Simple Hand Driven Dual Mode Portable Generator

Pritika N. Patil[1], A. Raghu Rama Chandra[2] and Shweta Arun Mandhare[3]

[1]Assistant Professor, Alamuri Ratnamala Institute of Engineering and Technology, Shahapur

[2]Assistant Professor, Geethanjali college of Engineering and Technology

[3]Assistant Professor, Alamuri Ratnmala Institute of Engineering and Technology

Email: [1]pritikapatil.25@gmail.com, [2]raghu.ramchandar@gmail.com and [3]mandhareshweta12@gmail.com

***Abstract*—** Electricity, heart of electronics and electrical appliances has become the fourth basic need of human. Its demand and urge is rapidly increasing and since it is a conventional source of energy, it is horribly depleting causing some ill-effects on the nature forcing us to switch towards non-conventional source of electricity. We have constructed a simple hand driven dual mode portable generator which is able to give both AC and DC output using a switch. Primary input is given by some simple mechanism and materials like bicycle wheel, V-Belt pulley couples to a series wounded permanent magnet generator. The speed of hand driven bicycle wheel is boosted using simple velocity ratio principle. We tried to implement new winding technique on stator poles and series connections for armature. Permanent neodymium magnets on rotor provided brushless operation, thus, reducing noise and friction. Hexagonal rotor structure is made from mild steel which is coated which is coated with pure non-magnetic steel bolts which made the handling of neodymium magnets much simpler, increased rotor strength and prevention of core saturation. Converter is used to store generated electricity. Switching mode provided access to both AC and converted DC output.

***Keywords*—** hand crank generator, rectifiers, non-conventional energy sources.

I. INTRODUCTION

The growing consumption of energy has resulted in the country becoming increasingly dependent on fossil fuels such as coal, oil and gas. Rising prices of oil and gas and their potential shortages have raised uncertainties about the security of energy supply in future, which has serious repercussions on the growth of the national economy. Increasing use of fossil fuels also causes serious environmental problems.

Hence, there is a primary need to use renewable energy sources like solar, wind, tidal, biomass and energy from waste material. They are called non-conventional sources of energy.

The important aspect of concentrating on the development of dual mode portable hand crank generator is for the purpose of emergency. Trekkers can use this portable hand crank generator when they track for mountainous areas, jungle or in some remote areas where there is no source of energy for charging their appliances. The generator can be used to charge the mobile phones, rechargeable batteries used in torch, low power consumption equipment and so on.

The generator can be used to charge motorcycle batteries in emergency to a level sufficient to start it. Low power AC bulbs can also be illuminated. it can be used in remote rural area. In such areas, due to frequent load shedding means of communication like TV cannot be used for acquiring information. They are fully depended on battery powered radios for knowing about the important news or information. The radios can be used for only short period of time as far as the batteries are charged. For this purpose, the hand crank generator can be used to generate electricity to charge the batteries through ultra-capacitors so that the radios can be used for long period of time as well as when required.

II. LITERATURE SURVEY

The first electric generator in the world was made by Michael Faraday in 1831 popularly known as the 'Faraday disk' a type of homo-polar generator, using a copper disc rotating between the poles of a horseshoe magnet. It produced a small DC voltage thus proving that the rotary mechanical power can be converted into electric power. The race for practical generator began. Various generator schemes were tried, mostly employing permanent magnets to create the necessary magnetic field. This design was inefficient, due to self-cancelling counter-flows of current in regions that were not under the influence of the magnetic field. While current was induced directly underneath the magnet, the current would circulate backwards in regions that were outside the influence of the magnetic field. This counter-flow limited the power output to the pickup wires, and induced waste heating of the copper disc. Another disadvantage was that the output voltage was very low, due to the single current path through the magnetic flux.

The first-hand crank generator was made by Ampere and Hippolyte Pixii in1832. The dynamo was the first electrical generator capable of delivering power for industry. The dynamo uses electromagnetic induction to

convert mechanical rotation into direct current through the use of a commutator. The first dynamo was built by Hippolyte Pixii in 1832. Werner Siemens (1816-1892) perfects the dynamo in 1866, a generator in which part of the generator's working current is used to power the field windings, eliminating both the need for permanent magnets and one of the basic limits to generating electric power. Several other inventors, including Wheatstone and Wilde, reached almost the same design. Through a series of accidental discoveries, the dynamo became the source of many later inventions, including the DC electric motor, the AC alternator, the AC synchronous motor, and the rotary converter.

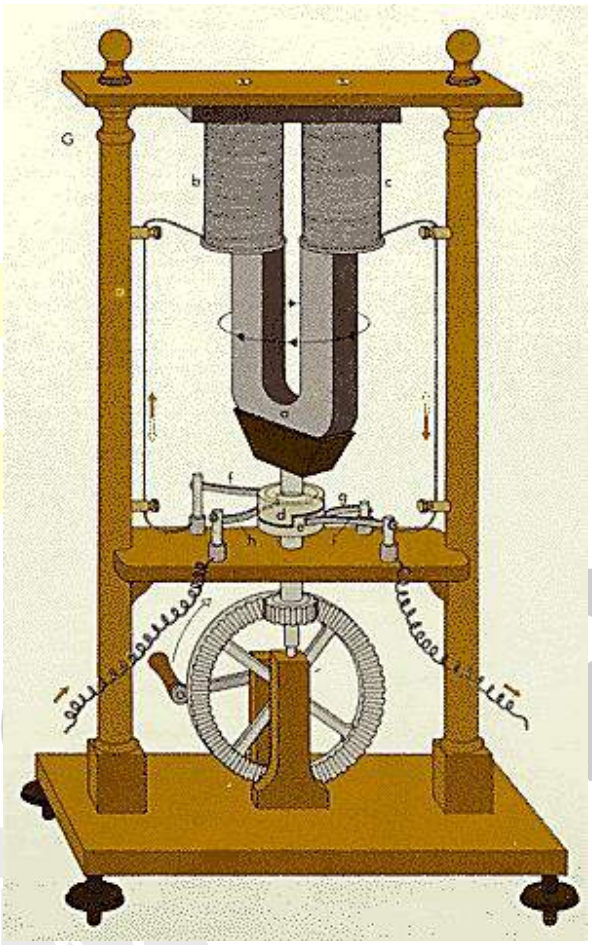

Fig 1. Firsthand crank generator by Ampere

III. SYSTEM ARCHITECTURE

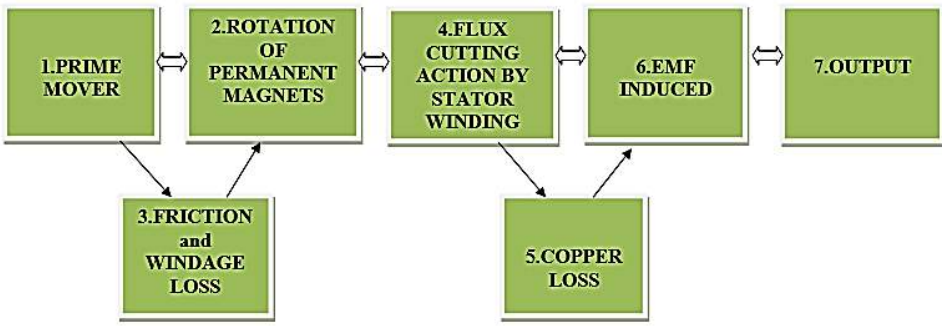

Fig.2 System Architecture

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A. First Block - Prime Mover

The first block represents the prime mover. It is basically a small bicycle wheel. One of spokes of the wheel is drilled so that a handle can be fixed and taken out whenever required. this handle makes the driving of the wheel easy and requires less power. the wheel is connected to the pulley with a rubber belt. this arrangement is known as V-belt pulley arrangement. Due to such an arrangement, when the wheel completes its one rotation, the pulley rotates for about 8 times. Hence, this has helped in boosting the speed of the pulley, indirectly the speed of the rotor.

B. Second Block - Rotation of Permanent Magnets

The rotor is actually two NUTS which are bigger and thicker and size and are welded together and are packed with mild-steel material. The hexagonal rotor structure provides room for six neodymium magnets. As the wheel rotates, the pulley rotates which further rotates the rotor. Magnets are therefore rotated producing magnetic flux required for the flux cutting action.

C. Third Block - Friction and Windage Loss

Ball bearings are present inside the hub which enables the rotation of the shaft inside the hub. But since those are in contact with each other, there occurs a frictional loss which slightly reduces the rotor speed. Due to this friction It is observed that there occurs a small sound from the hub while the hand-crank generator is in put to use. Since the magnets used resemble salient pole type rotor arrangement, they provide opposition to air. Hence, because of the air resistance, wind-age loss also occurs.

D. Fourth Block - Flux Cutting Action by Stator Winding

The rotation of the magnets produces a magnetic field. The windings present inside the stator cuts this magnetic field, therefore, giving rise to current in the windings which in turn produces voltage at the output terminals of the windings.

E. Fifth Block - Copper Loss

The copper winding is of 30 gauges, so, its effective resistance is high. Also, the windings are wounded by hand; therefore, the copper losses are much greater than the actual generator. Therefore, the net output is the difference of stator pole + winding losses and actual output.

F. Sixth Block - EMF Induced

Stator windings are perpendicular to the field poles. the rotation of field poles and hence the magnetic field cuts the stationary armature poles tends to induce emf in the armature.

G. Seventh Block - Output

The output terminals are then connected to the common points of a slide switch. One point of the slide switch is connected to a step-up transformer (18/230V). When the switch is made to slide at this particular point, the voltage level is raised up to 230V with help of transformer. This output is given to AC bulbs rated 0.8 Watt each. The second point of the switch is connected to rectifier circuit which gives pure DC output of 5volts and 12 volts. Switching is provided at this circuit to obtain the 5volt and 12volt output simultaneously.

IV. HARDWARE DESCRIPTION

A. Rotating Parts

Bicycle wheel: A wheel of a small bicycle is used as mechanical input i.e. it is hand driven using muscular energy and further this energy is converted into electrical energy using suitable circuit connection.

Wheel Handle: A wooden handle is used to drive the wheel. It provides a better grip so as to drive the wheel smoothly and rapidly.

Hub: A hub of a bicycle wheel is used at the generating side. It is arranged in such a fashion that is supports the velocity ratio principle in order to boost the speed of the rotor.

Industrial Rubber Belt: The belt used is made up of rubber. The bicycle wheel and hub are connected through this rubber. A V-Pulley arrangement is brought up using the rubber belt. The friction between the wheel and the belt and the hub is well suited for the rotating conditions.

Pulley and Bearing Bolt: Pulley and bearing bolt are used as actual mechanical input to the generator. They are connected with the hub such that they are forming another part of the V-belt pulley arrangement.

B. Supporting Structure

Wooden Plank: A wooden plank is used as the base for the hand driven generator. It is drilled at suitable points to fix the rest of the mechanical parts.

Hub Base: A wooden block is used as the base for the hub. Even this is drilled and screw-fitted on the wooden plank firmly.

Wheel Support: Another wooden piece which is vertically greater in length is drilled from below and is fitted on the plank. The rod is drilled from one of its side so the wheel can be attached to it and can be removed again with the help of washers and nuts. This rod is bolted from the bottom side of the plank. Since the nuts

can be removed and put up back again whenever required, the wheel along with wooden rod can be removed and placed back at its place again. This makes the wheel portable.

Nuts and Bolts: Different nuts and bolts are used to hold the mechanical structure firmly.

C. Generator Parts

Neodymium Magnets: Six neodymium magnets are used. The magnets are of bar type. The rotor is actually a big nut with hexagonal structure. So, it provides room for six bar magnets. Hence theses six magnets are placed on each side of the nut in such a way that the adjacent magnet is of opposite polarity as per the standard construction of a generator.

Windings: Copper insulated windings of 30 gauge are used. They are wound on an aluminum plate. Each winding has approximately 1500 turns. The resistance f each winding is 60 Ω. Total 4 windings are placed inside the yoke. Its output terminals are connected to the crocodile clips for the connection purpose.

Stator and Rotor Core: Stator core is made up of aluminum plate. Since the aluminum is a non-magnetic material, aluminum plate is put into use. Rotor core is made up of a two mild steel material 'NUTS' welded together. The rotor core is hexagonal in shape and its each side is of 2cm. A solid iron rod of 4cm is embedded in the welded nuts and drilled to fix it with the hub.

Yoke: Yoke is non-magnetic. Hence aluminum material (plate) is used for its construction. Yoke is made portable. Yoke is made to remain still by placing two fixed wooden plates in slanting positions at the base. A thin layer of thermocol material is placed at the inner side of the yoke and is shaped in such a fashion the windings properly get fixed into it.

D. Speed Boosting Technique

The rotating bicycle wheel connected with the hub by a rubber belt is arranged is such a way that the speed of rotor is boosted up to a great extent. This arrangement is called 'V-Pulley' arrangement. Because of this type of arrangement, the rotor rotates with a ratio of 8:1 with respect to the wheel i.e., when the wheel completes 1 rotation; the rotor completes approximately 8 rotations. This is possible because of the 'velocity ratio principle'. Hence, this law is implemented to increase the rotor rotation to increase the output.

V. APPLICATIONS OF PROJECT

The maximum no load voltage of generator is 50v. For maintaining 50Hz frequency, 33v output is sufficient. As the load is connected, the voltage drops down to 20-22v.this output voltage is divided in two ways with the help of slide switch. First the output of the slide switch is given to18V-230V step-up transformer. The 230V step-up transformer voltage is used for A.C applications like lamp bank of 4W and the other output is given to the rectifier circuit.

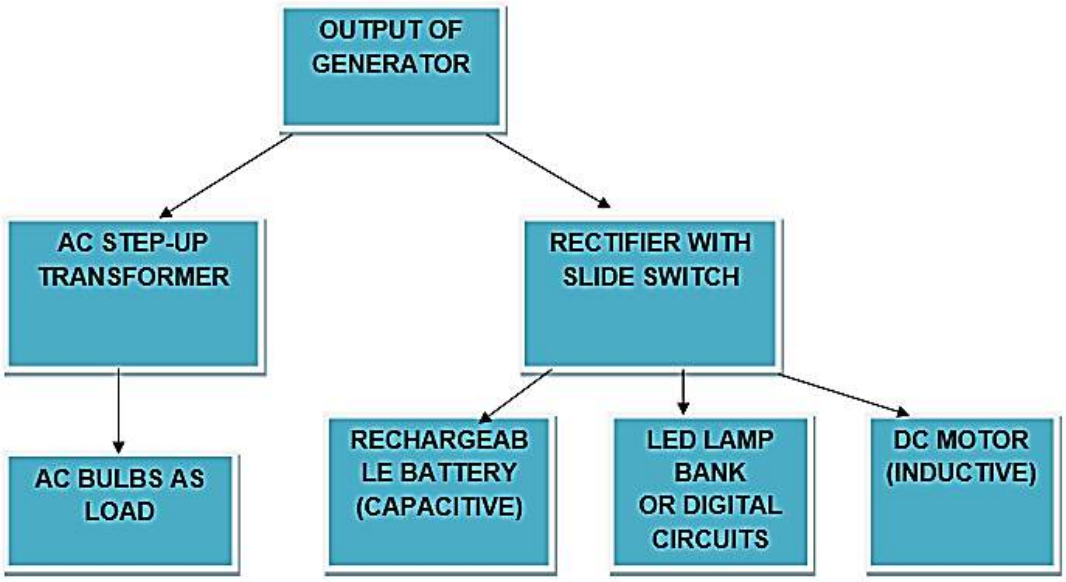

Fig.3 Applications of Generator

This rectifier output is further divided in two ways using another slide switch which provides both 5v and 12v dc output voltage. this output of the rectifier is given to resistive, capacitive, and inductive loads. The output of

5v rectifier circuit is given to LED lamp bank. The 12v rectified output is given to capacitive load which is a 6v battery and also to 12v motor which is used as inductive load.

VI. CONCLUSION

The urge for electricity in present world is rapidly growing but at the same time resources required for the generation of electricity are horribly depleting. By keeping this point in view, we decided and succeeded in making a working model which can cope up with these limitations since our project needs muscular energy which is non-conventional. Thus, the urge for electricity can be made up in the near future by putting this concept into actual use.

In addition to this, our generator is portable, that is, it is very easy to dismantle and re-built is again in no time. This makes it possible to carry wherever necessary, such as, places where electricity is not easily available and could be required at any instance.

After some observation, it was observed that this technique of electricity generation can be applied in much other day-to-day work. For ex. sewing machine, cardio cycle at the gym, treadmill etc.

Its construction is same as that of an ordinary generator. But the unique thing is that this generator is portable. It provides both AC and DC outputs simultaneously with the help of slide switch. Also, at the DC circuitry part, another slide switch is provided to obtain 5volts and 12volts DC outputs simultaneously.

During the testing and various calculations of the generator, it was observed that it has very good voltage regulation at inductive load. Although the 'VA' capacity of the generator is low, still, it is very effective in case of small appliances and emergency usage.

At the rectifier part, the DC circuit for the output is so designed that we can make the most output from it. In case of any electricity shortage, a minimum 12volts of battery can be charged and put into use accordingly.

Hence, it can be concluded that the overall project gives satisfactory output and is very useful in any case of urgency. Also, the near future will be implementing similar techniques and models to substitute conventional energy resources. Even the market importance and scope will be at the peak after some modification and exhibition.

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