PROJECT SYNOPSIS ON

SAFE STARTING,PROTECTION AND SPEED CONTROL OF INDUCTION MOTOR

Project Synopsis submitted in partial fulfillment of the degree of

BACHELOR OF ENGINEERING

BY

QURESHI DANISH

KONDKARI IBRAHIM

ANSARI SHEHBAZ

ANSARI MOHAMMED SAAD

UNDER GUIDENCE OF

PROF. RIZWAN FARADE

DEPARTMENT OF ELECTRICAL ENGINEEING

ANJUMAN-I-ISLAM’S KALSEKAR TECHNICAL CAMPUS

SCHOOL OF ENGINEERING AND TECHNOLOGY

(Affiliated to University of Mumbai)

ACADEMIC YEAR 2016-17

SYNOPSIS OF PROJECT WORK

NAME OF THE PROJECT – **SAFE STARTING,PROTECTION AND SPEED CONTROL OF INDUCTION MOTOR**

NAME OF THE STUDENTS AND ROLL NO.: -

1. QURESHI DANISH (14DEE03)
2. KONDKARI IBRAHIM (14DEE09)
3. ANSARI SHEHBAZ (13EE71)
4. ANSARI MOHAMMED SAAD (12EE101)

CLASS & BRANCH: - B.E. ELECTRICAL ENGINEERING

NAME OF THE COLLEGE: - ANJUMAN-I-ISLAM'S KALSEKAR TECHNICAL CAMPUS

PROJECT GUIDE EXTERNAL EXAMINER

PROF. RIZWAN FARADE

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included .I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will because for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Signature)

1.---

2.---

3.---

4. --

(Name of student and Roll No.)

Date:

Place :

ACKNOWLEDGEMENT

We take this opportunity to express our deep and sense of gratitude to our guide

Professor Rizwan Farade for his valuable guidance and inspiration inspite of his busy

schedule. He devoted himself in completing our task with the admirable excellence.

We also thank to our HOD Sayyed Kaleem Sir for cheerful encouragement and

notable guidance.

Our special thanks to the staff members who gave prestigious guidelines for our

project.

We also express our heart full thanks to our beloved director Mr. Abdul Razzak

Honnutagi for the facilities provided to us during the project.

ABSTRACT

Single phase power system is widely used as compared to three phase system for domestic purpose, commercial purpose and to some extent in industrial purpose.

As the single phase system is more economical and the power requirement in most of the houses, shops, offices are small, which can be easily met by single phase system.

The single phase motors are simple in construction, cheap in cost, reliable and easy to repair and maintain.

Due to all these advantages the single phase motor finds its application in vacuum cleaner, fans, washing machine, centrifugal pump, blowers, washing machine, small toys etc.

The single phase ac motors are further classified as:

1.Single phase induction motors or asynchronous motors.

2.Single phase synchronous motors.

3.Commutator motors.

Induction motor Protection system from single phasing, over voltage, under voltage, overheating and phase reversal provides the smooth running of the induction motor expands its lifetime and also efficiency. Generally, these faults occur when supply system is violating its rating.

When the motor is running at rated current, load and voltage then these faults will not be generated.

Generally, the smooth running of the motor can be depends on the supply voltage under the set limit & load which is determined by the motor should also be under the stated limit.

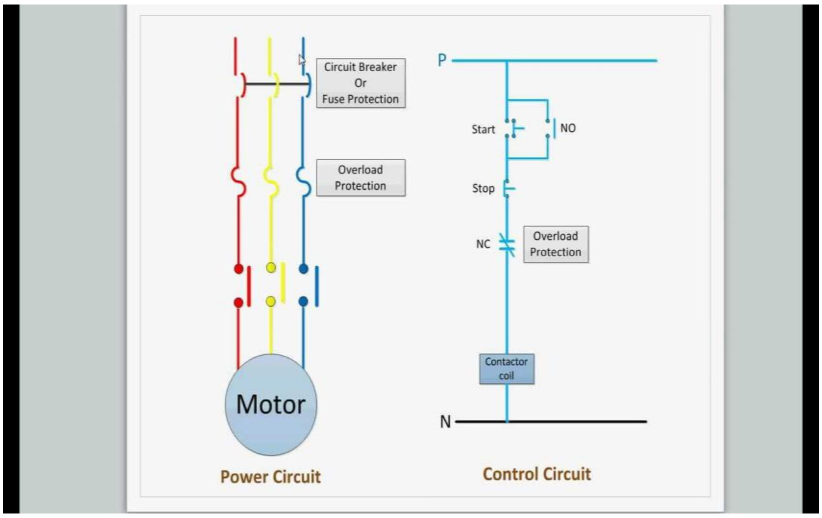
Therefore, this is all about induction motor protection, safe starting and speed control system project and its working.

TABLE OF CONTENTS

CHAPTER 1

Introduction

In order to control a motor group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller panel might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.



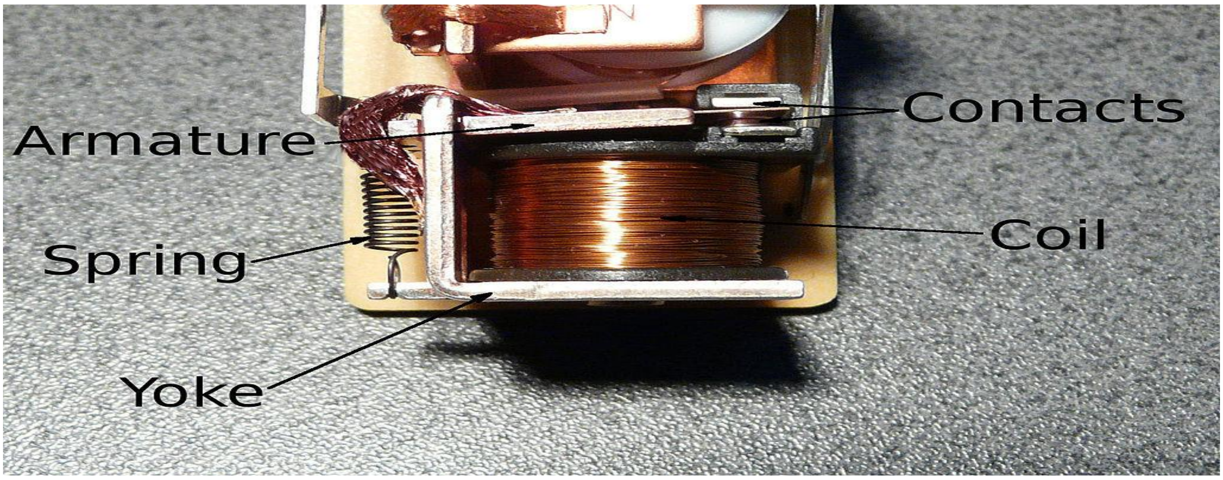
Every electric motor has to have some sort of controller panel. The motor controller will have differing features and complexity depending on the task that the motor will be performing.

The simplest case is a switch to connect a motor to a power source, such as in small appliances or power tools. The switch may be manually operated or may be a relay or contactor connected to some form of sensor to automatically start and stop the motor. The switch may have several positions to select different connections of the motor. This may allow reduced-voltage starting of the motor, reversing control or selection of multiple speeds. Overload and over current protection may be omitted in very small motor controllers, which rely on the supplying circuit to have over current protection.

Small motors may have built-in overload devices to automatically open the circuit on overload. Larger motors have a protective overload relay or temperature sensing relay included in the controller and fuses or circuit breakers for over current protection. An automatic motor controller may also include limit switches or other devices to protect the driven machinery.

A small motor can be started by simply plugging it into an electrical receptacle or by using a switch or circuit breaker. A larger motor requires a specialized switching unit called a motor starter or motor contactor.

A type of relay that can handle the high power required to directly control an



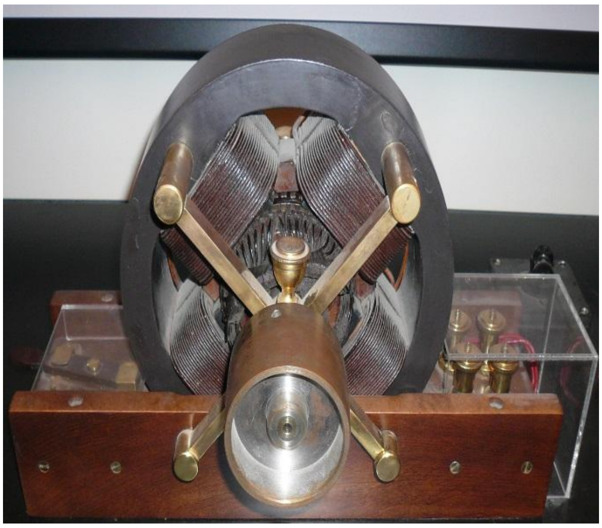
electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults;

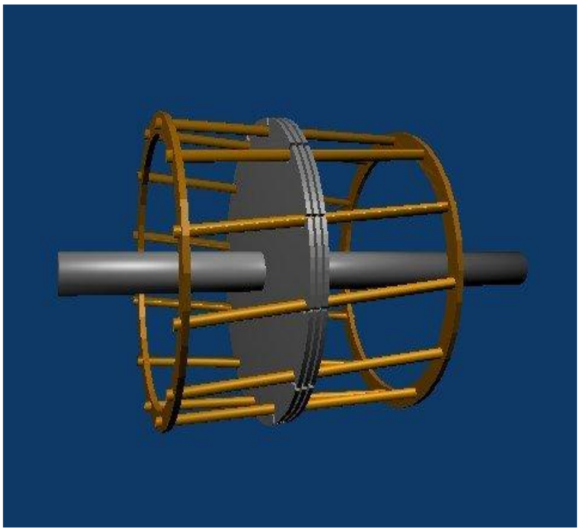
A miniature or molded - case circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by over current or overload or short circuit. Its basic function is to interrupt current flow after protective relays detect a fault. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

CHAPTER 2

History

In 1824, the French physicist François Arago formulated the existence of rotating magnetic fields, termed Arago's rotations, which, by manually turning switches on and off, Walter Baily demonstrated in 1879 as in effect the first primitive induction motor. In the 1880s, many inventors were trying to develop workable AC motors because AC's advantages in long-distance high-voltage transmission were counterbalanced by the inability to operate motors on AC. The first alternating-current commutatorless induction motors were independently invented by Galileo Ferraris and Nikola Tesla, a working motor model having been demonstrated by the former in 1885 and by the latter in 1887. In 1888, the Royal Academy of Science of Turin published Ferraris's research detailing the foundations of motor operation while however concluding that "the apparatus based on that principle could not be of any commercial importance as motor.





In 1888, Tesla presented his paper A New System for Alternating Current Motors and Transformers to the AIEE that described three patented two-phase four-stator-pole motor types: one with a four-pole rotor forming a non-self-starting reluctance motor, another with a wound rotor forming a self-starting induction motor, and the third a true synchronous motor with separately excited DC supply to rotor winding.One of the patents Tesla filed in 1887, however, also described a shorted-winding-rotor induction motor. George Westinghouse promptly bought Tesla's patents, employed Tesla to develop them, and assigned

C. F. Scott to help Tesla; however, Tesla left for other pursuits in 1889.

The constant speed AC induction motor was found not to be suitable for street cars but Westinghouse engineers successfully Telluride, Colorado in 1891. adapted it to power a mining operation inSteadfast in his promotion of three-phase development, Mikhail Dolivo-Dobrovolsky invented the three-phase cage-rotor induction motor in 1889 and the three-limb transformer in 1890.

This type of motor is now used for the vast majority of commercial applications. However, he claimed that Tesla's motor was not practical because of two-phase pulsations, which prompted him to persist in his three-phase work.

Although Westinghouse achieved its first practical induction motor in 1892 and developed a line of polyphase 60 hertz induction motors in 1893, these early Westinghouse motors were two-phase motors with wound rotors until B. G. Lamme developed a rotating bar winding rotor.

The General Electric Company began developing three-phase induction motors in 1891. By 1896, General Electric and Westinghouse signed a cross-licensing agreement for the bar-winding-rotor design, later called the squirrel-cage rotor.

Induction motor improvements flowing from these inventions and innovations were such that a 100 horsepower (HP) induction motor currently has the same mounting dimensions as a 7.5 HP motor in 1897.

CHAPTER 3

General principles

Motor protection is used to prevent damage to the electrical motor, such as internal faults in the motor. Also external conditions when connecting to the power grid or during use have to be detected and abnormal conditions must be prevented. Additionally, the protection relay prevents the disturbance to spread back into the grid.Motor protection schemes have several protection functions to consider:

Motor horsepower rating and type

Supply characteristics such as voltage, phases, method of grounding, and available short-circuit current

Vibration, torque, and other mechanical limits

Environment of motor, associated switching device

Hot and cold permissible locked-rotor time and permissible accelerating time

Frequency of starting

The protection relays provide main protection for synchronous and asynchronous motors. They can be used for circuit-breaker and contactor-controlled motors in a variety of drive applications, such as, motor drives for pumps, fans, compressors, mills and crushers.

When a motor is switched on, there is a high inrush current from the mains which may, especially if the power line section is inadequate, cause a drop in voltage likely to affect receptor operation. This drop may be severe enough to be noticeable in lighting equipment. To overcome this, some sector rules prohibit the use of motors with direct on-line starting systems beyond a given power. There are several starting systems which differ according to the motor and load specifications. The choice is governed by electrical, mechanical and economic factors. The kind of load driven is also important in the choice of starting system.

Main starting modes:- This is the simplest mode, where the stator is directly connected to the mains supply . The motor starts with its own characteristics. When it is switched on, the motor behaves like a transformer with its secondary, formed by the very low resistance rotor cage, in short circuit. There is a high induced current in the rotor which results in a current peak in the mains supply: Current on starting = 5 to 8 rated Current. The average starting torque is: T on starting = 0.5 to 1.5 rated T. In spite of its advantages (simple equipment, high starting torque, fast start, low cost), direct on-line starting is only suitable when: - the power of the motor is low compared to that of the mains, which limits interference from inrush current, - the machine to drive does not need to speed upgradually or has a damping device to limit the shock of starting, - the starting torque can be high without affecting machine operation or the load that is driven.

Direct On Line Starter :- To start, the contactor is closed, applying full line voltage to the motor windings. The motor will draw a very high inrush current for a very short time, the magnetic field in the iron, and then the current will be limited to the Locked Rotor Current of the motor. The motor will develop Locked Rotor Torque and begin to accelerate towards full speed.

As the motor accelerates, the current will begin to drop, but will not drop significantly until the motor is at a high speed, typically about 85% of synchronous speed. The actual starting current curve is a function of the motor design, and the terminal voltage, and is totally independent of the motor load.

The motor load will affect the time taken for the motor to accelerate to full speed and therefore the duration of the high starting current, but not the magnitude of the starting current.

Provided the torque developed by the motor exceeds the load torque at all speeds during the start cycle, the motor will reach full speed. If the torque delivered by the motor is less than the torque of the load at any speed during the start cycle, the motor will stops accelerating. If the starting torque with a DOL starter is insufficient for the load, the motor must be replaced with a motor which can develop a higher starting torque.

Motor Protection:- Every electric motor has operating limits. Overshooting these limits will eventually destroy it and the systems it drives, the immediate effect being operating shutdown and losses. This type of receiver, which transforms electrical energy into mechanical energy, can be the seat of electrical or mechanical incidents.

• Electrical - power surges, voltage drops, unbalance and phase losses causing variations in the absorbed current, - short circuits where the current can reach levels that can destroy the receiver.

• Mechanical - rotor stalling, momentary or prolonged overloads increasing the current absorbed by the motor and dangerously heating its windings.

• Every starter motor unit should include - protection against short circuits, to detect and break abnormal currents – usually 10 times greater than the rated current (RC) – as fast as possible these incidents can be high. It includes production loss, loss of raw materials, repair of the production equipment, non-quality production and delivery delays. The economic necessity for businesses to be more competitive implies reducing the costs of discontinuous output and nonquality.Protection is necessary to overcome these incidents, or at least mitigate their impact and prevent them from causing damage to equipment and disturbing the power supply. It isolates the equipment from the mains power by means of a breaking device which detects and measures electrical, - protection against overloads to detect current increase up to about 10 RC and open the power circuit before the motor heats up, damaging the insulation. These protections are ensured by special devices such as fuses, circuit breakers and overload relays or by integral devices with a range of protections.

Motor circuit breakers:-This device is a thermal and a magnetic circuit breaker in the same package which protects a motor against short circuits and overload by rapidly opening the faulty circuit. It is a combination of a magnetic circuit breaker and overload relays. In these circuit breakers, the magnetic devices (protection against short circuits) have a non-adjustable threshold, usually about 10 times the maximum current setting of thermal release units.

The thermal elements (protection against overload) are compensated for fluctuations of the ambient temperature. The thermal protection threshold can be adjusted on the front of the unit. Its value must correspond to the rated current of the motor to be protected. In all these circuit breakers, coordination (type II) between the thermal elements and short-circuit protection is built into the device. Moreover, in the open position, the insulation distance (between contacts) in most of these units is adequate to ensure isolation. They also have a padlocking device.

Speed Control Of Motor :- Every day engineers design products that employ single-phase induction motors. Speed control of single-phase induction motors is desirable in most motor control applications since it not only provides variable speed but also reduces energy consumption and audible noise.

When you first connect the motor to an AC supply, the stator field starts rotating at the supply frequency while the rotor is stationary. There is maximum slip and due to effects i am not going to go into, the generated torque is relatively low. When the rotor starts turning, the slip will decrease and torque increases until it reaches maximum with a small slip. The torque and thus actual rotation speed is a complex function of the load, supply voltage and frequency. Proper speed control means that you need to vary both the motor voltage and frequency to control slip and keep it in a sweet zone in relation to the actual rotation speed. For single phase induction motors this idea does not really work.

In certain kinds of application, We can skip variable speed drives and simply control the motor by controlling the effective stator voltage using a triac or thyristor or autotransformer.

Autotransformer :-An autotransformer is an electrical transformer with only one winding . In an autotransformer, portions of the same winding act as both the primary and secondary sides of the transformer. In contrast, an ordinary transformer has separate primary and secondary windings which are not electrically connected.

The winding has at least three taps where electrical connections are made. Advantages of autotransformers include lower leakage reactance, lower losses, lower excitation current, and increased VA rating for a given size and mass.

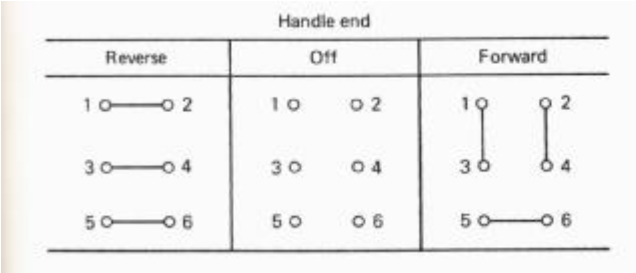
Autotransformers are often used to step up or step down voltages in the 110-115-120 V range and voltages in the 220-230-240 V range.

An autotransformer has a single winding with two end terminals, and one or more terminals at intermediate tap points, or it is a transformer in which the primary and secondary coils have part of, or all of their turns in common. The primary voltage is applied across two of the terminals, and the secondary voltage taken from two terminals, almost always having one terminal in common with the primary voltage. The primary and secondary circuits therefore have a number of windings turns in common.

One end of the winding is usually connected in common to both the voltage source and the electrical load. The other end of the source and load are connected to taps along the winding. Different taps on the winding correspond to different voltages, measured from the common end. In a step-down transformer the source is usually connected across the entire winding while the load is connected by a tap across only a portion of the winding. In a step-up transformer, conversely, the load is attached across the full winding while the source is connected to a tap across a portion of the winding.

Reverse Forward Switch:-The drum switch is a manual switch that lets one manually reverse the direction in which a motor is turning. The switch contacts are open and closed manually by moving the drum switch from the off position to the forward or reverse position. Figure 1 shows a picture of the drum switch and Figure 2 shows a diagram of the drum switch contacts. Figure 2a shows the drum switch contacts when the switch is in the reverse position, Figure 2b shows the contacts when the switch is in the off position, and Figure 2c shows the contacts when the switch is in the forward position. When the switch is in the reverse position, note that terminal 1 is connected to terminal 2, terminal 3 is connected to terminal 4, and terminal 5 is connected to terminal 6. In the off position, all contacts are isolated from all other contacts. In the forward position, terminal 1 is connected to terminal 3, terminal 2 is connected to terminal 4, and terminal 5 is connected to terminal 6.

A drum switch Notice the handle requires the operator to manually change the position of the switch from forward to reverse or to the off position.



Contacts of a drum switch when it's switched to the reverse position. (b) Contacts of a drum switch when it's switched to the off position. (c) Contacts of a drum switch when it's switched to the forward position.

After understanding the operation of the drum switch in its three positions and the methods of reversing each type of motor, these concepts can be combined to develop manual reversing circuits for any motor in the factories long as its full- load and locked-rotor amperage (FLA and LRA) don't exceed the rating of the drum switch. Figure 3a shows an AC single-phase motor connected to a drum switch. Notice that the start winding must be reversed for the motor to run in the reverse direction, so the start winding is connected to terminals 3 and 2.

CHAPTER 4

Advantages

Adjustable Speed motors are used in any application in which there is mechanical equipment powered by motors; the drives provide extremely precise electrical motor control, so that motor speeds can be ramped up and down, and maintained, at speeds required; doing so utilizes only the energy required, rather than having a motor run at constant (fixed) speed and utilizing an excess of energy.

Since motors consume a majority of the energy produced, the control of motors, based on demands of loads, increases in importance, as energy supplies become ever more strained. Additionally, end users of motors can realize 25 - 70% energy savings via use of motor controllers. (Despite these benefits, the majority of motors continue to be operated without speed control)

Here are some additional benefits of motor speed control and protection system.

1.Controlled Starting Current -- When an AC motor is started "across the line," it takes as much as seven-to-eight times the motor full-load current to start the motor and load. This current flexes the motor windings and generates heat, which will, over time, reduce the longevity of the motor. An Adjustable Speed AC Drive starts a motor at zero frequency and voltage.

As the frequency and voltage "build," it "magnetizes" the motor windings, which typically takes 50-70% of the motor full-load current. Additional current above this level is dependent upon the connected load, the acceleration rate and the speed being accelerated, too. The substantially reduced starting current extends the life of the AC motor, when compared to starting across the line. The customer payback is less wear and tear on the motor (motor rewinds), and extended motor life.

2.Reduced Power Line Disturbances -- Starting an AC motor across the line, and the subsequent demand for seven-to-eight times the motor full-load current, places an enormous drain on the power distribution system connected to the motor. Typically, the supply voltage sags, with the amplitude of the sag being dependent on the size of the motor and the capacity of the distribution system. These voltage sags can cause sensitive equipment connected on the same distribution system to trip offline due to the low voltage. Items such as computers, sensors, proximity switches, and contactors are voltage sensitive and, when subjected to a large AC motor line started nearby, can drop out. Using an Adjustable Speed AC Drive eliminates this voltage sag, since the motor is started at zero voltage and ramped up.

3.Lower Power Demand on Start -- If power is proportional to current-times-voltage, then power needed to start an AC motor across the line is significantly higher than with an Adjustable Speed AC Drive.

This is true only at start, since the power to run the motor at load would be equal regardless if it were fixed speed or variable speed. The issue is that some distribution systems are at their limit, and demand factors are placed on industrial customers, which charges them for surges in power that could rob other customers or tax the distribution system during peak periods. These demand factors would not be an issue with an Adjustable Speed AC Drive.

4.Controlled Acceleration -- An Adjustable Speed AC Drive starts at zero speed and accelerates smoothly on a customer-adjustable ramp. On the other hand, an AC motor started across the line is a tremendous mechanical shock both for the motor and connected load. This shock will, over time, increase the wear and tear on the connected load, as well as the AC motor. Some applications, such as bottling lines, cannot be started with motors across the line (with product on the bottling line), but must be started empty to prevent breakage.

5.Adjustable Operating Speed -- Use of an Adjustable Speed AC Drive enables optimizing of a process, making changes in a process, allows starting at reduced speed, and allows remote adjustment of speed by programmable controller or process controller.

6. Adjustable Torque Limit -- Use of an Adjustable Speed AC Drive can protect machinery from damage, and protect the process or product (because the amount of torque being applied by the motor to the load can be controlled accurately).

An example would be a machine jam. With an AC motor connected, the motor will continue to try to rotate until the motor's overload device opens (due to the excessive current being drawn as a result of the heavy load). An Adjustable Speed AC Drive, on the other hand, can be set to limit the amount of torque so the AC motor never exceeds this limit.

7. Controlled Stopping -- Just as important as controlled acceleration, controlled stopping can be important to reduce mechanical wear and tear -- due to shocks to the process or loss of product due to breakage.

8. Energy Savings -- Centrifugal fan and pump loads operated with an Adjustable Speed AC Drive reduces energy consumption. Centrifugal fans and pumps follow a variable torque load profile, which has horsepower proportional to the cube of speed and torque varying proportional to the square of speed. As such, if the speed of the fan is cut in half, the horsepower needed to run the fan at load is cut by a factor of eight (1/2)3 = 1/8. Using a fixed speed motor would require some type of mechanical throttling device, such as a vane or damper; but the fact remains that the motor would still be running full load and full speed (full power). Energy savings can be sufficient to pay back the capitalized cost in a matter of a couple of years (or less), depending on the size of the motor.

9. Elimination of Mechanical Drive Components -- Using an Adjustable Speed AC Drive can eliminate the need for expensive mechanical drive components such as gearboxes. Because the AC Drive can operate with an infinite variable speed, it can deliver the low- or high-speed required by the load, without a speed-increasing or reduction devices between the motor and load. This eliminates maintenance costs, as well as reducing floor-space requirements.

CHAPTER 5

Applications

Induction motors are the most used driving system, from fractional horsepower to hundreds of horsepower.Where speed rotation does not require varying. Single-phase induction motors are largely used in low power applications.

Thus bearing design strongly depends upon the final application of the motor. Capacitor-start motors are the most widely used single-phase motors in the marine engineering field. They are found on small refrigeration units and portable pumps. They come in a variety of sizes up to 7.5 horsepower.

Motors with variable speed use in Elevators.

OTHER APPLICATIONS ARE :

- Pumps
- Blowers
- Conveyors
- Compressors

CHAPTER 6

FUTURE SCOPE

Research is endless. The work done in this thesis could be further researched upon and extended by considering various other sophisticated advanced simulation tools, both in the hardware and in the software levels.

The developed control strategy is not only simple but also reliable and may be easy to implement in real-time applications using some interfacing cards such as the dSPACE, Data acquisition cards, TMSDSP cards, NI cards, etc.

For control of various parameters and can also be combined with fuzzy, ANNs and rough sets for other applications. Genetic algorithms combined with fuzzy and neural networks can be considered a future entity.

Speed control of IMs using sliding mode control, model predictive control and multirate output feedback control strategies such as the periodic output feedback and fast output sampling feedback could also be used.

Fault tolerant strategies can also be used as one of the options for checking robustness issues in speed control. The robustness of the proposed controllers could be further investigated using simulation studies for various parametric changes/variations. One of the robust control techniques, viz., the $H\infty$ control scheme, could be used as one of the future options along with hybrid controllers.

CHAPTER 7

CONCLUSION

Motor protection is an essential function for ensuring the continuity of machine operation. The choice of protection device must be made with extreme care. The user would be wise to select devices that include electronic communication features to foresee and prevent any faults. These greatly improve the detection of abnormalities and the speed with which service is restored.

Protection Of Induction Motor against high starting Current, over Current and over voltage can be achieved by using Motor protection devices such as Motor Starter and Circuit Breakers.

The single phase induction motor is widely being used in Industries. So keeping it in mind the suitable protection is provided for safe operation of Motor.

The Speed control of Motor is Achieved.

There are not any microprocessor and program based devices. Thus it keeps the Protection and speed control Process is more easy, simple and less complex.

CHAPTER 8

BIBLIOGRAPHY

Books:

Fink, Donald G.; Beaty, H. Wayne, Standard Handbook for Electrical Engineers, '14th ed., McGraw-Hill, 1999, ISBN 0-07-022005-0.

Houston, Edwin J.; Kennelly, Arthur, Recent Types of Dynamo-Electric Machinery, American Technical Book Company 1897, published by P.F. Collier and Sons New York, 1902

Kuphaldt, Tony R. (2000–2006). "Chapter 13 AC MOTORS". Lessons In Electric Circuits—Volume II. Retrieved 2006-04-11.

Rosenblatt, Jack; Friedman, M. Harold, Direct and Alternating Current Machinery, 2nd ed., McGraw-Hill, 1963

Links:

•www.electricalmachines.com

• www.electricaleasy.com

•www.citizendium.org/Electric_motor

•www.electrical4u.com

•www.johnsonelectrical.com