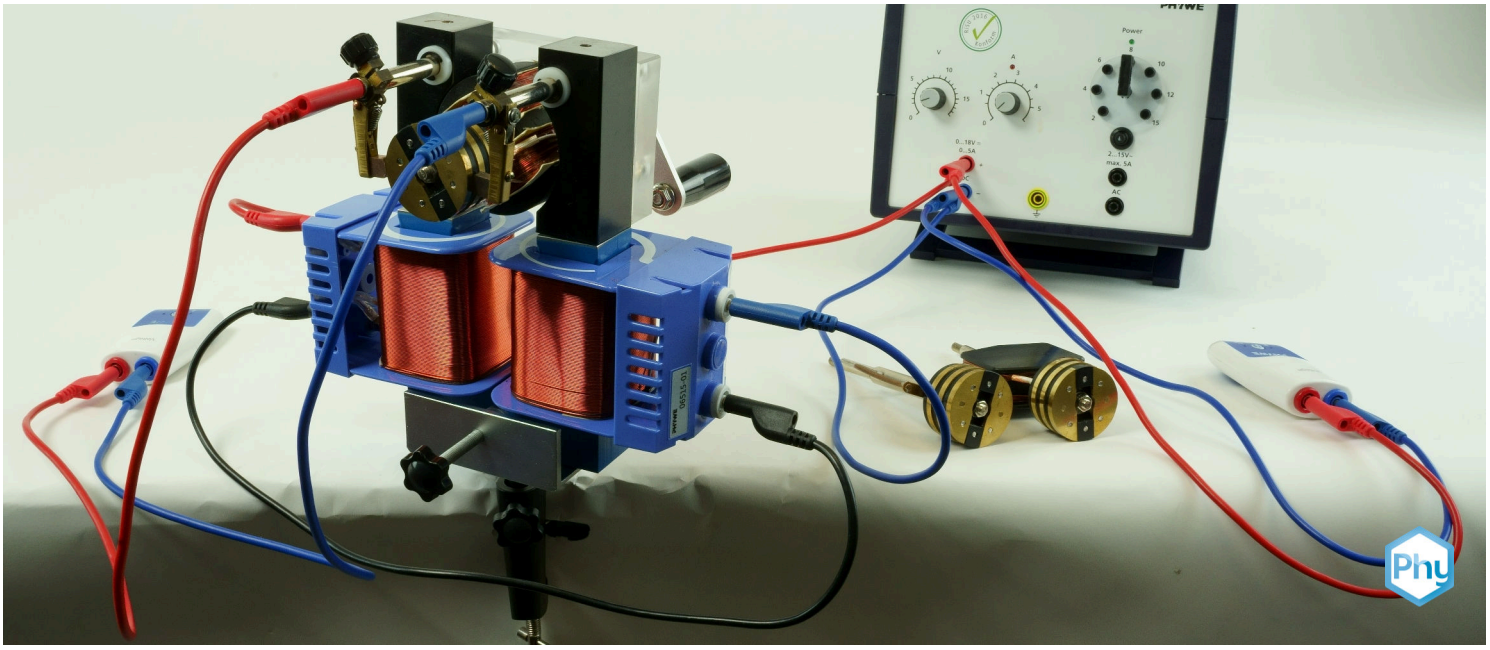
Comparison of the rotor coils (DEMO)



Physics > Electricity & Magnetism > Electromagnetism & Induction

Difficulty level	Group size	Preparation time	Execution time
medium	-	10 minutes	20 minutes

This content can also be found online at:

http://localhost:1337/c/6493027a7844c30002a65ea0

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Teacher information

Application

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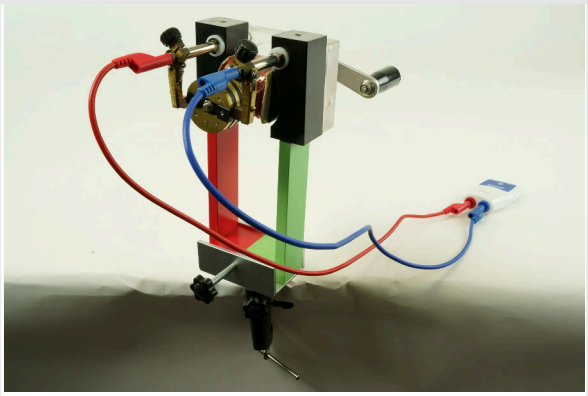

Experimental setup

An electrical generator is an electrical machine that converts kinetic energy into electrical energy. The generator is the counterpart to the electric motor, which converts electrical energy into kinetic energy. It is based on the principle of electromagnetic induction discovered by Michael Faraday in 1831.

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Other teacher information (1/2)

PHYWE

Prior knowledge

No prior knowledge is required.

Principle

In this experiment, individual components of a direct current generator are tested. In the first part of the experiment, the effect of the number of turns of the rotor coil is examined. In the second part, an electromagnet is installed instead of a permanent magnet and the voltage of the electromagnet is examined.

Other teacher information (2/2)

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Learning objective

Students should understand how a DC generator works.

Tasks

Investigate the dependence of the induction voltage on the number of turns of the rotor coil.

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Student information

Motivation

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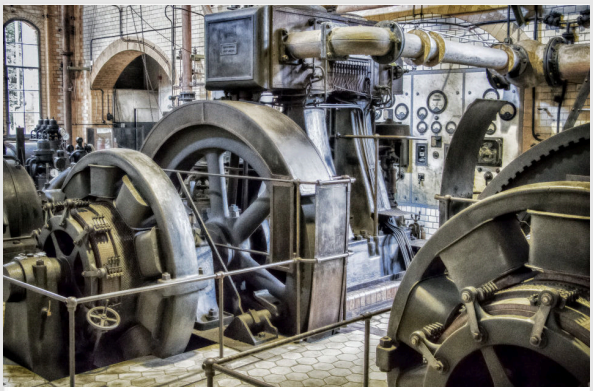

Historical generator

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Equipment

Position	Material	Item No.	Quantity
1	PHYWE Power supply, universal, analog display DC: 18 V, 5 A / AC: 15 V, 5 A	13503-93	1
2	Bench clamp	02012-00	1
3	Plate holder, opening width 2 - 35 mm	06509-00	1
4	U-magnet, large, U-shaped, limb length 130 mm, colored poles	06320-00	1
5	Motor set	06550-00	1
6	Cord pulley	06558-01	1
7	Crank handle	06559-01	1
8	Rotor coil, Double-T armature	06554-00	1
9	Rotor coil,10 turns	06552-00	1
10	Rotor coil,1 turn	06551-00	1
11	Iron core, U-shaped, laminated	06501-00	1
12	Coil, 1200 turns	06515-01	2
13	Connecting cord, 32 A, 750 mm, red	07362-01	3
14	Connecting cord, 32 A, 750 mm, blue	07362-04	3
15	Connecting cord, 32 A, 750 mm, black	07362-05	1
16	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-01	2
17	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (1/4)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

Set-up (2/4)

Experiment part 1:

- Assemble the motor attachment according to fig. 1 and fig. 2.
- Push the axle [1] of the double T-anchor into the bearing hole [3] of the motor attachment, screw it tight with the pulley [2] and put the crank on the pulley.
- Place the abrasive brushes [4] of the motor attachment on the interrupted slip ring [7] as shown in Fig. 2 and fasten them with the knurled screws [5] so that the springs are tensioned and the brushes press on the slip rings.

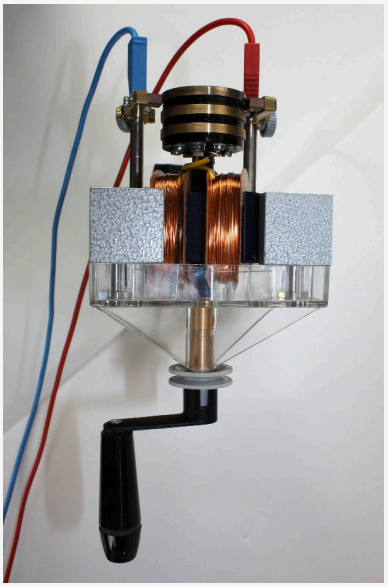

Fig. 1

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Set-up (3/4)

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- Tighten the knurled screws [5]. This establishes the electrical contact between the armature coils and the connection sockets [6].
- Set up the experiment according to Fig. 3.

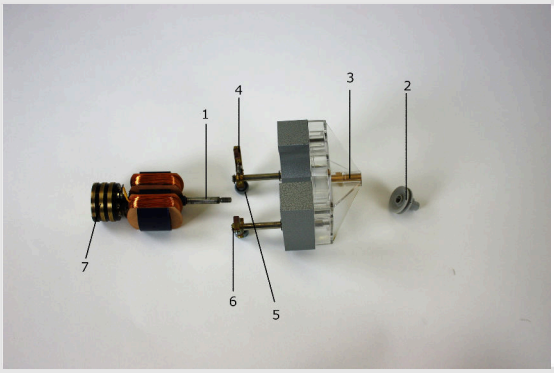

Fig. 2

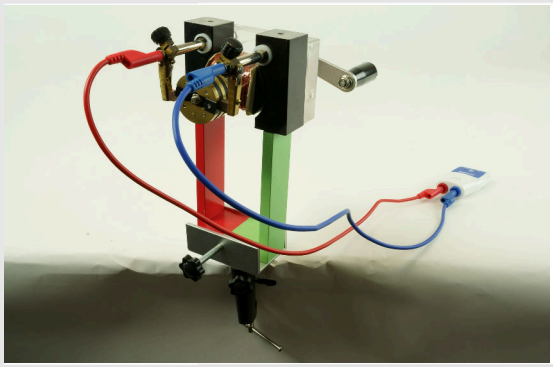

Fig. 3

Set-up (4/4)

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Experiment part 2:

- Set up the experiment according to Fig. 4.
- Assemble the motor as in experiment part 1 (fig. 1 and 2).
- Place the coils (1200 turns) on the iron core and connect them in series with the power supply unit (direct current).
- Connect the second SMARTsense sensor in parallel to the voltage source.

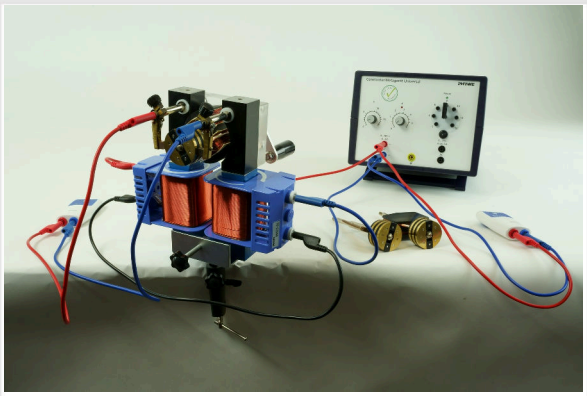

Fig. 4

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Procedure (1/3)

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Cobra SMARTsense

- Switch on the SMARTsense sensors and make sure that the end device can connect to Bluetooth devices.
- Open the PHYWE measureApp and select the "Voltage" sensors. sensors.
- Select the sampling rate of your choice. The higher the sampling rate, the more accurate the measurement.

Procedure (2/3)

PHYWE

Experiment part 1:

- crank at constant speed and observe the induced voltage in the measuring software.
- Rebuild the generator. Insert the rotor coil with 10 turns.
- crank at about the same speed as with the double-T armature and again observe the induced voltage in the measuring software.
- Rebuild the generator again. Insert the rotor coil with 1 turn.
- crank again at about the same speed and observe the induced voltage in the measuring software.
- Compare the induced voltages.

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Procedure (3/3)

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Experiment part 2:

- Crank with constant speed.
- Limit the current at the power supply unit to 1 ampere and increase the voltage at the power supply unit in 4 V steps. Record the induction voltage for each 4 V step with the measuring software.
- Rebuild the generator and repeat the experiment with the rotor coil with 10 turns and 1 turn.
- Compare your results.

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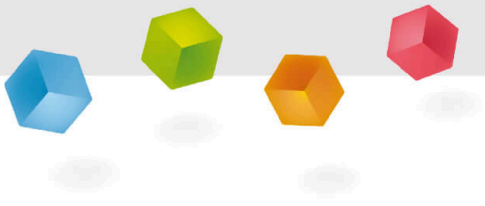

Report

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Task (1/5)

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Measured values test part 1:

	Double T anchor	Rotor coil 10 turns	Rotor coil 1 turn
U_{ind} [mV]			

Task (2/5)

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Measured values test part 2:

U_0 [V]	Double T	Rotor coil 10 turns	Rotor coil 1 turn
0			
4			
8			
12			
16			

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Task (3/5)

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What is the dependence between induction voltage and supply voltage?

- proportional
- No dependence
- antiproportional

Task (4/5)

PHYWE

Drag the words into the correct boxes!

The _____ has 2 times 300 turns. From point 2, this should produce an _____ 60 times higher than the _____ with _____ turns. However, the induced voltage is much higher. The reason for this is the _____ of the double-T armature.

- 10
- induction voltage
- rotor coil
- iron core
- double-T armature

Check

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Task (5/5)

PHYWE

Drag the words into the correct boxes!

The _____ is _____ with a higher _____, as well as with a higher supply voltage, since you have to crank _____.

- clearly noticeable
- more forcefully
- number of turns
- mechanical energy

Check

Slide	Score / Total
Slide 18: Induced voltage dependencies	0/2
Slide 19: Observation on the double T anchor	0/5
Slide 20: Mechanical energy	0/4

Total score 0 / 11

Show solutions | Repeat | Export text

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