Main and shunt motor

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

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/617aaacb8e47ed0003a82b15

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Teacher information

Application

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Tramway (tram) of the city of Berlin driven by a series-wound motor

So far, only electric motors consisting of a permanent magnet and an electromagnet have been investigated. However, it is possible to design both the rotor and the stator as electromagnets. This means that both the rotor and the stator are provided with coils (windings) so that the electromganetic field can be generated.

A further distinction is made between shunt-wound motors (rotor and stator connected in parallel), series-wound motors (rotor and stator connected in series) and the main shunt-wound motor (a special design of the series-wound motor).

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

Previous

Students should already understand the basic operating principle of the DC electric motor and the synchronous motor.

Principle

The basic principle of the series or shunt motor is the same as that of the DC or synchronous motors. However, they differ in that both the stator and the rotor are represented as a coil and thus as an electric motor and consequently must be energized. In the case of the shunt-wound motor, both coils are connected in parallel, whereas in the case of the series-wound motor, the stator and rotor are connected in series.

Other teacher information (2/2)

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Learning

In this experiment, students will learn and understand the basic structure and operation of the main and shunt motors.

Tasks

The students are to build an electric motor whose stator and rotor consist of an electromagnet. For this, they build different variants of the motor:

1. two different variants of the shunt motor
2. a variant of the in-line or main-sequence motor.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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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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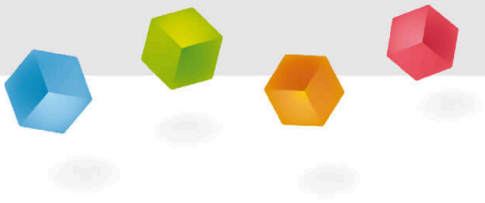

Student Information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

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Tramway (tram) of the city of Berlin driven by a series-wound motor

In contrast to electric motors with built-in permanent magnets, such motors can also be built with two electromagnets. This form of electric motor is available in different variants. These are on the one hand the shunt motor, in which the coils are connected in parallel, and on the other hand the series motor, in which the coils are connected in series. Due to their different characteristics. the motors are used for different purposes depending on the application. Trams, for example, are often operated with series motors, as these have a large so-called starting torque.

Tasks

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In this experiment you will learn about the functional principle of the so-called shunt and series motors and the advantages of the different designs.

For this purpose you will build and examine different varieties of electric motors:

1. two different variants of the shunt motor
2. a variant of the in-line or main-sequence motor.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
www.phywe.de

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
3	Connecting cord,15A,25cm, red	07313-01	1
4	Connecting cord,15A,25cm, blue	07313-04	1

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Tel.: 0551 604 - 0
Fax: 0551 604 - 107
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Additional material

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Position	Equipment	Quantity
1	Lubricating oil	

Structure & Implementation (1/4)

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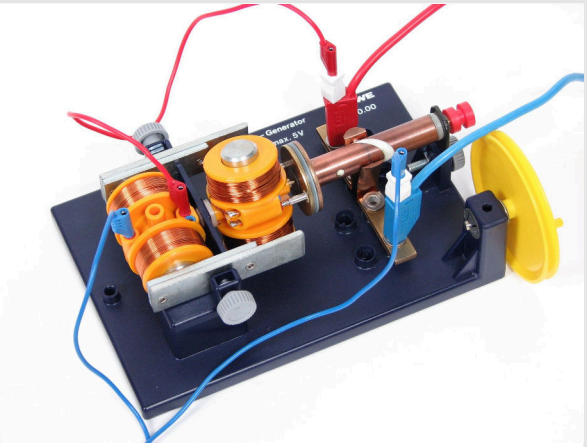

Experimental setup: Shunt motor 1

ATTENTION!

Make sure during the entire experiment that the DC or AC voltage $5 - 6\,V$ and you're only ever going to get **red** sockets of the coil as connections.

Experiment 1, shunt motor 1:

- Assemble the electric motor as shown in the figure.
- In the initial position, the rotor should be vertical.
- Apply a DC voltage of about $5\,V$ and watch the engine.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Structure & Implementation (2/4)

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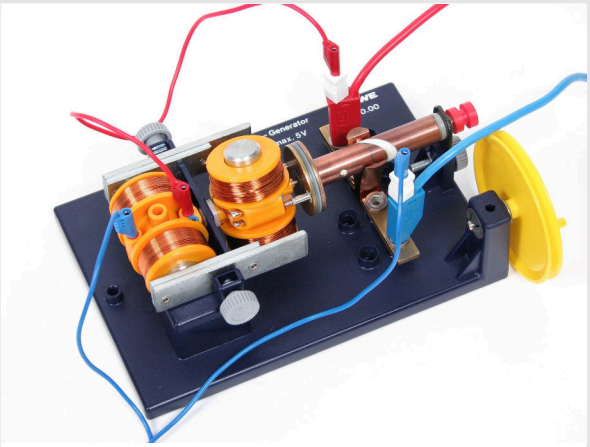

Experimental setup: Shunt motor 1

- Experiment 1: Shunt motor 1
- Reverse the polarity of the leads leading to the coil in the stator. Put again $5\,V$ DC voltage on and observe.
- Consider which electromagnet is regularly reversed in polarity.
- Now check whether the motor also works with alternating voltage by connecting it to an alternating voltage source. $6\,V$ ...and you're gonna have to hook it up. You may have to give the rotor a push until it runs on its own. Observe the behavior of the motor.

Structure & Implementation (3/4)

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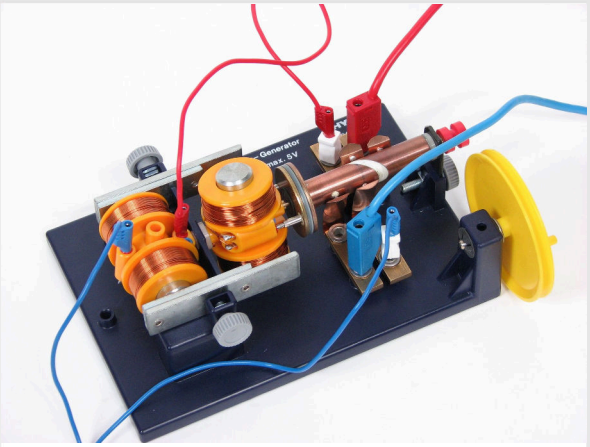

Experimental setup: Shunt motor 2

Experiment 2: Shunt motor 2

- Reassemble the electric motor shown in the figure (note the contacts on the commutator) and test it using the same procedure as for shunt motor 1. To do this, apply a DC voltage of $5\,V$ and watch the engine.
- Reconnect the poles and apply a DC voltage again. $5\,V$ on. Which electromagnet is reversed in polarity?
- Check whether the motor can also be operated with AC voltage.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Structure & Implementation (4/4)

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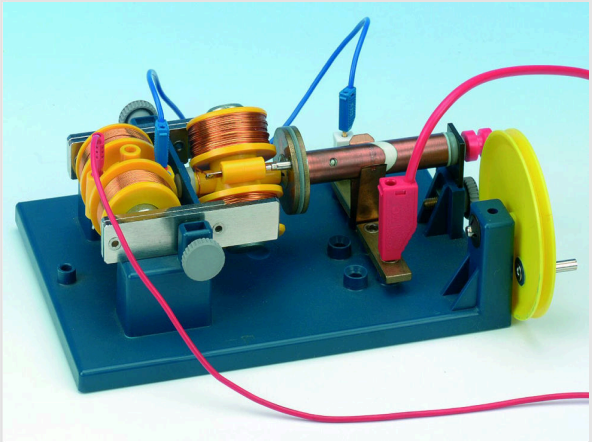

Experimental setup: series-wound motor

(main shunt motor)

Experiment 3: Main shunt motor

- Also in this experiment, build the electric motor shown in the illustration and examine it using the known procedure.
- Apply a DC voltage $5\,V$ and watch the engine.
- Reverse the polarity of the leads and reapply a DC voltage... $5\,V$ on. Which electromagnet is reversed in polarity?
- Again, check whether the motor can also be operated with AC voltage.

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Report

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Task 1

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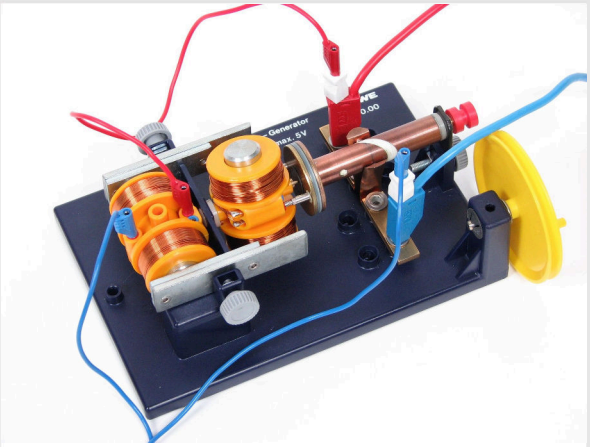

Experimental setup: Shunt motor 1

What was your observation during the 1st attempt? (shunt motor 1)

- Shunt motor 1 could not be operated with either direct or alternating current.
- Shunt motor 1 could only be operated with direct current.
- Shunt motor 1 could only be operated with alternating current.
- Shunt motor 1 could be operated with direct current as well as with alternating current.

Task 2

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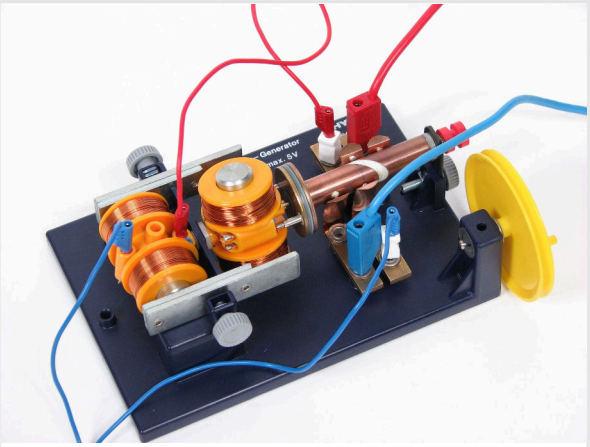

Experimental setup: Shunt motor 2

What was your observation during the 2nd attempt? (shunt motor 2)

- Shunt motor 2 could be operated with direct current as well as with alternating current.
- Shunt motor 2 could not be operated with either direct or alternating current.
- Shunt motor 2 could only be operated with alternating current.
- Shunt motor 2 could only be operated with direct current.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

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Task 3

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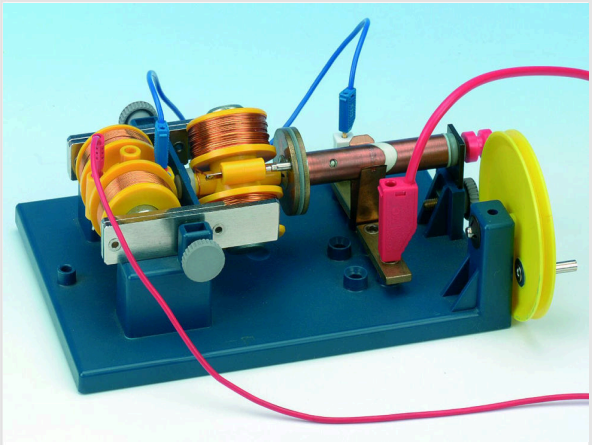

Experimental setup: series-wound motor

What was your observation during the 3rd attempt? (series-wound motor)

- The series-wound motor could be operated with both direct and alternating current.
- The series-wound motor could not be operated with either direct or alternating current.
- The series motor could only be operated with direct current.
- The series-wound motor could only be operated with alternating current.

Task 4

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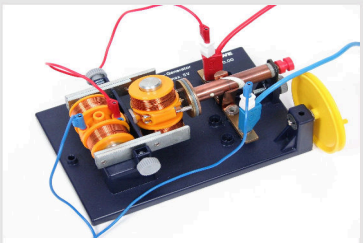
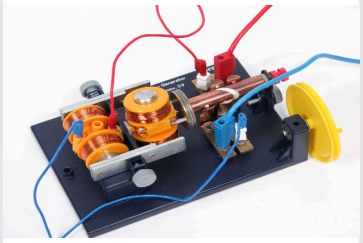


Shunt motor 1



Shunt motor 2

What is the effect of reversing the polarity of the stator with DC voltage?

By _____ the _____ of the applied current is changed. Thus the _____ of the _____ is also reversed.

direction of rotation | rotor | sign | reversing the polarity

Check

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Task 5

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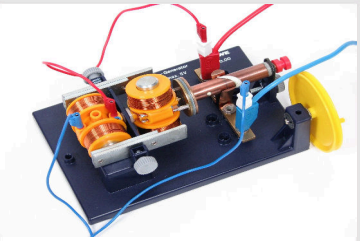
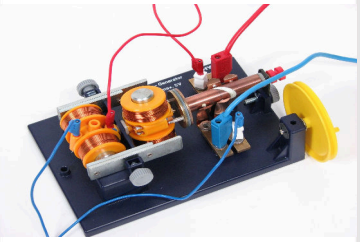


Shunt motor 1



Shunt motor 2

Which electromagnet is reversed in polarity in each case during the experiments on the shunt motor when operated with DC voltage?

- ☐ Shunt motor 1: Rotor
- ☐ Shunt motor 1: Stator
- ☐ Shunt motor 2: Stator
- ☐ Shunt motor 2: Rotor

Check

Task 6

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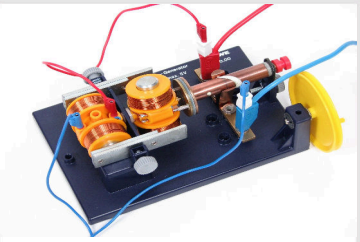
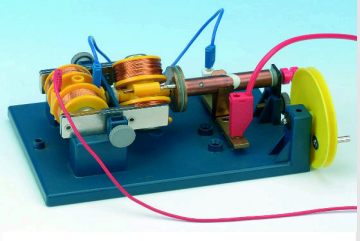


Shunt motor 1



In-line motor

What is the main technical difference between a series engine and a shunt engine?

In the shunt motor, the two electromagnets are connected _____, whereas in the series motor they are connected _____.

in parallel | in series

Check

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
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Task 7

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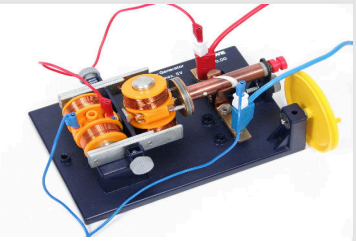
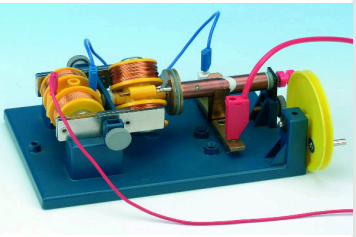


Shunt motor 1



In-line motor

What is the advantage of the two types of engines?

- [ ] The shunt motor can be operated with both direct and alternating current.
- [ ] The series-wound motor can be operated with both direct and alternating current.
- [ ] The series motor has a constant speed under load.
- [ ] The shunt motor has a constant speed under load.

Check

Slide	Score / Total
Slide 16: Observation: Experiment 1	0/1
Slide 17: Observation: Experiment 2	0/1
Slide 18: Observation: Experiment 3	0/1
Slide 19: Conclusion 1	0/4
Slide 20: Reverse polarity shunt motor	0/2
Slide 21: Untitled: Drag Text	0/2
Slide 22: Advantages	0/2

Total 0 / 13

Solutions Repeat

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de