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Fabrication and Experimental Investigation of Magnet Eddy Current Braking Syatem

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ABSTRACT: -

Braking System should ensure the safety and comfort of the passenger, driver, and another road user. The brake must be strong enough to stop the vehicle during an emergency within the shortest distance. The conventional braking system is bulky and the power to weightratio is low.Traditional braking systems like Disc brake systems,Drum brake systems, and hydraulic braking systems had low efficiencies compared with this electromagnetic braking system. Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles.In the operation of any machinery, the primary safety system is the braking system. The most basic designs of the braking system involve the conversion of kinetic energy to heat energy by friction. This is accomplished by friction between two rubbing surfaces. These brakes pose several problems i.e. significant wear, fading, complex and slow actuation, etc. This paper is an attempt to solve these problems, where a contactless magnetic brake has been developed by using a metal disc that will conduct eddy currents generated by magnets.

KEY WORDS: Brake, Electromagnetism, Eddy current, Torque.

I. INTRODUCTION:-

Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles. We outline the general principles of regular brakes and several alternative retardation techniques in this section. The working principle and characteristics of electromagnetic brakes are then highlighted.The principle of braking in road vehicles involves the conversion of kinetic energy into thermal energy (heat). When stepping on the brakes, the driver commands a stopping force several times as powerful as the force that puts the car in gesture and dissipates the associated kinetic energy as heat. Brakes must be able to arrest the speed of a vehicle in a short period regardless of how fast the speed is. As a result, the brakes are required to have the ability to generate high torque and absorb energy at extremely high rates for short periods. Brakes may be applied for prolonged periods in some applications such as a heavy vehicle descending a long gradient at high speed. Brakes have to have the mechanism to keep the heat absorption capability for prolonged periods.In the electromagnetic brake, the rotating non-magnetic metal cuts the magnetic field thus eddy current is induced. The steel/aluminum disc is fixed to a rotating axlewhen the driver wants to apply the brake to the vehicle permanent magnet is brought nearer to the rotating disc due to the generation of eddy current vehicle tends to stop.In lathes,escalators,aircraft industry,this electromagnetic braking system has a wide range of applications.

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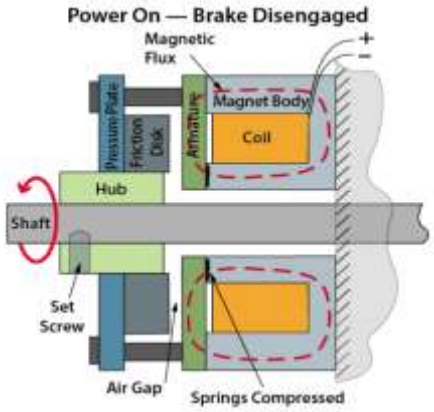

Fig 1

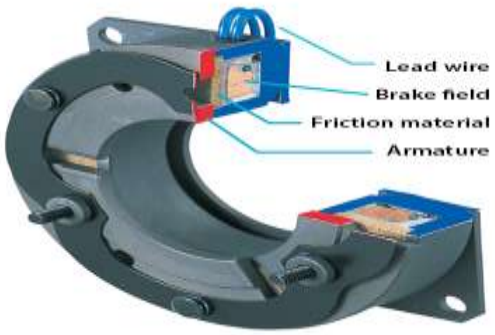

Fig 2

II. LITARATURE RIEVIEW:-

Prof. N.B.Totala Limitations of drum brakes, hydraulic brakes and pneumatic brakes electromagnetic brake is a better and reliable solution.Electromagnetic brake control system is an electric switching system which gives it superior controllability. The installation of an electromagnetic brake is not very difficult. From the foregoing, it is apparent that the electromagnetic brake is an attractive complement to the safe braking of heavy vehicles. Good results with current design, a larger budget would improve performance.

Dr. G. V. Naveen Prakash The purpose of the study was to perform a comparative study of experimental and analysis using COMSOL MULTIPHYSICS software. From experimentation, we found that Aluminum 6061 has greater percentage reduction in braking time compared to copper discs. In permanent magnets, NdFeB magnet (1.3T) induces greater magnetic flux density compared to Ferrite magnet (0.3T). Larger the surface area of magnet, more exposure of disc surface to magnetic flux. In case of air gap, it was found that lesser the air gap; more eddy currents were induced due to less air resistance. According to our experimentation we found that 6mm air gap is better compared to 10mm. It was also observed that, as the rpm decreases eddy currents induced in disc also decreases. Hence the percentage reduction of braking time decreases. Conversely, as the rpm increases eddy currents induced in disc also decreases. Hence the percentage reduction of braking time increases. The same results were obtained during software analysis.

Bhushan.E.Lokhande In electromagnetic braking system as four disc plates, coils and firing circuits are attached individually on each wheel, even any coil fails the brake does not completely fails remaining three coil works properly. It is found that electromagnetic brakes make up approximately 80% of all of the power applied brake applications. 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. These electromagnetic brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure. ABS usage can be neglected by simply using a micro controlled electromagnetic disk brake system. These electromagnetic brakes can be used in wet conditions which eliminate the anti-skidding equipment, and cost of these brake are cheaper than the other types. Hence the braking force produced in this is less than the disc brakes.

BASIC FUNCTIONING:-

Eddy current brakes use the drag force created by eddy currents as a brake to slow or stop moving objects. Since there is no contact with a brake shoe or drum, there is no mechanical wear. However, an eddy current brake cannot provide a "holding" torque and so may be used in combination with mechanical brakes, for example, on overhead cranes. Another application is on some roller coasters, where heavy copper plates extending from the car are moved between pairs of very strong permanent magnets.

Electrical resistance within the plates causes a dragging effect parallel to friction, which dissipates the kinetic energy of the car. The same technique is used in electromagnetic brakes in railroad cars and to quickly stop the blades in power tools such as circular saws. Using

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electromagnets, as opposed to permanent magnets, the strength of the magnetic field can be adjusted and so the magnitude of the braking effect changes. Eddy's current braking technology is a useful tool in a growing world. Innovations in exercise equipment, industrial tools, entertainment, roller coasters, and transportation are just the tip of the iceberg. As new advancements are being produced a safer and more efficient world is being born. The eddy current brake can be applied to many things in our everyday world, even more than we might expect. Take notice of the everyday applications of this high-tech innovation. The risk management improvements and economic advantages that accompany the eddy current brake has made it a popular choice among engineers when developing new technologies or improving the old. This intricate network of magnets is used more commonly than you might think.

METHODOLOGY AND WORKING PRINCIPLE:-

Initially, the rotor disc is mounted on a mild steel shaft which is coupled to single phase AC motor. The speed of the disc is varied with the help of 3 channel rpm regulator. By the application of brake lever the permanent magnet is brought near the rotating disc with very small air gap. Then eddy currents are induced in the rotor due to varying magnetic flux and these eddy currents oppose the rotation of the disc by the principle of Lenz law and hence within a few seconds the disc comes to rest. The air gap can be adjusted by threaded screw mechanism. Aluminum 6061 and Copper discs have been used. Neodymium Iron Boron (NdFeB) and Ferrite permanent magnets have been used.

The working principle of the electric retarder is based on the creation of Eddy currents within a metal disc rotating between two electromagnets, which sets up a force opposing the rotation of the disc. If the electromagnet is not energized, the rotation of the disc is free and accelerates uniformly under the action of the weight to which its shaft is connected. When the electromagnet is energized, the rotation of the disc is retarded and the energy absorbed appears as heating of the disc. In this type of electromagnetic braking system, electromagnet is fixed in the back plate in this way the unequal braking effect at one shoe are balanced, even if the lining on one shoe is worn more than other the plunger will move to one side so that shoe still share equal acting force. In this braking system, any one shoe out of two will remove & instead of it we will use the electromagnetic coil. As the current passes through this electromagnetic coil, it will produce the magnetic flux, this flux will attract the shoe with much force, and brake will apply.

An electromagnet is made by winding the copper wire with the cylindrical body and attached to it's base. Furthermore, an 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.Also a fan is also attached to motor and the motor is attached to the base. So the electromagnet and the motors of wheel and fan are circuited to an external battery and by turning it on, they work respectively. The electromagnetic brake is a relatively primitive mechanism, yet it employs complex electromagnetic and thermal phenomena. As a result, the calculation of brake torque is a complex task. The case study of electromagnetic brake is done, and literature survey has been studied. Aluminium and Copper are the preferred materials for the disc due to their electric, thermal, and magnetic properties. 3D CAD model is prepared based on the required dimensions. Different electromagnets and different air gaps for the electromagnets were taken for purpose of comparison and design of experimentation. Maximum Braking torque, Maximum Braking force and Stopping Distance were calculated. Design of electromagnetic braking system is done based on the calculations.

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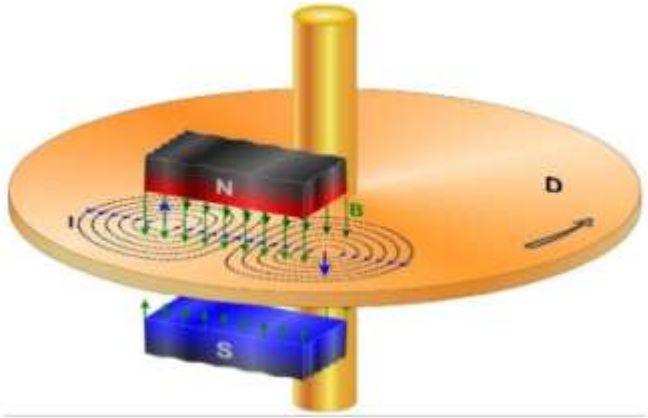

Fig 3

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.

Fig 4 CAPACITOR

DC motor: DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary ŵotioŶ; A linear motor directly produces force and motion in a straight line.We used dc motor as shown in fig.

Fig 5

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ALUMINUM DISC: Al 6061 being very light metal higher speeds were attained compared to copper. The time required by Al 6061 disc to stop without magnet and with NdFeB, Ferrite magnets against air gaps of 6mm and 10mm are tabulated in Table 2. From Table 2 we can notice that the reduction percentage in time gradually increases with increase in rpm.

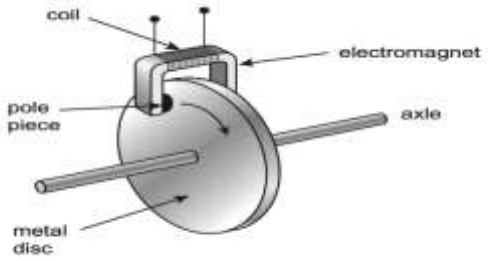

Fig 6 Aluminium disc

POWER SOURCE:-A 240 V of Alternat Current is used as power supplying unit for driving the dc motor.In which a power transformer is exists to convert A.c to D.c. Battery supply the current to the Electromagnetic coil whenever required to apply the brake.

Fig 7 A.C TO D.C Step Down Transformer

MERITS OF THE TECHNOLGY:-

• 1. Quitter in operation. • 2. No moving parts hence no friction • 3. Almost no wear (Wear only if coolant system failure). • 4. Essentially zero maintenance. • 5. Produce no chemical pollution. • 6. No parts need to be replaced • 7. Can be activated at will via electrical signal • 8. There is no need to change brake oils.

UPCOMING POSSIBILITY OF PROJECT:-

Many new technologies are coming to the world. They createtons of effect. Many industries have found their new face as a result of this advent of technology. industry moreover one of them. There is prosperity in the global industry. So, a lot of research goes here too. As an integral part of the car, there are also new features on the brakes. The electromagnetic brake is one of them. This improved braking system not only improves efficiency braking but also helps to avoid accidents and reduce the frequency of accidents to a minimum. In addition, electric brakes prevent the risk of long-term use of the brake in addition to its heat dissipation capabilities.

III. CONCLUSION:-

A Braking System should provide retardation. Ineffective way of braking leads to accidents most of the accidents are due to faulty way of braking and due to their inefficient mechanism to control vehicle during the mischance. Electromagnetic braking system consists of solenoid coil which is uses principle of electromagnetic effect of electrical current for braking. This is combination of electrical and mechanical components here electrical energy is used to apply braking torque or retardation. It produces negative power which is twice of the

power of machine in a rapid and efficient way The electromagnetic brakes has excellent heat dissipation efficiency owing to the high temperature of the surface of the disc which is being cooled and also because the flow of air through the centrifugal fan is very rapid. Therefore, the curie temperature of the disc material could never been reached (Reverdin 1974). The practical location of the electromagnetic brakes prevents the direct impingement of air on the brakes caused by the motion of the vehicle. Any air flow movement within the chassis of the vehicle is found to have a relatively insignificant effect on the air flow and hence temperature of both front and rear discs. 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 coils and firing circuits are attached individually on each wheel, even any coil fails the brake does not completely fails remaining three coil works properly. And this system needs very little of maintenance. In addition, it is found that 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.

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