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A NOVEL DESIGN AND ANALYSIS OF THREE PHASE INDUCTION MOTOR FROM THE PERSPECTIVE OF SMALL SCALE INDUSTIES TO WORK AS AN INDUCTION MOTOR & A WELDING TRANSFORMER SIMULTANEOUSLY

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ABSTRACT:

AN induction motor, founds suitable for more than 85% of the industrial applications. The industries in this era of automation may not work very efficiently without the use of induction motors for various processes. The induction motors working on the electromagnetic induction and can also be considered as rotating transformer. Nowadays these motor are used as induction generators. The induction generators are available in the market. Authors have designed and developed and induction motor to work as a motor and the welding transformer. The small industries having lack of space and budget are the beneficiaries of this invention. A perfect balanced 3 phase, welding transforms is not available in market which is very essential to run on small 3 phase alternator (of same rating). Basically the welding transformer is a single phase machine. Only few welding transformers are three phase. The machine developed will work as induction motor and welding transformer simultaneously.

KEYWORDS: Induction motor, welding transformer, squirrel cage rotor, slip ring rotor, stator, phase changer, etc

INTRODUCTION:

The induction motor is always the common area of the research for the years due to its popularity, low cost, better performance and plenty of applications. The researchers have developed and implemented several modified models for the induction motor. Despite of the fact that the huge research is going on the basic structure of an induction motor remains the same and its working will never be changed. As we know the principle of conduction used in various D.C. motors have the losses at commutator and brushes, the induction motors have replaced the D.C. motors almost in all the applications in last 3 decades. The rotor circuit of an induction motor is electrically separated from the input supply still due to electromagnetic induction an E.M.F. will be induced in rotor conductors. This makes the induction motor equivalent to the transformer and hence it is also called the generalized transformer.

The welding transformer is different than the normal transformer as it needs very high current for the purpose of welding. In the process of welding the metal parts are melted and joined to each other. Basically a welding transformer requires low voltage (50 to 60volts) and high current (upto200A) for joining of two metal parts by electrical arc welding. Some design modifications can be done in stator winding of induction motor.

Also the same motor can be implemented for operating on the single phase supply. The running and starting winding of the single phase operation are placed in same slots that are used for the three phase operation. So at a time anyone of them can be used to supply or produce excitation in order to employ rotation of rotor. While performing single phase operation, the Multifunctional Induction Machine capacitor can be used to produce starting, torque then after acceleration, starting winding can be disconnected by simple arrangement.

Now, when supply is given for three phase, the EMF is also induced in winding used for single phase operation. Here the starting and ending of each coil group is brought out. Which when connected in series, gives out half of input supply (i.e.200V approx.) hence step down of voltage is done and when connected in

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parallel, gives (50V approx.) with high current(up to200A) which is ideal supply used for 'Electric Arc Welding' hence another application i.e. Electric arc welding. Opposite to above concept, when supply is used to operate motor for single phase operation, after capacitor starting, we get double of input supply i.e.(400V approx.) across open circuit phases of three phase winding terminals. Hence, motor gives step up operation as well.

Now, after doing some modifications on stator winding of motor, we get the 'Multifunctional Motor' which can be applied for the following functions,

1) As three phase induction motor.
2) As single phase induction motor (capacitor start).
3) As rotary phase converter.
4) As welding transformer.
5) As tapping transformer.

Out of the various possible applications the scope of the study was limited to three phase induction motor and welding transformer.

DESIGN OF IMPLEMENTED MODEL:

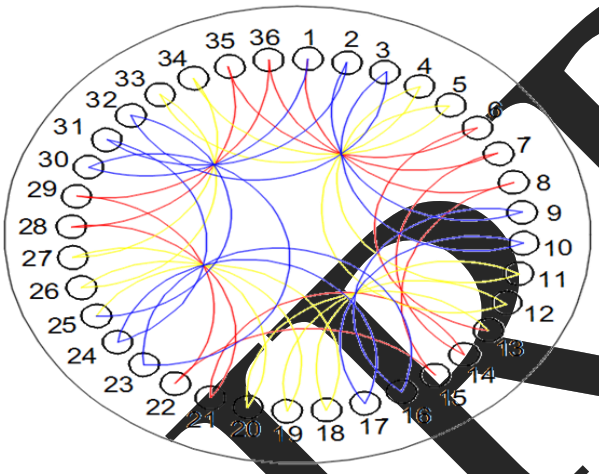

Fig No.1: Redesigned Winding Diagram of an three phase Induction Motor

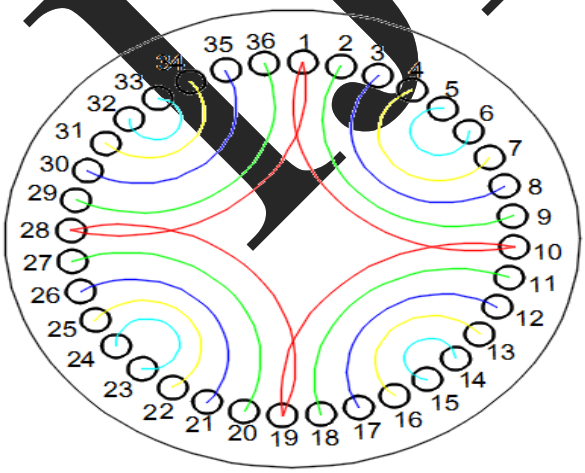

Fig No.1: Redesigned Winding Diagram of a welding transformer

Fig No. 3: The implemented redesigned Induction motor – welding transformer model

SPECIFICATIONS AND OTHER DETAILS OF THE IMPLEMENTED MODEL:

FOR INDUCTION MOTOR:

Table 1: Specifications and design parameters of the redesigned induction motor

Sr. No.	Design Parameter	Specification
1	Output	5 HP
2	Number of turns per coil	20
3	Stator pitch	8
4	No. of stator slots	36
5	Frequency	50Hz
6	Full load speed	1440 rpm
7	Voltage	440V
8	Rated current	14.2-12.8/6.40 A
9	No-load current	6.12/3.06 A
10	Ambient temperature	-20°C - +40°C

FOR WELDING TRANSFORMER:

Table 2: Specifications and design parameters of the designed welding transformer

Sr. No.	Design Parameter	Specification
1	Primary side Voltage	230V
2	Secondary side Voltage	120V
3	Secondary side Current	31A
4	Electrode size	1/8''
5	Current range of electrode	30-60A
6	KVA rating	3.1KVA
7	Fuse rating	30-40A

REDESIGNING CALCULATIONS OF AN INDUCTION MOTOR:

- no. of slots:36
- No. of phase:3
- Slots per phase:12
- Each slot = 10 coils
- Coils per phase=10*12=120
- Total no. coils 10*12*3=360 coils
- Pitch: 8

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- Winding: lap winding
- Copper:20 gauge of copper wire

REDESIGNING CALCULATIONS OF A WELDING TRANSFORMER:

- Total no. of groups:4
- First eight slots:28 conductors
- Last two slot:20 conductors
- No. of slots:36
- No. of phase:1
- Slots per phase:12
- Each slot = 10 coils
- Coils per phase=10*12=120
- Total no. coils=10*12*3=360 coils
- Pitch:2,4,6,8,10
- Winding: lap winding
- Copper:20 gauge of copper wire
- Total no. of conductors for each group:28*8+20*2=264 conductors
- Total no of conductors:264*4=1056 conductors

TESTING AND RESULT'S:

No load and blocked rotor test was carried out to understand the performance and feasibility of the redesigned induction motor and the results are found satisfactory.

A) NO LOAD TEST:

Table3: The observation of the No load test carried out on an induction motor

SR.NO	V_o(Volt)	I_o(Amp)	W_1(Watt)	W_2(Watt)	W_o(Watt)
1)	**360**	**3.5**	**-90×8 = -720**	**190×8 = 1520**	**800**

B) BLOCKED ROTOR TEST:

Table4: The observations of the blocked rotor test carried out on an induction motor

SR.NO	V_{SC}(Volt)	I_{SC}(Amp)	W_1(Watt)	W_2(Watt)	W_{SC}(Watt)
1)	**40**	**8**	**-20×8 = -160**	**55×8 = 440**	**280**

C) RESULT TABLE:

Table5: The results of the No load & Blocked rotor test carried out on an induction motor

SR.NO	R_1(Ω)	X_1 (Ω)	r_2'(Ω)	X_2'(Ω)	R_o(Ω)	X_o(Ω)
1)	**1.2**	**2.391**	**0.258**	**2.391**	**162.22**	**133.14**

EFFICIENCY = 67.27%

The above testing carried out and the results observed prove authors have not compromised on the efficiency; the redesigned motor has acceptable efficiency even when redesigned.

CONCLUSION:

We consider overall performance the machine is very useful in mega workshop where of operation are performed simultaneously. As one machine performs number of applications, it is economically useful and suitable at places where less space is available. We compare the machine with different devices used for same applications; and found that cost of project machine is half of total cost of different machines. Therefore cost is 50-60% reduced. We have got very useful information about design of induction motor that some further modification can also be done in order to achieve better performance, efficiency and regulation. Hence the use of multifunctional motor results in lots of advantages and convenient to use.

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