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STUDY OF ELECTRICAL ASPECT IN RAILWAY LOCO SHED

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ABSTRACT: Loco shed refers to the home shed of any locomotive. It happens frequently that, locomotives travel to the different zones, and when they are off duty, they are then kept at temporary rest house, that is, the loco trip shed. Electric Loco Shed is nothing but an electric engine shed. We have visited and our study is carried out in the railway zone. It is the largest of locomotive sheds in the Eastern Railway zone.The main objective of this loco shed is to inspect and maintain the locos that operate throughout the year. The pantograph used in the electric railways is the main attraction in the study.

I. INTRODUCTION

The Electric Loco Shed, Ajni, under Central Railway's Nagpur division has achieved a milestone by completing maintenance of 222 locos in the current financial year. This is already 47 locos more than its capacity to overhaul 175 locos each year. The Central Railway is in process of increasing Shed's capacity to 200 locos which would pave way for even higher output in coming years. Loco shed at Ajni is considered best among 30 loco sheds in the country. In 2009-10 railway budget sanctioned works to increase its capacity from 120 to 175. However, in July 2014, even before expansion, it had flagged off its 200th locomotive. The shed was set up on September 22, 1990, to maintain goods train locomotives. In the past 27 years, it has come a long way and is now maintaining all types of locomotives that haul goods trains as well as premium trains like Rajdhani, Duronto and other mail/express ones.

The entire facility is spread over 18 acres of which the shed itself covers three acres. Now it is being expanded. The area in repair section has been extended and a 50-tonne capacity crane has been added. Similarly, auxiliary changing, transformer changing, work for underground pits each for inspection and testing and for carrying major schedules are being constructed. Besides, electronic lab having advanced testing facilities for various type of electronic cards used in 3-phase WAP 7 & WAP9 locos will also be in place. The shed has switched to LED lighting, which has helped save almost 10% energy till last month.

II. THE LOCO AND LOCO SHED

Loco is engine of the locomotives, Loco shed is the place where the maintenance of the locos has to be done, There are two types of loco shed,

a) ElectricalLoco shed
b) DieselLoco shed

III.ESTABLISHMENT

In 2009-10 railway budget sanctioned works to increase its capacity from 120 to 175. However, in July 2014, even before expansion, it had flagged off its 200th locomotive. The shed was set up on September 22, 1990, to maintain goods train locomotives. In the past 27 years, it has come a long way and is now maintaining all types of locomotives that haul goods trains as well as premium trains like Rajdhani, Duronto and other mail/express ones.

An electronic lab having advanced testing facilities for various type of electronic cards used in 3-phase WAP 7 & WAP 9 locos will also be in place. The shed has switched to LED lighting, which has helped save almost 10% energy till last month. Present loco holding is 120 to 175.

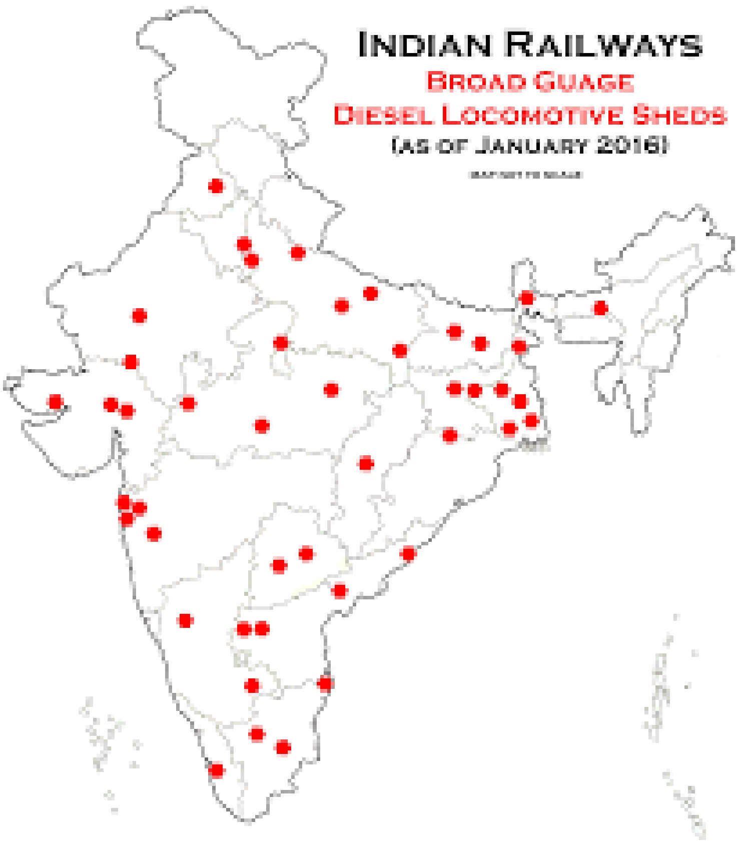

Fig.3.1. Electromotive sheds in India

IV. NO. OF SECTIONS

1) MECHANICAL WORKSHOP
2) ELECTRICAL WORKSHOP
3) PAINTING WORKSHOP

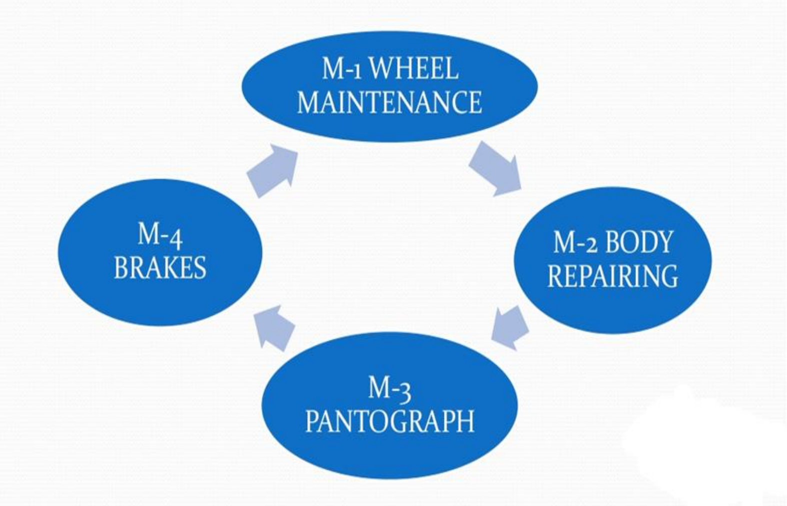

Fig.4.1 Arrangement of mechanical department

V. WHEEL AND AXLE ASSEMBELY WHEEL

Wheel of a rake is a specifically made cylindrical portion having outer edge shape to fit in the rail track. It is made of Stainless Steel. Wheel is the member of wheel and axle assembly which takes the complete load of the loco and rolls on the railway track to move the whole locomotive. Wheel is generally made up of stainless steel and at its inner side a flange is provided which helps wheel to make in proper contact with the track. The method of production of wheels is casting but due to some defects of casting such as inclusions, nonproper cooling and solidification there are some chances of failure to avoid this there should be use of forging as in case of metro wheels.

Fig.5.1. Arrangement of wheel and axle

VI. AXLE

Axle is the mail long cylindrical bar on which wheels are fixed with the help of bearings. This is also made of stainless steel like wheels. Each Axle contains two wheels the brake cylinder is also attached to it and the braking discs are fixed on the axle.

Fig.6.1. Arrangement of axle

VII. AIR BRAKE SYSTEM

Air Brake System in this compressed air is used for operating the brake system. The locomotive compressor charges the feed pipe and the brake pipe throughout the length of the train. The feed pipe is connected to the auxiliary reservoirs and the brake pipe is connected to the brake cylinders through the distributor valve. Brake application takes place by dropping the pressure in the brake pipe.

Two brake disks with diameter 640 mm and width 110 mm. In built slack adjusting brake cylinder fitted. Two-wheel discs. A taper roller cartridge type bearing is used and it makes up a preassembled unit. The axle bearings on the bogie are fitted with sensors for detecting speed (whose signal is elaborated by the ant slipping system) and a current return device. The ends of the control arms are fitted with centring devices for the primary suspension spring assembly. The bearing lubricating plug is fitted in the lower part.

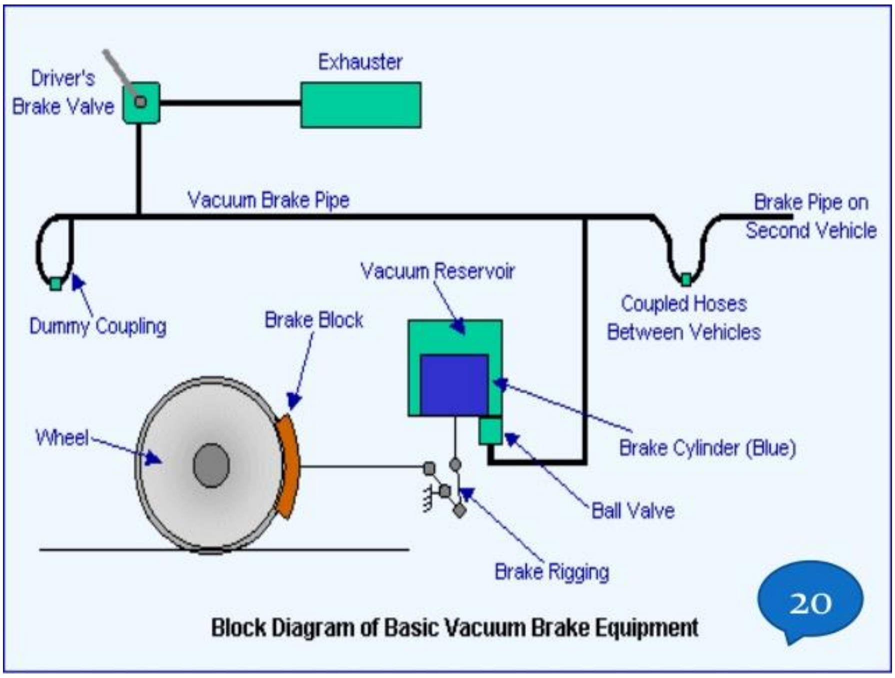

Fig.7.1. Air brake system in rail

VIII. PANTOGRAPH

A pantograph is a device that collects electric currents from overhead lines for electric trains or trams. It is spring loaded and pushes a contact shoes up against the contact wire to draw the electricity needed to run the trains. Pantographs are typically operated by compressed air from the vehicle's braking system, either to raise the unit and hold it against the conductor. Now a days all locos are running through Electricity with the help of OHE line Pantograph is used to connect the loco with OHE line Loco contains 2 Bogies, each Bogie consist of 6 wheels. So totally loco consists of 12 wheels. Pantograph draws 25 KV of electricity from OHE line, which is very high AC voltage. A pantograph is operated by the compressed air of compressor which is located nearby the compressed air cylinder of braking system. when brakes are applied there is no need of the electricity for running of the loco so the pantograph get down and after release of break when need of tractive power arises then once again the pantograph get raised and collects the electricity. Pantograph has some parts such as Upper arm, Lower arm, Coupling rod, Carbon strips (initially made up of mild steel), Lifting mechanism, Collector panel, Frame, Guiding rod etc. When the pantograph slides in contact with the OHE line then it collects electricity and sends it to a collecting device where it is stored and then it goes to the batteries and get stored.

VIII.I. SINGLE AND DOUBLE PANTOGRAPH

Pantographs may have either a single or a double arm. Double-arm pantographs are usually heavier, requiring more power to raise and lower, but may also be more fault-tolerant.

On railways of the former USSR, the most widely used pantographs are those with a double arm ("made of two rhomb's"), but since the late 1990s there have been some single-arm pantographs on Russian railways. Some streetcars use double-arm pantographs, among them the Russian KTM-5, KTM-8, LVS-86 and many other Russian-made trams, as well as some Euro-PCC trams in Belgium. American streetcars use either trolley poles or single-arm pantographs.

VIII.II. AC or DC traction

It doesn't really matter whether you have AC or DC motors, nowadays either can work with an AC or DC supply. You just need to put the right sort of control system between the supply and the motor and it will work. However, the choice of AC or DC power transmission system along the line is important. Generally, it's a question of what sort of railway you have. It can be summarised simply as AC for long distance and DC for short distance. Of course, there are exceptions and we will see some of them later.It is easier to boost the voltage of AC than that of DC, so it is easier to send more power over transmission lines with AC. This is why national electrical supplies are distributed at up to 765,000 volts AC . As AC is easier to transmit over long distances, it is an ideal medium for electric railways. Only the problems of converting it on the train to run DC motors restricted its widespread adoption until the 1960s.

DC, on the other hand was the preferred option for shorter lines, urban systems and tramways. However, it was also used on a number of main line railway systems, and still is in some parts of continental Europe, for example. Apart from only requiring a simple control system for the motors, the smaller size of urban operations meant that trains were usually lighter and needed less power. Of course, it needed a heavier transmission medium, a third rail or a thick wire, to carry the power and it lost a fair amount of voltage as the distance between supply connections increased. This was overcome by placing substations at close intervals – every three or four kilometres at first, nowadays two or three on a 750 volt system – compared with every 20 kilometres or so for a 25 kV AC line.

It should be mentioned at this point that corrosion is always a factor to be considered in electric supply systems, particularly DC systems. The tendency of return currents to wander away from the running rails into the ground can set up electrolysis with water pipes and similar metallics. This was well understood in the late 19th Century and was one of the reasons why London's Underground railways adopted a fully insulated DC system with a separate negative return rail as well as a positive rail - the four-rail system. Nevertheless, some embarrassing incidents in Asia with disintegrating manhole covers near a metro line as recently as the early 1980s means that the problem still exists and isn't always properly understood. Careful preparation of earthing protection in structures and tunnels is an essential part of the railway design process and is neglected at one's peril.

The mechanics of power supply wiring is not as simple as it looks (Figure 1). Hanging a wire over the track, providing it with current and running trains under it is not that easy if it is to do the job properly and last long enough to justify the expense of installing it. The wire must be able to carry the current (several thousand amps), remain in line with the route, withstand wind (in Hong Kong typhoon winds can reach 200 km/h), extreme cold and heat and other hostile weather conditions.

Overhead catenary systems, called "catenary" from the curve formed by the supporting cable, have a complex geometry, nowadays usually designed by computer. The contact wire has to be held in tension horizontally and pulled laterally to negotiate curves in the track. The contact wire tension will be in the region of 2 tonnes. The wire length is usually between 1000 and 1500 metres long, depending on the temperature ranges. The wire is zigzagged relative to the centre line of the track to even the wear on the train's pantograph as it runs underneath.

The contact wire is grooved to allow a clip to be fixed on the top side (Figure 8). The clip is used to attach the dropper wire. The tension of the wire is maintained by weights suspended at each end of its length. Each length is overlapped by its neighbour to ensure a smooth passage for the "pan". Incorrect tension, combined with the wrong speed of a train, will cause the pantograph head to start bouncing. An electric arc occurs with each bounce and a pan and wire will soon both become worn through under such conditions.

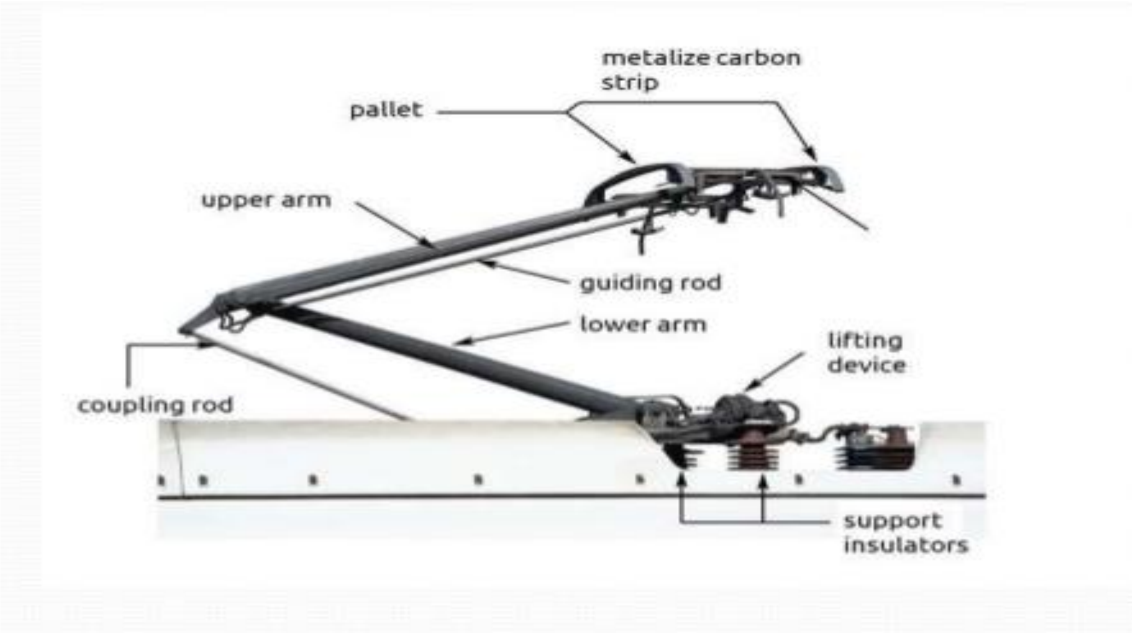

Fig.8.2.1. View of pantograph

VIII.III. AC SECTION

Overhead lines are normally fed in sections like 3rd rail systems, but AC overhead sections are usually much longer. Each subsection is isolated from its neighbour by a section insulator in the overhead contact as shown in this picture below. The subsections can be joined through special high speed section switches.

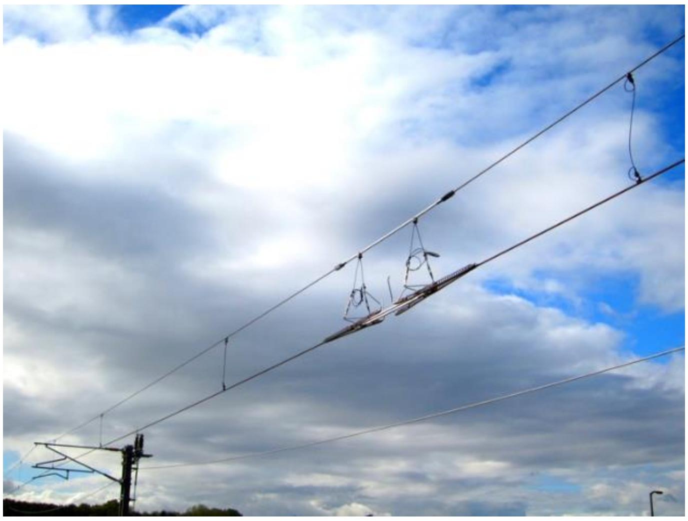

Fig. 8.3.1. Overhead Lines

VIII.IV. CATENARY SUSPENSION SYSTEMS

Various forms of catenary suspension are used (see diagram below), depending on the system, its age, its location and the speed of trains using it. Broadly speaking, the higher speeds, the more complex the "stitching", although a simple catenary will usually suffice if the support posts are close enough together on a high-speed route. Modern installations often use the simple catenary, slightly sagged to provide a good contact. It has been found to perform well at speeds up to 125 m/hr (200km/hr).

At the other end of the scale, a tram depot may have just a single wire hung directly from insulated supports. As a pantograph passes along it, the wire can be seen to rise and fall. This is all that is necessary in a slow speed depot environment. I haven't yet mentioned trolley poles as a method of current collection. These were used for current collection on low speed overhead systems and were common on trams or streetcars but they are now obsolete.

VIII.V. AUTO TRANSFORMERS

A more efficient system of AC electrification is known as the auto transformer system. In effect, it is based on distributing power at 50 kV AC but feeding the power to the trains at 25 kV AC. To achieve this, the supply sub-station transformer is provided with a centre tap secondary winding at 50 kV (set to 55 kV for the maximum limit of contact wire voltage of 27.5 kV). The centre tap is solidly connected to ground so that one terminal is at +25 kV and another at -25 kV. The two supplies at a phase difference of 180 degrees.

With this system, the contact wire is fed at +25 kV and the feeder wire at -25 kV thus the voltage in between these circuits is 50 kV but to ground is 25 kV. The insulation and clearances may still be designed for 25 kV AC only.

Fig. 8.5.1. Autotransformer

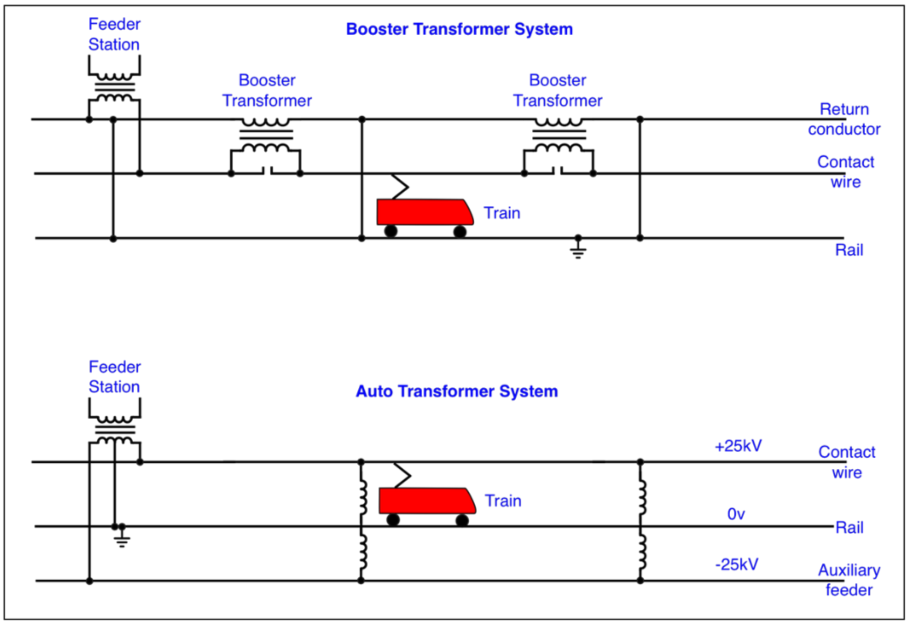

Fig. 8.5.2. Booster Transformer System

IX. BODY REPAIRING AND SUSPENSION

IX.I. PRIMARY AND SECONDARY SUSPENSION

Primary suspension consists of two steel coil springs (internal/external) laid out on the Control Arm upper part. Secondary suspension consists of two spring packs which sustain the bolster beam over the bogie frame. Each spring pack is made up by an internal and external spring. An Anti-roll bar fitted on the bogie frame realizes a constant, reduced inclination coefficient during running. The bogie frame is linked to the bolster beam through two vertical dampers, a lateral damper, four safety cables and the traction rods. The bogie frame is linked to the coach body through two yaw dampers.

Bogie frame, BOGIEFRAME, Rubberdisks, centringdisk, Internal spring, External spring, Bumpstops, Centring disk, Control Arm Lower Part, Plate, Block, Rubber joint, Control Arm Upper Part, Damper The traction Centre transmits traction and braking forces between bogie frame and body by a traction lever on the bolster beam pin and two rods. Disk Brakes – The FIAT bogie is fitted with pneumatic disk brakes. The pneumatically operated brake cylinders

The secondary suspension enables lateral and vertical displacements and bogie rotation with respect to body when running through curves. It is implemented by two spring packs which sustain the bolster beam,over the bogie frame, each spring pack is made up by an internal, and an external springmounted and positioned through the centringdiscs, An anti-roll bars,fitted on the bogie frame, realizes a constant, reduced inclination coefficient during running

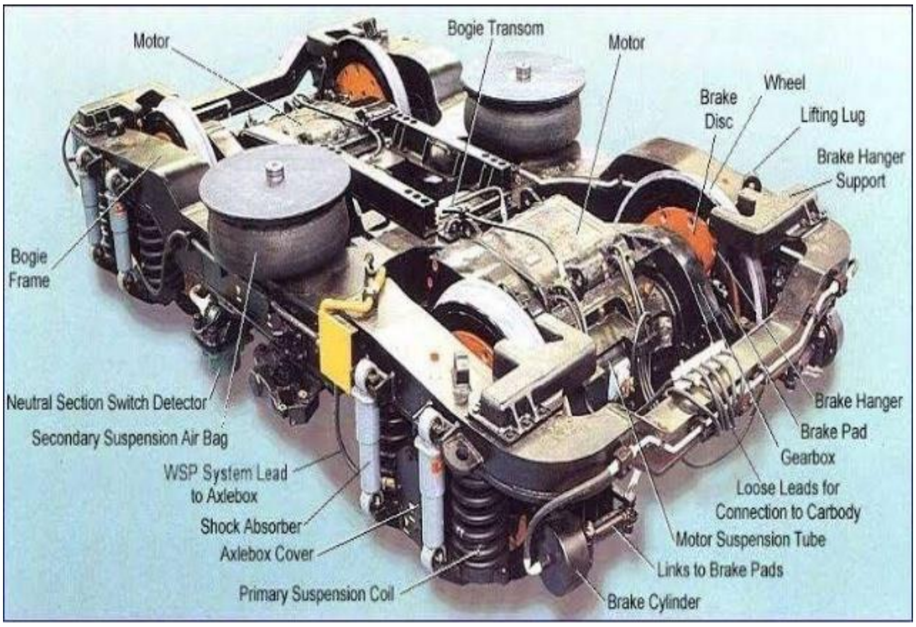

Fig. 9.1. Suspension system

X. ELECTRICAL FITTINGS AND OTHER PARAMETERS

Ensure proper condition of electrical distribution panels, ensure proper condition of shed wiring, it should not be in defective condition,ensure proper condition of switch boards etc., Ensure general upkeep of shed premises, Ensure proper cleaning of rooms, shop floor, pits, Keep scrap material in proper place and arrange for timely disposal, Display Electrical power, control and pneumatic circuit diagrams in trip shed premises, Staff shall be deputed for periodic training and refresher courses at training centresandmaintain record, Maintenance staff should be trained in a systematic manner for 3 phase loco technologyso that technology of 3 phase loco is imbibed smoothly for better and correctmaintenance practices, Staff shall be made familiar about advance/ digital tools by means of training for efficientworking, Display motivational slogans as and where possible.

XI. CONCLUSION

Study and frequent visit reveal the knowledge regarding loco shed of ajni rail loco shed. It is found that continuous upgradation of machines and method of testing is carried on, which result in most efficient production and economical.

XII. REFERENCE

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