Electrical Machines

1- D.C. Machines

2- Transformers

References

1- Electrical technology: Hughes
2- Electrical technology: Gupta
3- Principles of electrical machines: V.K. Mehta
4- Electrical machines and their applications: John Hindmarsh

D.C. Machines

Introduction:

Although a far greater percentage of the electrical machines in services are A.C. machines, the D.C. machines are of considerable industrial importance. The principle advantage of the D.C. machine, particularly the D.C. motor, is that it provides a fine control of speed such an advantage is not claimed by any A.C. motor. However, D.C. generators are not as common as they used to be, because direct current, when required, is mainly obtained from an A.C. supply by the use of rectifiers. Nevertheless, an understanding of D.C. generator is important because it represents a logical introduction to the behavior of D.C. motors.

Construction of D.C. machines:

The D.C. generators and D.C. motors have the same general construction. Any D.C. generator can be run as a D.C. motor and vise-versa. All D.C. machines have five principle components as shown in figure.1.

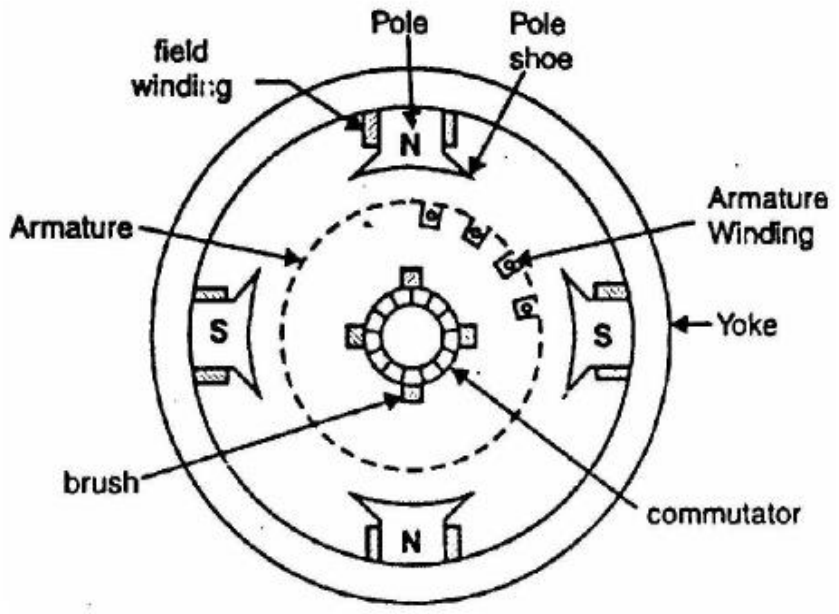

Fig-1-

1- Field system; the function of the field system is to produce uniform magnetic field within which the armature rotates. It consists of a number of salient poles (of course, even number) bolted to the inside of circular frame (generally called yoke). The yoke is usually made of solid cast steel whereas the pole pieces are composed of laminations. Field coils are mounted on the pole and carry the D.C. exciting current. The field coils are connected in such a way that adjacent poles have opposite polarity. The m.m.f. developed by the field coils produces a magnetic flux that passes through the pole pieces, the airgap, the armature and the frame as shown in Figure.2. Practical D.C. machines have air gap ranging from 0.5mm to 1.5mm.

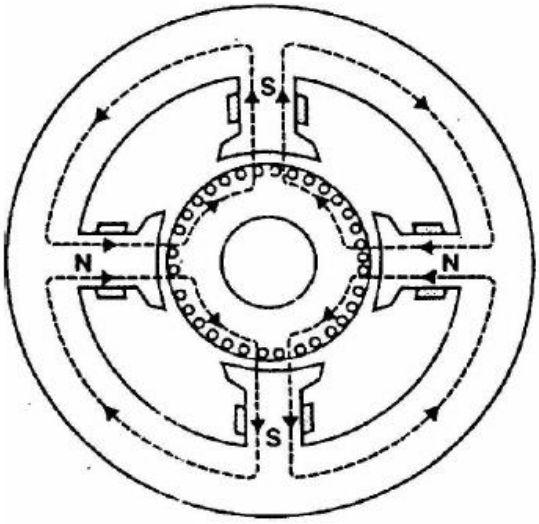

Fig-2-

2- Armature core: the armature core is keyed to the machine shaft and rotates between the field poles. It consists of slotted soft-iron laminations (about o.4 to 0.6 mm thick) that are stacked to form a cylindrical core as shown in figure.3.

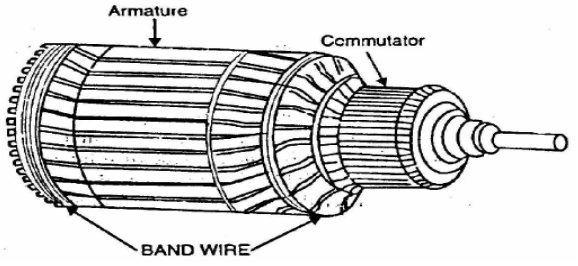

Fig-3-

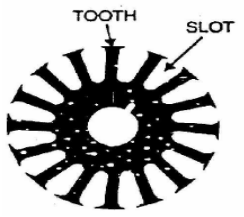

Fig-4-

The laminations are individually coated with a thin insulating film so that they do not come in electrical contact with each other as shown in figure.4. The purposes of laminating the core is to reduce the eddy current loss. The laminations are slotted to accommodate and provide mechanical security to the armature winding and to give shorter air-gap for the flux to cross between the pole face and the armature "teeth".

3- Armature winding: The slots of the armature core hold insulated conductors that are connected in a suitable manner. This is known as armature conductors or armature winding. The armature windings of a D.C. machine is closed-circuit winding.

4- Commutator: A commutator is a mechanical rectifier which converts the alternating voltage generated in the armature winding into direct voltage across the brushes. The commutator is made of copper segments insulated from each other by mica sheets and mounted on the shaft of the machine, as shown in figure.5. The armature conductors are soldered to the commutator segments in a suitable manner to give rise to the armature winding.

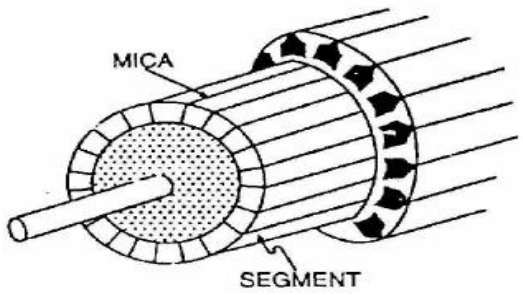

Fig-5-

5- Brushes: The purpose of brushes is to ensure electrical connections between the rotating commutator and stationary external circuit. The brushes are made of carbon and rest is adjusted by means of adjustable springs.