4.1 Construction of Induction Machine

Construction of Stator

The stator is built up of high-grade alloy steel laminations to reduce eddy current losses. It has three main parts, namely outer frame, the stator core and a stator winding.

Outer frame

It is the outer body of the motor. Its main function is to support the stator core and to protect the inner parts of the machine. For small machines, the outer frame is casted, but for the large machine, it is fabricated. The figure below shows the stator construction.

Stator Core

The stator core is built of high-grade silicon steel stampings. Its main function is to carry the alternating magnetic field which produces hysteresis and eddy current losses. The stampings are fixed to the stator frame. Each stamping are insulated from the other with a thin varnish layer. The thickness of the stamping usually varies from 0.3 to 0.5 mm. Slots are punched on the inner side of the stampings as shown in the figure below.

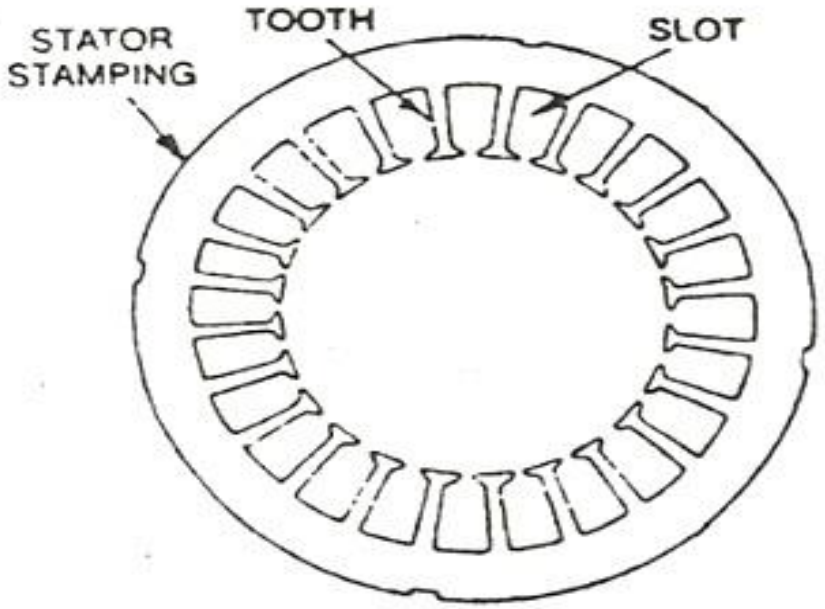

Figure 4.1.1 Stator stamping

[Source: "A Course in Electrical Machine Design" by A.K.Sawhney, page-10.1]

Stator windings

The core of the stator carries three phase windings which are usually supplied from a three-phase supply system. The six terminals of the windings (two of each phase) are connected in the terminal box of the machine. The stator of the motor is wound for a definite number of poles, depending on the speed of the motor. If the number of poles is greater, the speed of the motor will be less and if the number of poles is less than the speed will be high.As the relationship between the speed and the pole of the motor is given as

$$N_s = \frac{120f}{p}$$

Construction of Rotor

The rotor is also built of thin laminations of the same material as the stator. The laminated cylindrical core is mounted directly on the shaft. These laminations are slotted on the outer side to receive the conductors. There are two types of rotor.

Squirrel Cage Rotor

A squirrel cage rotor consists of a laminated cylindrical core. The circular slots at the outer periphery are semi-closed. Each slot contains uninsulated bar conductor of aluminum or copper. At the end of the rotor the conductors the short-circuited by a heavy ring of copper or aluminum. The diagram of the cage rotor is shown below.

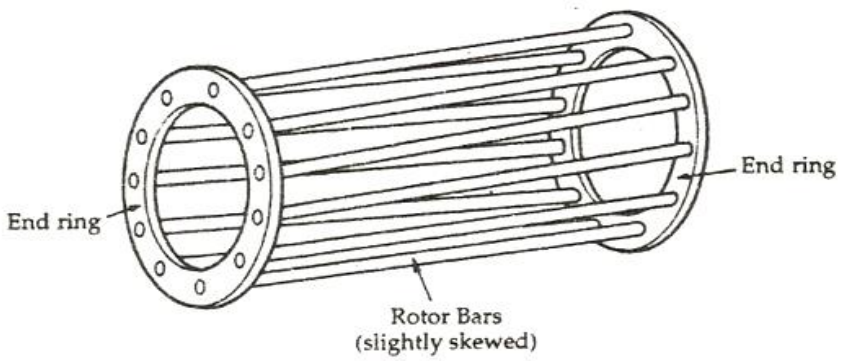

Figure 4.1.2 Squirrel cage rotor

[Source: "A Course in Electrical Machine Design" by A.K.Sawhney, page-10.2]

The rotor slots are usually not parallel to the shaft but are skewed. The skewing of the rotor conductors has the following advantages given below.

- It reduces humming and provide smooth and noise free operation.
- It results in a uniform torque curve for different positions of the rotor.
- The locking tendency of the rotor is reduced. As the teeth of the rotor and the stator attract each other and lock.
- It increases the rotor resistance due to the increased length of the rotor bar conductors.

Advantages of Squirrel Cage Rotor

The following advantages of the cage rotor are given below.

- The cage rotor is cheaper, and the construction is robust.
- The absence of the brushes reduces the risk of sparking.
- Its Maintenance is less.
- The power factor is higher
- The efficiency of the cage rotor is higher.

Phase Wound Rotor

The Phase wound rotor is also called as Slip Ring Rotor. It consists of a cylindrical core which is laminated. The outer periphery of the rotor has a semi-closed slot which carries a 3 phase insulated windings. The rotor windings are connected in star.The slip ring induction motor is shown in the figure below.

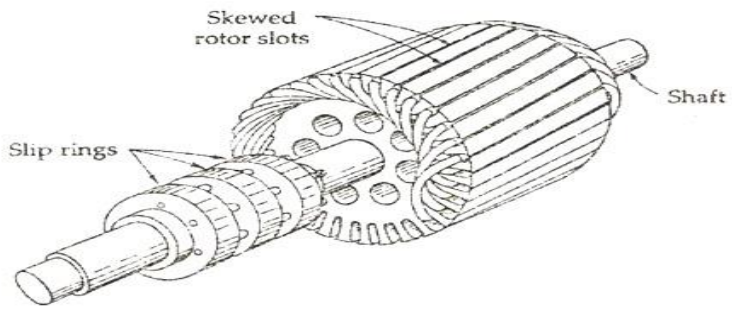

Figure 4.1.3 Slip-ring rotor

[Source: "A Course in Electrical Machine Design" by A.K.Sawhney, page-10.2]

The slip rings are mounted on the shaft with brushes resting on them. The brushes are connected to the variable resistor. The function of the slip rings and the brushes is to provide a means of connecting external resistors in the rotor circuit. The resistor enables the variation of each rotor phase resistance to serve the following purposes given below.

- It increases the starting torque and decreases the starting current.
- It is used to control the speed of the motor.

In this type also, the rotor is skewed. A mild steel shaft is passed through the center of the rotor and is fixed to it. The purpose of the shaft is to transfer mechanical power.