Design And Working Of Regenerative Clutch For Power Generation

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Abstract- *In this paper we have introduced the regenerative clutching system for power generation.The electromagnetic clutch is a type of clutch that is used to transmit power from a driving member to driven member without any mechanical linkages. Electromagnetic clutch which exists already have some problem like wear and slip. This equipment has been mainly developed for utilizing the clutch operation in four wheelers or two wheelers. By using regenerative clutch, we have generated the electrical power through clutching system. In some vehicles electrical Accessories are fitted to provide a good look to vehicle, but it needs more electric power than the power generated by vehicle battery to work. So we are using a dynamo for producing the electric power with the arrangement of clutching system. The newly generated electromagnetic clutch is free from slipping hence smooth power is produced, so there is no way of wear problem occurs. This new electromagnetic clutch has only less no linkages so takes less space in vehicles.*

Keywords- Regenerative Clutch, Dynamo, Power generation

I. INTRODUCTION

Electromagnetic clutches transmit torque mechanically where its operate electrically. This is why they used to be referred to as electro-mechanical clutches. Electromagnetic clutches are often found in AWD systems, and are used to control the amount of power sent to wheels or axles individually. A smaller electromagnetic clutch connects the pulley driven by the crankshaft to the air conditioning compressor, allowing the compressor to continuity cycle when needed. Major application of this clutches are in packaging machinery, printing machinery, food processing machinery, and factory automation. Multiple disk clutches are used to deliver extremely high torque in a relatively small space. These clutches can be used as both dry and wet (oil bath). Running the clutches in an oil bath will greatly increases the heat dissipation capability, which makes the clutch ideally suited for multiple speed gear boxes and also machine tool applications.

II. LITERATURE SURVEY

Bingli Zhang et al., [1] in this paper it is discussed to resolve problems in power train components, about over running clutch based to speed coupling which is applied to Parallel Plug-In Hybrid Electric Vehicle (PHEV). The speed coupling strategy of PHEV is taken forward and the control strategy resolve in this paper using chain power coupling platform, which provides basic method for designing multiple control strategy.

QingliangHou et al., [2] this paper gives solution to resolve the issue of power train components speed coupling based on over-running clutch applied to PHEV. The controller strategy models can be established using Mat lab program. The establishment through software is according to the structure of overrunning clutch but the discrete PID controllers exactly control power train components output. **M.Jaindl et al., [3]** in this paper they have studied that electromagnetic clutch can transmit a continuously adjustable torque from the main shaft to the moving shaft. In different from friction clutches, the electromagnetic clutch transmit rotation by a magneto-rheological fluid consists of a base fluid mixed with numerous Ferro-magnetic micro-sized particles. When the density of flux increased, the micro-sized particles start to form tightly tied chains increasing transmitted torque. The magnitude of torque can be regulated by application of applied magnetic field simulated by finite element analysis method.

FeiMenget al., [4] in this paper a wet clutch transmission is developed with integrated clutch satisfying phase control for gear shifts. In order to gain smooth power transmission in automatic power transmission likely in clutch to clutch shift , synchronizing the oncoming clutch and the off going timely and as well as the pressure control for engagement of oncoming clutch was studied. **Francesco Bucchiet al., [5]** this article describes about the torque characteristic of a permanent magnet magneto rheological (MR) clutch and its investigation focusing on the influence of temperature in it. An experimental campaign was carried out equipped with caulk oxen which is heating up to 80’C. Particularly, we have found that there is a loss of transmitted torque for increasing temperature. The dependence of MR fluid shear stress on

temperature which is useful for similar devices was also obtained. In this article work, the effects of temperature on the torque transmission characteristics of an MR was experimentally investigated and reported. **Martin Steinberge et al., [6]** in this paper a friction clutch which is capable with an electromagnetic actuator has considered. The aim of the article is to estimate the air gap between an electromagnet and an armature, which allows compressing of the clutch disc. Starting at point of the design of an observer by linearization is along a line. In order to move forward to the estimation, a sliding mode of the observer using super twisting concepts is developed.

III. DESIGN OF EQUIPMENT AND DRAWING

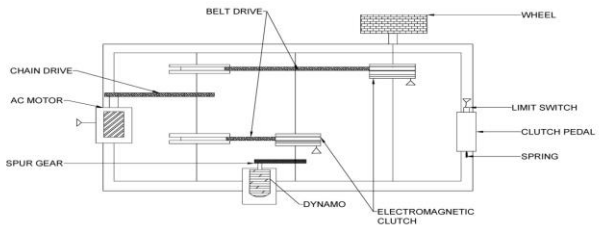

Figure 1: Regenerative clutch design layout

Table 1: List of components in regenerative clutch setup

SL.NO	COMPONENT	QUANTITY
1	Chain & sprocket	2
2	AC motor	1
3	Electromagnetic clutch	2
4	Dynamo	1
5	Gears	2
6	battery	1
7	wheel	1

IV. CONSTRUCTION AND WORKING PRINCIPLE

The main components used in this project are motor, spur drives, dynamo, electromagnetic clutch, bearings, and limit switch, clutch pedal and battery. The basic concept is to generate electricity while the clutch is in engaged position. Here belt drive is used to couple the wheel with the electromagnetic clutch and similarly to couple the dynamo setup with the electromagnetic clutch from motor.

When the motor rotates which is coupled with the dynamo setup the wheel also rotates with the help of two electromagnet clutches using belt drives. The Limit switch is placed just below the clutch pedal. Whenever we press the clutch pedal the limit switch gets activated which gives signal for disengagement of the electromagnetic clutch near wheel and engagement of the electromagnetic clutch near dynamo setup. So dynamo will produce power accordingly by its rotation. The generated power is converted and stored in Battery with the help of inverter circuit. So whenever the clutch is applied, some amount of power is produced and 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.

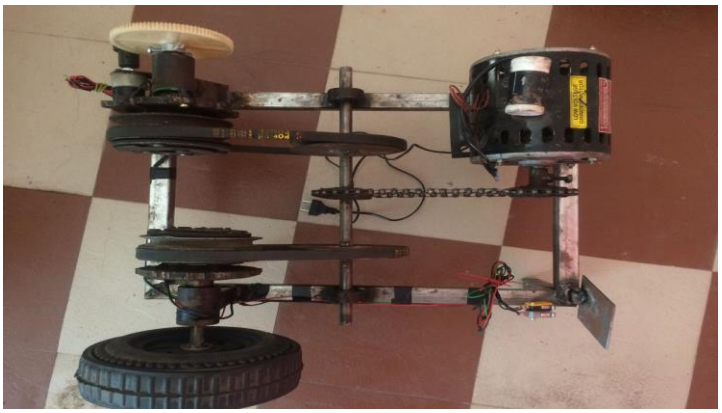

Figure 2: Regenerative clutch model developed – Top view

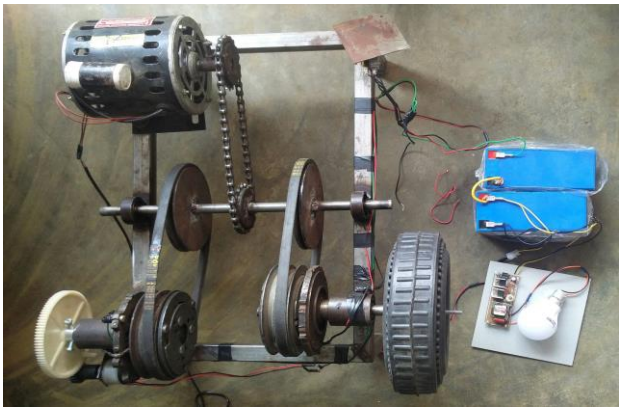

Figure 3: Regenerative clutch model developed with LED to show power generation

V. DESIGN CALCULATION

1. MOTOR CALCULATIONS

1.1 SPECIFICATION:

Speed N = 1440 RPM
Voltage V = 230 Volt
Current I = 1.62 A (full loading condition)
Power P =V x I ---------- (1)
=230x0.40= 183 WATT
P = 0.25 HP

Motor Efficiency = 80%

1.2 TORQUE OF THE MOTOR:

And the formula for calculating torque will be

$$T = (I * V * E * 60) / (N * 2\pi) \text{ --------- (2)}$$

$$= (.40 \times 230 \times 0.8 \times 60)/1440 \times 2\pi$$

Torque = .488 Nm

Torque (T): 4.89kgcm

2. CHAIN DRIVE CALCULATION:

1. Calculate the drive ratio R (velocity ratio) given the input RPM and output RPM.

Drive ratio=N1/N2 = T2/T1 ---------- (3)

Here, N1-speed of the larger gear

N2-speed of the smaller gear

T1 – tooth of larger gear

T1 – tooth of larger gear

Velocity ratio = N1/N2 ---------- (4)

So,

N1/N2 = T1/T2

N1= 1440

N2= ?

T1= 18

T2 = 18

N1/N2 = T1/T2

1440/N2 = 44/18

N2 = (1440) / (1818)

N2 = (1440)/1

N2 = 1440 RPM

Velocity ratio = N1/N2

= 1440/1440

Velocity ratio =1

2. Determine the number of teeth of the sprockets.

Minimum number of teeth on the sprocket = 18

3. Number of teeth on the larger sprocket

Number of teeth on the larger sprocket = 18

4. Find the velocity.

Velocity, v = (π D N)/60 ---------- (5)

(3.14×0.0065×1440)/60

0.49 m/s

3. GEAR CALCULATIONS

3.1 Given:

N1 = 1200

T1 = 96Teeth

T2 = 24Teeth

3.2 To find:

N2 =? N1/N2 =T2/T1

Here, N1-speed of the larger gear

N2-speed of the smaller gear

T1 – tooth of larger gear

T1 – tooth of larger gear

3.3 FORMULA TO BE USED:

N1/N2 = T2/T1

1200/N2 = 24/96

N2 = 1200*(96/24)

N2 = 4800 rpm

4. DYNAMO

Speed = 4800rpm

Volts = 12 v

Watts = 18 w

If the dynamo rotates at 4800rpm it will produce 10-12 v

5. BATTERY CALCULATION:

To find the Current

Watt = 18 w

Volt = 12v

Current =?

From Equation (1) P= V x I

18 =12 x I

I = 18/12

= 1.5 AMPS

BATTERY USAGE WITH 1.5 AMPS

B_{AH} /I

8/1.5 = 5.3 hrs

VI. RESULTS AND DISCUSSIONS

The present paper work epitomise the working of regenerative clutch, the following conclusions are worth mentioning. □n this newly designed regenerative clutch, it is very useful for recovering the waste energy from the clutch system. Better transmission power is obtained by using this clutch as the newly designed clutch is replaced with splines to engage and disengage the power from engine to gearbox. Absolute engagement of clutch is achievable without any slip because of the use of splines. This newly designed regenerative clutch will make an impressive mark and makes automobile more user friendly.

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