

Users manual for Hand dynamo no. 4716.10

17.12.10

Ae 4716.10



Description

The hand powered generator is mounted in a transparent plastic housing. By cranking a handle a small generator is turned via a gear box. The generator can deliver up to 8 watts of electrical power. The hand generator is provided with an E10 socket for small light bulbs as well as leads with a connector to the generator and mini alligator clips for making convenient connections to measuring instrument, electrolysis apparatus or other electrical devices.

Spare parts

Light bulbs: 6 V; 0.5 A. Order number 4250.35

Experiments

Experiment 1: Getting to know the hand generator
Here are a few tips which can make it easier to get started using the hand generator. Connect the output leads to the connector on the back of the generator, and connect the alligator clips to a small 6 volt bulb. (You can also observe the bulb which is built-in.) Turn the handle slowly at first, then build up speed until the bulb lights up.

Note the following:

In general the bulb will light up more brightly the higher the generator output voltage (pulsating DC about 6 volts).

If you crank the handle too fast, you run the risk of burning out the bulb (or other items which may be connected).

Even though the generator is well-made, the handle should not be cranked too quickly. Otherwise the gear box can be damaged, particularly when the generator is short-circuited.

Note that the handle can be cranked in both directions. Voltage is generated either way but of opposite polarities.

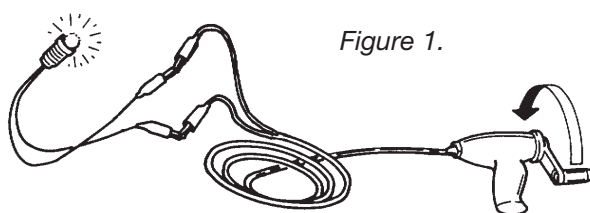


Figure 1.

Experiment 2: Polarity test

You can check the polarity of the generator output voltage in several ways.

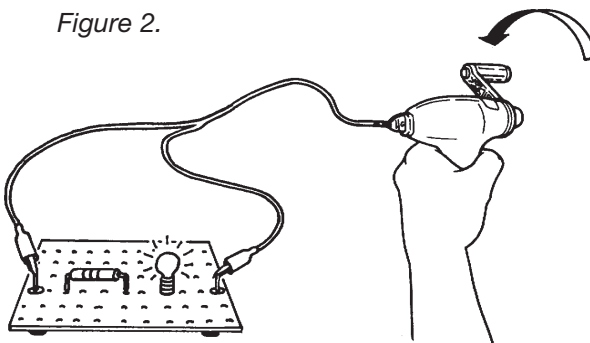


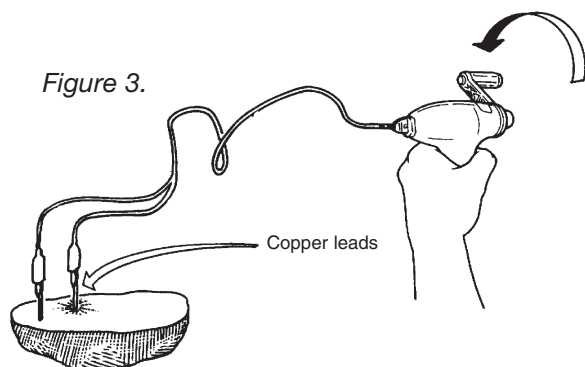
Figure 2.

You can of course use an ordinary voltmeter. Connect the leads to the voltage input terminals. Adjust the scale to the appropriate range e.g. 15 volt DC. Turn the handle and observe the display. Crank the handle in the other direction and note that the polarity is reversed from positive to negative or vice versa. If a small diode is available which can be mounted in series with a light bulb, then prepare the setup and connect the generator to the circuit as shown in the figure. If the positive lead from the generator is connected to the anode of the diode, then a current

will flow when the handle is cranked, and the bulb will light up. A light emitting diode (LED) in series with a 500 ohm resistor can also be used instead of the light bulb.

Experiment 3: A potato as polarity tester

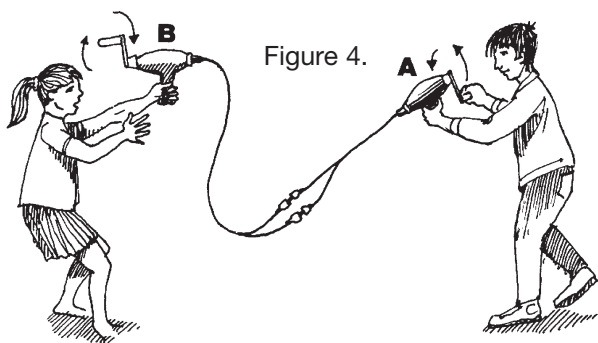
Here is an unusual way to find the polarity of the voltage produced by the generator. Cut a potato in half. Prepare two short (ca. 5 cm) pieces of heavy gauge copper wire (about 1-2 mm in diameter). Polish the ends of these conductors using fine sandpaper, so there will be good electrical connections to the potato. Insert the leads as shown in the figure about 5 millimetres from one another. Connect the conductors to the generator using the cable with the alligator clips.



Turn the crank vigorously for about 30 seconds. Notice that a blue-green region will appear around one of the conductors but not around the other. This colouration only appears around the positive lead. The colouration is due to the formation of copper chloride which is created due to the electrolysis of salt (NaCl) which occurs naturally in the potato juice.

Experiment 4: One hand generator drives the other

Because the hand generator is supplied in a package of two units, one generator can be connected to the other as shown in the figure using the leads provided.



Call one generator A and the other B. When a student cranks generator A, the handle on B will begin to turn of its own accord to the surprise and delight of your students. Try turning the crank the other way. Change roles by cranking generator B and observing A.

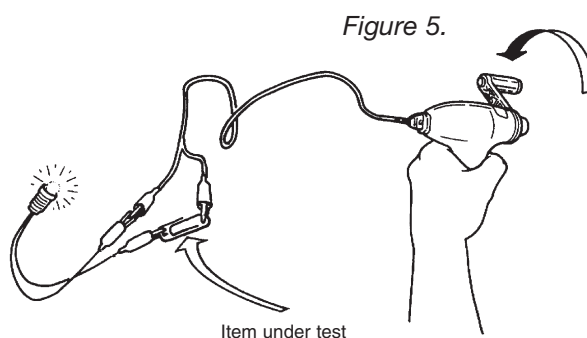
In this experiment one hand generator is acting as a generator while the other acts as a motor.

Note the energy conversions involved: the physical work exerted by the students is converted to mechanical energy which is converted to electrical energy by the first hand generator. The electrical energy is transmitted to the second generator where it is converted from electrical to mechanical energy.

Be careful not to let the alligator clips touch during the experiments, because this will short circuit both generators.

Experiment 5: Hand generator test circuit

The hand generator can be used as a circuit tester to investigate the conductivity of various materials. Use a test leads and a bulb with leads as shown in the figure.



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Students can perform experiments with various objects to discover whether or not they are good conductors. Paper clips, plastic, wood, metal bars, aluminum foil, pencils, etc. can be used. The students can prepare a catalogue of materials showing which are good and poor conductors.

Experiment 6: Bulbs in series

Connect one bulb to a hand generator, and note how much the bulb lights up, when the crank is turned at a particular rate (it helps to count aloud). Now try inserting two bulbs as shown in the figure. Try cranking at the same rate, and note how much the bulbs light up.

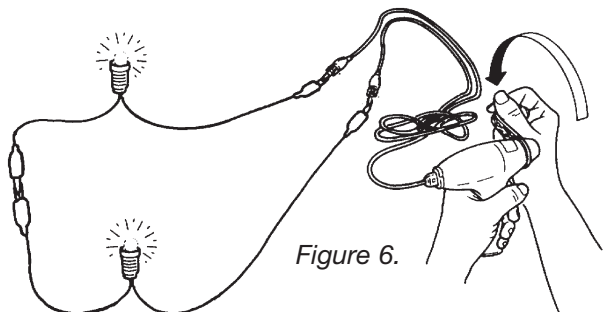


Figure 6.

Try if possible with three or four bulbs in series, and make a note of the result.

With one student operating the crank of the hand generator, another student should loosen a bulb in the series circuit. What happens to the hand generator? What happens to the other bulbs in the circuit?

Experiment 7: Bulbs in parallel

Now prepare a circuit as shown in the figure with a number of bulbs in parallel.

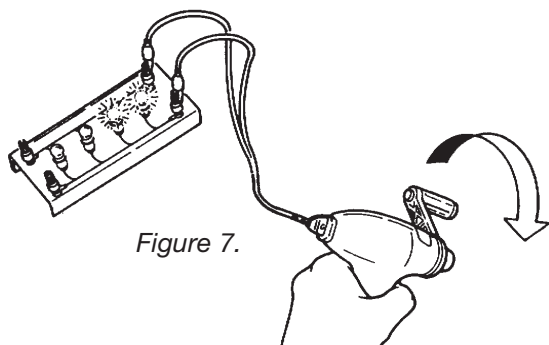


Figure 7.

Insert one bulb in the circuit, and crank the hand generator. Mount the bulbs loosely in the other sockets so that they do not complete the electrical connection to the bottom of the socket.

Now crank the hand generator at a constant rate (counting aloud) while an assistant completes screwing in the other bulbs one at a time, so that they also become part of the circuit.

What does the crank operator experience as additional bulbs are connected in parallel?

Experiment 8: The hand generator and a variable resistor

Prepare a circuit as shown in the figure.

In addition to the bulb, which acts as a current indicator, a variable resistor (rheostat) is used. One student should crank the hand generator at a constant rate. The other should change the resistance by ad-

justing the rheostat. It should be adjusted from the position with highest resistance towards the position with low resistance.

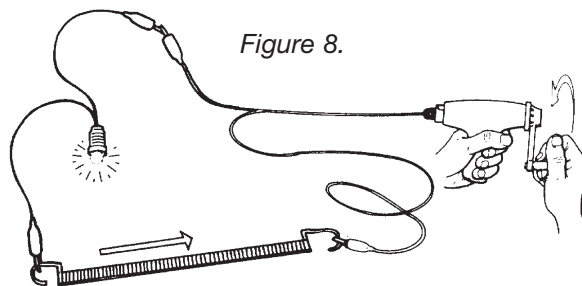


Figure 8.

What happens to the bulb? What does the crank operator experience as the resistance is decreased?

Experiment 9: The conductivity of salt water

Set up the experiment as shown in the figure.

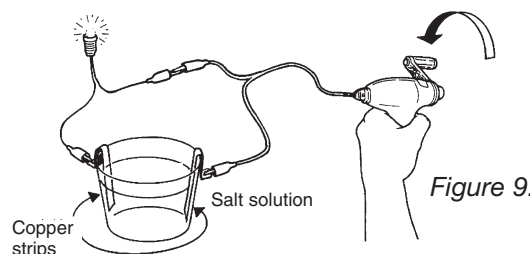


Figure 9.

First try placing the leads from the generator at two different points in a pile of dry table salt to determine whether or not dry salt is a conductor of electricity. Turn the crank and note whether or not the bulb lights up.

Now pour distilled water (no salt yet) into the container with the two strips of copper. Connect the leads and test again whether or not electricity is conducted.

Finally it is time to mix some salt into the water. Start with a small amount. Stir thoroughly until the salt is dissolved, turn the crank and observe. Gradually add some more salt, being careful to continue mixing, and observe what happens to the bulb while the crank is turned.

Experiment 10: Electrolysis

Dissolve about 28 grams of copper sulphate (CuSO_4) in a clear plastic cup which is about 2/3 filled with warm water. Polish a copper strip, and place it in the solution as shown in the figure.

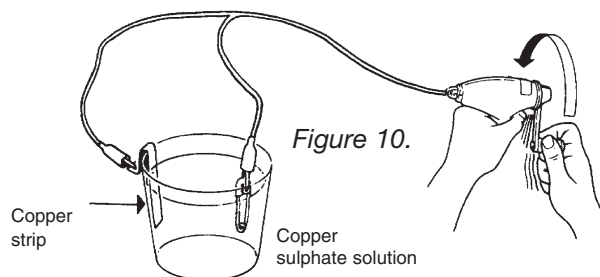


Figure 10.

Connect the POSITIVE lead from the generator to the copper strip. Connect the other lead, the NEGATIVE, to a small metal object e.g. an iron nail. Use tape to fix the object to the cup so that only the item and not the alligator clip is immersed in the solution. Now turn the handle slowly in the clockwise direction for 20 to 30 seconds. Almost immediately you should notice that a dark layer is formed on the nail. Dry off the nail. Repeat the procedure a number of times. After a few minutes one should be able to clearly see a layer of copper on the nail.

Experiment 11: The hand generator and magnetism

Wind a piece of copper wire around a magnetic compass as shown in the figure. Six or seven windings should be fine.

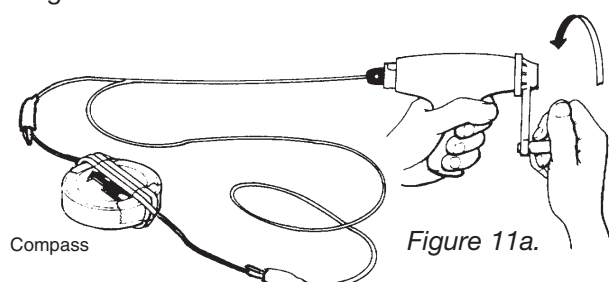


Figure 11a.

Now turn the crank SLOWLY, and observe what happens to the compass needle.

Turn the handle in the opposite direction and observe the needle. Only use the hand generator a few seconds at a time, because in this experiment the output is short circuited. A current limiting resistor (e.g. 50 ohms) can also be inserted in series, if desired.

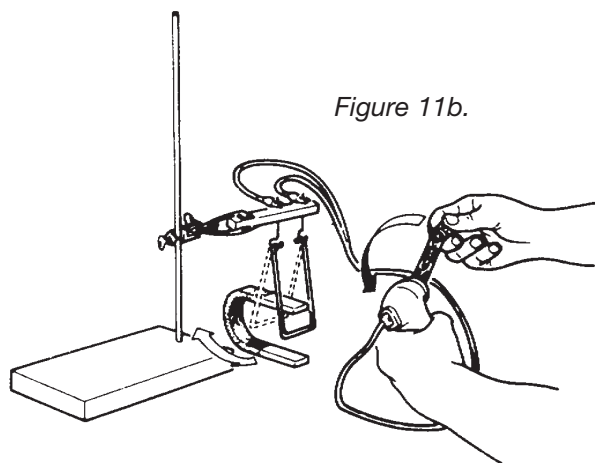


Figure 11b.

It is also possible to suspend a small piece of conductor (e.g. heavy gauge copper wire) as shown in the illustration between the poles of a horseshoe magnet. Turn the crank carefully, and observe what happens to the suspended conductor.

List of accessories:

Experiment 1	
Lamp socket, E10	752010
Small bulbs, package of 10 ea.	425035

Experiment 2

Voltmeter	381060
Diode	623390
Light emitting diode (LED)	622010
Resistor, 470 ohm	603747

Experiment 3

Copper wire, 1.0 mm	113530
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Experiment 5

Lamp socket, E10	639220
Small bulbs, package of 10 ea.	425035
Mini-leads with alligator clips, package of 10	106220

Experiment 6

Lamp socket, E10	639220
Small bulbs, package of 10 ea.	425035
Mini-leads with alligator clips, package of 10	106220

Experiment 7

Lamp socket, E10	639220
Small bulbs, package of 10 ea.	425035
Mini-leads with alligator clips, package of 10	106220

Experiment 8

Lamp socket, E10	639220
Small bulbs, package of 10 ea.	425035
Mini-leads with alligator clips, package of 10	106220
Variable resistor	608808

Experiment 9

Lamp socket, E10	639220
Small bulbs, package of 10 ea. 4V 0.3A	425020
Mini-leads with alligator clips, package of 10	106220
Copper plate 5x9 cm (can be cut into four strips)	449800
Option: Copper foil, package with 500 grams	118510
Plastic cups, package of 40 ea. 2 dl	051710
Kitchen salt, 500 gram	Purchase locally

Experiment 10

Lamp socket, E10	639220
Small bulbs, package of 10 ea.	425035
Mini-leads with alligator clips, package of 10	106220
Copper plate 5x9 cm (can be cut into four strips)	449800
Option: Copper foil, package with 500 grams	118510
Iron nails, 8 cm, box with 2 kg.	338520
Plastic cups, package of 40 ea. 2 dl	051710
Copper sulphate, 250 grams	Purchase locally

Experiment 11

Copper wire, 1.0 mm	113530
Pocket compass	340500
Horseshoe magnet	331510
Retort stand	