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Single-Phase Permanent Magnet Dual Stator Induction Generator

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ABSTRACT: As the world is running behind non-renewable sources and we are at the edge of the time to lose all this source. The need for new energy sources had led to a number of alternatives, which have been unaffordable and unavailable due to huge cost and scarcity. In response to this, Dual power induction generator is designed and developed using local materials. The proposal of this, paper is to use fewer amounts of non-renewable sources and to gain full benefit from it the generator comprises an inner stator as first layer and second layer of outer stator in between this two stator assembly magnetic rotor is arranged. In future, it might solve all problems regarding to the power of the world. The driving mechanism of dual power generator is the 0.5hp alternator current motor, powered by a 230-volt power supply, which spines the 600 watts from both terminals of alternator to produce electricity. It is pollution-free and eco-friendly. The test unit was built in March, 2017.

KEYWORD: DSIG-Dual Stator Induction Generator, SPR-Salient Pole Rotor, PMG-Permanent Magnet Generator SPPMDSIG-single-phase permanent magnet dual stator induction generator.

I. INTRODUCTION

In order to find other ways of producing energy, a number of alternatives have been considered [1], [2]. One of these alternatives is the generation of electricity from a DSIG in an isolated power generation system with low maintenance cost. A DSIG produces electricity 24/7 without fuel (petrol, diesel, gas, sun, wind energy) [3], [4]. The driving mechanism is the AC motor, which is driven by a power supply (230v). The power drives the AC motor, which in turn spine the alternator to produce electricity and at the same time, since dual single phase ac power is generated one terminal output is fed back to AC motor with the help of switches. DSIG has no negative impact in the environment; it is noiseless, pollution free, self-dependent. It can be built to the capacity of the load you want it to power.

II. CONSTRUCTION OF MACHINE

SALIENT POLE ROTOR:

Basically, SPR of the machine is composed of permanent magnets placed around the circular tube in over project we have used fiber tube on which permanent magnets are mounted. It's a 4-pole machine hence 4 bar magnets are mounted on the fiber tube [5], [6], [7].
Dimensions of bar magnets: 20mm*10mm*5mm
Salient pole rotor is placed between the 2 stators of the machine.
Radius of Rotor

Inner diameter (mm) =66
Outer diameter (mm) =98

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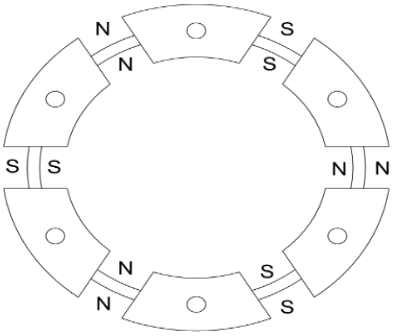

Fig.1: Salient pole rotor using of permanent magnets

STATOR:

Machine consists of 2 stators. Each stator consists of 24 slots and winding calculation of stator is given at below table fig. 5. The laminated silicon steel is stamped together with class C insulation type.

Inner Stator Diameter= 64.5mm
Outer Stator Diameter=100mm

Fig.2: Inner stator

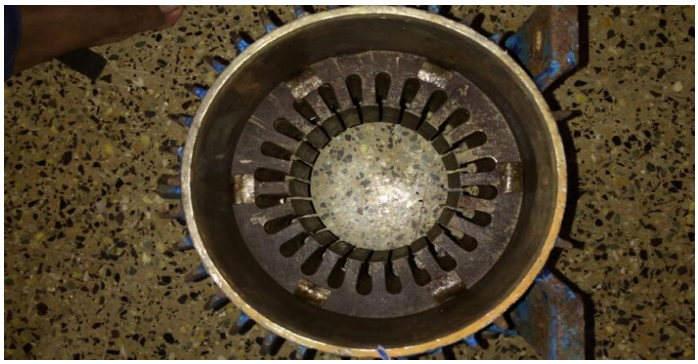

Fig.3: Outer stator

III. DESIGN OF THE MACHINE

WINDING CALCULATION:

Calculation of both stator windings are as follows:

The total number of conductors per coil **ZC = 2T**
The total number of conductors for machine **Z = ZCC**
Total number of coil groups/phase = $\frac{Number\ of\ coil\ groups}{Number\ of\ phases} = \frac{mP}{m}$

Where, m = number of phases

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P = number of poles

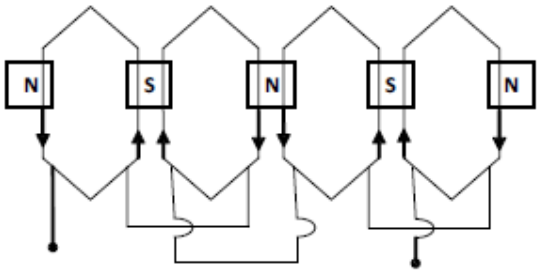

Fig. 4: Coil groups

One pole pitch = $\frac{number\ of\ slots}{number\ of\ poles} = \frac{s}{p}$ =180^0_{ed} or 180^0_e

Developing a single phase, single layer AC lap winding for a 4 pole AC machine having 24 slots

Pole pitch = $\frac{number\ of\ slots}{number\ of\ poles} = \frac{24}{4}$ =6

Slots 1 to 7 and 13 to 18 lie under North Pole regions N1 and N2 respectively. Similarly slots 7 to 12 and 19 to 24 lie under South Pole regions S1 and S2 respectively. In other words, the first pole pair covers slot 1 to 12 and the second pole pair covers slots from 13 to 24. For full pitch winding, angle between the two sides of the same coil is 180^0_{ed}. 180^0_{ed} corresponds to 6 slots

Number of coils (or slots) per pole= 6.

The coil in slot no. 1 is to be connected to coil in slot no. (1 + slots per pole = 1 + 6 =) 7 or back pitch, Y_b = 7, i.e., if slot no. 1 is at the beginning of the first North Pole, N1, the slot no. 7 will be at the beginning of the first South Pole, S1.
The winding pitch, Y = +2 (progressive winding)
Therefore, the front pitch, $Y_f = Y_b - Y = 5$

SL.NO	Y_f	Y_b
1	1+6=7	7-5=2
2	2+6=8	8-5=3
3	3+6=9	9-5=4
4	4+6=10	10-5=5

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5	5+6=11	11-5=6
6	6+6=12	13
7	13+6=19	19-5=14
8	14+6=20	20-5=15
9	15+6=21	21-5=16
10	16+6=22	22-5=17
11	17+6=23	23-5=18
12	18+6=24	24

Fig. 5: Winding table

IV. LAYOUT OF THE MACHINE

The machine is designed based on the layout drawn as shown in fig. 6.

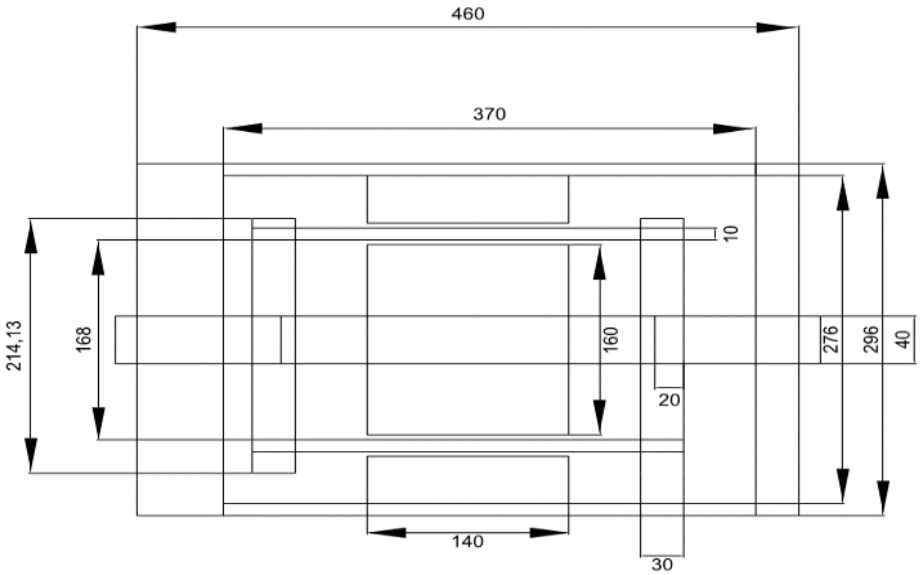

Fig.6: Layout design of machine

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V. ASSEMBLY OF THE SINGLE PHASE DUAL POWER GENERATOR

Winding of Inner stator is shown in fig.7.

a)

b)

Fig.7a: Without winding; 7b: With winding of Inner stator

The SPR of the machine is made up of cylindrical fiber with 8 slots for placing 8 magnets around the cylindrical SPR. Supportive drives are connected at both end of the shaft. A 4-supportive iron threaded rods are connected to the drive of the SPR assembly. The complete setup of the machine is shown in fig.9.

Fig.8: Rotor Assemble

Fig.9: Dual Power Generator

Outer stator of the dual power generator is shown as in fig.10 with and without winding

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Fig.10a: Without winding

Fig. 10 b: With winding of Outer stator

Driving gears used to drive the dual power generator and assembly parts

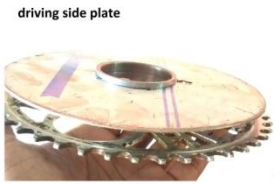

Fig.11: Prototype rotor support assembly

Fig.12: AC motor

Around 64 neodymium permanent magnets are used. These magnets are placed around SPR of the machine [8].

Fig.13: Permanent magnets [9]

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VI. WORKING OF SINGLE PHASE DUAL POWER GENERATOR

The working principle of DSIG is same as that of existing machines but the only difference between existing and DSIG is that two pair of single phase AC power can be generated from each of the stator i.e. 230V for driving the DSIP, A single phase 230 volts 0.5HP motor is coupled as a prime mover. Since permanent magnets are used for generation of electricity there is no need of DC excitation for it. The rated RPM of DSIG is 1000rpm and the prime mover is 3000 rpm by using speed regulator we varied the speed of motor. The DSIG can generate is 600-watt from each of the stator.

PROTOTYPE MACHINE ASSEMBLY:

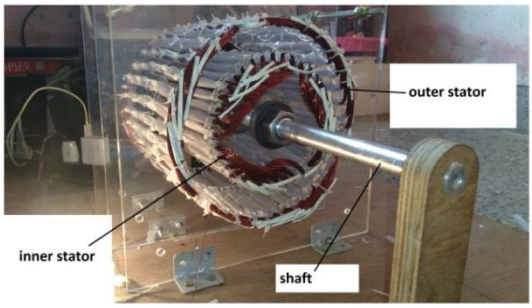

Fig.14: Prototype stator assembly

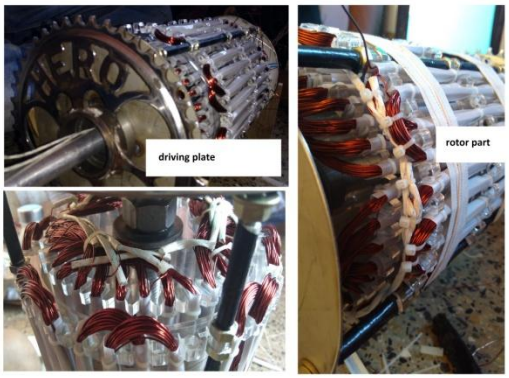

Fig.15: Prototype rotor assembly

From prototype machine which is developed first generates around 15 volts from each of the stator. With reference to that iron cored machine is constructed to generate 230 volts. Prototype machine is air cored type generator. Since its air cored machine efficiency of the machine is less. Magnetic flux produced around gets wasted because of air cored type.

VII. RESULTS AND DISCUSSIONS

Since iron cored machine is rotated manually by hand because still we are analyzing the machine we got 10 volts from both side of the stators. Later it will be connected to a DC motor of 0.5 HP to test its maximum efficiency of the machine. The advantage of PMG machine is its compact, a single machine can generator electricity same as that of we 2 machines are combined. In efficient way, magnetic flux is used. Future scope of the dual power stator is to build a 3-phase system so that in large scale electricity can be generated so that it can helpful for industries also.

Fig.16: Output

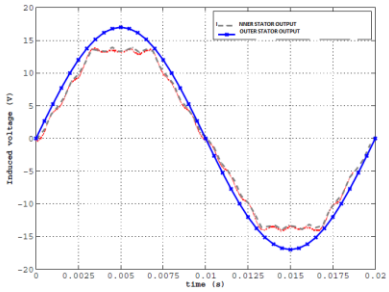

Fig.17: Output waveform

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VIII. CONCLUSIONS

This DSIG can also be used for both industrial as well as domestic purpose with high efficiency, since alternator produces two pairs of voltages, one pair can be used run prime mover coupled to the generator. This setup provides a free generation in domestic sector and only additional power need to supply to fulfill the losses of motor. If we consider the power generating stations this type of DSIG are very useful to meet the demand. It is possible to generate two pair of single phase power by single rotor with same amount of input mechanical energy whether it is field excited or by using of permanent magnets. This paper gives the complete detailed evidence that, it is possible to generator dual power, hence doubling the output compared with existing generator.

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