IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 4, June 2023

Electromagnetic Braking System

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Abstract: *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 strongenough to stop the vehicle during emergency within shortest distance. The convential braking system are bulky and power to weight ratio is low. Electromagnetic braking system is high-tech braking system find itsuse in small & heavy vehicle like car, jeep, truck, busses etc. This paper represents about minimizing the brake failure in order to avoid the accident. It also reduces the maintenance of braking system. The effectiveness of brake should remain constant. The proper cooling of brake gives anti fade character and efficient operation of brake. Proper lubrication and maintenance must be done to operate brake safe, effective and progressive with minimum fatigue to driver. This system provides better response time for emergency situations and in general keeps the friction brake working longer and safer.*

Keyword: *Brake, Electromagnetism, Brake Power, Torque.*

I. INTRODUCTION

Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles. Weoutline 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 motion and dissipates the associated kinetic energy as heat. Brakes must be able toarrest the speed of a vehicle in a short period of time regardless how fast the speed is.

As a result, the brakes are required to have the ability to generating high torque and absorbing energy at extremely high rates for short periods of time. Brakes may be applied for a prolonged periods of time in someapplications such as a heavy vehicle descending a long gradient at high speed. Brakes have to have the mechanism to keep the heat absorptioncapability for prolonged periods of time. In the electromagnetic brake, the coilor solenoid attracts a steel disc.The steel disc presses a brake disc made ofsintered or asbestos material between itself and a stationary steel disc. Thetorque is thus 'grounded' and braking action takes place. This type of brake isused in machines like lathes, presses etc.In electro-magnetic braking systemelectro-magnetic property is used due to this action of braking will be done. Inthis system, electro magnet iron plate, liners, tension spring, stud, disc brakeplate are used.The brake liners are attached with electro- magnet and ironplate individually and both plates insert the disc plate and this plate rigidlyattached with wheels. The battery of minimum 12 volt is used for externalpower supply.

Electromagnet consists of wire wound over a soft iron core.When current is passed through the coil, it produces a magnetic field which magnetizes the core into the bar magnet with the polarities. Strong magneticfield is obtained by high currents of large self-induction. High currents are notalways feasible, which is why a high self-induction is obtained by making aloop of wire in the shape of a coil, a so-called solenoid. More current andmore turns produce a stronger magnetic field which results in strongerelectromagnet. When current is switched OFF field disappears and the ironcore no longer a magnet. This ability of an electromagnet provides a strong

II. LITERATURE SURVEY

Electromagnetic Braking System for High-Speed Trains" by G. P. Bulirschand A. R. Suess (2001):

This paper proposes an electromagnetic braking system for high-speedtrains. The system uses a combination of permanent magnets andelectro magnets to create a magnetic field that slows down the train. Theauthors also discuss the benefits and limitations of the proposed system.

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"Design and Analysis of Electromagnetic Braking System for Elevator" by Z.Cui and X. Guo (2012):
This paper presents the design and analysis of an electromagnetic brakingsystem for an elevator. The authors use the finite element method (FEM) to model and simulate the system. The results show that the proposed systemhas good braking performance and is suitable for elevator applications.
"Experimental Study on Electromagnetic Braking System for WindTurbines" by M. Matsuo et al. (2014):
This paper presents an experimental study on an electromagnetic brakingsystem for wind turbines. The authors use a laboratory-scale wind turbine totest the system and measure its braking torque. The results show that theproposed system is effective in stopping the turbine quickly and safely.
"Development of an Electromagnetic Braking System for Electric Vehicles"by S. Nakano et al. (2016):
This paper presents the development of an electromagnetic braking systemfor electric vehicles. The system uses a combination of eddy current brakingand regenerative braking to slow down the vehicle. The authors also discussthe challenges and opportunities of implementing such a system in electricvehicles.
"Modelling and Simulation of an Electromagnetic Braking System forRailways" by A. R. Ali et al. (2018):
This paper presents a modelling and simulation study of an electromagnetic braking system for railways. The authorsuse the Simulink software to modeland simulate the system. The results show that the proposed system hasgood braking performance and can be used in high-speed railway applications.

III. PROPOSED METHODOLOGY

Determine the requirements of the braking system: The first step is todetermine the requirements of the braking system such as the maximum speed of the moving object, the weight of the object, the required stoppingdistance, and the maximum allowable braking force.
Select the appropriate type of electromagnetic brake: Based on therequirements of the braking system, select the appropriate type of electromagnetic brake such as hysteresis brake, eddy current brake, ormagnetic particle brake.Determine the specifications of the electromagnet:Determine thespecifications of the electromagnet such as the size, number of turns, and themagnetic flux density required to achieve the desired braking force.
Design the mechanical structure of the braking system: Design themechanical structure of the braking system such as the brake pad, thearmature, and the housing that will hold the electromagnet.
Perform simulations and calculations: Use simulation software andmathematical calculations to determine the performance of the brakingsystem. This includes calculating the braking force, the stopping distance, andthe heating of the system.
Fabricate and assemble the components: Fabricate the components of thebraking system such as the electromagnet, the armature, and the housing.Assemble the components into a complete braking system.
Test the braking system: Test the braking system to ensure that it meetsthe requirements of the system. This includes testing the stopping distance,the braking force, and the heating of the system.Optimize the design: Based on the results of the testing, optimize thedesign of the braking system to improve its performance and efficiency.
Implement and maintain the system: Implement the braking system into theapplication and maintain it regularly to ensure its proper functioning.

IV. ADVANTAGES

- High Accuracy: Electromagnetic brakes offer precise control over theamount of braking force applied to the object, making them ideal forapplications that require high accuracy.
- Fast response: Electromagnetic brakes can be activated anddeactivated quickly, which is especially useful in applications that requirerapid stopping or changes in direction.
- Maintenance-free operation: Electromagnetic brakes have few movingparts and do not require regular maintenance, reducing downtime andoperating costs.
- Energy efficiency: Electromagnetic brakes can convert kinetic energyinto electrical energy, which can be reused in the system, making themenergy-efficient.
- Quiet operation: Electromagnetic brakes operate quietly and withoutvibration, making them suitable for applications where noise and vibrationare a concern.

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- High reliability: Electromagnetic brakes are highly reliable and have along lifespan due to their simple design and few moving parts.
- Safety: Electromagnetic brakes can provide safe and reliable brakingin emergency situations, which is essential in applications where humansafety is a concern.

V. APPLICATION

Elevators and escalators: EM brakes are used in elevators and escalators toensure that the cab or platform stops at the desired level and does not movewhen the power is off.

Cranes and hoists: EM brakes are used in cranes and hoists to control thedescent of loads and prevent over-speeding.Machine tools: EM brakes are used in machine tools such as lathes, grinders,and milling machines to stop the rotation of the spindle quickly and precisely.

Wind turbines: EM brakes are used in wind turbines to slow down and stopthe rotor blades during maintenance.

VI. FUTURE SCOPE

The future scope of electromagnetic (EM) braking systems is quite promisingas it offers numerous advantages over traditional friction-based brakingsystems. Here are a few potential future developments in the EM brakingsystem:

1. Improved Energy Efficiency: EM braking systems can potentially offerimproved energy efficiency compared to traditional friction-based brakingsystems. This is because the energy generated during braking can berecovered and used to power the vehicle or stored in a battery for later use.
2. Enhanced Safety: EM braking systems can offer enhanced safety featuresby providing faster response times and better control during emergencybraking situations.
3. Reduced Maintenance: EM braking systems have fewer moving parts thantraditional braking systems, which means they require less maintenance andhave longer lifetimes.
4. Lightweight Design: EM braking systems can be designed to be lightweight,which is essential for electric vehicles (EVs) and hybrid electric vehicles(HEVs) that require lightweight components to maximize their range andperformance.
5. Autonomous Driving: EM braking systems can be integrated withautonomous driving systems to provide advanced features such as predictivebraking, which can improve safety and reduce energy consumption.
6. Regenerative Braking: Regenerative braking systems, which are a type ofEM braking system, can capture and store energy during braking. This energycan then be used to power the vehicle, resulting in increased energy efficiencyand reduced emissions.

Overall, the future of EM braking systems is bright as they offer numerousadvantages over traditional friction-based braking systems, making them anattractive option for modern vehicles.

VII. CONCLUSION

In conclusion, electromagnetic (EM) braking systems are a promisingtechnology that can offer numerous advantages over traditional friction-basedbraking systems. EM braking systems can potentially provide improvedenergy efficiency, enhanced safety, reduced maintenance, lightweight design,and can be integrated with autonomous driving systems. Additionally,regenerative braking, a type of EM braking, can capture and store energyduring braking, resulting in increased energy efficiency and reducedemissions. As the world continues to shift towards electric and hybrid vehicles,the development and implementation of EM braking systems are likely toincrease, making them an important technology for the future oftransportation.

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