PNEUMATIC

Preface

In sub-urban EMU/MEMU services role of the pneumatic equipments are vital as their effective and reliable operations are very much needed even for energisation of the coach and throughout in service. Since, vital equipments like circuit breaker, various EP contactors and relays, safe and trouble-free operation of air brake system are being controlled pneumatically hence a thorough knowledge of pneumatic circuit and study of associated troubles with their remedies are essential to ensure quality maintenance of EMUs/MEMUs.

Advantage of Air Brake Systems

- Quick & simultaneous application and release throughout the train.
- The self-lapping feature provides step-less control of the braking effort to any desired degree, thus enabling accurate stoppage of the train.
- High values of retardation, essential for a fast suburban service with a large no. of stops is possible by this system of braking.

All BG EMU/MEMU stocks have been provided with self lapping electro-pneumatic combined with automatic compressed air brakes. Two makes of braking equipments are in use viz. Westinghouse & Knorr-Bremese (presently Escorts). Though the details of equipments differ appreciably but both the systems are quite similar in principle.

Types of Brake in EMU/MEMU

- Electro-pneumatic (EP) brake.
- Auto brake.
- Driver's emergency brake.
- Guard's emergency brake.
- Dead-man brake.
- Hand brake in conventional EMUs.
- Parking brake in MEMUs and EMUs fitted with air spring.

Main Components of the Brake System

- A main reservoir system consisting of a main compressor in each Motor coach feeding into main reservoirs on Motor coaches & supplementary reservoirs on Trailer coaches interconnected from end to end of the train by a main reservoir (MR) pipe with flexible couplings in between the coaches. The MR pressure is maintained between 6 to 7 kg/cm^2 by means of pressure governor (MCP Governor) controlling each compressor. All the main compressors in a train are synchronized to start & stop together.
- A brake pipe (BP) from end to end of the train with flexible interconnections between coaches. The pressure in this pipe is maintained at 5 kg/cm^2 to keep the automatic brakes released.
- A brake unit in each coach consisting of the controlling valves for control of EP & Auto brakes.
- The brake cylinders on each bogie with automatic slack-adjusters and associated brake rigging. Usually the number of brake cylinders is 4 per bogie on Motor coaches

& 2 per bogie on Trailer coaches. However the number of brake cylinder is 4 in motor and trailer coach bogies fitted with air spring arrangement.

- A brake controller in each driving cab. The controller in the driving cab is being made operative by means of an "isolating valve switch" operated by the driver's Brake Isolating Key.
- A brake application relay in each driving cab. The one in the operative cab responding to the operation of the brake controller to control the supply to the brake control train wires carried along with the other control wires through inter-vehicular jumpers/couplers.
- Five train wires, viz. EP supply wire, brake application wire, brake holding wire, brake application indication wire & EP return wire.
- A pilot valve & emergency valve to operate the brakes if the dead-man's device is released.
- Isolating cocks, pressure gauges, pressure governors & control switches.
- Release valve with pull chain for manual release of brakes in each coach.

Different Isolating Cocks

The isolating cocks are provided in the different areas of pneumatic pipe lines to facilitate the isolation of a particular circuit or equipment whenever required. When the handle of the isolating cock is parallel to the pipe line it indicates the cock is opened to air supply & when the handle is at 90^0, the cock is closed to air supply. Various isolating cocks are:

i) CIC – Compressor isolating cock to stop air supply from the main compressor.

ii) BIC – Bogie isolating cock to stop air supply to the brake cylinder of a particular bogie. Each bogie is having an individual isolating cock.

iii) EPIC – EP unit isolating cock to stop air supply to the EP unit of a particular coach.

iv) ICA – Isolating cock for auto brake to isolate auto brake of a particular coach.

v) MR Isolating Cock – Provided at both end of each coach for cutout MR pressure supply to a particular coach whenever required.

vi) BP Isolating Cock – Provided at both end of each coach for cutout BP pressure supply to a particular coach whenever required.

vii) Horn Isolating Cock – Provided in driving cab to stop air supply to the horn circuit.

viii) Dead-man Isolating Cock - To stop air supply to the dead-man valve & is provided on BP pipe line below driving cab.

ix) Isolating Cock for Control circuit - To stop air supply to the pneumatic control circuit of tap-changer and switch group & is provided in HT compartment. Generally this cock is known as control cock.

x) Panto Isolating cock - To stop air supply to the Panto circuit.

xi) Air dryer isolating cock – To stop air supply to the air dryer in case of air leakage/non- functioning of air dryer. There are three cocks viz. 'A', 'B' & 'C'. In normal condition, cock 'A' & 'B' are to be kept open and cock 'C' will remain closed. In case of isolation of air dryer, cock 'C' is to be made open and cock 'A' & 'B' are to be made isolated.

xii) Parking brake isolating cock with vent hole (located in driving cab/LT compartment where parking brake is provided) - To stop air supply to the parking brake and release the air from parking brake cylinder. Thus parking brake needs to be uncoupled mechnically when parking brake is isolated since parking brake gets applied when there is no air in the parking brake cylinder.
In new EMU rakes parking brake isolating cock is provided in each bogie.

xiii) Parking brake magnet valve by-pass cock (where parking brake is provided) - Normally the cock will remain in isolated condition. In case of failure of parking brake magnet valve, the cock is to be made open so that MR pressure will directly go to the parking brake cylinder by-passing the magnet valve. The cock is located in LT compartment/driving cab.
In modified parking brake arrangement, Rotex make magnet valve is provided which is having two push button, application & release. Therefore by-pass arrangement is not required in the coaches provided with modified parking brake arrangement.

Following isolating cocks are provided in newly supplied coaches provided with air spring:

i) Air spring isolating cock (ASIC) – To stop air supply to the Air spring in entire coach.
ii) Air Spring bogie isolating cock (ASBIC)- To stop air supply to the Air spring in each bogie.

Drain Cock

In the pneumatic system the hot compressed air delivered from compressor carries moisture particles which in turn get accumulated in the reservoirs & dust-collectors and pipe lines. It is essential to drain the accumulated water periodically to improve the reliability of pneumatic equipments. To facilitate periodical draining, drain cock is provided in main reservoir, supplementary reservoir, horn reservoir, panto reservoir, ABB reservoir & centrifugal dust collectors. The drain cock handle when remain parallel to the pipe line indicates cock is closed & when the handle is at 90^0 indicates cock is open for draining.

Different Air Reservoirs

Main Reservoir : It is located in the under-frame of the Motor coach. Compressed air created by the main compressor is stored in main reservoir & is called MR pressure. During EP brake application, compressed air is fed to the brake cylinder from main reservoir through EP unit. The main reservoirs are fitted with drain cocks for draining off the condensate.

Supplementary Reservoir: Each Trailer coach is provided with two supplementary reservoirs connected in parallel and located at under-frame. These reservoirs are connected with the main reservoir of Motor coach meant for storing the compressed air. During EP brake application, compressed air is fed to the brake cylinder from supplementary reservoir through EP unit.

Auxiliary Reservoir : This reservoir is a part of brake circuit and is connected to brake pipe through triple valve of EP unit & remains charged at a pressure of 5 kg/cm^2 when the brakes are released. During auto brake application, compressed air is fed to the brake cylinder from auxiliary reservoir through EP unit.

Equalizing Reservoir : This reservoir is located in the underneath of driving cab and connected with equalizing discharge valve through isolating valve switch of brake controller & contains compressed air at a pressure of 5 kg/cm^2.

Horn Reservoir : It is located in the under-frame below the driving cab & is connected to the MR pipe line. Requisite compressed air supply needed for horn sounding is made available by this reservoir.

Control & Panto Reservoir: These two reservoirs are provided in HT compartment. Control reservoir is provided for supplying compressed air to the tap changer & switch groups. Panto reservoir is provided for supplying compressed air to the Servo motor of pantograph and ABB.

Different types of Governors:

i) **ACP (Aux. compressor) governor**: This is located at HT compartment and controls the working of aux. compressor. The governor is set at 5.2 kg/cm^2 (cut in) / 6.7 kg/cm^2 (cut out). There is a bypass switch (located in driving cab) in parallel with this governor. This is a normally closed type governor i.e. after building up of requisite pressure it's inter lock opens to switch off the ACP.

ii) **MCP (main compressor) governor**: This is located at HT compartment and controls the working of main compressor. The governor is set at 6 kg/cm^2 (cut in) /7 kg/cm^2 (cut out). There is a bypass switch (located in driving cab) in parallel with this governor. This is a normally closed type governor i.e. after building up of requisite MR pressure it's inter lock opens to switch off MCP.

iii) **ABB governor**: This is located at HT compartment and prevents the closing of ABB in low pressure. The governor is set at 4.5 kg/cm^2 (cut out) & 5.2 kg/cm^2 (cut in). This is a normally open type governor i.e. after building up requisite pressure its inter-lock gets closed.

iv) **CONTROL governor**: It is provided in driving cab on BP pipe line to prevent the closing of Motor contactors till BP line is charged. This governor is set at 3.2 kg/cm^2 (cut-out)/4.2kg/cm^2 (cut-in) and is having a bypass switch located in driving cab. This is a normally open type governor i.e. after building up requisite pressure its inter-lock gets closed.

v) **Equipment governor:** It is connected to incoming pipe line of tap changer and switch groups to prevent closing of EP contactor at low pressure and is located in HT compartment. This governor is set at 3.2kg/cm^2 (cut-out)/4.2kg/cm^2 (cut-in) and is having a bypass switch located in driving cab). This is a normally open type governor i.e. after building up requisite pressure its inter-lock gets closed.

vi) **Parking Brake governor:** This is provided in newly received motor coaches and MEMUs in which provision of parking brake is made. It prevents closing of motor contactors and extends feed to indication lamp if parking brake is in applied condition. This governor is set at 3kg/cm^2 (cut in) and 2kg/cm^2 (cut out).

DIFFERENT SAFETY VALVES:

The safety valves are provided in pneumatic circuit to protect the related circuit from building up of excessive pressure in the system.

ACP Safety Valve: This is provided in control circuit and located in HT compartment. The safety valve is set at 7.75kg/cm^2

MCP Safety Valve: This is provided in main compressor pipe line and is set at 7.75kg/cm^2.

LP (Low pressure) Safety Valve: This is provided in LP delivery of main compressor and is set at 3.5kg/cm^2.

Brake cylinder Safety Valve: This is provided in EP unit of each motor coach and trailer coach and is set at 2.7kg/cm^2 (for M/coach) and 3.5kg/cm^2 (for T/coach)

Pneumatic Ckt. of Motor Coach.

Auxiliary compressor and its associated pipe line in HT compartment is responsible for creating air pressure initially to raise the pantograph, closing of ABB and operating the EP contactors. The ACP will cut off automatically at 6.7kg/cm^2 pressure through ACP governor. The governor can be bypassed by a switch called ACP bypass switch. A safety valve is provided which acts whenever air pressure rises beyond 7.75kg/cm^2. Air produced by ACP is being stored in three reservoirs, called control reservoir, panto & ABB reservoir.

The pressure required to raise the pantograph and to keep it in raised condition, is fed to servomotor from panto reservoir through panto operating valve and throttle valve. A panto isolating cock is provided before panto operating valve to isolate the concerned pneumatic circuit whenever necessary. The raising and lowering of pantograph is controlled by means of two latch type operating valves (called raising valve and lowering valve) which are operated from driving cab through BL switch, fed from 110V DC supply. The minimum air pressure required to raise the pantograph is 4.5kg/cm^2 and it starts lowering when pressure drops below 3.5kg/cm^2. The throttle valve regulates the raising time (6to10seconds) and the lowering time (10seconds) of pantograph.

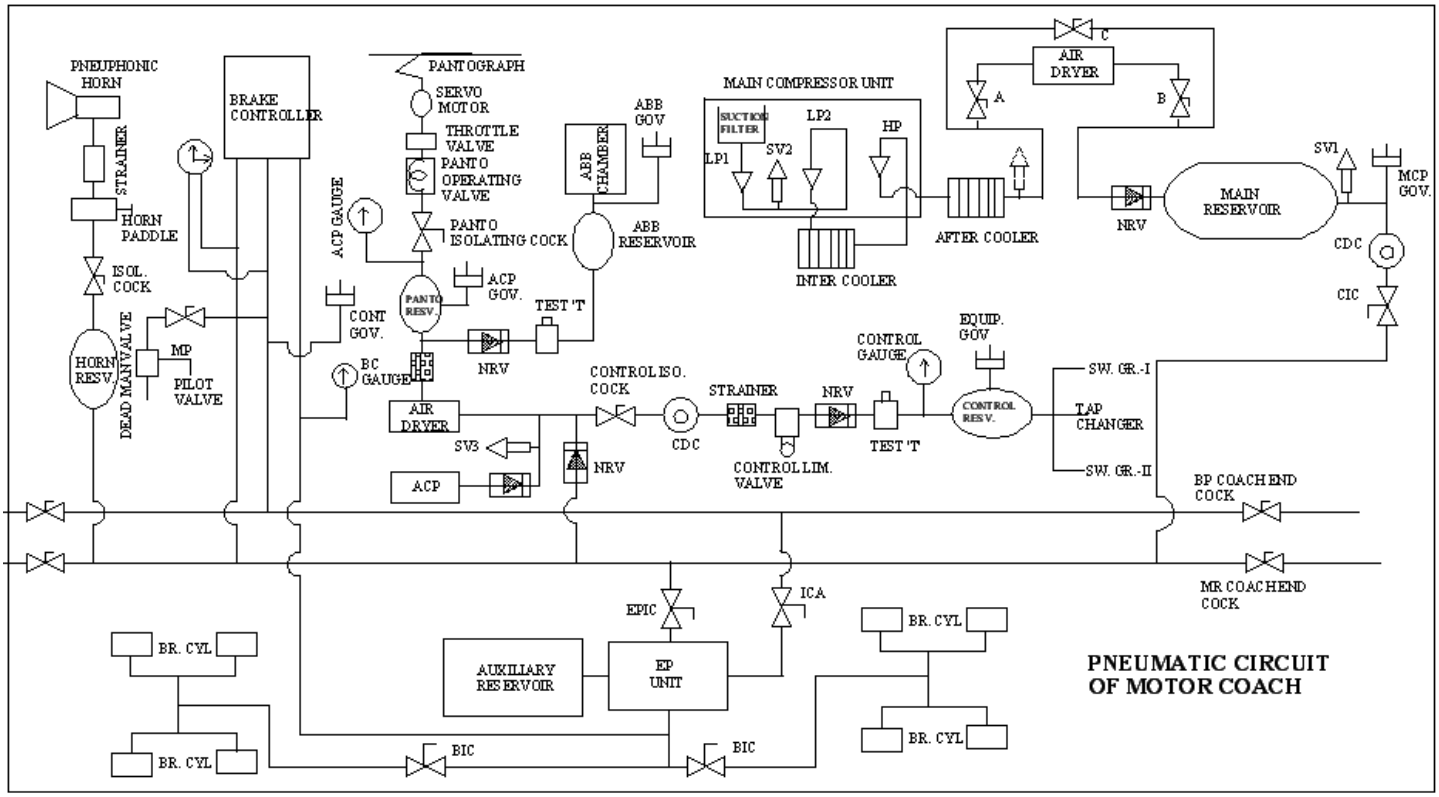
The required air pressure for closing the circuit breaker goes from ABB reservoir. The ABB reservoir is fed from ACP through a non-return valve for protection against any loss of pressure in its preceding circuit. A pressure switch called ABB governor is connected with ABB reservoir to prevent the closing of ABB in low pressure.

The pressure required for operation of EP contactors (in tap-changer and switch group cubicle) is fed from control reservoir. This reservoir is initially fed from ACP through a limiting valve which reduces the pressure to 5kg/cm^2. An isolating cock (named control cock) is provided before control limiting valve to isolate the control circuit whenever necessary. A pressure switch called Equipment governor is provided in control reservoir pipe line after the limiting valve which prevents the closing of EP contactors at less air pressure to avoid unwanted flashing and welding of the contactors.

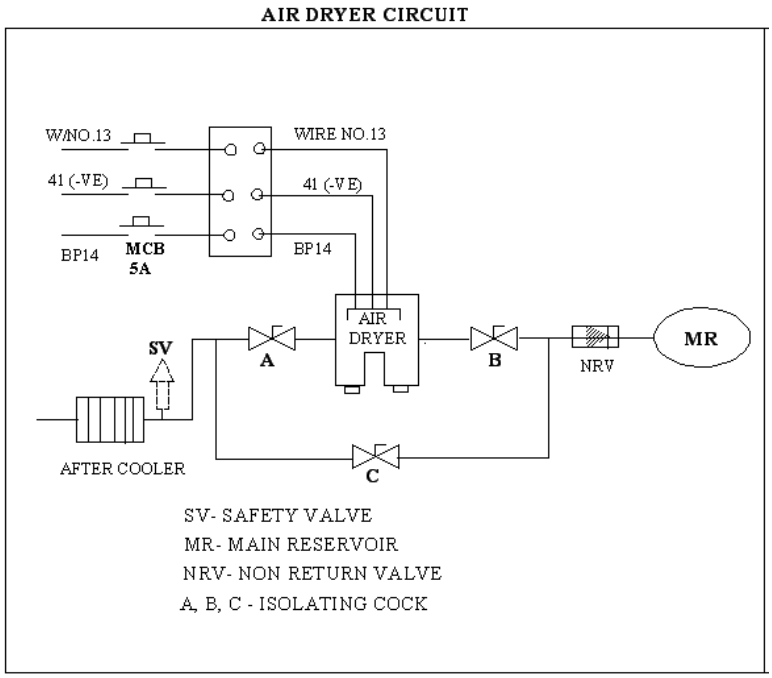
The pneumatic circuit in HT compartment is interconnected with the main reservoir air supply through a non-return valve so that once coach is energized and MCP starts working, ACP will not work further. Thus the whole pneumatic circuit is being fed from main compressor.

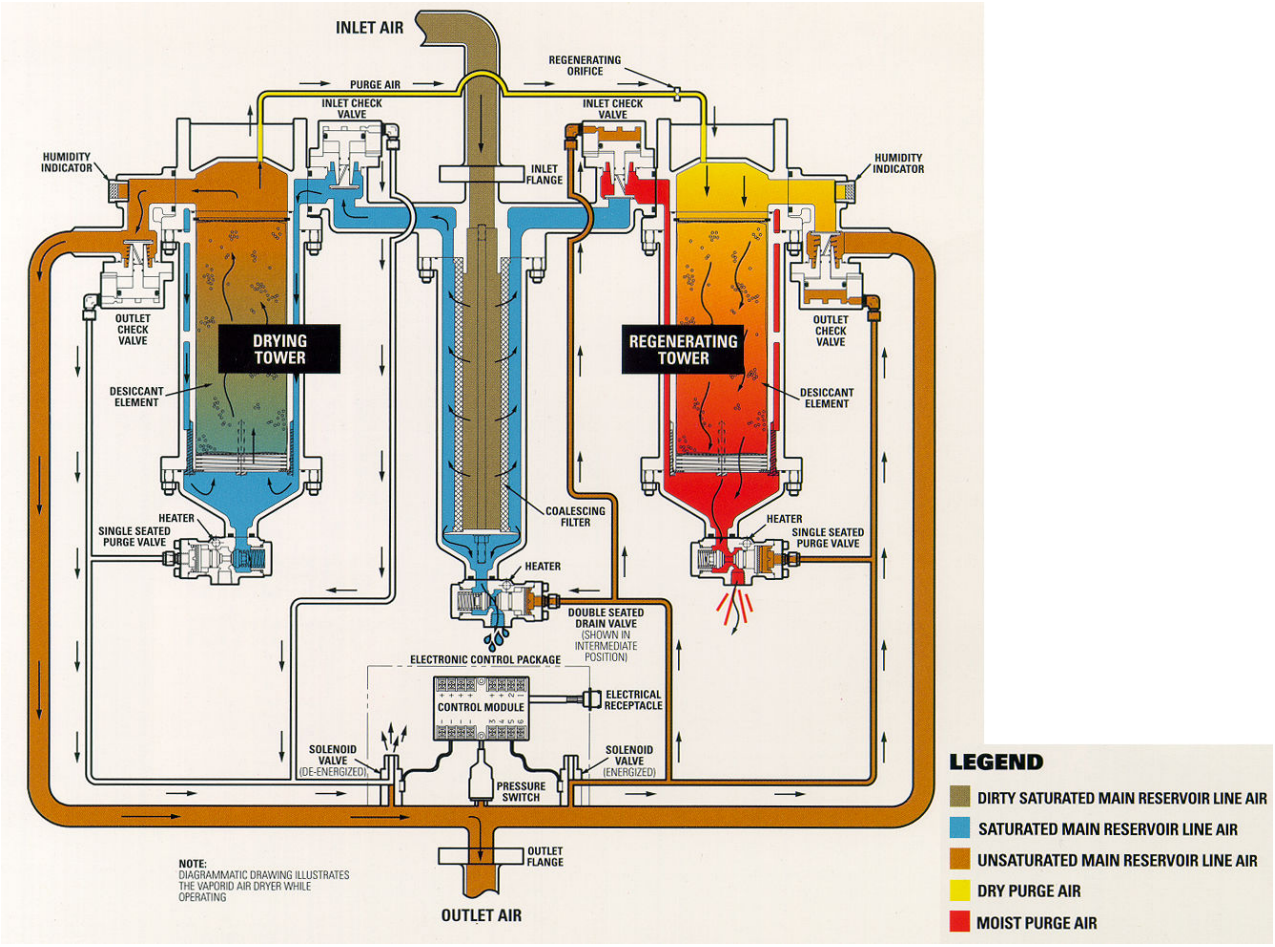
MCP is a horizontal three cylinders, two stage, pipe ventilated and flood-proofed machine of light weight construction, directly driven through an extended crank shaft by an integral electric motor. MCP sucks atmospheric air through oil bath suction filter, compresses it to a pressure of about 3kg/cm^2 in low pressure (LP) stage. This hot

compressed air passes through inter cooler where it gets cooled and then enters the high pressure (HP) suction side. In HP stage of the MCP, the air is finally compressed to a pressure of 6 to7 kg/cm^2 and passes through after cooler and finally gets delivered into main reservoir through a non-return valve.



Twin tower heatless regenerative type Air dryer is provided in EMUs/MEMUs to ensure supply of clean & dry air and does not allow any condensation of the moisture in the system for trouble free operation of electro-pneumatic and pneumatic equipments. It is light weight (not exceeding 100 Kg.) equipment, mounted in under frame on compressor delivery pipe line. The air dryer is capable to work at nominal MR pressure between 6-8 Kg./ cm^2 in EMUs/MEMUs.





Importance of an Air dryer in Pneumatic Circuit:

Moisture in a compressed air system can corrode air pipe lines and equipments, wash away equipment lubrication, decrease reservoir volumes. Moisture & oil may disturb specified timing of air brake valves. Moisture & oil may also cause damage to the rubber components of air brake valves & other equipments.

Major components of air dryer:

1. Coalescing filter assembly
2. Drain valve
3. Desiccant housing
4. Purge valve
5. Humidity indicator
6. Electronic control module
7. Solenoid valve
8. Pressure switch

Coalescing filter assembly functions to remove volume moisture, oil aerosols and debris from compressed air before entering desiccant element.

Drain valve is pneumatically operated & piloted by air furnished by solenoid valve. It is a double seated valve which operates to exhaust the coalescing filter housing air upon each cycle of the dryer.

Desiccant housing contents desiccant element with cap screw. **Desiccant element** is cylindrical shaped nylon felt bag, approximately 11" L X 4" dia. Each bag contains just less than 5 pound of air brake quality molecular sieve desiccant.

Purge valve is located at the bottom of the desiccant tower. The purge valve acts to direct the volume in the desiccant tower to atmosphere by tenderization of solenoid valve.

Humidity indicator is used to determine the operating condition of the dryer. A litmus paper is provided, with the change of its colour condition of the air dryer can be determine as follows:

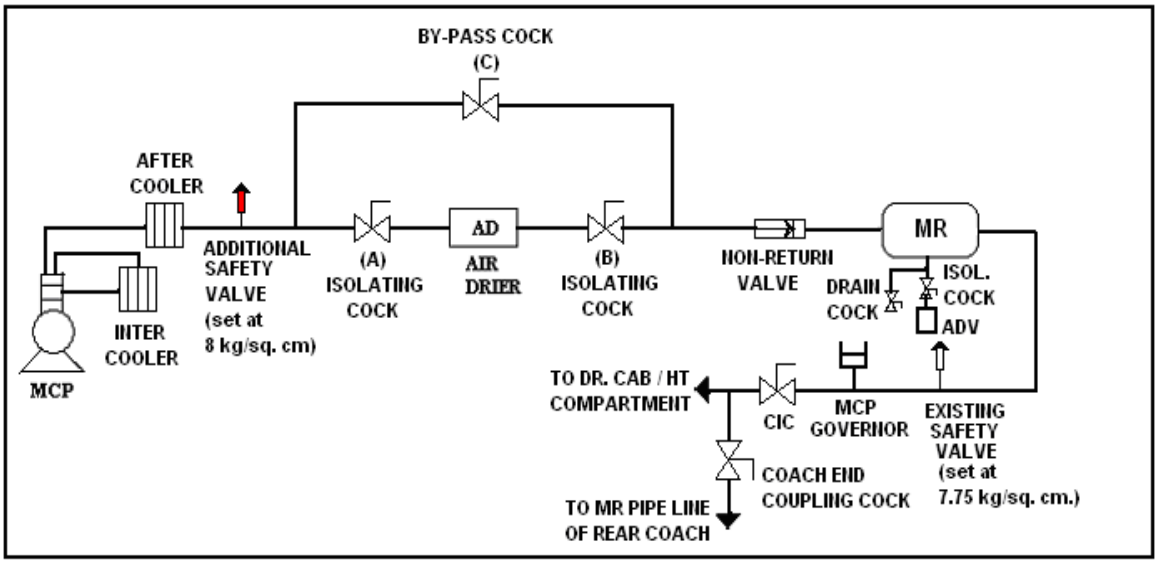
Blue	- Satisfactory
Pink	- Approaching saturation
White	- Saturated
Brown	- Desiccant element is saturated with oil & needs replacement.

Electronic control module alternately energizes & de-energizes the solenoid valve to provide purging & regenerative cycles of the desiccant tower.

Solenoid valve is provided in each side of the dryer for its controlling. One valve is energized at a time. On energization of solenoid valve air is sent to inlet check valve, outlet check valve, purge valve & drain valve.

Pressure switch is the component of electronic controls. It delays the operation of dryer until the main reservoir system pressure reaches to 7 bar.

LAYOUT OF AIR DRIER WITH BY-PASS ARRANGEMENT AND ADDITIONAL SAFETY VALVE



Normally by-pass cock 'C' will remain isolated, cock 'A' & 'B' will remain open. In case of failure of air dryer due to air leakage or non-functioning cock 'C' to be made open to by-pass the air dryer and cock 'A' & 'B' are to be isolated.

In no case cock 'A' or 'B' & 'C' are to be kept isolate simultaneously since it will stop the passage of air flow generated by the compressor and thus air pressure will be excessive high in compressor delivery pipe line between the isolating cocks and

compressor which may cause bursting of after cooler/ inter cooler pipe line. To prevent the same an additional safety valve (set at 8 Kg. /cm^2) has been provided after the air cooler to blow out the excess pressure in the pipe line at said zone.

Inter cooler and After cooler are provided to reduce the temperature of the compressed air. In general, they are lengths of plain pipes and are exposed to a definite flow of external cool air.

The compressed air coming out of main reservoir is called MR pressure and is at a pressure of 7 kg/cm^2. This MR pressure is utilized for feeding following circuit:-

- For feeding entire pneumatic circuit in HT compartment when the motor coach is energized.
- For feeding supplementary reservoirs in trailer coaches and MR reservoir in motor coach required for supplying compressed air to brake cylinders during EP brake application.
- For feeding horn reservoir in driving cab required for horn sounding.
- For feeding entire BP pipe line and its associated reservoirs in the rake through reducing valve in brake controller.

Brake pipe pressure is obtained through reducing valve of Brake Controller which reduces incoming MR pressure to a pressure of 5kg/cm^2. Aux. reservoirs in motor coach and trailer coach are connected to brake pipe through triple valve of EP unit and is maintained at a pressure of 5kg/cm^2. This brake pipe pressure is utilized to supply compressed air to brake cylinder during 'Auto' brake application, Dead-man-brake application, Guard's emergency brake application. During Driver's emergency brake application BP pressure is destroyed to actuate Auto brake application with EP brake simultaneously.
Brake pipe is 1 inch. in diameter and green in colour, whereas MR pipe is ¾ inch in diameter and red in colour.

Pipe line air filters with drain cocks are fitted in the MR pipe at the junctions of the branch pipes leading to the brake controller. The purpose of these filters is to prevent water and possibly other impurities from entering the brake controller.

Duplex pressure gauge and single pressure gauge are mounted near the brake controller in the driver's compartment. The former indicates the pressure in the main air reservoir pipe and in the automatic brake pipe, while the later shows the pressure in the brake cylinder.

Isolating cocks are fitted in the supply pipes leading to the EP brake unit. These isolating cocks may be used in the event of a defect occurring in the EP circuit, to cut off the air supply. Isolating cocks are also provided in the brake cylinder pipe leading to the bogies. In the event of failure of brake in one of the bogies for instance rupture of hose connection, the pipe leading to that bogie can thus be isolated, while the brake in other bogie continues to operate. The passage of brake cylinder pipes from bogie frame to the brake cylinder is connected through rubber hose.

MAIN COMPRESSOR

Presently two types of main compressor are used in EMU/MEMU motor coaches. These are KPC 3HC55 and ELGI TRC 1000 DCM.

Specification of KPC make compressor:

Model	: KPC 3HC 55
Type	: Reciprocating, Air Cooled, Forced Feed Lubricated, Mono-block.
No. of Cylinders	: 3 (LP-2 & HP-1)
No. of Stages	: 2
Nominal Speed	: 1150 rpm.
Swept Volume	: 1560 lts/min.
Free Air Delivered	: 1075 lts/min.
Power Input at 7 kg/cm^2	: 8.5 KW
Sump Capacity	: 6.24 lts. Max. & 3.12 lts. Min.
Recommended Lubricant	: Servo System 68 or Enklo 68.

Specification of ELGI Compressor :

Model	: ELGI TRC 1000 DCM
Type	: Reciprocating, Air Cooled, Forced Feed Lubricated, Mono-block.
No. of Cylinders	: 3 (LP-2 & HP-1)
No. of Stages	: 2
Nominal Speed	: 1160 rpm.
Free Air Delivered	: 1100 lts/min.
Power Input at 7 kg/cm^2	: 9 KW
Sump Capacity	: 6.25 lts. Max. & 3.25 lts. Min.
Recommended Lubricant	: Servo System 68 or Enklo 68.

Specification for Motor for ELGI Compressor:

Model	: 160 EMC/1
Voltage	: 110V DC
Current	: 99A
Output	: 9.12 KW
RPM	: 1160
Weight	: 265 kgs (Approx.)
Make	: Elgi Electric & Industries Ltd., Tamaraikulam Post, Pollachi, Coimbatore- 642 109

Specification for Motor for KPC Compressor:

Model	: To suit 3HC 55 KPC compresor
Voltage	: 10V DC
Current	: 96 A
Output	: 11.38/9.12 KW
RPM	: 1150
Weight	: 245 kgs (Approx.)
Make	: Laxmi Hydraulics Pvt. Ltd.td., 129/130, Indusrial Estate, Patil Nagar, Hotgi Road, Solapur- 413 003 (India).

AUXILIARY COMPRESSOR

COMPRESSOR

Make	: Elgi Festo
Type	: Single cylinder, Reciprocating, Monoblock
Power required	: 1 H.P.
Maximum operating pressure	: 8 kg/cm^2
Piston Displacement	: 150 lpm
Speed at 8kg/cm^2	: 1500 rpm
Crank case lubrication	: 300ml

MOTOR

Make	: Elgi Electic
Type	: Open TYPE, Screen protected
Power Supply	: 110V DC
Current	: 8.5A

BRAKE CONTROLLER

Electro-pneumatic brake controller is installed in the driving cab of the train to control the application and release of both the EP and Automatic brakes. Presently two types of brake controller are used in EMU/MEMU and these are:

- ED-6 type brake controller of Westinghouse make
- Modular brake controllers of Escorts make (Type- ESBC-II, ESBC-III, ESBC-III M).

Each type of brake controller is provided with a controlling handle with following positions:-

- Position I - Release & Running
- Position II - Full service EP
- Position III - LAP
- Position IV - Service Automatic
- Position V - Emergency

Selection of type of brake to be applied is decided by Motorman by keeping the handle in desired position. The EP brake is controlled in between position I and II while the automatic brake in positions I, III and IV. Both EP & Auto brakes are applied in position V (Emergency position).

Main parts of WSF type brake controller:

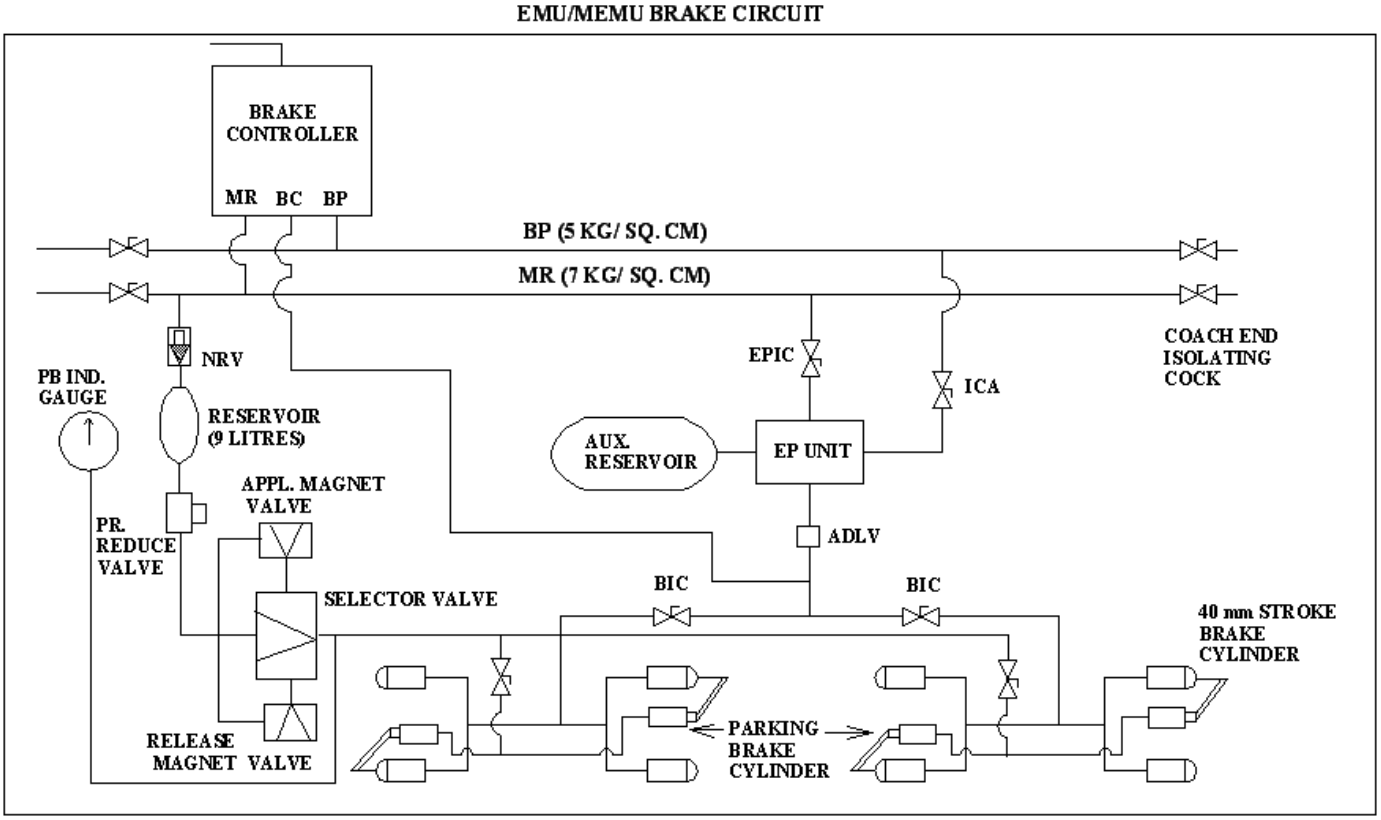
- The brake valve unit
- The reducing valve
- The isolating valve switch

Main parts of Modular brake controller:

- The 'C' bracket
- The Auto valve unit
- Hand operated isolating valve
- MR isolating valve
- Reducing valve

- Equalising Discharge Valve
- BC feedback cylinder isolating valve

In each type of brake controller, above parts are mounted on the controller pipe bracket. Pneumatic connection between the valves and pipe bracket are made through ports in the fixing flanges and bolting faces. The connections are sealed by synthetic gaskets. The external pipe work is permanently connected to the pipe bracket and compressed air is distributed within the controller by passages in the pipe bracket casting.



EP UNIT

Each motor coach and trailer coach in a rake is provided with an EP brake unit, through which, depending on the pre-controlling action of the brake controller, air is admitted to or exhausted from the brake cylinders. This EP unit is connected to the MR pipe as well as to the BP pipe. Centrifugal filters with drain cocks are provided at the junction of branch pipes, for the separation of condensate.
Presently two types of EP units are used namely WSF type and EK (Escorts-Knorr) type EP unit.

Main parts of WSF EP unit

- **Triple valve**- The diaphragm operated triple valve is part of the automatic brake equipments and controls the application and release of the brakes in conjunction with the auxiliary reservoir when the air pressure in the brake pipe varies. This valve consists of:-

  (i) Graduating valve- This valve connects the auxiliary reservoir to BC line when the brake pipe pressure is reduced during auto brake application. After

recharging of BP pipe, when BP pressure and auxiliary reservoir's pressure becomes equal then this valve disconnects the aux. resv. supply to BC line.

(ii) Quick Service valve - This valve connects the brake pipe to the triple valve bulb and causes a local reduction in brake pipe pressure. This decreases the time required for the brake pipe pressure to reduce sufficiently to actuate operation of the triple valve on the next vehicle to the rear, when a similar local brake pipe pressure reduction occurs. The action of successive triple valves in increasing the rate of brake pipe pressure (which was reduced during auto brake application) ensures an even and nearly simultaneous response of the brakes throughout the train.

(iii) Bulb Exhaust valve – Through this valve the brake pipe pressure temporarily stored in triple valve bulb gets exhausted to atmosphere when the triple valve is in release condition. This empty bulb then ensures storing of brake pipe pressure (thus ensuring additional drop in BP pressure) through quick service valve during next auto brake application.

(iv) BC Exhaust valve- This valve closes the exhaust port of BC line to atmosphere during auto valve application and connects the same during release of auto brake.

- **Magnet Valve Unit** (EP portion) consists of:

(i) Holding Magnet valve - During EP brake application this valve closes the BC exhaust port to atmosphere and during release connects BC pipe to atmosphere.

(ii) Application Magnet valve- During EP brake application this valve connects MR line to BC line and thus supplies compressed air to brake cylinder required for brake application

(iii) Application Check valve- This valve retains the compressed air in the brake cylinders while the brake is held at constant pressure with the application magnet valve de-energized.

- **Stabilizing valve**- This valve and its associated bulb ensures that the triple valve is always in the 'Release' position when the EP brake is being used.

- **Limiting valv**e- The maximum brake cylinder pressure which can be obtained during EP service brake application is determined by the setting of the limiting valve.

- **Safety valve**- Safety valve releases any excessive pressure, which may arise in the brake cylinders under abnormal conditions.

Main parts of EK type EP unit:

- **Holding magnet valve**- During EP brake application this valve closes the BC exhaust port to atmosphere and during release connects BC pipe to atmosphere.

- **Application magnet valve** – During EP brake application this valve connects MR line to BC line and thus supplies compressed air to brake cylinder required for brake application.

- **Triple valve** –This valve is responsible for auto brake application and supplies compressed air to brake cylinder by connecting the auxiliary reservoir to BC line when there is a drop in brake pipe pressure.

- **Stabilizing valve**- This valve is used in conjunction with the EP brake. The purpose of this valve is to reduce the pressure in the auxiliary reservoir to about 0.2 kg/cm^2 (3psi) below the pressure reigning in the automatic brake pipe. This reduction is necessary in order to prevent the direct-release triple valve connected to the EP brake unit from being moved out of release position into lap position by pressure fluctuation that may occur. The stabilizing valve reduces the pressure in the auxiliary reservoir by connecting it with a bulb in the valve support. The pressure in the brake cylinder controls this valve.

- **Limiting valve**- The function of the pressure limiting valve is to limit the air pressure in BC pipe line to a specified value (3.2kg/cm^2).

- **Safety valve**- This valve protects the brake cylinder line from over-pressure thus preventing consequent damage on brake-block and wheel.

- **Check valve**- During purely pneumatic application, the check valve prevents the escape of air from the brake cylinders through the exhaust port of holding magnet valve.

Electro-pneumatic (EP) brake:

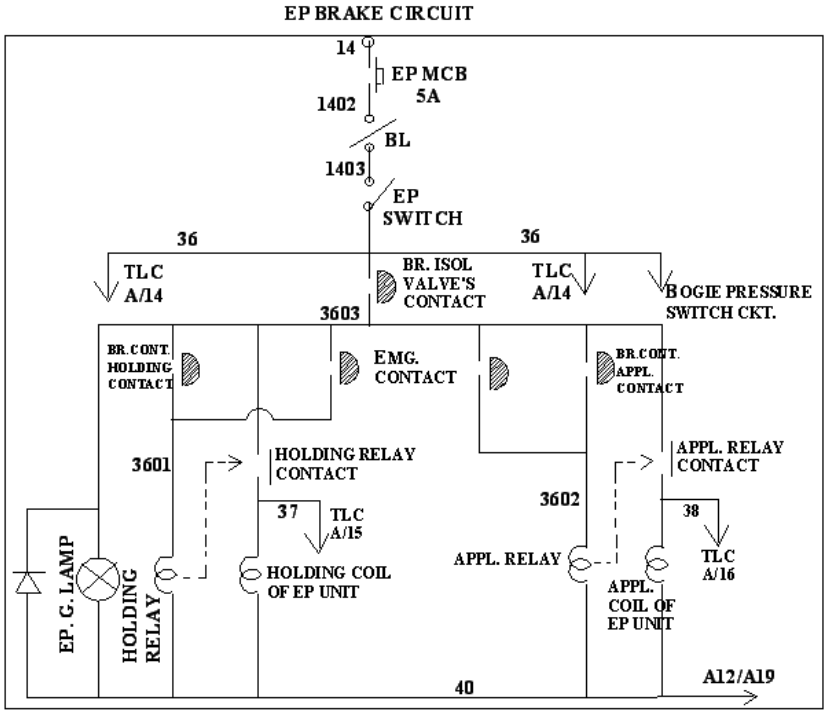
The EP brake is an electrically controlled and pneumatically applied straight air brake which admits compressed air to the brake cylinders under the control of two magnet valves i.e. holding magnet valve and application magnet valve on each coach of the train. It is referred as service brake for EMU.

All the magnet valves and brake controller are connected by train wires (usually with contactors included in the ckt.). Movement of the brake controller handle between position I (Release and Running) and position II (Full EP) connects the holding contact first. This in turn closes the holding contact of EP relay and energizes wire no. 37. As a result holding coil of each EP unit provided in each coach is energized and brake cylinder exhaust port to atmosphere is closed. The system is now ready to hold the pressure. Further movement of the brake controller handle closes the application contact which in turn closes application contact in EP relay thereby energizing wire no. 38. Charging of wire no. 38 actuates application magnet valve in each EP unit and allows MR pressure to brake cylinder line through limiting valve which is set at 1.6 kg/cm^2 in motor coach and 2 kg/cm^2 in trailer coach. In HCC bogies fitted with air spring the brake cylinder pressure in trailer coach is 1.2 kg/cm^2 whereas the brake cylinder pressure in motor coach remains same i.e. 1.6 kg/cm^2.

Gradual application of EP brake is determined by the amount of handle movement of brake controller from position I and is controlled through self lapping mechanism in brake controller. Maximum EP service braking is obtained with the handle in position II.

During release of EP brake, brake controller handle is moved towards position I. As a result application contact gets opened de-energizing wire no. 38. Consequently application magnet valve in each coach gets de-energized stopping further supply of MR pressure to brake cylinder line. Further movement of brake controller handle at position

I open the holding contacts and thus cut the feed to wire no 37 resulting in de-energization of holding magnet valve in each coach. This results in opening of exhaust port and connects compressed air of brake cylinder to atmosphere. Hence release of EP brake is achieved.



AUTOMATIC BRAKE:

This is a purely pneumatic brake and during parting of train this brake comes into action automatically and hence the term AUTO BRAKE is coined to it. Automatic brake is controlled by varying the air pressure in the brake pipe which a continuous pipe is carried through out the length of the train. The brake pipe is charged with compressed air delivered at constant pressure of 5kg/cm^2 by the reducing valve mounted on the brake controller pipe bracket. The high-pressure air supply to the reducing valve is obtained from main reservoir system.

The automatic brake is applied by discharging air from the brake pipe and released by restoring the air pressure in the brake pipe.

A triple valve on each vehicle is connected to the brake pipe and applies or releases the automatic brake in response to the brake pipe pressure variations. Graduated application of auto brake is achieved through graduated destruction of equalizing pressure of brake controller. Bringing the brake controller handle first to 'Auto' position and then to 'Lap' position can do this. Equalizing reservoir in driving cab is charged to brake pipe pressure. The reduction of pressure in the equalizing reservoir is reproduced in the brake pipe by the equalizing discharge valve, which closes slowly and prevents pressure surges from being set up in the brake pipe.

During AUTO brake application BP pressure is reduced by bringing the brake controller handle to AUTO position. This pressure reduction acts on the triple valve in the EP brake units, through which the auxiliary reservoirs are connected to the brake cylinders. Depending on the degree of pressure reduction, a corresponding pressure rise is produced in the brake cylinders. By reducing the pressure in the automatic brake pipe

step by step, the brake cylinder pressure can be increased step by step, until, in the full application position, the maximum brake cylinder pressure is reached. This is limited by a safety valve in the EP brake unit to 4kg/cm^2.When the handle is moved back towards running position, for release the pressure in the automatic brake pipe is raised again, whereupon the brake cylinders are fully exhausted. Thus graduated release is not possible when using the automatic brake. During release, the auxiliary reservoirs are simultaneously recharged with air pressure from the automatic brake pipe.

DRIVER'S EMERGENCY BRAKE:

This brake is provided to the driver to initiate brake application in case of an emergency and driver has no time to opt for a particular type of brake e.g. EP brake or AUTO brake. To affect emergency brake application, the brake controller handle is to be kept in emergency position.

In the emergency application position the automatic brake pipe is rapidly and directly exhausted via the brake controller, so that when the electrically controlled brake is in operation the automatic air brake also comes to action. Thus rapid application brake is ensured.

DEAD-MAN BRAKE:

As EMU/MEMU train is single man's drive, it is necessary to provide a device of brake application as well as cut off the traction feed to bring the train to a stop in the event of incapacitation of the driver. This is arranged by means of a dead-man device associated with the master controller. With the reverser key thrown in the either position (forward or reverse), the MP handle has to be kept under continuous pressure. If the pressure on the handle is released for any reason, power for traction control circuit is interrupted and brake is applied automatically.

The application of brake is being done through the pilot valve and dead-man valve. The dead-man valve has two chamber-upper and lower chambers. The upper chamber is connected to the pilot valve of MP, while the lower chamber is connected to exhaust. In normal condition the pressure in both chambers are equal. The pilot valve is fitted on MP and mechanically coupled with MP handle. If the MP handle is released while reverser is thrown in either direction then the pilot valve will vent BP pressure slightly.

This will cause an imbalance of pressure in two chambers of dead-man valve resulting rapid exhaust of BP pressure through dead-man valve lower chamber connected with exhaust. This reduction of BP pressure causes auto brake application.

GUARD'S EMERGENCY BRAKE:

This brake is provided to guards for application of brake under emergency. This is a kind of auto brake actuated by rapid destruction of BP pressure through a guard's emergency valve provided at guard's side in the driving cab.

This valve is basically an isolating cock, one end of which is connected to brake pipe and the other end to atmosphere. Normally this valve is kept closed. In case of an emergency the guard operates the handle to make it 'ON' which results in rapid exhaust of BP pressure to atmosphere, thus causing auto brake application.

PARKING BRAKE:

This system of brake is provided in all the MEMU motor coaches and EMU motor coaches provided with air spring in secondary suspension. Parking brake is applied while the rake is stabled and thus to prevent rolling. Hence parking brake is a substitute of hand brake.

Four numbers of parking brake cylinders have been provided in each motor coach adjacent to wheel number 1, 3, 5 and 7. These cylinders are mechanically coupled with existing brake cylinders' piston through lever arrangement. Function of parking brake cylinder is just opposite to the normal brake cylinder.

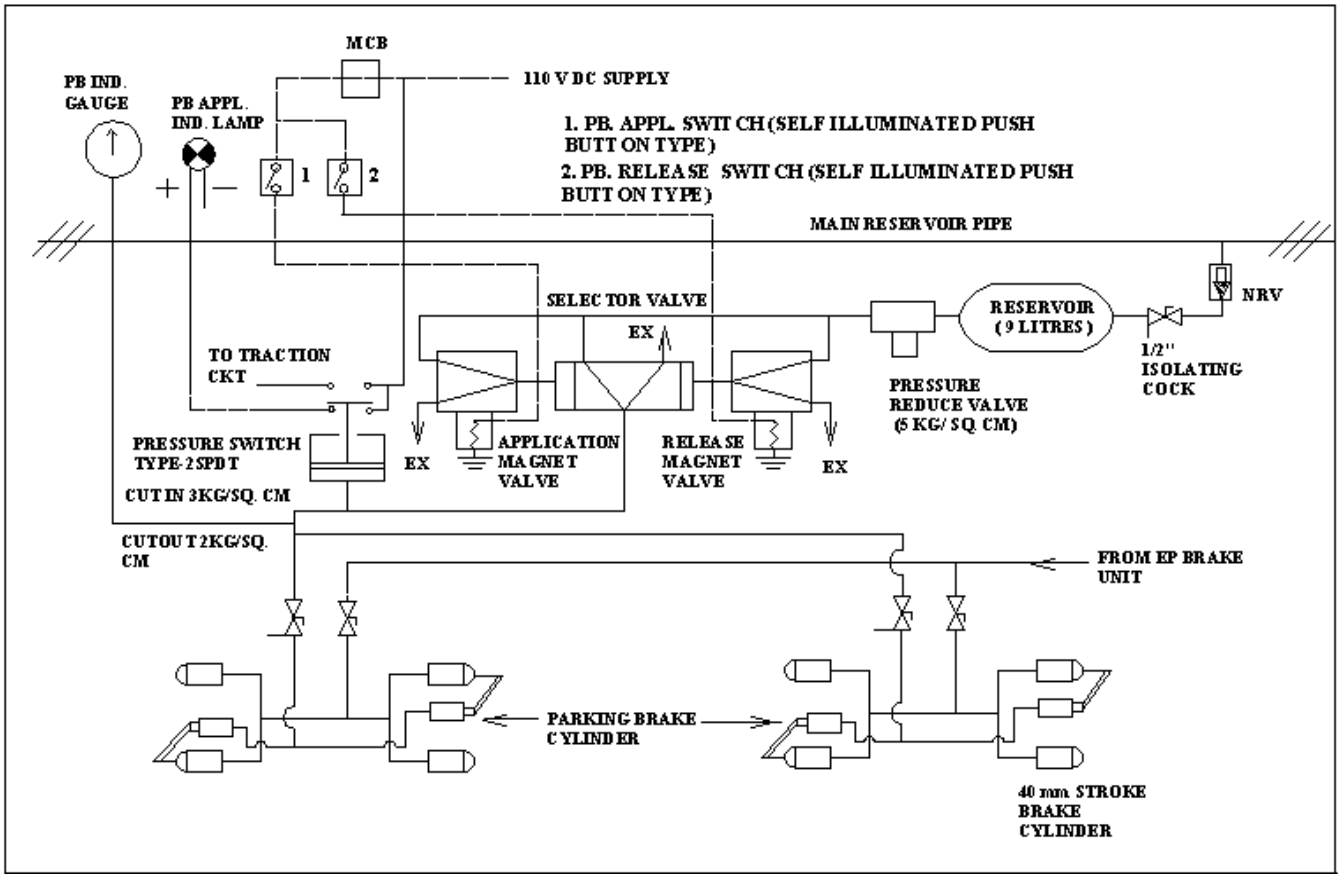
When the air pressure is applied to parking brake cylinder, the brake gets released and when there is no pressure in the parking brake cylinder the brake is applied by the spring action. The spring is provided inside the parking brake cylinder. Working of the cylinder is being controlled by a magnet valve provided in MR pipe line and is located in driving cab. The magnet valve is energized through a switch in BL box in driving cab. During running condition the switch will remain in 'ON' position and thus air will be supplied to the parking brake cylinder through a limiting valve (known as parking brake limiting valve set at 5 kg/cm^2 and is provided in driving cab) and parking brake will be in released condition. In stable condition, the parking brake switch is to be put 'off' and thus brake will be applied.

A governor is provided on parking brake cylinder line. This governor has two interlocks- one N/O contact connected in motor contactor control circuit and one N/C contact provided for indication of parking brake application in driver's LED indication panel. When parking brake is applied, there is no air in the parking brake cylinder. Then N/O contact of the governor will be opened causing non-closing of motor contactor and at the same time parking brake application indication will glow through its N/C interlock. During release of parking brake air will be available in parking brake cylinder line. This will cause closing of N/O contact resulting in closing of motor contactor and opening of N/C contact to extinguish the parking brake application indication. A bypass switch is connected in parallel with parking brake governor, so that in case of non-functioning of governor, the switch is to be put 'ON' to bypass the governor. A manual release device (release handle) is provided in the system to uncouple the parking brake manually if required.

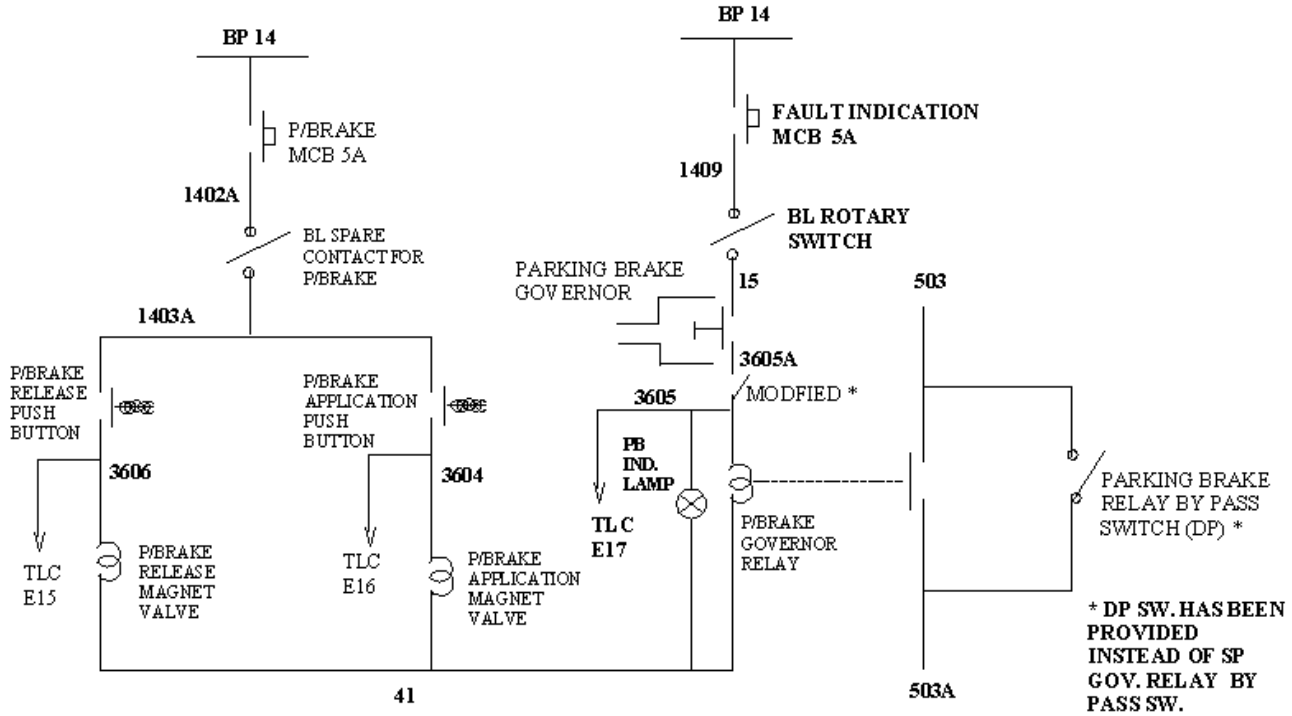
A bypass isolating cock is provided in parallel to parking brake magnet valve and is normally kept isolated. In case of failure of magnet valve, this cock is to be made normal to supply air to the parking brake cylinder bypassing the magnet valve.

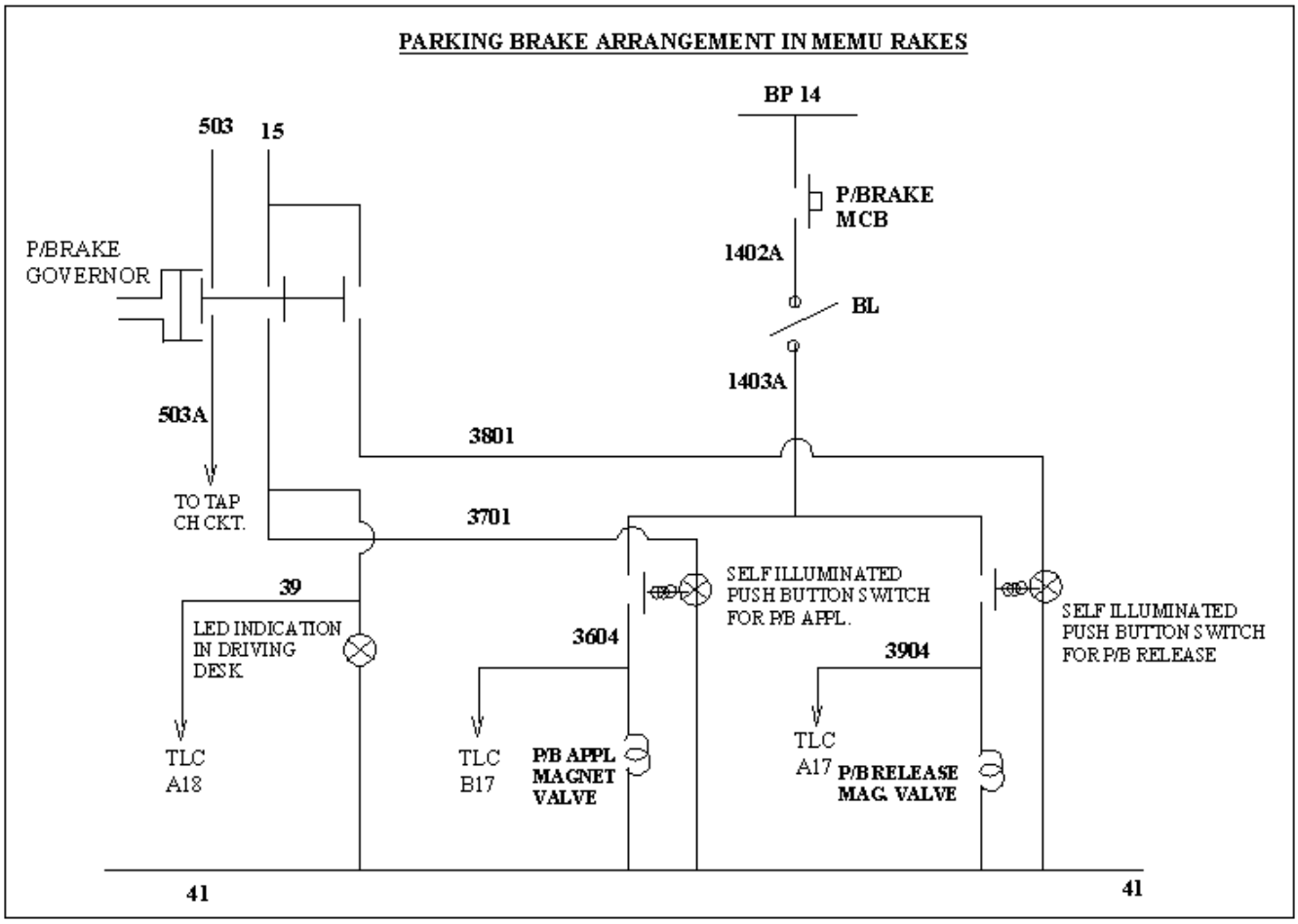
During shunting work in dead condition of motor coach, it is required to release the parking brake. So the release handle is to be operated to uncouple the parking brake lever which is coupled with the brake cylinder piston.

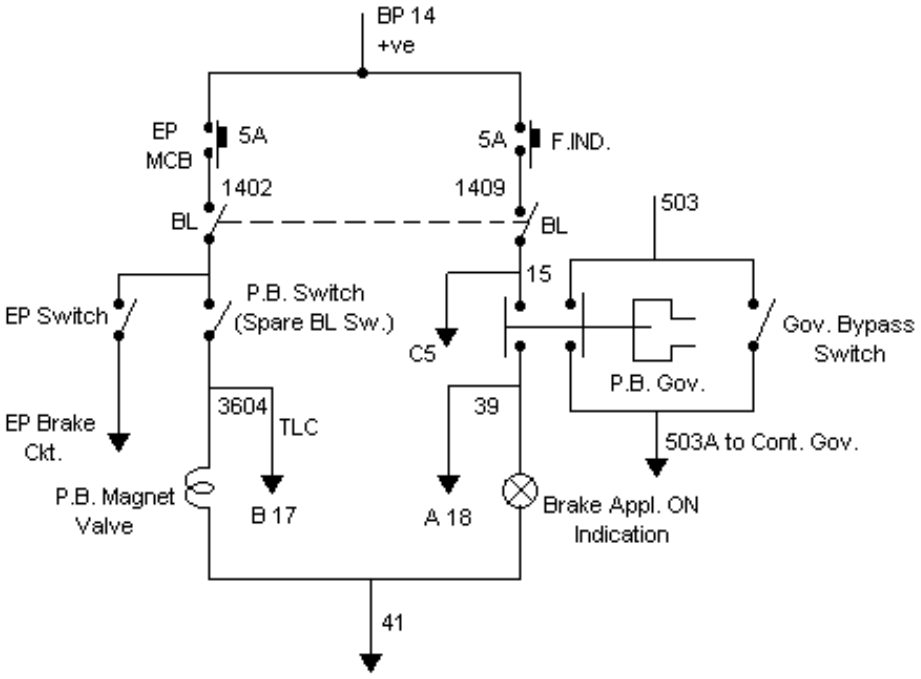
MODIFIED PARKING BRAKE ARRANGEMENT



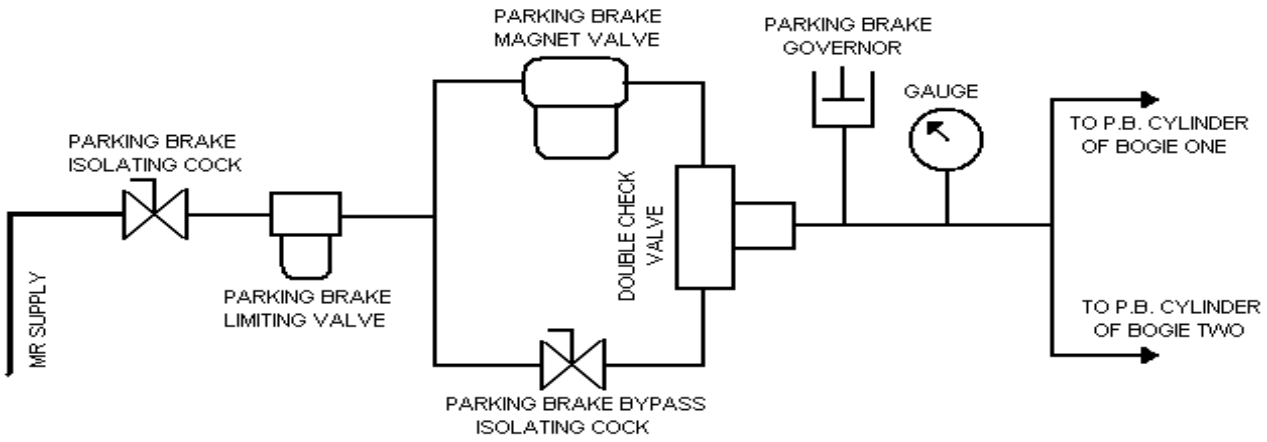
PARKING BRAKE ARRANGEMENT IN AIR SUSPENSION RAKE







ELECTRICAL CIRCUIT FOR PARKING BRAKE (Non-modified)



PARKING BRAKE BYPASS ARRANGEMENT (NON-MODIFIED)

Conditions warranting for mechanical release of Parking Brake.

1. Parking brake not released by putting PB switch in 'on' position due to any electrical fault or defect in magnet valve.
2. Non-availability of MR pressure.
3. Disconnection of 'B' jumper (parking brake in rear M/C to be released manually).
4. For movement of loose M/C in dead condition.
5. Any mechanical fault in the system.

Instructions for motormen & maintenance staff for mechanical release of parking brake on line due to any of the reasons mentioned above.

1. Provide skid, release EP & Auto brake.
2. Keep the parking brake switch 'on' in BL box.
3. Ensure parking brake MCB in driving desk is 'on'.
4. Isolate parking brake isolating cock in affected M/C.
5. Manually release the parking brake on wheel no. 1,3,5,7 in affected M/C & ensure brake blocks are released from wheels.
6. Put the parking brake governor bypass switch 'on' in affected M/C.

Note: In case of manual release of parking brake, 'parking brake on' LED indication in driver's desk will remain glowing.

Improved version of Parking brake

In improved version (modified arrangement) of parking brake system, if there is a pressure drop in MR, PB system will not be affected as there is a 3/2 way selector valve & this valve will not allow the PB cylinder to exhaust until PB application valve is operated. Also there is an 9 ltr. capacity auxiliary reservoir which will keep the PB released in case of MR pressure drop. In case this air reservoir also gets exhausted then only PB are to be released manually by manual release mechanism.

In modified system electrical failure will not cause PB application or release because unlike earlier the present magnet valves used are energize to apply & energize to release (two separate 3/2 way magnet valves are provided).

In modified arrangement air will always be in PB system for keeping the PB in released condition. But if this air also leaks out then manual release mechanism has to be operated. This will happen in case of extreme emergency only.

A current pulse has to be given to the release magnet valve, which will shift the spool in the selector valve so the air supply from MR is connected to the PB cylinder to release. Similarly for application of PB the application magnet valve is to be made energized. This will shift the spool in the selector valve so the air in PB cylinder will be connected to atmosphere through exhaust port & PB will be applied. The magnet valves are not always energized.

There is an electrical signal in the driver's cab. Whenever there is a pressure drop in the PB system due to bursting of air pipe or any air leakage & PB gets applied this indication will glow in driver's desk. At the same time there will be traction cut through the pressure switch (set at cut in 3Kg./cm^2 & cut out 2 Kg./ cm^2) provided in PB circuit. A separate MCB is provided in PB circuit.

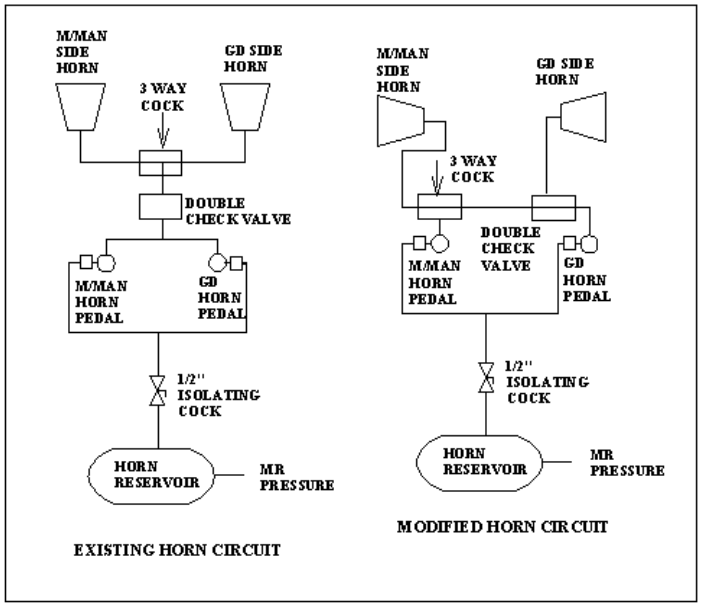
In modified arrangement PB application is independent of power failure as it has energized to apply & energize to release type magnet valves. In case of disconnection of 'A' jumper PB is to be released manually in rear M/coaches.

Mechanical arrangement is same as in earlier PB system. Quality of manual locking/ release mechanism has been improved.

In conventional non-HCC trailer bogies 60 mm. stroke Brake cyl. are to be used & in case of HCC bogie 40 mm. stroke Brake cylinders should be provided.

HORN:

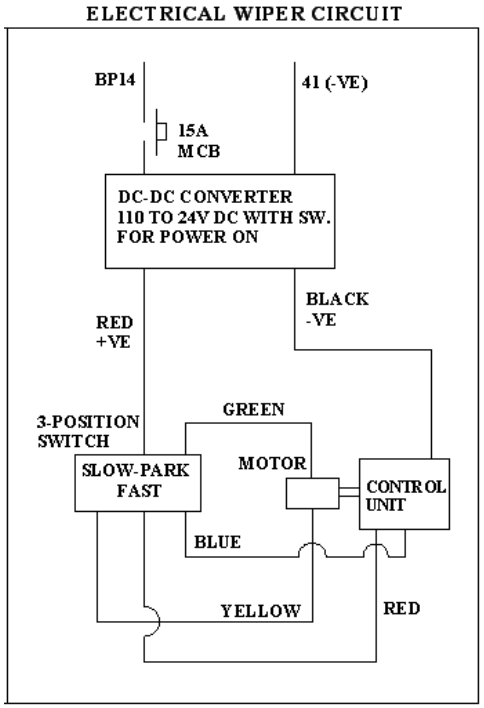
Diaphragm type horn is provided at both side in front of driving cab (in new coaches position of horn is provided in under gear behind the cattle guard). It is connected to horn reservoir through a three way cock & double check valve. A horn padel is provided to sound the horn. Presently both the horns are being shifted to cab roof for better sound effect.



WIPER:

Wiper is provided in EMUs & MEMUs to wipe out the rain water/dew drops from front look out glasses. Movement of wiper is achieved through a servomotor which is being operated by MR pressure. One switch with regulator is provided on driver's desk to switch 'ON'/'OFF' and regulate the wiper movement.

Since failure rate of pneumatic wiper is high, electrical wiper has been developed. Provision of sprinkler arrangement in wiper is under development to avoid scratches on look out glass occur due to movement of wiper blade on dry surface of glasses during testing. All the existing pneumatic wipers shall be replaced by electrical wiper for better reliability.

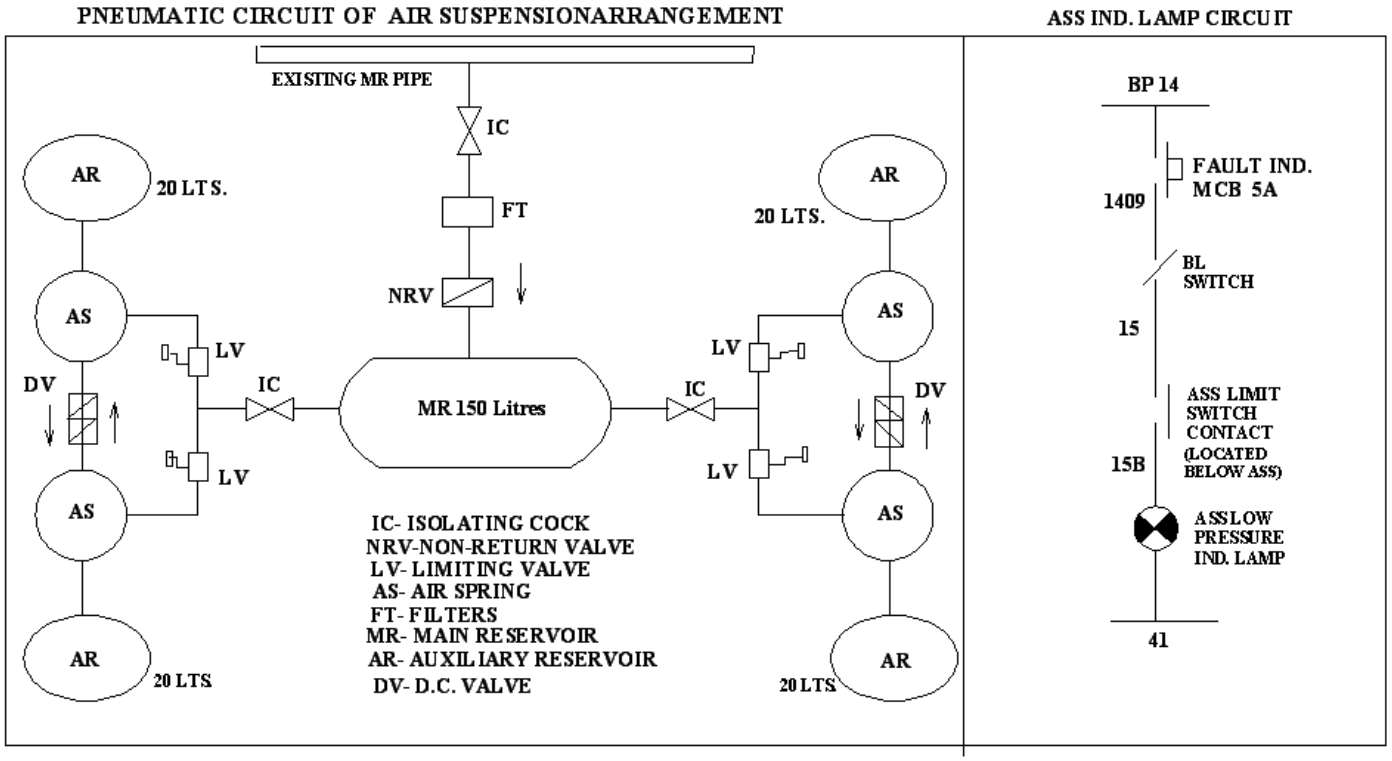


AIR SUSPENSION:

New EMU rakes are provided with air spring in secondary suspension to have better riding comfort. These springs are normally maintenance free pneumatically controlled system. Compressed air supply to the spring assemblies shall be maintained through the existing compressor provided in the motor coach. Pneumatic circuit of the air spring assembly is connected to the MR through feed pipe and reservoirs to maintain continuous supply of compressed air to the air spring assembly. An 150 lts. auxiliary reservoir has been provided. In addition to that each bogie is provided with two numbers of 20 lts. capacity reservoirs.

All the pneumatic suspension control equipments shall be able to work under pressure between 1.0 kg/cm^2 to 10 kg/cm^2 and withstand an applied frequency of up to 10 Hz during run.

Each coach is fitted with four air spring assemblies (two per bogie) and each air spring is controlled by an independent leveling valve (4-point control system). Two air springs of the same bogie shall be connected through a Duplex check valve set to act at a pressure differential of 1.5 or 1.0 kg/cm^2 as per requirement.



Leveling Valve:

Leveling valve is having simple and robust construction and incorporates a built-in non-return valve to control the inlet of compressed air and to prevent loss of air from the suspension system in the event of a burst hose etc. It regulates the car body level irrespective of the load condition of the vehicle by charging or discharging the air suspension bellows.

Increased Loading condition:

An increase in vehicle loading compresses the air in the suspension bellows and the vehicle, together with leveling valve body, sinks with respect to the bogie frame and the rails. As the valve body sinks, the rigid rod acting against the end of the control lever, prevents the end of the lever from moving, with the result that the valve opens and allows pressurized air to pass to the suspension bellows. The increasing air pressure in the suspension bellows lift the vehicle body back to the 'ride height' at which point the leveling valve 'laps off' preventing air from entering or leaving the suspension bellows.

Decreased loading condition:

A decrease in vehicle loading has the opposite effect. The compressed air in the suspension bellows expands, raising the vehicle body together with the leveling body with respect to the body and the rails. As the valve body raises, the rigid rod acting against the end of the control lever, prevents the end of the lever from moving and opens a passage to an exhaust port in the valve allowing pressurized air from the suspension bellows to vent to atmosphere. As air pressure in suspension bellows falls the vehicle sinks until it reaches the 'ride height' at which point the valve 'laps off' cutting off the venting of air to atmosphere.

The leveling valve does not require any routine maintenance. It is sufficient for the valve to be checked in the course of specified general inspection.

Duplex Check Valve:

The Duplex check valve is designed for installation between the two air bags on the two sides of a bogie and prevents a differential air suspension pressure, greater than a preset value, existing between the two air bags. Various versions are available for installations where an average feed is required from the duplex check valve for the brake control unit, and also for those installations using a separate averaging valve for the suspension pressure signal.
Duplex check valve comprises two opposed check valves side by side, arranged so that air can flow in either direction when the air pressure differential exceeds the preset value.
When the air pressure at one input exceeds the air pressure at the other input port by more than the differential limit, the higher pressure overcomes the spring and opens the valve, allowing air to flow from high to low pressure. This flow continues until the differential pressure is reached when the valve closes. In the event of one air suspension bag losing pressure completely, the pressure in the other bag will fall to the preset differential pressure.
There are two types of duplex check valve with minor variation in the body dimensions.
This valve requires no routine maintenance between overhauls which should be carried out at the intervals specified in the system maintenance schedule. In the absence of such a schedule, the valve should be overhauled in every 3 years interval.

Main accessories of Air spring assembly

S/no.	Item	Quantity per coach
1	Leveling valve	4
2	Installation lever	4
3	Duplex check valve with 1.5 kg/cm^2 (or 1.0 kg/cm^2) pressure setting	2
4	Main pressure tank (Auxiliary reservoir) 150-dm^3 (150 lits) capacity with ½ " drain cock	1
5	Air reservoir (additional reservoir) of 20 dm^3 (20 lit) with ½ "drain plug or 40 dm^3 (40 liters) capacity with ½ "drain cock".	4
6	Check valve (non return valve) 20 mm bore with 3mm choke	1
7	Two way centrifugal dirt collector (20mm bore)	1
8	Isolating cock (OLP type) 20mm bore i) For main supply line pressure isolation ii) For bogie pressure isolation	 1 2
9	Hose connections	4
10	Air bellow	4

Note: For further details please refer RDSO CMI-9802 (Rev.2), RDSO STR no. C - K407 with latest amendments and manufacturers manuals.

SOME MUST FOR BRAKE EQUIPMENTS

- While carrying out works on pipe lines or valves, make sure that the relevant ckt. has been properly isolated and there is no air pressure in the parts to be attended.

- While isolating CIC of a motor coach, always disconnect electrically MCP governor of that motor coach through MCP control MCB. Otherwise NC interlock of the governor will not open in absence of air pressure and will keep MCPs of other motor coaches working through synchronization. This will result in excessive building up of air pressure and MCP safety valve will blow continuously.

- If ICA cock is to be kept isolated for leakages etc., also isolate EPIC and release BC pressure and then isolate both BICs. Isolation of ICA cock alone will result in brake binding and if not instantly then during EP brake application afterwards.

- Draining of condensate from coolers and relevant reservoirs should be carried out to the extent possible as this enhances the reliable operation of brake equipment.

- While isolating cocks during brake binding, first isolate ICA & EPIC, then release BC pressure by pulling release chain and then isolate both BICs.

- Never left MCP governor-isolating cock in isolate position alone. If it is to be kept isolated then disconnect the concerned governor electrically.

- During replacement of brake block, the lever arrangement of PB system has to be open to adjust the service brake cylinders.

SOME IMPORTANT GUIDELINES OF RDSO

1. Permissible brake power in EMU stock as per RDSO's letter no. MC/EMU/AVB dtd. 23/24.08.2004:

- Rakes leave car shed should have 95% effective brake cylinder.
- Rakes leave night stabling points should have 90% effective brake cylinders.
- During the day's service if the number of effective brake cylinders goes below 90% but above 85% the service may be continued at a restricted speed of 75 kmph.
- If the number of effective brake cylinder goes below 85% the motor man should operate at the restricted speed of 70 kmph or which he feels is safe and the rake should be withdrawn from service after the completion of the service.

Permissible no. of ineffective brake cylinders as per the above conditions.

Brake power	For 9-car rake with non-HCC bogie no. of ineffective brake cylinders	For 9-car rake with HCC bogie no. of ineffective brake cylinders
95%	2	4
90%	4	8
85%	6	12

No. of permissible ineffective brake cylinders for other formations like 8 car, 12 car etc. may be determined accordingly.

2. Speed restriction on EMU and MEMU in deflated condition of air suspension system (Ref. RDSO letter no SV.AS.EMU.RAS dtd. 04.04.2008):

May be operated upto a maximum speed of 60 kmph upto the terminal point for maintenance.

3. Permissible leakage in pneumatic system:

- Leakage from brake cylinder should not be more than 0.1 kg/cm^2 in 10 minutes (Ref. RDSO letter no. MC/EMU/BKS dtd. 27.08.10).
- MR pipe leakage with EP unit (BP isolate) - 0.1 kg/cm^2 in 5 minutes (Ref. ACTM Volume-III, 1994).
- BP pipe line leakage with auto unit - 0.1 kg/cm^2 in 5 minutes (Ref. ACTM Volume-III, 1994).
- MR pipe line with BP pipe line - 0.1 kg/cm^2 in 5 minutes (Ref. ACTM Volume-III, 1994).
- MR pipe line, BP pipe and BC applied with full EP - 0.8 kg/cm^2 in 5 minutes (Ref. ACTM Volume-III, 1994).

4. Brake cylinder pressure in EMUs/MEMUs (Ref.: RDSO letter no. MC/EMU/BKS dtd. 14.12.05):

Pressure setting of	Pressure setting (Kg./cm^2)		
	Motor coach	Trailer coach	
		HCC	Non-HCC
EP unit limiting valve	3.6	3.6	3.6
Addl. Limiting valve	1.6	1.2	2.0
Safety valve after addl. Limiting valve	1.8	1.4	2.2

EMERGENCY BRAKING DISTANCE

Type of Stock	No. of coaches	Speed (Kmph)	Level Section (m)	Gradient Section (m)	Remarks
EMU	9	80	570	590 (1 in 600 DN)	Sr.DOM/KGPs letter no. GW/1/Trans/300 dtd. 08.12.06
MEMU	8	80	542	672 (1 in 600 DN)	Sr.DOM/KGPs letter no. GW/1/Trans/300 dtd. 08.12.06
EMU	9	90	781	855 (1 in 200 Dn)	Sr.DOM/KGPs letter no. GW/1/Trans/285 dtd. 23.11.06
EMU	9	95	781	855 (1 in 200 Dn)	Sr.DOM/KGPs letter no. GW/1/Trans/191 dtd. 14.09.06
MEMU	8	95	--	480 1 in 100 Dn)	Sr.DOM/KGPs letter no. GW/1/Trans/191 dtd. 14.09.06

GUIDE TO SOME COMMON PNEUMATIC TROUBLE

S/no.	TROUBLE	CAUSE	REMEDY
1.	BP pressure drops	Reducing valve not charging	Isolate the brake controller and go for driving from rear cab as per GR 4.21
		MR pipe burst/ leakage	-do-
		BP hose burst/leakage	Detect the location of leakage and isolate BP coach end isolating cock on either side of the leaking pipe. Charge both end brake controller in driving cab. Remember that Auto brake will be available from leading cab to the point of isolation. Similarly Guard emergency brake will be available from rear cab to the point of isolation but EP will be available for full rake.
		Leakage in BP metallic pipe of coach	Isolate both coach end BP cock. Isolate EPIC, ICA. Release BC pressure through release chain. Isolate both BIC. Charge both end driving cab brake controller.
		Leakage in BP metallic pipe between ICA cock and EP unit	Isolate ICA cock, EPIC cock, release BC pressure through release chain and isolate both BIC.
		Leakage from Dead-man valve	Isolate the Dead-man cock. This will make Dead-man brake ineffective and hence should be attended at the earliest opportunity.
2.	MR pressure drops	MCP is not working : • CR not set • MCP governor defective • MCP fuse melts	 Set CR Bypass MCP governor Replace MCP fuse
		MR hose burst/leakage	Isolate both coach end MR cock. To avoid continuous blowing of MR safety valve in this condition, disconnect electrical synchronization of MCP governors by disconnecting wire no. 13
		Leakage in MR metallic pipe between MCP & CIC	Isolate CIC cock. In such case, MCP governor of affected motor coach must be disconnected electrically.
		Main reservoir drain cock broken due to external hit	Make the draining outlet of reservoir temporarily dummy by inserting wooden wedge available with motorman.

S/no.	TROUBLE	CAUSE	REMEDY
3.	MCP safety valve blowing	CC1 welded in M/coach	Remove CC1 welding.
		MR coach end cock is somewhere isolated in the rake	Check for isolation and make MR cock normal if there is no leakage.
		Safety valve defective	Change the safety valve at the earliest opportunity and till then keep CIC in isolated condition. Concerning MCP governor should be disconnected electrically.
		CIC cock isolated	Check for any leakage, otherwise make it normal.
		MCP governor isolating cock in HT compartment is isolated	Make the cock normal if there is no leakage, otherwise isolate the governor electrically.
		MCP governor bypass switch is 'ON' in any of the motor coach	Put the bypass switch 'OFF' if the governor is functioning OK.
4.	Horn not sounding	Horn incoming pipe choked	Check the strainer and gaskets in pipe joints and flexible pipes to ensure sufficient flow of pressure.
		Horn diaphragm crack/bent	Replace the horn diaphragm.
		Horn assembly broken	There is a 2/3-way cock which incorporates the facility for sounding both side horns simultaneously or either side horn individually by keeping the cock handle in respective position.
		Horn flexible pipe burst	Isolate the horn isolating cock and replace the pipe at the earliest opportunity.
5.	Brake binding	Brake binding in coach due to trouble in EP unit	Isolate EPIC, ICA. Release the BC pressure through release chain. Ensure all brake blocks are release from wheel and finally isolate both BIC.
		Brake binding in one of the bogie due to late release	Isolate the concerned BIC.
		Brake cylinder over travel	Carry out necessary hole adjustment of tie rod and then isolate the concerned BIC.
6.	MR pressure dropping rapidly on EP application	Holding contact of brake controller less crushing	Adjust the crushing of finger of brake controller.
		Holding contact of EP relay less crushing/coil open ckt.	Adjust the crushing. In case of open ckt. of holding coil, short wire no. 37 & 38. Remember, that in such condition EP brake will not have any self lapping.
		Jumper connection loose	Tap all 'A' jumpers.

7.	Graduated application of Auto Brake not available (BC pressure raises to full value even on partial application of Auto Brake)	Leakage in equalizing circuit	Check and arrest the leakage in equalizing pipe line.

PROFORMA FOR BRAKE TESTING OF EMU/MEMU RAKES

Rake No. : Date -

S/ No.	Parts to be inspected	Recommended value, if any	Value obtained	Remarks
1.	All inter coach hose connections / couplings are intact & all isolating cocks, drain cocks etc. are in normal position.	Normal		
2.	MR pressure is maintained between 6-7 Kg/cm^2 & compressor start & stop respectively at these values of pressure.	Normal time to build up $7Kg/cm^2$ is 9 min.		Ref.: ACTM, Vol-III, 1994
3.	Check the blowing pressure of compressor safety valve	$8Kg/cm^2$		Ref.: ACTM, Vol-III, 1994
4.	Ensure drivers control switch, E.P. brake switch & isolating valve switch (BI switch) are put on, the green indicator light in the driver`s desk glows.	OK		
5.	Ensure brake pipe pressure builds upto $5Kg/cm^2$.	In 90 secs		
6.	Ensure the brake controller handle is moved from position I to II step by step (min. 6 steps), the brake cylinder pressure builds upto the value proportionate to the handle position and is maintained at this value by the self-lapping mechanism.	In position II, BC pressure should be 1.6 Kg/Cm^2 for M/C and 2.0 Kg/cm^2 for Non-HCC T/C and 1.2 Kg/cm^2 for HCC T/C (Each brake cylinder pressure to be measured with brake testing gauge)		Ref.: RDSO letter no. MC/EMU/ BKS dtd. 14.12.05
7.	Ensure when the handle is moved back from position II to I step by step (min.6 steps), the brake cylinder pressure is reduced to the value corresponding to the handle position and is maintained by the self- lapping mechanism.	OK		
8.	Ensure, when the handle is quickly moved from position I to II the brake cylinder pressure is raised to the maximum set value.	OK		

S/ No.	Parts to be inspected	Recommended value, if any	Value obtained	Remarks
9.	Ensure, when the handle is quickly moved from position II to I the brake cylinder pressure drops to zero.	OK		
10.	Ensure that on EP application & release the brake pipe pressure is not affected i.e. proper BP pressure is maintained during EP application.	Brake pipe pressure is OK		
11.	Put off EP switch and ensure proper functioning of Auto brake.	OK		
12.	Ensure, when brake controller handle is moved from position I to III and then to IV, the brake pipe pressure drops gradually with sound of escaping air, the brake cylinder pressure rises correspondingly.	OK		
13.	Ensure, when the controller handle is moved back to III, the drop in brake pipe pressure and the rise in brake cylinder pressure should be arrested.	OK		
14.	Ensure, when controller handle is moved from position I (after allowing full BP pressure to build up) quickly to `Emergency' position V, brake pipe pressure is reduced rapidly and brake cylinder pressure rises.	Reduced BP pressure should be slightly more than 3.9 Kg/cm^2 within 2.5secs.		
15.	Ensure that while the brake controller's handle in position II, the brake cylinders on each bogie are functioning and there is no leakage.	OK		
16.	Check that the manual release valve has wires attached to them to facilitate operation from the sides of the train.	OK		
17.	Ensure proper functioning of Guard Emergency Brake.	OK		
18.	Check brake controller for any abnormality and clean it.	No abnormality & cleaned		
19.	Clean the application & holding magnet valve with air blowing and apply grease.	Valve cleaned & grease applied		
20.	Check the electrical connection of EP unit & Brake Controller.	OK		
21.	Check physical application and release of brake in each coach during both EP & Auto.	OK		
22.	Check proper functioning of Parking brake	OK		
23.	Ensure manual uncoupling of Parking Brake	OK		

S/ No.	Parts to be inspected	Recommended value, if any	Value obtained	Remarks
24.	Leakage test: i) Leakage from brake cylinder	i) 0.1 kg/cm^2 in 10 min		Ref. RDSO letter no. MC/EMU/BKS dtd. 27.08.10
	ii) MR pipe leakage with EP unit (BP isolate) iii) BP pipe line leakage with auto unit iv) MR pipe line with BP pipe line v) MR pipe line, BP pipe and BC applied with full EP	ii) 0.1 kg/cm^2 in 5 min iii) 0.1 kg/cm^2 in 5 min iv) 0.1 kg/cm^2 in 5 min v) 0.8 kg/cm^2 in 5 min		Ref.: ACTM, Vol-III, 1994

Signature of staff

1. ----------
2. ----------

Signature of supervisor
