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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 like car, jeep, truck, busses etc. This system is a combination of electro-mechanical concepts. The frequency of accidents is now-a-days increasing due to inefficient braking system. In this research work, with a view to enhance to the braking system in automobile, a prototype model is fabricated and analyzed. It is apparent that the 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. This combination is designed to be used in the automotive industry as an electric all-wheel drive system that can be managed by available traction and stability control technology. This project does not address the control aspect of the system; it addresses the physical concept of using an induced electromagnetic field to slow the proposed vehicle. The goal is lessening the lifetime maintenance of a vehicle and eliminating several high maintenance items. This system is designed as a "frictionless" system and although it is not completely frictionless it eliminates the need for standard hydraulic brake pads and rotors which wear and fail due to friction material loss. This saves the consumer time and money in maintenance.

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I. INTRODUCTION

There were many objectives to be completed over the course of this project. This project has undergone many changes since its inception and has made the assigned tasks change accordingly. This constant upkeep of the schedule was a difficult task for one individual. I have been through every single aspect of this project, from concept, to design, to machining, to construction, and to assembly. With the help of only a select few, I have personally accomplished every single aspect of this project. However, setbacks have loomed over my head and hindered my progress almost like clockwork. I have had to revise time tables and reschedule construction in order to meet others schedules and properly complete tasks.

Many aspects of projects of this nature go unnoticed because the final products do not represent the time commitment that has been poured into it. Similarly there are many aspects of this project that would typically be overlooked. Planning and construction items such as creating CAD and CAM models and conceptualizing a new concept can take dozens of hours. An example of this was after my very first meeting with Professor Emanuel; he informed me that the force derived from this brake would be directly proportional to the velocity of the rotor . This made my heart drop because that would mean that this brake alone would not suit an automotive application – the brake would slow but never stop (explanation later). I spent the rest of that day attempting to regain control of the project. After several hours of deliberation I decided that in order to save this project the "brake alone" concept would have to be abandoned. I decided to create an integrated motor -eddy current brake design so that once the brake became ineffective the motor could bring t he vehicle to a stop.

Hurdles such as this one were almost a weekly happening. From figuring out how to machine different parts with many different machines at my disposal to simplifying a dangerous design, each step I took to accomplish this project had obstacles. Each obstacle took time to overcome, and time was one of only two depreciating variables in this project, the other variable was my budget.

II. PROBLEM STATEMENT

A frictional brake system is found in many automobiles. They are service brakes, and typically found in two forms; pads and shoes. As the name implies, these brakes use friction to stop the automobile from moving. They typically include a rotating device with a stationary pad and a rotating weather surface. On most band brakes the sho e will constrict and rub against the outside of the rotating drum, alternatively on a drum brake, a rotating drum with shoes will expand and rub against the inside of the drum. A hydraulic brake system is composed of a master cylinder that is fed by a reservoir of hydraulic braking fluid. This is connected by an assortment of metal pipes and rubber fittings which are attached to the cylinders of the wheels. The wheels contain two opposite pistons which are located on the band or drum brakes which pressure t o push the pistons apart forcing the brake pads into the cylinders, thus causing the wheel to stop moving.

III. LITERATURE SURVEY

Aboutalebi (2007) presents the mathematical model has been developed to simulate turbulent fluid flow and solidification in the presence of a DC magnetic field in an extended nozzle for metal delivery to a single belt caster. This paper reports on predicted effects of DC magnetic field conditions in modifying flows and solidification behaviour in the metal delivery system. It is shown that the application of a DC magnetic brake to the proposed system can result in a reasonably uniform feeding of melt onto the cooled moving belt. This, in turn, optimises the rate of even shell growth along the chilled substrate. In order to account for the effects of turbulence, a revised low-Reynolds k–e turbulent model was employed. A Darcy-porosity approach was used to simulate fluid flow within the mushy solidification region. Simulations were carried out for plain carbon steel strip casting. The fully coupled transport equations were numerically solved using the finite volume method. The computed flow patterns were compared with those reported in the literature. The performance of the magnetic flow control device proposed in this work is evaluated and compared with flow modifications obtained by inserting a ceramic filter within the reservoir.

Bottaussio et al,. (2008) presents the electromagnetic diffusion and the electromechanical phenomena arising in a solid cylinder rotating inside a magnetic field are here analysed. The study is developed through a time stepping Finite Element voltage -driven formulation, employing the sliding mesh technique for handling the cylinder motion. The influence on the dynamic behaviour and energy dissipation of the material electric and magnetic properties, the geometrical parameters and the supply conditions is investigated considering a model problem. In this work a coupled electro-magneto-mechanical formulation has been developed and applied to the analysis of a solid cylinder rotating in a magnetic field. Despite the model simplicity, all the physical phenomena governing the device behaviour have been taken into account.

Romin (2016) presents the problems of many conventional brakes, which are currently used in the vehicle, are frictional brake. This causes drag and wear. If the vehicle speed is high, the brake cannot provide the much higher force and cause braking problems. This disadvantage ordinary brakes can be overcome by a simple and effective mechanism of braking systems “Electro -magnetic braking” or “eddy current brake”. In the Electromagnetic Brake when the rotating wheel enters the magnetic field, an electric field is induced in the metal and eddy currents are generated. These currents act to oppose the change in flux through the plate, according to Lenz’s law. This eddy current produce heat finally it reduce its kinetic energy. As a result it develops a torque and eventually the vehicle comes to rest .In this project the advantage of using the electromagnetic braking system in automobile is studied. These brakes can be incorporated in heavy vehicles as an auxiliary brake. The electro-magnetic 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.

Smit (2015) presents the 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 magnet ic field is developed across the armature. The eddy-current is created by the relative motion between a magnet and a metal (or alloy) conductor. The current induces the reverse magnetic field and results in the deceleration of motion. The proposed mechanis m implements this phenomenon in developing a braking system. The potential applications of the braking system can be a decelerating system to increase the safety of an elevator or any guided rail transportation system As a result it develops a torque and eventually the vehicle comes to rest. In this project the advantage of using the electromagnetic braking system in automobile is studied. These brakes can be incorporated in heavy vehicles as an auxiliary brake. 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. . It also reduces the maintenance of braking system.

IV. METHODOLOGY

A. Modelling in software.

Putting the ideas on the modelling software for visualization of the prototype and making it more and more compatible so that there will be less complexity in designing.

B. Material Selection and Procurement

In this phase material selection is done and also its procurement as per need the dimensions are taken from software model.

C. Fabrication

This phase includes fabrication of prototype in the workshop from the procured material and preparing the Prototype model from the software model.

D. Assembly & Testing

This phase include Assembly of all the sub parts, also the arrangement of the motor and its wiring is done, all finishing operations like grinding, trimming, painting is done here. Testing phase includes testing of the Prototype model under real environment.

V. DESING AND WORKING

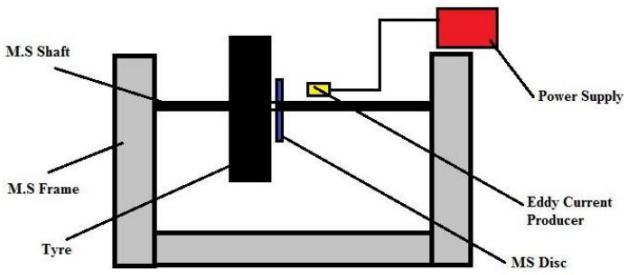

Fig 1. Magnetic breaking system

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. If the current exciting the electromagnet is varied by a rheostat, the braking torque varies in direct proportion to the value of the current. A typical retarder consists of stator and rotor. The stator holds 16 induction coils, energized separately in groups of four. The coils are made up of varnished aluminium wire mounded in epoxy resin. The stator assembly is supported resiliently through anti-vibration mountings on the chassis frame of the vehicle. The rotor is made up of two discs, which provide the braking force when subject to the electromagnetic influence when the coils are excited. Careful design of the fins, which are integral to the disc, permit independent cooling of the arrangement.

VI. ADVANTAGES AND DISADVANTAGES

Advantages:

1. Burnishing is the wearing or mating of opposing surfaces .This is reduced significantly here.
2. In the future, there may be shortage of crude oil; hence by-products such as brake oils will be in much demand. EMBs will overcome this problem.
3. Electromagnetic brake systems will reduce maintenance cost.
4. The problem of brake fluid vaporization and freezing is eliminated.
5. Electric actuation, no fluid.
6. Easier integration with anti-lock, traction, and dynamic stabil ity controls.
7. Easy individual wheel braking control.

Disadvantages:

1. Dependence on battery power to energize the brake system drains down the battery much faster.
2. Due to residual magnetism present in electromagnets, the brake shoe takes time to come back to its original position.
3. The installation of an electromagnetic brake is very difficult if there is Not enough space between the gearbox and the rear axle.

VII. CONCLUSION

With all the advantages of electromagnetic brakes over friction brakes, they have been widely used on heavy vehicles where the brake fading" problem exists. The same concept is being developed for application on lighter vehicles. The concept designed by us is just a prototype and needs to be developed more because of the above mentioned disadvantages. 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 find vast applications in heavy vehicles where high heat dissipation is required. In rail coaches it can used in combination of disc br ake to bring the trains moving in high speed. When these brakes are combined it increases the life of brake and act like fully loaded brakes. These electromagnetic brakes can

be used in wet conditions which eliminate the antiskidding 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 if can be used as a secondary or emergency braking system in the automobiles.

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