Storage of the electric energy won from wind energy in a capacitor

Task and equipment

Information for teachers

Additional information

A capacitor is a passive electric component with the ability to store electrical charge and so the corresponding energy.

Notes on the setup and procedure

The double-layer capacitor used in this experiment, which is also called Gold Cap, functions in a similar way to an electrolytic capacitor. Care must therefore be taken to always make connection to the positive pole of the capacitor with the red connecting cable of the wind generator. Wrong polarity would lead to destruction of the dielectric and so also of the capacitor.

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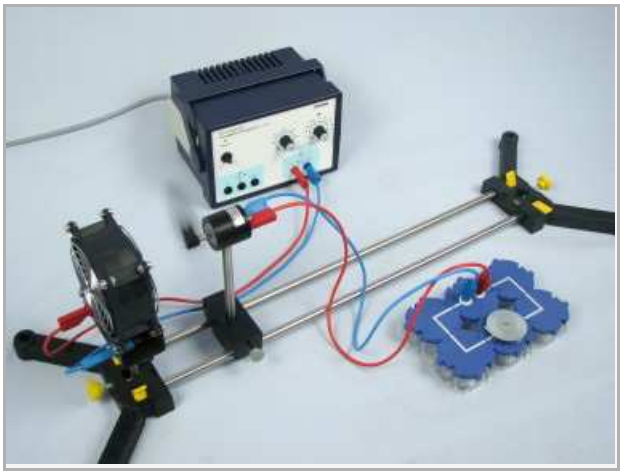
Task and equipment

Task

How can wind energy be stored without using a rechargeable battery?

Try to store the energy produced by a wind-driven generator in a capacitor.



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Equipment

Position No.	Material	Order No.	Quantity
1	Connecting cord, 32 A, 500 mm, red	07361-01	2
2	Connecting cord, 32 A, 500 mm, blue	07361-04	2
3	Connecting cord, 32 A, 250 mm, red	07360-01	1
4	Connecting cord, 32 A, 250 mm, blue	07360-04	1
5	Angled connector module, SB	05601-02	4
6	Interrupted connector module, SB	05601-04	1
7	On-off switch module, SB	05602-01	1
8	Motor with indicating disc, SB	05660-00	1
9	Junction module, SB	05601-10	2
10	Straight connector module, SB	05601-01	1
11	Blower, 12V	05750-00	1
12	Generator with metrical thread axis and nut	05751-01	1
13	Rotor, 2 pieces	05752-01	1
14	Support base, variable	02001-00	1
15	Digital stop watch, 24 h, 1/100 s & 1 s	24025-00	1
16	Measuring tape, l = 2 m	09936-00	1
17	Slide mount for optical bench	09822-00	1
18	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	2
19	Capacitor (gold cap), 1F, SB	05650-10	1
20	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13505-93	1

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Set-up and procedure

Set-up

Use the variable support stand and the two rods to construct the rail support (Figs.1 and 2).

Fig. 1

Fig. 2

Clamp the blower in the left part of the support base so that the side with the sockets faces away from the rail support (Fig. 3).

Fig. 3

Successively plug each of the two rotors on the axis of the generator (Fig. 4).
The 6 vanes should be at the same distance from each other, with the writing readable from the front (Fig. 5).

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Fig. 4

Fig. 5

Fix the generator in the slide mount and position it on the rail support so that the distance between generator and blower is 5 cm (Fig. 6).

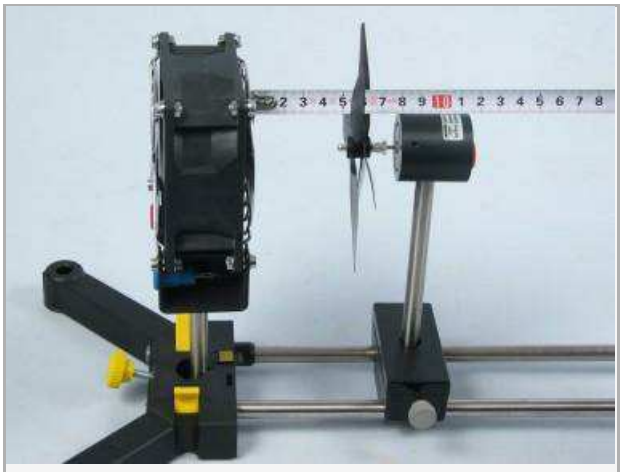

Fig. 6

Use the long cables of the blower to connect it to the direct voltage output of the power supply (Fig. 7).
The power supply is switched-off.

Fig. 7

Set up the circuit shown in Fig. 8.

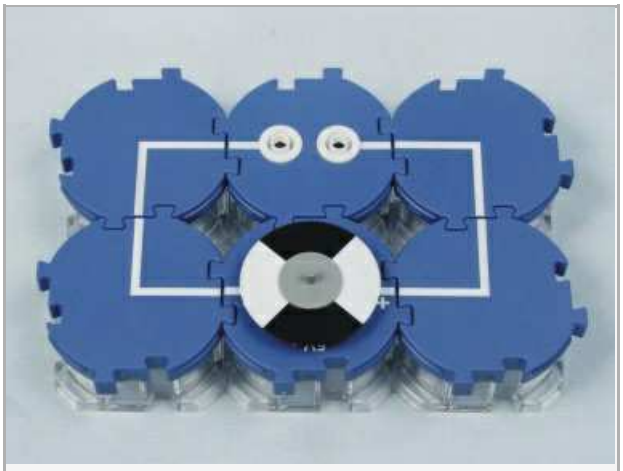

Fig. 8

Correct the generator to the circuit (Fig. 9). Pay attention to correct polarity.

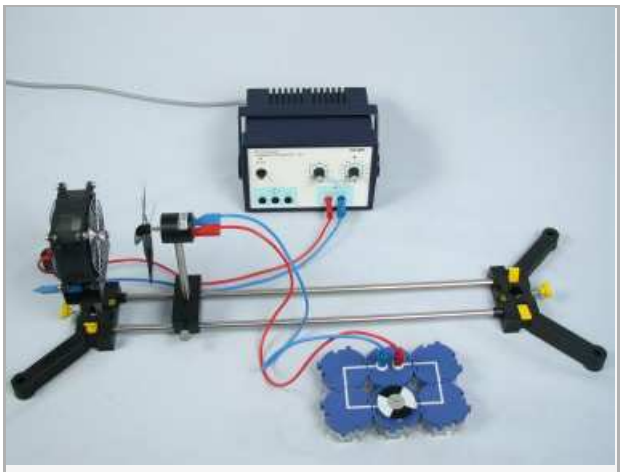

Fig. 9

Procedure

Part 1 of the experiment

Switch the blower on (turn the adjusting knobs for current and voltage fully clockwise) and simultaneously start the stop watch.

Observe the motor and switch the blower off after 1 minute.

Note your observations regarding the motor under Result - Observations 1 in the report.

Now additionally connect the capacitor to the wind generator (Fig. 10).
Make sure that the red wind generator cable is connected to the positive pole of the capacitor (Fig. 11).

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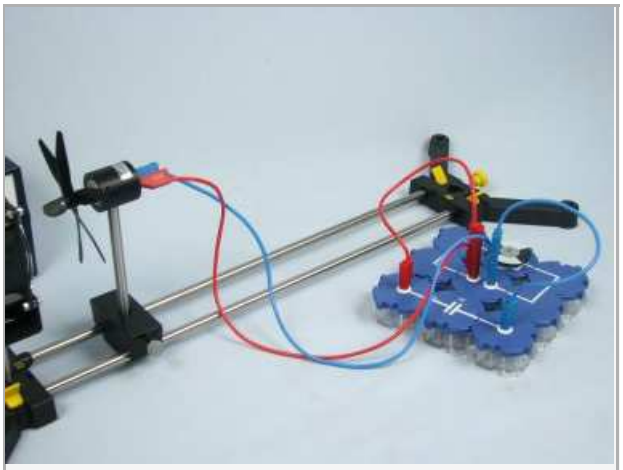

Fig. 10

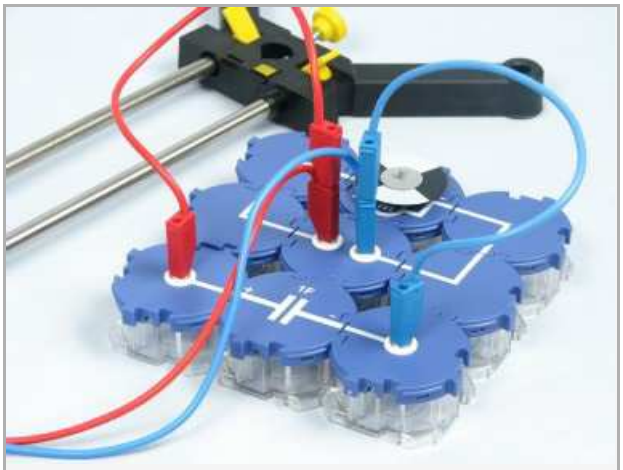

Fig. 11

Switch the blower on and simultaneously start the stop watch.

Observe the motor and switch the blower off when it no longer runs.

Note your observations regarding the motor under Result - Observations 2.

Part 2 of the experiment

Set the circuit up as in Fig. 12 and open the switch (Fig. 13).

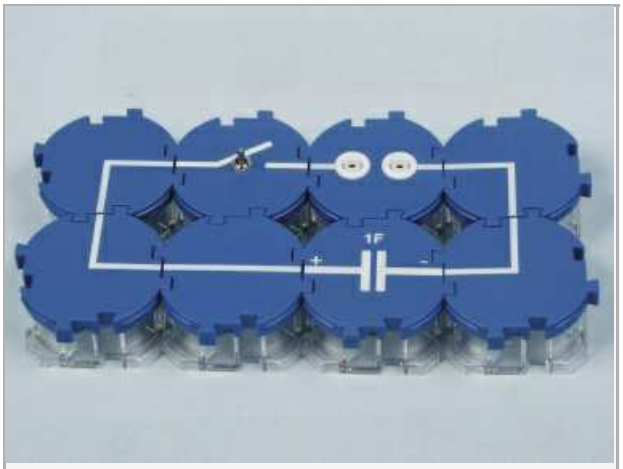

Fig. 12

Fig. 13

Connect the capacitor to the wind generator (Fig. 14). Make sure that the positive pole of the capacitor is connected to the red connecting socket.

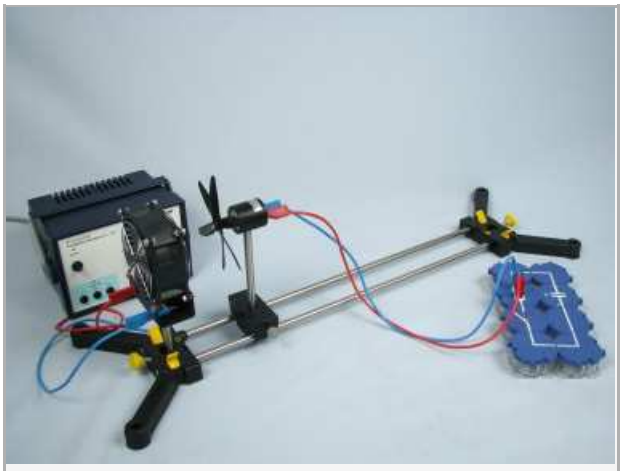

Fig. 14

Switch on the blower.

Close the switch and simultaneously start the stop watch.

Open the switch again when time t = 1 min.

Remove the cable from the generator and replace it with a voltmeter (Fig. 15) so that you are able to measure the voltage of the capacitor.

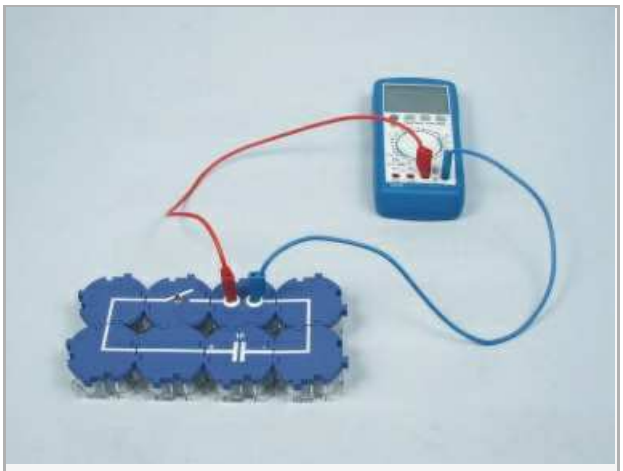

Fig. 15

Close the switch and note the voltage U (measurement range: 20 V-) in Table 1.

Open the switch. Replace the connecting module with the motor (Fig. 16).

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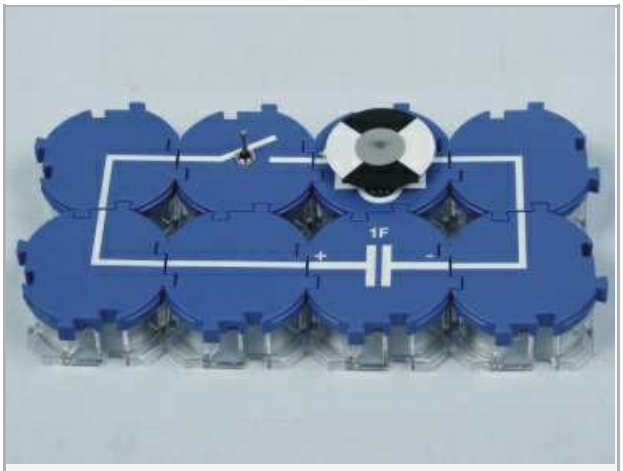

Fig. 16

Close the switch and simultaneously start the stop watch.

Observe the motor. Note the time T during which it runs in Table 1.
Open the switch when it stops rotating.

Repeat part 1 of the experiment with various charging times
1) t = 2 min
2) t = 3 min
3) t = 4 min

Note the results (voltage U and running time T) in Table 1.

After the last measurement:

Change the circuit and connect the multimeter (Figs. 17 and 18).

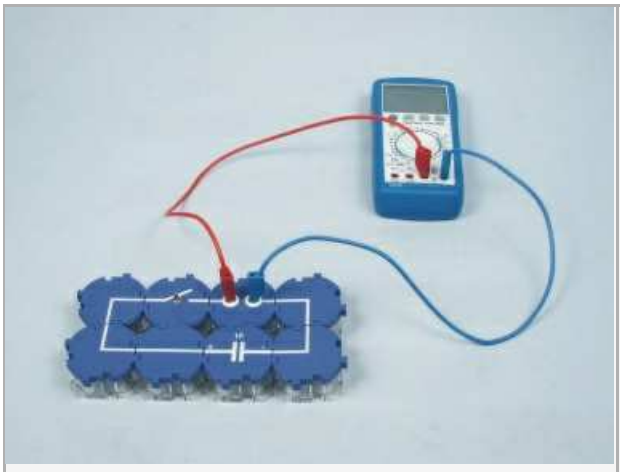

Fig. 17

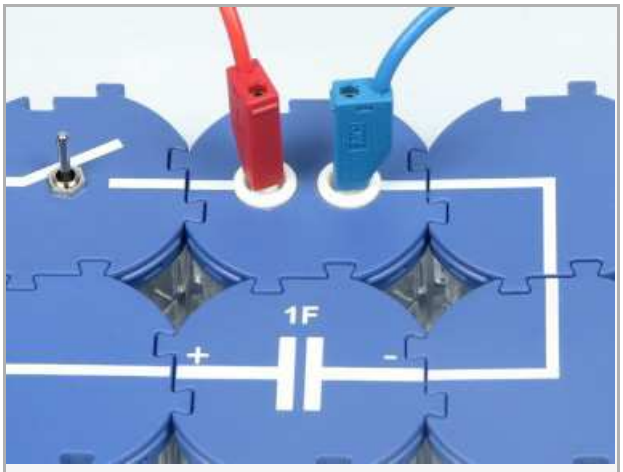

Fig. 18

Measure the voltage at the capacitor and note it in Table 1 under t = 0.

Report: Storage of the electric energy won from wind energy in a capacitor

Result - Observations 1

How did the motor react after the blower was switched off?

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Result - Observations 2

How did the motor react after the blower was switched off?

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Result - Table 1

Record your measured values in the table.

t in min	*U* in V	Running time *T* in s
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0

Evaluation - Question 1

Compare the observations you made in the first part of the experiment. Which function does the capacitor have?

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Evaluation - Question 2

Explain the dependence between the charging time (t), the voltage of the capacitor (U) and the running time of the motor (T).

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Evaluation - Question 3

Why can the capacitor not be charged to a higher voltage than 3.7 V?

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