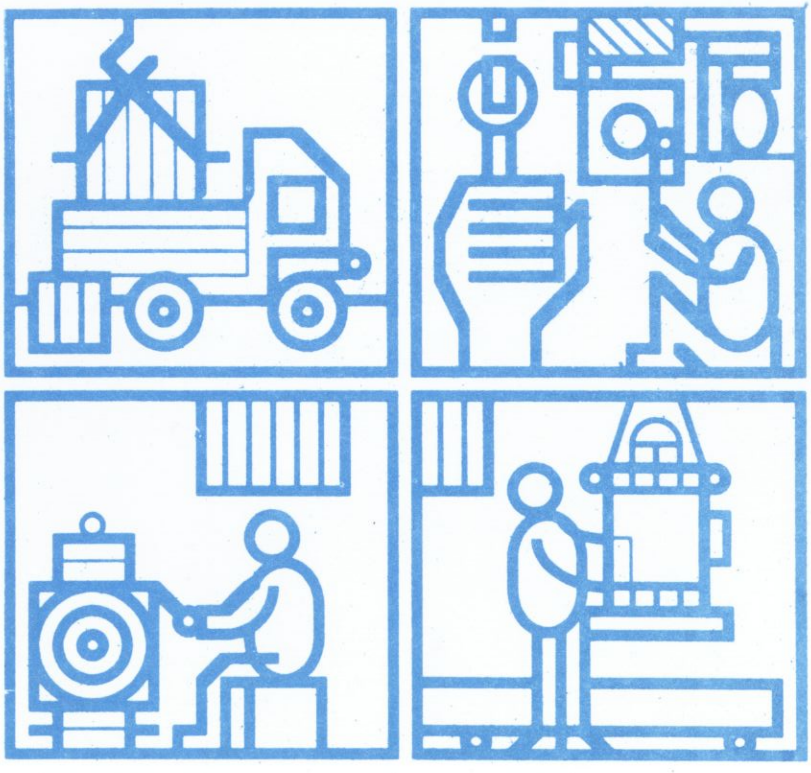
Jyoti Ltd.

'Jyoti'
12 kV, 26.4 kA, 1250 / 1600 Amps Outdoor Vacuum Circuit Breaker
(Type : VK 10 M 25 D)

Installation, Operation and Maintenance Manual



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CONTENTS

1. GENERAL

This instruction manual describes the methods and procedures for unpacking, storage, maintenance and inspection of 'JYOTI' outdoor vacuum circuit breaker type VK. The outdoor circuit breaker type VK is a compact unit that can be used for applications with excellent reliability.

The breaker has been especially designed for tropical, humid and vermin infested climate as normally obtained in INDIA.

2. RECEIPT AND STORAGE

2.1 ACCEPTANCE AND UNPACKING

Each circuit breaker is subjected to extensive testing and thorough inspection at factory before being wrapped and packed in suitable wooden boxes. The circuit breaker is packed in two cases, one containing complete circuit breaker unit itself and another one containing support structure made up of steel.

TO PROTECT THE CIRCUIT BREAKER AGAINST TRANSPORT DAMAGE, ALWAYS KEEP THE BOX WITH ITS RIGHT SIDE UP.

Do not put it on its sides or up side down.

Before unpacking, check if there is any damage or breakage of the packing. After unpacking, check for the following :

a) Check the accessories and spares, if ordered.

b) Check that no parts are missing and no damage sustained.

c) If any part is missing or found damaged, immediately inform to the nearest Branch Office or Marketing Division, Switchgear Plant, Jyoti Ltd., J 44-59, BIDC, Gorwa Vadodara - 390 016.

2.2 LIFTING (FIG. 1)

When lifting the circuit breaker, always hook the rope / chain at the lifting hook flat provided on pole box unit for this purpose as shown.

The circuit breaker unit is provided with loose bolted channel (transport channel) at the bottom to prevent the toppling of circuit breaker. While unpacking, keep circuit breaker bolted with transport channel till it is installed at its place carefully.

CAUTION

DO NOT LIFT OR DROP THE BREAKER WITH A JERK DURING LOADING OR UNLOADING. IT CAN DAMAGE THE VACUUM INTERRUPTERS.

2.3 STORAGE

If the circuit breaker is not going to be installed immediately, the following precautions should be taken during storage.

a) Store it in a place free from corrosive gases and dust.

b) Put the dust cover over the breaker when storing it.

c) Keep the loose spares and accessories properly so that they do not get lost.

d) Keep the circuit breaker bolted with transport channel to prevent toppling.

3. DESCRIPTION OF CIRCUIT BREAKER

'JYOTI' three phase outdoor vacuum circuit breaker type VK is a compact unit having three single column housing the vacuum interrupter in upper bushing. These columns are mounted on common frame. The common frame houses the linkage drive for each pole.

The cabinet below the common frame houses the spring operating mechanism and control wiring alongwith terminal stations.

The cabinet is provided with cable gland plate for the entry of control wiring cable and plug and socket arrangement for maintenance purpose.

The closing springs provides the energy for closing the breaker, charging the opening springs and applying sufficient contact pressure on moving contact of vacuum interrupters.

The mechanism energy is transmitted to the vacuum interrupters through linkage drive from mechanism to pole box and from pole box to individual poles.

4. ERECTION

The erection of 'JYOTI' outdoor vacuum circuit breaker is very simple. The complete unit with support structure can be placed on foundation as per foundation drawing. Follow the foundation drawing submitted for particular order.

Following procedure should be followed for erection.

1. Prepare the foundation as per drawing.
2. Grout the foundation bolt as per drawing and ensure proper levelling of foundation. Make sure that foundation bolt of correct size and length is used. (It is preferable to have foundation bolt with longer length if correct length is not available.)
3. Allow sufficient time for the setting of foundation after grouting the foundation bolt.
4. Place the support structure over foundation bolt.
5. Level the support structure properly using packing if required. Use spirit level to check the level if necessary and fasten the support structure with foundation bolt.
6. Place the vacuum circuit breaker unit over the support structure and bolt them together. There are in all 10 bolts for fixing support structure and vacuum circuit breaker unit. Use all of them and tighten fully.
7. The vacuum circuit breaker is now installed and ready for mechanical operations.

   The unit is completely assembled and properly factory tested. It does not require any type of setting at site during / after erection.
8. The breaker is provided with a cable gland plate fitted in cabinet. Dismantle the gland plate and make hole suitable for cable gland. Pass the cable through the hole, seal the gland plate and assemble it to the cabinet properly Keep sufficient length of cable after sealing so that there is no inconvenience to connect cable wire to terminal station of circuit breaker.
9. Connect the cable wire to their respective terminals of breaker after checking the wiring diagram.
10. Check the operations of vacuum circuit breaker.

    The circuit breaker is now ready for commissioning after usual pre-commissioning checks.

5. COMMISSIONING INSTRUCTIONS

1. Check that all insulating parts exposed to air are cleaned properly with clean and dry cloth or compressed air.
2. Perform charging, closing and tripping operations mechanically as well as electrically.
3. Check all indicators provided (e.g. charged/discharged and open/closed)

are working properly.

4. Check there are no loose connections.

5. Carry out insulation resistance measurement test.

	Measuring Location	Insulation Resistance	Megger
a)	Main conductor to ground	500 M Ohms or more	1000 V
b)	Between main circuit terminals with breaker open	100 M Ohms or more	1000 V
c)	Control circuit to ground	2 M Ohms or more	500 V

If insulation resistance in condition (a) and/or (b) is less than specified, clean the external surface of porcelain bushing with clean and dry cloth and repeat the test.

6. OPERATION (FIG. 3)

6.1 MANUAL OPERATION

6.1.1 CHARGING OF CLOSING SPRINGS

Hold the charging handle and move it up and down several times (approx. ten times) until a distinct clicking sound is heard. Now the charged / discharged indication will show 'CHARGED' indication. This is the position when closing springs are fully charged.

NOTE : The number of times charging handle is to be moved up and down depends on angle of handle movement.

6.1.2 CLOSING OPERATION

Push the closing push button (green) to close the circuit breaker. The circuit breaker will get closed. The indicator will show 'CLOSED' and the charged/ discharged indicator will show 'DISCHARGED'.

6.1.3 Opening Operation

To open the circuit breaker, energise the opening coil. The circuit breaker will get opened.

6.2 ELECTRICAL OPERATIONS

6.2.1 CHARGING OF CLOSING SPRINGS

To charge the closing springs, energise the motor circuit. The motor will start & closing springs will get charged. When charging is completed, 'CHARGED/ DISCHARGED' indication will show 'CHARGED' & supply to motor will get automatically cut off.

6.2.2 CLOSING OPERATION

To close the circuit breaker, energise the closing coil. As soon as the circuit breaker will get closed, motor will re-start and will re-charge the closing springs. After the charging operation is completed, motor will stop and charged/discharged indicator will show 'CHARGED'.

6.2.3 OPENING OPERATION

To open the circuit breaker, energise the opening coil The circuit breaker will get opened.

7. FUNCTION OF OPERATING MECHANISM (FIG. 3 & 4)

7.1 CHARGING OPERATION

Breaker is in 'OPEN' condition and closing springs are in discharged condition.

7.1.1. MANUAL CHARGING OPERATION

Hold the charging handle (1) and move it by approximately 30 degrees till it stops. This will rotate the gear (2) which in turn will rotate the gear (3). The gear (3) will rotate the cam shaft (4). The closing springs (5) which are hinged at one end, will start getting charged due to rotation of cam shaft as the other end of the spring is connected to crank (6) fitted on cam shaft (4).

Now return the charging handle back to its original position and move it up again. A distinct clicking sound will be heard as soon as springs are fully charged.

Mow the charged/discharged indicator will show 'CHARGED' indication. The circuit breaker is ready for 'CLOSING'.

7.1.2 MOTOR CHARGING OPERATION

As soon as supply is given to charging motor (7), it will rotate the shaft (8) which in turn will rotate the gear (3). The remaining charging operation is similar to manual charging operation.

When the springs are about to get charged fully, the cam (9), mounted on cam shaft (4) will operate the micro switch (10) through level (11) and supply to motor will get cut-off.

7.2 CLOSING OPERATION

When springs are fully charged, the linkages attain position (A). Now the circuit breaker is ready for closing operation.

7.2.1 MANUAL CLOSING OPERATION

Push the closing push button (12). This will rotate the closing shaft (13), which in turn will release the closing catch (14). Now the energy of closing springs will cause the cam (15) to rotate at fast speed and will bring the linkages into the position (B).

Thus the rotation of cam will rotate the main shaft (16). This will rotate pole box shaft (30) through connecting link and the breaker will get closed. The opening springs (17), mounted on main shaft (16) will get charged during closing operation.

7.2.2. ELECTRICAL CLOSING OPERATION

When supply is given to closing coil (18). The plunger (19) of closing coil will push the closing paddle (20). This will cause the closing shaft (13) to rotate.

The remaining operation is similar to manual operation. As soon as breaker get closed, the supply to the motor is reconnected through the operation of cam (9), lever (11) and micro-switch (10). the closing springs immediately get recharged and linkages attain the position (D).

7.3 OPENING OPERATION

When the circuit breaker is closed, the linkages attain the position (D). Now the circuit breaker is ready for opening operation.

7.3.1 MANUAL OPENING OPERATION

Push the trip push button (21). This will rotate the trip shaft (22) through tripping paddle (23), which in turn will release the tripping catch (24).

The energy of opening springs (17) will cause the linkage to attain the position (A).

This movement of linkages will rotate the main shaft (16) and the circuit breaker will be opened. During opening operation, initially energy of wipe spring (25) will be releascd to attain the required initial speed. The same will be further maintained by the release of opening spring energy.

7.3.2 ELECTRICAL OPENING OPERATION

When the supply is given to tripping coil (26), the plunger (27) of tripping coil will push the tripping paddle (28). This will cause the tripping shaft (22) to rotate. The remaining opening operation is similar to manual opening operation.

7.4 AUXILIARY SWITCHES

Auxiliary Switch	AS cam switch (Rotary Switch)
Auxiliary Switch	LS1 Micro Switch
Auxiliary Switch	LS2 Micro Switch
Auxiliary Switch	SW1 Toggle Switch
	SW2 Toggle Switch
	SW3 Toggle Switch
	V Local Remote Switch

The auxiliary switch AS (cam switch / rotary switch) is controlled by the breaker movement and it is operated by main shaft through linkages. This switch has 14 contacts (7 NO + 7 NC). When the circuit breaker gets closed, the contacts in closing circuit gets opened and the contact in tripping circuit gets closed and vice versa.

The auxiliary switch LS1 is a micro switch. It is controlled by rotation of cam shaft. When the closing springs are in discharged condition, its closed contact connects the charging, its contact cuts off the supply to motor control relay disconnecting motor supply.

The auxiliary switch LS2 is also a micro switch and operates exactly the same way as LS1. The switch LS2 is used for charged / discharged indication lamp.

The auxiliary switch SW1 is a toggle switch and used in the charging circuit. On switching On the switch, the supply to motor circuit starts, It is to be normally kept 'ON' unless motor circuit is to be disconnected for any maintenance prToggle Switch purpose. The running of motor in charging circuit is controlled by operation of motor control relay.

The switch SW2 is also a toggle switch and is used in heater circuit. During moist weather, to prevent condensation in the cabinet, the switch SW2 is to be made 'ON' to start the heater.

The switch SW3 is also a toggle switch and is used to switch ON & OFF the plug socket provided.

The auxiliary switch V is a cam switch (rotary switch). It is used for the changes over of supply to closing and tripping circuits from local to remote and vice versa.

8. MAINTENANCE & INSPECTION

8.1 Check Point for Periodical Inspection

Vacuum circuit breaker incorporates a specially designed and completely sealed vacuum interrupter to perform its basic function of opening when opening command is given under normal operating conditions and also under fault conditions such as short circuit; and closing when closing command is given under normal condition and making under fault condition such as short circuit. The energy required to operate the vacuum

interrupter at specified speeds is very small as compared to oil and other types of circuit breaker for the same rating.

As operating energy is very small, the vacuum circuit breaker requires minimum maintenance. The table -1 gives the various maintenance check points and its methods to ensure consistent performance.

The checking should be done first time after 2000 operations or one year whichever is earlier and there after every three years or 5000 operations whichever is earlier.

8.2 CHECK ON VACUUM

The relation between the dielectric breakdown voltage and vacuum internal pressure is shown in fig.6.

The breakdown occurs in the vacuum interrupter when applied with a voltage of about AC 17 kv to 21 kv rms under atmospheric pressure. Whether the interrupter maintains a high internal vacuum can be checked by applying the voltage of AC 25 kv in this voltage withstand test.

When internal vacuum is not sufficiently high, there is almost no delay in the breakdown. So 10 seconds of voltage application duration is enough.

Measurement is taken with the vacuum circuit breaker open and the voltage applied between the terminals of the vacuum interrupter.

If test set up trips, repeat the process thrice, If test set up trips all the time, the vacuum interrupter is deemed to be defective.

8.3 MEASUREMENT OF WIPE (FIG. 5)

Nominal value of wipe, when circuit breaker is supplied, is 3.0 ± 0.5 mm. this can be seen by the RED mark on link with circuit breaker closed.

When the value of wipe reaches 1 mm or less, the vacuum interrupter is required to be replaced.

When the red mark is about to disappear with breaker closed, the value of wipe reaches to its minimum permissible value.

9.0 REPLACEMENT OF PARTS

Customers are advised not to replace components like vacuum interrupter themselves. For such replacement, customers are advised to contact JYOTI LIMITED, 'Marketing Division', Switchgear Plant, Gorva, VADODARA - 390 016 or nearest JYOTI Branch / Zonal Office.

Even replacement of other parts like coil, motors, micro switches etc. should be done only by those personnel who are properly trained at our Works, which can be arranged on specific request.

10. SPARES

10.1 LIST OF RECOMMENDED SPARES

Sr. No.	Item	Type form on rating	Part No. or Draw No.	Qty. per Unit
1.	Closing Coil	220 V DC 110 V DC 30 V DC 24 V DC	DEG/VS/TP/237/07	1
2.	Tripping Coil	220 V DC 110 V DC 30 V DC 24 V DC	DEG / VS / TP / 237 / 06	1
3.	Auxiliary Switche		DEG / VS / TP / 237 / 14	1
4.	Microswitch		DEG / VS / TP / 237 / 09	2
5.	Control relay	220 V DC 110 V DC 30 V DC 24 V DC	DEG / VS / TP / 237 / 04	
6.	Thermal Overload Relay		DEG / VS / TP / 237 / 05	1
7.	Gaskets		4VC62 - 0036 / 01 4 VC62 - 0036 / 02	6 6
8.	Packing		4VC62 - 0067	3

TABLE - I

11. CHECK POINTS FOR PERIODICAL INSPECTION

Sr. No.	Check Point	Item	Checking Method	Criteria	Actions required
1.	Complete Circuit breaker	Screws, bolts & Nuts	By screw driver & wrench	There should not be any loose screw, bolts or nut	Tighten if found loose
		Dust & foreign matter	Visual check	The breaker shold be clean & should not have any foreign matter on it	Clean with compressed air and wipe with clean and dry cloth
		Deformation, excessive wear	Visual check	There should be no deformation or excessive wear or damage to any part	Remove cause and replace the part if required
2.	Operating Mechanism	Dust & foreign matter	Visual check	There should be no dust or foreign matter	Clean with compressed Air
		Smooth operation	Manual operation	Operation should be smooth	
		Lubrication of bearings, pins, latches etc.	Visual check	Should be well lubricated	Apply PTFE grease, Beacon Q2 grease or its equivalent
		Closing and tripping shaft	Visual check	Must rotate freely	Apply grease
3.	Porcelain Bushings	Dust and Foreign matter	Visual check	The bushing should be clean and no dust or foreign particles on bushings	Clean with compressed air and wipe with clean and dry cloth.
4.	Vacuum Interrupter	Contact Wear	Visual check	Wipe shoulod be 3.0 +/- 0.5 mm when breaker closed	If it is less than 1 mm, vacuum interrupter should be replaced

		Vacuum	See check on vacuum		Vacuum interrupter should be replaced when vacuum is not sufficient
		Number of operations	Counter	When counter reading reaches 10,000 operations check vacuum. If OK, continue to use and check again when counter reading reaches 15,000. operations. If vacuum is O.K. continue to use. Check again at 20,000 oeprations	Vacuum Interrupter should be replaced, if check on vacuum is not OK or when counter reaches 20,000 operations.
5.	Ausiliary Switch	Terminal	Tighten by screw driver	There should be no loose connection	Retighten if found loose
		Case & contacts	Visual check	There should not be any damage	Replace if found damaged
6.	Control circuit	Operate Breaker electrically	Charge, Close and Open operations	Smooth operation	Check circuit and operation of auxiliary switch

Sr. No.	Check Point	Item	Checking Method	Criteria	Actions required
7.	Measurement of Insulation resistance	Measuring Location	Insulation resistance	Megger	When insulation resistance between the main circuit terminals is lower than specified, clean outer surface of porcelain bushings by cleaning and dry cloth and recheck.
		Main conductor to ground	50 M Ohm or more	1000 V	
		Between main circuit terminals when breaker open	100 M Ohm or more	1000 V	
		Control circuit to ground	2 M Ohm or more	500 V	

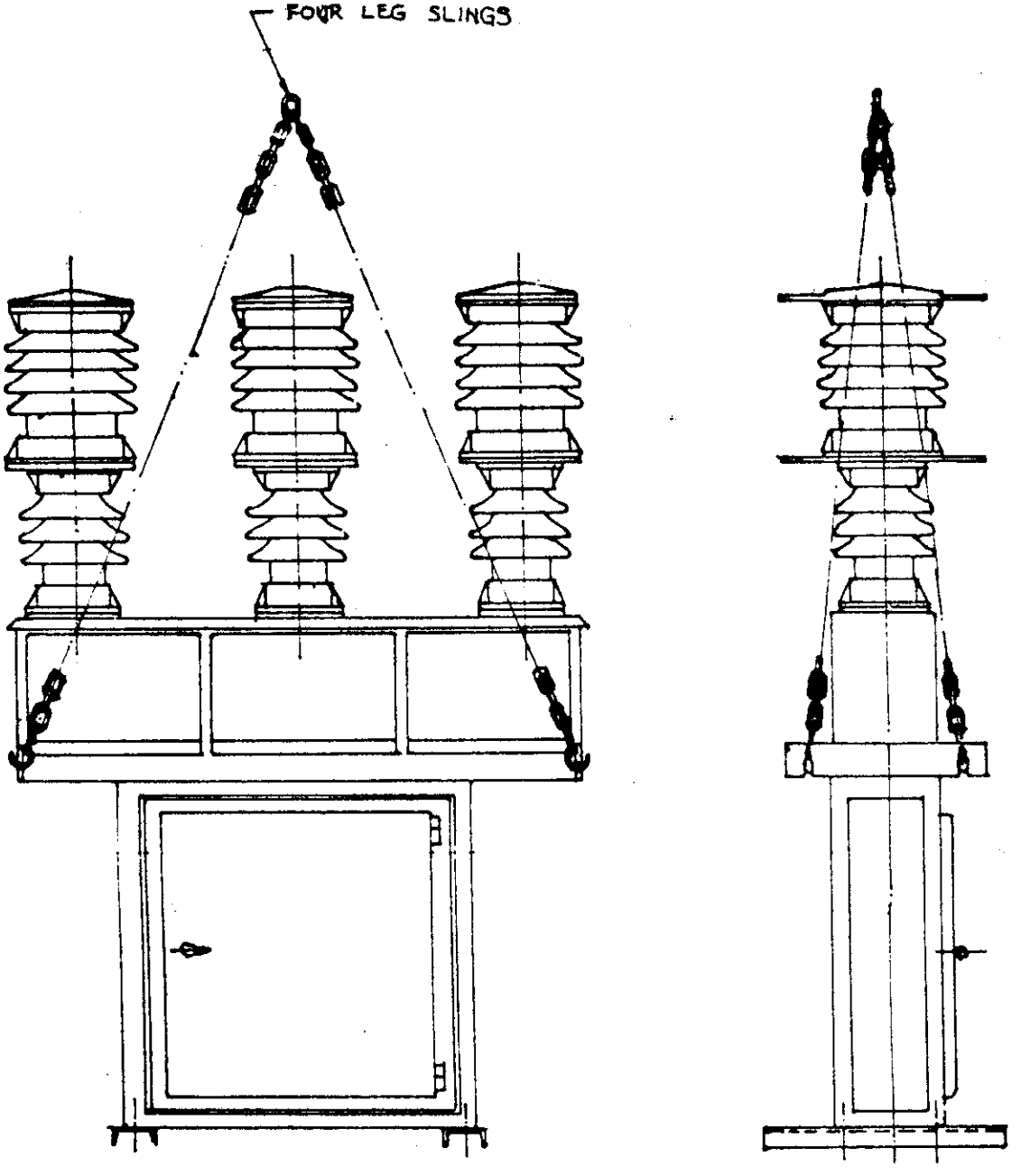
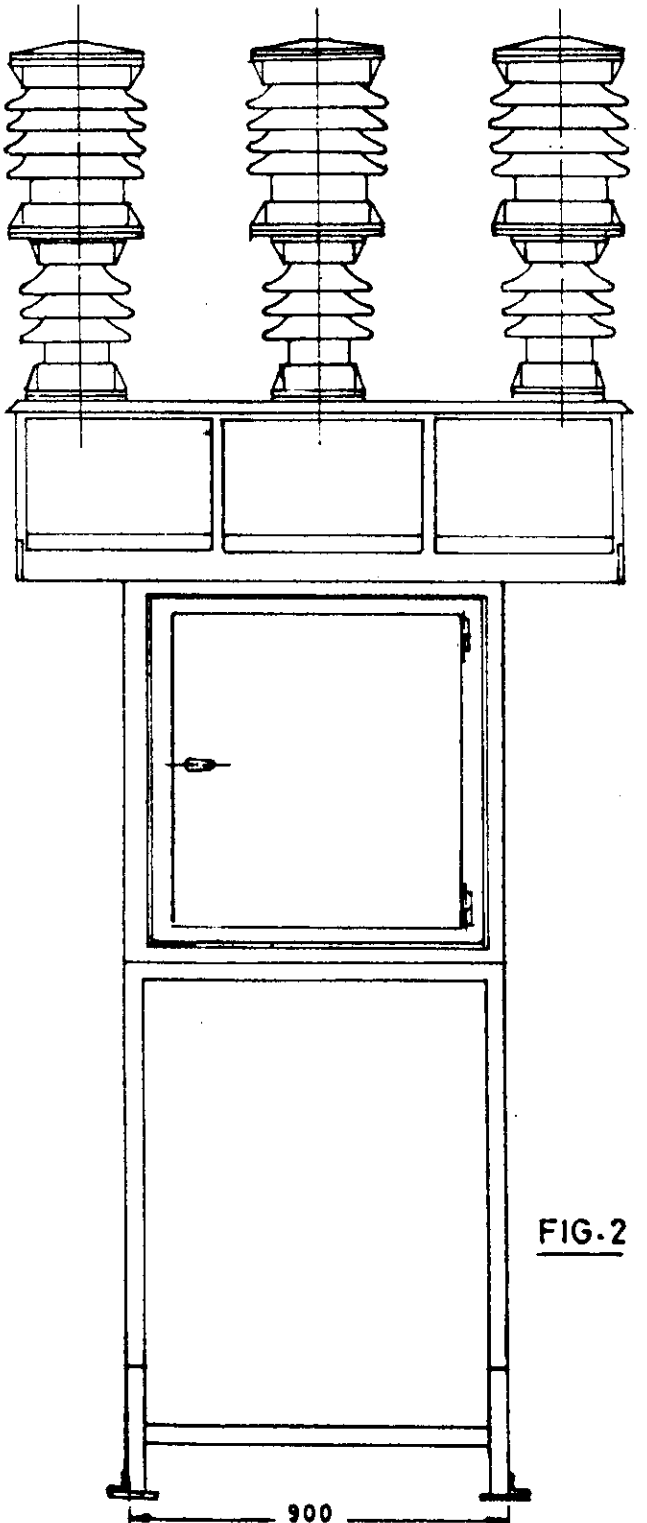


Fig. 1 LIFTING OF CIRCUIT BREAKER



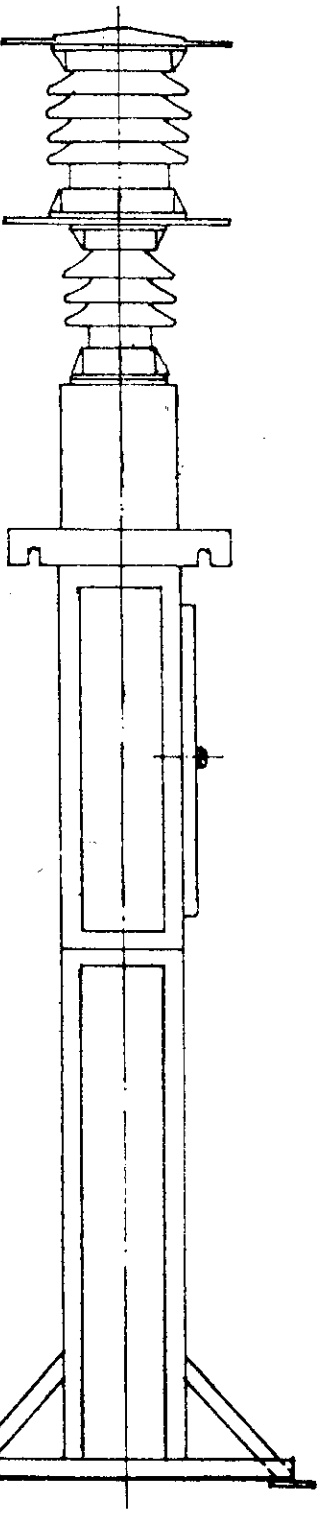
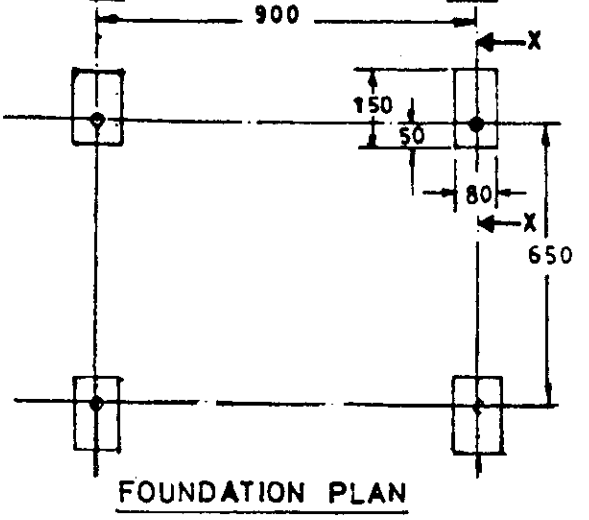
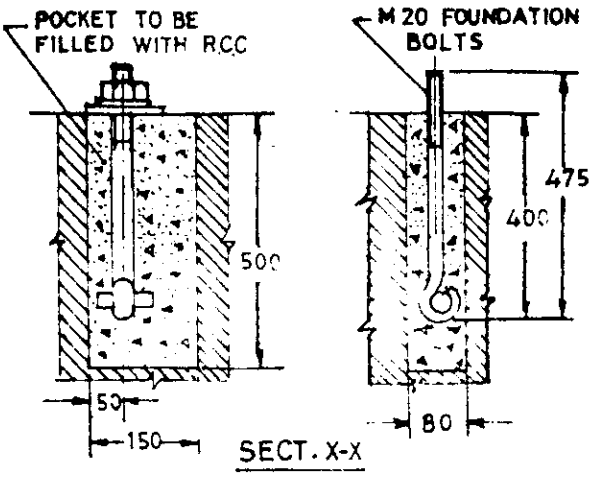


FIG.2 OUTDOOR V.C.B



FOUNDATION PLAN



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A 4

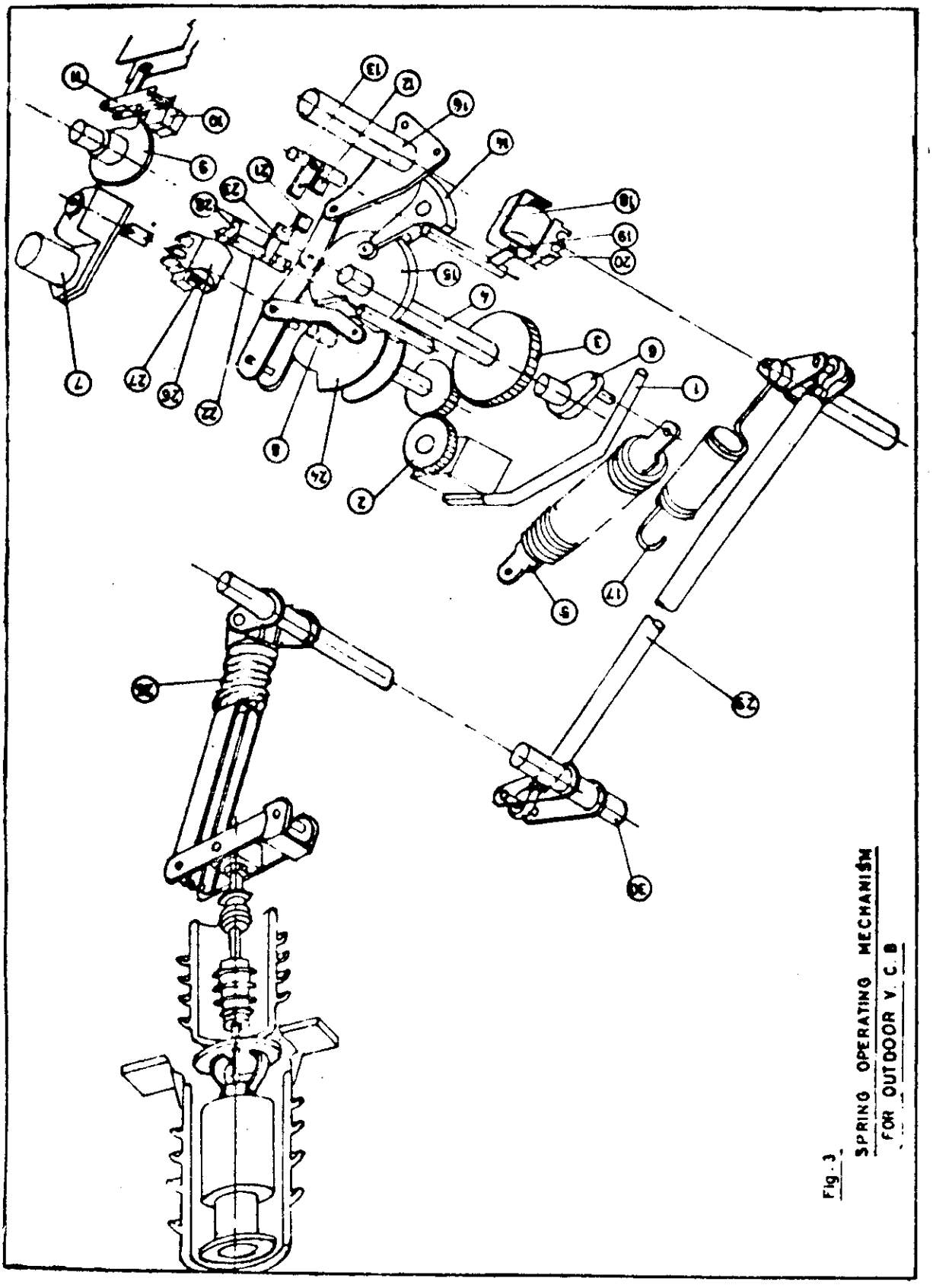
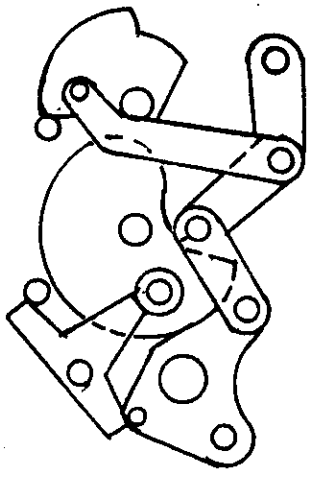


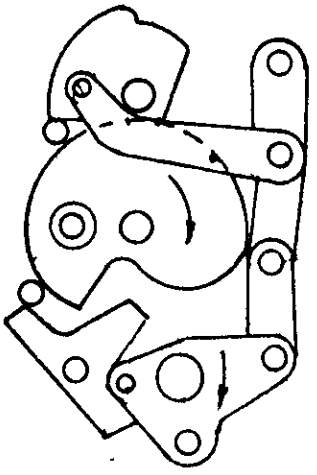
Fig. 3
SPRING OPERATING MECHANISM
FOR OUTDOOR V.C.B

LEGEND FOR ITEM NUMBERS IN FIGURE 3

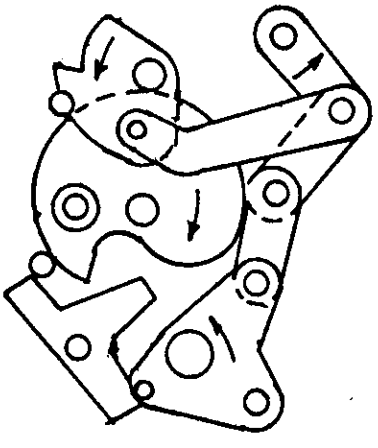
1. Charging Handle
2. Gear
3. Gear
4. Cam Shaft
5. Closing Spring
6. Crank
7. Motor
8. Shaft
9. Cam
10. Micro-switch
11. Lever
12. Push Button **'ON'**
13. Closing Shaft
14. Closing Catch
15. Cam
16. Main Shaft
17. Opening Spring
18. Closing Coil
19. Plunger of Closing Coil
20. Paddle
21. Push Button **'OFF'**
22. Opeining Shaft
23. paddle
24. Trip Catch
25. Wipe Spring
26. Opening Coil
27. Plunger of opening coil
28. Paddle
29. Connecting link
30. Pole box shaft



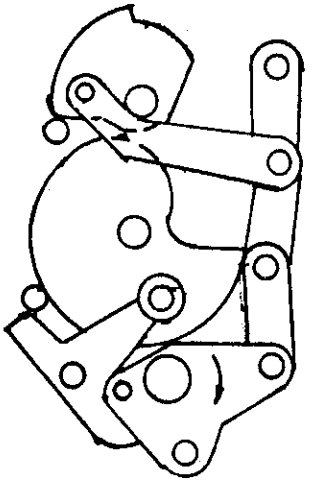
POSITION-A
OPEN & CHARGED



POSITION - B
CLOSED & DISCHARGED



POSITION - C
OPEN & DISCHARGED



POSITION - D
CLOSED & CHARGED

FIG.4

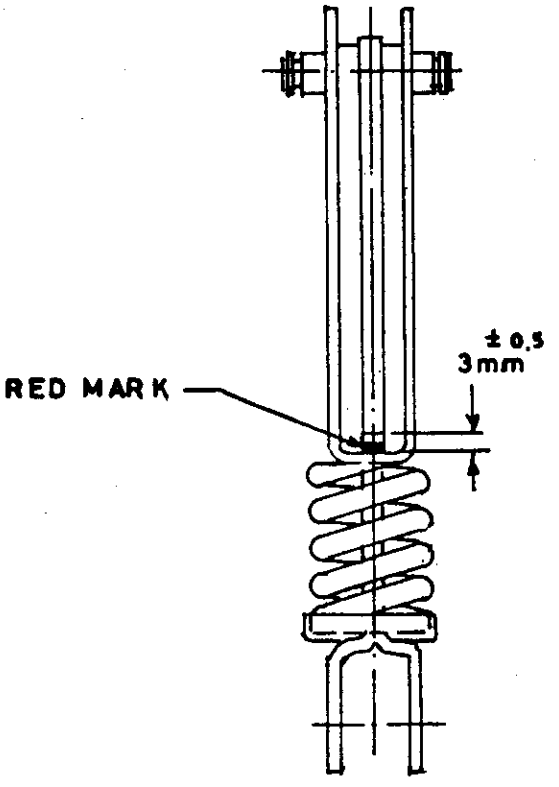


Fig.5 MEASUREMENT OF WIPE

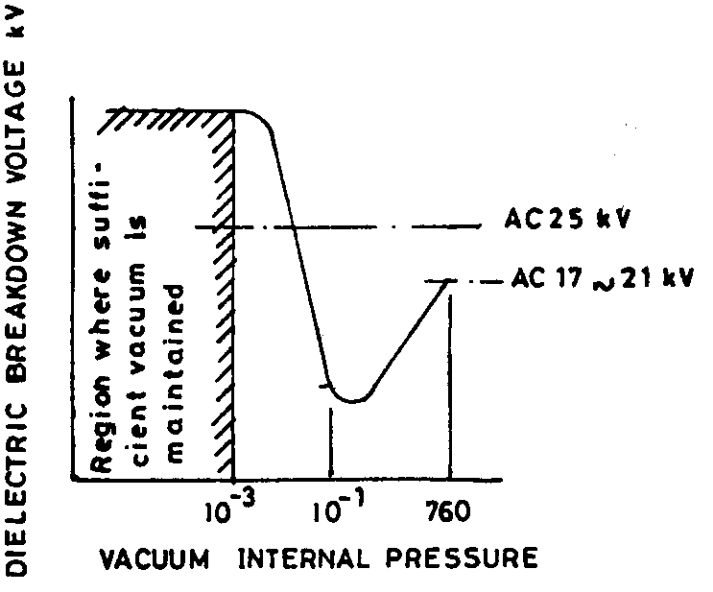


Fig 6 CHECK ON VACUUM