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DESIGN AND FABRICATION OF ELECTROMAGNETIC BRAKING SYSTEM

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Abstract— The braking system of a two wheelers is undoubtedly one of its more important feature. The aim of this work is to create a better braking system. The purpose is to replace existing hydraulic systems with an electro mechanical alternative to improve performance, controllability and to provide more environmentally and friendly solution. Research indicated that a system based on a magnetic phenomenon named eddy - currents could produce the desired result. This is a contact less system there is no wear of brake pads and maintenance cares are also reduced. Another major advantage associated with this design lies in the absence of moving parts, exception made naturally to the rotating disk, thus limiting the chances of malfunction

Keywords— Contactless, eddy-current, no wear to brake pads, absence of moving parts

I. INTRODUCTION

The mechanism which is used to slow and stop to vehicle is known as barking system. It is an important component of a vehicle. In other words, the total system starting from brake pedal or lever to the brake shoe is known as braking system.

II. BRAKING SYSTEM

A. Principle

In this system, the kinetic energy is converted into heat energy due to friction between two mating surfaces of brake lining and brake drum. Then, the heat is dissipated into the atmosphere. There are other types of brakes in which friction is neglected and the heat dissipation is low.

B. Types of Braking System

There are several types of braking systems used in automobiles. Car accidents often happen due to poor braking systems. The most commonly used braking systems in vehicles are as follows:

i. Pneumatic braking system.

ii. Hydraulic braking system

iii. Frictional braking system

iv. Pumping braking system

v. Electromagnetic braking system

vi. Emergency braking system

vii. Servo brake system

III. EXISITNG CONDITION

C. Conventional Friction Brake

The conventional friction brake system is composed of the following basic components: the "master cylinder" which is located under the hood is directly connected to the brake pedal, and converts the drivers' foot pressure into hydraulic pressure. Steel "brake hoses" connect the master cylinder to the "slave cylinders" located at each wheel. Brake fluid, specially designed to work in extreme temperature conditions, fills the system. "Shoes" or "pads" are pushed by the slave

cylinders to contact the "drums" or "rotors," thus causing drag, which slows the car. Two major kinds of friction brakes are disc brakes and drum brakes.

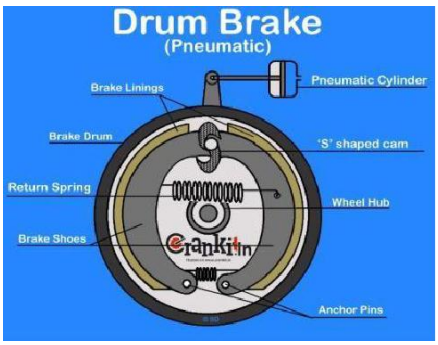

Fig.1Drumbrake

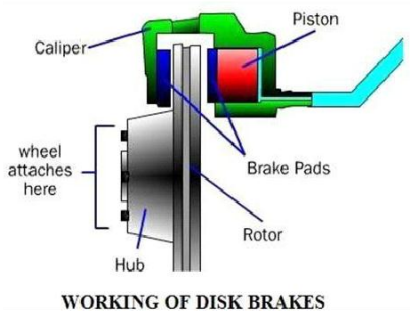

Fig.2 Diskbrake

Drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. The term drum brake usually means a brake in which shoes press on the inner surface of the drum. When shoes press on the outside of the drum, it is usually called a clasp brake. Where the drum is pinched between two shoes, similar to a conventional disk brake, it is sometimes called a pinch drum brake, though such brakes are relatively rare. A related type called a band brake uses a flexible belt or "band" wrapping around the outside of a drum.

Disc brake is a type of brake that uses callipers to squeeze pairs of pads against a disc or "rotor" to create friction. This action retards the rotation of a shaft, such as a vehicle axle, either to reduce its rotational speed or to hold it stationary. The energy of motion is converted into waste heat which must be dispersed. Hydraulically actuated disc brakes are the most commonly used form of brake for motor vehicles, but the principles of a disc brake are applicable to almost any rotating shaft.

IV. **WORKING PRINCIPLE**

A. Electromagnetism

Electromagnetism is one of the four fundamental interactions in nature. The other three are the strong interaction, the weak interaction and gravitation. Electromagnetism is the force that causes the interaction between electrically charged particles; the areas in which this happens are called electromagnetic fields

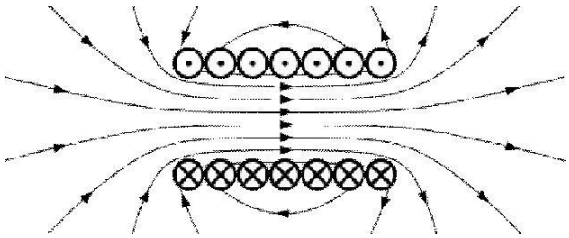

Fig.3 Electromagnetism

Electromagnetic brake is as new concept. It is found that electromagnetic brakes can develop a power which is nearly twice the maximum power output of a typical engine, and at least three times the braking power of an exhaust brake to stop vehicle.

The brake is a mechanical device which involves the conversion of kinetic energy into thermal energy (heat) by stopping vehicle in a motion. When braking force is applied by brake to inhibit the motion of vehicle lots of kinetic energy is dissipated in the form of heat energy.

Advantages

1. Friction less

2. Low Maintenance

3. No Lubrication
4. No Wearing of Brakes
5. Very Reliable

Disadvantages

1. Dependence on battery power to energize the brake system drains down the battery much faster.
2. Due to residual magnetism present in electromagnets, the brake shoe takes time to come back to its original position.
3. A special spring mechanism needs to be provided for the quick return of the brake shoe.

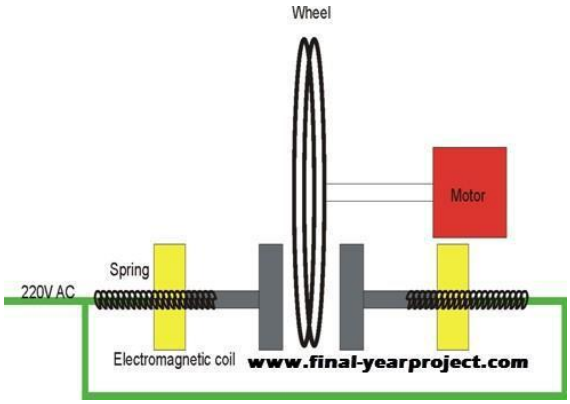

Fig.4 Electromagnetic Braking System

B. *Principle of Electromagnetic Braking System***:**

The main principle of the electromagnetic braking system is eddy current. Eddy currents (also called Foucault currents) are loops of electrical current induced within conductors by a changing magnetic field in the conductor due to Faraday's law of induction.

Eddy currents flow in closed loops within conductors, in planes perpendicular to the magnetic field. The magnitude of the current in a given loop is proportional to the strength of the magnetic field, the area of the loop, and the rate of change of flux, and inversely proportional to the resistivity of the material. By Lenz's law, an eddy current creates a magnetic field that opposes the change in the magnetic field that created it, and thus eddy currents react back on the source of the magnetic field.

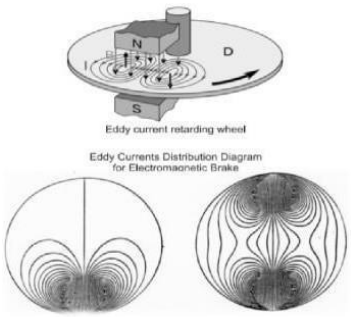

Fig.5 Eddy current Principle

V. ELECTROMAGNETIC BRAKES

A. Working of Electromagnetic Braking System

Electromagnetic brake works on the principle of electromagnetism. They are totally friction- less. Due to this they have longer life-span and durable. Less maintenance is required in these brakes. It can be used as supplementary brakes and can also use to stops rotating shafts of high-grade machines in industries.

This brake uses both eddy current and attraction force of magnet to stop vehicle. Eddy current is used to retard the vehicle while magnetic force is used to bring vehicle to rest. This braking is based on attraction property of magnets. The electromagnet is energized by the AC supply where the magnetic field produced is used to provide the braking mechanism. When the electromagnet is not energized, the rotation of the disc is free and accelerates uniformly under the action of weight to which the shaft is connected. When the electromagnet is energized, magnetic field is produced thereby applying brake by retarding the rotation of the disc and the energy absorbed is appeared as heating of the disc.

So when the armature is attracted to the field the stopping torque is transferred into the field housing and into the machine frame decelerating the load. The AC motor makes the disc to rotate through the shaft by means of pulleys connected to the shaft.

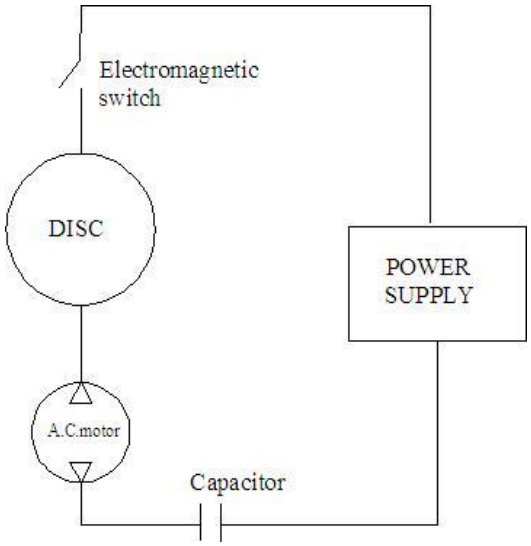

Fig.6 Working of the Electro Magnetic Braking

Fig.7 Assembled View of the Electro Magnetic Braking

B. Belt Length Calculations:

Centre distance between pulleys c=0.20m

Diameter of the driving pulley D=0.065m

Diameter of the driven pulley d=0.03m

Speed of the driven pulley N2=1400rpm

A) Determination of speed of driving pulley: N1*d=N2*D

i=N1/N2=D/d

N1= (D/d)*N2

N1= (0.065/0.03)*1400

N1=3033.33rpm

B) Check for the centre distance: C>= (D+d)/2

0.2> (0.065+0.03)/2

0.2> 0.0475 Verified

C) Arc of contact:

$=180 - (D-d)/c * 60^0$

$=180 – (0.065-0.03)/0.2 * 60^0$

$=169.5^0$

D) Length of the belt:

$L0=2C+\pi/2(D+d)+(D-d)^2/4C$

$=2*0.2+\pi/2(0.065+0.03)+(0.065-0.03)^2/4*0.2$

L =0.551m

E) Actual length of the belt: L=L0 --[1% of L0] =0.551-[0.01*0.551] L=0.545m

VI. CONCLUSION

Electromagnetic brakes have many advantages over frictional braking system. The combination of eddy current and magnetic forces makes this brake more effective. This brake can be used as auxiliary brake system in vehicle. The usage of abs can be neglected by using a micro controlled electromagnetic system.

It can be used in rail coaches to decelerate the train moving in high-speed. Combination of these brakes increases the brake life and act like fully loaded brakes. These brakes can be used in wet condition, so there is no use of anti-skidding instrument. It is fully electrically controlled which results in less accidents. The braking force produced in this brake is less than the disc brakes. Hence, it can be used as a secondary or emergency braking system in the automobiles.

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