IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, May 2023

Design, Development and Innovation of Rotating Brake-Pads

Harsh Madnani
Student, Department of Automobile Engineering
Dhole Patil College of Engineering, Pune, Maharashtra, India

Abstract: *The aim of this contribution is to provide with new approach and improved technology of braking which even though exists in just theoretical sense can be a potential replacement of the system which shares similar building blocks and concepts used in any other conventional braking systems. It consists of 4 calipers running all around the rotor with the shear intension of giving a support structure to the pads who along with just working as any other conventional disc brake, also rotates in the opposite direction of the rotor which not only suffice all the benefits of conventional disc brake but also offers more adjustments and tunability for the new system. This reverse rotation of pads help in mitigating the inertial forces being applied on the rotor while in motion and in general theoretical perspective improves the consistency and efficiency of braking system. It has a specially designed& developed CAD model for brake pads which sharetooth profile of a sprocket on the circumference of the pressure plate (after which on the face of the plate are usually the brake pads assembled). It also exhibits a novel and versatile mechanism developed using designing software to run the whole system effortlessly without compromising much. As this mechanism is a standalone system it can be mounted on the exact mounting points as any other assembly of rotor and calliper in a braking system. These results and finding can be incorporated in ample fields where there is a need for better and effective braking technology which usually runs in high risk environment.*

Keywords: Braking system, Brake pads, Rotating Calliper, Disc Brake, etc

I. INTRODUCTION

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction. Most brakes commonly use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat, though other methods of energy conversion may be employed.

Figure 1: Rotor with multiple calipers

In a disc-braking system, the car's wheel is attached to a rotor, that spins along with the wheels. The job of the caliper is to slow the car's wheels by creating friction with the rotors. The brake caliper fits over the rotor like a clamp. Inside each caliper is a pair of metal plates bonded with friction material, these are calledbrakepads.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, May 2023

The outboard brake pads are on the outside of the rotors (toward the curb) and the inboard brake pads on the inside (toward the vehicle). When you step on the brake, brake fluid from the master cylinder creates hydraulic pressure on one or more pistons in the brake caliper, forcing the pads against the rotor. The brake pads have high-friction surfaces and serve to slow the rotor down or even bring it to a complete halt. When the rotor slows or stops, so does the wheel, because they're attached to one another.

Now even though the field has hit stagnancy where the last noticeable increment was filed almost 2 decades ago, the system is still very promising but has again its limitation intact and no room for versatility. The traditional disc brake technology is at its limits as adding components result in dropped efficiency and consistency of the system as a whole.

When it comes to the logical approach, one might think that adding more pads and calipers would result in increased braking power and decrease in braking effort and distance. Because the limiting factor for braking distance isn't the disc brake itself: It's the tires. Any reasonably well-maintained vehicle built in the last50–60 years has brake callipers (or shoes) that are powerful enough to lock all four tires. So it is clearly the tires that run out of grip before the brakes. Adding another caliper won't be the right approach as long as the changes made in some way or other affects the actual element which stops the vehicle. i.e. the tires; which is exactly where this system focuses on, thereby providing an eloquent solution to the above problem.

This system will also prolong the validity of Uniform Pressure Theory, which usually is applied on new brake discs as all the points on the rotor will be forced to imitate similar fading or wear over time due to the lack of vibration when compared to a conventional disc brake with single caliper. It could also make the regularly in-use floating (sliding) calipers obsolete if advancements are pivoted in the direction of this study.

II. WORKING OPERATION

Assembly of Mechanism

Conventional Caliper and Piston Arrangement

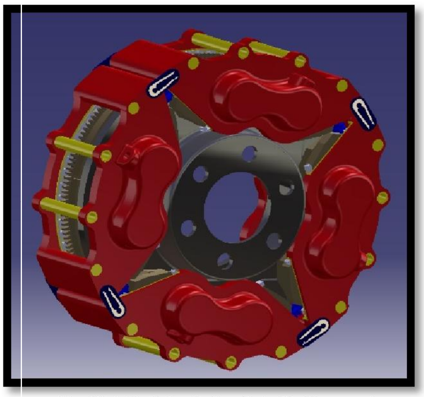

Figure 2: CAD Model of 4 Caliper Arrangement

The mechanism uses a conventional (High performance) caliper with quad piston (two on each side) arrangement. Calipers can be placed in any of the 3 arrangements which can suffice the need of brake-pad rotation around the rotor.

The calipers can be placed apart in the formation:

(A) 180 Degree { 2 Calipers }

(B)120 Degree { 3 Calipers }

(C) 90 Degree { 4 Calipers }

Such that when the brake pedal is pressed it can distribute the pressure on the pads equally all along the rotor to minimize the wear and vibration incurred which in motion.

As seen in (fig 2) the four calipers have been attached with a linkage which connects the two ends of the calipers and has a similar structure as a chain master-link. Such that it is easier to assemble and dismantle the whole system and convenient to access any part of the mechanism like bleeding valve, etc. while attaching the wheel.

Bearing housing & Needle Bearings:

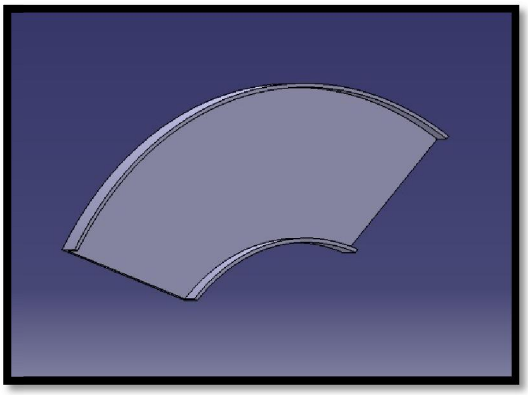

Figure 3: CAD Model of Bearing Housing

As the name suggests, Needle bearings is placed in the Bearing housing. It acts as the fundamental part of the mechanism which pushes the needle bearing thereby transmitting the overall force, transferred by the pistons into the brake pads. It is nothing but a steel plate molded in a way to fit the profile of groove inside the caliper.

.

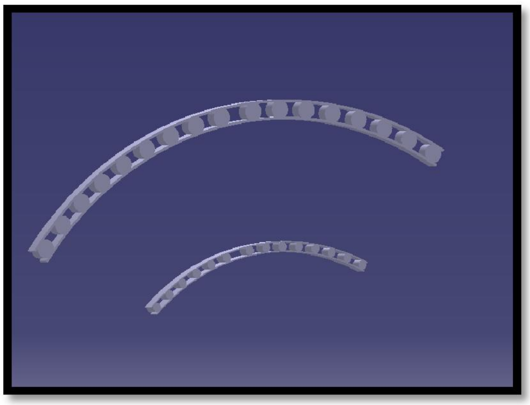

Figure 4: CAD Model of Needle Bearing.

According to the mechanism the rotation of brake pads was assumed to have an approximate range of 300-800 RPM. So, to meet the required standards of operation two sets of needle bearing were used to give a proper support for the pressure plates of brake pads which are K165x173x26 and K265x280x42 for smaller and larger rings respectively.

Brake-pads & Sprocket placements

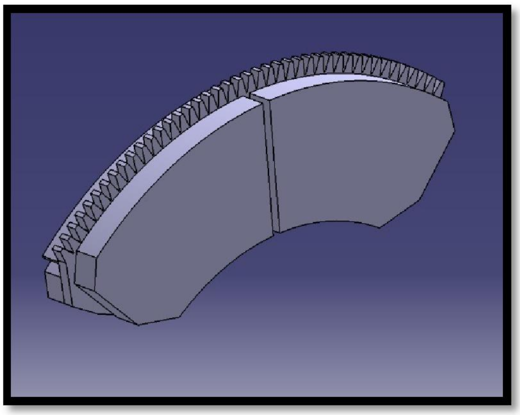

Figure 5: CAD Model of Brake-pads.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
IJARSCT
Impact Factor: 7.301
Volume 3, Issue 1, May 2023

For the 'Rotating brake-pads' mechanism to work a special kind of brake-pads were designed and developed such that it can meet the necessary requirements of the operation and to maintain the reliability while sustaining such heavy forces along the operation.

The circumference of the pressure plate has been designated with a tooth profile, when locked with the driving gear can turn the whole assembly in the direction opposite to the direction of wheel.

Sprocket joint:

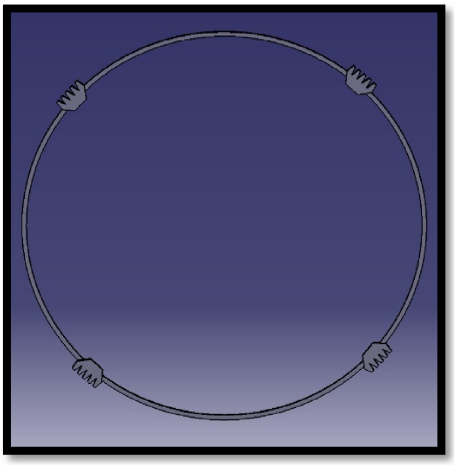

Figure 6: CAD Model of sprocket joint

This is an intricately designed joint fixed around the mild-steel ring with diameter slightly below the dedendum circle of the brake-pad's tooth profile. So, it can match the existing gaps in between the teeths of different brake-pads to help with the continuation needed for the driving gear to operate without misses thereby ameliorating the smoothness needed for operation.

The mild-steel ring is concentric to groove on the back of the brake-pad such that it creates a perfect fit when seen from the side and front of the assembly.

III. WORKING

Figure 7: CAD Model of the dismantled view of the whole mechanism.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, May 2023

The working of ‘Rotating brake-pads’ comprises of multiple different scenarios of activation along with its ample applications in different parts,implied that the ‘braking system’with similar building blocks is used.

It starts with a pair of bevel gear setup with least 4 times the ratio adjacentlyattached to the axleand one of the calipers acting as a driving gear for the corresponding system to work. This gear is locked in with the tooth profile of the brake pad which sets the whole system in motion.Specifically for the 90 Degree formation of the mechanism, the gap between the adjacent pad’s teeths is minimum for which we have the sprocket joint working as a bridge as shown in the above (fig.7).

It fills the gap between the two brake pads and serves as a continuity for a smooth operation of the whole mechanism.

The pads move freely as they are suspended between two needle bearings, one with a biggerradii and other with a smaller to support the top and bottom surface of the brake pad.

When the user applies the force on the pedal the brake fluid is pushed through the master cylinder into the brake lines all the way into the caliper to push the pistons against the bearing housing.

These bearing housing then further transmits the force towards the bearing and with it the brake pads.

This system then puts pressure on the rotor to cancel its motion. Only now the brake-pad mechanism is powered by the driving gear, which is in motion but in reverse direction to that of the rotor.

This conjunction of opposite forces may theoretically result in cancelling out the inertial forces being applied while braking on the rotor and help the stopping vehicle much more conveniently then the conventional disc brakes

IV. CONCLUSION

The main goal of this work was to develop an alternative to a very promising system yet stagnant in terms of advancements which this system and mechanism apparently offers in ample of different ways.