

### Task

To open and close a circuit by means of an electromagnetic switch.

### Equipment

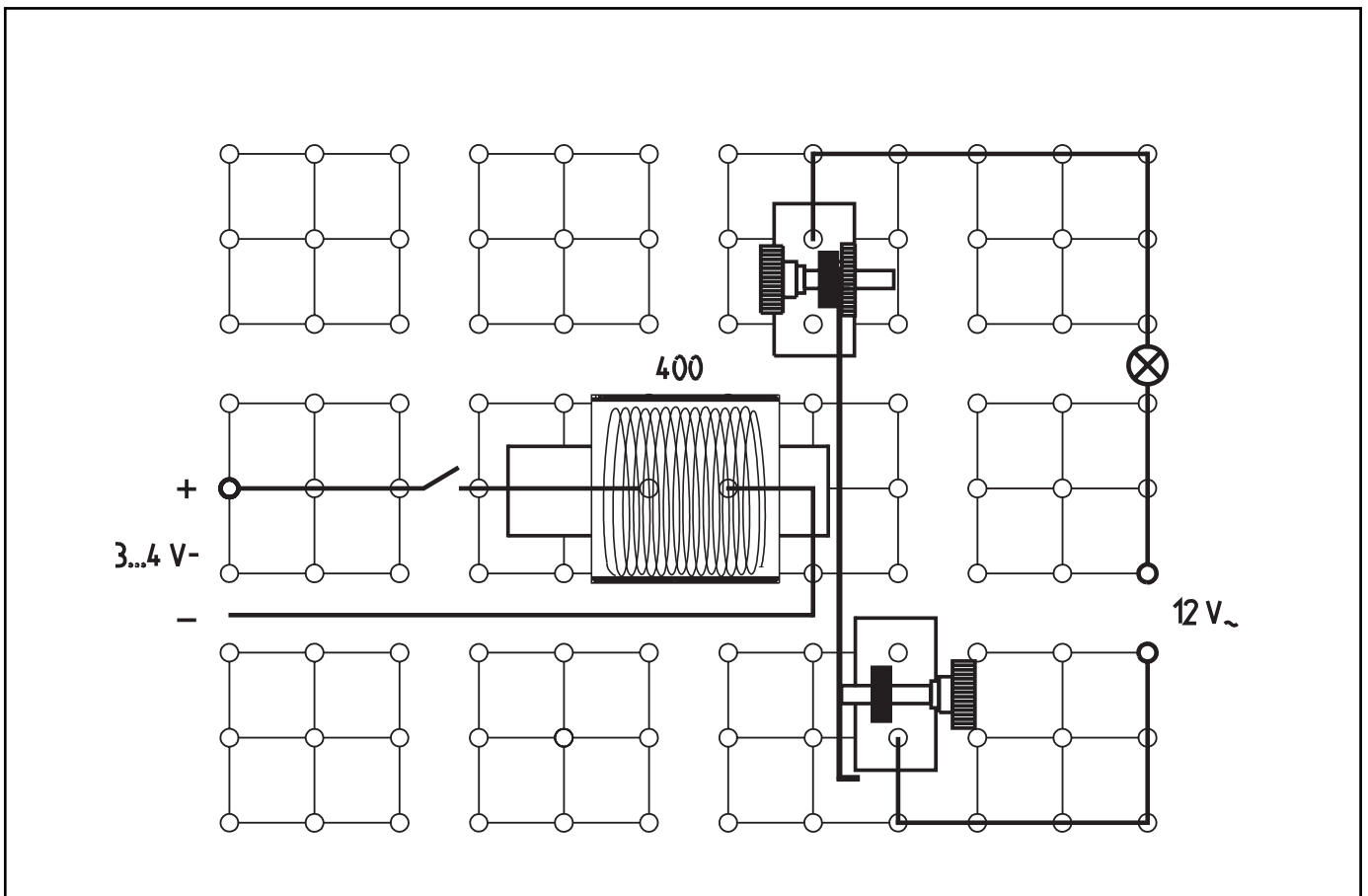
Plug-in board	06033.00	1
On/off switch	39139.00	1
Wire building block	39120.00	2
Lamp holder E10	17049.00	1
Universal holder	39115.02	2
Bell striker / contact knife R / S	13024.12	1
Coil, 400 turns	07829.01	1
Yoke	07833.00	1
Connecting plug, 2 pcs	07278.05	1
Connecting cable, 25 cm, blue	07313.04	1
Connecting cable, 50 cm, red	07314.01	2
Connecting cable, 50 cm, blue	07314.04	2
Power supply, 0...12 V-, 6 V~, 12 V~	13505.93	1
Filament lamp, 12V/0.1 A, E10	07505.03	(1)

### Set-Up and Procedure

#### First experiment

- Connect up the circuit as shown in Fig. 1; use the two connecting plugs to fit the coil on the board and slide in the iron core (yoke).
- Adjust the milled screw of the lower universal holder so that good contact is made with the armature spring (bell striker), if appropriate, remove the milled screw; move the upper leg of the iron core to about 3 mm from the spring.
- Switch on the power supply, set the current limitation to 1 A and adjust it to 3 or 4 V.
- Close and open the switch several times, and thereby observe the armature spring and the filament lamp.
- Open the switch, switch off the power supply and note your observation under (1).

Fig. 1



## Second experiment

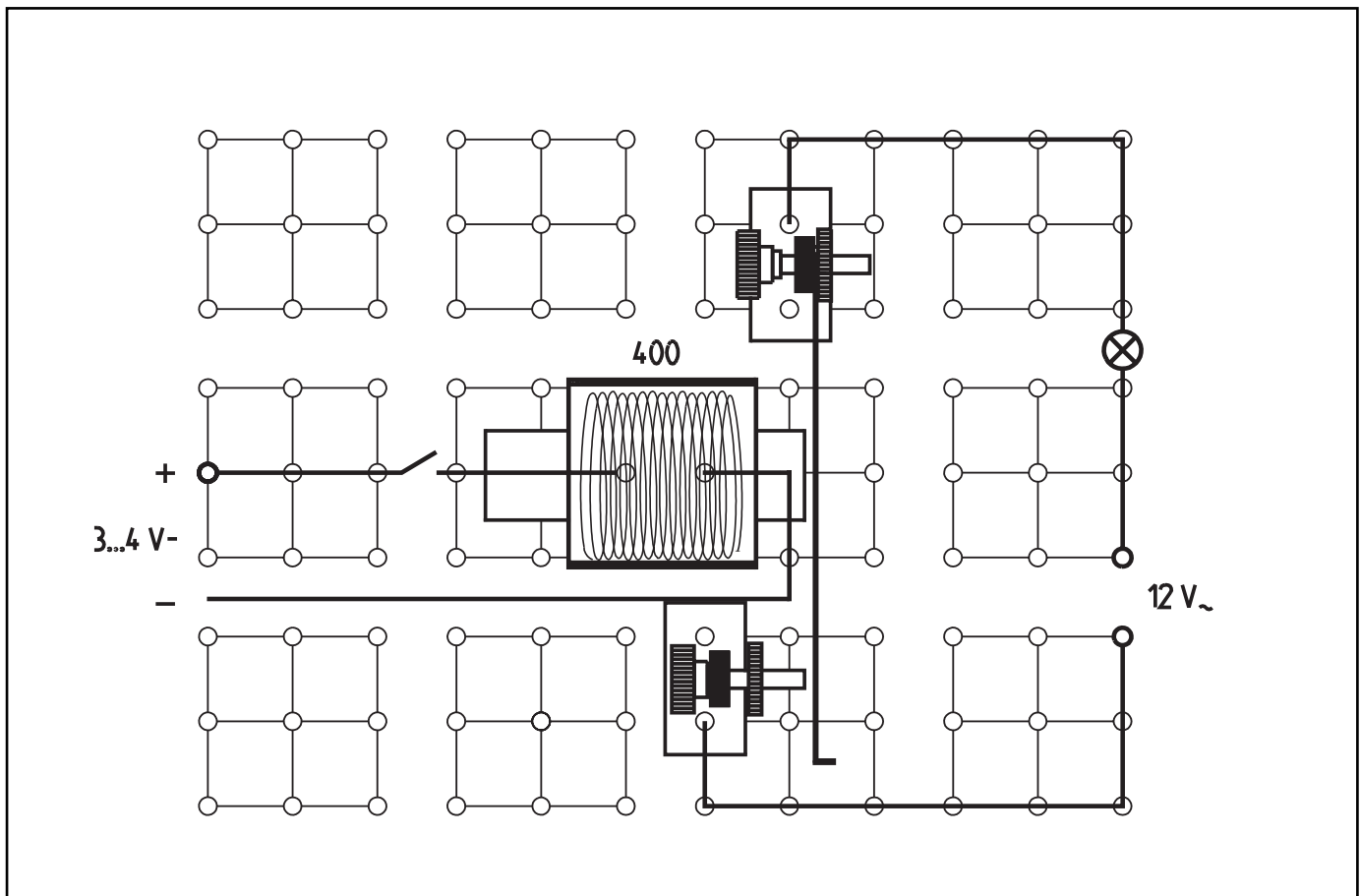
- Turn the universal holders around by  $180^\circ$  and insert them as shown in Fig. 2; turn the contact screw until it is at a distance of about 2 mm from the armature spring.
- Switch on the power supply and close and open the switch several times, observing the armature spring and the filament lamp thereby.
- Switch off the power supply and note your observation under (2).

## Observations

(1)

(2)

Fig. 2



**Evaluation**

1. The circuit containing the electromagnet is called the control circuit, the one with the filament lamp the working circuit. The arrangement with electromagnet, leaf spring and contacts is called an electromagnetic relay. What can a relay be used to do?

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2. In the first experiment the relay acts as a resting circuit relay (opener), in the second experiment as a working circuit relay (closer). Complete the following Table.

Control circuit	Working circuit	Function of the relay
Closed		Opener (resting circuit relay)
	Closed	Closer (working circuit relay)
Open	Open	
	Closed	Opener (resting circuit relay)

3. Name examples of beneficial uses of relays.

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**How can electromagnets be used to carry out  
switching functions?**



Room for notes

(How can electromagnets be used to carry out switching functions?)

Various constructed relays are frequently used in circuitry, e.g. to open or close very distant or difficultly accessible electric circuits.

In this experiment the students should learn to understand the working principle of an electromagnetic relay.

### Notes on Set-Up and Procedure

The advantage of the set-up which is recommended is that very little expenditure is required to change from the first to the second experiment.

The setting of the current limitation to 1 A is merely a safety precaution for protection of the coil. When the power supply used does not have an adjustable electronic current limitation, then the students should be advised not to exceed a voltage of 3 V on the coil (although the coil can hold up to a higher load for a short-term).

### Observations

- (1) As soon as the circuit with the electromagnet is closed, the electromagnet attracts the armature spring and opens the circuit with the filament lamp, causing it to extinguish.
- (2) As soon as the circuit with the electromagnet is closed, the electromagnet attracts the armature spring and closes the circuit with the filament lamp, causing it to light up.

### Evaluation

1. A relay enables a control circuit to open or close a working circuit.

2.

Control circuit	Working circuit	Function of the relay
Closed	Open	Opener (resting circuit relay)
Closed	Closed	Closer (working circuit relay)
Open	Open	Closer (working circuit relay)
Open	Closed	Opener (resting circuit relay)

3. Examples:

- Control of a strong working current with a weak control current.
- Opening or closing of far distant working circuits.
- Opening or closing of difficultly accessible working circuits.
- Simultaneous opening and/or closing of several working circuits.
- Light switches at home (the line voltage is switched with a small voltage which poses no danger).

### Remarks

Relays which, with a weak control current, can control high performance working circuits are called protectors.

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## **Electromagnetic relays**



(How can electromagnets be used to carry out switching functions?)

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