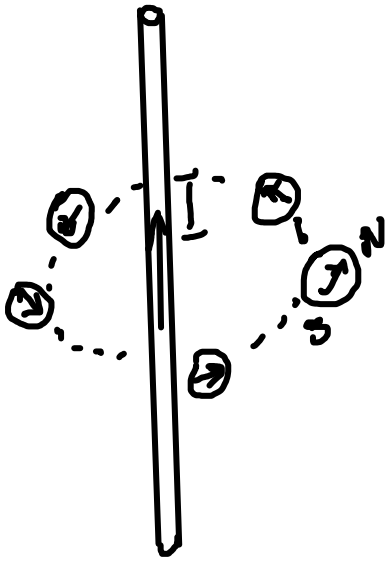
draw the pattern of the magnetic field due to currents in straight wires and in solenoids and state the effect on the magnetic field of changing the magnitude and/or direction of the current

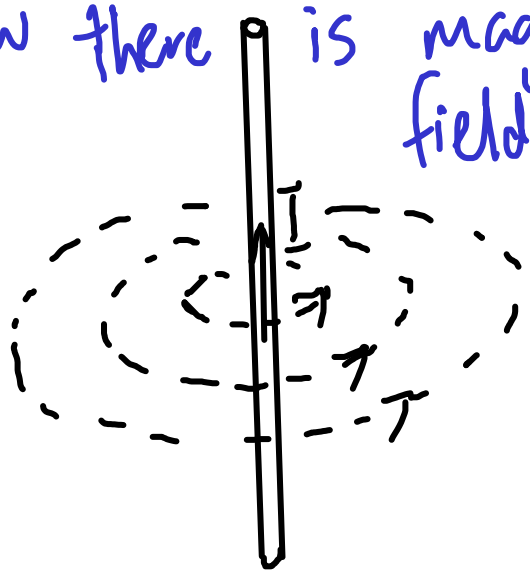
Field due to Current

Dr K M Hock

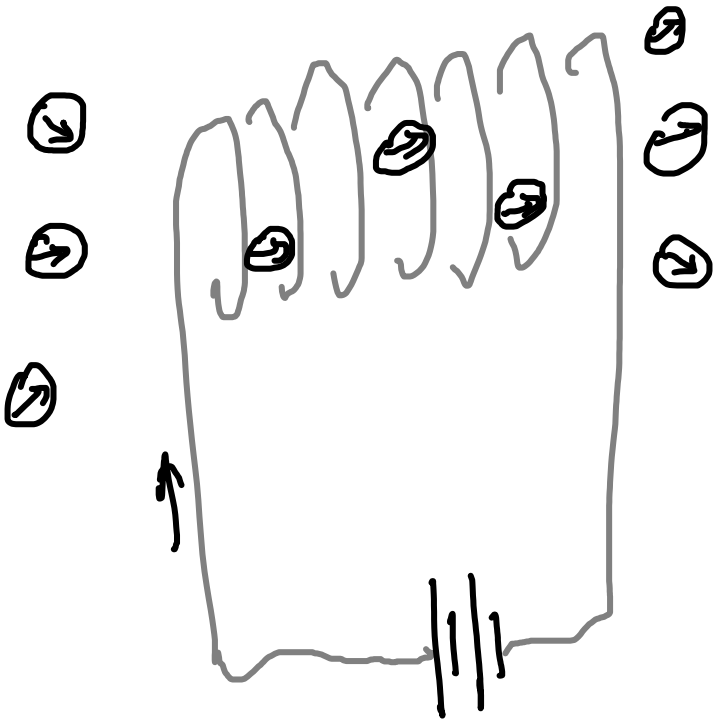
Compass affected by current like this:



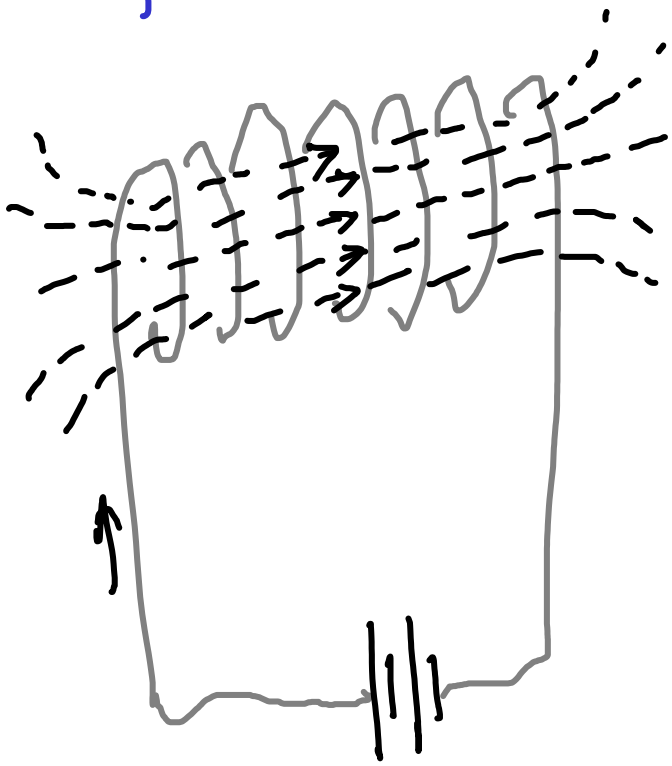
Show there is magnetic field:



Solenoid:



field

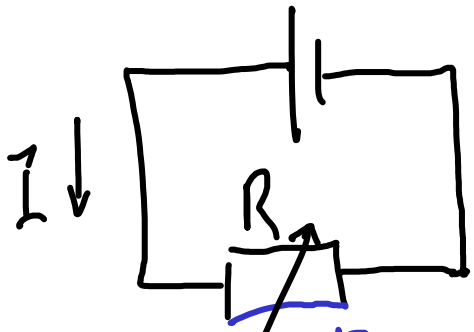


describe the application of the magnetic effect of a current in a circuit breaker

Circuit Breaker

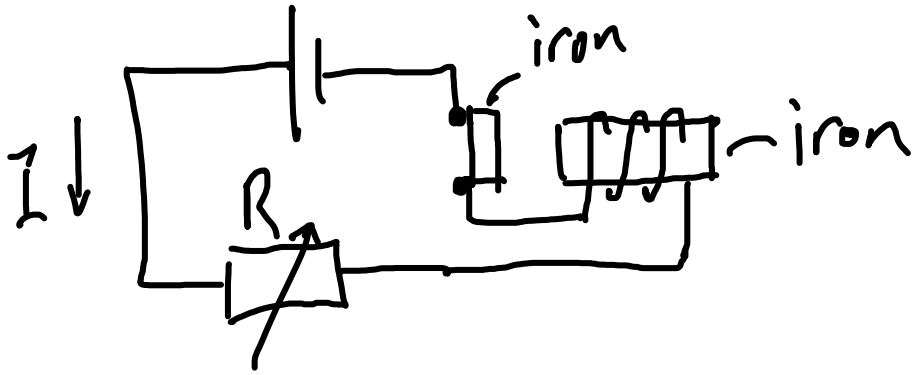
Dr K M Hock

To stop electric current when it gets to big - fuse or
- Circuit breaker

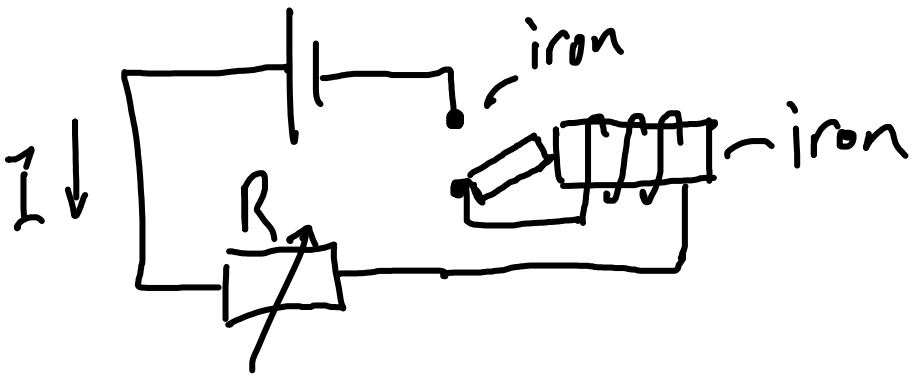


Suppose we adjust R to increase I.
When I is to big, we want it off.

E.g.



When I is big enough, electromagnet is strong enough to:



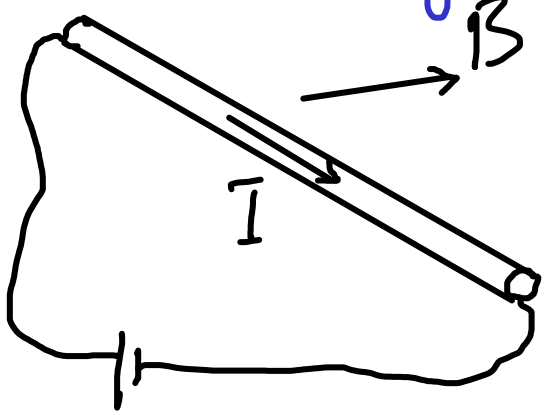
Then current stops.

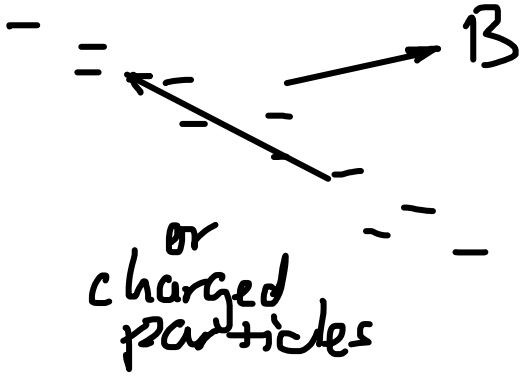
describe experiments to show the force on a current-carrying conductor, and on a beam of charged particles, in a magnetic field, including the effect of reversing (i) the current
(ii) the direction of the field

Force on Current

Dr K M Hock

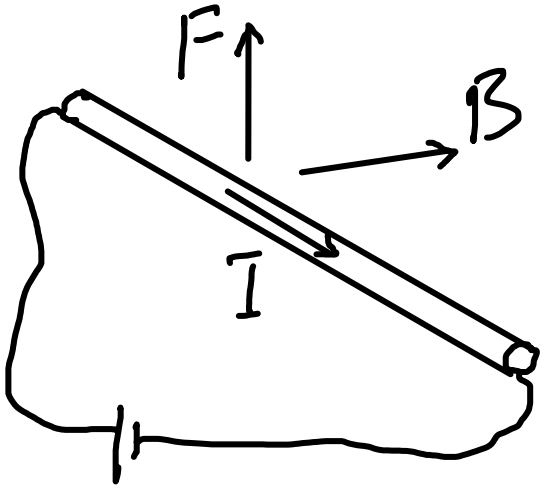
If a current goes thru' a magnetic field B:

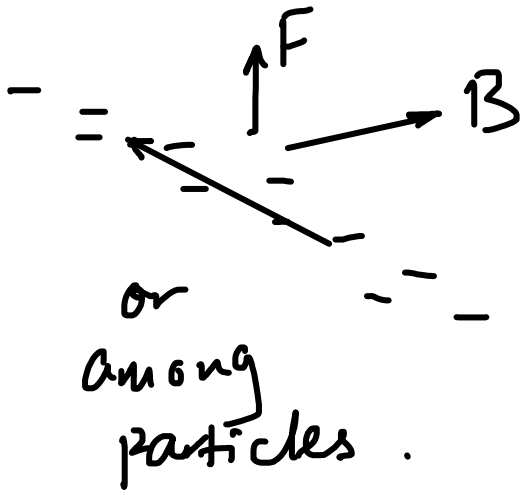




or charged particles

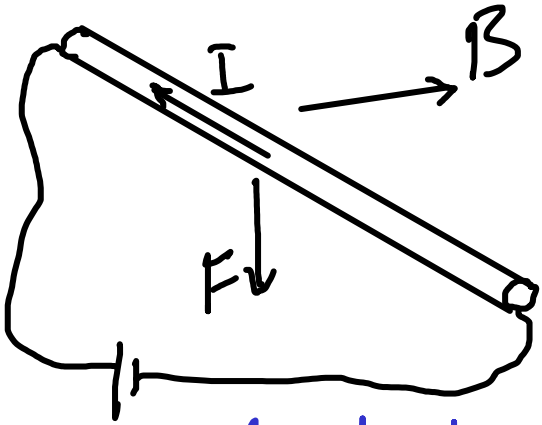
Then the field exerts a force on the current

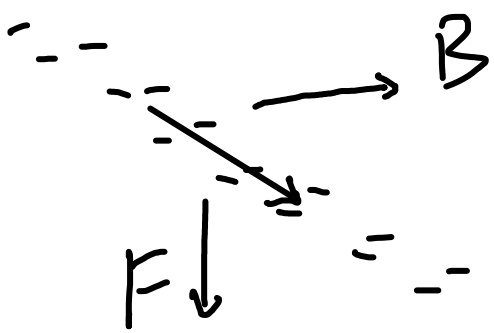




or among particles.

Reversing current reverses force direction:





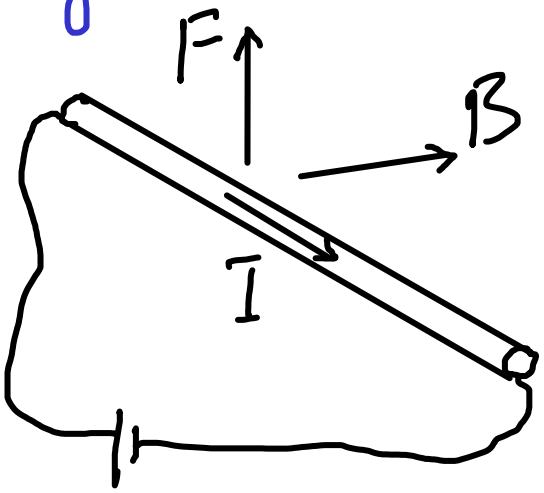
Reversing field also reverses force direction

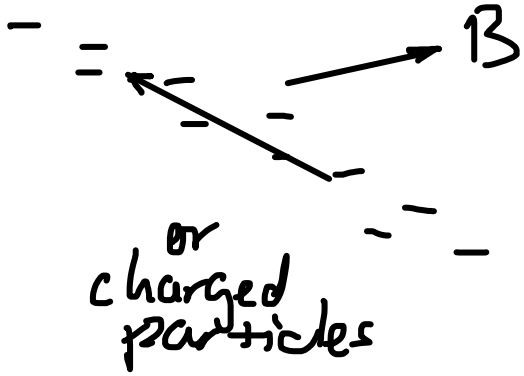
deduce the relative directions of force, field and current when any two of these quantities are at right angles to each other using Fleming's left-hand rule

Fleming's Left-hand Rule

Dr K M Hock

Magnetic field exerts a force on the current





Can find force direction using

Fleming's left hand rule.

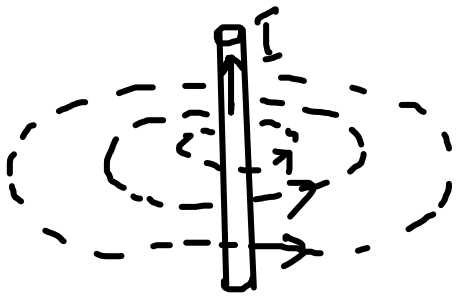
(If current is negative particles, then I is opposite to particles' direction.)

describe the field patterns between currents in parallel conductors and relate these to the forces which exist between the conductors (excluding the Earth's field)

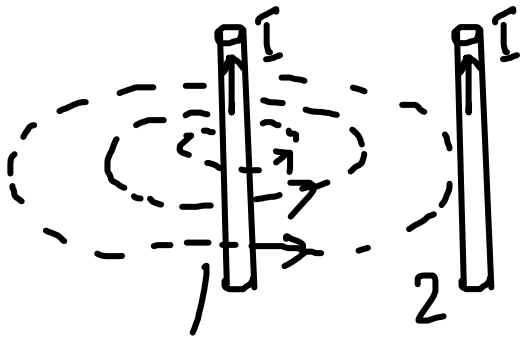
Parallel Currents

Dr K M Hock

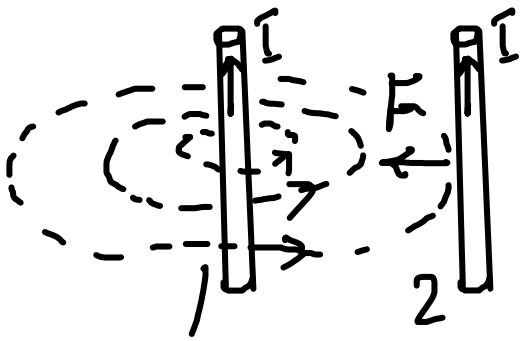
Field around current in straight wire:



What if there is a parallel current?



Using Fleming's left-hand rule the field from current 1 gives a force on current 2:



So

Currents in same direction <u>attract</u>

and

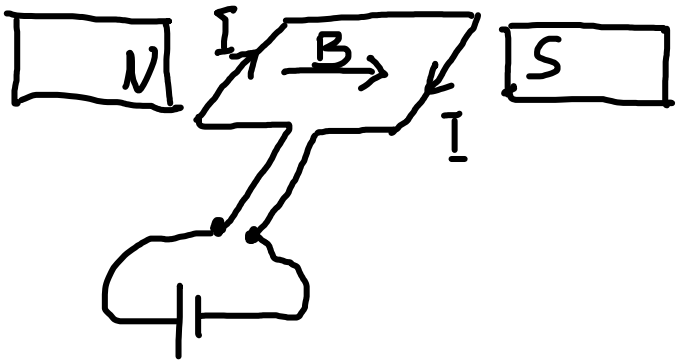
Currents in opposite direction _____

explain how a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by increasing (i) the number of turns on the coil (ii) the current

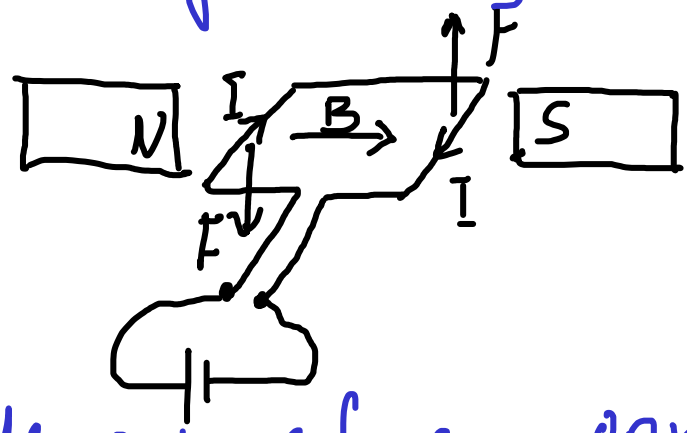
Coil in Field

Dr K M Hock

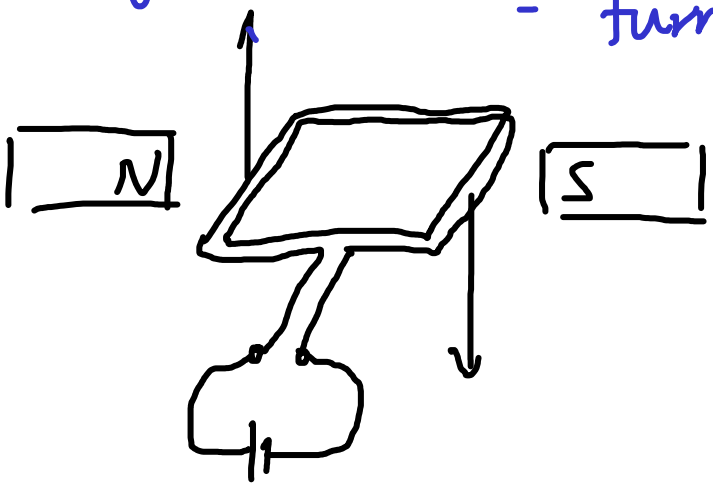
A coil in a field. It carries a current.



Using Fleming's left-hand rule



Each side gets a force - opposite directions
- turning effect

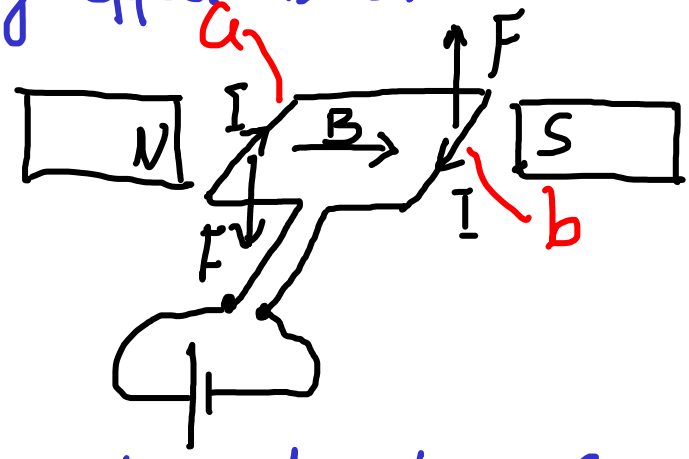


More turns in coil → bigger turning effect.
Stronger current, also ↗

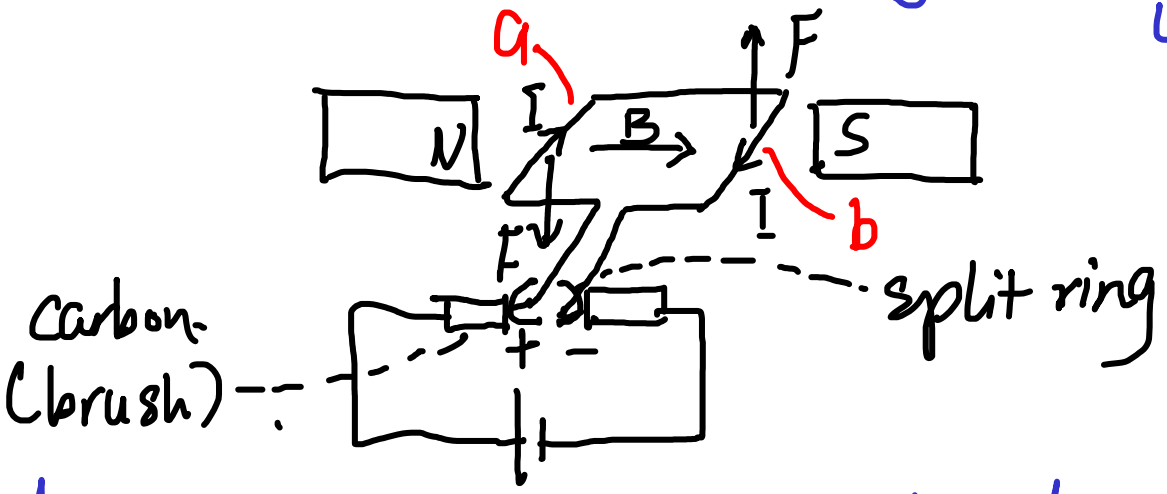
Electric Motor

Dr K M Hock

This turning effect is used in a motor

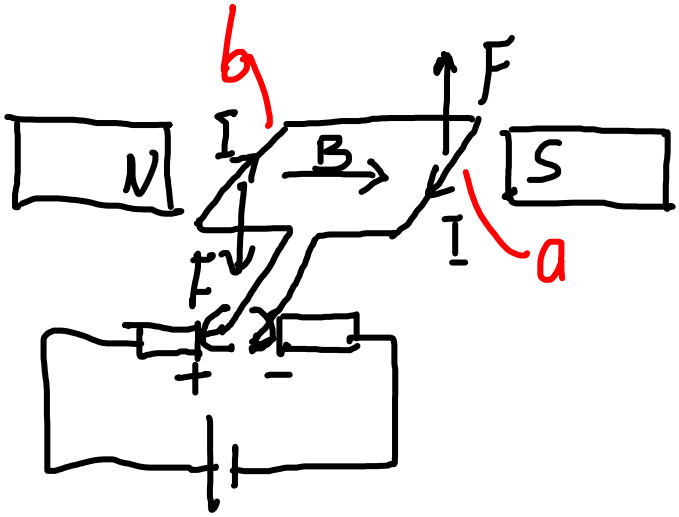


But
Can't rotate.
because force on each side always same direction, unless...



A split ring is attached to the coil and 2 carbon blocks attached to battery.

+, − halves of split rings change side

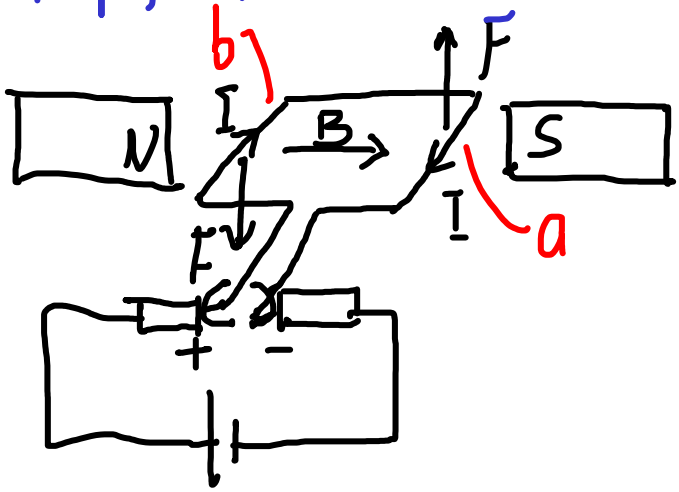


describe the action of a split-ring commutator in a two-pole, single-coil motor and the effect of winding the coil on to a soft-iron cylinder

Split-ring commutator

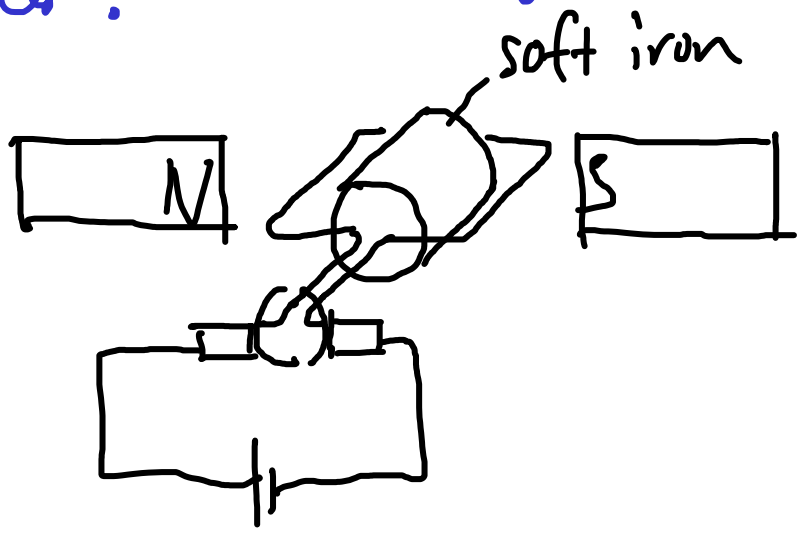
Dr K M Hock

When coil flips, force on each side also flips:



CAN ROTATE!

To make motor stronger, insert soft-iron cylinder:



Soft iron become induced magnet → extra field → stronger turning effect.

Then just connect coil/iron to wheel, fan, etc. to rotate.