



GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

**MAINTENANCE HANDBOOK FOR
GEC MAKE VACUUM CIRCUIT BREAKER
TYPE 20 CB FOR ELECTRIC LOCOMOTIVE**

CAMTECH/98/E/VCB/9.0

OCTOBER 1998

Centre
for
Advanced
Maintenance
TECHnology



MAHARAJPUR, GWALIOR - 474 020

FOREWORD

Emerging technological changes requires dissemination of new knowledge and induction of new maintenance practices. The Vacuum Circuit Breakers were although inducted quite some time back in Railway system but maintenance handbooks on the subject were not available. The Electrical wing at CAMTECH, therefore, took upon the task of preparing a consolidated maintenance handbook on Vacuum Circuit Breaker Maintenance.

A seminar was conducted at CAMTECH in March, '98 to ascertain field problems and innovative solutions adopted by the field units in this direction. This book incorporates the outcome of deliberations of this seminar apart from compilation of maintenance information scattered if at various places on the subject.

I am sure that the book will prove to be very useful reference guide for maintenance supervisors and staff in field units and will help Railways in improving the reliability of Vacuum Circuit Breakers in service.

Gwalior
March 17, 1999

D.K. Saraf
Director/CAMTECH

PREFACE

The need for Vacuum Circuit Breaker (VCB) were felt for many years but it became available only during the last decade. Now these are in the process of replacing Air Blast Circuit Breakers (ABCB).

Due to lack of knowledge and deficiency of literature at field level, CAMTECH has taken up the job of documentation and upgradation of information in maintenance practices. This maintenance handbook has been prepared with the objective of improving the maintenance practices so as to increase availability and reliability of VCBs. It is however clarified here that this handbook does not supersede any existing provisions laid down in the “Maintenance Manual of Electric Locomotive” and “A.C. Traction Manual”.

I am sincerely thankful to Shri Siyaram, Jt. Dir./RDSO, Shri R.D. Marvaha CDA/RDSO for their valuable comments, and I am also thankful to all field personnel who helped us in preparing this handbook. Shri Akhilesh Singh, CTA has done a good job in collecting useful technical information on the subject and Shri Dhiraj Shrivastava, C.O. has prepared good aesthetic composition of the written material for this handbook.

Technological upgradation and learning is a continuous process. Hence please feel free to write us for any modification/addition in the book or if you have any new ideas. We shall be highly appreciating your contribution.

CAMTECH, Gwalior
Date : 12th October, 1998

Khushi Ram
Joint Director (Elect.)

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CHAPTER 1

INTRODUCTION AND BRIEF CONSTRUCTION

1.1 INTRODUCTION

These Vacuum Circuit Breakers are replacing the air blast Circuit Breakers used on Elect. Locos/EMUs due to following advantages:-

- Less maintenance
- Space saving
- Greater reliability
- Simplified control
- Quiet in operation

1.2 CONSTRUCTION

The main switching unit uses two Vacuum interrupters connected in series. The interrupters operating rods are connected to a pneumatic, dual-pistoned actuator, which closes the contacts with the application of the air supply. The contacts are held normally open by heavy duty springs which ensure the breaker fails safe with the loss of the air supply.

The actuating mechanism and Vacuum interuters are contained in the horizontal arms of the porcelain insulator.

The exploded view of the GEC make VCB is shown in the figure no.1.1

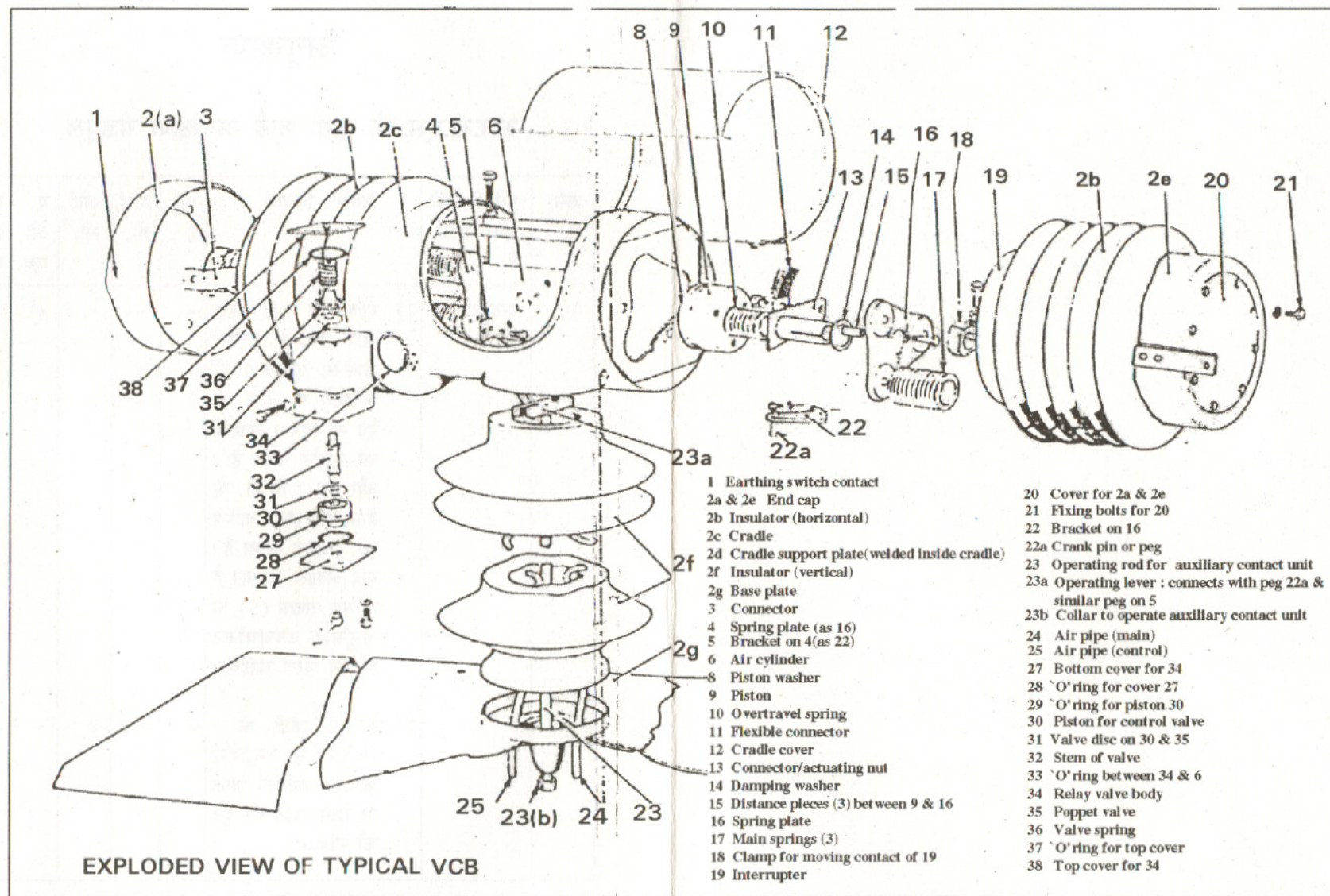


Figure 1.1

CHAPTER 2

MAINTENANCE

2.1 MAINTENANCE SCHEDULE IN TABULATED FORM ISSUED BY RDSO

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
01	Interrupter	<p>1) Checking the distance between the cylinder & each of the moving contact assembly connector with breaker open. The gaps are to be balance and are of the order of 2 mm each if interrupter is sound. If gap is unequal. HV test as per item (5) to be conducted.</p> <p>2) Check the distance of the datum line on the moving contact operating shaft from the edge of the interrupter body.</p>	-	-	x	x	x
			-	-	-	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
		<p>For the new contact = 3 mm and Fully worn contact = 0 mm - 1 mm. When VCB is closed. Change vacuum interrupter of fully worn out contacts.</p> <p>3) Check the contact travel. New 8-9 mm (min.) Eroded contacts 11-12 mm (max).</p> <p>4) Check the piston overtravel 0.3 mm after contacts close.</p> <p>5) Check the soundness of interrupter by earthing the VCB base and applying 40 KV 50 Hz for 1 min. across each interrupter in turn in open condition.</p>	-	-	x	x	x
			-	-	-	x	x
			-	-	-	x	x
02	Insulators	<p>1) Check for cracks, chips, flash marks.</p> <p>2) Clean with soft, clean dry cloth</p>	x	x	x	x	x
			x	x	x	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
03	Cradle	1) Check the 4 drain holes are clear.	x	x	x	x	x
		2) Make the seal with silicon elastomer sealing compound.	-	-	x	x	x
04	Pressure switch	1) Check : Closes at 4.65 kg/cm ² Opens at 4 kg/cm ²	-	-	x	x	x
05	Pressure regulator	1) Check the setting of regulator. The setting should be 70 p.s.i.	x	x	x	x	x
		2) Dismantle, clean the parts with denatured alcohol and blow out the body with clean compressed air. Reassemble the parts.	-	-	-	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
06	Auxiliary contacts	1) Clean the contacts.	-	-	x	x	x
		2) Check the tightness of all fixing bolts, nuts and connections.	-	-	x	x	x
		3) Check the proper operation of the contacts.	-	-	x	x	x
		4) Check the contact pressures and gaps.	-	-	-	x	x
		5) Replace completely worn out contacts.	-	-	x	x	x
07	Air filter	1) Porous bronze filter elements to be washed with denatured alcohol.	-	-	-	x	x
		2) Blow out with clean compressed air.	-	-	-	x	x
		3) Washed out bowl with household soap.	-	-	-	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
08	Magnet valve	1) Check the tightness of all connections and fixing screws. 2) Check the air leakage when operated manually.	-	-	-	x	x
09	Relay valve	1) Replace 'O' rings & PTFE washer. 2) Overhaul and lubricate the relay valve.	-	-	-	x	x
10	Air receiver	Check the condition of the desiccant, if changed from blue to pink, change the silicagel. Also weigh the air drier.	-	-	x	x	x
11	Air dryer	Weigh the air dryer if more than 0.8 Kg. from the new weight, change molecular sieve or regenerate by heating.	-	-	-	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
12	Electrical connections	1) Check for proper tightness.	-	-	x	x	x
		2) Check the condition and security of the end connections of the flexible connector (Shunts provided between two interrupters).	-	-	x	x	x
		3) Check the condition of the fixed contact end connectors fit new braids if necessary.	-	-	x	x	x
13	Air connections	After opening cradle cover and base plate cover.					
		A)1.Check for proper air piping connections.	-	-	x	x	x
		2. Check for air leakage from the exhaust port of the air control valve by operating magnet valve manually.	-	-	x	x	x

Sr No	Parts to be inspected	Inspection details	I A	I B	I C	A O H	I O H
		3. Check for air leakage in general.	-	-	x	x	x
		B) Measure Air Leakage at 65 Kg/cm ² for 10 minutes in open and close position of VCB. Pressure should not decrease more than 10% of the set value.	-	-	x	x	x
14	Surge suppresser (Magnet valve)	Check for its healthiness by applying 110 V AC 50 Hz across it, current shall not exceed 15 Amp.	-	-	-	x	x
15	Lubrication	Lubricate air cylinder through its small hole when relay valve removed.	-	-	-	x	x
16	Vacuum circuit breaker assembly	Check up closing speed with the help of contact travel records as per SMI 136.	-	-	-	x	x

2.2 ADDITIONAL MAINTENANCE INSTRUCTIONS

2.2.1 Lubrications and Sealing in the VCB

As per SMI No 161(Rev 1), 162(Rev 1), issued by RDSO.

2.2.1.1 Thread Sealing of Compressed Air Joints

Since most of the threaded joints of compressed air path of VCB, are of parallel thread type- PTFE thread sealing tape should be used on male threads before refitting the item such as pressure switch, Air connection on pressure regulator air filter etc. To avoid air leakage from threaded joints.

2.2.1.2 Pipe Joints

Two type of Ferrules are used for pipe joints. An exploded view of a pipe joint is shown in figure 2.1 & 2.2.

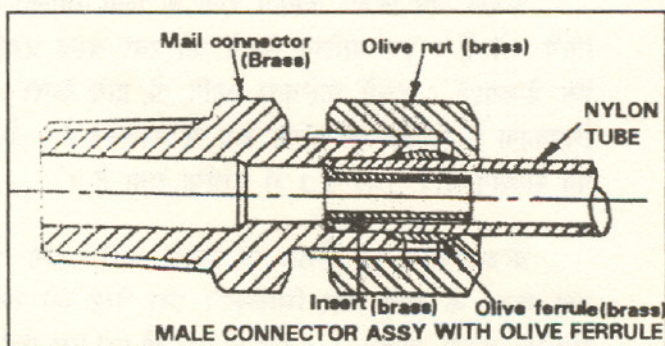


Figure 2.1

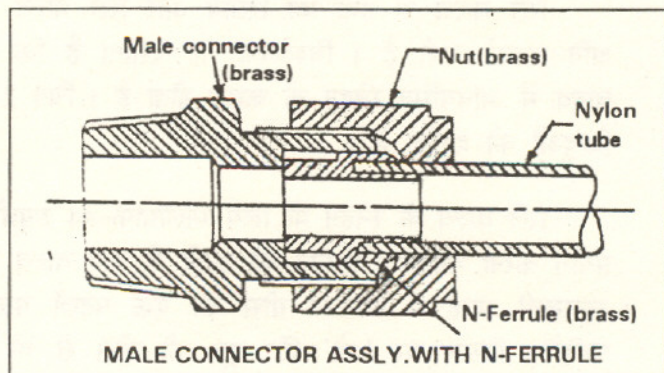


Figure 2.2

2.2.1.3 Sealing of Cradle Cover

Failures of VCB s have been reported due to seepage of water to the inside of the cradle, resulting from the improper sealing of the cradle cover. Extra care is required to seal this cover to prevent such failures.

Cradle & cradle cover both have been provided with the sealing strip. This sealing strip is to be stuck to the cover/cradle by rubber based adhesive such as Dendrite/Duroflex etc. Which are commercially available. Section A-A of cradle cover is shown in figure 2.3.

After the fixing the cradle cover by its clamp on the cradle, further sealing should be done by applying Silicon Rubber paste all around the cover, as per SMI 161 (Rev 1) issued by RDSO.

2.2.1.4 Lubrication of Air Relay Valve

Leakage of air from relay valve and damage to the relay valve body have been reported. Analysis has shown that this may be due to improper lubrication of the relay valve. Figure 2.3 shows the lubrication points.

Lubricant-Molygraf-44 should be used for lubrication of relay valve. A thin layer of above grease should be applied to the valve body inner surface after removing the piston. Fill the 'O' ring groove on piston with grease. Fit the piston to the valve body and then apply a little grease on the body (to entrap this extra grease between cover and piston). Close the valve assembly with valve cover placing the 'O' ring at its location, as per SMI 162 (Rev 1).

2.2.1.5 Lubrication of Main Piston/Cylinder

Lubricate main piston/cylinder by filling the lubricant Molygraph-44 inside the cylinder from the holes as shown in figure 2.3 on next page. For this relay valve assembly has to be removed from its mounting.

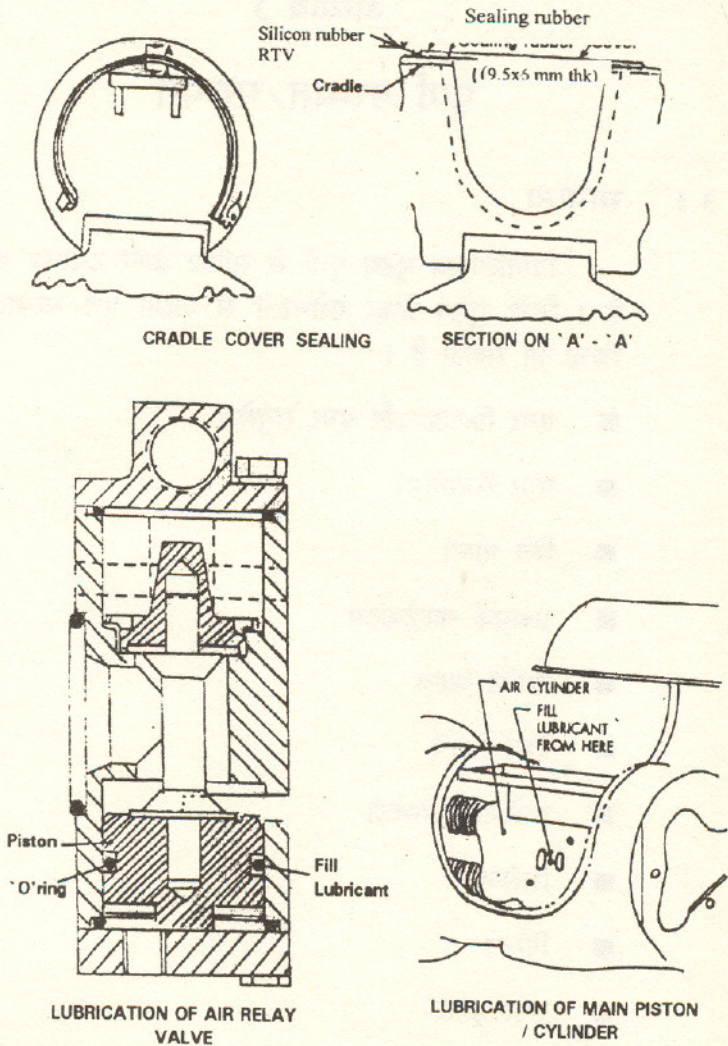


Figure 2.3

CHAPTER 3

OVERHAULING/REPAIR

3.1 GENERAL

The circuit breaker consists of the following main items of equipment which can be overhauled separately from the main breaker assembly.

- Air filter and air regulator
- Air reservoir
- Relay valve
- Auxiliary contacts.
- Magnet valve
- Pressure switch.
- Interrupter assembly.
- Cylinder
- Piston
- Air dryer

3.2 AIR FILTER AND REGULATORS

The principal of maintenance are the same for the filters or regulators irrespective of their types :

3.2.1 Filter - Maintenance

Refer the figure 3.1.

Porous-bronze filter element - Wash with denatured alcohol

Body- Blow out with clean compressed air.

Bowl- Wash out with household shop only.

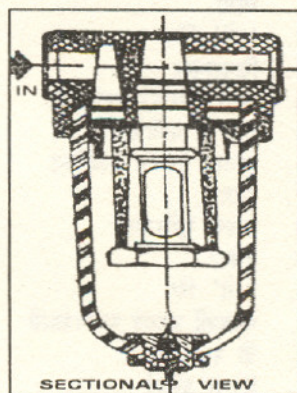


Figure 3.1

CAUTION : Never use carbon tetra chloride, Trychloroetheylene, Paint thinners, acetone or other similar solvent in cleaning any parts.

3.2.2. Regulator Maintenance

Parts - Clean with denatured alcohol.

Body - Blow out with clean compressed air.

3.2.3 Dis-Mantling and Re-Assembling of Air Filter and Air Regulator

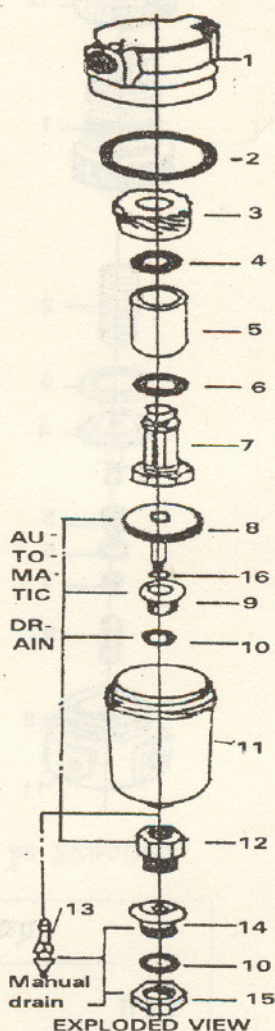
Shut off the air supply for detail refer the figures 3.2 & 3.3 on next pages.

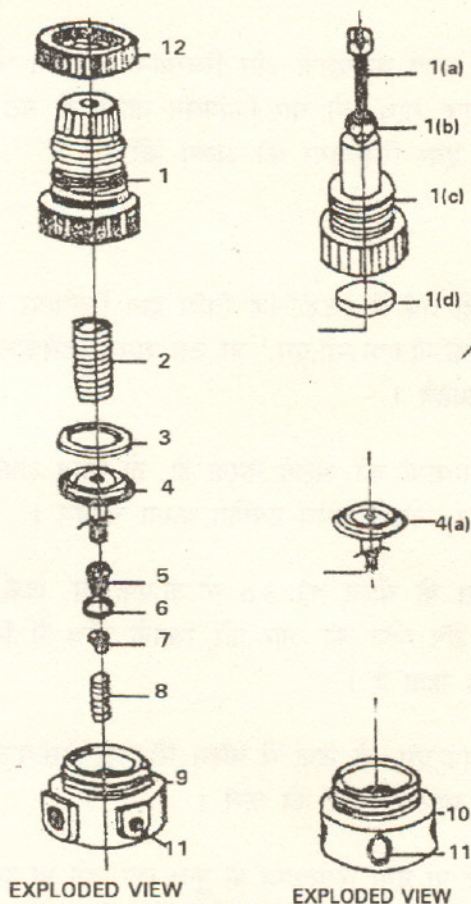
Air Filter Figure 3.2

- 1 Body
- 2 'O'ring
- 3 LOUVRE deflector
- 4 Upper gasket element
- 5 Filter element
- 6 Lower gasket element
- 7 Stud
- 8 Valve assembly
- 9 Insert
- 10 'O'ring
- 11 Transparent bowl with auto drain
- 12 Retainer insert
- 13 Valve
- 14 Insert
- 15 Hex nut
- 16 'O' ring

Air Regulator Figure 3.3

- 1 Bonnet assembly
- 1a Adjusting screw
- 1b Lock nut
- 1c Bonnet
- 1d Upper spring rest
- 2 Regulating spring
- 3 Slip ring
- 4 Diaphragm assembly
- 4a Diaphragm assembly substituted(4) for brass bonnet models.
- 5 Valve seat
- 6 Gasket
- 7 Valve assembly
- 8 Valve spring
- 9 Zinc body
- 10 Brass body
- 11 Pipe plug 1/8 in BSPT

**Air Filter (Type R07)****Figure 3.2**



EXPLODED VIEW

EXPLODED VIEW

AIR REGULATOR

OLD
(Type B681G)

MODIFIED
(type R07)

Figure 3.3

3.3 AIR- RESERVOIR

Remove the air reservoir by releasing the two air pipe connections and the nuts, washers from the four fixing bolts that go through the base plate and top plate of reservoir.

3.3.1 Maintenance

Pressure test the reservoir hydraulically to a pressure of 14 kgf /cm², every two years, with an empty desiccant container.

If the reservoir has had to be dismantled, adopt the following torque tightening procedure on reassembling .

- a. Tighten the M12 dia bolt from the bottom to the top plate sandwiching the reservoir cylinder to a torque of 3.6 Kgfm.
- b. Tighten the M6 dia nuts holding the desiccant container into the bottom plate to a torque of 0.97 Kgfm.

Upon refitting the air reservoir complete to the base plate, reseal the fixing bolt hex into the base plate with 'Evomastic' compound and ensure that four M12 dia plane washers are interposed between the base plate and reservoir top plate.

Refit the desiccant capsule in the container and ensure that no air leakage takes place from the joint.

3.3.2 Desiccant

Inspect the same, it should be blue colour when dry.
If not replace with fresh.

3.4 RELAY VALVE

Refer the figure 3.4.

- 27 Bottom cover
- 28 'O'ring
- 29 'O'ring
- 30 Piston
- 31 Valve disc
- 32 Valve stem
- 33 'O'ring for air outlet
- 34 Control valve body
- 35 Poppet valve
- 36 Valve spring
- 37 'O'ring for cover 38
- 38 Top cover

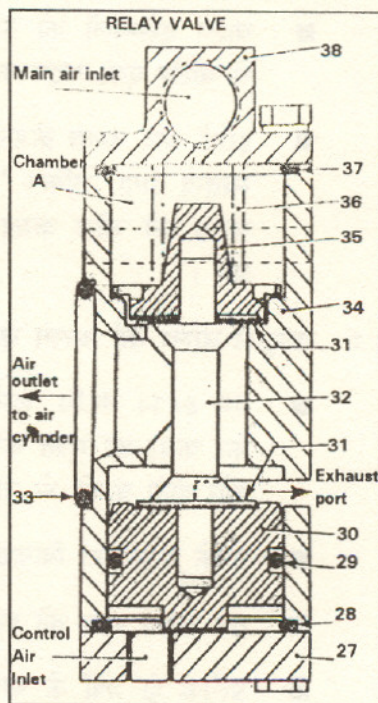


Figure 3.4

To remove the valve for cleaning and overhaul :

- Release the top air pipe connections on the valve assembly.
- Remove the two M6x60 mm long bolts and lock washers that fastened the valve assembly to the piston cylinder.
- After lifting up the valve assembly, release the bottom air pipe connection on the valve assembly.
- The valve will then be free to be remove through the opening in the cradle, but do not loose or damage 'O' ring sealing the valve to the cylinder body.

3.4.1 To Dismantle the Control Valve

- Release the cover by removing the four M6x14 mm long screws and lock washers. Underneath the top cover is a spring and under both covers are 'O' rings.
- Remove poppet valve and piston through their respective end.
- Then remove the valve stem.
- Remove the two valve disc and replace them with new one after every two years.

- Inspect the piston and the valve body for any scoring or debris specially the two mm dia orifice in the top cap.
- Remove any loose sealing compound in the air pipe entries in the covers.

3.4.2 For Assembly of Relay Valve

- Fit a new piston 'O' ring.
- Insert the valve stem, then poppet valve and piston assembly into their respective ends.
- Smear the piston 'O' ring with **Molygraf-44** grease to assist assembly.
- Refit the spring on the poppet valve locating collar, insert the 'O' ring into the valve body.
- Recess and bolt the top cover on the valve body by the two M6x14 mm long screw and lock washers.
- Insert the 'O' ring into the valve body recess and bolt the bottom cover on the valve body using the two M6x14 mm long screws and lock washers.

3.4.3 To Mount the Control Valve on the Cylinder

- Remake the bottom air pipe connection to the control valve assembly.

- Fasten the valve assembly to the cylinder by specified long bolts and long washer with 'O' ring seal in the piston.
- Remake the air pipe connection to the valve assembly.

3.5 MAGNET VALVE

3.5.1 Dismantling

Refer the figure 3.5.

- Remove the magnet valve from the equipment.
- Remove the armature retaining nuts (4), the armature (2) and the body bolt (16) ; the top plate (6) and air valve assembly are now disconnected form the magnet yoke.
- Remove the operating coil (17) from the magnet yoke (1).

- 1 Magnet yoke
 - 2 Armature
 - 3 Lock nut
 - 4 Armature retaining nuts
 - 5 Operating peg
 - 6 Top plate
 - 7 Sealing washer
 - 8 Valve
 - 9 Spring
 - 10 Valve stem
 - 11 Valve body
 - 12 'O'ring
 - 13 Valve
 - 14 Spring
 - 15 Sealing washer(rubber)
 - 16 Valve body bolts
 - 17 Operating coil
- A),B),C),D)- Valve ports

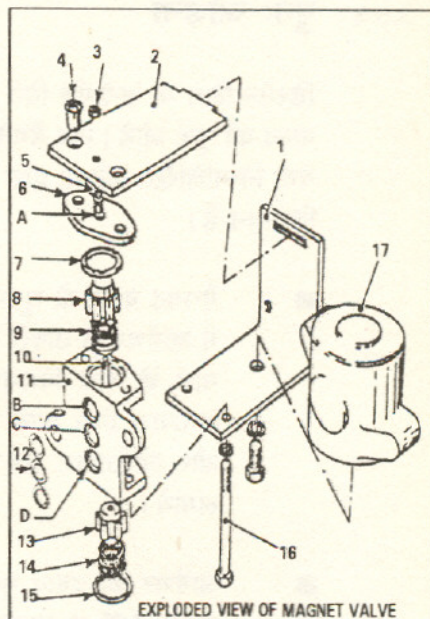


Figure 3.5

3.5.2 Reconditioning

Clean all parts and examine them carefully. Replace worn or damage parts with new one (viz - Rubber valve, 'O' ring etc)

Note : Use only white sprit to clean the valve assembly if it has become greasy or oily. Examine the operating coil carefully ; if any cracks can be seen in the encapsulating material, or if there is any evidence of overheating, fit a new one. Measure the resistance of coil and if it is not as stipulated in data, discard the coil.

3.5.3 Reassembling

Reassemble the magnet valve in the reverse order as described under dismantling. When the magnet valve has been reassembled, ensure the existence of the working clearance by the following procedure as given below:

- Verify that with the moving parts of the magnet valve in the de-energised position clearance exist between the outer surface of the armature and the heads of the two armature retaining nuts. When clearance is obtained remove the nuts, clean the stems and then apply LOCTITE 241 to the stems and refit the nuts.
- Verify that, as the armature is depressed, rubber valve [8] occurs before rubber valve [13] starts to move.
- Continue to depress the armature slowly until rubber valve [8] just touches seat at Q as denoted by the feeling that movement of the armature is opposed by solid resistance. Before adjusting this clearance remove locknut [3] & [5] clean them apply LOCTITE 241 to the threads and refit them. Now set the clearance and immediately lock the peg in position.
- Press and release the armature several times and ensure that it moves freely over the full length of its travel without any tendency to bind on the stems of the armature retaining nuts.

- An unsatisfactory result from any of the tests above indicates that the magnet valve has been assembled incorrectly, or that one or more parts is disorder is otherwise unserviceable. Before fitting the magnet valve to the equipment, check it for the leakage at air pressure of 77 kgf/mm^2 voltage of 77 Volts.
- Check that when the coil is de-energised the armature moves freely without clinging or binding.
- Check for leakage with the coil de-energised, at an pressure of 3.17 kgf/cm^2 .

Refit the magnet valve to the equipment, remake the electrical and pneumatic connections. Verify that it operates satisfactorily with an air pressure of 5 kgf/cm^2 and at a voltage of 69 Volts. If minimum operating voltages exceeds this figure, fit a new coil.

Modified coil resistance at 20° C	840 ohms $\pm 5\%$
Old coil resistance at 20° C	472 ohms $\pm 5\%$

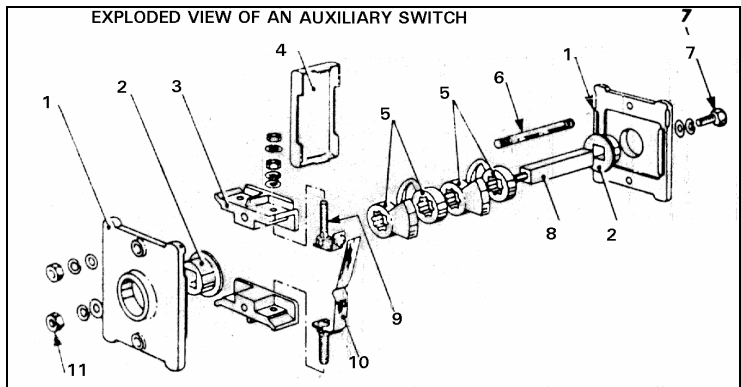
3.6 AUXILIARY SWITCH

3.6.1 Maintenance/Repair

Refer the figure no. 3.6

- Clean units thoroughly.

- Ensure that all fixing bolts, nuts & connections are secure.
- Ensure that the contact operate correctly.



1. End plate
2. Bearing bush
3. Contact carrier
4. Dust cover
5. Cam
6. Stud
7. Screw
8. Crank shaft
9. Fixed contact
10. Moving contact
11. Nut
12. Plain washer
13. Operating link.

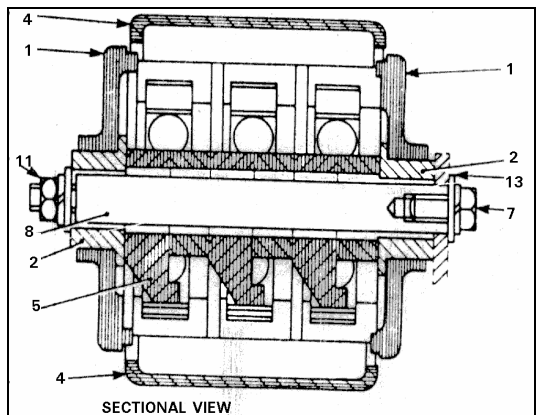


Figure 3.6

- Check that the contact pressure and gaps are within the tolerances quoted in DATA on next page.
- Adjust the contacts, or fit new ones as necessary.
- Whilst removing the cams, note their identification marks relative to the operating.
- When a new cam is fitted , apply a light smear of thin oil to the profile.

While re-assembling the unit ensure the following :

1. If the fixed and moving contact tips are not in line, a plain washer may be inserted between the moving contact and the contact carrier to correct the slight misalignment.
2. The screw (7) and nut (11) should be tightened in the sequence given below:

Tighten screw (7) at the operating lever end of the camshaft (8) until the plain washer (12) is firmly held against the end of the camshaft. Then tightens screw (11) at the end opposite the operating lever(14).

Note : Failure to follow the above procedure may result in, the operating lever not moving the camshaft.

Refit the unit on the equipment and check the contacts gaps.

Data

Contact gap	-	1.6 to 3.2 mm
Contact Pressure taken at the End of the Finger	-	90 to 200 gms
Contact Arrangement	-	6 NO + 2 NC

3.7 INTERRUPTER ASSEMBLY

Removing the interrupter assembly from the cradle is only necessary if :-

- The interrupter assembly requires detail attention, or
- The cylinder or the piston assembly requires attention.

3.7.1 Removing the Interrupter Assembly from the Cradle

Refer figure 3.7 & 3.8.

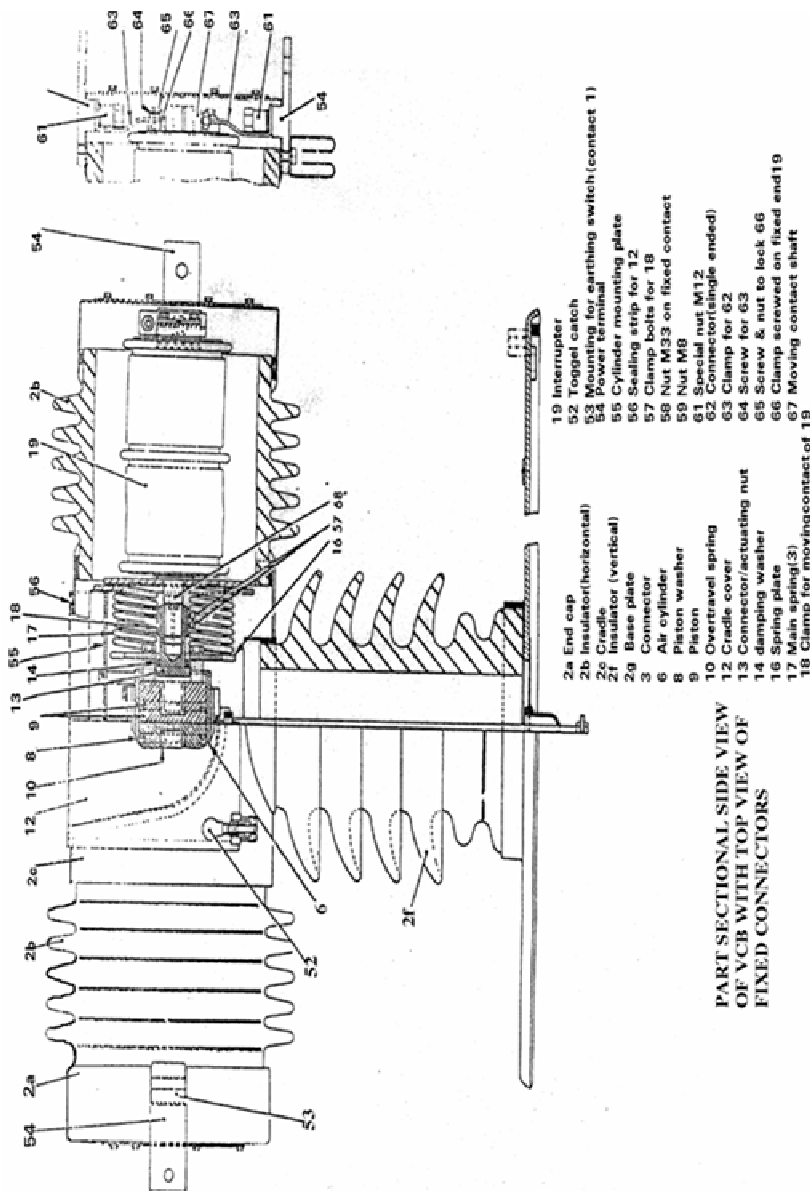
- Remove the outer limb end cap cover.
- Remove two interrupter fixed contact connector.
- Remove the cradle cover.
- Remove the flexible connector from the connector assembly by taking of M8 nuts and shockproof washers.
- Remove the equipment box cover from the underside of the base plate.

- Release the two M6 nuts and lock washers holding the auxiliary-contact-unit bracket and move the auxiliary-contact unit, to enable the operating rod to be withdrawn.
- With suitable supports, turn the circuit breaker so that the cradle is in a vertical position with the interrupter assembly which is about to be removed, at the top.
- Release the three M10 nuts and washers, holding the interrupter assembly, and adapter plate. This will allow the interrupter assembly and adapter plate now the interrupter assembly to be withdrawn through the end cap.

Note : Under no circumstances must the moving contact stem be pulled, twisted or deflected, as this could cause permanent damage to the bellows.

3.7.2 **Re-assembling the Interrupter Assembly in the Cradle**

- With suitable supports, position the circuit breaker so that the cradle assembly, is vertical.
- Clean the external and internal surfaces thoroughly of the porcelain, finish with a shaft, clean, dry cloth.
- Inspect the drain holes in the end-cap and cradle; if necessary, remove any debris.



Clean the connector connection position on the end cap and ensure that the end cap is clean internally.

- Insert the interrupter assembly into the outer limb.
- With the interrupter assembly in positions, shorten the fixing-stud insulation-tubes, if necessary, to ensure that the interrupter will be held firmly. Tighten the M10 nuts to a running torque of 0.69 kgf m and a tightening torque of 1.2 kgf m.
- Reconnect flexible connector to the connector assembly by its M8 nut and shockproof washer.
- The fixed contact nut used on the interrupter must be screwed on, but left un-clamped until aligned with the two connectors from the end plate.
- Fit the connector clamps, then tighten the clamping-screw and four connector clamp screw.
- Tighten the nuts for securing the connectors to the end cap.
- Rearrange the auxiliary-contact crank-pin with the operating rod. Bolt the auxiliary-contact bracket back in position under the baseplate.

3.7.3 Dismantling the Interrupter Assembly

It is only necessary to dismantle the assembly if :

- The interrupter must be changed due to loss of vacuum or when contact erosion had reached the maximum permissible.
- The operating springs require attention.
- It is required to overhaul the moving parts and seals.

For more details, manufacturer's Instruction manual should be referred.

3.7.4 Checking the parts of the Interrupter Assembly

Inspect all insulation details fitted to the spring-retaining or adapter plate, also the damping washer, if any parts are damaged or worn, fit new ones.

3.7.4.1 Checking the main springs

If the springs are outside the limits given below, fit new ones.

Free length = 76 mm

TEST -LOADING

Test	Load ± 5% (Kg)	AT (mm)
1	26.3	54
2	40.0	42.5

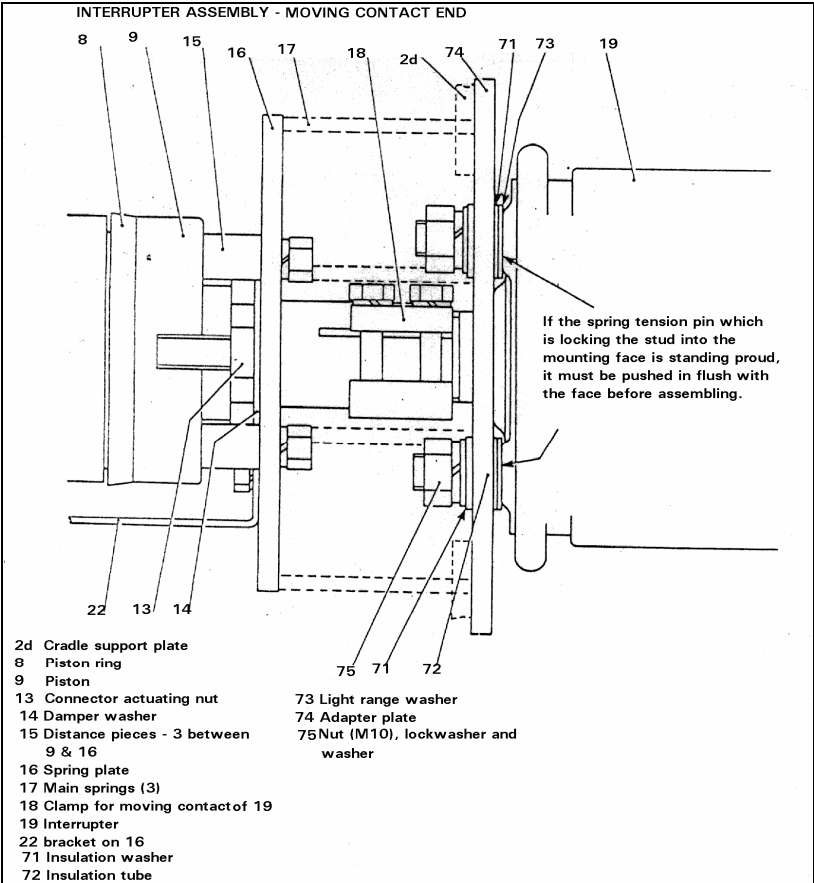


Figure 3.8

Note :It is essential to set the following dimension before continuing with assembling :

Distance between the face of the adapter plate and the back of the spring plate, should be 53.5 mm + 0.0 mm - 0.7 mm.

Caution : It is recommended that interrupter assemblies are not kept as assemblies because it could impair the life of the bellows.

3.8 CYLINDER

3.8.1 Dismantling

- Remove the cradle cover and the pipes.
- Remove both of the interrupter assemblies and the relay valve.
- Remove the four M6x45 mm long bolts, lock washers on top of the cradle. Then cylinder can be removed through the outer-limb end-cap.
- Examine the bore of the cylinder for score marks; if it is scored, fit a new cylinder; also ensure that the air passage from the relay-valve mounting-face are free from any foreign matter.

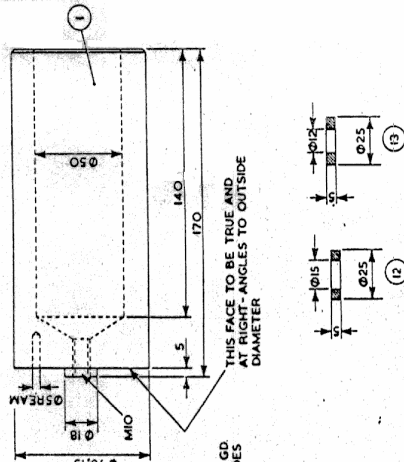
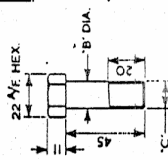
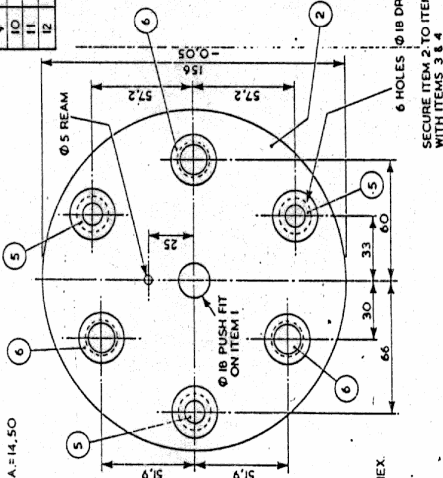
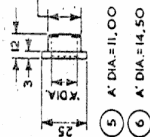
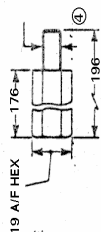
3.8.2 Reassembling

Prior to reassembling, smear the cylinder bore lightly with MOLYGRAPH 44 to lubricate the washers on the pistons.

A special tool is required for positioning the cylinder. This tool ST7/23062, is shown in figure 3.9, must first be assembled from the parts.

- Position plate 2 on spigot 1 with dowel 3 and fix it with bolt 4.
- Fit bushes 5 and 6 in the plate.
- Select the appropriate M10 bolts, nuts and packing washers 12. The washers are used only to act as packing pieces to prevent the nuts from reaching the unthreaded portion of the bolts.
- Enter the assembly through the outer limb and fasten the cylinder loosely in position, then fasten the checking plate in position.
- Tighten the fixing bolts.
- Remove the checking plate by releasing the nuts, bolts and washers fastening the checking plate to the cradle side-plate and withdraw through the outer limb.
- Retain the bolts, nuts and washers for further use.

BILL OF MATERIAL			QTY.
ITEM NO	DESCRIPTION	MATERIAL	REMARKS
1	SPIGOT	STRUCTURAL MILD STEEL	3 1/2in. DIA x 9 in. LG
2	PLATE	MILD STEEL PLATE	10 mm PLATE, FLAME CUT
3	DOWEL	CARBON STEEL	5 mm DIA x LENGTH TO SUIT
4	BOLT	MILD STEEL	M10 x LENGTH TO SUIT
5	BUSH	VEDAS CARBON STEEL	1 in. x 18 mm HARDEN & GRIND
6	BUISH	VEDAS CARBON STEEL	1 1/4in. x 18mm HARDEN & GRIND
7	HEX BOLT	BRIGHT MILD STEEL	22mm A/F HEX x 62
8	HEX BOLT	BRIGHT MILD STEEL	25mm A/F HEX x 62
9	HEX NUT	STEEL	M14 STANDARD
10	HEX NUT	STEEL	M10 STANDARD
11	WASHER	BRIGHT MILD STEEL	25mm DIA x 10mm LG
12	WASHER	BRIGHT MILD STEEL	25mm DIA x 10mm LG



CHECKING PLATE AND SPIGOT FOR VCB TYPE 20CB

TOOL NO. ST7/23062

3.9 PISTON

Inspection of the piston and piston washer is only possible after removing the interrupter assembly. If the piston is scored, fit a new one. This can be done by removing the three M8x30mm lg. Bolts, lock washers and distance pieces.

Warning : Take care as this releases the contact-over travel spring 10 which is within the piston body. Refer figure 3.8 of moving contact end of IA.

- Having removed the spring 10, check its free length. Fit a new spring if it is outside the limits.

Limit : The free length of the spring is 38.1 mm ± 5 % and its scale is 0.714 kg/mm ± 3 %.

- The piston washer is easily removed by expanding it slightly to slide over the piston body.
- Always fit a new piston washer, smearing it with Molygraf -44 before assembly. With the groove in the piston washer facing away from the operating assembly, slide the washer over the piston, ensuring that it is located fully in the recessed groove.
- Fit the spring and damping washer and reassemble on to the spring plate, ensuring that the spring is not trapped and that the three distance pieces are interposed between the piston and spring plate.

3.10 AIR DRYER

3.10.1 Maintenance (As per RDSO SMI No.137)

- At the time of initial fitment, weight of the air dryer should be taken in record and kept for future reference.
- Remove both air connections from the dryer.
- Remove the air dryer assembly by unscrewing the two M12 mounting bolts.
- Check the weight of the air dryer, if it is more than 0.8 kg from the new weight, change molecular sieve by new or re-generated. Method of re-generation is as under.
 - Re-generate the used sieve by heating in an oven at 200°C for 8 hours. Check the weight again and compare with the earlier weight. It should be less by 15 to 20%. There should be no visual indication of moisture contents.
- Unscrew one filter assembly from the body empty sieve material and replenish with new/regenerated leaving sufficient room for filter assembly. Refit and tighten the filter assembly.

- Dryer be 'Blown down' by giving compressed air from one end and keeping the other end open to remove any molecular sieve dust.
- Check for air leaks by using a soap solution around the filter assembly. For this purpose blank off one air connection and connect the other with compressed air.
- Remount the air dryer assembly on the loco and reconnect the air supply connections.
- Check the weight of molecular-sieve, to be regenerated.

Note :Refilling should be carried out as quickly as possible by scooping pellets into air dryer body from the 145 kg drum in case of replacement. After filling ensure the drum is properly closed with the lid and store in a dry cover area.

3.11 PRESSURE SWITCH

3.11.1 Setting

Refer the figure 3.10. The pressure controller is set by the rotating the knob [1] at the same time reading the main scale [2]. The difference in cut-in and cut-off values of pressure is set by rotating the differential adjusting roll [11], which is calibrated onto ten equal divisions. The maximum operating pressure is the sum of the setting pressure and the differential.

Connect magnet valve coil to the terminals of the switch [8]. These are the normally open contacts of the switch. These contacts make on rise of pressure to 4.65 Kgf/cm² and above while they break when the pressure falls to 4 Kgf/cm² and below.

Note : Ensure that the setting done are correct by mounting the switch on a test rig to which a standard gauge is fitted. Raise and lower the pressure applied on the switch and see if it operates efficiently at the required values. Carry out minor adjustment if necessary.

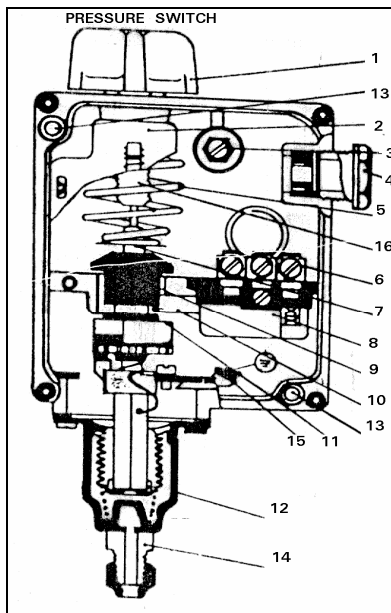


Figure 3.10

3.11.2 Maintenance

IMPORTANT: The maintenance is carried out with the switch in the normal position. Take care to assure the safety during the work. Isolate the earth electrical system and vent the pressure system.

- The essential requirement is that the switch interior must be kept clean.
- To ensure above open the painted steel cover by unscrewing the four screws, with a screw driver.
- Clean all the parts with a brush.
- Place the cover and secure it with the four screws.

<p>WARNING: In no case should the contact arm be tampered with otherwise there would be the possibility of the malfunctioning of the switch.</p>

DATA:

Range- 1 to 10 kgf/cm²

Pressure settings:

cut-off = 4.0 kgf/cm²

cut-in = 4.65 kgf/cm²

Contact arrangement:

1 NO + 1 NC.

CHAPTER 4

TESTING OF VCB

4.1 TEST EQUIPMENT

Variable-pressure air supply	Up to 7 Kg/sq mm.
Variable-voltage supply	Up to 110 V d.c.
Insulation tester	1000 V Megger.
Test supply for contact-resistance test.	Low-voltage, 500 A d.c. supply.

4.2 TESTS TO BE CARRIED OUT

4.2.1 Insulation Tests Using 1000 V Megger

Control wiring to frame	minimum 10 M ohms
Main connection points to centre piston	minimum 200 M ohm
Main terminals and centre. piston to earth	200 M ohms.

4.2.2 Sequence Tests

- Check that with the contacts closed , a falling air pressure operates the air pressure switch before the main contact piston.
- Check that at 3.17 Kgf/sq cm in the VCB reservoir and with 50% full voltage at the magnet valve terminals, the breaker operates with a clean action.

Note : Contacts of the air pressure switch must be held closed for this test.

- Repeat 2nd above with the air pressure at 6.34 Kgf/sq-cm and the magnet valve voltage as previously stated.

4.2.3 Air Leakage Tests

- After applying air at 6.34 Kgf/sq-cm to the breaker, with the control magnet valve de-energised, seal the air entry to the circuit breaker to a 1-litre reservoir and check the air pressure after 10 min.. The drop in pressure must not exceed 10% of the initial pressure.
- Repeat above with control magnet valve energised.

4.2.4 Contact resistance test

With the main contacts closed, connect a supply to the external connections of the breaker and pass a current

of 500 Amps. DC through the breaker. Measure the milli-volt drop between the end terminals.

The reading must not exceed 10 milli-volt. Repeat at the connection point of the other interrupter.

Note : Ensure that current is NOT SWITCHED by vacuum circuit breaker.

4.2.5 **Contact-Travel Tests**

The test should be done as per SMI NO. RDSO/ELRS/SMI-136 dated 17/01/91, which is beyond the scope of this book.

CHAPTER 5

DOs & DON'Ts

5.1 DO's

- Ensure that the overhead contact line is dead & is properly earthed, before going to inspect the VCB on the roof of the Locomotive.
- Earthed the Circuit breaker's base by means of temporary flexible strap which is solidly earthed at the other end before doing overhaul/repair.
- Always use PTFE thread sealing tape on male threads before refitting the items, since all joints is in compressed air path.
- Reseal the cradle cover with silicon rubber paste every time it is opened.
- Always use lubricant MOLYGRAPH-44 only to lubricate relay valve, main piston, cylinder at correct places.
- Make practice to replace 'O' ring & PTFE washers after every overhaul of relay valve.

- Clean the air filter and check pressure gauge in case of ET2 flash over.
- Always use denatured alcohol only to wash air filter.
- Molecular sieve of air dryers to be regenerated/replaced at least once in a year.
- See that three N/O contact used in series between contact nos 12-13 & each of these contacts has at least 2 mm contact gap in open condition.
- Give support to overhang portion of Hose pipe to avoid its breakage/Bursting.
- Do keep all tools, gauges, instruments in working condition.
- Always use Grommet for cable entry.
- Always use stainless steel fasteners.

5.2 **DON'Ts**

- Don't climb on the roof of Electric loco without taking proper shutdown by competent authority and before climbing, OHE as well as equipment must be properly earthed.
- Don't leave the cradle cover open/loose/unsealed.

- Never use Carbon tetra chloride, Tri-chloro athelene, Paint thinners, Acetone or other similar solvent in cleaning any parts of VCB.
- Never do the work on pressure switch without shutting of compressed air supply.
- In no case should the contact arm of the pressure switch be tempered with, otherwise there would be possibility of malfunction of the pressure switch.
- Don't kept interrupter assemblies as assemblies because it could impair the life of the bellows.
- Don't pull, twist or deflect moving contact stem of interrupter assembly as this could cause permanent damage to the bellows.
- Don't remove/re-assembly contact piston assembly without having the travel graphic's recording facility.

CHAPTER 6

FAILURES, DEFECTS AND REMEDIAL ACTIONS

6.0 The VCB has following failures, observed / reported by different electric loco sheds/workshops, all over Indian Railways.

6.1 INSULATOR BREAKAGE

Insulator breakage takes place due to cracks in the insulator body and loosening of cemented joints.

This problem has been minimised by upgrading the packing methods by using steel cage for two nos breakers & bolted at the bottom for transportation of circuit breaker. Manufacturers has introduced proper cementing by improving cementing process technology. Insulators are further strengthened and also changed the profile of vertical insulator.

6.2 VACUUM LOSS IN THE INTERRUPTER BOTTLE

Generally this is taking place due to ingress/ seepage of water/moisture into the interrupter bottle through

cradle cover gaskets, which gets damaged during maintenance/overhauling.

Besides above improper quality of brazing of the interrupter bottle may also affect the vacuum in the bottle.

To overcome the problem seal the cradle cover as per SMI 161(Rev 1). Bolted design cradle cover as per Modification No 209 has been introduced in new manufactured breakers.

6.3 RELAY VALVE FAILURES

The causes of the failure are as following:

6.3.1 Piston Jam

Jamming of piston is due to insufficient lubrication. The present acid free clear petroleum jelly is to be replaced by lubricant MOLYGRAF-44 as per RDSO's SMI No.162(Rev 1).

6.3.2 Sticking of Relay Valve

Using proper lubrication i.e. MOLYGRAF-44, the problem can be avoided.

6.4 AIR LEAKAGE FROM MAGNET VALVE

Due to improper use of rubber component air leakage occur. Rubber component should be changed in every opening schedule of maintenance with imported kit.

6.5 DEFECTS ON AUXILIARY SWITCH

It has been found that auxiliary switch inter-lock causes bad contact due to less contact pressure at elevated temperature during operation. It causes false indication to driver.

To avoid such type of failures the contact gap and pressure on the contacts of auxiliary switch should get more attention during maintenance.

The contact gap should be 1.6 mm to 3.2 mm and contact pressure at the end of finger is 90 gms to 200 gms.

In VCB's auxiliary inter-lock circuit, some cases of cam melting are also found. For the same a modification was carried out by M/s GEC on advice of RDSO by changing 6- pole auxiliary inter-lock to 8-pole. But then it is found that control cables were got over heated and shorted. The problem is yet to be solved.

Fish bone type auxiliary switches has been developed by the firm and provided few nos. on some Sheds for service field trials.

6.6 PUNCTURING OF MAIN AIR PIPE LINE

To overcome this problem , firm has introduced larger length pipe to increase the creepage path to new VCBs.

6.7 AIR LEAKAGE FROM INCOMING FLEXIBLE PIPE

To overcome this problem, replace incoming Steel Braided Flexible pipe by Reinforced Rubber pipe connected to VCB as per Mod/209 issued by the RDSO.

6.8 AIR PRESSURE REGULATOR FAILURE

Air leakage due to improper quality of ‘O’ rings is the main cause of the defect. For remedy good quality of rubber ‘O’ rings should be used, and should be replaced in every opening of the air pressure regulator.

CHAPTER 7

PRE-COMMISSIONING AND TRIP INSTRUCTIONS

7.1 PRE-COMMISSIONING INSTRUCTIONS

- Check flexible connections for its tightness after opening the cradle cover.
- Check the cradle cover is refitted and sealed properly with silicon rubber seal that no water can seep in.
- Check the air regulator, setting is 5 Kg/cm².
- Check the condition of desiccant capsule fitted in the VCB reservoir.
- Weigh the air dryer and keep a record of it.
- Check RC network fitted across auxiliary winding of transformer (RC network comprise of two parallel legs, each legs is being 25 µf , 560 V capacitor and 4.5 Ω, 380 Watt, 560 Volts connected in series).

Note : Above checks are in addition to the normal operational/electrical pre-commissioning checks.

7.2 **TRIP INSPECTION**

After the locomotive is brought under the isolated section of OHE, the following parts should be checked.

- Visual inspections of insulators, air inlet pipe connection for tightness.
- Clean externally with dry cloth.

APPENDIX - A**TECHNICAL DATA FOR INITIAL DESIGN AND LATEST
DESIGNED COMPONENTS OF VCB TYPE- 20 CB**

COMPONENTS	NEW	OLD
PRESSURE SWITCH		
Type	RT-116	PGS-ME 28
Range	1 to 10 Kg/cm ²	--
Pressure settings		
Cut off	4 Kg/cm ²	3.5 Kg/cm ²
Cut in	4.65 Kg/cm ²	4.5 Kg/cm ²
Contact arrangement	1 N/O + 1 N/C	1 N/O + 1 N/C

MAGNET VALVE :

Coil resistance	840 $\Omega \pm 5\%$	472 $\Omega \pm 5\%$
Min. Operating voltage	69 Volts	69 Volts

AUXILIARY SWITCH:

Contact gap	1.6 to 3.2 mm	1.6 to 3.2 mm
Contact pressure at the end of the finger	90 to 200 gms.	90 to 200 gms
Contact arrangement	6 N/O + 2 N/C	4 N/O + 2 N/C

COMPONENTS	NEW	OLD
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AIR PRESSURE REGULATOR :

Type	R07	B68 1G
Setting	5 Kg/cm ²	4.83 kg/cm2
Air Filter	R 07	B 261

WEIGHT OF VCB : 125 Kg. 119 Kg

APPENDIX B

MAIN TECHNICAL DATA OF VCB TYPE 20 CB

Max rated voltage	33 KV
System Frequency	50 Hz.
Rated Current	1000 Amps.
Mechanical shock limits	5 g
Cut off Air Pressure	4 Kgf/cm ²
Cut in Air Pressure	4.65 Kgf/cm ²
Auxiliary Switch Contact Arrangement	6 N.O. + 2 N.C.
Weight	125 Kg.