

Undamped electromagnetic oscillations (Item No.: P1401900)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

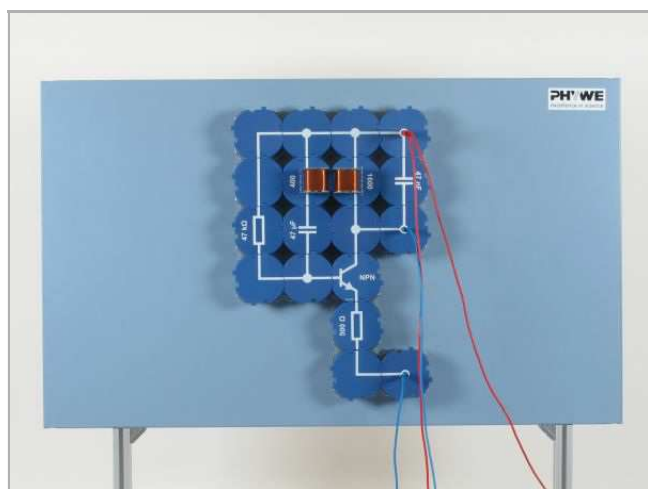
Experiment Variations:

Keywords:

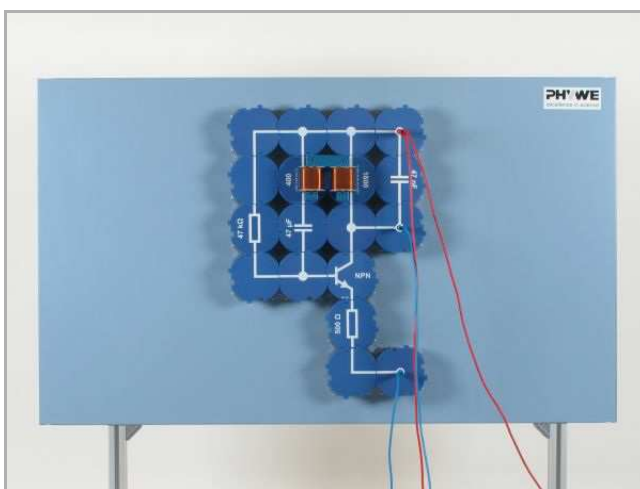
Principle and equipment

Principle

A demonstration is to be made to show how electromagnetic oscillations can be generated by feedback of a transistor amplifying circuit.



Experimental set-up Part 1



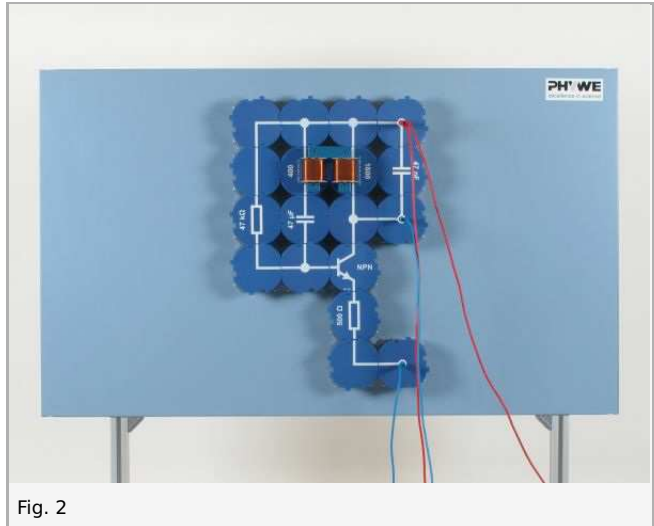
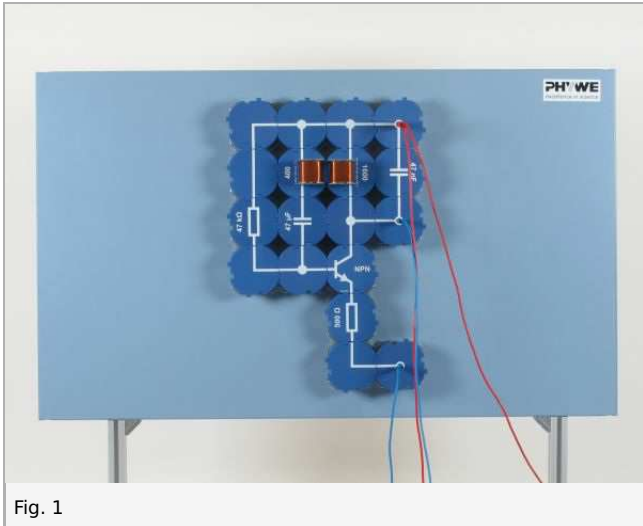
Experimental set-up Part 2

Equipment

Position No.	Material	Order No.	Quantity
1	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
2	Demo Physics board with stand	02150-00	1
3	Loudspeaker, 8 Ohm/5 kOhm	13765-00	1
4	Coil 400 turns, module DB	09472-01	1
5	Coil 1600 turns, module DB	09472-02	1
6	U-core	07832-00	1
7	Transistor BC337, module DB	09456-00	1
8	Junction, module DB	09401-10	1
9	Resistor 500 Ohm, module DB	09413-50	1
10	Resistor 47 kOhm, module DB	09415-47	1
11	Capacitor 10 nF, module DB	09442-10	1
12	Capacitor 47 nF, module DB	09442-47	1
13	Capacitor(ELKO)0.047 mF, module DB	09445-47	1
14	Yoke	07833-00	1
15	Connector, straight, module DB	09401-01	1
16	Connector, angled, module DB	09401-02	3
17	Connector, T-shaped, module DB	09401-03	4
18	Connector, angled with socket, module DB	09401-12	2
19	Connecting cord, 32 A, 1000 mm, red	07363-01	2
20	Connecting cord, 32 A, 1000 mm, blue	07363-04	2

Set-up and procedure

- Set up the experiment as shown in Fig. 1 with the 47 nF capacitor; select the 5 k Ω loudspeaker connection
- Set the power supply to 10 V- and switch it on
- Fit the U-core into the coil from above, as in Fig. 2
- Hold the yoke at the end areas of the U-core and vary the distance from them
- Replace the 47 nF capacitor with the 10 nF capacitor



Observation and evaluation

Observation

The loudspeaker does not make a sound until the U-core is inserted in the coil. The pitch is lower, the less the distance of the yoke from the U-core. When a capacitor of less capacity is used, the loudspeaker generates a higher tone.

Evaluation

With the amplifying circuit used, there is an oscillating circuit in the collector circuit that can be inductively coupled to a second coil. This is connected to the base of the transistor. This circuit can first be excited to electromagnetic oscillations, when the coupling between the two coils is made across the U-core and the amplification is sufficiently high.

The frequency of the electromagnetic oscillations generated in the oscillating circuit is dependent on the inductivity of the coil, that is increased by decreasing the distance apart of the yoke and U-core. Increased inductivity reduces the oscillating frequency and the tone is deeper. The oscillating frequency is also dependent on the capacity of the capacitor in the oscillating circuit. the lower the capacity of the capacitor, the higher the frequency of the tone.

Remarks

The dependence of the oscillating frequency on the values of the inductivity and capacity is expressed as follows:

$$f = \frac{1}{2\pi\sqrt{L \cdot C}} .$$

A determination of the frequency and a display of the electromagnetic oscillations are possible, when an oscilloscope or the Cobra3 Basic Unit is connected in parallel to the loudspeaker.