The main circuit motor (Item No.: P1398600)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Electricity
Subtopic: Electric generator, motor, transformer
Experiment: The main circuit motor

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

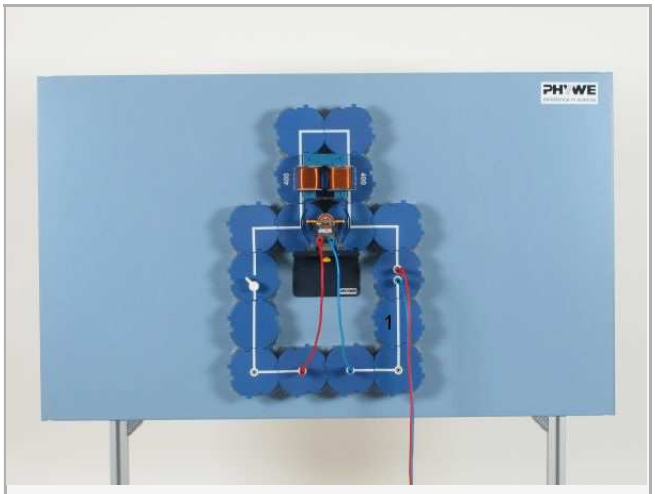
Experiment Variations:

Keywords:

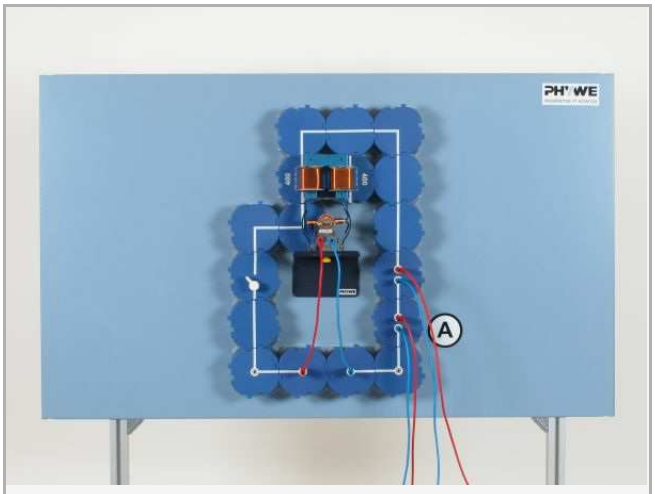
Principle and equipment

Principle

A model of a motor is to be used to demonstrate the construction and functioning of a main circuit motor.



Experimental set-up Part 1



Experimental set-up Part 2

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Motor model f. magnet board	07850-20	1
5	Coil 400 turns, module DB	09472-01	2
6	Switch on/off, module DB	09402-01	1
7	U-core	07832-00	1
8	Connector interrupted, module DB	09401-04	2
9	Junction, module DB	09401-10	2
10	Electr.symbols f.demo-board,12pcs	02154-03	1
11	Connector, straight, module DB	09401-01	4
12	Connector, angled, module DB	09401-02	6
13	Connector, angled with socket, module DB	09401-12	2
14	Holder f.electr.motor,magn.board	07849-00	1
15	Connecting cord, 32 A, 1000 mm, red	07363-01	2
16	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
17	Connecting cord, 32 A, 500 mm, red	07361-01	1
18	Connecting cord, 32 A, 500 mm, blue	07361-04	1

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Set-up and procedure

- Set up the experiment as shown in Fig. 1 with the switch open; place the motor model on the holder and screw it tight, then position it below the coil with the U-core

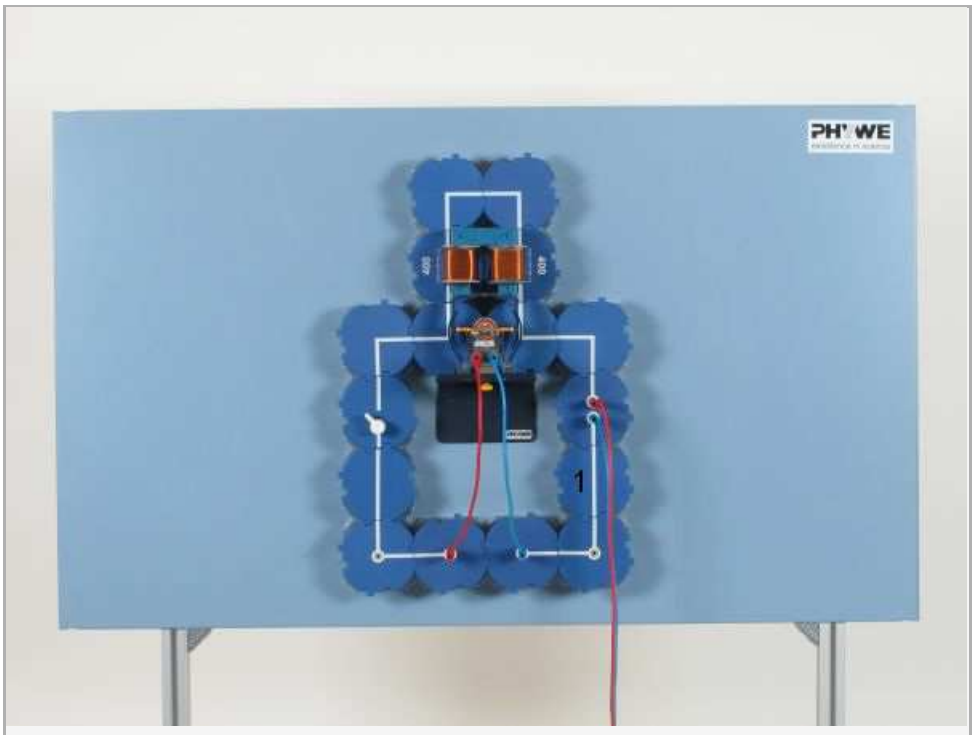

Fig. 1

- Apply a voltage of 6 V- and adjust the armature of the motor to an inclined position
- Close the switch; give the armature a slight push if necessary and notice the direction of rotation of the armature
- Open the switch and reverse the polarity of the operating voltage
- Close the switch; notice the direction of rotation of the armature and compare it with the direction previously determined (1)
- Open the switch and reverse the polarity of the operating voltage back to the original polarity; reverse the armature connections
- Close the switch; notice the direction of rotation of the armature and compare it with the direction that it had to start with (2)
- Vary the operating voltage between 4 V and 6 V and note the direction in which thearmature rotates (3)
- Open the switch; replace the straight building block marked 1 by an interrupted building block and an ammeter with a measurement range of 300 mA-
- Again set and operating voltage of 6 V and place a load on the motor by finger braking the front belt pulley; observe the speed of rotation and the behaviour of the ammeter (4)
- With the switch open, change the experimental set-up to that in Fig. 2; switch one of the two field coils out of the circuit and set the 3 A- measurement range
- Apply a voltage of 15 V-, close the circuit and observe the motor (5)

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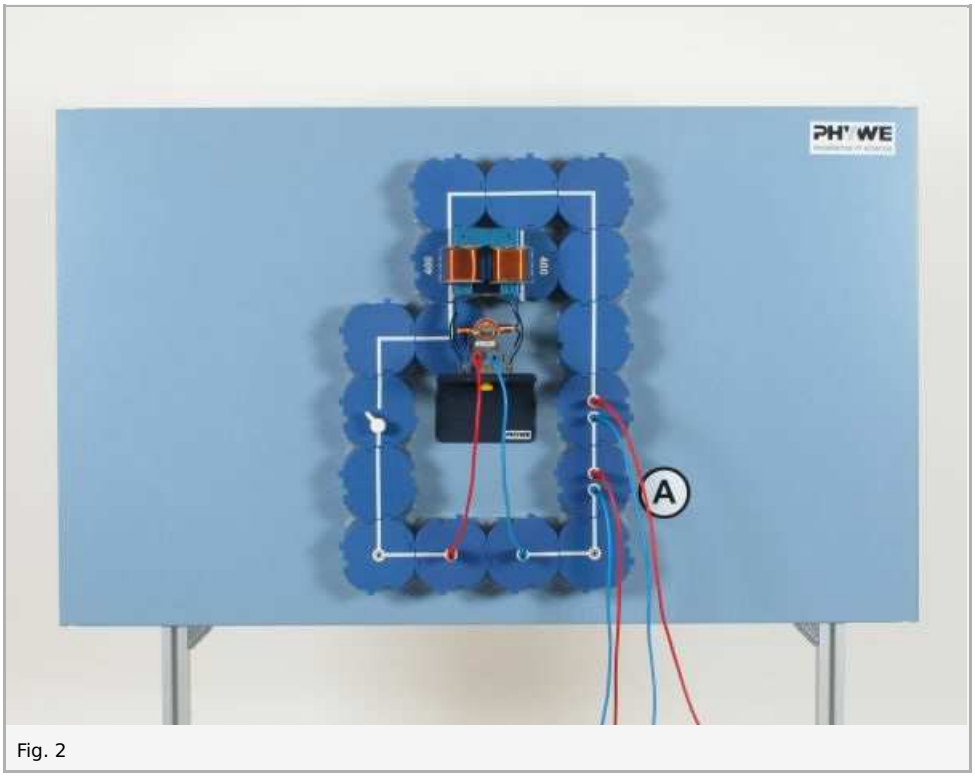

Fig. 2

Observation and evaluation

Observation

1. The direction of rotation of the armature does not change when the polarity of the operating voltage is reversed.
2. With unchanged operating voltage, the direction of rotation is reversed when the polarity of the armature is reversed.
3. The speed of rotation of the motor is greater the higher the operating voltage
4. With increasing load on the motor, the lower the speed of the motor and the higher the operating current
5. The motor also runs when it is operated with alternating current

Evaluation

The motor used in this experiment is operated as a main circuit motor. It has the field winding and the armature winding switched in series and is therefore called a series circuit or main circuit motor.

The direction of rotation of the armature only changes when the polarity of either the field winding or the armature winding is reversed. The direction of rotation is not changed when the polarity of the operating voltage is reversed because, through this, the polarity of the field winding and the armature winding is reversed.

This is why the motor can be used with both direct current and alternating current. All poles are then always simultaneously changed. Because it can be operated with both direct current and alternating current, the main circuit motor is also sometimes called an all-current motor.

Its speed of rotation increases with increasing operating voltage.Its operating current increases with increasing load; this results in a larger moment of rotation and so a higher performance of the motor.

Remark

The exclusion of a field coil in alternating current operation is necessary, as otherwise, with the 15 V- available, a sufficient operating current would not be reached.

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