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Comparative Study between Mechanical and Hydraulic Braking System

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ABSTRACT: This paper states the comparison of purely mechanical braking system and hydraulic braking system on the basis of different parts used, construction, working principle, pros and cons etc.

Mechanical brakes consist of mechanical elements for the deceleration or stop of axes in equipment drives. They use levers or links to transmit force from one point to another. Braking slows or stops the movement of the coupled axes. There are several types of mechanical brakes. Band brakes, the simplest brake configuration, have a metal band lined with heat and wear-resistant

In a hydraulic brake system, when the brake pedal is pressed, a pushrod exerts force on the piston(s) in the master cylinder, causing fluid from the brake fluid reservoir to flow into a pressure chamber through a compensating port.

KEYWORDS: Mechanical brakes, Hydraulic brakes, band brakes, braking system

I. INTRODUCTION

The mechanical braking system powers the hand brake or emergency brake. It is the type of braking system in which the brake force applied on the brake pedal is carried to the final brake drum or disc rotor by the various mechanical linkages like cylindrical rods, fulcrums, springs etc. In order to stop the vehicle. In this system large efforts needed due to mechanical linkages, but if we work smartly then we can reduce this effort by using mechatronics system.

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Components of Mechanical Brakes

Some of the components of mechanical brakes are as follows

- Brake Shoes or Pads: These are made of friction material that presses against the drum or rotor to create friction and slow down the wheel's rotation.
- Brake Drum or Rotor: This is a rotating component that the brake shoe or pad presses against to create friction and slow down the wheel's rotation.
- Caliper or Brake Lever: This is the component that applies pressure to the brake shoe or pad to create friction and slow down the wheel's rotation.
- Brake Fluid: This is used in hydraulic brakes to transfer the pressure from the brake pedal to the caliper or brake lever.

Working principle of Mechanical brakes

Mechanical brakes work by converting kinetic energy (motion) into thermal energy (heat) through friction. When the brake pedal or lever is pressed, the brake shoe or pad presses against the drum or rotor, creating friction. This friction



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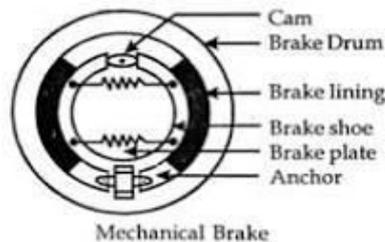
converts the kinetic energy of the moving object into thermal energy, which is dissipated into the environment. As a result, the object slows down or comes to a stop.

Advantages of Mechanical brakes

- Reliability: Mechanical brakes are simple and reliable, making them ideal for use in harsh environments or where other types of brakes may fail.
- Cost-effective: Mechanical brakes are less expensive than other types of brakes, making them a cost-effective solution for many applications.
- Easy to maintain: Mechanical brakes are easy to maintain, and most of the components can be replaced individually, which reduces downtime and repair costs.

Disadvantages of Mechanical brakes

- Low stopping power: Mechanical brakes have limited stopping power compared to hydraulic or electromagnetic brakes, making them unsuitable for high-performance applications.
- Heat buildup: Mechanical brakes generate a significant amount of heat, which can cause damage to the components or affect their performance if they are not properly cooled.
- Wear and tear: Mechanical brakes experience wear and tear, which reduces their performance over time and requires frequent replacement of brake



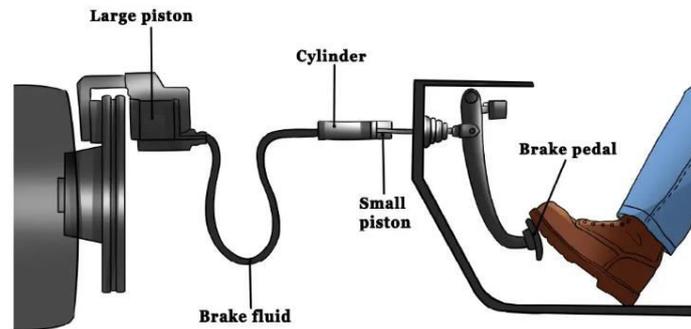
Components of Hydraulic Brake

- Brake Pedal/Brake Lever. The brake pedal or brake lever is also known as an input device as it is used to determine when the brakes will be activated and deactivated.
- Master Cylinder.
- Reservoir Tank.
- Hydraulic Pipe.
- Caliper / Brake Actuator.

Working principle of Hydraulic brake

Hydraulic brakes are a type of braking system that uses oil pressure from the brake lever to push the piston. To operate it, the hydraulic brake is quite easy to use because it only requires one finger. This advantage certainly makes the braking system easier to do and avoid your hands getting tired quickly. This system is certainly also very helpful, especially when you are driving on rocky or steep terrain.

The way the car works is based on Pascal's law where the fluid material is used to transmit the braking force from the brake pedal. Although it is easier to use, this system also has drawbacks, especially in terms of maintenance. Vehicle owners must check the oil regularly and require special tools to fill brake fluid. This makes you need to routinely carry out hydraulic brake maintenance at the workshop.



Advantages of Hydraulic Brakes:

- Does not experience expansion because it uses fluid instead of wire cables
- Maximum braking power or more grip
- Does not make annoying noise when braking

Disadvantages of Hydraulic Brakes:

- The components use are more complex
- If there is a leak in the fluid, it has the potential to damage the car components because it has acidic properties

II. MECHANICAL BRAKING SYSTEM VS HYDRAULIC BRAKING SYSTEM

TABLE I

Sr. No.	Particulars	Description
1	Cost	Mechanical discs brakes are cheaper than Hydraulic disc brakes
2	Maintenance	Mechanical disc brakes usually require less maintenance than hydraulic disc brakes
3	Wear & Tear	Mechanical disc brakes tend to wear out faster than hydraulic disc brakes.
4	Pressure	Hydraulic disc brakes use hydraulic pressure to power pistons, whereas mechanical disc brakes rely on the friction between a pad and a rotating drum that is linked to one or two calipers.
5	Efficiency	Hydraulic systems are generally considered more powerful and efficient than mechanical systems, and they also require less maintenance.
6	Impact of weather	Hydraulic systems can also be more susceptible to damage from freezing weather, while mechanical systems are not.
7	Impact of temperature	The hydraulic lines are relatively immune to changes in temperature; a hydraulic disc brake system is less likely to experience performance problems in extreme weather conditions.
8	strength	A hydraulic disc brake system also requires less hand strength than a mechanical disc brake system.



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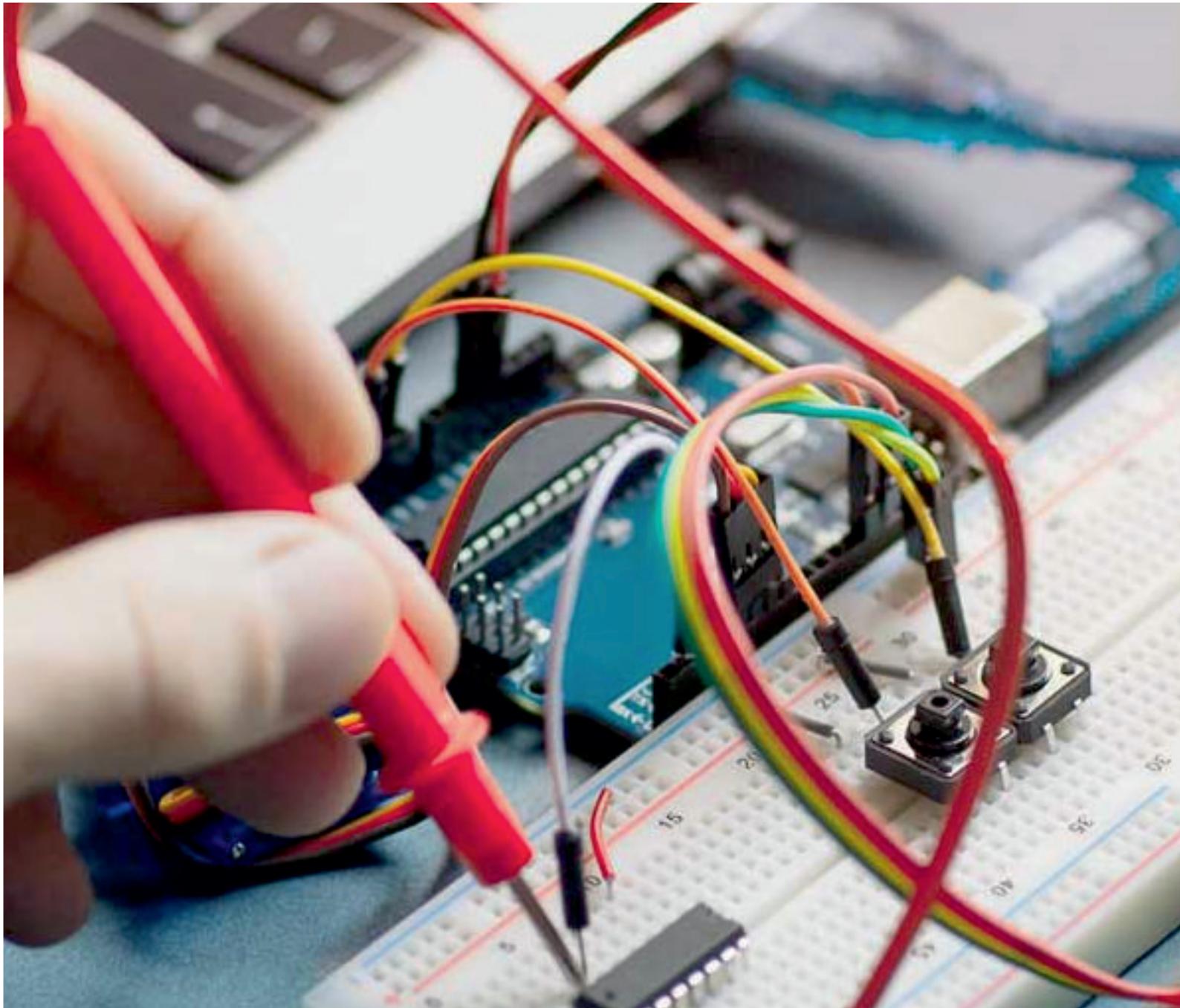
III. CONCLUSION

In Mechanical braking system lots of efforts required due the mechanical linkages, high wear and tear occurs and this effort can be reduced by using hydraulic braking system.

According to the priority an Automobile industry always focusing on braking systems. Mechanical brakes were used in many old automobiles, but they are now obsolete due to their ineffectiveness. However, there may be some mechanical braking flaws in the system. To overcome these problems specially for reducing efforts we must go with hydraulic braking system.

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