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# Design and modification of propeller shaft generating electricity

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**Abstract -** *A vehicle such as a large truck can generate electricity for operating a hybrid engine or recharging batteries by use of an electricity generating driveshaft. The electricity generating driveshaft is comprised of a magnetized driveshaft which acts as a rotor, and a series of copper wire coils surrounding the magnetized driveshaft which acts as a stator in an electrical generator. As the magnetized driveshaft spins as a result of power from the hybrid engine, an electrical field is created which is captured by the copper wire coils and used to power the hybrid engine or recharge a super capacitor.*

***Key Words***: **Hybrid Engine, Drive Shaft, Magnetized Drive Shaft, Rotor and Capacitor.**

## 1. INTRODUCTION

The field of the invention disclosed here in is an article of manufacture and method for generating electricity from the rotating driveshaft of a motor vehicle and using the driveshaft to slow the vehicle to a stop. Vehicles have been powered by a variety of sources over the years. Before the invention of the internal combustion engine, vehicles were powered by animals, wind, and manpower. Since the abuse of the internal combustion engine, vehicles have been fuelled by gasoline, diesel oil, natural gas, ethanol and combinations of ethanol and gasoline. These fuels are expensive to use, difficult to obtain and transport and are becoming increasingly scarce. In response to these problems with the so called "fossil fuels, vehicles are being powered by all electric motors or hybrid combinations of electric/gasoline or electric/diesel fuel engines. The use of electric motors or electric/fossil fuel hybrid engines is hindered by the difficulty of providing electricity to power the electric motor or the electric portion of the hybrid engine. Electric engines receive energy from batteries. However, the batteries are heavy decreasing the efficiency of the electric motor. The batteries also have limited storage capacity thereby decreasing the range of the vehicle driven by an electric motor. Moreover, stations to recharge the batteries are few limiting the usefulness of electric vehicles.

Electrical generators have been in use for many years in different applications. The general definition of a generator is a device that converts mechanical energy into electrical energy. This is possible due to principle of electromagnetism. As this electrical energy is produced, the generator will cause electric current to flow through an external circuit. Typically, generators are made up of an arrangement of magnets, copper winding and a rotor, which ultimately produce electricity from mechanical power. In a generator powered by a diesel engine, the mechanical energy is provided from the chemical energy that stems from the combustion of diesel fuel by the engine This mechanical energy provided to the generator is eventually converted into electrical power based on the principle of electromagnetic induction. As the magnetic field is changed, a current is produced through the conductor within the generator.

### 1.2 PROBLEM STATEMENT:

In current vehicles following are the Concern,
By using chain and belt mechanisms with the alternator with engine these are the problems

- Loss of power
- More friction
- Wastage of energy
- Less quantity of fuel on earth

## 2. Detailed Problem Description:

- **Loss of power:**

  In other system there are the various losses. Which include heat loss, friction loss etc. Which causes major loss of energy for this frictionless energy must be needed.

- **More friction:**

  Due to the friction more amount of heat is generated in the system and also it causes wear and tear of the material, also this heat causes the deflection of material. Due to the friction we have to exert more power to the machine it opposes the motion due to friction noise also produce in the machine. Due to friction engine consumed more fuel so there is wastage of energy. So we cannot convert all input power to the output energy.

- **Wastage of energy:**

  When energy is transfer between two bodies this total energy usually results in maximum loss of the system.

- **Less quantity of fuel on earth***:*

  There is a limited amount of fossil fuel. Which found in rare places each of those regions contains less than 15 percent of the world's proven reserves worldwide. In 2020, it is anticipated that non- OPEC and OPEC nations will produce about 120 million barrels of oil per day. Compare that to today where about 75 million barrels of oil are produced today.

## 3. DESIGN OF MODEL:

A digital mock up (DMU) designed as per standard part availability in market and there dimensions , A digital mock up (DMU) provide us with the basis for evaluating optimum package usage. As specialist in production-ready development we make sure all component are ideally positioned, including the ability to accommodate components in terms of geometry and actually fixing them in position. To ensure production gets off to smooth start. This is best industry method to design any machine using 3D software.

CATIA v5 software is used in this model.

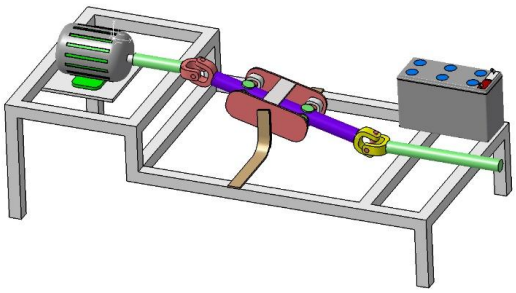

**Fig -1**: Design of model using CATIA v5 software

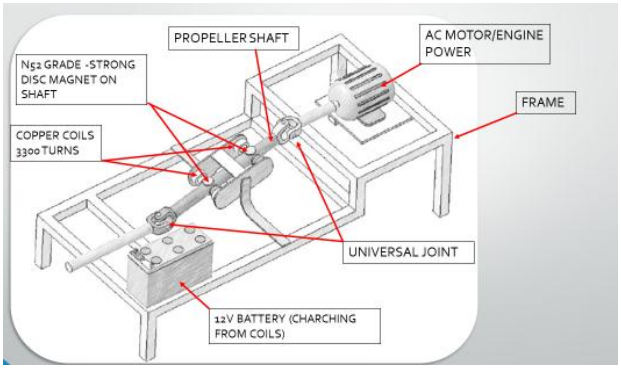


**Fig-2**: Detailed view of model

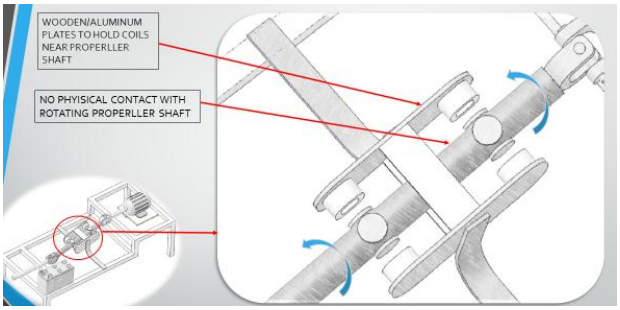


**Fig-3**: Close view of magnet arrangement

Here we are Converting rotary motion of shaft to electricity directly. This can generate electricity up to 10-30 Voltage with our Proposed Model.

## 4. DESIGN CALCULATIONS

1. **Design of Motor**

Speed=N= 1440 rpm
Torque = 20 Kg-cm =20*9.81*10^-2
=1.962 N-m
Angular Velocity=ω=(2*π*N)/(60)=
(2*π*1440)/(60)
=150.796 rad/sec
Power =P = T*ω =1.962*150.796
=295.862 watt

2. **Design of Shaft**

Material-Mild Steel (M.S.)
Syt=Yield Strength=170MPa
Sut=Ultimate tensile strength=290MPa
..... (Ref. Table 2.5 in Machine Design by R.S.Khurmi & J.K.Gupta)
Torque=20Kg.cm=20*9.81*10=1962N.mm
Speed=100rpm
Weight of 8 magnets=1kg
(maximum weight value, weight considered as per available magnets with supplier of magnets. i.e. 18mm dia and thick 3mm)
Consider Self-Weight of Shaft=5kg
Total weight=W=6kg=6*9.81=58.86N
Kb=combined shock & fatigue factor for bending=1.5
Kt=combined shock & fatigue factor for torsion=1.25
..... (Ref. Table 4.2 in Machine Design by V.B.Bhandari)
Applying A.S.M.E.Code,
Ƭper=Permissible stress
Ƭper=0.3*Syt=0.3*170=51MPa
Ƭper=0.18*Sut=0.18*290=52.2MPa
Selecting Ƭper whichever is minimum

…… (Ref. Page no.226 from Machine Design by V.B.Bhandari)

Ƭper=51MPa (selected)
Considering effect of key-way reduces this value by 25%,
Ƭper=0.75*51=38.25MPa
Maximum bending moment of simply supported shaft carrying central load,

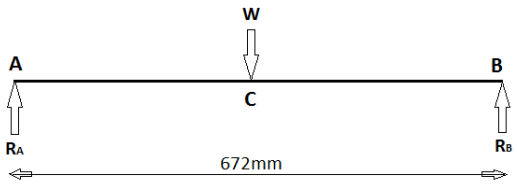


**Fig- 4**: Vertical loading diagram of shaft

$$Mc = \frac{WL}{4}$$

Mc = (58.86*672)/4=26369.28N.mm =9888

We know that, the equivalent twisting moment,

$$Te = \sqrt{(Kb * Mc)^2 + (Kt * T)^2}$$

$$Te = \sqrt{(1.5 * 26369.28)^2 + (1.25 * 1962)^2}$$

Te= Under root of ((1.5*9888)^2+(1.25*1962)^2)

Te=15034.105 N.mm

Therefore,
We also know that, equivalent twisting moment,

$$Te = \frac{\pi}{16} * Ƭper * d^3$$

…….. (Ref. Page no.226 from Machine Design by V.B.Bhandari)
Putting values,
15034.105= (3.14/16)*38.25*d^3
d=12.60 mm
factor of safety is selected=1.5
d=1.5*12.60 = 18.9mm =19 mm,
The standard size of shaft available nearby to 19 is 20mm
Therefore, shaft diameter(d) we considered as 20mm.

### 3. Flux:

The magnitude of the magnetic flux is greatest when the coil in a magnetic field is perpendicular to the field. In the design of an axial flux generator it is best to keep the coils perpendicular to the field produced by the permanent magnets. In many conventional motors a winding rotates inside a magnetic field. The number of windings is increased so that each winding is positioned close to 90 degrees to the field. Figure 4.1 illustrates this concept. In our design the angle between the coils and the field does not change, instead the field itself varies with time.

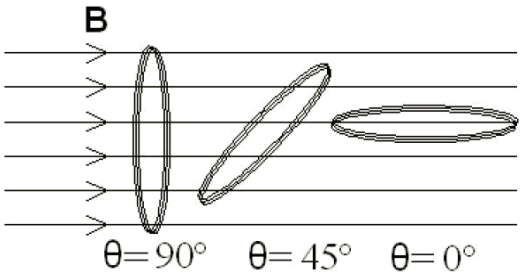


**Fig-5**: Field Lines through Coils

Faraday's law of induction states that the induced electromotive force is equal to the change in magnetic flux over the change in time. Generally, the coils, which pass through this field, contain more than one winding. The number of turns adds to produce a greater voltage. In order to take advantage of the property of Faraday's law, we wound our coils with 5000 turns. This design choice will increase the voltage each coil will produce.

### 5. Selection of bearing

From Suppliers catalogs

Dimensions: 18mm Dia x 3mm thick

Magnetic Face; 18mm diameter

Magnets Type; Neodymium

Material: NdFeB,

Grade: N52

Plating /Coating: Ni-Cu-Ni (Nickel)

Magnetization Direction: Axial/radial(Poles on Flat Ends)

Max Operating Temp: 176ºF (80ºC)

Quantity: 08 pcs

## 5. WORKING:

Expected Outcome of the Work:

When the propeller shaft is rotating at high speeds, the disc magnets also rotates with its axis when the magnet spins, the magnetic field around the top and bottom of the coil constantly changes between a north and a south pole.

This rotational movement of the magnetic field results in an alternating EMF being induced into the coil as defined by Faraday's law of electromagnetic inductions.

Copper coils generates 10 to 30 AC Volt, by using AC to DC Converter circuit, we can convert it to Dc and charge the batteries.

Further By using the power we run the vehicle in hybrid vehicles or electric vehicles.

## 6. APPLICATION:

- In hybrid vehicles like Trucks, busses, low duty commercial vehicles for charging battery.
- To power Ac on vehicles batteries are used to charge these batteries
- Power a hybrid engine or recharging a super capacitor
- Other sources in automobile.

## 7. ACTUAL CALCULATION:

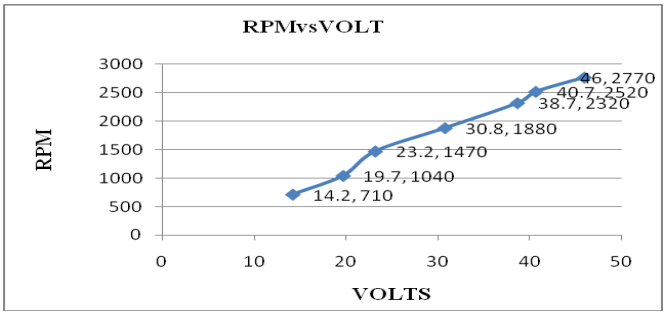


**Chart-1:** RPM vs. VOLTS

**Table-1**: RPM vs. VOLTS

| RPM | VOLTS |
|---|---|
| 710 | 14.2 |
| 1040 | 19.7 |
| 1470 | 23.2 |
| 1880 | 30.8 |
| 2320 | 38.7 |
| 2520 | 40.7 |
| 2770 | 46 |

Here we get 14.2 volt at 710 rpm and 46volt at 2770rpm

## 8. CONCLUSION:

Batteries are charged with the help of alternators in vehicle, but as the alternation is in direct contact with engine with the belt drives, some amount of resistance is experienced on the engine. Hence to reduce this resistance and to increase the efficiency of the engine we had modified the design of propeller shaft so that while transmitting the drive from engine to differential it also generates electricity that charge the batteries and due to this no work load is added on engine hence the efficiency of the engine also increases

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