Electricity from Tuna and Other Non-Traditional Sources

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This paper describes three non-traditional ways of "producing" electricity. First, we will use food and a Peltier module to power a small engine. Second, we use a piezoelectric speaker to turn on a LED. Third, we focus on a board, in the vicinity of which a LED lights up due to electromagnetic induction.

Electricity from food

Goal

The goal of the experiment is to "produce" electricity in a simple way using food and a Peltier module.

Course of the Experiment

We will "produce" electricity from tuna, butter and salami. The process of "producing" electricity is the same for every food. We insert a wick into the delicacy, and light it. We place a Peltier cell that "produces" electricity a few centimetres above the flame.

Equipment

can of tuna in oil, butter, salami, Peltier module, electric motor, wick or absorbent string, hammer, nail (approx. with the same diameter as the wick), matches

Procedure and Theory

Let's start with the tuna electricity. Using a hammer and a nail, make a hole into the lid of the tuna can (the tuna must be in oil). Thread the wick through the hole; it will absorb a small amount of oil from the can. Now we can light it. The burn time is around ten hours. It depends, however, on many factors, such as the amount of oil in the can, the size of the flame, wick size and so on. This "tuna candle" (Fig. 1) is very practical not only due to the long burning time, but also due to other advantages. It is ecological, because it uses oil that we would pour into the waste. The flame also heats the can slightly, so that its contents will be a few degrees Celsius warmer after the end of the experiment. At the same time, a lit candle does not smell of tuna, which we will especially appreciate with the decorative function of the candle.

Now we will add Peltier module. It is actually a battery of Peltier modules, which are hidden between two porcelain plates. After connecting the module to a DC source, one side of it starts to heat up and the other cools down. Usually this component is used for cooling e.g. in travel refrigerators or in electronic devices.

We will use the fact that this phenomenon works "vice versa". One side of the module can be heated, the other cooled, and thus electric current is "produced" (Fig. 4). The larger the temperature difference on the sides of the module, the more electricity we "produce". We connect the module terminals to the electric motor and place the module above the candle flame. The electric motor starts to spin after a few seconds. The temperature of the flame is sufficiently large so that it is not necessary to actively cool the other side of the module. The problem occurs after a longer time of operation of the experiment, since the module is warmed up as a whole, thereby reducing the temperature difference of its sides. This problem can be solved, for example, by fixing a metal to the cooler side of the module, which dissipates heat better.

Better results can also be achieved by using Peltier module type "TEG" (Thermo-Electric Generator) (Fig. 6) instead of the conventional module type "TEC" (Thermo-Electric Cooler) (Fig. 5), which differs from the TEG module slightly in construction and is primarily used for cooling, not to "produce" electricity, like the TEG module.

We can conduct a similar experiment with butter and salami (Fig. 2). We make a hole (e.g. using a screwdriver) into the butter and the salami sausage. We insert the wick and light it. Again, we will use a Peltier module to "generate" electricity, just as we did with the tuna candle. A butter candle burns very nicely, but unfortunately the butter is consumed within a few minutes. The salami candle is not suitable due to the small amount of fat and the large amount of meat, which prevents the passage of fat from more distant parts of the salami into the wick during burning. This problem can be solved by heating a pan with the sliced salami over a small flame. The fat gets out of salami and can be poured into a container in which we can insert the wick. After several minutes, the fat solidifies and after lighting the wick, we have a candle similar to the butter candle (Fig. 3).

Fig. 1. Tuna candle

Fig. 2. Butter and salami candle

Fig. 3. Candle made of fat fried from salami

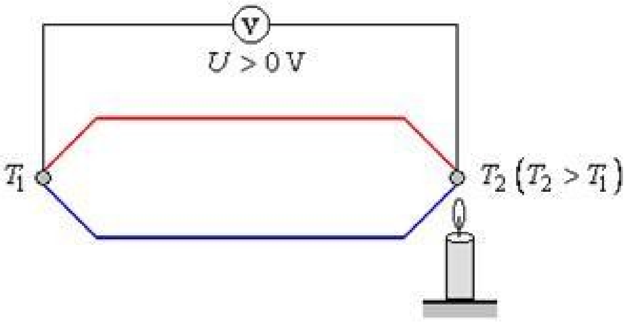

Fig. 4. The principle of electricity "generation" with P. module [2]

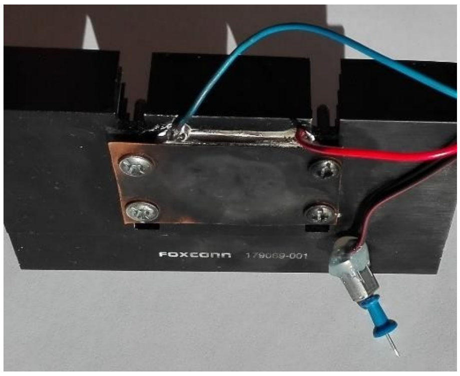

Fig. 5. P. TEC module with cooler

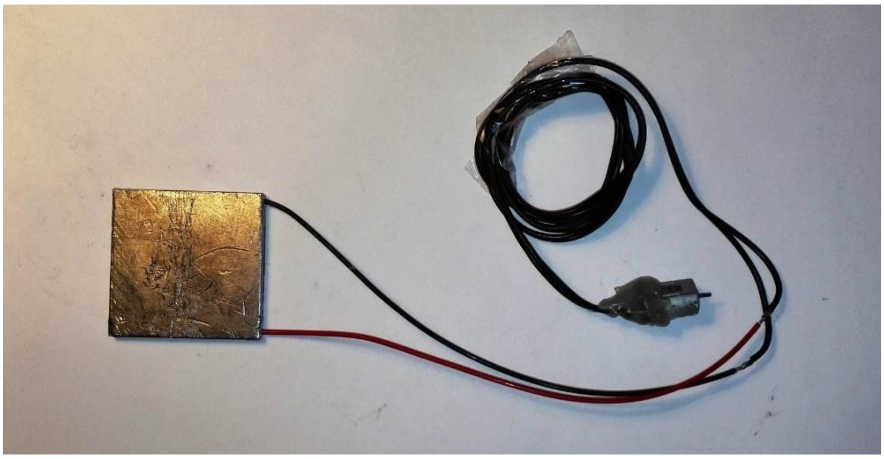

Fig. 6. P. TEG module with connected electric motor

From the measured temperatures of the flame of various candles (with considerable inaccuracies) we can see that the candle made from Hunter's salami and tuna have approximately the same flame temperature as a tea light. In terms of flame temperature, the most suitable candle is the one made from the fat of Hunter's salami, as it reaches a slightly higher temperature than other measured candles.

Tab. 1. Overview of the flame temperatures of different candles

	Fat from the Hunter's salami	Tuna in vegetable oil	Tea light
Temperature at the top of the flame [° C]	615	490	615
Temperature just above the wick [° C]	605	600	600
Maximum temperature [° C]	720	620	640

The flame temperature of various candles was measured with a Vernier point thermometer

Piezoelectric Speaker as a Source of Electricity

Goal

The goal of the experiment is to show that electricity can be "produced" by equipment that originally serves a completely different purpose – production of sound.

Course of the Experiment

We can "produce" electricity by gently tapping on a piezoelectric speaker (also known as piezoelectric transducer), or gently pressing it with our fingers. The speaker is connected to an LED that flashes when tapped.

The experiment can be enriched with two improvements. The first is the anti-parallel connection of the second LED. Thanks to this it is possible to see that during speaker compression one LED lights up and when we release the speaker, the second LED lights up.

The second improvement is the connection of an MP3 player to the piezoelectric transducer. This shows that the piezoelectric transducer is a component capable of producing sound.

Equipment

piezoelectric transducer, 2x LED, MP3, amplifier

Procedure and Theory

Piezoelectric transducer contains a crystal, which is located between two electrodes. The voltage on these electrodes causes the crystal to deform, and also bends the metal plate on which the crystal is placed. Electrical impulses from the player ensure that the crystal deforms at appropriate intervals. As a result, the transducer emits sound in the form of music.

Now we turn the situation around. We will press the speaker, i.e. indirectly the crystal. Thus, electrons start to move in the circuit which creates electrical current sufficient to light up LED.

If two LEDs are connected in anti-parallel, the situation described above will occur. This phenomenon can be simply explained like this: when pressing the speaker, the electrons in the circuit start to move in one direction and when releasing the speaker, the electrons move in the opposite direction. As a result, the second LED lights up.

When the unloaded piezoelectric transducer is pressed, a voltage of approx. 50 V is generated at its contacts, and approx. 40 V is generated when it is released.

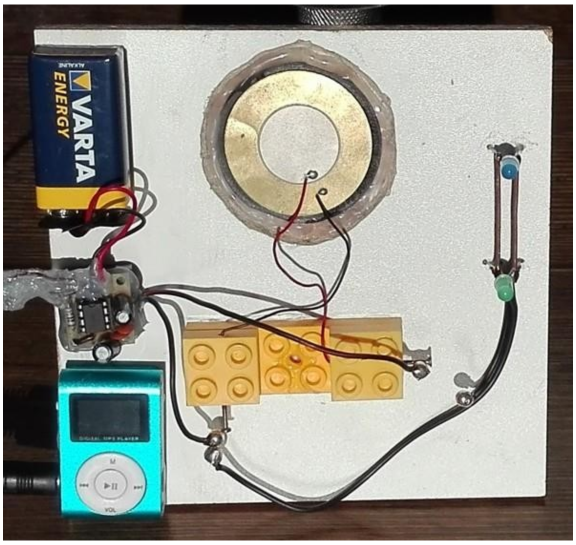

Fig. 7. On the left there is an MP3 player and an amplifier. In the middle there is the piezoelectric speaker and in the right part there is the LEDs connected in anti-parallel

Induction board

Goal

The goal of the experiment is to show the basic phenomena associated with electromagnetic induction. We can use this experiment to show characteristics of magnetic induction flux, the principle of inductive charger for wireless charging of mobile phones, induction heater, transformer, transistor and coil.

Course of the Experiment

We place a coil with LED on the board or a few centimetres above it. The LED lights up.

Equipment

insulated copper wire, resistor 10 kΩ, transistor 2N2222, one galvanic cell type AA, or two in series

Procedure and Theory

The experiment consists of two parts. The first part (Figs. 9 and 10) is the source of the variable electromagnetic field. It consists of a battery of galvanic cells, a transistor, a resistor and a coil. The second part is a receiver in which the electrical current is generated due to electromagnetic induction.

In the first part, the transistor and the winding of the primary coil play a key role. One end of the primary coil is connected to the collector of the transistor, the other end of the coil is connected to one terminal of the resistor, the other terminal of the resistor is connected to the base of the transistor. The negative battery terminal is connected to the emitter of the transistor. The positive battery terminal is connected to a loop of the coil, which was formed by pulling the wound wire in the middle of the turns, i.e. twenty turns.

After connection, the circuit behaves as an el. oscillator – source of electrical non-harmonic oscillations.

The second part (Fig. 8) is very simple. It is a coil with forty turns, the ends of which are connected to an LED.

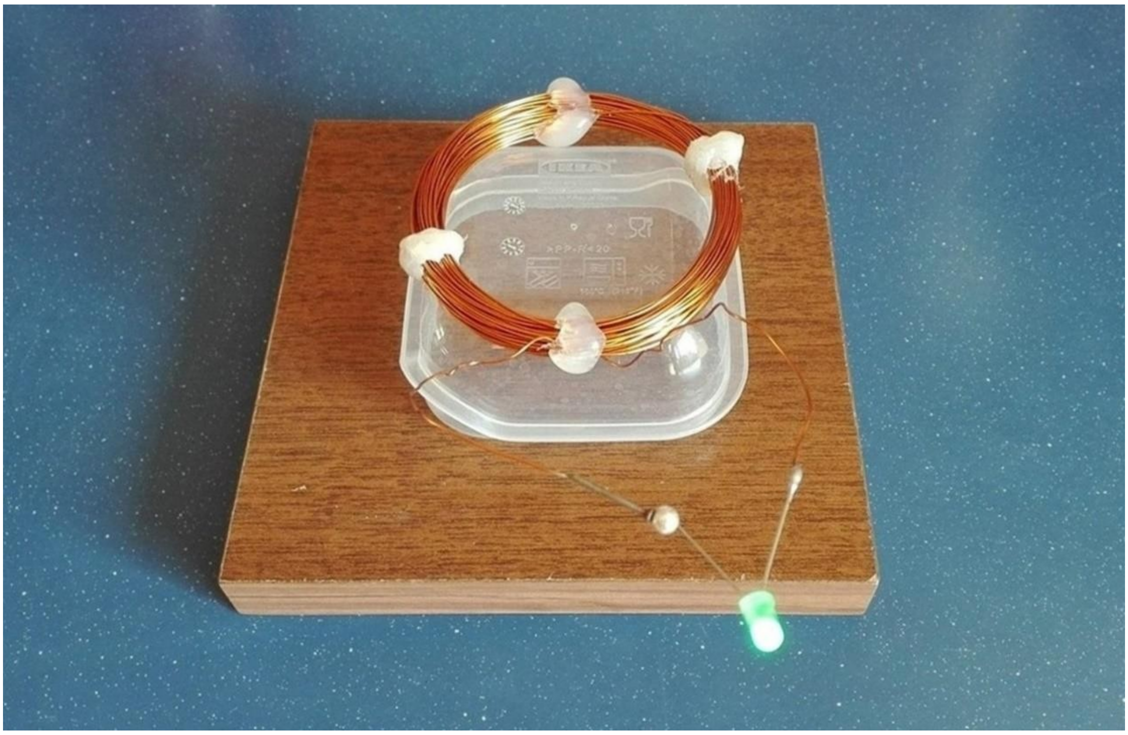

Fig. 8. Coil with connected LED

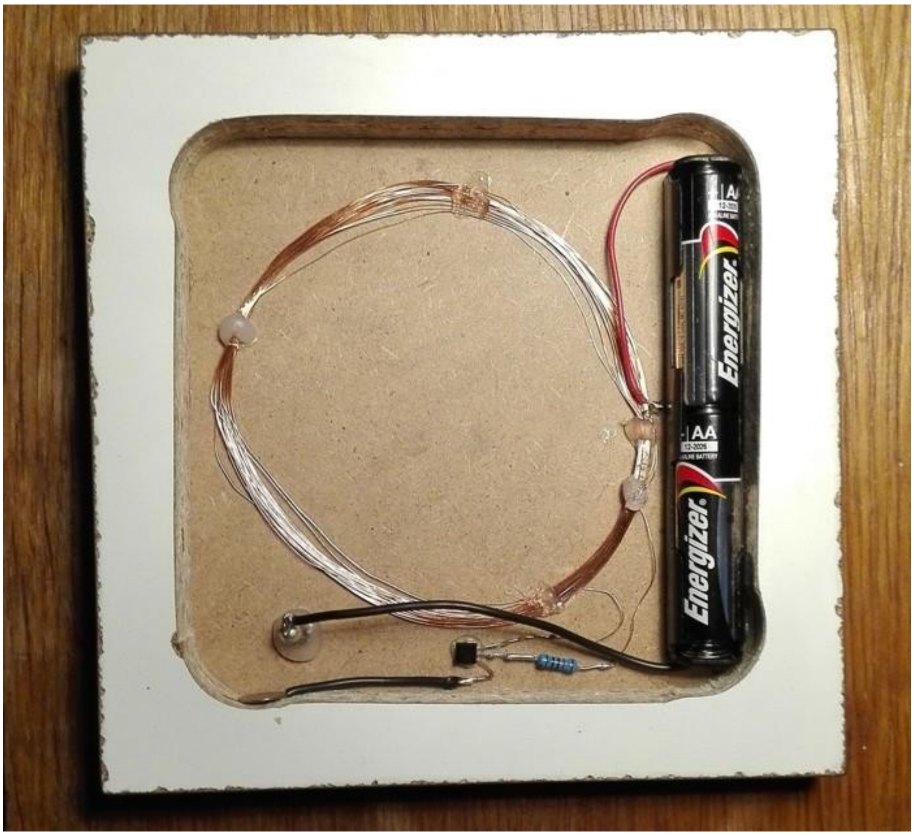

Fig. 9. El. circuit inside the board

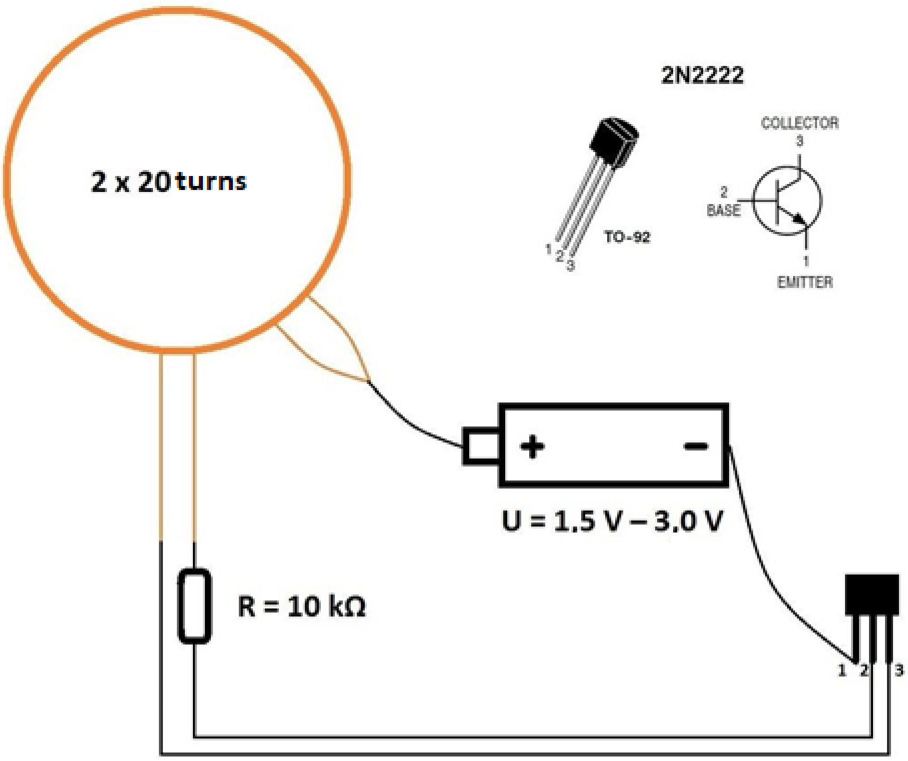

Fig. 10. El. circuit inside the board [2]

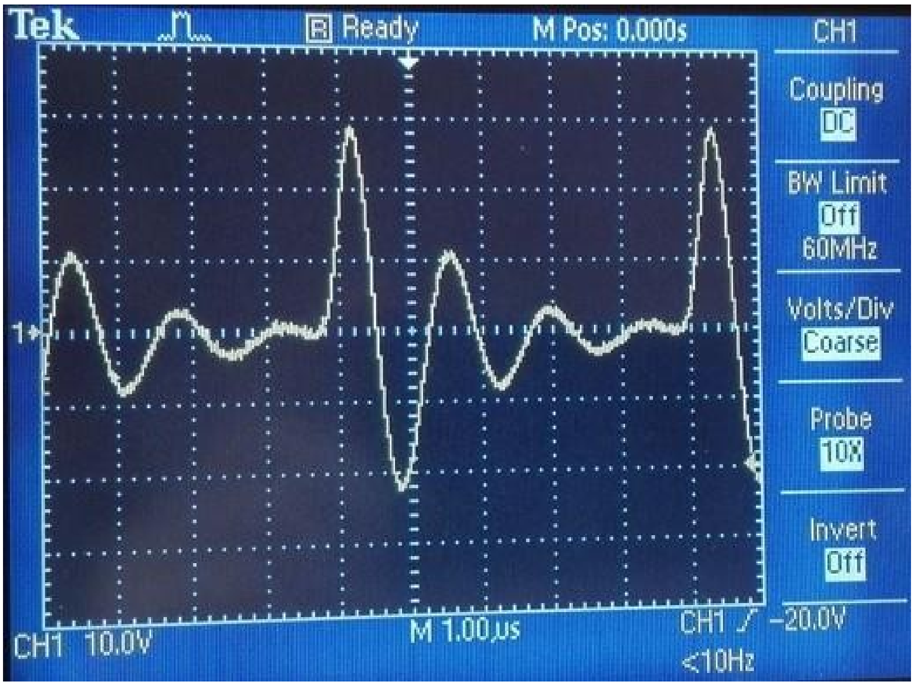

Fig. 11. Voltage on the secondary coil placed on the board (without LED)

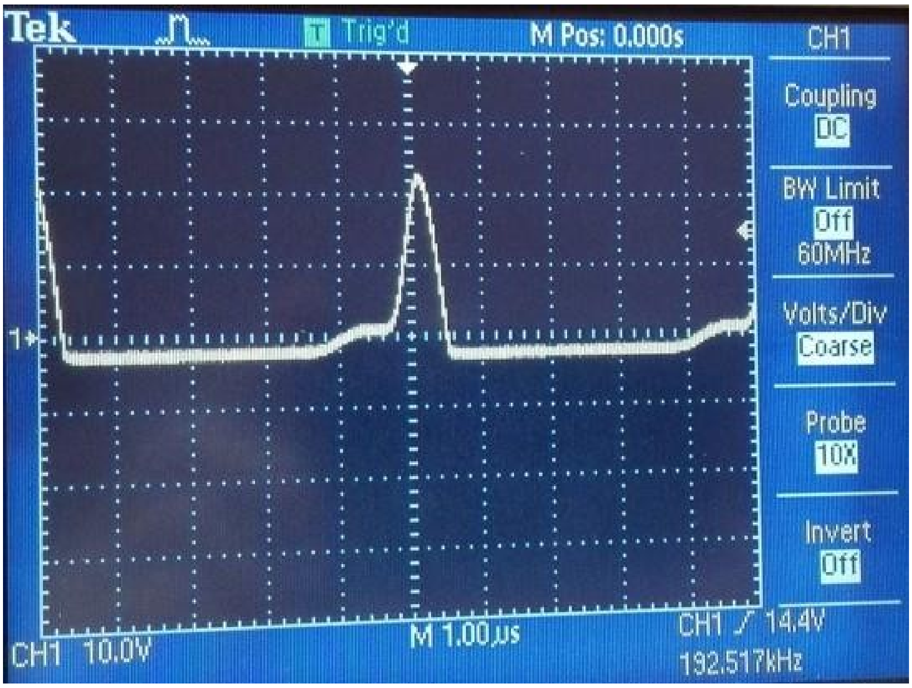

Fig. 11. Voltage on the secondary coil placed on the board with LED connected

Literature

[1] At http://fyzika.jreichl.com/main.article/view/911-peltieruv-jev

[2] Electrical circuit diagram: youtube channel *Muy Fácil De Hacer*. Available at https://www.youtube.com/watch?v=T75V9hHXwNs