Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 05, May-2020

Power Charging Unit using Rotary Leverage System

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***Abstract*— Demand for Electrical energy is ever increasing since independence. As on December 31st 2019, installed capacity of India is 368.79 GW, out of which 34.86% is renewable. With time, demand increases. Current renewable energy systems are not efficient. Either improvement is to be proposed or new technology is the need of the hour. Our team is proposing generation of electric energy that can be used to charge batteries or other devices using a rotary leverage system. Proposed system is efficient, environmentally friendly and inexpensive. System uses a flywheel that stores excess energy and even when input power is low the system gives a constant output.**

***Keywords*— Charging unit, Efficiency, Flywheel, Leverage system.**

I. INTRODUCTION

The energy crisis has been the major concern of the world. As the population rises, the demand for the limited natural resources increases. These natural resources are limited. While they do occur naturally, it can take hundreds of thousands of years to replenish these sources. Governments and concerned individuals are working to make the use of renewable resources a priority, and to lessen the irresponsible use of natural supplies through increased conservation.

The proposed system works as a charging unit with self generating power. This power charging unit operates on the principle of increasing the torque through the leverage system. The system has a very high efficiency. Since continuous power is required to run the leverage system, part of this output power is given as input to the DC motor which runs the leverage system. The excess power can be used for various applications.

The leverage assembly is the heart of this system. The leverage assembly system generates the energy that not only runs the system continuously but also produces energy which can be used for various applications. This system consists of a rotary leverage system which produces energy and a flywheel which stores the additional energy produced and uses it effectively.

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A. Rotary leverage system

The rotary leverage system is a first order lever which is mounted through its fulcrum. It consists of an effort arm where a weighted body is fitted to the extreme end. A load arm is present at the opposite end of the effort arm. A force required to oscillate the effort arm by 90 degrees is applied on the effort arm. But, due to the moment of inertia the lever rotates 180 degrees which in turn rotates a larger lever. As the radius of rotation increases, there is an increase in torque which produces energy.

B. Flywheel

The energy that is generated by the rotary leverage system is then stored in a flywheel. A flywheel is a heavy metallic disc (usually made from cast-iron). The main advantage of a flywheel is that it stores the energy that is produced in excess and releases it when the input energy is lower than required. The flywheel stores the energy and discharges it slowly to the DC generator which produces the output power.

C. Objectives of the proposed work

- To survey various published papers to understand the working and development of existing systems.
- To design an eco-friendly and an energy efficient power charging unit using rotary leverage assembly and flywheel technology.
- To test and compare the proposed system with existing ones.

II. METHODOLOGY

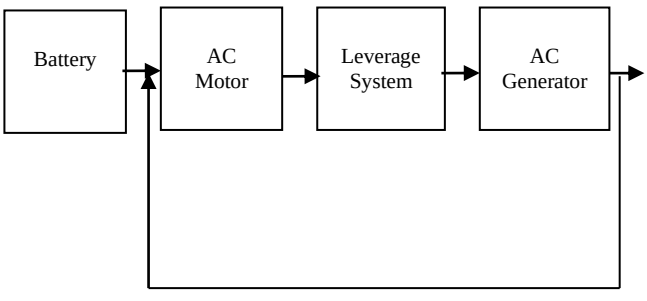

Fig 1. Block Diagram of the system

International Journal of Engineering Research & Technology (IJERT)
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Simplified block schematic of the proposed power charging by rotary leverage system is shown in figure 1. Battery source is the input. In all commercial applications lithium batteries are replacing nickel cadmium batteries because of its portability feature and many other advantages that will be detailed later.

The heart of the charging system is the leverage assembly which consists of the rotary leverage system and the flywheel. The flywheel stores kinetic energy and it can be used any time a need arises. Use of flywheel is gaining importance world over. As a flywheel is a rotational system, an AC motor is used to provide rotational energy. AC motor and flywheel are coupled together.

On the other side of the flywheel, an AC generator is mechanically coupled to receive kinetic energy stored in the flywheel as input. AC generator produces AC output voltage or AC power at its output and that can be used especially by electric vehicles. Output power needs control as user may not always draw constant power. Feedback from output is given to AC motor to control the rotational movement of motor or to optimize the use of battery. This is a critical part of the work and figure shows unity feedback and in reality, it may not be so.

Specifications of expected power output decides the selection of battery, AC Motor flywheel and AC generator. The energy stored in the flywheel is more than the energy available in the battery. This means higher energy is available even if the battery energy is low.

As the motor and generator section is crucial, we mechanically leverage the output torque of the motor at a lower power rating to rotate the rotor of higher power generator by magnifying the torque through rotary leverage.

A motor with a high rpm (3000 rpm motor) and a power rating of 2 kW is selected. And we select a permanent magnet type alternator with power rating 3.3 kW with lower rpm (500 rpm). We know that $P=T\omega$, where, P is the power, T is the torque and ω is the angular velocity. So, torque and rpm are inversely proportional. Therefore, when we use a 5:1 gearbox to reduce rpm of motor output from 3000 to 600, the torque produced on the output side is 5 times the torque on the input side.

The mechanical coupling path between the motor and generator is 5:1 gearbox. Thus, usually when the torque is increased through any mechanical link be it a gearbox or a belt gear, rpm is lost. When observed that the motor side belt and alternator side belt are also coupled to the flywheel through a gear that's on the flywheel on opposite sides at the centre of the flywheel. This means that at the flywheel there is a gain in Torque but no loss in rpm, since both the gears(with motor side belt and alternator side belt) are attached to the flywheel both of them are forced to have the same rpm, but since the size of the gears is different the torque on the motor side of the flywheel and the alternator side of the flywheel are different i.e. the torque is higher on the alternator side.

The reason this works is that since the flywheel is heavy and has high inertia, it can magnify the torque based on gear size at the flywheel without change in rpm. Essentially, the inertia of the flywheel is harvested to achieve this torque boost.

The flywheel stores energy in the form of kinetic energy. So, when a 2kW motor and 3.5 kW generator are directly coupled to each other, the motor cannot rotate the generator to produce energy because the motor won't have enough torque, but the system assembled can produce energy.

III. RESULTS AND DISCUSSION

In the proposed system, an alternator with a power rating of 3.3 kW with speed of 500 rpm, the motor used is of higher speed of 3000 rpm with a power rating of 2 kW are being used. In order to run a motor at higher speed, more power needs to be generated. For an input of 1 kW, the output produced is 2.3 kW. This is used for our power charging purpose. The system also has an edge, as a part of the output is taken and is supplied to the input. Since the flywheel has high inertia and is heavy, based on the gear size of the flywheel, the system is able to magnify the torque without changing the rpm.

Like any system, this too has advantages and disadvantages.

A. Advantages:

- The system does not make use of any form of fuel which makes it ecofriendly.
- As the output produced is 1.3 kW more than the input, the efficiency of the system is high.
- Part of the output is given as input to the system which makes it a self-generating system.

B. Disadvantages:

- The system consists of heavy mechanical parts which results in the increase of the overall weight of the system. Due to increased weight, the system becomes immobile.
- The use of flywheel and rotary leverage system produces a lot of noise which may lead to noise pollution.
- Flywheel and rotary leverage system are constructed with the help of a lathe machine. Labour charge for this machine is very high, unless it is mass produced.

IV. CONCLUSION

As stated in the beginning, the main aim was to develop a system which can be used as a charging unit that is eco-friendly and at the same time yields a high efficiency. Thus, due to the construction of a rotary leverage system using flywheel and a feedback loop, the combined effect of rotary leverage system with flywheel energy storage system, results in the increase of overall efficiency of the system. The system produces 1.3 kW more than the input. A part of the output power which is taken and given as an input, helps the system to work efficiently even when there is no input given. Therefore, the system has a wide scope of application owing to the power crisis.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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