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Multifunctional Induction Machine

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ABSTRACT:
Induction motors play a very important role in industries, contributing to more than 85% of the total electrical load. Due to their strong construction, low maintenance, and cost-effectiveness, they are widely used in both agricultural and industrial sectors. They are essential for automation, and without them, industrial processes cannot operate efficiently. This paper focuses on redesigning the stator winding of a polyphase induction motor to perform multiple functions. The proposed motor can operate on both three-phase and single-phase supply. In addition to its normal operation, it can also function as a welding transformer and a phase converter. Thus, the redesigned motor improves flexibility, reduces equipment cost, and increases overall efficiency in industrial applications.

1. INTRODUCTION

Multifunction Machines Are Gaining Importance. A Multifunction Induction Motor Uses A Double-Layer Stator Winding And Can Perform Multiple Operations In A Single Machine.

A Three-Phase Induction Motor Consists Of Two Main Parts: Stator (Stationary) And Rotor (Rotating). It Works On Faraday's Law Of Electromagnetic Induction. When A Three-Phase Supply Is Given To The Stator, A Rotating Magnetic Field Is Produced, Which Induces Current In The Rotor And Generates Torque.

In Industries, Induction Motors And Welding Transformers Are Usually Used Separately, Which Increases Installation Cost. To Reduce This Cost, A Single Induction Motor Can Be Designed To Perform Multiple Functions Such As Motor Operation, Welding Transformer, And Single-Phase Motor Operation.

An Induction Motor Can Also Act As A Transformer Because It Works On A Similar Principle. It Can Be Used As A Welding Transformer To Provide Low Voltage (50–60 V) And High Current Required For Welding.Additionally, The Same Motor Can Operate On A Single-Phase Supply By Using Appropriate Windings.

Phase Converters (Static And Rotary) Can Also Be Used To Convert Single-Phase Power Into Three-Phase Power.

Thus, A Multifunction Induction Motor Reduces Cost, Saves Space, And Improves Efficiency, Making It Suitable For Modern Industrial Applications.

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.

Concept diagram

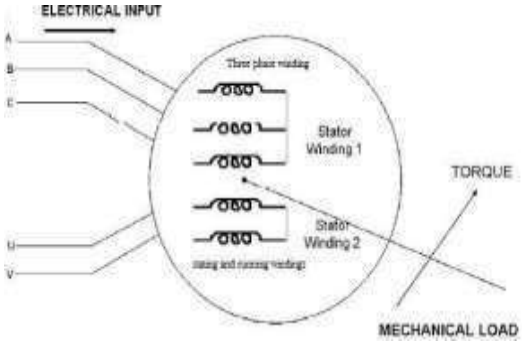

Fig.1 Double winding induction motor.

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	1440RPM
4	Voltage	415volts
5	Connection	Delta
6	Insulation class	B
7	Phase	3Ph
8	Pitch	1-8,1-10
9	Number of poles	4
10	Slots	36

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, 1440 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/V3.

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 36 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.

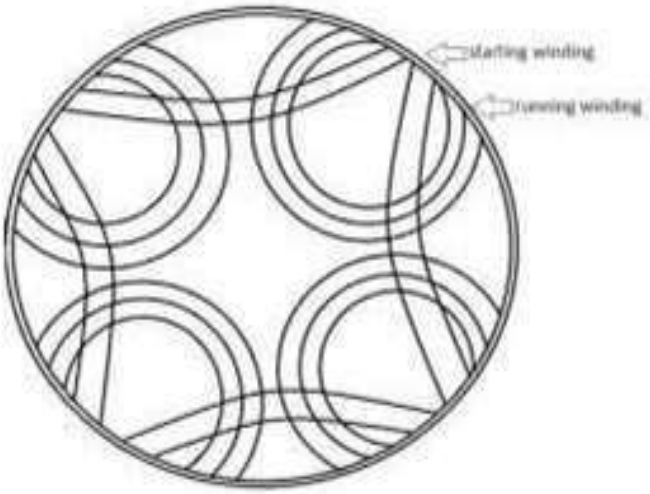

Fig2 Connection Diagram of both Three Phase and Single Phase Winding.

A. Three Phase Winding Design

For redesigned motor, there will be triple layer winding with following considerations:

Total turns for three phase=156

Coil pitch = 1 to 8

Turns/coil = 13*3 =39 turns

Total Coil = 4*3 = 12coils

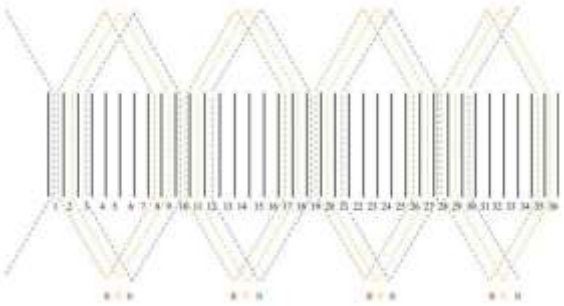

Fig.2 and Fig.3 shows the connection of poles and winding diagram for three phase motor.

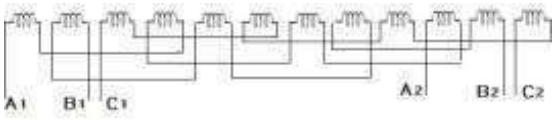

Fig.3 Connection of poles for three phase motor.

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:

156 turns/1.73= 90turns
Total turns for single phase =90
90/4 (poles) =23 turns/pole
Coils/pole =4
Turns/coil =8

For single phase operation, capacitor starts then it will give doubled input supply. Hence the motor gives step up operation.

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 B 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 50-60V 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.

ADVANTAGES

- This multifunction induction motor is simple and robust in construction.
- It requires less space.
- It has less installation cost.
- It has less maintenance cost.
- Total Weight reduces because single motor performs multifunction's.
- This motor at a time perform two operations.

APPLICATIONS

- This multifunction motor used in Conveyor Belt.
- It is used in Mega Workshops.
- It is used in Steel Industry.
- It is also used in Heavy Fabrication Industry.

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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