

Four Point Starter Kit for DC Compound Motor

Mr. Shantaram Narvekar¹, Ms. Chinmayee Naik², Ms. Purva Devrukhkar³, Ms. Pranjali

Gawas⁴, Mr. Jay Narvekar⁵, Prof. Mr. D.D.Patil⁶

¹⁻⁵ Students, Department of Electrical Engg, Yashwantrao Bhonsale Polytechnic, Sawantwadi

⁶ Prof. Mr. D.D.Patil

Abstract: The first starter was generated by Coleman in 1903 he is an American scientist. Later, in 1911 Kettering and Henry M. Leland further showed experiments on the starter. In 1911, they intended an electrical starter that may be used to start the electrical machine. This motor is simply considered because the starting motor which is employed to grant power to the engines in vehicles. The electrical starter finds its application mostly within the case of the auto industry. But within the case of electricity, the electrical starter we use is of various operation. This starter is employed to boundary the first current that's carried to the motor. We shall discuss thoroughly about this subject during this article. During this article, we shall discuss what's a Four-point starter, its principle, construction, operation, and applications how it's used with a DC compound motor.

the machine speeds up. So, the armature current of a motor is given by:

$$I_a = V - E \div R_a \dots \dots \dots (1)$$

Thus, I_a depends upon E and R_a , as input voltage V is kept constant. When the motor is switched ON, the armature is stationary and hence, the back EMF E_b is zero. The initial starting armature current i.e I_{as} is given by:

$$I_{as} = V - 0 \div R_a \\ = V \div R_a \dots \dots \dots (2)$$

Since, the armature resistance of a motor is extremely small, generally but one ohm, the starting armature current I_{as} becomes very large. Therefore, to limit this high starting current starter are used with the DC motor

1. INTRODUCTION

While starting a DC motor huge amount of current may be driven to the windings because of the absence of the back emf. This may rise about 4-6 times above the rated load current of the winding wire. So, during the starting of motor, due to heavy current the parts of motor may get damaged. Hence, to stop such high current rush, starters are utilized in DC motors. A starter consists of a variable resistance in series which is connected to the armature of the motor. It's utilized in order to cut back the starting voltage across the winding. When the motor hurries up the starter resistance decrease gradually. And it'll disconnect completely when the armature attains enough speed to come up with the back emf (that is that the normal speed). When the motor gains full speed, there is no effect on the armature circuit of the motor due to the starter. Then the contacts of the motor terminals are going to be directly connected.

1.2 WHAT IS 4-POINT STARTER?

The functional characteristics of a 4-point starter are similar to a 3-point starter. 4-point starter works as a current controlling device in the deficiency of back EMF while starts running of the DC motor. A 4-point starter also works as a protecting device. The main difference between a 4-point starter compared to a 3-point starter is, the holding coil is detached from the shunt-field circuit. After this, it is connected in series with the current limiting resistance (R) across the line.

1.1 NEED OF STARTERS FOR DC MOTOR:

The dc motor has no back emf. During the starting of the motor, the armature current is controlled by the resistance of the. The armature resistance R_a is very low (negligible), and when the full voltage is applied at the standstill condition of the motor, the armature current I_a becomes very high which may damage the parts of the motor. Due to the high armature current, the additional resistance is placed within the armature circuit at starting. The starting resistance of the machine is removed from the circuit when



Fig. 1 4-point starter

The four terminals of 4-point starter are-

1. 'L' Line terminal. (Connected to positive of supply).
2. 'A' Armature terminal. (Connected to the armature winding).

3. 'F' Field terminal. (Connected to the sector winding).
4. And 4th point N. (Connected to the No Voltage Coil)

Advantages of 4-point starter

- 1) The no volt coil is not affected by the change in field current. So, the user can increase or decrease the field current to control the flux and thereby control the speed of the motor.
- 2) Protects the armature coil from burning up due to heavy armature current.
- 3) This starter reduces the starting current and protects the motor from unstable voltage/over voltage and short circuit faults.
- 4) Protects the brushes and commutator from heavy sparking.

1.3 WHAT IS DC COMPOUND MOTOR?

A compound wound DC motor could be a self-excited motor. The self-excited motor requires only 1 DC source which is employed for both the stator and the rotor winding. These are the motors that are most typically used for their advantage. The compound wound DC motor is formed by the mixture of the shunt wound DC motor and series-wound DC motor so it could achieve both of their properties a shunt wound Dc motor has better speed regulation characteristics while the DC series motor has high starting torque so the compound wound Dc motor has achieved both of those characteristics so it's higher starting torque and better speed regulation ability so it is often used for industrial applications.



Fig. 2 DC compound motor

2. PROJECT CONCEPT

Our project is a testing kit of DC compound motor with 4-point starter. Usually a 4-Point starter works as a current controlling device and also a protective device for DC motor. It is a type of starter used for the protection of the device by not allowing excess current to pass the inner parts. So basically, we are making a panel consisting of a 4-point starter kit and a compound DC motor. We can also call it Load Test panel/ Testing kit of DC Compound Motor using 4-point starter.

2.1 CIRCUIT DESIGN

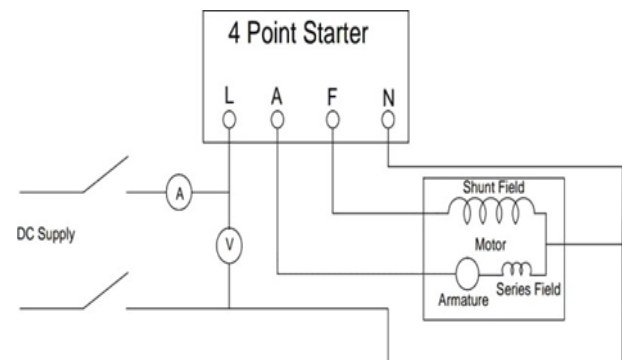


Fig. 4-point starter

2.2 OPERATION OF 4-POINT STARTER WITH A COMPOUND MOTOR:

For speed control of DC shunt or compound motors, a rheostat (variable resistor R_h) is connected in series with the field winding, as shown in Fig. 3. in this case, if a three-point starter is employed and the value of R_h is so adjusted that the current flowing through the shunt field coil is incredibly small. it's going to be seen that the same current flows through the no-volt release coil, then the magnetic strength of the coil is also insufficient to carry the plunger at its ON position, this undesirable feature of a three-point starter makes it unsuitable for such applications.

Hence, a four-point starter is designed in such a way that the disadvantages of 3-point starter are overcome in it. as shown in Fig. 3, the current flowing through the no-volt release coil is made independent of the shunt field circuit. Fig. 3 shows a starter used with a compound wound machine.

The working of a four-point starter is comparable to a three-point starter with slight changes. during this case, when the plunger touches the first stud, the line current is split into the subsequent three parts:

- i. First part passes through starting resistance and armature (as well as in series field for compound motors).
- ii. Second part passes through the field winding (and speed control resistance if applied) and
- iii. The third part passes through no-volt release coil and protective resistance connected in series with coil.

It is evident that's a four-point starter, the no-volt release coil circuit is independent of the field circuit. Therefore, the change of current within the field circuit don't affect the pull exerted by the holding coil which remains always sufficient to prevent the spring from restoring the plunger to its OFF position. While starting a motor with a four-point starter it's necessary to make sure that the field circuit is closed and therefore the rheostat connected in series with the shunt field winding must be at zero resistance position. Moreover,

whole of the starting resistance must be available series with the armature.

When a shunt motor is to be stopped, it should be stopped by opening the line switch. In fact, this switch is opened with none appreciable arc since the motor develops back emf nearly equal to applied voltage and therefore the net voltage across the switch contacts is extremely small. The electromagnetic energy stored within the field doesn't appear at the switch but it gradually discharges through the armature. To stop the motor we should never bring the plunger (starting arm) back to the OFF position, because in such cases, when the field circuit breaks at the last stud placed near the OFF position, a heavy spark occurs due to the inductive nature of the field. Usually, this sparking burns the contact. Moreover, while stopping the motor, the value of resistance connected within the field circuit should be reduced to zero so speed of motor falls to its normal value. This ensures that, when the motor is started next time, it must start with a robust field and better starting torque.

3. FUTURE SCOPE:

This project is already a modification of 3-point starter. 4-point starter is always preferred over 3-point starter as it is more advantageous.

Help the further students to understand about 4-point starter practically:

As we know that our syllabus contains study of 4-point starter. So, this project can be used in our college premises for the practical purpose for showing the working of 4-point starter. Students would understand this concept practically very well because of our project.

Starting the various types of DC motors:

The 4-point starter is used mainly with DC compound motors but it can be used with DC shunt motors too. This circuit can be used in separately excited DC Motor and the DC Shunt Motor without affecting the field current going through the field winding of the motor.

Protection of DC motor:

Mainly the function of this starter is to reduce the starting current and to protect the motor from unstable voltage. This is also used as a protective device for motors.

Modify into soft-starter:

As it is already a modified version, we don't need any modification but if needed than slight modifications and changes in this project can make it a soft starter.

4. CONCLUSIONS

Mainly the function of this starter kit is to reduce the starting current and to protect the motor from unstable voltage. This is also used as a protective device for motors. This 4-point starter kit is used mainly with DC compound motors but it can be used with DC shunt motors too. This circuit can be used in separately excited DC Motor and the DC Shunt Motor

without affecting the field current going through the field winding of the motor.

As we compare the results of various starter of dc motor, we conclude that depending upon the specification, type and conditions that the motor has to operate, clients must select the appropriate motor and the starter mechanism. This is all about 4-point starter, and it's working. From the above-mentioned information finally, we can conclude that the 3-point starter & 4-point starter both are similar in construction. In 3-point starter, once the motor speed changes then the flow of current through the field coil & the current will have effect on the no voltage coil. Hence in order to reduce this produce or completely remove this problem 4-point starter is implemented or used.

Also, it will help the further students to understand about 4-point starter practically. As we know that our syllabus contains study of 4-point starter. So, this project can be used in our college premises for the practical purpose for showing the working of 4-point starter. Students would understand this concept practically very well because of our project.

REFERENCES:

- [1] S. K. Bhattacharya **Electrical Machines** © 2009, by Tata McGraw Hill Education Pvt. Ltd.
- [2] B. L. Theraja, A. K. Theraja **The Text Book of Electrical Technology** Volume II AC and DC machines in S.I. system of units.
- [3] Starting a DC Motor n.d., viewed 13 September 2017, <<https://au.mathworks.com/help/physmod/sps/examples/starting-a-dc-motor.html>>.
- [4] Classification of Electric Motors n.d., viewed 14 September 2017, <<http://www.electricalknowhow.com/2012/05/classification-of-electric-motors.html>>.
- [5] Electric motor n.d., viewed October 2 2017, <https://en.wikipedia.org/wiki/Electric_motor>.
- [6] Need of starters : <circuitglobe.com>
- [7] <https://www.electrical4u.com/compound-wound-dc-motor-or-dc-compound-motor>