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Design and Fabrication of Regenerative Clutch Assembly Model

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Abstract - *This paper aims at introducing a regenerating clutching system model. A regenerative braking system is a common now a days, but this concept is different. Here electromagnetic clutches are used for power generation. A model was developed for utilizing the energy during clutch operation in four wheelers or two wheelers. Electrical power is generated through clutch system while clutch is in disengaged position. By this arrangement we 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. This project made up of the following parts; dynamo, battery, wheel, Alternating Current motor and electromagnetic clutch.*

Key Words: Regeneration, energy recovery, electromagnetic clutch, control unit, dynamo, belt and pulley, bearings

1. 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.

2. LITERATURE REVIEW

The history of the automobile begins as early as 1769, with the creation of steam- powered automobiles capable of human transport In 1806, the first cars powered by internal combustion engines running on fuel gas appeared, which led to the introduction in 1885 of the ubiquitous modern gasoline or petrol fueled internal combustion engine. Cars powered by electricity briefly appeared at the turn of the 20th century but largely disappeared from commonality until the turn of the 21st century, when interest in low and zero emissions transportation was reignited. In electronics, a battery or voltaic cell is a combination of many electrochemical Galvanic cells of identical type to store chemical energy and to deliver higher voltage or higher current than with single cells

Most commonly brakes use friction to convert kinetic energy into heat, though other methods of energy conversion may be used. This work is based on regenerative braking which converts much of the energy to electrical energy, which may be stored for later use [1]. The driving range limitation is the key restriction for the large scale development of EV (electric vehicle), and regenerative braking is one of the effective approach to extend the driving range of EV. To protect the battery from broken due to large charging current during regenerative braking, the control strategy that makes the charging current as control object [2]

Regenerative braking is a small, but still a very important step towards our gradual independence from fossil fuels. These technique allow batteries to be used for longer periods of time without plugging into an external charger [3]. Kinetic energy recovery system used in the vehicles saves a part of the energy lost during braking. It can also be operated at high temperature range and are very efficient as compared to conventional braking system. The results from some of the test conducted show that around 30% of the energy delivered can be recovered by the system [4]

Environment protection and energy conservation was the main reason for the development of electric vehicles. However, the commercialization of theses was not successful. The main reason was that it could not satisfy the consumers' need due to high cost and short range [5]. The possibility to recover vehicle energy otherwise lost as heat during braking is an inherent advantage of a hybrid electric or a fully electric vehicle. Regeneration has the potential to answer this problem by aiding in range extension with recuperation of

vehicle energy during braking. The control and dynamics of braking undergoes a major change as compared to a conventional vehicle with friction braking, due to the addition of motor-generator. [6]

3. DESIGN AND DRAWING

The regenerating braking system is consists of the following components to full fill the requirements of complete operation of the machine.

. AC Motor

. Dynamo

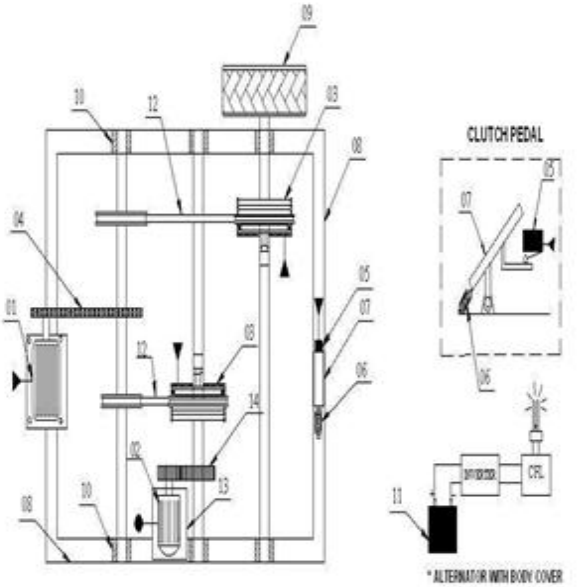
. Spur gear

. Belt and pulley

. Electromagnetic clutch

. Bearing

. Tyre



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	AC MOTOR	05	LIMIT SWITCH	09	AUTO WHEEL	13	BODY COVER
02	DYNAMO	06	SPRING	10	BEARING	14	SPUR GEAR(40T*16T)
03	ELECTROMAGNETIC CLUTCH	07	CLUTCH PEDAL	11	BATTERY		TO CONTROL UNIT
04	CHAIN DRIVE	08	BASE FRAME	12	BELT DRIVE		TO BATTERY

Fig. 1: Drawing of the concept

Power of electric motor, P = I × V (1)

P = 0.5 ×440 = 220W

Torque of the motor, T= 60P/ 2 π N =1.459 N-m (2)

DESIGN OF ELECTROMAGNETIC CLUTCH

Torque produced= 1.459N.m

Diameter, $d^3 = 16M_t/ \pi T_s$ (3)

Where T_s is the allowable shear stress for shaft,

Mt is the torque

Taking C-40 steel, the shaft material, for that material

T_S=65.7N/mm2

So, d=113.157mm

Assuming that dynamo rotates at 1500 rpm, then it will produce 6 - 8 V

BATTERY CALCULATION

B_{AH} /C_I = 8 Ah/420mA = 19 hrs (4)

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 = B_{AH} /I = 5.3 hrs. (5)

The design calculations are based on data book [8].

4 WORKING PRINCIPLE

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 electro-magnetic clutch is engaged. Dynamo setup near the electromagnetic clutch is disengaged.

Fig.2: Final model of the concept

5 MERITS & DEMERITS

5.1 Merits

. Automatically operate

. Implementation is easy

. Maintenance is easy

5.2 Demerits

. Power produced is less

. Un-economical if produced in small numbers.

6. CONCLUSIONS

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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