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Retaining Waste Rotational Energy through Repulsive Magnetic Coupling

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ABSTRACT:The main motto behind the execution this project is to utilize and investigate on the waste energy from the rotational devices where the natural repulsion or the repelling characteristic of magnetic waves can be used to create a motion by linking them with a magnetic fan. Besides this, the plan is also to spread awareness in public about the development of a new technology that can be used to change the reliability on the non-renewable energy sources such as fossil fuels which deplete and pollute to the environment.

KEYWORDS:Rotational Devices and Energy, Magnetic Fan, Repulsive Magnetic Coupling, Neodymium Magnets.

I. INTRODUCTION

Free energy means zero cost energy. It is a method of heaving power without burning fuel from the resident environment. Some of the methods which can be used as the free energy devices are as follows:

1. Magnet power
2. Gravity powered system
3. Battery charging pulse system
4. Motion and motionless pulsed system

More than 90% today's world's power is being generated using electromagnets based on the Faraday's law of "Electro-Magnetic Induction". The amount of power which can be obtained is very high and a few kW of power which is utilized to power a household is most definitely within the reach.

In a simple motor, magnetic field is created by the electric coils generally Copper and Aluminium coils. These motors uninterruptedly need electrical supply to induce magnetic field. There is a massive energy loss. The Magnetic Motors Consist of no such coils. Hence, there are negligible losses. Magnet Engine is a facile device to generate electrical energy. It works on the principle of Neodymium Magnets. It uses the permanent magnetic field of the magnets to generate the essential force to drive the motor.

The wasted energy from any rotating machine is be utilized for suitable application. In normal couplings, In case of accident, failure can be befall in both the sides of the system. But by using the magnetic coupling, the damage is not transferred to the other side, also jerks are avoided and smooth transmission is obtained. As, there is no direct contact between any two magnetic couplings, mechanical losses are reduced. The coupling tends to misalign the two shafts due to the effect of force acting on shaft and coupling. This problem can be conquered with help of magnetic couplings.

II. LITERATURE SURVEY

A. Neodymium Magnets –

Depending upon their physical structure with their respective physical properties, there are four natures of the contemporary magnets. These categories are Samarium Cobalt, Alnico, Neodymium Iron Boron and Ceramic.

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Neodymium magnets (also known as NdFeB, NIB or Neo magnets) are to be used here, as they possess fierce magnetic power. Neodymium ferromagnetic metal, meaning that like Fe it can be magnetized to become a magnet, but because of its low Curie temperature (19 Kelvin or $-254^{\circ}\text{Celsius}$), the magnetism only appears at extremely low temperatures in its unadulterated form.

Neodymium magnets have replaced alnico and ferrite magnets in many of the innumerable applications in contemporary technology where powerful permanent magnets are required, because their greater strength with the use of compact, lighter magnets for a given application.

B. Anodized Aluminium Disc –

These discs are manufactured by sandcasting process of lightweight aluminium material with diameter 240mm and thickness 10mm with hub diameter 40mm. Anodizing is an electrolytic passivation method, uses anode electrode of an electrical circuit to increase the thickness of the natural oxide layer on the surface of metal. Anodized aluminium alloy objects do not have increased strength but have better corrosion resistance, improved lubrication. Anodizing is one of the more environmentally favourable metal finishing methods.

When exposed to air at NTP, or any other gas containing oxygen, pure aluminium self-passivates itself by forming an amorphous layer of amorphous aluminium oxide 2 to 3 nm thick.

C. Pedestal Bearing –

Pedestal bearing unit (also called as NTN bearing) is a blend of a radial ball bearing, a housing of high-grade cast iron or pressed steel and seal which comes in several structures. The external surface of the bearing and the internal surface of the housing are spherical, so that the component is self-aligning. Any misalignment of axis has to be due to poor workmanship on the shaft or errors in fitting.

The NTN bearings do not require any maintenance, prevents any leakage of grease or infiltration of dust and water from outside, contains a high-grade lithium-based grease, which is excellent for a long term use and is ideally suited to sealed-type bearings.

Fastening the bearing to the shaft is done by tightening the ball-end set screws situated on the inner ring, which prevents its loosening, even if the bearing is subjected to intense vibrations and shock waves which is its unique feature.

III. PROPOSED METHODOLOGY

The setup is designed for any machine with rotational motion. This rotational motion is transmitted to the working shaft through belt and pulley arrangement. Due to this transmitted rotational motion, the shaft starts rotating. At the other end of this shaft, an anodized aluminium disc is fitted with a key assembly to shaft. Neodymium magnets are joined to the surface of disc, equally spaced on designed pitch circle. This shaft is fixed at two ends on the body by using pedestal bearings.

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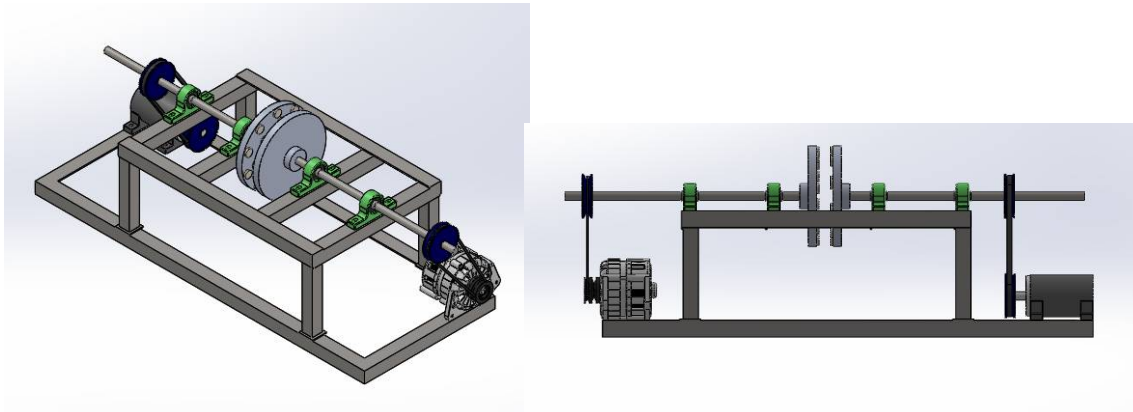


Fig. [1] Computer Aided Drawing of the System

As shown in above Fig. [1], an identical arrangement is made on the other shaft which is located on the body at the opposite end. The gap is maintained between the two discs as per the requirement of speed or stored voltage. Because of the constant and simultaneous attraction and repulsion, rotational motion of one shaft is transmitted to another with repulsive magnetic coupling controlling the motion. This motion is not fully transmitted, as there are some losses during transmission. But the motion transmitted without any direct contact between two shafts.

This motion can be used instantly as per the necessity in any mechanical device, but the method can also be generalised by converting this energy into an electric energy and storing it for later use. For this conversion to happen, an alternator is used between the shafts and pulley by belt arrangement. By this arrangement, the alternator gets the mechanical input which is further converted into an electrical supply by it. But, for this entire efficient operation, the alternator needs some preliminary supply to overcome its initial lag. A small set of batteries, as small as 6V capacity, which is normally used in UPS system, can do this job. One is essential to store the generated electrical energy, which will further be used to drive the desired electrical appliance, and second is to give preliminary voltage supply to the alternator to overcome lag. To manage all this arrangement effectively, some knobs and regulators can be used in electrical connections.

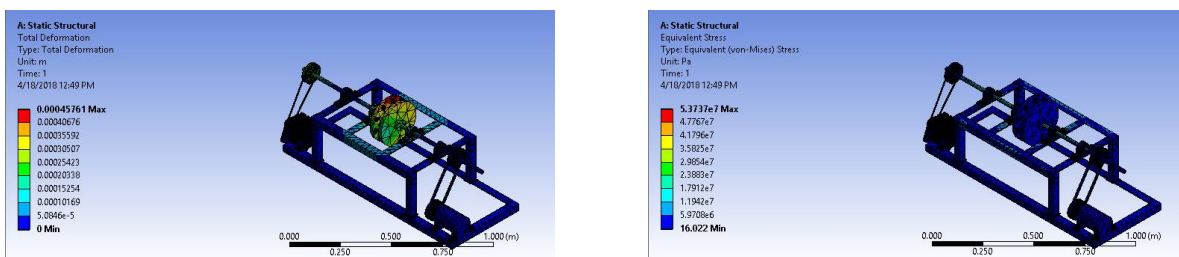


Fig. [2] Deformation and Equivalent Stress Analysis of the System

As shown in above Fig. [2], according to Von Mises Theory, the equivalent stress comes out to be 5.37×10^7 Pa. Corresponding to this stress, the maximum deformation is 0.457mm.

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IV. CALCULATION

A. Shaft Design:

$$T_1 = 146 \text{ N}$$

$$T_2 = 13.26 \text{ N}$$

$$W_d = 45 \text{ N}$$

$$W_p = 10.69 \text{ N}$$

$$P = 3.73 \text{ KW}$$

Vertical bending moment:

$$\Sigma M_B = 0$$

$$45 \times 15 + R_A \times 20 - 10.69 \times 35 = 0$$

$$R_A = -15.04 \text{ N}$$

$$M_A = 160 \text{ N-mm}$$

$$\Sigma M_A = 0$$

$$-10.69 \times 15 - R_B \times 20 + 45 \times 35 = 0$$

$$R_B = 70.73 \text{ N}$$

$$M_B = 675 \text{ N-mm}$$

Horizontal Bending Moment:

$$\Sigma M_B = 0$$

$$-159.26 \times 35 + R_A \times 20 = 0$$

$$R_A = 278.71 \text{ N}$$

$$M_B = 0 \text{ N-mm}$$

$$\Sigma M_A = 0$$

$$159.26 \times 15 - R_B \times 20 = 0$$

$$R_B = 119.45 \text{ N}$$

$$M_A = 2.38 \times 10^3 \text{ N-mm}$$

$$T = (T_1 - T_2) D p / 2 = 5309.6 \text{ N-mm}$$

$$T_e = ((K_b M)^2 + (K_t T)^2)^{1/2}$$

$$= (((2 \times 2.38 \times 10^3)^2) + (1.5 \times 4977.75)^2)^{1/2}$$

$$= 8854.83 \text{ N-mm}$$

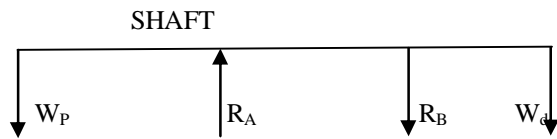
$$\tau = \frac{16 T_e}{\pi d^3}$$

$$S_{ut} = 650 \text{ N/mm}^2 \implies 0.18 S_{ut} = 117$$

$$S_{yt} = 380 \text{ N/mm}^2 \implies 0.3 S_{yt} = 114$$

$$85.5 = \frac{16 \times 8854.83}{\pi d^3}$$

$$D = 8.079 \text{ mm} \cong 20 \text{ mm}$$



B. Key Design:

The key has rectangular cross-section. (The usual proportions of rectangular key)

Width of key, $w = d/4$

Height of key, $h = (2/3) \times w$

The key has the taper of 1 in 100 on the top side only.

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C. Belt Design:

N= 1440 rpm

I = 1

Design Power, $P_d = P \times f_a = 0.75 \times 1.2$

$P_d = 0.9$ kw

Selecting standard belt from PSG page 7.85

Belt – ‘A’ (For 0.75-5 kW)

Diameter of Pulley, $d = 75$ mm

Width of Pulley, $w = 13$ mm

Thickness, $T = 8$ mm

Weight per meter, $\text{kgf} = 0.106$ kgf

Dimensions:

$$\tan\beta = \frac{w/2}{h}$$

$$h = \frac{w/2}{\tan\beta} = \frac{6.5}{\tan 19} = 18.87 \text{ mm}$$

$$\tan\beta = \frac{\frac{b}{2}}{(h-T)}$$

$$\tan 19 = \frac{b/2}{(18.87-8)}$$

$$b = 7.48 \text{ mm}$$

Cross-Section of belt,

$$a = \left(\frac{w+b}{2}\right) \times T = \left(\frac{13+7.48}{2}\right) \times 8 = 81.92 \text{ mm}^2$$

Diameter of Driven Pulley,

$$D = d \times \frac{N_1}{N_2} \times \eta$$

$$D = 75 \times 1 \times 0.98 = 73.5 \text{ MM}$$

Selecting standard size from PSG 7.54

$$D = 80 \text{ mm}$$

Length of Belt –

$$\frac{D}{d} = \frac{80}{75} = 1.0667$$

From PSG page 7.61,

$$d \times \frac{c}{a} = 1.5$$

$$c = 1.5 \times 80 = 120 \text{ mm}$$

Where,

$$C_{\max} = 0.5(D + d) = 77.5 \text{ mm}$$

$$C_{\min} = 2(D + d) = 310 \text{ mm}$$

We get, $C_{\max} \geq C \geq C_{\min}$

$$C = 300 \text{ mm}$$

$$L = \frac{\pi}{2}(D + d) + 2C + \frac{(D-d)^2}{4C}$$

$$= \frac{\pi}{2}(80 + 75) + (2 \times 300) + \frac{(80-75)^2}{4 \times 300}$$

$$= 843.5 \text{ mm}$$

Selecting standard belt length from PSG page 7.60

$$L = 848 \text{ mm}$$

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$$\text{Number of belts required} = \frac{P \times f_a}{k_w \times f_c \times f_d} = \frac{0.75 \times 1.3}{0.683 \times 0.85 \times 1} = 2$$

D. Design of Bearing –

The ball bearings use the spherical balls as the rolling elements. The contact between the inner race and the ball or the outer race and the ball is point contact.

Factors affecting selection of bearing type:

- Type of load
- Combination of Radial and Thrust Load
- Magnitude of Load
- Alignment of shaft-with Respect to Housing
- Rigidity of system Operating speed
- Compactness

Design -

Weight of Disc = 3kg

Weight of the Pulley = 3kg

Weight of the shaft = 6kg

Solution -

Radial force acting on the bearing

$$F_r = (3+3+5) \times 9.81$$

$$F_r = 117.72 \text{ N}$$

$$P_e = (X \times V \times F_r + Y \times F_{cl}) \times S \times K_t$$

$$= (1 \times 1.2 \times 117.72 + 0) \times 1.2 \times 1$$

$$= 169.52 \text{ N}$$

$$= 17.286 \text{ kgf}$$

Assuming bearing life 4000 hrs

$$L_{mr} = \frac{L_h \times N \times 60}{10^6} = \frac{4000 \times 1500 \times 60}{10^6}$$

$$L_{mr} = 360 \text{ Million Revolutions}$$

$$C = P_e \times (L_e)^{\frac{1}{k}}$$

$$= 17.286 \times 360^{(1/3)}$$

$$= 122.968 \text{ Kgf}$$

Selecting bearing of basic design.

(SKF) 6004

d = 20mm

D = 42 mm

D₁ = 23 mm

D₂ = 36 mm

B = 12m

Co = 450 kgf

C = 735 kgf

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E. Magnetic Forces –

$$F(x) = \frac{3\pi B^2}{2\mu x^2} \times R^4 h^2$$

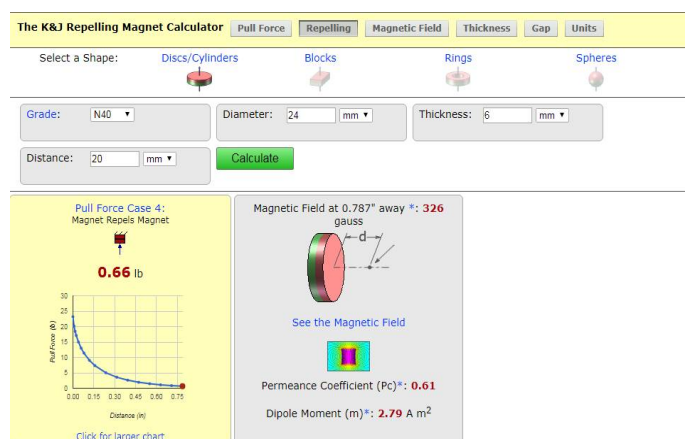


Fig. [3] Magnetic Force Calculation

From the above Fig. [3], for N40 grade magnets kept at distance of 20mm apart from each other having a diameter and thickness of 20mm and 6mm each, 0.66lb force is generated individually. As 10 magnets are being used here to generate force, $0.66 \times 10 = 6.6 \text{ lb} \sim 29.385 \text{ Newton}$ force is generated. If the distance is reduced or diameter and thickness is further increased, greater force is observed.

V. CONCLUSION

Thus, by trailing, it is clear that the waste energy can be stored from the rotational devices to a battery. An external system is required to be attached to the rotating device which does not hamper system's overall performance. Also, on implementing, this system can substantially reduce the machining cost for a considerable period.

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