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Speed Control of Three Phase Induction Motor by Variable Frequency Drive

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ABSTRACT: There are several terms used to describe devices that controls the speed. Variable frequency drive uses power electronics to vary the frequency of input power to motor, thereby controlling motor speed. AC motor drives are widely used to control the speed of pumps, blower speeds, machine tool speeds, conveyor systems speeds and other applications that require variable speed with variable torque. A modern industrial power system may include variable frequency drive (VFD) loads at several locations. The complete system consists of an ac voltage input that is given through a diode bridge rectifier to produce a dc output which is across a shunt capacitor. this will feed the PWM inverter. The PWM inverter is controlled to produce a desired sinusoidal voltage at a particular frequency, which is further filtered by the use of an inductor in series and capacitor in shunt and then through squirrel cage induction motor. The design and analysis of a three phase induction motor drive using IGBT‟s at the inverter power stage with volts hertz control (V/F). A 5HP, 3-phase, 400V, From 17 Hz to 50Hz induction motor is used as load for the inverter. The experimental results for V/F control of 3- Phase induction motor using PLC clearly shows constant volts per hertz and stable inverter line to line output voltage.

Keywords:- PLC, Diode rectifier, IGBT, PWM inverter, 3-phase induction motor.

I. INTRODUCTION

Induction motors for many years have been regarded as the workhorse in industrial applications. In the last few decades, the induction motors have evolved from being a constant speed motor to a variable speed, variable torque machine. When applications required large amounts of power and torque, the induction motor became more efficient to use. With the invention of variable voltage, variable frequency drives, use of an induction motor has increased.

Because of advances in solid state power devices and PLC. The variable Speed Induction motors powered by switching power converters are becoming more and more popular. Switching power converters offer an easy way to regulate both the frequency and magnitude of the voltage and current applied to a motor. As a result, much higher efficiency and performance can be achieved by these motor drives with less generated noise. Use of variable speed control of induction motors has increased sharply over the last decade as the promise of energy savings and more control techniques are being realized. This is particularly true in applications that require full speed operation for only a small percentage of the time. Variations in Load demand have historically been handled by someone between the motor and load.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

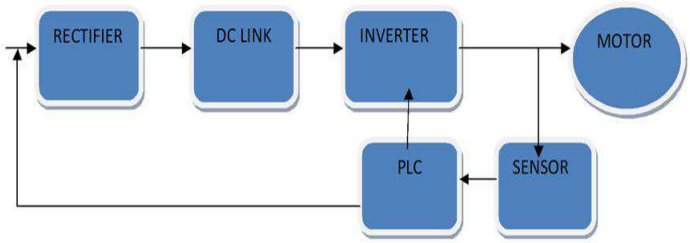

Fig 1. Block diagram of proposed system

When power is supplied to an induction motor at the recommended specifications, it runs at its rated speed. However, many applications need variable speed operations. For example, a washing machine may use different speeds for each wash cycle. Historically, mechanical gear systems were used to obtain variable speed. Recently, Electronic power and control systems have matured to allow these components to be used for motor control in place of mechanical gears. This power electronics not only control the motor's speed, but can improve the motor's dynamic and steady state characteristics. In addition, power electronics can reduce the system's average power consumption and noise generation of the motor. Three-phase AC induction motors are widely used in industrial and commercial applications. These motors are self-starting and use no capacitor, start winding, centrifugal switch or other starting device. These are classified either as squirrel cage or wound-rotor motors.

III. DESIGN AND DEVELOPMENT OF HARDWARE

Design of Starter Unit

In the Three Phase Starter Unit, following components are used:

- Wire Wound Resistors
- Relays
- Safety Fuses

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Motor ratings and its details

1. **Fuel feeder motor ratings and details**

Power	3.7kwatts/5HP
Current	7 amps
Speed	2900rpm
Torque	1.24 n-m
Efficiency at FL	84%
Efficiency at HL	82%
Power factor at FL	0.86
Power factor at HL	0.75
Supply voltage	415volts
Wight in kg	51kg
Operating frequency	0Hz to 50Hz

2. **Individual drought fan motor**

Power	55kwatts/75HP
Current	91 amps
Speed	2965rpm
Torque	18.07 n-m
Efficiency at FL	93%
Efficiency at HL	91%
Power factor at FL	0.90
Power factor at HL	0.84
Supply voltage	415volts
Wight in kg	528kg
Operating frequency	0Hz to 50Hz

3. **Forced drought AC drives.**

Power	200kwatts/270HP
Current	313amps
Speed	2985rpm
Torque	65.26 n-m
Efficiency at FL	95%
Efficiency at HL	93.5%
Power factor at FL	0.94
Power factor at HL	0.86
Supply voltage	415volts
Operating frequency	0Hz to 50Hz

IV. CONCLUSION

The device used in this having very low switching losses, and having very fast ouperating speed. These devicess are smaller in size their by reducess the overall cost. Higher operating speed gives higher performance that is high starting torque and good performance at lower speeds.By this drive we can save the power up to the maximum limit by controlling the speed of the motor by VFD.

The Variable Voltage Variable Frequency drive for a three phase induction motor is successfully developed and verified in cement plant. The control of motor speed is acquired with an accuracy of ±464 rpm. The selected rpm is locked irrespective of change in load. Speed of the Induction motor is varied from464RPM to 1740 RPM and corresponding Frequency range is from 17 Hz to 50 Hz. PWM pulses produced had a Constant $\frac{V}{f}$ ratio. Drive is operated at an Input Voltage of Three Phase 400 Volt and corresponding readings of Stator Voltage, Stator Current, Rectifier Output Voltage and Frequency values at different Speeds are taken.

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