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Frictionless electricity generation using propeller shaft

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ABSTRACT

The shaft can generate electricity if it gets magnetized which can be used to power other components. A vehicle such as this can generate electricity for operating a hybrid engine or recharging batteries by use of an electricity generating driveshaft. The electricity generating drive shaft consists 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. In this project we will use the propeller shaft which rotates at high speed, on which we will mount the disc magnet and the wooden or aluminum plates to hold the coils near the magnets mounted on the propeller shaft. This rotational movement creates a magnetic field and generates EMF into the coil as defined by Faraday's law of electromagnetic inductions.

Keywords: *Electromagnetic Induction, Magnetized driveshaft, Catia Software, Software analysis.*

1. INTRODUCTION

The field of research is revealed in a piece of writing for designing and generation of electricity by rotating shaft of an automobile and using a drive shaft to lower the speed of the vehicle [1].

As the market is taken by the combustion vehicles which work on fuels like gasoline, diesel oil, and natural gas which leads to a big issue of their availability. For solving these types of problems, the vehicles are converted to hybrid ones or the vehicles get power by electric motor [5]. As the solution is made there is a difficulty for charging the vehicles due to their less availability of charging stations. So, the vehicle has less efficiency because of the load on the motor which leads to heat and frictional losses.

So, a solution is made for these types of problems where an electricity generating driveshaft is used. This typically comprises 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 the electrical generator. One of the main components of this research is the propeller shaft which is also known as the driving shaft. The purpose is to transmit power via rotation which may lead to various types of stresses such as torsional or shear stresses [6]. To transmit more power the propeller shaft must be strong enough so it can withstand such stress so the design concern is also taken into consideration so the transmission must be smooth.

1.1 Problem statement

As we know that the automobile sector is turning towards the electrification of vehicles in which charging of batteries is a time-consuming process. Also, after the charging, it is limited to a certain interval of time as per the usage of the vehicle after which it needs to be charged again. So, if some rotary components present in the machine are converted into electrification with minimal losses, we can generate electricity from them, and it can also charge a battery and be used for further applications.

To overcome such problems, we have designed this model by using a chain and belt mechanism where we can use rotary energy of the propeller shaft with nano coils and magnets to generate electrical energy.

1.2 Working principal

This experimental setup is working on the principle of 'Electromagnetic Induction' founded by Michael Faraday. The law states that the induction of an electromotive force by the motion of a conductor across a magnetic field or by a change in magnetic flux in a magnetic field. This either happens when a conductor is set in a moving magnetic field (when utilizing AC power source) or when a conductor is always moving in a stationary magnetic field.

So, when a bar magnet passes through the snaking, the voltage is measured in the circuit. The importance of this is a way of producing electrical energy in a circuit by using magnetic fields and not just batteries anymore. The machines like generators, transformers and motors work on the principle of electromagnetic induction.

1.3 Construction

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 the 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 produces electricity from mechanical power. The electric generator consists of two main components, a rotor and a stator. Typically, a stator is composed of one or more magnets and copper winding, and the rotor is a metal loop or shaft that rotates within the stator. When the rotor revolves within the stator, an electric current is generated because the magnetic field in relation to the electron's changes. With every complete turn of the rotor within the stator, the magnetic field is changed, creating electricity which travels to an external electrical circuit through a coil or the copper winding. This concept of electromagnetism can be applied to vehicles, or virtually anything that utilizes a drive axle or drive shaft.[1]

- When the propeller shaft is rotating at high speeds, the disc magnets also rotate 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 generate 10 to 30 AC volts, by using AC to DC Converter circuit, we can convert it to DC and charge the batteries.
- Further by using this power we run the hybrid vehicles or electric vehicles.[5] To transmit power from one point to another in a smooth, continues action.[1] Firstly we use the coil and neodymium magnet system which mounted on the propeller shaft and then its start producing the power with the coils around the propeller shaft.

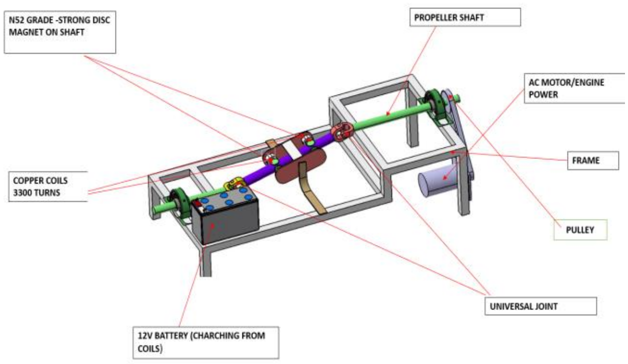

Chart-1 Construction diagram

Table-1: Parts Used

PARTS	MATERIAL
Frame	Mild Steel
Wooden Sheet	Wood
Shaft	Steel
Coil	Copper Coils
Battery	STD
Bearings P204	STD
Motor	STD
Disc Magnets	Neodymium
Screw Nut Bolt M6	STD
Pulley	Mild Steel
Belt	STD

1.3.1 Coils

An electromagnetic coil is an electrical conductor such as a wire in the shape of a coil, spiral or helix. A current through any conductor creates a circular magnetic field around the conductor due to Ampere's law. The advantage of using the coil shape is that it increases the strength of the magnetic field produced by a given current. The magnetic fields generated by the separate turns of wire all pass-through the center of the coil and add (superpose) to produce a strong field there. [1]

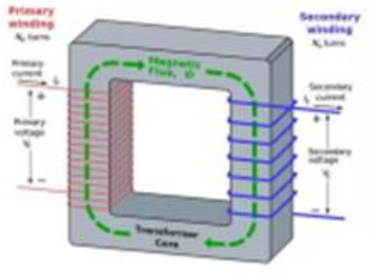

Chart-2 Coil

1.3.2 Universal Joint

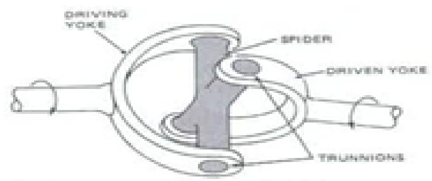

Chart-3 Universal Joint

A simple universal joint does not transmit the motion uniformly when the shafts are operating an angle. Because of this, two universal joints are used in a vehicle, one between the gearbox and the propeller shaft and other between the propeller shaft and the differential pinion shaft.

1.3.3 Neodymium Magnets

The Neodymium metal element is initially separated from refined Rare Earth oxides in an electrolytic furnace. The "Rare Earth" elements are lanthanides (also called lanthanides) and the term arises from the uncommon oxide minerals used to isolate the element Permanent magnets are magnets that are permanently charged. They are different from electro-magnets in that electro-magnets only have magnetic properties when an electrical current is flowing through them.[1]

1.4 Design

1.4.1 Coil Design

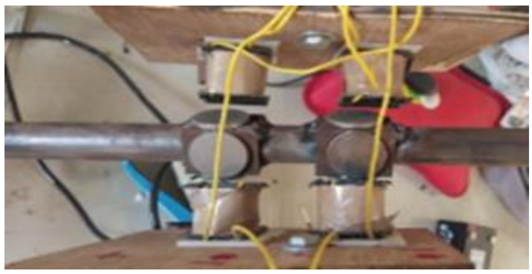

Chart-4 Coil

We have chosen to use a very high gage wire to increase the amount of voltage the generator can provide. If the generator is required to produce more current the coils can be replaced with those of a smaller gage wire. The permanent magnets we have chosen to use provide a very strong magnetic field [1]

1.4.2 Base frame design

Mild steel angles are used to support the whole mechanism. These angles are welded together in order to form a frame which will support the rollers and the assembly. We design a basic frame for a prototype by mild steel channel (L beam) [1]

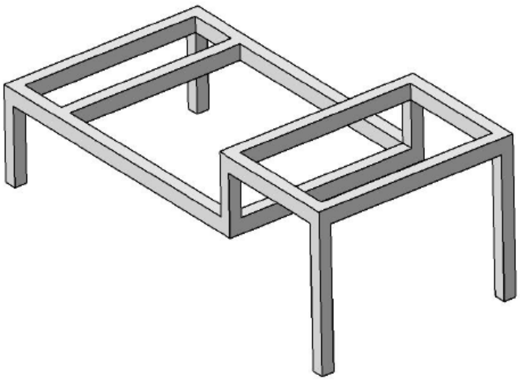

Chart-5 Base frame

1.4.3 Design of Motor

The purpose of a motor, regardless of the application, is to change electrical power to mechanical power in order to provide rotational movement. Every application will have its own distinct parameters for input and output power. The diagram in Figure 1 provides a visual representation of the input and output parameters of a motor. The input electrical power can be in the form of a DC battery, AC line voltage, rectified AC line voltage, or a wide variety of controls. Affected by application and environmental constraints along with the necessary power needed to move a load, the input power will be volts, amps, and frequency. The output power is the motor speed and torque response required to accomplish the task.

Chart-6 Motor

According to our project design we need a variable speed motor, so as per manufacturer's catalogues, we have studied the rpm factor and as per our costing we have selected 1 motor.

Torque Calculations

Power transmitted by motor shaft,

$$(P = 2 * \pi * N * T / 60)$$

$$P = 2 * \pi * N * T / 60$$

Where, N→ Rpm of shaft 1 = 8500

T →Torque transmitted

P→ Power Available = 50W

$$50 = (2\pi \times 8500 \times T) / (60 \times 1000)$$

$$50 = (2\pi \times 8500 \times T) / (60 \times 1000)$$

$$T = 56.24 \text{ N m}$$

$$= 56\ 240.00 \text{ N mm}$$

This is torque of motor

1.4.4 Design of Shaft

When designing our attachment, the following considerations were taken into account.

1. The device should be suitable for local manufacturing capabilities.
2. The attachment should employ low-cost materials and manufacturing methods.
3. It should be accessible and affordable by low-income groups and should fulfill their basic need for mechanical power.
4. It should be simple to manufacture, operate, maintain, and repair.
5. It should employ locally available materials and skills. Standard steel pieces such as steel plates, iron rods, angle iron, and flat stock that are locally available should be used. Standard tools used in machine shops such as hacksaw, files, punches, taps & dies; medium duty welder; drill press; small lathe and milling machine should be adequate to fabricate the parts needed for the machine.
6. Excessive weight should be avoided, as durability is a prime consideration.

As per design data book considering the standard size of the shaft is 20 mm. And assuming factor of safety 1.5

1.5 Analysis

1.5.1 Shaft Analysis

Analysis boundary conditions

Stage 1

From cad model,

We are applying 2 kg=19.61 newtons load on shaft,

Considering magnets weight 1 kg and factor safety 1kg, total 2kg load.

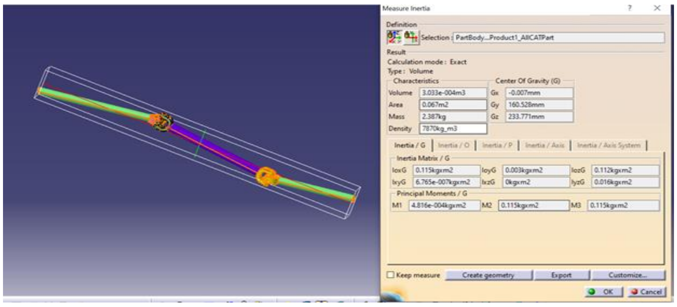

Chart-7 Measure inertia

Stage 2

To shaft, material we assigned to frame is Mild steel with density 7860.

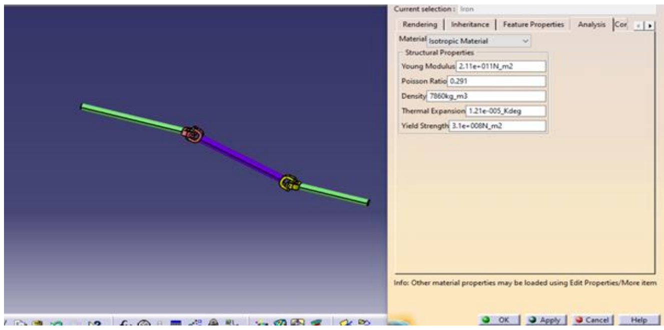

Chart-8 Applying material selection

Stage 3

Applied force on shaft where we attached magnets, fixed the two ends

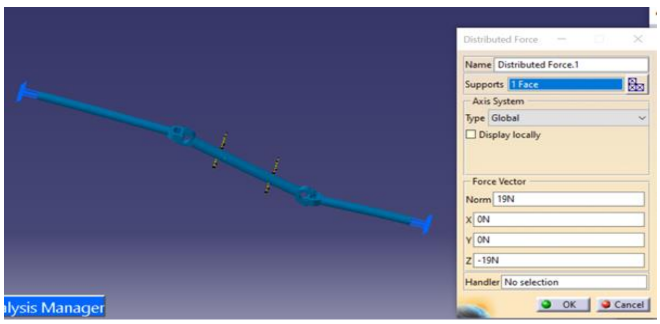

Chart-9 Applying Forces & fixing two ends

Material	Iron
Young's modulus	2.11e+011N_m2
Poisson's ratio	0.291
Density	7860kg_m3
Coefficient of thermal expansion	1.21e-005_Kdeg
Yield strength	3.1e+008N_m2

Chart-10 Material's Values

1.5.2 Shaft Analysis Result

Chart-11 Static Case solution-von mises stress

From the material properties the yield strength of mild steel MS iron is 3.1e+008N_M2 and from the results the green part We value of von mises stress value is 1.6e+006 hence our design is safe for the propeller shaft with material MS.

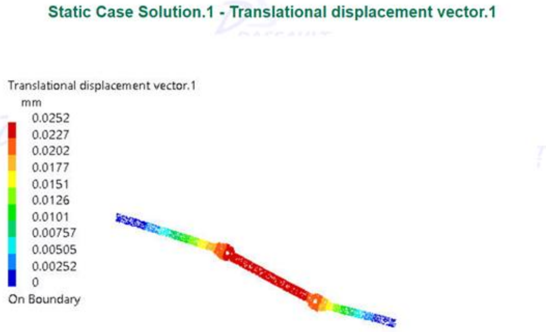

Chart-12 Static case solution-displacement

The displacement of the shaft after applying force is 0.0126 mm.

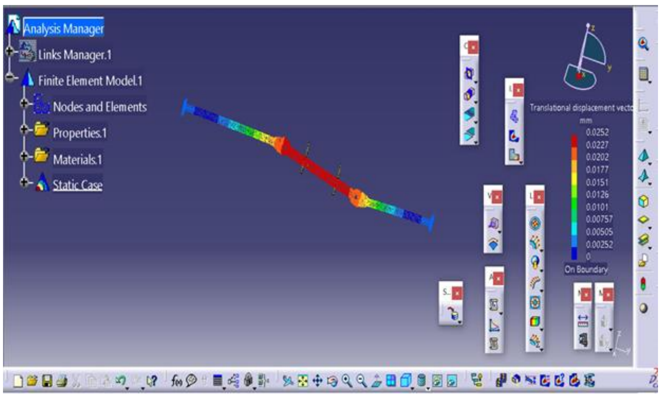

Chart-13 Final Analysis

1.5.3 Base Frame Analysis

Analysis boundary conditions

Stage 1:

From cad model,

We are applying 13 kg=127.48645 newtons load on frame,

Considering battery, bearings, propeller shaft, pully, coil supports brackets and other.

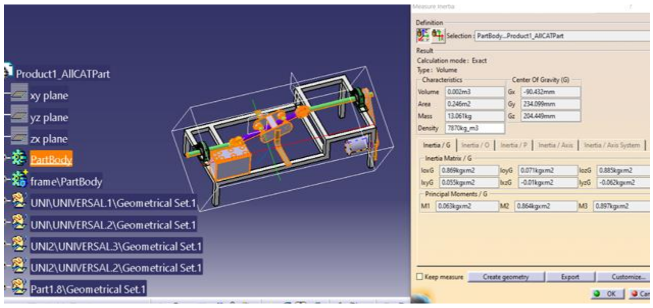

Chart-14 Measure inertia

Stage 2

To frame, the material we assigned to frame is Mild steel with density 7860.

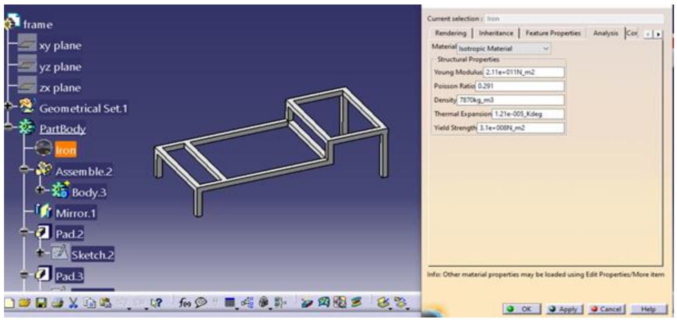

Chart-15 Applying material selection

Stage 3:

Applied force on frame, fixed the base.

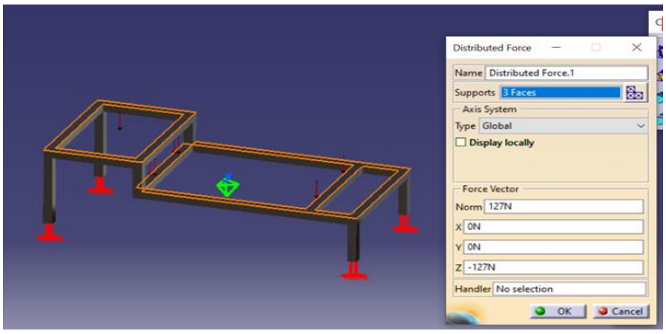

Chart-16 Applying forces & fixing ends

Material	Iron
Young's modulus	2.11e+011N_m2
Poisson's ratio	0.291
Density	7870kg_m3
Coefficient of thermal expansion	1.21e-005_Kdeg
Yield strength	3.1e+008N_m2

Chart-17 Materials properties

1.5.4 Base Frame Analysis Result—

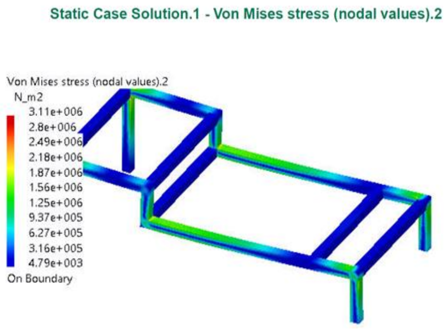

Chart-18 Static case solution-von mises stress

From the material properties the yield strength of mild steel MS iron is 3.1e+008N_M2

And from the results the green part We value of von mises stress value is 1.56e+006 hence our design is safe for the frame. The displacement of the shaft after applying force is 0.0147mm

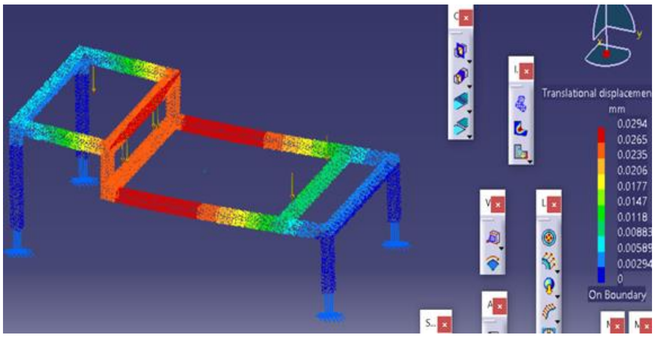

Chart-19 Static case solution-displacement

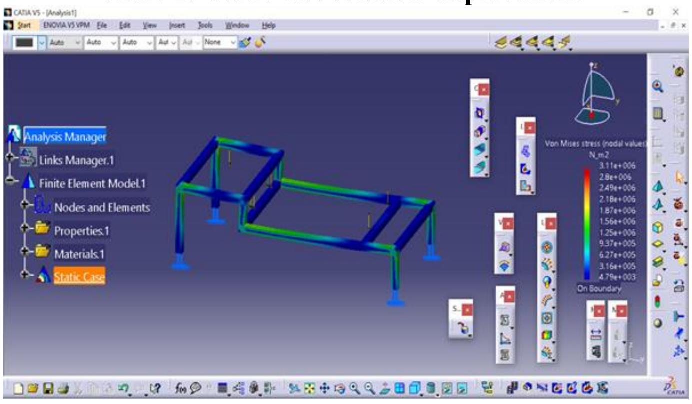

Chart-20 Final Analysis

2. CONCLUSION

The presented work aims to reduce the fuel consumption of the automobile in the particular or any machine, which employs drive shafts, in general it is achieved by using light weight composites. The battery is charged with the help of the vehicle's alternator, but due to the alternating current being in direct contact with the engine with a transmission, the engine will experience a certain degree of resistance. Therefore, in order to reduce this resistance and improve the efficiency of the engine, we modified the design of the drive shaft so that while transmitting the driving force from the engine to the differential, it also generates electrical energy to charge the battery, so it will not utilize engine power. Therefore, increasing the efficiency of the engine.

We have done the analysis on the propeller shaft and Frame and found out that it is safe by taking into consideration the weight saving, deformation, shear stress induced. The usage of composite material will decrease the amount of weight, when compared to conventional steel shafts. When the weight decreases, fuel consumption also decreases. In this analysis a composite shaft is comparatively better. Because they have less deformation when compared to conventional steel shafts.

In the software analysis, the ANSYS is more accurate as compared to Solid work software.

3. ACKNOWLEDGEMENT

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