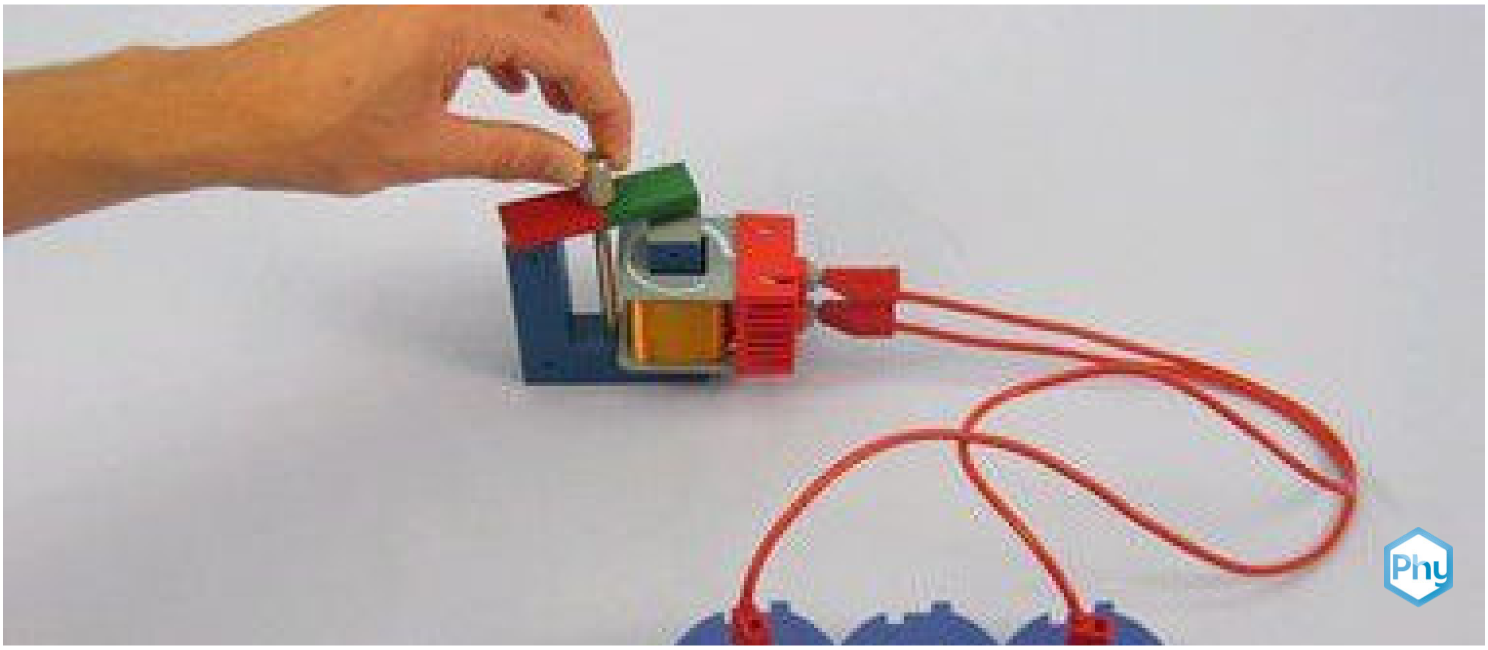
The alternator



The pupils are already familiar with a simple alternating current generator, the bicycle dynamo, the operating principle of which is to be worked out in this experiment.

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

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

This content can also be found online at:

http://localhost:1337/c/617aabe98e47ed0003a82b71

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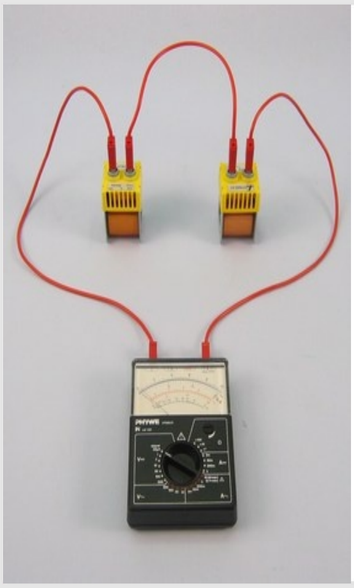
Teacher information

Application



Test setup

An alternator or alternator is a particular embodiment of an electrical generator used to produce single-phase alternating current.

Since there is no commutation in this type of generator, unlike the DC generator, an alternating current is generated whose frequency is proportional to the rotor speed. The most widely used alternator is the bicycle dynamo, which operates according to the generator principle designed by Hippolyte Pixii.

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Other teacher information (1/2)

Previous

The fact that a voltage is induced in a coil as long as the magnetic field encompassed by the coil changes is assumed to be known by the students.

Principle

The change in magnetic flux through an electrical conductor induces an electric current in it. A rotating magnetic field induces an alternating current.

Other teacher information (2/2)

Learning

The pupils are already familiar with a simple alternating current generator, the bicycle dynamo, the operating principle of which is to be worked out in this experiment.

Tasks

Build a simple model of an alternator and use it to explain how alternating current is technically generated.

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Safety instructions

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

Student Information

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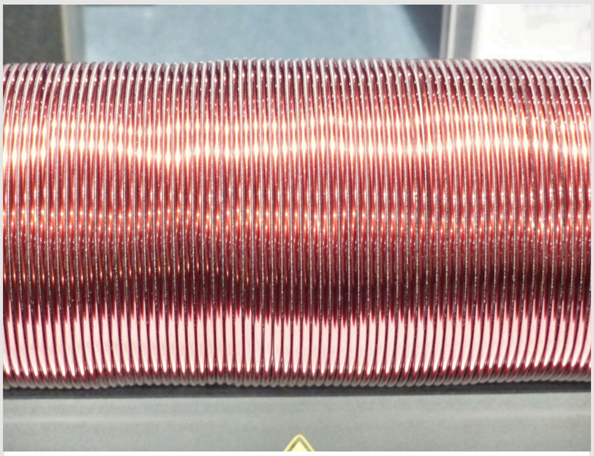
Motivation

An alternator or alternator is a particular embodiment of an electrical generator used to produce single-phase alternating current.

Since there is no commutation in this type of generator, unlike the DC generator, an alternating current is generated whose frequency is proportional to the rotor speed. The most widely used alternator is the bicycle dynamo, which operates according to the generator principle designed by Hippolyte Pixii.



Coil

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Equipment

Position	Material	Item No.	Quantity
1	Junction module, SB	05601-10	2
2	Socket module for incandescent lamp E10, SB	05604-00	1
3	Coil, 400 turns	07829-01	2
4	Coil, 1600 turns	07830-01	1
5	Iron core, U-shaped, laminated	07832-00	1
6	Rotating stem	07836-00	1
7	magnet, l = 72mm, rodshaped, colored poles	07823-00	1
8	Connecting cord, 32 A, 250 mm, red	07360-01	1
9	Connecting cord, 32 A, 250 mm, blue	07360-04	1
10	Connecting cord, 32 A, 500 mm, red	07361-01	2
11	Filament lamps 4V/0.04A, E10, 10	06154-03	1
12	Analog multimeter, 600V AC/DC, 10A AC/DC, 2 MΩ, overload protection	07021-11	1

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Structure and implementation

- Set up the experiment according to Fig. 1.
- Move the pointer of the measuring instrument from the zero position as far as possible to the right. (Adjusting screw on the underside of the measuring instrument).
- Select the measuring range 100 mV / 50 μA .
- Screw the Mangeten tightly onto the rotating handle.
- Place the magnet between the two coils so that the poles are about 1 cm away from the coils. Cf. fig. 2.

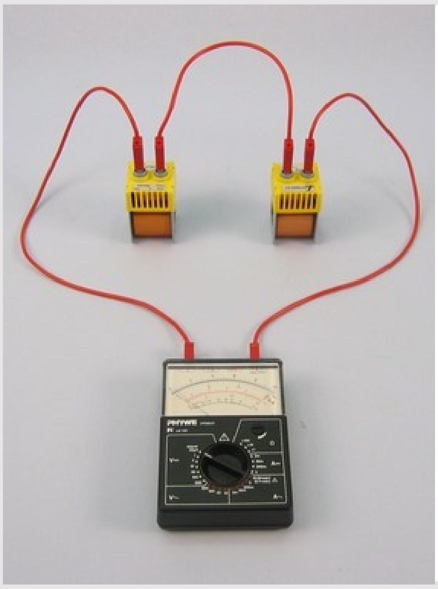

Fig. 1

Structure and implementation

- Rotate the magnet at different speeds and observe the measuring instrument. Note your observations under "Result - Observations 1" in the protocol.
- Push an I-core into one of the coils (cf. Fig. 3) and rotate the magnet again. Observe the measuring instrument. Note your observations under "Result - Observations 2" in the protocol.
- Turn the magnet slowly and observe how often the pointer of the measuring instrument moves to the left and to the right during one full turn of the magnet. Note your observations under "Result - Observations 3" in the protocol.

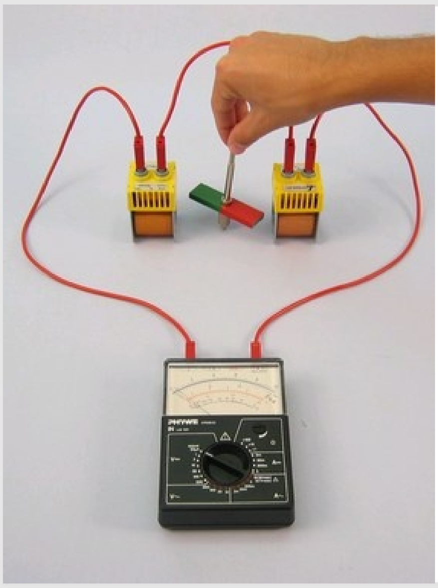

Fig. 2

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Structure and implementation

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- Turn the magnet as fast as possible and observe the deflection of the measuring instrument. Compare with the previous deflection and note your observations under "Result - Observations 4" in the protocol.
- Instead of the two coils with 400 turns each, connect 1 coil with 1600 turns to the measuring instrument (see Fig. 4). Push the yoke into the coil and turn the magnet next to the coil. Compare the pointer deflection with that of (2) and note your observations under "Result - Observations 5" in the protocol.

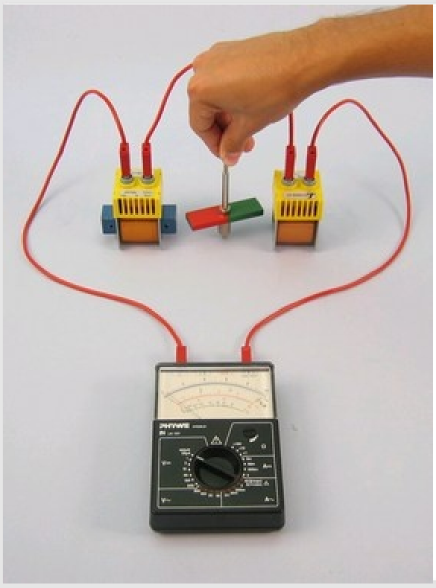

Fig. 3

Structure and implementation

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- Place the coil with 1600 turns on the U-core. Connect a lamp socket with a 4 V / 0.04 A incandescent lamp to the coil.
- Insert the thin end of the rotating stem with magnet into the U-core (see Figs. 5 and 6). Choose a distance of approx. 5 mm. Let the magnet rotate very fast, observe the lamp and note your observations under "Result - Observations 6" in the protocol.

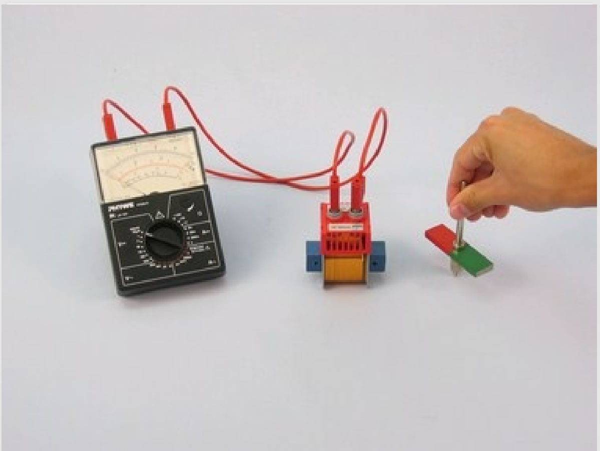

Fig. 4

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Structure and implementation

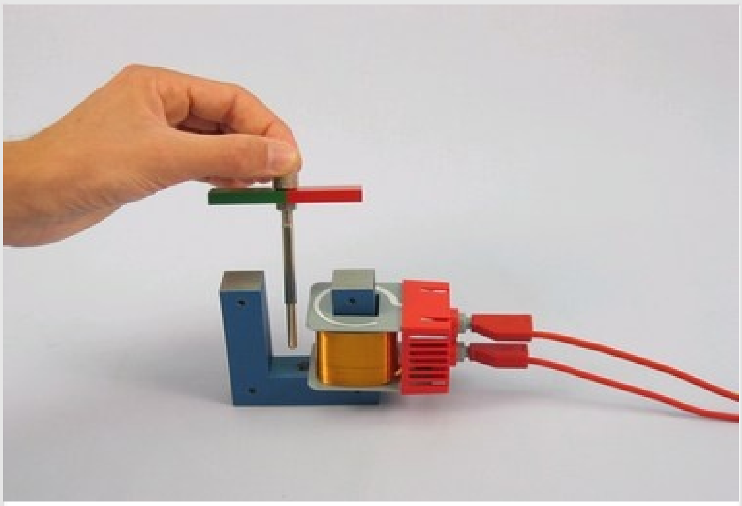

Fig. 5

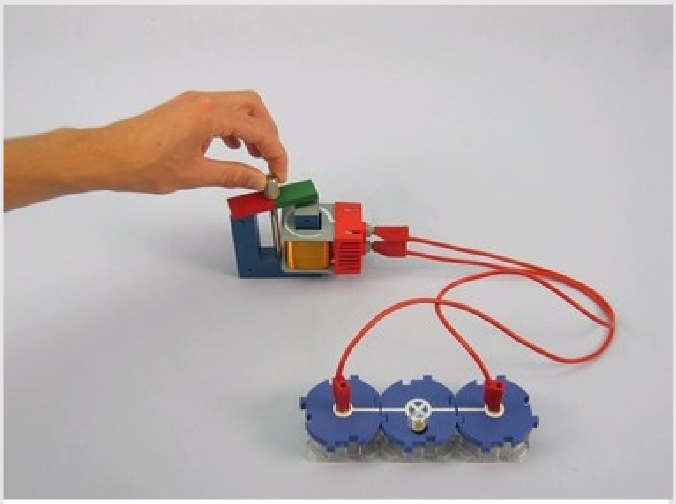

Fig. 6

Report

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Observation (1/6)

Write down your observations.

Observation (2/6)

Write down your observations.

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Observation (3/6)

Write down your observations.

Observation (4/6)

Write down your observations.

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Observation (5/6)

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Write down your observations.

Observation (6/6)

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Write down your observations.

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Task (1/4)

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What follows from the observation that the pointer of the measuring instrument oscillates around its rest position during the rotation of the magnet?

- A DC voltage is induced.
- No voltage is induced.
- An alternating voltage is induced.

Task (2/4)

PHYWE

Explain the observation noted under "Result - Observations 2".

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Task (3/4)

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Why may an instrument for measuring DC current (or DC voltage) not be used for measurements in the AC circuit?

- High frequencies can damage the device.
- The device cannot reproduce the amplitude of the AC voltage.
- Information about the AC voltage is lost.

Task (4/4)

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Explain the observation noted under "Result - Observations 5".

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Slide	Score / Total
Slide 21: Pendulum	0/1
Slide 23: Measuring devices	0/1

Total score 0 / 2

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