(FOR OFFICIAL USE ONLY)

MAINTENANCE HANDBOOK ON DYNAMIC BRAKING RESISTOR AND MOTOR

CAMTECH/2003/E/DBR/1.0

MARCH, 2003

Centr***e***
for
Advanced
Maintenance
TECHnology

उच्च अनुरक्षण प्रौद्योगिकी केन्द्र

Excellence in Maintenance

Maharajpur, GWALIOR - 474 020

MAINTENANCE HANDBOOK ON DYNAMIC BRAKING RESISTOR AND MOTOR

FOREWORD

The proper maintenance of dynamic braking resister and motor is necessary for its reliable operation to drive all benefits of dynamic braking. CAMTECH has prepared this handbook to cover all essential aspects of maintenance.

The handbook describes various maintenance schedules along with their periodicity and detailed procedure to be adopted during repair and overhauling. A very useful compilation of list of common defects and their remedies is included in the handbook. I am sure the staff in electric loco sheds will benefit greatly from this handbook.

CAMTECH, GWALIOR *C.B.MIDDHA*
14th March, 2003 ***EXECUTIVE DIRECTOR***

PREFACE

Rheostatic braking makes possible to control heavily loaded train over steep gradients and reduces mechanical wear and tear of brake blocks and wheels. The Dynamic braking resistor is used in all WAG5, WAG7 and a few of WAP4 class of AC electric locomotives. Its proper upkeep and maintenance is necessary to ensure reliability and safety with application of rheostatic braking. This handbook on "Maintenance of DBR and its Motor" has been prepared by CAMTECH with the objective of making our maintenance personnel aware of correct maintenance and overhaul techniques to be adopted in field.

It is clarified that this handbook does not supersede any existing provisions laid down in the “Maintenance manual of electric locomotive” and “AC traction manual” or instructions issued by Railway Board/ RDSO and this is not a statutory document.

I am sincerely thankful to all officers and staff of Electric Loco Directorate RDSO/LKO for their valuable comments. I am also thankful to all field personnel who helped us in preparing this handbook.

Technological upgradation and learning is a continuous process. Hence feel free to write to us for any addition/ modification in this handbook. We shall highly appreciate your contribution in this direction.

CAMTECH, GWALIOR ***RANDHAWA SUHAG***
13th March, 2003 ***IRECTOR(ELECTRICAL)***

CONTENTS

ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/2003/E/DBR/1.0/C.S. # XX date----------

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No.	Date of issue	Page no. and Item no. modified	Remarks

CHAPTER 1

INTRODUCTION

1.0 GENERAL

As a result of phenomenal increase of both the industrial activity and population, we have to resort to heavy and faster trains to deal with heavy traffic requirement. On the other hand dissipation of large amount of kinetic energy during braking in shortest possible time have great significance. Mostly mechanical and electrical braking are being used. Electrical braking is classified into plugging, rheostatic braking, regenerative braking and eddy current braking. All types of electrical braking are effective only when the train is moving above certain speed. They are, although helpful in reducing the speed of train but can not keep it stationary on down gradients. As such electric braking has to be supplemented with mechanical braking. The main advantages of electrical braking are as under:

- Reduced energy consumption
- Less wear and tear of brake blocks, wheels and track consequently increases their life.
- Increases life of bearings.
- Ease and safe with which heavy loads can be hauled over steep gradients.

WAG5, WAG7 and some of the WAP4 class of locomotives are facilitated with rheostatic braking system. Dynamic braking resistor (DBR) and its cooling blower are most important part of this system. Therefore to achieve above advantages and over all economy in operation of electric locomotives, it is very essential to have DBR in healthy working condition in the locomotives.

1.1 BRIEF DESCRIPTION

DBR consists of a compact resistance chamber with a blower motor unit mounted below the resistance chamber. The resistor box is constructed from a heat resisting material having flame retardation properties. Resistor box is also clad on all four sides with access underneath for incoming cables. The box material is cut from a high temperature rigid laminate 10mm thick comprising of mica paper bonded with high temperature silicon resin and designed specifically for withstanding the heat generated during braking. Material has excellent resistance to mechanical forces and very low moisture absorption.

The resistance chamber consists of six trays of resistances. Each tray comprising of four resistance elements are connected in 2S-2P combination as shown in figure 1.2. Total resistance should not be more than 0.5 ohms.

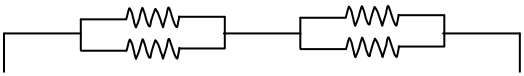


Figure 1.1 Combination of Resistance

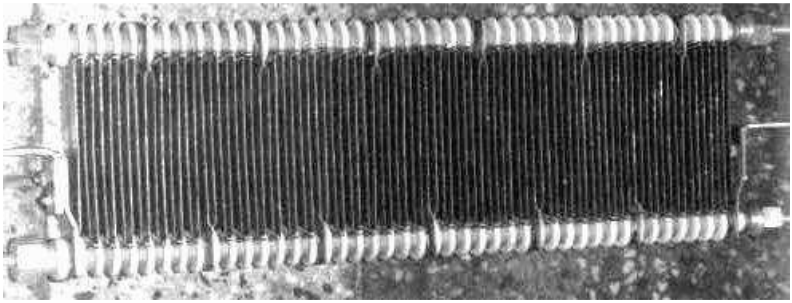
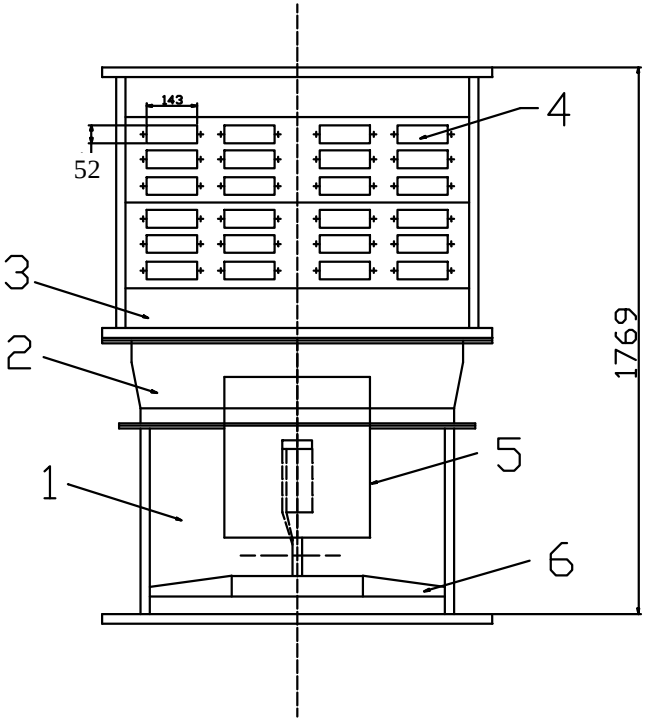


Figure 1.2 (a) Resistance Element

Figure 1.2 (b) Resistance Chamber

They are forced cooled by a vertically mounted motor blower set. The impeller of this blower unit is mounted on the shaft of D.C. series motor.

The unit is incorporated with a protection system for low airflow. A view of DBR assembly is shown in Figure 1.3



No.	Part
1.	Motor Mounting Cell – Blower Duct
2.	Diffuser
3.	Mica Board Sheet
4.	Resistance Element
5.	Dc Motor
6.	Fan
7.	Mounting Flange

Figure 1.3 DBR Assembly

1.2 PRINCIPLE OF WORKING

During application of dynamic braking resistor (DBR), all the traction motors are disconnected from the power supply and each resistor tray of DBR unit (consisting of 06 trays) is connected across the traction motor through CTF contacts. Simultaneously, the main fields of all the traction motors also get connected in series through CTF contacts, thus making the traction motors to work as separately excited generators. Excitation current to the fields already connected in series is fed from ATFEX, which is connected across one secondary winding of main transformer. Current in the separately excited fields of each traction motor may be increased or decreased by progression/ regression of tap changer through master controller depending upon the dynamic braking effort required to control the speed of the train. Hence all the kinetic energy of the moving masses is converted into electrical energy generated by traction motors and dissipated in the forced air-cooled braking resistance bank (DBR). A block diagram of the working principle is shown in Figure 1.4.

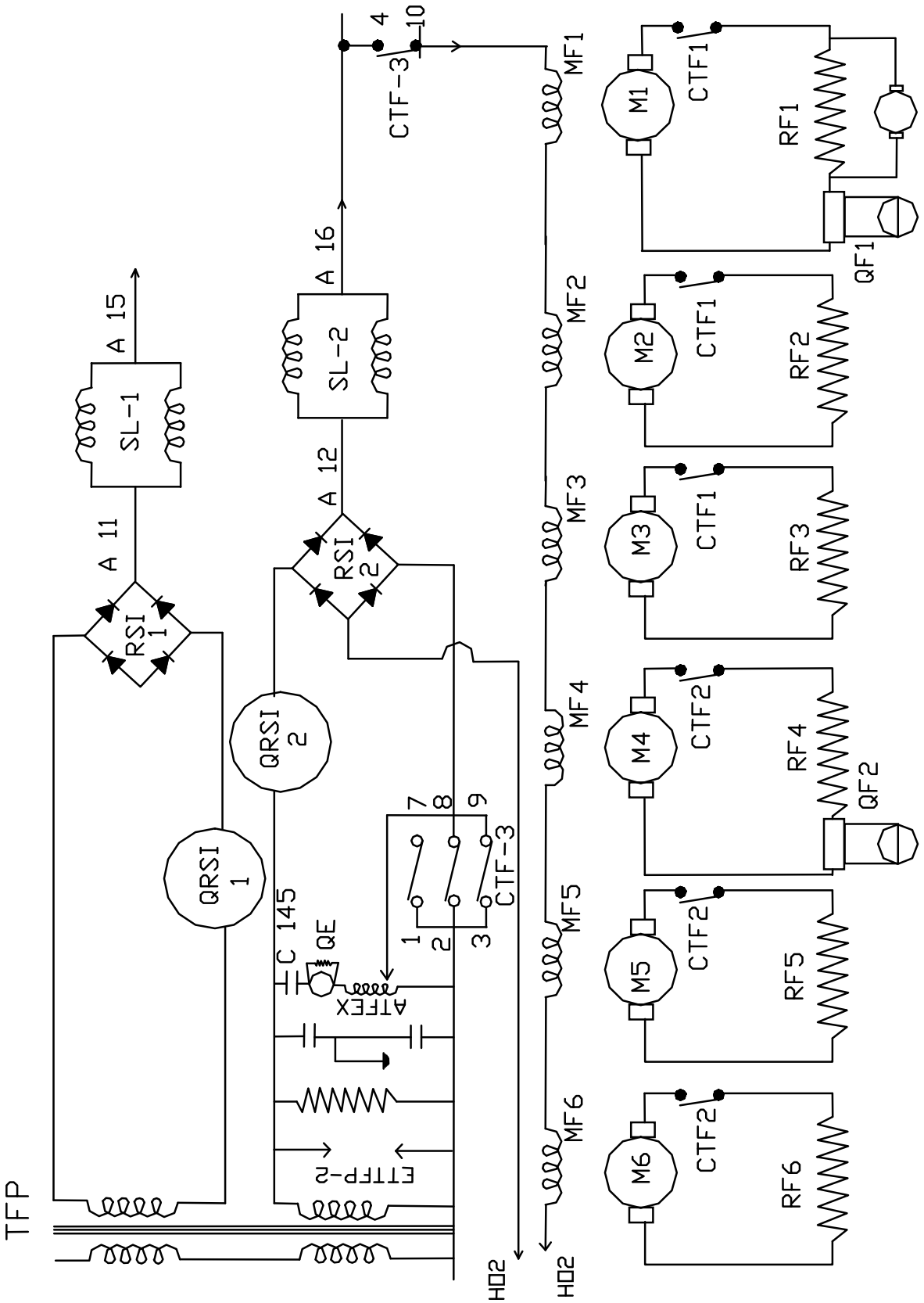


Figure 1.4 Working Principle of DBR

Maintenance Handbook on DBR and Motor March,2003

1.3 TECHNICAL SPECIFICATION OF DBR

RESISTOR	
Continuous rated current	900 amps.
Heat dissipated in resistance corresponding to 900 amp. braking current	2430 kW
Peak overload rating	1.25 times the rated power for 10 min.
Total resistance at operating temperature	6 x 0.5 ohms
Melting point	More than 1400 °C
Winding width	Not more than 140 mm
Temperature withstand ability of holding insulator	1500 °C
Max. weight of unit	Not more than 900 kg.
Temperature limit of joint of cable socket	Less than 70°C
Temperature of exit air	Max. 300 °C
Type of MVRF	DC series motor
Enclosure	Totally enclosed type (TEFC) IP-55.
Cooling	Forced air cooled by vertical blower
Material	60/15 Nickel /chrome alloy
Strip type	Cronifier II-E corrodable resistor strip M/s Krupp VDM Germany or equivalent
Element size	0.56 x 52 mm
Specific resistance at 20^0C	1.13 Ohms sq. mm/ meter

Ohmic value per TM at 600^0C	0.5 ohms
Tolerance	The value of the resistance measured when cold and if corrected to 20 °C shall not vary +7 %, -5 %
Max. operating temperature	850 °C
Max. Altitude	1000 meters.
Average operating temperature of element.	600^0C.
Inlet arrangement	Opening at loco floor with inlet cone.
Outlet arrangement	Opening at loco roof.
PROTECTION DEVICES	
Pressure switch	Type : LGW 10A2 or similar
Range	10 mm to 100 mm
Setting value	$-12\ ^{+0}_{-2}$ mm WC (Provided at suction side)
Make	Electromation, Germany, Dycor or Switzer.
Qty. per DBR	1 no.
Location of QVRF relay	As per RDSO TC No. 0072 dated 28.09.2001/03.10.2001

BLOWER MOTOR	
Type	DC/ AC motor
Rated power	30 to 45 kW
Voltage	400 to 500 V
Speed	3000 to 3500 RPM
Insulation Class	H
Fan output	12.5 m^3/sec. with resistor box requirement
Insulation level from frame to resistor section	3.875 kV AC for 1 min.
Insulation level from grid bolt to frame	2.5 kV AC for 1 min.

1.4 CIRCUIT DESCRIPTION

The feed for operating the solenoid valves of the traction motor reverser (J) and traction/braking switches (CTF) is given via the reversing drum (MPJ), the running braking drum (MP) master controller.

BL key is inserted in the BL key switch box of the particular cab to be used for operation. Operation of this key supplies power to the running/braking drum (MP) via the associated set of the contacts (BL). The reversing drum (MPJ) is operated only when the running/braking drum (MP) is in position "O" (mechanically interlocked). Both the traction motor double reverser (J) and the traction/ braking inverser (CTF) are changed over only at the zero position of the tap changer (GR). Supervision takes place via the auxiliary contracts GR 47-48, 49-50, 53-54 and 55-56.

In the case of multiple unit operation all commands from leading locomotive are transmitted to the trailing locomotives via the MU couplers.

1.5 DESCRIPTION OF CONTROL CIRCUIT FOR RELAY Q-50 AND BRAKING EXCITATION CONTACTOR C-145

(Refer circuit diagram on page 15 & 16)

1.5.1 Operation in Running Position

For energizing the relay Q-50 and for moving the tap changer in the up direction, the following conditions must be satisfied.

- The selected position (running) on the master controller (MP) must coincide with the corresponding operating position of the traction/ braking switches (CTF1-2). Supervision takes place via the auxiliary contact of reverser J1-J2. Similarly supervision of reverser J1-J2 is done through auxiliary contacts of CTF 1 and 2.
- Main circuit breaker (DJ) must be closed.
- Tap changer (GR) must be at position "0".

1.5.2 Operation in Braking Position

When changing over from running to braking operation the MP drum must be pushed on position "P" for a few seconds till the signal lamp LSB goes out. For energizing the relay Q-50 the following conditions must be satisfied.

- Conditions as under para 1.5.1 above.
- The braking excitation contactor (C-145) must be closed.

When the running/ braking drum (MP) is brought to braking position "+", the energizing of the "Up" valve of the tap changer takes place and rheostatic braking is initiated.

An immediate switching off of the braking excitation contactor and the associated termination of braking process results in the event of operation of the braking overload relay QF1-2, the braking excitation overload relay QE, or development of pressure in SWC. De-energisation of IP magnet valve through contacts of QF, QE, Q30 relays will cause automatic mechanical braking.

1.5.3 Operation at Position "+" with Running or Braking Operation

Provided air motors of all coupled locomotives are in operation, the switching sequence of the supervision of synchronous up movement of the tap changer takes place as follows:

Energising of synchronising relay Q-49 via control line 079, tap changer leaving a notch. Feeding of notch to notch relay Q-52, via contacts of relay Q-49 in the run of lines 211-079, as well as of auxiliary contacts 7-8 of ASMGR which are closed between notches. Self-holding of notch to notch relay Q-52 via its auxiliary contacts in the run of lines 079-078, since relay Q46 is not energised. Tripping of relay Q49 owing to opening of contacts of notch to notch relay Q52 and the contacts 7-8 of the ASMGR, which are

closed between the notches, are connected in parallel with the contact 211/079 of the relay Q-49 in the energising circuit of the notch to notch relay Q52.

Should one or more air motors fail to operate or fail to follow the orders given by the position of the master controller (MP) air motors are locked.

On the faulty machine or machines the relay Q49 remains energised. However, on which locomotive the air motor could continue to run the relay Q52 is held in via control circuit couplers P and thus further upward notching operations can not take place.

The supervisory circuit for synchronous running does not function if one of the tap changers does not leave the "O" position. In such case relay QV62 on the faulty locomotive remains energised. The feed circuit for the relay Q49 is thus opened. In such a case the lamp LSGR on the driver's control desk is not extinguished.

Further operation with faulty locomotives in multiple unit operation is then possible as follows:

The faulty locomotive must be switched off on the battery side by opening the battery-isolating switch (HBA). The locomotive then runs like a trailer coach, nearly passing on the control impulses. The opening of the HBA switch causes the relay QV62 to drop out. The lamp LSGR is extinguished.

The switch ZSM - GR must be opened. This will prevent a supply from being fed to the relay Q49 on the faulty locomotive.

1.5.4 **Operation at Position "+" or "-" with Running or Braking in Multiple - Unit Operation.**

When a "+" or "-" command is given with the master controller (MP) the notch to notch relay Q52 is energised in all locomotives. The auxiliary contacts of this relay in the run of the line 080-081 prevent the synchronous running supervisory relay Q49 from being energised.

If one of the air motors does not follow the order, the relay Q49 on this faulty locomotive remains energised. The relay Q52 is held energise on the healthy locomotives too via the control coupler via the line run 211 - 085, thereby preventing further movement of tap changer air motors.

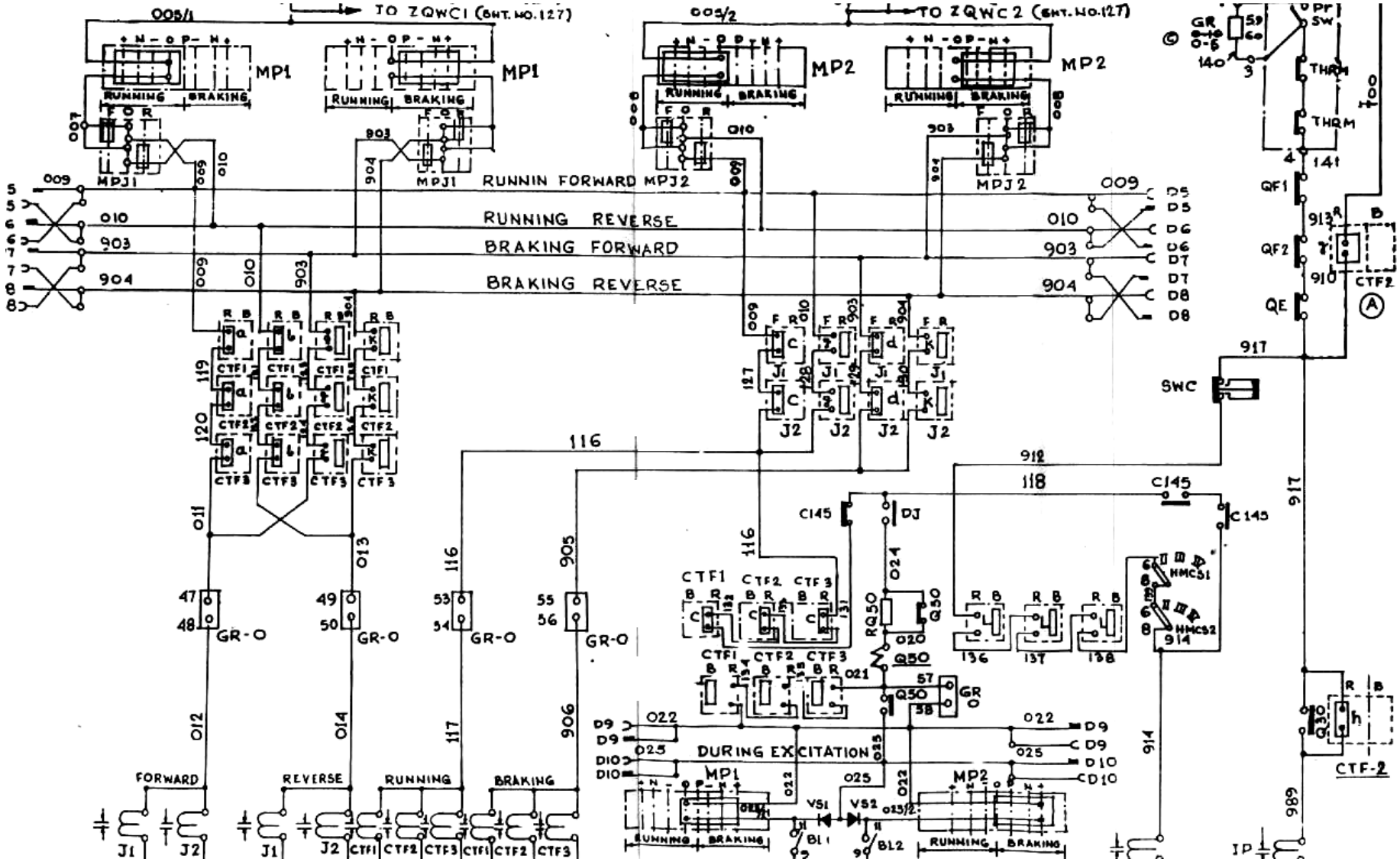


Figure 1.5 Traction Control Circuit

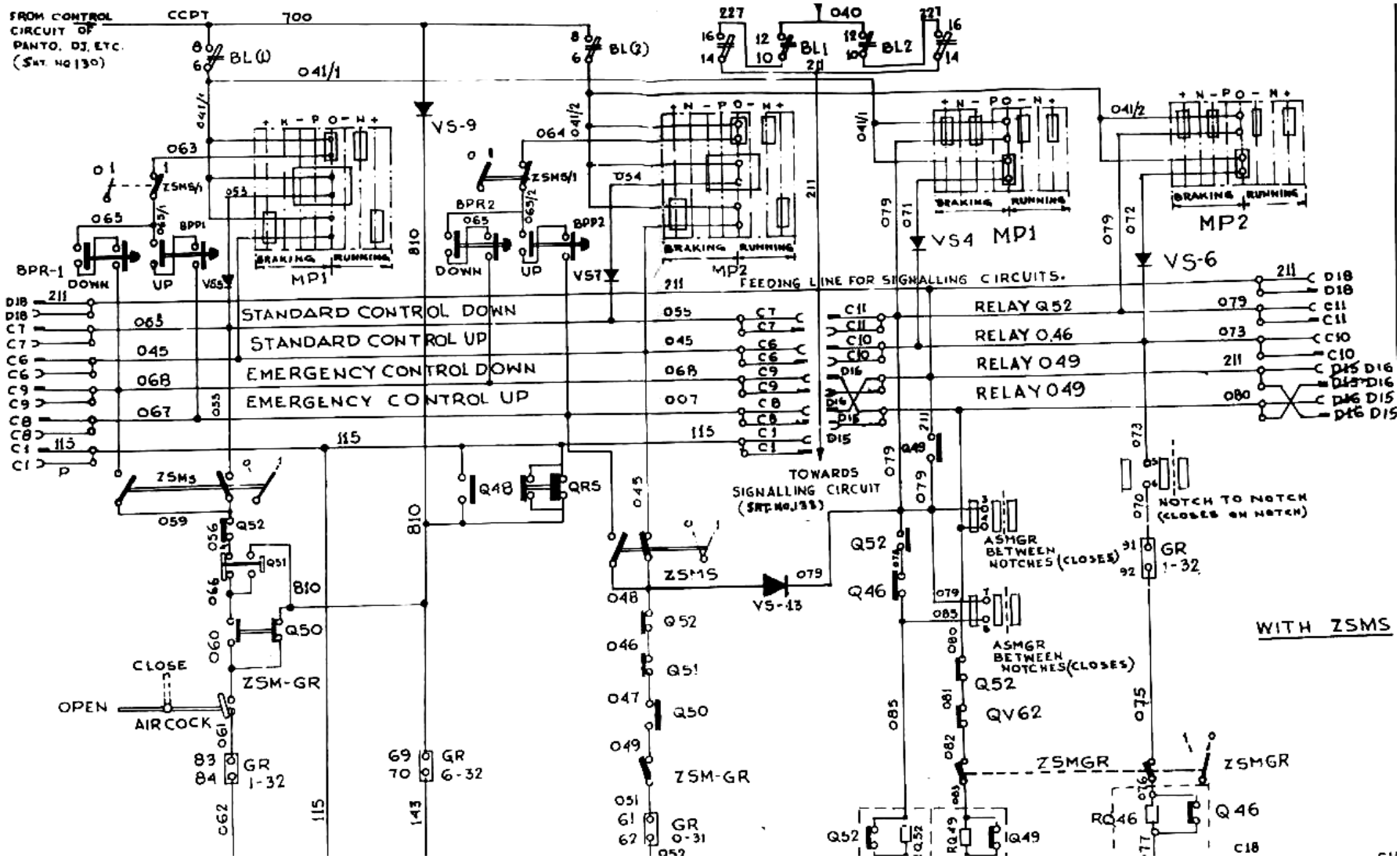


Figure 1.6 Traction Control Circuit

CHAPTER 2

MAINTENANCE

2.1 PERIODIC SCHEDULES FOR DBR

IA, IB, IC AOH, IOH periodic schedules are to be carried out for maintenance of DBR.
Indication: (-) work not to be done, (*) work to be done.

DESCRIPTION	IA	IB	IC	AOH	IOH
MVRF					
Check brush size (unsafe limit is 20 mm)	-	-	-	*	*
Check connection tightness	-	-	*	*	*
Check spring tension of brush holder (567 gms.)	-	-	*	*	*
Movement of brush up & down several times in the brush holder to release carbon dust.	-	-	*	*	*
Inspect commutator surface	*	*	*	*	*
Check clearance between brush holder and commutator (2-3 mm)	-	-	*	*	*
Ensure all covers are secured	*	*	*	*	*
Check IR of armature, compoles, field coils. IR should not be less than 0.5 mega ohms.	-	-	*	*	*
Lubricate bearing with servogem-3 or equivalent grease on both ends with 12 gms.	-	-	-	*	*
Resurface commutator when ovality exceeds 0.1 mm	-	-	-	*	*
Overhaul MVRF	-	-	-	-	*

DESCRIPTION	IA	IB	IC	AOH	IOH
MAGNET VALVE					
Clean valve rod and valve sheet with petrol and overhaul	-	-	-	-	*
Check continuity of magnet coil and insulation resistance	-	-	-	-	*
CTF					
Ensure provision of double roll pin of CTF drum	-	-	-	*	*
Check 'U' fork and roller. Replace if worn out.	-	-	-	-	*
Ensure provision of brass roller instead of nylon roller	-	-	-	*	*
Check for any air leakage	*	*	*	*	*
Check contact gap and contact pressure of main and auxiliary contacts bedding	-	-	*	*	*
Check tip of the main contact	-	-	-	-	*
Check for shunt condition and tightness	-	*	*	*	*
Smear main contacts with Vaseline	-	-	*	*	*
Lubricate servo motor drum bearing. Smear cam with Vaseline and check free movement	-	-	*	*	*

DESCRIPTION	IA	IB	IC	AOH	IOH
Replace piston cup	-	-	-	*	*
Check piston wear and lubrication of cylinder wall	-	-	-	*	*
Replace piston packing if necessary.	-	-	-	-	*
Check condition of fixed and mobile contact	*	*	*	*	*
Check condition of rubber bucket.	-	*	*	*	*
Check proper operation of J/CTF	*	*	*	*	*
Check all dowel pins condition for breakage	-	-	*	*	*
Check healthiness of 'U' fork fixing screw and replace if worn	-	-	*	*	*
Check condition of rivets meant for fixing of end bush flange.	-	-	*	*	*
Tighten all nut and bolts of auxiliary switch	-	-	-	*	*
Check overshooting manually	-	-	*	*	*
Aralditing of allen screw of contacts	-	-	-	*	*
Overhaul CTF	-	-	-	-	*

DESCRIPTION	IA	IB	IC	AOH	IOH
ATFEX					
Check tightness of connections	-	*	*	*	*
Clean through side cover	-	-	*	*	*
Check for overheating marks	-	-	*	*	*
Check visually for base crackness	*	*	*	*	*
Remove bottom cover and blow dust with dry compressed air.	-	-	*	*	*
DYNAMIC BRAKE RESISTOR (RF)					
Visually check from top and bottom for any abnormality	-	-	*	*	*
Check tightness of nuts bolts and screws.	-	-	*	*	*
Blowout resistor bank with dry compressed air or suck by vacuum cleaner	-	-	*	*	*
Inspect resistances for any damage	-	-	*	*	*
Repair defective DBR	*	*	*	*	*
Examine insulators and supports and wipe with a clean dry cloth	-	-	*	*	*
Check operation of QVRF by sucking air through connecting pipe	-	-	*	*	*
Check for de-lamination/burning of Mica insulation boards. Replace if damaged	-	-	*	*	*
Cleaning of insulation surfaces to avoid tracking and flash-overs.	-	-	*	*	*
Overhaul RF	-	-	-	-	*

2.2 AOH/IOH SCHEDULE

2.2.1 Dismantling of DBR

Following sequence should be followed while dismantling the DBR unit from locomotive.

1. First open the hood of loco below which DBR unit is fitted to the under frame.

2. Unscrew the bolts from DBR base to loco floor.

3. Open the power cables and secure them properly before lifting.

4. Put lifting brackets on the top of the DBR unit and lift by crane. Ensure that outer portal should not damage while lifting the DBR unit.

5. Take out front and back cover.

6. Dismantle the busbar connection from front and backside.

Figure 2.1 DBR Unit

7. First open lock nuts then push from front and backside simultaneously.

8. Remove insulation plate from front side and carefully takeout the resistor grids and stack them on clean surface. Mark the top tray elements separately as they have different resistance value to the elements of other trays.

2.2.2 Examination and Cleaning of Components and Resistor Elements

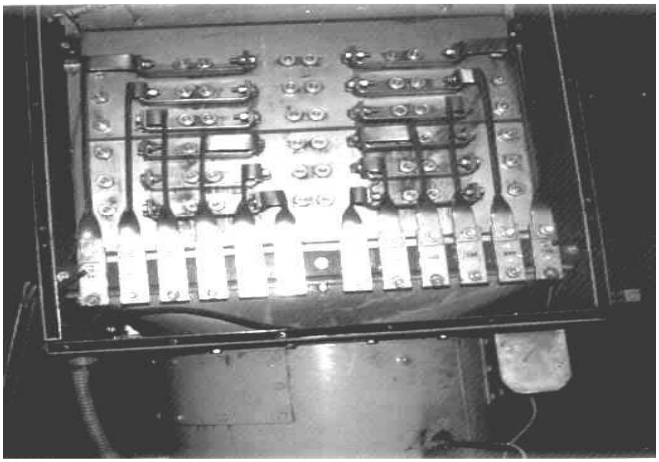


Figure 2.2 Resistor Box Board

1. Resistor box boards (silicon bonded mica boards) should be cleaned to remove any deposits with a soft cloth.

2. Check resistor box boards for de-coloration, de-gradation or de-lamination and for any damage.

3. Replace damaged or burned boards.

4. Electrically intact resistor banks should be cleaned to remove dirt and dust. If required same should be washed with forced water jet to remove sticky particles and to be dried.

5. Ensure that element in resistor banks should be free from any deformation (caused by overheating), broken ceramics and sagging of grids in the centre of the resistor banks.

6. Ensure QVRF relay operation provided at suction side.

2.2.3 **Assembly of DBR Unit**

Following sequence to be followed during assembly of DBR units.

1. Check for any cracks or damage of insulation plates before re-assembly.

2. Arrange the resistor elements in line as per drawing.

3. Put four elements of bottom (last) tray and push slowly the insulation plate with the help of bush. Follow this sequence up to top tray.

4. Lock the bush with the help of lock nut.

5. Connect busbar connections as per drawing.

6. Before putting resistor bank on the top of blower, ensure that impeller is moving freely and blower motor is covered with side cover.

7. After complete assembly, apply suitable sealant to fill gaps on resistor box and on motor inspection cover.

2.2.4 **Dismantling of MVRF**

Before dismantling, the motor frame should be supported on a suitable cradle. Now dismantle fan, end shields, bearing caps etc. as following and mark them to ensure re-assembly in the same condition.

2.2.4.1 **Removal of fan and guide vane**

- Remove the split pin and lock nut from the shaft in the recess in the fan hub.
- Withdraw the fan from taper shaft using an extractor, which engages with the internal threads in the fan hub.
- Remove guide vane by unscrewing hex. head screws.

Figure 2.3 Fan Assembly

2.2.4.2 **Removal of motor from housing**

- Remove the air duct assembly by unscrewing the hex. screws from the housing.
- Unscrew the M20 hex bolts and lift the motor from the top.

2.2.4.3 **Removal of end shields, armature and bearings**

- Unscrew hex. head bearing cap screws and remove the bearing caps.
- Disconnect the brush gear leads and lift the brushes to clear of the commutator.
- Release end shield by removing countersunk screws.
- Withdraw the armature through either end. Care should be taken not to damage commutator windings or core.
- Remove lock nuts from shaft for unscrewing bearings.
- Pull out the bearings by using an extractor.

2.2.5 **Overhauling of MVRF**

2.2.5.1 **Armature**

1. Check armature for damaged or loose bands and coils, commutator for mica grooves etc.
2. All disassembled parts of the machine should be thoroughly cleaned by following-
    a. Dry compressed air/ vacuum cleaner
    b. Any cleaning solvent like ORION-77
3. After ensuring that armature does not require any major repair, recondition it.
4. Preheat armature at 120-130^0 C for 6 hours; dip the insulated portion of armature in F2005/500EK varnish and post cure at 140-160^{0}C for 8 hours.

2.2.5.2 **Commutator**

1. Carry out the pressure check.

2. Turn the commutator if required following the specified procedure. Blow out the complete armature for removal of copper and mica dust.

3. Paint the commutator neck groove with epoxy red anti-tracking paint.

4. Clean "V" ring on the front of commutator.

5. Check conduct bar to bar test and record HV drop pattern.

6. Examine the inner and outer race for bearing and their components.

2.2.5.3 **Brush gear**

1. Check brush gear components for blisters and damages.

2. Check brush holder spring tension.

3. Check brush holder insulated arms. If they appear to be good, subject them to 2 kV AC for 15 seconds. Apply one coat of red anti-tracking paint and dry.

4. Provide new carbon brushes.

2.2.5.4 **Field coil and connections**

1. Check the field coils and connections for any loose joints.
2. Check field coils and washer for any signs of overheating and ensure the field coils are sound.
3. Check and tighten all field connections and main pole bolted joints.
4. Check and record the IR of all the field coil to earth. If found satisfactory, subject the magnet frame complete with field coils to heating and check hot IR.
5. Replace defective coil if any using proper shim. Make all filed connections as per diagram.
6. With frame still hot, apply one coat of solventless polyester varnish. Allow varnish to cure.
7. Conduct polarity test for shunt coils and main field coil.

2.2.6 **Re-assembly of MVRF**

Re-assembly should be done in the reserve order of dismantling by following the points given below:

1. All the shims and packing pieces should be restored to the original position.
2. The pole spacing should be checked to ensure that the gaps between the pole tips are equal, tolerance ±0.8 mm.

3. All bolted connections should be tightened and where necessary leads should be taped together to prevent undue movement.
4. Keep the bearings absolutely clean.
5. New bearings should not be removed from wrapping until required for use.
6. Bearing caps should be filled approximately two thirds full of grease.
7. Grease should be pressed into the bearing to fill the space between the races.
8. The bearing seating on the shaft should be free of all dirt etc.
9. Ensure that the bearing is seated accurately on the shaft.
10. Finally secure the bearings and lock in position.
11. Clearance between the brushes should be equally spaced, tolerance ±0.8 mm.
12. Now lower the complete motor vertically in the housing and assemble by providing M20 bolts and spring washers.
13. Turn the motor along with housing upside down and assemble the impeller.
14. Balance the impeller in position by portable balancer.
15. Assemble air duct on the top of the motor.

2.3 INSTALLATION INSTRUCTIONS

Lifting eyes are provided on top of the unit for handling by overhead crane but small "D" shackles must be fitted to ensure crane hooks do not damage outlet portal.

Before any attempt is made to supply power to the resistor unit, the following criteria must be satisfied.

1. The DBR must be perfectly located and fitted.
2. It is imperative that the air intake area is free from foreign bodies. Ensure that the wire mesh guard is provided at the fixing location i.e. mesh welded in the inlet cone.
3. QVRF relay is provided at the bottom of resistor box and connected to the suction nipple with proper size of rubber hose.

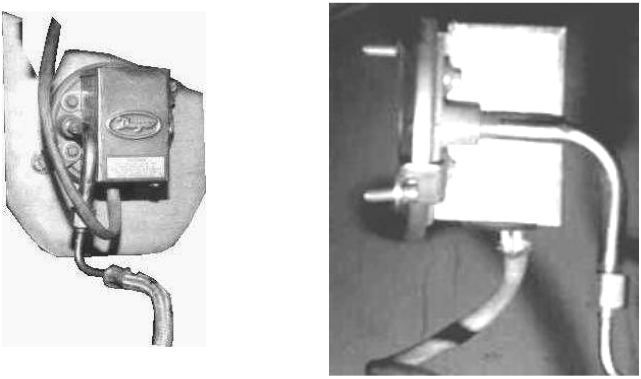


Figure 2.4 Protection Device

4. Follow the instructions contained in RDSO's TC No. 0072 regarding QVRF relay connection.

5. MVRF connections are directly taken to resistor terminals of top tray and connected.

6. Fan unit grease relief plug allen screws should be removed and discarded on completion of installation.

7. Ensure all power connections are correct and polarity observed. Cables are terminated on main terminals bar.

8. Ensure airflow device is wired to the control circuit, which will disconnect DBR in the event of loss of airflow. Connect the wires of over temperature control device if any to the respective circuit.

9. The airflow must be through the resistor and out from top of the resistor box (opening in the loco roof).

CHAPTER 3

COMMON PROBLEMS, CAUSES AND REMEDIES

3.1 TROUBLE SHOOTING FOR BLOWER MOTOR

PROBLEM	CAUSES	REMEDY
Motor does not start	Open circuit	Check the location of open circuit. Reconnect connections if any lead or cable is broken. In case of winding open circuit, replace the motor.
	Incorrect connections	Correct connections
	Undue overloading (locked rotor condition)	Check the driven equipment.
In correct motor speed	Incorrect connections	Correct connections as per drawings.
Low insulation resistance, earth fault.	Damaged insulation. Dirty windings. Decay in insulation	Attend/repair.

PROBLEM	CAUSES	REMEDY
Bad commutation or sparks at the brushes	Incorrect brush position	Rest the brush in correct position.
	Worn out brushes	Change the brushes of specified quality.
	Uneven bedding of brush	Bed the brushes properly.
	Brushes do not slide freely in the brush holder.	Make brushes to slide freely.
	Brush pressure too low	Replace the brush spring.
	Brush pressure high	Adjust pressure
Noisy bearing	Bearing damaged/dry.	Change bearings
Motor too hot.	Inadequate ventilation	Check the cooling
	Short circuit of field windings.	Replace the motor.

3.2 **DO'S**

1. Ensure air intake area should be free from foreign bodies.
2. Ensure all power connections are intact.
3. Lifting hooks to be removed from top after fixing DBR unit on to the loco and same to be fixed on bottom portion of the resistor bank.
4. Mesh guard fixed at the bottom portion of the DBR unit to be removed before fitting DBR unit on the loco.
5. Provide 10mm thick Neoprene gasket over the fixing holes of loco floor.
6. Power to resistor must be removed immediately in the event of over temperature or airflow failure.
7. Assembly/repair is to be done by technically qualified and skilled person.
8. Restrict overloading of resistor elements.
9. Ensure current carrying capacity and voltage grade of control and power cables.
10. Ensure working of QVRF (on DBR), QF and QE relays.
11. Ensure regular calibration of QF & QE relays. Cable resistance also to be taken into account.
12. Check insulation resistance of motor before putting into operation after overhaul or repair.

13. Ensure proper flow of cooling air. Ventilation openings must be clean and unobstructed.
14. Ensure implementation of MSs, SMIs & TCs issued by RDSO.
15. Use vacuum cleaner for cleaning of carbon dust, inside the motor instead of blowing by dry compressed air.
16. Ensure provision of CTF N/O interlock in MVRF circuit on positive side.

3.3 **DON'TS**

1. Don't disturb OVRF settings.
   Set value -12^{+0}_{-2} mmWC
2. Don't clean with hard wire brush or file.
3. Don't apply any resin or varnish on boards of DBR.
4. Don't reuse lock washers, oil seals and felt packing. Replace them with new ones.
5. Don't do any modification without approval of competent authority.
6. Don't by pass protection devices provided in DBR circuit.
7. Don't mix up elements of top tray to the elements of other trays.
8. Don't use dynamic brake, if any of the traction motor is isolated, working on ECC, MVRF not working and relay Q50 is wedged.
9. Don't operate SA9 under any circumstances while working DBR.

ANNEXURE - A

LIST OF MSs, SMIs AND TCs

S.N	TITLE	MS/SMI/TC NOS.
1.	Testing of solenoids	RDSO/ELRS /SMI/ 59 dated 12.12.79
2.	Method for screening out coils having manufacturing defects	RDSO/ELRS /SMI/ 69 dated 31.7.80
3.	Alteration of connections in DBR of BHEL make	RDSO/WAG5/2 dated 7.11.89
4.	Condition monitoring of solenoids by surge comparison method	RDSO/ELRS /SMI/ 157 dated 10.7.93
5.	Modified arrangement of air inlet wire mesh to be fitted on to the under frame below BHEL make DBR having horizontally mounted blower motor	RDSO/WAG5/9 dated 31.3.93
6.	Provision of visual indication of the functioning of the blower motor in EATOM make dynamic braking equipment	RDSO/WAG5/14 dated 26.4.94
7.	Replacement of grease bearing by sealed bearing on non driving end of blower motor of EATOM make DBR	RDSO/WAG5/20 dated 5.2.96
8.	Only train brakes are permitted in conjunction with DBR.	RDSO/WAG5/21

S.N	TITLE	MS/SMI/TC NOS.
9.	Duct extension and air inlet cone arrangement in locomotive fitted with high capacity DBRs	RDSO/WAG5/26 dated 19.1.98
10.	Modification in the DBR control circuit to prevent opening of C-145 contactor with snap action and thus to avoid jerk in case of DBR cut-off.	RDSO/ ELRS/ MS/ 026 dated 30. 06. 99
11.	Optimisation of performance of vertical dynamic brake resistance	RDSO/ELRS/TC / 0072-2001 (Rev0) dated 3.10.01
12.	Provision of vertical DBR on WAP1/ WAP4 (non modular locomotives)	RDSO/ELRS/MS/ 0315 dated 9.8.02
13.	Modification of QRS relay feeding circuit to prevent its de-energisation during blending of air brakes through A9	RDSO/WAG5/32
14.	Modification in MVRF circuit of non modular WAG7 locomotives	RDSO/ ELRS/ MS/ 0317

ANNEXURE - B

REFERENCES

1. Maintenance manual of CLW for WAG5 locomotives.

2. CLW specification No. CLW/ES/R-29 Alt. - L for rheostatic braking resistors.

3. Maintenance Schedules issued from Central Railway and ELS/BZA.

4. Suggestions given by various sheds during visit as well as during seminar.

5. Maintenance literature provided by various manufacturers.

6. Papers presented by participants during seminar held at CAMTECH on date 28. 10. 2002

*****