Novel Design and Analysis of Free Electric 2.2 Machine

S. Usha, A. Geetha, T.M. Thamizh Thentral, C. Subramani, Pranjul Mani Dubey

Abstract: As per the data provided by the governments of Bihar, Uttar Pradesh and Assam, 82.84 per cent, 72.97 percent and 62.93 percent of their rural households, respectively, are still without any access to electricity. Every Machine to perform its function needs electricity, therefore electricity is the basic backbone which is needed to drive even a small machine. It has become a necessary piece of development that has led to the rise of other development. 500 million people are still left without electricity. This paper aims at designing a machine which will use electro-mechanical energy of the body to generate free electricity for the basic needs and is eco-friendly i.e.it will not cause any kind of pollution. The Free Electric 2.0 machine is created, which works on a normal and simple principle of an electrical dynamo. The basic idea is, whenever the machine is paddled, it results in rotation of a free wheel. The free wheel is connected to a shaft and the shaft is connected to another free wheel on the other side. This free wheel is connected to a wheel which is connected to generator. Power thus produced is stored in a battery and can be used for the basic necessities like lightning bulbs, fan and charging mobiles. The major necessity of this type of machine are in places which are very hostile or places which doesn't have a power grid line setup. It can also be used in places which are prone to disaster. Having this device at our homes will provide electricity for at least the basic necessities

Keywords: Alternator, free electricity, Machine design neodymium magnet, permanent magnet rotor.
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I. INTRODUCTION

The generator uses neodymium magnets as a rotor and the stator consists of coil. So whenever the rotor moves, it induces an EMF in the stator coils and hence the voltage is produced. The major necessity of this type of machine are in places which are very hostile or places which doesn't have a power grid line setup. It can also be used in places which are very prone to disaster. The proposed design is very cheap, eco-friendly and portable. The alternator used in the model is of minimal cost, which works less than the synchronous speed, and does not require any kind of excitation to produce AC current. Therefore, the proposed design can be used in hostile places to produce electricity for their basic requirement like lightning bulbs, charging phones, etc. The major problem in terms of providing electricity is to provide cheap, ecofriendly and continuous supply of electricity. Everything in today's world requires electricity hence it is a great equalizer. Scarcity of electricity is one of the major concerns in today`s world. There should be effective utilization of electricity and it should be cost effective (Mukhopadhyay, 2003; T.Meenakshi, S.Sujithkumar, S.Suganya, 2014). It is the most essential thing that gives rise to all others. Many Indian villages still don't have a power grid implying that they still lead a primitive lifestyle similar to that before the discovery of electricity. In case of disasters the destruction caused results in the area getting cut off from the rest of the world thus increasing severities. As the population is increasing, the demand of energy is also increasing which is resulting in the depletion of fossil fuel reserves of the earth. So it is very important to find an alternative and a cheaper source of energy. So as to provide financial benefits and to produce a clean energy this project is ecofriendly and doesn't burns any fossil fuels (Imran khan, Muhammad Amin, Muhammad Imran., 2014) but by using this machine enough electricity could be paddled to meet the basic requirements.

The Objective of this paper is to make a machine which is eco-friendly, cheap, easy to maintain and capable of producing electricity at any time and at any place which can be used at the time of emergency. The concept of producing electricity using magnets and dynamo is not new; it has been in practice from the olden days. But producing electricity for the basic needs using the same principle is a new concept and it is a key for clean and cheaper energy (Himank Pratap Singh, UtkarshSrivastava, OmPrakashYaday, 2015). In a normal ac generator RMF is provided by the additional DC supply connected, but these types of generators have many drawbacks like the DC supply needed for working of the generator (Manoj Gattani, 2012).Permanent magnet based motor and generator is a new field in electrical engineering and the energy generated is the efficient solution for many applications (M. Vishnu Raajan, R.Bharanikumar, S.Bhuvaneswari, C.Subramani, 2015)

The earlier models made using this principle have a very long history and the latest known model in this principle is known as "free electric" and was manufactured by a company named "Billions in Change". They have used a model which uses an alternator and a battery for storage. But the major drawback of that model is that it is very costly and the construction is also complex. The proposed model has been designed keeping the factors -Cheaper, Easier Maintenance, user friendly in regard.

S. Usha, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Chennai, India. Email: ushakarthick@gmail.com

A. Geetha*, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Chennai, India. Email: geeanbu@gmail.com

T.M. Thamizh Thentral, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Chennai, India. Email: thentral2kuna@gmail.com**.**

C. Subramani, Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Chennai, India. Email: csmsrm@gmail.com**.**

Pranjul Mani Dubey, Unacademy Institute, India.

The free electric is basically a device which uses electro-mechanical power of humans to generate electricity. Pedaling for 1 hour will result in electricity for 7-8 hours at a stretch. Its basic principle is based on a normal dynamo. The construction of this machine is made very simple, so that it can be handled by anyone, at any place and at any time. It is made up of a standard bicycle pedal, some weight, an alternator and a normal 12 volts battery. By considering the aspect of simplicity, there is only one gear set which spins the flywheel which turns the generator which in turn charges the battery. Under working condition, the cycle yields enough electricity to serve one house with clean electricity. Using pedal power to generate electricity is not a new idea. Conventionally dynamos were used to produce electricity, but before free electric came into existence there wasn't any device that could generate sufficient electricity for a normal home usage at a low cost.

In this work chapter II describe the basic model of the machine. Chapter III explain about the Chapter IV describe PWM scheme for the proposed inverter. Chapter V delineate simulation circuits and results of 9 level transistor clamped H Bridge cascaded multilevel inverter. Finally, it is concluded in Chapter VI.

II. THE BASIC MODEL OF THE MACHINE

Producing power with the help of a dynamo in cycle is a very old concept and has been used many a times but producing power in such a great scale for basic necessity is a new and innovative concept. On observing the present situation electricity has become one of the major necessities today. In keeping all this in mind a company named billions in change lead by Manoj Bhargawa invented a model which can produce electricity. They claimed that if the machine is pedaled for one hour in stretch enough electricity is produced for 7 to 8 hours for basic necessity. They use the normal construction consisting of bicycle chain, generator, etc. It consists of a paddling unit connected with a bicycle chain connected to a generator and a battery. This type of machine can be very useful in areas where there is no electricity. But the major disadvantage of this machine was that the cost of this machine was very high which can't be afforded by poor people.

The size of machine was also very big due to which it was not portable. The normal alternator works on the principle of electromagnetic induction it consists of two parts a rotor and stator. The stator contains the armature windings and the rotor consists of field winding. According to the faradays law of electromagnetic induction whenever a coil is moving in a magnetic field it produces an EMF in it and AC generator uses a RMF (rotating magnetic field) for the production of alternating current. For attaining this, conventional AC Generators uses an external excitation system. In this a DC current is supplied to the field winding of the stator and when the rotor rotates it produces an AC current in the stator. The major disadvantage of such AC generators is that such generators require an external circuit for excitation of the field winding and this type of generator (synchronous generator) requires a synchronous speed to work i.e. 1500 rpms of speed. The self-excitation system for excitation is used then also DC supply needed at the time of starting of the generator and

attaining a speed of 1500 rpm which is not an easy task to achieve. The proposed paper discusses about a machine in which to develop a generator which does not require any type of external excitation system for working and it also does not require to attain a synchronous speed for producing alternating current.

The machine uses all the basic components which can be easily available at any part of the world. The machine mainly consists of some parts of bicycle, normal cycle gear set, an alternator, battery, Converter, charger and the frame. Also, the objective has been to make the construction of the machine easy so that it can be repaired and maintained in anywhere irrespective of the sources available.

Basically, the machine can be divided in two parts, first is the rotation machinery and the second is the stationary part. The stationary part consists of a frame work which holds a generator, seat and a pedaling unit together. It forms the basic structure of the machine. In other words, it holds the machine together. In the initial model, the size of the machine was very large but by constant innovation and attempts, its size has been reduced. The rotating part is the heart of the machinery and provides electricity. It includes the pedaling section, gear set and a generating section. Firstly, the pedal is connected to a free wheel through a chain. Then, this free wheel is connected to a shaft which is connected to a second free wheel. This free wheel is connected to a wheel through a long chain which contains generator and the process of free electric two is shown in Figure 1.
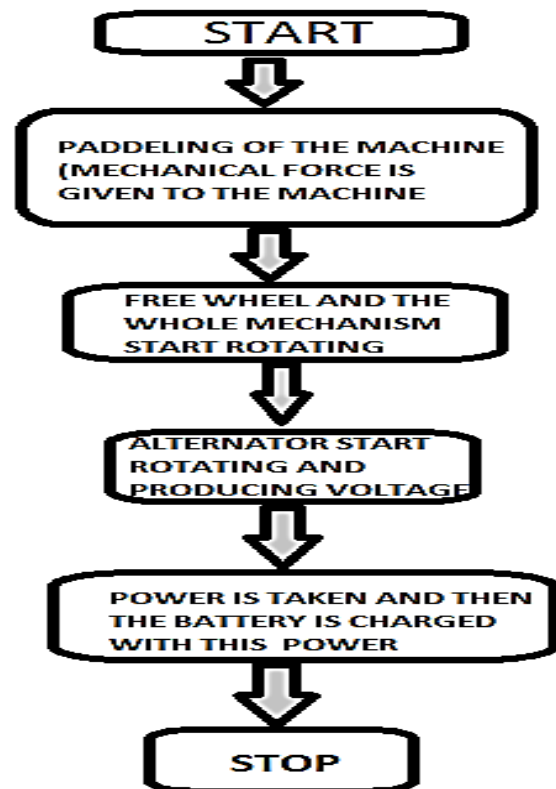

Fig.1. Flow chart for basic model of machine

In the earlier models, since the gap between the free wheels and the wheel was very large therefore at the time of operation, the chain displaced itself from its position. This problem was eliminated by the use of an auxiliary free wheel which balances the tension of the chain and also gives the support to the chain. But in secondary models, this problem has been overcome by using a special type of arrangement which is more effective and has a greater efficiency. It has an efficiency of about 85%. For the shaft to rotate, two bearing of no. 6002 which are held with the help of clamps on the base and the shaft that goes through the bearing inner hole have been used. In order to keep the operation of machine as simple as possible, continuous attempts and innovations are being carried out to achieve more stability and easy operation. This model demonstrates a speed of 500 rpm if used at normal operation. If the user can pedal with more strength it can reach speeds up to 650 rpm under tested condition. Overall construction of proposed machine demonstrated in Figure 2.
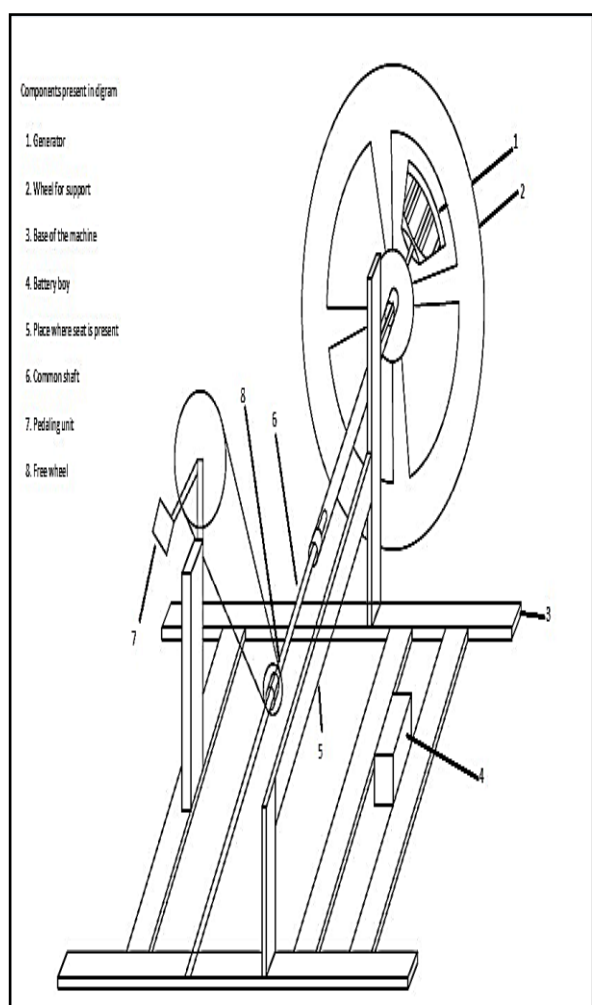

Fig.2. Construction diagram of proposed machine

The major advantage of our model is Ecofriendly, Cheap maintenance, Easy construction, Simple working, and highly robust, cheapest generator in its field, does not produce any kind of pollutant and can be used in any condition

III. MODELLING OF THE PROPOSED GENERATOR

This Electromotive Force induced in a Direct Generator depends upon its speed, number of armature inductors connected in between the brushes and the total flux per pole.

It does not depend on the manner in which flux is distributed, provided the brushes are in neutral phase. But in the case of Alternator or AC Generator, however, the electromotive force depends upon the way in which the flux is distributed. It can be said that the same total flux will give different value (maximum and root-mean Square) of electromotive force, by the mere change in its Distribution pattern. In AC Generators, the electromotive force will also depend on number of Armature windings and its pitch and coil speed. The electromotive force induced in any coil on the armature of an Alternator is given by $e = -N \dfrac{d\phi}{dt}$ (1)

Where 'N' is the number of turns in coil 'e' is the Electromotive Force. Each coil consists of a number of turns which are laid in single pair of slots. All the coils are connected either in Lap winding or Wave winding Let the flux from the poles be distributed such that the flux linking with any Armature coil varies as some function of maximum flux ϕ_m and Angular displacement α The root-mean square value of this Generator is the same as the normal one.

$$e = -N\left[\frac{1}{\pi}\int_0^\pi \left(\frac{d}{dt}f(\phi_m,\alpha)\right)^2 d\alpha\right]^{\frac{1}{2}} \quad (2)$$

$$e = \omega N \phi_m \sin \omega t \quad (3)$$

$$E = \omega N\left[\frac{\omega}{\pi}\int_0^{\frac{\pi}{\omega}} \varphi_m^2 \sin^2 \omega t\, dt\right]^{\frac{1}{2}} \quad (4)$$

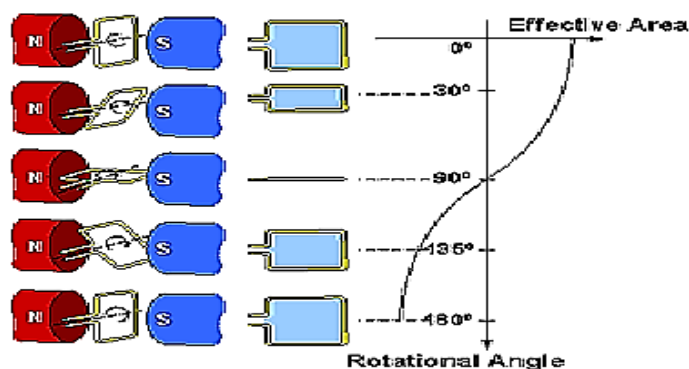$$E = 4.44 N \phi_m 10^{-8}\, volts \quad (5)$$

Fig. 3. Waveform of the magnetic field in different orientation of the coil.
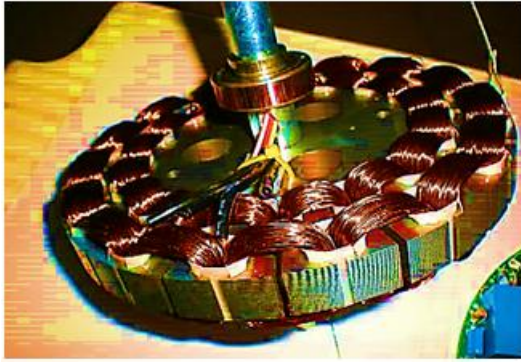
Fig. 4. Stator coil with primary and secondary winding

IV. CONSTRUCTION WORKING AND ASSEMBLY OF THE MACHINE

A normal ac generator converts mechanical energy into electrical energy in the same way as a dc generator does by means of electromagnetic induction. The generator converts mechanical energy into ac current and voltage. The normal type of ac machinery uses slip rings which are connected to the end of the armature coils and to the generator brushes. Therefore, in normal operation when the armature is rotated in magnetic field a voltage is generated at each end of armature coil. Normally all the ac generator uses a slip ring but the generator which has been created here is a bit different is eliminated. The use of slip ring in the generator thus reducing the cost and losses from a normal ac generator. A normal generator consists generally of two most important parts stator and rotor.

The Stator is termed as the stationary part of the Machinery and generally contains the Armature windings. The Stator which have used in somewhat similar to a Ceiling fan winding or a Ceiling fan coil. The construction of Stator uses iron stampings. Soft iron sheets are mounted together for making the Stator and coil spaces are cut at the circumference. The arrangement of coils is in the form of Lap winding. A Shaft is connected from between of Stator which holds the Rotor to Stator. Unlike the normal AC Generator, Stator is present in middle of the Generator and Rotor arrangement is available at the circumference. An enlarged section of a Stator coil or how the Stator coil is present in the Generator has been presented in Figure 4.

The Stator which has been used here has the following specifications. The Stator consists of two types of windings-one is known as Primary winding and other is known as Secondary winding. The Primary winding is present at outer circumference while the Secondary winding is present at inner circumference. The output is taken from the Stator itself using wire since Stator is always stationary. No carbon brushes or slip rings are used hence eliminating the loss due to carbon brushes and at the same time reducing the cost of the Generator. The Rotor employed in the proposed machinery is of very special type because of the usage of Neodymium magnet. A Neodymium magnet (also known as Nd_2Fe_2B magnet) is the strongest permanent magnet on earth. It has a very high magnetic field. In this Rotor, for producing a magnetic field strong enough to produce voltage, ferromagnetic magnet is not enough. So for creating desired amount of magnetic field, a special type of magnet known as Neodymium magnet has been incorporated. For this Rotor employed here Neodymium magnet of dimensions-25mm*10mm*2mm has been used. A small cylindrical kind of shape is constructed and the Stator magnet

is placed inside the cylinder. These small magnets are placed in a regular arrangement of North and South that is one magnet is placed facing North Pole and other is placed facing South Pole. They are arranged in such a manner so as to produce a regular magnetic field which is shown in Figure 5.
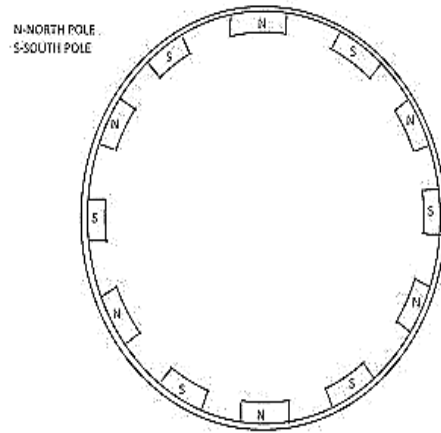

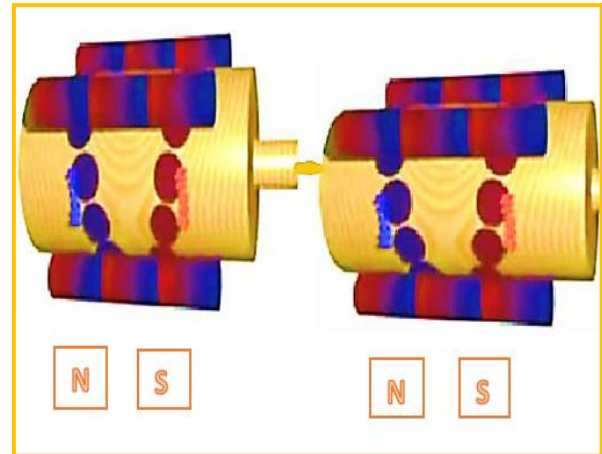**Fig. 5a. Planning of the magnets in rotor**

Fig. 5b. Arrangement of the Magnets in rotor

Table- I: Specification of rotor

Parameter	Value
Radius of Stator	6.5 Cm
Number of Coils in 1st row	14
Number of Coils in 2nd row	14
Thickness of core	1.2 Cm
Thickness of Stator	2.5 Cm
Length of Single coil (1st)	3 Cm
Length of Single coil (2nd)	2 Cm
Type of winding used	LAP Winding

The Neodymium magnet has a magnetic field of nearly 350mT at 1cm distance. The distance of air gap length is nearly 1.5mm (L_g).In order to have one magnetic pole for each stator coil, 14 poles made up of magnet have been used.

As of now, as the rotor rotates it produces a rotating magnetic field (R.M.F) because of the presence of magnet inside it. In accordance with faraday`s coil cuts a magnetic field it induces an EMF and hence ac current and ac power can be obtained by increasing the number of poles.
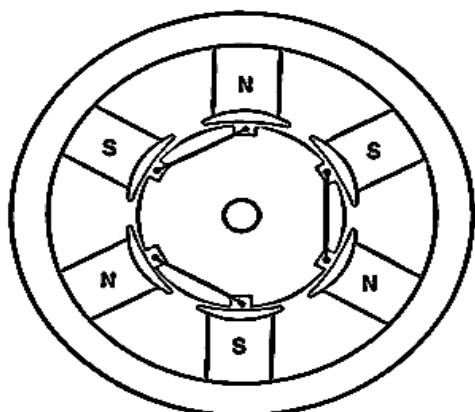

Fig. 6. Arrangement of magnet and direction of its magnetic field

This generator has a capability of producing 440 volts with more than 4 amperes hence making it the world's cheapest generator. As the user starts paddling the paddles, a chain is connected through it to a Fly wheel. This fly wheel is connected to a shaft and another Fly wheel is connected to the end of the shaft. The second Fly wheel is connected to the wheel at the far end and the wheel is connected to a Generator. Therefore, when the user paddles the Machine, Chain moves due to which the Fly wheel moves. Since it is connected to a shaft so the shaft also starts rotating. This Shaft is also connected to the second Fly wheel so now it also starts moving. The wheel also moves and the Generator also starts working. The supply of the Generator is connected to a battery passing through a Convertor and then this supply can be taken for normal usage. The Arrangement of magnet and direction of its magnetic field is shown in Figure 6.

In order to increase the net output produced by the machine a parallel generator system is used in which the two generators work parallel to each other in same direction of rotation this result in increasing the net output and efficiency of the machine.
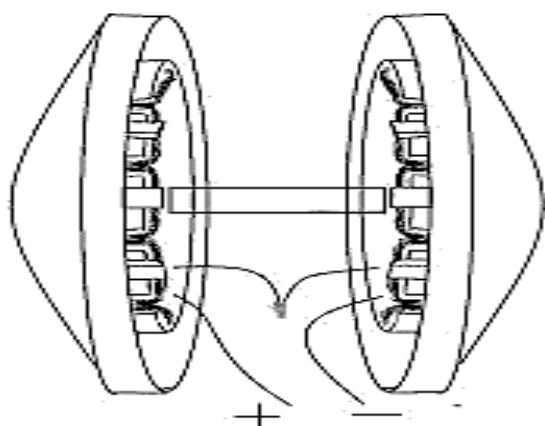

Fig. 7a. The parallel generator

The specifications of stator parameters and values are presented table 1. voltage.Currently220 volts with 0.9 to1 ampere can be produced but an increase in the net output law of electromagnetic induction whenever
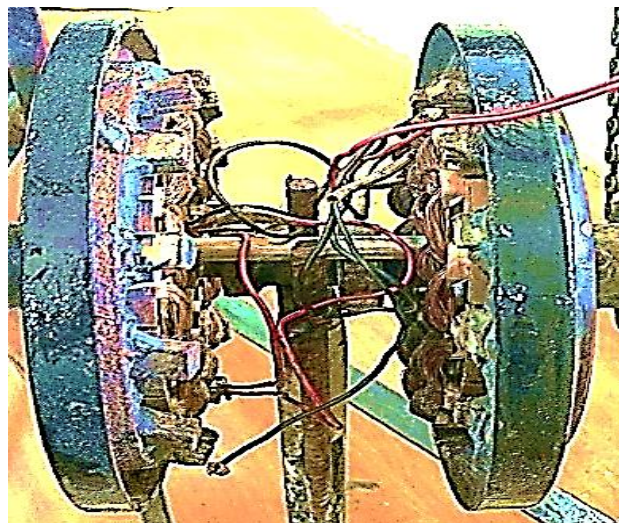

Fig. 7b Hardware setup for parallel generator

The figure 7 shows the setup of the parallel generator as per the system in the machine this setup results in higher output and increased efficiency.

V. RESULT AND DISCUSSION

While testing the generator mentioned here, various types of magnetic arrangements have been tried for the rotor, but most of them failed while producing the output.

A. The First Testing

For the first testing a small disk shaped 20mm diameter magnet was used. But since these magnets were having very less magnetic field only 2 volts was obtained. Thus, it was not enough as the magnetic field was very less.

B. Second Testing

During second testing a disk-shaped permanent magnet which was 15 cm thick and 15 cm in diameter was used. For this arrangement, two permanent magnets of Ferromagnetic setup.

The machine showed in Figure 8. has some successful results as compared to the first testing thereby giving 16 volts but this much voltage was not enough and this design had many flaws which were as follows-Since for producing power, magnets were to be placed very close to the coils. This resulted in repeated damage to the coil. The system is very fragile mechanically. The weight of the generator increased drastically as bigger piece of magnet was placed. The system could get damaged very easily as it was not so robust. Holding the stator at the center position was not easy. Therefore, this model failed.

C. Third Testing

Failure of the last model, led to the usage of some small component which were having less weight and more strength to produce magnetic field.

With the idea of using 5mm*10mm*2mm magnet of ferromagnetic material, the mentioned problem was rectified. This was smaller, stronger and better. But now the bigger problem was to find an arrangement of magnets which could give the highest possible magnetic field. In a nutshell, the aim was to find out an arrangement which would give the greatest efficiency possible. This was the major concern now.

**Fig. 8. Output voltage in second testing**

Fig.9. Complete arrangement and representation of the generator in final testing

In this arrangement half side of Rotor was covered with North side of the magnet and other half side of the Rotor was covered with South side of the magnet. It was a good idea but was able to generate only 5 V of voltage similar to the Second Testing soother alternatives were explored. The arrangement with North South -North South pole was the most successful arrangement so achieved. It was the most efficient technique for producing voltage. In this arrangement a voltage of 220V and 2A of current is being obtained. In this arrangement magnets are arranged in the North South- North South fashion, so in total 14 poles are used thus 7 poles are North poles and 7are South poles. This was the most efficient and the best method to produce maximum magnetic field. The complete arrangement and representation of the generator in final testing is shown in Figure 9 and figure 10.

As per the testing, the whole machine is capable of producing a voltage of nearly 210-217 volts and 2 amperes current when run at 600 to 650 rpm. Also, the machine was capable of charging a battery, lighting a CFL and making a fan work under tested conditions. The machines can easily a speed of 600 rpm in the normal operation which is shown in Figure 11.
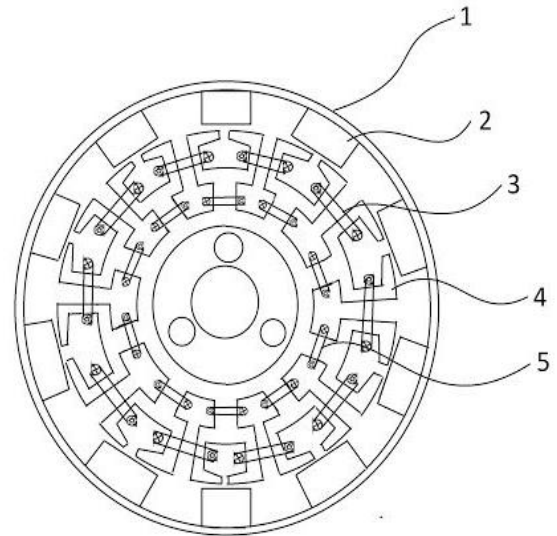
1. ROTOR
2. MAGNETS IN ROTOR
3. STATOR OUTER COIL
4. STATOR CORE
5. STATOR INNER COIL

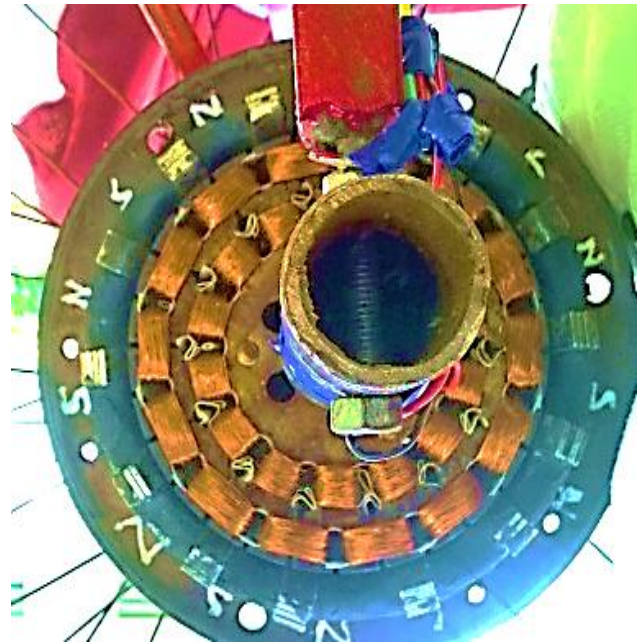**Fig. 10a. Complete arrangement and representation of the generator in final testing**

Fig. 10b. Hardware setup for complete arrangement and representation of the generator in final testing.

Fig. 11.   output voltage in final testing

D. Fourth Testing

From the third testing a new model is created which was more light and more portable and in our final model a parallel generator is placed in the system is shown in figure 12.It is able to attain a voltage of above 350 volts in just 400 rpm of speed and the total cost of machine is also very less

Fig. 12. Full setup of the machine consisting of parallel generator system

VI.   CONCLUSION

This paper presents a Model to produce free electricity using electromechanical power of humans. It is cheap, user friendly and easy to maintain. With the capability of generating 220 volts and 2 amperes of current, it can be used for normal home usage at a low cost. By using the principle of faradays law of electromagnetic induction, a new machinery has been developed which is the world's cheapest machine. It can be used in Hostile at dangerous places or in places where there has been a natural calamity. Hence this model can be used at any place and at any time.

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AUTHORS PROFILE

Usha Sengamalai, she received B.E Electrical and Electronics Engineering and M.E Power Electronics and Drives from Anna University, Chennai in 2007 and 2012 respectively. She is currently pursuing Ph.D in SRM University, Also working as an Assistant professor in the department of Electrical and Electronics Engineering SRM Institute of Science and Technology. Her area of interest is Power Electronics Converters and Stability analysis of Induction motors.

A. GeethA, he received her Bachelor's Degree in Electrical and Electronics Engineering from Shri Andal Alagar College of Engineering (Anna University) Tamilnadu, India, and Master of Technology in Power Electronics and Drives from SRM Institute of Science and Technology, Tamilnadu, India, in 2009 and 2012 respectively. She is currently working as an assistant professor in the department of Electrical and Electronics Engineering SRM Institute of Science and Technology. Her research areas of interest are: Energy Management, Electric Vehicle, Battery Management system, Electric Drives and its Control.

Thamizh Thentral T M, Received Her Bachelor Of Engineering Degree In Electronics And Communication Engineering From Periyar Maniammai, College Of Technology For Women, Vallam, India, In 1994 Under Bharathidasan University; And Her Master Of Engineering Degree In Power Electronics And Drives From Anna University (Easwari Engineering College,) Chennai, India, In 2008. She Is Presently Working In Srm Institute Of Science And Technology And Doing Part Time Ph.D. Degree At Srm Institute Of Science And Technology, Chennai, India. Her Current Research Interests Include Shunt Active Filters And Power Quality.

Subramani Chinnamuthu, he received B.E Electrical and Electronics Engineering from Bharathiar University and M.E Power Systems from Anna University, Chennai in 2004 and 2006 respectively. He has completed Ph.D degree in Electrical and Electronics Engineering from SRM University in 2012. He is presently working as an Assistant professor in the Department of Electrical and Electronics Engineering SRM Institute of Science and Technology. He has published 52 research papers in referred International Journals/Conferences. He is having 15 years of teaching and industrial experience. His research areas are power system stability, power system control and FACTS, electrical machine design.

Pranjul Mani Dubey, he received B.Tech Electrical and Electronics Engineering from SRM Institute of Science and Technology. He is an educator at Unacademy and teaches gate and electrical engineering. He has a keen interest towards power generation and distribution systems and always been interested towards learning new things related to it. He created many projects such as pulse motor and try to find out solutions to complex problems.

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