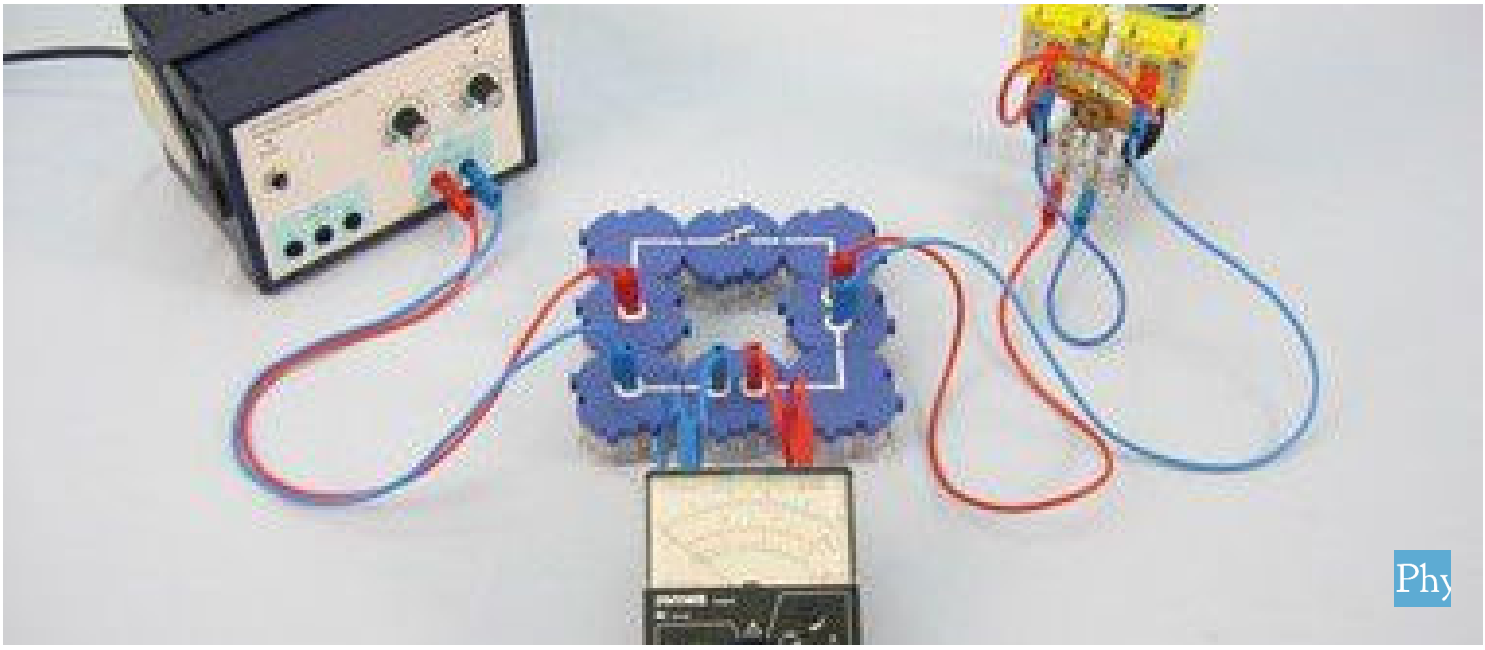
The shunt motor



With this experiment, the students should work out the basic construction and the functional principle of an electric motor with electromagnets.

Physics > Electricity & Magnetism > Electric generator, motor, transformer

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

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Teacher information

Application

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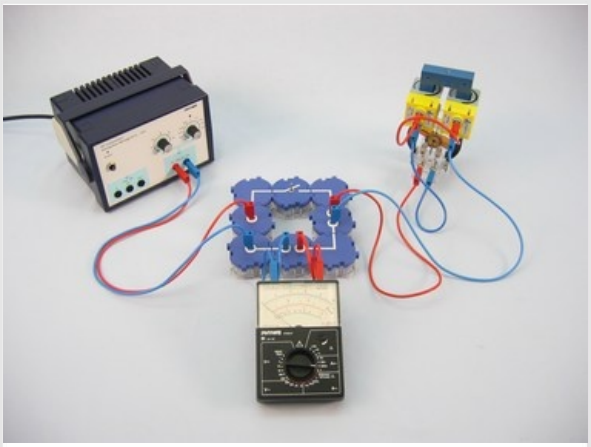

Test setup

An electric motor is an electromechanical transducer (electrical machine) that converts electrical power into mechanical power. In conventional electric motors, current-carrying conductor coils generate magnetic fields whose mutual attractive and repulsive forces are converted into motion. The electric motor is thus the counterpart to the generator, which has a very similar structure and converts motive power into electrical power.

Electric motors usually generate rotating movements, but they can also be designed for translational movements (linear drive). They are used to drive many devices, machines and vehicles.

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Other teacher information (1/2)

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Previous

The students should have gained first experimental experience in using the student power supply.

Principle

The rotary motion of an electric motor is based on the attractive and repulsive forces that several magnetic fields exert on each other (Lorentz force). In the usual electric motor there is a fixed outer part and an inner part rotating inside it. Either one of them has permanent magnets and the other electric coils, or both components have coils.

Other teacher information (2/2)

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Learning

With this experiment, the students should work out the basic construction and the functional principle of an electric motor with electromagnets.

Tasks

Build a model of an electric motor in which the permanent magnet is replaced by an electromagnet. Investigate the properties of the motor when the coils of the stator and the rotor are connected in series and in parallel, respectively.

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Safety instructions

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- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student Information

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Motivation

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An electric motor is an electromechanical transducer (electrical machine) that converts electrical power into mechanical power. In conventional electric motors, current-carrying conductor coils generate magnetic fields whose mutual attractive and repulsive forces are converted into motion. The electric motor is thus the counterpart to the generator, which has a very similar structure and converts motive power into electrical power.

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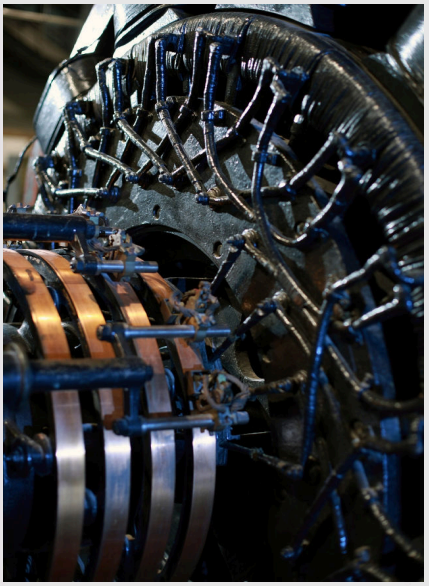

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Equipment

Position	Material	Item No.	Quantity
1	Straight connector module, SB	05601-01	1
2	Angled connector module, SB	05601-02	3
3	Interrupted connector module with sockets, SB	05601-04	1
4	Junction module, SB	05601-10	2
5	On-off switch module, SB	05602-01	1
6	Coil, 400 turns	07829-01	2
7	Iron core, U-shaped, laminated	07832-00	1
8	Motor model for student experiments	07850-10	1
9	Connecting cord, 32 A, 250 mm, red	07360-01	2
10	Connecting cord, 32 A, 250 mm, blue	07360-04	2
11	Connecting cord, 32 A, 500 mm, red	07361-01	2
12	Connecting cord, 32 A, 500 mm, blue	07361-04	2
13	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
14	Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1

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Structure and implementation

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- Build the model of the motor according to Fig. 3. Connect the windings of the armature and the electromagnet in parallel.
- Set up the experiment as shown in Fig. 1 and Fig. 2. Connect the ammeter directly to the power supply unit so that sufficient connecting leads are available. Select the measuring range of 3 A-.
- Turn on the power supply and set it to 5 V.
- Bring the armature into an inclined position. Close the switch and push the armature slightly if necessary. Observe the direction of rotation.

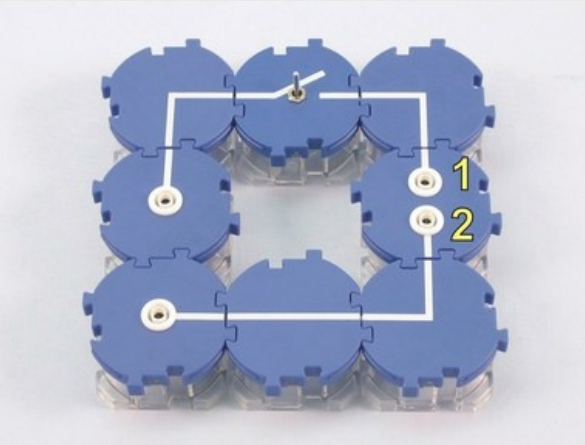

Fig. 1

Structure and implementation

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- Reverse the polarity of the operating voltage of the motor by swapping contacts 1 and 2. Observe the direction of rotation of the armature and compare it with the previous direction of rotation. Note your observations under "Result - Observations 1" in the protocol.
- Open the switch. Reverse contacts 1 and 2 again and now only reverse the connections on the armature. Close the switch. Observe the direction of rotation and note your observations under "Result - Observations 2" in the log.

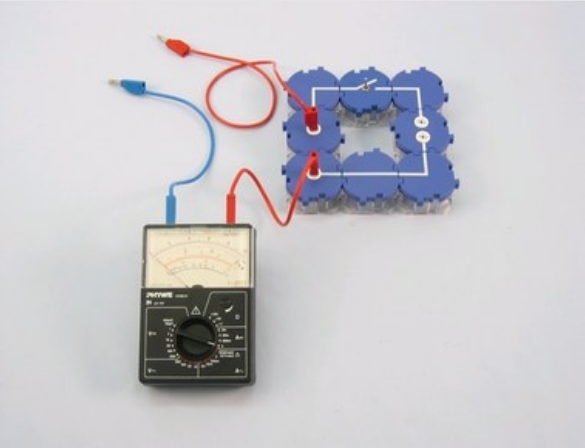

Fig. 2

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Structure and implementation

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- Vary the operating voltage between 4 V and 6 V and observe the speed. Note your observations under "Result - Observations 3" in the protocol.
- Set the operating voltage to 6 V- and load the motor. Brake the armature by finger pressure on the disc with the commutator. Observe the speed and the display of the ammeter. Note your observations under "Result - Observations 4" in the log and open the switch.

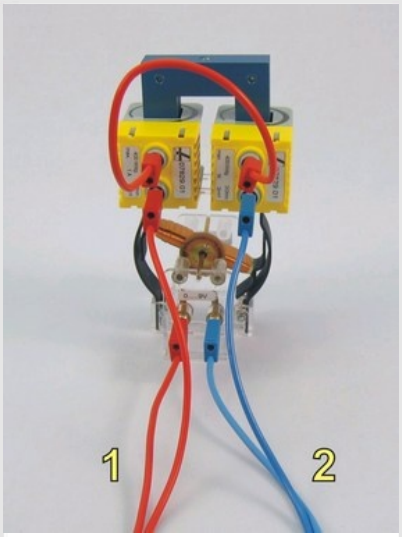

Fig. 3

Structure and implementation

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- Now switch the ammeter to the current branch with the armature (to check the armature current). Close the switch and load the motor again. Note your observations under "Result - Observations 5" in the log.
- Now switch the ammeter into the current branch with the two coils (to check the field current).
- Close the switch and load the motor again. Note your observations under "Result - Observations 6" in the log.
- Open the switch. Set an AC voltage of 6 V and select a measuring range of 3 A~. Close the switch and observe the motor. Note your observations under "Result - Observations 7" in the log.
- Turn off the power supply.

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Report

Observation (1/7)

Write down your observations.

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Observation (2/7)

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Write down your observations.

Observation (3/7)

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Write down your observations.

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Observation (4/7)

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Write down your observations.

Observation (5/7)

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Write down your observations.

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Observation (6/7)

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Write down your observations.

Observation (7/7)

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Write down your observations.

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Task (1/3)

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Why can a shunt motor be operated with direct current and with alternating current?

This motor is constructed like a DC series motor and can in principle also be operated on DC. When connected to _____, both the exciter field and the _____ reverse direction simultaneously at each half-wave. Thus the _____ is maintained.

AC

direction of rotation

armature field

Check

Task (2/3)

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How to change the direction of rotation?

The polarity of the armature must be reversed.

The direction of rotation cannot be changed.

What can be expected in terms of direction of rotation if you reverse the polarity of the field coils instead of the armature?

The direction of rotation is also changed.

The direction of rotation does not change.

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Task (3/3)

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How do the field current strength (current strength in the coils of the electromagnet) and the armature current strength change under load?

Slide	Score / Total
Slide 21: Type of debt collection	0/3
Slide 22: Multiple tasks	0/2

Total score 0/5

Show solutions | Repeat | Export text

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