Dual Rotor Generator for Increased Efficient Power Generation

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Abstract:- The generators that we have today consist of a rotor that rotates and a stationary stator. In generator, according to faradays law EMF induced in conductor because of the relative motion between the conductor and flux. To induce EMF in generator, the basic need is to produce change in magnetic flux linked with the coil. The change in flux is proportional to induced EMF in the generator. In this model, both the coils are made rotate in opposite directions to get high relative speed. Since the relative velocity between the magnets and the coil is doubled, the magnetic flux change will also be doubled. As the rate of change of flux linking with the conductor is doubled, the induced e.m.f. will also be doubled. Hence we can achieve doubled power generation. To rotate the two rotors in counter direction mechanical transmission design is preferred with proper alignment to reduce frictional losses.

1. INTRODUCTION

An electric generator is a device used to convert mechanical energy into electrical energy. The generator is based on the principle of "electromagnetic induction" discovered in 1831 by Michael Faraday, a British scientist. Faraday discovered that if an electric conductor, like a copper wire, is moved through a magnetic field, electric current will flow (be induced) in the conductor. So the mechanical energy of the moving wire is converted into the electric energy of the current that flows in the wire. In normal generator consist of rotor and stator part but we are designing dual rotor generator without stationary part. This two rotors are rotates in opposite direction to get high relative speed. Since the relative velocity between the magnets and the coil is doubled, the magnetic flux change will also be doubled. As the rate of change of flux linking with the conductor is doubled, the induced e.m.f. will also be doubled. If the e.m.f. induced is doubled, we can achieve double the power generation.

2. PROBLEM STATEMENT

In any of the 3 phase conventional generator the prime movers has to rotate the rotor of generator in 1500rpm to get the output of 50Hz, 230V (L-N), 415V (L-L). In case if we need increased output than the conventional generator, we need to rotate the rotor in speed greater than 1500rpm corresponding to expected output. This might lead to the instability in speed-torque characteristics of the prime mover (input of the generator).

3. SCOPE OF PROJECT

In this innovation, both the coils are made rotate in opposite directions to get high relative speed. Since the relative velocity between the magnets and the coil is increased, the magnetic flux change will also be increased. As the rate of change of flux linking with the conductor increases, the induced e.m.f. will also be increased. Hence we can achieve increased power generation. To rotate the two rotors in counter direction mechanical transmission design is preferred with proper alignment to reduce frictional losses.

4. OBJECTIVES OF PROJECT

In this innovation

- We constructed a generator which produces ideally doubled the output power compared with available generator of same rating, by doubling the relative speed between two rotors.
- In this design there are two rotors, with no stator machine generates electricity by rotating both rotors in opposite direction to maintain the high relative speed between two rotors.
- Conversion of single phase to three phases with increased power can be achieved if we use single phase induction motor as the prime mover.

5. METHODOLOGY

In this Project, The single phase motor is connected to the inner rotor shaft of the dual rotor generator through pulley. The outer rotor of the dual rotor generator is connected to the single phase motor through gears. This enables to both the rotors of generator to rotate in opposite direction so that the relative speed between the two rotors can be maintained high. As the relative speed increases, the rate of change of flux cut also increases. This influences the output to get increased compared to other normal generators. Thus we can generate three phase power with increased output power from single phase power. Since we observe change in frequency because of increased relative speed, we use AC to DC and DC to AC converters to get the output of standard frequency. Instead of using single phase motor we also can replace it with the turbines or any prime movers to generate the electricity. During running condition, if the output is synchronized with the input supply, then the input can be drawn from one phase of the output of the same generator and made to generate the power freely.

6. DESIGN AND COMPONENTS OF DUAL ROTOR GENERATOR

In this Design of dual rotor generator, we have two rotors.
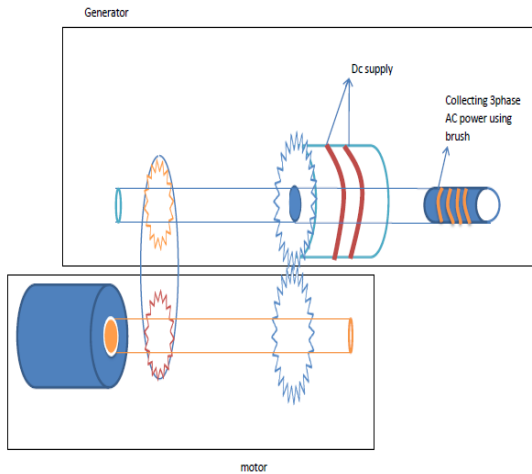1. Inner rotor
2. Outer rotor

Fig. 6.1 : Design of generator coupled with motor

6.1 Inner rotor: It consists of three phase armature winding with 24 slots from which the electric output generated will be taken out through brushes. The windings are star connected. Inner rotor is connected to the shaft. The direction of rotation of shaft and inner rotor are same. The shaft is connected to the base at it's 2 ends by using pillar bearings. This gives the whole support to the inner rotor to be placed at its balanced position.

6.2 Outer Rotor: It consists of field winding with 4 poles. For the excitation of field winding, we are giving DC supply through brushes. The outer rotor is attached to the shaft through bearings so that the free rotation of outer rotor can be achieved and the outer rotor is driven by gears in its direction opposite to the direction of inner rotor.

If we run the generator beyond the conventional generator's speed to get the increased power, then the frequency of the output taken will not be standard bus bar frequency (50Hz). Therefore the output of each phase is rectified to DC and then converted to AC with standard bus bar frequency.

6.3 Bearings: In this innovation mainly four bearings are used for supporting outer rotor and shaft of the dual rotor generator. Two bearings are at both the ends of the outer rotor to get the support from the generator shaft and another two bearings (pillar bearings) are at both the ends of the shaft to get the support from the generator base. Bearing size with inner diameter 30mm and outer diameter 62mm has been used. Bearing series is 6206.

6.4 Gears and pulley: Gears are used to rotate the outer rotor in opposite direction of motor shaft direction. Pulleys are used to rotate the inner rotor which is directly mounted to the generator shaft in same direction of motor shaft direction. Both are used such that the rotors are rotated in opposite direction and hence the relative speed can be increased.

6.5 Base: The base can be classified as generator base and motor base.

The generator base gives the support to the generator set at its shaft ends through pillar bearings. It bears the load of both the rotors and it's components like gears and pulleys along with shaft.

The motor base gives support to the driving shaft that consists of pulley and gear which drives the pulley and gear connected to the generator. The driving shaft can be connected to any prime movers like single phase motor or the turbines etc.

Both bases are maintained at a particular distance such that the pulley as well as the gears of generator side and prime mover side has to fit and connect properly for its best performance.
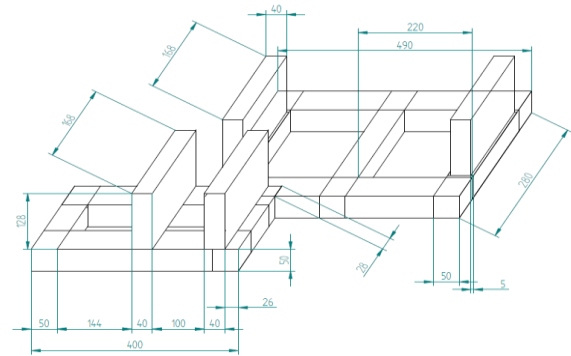

Fig. 6.2. Motor-Generator base

7. ADVANTAGES

The following points can be observed in this project,

- We can get the output of normal generator using this project, with much lesser rotor speed, i.e., with lesser input rotations (rpm), as the relative speed between two rotors of generator can be maintained with the speed of normal generator to develop the same amount of output. Thus to develop the same amount of output, the input speed (rpm) for the generator required will be less.

- The cooling fan requirement looks quite redundant as both the rotors can be rotated in low speed to get the same output as compared to normal generator and also both the rotors have the ability to cool their cores themselves dynamically as it rotates.

- While rotating the generator with the relative speed of much higher than the normal generator speed, required no. of conductors can be made less compared to normal generator.

- If the relative speed of the generator is maintained much higher than the normal generator, we observe increase in emf generated because of increased relative speed (change in magnetic flux is proportional to the emf generated). Thus we can get higher output power with increased speed.

- Instead of using single phase motor we also can replace it with the turbines or any prime movers to generate the electricity.

8. THE MAIN DIMENSIONS

- Number of slots = 24 (Inner rotor)
- Number of poles = 4 (Outer rotor)
- Speed of a rotor, N1=N2=750rpm
- Relative speed N = 1500rpm
- Diameter of the bore = 0.2345m
- Diameter of the core = 0.1626 m
- Length of the core = 0.118 m
- Turns per slot = 48
- Turns per phase Ts = 384
- Slot depth 17 mm
- Slot width 5mm

9. EXPERIMENTAL RESULT OF THE PROJECT

From the experiment, following result of output voltage has been obtained.

Voltages at different Terminals		Voltage at no-load condition (V)
Line Voltage	R-Y	382
	Y-B	380
	R-B	377
Phase Voltage	R-N	192
	Y-N	189
	B-N	185

Fig. 9.1: Output Voltages

10. EXPERIMENTAL ANALYSIS

On the basis of the methodology, the experiment was conducted. And found the following analysis,

- During the construction of this project, the design for the transmission system which is responsible for both the rotors to rotate in opposite direction was changed due to the issue that the construction of that design as shown in Fig. 10.1 is very expensive. So considering the cost of the model the transmission system's design was changed to the design mentioned earlier.
- During the running condition, both pulley and the gears that are connected to the inner rotor and the outer rotor respectively have to be fitted tightly. Otherwise, loosening of pulley leads to the inner rotor to rotate in same direction as the outer rotor rotates. This leads to the reduction in output of the generator.
- The connection of phase and neutral has to be proper for the input of the diode rectifier circuit. Otherwise the poles don't get excited properly and the output will not be available.
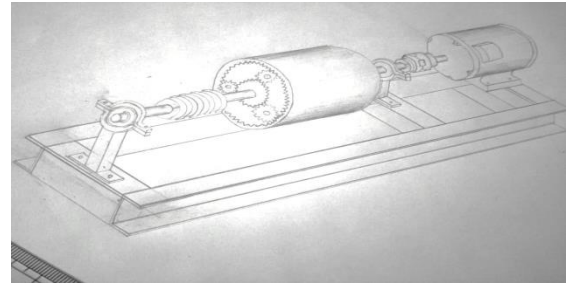

Fig. 10.1: Earlier Design

11. CONCEPT OF FREE POWER GENERATION

Here the power is generated freely except only at the starting of this generator. The External AC supply is needed at starting. This can be achieved by using a concept of back to back technique.
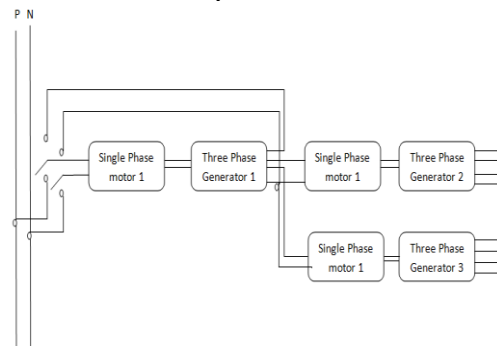

Fig. 11.1: Block diagram of back to back technique for Free Power Generation.

Procedure:

- Single phase Motor 1 is started using external supply.
- Generator 1 is driven by single phase motor 1.
- Out of 3 phases of output of generator 1, 1 phase is used to power up the single phase motor 1 by disconnecting with the external supply.
- The other 2 phases of generator 1 output, powers up the single phase motor 2 and 3 respectively which drives generator 2 and 3 respectively.

This is done only to balance and stabilize the output of generator 1.
By this method we can constantly get 2 three phase balanced output powers freely.

12. BENEFITS OF CONCEPT OF FREE POWER GENERATION

- By this method we can constantly get 2 three phase balanced output powers freely.
- The generation of energy without the usage of any non-renewable energy resources can be seen..
- Electricity generation can be done without the usage of any resources that pollutes the environment. That is echo-friendly.
- In comparison to the renewable energy resources, the rate of Power generation can be expected more in the concept of free power generation than the rate of Power generation from the renewable energy resources.
- More efficient.

- Costing and Billing for the electricity to the customers can be lowered to the most. And some might get it for free of cost.

13. CONCLUSION

Here we have discussed a new project design that has several advantages over the conventional generator.

It is experimentally proved that the same amount of generation of power compared to conventional generator can be done with reduced speed of rotors of proposed model. The generator design which generates increased power has been discussed. This enables the reduced usage of no. of conductors and thereby cooling fan for its minimal losses as well as for its good efficiency. Also we have discussed about the free generation of power by using back to back technique.

14. FUTURE SCOPE

- The concept of Free Power Generation can be implemented practically by constructing the required sets of models.
- The concept of free power generation generates two 3 phase outputs freely and this concept can rule the world in various sectors of power generation to reduce the usage of non-renewable energy resources and also the resources that pollutes the environment.
- This might lead to the simplicity of cost and billing for the electricity usage that is very much affordable for all the customers of electricity around the world and even some customers might can get it for free of cost under the government policies.

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