
UNIT 6 BRAKING SYSTEM

Structure

- 6.1 Introduction
 - Objectives
- 6.2 Functions of Brakes
- 6.3 Principle of Vehicle Braking
- 6.4 Classification of Brakes
- 6.5 Short Notes on Miscellaneous Braking Systems
 - 6.5.1 Air Brakes
 - 6.5.2 Vacuum Brakes
 - 6.5.3 Electric Brakes
- 6.6 Hydraulic Brakes
- 6.7 Advantages and Disadvantages of Hydraulic Brakes
- 6.8 Construction and Working of Mechanical Brakes
- 6.9 Disc Brakes
- 6.10 Parking Brake or Emergency Brake
- 6.11 Bleeding of Brakes
- 6.12 Adjustment of Brakes
- 6.13 Summary
- 6.14 Key Words
- 6.15 Answers to SAQs

6.1 INTRODUCTION

Braking system is necessary in an automobile for stopping the vehicle. Brakes are applied on the wheels to stop or to slow down the vehicle.

Objectives

After studying this unit, you should be able to

- ,
- ,
- , and
- .

6.2 FUNCTIONS OF VEHICLE BRAKING

There are two main functions of brakes :

- (a) To slow down or stop the vehicle in the shortest possible time at the time of need.
- (b) To control the speed of vehicle at turns and also at the time of driving down on a hill slope.

6.3 PRINCIPLE OF VEHICLE BRAKING

Braking of a vehicle depends upon the static friction that acts between tyres and road surface. Brakes work on the following principle to stop the vehicle :

“The kinetic energy due to motion of the vehicle is dissipated in the form of heat energy due to friction between moving parts (wheel or wheel drum) and stationary parts of vehicle (brake shoes)”.

The heat energy so generated due to application of brakes is dissipated into air.

Brakes operate most effectively when they are applied in a manner so that wheels do not lock completely but continue to roll without slipping on the surface of road.

6.4 CLASSIFICATION OF BRAKES

On the Basis of Method of Actuation

- (a) Foot brake (also called service brake) operated by foot pedal.
- (b) Hand brake – it is also called parking brake operated by hand.

On the Basis of Mode of Operation

- (a) Mechanical brakes
- (b) Hydraulic brakes
- (c) Air brakes
- (d) Vacuum brakes
- (e) Electric brakes.

On the Basis of Action on Front or Rear Wheels

- (a) Front-wheel brakes
- (b) Rear-wheel brakes.

On the Basis of Method of Application of Braking Contact

- (a) Internally – expanding brakes
 - (b) Externally – contracting brakes.
-

6.5 SHORT NOTES ON MISCELLANEOUS BRAKING SYSTEMS

6.5.1 Air Brakes

Air brakes are applied by the pressure of compressed air. Air pressure applies force on brake shoes through suitable linkages to operate brakes. An air compressor is used to compress air. This compressor is run by engine power.

6.5.2 Vacuum Brakes

Vacuum brakes are a piston or a diaphragm operating in a cylinder. For application of brakes one side of piston is subjected to atmospheric pressure while the other is applied vacuum by exhausting air from this side. A force acts on the piston due to difference of pressure. This force is used to operate brake through suitable linkages.

6.4.3 Electric Brakes

In electrical brakes an electromagnet is used to actuate a cam to expand the brake shoes. The electromagnet is energized by the current flowing from the battery. When flow of current is stopped the cam and brake shoes return to their original position and brakes are disengaged. Electric brakes are not used in automobiles as service brakes.

6.6 HYDRAULIC BRAKES

The brakes which are actuated by the hydraulic pressure (pressure of a fluid) are called hydraulic brakes. Hydraulic brakes are commonly used in the automobiles.

Principle

Hydraulic brakes work on the principle of Pascal's law which states that "pressure at a point in a fluid is equal in all directions in space". According to this law when pressure is applied on a fluid it travels equally in all directions so that uniform braking action is applied on all four wheels.

Construction and Working of Hydraulic Brakes

When brake pedal is pressed, the force is transmitted to the brake shoes through a liquid (link). The pedal force is multiplied and transmitted to all brake shoes by a force transmission system. Figure 6.1 shows the system of hydraulic brake of a four wheeler automobile. It consists of a master cylinder, four wheel cylinders and pipes carrying a brake fluid from master cylinder to wheel cylinder.

Figure 6.1 : Hydraulic Brake

The master cylinder is connected to all the four-wheel cylinders by tubing or piping. All cylinders and tubes are fitted with a fluid which acts as a link to transmit pedal force from master cylinder to wheel cylinders.

Brake Fluid

The fluid filled in the hydraulic brake system is known as brake fluid. It is a mixture of glycerine and alcohol or castor oil and some additives.

Master cylinder consists of a piston which is connected to pedal through connecting rod. The wheel cylinder consists of two pistons between which fluid is filled.

Each wheel brake consists of a cylinder brake drum. This drum is mounted on the inner side of wheel. The drum revolves with the wheel. Two brake shoes which are mounted inside the drum remain stationary. Heat and wear resistant brake linings are fitted on the surface of the brake shoes.

Application of Brakes

When brake pedal is pressed to apply the brakes, the piston in the master cylinder forces the brake fluid. This increases the pressure of fluid. This pressure is transmitted in all the pipes and upto all wheel cylinders according to Pascal's law. This increased pressure forces out the two pistons in the wheel cylinders. These pistons are connected to brake shoes. So, the brake shoes expand out against brake drums. Due to friction between brake linings and drum, wheels slow down and brakes are applied.

As shown in Figure 6.2, two pipes carrying braked fluid are connected to front wheel cylinders which may be same as rear wheel cylinders. The front wheels may also have same type of brakes (drum brakes) as shown in the rear wheels. But, in modern cars, there are disc brakes in the front wheels and drum brakes in the rear wheels.

Figure 6.2 : Mechanical Brake (Internal Expanding Type)

Release of Brakes

When pedal is released, the piston of master cylinder returns to its original position due to retractor spring provided in master cylinder. Thus, fluid pressure drops to original value. The retractor spring provided in the wheel cylinders pulls the brake shoes and contact between drum and brake linings is broken. Therefore, brakes are released.

6.7 ADVANTAGES AND DISADVANTAGES OF HYDRAULIC BRAKES

Advantages

- (a) Equal braking action on all wheels.
- (b) Increased braking force.
- (c) Simple in construction.
- (d) Low wear rate of brake linings.
- (e) Flexibility of brake linings.
- (f) Increased mechanical advantage.

Disadvantages

- (a) Whole braking system fails due to leakage of fluid from brake linings.
- (b) Presence of air inside the tubings ruins the whole system.

6.8 CONSTRUCTION AND WORKING OF MECHANICAL BRAKES

Internal expanding shoe brakes are most commonly used in automobiles. In an automobile, the wheel is fitted on a wheel drum. The brake shoes come in contact with inner surface of this drum to apply brakes.

The construction of internal expanding mechanical brake is shown in Figure 6.2. The whole assembly consists of a pair of brake shoes along with brake linings, a retractor spring two anchor pins a cam and a brake drum. Brake linings are fitted on outer surface of each brake shoe. The brake shoes are hinged at one end by anchor pins. Other end of brake shoe is operated by a cam to expand it out against brake drum. A retracting spring

brings back shoes in their original position when brakes are not applied. The brake drum closes inside it the whole mechanism to protect it from dust and first. A plate holds whole assembly and fits to car axle. It acts as a base to fasten the brake shoes and other operating mechanism.

How Brakes are Applied and Released

When brake pedal is pressed, the cam turns through brake linkages. Brake shoes expand towards brake drum due to turning of cam. The brake linings, rub against brake drum and therefore motion of wheels is stopped. The pedal force is transmitted to the brake shoes through a mechanical linkage. This mechanism also multiplies the force to apply the brakes effectively.

When force on brake pedal is removed, the retractor spring brings back shoes in original position and brakes are released.

6.9 DISC BRAKES

Modern motor cars are fitted with disc brakes instead of conventional drum type brakes. In Santro car and Maruti-800, front wheels are provided with disc brakes whereas rear wheel are provided with drum brakes. A disc brake consists of a rotating disc and two friction pads which are actuated by hydraulic braking system as described earlier. The friction pads remain free on each side of disc when brakes are no applied. They rub against disc when brakes are applied to stop the vehicle. These brakes are applied in the same manner as that of hydraulic brakes. But mechanism of stopping vehicle is different than that of drum brakes.

Advantage of Disc Brakes

- (a) Main advantage of disc brakes is their resistance to wear as the discs remain cool even after repeated brake applications.
- (b) Brake pads are easily replaceable.
- (c) The condition of brake pads can be checked without much dismantling of brake system.

Disadvantage of Disc Brakes

- (a) More force is needed be applied as the brakes are not self emerging.
- (b) Pad wear is more.
- (c) Hand brakes are not effective if disc brakes are used in rear wheels also. (Hand brakes are better with mechanical brakes).

6.10 PARKIG BRAKE OR EMERGENCY BRAKE

Parking brakes or emergency brakes are essentially mechanical brakes operated by hand. These are used to prevent the motion of vehicle when parked at a place or when parked on slopes. In cars, these brakes are generally attached to rear wheels. In this type, a cable connects the hand lever to the brake. Brakes are applied by pulling the lever and released by pushing a button (provided on lever) and pressing the lever down.

6.11 BLEEDING OF BRAKES

When air enters, into the brake system and any brake line is disconnected, bleeding of brakes has to be done. Since air is compressible so any presence of air inside brake lining does not allow to transmit brake force to apply brakes. Therefore, the system must be free from presence of air. *Bleeding is the process of removal of air from the braking system.*

Bleeding Procedure

Following steps are followed for bleeding of brakes :

- (a) Remove all dirt from the master cylinder filler plug. Then fill the master cylinder upto lower edge of the filler neck by removing the filler plug.
- (b) Clean all the bleeding connections provided on all wheel cylinders.
- (c) After this bleeder hose and fixture is connected to that wheel cylinder which has longest brake line. The other end of bleeder hose is placed in a glass jar, and submerge this end in the brake fluid.
- (d) Now bleeder valve is opened by half to three quarter turn.
- (e) Then press the foot pedal and allow it to return back slowly.
- (f) This pumping action must be continued till all the air along with some brake fluid comes out through bleeding hose.
- (g) After this bleeding operation is carried out on all wheel cylinders. This completes the bleeding operation. At the end master cylinder is filled with brake fluid to required level.

6.12 ADJUSTMENT OF BRAKES

When pedal is pressed to apply brake, there should be atleast 1/2 inch free pedal movement before breaking action starts. This may vary from company to company.

The brakes are adjusted as per the above mentioned recommendation before they are ready to use. This is done by following a definite procedure.

- (a) List the wheels by screw jack.
- (b) Loosen the lock nut for the forward brake shoe and keep it in this position.
- (c) Turn the eccentric with other wrench towards the front of automobile till the brake shoe touches the drum.
- (d) Release the eccentric while turning the wheel with one hand, till wheel turns freely.
- (e) Hold the eccentric in this position and tighten the lock nut.
- (f) Repeat the same operation to adjust other shoe, but turn the eccentric in the backward direction of the vehicle.
- (g) Above procedure is repeated for all the four wheels.

SAQ 1

- (a) Write the functions of brakes in an automobile.
- (b) Explain the construction and working of mechanical brakes.
- (c) Describe in brief the construction and working of hydraulic brakes.
- (d) Write the advantages and disadvantages of hydraulic brakes.
- (e) Write short notes on :
 - (i) Vacuum brakes,
 - (ii) Electrical brakes, and
 - (iii) Air brakes.

SAQ 2

- (a) What are the functions of parking or emergency brakes?
- (b) What do you mean by bleeding and adjustment of brakes?
- (c) Describe the procedure of bleeding of brakes.
- (d) Describe the procedure of adjustment of brakes.
- (e) Why disc brakes are better than drum type brakes?

6.13 SUMMARY

6.14 KEY WORDS

6.15 ANSWERS TO SAQs

Refer the preceding text for all the Answers to SAQs.