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Energy Conservation by Using Automatic Star-Delta-Star Starter

Mrs. S.S.Patil¹, Mr. G.S. Nikam², Ms.M.J.Patil³, Ms. P.S.Waghmode⁴,
Ms. R.P. Rajeshirke⁵, Mr.A.Z.Mulani⁶

Professor, Dept. of EE, Rajarambapu Institute of Technology, Rajaramnagar, India¹

Diploma Student, Dept. of EE, Rajarambapu Institute of Technology, Rajaramnagar, India²

Diploma Student, Dept. of EE, Rajarambapu Institute of Technology, Rajaramnagar India³

Diploma Student, Dept. of EE Rajarambapu Institute of Technology, Rajaramnagar, India⁴

Diploma Student, Dept. of EE, Rajarambapu Institute of Technology, Rajaramnagar, India⁵

Diploma Student, Dept. of EE, Rajarambapu Institute of Technology, Rajaramnagar, India⁶

ABSTRACT: India is a developing country. Electrical energy is the basic necessity of our country. So the efficient use of electrical energy is required. In view of energy conservation this paper presents the efficient use of star delta starter. The delta star converter is interfaced with the conventional star delta starter. This starter works when the load on the motor is less than 50% of full load, then it switches the motor in star mode to save the electrical energy. When the motor exceeds the 50% of full load, it switches automatically in delta mode without any disturbance to the motor. By implementing this module energy conservation is done. To reduce maximum demand and KVA to increase efficiency and power factor of the system we gave some contribution to our country.

KEYWORDS: KVA, NC, NO

I. INTRODUCTION

In recent years, the power demand has increased desperately. But there is limitation of power generation and transmission due to limited resources and environmental restrictions. Because of increased power demand fossil fuels are burned which has adverse effect in environment. In India the total installed capacity is 2, 07006 MW and the maximum present peak demand is 21, 70, 000 MW. This gap can be decrease either by increased generation or by energy conservation. But the power generation and transmission has been restricted by limited resources and environmental restrictions. So to narrow this gap we have to save the energy as early as possible. At this situation it is very important to manage efficient power.

In industries 80% of motor used are AC induction motor. An AC induction motor can be single phase, poly phase, brushed or brushless. So industries contained these motors consuming more power, hence we have to concentrate on energy conservation in this area. This system conserves the energy by changing the stator windings either in star or delta mode with the load variation. When load on the motor reduces less than 50% of load, It switches the motor in star mode to save energy. When the load exceeds 50% of the full load, it switches the motor in delta mode. Since the power consumption in star is one 3rd of delta, because of this energy conservation is done.

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II. WORKING OF CONVENTIONAL STAR DELTA STARTER

This method is used to delta connected three phase squirrel cage induction motor. Motor terminal box should have 6 terminals from the three phases of stator. By using conventional star delta star starter we can start the threephase induction motor. It required sufficient time delay to allow the motor peaks up to its normal running speed, before the motor switches the mode. This period may be taken as 10 second, but could be less for a lightly loaded motor and greater for heavily loaded motor. In an automatic star-delta starter, this delay is obtained by using a timer. During starting period motor must start in star mode, applied voltage is reduced by 1/3rdoperatedvoltage.Sincethestartingcurrentofmotorwill reduced 1/3rd of the current as compared to the delta connection. Since the torque developed by induction motor is proportional to the square of applied voltage. Therefore star delta starting reduces the starting torque by 1/3rd that of the direct online starting.

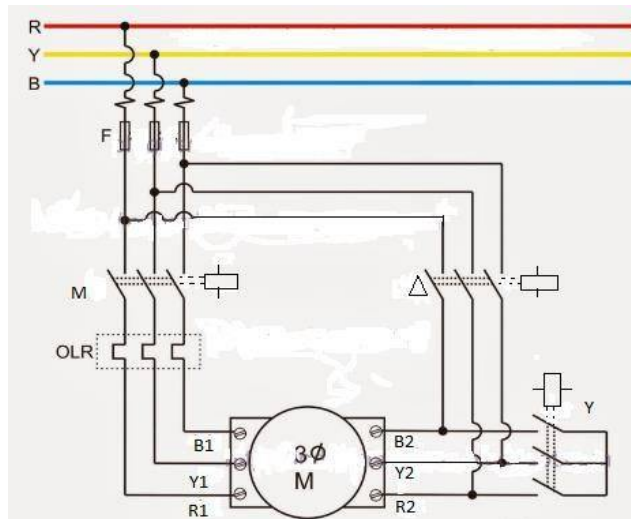


Fig.1: Power circuit diagram of Automatic Star-Delta Starter

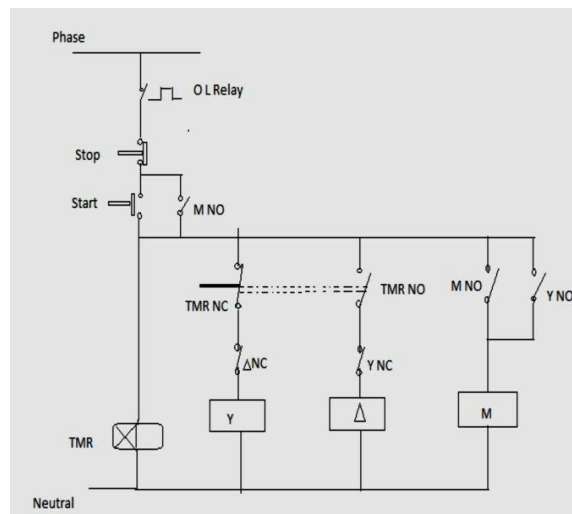


Fig.2:Control circuit diagram for Automatic Star Delta Starter

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When the start push button is pressed then star contactor gets energized and connecting the stator terminal in star mode. When three phase supply is given to the winding through the main contactor which is now energized due to the closing NO contact of star contactor. TheWhen the start push button is pressed then star contactor gets energized and connecting the stator terminal in star mode. When three phase supply is given to the winding through the main contactor which is now energized due to the closing NO contact of star contactor. Themotor will start rotating in star mode. When the motor peaks up normal speed (say in 10 sec) the time delay contacts will open and de- energies the star contactor. NO contact of star contactor will closeandthereforedeltacontactorwillgetenergizedconnectingthe winding terminals in delta mode across the supply. For interlocking between the two contactors star and delta, one NC contact of star contactor has been connected in series with delta contactor and one NC contact of delta contactor has been connected in series withstar contactor.

III. PROPOSED STAR DELTA STAR STARTER

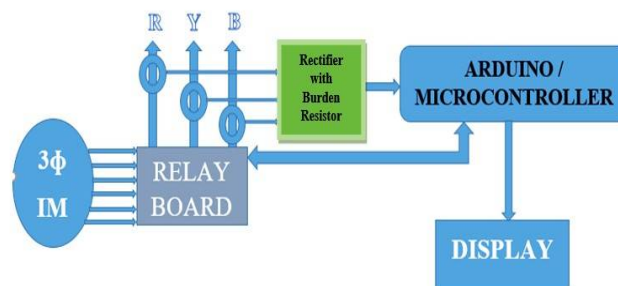


Fig 3. Block Diagram

Above block diagram shows the basic idea. Arduino is main device in which we interface relay circuit and reset circuit. The main heart of this module is Arduino Uno. Arduino Uno is supplied with 12V with the arrangement of 12V travel adapter.

When we give three phase supply to our star delta star starter and other terminals are connected to the motor windings. First, it starts in star mode and after 30sec, it converted into delta mode with change in load variation. Current transformer is used to sense the current variations for the purpose of switching. Here we used rectifier and Burdon resistor for processing the output current into proportional voltage. Also relay board is used for changing the stator terminals either in star or in delta with load variations. Arduino Uno is used for controlling the stator connections by using program. It is a device which conserves electrical energy with load variations in three phase induction motor. If the windings of motor are connected in star then the voltage is applied to the winding connected directly across supply line phases in delta.

When the motor is connected in star mode then total output torque is only 1/3of the rated torque produce when running in delta. When there is less load or no load and 415V is given to the motor, but that much power is not required in that load condition. So by reducing the applied voltage during less load or no load condition power can be saved. Normally motors run in delta mode (not depends upon load). So by making motor to run in star mode during these no load periods only $1/\sqrt{3}$ time's line voltage is applied which reduces power input to the motor. Current sensor continuously monitors the current variations and provides the necessary feedback as per the design.

Based on the feedback from current sensor the delta-star module performs as an energy saver, to avoid the frequent

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unwanted switching's the output from the sensor will be monitored by using an additional timer and this period can be varied manually as per the requirement. Motor always start in star mode and change over to delta mode. If load is greater than 50% then motor switches in delta mode and when load on motor less than 50% then motor switches into star mode. In this way electrical energy can be saved by using this Automatic Star delta star starter.

IV. CONTROL CIRCUIT DIAGRAM OF PROPOSED STAR DELTA STARTER

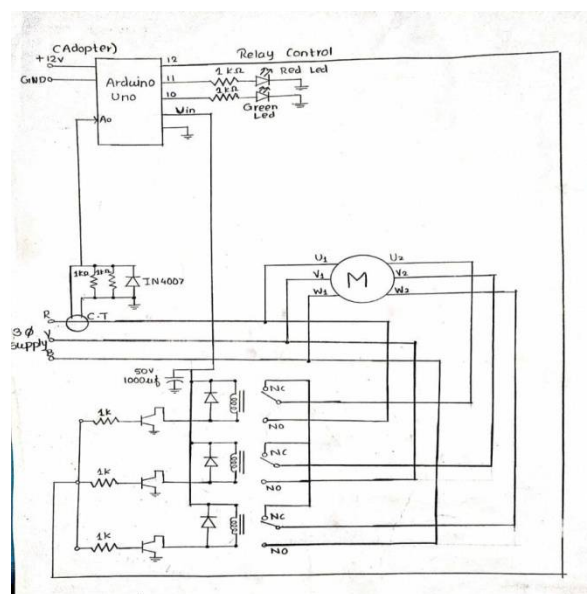


Fig.4: Control circuit diagram of proposed starter

In this circuit three phase supply is given to three phase induction motor. Current transformer is connected in “R” phase which is used to sense the current. The ratio of current transformer that we used in this circuit is 1:1000. then the output of this is given to the Burdon resistor which produce output voltage proportional to the resistor value. The diode 1N4007 is connected across the burdon resistor. It is used as a rectifier. i.e. It only passes electrical signal in one direction that is used to convert AC power into DC power. Then its output is given to the A0 pin of the Arduino. In Arduino when value of Irms is more than 2A and if motor is in star mode, then it switches into delta mode. When value of Irms is less than 4.5A and if motor is in delta mode then it switches into star mode. At starting pole is connected to the NC so, motor is in star mode. Pole means U2, V2, and W2 terminals of the motor. When the voltage is 3.3V then the signal is given to the relay circuit through Vin pin of the Arduino. When relay circuit receives the signal from Arduino its coils get energies and pole is connected to the NO that means motor gets switched into delta mode. We also used 2 LED S Green and Red. Green Led indicates motor is in star mode and red led indicates motor is in delta mode. The ripples in power supply signals are harmful to other devices connected in the circuit. So to avoid this decoupling capacitor is used in the circuit. 3 NPN transistors are used in this circuit to switch turn on or turn off by controlling base signal. We also used the Arduino Uno software, in that we can observe voltage, current and states of motor. i.e. Either in Star or deltamode.

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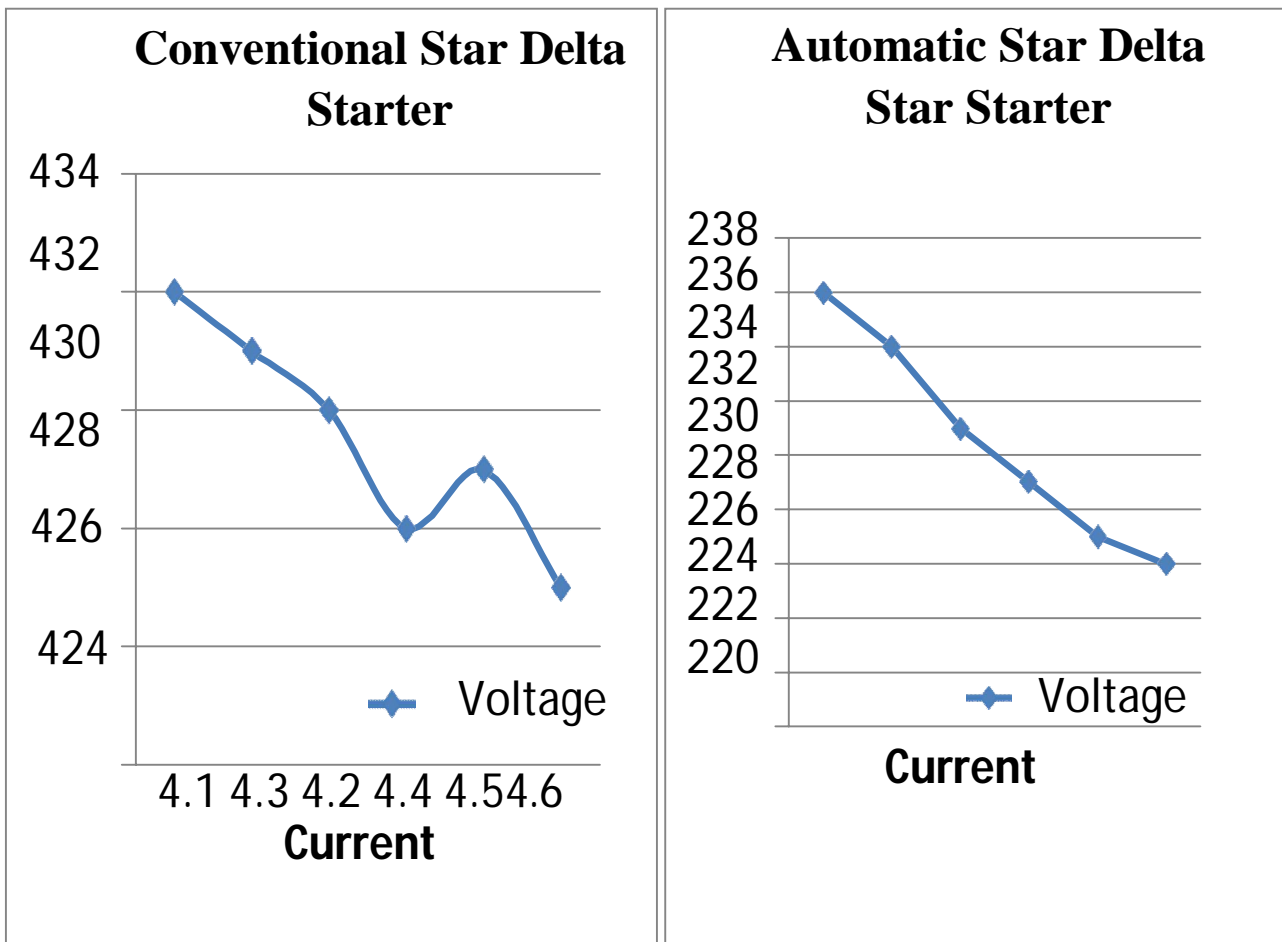
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V. RESULT AND RESULT ANALYSIS



Fig.5: Actual Hardware





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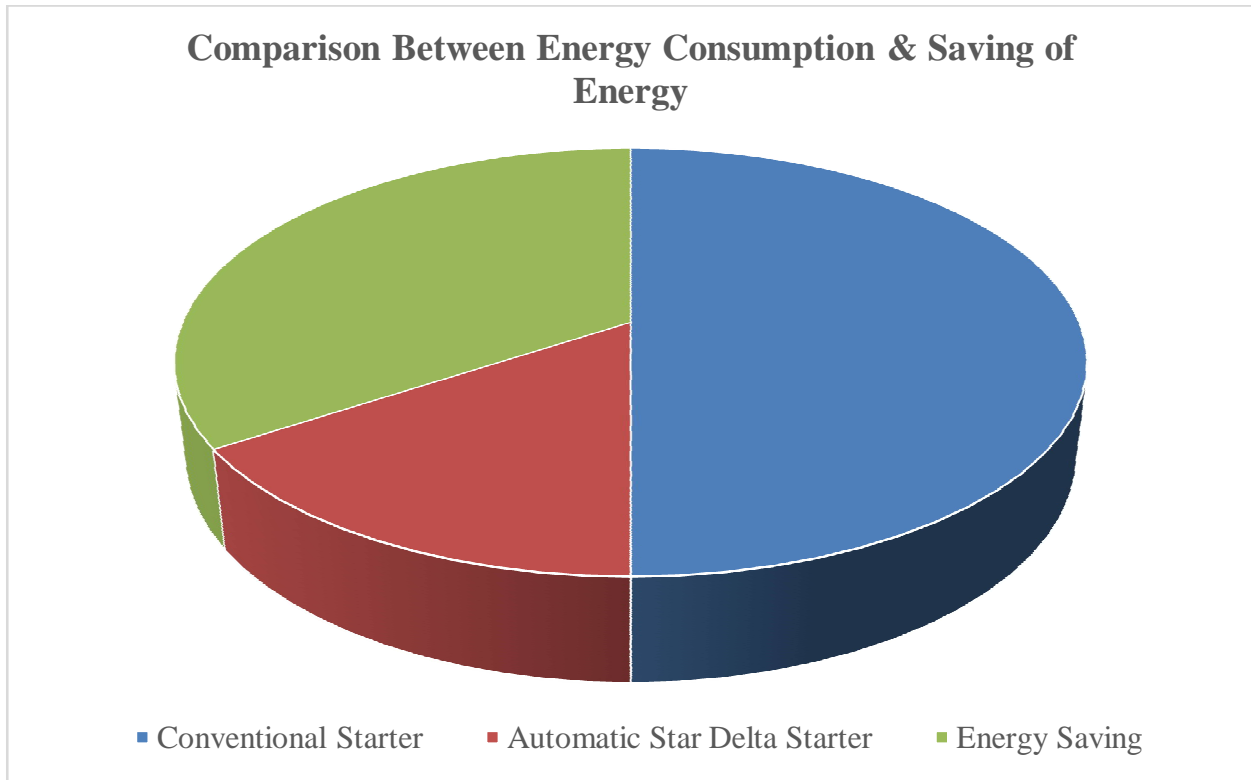


Fig.6: Energy Conservation & Saving

VI. CONCLUSION

If the motor can meet the torque requirement in star mode then we can always run the motor in star mode. This can save 25% of power when compared to deltamode. The lifespan of the machines and efficiency also increased by the implementation of this.

- I. Power factor is better in star delta star starter as compared to star deltastarter.
- II. Usage of capacitor banks to improve power factor is reduced.
- III. The size of the conductor can be reduced.
- IV. Reduced stress on power grid when starting.
- V. The components required very little space.
- VI. It saves money.

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