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Brake System Delhi Metro

SHIKHAR AGNIHOTRI, DEVENDRA KUMAR PANDEY

STUDENT, ASSISTANT PROFESSOR

BACHELOR OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

PRANVEER SINGH INSTITUTE OF TECHNOLOGY, KANPUR, INDIA

Abstract:-

While studying about this topic, I took help from the DMRC, I was explained in detail about the various systems in Delhi metro, especially brake system of Delhi metro. I eagerly wanted to know about the brake system of the Delhi metro as I always knew this would be a great technology to learn about.

There are 5 types of brakes which I got to know about, which are Service Brake, Emergency Brake, Parking Brake, Holding Brake, BP (Brake Pipe) – back up Brake.

In it I also learned about Pneumatic Air distribution System which is a main factor behind the brake system of Delhi metro to make them work properly. It comprises of Main Compressor, Air Dryer and Filtration, Main Reservoir, Auto Drain Valve, Isolating Cocks, Single Protection Valve.

INTRODUCTION:-

Metro is like a dream come true for Delhi, a revolutionary change in the city transport. Delhi needs metro system in the first place and it would change things for the betterment of the people who would use it and also for the people living in Delhi by reducing congestion, air pollution, noise pollution and accidents.The Delhi Metro has also contributed tremendously on the environment front by becoming the first ever railway project in the world to claim carbon credits for regenerative braking. DMRC has also been certified by the United Nations (UN) as the first Metro Rail and Rail based system in the world to get carbon Credits for reducing Green House gas emissions as it has helped to reduce pollution levels in the city by 6.3 lakh tons every year thus helping in reducing global warming.It has also set up roof top solar power plants at many of its stations. All stations presently under construction corridors are being constructed as green buildings. In the present phase of Delhi Metro's construction, the DMRC is nearing the completion of 160km of Metro lines which has woven a web of Metro corridors along the city's Ring Road besides connecting with many other localities in NOIDA, Ghaziabad, Bahadurgarh and Ballabhgarh.Apart from providing Delhites with a comfortable public transport option, the Delhi Metro is also contributing significantly towards controlling pollution as well as reducing vehicular congestion on the roads. Delhi metro brakes makes it all over very confident and successful in its work as it make things quite clear and perfect for the metro.

BRAKE SYSTEM

TYPES OF BRAKES:-

1. **SERVICE BRAKES:-** Electric Regenerative Brake and Electro-Pneumatic (EP) friction brake blending, load weighed and jerk controlled.

2. **EMERGENCY BRAKE:-**EP friction brake and load weighed.
3. **PARKING BRAKE:-** Spring applied, air-release parking brake
4. **HOLDING BRAKE:-** EP friction brake
5. **BP (BRAKE PIPE) BACK UP BRAKE:-** Pneumatic friction brake

SERVICE BRAKES:-

Priority of Braking effort – Electric Regenerative Brake controlled by C/I of Motor Car, EP friction brake controlled by BECU of Driving Tailed Car, EP friction controlled by BECU of Motor Car (in the beginning and the end of the service brake.), EP friction brake of driving trailer car and motor car (in case of failure of service brake).

BRAKE BLENDING:-

The Electric brake of each Motor car is used in preference to the pneumatic brake, as it works without wearing either brake blocks and is therefore more economical. The electric brake is controlled by the C/I (Converter/ Inverter),In case that the Electric Regenerative brake cannot provide the braking effort as demanded by the master controller of the driver, the missing brake effort will be supplied by the pneumatic brake. This feature is called „blending“. The M car BECU on a two-car basis controls the brake blending. Blending is carried out between Motorcar and Driving trailer car of a unit.

EMERGENCY BRAKE:-

The train set is equipped with an emergency brake loop wire. The emergency brake loop is connected to the emergency brake magnet valve, which is opened when de-energized and closed when energized (Fail-safe system). So, in case the emergency brake magnet valve is de-energized by interrupting emergency brake loop, the emergency brake will be applied automatically.

HOLDING BRAKE:-

The holding brake is provided to prevent the train from rolling backwards on a rising gradient and the train from moving at the station. The holding brake is released when C/I sends the signal “Reset Holding Brake” to the BECU. The tractive effort, which is applied when the signal “Reset Holding Brake Request” is initiated, shall ensure that the train will not roll backwards at a slope. The holding brakes are 70% of full service brakes.

PARKING BRAKE:-

Parking brake is used for parking the train in depot and these are installed at Driving trailer car and Motor cars (1 set per axle). Parking brake can be applied manually or these may apply automatically also when the MR pressure is low. To apply parking brake put Mode Selector at Standby position and press “Parking Brake on Push Button”. To release press “Parking Brake OFF Push Button”. Parking brakes are automatically applied in the event of loss of the main reservoir pipe pressure.

PARKING BRAKE MANUAL RELEASE:-

When MR pressure is low, it is possible to release individual parking brake manually from track level by; pulling out the manual release device installed at the parking brake cylinder.Operation of parking brake is monitored through the parking brake lamp installed at driver’s desk and TIMS screen. When the parking brake is applied the parking brake lamp will be illuminated and the application can be read through TIMS screen also.

LOAD WEIGHING:-

The load dependent pressure limiting valve (B3.C) is used to limit the supply reservoir air pressure according to the actual car load. At the same time the average load signal is electrically fed to the BECU from the T pressure transducer on the EP-BCU. This signal is used for load compensation of the propulsion and airconditioning system.

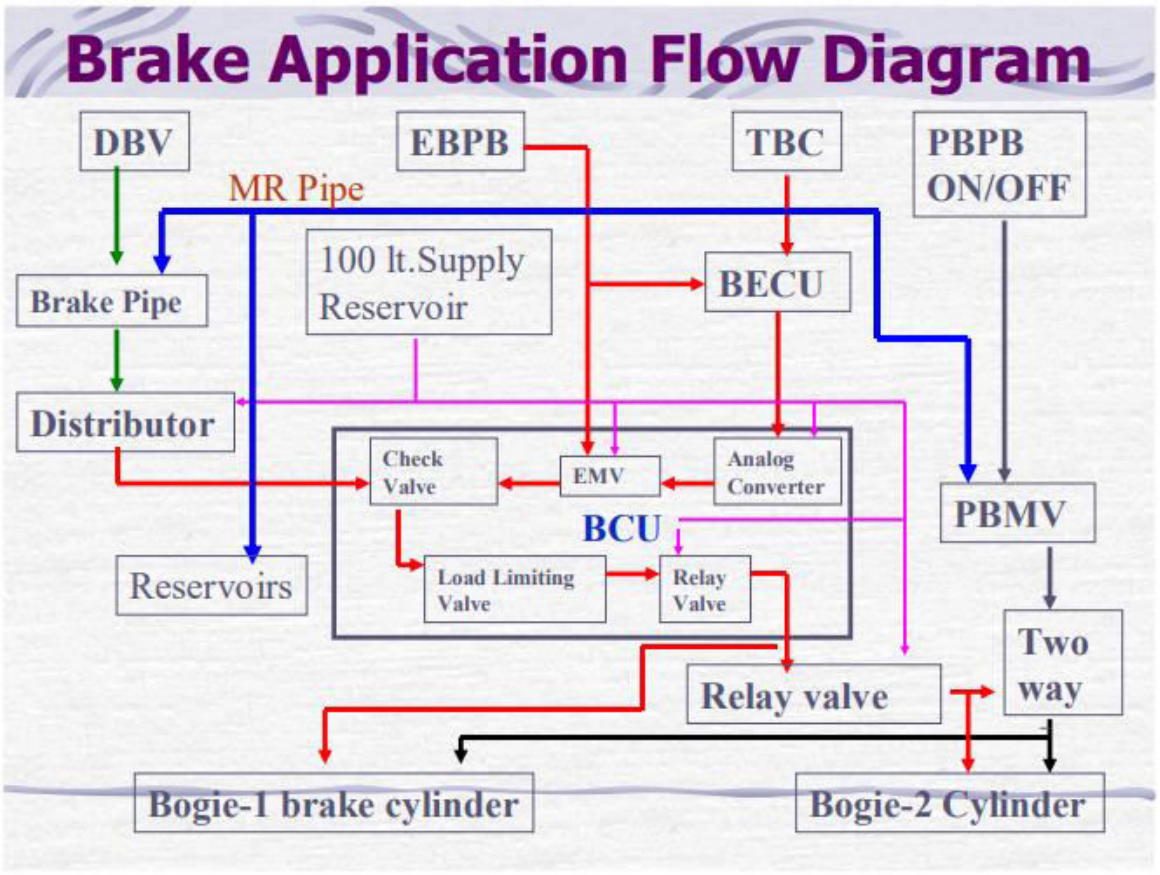
WHEEL SLIDE PROTECTION (ANTI-SKID CONTROL):-

Wheel slide protection is used to optimize the stopping distance and to avoid the wheel flats under wheel sliding conditions. Wheel slide protection is active in service brake and emergency brake. The wheel slide protection acts per bogie on each car by the dump valves (G2). Wheel-slide protection is operational at all speeds down to 3 km/h. Speed sensor mounted on the cover of each axle box, detects the speed of the associated wheel. When a potential wheel-slide event is detected, the BECU will release/apply the brakes through energizing/ de-energizing the magnets of the dump valves. Wheel slip/slide is also controlled by CI during electric regenerative braking and powering.

BP-BACK UP BRAKE:-

Additional BP (Brake pipe) controlled back-up brake system is provided in order to take over the brake control function in case of failure of individual electronic or electrical control elements. The driver can continue to control the pneumatic friction brake by using the driver's brake valve. The driver is able to apply or release the pneumatic brake by operating the driver's brake valve installed at the driver's cab.By the brake valve the brake pipe (BP) pressure can be reduced or increased depending on the time the brake lever is maintained at "braking" or "driving". During the normal service brake operation, the drivers brake valve lever shall be maintained at "driving".

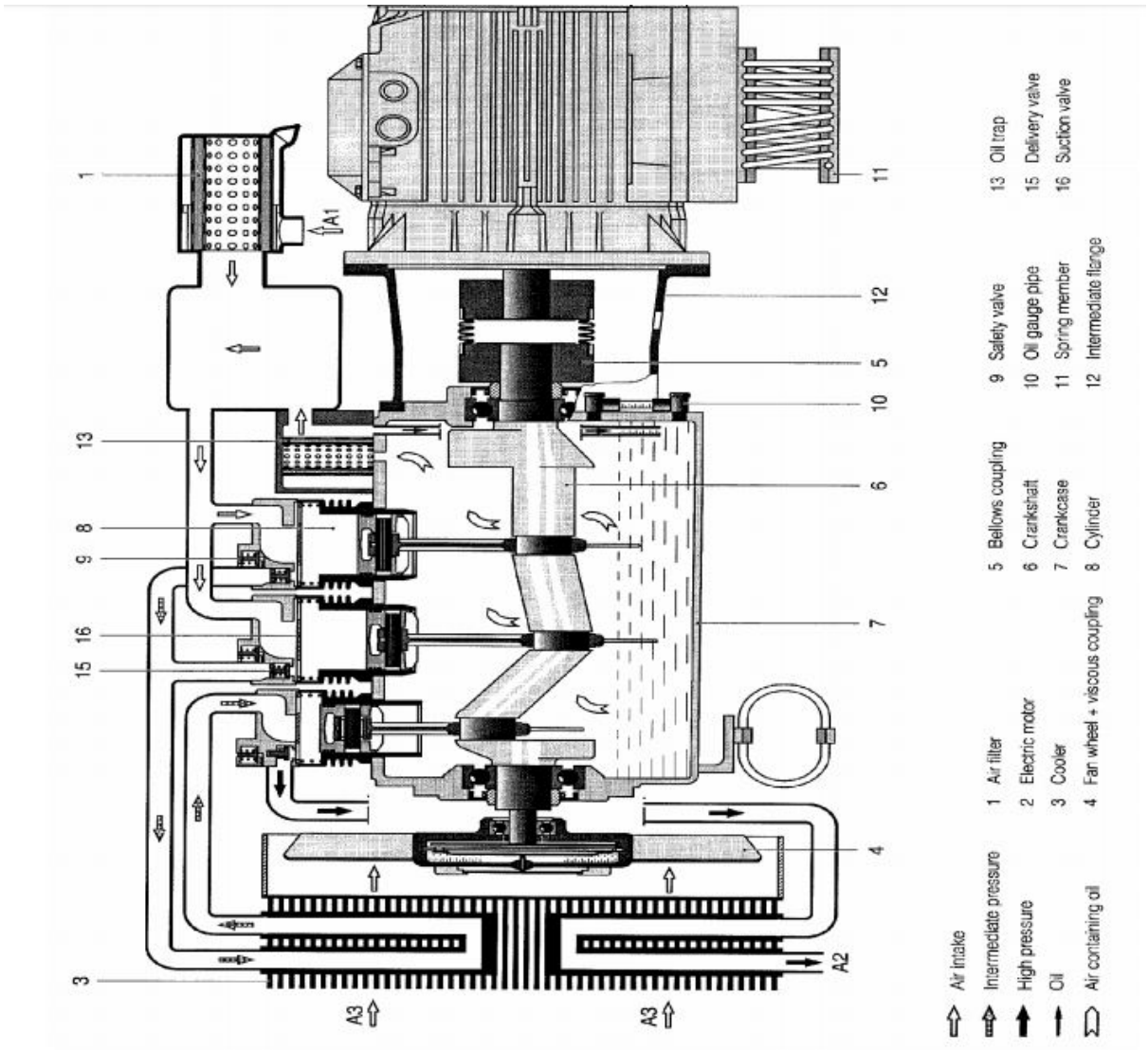
BRAKE APPLICATION FLOW DIAGRAM:-



PNEUMATIC AIR DISTRIBUTION SYSTEM:-

MAIN COMPRESSOR:-

The compressor is a cylinder piston compressor powered by a 415 V AC, 50Hz motor and it has a capacity of approximately 900 L/min free air at 10 bar. The main air-compressor unit is controlled by one relay contact of BECU in the software to 8.0 bar for cut in and 10 bar for cut out. The second pressure switch (A9) – set to 7.5 bar for cut in and 10 bar for cut out is provided as hardwired back-up in case of failure of BECU. Based on the electrical signals of the pressure switch A9 and pressure transducer A10 the main motor contactor is controlled. In normal service operation the air compressors of each DT car is controlled individually by the relevant BECU at that trailer car. The BECU in turn communicates with all other BECU installed in the train consist to determine which air compressor should be operated.



AIR DRYER AND FILTRATION:-

Moisture in compressed air systems often causes the pneumatic equipment to malfunction and wear prematurely as a result of corrosion and freezing. The compressed air supplied by the main air compressor is filtered by oil separator and dried by the air dryer unit and filtered by the oil micro filter. The air dryer unit consists of two chambers with a adsorptive desiccant. While the main air flow is being dried in one chamber (I), the desiccant of the other chamber (I) is being regenerated by the reversed air flow.

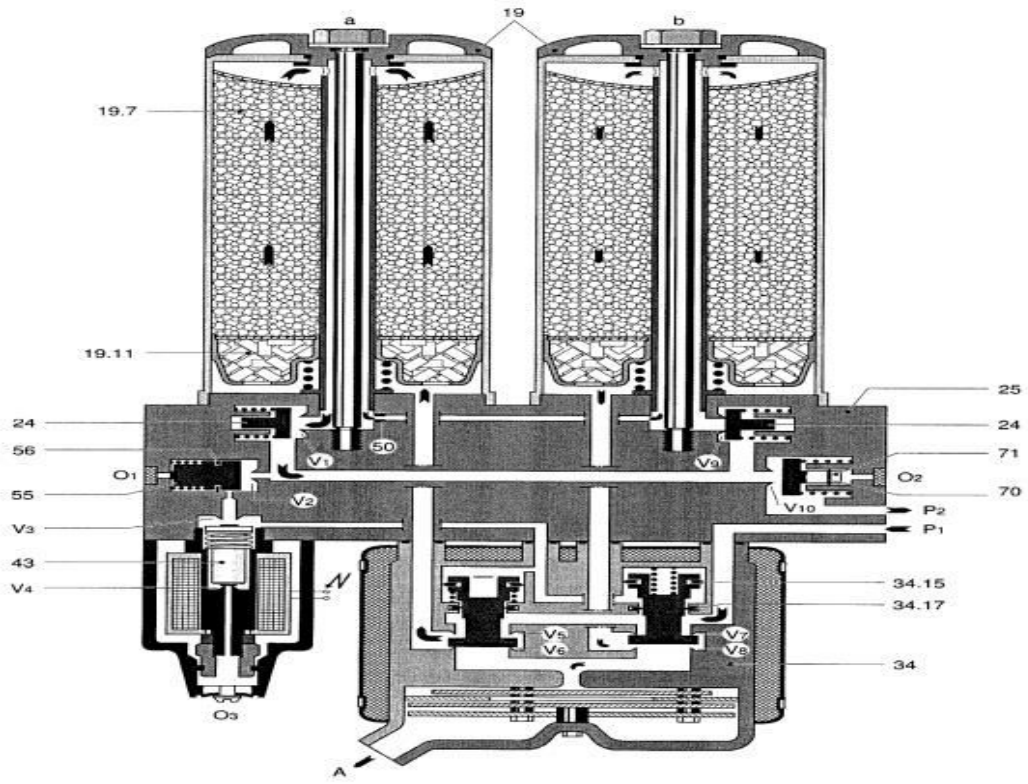
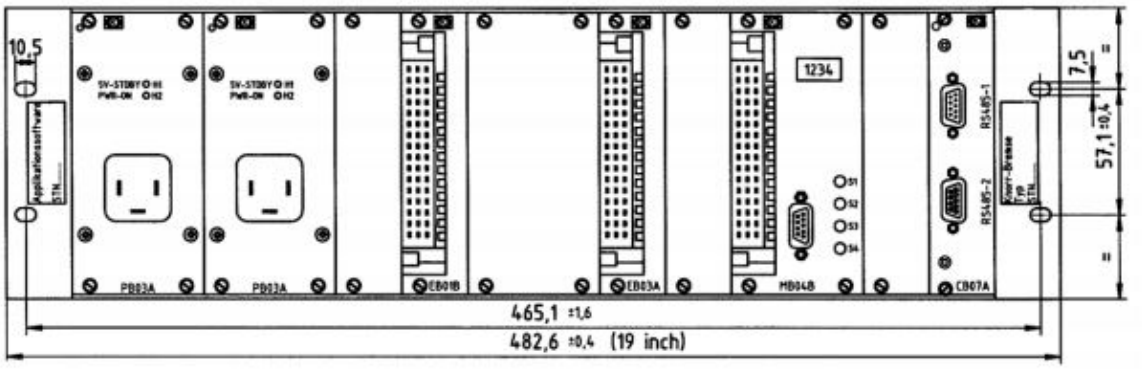


Fig. Air Dryer Unit

BRAKE ELECTRONIC CONTROL UNIT:-

The BECU commands the brake system and implement anti-skid functions by evaluating the set points for the brake value out of various input signals (e.g. brake demand signals, speed signals or load signals.). BECU calculates the required brake force according to brake demand and send electrical signal to the BCU. Every car has its individual BECU. To achieve a comfortable ride in all braking modes, load correction and wheel slide control and jerk control are active.

EQUIPMENT LAYOUTS:-



Brake Electronic Control Unit

The BECU consists of following PCB's:-

1. **MB04B Card:-**MB04B is a main board. It is loaded with application software. It consists of a main board MB03B and a man machine interface (MMI).
2. **EB01B Card:-** EB01B is an extension board in the ESRA system. The board is used to enhance the input and output operations of the main board. The EB01B extension board provides relay outputs and optocoupler inputs and outputs. EB01B interfaces with the peripherals
3. **CB07A Card:-** CB07A Card is a communication board in the ESRA System. The board transforms messages between the internal BECU bus and an external RS485 bus.
4. **PB03A Card:-** PB03A is used to power the BECU. It meets the demands of both the electronic boards and the sensors and the actuators.

CONCLUSION:-

Delhi metro is a rapid transit system used for the mass mobility within Delhi and NCR. A lot of research and engineering is done to make metro eco-friendly and comfortable for modern passenger. Metro train carrying lakhs of passengers is running smoothly from several years due to various systems in it, and one of the best and about which I explained is BRAKE SYSTEM and various systems are : Door System, HVAC, Propulsion System, Brakes and Pneumatics System etc. together every system and subsystem is responsible for efficient operation of Delhi Metro. Pneumatic System plays a major role in the working of the train like applying brakes, blowing horn and raising the pantograph while the train is in dead condition. Brakes system is a very complex stuff in itself to understand and it makes the Delhi metro successful single handedly.

Having constructed a massive network of about 373 km with 271nstations in record time in Delhi, NCR, the DMRC today stands out as a shining example of how a mammoth technically complex infrastructure project can be completed before time and within budgeted cost by a Government agency.

All the systems are very well maintained by various depots spread over hectares of land in various parts of Delhi and NCR.

REFERENCES:-

Report by Ojo Femi on www.seminartopics.com