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Fluid braking system:-using incompresible fluid

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Abstract

Till now the brakes used in the automobiles uses solid friction method. Fluids are used in brake systems but only in hydraulics which make the solid contact of the brake pads. This type of brakes are less efficient, less durable and less reliable. To compensate the durability and efficiency need and to make it more reliable, some new kind of braking method is to be developed. In this paper we introduce the new method of braking which uses incompressible fluid for friction.

Keyword: *fluid, hydraulics, brakes, automobiles, piston, cylinder*

I. INTRODUCTION

In this fast developing, rapidly growing world, the only thing that matters is speed. Now a days Vehicles have speed but that's not enough as they should have a better system for stopping too. A brake is a mechanical device that inhibits motion by absorbing energy from a moving vehicle. Various braking system exists such as disc braking system, drum braking system, etc. But we found some disadvantages of these systems like they are less durable and there are chances of brake failure as solid surfaces gets teared easily after a period of time hence, we found the need of new system which can be used as alternative of these primarily used braking system with much less disadvantages.

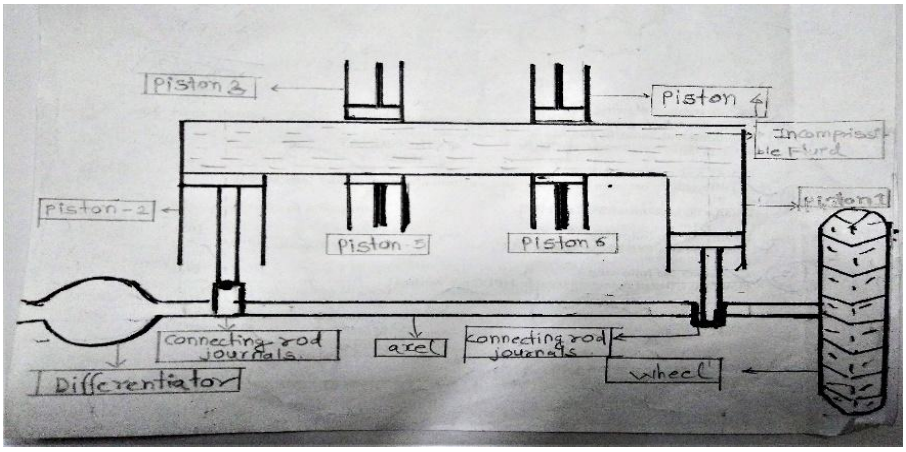
In typical braking system with solid friction as a basic principal, To figure out the disadvantages of less durability and periodic maintenance , We have a solution of fluid braking system from which we can remove these disadvantages and can use brakes efficiently. This new fluid type of braking system can be used in all types of vehicle. It is also a good option for braking system of heavy automobiles as it is such tough and durable to handle such high torque.

This also requires relatively less braking effort to deliver the same output. The efficiency of the fluid braking system is greater than that of other mechanical braking system. This system is also suitable for vehicles having independent suspension. Also this is fully compensated system so that each brakes receives its full share of the pedal effort. Because of these advantages over other braking system, we present this paper.

1. STRUCTURALDESIGN

The typical braking system used in automobiles like disk braking system or drum braking system consists of two solid surfaces for friction, like in disk type of braking system the two of the surfaces are disk fixed to the wheel and the pads which are manually controlled for applying brakes. Also in drum brakes the brake shoe and the drums comes in contact to create friction. But in both the cases one of the solids or both of them will undergo wear and tear after a period of time and results in decrease in braking efficiency and hence increase in stopping distance. So for better braking these brake pads or brake shoes(in case of drum brake)must be changed periodically. This is time consuming and costly, so we started developing the new method of braking which will not have any solid surface to be wear or tear and should have less maintenance.

After a period of research, we had an idea about a mechanism which uses fluid for the friction. In this mechanism we used two piston-cylinder assembly connected to each other through another cylinder. This whole system is filled with incompressible and less viscous fluid and on the connecting cylinder, there are another 4 pistons which



are mounted on cylinder to control the diameter of the connecting cylinder.

Figure 1. design of fluid braking system.

Fig(1). Shows that the piston is connected to the axel using ‘connected rod journals’, And further to wheel.The piston assembly and the fluid inside it moves continuously with the wheel during normal motion. And hence no opposition is observed as the diameter in whole cylinder remains same and fluid moves almost frictionless.

When we apply brakes by pressing brake paddle, the piston 3 and piston 5 (1). are pushed using hydraulic ramp and the effective diameter of the cylinder decreases. This results to fluid move with high amount of friction and by pascals law high amount of force for piston is required to push the fluid from the decreased area and hence reaction force on the piston will retard the motion of the crank shaft of the axel and further wheel.

But, after practical model we found that to apply brakes the hydraulic push is not enough as with the diameter, the area and hence volume of the cylinder is decreasing and as the cylinder system is intact, the fluid inside has to get compressed. But it contradicts as we have used incompressible fluid. So the provision in the construction model only has to be made such that area should be decreased by not altering the volume.

To overcome this problem we added another pair of pistons to the connecting cylinder itself beside the previous braking pistons which will work exact opposite to that of the piston 3 and 5.when these piston 3 and piston 5(say brake applying piston) will be pressed and diameter will be reduced. At the same time these piston 4 and piston 6 will be pulled back with same amount that is required to keep the volume same. This will not alter the volume even if the diameter and area is decreased and with this mechanism the brake applying piston will work on less force and hence efficiency is increased.

1.1 Design of volume maintaining mechanism

After the application of the brakes the brake piston is pressed with the same amount and at same time piston 4 and pistons ,(say volume maintaining pistons) are pulled back to keep the volume constant. But there is need of a mechanism to do it accurately as driver has to only press the brake paddle.

So as a solution over it, we connected these pairs alternately to each other side by side i.e. piston 3 is connected to piston 4 and piston 5 to piston 6 by a rod with movable joints and same for other two. This rod is further fitted to cylinder and this assembly is moved by hydraulic ramps as shown in Fig(2).

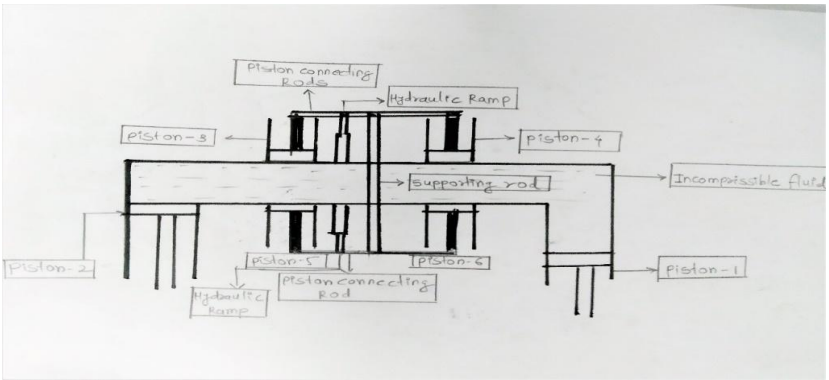


Figure 2: diagram for volume maintaining mechanism in braking system

The hydraulic will move and push the metal rod inward, this will push the braking piston and at the same time it will also pull the volume maintaining piston backward by same length mechanically. By this mechanism, braking system can be converted effectively and efficiently as a practical braking system which can be substituted as a main braking system in all types of automobiles.

2. IMPLEMENTATION ANDAPPLICATION OF BRAKES

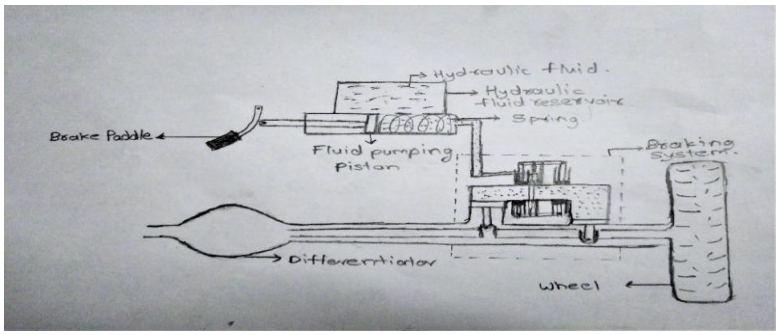


Figure 3: implementation of brakes in automobile.

Considering the whole braking system as a part of the automobile, when the driver applies brakes by pressing brake paddle this brake paddle will just push the hydraulic fluid from the reservoir to hydraulic which drives the brakes piston Fig(3). This brake pistons apply brakes by discussed method and motion of the automobile retards. When driver releases the brake it regains the original position due to the spring in the paddle hydraulic piston Fig(3).

II. EQUATIONS

This braking system totally works on Pascals law for hydraulics, which mathematically states that force divided by area of one hydraulic piston is equal to the other.

i.e. : $F_1/A_1=F_2/A_2$(equation 1)

Here, area is the area of the circular part of cylinder i.e.

$A_1=3.142 \times (r_1)^2$ and $A_2=3.142 \times (r_2)^2$

Hence, $F_1=F_2 \times A_1/A_2$ (1).

$F_1=F_2 \times (r_1/r_2)^2$ (equation 2)

Hence, force on the piston depends on the ratio of the radius of the two cylinder (2).

On normal going the radius of both piston cylinder and connecting cylinder is same i.e. : $r_1=r_2$

Hence ratio is 1.

Therefore :$F_1=F_2$.

When brake is applied, radius of connecting cylinder decreases hence radius ratio is greater than one

Hence,

: $F_1>F_2$.

And hence piston experience reaction force and retards motion of itself.

III.CONCLUSIONS

The fluid braking system:using incompressible fluid can be used as main braking system in automobiles especially in heavy automobiles as it is tough and durable because it doesn't contain any kind of solid surfaces which needs regular maintenance or which can wear or tear.

Although it is a durable system but as per the mentioned working, pistons always have to move the fluid which produces some opposition in normal running due to viscous force. But it is almost negligible against the automobile power, still little bit affects the automobile efficiency.

Over this limitations this type of braking system will largely affect the automobile industry if implemented.This is almost maintainence free and reliable braking as the chances of brake failure is reduceddue to intact system.

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