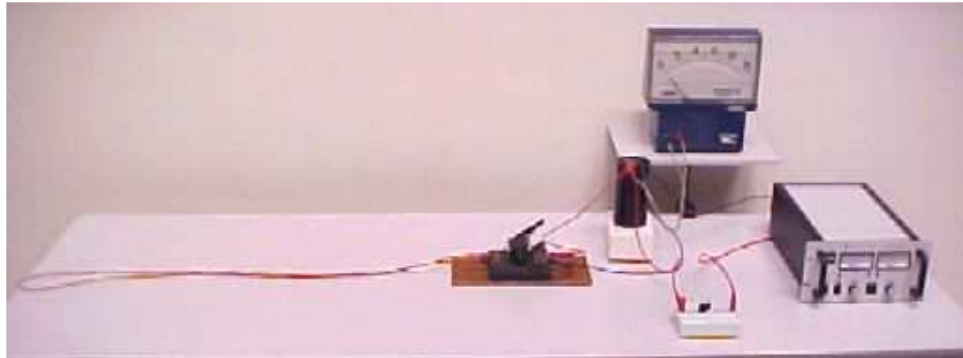


Force effect of current

Aim: To show that when a current is flowing in a wire, parts of the wire exert forces on one another.

Subjects: 5H40 (Force on Current Wires)

Diagram:



- Equipment:**
- Power supply, we use 1.2kV/.2A.
 - Capacitor, we use 2200 μ F/500Vdc.
 - Highcurrent switch.
 - Unipolar switch.
 - V-meter, large scale.
 - Wire, 2m.
 - Power supply, 100A.

Force effect of current

Presentation: First connect the 2m-wire to the 100A powersupply. Position the wire-parts close together (see Figure1A). Switch on the powersupply and see how the wire-parts move away from each other.

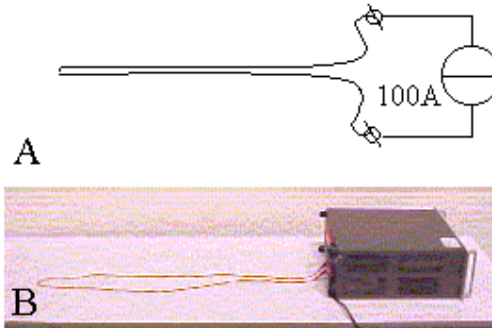


Figure 1

To make this effect stronger, we use the demonstration as shown in Diagram and Figure2A. First the capacitor is charged to 500V. Then switch S_1 is opened and the highcurrent switch is closed. The wire-parts fly away from each other (figure2B).

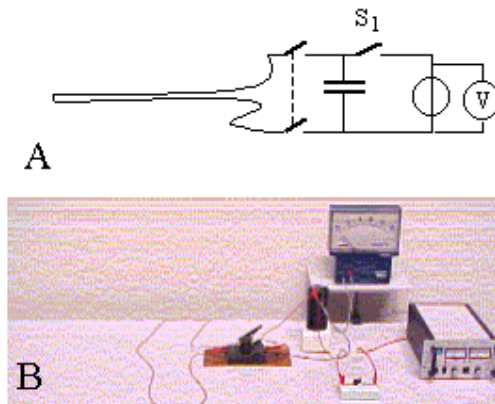


Figure 2

Ask the students what shape the wireloop would take if such a high current should flow continuously.

Explanation: The first part of the demonstration shows that opposing currents exert a repelling force on each other. Moreover, the demonstration shows how small this force effect of current is.

On this force effect the definition of the Ampere as the unit of electric current is based $\frac{\Delta F}{\Delta l} = 2 \times 10^{-7} \frac{I_1 I_2}{r}$. This demonstration, using $I_1 = I_2 = 100A$ and $\Delta l = 1m$ has to deal with a force of only $2 \cdot 10^{-3}N$. No wonder the displacement of the wire is small.

In the second part of the demonstration the current is much higher. Supposing the wire and contacts having a resistance of $.5\Omega$, a current of $1000A$ is flowing in the beginning of the discharge. Then the force on the wireloop is $.2N$. This hundredfold higher force exists only a short time. Not only F diminishes due to the increasing distance, but also due to the reducing discharge current (the circuit has a RC-time of about 1msec). Due to its impulse the wire-parts continue to move after the discharge (Figure2B).

If current should flow continuously the wire would take the shape of a perfect circle.

Force effect of current

- Remarks:
- Mind that when using the 100A powersupply that the 100A is not interrupted abruptly, because when this happens the high induced voltages can damage the powersupply.
- Sources:
- [Biezeveld, H. and Mathot, L., Scoop, Natuurkunde voor de bovenbouw, part 4/5 vwo](#), pag. 220
 - [Mansfield, M and O'Sullivan, C., Understanding physics](#), pag. 407 and 411