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New Invention in Converting Two Phase to Three Phase Employing an Induction Machine

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ABSTRACT: This paper proposes a new topology of converting two phase to three phase which can be used for domestic and small industrial loads. Three phase conversion are finding increased applications in industrial environment with greater demand for high voltage, high power processing techniques with improved efficiency. Winding changer included in this project, is a device that supplies three phase power from a two phase source to power inductive, resistive and capacitive loads with distinct advantages over any existing converter device. The essential advantage is the improvement in the output voltage signal quality using devices of low voltage rating with lesser switching frequency, thereby increasing the overall efficiency of the system.

KEYWORDS*:* winding changer, contactors, unbalance currents, OLR, preventer, phase sequence.

I.INTRODUCTION

Most probably, if any customer wants to run a three phase appliance on a two phase electric power, two phase to three phase convertor is essential. One of the reasons of not giving three phase electric power to the domestic customer is its high cost of connection installation. It's quite commonly seen that capacitor is employed in two phase to three phase conversion. Several solutions have been proposed, but the objective is to supply a three phase motor from two phase AC mains, it is very common to have only a two phase power grid in residential, commercial, manufacturing, and mainly in rural areas, while the adjustable speed drives may request a three phase power grid. Two phase to three phase AC-AC conversion usually employs a full bridge topology, which implies in ten power switches. This converter is denoted here as conventional topology. This paper describes the working of three phase induction motor using two phase supply for the conversion of two phase to three phase. Once the supply is given, the motor starts rotate at a low speed. After this, the motor can able to run at a rated speed with the help of contactors switches which changeover the end terminal connections. Hence the Third phase is generated and it combines with the existing two phase and the output will be three phase.

Capacitor less converters have been used to improve the performance of active power filters, uninterrupted power supplies (UPS), fault tolerance of doubly fed induction generators, and three phase drives. Usually the operation of converters in capacitor less requires for isolation. However, weight, size, and cost associated with the transformer is not used, the reduction of circulating currents among different converter stages is an important objective in the system design. To overcome these difficulties, a new topology emerges, with an induction machine which acts as a source for the third phase. The proposed system is conceived to operate where the two phase utility grid is the unique option available. Compared to the conventional topology, the losses of the proposed system may be lower than that of the conventional counterpart. The above mentioned benefits justify the initial investment of the proposed system, due to the increase of number of switches.

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II.BLOCK DIAGRAM

The block diagram of two phase to three conversion using induction machine is shown in fig 2.1.

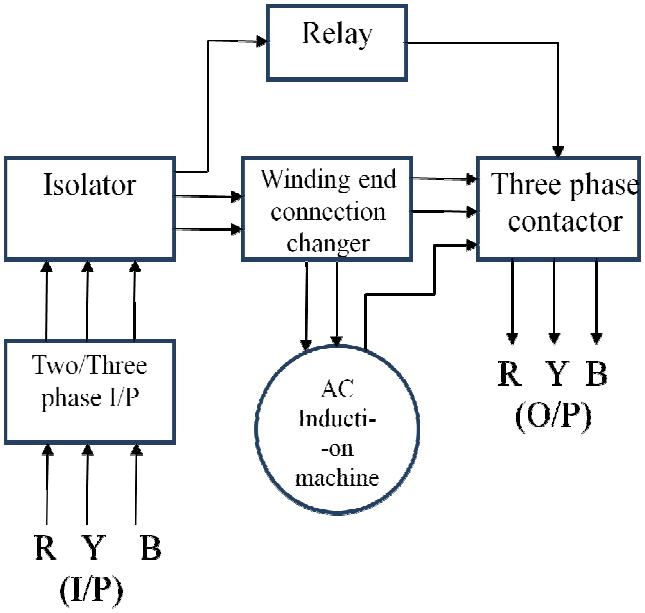

Fig 2.1 Block Diagram

When three phase input is given to relay it operates to provide direct three phase, and if two phase is available winding changer changes the end terminal connections of an induction motor and produces the third phase. Hence the output will be a three phase from two phase.

According to faraday's law of electromagnetic induction "whenever flux links the coil changes, emf is induced" when an induction motor gets excited by giving alternating current the flux is produced by the stator winding, this flux revolves with the synchronous speed. which is knows as rotating magnetic field(RMF). This rotating magnetic field makes the motor to rotate. By considering four poles, two pairs of brushes (A, B, C, D) induction motor two brushes (A, C) are connected with the supply, armature reactance ø1 flux setup in a low reactance path hence, emf $E_2=KI_1$ is setup between B & D brush. When brushes B & D are connected to a load, a current I_2 flows through the load. The load current I_2 setup another flux $ø_2$ causes an emf, $E_1=KI_2$ between the brushes A & C opposing the applied voltage. As the applied voltage is constant, resistance drop is negligible so that the back emf E_1 is also constant[1].

$$\text{Input} = E_1I_1 = KI_2I_1 = KIE_2/\mu = E_2I_2 = \text{output}[1].$$

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III.CIRCUIT DIAGRAM

The circuit diagram for conversion of two phase to three phase conversion using contactors is shown in fig 3.1

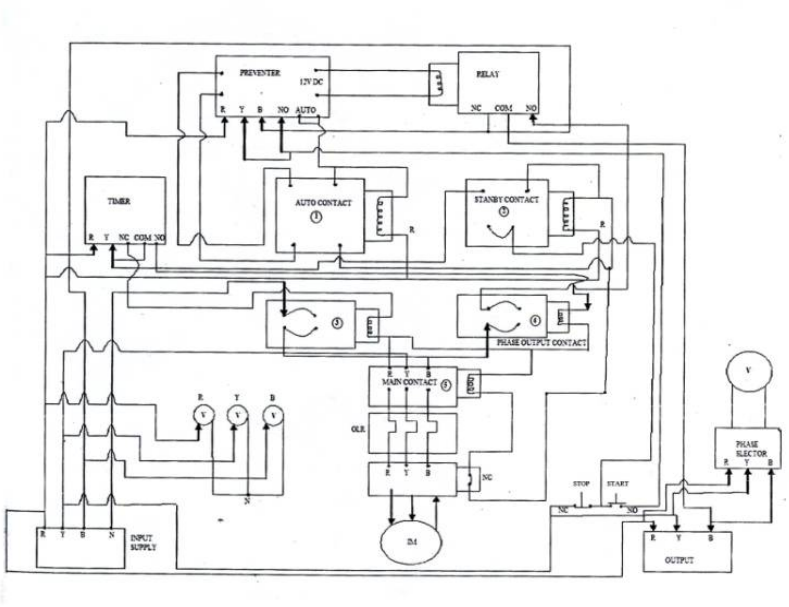

Fig 3.1 Circuit Diagram

When supply is given, the Preventer operates to check whether the supply is three phase or two phase. If it is two phase supply, the contactors operates to provide three phase output or else the three phase is directly fed from the supply.

IV.PROPOSED APPROACH

IV.i. WINDING CHANGER

In an induction motor (star-delta), end terminals are shorted in such a way that three phase input is given as shown figure, but in this topology end terminals are changed in a manner in the induction motor runs in a two phase supply. When the motor is started it runs at a slow speed in star connection and picks up to rotor speed (1500rpm) due to thechangeover to delta connection. As suggested above motor starts in star connection and run in delta connection by using the two pole contactor (winding changer).

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The step by step operation of the winding changes is shown in fig

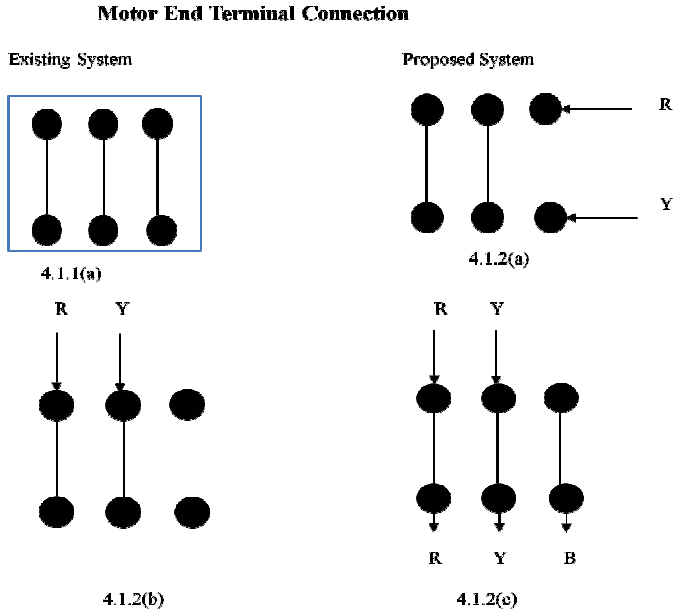

Figure . 4.1 Winding Changer

Fig 4.1.1(a) Existing System.

Fig 4.1.2 Proposed system

(a) Step 1.(b) Step 2.(c) Step 3.

Winding changer consists of four contractors which is used to change over the connection in the end terminals.

Contactor 1: This contactor acts as a stand by contactor.

Contactor 2: This allows two phase supply in star connections i.e, (B_2,C_1) as shown in figure 4.1.2(a).

Contactor 3: This allows two phase supply (C_2,A_2) in delta connection in which C_2,A_1 and A_2,B_1 are shorted as shown in figure4.1.2(b).

Contactor 4: This contactor shorts B_2 and C_1 and output from 3rd phase is taken as shown in fig 4.1.2(c).

IV. ii UNBALANCED CURRENT

The only sources of unbalanced phase currents was either a problem in the motor, such as an unbalanced number of turns in the windings, an uneven air gap or unbalanced phase voltage. Generally, unbalanced voltage will produce unbalanced currents that are greater than the percentage of voltage unbalance. The ratio is close to 8:1. ie the voltage unbalance of 1% could create unbalance phase current of as much as 8%. The unbalance current causes high operating temperature often, reduce the life and efficiency of the motor. Unbalanced current on 3 phase motor can be tolerated for the small amount of current. Excessive unbalanced currents reduce the motor life and increase energy consumption. It can also cause magnetic pull such as cogging and magnetic locking.

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Example: Determine the average from the below table

Phase	Loaded Amps
R	9.5
Y	16.2
B	21.3

Table 1 Current at each phase

(9.5+16.2+21.3)/3 =15.6 amps

Determine the difference percentage

(Highest phase-average)/average *100

(21.3-15.6)/15.6*100 = .38461*100 = 38.48

IV.ii.i Effects Of Unbalanced Currents

Problem	Solution
Blown fuse on power factor correction capacitor bank	Search, find and replace blown fuse
Uneven single phase loading of the 3 phase system	Locate single phase loads and distribute them more evenly on 3 phase circuit
Unbalanced voltages	If incoming voltages are unbalanced at light loads or no loads , the problems should be corrected.
Harmonic Distortion	Locate the sources of harmonics and use harmonic filters to control or reduce harmonics . Install line reactors on existing and new variable frequency controls.

Table 2

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IV.iii PHASE SEQUENCE

For the correct operation of 3 phase induction motor, it is necessary to have 3 phase with balance condition.(i.e. 120-degree phase difference between each phase). If the availability of two phase with 120-degree phase difference then another phase is generated by connecting one capacitor with any one of the phases. But this operation is quite risky, if we run for more time then the motor winding may be heated and it may burn. This is because of not having the exact 120-degree phase shift.

V. HARDWARE OVERVIEW

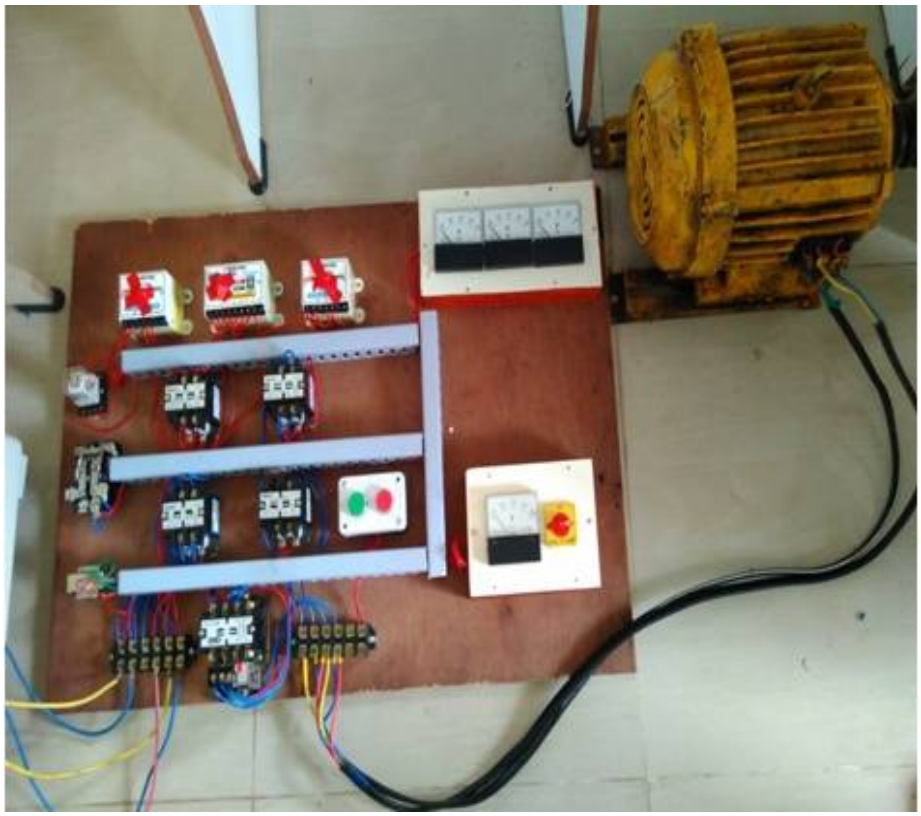

Fig 5 Hardware Kit

5.1 Hardware Specifications

Parameters	Range
Motor	3phase,5Hp,440v
Contactor	16 Amps
Relay	16 Amps

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VI .CONCLUSION

A two phase to three phase drive system composed of two-phase, a three-phase and an induction motor was proposed. The complete comparison between proposed and standard configuration has been carried out in this paper. Compared to the conventional topology, the proposed system permits to reduce the relay switch currents. In addition, the losses of the proposed system may be lower than that of the conventional counterpart. The initial investment of the proposed system cannot be considered on drawback especially considering the scenario where the justify such initial investment. The experimental results have shown that the system is controlled properly, with transient and occurrence of the fault.

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