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Pseudo Stator Power Generator for Multi Rotor Wind Turbine

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ABSTRACT: Wind energy is considered as one of the main source of energy in the future. But the present scenario is that the conversion rate of a wind turbine is about 50 % of total available wind passing through the drive train. This is because ordinary generator is being used for the purpose of power generation. So a new model of generator is being introduced. Usually generator consist of a single rotor & stator .But the proposed model consist of a rotor & a pseudo stator which is also a rotating part. For a wind turbine with a single rotor, the conversion rate will be 50 % . But when the proposed model is introduced, 2 sets of rotor blades will be there, which rotate the stator and rotor in opposite direction & conversion rate will be about double as that of ordinary wind turbine.

I.INTRODUCTION

In the modern world due to crisis of energy alternate sources of renewable energy are being explored and harnessed. Among the renewable sources wind energy is the most economical source.

Usually single rotor wind turbines are mostly used. But a disadvantage of such models is the low conversion rate. So various wind turbine systems are observed & various aspects are noted so as to generate an efficient turbine model. Such a model constitute a PSPG (Pseudo Stator Power Generator) which is the key part.

Pseudo Stator Power Generation is a type of generating the electricity from the special generator having no stator part as compared to the conventional generator. The name itself indicates that the stator part in a conventional generator is not present in this type of generators. In a conventional generator either the magnetic part or the armature coil is kept in static and other part is made to be dynamic so that the dynamic part forces the conductor to cut the flux in a direction and thus an emf is obtained. In PSPG both the armature and the magnetic part is dynamic so that both parts forces the generator to cut the flux at a very high rate and thus more emf is produced. PSPG is hanged type generator because it should be free to move both the main parts such as the armature and the magnetic part in opposite direction. Since the generator parts are always in dynamic motion, they must be made in such a way that stability should be maintained. Here in PSPG we can obtain double the output voltage compared to the output voltage of a conventional generator having the same rating. So here we designed a generator which can produce an
output voltage of about 60v when either the armature or the motor is made static. And while the both are in dynamics it can produce a voltage of about 120v. The
both part is rotated opposite with a speed nearly equal to the rated speed of the generator. So this generator can produce double the relative speed as compared to the conventional generator. In order to obtain a PSPG from the conventional generator we have to reconstruct the whole setup of generator to new type having some additional components which help the generator more stable and it makes the movement of both the armature and the magnetic in opposite direction possible. The rest of constructional features of the generator is same as that of the conventional generator. Here since the armature coil is always in
dynamic, there should be a mechanism that help to tap the output voltage from the dynamic part of the generator to the static part where the measurement of output voltage from the dynamic part of the generator to the static part where the

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measurement of the output voltages and the loading is possible. Therefore a slip ring mechanism or other mechanism should be needed to tap the output voltage from the armature coil.

II. THEORY OF PSPG

The basic principle of the PSPG is also the Faradays low of electromagnetic induction. "Any change in the magnetic environment of a coil of wire will be cause a voltage (emf) to be 'induced' in the coil. No matter how the change is produced, the voltage will be generated. The change could be produced by changing the magnetic field strength, moving a magnet toward or away from the coil, moving the coil into or out of the magnetic field, rotating the coil relative to the magnet, etc.
That is,
$e = -N \Delta\phi / \Delta t$ ……(2.1)
Where,
-ve indicates direction of emf according to Lenz's law.
e = EMF generated or Induced voltage.
N = Number of turns in the coil.
$\Delta\phi / \Delta t$ = Rate of change of flux linkage with respect to time.

From the above expression the EMF is directly proportional to the following
1. Number of turns in the coil.
2. Rate of change of flux cutting the armature coil per second.

Therefore there are two possibilities such as either increase the number of turns in the coil or increase the rate of change of flux cutting per second. The increase in the armature coil causes the size of the generator bulky and this is widely used in the modern generator that's why armature coils of high rated generator is made static and magnet is used as rotor. As we know that the rate of change of flux cutting per second is directly proportional to the speed of rotation of the magnetic part or the armature coil. As the speed increases the rate of change of flux cutting in the coil increases and thus produce more emf in the coil. But the amount of the speed applied to a particular generator is limited to the rated speed. Since the rated speed determines the limit of the stability of the rotating part, we cannot increase the speed rotor above its limit. But in PSPG we are increasing the rate of change of the flux cutting per second without exceeding the rated speed of the generator. It can be done by rotating the magnetic part in one direction and the armature part in other direction. Both rotations will be at the rated speed so that the related speed is increased to the double the rated speed of conventional type generators. Thus if the same rating of conventional generator and the same rated PSPG is made to rotate at its rated speed, conventional generator utilizes only50% of the rate of change of flux cutting whereas the PSPG utilizes the 100% of the rate of change of flux cutting. This cause the generator to produce double the output voltage.

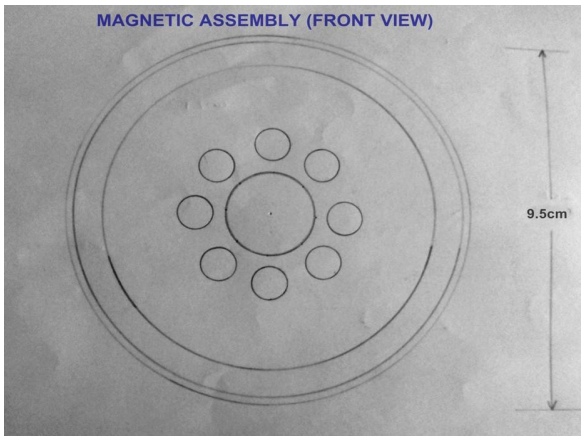

Fig 2.1 Magnetic assembly

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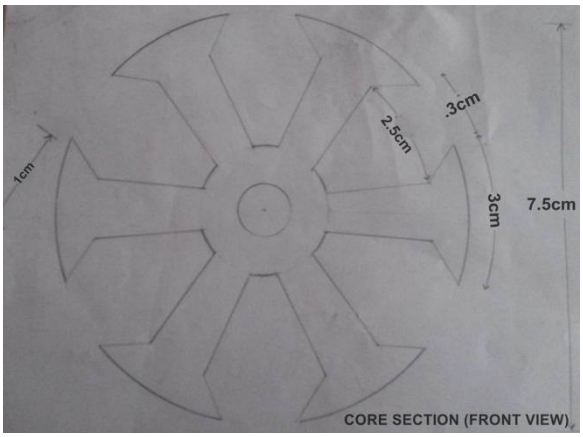

Fig.2.2 core section

In the PSPG, since the both parts are in dynamic motion the taping of the voltage from the armature is done by a special way. Since the armature is rotating, the coils placed inside the armature also rotates so we uses a special type of construction to the shaft and the armature coil terminals are put to a stationary surface by means of the bearing which act as a perfect slip ring with the negligible losses compared to the cost of brush, the losses of the brush, also the sparking is not produced here. In a bearing, because of the presence of the conducting balls current is passed through a rotating layer to the static layer of the generator. The armature coil terminals are fixed at the rotating layer so that tapping is possible from static layer.

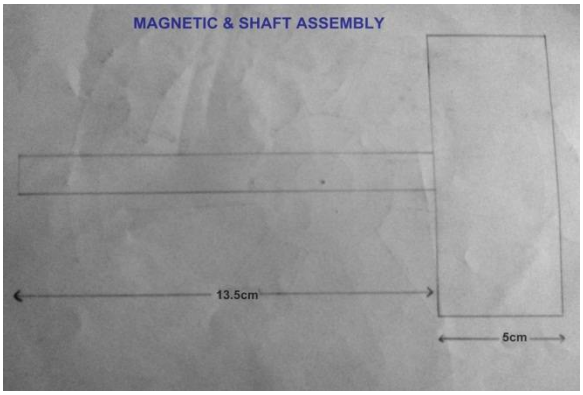

Fig 2.3 magnet & shaft assembly

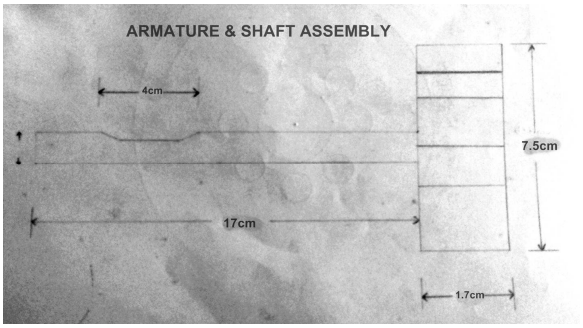

Fig 2.4 Armature & shaft assembly

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III. WORKING OF PSPG

The PSPG is constructed as explained above and it should be tested to know that whether the generator will give the sufficient output voltage or not. The basic working principle of this generator is the Faraday's law of electromagnetic induction itself. The working of the generator is same as that of the ordinary generator. The only changes here is that here both the armature and the magnet are rotated at the rated speed in opposite direction. This will cause the relative speed to increase about the twice that of the conventional generator.

Here as you can see there are two pulleys attached to the shaft and the body of the magnet. These pulleys are driven by the prime mover. The prime mover used here is the AC universal motor. There is a mechanism to control the speed of the motor. For that heating coil is used here. The working of the machine consists of two parts. One is that the generator shaft is made to rotate at the rated speed where is set voltage is produced as the output terminal in the slip bearing.

Now we can said that the tapping from the heater coils are made to rotate the corresponding pulley at the same speed. That is both the motors are now set to rotate at the same speed. Now the first motor is turned on and it is rotated to it set speed and it measures the set voltage at the terminal of the output then the other motor is turned on and it is rotated at the set speed in the opposite direction. So now the magnetic part and the armature of the generator is now runs at the same speed in the opposite direction. Therefore the output of this generator must increase to the double the voltage produced when the one of
the motor made off. This should be occurred if the faradays law is true. Otherwise we can say that the faradays law has some limitations. So in order to make sure of this we have to check the result of the PSPG practically under the same working procedure as explained above.

IV. TESTING OF PSPG

The PSPG unit will consist of the shaft, armature core with coil wounded on it, magnetic body, pulley, prime mover, heater coils and supporting platform. The shaft is first designed and shaped in the horizontal lathe according to the design pattern. The metal used to construct the shaft has the good strength and is a hard one. It is an alloy of iron graded by name EM 16. Using the horizontal lathe the shaft is made for the diameter that is suited for the inner diameter of the bearings. There is an additional reduction of the diameter at the points where the slip bearings are need to placed. The additional depth is constructed in order to insulate the inner layer of the bearing to the shaft. A groves is made in the shaft at opposite direction from the midpoint to the two slip bearings positions. The grove is made in order to take the armature coil terminals outside the rotating shaft. An insulated copper wire is used place in the grooves till the slip bearing contacts. Teflon coated copper wire is used here. One end of the Teflon coated copper wire is soldered with the armature coil terminal and the other end of Teflon coated copper wire is soldered to the inner layer of the bearing. So first after the shaft is made the one hot end bearing is inserted into the shaft from one end to the other. The bearing is heated up to some Celsius in order to expand the inner diameter of the bearing and thus the insertion of the bearing is made much simpler. After the insertion of two bearing two Teflon coated wire is inserted to the two groves such that the one end of each wire will come under the midpoint of the groves provided for the two slip bearings. Then it is fixed by a binding material to fix the wire inside the groves. Then the slots for the slip bearing is filled with the insulating materials in such a way that thickness of the insulating material so that when the bearing is inserted the inner layer of the bearing will touch the conducting part of the wire. This will cause the bearing to conduct from inner layer to the outer layer through the balls provided between them. Then the first slip bearing is inserted to the first slot and then the other bearing is inserted to the next slot position of the slip bearing. Thus the two slip bearings will be insulated from the shaft and with respect to each other. Also the bearing will be in tight because of the insulating medium provided between the shaft and the inner layer of the bearing.

Next a casing is to be made to the magnetic part in order to fix the poles. For the construction of the PSPG here we uses a six pole of alnico magnet having an arc shape. The casing is molded in a molding case and then shaped accordingly

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with the help of the horizontal lathe. After that a cement is pasted in the inner layer of the magnetic body and the magnets were stabbed to the exact position through a machine then it is made to be rest for long time to make the cement paste to harden. A bearing housing is provided at the one end of the magnetic casing. Then by using similar method a cap to that magnetic casing is constructed. Both the casing are fixed with the bearing house and then using a vertical lathe a hole of diameter slightly greater than the shaft diameter is made in the housing provided for bearing in both case at the exact midpoint of the housing. This is done in order to eliminate the occurrence of play in the shaft. After that one of the magnetic casing body with the bearing in the housing of the body is inserted to the next position of the shaft.

Then the laminated armature core is winded by the 31 SWG copper wire I series with 417 turns per poles. After that the laminated core is inserted to the shaft and the terminals of the copper wire are then soldered to the ends of the Teflon coating. Then the soldered part is insulated by using insulation after that the armature core is fixed under the exact position where the magnet lies inside the cylindrical body case that we already inserted to the shaft with the bearing. Then using a grub screw the armature core is made fixed strongly in the shaft. This is done because when the machines run slip in the armature is possible so in order to eliminate the slip due to magnetic locking a three grub screw is fitted in the armature that cause the armature to stick with the shaft thus occurrence of the slip is avoided. After that the cap of the body with the bearing is inserted into the shaft. Then the cap is locked with the magnetic body. Then a pulley with the diameter equal to the body is made using the lathe and is welded in the body. Thus the pulley is fixed with the body. That is when the pulley rotates the body also rotates. After that the next pulley is made with the diameter equal to the shaft diameter equal to the shaft diameter with a grub screw is made and inserted to the shaft. The grub screws are tighten well so that this pulley will rotates along with the shaft. Then the next end bearing is inserted into the end of the shaft and is locked by means of nut. At the end of the shaft there is a thread provided to tight the nut well. Thus the main parts are fixed and a PSPG generator is formed. In order to support the PSPG generator a bearing housing is provided for the end bearing to fix the outer layer to the supporting platform. Two rods are used to support the end bearing of the shaft. The two rods are provide with the turnings in the both ends so that the height of the rods are varied by using the nuts and make the alignment equal at both sides of the shaft. Then the two 750w motors (prime movers) are fixed at the sides of the shaft such that the axis of the two motors and the shaft is made in the same direction. Only the difference is that the motor is place in such a way that when rotating, both will rotate in opposite directions. This is made in order to make the rotation of the both the armature and the magnetic part in opposite direction. Using two V belts of grade B the two motors are controlled by using there heater coils fixed at the wooden piece. The one terminal of the winding is put to the neutral and the other to the position in the heater coil. The one terminal of the winding is put to the neutral and the other to the position in the heater coil. The one terminal of the heater coil is connected to the phase of the single phase ac supply. By varying the points in the heater coil the variation of speed without the reduction of much torque is possible. Two switches are provided to the motor to enable on and off of each motor.

V.RESULT FROM PSPG

The working of the PSPG is explained briefly as above. To obtain the result,

First the shaft of the machine is run to the speed which gives an output of 60 V at the output terminal of the generator by keeping the magnetic body at zero rpm. Then the magnetic part of the machine is made to run a speed which can obtain the output of 60V at the output terminal of the generator by keeping the shaft rotation at zero rpm. Now the both shaft and the magnetic case of the PSPG is made to rotate at the speed which is obtained before by a motor alone. The motors are rotating at opposite direction with the same speed and the result obtained at the terminal is 120 V.

Which is the double the output when any one of the motor is kept off . This means the relative speed is increased by twice and the PSPG utilizes the rate of change of flux cutting by the armature coil to its maximum limit. Also it shows a way to increase the output voltage of the generator for the particular rated speed. We can say in other words that if we

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Fig 5.1 PSPG

want a particular voltage then the rated speed of thatmachine is made to half the rated speed of the same voltage producing conventional generator. Since the result obtained is about twice the voltage as we are designed to obtain, our project is a success one and here we are introducing the existence of such a machine that can increase the voltage production by making some more alternations to the higher voltage applications.

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