

Course Code - EEE-401
Course Title – Energy Conversion and
Special Machine
Lecture- AC Series Motor

AC Series Motor

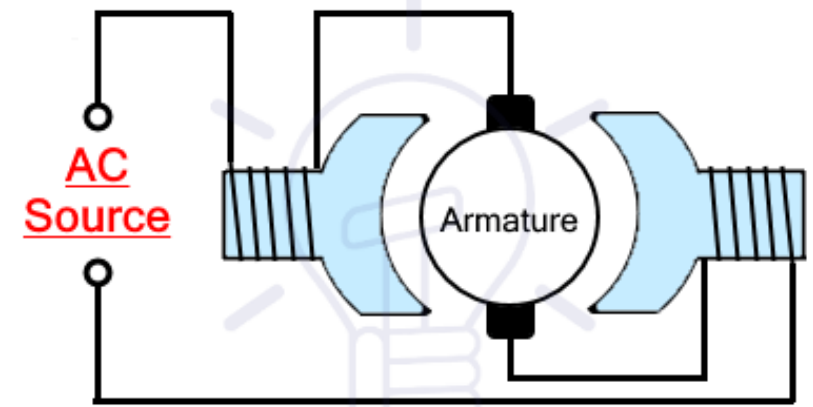
AC Series Motor

DC series motor satisfy all requirements of work and services but the transmission of ac power is more economical than DC. This has lead to the development of the AC series motor. The DC motor which runs on alternating supply called an AC series motor. However, some changes must be made in the DC series motor that is to operate satisfactorily on alternating supply.

The performance of DC motor will not be satisfactory at AC supply for the following reasons :

- The alternating flux would cause excessive eddy current loss in the yoke and field cores which will become extremely heated.
- Vicious sparking will occur at brushes because of the huge voltage and current induced in the short-circuited armature coils during their commutation period.
- Power factor is low because of high inductance of the field and armature circuits

By proper modification of design and other refinements, a satisfactory single-phase motor has been produced.

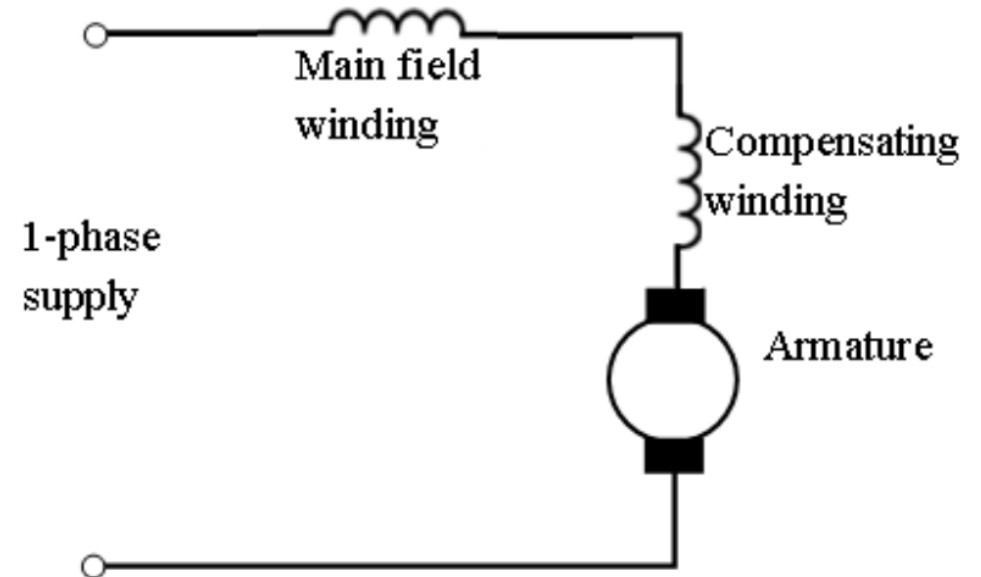
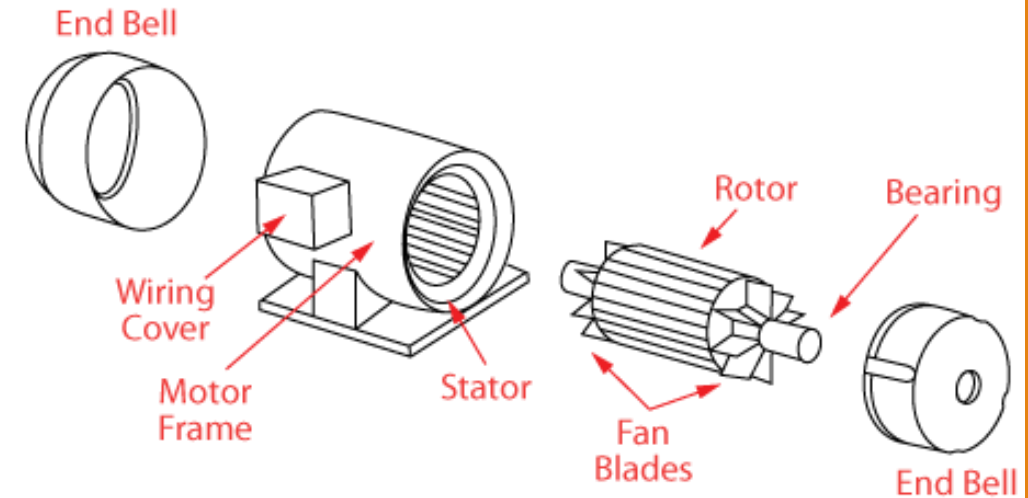


AC Series Motor

Construction of AC Series Motor

Modification in Construction

- The eddy current loss has been reduced by fully laminated poles and yokes.
- Power factor is improved by reducing the magnitudes of the reactance of the field and armature windings. Field reactance is reduced by reducing the number of turns on the field windings but it increases the armature reaction.
- A compensating winding is used in AC series for reducing the effect of the armature reaction and improving the commutation process.
- Number of poles is increased for supplying less flux per pole.
- The air gap is made very small so that fewer field turns can be used per pole.
- The frequency of supply used is reduced. The emf is proportional to frequency and hence good commutation is easy at lower frequencies.



Working principle of AC Series motor

Working principle

- Consider a two-pole motor, when alternating current be in its positive half, then the polarity of the field poles and the currents flowing through the armature conductors be as indicated in figure-1.
- The armature conductors carry inward currents under N-pole and outward currents under S-pole.
- By applying Fleming's left-hand rule it will be seen that the torque developed in the armature will try to rotate in an anti-clockwise direction.
- When the alternating current goes through the negative half cycle then the current through the field winding and armature will also change as shown in figure-2.
- It will be again seen that the armature will tend to rotate in the same direction because of the uniform torque produce by the two halves of the cycle.

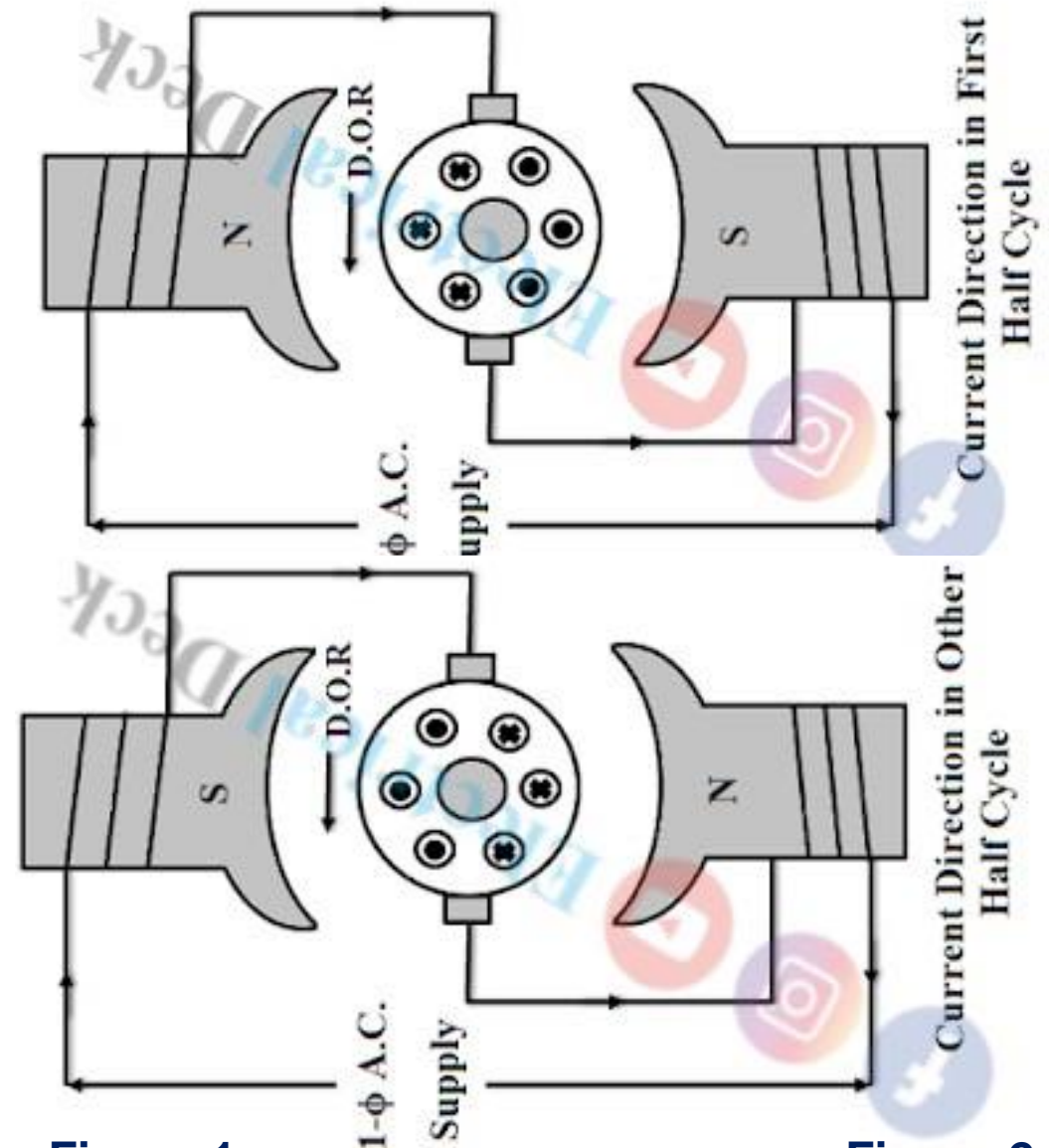


Figure-1

Figure-2

Advantages, Disadvantages and Application of AC Series Motor

Advantages

- High starting torque and high-speed.
- Low startup power demands that also protect components on the receiving end
- Controllable starting current levels and acceleration
- High durability and longer life spans
- Controllable speed and torque at different stages of use
- Capabilities for multi-phase configurations

Disadvantages

- Its efficiency is low due to hysteresis and eddy current losses.
- Its Power factor is low due to the large reactance of field and armature winding.
- Sparking at the brushes is more.

Application

- High-speed vacuum cleaner
- Sewing machines
- Used in drills and power tools
- Electric shavers

Mathematical problems of Ac series motor

Problem-01

A AC series motor has resistance of 40 ohm and an inductance of 0.8 H and it runs at 1500 r.p.m. Estimate its back emf and power factor when connected to a 250-V, 50-Hz AC supply and loaded to take 1.2A current.