Multiple induction motors' starter using liquid rheostat

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Certificate

We take the work restrained in this report as a confirmation to the required standard for the partial fulfillment of the degree of BS (EE).

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Dedications

I devote this undertaking to God Almighty my maker, my solid column, my wellspring of motivation, shrewdness, information and comprehension. He has been the wellspring of my quality all through this program and on His wings just have I taken off. I likewise devote this work to my folks; who has empowered me as far as possible and whose consolation has ensured that I give it everything necessary to complete what I have begun. To my instructors Madam Madiha Zohaib, Sir Asda Waqar and Sir Junaid Imtiaz who all help us. Much obliged to you. For all of you can never be measured. God favor all of you.

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Abstract

Induction motor is an efficient machine overcoming a wide range of industries now a days but due to heavy inrush current in the start up the current becomes high than rated current. Due to which it is started with a starter which reduces or limitize current. Up till now each motor has its own starter in all of the industries e.g. star delta starter is one of the most common starter used among other conventional starter that are soft starter, direct online starter, frequency starter etc. but there are some drawbacks of theses starters which makes them inefficient first drawback that there is a single starter for a single motor secondly these starters damages motor in most of the cases. Luckily there are certain techniques by which we can sequentially start more than one motors from a single Starter in a protected way which makes it cost effected because large number of starters are not required secondly implementation of our proposed starter is much simpler .This report gives us ideas that how we can use one starter for multiple motors.

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Chapter # 1

Introduction

These days an induction motor enormously efficient and robust machine of its kind are used instead of classical thermo-mechanical heat engines. These machine has capabilities beyond the reach of heat engine as for as productivity, durability and efficiency is concerned.

After late 50s induction motor is being used with rotatory as well as translator y apparatus in all types of industries overcoming a wide range of process industries and textile. The main reason of using induction motor is its uncomplicated design, comparatively cheap and sustainable for heavy load in a better way. Apart from said benefits; an induction motor has few technical obstacle to deal with. One of the major issues is its inrush current which is 6 to 8 times of its rated value. This behavior needs to be deal with dependable engineering solution. The reason is, at the start the slip of motor is maximum and the rotor is stationary at the start the relative velocity of the stator field and rotor is maximum so is induced voltage and hence current (ohms law). By limiting inrush current we can:

1. Secure the motor winding from heavy amount of inrush current.
2. Secure the switch gear.
3. Reduces cost as the switch gear is designed for rated current rather than for inrush current.

If the inrush current is controlled by some procedure we can efficiently use induction motor. Since, there are multiple techniques to reduce this inrush current (will discuss it in literature review) but the efficient one is to use liquid rheostat starter. This method is still working on industrial policy but they are using single liquid rheostat with single motor. As when the inrush current of the motor is managed by the starter it is bypassed and we can use it for another motor by some strategies. In our project we are doing this. We are automating the current controlling process and we are starting multiple motors sequentially using a single liquid rheostat starter. For the sake of prototype we are using two motors but by using the same methodology that we shall discuss later we can start a number motors with the same starter sequentially.

1.1 Motivation

In the course our experience at different industries. Motor of 5.5MW controlling raw mill and a motor of raw mill fan of 5.8MW both were started using liquid rheostat starter individually. And there was a motor of E.P of 900KW, motor of cement mill of 2.5MW all were started via liquid rheostat starter. All of these motors were started using a individual starter at cement plant and if all of these motors are started with only one starter the mechanism would be much more easy and economical due to this motivation we decided to make liquid starter which can start more than one motors.

1.2 Objective

Using one liquid rheostat starter for multiple motors the following objectives shall be fulfilled.

1. Design cost effective: there are three tanks for three phase induction motors no matter how many motors are starting sequentially.

2. Running cost effective; as there would be less tanks there would be less maintenance cost.

3. There would be compact design.

1.3 Methodology

In our project we are using liquid rheostat starter for limited the increased amount of current at the start, for multiple induction motors.

1. First of all a logic is created so that the starter after starting first motor can get bypassed and connected to the second motor and vice versa.
2. Secondly the resistance span of the starter will cover all ratings of all motors. So, there should be a proper logic to control the up and down motion of that starter which is used for increasing or decreasing the inrush current of motor. For this purpose, we shall use a LM298 module to control the up and down motion of servo motor to set the resistance as per motor requirement.
3. This assembly can be used either on stator or rotor side of the motor as we are using squirrel cage motor so we implemented it on rotor side.

1.4 Organization of the Report

Chap 2 tells literature review about the existing work on the startup of induction motor and difference between liquid starter with other starters and how liquid starter is more suitable than others. Also it tells the interest of latest design that is proposed by us.

Chapter 3 tells the requirements, ratings and specifications of different components used in our project.

Chapter 4 discusses the proposed design in detail and the simulation that is used to verify the results.

Chapter 5 reveals the details of implementation process and detail of every individual component that is being used to carry out the project.

Chapter 6 would be the detailed discussion on the evaluation of procedure testing of equipment's and functionality testing and seeking the expected results.

Chapter 7 there would be a brief discussion on the conclusion drawn from the project its impact on industry and what amendments shall be made in future to make the design more reliable and beneficial.

Chapter # 2

Literature Review

As there are numerous strategies to control the beginning current of acceptance engine. The technique we are using is also being used in the industry but they just start one motor with one liquid starter. Our addition is; we are starting more than one motors with one liquid starter which is unique. Now we shall discuss each method one by one and shall tell you the drawbacks of each method and finally discuss why we selected to work on liquid starter rather than other starters:

2.1 Intro

There are a few strategies for turning over an acceptance engine accessible in the market. Those point by point right now: the Direct Online, Star-Delta, Autotransformer, Soft Starter and Frequency Inverter. All the starters referenced play out an essential capacity which is to supply voltage to the acceptance engine during startup period. Be that as it may, every one of these starters conveys their own points of interest and impediments. In this manner, so as to figure out which beginning technique is the best and generally appropriate for a specific application, an examination is made to evaluate the different beginning attributes as far as voltage, beginning present and beginning torque, the beginning expense of establishment, the support cost and compensation period...[4]following are motivation behind why we use starters:

2.1.1 Reduction of Inrush Current

Right now of stimulation, the present that is drawn by a squirrel-confine acceptance engine is an element of its bolted rotor impedance. Commonly, the present which is attracted is four to multiple times the current the engine will draw when it is up to speed and completely stacked. Inrush or bolted rotor flow can cause numerous questionable impacts on the electrical circulation framework. One of the most observable impacts of full-voltage beginning is that the lights will diminish or flicker while the engine is turning over. This is particularly valid in provincial regions or in different regions where the electrical circulation on lattice isn't of sufficient limit, or sufficiently directed, to begin an enormous engine without over the top line voltage drops. While beginning current is controlled by the impedance of the engine while turning over, decrease of the stator voltage will lessen the

beginning current necessity. In the event that the beginning voltage is decreased to 50 percent of its ostensible worth, the beginning current will likewise be diminished by a similar rate, as per Ohm's law V=IR. As Z is basically a fixed esteem at the moment of beginning, any adjustment in voltage will influence the beginning current straightforwardly. Obviously, as the engine speeds up, its

impedance will increment. The beginning current, which has been appeared as multiple times the full-load esteem, remains genuinely steady until the engine has arrived at around 50-percent speed. In the event that the beginning voltage were diminished, the whole bend would move descending. [4]

2.1.2 Torque Reduction

The beginning torque at gridlock of a squirrel-confine acceptance engine is around relative to the square of the applied voltage. This is appeared in the condition:

$T = KV^2$

Where T is the torque at gridlock, K is a steady controlled by the specific engine and V is the voltage applied to the stator windings. From the condition, if the voltage is decreased by half, the beginning torque at gridlock will be just 25% of its typical full-voltage esteem. The potential results of applying too high a turning over torque to engine burdens may incorporate harm to apparatus or gear. Extra issues could incorporate harm to apparatuses or couplings, belt slippage, or unexpected jolting of material being handled or passed on. Diminished voltage beginning for the most part is utilized on engines that don't have enormous beginning torque necessities. [4]

2.2 Direct Online Starter (DOL)

Direct The starting torque at gridlock of a squirrel-limit acknowledgment motor is around comparative with the square of the applied voltage. This is showed up in the condition:

$T = KV^2$

Where T is the torque at gridlock, K is a consistent constrained by the particular motor and V is the voltage applied to the stator windings. From the condition, if the voltage is diminished significantly, the starting torque at gridlock will be only 25% of its commonplace full-voltage regard. The potential aftereffects of applying too high a giving torque to motor weights may join damage to device or apparatus. Additional issues could consolidate mischief to devices or couplings, belt slippage, or sudden shocking of material being taken care of or passed on. Lessened voltage starting generally is used on motors that don't have tremendous starting torque necessities. [4]

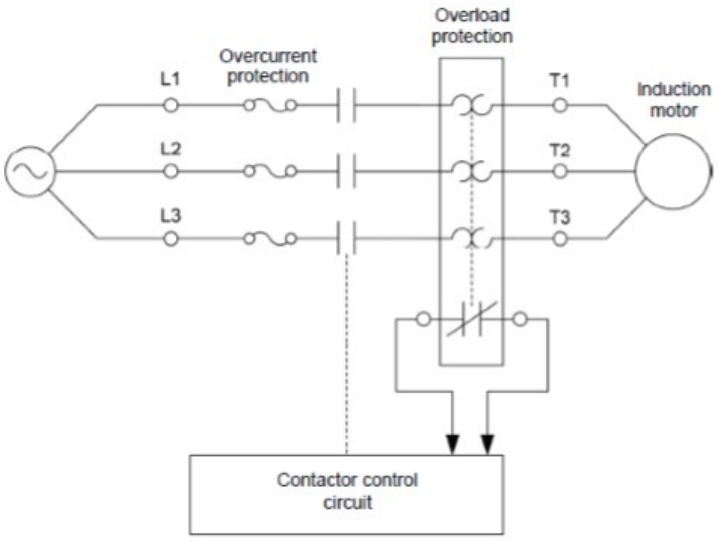

Figure 2.1: Direct Online Starter [2]

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or couplings, belt slippage, or sudden shocking of material being taken care of or passed on. Lessened voltage starting generally is used on motors that don't have tremendous starting torque necessities. [4] [1].

The following are the draw backs of DOL starter:

1. Starting torque is high causing jerks and damages to the equipment.

2. Terminal voltage dip.

3. Equipment damaging danger.

4. Switch gear has to be designed according to starting current.

2.3 Star Delta Starter

The Star-Delta starter as show in the figure2.2 is a diminished voltage starter. It applies a beginning voltage in a star configuration which viably decreases the applied voltage to each stage twisting by 58 percent (1/3) of the appraised voltage. As a result, the beginning current and torque are both made lower, less to 33.3 of the voltage esteems as torque is relative to the square of the terminal voltage. When the engine speed comes to around 70 percent of the appraised speed, the stock association with the engine will change to a delta association in this way giving it a full voltage supply. Despite the fact that the voltage is being made lower subsequently giving a lower inrush current, this strategy anyway neglects to defeat a portion of different issues looked by the DOL starter. A typical issue looked by the Star-Delta starter is the sharp point that happen during change from star to delta configuration. This is known as the open change Star-Delta starter. To dispense with this issue, a shut change starter was created which utilizes arrangement resistors to dispose of the present sharp point experienced by the open progress starter. The Star-Delta starter is the most widely recognized and least expensive of the decreased voltage starters. Its rough and basic development guarantees believability with insignificant support. Its startup cost is somewhat higher than that of a Direct Online Starter as there are more parts required, nonetheless, its decreased voltage abilities gives it a preferred position over the direct online starter as far as long haul cost and engine maintenance[1] .The following are the draw backs of STAR-DELTA STARTER of starter:

1. Cannot be installed at rotor side because rotor is always in star.

2. Lowering of voltage is only one step and cannot be controlled.

3. Switching cause's abnormalities in the running of motor.

4. Not suitable for heavy loads

2.4 Soft Starter

The Soft Starter as appeared in the figure 2.3 is additionally a kind of diminished voltage starter. A delicate starter is a gadget which lessen the torque applied on electric engine. The Soft Starter for the most part comprise of strong state gadgets like thyristors to control the use of supply voltage to the engine . These AC switches may have a potential three configurations which are, one TRIACs per stage (converse equal associated thyristors), a SCR and a diode associated backward corresponding to each stage, and two SCRs associated backward equal. These strong state switches are stage controlled where they are turned on for length of degrees for one cycle. The normal voltage can be constrained by moving the conduction point of the thyristor. This strategy for voltage control profoundly improves the efficiency of the acceptance engine at light loads. The Soft Starter works by consistently expanding the information voltage entering the acceptance engine straightly up till arrives at the appraised speed. An extraordinary bit of leeway the delicate starter has over ordinary starters is its capacity to alter the torque as per our necessity. This is finished by additionally changing the conduction edge of the thyristors.

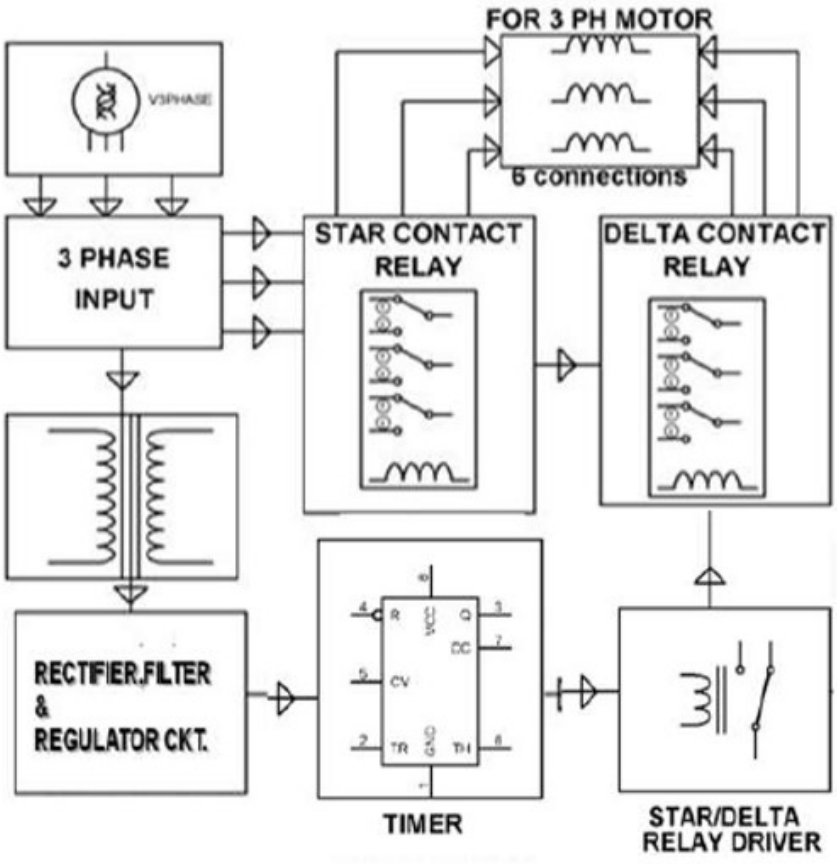

Figure 2.2: Star-Delta starter [1]

Another bit of leeway of the Soft Starter is its delicate stop work. This is strongly valuable in applications like as siphons where water pounding can occur in channeling frameworks if an abrupt stop is applied. With delicate stop, the voltage applied can be decreased routinely in this way moving toward the halting time and taking out water pounding In monetary terms, the Soft Starter early expense is a lot more noteworthy contrasted with that of traditional starters. In any case, the delicate starter figure for it in the long haul with a decent recompense period. Lower support cost is an assurance contrasted with regular starters [1].

The following are the draw backs of SOFT STARTER of starter:

1. Three phase soft starters are expensive.

2. Two phase soft starters are not suitable for heavy loads.

3. Single phase soft starters cannot reduce current the only reduce torque.

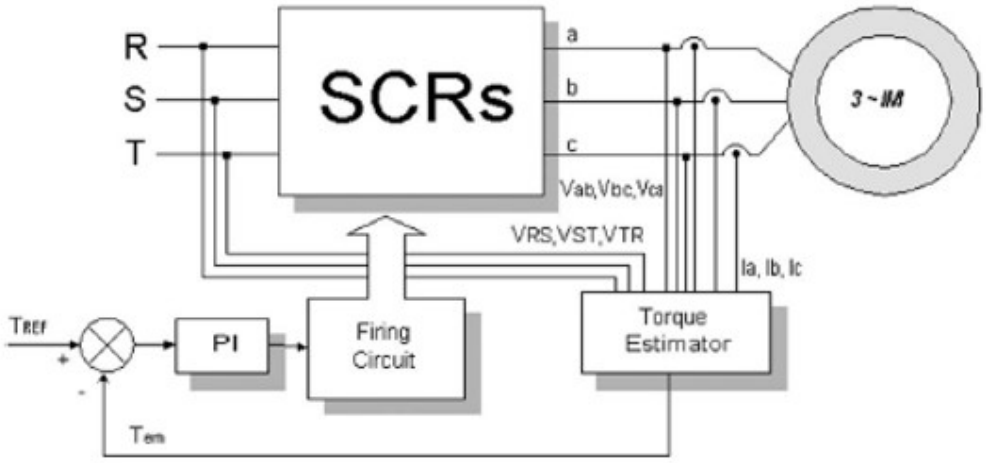

Figure 2.3: Soft Starter [1]

2.5 Autotransformer Starter

Another preferred position of the Soft Starter is its delicate stop work. This is The Autotransformer starter can be viewed as an improvement of the Star-Delta starter. The Autotransformer starter utilizes transformer taps to bring down the voltage applied to the enlistment engine at the hour of start. For the most part, the Autotransformer starter may have taps going from 50 percent to 80 percent of the full stock voltage. The client can choose which tap as per their prerequisite or specific application. Be that as it may, when the tap is chosen it, can't be changed. In light of IEEE modification, an autotransformer starter can be utilized to turn over enlistment engines going from 10HP to 25HP. Like a Star-Delta starter, there are two configurations for the Autotransformer. The first most is the open progress starter and the second is the shut change starter. Durance the beginning time of an open change starter, the Autotransformer applies a lower voltage to the acceptance engine till the engine quickens to the speed referee by the transformer tap. When this is achieve, the transformer tap contactor will detach and another contactor will close an association between the engine and the full voltage supply to achieve max throttle. Because of this, when the engine is reconnected to the inventory, a sharp point in current will show up which will make a high current travel through the engine windings, indistinguishable from a Star-Delta open progress starter. This can cause harm after some time. [1]