

DESIGN AND FABRICATION OF REGENERATIVE CLUTCH FOR POWER GENERATION IN AUTOMOBILE

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering degree in
Mechanical Engineering

By

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**DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade “A” by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of ALAN JOHN FRANCIS (Reg. No. 38150010) who carried out the project entitled "**DESIGN AND FABRICATION OF REGENERATIVE CLUTCH FOR POWER GENERATION IN AUTOMOBILE**" under our supervision from September 2021 to April 2022.



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DECLARATION

I ALAN JOHN FRANCIS (Reg. No. 38150010) hereby declare that the Project Report entitled “**DESIGN AND FABRICATION OF REGENERATIVE CLUTCH FOR POWER GENERATION IN AUTOMOBILE**” done by me under the guidance of **Dr. G. ARUN KUMAR,M.E., Ph.D.**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.



DATE:20.04.22

SIGNATURE OF THE CANDIDATE

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ABSTRACT

We have established the regenerating clutching system it's a new innovative concept. It has been mainly developed for utilizing the braking operation in four-wheelers. We have generated the electrical power through the clutch system. In some vehicles, electrical accessories are fitted to provide a good look to the vehicle, but it needs more electric power to work it, so we are using a dynamo for producing the electric power with the arrangement of the clutch system. This project is made up of the following parts; dynamo, battery, wheel, belt drive, AC motor, limit switch, battery, and Electromagnetic clutch.

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LIST OF SYMBOLS AND ABBREVIATIONS

I	Ampere, Electric current
V	Voltage
P	Power
T	Torque
D	Diameter

CHAPTER-1

INTRODUCTION

A brake (device), is a device used to slow and stop a rotating wheel and thus a moving vehicle. Brakes such as those on automobiles, trucks, trains, and bicycles use friction between a wheel and another object to slow the motion of the vehicle. The friction created by the rubbing together of two objects generates a large amount of heat. A brake system must be capable of dissipating the heat as rotating wheels slow because excess heat can cause the brakes to lose their grip and fail.

A **magnet** (from Greek μαγνήτις λίθος magnētis líthos, Magnesian stone) is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials like iron and attracts or repels other magnets.

A **permanent magnet** is an object made from a material that is magnetized and creates its own persistent magnetic field. An everyday example is a refrigerator magnet used to hold notes on a refrigerator door. Materials that can be magnetized, which are also the ones that are strongly attracted to a magnet, are called ferromagnetic (or ferrimagnetic). These include iron, nickel, cobalt, some alloys of rare-earth metals, and some naturally occurring minerals such as lodestone. Although ferromagnetic (and ferrimagnetic) materials are the only ones attracted to a magnet strongly enough to be commonly

considered magnetic, all other substances respond weakly to a magnetic field, by one of several other types of magnetism.

Ferromagnetic materials can be divided into magnetically "soft" materials like annealed iron which can be magnetized but don't tend to stay magnetized, and magnetically "hard" materials, which do. Permanent magnets are made from "hard" ferromagnetic materials which are subjected to special processing in a powerful magnetic field during manufacture, to align their internal microcrystalline structure, making them very hard to demagnetize. To demagnetize a saturated magnet, a certain magnetic field must be applied and this threshold depends on the coercivity of the respective material. "Hard" materials have high coercivity whereas "soft" materials have low coercivity.

An electromagnet is made from a coil of wire which acts as a magnet when an electric current passes through it, but stops being a magnet when the current stops. Often an electromagnet is wrapped around a core of ferromagnetic material like steel, which enhances the magnetic field produced by the coil.

The overall strength of a magnet is measured by its magnetic moment, or alternately the total magnetic flux it produces. The local strength of the magnetism in a material is measured by its magnetization.

A regenerative brake is an apparatus, a device or system which allows a vehicle to recapture and store part of the kinetic energy that would otherwise be 'lost' to heat when braking Honda's patented IMA(Integrated Motor Assist) concept is quite simple - use an efficient Otto engine supplemented by an electric motor when additional power is needed. Also referred to as a 'hybrid' system because it uses two

power sources, the IMA concept allows the Civic Hybrid to use a smaller gasoline engine without any significant loss in performance. This system is especially effective due to the fact that acceleration requires a significantly higher power than needed for cruising on a level road (where vehicles spend most of their time). An engine more powerful than needed has to work under low load most of the time, a condition where its efficiency is lower than under high loads, thus worsening the vehicle's fuel economy. The electric motor-generator positioned between the engine and transmission assists the engine when accelerating and recovers energy to store in batteries when braking or decelerating, allowing it to operate independently without the need for a grid power supply. When the Civic Hybrid is coasting or its brakes are applied, its electric motor becomes a generator, converting forward momentum (kinetic energy) into electrical energy, instead of wasting it as heat during conventional braking. Energy is stored in a battery pack located behind the rear seat

A. Brake

A brake is a machine element and its principal object is to soak up energy during deceleration. In the vehicle, brakes are used to absorb kinetic energy whereas in hoists or elevators brakes are also used to absorb potential energy. By connecting the moving member to a stationary frame, normally brake converts kinetic energy to heat energy. This causes wastage of energy and also wearing of frictional lining material.

B. REGENERATIVE CLUTCH POWER GENERATION

Regenerative clutch power generation is the way of slowing a vehicle by using the motors as brakes. Instead of the surplus energy of the vehicle being wasted as unwanted heat, the motors act as generators and return some of it to the overhead wires as electricity. The vehicle is primarily powered by the electrical energy generated from the generator, which burns gasoline. This energy is stored in a large battery, and used by an electric motor that provides the motive force to the wheels. The regenerative braking taking place on the vehicle is a way to obtain more efficiency; instead of converting kinetic energy to thermal energy through frictional braking, the vehicle can convert a good fraction of its kinetic energy back into charge in the battery, using the same principle as an alternator. Therefore, if you drive a long distance without braking, you'll be powering the vehicle entirely from gasoline. The Regenerative clutch power generation comes into its own when you're driving in the city and spending a good deal of your time braking. You will still use more fuel in the city for each mile you drive than on the highway, though. (Thermodynamics tells us that all inefficiency comes from heat generation. For instance, when you brake, the brake pedals heat up and a quantity of heat, or energy, is lost to the outside world. Friction in the engine produces heat in the same way. Heat energy, also, has higher entropy than, say, electric, meaning that it is less ordered.).

C. Definition of Braking method

It in which the mechanical energy from the load is converted into electric energy and regenerated back into the line is known as Regenerative Braking. The Motor operates as a generator.

D. Regenerative Braking For Hybrid Vehicle

In most electric and hybrid electric vehicles on the road today, this is accomplished by operating the traction motor as a generator, providing braking torque to the wheels, and recharging the traction batteries. The energy provided by regenerative braking can then be used for propulsion or to power vehicle accessories.

The use of a hybrid power unit is most suitable in the application where:

1. The vehicle is operated in traffic with frequent stops or a highly variable speed.
2. Annual mileage is sufficient to pay off the initial investment in the hybrid system.
3. The vehicle and the driving pattern is such that acceleration resistance is dominant

CHAPTER -II

LITERATURE SURVEY

VEHICLE

The history of the automobile begins as early as 1769, with the creation of steam-powered automobiles capable of human transport [1]. 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. As such, the early history of the automobile can be divided into a number of eras based on the prevalent method of automotive propulsion during that time. Later periods were defined by trends in exterior styling and size and utility preferences.

HISTORY OF MAGNETIC

The earliest known surviving descriptions of magnets and their properties are from Greece, India, and China, around 2500 years ago. The properties of lodestones and their affinity for iron were written of by Pliny the Elder in his encyclopedia *Naturalis Historia*. By the 12th to 13th centuries AD, magnetic compasses were used in navigation in China, Europe, and elsewhere. For more details, see the main Magnetism article.

NEED OF REGENERATIVE SYSTEM FOR BRAKING

Brakes convert mechanical into thermal energy only when applied otherwise they do nothing. Driving on a highway at a constant speed, they waste no energy at all. Driving in a city, they convert kinetic into thermal energy at each traffic light. Taking the foot off the gas pedal farther away from the traffic lights, if possible, helps reducing the waste of energy. The mechanical brakes replaced by electric motors to slow down the cars, the kinetic energy would be converted into electrical, instead of thermal energy, and stored in batteries or capacitors, and could be used to accelerate the car after the light turned green again - that is what hybrid cars do. Mostly braking systems in automobiles convert wheel motion into heat energy while pushing the brakes inside. Else, the brake system sorts out nonentity. Automobile moves at higher cruising speeds on main road, all the energy utilizing no wastage of energy. Metropolitan city driving conditions are different from high ways maximum energy is wasted due to frequent stops and starts vehicles due to traffic and signal lights. Now is the time to introduce the new technique of regenerative braking system and replace the conventional braking system. In this system, the motors convert heat energy into electrical energy and charge the batteries and capacitors available in automobiles. In addition, might be recycled to speed up the automobile subsequently the light signal changes to green again – the same principle keep an eye on in hybrid automobiles also. Conventional brakes have low complexity and are cheap when compared to regenerative braking systems. The

regenerative braking system works all the way of vehicle propels. Depress the brake plate on a hybrid vehicle or electric mobility, these brakes change the vehicle's electric motor into opposite which creates it track recessive, in order decelerating the automobile steering wheel. Hence, on the trot retrograde, the mechanical device like motor performances as an electric device like originator by creating current power that's transported into the hybrid electric vehicle batteries. All automobiles equipped with a steering system with all the wheels while turning in confined space follow the four-wheel steering and careless for parallel lane parking and guiding the automobile reasonably through not at all misfortune taking place main and public road. At higher cruising speeds, this regenerative braking system gives results that are more fruitful. It effectively works in metropolitan cities because of more traffic and signals due to this the automobile moves in a press-and depressing manner. Electric automobiles and hybrid vehicles maintain friction brakes. These friction brakes act as a standby system where proper power is not supplied by the regenerative braking system. These situations are overcome by giving training to automobile drivers to avoid dread situations. That means furthermore pressure is applied to the brakes.

CHAPTER -III

DESCRIPTION OF EQUIPMENTS:

3.1 MOTOR

A.C. SYNCHRONOUS MOTORS

Ac synchronous motor is distinguished by a rotor spinning and coil Passing magnets at the same rate as the alternating current and resulting magnetic field that drives it. Speed is independent of the load provided and sufficient field current is applied. Accurate control in speed. This motor power factor can be adjusted to unity by using a proper field current relative to the load. The motor converts electrical power to mechanical power in its rotor.

There are several ways to supply power to the rotor. this ac motor power is induced in the rotating device. Since the motor has no significant current rise on starting, this motor is ideal for an application that requires six or more starts per minute. One winding to another results in a reversal of motor direction. A single pole three-position switch can be used for forwarding, Reverse & Off control as shown in the following diagram. Metal varistor oxide may be used to minimize the switch contact arcing.

The motor will not be overheated if stalled because starting; full load and no-load currents are the same. However prolonged operation against a solid stop will eventually produce bearing failure due to the resultant shaft vibrations. The motors are having extremely rapid

starting; there is a limit to the inertia load at which the motor will start from rest. Powder-coated cast aluminum body with steel shaft.

Asynchronous is that in the latter a current is supplied onto the rotor. This then creates a magnetic field that, through magnetic interaction, links to the rotating magnetic field in the stator which in turn causes the rotor to turn. It is called synchronous because at a steady-state the speed of the rotor is the same as the speed of the rotating magnetic field in the stator.

3.2 BEARING

A bearing is a device to permit constrained relative motion between two parts, typically rotation or linear movement. Bearings may be classified broadly according to the motions they allow and according to their principle of operation. Low friction bearings are often important for efficiency, reducing wear, and facilitating high speeds. Essentially, a bearing can reduce friction by virtue of its shape, its material, or by introducing and containing a fluid between surfaces. By shape, gains advantage usually by using spheres or rollers. By material, exploits the nature of the bearing material used. Sliding bearings are usually called bushes bushings journal bearings sleeve bearings rifle bearings or plain bearings. Rolling-element bearings are ball bearings and roller bearings.

Jewel bearings, in which the load is carried by rolling the axle slightly off-center. Fluid bearings, in which the load is carried by a gas or liquid magnetic bearings, in which the load is carried by a magnetic field. Flexure bearings are in which the motion is supported by a load

element that bends. Bearings vary greatly over the forces and speeds that they can support. Forces can be radial, axial (thrust bearings), or moments perpendicular to the main axis. Bearings very typically involve some degree of relative movement between surfaces, and different types have limits as to the maximum relative surface speeds they can handle, and this can be specified as a speed in ft/s or m/s.

The moving parts there is considerable overlap between capabilities, but plain bearings can generally handle the lowest speeds while rolling element bearings are faster, hydrostatic bearings faster still, followed by gas bearings and finally magnetic bearings which have no known upper-speed limit.

3.3 SPUR GEAR

Spur gears are the simplest and most common type of gear. Their general form is a cylinder or disk. The teeth project radially, and with these straight-cut gears, the leading edges of the teeth are aligned parallel to the axis of rotation. These gears can only mesh correctly if they are fitted to parallel axles. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears. The force will have both a radial and a circumferential component. Gears are a very useful simple machine. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears.



fig 3.3.1 (spur gear)

A gear is component within a transmission device. Transmit rotational force to another gear or device. A gear is different from a pulley in that a gear is a round wheel. Mesh with other gear teeth, allowing force to be fully transferred without slippage. Depending on their construction and arrangement, geared devices can transmit forces at different speeds, torques, or in a different direction, from the power source. Gears are a very useful simple machine. The most common situation is for a gear to mesh with another gear, but a gear can mesh with any device having compatible teeth, such as linear moving racks.

3.4 PULLEY

A pulley is a wheel with a groove along its edge, also called a sheave, for holding a rope or cable. Pulleys are usually used in sets designed to reduce the amount of force needed to lift a load. The same amount of work is necessary for the load to reach the same height as it would without the pulleys. The magnitude of the force is reduced, but it must act through a longer distance. The effort needed to pull a load up is roughly the weight of the load divided by the number of wheels.

The more wheels there are, the less efficient a system is, because of more friction between the rope and the wheels.

The pulleys and lines are weightless, and there is no energy loss due to friction. It is also assumed that the lines do not stretch. With this assumption, it follows that, in equilibrium, the total force on the pulley must be zero. This means that the force on the axle of the pulley is shared equally by the two lines looping through the pulley. The lines are not parallel, the tensions in each line are still equal, but now the vector sum of all forces is zero.

A second basic equation for the pulley follows from the conservation of energy the product of the weight lifted times the distance it is moved is equal to the product of the lifting force times the distance the lifting line is moved. The weight lifted divided by the lifting force is defined as the advantage of the pulley system. It is important to notice that the amount of work done in an ideal pulley is always the same. The work is given by the effort times the distance moved. The pulley simply allows trading effort for distance.

3.5 BELT

Belts are used to mechanically link two or more rotating items. They may be used as a source of motion, to transmit power at up to 98% efficiency between two points, or to track relative movement.



fig 3.5.1 (conveyor belt)

As a source of motion, a conveyor belt is one application where the belt is adapted to continually carry a load between two points. A belt may also be looped between two points so that the direction of rotation is reversed at the other point. Power transmission is achieved by specially designed belts and pulleys. The demands on a belt drive transmission system.

Belts normally transmit power only on the tension side of the loop. Designs for continuously variable transmissions exist that use belts that are a series of solid metal blocks, linked together as in a chain, transmitting power on the compression side of the loop.

3.6 ELECTROMAGNETIC CLUTCH

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 sixty 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. This article mainly deals with these types of clutches.

CONSTRUCTION

A horseshoe magnet (A-1) has a north and south pole. If a piece of carbon steel contacts both poles, a magnetic circuit is created. In an electromagnetic clutch, the north and south pole is created by a coil shell and a wound coil. In a clutch, (B1) when power is applied, a magnetic field is created in the coil (A2 blue). This field (flux) overcomes an air gap between the clutch rotor (A2 yellow) and the armature (A2 red). This magnetic attraction, pulls the armature in contact with the rotor face. The frictional contact, which is being controlled by the strength of the magnetic field, is what causes the rotational motion to start. The torque comes from the magnetic attraction, of the coil and the friction between the steel of the armature and the steel of the clutch rotor. For many industrial clutches, friction material is used between the poles. The material is mainly used to help decrease the wear rate, but different types of material can also be used to change the coefficient of friction (torque for special applications). For example, if the clutch is required to have an extended time to speed or slip time, a low coefficient friction material can be used and if a clutch is required to have a slightly higher torque (mostly for low rpm applications), a high coefficient friction material can be used.

In a clutch, the electromagnetic lines of flux have to pass into the rotor, and in turn, attract and pull the armature in contact with it to complete clutch engagement. Most industrial clutches use what is called a single

flux, two pole design (A-2). Mobile clutches of other specialty electromagnetic clutches can use a double or triple flux rotor (A-4). The double or trip flux refers to the number of north/south flux paths (A-6), in the rotor and armature. These slots (banana slots) (A-7) create an air gap which causes the flux path to take the path of least resistance when the faces are engaged. This means that, if the armature is designed properly and has similar banana slots, what occurs is a leaping of the flux path, which goes north south, north south (A-6). By having more points of contact, the torque can be greatly increased. In theory, if there were 2 sets of poles at the same diameter, the torque would double in a clutch. Obviously, that is not possible to do, so the points of contact have to be at a smaller inner diameter. Also, there are magnetic flux losses because of the bridges between the banana slots. But by using a double flux design, a 30%-50% increase in torque, can be achieved, and by using a triple flux design, a 40%-90% in torque can be achieved. This is important in applications where size and weight are critical, such as automotive requirements.

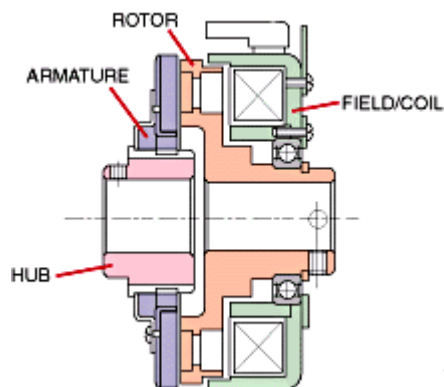


fig 3.6.1(symmetrical view)

The coil shell is made with carbon steel that has a combination of good strength and good magnetic properties. Copper (sometimes

aluminum) magnet wire, is used to create the coil, which is held in shell either by a bobbin or by some type of epoxy/adhesive.

To help increase life in applications, friction material is used between the poles on the face of the rotor. This friction material is flush with the steel on the rotor, since if the friction material was not flush, good magnetic traction could not occur between the faces. Some people look at electromagnetic clutches and mistakenly assume that, since the friction material is flush with the steel, that the clutch has already worn down, but this is not the case. Clutches used in most mobile applications, (automotive, agriculture, construction equipment) do not use friction material. Their cycle requirements tend to be lower than industrial clutches, and their cost is more sensitive. Also, many mobile clutches are exposed to outside elements, so by not having friction material, it eliminates the possibility of swelling (reduced torque), that can happen when friction material absorbs moisture.

BASIC OPERATION

The clutch has four main parts: field [disambiguation needed], rotor [disambiguation needed], armature, and hub [disambiguation needed] (output) (B1). When voltage is applied the stationary magnetic field generates the lines of flux that pass into the rotor. (The rotor is normally connected to the part that is always moving in the machine.) The flux (magnetic attraction) pulls the armature in contact with the rotor (the armature is connected to the component that requires the acceleration), as the armature and the output start to accelerate. Slipping between the rotor face and the armature face continues until

the input and output speed is the same (100% lockup). The actual time for this is quite short, between 1/200th of a second and 1 second.

3.7 DYNAMO

Dynamo is an electrical generator. This dynamo produces direct current with the use of a commutator dynamo were the first generator capable of the power industries. The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils.

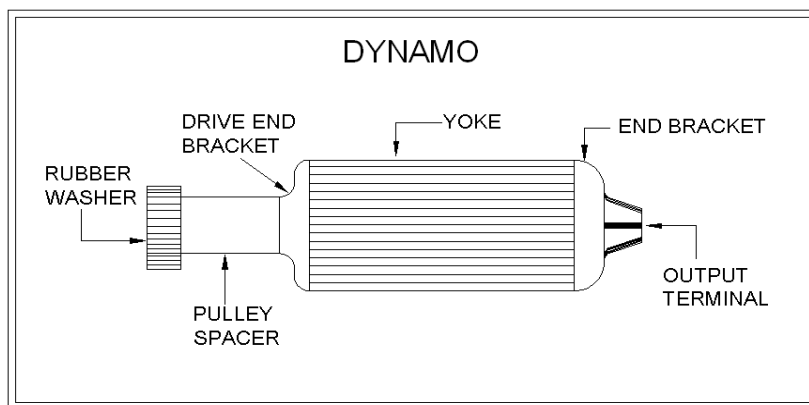


fig 3.7.1(Dynamo)

The commutator was needed to produce direct current. When a loop of wire rotates in a magnetic field, the potential induced in it reverses with each half turn, generating an alternating current. However, in the early days of electric experimentation, alternating current generally had no known use. The few uses for electricity, such as electroplating, used direct current provided by messy liquid batteries. Dynamos were invented as a replacement for batteries. The commutator is a set of contacts mounted on the machine's shaft, which reverses the connection of the windings to the external circuit when the potential reverses, so instead of alternating current, a pulsing direct current is produced.

3.8. BATTERY

In our project we are using secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out. After wearing out some batteries can be recycled.

Batteries have gained popularity as they became portable and useful for many purposes. The use of batteries has created many environmental concerns, such as toxic metal pollution. A battery is a device that converts chemical energy directly to electrical energy it consists of one or more voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte.

One half-cell is the positive electrode, and the other is the negative electrode. The electrodes do not touch each other but are electrically connected by the electrolyte, which can be either solid or liquid. A battery can be simply modeled as a perfect voltage source which has its own resistance, resulting voltage across the load depends on the ratio of the battery's internal resistance to the resistance of the load.

When the battery is fresh, its internal resistance is low, so the voltage across the load is almost equal to that of the battery's internal

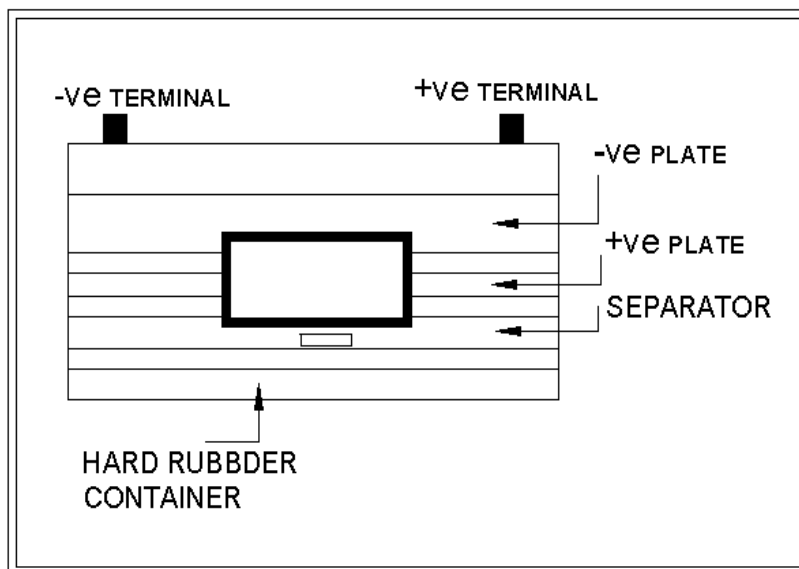


Fig
3.8.1(Battery)

voltage source. As the battery runs down and its internal resistance increases, the voltage drop across its internal resistance increases, so the voltage at its terminals decreases, and the battery's ability to deliver power to the load decreases.

CHAPTER-IV

DESIGN AND CALCULATION

4.1 MACHINE COMPONENTS

The REGENERATIVE CLUTCH POWER GENERATION system is consists of the following components to full fill the requirements of complete operation of the machine.

- EMC
- Motor
- Dynamo
- Battery
- Spur gear

Calculation for motor drive:

Given data:

$P = 2750W$

$N = 1400RPM$

$I = 25A$

$\theta = 20^\circ$ coil winding

Motor specification

Rpm = 1440

Volt= 230

Watt = 180

Amps = 25

$$H_p = \frac{1}{4}$$

$$P_h = 1 \text{ phase}$$

Electrical (electric) power equation:

$$\text{Power } P = I \times V$$

Where

$$I = 25 \text{ amps}$$

$$V = 230$$

$$P = I \times V$$

$$= 25 \times 230$$

$$P = 5750$$

To find the torque of the motor

$$P = 2 \times 3.14 \times N \times T / 60$$

$$T = P \times 60 / 2 \times 3.14 \times N$$

$$T = 5750 \times 60 / 2 \times 3.14 \times 1440$$

$$T = 38.15 \text{ N-m}$$

Battery calculation:

$$B_{AH} / C_I = 8 \text{ ah} / 420 \text{ ma (milliamps)}$$

$$= 19 \text{ hrs}$$

To find the Current

$$\text{Watt} = 18 \text{ w}$$

$$\text{Volt} = 12 \text{ v}$$

$$\text{Current} = ?$$

$$P = V \times I$$

$$18 = 12 \times I$$

$$I = 18/12$$

$$= 1.5 \text{ AMPS}$$

BATTERY USAGE WITH 1.5 AMPS

$$B_{AH}/I$$

$$8/1.5 = 5.3 \text{ hrs}$$

Spur gear calculation:

Diameter of gear = $\varnothing 105\text{mm}$

No of teeth = 96 no

Thickness of the gear = 10mm

MODULE :m

This is the standard term used in S.I. units. It can be defined as the length on the pitch circle diameter per tooth. It is the reverse of the diameter pitch.

$$m = D/T$$

$$m = 105/96$$

$$m = 1.093 \text{ mm}$$

ADDENDUM: (a)

The radial distance between the pitch circle and the tip circle is known as Addendum.

$$a = 1 \text{ m}$$

$$a = 1 \times 1.093$$

$$a = 1.093 \text{ mm}$$

DEDENDUM: (d)

The radial distance between the pitch circle and the root circle is known as Dedendum (d).

$$d=1.25m$$

$$d = 1.25 \times 1.093$$

$$d = 1.366 \text{ mm}$$

CIRCULAR PITCH (Pc):

The distance between the corresponding sides of two adjacent of a gear measured on the pitch circle is known as circular pitch.

$$P_c = \pi D / T$$

$$P_c = \pi (105) / 96$$

$$P_c = 3.433 \text{ mm}$$

Diametrical Pitch (Pd):

It is the ratio of the number of teeth per unit pitch diameter. This

Is a mostly used in F.P.S. system.

$$P_d = T / D$$

$$P_d = 96 / 105$$

Gear 2:

Diameter of gear = $\varnothing 30\text{mm}$

No of teeth = 24 no

Thickness of the gear = 10mm

$$m = D / T$$

$$m = 30 / 24$$

$$m = 1.25 \text{ mm}$$

$$a = 1 \text{ m}$$

$$a = 1 \times 1.25$$

$$a = 1.25 \text{ mm}$$

$$d = 1.25m$$

$$d = 1.25 \times 1.25$$

$$d = 1.56 \text{ mm}$$

$$P_c = \pi D / T$$

$$P_c = \pi (30) / 24$$

$$P_c = 3.925 \text{ mm}$$

$$P_d = T / D$$

$$P_d = 24 / 30$$

$$P_d = 0.8 \text{ mm}$$

Shaft calculation:

Following stresses are normally adopted in shaft design

Max tensile stress = 60 N/mm²

Max shear stress = 40 N/mm²

Considering 25 % overload

$$T_{\max} = 1238 \times 1.25 = 1.525 \times 10^3 \text{ N-mm}$$

The shaft is subject to pure torsional stress we know

$$T = \frac{3.14}{16} \times f_s \times d^3$$

$$15250 = \frac{3.14}{16} \times 70 \times d^3$$

$$D = 10.20 \text{ mm}$$

$$\text{FOS} = 1.5 (\text{factor of safety})$$

$$10.20 \times 1.5 = 15.3 \text{ mm}$$

$$15.3 = 15 \text{ mm (STANDARD)}$$

Ball bearing calculation:

$$\text{Radial load of ball bearing (Fr)} = 700 \text{ N}$$

$$\text{Thrust load of ball bearing (Fa)} = 300 \text{ N}$$

$$\text{Service factor (s)} = 1.2$$

$$\text{Hours in use per week} = 35$$

$$\text{Number of years} = 3$$

$$\text{Speed } N = 500 \text{ Rpm}$$

$$\text{Diameter of Shaft} = 15 \text{ mm}$$

LIFE OF BEARING

$$\text{Total life of bearing} = 35 \times 3 \times 52$$

$$= 5460 \text{ hrs}$$

$$\text{Equivalent Load} = P = (X Fr + y Fa) S$$

$$\text{Load factor} = x = 0.56$$

$$\text{Trust factor} = 1.4$$

$$(\text{FROM PSGDB 4.4 AND 4.6})$$

$$P = (0.56 \times 700 + 1.4 \times 300) 1.2$$

$$= 812 \text{ N}$$

$$\text{Loading ratio} = C/P (\text{FROM PSGDB 4.14})$$

$$= 6.2$$

$$C = 6.2 \times P$$

$$= 6.2 \times 81$$

$$= 5034 \text{ N}$$

$$C = 880 \text{ Kg } f = 8800 \text{ N}$$

Since $C = 8800 > 5034$, the Selected bearing is suitable.

Selected bearing = SKF6002.

4.2 DRAWING

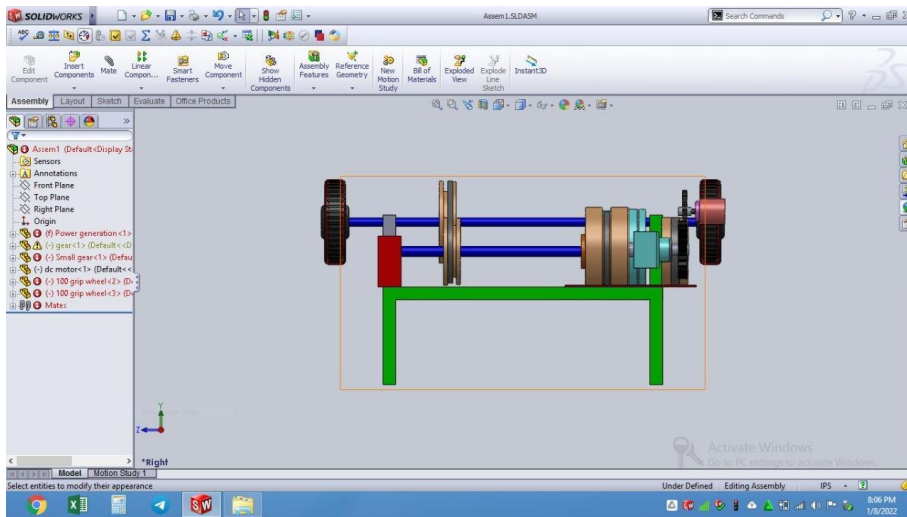


Fig 4.2.1(Front view)

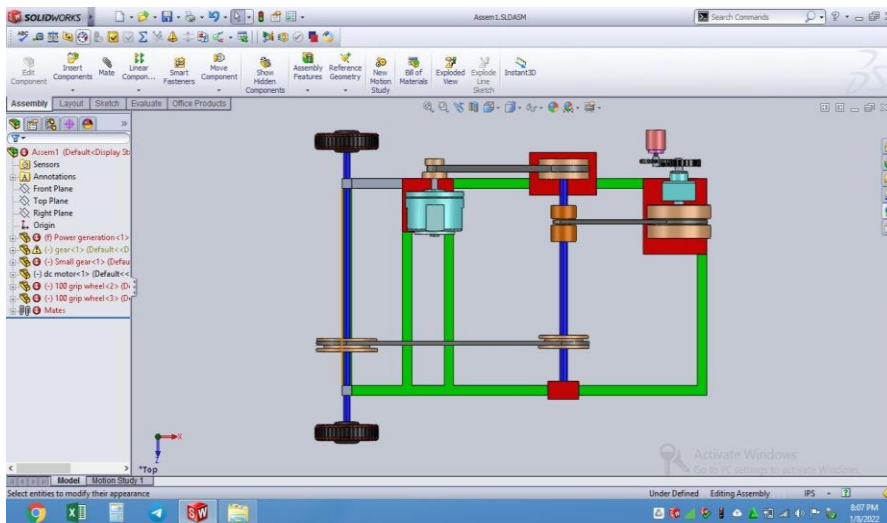


Fig 4.2.2(Top view)

CHAPTER-V

WORKING PRINCIPLE

When voltage is applied to the input shaft, wheel starts rotating in clockwise direction. This clockwise motion is also transferred to the second shaft through the timing pulley and hence the sprocket to the shaft 3. We are using Timing pulley since its efficiency is 99.99% hence, the friction losses are neglected. Motion which is transmitted to the sprocket shaft is carried to the third shaft from which flywheel is connected. Motion of the shaft is transmitted to the flywheel and it is connected to 1:1 gear ratio gear with the dynamo. The dynamo is used to convert the rotational energy to the mechanical energy. Basically its work is to store the energy. When we apply the brake the motor continues to work but the wheel gets stopped and thus the sprocket shaft also gets stopped but the flywheel keeps on rotating which stores the waste energy of the wheel lost due to friction or heat to the atmosphere. Now this rotating mechanical energy is transferred to the dynamo from where battery or any equipment is connected which can work by taking this energy. Dynamo connected to the flywheel means of gear pair converts rotational mechanical energy to electrical energy. Potentiometer which regulates the voltage is used for varying the speed. By regulating the voltage we can vary the input speed from which different readings are taken by connecting different load.

CHAPTER -VI

MERITS AND DEMERITS

MERITS

- Automatically operate
- Implementation is easy
- Maintenance is simple

DEMERITS

Production of power is less

CHAPTER-VII

APPLICATIONS

APPLICATION

It can be applicable in all type of four wheeler and two automobile vehicles.

CHAPTER-VIII

LIST OF MATERIALS

FACTORS DETERMINING THE CHOICE OF MATERIALS

The various factors which determine the choice of material are discussed below.

1. Properties:

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection

- a. Physical
- b. Mechanical
- c. From manufacturing point of view
- d. Chemical

The various physical properties concerned are melting point, thermal Conductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties Concerned are strength in tensile, Compressive shear, bending, torsional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are,

- Cast ability
- Weld ability
- Bribability
- Surface properties
- Shrinkage
- Deep drawing etc.

2. Manufacturing case:

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

3. Quality Required:

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

4. Availability of Material:

Some materials may be scarce or in short supply. It then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed the delivery of materials and the delivery date of product should also be kept in mind.

5. Space consideration:

Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

6. Cost:

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored.

Sometimes factors like scrap utilization appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

CHAPTER-IX

COST ESTIMATION

1. LABOUR COST:

Lathe, drilling, welding, grinding, power hacksaw, gas cutting cost
=Rs 4500

2. OVERGHEAD CHARGES:

The overhead charges are arrived by "manufacturing cost"

$$\begin{aligned}\text{Manufacturing Cost} &= \text{Material Cost} + \text{Labour Cost} \\ &= 8000 + 4500 \\ &= 12500\end{aligned}$$

$$\begin{aligned}\text{Overhead Charges} &= 20\% \text{ of the manufacturing cost} \\ &= 2500\end{aligned}$$

3. TOTAL COST:

$$\begin{aligned}\text{Total cost} &= \text{Material Cost} + \text{Labour Cost} + \text{Overhead Charges} \\ &= 8000 + 4500 + 2500 \\ &= 15000\end{aligned}$$

Total cost for this project = 15000

CHAPTER-XI

CONCLUSION

The project carried out by us will make an impressing mark in the field of automobile.

This project has also reduced the cost involved in the concern. The project has been designed to perform the required task taking minimum time.

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