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INSTRUCTIONS, INSTALLATION & MAINTENANCE MANUAL

145kV SF6 Gas Circuit Breaker

Type - 120-SFM-32B



ISO 14001:2004
OHSAS 18001:1999
Integrated Management Systems

Bureau Veritas
Certification



ISO 9001
BUREAU VERITAS
Certification



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Tel: 91-253-2301494/95/96

For Export

Bipin Deo
From Services
Email: bipin.deo@cgglobal.com
Tel: 91-253-2301666

Safety Instructions

SAFETY INSTRUCTIONS

1. INSTALL THE CIRCUIT BREAKER ON PROPER FOUNDATION AND ENSURE NO GAP BETWEEN STRUCTURE AND FOUNDATION.
2. TIGHTEN ALL FOUNDATION BOLTS AND HARD-WARES WITH ADEQUATE TORQUE.
3. WHILE HANDLING THE POLE UNIT i.e. DURING ERECTION & DISMANTLING POSITIVE PRESSURE INSIDE POLE UNIT SHOULD NOT EXCEED 0.5 KG/CM².
4. USE LOCK PINS FOR SAFETY OF PERSON WORKING WITH THE BREAKER DURING MAINTENANCE.
5. NEVER OPERATE THE CIRCUIT BREAKER WITHOUT SF6 GAS FILLED AT RATED PRESSURE WITH RESPECT TO TEMP.
6. MUST ENSURE BOTH CLOSING & TRIPPING SPRING ARE IN DISCHARGED FOR THE MAINTENANCE WORK IN OPERATING MECHANISM. FOR ADDITIONAL SAFETY OVER ALL MAINTENANCE PURPOSE ALSO ENSURES BOTH SPRING ARE DISCHARGED.
7. USE SF6 GAS HANDLING PLANT FOR RETRIEVAL AND REFILLING OF SF6 GAS DURING MAINTENANCE. BREATHING OF USE / PURE SF6 GAS IS DANGEROUS AS IT DISPLACES OXYGEN & CAUSES SUFFOCATION.
8. USE GLOVES, MASK WHILE HANDLING THE COMPONENTS SUBJECTED TO SF6 GAS OR ITS DECOMPOSITION PRODUCTS.

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SECTION 1 - INTRODUCTION

1.1 GENERAL

The circuit breaker is one of the most important units in the electrical power system. The protection, stability and continuity of the system depends on the circuit breaker's ability to switch line, load and exciting currents and to interrupt fault currents. The SF6 gas circuit breaker assures the high level of performance required for the reliable operation of the electrical system by making full use of the exceptionally good electrical insulating characteristic and excellent arc quenching properties of sulphur hexafluoride (SF6) gas. The reliability of the system is further increased by the use of a SF6 gas insulating system and a single pressure dual flow SF6 gas puffer interrupter which reduces the number of moving cylinder and auxiliary systems in the circuit breaker. The pressure required to blast the SF6 gas against the arc and interrupt the current is generated by the compression of the gas between the moving cylinder and the stationary position of the interrupter during the opening operation. This simple principle is shown in Fig.1. While communicating

regarding the product covered by this instruction book include all data contained on the nameplate attached to the equipment. Also, to facilitate replies when particular information is desired, be sure to state fully and clearly the problem and attendant conditions. For a permanent record, it is suggested that all nameplate data be duplicated and retained in a convenient location.

IMPORTANT

PROPER INSTALLATION AND MAINTENANCE ARE NECESSARY TO ENSURE CONTINUED SATISFACTORY OPERATION. CIRCUIT BREAKER ARE DESIGNED, DEVELOPED AND TESTED TO PERFORM THE FUNCTION OF CIRCUIT PROTECTION BY INTERRUPTING CURRENTS UP TO THE RATED BREAKING CAPACITY AT RATED VOLTAGE AS GIVEN IN RATING PLATE. **THE CONSEQUENCES OF OPERATING A BREAKER ABOVE THE RATING CAN LEAD TO A CATASTROPHIC FAILURE. THIS COULD RESULT IN PROPERTY DAMAGE AND / OR PERSONAL INJURY.**

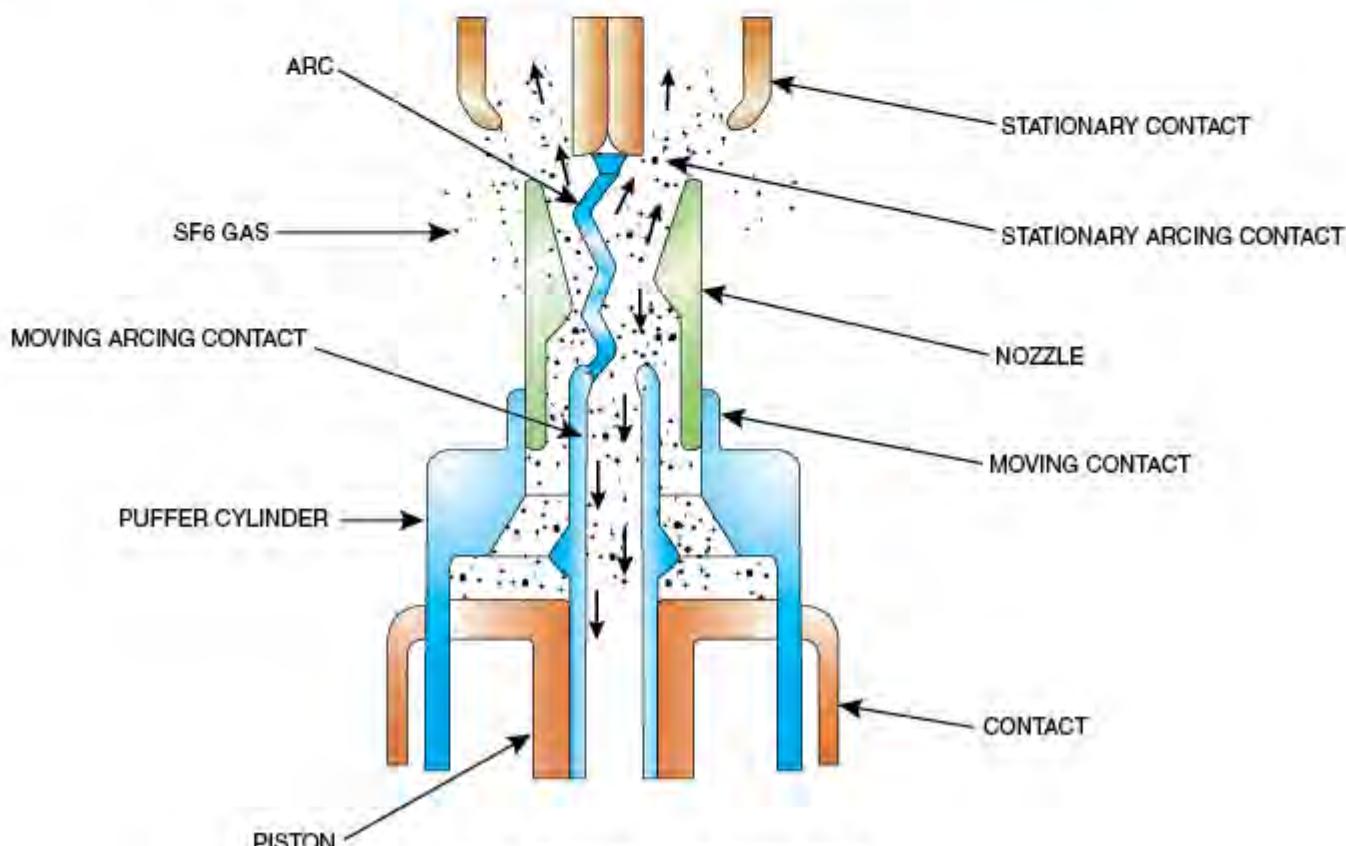


FIG. 1 : INTERRUPTING PRINCIPLE

Introduction

1.2 CAUTION

In order for the Circuit Breaker meet its required rating, it is important that the circuit Breaker and particularly the gas system be clean, dry and leak tight. The following general precautions should be followed during installation and maintenance.

1. Do not expose the interior of the Breaker to dust or excessive moisture during installation or maintenance.
2. Protect the porcelains and gas pipes from damage.
3. Do not scratch O-rings and the flange seal surfaces.
4. Store O-rings in protective wrapping to maintain cleanliness and prevent exposure to sunlight.
5. Clean O-rings and sealing surface prior to assembly.
6. Use only specified O-rings and follow caulking and sealing of joints as described in this instruction Book.

7. The equipment is not water and moisture tight during transit & storage and special precautions should be taken during Transit & storage.

1.3 SCOPE

The instruction book applies to the Type SFM circuit breaker. The Type SFM is a live tank, single pressure, SF6 filled, puffer circuit breaker. The information provided includes general construction details and operation / maintenance instruction. The information for installation procedure is referred to installation, operation, or maintenance, and all details and variations of this equipment are not claimed to be covered by these instructions. The customer's outline drawing, control schematic and wiring diagrams and SF6 gas schematic should be referred to for specific information for a particular breaker. The instruction in this book apply to circuit breaker with the following ratings:

Table 1.1 Ratings

Type of GCB	120 - SFM - 32B
Rated Voltage (kV)	145
Rated lightning impulse withstand voltage (kV (p))	650
Rated power frequency withstand voltage (kV)	275
Rated normal current (A)	upto 3150 A
Rated short - circuit Breaking Current (kA RMS)	40
Closing and latching current (kA peak)	100
Rated frequency (Hz)	50
Rated operating sequence	0 - 0.3 sec - CO - 3 min. - CO or CO - 15 sec. - CO
Rated break time (cycles)	3
Rated close time (msec.)	135
Rated gas pressure (Kg/cm ²) - g at 20°C (68°F)	7/7.5
Operating method	Closing - Spring. Opening - Spring
Charging time of closing spring (sec.)	15

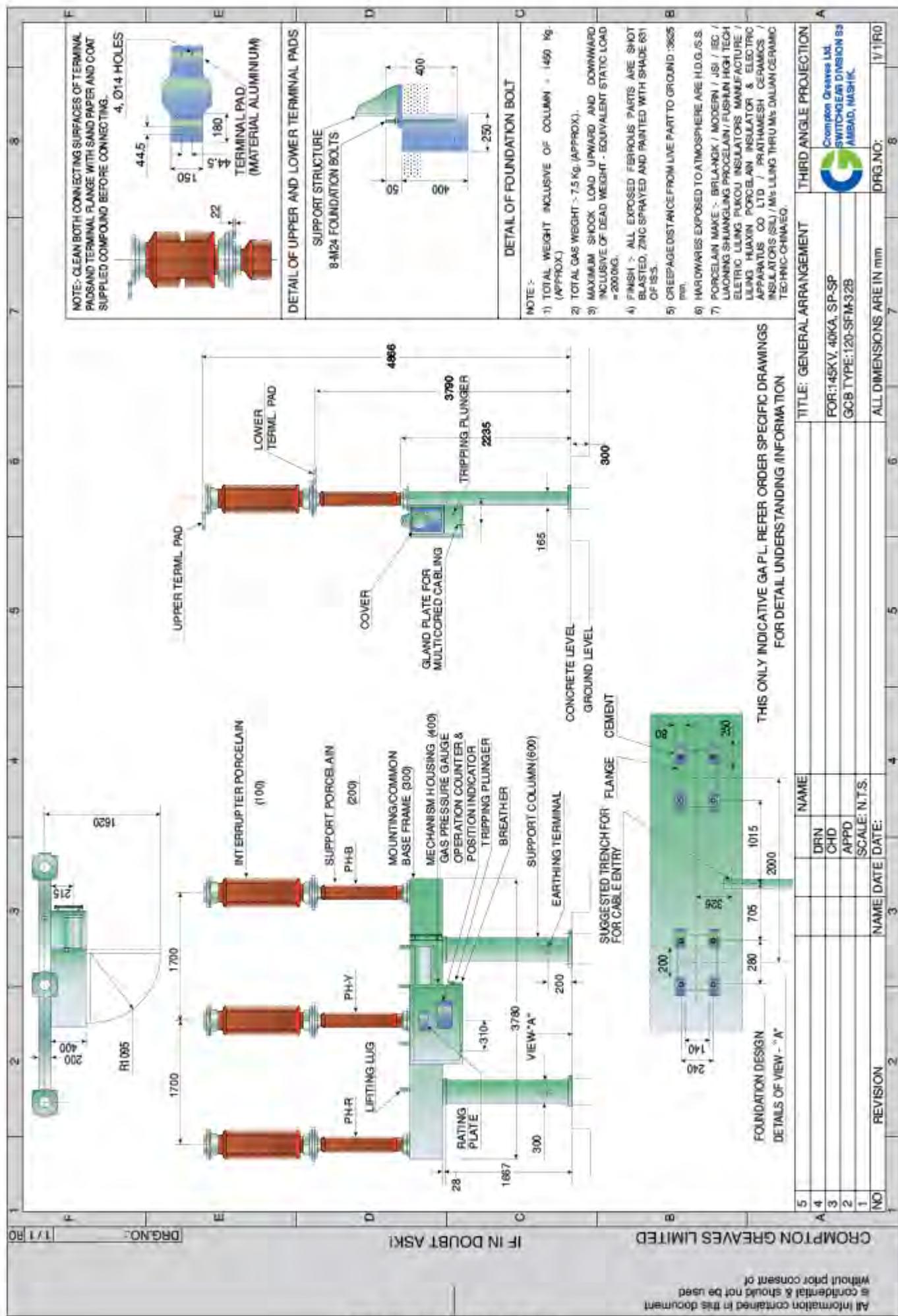


FIG. 2 - (SINGLE STACK)

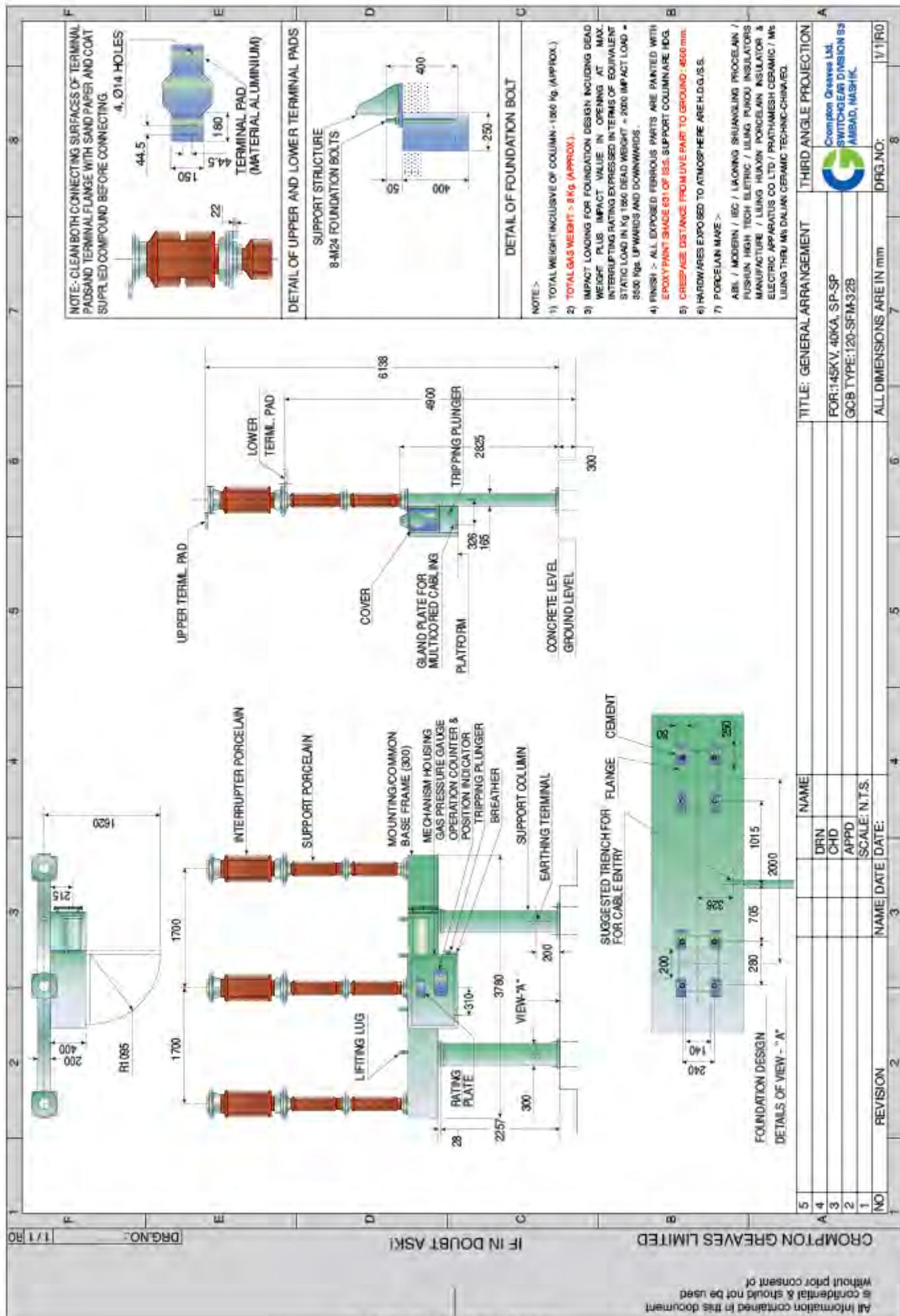


FIG. 2 - (DOUBLE STACK)

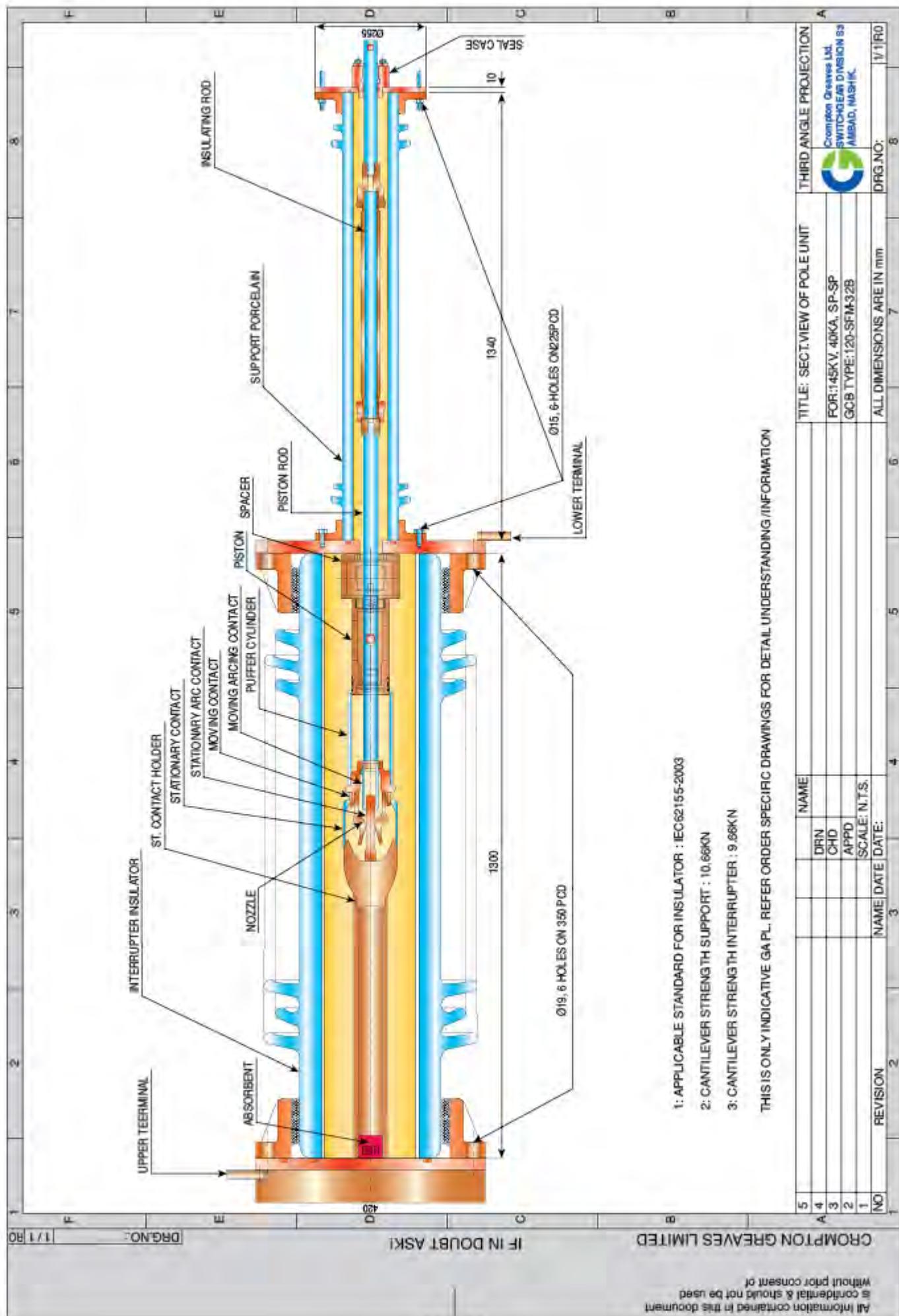


FIG. 2A

SECTION 2 - DESCRIPTION**2.1 GENERAL**

The type SFM spring operated live tank gas circuit breaker is shown in Fig.2 All three phases of the breaker are mounted on a common frame (300). The common frame is mounted on support structure columns (600). All three Poles are operated in a single spring mech. located in operation mech. Housing (400). The pole units contain gas and are connected together providing a single gas system. The electrical controls are located in the Operating Mechanism Housing (400).

2.2 CONSTRUCTION

Construction of the Breaker is illustrated in Fig.3. The breaker consists basically of three vertical interrupter Units (100) which contain puffer type interrupters, Spring Operating Mechanism (500) which is mounted in Mechanism Housing (400) and Frame (300). Opening operation is effected by the opening spring and closing operation is accomplished by the closing spring, charged by the ratchet linked to the motor. Each interrupter Unit (100) is filled with SF6 gas and kept at the same pressure through Copper Gas Pipe (301) connecting to the other two interrupter Units (100). The same Gas Pipe (301) also leads to Gas Pressure Gauge (402), Temperature Compensated Gas Pressure Switch (401) and Gas Feed Port (403). All the moving parts of the three interrupter Units (100) are connected mechanically to Spring Operating Mechanism (500) by Horizontal Rod (302).

2.3 INTERRUPTER UNIT

The cross-section of interrupter unit is illustrated in Fig.4

2.3.1 Interrupter Porcelain Assembly

The interrupter unit is a single pressure puffer type which consists of Puffer Cylinder (105) and Piston (106), Moving Main Contact (103), Moving arcing

contact (112), Nozzle (111), assembled on bottom side of interrupter porcelain (102). Stationary Main Contact (110) and its assembly are mounted on the top side of interrupter Porcelain (102).

(1) Opening Operation

By the Insulating Rod (202) & Piston Rod (113), the Puffer Cylinder, Moving Contact, Moving Arcing Contact and Nozzle are pulled downward. After a certain wiping, Stationary arcing contact (109) & Moving Arcing Contacts (112) separate, generating the arc. The gas pressure in the puffer cylinder build up and the powerful gas flow quenches the arc.

(2) Closing Operation

In closing operation, Insulating Rod (202) is pushed up and all parts move in the reverse order of the opening operation. The fresh gas is taken into the puffer cylinder.

2.3.2 Support Porcelain Assembly

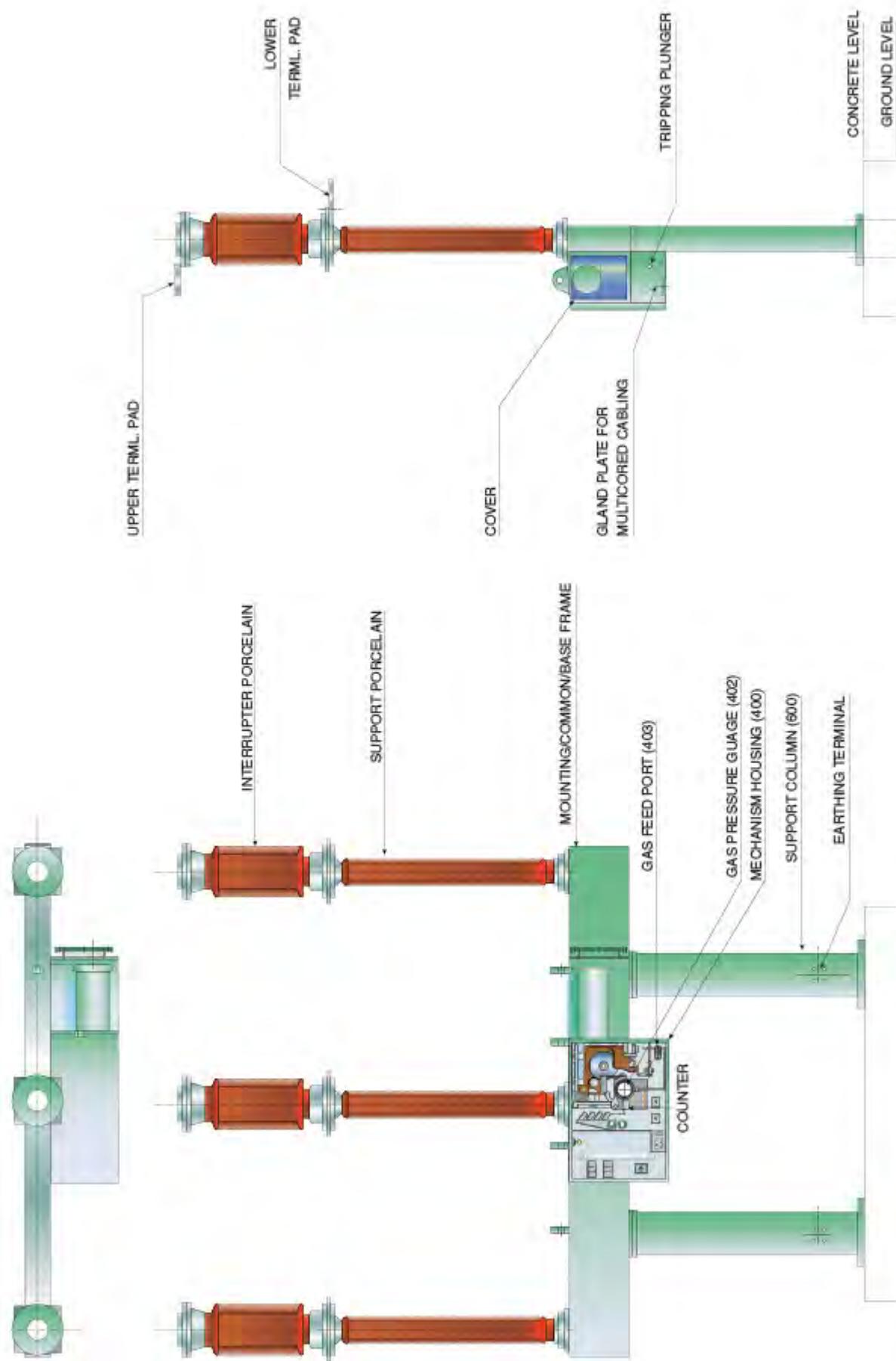
Support Porcelain (201) supports interrupter Porcelain (102) and insulates the live parts from the ground. The inside of the porcelain is filled with SF6 gas which is common to that of the interrupter unit.

2.3.3 Slide Seal and Absorbent

Slide Seal Assembly (203) should not be disassembled in the field, because it needs special care and workmanship. This is completely assembled and checked at the factory. Absorbent (101) should be replaced, when the contact is inspected. The absorbent keeps the SF6 gas dry and absorbs the deteriorated gas which is decomposed by the arc.

2.4 SPRING OPERATING MECHANISM (Fig. 5)

With the energy for closing operation the breaker is provided by the type BM spring operating mechanism. The energy for operation is stored in a spring (502)

**FIG. 3 CONSTRUCTION - (SINGLE STACK)**

Description

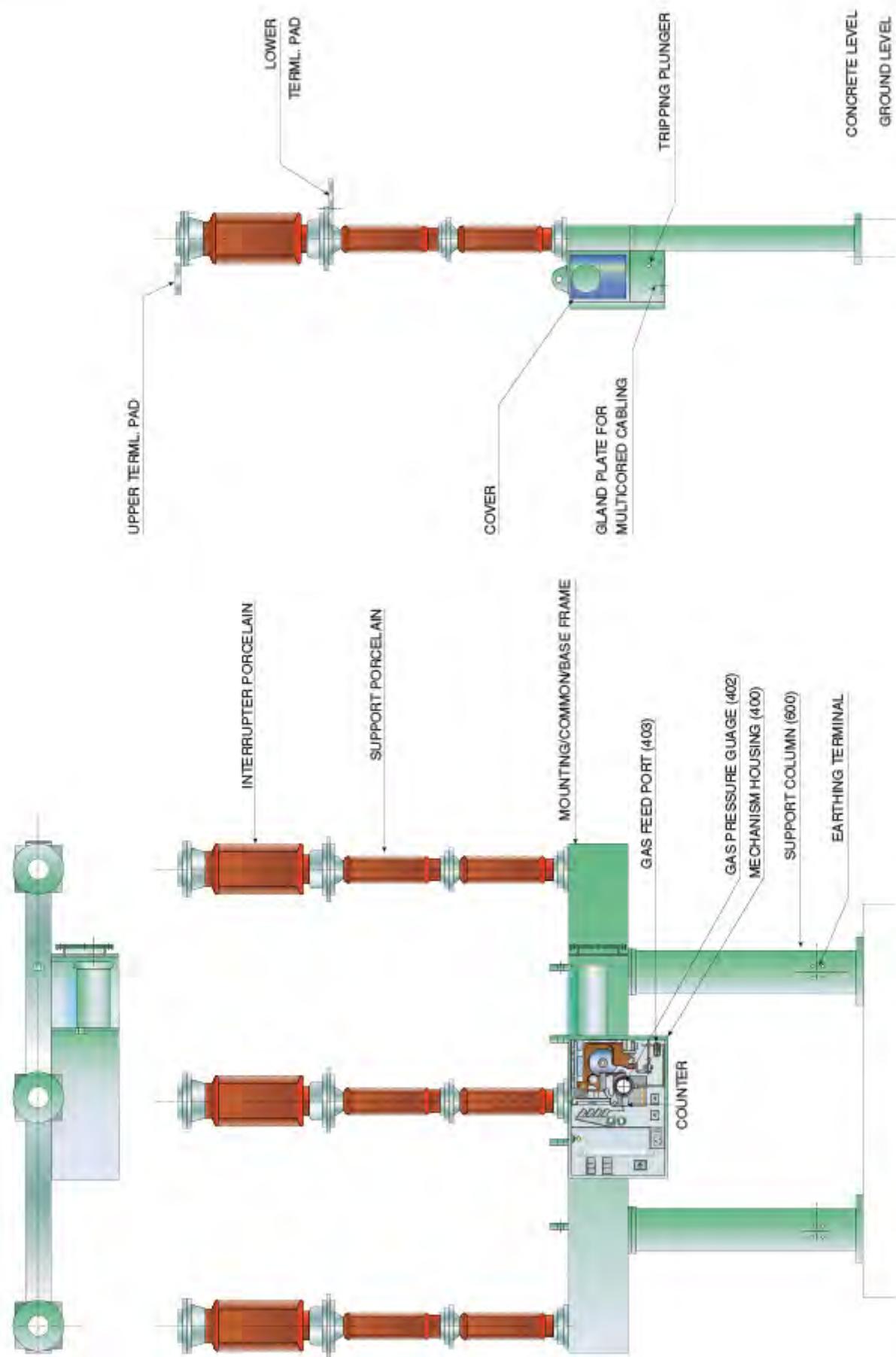


FIG. 3 CONSTRUCTION - (DOUBLE STACK)

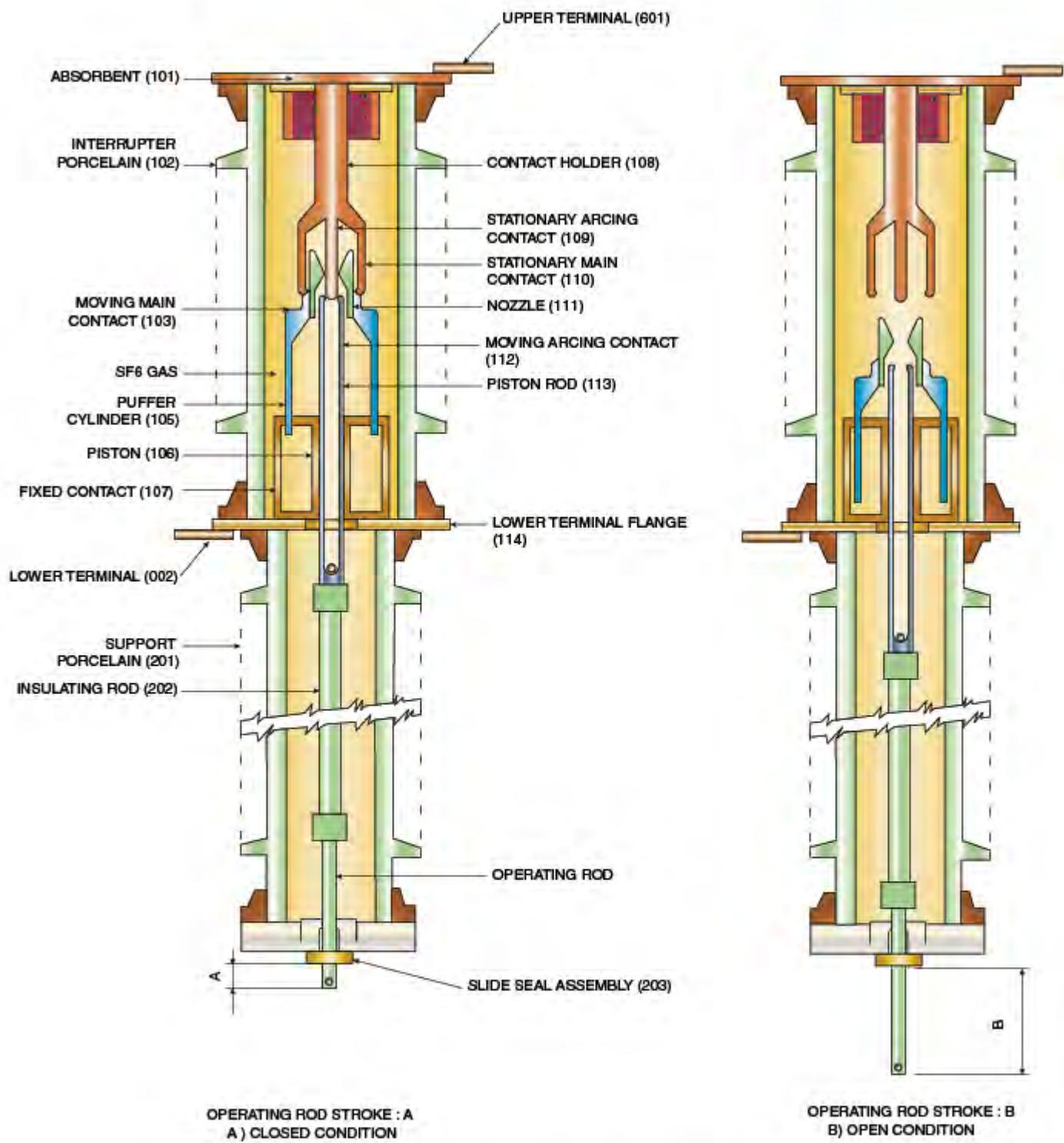


FIG. 4 INTERRUPTING UNIT

Description

for closing which during the closing operation compresses spring (501) for the trip operation. An electrical motor provides with the energy for recompressing Closing spring (502).

From the breaker closed position, the mechanism will perform a open-close-open operation with the energy available in the closing spring (502). The motor will recharge the closing spring (502) within 15 seconds for additional operations. A detailed explanation of the mechanism operation is as follows.

2.4.1 Opening operation

With The breaker contacts closed and the closing spring (502) charged the mechanism linkage is as shown in Fig.5 (a). In this position, Lever A (510) and B (511) (which are connected by a hexagonal shaft) receive a counterclockwise torque because of load from Trip Spring (501). This torque is blocked by Trip Holding latch (512) and Trip Trigger (513), holding the mechanism and contacts in closed position. At the start of the opening operation, Trip Coil (507) is energized by the opening signal causing Trip Plunger (526) to impact the Trip Trigger (513) rotating it clockwise allowing the trip holding latch (512) to rotate it clockwise. Consequently, Pin A (514) is released and the lever B (511) is rotated by the force of the trip spring (501) driving the interrupter unit (100) to the open position as shown in Fig. 5-1(b). Located inside the trip spring (501) is a sealed, maintenance free, hydraulic shock absorber (530) to absorb impacts of the opening operation.

2.4.2 Closing Operation

As shown in Fig. 5-1 (b) for part reference refer fig 5-1(a), Cam Shaft (517) receives a counterclockwise torque from the closing spring (502), which is connected to Ratchet Wheel (503).

This torque is blocked by Closing Trigger (505) and Closing Holding Latch (504) which engages Pin B (516) attached to the ratchet wheel (503). At the start

of the closing operation, Closing Coil (506) is energized by the closing signal causing Anti-pumping Lever (515) to impact the closing trigger (505) rotating it clockwise allowing the closing holding latch (504) to rotate counterclockwise.

Consequently, the pin B (516) which is attached to the ratchet wheel (503), is released and Cam (508) which is fixed to the Cam shaft (517), is rotated counterclockwise by the force of the closing spring (502), forcing the lever B (511) to rotate clockwise, while compressing the trip spring (501). Fig. 5-1 (c) shows the position in which the closing operation is completed and the pin A (514) is blocked by the trip holding latch (512) again, and the closing spring (502) is discharged.

2.4.3 Charging of Closing Spring

As shown in Fig. 5-1 (c) after the closing operation is completed, the closing spring (502) is in the discharge state. Ratchet Shaft (518) is connected to the motor by gears other than those shown in the figure. For the charging operation of the closing spring (502), the motor is started to rotate the ratchet shaft (518). The ratchet shaft (518) is eccentric, causing two Pawls (509) to move in and out alternately engaging and moving the ratchet wheel (503).

By this action, the ratchet wheel (503) is rotated counterclockwise compressing the closing spring (502) the cam shaft (517) is also rotated up to the position where the dead point is passed. At this point, the cam shaft (517) and the ratchet wheel (503) are given a counterclockwise rotating force by the closing spring (502) which is blocked by the closing holding latch (504), engaging the pin B (516). This condition is shown in Fig. 5-1 (a).

2.4.4 Mechanical Anti-pumping (Fig.5.2)

The “anti-pumping” feature is provided to assure that only one closing operation will result when the closing

control device is initiated and continuously energized. This feature is provided with both electrical controls and a unique mechanical device on the mechanism. The electrical anti-pumping is described in 2.6.4.

- The pin B (516) gives counterclockwise torque to the closing holding latch (504) and this torque is blocked by the closing trigger (505) which is held by Spring A (522) through Roller (521).
- When the closing coil (506) is energised by the closing signal, plunger (520) and the antipumping lever (515) move in a straight line. The antipumping lever (515) kicks the closing trigger relieving the closing holding latch (504). It also pushes against Antipumping Pin (519) compressing Spring B (523).
- Since the closing trigger (505) continue its clockwise rotation, the antipumping lever (515) is released from the antipumping pin (519) by the closing trigger (505). And the antipumping pin (519) returns to its normal position.
- When the closing coil (506) is de-energized, the plunger (520) and the antipumping lever (515) are returned to the position shown in Fig. 5-2(a) by a spring (not shown) within the closing coil (506). Fig. 5-2(d) shows the condition at the completion of the closing operation. If the charging of the closing spring is completed, the mechanism returns to the same condition as shown in Fig. 5-2(a).
- In the event of an immediate trip operation from the position shown in Fig. 5-2(c), the antipumping lever (515) is prevented from engaging the closing trigger (505) by the antipumping pin (519), even if the closing trigger (505) and the closing holding latch (504) are returned to former position by the closing spring with charged condition. In this state, next closing operation cannot be initiated until the original closing signal is terminated. When the

closing signal is cut off, the closing coil (506) is deenergized, and the plunger (520) and the antipumping lever (515) are reset for the next closing operation as shown in Fig. 5-2-(a).

2.4.5 Accessories

Other accessories connected to and operated by the mechanism are auxiliary switches, a mechanical operation counter and a position indicator.

2.5 OPERATING MECHANISM HOUSING

The operating mechanism housing (400) contains the operating mechanism (500) and its accessories which are Auxiliary Switches, Operating Counter and Position indicator but all the components essential for control of the circuit breaker operation such as

- Gas Pressure Gauge (402)*
- Temperature-compensated Gas Pressure switch (401)*
- Control Panel for control
- Gas Feed Port (403)

* Depending on make gauge & switch will combine in one unit.

2.6 ELECTRICAL CONTROL SCHEME

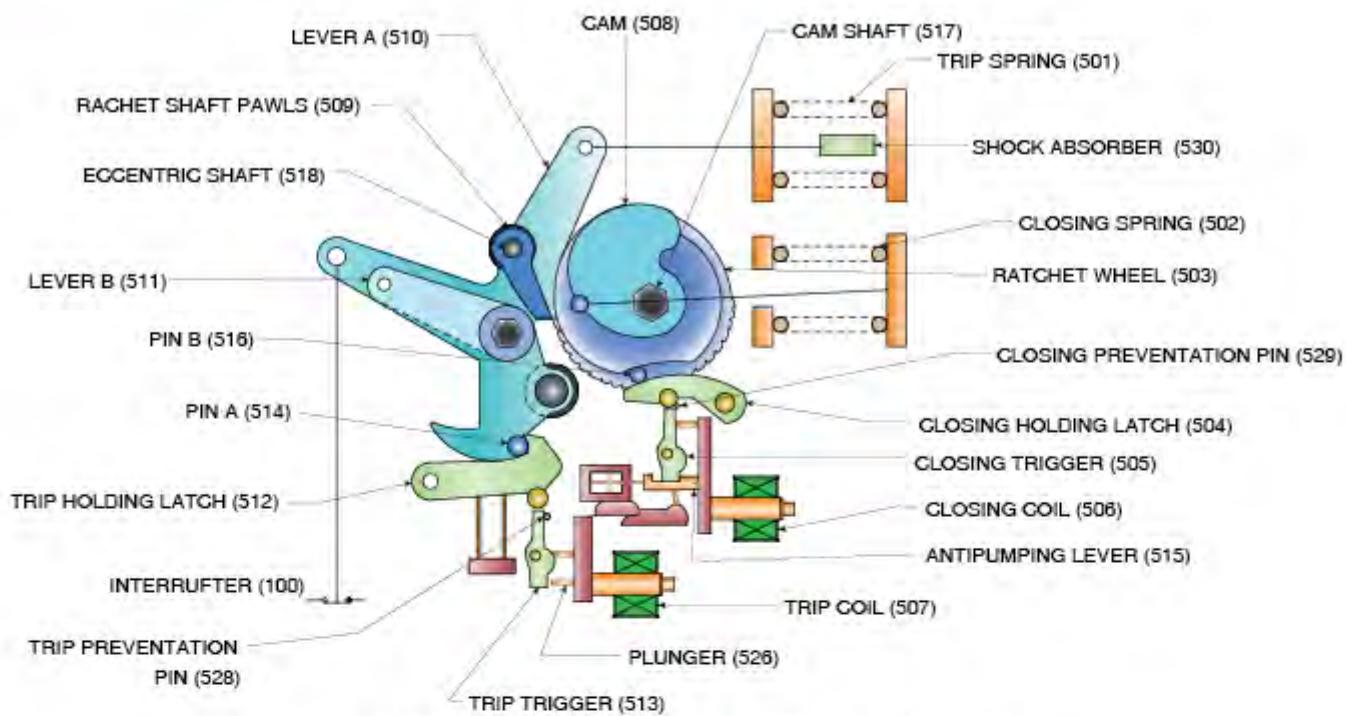
A typical schematic diagram is shown in Fig.6 which is only illustrative of principle. For more complete detail, the specific diagram for your breaker should be referred is because of the many variations possible. The standard control schematic provides for a single closing coil and a double trip coil and lockout of operation in the event of low gas pressure

2.6.1 Closing Operation

The closing signal current flows to the closing coil 52C through the auxiliary switch contact 52b. Antipumping relay contact 52Yb and the gas pressure switch contact 63GL.

Since the contact 52b and 52Yb are closed and contact 63GL is closed when gas pressure is normal,

Description



a) CLOSED POSITION (CLOSING SPRING CHARGED)

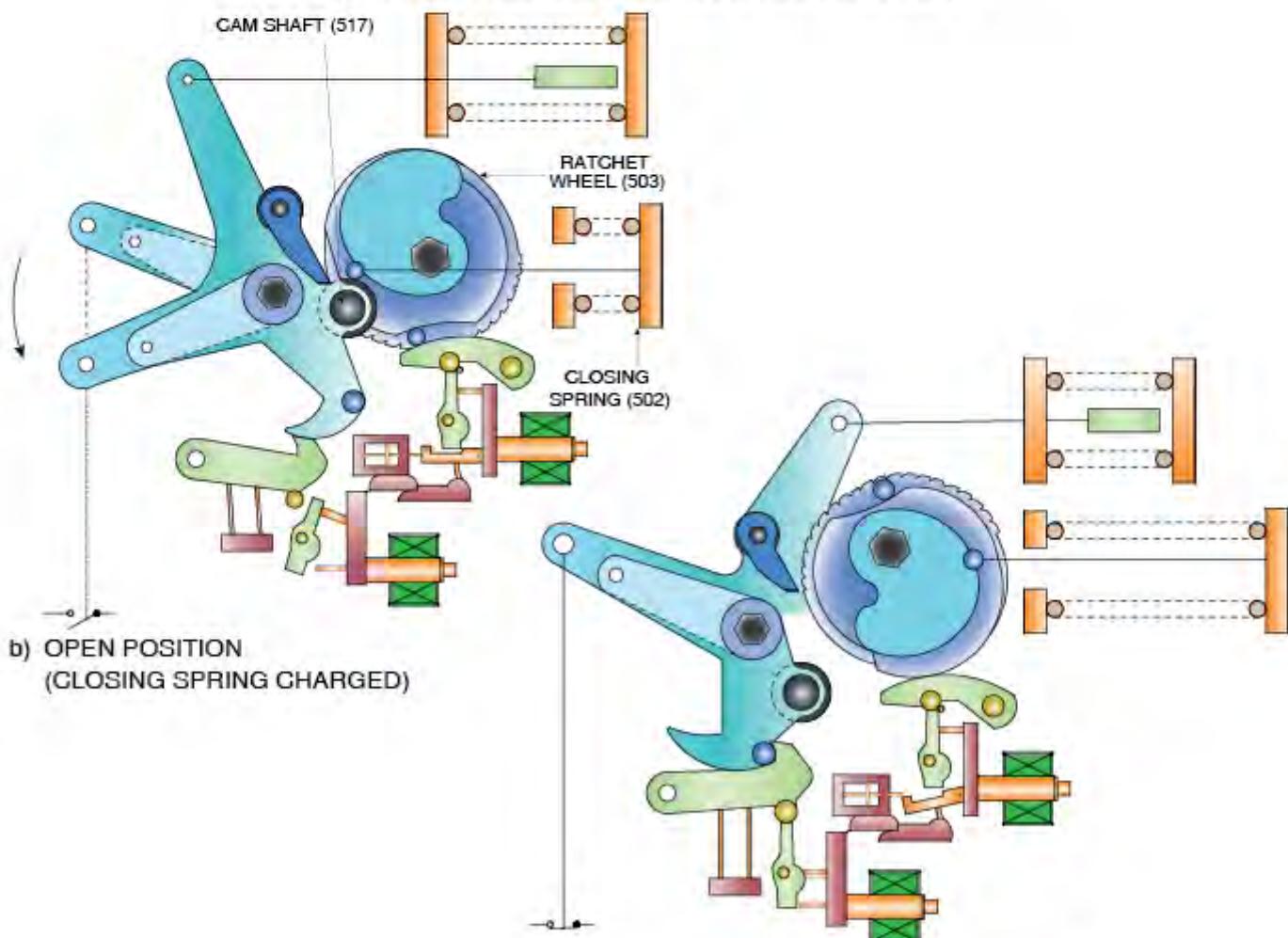
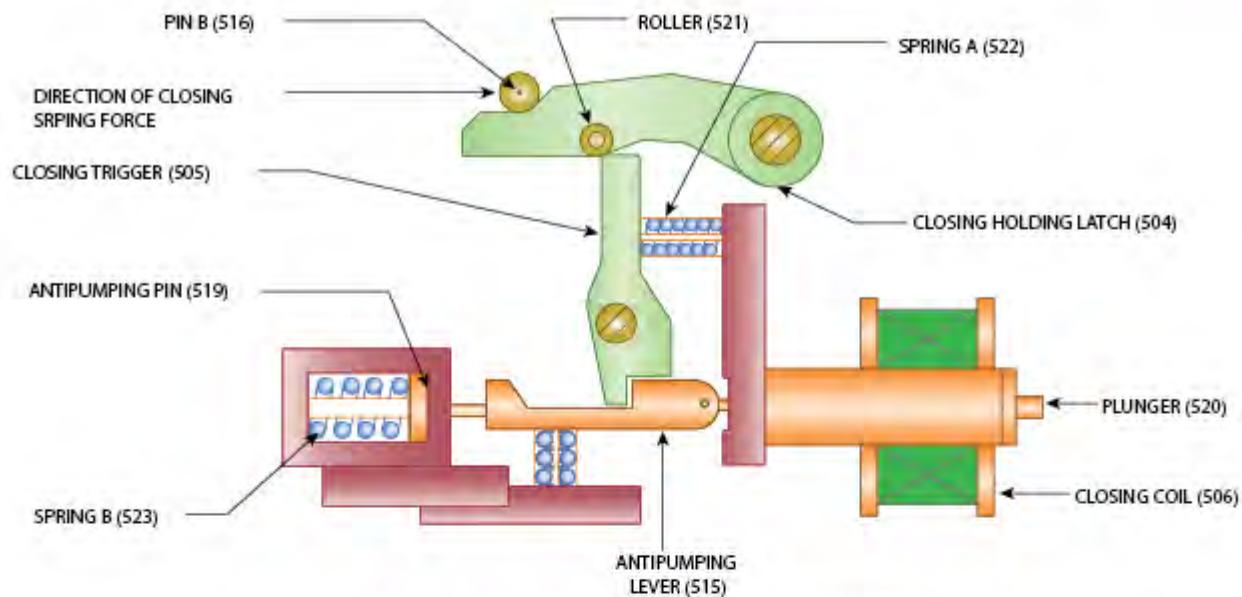
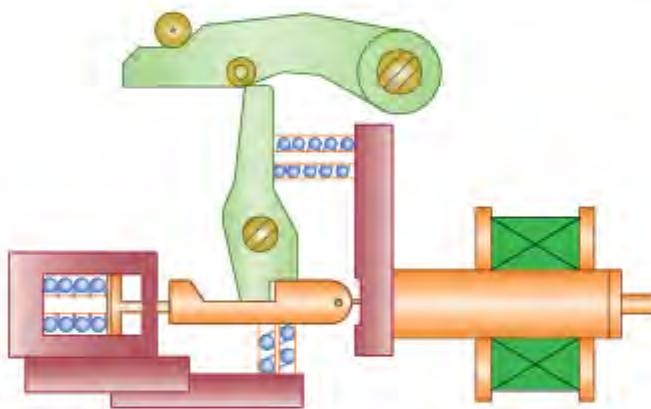


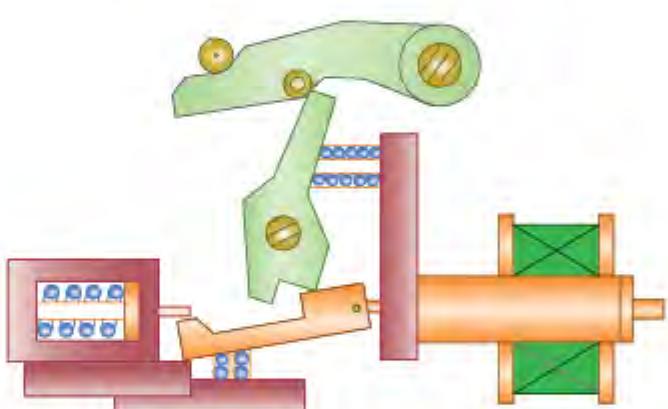
FIG. 5.1 SPRING OPERATING MECHANISM



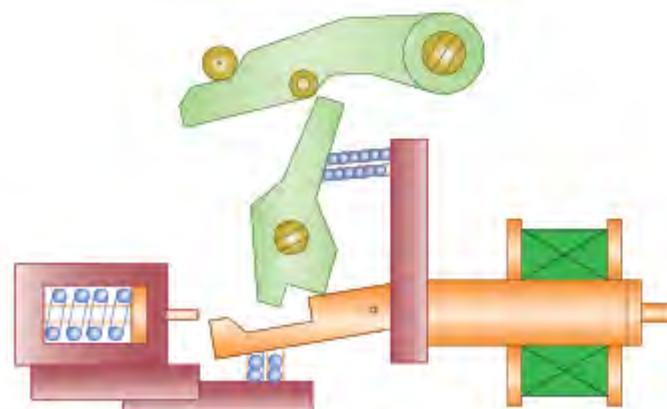
a) OPEN WITH CLOSING SPRING CHARGED



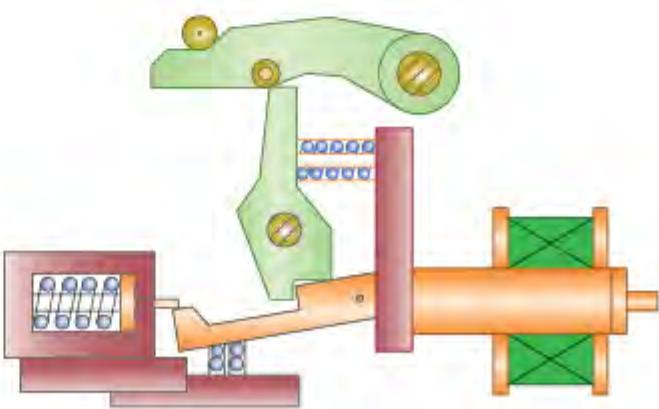
b) IN PROCESS OF CLOSING WITH CLOSING COIL ENERGIZED



c) CLOSED WITH CLOSING COIL ENERGIZED



d) CLOSED WITH CLOSING COIL DE-ENERGIZED



e) OPEN WITH CLOSING SPRING CHARGE AND CLOSING COIL STILL ENERGIZED (ANTIPOUMPING POSITION)

FIG. 5.2 ANTIPOUMPING MECHANISM

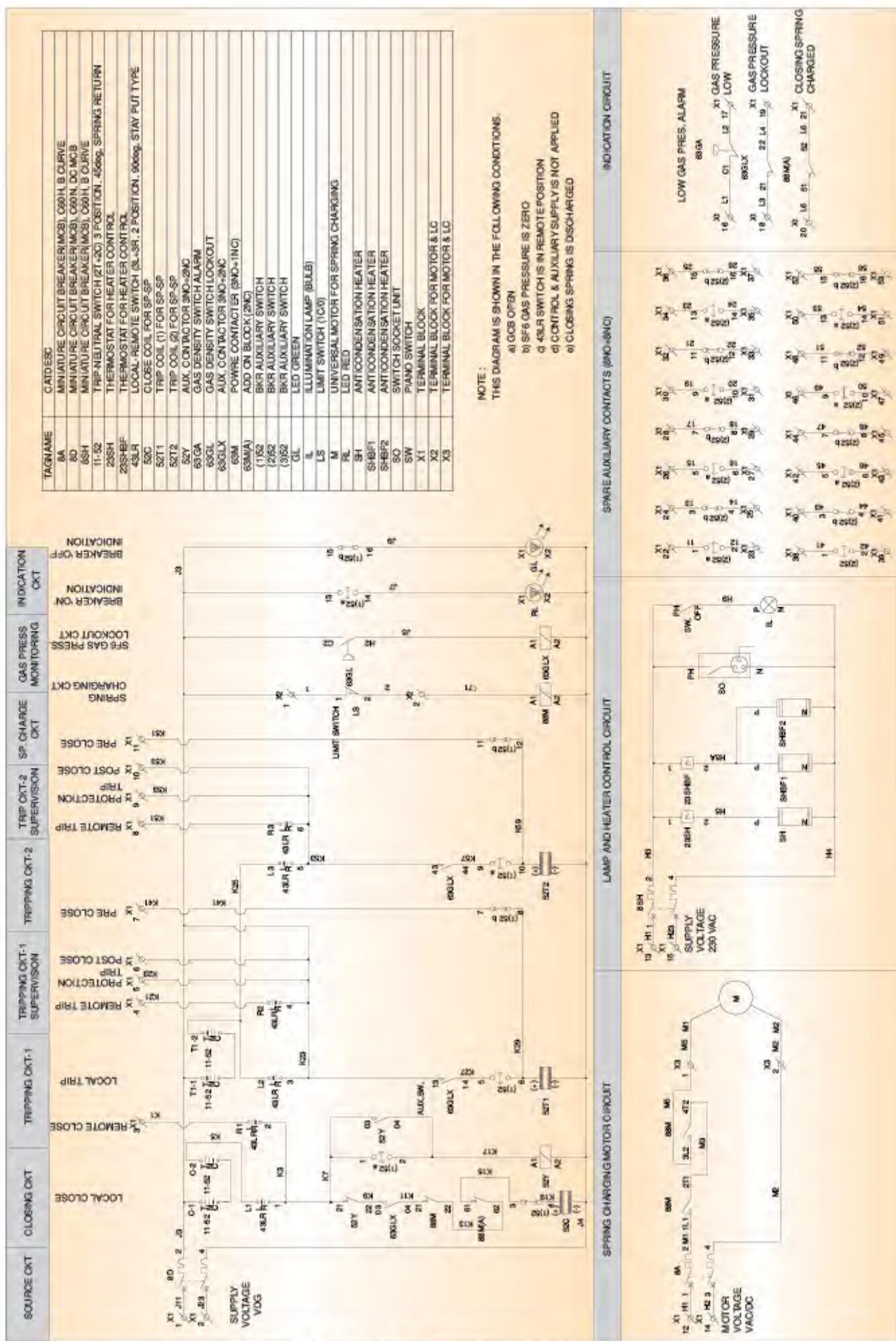


FIG. 6 TYPICAL SCHEMATIC DIAGRAM

the closing coil 52c is energized and the breaker is closed.

2.6.2 Tripping Operation

The tripping signal current flows to the trip coil 52T through the auxiliary switch contact 52a and the gas pressure switch contact 63GL and the breaker is opened

If the gas pressure drops below the minimum operation pressure the gas pressure switch contact 63GL opens and cuts off both closing and tripping circuits.

2.6.3 Charging of Closing Spring

After the closing of the breaker limit switch LS is closed and magnetic switch 88M is energized. Consequently, the motor starts to energize the closing spring as explained in section 2.4.3. When the spring is charged the limit switch LS opens to stop the motor. The MOTOR CIRCUIT is provided with a MCB.

2.6.4 Electrical Anti-pumping operation

The anti-pumping relay 52Y is provided to assure that only one close operation will result from one energization of the closing coil regardless of duration of signal. The function of the relay is as follows.

During the normal closing operation described in section 2.6.1 the 52a contact in the 52Y relay circuit closes as the breaker approaches the closed position. The energizing of the 52Y relay opens 52Yb in its own coil circuit which cuts off closing circuit. It also closes its contact 52Ya which parallels the 52a contact. This will result in continuous energization of 52Y relay coil for as long as the closing signal is maintained, even in the event of subsequent trip operation. As long as the 52Y relay is energized, its 52Yb contact in the closing coil circuit will be open preventing a closing signal. Removal of the closed signal is required to de-energize the 52Y relay and permit the initiation of a subsequent closing operation.

2.7 GAS SYSTEM (Fig. 7)

The gas within the pole units is connected through pipes to form a gas system which is monitored by a Gas Pressure Gauge (402) and a Temperature-compensated Gas Pressure Switch (401) located in the mechanism housing. The gas system also provides a Gas Valve E (406) for shutting off the gauge (402) and switch (401) from the breaker as to permit their inspection and maintenance. Gas Valve D (405) also located in the mechanism housing is provided for gas filling or evacuation of the breaker during installation or maintenance. Rupture disc assemblies are provided only when ordered.

2.7.1 Temperature-compensated Gas Pressure Switch (Fig. 8)

The SF6 gas system is a sealed, fixed volume filled with a specific quantity of gas. This results in the gas system pressure, at a constant density, changing with temperature variations. The correct pressure for a specified density at a specific temperature can be obtained by referring to the graph table 2.1.

A switch is provided to monitor the density of the gas system. The switch compensates for changes in the pressure due to temperature and responds only to changes (gas leaks) in the density of the gas system. The switch (Fig. 8) has a plate which rotates about its center. At one end of the plate is a rod connected to a bellows and tubing going to a sealed sensing bulb containing SF6 gas at the same density as the gas system. If the pressure changes because of a leak in the gas system, then the plate will rotate causing the pressure switch contact to operate. The pressure switch has two sets of electrical contacts. One set of contacts (63GA) is the low pressure alarm, set to operate at 10% below the normal gas pressure. The second set of contacts is the low pressure cutout (63GL), set to operate at 20% below normal gas pressure. Setting pressure of the pressure switch is shown in table 2.1.

Description

CAUTION : DO NOT OPERATE THE CIRCUIT BREAKER BY OPERATING MECHANISM WHEN THE SF6 GAS PRESSURE IN THE POLE UNIT IS BELOW THE LOCKOUT PRESSURE

2.7.2 SF6 Gas Pressure Gauge

A compound pressure gauge is provided for local visual indication of the SF6 gas pressure. It is a compound gauge which will not be damaged when the gas system is under vacuum. The dual dial is scaled in kg/cm². The vacuum range is from 0 to 76 cm Hg.

Note : The pressure varies with the temperature. The temperature should be recorded with the pressure reading to determine the density.

2.8 SULPHUR HEXAFLUORIDE (SF6) GAS

In the breaker this gas is used both for arc interruption and electrical insulation. A chemical breakdown of sulphur hexafluoride (SF6) occurs when it is exposed to a very high temperature or electrical arc as in the circuit breaker. The decomposition produces, toxic gas, strong irritants and acts as an irritant and attacks the respiratory system.

Arched SF6 gas is accompanied by a strong and irritating odour indicating toxic decomposition products. These products are injurious and exposure to them should be avoided. The arc powders are reactive with moisture and if inhaled could cause irritation in the nose, throat and lungs. Contact with body perspiration could cause skin irritation. A strong irritating odour is sufficient warning of the presence of the decomposition products. This would normally be present only after several major fault interruptions or an unusual arcing conditions within the gas enclosure. If this condition occurs, the area should be thoroughly ventilated. If work is necessary within this environment prior to the area being adequately ventilated, a self contained breathing mask should be used. It is recommended to dispose the arched gas. However if desired arched gas containing decomposition

can be cleaned and reused. In this case the gas should be circulated through molecular sieve filters to remove the active products. Most gas service trailers are equipped with molecular sieve filters and with provisions for circulation and cleaning the gas.

CAUTION : All freshly activated absorbents should be cooled to ambient temperature before introducing to SF6 gas to avoid exothermic reaction. Large accumulation of powders (solid decomposition products), such as resulting from abnormal arcing conditions, can be neutralized by mixing in a bucket of water and bicarbonate of soda solution and safely disposed.

2.8.1 Handling of Sulphur Hexafluoride Gas (SF6)

Introduction

SF6 gas & decomposition products present no injury or illness problem if dealt with properly. As with other chemicals, health hazards may exist under particular conditions, if exposure or handling is careless or improper.

Properties of SF6 Gas

In its pure, natural state SF6 gases is odourless & tasteless & possess a low order of toxicity. The only danger in breathing pure SF6 gas is that it displaces oxygen & can cause suffocation. SF6 gas is chemically inert & non-flammable. The gas has a high dielectric strength and thermal properties conductive for insulating high voltage & quenching electrical arcs.

Some of the SF6 decomposition product form corrosive & conductive compounds when exposed to moisture. These compounds, which can be harmful to human beings, are also aggressive towards materials within the circuit breakers, especially insulating surfaces if subjected to prolonged exposure. That's why it is best not to perform breaker maintenance on rainy, humid days.

By weight SF6 gas is approximately 5 times heavier than air & tends to diffuse towards the pull of gravity & pools in low places. As a result of pooling, the gas

displaces oxygen & can cause suffocation.

Looking into above following precautions are recommended.

1. Always use Gas handling plants for removal of

gas from the breaker during maintenance.

2. Use mask when handling gas.

3. Use gloves when handling components, which have been subjected to SF6 gas or its decomposition products.

Table - 2.1

PRESSURE - TEMPERATURE CHARACTERISTICS OF SF6 GAS FOR 120-SFM-32B

SR. NO.	AMBIENT TEMPERATURE (deg. C)	RATED GAS PRESSURE (Kg/cm ²)	ALARM GAS PRESSURE (Kg/cm ²)	LOCKOUT GAS PRESSURE (Kg/cm ²)
1.	-10	6.25	5.75	5.25
2.	-8	6.3	5.8	5.3
3.	-4	6.4	5.9	5.4
4.	0	6.5	6	5.5
5.	4	6.6	6.1	5.6
6.	8	6.7	6.2	5.7
7.	12	6.8	6.3	5.8
8.	16	6.9	6.4	5.9
9.	20	7	6.5	6
10.	24	7.1	6.6	6.1
11.	28	7.2	6.7	6.2
12.	32	7.3	6.8	6.3
13.	36	7.4	6.9	6.4
14.	40	7.5	7	6.5
15.	44	7.6	7.1	6.6
16.	48	7.7	7.2	6.7
17.	50	7.75	7.25	6.75

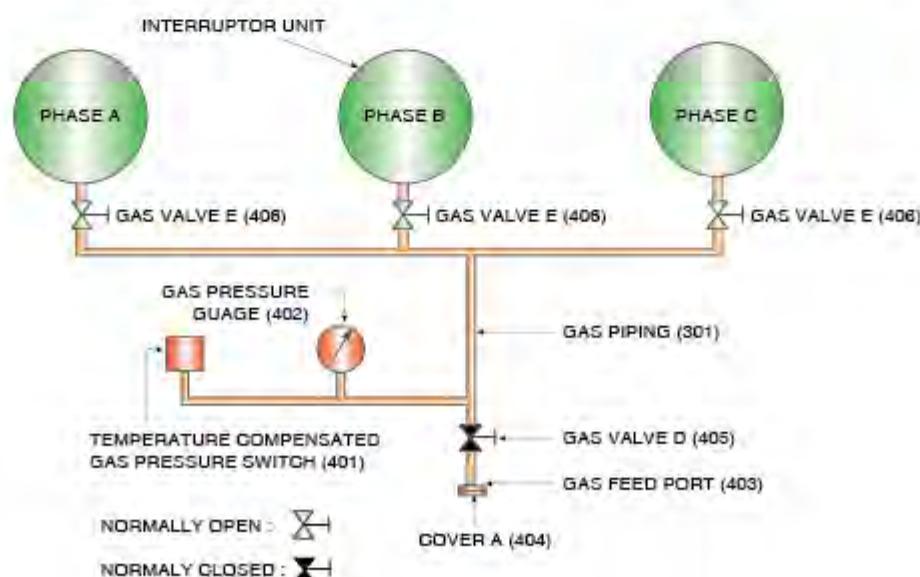


FIG. 7 : GAS SYSTEM

Note: Depending on make gas pressure switch & guage will be combined or separate.

Description

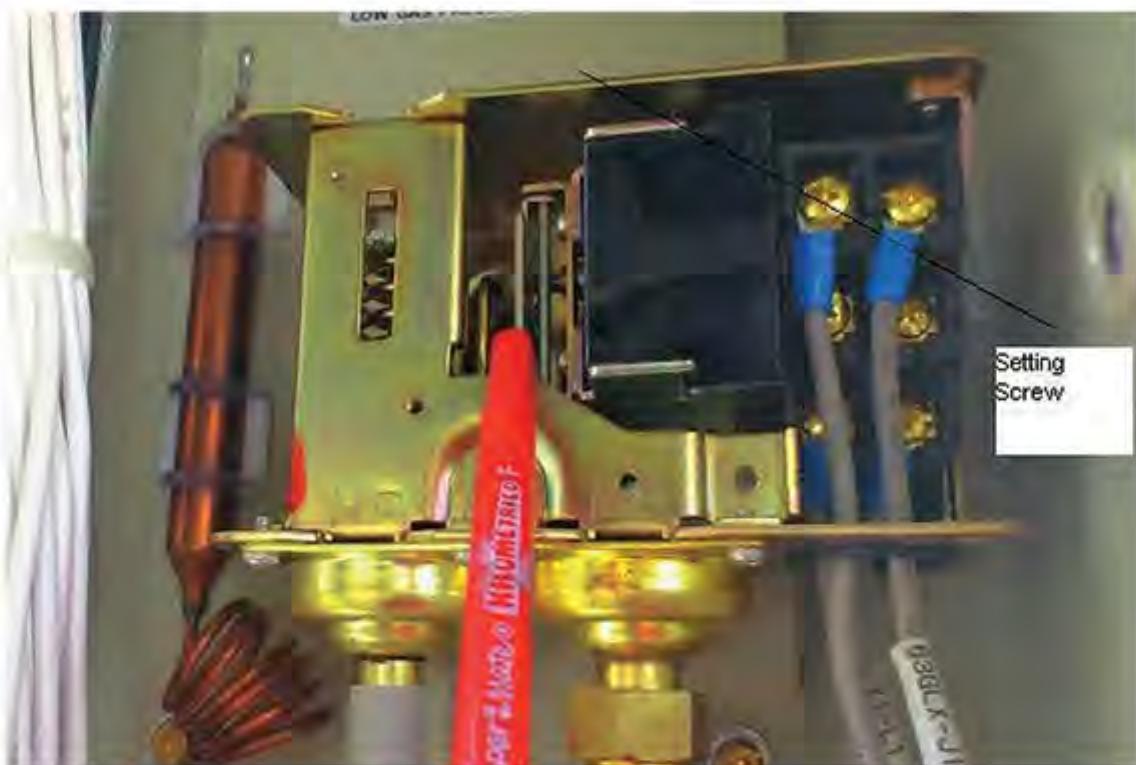


FIG. 8 CONSTRUCTION OF TEMPERATURE - COMPENSATED GAS PRESSURE SWITCH

Please follow the below mentioned procedure for gas pressure switch setting if required

1. Keep the Circuit Breaker in off position.
2. Switch off all the MCB's of DC supply, AC Supply and Motor.
3. Insert the prevention / locking pins.
4. Open the partition valve beneath all poles to separate the pole from the gas monitoring system.
5. Connect continuity tester / Multimeter to Alarm and Lockout contacts (Ref drawings).
6. Carefully and slowly release gas feed port to bring the gas pressure in the gas pipe up to rated alarm pressure.
7. Rotate the top adjusting screw in Anti-clockwise direction till the alarm signal switched Off.
8. Connect the continuity tester/multimeter at the gas switch lock out contact.
9. Reduce the pressure in the gas pipe gradually till the lock out signal Switched on.

10. Refill the pressure in the gas pipe by temporarily connecting any of the partition valve. Then again open it.
11. Connect the continuity tester/multimeter at the gas switch alarm contact
12. Reduce the pressure in the gas pipe gradually till the lock out signal gives alarm
13. Check the pressure at the gas gauge whether it is in limit.
14. Connect the continuity tester/multimeter at the gas switch lock out contact .
15. Reduce the pressure in the gas pipe gradually till the lock out signal Switched on.
16. Check the pressure at the gas gauge whether lockout value is within limits.
17. NOTE: Once the Alarm is set, the Lockout sets automatically.

SECTION 3 - RECEIVING, STORING AND HANDLING

3.1 RECEIVING

One breaker is shipped in 2 packages. First package includes 3 pole units. Second is the other than 3 pole units including the horizontal rod assembly with the operating mechanism and supporting structures. Touch up paint and the standard accessories are packed suitably. The packing are meant for maintaining the assemblies clean and dry while in transit and for short periods of storage as follows –

- Housing containing the operating mechanism and electrical auxiliaries is closed and contains desiccant material. (The housing is shipped with the horizontal rod assembly.)
- Pole units are sealed, pressurized with SF6 to 0.5g (7.1 psig) and contain absorbent.
- Miscellaneous parts - installation parts, erection & maintenance tools and spare parts (if required) are packed in plastic bags and crated.

On receipt of the equipment, the material received should be checked against the packing list to be sure that all parts are received. An examination should be made for any damage sustained during shipment.

3.2 HANDLING AND UNPACKING

The weight of the crate and its contents are marked on the crate and on the packing list. Select the appropriate crane capacity, and it is recommended to use nylon rope or slings for lifting. Since the breaker pole units contain a small positive- pressure, care must be taken not to apply any external forces to the pole units during lifting. The pole unit assemblies have large porcelain insulators which can be easily damaged by impacts or excessive forces. During unpacking it is recommended that a nail puller be used to assure no impacts on the porcelain. The contents of the packing cases should be confirmed by the packing list and inspected for damage. Any shortages or damage should be reported immediately. Do not remove any identification tags attached to the components as they will be useful for identification during installation.

3.3 STORAGES

If immediate installation is not scheduled after inspection and inventory the equipment should be

repacked and stored in a protected area. The details, accessories and spare parts should be stored indoors in a dry, clean place.

3.3.1 Short Term storage (less than 3 months)

The pole unit assemblies are sealed, pressurized and contain absorbent to maintain dry interior. These must remain sealed; if the seal is disturbed, the absorbent must be replaced. The mechanism housing should be protected from moisture and corrosion by keeping the housing door closed and vents sealed with desiccant material inside the housing.

3.3.2 Long Term Storage

Indoor Storage - To maintain the breaker in 'as new' condition, it is preferred to store the breaker indoor in a clean, dry area to protect it from moisture and corrosion.

1. The pole units are shipped sealed and pressurized. Maintain these units pressurized during storage to keep atmospheric air from entering.
2. Housing should have its space heater energized to maintain the interior dry and free from corrosion.
3. Grates / boxes containing detail items must be stored indoors.
4. Every care should be taken to avoid corrosion, degradation of packing boxes etc.

HANDLING STORAGE, DISPOSAL OF PACKING MATERIAL AT SITE

Due care shall be taken in Handling, Storage & Disposal of Packing Materials.

The following table gives the recommendations. Table 3.1

Sr. No.	Material	Handling/Storage/ Disposal Method
1.	Packing Wood	Reuse
2.	Steel Cases	Reuse
3.	Plastic Covering >20 microns	Recycle / Reuse
4.	Mild Steel items & Hardware's	Recycle / Reuse
5.	Card Board Sheets	Reuse

Oil Disposal

Oil to be incinerated or disposed to authorized recyclers.

SECTION 4 INSTALLATION

4.1 GENERAL CAUTION (DO'S & DONT'S)

Do keep all parts free from any dust and any damage especially gas, sealing parts and mechanical linkage parts.

Do check all parts to be installed just before installation.

DON'T do any installation under rainy weather.

DON'T give any shock to the porcelains.

with rated-pressure of SF6 gas with respect to temperature.

4.3 TOOLS AND EQUIPMENT REQUIRED FOR INSTALLATION

All tools and Material as per table 6.5 & 4.3 supplied by CGL are required. In addition the purchaser is to arrange for tools & material as per table 4.2 and 4.4.

4.2 WARNING

DON'T operate the circuit breaker unless it is filled

4.4 RECOMMENDED INSTALLATION SEQUENCE

The installation shall proceed in 12 steps as shown in table 4.1

TABLE 4.1

1.	RECEIVING STORING	SEE 4.5.1
2.	UN-PACKING	SEE 4.5.2
3.	FOUNDATION BOLTS SETTING	SEE 4.5.3
4.	FIXING OF SUPPORTING STRUCTURE	SEE 4.5.4
5.	FIXING OF FRAME	SEE 4.5.5
6.	FIXING OF INTERRUPTER UNIT	SEE 4.5.6
7.	CONNECTING OF GAS PIPE	SEE 4.5.7
8.	EVACUATION AND GAS FILLING	SEE 4.5.8
9.	GAS LEAKAGE TEST	SEE 4.5.9
10.	CONFIRMATION OF SETTING PRESSURE OF GAS DENSITY SWITCH	SEE 4.5.10
11.	OPERATION TEST AND OTHER TEST	SEE 4.5.11
12.	FINAL CHECK	SEE 4.5.12
13.	WEATHER SEALING	SEE 4.5.13

Table : 4.2 Tools and equipment to be supplied by the purchaser.

NO.	Name	Detail	Qty	Used for
1.	Mobile crane	 10 TON.	1	Lifting
2.	Plumb-bob	 500g	1	
3.	Level	 250 MM	1	Levelling
4.	Wire rope	 D=16MM	2	Picking up
5.	Shackle	 D=12MM D=16MM	4	
6.	Claw bar	 1.5M	Some	
7.	Eye bolt	 M20	4	Lifting
8.	Safety belt		Some	
9.	Nail puller		Some	Unpacking
10.	Saw		Some	Unpacking

Installation

NO.	Name	Detail	Qty	Used for
11.	Ladder		1	Working at Ht.
12.	Step Ladder		1	Working at Ht.
13.	Nylon sling		Each 2	
14.	Socket wrench		Each 2	
15.	Socket		Each 2	
16.	Spanner		Each 2	Tightening / Losing
17.	Torque wrench		Each 2	Tightening / Losing
18.	Wire stripper		Some	
19.	Cable joint		Some	Cabling
20.	Side cutting plier		Some	
21.	Diagonal cutting nipper		Some	

NO.	Name	Detail	Qty	Used for
22.	Electric soldering iron		Some	Soldering
23.	Knife for electrician		Some	Cutting wire
24.	Screw driver	 L=100MM, L=150MM	Each 2	
25.	SF6 gas leakage detecting equipment		1	If available no equipment leakage test can be substituted by soapauds.
26.	Timing test equipment		1	
27.	Circuit tester		1	
28.	Meggar	5000V, 1000V	Each 1	Insulation resistance test

Installation

Table : 4.3 Consumable material supplied by CGL

NO.	Name	Detail	Qty	Used for
1.	Gas sealer	ANABOND 681 (Milky)	1 Tube	Gas sealing
2.	Liquid gasket	Three Bond (Red)	1 Bottle	* See Note 1
3.	Sealing compound	ANABOND 680 (Translucent)	1 Tube	Water Proofing
4.	Joint compound	Jointal Z (Green)	1 Bottle	Terminal pads connection
5.	O Ring 252 mm x 4.5		3	SSS Flange

* Note 1

Liquid gasket (Three Bond # 1101) is used for small size gas pipe (6 mm dia.) connection.

Usually no connection is required, however, small amount of liquid gasket is supplied just in case.

Table : 4.4 Consumable material to be supplied by the purchaser

NO.	Name	Detail	Qty	Used for
1.	Waste cloth	White cloth	Some	Parts cleaning
2.	Abrasive paper	Grain size No. 280, No. 400	Some	Terminal pads connection
3.	Cleaning agent		Some	Parts cleaning
4	Loctite		Some	

* Alternatively petrol or carbontetrachloride may be used.

4.5 INSTRUCTIVE INSTALLATION

4.5.1 RECEIVING, STORING

Immediately upon the receipt of the equipments, the purchaser should check the material actually received against the packing list to be sure that all parts have been received. Also an examination should be made for any damage sustained while transportation. If damage is evident or there are visible signs of rough handling, put in a claim for damage with the carrier, and promptly notify the nearest representative of CGL. All parts should be stored indoor unless the equipment is immediately installed. If the storage period has exceeded 6 month, check the shipping assembly carefully for damage caused by moisture, dirt and rust.

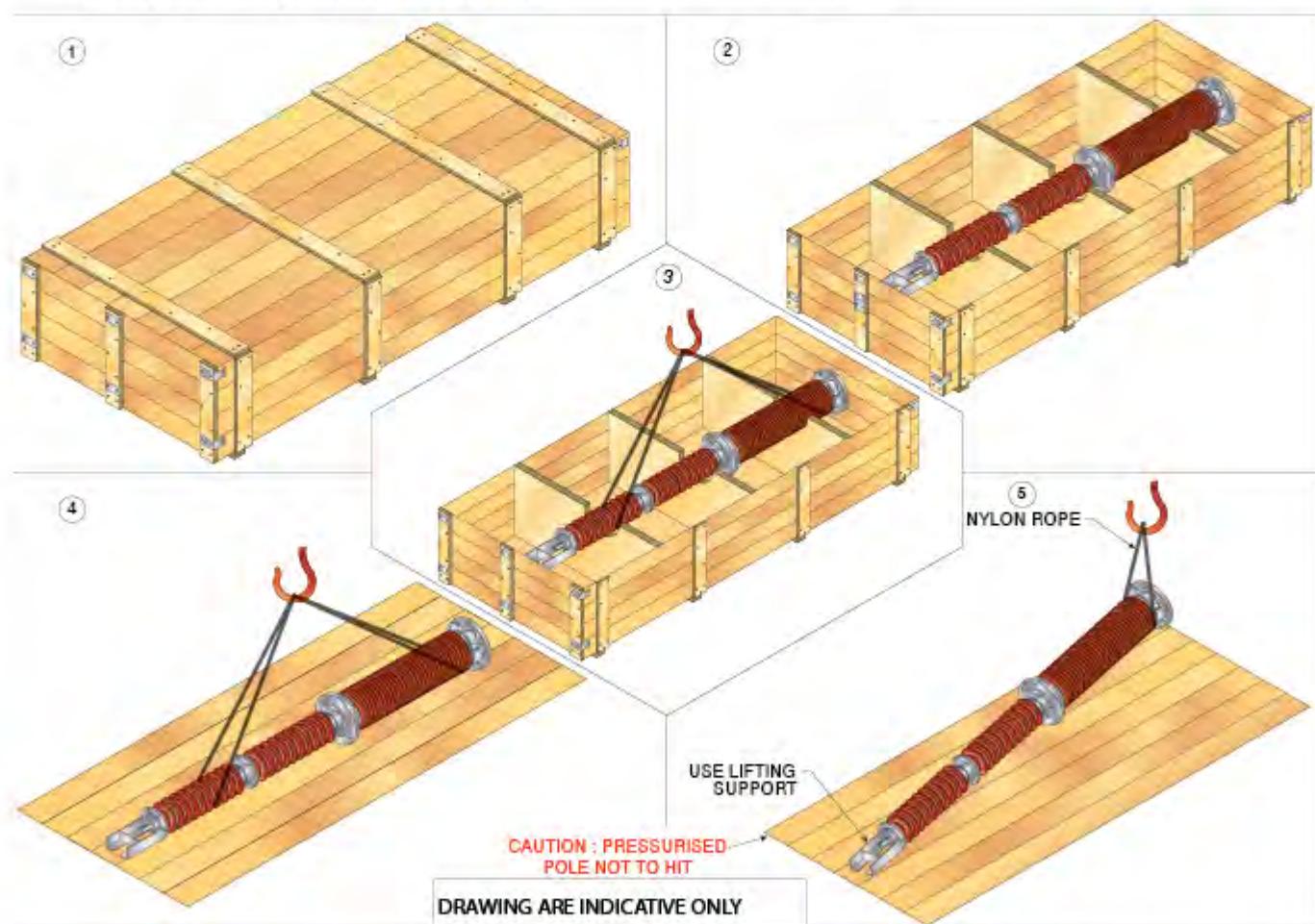
4.5.2 UNPACKING

(1) Normally, unpacking should be made indoors or near the installation. If unpacking is done outdoors, the equipment should be protected from rainy weather conditions.

(2) Use a nail puller to open the crates. Do not allow the pole unit to be struck by the tool.

Particular care must be taken when removing the pole unit from their packing slots as it may be easily chipped or damaged. Remove the poles as shown below.

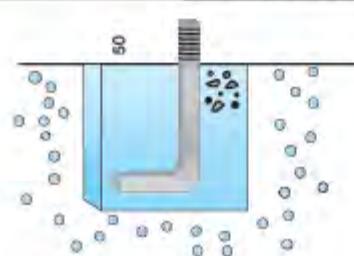
NOTE: Packing case dimensions & material may change as per design /environment friendly aspect requirement.



4.5.3 SETTING OF FOUNDATION BOLTS

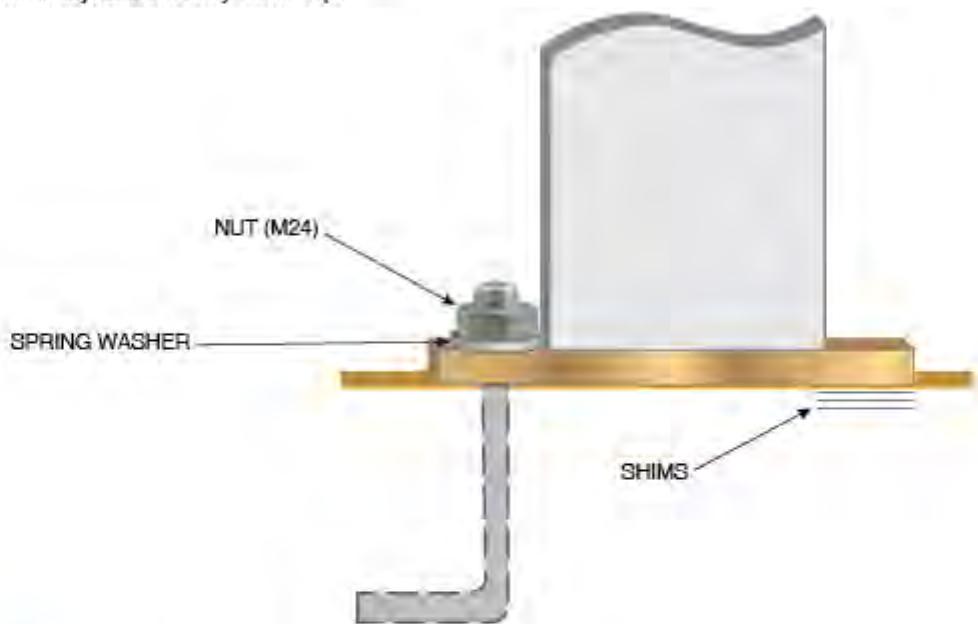
Install the foundation bolts according to the drawing approved mutually.

Level out upper surface of the foundation. Give enough curing time for concrete.



4.5.4 FIXING OF SUPPORTING STRUCTURE

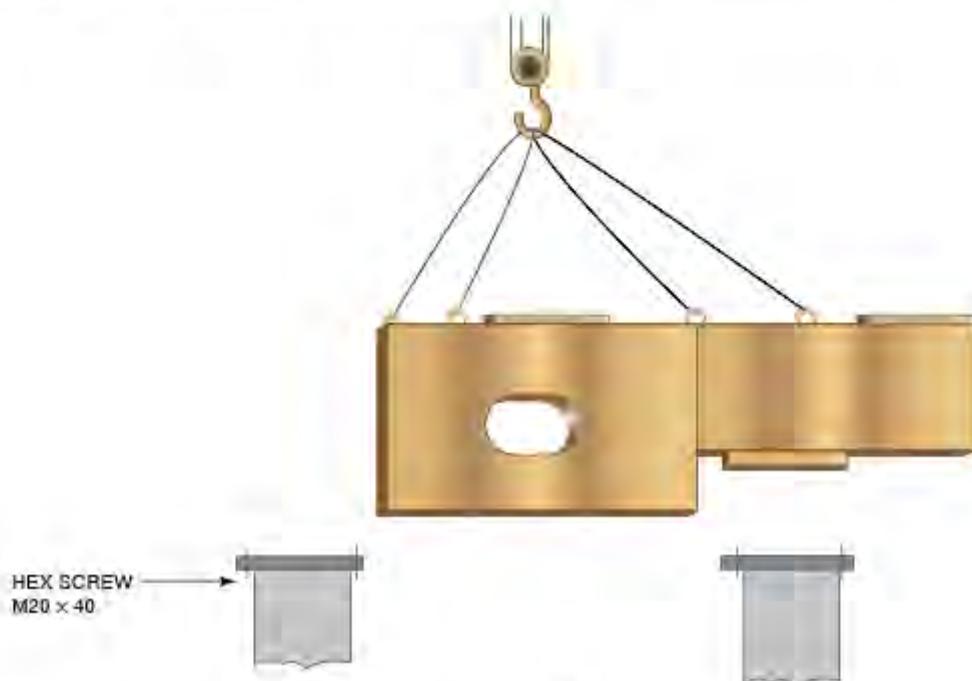
Fit in the supporting structures / columns onto the anchor bolts. Eye bolts will be helpful for lifting them up. Direction of the structure must be carefully checked. Fasten anchor nuts with spring washers temporarily as final adjustment may come up.



4.5.5 FIXING OF FRAME

Remove the shipping covers of the frame and three protection covers as well. Fix the frame onto the supporting structures. Fit and fasten eight M20 screws. Then fasten nuts with anchor bolts. Use shims if necessary under the support structure to level the

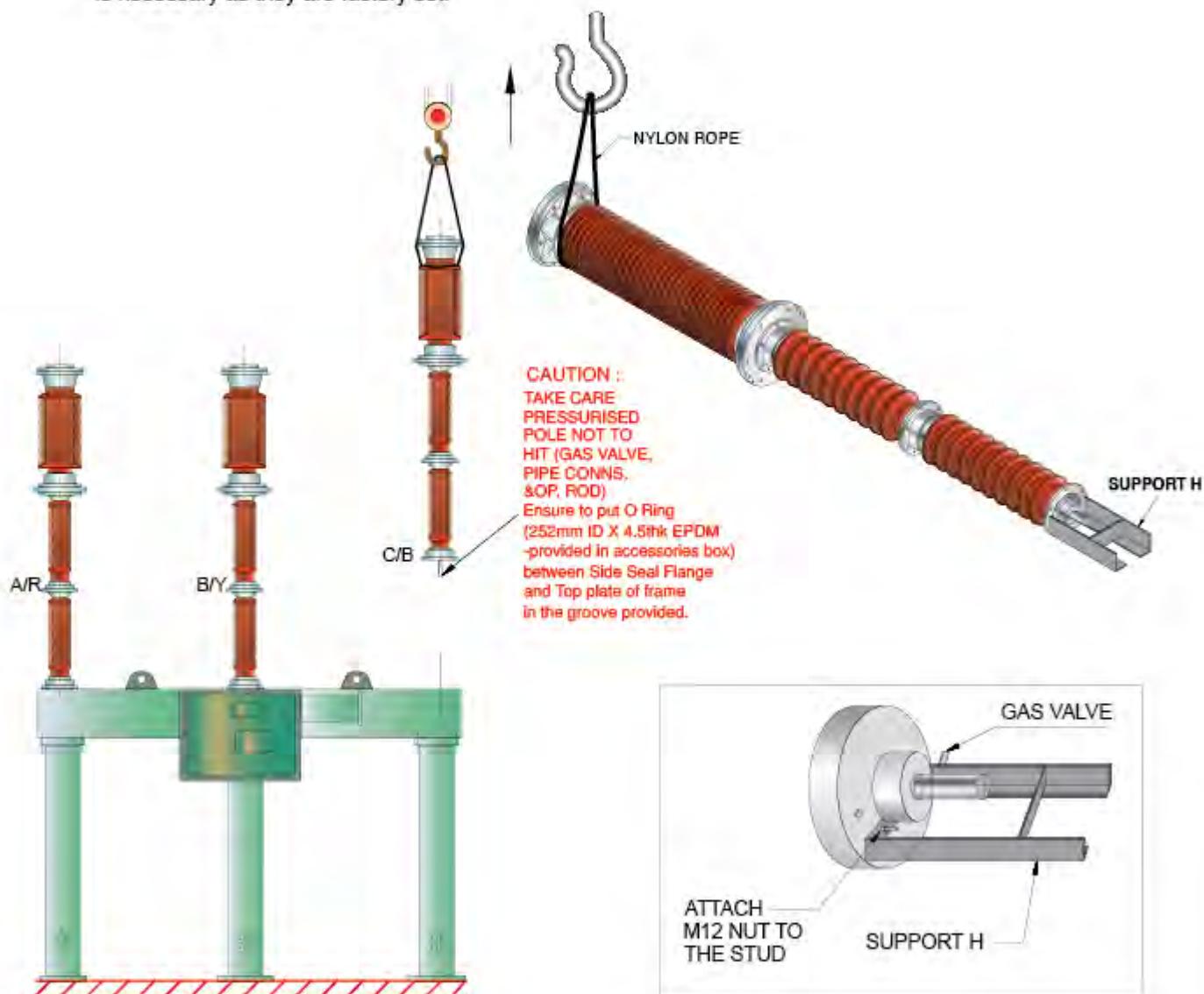
seats of poles with the help of spirit level. Recommended fastening torque is shown in Appendix-B. After applying the fastening torque, level of pole mounting seats should be checked again.



4.5.6 FIXING OF INTERRUPTING UNITS

4.5.6.1 Matching Indication of Interrupting units

The phases are marked on the each interrupting units A, B, C or R, Y, P. When viewed from front of breaker A/R is on the left, B/Y in middle and C/B right side while mounting on the frame Match interrupting units with match marks on housing. This is necessary as they are factory set.

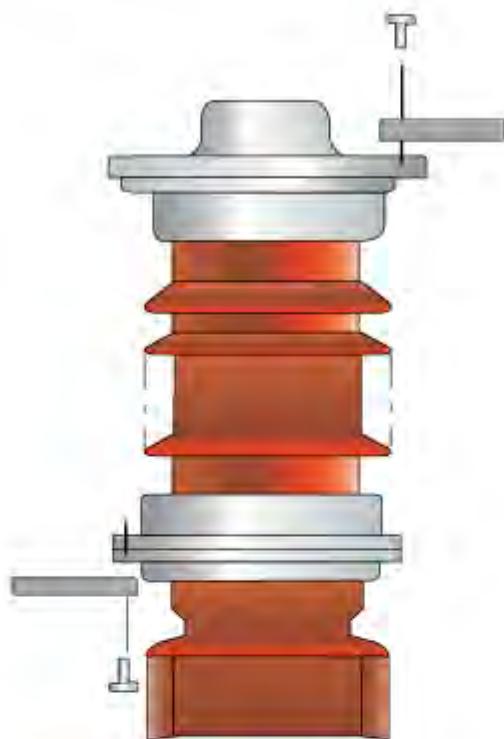


4.5.6.2 Attach Terminal Pads

Attach the terminal pads onto both upper and lower terminal flanges of the circuit breaker. The terminal pads can be attached either side, front or rear of the breaker.

Joint compound must be used as instructed in Appendix E.

The above can be done also after erection, however, the work is convenient when pole is down.



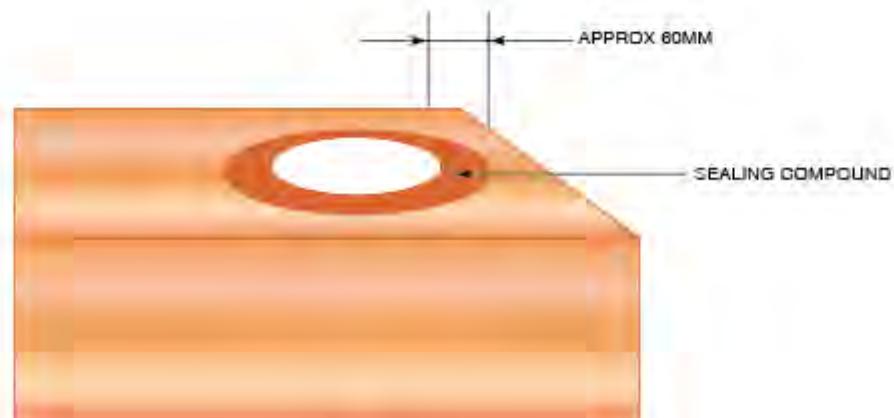
4.5.6.3 Lift up Interrupting Unit

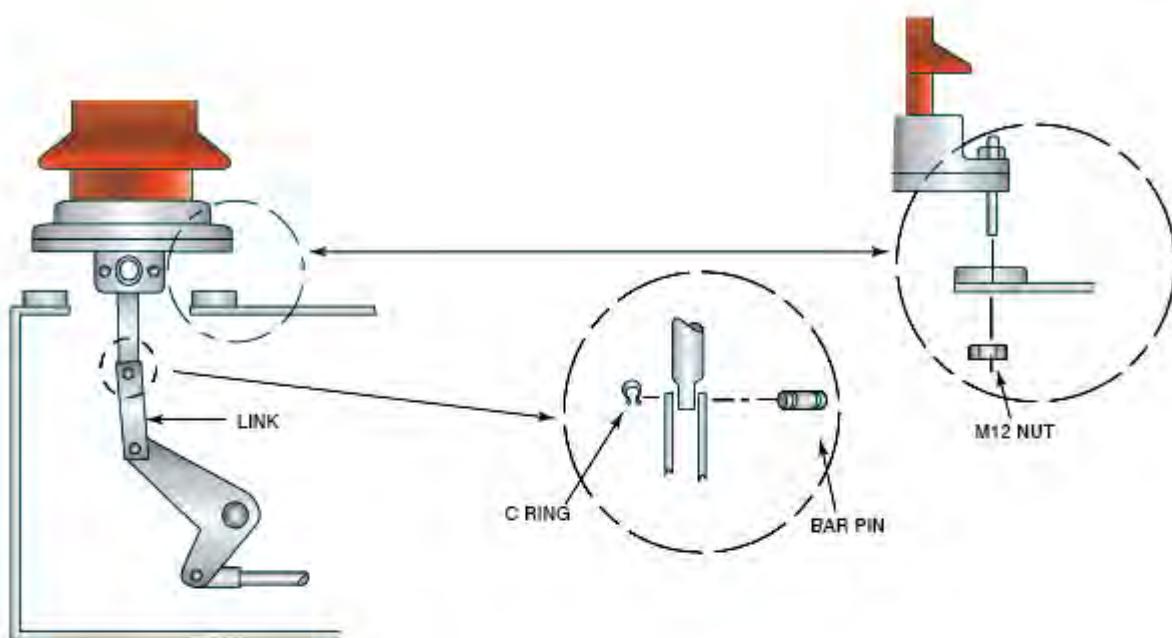
Attach the support - H and nylon sling as shown in fig. Lift the interrupting unit vertically using nylon slings. Remove the protection cover which protects operating rod. The interrupting unit is shipped in the closed position. After the pole is lifted vertically up in the air, pull down the operating rod downward i.e. to open position. **Ensure to put O Ring (252mm ID X 4.5thk EPDM -provided in accessories box) between Side Seal Flange and Top plate of frame in the groove provided as per procedure on page no.48.**

Lower down the pole slowly on the appropriate place with gas connection portion at the bottom, facing to rear of the breaker. Then fasten the, pole with M12 nuts and M12x40 long screws as per the recommended fastening torque Refer APP. B.

4.5.6.4 Apply Sealing Compound

Before fitting the interrupting unit, apply the sealing compound (Anabond/Silastic 680) to the fitting portion area of the frame. The sealing compound is to be applied in a width of about 60 mm from the inner diameter of the frame.





4.5.6.5 Connect Mechanical Linkage

Remove the bar-pin of the link first. Pull down or up, the operating rod and engage the bar pin. Fit the C-ring on the bar pin's groove as instructed in Appendix-C (Attachment of 'C' type retaining ring). Then fix the interrupting unit with the frame with 6 (six) M12 nuts and -2 (two) M12x40 bolts. Recommended fastening torque is shown in Appendix - B.

Move / rotate the shaft of pole to align with the links of mechanism as necessary for fixing the bar pin.

CAUTION : ENSURE POSITIVE ENGAGEMENT OF CIRCLIP IN THE GROOVE OF BAR PIN (ROTATE TO CHECK) REF. DIA IN APP. C.



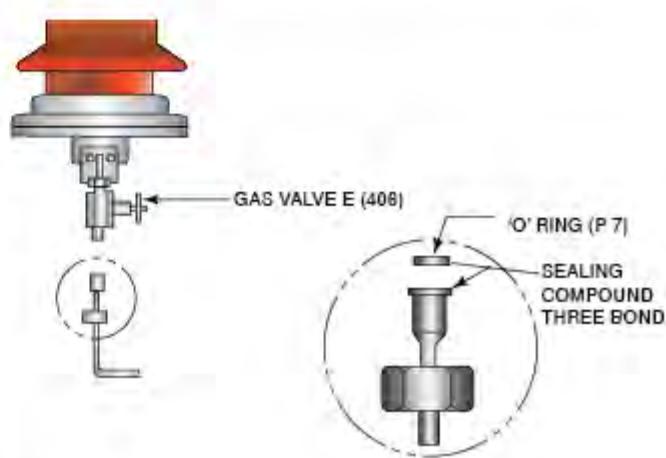
4.5.7 CONNECTING OF GAS PIPE

Degrease gas valve [E] inlet surface with toluol damped white waste cloth.

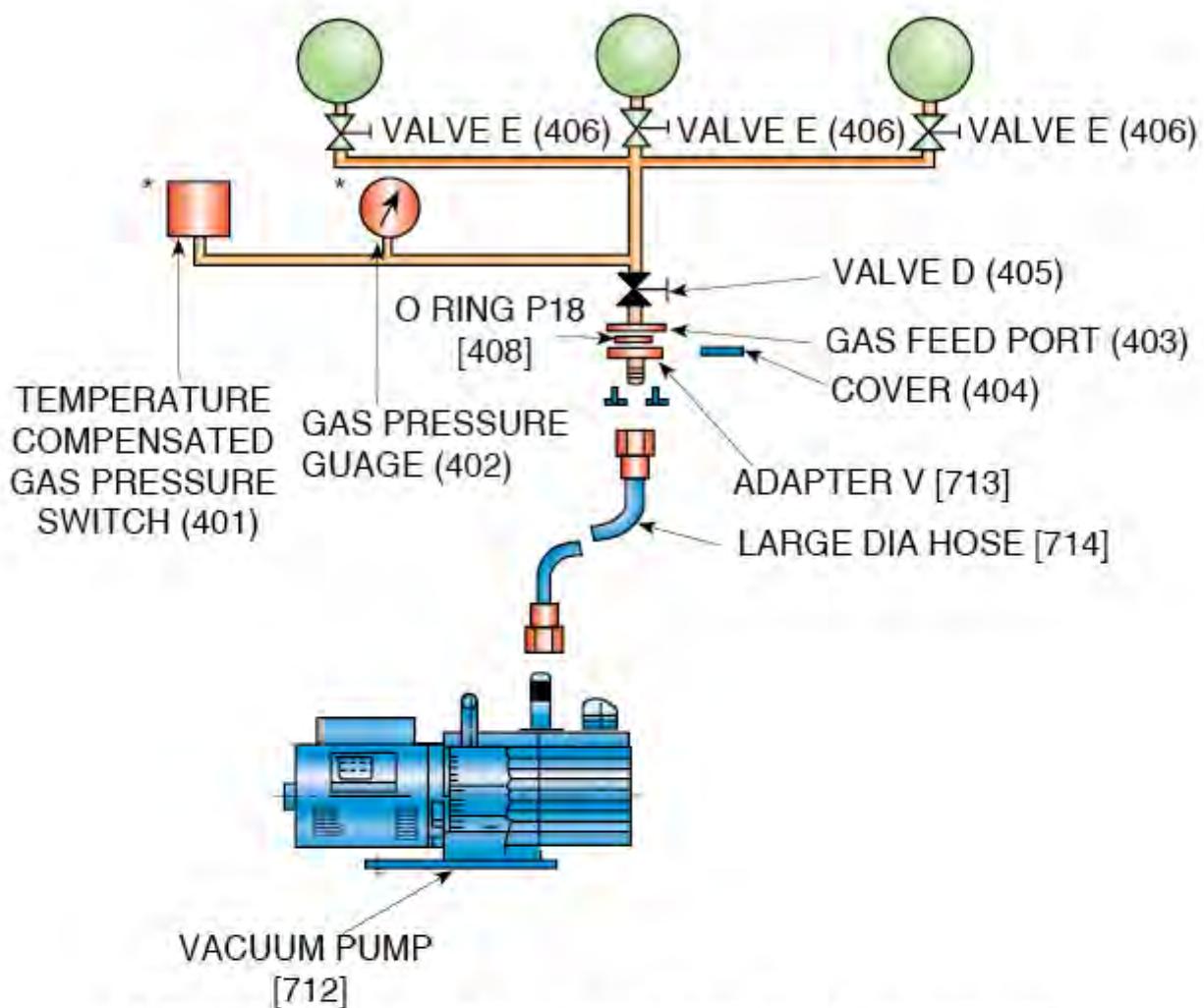
Make sure the sealing surfaces of the valve inlet and 'O' ring are free from any dust. Fit 'O' ring [P-7] and apply three bond to the 'O' ring and connect the gas pipe to the gas valve inlet as shown below.

4.5.6.6 Apply Sealing Compound

For the outdoor use breaker, apply the sealing compound (Anabond 680) all around the connecting surface of the frame and the flange. As well as the bolt heads to avoid rain water ingress to a small clearance surrounding the bolts above Ref. Appendix F.



Installation



Note: * Depending on make gas pressure guage switch & guage combined/separate.

FIG. 9 CONNECTION OF GAS PIPE

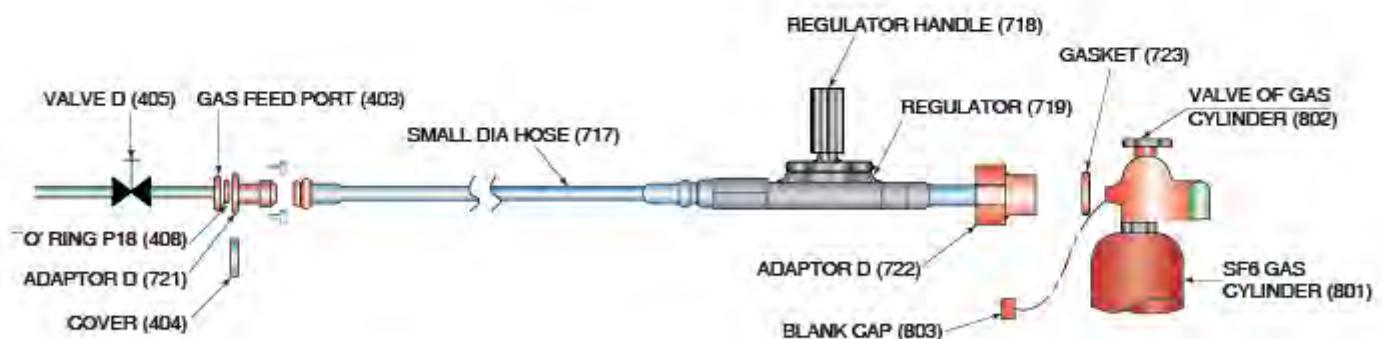


FIG. 10

4.5.8 SF6 GAS FILLING.

(Applicable for only saginomiya valve for Dilo, refer appendix K) The Evacuation is to be done pole by pole to a vacuum level of 50 mm of Hg (70). Refer Fig. [7]. Remove the cover A from gas feed port [403] at the front side of mechanism housing. Open the gas valve [E] and [D] slightly and drive out the air in the gas piping by SF6 gas in the interrupter through gas feed port. After discharging the air in the gas piping, attach adaptor [F] to filling port [403] and regulator to gas cylinder as shown in Fig [10]. Attach small dia hose with one end tightly to regulator and the other end loosely to adaptor [D]. Open the valve on the cylinder and slowly open valve on regulator, the gas will come out. Purge the hose with gas and tighten the end on adaptor [D]. Now open the valve [D] and valve on regulator. The valve on regulator opens when turned clockwise.

In fact it is better to top up over & above an additional 0.2kg so that any doubts about human error while filling or guage list count can be eliminated.

Fill up to the rated pressure and then close valve [D]. Close valve regulator and gas cylinder.

Disconnect the coupling nut (female dilo valve) from male housing (male dilo valve) & attach blanking cap in its place tighten the joint carefully.

CAUTION : DURING SERVICE VALVE [D] MUST ALWAYS BE IN CLOSED CONDITION AND VALVE [E] IN OPENED CONDITION.

4.5.9 GAS LEAKAGE TEST

Perform gas leakage test on each gas pipe jointed at site.

Use SF6 gas leakage detector or apply soapsuds. Check for bubbles for more than 30 seconds. Refer section 6.5.3.

4.5.10 CONFIRMATION OF SETTING PRESSURE OF GAS DENSITY SWITCH

Close the valve D and be sure the valve E is closed. Remove the blind cover of gas feed inlet.

Connect a bell or circuit tester to the terminals of pressure switch.

Slowly open the valve D and watch the pressure when the contacts changeover as the pressure lowers. Repeat 2-3 times to check consistency.

Be sure to place back the blind cover and valve position.

Criterion is listed in criteria section 5.4

4.5.11 OPERATION TEST AND OTHER TESTS

Perform operation tests at rated control voltage. Confirm the closing time and opening time are within the allowable range.

4.5.12 FINAL INSPECTION

Visually check overall appearance of the breaker. If there are any abnormality. If something abnormal i.e. the bolts are loosened or rusted part is found on the breaker installed, those must be rectified or corrected properly.

4.5.13 WEATHER SEALING

Put the protection covers at the rear and bottom of the Breaker After fixing covers apply sealant ANABOND 680 in the gaps & completely cover the bolt head so as to prevent rain water and moisture from getting inside.

SECTION 5 - COMMISSIONING

The circuit breaker operator should be knowledgeable of both the power company's operating procedures and the operations of the circuit breaker. The circuit breaker is designed for operation at unattached locations, however, there are recommendations for periodic observations to assure the breaker will function reliably. Refer to "Patrolling" inspection recommendations.

CAUTION : Failure to follow breaker operating, installation and maintenance instructions can result in property damage, unscheduled outages, or loss of life.

5.1 MANUAL OPERATION

Operate the breaker manually as per procedure in section 6.6.1 and check for any abnormal rubbing.

5.2 ELECTRICAL OPERATION

Electrical closing and opening operations are made from the central control panel or the local control panel at the circuit breaker. SF6 gas pressure switch contacts will prevent the closing and will either block or trip the breaker if the gas system pressure falls below the lockout pressure. The controls schematic received with the breaker should be reviewed to determine what controls were ordered. The following items should be checked before electrically operating the breaker.

- Operation is in accordance with power company's procedure.
- SF6 gas system is at normal operating pressure. Gas System valves are in proper position.

145 kv
 Normal pressure 7 / 7.5 kg/cm² } at 20°C
 Alarm pressure 6.5 / 7 kg/cm²

Lockout (or Auto Trip)
 pressure 6 / 6.5 kg/cm²
 Gas pressure as per approved drawing.

- Manual jack has been removed from the mechanism and the trip and close prevention pins are removed.
- DC controls and AC auxiliary voltages are normal and all control switches are closed.

5.3 EMERGENCY OPERATION

5.3.1 Loss of DC Power

The circuit breaker can be opened and closed without

'DC' power by pushing on the trip or closing coil's amature / plunger inside the mechanism cabinet.

CAUTION : The SF6 lockout switch is by-passed during the emergency operation. Check the SF6 gas pressure gauge for sufficient pressure before making an emergency

5.3.2 Loss of AC Power

In case the power supply of the motor is AC power with the loss of 'AC' power the charged closing spring will provide stored energy for operation. With the breaker in the closed position, the charged closing spring will be capable of an O-C-O Operation. If the spring will provide a C-O operation. Without AC power, the closing spring can be charged by manual operation using a hand jack as described in section 6.6.2. After manual charging of the spring normal operation of the breaker with DC control power is possible.

5.4 CRITERIA TABLE FOR SITE TEST

Test Item	Criteria
(1) Gas leakage : 1 % / Year max.	Should be detected by soap bubble or gas leak detector

(2) Gas density switch setting

63GA Operate	6.5 / 7 ± 0.3 (kg/cm ²) = PA
Reset	PA + (0.1 - 0.5) kg/cm ²
63GL Operate	6.0 / 6.5 ± 0.3 (kg/cm ²)
Reset	PB + (0.1 - 0.5) kg/cm ²

(3) Timing Test (at normal control voltage)

Opening	less than 32ms
Closing	less than 130ms

5.5 INSULATION RESISTANCE

Wipe the insulators clean. Check the resistance of main circuit using 5kV megger with circuit breaker in open condition. The resistance should be greater than 1500 MΩ for both. Interrupter and support porcelains. Check the insulation of aux. and control circuit by using 2kV breakdown tester. Refer checklist.

SECTION 6 - INSPECTION AND MAINTENANCE

6.1 INSPECTION PROGRAM

A proper program of inspection and maintenance will assure the reliability of the equipment. Maintain a permanent record for each circuit breaker. The inspection requirements vary depending on the length of time in service, severity and frequency of operation. A recommended inspection maintenance program has been divided into two categories identified as follows.

Table 6.1 Inspection Program by Time in Service

Inspection	Frequency	Description
Patrol- P	Monthly	External visual inspection of energized breaker.
Routine - R2	Every 24 to 30 months	External inspection, de-energized breaker, minor adjustments, lubrication & Timing.
Operational - O	Operations as per Table 6.2	Internal inspection, breaker degassed, contacts inspected & commissioning tests. Recommend to be carried out under CG Supervision.

Table 6.2 - Operational Inspection (O) Based on Operations

Type	Operating Condition	Inspection Period
Inspection or replacement of arc contacts	Small current interruptions 0 to 900 A	4,000 operations
	Rated load current switching	2,000 operations
	Short circuit interruptions per phase	
	Rated - 40 KA	10 operations
Replacement of mechanism parts	Approximate number of operations	5,000 operations

Operational Inspection (O) should be done when any of the condition in Table 6.2 is met.

6.2 MAINTENANCE PRECAUTIONS

The electrical performance of the circuit breaker requires that the interior and insulation parts be clean and dry. The interior of the breaker interrupters should not be exposed to inclement weather conditions. Whenever the interrupters are open, temporary coverings should be available to prevent exposure to dust, dirt and moisture.

Following are some detail of precautions which should be observed.

- (1) Open the circuit breaker and disconnectors at both sides of the breaker, and apply grounds to the breaker terminals.
- (2) **DO NOT OPERATE THE CIRCUIT BREAKER WHEN THE SF₆ GAS PRESSURE IS BELOW THE LOCKOUT PRESSURE**
- (3) Open switches to breaker DC control and AC control.
- (4) For inspections within the interrupters, refer to section (2.8) on precautions with arced SF₆ gas.

Inspection and Maintenance

(5) At the time of internal inspection and / or inspection of the mechanism, insert close or trip prevention pin. Be sure to remove these pins upon completion of the inspection.

(6) Do not disassemble the shaft sliding seals.

(7) Cover interrupter openings with plastic sheeting or bags whenever active work is not being performed.

(8) Use specified lubricant. Do not apply the lubricant on the insulators.

(9) Thoroughly clean interior after inspection and maintenance.

(10) Replace absorbent whenever interrupters are opened. Replacement should be made immediately before evacuation.

(11) Renew all the O-rings at the flanges which has been opened for inspection. Handle O-ring with special care to avoid any damage. Do not reuse O-rings.

(12) Apply gas sealant (white colour) to the air side of the groove for O-ring and O-ring contact surface.

(13) Tighten each bolt with proper torque.

(14) Perform gas leakage test after any seals are opened.

(15) Compare the mechanical operation data obtained before and after the inspection to ensure orderly operation of breaker.

(16) The moisture content of SF6 gas in the breaker has to be below 300 ppm (volume).

6.3 INSPECTION CHECK LIST

The inspection check list identifies the recommended action required for each type of inspection or maintenance.

Table 6.3
Inspection Checklist

System	Inspection Item	Action Required	Type of the Inspection		
			P	R2	O
Structural	Procelain contamination	Clean		X	X
	Procelain cracks, chips	Replace		X	X
	Terminal corrosion	Clean with abrasive and regrease		X	X
	Housing, frame and support structures rusting	Clean area and touch up with paint or completely repaint		X	X
	External hardware tightness	Retorque all loose hardware		X	X
	Grounding terminals	Check tightness, retorque	X	X	
Gas system	Gas pressure	Record	X	X	X
	Ambient Temperature	Record	X	X	X
	Check valves positions	Gas Value D-closed Gas valve E-open	X	X	X
	Gas pressure switch	Check operating pressure - reset	X	X	X
	Leakage	Leak test any disassembled joints			X

System	Inspection Item	Action Required	Type of the Inspection		
			P	R2	O
Mechanism	Operations counter	Record	X	X	X
	Spring charge indication	Check its working	X		
	Trip and Closing coils	Check by operation replace		X	X
	Lubrication	Clean & relubricate (Refer below table)		X	X
	Hardware & retaining rings	Check for looseness retorque or replace (Refer below table)		X	X
	Shock absorber (Located in the horizontal rod ass'y)	Check for oil leakage		X	X
	Closing coil assembly	Check setting dimensions - resetting		X	X
	Trip coil assembly	Check setting dimensions - resetting		X	X
	Mechanism housing and base frame door	Check proper & effectively closed	X		
	Gap between cam and roller	Check setting dimensions - resetting		X	X
Interrupter	Door locks	Check properly locked	X		
	Contacts	Inspect for arc erosion, replace as required			X
	Nozzle	Measure for erosion,			X
	Absorbent	Replace			X
Control	Hardware	Check for tightness		X	X
Housing	Control wiring	Termination secure		X	X
		Availability of Rated control Voltage and Motor voltage during coil activation and motor charging and commissioning	X		
		Termination screws tight		X	X
		Insulation check with 500V megger (2 Meg ohm min.)		X	X
	Weather seal	Door gasket condition - replace if aged		X	X
		Water leaks		X	X
	Shock-proof rubber of control panel	Check for aging replace if		X	X
	Thermostat	Setting		X	
	Heater	Check functioning and measure resistance		X	X

System	Inspection Item	Action Required	Type of the Inspection		
			P	R2	O
	Contact resistance of main circuit	Measure resistance		X	X
	Contact wipe	Measure contact wipe at mechanism			X
	Operation test	Check closing and opening times Check charging time of closing spring	X	X	X

Lubrication points	
Grease	Ratchet, Pwals springs, Bewell gear, Base frame/mounting frame barpins, HRA (horizontal rod assembly) in base frame/ mounting frame ,Hex shaft of main frame.
Oil	Antipumping pin,closing spring guide,Trip coil moving core, closing coil & plunger, moving trip assembly, Bearing of trip latch, Close latch assembly, tripping spring, shaft.
Hardware tightness check	Tighten all hardware's with appropriate torque connected to different assemblies & support structure & foundation bolt in GCB Refer appendix B table B.1

6.4 MATERIALS AND SPECIAL TOOLS

6.4.1 Patrolling Inspection

Normally no tools or material are required since objective of patrolling inspection is to maintain a continuous "log" of breaker condition and identify any abnormalities that may need maintenance.

6.4.2 Routine Inspection and Maintenance

All the spacial tools (Table 6.5) and consumable supplied by CG are required.

These tools and materials are supplied for installation of the breaker.

If they are not available, the customer is expected to reorder.

Tools, equipment and materials required to be arranged by customer.

1. Hand tool set (metric wrenches and their sockets)
2. Filler gauges
3. Steel Rule
4. Oscillograph timing equipment

5. Multimeter

6. 100 A low resistance ohmmeter

7. Vacuum pump set (if not ordered from CGL)

6.4.3 Operational Inspection and Maintenance

All the special tools (Table 6.5) and consumable supplied by CGL are required. In addition following material is required.

1. Tools listed in section 6.4.2.1

Part Description	Part #	Q'ty
1. Mechanism grease	Darina # 2	
2. Contact grease	Microcarbon	
3. Joint compound	Jointal - Z (green)	
4. Absorbent	# 101 0.9 kg	
5. O-ring for Gas feed port P 18	# 408	1
6. O-ring for contact holder G 220	# 116	3
7. Set of arcing contacts # 518, 521		3+3
8. Nozzle	# 111	
9. Gas sealant	Anabond 681	

Tools, equipment and material required to be supplied by customer

- 1) Hand tool set [metric wrenches and their sockets]
- 2) Filler gauge
- 3) Mechanics scales
- 4) SF6 gas
- 5) SF6 leak detector
- 6) Leak detection fluid [soap solution]
- 7) Oscillograph timing equipment
- 8) Multimeter
- 9) Plastic sheets
- 10) Plastic bags
- 11) Bucket truck
- 12) Torque wrenches 60 kg-cm, 280 kg-cm, 1200 kg-cm.
- 13) Socket 24 mm
- 14) Abrasive-scotch brite preferred or 120 grit sand paper
- 15) Solvant cleaner Ethanol/Toluol/Thinner/Petrol/Carbontetracloride
- 16) Loktite [242 blue or equivalent]
- 17) 100A low resistance ohmmeter.

6.5 MAINTENANCE OF SF6 GAS SYSTEMS

6.5.1 Adding of SF6 Gas

Should the gas pressure fall below the rated pressure value shown by table 2.1, then gas has to be filled in. Set the filling apparatus by referring sec 4.5.8 and fill the gas to the rated pressure. This can be done even if the breaker is in live condition.

6.5.2 Removal of SF6 Gas

For internal inspection during operational inspection, it is necessary to remove the SF6 gas. Reference should be made to section 2.8.1 for precautions in handling arced SF6 gas. The gas can be reclaimed by the use of a gas service trailer or SF6 gas reclaiming cart.

6.5.3 & 4 Evacuation and Gas Filling After Maintenance

If the poles have been opened any time during the

maintenance then they have to be evacuated before filling the gas. This can be achieved by using the vacuum pump. Set the evacuation apparatus as follows :

Refer Fig.[9]. Attach adaptor [V] to valve port. Connect one end of big hose to adaptor [V] and the other end to vacuum pump. Open valves [D] and [E]. Start the vacuum pump and watch the Gas Pressure Gauge. After needles shows 76cm, run the pump for at least 30 min. Close valve [D] and switch off pump. Remove adaptor [V]. For gas filling refer section 4.5.8

6.5.5 Gas Leak Inspection [Refer to Fig. 11]

All gas seal joints which have been disturbed whenever the breaker has been opened for internal inspection should be checked for leaks.

This can be done by using leak detection fluid soap suds or SF6 gas leak measuring apparatus after the completion of gas filling.

[a] Check with test solution [Refer to Fig. 11 [a]]. Daub test solution over the gas sealed connection. Check for bubbles for more than 30 seconds. If no bubbles appear, wipe off the solution.

[b] Check with leak Detector [Refer Fig. 11[b]]. Cover the joint to with plastic sheet and tie properly so that the air can not escape. Allow the joint for minimum four hours for collecting any leaked gas. Then Homogenize the air contained and insert the probe.

6.5.6 Gas Pressure Switch Inspection [Refer to Fig. 7]

Valve is provided to isolate the temperature - compensated gas pressure switch [401], the gas pressure gauge [402] and the gas piping [301] and other forms of the breaker gas system.

Inspection of the gas pressure switch [401] operation can be done as follows.

- 1) Close the valve E [406] and remove the cover A [404].
- 2) Connect electrical continuity instrument [e.g. bell or lamp] across the alarm and lockout contacts of the gas pressure switch [401].

- 3) Release the gas from the gas piping [301] slowly through the valve D [405].
- 4) Record pressure at which the alarm and lockout switches contact makes. The required operating pressure will vary with the temperature. Measure temperature and refer to graph Fig. 8[C] for correct pressure.
The permissible tolerance is $\pm 0.3 \text{ kg/cm}^2 - \text{g}$ [4.3 psig]
- 5) The switch [401] operation can be rechecked by closing the valve D [405] and opening the valve E [406] to refill the gas piping (301) and repeating the steps 1) to 4) above. If operation is incorrect, rotate the star shaped disc to get the correct settings.
- 6) After the inspection is completed, attach the cover [404] with the ring to the gas feed port [403].
- 7) Be sure the valve D [405] is closed and the valve E [406] is open.

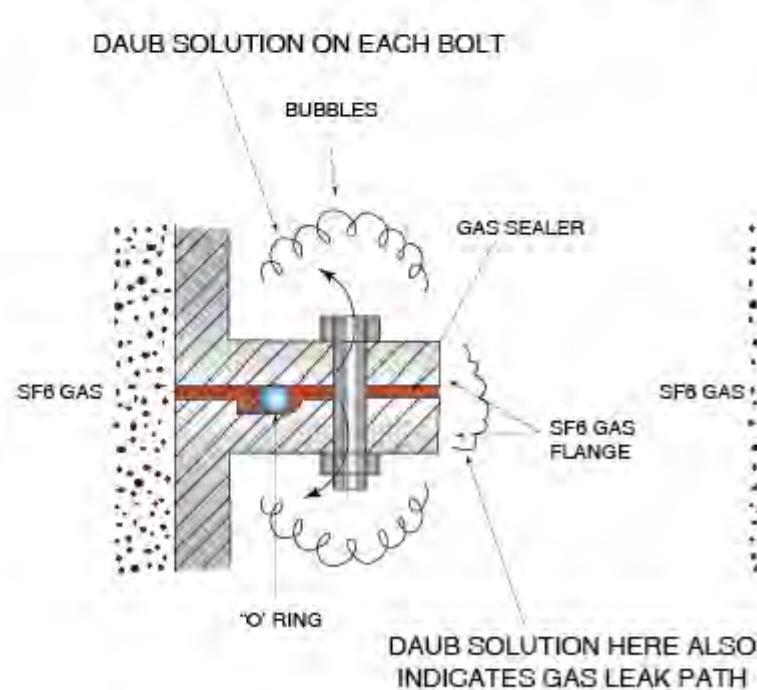
6.5.7 Gas Moisture Control

It is important to protect the SF6 gas compartments

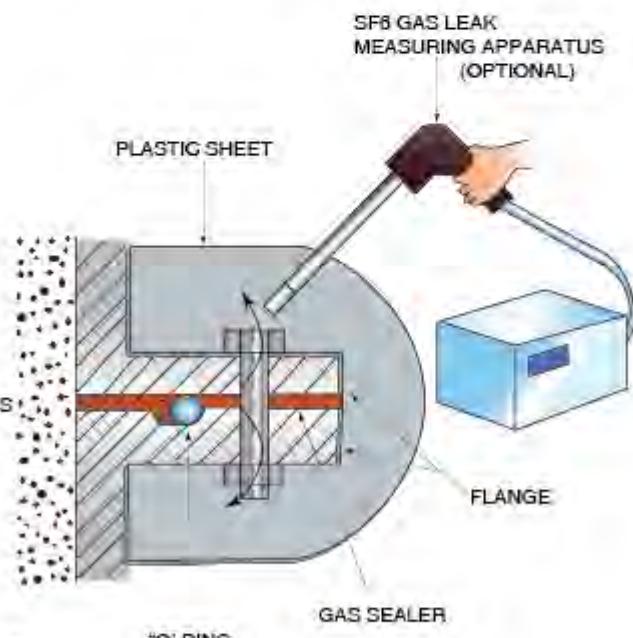
from prolonged exposure to excessive moisture during maintenance. The breaker interior should not be left open to the environment and must be temporarily sealed when left for any extended period of time. If these precautions are observed and the evacuation procedure in section 4.5.8 followed, the interior and SF6 gas will be dry and maintained dry by the absorbent installed in the breaker. The absorbent is located inside of the contact holder and should be renewed at each internal inspection installations is described in appendix H.

If there is any concern over possible excessive moisture in the gas, the gas feed port [403] may be used for connection of a moisture measuring instrument.

The SF6 moisture level should be monitored as Appendix I. If measurement exceeds this level, rechecks should be made to assure no errors in measuring procedure have been made. If the high moisture level persists, corrective action would be to evacuate, replace the absorbent and dry the SF6 Gas or use new dry gas.



(A) CHECK WITH LEAK TEST SOLUTION



(B) CHECK WITH SF6 GAS LEAK MEASURING APPARATUS (OPTIONAL)

6.5.8 Renewal of Absorbent

The absorbent is put into the contact holder on each interrupter unit. The absorbent should be replaced whenever the interrupter unit is opened to inspect the contacts. The procedure for replacing the absorbent is described in Appendix H. The contact holder (108) and the interrupter porcelain O-ring seal surface should be cleaned and applied with gas sealant as described in Appendix A.

6.6 MECHANISM AND LINKAGE INSPECTION

6.6.1 Manual Operation (Refer to Fig. 12 & 13)

A hand jack is available for slow closing and opening of the mechanism and breaker contacts. This procedure provides an opportunity to check linkage settings, contact engagements, and possible identification of frictions areas. This procedure for application of the hand jack is as follows.

1. Open DC and AC power switches.
2. Insert the close prevention pin (529) if the closing spring (502) is charged
3. Insert the trip prevention pin (528) if the breaker is in the closed position. Refer to Fig.13 for the hand jack assembly.
4. Remove Blank Cover (407)
5. Apply grease to the thread of the jack bar (724)
6. Engage Nut (726) on to the jack bar (724)
7. Position bearing (725) on to the nut (726)
8. Mount Jack Bar (724) on Bar Pin of the lever B (511) through the bottom hole of Mechanism Housing (400).
9. A special Socket (727) which is operated by a conventional Ratchet Wrench with its socket (30 mm) is provided to fit the nut (726). Turning clockwise will close the breaker contacts.

Manual Opening

CAUTION : If the closing spring (502) is charged, the

close prevention pin (529) must be inserted. And also, be sure the trip prevention pin (528) is inserted because the breaker is closed.

With the hand jack (724 to 726) attached, turn the nut (726) counterclockwise with the ratchet wrench and socket (30mm) through the socket (727). After the jack bar (724) becomes tight (approximately 0.5 turn of the nut (726) against the bar pin in the lever B (510) (This means that the pin A (514) is positioned to an over-travelled position), remove the trip prevention pin (528).

Refer to Fig. 5-1a; to release engagement between the trip holding latch (512) and the pin A (514) of the lever B (511), push the trip plunger (526) on the trip coil assembly. The movements of the mechanism by this action are as follows ;

- 1) The plunger (526) pushes the trip trigger (513)
- 2) The trip trigger (513) rotates clockwise, and disengages from the roller of the trip holding latch (512).
- 3) The trip holding latch (512) rotates clockwise, since the trip holding latch (512) blocks the counter clockwise torque of the lever B(510) by the trip spring (501)through the lever A (510).
- 4) The pin A (514) is disengaged from the trip holding latch (512). Continue the pushing until the above movements are completed. Turn the nut (726) clockwise with the ratchet wrench with socket (30 mm) to open the breaker.

At the complete open position, the jack bar (724) becomes free.

Manual Closing

CAUTION : If the closing spring (502) is charged, the close prevention pin (529) must be inserted.

Turn the nut (726) counterclockwise with the ratchet wrench until the trip trigger (513) engages the roller of the trip holding latch (512). Since this position is an over-travelled position, the nut (726) must be

FRONT VIEW OF MECHANISM

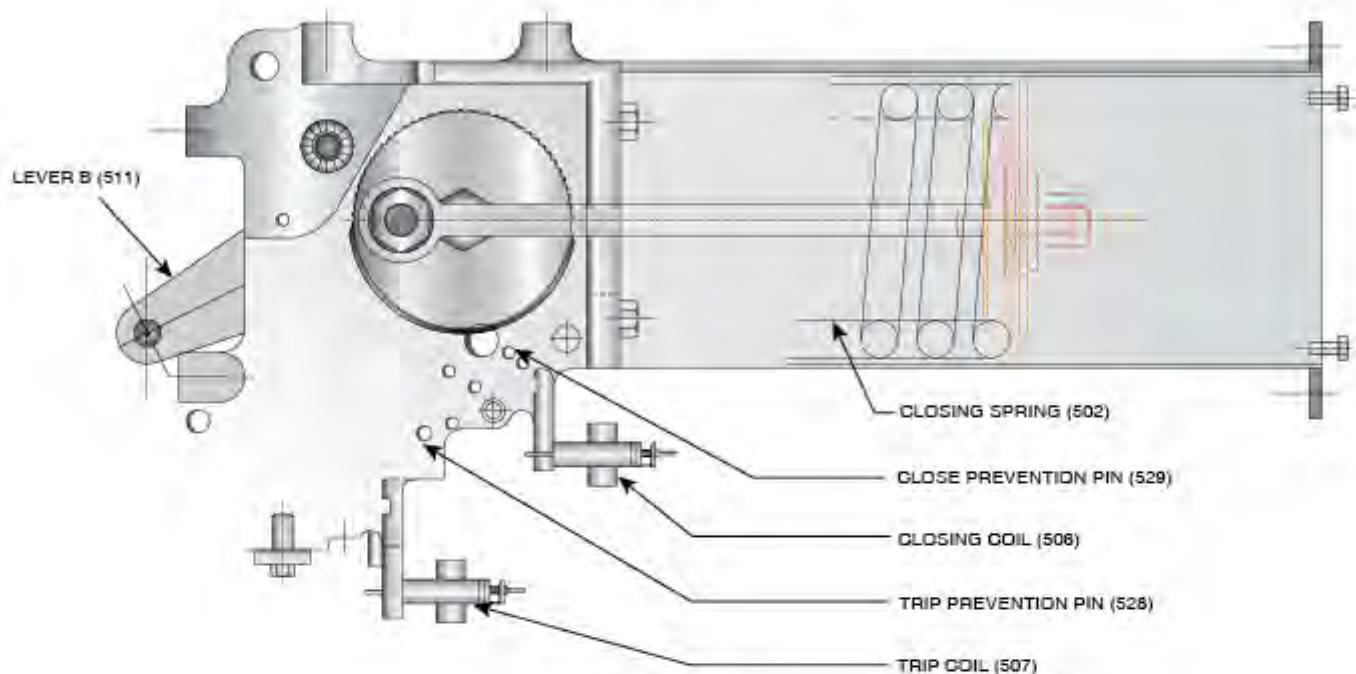


FIG. 12

turned clockwise to get the complete closed position.

At the complete closed position, the pin A (514) engages with the trip holding latch (512) and the jack bar (724) becomes free.

CAUTION : If the hand jack assembly is removed with the breaker closed condition, be sure to insert the trip prevention pin (528) while work of removing the Jack assembly is in progress.

6.6.2 Manual charging of Closing Spring (Refer to Figs. 14 and 15)

In the event of no power supply for the motor, the closing spring (502) can be charged by fitting Socket (17mm)* Extension Bar * and Ratchet Wrench * as shown in Appendix G to the hexagonal part of the ratchet shaft (518) as shown in Fig. 15. Turning the ratchet shaft (518) clockwise by the ratchet wrench * until the closing holding latch (504) of fig. 5-1 (A), engages with the pin B (516) will fully charge the closing spring (502).

CAUTION : This manual charging tools can be used only for charging of the closing spring (502), and cannot be used for manual discharging of it, since the

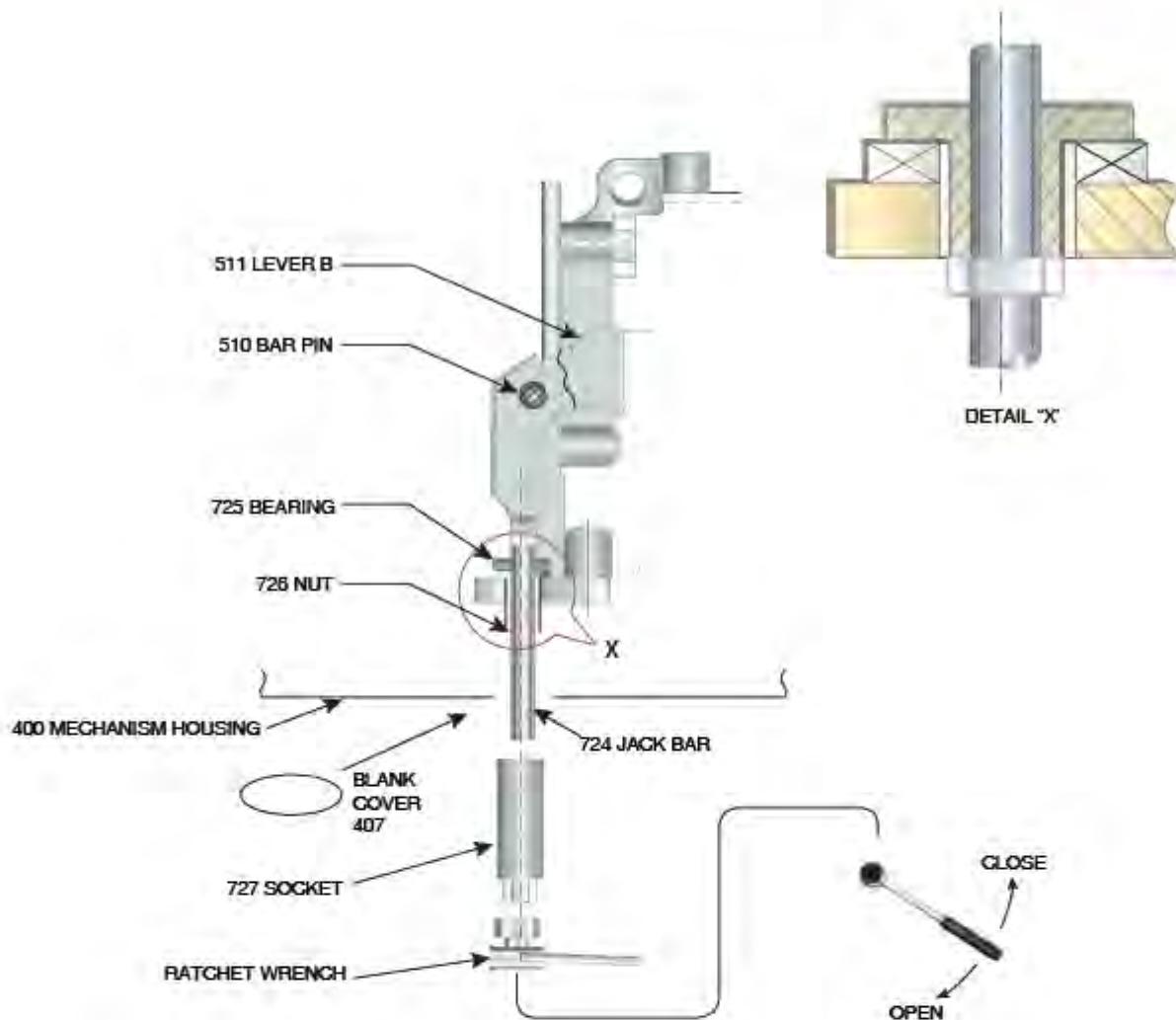
ratchet wheel (503) acts in charging direction only.

6.6.3 Mechanism Lubrication

Lubrication of the mechanism is required during routine inspections. The lubricant Darina # 2, available from CGL is the only authorised grease for this application. Relubrication requires removal of the old grease and applying fresh grease. Ref. Appendix - D. Fig. 16 shows the points requiring lubrication. All points should be relubricated at operational maintenance

- (1) The following items marked on Fig.16 are to be lubricated every 24-36 months.
 - 1) Bevel gears of Motor drive.
 - 2) Inner surface of Spring Guide for the closing spring (502)

(This should be done with the closing spring (502) charged so that access to guide surface is available. When the lubrication requires, take off the cover of the spring guide.)
- 3) Pivot pins of the trip holding latch (512)
- 4) Pin A (514)



RATCHET WRENCH AND ITS SOCKET (30 MM) AE OPTIONAL

FIG. 13

Both these pins should be removed, cleaned and lubricated. This work will require following material and tool.

Shaft C-ring (snap ring) 20	Qty. 2
Snap ring plier 51 - 1 A	Qty. 1

6.6.4 Mechanism Adjustments

During routine maintenance travel, cam clearance and settings of the trip and closing coil assemblies should be inspected and adjusted if necessary.

Mechanism Travel (Refer to Fig.17)

The mechanism travel (S.M.) is measured at the end of the rod end which is connected to the lever A (510).

- At open position, measure and record SM1

CAUTION : If the closing spring (502) is charged, the close prevention pin (529) must be inserted.

- Move the mechanism (500) with the hand jack assembly to closed position in accordance with the manual closing procedure described in section 6.6.1.
- At complete closed position, measure and record SM-2, the trip prevention pin (528) should be inserted.
- The mechanism travel (S.M) is given by following formula.

$$S.M. = SM1 - SM2$$

The travel is specified in Table 6.4.

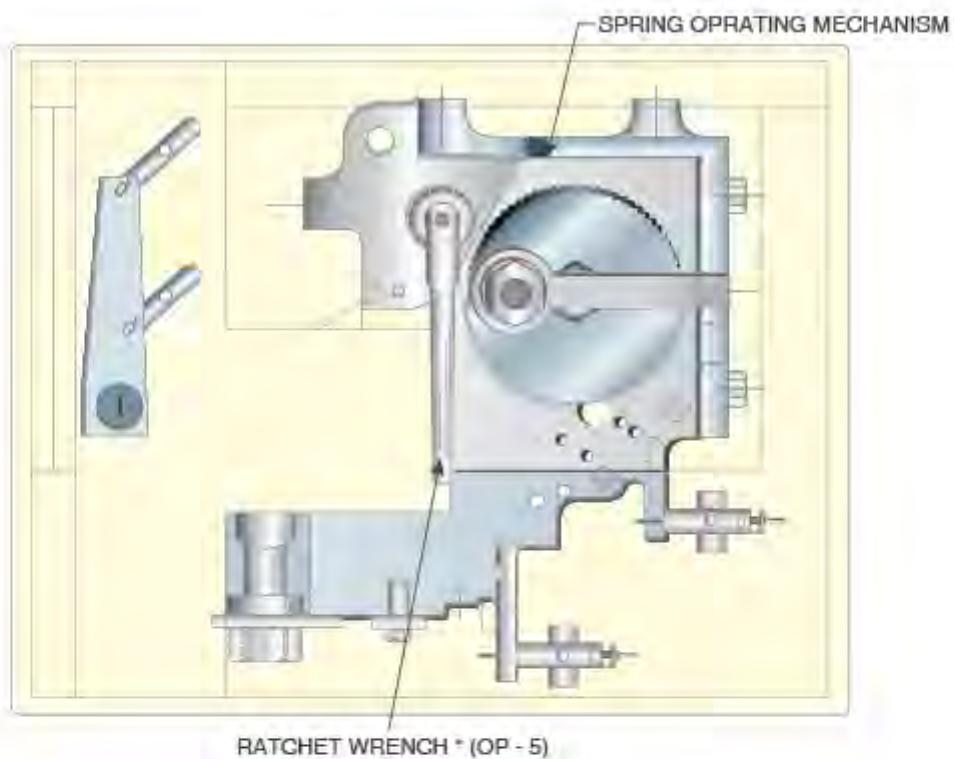
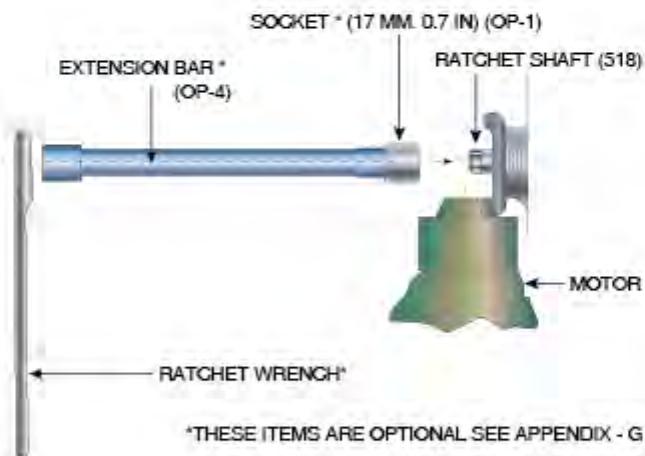


FIG. 14



*THESE ITEMS ARE OPTIONAL SEE APPENDIX - G

FIG. 15

Cam Clearance (Refer to Fig. 17)

With the mechanism (500) and breaker contacts in the open position and the closing spring (502) charged, measure the gap (G) between the cam (508) and the roller of the lever B (511).

CAUTION : Be sure the close prevention pin (529) is inserted during this inspection.

The gap (G) specification is given in Table 6.4. If the

gap (G) does not meet the specification, adjustment is made with Turnbuckle Connector between the trip spring (501) and the lever A (510).

Trip Coil Assembly (Refer to Fig. 18-(A))

With the mechanism in the closed position and the trip prevention pin (528) inserted measure the stroke "S.T" of Moving Core (A) (525) and gap "G.T" between the trip plunger (526) and the trip trigger (513) with a feeler gauge. The stroke "S.T" of the moving core (A)

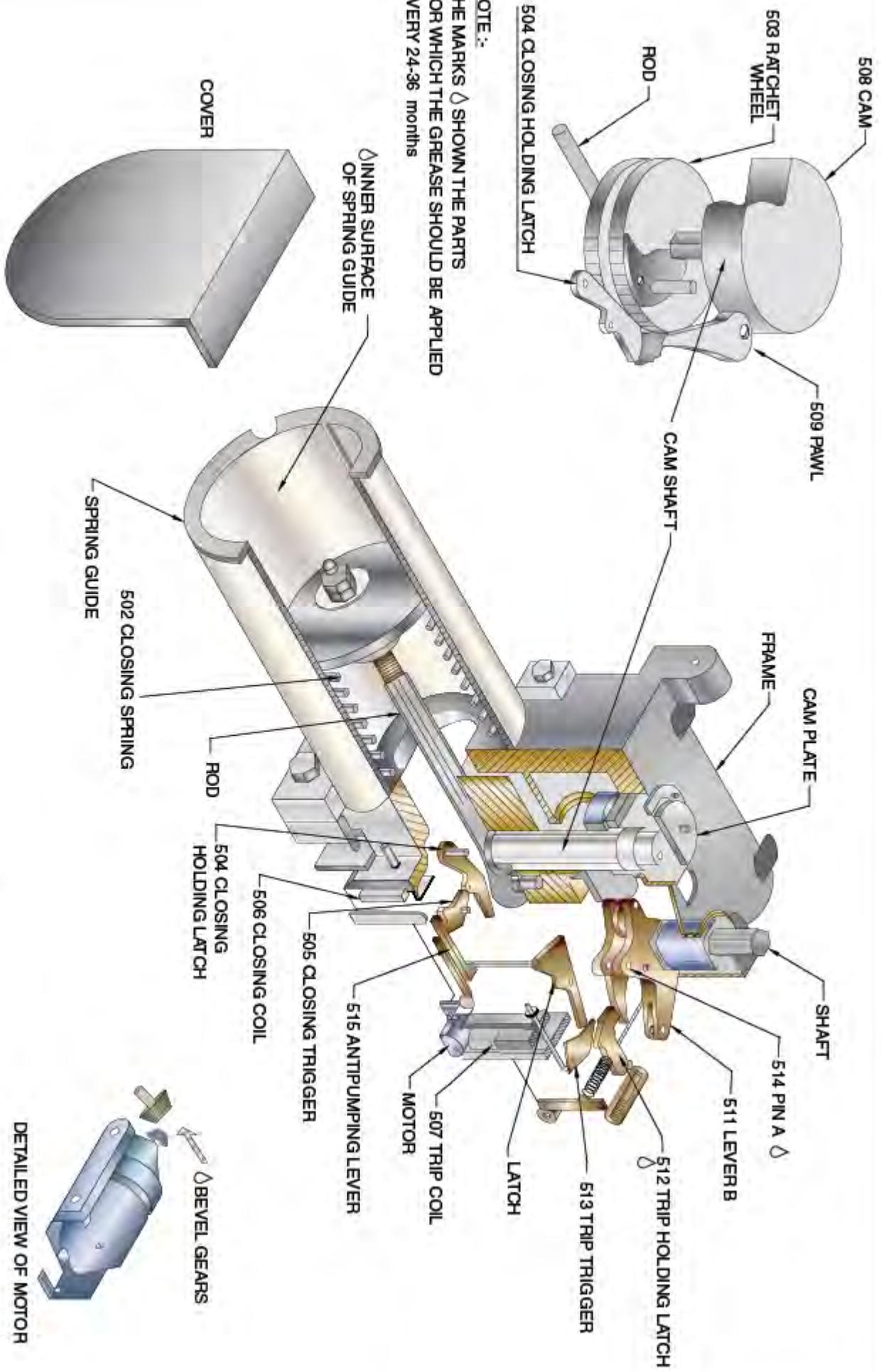


FIG. 16 SOLID CROSS-SECTIONAL VIEW OF TYPE BM SPRING OPERATING MECHANISM

Inspection and Maintenance

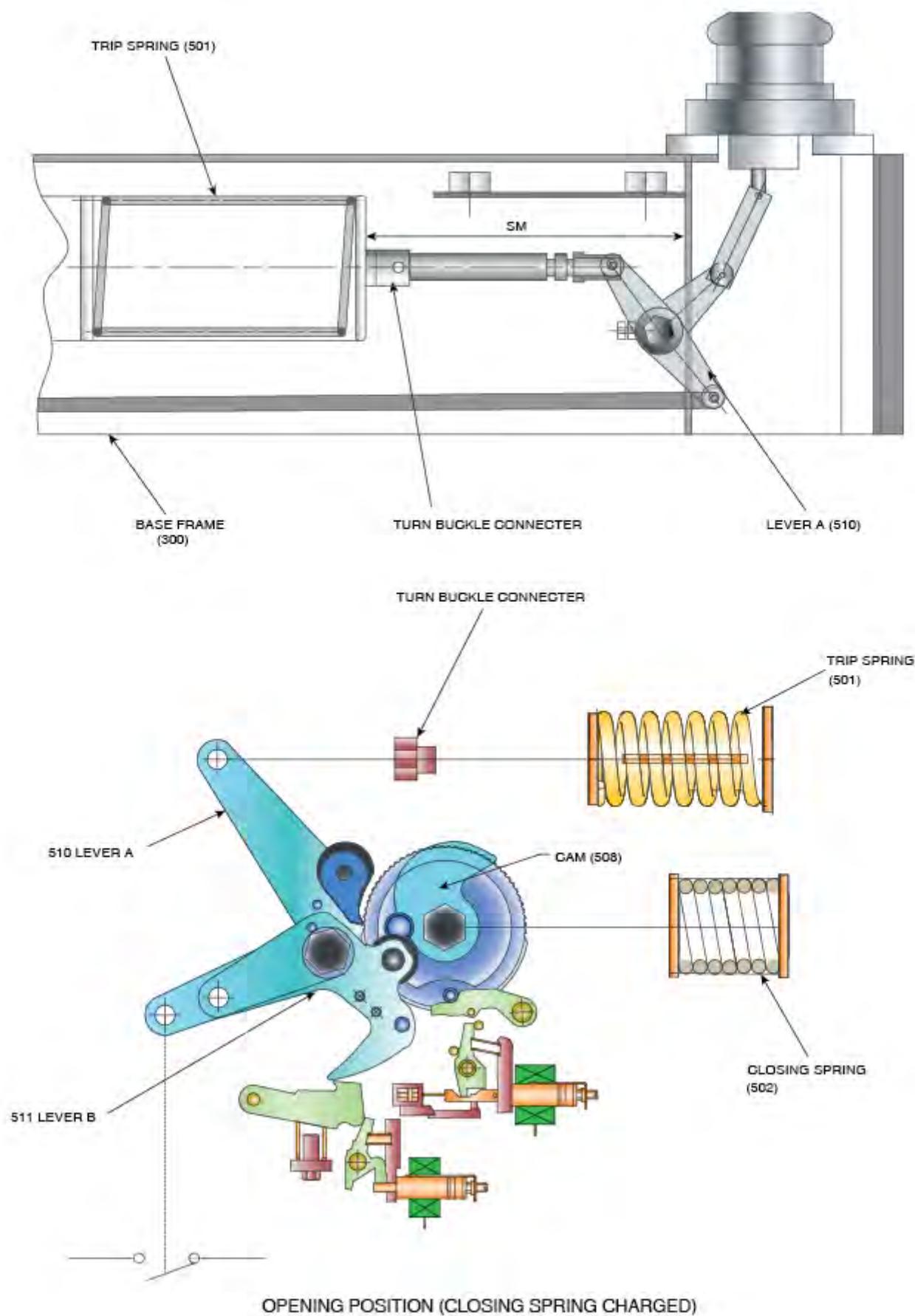
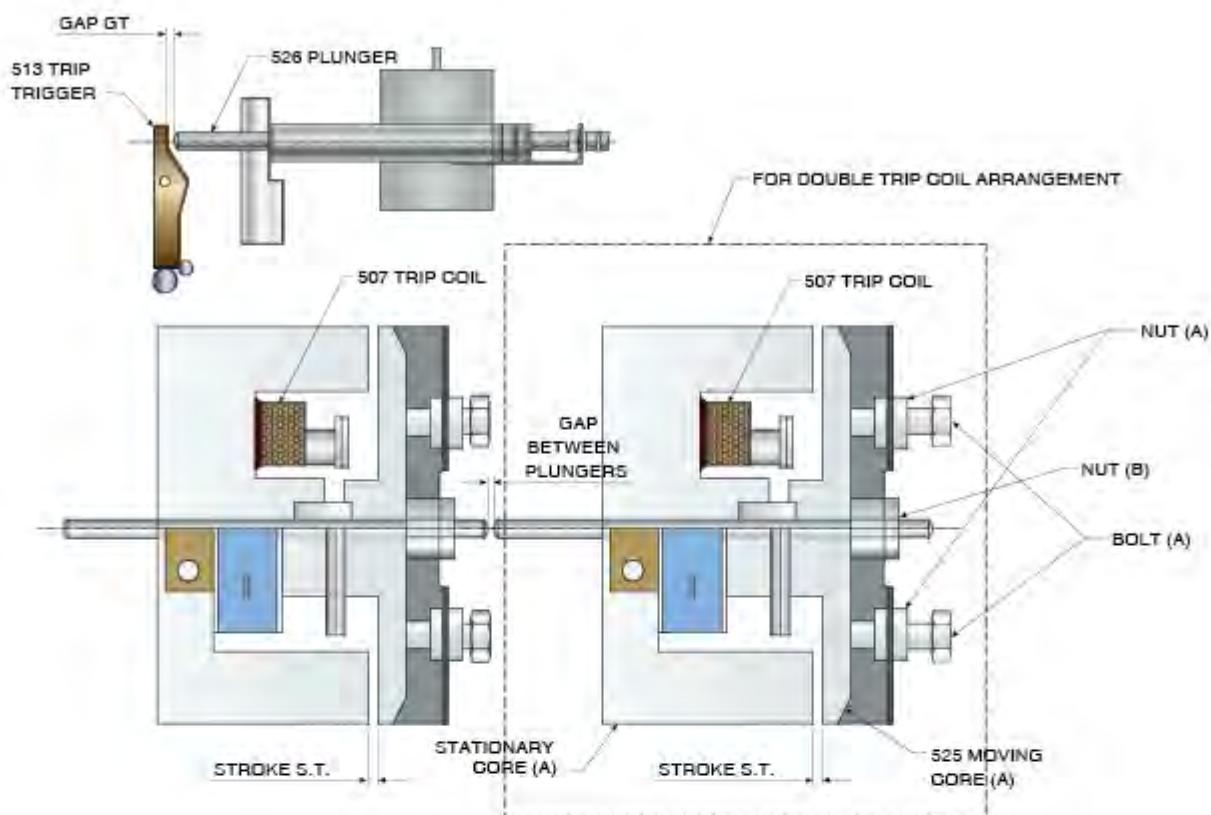
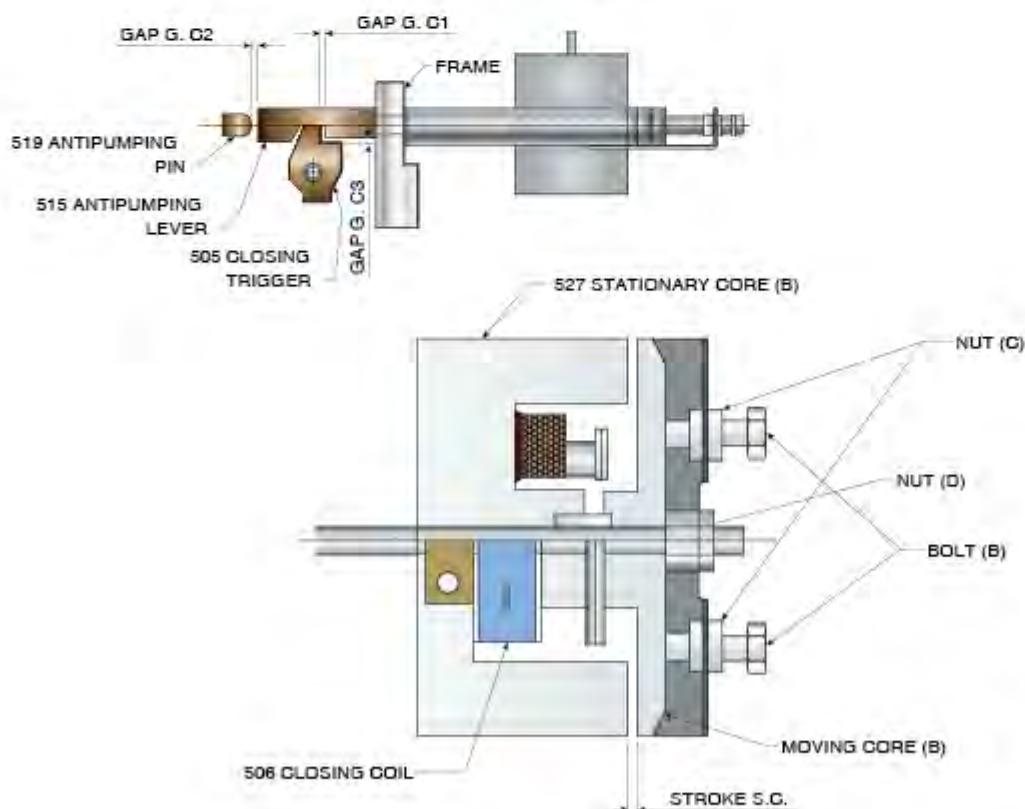


FIG. 17



(A) TRIP COIL ASSEMBLY



(B) CLOSING COIL ASSEMBLY

FIG. 18

(525) is determined by measuring the gap between the moving core (A) (525) and Stationary Core (A). The specified dimensions should meet Table 5. Adjustment of the stroke "S.T" is made with loosening Nuts (A) and driving Bolts (A). The gap "G.T" is adjusted by loosening Nut (B) and driving the plunger (526) to the correct dimension. After adjustments, the nuts should be relocked.

Closing Coil Assembly (Refer to Fig. 18 - (B))

With the closing spring (502) charged and the closed prevention pin (529) inserted, measure the stroke "S.C" of Moving Core (B) (527), the gap "G.C1" between the antipumping lever (515) and the closing trigger (505), the gap "G.C2" between the antipumping pin (519) and the antipumping lever (515) and the gap "G.C3". The stroke "S.C." of the moving core (B) (527) is determined by measuring the gap between the

moving core (B) (527) and stationary Core (B). The specified dimension should meet Table 6.4. The stroke "S.C" is adjusted with loosening Nuts (B) and driving Bolts (B).

The Gap "G.C1" adjustment is made only when gap is less than 2.0 mm (0.079 in). In this case, insert 0.5 mm thickness of Brass Washer (0.5-11 X22) between the stationary core (B) and the mechanism frame. If the gap is over 3.0 mm (0.118 in), replace the closing coil assembly. The gap "G.C2" is adjusted with shifting of the mounting bolts (not shown in Fig.18) of the antipumping pin assembly. The gap "G.C3" is adjusted with shifting of the mounting bolts (not shown in Fig.18) of the closing coil assembly.

Adjustable ranges of the gaps "G.C2" and "G.C3" are maximum 1.0 mm (0.039 in) and maximum 1.25 mm (0.049 in) respectively.

Table 6.4 Measurement of Dimensions

Item	Mark	Standard Dimensions	Referred Fig. No.
Stroke of moving core of trip coil	S.T.	2.8 - 3.2 mm (0.110 - 0.126 in)	Fig. 18 - (A)
Gap between plunger of trip coil and trip trigger	G.T.	1.0 - 1.4 mm (0.039 - 0.055 in)	ditto
Difference between stroke (S.T.) and gap (G.T.)	S.T. - G.T.	1.6 - 2.4 mm (0.063 - 0.094 in)	ditto
Stroke of moving core of closing coil	S.C.	4.5 - 5.5 mm (0.177 - 0.217 in)	Fig. 18 - (B)
Gap between antipumping lever and closing trigger	G.C1	2.0 - 3.0 mm (0.079 - 0.118 in)	ditto
Difference between stroke (S.C) and gap (G.C1)	S.C.-G.C1	2.5 - 3.5 mm (0.098 - 0.138 in)	ditto
Gap between antipumping lever and antipumping pin	G.C2	1.0 - 2.0 mm (0.039 - 0.079 in)	ditto
Gap between antipumping lever and closing trigger	G.C3	2.0 - 3.0 mm (0.079 - 0.118 in)	ditto
Stroke of spring operating mechanism	S.M	100 (3.937 - 3 mm + 0.039 in - 0.118 in)	+ 1 mm Fig. 17
Gap between roller and cam	G	1.4 ± 0.3 mm (0.055 - 0.012 in)	ditto

Procedure For Replacing Trip Coil:

Refer fig 18-A from topic trip coil assembly

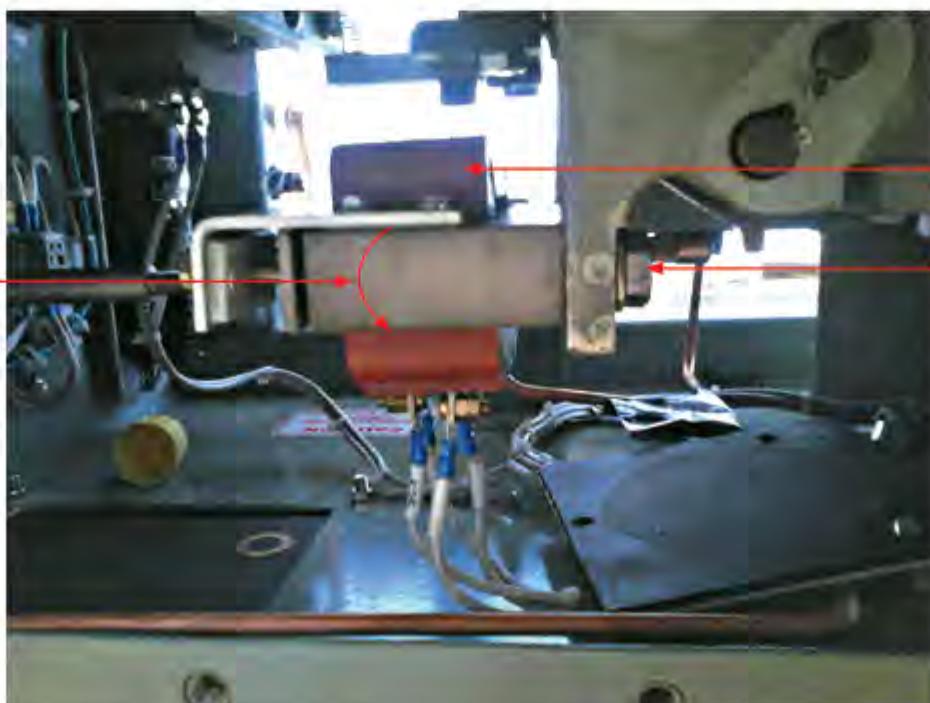
1. Before starting the actual coil replacement ensure closing & tripping spring are discharged.
2. Insert lock pins for safety of person while doing replacement work.
3. Open rear cover sheet of housing bolted below base frame (mounting frame)
4. Remove the wire connected to the coil terminals.
5. Loose M10 x 25 bolt refer photo, do this defective coil become loose from mechanism.
6. Release the trip coil assembly free from mechanism.
7. Replace this assembly with new one.
8. Tight new assembly with M10 x 25 bolts at same place give proper torque as per table B.1 in appendix B.
9. Do the coil connection as per approved schematic drawing.
10. Maintain gap GT as per table 6.4.
2. Insert lock pins for safety of person while doing replacement work.
3. Open front door of housing.
4. Remove the spring refer the photograph.
5. Open rear cover sheet of housing bolted below base frame (mounting frame).
6. Remove the wire from the coil terminals.
7. Loose M10 x 25 bolt refer photo, do this defective coil become loose from mechanism.
8. Release the close coil assembly along with attached anti pumping lever.
9. Remove this anti pumping lever from coil assembly by removing bar pin attached to it.
10. Replace this assembly with new one.
11. Re insert the anti pumping lever & bar pin again as per previous assembly tight bar pin with help of split pin.
12. Re insert the spring in the notch same as previous assembly refer the photograph in the manual.
13. Tight new assembly with M10 x 25 bolts at same place give proper torque as per table B.1 in appendix B.
14. Do the coil connection as per approved schematic drawing.
15. Maintain gap G1 & G2 as per table 6.4.

Procedure For Replacing Close Coil:

Refer fig 18-B from topic close coil assembly.

1. Before starting the actual coil replacement ensure closing & tripping spring are discharged.

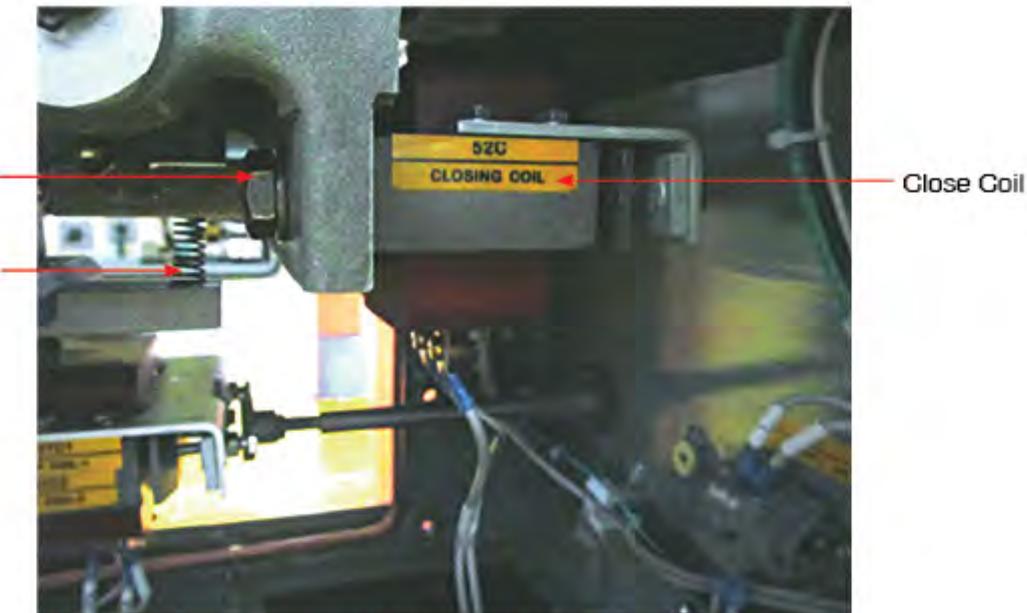
13. Maintain gap G1 & G2 as per table 6.4.



CAUTION : After replacement maintain gap between manual tripping plunger & tripping plunger 1 mm & other gap as per table 6.4

Inspection and Maintenance

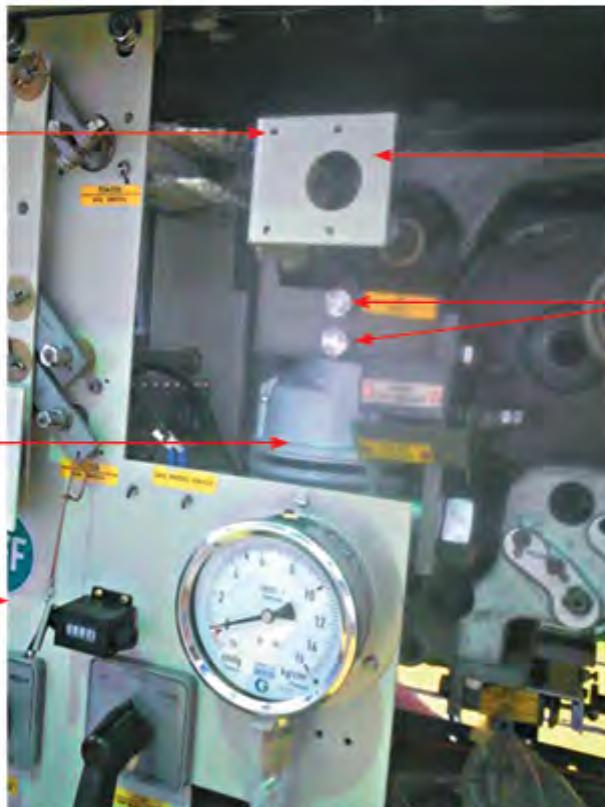
Remove M10 x 25 bolt on either side to release assembly



Remove & reinser this spring as per procedure

CAUTION : After replacement maintain all gap as per table 6.4

1. Remove 2 nos M10 x 40 Bolts attached to this bracket



2. Remove manual charging bracket

3. Remove M10 x 30 Bolts

4. Now motor block can taken out from mechanism from here

5. Loose all nut bolts connected to the block for releasing motor from block

Procedure For Replacing Motor :

1. Before starting the actual motor replacement ensure closing & tripping spring are discharged.
2. Insert lock pins for safety of person while doing replacement work.
3. Open front door of mechanism housing.
4. Remove the wire connection from the motor terminals.
5. Loose M 10 x 40 bolts refer photo, & then release manual motor charging bracket/port
6. Loose M 10 x 30 bolts refer photo,
7. Then release motor block from housing refer direction shown in photo
8. Now loose all net bolt connected to block
9. Remove defective motor
10. Tight new motor in the block with same nut bolts at same place give proper torque as per table B.1 in appendix B
11. Do the motor connection as per approved schematic drawing.

6.7 CONTACTS INSPECTION

The need for internal inspection of the contacts is determined by the number of operations and interruptions as specified in description of Operational inspection section 6.1 or by external measurements such as contact resistance which may identify an abnormal internal condition. The breaker contacts should be in the close position for inspection. The inspection procedure is as follows.

- (1) Open the circuit breaker and the isolators at both sides of the breaker, and apply grounds to the breaker terminals. Close the circuit breaker.
- (2) Open DC and AC control switches.
- (3) Insert close prevention pin (529) if the closing spring is charged.
- (4) Remove SF6 gas as described in section 6.5.2.
- (5) Take out stationary assembly by unscrewing 6-M 16x80 Bolts, Nuts and Washers (118) as shown in Fig.19 - (a) and 19 - [b]

CAUTION :

1. Do not loosen indicated bolts and nuts.
2. Do not touch the contact to the porcelain.
- (6) Remove the stationary arcing contact (109) by using Spanner C (703) and Torque Wrench *, Socket (24mm)* as shown in Fig.19-(c) This work will require Torque Wrench * and Socket (24mm)* shown in Appendix - G.
- (7) Check the erosion of the tip of the stationary arcing contact (109) comparing with the service limit shown in Fig.20.

If the erosion is minor, polish the surface of the tip of the contact (109) with fine sandpaper. Apply a very light film of micro-carbon grease to the surface of the contact (109) as shown in Fig.21- (a). And in this case (viz. the erosion is minor), no further disassembly is necessary. Carry out reassembly (from procedure (14)). If the erosion exceeds the service limit, (max. erosion 2 mm in length) replace with a new one, and following procedure should be required.

- (8) Remove the nozzle (111) using Spanner A (701) as shown in Fig.19 - (d) and turning

counterclockwise.

- (9) Remove the moving arcing contact (112) using Spanner B (702) with Torque Wrench and its Socket (24 mm)* as shown in Fig. 19 - (e) and turning counterclockwise.
- (10) Thoroughly clean the interrupter using vacuum cleaner to remove dirt and powder.
- (11) Apply a very light film of micro-carbon grease to the thread and the contact surface of new moving arcing contacts (112) as shown in Fig.21-(b). Use the tools described in (9) and tighten with 1200 kg-cm (86.8 lb-ft) torque as shown in Fig.19 (e).
- (12) Clean new nozzle (111) with solvent (ethyl alcohol) and lint-free cloths. Install the nozzle (111) using the spanner A (701) as shown in Fig.19-(d). The nozzle (111) locks into position by an interference fit, as it is threaded into position, the turning resistance will increase and then decrease.
- (13) Apply a very light film of micro-carbon grease to the surface of new stationary arcing contact (109) as shown in Fig.21 - (a). The stationary arcing contact (109) will be provided with the contact as spare parts when customer ordered.
- Use the tools described in (6) and tighten with 1200 kg-cm (86.8 lb-ft) torque as shown in Fig.19 (c).
- (14) Replace the absorbent (101) in each of the contact holder (108) as shown in Appendix - G

CAUTION : At installation of new absorbent (101), the screws of 4-M6 x 12 bolts should be applied Locite 242 (blue).

- (15) Renew O-ring (116) / (117) and apply gas sealant to the sealing surface as shown in Appendix - A.
- (16) Attach the stationary assembly to the flange of Interrupter Porcelain (102) with 6-M16 x 80 bolts, washers and nuts.
- (17) Evacuate and fill with SF6 gas as described in section 4.5.8.

Inspection and Maintenance

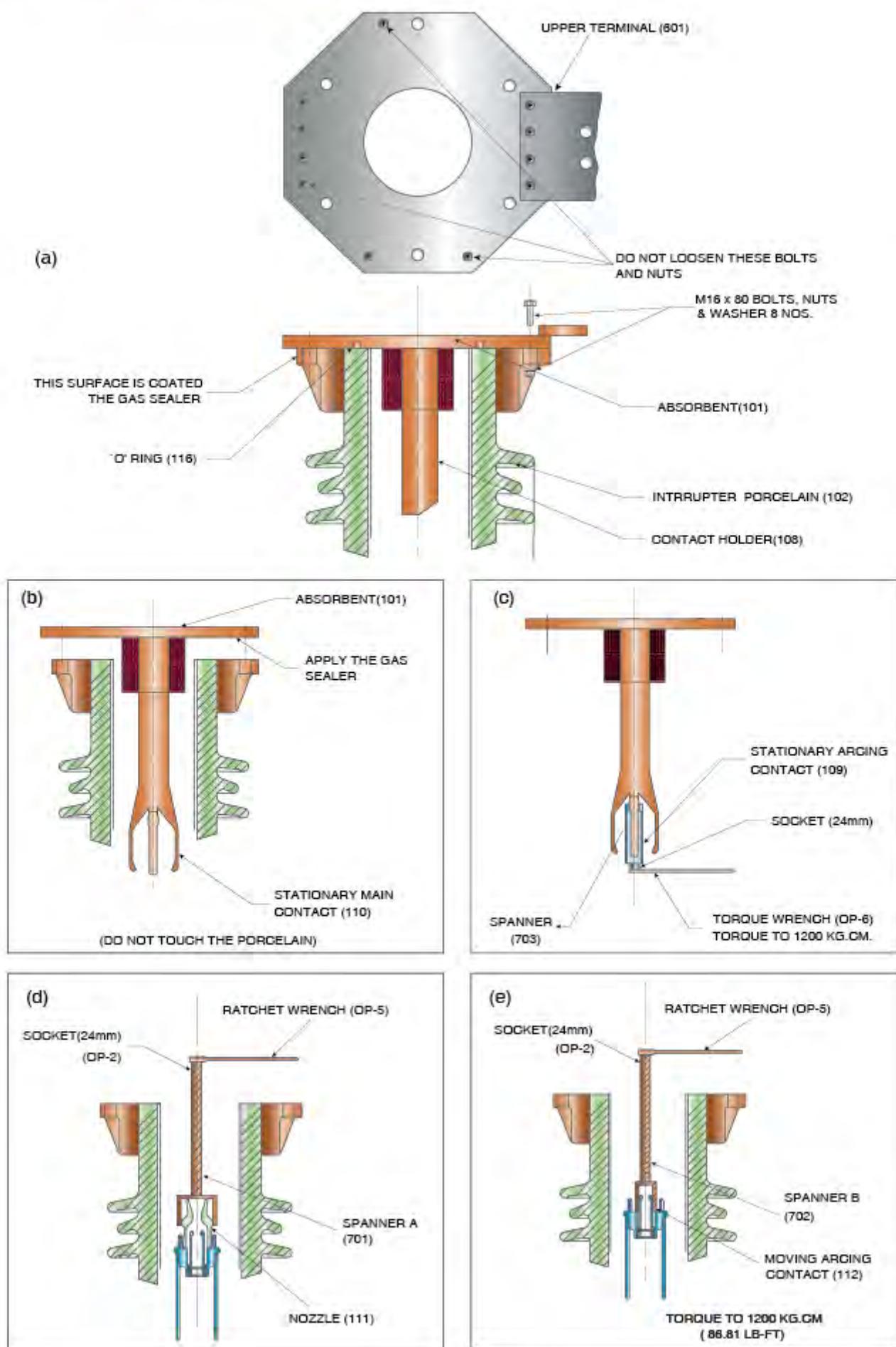
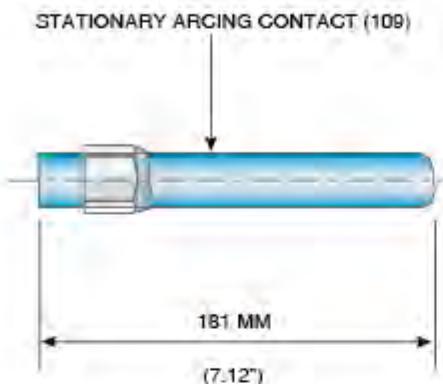


FIG. 19

**SERVICE LIMIT**

THE TIP OF THE STATIONARY ARCING CONTACT ERODES MORE THAN 2mm FROM THE DIMENSION SHOWN IN THE LEFT DRAWING OR IS CHIPPED SIGNIFICANTLY OR IS DISTORTED.

FIG. 20 SERVICE LIMIT OF STATIONARY ARCING CONTACT

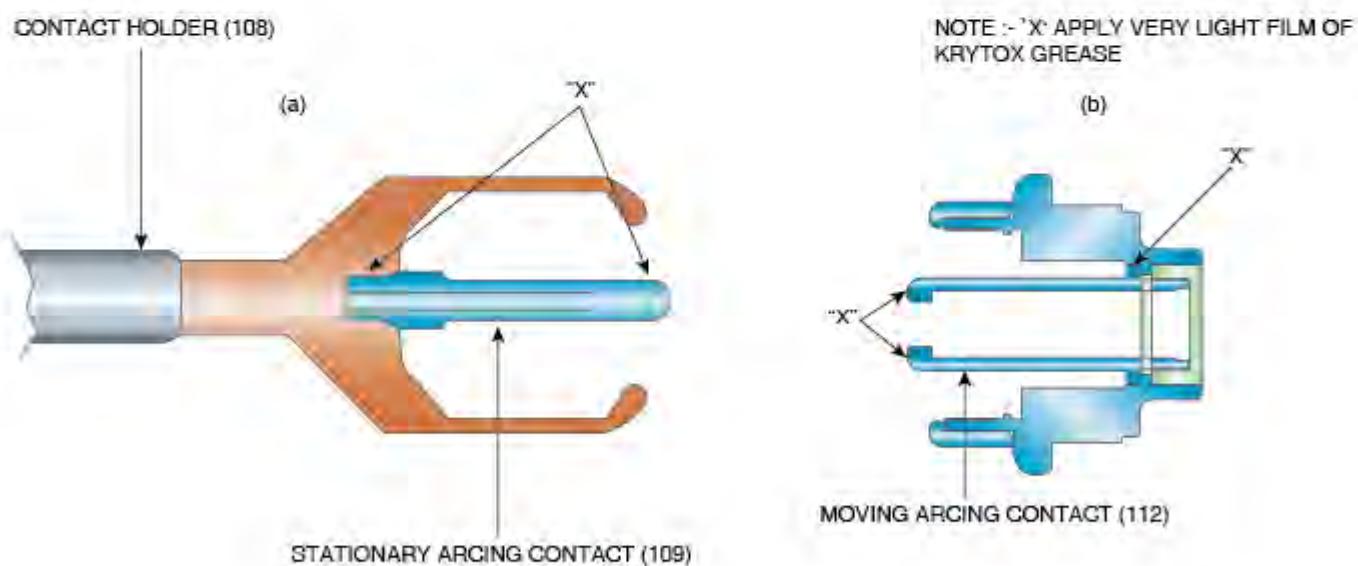
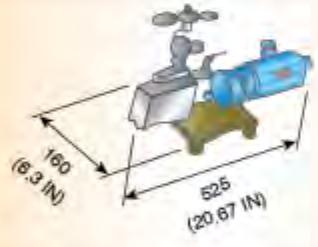
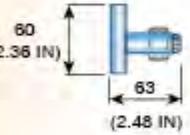
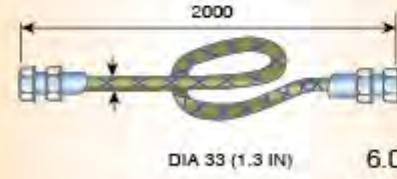
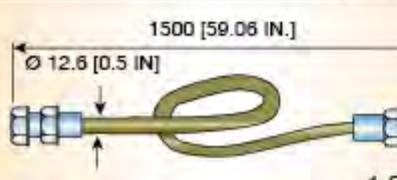


FIG. 21 APPLICATION OF KRYTOX GREASE

Inspection and Maintenance

TABLE : 6.5 DETAIL OF SPECIAL TOOLS

PART NO.	NAME	QTY	SKETCH (WEIGHT)	USE
701	SPANNER A	1	 29 KG	INSPECTION OF NOZZLE
702	SPANNER B	1	 38 KG	INSPECTION OF MOVING ARCING CONTACT
703	SPANNER C	1	 2 KG	INSPECTION OF STATIONARY ARCING CONTACT
712	VACUUM PUMP	1	 0.3 KG (66 Lb)	EVACUATION
713	ADAPTER V	1	 0.3 KG (0.7 Lb)	EVACUATION AND GAS SUPPLY
714	LARGE DIA. HOSE	1	 6.0 KG (13.2 Lb)	EVACUATION AND GAS SUPPLY
717	SMALL DIA. HOSE	1	 1.0 KG (2.2 Lb)	GAS SUPPLY

Note : all dimensions & weights are for identification only.

TABLE : 6.5 CONTD....

PART NO.	NAME	QTY	SKETCH (WEIGHT)	USE
718	REGULATOR	1	 Regulator 1.0 KG [2.2 Lb]	GAS SUPPLY
721	ADAPTER F	1	 [2.36 IN] 60 41 [1.61 IN]	GAS SUPPLY
724	JACK BAR	1	 Ø 24 [0.95 IN] 380 [14.96]	MANUAL OPERATION
725	BEARING	1	 Ø 20 Ø 12 [2.05 IN]	MANUAL OPERATION
726	NUT	1	 Ø 50 [1.97 IN] 1500 [59.06 IN] 75 [2.95 IN]	MANUAL OPERATION
727	SOCKET	1	 Ø 50 [1.97 IN] 202 [7.95 IN]	MANUAL OPERATION
728	RING PLIERS STRENGTH	1	 8 [0.31 IN] 155 [6.10 IN]	ATTACHMENT OF "G" RING

Inspection and Maintenance

TABLE : 6.5 CONTD....

PART NO.	NAME	QTY	SKETCH (WEIGHT)	USE
729	RING PLIERS BENT	1	<p>65 12.56 IN 150 [5.91 IN]</p> <p>0.4 KG (0.9 Lb)</p>	ATTACHMENT OF "G" RING
730	SUPPORT - H	1	<p>200 150</p>	LIFTING OF POLE
731	NYLON ROPE	1	<p>1.5 m</p>	LIFTING OF POLE
732	RATCHET WRENCH	1	<p>200</p>	MANUAL CHARGING OF CLOSING SPRING
733	EXTENSION BAR	1	<p>200</p>	MANUAL CHARGING OF CLOSING SPRING
734	SOCKET	1	<p>17 mm</p>	MANUAL CHARGING OF CLOSING SPRING

SECTION 7 - TROUBLE-SHOOTING GUIDE

The reliability of the circuit breaker is verified by design tests in various conditions and in general no trouble ought to occur. If the faults are nevertheless experienced, they can have only a few causes. The faults and contingent causes are shown in Table 6.

Table 6. Trouble-Shooting Guide

No.	Kind of Trouble	Causes	Inspection Items and Counter measures
1.	Electrical closing	1.1 Low or Loss of power supply	Check whether control voltage is kept more than minimum operating voltage.
		1.2 Trouble of electrical control system	Check the wires for disconnection, terminals for looseness, closing coil, auxiliary switches.
		1.3 Others	Check whether manual closing operation is possible or not.
2.	Manual closing is impossible	2.1 Poor adjustment or mechanical abnormality of plunger for closing coil	Adjust the gaps "G.C1", "G.C2", and "G. C3" and the stroke "S.C." as shown in Fig. 18-(B) and Table 6.4 or replace the abnormal parts.
3.	Electrical opening is	3.1 Low or Loss of power is supply	Check whether opening control voltage is kept more than minimum operating voltage.
		3.2 Trouble of electrical control system	Check the wires for disconnection, terminals for looseness, trip coil, gas pressure switch, auxiliary switches etc.
		3.3 Others	Check whether manual opening operation is possible or not.
4.	Manual opening is impossible	4.1 Poor adjustment or mechanical abnormality of plunger for trip coil	Adjust the gaps "G.T". and the stroke "S.T." as shown in Fig. 18 (A) and Table 6.4 or replace the abnormal parts.
5.	Low gas pressure	5.1 Gas Leakage	Supply the SF6 gas and search for the leak point.
		5.2 Trouble of electrical control system	Check the wires for disconnection, terminals for looseness, coils, gas pressure switches, etc.

SECTION 8 - PARTS LIST

No.	Parts List	No.	Parts List
100	Interrupter Unit	500	Spring Operating Mechanism
101	Absorbent (zeolum F-9)	501	Trip Spring
102	Interrupter Porcelain	502	Closing Spring
103	Moving Contact	503	Ratchet Wheel
104	SF6 Gas	504	Closing Holding Latch
105	Puffer Cylinder	505	Closing Trigger
106	Piston	506	Closing Coil
107	Fixed Finger Contact	507	Trip coil
108	Contact Holder	508	Cam
109	Stationary Arcing Contact	509	Ratchet
110	Stationary Main Contact	510	Lever A
111	Nozzle	511	Lever B
112	Moving Arcing Contact	513	Trip Holding Latch
113	Piston Rod	514	Pin A
114	Lower Terminal Flange	515	Anti-pumping Lever
115	M12 Jack Bolt	516	Pin B
116	O Ring G220	517	Cam Shaft
117	O Ring G175	518	Ratchet Shaft
118	Bolts, Nuts and Washers (6-M 1 Ox60)	519	Anti-pumping Pin
200	Support Unit	520	Plunger
201	Support Porcelain	521	Roller
202	Insulating Rod	522	Spring A
203	Slide Seal Assembly	523	Spring B
204	Gas Valve A	524	Spring C
205	Gas Valve B	525	Core of Trip Coil
206	Gas Valve C	526	Plunger
207	Rupture Disc Assembly	527	Core of Closing Coil
300	Frame	528	Trip Prevention Pin
301	Copper Gas Pipe	529	Close Prevention Pin
302	Horizontal Rod	530	Shock Absorber
303	Connecting Bolts (2 x 4 - M20 x 40)	600	Supporting Structure
400	Mechanism Housing	601	Upper Terminal
401	Temperature Compensated Gas Pressure Switch	602	Lower Terminal
402	Gas Pressure Gauge		
403	Gas Feed Port		
404	Cover		
405	Gas Valve D		
406	Gas Valve E		
407	Blank Cover		
408	O Ring (P18)		

SECTION 8 - PARTS LIST

No.	Parts List	No.	Parts List
701	Spanner A	718	Regulator Handle
702	Spanner B	719	Regulator
703	Spanner C	721	Adapter F
712	Vacuum Pump	722	Adapter D
713	Adapter V	723	Gasket
714	Large Dia. Hose	724	Jack Bar
717	Small Dia. Hose	725	Bearing
		726	Nut
		727	Socket
		728	Ring Pliers Straight
		729	Ring Pliers Bent.
		801	SF6 Gas cylinder
		802	Valve of Gas Cylinder
		803	Blank Cap
		805	Adapter A
		806	Adapter B

Note

1. Standard special tools are Parts Nos. 701 to 703 & 717 to 729
2. Evacuation tools (Parts Nos. 712 to 714) are optional and provided by customer's order.

APPENDIX A - SF6 GAS SEALS

This instruction describes the procedure for making a leak tight seal for bolted O-ring joints of size 32 mm and larger on SF6 gas filled equipment. The gas sealant is applied to the complete surface of the flange face between the O-ring groove and the outside edge of the flange to eliminate corrosion caused by water entering between the flanges. For sizes less than 32 mm the entire groove shall be filled with sealant.

NOTE : Do not reuse O-rings from previous gas sealed joints.

1. Material

Gas sealant Anabond/Silastic 681

Ethanol / Toluol / Thinner / Petrol

Clean waste cloth

Plastic Spatula

Plastic hammer

2. Installation of O-ring

Clean the O-ring groove, flange face and adjoining sealing surface with clean waste cloth moistened with ethanol, toluol or thinner. Use a plastic spatula (plastic paint scrapper) to remove old gas sealant. Dry the groove and sealing surface. Inspect the groove and the sealing surface for defects such as nicks, dents, lint or dirt. Inspect the O-ring for cuts, pits or other surface defects and dust. Clean the O-ring with ethanol, dry it and place it in the groove to check that it is the proper size.

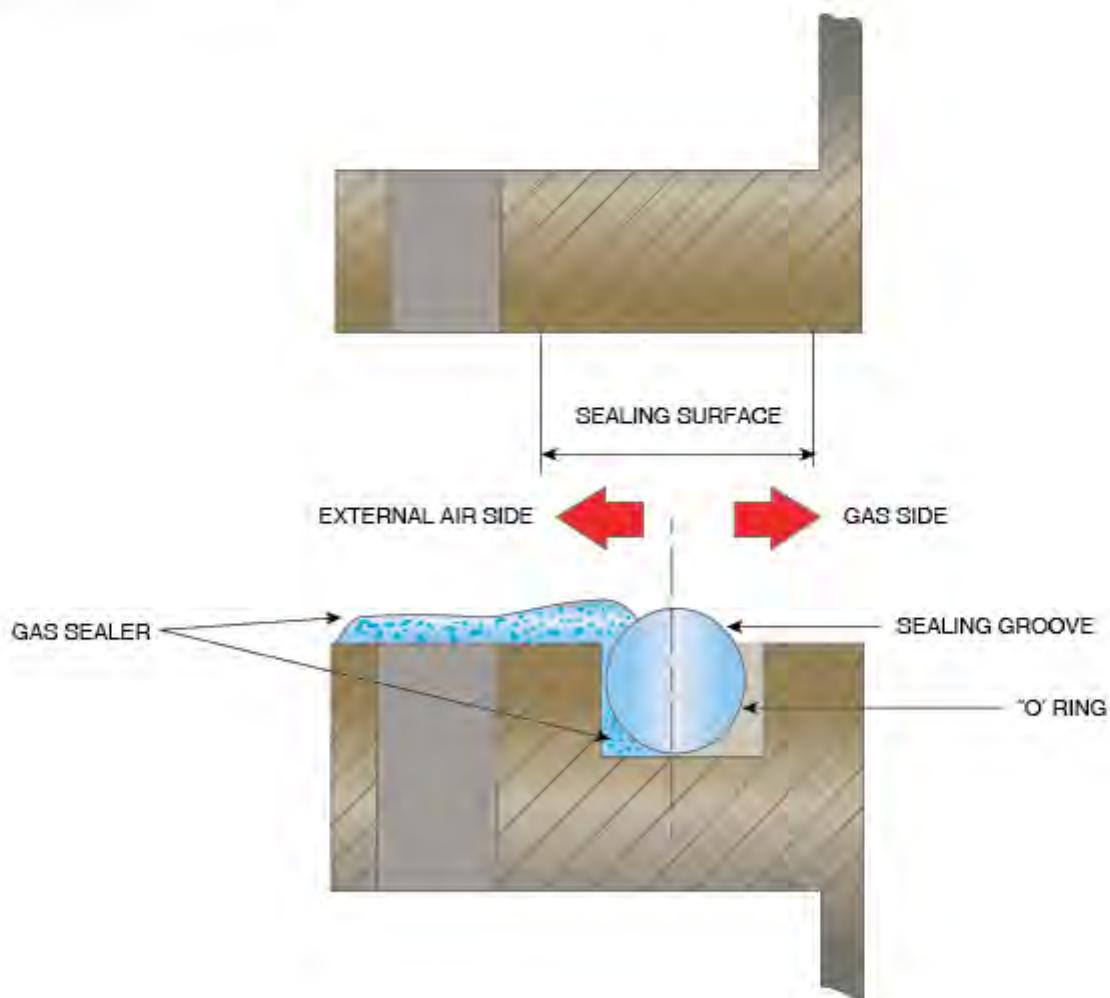


FIG. A1

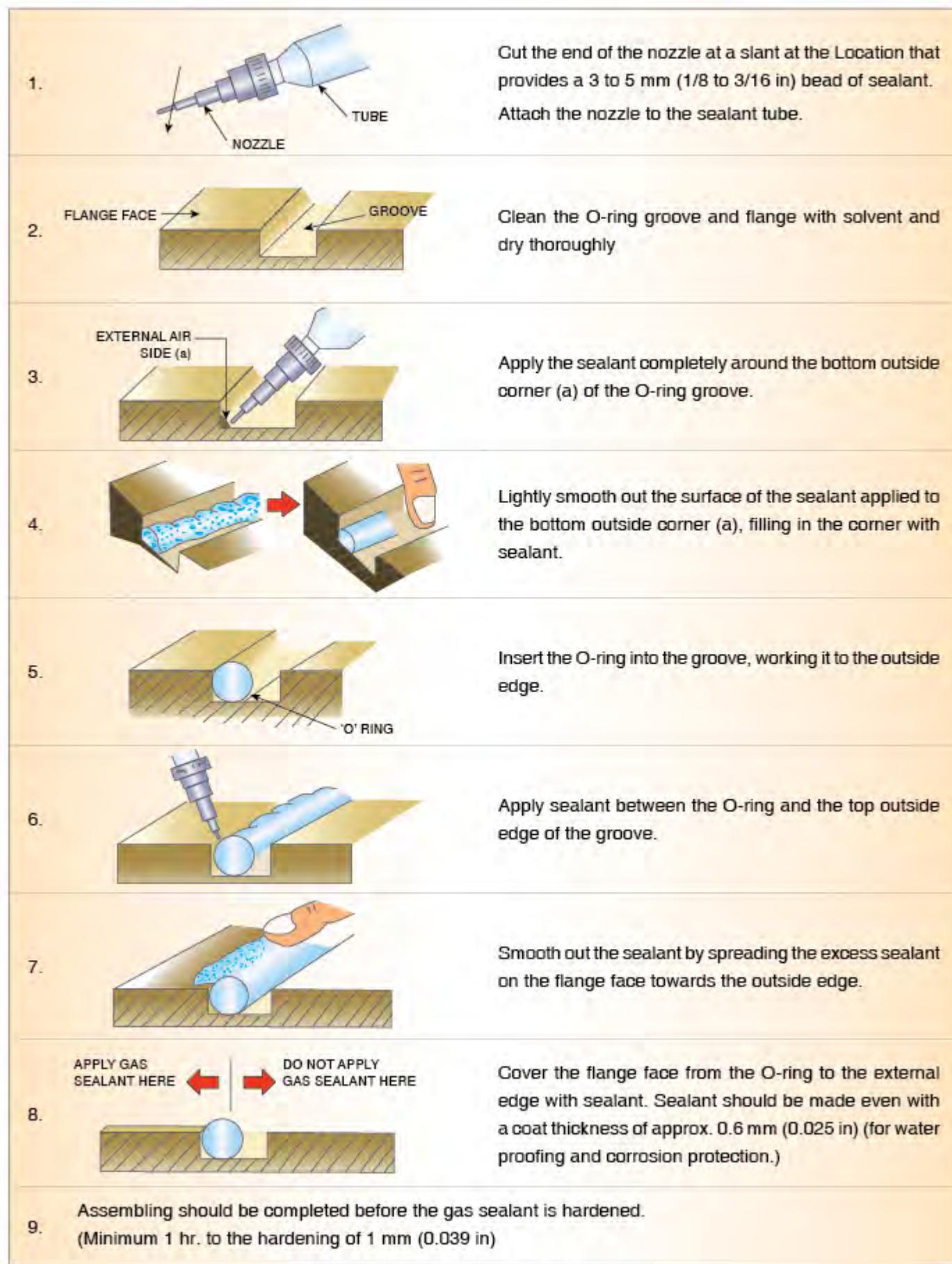


Fig A2 Application Procedure for Gas Sealant

Torquing of Bolts

APPENDIX B - TORQUING OF BOLTS

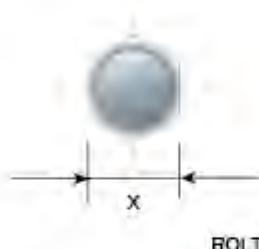
These instructions cover the torque values and standard method for the tightening of bolts on circuit breakers.

1. Torque Values

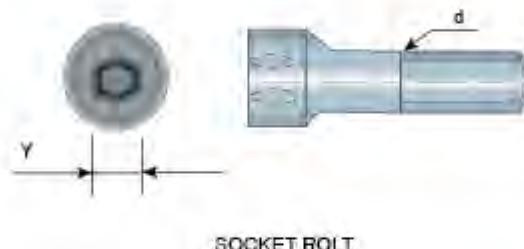
Torquing the bolt is recommended to obtain uniformity in the bolt loads and to avoid the possibility of bolt failure in pressure tight joints. When a number of bolts

are used to fasten two parts together, the load carried by each bolt depends on the tightness of the bolt relative to the other bolts; the tighter the bolt the greater the load.

The standard torque values are for metal-to-metal bolted joints for various sizes of bolts.



BOLT



SOCKET BOLT

Table B. 1

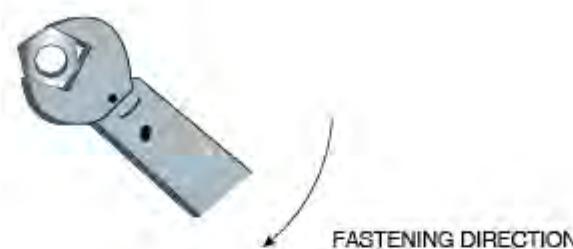
Size d	Dimension		Fastening Torque		
	X (FOR BOLT)	Y (FOR SOCKET BOLT)	kg - cm	N - m	1 b - ft
M6	10	5	60	5.9	4.3
M8	13	6	140	13.7	10.1
M10	17	8	280	27.5	20.3
M12	19	10	480	47.1	34.7
M16	24	14	1200	118	86.8
M20	30	17	2200	215	159
M24	36	19	3900	382	282
M30	46	22	7700	755	557

2. Torquing Sequence

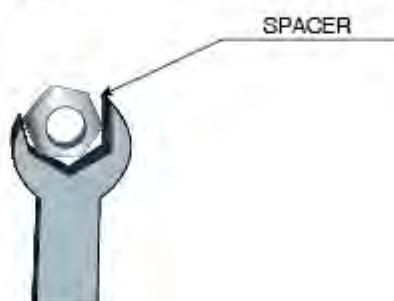
Torque the bolts in a diametrically opposite / diagonally opposite order with a torque wrench. The sequence should be repeated to assure the bolts are tightened to the proper torque.

3. General Cautions

(1) Use the spanner as shown



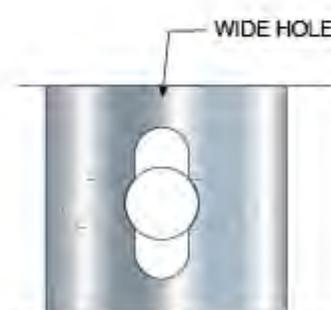
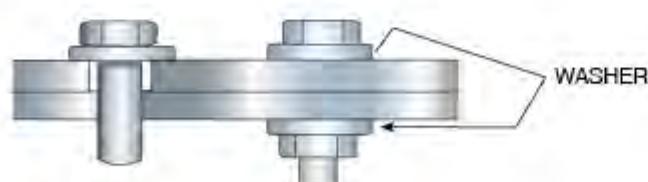
(2) Do not use any spacer between the bolt and the spanner



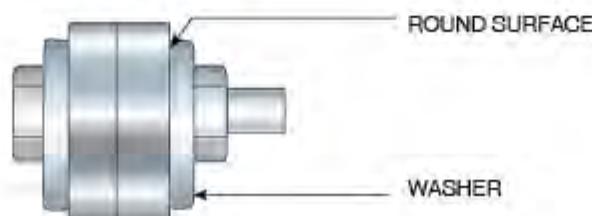
(3) Standard of fastening thread length



(4) Use washers to protect insulation surfaces and non-ferrous metals and for wide holes.



(5) The washer should be inserted as shown.



'C' Type Retaining Ring

APPENDIX - C ATTACHMENT OF 'C' TYPE RETAINING RING

1. Scope

This sheet describes the attachment of the "C" type retaining rings (Circlips.) As correct attachment of these rings is critical, set them in accordance with this instruction.

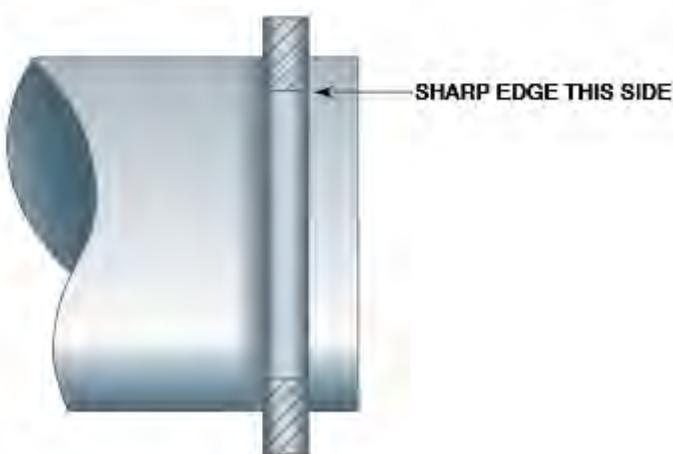
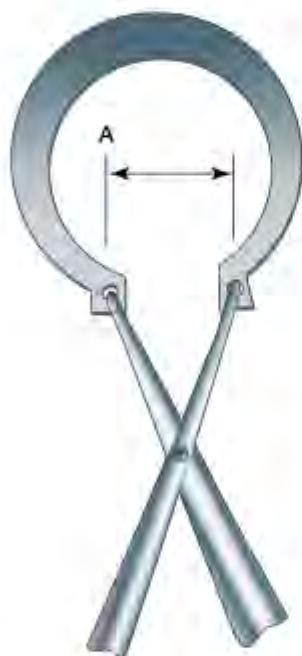
2. Instruction

- 1) When the 'C' ring is attached, use the suitable retaining ring plier for the size of 'C' ring. For example, tool no 728 and 729 (standard tool) are applicable to the 'C' ring of sizes 8 to 20.
- 2) During setting, the distance between both small holes of 'C' ring shall not enlarge more than dimension A shown on table 1

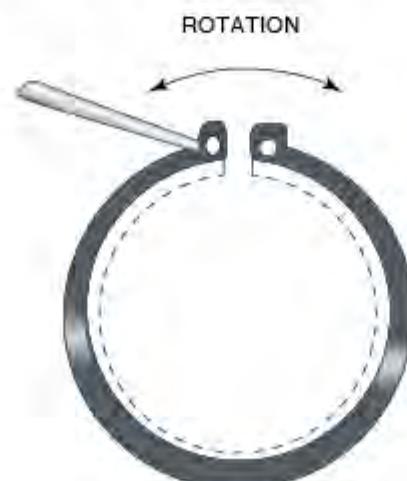
Table 1

Size of 'C' ring	Dimension A
10	8.0 mm (0.31 in)
13	11.0 (0.43 in)
16	14.0 (0.55 in)
20	13.5 (0.53 in)

3. A C-ring has one sharp edge and one rounded edge. During setting make sure the sharp edge of C-ring is facing to outside of the bar pin as shown in the fig on the right side.



After setting the C-ring should be rotating inside its groove when pushed by ring plier.



APPENDIX D - LUBRICATION

The correct lubricant must be applied and used as specified in the instruction book.

1. Application of Lubricants

Darina Grease # 2	Linkage in SF ₆ gas, & air
Shell Oil Co.	Mechanism.
Microcarbon Grease	Interrupter contacts
Kyodo Oil Co.	

2. Procedure

(a) Clean the various parts of the switchgear to be

greased. Remove the former grease, oil, water and dust.

- (b) Keep the lubricants and greases clean and free of contaminants. This can be confirmed by feeling the grease between the fingers.
- (c) Apply the grease thinly and uniformly to the parts.
Note : Do not mix different greases.
- (d) Assemble the parts before the greases or parts become contaminated with dust or dirt.

Electrical Joint Compound

APPENDIX E - APPLICATION OF ELECTRICAL JOINT COMPOUND

These instructions cover the application of electrical joint compound to connect high voltage connections made of aluminium.

1. Joint Compound Material : JOINTAL - Z (Green)
2. Aluminium forms a thin film of oxide on its surface when exposed to air, and very quickly develops the film. This oxide film protects the metal from further corrosion, however, the film of oxide has a high value of resistance and acts as an insulator. The oxide film must be removed and joint compound should be applied to the connection surfaces in order to maintain the efficiency of the metals as a connector. The joint compound also helps in penetrating the film of oxide during the cleaning process.

3. Procedure

Apply a coat of the joint compound to the connecting surfaces of the connectors.

Remove the oxide film with 'Scotch-Brite' or nonmetallic abrasive paper. Wipe off the joint compound that contains metal particles.

Apply new joint compound thinly to the connecting surfaces within three minutes after the previous compound is removed. Bolt any connectors together.

Remove any excessive joint compound.

NOTE : Do not use a brush or abrasive paper on silver plated or tin plated connectors.

Lightly buff the surfaces to a bright finish.

Weather Sealing

APPENDIX F - WEATHER SEALING

These instructions cover the weather sealing of joints and hardware to prevent corrosion of the equipment. Outdoor high voltage circuit breaker are exposed to all kinds of weather. Moisture and other pollutants react to cause serious damage to the equipment. The following weather sealing procedure are recommended to reduce the corrosion and extend the life of the equipment.

1. Weather Sealant Material Anabond 680

2. Application

The weather sealant should be applied sufficiently to the entire area to eliminate the penetration of moisture into the joints.

The surface and parts to be sealed should be clean - and free from any deposit of the solvent used for cleaning.

Where the sealant is applied between mating surfaces, the assembly of parts should be completed within one hour before the sealant hardens. The minimum set time is one hour for 1 mm (0.025 in) layer.

3. General Cautions

- Do not mix the weather sealant with any other grease or water.
- Smooth out the weather sealant which extrudes from flange surfaces.
- Replace the cap to the tube of weather sealant before storing.

4. External Joints

The joint between the flanges and the hardware, particularly in the horizontal position, should be sealed with the weather sealant.

Optional Tools

APPENDIX G - OPTIONAL TOOLS (AVAILABLE ONLY WHEN SPECIFICALLY ORDERED)

Table G1

Tool name	Part No.	Specn	Use	Type Designation
Socket	OP - 1	17 mm	Manual operation and m10 bolts of contact holder	Tone 4D-17
	OP - 2	24 mm	Inspection of moving and stationary arcing contact	Tone 4D- 24
	OP - 3	30 mm	Manual charging	Tone 4D-30
Extension Bar	OP - 4	250 mm	Manual charging	Tone 407
Ratchet Wrench	OP - 5		Manual operation and manual charging inspection of nozzle	Tone 371
Torque Wrench	OP - 6	400 to 1800 kg-cm	Inspection of moving arcing contact and stationary arcing contact	TOHNICHI 1800 QL
	OP - 7	200 to 900 Kg-cm	10 M bolts of contact holder	TOHNICHI 900 QL
Torque Wrench	OP - 8	60 Kg-cm	Inspection of cover for absorbent	TOHNICHI 10 x 80 SP x 60 kg. cm
Vacuum pump	712	150 l/min	Evacuation of circuit breaker	
Adapter V	713	3/4"	Evacuation of circuit breaker	
Large Dia Hose	714	3/4"	Evacuation of circuit breaker	

APPENDIX H - APPLICATION OR RENEWAL OF ABSORBENT

These instructions covers the installation or renewal of absorbent in SF₆ gas compartments

1. Purpose of Absorbent

Absorbent is used in the SF₆ gas enclosures to maintain a dry atmosphere. The absorbent should be replaced when the gas enclosures is opened.

2. General Cautions

The time from removing the absorbent from its container and plastic bag until it is inside the sealed SF6 gas compartment should be less than two hours.

The SF₆ gas enclosure should be evacuated as soon as possible after the absorbent is placed inside the equipment.

Do not directly expose the absorbent to moisture like rain or high relative humidity.

3. Absorbent Material and Accessories

The absorbent is a molecular sieve material and is available in bulk form in sealed containers.

Loctite Adhesive, blue # 242 (or equivalent)

4. Renewal of Absorbent

Renewal of the absorbent should be done every time the interrupting unit is opened. The absorbent should

not be left in the open air and hence it is recommended that it is filled just before replacing stationary contact after inspection.

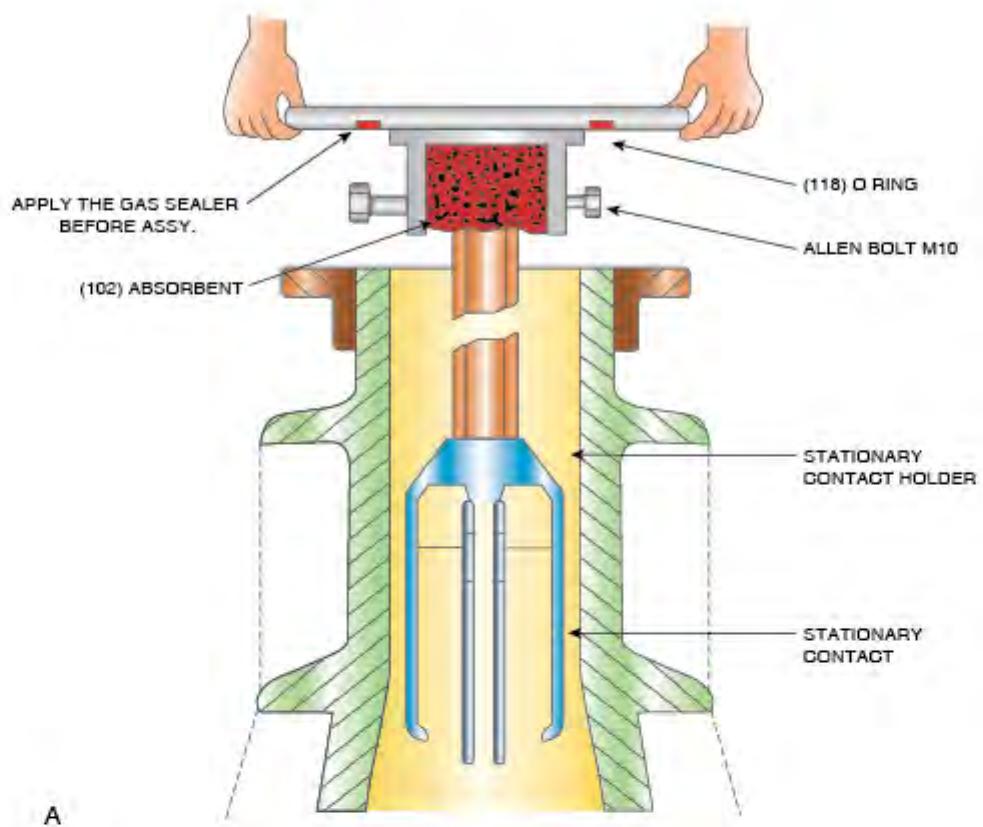
Absorbent (102) is contained in the stationary contact holder.

One interrupting unit has approx. 250 gm. of the absorbent To take out the absorbent unscrew the Allen Bold M10 bolt (Black) near flange and take up shield & Aluminium mesh & hold stationary contact holder in horizontal position and shake. After removal of old absorbent pour fresh one & tighten with M10 Allan Bolt. Filling of absorbent is to be done first prior to assembly of stationary contact holder with the interrupter porcelain (Ref. Fig. 6.2A). Clean the contact surface of the flange of the stationary contact holder.

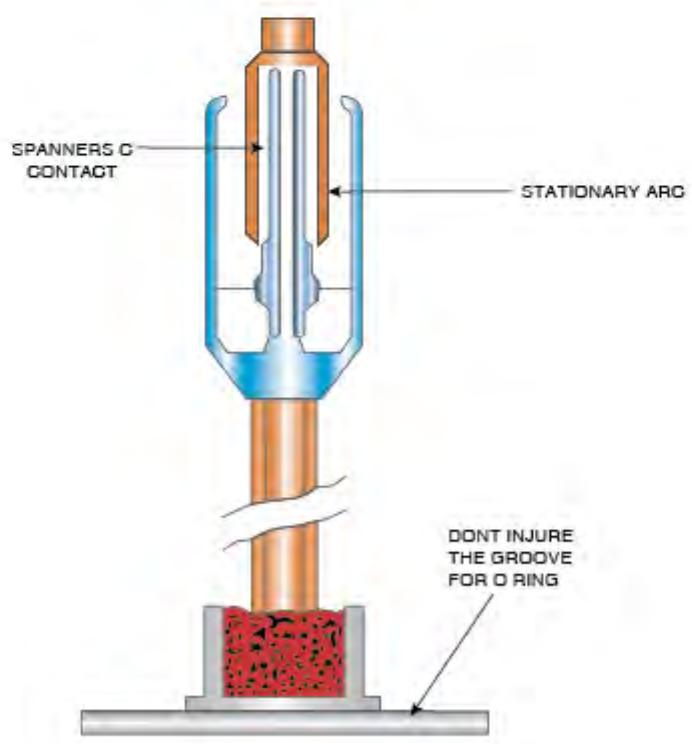
Put new 'O' Ring (118) and gas sealer on the contact surface.

The surface of the 'O' Ring (118) should be free of scratches and dust in order to prevent the gas leakage. Reset the stationary contact holder so that its stationary arc contact mates with moving arc contact. Tighten M16 bolts on the flange. Brush the contact surface of both the upper terminal and the upper terminal flange with emery cloth finer than 400. After cleaning the contact surface, coat them slightly with joint compound.

Application or Renewal of Absorbent



A

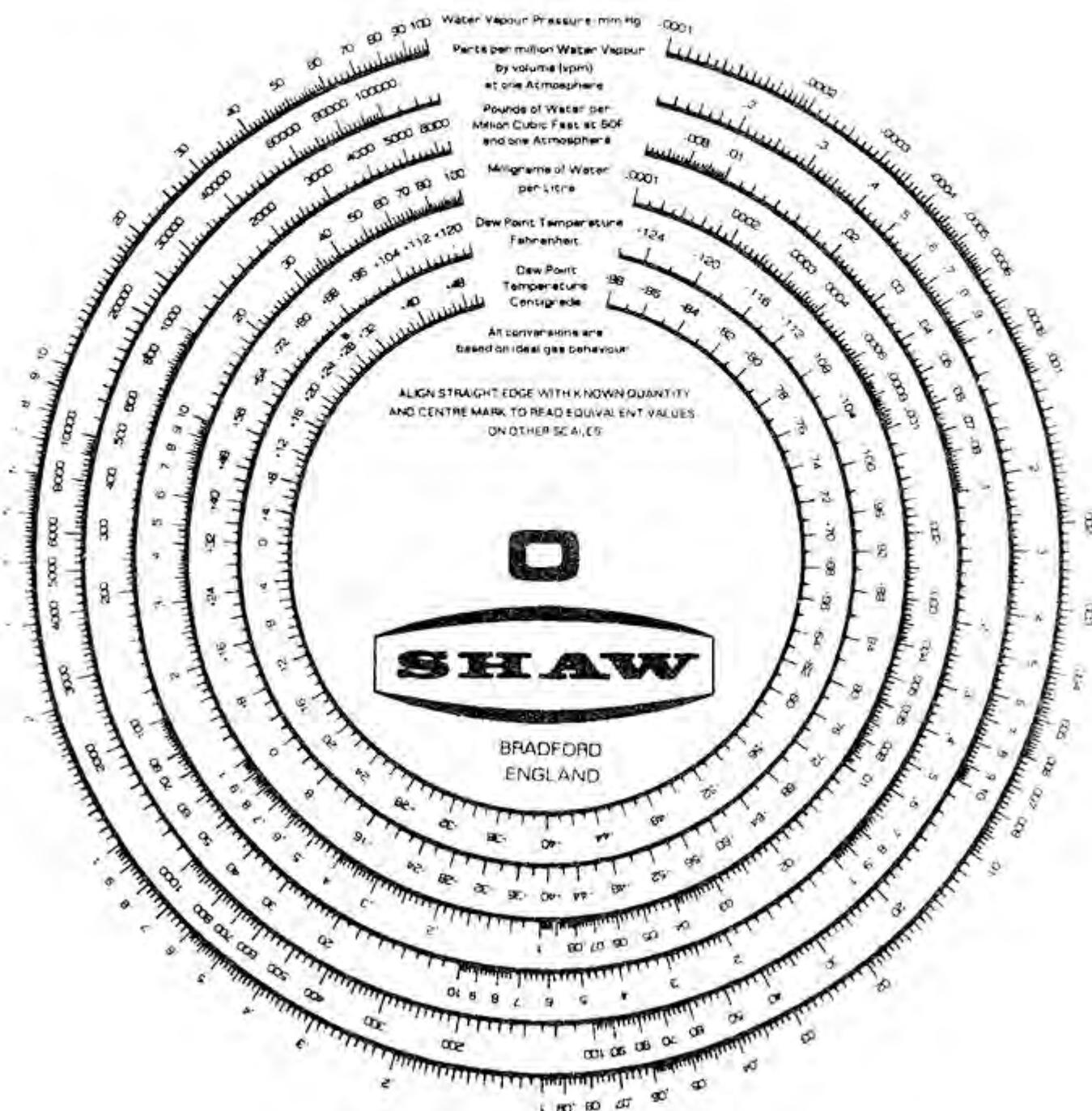


B

FIG. 6.2

APPENDIX I - MONITORING OF DEW POINT IN SF₆ BREAKERS

- 1) Recommended Instruments
SHAW MOISTURE METERS U.K.
- 2) Allowable moisture content
200 PPM by weight
1600 PPM by volume
Corresponding Dew Point - 15°C
- 3) Recommended frequency of monitoring:
3 years after installation and once in a year thereafter.



APPENDIX K - DILO GAS VALVES

1.0 This section covers the construction and features of DILO type gas valves which are used in the breaker in place of regular gas valves.

2.0 Construction :

General arrangement of DILO gas valve is shown in Fig. K1.1. It consists of male housing (1), coupling nut (2), Female housing (3), connecting nut (4), & end connector (5), End connector (6) is brazed to the copper pipe. Inside male & female housings there is needle type valve assembly. The gas valve opens when the coupling nut (2) is tightened on to male housing (1) in clockwise direction. The valve closes when coupling nut is loosened in anticlockwise direction. The connection of gas isolating valve and gas feed valve to pole unit is shown in Fig. K 1.2.

3.0 Connection to gas pipe :

Isolating value B is having a blank cap on it's male housing. Remove this blank cap.

The gas pipe is to be connected to pole unit (Fig. K1.3.) For this first turn the coupling nut (2) on to the male housing (1) slightly. Then tighten connecting nut (5) in the gas pipe on to the threads of female housing (4). This will connect the isolating valve (Valve B) to the pole unit. At this point the isolating valve is still closed.

Now tighten coupling nut of isolating valve fully. At this point the SF6 gauge will show the positive pressure (0.2 to 0.5 Kg /cm²). This makes sure that the pole is partly filled with SF6 gas. Otherwise the pole has to be evacuated as per item 5 below.

4.0 Gas Filling :

Gas feed valve (Valve A) is having a cap on its male housing. Remove this cap. Connect the coupling F (consisting of coupling nut, female housing and connecting nut) to the male housing by tightening the coupling nut on to the threads on male housing for one or two threads. Again loosen the coupling nut so that the feed valve gets closed.

Attach gas regulator to gas cylinder. Now connect 1/4" dia hosepipe to the end connector on the connecting nut of gas valve loosely and to the regulator on the other

end tightly. Never hold the gas regulator with hand for tightening, instead grip the ends with spanner. Keep the cylinder in its upright position near the breaker and remove undue bends and twists of the pressure hose.

The pressure regulator opens when the opening screw is screwed in and closes when it is screwed out. Make sure that the regulator is shut. Now open valve C on the gas cylinder. The high pressure gauge will read the cylinder pressure. Slowly open the gas regulator till gas hoses out. The SF6 gas will drive out the air in pressure hose from the loose end. Now tighten the loose end of the pressure hose. Open the feed valve under the pole. This is done by tightening the coupling nut fully on to the male housing of the valve.

Fill the gas to the required pressure as per Fig 8-C Now close valve A, C & D in sequence.

Disconnect the hose from coupling F. Remove coupling F from feed valve and attach blank cap in its place Pressure coupling F carefully.

5.0 Evacuation of Pole :

Remove the blank cap under the feed valve A. Connect the coupling F to the valve. Tighten the coupling nut fully so that the valve opens and any trace of gas inside the pole is driven out.

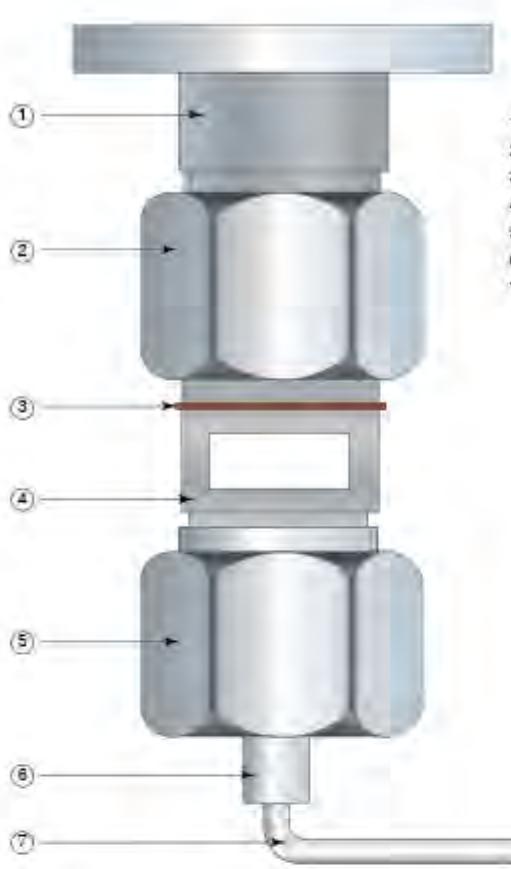
Now make the connection as shown Fig. K 1.4 Connect 1/4" hose pipe to coupling F on the end and adapter E on the other end Connect 3/4" hose pipe to adapter E on one end & to the section of vacuum pump on the other end.

Ensure oil is filled in the vacuum pump to the level marked. Start the vacuum pump and watch the gas pressure gauge. As the pump goes on evacuating the needle will fall on the red band. After approximately 30 minutes the needle will show 76 cm. After the continue to run the pump for further 45 minutes. Then close the feed valve A tightly by loosening the coupling nut.

Disconnect the 1/4" hose pipe. Remove coupling F.

Disconnect adapter E from 1/4" & 3/4" hose pipes.

Preserve coupling F & adapter E.



1. MALE HOUSING
2. COUPLING NUT
3. EXT. CIRCLIP
4. FEMALE HOUSING
5. CONNECTING NUT
6. END CONNECTOR
7. CU-PIPE

NOTE :-

- 1) GAS VALVE AUTOMATICALLY OPENS BY TIGHTENING THE COUPLING NUT (ITEM NO. 2) GAS VALVE AUTOMATICALLY CLOSES BY LOOSENING THE NUT (ITEM NO 2)
- 2) OPERATE ONLY COUPLING NUT (ITEM - 2) FOR OPENING AND CLOSING OF GAS VALVE
FOR OPENING - TIGHTEN THE NUT "FOR CLOSING - LOOSEN THE NUT"
DON'T DISTURB CONNECTING NUT (ITEM -5)

FIG. K 1.1 DILO GAS VALVE ASSEMBLY

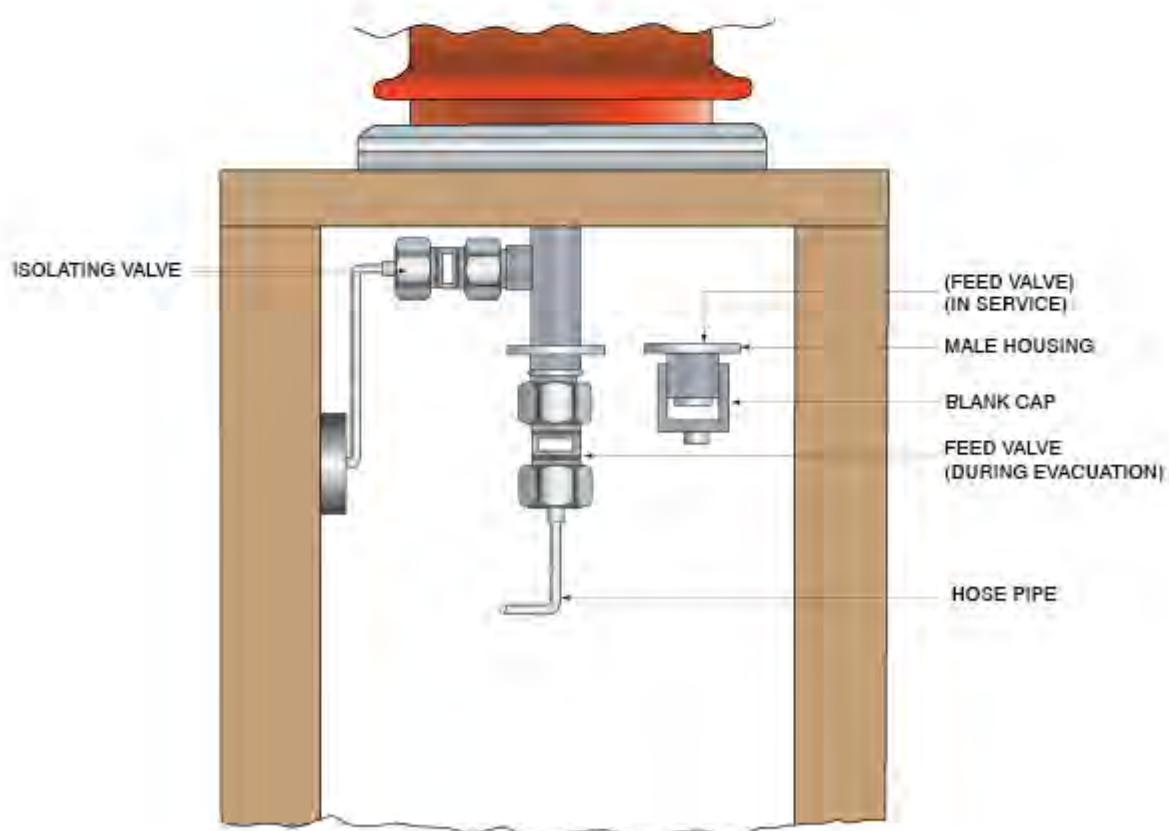


FIG. K 1.2 ASSEMBLY OF DILO VALVE POLE UNIT

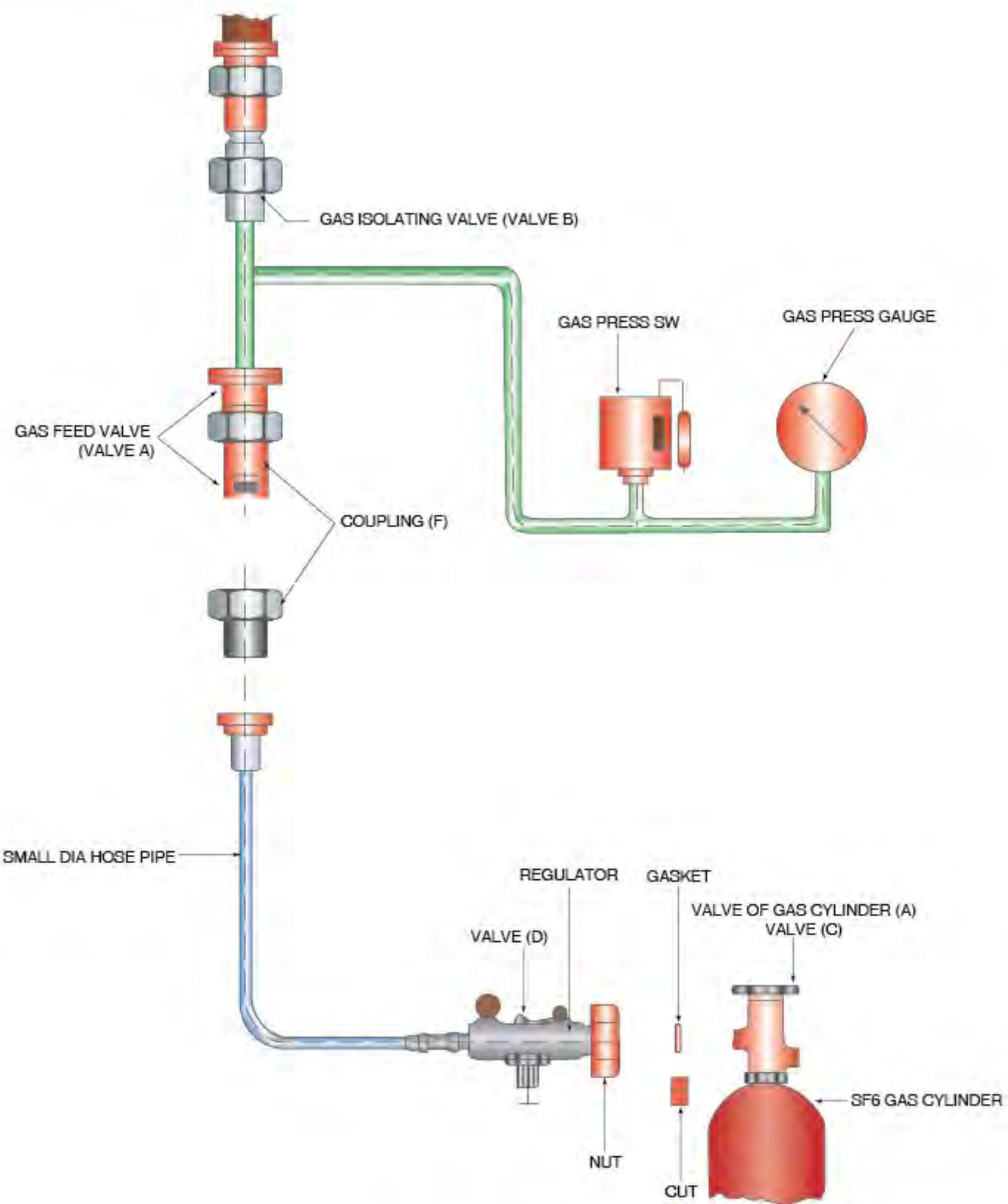


FIG. K 1.3 GAS FILLING

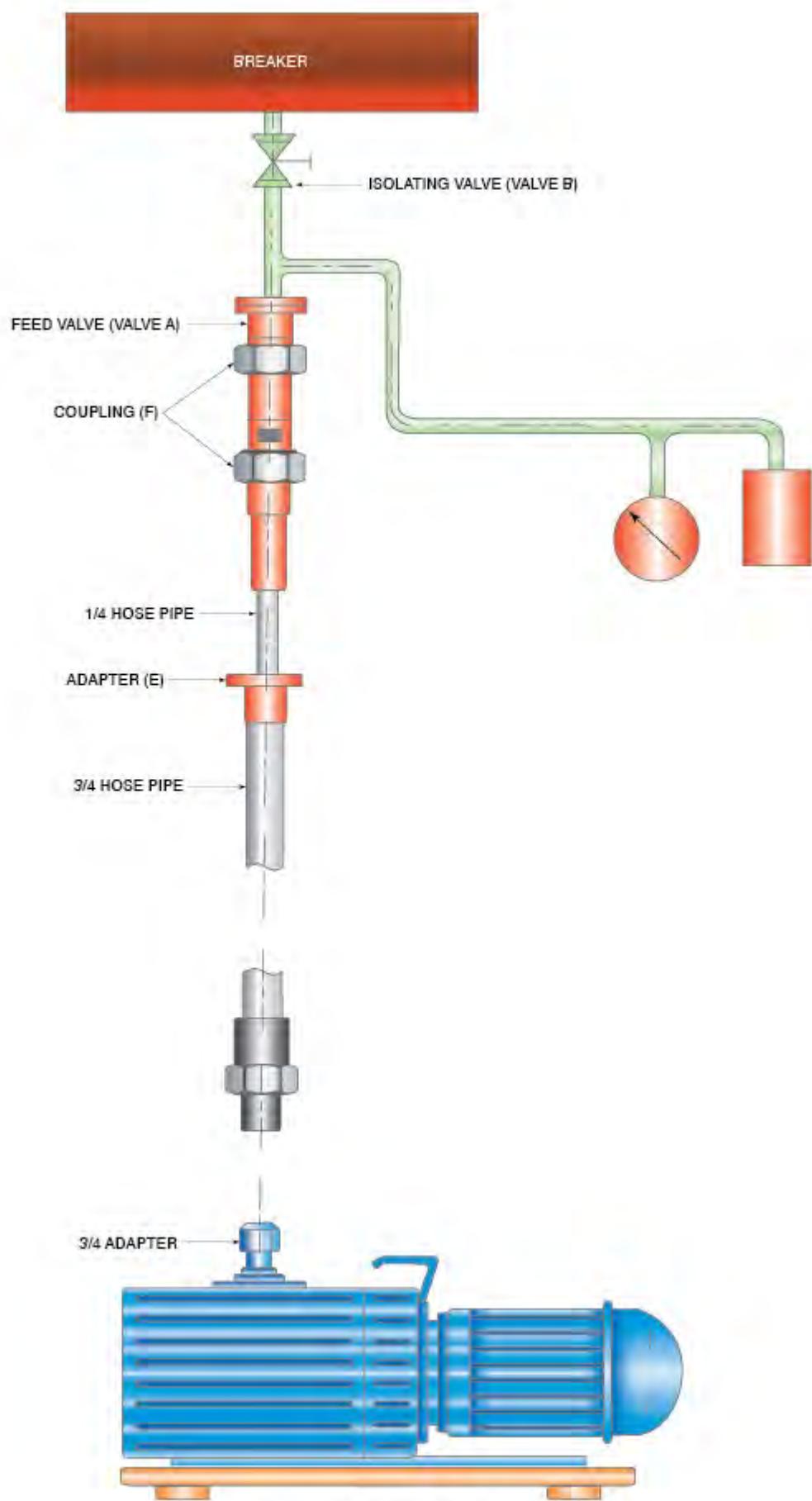


FIG. K 1.4 GAS EVACUATION

Instructions For Disposal Of Product

INSTRUCTIONS FOR DISPOSAL OF PRODUCT

The disposal procedure for various materials of Gas Circuit Breaker is as given below:

a) After unpacking of products at site, packing material in form of wood or steel is to be recycled. Always keep these wood and steel in dry place to avoid soil and water pollution.

b) After useful life of product is over, the breaker is to be dismantled. The gas to be removed using gas handling plant to prevent its escape to air. For all the remaining materials of breakers the disposal procedure is as below.

Sr. No.	Material	Environmental Hazardous	Handling/Storage/Disposal method
1.	Used contacts	No	Recycle/reuse
2.	Nozzle (PTFE)	No	Recycle/reuse
3.	Moisture absorbent	Yes	Refer local regulations for disposal procedure.
4.	Porcelains	No	To be crushed & used for filling. Refer local regulations for disposal procedure.
5.	Steel Components	No	Recycle/reuse
6.	Copper Components	Yes	Recycle/reuse
7.	Brass Components	Yes	Recycle/reuse
8.	Aluminium Components	No	Recycle/reuse
9.	Gaskets	No	Recycle/reuse
10.	SF6 Gas	No	Refer instruction manual for handling procedure
11.	Shock Absorber Oil	Yes	To be incinerated to authorized recycler

Note : For disposal of hazardous waste please refer local regulation.

CHECK LIST FOR COMMISSIONING OF SF6 GAS CIRCUIT BREAKER.

Page 1 of 2

Customer : Substation :

Type of GCB : 120 SFM 32B (GO) Breaker Sr. No. :

Year of Mfg : Installation Date :

Checks	Result	Acceptance Criteria
1. Installation sequence	OK / NOT OK	Correct sequence. (Same serial number & Phase of Poles mounted on same serial number & Phase of Mechanism Housing)
2. Foundation Leveling	OK / NOT OK	Check with spirit level
3. Hardware & Fastener Tightness	OK / NOT OK	Application of adequate torque
4. Manual spring charging operation	OK / NOT OK	OK
5. Slow closing operation of the interrupter unit		
i) Stroke (A1-A3) mm	150 (+2/-5) mm
ii) Wipe (A2-A3) mm	29 (\pm 2) mm

6. Gas system Pressure		All values at 20 Deg. (Refer Approved Drawing)
i) Rated Gas pressure		6.0 Kg/sq cm at 20 Deg.
ii) Low Gas Pressure alarm [PA] 63GA		5.5 Kg/sq cm (+/- 0.3)
iii) Low Gas Pressure alarm Reset		6.0 Kg/sq cm (+/- 0.3)
iv) Low Gas Pressure lockout [PL] 63GL		5.0 Kg/sq cm (+/- 0.3)
v) Low Gas Pressure lockout Reset		5.5 Kg/sq cm (+/- 0.3)
7. Spring charging mechanism		
i) Spring charging time		< 15 sec.
ii) Limit switch operation.		OK / NOT OK
8. Operational Test		As per schematic diagram
i) Electrical operation		
ii) ON/OFF indication Check		
iii) Antipumping Check		
iv) Lamp Heaters check		
v) Lockout Operation		
vi) Manual Tripping		
9. Coil Resistance		As per CB Drawings
i) Trip coil I		
Trip Coil II		
ii) Close coil		
10. Timing Test at Rated voltage	A B C	
A) Close		< 80 msec.
B) Open		
i) Trip Coil -1		< 37 msec
ii) Trip Coil - 2		
11. Insulation Resistance		
A) Breaker Open		> 1500 M Ohm
B) Breaker Close		> 1500 M Ohm
12. Gas Leakage Test		No Leakage at site.

Caution: Please ensure Isolating valves are kept OPEN and Feed Valve is kept closed before charging Breaker

Customers Representative:

CGL Engineer

Name:

Name:

Signature:

Signature:

Note: Drawing shown in this manual are for indicative purpose subject to change as per design development.

TROUBLE SHOOTING

DATE OF COMMISSIONING

BREAKER SR. NO.:

Fault Observed	SECTION	PAGE NO.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local CROMPTON GREAVES LIMITED office should be contacted.

Switchgear Poem

There occurs a fault
Then the current should halt
Otherwise the fault current will increase
& the service continuity decrease

But the relay acts quick
& the CIRCUIT BREAKER trips

The faulty part is disconnected
& the power system is protected

Thank you Mr. SWITCHGEAR
Because of you there is little fear !!

Our Major Customers :

International Customers :

ENDESA - Spain; ENEL, TERNA - Italy; KEPCO - Korea; TNB - Malaysia; TPC - Taiwan; CEB - Sri Lanka; NPPMB, CPPMB, SPPMB, HCMCPC, PC1, PC2, PC3, PTC4 - Vietnam; PGCB, REB, DESA, BPDB - Bangladesh; NPC Transco - Philippines; TXU, ERGON, AGL, POWERCOR, ETSA, TRANSGRID, INTEGRAL, ENERGEX - Australia; ZESA - Zimbabwe; NEPA - Nigeria; PEDEEE, PEEGT - Syria; KWPA, HREC, KHREC - Iran; EPE - Argentina; PT PLN - Indonesia; PEA, EGAT - Thailand; ESKOM, SPOORNET - South Africa; VRA, ECG - Ghana; KPLC - Kenya; AMPLA, COELCE, ELECNOR, COPEL, ELETROSUL, RGE - Brazil; EDELNOR, ELECTROSUR - Peru; Chillectra, EMEL, EFE - Chile; EDENOR, EDESUR, SECHEEP, EPE, TRANSBA - Argentina

SIEMENS - Germany, Thailand, Indonesia, Bangladesh, Turkey, India. AREVA - Indonesia, Singapore, Australia.

ABB - Norway, Turkey.

HYOSUNG; LG; HYUNDAI HEAVY IND; HYUNDAI ENGG; HYUNDAI CONST - Korea.

TRAFO - Brazil

CONCO - South Africa.

Domestic Customers:

POWERGRID, NTPC, NHPC, REL

Indian RAILWAYS, DMRC,

TNEB, APTRANSCO, APGENCO, KPTCL, KSEB

WBSETCL, DVC, JSEB, ASEB, CESC, OPTCL

GETCO, GSECL, MSETCL, MPPGCL, MPPTCL, CSEB,

RRVPNL, UPPCL, PSEB, HVPNL, DTL, UPPTCL, UPCL,

J&K GPDD.

All Major EPC Contractors like L&T, EMCO, SIEMENS, ABB, AREVA, IRCON, JSL etc. All Industrial Customers.

For any clarifications/feedback regarding installation and maintenance of GCB, kindly revert back to us.

For domestic

Sachin Thavare

From Services

Email: sachin.thavare@cgglobal.com

Tel.: 91-253-2301494/95/96

For Export

Bipin Deo

From Services

Email: bipin.deo@cgglobal.com

Tel.: 91-253-2301666

Crompton Greaves Limited

Switchgear Division : Power Systems

A-3 MIDC, Arbad, Nashik 422 010, Maharashtra, India

Tel.: +91 253 238 2271

Fax: +91 253 238 1247

E-mail: swgr.contact@cgglobal.com

URL: www.cgglobal.com

Regd. Office : 6th Floor, CG House,

Dr. Annie Besant Road, Worli, Mumbai - 400 030, India.



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