Conversion of electrical energy into kinetic energy

Physics > Energy > Energy forms, conversion & conservation

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/6167de062d1cf30003518beb

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Teacher information

Application

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Charging process of a motor vehicle driven by an electric motor

Electric motors are capable of converting electrical energy into kinetic energy and are therefore used in many areas of technology.

Electric motors usually consist of a rotor (the drive shaft) and a stator (a fixed body). The rotor is often equipped with one or more coils. The stator is usually a permanent magnet.

If these coils are energized, an electromagnetic field is created which generates a moment at the stator due to repulsion or attraction forces (Lorentz force), so that the drive shaft of the motor is set in rotation.

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Other teacher information (1/2)

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Previous knowledge

The students should already have a sound basic knowledge of the physical quantities such as current, voltage, force and torque in order to be able to complete the experiments regarding the electric motor. In addition, they should already have knowledge about the magnetic fields of permanent and electromagnets.

Scientific principle

Electric motors are often made up of several so-called conductor coils. If these are energised, a magnetic field is generated which causes the drive shaft to rotate due to attractive and repulsive forces. Thus, the electric motor serves as a converter of electrical energy into mechanical energy. The force acting through a magnetic field is also referred to as the Lorentz force.

Other teacher information (2/2)

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Learning objective

The experiment is intended to demonstrate how electrical energy is converted into kinetic energy in an electric motor.

Tasks

An electric motor converts electrical energy into mechanical energy. In this experiment, students will investigate how the electric motor converts electric current into rotary motion.

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Safety instructions

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

Notes on structure and implementation:

When installing the pole shoes, make sure that the coil can move freely between them and that the pole shoes do not touch the iron core even in the horizontal position.

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Motivation

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Charging process of a motor vehicle driven by an electric motor

Electric motors are very important drive components in all areas of technology. Whether in rail vehicle technology, energy generation or now also in the vehicle industry. They are used to convert electrical energy (current) into mechanical energy (motion).

An example of this that is now very well known is electric vehicles, which can be seen more and more on the roads. The illustration shows an electrically powered car whose batteries are being recharged.

The batteries store the electricity that runs the car's electric motors.

Tasks

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In an electric motor, electrical energy is converted into mechanical energy.

In this experiment, you will investigate how motion is created from electricity.

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Equipment

Position	Material	Item No.	Quantity
1	Student set Electric motor / Generator, TESS advanced Physics	15221-88	1
2	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up

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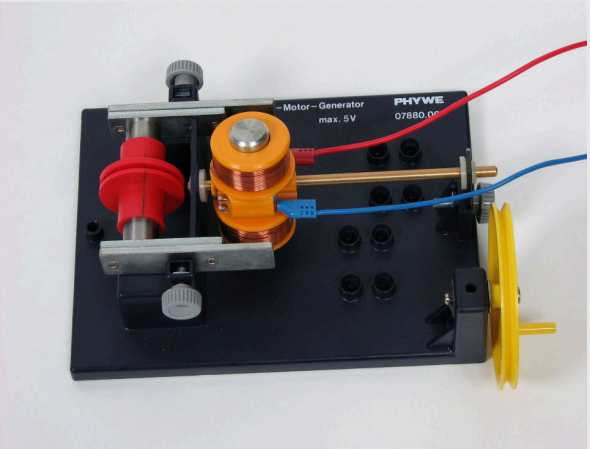

Experimental setup of the schematically reproduced electric motor

Set up the experiment as shown in the figure opposite.

Make sure that the coil can move freely between the pole pieces. A DC voltage of $4...4,5V$ created

(Attention! Use red sockets of the coil!).

The coil must be vertical and the current is switched off.

Procedure

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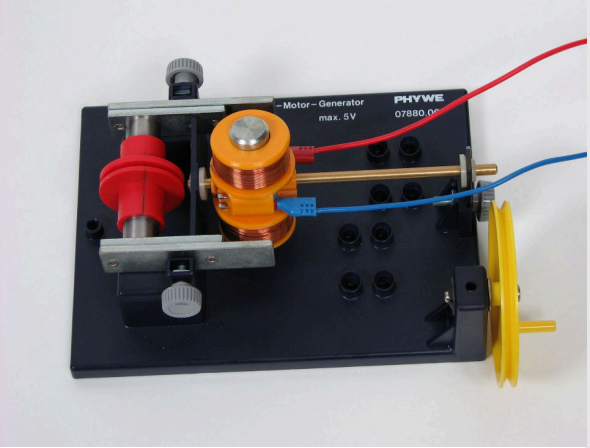

Experimental setup of the schematically reproduced electric motor

Experiment 1:

- Turn the power on. What do you observe? Write down your observations in the protocol.

Experiment 2:

- Interrupt the current and reverse the current supply at the DC voltage source. Place the coil vertically again. Make sure that the same half of the coil is at the top as in the first measurement.
- Turn the power back on. Observe carefully if anything changes and if so, what?

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Report

Task 1

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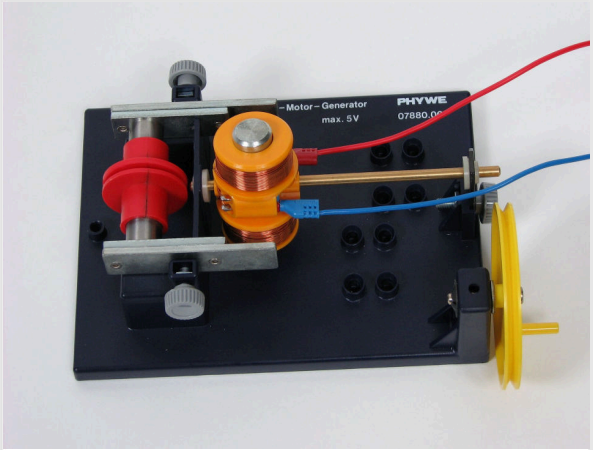

Experimental setup of the schematically reproduced electric motor

What was your observation during the 1st experiment?

- ○ The coil has moved 90° rotated to the horizontal position.
- ○ The coil did not move during the test.
- ○ The coil has moved 180° turned.

Check

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Task 2

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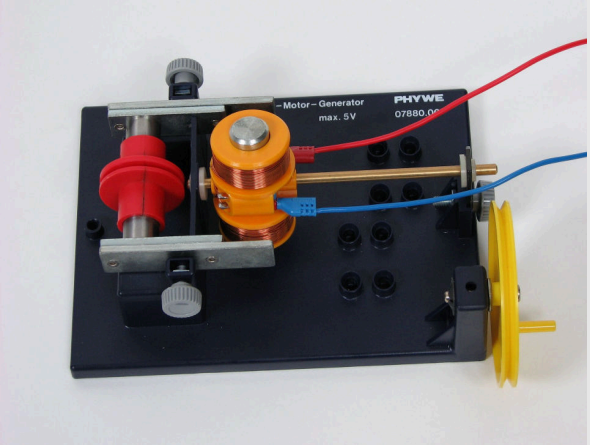

Experimental setup of the schematically reproduced electric motor

What was your observation during the 2nd experiment?

The _____ has again moved to the horizontal _____. In this experiment, however, in the opposite _____ compared to the 1st experiment. The _____ did not move.

coil | position | direction | permanent magnet

Check

Task 3

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What decides the direction of rotation of the coil?

When a _____ is passed through the _____, it has a _____, just like a _____. Since like poles _____ and unlike poles _____ each other, the coil aligns itself so that the _____ of the coil is close to the south pole of the pole-shoe magnet. The same is true for the _____ of the coil and the north pole of the pole-shoe magnet.

north/south pole | south pole | current | magnet | repel | attract | coil | north pole

Check

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Task 4

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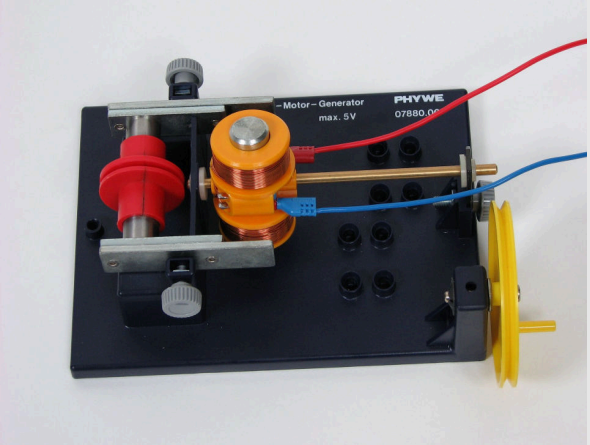

Experimental setup of the schematically reproduced electric motor

What is the effect of reversing the polarity of the coil?

- [ ] By reversing the polarity, the north and south poles of the coil magnetic field are reversed.
- [ ] The pole reversal causes the magnetic field lines of the coil to turn around.
- [ ] Reversing the polarity of the coil changes the direction of the current.

Check

Task 5

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The coil has moved during the test only by 90° rotated. Think about how you can achieve a full rotation of the coil. Drag the words into the correct boxes!

To achieve a full rotation, you must reverse the polarity of the _____ at the moment it has rotated to the _____ position. The south pole of the coil then becomes a _____ and the north pole becomes a _____. This will then cause _____ poles to be next to each other. The _____ will then continue to turn half a _____ until _____ poles are adjacent again. This can be repeated as often as desired.

south pole
horizontal
north pole
coil
opposite
turn
rotor
equal

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Slide	Score / Total
Slide 13: Observation: Experiment 1	0/1
Slide 14: Observation: Experiment 2	0/4
Slide 15: Conclusion	0/8
Slide 16: Conclusion 2	0/3
Slide 17: Conclusion 3	0/8

Total 0 / 24

Solutions Repeat

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