7 Making Single-Phase Induction Motor Self-Starting

The single-phase induction motor is not self starting and it is undesirable to resort to mechanical spinning of the shaft or pulling a belt to start it. To make a single-phase induction motor self-starting, we should somehow produce a revolving stator magnetic field. This may be achieved by converting a single-phase supply into two-phase supply through the use of an additional winding. When the motor attains sufficient speed, the starting means (i.e., additional winding) may be removed depending upon the type of the motor. As a matter of fact, single-phase induction motors are classified and named according to the method employed to make them self-starting.

(i) Split-phase motors-started by two phase motor action through the use of an auxiliary or starting winding.

(ii) Capacitor start motors-started by two-phase motor action through the use of an auxiliary winding and a capacitor.

(iii) Capacitor start Capacitor run motors-started by two-phase motor action through the use of an auxiliary winding and two capacitors.

(v) Shaded-pole motors-started by the motion of the magnetic field produced by means of a shading coil around a portion of the pole structure.

7.1 Split-phase induction motors

The stator of a split-phase induction motor is provided with an auxiliary or starting winding S in addition to the main or running winding M. The starting winding is located 90° electrical from the main winding and the picture of split phase induction motor [See Fig12 (i))] and operates only during the brief period when the motor starts up. The two windings are so resigned that the starting winding S has a high resistance and relatively small reactance while the main winding M has relatively low resistance and large reactance to be as inductance (the current delay with voltage) to make shifting current as shown in the schematic connections in Figure 12 (ii)). Consequently, the currents flowing in the two windings have reasonable phase difference c (25° to 30°) as shown in the pharos diagram this shifting in current its necessary for starting torque in Figure 12 (iii)). Figure 12 (iv) shows typical torque speed characteristics.

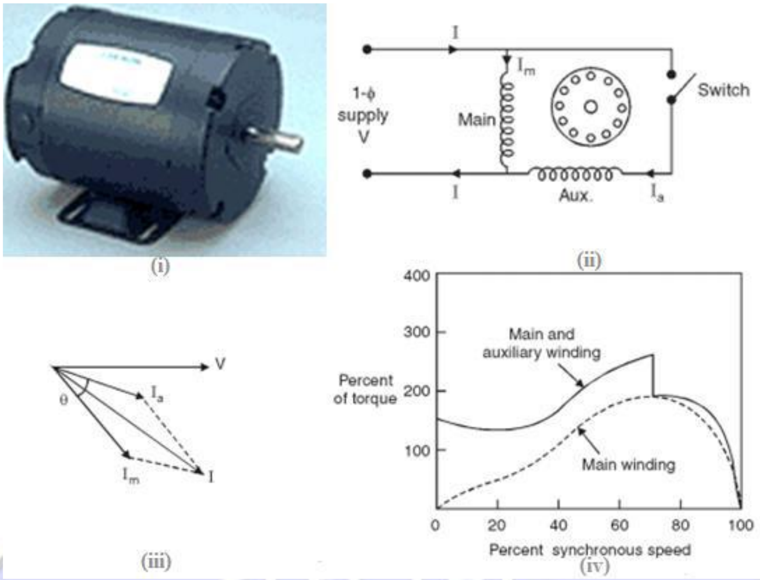

Figure 12 Split-phase induction motors.

7.1.1 Operation

(i) When the two stator windings are energized from a single-phase supply, the main winding carries current Im while the starting winding carries current Is.

(ii) Since main winding is made highly inductive while the starting winding highly resistive, the currents Im and Is have a reasonable phase angle a (25° to 30°) between them. Consequently, a weak revolving field approximating to that of a 2-phase machine is produced which starts the motor.

(iii) When the motor reaches about 80% of synchronous speed, the centrifugal switch opens the circuit of the starting winding. The motor then operates as a single-phase induction motor and continues to accelerate till it reaches the normal speed. The normal speed of the motor is below the synchronous speed and depends upon the load on the motor.

7.1.2 Characteristics

(i) The sinning torque is 2 times the full-loud torque mid (lie starting current is 6 to 8 times the full-load current. (ii) Due to their low cost, split-phase induction motors are most popular single phase motors in the market.

(iii) Since the starting winding is made of fine wire, the current density is high and the winding heats up quickly. If the starting period exceeds 5 seconds, the winding may burn out unless the motor is protected by built-in-thermal relay. This motor is, therefore, suitable where starting periods are not frequent.

(iv) An important characteristic of these motors is that they are essentially constant-speed motors. The speed variation is 2-5% from no-load to full load.

(v) These motors are suitable where a moderate starting torque is required and where starting periods are infrequent e.g., to drive:

(a) fans (b) washing machines (c) oil burners (d) small machine tools etc.

The power rating of such motors generally lies between 60 W and 250 W.