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FRICTIONLESS BRAKING SYSTEM USING EDDY CURRENT

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ABSTRACT— Majority of braking system work on the principle of dissipation of kinetic energy to heat energy.This method has its own drawbacks and must be replaced with more reliable braking system that is quick in response,doesn't heat and also maintanenece free.In this project,a frictionless braking system is proposed using eddy current phenomenon.This phenomenon is governed by faraday's law of electromagnetic induction and Lenz law.Eddy cureent is created by the relative motion between a magnet and a metal(or alloy) conductor.The current induces magnetic fieldsin the conductor which opposes the actual magnetic field of the magnet and results in the decceleration of motion (Lenz law).The constant magnetic field is the simplest and easiest design to implement.The mechanism implements this phenomenon in developing a braking system.This braking system is frictionless,hence it's advantageous over conventional friction brakes in terms of performance and maintanence.The proposed system is implemented in rear wheel of vehicles.

Keywords— ***Aluminum Disc;Neodymium Magnet; Speed sensor..***

1, INTRODUCTION

The goal of this project is to use the physics of eddy current.We have created an eddy current brake which uses the same eddy current effect as an eddy current motor but is simpler to build.We hope to learn the effect of stor spacing,magnet size and shape,number of magnets,magnet radius,and phase angle have on braking force.Thus information will be used by another team to create an eddy current motor.

An eddy current brake like a conventional friction brake is device used to slow or stop a moving device by dissipating it's kinetic energy as heat.However,unlike Drum and Disc brakes,in which the drag force are used to stop the moving object provided between two surfaces pressed together by friction,the circular electric current brake called eddy current brake whose drag force is an electromagnetic force between a magnet and a nearby conductive object in relative motion,because of the eddy currents induced in the conductor through electromagnetic induction.

2, AIR-GAP EFFECT

Figure 1.1, and 1.2 shows the effect regarding air-gap of 1mm,2mm,3mm and 4mm respectively,for both the series of aluminium.Constant voltage supply of 11v been supplied to the DC motor with the use of electromagnet, for the betterment of effective eddy current braking effect is.Kapjin Lee and friends in their research mentioned that

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small Air-gap will produce a stronger magnetic field B.Higher magnetic flux been induced in the small air-gap of 1mm compared to 2mm.It means that force has been dragged which is generated in the smaller air-gap for both Al6061 & Al7075 disc will contribute to slow the motion faster.

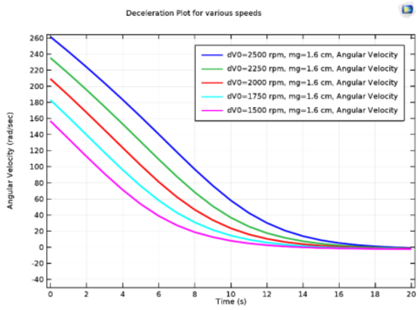

Figure1.1: Deceleration graphs for 1mm air gap

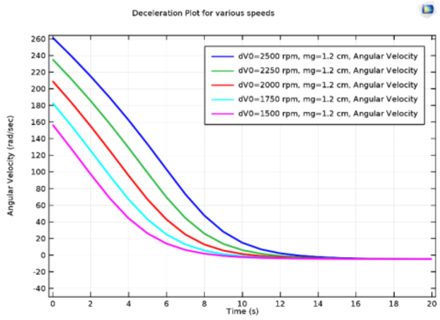

Figure 1.2: Deceleration graphs for 2mm air gap

3, PROPOSED SYSTEM

3.1 Construction

The magnet has been attached in the mechanicle slider for the motion of forward and backward.This kind of slider makes the magnet contactless with that of aluminium disc and hence frictionless.A cable was a plugged in the hole of the slider when in needs of decelaration the person can apply the brake eventually the magnet slides in it and causes the decelaration.The magnet is placed between a two nails which does not allows the magnet to come across the threshold limit.

Figure 2: Magnet attached in the sliding frame

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3.2 Working

The explanation of the magnetic function of an electromagnetic retarder based on the Maxwell principles may be applied to the following physical arrangement:

- A disc having a ferro-magnetic with a permeability, m , also an electric conductivity, r rotates in an alternate polarity at the face of a ring of magnetic poles. Each pole exhibits a magnetic excitation flux, NO which is directly proportional to the excitation current within the coil until the core is not saturated. The magnetic flux lines, N, form loops through the very small air gap within the disc which are arranged between the poles and the Disc.

- While the disc is rotating,as a first approximation,when the flux varies in a sinusoidal function of time at a point given within the disc according to the following expression:

$$\emptyset = \emptyset_{0sin}\left(\frac{pN}{60}\right)t$$

Where

P: number of pairs of poles

N: revolutions per minute of the disc

T: time variable in seconds

Figure 3: Implemented setup of eddy current brake

Eddy currents are created alternatively within the disc having a strength proportional to the flux, N

- These currents can be winded themselves around the lines of flux. The electric conductivity, D, of the material disc causes these eddy currents to exhibit heat within the disc.If a magnetic system is rotating about an axis normal to a conducting sheet, the induced eddy currents field would set up a retarding torque on the system which is directly proportional to its angular speed.The braking torque is generally a function of the flux and also the excitation current.

4, RESULTS AND DISCUSSIONS

The wheel was subjected to various speeds which are tabulated above in first column of table 1.The wheel was allowed to come to rest without any application of brakes. The time for the wheel to come at rest without the application of brakes were noted and tabulated.From the table the graph figure 5 was plotted between speed(Km/hr) vs Time(sec). Now the wheels were subjected to same speeds but with the application of magnets. Firstly, one magnet was used to apply the brake. The corresponding time required for the wheel to come to halt is noted and tabulated. Then, two magnets were used for the application of brake and its corresponding time taken for the wheel to stop is also noted and tabulated. Also the a graph (Figure 6) was plotted between the corresponding speed(Km/hr) vs Time(sec) of one and two magnets.

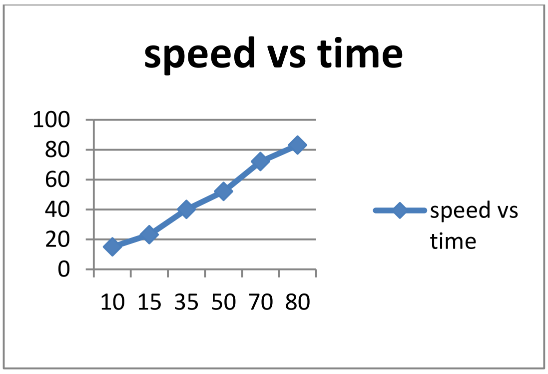

Figure 4 : Speed vs time graph without magnet

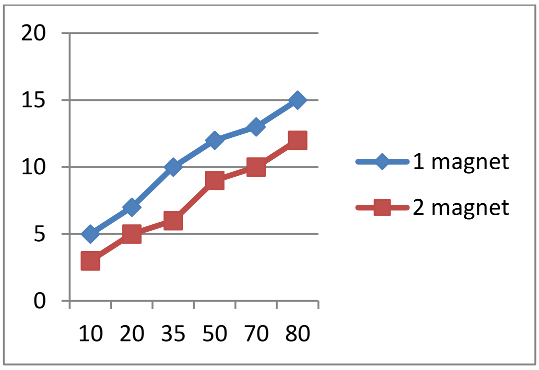

Figure 5: Speed vs time graph with magnet

Comparing the graphs Figure 5 and Figure 6 it is clear that the eddy current brake works and by increasing the various influential parameters especially the diameter of the disc rotor and the magnetic field strength, the eddy current brake can be made as efficient or even more efficient that the conventional friction brakes.

Table 1: Practical experimental readings of eddy current brake

WITHOUT MAGNET		**WITH MAGNET**			
		1 MAGNET		2 MAGNETS	
SPEED (KM/HR)	TIME SEC	SPEED (KM/HR)	TIME SEC	SPEED (KM/HR)	TIME SEC
10	15	10	5	10	3
20	23	20	7	20	5
35	40	35	10	35	6
50	52	50	12	50	9
70	72	70	13	70	10
80	83	80	15	80	12

Moreover, the design constrictions(the disc rotor diameter is limited to 240mm due the frame design of the bicycle which reduces the braking torque and the bicycle being made of ferromagnetic material that attract magnets) of the actual implemented eddy current brake in the bicycle make the eddy current brake seem to be less efficient than the conventional friction brake. But, when the entire vehicle is designed keeping in mind of the eddy current braking system, this braking system will be more efficient and advantageous than the conventional friction brake.

5,ADVANTAGES

a.Abrasion Free

The existing braking system uses a mechanical blocking which leads to high levels of wear and tear of the system specifically in automobiles reducing the life of the systems.

b.High Braking Force

The Drum and Disc braking system does not produce high braking forces for inhibiting systems moving in high speed which give thrust to a need for an effective braking of high speed machines.

6,CONCLUSION

The ordinary brakes which uses a mechanical blocking can causes three main problems skidding,wear and tear of the vehicle. The ordinary brakes which has these drawbacks can be overcome by a simple and effective mechanism of braking system 'This eddy current brake is an Abrasion-free method which can be implemented in vehicles including trains.Another advantages is of high reliability and safety.This alternative and effective method of braking system canw ork even in the toughest environmental conditions.

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