

UNIT

**3**

## Braking System

### Structure

- 3.0 Introduction
- 3.1 Functions of Brakes
- 3.2 Requirement of automobile Brakes
- 3.3 Stopping time and stopping distance
- 3.4 Types of Braking system - Disc and Drum Braking system
- 3.5 Construction and working of Mechanical, Hydraulic and Air brakes.
- 3.6 Bleeding of brakes in Hydraulic brakes.
- 3.7 List out types of Brakes used in various vehicles.

### Learning Objectives

After learning this unit, the student should be able to learn about .

- Purpose of brake, fundamental types of brakes in different vehicles
- Stopping time and stopping distance.
- Application of different types of brakes in various types of vehicle
- Commonly occurred troubles in brakes with their rectification

### 3.0 Introduction

In Automobiles brakes play important role in slowing down and stopping of the vehicle as and when required by the driver. Fundamentally the brakes are of two types (i) **Internal expanding** (ii) **External contracting type**. Different types of brakes are used in different vehicles as per the requirement. According to application, the brakes are of different types-**mechanical, hydraulic air, vacuum, Air assisted Hydraulic**.

### 3.1 Functions of Brakes

- (i) To slow down or to stop the vehicle as and when required.
- (ii) To control the vehicle when the vehicle is rolling down on a slope road down ward.
- (iii) To travel smoothly and safely even in heavy flow of traffic by controlling the movement of the vehicle.

### 3.2 Requirement of Automobile Brakes

- (i) The brakes must stop the vehicle within shortest possible distance.
- (ii) These must be released suddenly after releasing them
- (iii) Total control of the vehicle should be there

### 3.3 Stopping time and Stopping Distance

The stopping time and stopping distance shows the efficiency of brakes.

The maximum retarding force applied by the brake at the wheels,  $F$ , depends upon the coefficient of friction between the road and tyre surface  $\mu$  and the component of the weight of the vehicle on the wheel,  $w$ .

$$F = \mu w$$

In actual practice 100% of brakes efficiency is not used. The stopping time and distance depend upon

- (i) Vehicle speed
- (ii) Condition of road surface
- (iii) Condition of tyre tread.
- (iv) Coefficient of friction between the tyre tread and road surface.
- (v) Coefficient of friction between brake drum and brake lining (in case of Drum brakes).

- (vi) Coefficient of friction between the disc and the friction pad (in case of Disc brakes).
- (vii) Brake force applied by the driver.

However, during emergency braking, the reaction of the driver and response time of the brakes also play an important role. The total stopping distance in case of emergency braking may be divided into three parts :

- (i) Distance travelled during the reaction time of the driver.
- (ii) Distance travelled between the time elapsed between driver pressing the brake pedal and actual application of brakes at wheels.
- (iii) Net stopping distance, depending upon the deceleration.

Keeping all the factors in view, the assumed brake efficiencies for some of the vehicle may be like the values given in the table approximately.

Efficiency %	Approximate stopping distance (in metres) for the speeds			
	30 Km/H	50 Km/H	80 Km/H	100 Km/H
100	3.5	9.8	25.2	39.3
80	4.4	12.2	31.5	49.1
60	6.0	16.3	42.0	65.5
30	12.0	32.6	84.0	131.0

These values depend upon the distance travelled during the reaction time of the driver and distance travelled between applying pedal and actual application of brakes at wheels.

### 3.4 Types of Braking system - Disc and Drum Braking system

#### Disc Brakes

The disc brake consists a cast iron disc bolted to the wheel hub and a stationary housing called calliper. The Calliper is connected to some stationary part of vehicle, like axle casing or the stab axle and is cast in two parts, each part containing a piston. In between each piston and the disc, there is a friction pad held in position by retaining pins, spring plates etc.

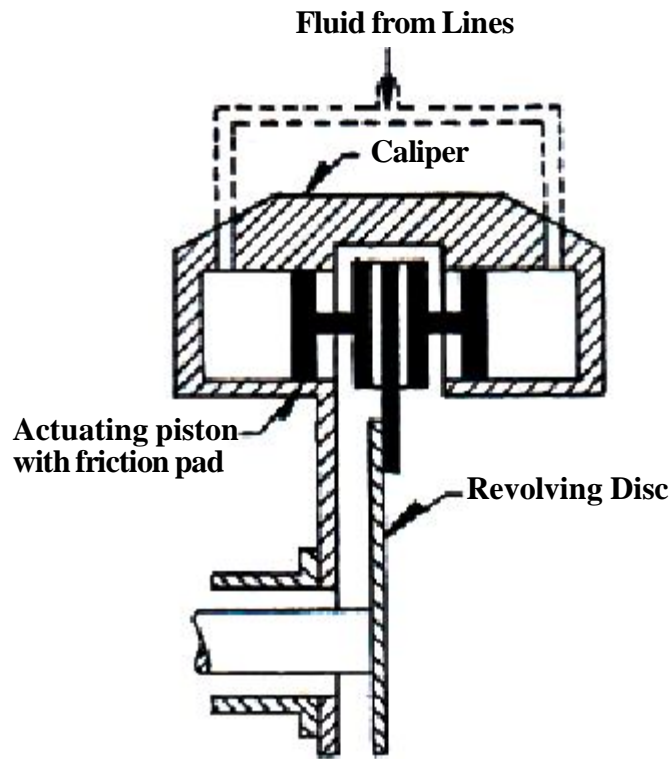


Fig 3.1 Disc Brake

When the brakes are applied, hydraulically actuated piston move the friction pads into contact with the disc, applying equal and opposite forces on the later. On releasing brakes, the rubber sealing rings act as return springs and retract the pistons and the friction pads away from the disc.

**Drum Brakes**

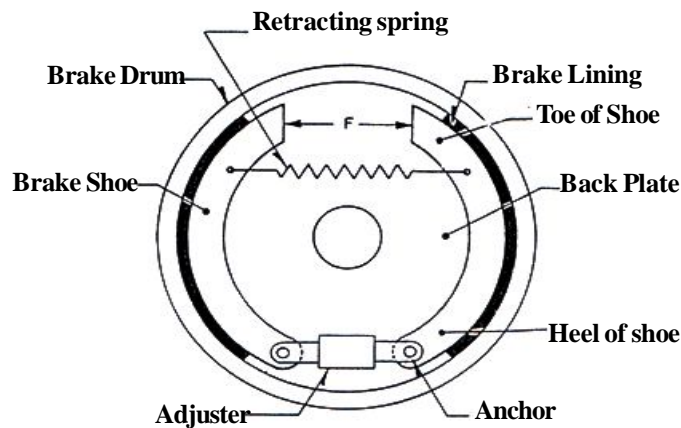


Fig 3.2 Drum Brake

In this type of brakes, a brake drum is attached concentric to the axle hub whereas on the axle casing is mounted a back plate. In case of front axle, the brake plates are bolted to the steering knuckle. The back plate is made of pressed steel and is ribbed to increase rigidity and to provide support for the expanding brake shoes. These brakes are also known as internal expanding brakes.

### **3.5 Construction and working of Mechanical, Hydraulic and Air brakes.**

#### **3.5.1 Construction and working of Mechanical Brakes**

These brakes are operated completely through mechanical links and lever. These are applied in two wheelers and these wheelers. These are also applied in four wheelers as parking or Emergency brakes. In the wheel drum there are two brake shoes which are linked closely by a retracting spring. There will be a can between the two shoes. When brake pedal is applied, the can will rotate causing the brake shoes expand against the force of the returning spring. This causes the shoes to rub against rotating wheel drum and thereby stopping it. When brake pedal is released, the can inside wheel drum will come back to its position causing the brake shoes to come back with the presence of returning position and thus releasing brakes.

#### **3.5.2 Construction and working of hydraulic brakes**

The hydraulic brakes are being operated in the Pascal's law which states that "The pressure applied on any liquid is equally transmitted to all the direction at the same time". In the same manner the pressure of brake pedal which is applied on the brake fluid in the master cylinder is transmitted to all the four wheel cylinder with equal pressure and at the same time. In this way the brake shoes which are attached to the wheel cylinder (s) are expanded and thus the brakes are applied.

The parts of hydraulic braking system are (i) Brake pedal (ii) Pull and push rod (iii)- Master cylinder (iv) Brake pipe lines (v) wheel cylinder (vi) brake shoes.

When the brake pedal is applied the piston inside the master cylinder is pushed forward and it caused the pressurized brake fluid moves forward to all the four wheel cylinder at the same time with same pressure. There at the wheel cylinder the brake shoes will be expanded with the developed pressure in the wheel cylinder. All the wheel cylinder will be operated at the same time according to Pascal's law. This is how the brakes are applied. While releasing brakes with contracting of brake shoes with spring force the brake fluid in the

wheel cylinder will try to go back to the master cylinder. As there is no pressure on the position of the master cylinder, the brake fluid push the check valve of master cylinder and the enter into the reservoir through barrel and by pass valve of master cylinder.

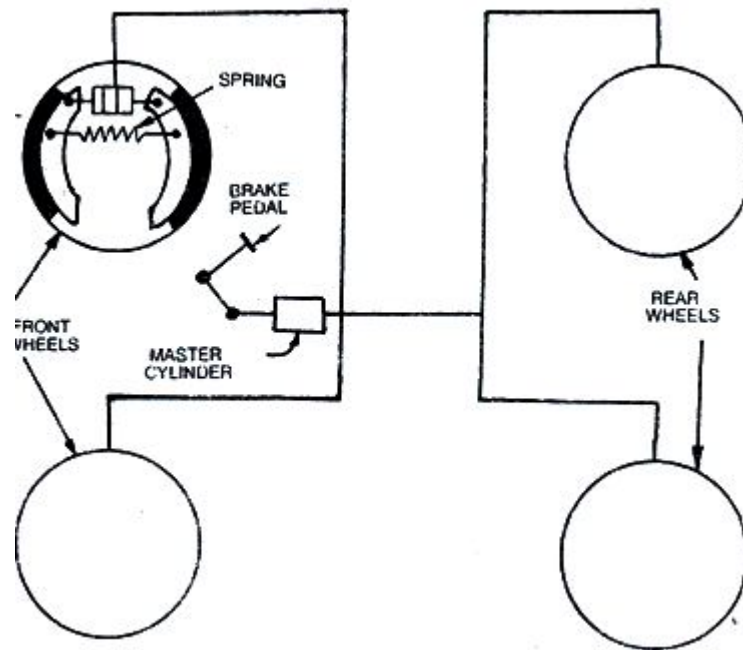


Fig 3.3 Hydraulic Brake System

### Master cylinder

It is the most important part of hydraulic braking system . It contains two main chambers .

- (i) Fluid reservoir – which stores the brake fluid in it
- (ii) Barrel-which is compressor and develops pressure in brake fluid

**(i) Reservoir :** The reservoir also contains two parts . The larger part is called filler or intake port and the smaller port is called by pas through which the returned fluid from the system will enter into reservoir from barrel.

**(ii) Barrel :** In the barrel of master cylinder the parts are – (a) Primary cup (b) Position (c) Secondary cup (d) Return spring (d) Return spring (e) Check value .

When the brake pedal is applied the push rod will push the piston of master cylinder and there by the pressure is applied on the Hydraulic Brake fluid. The pressurized brake fluid will enter into system through check valve

which does not allow the fluid to return back. This causes the pressure on the system and applying brakes at the wheel cylinder.

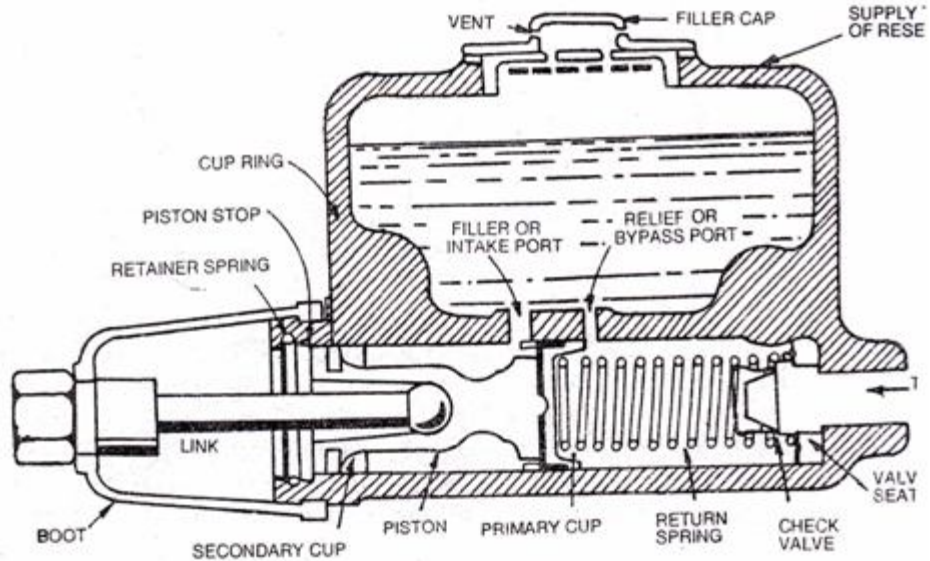


Fig 3.4 Master Cylinder

### Wheel cylinder

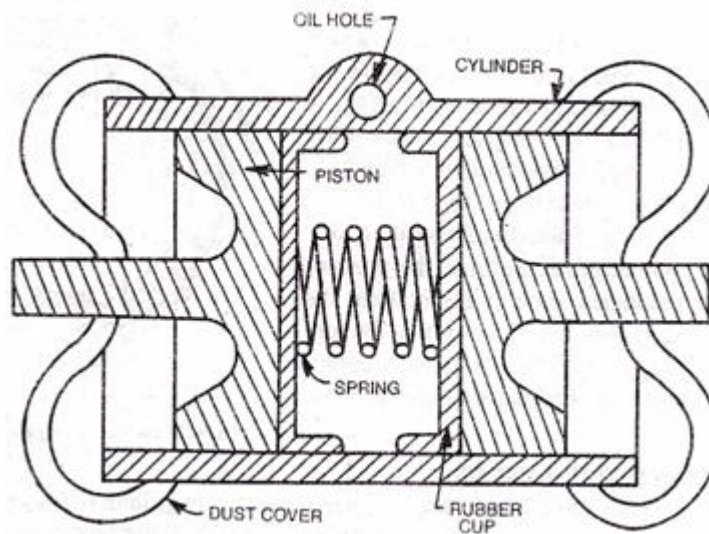


Fig 3.5 Wheel Cylinder

Wheel cylinder or slave cylinder assist the main master cylinder in covering the pressure to the piston inside it and push the brake shoes attached to it. Some of the wheel cylinder having one piston and some having two pistons. The wheel cylinder having one piston will operate only one brake shoe and the two wheel cylinder are require to operate two brake shoes. In some wheel cylinder, both brake shoes are operated as they are having two piston in them.

When brakes are applied the brake fluid enter into the cylinder through a brake pipe line. It cause to force out the piston. This motion is transmitted to brake shoes causing them to expand against the running wheel drum to hold it tightly and stop it.

### 3.6 Bleeding of brakes in Hydraulic brakes.

In Hydraulic Brakes, the removal of air from the entire Hydraulic system starting from master cylinder to different wheel cylinders is known as Brake Bleeding

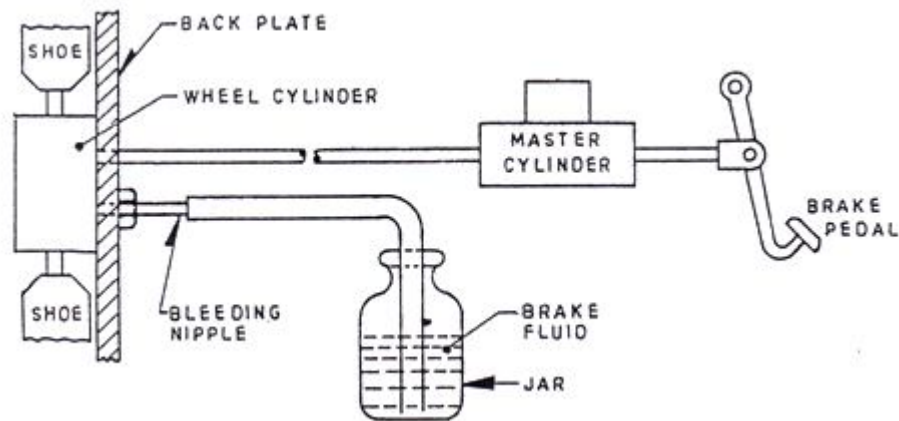


Fig 3.6 Wheel Cylinder

It includes the following process :

- (i) At first check all the pipe lines and junction boxes from master cylinder to wheel cylinder. Whether there is any leak among them.
- (ii) Ask one person to pump the brake pedal and keep it in pressing position
- (iii) The second person should loosen the bleeding nipple at the back plate of the wheel cylinder position.



- (iv) Keep the bleeding nipple in open until the air bubbles disappear and the brake fluid comes out with a force . Collect the brake fluid in a glass tumbler.
- (v) Then tighten the bleeding nipple
- (vi) Repeat this process in all the wheel cylinders starting from the farthest wheel to the master cylinder and ending with the nearest wheel.
- (vii) Make sure that the level of brake fluid in master cylinder is  $\frac{1}{4}$  less than the top covers while filling it.

### Air Brakes

The manufacturers of braking systems offer a variety of air brake equipment. However, the simplest system consists of an air compressor, a brake valve, series of brake chambers, unloader valve, a pressure gauge and a safety valve. These are all connected by lines of tubing. The other braking systems may have additional components such as stop-light switch, a low pressure indicator, an air supply valve to supply air for tyre inflation, a quick release valve to release air quickly from the front brake chambers when pedal is released, a limiting valve for limiting the maximum pressure in the front brake chambers and a relay valve to help in quick admission and release of air from rear brake chambers.

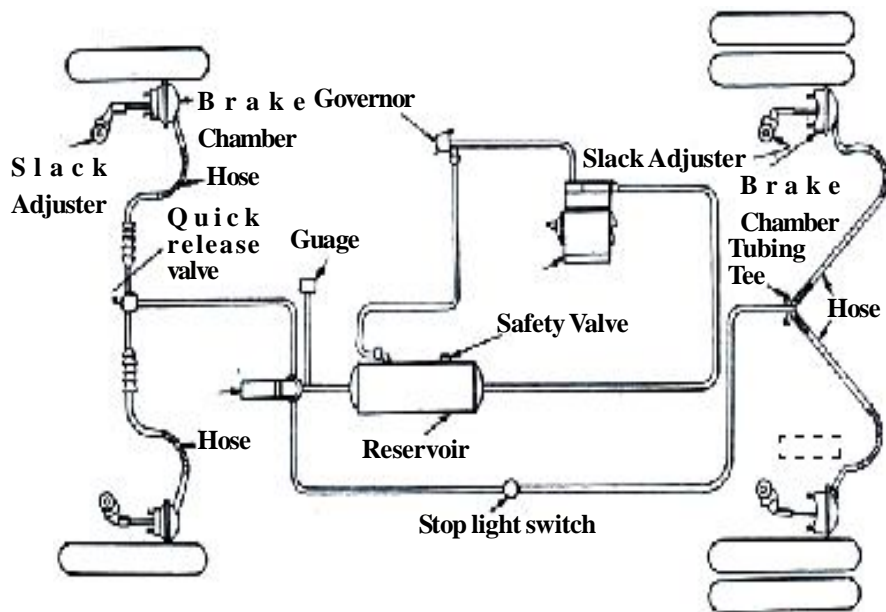


Fig 3.7 Air Brake

The compressor sends compressed air to the-reservoirs which are connected to the brake. valve. The lines of tubing from the brake valve extend to the front and rear brake chambers. When the driver depresses the pedal, it operates the brake valve thus admitting compressed air to all the brake chambers. The compressed air operates the diaphragm of the brake chambers thereby applying the brakes.

### 3.7 List out types of Brakes used in various vehicles.

S.No	Vehicle Make	Type of Brake	Dia of drum (mm)	Linings
1	Mamui (Suzuki) 800	Hydraulic Front-Disc Type Rear-Drum Type	Pad thickness = 15.5 mm Disc thickness = 11 mm Drum dia = 180 mm	Ferodo MR41 or DM85
2	Hindustan Ambassador Mark II	Hydraulic	203.2	Ferodo
3	Fiat 1000 (Premier Padmini)	Hydraulic	250.0	Ferodo
4	Jeep CJ Series	Hydraulic	221.6	Ferodo
5	Ashok Leyland Comet Passenger, Viking	Air Pressure Diaphragm-operated	393.7	Ferodo F3H
6	Dodge/Fargo Model 89 M4	Hydraulic, with com- pressed air booster	Front 406.4 Rear 431.8	Ferodo
7	Tata 1210 E	Hydraulic air pressure booster	Front 412.0 Rear 412.0	Ferodo
8	Standard 20	Hydraulic	319.4	Ferodo
9	Swanij Mazda	Hydraulic with vacuum booster	Front 300.0 Rear 228.6	Ferodo

## Summary

- Brakes are used to slow down or to stop the vehicle as and when required by the driver.
- Brakes are of two types
  - i. Internal Expanding brakes.
  - ii. External contracting brakes.
- According to usage, the brakes are classified as
  - i. Mechanical brakes
  - ii. Hydraulic brakes
  - iii. Air brakes
  - iv. Vacuum brakes
  - v. Air assisted hydraulic brakes
  - vi. Hydrovac brakes etc.
- Requirements of Brakes
  - i. The brakes must stop the vehicle within shortest possible distance.
  - ii. These must be released suddenly immediately after releasing them.
  - iii. Total control of the vehicle should be ther.
- Mechanical brakes are operated through mechanical links and levers.
- These are used in two wheelers and in case of 4 wheeler. These are used as 'Parking Brakes' or 'Emergency Brakes'.
- Hydraulic brakes are operated according to pascal's law which states that "the pressure applied on any liquid is equally transmitted to all the directions at the same time."
- Main parts of hydraulic brakes system are
  - i. Brake pedal
  - ii. Master cylinder
  - iii. Brake pipe line

iv. Wheel cylinder

v. Brake drum

- Air brakes are operated with the assistance of compressed air.

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### Short Answer Type Questions

1. What is the purpose of Brakes?
2. Define stopping distance?
3. Mention the main parts of hydraulic brakes.
4. On which law the hydraulic brakes work?
5. What is meant by 'Brake bleeding'?

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### Long Answer Type Questions

1. Briefly explain the construction and working of mechanical brakes.
2. Explain the hydraulic brakes with neat sketch.
3. Explain the master cylinder with neat diagram.
4. Explain the brake bleeding process with sketch.
5. Explain the air braking system with sketch.