Chopper Controlled Slip Ring Induction Motor
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Abstract—This paper describes the design of a circuit that includes chopper to control the speed of slip ring induction motor. Unlike other conventional method chopper controlled method provide contactless control of speed of slip ring induction motor. By using this method we can conserve the energy as the energy loss due to friction will be removed.

Key words: Power Supply, IC 555, IGBT, Three Phase Bridge Rectifier, Wound Rotor Induction Motor

I. INTRODUCTION

IGBT controlled chopper circuited is used on the rotor side for speed control of slip ring induction motor drive. This control scheme provides contact less and continuous variation of rotor resistance. Conventionally, the rotor resistance is controlled manually and in discrete steps. With the advent of power semiconductor, the conventional resistance control scheme can be eliminated by using a three phase rectifier bridge and chopper controlled external resistance.

The following block diagram shows the Chopper controlled SRIM:

II. COMPONENTS

A. Power Supply:
A transformer (Tx= primary 230 volts, secondary 12 Volt, 1 Amp step down transformer) is used to convert 230 V to 12V from mains . Here used a bridge rectifier made by four 1N4007 or IN4003 diode to convert AC to DC. The filtering capacitor 1000uF, 25V is used to reduce the ripple and get a smooth DC voltages. This circuit is very easy to build. For good performance the input voltage should be greater than 12 volt in pin -1 of IC LM 7808.

B. IC 555:
The 555 timer IC is an integrated circuit used in variety of the timer, pulse generation, and oscillator applications. The 555 can be used to provide time delays as oscillator, and as a flip flop element derivatives provide up to four timing circuit in one package. The 555 timer comes as 8 pin DIP (dual in – line package) device.

C. IGBT:
An insulated-gate bipolar transistor (IGBT) is a three terminal power semiconductor device primarily used as an electronic switch which, as it was developed, came to combine high efficiency and fast switching. In this project we are using IGBT 25N120 because of low saturation voltage, low switching loss, positive temperature coefficient. The application of this IGBT used in induction heating and Microwave oven.
Each pair order to keep the on-ents to obtain adjustable voltages and ed of slip ring induction motor. In application is very important, since this ghly in effecient ne. The output of IC 555 is of the waste (IC) 555. IC 555 consists of 8–o load BTs have higher carrier lifetimes and low E. (AC) to direct current (DC).

Rectification is the conversion of the alternating current project we are using voltages power a applications and for transmission of energy as DC. Most low power rectifiers for domestic equipment are being the most common number of phases). Most low power rectifiers include transistors, diodes, and capacitors. Each phase rectification is very important for industrial applications and for transmission of energy as DC. For high voltages power application, six diodes are used. Each pair works as double to enable full wave rectification. In this project we are using metal diode of the 16 Amp. Rectification is the conversion of the alternating current (AC) to direct current (DC).

Fig. 5: IGBT: (a) Forward characteristics and (b) transfer characteristics

To turn-off the IGBT, gate is shorted to the emitter to remove the MOS channel and the base current of the p-n-p transistor. The collector current is suddenly reduced because the electron current from channel is removed. Then the excess carriers in the n− drift region decay by electron–hole recombination, which causes a gradual collector current decay. In order to keep the on-state voltage drop low, the excess carrier life time must be kept large. Therefore, similar to the other minority carrier devices there is a tradeoff between on-state losses and faster turn-off switching times. In the punch-through (PT) IGBT structure of the switching time is reduced by use of a heavily doped n buffer layer in the drift region near the collector. Because of much higher doping density in the buffer layer, the injection efficiency of the collector junction and the minority carrier lifetime in the base region is reduced. The smaller excess carrier lifetime in the buffer layer sinks the excess holes. This speeds up the removal of holes from the drift region and therefore decreases the turn-off time. Non- punch-through (NPT) IGBTs have higher carrier lifetimes and low doped shallow collector region, which affect their electrical characteristics. In order to prevent punch through, NPT IGBTs have a thicker drift region, which results in a higher base transit time. Therefore in NPT structure carrier lifetime is kept more than that of a PT structure, which causes conductivity modulation of the drift region and reduces the on-state voltage drop.

D. Three Phase Bridge Rectifier:

Rectifier circuits may be single phase or multi phase (three being the most common number of phases). Most low power rectifiers for domestic equipment are single phase, but three phase rectification is very important for industrial applications and for transmission of energy as DC. For high voltages power application, six diodes are used. Each pair works as double to enable full wave rectification. In this project we are using metal diode of the 16 Amp. Rectification is the conversion of the alternating current (AC) to direct current (DC).

E. Voltage Regulator:
The LM7808 series of three terminal positive regulators are available with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

III. WORKING

In this project the three phase supply is given to stator. The ac output voltage of rotor is rectified by a diode bridge rectifier. First we make a power supply, the power supply is given to integrated circuit (IC) 555. IC 555 consists of 8 pins. IC555 timer is an integrated circuit used in variety of timer pulse generation and oscillator. In IC555 we attach a variable port on particular pin. By the help of variable port controlling of SRIM has been done. The output of IC 555 is given to opto-coupler. Opto-coupler is basically used for isolation purposes. The emitter terminal of opto-coupler is applied to gate of IGBT. The diode bridge rectifier which convert AC to DC. The output of bridge is applied to load across the IGBT. The load will increase, the speed will be decrease. The main demerit of this method of control is that energy is dissipated in rotor circuit resistance, internal and external, and this energy is wasted in the form of heat. Because of the waste-fullness of this method, it is used where speed change are needed for short duration only.

IV. CONCLUSION

In rotor resistance control method the starting torque can be varied with the variation of rotor resistance. The maximum torque however, remains unaffected. Thus for operation requiring high starting torque, the rotor resistance can be varied to even to obtain the maximum torque during starting but simultaneously the copper losses will increase due to increase in resistance. So this method is highly in efficient and can not be used through operation that’s why this method of chopper controlled slip ring induction motor can be applied as this method remove the copper loss due to increase in resistance. In speed control of slip ring induction motor using chopper the speed is controlled electrically and not mechanically and due to this the friction loss has been decreased as it controls the speed without any physical contact and this is the reason it can be called contactless method of controlling speed of slip ring induction motor. In speed control of slip ring induction motor using chopper the overall efficiency also increased due to less losses as compared to other methods.

V. FUTURE SCOPE OF PROJECT

Research is endless. The work done in this project could be further researched upon and extended by considering various other sophisticated advanced simulation tools, both in hardware and software. It can be used in industries where minimum power consumption is very important, since this method of speed control uses purely electrical method. So, the frictional loss does not occur lowering the overall consumption of power. As we know slip ring induction motor when compared squirrel cage motor have high starting torque and good running characteristics so they are
used in lift, cranes, and conveyors but after applying this chopper control SRIM method the lift, cranes, conveyors can also be used with adjustable speed. As we can increase the speed when we need to do work very fast and can decrease the speed when proper care is needed. As we know induction motor is widely used in electrical drives so with the help of chopper control of slip ring induction motor the drives where speed control is required without energy loss this method can be applied it will not only control the speed but also conserve the energy.

REFERENCES

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