Speed control of single phase induction motor using cycloconverter

Sagar Thakur, Mahadevi Biradar
M.Tech Power Electronics, Associate Professor Dept. of EEE
Poojya Doddappa Appa College of Engineering

Abstract: ***Now a day's single phase induction motor (SPIM) have great advantages of being relatively inexpensive and very authentic. The SPIM has various advantages in small industries, home appliances and business sectors. Due to increase in popularity of SPIM the speed control is very important. This paper presents speed control method for SPIM using cycloconverter. Due to increase in demand of power supply the SPIM can be run on renewable energy such as solar/wind. In my model stored DC supply act as renewable energy in simulink, this dc supply is converted to ac supply using inverter model then it is fed to SPIM through cycloconverter. It provides better voltage profile and reduced harmonics at the output. The simulink prototype for speed control of SPIM model is done using MATLAB.***

Index Terms - Inverter, Cycloconverter, SPIM speed control, simulation, MATLAB..

I. INTRODUCTION

Many motors are being used for different applications; these applications may work on constant speed or variable speed. The speed control acts an important role which can be achieved by various speed control methods. The speed control of the single phase induction motor can be varied by varying the slip(S) or number of poles (P) or frequency (F) of the supply. The ability of varying any one of the above three quantities will provide methods of speed control of an induction motor. The speed control through varying no of poles method is not reliable and the number of poles can't be varied under running conditions and the size of the machine also becomes large.

Other speed control techniques such as changing parameters like current, voltage etc. this can be done by field control method, armature control method etc. By improvement in power electronics devices the speed control of the SPIM can be achieved easily by power devices such as MOSFET, IGBT, and SCR. The nature of speed control requirement for an industrial drive depends upon its type. Some drives may require continuous variation of speed thought the operation which ranges from zero to full speed or over a portion of the range.

II. SPEED CONTROL OF INDUCTION MOTOR USING CYCLOCONVERTER

Cycloconverter are the device which converts constant supply voltage and frequency to variable voltage and variable frequency. Cycloconverter uses IGBT as switches in order to change the output frequency to control the speed of the SPIM. IGBT are fast switching three terminal devices. Speed of the SPIM can be control by varying the input voltage or by varying the frequency. In my work the speed control operation is carried by varying the frequency using cycloconverter.

With the increase in demand of the renewable energy, we conducted simulation experiment by assuming DC source as renewable energy and through IGBT switches present in the inverter it is converted to AC supply and connected to cycloconverter to obtain different stages of the frequencies to vary the motor speed. During positive half cycle the switches S1 and S2 will conduct for given period from the positive converter and S5, S6 conduct for remaining period from the negative converter to achieve the required frequency. Similarly for negative half cycle the switch S3 and S4 conduct from positive converter for remaining period, the switches S7 and S8 will conduct from negative converter.

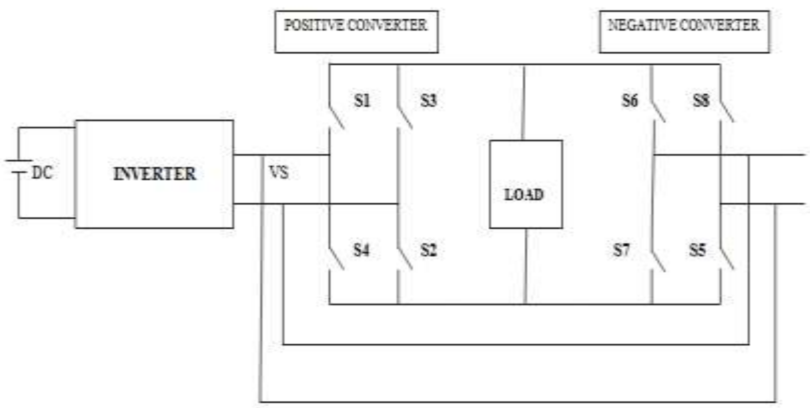

Fig 1: circuit diagram of cycloconverter for speed control of SPIM

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III. SIMULATION RESULTS

Simulation prototype is shown which includes DC source as renewable energy supply, which is given to inverter to convert it to AC and through cycloconverter varying the frequency to control the speed of SPIM. The experiment is carried for the different frequency, the speed variation is observed. As frequency of operation decreases the speed of the SPIM get reduced and increases with increase in frequency. The waveform of voltage, current and speed from below figure 3. It is concluded that starting current is very high to drive the SPIM to its nominal speed. The main advantage of the proposed system is it reduces total harmonic distortion in voltage and current and smoothness and speed control of the SPIM is also obtained.

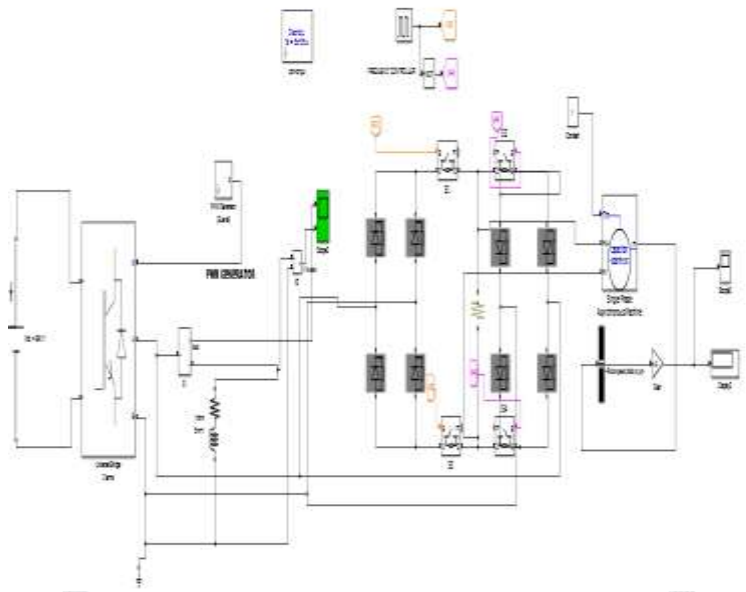

Fig 2: simulation structure of speed control of SPIM

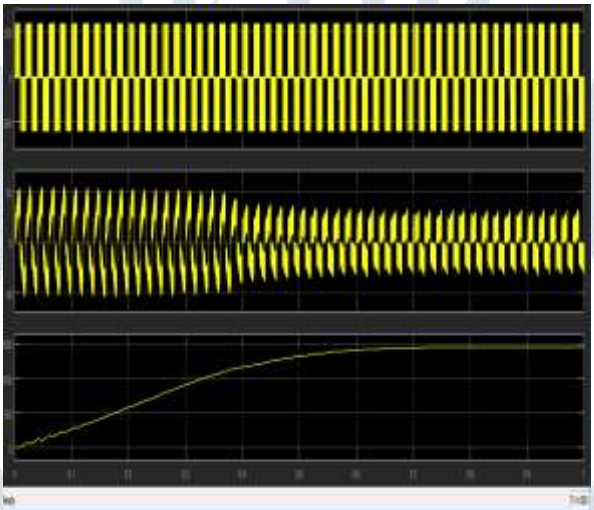

Fig 3: waveform of output voltage, output current and speed of SPIM

TABLE 1: Frequency v/s speed

S. no	Frequency(Hz)	Synchronous speed(rpm)
1	16.66	444.9
2	25	691.7
3	50	1472

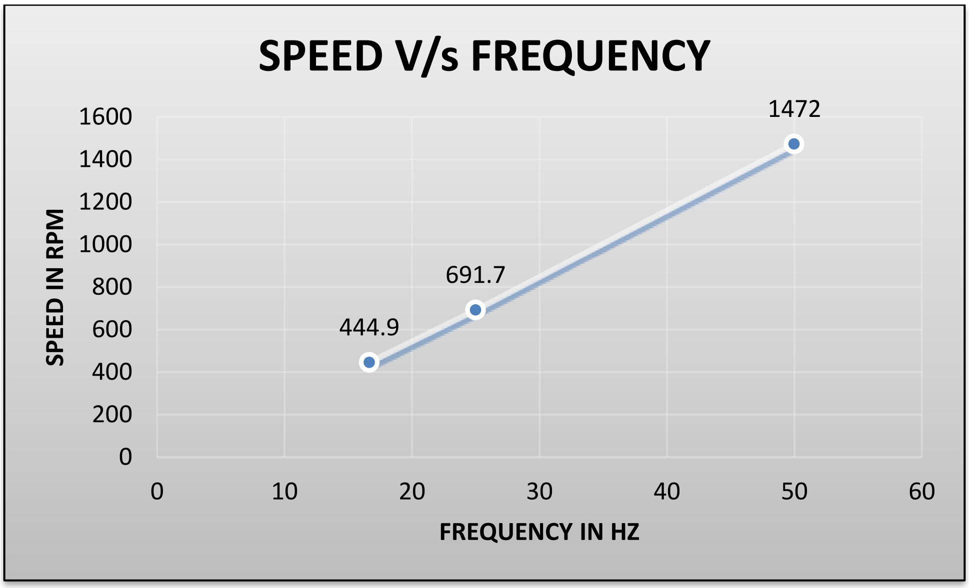

Fig4: Graph for Frequency v/s Speed

IV. EXPERIMENTAL RESULTS

The experimental model is composed of several modules. The SCR based cycloconverter, opto isolator circuit (interface circuit), microcontroller and power supply to both driver circuit and cycloconverter and load as quarter hp capacitor start and run single phase induction motor.

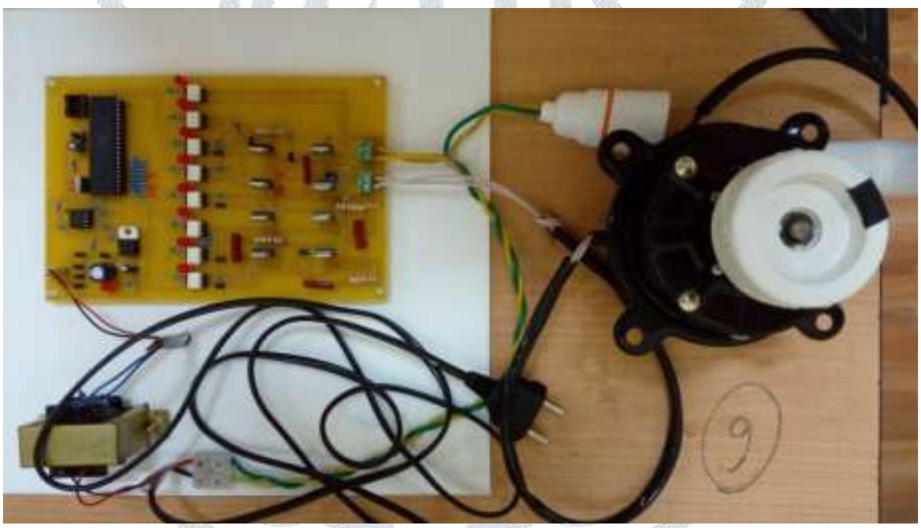

Fig5: Picture of the cycloconverter using thyristor

The main function of the microcontroller is to provide required firing pulses to the SCR's of cycloconverter through opto coupler to control the speed of the SPIM. The experiment is carried for different frequency f, f/2 and f/3 and speed variation is observed for given frequencies. Microcontroller 8051 triggers the cycloconverters circuit for different stages of speed with the help of switches given to change the speed of induction motor.

TABLE 2: Frequency v/s speed

S. no	Frequency(Hz)	Synchronous speed(rpm)
1	16.66	818.8
2	25	1323
3	50	2927

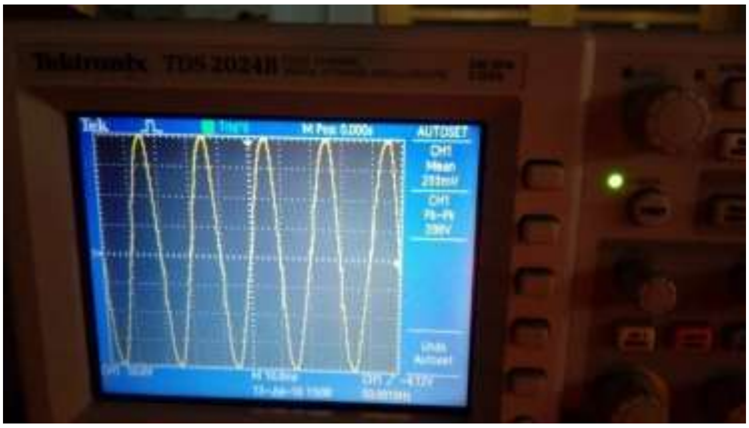

Fig5.1: output voltage at frequency 50Hz

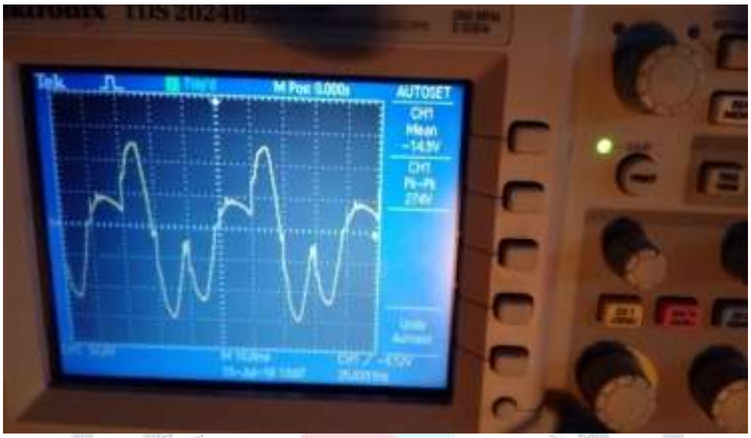

Fig5.2: output voltage at frequency 25Hz

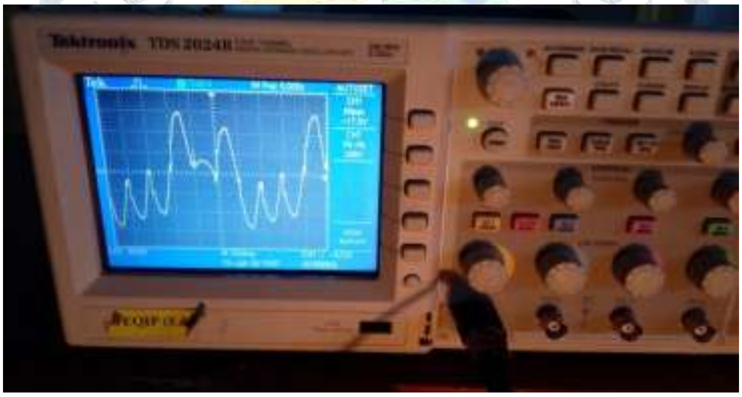

Fig5.3: output voltage at frequency 16.67Hz

V. CONCLUSION

Increase in popularity of SPIM its usage has also increased in many sectors, with increasing demand for renewable energy and advancement in power devices. Speed of SPIM is controlled by using cycloconverter and usage of renewable energy is also achieved. Harmonics present at output, voltage and current are also reduced to maximum extent. Therefore smoothness is obtained in speed.

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