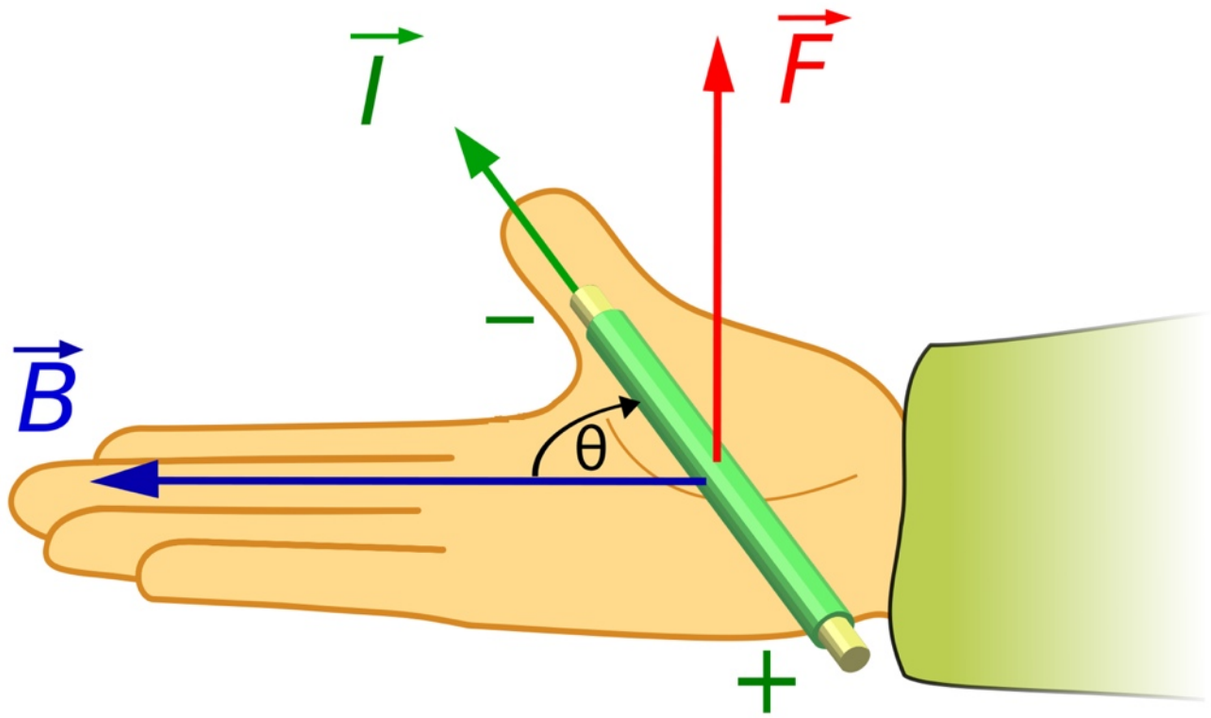
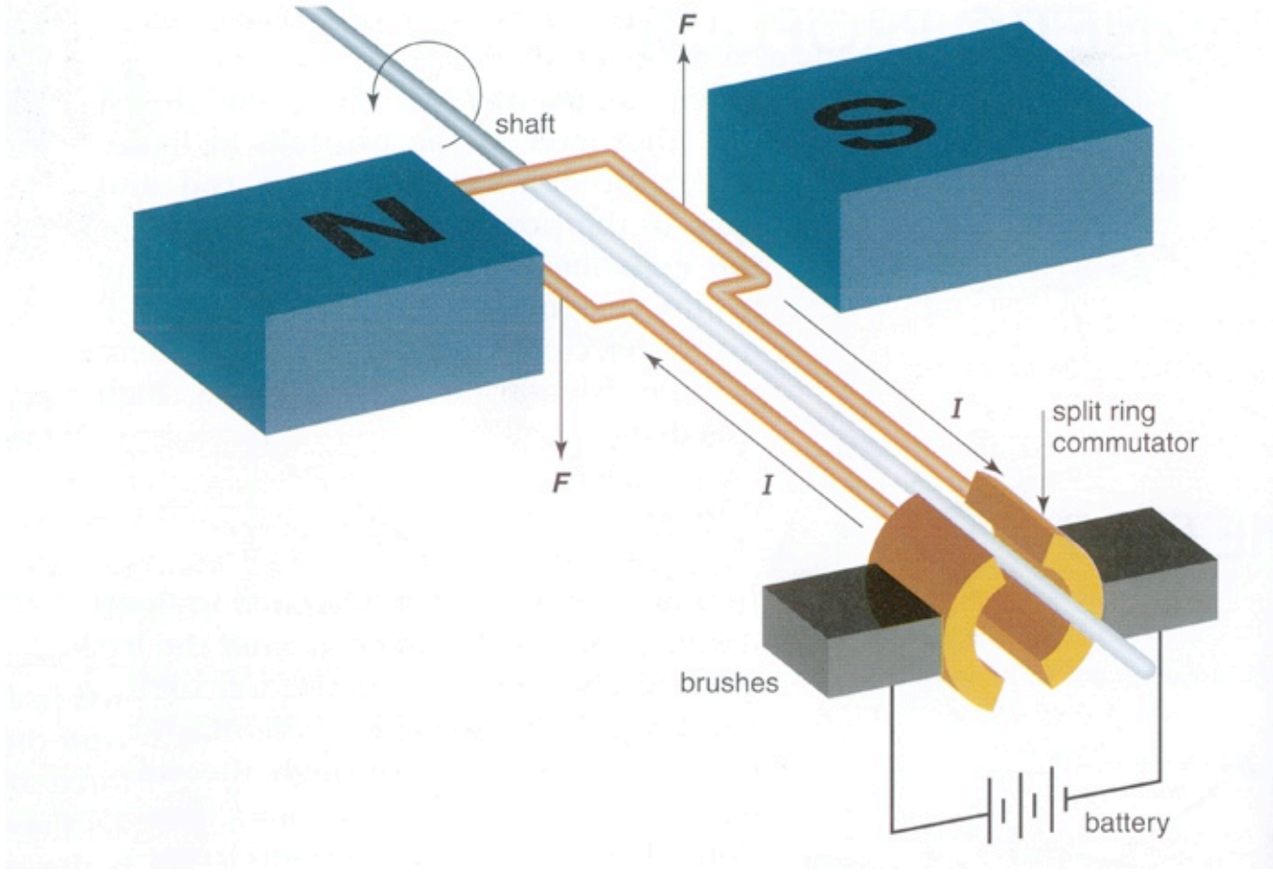
DC Motors - The right-hand slap rule

- **Right hand slap rule**: shows the direction of the net force for a current flowing perpendicular to the magnetic field.
- **Thumb** indicates the direction of conventional current (+ to -) through the wire.
- **Fingers** indicate magnetic field direction.
- **Palm** indicates the direction of the Lorentz force on the wire.
- (There is also Fleming's left hand rule for a similar outcome)



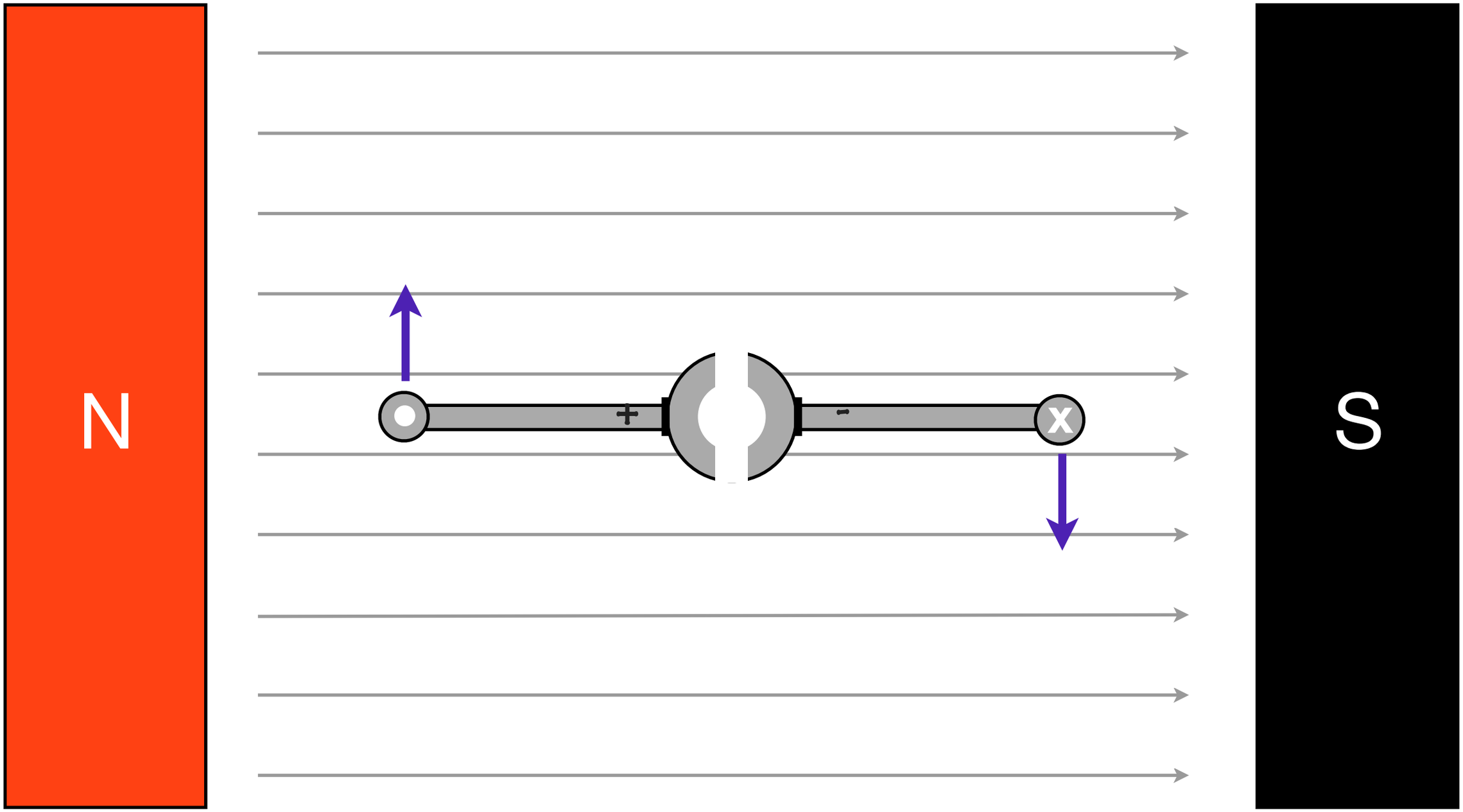
DC Motors

- Current through loops of wire in magnetic field - force on wire causes rotation. (One side forced up, the other forced down)



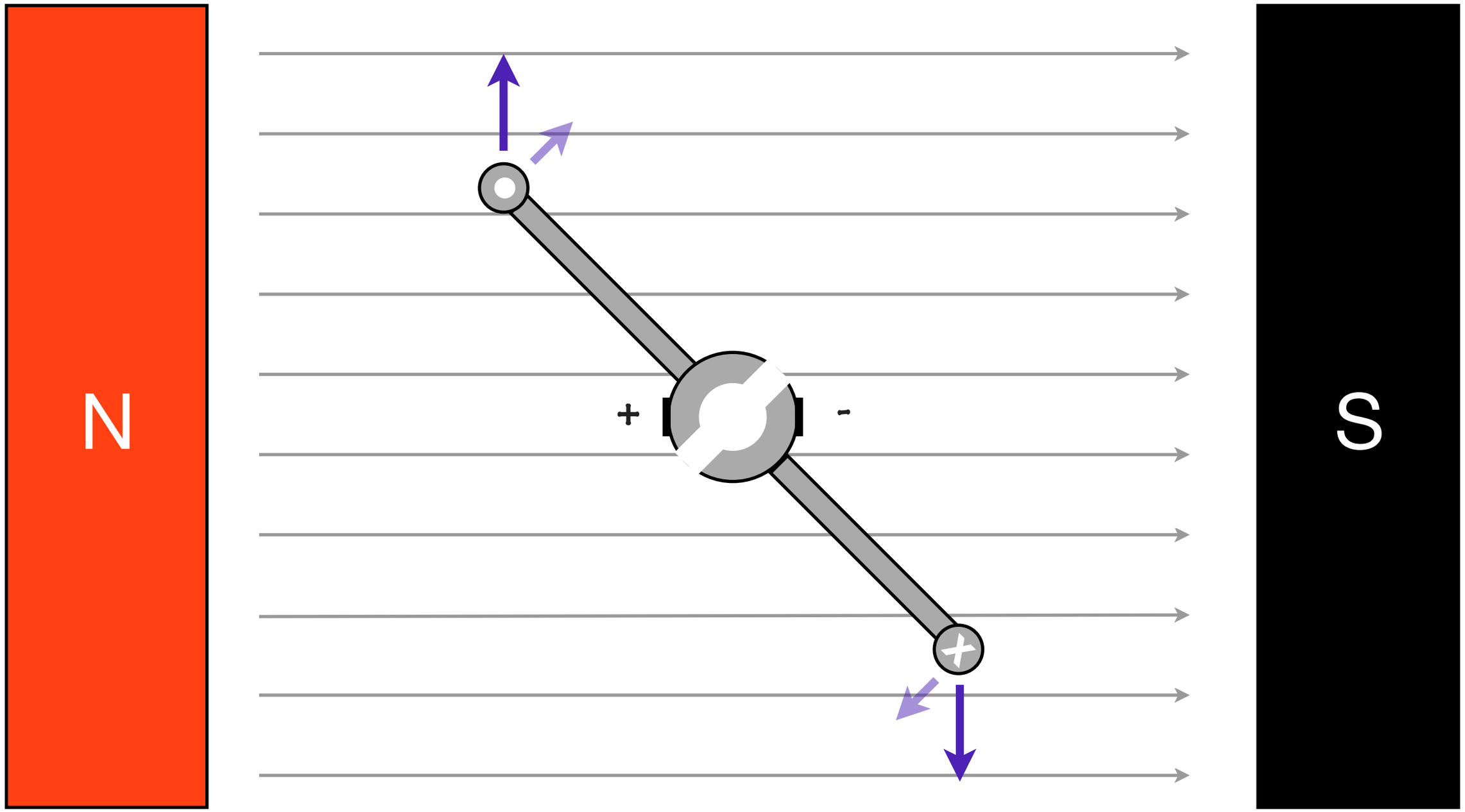
DC motor

Rotation of DC motor



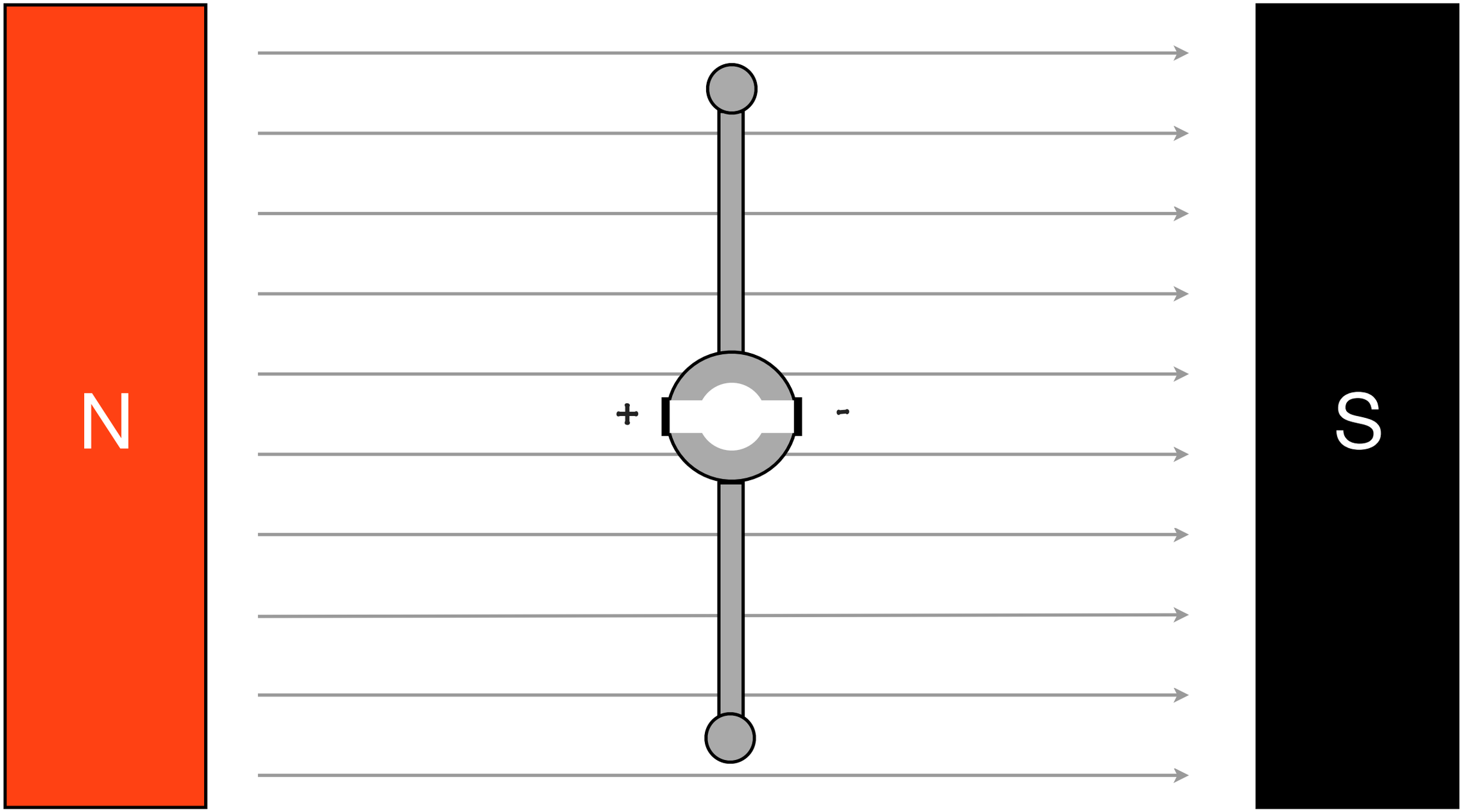
Maximum torque (turning effect)

Rotation of DC motor



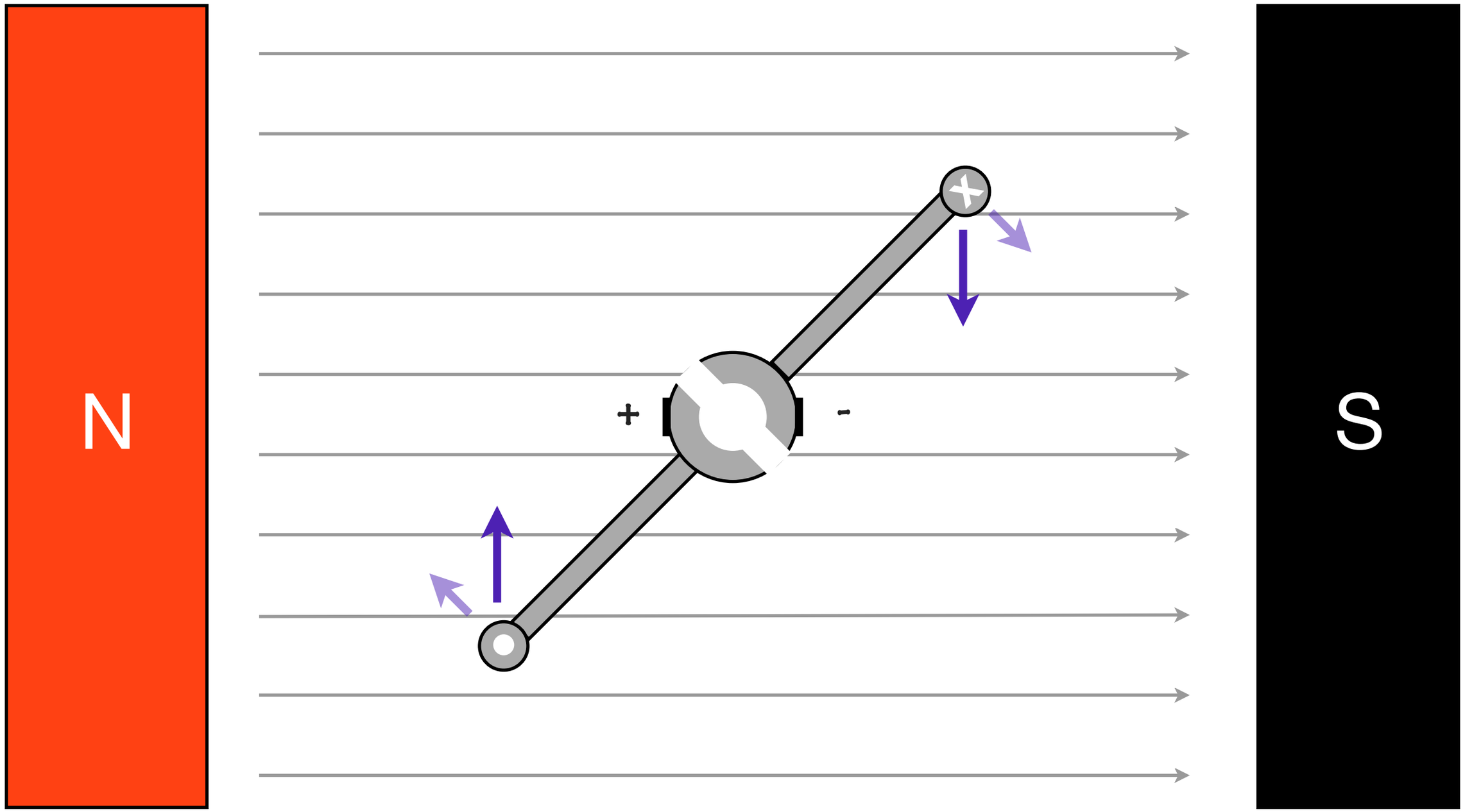
Less torque as the force is not perpendicular to armature

Rotation of DC motor



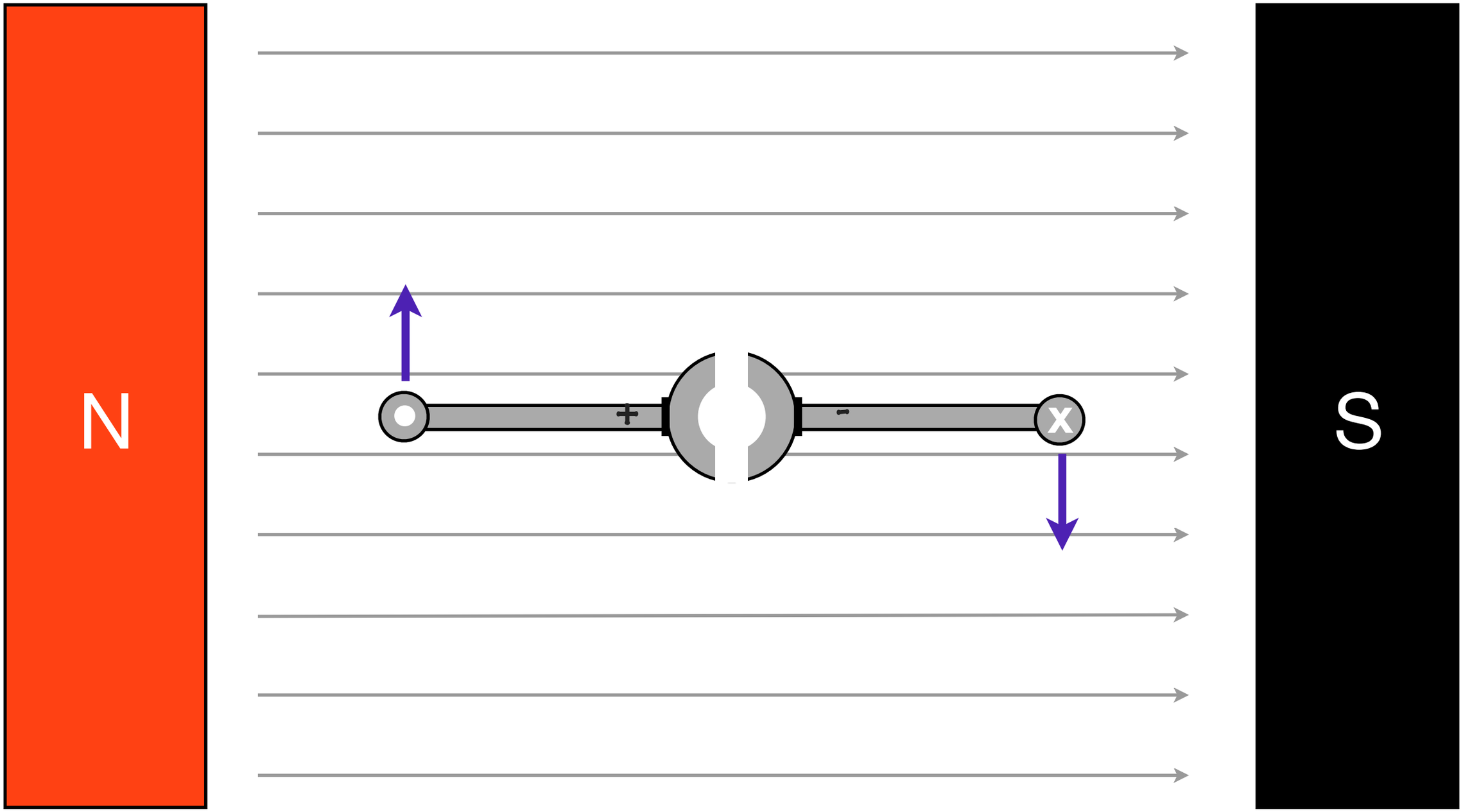
No torque. Commutator will reverse direction of current.

Rotation of DC motor



Rotation is preserved as the current direction has been changed.

Rotation of DC motor

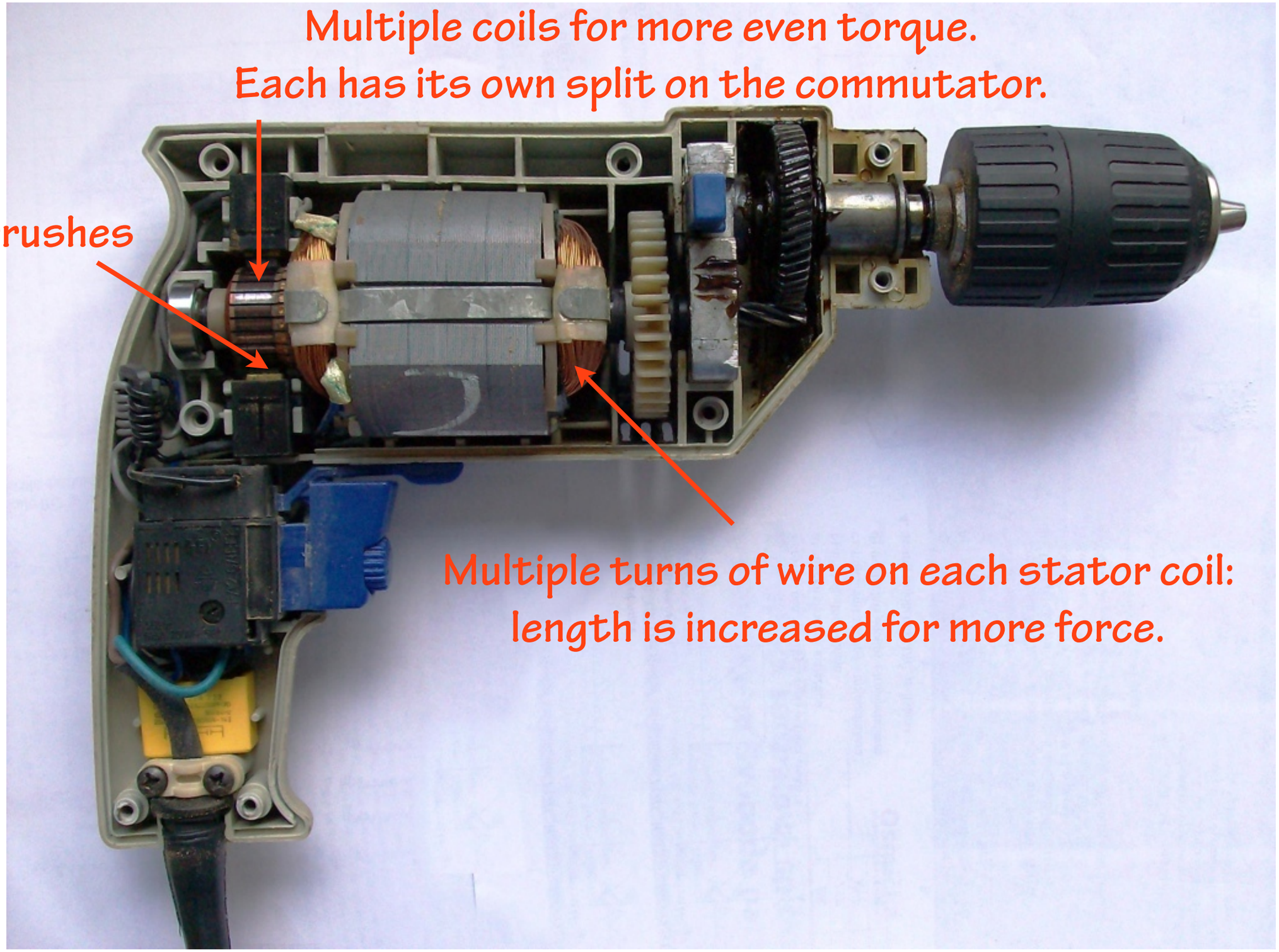


Maximum torque (turning effect)

DC Motors

- **Commutator** changes the direction of current flow every half cycle to preserve direction of rotation.
- Carbon **brushes** make the contact from the commutator to the armature.
- Forces can be increased by using stronger magnets (B), more current (I) or more turns of wire (L).
- The variations in **torque** can be reduced by using multiple planes of wires rather than just one eg 6 planes at 30° angles. This requires 12 splits in the commutator.
- Often, electromagnets are used as the **stator magnets** due to the stronger possible fields.
- A **universal motor** uses electromagnetic stators & can be run from DC or AC. The current through the armature is changing at the same rate as the field from the stators - the direction of rotation is always the same.

DC Motors


Multiple coils for more even torque.
Each has its own split on the commutator.
Carbon brushes
Multiple turns of wire on each stator coil:
length is increased for more force.