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A REVIEW PAPER ON VARIABLE FREQUENCY DRIVE

Mr. Amit Kale[1], Mr. Nikhil R. Kamdi[2], Ms. Priya Kale[3], Prof. Ankita A. Yeotikar[4]

[1] *Bachelor Student, Electrical Engineering, DES'sCOET Dhamangaon (Rly), Maharashtra, India*

[2] *Bachelor Student, Electrical Engineering, DES'sCOET Dhamangaon (Rly), Maharashtra, India*

[3] *Bachelor Student, Electrical Engineering, DES'sCOET Dhamangaon (Rly), Maharashtra, India*

[4] *Assistant Professor, Electrical Engineering, DES'sCOET Dhamangaon (Rly), Maharashtra, India*

Abstract - *This paper discuss about the speed controlling of Induction Motor by using A Variable Frequency Drive (VFD). The Variable Frequency Drive (VFD) is an electronics device to change utility power source to variable frequency to control AC motor in variable speed operation. The load of an Induction Motor is not constant. It can be varies as per the load requirment. So, speed must be changes as per increasing or decreasing the load. If supply voltage decreased, motor torque are also decreased. Motor speed is directly praportioal to supply frequency. Hence, to maintain the speed supply voltage and frequency must be vary accordingly.There are several ways to define Variable Frequency Drive (VFD). This paper is inteded to provide a basic understanding of Variable Frequency Drive (VFD) terms, Variable Frequency Drive (VFD) Operation.*

Key Words: Variable Frequency Drive (VFD), Inverter, Single Phase Induction Motor, Rectifier, Microcontroller etc…

1. INTRODUCTION

The Variable Frequency Drive (VFD) are also one of the technique which can be used for controlling the speed of Electrical Machines or Electrical Generator. In this method for controlling the speed of Electrical Machines or Electrical Generator the Power Electronic Device are used. The Power Electronic Device are used to vary the frequency of Input Power to the motor and theirfore controlling the speed of Electrical Machines.

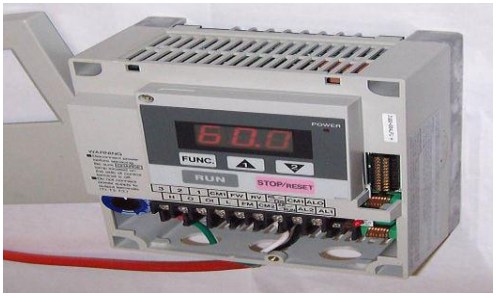

Fig -1: Varible Frequency Drive

The controlling becomes more and more accurate and this concept Variable Frequency Drive (VFD) also provides the ease of case.

Whenever we study the Electrical Machines, Electrical Generator we think that the speed of the rotation of Electrical Machines or Electrical Generator are totally depends upon the or speed are cotrolled by the applying the voltage and frequency of the stator side of the machines.

Another way to change the speed is to change the torque produced the motor which is given by

$T = KsE^2R / R^2+(SX)^2$

i.e.,

T = Torque which is produced by motor

Ks = Constant Term

E^2 = Induced EMF in Rotor

R^2=Rotor Resistance

$(X)^2$=Rotor Inductive Reactance

If the motor torque is less than the load torque then the motor speed will decreased and if the motor torque becomes higher then the load torque, then the motor speed will increasd.

Another simple method of speed control of Electrical Machines is by changing the stator frequency and number of poles. The speed at which the rotating magnetic field rotates. Ns is dependent only on the staator frequency F and number of poles P.

If the number of poles P is constant then the only way to change the synchronous speed is to change the stator frequency F.

Ns = 120F / P

i.e.,

Ns = Synchronous Speed Of Induction Motor

F = Stator Supply Frequency

P = Number Of Poles Of The Motor

The parameter like supply frequency, supply voltage, number of poles or external stator resistance can be controlled on the stator side for controlling the speed. Wheras we can control the rotor resistance or use cascade to achieve the speed control from the rotor speed. There are so many techniques are used to control the speed of Electrical Machines or Electrical Generator.

2. Methods

The speed controlling techniques are given below:

2.1 Stator Frequency Control

We know that Actual Speed N is given by,

N = Ns (1 - s)
i.e.,
N = Actual speed
Ns = Synchronous speed
S = Slip
So, we can change the actual speed N by changing the synchronous speed. but synchronous. But synchronus speed Ns can be changed by changing the stator supply frequency. So, theoretically we can control the speed by changing only Frequency.

2.2 Controlling The Number of Poles

We knoe that the synchronous speed is given by,

Ns = 120F / P

i.e.,

Ns = Synchronous Speed Of Induction Motor

F = Stator Supply Frequency

P = Number Of Poles Of The Motor

So, it is possible to change the synchronous speed by changing Number of Poles. The Number of Poles can be changed by changing the connections of stator winding with the help of simple switching. So, we get different speed.

i) $3000 \text{ rpm} = \frac{50 \times 120}{2}$

ii) $1500 \text{ rpm} = \frac{50 \times 120}{4}$

iii) $1000 \text{ rpm} = \frac{50 \times 120}{6}$

2.3 Changing in Stator Resistance

In this method we can control the speed by changing the stator resistsance. This control is basically the stator voltage control because when we change the rheostat connected in the stator circuit, a part of supply voltage will drop across the rheostat. Hence the actual voltage applied to the stator is reduced. The speed changes due to variable stator voltage. In that start position a minimum stator voltage is applied and the speed of the induction motor is minimum. As the rheostat is reduced, the ststor voltage is increased ad the speed also increases.

3. ACTUAL WORKING of VFD

The speed of an Induction Motor is directly depends upon the stator frequency. The expression of synchronous speed of Induction Motor are given below.

Ns = 120F/ P

i.e.,

Ns = Synchronous Speed Of Induction Motor

F = Stator Supply Frequency

P = Number Of Poles Of The Motor

Generally, by changing the frequency and supply voltage using of Variable Frequency Drive (VFD) the speed of an Induction Motor can be controlled. The Variable Frequency Drive (VFD) are made by Power Electronics Device. In that device consist the Rectifier, Inverter and the third and one of the most important part is Microcontroller.

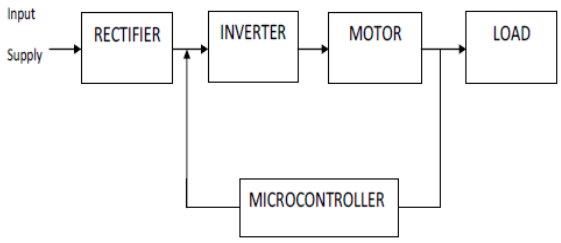

Fig -2: Block Diagram of VFD

A rectifier is an Electrical device which can be converted Alternating Current (AC) into Direct Current (DC). This AC three phase, 50 Hz supply are converted into DC three phase supply and this rectified supply gives to the input of the inverter. The microcontroller reqired DC supply that's reason the rectifier are used.

Inverter is an Electronic device that convert Direct current (DC) into alternating current (AC). The inverter does not produces any power; the power is provided by DC source.

The microcontroller are used for the controlling the speed of an Induction Motor. The Microcontroller regulates the output voltage and Frequency for controlling the speed of an Induction Motor.

4. ADVANTAGES

1. Large energy saving at lower speed.

2. Increased Life of rotating components due to lower operating speed.

3. Reduces Noise and Vibration level.

4. Reduction of thermal and mechanical stresses.

5. APPLICATION

Variable Frequency Drive are generally used in Fans, Blowers, Pump, Cnveyors. HVAC application in the three phase Induction Motor, although some smaller application may used single phase Induction Motor. For the purpose of saving energy the Variable Frequency Drive are used.

6. CONCLUSIONS

Thus, we concluded that when the motor works at lower speed, then it will be the less energy utilise. So, significant amount of power can be saved with the help of Variable Frequency Drive (VFD).By changing the frequency and supply voltage of Innduction Motor the speed of Induction Motor can be changed. Thus, the Variable Frequency Drive (VFD) can serve both in case of speed control as well as Energy Saving.

As we know that the energy conservation are one of the most important need in all over the world. Thus, after the study of speed control of Induction Motor by using Variable Frequency Drive (VFD), it can easy to possible change the speed of Induction Motor as well as save the energy. Both operations are performed by Variable Frequency Drive (VFD).

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BIOGRAPHIES

Mr. Amit Kale

Email: amitkale1052@gmail.com

He was born in Chandrapur, Maharashtra, India in 1994. He completed his Diploma with First Class Division in Electrical Engineering in Government Polytechnic, Arvi and pursuing B.E Degree in Electrical Engineering from Sant Gadge Baba Amravati University (SGBAU), Amravati, India, in 2014-2017. His research interest includes Variable Frequency Drive and He also submitted disseitation on this topic.

Mr. Nikhil Kamdi

Email:
nikhilkamdi1995@rediffmail.com

He was born in 1995 in Wardha, Maharashtra, India. In 2014 he received Diploma in Electrical Engineering from Government Polytechnic, Arvi and pursuing B.E. in Electrical Engineering from Sant Gadge Baba Amravati University (SGBAU), Amravati, India, in 2014-2017.

Ms. Priya Kale

She was born in Dhamangaon Railway,Maharashtra, India. She pursuing B.E. in Electrical Engineering from Sant Gadge Baba Amravati University (SGBAU), Amravati, India, in 2014-2017.