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HYDRAULIC BRAKING SYSTEM

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ABSTRACT

The focus of this project was the development of a physical model to show the transfer of forces from the mechanical domain to the hydraulic domain, and round back to the mechanical domain. To do this, a wheel was designed to be stopped untold a brake connected hydraulically to a set of calliper's and a brake rotor. Using a motor the wheel on the dead axle was spun and once the wheel acquired enough speed, mechanical force was applied to the hand brake to bring the wheel to a stop. Calculations for the model were made to determine flexure, stress concentrations, natural frequency and the mechanical advantage of the braking system.. Once all these calculations ensured that the successful working of the model, it was proceeded with construction of a physical model was constructed. The physical model was tested during its operation and it showed that the calculations were accurate. The final model successfully shows the shift of mechanical force (generated when the user squeezes the handle) to hydraulic force (on the moving of piston) to mechanical force, which creates friction between the callipers' and the brake rotor to bring the rotating wheel to a stop.

1. INTRODUCTION

Hydraulic braking system is a type of braking system which compared to the mechanical braking system utilizes the hydraulic fluid to transmit the brake pedal or brake lever force towards the final drum shoes or disc calliper so that one can achieve braking. In this type of braking system the mechanical force applied by the driver on the brake pedal is changed into the hydraulic pressure by a device known as master cylinder and then the obtained hydraulic pressure is sent to the final drum or disc calliper in order to enable the deacceleration the vehicle. Brake fluid is used in hydraulic brake mechanism. Glycol is used to transfer pressure from controlling system to brake apply system.

2. LITERATURE REVIEW

Brakes and tires are two essential component of the automation system in a car. Meanwhile, a large portion of safety factors are focused on the selection of the most efficient brake system along with the most durable and fit tires. That's why since the early times in the history of car manufacturing the form and functionality of both brake systems and tires have been in continual development. For brake systems, mechanical drum brake was the earliest brake form that was invented in 1902 by Louis Renault, the French car manufacturer .Meanwhile, the concept of brake system was initiated by Gottlieb Daimler who devised a drum with an anchoring cable to the vehicle's body is useful for stopping the car .Then, the internal shoe brake was invented and used widely then it was abandoned by the invention of hydraulic brakes in 1920s to avoid the problem of shoe brake that was susceptible to many factors like temperature. In the middle of the 20th century, the Disc brakes were invented to go with the new types of vehicles that were faster ad heavier in weight as well. However, some companies decided to make a mix between the two systems for example the Chrysler Imperial to get the advantages of both system, so that we can have the new hydraulic disc brake system. Recently, with the progress in development, the world has the new anti-lock brake system, or (ABS) that prevented the lock of brakes while one is driving. Wheels were the most significant invention in the history of humans as it enabled them to transport their objects and to travel on carts from place to another. However, metal tires were used in first car in history. Then metal tires were replaced by rubber filled with air in 1905 which was the first pneumatic tire with a tread. In 1931 the synthetic rubber was introduced by the DuPont Company which led to increase in tire production. In 1947 tubeless tire were introduced in order to reduce costs. It helped reduce weight and make saving of fuel. It was followed by the invention of radial tires in the 1950s, with cords and carcass plies. Then in 1979, the run-flat tire were developed which allowed the enabled tires to run with puncture. With enhancements for brakes and car drivability, the tires are now greater in size than 16 inches

3. TYPES AND CONSTRUCTION DETAILS

Types

The Hydraulic braking system has been classified on 2 basis-

1. ***Based on frictional contact mechanism***

(i) Drum brake also referred as internal expanding hydraulic brakes

(ii) Disc brakes also referred as external contracting hydraulic brakes.

2. ***Based on brake force distribution***

(i) Single acting hydraulic brakes

(ii) Dual acting hydraulic brakes

Drum brake: -It is a brake that utilizes the friction caused by the shoes or pads that press outwards towards a rotating cylinder-shaped part referred to as brake drum. The term drum brake usually refers to a brake in which shoes are pressed on the inner surface of the drum. When shoes are pressed on the outside region of the drum, it is commonly called a clasp brake. A pinch drum brake refers to when the drum is pinched between two shoes, quite similar to a conventional disc brake. Another type called a band brake makes use of a flexible belt or "band" wrapping around the outside of a drum.

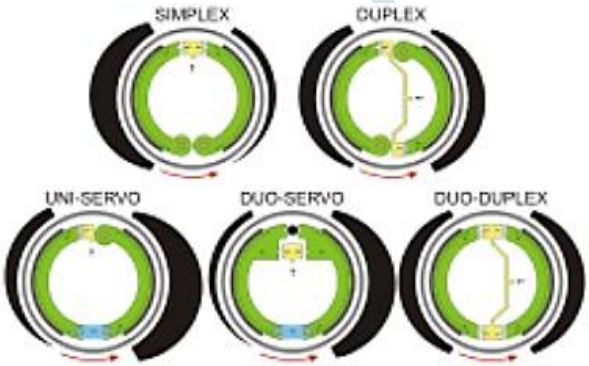

Fig 1 Drum brakes

Disc brake makes use of the callipers to squeeze pairs of pads against a disc or a rotor to generate friction. This action slows down the rotation movement of a shaft, such as a vehicle axle. The motion energy is converted into waste heat which must be distributed. These are the most commonly used types of brake for motor vehicles

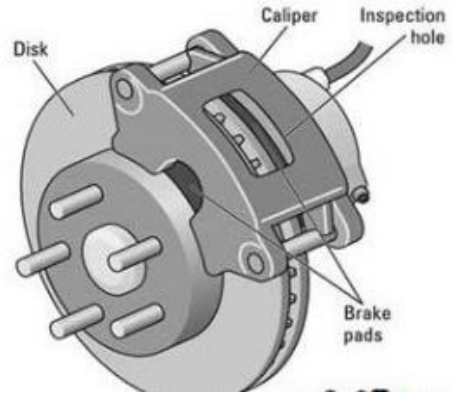

Fig 2: Disc brake

3. METHODOLOGY

The friction between the pads and the rotor causes a braking torque to be generated, which bring down slow speed. Heat generated by this friction is released through vents and channels in the rotor or is transferred through the pads, which are made of special heat-tolerant substances such as Kevlar or sintered glass. In similar fashion, in a drum brake, the fluid moves into the wheel cylinder and presses one or two brake shoes towards the inside of the spinning drum. This action first relieves the hydraulic pressure on the calliper, and then applies suction to the brake piston in the calliper assembly, moving it back into its housing and enabling the brake pads to release the rotor.

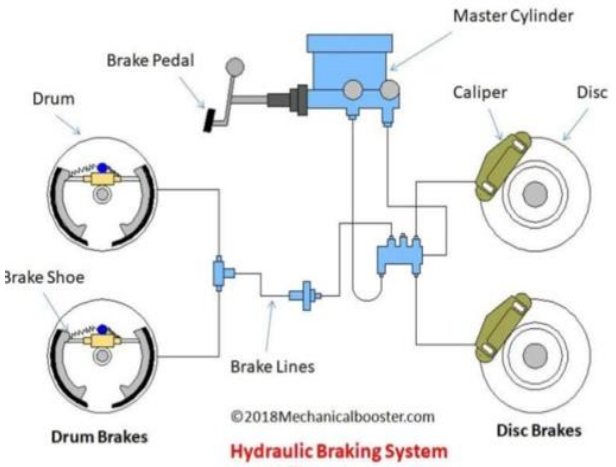

Fig 3: Construction of Hydraulic braking system

Working of master cylinder of hydraulic brake:

i) Brakes applied:

When the brake pedal is used, the pushrod moves the piston towards the action of the spring force. When sufficient pressure is built up, the rubber cap of fluid check valve deflects and the high-pressure fluid enters the wheel cylinder through fluid lines and operates the brake shoe against the revolving drum.

ii) Brakes released:

When the pedal is allowed to release, the piston return towards its initial position due to the spring force and stops the fluid check valve for a short duration to avoid entry of any air. The fluid from the lines also comes back in the compression chamber by lifting the check valve off its seat.

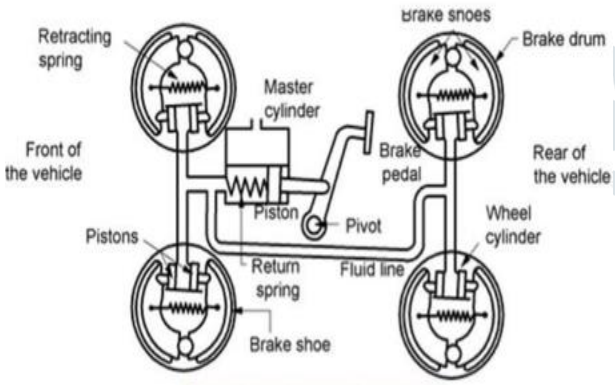

Fig 4: Hydraulic braking system

Method of Bleeding of hydraulic brakes:

1) Pressure Bleeding

The master cylinder is supplied pressurized brake fluid from the pressure bleeder. the pressure force air and brake fluid out of the bleeder screw on the opening of the bleeder screw. With the aid of pressure bleeder, one can bleed the hydraulic system without requiring helper.

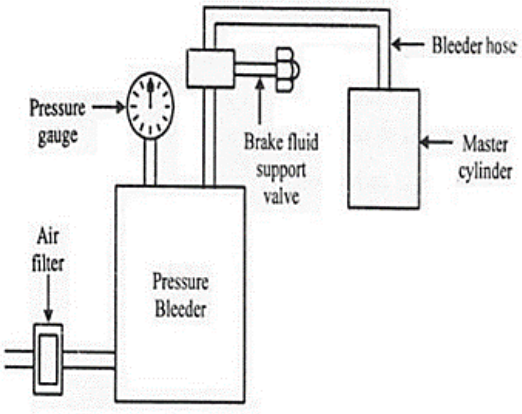

Fig 5: Pressure bleeding

2) Manual Bleeding

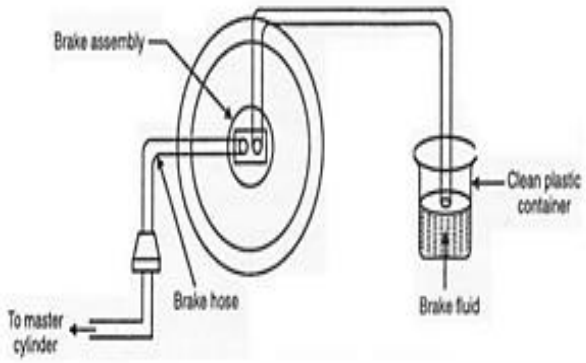

Fig 6: Manual bleeding

Two service technicians are required for the operation of manual bleeding process. One technician works towards opening the bleeder and the other operator depresses the pedal, to force out air and brake fluid from the bleeder screw.

3) Gravity bleeding

Gravity bleeding is the method of bleeding that utilizes the earth's gravity to bleed air from the hydraulic system. It requires no application of external force is to the brake fluid.

4. CONCLUSION

The conventional braking system has ability to developed maximum <80% of the braking effort that required to stop the vehicle in desired distance. While, the braking system is designed to develop 100% braking effort to stop the car in desired distance corresponding to the speed. The lacking of the braking effort development due to the slow response of the driver Chances of brake failure are reduced in the hydraulic braking system compared to the mechanical types, because of the direct connection between the actuator (brake pedal or lever) and the brake disc or drum. The hydraulic braking system is very easy to fix due to its less complexity compared to mechanical brakes. The Hydraulic Brake System is being more popular due to its advantages and easy to use. The modern automobiles like bikes, cars, and heavy vehicles are adapting this technology. The fluids used in this system can vary according to its application because the heavy vehicles require more effort or pressure to push the brakes and stop the rotary wheel. Few of its applications can be seen in mopeds nowadays.

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