14. Brake Systems

An efficient and reliable brake system is needed for stoppage of vehicle in minimum possible distance. The system should be such that vehicle should not experience jerks and should stop smoothly.

The railway brake system should have the following features :

- **Automatic application**. The brakes should apply automatically in case of train parting, or failure of power system.
- The brakes should apply as fast as possible.
- The brake should simultaneously apply on each vehicle of the train.
- The brake force should not reduce with passage of time.

Indian Railways have employed the following brake systems for its rolling stock :

Earlier most of our rolling stock are fitted with AVB (Automatic Vacuum Brake).

Air Brakes - Twin- pipe system of air brakes have been used in Mail/Express/Passenger trains and single- pipe system in our freight trains. Air Brakes are also used on the locomotive.

All wagons are fitted with hand brakes for stabling. Locomotives and brake van are fitted with hand brakes which can be applied while the train is in motion.

All locos are provided with compressor and or exhauster for brake system of loco and other vehicles of the train.

A-9 and SA-9 brake valve - In WDM2 loco, by application of A-9 handle simultaneous control of loco & train brakes is done. However, only loco brakes can be applied or released through Independent brake handle SA-9.

Dynamic Brake - Some Diesel and Electric locomotives are fitted with dynamic brakes for continuous application on down grades. On down gradient the traction motors are used as generators and thus Kinetic energy of train gets converted to electrical energy creating a retarding or braking effect. Electric energy so produced is fed to resistance grids where the electrical energy is converted to heat energy. This is ideal for controlling the train on Ghat sections or lowering the speed of train, but becomes quite ineffective at low speeds.

Vaccum Brake System

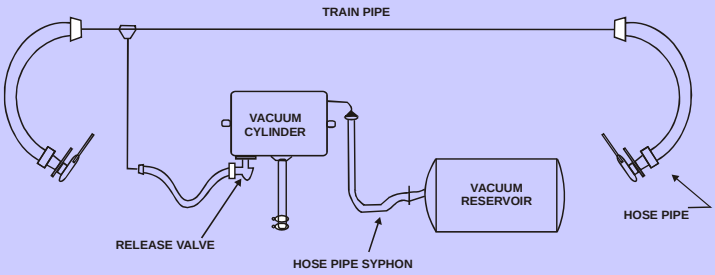

FIG. 7.2- Schematic arrangement of Vacuum Brake Equipment

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Vacuum Brake system consist of following component /assemblies - Vacuum Cylinder - Piston and Piston rod - Brake shaft - Brake rigging - Brake shoe

The vacuum brake system derives its brake force from the atmospheric pressure acting on lower side of piston while a vacuum is maintained above the piston. The vacuum is created in the system by exhauster provided in the locomotive.

The vacuum cylinder is divided by piston and rolling ring into two air tight chambers called upper chamber and lower chamber. The volume of upper chamber is kept as large as possible by providing a dome. The release valve is connected to train pipe by flexible siphon pipe, the lower end of piston rod is connected to brake shaft arm. When vacuum is created, release valve allows withdrawal of air from both chambers and piston by its own weight comes to rest at the bottom of cylinder and brakes are released. When vacuum in train pipe is destroyed, air enters the lower chamber, raising the piston. At this time upper chamber is disconnected by rolling ring. So vacuum is still there in upper chamber. The brake shaft arm is lifted with the movement of piston and brake shoes are jammed against the tread of wheel with the help of brake rigging. The release valve when operated allows air admission to upper chamber so that pressure is equalized on both sides of piston and brakes are released.

Vacuum Cylinder --IR has made many improvements in AVB to overcome its inherent drawbacks. These are discussed briefly.

Use of F type cylinder with Vac reservoir-- With the upward movement of piston in the traditional E type cylinder, the volume of upper chamber decreases, causing fall in vacuum level and drop in effective force. To partially overcome this drawback, a large vacuum Reservoir is attached to the upper chamber. The percentage change in vol. of upper chamber due to piston movement is negligible and hence brake force is not reduced.

Direct Admission Valve : The brake application takes quite some time and propagation rate is slow as air has to travel from locomotive to each vacuum cylinder throughout the train. To reduce this time delay, DA valves are fitted on each cylinder. The DA Valve connects the lower chamber to atmosphere immediately on drop in train pipe vacuum till lower chamber vacuum becomes equal to train pipe. Thus, brake application and propagation is faster.

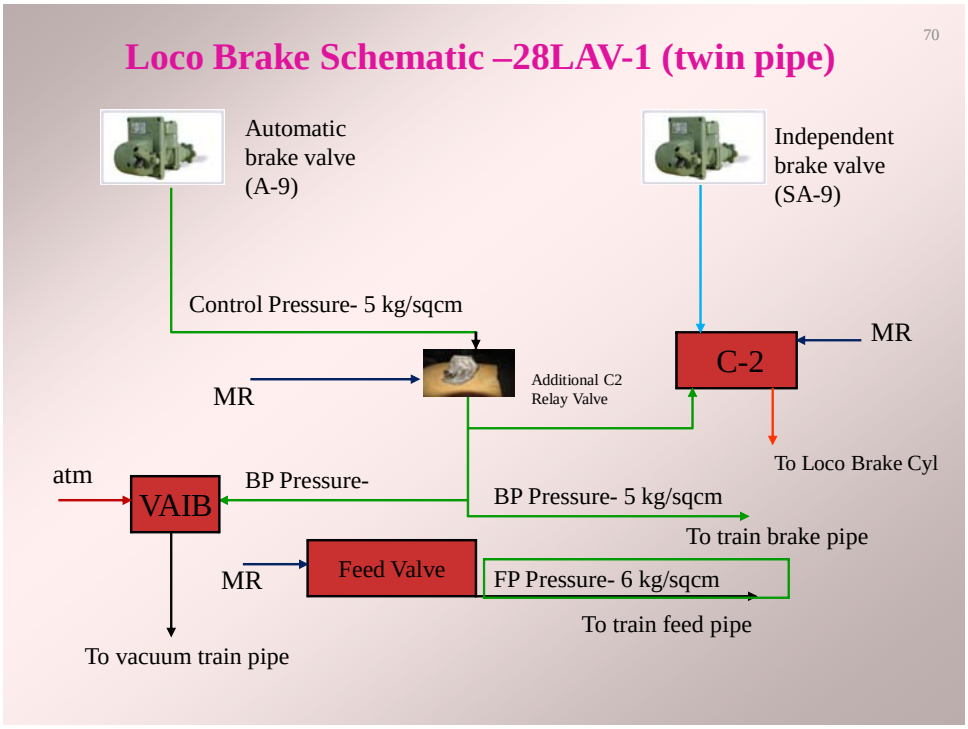
Slack adjuster : With the frequent brake application, the brake blocks wear out. The pins also wear and develop slack in the system. This absorbs part of piston movement and brake application is delayed and brake force reduces. The slack adjuster is a device which maintains brake shoe-wheel clearance to predetermined value even with the wear in the system.

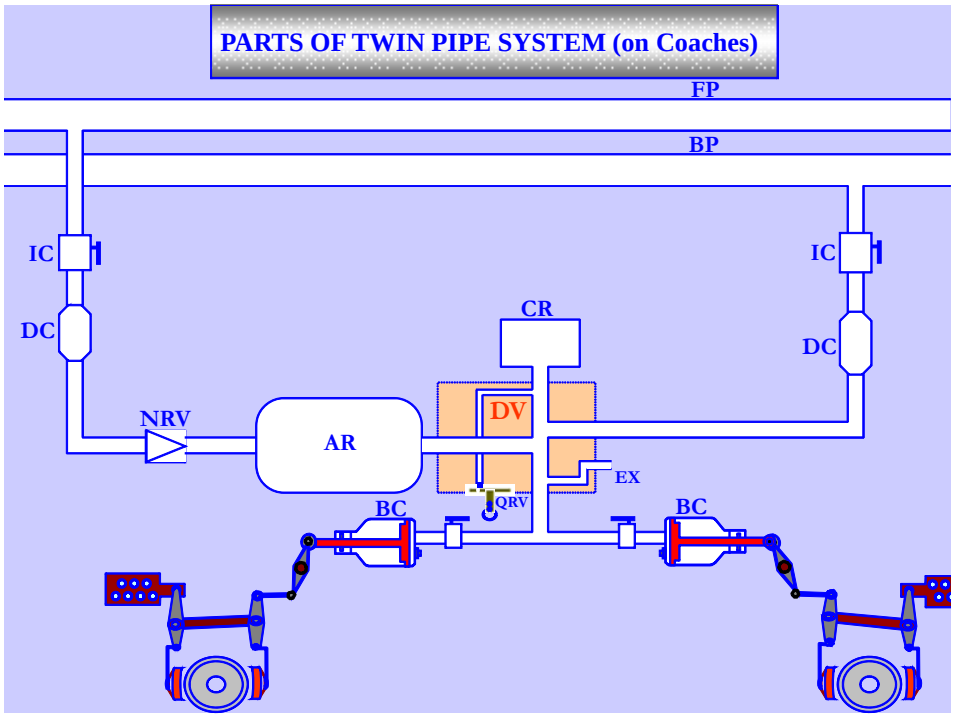
Empty load box: There is huge variation between tare and loaded weight of BOX and BOXN wagons. The brake rigging designed for one situation is not suitable for another situation. Empty load box is a device which alters the mechanical advantage of brake rigging for loaded and empty situations by simply operating a lever or wheel. It thus helps to get optimum brake force in loaded and empty conditions.

Alarm Chain Pulling signal fitted on Passenger coaches: The alarm chain running longitudinally along the coach length, when pulled, opens air delivery to vacuum system and rotates a disc at each end to identify the coach from which alarm chain was pulled.

The destruction of vacuum applies brakes to the train. Driver and Guard come to know of some emergency. This system is provided to enable passengers to able to stop the train in case of an emergency. The system was misused by roof travellers, who used to operate the clappet valve at the coach-end and stop the train. This system is being modified so that the valve cannot be operated from outside the coach.

Air Brake System:





Working of twin pipe air brake system

The feed pipe and brake pipe which run throughout the length of the train have air pressure at 6kg/cm2 and 5kg/cm2 respectively.

The compressed air is supplied by the compressor/ expressor on the locomotive and the pipes of adjacent coaches are joined by using flexible couplings. For application of brakes, the air pressure in the brake-pipe is reduced (the drop in pressure being proportional to the braking effort required).

This drop in pressure is sensed by the Distributor valve (DV) which allows compressed air from the Auxiliary Reservoir into the Brake cylinder and results in brake application.

When the discharge of air from the brake pipe is stopped, the pressure of 5kg/cm2 is restored and DV cuts off supply of air to the brake cylinder, thereby releasing the brakes. The brake cylinder develops a maximum air pressure of 3.5kg/cm2 during emergency brake application.

The function of the feed pipe having air pressure of 6kg/cm2 is to restore the air pressure in the brake pipe and the auxiliary reservoir after brake application so that the brakes get released quickly and the train can restart. Our goods trains are working on single pipe system in which only brake pipe is present & therefore charging of Auxiliary reservoirs is also through brake pipe.

Advantages of Air brake over Vacuum brakes –

- More efficient and powerful braking.
- Reduced braking distances - Uniform braking effort over the length of the train (in vacuum brake trains there is a 15to 20% reduction in brake power along the train length).
- Brake power maintained over long runs there by enabling end to end running (Vacuum brake trains experience a 10 to 15% deterioration in brake power within 500 kms. of run.)
- Requires less time for examination thereby reducing Pre-departure detention of trains for brake power certification Vacuum brake trains - takes 2 hours. Air Brake trains - takes 1 hours.
- Lighter weight of brake equipments thereby enabling higher pay loads for vacuum brakes - 685 kgs. per wagon. for Air brakes - 275 kgs. per wagon.

Alarm Chain Apparatus - Air Braked trains are also having alarm chain apparatus to enable stoppage of trains by passengers during emergency. However, to avoid incidence of train parting in certain conditions of chain pulling, a choke has been provided to reduce its effectiveness. But driver gets the indication through **'Air flow Indicator'** provided in the Locomotives and should apply brakes for expeditiously stopping the train.

15. 140 TON Diesel Break Down Cranes

All BG 'A' class accident relief trains (ART) are required to be equipped with 140 tons diesel crane or 65/ 75 ton steam train. However earlier most of ARTs were only equipped with only 75/ 65 ton steam crane which could not lift a loaded bogie wagon. Therefore, prior unloading of wagon was required before lifting loaded wagons, which led to lot of delay in carrying out restoration of traffic.

To overcome this problem in mid 80's, Indian railways have procured a few 140 tons diesel break-down cranes from M/s Gottwald, Germany and Cowans Sheldon, U.K. (also known as Jessops crane because of their collaboration with Jessops).

Maxm. Permissible Speed of these cranes are as under: Gottwald - 90 Kmph Jessops - 75 Kmph.

These cranes are required to be hauled by locomotive to reach the accident site, but at the site the cranes can move without loco. The self propelled speed of these cranes without load is 12 Kmph whereas with load it is 6 Kmph.

Safe Working Load: Though the cranes are designed to lift a maximum load upto 140 tons, but in actual working condition the safe working load will be limited on account of

- Working Radius
- Outriggers position
- Slewing Angle
- Counter weights

Charts are available in the cranes to indicate safe load limit under various conditions.

Features - Both the cranes are totally different in design.

Working Of Crane

- Crane should travel with jib lowered and in alignment with centre of track.
- **In Electrified Sections** - Power Block must be obtained & OHE should be switched off before crane operation.
- After counter weights are placed, the crane should not be swiveled without propping up the crane.
- Lifting of entangled loads should be avoided .
- Safe Load Limit should not be exceeded.

140 t Crane, 285 hp (1986)