DC Motor

DC motors are devices designed to convert direct current electrical energy to mechanical energy! This rotary electrical device has different types, all of them containing either electronic internal mechanism or electromechanical internal mechanism responsible for changing the direction of current in the motor.

Different Parts of DC motor shown in Fig 1.

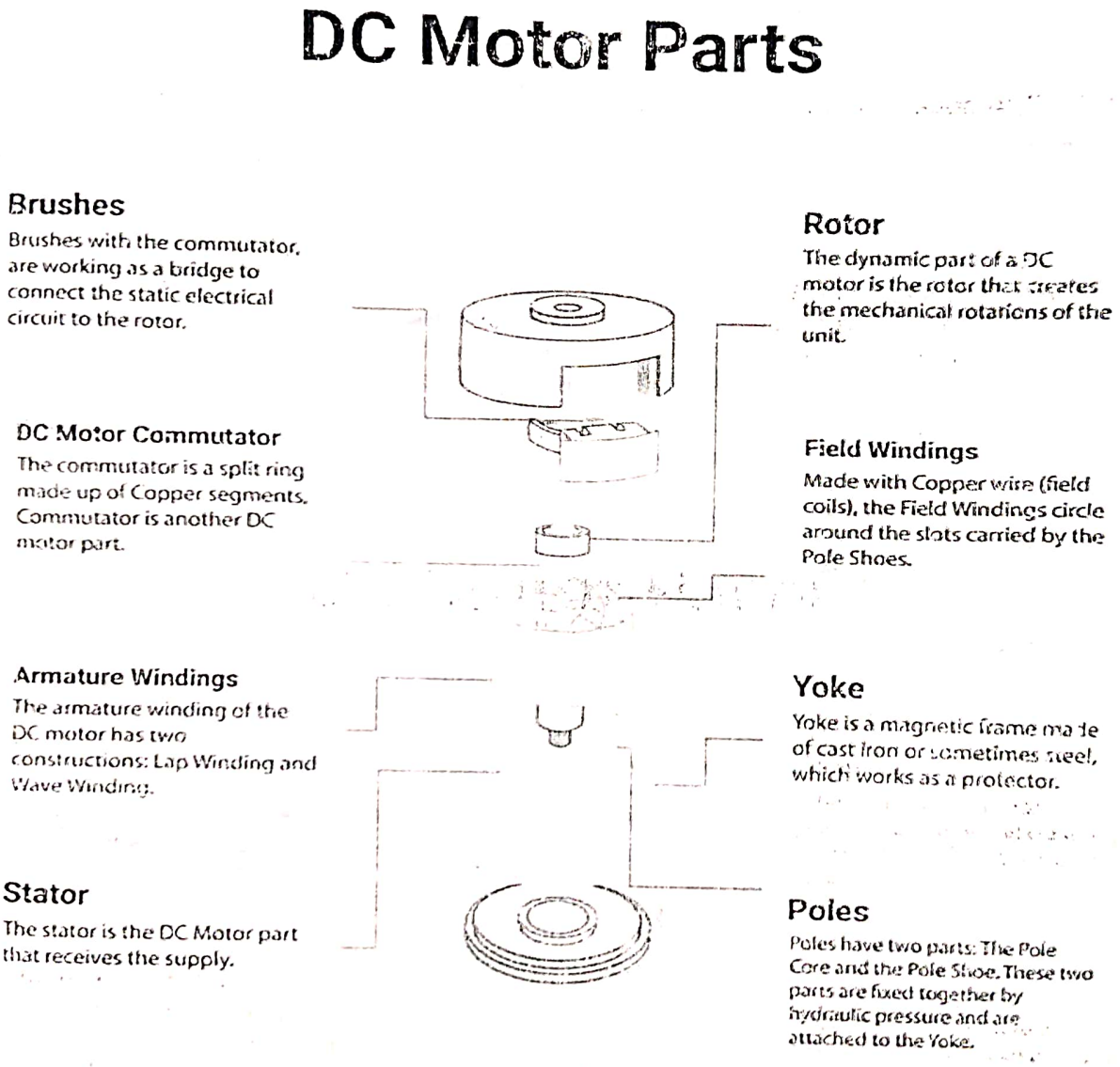


Fig 1: Different Parts Of DC Motor

Some of the most popular designs for DC motors are Permanent magnet, Brushless, Shunt, Series, and Compound wound or stabilized shunt. The DC motor parts are normally the same within these different designs and the overall operation is similar. How it operates is that a conductor, carrying the current is implanted in a magnetic field, and the power applied through the conductors enables the rotation of the motor. The generation of electromagnetic fields and its place, whether in the rotor or stator is the reason these designs differ from each other. As getting acquainted and understanding the diverse types of direct current motors will aid you to figure 2.how they are used for different applications and which one is more suitable for your application, in what follows, we will elaborate the function of some of these types.

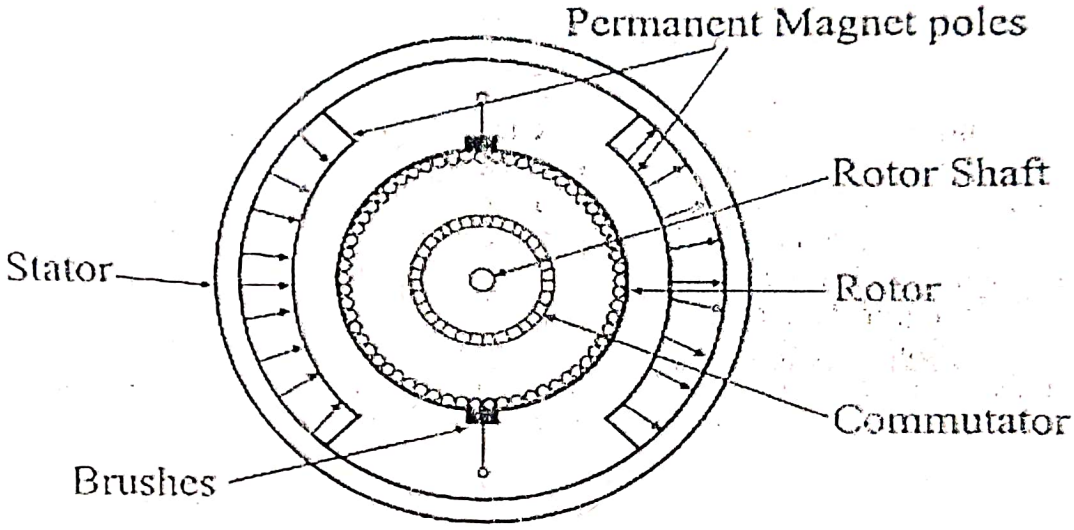


Fig 2: Different Types Of DC Motor

1. **Permanent Magnet Motors**
   Permanent Magnet Motors (also known as a PMDC motor) apply a permanent magnet to make a field flux. This type of DC motors creates a great starting torque with a good speed regulation. With limited torque it has, permanent magnet type typically is used on low horsepower applications.
2. **Shunt Motors**
   the field of shunt type is connected in parallel with the armature windings. As the shunt field can excited separately from the armature windings, this type of motors provides a great speed regulation. Besides, shunt motors also offer simplified reversing controls.
3. **Series Motors**
   A series DC motor consists of a field wound with some turns of a wire which carries the current of armature. Like permanent motors, series motors create a large amount

of starting torque. In comparison with permanent motors, series type can't regulate speed. In addition, if series motors run with no load, they can be damaged. These limitations make series motors unsuitable for variable speed drive applications.

4. **Compound Motors**

Like shunt DC motors, compound motors possess a shunt field which is separately excited. Just like permanent and series motors, compound motors enjoy good starting torque with some problems in speed regulation in variable speed drive applications.

These four main types of DC motors have the numerous potential applications Each type of these motors possesses its strengths and weaknesses. As mention in the beginning of this section, getting acquainted with different types can assist you figure out which type is more suitable for your applications.

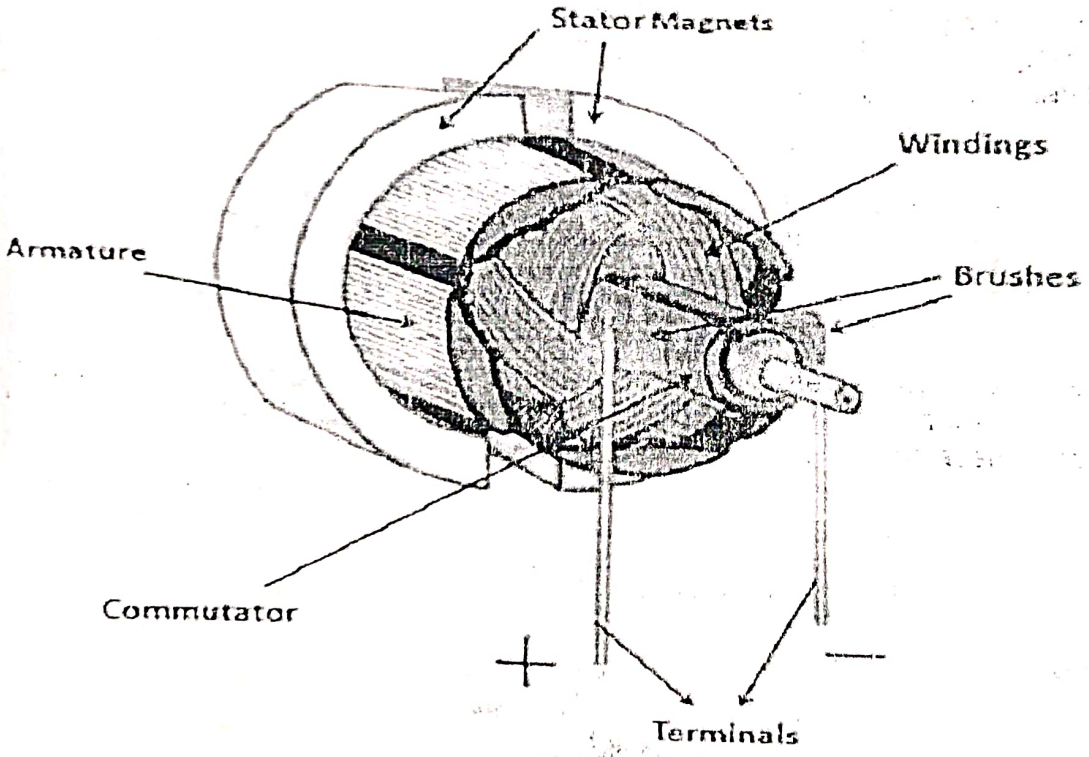


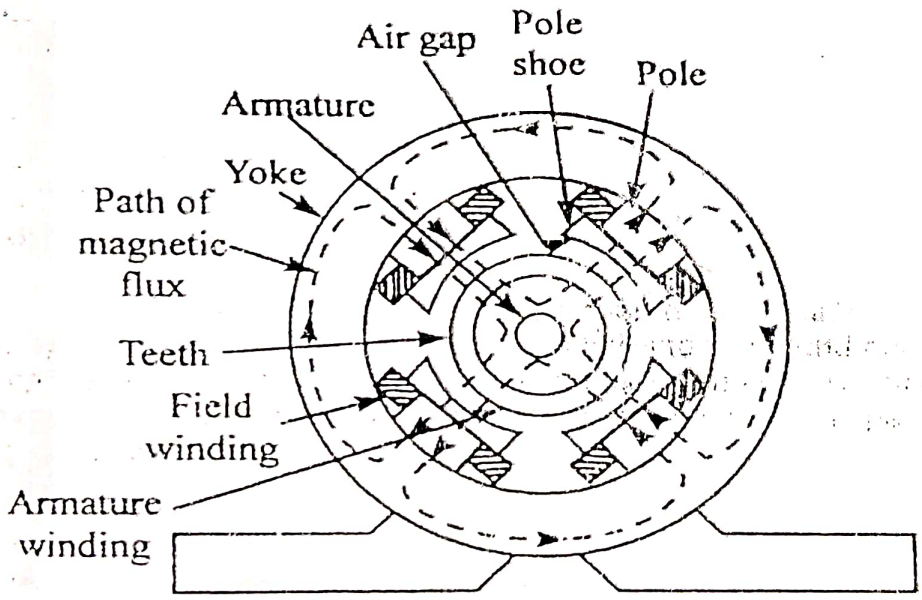
Fig 3: Internal Diagram Of DC Motor

What are DC Motor Parts and how they work

8 Parts of DC Motor are:

- Stator
- Rotor
- Yoke
- Poles
- Field Windings
- Armature Windings
- DC Motor Commutator
- Brushes

A DC motor contains different parts that understanding each one can assist to know deeply these parts cooperate with each other and in the end how DCs work. These components are: a stator, a rotor, a yoke, poles, armature windings, field windings, commutator, and brushes. Many of its parts are the same as parts of AC motor, but with a little change.



Construction of D.C. Motor

1. Stator

A stator is one of the DC motor parts that is, as the name suggests, a static unit containing the field windings. The stator is the DC Motor part that receives the supply.

2. Rotor

The dynamic part of a DC motor is the rotor that creates the mechanical rotations of the unit.

3. Yoke

Another unit of the DC motor parts is the Yoke. A Yoke is a magnetic frame made of cast iron or sometimes steel, which works as a protector. This protective cover keeps the inner parts of the motor safe and sound and also supports the armature. Yoke also houses the magnetic poles and field windings of a DC motor to help supporting the field system.

4. Poles

DC motor has magnetic poles that fit into the inner wall of the Yoke with the help of screws to tighten them up. Poles have two parts: The Pole Core and the Pole Shoe. These two parts are fixed together by hydraulic pressure and are attached to the Yoke. Each part of the Poles has a specific task based on its design. The core holds the Pole Shoe over the Yoke while the Pole Shoe is structured to both carry slots for the field winding and spread the produced flux by the field windings into the air gap between the rotor and stator. It helps to reduce the loss caused by reluctance.

5. Field Windings

Made with Copper wire (field coils), the Field Windings circle around the slots carried by the Pole Shoes. The field windings form an electromagnet capable of producing field flux. The rotor armature rotates inside the field flux, resulting in the effective flux cutting.

6. Armature Windings

Another DC motor parts is armature winding. The armature winding of the DC motor has two constructions: Lap Winding and Wave Winding. Their difference is in the number of parallel paths. Armature Winding is attached to the rotor and alters the magnetic field in the path that it rotates. The result of this procedure is magnetic losses. Designers try to reduce the magnetic losses by making the armature core with some low-hysteresis silicon steel lamination. Then, the laminated steel sheets will be piled up together,

creating the cylindrical structure of the armature core. There are slots designed inside the armature core with the same material.

7. DC Motor Commutator

The commutator is a split ring made up of Copper segments, Commutator is another DC motor part. The operating system of a DCs is based on the interaction of the two magnetic fields of rotating armature and a fixed stator. As the north pole of the armature is attracted to the south pole of the stator and south pole of armature is attracted to the north pole of the stator, a force is produced on the armature which makes it to turn. the process in which the field in the armature windings is switched to produce constant torque in one direction is called Commutation. the commutator is a device connected to the armature enabling this switching of current. Different segments of its cylindrical structure are insulated from each other by Mica. The commutator is designed to commute the supply current to the armature winding from the mains. The commutator passes through the brushes of the DC motor.

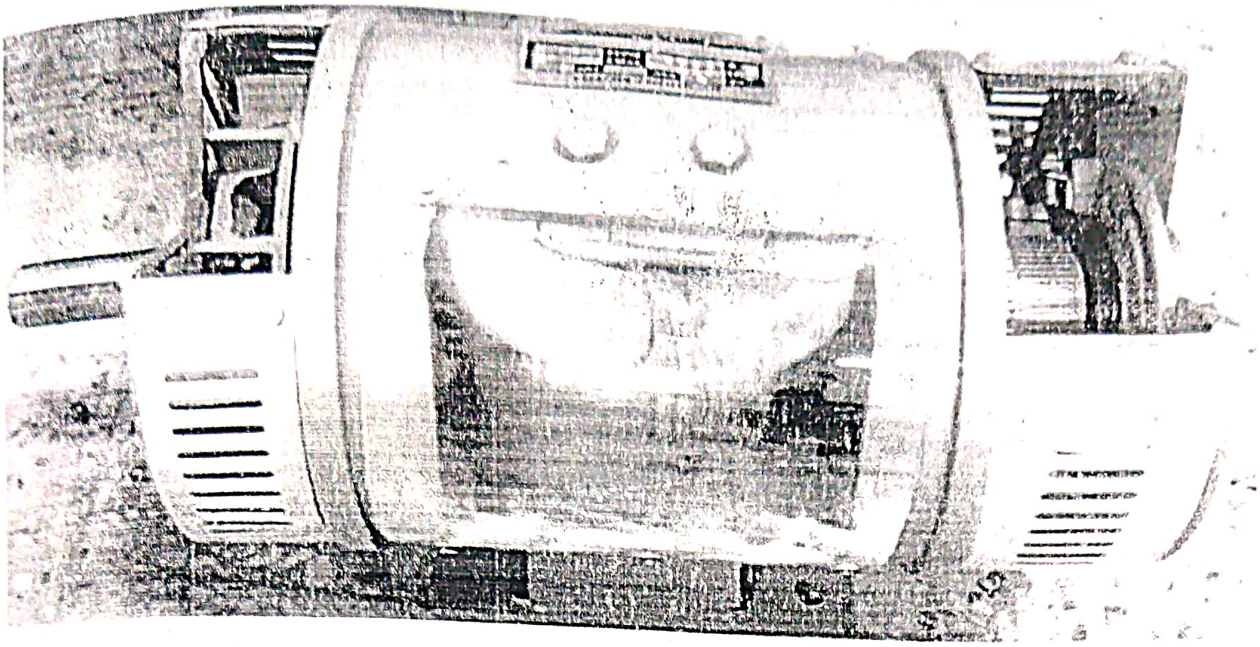
The basic purpose of commutation is to certify that the torque acting on the armature is always in the same direction. Naturally, the generated voltage in the armature is alternating, the commutator converts it to the direct current. To control the direction the electromagnetic fields are pointing to, the commutator turns the coils on and off. On one side of the coil, the electricity should always flow away, and on the other side, electricity should always flow towards. This ensures that the torque is always produced in the same direction.

8. Brushes

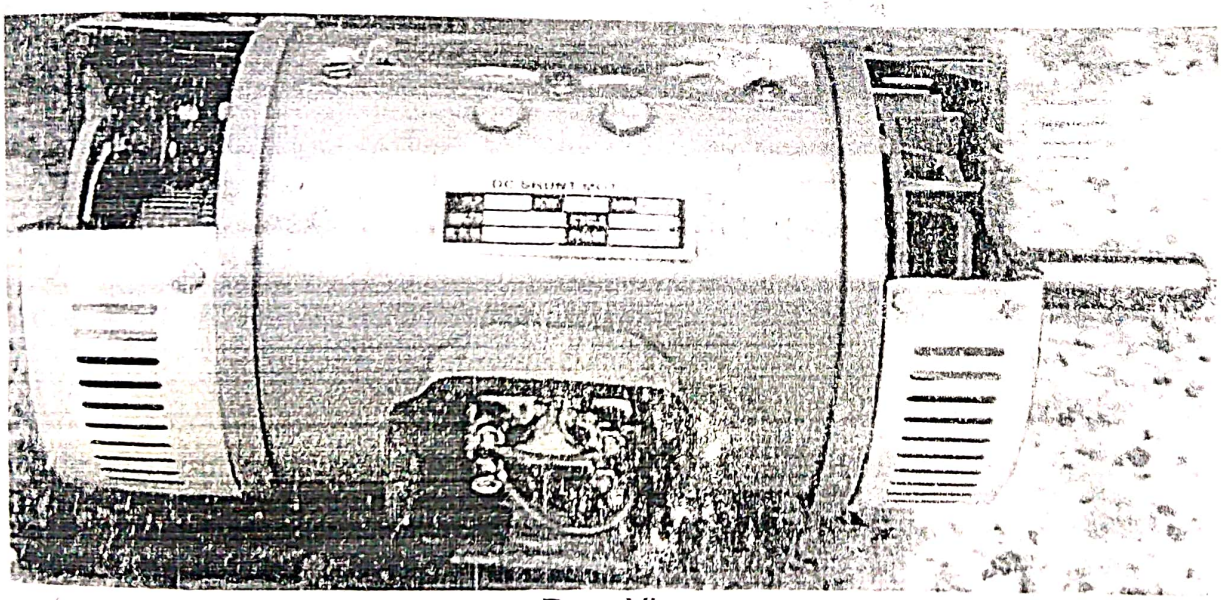
The last item on the DC motor parts list is Brushes that are made of Carbon or Graphite structures. Brushes with the commutator, are working as a bridge to connect the static electrical circuit to the rotor. Brushes are in contact with the commutator and relay the produced current to the commutator from an external circuit. The current then moves into the armature winding.

What is the Mechanism Through Which a DC Motor Generates Torque?

A rotating magnetic field can be created by sequentially turning on and off coils. There are a number of moving magnets (permanent or electromagnets) that interact with these revolving magnetic fields to produce a torque on the armature, which causes it to revolve.



Front View



Rear View