Development of Regenerative Energy System by Using Flywheel

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Abstract - **The intention of this project is to build a Flywheel base rechargeable battery, for energy saving as well as longer range for electric vehicle; currently model is design & build for bicycle and by making some changes we can use this model in two wheelers as well as in cars. This project will help to develop engineering skills while learning about regenerating electricity or using more efficiently and satisfying our requirement of more range for EVs. We are going to use the dynamo & Flywheel to generate electricity due to which our battery will be recharge. This is totally clean way of regenerating energy. As fuel is not a renewable energy sources are limited and the prices are increasing day by day also, extraction on conventional fuels are harmful for nature. It will not be affordable by a common man after some period & use of fossil fuels increase global warming. So we need to use electricity as efficiently as we can, so everybody can afford and use more and more electric transportation. Also it eliminates the emission of CO_2 which will reduce the pollution.**

For the project to work we need use dynamo & flywheel with bearing for lesser friction as we know due to friction energy losses will be their; also in some cases we can use strong electromagnets to regenerate electricity but as we want to use this application for e-bicycle where we will get less torque & power for flywheel. The basic idea of this principle comes from the functioning of motor, that is how it rotates in the magnetic field and cut's the magnetic line and how flux is introduced into the coil. The motivation behind the project is to generate electricity for longer range for all types EV bikes so we are turning towards dynamo & flywheel application. As when the bike is at lower speed still the motor will rotate with it specified RPM and that energy will be transferred to flywheel & by using flywheel inertia we can recharge battery. Also, while breaking also similar phenomena happen & in that case too we can recharge the battery to increase the range of all types of EVs.

Keywords: Regenerative, Energy System, Flywheel, EV, rechargeable battery.

I. INTRODUCTION

Regenerative Energy System by Using Flywheel:

This is a mechanical device which uses the wheel to store energy in the form of inertia. In this system we applied an additional energy source to start the main motor like electricity. In this system main motor is used to drive a series of pulley and belt arrangement which forms a gear train arrangement which produce a twice/ thrice speed at the shaft of generator. The significant thing about the system is that the electricity generated at the output of the shaft is more than that of input. The inertia of wheel can be increased by increasing the radius of wheel and weight of wheel. It also increases if the wheel weight is concentrated as far out toward the rim of the wheel as is possible. Firstly, the requirement for an effective system needs to be a suitable wheel with a large diameter and vast majority of the weight needs to be close to rim. The construction needs to be robust and secure as ideally. The rate of rotation will be as high as possible as the weight on the wheel is concentrated outward of the rim which needs to be exactly at right angles to the axle on which it rotates and exactly centered on the axle. The main motor is at low speed, low voltage input motor, the generator is high speed, and high voltage output generator. Therefore, when we apply an extra energy to the main motor it starts running, which causes to rotate the wheel. When the motor is reaches the highest speed (constant speed) we switch the power by applying the electrical energy generated by the generator. We add the extra thing in the system like transformers, rectifier, inverter etc. to run the system and take the efficiency output. Electric trains, cars, and other electric vehicles are powered by electric motors connected to batteries. When we're driving along, energy flows from the batteries to the motors, turning the wheels and providing us with the kinetic energy we need to move. When we stop and hit the brakes, the whole process goes into reverse: electronic circuits cut the power to the motors. Now, our kinetic energy and momentum makes the wheels turn the motors, so the dynamo work like generators and start producing electricity instead of consuming it. Power flows back from these motor-generators to the batteries, charging them up. So a good proportion of the energy we lose

by braking is returned to the batteries and can be reused when we start off again.

II. WORKING

In design, the flywheel & dynamo are arranged in such a way that when power is transmitted to wheel through shaft & flywheel & dynamo is connected to use excess energy of flywheel to regenerate electricity & recharge battery.
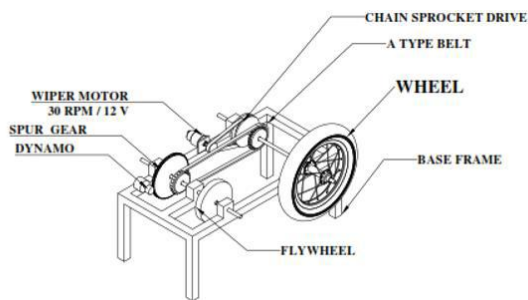
Experimental Setup Design:

Figure 1: Experimental Setup Design

Frame: It holds all components together and provides stability to all mechanisms attached.

Battery: The Lead-acid battery is one of the oldest types of rechargeable batteries. These batteries were invented in the year 1859 by the French physicist Gaston Planet. Despite having a small energy-to-volume ratio and a very low energy-to-weight ratio, its ability to supply high surge contents reveals that the cells have a relatively large power-to-weight. Lead-acid batteries can be classified as secondary batteries. The chemical reactions that occur in secondary cells are reversible. Batteries = 2 (12v each).

Dynamo: In this project the dynamo act as a power generator from the rotation of rear wheel while it is running, because the rear wheel and dynamo are coupled due to friction between threads provided on both dynamo wheel and rear Tyre thread. The amount of power generated in the dynamo by the revolutions made by rear wheel is supplied to the rechargeable battery. The range of dynamo is 12v.

Chain-Sprockets: Sprockets wheels with teeth that lock onto a chain. As the sprocket spins, the teeth grab onto the chain and move other parts that interlock with the chain. This sequential series of operations allows for simple and controlled rotational movement and it will transmit rotational motion from driver shaft to drive shaft.

Flywheel: The working principle of a flywheel is quite easy and interesting as it stores energy for the vehicle's usage. It

stores the inertia energy while the continuous rotational movement & due to its shape.

Motor: It is the device that converts electrical energy to mechanical rotary energy with the help of magnetic flux.

III. METHODOLOGY

1) The dynamo arranged in a model will generate electricity when the vehicle is in running condition.
2) In general, the wheel starts by the rotary movement of the motor, which is in contact with the chain-sprocket.
3) The dynamo, which is connected to the rear part of the shaft near the flywheel to generate electricity.
4) Electricity generated by the dynamo as above said process is stored in a lead acid battery, which is further will be used to the motor connected at the wheel.
5) Here, the motor gives movement to the wheel and helps to continue running. The electricity generated by the dynamo, the consumption of electricity by the motor occurred simultaneously, thereby the life of the battery also enhances when compared with bicycle without dynamo.
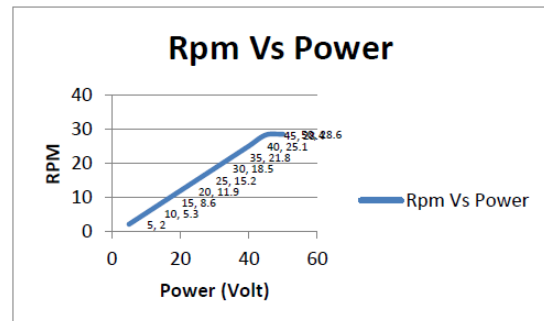
Graphical presentation of reading:

Figure 2: Graphical presentation of reading

From the graph we come to know that after certain speed voltage generation in constant.

Calculation for Flywheel selection:

(i) Calculation of Total Output and Efficiency for Motor, Input voltage (system voltage) - 220 V

Rated voltage - 230 V

Rated rpm - 1500 rpm

Input current – 230 V →21.8A (measured value)

220 V → 220x21.8/230=20.85A

Input current = 20.85 A

Input power → P =VI cos ɵ = P = 3669.6 W

Motor input = 3.7 kW

For Generator, Output voltage - 250 V

Rated voltage - 300 Rated rpm - 1500 rpm

Output voltage – 300 V→ 5 kW

Output voltage − 250 V → 4166.67 W = 4.167 kW

Alternator / Generator output = 4.167 kW

Shaft rpm = 750 rpm

ω = = 78.54 rad/s Torque, T= P/ ω = (4166.67 W)/ (78.54) = 53.05 N-m

Total Efficiency (η) = Total alternator output/total motor input

η =4166.67/3669.6x100%

η = 0.113 % η ~ 100% η = 100%

Therefore, extra (100) % output is obtained from the system. Calculations for Energy stored (kinetic energy) in Flywheel,

Where,

N = angular speed of flywheel (N-m)
v = velocity of flywheel (m/s)
E= kinetic energy stored in flywheel (Joules or kgm^2/s^2)
m = mass of flywheel (kg)
D = diameter of flywheel (m),
D = 10.16 cm = 10.16 × 10-2 m = 0.1016 m
m = 185 kg
v = πDN/60 = (3.142×0.1016×750)/60 = 3.99 m/s
E = (mv^2)/2 = (185× 〚 (3.99) 〛 ^2)/2 = 1472.61 J or kg m2 /s2 ~ 1473 J or kg m^2/s^2
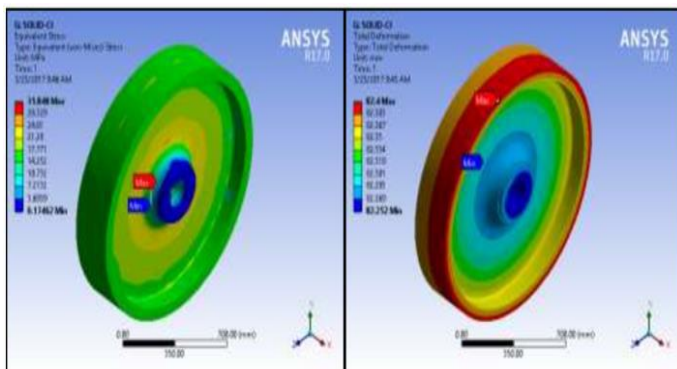
Flywheel Simulation:

Figure 3: Flywheel Simulation

IV. CONCLUSION

We can conclude that, the system arrangement generates electricity by using dynamo and can be utilized in the right amount. We have successfully designed the project and implemented on proto frame, the generated power is utilized to charge the battery of electrical vehicle; we also understand the concept of electromagnetism and how to generate power by using flywheel & dynamo. A battery connected to the generator assembly is continuously charged when shaft moves at 50- 55 rpm. By this assembly battery is continuously recharging.

REFERENCES

[1] Michael Mathew, Design of flywheel for improved energy storage using computer aided analysis, Department of Mechanical Engineering National Institute of Technology Rourkela,769008 (2008-2009).

[2] B. Sneha, Dr. M. Damodar Reddy, "Generation of Power from Bicycle Pedal", October 2015.

[3] Akhilesh Barwahe: - "Electricity Generation Using Flywheel'" Volume 4 Issue IV, April 2016 IC Value: 13.98 ISSN: 2321-9653.

[4] Huang, K. David., & Tzeng, Sheng Chung. (2004). A new parallel-type hybrid electric-vehicle. Applied Energy, 79(1), 51-64.

[5] Yan, Wenguang., Utkin, V., &Rizzoni, G. (2005, June). Power flow control for a series hybrid electric vehicle. In Proceedings of the IEEE International Symposium on Industrial Electronics, 2005.ISIE 2005.IEEE.

[6] Quinn, C., Daniel Zimmerle, D., & Bradley, T. H. (2007). An evaluation of state of-charge limitations and actuation signal energy content on plug-in hybrid electric vehicle, vehicle-to-grid reliability, and economics. IEEE Transactions on Smart Grid, 3(1), 483-491.

[7] Ian Vince McLoughlin et al., "Campus Mobility for the Future: The Electric Bicycle", "Journal of Transportation Technologies", Scientific Research, 2012, 2, 1-12.

[8] Minas Roukas et al., "Development of the Control System for an Electric Vehicle", Master Thesis, Chalmers University of Technology, October 2013 Report number: EX050/ 2013.

[9] Vivek Kumar et al., "Design & Implementation of Electric Assisted Bicycle with Self Recharging Mechanism".

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