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Abstract-

The versatile control characteristics of DC motor have contributed in the extensive use of DC motor in the industry. With the increasing use of power semi conductor units, the speed control of DC motor is increasingly getting sophisticated and precise. Speed of the DC motor is controlled by controlling the armature voltage. Armature voltage is controlled using different single phase AC/DC converter. Half converter, semi converter, full converter and dual converter are some of the thyristor based circuits which are used for speed control of DC motor. This paper studies different speed control techniques of DC motor and makes a comparative study of different converter based speed controller techniques.

Motors are widely used in industry because of its low cost, less complex control structure and wide range of speed and torque. There are many methods of speed control of DC drives namely field control, armature voltage control and armature resistance control methods. DC motors provide high starting torque which is required for traction applications. In DC motor control over a large speed range, both below and above the rated speed can be achieved quite easily. DC motors have inherent disadvantages that it needs regular maintenance and it is bulky in size. DC motors are tailor made, so it is very difficult to replace them. In general, armature voltage control method is widely used to control the DC drives. In this method, a controlled rectifier, or chopper is used but due involvement of power electronics elements, nonlinear torque speed characteristics are observed which are undesirable for control performance. Nowadays state of art of speed control techniques of DC motor are available. Thyristor based DC drives with analog and digital feedback control schemes are used. Phase locked loop control technique is also used for precise speed control and zero speed regulation. In past, many researchers presented various new converter topologies of DC motor control for different applications of industry [5,6,8,9], but at the basic level in all of them thyristor based AC-DC converter are used. MATLAB with its toolboxes like Simulink and Semi Power System are used for simulation.

Keywords-
Motor,Speedcontroller,Thyristor,Semiconductor

I. INTRODUCTION

One of the field in which the electronic engineers are trying to do improvement for the last few decades of variable speed drives. Transistor / Thrusters (Silicon controlled rectifiers of SCR s) have revolutionized the art of speed control of drives.

In the field of variable speed drives a, dc motor controlled by a converter circuit is a popular choice. The dc motor can provide speed control over a wide range. The methods of speed control are normally simpler and less expensive than those of ac drives. With the recent advancements in power conversions, control techniques and microcomputers, the ac motor drives are becoming increasingly competitive with dc motor drives. Although the future trend is towards ac drives, dc drives are currently used in many industries. Because of they have advantages such as: -

1) Very good starting torque.
2) Easier speed variation technique
3) Easier speed control mechanism with various controller techniques,

Some important applications are rolling mills, paper mill, traction printing press, textile mills, excavators and cranes, electric trains

An industrial drive system basically consists of a mechanical working equipment or load which has to be kept in motion to turn out mechanical work, These drive demand precise adjustment of speed in a steeples continuous manner over the complete speed range required. In industrial drives, electric drives using AC or Dc motors are predominately employed for this purpose due to their inherent advantages such as overload capacity, efficiency better dynamic and transient behavior, availability in various sizes and designs compatible to load requirements etc. The electric motors used many require some types of control equipments to achieve speed control and / or torque control. These controls make the motor work on a specific speed torque curve , and may be operated using open loop or closed loop control.

DC MOTOR

Among the electric motors, the dc motors are very versatile in that provide a smooth speed control over a wide range .The method of speed control are normally simple and less expensive. Since DC motors have some important advantages, they play a significant role in modern industrial applications. DC motors are very versatile as they provide a easier speed control over a wide range and have very good starting torque. So dc motor plays a significant role in modern industrial applications.

Basically there are three types of Dc motors

1) Series Wound.
2) Shunt Wound.
3) Compound Wound.

1) Series Wound: -

In this type of motor field and armature winding are in series. They have highest starring torque. They have poor speed regulation and also if used at no load, over speeding o motor take place.

2) Shunt Wound: -

In this type of motor field and armature windings are in parallel. They have medium starting torque good speed regulation and can be used from low to rated loads.

4) Compound Wound: -

One of the field wildings is in series and other in parallel with armature. Performance optimized to suit applications. Better then series wound and can be used from low to rated loads.

MOTOR PRIANCIPLE: -

This shows separately excited motor. In this separate supply is given to armature and field winding. When both the supply is given to the windings they experience a opposite force which tends to rotate the armature. Hence when motor armature rotates, the conductor also rotates and hence cut flux. So e. m. f. is induced in them in accordance with laws of electro – magnetic induction. The e. m. f. is reduced in opposite direction. So it is called back e. m. f.

BLOCK DAIGRAM AND EXPLANATION

Implementation and hardware specification:-

1) DC motor: separately excited DC shunt motor 0.5 HP

2) Control method: Armature voltage control rated up to 0-230V.

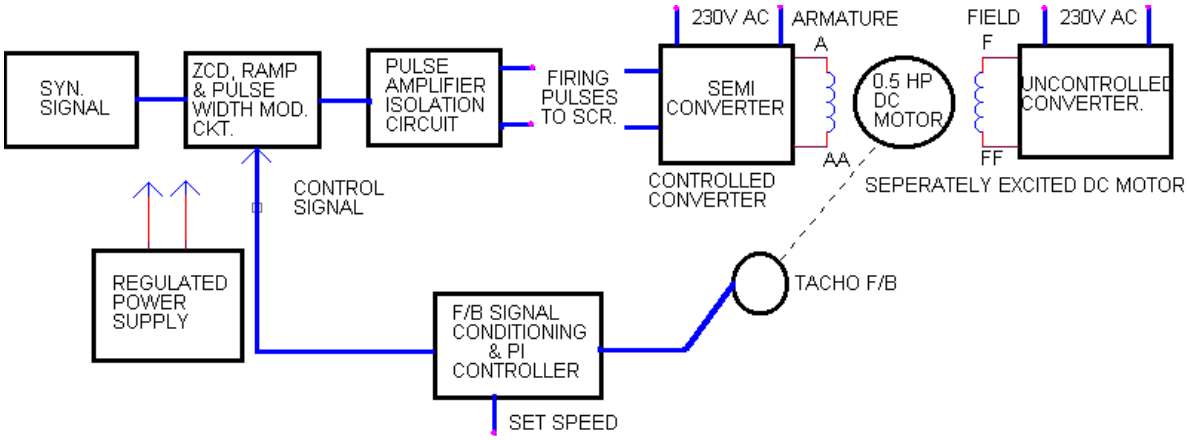
3) Maximum current 0-2.6Amp as per rating.

4) Field current 100-500ma as per rating.

5) Firing scheme linear From 180 deg to 0 deg.

6) Converter used semi-converter.

BLOCK DAIGRAM:



BLOCK DIAGRAM :- SPEED CONTROL OF DC MOTER (0.5HP)WITH PI ACTION

Power control using Semi converter.

Power control or regulator may have different method. Selective method will be of static devices, which may improve the efficiency and decreases the power losses. To control the voltage, power of load from the available energy source of 230V or 440V no's of existing methods are available. Among these methods semi-converter control is the best one due to efficiency and inherent freewheeling action. The voltage control of a resistive load such as heater or speed control of DC motor by varying armature voltage is the application of semi-converter technique. The speed of DC motor can be achieved by various methods of controller and devices. The motors are classified according to their principle working such as DC shunt motor, series motor and compound motor. As per the load handling capacity motors are specified in terms of HP ratings. Here we are controlling the developing the system to control a power up to 1HP.

To control the output voltage, semi-converter configuration is implemented. Firing of the two SCR's are controlled by linear firing scheme using operational amp. The output voltage is directly proportional to Vav.

Vdc = Vav of semi converter.

=(Em/pi)(1+cosα)

Where alpha is the firing angle. Alpha varies from 180 to 0 degree as per its variation Vdc varies from 0 to 208V. The system block diagram is as shown in fig. Firing circuit generates the required pulses for firing angle for required voltage. Buffer, driver and pulse amplifier circuit and isolation circuit is provided using pulse transformer and some passive component. The reference of ZCD circuit is provided to provide synchronization for the firing.

Block diagram consist following different blocks:

ZCD:

This block provides the zero crossing reference of the line frequency to the trigger circuit. It consists the comparator block using op-amp. Its output swings to either +saturation or negative saturation.

Ramp Generator:

Ramp generator block will get reference from zcd pulses; Ramp generator circuit will produce saw tooth waveform. The circuit is designed using op-amp. It consist RC circuit as differentiator and RC circuit as integrator. The output of the circuit linearly increases from 0v to 5V for the period of 10msec.

Pulse Amplifier and Isolation:

The ramp signal is compared with the reference of DC voltage. The comparator will take decision of firing angle. It's output will be Pulse width modulation in relation with the required firing angle. Isolation is provided using pulse transformer.

Semi-converter:

The conversion and control action of the supply will take place it consists two SCR and two diodes. It works as controlled converter to convert ac power into dc power.

F/B Signal conditioning.

This block depends upon the output whether resistive or inductive load is connected as a load. The f/b and reference signal will decide the action to be taken in controller.

Regulated power supply.

Dual supply of 12V is designed to provide power to all op-amp circuit.

SAFETY PRECAUTIONS

1. As some parts of the circuit are at mains potential, care should be taken, while connecting and testing the power circuit.

2. Do carefully while connecting polarities of mains. Live and neutral should be same as shown in circuit.

3. Shunt wire should be cleaned properly and it should be titned with nut bolt.

4. Before starting the project check the position of switch and current set potentiometer should be minimum.

5. Transformers are connected to PCB with wire so, care of that wires do not stretch while moving that.

6. Firing reference and transformer main should be in synchronization.

Advantages & Application

1) Application at mines, paper mills, heavy duty load
2) Close loop control system with protection circuit.
3) Linear firing control scheme hence smooth control
4) Isolation is provided with the help of pulse transformer.
5) Advantages of semi-converter over full converter.
6) Sharp and smooth control using soft start may be provided.
7) After modification LCD display shows status and speed of drive.

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