Generation of an induction voltage with permanent magnets (Item No.: P1376500)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 7-10
Topic: Elektrizitätslehre
Subtopic: Elektromotor und Generator
Experiment: Erzeugen einer Induktionsspannung mit Dauermagneten

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

Additional Requirements:

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional information

The students know that a current-carrying conductor is surrounded by a magnetic field which can cause mechanical movement in interaction with another magnetic field. They should demonstrate the reversal of this phenomenon, i.e. demonstrate that electrical energy can be generated by mechanical movement. They should come to the realisation, that a voltage is only induced, when the magnetic field which is contained by a coil (or conductor loop) changes.

Notes on setup and procedure

The galvanometer has the advantage over the multi-range meter, that it can deflect to either side and therefore allows differently directed current to be indirectly observed. Quantitative statements on induction voltage are not strived for in this experiment.
As the galvanometer movement includes a permanent magnet, it must be ensured that the bar magnet used in this experiment is not moved in the immediate vicinity of the galvanometer, otherwise the sensitive movement will react to the magnet and falsify the measured values by induction.
(To make clear that the bar magnet should be kept as far as possible from the galvanometer during handling, it is shown in Fig. 1 at the far front.)

Remarks

During the last steps of the experiment, it should become clear to the students – if necessary with the teacher’s help – that the relative movement of the coil and permanent magnet to each other is a necessary condition for the generation of an induction voltage, but it is not alone sufficient for it. Thus the movement must be so made that it causes the magnetic field contained by the core to change.

The entries for the direction of the pointer deflection in Result - Table 1 are only meant as examples. The movement to the left or right is dependent on the connection of the two coils.

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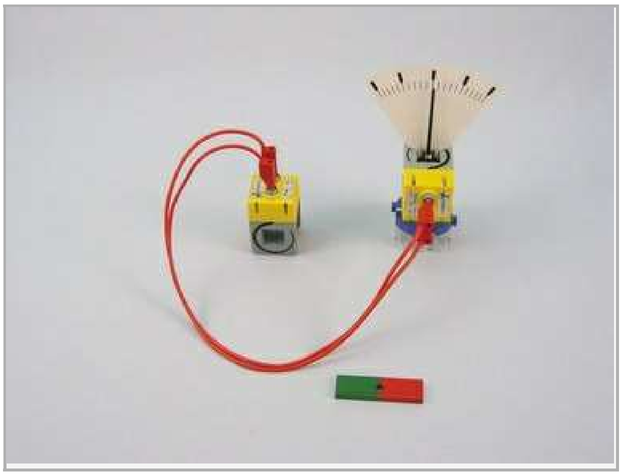
Task and equipment

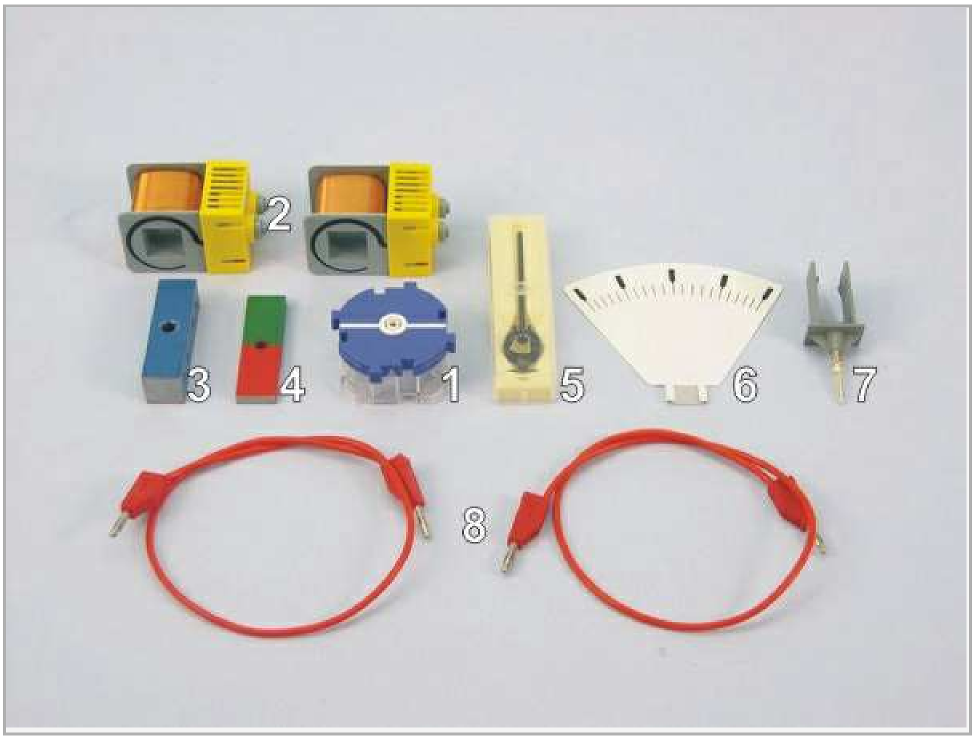
Task

Can an electric potential be generated by moving a conductor or a permanent magnet?

Investigate if the process in which a current-carrying conductor is deflected in a magnetic field, i.e. in which electrical energy is converted into mechanical energy, is reversible.



Equipment



Position No.	Material	Order No.	Quantity
1	Straight connector module with socket, SB	05601-11	1
2	Coil, 400 turns	07829-01	2
3	Yoke	07833-00	1
4	Bar magnet, l = 72mm	07823-00	1
5	Galvanometer movement	07875-00	1
6	Galvanometer scale	07876-00	1
7	Notch bearing with plug	07877-00	1
8	Connecting cord, 32 A, 500 mm, red	07361-01	2

Set-up and procedure

Set-up

- Assemble the galvanometer model as shown in Fig. 2, Fig. 3 and Fig. 4, and position it into a connector building block with socket.
- Set up the circuit as shown in Fig. 1; position the coil as far as possible away from the galvanometer.

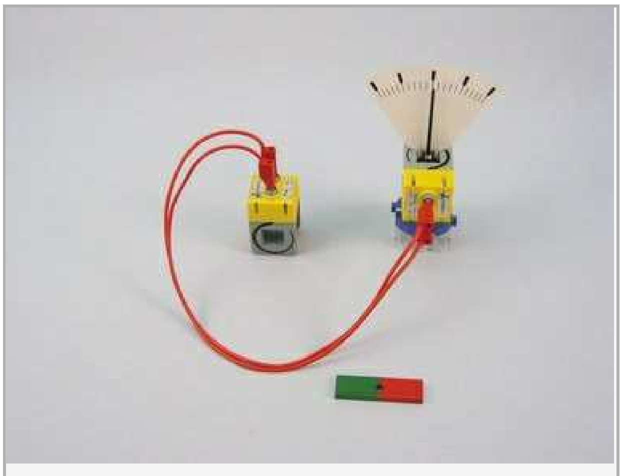


Fig. 1


Fig. 2

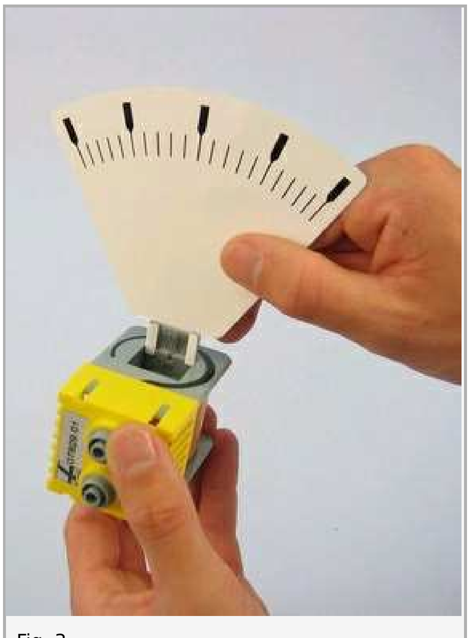


Fig. 3


Fig. 4

Procedure

Successively carry out the following steps of the procedure, at each step observe the deflection of the galvanometer pointer and note your observations in Table 1 in the report.

1. Move the magnet with the North pole into the coil.
2. Move the magnet out of the coil.
3. Move the magnet with the South pole into the coil.
4. Move the magnet out of the coil.
5. Move the magnet more quickly into the coil and out.
6. Move the coil to the magnet.
7. Move the coil away from the magnet.
8. Rest the magnet in the coil.
9. Turn the magnet in the coil round its longitudinal axis.

Note: The movements in steps 1 to 4 and 6 and 7 should be carried out as quickly as possible.

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Report: Generation of an induction voltage with permanent magnets

Result - Table 1

Note your observations in the table.

Movement	Pointer deflection (to the left/right; more/less)
1. North pole into the coil	
2. North pole out of the coil	
3. South pole into the coil	
4. South pole out of the coil	
5. Quicker movement of the coil	
6. Coil to the magnet	
7. Coil away from the magnet	
8. Magnet rests in coil	
9. Magnet turned in the coil round longitudinal axis	

Evaluation - Question 1

The voltage which the galvanometer showed in this experiment is called the induction voltage; the process in which it is generated is called electromagnetic induction.

a) What is the direction of the induction voltage dependent on (refer to the results from steps 1 to 4)?

b) What is the height of the induction voltage dependent on (refer to the results from step 5 and also formulate your reply with "The ... the ...").

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Evaluation - Question 2

Which conclusion can you draw from the comparison of steps 1 to 4 with steps 6 and 7?

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Evaluation - Question 3

During the movement of the magnet and the coil (the induction coil) relative to each other, the magnetic field surrounding the coil changes. In steps 8 and 9 it apparently does not change. Now answer the question: Under which conditions is a voltage induced?

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