LINEAR INDUCTIONMOTOR

The linear induction motor works on the same principle as that of normal induction motor with difference that instead of rotational movement, the rotor moves linearly. If the stator and rotor of the induction motor are made flat then it forms the linear induction motor. The flux produced by the flate stator moves linearly with the synchronous speed from one end to the other. The synchronous speed is given by,

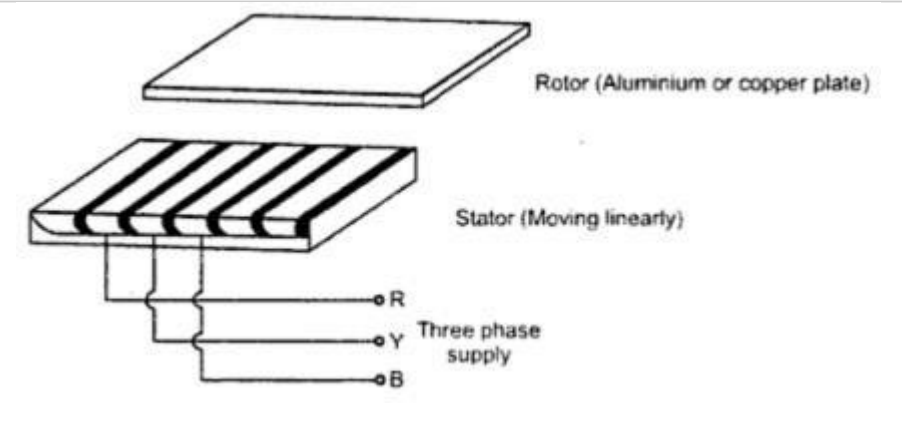
$$v_s = 2wf$$

where v_s = Linear Synchronous Speed (m/s)

w = Width of one pole pitch (m)

f = Frequency of supply (Hz)

It can be seen that the synchronous speed is independent of number of poles but depends only one width of pole pitch and supply frequency. The schematic of linear induction motor is shown in the Fig. 1.



The flux moves linearly and forces the rotor to move in straight line in the same directions. In many of the practical applications the rotor plate is a stationary member whereas stator moves. The analysis of linear machines is nearly same as that of rotating machines. All the angular dimensions and displacements are displaced by linear ones and torque is replaced by the force. The expressions for machine parameters are derived analogously and the results are similar in form. Some of the typical results are as given below, Slip, $s = \frac{v_s - v}{v_s}$ where v is the actual speed.

Force, $F = \frac{P_2}{v_s}$ where P_2 is active power supplied.

Rotor Cu loss, $P_{cu} = sP_2$

Mechanical power, $P_m = (1 - s) P_2$

The linear induction motors are widely used in transportation fields i.e. in electric trains. The stator is mounted on the moving vehicle and a conducting stationary rotor forming the rails. The induced currents in the rail not only force the stator to move but also provide magnetic levitation in which the train floats in air above the track. This mechanism proves better for high speed transportation without the difficulties associated with wheel-rail interactions present in conventional rail transport. Thus the trains may have speed of about 300 km/hr. A powerful electromagnet fixed underneath the train moves across the rails which are conducting. The induces the currents in the rail which provides levitation so that the train is pushed up above the track in the air. The operation of such system is automatic and the system is reliable and safe.

Linear motors also find application in the machine tool industry and in robotics where linear motion is required for positioning and for operation of the manipulators. In addition to this, reciprocating compressors can also be driven by the linear machines.

REPULSION MOTOR

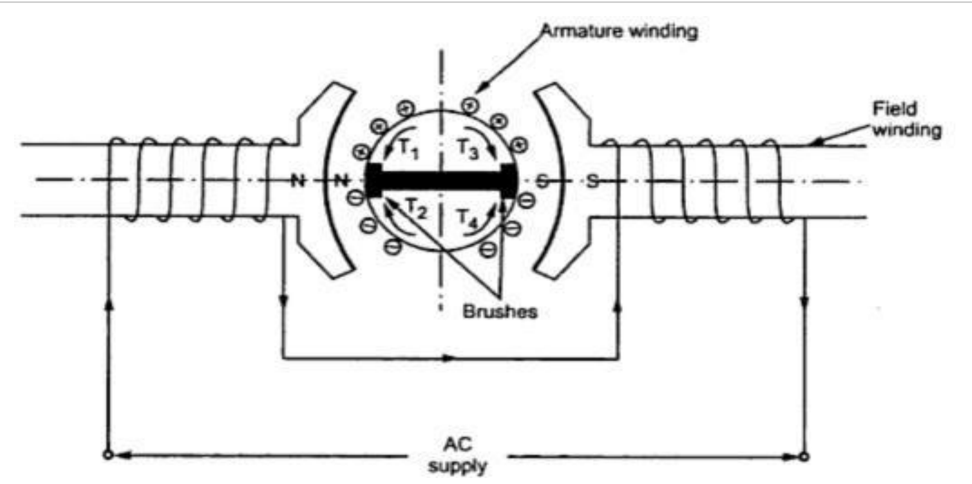
Repulsion motor works on the principle of repulsion between two magnetic fields. These motors give excellent performance characteristics. Before going ti actual discussion about motor let us consider the principle on which motor works.

Repulsion principle

For understand the torque production by motor using repulsion principle consider a tow pole salient pole motor having magnetic axis horizontal. The armature of the machine consists of a d.c. windings having commutator and brushes. The brushes are short circuited by a low resistance jumper.

The stator winding is given excitation in such away as to form the poles as shown in the Fig.1. The brushes are aligned in the same direction of the field axis. The stator winding will produce alternating flux which will induce e.m.f. in the armature conductors by transformer action. The direction of induced e.m.f. can be found using Lenz's law. The direction of induced current will depend on position of brushes, These currents will lag behind the induced voltage by almost 90^{o} . Because of the current flowing through the armature, it will produce its own magnetic field with the poles as shown in the Fig.1. Thus equal force of repulsion exists between like poles which will not produce any torque.

Fig. 1



Alternatively it can be also explained as the armature to be divided into four quadrants producing four torques T_1, T_2, T_3 and T_4 which are equal and hence the net torque is zero If brushes are shifted by90^o , so the conductors undergoing short circuit are also changed. The induced emf are in the same direction as before. The arrangement is shown in the Fig.2.

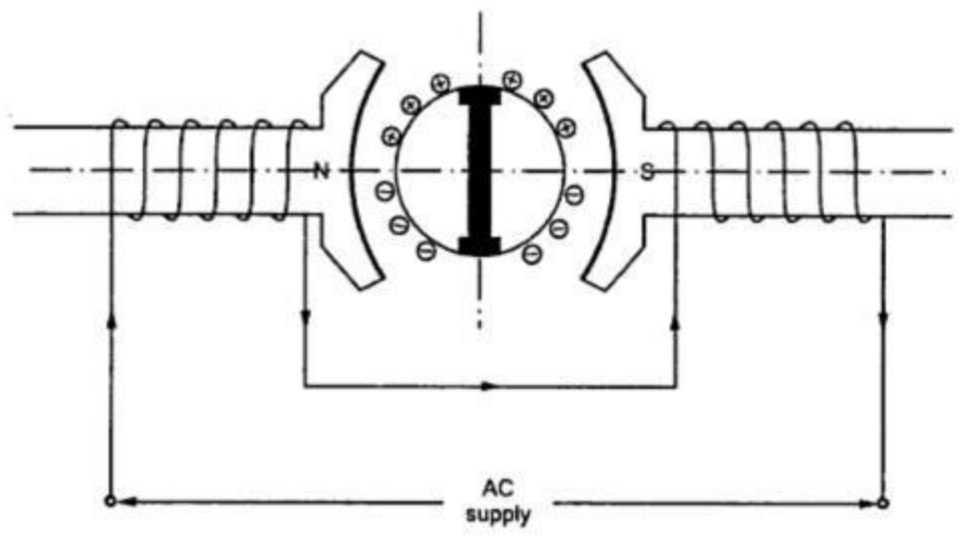
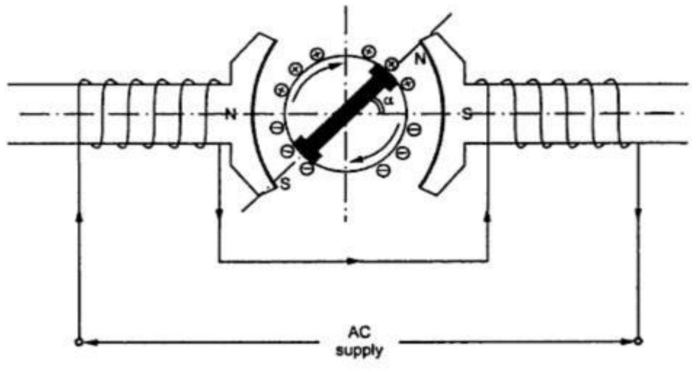


Fig. 2

Apart from the coils undergoing short circuit, the remaining armature winding gets divided into two parallel paths. It can be seen that the induced emfs are balanced and the resultant emf is zero. Thus no current flows through the brushes and the resultant torque is also zero.

If the brushes are in the position shown in the Fig.3. In this case, the brushes axis is not in the line of main field or at an angle of 90^o to main field but it is at an angle of **α** with the main field.



Again the emf will be induced in the armature conductors and there will be net voltage across brush terminals which will produce current in the armature. Thus the armature will also produce its own magnetic field with the poles as shown in the Fig.3. The north and south poles of stator and rotor will attract each other and there will be net torque available which will run the motor in the clockwise direction. Alternatively we can say that the north pole formed by armature winding will be repelled by the north pole formed by the main field winding and similarly the south pole will be repelled by south pole formed by the main field winding and the motor runs in clockwise direction. As the forces are of repulsion which contributes in the motion so the name of the motor is repulsion motor. If the brush is given shift in the opposite direction to that shown in the Fig.4 then motor runs in anticlockwise direction which can also be explained on the similar lines. Hence the position of brushes decides the direction of rotation. he torque produced by the motor depends on the brush shift angle **α**.

Thus the control of speed and torque can be done with the help of brush shift. The variation of torque with brush shift is shown in the Fig.4.

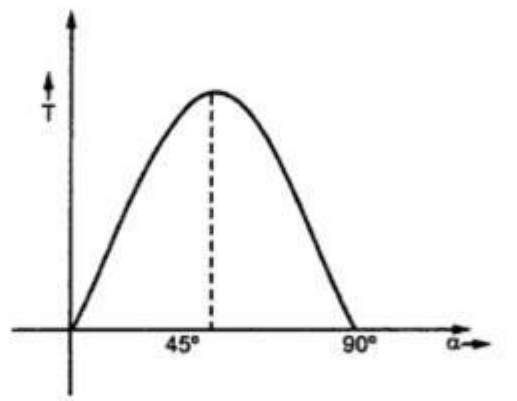


Fig. α = 45° maximum torque is available