

Automatic Star-Delta Starter

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Abstract - This equipment/appliance reduces starting current and starting torque. Automatic Star Delta Starter design normally consists of three contactors, Miniature circuit breaker, and a timer for setting the time in the Star position (starting position). For the Star Delta Starter, a motor must be in delta connected position during a normal run and the main purpose is to be able to use the starter. When the motor is at idle, it just is like the short-circuited transformer at secondary side because all the rotor bars are connected together to form a closed path. This will draw a large current flow through the rotor bars. So, when the motor is started, stator draws high current which is 8-10 times that of the rated current. Therefore, before starting the motor, it is necessary to reduce the voltage applied to the motor. In Star connection current is in different phases but line voltage is root three times that of the phase voltage. So, the voltage is reduced which results in reduction of current if motor is started in star connection. In Delta connection the voltage is same as that of phase voltage so full voltage is applied if we run the motor in delta connection. The Star/Delta Starter is generally obtained from three contactors, pneumatic timer, and a thermal overload relay or circuit breaker, for 3 phase motor at 440 volt AC main supply 50 Hz.

Starting current having high value of current then after to reduce this high current.

2) EQUATION OF STAR-DELTA CONNECTION

A) STAR CONNECTION:-

Phase Voltage $V_s = 3$ Phase Voltage

$$= V_1 \times 1/\sqrt{3}$$

Phase Current $I_{S1} = \text{Phase Voltage } V_s / Z$

$$= \sqrt{3} \times V_1 / 3Z$$

Line Current = Phase Current I_{S1}

$$= \sqrt{3} \times V_1 / 3Z$$

B) DELTA CONNECTION:-

Per Phase Voltage $V_s = 3$ Phase Voltage V_1

Phase Current $I_{S2} = \text{Phase Voltage } V_s / z$

$$= V_1 / Z$$

Line Current = $\sqrt{3} \times \text{Phase Current } I_{S2}$

$$= \sqrt{3} \times V_1 / 3Z$$

3) CONSTRUCTION AND CRICUIT COMPONENT OF STAR-DELTA STARTER a) Wiring Diagram:

The circuit breaker serves as the main power supply switch that supplies electricity to the power circuit. The main contactor connects the reference source voltage R, Y, B to the primary terminal of the motor. In operation, the Main Contactor and the Star Contactor are closed initially, and then after a period of time, the star contactor is opened, and then the delta contactor is closed.

The control of the contactors is by the timer built into the starter. The Star and Delta are electrically interlocked and preferably mechanically interlocked as well. The star contactor serves to initially short the secondary terminal of the motor for the start sequence during the initial run of the motor from standstill. This provides one third of DOL current to the motor, thus reducing the high inrush current inherent with large capacity motors at startup.

Key Words: Three Phase Induction Motor, Reduce Starting Current, low current start.

1) INTRODUCTION

Three phase induction motors are widely used due to their low cost, rugged construction, fast pickup, low maintenance and high efficiency. The direct online starters don't provide sufficient protections against voltage fluctuation and single phasing while induction motors are highly sensitive to these. Induction motors if not switched to delta mode of operation within a few seconds then motor can draw heavy current and burn out itself so a sensitive protection and switching device are needed to avoid such conditions and protect the motor. For this purpose we use automatic star delta starters with timer relays with the help of which we can switch the mode of operation of the motor from star mode drawing low current to delta mode drawing the full load current. This will be used for best protection of motor against high current. This method also having single phasing protection.

Controlling the interchanging star connection and delta connection of an AC induction motor is achieved by means of a star delta or delta control circuit

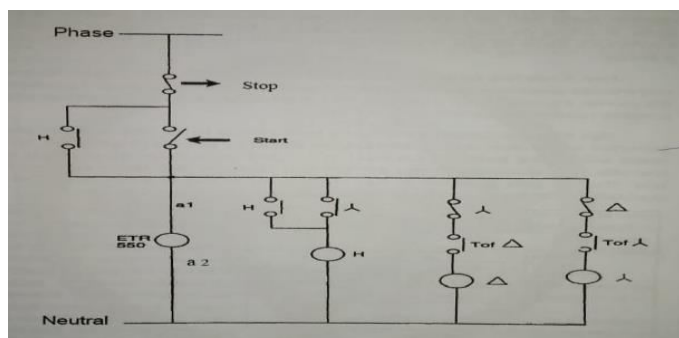


Fig.1 wiring diagram of automatic star delta starter

b.) Control circuit

ON push button starts the circuit by initially energizing Star Contactor Coil of star circuit and Timer Coil circuit. When Star Contactor Coil energized, Star Main and Auxiliary contactor change its position from NO to NC. When Star Auxiliary Contactor (which is placed on Main Contactor coil circuit) became NO to NC it's complete The Circuit of Main contactor Coil so Main Contactor Coil energized and Main Contactor's Main and Auxiliary Contactor Change its Position from NO To NC. This sequence happens in a fraction of time.

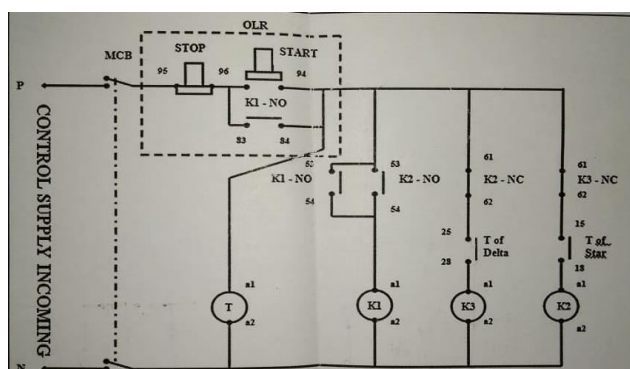


Fig. 2 Control Circuit Diagram of Star-Delta Starter

After pushing the ON push button switch, the auxiliary contact of the main contactor coil (2) which is connected in parallel across the ON push button will become NO to NC, thereby providing a latch to hold the main contactor coil activated which eventually maintains the control circuit active even

after releasing the ON push button switch. When Star Main Contactor close its connect Motor connects on STAR and it's connected in STAR until Time Delay Auxiliary Contact become NC to NO. Once the time delay is reached its specified Time, the timer's auxiliary contacts in Star Coil circuit will change its position from NC to NO and at the Same Time Auxiliary contactor in Delta Coil Circuit (4) change its Position from NO to NC so Delta coil energized and Delta Main Contactor becomes NO to NC.

Now Motor terminal connection change from star to delta connection. A normally close auxiliary contact The from both star and delta contactors are also placed opposite of both star and delta contactor coils, these interlock contacts serves as safety switches to prevent simultaneous activation of both star and delta contactor coils, so that one cannot be activated without the other deactivated first. Thus, the delta contactor coil cannot be active when the star contactor coil is active, and similarly, the star contactor coil cannot also be active while the delta contactor coil is active. The control circuit as shown in fig.3 above also provides two interrupting contacts to shut down the motor. The OFF push button switch break the control circuit and the motor when necessary. The thermal overload contact is a protective device which automatically opens the STOP Control circuit in case when motor overload current is detected by the thermal overload relay, this is to prevent burning of the motor in case of excessive load beyond the rated capacity of the motor is detected by the thermal overload relay. At some point during starting it is necessary to change from a star connected winding to a delta connected winding. Power and control circuits can be arranged to this in one of two ways - open transition or closed transition.

4)Advantages automatic star -delta starter

- The operation of star delta method is simple and rugged.
- It is relatively cheap compared to other reduced voltage methods.
- Good torque/current performance.

5)Disadvantages automatic star-delta starter

- Low starting Torque
- Break in Supply It required 2 set of cables from starter to motor.

6) Conclusion:-

As we have performed this project we can conclude that this type of starting is used for low to medium voltage applications. It is the cheapest way to reduce the starting current for three phase induction motors as it is in the order of three to four times that in case of direct online starter. By this project we can conclude that this method of starting the motor can be easily implemented with the help of relays and the electronic timer circuit.

The way of connecting the relays gives prevention of the motor from the single phasing. It has been implemented by the using of induction motor starter but here in our project we are using six lamps instead of induction motor. Star- delta starter are also used by Direct Online method but by automatic star delta starter they will be switched from one mode to other automatically by the use of adjustable electronic timer. Initially Timer will set a finite no. of second to switch over from star to delta operation mode. Basically the main advantages of this method is to protect the motor of high starting current but in DOL method motor will not be protected well. The display of the monitored voltage is easily indicated by the difference in the glow of lamps.

7) Future Scope:-

Compared to the reduced voltage methods it is the simple and cheapest way of starting the motor. But it takes large in rush currents during switching operation. Further *the project can be enhanced by using a Thyristor in firing angle control principle for soft start of the induction motor* that would overcome all the drawbacks of star delta starter

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