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Multifunctional Induction Machine

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Abstract:- An induction motor is nothing but generalized rotating transformer. In this paper, we are going to implement the redesigning of stator winding of single phase induction motor without change in rotor design and dual stator winding gene concept. Hence the motor act as multi-functional operation such as single phase motor, three phase motor, welding transformer and phase converter.

Keywords:- *Induction Motor, Rotating Transformer, Redesigning, Dual Stator Winding, Multi-Functional Operation.*

I. INTRODUCTION

An induction motor having rugged construction and very less maintenance, hence it will accepted for industrial as well as agriculture purpose for converting electrical power to mechanical power. An induction motor is nothing but generalized rotating transformer. This concept can be used to new distinct winding scheme is used to utilize three phase induction motor for multifunctional operation. This new winding does not required any kind of special arrangement to any standard 3 phase induction motor. The starting and running winding are placed in same slot of three phase for the operation of capacitor start induction motor.

The purpose of this machine is that it can work in multiple operations, such as at the same time it can act as single phase induction motor or three phase induction motor. It also works as phase converter like three phases to single phase. Whenever the motor works as a three phase induction motor at the same time it can work as welding transformer by some modification can be done in the running winding of single phase motor. At a anyone operation can work either single phase or either three phase.

II. MAIN FUNCTION

This proposed I.M having with has all advantages of ac machine with implementation in the redesigning of starting winding so, it can be act as Multifunctional function are implemented.

1. Three Phase I.M (LV)
2. Single Phase I.M
3. A Rotary Phase Converter
4. Welding Transformer

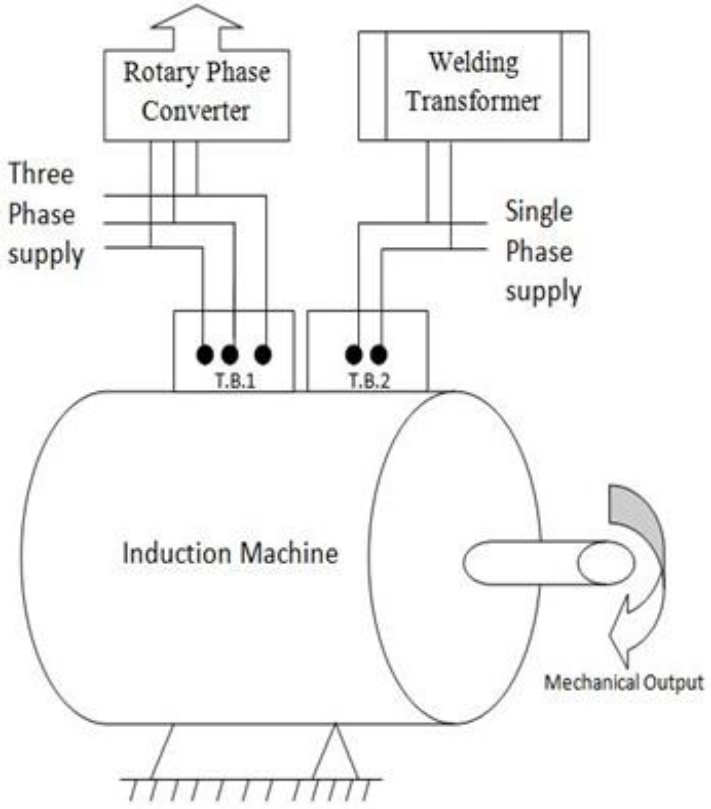

Fig 1:- Block Diagram

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III. MOTOR REDESIGNING AND DEVELOPMENT

In redesigning of motor we just observe the original design of its motor and its specification. The original winding is divided in 3 parts on the basis of no. of turns. Out of these winding the first winding is with same gauge wire and half of the original no. of turns. Hence, this is a winding of three phase induction motor and as number of turns are half the motor is of half capacity i.e. 1.3 Horsepower. The second and third winding is used for the purpose of welding and is act as tap transformer. As we know the welding application requires high current rating, the triple layer winding is used to improve the current rating. The same motor is used for single phase induction motor. Hence these winding are also used as starting and running winding of single phase induction motor.

SR. NO.	Parameter	Value
1	Speed	1500
2	Connection	delta
3	Insulation	Class B
4	No of Slots	36
5	Slot pitch	1 to 8
6	No of conductor per slot	72
7	Old wire gauge	18
8	power	5 HP
9	Voltage, Current and frequency	415V,3.5A,50Hz

Table 1:- Specification of old induction motor

Fig 2:- Empty stator core and casing

- *Hardware Implementation of Three Phase Winding Design*

The farma is used to take coil pitch of the previously designed motor winding. Then the farma is manually set by hands for taken coil pitch. Then there will be ease of doing coil groups of both single and double layer winding. The film papers are first inserted with proper size in order to protect conductor insulation which may be damaged by rubbing stator. Again the coils are also covered at upper portion. Then the free place will be there in order to do single phase connection. In this way three phase winding can be designed. For redesigned motor, there will be double layer winding with following considerations;

Coil pitch=1 to 8
Turns/slot=17
For 3 phase= 45 turns/coil
Total turns=612 (17 x 36)
Gauge = 17

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Fig 3:- Three Phase winding insertion

- *Hardware Implementation of Single phase Winding Design*

For designing the stator winding the size of conductor should be considered. The second step is to determine size of coil i.e. coil pitch. The coil pitch of original motor design is measured by the device called 'FARMA' The original motors coil group is brought out from the motor and then the farm is adjusted and fitted manually. Once farma is adjusted as our requirement, now anyone can able to do further single layer or double layer groups on farma.

Fig 4:- Running coils of Single phase winding

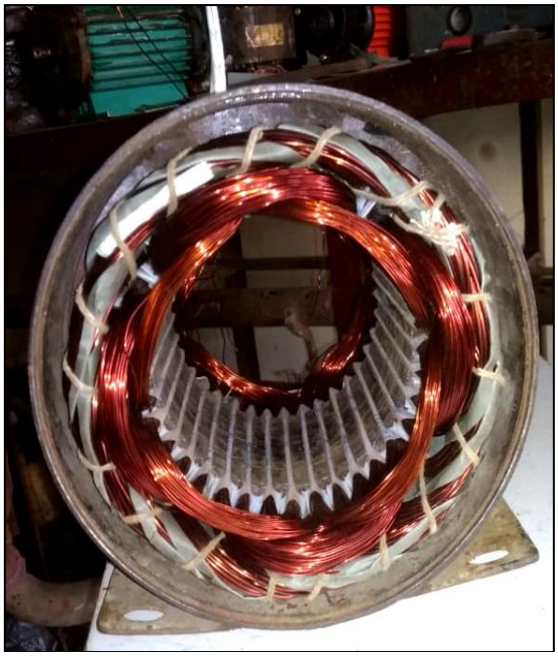

Fig 5:- Three Phase and Single phase starting running winding insertion

Winding	Pitch	Description
Starting	1-5	17 Turns Double coil 26 gauge
	1-7	18 Turns Double coil 26 gauge
	1-9	17 Turns Double coil 26 gauge
Running	1-8	34 Turns 22.5 gauge
	1-10	17 Turns 22.5 gauge

Table 2:- Winding Specification for Single Phase Motor

Fig 6:- Varnishing and terminal Connections of Three Phase and Single phase winding

IV. TESTING AND SPECIFICATIONS OF MACHINE

A. Testing on Three Phase machine

As shown in test setup no load and block rotor test carried out on 3 ph machine by using conventional Two wattmeter method with Multiplying Factor 4, for calculation of efficiency of motor.

Fig 7:- Three Phase No load and block rotor test setup

B. Phase shift test:

By using CRO with support of signal generator phase test carried out for three phase supply each phase shift from each other 120 degree.

C. Testing on single phase machine:

By using single wattmeter method with Multiplying Factor 4, No Load Test and Block Rotor Test done on single phase machine

Fig 8:- Single Phase No load and block rotor test setup

➢ *No Load Test:*

V_0 (VOLT)	I_0 (AMP)	W_0 (WATT)
220	5.5	50x 4= 200

Table 3:- No load test of I.M.

➢ *Block Rotor Test:*

V_{sc} (VOLT)	I_{sc} (AMP)	W_{sc} (WATT)
50	4.6	44 x 4 = 176

Table 4:- Block rotor test of I.M.

V. RESULT AND CALCULATIONS

➢ *For single phase operation:*

Input power (Pin) =230 x 6.1 x 0.8 = 1122.4 W

$$Output\ power\ (Pout) = Pin - (No\ Load\ loss + block\ Rotor\ Loss)$$

=1122.4 - (200+176)

=746.4 W

Hence efficiency, $\eta = \frac{Pout}{Pin}$ x100

$= \frac{746.4}{1122.4}$ x100

= 66.5%

➢ *2. For Three phase LV operation:*

Input power (Pin) $= \sqrt{3}\ X\ 100\ X\ 7\ X\ 0.8$

$= 969.94\ W$

$$Output\ power\ (Pout) = Pin - (No\ Load\ loss + block\ Rotor\ Loss)$$

= 969.94 - (200+70)

= 697.94 W

Hence efficiency, $\eta = \frac{Pout}{Pin}$ x100

$= \frac{697.94}{969.94}$ x100

= 71.95 %

➢ *Phase Converter- Single phase to three phase:*

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

Table 5:- Output Voltages of Phase Converter

➢ *Welding Transformer Output:*

Sr. No	(Not More than 50 seconds)		
	Connection	Voltage (Volt)	Current (Amp)
1	Parallel Running coils	36	≤ 65

Table 6:- Output Parameter of Welding

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VI. SPECIFICATIONS

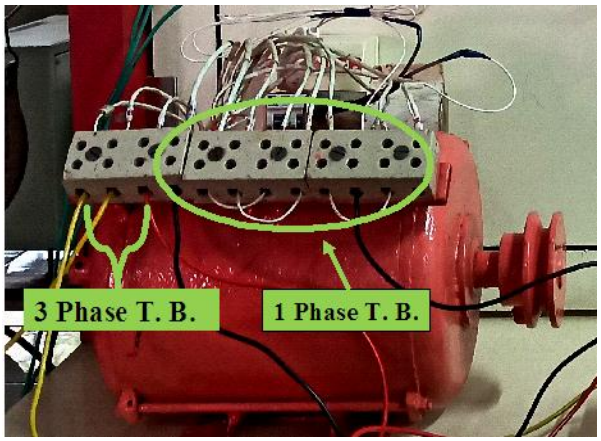

Fig 9:- Terminal Boxes

Sr. no	Parameter	Value
1	Power	1.5 HP
2	Frequency	50 Hz
3	Speed	1500 rpm
4	Voltage	230V
5	Insulation Class	F
6	Current	6.1 A
7	Phase	1 Ph

Table 7:- Specification for single phase motor

Sr. no	Parameter	Value
1	Power	1.3 HP
2	Frequency	50 Hz
3	Speed	1500 rpm
4	Voltage(LV)	110V
5	Insulation Class	F
6	Current	7.0 A
7	Phase	3 Ph

Table 8:- Specification for three phase motor

VII. ADVANTAGES AND DISAVDVANTAGES

The Multifunctional machine having simple and robust construction and it have less space requirement as compared to separated combination of single phase and three phase induction motor, Phase converter and welding transformer similarly total weight also reduced. With moderate efficiency of single phase machine total cost requirement for four individual machine is get reduced. The machine operate at a time two operation.

Insulation requirement increases for provide isolation between single phase and three phase redesigned winding. The three phase motor winding get highly stressed hence it operated on low voltage. Also Power rating of motor get reduced compared with old motor and at time motoring operation shaft get small jerk because of welding process.

VIII. APPILICATIONS

Multifunctional Machine are very useful in following Applications,

- Mega Workshops Electric Traction System
- steel industry
- Metal cutting Workshops
- Mega Workshops
- Heavy fabrication Industry

IX. CONCLUSION

The new distinct winding scheme provide solution for Industrial, Commercial and Agricultural as operated multifunction using single machine. With Some modification of old standard induction motor new machine designed with Improvement in efficiency of single phase machine provides energy saving opportunity.

This type of redesigned motor can used as Three phase LV motor, single phase motor, phase, welding transformer and phase converter (regeneration at non supplied terminals)

X. ACKONWLEDGMENT

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