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DESIGN AND DEVELOPMENT OF SHAFT BREAKING SYSTEM

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Abstract: The main objective of this project is to create a model of a shaft braking system that can apply the brakes efficiently, considering all relevant factors, including friction loss. It uses two electromagnets that get their power from a circuit to run. A vehicle retardation device is one potential use for this kind. While physical braking is still required, an electromagnetic braking system may activate the brake by using magnetic attraction. The disc and the electromagnet are linked by a shaft that is mounted on the frame.By passing current through the coil, an electromagnetic field is generated across the armature. An eddy-current is generated when a magnet and a metal (or alloy) conductor move in relation to one another. By generating a magnetic flux in the opposite direction of its normal direction, the current reduces the speed of light. This system's braking mechanism is designed to include this event.

Keywords— Shaft Braking, Electromagnet, Eddy Current, Magnetic Field, Electromechanical, Current, Electromagnet

INTRODUCTION

Our current focus is on developing a technique for electrically delaying movement while precisely transferring torque in order to slow things down. Electromagnetic shaft brakes stop motion by applying an electromagnetic field that acts as a mechanical barrier or contact. The word was eventually changed to electromagnetic brakes from electro-mechanical shaft brakes to reflect the mode of activation. Electromagnetic braking systems, used mostly in cable cars and railroads, were popular around the middle of the twentieth century. After then, the framework received a plethora of new applications and brake structures, but at its core, the braking mechanism remains unchanged. Electromagnetic brakes are used to reduce the speed of the electric and attractive forces. They are lowering the bar for electromagnetic. These brakes are an excellent substitute for the convectional braking systems because of their numerous useful features. Vehicles should utilise this brake to save brake wear as it does not generate any friction.

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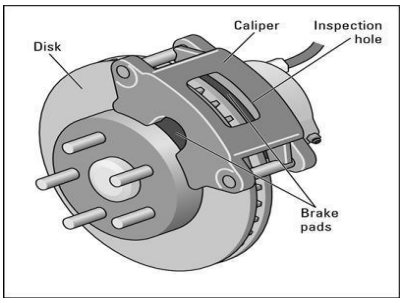
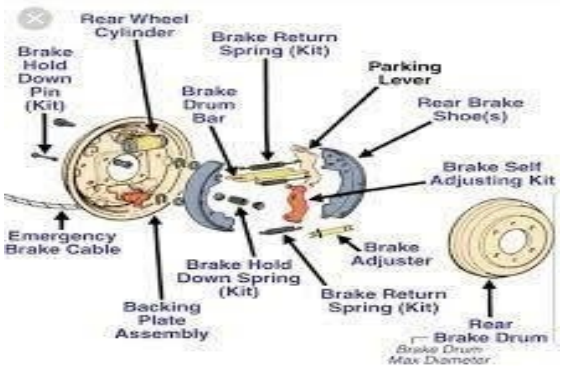


Disc Brake

By applying frictionless braking using the concept of electromagnetism, the electromagnetic slowing mechanism improves the brakes' longevity and dependability.In contrast to more conventional means of slowing down, which have a tendency to slip, this stopping system has attractive, snappy brakes. Because it does away with the need for rubbing or oil, this innovation is much favoured in crossovers. This braking mechanism is much more compact compared to the conventional ones.



Drum Brake

II. LITERATURE REVIEW

Authors Yogesh Kumar Yadav, Jitendra Kumar Yadav, Aadarsh Kumar Shah, and Jitendra Pratap Patel of IMS Engineering College's mechanical engineering department collaborated on a 2008 publication titled "Electromagnetic Braking System" that was published in the "International Research Journal of Engineering and Technology (IRJET)" in April. The ISSN for the print version of the publication is 2395-0072, while the one for the online version is 2395-0056.
Akshyakumar S. Puttewar, Nagnath U. Kakde, and Bhushan Nandeshwar, assistant professors, enhance vehicle braking systems using electromagnetic braking.

Dr. Babasaheb Ambedkar's Mechanical Department

The 2009 edition of the "IOSR Journal of Mechanical and Civil Engineering" had an article by Huzaifa A. Fidvi, an assistant professor in the mechanical department of Nagpur's Anjuman College of Engineering and Technology, as well as the College of Engineering & Research in Nagpur. The ISSN for the printed edition of the publication is 2320-334X, while the one for the online version is 2278-1684.
The 2017 edition of the "International Journal for Scientific Research & Development (IJSRD)" published the article "Electro-Magnetic Braking System" in Volume 4, Issue 11. The post was penned by Miss Sangale Surekha and co-written by five Mechanical Engineering students from S.C.S.C.O.E. in Shrishivajinagar: Bhadane Kalpesh Nilkanth, Chattar Sujit Sanjay, Deshmukh Shubham Anantrao, and Shinde Natha Balu. The article may be accessed online using the ISSN number 2321-0613.

III. CONSTRUCTION

Serial No.	Materials Used
1	Electric Motor
2	Magnetic Lining
3	Chain
4	Sprocket
5	Supports
6	Solid Shaft
7	Electromagnet
8	Wiring
9	Bearing
10	Battery
11	Lever Switch

Materials Use

Electric Motor

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An electrical motor is device thatconverts electrical energy into mechanical energy. The motor we used here is a dc motor. A DC motor consists of a stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the 2 magnetic fields within the motor cause it to

Electric MotorMagnetic Lining

The surface that is subjected to the magnetic force is known as the magnetic lining. The lining is the sole one that the electromagnetic energy is directed at. A magnetic liner made of iron is fastened to the wheel of the vehicle or any piece of equipment that is meant to stop. The wheel also stops because the lining or iron plate, which is in motion, comes to rest due to the electromagnetic braking force.

Magnetic Lining (represented by arrow)Solid Shaft

A shaft is a rotating machine component,sometimescircular in cross section, that is employed

turn. DC motors are the simplest sort of motor and are also employed in household appliances, such as electrical razors, and in electrical windows in cars.

Shaft

to transmit power from one part to another part, or from a machine that produces power to a machine which absorbs power. The various members like pulleys and gears are mounted on that.

Electromagnet

One possible definition of an electromagnet is a magnet capable of producing very high currents. Changing the current passing through an electromagnet may change its characteristics, unlike a static magnet. In order to switch the orientation of an electromagnet's shafts, the current must be reversed.

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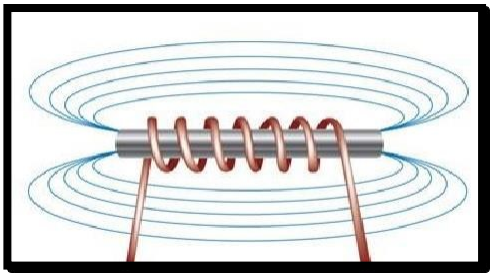

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Electromagnet

Bearing

. For instance, the bearing's design can allow the moving component unrestricted rotation around a fixed axis or linear motion.

IV. METHODOLOGY

Electromagnetism

Among the four basic modes of communication used by nature, electromagnetism is one. The other three are enticing energy, helpless collaboration, and solid communication. An electromagnetic field and the force that generates it are the terms used to describe the environment in which charged particles interact with one another.

Magnetic Effect of Current

By definition, "a current flowing in a wire produces a magnetic field around it" is what a phrase like "magnetic effect of current" means. The theory of the magnetic effect of current was first proposed by Oersted in 1820. Based on what Oersted found, a wire that carries electricity may redirect a magnetic needle.

Electromagnet

Using an electric current is one method to make a magnet, which is referred to as an electromagnet. To transfer current, a non-magnetic material makes use of a magnetic field. Placing a core, which is a supple iron rod, inside a solenoid enables the magnetic field strength to rise significantly because the iron ore is magnetised by induction.

Eddy Current

An eddy current is a phenomena where the current flows in a circular pattern due to a change in the magnetic field within a conductor, as stated by Faraday's law of induction. Closed loops along lines of magnetic field carry eddy currents via conductors. The phenomenon known as an eddy current arises from Lenz's law, which asserts that an eddy current's magnetic field will be of opposite intensity to its source. Using this phenomena, eddy current brakes quickly bring power equipment to a halt when turned off. The energy that is transmitted from the current via the resistance of a conductor is also lost as heat inside the material, according to Faraday's law of induction. Eddy currents circulate in closed loops through conductors in a direction perpendicular to the applied magnetic field. The phenomenon known as an eddy current arises from Lenz's law, which asserts that an eddy current's magnetic field will be of opposite intensity to its source. Using this phenomena, eddy current brakes quickly bring power equipment to a halt when turned off. As a current passes through a material and encounters resistance, some of that energy is lost as heat.

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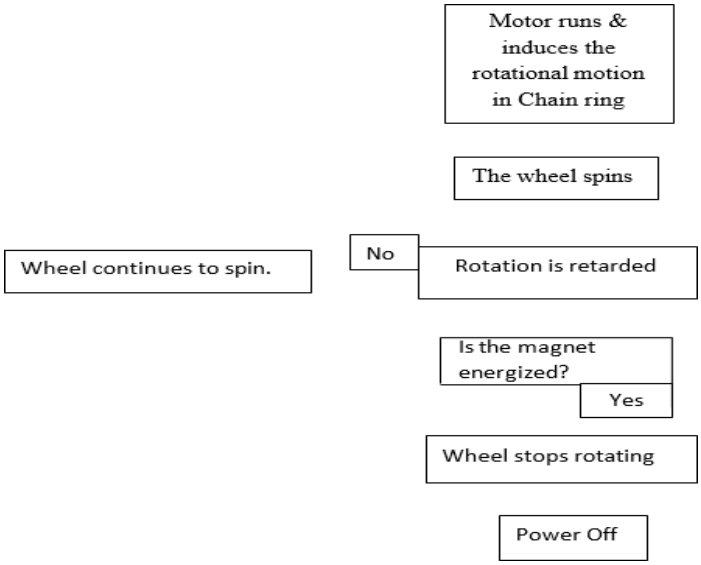
Working



The main objective of this research was to analyse the electromagnetic braking system and provide judgements on how well it complements the hydraulic braking system. The mounting platform and magnetic base are the first components.

A fulcrum is created. The next step is to build a wheel and attach it to the spook. Then, using bearings, secure the spook to the platform.

A standard electromagnet has a cylindrical base that is attached to a copper wire coil. The ends of the U-shaped rod and L-shaped bar that make up the brake shoe are welded together inside the electromagnet.

Flowchart of working mechanism

V. CALCULATIONS & OBSERVATIONS

Assumptions

- The model is not in account of load andfriction.
- The cross-section of copper wire is uniformthroughout its length.
- The data are taken in room temperature.
- All the types of vibrations are neglected.

Calculation

1. Magnetic force produced (B)=μIN

$$=4\pi*10^{-7}*7*4000$$

=0.0351 T

which is magnetic force produced by one electromagnet as we are using twoelectromagnets. So our total force will be, Total Magnetic force (B)=2*B

=0.0703 T.

2. Resistance of wire(R)=ρL/A

=1.7*10^{-8} * 10

=0.337 Ω

Where, I is current, N is number of turns, A is crosssectional area, G is the gap between magnet and iron, R is the resistance of copper wire, L is the length of copper wire, ρ is the resistivity of copper, T is time in seconds.

Observations

Time required to stop the rotation of wheel without applying brake= 4.9 seconds

Time required to stop the rotation of wheel with applying brake= 3.1 seconds

VI. Applications

Locomotives use a mechanically linked electromagnetic braking system.

Trains and trams employ electromagnetic track brakes, which attach the braking device to the rail via magnetic force. In contrast, mechanical track brakes use a mechanical force to press the braking device on the rail.

Electric motors used in industrial and robotic applications are another area where electromagnetic brakes find utility.

Modern innovations in aircraft design have made electromagnetic brakes standard equipment. This program spins the tires up to speed before landing using a motor/generator combination, and then it utilises the generator to provide regenerative braking, reducing tire wear.

VII. CONCLUSION

This research showcases the performance of a multi-component electromagnetic braking system by highlighting its cost-effectiveness and efficient techniques to using the delivered energy. By using the robust and efficient magnetic, we can get a brake system that is more effective.

Based on our findings, this strategy not only reduces the system's total cost but also provides substantial advantages over more conventional braking techniques. Small adjustments to the vehicle's architecture are all that's needed to incorporate this technology into almost any system. As an additional braking system, this technology can keep the conventional one from becoming too hot and breaking down.

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