

TITLE - REGENERATIVE POWER GENERATOR

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ABSTRACT

The regenerative power generator gives net power output which is more than the conventional generator. The regenerative arrangement is capable to produce electric power by using faraday law of electromagnetic induction principle along with conventional generator. In regenerative power generator, the new regenerative arrangement of install on extended part of shaft. Extend part shaft up to quite affect on current efficiency of power plant. A light weight non-metal circular disc (Ring) fixed on middle position of shaft with 4 Aluminum or shielding metal chips laterally fixed on compact circular disc (Ring). A base frame for holding a non-ferrous metal circular ring is installed around the circular disc (ring) at middle position of shaft between generator and turbine impeller. The circular ring hold the 'U' shape type of magnets (bend end faces of magnet appear as poles are opposite of each other with air gap) as the magnetic field of magnets easily break by Aluminum metal chips. The 4 'U' shape magnets suspended along inner periphery of circular ring, out of two of them parallel and remaining two are perpendicular to axis of rotation of shaft, the each magnet having copper coil winding wounded along the surface. When the shaft rotates, also circular disc rotates with Aluminum metal chips, as chips passing through the 'U' shape magnetic field then time variant magnetic flux generates the EMF (DC voltage) in copper coil according to faraday law of electromagnetic induction. Avoiding the eddy current and air friction losses, thus system made compact, hence regenerative arrangement yield more power output than conventional generator.

Keywords : Regeneration, Power Output, Electromagnetic Induction, EMF,

I INTRODUCTION

Since realizing the application of electricity, the various methods have been used to generate electricity. Now-a-days, we are producing major electric power from nuclear, thermal, wind mills, hydroelectric power plants by using electromagnetic generator. The electromagnetic generator converts the mechanical power into electric power using principle of faraday law of electromagnetic induction.

The operating principle of electromagnetic generator was discovered in the years 1831-1832 by Michael faraday. The faraday given the first experimental demonstration on August 29, 1831, then the principle was later called as faraday's law of induction which was an electric conductor which encircles a varying magnetic flux. H.C. Oersted in

1820, demonstrated that electric currents produce a magnetic field. Faraday noted this and in 1821, he experimented on the theory that, if electric currents in a wire can produce magnetic fields, then magnetic fields should produce electricity.

In the paper of 1831 in which he described his discovery of electromagnetic induction, he presented law in the terms of wire cutting the magnetic curves or magnetic line of force which defined as follow (17, p.281, 114), Faraday told the line of magnetic forces, modified by using juxtaposition of poles, which would be depicted by iron fillings; or those to which a very small magnetic needle would iron tangent. In 1845 he gave the definition with the following words, (1.7, p.595, 2149); Faraday said, "But before I proceed to them, I will define the meaning, I shall have occasion to use: thus, by line?/magnetic force, or magnetic line, mean that exercise of magnetic which is exerted in the lines usually called magnetic curves and equally exists as passing from or to magnetic poles or forming concentric circles round an electric current. The faraday began to mention the magnetic field in his publication presented to royal society in 1845 and published in 1846 (7,p. 608, 2247).

The faraday in 1852 published paper (7, p.758, 3071 I) faraday told, A line of magnetic force may be defined as that line describe by very small needle, it is so moved in correspondent to its length, that the line along which if a transverse wire be moved in either direction, there is no tendency of formation of current in wire, If moved in any other direction coincides with direction of magnecrystallic axis of crystal of bismuth, which is carried in either direction along it. The direction of these lines about and amongst magnets and electric current is easily represented and understood; A clear definition of faraday understood by a magnetic field appeared in paper read in 1850 at the royal society and published in 1851(7, p.690, 2806). The faraday magnetic field may be taken as any portion of space traversed by lines of magnetic power and magnetic power can be visualized by iron fillings. It is interesting to note that faraday mainly from 1851 onwards, considered the line of magnetic power (7, p.759.30571).

In 1830, Joseph Henry (1797-1878), discovered that a change in magnetism can make currents flow, but he failed to publish this. In 1832 he described self-inductance - the basic property of inductor. In recognition of his work, inductance is measured in henries. The stage was then set for the encompassing electromagnetic theory of James Clerk Maxwell. The variation of actual currents is enormous. Therefore, the time starts to build the generator by using above principles of Faraday and Henry. The dynamo was the first electrical generator capable of delivering power to industry. The dynamo uses the electromagnetic induction to convert mechanical rotation into direct current. An early dynamo was built by Hippolyte pixie in 1832. Though the series of discoveries, the dynamo was succeeded by many later inventions especially the DC generator, AC alternator which were capable of generating current. In 1871, when Gramme introduced his motor and generator, that the electric generator was used commercially. By 1872, Siemens and Halske of Berlin improved on Gramme's generator, by producing the drum armature. Other improvements were made, such as the slotted armature in 1880 but by 1882, Edison had completed the design of the system we still use to distribute electricity from power stations.

Nikola Tesla was envisioned a world without poles and power lines. Tesla's system triumphed to make possible the first large-scale harnessing of Niagara Falls with the first hydroelectric plant in the United States in 1886. With the DC generator being in operation by 1882, it was not long before the first direct-current central power station built in the United States, in New York, was in operation in 1882. Around this period however, the scientists were still active, as they realized that with DC current, they could not transmit it over long distances. Nikola Tesla, was experimenting on generators and he discovered the rotating magnetic field in 1883, which is the principle of alternating current. This rotating magnetic field changes in opposite directions fifty times a second and is called 50 Hertz. The alternating current generator has a rotating magnetic field and is referred to as a A.C. current. The direction current generator generates current in the one direction hence DC current. He then developed plans for an induction motor, that would become his first step towards the successful utilization of alternating current.

In 1885, George Westinghouse, head of the Westinghouse Electric Company, bought the patent rights to Tesla's poly phase system of alternating current. In America, in 1886 the first alternating current power station was placed in operation, but as no AC motor was available, the output of this station was limited to lighting. Although Tesla developed the poly phase AC induction motor in 1883, it was not put into operation until 1888 and from then on, this AC motor became the most commonly used motor for supplying large amounts of power.

The alternating current generating system is known simple forms Michael faraday original discovery of magnetic induction of electric current, but there are mechanical power losses of rotation, also the problem associated with above power generation that efficiency in power generation is low. Hence there is need for simple, efficient method for giving more output power than traditional electricity generation system. The embodiments of present invention are shown in figure, which shows conversion of the mechanical power into electrical power by physically coupling with generator and regenerative apparatus arrangement at middle position of shaft for generating time variant magnetic flux that yields electricity. The cost of utilizing new regenerative arrangement along with conventional generator is not much more than the conventional generator, that's reason regenerative power generator efficient over conventional electricity producing system.

II OBJECTIVES

- To utilize the existing electricity generation system for continuous improvement in power output.
- To find economic energy producing system.
- Approach towards the need of searching constant energy source.

III FARADAY LAW OF ELECTROMAGNETIC INDUCTION

In 1831, Michael Faraday showed that a changing magnetic field can induce an emf in a circuit. Consider a conducting wire loop (a closed circuit) connected to an ammeter (A) with a bar magnet (initially at rest) placed

above the center axis of the wire loop, as shown in Figure. When the magnet is held stationary, there is no current in the loop, even if the magnet is inside the loop. However, when the magnet is brought near (or pulled away from) the loop, the ammeter needle deflects indicating an induced current in the loop produced by an induced emf. From these observations, Faraday concluded that there exists a relationship between the induced current/emf and the changing magnetic field.

The results of his experiments are now referred to as Faraday's Law of Induction. In general, Faraday's Law states that an induced emf (E) along any closed path in a magnetic field is equal to the rate at which the magnetic flux sweeps across the path. The closed path can be thought of as the surface within the path that the magnetic field intercepts. Quantitatively,

$$E = -d\Phi B / dt \quad - (1)$$

where ΦB is the magnetic flux through the closed path, expressed as $\Phi B = RB \cdot dA$. If the loop enclosing the area A lies in a uniform magnetic field B , then the magnetic flux is equal to $BA \cos(\theta)$, and thus the emf can be written as

$$E = -d/dt (BA \cos(\theta)) \quad - (2)$$

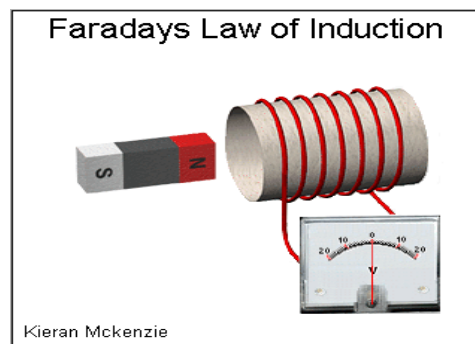


Fig 3.1 shows when change of magnetic field voltage is induced in galvanometer

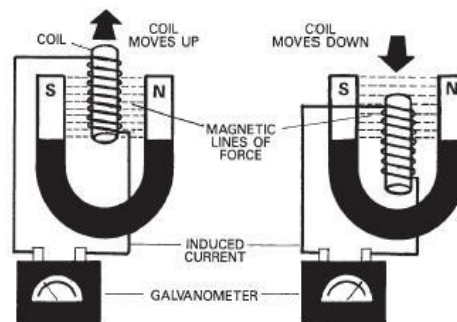


Fig 3.2 shows the change of magnetic field of U shape magnet

1) First law of electromagnetic induction

Whenever the magnetic flux linked with a circuit changes, an EMF is induced in it.

OR

Whenever a conductor cuts magnetic flux, an EMF is induced in that conductor.

2) Second law of electromagnetic induction

The magnitude of induced EMF is equal to the rate of change of flux linkages.

3.1 LENZ'S LAW

Whereas Faraday's Law defines the magnitude of the voltage induced in a coil placed in a changing magnetic field, lenz law defines the polarity (direction) of the induced voltage. When the current through a coil changes, an induced voltage is created as a result of the changing electromagnetic field, and the direction of the induced voltage is such that it always opposes the changes

IV LIST OF MATERIALS

SR.NO.	MATERIALS	QUANTITY
1)	Generator	1
2)	Motor / Impeller	1
3)	Basement frame for holding Non-ferrous metal Circular ring	1
4)	Compact Circular disc	1
5)	Aluminum or shielding material chips	4
6)	'U' shape magnet (bend end faces As poles of magnet appear opposite Of each other with air gap)	4
7)	copper coil windings	4
8)	Ammeter/ Multimeter (power Output measuring device)	2
9)	LED bulbs/ power lines	4
10)	Battery source for storing Electricity	2

V NOMENCLATURE

- 1- Basement frame
- 2- Impeller
- 3- Shaft
- 4- Generator
- 5- POMD1 Power output measuring device 1

- 6- POMD2 Power output measuring device 2
- 7- Power line to POMD 1
- 8- Power line to POMD 2
- 9- Non - ferrous metal circular ring
- 10- Compact Circular disc
- 11- Power collecting lines

- 12,13,14,15, - U-shaped magnets with copper coil winding 1,2,3,4

- 16,17,18,19, - AMC1, AMC2, AMC3, AMC4 Aluminum metal chips

- 20,21,22,23 - Power lines of magnets 1,2,3,4

VI CONSTRUCTION

Drawing shows the embodiments of invention. The starting point of system is impeller which drives the shaft means produced mechanical energy as mechanical power. The impeller requires enough speed to system run up and running operation of power plant. The shaft is connecting element which is physically coupled with generator for the purpose of converting mechanical power into electric power. Where I slight increase the length of shaft for installing new regenerative apparatus arrangement. The new apparatus arrangement consists the non-metal compact circular disc with Aluminum metal chips fitted on disc body; both should be laminated for avoiding the heat losses.

The compact circular disc should be mounted stationary on the middle position of shaft between impeller and generator. The basement frame created to providing stationary support to non-ferrous metal circular ring , the circular ring can rigidly hold the magnets by using holding elements along the inner periphery of circular ring . The circular ring holds two magnets parallel and two are perpendicular to the axis of rotation of shaft .The 4‘U’ shape magnets with bend end faces of magnets as the poles of magnet appears opposite of each other with the some constant air gap in poles are used in regenerative arrangement. The magnet having copper coil winding wounded along the surface. The coil changes the shape during the operation that’s reason coil is bind to the magnet. The electric power producing device either AC or DC generator .

The system shows AC generator . The generator and basement frame installed in stationary position. The output power lines of copper coils connected to power collecting lines, further the power collecting lines electrically connected to power output measuring device. The generator is electrically connected to power output measuring devices through power lines.

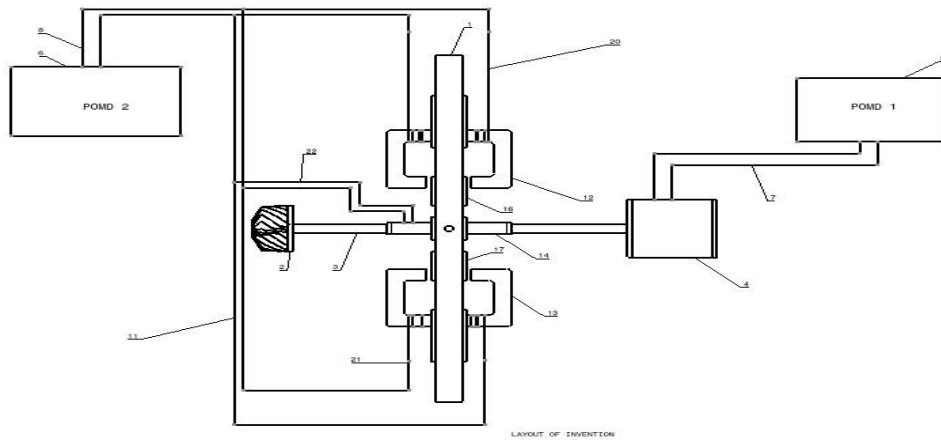


Fig .6.1 shows the Layout diagram of regenerative power generator

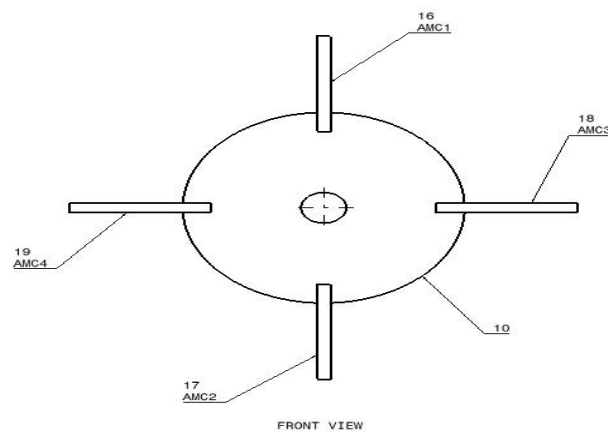


Fig 6.2 shows the Front view of circular disc

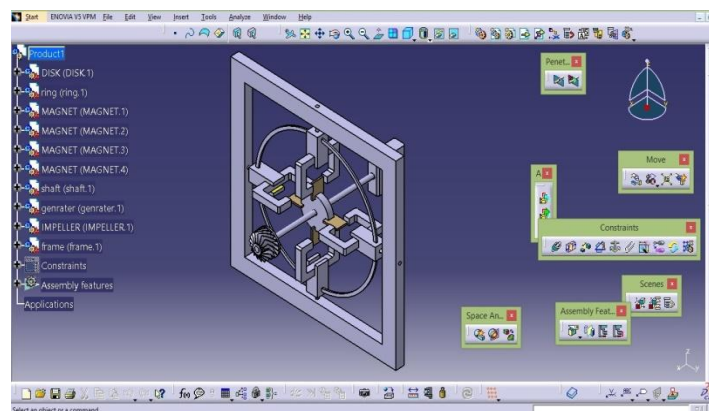


Fig 6.3 shows that the isometric view of regenerative power generator

VII WORKING

Further description is given on the embodiments present in the invention occupying with the following figure.

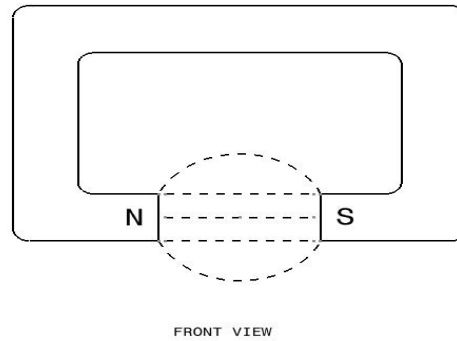


Fig7. 1Shows ‘U’ shape magnet with its magnetic field shown by magnetic line of force.

(Where magnet having bend end faces appears as poles are exactly opposite of each other with air gap)

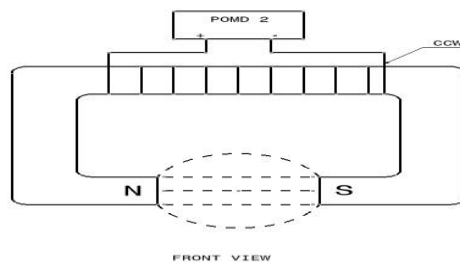


Fig .7.2 Shows ‘U’ shape magnet with copper coil winding

U’ shape magnet with copper coil winding which shows the magnetic field with air gap, hence there is no voltage induced.

- 1) U-shaped magnets with copper coil winding 1,2,3,4
- 2) CCW – Copper coil winding

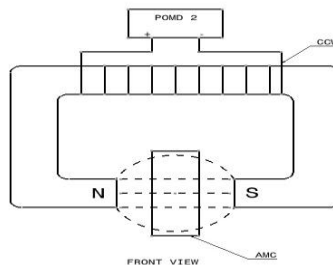


Fig.7.3 Shows ‘U’ shape magnet with copper coil

Shows 'U' shape magnet with copper coil winding in which magnetic line of force broken by Aluminum metal chips. The figure shows induced voltage in copper coil winding.

1) AMC - Aluminum metal chips

2) POMD2 - Power output measuring device 2

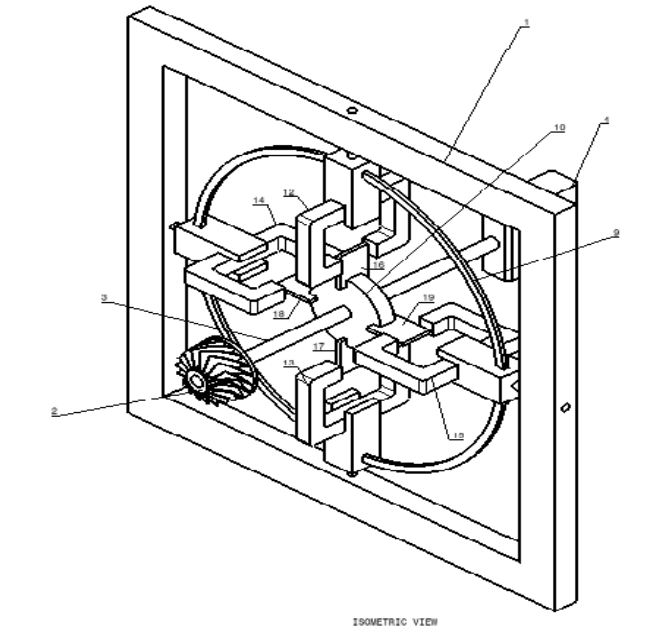


Fig 7.4 shows the Isometric view of regenerative power generator

The power transfer mechanism is positioned to transfer energy by the shaft to generator and circular compact disc by physical contact. When impeller rotates the shaft means the system start up running operation, the circular disc also rotates along with shaft. The Aluminum metal chips are laterally fitted on disc body. The size of the chips slight less than the air gap between poles of magnet. The chips are continuously moves along with shaft between poles of magnet by the continuous movement of chips break the magnetic field of magnets, that's reason time variant magnetic flux is generates which induces the EMF in copper coils. The system consist four magnets, the power lines of each magnet connect to power collecting lines. The power collecting lines connected to the power output measuring devices which shows power output of regenerative arrangement.

The generator converts the mechanical power into electricity. The power output measure against the load on shaft. By installing regenerative arrangement, the load on shaft increases that causes decrease in the output power of generator, the generator electrically connected to the power output measuring devices through the power lines. When I take collectively power output this new regenerative arrangement and conventional generator gives net power output more than the conventional generator arrangement. Which is formulate as

$$(\text{Regenerative power generator output}) > (\text{conventional generator output})$$

That's why we realize that the regenerative power generator is capable to produce net power output more than the conventional electricity producing system

VIII METHODOLOGY

For calculating power output of regenerative power generator, we comprising the Following

1. Power output of conventional generator
2. Net power output of conventional generator and regenerative power generator.

Measuring the power output generator by using multimeter, we get power output in voltage, then Finding electric current output by using following formulas

$$1) I (\text{Electric Current}) = \frac{746 \cdot \text{HP}}{E \cdot \text{efficiency} \cdot \text{P.F}}$$

P.F – power factor

T – Torque output

$$2) \text{Power output} = VI$$

V- Voltage induced.

I – Electric current

$$3) P (\text{Power output}) = T \cdot W$$

Then we conclude, **P1** is the power produced by conventional generator

P2 is Power output of regenerative arrangement (It is the collection of power from each magnet of regenerative arrangement)

Pnet is Net power produced regenerative power generator

Pnet = power produced by conventional generator **P1** + power out. regenerative arrangement **P2**

Hence, **Pnet > P1**

IX CONCLUSION

The present invention relates to an advance method and creative apparatus arrangement for converting mechanical energy into a useable electric power output. The regenerative power generator is economic for electric power generation. This system should have compact apparatus arrangement for avoiding eddy current and air friction losses. The surface of working component like compact circular disc and Aluminum metal chips should be laminated for avoiding heat losses. The size of the regenerative power generator can be varying with power requirement. The given apparatus arrangement can be effective for all type of power plants like thermal, wind mills, nuclear and hydroelectric power plant etc. except solar energy power plant.

The present invention uses the 'U' shape magnets with copper coil winding. The shape of copper coil can change during operation; this is undesirable for generator performance, avoiding this you have to bind the winding along magnet surface. The compact circular disc and chips are made up of light weight and non-ferrous metal material like Aluminum. The output of given generator system varies with performance parameters like strength of magnet, number of metal chips, number of turns in copper coil, weight of compact disc and chips etc.

When I implement this new arrangement on rotating shaft then the output of conventional generator decreases, but I realize that the new apparatus arrangement generates electric power output from time variant magnetic flux. Thus by implementing this new arrangement power output of conventional generator decreases. When I take collectively power output this new regenerative arrangement and conventional generator gives net power output more than the conventional generator arrangement. Hence regenerative power generator is capable to produce more power than conventional generator.

10. ACKNOWLEDGEMENT

It gives us a great pleasure to present the project entitled "**Regenerative power generator**". Apart from our efforts, the success of project work depends largely on the encouragement and the guidelines of many others.

We take this opportunity to express our gratitude to people who has success in the work. We would like to show our greatest appreciation to Prof S V Deshpande from his support and help.

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REFERENCE

Journal Papers:

- [1] D.E. Tilley, Exceptions to flux rule for electromagnetic induction, *Am.J. phys.*36, 458 (1968)
- [2] A. Nussbaum, faraday's law of paradox, *phys. Educ.*7, 231 (1972)
- [3] D.K.cheng, fundamentals of engineering electromagnetism (Addison-Wesley co, New York, 1993)
- [4] Linear motion electric power generator, John A. Konotchick, *US 5347186 Sep. 13, 1994*
- [5] Variable speed operation of generators with rotor – speed feedback in wind power application, Eduard Muljadi, C.P. Butterfield, Paul Migliore, NREL (*TP-441-8169, January 28- Feb 2, 1996.*)
- [6] The method of generating electricity by Luciano Vasija, Joseph L. Perdomo, *US 6236118 B1, May 22, 2001.*
- [7] Dynamotor electric generator 11/009798 Electric generator patent application 11-009798 by Robert William Jackson, *USA. December 4/2003.*
- [8] Installation of power generation by ocean wave, Wai Fong Lee, *US 67118972 B2, Mar. 30, 2004.*



- [9] A.K.T.ASSIS, J.E.A.A. Ribeiro and A. Vannucci, The field concepts of Faraday's and Maxwell in: Institute of physics Gleb, Wataghin, university of capinas, institute of state university of sao Paul USP, 2009
- [10] Electric power generation from moving vehicles, Matthew R. Bailey, Jacob B. Angelo, Michael L.Gotcher, *US 0298222 A1*, Dec.8,2011.
- [11] Linear faraday induction generator for generation of electrical power from ocean wave kinetic energy and arrangement, Reed E. Phillips, *US 8629572 B1* Jan.14, 2014.

Books

- [1] Experiment on faraday's law of induction, second edition. *Electromagnetic field theory fundamentals* by Bhag Guru and Huseyin Hiziroglu, 2004.