Construction of Practical DC Machine

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CONSTRUCTION OF DC MACHINE:

Both dc generator and motor need the following for their operation:

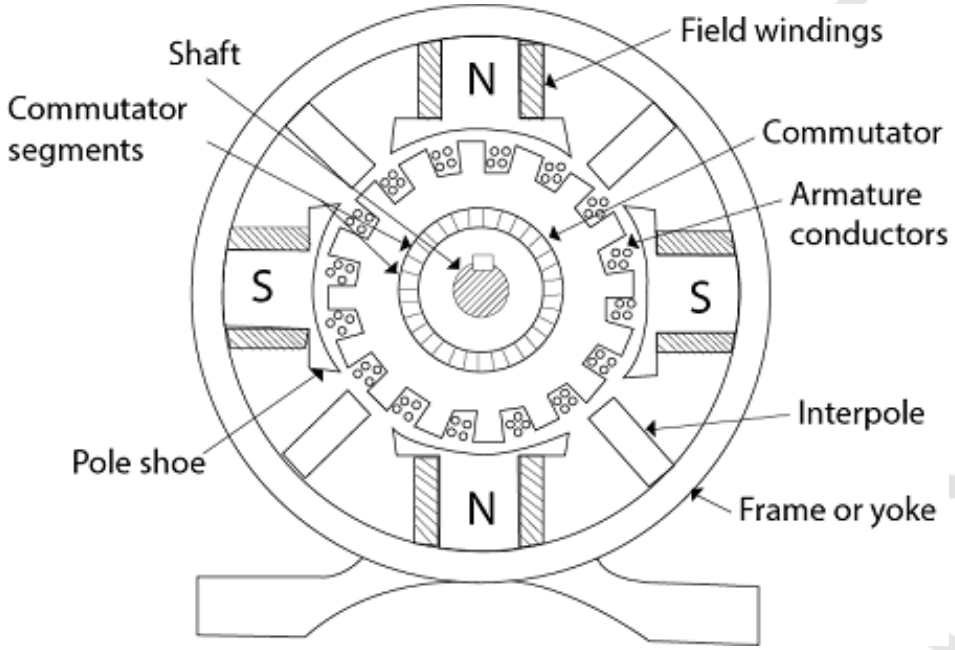
Armature: It consist of number of conductors placed in armature slots and connected so as to form a closed winding (armature winding). It is the rotating part of the machine.

Field system: It is the stationary part of machine and its function is to produce magnetic field. In practical generators, electromagnetic poles are used. Advantages of using electromagnets in dc machine are:

- Better field strength
- Better control of field strength by controlling the field current
- Better control of output voltage in generator and speed in motor

Commutator: It consists of a large number of commutator segments which are properly insulated from each other. Each commutator segment is connected to one armature coil. The function of commutator is to convert an ac wave in the armature winding to a dc wave at terminals of dc generator, whereas in case of dc motor, it inverts the dc input wave to an ac wave in the armature winding.

GENERAL ARRANGEMENT OF A DC MACHINE :



Armature: It is of cylindrical shape and rotating in the space between the magnetic poles. It consists of: (a) armature slots (b) Teeth (c) armature core (d) armature winding in the slots.

Main field poles: Stationary part of the machine, consisting of: (a) pole core (b) pole shoe (c) field winding.

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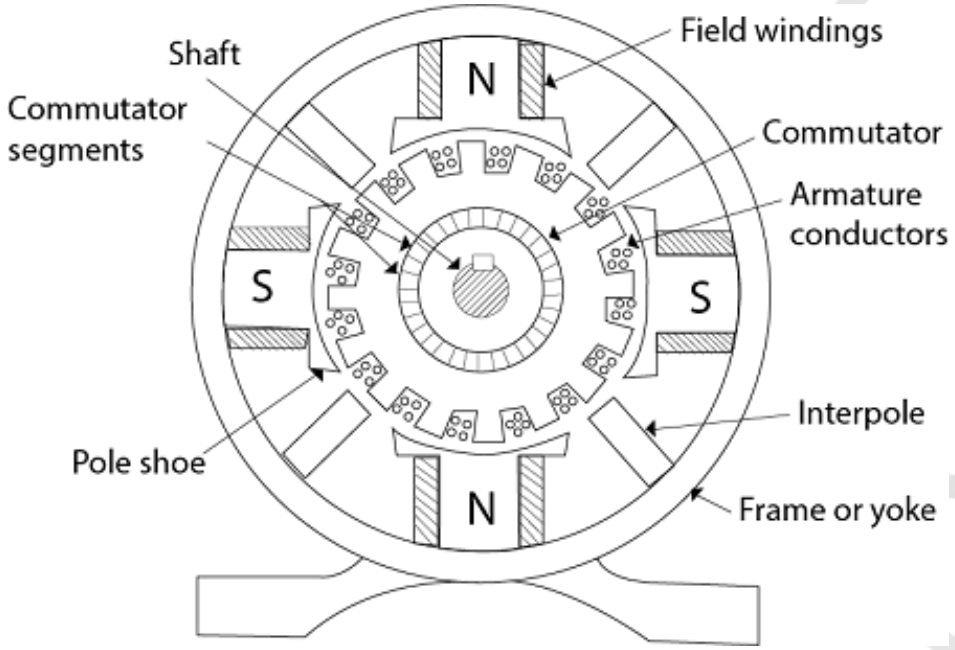
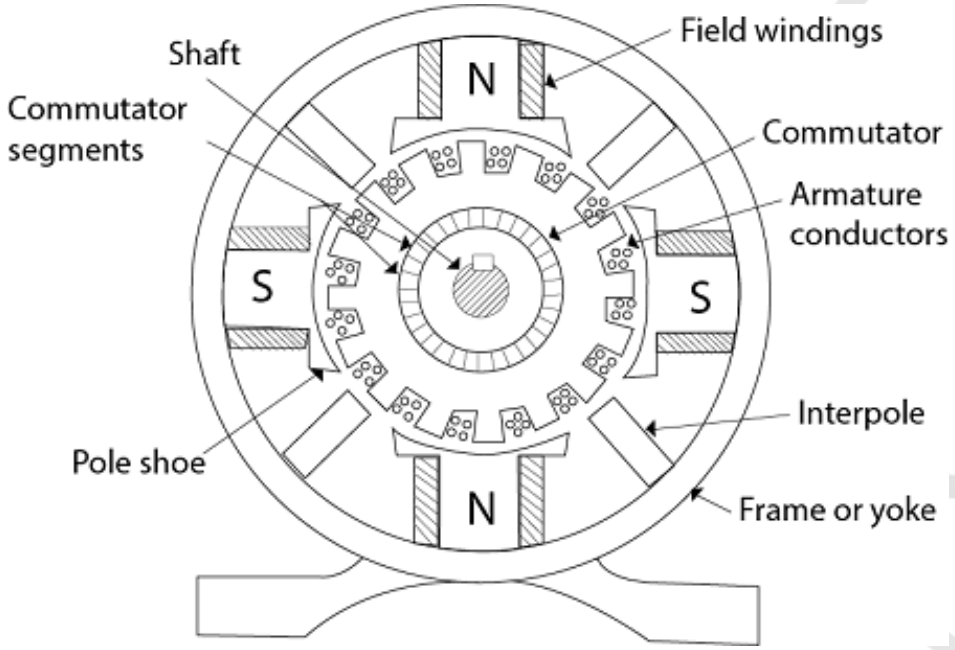


Commutating poles or inter poles: These are arranged midway between the main poles to ensure sparkless operation at the brushes under loaded operating conditions.

Yoke: Serves as mechanical support and provides the path for magnetic flux.

Commutator: It rotates with armature and rectifies the alternating emf induced in the armature coils.

GENERAL ARRANGEMENT OF A DC MACHINE :



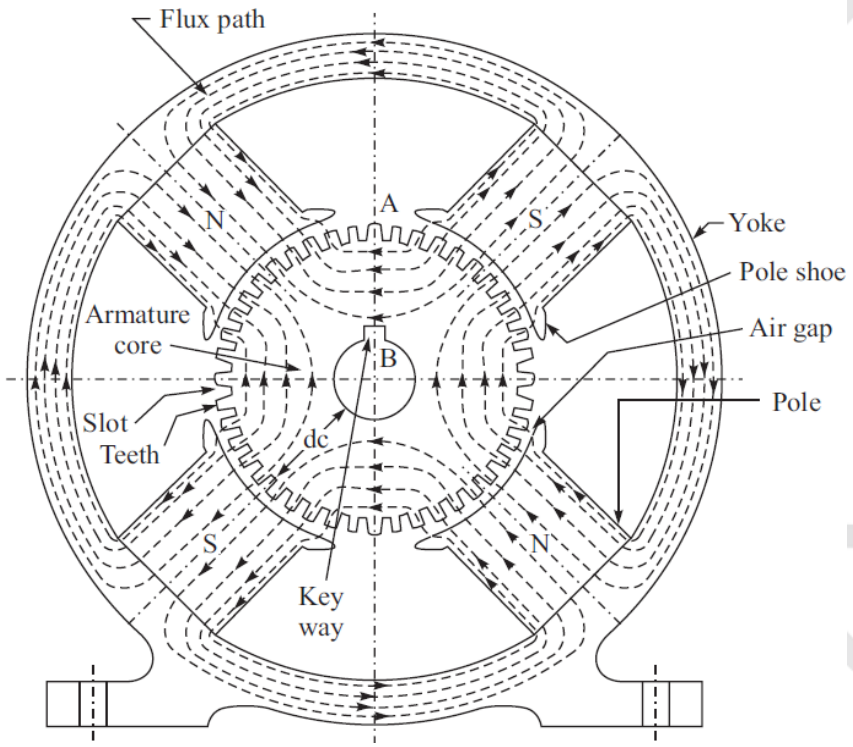
Brushes: Brushes are stationary and their function is to collect the current from the rotating commutator in case of generator and to lead the current to it in case of motor.

Brush holders: To accommodate the brushes.

Bearings: To support the rotating parts and to reduce friction.

Cooling arrangement: To keep the temperature rise within permissible limits.

YOKE :

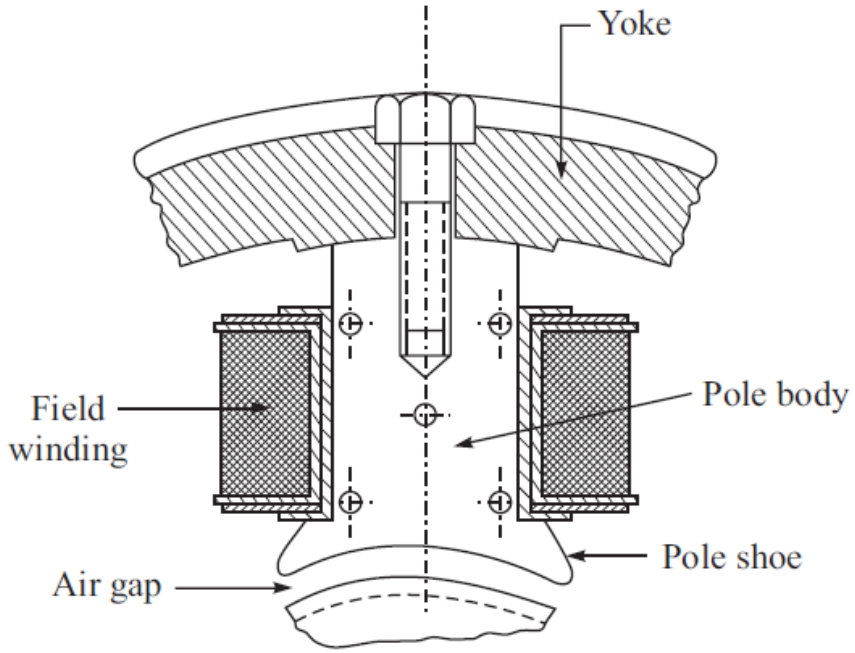


The function of outer frame or yoke is:

- To provide mechanical support for the poles.
- To act as a protecting cover for the whole machine.
- To provide a path for magnetic flux produced by poles.

In small machines, yoke is made up of cast iron. But for large machines usually cast steel or rolled steel is used.

FIELD POLES:



The field magnet consists of a pole core and pole shoe.

The function of pole shoe is:

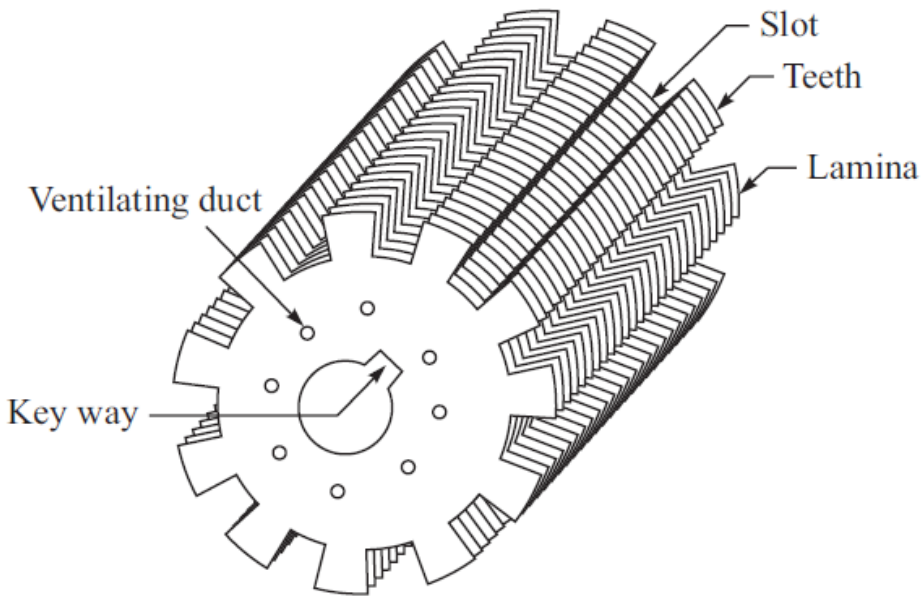
- To support the field coil.
- To spread out the flux in the air gap.
- To reduce the reluctance of magnetic path by increasing the area of cross-section.

Even number of poles are bolted to the yoke.

Pole core is made from laminations of sheet steel, insulated from each other, and rivetted together.

For small machines, field coils are wound with enameled copper wire or strip. Double cotton covered copper wire is used for large machines.

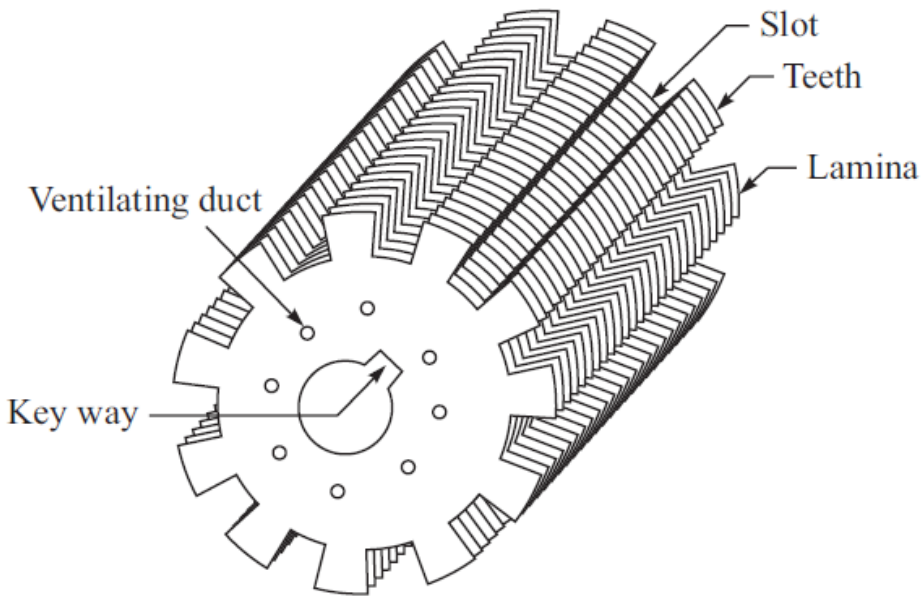
ARMATURE:



It is of cylindrical shape, consisting of armature slots, teeth, armature winding and armature core. It is the rotating part of the machine and mounted on the shaft.
It is made up of thin laminations, insulated from one another by a thin layer of varnish. The armature is normally built up of 0.4 to 0.5 mm dynamo steel or silicon steel laminations.

In case of small armatures (diameter up to 100 cm), the laminations are in the form of one complete disc and are directly keyed to the shaft. In case of larger armatures, number of segments are used to built the core. Ventilating ducts are provided in the core to improve the cooling.

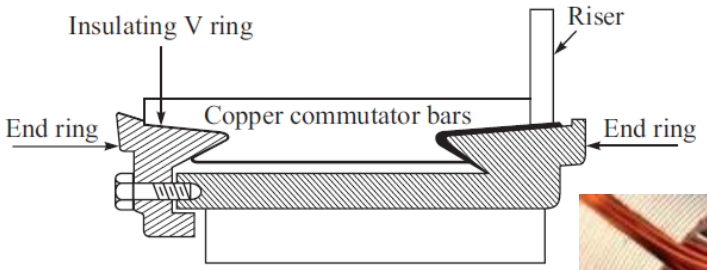
ARMATURE:



The slots in armature are rectangular in shape in which armature winding is placed. The armature winding is made up of enameled copper wire in case of small machines and cotton covered copper wire in case of large machines. It is insulated from core by using insulating materials like press board, fiber, mica cloth etc.

The coils are held in the slots by inserting properly shaped wooden or fiber wedges in the upper portion of the slot.

COMMUTATOR:



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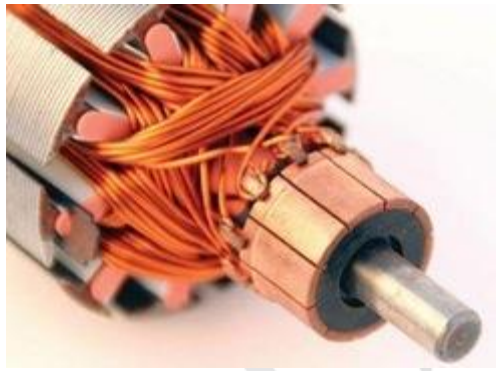
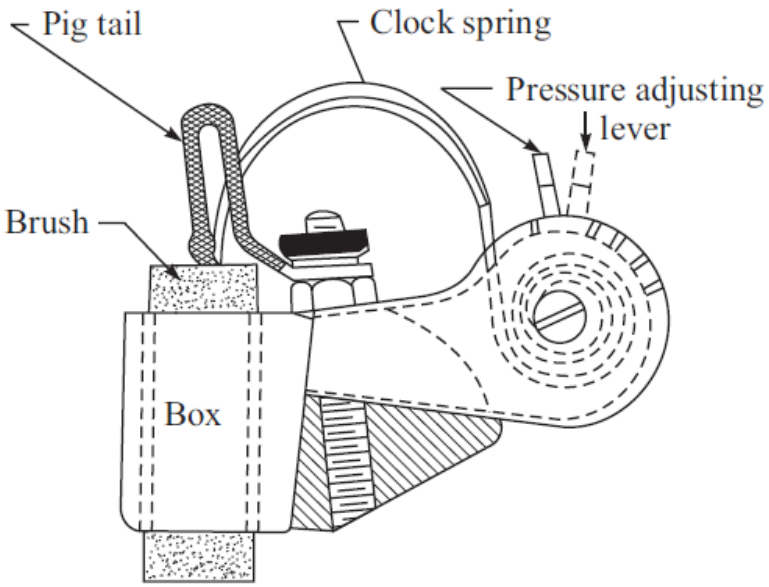


It is built up of a number of wedge-shaped segments made up of high conductivity hard drawn copper. These segments are insulated from each other by mica of about 0.8 mm thickness. The number of segments is equal to the number of armature coils.

Each commutator segment is connected to the armature conductor by means of a copper lug or strip called as riser. The segments have 'V' grooves to prevent them from flying out under the action of centrifugal force.

BRUSH AND BRUSH HOLDER:



Function of brushes is to collect the current from rotating commutator in case of a generator and to inject the current in to the rotating armature in case of a motor.
The brushes are made of carbon or graphite. They possess high electrical conductivity, reduce friction and excessive wear. They are softer than the commutator segments. Therefore, the commutator surface experiences very little wear.

If they are too soft, they have to be replaced frequently and if they are too hard, the commutator surface will wear excessively.
Brushes are placed in the brush holder where a spring presses it against the commutator. Spring pressure can be adjusted with the help of pressure adjusting lever.

BEARINGS AND AIR GAP:

Bearings: Their function is to support the rotating parts and to allow its smooth motion with minimum friction. In small machines, normally, ball bearings are used. For medium size machines, roller bearings can be used. The ball and rollers are generally packed in hard oil for smooth and noiseless operation.

Air Gap: The rotor rotates in the space provided by the stator. This space is called air gap. It provides high reluctance path to magnetic flux. Hence, it is always desirable to make it as small as possible. The armature and field poles are required to be accurately positioned to avoid unsymmetrical air gap.

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