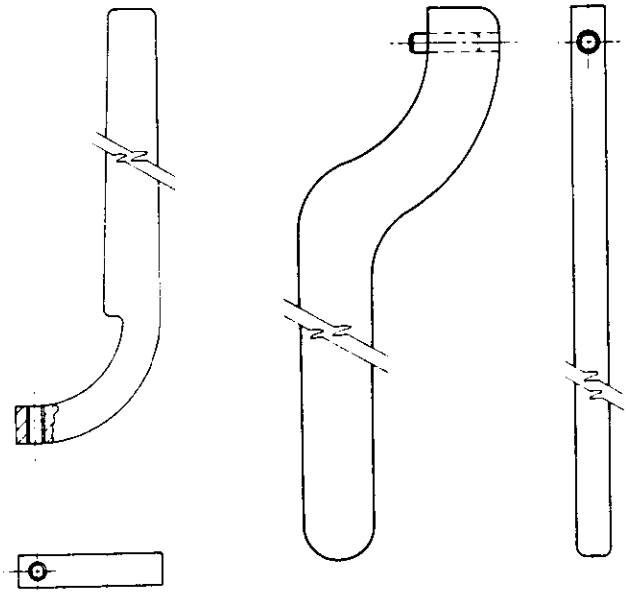
13207

FIG. 48
13207 TOOL-STATIONARY
CONTACT HOLDER



13401

FIG. 49
13401 TOOL-PULL ROD EXTENSION



13281 13400

FIG. 47
TOOL-SPANNER WRENCHES
FOR PULLROD

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