Outdoor Vacuum Circuit Breaker - Type OVB-SDB

Instruction for Storage, Installation, Service and Maintenance

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1.0 PACKING LEGEND AND HANDLING DURING TRANSPORTATION

1.1 Packing legend

Each case is marked with the case number on at least two sides (for exports - four sides) and gross weight on one short side.
Case number and gross weight are painted in black directly on the case. Other information is written on a plywood disc/label, which is max. 620 x 480 mm with a standard text height of 20 mm. If not otherwise specified by the customer. This plywood disk/label is fastened on two sides of the case.
In addition to the above, the cases are marked with the following symbols, in black. These should be observed when choosing lifting equipment.

- Glass porcelain handle with care

- Up

- Center of gravity

- Must be protected from moisture and rain

Fig. A

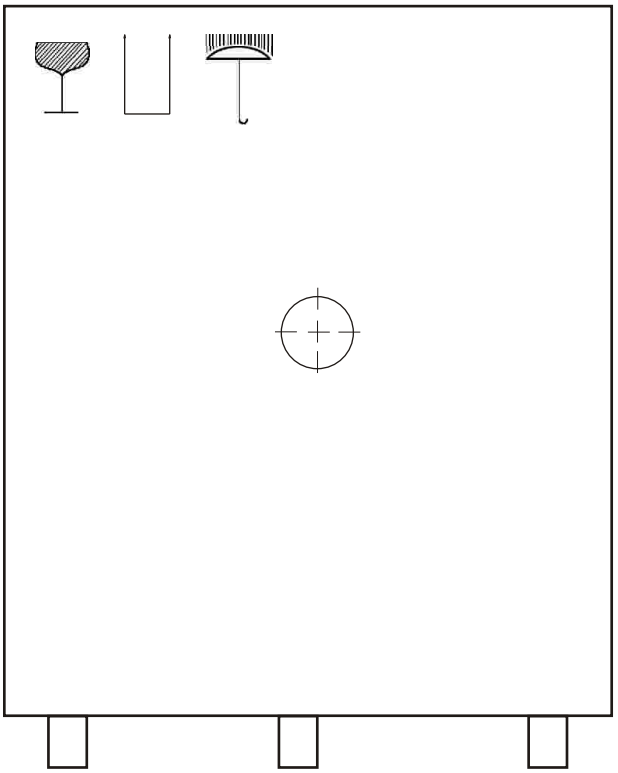


Fig. B

1.2 Handling during transportation

The circuit- breakers shall never be transported without packing.
The cases shell be transported in such a way that they:

- **Do not stand in water.**
- **Are not exposed to damage**

Every case must be secured during transport. They must be arranged so that the cases cannot move in any direction. The speed must be adapted to the road conditions.

- **Factory packed Breaker should not be stacked one over the other.**

1.3 Lifting

Before lifting the case, observe the information on it (such as symbol, weight, etc.). The cases shall be lifted by a lifting device equipped with forks or slings (see Fig C).
If a crane is used, slings shall be used. The units must not be rolled or dropped.

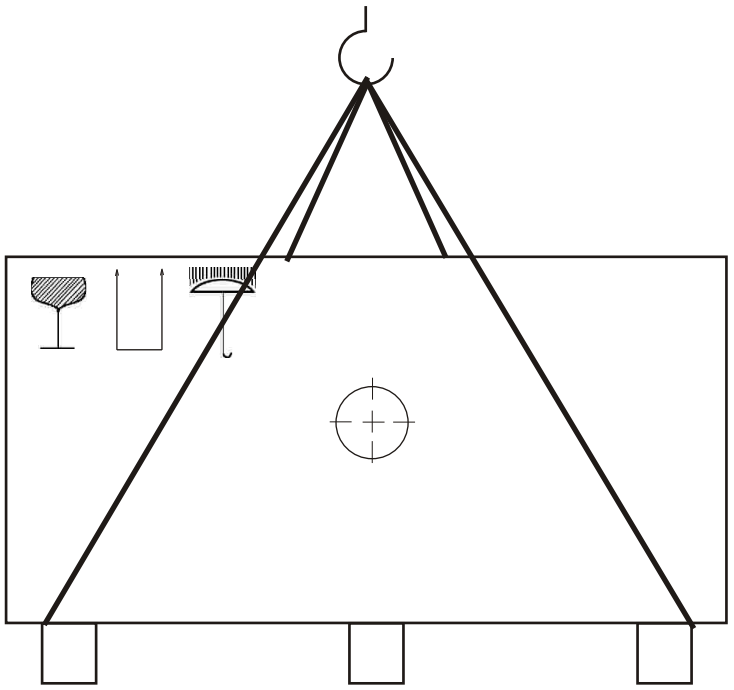


Fig. C Lifting the case

1.4 Lifting the breaker out of the case

Lifting the breakers out of the transport cases is necessary only just before erection (see product information kept inside the cabinet). If they are to be stored during some time, see "Storage Prior to Erection".

2.0 STORAGE PRIOR TO ERECTION

2.1 General

Circuit- breakers intended for outdoor operation are generally delivered in units, which are designed for transport purpose.

Intermediate storage of these units should be avoided. If it is not possible, then to avoid intermediate storage, they should be stored indoors or under roof. They must also be stored on a plane surface above ground level to prevent breaking and water seepage. On arrival it is important that plastic sheets are removed in order to prevent corrosion by condensation (except for the spare parts; see separate instructions).

Storage in a humid climate without proper ventilation may lead to discoloration of the galvanized surface. This discoloration is normally known as " White rust" consisting mainly of Zinc hydroxide and is a result of a chemical process between the pure zinc on the surface and moisture.

The long-term corrosion protection is not influenced, since the iron-zinc layer below the surface remains unaffected. The presence of white rust is no reason for rejection of goods.

On arrival, each unit should be checked in the following way:

- Delivery is in accordance with order and delivery documents.
- Any damage in delivery, and material loss.

In cases where damage is detected or suspected, the units should be opened and damages must be photographed. Both damage and shortages should be reported.

In general all material should be stored in an approved storage (Note 1, Page 8). The ambient air should not be heavily contaminated by dust, smoke, corrosive or combustible gases, vaporous and salt, otherwise the equipment must be cleaned before erection.

The original transport unit may be used for storage. The coupling joints of the assemblies, as well as connections, are fitted with transport covers or protective caps, which shall not be removed till erection.

- **Factory packed Breaker should not be stacked one over the other.**

The medium voltage circuit breaker type VBF is delivered firmly secured to the floor/ bottom of their containers or crates and must always be transported or stored with care. The circuit breaker is transshipped in suitable packing in the contact open position (off) and with closing spring discharged.

2.1.1 Receipt

Each delivery is to be checked on receipt for,

- Completeness and correctness. (Check against order and delivery documents)
- Any possible damage in transit and material losses.
- Abnormality, if any, must be notified immediately to: ABB, Nasik , forwarding agents and the insurance company.

2.2 Operating Mechanism

The operating mechanism should be unpacked on arrival. If it is not going to be stored in an approved storage (Note 1), the heating elements must be connected permanently to the electric supply to protect the control equipment from corrosion or freezing damage.

2.3 Circuit-Breakers

The breaker should be stored in their original transport units, where they are well protected from damage. The unit shall be prevented from standing in water. The breakers which are stored outdoors, should be covered with at least a tarpaulin. The tarpaulin should not be placed directly onto the galvanized surface. An air gap should be left to prevent condensation.

The minimum allowed ambient tem perature for the Outdoor Vacuum Circuit Breaker is -30°C.

2.4 Spare parts

The spare parts shall be stored indoors in an approved storage (Note 1), in their original units. This is particularly valid for rubber sealing parts, which must also be protected from sunlight in order to prevent them from ageing. Rubber sealing can be stored only for a limited period, so avoid storage of these parts. Structures may be stored outdoors.

Note 1: We define an approved storage with:

- Roof
- Solid ground
- Relative humidity less than 50%
- Temperature 20°C (± 10° C)

3.0 SAFETY PROVISIONS AND ASSEMBLY INSTRUCTIONS FOR CIRCUIT-BREAKERS WITH OPERATING DEVICE

Read carefully the entire assembly instruction before starting assembly work.

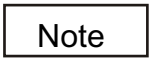
3.1 Warning texts

Warning texts are stated in 5 different degrees of urgency, which should be carefully observed. These are described below:

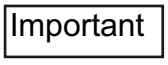
DANGER indicates an immediate risk situation that can lead to death or serious personal injury if not avoided.

Warning indicates a risk situation that can lead to death or serious personal injury if not avoided.

Caution indicates a risk situation that can lead to small or moderate damage.



Note is used when there is danger that can lead to equipment damage only



Important indicates an operation or a suggestion for handling

3.2 Unpacking

- Place the case horizontally on a flat surface before opening the cover.
- Check that all parts are included in the delivery. Check the packing list.
- Check that no parts have been damaged during transport; especially the porcelain insulators.
- Report any faults immediately to the ABB representative.

3.3 Safety Precaution

When working on high-voltage circuit breaker the below-mentioned risk must be taken into consideration and corresponding safety measures taken.

RISK	SAFETY MESAURES
1) Work next to high voltage	Warning plate is placed inside the door of the operating device. Disconnect the supply and earth near the workplace. If work must be carried out near energized parts of the plant, it has to follow local safety regulation of the organization responsible for the circuit breaker.
2) Work on ladders and platforms	The work shall follow the directions of the authority for occupational safety and health. Avoid work in severe weather conditions, which entails a great deal of climbing for short periods.
3) Work with low- voltage. Both D.C. and A.C. voltage may be drawn to the operating device.	Do not connect control or heating voltage until all connection work is completed.
4) Risk in operating mechanism and link system The spring operated device has energy stored in the opening spring, when it is in charged condition. The device can be activated by heavy vibrations or unintentional, slight touch on mechanical latch parts.	Warning plate is placed on the supporting frame. No work must be carried out unless the closing and opening springs are discharged, the circuit-breaker is in position OFF “0” and the supply to the motor is disconnected. The operating mechanism must not be operated unless it is connected to the circuit
5) Work on pressurized porcelain Insulators. Normally, the work pressure is up to 1.2 bar absolute. Damages in the porcelain can cause risk of the porcelain breaking.	Work close to the insulators of the circuit breaker that entails risk of porcelain damage must not be carried out until the gas pressure has been lowered to 1.0 bar absolute pressure.

PART B: INSTRUCTION FOR ERECTION, OPERATION & MAINTENANCE

1.0 General

1.1 Type designation

OVB-SDB 15 20 25

Outdoor Vacuum Circuit Breaker

Type SDB

Rated voltage – 15kV

12 for 12kV
15 for 15kV

Rated normal current - 2000A

08 for 800 Amp
12 for 1250 Amp
16 for 1600 Amp
20 for 2000 Amp

Rated breaking capacity – 25kA

18 for 18.4 kA

20 for 20kA

25 for 25kA

1.2 Specifications

Specifications are contained in the order documentation and on the nameplate.

Type	Vacuum Circuit Beaker OVB-SDB 15
Sr. No.	Breaker production Serial No.
Year	Year of manufacture
Standard	IEC – 62271-100
Rated voltage	15kV
Frequency	50 Hz
Insulation level	50/110kV.
Normal current	630, 1250, 1600, 2000 Amps.
Short circuit breaking current	46, 50, 66 kA
Operating sequence	0-0.3S-CO-3 Min.-CO
Weight	390 kg.
Auxiliary voltage	
Closing coil	Voltage of closing coil
Operating coil	Voltage of opening coil
Motor (if applicable)	Voltage spring charging motor
Instruction Manual	1VDU28004-YN

1.3 Weight of the Circuit Breaker

The weight of a complete circuit breaker is approximately contributed by

Weight of duct with poles - 172 kg.
Weight of cabinet with mechanism - 120 kg.
Weight of mounting structure - 98 kg.
(** Without CT Structure)

2.0 DESIGN

The circuit breaker type OVB-SDB is a three pole vacuum circuit breaker and designed in a column type construction with either "spring stored energy operating mechanism" or "Magnetic Actuator mechanism", mounted beneath the middle part. It consists of, (Refer Fig.2 & 3, page no. 51 & 52)

- Three interrupting chambers – Fi
- Three supporting insulator-Vi
- Support structure – Vs
- Control cabinet with spring stored energy mechanism – Ms
- Foundation bolt – Fb.
- Current transformer mounting structure – Ct.

2.1 Breaker Pole

The breaker pole consists of (ref. Fig. 4, page no. 53)

- Insulator body - 10001 & 10002
- Vacuum interrupter - 10204
- Lamellar contact - 10003
- Current collecting hub - 10203
- Upper and lower terminal - 10009 & 10010
- Insulating Rod - 10100
- Sealing bellow - 10006

Poles are filled with SF_6 or Nitrogen gas individually at a pressure of 1.2 bar (abs).

3.0 FUNCTION

The typical schematic circuit diagram of the breaker shown in Fig.5, page no. 54. The control circuit can also be referred in the order related engineering drawings.

3.1 Switching operations

As supplied from ABB Limited, Nasik the circuit breaker will be in open position and closing spring in discharged condition. In case of spring charged mechanism, when the control supply is given to the breaker, closing spring will get charged automatically by means of spring charging motor. In case of magnetic actuator, when the control supply is given to the breaker, the capacitor will get charged automatically by means of the electrical circuits.

3.2 Closing operation

A Spring operated mechanism

To close the circuit breaker the “ CLOSE" control element is actuated either electrically through the closing magnet or mechanically through push button arrangement. This enables the, spring stored energy mechanism to release the spring energy, through the linkage system, which rotate the common shaft. The rotation of the common shaft moves the moving contact of all the poles upward through the operating stud, closing the circuit breaker. This movement also exerts the required contact pressure on the moving contact.

B Magnetic Actuator

To close the circuit breaker the closing coil is energized. This moves the armature upward, which in-turn rotates the common shaft through the linkage system. The rotation of the common shaft moves the moving contacts of all the poles upward through the operating stud, closing the circuit-breaker. This movement also exerts the required contact pressure on the moving contact. Mechanical closing operation cannot be performed on the Magnetic Actuator Drive.

3.3 Opening operation

A Spring operated mechanism

To open the circuit breaker, the "OPEN" control element is actuated either electrically through the opening magnet or mechanically through push button arrangement. This enables the spring stored energy mechanism to release the spring energy through the linkage system, which rotate the common shaft in opposite direction. This rotation forces the moving contact of all the poles to move downward, opening the circuit breaker.

B Magnetic Actuator

In case of magnetic actuator the rotation of common shaft is effected through the downward movement of armature by energizing the opening coil. This movement forces the moving contact of all the poles to move downward, opening the circuit breaker.

4.0 ERECTION

4.1 General

As supplied from ABB Ltd., Nasik the circuit breaker are complete in all respect with all the necessary settings for smooth and trouble free operations of the circuit breaker. All the moving parts of the circuit breaker are positioned correctly and coupled together and they are well secured with the fasteners.

It is recommended to use standard tools and standard practices for lifting and transport of the circuit breaker at time of erection so as to avoid mechanical damage of the pole parts. In general the lifting of the circuit breaker shall be done as shown in Fig.1 (page 50)

4.1.1 Preparations

The following are to be made available --

- An erection crane with a load carrying capacity of about 1000 kg, and a crane hook with height of at least 4 m (= 13 feet) above the floor.
- Lifting ropes.
- Dimension drawings, erection drawings, wiring and circuit diagram.
- Torque wrench for a range of 6-100 NM
- Circlip pliers.
- Commercially available set of open and ring spanners size from 7 mm to 43 mm.
- Cleaning and working material like cloth etc.
- Conducting grease.
- Spirit level.

4.2 Erection procedure

- Attach consignment unit breaker assembly with crane using hooks (Fig.1, page no 50.)
- Place the support plate of the mounting structure leg assembly on the prepared foundation; tighten the structure with the foundation bolts with the specified hardware (Fig.2&3, page no 51& 52.).
- The exact location and the method of foundation can be obtained from the installation layout plan or a general arrangement drawing (Fig. 2&3, page no 51 & 52.)
- The complete circuit breaker with control cabinet has to be mounted on the structure as shown in GA drawing (Fig.2&3, page no 51 & 52.) in such a manner to achieve minimum required ground clearance.
- Once the height is maintained, the fasteners shall be tightened.
- Ensure the level of the breaker by spirit level.

4.7 High voltage connection

The high voltage connection fasteners shall be preferable of M12 size stainless steel bolts/galvanized bolt and nut and at least one washer and 1 spring washer. Terminal connectors (Aa - Fig.2 & 3, page no51 & 52) should be properly cleaned using stainless steel wire brush to remove the aluminum oxide film and conducting grease to be applied.

The cable terminals shall be connected in such a fashion that clearances are maintained properly.

4.8 Low voltage connections

The Auxiliary circuit connections shall be checked as per relevant schematic diagram for correctness (See Fig 5, page no.54 for typical schematics).
A removable gland plate is provided in the bottom of the control cabinet which can be suitably drilled as per control cable glands.

4.9 Earthing

Earthing connection should be made as shown in GA drawing (Fig. 2 & 3, page no.51 & 52). All earthing joints should be securely bolted together. Connections to the station earthing should have a cross section, not less then that of the earth connection pad welded on the structure.

5.0 COMMISSIONING

5.1 General checks

All necessary settings and adjustments have been made and the units have been fully tested both electrically and mechanically before dispatch at the factory. Hence, normally no setting and adjustment are required at the site.

5.2 Wiring

Unit wiring is identified by numbered ferrules. Any external wiring required should be done at site as per the relevant schematic diagram fig.5, Page 54.

5.3 Cleaning

All the insulating parts, porcelain insulator should be cleaned either with chamois leather or equivalent cloth. These insulating parts should not be cleaned with a material, which will deposit loose fibers.

5.4 Electrical checking

5.4.1 Low voltage circuits

The auxiliary circuit wiring shall be checked with a 500V or 1kV Megger. The insulation resistance shall be about 2 mega ohms.

5.4.2 High voltage circuits

Prior to commissioning the breaker, or putting it back into service after a maintenance outage, the insulation resistance of the high voltage circuit shall be checked using a 5kV Megger.

The breaker shall be earthed and isolated from other equipment before doing this test. All insulation parts shall be clean and dry.

The insulation resistance shall be checked for the following configuration,

A Circuit breaker in open position

- Across open contact of each phase.
- Between top terminal and earth of each phase.

B Circuit breaker in close position

- Between terminals and earth.

If the insulation resistance values are satisfactory (more then 100 mega ohms), then a high voltage test with 28kV (in case of 12kV) and 50kV (in case of 15kV) for 1 minute shall be done for other configurations, similar to Megger test.

If the insulation resistances are appreciably lower then 100 mega ohms, an inspection for insulation fault should be made before proceeding with high voltage test.

5.5 Checking the soundness of vacuums interrupters

Before putting the breaker in service or if any interrupter is suspected for leakage, then the interrupter shall be checked for satisfactory level of vacuum by applying a high voltage of 22 kV across the open gap of the interrupter for a period of 1 minute. Care should be taken to ensure that the external sequential isolators are opened prior to high voltage application.

5.6 Space heaters

A space heater is provided in the control cabinet. The heater switch must be always "ON" when the breaker is in service to prevent condensation.

5.7 Final commissioning check

When breaker has been installed and all mechanical and electrical connection completed, EXCEPT ENERGIZING THE POWER LINE, the following points of inspection are recommended.

Mechanical and electrical inspection

1. See that the unit is properly bolted in place and essentially level on its foundation.
2. Make a check for the tightness of hardware.
3. See that the operating mechanism is free of packing or foreign material, and operate freely. Lubrication is generally not required and should be applied sparingly if necessary.
4. Terminal connection should be secured tightened.
5. Check control cable entrance fitting for tightness.
6. Examine control wiring insulation for evidence of chafing or abrasion. If desired, a dielectric test can be made, duplicating details of production tests, as described earlier in this book. Check connections, according to schematic or connection diagram.
7. See that all covers and bolted connectors are securely in place.
8. Make a continuity check, preferably one, which involves measuring resistance in micro-ohm magnitude, to determine tightness of bolted joints. Also make the over voltage test on each interrupter for at least one minute. If interrupter has lost the vacuum, the open contacts quickly flash over, in a positive manner, well before the adjustable hi-pot tester can reach 28kV.

All the data/ parameters, which are checked and measured, shall be entered in a commissioning record and kept for comparison. The final trial switching operations shall be carried out on fully erected circuit- breaker isolated from the high voltage system and earthed according to recommendations. Once the auxiliary circuit is connected to the low voltage system, in case of spring charged operating mechanism, the spring charging motor gets the supply and charges the spring. The supply will cut off automatically by means of the motor cut off micro-switch. Now, the breaker is ready for closing operations and the closing operation can be done as described earlier.

In case of magnetic actuator, the charging circuit gets the supply and charges the capacitor. As the capacitor is charged to 80 V, the charging unit will cut off the supply to the capacitor and capacitor charged indication will appear. Now the breaker is ready for closing operation and the closing operation can be done as described earlier.

5.8 Starting conditions

The erected circuit breaker is isolated from high voltage system and earthed according to regulation. The control current circuit is connected to the low-voltage system.

5.9 Function test

Check correspondence with the customer related diagram and that the connections have been made correctly. Then the trial switching can be carried out from a protected position.

The trial switching may be performed if:

- The circuit breaker is isolated from the high voltage and earthed according to regulations.
- The spring tension indicator of the spring operated mechanism indicates the position “tensioned”

5.10 Trial switching operations

Give few Close/Open command and see that the breaker Close/Open Properly.

5.11 Anti-pumping device

- Issue a "close" command by applying a control voltage to terminal 101 & 102 leave the voltage applied. The breaker will close.
- Issue open command by applying a voltage to terminal 103 &104 The breaker will open.
- After the interruption by OPEN command the circuit breaker should not re-close in spite of the CLOSE command still being present.

Note:

The ESH operating mechanism on OVB-SDB circuit breaker is fitted with a mechanical anti-pumping device, which prevents re-closing due to either electrical or mechanical commands.

5.12 Check of heaters:

Measure the resistance or apply voltage and measure the current, when the thermostat controlled additional heater is installed, check the adjustment of thermostat.

5.13 Concluding Work:

- Remove all test and measuring equipment.
- Connect circuit breaker to high voltage power lines.
- Make sure that safety regulations are followed.
- Take the breaker in to service.

6.0 MAINTENANCE

6.1 Caution

Before carrying out any maintenance work ensure that,

- The circuit- breaker is opened and the external sequential isolators are opened and the unit is properly earthed.
- The closing spring is discharged.

6.2 General

During normal service the circuit breaker require only limited maintenance. The frequency and the sort of inspection and maintenance basically depend on the service conditions. Various factors must be taken into account e.g. frequency of operation; interrupted current values and relative power factor as well as the installation ambient.

The following table gives the maintenance schedule showing the relative time intervals between maintenance work. As far as the time interval between this operation is concerned, it is advisable to comply with specification given in the table.

On the basis of the result obtained during the periodic inspection, it is possible to set the optimal time limits for carrying out maintenance work.

Any circuit- breaker which will only operate a few times or which will remain closed (ON) or open (OFF) for long periods should be operated from time to time to prevent clogging which may cause a reduction in the closing or opening speed.

6.3 Lubrication

All the sliding parts of operating mechanism and linkages subjected to friction must be lubricated at the specified time interval with self-lubricating grease BR plus 100.

6.4 Maintenance Schedule

Maintenance operation	**Installation in normal ambient**	Installation in dusty or polluted ambient
Carry out the general inspection (For details, refer clause 6.5)	2 years	1 year
Measure the insulation resistance	4 years	2 years
Lubricate the sliding points	2 years	1 year
Carrying out the operating mechanism maintenance	Five years or every 10000 operations	Three years or every 5000 operations
Complete overhaul	Ten years or every 10000 operations	Five years or every 10000 operations
Connection of electronics circuit	2 years	1 year
Cleaning of electronic circuit	2 years	1 year
Retention of spring circlips and spring washer	2 years	1 year

6.5 General Inspection of the circuit breaker

Part subjected to	Abnormalities noticed	Remedies
Spring operated mechanism	Presence of dust on the mechanism	Clean with a dry brush or cloth
	Distorted or oxidised spring	Replace the damaged spring
	Locking rings out of place, loose nuts or screws.	Re-fix the locking rings in Their position and tighten the nuts & screws
High voltage breaker pole parts	Presence of dust or dirt on the the insulating parts	Clean with a dry brush or cloth
	Locking rings out of place, loose nuts or screws.	Re-fix the locking rings in Their position and tighten the nuts & screws
	Distortion or cracking of the insulating parts	Ask ABB Nasik for replacement of the damaged parts
	Trace of overheating or loose screws on the connection to the circuit breaker terminals	Clean the connections and the breaker terminals with a rough rag soaked in a suitable solvent cover them with neutral grease and tighten the screw
Earthing connection	Trace of the oxidation and / or loose nuts	Clean with a rough cloth soaked in a suitable solvent. Tighten the earthing connection fully and cover it with neutral grease
Auxiliary circuit supply voltage	Check the supply voltage of the operating mechanism electrical accessories	The close/ opening coils must operate correctly for values between 85% and 110% of the relative rated voltage
Operating and control elements	Carry out the functional tests	Replace the damaged or faulty elements (if necessary as ABB Nasik)

PART C: OPERATING MECHANISM WORKING PRINCIPLE AND MAINTENANCE

1.0 BREAKER WITH SPRING CHARGED MECHANISM

1.1 General

The operating mechanism has a spring charging device, which can be operated by motor or manually. The operating device has helical tension spring for closing and opening. The opening spring is charged automatically when the breaker is closed.

A closed breaker with charged closing spring can thus be operated OPEN - CLOSE - OPEN without intermediate motorized or manual spring charging, and the breaker can, therefore, be used for auto re-closing duty cycle.

An indication shows whether the closed spring is charged or not, and the number of opening operations are recorded by the counter.

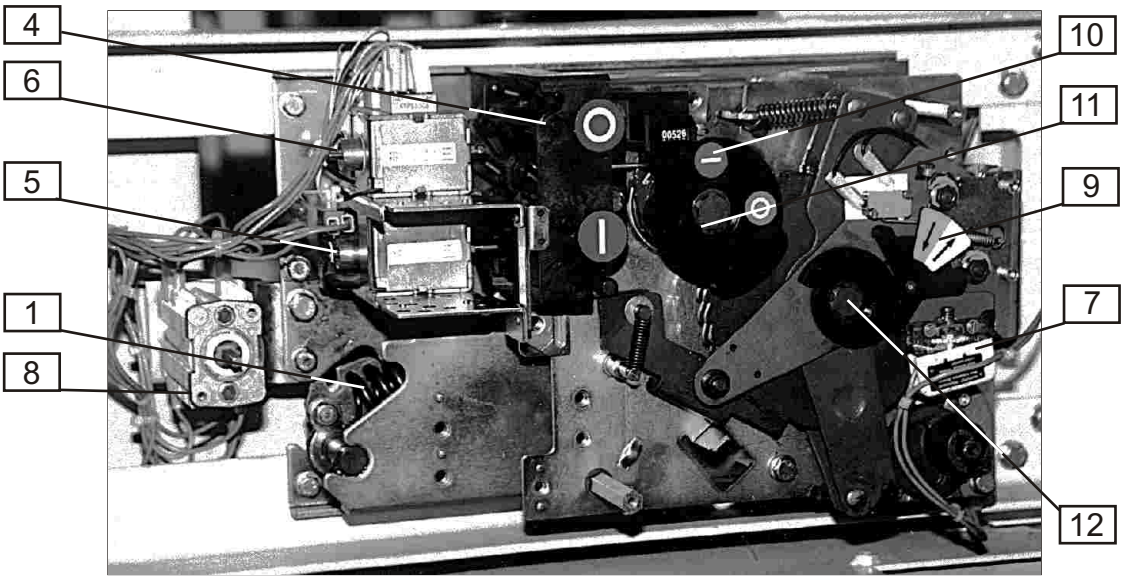
The motor can be supplied via station battery, a network or via transformer with a limit load of at least 500 VA. The motor starts after each closing operation and charges the closing springs within 15 seconds.

1.2 Construction

The construction of the operating mechanism is shown in Fig D,

Major components of ESH mechanism are:

1. Closing Spring
2. Tripping Spring
3. Geared-Motor
4. Push Button Assembly
5. Closing Coil
6. Tripping Coil.
7. Motor cut-off switch.
8. Auxiliary switch.
9. Spring Charged indication
10. Breaker ON/OFF indications
11. Charging Shaft
12. Power Shaft



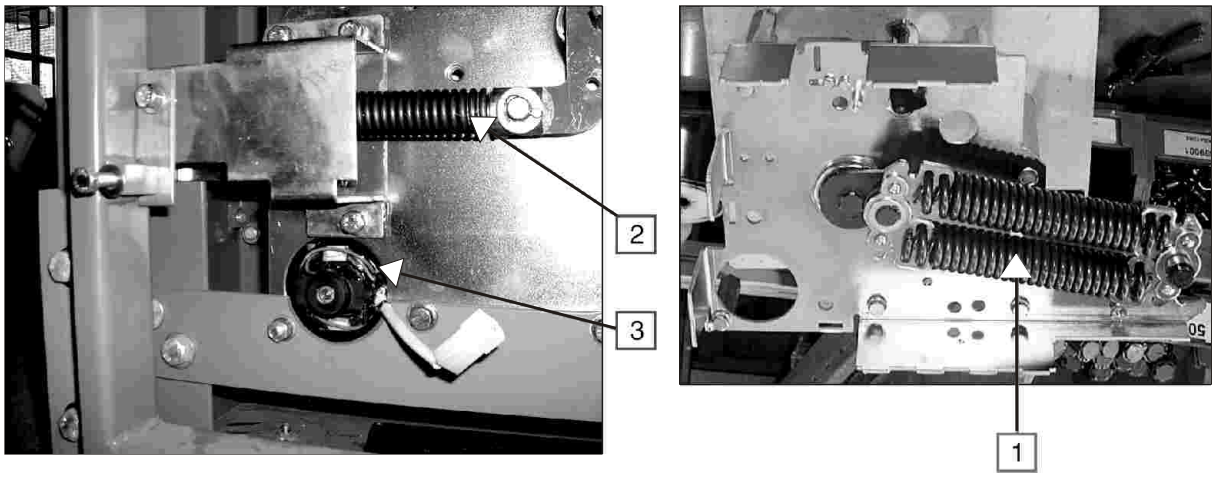


Fig. D

1.3 Operating mechanism - Working principle

There are two options for charging the springs

1. By electric motor.
2. Manual operation

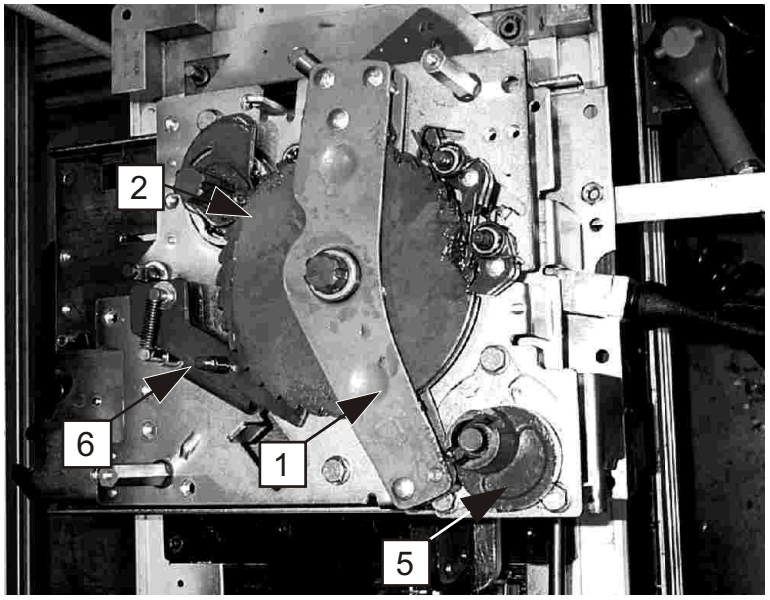
1.3.1 Electrical Spring Charging (Ref Fig E)

Spring charging unit consists of Arm (1), Charging gear (2), Closing Spring (3), latches (4), reduction gear with Spring charging Motor and Cam (5). Closing - Spring assembly & charging gear are mounted on power shaft. When the Motor rotates, the reduction gear connected to that gives 1/144 reduction. Reduction gear assembly is connected axially with the Cam that rotates the spring-charging arm.

The arm rotates the charging gear, at the same time; the latches hold the charging gear and arm returns to its position. Closing spring gets stretched and this continues till the spring gets fully charged. The backward rotation of the charging gear (2) is prevented by latches (4). A plastic cam activates Motor-cut-off switch & Spring Charged indication will appear after full charging. Closing lever (6) stops the shaft from further rotation. Motor cutoff switch disconnect the supply of the motor.

Fig F shows initial stage of closing spring and associated lever (L1).

FigG shows the condition after closing spring gets fully charged. During this process latch L1 rotates of about 180°.



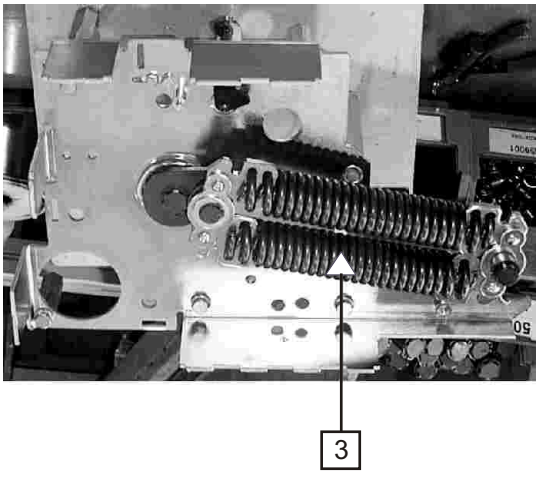


Fig E

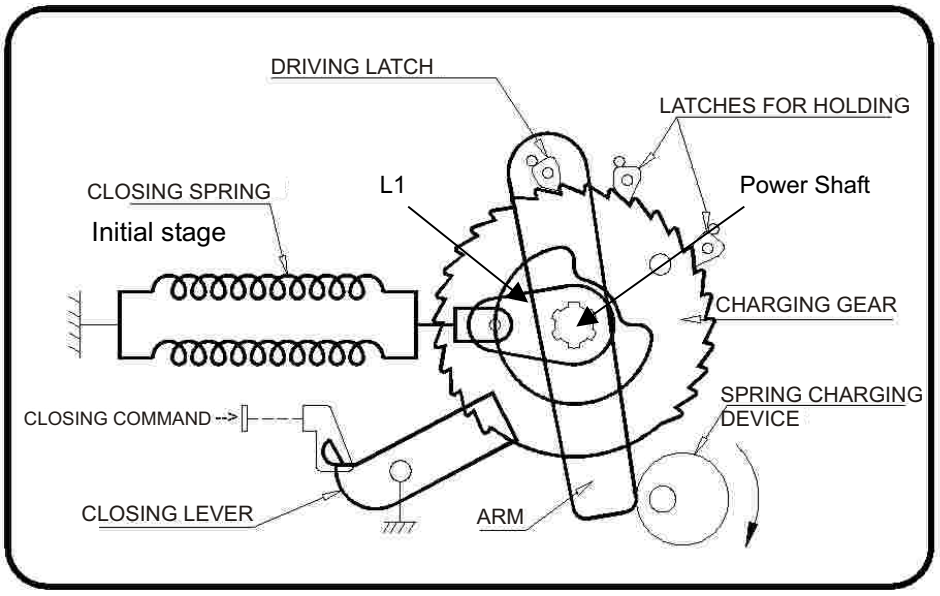


Fig F Mechanism in open condition & both the springs in discharged condition

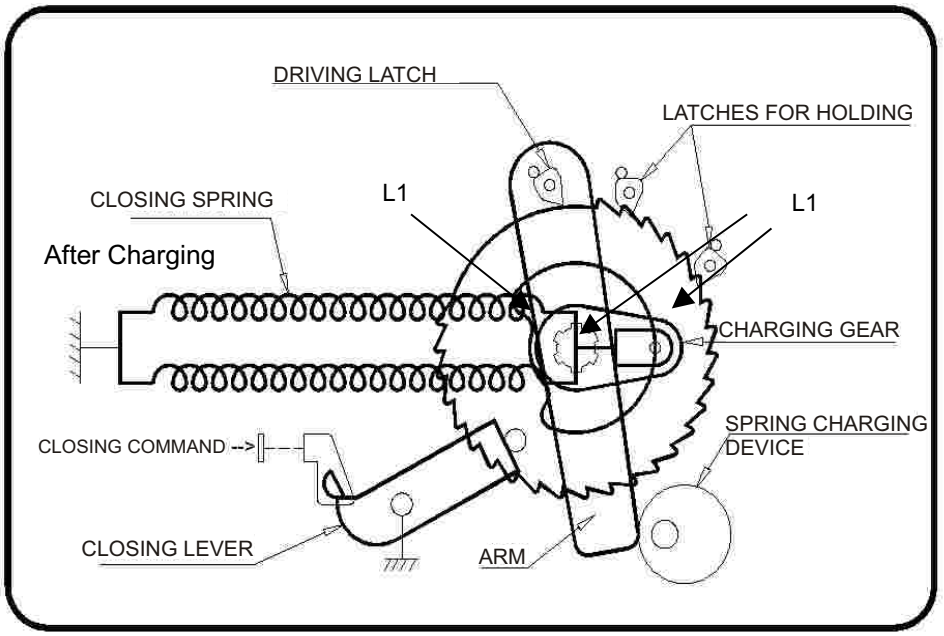


Fig G Closing spring is charged, ready for closing operation

The spring charging motor charges the springs after each closing operation until the spring-charged indication appears. Should there be no voltage during charging, the geared motor stops, and starts recharging the springs automatically when the voltage is on again. It is, however, always possible to complete the charging operation manually. Motor supply gets cut-off automatically as the spring gets completely charged.

1.3.2 Manual Spring Charging

For charging the Closing-springs manually, fully insert the charging handle into the seat and rotate it clockwise until you see the spring-charged indication.

Ensure the handle is engaged with the seat.

The force, which can normally be applied to the charging handle, is 130 N. In any case, the maximum force applied must not exceed 170 N. As the springs get charged, a sound [internal latches getting engaged] can be heard.

The arm won't rotate the charging-gear further, since the charging-gear has no teeth on remaining periphery.

1.4 Breaker Operations

1.4.1 Closing Operation:

Consider both the springs are in discharged condition and breaker is open (Ref Fig. H) In this condition neither close nor open operation is possible to perform on the breaker. Latch assembly (La) and (Lb) are in released condition. The closing spring can be charged either electrically or manually as explained in section1.3. During the process of charging pin (P1) comes in contact with closing lever (Ref Fig F, Page 29). Pin (P1) will creates pressure on closing lever as closing spring is fully charged. Position of the closing lever in this condition is retained by half shaft.

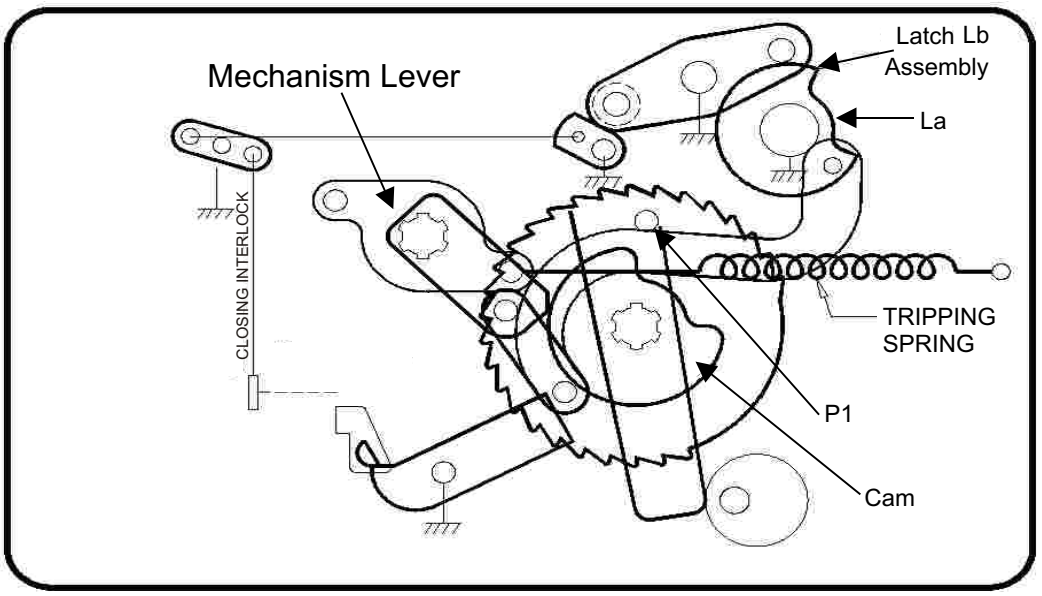


Fig. H Mechanism in open condition & both the springs in discharged condition

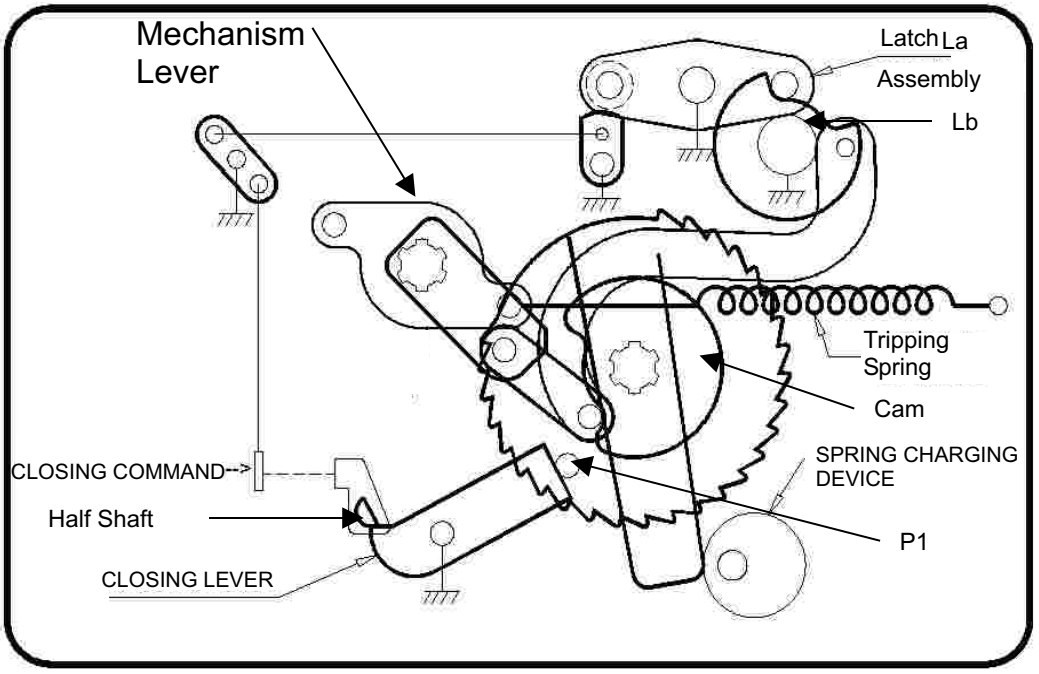


Fig. I Mechanism in open condition & closing springs is charged

If close command is initiated now, it will rotate half shaft (Ref Fig. J). Rotation of half shaft will release closing lever and hence charging gear. Due to this spring energy stored in closing spring acts on power shaft, which will cause the rotation of the cam mounted on the power shaft. Mechanism lever (Ref. Fig.J) is resting on the outer periphery of this cam, which is directly connected to charging shaft. Rotation of cam will push this mechanism lever upwards, this will results in rotation of the charging shaft. Tripping lever is mounted on same charging shaft. One end of this tripping lever is connected to common shaft of the breaker via link, and another end is connected to tripping spring. Rotation of around 90° will close the circuit breaker as well as charging of the tripping spring.

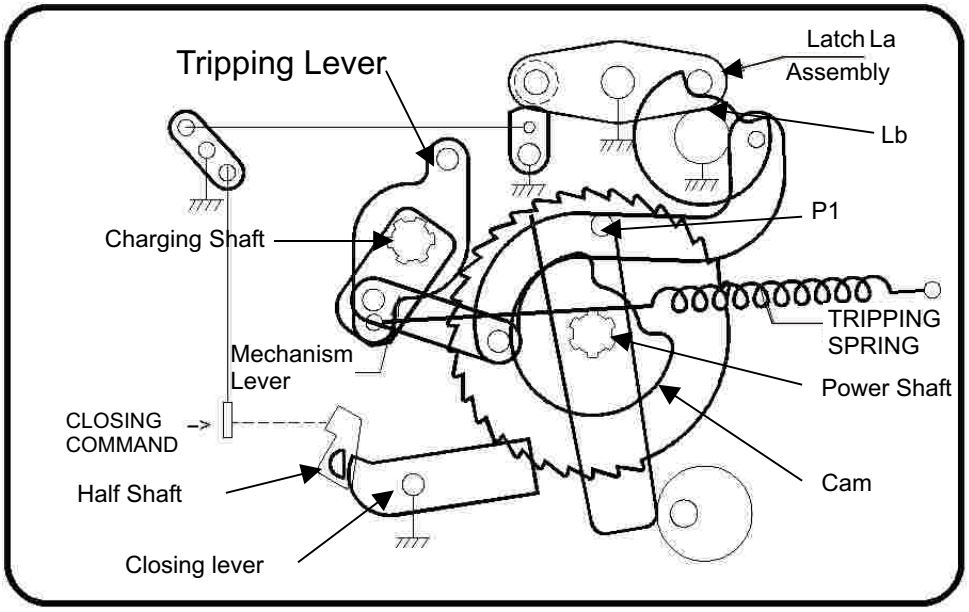


Fig. J Circuit Breaker closed, tripping spring charged

1.4.2 Tripping Operation:

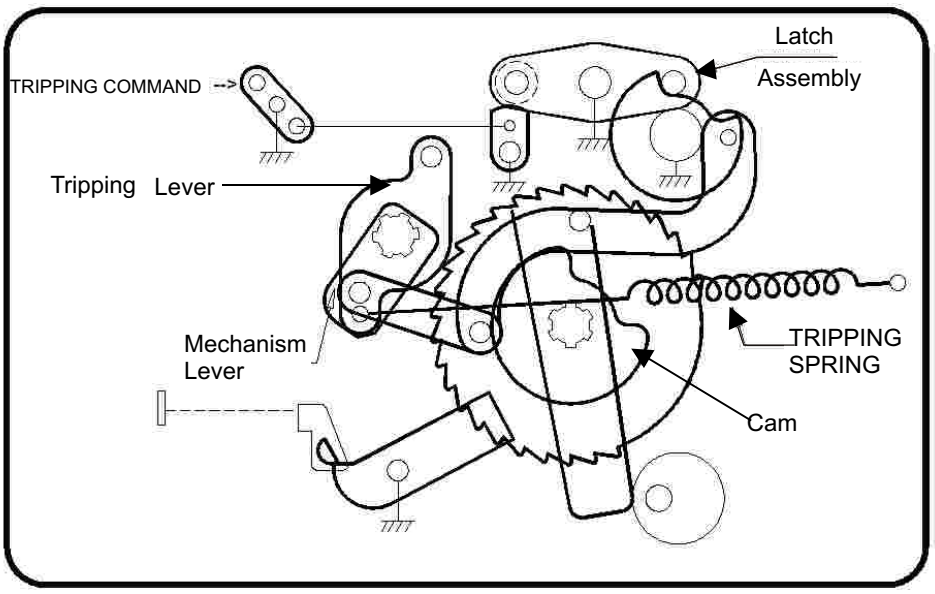


Fig. K Circuit breaker in close condition, ready for tripping operation

Now with previous reference consider tripping spring is in charged condition. Fig. K shows the charged condition of the tripping spring and internal detail for position of different components. Latch Assembly (La) and (Lb) engaged with each other. Engagement of (La) and (Lb) will confirm that breaker will not open in this condition unless and until the opening command is initiated.

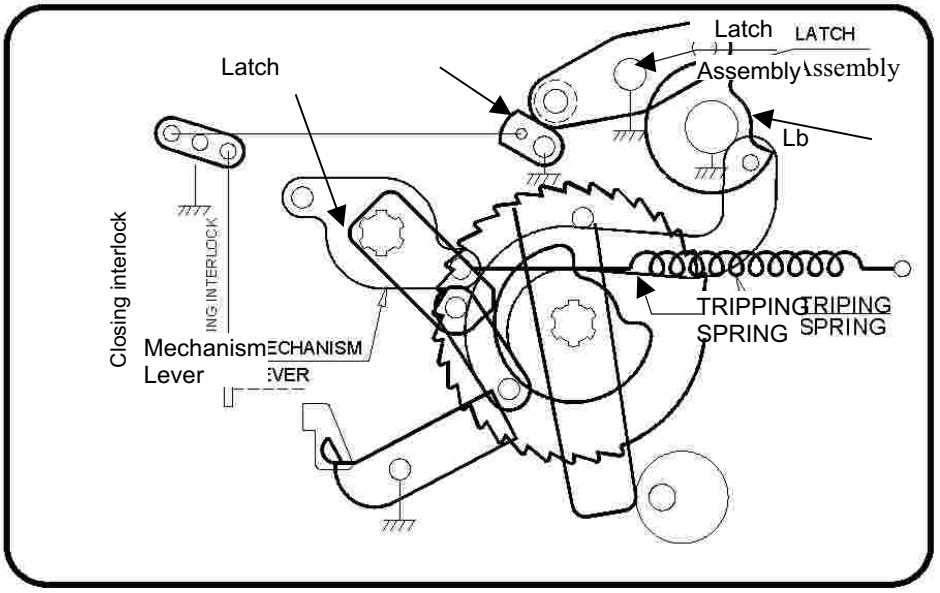


Fig. L Circuit Breaker in open condition

If trip command is initiated now, it will pull the latch (Ref. Fig. L). Hence its engagement with the latch assembly will break. This will move the latch assembly La in downward direction. Downward movement of latch assembly will release the latch Lb. Hence there is no more pressure or any engagement that will retain the current poison of arm and leverage. Arm and leverages are free to move now. As previously discussed these components are directly connected to charging shaft. Tripping spring directly exerts pressure on the shaft via tripping lever. As leverage becomes free to move tripping spring will pull back the tripping lever and open the circuit breaker.

1.5 Maintenance of Operating Mechanism

Before carrying out the maintenance of operating mechanism ensure that the breaker is open, the sequential isolators are open and the closing and opening springs are discharged.

1.5.1 Maintenance schedule

Sr No.	Description	Before start Up	Every 1000 operations
1.	Checking of operating mechanism.	✓	✓
2.	Checking of fastener tightness.	✓	✓
3.	Checking of shock absorbers for leakage or struck up.	✓	✓
4.	Checking of various tension springs and bending springs for their proper place.	✓	✓
5.	Closing and tripping spring assembly and split pin/ Circlip on them.	-	✓
6.	Bearing items.	-	✓
7.	Checking of Operation box Assembly for proper open/close operation.	✓	✓
8.	Checking of setting. Proper engagement of lever on shaft.	✓	✓
9.	Spring cut off micro switches.	✓	✓
10.	Lubrication of charging device and operating gear		✓

NOTE

1. Complete overhaul of circuit breaker operating mechanism to be done after 10000 operation or 10 years, whichever is earlier.

2. Ask ABB Nasik for details of overhaul procedure.

1.5.2 Fault finding chart

FAULT	CAUSE	REMEDY
Spring does not get charged	Motor has wrong or no operating voltage. Motor shaft broken. Motor gear damaged. The latch for the tripping device does not function. Disconnection in the wires. Micro-switch arm wrongly adjusted.	Measure voltage on the motor leads. Change motor. Change motor. Change mechanism. Check by measuring. Adjust the micro-switch operating arm.
Closing of breaker does not take place although there is an indication that the springs are charged.	Breaker closes then opens again. Operating coils does not operate. The toggle joints of the mechanism are incorrectly adjusted. Wrong wiring of the auxiliary circuit. Wrongly adjusted clearances of opening magnets armature.	Measure the voltage adjust the coils adjustment screw. Check the springs. Adjust the toggle joints. Check the wiring as per schematic drawing. Adjust the opening magnet.
Breaker continuously opens and closes.	Anti pumping relay wrong or faulty.	Change relay.

1.5.3 Replacement of operating coil

Refer Fig.9 to 12, (page no 58 to 59) indicates the mounting arrangement for closing coils and the tripping coils.

1.5.4. Replacement of micro-switch Refer fig. 16 & 17, (page no. 62) indicates the mounting arrangement for micro-switch.

1.5.5 Replacement of motor Refer fig.14 & 15,(page no. 60 & 61) indicates the mounting arrangement for motor.

1.5.6 Replacement of operating mechanism

The operating mechanism shall be replaced in the following manner.

a. Disconnect the linkage of the operating mechanism to the main shaft

b. Disconnect the electrical connection.

c. Loosen screws that fix the operating mechanisminside the cabinet.

d. Take out the operating mechanism and fix new one.

e. Reconnect the electrical connections and the linkage of the main shaft. After fixing the operating mechanism the following check shall be carried out.

f. Charge the closing spring.

g. Close the breaker.

h. If required then adjust the micro-switch for proper operation.

i. Check the breakers with the auxiliary supply connect while charging at minimum operating voltage of the motor.

j. Take few operations for the new mechanism.

k. Seal various lock nuts of various settings with red paint.

1.5.7 Recommended spares parts

The following spares shall be kept to take care of any contingency

Sr. No	Name of parts	Part No.
1	Spring charging motor	15032
2	Tripping/closing coils	15030(A,B)
3	Micro-switches	15033
4	Auxiliary switches	15027
5	Shock absorber	15007
6	Operating box assembly	15012
7	Opening transmission lever	15010
8	Closing transmission lever	15011
9	Operating Mechanism	15000A

2.0 BREAKER WITH MAGNETIC ACTUATOR MECHANISM

2.1 General

This is the latest innovative operating mechanism technology with the following salient features,

- Force generated by magnetic actuator
- Latching by magnetic actuator
- Release by magnetic actuator
- No parts subjected to wear
- Maintenance free as a standard feature

All the operating mechanism functions are integrated with the magnetic actuator. The magnetic actuator provides perfectly suitable travel time and force travel characteristics for vacuum switching devices.

2.2 Operating principle

The actuator is a bi-stable magnet system in which switching of the armature to the relevant limit position is effected by the magnetic field of two electrically excited coils. The field of two permanent magnets holds the armature magnetically in the limit positions. Switching operations are released by excitation of one of the coils until the retaining force of the permanent magnet is exceeded. Even on failure of auxiliary power, electrical operation is still possible for a period of 200 seconds. The circuit breaker can then be opened by the standard emergency manual operating system. The magnetic actuator is designed in such a way that, the armature can acts directly via the lever on the main shaft, on the moving contact of the vacuum interrupter. With this method of actuating force generation and transmission, there is no wear of the mechanism. Maintenance up to extremely high number of operating cycles is simply a thing of the past.

2.3 Conclusion and operation (Fig. 18, page no. 63)

The magnetic actuator used in the vacuum circuit breaker type OVB-SDB uses a laminated yoke structure 1 to facilitate the permanent magnet 2 to hold the structure 5 in the end positions. A pair of electromagnetic coils (3A and 3B) is used to drive the armature between the two end positions. The temporary application of current of appropriate polarity in the upper coil (3A) will cause a high flux to be forced across the upper air gap as shown in fig 18,page no.63 providing an upward motive force on the armature 5 in order to close the air gap. As the flux induced by coil (3A) is greater than the flux present in the lower part of the magnetic circuit, the armature will be "flipped" to the upper position, which corresponds to the upper limit position of the actuator. The armature will be held in that position by the magnetic flux provided by permanent magnet.

In the similar manner, if the lower coil 3B is energized. The magnetic flux in the lower part will be increased and the armature 5 will be moved to the lower position, which corresponds to the lower end position of the actuator. The energizing current to the coils is supplied from a capacitor unit, which is charged by an electronic unit. When the armature reaches the end position, the proximity sensors / or the limit switches sense that and give signal to the electronic unit to stop the discharge from the capacitor. The electronic circuit consists of an AC DC converter and gives a constant output voltage to charge the capacitor irrespective of the input supply voltage. It also includes a control unit, which monitors all the function of the circuit breaker. The energy stored in the capacitor not only provides the necessary coil energy, but also ensures power supply to the electronic circuit.

3.0 BREAKER POLE

3.1 General

The 12/15 kV Outdoor Circuit Breaker type OVB-SDB is developed using well-proven vacuum interrupters. Excellent arc quenching and insulating properties of vacuum offer long reliable service.
The construction of the pole of this breaker is very simple and has very less number of moving parts, so the operating energy level is very low, thus it requires practically no maintenance. The pole assembly is an independent assembly. Before you start dismantling the pole ensure that the breaker is isolated from the system and auxiliary supply. Also ensure that the breaker is in open condition and spring is in discharge condition.

3.1 Dismantling

1. Three poles of the breaker are mounted on the cross member called duct (Fig. 2, page no. 51). Remove the cover of the duct and disconnect the pole-operating pin.
2. Remove the nut bolts, which connect pole assembly and duct.
3. Lift the pole from the duct keep it in a clean and dust free area.
4. Check the dimension "A" and record it (Refer Fig 4, page no. 53). Note that the complete pole shall be dismantled and assembled in a clean and dust free area.
5. Remove the hardware, which connects the top insulator, lower terminal plate and bottom insulator; take out the support insulator 10002 from the pole assembly. Take care of rubber bellow during dismantling; avoid any kind of damage to rubber bellow.
6. Remove the top machined-cover 10007 and bolt 10015 (which holds the vacuum interrupter) from top terminal plate 10009.
7. Remove the top terminal plate 10009 and take away the top insulator 10001 from the assembly.
8. Hold the vacuum interrupter 10204 in a firm position with reference to one side of the lower terminal plate 10010 and remove the operating stud 10100 from the other side by using proper spanner.
9. Remove vacuum interrupter from the current collector hub 10018 of the lower terminal assembly. In case of flexible connection as shown in fig. 4c remove the hardware, which binds flexible connection (10207) with lower terminal plate. Detach the current collector (10208) from stem of the vacuum interrupter.
10. Check each and every component of the assembly for damage and wear.
11. Check the vacuum interrupter for its correctness. The correctness of vacuum interrupter can be checked for its vacuum level by following method. Hold the vacuum interrupter firmly and pull out the moving contact will pull back to its original position. This means the vacuum level is good.

3.1 Assembly of the pole (Ref. Fig 4, page no.53)

1. Clean all the components used in the pole.
2. Interrupter Assembly: -Insert the plug for lamellar contact 10203 on the stem of the interrupter. Maintain the distances B and C as shown in fig.4, page no. 53 and tighten the assembly by applying proper torque. Fix the lamellar contact 10003 and guide ring 10202 in proper grooves provided on the plug 10203. Lubricate plug and lamellar contact with contact grease.
3. Now, insert the interrupter assembly in current collector hub 10018, which is fixed on lower terminal plate.
4. Fix the operating stud 10100 from the other side of the lower terminal plate.
5. Hold the vacuum interrupter 10204 in a firm position and tighten the operating stud 10100 firmly with proper torque. Negligence in holding the moving contact of the vacuum interrupter may damage the bellow of the vacuum interrupters.
6. Now, insert the O-ring (big) 10005 and O-ring (small) 10004 on the respective sides of the lower terminal plate 10009 and apply sealing grease.
7. Lift the support insulator and place it over duct, attach it temporarily to duct with nuts and bolts.
8. Insert the operating stud with rubber bellow inside the suppor t insulator and place lower terminal plate and interrupter over support insulator.
9. Lift the top insulator and put it over the lower terminal plate, Engage lower terminal plate and insulator flanges by using nut bolts.
10. Cover the top insulator by top terminal plate, before that fix O-ring 10005 on the top terminal plate and apply sealing grease. Engage it with flange of top insulator by appropriate hardware; eyebolts 10020 must be placed at their original position.
11. Fix the bolt 10015 on the top terminal plate 10009, which firmly holds the interrupter. Initially keep this bolt loose till the relaxation of the contacts takes place.
12. Perform 5-10 manual operations on the poles by pulling the operating stud down for relaxation and alignment of the whole assembly. This will ensure the setting of lamellar contact assembly in the current collector hub.
13. Tighten the bolt 10015 on the top terminal plate with a torque of 90 Nm. Tighten all nut bolts except used for duct and support insulator fixing with torque of 67 Nm.
14. Now remove the hardware used for fixing support insulator and duct, lift the pole upwards and take the rubber below between bottom flange and duct and tighten it with proper hardware.

OVB-SDB circuit breaker

FAILURE REPORT

Number (by ABB)

In case of failure please take a copy of this form is and complete it as fully as possible, to make feasible failure analysis and rectify it. For selecting options tick suitable box. If no alternative is applicable, proper description can be filled out in the space provided. Item description should be given for both circuit- breaker and operating mechanism.

1. Identification

Date ----------

Customer ----------

Item designation Serial number

---------- ----------

---------- ----------

---------- ----------

---------- ----------

Order number ----------

2. Historical data

Date taken into service ----------
Date of failure ----------
Date of last overhaul ----------
Total number of operating cycles since taken into service ----------
Total number of operating cycles since last overhaul ----------
Condition of the breaker when the failure was detected (only one alternative to be selected)

- ☐ In service
- ☐ During maintenance
- ☐ During installation

Use of the circuit- breaker (Only one alternative to be selected)

- ☐ Line breaker
- ☐ Reactor breaker
- ☐ Capacitor breaker
- ☐ Transformer breaker
- ☐ By-pass breaker

3. Characteristics of the failure (many alternatives may be selected)

- ☐ Does not close on command.
- ☐ Does not open on command.
- ☐ Closes without command
- ☐ Open without command
- ☐ Does not make the current
- ☐ Does not break the current
- ☐ Fails to carry current
- ☐ Breakdown to earth
- ☐ Breakdown between poles
- ☐ Internal breakdown across open pole
- ☐ External breakdown across open pole
- ☐ Locking on open or closed position
- ☐ Corona
- ☐ Loose parts
- ☐ Missing parts
- ☐ Faulty parts
- ☐ Corrosion
- ☐ Surface defect other than corrosion
- ☐ Incorrect function

Change in functional characteristics

- ☐ Incorrect closing time
- ☐ Incorrect opening time, coil I

- ☐ Incorrect opening time, coil II
- ☐ Incorrect damping
- ☐ Incorrect CLOSE/OPEN time
- ☐ Too high resistance
- ☐ Incorrect pre-insertion time for the resistors
- ☐ Incorrect time span between contacts

4. External circumstances

(Many alternatives may be selected)

- ☐ Strong wind
- ☐ Rain
- ☐ Sudden variation in temperature
- ☐ Snow, ice or hoar-frost
- ☐ Corrosive atmosphere
- ☐ Fog or high humidity
- ☐ Lightning

Ambient temperature(^{o}C)

5. Component responsible (Many alternatives may be selected)

Components at service voltage

Making and breaking unit

- ☐ Current collector hub
- ☐ Plug
- ☐ Laminar contact
- ☐ Top cap
- ☐ Interrupting Chamber insulator
- ☐ Vacuum interrupter
- ☐ Top terminal plate
- ☐ Bottom terminal plate

Main insulation to earth

- Post insulator
- Interrupting Chamber insulator

Electrical control and auxiliary circuits

- Operating magnet
- Closing magnet
- Auxiliary contact
- Counter
- Control panel
- Limit switch
- Micro switch
- Thermal relay or heater
- Terminal blocks, cables
- Driving motor for mechanism

Operating mechanism unit

- ESH mechanism
- Magnetic actuator

Different Assemblies in ESH Mechanism

- Opening coil set up
- Closing coil set up
- Tripping spring assembly
- Electric motor
- Auxiliary switch
- Indicators
- Counter
- Opening breaker indicator
- Closing breaker indicator
- Hook assembly for charging gear
- Charging gear assembly
- Shock absorber
- Closing lever
- Opening box assembly

- ☐ Opening transmission lever
- ☐ Closing transmission lever

Different assemblies in magnetic actuator

- ☐ Electronics Unit
- ☐ Charging Capacitor
- ☐ Magnetic Actuator

Mechanical transmission

- ☐ Mechanism housing
- ☐ Operating Shaft
- ☐ Lever
- ☐ Common Shaft

Plates

- ☐ Instruction plate
- ☐ Rating plate
- ☐ Cabinet
- ☐ Packing

6. Consequences (Multiple alternatives may be selected)

- ☐ Unplanned removal from service
- ☐ Planned removal from service
- ☐ Major disturbance
- ☐ Minor disturbance
- ☐ Fire or explosion
- ☐ Removal from service of other breakers to prevent repetition of failure

Circuit- breaker downtime, ----------

Beyond planned time (hours)----------

7. Action taken (Select only one alternative)

- ☐ Repair of defective component
- ☐ Exchange of defective component
- ☐ Exchange of circuit- breaker pole
- ☐ Exchange of operating device
- ☐ Exchange of circuit- breaker

Action to be taken (Select only one alternative)

- ☐ By personnel from ABB in Nasik
- ☐ By personnel from ABB in current company
- ☐ By customer's personnel

Time required to obtain spare parts (hours) ----------

Time required for repair (hours)----------

Place: ----------

Signature

Date: ----------

(Name & Designation)

LIST OF DRAWINGS

LEGEND FOR FIG.4

10001	Top Insulators
10002	Support Insulator
10100	Operating stud assembly
10200	Interrupter assembly
10003	Lamellar contact; L=145
10004	Top 'O' Ring
10006	Sealing bellow
10007	Cover machined
10008	'O' ring
10009	Top terminal with SDB with VG4
10010	Bottom terminal for SDB (VG4)
10011	Gas filling valve
10012	S.S. Hex Bolt M8 X 20
10013	S.S. Hex Bolt M12 X 75
10014	S.S. Hex Bolt M12 X 50
10015	S.S. Hex Bolt M12 X 45
10016	Conical Spring Washer S.S. M8
10017	Conical Spring Washer S.S. M12
10018	Current collector hub for SDB
10019	S.S. Hex Nut (M12)
10020	Eye Nut
10021	M.S. Hex hd. Bolt M8 X 40
10022	SS plain washer M8
10023	Plain washer 14X24X2.5 (SS)
10024	Conical spring washer M8
10201	Special washer
10202	Guide ring
10203	Plug for lamellar contact
10204	Vacuum interrupter VG4-12kv, 25kA
10205	Safety washer VS12 - FST
10206	M. S. Hex lock nut (M12X1.75X7)

LEGEND FOR FIG. 6, 7 & 8

15000A	Operating Mechanism
15000	Closing Lever
15001	Cam
15002	Charging Gear Assembly
15003	Charging lever group Assembly
15004	Tension Spring
15005	Closing Spring Assembly
15006	Indicator
15007	Shock Absorber
15008	Counter
15009	Circlip
15010	Opening Transmission Lever
15011	Closing Transmission Lever
15012	Shaft for closing lever
15013	Shaft for Spring
15012	Operation Box Assembly
15013	Push button For Closing
15014	Push button For Opening
15015	Opening Breaker Indicator
15016	Posterior Plate Assembly

15017	Column For fixing Shield
15018	Bending Spring
15019	Hook Assembly
15020	Hook Support Shaft
15021	Intermediate Plate
15022	Front Plate
15023	Power Shaft
15024	Bearing Spacer
15025	Bearing
15026	Charging Shaft
15027	Auxiliary Switch
15028	Connection link
15029	Tripping Spring Assembly
15030	Shunt operating release(Y01,Y02)
15031	Shunt Closing release
15032	Electric Motor
15033	Micro-Switch
15034	Common Shaft
15035	Lever
15036	Operating Rod

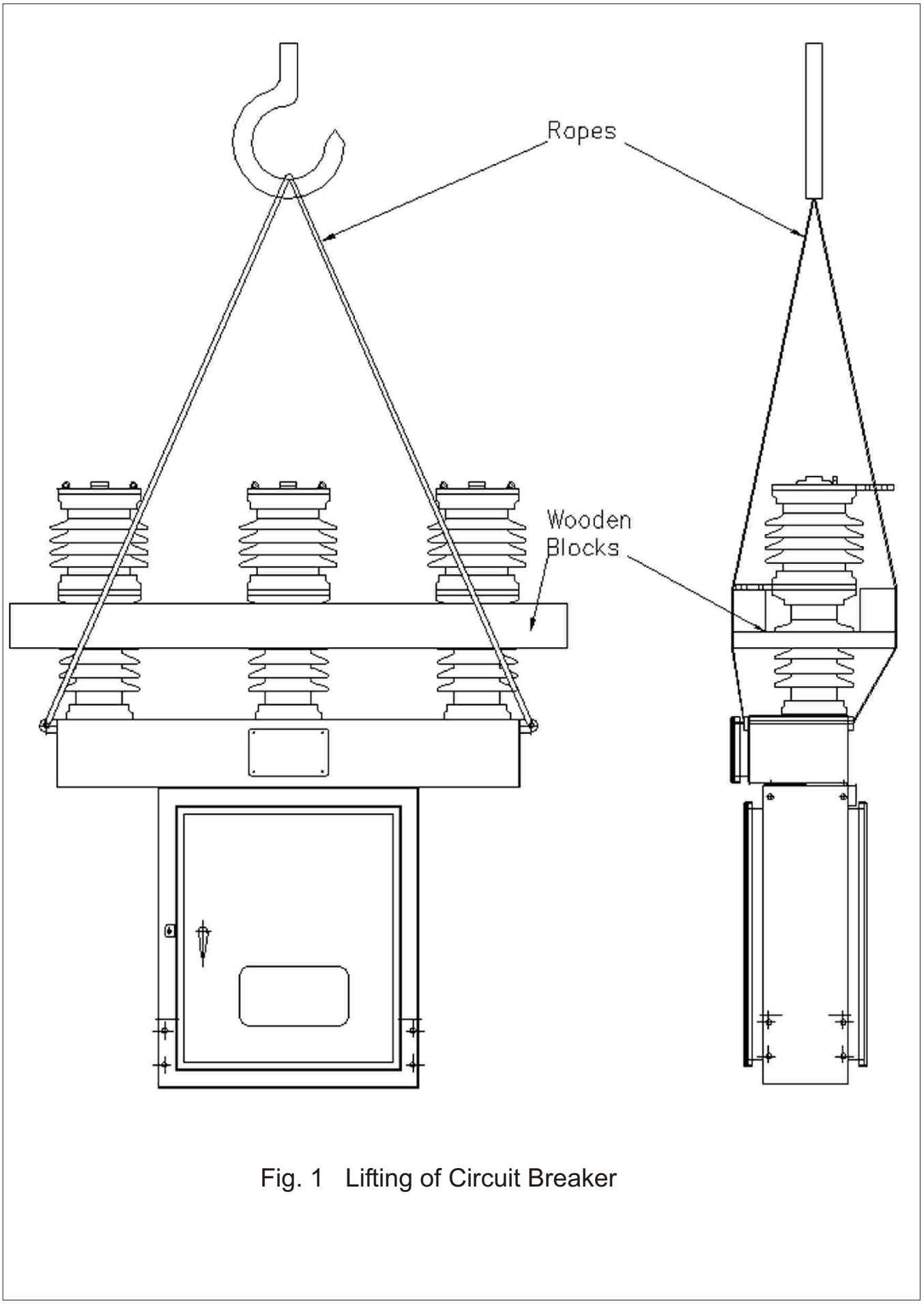


Fig. 1 Lifting of Circuit Breaker

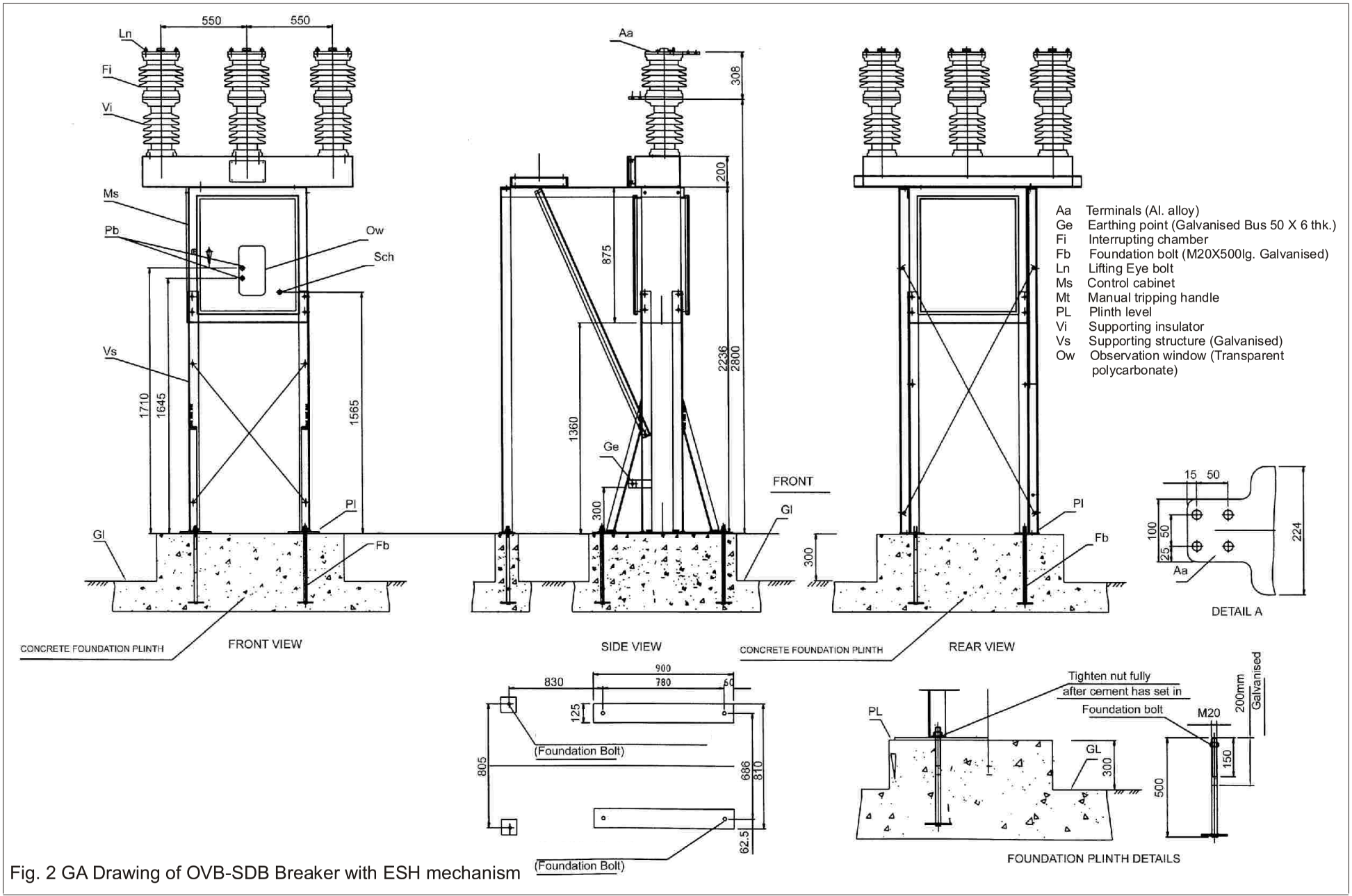


Fig. 2 GA Drawing of OVB-SDB Breaker with ESH mechanism

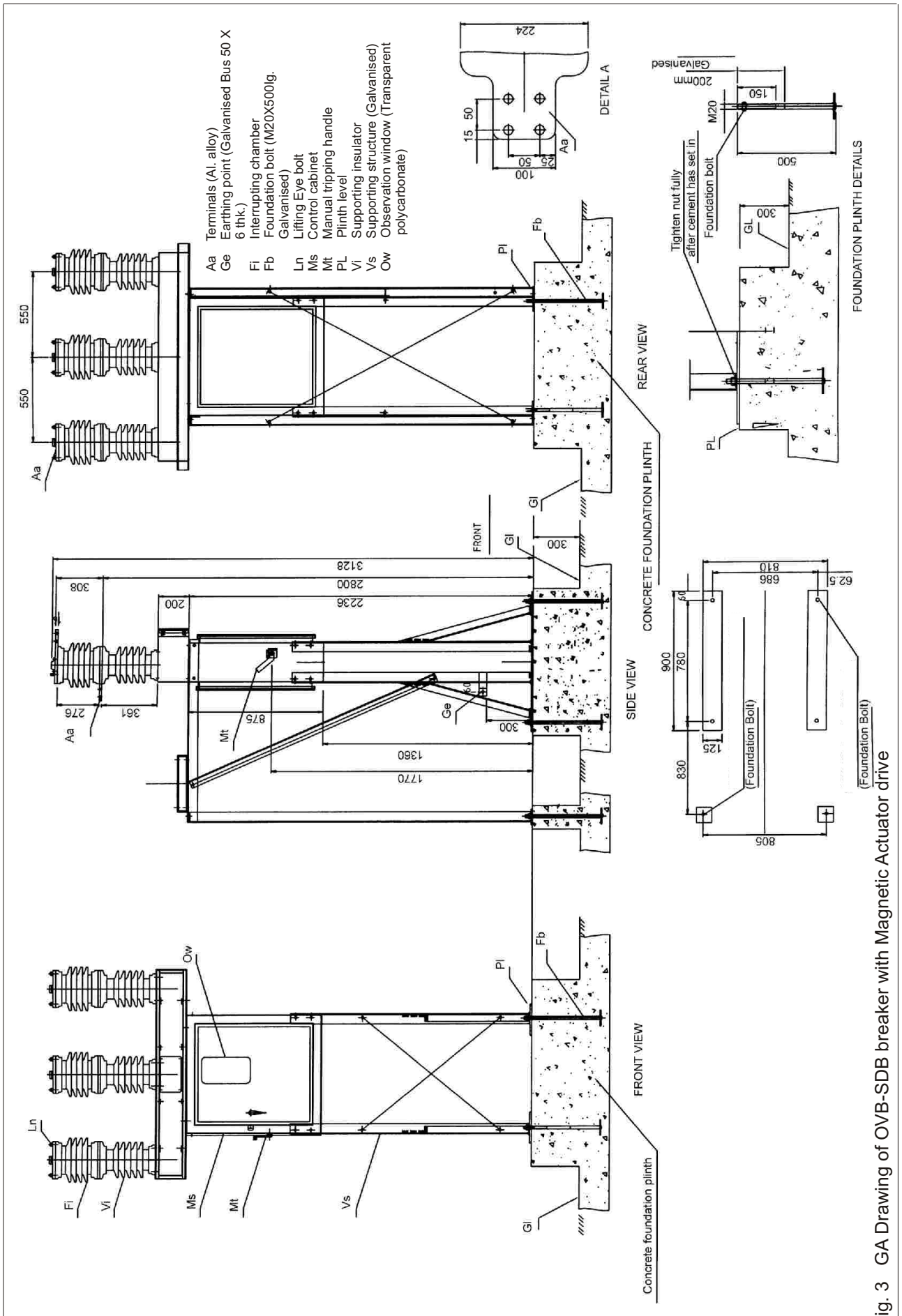


Fig. 3 GA Drawing of OVB-SDB breaker with Magnetic Actuator drive

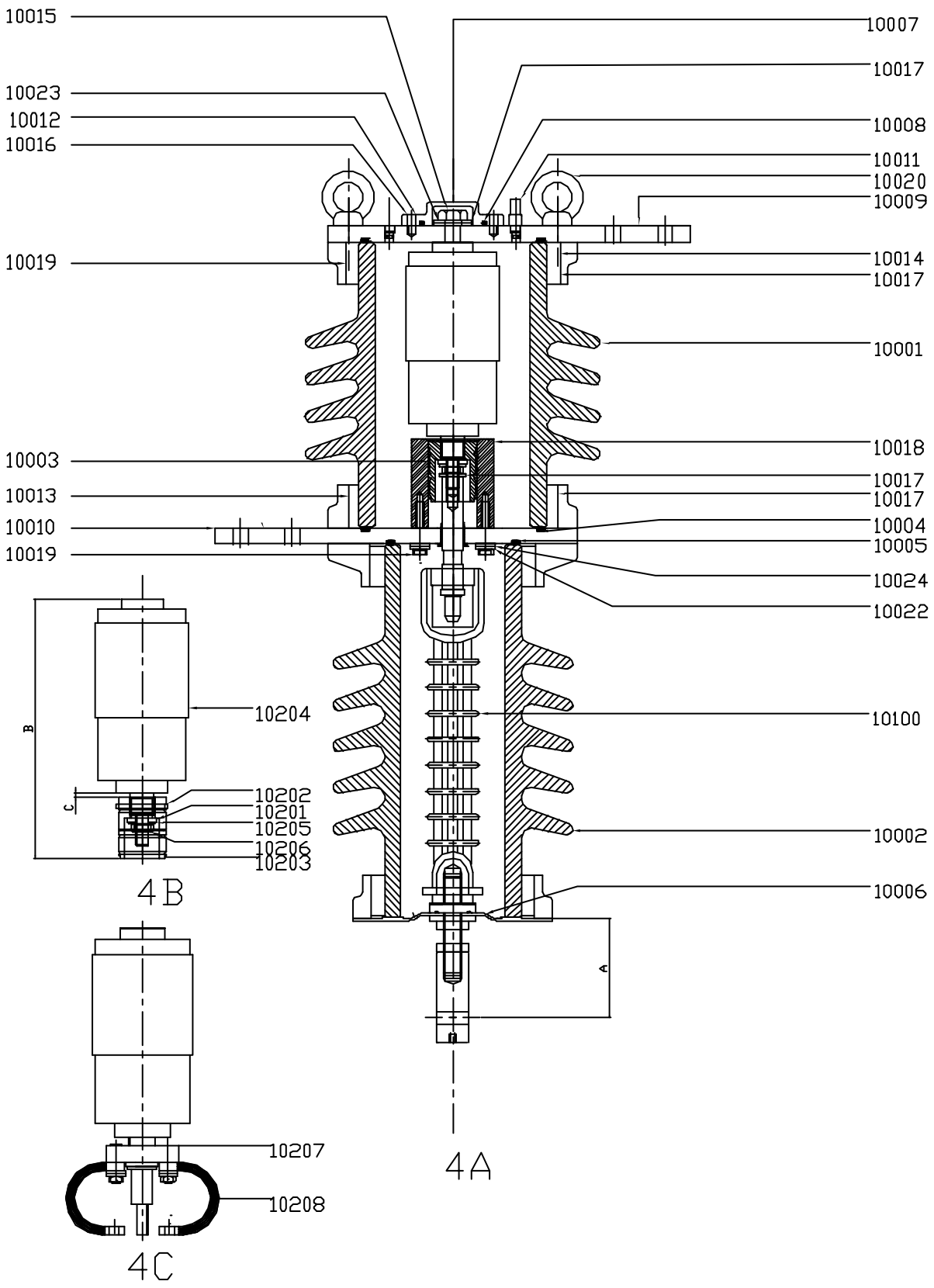


Fig. 4 Breaker Pole Assembly (Refer legend on pg. 48)

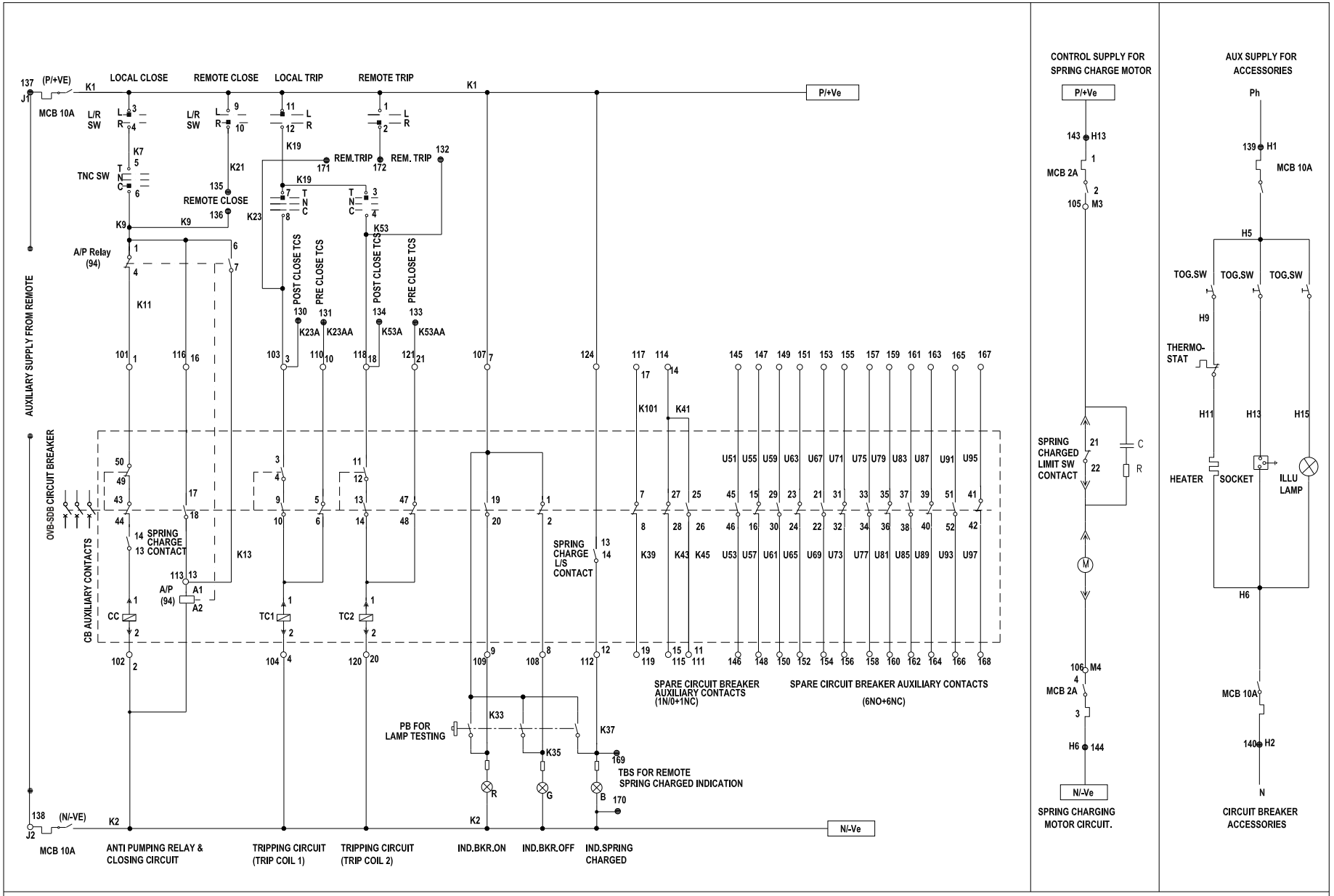


Fig 5 Schematic Circuit Diagram

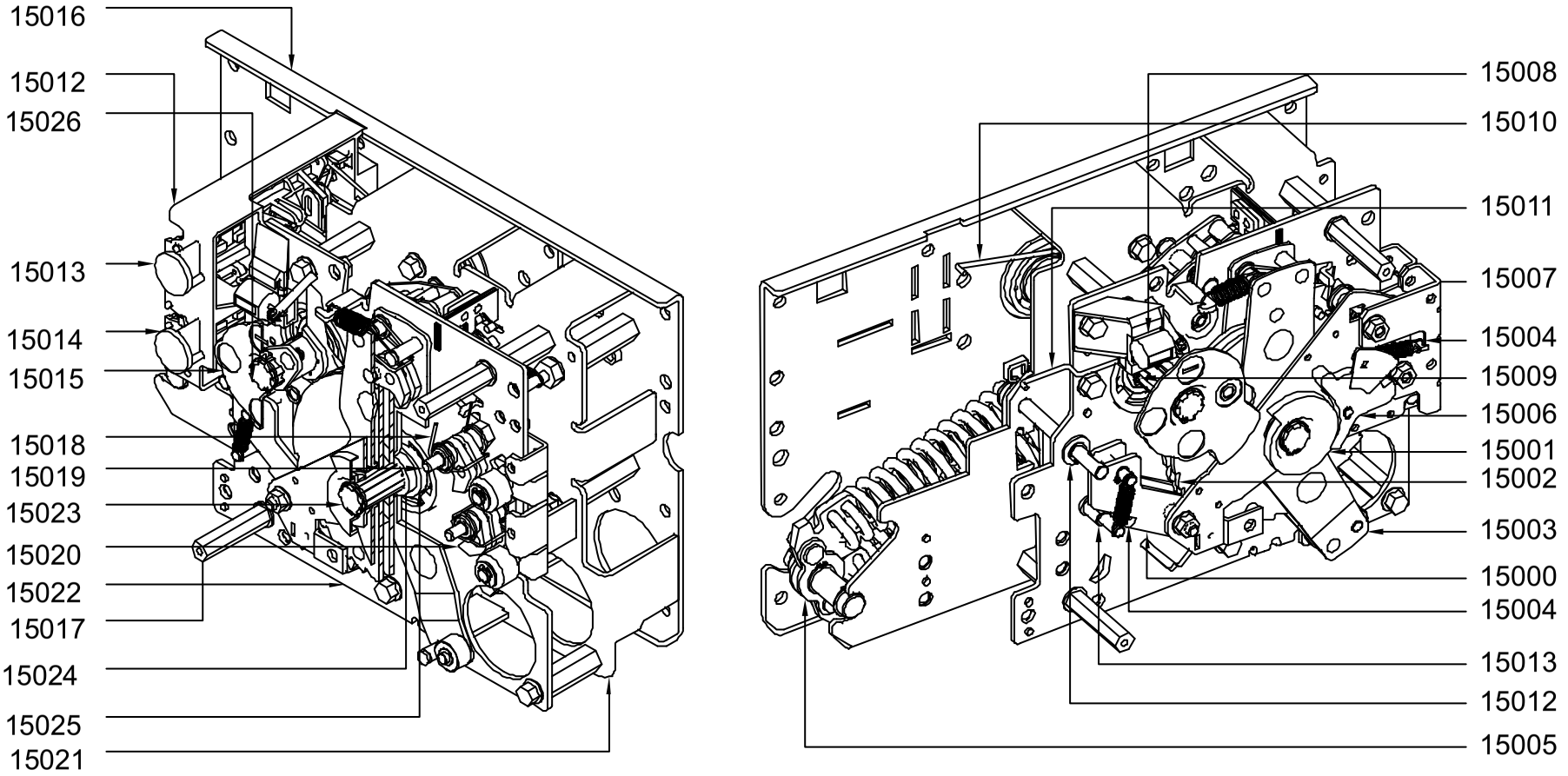


Fig. 6 ESH Mechanism with Cabinet (Refer Legend on page 49)

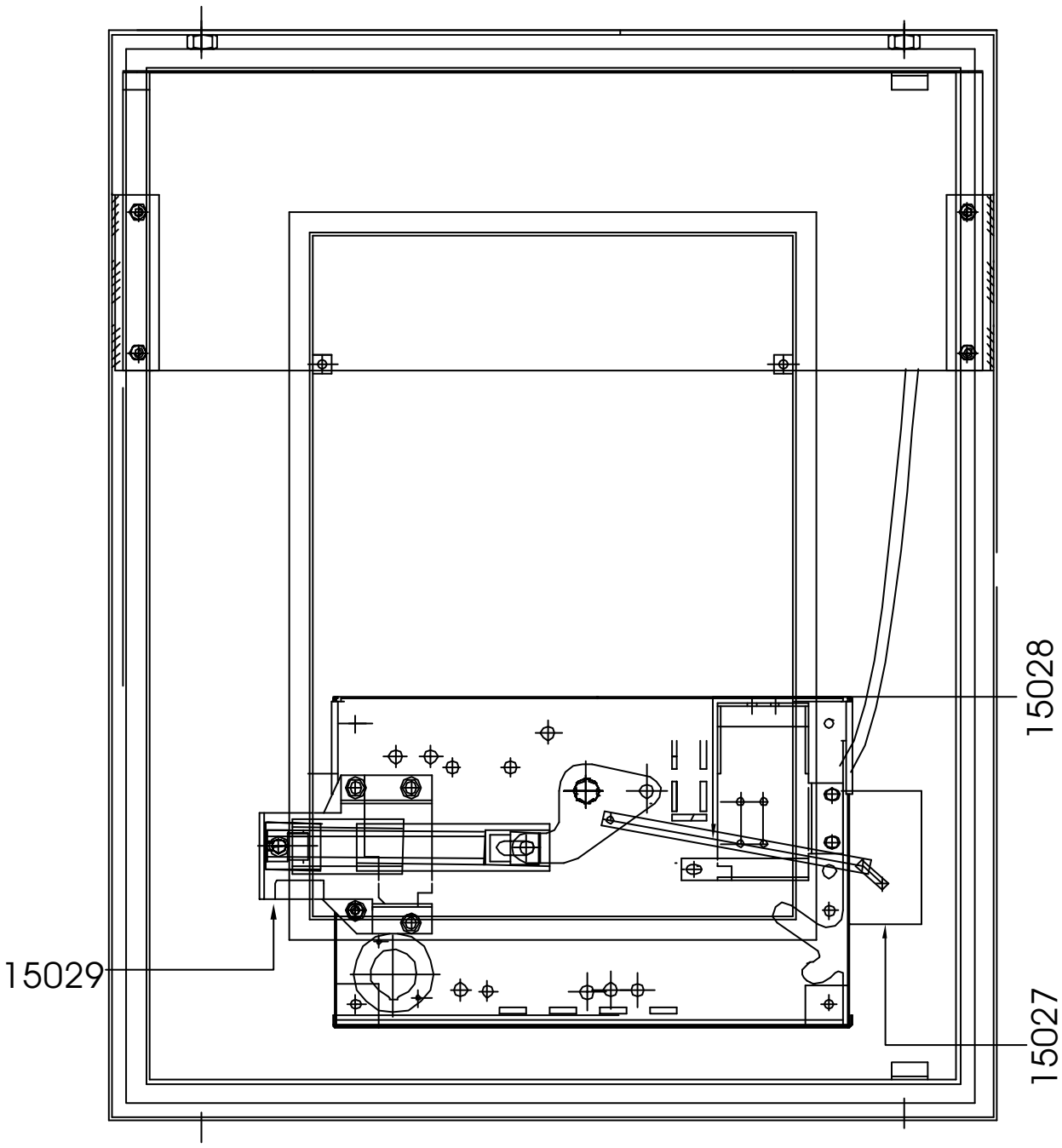


Fig.7 ESH Mechanism with Cabinet (Refer legend on pg. 49)

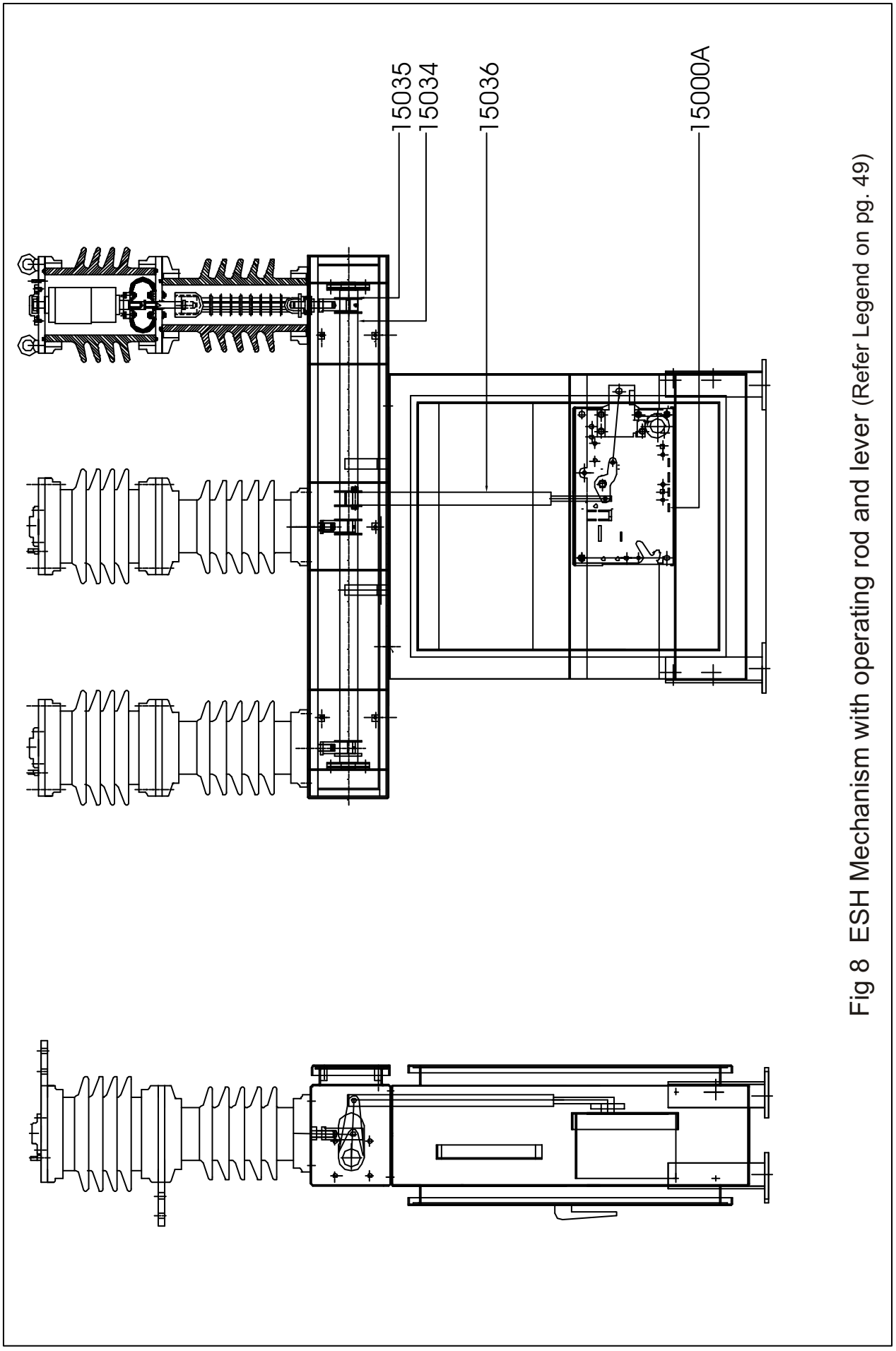
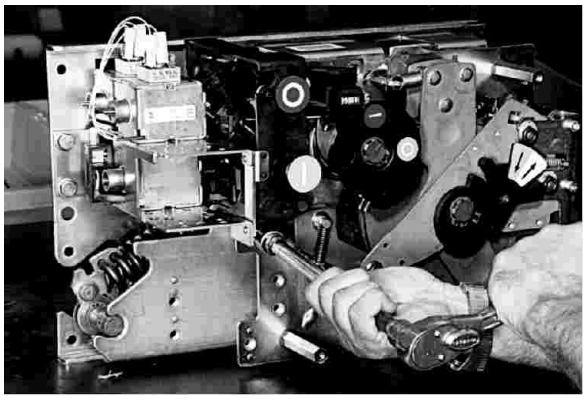
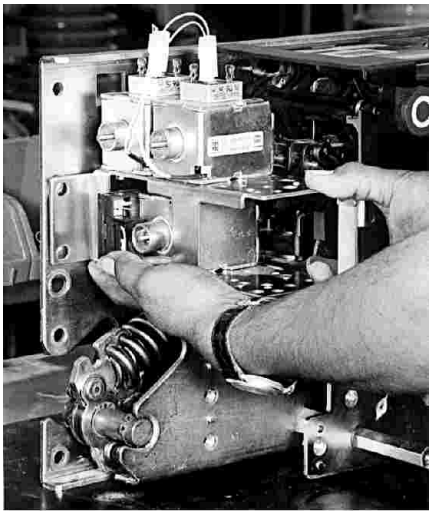


Fig 8 ESH Mechanism with operating rod and lever (Refer Legend on pg. 49)

Dismantling of Operating Coils Setup



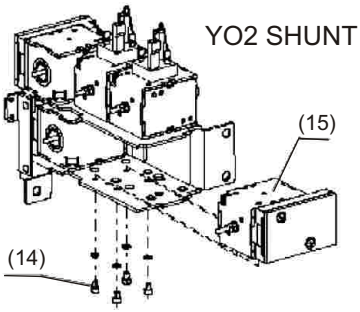
Unscrew the fixing screw of the release group mount



Withdraw the release group mount from the front of the operating mechanism. For assembly, proceed in the reverse order.

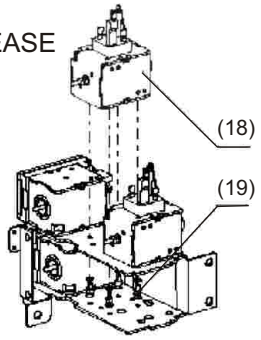
Fig.9

Steps for replacement of shunt opening release (Yo2) 15030



Unscrew the four coil fixing screws (14) and withdraw the relative YC coil (15).

YO2 SHUNT OPENING RELEASE



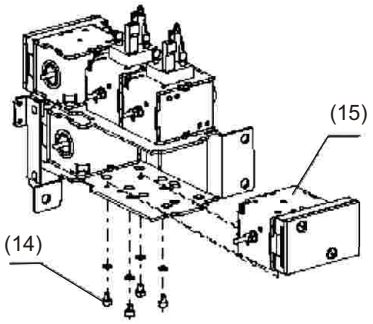
Unscrew the four coil fixing screws (19) and withdraw the relative YO1 coil (18).

FOR ASSEMBLY, PROCEED IN REVERSE ORDER

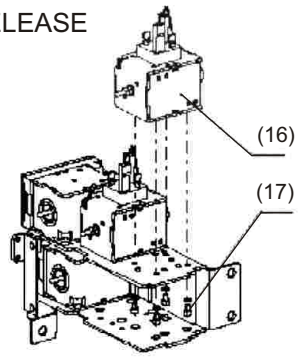
Fig. 10

Steps For Replacement of Shunt Opening Release (YO1) 15030

YO1 SHUNT OPENING RELEASE



When the YC shunt closing release is present, unscrew the four fixing screws (14) and withdraw it (15)



Unscrew the four fixing screws (17) and withdraw the relative YO1 release(16).

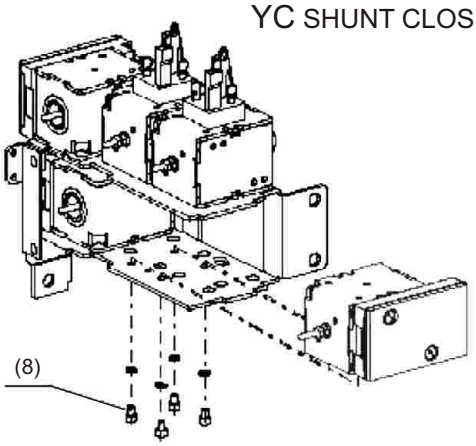
FOR ASSEMBLY, PROCEED IN REVERSE ORDER

Fig. 11

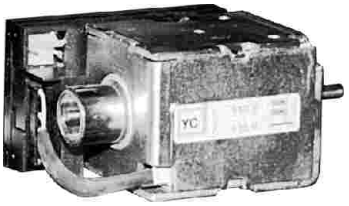
Steps For Replacement of Shunt Closing Release (YC) 15031

Disconnect the power supply connectors of the additional shunt opening release

YC SHUNT CLOSING RELEASES



Unscrew the four fixing screws and withdraw release (8)



FOR ASSEMBLY, PROCEED IN REVERSE ORDER

Fig. 12

Operating Coil Set-Up for Temperature –10 deg. C

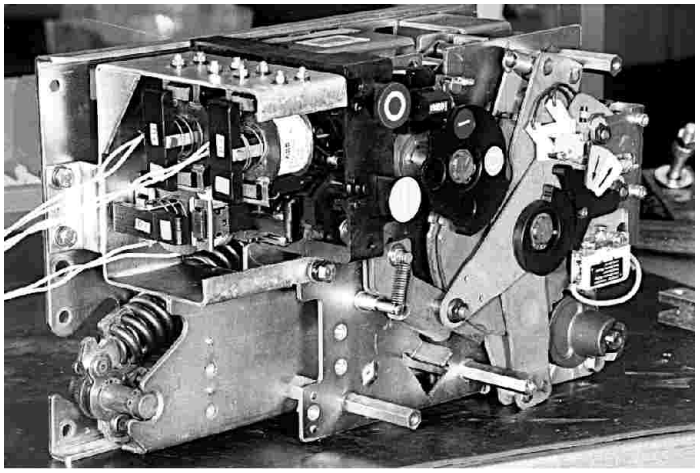
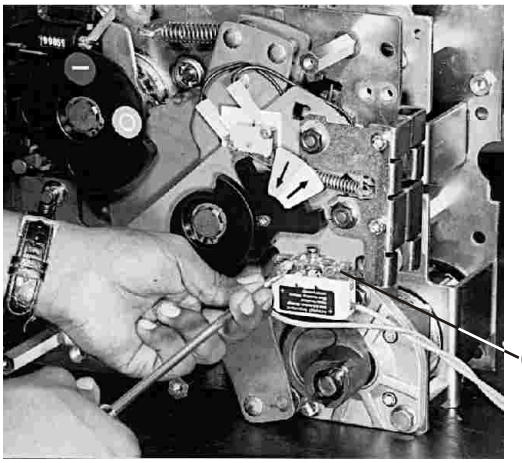
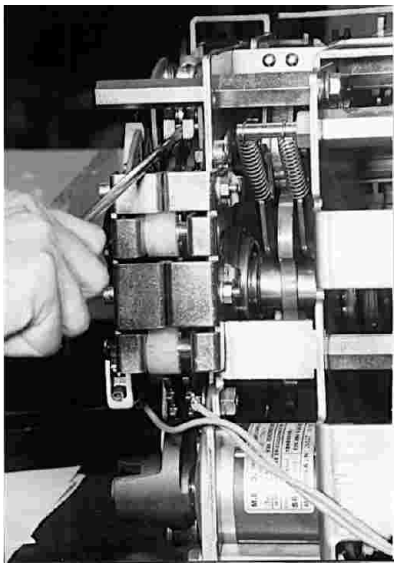


Fig. 13

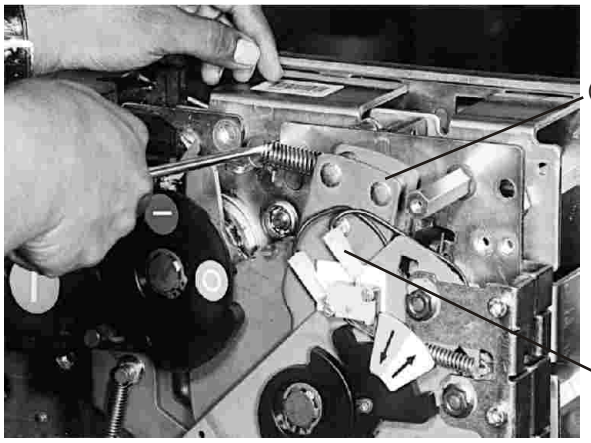
Steps For Replacement of Motor 15032



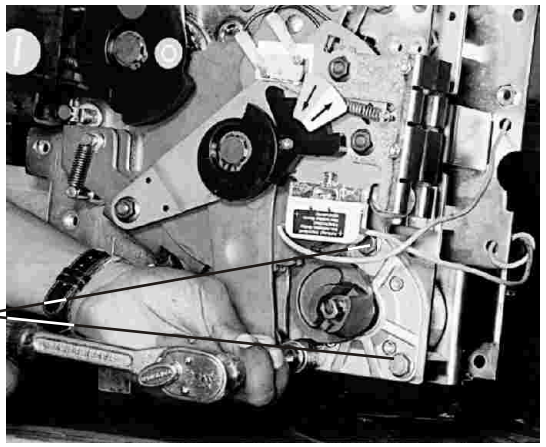
Remove the two motor limit microswitch fixing screws (2)



Raise the pair of driving latches using screwdriver and push the lever (3) forward.

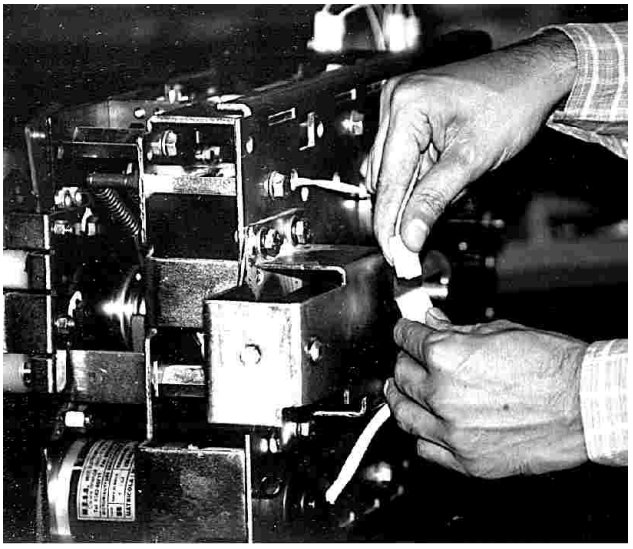


Release the return spring, raise the pair of charging pawls and push the lever towards (4).

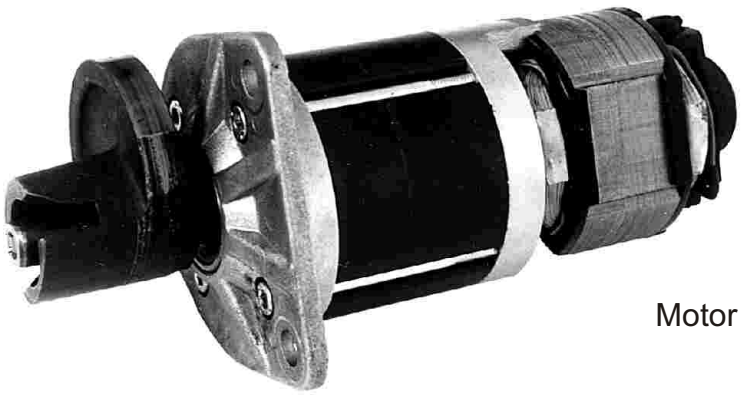


Unscrew the motor flange fixing screws (6)

Fig. 14



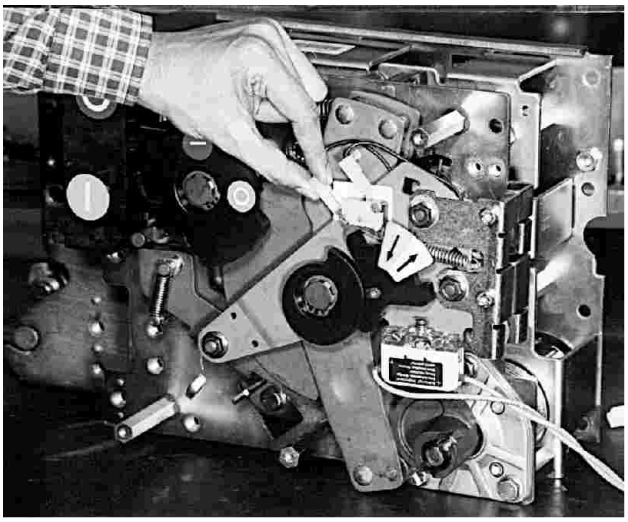
Disconnect the motor power supply (7)



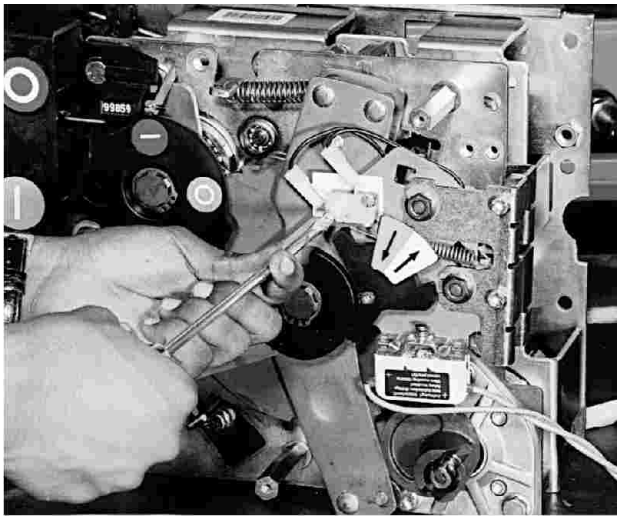
Motor

Fig. 15

Steps for replacement of micro-switch 15033



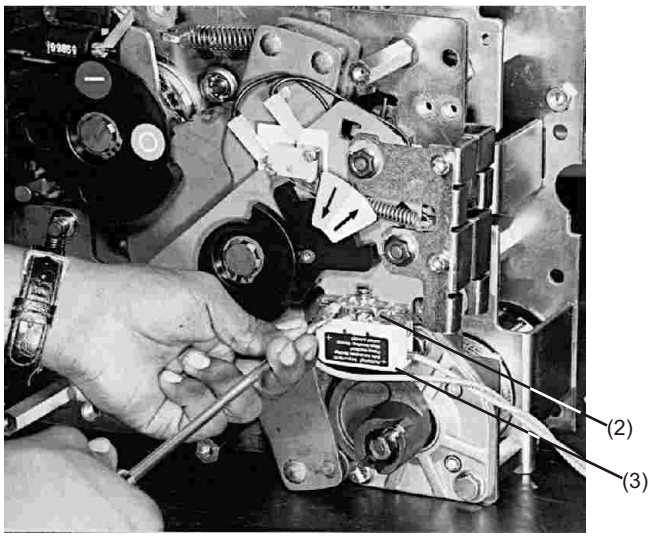
Disconnect the microswitch connection



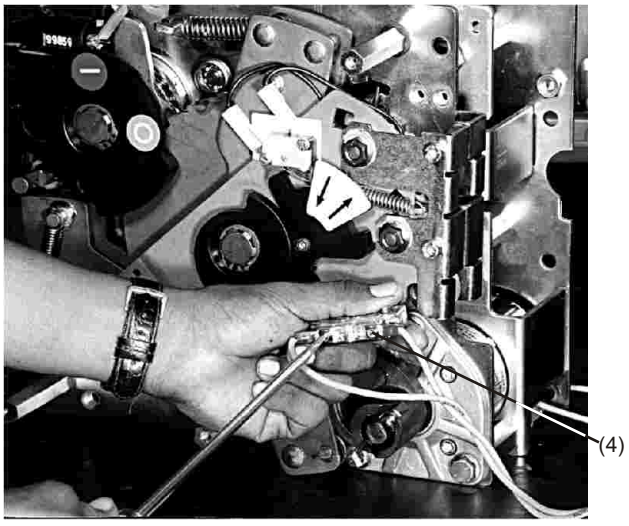
Unscrew the microswitch fixing screws

For assembly connect the Faston as it was in its original position

Fig.16



Unscrew the microswitch fixing screws (2)



Disconnect the microswitch connection (4)

Pull down cover of microswitch (3)

To assemble, proceed in reverse order

Fig.17

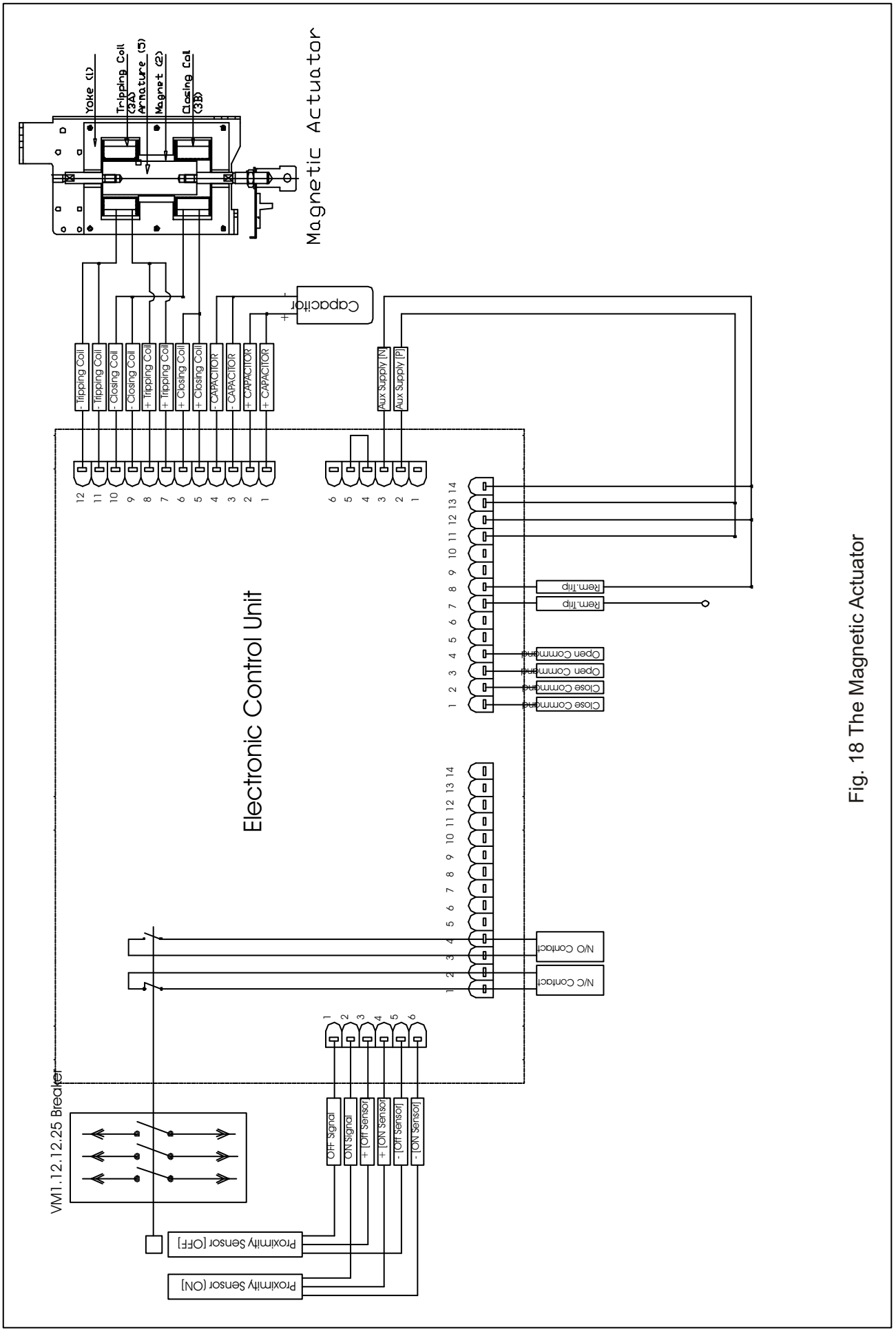


Fig. 18 The Magnetic Actuator

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