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

Repulsion Motor

Repulsion Motor

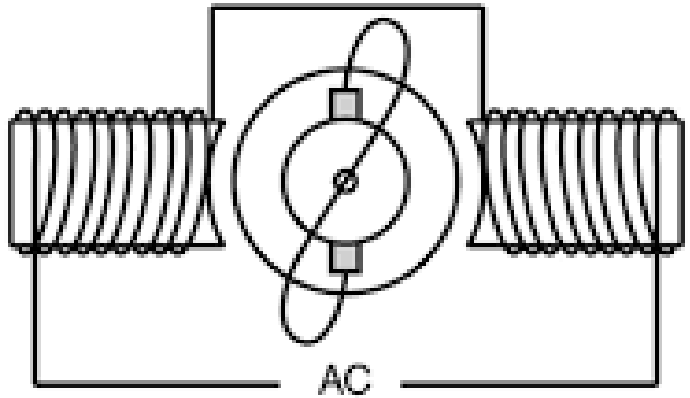
- Repulsion Motor is a special kind of single phase AC motor which works on repulsion principle.
- It works on the principle of magnetic repulsion between two poles.
- A repulsion motor will start with repulsion between two unlike poles and then runs as an induction motor.

Types of Repulsion Motor

- Compensated Repulsion Motor.
- Repulsion Start Induction Motor
- Repulsion Induction Motor

Application

- Pumps and fans.
- Electric trains
- Air compressors
- Printing presses
- Machines in Textile
- High-speed lifts
- Mixing machines

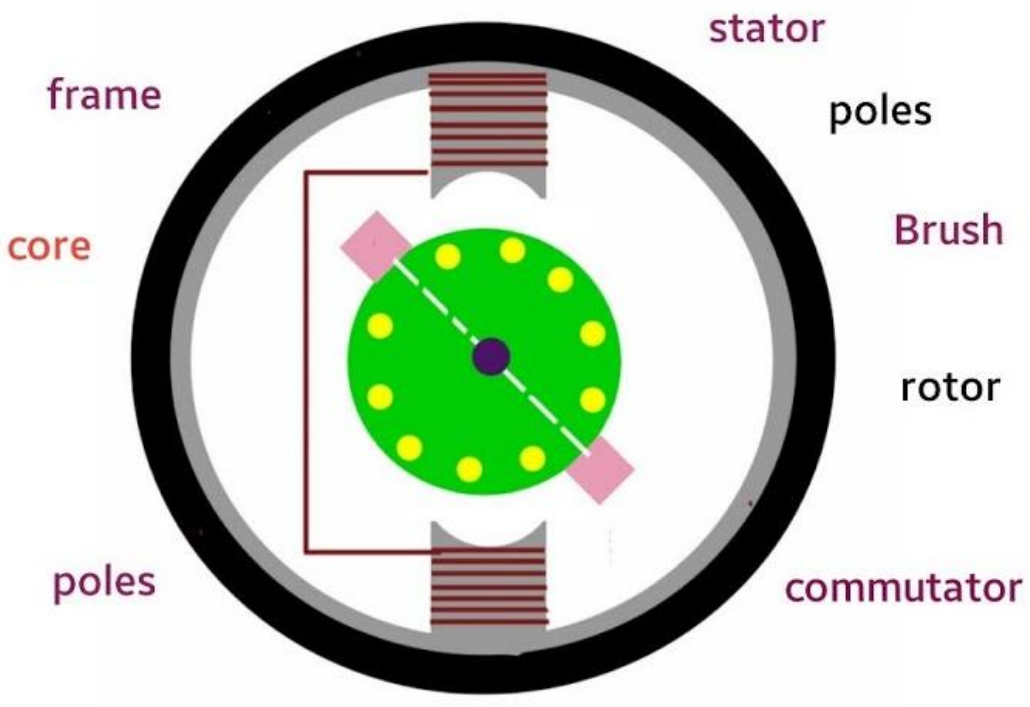


repulsion motor

Construction of Repulsion motor

Construction

- Stator winding of the distributed non-salient pole type housed in the slots of a smooth-cored stator. The stator is generally wound for four, six or eight poles.
- A rotor carrying a distributed winding which is connected to the commutator.
- A commutator, which may be one of the two types : an axial commutator with bars parallel to the shaft or a radial or vertical commutator having radial bars on which brushes press horizontally.
- Carbon brushes which ride against the commutator and are used for conducting current through the armature (i.e. rotor) winding.



Rotor

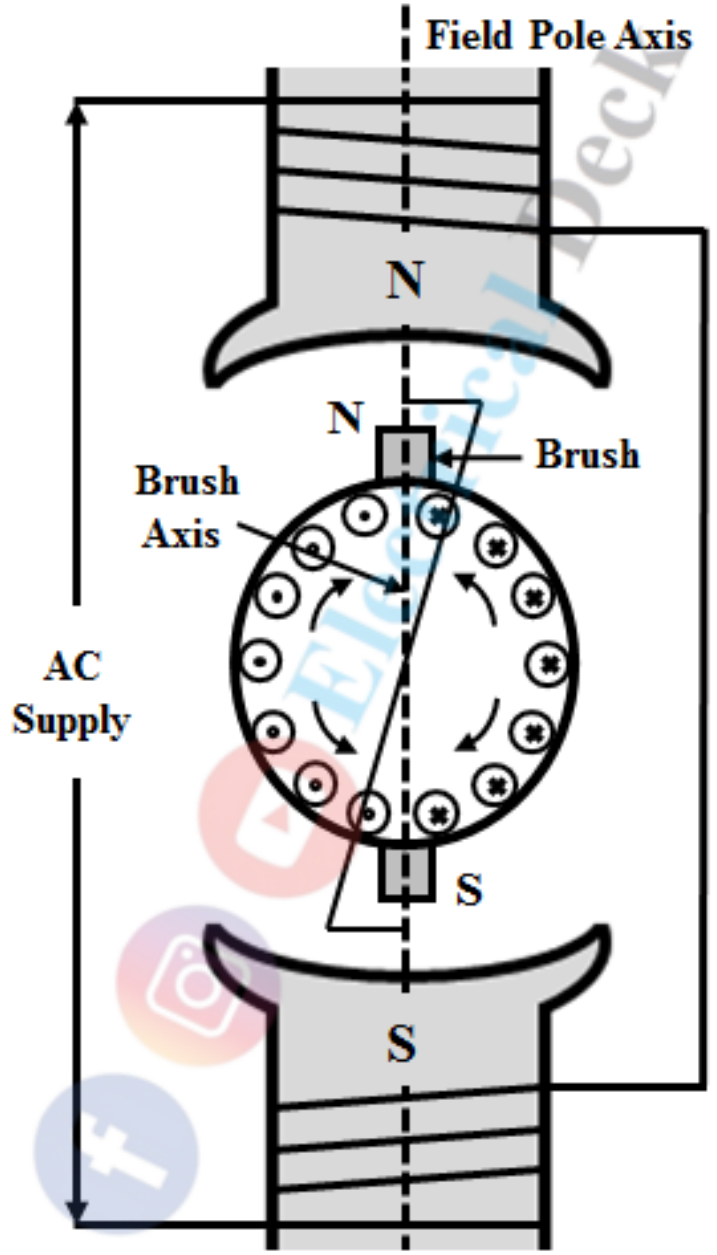
Working principle of Repulsion motor

Working principle

Let us consider a 2-pole motor to understand the working principle. Suppose that the direction of flow of the alternating current in the field (stator) winding is such that it creates a N-pole at the top and a S-pole at the bottom. This alternating flux when links with the rotor it induces an emf in the rotor conductors by induction principle. Now torque developed on the rotor at different instants of brush axis with respect to stator field pole axis.

i. When brush axis is aligned with field axis (α = 0°) :

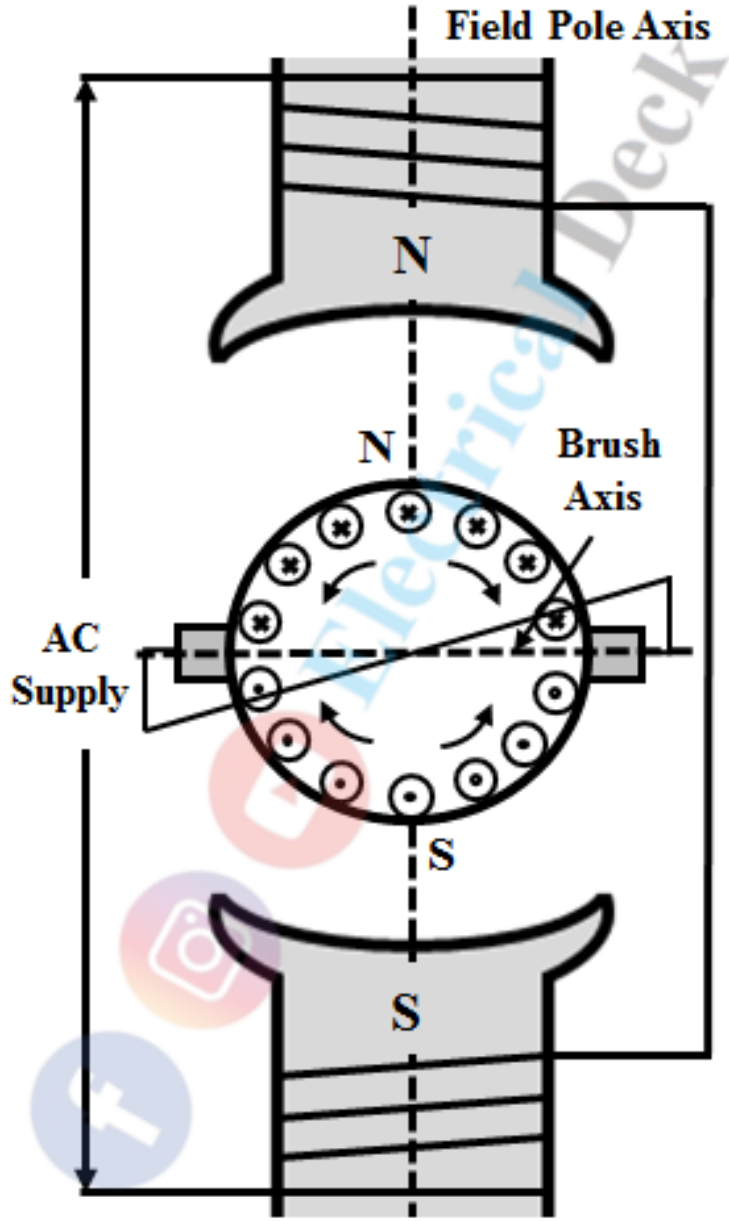
- If brush axis is colinear with magnetic axis of the main poles, the directions of the induced currents (shown by dots and arrows) will be as indicated in figure.
- As a result, the upper-half rotor conductors produce N-pole and lower-half with S-pole.
- Because of this face-to- face positioning of the main and induced magnetic poles, no torque will be developed.
- As a result the rotor in not rotate due to repulsion force by the two field poles at the same time



Working principle of Repulsion motor

ii. When brush axis is perpendicular with field axis (α = 90°) :

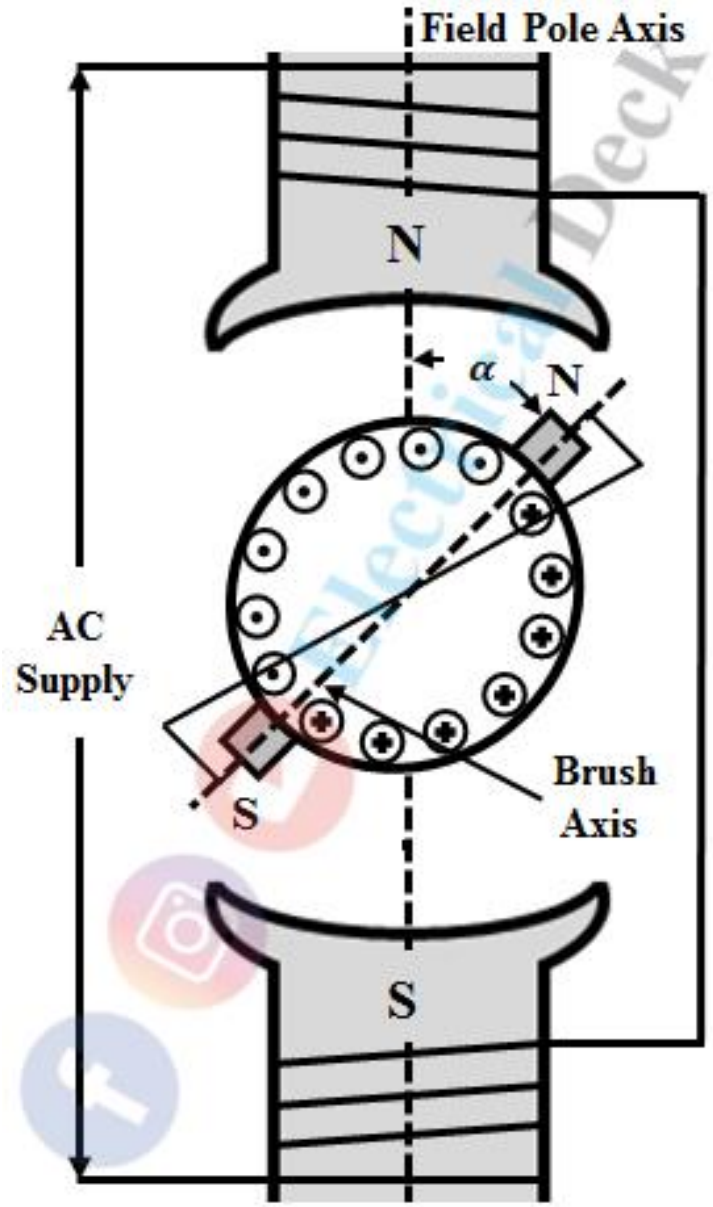
- If brushes are shifted through 90º to the position shown in figure so that the brush axis is at right angles to the magnetic axis of the main poles
- At this position, the direction of rotor induced emf is similar to that of the previous case as shown below by dots (.) and cross (×).
- Hence, the voltages induced in the armature conductors in each path between the brush terminals will neutralize each other,, and no current flows in it.
- Therefore, the net torque produced on the rotor will be zero and it remains at the same position.



Working principle of Repulsion motor

iii. When brush axis is shifted with some α° from field axis :

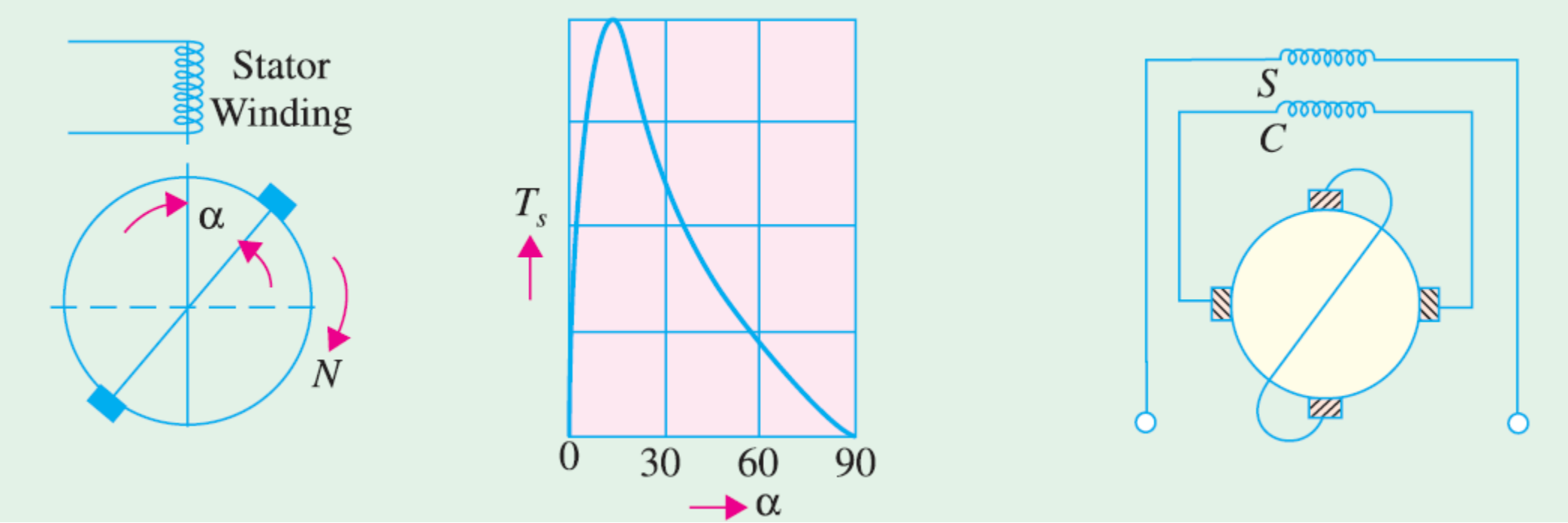
- If brush axis shifted by an angle α° in a clockwise direction, a net voltage will be induced between the brush terminals which will produce armature current.
- The armature will again act as an electromagnet and develop its own N-and S-poles which, in this case, will not directly face the respective main poles
- Hence, rotor N-pole will be repelled by the main N-pole and the rotor S-pole will, similarly, be repelled by the main S-pole. Consequently, the rotor will rotate in clockwise direction.
- Since the forces are those of repulsion, it is appropriate to call the motor as repulsion motor



Compensated Repulsion Motor

Compensated Repulsion Motor

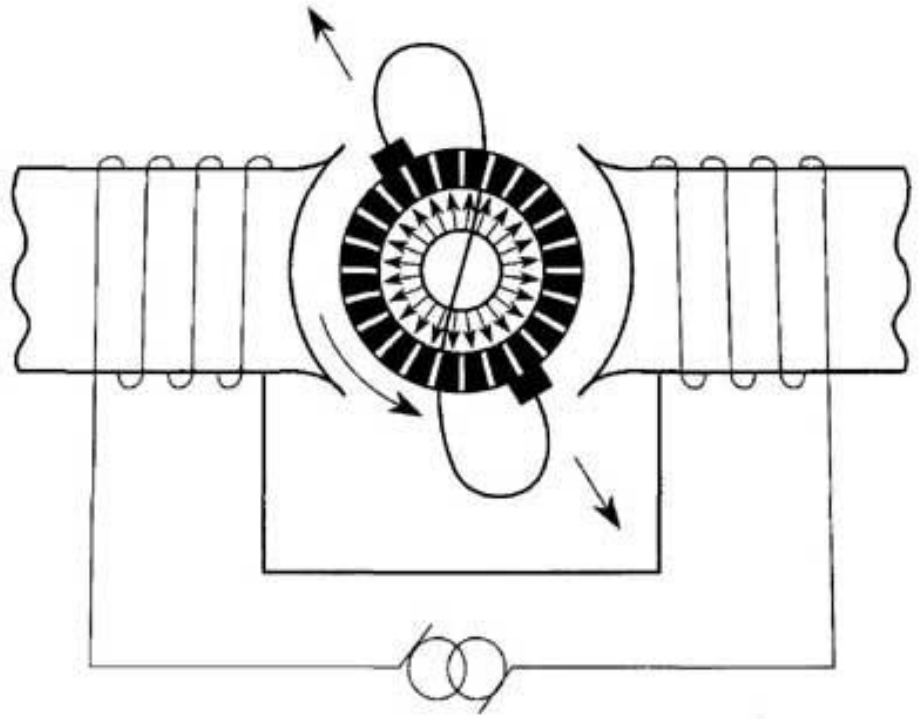
- It is a modified form of the straight repulsion motor.
- It has an additional stator winding, called compensating winding whose purpose is
  (i) to improve power-factor and
  (ii) to provide better speed regulation.
- This winding is much smaller than the stator winding and is usually wound in the inner slots of each main pole and is connected in series with the armature through an additional set of brushes placed mid-way between the usual short-circuited brushes



Repulsion-start Induction-Run Motor

Repulsion-start Induction-Run Motor

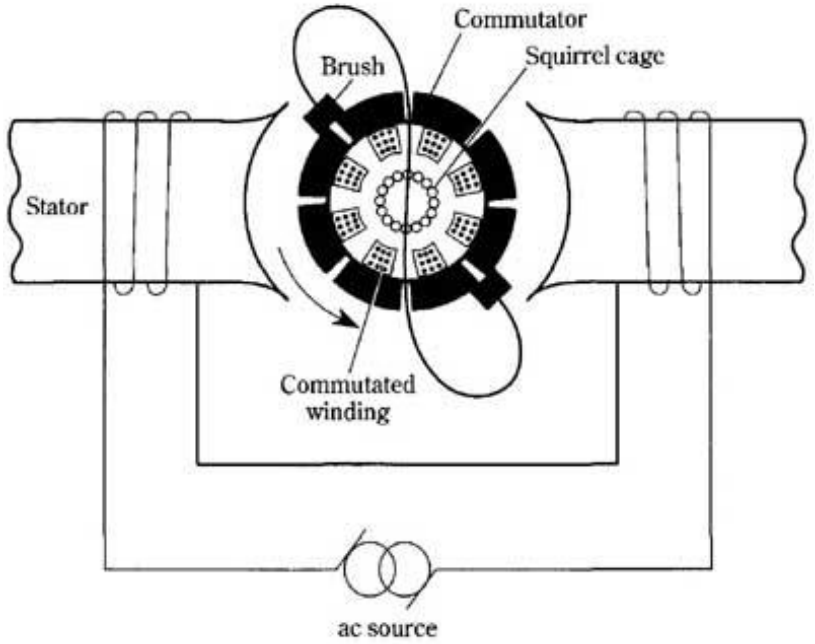
- This motor starts as an ordinary repulsion motor, but after it reaches about 75 percent of its full speed, centrifugal short-circuiting device short-circuits its commutator after that it runs as an induction motor, with a short-circuited squirrel-cage rotor.
- After the commutator is short-circuited, brushes do not carry any current, hence they may also be lifted from the commutator, in order to avoid unnecessary wear and tear and friction losses.
- Applications of such motors include machine tools, commercial refrigerators, compressors, pumps, hoists, floor-polishing and grinding devices etc.



Repulsion Induction Motor

Repulsion Induction Motor

- In the field of repulsion motor, this type is becoming very popular, because of its good all-round characteristics.
- This motor is a combination of the repulsion and induction types and is sometimes referred to as squirrel-cage repulsion motor.
- It has the usual stator winding as in all repulsion motors. But there are two separate and independent windings in the rotor (i) a squirrel-cage winding and (ii) commutated winding
- The brushes are short-circuited and ride on the commutator continuously and it requires no centrifugal short-circuiting mechanism.
- Its field of application includes house-hold refrigerators, garage air pumps, petrol pumps, compressors, machine tools, mixing machines. lifts and hoists etc.



Advantages and Disadvantages of Repulsion Motor

Advantages of Repulsion Motor

- Excellent torque developed at the time of starting.
- Wide range of speed control.
- A smooth variation in the speed can be achieved by varying the brush axis.
- Starting current required is low.

Disadvantages of Repulsion Motor

- Sparks will occur at brushes.
- The power factor is very less at less speed.
- The speed at no-load condition is extremely high & unsafe.
- Brushes & commutator exhaust quickly due to heat generation & arcing at the assembly of the brush.
- Maintenance required for commutator is more.
- Repulsion motors are more expensive.
- It is not a constant speed motor and speed decreases with an increase in load.
- The operation of repulsion is noisy.