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Design & Fabrication of Electromagnetic Clutch

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ABSTRACT

A clutch is a device used to make and brake contact from the transmission. When it engages, then power is transferred from engine to gear box and when it disengages, power flow is stop, hence it is called free running of engine. There is an innovation done in automobile industry, called electromagnetic clutch, which is recently used by Renault Car Company, which uses the basic principle of electrical energy as well as magnetic forces. This project revels the manufacturing of electromagnetic clutch. In place of Engine, shaft is directly attached to variance (variable motor) and clutch disc as well as pressure plate is used, in between them friction material called "Asbestos" used to grip between the pressure plate and clutch plate. This project shows, experimental analysis of Electromagnetic clutch, and at last at which speed clutch engages as well as disengage is measured and when clutch disengage, at that time speed of flywheel is also measured.

Introduction

This paper aims to discuss the fundamental knowledge of Research, Design, Development and Optimization of Electromagnetic Clutch. Electromagnetic clutches are used in a wide variety of applications where precise and controlled power transmission is needed, including automobiles, industrial machinery, robotics, and even home appliances. They facilitate smooth and quick engagement and disengagement of power transmission, often controlled by an electrical signal. Whole project is Eco-friendly and the material was decided based on the availability of the material. The Research was Carried on the Classical Electromagnetic Clutch and Further design was prepared based on the Calculations done in the project to determine the size of pressure plate, clutch plate and number of turns in the solenoid. The material was procured online from the Vendor “Alibaba”. Industrial electromagnetic clutches, electromagnetic brakes and clutch brakes are used in many types of high speed, high cycle rate and long-life machines including printers, packaging machines, food processing equipment, industrial mixers, and cash counting machines. Electromagnetic clutches operate electrically but transmit torque mechanically. This is why they used to be referred to as electro-mechanical clutches. Over the years, EM became known as electromagnetic versus electro-mechanical, referring more about their actuation method versus physical operation. Since the clutches started becoming popular over 60 years ago, the variety of applications and clutch designs has increased dramatically, but the basic operation remains the same today. The Main Components of this Project is Clutch Plate, Pressure Plate and Solenoid. After the design is Completed, the product was made on the real time basis. The Assembly of the Components was done after the procurement of the components.

Objective

The main objective of an electromagnetic clutch is to Immediately connect or disconnect the transmission of power between two rotating shafts using an electromagnetic force. This allows for precise control over torque transmission, enabling smooth engagement and disengagement without sudden shocks or stops. In essence, it acts as a switch for power transfer, allowing for applications like starting heavy loads with low power, remote control, and precise engagement in various industrial processes,

Fabrication

Step 1: Shaft and Clutch PlatePreparation

The shaft is machined using a lathe machine to the required diameter (typically 20–25 mm). A keyway is cut to mount the clutch plate securely.The clutch plate is laser cut or machined from mild steel sheet and then drilled for mounting holes.

Step 2: Electromagnet Winding

A bobbin is fabricated from an insulating material like plastic or fibre.A copper wire (SWG 26–30) is wound over the bobbin using a coil winding machine. The coil ends are connected to terminals to receive DC power.

Step 3: Armature Fabrication

The armature plate is cut from cast iron or soft MS and surface-ground to ensure flatness. Holes are drilled for mounting or balancing.This plate must have high magnetic permeability for quick response.

Step 4: Housing and Assembly

A housing isfabricated from MS sheet metal using shearing, bending, and welding. Bearings are press-fitted into the housing to support the rotating shaft.The coil is mounted inside the housing and electrically insulated using mica or fibre sheets. The clutch and armature plates are aligned carefully to ensure smooth engagement.

Step 5: Electrical Connection

A DC power supply (12V or 24V) is connected to the coil through a switch or control relay.When power is supplied, the electromagnetic field pulls the armature plate toward the coil, engaging the clutch.

Step 6: Final Testing and Finishing

The system is run at low speed to observe the engagement/disengagement.

Necessary adjustments are made to reduce clearance and improve magnetic response. Painting or surface coating is done to prevent corrosion and improve aesthetics.

Working

Motor Starts

The 12V DC motor begins rotating.This rotation is connected to the input disc (can be part of the pressure plate or a separate rotating disc).

Electromagnetic Clutch Coil Energized

When you press a button or switch, current flows through the electromagnetic coil.This creates a magnetic field, which pulls the pressure plate toward the clutch plate.

Torque Transfer Begins

The pressure plate pushes the clutch plate against the rotating disc.Due to friction and magnetic force, the clutch plate locks in and starts rotating with the motor.

Output Rotates

The axle connected to the clutch plate starts spinning.As a result, the wheel connected to the axle also rotates.his simulates a vehicle wheel being driven by an engine through a clutch system.

Clutch Disengaged

When power to the electromagnet is turned OFF:The magnetic field collapses.Pressure plate releases the clutch plate.

The clutch plate and axle stop rotating.

The wheel comes to a stop — motor is still running but no power is transferred

Conclusion:

Electromagnetic clutches are essential components in modern mechanical and automotive systems, offering efficient and rapid engagement and disengagement of power transmission without requiring physical contact. Their operation, based on electromagnetic principles, allows for smooth, precise, and remotely controlled clutching action. These clutches are widely used in vehicles, machine tools, conveyors, and various industrial applications due to their reliability, quick response time, and ease of automation. However, their performance can be influenced by factors like heat generation, wear of friction surfaces, and power supply quality. Overall, electromagnetic clutches provide a highly effective solution for applications requiring controlled torque transmission and rapid response

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