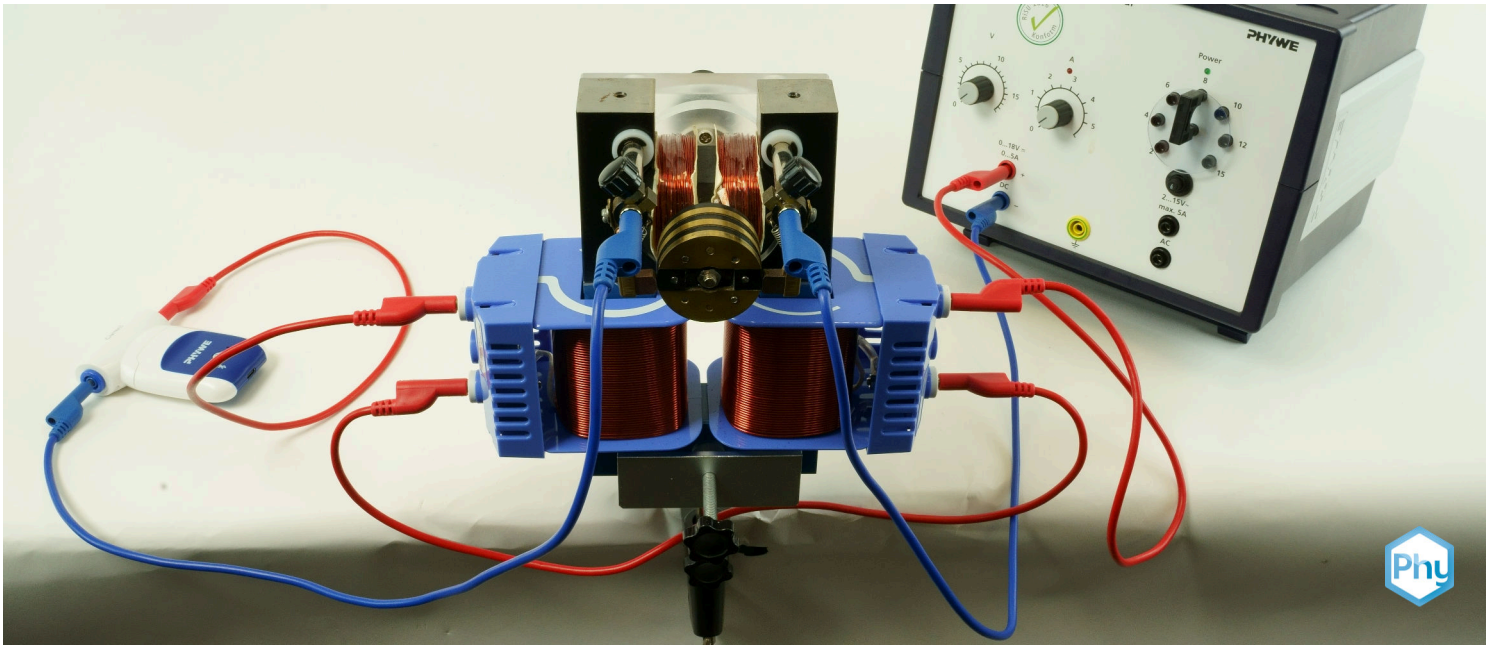
The series motor (DEMO) with Cobra SMARTsense



Physics > Electricity & Magnetism > Electromagnetism & Induction

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

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/647641eba4c6900002803dd9

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Teacher information

Application

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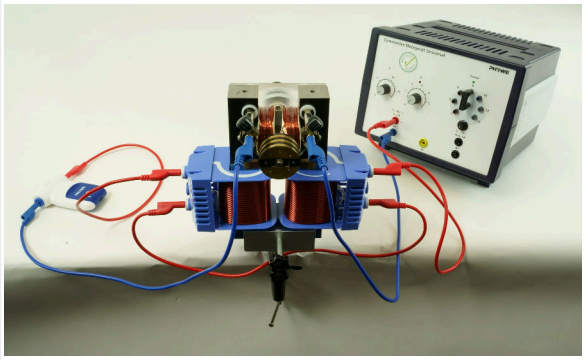

Experimental setup

Electric motors are installed in many machines. Be it the electric car or the electric toothbrush. In addition to a permanent magnet, an electric motor can also be operated with an electromagnet. If armature coils and field coils are connected in series, then it is a main shunt motor.

The properties of this motor are investigated by observing the direction of rotation and measuring the current. In this experiment, the principle of the main shunt motor is clarified.

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Other teacher information (1/2)

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Prior knowledge

No prior knowledge is required.

Principle

The attraction and repulsion of magnetic fields causes the motor to rotate. The external magnetic field is generated by the coils connected in series. The T-armature also forms a magnetic field, which is reversed at the right time with the help of a commutator.

Other teacher information (2/2)

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Learning objective

The students should understand how a main shunt motor works.

Tasks

Investigate how a main shunt motor works with direct current.

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Student information

Motivation

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Electric motors are installed in many machines. Be it the electric car or the electric toothbrush. In addition to a permanent magnet, an electric motor can also be operated with an electromagnet. If armature coils and field coils are connected in series, then it is a main shunt motor.

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An electric car

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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	Cobra SMARTsense High Current - Sensor for measuring electric current ± 10 A (Bluetooth + USB)	12925-00	1
3	Bench clamp	02012-00	1
4	Plate holder, opening width 2 - 35 mm	06509-00	1
5	Iron core, U-shaped, laminated	06501-00	1
6	Coil, 300 turns	06513-01	2
7	Motor set	06550-00	1
8	Rotor coil, Double-T armature	06554-00	1
9	Cord pulley	06558-01	1
10	Connecting cord, 32 A, 750 mm, red	07362-01	3
11	Connecting cord, 32 A, 750 mm, blue	07362-04	2
12	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up (1/3)

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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 (2/3)

- Assemble the motor attachment according to Fig. 1.
- Push the axle [1] of the double T-anchor into the bearing hole [3] of the motor attachment and screw it tight with the cord washer [2].
- Place the abrasive brushes [4] of the motor attachment against the interrupted copper ring [7], tighten the knurled screws [5] slightly upwards so that the spring of the lever arms is tensioned. This presses the brushes firmly onto the copper ring. The electrical contact between the armature coils and the connection sockets [6] is established.

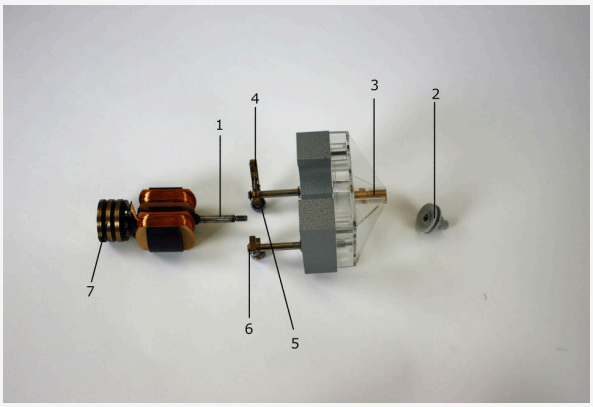

Fig. 1

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Setup (3/3)

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- Complete the set-up according to Fig. 2 and Fig. 3.
- Clamp the iron core with holder in the bench clamp.
- Place the coils and motor attachment on the iron core.
- Set the DC voltage at the power supply unit to 0 V-.
- Connect field coils and armature coil in series and connect the motor to the power supply unit via the meter.

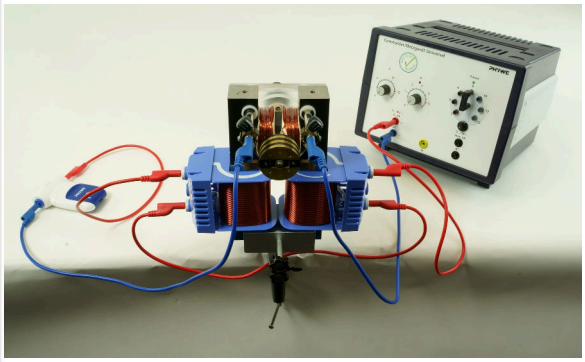

Fig. 2

Procedure (1/2)

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Cobra SMARTsense

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

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Procedure (2/2)

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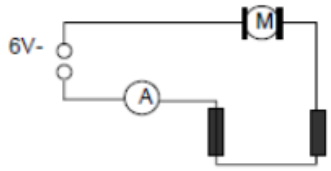

Fig. 3

- Set the voltage to approx. 6 V-, you may have to "start" the motor by turning it.
- Change the voltage. Observe the speed and the recorded measurement signal.
- Set the voltage to 0 V-. Reconnect the operating voltage at the power supply unit. Increase the voltage and observe the direction of rotation.
- Set the voltage to 0 V-. Reverse the voltage at the terminals of the armature coil. Increase the voltage and observe the direction of rotation.
- Load the motor by pressing on the pulley with your finger. Observe the speed and the recorded measurement signal.

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Report

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Task (1/6)

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How does the speed of the motor and the amperage change as the voltage increases?

- The speed changes little, the amperage increases.
- The speed increases, the current changes little.
- The speed and the current increase.
- The speed and the amperage change little.

Task (2/6)

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By reversing the polarity of the operating voltage...

- ... the direction of rotation remains constant.
- ... the engine stops.
- ... the direction of rotation changes.

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Task (3/6)

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If the direction of current only changes in the armature coil,...

- ... the engine stops turning.
- ... the direction of rotation remains constant.
- ... the direction of rotation changes.

Task (4/6)

PHYWE

With increased load...

- ... the speed of the motor decreases and the current increases.
- ... the speed of the motor increases and the current decreases.
- ... the speed of the motor decreases and the amperage decreases.
- ... the speed of the motor increases and the amperage increases.

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Task (5/6)

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Drag the words into the correct boxes!

If an _____ is used to operate an _____, it must generate a sufficiently large _____ in the vicinity of the armature. Therefore, a U-shaped iron core with two field coils is used, between whose poles the armature runs. The _____ and field coils are connected in _____ in a main shunt motor (Fig. 3).

series
electric motor
electromagnet
armature coils
magnetic field

Check

Task (6/6)

PHYWE

Drag the words into the correct boxes!

When the polarity of the _____ is reversed, both the field of the armature coil and that of the _____ are reversed, so that the _____ remains the same. If, on the other hand, only the _____ of the armature coil changes, then only this magnetic field changes its _____ and thus also the direction of rotation.

current direction
direction
field coils
sense of rotation
operating voltage

Check

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Slide	Score / Total
Slide 14: Engine speed	0/1
Slide 15: Reversing the polarity of the operating voltage	0/1
Slide 16: Current direction of the armature coil	0/1
Slide 17: Behaviour under load	0/1
Slide 18: Main shunt motor	0/5
Slide 19: Reverse polarity behaviour	0/5

Total score 0 / 14

Show solutions Repeat

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