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Design of Starting Resistance for AC and DC Machines using Computer Analysis using C language

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Abstract - *The speed of any type of the motor has to be increased initially from zero speed to its operating speed. This is said to be starting of the motor. We know that DC motors play important role in converting energy. Starter in series with the motor is highly used for reducing the high starting current and start the motor a very low speed. With the help of Computer analysis, Design of Starter required for AC and DC machines will be eased to a very great extend. We know that nowadays, use of motors have been increased very widely, hence requirement of starter has also been increased, which can be easily manufactured using this technique. In this work the designing of starter for DC and AC motors has been done in such a way that only the desired parameters of the motors has to be given and the values required for the starter in terms of resistance(ohms) will be obtained.[1]This method can also be used by the manufacturer of any DC and AC motors in order to supply the starter of the desired motor wished by the consumer. Mainly this work supports user-friendly environment for operation as any layman can use this program without any difficulty[2].*

Key Words: **DC Series Motor, DC Shunt Motor, Slip-ring Induction motor, Computer analysis, Starters, Speed regulation, C program**

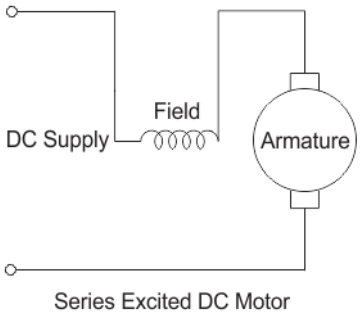
1. INTRODUCTION

In most of the industries, nowadays there is a huge requirement of motor which includes both AC as well as DC motors depending upon the load requirement. The motor mainly convert the electrical energy in mechanical energy. The AC motor works on alternating current/Voltage and the DC motor works on the Direct current/Voltage. The output from this motor results into development of torques. This paper mainly focus on the design of starter for different kind of Motor using Computer Analysis using C.[4]

There are three different types of motor.

1) DC Series Motor
2) DC shunt Motor
3) Slip-ring Induction Motor (AC Motor).

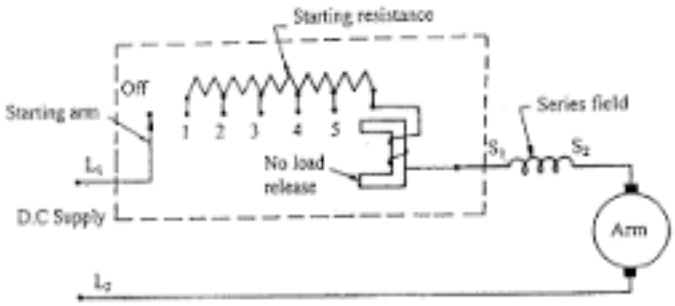
2. DC SERIES MOTOR



Series Excited DC Motor

The series motor which is also known as series wound motor should never be started when there is no load condition, as there is mechanical load which results into low current, hence the back emf becomes weak due to which the rotation of the armature of motor becomes faster to match the supply voltage hence it damage the motor.
This type of motor is used to provide high inertia starting of loads, such as elevators, trains etc.

2.1 DESIGNING OF STARTER FOR DC SERIES MOTOR



Series motor starter, no-load release.

For the sake of designing of Starter we consider we consider there are n+1 studs and n section resistance connected in the circuit.

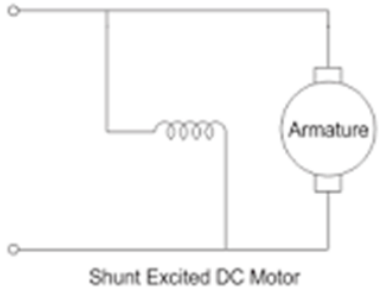
```
                          1) DC series motor
                          2) DC Shunt motor
                          3) Slip ring Induction motor
                          Enter the choice: 1
Enter the Output Power given by motor =3300

Enter the Supply Voltage given to motor =230

Enter the Motor circuit resistance =1.68

Enter the number of studs=5

Number of resistance sectoions required = 4
Enter the Range of starting current varying from X times the full load current
Enter the Starting current varying from =1.5

Enter the starting current varying to =2

Is full load efficiency given? (Press 1 for YES and Press 0 for NO)=1

Enter the full load efficiency motor =0.75

Maximum Starting Current I[1]= 38.260872
Minimum Starting Current I[2]= 28.695654
Enter the value of BETA=1.1

Alpha= 0.750000
Y=0.825000
```

Figure 1 DC Series Motor (a)

```
-------------------------------------------------------------------|
STUD No.        |Resistance Section          |Total Resistance
-------------------------------------------------------------------|
Stud[1]         |r[1]=1.653125 ohms          |R[1]=6.011364 ohms
-------------------------------------------------------------------|
Stud[2]         |r[2]=1.363828 ohms          |R[2]=4.358239 ohms
-------------------------------------------------------------------|
Stud[3]         |r[3]=1.125158 ohms          |R[3]=2.994411 ohms
-------------------------------------------------------------------|
Stud[4]         |r[4]=0.928256 ohms          |R[4]=1.869252 ohms
-------------------------------------------------------------------|

------------------------------
Process exited after 41.34 seconds with return value 5
Press any key to continue . . .
```

Figure 2 DC Series Motor (b)

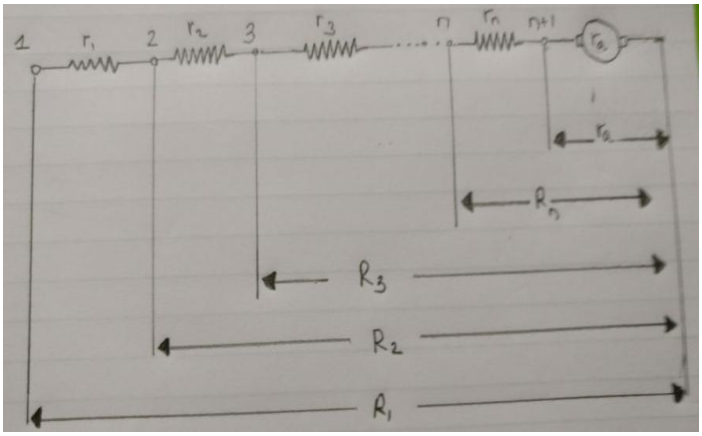
3 DC Shunt Motor



In DC shunt motors the field winding are connected in parallel to an armature with the use of a common DC supply source. This type of motors has the property of good speed regulation but this does not offer the starting torque as high as the DC series motors.[3]

This motor consists of extremely smooth running which results in low mechanical stress on it and also possess the property of low speed and large range of control due to which it is widely used in the industries.

3.1 DESIGNING OF STARTER FOR DC SHUNT MOTOR

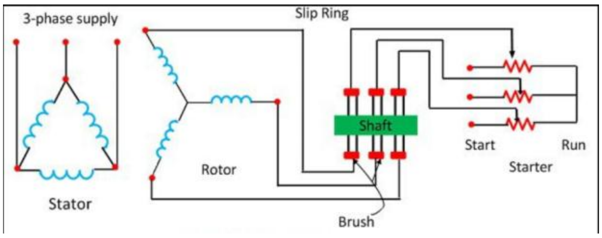


For the sake of analysis consider the number of studs equal to n+1 and the section resistance of the circuit equal to n.

```
                          1) DC series motor
                          2) DC Shunt motor
                          3) Slip ring Induction motor
                          Enter the choice: 2
Enter the Output Power given by motor =3900

Enter the Supply Voltage=250
Is full load efficiency is given ?
y
 enter full load efficiency =0.71

Enter the number of Studs=6

Enter the armature resistance=0.95
Total resistance at starting R1=11.378205 ohms
Alpha=0.608597

Lower limit of current=13.371995

Enter the full load speed of the motor=1325
```

Figure 3 DC Shunt Motor (a)

4. Slip-Ring Induction Motor



Slip-Ring Induction motor is widely known as a phase-wound Induction motor. With the help of this motor, Pull-Out torque can be obtained from the zero speed in terms of RPM.

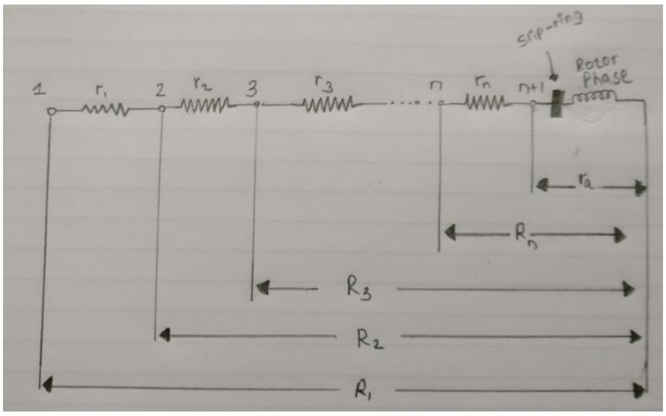
It also consist of extremely high starting torque in comparison to squirrel-cage induction motor. Moreover the speed of this motor can be easily be controlled.

STUD No.	Speed	BACK EMF	Resistance Section	Total Resistance
Stud[1]	N[1]=412.356079 rpm	EMF[1]= 97.85 Volts	r[1]=4.453461 ohms	R[1]= 11.38 ohms
Stud[2]	N[2]=663.314880 rpm	EMF[2]=157.40 Volts	r[2]=2.710364 ohms	R[2]= 6.92 ohms
Stud[3]	N[3]=816.047668 rpm	EMF[3]=193.65 Volts	r[3]=1.649520 ohms	R[3]= 4.21 ohms
Stud[4]	N[4]=909.000366 rpm	EMF[4]=215.70 Volts	r[4]=1.003893 ohms	R[4]= 2.56 ohms
Stud[5]	N[5]=965.571228 rpm	EMF[5]=229.13 Volts	r[5]=0.610967 ohms	R[5]= 1.56 ohms

```
Process exited after 44.51 seconds with return value 0
Press any key to continue . . .
```

Figure 4 DC Shunt Motor (b)

4.1 DESIGNING OF STARTER FOR DC SHUNT MOTOR




```
                    1) DC series motor
                    2) DC Shunt motor
                    3) Slip ring Induction motor
                    Enter the choice: 3
Enter the Output Power given by motor =40000

Enter the Supply Voltage given to motor =415

Enter the Motor circuit resistance =0.14

Enter the number of studs=6

Number of resistance sectoins required = 5.000000
Total full load rotor copper loss given? (Press 1 for YES and Press 0 for NO)=1

Enter the full load rotor copper loss=1147

Slip at full load=0.028675
Is Maximum starting current = Full load current? (Press 1 for YES and Press 0 for NO)=0

What times the maximum current is of the full load current=1.74

Slip at maximum starting current= 0.049895
Alpha=0.549048
```

Figure 5 Slip-Ring Induction Motor (a)

STUD No.	Slip at various Studs	Resistance Section	Total Resistance
Stud[1]	Slip[1]=1.000000	r[1]=1.265334	R[1]=2.805920
Stud[2]	Slip[2]=0.549048	r[2]=0.694730	R[2]=1.540586
Stud[3]	Slip[3]=0.301454	r[3]=0.381440	R[3]=0.845856
Stud[4]	Slip[4]=0.165513	r[4]=0.209429	R[4]=0.464416
Stud[5]	Slip[5]=0.090875	r[5]=0.114987	R[5]=0.254987

Figure 6 Slip-Ring Induction Motor (b)

5. Applications of this work in Industries

Manufactures offer a very wide variety of motors which can be used for different applications.AC motors and DC motors can be used in most of the industrial automation requirement. But we know that any ideal motor depends upon the type of application. It involves all constant speed, variable torque, variable speed etc applications.[5]

For all this type of requirement of motor according to requirement there is always a requirement of suitable starter which can drive the motor properly without any damage to the motor. Using this designing work the user can

avail whatsoever requirement he wants by just giving the desired parameters of the motor depending upon the application

6. Merits of this work

- Use of starter is universal for types of motor. Hence designing and grading of starter has to be done manually or automatically. With this work it can be done automatically.
- Precise values of resistance sections for the starter are obtained.
- We are able to obtain the speed of the motor at different studs so as to check the gradual increase in the speed instead of rapid increase in the speed.

This analysis requires very less time to derive the results also the compilation time is very less.

7. Demerits of this work

- This analysis is not able to store the obtained results in the memory.
- This work provides designing of starter only for DC Shunt Motor, DC Series motor and Slip-ring Induction motor.

8. .Future works

- This analysis has been done on C language programming and it takes approximately 44.52 seconds to obtain the results. So analysis of designing of the starter using different languages such C++,C sharp, JAVA, python etc will be done.
- The terminal is a pure C-terminal. Efforts will be made on the program to improve its visuals and graphics when the program is run.
- Also efforts will be made to make the program more user-friendly.
- Designing of starter of different motors other than the above motors will be made.

9. CONCLUSIONS

In this work, the analysis done using C program for designing of starter is shown and with the help of above results we obtain the values for section resistance, speed of the motor at each stud, emf produced at each stud just by entering the desired parameters of the motor.

10. REFERENCES

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