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Frictionless Braking

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ABSTRACT: A frictionless braking system utilizes electromagnetic or magnetic repulsion technology to slow down or stop a vehicle without physical contact between components. This system reduces wear and tear, minimizes maintenance, and enhances efficiency and safety. It is especially beneficial in high-speed and heavy-duty applications like trains and electric vehicles.

KEYWORDS: Advanced braking technology, Eddy currents, Electromagnetic braking, Frictionless braking, High-speed braking systems, Magnetic repulsion, Maintenance-free braking, Non-contact braking, Regenerative braking, Vehicle safety.

I. INTRODUCTION

Traditional braking systems rely on friction between brake pads and wheels to slow down or stop a vehicle. While effective, these systems suffer from wear and tear, heat generation, and require frequent maintenance. To overcome these limitations, frictionless braking systems have been developed using principles of electromagnetism. These systems utilize magnetic fields or eddy currents to create resistance against motion without physical contact. As a result, they offer smoother operation, reduced maintenance, and improved performance, especially in high-speed and heavy-load applications. Frictionless braking technology represents a significant advancement in modern transportation systems, contributing to safer and more efficient mobility.

A. Steps Involved in Frictionless Braking System:

1. Detection of Braking Need:
Sensors detect when the driver initiates braking.
2. Activation of Electromagnets:
Electromagnets are activated near the rotating parts (like wheels or discs).
3. Generation of Magnetic Field:
A magnetic field is generated, interacting with the motion of the rotating component.
4. Eddy Current Formation:
The magnetic field induces eddy currents in the metal, creating resistance to motion.
5. Deceleration:
The magnetic resistance slows down the vehicle smoothly without physical contact.
6. System Deactivation:
Once the vehicle slows or stops, the electromagnetic field is turned off.
7. Regeneration (optional):
In regenerative systems, the kinetic energy is converted into electrical energy and store

II. RESULTS

3.1 Performance Evaluation

Speed vs. Braking Force: Braking efficiency increased with rotational speed, demonstrating proportionality (Figure 1).
Thermal Behaviour: No significant heat generation, unlike friction-based systems.
Durability: No wear observed after repeated cycles, confirming long-term reliability.
Figure 1: Braking force as a function of disc speed.

3.2 Advantages

Contactless operation: Eliminates mechanical wear.

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Low maintenance: No replacement of brake pads or lubrication.
Silent and smooth deceleration: Ideal for passenger vehicles and elevators.
3.3 Limitations
Reduced effectiveness at low speeds: Requires supplementary brakes for complete stoppage.

Figure 3.4.1: Welding

III. CONCLUSION

The frictionless braking system using eddy currents represents a significant advancement in braking technology, especially for applications requiring minimal maintenance, high efficiency, and reliable performance. By eliminating physical contact between components, this system reduces wear and tear, enhances the lifespan of parts, and operates silently and smoothly. Through the use of copper discs and neodymium magnets, the project successfully demonstrates the principle of electromagnetic braking in a compact and effective setup. This innovative approach aligns well with current trends in sustainable engineering and smart vehicle systems. The project not only highlights the practical benefits of using eddy currents for braking but also encourages further research and development in this field. With continued improvements in materials and control systems, frictionless braking has the potential to revolutionize how modern vehicles and machinery achieve safe and efficient deceleration. Overall, the project has deepened our understanding of electromagnetic applications in mechanical systems and showcased a forward-thinking solution supports the future of green and intelligent transportation.

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