RESEARCH ARTICLE OPEN ACCESS

Recent Trends in Electromagnetic Braking - A Review

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ABSTRACT:

Magnetic braking system is the most emerging technology in the automobile sectors. Braking system is the one which is mainly considered while describing the safety in driving of any automobiles. Magnetic braking system is the emerging concept which is to be incorporated with the conventional brakingsystem in the automobiles to increase the efficiency of the braking system. The working of the braking system is explained with prototypic model. The ferromagnetic material is attached to the axial of the rear wheel and is surrounded by a casing containing magnetic coils. On the application of brake with the help of the electricity, the magnetic coils generate the repulsive force against the rotating element on the rear axial. Which helps to slow down the vehicle in an efficient manner.

KEYWORDS:*Magnetic braking, magnetic coils, ferromagnetic materials and repulsive force.*

1.Introduction:A brake is a mechanical device which helps to regulate or forbid the motion of the vehicles. Various types of braking mechanisms like drum brake, hydraulic brake, pneumatic brake and air brake are used to slow down the vehicles. Those systems are mainly works by creating frictional force between wheel drum and the brush. The only difference is of using different mechanisms. Many industries especially automobile industries come up with new innovations on automobiles. Magnetic braking system is one of the new emerging concept to control the movements of the vehicle.Braking systems are vary with vehicles according to the requirements or purpose of the vehicles. For example, most passenger vehicles are come up with hydraulic braking system while in heavy load vehicles and bikes air brakes and mechanical brakes are used respectively. By the way magnetic braking system is one of the new concept, which works based on the principle of repulsion and is to be incorporated with conventional braking system to increase the efficiency of braking.

2.Eddy current braking systems

The effect on braking torque, an experiment on eddy current brakes by changing the time varying A.C. field. They obtain the result within 10% error. Finally, they revealed that the time varying field increases the braking torque generation capacity of an eddy current brake. [1]. The comparison between the electromagnetic braking system and conventional exhaust braking system were studied. In this various pros, cons and applications were described. This paper concludes by describing electromagnetic braking system is more reliable than other braking systems.[2]. The efficient use of contactless brake over rubbing brakes. With their points, contactless brakes are mostly used in heavy vehicles where the brake blurring issue is not kidding[3].Thematerial used in eddy current braking system. Materials such Al – 6061, Al – 7075 and Al – 7475 were chosen for their higher workability, ultimate yield strength and thermal conductivity were studied. Experiment is carried out for the speed range between 50 and 140 kmph[4].An experiment was conducted to investigate working of eddy current brake by using different materials like copper, aluminium and brass. Here speed reduction and time taken for speed reduction is tested by using the materials. It is observed that percentage of speed reduction is more and time taken for the speed reduction is less while using aluminium disc when compared to other materials and this is due to positive susceptibility, higher permeability and higher depth of penetration in aluminum disc.[5]

3.Efficiency of Eddy Current Braking system

The eddy current braking system and heating system was studied in which is to be used in electric buses as efficient braking energy recovery system. Performance test is carried out under three different modes of heating by designing a basic eddy current braking and heating system. This experiment reveled that this system improves the efficiency when compared to other system. [6]. The combined working eddy current and electromagnetic braking was also studied. In this research the limitations are exhibited such as demerits on battery power can be overcome by combining eddy current and electromagnetic brakes and also says that 80% of power is make up by this braking system. [7]. Prototyping of aneddy current braking system was executed and analyzed with COMSOL multi physics software and stoppage time is tested at five different speeds. The air gap between the disc and the coil is varied and tested. Finally, they found that the system got failed beyond 3mm of the air gap. And also magnet having higher magnetic flux density was used to minimize the braking time. [8]

4.Simulation Techniques of Electromagnetic braking systems

An eddy current braking system using SIMULINK software was modelled and the parameters that affects the efficiency of braking were tested. Parameters such as magnetic field, air gap, velocity and thickness were altered and analyzed the effect on the braking force. It is found that the distance between the poles affects the efficiency of the braking [9]. In addition,anotherelectromagnetic braking model prototypedand analyzed the same for efficient braking. Specific location of braking system has better heat dissipation capability to overcome some problems raised on friction braking. [10]. The eddy current and magnetic rail brakes for high speed trains were analyzed. It reveals that a rail brakes that combines both magnetic rail brake and eddy current brake permits profitable braking action through the range of acceptable speeds. [11]. An eddy current braking model was developed. They used aluminum disc to design the model. This model is tested under five different speeds and the braking time for the same is measured. It is found the eddy current braking system is very effective at high velocities. [12]. Structural health monitoring (SHM) takes NDE a step further and is a process of periodically or continuously monitoring and assessing the performance and safety of a structural system. The development of this sensor technology is novel because it can be automated and has a sensing region far larger than the sensor footprint. The eddy current senor is demonstrated to identify both corrosion and damage in the form of a small hole well outside the sensors footprint.This study has experimentally validated the automated eddy current sensor to identify damage in a conductive structure. It was found that damage to the structure was reflected as a small change in the inductance of an inductor. The sensor was shown to have little variation between measurements, significantly decreasing the error bounds and providing low chance for false positives and negatives. [13]

5. Traction forces of Locomotive and Eddy Current Braking system: The design a magnetic braking system based on the parameters that are followed based on the magnets and the drag force which is used to stop the speed of the motor or other automobile or locomotive. Essential thing in this braking system is selection of magnetic material and evaluating magnetic flux. So that they have be designed then stimulated to demonstrate the air gap which has a significant effect on the magnetic flux density from the FEM flux model. [14]. The working principle of the electromagnetic braking system and the incorporation of the brake with the heavy vehicle as an auxiliary brake. To avoid the traction force or brake looking this brake can be used it can be incorporate with the ABS for the better performance. [15]. The braking of the electric drives such as AC and DC electric motors using the eddy current braking system was investigated that the operation defects in DC traction engines and avoiding the traction using eddy current braking system by using AC motors. [16]. Avoiding the accidental damage to the vehicle by applying brake using the magnetic braking system Attractive slowing down mechanism and contrast of mechanism with other mechanism. [17]. Many conventional brakes,avoiding the high force to applying on the brake disc and avoiding unwanted heat dissipating because of the simple of the vehicle and simple effective mechanism of braking system and avoiding brake fading exists. [18]. The application of the existing techniques for modelling the eddy current braking system was investigated. The theoretical model derived for the eddy current behaviour at low speed zone The dragging torque value is estimated by an appropriate nonlinear observer. Experimental results are presented.Application results obtained on an eddy current brake process are included to illustrate the modelling and the regulator design procedure. [19]. [20]

6. Conclusion: With all the points on magnetic braking system, that they are more reliable than the conventional braking system. the properties of disc brakes, disc brakes are exposed to large thermal stresses during routine braking and extraordinary stresses during hard braking. In the absence of thermal shock, a relatively small number of high-g braking cycles are found to generate macroscopic cracks running through the rotor thickness and along the radius of the disc brake. The analysis herein shows that rotor failure is a consequence of low cycle thermo-mechanical fatigue.Choosing of materials for braking also needed for efficient braking. The air gap between the disc and the electromagnetic coil also affects the efficiency of braking. Thus all the studies revealed, magnetic braking system is more efficient at higher velocities and less efficient on low velocities.

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