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Multifunctional Induction Machine

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ABSTRACT:-A three phase ac motor or asynchronous motor is an electric motor in which the rotating magnetic field is produced in the air gap between stator and rotor the current in the rotor is needed to produce torque is induced by RMF generated by the stator winding. The aim of this paper is to present an redesign model for the analysis of Stator winding of induction motor which is redesigned and motor is used as three phase IM,single phase IM,Phase converter as well as welding transformer.

Keywords: Double winding Induction machine; Winding design;Capacitor;Multiphase machine

I. INTRODUCTION

Three phase induction motors are the most frequently encountered in Industry. They are simple and easy to maintain. Recently, multifunction machines may have been received great deal of attention. Generally, multifunction induction machines have been introduced a long time ago. The multifunction induction machine has the double layer stator winding. As we know three phase a.c motors receive electric power from three phase a.c. supply. A three phase induction motor has two main parts: a stationary stator and rotating rotor.

In today's world, in industries an induction motor and the welding transformers are frequently used in the industries for their own applications. To meet their requirement they are used separately in the industries which increases the installation cost of the industry.To overcome this difficulty we are going to implement our proposed model to operate three functions on the same induction motor. The use of multipurpose motors is very convenient for used in mega workshops. Hence the cost require for two machine gets reduces. Also an approach towards the motor performance gets increases.

The principle of operation of three phase induction motor which is works upon the application of Faraday's law of electromagnetic induction. The stator winding are connected to the three phase supply and the rotor circuit is short circuited, the induced voltages in the rotor windings produce rotor current that interact with the air gap field to produce torque. As the induction motor is nothing but generalized transformer, this same concept can be used to implement the motor as welding transformer In fact, an induction motor can be treated as a Rotating transformer i.e. one in which primary winding is stationary but the secondary is free to rotate. As the induction motor is nothing but generalized transformer, this same concept can be used to implement the motor as welding transformer. Welding transformer requires low voltage (50 to 60volts) and high current (upto-A) for joining of two metal parts using electrical welding.

The same motor we can be used as single phase induction motor. 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 giving supply as per for our required operation anyone of them can used to produce excitation in order to start rotation of rotor.A three phase converter is a device that produces three phase electrical power from a single phase source, thus allowing the operation of three phase equipment at a site that only has single phase electrical service these were static phase converter and they have changed little since time. Over the years, other technologies have been employed as a phase converter. There are two common types of phase converter one is static phase converter and second is rotary phase converter.

II. DETAIL MACHINE DESIGN

The main focus of this paper is to design the model of multifunctional induction motor with double layer windings in the same stator and conventional squirrel cage rotor.

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Concept diagram

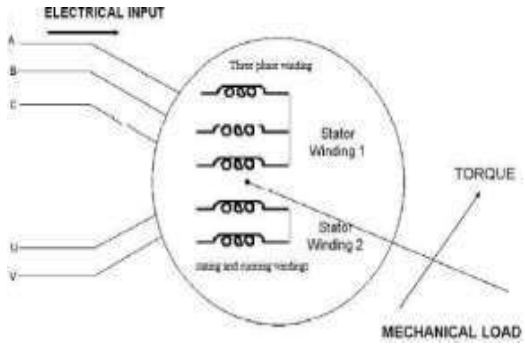

Fig.1 Double winding induction motor.

A three phase supply is applied to one of the stator windings, a revolving magnetic field is developed in the air gap and this field is shared by both windings. Also it is possible to apply single phase supply to one of the stator winding for single phase motoring operation.Fig.1 Show the concept diagram of double winding induction motor.

Table:1 Specifications of standard motor.

Sr.No.	Specification	Values
1	Power	5HP
2	Frequency	50Hz
3	Speed	2900RPM
4	Voltage	415volts
5	Connection	Delta
6	Insulation class	F
7	Phase	3Ph
8	Pitch	1-6,1-8
9	Number of poles	2
10	Slots	24

Standard squirrel cage induction motor, rated at 5HP, was used to design the new drive configuration. An induction motor was designed by considering a conventional three-phase motor as baseline. The new winding distribution aquires the same frame size as the baseline of standard three-phase motor. The hardware arrangement of the model along with its working will be discussed under this section.

III. MOTOR RE-DESIGNING

The Conventional induction motor consists of only one set of winding in its stator and DWIM consists of two sets of windings in the same stator. A three phase supply is applied to one of the stator windings. The newly designed winding is divided into three parts on the basis of number of turns. Out of these winding the first winding is with same gauge wire and half of the original number of turns. Hence, this is a winding of 3-ph induction motor and as number of turns are half the motor is of half capacity i.e. 2.5 HP. The second and third winding is used for welding and it act as tap of welding transformer. Welding application requires high current rating; triple layer winding is used to improve the current rating. The same motor is used for 1-ph induction motor. Hence these winding are also used as starting and running winding of 1-ph induction motor.

Hardware Design and Working

In this proposed model we have taken the Induction motor having rating of three phases, 5HP, 2900 RPM. Therefore, No. of pitch = No. of stator slot /No. of poles ± 1 Therefore after each 8 or 10 pitch distance the coil passes towards another slot. For Three phase Induction motor double layer, single conductor is used. The turn per coil of proposed model is 128. Thereby obtaining actual turns, Therefore, Actual turns = No. of turns/2. For three phase Double layer winding is used so, turns per phase being half of that.

In Redesigning we have to connect winding in star, Therefore, Turns/Phase =Actual turns/√3.

Therefore, Turns/slot = No. of slot * Half of turns/phase. For single phase, Total No. of turns = Turns of Three phase winding /3.

The stator cores there are 24 slots. In each slot winding is divided in three parts on the basis of number of turns. Out of these windings first winding is for the three phase induction motor and second and third winding is made for the single phase induction motor and welding transformer.

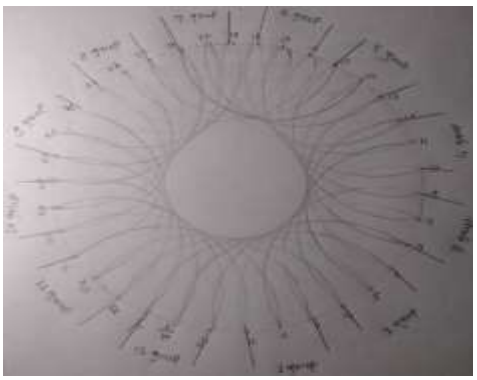

Fig2 Connection Diagram of both Three Phase and Single Phase Winding.\

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A. Three Phase Winding Design

For redesigned motor, there will be triple layer winding with following considerations:
Total turns for three phase=440
Coil pitch = 1 to 6
Turns/coil = 55*2 =110turns
Total Coil = 4*3 = 12coils
Fig.2 and Fig.3 shows the connection of poles and winding diagram for three phase motor.

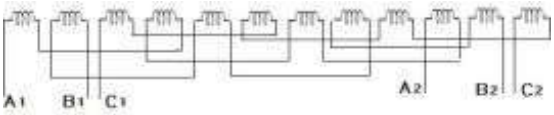


Fig.3 Connection of poles for three phase motor.

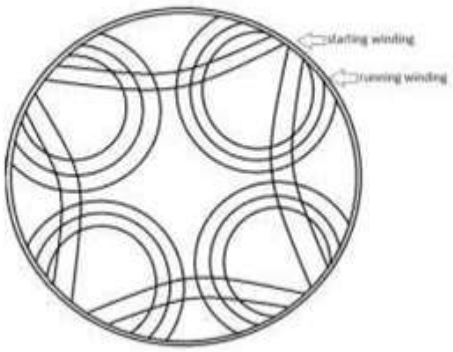
B. Single Phase Winding Design

When supply is given to single phase induction motor, its stator winding produces alternating flux. Alternating flux acting on a stationary squirrel cage rotor cannot produce rotation so a single phase induction motor is not a self starting. Single phase induction motor works on the principle of double field revolving theory [10]. The single phase winding is designed with following specifications:

440 turns/1.73= 254 turns
Total turns for single phase =254
254/4 (poles) =64 turns/pole
Coils/pole =3
Turns/coil =51
For single phase operation, capacitor starts then it will give doubled input supply. Hence the motor gives step up operation.

Table 2. Winding Specification For Single ph

Winding	Pitch	Coils
Starting winding	1-6	51 turns
	2-5	51 turns
Running winding	1-6	51 turns



In the redesigning gauge of copper wire changes but turns remains same as that of original three phase Winding used for induction motor is generally lap type with a diamond shaped coils is for stator. Insulation used for winding is class F and insulation paper used is of nomex. For three phase winding, the conductor is of single layer double conductor and for single phase, double layer single conductor.

C. Act As A Welding Transformer

Normally, the welding can be used for joining of two metals. The welding transformer requires low voltage and high current. As we know the induction motor is a generalized rotating transformer, the same principle can be used to operate induction motor as a welding transformer. A step down transformer with open circuit voltage near to 50-70V and having negative voltage characteristic can be used for welding work. Hence for this some design modification can be done in stator winding and we can use induction motor as welding transformer.

D. Act As A Phase Converter

The phase converter is usually used where three phase service from the utility is not available. Three phase service is generally expensive to install so we need phase converter for working different applications.

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IV. RESULTS

Table: 3 No Load Test of Induction Motor.

V0 (Volt)	I0 (Amp)	W0 (Watt)
220	5.4	50x4=200

Table: 4 Blocked Rotor Test of Induction Motor.

Vsc (Volt)	Isc (Amp)	Wsc (Watt)
50	4.6	44x4=176

Table: 5 Output Voltages of Induction Motor.

Sr. No	Terminals	Line Voltage (Volt)
1	R-Y	110
2	Y-B	108
3	R-B	112

Table: 6 Welding Transformer Output.

Sr. No	Connection	Voltage (Volt)	Current (Amp)
1	Parallel Running Coils	48	<65

V. ADVANTAGES

1. Multifunction induction motor is more convenient as compared to the normal induction motor.
2. Motor requires less space.
3. Motor is able to do at time two operations that is motoring and welding.
4. One more advantage is that less weight compared to separate combination of welding transformer and induction motor as well. Hence cost requires for two machines get reduced.
5. As per industrial point of view, it helps to reduce installation cost because multiple operation in same induction motor.

VI. DISADVANTAGES

1. As there is redesigning of stator winding, due to separate combination of single and three phase windings get high stresses on windings.
2. Original power ratings of motor get reduced.
3. At the time of welding operation load on the any one phase get increased.

VII. APPLICATIONS

1. The use of multiple motor used in mega workshops.
2. This motor is also used for traction. Metal cutting workshops.
3. It can be used for heavy fabrication industry and steel industry.
4. Useful for steel industries.

VIII. CONCLUSION

In our proposed model the one machine performs number of its economically useful and suitable at places where less space required. Cost of project machine is half to that of total cost of different machine. Therefore cost is 50- 60%.

We are getting very useful information about design related to the calculations of induction motor. Hence the use of multifunctional motor result in lots of advantages and convenient to use.

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