IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Frictionless Energy Generation Using Flywheel For Electrical Vehicles

[1]Kalesh Pattar, [2]Kiran Rathod, [3]Mallanagouda T, [4]Pramod Goudra, [5]Prof. Suprit Malagi, [6]Dr. Rajendra M. Galagali

[1,2,3,4] Student, [5] Assistant Professor, [6] HOD

[1] Department of Mechanical Engineering,

[1] S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India

Abstract: The electrical energy producing within the electrical vehicle is challenging now days. Our project produces the electricity while vehicle is in running condition and breaking condition. This is works like regenerative breaking traction mode in hybrid electrical vehicles. Our modified vehicle (bicycle) stores the kinetic energy with help of flywheel arrangement, use this kinetic energy and converts the electrical energy. This electricity can be used for many applications like to charge the batteries, lighting purpose, to run starter motor, to horn and indicator, music etc. our project setup reduces the friction while power generation and the electricity production is based on the Faraday's law.

Keywords: Electrical vehicles, Flywheel, Faraday's law, Electricity, Friction, Electrical energy storage.

I. INTRODUCTION

Kinetic energy recovery system collects the kinetic energy of the vehicle(bicycle), when acceleration mode, stores the energy and release the energy back into the electricity generator setup. The kinetic energy is wasted or dissipated into outside environment in vehicles but our project utilizes the kinetic energy and produce the electricity. If we use the dynamo to produce the electricity there is more friction. Due to friction loss the efficiency of the power generation is reduce, to eliminate this problem we use axial flux generator. In this type of generator there is gap between stator and rotor, to build this type of generator the proper coil and magnet arrangement is necessary. This project setup can be easily modified for other type of vehicles, especially for electrical vehicles. We modified the bicycle which is perfect example for low power generation. If we apply this concept for electrical vehicle we can generate more and efficient power.

II. LITERATURE REVIEW

In recent researches show that electricity can be generated with less friction, [1] Rahul P. Ambre, Dinesh S. Sathe, Avinash S. Pangat February 2019 "Design and fabrication of contactless energy generation system with flywheel". They conclude that, electrical energy can generate without friction with help of flywheel and utilizes in maximum amount. They designed the project successfully and implemented, the produced power is used to charge the batteries, mobile phones and other mobile accessories or devices. They also studied the electromagnetism concept and power generation by making proper coil and magnet arrangement without making rotor and stator contact. Output voltage from model is depend on the rpm of the wheel which is fluctuating the voltage so battery is used for Stable power supply.

[2] Mayur M. Umbare, Sujay S. Udawant, Rohan B. Gujar, Sahil G. Urkunde April 2019, "Contactless energy generation using flywheel for EV". They build the model that produce the electrical energy without friction and its eco-friendly. Magnetic flywheel can work under dynamic operating condition and reaches the energy requirement for electrical vehicle. Their project model generates output voltage up to 12 V.

[3] B. Karthik, A. Marimuthu, K. Pradap, "Kinematic energy recovery system on bicycles". They developed a kinematic energy recovery system bicycle it helps for achieve easy cycling and stores the temporary kinetic energy in flywheel. This experimental setup can easily develop and modify according to the application.

[4] Mayuresh Bhoir, Anupraj Shirke, Pratik Yadav, May 2020, "KERS Bicycle". This team studied, the flywheel will store some part of energy while bicycle is in running and recovers the energy back. They successfully design the KERS which is satisfactorily store the efficient energy and provides to the power generation. Using of flywheel in bicycle concept is new, development of this concept has good scope in upcoming days.

[5] Partha Borah and Kaushik Kalita stated the efficiency of the system in KERS can increase if minimize the air resistance and friction loss in their research titled as application of KERS in bicycle: An investigation. This research mention that heavy mass flywheel produces more kinetic energy but less weight bicycle allows the driver to incorporate ride. To make proper balance of vehicle exact flywheel installation require and proper enclosing for flywheel is prevent the air friction losses.

[6] Mayank Joshi, Hemant Negi, Deepak Rautela and Devendra Singh did study on kinetic energy recovery system. They studied different types of KERS and find out the suitable system for bicycle. They said flywheel-based system is does not harmful to humans and environment and this system promises future scope. This technology boosts the efficiency of energy storage and generates the electrical power.

III. COMPONENTS

1. Neodymium Magnets

It's also known as NdFeB magnet and these are strong permanent magnet widely used for many applications for example electric motors, electric generator for wind turbine, magnetic coupling and bearing, headphones and speakers, electrical power steering system etc. Neodymium magnets has good magnetic properties, the strength of the magnetic field is high it is known as remanence. They have higher coercivity and energy product but curie temperature is lower than the other types of the magnets. We can use N30 to N55 grade NdFeB magnets for this project, N52 grade magnet is suitable for our model setup.

2. Flywheel

Flywheel is main component of our System. Flywheel rotates even though brakes are applied. Flywheel is another main component of assembly. Material of flywheel is selected on basis of energy storage requirements. The component property has indirect effect on output voltage.

3. Material Selection of Flywheel

Flywheel can made from many materials, it is based on the application and working condition. In children's toys small flywheels are used which are made of lead. Flywheels are made from cast iron are used in steam engines. Forged or nodular iron, metal flywheels are in vehicles. High strength steel flywheel uses in vehicle breaking and energy storage system. Suitable material selection for flywheel is depend upon the application, the goal is to increase the energy storage in system. The maximum energy stores per unit weight is determines the efficiency of flywheel.

4. Coil

In our project coil means an electromagnetic coil is an electrical conductor wire in the shape of coil or spiral. These coil uses where magnetic field and electric current interact with each other, in appliances such as electrical generators, motor, transformer. Electric current flows through the coil wire and generate the magnetic field, in conductor the external magnetic field through the arrangement of the coil generate an electromotive force. Due to Ampere's law magnetic field create around the conductor when current passes through that conductor. Coil shape winding increase the magnetic field strength. More number of turns of wire produce the stronger field, in conductor voltage is induced by external magnetic flux changing conversely due to Faraday's law of induction. This induced voltage can increase with help of coil or winding the wire because circuit and field lines intersect with each other multiple times. Coil produces magnetic field; the magnetic field direction can be determined by right hand grip rule, magnetic field lines direction showed by the thumb and other fingers shows current direction. Different types of coils used in electronic and electric appliances.

5. Axial Flux Generator

Axial flux generator construction is similar to the axial flux motor where the gap between the stator and rotor. Magnetic flux direction between rotor and stator is parallel with rotation axis. To build this type of generator permanent magnet requires. Some axial designs allow the geometry considerations those are not practical in radial geometry but some operating principles, design and applications are possible to achieve. Axial flux generators used for low power or medium power applications. Rotor is placed parallel to the stator setup with equal distance. When the rotor rotates the electricity generates and passes through the circuit and stored in the battery. We are select this type of generator because it can build on flat structure and reduce the rotor weight, the structural parts are also flat.

IV. METHODOLOGY

We have used the flywheel which is connected to the bicycle rear wheel sprocket by chain. When the driver pedals the bicycle front chain wheel or sprocket rotates which is connected to pedal and crank. Rear sprocket is mounted on right side of the rear wheel and it is connected with front sprocket by means of chain and another big sprocket is mounted on left side of the rear wheel. Flywheel and axial flux generator setup are placed above the rear wheel. The coil arrangement is stator, magnets are attached on flywheel surface which is known as rotor. The motion is transfers from pedal to rear wheel and flywheel. The kinetic energy stores in the flywheel while vehicle is in running condition and it release the kinetic energy back to the system or coil and magnet arrangement when apply break on the wheel. The coil is in fixed position and rotor rotates; here electromotive force is produced. The electric power is generated and stored, later it will be utilized for many applications.

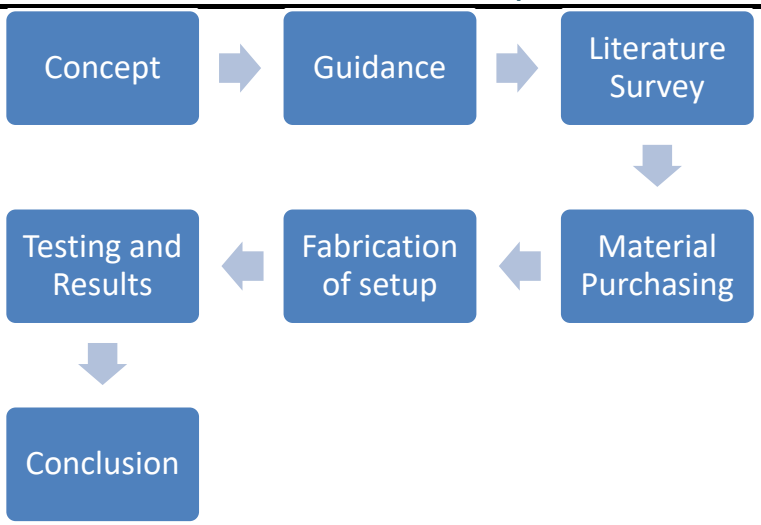

Fig. 1: Process Chart

V. CALCULATION

Calculation of the energy storage in flywheel:

Bicycle rider weight	65kg (Assumption)
Bicycle weight	9.4kg
Possible payloads	10kg
Allowable weight for flywheel	0.6kg
Overall weight	85kg

We assumed that the overall system reaches 10km per hour in 5 second, this energy is stored in flywheel.
Final velocity (v) = 10km/hr = 10 ×1000/3600 = 2.78 m/sec
Initial velocity (u) = 0km/hr = 0 m/sec
Time = 5sec
Acceleration (a) = (v – u)/ Time = (2.78-0)/ 5 = 0.556 m/s^2

When system reaches 10 km/hr the energy of the system is
Energy (E) = ½×m×v^2 = 328.45 joules.

Speed of the flywheel and wheel is calculated below
Bicycle wheel diameter (DR) = 26inch ≅ 660.4mm
Wheel revolutions at 10km per second is
N = v/(2×π×R) = 1.339rps = 80.39rpm

Required force for the bicycle to take the system rest condition to 10km per hour in 5 second
Axial force (Fa) = m×a = 47.26N

Friction resistance (Ff) = 5N
Total required force (Tf) = Fa + Ff = 52.26N

Required torque at wheel center to achieve required force is
Tw = Force (F) × Radius (r) = (52.26 × (0.6604 /2)) = 17.25 Nm

Calculation of the Chain Length

The chain length can determine by multiplying with chain pitch and units.
Length (L) = K×p
Where
K = Number of chain link units
L = Chain length
p = Chain pitch
Chain link numbers found out from the below formula and this formula is taken from book “Machine Design” written by R. S. Khurmi and Gupta
$K = ((T1+T2) / 2) + (2X / p) + ((T2-T1) / 2\pi)^2 \times (p / X)$
Consider the following data
T1=15
T2 = 60
X = Two center distance = 0.5 m
p = 12.7mm
$K = (15+60/2) + (2*500/12.7) + (60-15/2\pi)^2 \times 12.7/1000$
$= 116.89 \cong 117$
L = 117× 12.7 = 1485.9mm

To find the diameter of flywheel, we take gear ratio is 4 as per our design requirement
Let,
$N_1/T_1 = N_2/T_2$
$N_2 = (T_2\ N_1)/\ T_1 = (60\ 80.39)/\ 15 = 321.56$ rpm
Velocity (v) = $(\pi \times D \times N)\ /60$
Diameter of flywheel = $(v \times 60)/\ (\pi \times N) = (2.78 \times 60)/\ (\pi \times 321.56) = 0.1651$mtr = 165mm.

VI. POWER GENERATION

When plan to build a generator on flat surface, axil flux generator is more suitable. Calculation and design of power generation must need before building the generator. The output voltage is also depending on the field thickness size in loop region. The field thickness and region connection related as motion. This motion fluctuates with time is depend on the generator power design and plan. To create voltage generator utilizes the transition adjustment. From each loop the voltage is created and it is determined by Faraday's law. In our project mechanical rotary motion (mechanical energy) is converted into electrical energy.

VII. COIL DESIGN

More number of windings for coil create a design difficulty. Each coil produce voltage, this voltage can be increased by a greater number of winding but more winding increases the coil size. To minimize each coil size, increase the wire gauge size and another problem is created, less current flow in smaller wire before the wire heats because of high resistance in small wire. In our project each coil has resistance up to 40 Ω; if we use less gauge wire for winding reduce this resistance in this design. We chose the axial flux generator which separates the coil and magnet. Our design improves the voltage output by increasing the field density. The proper coil arrangement and design is necessary for efficient power generation.

VIII. CONCLUSION

Finally, we conclude that, our project setup or arrangement produce the electricity with minimum friction with flywheel and it use in greater amount. We successfully build the project and designed it. The generated electrical energy is stored in the battery system and then it is used for many applications. We studied the electromagnetic concept and understood the electrical energy generation concept by designing the coil and magnet position. We minimize the friction while the power generation by placing the coil and magnet with stator and rotor system. This is stator and rotor system does not contact with each other. From the model setup output voltage is taken and voltage is depended on speed of the vehicle or rpm of the wheel, so output voltage fluctuates due to this battery is used for constant supply of power. Electricity is stored in battery and it is continuously charging.

IX. ACKNOWLEDGEMENT

The entire of this project completion will got more knowledge of various components, different types of design, the main concept of selection process and many laws to generation of electricity. It's our duty to acknowledge the guidance received from many persons and who helps us to prepare this report. Our sincere thanks to Dr. B. R. Patagundi, principal, SGBIT Belagavi and Dr. Rajendra M. Galagali, HOD, Mechanical department for the guidance and suggestions. The library, laboratory and work shop facilities they provide for us to prepare this research paper. We would express our thanks to our project guide Prof. Suprit Malagi for guiding us research and investigation for our project work.

REFERENCE

[1] Akhil Bhat, Shrikrushna Borbale and S. H. Joshi, "Contactless energy generation using flywheel", IRJET Volume 06, Issue 06, June 2019.
[2] Rahul P. ambre, Dinesh S. Sathe, Avinash S. Pangat, Nitin N. Hajare, Arjun B. Meherkhamb, "design and Fabrication of contactless energy generation system with flywheel" NCTEP-February 2019.
[3] Magnus Hedlund, Johan Lundin, "Flywheel Energy Storage for Automotive Applications" by Energies 2015, 8, 10636-10663
[4] Michel A Conteh, Emmanuel C. Nsofor Composite flywheel material design of high-speed energy storage on journal of applied research and technology 14 (2016) 184-190
[5] Chung–Neng Huang, Yui-Sung Chen, "Design of magnetic flywheel control for performance improvement of fuel cells used in vehicles journal on Energy" (2016) 1-13
[6] Rushikesh Bade, Sourabh Bharambe, S.H.Joshi, "Review of Free Energy Generation using Flywheel", IRJET Volume 06, Issue 04, April 2019 (869-876).
[7] Mayur M. Umbare, Sujay S. Udawant, Rohan B.Gujar, Sahil G. Urkunde and Renu Yeotikar, " Contactless Energy Generation Using Flywheel for EV", IETIR Volume 06,Issue 04, April 2019 (377-384).
[8] B. Krathik, A. Marimuthu, K. Pradap, P. Premkumar, A. Soundhar, "Kinametic Energy Recovery System on Bicycles", IJRDT Volume 07, Issue0 4, April 2017 (155-160).
[9] Mayur Bhoir, Danish Shaikh, Anupraj Shirke, Pratik Yadav and Jaslok Pandey, "KERS Bicycle", IJERT Volume 09, Issue 05, May 2020 (1309-1313).