“Vacuum braking system”
ABSTRACT

A moving train contains energy, known as kinetic energy, which needs to be removed from the train in order to cause it to stop. The simplest way of doing this is to convert the energy into heat. The conversion is usually done by applying a contact material to the rotating wheels or to discs attached to the axles. The material creates friction and converts the kinetic energy into heat. The wheels slow down and eventually the train stops. The material used for braking is normally in the form of a block or pad.
INTRODUCTION

- The vast majority of the world's trains are equipped with braking systems which use compressed air as the force used to push blocks on to wheels or pads on to discs.

- An alternative to the air brake, known as the vacuum brake, was introduced around the early 1870s, the same time as the air brake. Like the air brake, the vacuum brake system is controlled through a brake pipe connecting a brake valve in the driver's cab with braking equipment on every vehicle.
COMPONENTS OF THE VACUUM BRAKE SYSTEM

Block Diagram of Basic Vacuum Brake Equipment
Above diagram shows the principal parts of the vacuum brake system as applied to an electric or diesel train.

1> DRIVER’S BRAKE VALVE:
- The means by which the driver controls the brake. The brake valve will have the following positions:
  - Release
  - Running
  - "Lap" and "Brake On".
- There may also be a "Neutral" or "Shut Down" position.

2> EXHAUSTER:
- A two-speed rotary machine fitted to a train to evacuate the atmospheric pressure from the brake pipe, reservoirs and brake cylinders to effect a brake release.
3> BRAKE PIPE:

- The vacuum-carrying pipe running the length of the train, which transmits the variations in pressure required to control the brake.

4> DUMMY COUPLING:

- At the ends of each vehicle, a dummy coupling point is provided to allow the ends of the brake pipe hoses to be sealed when the vehicle is uncoupled.

5> COUPLED HOSES:

- The brake pipe is carried between adjacent vehicles through flexible hoses.

6> BRAKE CYLINDER:

- Each vehicle has at least one brake cylinder. Sometimes two or more are provided.
7> VACUUM RESERVOIR:
   - Vacuum is created by the movement piston in cylinder and stores.

8> BRAKE BLOCK:
   - This is the friction material which is pressed against the surface of the wheel tread by the upward movement of the brake cylinder piston.

9> BRAKE RIGGING:
   - This is the system by which the movement of the brake cylinder piston transmits pressure to the brake blocks on each wheel.

10> BALL VALVE:
   - The ball valve is needed to ensure that the vacuum in the vacuum reservoir is maintained at the required level.
“Calculation of braking force required”

- The equations used for the calculations of acceleration can also be used for calculating the braking distance except to the accelerating force becomes the braking force \( F_b \).
- The brake force \( F_b = p \times \eta \times \mu \)
- Where \( p = \) brake shoe pressure
  - \( \mu = \) co-efficient of friction between brake shoe and wheel
  - \( \eta = \) efficiency of braking
WORKING OF VACUUM BRAKE

- A vacuum has been created in the brake pipe, the vacuum reservoir and underneath the piston in the brake cylinder. The removal of atmospheric pressure from the system has caused the ball valve to open the connection between the vacuum reservoir and the brake pipe. The fall of the piston to the bottom of the brake cylinder causes the brake blocks to be released from the wheels.
“Position of piston, when brake is released”

Diagram of Vacuum Brake Cylinder - Brake Released
“Position of piston, when brake is applied”

Diagram of Vacuum Brake Cylinder - Brake Applied
‘Parts of brake cylinder’
“TWO PIPE SYSTEMS”

Schematic of Two Pipe Vacuum Brake System Used on BR Diesel Cars
“Use of two pipe system”

- Another version of the vacuum brake used two train pipes. The usual brake pipe operated in the conventional way but the second pipe was provided to give an additional supply to speed up the brake release. The second pipe is called the reservoir pipe.

- The two-pipe system was introduced on diesel railcars where the exhauaster was driven directly off the diesel engine.
“Advantage of vacuum braking system”

- simple in design
- ability to get partial release, something the pneumatic brake could not do without additional equipment
- highly reliable in the case of rail wagons
- Permits the automatic application of brakes down the entire length of the train from a simple control in the drivers hand
“CONCLUSION”

The vacuum brake was considered preferential to the air brake in railroad applications largely because it was cheaper to install on a steam locomotive. Air brakes required a steam-powered compressor - bulky, noisy, unsightly and using a lot of power, while the vacuum ejector used to generate vacuum was a much simpler device. It has the advantage of being simple in design and of having the ability to get a partial release, something the air brake could not do without additional equipment.
Thank You.