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Aim: Study about the construction and principle of induction motor and synchronous generator.

Theory:

Induction Motor:

The most common type of AC motor being used throughout the work today is the "Induction Motor". Applications of three-phase induction motors of size varying from half a kilowatt to thousands of kilowatts are numerous. They are found everywhere from a small workshop to a large manufacturing industry.

The advantages of three phase AC induction motor are listed below.

- Simple design
- Rugged construction
- Reliable operation
- Low initial cost
- Easy operation and simple maintenance
- High simple control gear for starting and speed control.
- High effeciency.

Types and Construction of Three phase Induction motor

Three phase induction motors are constructed into

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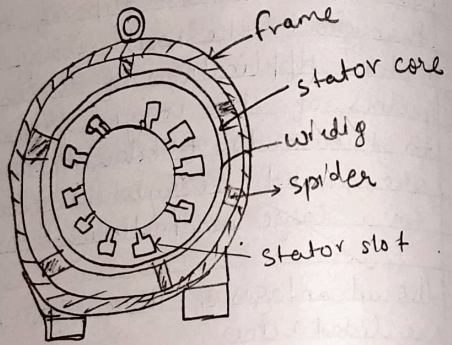

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two major types:
1. Squirrel cage Induction Motors
2. Slip ring Induction Motors

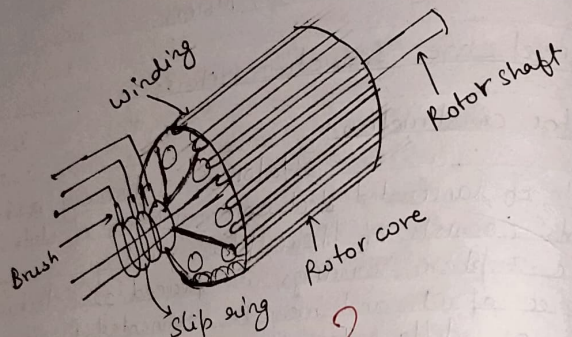
Squirrel cage Induction Motors

Stator construction

- Stator is stationary part.
- Made of laminated steel core with no. of slots
- Slots consists of three phase winding.
- The 3 phase windings are placed 120 electrical degree apart and may be connected in either star or delta externally.
- When the stator is energized from a three phase voltage it will produce a rotating magnetic field in the stator core.

Rotor Construction

- It has a cylindrical core constructed of steel laminations with no of slots.
- In slot copper conductor bars mounted.
- Conductor bars are short circuited by an end rings at both end of the rotor core



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Slip ring Induction Motors:-

Stator Construction:

The construction of the slip ring induction motor is exactly similar to the construction of squirrel cage induction motor. There is no difference between squirrel cage and slip ring motors.

Rotor Construction:

- The rotor of the slip ring induction motor is also cylindrical or constructed of lamination.
- Slip ring motors having "three windings" connected in star.
- The winding is made of copper wire
- The terminals of the rotor windings of the slip ring motors are brought out through slip rings which are in contact with stationary brushes.

Working Principle of Induction Motor

When the three phase supply is given to the stator, the rotating magnetic field produced and set up in the stator. The conductors of the rotor and stationary. This stationary conductor cut the rotating magnetic field of the stator

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and because of the electromagnetic induction, the EMF induces in the rotor.
The conductors of the rotor are short-circuited either by the end rings or by the help of the external resistance. The relative motion between the rotating magnetic field and the rotor conductor induces the current in the rotor conductors.
The direction of induced rotor current, according to lenz's law, is such that it will tend to oppose the cause of its production

As the cause of production of rotor current is the relative velocity between rotating stator flux and the rotor, the rotor will try to catch up with the stator RMF. Thus the rotor rotates in the same direction as that of stator flux to minimize the relative velocity. However, the rotor never succeeds in catching up the synchronous speed.
The speed of the rotor is always less than the rotating magnetic field or synchronous speed. The rotor tries to the run at the speed of the rotor, but it always slip away. Thus, the motor never runs at the speed of the rotating magnetic field, and this is the

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reason because of which the induction motor is also known as the asynchronous motor.

Synchronous speed :-

The rotational speed of the rotating magnetic field is called as synchronous speed.

Synchronous speed $N_s = 120f/P$

where, f = frequency of the supply

P = number of Poles

Slip :-

The difference between the synchronous speed (N_s) and actual speed (N) of the rotor is called as slip

$$\% \text{ slip } S = \frac{N_s - N}{N_s} \times 100$$

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Viva - Questions

Q.1. What is an Electric Motor?
Ans. An electric motor converts electrical energy into mechanical energy. The motor drives the mechanical load.

Q.2. Who invented Induction Motor?
Ans. Nikola Tesla invented the induction motor.

Q.3. What is an Induction Motor?
Ans. The induction motor has a stator and rotor as two major parts. The stator produces a magnetic field that links to the rotor conductor. The interaction of the flux and the rotor current produces torque in the motor.

Q.4. Why is the speed of the rotor and the speed of the synchronous speed different in an induction motor?
Ans. The synchronous speed is the speed of a rotating magnetic field. The rotor of the motor cannot rotate at a synchronous speed because of Copper loss in the rotor. If the

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speed of the rotor is equal to synchronous speed, the motor produces no torque because the emf induced in the rotor is zero. Therefore, the motoring operation is possible if the rotor speed is less than the synchronous speed.

Q.5. What is the synchronous speed of an induction motor?

Ans: When we feed a three-phase supply to the stator, a rotating magnetic field is produced. The speed at which the magnetic field rotates in the air gap of the motor is the synchronous speed of the motor. The synchronous speed depends on:

Number of poles
frequency of the supply voltage

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

Q.6 Why AC generator is called Alternator?

Ans: An alternator is such a machine which produces alternation electricity.

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Q.7. Why Alternator is called Synchronous generator?

Ans: Because it rotates at a constant (i.e. synchronous speed) no matter what the load on alternator is.

Q.8. How are alternators classified?

Ans: According to shape of field system
- Salient pole type
- Smooth cylindrical type

Q.9. Why is the stator core of Alternator laminated?

Ans: The stator core of Alternator is laminated to reduce eddy current loss.

Q.10. What are the essential features of Synchronous machine?

Ans: i) The rotor speed is Synchronous with stator rotating field.
(ii) Varying its field current can easily vary the speed.
(ii) It is used for constant speed operation.

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