Self-induction when switching off a circuit (Item No.: P1400000)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 16-19
Topic: Electricity
Subtopic: Electromagnetic induction
Experiment: Self-induction when switching off a circuit

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

Additional Requirements:

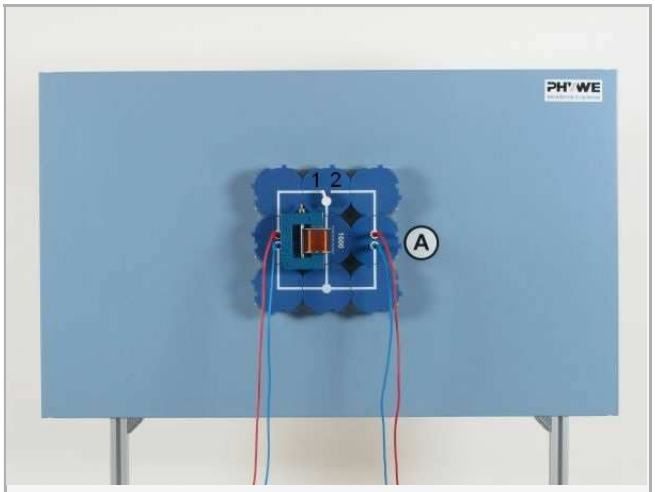
Experiment Variations:

Keywords:

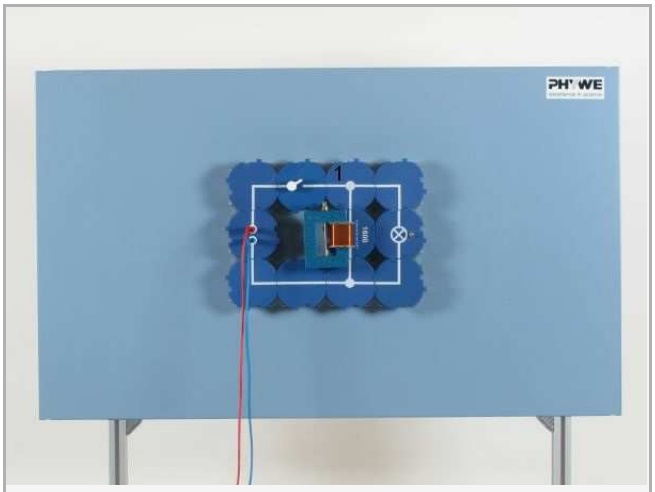
Principle and equipment

Principle

The properties of the self-induction potential that is generated when the current that flows through a coil of high inductivity is interrupted are to be demonstrated.



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	Coil 1600 turns, module DB	09472-02	1
5	Switch on/off, module DB	09402-01	1
6	Switch, change-over, module DB	09402-02	1
7	U-core	07832-00	1
8	Socket for incandescent lamp E10 ,module DB	09404-00	1
9	Connector interrupted, module DB	09401-04	2
10	Electr.symbols f.demo-board,12pcs	02154-03	1
11	Yoke	07833-00	1
12	Connector, straight, module DB	09401-01	1
13	Connector, angled, module DB	09401-02	4
14	Connector, T-shaped, module DB	09401-03	2
15	Tightening screw	07834-00	1
16	Connecting cord, 32 A, 1000 mm, red	07363-01	2
17	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
18	Neon lamp 110 V AC, E10	07506-90	1

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Set-up and procedure

1st. Experiment

- Set up the experiment as shown in Fig. 1; insert the U-core in the coil and press the yoke tightly on the U-core with the tightening screw
- Set the -10 ... 0 ... +10 mA- measurement range and clearly label the polarity of the measuring instrument
- Switch on the power supply; set a voltage of 10 V-; turn the reverse switch to position 1 and so close the circuit on the left
- Turn the reverse switch to position 2 and so close the circuit on the right; observe the deflection of the ammeter
- Operate the reverse switch several times and note your observations (1)

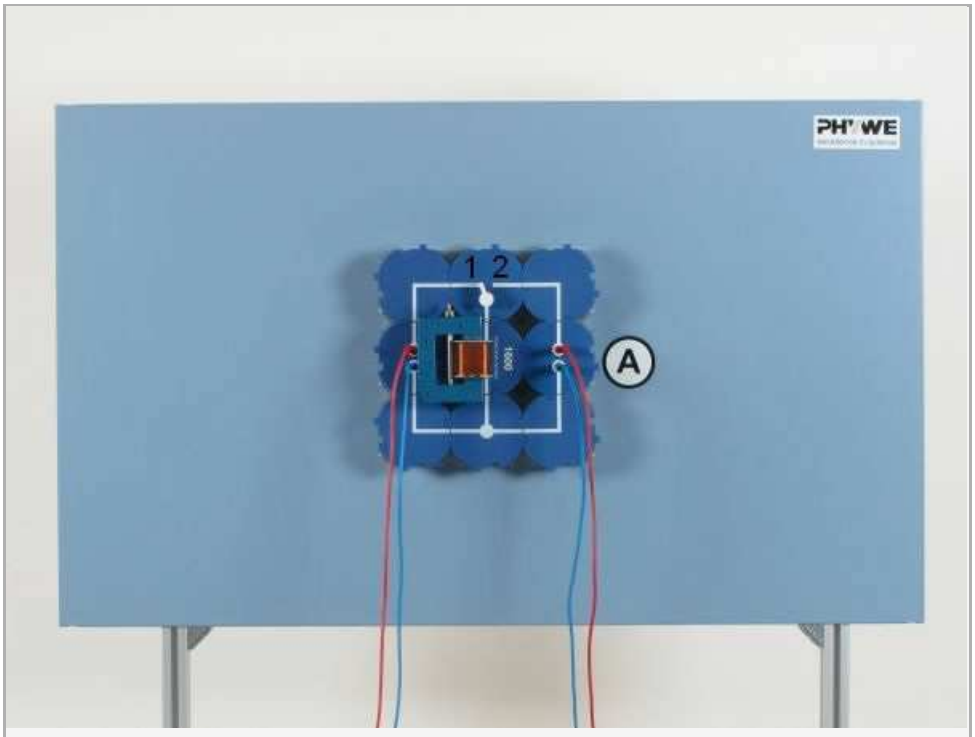

Fig. 1

2nd. Experiment

- Set up the experiment as shown in Fig. 2, with the switch open and the same coil as previously still installed
- Make conscious of, or demonstrate, that the neon lamp needs an operating voltage of about 100 V to light up; to do this, for example, remove the coil and operate the switch several times to show that the neon lamp does not light up, then stress which operating voltage it requires
- With the circuit complete, turn the switch on and off several times while observing the neon lamp (2)

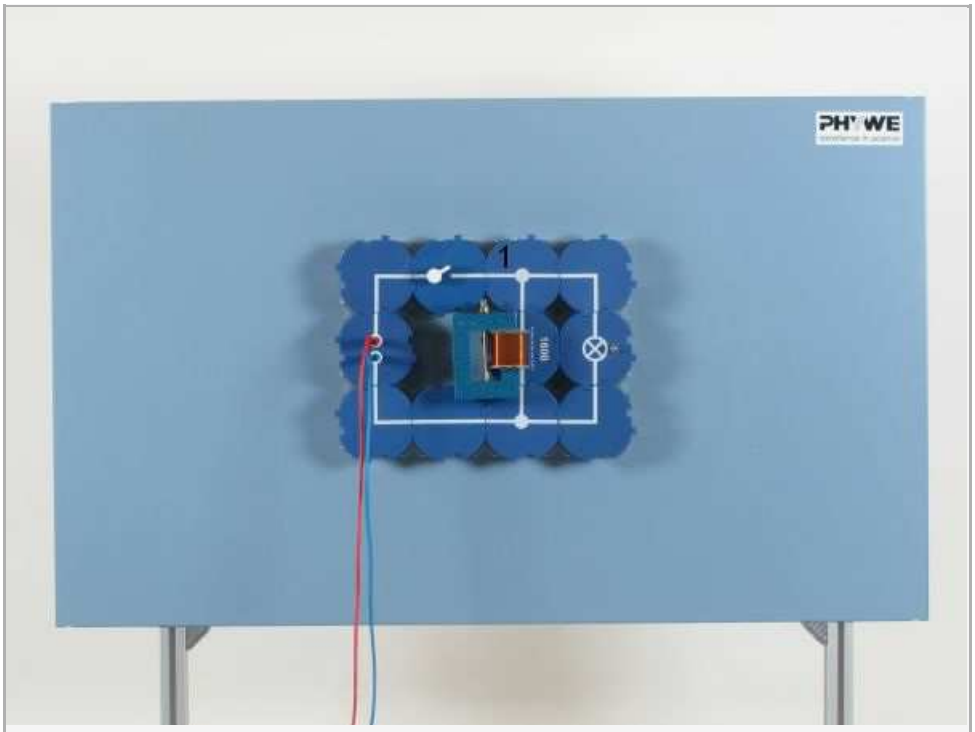

Fig. 2

Observation and evaluation

Observation

1. The pointer of the ameter briefly to the left when the circuit on the left, the original circuit, is interrupted.
2. Each time that the circuit is interrupted, the neon lamp briefly lights up.

Evaluation

As soon as the coil is disconnected from the source of current by switching off, the magnetic field breaks down. The change in the magnetic field inside the coil generates a self-induction potential that, according to Lenz's law, acts against its cause - which is here the breakdown of the magnetic field.

The self-induction current therefore has the same direction as the current which originally flowed through the coil. In the 1st experiment, proof was given by an ammeter that, after reversing (position 2), the coil lies in a common circuit. Fig. 3 can be used to further clarify this experimental result.

From the result of the 2nd experiment, it follows that the self-induction voltage is much higher than the (original) applied voltage.

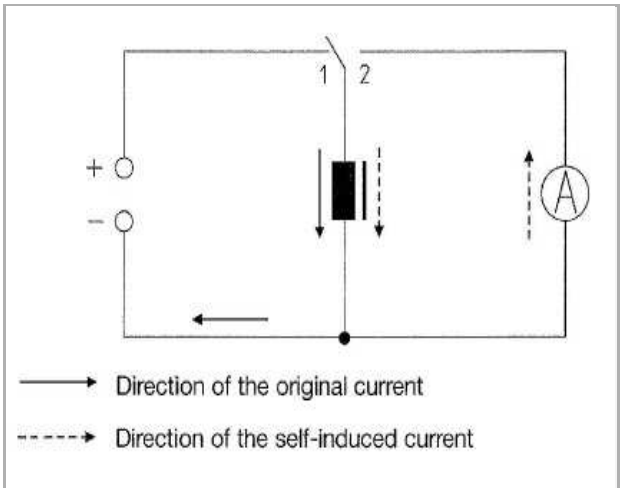

Fig. 3

Remarks

In connection with the second experiment, it should be pointed out that the high induction voltages that are generated by switching off can cause damage to electrical instruments. This must be taken into consideration during their development.