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# Design and Devlopment of Electromagnetic Breaking System

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***Abstract -*** *An Electromagnetic Braking system utilizes Magnetic drive to connect with the brake; however the power required for braking is transmitted physically. The disc is associated with a shaft and the electromagnet is mounted on the edge .When power is connected to the curl(coil) a magnetic field is produced over the armature as a result of the present streaming over the loop and makes armature get pulled in towards the coil. Thus it builds up a torque and in the end the vehicle stops. In this venture the upside of utilizing the electromagnetic stopping mechanism in car is considered. These brakes can be consolidated in substantial vehicles as an assistant brake. The electromagnetic brakes can be utilized as a part of business vehicles by controlling the current provided to deliver the attractive flux. Making a few enhancements in the brakes it can be utilized as a part of automobiles in future.*

***Keywords****: Peak Force, Fade, Drag, Flux, Electro Magnet*

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## I. INTRODUCTION

In this project we have designed and establishment and Electromagnetic disk braking system so as to have a future alternative to traditional breaking systems. Electromagnetic disk braking system slows an objects by creating an eddy current through electromagnetic induction which create resistance. When electromagnetic are used, control of the breaking action is made possible by varying the strength of the magnetic field of the electromagnets creates eddy currents in the discs. These eddy currents generate an opposing magnetic field (Lenz's law), which then resists the rotation of the discs, providing braking force. The net result is to convert the motion of the rotors into heat in the rotors.

### 1.1 Friction Braking of Vehicles and It's Disadvantages

Road, rail, and air vehicles all rely mainly or solely on mechanical friction brakes. These brakes are composed of two functional parts: a rotor connected to the wheels and a stator fixed to the chassis of the vehicle. The rotor is either a drum or a disc generally made of cast iron for road and rail vehicles, and carbon fibre for aircraft. The stator comprises shoes (drum brakes) or pads (disc brakes) made of a soft friction material and an actuator, generally a hydraulic piston.

Although the principle is the same for drum and disc brakes, the terminology used from there on refers to disc brakes. The contact between the soft material of the pads and the surface of the rotor is characterized by a high friction coefficient. When braking is commanded by the driver, the actuator presses the pads against the rotor, thus inducing a friction force tangential to the surface of the rotor, which opposes the motion of the vehicle (Fig. 1). The braking force is proportional to the normal force developed by the actuator pressing the pads against the rotor and the coefficient of friction:

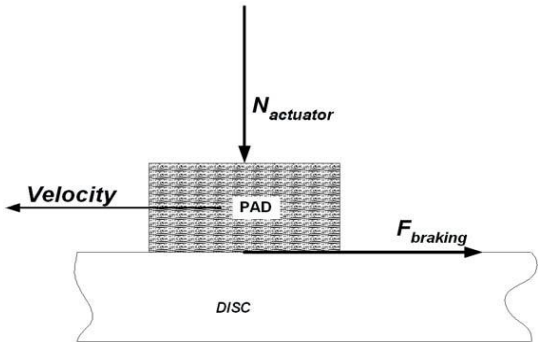



*Fig. 1: Forces involved in friction braking*

**1.2 Fundamental physics of eddy-current braking**

An eddy-current brake consists of a stationary source of magnetic flux (permanent magnet or electromagnet) in front of which a conductor (metal disc, drum or rail) is moving. Because of the motion, the conductor experiences a time-varying magnetic flux density, which by virtue of Lenz's law results in an electric field:

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad \text{..... (2)}$$

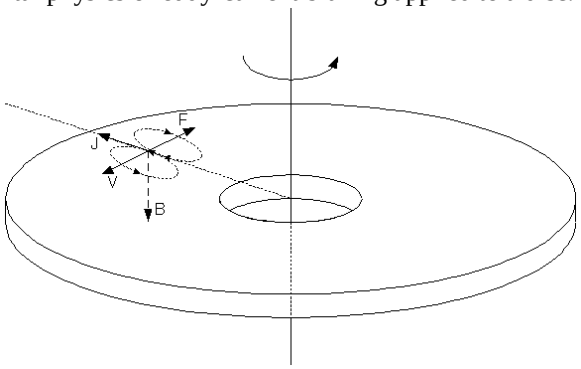
This electric field results in circulating currents in the conductor by virtue of Ohm's law:

$$\vec{J} = \sigma \cdot \vec{E} \quad \text{..... (3)}$$

These currents are called "eddy-currents". The interaction of eddy-currents with the flux density results in a force that opposes the motion:

$$\vec{F} = \vec{J} \times \vec{B} \quad \text{..... (4)}$$

Fig. 4 illustrates the fundamental physics of eddy-current braking applied to a disc.




Fundamental physics reveal three important characteristics of eddy-current braking:

- A braking force is induced without any mechanical contact between the rotor and the stator. Eddy-current brakes are thus wear-free.
- The braking force is easily controllable by controlling the magnitude of the flux source

**1.3. Problem Statements**

1. Conventional brakes requires lot of efforts in maintenance like brake fluid (bleeding), change of brake pads etc.
2. Disk brake assembly has more moving parts and it is more complex than drum brakes.
3. If any air remains in disk brake system, it can be problematic as brakes may not work effectively
4. Wear and tear happens at brake surfaces
5. Heat dissipation is not uniform
6. Braking fluid leakage could happen which will result in brake failure

## II. CONSTRUCTION

The parts of Electromagnetic Braking Systems are:

1. Frame
2. Electromagnet (12V)
3. Transformer (230V to 12V Converter)
4. DC Motor (12V)

5. Disc
6. Chain and Sprocket
7. Shaft
8. Wheel
9. Wire
10. Switch
11. Wooden Plate
12. Nut & Bolts.

The construction of the system is done by the following manner. The system consists of a vertical column. The pulley is mounted at the top of the vertical column. This setup is fitted on a wooden board which is act as a base. On the other end of the base, the motor is fitted with the help of bolts. The driving wheel pulley (motor) and the driven wheel sprockets are looped by a typical v-belt. A metallic disc is mounted with the front of the driven sprockets. An electromagnet is fitted in the front of the metallic disc which is fitted with driven pulley. The important thing is that the electromagnet is to be fitted with the smallest clearance with the metallic disc. The ON/OFF switch and the regulator are connected with the electromagnet and the motor respectively with the help of the electric wires to control the current supply to them.

## III. WORKING

If we wound a piece of copper wire around a metal conductor and connect it to the battery, it will turn that metal conductor into an Electromagnet. Whenever the current carrying conductor cuts the magnetic field, it results in generation of Electromagnetic Force. The electromagnetic braking system is based on the creation of eddy current within a metal disc rotating between two electromagnets as shown in Fig. which set up a force opposing the rotation of the disc. The rotation of the disc is free when the electromagnet is not energized and the disc accelerates uniformly under the action of the weight to which its shaft is connected. The rotation of the disc is retarded when the electromagnet is energized and the disc gets heated as the result of absorption of energy. The problems that occur in the conventional braking system can be eliminated by using the updated electromagnetic braking system.

### 3.1. Working Mechanism

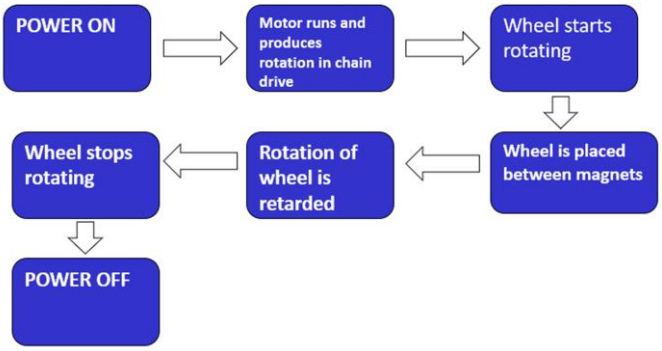



*Fig.3.4 flow chart of working mechanism*

## IV. CONCLUSIONS

With every one of the upsides of electromagnetic brakes over grating brakes, they have been generally utilized on overwhelming vehicles where the 'brake fading' issue exists. A similar idea is being created for application on lighter vehicles. The concept designed by us is just a prototype and needs to be more developed. These electromagnetic brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure. ABS use can be ignored by just utilizing a smaller scale controlled electromagnetic plate slowing mechanism .These find endless applications in overwhelming vehicles where high warmth (heat) dissemination is required. In rail mentors it can utilized as a part of mix of plate brake to acquire the trains moving rapid. When these brakes are combined it increases the life of brake and act like fully loaded brakes. These electromagnetic brakes can be used in wet conditions which eliminate the anti-skidding equipment, and cost of these brake are cheaper than the other types. Consequently the braking power created in this is not as much as the plate brakes if can be utilized as an optional or crisis slowing mechanism in the vehicles.

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