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Design and Fabrication of Electromagnetic Braking System

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ABSTRACT: An electromagnetic brake is a new and revolutionary concept. Electromagnetic braking system is a modern technology braking system used in light motor & heavy motor vehicles. This system is a combination of electro-mechanical concepts. It is electromagnetic brake is an essential complement to the safe braking of heavy vehicles. It aims to minimize the brake failure to avoid the road accidents. It also reduces the maintenance of braking system. An advantage of this system is that it can be used on any vehicle with minor modifications to the transmission and electrical systems. An Electromagnetic Braking system uses Magnetic force to engage the brake, but the power required for braking is transmitted manually. The disc is connected to a shaft and the electromagnet is mounted on the frame when electricity is applied to the coil a magnetic field is developed across the armature because of the current flowing across the coil and causes armature to get attracted towards the coil.

The electromagnetic brakes can be used in commercial vehicles by controlling the current supplied to produce the magnetic flux. Making some improvements in the brakes it can be used in automobiles in future. O

KEYWORDS: Electromagnetic brake, Safe breaking, Armature, Magnetic flux.

I. INTRODUCTION

In this project we are trying to make a braking system. Which can be applicable in two wheeler at high speed and low maintenance cost. Here we are using an electromagnetic coil and a plunger. There is an electromagnetic effect which moves the plunger in the braking direction. When electricity is applied to the field, it creates an internal magnetic flux. That flux is then transferred into a hysteresis disk passing through the field. The hysteresis disk is attached to the brake shaft. A magnetic drag on the hysteresis disk allows for a constant drag, or eventual stoppage of the output shaft.

This projects intends to the design and implementation of new system of retardation (braking) for automobiles. The design of the new brakes is based upon the phenomenon of electromagnetic induction and eddy currents the design basically consists of very strong magnet and rotating metallic wheel. The wheel develops eddy currents due to the change in magnetic flux associated to the wheel due to its rotation. The eddy current development obeys Maxwell's law of electromagnetic induction and Lenz's law of direction of induced current. The current in turn dissipates the rotational energy of the wheel as heat bringing the wheel to a stop.

Sr no.	Title Of The Paper	Authors	Name Of Journal / ISSN No. / Volume Number /Year	Proposed Concept And Details
1.	Innovative electromagnetic braking system	<u>P. Sevel,</u> <u>N. Kannan,</u> <u>S. Marsmukesh</u>	International Journal of Innovative Research in Science, Engineering and Technology 2014	An Electromagnetic Braking system uses Magnetic force to engage the brake, but the power required for braking is transmitted manually. The electromagnetic brakes can be used in commercial vehicles by controlling the current supplied to

produce the magnetic flux

II. LITERATURE SURVEY

Sr no.	Topic Of The Paper	Authors	Name Of Journal / ISSN No. / Volume Number /Year	Proposed Concept And Details
2	Automatic Braking System Using Ultrasonic Sensor	J.V.Sai Ram, G.Pavanth, B.Jagadeep, Dr.B.Raghu Kumar	International Journal of Innovative Science and Research Technology ISSN No: - 2456 - 2165	When compared with olden days life span of human is reduced. Death rate due to accident is drastically increased because vehicles usage is increasing by day by day. Due to brake failure so many accidents are occurring so when we control the brake by automatically we can reduce the effect of accident.
3	Fabrication of Auto-Braking System for Pre-Crash Safety Using Sensor	Eung Soo Kim Div. Digital Media Engineering, Pusan University of Foreign Studies, Busan, Korea	International Journal of Control and Automation Vol. 2, No. 1, March, 2009	The auto-braking system was designed by VHDL and fabricated to keep a distance between two cars. It provides pre-crash safety system for intelligent car. This module can detect the distance between front vehicle and driver's vehicle to keep a constant distance using a sensor and operate the brake system forcibly if the driver does not decrease the speed of car.

III. METHODOLOGY

Basically, this project was to study and analyse electromagnetic braking system as a secondary measure for the hydraulic braking system. First, the base for the electromagnets and the stand for fitting the wheel, is made.

Then, a wheel is made and attached to the spook whereas the spook is attached to the stand by the help of bearings an electromagnet is made by winding the copper wire with the cylindrical body and attached to its base. Furthermore, a U shaped metal rod is welded with a L shaped metal bar forming a brake shoe and then its end are rest inside the electromagnet.

The motor is attached to the base. So the electromagnet and the motors of wheel are circuited to an external battery and by turning it on, they work respectively.

Theoretical/Conceptual Framework Our model is divided mainly into two different units

1) DRIVING UNIT

A. Electric Motor: An Electric motor is an electrical device that converts electrical energy into mechanical energy. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. Electric motors may be classified by electric power source type, internal construction, application type of motion output. And so on.

B. Wheel: Wheel gets in motion with the help of running motor. Both motor and wheel is connected with the help of connecting chain and chain ring c Power Control: This division consists of power supply to whole system and a separate power control system to control the motion of motion.

2) BRAKING UNIT

A. Electromagnet: An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. The magnetic field disappears when the current is turned off.

B. electromagnets usually consist of insulated wire wound into a coil A current through the wire creates a magnetic field which is concentrated in the hole in the centre of the coil. The wire turns are often wound around a magnetic core

Shoe: main b. Brake Shoe: It is part that will stop the wheel when the electromagnet is turned on.



Figure 1: DC motor

Windshield wipers are powered by a small electric motor, usually mounted on the firewall or under the cowl (the area under the windshield's base). The motor activates linkage that moves the wiper arms back and forth. On vehicles with a rear window wiper, a separate motor powers the one in the rear.

BEARING

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis, or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole.



Figure 2: Bearing

SPROCKET

A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc.



Figure 3: sprocket

CHAIN

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing

over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, United States. This has inverted teeth



Figure 4: Chain

DISC

Disc are familiar from automotive applications where they are used extensively for car and motorcycle wheels. These typically consist of a cast iron disc, bolted to the wheel hub. This is sandwiched between two pads actuated by pistons supported in a caliper mounted on the stub shaft. When the brake pedal is pressed, hydraulically pressurized fluid is forced into the cylinders, pushing the opposing pistons and brake pads into frictional contact with the disc



Figure 5: Disc

IV. CALCULATION

Calculation for Force to operate Brake shoe

$$(F) F = (m + M)/C$$

$$\text{Allowable pressure for Asbestos} = 0.7b \text{ N/mm}^2$$

Total moment of Normal force (M)

$$\begin{aligned} M &= \frac{1}{2} p \text{ br OA } [(\theta_2 - \theta_1) + \frac{1}{2} (\sin 2\theta_1 - \sin 2\theta_2)] \\ &= \frac{1}{2} \times 0.75 \times 5 \times 97 \times 85 [(1.83 - 0.175) + \frac{1}{2} (\sin 20 - \sin 216)] \\ &= 39959.47 \text{ N-mm.} \end{aligned}$$

Total momentum of the friction force (M)

$$\begin{aligned} M &= \mu p \text{ br } [r (\cos \theta_1 - \cos \theta_2) + \text{OA}/4 (\cos 2\theta_2 - \cos 2\theta_1)] \\ &= 31947.52 \text{ N mm} \end{aligned}$$

Therefore Force (F) = (M + M)/C

$$= (39959.47 - 31947.52)/155 = 51.69 \text{ N.}$$

Force to operate brake shoe = 51.69N.

Calculation for Diameter of shaft

Subjected to torque

Material	= Carbon steel (C14)
Force	= 51.69 N = 5.269 kgf.
Radius	= 0.097 m.
Torque	= Force x Radius (kgfm)
	= 5.269 x 0.097
	= 0.511 kgfm

dia of the shaft = 20.5 mm (From PSG-Design Data book)

Calculation of force exerted by the solenoid

No of turns of copper = $N = 400$

Current = $I = 10A$

$MMf = M * I = 400 * 10 = 4000 \text{ AT}$

Reluctance of force = $\frac{1}{\mu_0 * \mu_r * a} + \frac{1 * g}{\mu_0 * a}$

= 250.88 * 10³

Flux = $\frac{MMf}{Reluctance}$

= 15.94 m wb

Flux density = $B = \frac{\text{Flux}}{\text{cs area}}$

$B = 70.53 \text{ wb/m}^2$

Force = $\frac{B * 2 * a * N}{\mu_0 * \mu_r * 9.81}$

Force = 570 N

V. FABRICATION OF MODEL

In electro-magnetic braking system we use electromagnetic property due to which action of braking will be done. In this system we used electro magnet iron plate, liners, tension spring, disc brake plate. The brake liners are attached with electro-magnet and iron plate individually and both plates insert the disc plate as shown in figure and this plate is fixed with wheels. The battery of minimum 12 volts is used for external power supply. In electro-magnetic braking system we use silicon control rectifier (SCR) The gate pulse of SCR is fired and the output of SCR is given to electro-magnet for braking the wheels. This SCR provides high current to our electro-magnetic braking system, electro-magnet and attracts the iron plate towards itself. This method opposes the motion of wheels, here we have designed electro-magnetic coil and liner system.

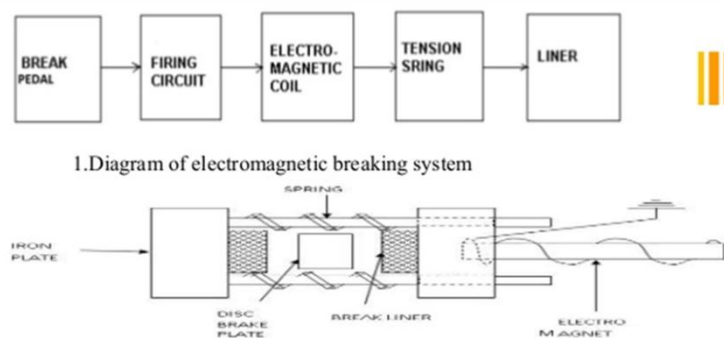


Figure 7: Diagram Of Electromagnetic Braking System

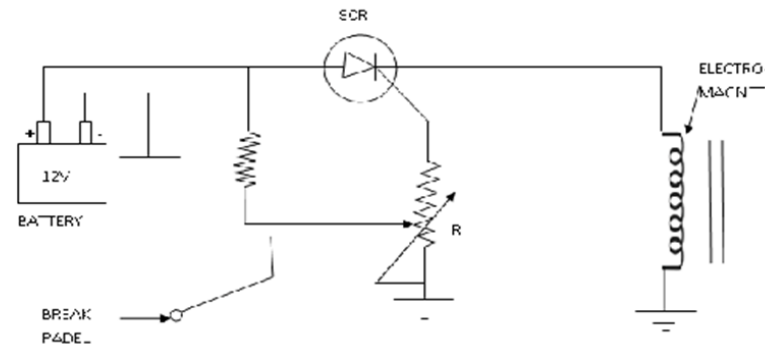


Figure 8: Firing Circuit

The various stages of fabrication of the prototype model is as follows:

Fabrication of frame

Attachment of wheel to frame Coil with braking plate & chain drive along with motor is added to the frame
Finally, control circuit box with battery is assembled and connected to the limit switches.

Final assembly

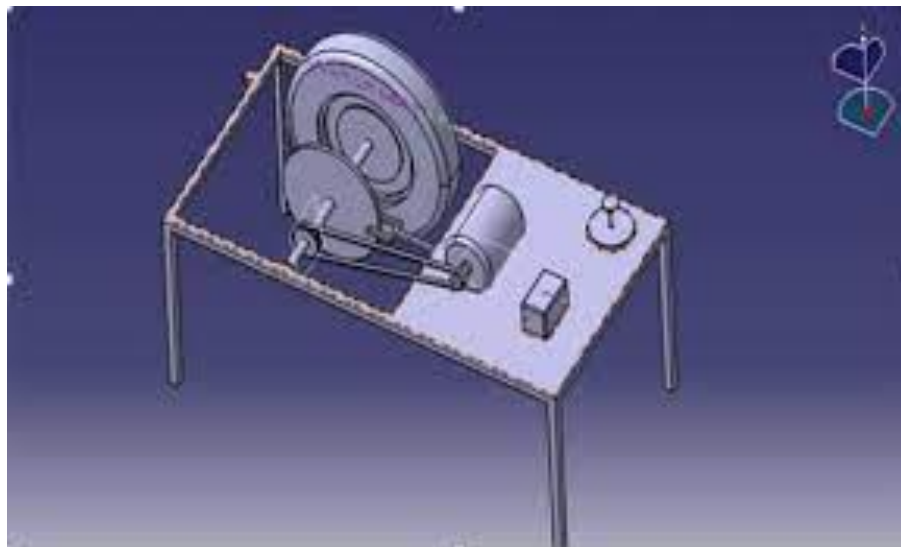


Figure 9: CAD Model

VI. CONCLUSION

An electromagnetic braking for automobiles like bike, car has an effective braking system. In addition, by using these electromagnetic brakes, we can increase the life of the braking unit the working principle of this system is that when the electromagnetic flux passes through and perpendicular to the rotating wheel the eddy current is induced in the rotating wheel Eddy current flows opposite to the rotating wheel. This eddy current tries to stop the rotating wheel or TX

This results in the rotating wheel or rotor comes to rest. Electromagnetic braking system is found to be more reliable as compared to other braking systems.



In oil braking system or air braking system, even a small leakage may lead to complete failure of brakes. While in electromagnetic braking system as four disc plates, coil and firing circuits are attached individually on each wheel, electromagnetic brakes make up approximately 80% of all of the power applied brake applications. Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles.

REFERENCES

1. Grahame, James "1968: Amc's Amazing Amitron Electric Car" Retro Thing: Vintage Gadgets And Technology 22 September 2008, Retrieved On 13 April 2009.
2. "Next: The Voltswagon?" Time Magazine, 22 December 1967, Retrieved On 13 April 2009.
3. GM Patents 5775467 -Floating Electromagnetic Brake System. Roger Ford (July 2, 2007). "Regenerative Braking Boosts Green Credentials".
4. Railway Gazette International
[Http://www.Railwaygazette.Com/Features_view/Article/ 2007/07/7577/Regenerative_braking Boosts_green_Credentials.Html](http://www.railwaygazette.com/features_view/article/2007/07/7577/regenerative_braking_boosts_green_credentials.html). Delhi Metro Prevents 90,000 Tons Of CO₂. [Http:// Economictimes.Indiatimes.Com/Earth/Delhi-metro-cuts 90000-tons-of-co2/Articleshow/41](http://economictimes.indiatimes.com/Earth/Delhi-metro-cuts-90000-tons-of-co2/articleshow/41)
5. Andreen, J.H., Gibson, J.W. and Wetmore, O.C., 1953. Fabric evaluations based on physiological measurements of comfort. Textile Research Journal, 23(1), pp.11-22. 2.
6. Totala, N.B., Bhosle, P., Jarhad, S., Jadhav, S. and Kuchekar, K., 2015, April. Electromagnetic Braking System. In National Conference on Innovations in Mechanical Engineering (Vol. 6, p. 8).
7. Innovative Electro Magnetic Braking System by Sevvell P and S Mukesh published in International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume-3 in April 2014
8. Flybird System
9. Torotrak



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