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Electromagnetic Braking System

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ABSTRACT: The principle of braking in road vehicles involves the conversion of kinetic energy into heat. In this paper we had develop the electromagnetic braking system. Braking System should ensure the safety and comfort of the passenger, driver and other road user. The brake must be strong enough to stop the vehicle during emergency within shortest distance. Electromagnetic braking systems have emerged as efficient alternatives to traditional friction-based braking systems in various applications ranging from automotive to industrial machinery. This abstract provides an overview of electromagnetic braking systems, their working principles, advantages, and applications.

KEY WORDS- Brake, Electromagnetism, Brake power, Torque

I.INTRODUCTION

A brake is a mechanical device which retards motion. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction. Brakes may be broadly described as using friction, pumping, or electromagnetic. Brakes use friction between two surfaces to convert the kinetic energy of the moving object into heat. But the Electromagnetic brakes are used as supplementary retardation equipment additionally to the regular friction brakes on heavy vehicles. They work on the principle of electromagnetism. The working rule of this technique is that when the magnetic flux passes through and perpendicular to the rotating wheel the eddy current flows opposite to the rotating wheel/rotor direction. By using the electromagnetic brake as supplementary retardation equipment, the frictions brakes are often used less frequently and thus practically never reach high temperatures.

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 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 project intends to the design and implementation of new system of retardation for automobiles
- > The design of new brakes is based upon the phenomenon of electromagnetic induction and eddy currents
- > 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 induction current
- > The current in turn dissipates the rotational energy of the wheel as heat bringing the wheel to a stop

The ever-growing demand for efficient, reliable, and environmentally friendly braking solutions has led to extensive research and development in the field of electromagnetic braking systems. Electromagnetic braking systems are often used in applications where precise control, rapid response, and minimal wear and tear are important, such as in electric trains, elevators, roller coasters, and hybrid or electric vehicles. It is found that electromagnetic brakes can develop a negative power which represents nearly twice the maximum power output of a typical engine, and at least three times the braking power of an exhaust brake. (Reverdin 1994). This performance of electromagnetic brakes makes them a much more competitive candidate for alternative retardation equipment compared with other retarders. By using by using the electromagnetic brakes are supplementary retardation equipment, the friction brakes can be used less frequently and therefore practically never reach high temperatures.

The brake linings would last considerably longer before requiring maintenance and the potentially “brake fade” problem could be avoided. In research conducted by a truck manufacturer, it was proved that the electromagnetic brake assumed 80% of the duty which would otherwise have been demanded of the regular service brake (Reverdin 1974). Furthermore, the electromagnetic brakes prevent the danger that can arise from the prolonged use of brake beyond their capability to dissipate heat. This is most likely to occur while a vehicle descending a long gradient at high speed. In a study with a vehicle with 5 axles and weighting 40 tones powered by a powered by an engine of 310 b.h.p travelling down a gradient of 6% at a steady speed between 35 and 40 m.h.p, it can be calculated that the braking power necessary to maintain this speed at the order of 450 hp. The brakes, therefore, would have to absorb 300 hp, meaning that each brake in the 5 axels must absorb 30 hp, that a friction brake can normally absorb with self destruction. The magnetic brake is well suited to such conditions since it will independently absorb more than 300 hp (Reverdin1974). It therefore can exceed the requirements of continuous uninterrupted braking, leaving the friction brakes cool and ready for emergency braking in total safety. The installation of an electromagnetic brake is not very important if there is enough space between gearbox and rear axel. If did not need a subsidiary cooling system. It relay on the efficiency of engine components for its use, so do exhaust and hydrokinetic brakes. The exhaust brake is an on/off device and hydrokinetic brakes have very complex control system. The electromagnetic brake control system is an electric switching system which gives it superior controllability.

II. PRINCIPLE AND OBJECTIVE

Principle

Principle of Electromagnetism is employed in Electromagnetic Braking systems. When a specific amount of current is skilled a round conductor then it produces magnetic flux, which is uniform nductor higher the magnetic flux gets created. Solenoid is everywhere the conductor. The magnetic flux strength depends on the present flowing through conductor and therefore the no of turn’s more than of turns and higher the current flowing through cothe coil having more no of turns and it wants to produce high strength magnetic flux.

Objective

The main objective of is to design and fabricate Electromagnetic Braking System model. Besides the main objective, following are secondary objectives:

- >To understand project planning and execution.
- >To understand the fabrication techniques in a mechanical workshop.
- >To make human life easier by using technology.

III.COMPONENTS REQUIRED

A Base Frame, Alternate current motor, Battery, ‘V ’belt, Wheel, Metal disc, Electromagnetic coil; Pulley; Shaft; Bearing;Capacitor

3.1 USED DEVICES

AC MOTOR

Voltage - 200/220V; Frequency - 50HZ,1PH P; AMPS - 2 AMPS; Power - 0.25 HP; RPM -1420; KW-0.18



Fig.1 AC MOTOTR

An AC motor, or alternating current motor, is a type of electric motor that operates on alternating current. It converts electrical energy into mechanical energy to perform various tasks, such as driving machinery, pumps, fans, and compressors. AC motors are widely used in industrial, commercial, and residential applications due to their reliability, efficiency, and ease of control. There are different types of AC motors, including induction motors, synchronous motors, and brushed and brushless DC motors. An AC motor, or alternating current motor, is a type of electric motor that operates on alternating current. It converts electrical energy into mechanical energy to perform various tasks, such as driving machinery, pumps, fans, and compressors. AC motors are widely used in industrial, commercial, and residential applications due to their reliability, efficiency, and ease of control. There are different types of AC motors, including induction motors, synchronous motors, and brushed and brushless DC motors.

REGULATOR

The regulator is used in order to control the speed of the electric motor. The speed is controlled by changing the frequency of the electric supply to the motor. The frequency can be adjusted to match the need of the process. The higher the frequency of the output voltage is, the higher the speed of the motor, and thus, the output of the process. Here the capacity of the regulator is $220V \pm 10\%$ in voltage, 50HZ in frequency.

BELT PULLEY

Belt drives are commonly used in transmission of power between two shafts which are at some distance. The belts run over pulleys, the pulley connected with the source of power is called the driver pulley and the other pulley is called a driven Belt-Pulley is like Chains and gears that transmit power from one shaft to another shaft that uses belts and ropes when the distance between the two shafts is large.

METAL DISK

The metal disc is one of the important components used here. It is made up of cast iron plate. In an electromagnetic braking system, a metal disk is typically used as part of the braking mechanism. When the brake is engaged, electromagnetic forces are applied to the metal disk, causing it to slow down and eventually stop. This process converts the kinetic energy of the moving parts into heat energy, thereby slowing down or stopping the motion of the system. These systems are commonly used in applications such as trains, elevators, and industrial machinery.

DC BATTERY



Fig.2 DC BATTERY

Battery specifications :

Capacity : 12V and 7.3Ah; Rechargeable battery one; Battery type : lead- Acid Battery; Charge Capacity:4.2 hour loading condition; Charging time : 3 hour

CHAIN DRIVE

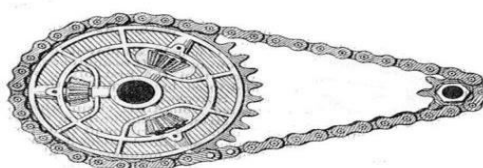


Fig.3 CHAIN DRIVE

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. In an electromagnetic braking system, a chain drive could be utilized to transmit the braking force from the electromagnetic brake to the braking mechanism.

ELECTRO MAGNETIC COIL



Fig.4 ELECTRO MAGNETIC COIL

The key to understanding the role of permanent magnet's gear shifting lies in the general issue of biasing. Consider the simplest magnetic as shown in the figure, but omit the lower electromagnet

ELECTROMAGNET

Various types of electromagnet are available in market, some of basic electromagnet are described below:

(1) Single Disc electromagnetic brakes:

Technical Features: Technical Features Torque: 3NM to 500NM High Operating Reliability/frequency; Single Plate Dry Type; Simple Construction; Unique pre-stressed spring; Raw material to DIN standards; Special friction material

(2) Multi disc electromagnetic brakes

Technical Features: Coil Voltage: 24 V; Torque: 3 N-mt 3600 N-m; Compact design; Electromagnetic brakes are provided; with or without outer carrier, jaw and driver; With inner & outer multiple discs.

CAPACITOR

A capacitor is a passive two terminal electrical component used to store electrical energy temporarily in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors (plates) separated by a dielectric (i.e. an insulator that can store energy by becoming polarized). The conductors can be thin films, foils or sintered beads of metal or conductive electrolyte, etc. The non conducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, air, vacuum, paper, mica, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices.

SWITCH AND WIRES

ON/OFF switch used to control the power; supply to the electromagnet. It is connected with the electromagnet. A typical common; electric switch is used here. When the rotation of the pulley is to be stop, the braking is applied by turned the switch on

When the free rotation of the pulley is required the switch is turned off to provide the electric supply to the motor and the electromagnet the electric wire is used here. The copper wire has been used here since it has the better electrical conductivity.

IV.WORKING OF ELECTROMAGNETIC BREAKING SYSTEM

An electromagnetic braking system works by using the principles of electromagnetism to generate braking force without friction. When the brakes are applied, an electric current is passed through a coil within the brake assembly, creating a magnetic field. This magnetic field interacts with the metal rotor, inducing eddy currents, which in turn create an opposing magnetic field. The interaction between these magnetic fields causes the rotor to slow down, effectively applying braking force. This system offers advantages such as reduced wear and tear, smoother braking, and regenerative braking capabilities in some designs.

4.1 APPLICATION

- Already in use under some railway system
- Can be used for any road vehicles
- Equally applicable to heavy and light vehicles
- Can be used as additional retarder for aircrafts
- May also find application in virtually any rotating system which have metallic parts
- This brake system can be use in two wheeler.
- Electromagnetic braking system can be used as a modern technology of braking in automobile.
- Electromagnetic braking system will be used in all types of light motor vehicle like car and heavy motor vehicle.

4.2 LIMITATIONS

- Failure to act as a holding device
- Usage of electric power for braking
- Less effective under very low velocities
- The installation of an electromagnetic brake is very difficult if there is
- Not enough space between the gearbox and the rear axle.
- Need a separate compressor.
- Maintenance of the equipment components such as hoses, valves has to done periodically.
- It cannot use grease or oil.
- Dependence on battery power to energize the brake system drains down the battery much faster.

4.3 ADVANTAGES

- Problems of drum distortion at widely varying temperatures. Which is common for friction-brake drums to exceed 500 °C surface temperatures when subject to heavy braking demands, and at temperatures of this order, a reduction in the coefficient of friction („brake fade") suddenly occurs.
- This is reduced significantly in electromagnetic disk brake systems.
- Potential hazard of tire deterioration and bursts due to friction is eliminated
- There is no need to change brake oils regularly.
- There is no oil leakage
- The practical location of the retarder within the vehicle prevents the direct impingement of air on the retarder Caused by the motion of the vehicle.
- The retarders help to extend the life span of the regular brakes and keep the regular brakes cool for emergency situation.
- The electromagnetic brakes have excellent heat dissipation efficiency owing to the high temperature of the surface of the disc which is being cooled.
- Due to its special mounting location and heat dissipation mechanism, electromagnetic brakes have better thermal dynamic performance than regular friction brakes.
- Burnishing is the wearing or mating of opposing surfaces. This is reduced significantly here.

V. RESULT

By using the electromagnetic brake as supplementary retardation equipment, the frictions brakes are often used less frequently and thus practically never reach high temperatures. The brake linings would last considerably longer before electromagnetic brake assumed 80% of the duty which might otherwise is demanded of the regular service brake. Furthermore, the electromagnetic brake prevents the risks which will arise from the prolonged use of brakes beyond their capability to dissipate heat. This is often presumably to occur while a vehicle descending an extended gradient at high speed. The installation of an electromagnetic brake isn't very difficult. It doesn't need a subsidiary cooling system. It doesn't effect on the efficiency of engine.

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, while using electromagnetic coils in an ABS system has some potential advantages, it is important to carefully consider the specific implementation and the potential trade-offs in terms of cost, complexity, and performance. Using electromagnetic coils in an ABS system has some potential advantages over other implementations. For example, it can be more precise than other methods and can be more easily integrated into existing brake systems.

Future work

- The proposed winding model should be verified and its validity with respect to frequency and model parameter settings investigated.
- In the core model the static hysteresis model should be improved, especially regarding the modelling of minor loops. E.g., the distribution function of the pseudo particles and the relation between reversible and irreversible processes should be studied more in detail.
- In the dynamic magnetization model the optimization of the Causer circuit sections and the frequency and amplitude dependency of the parameter VO could be studied. If it is possible to find that dependency for a class of material, this would make this model a very useful tool. Then the only necessary adapting step would be to fit the static curve to the measured static curve.
- The composite transformer model should also be validated in other operation modes like transient over voltage.

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REFERENCES

- [1] Dr Kirpal Singh. Automobile Engineering and Technology, Vol 1
- [2] R.A. Barapate "Electromagnetic Engineering" Technova Educational Publication
- [3] Khurmi & Gupta "Machine Design" S Chand Publication.
- [4] V.B. Bhandari "Design of Machine Elements" Tata McGraw Hill.
- [5] K. Balaveera Reddy. "Design data hand-book for mechanical engineering.
- [6] Flemming, Frank; Shapiro, Jessica (July 7, 2009). "Basics of Electromagnetic Brakes" .machine design.
- [7] Kren, Lawrence; Flemming, Frank (August 5, 1999). "Getting a Handle on Inertia" .machine design: pp. 92–93.
- [8] Auguston, Karen; Flemming, Frank (September 1999). "Floating Armature Speeds Response" .Global Design News: pp. 46–47.
- [9] Zalud, Todd; Flemming, Frank (September 9, 1999). "Getting a Grip on Brake Selection" .machine design: pp. 83–86.
- [10] Electromagnetic Compatibility, design handbook series 1.0. John Wiley & Sons.
- [11] D. Schieber, Electromagnetic Induction phenomenon, springer series in electrophysics Vol 16 (Springer, Berlin).
- [12] Modelling and analysis of a new axial flux permanent magnet biased eddy current brake M. Gulec; M. Aydin 2016 XXII International Conference on Electrical Machines (ICEM) Year: 2016.
- [13] Simplified model of eddy current brakes and its use for optimization Christoph Holtmann; Frank Rinderknecht; Horst E. Friedrich 2015 Tenth International Conference on Ecological Vehicles and Renewable Energies (EVER) Year: 2015
- [14] Parameter identification of eddy current braking system for various applications Arunesh Kumar Singh; Ibraheem; Amit Kumar Sharma 2014 Innovative Applications of Computational Intelligence on Power, Energy and Controls with their impact on Humanity (CIPECH) Year: 2014
- [15] A.K. Sawhney, Electrical Machine Design, (Dhanpat Rai & Co).
- [16] DP Kothari, I J Nagrath, Electric Machines 4/E 4th edition (McGraw Hill Education)
- [17] 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.
- [18] 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).
- [19] Yadav, Y.K., Shah, A.K., Yadav, J.K. and Patel, J.P., 2018. Electromagnetic Braking System.
- [20] HOLT, A., 1986, June. Electromagnetic braking for Mars spacecraft. In 22nd Joint Propulsion Conference (p. 1588)



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