INSTRUCTIONS MANUAL FOR

VK TYPE VACUUM CIRCUIT BREAKER OF SPRING OPERATION TYPE

APPLICABLE TYPE FORM

VK-6M32B.2

TOSHIBA CORPORATION

FCF60001A

CODE V,C,B, , ,

CONTENTS

1. Introduction

This instruction manual describes the method and procedures for unpacking,storage,maintenance, inspection and part replacement fc VK type vacuum circuit breakers of spring operation type.

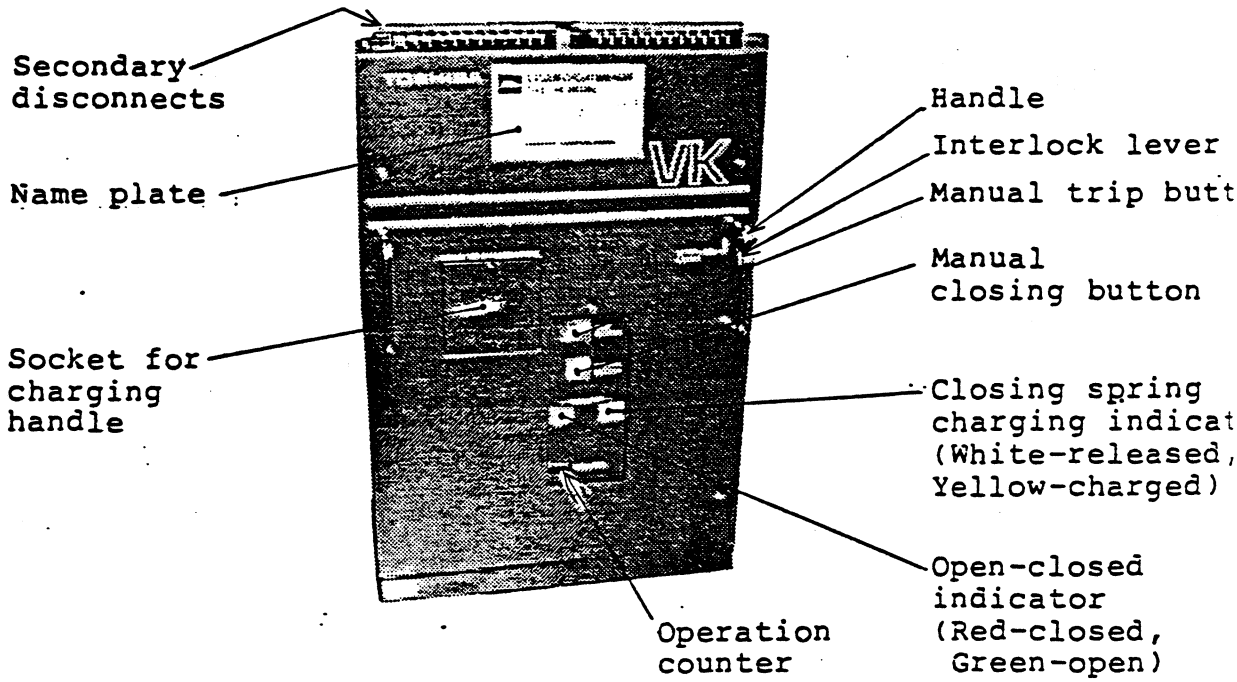

Fig.1 External view of the motor spring operation type VK vacuum circuit breaker

2. Receiving and Storage

2-1. Receiving and Unpacking

(1) The circuit breakers are subjected to complete factory production tests before being wrapped in polyethylene sheet ar packed.

(2) To protect the circuit breaker against any damage, do not lay it on its side or upside down. Upon receving, please check for visible damage.

(3) After unpacking, check the following points.
Check the accessories and spares, and also check that no part are missing nor any damage sustained. If there should be any part missing or damaged, immediately inform the nearest Toshib agent or service station.

2-2. Moving

When carring the circuit breaker, suspend it as shown in Figs.2 and 3.

NOTE; Take caution when lifting the circuit breaker. The circu breaker, when lifted, will incline slightly backward as the center of gravity is located at the rear side (the ma circuit terminal side).

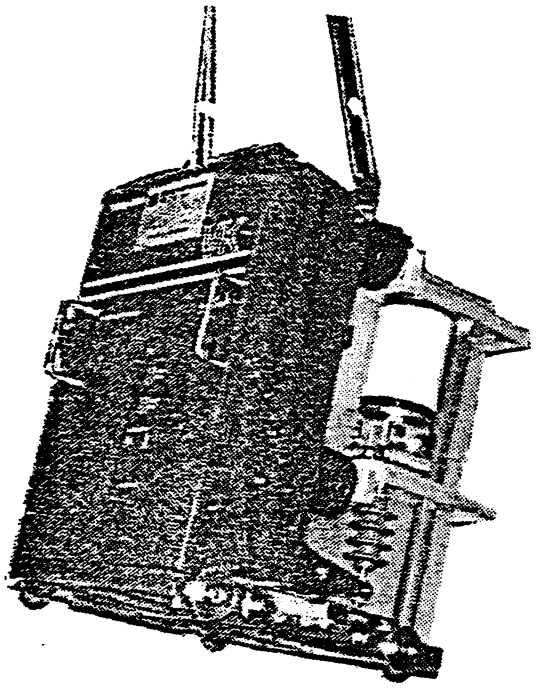

Fig.2

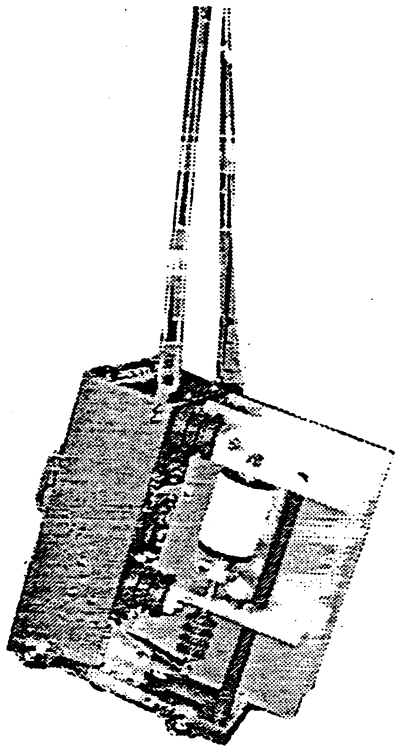

Fig.3

2-3. Storage

If the circuit breaker will not be operated for a long period after being installed or if it will be stored for a long perioc befor starting installation work, the following precautions sh be taken.

(1) Do not subject it to high moisture or sun rays.
(2) Store it in a place free from corrosive gases and dust.
(3) Be sure to put the dust cover over the circuit breaker when storing it.

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3. Outside View of Circuit Breaker and Items to be Checked.

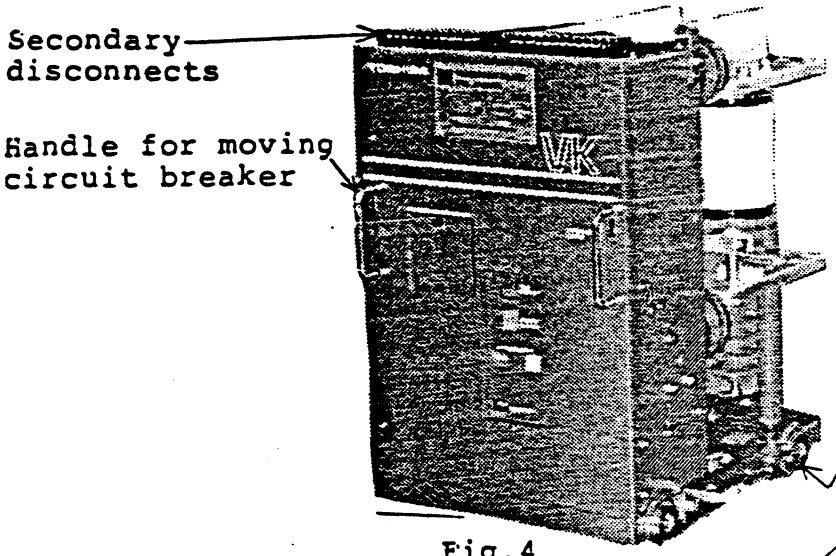

Fig.4

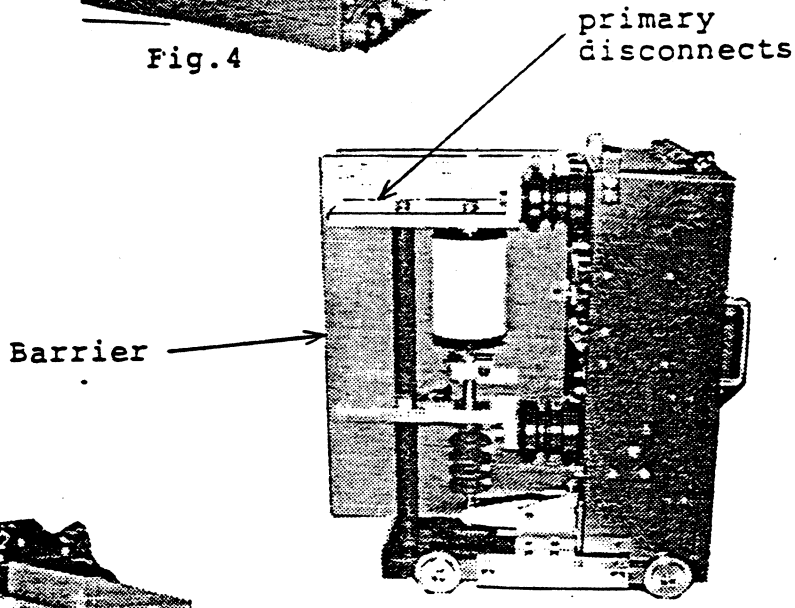

Fig.5

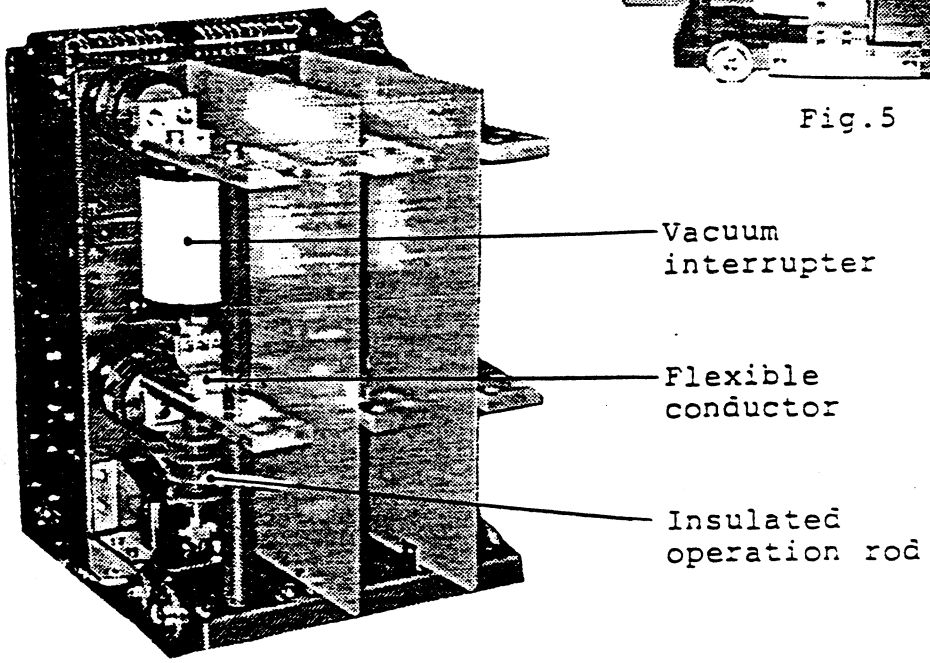

Fig.6

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4. Operation

4-1. Manual Operation

4-1-1. Charging of Closing Spring

Insert the charging handle into the opening for manual charging handle and move it up and down several times (usually times) until a clicking sound is heard when the closing spring charging indicator will change its color from white to yellow. This is the position where the closing spring is charged.

NOTE; The number of times the handle must be operated depends the angle of handle operation.

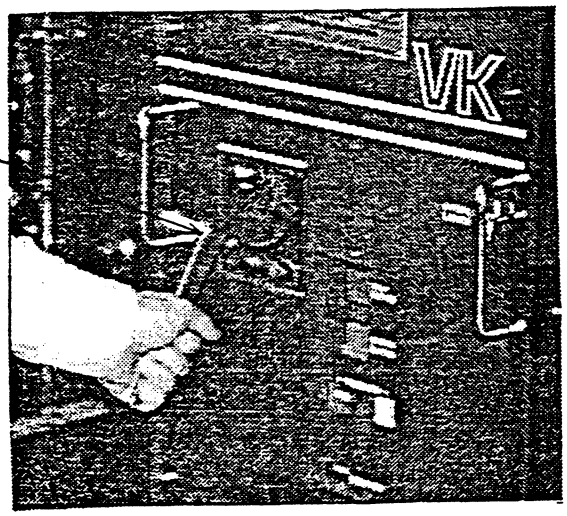

Fig.7

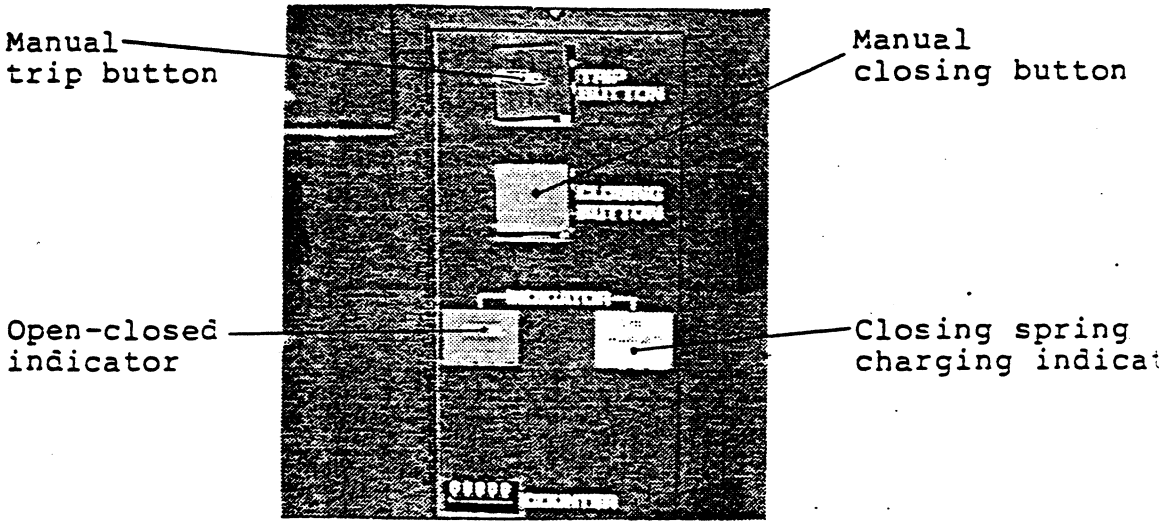

Fig.8

4-1-2. Closing Operation

Push the manual closing button and the circuit breaker will close. At this time the open-closed indicator reads "CLOSED" and the spring charging indicator turns to white.

4-1-3. Opening Operation

Push the manual trip button and the circuit breaker will open and the open-closed indicator will read "OPEN".

4-2. Electrical Operation

4-2-1. Charging Operation of Closing Spring

Connect the control circuit of the circuit breaker and turn on the power switch and the motor will immediately start. When the spring is charged, the closing spring charging indicator turns from white to yellow and the motor stops. Then the spring charging is completed.

4-2-2. Closing Operation

When the closing switch is turned to "CLOSE" position, the closing coil will be immediately energized and the circuit breaker is closed. After the closing of the breaker, the motor runs until the closing spring is charged when the open-closed indicator will read "CLOSED" and closing spring charging indicator will turn to yellow.

4-2-3. Opening Operation

When the trip switch is turned to "OPEN" position, the trip coil will be immediately energized and the circuit breaker is opened, with the open-closed indicator reading "OPEN".

5. Sequence of Operation of Circuit Breaker

5-1. Control Circuit (see Fig.9)

(1) Closing

Fig.9 shows the condition in which the charging is completed and the circuit breaker is open. In this condition, if the external operation switch CS(1) is turned to the "CLOSE" position, the circuit IL,bl,Y-b,CC energizes the closing coil instantly and the circuit breaker is closed in about 50msec.

With the circuit breaker closed, an auxiliary switch bl is changed over to deenergize the closing coil. And then the auxiliary relay Y is energized, completing the anti-pumping circuit.

(2) Charging

At the same time that the circuit breaker is closed the limi switch LS of open state closes, energizing the control relay X, which charges the closing spring. With the control relay X energized, the circuit LS,LS,X-a,M,F causes the motor to run (for about 4msec.) until the closing spring is charged. The limit switch LS then opens, deenergizing the control relay X.

(3) Tripping

The tripping of the circuit breaker involves only the al,TC circuit. When the external operation switch CS(2) is turned t the "TRIP" position, the trip coil is energized and the circu breaker is tripped in about 35msec. With the circuit breaker tripped, the auxiliary switch is changed over, deenergizing t trip coil.

NOTE; When the control circuit is energized, the closing spri will be charged immediately.

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5-2 Operation of Mechanism (see Figs.11 and 12)

(1) Closing

Fig.12(A) represents the condition where the circuit breaker is open and the closing spring is charged (ready for closing). In this condition, if the closing catch is relersed by the closing button or the closing coil, the closing spring causes the cam to rotate quickly into the condition shown in Fig.12. (B) in which the circuit breaker is closed.

(2) Charging

From the closed condition of Fig.12(B) only the closing cam i rotated by the motor, with the circuit breaker kept closed,unt the roller on the cam engaged with the catch.

(3) Tripping

When the trip shaft is released by the trip button or the tri coil, all the links return to the original open condition show in Fig.12(A).

(4) Trip free

When the trip catch is released, the link will move to the tr free condition shown in Fig.12(C). When the charging operation is completed, the link will assume the open condition.

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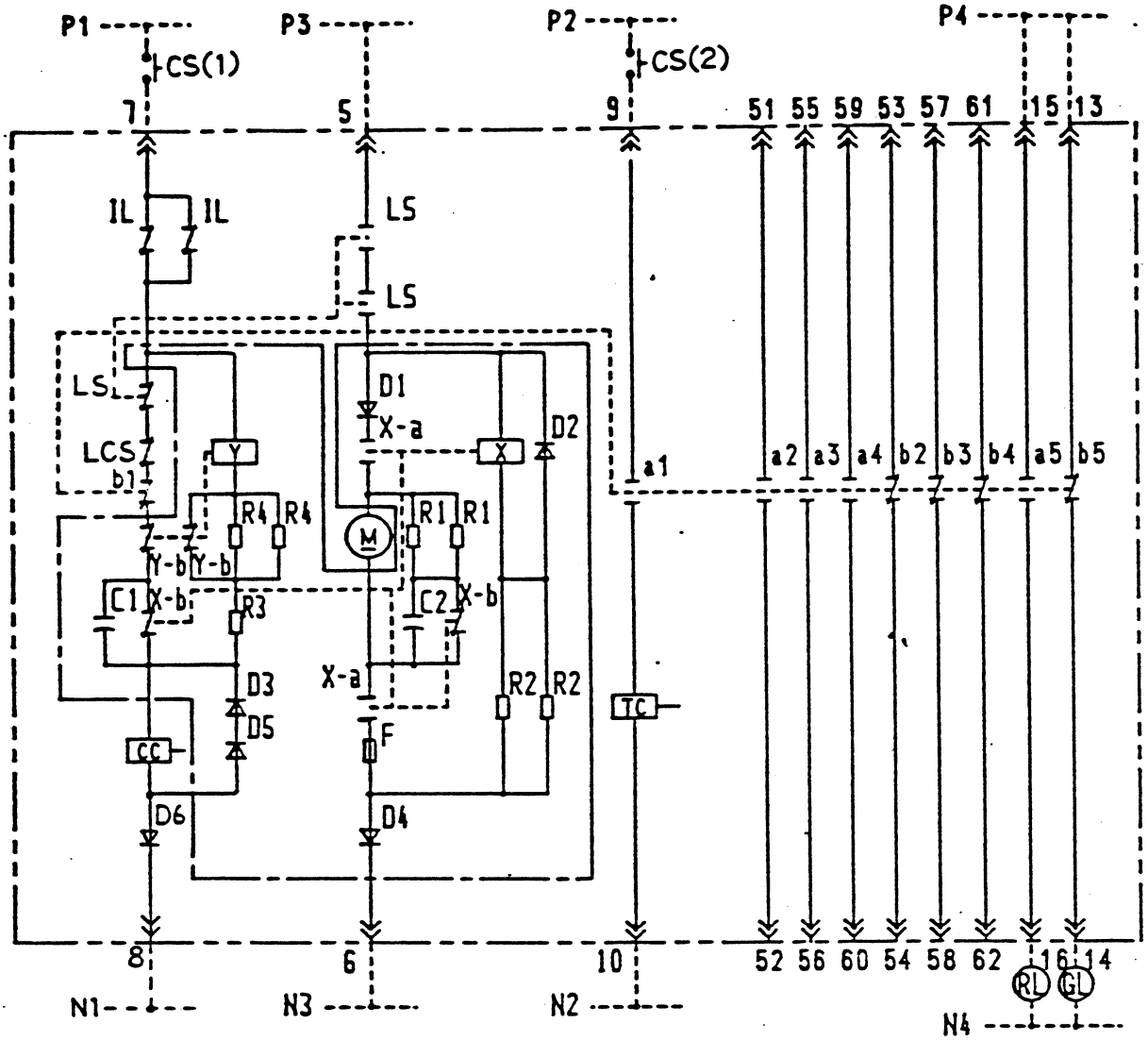

SYMBOLS	DESCRIPTION
Y	AUXILIARY RELAY COIL
Y-b	AUXILIARY RELAY CONTACTS (N.C.)
X	CONTROL RELAY COIL
X-a	CONTROL RELAY CONTACTS (N.O.)
X-b	CONTROL RELAY CONTACTS (N.C.)
CC	CLOSING COIL
TC	TRIP COIL
a	AUXILIARY CONTACTS (N.O.)
b	AUXILIARY CONTACTS (N.C.)
M	CHARGING MOTOR
LS	LIMIT SWITCHES
D1-D6	DIODES
R1-R4	RESISTORS
IL	INTERLOCK SWITCHES
C1,C2	CAPACITORS
RL	RED SIGNAL LAMP
GL	GREEN SIGNAL LAMP
F	FUSE
LCS	LATCH CHECKING SWITCH

Fig.9

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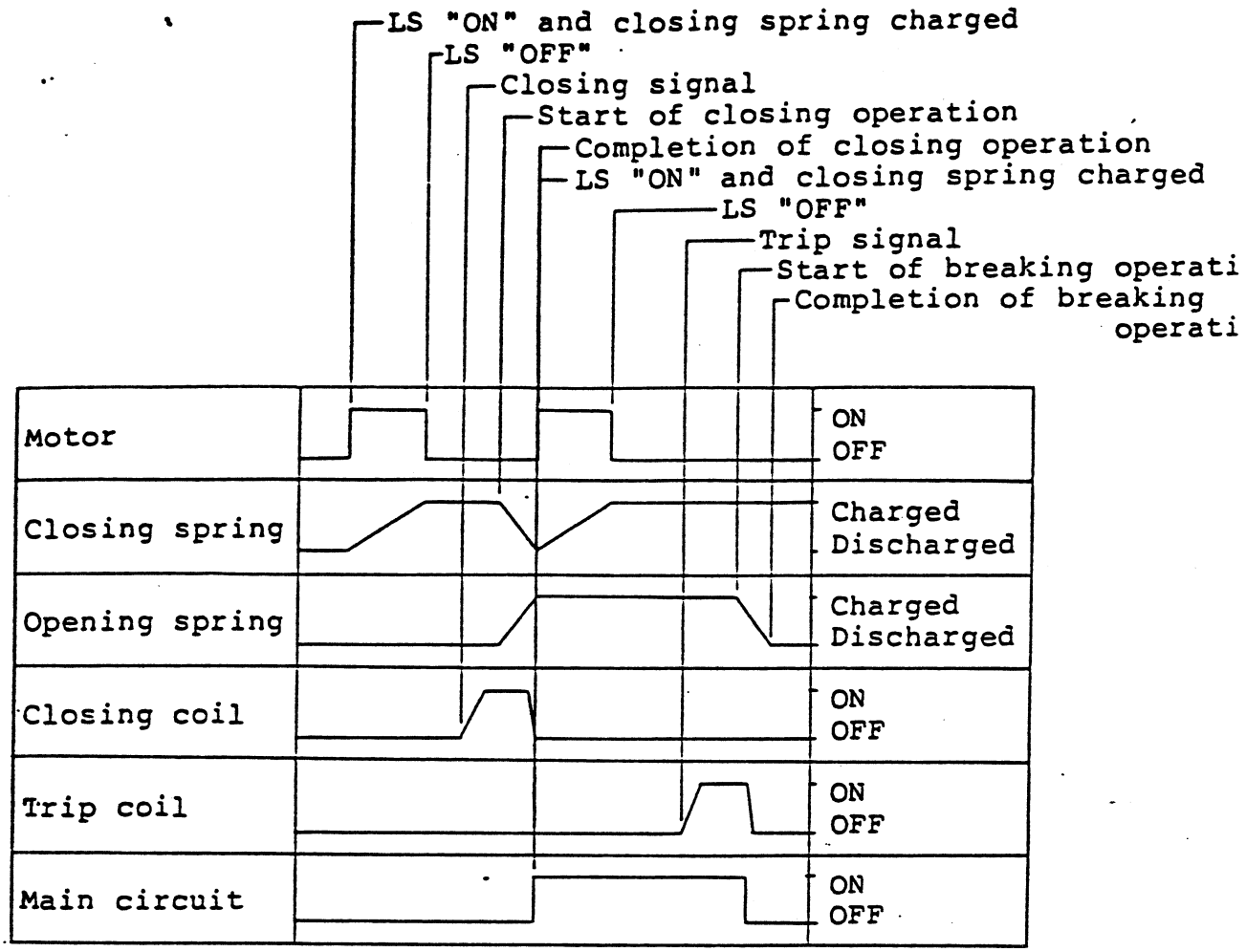

LS "ON" and closing spring charged
LS "OFF"
Closing signal
Start of closing operation
Completion of closing operation
LS "ON" and closing spring charged
LS "OFF"
Trip signal
Start of breaking operati
Completion of breaking operati
Motor
ON
OFF
Closing spring
Charged
Discharged
Opening spring
Charged
Discharged
Closing coil
ON
OFF
Trip coil
ON
OFF
Main circuit
ON
OFF

Fig.10

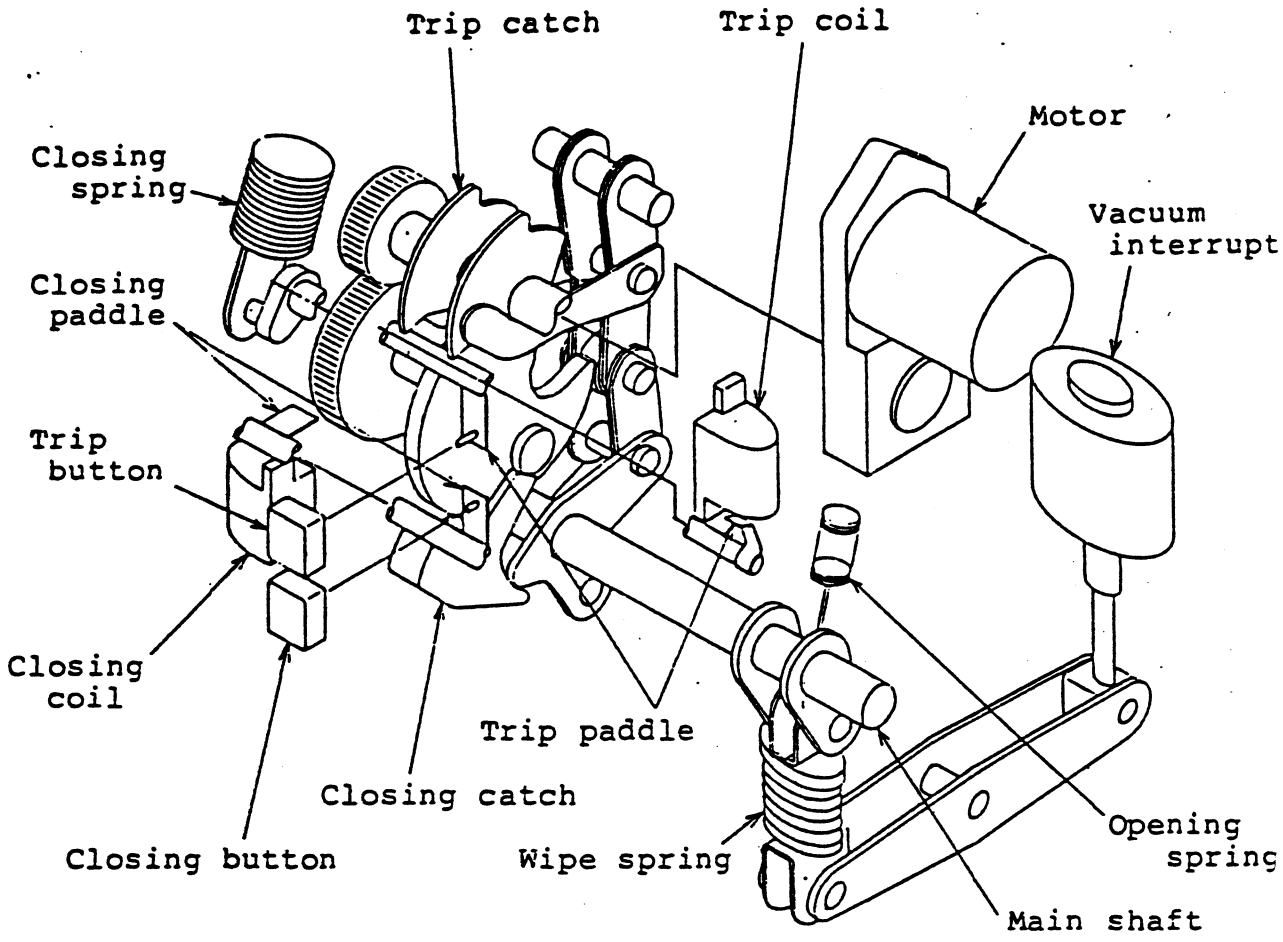
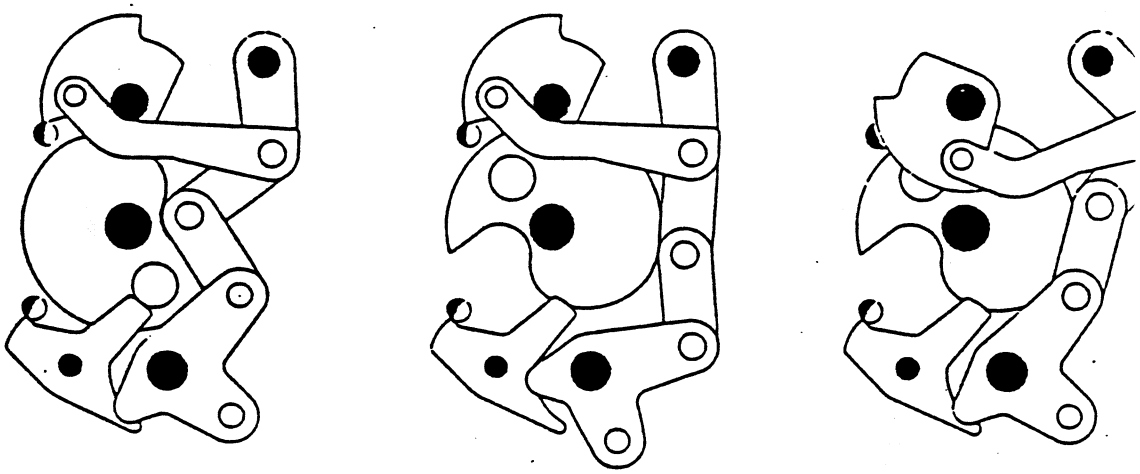


Fig.11 Mechanism



(A) Ordinary opened

(B) State immediately after closing effected by a closing signal

(C) Trip free

Fig.12 Operation of Mechanism

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6. Maintenance and Inspection (Check should be done one year after purchase and thereafter every 3years)

6-1. Check Points for Periodical Inspection

No.	Check point	Check item	Check method	Criteria	What to do	Remarks
1	Entire circuit breaker	Tightness of hardware.	By tightening them with screw driver and wrench.	There should be no loose fastenings.	Retighten loose fastenings.	
		Dust and foreign matter.	Visual check.	The circuit breaker shall be clean and contain no foreign matter.	Clean by pressure air and wipe with a clean dry cloth.	
		Deformation, excessive wear and damage.	Visual check.	There shuld be no deformation, excessive wear or damage.	Remove cause and replace parts.	
		Lost or missing parts.	Visual check	There shuld be no missing parts.	Reinstate to the normal condition.	
2	Operation mechanism	Dust and foreign matter.	Visual check	There shuld be no dust and foreign matter.	Remove foreign matter by pressure air.	
		Smooth operation.	Manual operation.	Operation shall be smooth.		
		Lubrication of bearing pins.	Check by feel and sight.		Supply a small amount of machine oil.	
		Shaft of closing and tripping	Visual check	Must rotate smoothly.		

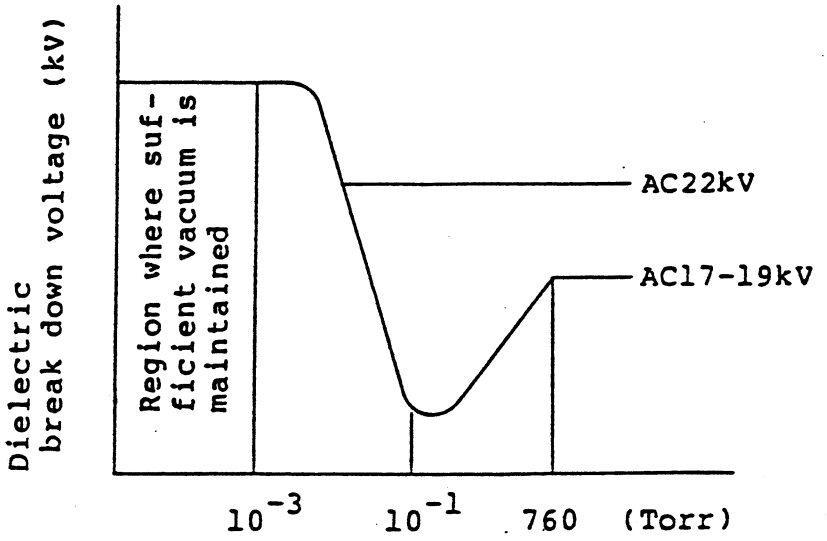
No.	Check point	Check item	Check method	Criteria	What to do	Remarks
3	Vacuum interrupter	Contact wear	Visual check	Red marking shall be seen.	If the red marking is not visible, replace the vacuum interrupter.	Fig.28
		Vacuum pressure	See section 6-2.		Replace when vacuum pressure is not sufficient.	
		Number of open-close operation.	Counter	When the counter reading reaches 10,000 (for the rated current interruption), check the internal pressure. The next check shall be done at the reading of 15,000. But be sure to replace the vacuum interrupter when the counter reading reaches 20,000. For the method of checking the vacuum pressure, see section 6-2.	Replace the vacuum interrupter if the internal pressure is not sufficient or when the counter reading reaches 20,000.	Fig.26 Fig.27
4	Auxiliary switch	Terminals.	Tighten by screw driver.	There should be no loose screws.	Retighten.	Fig.16
		Case and	Visual check.	There shuld be no da-	Replace when damaged.	Fig.16

No.	Check point	Check item	Check method	Criteria	What to do	Remarks
6	Control circuit	Closing and tripping by electricity.	Check at the test position or the disconnected position.	The closing and tripping operations can be done smoothly.	Check circuits and the closing and tripping devices, also check the microswitches and fuse.	
7	Secondary disconnects	Insulating portion.	Visual check.	There shuld be no damage.	Replace if there is any damage.	
		Contact surface. (only for auto-matic coupling)	Visual check.	There shuld be a thin film of Toshiba B8 grease on the contact surface.	If the contact surface has no grease on it, apply a small amount of B8 grease.	
8	Barrier (Vacuum interrupter support)	Contamination and discoloration.	Visual check.	There shuld be no dust and foreign matter. There should be no cracks or damages.	Clean by pressure air and then wipe with a clean cloth. Replace when cracked or damaged.	Fig.5
9	Measurement of insulation resistance				When the insulation resistance between the main circuit is low, clean the surface of the vacuum interrupter with a dry cloth and then take measurements	

Measuring location	Insulation resistance	megger
Main circuit-Ground	500Mohm or more	1000V
Control circuit -Ground	2Mohm or more	500V
Between main circuit	500Mohm or more	1000V

6-2. Check on Vacuum

The relationship between the dieletric breakdown voltage and vacuum interrupter internal pressure is shown below.



Vacuum interrupter internal pressure

Fig.13

Since the breakdown occurs in the vacuum interrupter when applied with a voltage of about AC17-19kV under atmospheric pressure, whether the vacuum interrupter maintains a high vacuu can be checked by the voltage of AC22kV in this voltage withsta test. When the internal pressure is not sufficiently high vacuu there is almost no delay in the breakdown, so 10 seconds of voltage application duration is enough. Measurement is taken wi the circuit breaker open and the voltage applied between the terminals of the vacuum interrupter.

* As an option a compact vacuum checker (TYPE CI35-1D) is available, which enables a quick and easy check on the vacuum interrupter internal pressure.

(1) Example of withstand voltage test circuit

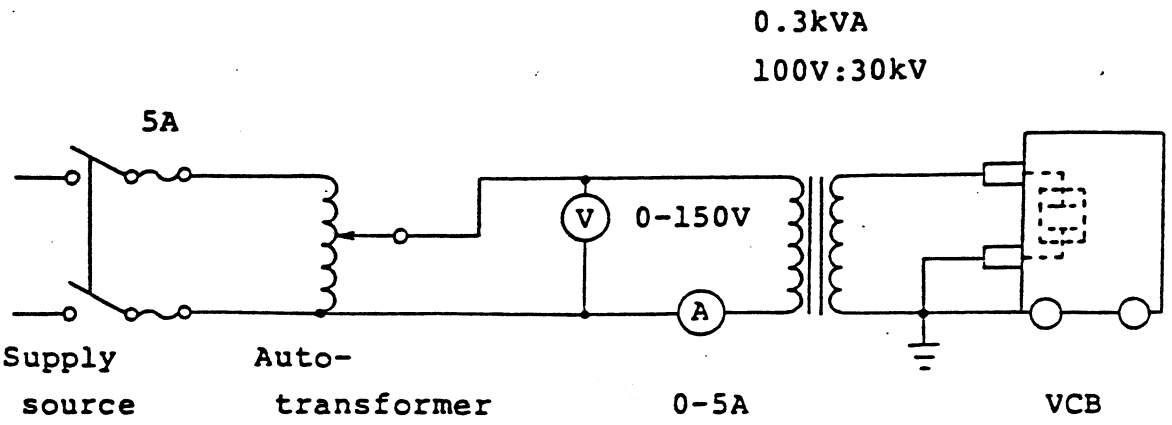


Fig.14

(2) Method of applying voltage

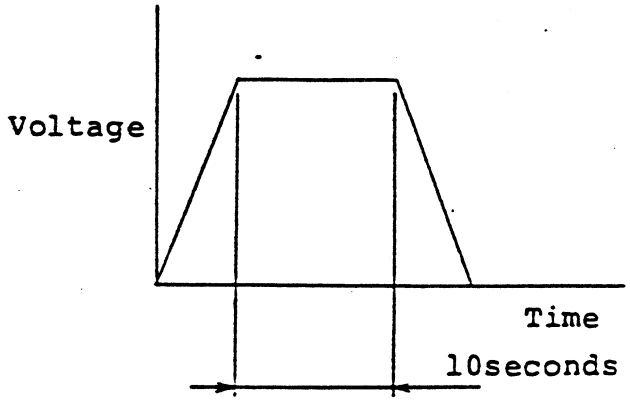


Fig.15

While the voltage is being increased, if the ammeter pointer shows the current flow, the voltage must be reduced to zero and then increased. Repeat this process two or three times. Those interrupters in which the current increases with the voltage increase are defective, and those in which the current is kept almost zero are good.

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6-3. Diagnosis of Troubles

(1) Failure to close

- Dose not close at all (when a closing signal is supplied)
  - Mechanism
    - Closing spring (damaged or dislocated) Fig.16
    - Closing catch (seized or galled) Fig.11
    - Closing paddle (dislocated) Fig.11
    - Closing coil (burned, armature damaged, galled) Figs.16,20-21
    - Motor (burned) Figs.16-18
  - Control circuit
    - Auxiliary switch (poor contact or burned) Figs.16,19
    - Control relay (poor contact or burned)Figs.16,22-25 Replace the whole control circuit board.
    - Auxiliary relay (poor conta or burned) Figs.16,22-25 Replace the whole control circuit board.
    - Motor (poor contact or burned) Figs.16-18
    - Terminal and connector (poo contact or burned)
    - Microswitch (poor contact o burned) Fig.30
    - Fuse (blown)

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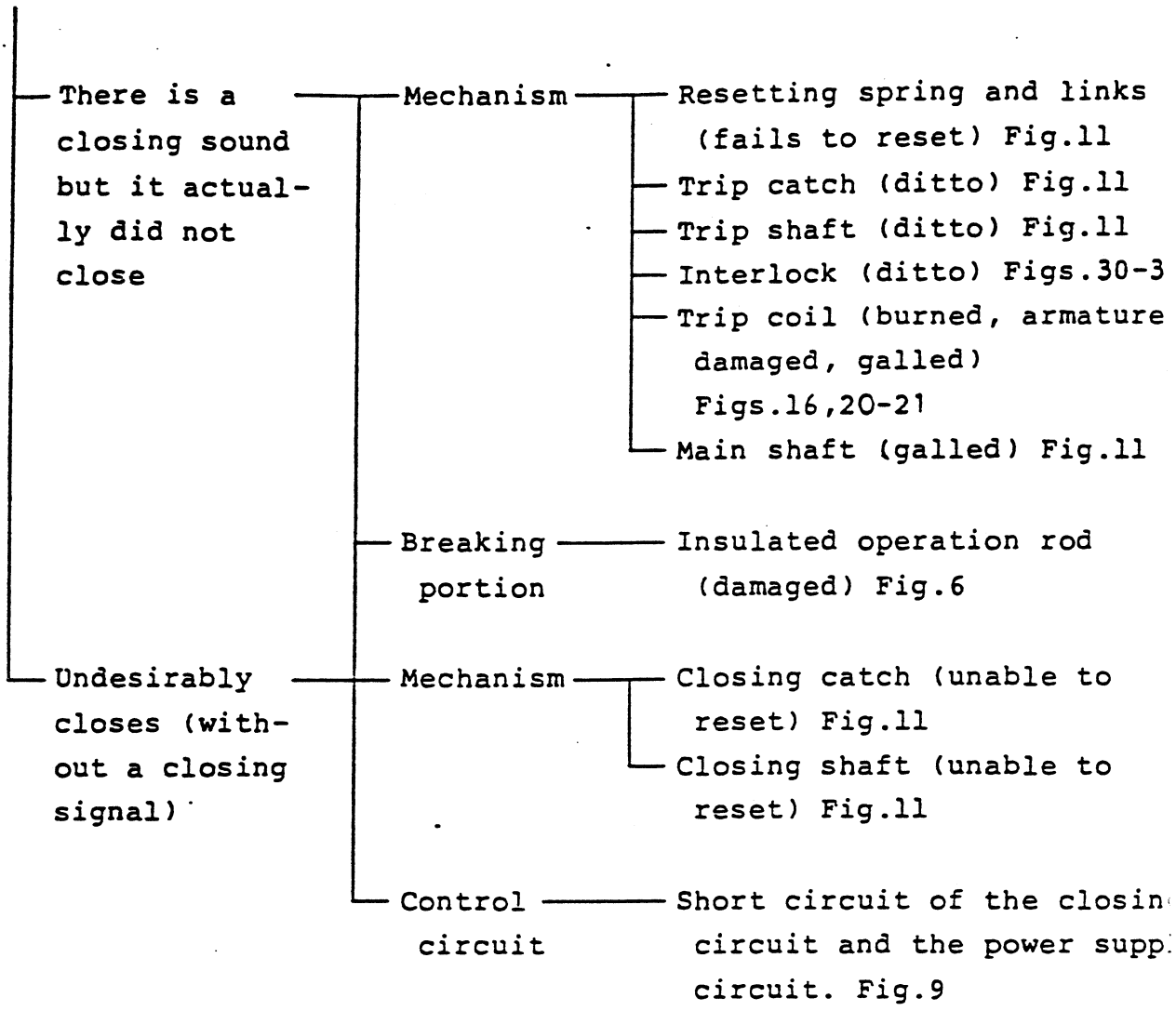
There is a closing sound but it actually did not close
Mechanism
Resetting spring and links (fails to reset) Fig.11
Trip catch (ditto) Fig.11
Trip shaft (ditto) Fig.11
Interlock (ditto) Figs.30-3
Trip coil (burned, armature damaged, galled) Figs.16,20-21
Main shaft (galled) Fig.11
Breaking portion
Insulated operation rod (damaged) Fig.6
Undesirably closes (without a closing signal)
Mechanism
Closing catch (unable to reset) Fig.11
Closing shaft (unable to reset) Fig.11
Control circuit
Short circuit of the closin circuit and the power supp circuit. Fig.9

(2) Failure to trip

- Dose not trip" at all (when a a tripping signal is supplied)
  - Mechanism
    - Trip coil (burned or galled Figs.16,20-21
    - Trip shaft and catch (galle Fig.11
    - Trip paddle (dislocated) Fig.11
    - Main shaft (galled) Fig.11
  - Breaking portion
    - Welded together
  - Control circuit
    - Auxiliary switch (poor contact or burned) Figs.16,19
    - Trip coil (burned, armature damaged, or galled) Figs.16,20-21
    - Terminal and contactor (poo contact or burned)
- There is a tripping sound but it actually did not trip
  - Mechanism
    - Link (galled) Fig.11
- Undesirably trip (without a tripping signal
  - Mechanism
    - Trip catch (damaged) Fig.11
  - Control circuit
    - Short circuit of the trippi circuit and the power supp circuit. Fig.9

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7. Replacement of Parts

7-1. Location of Each Component Part

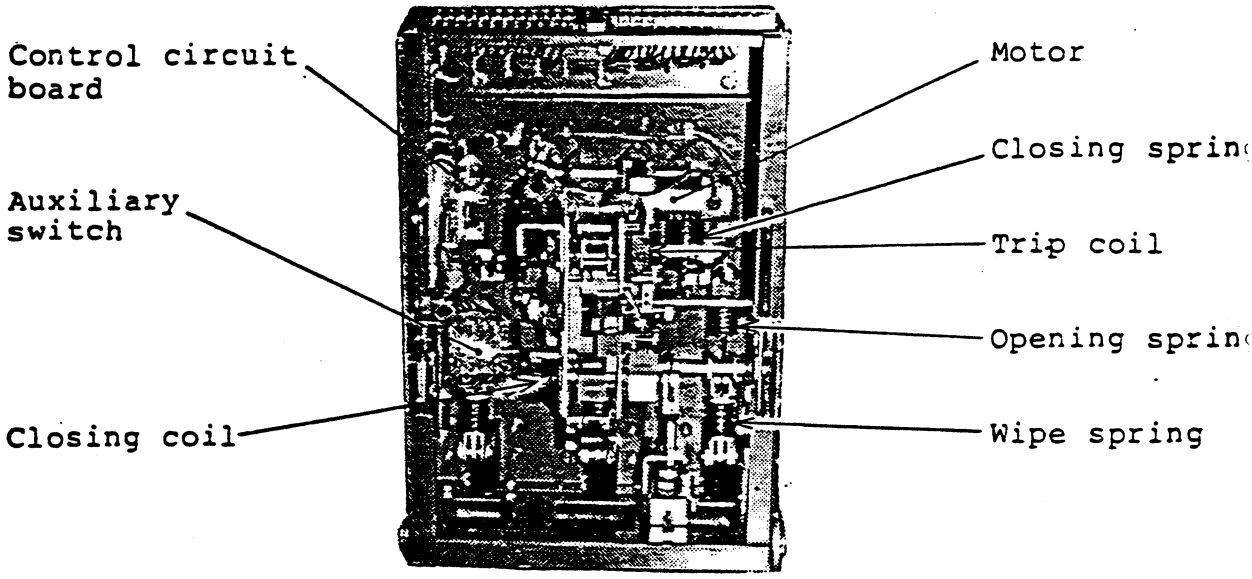
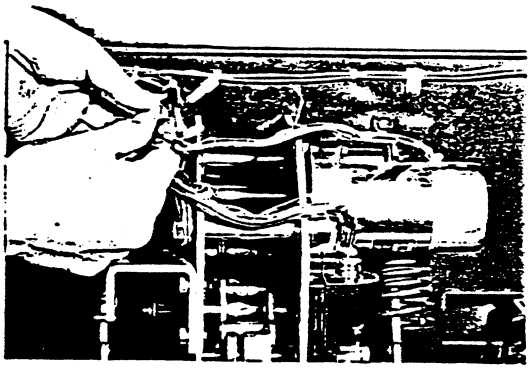


Fig.16

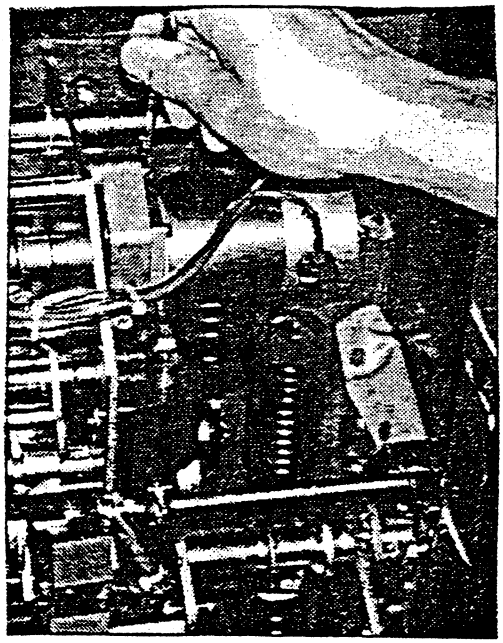
7-2. Replacement of Motor

Tool:Spanner or wrench (M6)



Remove connector

Fig.17



Remove three mounting bolts(M6) from the moto

Fig.18

7-3. Replacement of Auxiliary Switch

Tool:Screw driver
Spanner(M8)
Pliers

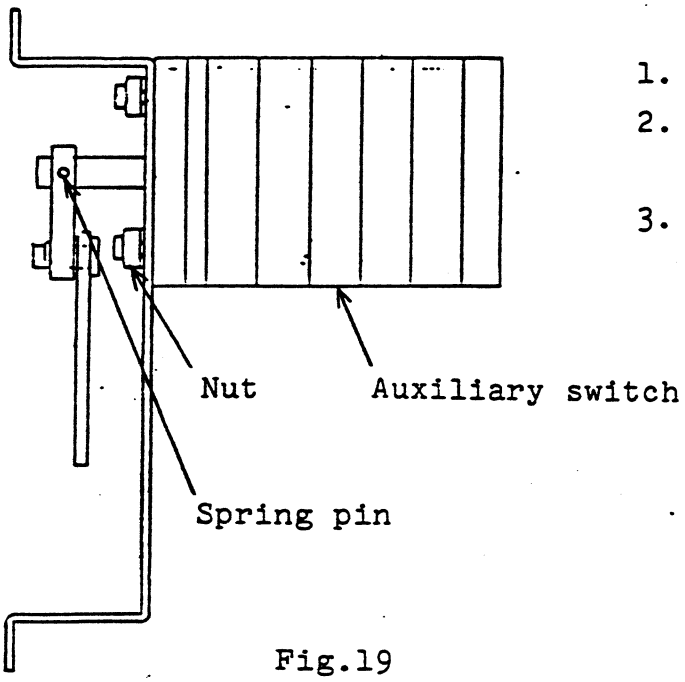
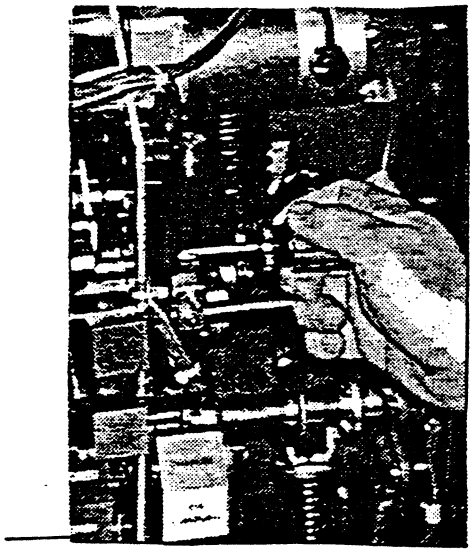


Fig.19

1. Pull out the spring pin.
2. Take off the two nuts which attach the switch.
3. Remove the wire terminals from the switch.

7-4. Replacement of Closing Coil and Trip Coil

Tool:Screwdriver(M4)



Fig,20

NOTE; The closing coil and trip coil are identical in shape.

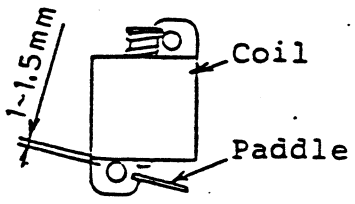


Fig.21

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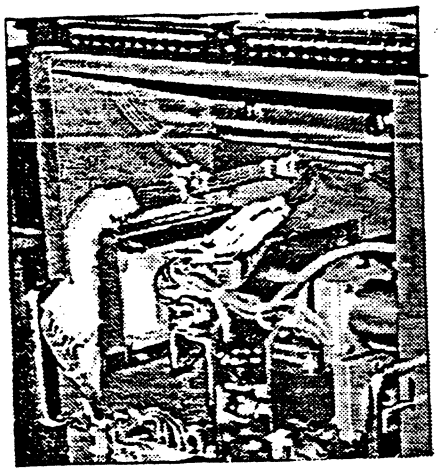
7-5. Replacement of Control Circuit Board

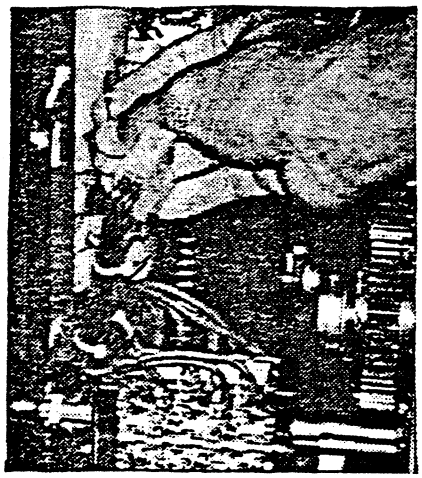


Pull out the connector

Fig.22

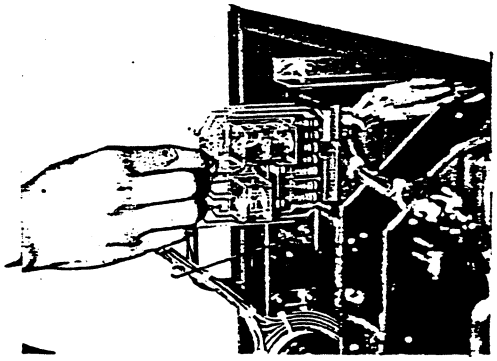
Remove the knob screw

Fig.23



Draw out the fixture

Fig.24



Pull out the
control circuit board

Fig.25

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7-6 Replacement of Vacuum Interrupter

Tool:Spanner or wrench(M10,M12,M6)

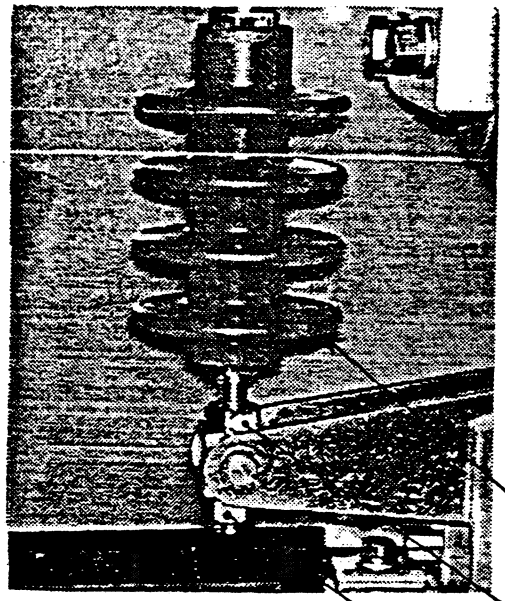

Fig.26

1. Remove the low side nut.
2. Turn the up side nut unti-clockwise to the end.
3. Turn the operation rod unti-clockwise and remove it from the interrupter.
4. Remove four bolts(M6) which connect the flexible conductors to the coupling.

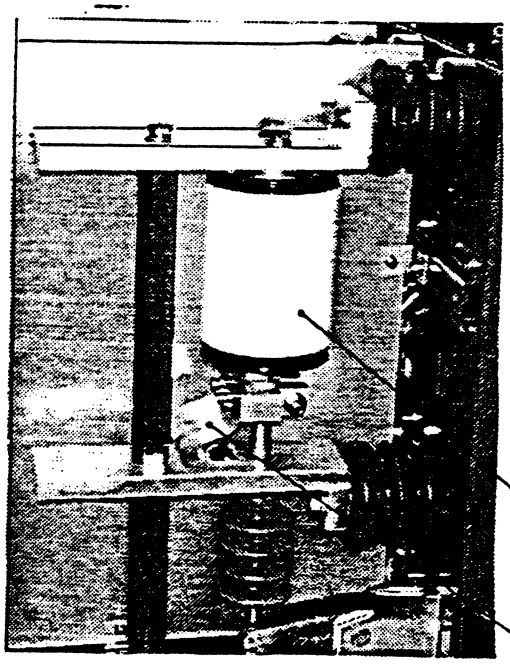

Fig.27

5. Remove two bolts which mount the interrupter.

NOTE; When fastening the operation rod, fix the axis of interrupter with a spanner or a wrench to protect the bellows of interrupter

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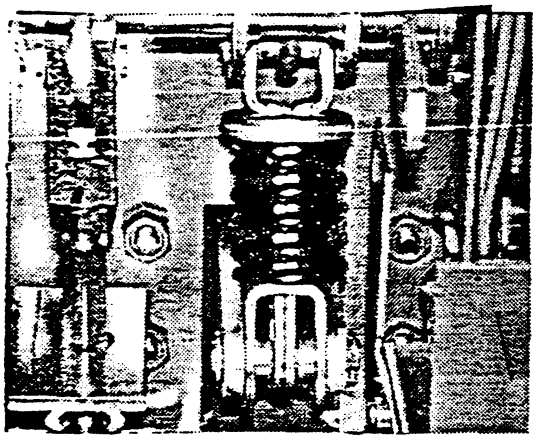
7-7. Adjustment (Securely tighten the fastenings after adjustment made.)

After the vacuum interrupter are replaced, adjust the wipe length to that shown in Fig. 8 with the circuit breaker closed. Adjust the wipe length by loosening the C-nut at the rear of th circuit breaker and rotating the B-nut. The wipe length size widens when the B-nut is turned clockwise and reduces when turn counter-clockwise (see Fig. 9). The required wipe length is 3mm In Fig. 8 the wipe length is measured from the wipe base line (red mark under line) to the bottom surface of the wipe spring mounting fixture. When the length from the red mark to the bottom of mounting structure is 0.5mm, the wipe length is to be 3mm.



Point of measurement for wipe length

Fig.28

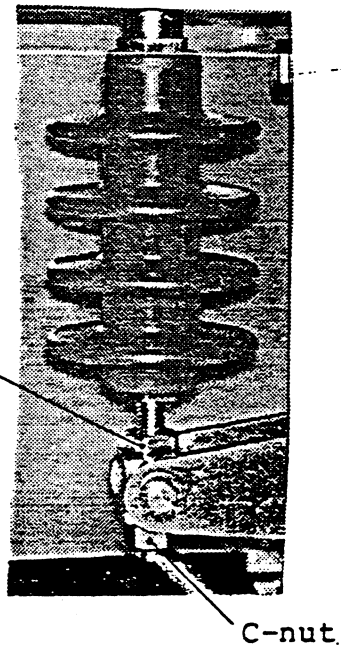
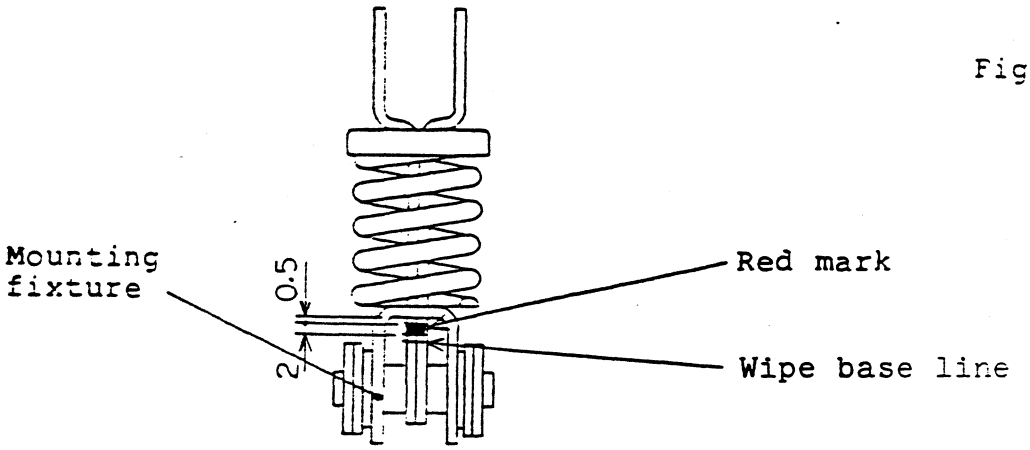


Fig.29



Detail of Fig.28

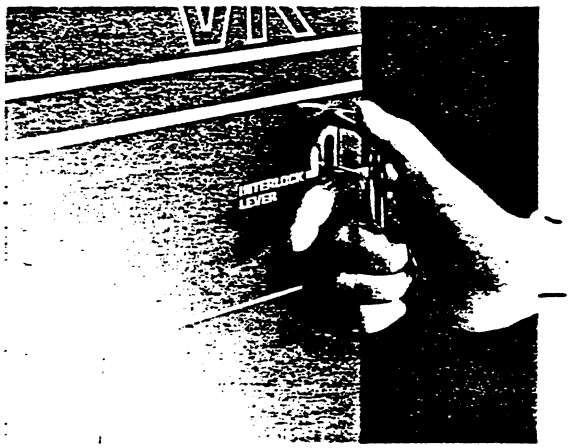
FCF50010

8. Interlock for Circuit Breaker

(1) The interlock lever cannot be lifted when the circuit breake is closed. Before lifting the interlock lever, check that the open-closed indicator is green (circuit breaker is open).

(2) When the interlock lever is lifted, the closing action is blocked both electrically and mechanically.

Note; As shown in Fig.31, when the interlock lever is lifted up, the microswitch is cut off and the circuit breaker blocked from being electrically closed.



Interlock lever on the right side.

Fig.30

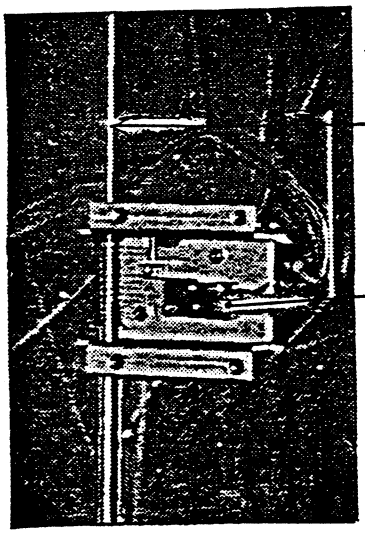
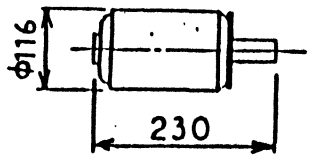
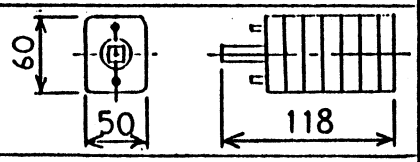
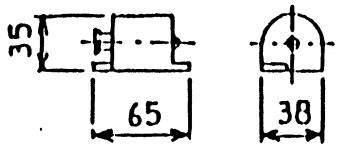
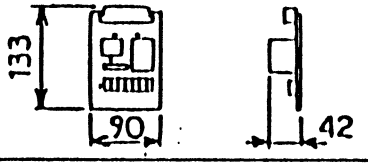
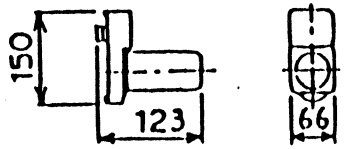
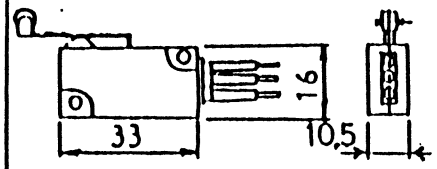


Fig.31

FCF50011A

9. List of Replacement Parts

NO.	Description	Outline	Applicable	Manufacturere Drawing No.	Figure No.
1	Vacuum interrupter		VK-6M32B2	4D9A2584G012	Fig.6

NO.	Description	Outline	Applicable		Hanufacturere Drawing No.	Figure No.
2	Auxiliary switch		Common for all		4D9A2584 G011	Fig. 16
3	Closing coil and Trip coil		Common for all	DC 30V DC 48/50V DC 100/ 110V DC 125V DC 200/220V	4D9A2174 G006 4D9A2174 G005 4D9A2174 G004 4D9A2174 G003 4D9A2174 G002	Fig. 16
4	Controll circuit board		Common for all	DC 30V DC 48/50V DC 100/ 110V DC 125V DC 200/220V	4D9A2584 G001 4D9A2584 G002 4D9A2584 G003 4D9A2584 G004 4D9A2584 G005	Fig. 16
5	Motor		Common for all	DC 30V DC 48/50V DC 100/110V DC 125V DC 200/220V	4D9A2597 G006 4D9A2597 G005 4D9A2597 G004 4D9A2597 G003 4D9A2597 G002	Fig. 16
6	Micro switch		Common for all		4D9A2462 G001	Fig. 31