MECHANICAL DESIGN AND ANALYSIS OF FREE POWER GENERATOR WITH FLYWHEEL AND V-BELT

Submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering / Technology degree in mechanical engineering

By

R Raju(37150150)

DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC I 12B Status by UGC I Approved by AICTE

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

March – 2021

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Raju R**

(37150150) who carried out the project entitled **"MECHANICAL DESIGN AND ANALYSIS OF FREE POWER GENERATOR WITH FLYWHEEL AND V-BELT",** under our supervision from November 2020 to April 2021

Internal Guide

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Submitted for Viva voce Examination held on **APRIL 2021**

Internal Examiner **External Examiner**

DECLARATION

I **Raju R (37150150)** hereby declare that the project Retort entitled **““MECHANICAL DESIGN AND ANALYSIS OF FREE POWER GENERATOR WITH FLYWHEEL AND V-BELT”** done by me under the guidance of **Dr.G.Arunkumar, M.E., Ph.D**., is submitted in partial fulfilment of requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

DATE: **SIGNATURE OF THE CANDIDATE**

PLACE: CHENNAI

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I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr. G. Arunkumar, M.E., Ph.D.,** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work**.**

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Mechanical Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

This project deals with the general concept of free energy generation system and its generating energy using flywheel the energy storing system of flywheel is used to generate extra amount of free energy. The extra amount of free energy is used to run the electrical home appliance and others.it consist A.C motor is used to rotate a series of pully by connecting belt which form a gear train and produce double the rpm at the shaft of an alternator.the most important thing about the system is larger output power can be obtain from the alternator than the power used in input AC motor it done with the help of flywheel.the flywheel is connected with pully in order to produce extra amount of energy.

***Keywords*:** flywheel,free energy,double rpm,altenator,AC motor,conventional energy.

TABLE OF CONTENTS

ABBREVIATION

- HP- Horse Power
- AC- Alternating Current
- DC- Direct Current
- UPS- Uninterruptible Power Supply
- FES- Flywheel Energy Storage
- CVT- Continuously Variable Transmission
- KERS- Kinetic Energy Recovery System
- RE- Regenerative Energy
- KW- kilowatts

NOMENCLATURE

- P = Power, kW
- d1 = Diameter of driver pulley, mm
- d2 = Diameter of driven pulley, mm
- N1 = Speed of driver pulley, rpm
- N2 = Speed of driven pulley, rpm
- Fa = Service Factor
- Pd = Design Power, kW
- L = Length of Belt, mm
- C = Center Distance, mm
- Fc = Correction Factor
- α = arc of contact
- Pr = Power Rating, kW
- Z = No. of Belts
- ω = Angular Speed, rad/s
- K.E.f = Kinetic energy of flywheel, Nm

- I = Moment of Inertia, Kg m2
- m = Mass of Flywheel, Kg
- r = Radius, m
- k = Flat solid disk of Uniform Thickness
- Syt = Yield Stress, N/mm2
- τ = Permissible shear stress, N/mm2
- Mt = Torsional Moment, Nmm
- W = Weight, Kg
- g = 9.81 m/s2

LIST OF FIGURES

LIST OF TABLES

CHAPTER-1

INTRODUCTION

The energy which has no cost is called free energy the concept of project is explore the possiblities of combinig three units.i.e. torsional vibration, flywheel and mechanical drive into a single unit, such that the device generates energy. Nikola Tesla once claimed that everyone should have access to free energy sources. There is unlimited electricity anywhere, and it can power the world's machinery without the use of gas, coal, or oil. Nikola Tesla once said that everyone should have access to free energy sources. Electricity occurs in unlimited amounts anywhere and can fuel the world's machines without the use of gas, coal, or oil. The term "free energy" refers to energy that is provided at no cost. Other energies obtained include wind power, water power, and telluric power. Mechanical energy powers windmills, and solar energy in solar cells transforms into DC current in solar cells. A mechanism for generating these forms of energy is known as a free energy generator. The idea of free energy suppression is that corporate energy interests deliberately suppress developments that could provide energy at a very low cost. Earth batteries, ambient energy, telluric currents, and pressure system shifts are some of the remaining untouched powers of nature that are well-known in the scientific literature. Perpetual motion's energy is referred to as fantastical powers. These devices make use of quantum vacuum energy, quantum vacuum perturbation, spinning magnets, and other ostensibly hydrogen-cracking techniques. Free energy is a term that refers to a method of obtaining energy from the local environment without the use of fuel. There are several different ways to do this. These approaches span decades and continents. The amount of power that can be produced is often enormous, and the few kW necessary to power a household are well within reach. As a result, we can assume that energy can be produced in adequate amounts from the local environment to satisfy our basic needs. This fundamental truth is rejected at any opportunity by orthodox science, which remains adamant in its refusal to consider it. Given financial interests, it appears that the root cause of this inability to consider this fact is probable. The real scientific method is to

improve scientific theory by observing facts and making new observations, but this method is not currently being used.

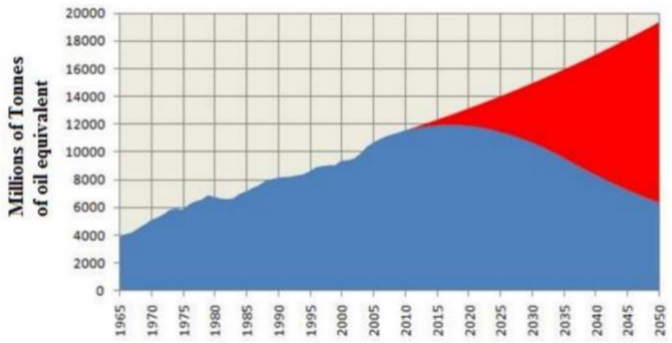

Figure *1.1 Predicted energy supply vs. demand (DOE)*

1.1 Introduction to Free Energy Generating System

Electricity exists in infinite quantity anywhere and can power the world's machinery without the need of carbon, coal, or oil. The word "free electricity" refers to energy that is delivered at no cost. Other energies are derived from wind power, water power, and telluric power. Mechanical energy powers windmills, and solar energy in solar cells transforms to DC current in solar cells. A mechanism for generating these forms of energy is known as a free energy generator.

The principle of free energy repression is that business energy interests actively block developments that might supply energy at a relatively low cost. Planet batteries, ambient voltage, telluric waves, and pressure field transitions are some of the few unexplored natural forces, according to science literature. Perpetual motion's energy is regarded as fantastical powers.

Free Energy is a term that refers to a way of obtaining energy from the local atmosphere without the use of electricity. This can be accomplished in a variety of ways. These methods cover decades and continents. The amount of electricity that can be generated is always enormous, and the few kW required to power a household are

well within control. The following are some of the approaches that can be used as free energy devices:

- Battery-Charging Pulsed Systems
- Moving Pulsed Systems
- Energy-Tapping Pulsed Systems
- Aerial Systems and Electrostatic Generators
- Motionless Pulsed Systems
- Fuel-less Motors
- Magnet Power
- Passive Systems
- Gravity-Powered Systems

1.2 FLYWHEEL

Flywheels have been around for a long time. The potter's wheel is the first application. Internal combustion engines are perhaps the most widely used application in recent years. A flywheel is a type of mechanical energy storage system that is simple in design. The revolving disc stores energy by spinning around its axis. This energy is proportional to its mass and rotational speed squared. Advances in magnetic bearings, power electronics, and flywheel materials, combined with mechanisms integration, have resulted in DC supply flywheel energy storage systems that can be used as a supplement or auxiliary to UPS batteries. Flywheel systems are generally more expensive than batteries, but their longer life, lower initial cost, easier maintenance, and smaller footprint make them a viable alternative to batteries. Flywheel Energy Storage (FES) is a type of kinetic energy storage that is used in a variety of technical fields. The energy in the system is maintained as rotational energy by increasing the

speed to a very high revolving speed. By slowing down the flywheel, the energy is re-transformed. The rotational speed and the inertia effect provide the available efficiency. Mechanically powered composite flywheels, electrically driven flywheels Devices that use mechanical energy directly are being produced, but most FES systems use electricity to accelerate and decelerate the flywheel mass. Mr. Campbell recently demonstrated that a flywheel electric device can produce power gain in Australia. When he applied for a patent, he failed to demonstrate to the scientific community how energy is gained from gravity using a flywheel.

But the fact remains that the He's producing device generates a large amount of free energy from gravitational forces. By receiving the flywheel up to rapidity and then moving the i/p drive motor to the generator, the extra energy is verified. As a result, you'll have a self-powered machine that can handle additional loads. Lawrence Tseung demonstrated the energy addition gravity-based pulse theory in October 2009. Excess energy = 2mgr (m = mass, g = gravitational, r = radius) according to theory; fed into flywheel. If the flywheel is powered at constant speed, there will be no energy gain. If gravity is unequal, however, energy is taken from it. The energy of a flywheel increases as its diameter, weight, coupling force, and impulses increase. A diagram of a motor/generator is shown in reference no. 12 from the book. With a fully charged battery, he kept it going for three years. Jim Watson has created a black and white portrait of a large structure version of the engine. Due to the large size and weight of his flywheel, he was able to produce additional output of several KW. The free energy is extracted from gravity, as previously stated. There are two things to remember. The first is the flywheel's weight, height, and rotational speed, and the second is the effectiveness of the flywheel and the drive motor.

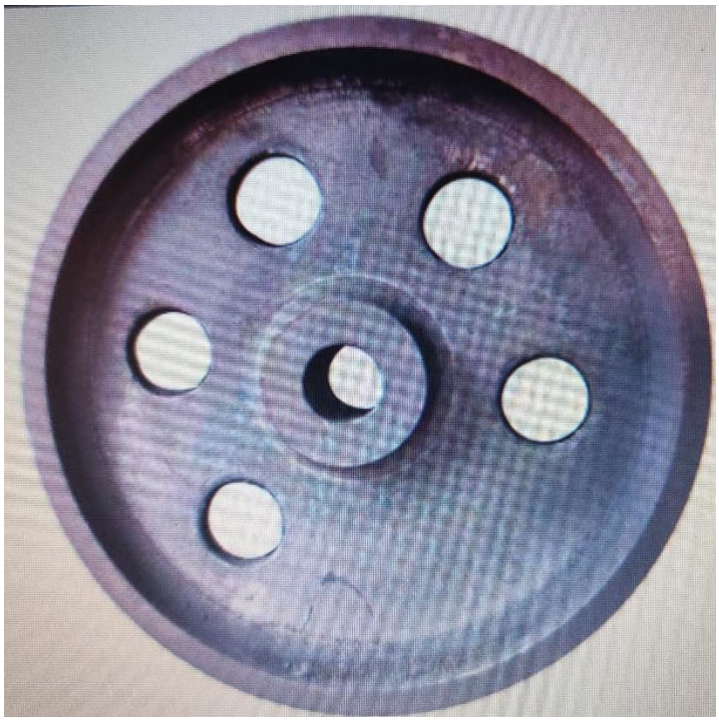

Figure 1.2 flywheel

1.2.1The project's objectives

- The primary goal of the system is to make use of gravity by using a flywheel.
- The most important move is to increase the ratio of input to output speed.
- The generator's energy is then used to power the load bank in the second stage
- Obtaining the maximum performance and measuring the working model's maximum efficiency.

The Benefits of Using a Flywheel in a Free Energy Generation System

A flywheel is a mechanical system that stores rotational energy efficiently. The moment of inertia of a flywheel stops it from altering rotational speed. A flywheel's energy storage is proportional to its rotational speed squared. Increase or decrease the rotational speed of a flywheel by applying a torque parallel to its axis of symmetry to adjust the stored energy.

Flywheels are usually made of steel and rotate on standard bearings with a nominal revolution rate of a few thousand revolutions per minute. Flywheels with high energy density can be constructed of carbon fibre composites and magnetic bearings, allowing them to spin at speeds of up to 60000 rpm (1 kHz). , where (a) represents a traditional flywheel and (b) represents a new automotive engine flywheel.

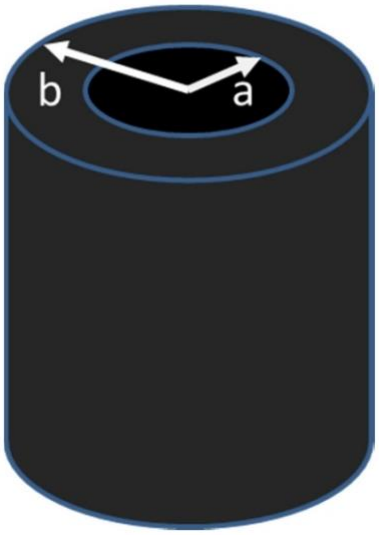

Figure 1.3 *Hollow cylinder flywheel.*

1.2.2 Flywheel Applications

Flywheels are sometimes used to provide constant power production in systems with intermittent energy sources. In a reciprocating motor, for example, a flywheel is used to smooth rapid angular velocity variations of the crankshaft. As a firing piston exerts torque on a crankshaft flywheel, it retains the energy and returns it to the piston to compress a fresh charge of air and fuel.

A flywheel may also be used to provide transient bursts of energy at power levels that are higher than the energy source's capabilities. This is accomplished by storing energy in the flywheel for a period of time at a rate consistent with the energy supply, and then releasing it at a much higher rate in a very short period

of time when it is needed. Control hammers and riveting machines both use flywheels.

Flywheels, gyroscope, can be used to control course and counteract unwelcome movements. Flywheels are used for a variety of purposes, including instrumentation, ship stability, and satellite stabilisation (reaction wheel), keeping a toy spin rotating (friction motor), and stabilising magnetically levitated artefacts (friction motor).

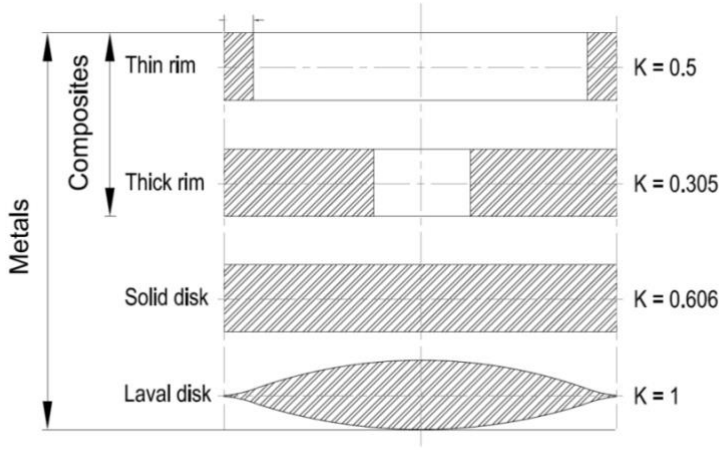

Figure 1.4 *Different flywheel cross sections*

Table 1.1 Flywheel shape factors

Flywheel shape	K
Constant stress disk	0.931
Constant thickness disc	0.606
Thin rim	0.500
Constant stress bar	0.500
Rod or circular brush	0.333
Flat pierced disc	0.305

Table 1.2 Specific strengths of flywheel materials

Flywheel material	Specific strength (kJ/kg)
Cast iron	19
Carbon steel	44
Alloy steel	100
Wood (beech)	130
Kevlar	1700
S-glass	1900
Graphite	8900

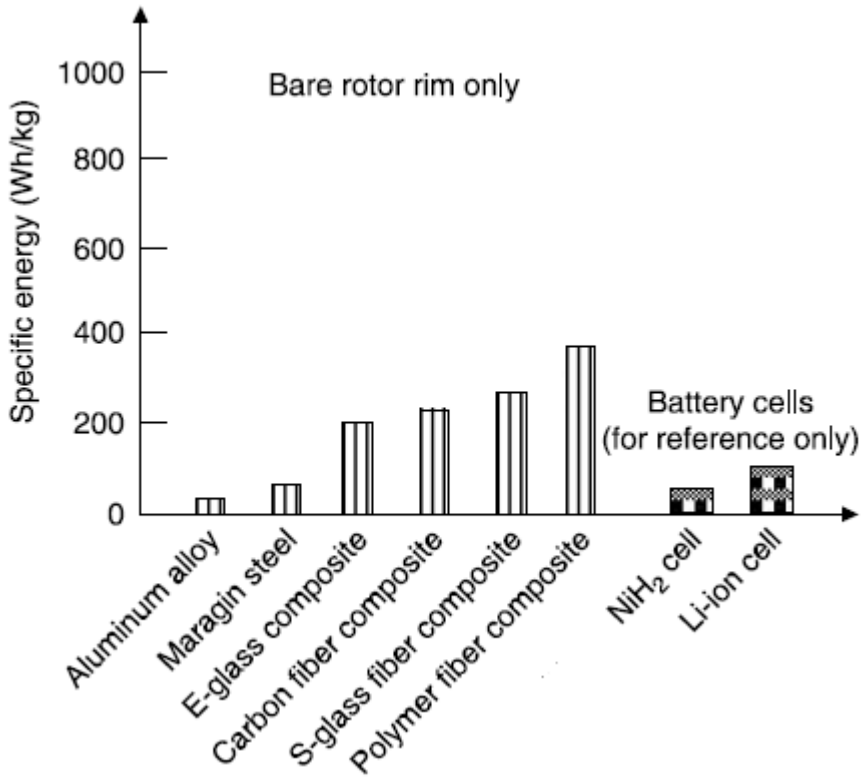

Figure 1.5 *Theoretical maximum specific energy for various materials*

1.2.3 Advantages and Disadvantages of Flywheel

Temperature variations have little effect on flywheels, and they don't have the recall effect that chemical rechargeable batteries do. They're much less likely to damage the atmosphere because they're made of either inert or neutral materials. Another advantage of flywheels is that the exact amount of energy stored can be determined simply by measuring the rotation speed. However, the use of flywheel accumulators is actually hindered by the possibility of the large wheel exploding due to overload.

The tensile strength of the rotor material is one of the key limitations of flywheel construction. The heavier the disc, the easier it can be rotated and the more energy it can hold in the device. When a flywheel's tensile strength is surpassed, it can burst, releasing all of the accumulated energy at once. This is known as a "flywheel blast," since wheel parts will provide kinetic energy equal to that of a projectile. As a result, conventional flywheel systems necessitate large storage vessels that can accommodate the device's total mass.

Flywheels operate as gyroscopes in cars because their angular momentum is usually of the same order of magnitude as the forces acting on the driving body. This property can have a negative impact on the vehicle's turning characteristics. This land, on the other hand, could be used to keep the car steady and prevent it from turning over at sharp curves. In contrast, mounting the flywheel inside a properly implemented series of gimbals will almost completely eliminate the effect, preserving angular momentum without disrupting the vehicle. For example, a single gimbal Driving uphill, for example, will necessitate a new gimbals system and a new degree of independence.

Table 1.3 Comparison of typical flywheel energy storage capabilities

Material	**Density 10^3 kg/m3**	**Useful Energy 10^3 J/kg**	**Mass of the flywheel 10^3 kg**
Wood birch	0.55	21.0	1720
Mild steel	7.80	29.5	1220
S-Glass	1.90	70.5	509
Maraging steel	8.00	86.4	417
Carbon 60% fibre	1.55	185.4	194
Kevlar 60% fibre	1.4	274.3	131

1.3 PRINCIPLE

The goal of this project is to recover energy of flywheel by using concept of energy recovery system from flywheel and generate enough energy to run the project set up and also some additional energy to run external power supply.

Generator by CHAS CAMPBELL served as inspiration for this project. Initially, an AC motor is powered by an AC supply. With the aid of pulleys of various diameters, the speed can be varied. The original AC input supply is gradually replaced by the generator's output supply.

1.4 Flywheel Energy Generating Machine Modules

1.4.1 Pulley

A pulley is a wheel mounted on an axel or shaft that facilitates the rotation and direction changing of a taut rope. Blocks are the shells that protect the other shells. A pulley, also known as a sheave or drum, may have a groove or grooves running along its circumference between two flanges. A rope, cord, belt, or chain that runs over the pulley within the groove or grooves may be used as the drive part in a pulley system. Figure 3 illustrates a basic three-groove pulley, but in this system, only two grooves are used.

1.4.2 Belt Drive

A belt drive is similar to a chain drive, except the belt sheave should be flat, so the mechanical advantage is approximated by the pitch diameter ratio of the sheaves only, rather than set precisely by the tooth ratio as in gears and sprockets. Without a groove or flanges, a drum-style pulley is often slightly convex in order to hold the flat belt balanced. A crowned pulley is another name for it. This kind of pulley, which was once commonly used on factory line shafts, is now used to drive the revolving brush in upright vacuum cleaners, belt sanders, and band saws. Up to the early 1950s, most agricultural tractors had a belt pulley with a flat belt. Other systems with greater variety in methods of use, such as power take-off and hydraulics, have largely replaced it.

The diameters of pulleys are a way to provide multiple drive ratios in a belt and pulley mechanism that can be moved if desired, just like the diameters of determine a gear ratio and thus the speed increases or reductions and the mechanical benefit that they can deliver, just like the diameters of determine a gear ratio and thus the speed increases or reductions and the mechanical advantage that they can deliver. The most popular way hat drill presses produce a variety of spindle speeds is by V belt stage pulleys.

1.4.3 Motor/Generator

Flywheels are complicated structures in which energy is physically collected and transmitted to and from the flywheel by electrical devices including motors and generators. The electrical devices can act as both a motor and a generator, transferring electrical energy to the flywheel and returning the energy contained in the flywheel. The

electric energy supplied to the stator winding is converted into mechanical energy when operating as a generator, raising the speed of the flywheel. In generator mode, the rotor's kinetic energy is converted to electrical energy. The motor/generator portion has a lot of enhancement potential, and its architecture is getting better all the time.

CHAPTER-2

LITERATURE REVIEW

A. Referring the Book by Perry I-Pei TSAO

It introduces the key system design issues for flywheel energy storage systems. First, the energy storage requirements in hybrid electric vehicles are presented. Then integrated flywheel energy storage systems and their advantages are described. The motor requirements for flywheel systems and homopolar motors are discussed. This work describes the design of an combined gravity wheel energy storage system along with motor or generator of homopolar & a drive at high frequency for high power applications. A system level design method for integration, design detail & its analysis of the flywheel system motor/generator are shown. This thesis presents a brief information on application, competing energy storage of flywheel and its different technologies

B. Referring the book by Cibulka, J

This paper deals with the design of KERS by means of FES. This is currently under development both for road hybrid automobiles & motor sport. The aim of the work is the optimization and implementation to the electric & hybrid automobiles. Design of Simplified FES was made for Testing equipment for the experimental study.

C. SJSU-RBS by Tai-Ran Hsu

This paper represents a flywheel-based RE recovery, storage & release system developed at laboratory. It can recover and store RE produced by braking motion generator with alternating rotary velocity such as the rotor of a wind turbo generator subject to irregular intake wind and the axels of electric & gas-electric automobiles during frequent braking & coasting.

The alternator converts the stored RE in the flywheel into electricity as it releases it. The SJSU-RBS is a proof-of-concept prototype that was designed, developed, and tested by students with the help of a technical staff at the author's school.

A new regenerative braking system, the SJSU-RBS was developed with the design, construction and testing of a proof-of-concept prototype. It involves a fast spinning flywheel/alternator unit with a uniquely designed progressive braking system and an epicyclic gear train. During braking and coasting, this new SJSU-RBS can be easily adapted to power plants powered by renewable energy from alternating sources such as solar, wind, and hybrid gas-electric vehicles.

The SJSU-RBS was put to the test to see if it was feasible and practical for the applications it was designed for. Despite the preliminary bench-top testing of the SJSU-RBS prototype's performance as described in the paper, a few key technical issues remain. Optimal flywheel configuration for optimum net recovery and storage of regenerative energies; quantification of aerodynamic and electromechanical resistance to the free spinning of the flywheel; efficient and optimal control of the motion of the flywheel and the driving shafts, and so on.

Further research on the detailed design and integration of the SJSU-RBS to wind power generating plants and EVs and HEVs for performance enhancements is desirable. The success of such integration will result in great economical returns to the renewable power generation industry. RBS's effective power generation from renewable energy sources would contribute significantly to the global economy's long-term sustainability and the well-being of all people.

	University of Texas- Austin	Launch Point Technologies	Artemis Project	Michigan State University	Philip Medlicott, Ltd
Energy Storage Capacity	1 KW-hr	2KW-hr	500 W-hr	1 KW-hr	2KW-hr
Inner steel rotor present?	YES	NO	YES	YES	YES
Bearings	HTS superconducting bearings	Passive and Active Magnetic bearings	HTS superconduct-ing bearings	Active Magnetic bearings	Passive and Active Magnetic Bearings
Motor/Generato r Type	Synchronous Reluctance type	Brushless, PM type	Brushless, PM type	Synchronous Reluctance type	Synchronous Reluctance type
Operating speed	10,000 rpm	12,000 rpm	30,000 rpm	25,000 rpm	15,000 rpm
Proposed Overall Weight	~200 Kg	~280 Kg	200-250 Kg	Not Specified	~230 Kg
Comments	The test rig failed because of bearing failure.	Failed due to detachment of the rotor components from the flywheel	Has not been built	Requires starter for the motor, excitation issues.	Demagnetization issues and cost due to PM material.

Table 1.4 Comparison between ongoing research project

CHAPTER-3

Aim and scope

The first steps in the construction of a simulation FESS model were taken in this study. The basic components required to simulate a FESS device have been established. PSCAD/EMTDC, an electromagnetic time domain transient simulation environment, was used to create the model. The model can be seen in the future.be used to assess the capacity of a grid-connected FESS to tackle different power quality issues or other issues In electricity grids, there are a variety of uses. After that, the model is tested in a peak shaving sample. 'The' Appendix A1 describes the built model in greater detail. The model and control system is made up of standard PSCAD/EMTDC master library modules.

CHAPTER-4

WORKING PRINCIPLE AND COMPONENT USED

4.1 A. Working Principle

In the free energy generation process, a motor with a 4 inch pulley drives a shaft onto which two pulleys are connected by a belt. With the support of a belt, the motor pulley is attached to a 5 inch pulley that is fitted on one end of the shaft. The shaft1 rotates at the same speed as the engine. The other end of the shaft1, which has a 14-inch pulley, drives another shaft, shaft2, which has different-sized pulleys and a flywheel. With the support of a belt, this 14-inch pulley is attached to a 5-inch pulley that is fitted on one end of shaft2, doubling the speed of shaft2. The flywheel, which is mounted on the shaft, rotates at a high rate and stores the energy as a result. The alternator is driven by a pulley and belt on the other end of the shaft2, which has an 8-inch pulley on it. The flywheel's energy is used to power the alternator, which produces the maximum amount of current needed. When the alternator generates the full amount of current, the current is supplied to the motor through an electrical link to power the motor. The electric supply that was previously used to power the motor is disconnected, and the alternator's current is used to power the motor. The alternator now drives the motor and vice versa using a shaft, pulleys, and belts. As a result, free energy is produced.

4.2 B. Components Used

4.2.1 AC Motor: An alternating current (AC) motor is an electric motor that runs on alternating current. The flywheel is rotated by two shafts using a 2HP AC motor. The AC motor specifications are described in the table below.

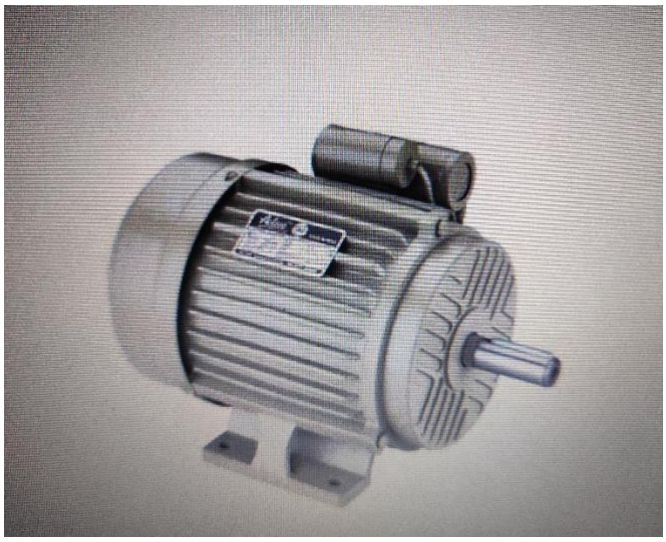

Figure 1.6 a.c motor

4.2.2 Alternator: An alternator is a type of electrical generator that transforms mechanical energy into alternating current electricity. With the aid of flywheel stored energy, a 5KV alternator is used to produce electric current. The alternator's top Speed is 1500 RPM. The table below shows the alternator's detailed specifications

Figure1.7 alternator

4.2.3 Flywheel: A flywheel is a rotating mechanical device that stores energy. The energy is stored in a 22-inch diameter rib style flywheel. The stored energy is transferred to the alternator through belt drives, which generates electricity.

4.2.4 Shaft: A shaft is a rotating machine component that transmits power from one to another through transmission elements such as pulleys and gears. Two shafts with a length of 2 feet and a diameter of 2 inches are used to transfer motion from the AC motor to the flywheel.

4.2.5 Pulley: A pulley is a wheel on an axle or shaft that supports movement and direction shift of a taut cable or belt, as well as power transfer between the shaft and cable or belt. To relay motions, six pulleys of various diameters are used.

Figure 1.8 pulley

4.2.6 Belt: A belt is a versatile material ring used to manually connect two or more spinning shafts, usually in parallel. Belts may be used as a source of motion, a means of efficiently transmitting electricity, or a means of tracking relative movement. Belts are looped over pulleys with a twist between them, and the shafts do not have to be parallel. Two shafts, an engine, a flywheel, and a generator are all connected by three V-type belts of differing lengths.

Figure 1.9 belt

4.2.7 Structural frame: A structural frame is used to transfer moving member loads and movements to the floors. All of the components are carried on a C-Channel frame with a 2 inch diameter, 6 foot length, and 3 foot width.

4.2.8 Bearings: A bearing is a machine component that eliminates friction between moving parts by restricting relative motion to only the desired motion. Shafts 1 and 2 are supported by four journal bearings with a diameter of 2 inches.

Figure 1.10 bearing

4.3 General Consideration

The following parameters are the main focus of this system design. The system consists of different parts such as a pulley, flywheel, belt drive, shaft, bearings, and so on.

4.3.1 Shaft and Bearing Design: The mechanism is designed with two shafts. As a result, Shaft Configuration must be measured in order to decide the correct Shaft diameter that will easily withstand the load while transmitting the maximum amount of energy with the least amount of damage. Bearing selection is also a critical criterion for ensuring the system's smooth and long-term operation.

4.3.2 Belt Drive Design: At the outset: we chose a pulley based on standard specifications. We all know how useful a belt drive is for power transmission via pulleys. The diameter and speed of each pulley vary. For power transmission, belt and wire (rope) drives are used. We'll use a total of six pulleys in the build, so we'll need three separate belt drive

4.3.3 Flywheel Design: The aim of this project is to generate free energy by using gravitational energy. As a result, we are using a flywheel with a mass of 10 kg, which can use gravitational energy and provide us with more production

4.4 SHAFT DESIGN:

Yield stress бy = 250 N/mm2,

Length of the shaft L=609.6mm,

Density of mild steel ρ =1.491kw

τmax = 0.5 бy/fos = 0.5X250/3 = 41.66N/mm2

Torque = $\mathbf{Mt}$ = 60X106XKW/2πn = 60X106X1.4912/πX720

$\mathbf{Mt}$ = 19772.43 Nmm

4.5 Bending Moment

For pulley 1:

(P1−P2)Xd1 = Mt

(P1−P2)X101.6= 19772.43

P1−P2 = 194.67

P1−P2= e^(μα/sinθ/2)

For V- Belt , θ = 40, μ = 0.2

α = 180 – 2 x sin−1d2−d12c

C = (d1+d2) + 100 =101.6 + 203.2 + 100

C = 404.8

α = 180 - 2sin−1203.2−101.62 X 404.8

α = 172.77

P1P2=e0.2X172.77sin20= 2.203

$\mathbf{P1=356N}$

$\mathbf{P2=161.82N}$

P1+P2+W = 356+161.82+0.9x81 = 527.20

MA = 637.65 x 204.8 – 527.20 x 100

= 130590.72 – 52720

$\mathbf{MA=77870.72Nmm}$

Pulley 2:

(P1−P2)X177.8=19772.43

P1−P2=111.206

α = 180.2 x sin−1345.6 X 6 X 101.62 X 556

α = 154.95

P1P2=e0.2X154sin20 = 2.223

P1=2.223P2

1.223P2=111.206

$P1^{=}202{\cdot}134N$

$P2^{=}90{\cdot}92N$

= P1+P2+W=90.92+202.134+0.9 X 9.81

= 301.883 N

MB= 637.65 X 204.81 – 301.883 X 100

MB=130590.72−30188.3

MB= 100402.42 Nmm

τmax= 16πd3√(100402.42)2+(19772.43)2

d3= 16π X 41.66 √(100402.42)2+(19772.43)2

= 16π X 41.66√(10471594930)

= 39301.319π = 12508.377

d = 23.213 mm

d = 50.8 mm

4.6 Selection of bearing

Speed of shaft N2 = 720 rpm

L10h = 20000

P (P1 + P2+ W1) = 527.2 N

Bearing Life

L10= 60 x n x 40h106 = 60 x 720 x 20000106

L10=864

4.7 Dynamic Load Capacity

C = P (L10)^3/1=527.2 X (864)^1/3

C = 5021.26 N

50 BC 02 or 55 BC 02

Selected as: C50=27070 N , C55=33340 N

Similarly Bearing 2: P = 301.883 N

L10=60 X n X 40h /10^6= 60 x 720 x 20000/10^6 = 864

C = 301.883 x (864)^1/3

C = 2875.25 N

As per standard bearing capacity C

Bearing no; for d=50.8mm

4.8 Design Of V-Belt

2 HP motor 1440 RPM

2 HP = 1.49 Kw

N1 = 1440 RPM

PR = 1.49 Kw

4.9 Number of Belt : -

N=pd/(power /belt)

n =0.65 ∴ n ≈ 1

Total Power = No Of Belt × Power/Belt

Total Power = 2.5224 Kw

4.10 Fly wheel

.E = 12IW2 K

Input Rpm to Wheel

N1N2=d2d1=1440N2=54

N2=1152 rpm

N3N4=d4d3=1152N4=516

N4= 3686.4

K=0.9 fly wheel with rim/rib

m = 60kg

I = Kmr2

I = 0.9×60×9.81×0.30482

I = 49.214 Kg-m2

W = $2\pi n60=2\times\pi\times3686.460=386.038$

W2= 149025.337 rad/sec

K.E = 12×49.214×149025.337

K.E = 3667066.468 N-M

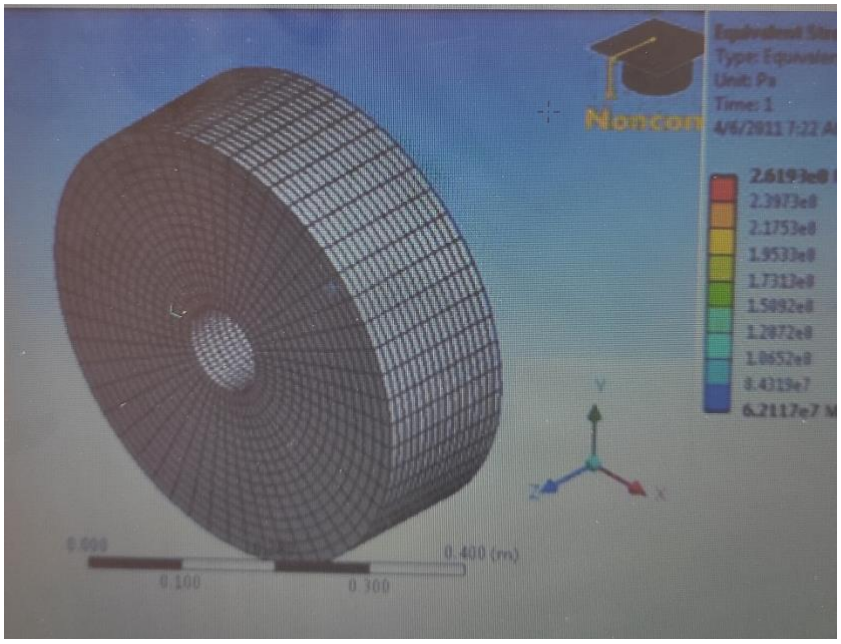

Figure 1.11 Preliminary model to verify initial calculations

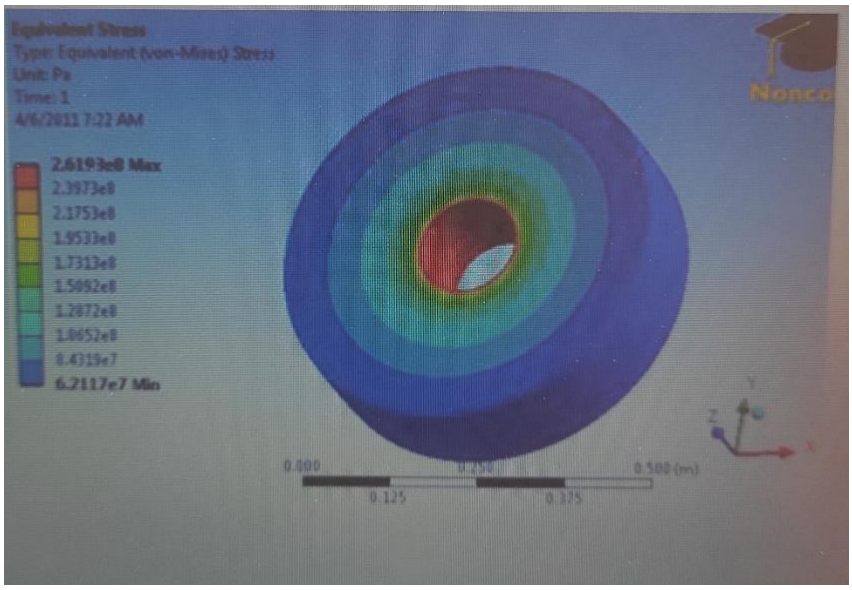

Figure 1.12 Preliminary model to verify initial calculation

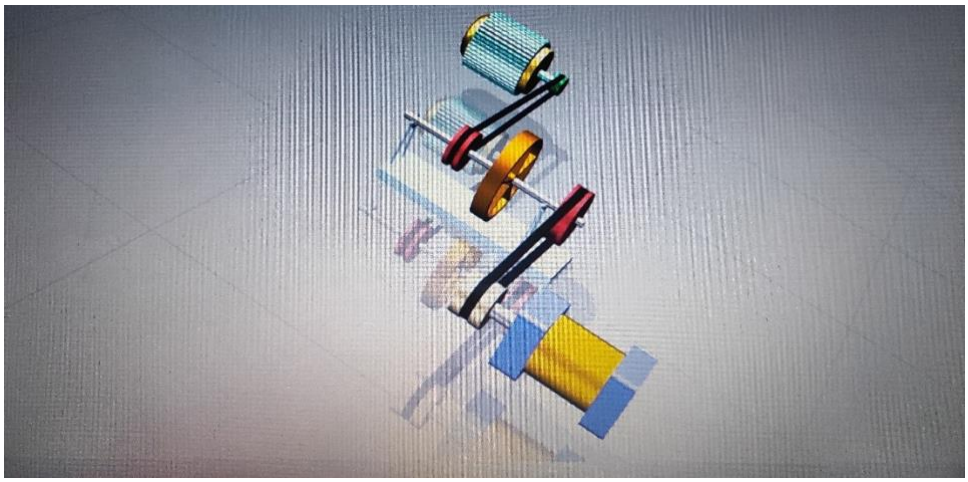

Figure1.13 3d model of flywheel generator (right angle)

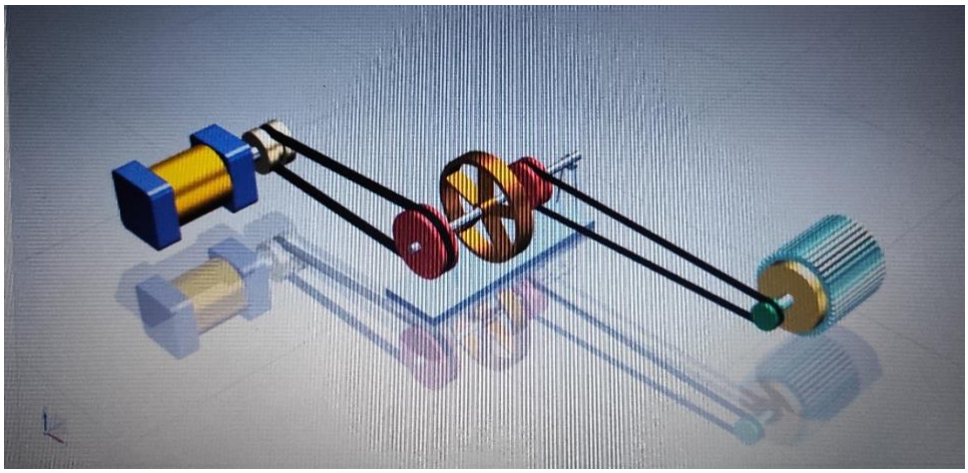

Figure1.14 3d model of flywheel generator (left angle)

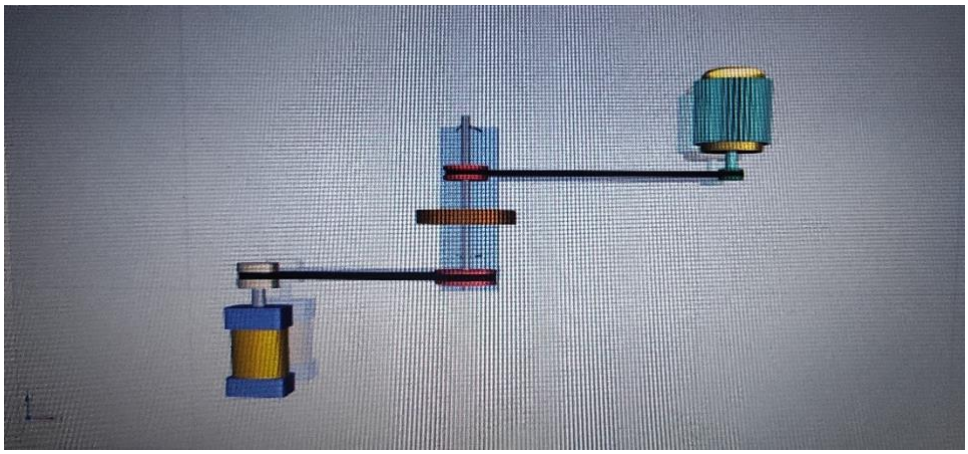

Figure1.15 3d model of flywheel generator (top angle)

4.11 Energy Storage and Topologies

This segment addresses the various energy storage solutions that are available for this project, as well as why flywheel energy storage was chosen.

4.12 Available energy storage technologies

There is no way to produce or kill electricity. It can, however, be modified from one shape to another. Electrical energy is a form of energy that can be effectively transferred and converted into other types of energy. The key drawbacks of electrical energy are the costs and efficiency of handling it. Different types of electrical energy may be transformed and stored:

- Electrochemical Energy
- Electrostatic Energy
- Electromagnetic Energy
- Electromechanical Energy

4.12.1 Electrochemical energy storage

Electrical energy is transferred and deposited as chemical energy in this form of storage. Batteries and fuel cells are the two major types [2].Internal chemical elements convert and store energy in batteries.Fuel cells, on the other hand, use fossil fuel (for example Hydrogen, methanol or hydrazine)externally supplied and stored All use an anode and a cathode as electrodes.Internally, they exchange ions with an electrolyte and electrons through an electrolyte.an external electric circuit

The most commonly used battery is the lead-acid battery, which was discovered by Plante in 1859. The battery is made up of two sets of lead electrode plates that are immersed in a dilute sulphuric acid electrolyte. Lead dioxide is applied to each alternater lead layer. When all electrodes are discharged, they are converted to lead sulphate. Charging returns the plates to their original state of lead and lead dioxide. The physical modifications in electrodes that occur while charging and discharging deteriorate them, limiting their life. They have a well-established technology, which is one of their key benefits. The below are the major disadvantages of batteries:

- Slow response during energy release
- Limited number of charge discharge cycles
- Relatively short life time

- High internal resistance
- Low energy density
- Maintenance requirements for some types
- Environmental hazards

In 1839, W. R. Grove showed the world's first hydrogen-oxygen fuel cell. Water is a byproduct of a hydrogen fuel cell. Hydrogen fuel cells store electrical energy by electrochemically decomposing water into hydrogen and oxygen and keeping them separate. The hydrogen is mixed with oxygen during discharge, converting chemical energy to electrical energy. The biggest benefits are that they are environmentally sustainable. The following are the key disadvantages of using fuel cells as a form of energy storage:

- Slow response during energy release
- Temperature dependence
- Corrosion problems
- Hydrogen storage
- Ineficient transfer of electrical energy to chemical energy

4.12.2 Electrostatic energy storage

Between the parallel plates of a charged capacitor, electric energy can be transferred and deposited in the shape of an electrostatic field. The sum of energy stored is equal to the square of the voltage across the parallel plates and to the square of the voltage across the parallel plates.capacitance is a term that refers to the amount of energy The volume energy density of a parallel plate at a fixed voltage The capacitance of a capacitor is equal to its capacitance, which is proportional to the permittivity of the capacitor.between the parallel plates' insulator The majority of insulators are relative insulators. Permittivity ranging from 1 to 10. Ordinary capacitors have a low capacitance due to their limited size.can only hold a small amount of energy Electrochemical materials are used in ultracapacitors to boost permittivity and therefore

energy density. In contrast to batteries, they need fewer maintenance and have much longer lifespans. They have a high energy density and there are no moving pieces in them. The below are the major disadvantages of capacitors:

- Cost
- Temperature dependence
- Not rugged

4.12.3 Electromagnetic energy storage

An electromagnetic field can be used to transform and store electric energy.A superconducting magnetic energy storage (SMES) coil is made up of a superconducting coil that is capable of holding massive DC currents. The inductance of the coil and the square of the DC current passing through it determine the amount of energy contained. The permeability of the material used for the coil determines the volume energy density. A cryogenic cooling system is needed to maintain the temperature of the superconductor below its critical temperature. The amount of energy stored increases as the DC current is increased. When the coil's current approaches its limit, the voltage around it is zero. Due to the coil's low resistance, this storage scheme has very low losses. SMES coils can also be constructed with more energy and strength. The following are the major disadvantages of SMES:

- Cost
- Reliability in maintaining cryogenic cooling
- Compensation of external stray fields
- Electromagnetic forces on the conductors
- Bulk/volume

4.12.4 Electromechanical energy storage

In a flywheel, electrical energy can be transformed and retained as kinetic energy. For energy transfer, motor/generator sets, DC machines, and induction machines are used.

For a given geometry stress, the volume of energy contained in a flywheel is equal to the square of angular velocity and its inertia.

The energy storage solutions listed above each have their own set of benefits and drawbacks, but flywheels offer the following advantages over other energy storage systems:

- Low cost
- High power density
- Ruggedness
- Greater number of charge discharge cycles
- Longer life
- Less maintenance
- Environmental friendly
- Fast response during energy release

Flywheels may be made to operate at low or high speeds. As opposed to a high-speed flywheel system, a low-speed flywheel system has the benefits of reduced cost and the use of validated technology.

4.12.5 The main disadvantages are:

- less energy stored per volume
- higher losses
- increased volume and mass

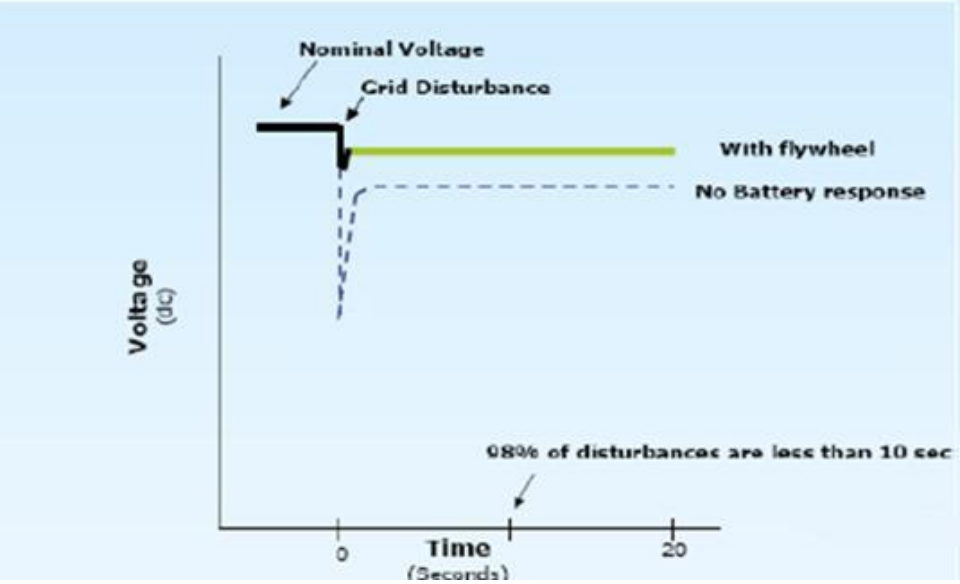

Figure 1.16 *Flywheel vs Battery response*

CHAPTER-5

RESULTS AND DISCUSSIONS

In this project, we run the flywheel at 800 rpm to generate 9 to 12 volts dc current, which charges the 12 volt battery. We also add additional components to the system, such as transformers, inverters, and any other circuits that are needed to run the system and calculate the performance.

5.1 FUTURE SCOPES

We are primarily working on a project to charge electric vehicle batteries while travelling to a remote location, and it can be expanded by increasing the number of magnets and coils and decreasing the space between the discs on which magnets and coils are placed, as this will allow the coil to cut the maximum line of force and generate the most flux fill, resulting in the highest induced voltage. We can charge a battery that takes 1 to 1:30 hours to fully charge using this project on a motorcycle. Through introducing this project, we will be able to resolve the drawbacks of typical power turbines, which use a dynamo as a power generator, creating friction and slowing down the vehicle's speed.

CHAPTER-6

CONCLUSION

We may infer that the system structure produces energy without friction using a flywheel and that it can be used to its full capacity. We effectively planned and executed the project on frame, and the produced electricity is used to charge the battery of an electric car. We also understand the principle of electromagnetism and how to produce power by simply putting an equal number of magnets and coils on separate discs without making contact. The voltage output from the assembly is completely dependent on the rpm of the wheels, so voltage fluctuates, necessitating the use of a battery to provide a steady power supply.

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