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NEED OF ELECTRONIC STARTER FOR DC MOTOR

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***Abstract*— Commonly used method for the starting of dc motors is reduced-voltage starting. This paper introduces a technique of soft starting. Thedevice which is based on triggering of thyristors. At starting, three single-phase silicon controlled rectifier are in OFF position to reduce inrush current and keep the starting current constant at preset value by adjusting the firing angle of silicon controlled rectifier.**

***Index Terms*—Current, Motor, silicon controlled rectifier (SCR), Starter**

I. INTRODUCTION

Studies have shown that approximately 90% of the motors employed in industrial applications use no form of control other than simple electromechanical switching. This results in increased machine wear as rapid acceleration causes damaging torque transients and high peak currents. Soft starters solve this problem through controlling the application of current during acceleration and deceleration.

Soft starters are used for the smooth start-up control of three-phase induction motors.[06]

In applications where motor speed can be varied, significant energy savings can be realized by using variable speed drives. However in fixed speed applications soft starters are still the most economical solution.

A motor soft starter is a device used with DC electric motors to temporarily reduce the load and torque in the power train and electrical current surge of the motor during startup. This reduces the mechanical stress on the motor and shaft, as well as the electrodynamics' stresses on the attached power cables and electrical distribution network, extending the lifespan of the system. Some of the objectives to meet are:

- reduced start current and start torque
- elimination of mechanical and electrical transients
- Increase the life of motor.
- Make the armature current of motor constant.[04]

II. NEED OF ELETRONIC STARTER

Maximum current that a dc motor can safely carry during starting is limited by that max. Current that can be commutated without sparking. For normally design machine, twice the rated current can be allowed to flow and for specially design machine it can be 3.5 times.

At standstill back EMF is zero and the only resistance apposing flow of current is the armature circuit resistance, which is quite small for all types of DC motor.[01] If a DC motor is started with full supply voltage across its terminal, a very high current will flow, which may damage motor due to heavy sparking at commutator and heating of winding. Therefore it is necessary to limit the current to a safe value during starting. When motor speed is controlled by armature voltage controlled, the controller which controls the speed can also be used for limiting motor current during starting to a safe value. In absence of such controller a variable resistance controller is used for starting. As motor accelerates and back emf rises, one section of the resister is cut out at a time, either manually or automatically with help of contactors, such that current is kept within specified maximum and minimum values.The time for the Electric motor to achieve the required rpm is calculated and shown in Table 1

Sr. No.	MOTOR H.P.	R.P.M.	TIME (in Sec.)
1.	1000	75	8.16
2.	1000	125	22.67
3.	1000	300	131.09=2.18 min.
4.	1000	500	363.63 =6.06 min.
5.	500	75	16.71
6.	500	125	45.76
7.	500	300	261.67 =4.36 min.
8.	500	500	726.25 =12.10 min.
9.	333	75	24.52

III. AVAILABLE METHODS OF RECOGNITION

- **Three point starter**

In this starter, the NVC and the field winding are in series. So while controlling the speed of the motor above rated, field current is reduced by adding an extra resistance in series with the field winding. Due to this, the current through NVC also reduced. Due to this, magnetism produced by NVC also reduces. This may release the handle from its RUN position The motor will develop Locked Rotor Torque and begin to accelerate towards full speed.

- **Auto-transformer**

Auto-transformer starter's offer limited performance because:

1. They offer only limited ability to adjust start torque to accommodate motor and load characteristics.
2. There are still current and torque transients associated with steps between voltages.
3. They are large and expensive.
4. They are especially expensive if high start frequency is required.
5. They cannot accommodate changing load conditions. E.g. loaded or unloaded starts.
6. They cannot provide soft stop.
7. Soft-starter to start and stop an electric motor smoothly. With adequate adjustments of the variables, the torque produced is adjusted to the needs of the load, so that the

- **Soft-Starters**

These are static starters that accelerate, decelerate and protect three-phase induction motors. The control of the voltage applied to the motor by means of adjustments to the firing angle of thrusters allows the The soft-starter line is top-notch in motor starting and stopping with features that allow the starting, stopping and protection of
required current is going to be the lowest possible for the starting procedure

switching off the motor. To avoid the dependency of NVC and the field winding, four point starter is used, in which NVC and the field winding are connected parallel.

- **Direct On Line Starter (DOL)**

To start, the contactor is closed, applying full line voltage to the motor windings. The motor will draw a very high inrush current for a very short time, the magnetic field in the iron, and then the current will be limited to the Locked Rotor Current of the motor.

- **Star-Delta Starter**

Star/delta starter's offer limited performance because: Start torque cannot be adjusted to accommodate motor and load characteristics.There is an open transition between star and delta connection that results in damaging torque and current transients.They cannot accommodate varying load conditions (e.g. loaded or unloaded starts).

They do not provide soft stop.

IV. COMPARISON OF VARIOUS STARTERS

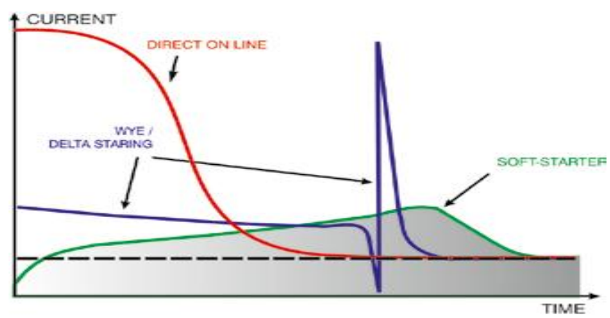
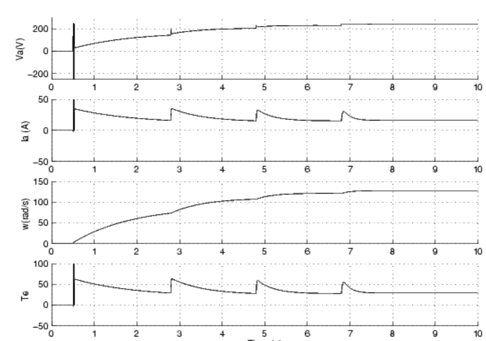


Fig.01:Comparison of various starters



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V. RATINGS & SELECTON OF DC SHUNT MOTOR

H.P. rating -5

Voltage -220 Volts

Current rating:

Rated current – 19A

No load starting current- 11.2 A

No load current- 0.8A

Speed- 1500RPM

Field winding - 213 ohm

Armature winding- 1.2 ohm

Maximum load - 100 kg

VI. SELECTION OF RESISTOR COIL

For selection wattage of starting resistor with the help of DC shunt motor, we use below formula:

$P = I^2 R$ Watts

Where,

I = 11.2 AMP

= No load starting current of DC shunt motor in AMP,

R = 10 ohm

= Resistance of existing resistor coil in ohm,

$$P = (11.2)^2 * 10$$

P = 1254 Watts

So, according to above calculation we design resistor coil of 1200 Watts & gave three tappings at various points of resistor coil. We gave three tappings at 6 ohm, 3 ohm & 1 ohm according to matlab.

Across each tapping one thyristor is connected & these thyristors are fired with the help of micro controller based firing circuit at specified intervals. First thyristor is fired after 3sec, second thyristor is fired after 2sec & third thyristor is fired after 2sec

VII. BLOCK DIAGRAM OF PROJECT

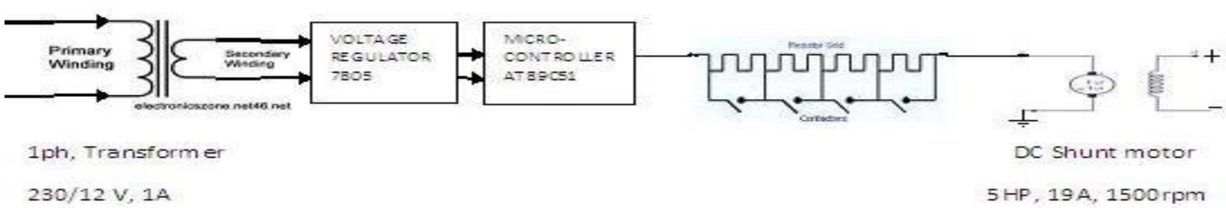

Fig04:Blockdiagram

WORKING

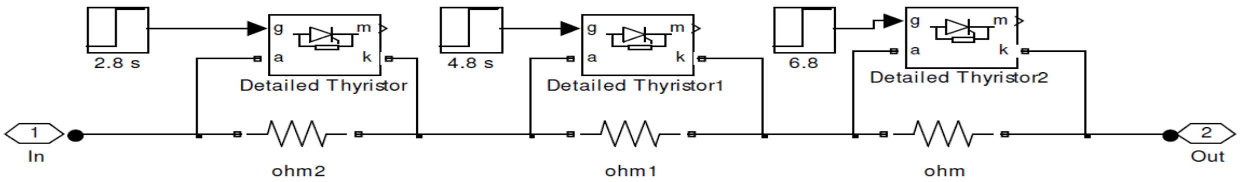

FIG05: Starter

Maximum current that a DC motor can safely carry during starting is limited by the maximum current that can be commutated without sparking. For normally designed machines, twice the rated current can be allowed to flow & for specially designed machines it can be 3.5 times. In order to limit the high starting current a resistor is connected in between supply & DC shunt motor. In our project 10ohm resistor is used in circuit. Resistor is divided in several Parts& across each part thyristors connected parallel to it.

Here resistor has been divided in three parts & three thyristors connected across it. At starting twice rated current flows through the motor. So thyristor should be of rating of twice the motor current. We used DC shunt motor which has rating of 19.1A rated current. So, thyristors of 40A are used.

When DC supply is connected to motor, due to presence of resistor in between supply & motor, motor will get less voltage & current than the rated voltage & rated current. So, at start motor will start slowly. In order to cut out the resistors connected across it thyristors have to be fired after specific intervals. For firing of thyristors microcontroller 8051 is used.

By using microcontroller 8051 signals are given to pulse transformers after specific time intervals. When pulse transformers receive signals from 8051, then they will generate pulses of 12V & these pulses are given to gate & cathode terminals of thyristors. As soon as thyristor receives gate pulse it turns ON & start conducting.[03] As thyristor start conducting it will create parallel path for current to flow eliminating resistor connected across it. As resistor is cut out from circuit supply voltage to motor increase & motor will run at slightly higher speed.

In this way after specific intervals all three thyristors are fired by 8051 micro controller & full supply voltage is applied to motor. As thyristors are fired motor voltage & motor speed will increase gradually & motor will start smoothly. This method is used when Speeds below the no-load speed are required. As the supply voltage is normally High Starting

Constant, the voltage across the armature is varied by inserting a Variable rheostat in series with the armature circuit. As controller Resistance is increased; voltage across the armature is decreased, thereby decreasing the armature speed. For a load constant torque, speed is approximately proportional to the voltage across the armature. From the speed/armature current characteristic, it is seen that greater the resistance in the armature circuit, greater is the fall in the speed.

The results illustrate that the circuit effectively reduces the inrush current at start-up moment. The circuit also provides the speed adjustment and can be further implemented with the speed regulation and the over-current protection.[05]

VIII. CONCLUSION

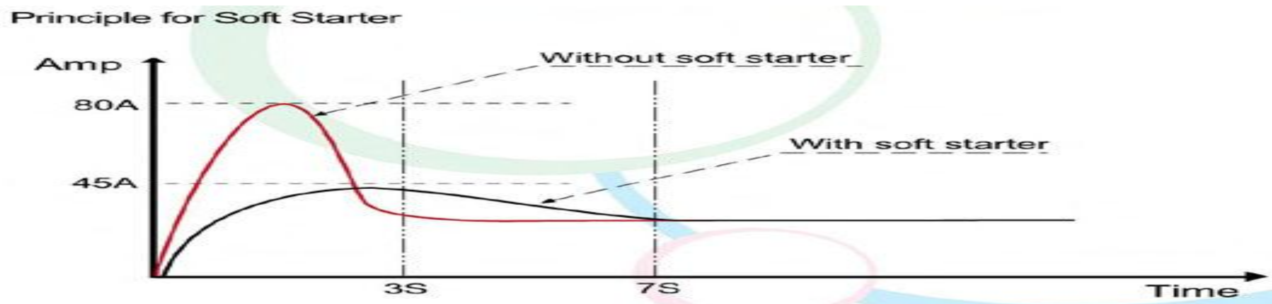

FIG 06Comparison between with & without starter

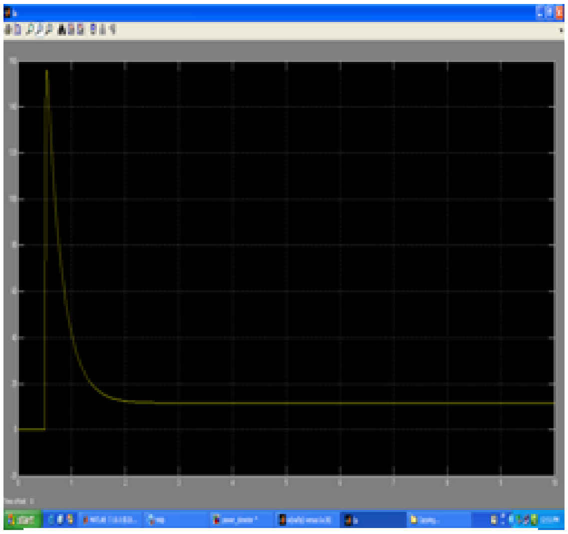

FIG 07:Current waveforms without starter

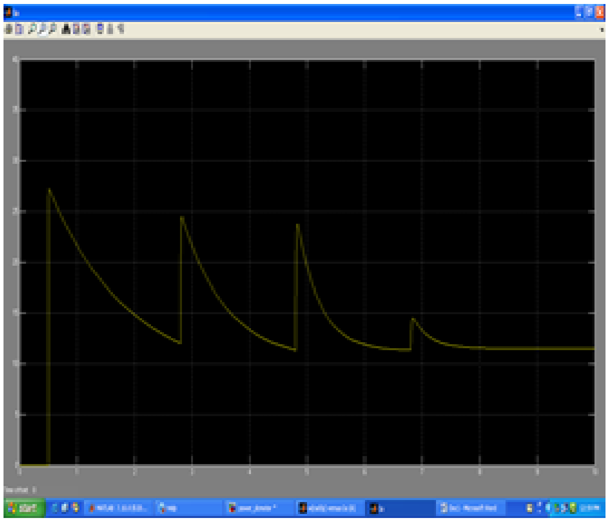

FIG 08: Current waveforms with starter

COMPARISON BETWEEN WITH & WITHOUT STARTER

1. Effectively reduces the inrush current at start-up moment.
2. It also provides the speed adjustment and can be further implemented with the speed regulation and the over-current protection.
3. The IGBT based circuit gives smoother control over the entire speed range as compared with the SCR based circuit.
4. The power loss with electronic starter is very less as compared to conventional starter.
5. Reliability is high.
6. The starting current limited by 45%.
   The above conclusions were found to be in accordance with the theoretical result

ADVANTAGES

- Electronic starter have no moving parts, so they are very durable.
- Sparking does not take place.
- Performance is fast & stepwise.
- Efficiency of motor does not get affected due to use of such starter.
- Less maintenance is required due to less sparking
- Smooth acceleration without the torque transients associated with electro-mechanical reduced voltage starters.
- Voltage or current is applied gradually, without the voltage and current transients Associated with electro-mechanical reduced voltage starters.
- Lower start currents and shorter start times because constant current control gives higher torque as motor speed increases.
- Easy adjustment of start performance to suit the specific motor and load.
- Precise control over the current limit.
- Consistent performance even with frequent starts.
- Reliable performance even if load characteristics vary between starts (E.g. loaded or unloaded starts).

In addition to superior starting performance, soft starters also provide a range of features not available from other reduced voltage starters. This includes areas such as:

- Soft stop (which helps eliminate water hammer)
- Metering and monitoring
- Braking
- Operating history and event logs
- Motor and system protection
- Communication network integration

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