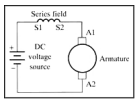
Series DC Motor

Like any other motor, series motors convert electrical energy to mechanical energy. Its operation is based on simple electromagnetic principle by which when the magnetic field created around a current carrying conductor interacts with an external magnetic field, a rotational motion is generated.

Parts and Principles of operation of a Series DC Motor

A DC series motor has all the 6 fundamental components-axle, rotor (armature), stator, commutator, field magnet(s) and brushes-that are present in a generic DC motor. The motor casing where two or more electromagnet pole pieces are housed forms the stationary part of the motor, the stator. The armature, windings on a core, electrically connected to the commutator comprise the rotor. Rotor has a central axle about which the rotor rotates in relation to the stator. Power is supplied to the armature windings through the stationary brushes touching the rotating commutator.

A typical DC motor layout is given in the following diagram:



Series Motor - Electrical Diagram

In series motors stator windings and field windings are connected in series with each other. As a result the field current and armature current are equal. Heavy currents flow directly from the supply to the field windings. To carry this huge load, field windings are very thick and have few turns. Usually copper bars form stator windings. These thick copper bars dissipate heat generated by the heavy flow of current very effectively.

Note that the stator field windings S1-S2 are in series with the rotating armature A1-A2.

In a series motor electric power is supplied between one end of the series field windings and one end of the armature. When voltage is applied, current flows from power supply terminals through the series winding and armature winding. The large conductors present in the armature and field windings provide the only resistance to the flow of this current. Since these conductors are so large, their resistance is very low. This causes the motor to draw a large amount of current from the power supply. When the large current begins to flow through the field and armature windings, the coils reach saturation that results in the production of strongest magnetic field possible.

The strength of these magnetic fields provides the armature shafts with the greatest amount of torque possible. The large torque causes the armature to begin to spin with the maximum amount of power and the armature starts to rotate.

Speed of DC Series Motors

In series motors, a linear relationship exist between the current flowing through the field windings and the amount of torque produced. As heavy currents flow through the very thick series field windings, large torques are produced in series motors. This feature makes series motors to be used as starter motors for industrial applications. Series motors can move comparatively heavier shaft loads. A series motor can start an automobile’s engine by drawing a heavy current of 500A. In a factory series motors can help operate huge cranes by carrying several thousands of amperes. Series motors generally operate for a very less duration, about only a few seconds, just for the starting purpose.

Series Motor Speed Control

Motor speed control is achieved by controlling the voltage applied to the motor. This essentially controls the torque developed by the motor. To increase the speed of a series DC motor a low resistance is placed in parallel with the series field. This shunt resistance lowers the field current, which produces a drop in magnetic flux and an increase in speed. To lower the speed an external resistance is connected in series with the field and the armature. This results in armature voltage reduction and a fall in speed.

When the armature speed increases the field current reduces, reducing the induced back emf.

This results in further increase in speed and virtually there is no upper speed limit. So running a series wound motor with no load is very risky, as it can accelerate to destruction.

Installation

Installing and wiring a series DC motor is very simple and easy. If the motor will rotate in only one direction, it can be connected permanently to a manual handle starter. If the motor needs its direction to be changed frequently it should be connected with a reversing starter. Troubleshooting series motors is not so complex.

Applications

Series Motors can generate huge turning force, the torque, from its idle state. This characteristic makes series motors suitable for small electrical appliances, mobile electric equipments, hoists, winches etc. Series motors are not suitable when a constant speed is required. The reason is that the speed of series motors varies greatly with varying load. Regulating the speed of series motors is also not an easy process to implement.

Advantages of DC series motors

- Huge starting torque
- Simple Construction
- Designing is easy
- Maintenance is easy
- Cost effective

Universal Motor
Series Motors are widely termed universal motors. They operate equally well from either an AC voltage source or a DC voltage source.