WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 11, Nov., 2022

EXPERIMENTAL OBSERVATION OF MECHANICAL ENERGY CONVERSION INTO HEAT ENERGY

Boydedayev Sobirjon Rahimjonovich,

Umaraliyev Maksud Mahmudovich,

Turgunov Adham Rakhmatillayevich
Namangan Engineering and Construction Institute
adxamturgunov2127@gmail.com

Abstract

Energy is one of the fundamental quantities in physics. Energy occurs in different forms, which can be converted one into the other. In a closed system, the total energy is conserved in the course of conversion processes. In this experiment, the equivalence of mechanical energy E_m and thermal energy E_{th} is established experimentally. Mechanical work E_m is expended by turning a crank handle against the frictional force. This leads to a temperature rise of the calorimeter and thus to an increase in the thermal energy E_{th}. The two energy forms can be registered quantitatively in units of newton meter (Nm) and Joule (J) by measuring the temperature ϑ and the number of revolutions so that their numerical equivalence can be demonstrated experimentally: $E_m = E_{th}$.

Keywords: mechanical energy, heat energy, conservation of energy, calorimeter, heat balance, heating.

The Main Part:

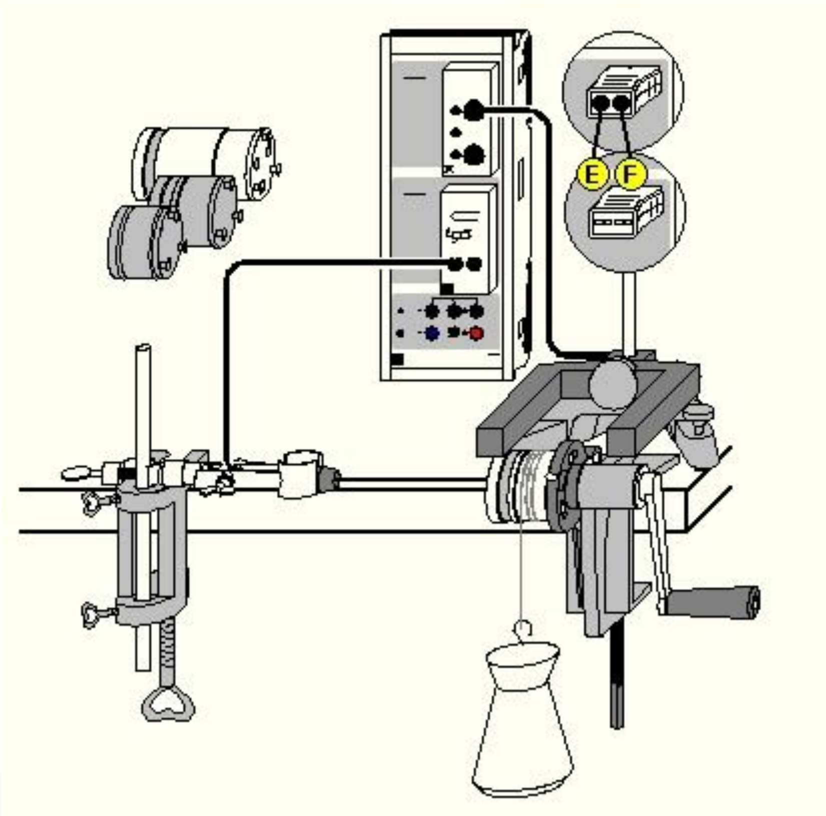
Energy is one of the most important fundamental laws of nature; according to it, in any closed system, energy does not appear from nothing and does not disappear, but only changes from one type to another. Burke, if there are only conservative forces in the system, the total mechanical energy of the system remains unchanged, that is, kinetic energy is transformed into potential energy and vice versa. If in a closed system there are non-conservative forces, such as frictional forces, in addition to conservative forces, the total mechanical energy of the system decreases with time. As a result, non-mechanical energies: thermal or chemical, electromagnetic field energies, etc., increase over time. But the sum of all forms of energy does not change over time.

We used the following equipment to observe the transformation of mechanical energy into thermal energy: Sensor-CASSY, CASSY Lab 2, Timer box or Timer S, Temperature box, Temperature sensor NiCr-Ni or NiCr-Ni adapter S , Temperature sensor NiCr-Ni, type K, Forked light barrier, infrared, Multicore cable, 6-pole, 1.5 m, Equivalent of heat, basic apparatus, Calorimeter, water calorimeter, copper calorimeter with heating, aluminum calorimeter with heating, large aluminum calorimeter with heating, Bench clamp, simple, Stand base, V-shape, 20 cm, Stand rod, 10 cm, Stand rod, 25 cm, Clamp with jaw clamp, Weight, 5 kg, PC with Windows XP/Vista/7/8.

When conducting an experiment, we assemble the device in the following order.

* The equivalent of a heating device is fixed to the corner of the table.
* A bench clamp is attached to the edge of the table at a distance of approx. 40 cm from the plastic mounting of the main device. As shown in the drawing, the clamp for the installation of the temperature sensor is fixed using a 25 cm rod with a jaw clamp.
* The calorimeter is installed with the hole facing up and water is poured into the hole.
* The cover is inserted into the hole and held in place by the locking screw.
* The filled calorimeter body is attached to the main apparatus, the rivet pins are placed in their plastic sockets and the calorimeter body is screwed to fix the pins.
* The temperature sensor is inserted into the hole of the calorimeter as deep as possible and the locking screw of the calorimeter is tightened. As shown in the drawing, the temperature sensor is fixed using the already prepared stand material.
* A weight of 5 kg is placed under the body of the calorimeter.
* The nylon strap is wound approx. Around the calorimeter 4 times (maximum 6) and it is connected to the weight on the floor. The weight should hang from the front side of the crank.
* The handle of the crank is operated and it is checked that the weight of 5 kg is raised a few centimeters and that it is kept at a constant height when the handle is turned more. If it rises too high, the number of turns of the nylon band is reduced; if it does not rise at all, the number of turns is increased.
* To measure the number of revolutions N_{A1}, the plug light barrier is placed using the stand base as shown in the drawing and connected to input A of Sensor-CASSY through the timer box.
* The temperature sensor ϑ_{B11} is connected to input B of the Sensor-CASSY through the temperature box (socket T_1) to measure the temperature.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 11, Nov., 2022



(pic.1)

The temperature ϑ_{B11} is already displayed graphically as a function of the number of revolutions N_{A1} during the measurement. In the prepared diagram Evaluation, the thermal energy is plotted against the mechanical energy that has been provided by turning the crank against the friction. The mechanical energy E_m is equal to the product of the frictional force and the covered path s: $E_m = F{\cdot}s$ (1) with $F = mg$. (2) F = frictional force, m = mass of the weight = 5 kg, g = acceleration of gravity = 9.81 m/s² and = $N{\cdot}d{\cdot}\pi$. (3)

s = frictional path, N = number of revolutions, d = diameter of the calorimeter = 0.047 m.

Thus the mechanical energy is: $E_m = m{\cdot}g{\cdot}d{\cdot}\pi{\cdot}N$. (4)

The increase in thermal energy as a result of the temperature increase is given by:

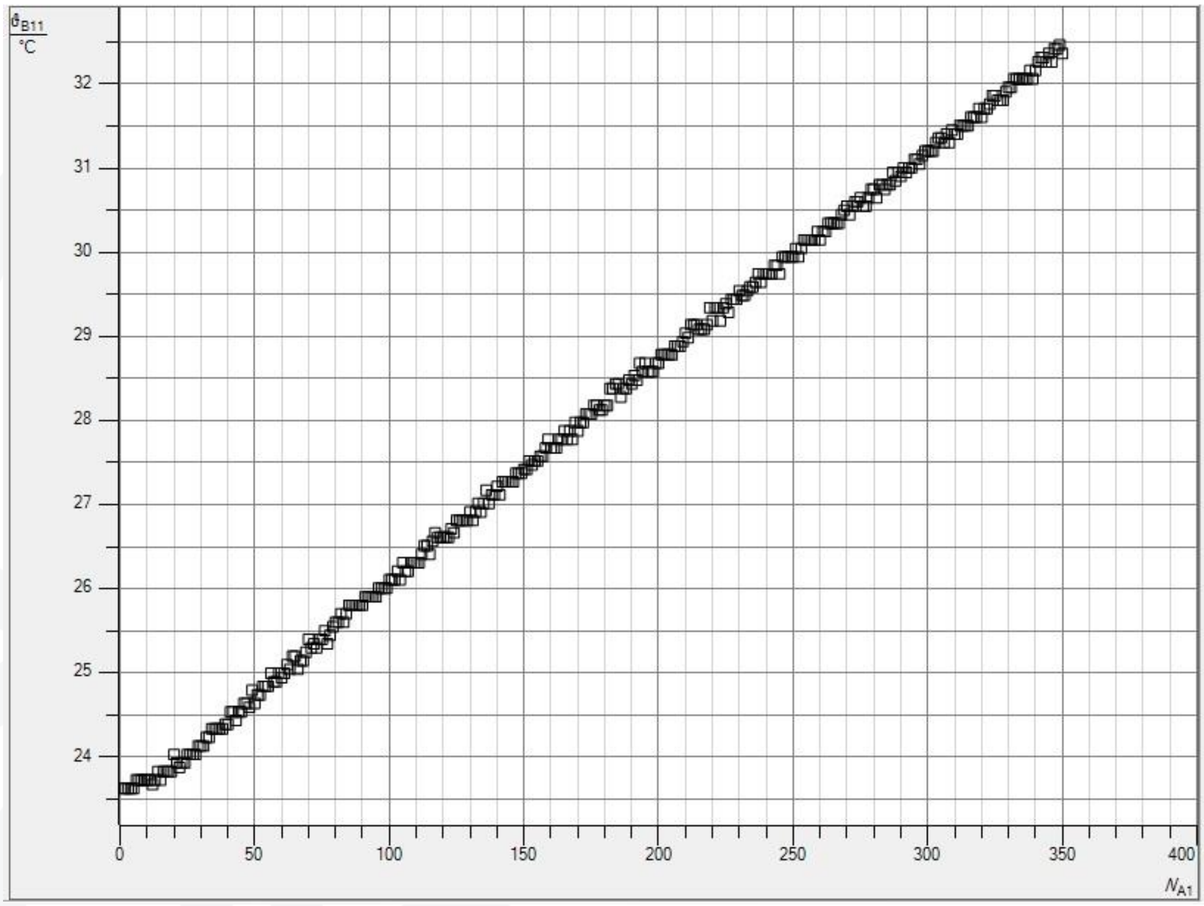
$$E_{th} = C{\cdot}(\vartheta_2 - \vartheta_1)\ E_{th} = C{\cdot}(\vartheta_2 - \vartheta_1) \quad (5)$$

The heat capacity C depends on the calorimeter used and is entered into the C setting according to the following table:

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 11, Nov., 2022

Calorimeter	Heat capacity C/(J/K)
Water	40 + m_{H2O}/g · 4.2 (mass of the water in g)
Copper	264 + 4.2 (for 1 g water in the bore)
Aluminum	188 + 4.2 (for 1 g water in the bore)
Aluminum, large	384 + 4.2 (for 1 g water in the bore)

The equivalence of the mechanical energy E_m and the thermal energy E_{th} can be confirmed by means of a fit to a line through the origin. Usually the slope of the straight line through the origin is somewhat smaller than 1. This is due to heat loss which is not registered, for example by thermal contact of the calorimeter with the nylon band or the plastic mounting.



(Pic. 2)

Summary

Using this device, it is very convenient to observe the transformation of mechanical energy into thermal energy, and the efficiency of the device is high. The law of conservation of energy is very well explained in the experiment. the experimental analysis is shown in Figure 2.

REFERENCES

1. Boydedayev, S. R., M. M. Umaraliyev, and A. R. Turgunov. "APPLICATION OF THE VENN DIAGRAM METHOD IN THE LABORATORY LESSON" DETERMINATION OF YOUNG'S MODULUS OF DIFFERENT METALS BY BENDING METHOD"." Web of Scientist: International Scientific Research Journal 3.9 (2022): 377-381.

2. Mamadjanov, Ahrorjon Ibragimovich, and Adhamjon Rakhmatillaevich Turgunov. "LIFE TIME KERR-NUT BLACK HOLE." Scientific Bulletin of Namangan State University 1.8 (2019): 39-44.

3. Rahimjonovich, Boydedayev Sobirjon, Umaraliyev Maksud Mahmudovich, and Turgunov Adham Rakhmatillayevich. "TO THE MAGNETO-OPTICAL ANISOTROPY OF THE Mg CRYSTAL THE EFFECT OF CHANGING THE MAGNETIC STRUCTURE OF FeBO3." Web of Scientist: International Scientific Research Journal 3.9 (2022): 175-180.

4. Rahimjonovich, Boydedayev Sobirjon, Umaraliyev Maksud Mahmudovich, and Turgunov Adham Rakhmatillayevich. "TO STUDY THE DEPENDENCE OF THE INTENSITY OF" ABSOLUTE BLACK MATTER" RADIATION ON TEMPERATURE AND DISTANCE." Galaxy International Interdisciplinary Research Journal 9.12 (2021): 671-675.

5. Rahimjonovich, Boydedayev Sobirjon, and Umaraliyev Maksud Mahmudovich. "STUDY OF FERROMAGNETIC HYSTERIZES CURVES IN CASSY LAB." Web of Scientist: International Scientific Research Journal 3.9 (2022): 520-525.

6. Mamadjanov, Akhror Ibragimovich, and Adhamjon Raxmatillayevich Turg'unov. "Measurement of Small Deformations with a Mach-Zehnder Interferometer." 2632-9417.

7. Mamadjanov, A. I., and M. N. Izzatullayeva. "MEASUREMENT OF THE MAGNETOSTRICTIVE EFFECT ON FERROMAGNETS USING A MICHELSON INTERFEROMETER." Web of Scientist: International Scientific Research Journal 3.1 (2022): 11-16.

8. Mamadjanov A. I., Soliyev A. Z., Hfsfnov X. B. "DETERMINATION THE RATIO OF HEAT CAPACITY AT CONSTANT PRESSURE WITH CONSTANT HEAT CAPACITY VIA THE VELOCITY OF SOUND WAVES IN GASES"
Web of Scientist: International Scientific Research Journal 2 (12), 54-61

9. Gulyamov, G., Dadamirzaev, M. G., Kosimova, M., & Uktamova, M. (2020). THERMOPHOTOEMF OF HOT CHARGE CARRIERS AT pn-JUNCTIONS UNDER

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 11, Nov., 2022

EXPOSURE TO A MICROWAVE FIELD AND LIGHT. Scientific-technical journal, 3(5), 66-70.
10. Косимова, М. О., & ўғли Сайфиддинов, О. О. (2022, May). СРАВНЕНИЕ ДИФФУЗИОННЫХ ЕМКОСТЕЙ ТРЕХМЕРНЫХ 3D И ДВУМЕРНЫХ 2D pn—ПЕРЕХОДОВ. In INTERNATIONAL CONFERENCES ON LEARNING AND TEACHING (Vol. 1, No. 8, pp. 90-94).