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3- COIL STARTER USE FOR STARTING D.C MOTOR

Rohit Kumar
Lecturer, Electrical Engineering Department
S.I.T. Meerut

ABSTRACT

We know that D.C. motor is self starting. But we use the external method for starting to D.C motor for safety purpose. Because if we are not use starter then motor can be burn. I shall explain further in this paper why burn motor if we will not use starter. Today we are using 3- point starter & 4-point starter. 4-point starter remove the drawback of 3-point starter. But 4-point starter having also some draw back. This draw back can be modifying by using 3- coil starter. Which will explain in this paper? The 3- coil starter has a lot of constructional and functional similar4- point starter, but this special device has an additional coil in its construction, which naturally brings about some difference in its functionality, though the basic operational characteristic remains the same.

I. INTRODUCTION

D.C motor is self staring motor. But several methods are used for starting to D.C. motor. In present time in industry. These two method are used in industry .these are given as 3-point starter & 4- point starter .Now in this research paper modified these starter draw Back. This starter is known as 3- coil starter. This starter is basically modified 4-point
Starter drawback.

II. STARTING OF DC MOTOR

The **starting of DC motor** is somewhat different from the starting of all other types of electrical motors. This difference is credited to the fact that a dc motor unlike other types of motor has a very high starting current that has the potential of damaging the internal circuit of the armature winding of dc motor if not restricted to some limited value. This limitation to the starting current of dc motor is brought about by means of the starter. Thus the distinguishing fact about the starting methods of dc motor is that it is facilitated by means of a starter. Or rather a device containing a variable resistance connected in series to the armature winding so as to limit the starting current of dc motor to a desired optimum value taking into consideration the safety aspect of the motor.

Now the immediate question in **why the DC motor has such high starting current?** To give an explanation to the above mentioned question let us take into consideration the basic operational **voltage equation** of the dc motor given by,

$$\mathbf{E = I_a R_a + E_b}$$

Where E is the supply voltage, I_a is the armature current, R_a is the armature resistance. And the back emf is given by E_b.

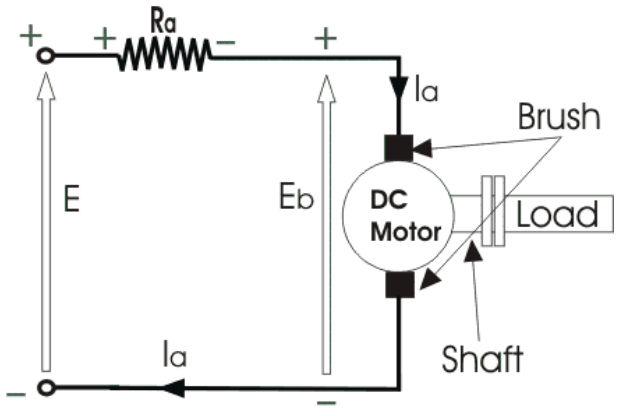
Now the back emf, in case of a dc motor, is very similar to the generated emf of a dc generator as it's produced by the rotational motion of the current carrying armature conductor in presence of the field. This back emf of dc motor is given by

$$E_b = \frac{P.\phi.Z.N}{60A}$$

and has a major role to play in case of the **starting of dc motor**.

From this equation we can see that E_b is directly proportional to the speed N of the motor. Now since at starting N = 0, E_b is also zero, and under this circumstance the voltage equation is modified to

$$\mathbf{E=I_a R_a +0}$$



$$Therefore, I_a = \frac{E}{R_a}$$

For all practical practices to obtain optimum operation of the motor the armature resistance is kept very small usually of the order of 0.5 Ω and the bare minimum supply voltage being 220 volts. Even under these circumstance the starting current, I_a is as high as 220/0.5 amp = 440 amp.

Such high starting current of dc motor creates two major problems.

1) Firstly, current of the order of 400 A has the potential of damaging the internal circuit of the armature winding of dc motor at the very onset.

2) Secondly, since the torque equation of dc motor is given by

$$\mathbf{T \propto \phi I_a}$$

Very high electromagnetic **starting torque of DC motor** is produced by virtue of the high starting current, which has the potential of producing huge centrifugal force capable of flying off the rotor winding from the slots.

Method use starting D.C. motor

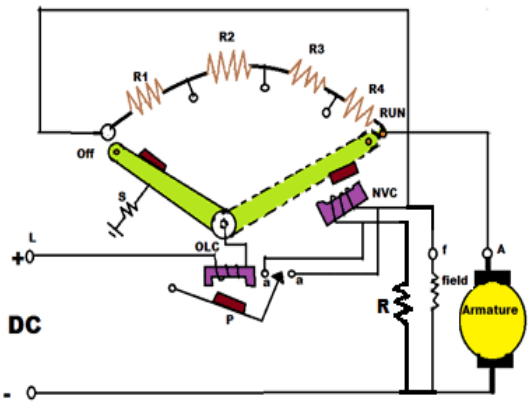
I) 3-point starter
II) 4-pont starter

New method explain in this research paper

I) 3-coil starter

III. 4 point starter

Constructional Details of 4-point starter



A 4 point starter is mainly the no-volt release coil is connected directly across the supply line through a protective resistance R to limit the starting current to a certain safer range. The resistance is subdivided in many variable resistances and this section of resistance contains the contact points called Studs, which are calibrated separately from OFF, 1, 2, 3, 4, 5 …. ,RUN. The main reason behind the name of 4 point starter is the 4 main points of the starter which are as follows:

- Line Terminal 'L', which is to be connected to the positive of supply.
- Field Terminal 'F', which is to be connected to the field winding.
- Armature Terminal 'A', which is to be connected to the armature winding.
- A 4th point N which is to be connected to the No Voltage Coil (NVC).

Now we are going to discuss about the **constructional details of this 4 point starter**, how this each and every parts are interconnected and also the sub-elements or subparts used in the construction of this **4 point starter**. With respect to the figure, the only difference between a three point starter and a four-point starter is the manner in which no-volt release coil is connected. However, we can tell that the working of the two starters is the same. The basic difference between three point and four pint starter is the connection of NVC. In 3 point starter, NVC is in series with the field winding while in four point starter NVC is connected independently across the supply through the fourth terminal called 'N' in addition to the 'L', 'F' and 'A'. Therefore we can say any change in the field current does not affect the performance of the NVC. Thus it is ensured that NVC always produce a force which is enough to hold the handle in 'RUN' position, against force of the spring, under all the operating conditions. Such a current is adjusted through NVC with the help of fixed resistance R connected in series with the NVC using fourth point 'N'.

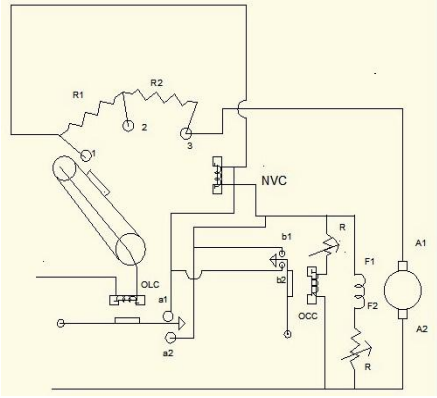
Working principle of 4-point starter

As we provide the d.c. supply to the motor, to make it switch on, the handle starts moving against the spring force to make a contact with stud No. 1, which was initially at OFF position. Thus field winding gets supply through the parallel path provided to starting resistance with the help of NVC. This is how we see the entire starting resistance comes in series with the armature and armature current which is high initially, gets checked to certain limit. Similar way the handle starts moving towards the other studs 2, 3, 4 etc., thus reducing the starting resistance gradually from the armature circuit and reaches the RUN position making the starting resistance R equal to zero and the motor keeps on rotating at its normal speed. Thus the working of the 4 point starter is just same as the 3 point starter. But we can say the main difference between a 3-point starter and a 4-point starter is the manner in which no-volt release coil is connected. The three-point starter also provides protection against an open-field circuit which is not at all provided by the four-point starter.

What is the main disadvantage of 4-point starter?

We have seen the only limitation of the **four point starter** is that it does not provide high speed protection to the motor. Under running condition, field gets opened then the field current reduces to zero. But there is some residual flux remaining and $N \propto 1/\Phi$ the motor tries to run with dangerously high speed. This is called high speeding action of the motor. Thus we see in four point starter NVC is connected directly across the supply and its current is maintained irrespective of the current through the field winding. So it will always maintain the handle in the run position, as long as supply is provided. And thus it does not protect the motor from field failure conditions which result into the high speeding of the motor. The most important difference between a three-point starter and a **four-point starter** is the manner in which no-volt release coil is connected. The three-point starter also provides protection against an open-field circuit which is not at all provided by the **four point starter**.

IV. 3-COIL STARTER



Construction details of 3-coil starter-

3-coil starter is also similar to 4- point starter but having several difference in construction.

It' s explains as:

It has three coils. These explain as:

I) OLC (OVER LOAD COIL)

II) NVC(NO VOLTAGE COIL)

III) OCC(OPEN CIRCUIT COIL)

These are following resistance R_1, R_2, R_3, R_4 extra resistance connected in series with armature in staring of D.C. motor. OCC (open circuit coil) connected across the field winding of the motor. Field winding terminals F_1F_2. Terminal f1 is connected to NVC (no voltage coil). Armature terminals A_1A_2. A_1 is connected to the last resistance terminals. Terminals a_1a_2 will become short circuit across the NVC coil. Terminal a_1a_2 will become short circuit when OLC coil operated. Terminals b_1b_2 will become short circuit coil across the NVC coil when OCC coil operated.

Working of 3-coil starter-

As we provide the D.C. supply to the motor, to make it switch on, the handle starts moving against the spring force to make a contact with stud No. 1, which was initially at OFF position. Thus field winding gets energies by passing the current. Field winding connected in parallel across the OCC coil. Total supply current is not passing through the field winding because a parallel resistance connected across the field winding. But this resistance having a very high value. This is how we see the entire starting resistance comes in series with the armature and armature current which is high initially, gets checked to certain limit. Similar way the handle starts moving towards the other studs 2, 3, 4 etc., thus reducing the starting resistance gradually from the armature circuit and reaches the RUN position making the starting resistance R equal to zero and the motor keeps on rotating at its normal speed. Thus the working of the 3- coil starter is just same as the 4 point starter.

V. Difference between 3-coil starter & 4-point starter

3- Coil starter remove the problem of 3- point starter & 4-point starter. Drawback in 4- point starter is that if field winding becomes open circuit then speed of dc motor become very high. 3- Coil starter remove this drawback of 4- point starter. When field winding will open circuit the total supply current pass through the OCC coil. So that OCC coil will energies. Due to energies of coil OCC terminal b_1b_2 become short circuit across the NVC coil. So that no current flow through the NVC coil. Then NVC coil deaneries due this reason handle will back to OFF position. If the short circuit occurs across the field winding then very high current flow through the field winding. Due to this high current OLC coil energies. Due to energies OCC terminal a_1a_2 short circuit. When a_1a_2 short circuit no current flow through the NVC coil and handle will become to back OFF position.

S.N	POINT STARTER	3- COIL TARTER
1	point starter having 2 coil	3-coil starter having 3 coil
2	these are following coil in 4-point starter. I) OLC II) NVC	These are following coil in 3-coil starter I)OLC II) NVC III) OCC
3	Drawback in 4-poin Draw back of 4-point starter. Is that it fail in the case of open circuit in field winding that	3-coil starter is operated in the case of Open circuit of field winding. It modify the draw back of 4- point starter.

VI. CONCLUSION

After study this research paper. I finalize that with the help of 3- coil starter we can remove the drawback of 3- coil starter. With the help of 3-coil starter D.C motor will become reach `

In off state if the field winding opens. So that motor not runs very high speed in the case of open field winding. I will try to that it will practically possible or not in lab. If this theory successful then we can solve a very big drawback of 4-point starter.

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