Development & Application of Electromagnetic Braking System for Two-Wheeler

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Abstract: This is an innovative technique used for braking of LMV and HMV like cars, trucks, trains and also the bikes. It majorly works on principle of dissipation of kinetic energy to heat energy. These are totally frictionless. It utilizes magnetic field to stop the vehicles, however the power required for braking is transmitted manually. This system is combination of electrical and mechanical concepts. The metal disc is connected to shaft and electromagnet to the frame keeping the air gap between disc and electromagnet. It will reduce the road accidents has it is safe and has low maintenance then other braking system. The material used in this project are easily available in market.

Keywords: **Electromagnet, Frictionless, Two-Wheeler, Magnetic field, Flux**

I. INTRODUCTION

The brakes play an important role in our life. In this project we are trying to make a braking system. Nowadays there are increase in accidents on the roads because of the poor braking system. The generally utilized brakes are drum brakes and disc brakes. Here we are using an electromagnetic coil and a plunger. When electricity is applied to the field, it creates an internal magnetic flux. An eddy current brake like conventional friction brake is device used to slow or stop a moving wheel by using kinetic energy as heat. The reason for using this brake in vehicles to reduce damage in brakes as it is frictionless.

II. OBJECTIVES

- The objective of our project is to make low maintenance braking system.
- It can minimize the time of braking.
- It focuses on to achieve maximum possible efficiency while stopping the vehicle.
- It does not use crude oils.

III. WORKING

3.1. Working principle

When a copper wire is wound on a metal piece and connected to battery it will create an electromagnet. The magnetic field generated in the wire is known as “right hand thumb rule”. This braking system is based on the eddy current within the rotating metal disc and the electromagnet that provide opposing force to the rotating disc.

The rotation of the disc is free when the electromagnet is not energized and the disc accelerated uniformly under the action of the weight to which shaft is connected.

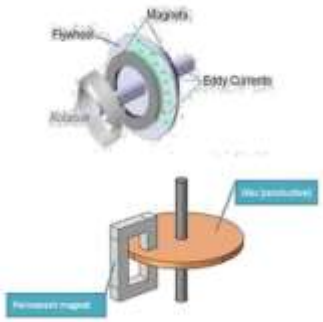

Fig. No. 1 Eddy Current Brake Design

3.2. Working of Model

- For working of our project, we are taking a bike with a rider.
- When a rider starts the bike, it moves forward and obtain a minimum speed.
- When an obstacle comes in front of the bike the rider presses the switch.
- The switch gives power to electromagnet and the magnetic field is produced between magnet and the disc.
- The electromagnet and the disc get engage and the bike gets stop.
- When the switch is turned OFF it gets disengage and the wheel starts in motion.
- This how the braking system works with no use of crude oil and better safety of the person.

IV. COMPONENTS USED

The components used are electromagnet, metal disc, battery, wires, frames, alloy wheel.

4.1 Metal Disc

The metal disc is the important component that is used. It is made up of cast iron that has thickness of 2mm. The diameter of the disc is 300mm and has a hole of 90mm in diameter to reduce weight.

Fig No. 2 Disc Brake

4.2 Electromagnet

This is also the component which is very important in this braking system. The electromagnet is energized by the power supply where the magnetic field is produced to apply brake. The copper winding is wounded on the metal piece to make a metal piece into electromagnet.

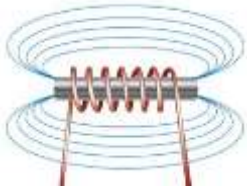

Fig No. 3 Electromagnet

4.3 Battery

It is the power source of the electromagnetic braking system. When the current from the battery is given to electromagnet it produces eddy current and brake is applied. Good batteries equal to more powerful the braking system.

Fig No. 4 Battery

4.4 Alloy Wheel

The alloy wheel is where the brakes will be applied. The rotation of wheel is stop has the switch is ON. It is the circular component that rotates on the axle bearing.

Fig No. 5 Alloy Wheel

4.5 Wires and Switches

The wires and switches are the connectivity of the braking system. Switches ON/OFF is used to control the power supply to the electromagnet. To stop the wheels from rotation switch ON the switch.

Fig No. 6 Switch

V. DESIGN CALCULATION

Design of model helps in defining, analyzing and communicating a set of concepts. The designing is done in the early stage of the project. Before manufacturing of the project there should be proper designing and planning is necessary. In this calculation we are calculating the permeability of free space, total magnetic flux in core, magnetizing force and also the power of electromagnet.

Area of Electromagnet: 12.4m

Current and Voltage Supplied (I/V): 7amp/230V

Length of electromagnet (L): 90mm

Let the maximum weight of plate & wheel assembly to be approximately 2kg which is 19.62N.

$F = (B^2 * A)/2\mu$

F = Force in newton

B = Magnetic field in tesla

A = Area of the pole face in square meters

μ = Permeability of free space

In case of free space (air) = $\mu = 4\pi.\ 10^{-7}$ H. m^{-1}

$19.62 = B^2\ (12.4)/2x4\pi x10^{-7}$

$B = 0.00199 wb/m^2$

5.1. TOTAL MAGNETIC FLUX IN CORE:

$Ø = B \times A$

$Ø = 0.00199\times12.4$ $Ø = 0.0246$ wb.

5.2. THE MAGNETIZING FORCE:

$H = B/\mu = 0.00199/4\pi\times10^{-7}$

$= 1583.59$ AT/m.

For air gap of 0.5 mm magnetic force is given by between magnet & plate.

$AT = H\times L = 1583.59\times90\times10^{-3}$

$= 142.52$ AT

To find the power of electromagnet which is manually constructed

Assuming N = number of turns in the electromagnetic = 800

$F= (N\times I)\ 2\ \mu a\ /\ (2\times g)$

g = air gap between electromagnet & plate

F= (8x1)2 4πx10-7 x 0.00199 / (2x0.5)2

F= 16.045N for each electromagnet.

Fig No. 7 Electromagnetic braking system

VI. TYPES OF BRAKING SYSTEM

6.1 Electromagnetic braking system

- Electromagnet brakes slow or stop motion using electromagnetic force.
- They were called has Electro-Mechanical brakes.
- Other brakes use fluid or plates but these brakes use eddy current.
- Less wear of segments.
- No oil spoilage.
- Less support cost.
- Longer life span.
- Fully electronically controlled.

6.2 Disc brake system

- Disc brake is also a good brake that uses fluid to stop the wheel.
- Friction plate is flat.
- Heat dissipation is quick.
- Braking effective but can fall the rider.
- Light in weight.
- Frictional area is less.
- Cost is more.

6.3 Drum brake system

- Drum brake was invented before the disc brake and uses friction plate in the system.
- Friction plate used in this system is semi-circular.
- Heat dissipation is slow.
- Braking is less effective.
- It uses cylindrical drum.

VII. APPLICATIONS

- This Electromagnetic braking System is used in cars and bikes.
- This system not only used in automobiles but also used in industrial applications to slow down the moving parts which are not efficiently perform by the other conventional method.
- It can be used as a safety brakes in the aircrafts to slow down have its speed is very high.
- It can also be used in trains braking system has its speed is also high.
- In companies the electromagnetic braking system can be used in conveyors, lifts etc.
- It is used in Robotics.
- Rides and Roller Coasters brakes.

VIII. CONCLUSIONS

- An electromagnetic brake system can be a better option in future has it has many advantages than nowadays brakes.
- The brakes used are drum brake, disc brake, ABS and other.
- Electromagnetic brake could substantially increase braking efficiency while reducing friction brake wear.
- This would reaffirm the company's commitment to safety and quality.
- The cost of these brakes is less than the other available substitutes as well as this system can work in wet conditions.
- This brake is more reliable than the conventional braking system. It can be used has a secondary safety braking system in trains.

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BIOGRAPHIES

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