Application No. 1: The World's Simplest Electric Motor

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Four simple objects make a small motor

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Disc magnet S-15-08-N (www.supermagnete.de/eng/S-15-08-N)

An experiment was reported in the magazine **Physik in unserer Zeit** that totally amazed everyone at supermagnete.de. Just when we were coming to terms with our fascination for our own magnets we learned that, with one of our magnets and only 3 additional elements, it would be possible to build a small electric motor (homopolar motor). A mere 5 minutes later we had recreated the motor and could not stop ourselves from spinning the magnets. An incredible phenomenon!

Required material

- 1 iron screw
- 1 alkali battery
- 1 piece bared copper cord
- 1 disc magnet (www.supermagnete.de/eng/S-15-08-N) of your choice (detailed information below)

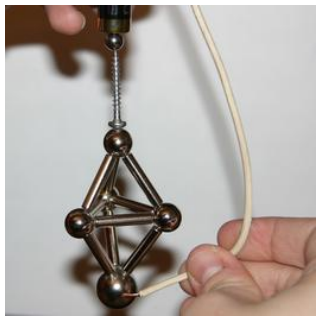
Assembly

Sphere magnet K-19-C (www.supermagnete.de/eng/K-19-C)

1. Connect the head of the screw with the disc magnet
2. Connect the tip of the screw with the negative pole (lower side) of the battery.
3. With the index finger, press the one bared side of the cord onto the positive pole (see photo below).
4. Grab the cord with the other hand and touch the magnet with the free end of the cord on the outer side

It worked best when we used a disc magnet with a diameter of at least 8 mm and a height of at least 3 mm. It definitely is more fun to do this experiment with larger magnets. If you already own a neodymium disc magnet, give it a try. The experiment also works with the rod and sphere magnets.

For Advanced Users



Endless variations are possible. Here again, a sphere K-19-C (www.supermagnete.de/eng/K-19-C) is brought into rotation. This is accomplished with a double tetrahedron made of connected rod magnets and steel spheres that rotates at an amazing speed.

Tips and Tricks

- **You can't get the magnet to rotate?** The most important thing, naturally, is that the circuit is closed. Make sure that the tip of the screw is in direct contact with the underside of the battery. During your first attempts, use larger magnets - success is usually easier to achieve with these.
- **The screw wobbles?** You have probably used a screw with a crooked tip. File the tip until it is straight or try another screw.
- **My rotating sculpture is too heavy; the magnetic pull is not strong enough to hold onto the battery.** Connect the battery and screw with a small sphere magnet, for example the K-08-C (www.supermagnete.de/eng/K-08-C) (shown in the last photo above).
- **Tip for the lesson [from our customer Michael Sexauer]:** "It's particularly impressive, and also visible to those students sitting in the back row, when a paper pinwheel is attached to the magnets. You get an instant fan!"

We have received permission from Wiley-VCH Verlag in Weinheim to publish the article (in German) on our website.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Homopolar motor with rotating wire

Addition from customer Maarten Duijnstee, Rotterdam (Netherlands):

Maarten Duijnstee, Physics Professor from Rotterdam, sent us an instructional experiment with a very simple electromagnetic motor and writes:

The homopolar motor is one of my favourite SuperMagnet-experiments. No soldering necessary, and the rotor can be formed out of a single piece of copper wire. Even children as young as 8 can make it.

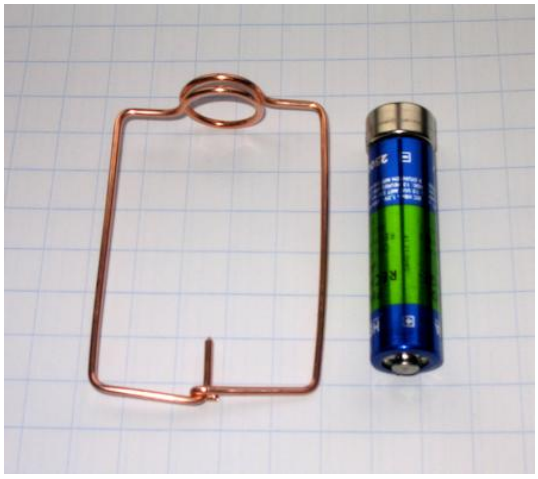
Material

- 1 S-15-08-N (www.supermagnete.de/eng/S-15-08-N)
- 1 normal AA battery
- 30 cm copper wire with 1 mm diameter, 30 cm long for the wire loop
- a small bowl with approximately 1 cm of water (optional, to ensure contact)

Tip: The copper wire can be made from a normal electrical cable with the isolation removed.

Instructions

1) First, form the circular portion of the wire loop by wrapping the wire around the magnet (one and a half wrappings). You can also use the battery to form the circular portion but you must be careful not to wrap too tightly or the loop won't fit over the somewhat larger magnet.



2) Bend the remainder of the wire into the shape shown in the photo. Then form the loop spike on which the battery will be placed.

The dimensions of the finished loop: 6 cm tall, 4,5 cm wide.

3) Place the magnet on the negative pole of the battery. If necessary you can make a small dent in the positive pole of the battery so that the spike can be better centered on it.

See the different versions of the homopolar motor in action:

YouTube Video: www.youtube.com/watch?v=xSeXdBCLWnU

Physical background

The homopolar motor is a nice experiment to demonstrate the so-called Lorentz force (www.supermagnete.de/eng/https://en.wikipedia.org/wiki/Lorentz_Force). This occurs when an electrically charged conductor is placed in a magnetic field. The direction in which the motor turns indicates where the north and south poles of the magnet are to be found.

Articles used

1 x S-15-08-N: Disc magnet Ø 15 mm, height 8 mm (www.supermagnete.de/eng/S-15-08-N)
1 x K-19-C: Sphere magnet Ø 19 mm (www.supermagnete.de/eng/K-19-C)
1 x K-08-C: Sphere magnet Ø 8 mm (www.supermagnete.de/eng/K-08-C)

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