The Shunt-Wound Motor (Demo) (Item No.: P1433505)

Curricular Relevance

Area of Expertise:	Education Level:	Topic:	Subtopic:	Experiment:
Physics	Age 16-19	Electricity	Electric generator, motor, transformer	The Shunt-Wound Motor (Demo)

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	1 Student

Additional Requirements:

- Demonstration multimeter
- Power Supply

Experiment Variations:

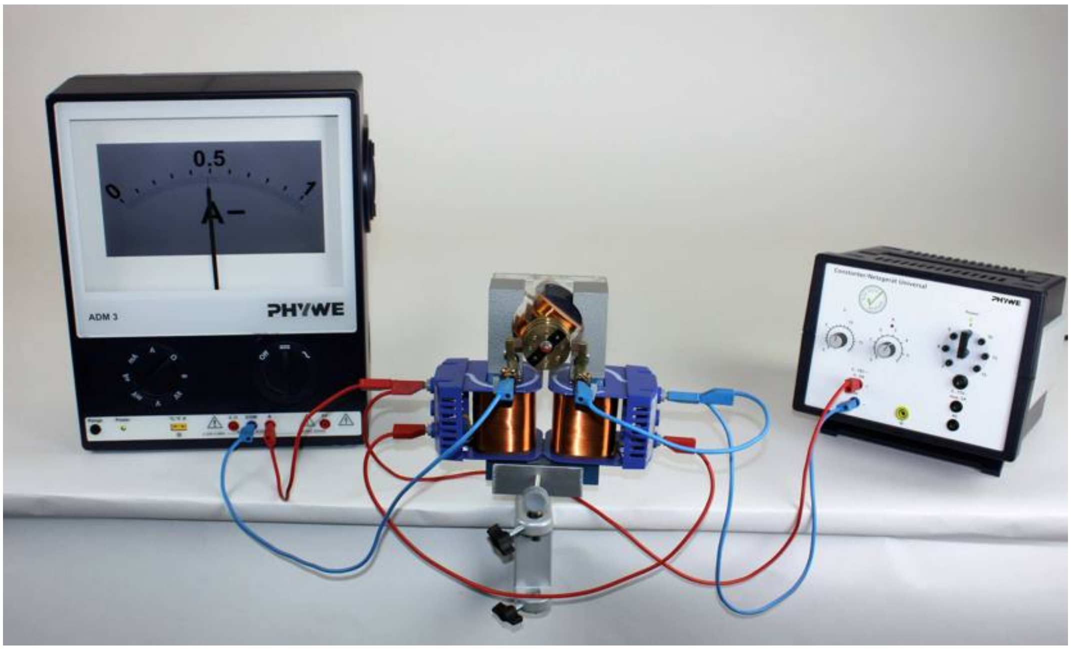
Keywords:

AC electric motor, electric motor

Information for teachers

Introduction

An electromotor can also be operated with an electromagnet besides a permanent magnet. If armature coils are connected parallel to the field coils, then this is called a shunt-wound motor. The properties of this motor are studied by observing the direction of rotation and measuring the electric current.



Equipment

Position No.	Material	Order No.	Quantity
1	Bench clamp expert	02011-00	1
2	Holder for U-magnet	06509-00	1
3	Iron core, U-shaped, laminated electric steel	06501-00	1
4	Coil, 1200 turns	06515-01	2
5	Motor set	06550-00	1
6	Double-T armature	06554-00	1
7	Cord pulley	06558-00	1
8	Connecting cord, 32 A, 750 mm, red	07362-01	3
9	Connecting cord, 32 A, 750 mm, blue	07362-04	3
10	PHYWE Demo Multimeter ADM 3: current, voltage, resistance, temperature	13840-00	1
11	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13504-93	1

Safety information

For this experiment, the general instructions for safe experimentation in scientific teaching apply.

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Introduction

Application and Task

In case of the shunt-wound motor, the electromagnet is connected in parallel to the motor. The shunt-wound motor is often used when the rotational speed needs to be contant, but the load fluctuates. Examples are conveyors or elevators. In this experiment, the shunt-wound motor will be examined.

Theory

The attraction and repulsion of magnetic fields create a rotational movement in the motor. The external magnetic field is generated by the parallel-connected coils. The T-armature also forms a magnetic field, which will be reversed using a commutator at the right time. Due to the parallel connection, the rotational speed is almost independent of the load. However, if the load is too large, the motor stops.

Setup and procedure

Setup

- The motor set is put together according to Fig. 1.
- Slide the axis [1] of the double-T armature in the bearing drill hole [3] of the motor set and fasten tightly with the cord pulley [2].
- Attach the contact brushes [4] of the motor set to the interrupted brass ring [7] (Fig. 2), pull the knurled screw [5] slightly upward and twist tightly so that the lever arm is clamping due to the tensioned springs. This will cause the contact brushes to press firmly onto the brass ring. The electrical contact is created between the armature coils and the connectors [6].

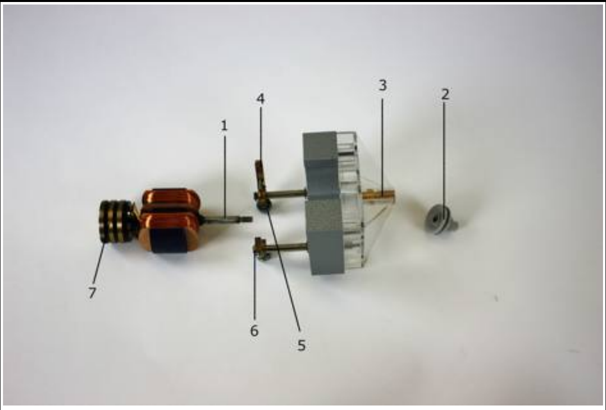

Fig. 1

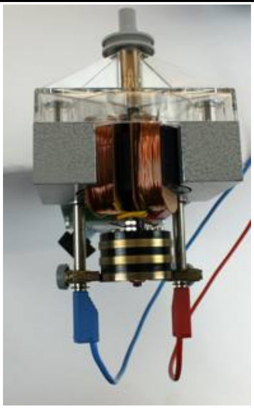
Fig. 2

- Complete the setup according to Fig. 3 and Fig. 4.
- Place the iron core with the holder in the bench clamp.
- Place the coils and motor set on the iron core.
- Adjust the DC-voltage on the power supply to 0 V.
- Connect both field coils in series.
- Connect the armature coil and the measuring device in series.
- Connect the field coils and armature coil (with measuring device in series) in parallel.

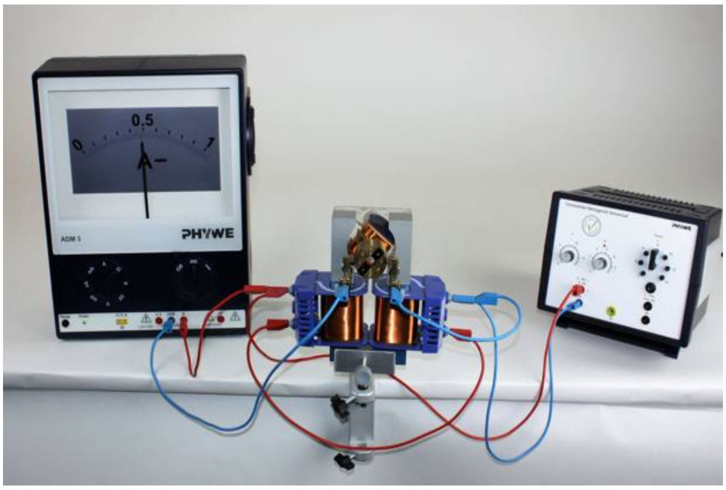

Fig. 3

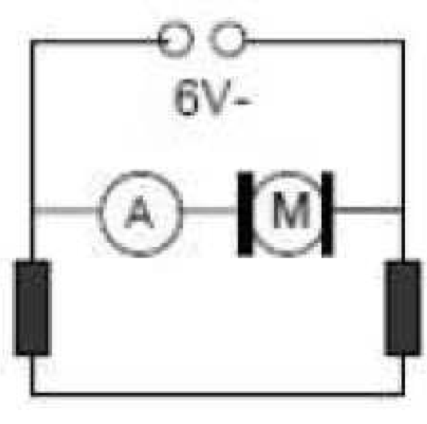

Fig. 4

Procedure

- Adjust the voltage to approx. 6 V, “crank up” the motor eventually by turning.
- Change the voltage, observe the ratotional speed, observe the measuring device (Observation (1)).
- Adjust the voltage to 0 V, switch the polarity of the operating voltage at the power supply and connection sockets at the measuring device, increase the voltage and observe the direction of rotation (Observation (2)).
- Adjust the voltage to 0 V, switch the polarityof the voltage at the connections for the armature coils, increase the voltage and observe the direction of rotation (Observation (3)).
- Apply friction on the motor by pressing the finger on the cord pulley, observe the rotational speed and the measuring device (Observation (4)).

Evaluation

Observation

1. The higher the voltage, the higher the rotational speed of the motor. The electric current does not change much.
2. By reversing the polarity of the operating voltage the direction of rotation remains constant.
3. If only the direction of the electric current is changed for the armature coils, then this changes the direction of rotation of the motor.
4. Due to a small load the rotational speed of the motor does not decrease significantly, due to a big load the motor stutters. Due to a load the amperage increases .

Result

If an electromagnet is used to operate an electromotor, it must create a large enough magnetic field near by the armature. This is why a U-shaped iron core with two field coils is used, where the armature runs between its poles. Armature coils and field coils are connected in parallel for a shunt-wound motor (Fig. 4).
When reversing the polarity of the operating voltage the field of the armature coils as well as that of the field coils are reversed so that the direction of rotation remains the same.
If on the other hand only the direction of the current of the armature coils changes, then only this magnetic field changes its direction and therefore also the direction of rotation changes.
If a load is exerted on the shunt-wound motor, the electric current of the armature coil increases. The electric current of the field coils can also be determined. They only change slightly in a shunt-wound motor.

Remarks:

1. In the armature coils, which rotate in the magnetic field of the field coils, a voltage is induced. The difference of the applied and induced voltage determines the electric current of the armature coils. If a load is applied the rotational speed of the armature decreases, which total subsequently reduces the induced voltage and the electric current becomes greater.
2. The rotational speed of a shunt-wound motor does not change much if a load is exerted compared to a series-wound motor. It is therefore best suited for actuations, which require constant rotational speed, such as for example in machine tools or elevators.