Fabrication of Regenerative Clutch for Power Generation

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Abstract

This project aims at introducing a regenerating clutching system model. Here electromagnetic clutches are used for power generation. Electrical power is generated through clutch system while clutch is in disengaged position. By this arrangement one can generate excess electrical power which can be used to function additional electrical accessories fitted to vehicles in the recent days. Effective recovery of waste energy is successfully attained with the help of electromagnetic clutch and limit switch assembly. In this work a small conceptual model is created and a motor is used as a substitute of an IC engine for delivering power.
Keywords: Regenerating, Electromagnetic, Recovery, Conceptual, Delivering Power

I. INTRODUCTION

Electromagnetic clutches are made to operate electrically and 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. Single face clutches make up approximately 90% of all electromagnetic clutch sales. The electromagnetic clutch is most suitable for remote operation, since it does not require linkages to control its engagement. It has very fast and smooth operation. However, because energy dissipates as heat in the electromagnetic actuator every time the clutch is engaged, there is a chance of clutch being overheated. Consequently the maximum operating temperature of the clutch is limited by the temperature rating of the insulation of the electromagnet.

II. COMPONENTS & DESCRIPTION

A. A. C. Motor

AC motor is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. The rotor magnetic field may be produced by permanent magnets, reluctance saliency, or DC or AC electrical windings.

1) Single Phase Induction Motor

It is found to drive the roller shaft which fixed on the end of the frame structure. The free end of the shaft in the motor a large pulley is found around which the belt runs. The other specification about the motor is discussed in design part of the machine.

B. Dynamo

Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons. A dynamo has the disadvantages of a mechanical commentator. Also, converting alternating to direct current using power rectification devices (vacuum tube or more recently solid state) is effective and usually economical.

1) Operation of Dynamo

An electric motor is essentially just a tight coil of copper wire wrapped around an iron core that's free to rotate at high speed inside a powerful, permanent magnet. When you feed electricity into the copper coil, it becomes a temporary, electrically powered magnet in other words, an electromagnet and generates a magnetic field all around it. This temporary magnetic field pushes against the magnetic field that the permanent magnet creates and forces the coil to rotate. By a bit of clever design, the coil can be made to rotate continuously in the same direction, spinning round and round and powering anything from an electric toothbrush to an electric train.

C. *Electromagnet Clutch*

Electromagnetic brakes operate electrically, but transmit torque mechanically. This is why they used to be referred to as electro mechanical brakes. Over the years, EM brakes became known as electromagnetic, referring to their actuation method. The variety of applications and brake designs has increased dramatically, but the basic operation remains the same. Single face electromagnetic brakes make up approximately 80% of all of the power applied brake application.

D. *Limit Switch*

A limit switch with a roller-lever operator; this is installed on a gate on a canal lock, and indicates the position of a gate to a control system. Standardized limit switches are industrial control components manufactured with a variety of operator types, including lever, roller plunger, and whisker type. Limit switches may be directly mechanically operated by the motion of the operating lever. A reed switch may be used to indicate proximity of a magnet mounted on some moving part. Proximity switches operate by the disturbance of an electromagnetic field, by capacitance, or by sensing a magnetic field. Rarely, a final operating device such as a lamp or solenoid valve will be directly controlled by the contacts of an industrial limit switch, but more typically the limit switch will be wired through a control relay, a motor contactor control circuit, or as an input to a programmable logic controller. Miniature snap-action switch may be used for example as components of such devices as photocopiers, computer printers, convertible tops or microwave ovens to ensure internal components are in the correct position for operation and to prevent operation when access doors are opened. A set of adjustable limit switches are installed on a garage door opener to shut off the motor when the door has reached the fully raised or fully lowered position. A numerical control machine such as a lathe will have limit switches to identify maximum limits for machine parts or to provide a known reference point for incremental motions.

1) Working of Limit Switch

In most cases, a limit switch begins operating when a moving machine or a moving component of a machine makes contact with an actuator or operating lever that activates the switch. The limit switch then regulates the electrical circuit that controls the machine and its moving parts. These switches can be used as pilot devices for magnetic starter control circuits, allowing them to start, stop, slow down, or accelerate the functions of an electric motor. Limit switches can be installed into machinery as control instruments for standard operations or as emergency devices to prevent machinery malfunction. Most switches are either maintained contact or momentary contact models.

E. *Bearing*

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Many bearings also facilitate the desired motion as much as possible, such as by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. The term "bearing" is derived from the verb "to bear"; a bearing being a machine element that allows one part to bear another. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices; their manufacture requires some of the highest standards of current technology.

F. *Battery*

A battery is a device in which chemical energy is directly converted to electrical energy. It consists of one or more voltaic cells, each of which is composed of two half cells connected in series by the conductive electrolyte. Consists of one or more voltaic cells in series. Each cell has a positive terminal, shown by a long horizontal line, and a negative terminal, shown by the shorter horizontal line. These do not touch each other but are immersed in a solid or liquid electrolyte. The electrolyte is a conductor which connects the half-cells together. It also contains ions which can react with chemicals of the electrodes. Chemical energy is converted into electrical energy by chemical reactions that transfer charge between the electrode and the electrolyte at their interface. Such reactions are called faradaic, and are responsible for current flow through the cell. Ordinary, non-charge-transferring (non-faradaic) reactions also occur at the electrode-electrolyte interfaces. Non-faradaic reactions are one reason that voltaic cells (particularly the lead-acid cell of ordinary car batteries) "run down" when sitting unused.

G. *Belt & Pulley*

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously.

III. CALCULATION

A. Design Calculation

Power of electric motor, $P = I \times V$
$P = 0.5 \times 440$ $P = 220W$
Torque of the motor, $T = 60P/ 2\pi N$ $T = 1.459$ N-m

B. Design of Electromagnetic Clutch

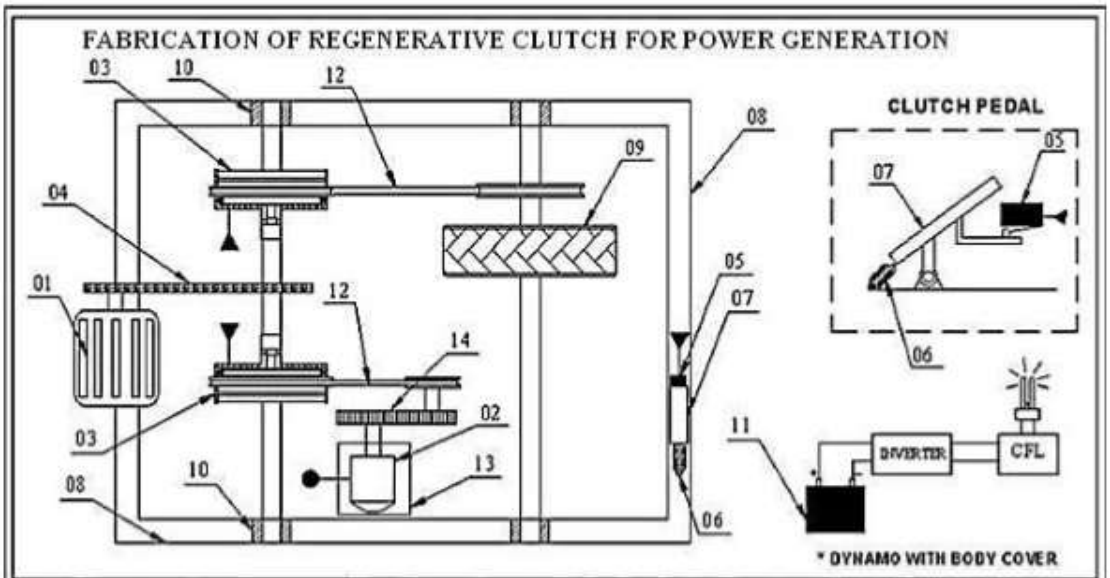
Torque produced = 1.459 N.m Diameter (d3) = 16 Mt/πTs
Where Ts: The allowable shear stress for shaft (TS = 65.7 N/mm^2) Mt: The torque Produced. (Taking C-40 steel, the shaft material, for that material) So, d = 113.157 mm
Assuming that dynamo rotates at 1500 rpm, then it will produce 6 - 8 V

C. Battery Calculation

BAH /CI = 8 Ah/420 mA
BAH/CI = 19 hrs
To find the Current Watt = 18 W Volt = 12 V
Power, P = V × I Current,
I = 1.5 A
Battery Usage with 1.5 A I = BAH /I = 5.3 hrs.

IV. WORKING

The main components involved in this project consist of motor, spur drives, dynamo, electromagnetic clutch, and bearing, and limit switch, clutch pedal and battery. The basic concept behind this project is to generate electricity while the clutch is in disengaged position. Here we are using a belt drive to couple the wheel with the electromagnetic clutch and similarly couple the dynamo setup with the electromagnetic clutch from motor. When the motor rotates coupled with the dynamo setup and wheel also rotates with the help of two electromagnet clutches using belt drives. Limit switch is placed below the clutch pedal. If we press the clutch pedal, limit switch activates it gives signal for disengage the electromagnetic clutch near wheel and engage the electromagnetic clutch near dynamo setup. The dynamo will produce power according its rotation. With the help of inverter circuit, the generated power is converted and stored in Battery. So whenever the clutch is applied, some amount of power can be produced which can be stored in the battery. If the clutch pedal in rest position, wheel near the electromagnetic clutch is engaged. Dynamo setup near the electromagnetic clutch is disengaged.



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	MOTOR	05	LIMIT SWITCH	09	AUTO WHEEL	13	BODY COVER
02	DYNAMO WITH BODY COVER	06	SPRING	10	BEARING	14	SPUR GEAR(48T*24T)
03	ELECTROMAGNETIC CLUTCH	07	CLUTCH PEDAL	11	BATTERY	▶	TO CONTROL UNIT
04	CHAIN DRIVE	08	BASE FRAME	12	BELT DRIVE	●	TO BATTERY

Fig. 1: Fabrication of Regenerative Clutch for Power Generation

V. ADVANTAGES & DISADVANTAGES

A. Advantages

1) It able to Increase the sureness in braking system.
2) Braking system able to give fast response.
3) System able to increase the pre-crash safety.
4) System able to provide more safety to the passengers.
5) Automatically operate.
6) Implementation is easy.
7) Maintenance is easy.

B. Disadvantages

1) Power produced is less.
2) Un-economical if produced in small numbers.
3) Initial cost.

VI. PHOTOGRAPHY

Fig. 2: Top View

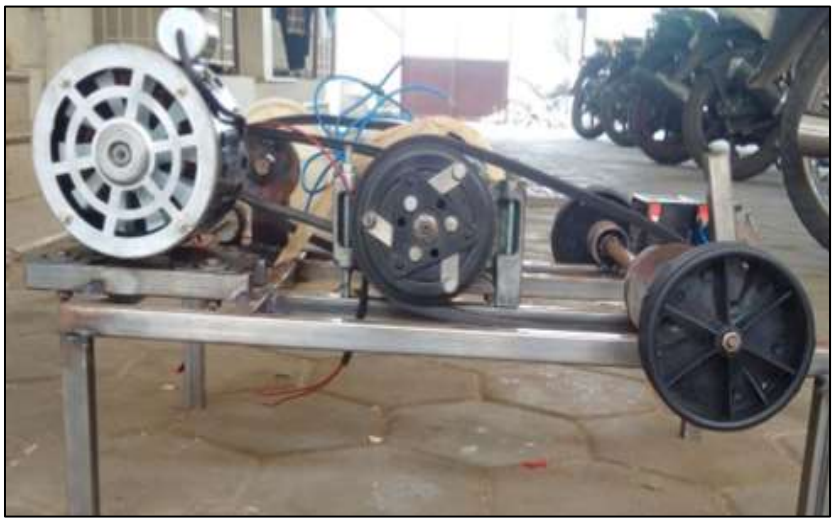


Fig. 3: Side View

Fig. 4: Front View

VII. CONCLUSION

The project carried out by us will make an impressing mark in the field of automobile. Regenerative clutch is an effective method of improving vehicle efficiency and longevity. The regenerative clutch system used in the vehicles satisfies the purpose of saving a part of the energy lost during clutch applied. Regenerative clutch system has a wide scope for further development and the energy savings. The use of more efficient systems could lead to huge savings in the economy of any country. It is very usefully for recover the energy waste from clutch system. The miraculous thing about regenerative clutch is that it may be able to capture as much as half of that wasted energy and put it back to work. This project has also reduced the cost involved in the concern. The project has been designed to perform the required task taking minimum time. The lower operating and environment costs a vehicle with regenerative clutch system should make it more attractive than conventional one. The traditional cost of the system could be recovered in few years only.

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