International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

ZERO FRICTION ELECTRO MAGNETIC BRAKING SYSTEM

Dr. Abid Ali M[1], Venkata Prasad T[2], Satish N[3], Murali Krishna U[4]

[2,3,4]*BTech students, Dept of Mechanical Engineering, Lingayas Institute of Management & Technology, Madalavarigudem, Vijayawada, Andhra Pradesh, India*

---***---

Abstract - Traditional braking systems convert kinetic energy into heat, which has drawbacks. This project proposes a friction-less braking system based on the eddy current phenomenon. Eddy currents are generated when a metal conductor moves relative to a magnet, as per Faraday's and Lenz's laws. These currents create magnetic fields opposing the magnet's field, slowing down motion. The system offers quick response, no heat generation, and maintenance-free operation. It utilizes a constant magnetic field design for simplicity. Implemented in the rear wheels of vehicles, it outperforms conventional friction brakes

Key Words: Friction less braking, Faraday's Lenz law, Magnetic Field.

1.INTRODUCTION

Magnetic brakes, also known as eddy current brakes or EC brakes, use magnetic force to slow down or stop motion without friction. Originally called "eddy-current brakes," they gained fame in the mid - 20th century, particularly in trains and trams. Over time, they became known as "magnetic brakes" due to their method of operation. These brakes are powered by magnetism and offer advantages over traditional brakes, such as reduced wear and tear. They work by generating eddy currents in a rotating disc when a magnetic field passes through it, creating resistance and bringing the disc to a halt. They're a promising option for modern vehicles due to their friction-less operation and potential to minimize damage to braking systems.

1.1 HISTORY

Magnetic brakes offer significant advantages over traditional braking systems. They can generate a braking power nearly double that of a regular engine and triple that of an exhaust brake. This makes them valuable supplementary deceleration equipment. By using magnetic brakes alongside friction brakes, heat-related issues and brake fade can be avoided. In studies, magnetic brakes have been shown to handle up to 80% of the braking load, reducing strain on friction brakes. This is particularly beneficial during long descents or continuous braking scenarios. Installation is relatively straightforward, requiring sufficient space between the gearbox and rear axle, with the option for a secondary cooling system if necessary. Compared to other braking systems like hydrokinetic and exhaust brakes, magnetic brakes offer better controllability due to their electrical switching control system. They can also be more economical, making them a promising solution for future transportation challenges, including heavy vehicle braking and energy efficiency.

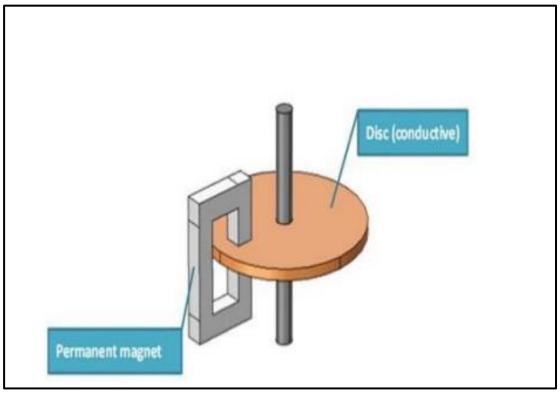


Fig -1: Magnetic Braking system Phenomenon

2. LITERATURE SURVEY

Stephen Z: Oldakowski, Bedford, Ohio A magnetic brake provides braking or locking capability and is remotely controlled by electric power. The magnetic brake comprises a rotatable shaft and a brake disc mounted on the shaft. A nonrotating core housing assembly located around the shaft includes a permanent magnet and a bipolar solenoid. A magnetic armature adjacent to the core housing assembly is capable of movement toward the core housing assembly and toward and into engagement with a brake disc to prevent rotation of the shaft. A spring urges the armature away from the core housing assembly and into engagement with the brake disc.

Karl Erny: The Holzhausem elevator drive incorporates a brake system with compression springs actuating brake levers, engaging brake linings on a drum for braking force. A sensor detects movement of a brake magnet armature tappet, connected to a bracket on one end and a sensor housing on the other. A restoring lug is fixed to the mechanical indicator. An integrated monitor evaluates the sensor signal and halts the drive-in hazardous conditions via a safety circuit, ensuring continuous brake status monitoring. As brake linings wear, the gap between armature and magnet housing decreases; contact compromises brake effectiveness. A magnetic conducting ring enclosing the aluminum fan, a permanent magnet disposed within the aluminum fan, a fixing seat for keeping the permanent magnet in position, a sliding seat mounted in the fixing seat and provided with a bearing, a housing, bolts provided on one side of the fixing seat and extending out of the housing, a mounting plate connected with the bolts and a wire connected with the mounting plate such that when the wire is pulled outwards, the permanent magnet will be moved outwards.

3. PRINCIPLE & OBJECTIVE

Principle: Principle of Electromagnetism is employed in Electromagnetic Braking system. When specific amount of current is skilled a round conductor then it produces magnetic flux, which is uniform everywhere the conductor. The magnetic flux strength depends on the present flowing through conductor and therefore the no of turn's more than oof turns and higher the current flowing through conductor higher the magnetic flux gets created. Solenoid is that the coil having more no of turns and its want to produce high strength magnetic flux which is employed during this electromagnetic braking.

Objective: The main objective of is to design and fabricate Electromagnetic Braking System model. Besides the main objective, following are secondary objectives:
1. To understand project planning and execution.
2. To understand the fabrication techniques in a mechanical workshop.
3. To make human life easier by using technology.

4. SCOPE OF THE PROJECT

The lots of new technologies are arriving in world. They create a lot of effect. Most industries got their new faces due to this arrival of technologies. Automobile industry is also one of them. There is a boom in World's automobile industry. Therefore, lots of research is also going here. As an important part of automobile, there are also innovations in brakes. Electromagnetic brake is one of them. This enhanced braking system not only helps in effective braking but also helps in avoiding the accidents and reducing the frequency of accidents to a minimum. Furthermore, the electromagnetic brakes prevent the danger that can arise from the prolonged use of brake beyond their capability to dissipate heat.

5. MATERIALS & METHODS

S. No	Materials	Quantity
1	Mild steel frame cut pieces	9
2	Copper Disc	1
3	Mild Steel Shaft	1
4	Deep Groove Ball Bearings	2
5	DC Motor RS775	1
6	Power Supply Unit	1
7	Chain Drive	1
8	Wires	4-6
9	Permanent Magnet	2
10	Magnet Holder	1
11	Nuts, bolts & clamps	As per requirements

Table -1: Components & Details

6. WORKING PRINCIPLE

If a piece of copper wire was wound, around the nail and then connected to a battery, it would create an electro magnet. The magnetic field that is generated in the wire, from the current, is known as the "right hand thumb rule". The strength of the magnetic field can be changed by changing both wire size and the amount of wire (turns). The fields of EM brakes can be made to operate at almost any DC voltage and the torque produced by the brake will be the same as long as the correct operating voltage and current is used with the correct brake. A constant current power supply is ideal for accurate and maximum torque from a brake. If a non-regulated power supply is used the magnetic flux will degrade as the resistance of the coil goes up. The hotter the coil gets the lower the torque will be produced by about an average of 8% for every 20°C. If the temperature is constant, and there is a question of enough service factor in the design for minor temperature fluctuation, by slightly over sizing the brake can compensate for degradation. This will allow the use of a rectified power supply, which is far less expensive than a constant current supply.

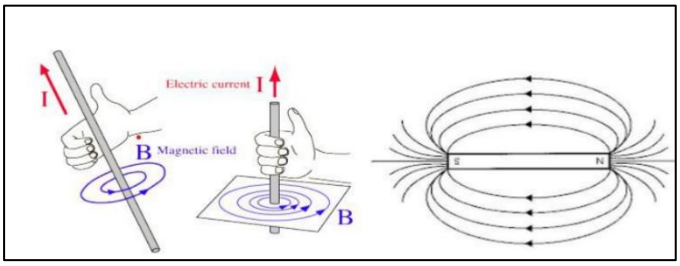


Fig -2: Working of Electro Magnetic field

7. RESULTS

When current passes through electromagnets, a braking force is generated by eddy currents induced in metal discs attached to rotating components. This resistance slows the rotation and provides braking force by converting kinetic energy to heat in the discs.

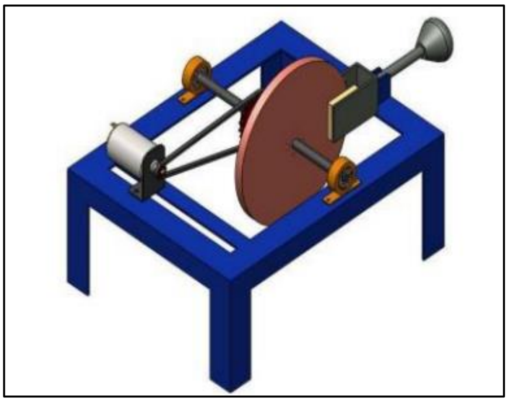
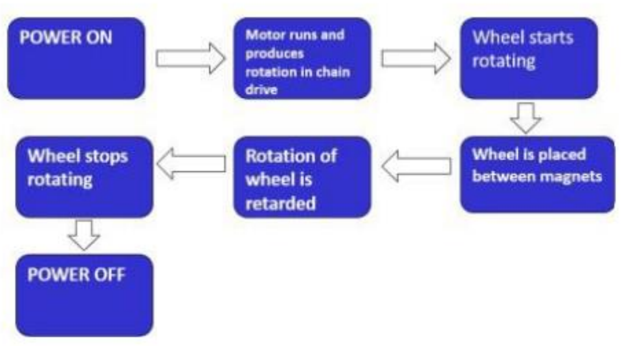


Fig -3: Final Fabrication

8. DISCUSSIONS

A friction – less braking system tends to increase life span and reliability of brakes since absence of friction leads to less wearing of brakes. Under operation it requires less maintenance and oiling as compared to other braking mechanisms.



Flow Chart – 1 : Working Mechanisms

9. CONCLUSIONS

The electromagnetic brakes have excellent cooling efficiency. Electromagnetic brakes have better thermal dynamic performance than regular. Electromagnetic brakes have numerous preferences over frictional slowing mechanism. The blend of swirl present and attractive powers makes this brake more successful.

ACKNOWLEDGEMENT

The heading should be treated as a 3rd level heading and should not be assigned a number.

REFERENCES

[1] A.Aravind, V.R.Akilesh, S.Gunaseelan, S.Ganesh "Eddy current embedded conventional braking system" - IJIRSET Volume 5, Special Issue 7, April 2016
[2] K. Kukutschovaa, V. Roubiˇceka, K. Malachovab, Z.Pavliˇckovab, R. Holuˇsab, J. Kubaˇckovac, V. Miˇckac, D.MacCrimmond, P. Filip d. 2009. Wear Mechanism in Automotive Brake Materials, Wear Debris and its Potential Environmental Impact, International Journal of Wear
[3] O. Uexkull, S. Skerfving, R. Doyle, M. Braungart. 2005. Carbide Antimony in brake pads—a carcinogenic component, J. Cleaner Prod. 13(2005) 19-31.
[4] Er shivanushrivastava "A Parametric Analysis of Magnetic Braking – The Eddy Current Brakes – For High Speed and Power Automobiles and locomotives" IJAREEIE Vol. 3, Issue 8, August 2014
[5] Sevvel "Innovative Electro Magnetic Braking System" IJIRSET Volume 3, Special Issue 2, April 2014 [6] Der-Ming Ma "The Design of Eddy-Current Magnet brakes "December 2010 Department of Aerospace Engineering, Tamkang University, Danshuei, Taiwan 25137, Republic of China [
7] Akshyakumar S Puttewar "Enhancement of Braking System in Automobile Using Electromagnetic Braking" IJAREEIE, 2010
[8] M. Jou, J.K. Shiau, C.C. Sun. 2006. Design of a Magnetic Braking System,
[9] Journal of Magnetism and Magnetic Materials, 304(2006) c234- c236.

BIOGRAPHIES

Dr. M. Abid Ali[1],
Head of the Department,
Dept. of Mechanical Eng.,
Lingayas Institute of Management & Technology, Vijayawada.

T. Venkata Prasad[2],
UG Student,
Dept. of Mechanical Eng.,
Lingayas Institute of Management & Technology, Vijayawada.

N. Satish[3],
UG Student,
Dept. of Mechanical Eng.,
Lingayas Institute of Management & Technology, Vijayawada.

U. Murali Krishna[4],
UG Student,
Dept. of Mechanical Eng.,
Lingayas Institute of Management & Technology, Vijayawada.