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Design and Development of Electromagnetic Clutch System

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Abstract: *The "Design and Fabrication of an Electromagnetic Clutch" project focuses on developing an advanced torque transmission system that operates on the principle of electromagnetism, offering a modern alternative to traditional mechanical clutches. Unlike conventional systems that rely on physical contact and friction for engagement, this electromagnetic clutch employs a magnetic field generated by a coil to transfer torque between the driving and driven members. This allows for rapid, smooth, and precise engagement or disengagement of power without direct mechanical contact, significantly reducing wear, vibration, and maintenance needs.*

The project explores the design, modeling, and implementation of an electromagnetic clutch system suitable for a variety of applications, including automotive gear transmission, industrial automation, robotics, and material handling systems. The clutch system is designed to be compact, durable, and energy-efficient, with a particular emphasis on fast response time, thermal stability, and operational reliability under varying load conditions. The clutch engages instantly when voltage is supplied to the coil, creating an electromagnetic field that attracts the armature plate to the rotor, thereby establishing contact with the friction disc and transmitting torque. Disengagement occurs as soon as the power supply is cut off.

This paper includes an in-depth study of electromagnetic force generation, coil design, selection of friction materials, and thermal management. Additionally, the integration of control circuits for automatic or manual actuation provides enhanced flexibility and user convenience. Through simulations and testing, the system's performance is evaluated in terms of engagement time, torque output, power consumption, and longevity.

Overall, the proposed electromagnetic clutch system offers significant improvements in performance, responsiveness, and safety over traditional clutch mechanisms, making it a suitable and effective solution for future-forward technologies in transportation, manufacturing, and smart machinery.

Keywords: Electromagnetic clutch, torque transmission, mechatronics, electromagnetic field, automation, power transmission, coil design

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