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Design and Fabrication of a Magnetic Prime Mover for Electric Power Generation

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Abstract: ***This work present the design and fabrication details of a magnetic prime mover suitable for light duty power generations. This Prime mover gets started by repulsive force of magnets. Magnetic repulsive force is used to develop oscillatory motions which drive a flywheel fitted in this prime mover. Four numbers of Neodymium magnet is used in this work .Output of the flywheel is transmitted by a v-belt to an electrical dynamo and electrical power is generated. An externally powered gun trigger act as the actuator and triggers the pendulum and cycle is repeated.***
The prototype model fabricated in this project work developed a power output of 12.1 V from magnetic force. The power generated is stored in the battery. The approach adopted in our work can be developed further by increasing the number of magnets to achieve more output to meet commercial applications.
Keywords: Actuator, Magnet, Pendulum, Prime mover, Power Generator.

I. INTRODUCTION

In nature, energy cannot be created or destroyed, but its form can change. In generating electricity, no new energy is created. Actually one form of energy is converted to another form. Power can be produced using both renewable as well as non-renewable energy sources.

Conventional power generation approach generally involves converting the energy contained in fuels first into thermal energy in a combustion unit, then converting the thermal energy to mechanical energy by a prime mover, with the mechanical energy being converted to electrical energy by the generator. External combustion systems have different equipment for all the three steps of conversion.

In internal combustion engine, combustion and conversion of thermal to mechanical energy take place within a single equipment unit. The diesel engine is one of the most versatile of internal combustion engines and is widely used in power generation. It is also considerably more efficient compared to the other alternative methods and has several practical advantages when used in certain types of power generation applications. However, conventional power generation produce the exhaust that contains large amounts of excess air and unwanted emissions.

To generate hydro electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical (machine) energy. The turbine turns the generator rotor which then converts this mechanical energy into another electricity energy form. Since water is the initial source of energy, we call this hydroelectric power or hydropower for short.

At facilities called hydroelectric power plants, hydropower is generated. Some power plants are located on rivers, streams, and canals, but for a reliable water supply, dams are needed. Dams store water for later release for such purposes as irrigation, domestic and industrial use, and power generation.

We can produce power from solar energy. This high growth rate in solar energy utilization is due to many reasons increasing cost of petroleum products and the parallel decreasing cost of producing power from solar, and a worldwide concern over on the harmful effects of using fossil fuels.

We can produce power from wind energy. Wind mills or turbines works on the principle of converting kinetic energy of the wind in to mechanical energy. Air density, which linearly affects the power output at a given speed, is a function of altitude, temperature and barometric pressure. Variation in temperature and pressure can affect air density up to 10 % in either direction. Warm climate reduces air density. wind machines should have large rotors and should be located in areas of high wind speeds. Practically, wind turbines are able to convert only a fraction of available wind power into useful power.

Non-renewable sources are critical today and that causes pollution and other harmful dieses to human being.

In order to reduce pollution and save extinct nature, we can start with idea of clean energy based on this concept magnet[1] which is used for power generation.

Magnetic forces[2] will be used to rotate the shaft by designing the in such a way that repulsive and attractive forces make the engine to give rotary as well as to and fro motion. With this considerations a prime mover based on magnetic forces a can be developed.

This paper describe the prototype model development of a magnetic prime mover. In this magnetic prime mover, repulsion force is utilized to maintain oscillation of a frees winging pendulum and transform its oscillating motion into rotary motion by installing horizontal connecting rod along with a flywheel to display the ultimate motion.

II. WORKING PRINCIPLE

This model working based on the magnet repulsive force. The actuators having a oscillator. Magnet is placed end of the pendulum. The pendulum is connected in the centre of the frame. One end of pendulum is connected to the connecting rod and flywheel arrangement and another end is placed to permanent magnet.

The gap between pendulum and oscillator is minimized and maximum repulsive force can be developed between two magnets. Oscillating pendulum effect the displacement of the connecting rod. Displacement created is converted as rotary motion by crank arrangement.

The flywheel arrangement is connected to the head pulley. V-Belt is connected from the head pulley to tail pulley. The head pulley diameter is made larger to increase speed of the tail pulley. Tail pulley is connected to generator end. Electricity is produced whenever the generator is actuated. The output power from the generator may be properly stored in a battery. A small amount of power is used to run the actuator.

III. CONSTRUCTIONAL DETAILS

The model shown in figure 1 has a rigid frame on which various elements such as the magnets, generator, flywheel, pulleys and bearings properly are mounted.

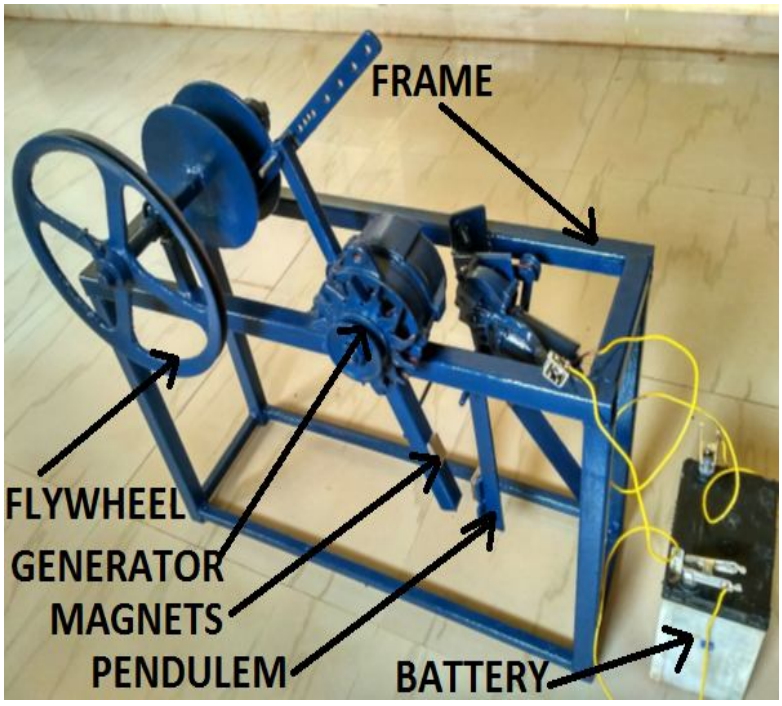

Figure 1 Prototype model of the magnetic prime mover

Square tubular iron frame for suitable dimensions is fabricated as per model shown the figure 1. About 60 m length of square is used for fabrication of this frame.

A battery as shown in the figure 2 is used for the output power storage in this setup. Batteries are typically made of six galvanic cells in a series circuit. Each cell provides 2.1 volts for a total of 12.6 volts at full charge.

Figure 2 Typical Battery

Lead battery is a rechargeable battery that supplies as well store electric energy. Traditionally, this is used for starting, lighting, ignition, and its main purpose is to start the engine.
These batteries are designed to release a high burst of current, measured in amperes, and then be quickly recharged. They are not designed for deep discharge, and a full discharge can reduce the battery's lifespan. Modern SLI batteries are lead-acid type and provide 12.6 volts of direct current, nominally 12 V.
Figure 3 show the dynamo generator (alternator) that is used in this model to charge the battery.

Figure 3 Typical dynamo generators

The dynamo generator is well mounted on the frame and is driven by the flywheel through belt & pulley connections. Once generator is actuated it cause the corresponding electric power generation.
Magnets are attached on solid bars and hence bars are made to swing like pendulums with proper links and hinges on frame. Figure 4 show an attached magnet and the zoom view of crank and connecting rod mechanism that is used in this model to run the coupled flywheel.

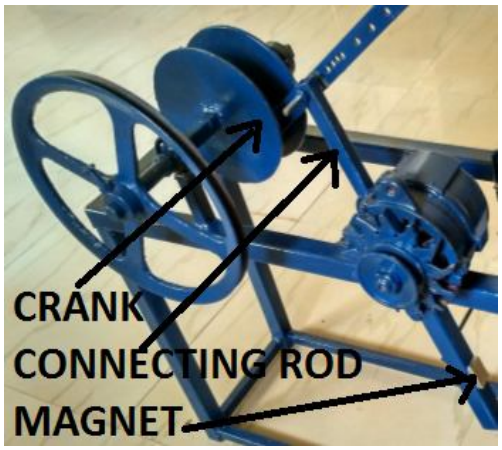

Figure 4 Zoomed picture showing the magnet, crank and connecting rod

A. Selection Of Magnets

A set of neodymium magnets have been used in our model to create and sustain the required oscillatory motions to drive the crank and connecting rod. Neodymium [3] magnets are the strongest type of permanent magnet commercially available. They are permanent magnets and the most widely used type of rare-earth magnets. These magnets are widely being used because the materials involved in manufacturing are relatively inexpensive. Their crystal structure and symmetry contribute to its strong magnetic properties. Intensity and direction of their magnetic field determine the forces of attraction or repulsion existing between the two magnets.

Neodymium magnets are metal, and they are coloured silver, like most other metals. Neodymium magnets (Rare Earth magnets) are 5 to 7 times stronger [4] than Ferrite Magnets and offer the greatest value for money. Neodymium magnets are graded according to their maximum energy [5] product, which relates to the magnetic flux output per unit volume.

B. Calculations And Specifications

Magnet repulsive force = 3.22 lb
= 14.32 N

Actuator oscillation
Time for one oscillation = 1 second
Pendulum oscillation = actuator oscillation = 1 second
Flywheel speed = Number of oscillation of pendulum per minute
Flywheel speed = 60 rpm
Flywheel speed = head pulley speed
head pulley diameter = 145mm
tail pulley diameter = 35 mm
stepping ratio = 145/ 35 = 4.142
Tail pulley speed = 60 x 4.142
= 250 rpm
.power generation at 250 rpm =12.1 V

IV. ANALYSIS AND DISCUSSIONS

Our model has been fabricated with a cost of Rs.9000.00. It is to be noted that the magnetic prime mover will become worth in generating power for tiny purposes which can work as a mini generator. And its running cost is much better when compared with other energy source s for light duty energy generations.

Our model can help in recharging of batteries and thus helps in energy saving. This approach can be developed further with increased number of magnets to improve angular force and hence to achieve more output. Our model can help to recharge mobile phones and mini emergency lamps in remote areas or during power cut.

V. CONCLUSION

Prototype model of a magnetic prime mover has been developed. This Prime mover gets started by repulsive force of magnets. Four numbers of Neodymium magnet is used. Magnetic repulsive force actuated a pendulum. Oscillatory motion of the pendulum rotated a flywheel fitted in this prime mover. Output of the flywheel is transmitted to an electrical dynamo and the dynamo generated electrical power. A gun trigger can be fitted to trigger the pendulum and cycle can be repeated for continuous power output.

Our model has shown a power output of 12.1V. The power developed is stored in a 12V, 35 Amps battery. The approach adopted in this work can further be developed by increasing the number of magnets to achieve more output to meet commercial applications.

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