Single phase induction motor

Single phase induction motors generally have a construction similar to that of a three phase motor: **an ac windings is placed on the stator, short-circuited conductors are placed in a cylindrical rotor**.

What is an Induction Motor?

An **induction motor** (also known as an **asynchronous motor**) is a commonly used AC electric motor. In an induction motor, the electric current in the rotor needed to produce torque is obtained via electromagnetic induction from the rotating magnetic field of the stator winding. The rotor of an induction motor can be a squirrel cage rotor or wound type rotor.

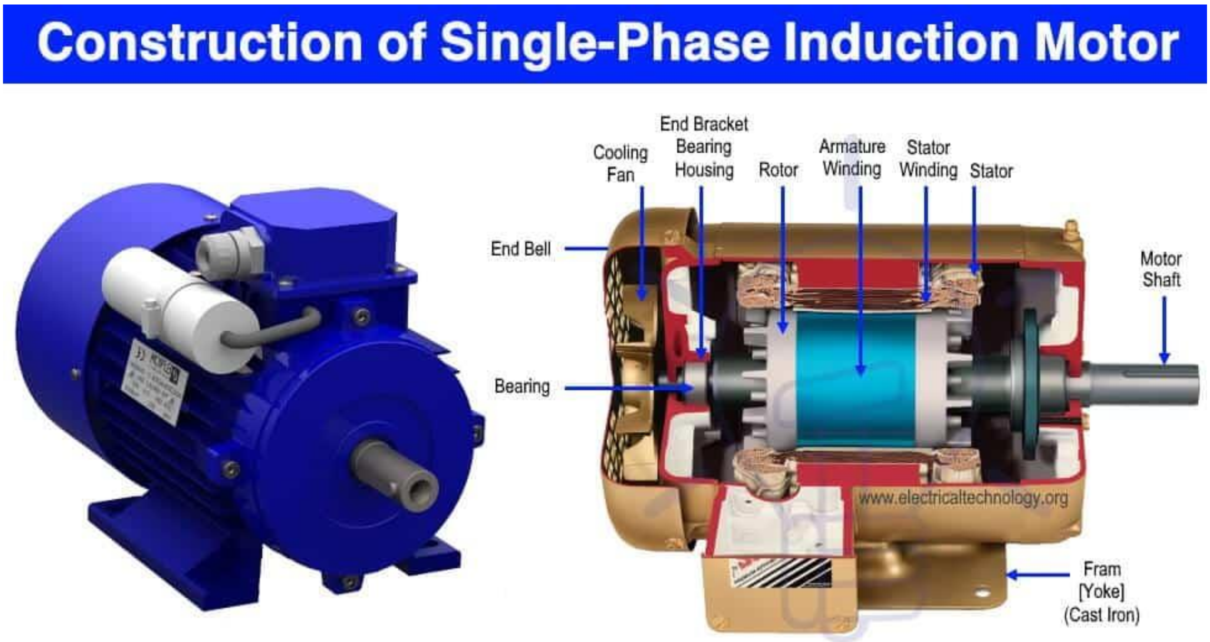
Single-Phase Induction Motor – Construction, Operation & Types of 1-Phase Induction Motors

The single-phase motors are more preferred over a three-phase induction motor for domestic, commercial applications. Because form utility, only single-phase supply is available. So, in this type of application, the three-phase induction motor cannot be used.

Construction of Single-Phase Induction Motor

A single phase induction motor is similar to the three phase squirrel cage induction motor except there is single phase two windings (instead of one three phase winding in 3-phase motors) mounted on the stator and the cage winding rotor is placed inside the stator which freely rotates with the help of mounted bearings on the motor shaft.

The construction of a single-phase induction motor is similar to the construction of a three-phase induction motor.



Similar to a three-phase induction motor, single-phase induction motor also has two main parts;

- Stator
- Rotor

Stator

In stator, the only difference is in the stator winding. The stator winding is single-phase winding instead of three-phase winding. The stator core is the same as the core of the three-phase induction motor.

In a single-phase induction motor, there are two winding are used in stator except in shaded-pole induction motor. Out of these two windings, one winding is the main winding and the second is auxiliary winding.

The stator core is laminated to reduce the eddy current loss. The single-phase supply is given to the stator winding (main winding)

Rotor

Rotor of single-phase induction motor is the same as a rotor of squirrel cage induction motor. Instead of rotor winding, rotor bars are used and it is short-circuited at the end by end-rings. Hence, it makes a complete path in the rotor circuit. The rotor bars are braced to the end-rings to increase the mechanical strength of the motor.

The rotor slots are skewed at some angle to avoid magnetic coupling. And it also used to make a motor run smooth and quiet.

The following fig shows the stator and rotor of a 1-phase induction motor.

Working of Single-phase Induction Motor

Single-phase AC supply is given to the stator winding (main winding). The alternating current flowing through the stator winding produces magnetic flux. This flux is known as the main flux.

Now we assume that the rotor is rotating and it is placed in a magnetic field produced by the stator winding. According to Faraday's law, the current start flowing in the rotor circuit it is a close path. This current is known as rotor current.

Due to the rotor current, the flux produced around the rotor winding. This flux is known as rotor flux.

There are two fluxes; **main flux which is produced by stator** and second is the **rotor flux which is produced by the rotor**.

Interaction between main flux and rotor flux, the torque produced in the rotor and it starts rotating.

The stator field is alternating in nature. The speed of the stator field is the same as synchronous speed. The synchronous speed of the motor depends on the number of pole and supply frequency.

It can represent by two revolving fields. These fields are equal in magnitude and rotating in the opposite direction.

Let say Φ_m is a maximum field induced in the main winding. So, this field is divided into two equal parts and that is $\Phi_m/2$ and $\Phi_m/2$.

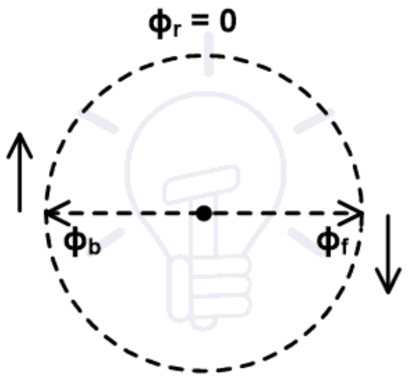
Out of these two fields, one field Φ_f is rotating in an anticlockwise direction and the second field Φ_b is rotating in a clockwise direction. Therefore, the resultant field is zero.

$$\Phi_r = \Phi_f - \Phi_b$$

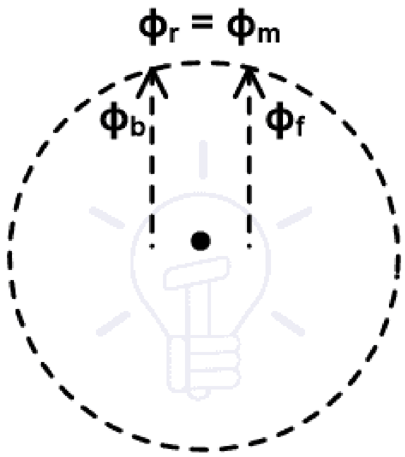
$$\Phi_r = \frac{\Phi_m}{2} - \frac{\Phi_m}{2}$$

$$\mathbf{\Phi_r = 0}$$

Now consider the resultant field at different instants.



When a motor starts, two fields are induced as shown in the above figure. These two fields are the same magnitude and opposite direction. So, resultant flux is zero.
In this condition, the stator field cannot cut by rotor field and resultant torque is zero. So, the rotor cannot rotate but it produces humming.



Now consider after the rotation of 90˚, both filed are rotated and pointing in the same direction. Therefore, the resultant flux is a summation of both fields.

$$\Phi_r = \Phi_f + \Phi_b$$

$$\Phi_r = \frac{\Phi_m}{2} + \frac{\Phi_m}{2}$$

$$\mathbf{\Phi_r = 0}$$

In this condition, the resultant filed is equal to the maximum field induced by the stator. Now, both fields rotate separately and it is alternative in nature.
So, both fields cut by the rotor circuit and EMF induced in the rotor conductor. Due to this EMF, the current starts flowing in the rotor circuit and it induces a rotor flux.
Due to the interaction between stator flux and rotor flux motor continues to rotate. T**his theory is known as Double Revolving Theory** or **double field revolving theory**.
Now, from the above explanation, we can conclude that the single-phase induction motor is not self-starting.