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Research Article

Exploration of the Star/Delta Electrical System Within the Electrical Engineering Division

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Abstract

The star delta starter of induction motor is designed to reduce high starting current and torque. The star delta starter is designed by three magnetic contactors, an overload relay, timer relay and circuit breaker. For Starter, a motor must be connected in delta mode position during a normal run. When induction motor is start in direct online. The motor winding draws a large amount of current. The starting high current can be reached in 8-10 times of the rated. So, there is need to control high starting current before starting the motor. Therefore, in a star connected system line current is equal to phase current but line voltage is equal to the root three times of phase voltage. For these reasons at first motor is connected to the star system and it reduce the high starting current. In delta connection, line voltage is equal to phase voltage and line current is equal to √3 times phase current. In run mode the motor connects in delta system so that the full voltage applied to the motor. The Starter is made by three magnetic contactors, timer relay, and a thermal overload relay or circuit breaker.

Keywords: *Star-delta starter, induction motor, starting current, torque reduction.*

Introduction:

Automatic Star/Delta starters are probably the most common reduced voltage starters. They are used in an attempt to reduce the start current applied to the motor during start as a means of reducing the disturbances and interference on the electrical supply. Most induction motors are started directly on line, but when very large motors are started that way, they cause a disturbance of voltage on the supply lines due to large starting current surges [1]. To limit the starting current surge, large induction motors are started at reduced voltage and then have full supply voltage reconnected when they run up to near rotated speed. Two methods used for reduction of starting voltage are: Automatic Star delta starting and Auto transformer starting.

Problem Statement/Justification:

Three phase induction motor is a self-starting electric machine. The rotating field has to be produced electromagnetic field and rotor flow the current. If the load increase on the motor, a huge amount of current flows through the rotor. For this reasons stator can draw heavy current and coil get heated up. Due to the excessive heat coil winding insulation fail and damage the motor. At the starting time the slip=1, therefore the rotor resistance become zero (Rs =R2/ (1-s). To limit this starting current, we need a starter of induction motor. The voltage is reduced to one way, which in turn reduces the torque.

Objective(s)of the study:

i) To design practical module of a star-delta starter for an induction machine.
ii) To construct and implement the design.
iii) To carry out performance and cost analysis.
iv) To analyze the benefit of reduced high starting current.

Literature Review:

Automatic Star-Delta starter is a fine method of starting the induction motor which reduces the starting torque and starting current. Induction motor is the most common types of electric motor in industry. This electric motor has very simple structure than any other moving machine. But the motor is very power full and high efficiency. The most common feature of the motors are low cost, quick pick up and easy maintenance. If the induction motor start in Direct on Line (DOL) method, the motor is started with application of full voltage and the starting current will be 7-10 times of rated current [2]. So large induction motors do not start using DOL method. Another induction motor start only star system, its gives low torque and if motor start only delta method, its gives high starting current. So, we need a secure protection to avoid such conditions and protect the motor. For this reason we use automatic star delta starters with help of magnetic conductor, timer relay and overload protection. This is the best protection against high current. Automatic Star delta starter design normally consists of three contactors, a circuit breaker, and a timer for setting the time for star delta switching. In automatic Star Delta starter, during normal run-time motor must be connected in Delta connection only. In automatic Star Delta starter, the received starting current is about only 33% of starting current during direct online start and the starting torque is reduced to about 33% of the torque available at the direct online start [3].

Methodology (Should include description of Study area/site/subjects, data collection and data analysis)

The automatic star delta starter system is designed and developed by contactor and timer relay. The induction motor have wide variety characteristics, industrially it plays the premier role. Some of those are self-starting mechanism, heavy construction, high efficiency, good power factor etc. Different types of induction motor are available. Squirrel cage induction motors are mostly used than the other types. Small and medium size induction motors are started directly on line, but when very large motors are started that way, because of large amount of current flow through the motor [11]. So when the motor is started, stator draws the high current which is 8-10 times that of the motor rated current. Before staring the motor, it is necessary reduce the voltage applied to the motor. To reduce the high starting current, large induction motors are started at reduced voltage and then have full supply voltage reconnected when they reached to near to the rated speed.

Block diagram of star-delta starter

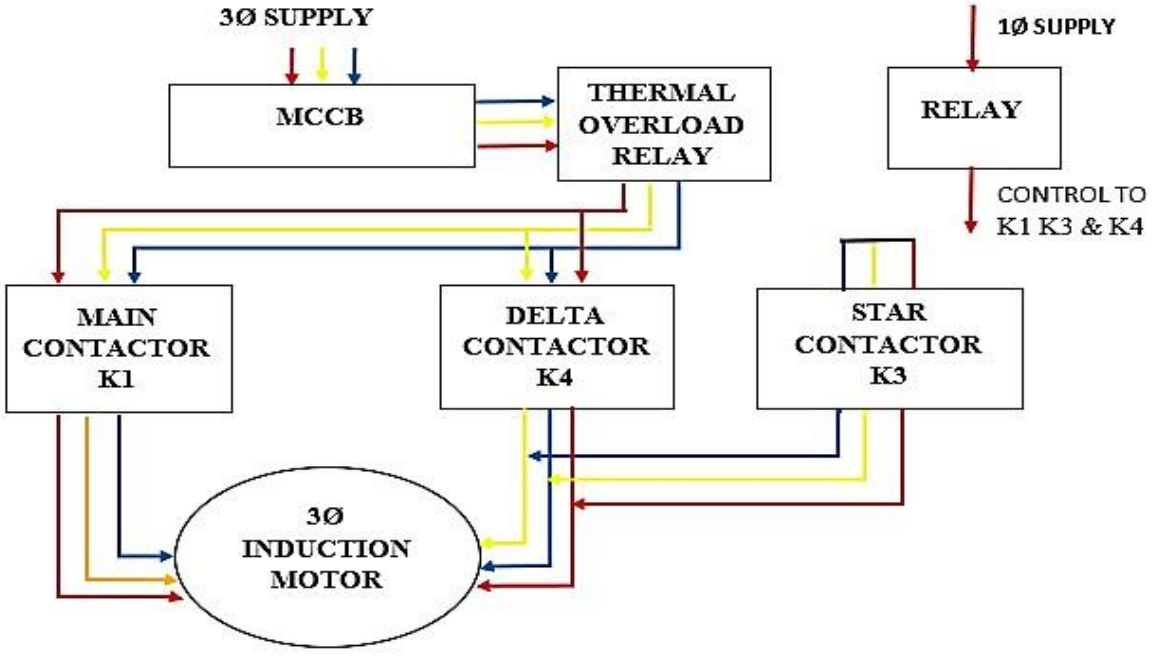

Fig 3.1: Block diagram of star-delta starter

The automatic Star/Delta starter is generally obtained from three contractors; electromechanical timer and a thermal overload for operating a 3-phase motor at 415 volt at ac mains supply 50 Hz. The interlocking arrangement of all the contactor coils is traditionally wired in 415volt AC. Fig 3.1 illustrates the specific design of the block diagram of the automatic star delta starter.

TEST		RESULTS	
1. Continuity Test	Phase R - R 0Ω	Phase Y - Y 0Ω	Phase B - B 0Ω
2. Insulation Test	Phase R - Y 7MΩ	Phase Y - B 6.5Ω	Phase B - R 6.8Ω
3. Earth Leakage Test	Phase R - Earth 10MΩ	Phase Y – Earth 10MΩ	Phase B - Earth 10MΩ
4. Off-load Test	Switching OK	Timing OK	
5. On-load Tesr	Phase R 6A	Phase Y 5.7A	Phase B 6.3A

Result Analysis

The presented system is planned and configured for practical use. This system is able to reduce high starting current. In this method at first motor terminal connect star system and we know start connection system line current is equal to the phase current and for this reason starting time motor achieve low starting current. After five second motor running delta mode operation. Delta connected system line current is root three times of phase current. So motor get full voltage and then the motor reaches its rated speed. The motor at starting is reduced to 1/3 as compared to starting current with the windings connected in delta. Finally motor run without damage. This method is used worldwide.

Behavior of induction motor with different sizes ranging from 4kw to 7.5kw due to starting method can be studied using this project. This study is valid for the low power rated motor.

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