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Design and Fabrication of Energy Conservation System Using Fly Wheel

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Abstract:
Our project's goal is to conserve energy by use of flywheel to produce free energy. The primary goal of a motor with a 2-horsepower capacity is to power a sequence of pulley and belt drives that together make up a gear train and generate more than twice the RPM at the alternator shaft. The system's interesting feature is that the alternator's output can produce more electrical output power than the input motor seems to be able to. Flywheel is used to aid with this. The gear train is connected to the gravity wheel, also known as the flywheel, to generate additional free or extra energy. To extract the optimum amount of freeenergy from the system, a thorough analysis is conducted using a variety of flywheel parameters.

Keywords: Flywheel, Bearings, Shafts, Pulleys, Belts. Motor, alternator.

INTRODUCTION

An energy conservation system using a flywheel is a mechanism designed to store and release energy efficiently. Flywheels are rotating mechanical devices that store energy in the form of rotational kinetic energy. They consist of a heavy wheel or disk mounted on a shaft and are often used in various applications to smooth out fluctuations in energy supply and demand, or to store energy for further use.

The energy conservation system using a flywheel typically works:

The system captures energy from a power source, such as renewable energy generators (e.g., windturbines or solar panels) or during periods of low energy demand.

The captured energy is used to spin up the flywheel, thereby storing the energy in the form of rotational kinetic energy. The flywheel continues to spin at a constant speed, maintaining its stored energy until needed.

When energy demand exceeds supply or during peak demand periods, the flywheel releases its stored energy. This energy can be converted back into useful forms, such as electrical energy through a generator or mechanical energy for powering machinery.

Flywheel systems can help smooth out fluctuations in energy supply and demand by absorbing excess energy during periods of high supply and releasing it during times of high demand. This can improve the stability and reliability of electrical grids or other energy systems.

Flywheel systems are often chosen for their high efficiency in storing and releasing energy compared to other storage technologies. They have rapid response times and can be cycled repeatedly with minimal degradation, making them suitable for applications requiring frequent charge and discharge cycles.

Energy conservation systems using flywheels find applications in various industries, including renewable

energy integration, grid stabilization, uninterruptible power supplies (UPS), regenerative braking systems in transportation, and smoothing out power fluctuations in machinery and equipment.
Energy conservation systems using flywheels offer a flexible and efficient way to store and release energy, contributing to a more reliable and sustainable energy infrastructure.

Design:
AC motor:

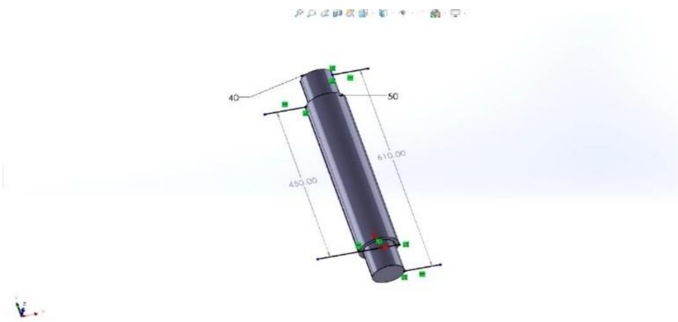
An electric motor, such as the motor, operates on alternating current to produce mechanical energy through magnetism mixed with AC. The structure of an AC motor includes coils to create a rotating magnetic field in a rotor connected to an output source so that a secondary magnetic field can be created.
These motors have been used for several years by designers and engineers to apply in different applications. These motors are very helpful in generating stable torque equal to the rated speed. These motors are very simple to handle & can be configured at a less cost.
Specifications of Motor:
POWER - 1.5KW
HORSEPOWER - 2H.P
SPEED - 1440RPM
PHASE - SINGLE
VOLTAGE - 220V

Fly Wheel:

The flywheel is a heavy, disk-like disc attached to the engine's output shaft. This makes a lot of sense when we talk about cars. It is also considered part of the binding function. The flywheel ensures smooth engine operation without changing the transmission system.
Specifications:

Mass of the flywheel	23KG
Diameter	40cm
Speed	1054rpm

Shaft:



A shaft is a rotating machine used to transmit the power received from the machine to other parts of the machine to be operated. In most cases, the cross section of a circle is a circle. . It is one of the most important parts of any machine. A machine cannot transmit power if it does not have switch.

Bearing

A bearing is a mechanical device which is used to hold shaft without resisting any motion by allowing rotary motion with minimum friction Bushed bearing consists of the cast iron block and the bush. Generally, the bush is made of soft materials like brass, bronze, or gun metal. Its consist of a grub screw which helps in pressing the bush in to the bore in the cast iron block to prevent in from rotating or sliding. Lateral adjustments can be done through Elongated holes in the base.

Specifications:

Bearing number	UCP211	Basic static load rating	29 kN
Housing number	P211	Limiting speed	3 000 r/min
Mass bearing unit	3.75 kg	Bolt size	M16
lynamic loadrating	43.6 KN	Shaft Dia	55 mm

Pulleys:

A Pulley is a wheel that carries a flexible rope ,belt ,chain, cord, etc.... pulleys are used singly or in combination to transmit energy and motion pulleys generally transmit motion or power through rotary motion in belt drives pulleys are affixed to shafts at their axis and power is transmitted between the shafts by means of endless belts that cross the pulleys A mechanical advantage can be obtained by using one or more independently rotating pulleys, particularly when lifting in power transmission belt drives are the most advantageous as they are more efficient and have very less power loss due to friction and only disadvantage slippage can be eliminated by using v- wedge belts.

The pulleys can be classified according to the type and number of grooves they have the pulleys may be single or multi grooves .and these groves can be either A, B,C,D…. sections

S.NO	JLLEYDIA [INCHES]	ROOVE TYPE	GROOVE WIDTH[mm]	GROOVE THICKNESS[mm]
1	4	B	17	11
2	5.5	B	17	11
3	7	A	13	8
4	4	A	13	8

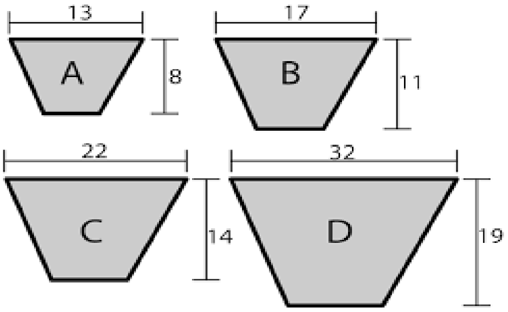
Belt Drives:

A Belt drive is a frictional drive that transmits power between two or more shafts using pulleys and an elastic belt. In most cases it is powered by friction, but it may also be a positive drive. They can be operated at different speeds and power requirements. And they are also highly efficient compared to other types of drives. A belt is a flexible material loop that is mechanically attached to two or more spinning shafts, usually in parallel.

V-Belt Drive:

V type power system for power distribution between parallel cables. It is a variation of the spindle on the right side when the belt is flat and the speed rating is higher when a V-belt is present. The V-belt has a trapezoidal section and runs on grooved pulleys, better known as pulleys. The wedge part of the V-belt creates a connection between two adjacent surfaces, creating a friction force on the surface. V-belts are produced endlessly and are available in different lengths.

The tensions TI and T2 on both sides of the transmission belt are related in the same way as for a flat belt, T1/T2 = eμ



Belt Section	Area(mm)2	Standard Pitch Lengths, inches(mm)	Length	Thickness
A	**87.74**	**54.4 (1382)**	**13**	**8**
B	**118.71**	**56.7 (1440.2)**	**17**	**11**
C	280	62.2 (1580)	22	14

Alternator:

A machine that transforms mechanical energy into electrical energy in the form of alternating current (at a particular voltage and frequency) is known as an alternator.

The electromagnetic induction concept underlies the operation of every alternator. According to this law, to produce electricity, we need a conductor, a magnetic field, and mechanical energy. All devices that generate and maintain alternating current through rotation recognizing the alternator's basic operating concept consider two opposite magnetic poles, north and south, and the flux traveling betweenthese two magnetic poles.

Specifications

RPM	-	1500 RPM
Amperes	-	21 AMP
Voltage	-	230 V
Phase	-	SINGLE PHASE
KVA	-	5 KVA

Working Principle of the System:

The pulley, which is fitted on one end of the shaft. The motor and the shaft rotate at the same speed. The other end of the shaft, on which another pair of pulleys is fitted, is the drive shaft, on which the flywheel is fitted. The pair of pulleys that are fitted at the flywheel will increase the speed of the shaft. Due to this, the flywheel, which is fitted on the shaft, rotates at high speed and stores energy. The other end of the shaft is where another pulley is fitted to drive the alternator.

The energy stored in the flywheel is supplied to the alternator to produce the maximum amount of current required. When the maximum amount of current is generated in the alternator, this current is supplied to the motor with the help of an electrical connection to run the motor. The electric supply, which we first used to run the motor, is disconnected, and the current produced in the alternator is used to run the motor. Now, with the help of shafts, pulleys, and alternators, the motor runs, and vice versa. Due to this, free energy is produced.

Design Calculations:

Mass of the fly wheel:

Motor Speed (N) = 1440 RPMPower =1.5x103W

Diameter of the fly wheel = 400mm =0.40mwe know that peripheral velocity.

$V= \pi DN/60$

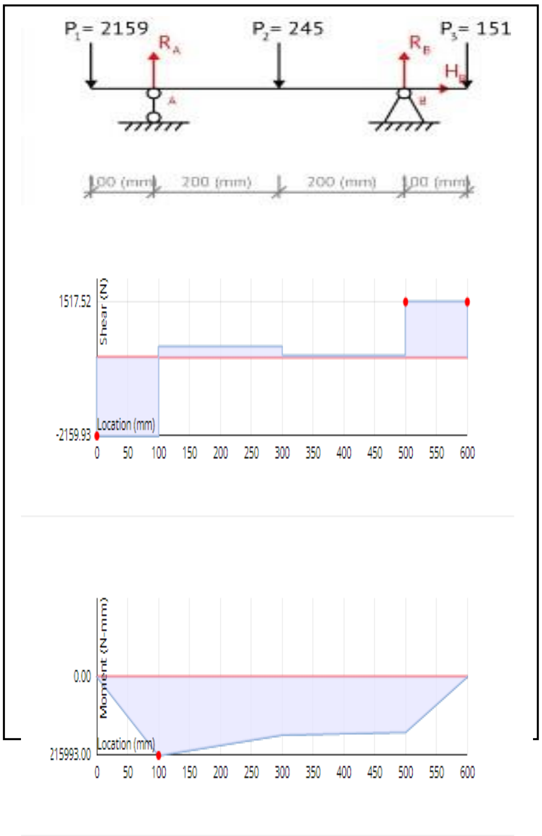
$= \pi \times 0.40 \times 1440 /60$

=30.15 m/swe know that power

$P=2\pi NT/60$

The mean torque transmitted by the flywheel
T=P x 60/2ΠN
= (1.5x103 x60)/(2 x π x1440)
= 9.94 N-m
Angular speed of the flywheel = 2πN/60
= 2π1440/60= 150.79 rad/sec
Fluctuation of energy ΔE = energy produced at alternator – energy produced at motor
= 4000-1500 = 2500watts or 2.5 KW
Moment of inertia of the fly wheel I = MK^2
= 23.55 x $(200)^2$ = 94200 kg/m^2
Kinetic energy o the flywheel KE = 1/2 mv^2
= 1/2 x 23.55 x$(30.15)^2$ =10720.06 J
Fluctuation of energy of the flywheel dE= I K_S x ω^2
=942 x 0.04 $(150.79)^2$ = 856753.67 J

Design of Shaft:



Reaction forces at both bearings RB+RD =2159.93+245+1517.52
=3922.45
Moments about B
-(100*2159.92)+(200*245)-(RD*400)+(1517.52*500)RD*400 = 591767
=591767/400
RB=1479.41 N
Moment about D

(100*1517.52) –(200*245)+(400*RB) – (2159.93*500 400*RB = (200*245) – (100*1517.52)+(2159.93*500)
RB=977213/400 RB=2443.03 N
Moments at A
=(-1517.52*600)+ (1479.41*500) (245*300)+(2443.03*100)
= - 4 NmmMoment at C
(200*2443.03)-(-2159.93*300)
= -159373 Nmm
Moment at E
(-2159.93*600)+(2443.03*500)+(-245*300)+(1479.41*100)
= -2
T_e =√(-2)^2 +(522.12)^2
=52522.12 N-mm
Equivalent twisting moment T_e
52522.12=(π/16)*43*d^3
8.44d^3= 52522.12d^3= (52522.12/8.44)d^3=6223.02
d=29.4mm
diameter of the shaft **d=30mmMe =** 1/2 $(M+\sqrt{(M^2+T^2)}$
=1/2(52522.13-2)
=26260.06 Nmm 26260.06=(π/32)*62*d^3d^3 =26260.06/6.086
d^3 =32.62mm
Diameter of the shaft =35mm

Design of Key

Dia of shaft = 50mm
shearing stress (τ)= 43 Mpa crushing stress (σc) =70 Mpa
→ Thickness of the key =D/6 = 50/6 = 8.33 mm ≈ 10 mm
→ width of the key = D/4 = 50/4 = 12.5 mm ≈ 14mm
→Shearing of the key
T = L× W×τ×D/2
= L ×14 × 43×50/2
T = 15050 ×L ---- (i)
→Torsional shearing strength T = Π/16×τ×d3
= Π/16×43×(50)3 = 1.05×106 N-mm ----- (ii)
From equ (i) and (ii)
L =1.05×106 / 15050
= 69.76 mm
→Crushing of the key
T = L× (t/2) × σC × d/2
= L× (10/2)×70 ×50/2
T = 8750×L ---(iii)
From the Equation –(ii) & (iii) L=1.05x10^6/8750 = 120mm
The Larger two values we have Length of keyL=120mm

Bearing Life:

→**bearing 1**

Radial load WR =1385.94N axial load WA = 0

Radial load factor and axial load factors are taken from data book X=1 Y=0Overall load of bearing W =X.V. WR +Y. WA

=1x1x1385.94+0x0

=1385.94N

Equivalent dynamic load, W =1385.94*2.0 =2771.88Basic dynamic load rating C =29KN=29000

Rating life L =(C/W)^k * (10^6)

=(29000/2771.88)^3*(10^6)

= 1145.17x10^6 =(1145.17x10^6/3600)

=318103.33 R.P.Hr

=5301.722 R.P.M

→Bearing 2

Radial load WR =704.41 axial load WA = 0from data book X=1 Y=0

Overall load of bearing W =X.V. WR +Y. WA

= 1x1x704.41

=704.41

W= 704.41x2.0=1408.82

Basic dynamic load rating C=29KN=29000Rating life L=(c/ω)^k×10^6

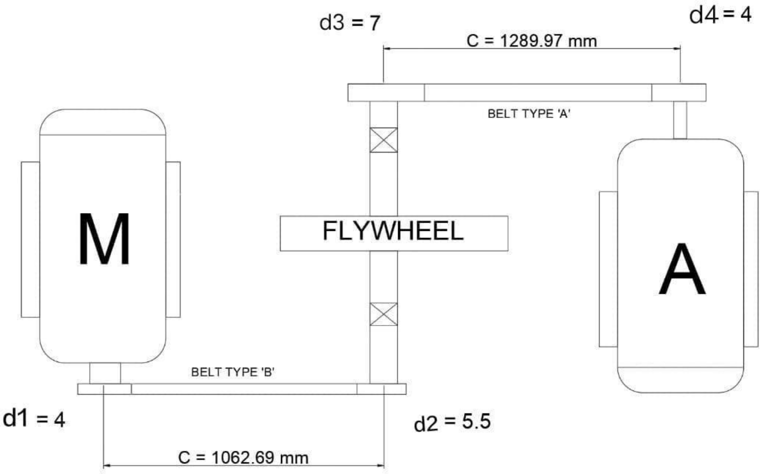
L=(29000/1408.82)^3×10^6

= 8727.47×10^6

= 8727.47×10^6/3600 = 2422841.29 RPM/hr

= 40351.25 RP Hr

Velocity Ratio of Pulleys:



Diameter of first pulley D1=4 inch Diameter of second pulley D2=5.5 inchDiameter of third pulley D3=7 inch Diameter of fourth pulley D4=5 inch
Motor speed=1500

→ velocity ratio formula : N2/N1 = D1/D2

→ **Pair- 1** 1500 /N2 = 4/5

0.727x1500 =1090.90rpm

[N2=N3]

N3/N4 = D3/D41090.90/N4 =7/5 = 1.4
1.4x1090.90 =1527.27 rpm

<u>Belt Tensions</u>

D1=4 inch =101.6mm μ =0.3

D2=5.5 inch =139.7mm N=1500 RPM

D3=7 inch =177.8mm P= 1.5 KW

D4=5 inch =127m

→ Centre distance of two pulleys (C) = (d1 +d2) +100

→ Pair :1 (D1,D2)

C = (101.6 +139.7) + 100 =341.3mm

→ α = sin - 1 (d1 +d2 / 2C)

= sin -1 ((101.6 +139.7) / 2xx341.3)

α = 20.48^0

→ θ = (180 -2α)

=(180-2x20.48) = 2.426 rad

→ linear speed of belt V=Πd1N/60

= Π x 101.6 x1500/60

= 7979.64 mm/s

→ Ratio of belt tensions = T1/T2 = eμθ

=e(0.3x2.426) = 2.0688T1= T2 X 2.068
→ Power transmitted (P) = (T1 - T2) V

F.S =4

1.5x103x103x4 = (T2 X 2.068 - T2) 7979.64

1.5x103x103x4 / 7979.64 = T2 (1.068)

751.9 =T2 (1.068)

Tension at slack side T2= 751.9/1.068 = 704.03 N Tension at tight side T1= 704.03 X 2.068 =1455.9 N

Torque Ta = (T1 - T2) (D/2)
= (1455.9 - 704.03) (101.6/2)
= 38194.99 Nmm

Length of the belt
Length of the belt L= Π(r1+r2)+2C+(r1 - r2)2 /C
→pair 1 : Π(50.8 +69.85)+2(341.3)+(50.8- 69.85)2 /265.1

= 1062.69 mm

→ pair 2 : Π(88.9+63.5)+2(404.8)+(88.9- 63.5)/404.8

= 1289.97 mm

Fabrication and Assembly:

Observations:

S.NO	LOAD	SPEED	VOLTAGE INPUT	VOLTAGE OUTPUT
1	1	1804	160	220
2	2	1780	160	213
3	3	1720	160	205
4	4	1690	160	195

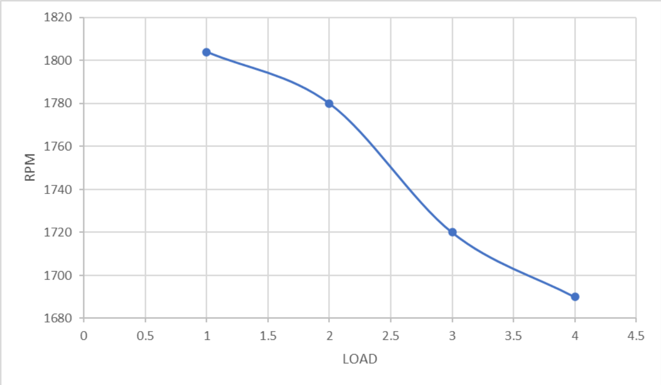
Results and Discussions:

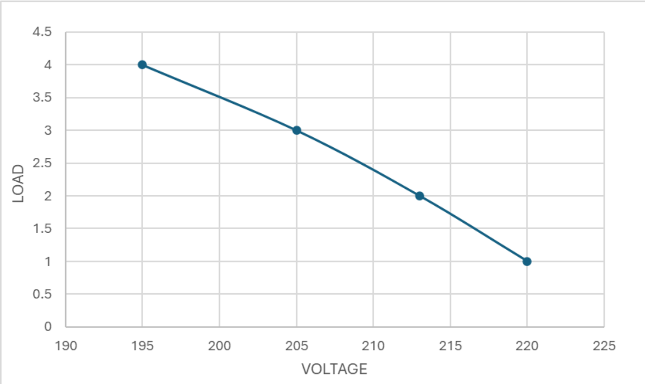
According to design and analysis of this system the following points were observed:

When we store the output power from the alternator in the form of storage batteries, the same power can be reused as the inlet source to the prime mover. The remaining part of power can beutilized for other needs.

By using flywheel, the voltage can boost up from low to high voltage as per energy conservationby varying the cu input current according to change in kinetic energy of the fly wheel.

By using the flywheel, it can maintain the constant speed irrespective of small variations of load sothat the system can maintain constant coefficient of fluctuations of speed.





Conclusion

The need for new energy sources has led to a number of alternatives with their attending high cost of fuel. However, in the future, if technology is further developed and embraced, the costs of electrical supply will reduce, and electricity will be efficiently distributed. Flywheels are one of the most promising technologies to replace traditional lead acid batteries as energy storage systems fora range of applications, such as remote power units frequently used in the telecommunications industry, automobiles, and affordable rural electrification systems.

After designing the system (design and fabrication of energy conservation system using flywheel) finally we concluded that, the energy conservation from electrical-to-electrical energy is not feasible to that of the energy conservation from thermal system to electrical system.

Recommendation:

To improve the conceptualization of the design and fabrication of an energy conservation systemusing a flywheel, the following are however recommended:

Design of a special AC motor, alternator, flywheel, and transformer for the purpose of construction of a fuel-less power generating set has to be encouraged by engineers in society in order to invest in clean and renewable energy, especially for solving the epileptic power supply and high cost of fuel experienced in Nigeria ·

The fuel-less generator should always be adopted and made available for use in electrical andpower establishments to enhance its value

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