14. WATER AS A SOURCE OF ENERGY[1]

14.1. Introduction

The existing energy carrier depletion and aggravating environmental situation have resulted in awareness of the need of a transition to inexhaustible and environmentally friendly hydrogen power engineering [127], [189], [191], [193].

Not only scientists, but also politicians are involved in a solution of this problem; that's why it is desirable to have a clear notion concerning the problems of the initial period. Now it is considered that fuel elements will be the main consumers of hydrogen. It is stipulated by the fact that the most widely spread environmentally friendly electric energy is produced as a result of environmentally friendly process of the combination of hydrogen with oxygen. In this matter, the main problem is a high cost of fuel elements.

The cost of 1 kW power produced by the fuel element is nearly 10000 US dollars. The cost of 1 kW power produced by a petroleum equivalent is 3 to 5 US dollars. It is the main cause, which restricts a transition to hydrogen power engineering at this stage of its mastering. In general, the achievements in the field of fuel element elaboration are great, but they are far from their wide industrial application.

A cell of the fuel element is a tank with two electrodes and a separating membrane, on which a catalytic agent (platinum) is applied. Hydrogen is supplied to one electrode; oxygen is supplied to another electrode. The catalytic agent divides the hydrogen molecules into the electrons and the protons. The protons penetrate via the membrane into this half of the tank where oxygen is situated; the electrons go to the power grid, which is connected with the oxygen electrode. Here, the electrons and the protons are united and produce the hydrogen atoms, which are combined with oxygen and form water.

The more hydrogen atoms are divided into the protons and the electrons by the catalytic agent, the more effective electric power fusion process takes place. But the calculations show that the modern catalytic agents divide only 0.5% of hydrogen atoms into the electrons and the protons. Actually, it is a direct coefficient of performance of the fuel element.

But the elaborators of the fuel elements determine a coefficient of performance of the fuel element in another way. They divide energy being produced with the help of hydrogen by energy spent for hydrogen production from water. In this case, an indirect coefficient of performance of the fuel element is obtained; it achieves 70% and more. It is not a bad index, but one should bear in mind that in this case 99.5% of hydrogen atoms do not take part in electric current production. Hereof, an important task of the fuel element elaborators results: it is necessary to increase their direct coefficient of performance.

It is known that the most perfect electrolyzers consume 4 kWh of electric energy for production of one cubic metre of hydrogen from water. If this amount of hydrogen is burnt, nearly 3.5 kWh of pure energy can be released. It appears from this that hydrogen can become a competitive energy carrier if power consumption for its production from water can be reduced to 2 kWh/m^3. It is the main task of the initial period of hydrogen power engineering development.

A solution of this task should begin with an analysis of the reserves of power consumption by the existing electrolyzers. They are hidden in their constant potential. The application method of this potential has already been worked out in order to reduce electric power consumption for hydrogen production from water. If there are six cells and voltage is nearly 10 V, this method reduces power consumption for a water electrolysis process 2-3 folds.

The largest reduction reserve of power consumption for water electrolysis is in the photosynthesis process. Annually during this process, water evolves hundred million cubic metres of hydrogen, the

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[1] The reader understands, that in conditions of the market the publication of the new experimental and theoretical results explaining them is inexpedient.

atoms of which are used as the connecting links in organic molecule construction. For implementation of this process, all living organisms have their own energy sources.

What if this process is modelled in a technical device? Hydrogen being produced will have no possibility to take part in organic molecule production and will escape into the atmosphere together with oxygen. The devices for location and division of these gases are already available. When this water electrolysis process takes place, the main condition is a small current magnitude.

The patents have already been obtained for some of such devices, and it is possible to see the operation of these devices. At present, they are small laboratory models with low productivity, but they break down water into hydrogen and oxygen steady when current strength is 0.02-0.03 A.

It has been found out that electrical potential at the electrodes made of one material appears before such electrolyzer is primed with electrolyte. A cell of such electrolyzer is charged within several minutes. When the charged cell is disconnected from the grid, its electrodes have enough potential for electrolysis process continuation during several hours. It appears from this that it is necessary to recharge such electrolyzer intermittently in order to keep it in an operating mode. As a result, power consumption for hydrogen production from water is reduced considerably.

It is easy to imagine what financial and intellectual resources of the world take part in a search of the ways of energy expense reduction for hydrogen production from water. In Russia, many scientific institutions of branch science and educational organizations are busy with this problem. There is a research hydrogen institute. In the United States of America and in Europe, the associations of the scientists who are involved in hydrogen power engineering have been set up.

Energy problem globality results from environmental hazard of oil and gas, not from their depletion. But the world owners of energy resources are not upset about the problem of environmental hazard of the modern energy carriers.

But energy effectiveness of water is not restricted by production of inexpensive hydrogen from it. Within the last years, a large number of the experiments have been carried out that prove the possibility of obtaining additional heat energy from water. It takes place in water cavitation processes as well as when pulse current exerts influence on its ions and clusters.

Below, we give a series of experiments, which show that water can generate additional heat energy and be broken down into hydrogen and oxygen with an energy effectiveness index, which significantly greater than unity.

14.2. Analysis of Measuring Processes of Energy Consumed in the Form of Pulses

14.2.1. Analysis of the Oscillogram Processing Methods

The specialists know that modern electronics is based on the digital techniques of transmission and reproduction of any electronic information. The essence of this method is in the fact that the ordinates of a function of any shifting process are converted into figures. In this form, information being described by such function is transmitted to a receiver, which converts the figures being obtained into functional dependence.

It is natural that the computer programs, which are intended for an implementation of the processes being described, are worked out and used. Accuracy of information being obtained in such a way depends on quantity of the ordinates being measured per time unit. This quantity can be hundred thousands per second and more. As a result, modern computer programs can determine an area under a functional dependence curve as well as an average ordinate value with any accuracy, which is necessary for practical purposes. Thus, the processing problem of the oscillograms of any form is solved on the highest level.

But the computer program can also give an erroneous result if the erroneous design formulas are used in its elaboration. That's why the writers of the programs for computer processing of the oscillo-

grams should know the details of the measurement process of electric energy being consumed in the form of pulses.

In order to understand the essence of errors made during processing of the oscillograms of voltage, current and power, let us begin to analyse the oscillogram processing methods. Let us see how a value of average voltage, which is supplied to a customer in the form of rectangular pulse, is evaluated (Fig. 127).

In Fig. 127, $T = 2\tau$ is a pulse follow period, s; τ is pulse duration, s. If the pulses are rectangular, their duty ratio S is determined according to the formula

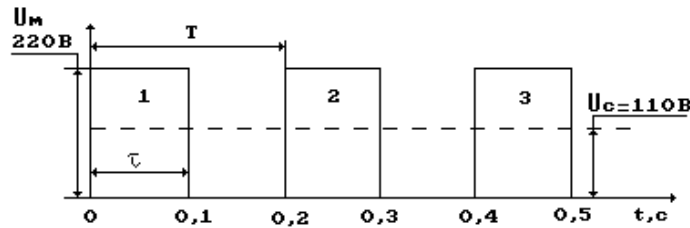$$S = \frac{T}{\tau} = \frac{0.2}{0.1} = 2.0. \qquad (439)$$

Fig. 127. Diagram of rectangular voltage pulses

Pulse duty ratio can be evaluated by means of division of the whole area, which corresponds to the pulse follow period by pulse area (Fig. 127).

$$S = \frac{220 \cdot 0.2}{220 \cdot 0.1} = 2.0. \qquad (440)$$

There exists a notion of duty cycle Z, which makes it possible to take into account a pulse form. If the pulses are rectangular, the pulse form coefficient $k = 1$ and duty cycle Z are determined according to the formula

$$Z = k / S = 1 / S = 1 / 2.0 = 0.50. \qquad (441)$$

If pulses are triangular, $k = 0.5$ and

$$Z = 0.50 / S = 0.50 / 2.0 = 0.25. \qquad (442)$$

Let us pay attention to the fact that pulse duty ratio of the triangular pulses will be

$$S = \frac{1}{Z} = \frac{1}{0.25} = 4. \qquad (443)$$

If current is direct< $T = \tau$ and $S = 1$. Average voltage supplied to the consumer will be equal to mains voltage $U = 220B$.

If voltage is supplied in the form of rectangular pulses with the amplitude U_{IC} (Fig. 127), average voltage value U_C is determined according to the formula

$$U_C = U_{IC} \cdot Z = 220 \cdot 0.5 = \frac{U_{IC}}{S} = \frac{220}{2} = 110V \ . \tag{444}$$

If the pulses have a triangular form

$$U_C = U_{IC} \cdot Z = 220 \cdot 0.25 = \frac{U_{IC}}{S} = \frac{220}{4} = 55V \ . \tag{445}$$

The oscillogram processing procedure for an evaluation of average value of voltage U_C being described is called a manual processing method. This method is seldom used now, because there are computer programs for oscillogram processing, which estimate the average value of voltage U_C automatically in the oscillogram record process.

Computer programs are composed in such a way that they estimate a sum of the ordinates in the pulse follow period and divide this sum by quantity of the ordinates (Fig. 127). Let us assume that the program is made in such a way that in the time interval being equal to the pulse duration of 0.1 s it measures 10000 ordinates, adds their values and divides a sum being obtained by quantity of the ordinates. As the pulses are rectangular, the sum of all ordinates measured in the time interval being equal to the pulse follow period T will be as follows: 220x100000+0x10000=2200000. Average value of voltage is determined according to the formula

$$U_C = \frac{220 \cdot 10000 + 0 \cdot 10000}{20000} = 110V \ . \tag{446}$$

Pulse duty ratio appears from this

$$S = \frac{U_{IC}}{U_C} = \frac{220}{110} = 2 \ . \tag{447}$$

Thus, the rectangular pulse oscillograms manual processing and the computer processing give one and the same result. It is natural that the current oscillogram is processed in the same way. If we assume that a current rectangular amplitude is equal to $I_{IC} = 10A$ and current pulse duty ratio is the same as voltage pulse duty ratio ($S = 2$), average value of current I_C is

$$I_C = \frac{I_{IC}}{S} = \frac{10}{2} = 5A \ . \tag{448}$$

It is natural that average power being realized by a load is determined according to the formula

$$P_C = U_C \cdot I_C = \frac{U_{IC} \cdot I_{IC}}{S^2} = \frac{220 \cdot 5}{2^2} = 275W \ . \tag{449}$$

If the pulses of voltage and current had a triangular form

$$U_C = \frac{U_{IC}}{S} = \frac{220}{4} = U_{IC} \cdot Z = 220 \cdot 0.25 = 55V \ . \tag{450}$$

$$I_C = \frac{I_{IC}}{S} = \frac{10}{4} = I_{IC} \cdot Z = 10 \cdot 0.25 = 2.5 A . \tag{451}$$

$$P_C = U_C \cdot I_C = \frac{U_{IC} \cdot I_{IC}}{S^2} = \frac{220 \cdot 10}{4^2} = 137.5 W . \tag{452}$$

The possibilities of manual processing of the oscillograms are limited. It can be used if the pulses have a similar period and if their form is close to a rectangular form or to a triangular one. In all other cases, the manual processing of the oscillograms is a time-consuming thing; that's why it is replaced by the computer processing.

A current oscillogram with a chaotically alternating amplitude and a pulse form with average current value being equal to nearly 2.6 A is shown in Fig. 128. Now we know how an average current value was obtained. The computer program measured 10000 ordinates in the interval of 0.1 s (Fig. 128). Then it added their values and divided by quantity of the ordinates. It is natural that the average voltage value was determined in the same way. It is not shown in Fig. 129. Average power (Fig. 130) was determined with the help of the computer program according to the formula (452).
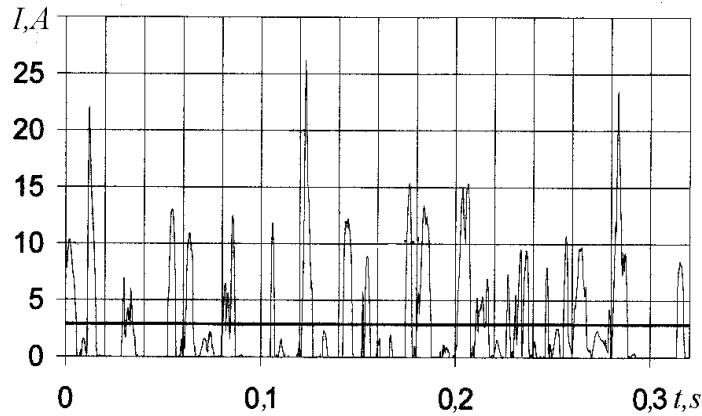

Fig. 128. Current change oscillogram in power supply circuit

It is easy to see (Fig. 128) that the chaotic change of the amplitude and the current pulse form excludes the determination possibility of their pulse duty ratio; that's why the ordinate method of such oscillogram processing is the only possible method.
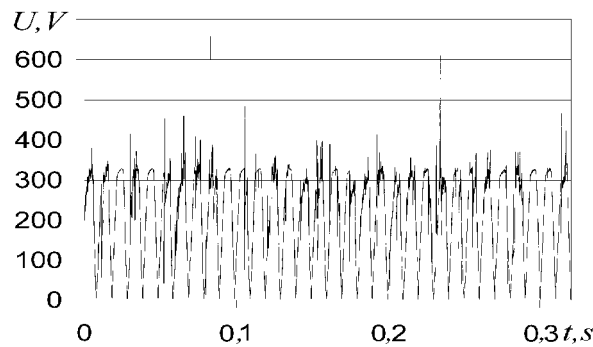

Fig. 129. Voltage change oscillogram in power supply net of the plasma electrolytic reactor

In Figs 128, 129, 130, the oscillograms of voltage, current and power are shown, which have been obtained by us together with the specialists of St.-Petersburg firm "Algorithm". The measurements

were carried out with the help of the electron oscillograph "Handyscope-2", which registered 10000 ordinates in 0.1 range; it provided high accuracy of the measurements.

The measurements were carried out at the same time in three ways: with the help of the voltmeter and the ammeter, the electric meter and the electron oscillograph. The following readings were registered in the protocol of control experiments during the experiment (300 s) given for one hour of the reactor operation: voltmeter and ammeter – 587 W; electron oscillograph – 716 W; electric meter – 720 W [109].
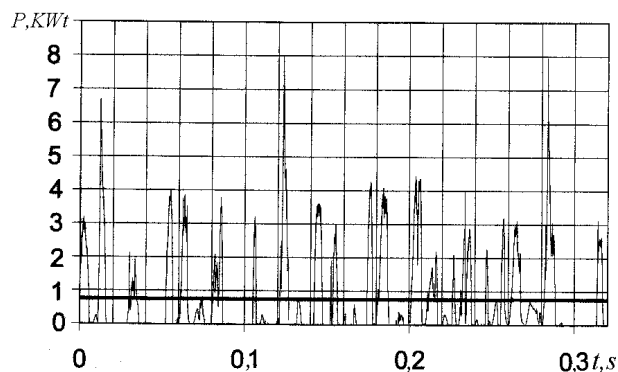
Fig. 130. Current change oscillogram in power supply circuit

Power change regularity (Fig. 130) in power supply circuit of the plasma electrolytic reactor in the gaseous mode of its operation is similar to the change of strength of current. Peak power reaches 8 kW though its mean value is only 720 W.

The program determined the average voltage value according to the formula (450), the current value according to the formula (451) and the power value (452). The average voltage value is equal to nearly 716/2.6=275 V (s. Fig. 129). As the computer program of processing of such complicated oscillograms of voltage and current replicates the readings of an electric power counter correctly, the results of computer processing of any oscillograms deserve complete confidence.

Thus, the ordinate method of oscillogram processing, which serves as a basis of their computer processing programs, can be considered as a universal method.

14.2.2. Pulse Power

Introduction

There is an American scientist among the laureates of the first Russian prize "Global Energy" of the year of 2003. He was awarded the prize, because (as it was informed) he managed in his laboratory to form an electric pulse, which power is equal to power of all power stations of the world. Let us show that a mistake during the pulse power calculation is a result of this experiment. For this purpose, let us analyze energetics of pulses of voltage, current and power being obtained by us while determining electric energy consumed by the cell of water electric generator of heat [1].

Analysis

The oscillograms of pulses of voltage, current and power being obtained with the help of PC-S500A oscilloscope are given in Figs 131, 132 and 133. Horizontal scale is 50 μs per division.

Fig. 131. Voltage pulse

Fig 132. Current pulse

Fig. 133. Power pulse

It is clearly seen (Figs 131, 132 and 133) that a form of pulses of voltage, current and power can be reduced to a rectangular form. Pulse duration will be equal to 0.00007 s, pulse repetition period is 0.00725 s, pulse frequency is f =1000/7.25=137.9. Duty ratio is equal to S=0.00725/0.00007 =103.6. If the pulse form is considered to be a rectangular one, duty factor will be equal to Z=1/103.6=0.0096. Voltage pulse amplitude is U_{IC} =300 V, current pulse amplitude is I_{IC} =50 A and power pulse amplitude is P_{IC} =300x50= 15 kW. Taking it into consideration, average voltage value will be $U_C = U_{IC} \cdot Z =$ 300x0.0096=2.88 V, average current value will be $I_C = I_{IC} \cdot Z =$ 50x0.0096=0.48A, average power value will be $P_C = P_{IC} \cdot Z$ =15000x0.0096=144 W.

Let us put a question: has power pulse (Fig. 133) 15 kW actually, and is average value of pulse power equal to 144 W? Is the calculation carried out correctly? [238].

In accordance with Si-system, if one voltage pulse with amplitude of U_{IC} and with assigned duration τ is supplied per second and one current pulse with amplitude of I_{IC} and with duration τ, the above-mentioned values of voltage and current can be used for power calculation **only in the case** when their duration corresponds to one second. Such requirement originates from the power unit definition by Watt. Watt is work done per second by current and voltage **continuously**.   Consequently, pulse action of voltage and current should be prolonged till one second. Naturally, an oblong rectangle is obtained instead of a pulse in this case. Height of this rectangle multiplied by a pulse form factor k (k =1 if the pulse form is reduced to a rectangular form and k =0.5 if the pulse form is reduced to a triangular form), and it will be an average value of voltage U_C if voltage pulse U_{IC} is spread, an average value of current I_C if current pulse I_{IC} is spread, and an average value of power P_C if power pulse P_{IC} is spread.

If not one, but several pulses are generated during one second, the above-mentioned average values of pulses of voltage, current and power, **as it is considered now**, should be multiplied by frequency of pulse f. This operation is equivalent to a division of amplitude values of voltage U_{IC}, current I_{IC}

and power P_{IC} by duty ratio S. If we take into account that $S = 1/k \cdot \tau \cdot f$, average values of voltage and current will be equal to:

$$U_C = U_{IC} \cdot k \cdot \tau \cdot f = \frac{U_{IC}}{S} = 300 \cdot 1 \cdot 0.00007 \cdot 137.9 = 2.88 B \qquad (453)$$

$$I_C = I_{IC} \cdot k \cdot \tau \cdot f = \frac{I_{IC}}{S} = 50 \cdot 1 \cdot 0.00007 \cdot 137.9 = 0.48 A. \qquad (454)$$

If we pay attention to the formulas (453) and (454), we'll see that the amplitude values of voltage U_{IC} and current I_{IC} are reduced to a duration of one second; that's why their values are in strict correspondence with Si-system. It is a vivid example of the fact that average power of the pulse should be determined according to the formulas:

$$P_C = U_C \cdot I_C = 2.88 \cdot 0.48 = 1.38 W \qquad (455)$$

$$P_C = \frac{U_{IC} \cdot I_{IC}}{S^2} = \frac{300 \cdot 50}{103.6^2} = 1.39 W \qquad (456)$$

But this result is considered to be erroneous, because voltage and current are changed simultaneously and synchronously, and their duty ratios are united in one duty ratio in power pulse; that's why, **as it is considered now**, average pulse power should be determined according to the formula [209], [216]

$$P_C = \frac{U_{IC} \cdot I_{IC}}{S} = \frac{300 \cdot 50}{103.6} = 144.80 W \qquad (457)$$

This value of average power will be obtained if we use the formula

$$P_C = P_{IC} \cdot k \cdot \tau \cdot f = 15000 \cdot 1 \cdot 0.00007 \cdot 137.9 = 144.80 W . \qquad (458)$$

Later on, we'll prove experimentally that power pulse (Fig. 133) has not 15000 W and 144.80 W, but only 1.40 W. That's why a question emerges: where does the essence of the mistake lie?
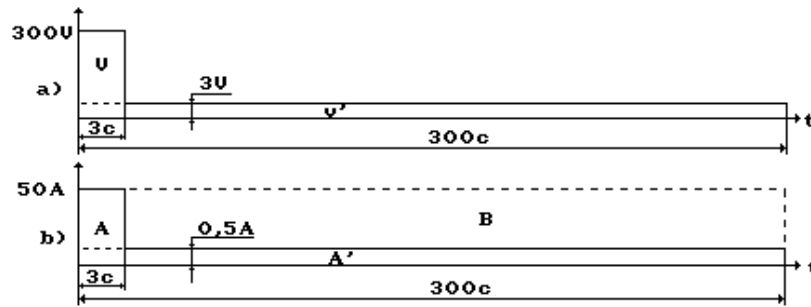

Fig. 134. Diagram of duration of maximal (300 V, 50A) and average (3.0 V, 0.5A) values of voltage and current

A single division by duty ratio of a product of the amplitude values of voltage U_{IC} and current I_{IC} (formula 457) is equivalent to stretching till duration of one second of power pulse. It appears from

this that either voltage pulse, or current pulse (i.e. one of two pulses) is stretched to duration of one second in the formula (457). This process can be shown graphically (Fig. 134) if it is supposed that the experiment has lasted 300 s.

If the experiment lasted 300 s, energy was supplied uninterruptedly during $t = 300 \cdot 0{,}00007 \cdot 137.9 = 2.89 \approx 3.0s$ with pulse frequency of $f = 137.9s^{-1}$ and one pulse duration of $\tau = 0.00007s$. It is natural that time, during which energy failed to be supplied to the cell, is 300-3.0=297 s.

Average values of voltage of 2.88≈3.0 V and current 0,48 ≈0.50 A have been obtained in consequence of division of their maximal values of 300 V and 50 A by duty ratio of 103.6 ≈100. If we divide only voltage $U_{IC} = 300$ V by duty ratio, and we'll not divide current $I_{IC} = 50$ A, it will mean that current value during 300 s with average voltage value of 3.0 V will be equal to 50 A (Fig. 134, b). It is a vivid contradiction, which results in the mistake in the formulas (457 and 458).

It is strengthened by the contradictory results of the calculation of average voltage U_C and average current I_C, which appear from the formula (457):

$$U_C = \frac{U_{IC}}{\sqrt{S}} = \frac{300}{\sqrt{100}} = 30V \quad . \tag{459}$$

$$I_C = \frac{I_{IC}}{\sqrt{S}} = \frac{50}{\sqrt{100}} = 5A . \tag{460}$$

These values of voltage and current are not indicated by the devices arranged before the cell, and they do not result from the oscillograms of the pulses of voltage U_{IC} and current I_{IC}.

As two values (voltage and current) are changed, it is necessary to determine average power during pulse consumption of energy according to the formulas (455 and 456). The formulas (457 and 458) take into account a change of one value, which forms power, voltage or current. That's why they should give an incorrect result. **How can it be checked?**

It is necessary to carry out such an experiment where not the electronic pulse generator connected with the whole grid galvanically has been used, but a rotating magnetic generator, like a magnetic inductor. Power pulses being generated by the magnetic inductor and sent to the consumer will be on the same shaft of the magnetic inductor and the electric motor, which rotates the magnetic inductor. Galvanic coupling between the general grid and the grid of the magnetic inductor is absent in this case. Electric energy of pulses of the magnetic inductor is converted into mechanical energy of the jointly rotating shafts of the magnetic inductor and the electric motor.

As the electric motor is connected in the general grid, an electric motor will show in general the energy being consumed by the electric motor, the magnetic inductor and the consumer connected to the grid of the magnetic inductor. If we write energy consumption by the electric motor, the magnetic inductor and the consumer and subtract electric energy consumption of the electric motor and the magnetic inductor from the obtained value, we'll get energy being generated by the magnetic inductor and consumed by the consumer [239], [240].

Thus, as we have the readings of the electric energy meter and the pulses of voltage and current being written with the help of the oscilloscope, we can see, which formula (455 and 456) or (457 and 458) is correct and which one is erroneous. A diagram of such experiment is shown in Fig. 135. An oscillogram of pulses of voltage and current is shown in Fig. 136.

Voltage pulses were rectified and corrected; the magnetic inductor was driven with the help of a single-phase electric motor from the grid (Fig. 135). In order to determine energy consumed by the elec-

tric motor, a domestic electric meter was used. The readings of the electric meter 5 were duplicated by the readings of voltmeter V_1 and ammeter A_1 being arranged before the cell 1 as well as by the readings of the oscilloscope 6 (Fig. 135). Heated solution energy was determined in a standard way.
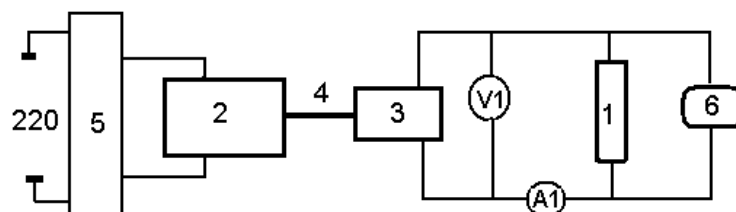

Fig, 135. Electrical diagram of the system: 1 - cell;
2 - electric motor; 3 - magnetic inductor; 4 - the coupling connecting the motor shaft with the generator shaft; 5 - electric meter; 6- Nektronix TDS 2014 oscilloscope

Fig. 136. Sample of an oscillogram of voltage and current being generated by the magnetic inductor
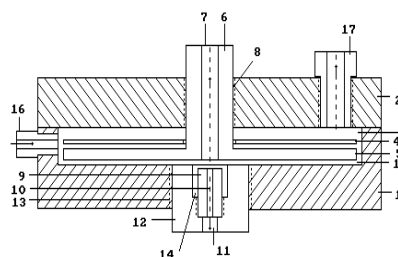
Fig. 137. Photo and diagram of the cell of the water electric generator of heat (patent No. 2258098)

The experimental results are given in Table 46. Here ΔP is power consumed by the cell from the mains. It is equal to a difference between the readings of the electric power meter when the load (the cell) is energized and de-energized. P_1 is heat power of the heated solution. P_2 is power being indicated by the voltmeter and the ammeter arranged before the cell. P_3 is power being indicated by the oscillo-

scope and determined according to the formula (464). P_3^0 is power indicated by the oscilloscope and determined according to the formula (465). $\eta = P_1 / \Delta P$ is an index of efficiency of the solution heating process.

Table 1. Indices of the direct experiment

Exper. No.	P_1, W	ΔP, W	P_2, W	P_3, W	P_3^0, W	$\eta = P_1 / \Delta P$
1	9.40	3.10	4.32	3.80	17.10	3.10
2	9.80	3.53	4.45	3.41	15.35	2.77
3	10.20	3.10	4.40	4.30	19.35	3.34
4	11.30	4.80	5.10	4.80	21.60	2.35
5	13.28	4.00	5.00	5.30	23.85	3.32

We managed to adjust the magnetic inductor in such a way that it generated voltage pulses; its average amplitude was equal to $U_{IC} \approx 46V$. Average amplitude of current pulse $I_{IC} \approx 1.5A$ was equal to. Pulse duration was $\tau \approx 0.0018s$. Pulse frequency was $f = 255.8$ Hz. Pulse duty ratio was $S \approx 4.5$. It is natural that such pulse form is easily reduced to a triangular form; then, $k = 0.5$. As a result, the formulas (453) and (454) give such average values of voltage and current.

$$U_C = U_{IC} \cdot k \cdot \tau \cdot f = \frac{U_{IC}}{S} = 46 \cdot 0.5 \cdot 0.0018 \cdot 255.8 = 10.60 B \tag{461}$$

$$I_C = I_{IC} \cdot k \cdot \tau \cdot f = \frac{I_{IC}}{S} = 1.5 \cdot 0.5 \cdot 0.0018 \cdot 255.8 = 0.345 A. \tag{462}$$

A calculation according to the formulas (455 and 456) gives a result P_3, which is close to the readings of the meter ΔP (Table 46, experience 2) and the readings P_2 of voltmeter V_1 and ammeter A_1 (Fig. 135).

$$P_C = P_3 = U_C \cdot I_C = 10.60 \cdot 0.345 = 3.66 W \tag{463}$$

$$P_C = P_3 = \frac{U_{IC} \cdot I_{IC}}{S^2} = \frac{46 \cdot 1.5}{4.5^2} = 3.41 W \tag{464}$$

Then according to formula (457), average power will be equal to (Table 46, experiment 2)

$$P_C = P_3^0 = \frac{U_{IC} \cdot I_{IC}}{S} = \frac{46 \cdot 1.5}{4.5} = 15.35 W \tag{465}$$

It is an explicitly wrong result, because the electric power meter has shown that in this case the cell has consumed ΔP =3.53 W (Table 46, experience 2).

When we compare the calculation results according to the formulas (454 and 455) with the experimental results ΔP and P_2 (Table 46, experiment 2), we see that when determining average power according to the oscillogram the amplitude values of voltage and current should be divided by duty ratio **not once** (465) as it is stipulated in the manuals [209], [216], **but twice** (464) as it is shown in the formulas (455 and 466). Only this power value will agree with the reality. It appears from this that the formulas (455, 456, 463 and 464) are correct and the formulas (457, 458 and 465) are erroneous.

Thus, the power pulse shown in Fig. 3 has not 15 kW and not 144.8 W, but only
$P = U_C \cdot I_C = 2.88 \cdot 0.48 = 1.40 W$.

Let us see what the results are when motor 2 and magnetic inductor 3 (Fig. 135) are replaced by the electronic pulse generator (Figs 138, 139). The oscillograms of the experiment are shown in Figs 131, 132 and 133.

As it is shown in Fig. 131, an average amplitude of voltage pulses is 300 V when an average value of voltage is 3.0 V (Fig. 139); an average amplitude of current pulses (Fig. 132) was 50 A when an average value current is 0.5 A (Fig. 139). Pulse duration is τ =0,00007 when duty ratio is S =100 and duty factor is $Z = 0.01$.
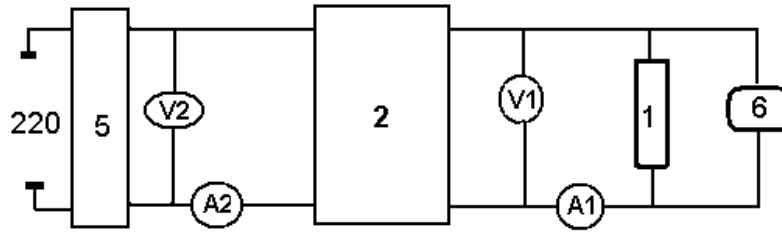
Fig. 138. Electrical diagram of the system: 1 - cell:
2- electronic pulse generator; 5 - electric power meter; 6- PCS500A oscilloscope
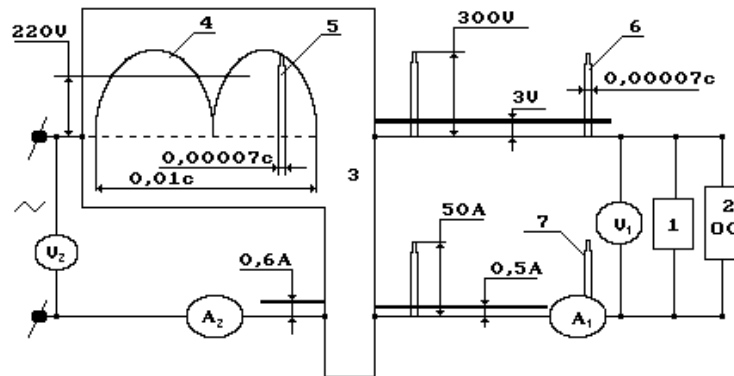
Fig. 139. Block diagram of electric value measurement:
1 - cell; 2 – PCS500A electronic oscilloscope; 3 - pulse generator

In accordance with the readings of voltmeter V_1, ammeter A_1 and oscilloscope (Figs 138, 139), power at the input into the cell of water electric generator of heat is P_C=3.0x0.5=1.50 W on average. A calculation according to the formulas (453 and 454) gives a near result of 1.40 W.

A question arises: what power will be indicated by the instruments: voltmeter V_2 and ammeter A_2 arranged before the pulse generator (Figs 138 and 139)? It is quite natural that the voltmeter will indicate mains voltage V_2= 220 V, current value is increased as well, because there are two loads before ammeter A_2: cell 1 and electronic pulse generator 3. I_2 =0.65 A is in our experiment (Fig. 139). As a result, power implemented by pulse generator 3 and cell 1 is P_1=220x0.65=143 W; it is at variance with the result (P_C=1.4 W) being obtained according to the formulas (455 and 456). **Their correctness has been proved by us experimentally.**

Let us pay attention to the fact that the obtained result is P_1=143 W. It is near to the result P_C =144.8 being obtained during the calculation according to the incorrect formulas (457 and 458).

Now we know that actual energy consumed by the cell is indicated by the instruments (voltmeter V_1, ammeter A_1) arranged before it. The oscilloscope readings will correspond to actual consumption of energy by the cell if the formulas (455 and 456) are used. The formulas (457 and 458) distort a result in proportion to pulse duty ratio. When pulse duty ratio is equal 100, the formulas (457 and 458) increase an actual power consumption by the cell nearly 100fold. Such are the properties of electric circuits with the **electronic pulse generator**. It does not implement evident energy efficiency of the cell. Energy efficiency of the cell is implemented only in the case when energy source, which is similar to **magnetic inductor**, is used (Table 46) [239], [240].

Thus, we have eliminated the contradictions between the instrument readings and the calculations during pulse consumption of electric power. Now let us put such a question: according to what formula has the laureate of the prize "Global Energy" calculated pulse power? An answer is clear: according to the formula

$$P_{IC} = U_{IC} \cdot I_{IC} = P_{WORLD} \tag{466}$$

which (as it is supposed in modern physics) determines instantaneous power of a pulse and which (as we have already shown) is a fictitious value.

As power of one pulse is given in the formula (466), it is quite natural that U_{IC} and I_{IC} can have very large values. But in any case, their product gives the fictitious value, not the actual value. If we take pulse duty ratio, which has been used in our experiments ($S = 100$) and keep in mind that in order to get actual pulse power the right part of the formula (466) should be divided by a square of duty ratio (in the case being considered by $S^2 = 100 \cdot 100 = 10000$), actual power of pulse P_{WORLD} is 10000fold less than the value, for which the prize was awarded. If we take into account the fact that pulse duration being obtained by the laureate was considerably less than the one being obtained during our experiment and duty ratio was considerably greater than 100, the actual value of the power pulse will be million fold less than the value, for which the prize was awarded.

CONCLUSION

Let us put the representatives of the committee "Global energy" at their ease. Their mistake is nothing as compared with the mistakes made by the Nobel prize [223], [241].

14.3. Thermal Effect Hypothesis

Within the last years, many experimental data concerning excessive heat production in various production processes have been published [50], [51], [59], [64], [65], [67], [72], [77], [79], [83], [103], [109], [130], [180], [206], etc. It has been proved experimentally that such heat is discharged in the ventilation systems and in the water cavitation systems. As our analysis shows, perfect vacuum is the most probable source of additional energy in the ventilation systems and in the water cavitation systems. The valence electrons of the destroyed ions and molecules take energy from it; then they discharge energy during their repeated fusion.

We have already analyzed energetics of chemical bindings of the molecules of hydrogen, oxygen and water; we have shown that the mechanical destruction of their chemical bindings requires twice as little energy than the thermal destruction of these bindings. As a result, after mechanical destruction of chemical bindings the valence electrons are in a state with energy insufficiency corresponding to such state. They compensate this insufficiency absorbing energy in the form of electromagnetic substance from the environment and discharging it in the form of the photons during the repeated fusion of the ions and the molecules of water.

As the mechanical destruction of the chemical bindings of the ions and the molecules of water requires twice as little energy than the thermal destruction of these bindings, it is the main reason why it

is impossible to increase an energy effectiveness index of the single-stage cavitation processes larger than 200%. Energy effectiveness can be increased with an increase of quantity of stages.

What if the chemical bindings are destroyed in the electrodynamic way? In this case, it is possible to find resonance frequencies and to decrease energy expenses for this process. During further fusion of the ions their valence electrons are sure to discharge the necessary quantity of energy.

The analysis shows that ion OH^- is the main heat generator (Fig. 140). When temperature is increased, the distance between the proton P_1 and the electron e_1 as well as between the electron e_1 of the hydrogen atom and the electron 1 of the oxygen atom is increased. As this increase takes place at the expense of the photons absorbed by the electrons, this process becomes a pulsating one. Frequency of these pulsations depends on the rate of increase of solution temperature and is not great in general. Current pulses, which are supplied to the electrodes, point the ion OH^- in such a way that the proton P_1 of the hydrogen atom is pointed to the cathode, and the electron 2 of the oxygen atom is pointed to the anode. As a result, the pulses are directed along the ion axis. As it is clear, it is possible to separate the proton P_1 of the hydrogen atom or the whole atom (the proton P_1 with the electron e_1). As a result, the oxygen atom remains. When only the proton is separated, it will go to the cathode, will get the electron and will form the hydrogen atom. If current density on the cathode surface is high, an array of the hydrogen atoms being formed will generate plasma. It is a very unstable and undesirable process in this case. What if the hydrogen atom separation is organized not in the cathode area, but in the area between the electrodes?
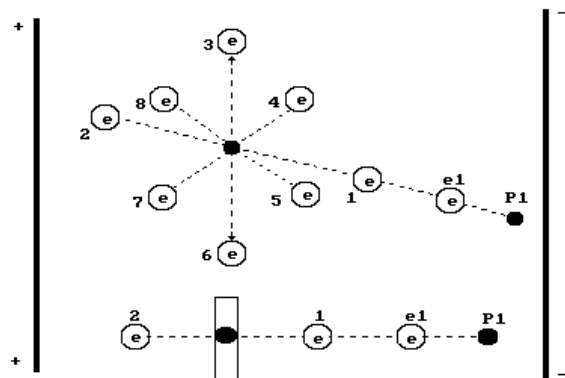

Fig. 140. Diagram of the hydroxyl ion OH^- in the electric field

If such pulses influence the ion OH^- that the hydrogen atoms separate, after resonance separation from the electron (1) of the oxygen atom the electron e_1 of the hydrogen atom having lost the bond will be in a state with a lack of energy (electromagnetic mass), which corresponds to binding energy. Where will it take energy from? Only from the environment. What if the environment has no photons, which are necessary for it? There is only one source – physical vacuum. Having absorbed necessary quantity of energy from physical vacuum, the electron of the hydrogen atom is able to contact again. It has two opportunities: it can join with the oxygen atom and form the ion OH^- being destroyed lately or it can join the second hydrogen atom and form a hydrogen molecule. Both these processes are exothermic ones.

The fusion processes of the ions OH^-, the molecules of hydrogen and oxygen will be accompanied by emission of the photons, , которые и будут нагревать раствор.

14.4. Experimental Check of the Thermal Effect Hypothesis

The main task of the experiment was to check the hypothesis: "Electrodynamic effect on the molecules gives the possibility to form resonant modes when energy consumption for the destruction of their bonds is reduced considerably". In order to solve this task, special experiments were carried out connected with electrodynamic destruction of chemical bonds of water molecules with electric pulses of various frequencies. The diagram of the installation used for experimental investigations is shown in Fig. 141 [204].

Instruments and equipment used during the experiment

Special experimental cell of the water electric generator of heat (Fig. 142); M2004 voltmeter of the highest accuracy class (accuracy class of 0.2, GOST 9711-78); M20015 ammeter of the highest accuracy class (accuracy class of 0.2, GOST 9711-78); electronic scale with scale division value of 2.0 g; stop watch with scale division value of 0.1 s; ACK-2022 is oscilloscope.
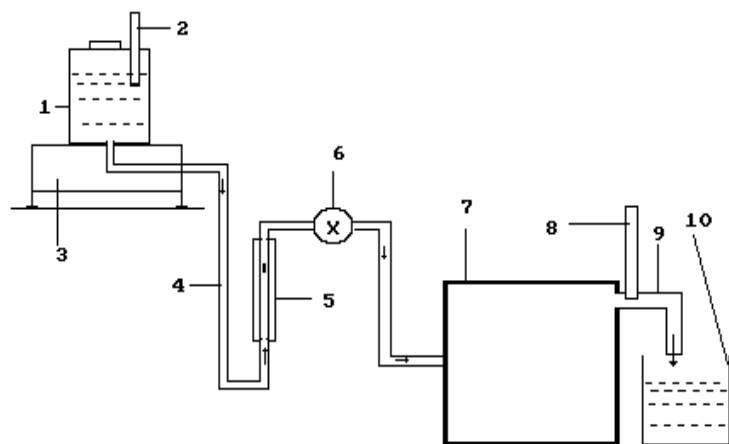
Fig. 141. Diagram of the experimental installation:
1 – tank for solution; 2 – thermometer; 3- electronic balance; 4 – solution feed duct; 5 - rotameter;
6 – solution fedd regulator; 7 – special fine plasma generator is at the stage of patenting; 8 – thermometer; 9- heated solution discharge; 10- inlet tank

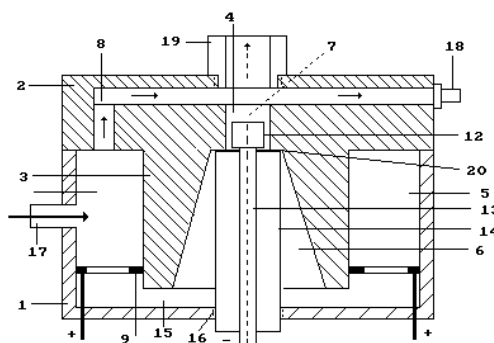### The first model of the cell (patent No. 2228390)

Fig. 142. Diagram of the first model of the cell of the water electric generator of heat: 1 – body, 2 – lid, 9 – anode, 12- cathode, 9 – pulse generator, 10 – control circuit, 20 – electrolytic gap
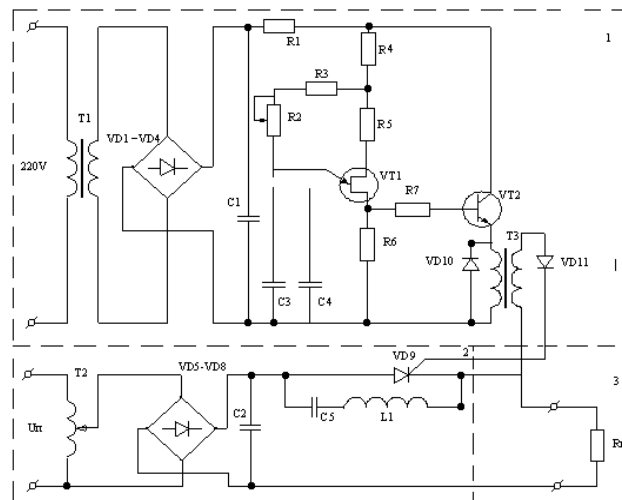
Fig. 143. Electrical diagram of the pulse generator (patent No. 2228390)

The electrical diagram of the pulse generator is given in Fig. 143.

In Fig. 144, the oscillogram of voltage pulses is given. In Fig. 145, the oscillogram of current pulses being registered during another experiment with pulse frequency of nearly 300 Hz is given. According to these oscillograms, the duty factor calculation has given the result of $Z = 0.11$. With mean values of amplitudes of pulses of voltage and current being equal to 250 V and 10.6 A, respectively, the mean components of voltage and current arriving into the generator of heat have been: $U_c = 0{,}11 \times 250 = 27.5$ V; $I_c = 0.11 \times 10.6 = 1.17$ A. According to the readings of the voltmeter and the ammeter, mean values of voltage and current were 25.0 V and 1.25 A in this experiment. In this connection, mean value of electric power supplied to the generator of heat was $27.5 \times 1.17 = 32.18$ W according to the data of the oscillographic measurements and $25 \times 1.25 = 31.25$ W according to the data of the pointer indicators.
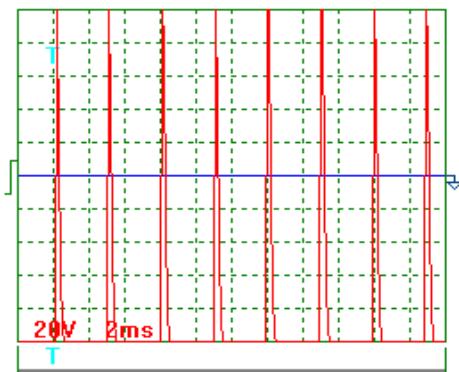

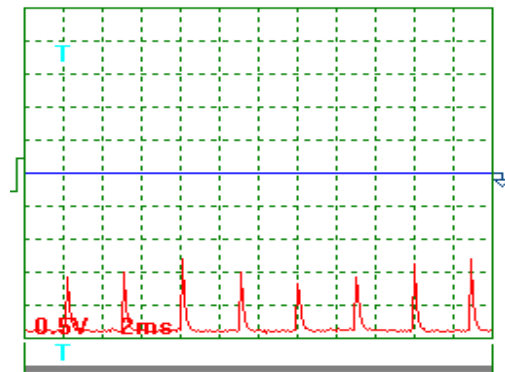Fig. 144. Oscillogram of supply voltage pulses at $V \approx 300$ Hz

Fig. 145. Oscillogram of current pulses via the generator of heat at $V \approx 300$ Hz

The energy efficiency calculation results of the generators of the heat for both methods of measurement with pulse frequency of nearly 300 Hz are given in Table 47. They are close in their values as well.

Table 47. Experimental indices of the water electric generator of heat with electric pulse frequency of nearly 300 Hz with the measurements of mean values of voltages and current with the help of the voltmeter, the ammeter and the oscillograph

Indices	Average
1. Mass of the solution, which has passed through the generator m, kg.	0.41
2. Temperature of solution at the input of the generator t_1, degrees	26.00
3. Temperature of the solution at the output of the generator t_2, degrees	76.00
4. Temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	50.00
5. Durability of the experiment $\Delta\tau$, s	300.00
6. Reading of voltmeter U, V	25.00
6'. Readings of oscillograph U', V	27.50
7. Reading of ammeter I, A	1.25
7'. Readings of oscillograph I', A	1.17
8. Electric power consumption, $E_1 = I \cdot U \cdot \Delta\tau / 1000$, kJ	9.38
9. Heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	81.79
10. COP of the generator $K = E_2 / E_1$	**8.72**

The second model of the sell
(the positive decision dated April 4, 2005, concerning the application No. 2003132719/15(035037)

The diagram of the second model of the cell is given in Fig. 146; the results of its testing are given in Table 48.
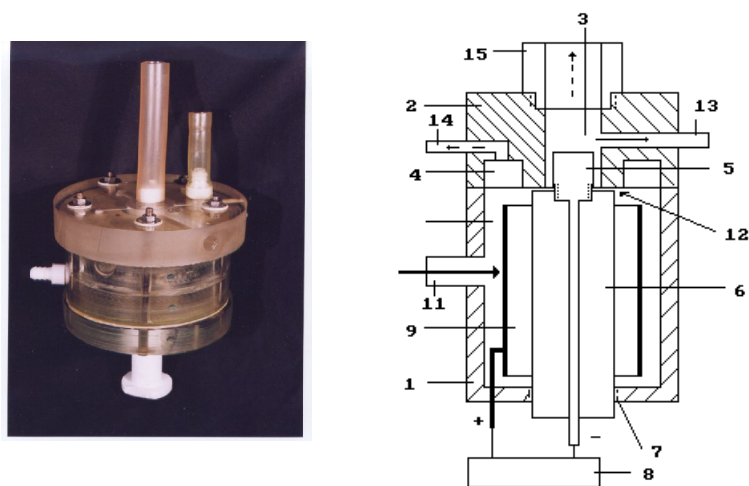

Fig. 146. The second model of the sell of heat generator

Table 48. Experimental indices of the water electric generator of heat with electric pulse frequency of nearly 100 Hz

Indices	Average
1. Mass of the solution, which has passed through the generator m, kg.	0.55
2. Temperature of solution at the input of the generator t_1, degrees	26.00
3. Temperature of the solution at the output of the generator t_2, degrees	38.00
4. Temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	12.00
5. Durability of the experiment $\Delta\tau$, s	300.00
6. Reading of voltmeter U, V	10.0
6'. Reading of oscillograph U ', V	9.75
7. Reading of ammeter I, A	0.50
7'. Reading of oscillograph I , A	0.51
8. Electric power consumption, $E_1 = I \cdot U \cdot \Delta\tau / 1000, kJ$	1.50
9. Heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t, kJ$	26.33
10 – COP of the generator $K = E_2 / E_1$	**17.56**

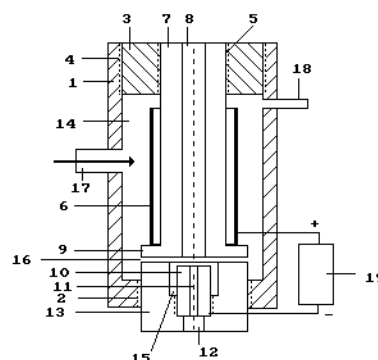**The third model of the sell (Patent № 2258097)**

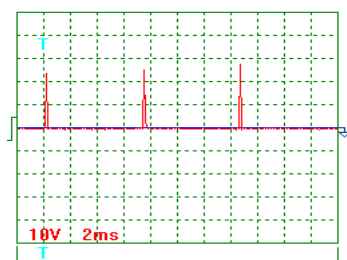Fig. 147. The third of the cell of the generator of heat
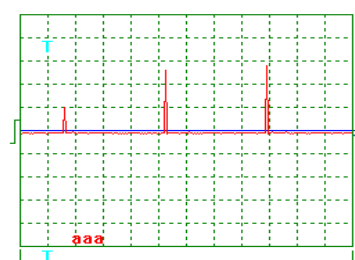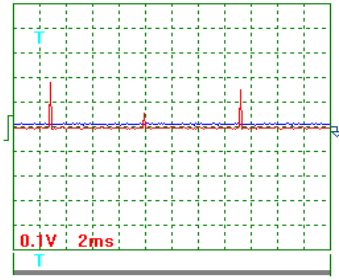

Fig. 148. Voltage

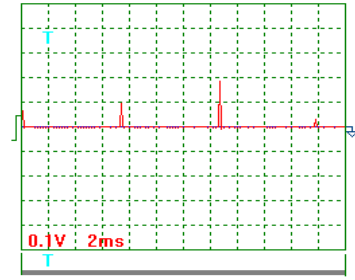Fig. 149. Voltage

Fig. 150. Current

Fig. 151. Current

Process parameter calculation according to the oscillograms (figs 148-151) to the check test protocol (Table 49) gave the following results.

Pulse scale 10.

Mean voltage amplitude according to Fig. 148 and Fig. 149:

Uma = (23+25+28+10+26+29) x 10/6 = 235 V.

Mean current amplitude according to Fig. 150 and Fig. 151:

Iacp = (20+6+17+7+10+19+3) x 10/7 = 117 A.

Pulse repetition period T = 7.4 ms.

Pulse duration t_i = 0.28 ms.

Pulse frequency f = 1000/7.4 = 135.1 Hz.

Relative pulse duration S = 7.4/0.28 = 26.32.

Space factor Z = 0.5/26.32 = 0.019.

Mean value of pulse voltage Um = 0.019 x 235 = 4.47 V.

Mean value of current in pulses Im = 0.019 x 117 = 2.22 A.

The test results of the third model of the cell of the water electric generator of heat are given in Table 49.

Table 49

Indices	Average
1 - mass of the solution, which has passed through the generator m , kg.	0.450
2 - temperature of solution at the input of the generator t_1 , degrees	22
3 - temperature of the solution at the output of the generator t_2 , degrees	65.67
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	43.67
5 - durability of the experiment $\Delta \tau$, s	300
6 - reading of voltmeter U , V	4.50
6' - readings of oscillograph U ', V	4.47
7 - reading of ammeter I , A	2.1
7' - readings of oscillograph I ', A	2.2
8 - electric power consumption according to the readings of voltement and ammeter, $E_1 = I \cdot U \cdot \Delta \tau / 1000$, kJ	2.84
9 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	78.40
10. COP of the generator $K = E_2 / E_1$	**27.60**

The fourth model of the sell (Fig. 137)

The test results of this cell are given in Table 50.

Table 50. Check test protocol

Indices	Average
1 - mass of the solution, which has passed through the generator m, kg.	0.312
2 - temperature of solution at the input of the generator t_1, degrees	20
3 - temperature of the solution at the output of the generator t_2, degrees	87.3
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	67.3
5 - durability of the experiment $\Delta \tau$, s	300
6 - reading of voltmeter U, V	5.17
7 - reading of ammeter I, A	1.77
8 - electric power consumption according to the readings of voltement and ammeter, $E_1 = I \cdot U \cdot \Delta \tau / 1000$, kJ	2.75
9 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	82.90
10. COP of the generator according to the readings of voltmeter and ammeter $K = E_2 / E_1$	**30.25**

The experimental samples of radiators are given in Fig. 152. Heat radiation surface: a) – 1.5 m²; b) – 1.6 m². Three water electric cells heat the solution in a) up to 86°C, in b) up to 81°C within one hour consuming 15 W of power. How much does a pump consume for solution and water priming? A conventional electric heater with power of 500 W heats the first radiator only up to 64°C. In order to heat the second radiator up to 81°C during the same time, a device with power of 880 W is required.
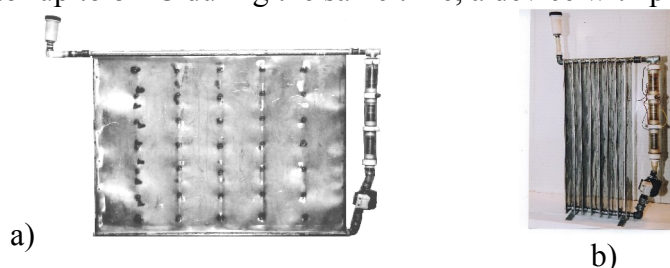

a)

b)

Fig. 152. Photo of water electric devices

The test results of an influence of the ion OH^- on an energy effectiveness index of the water electric generator of heat are given in Fig. 153. As it is clear, the energy effectiveness index K is increased with an increase of density ρ of the solution KOH.

The experiments have shown that an energy effectiveness value of the water electric process is influenced by two main factor: density of the electrolytic solution (Fig. 153) and the electrolytic gap value (Fig. 154). Stability of the plasma-free water electric process of heat energy generation in the electrolytic solution depends on the value of this gap (Fig. 142, position 20). Each construction of the cell (Figs 137, 142, 146 and 147) of the heat generator has its own dependencies given in Figs 153 and 154.
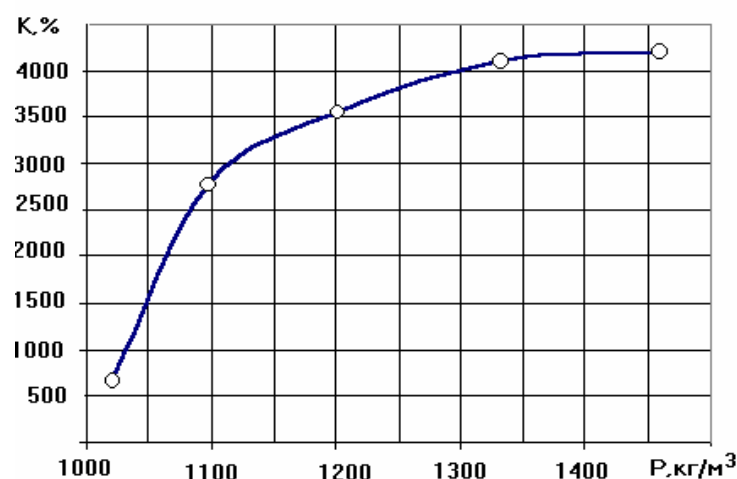
Fig. 153. Dependence of the energy effectiveness index K on density ρ of the solution KOH
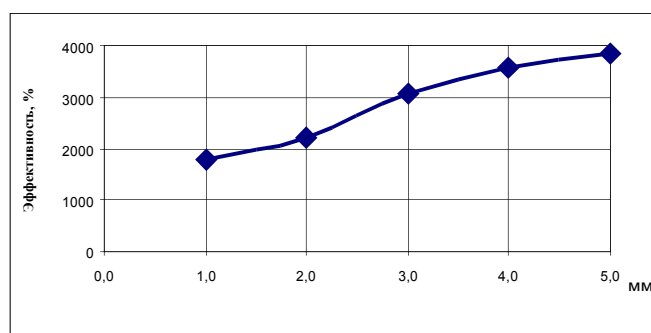

Fig. 154. Dependence of energy process effectiveness on a electrolytic gap value

Plasma-free operation mode of the cells of the water electric generator of heat is a main condition of its high energy effectiveness. For each contraction of the cell, there exist its own combination of optimal values of solution density and the electrolytic gap when a stable plasma-free operation mode is realized.

Thus, an analysis of energy balance of the molecules and the ions shows the possibility of the formation of additional heat energy with the energy effectiveness index greater than unity, and the experiments confirm this hypothesis.

14.5. PROTOCOL OF CONTROL TESTING

Reproducibility is the main requirement to the experimental investigations. If the results are reproduced steady and the independent experts confirm this fact, the hypothesis, which explains the essence of the process, acquires the rights of the postulate gradually. The representatives of the company SITIS from the city of Sarov expressed their wish to carry out the joint tests of the cell of the water electric generator of heat.

The tests were carried out on February 27, 2004, at the Kuban State Agrarian University (KSAU) in the city of Krasnodar. The independent experts watched the tests being carried out and registered the measurement results of all values.

The experiments were carried out in the presence of the following persons: from KSAU – Ph.M. Kanarev, A.I. Tlishev, D.A. Bebko, Yu. A. Drobot; from the joint-stock company SITIS – Yu.G. Kataev, V.F. Tyutin.

The cell of the water electric generator of heat is shown in Fig. 137. The diagram of the installation used for experimental investigations is shown in Fig. 155.
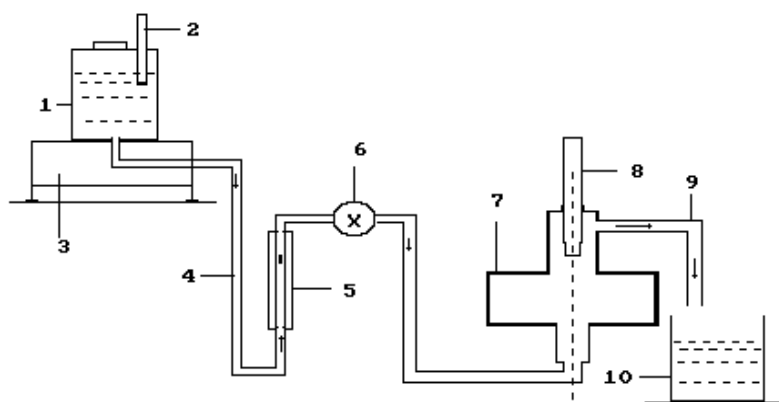

Fig. 155. Diagram of the experimental installation: 1 – tank for solution; 2 – thermometer; 3- electronic balance; 4 – solution feed duct; 5 - rotameter; 6 – solution fedd regulator; 7 – the sell of water electric generator of heat; 8 – thermometer; 9- heated solution discharge; 10- inlet tank

The diagram of electric energy supply to the cell of the water electric generator elaborated by the authors remains unchanged. The measuring part of the diagram is supplemented by PCS-500 digital memory oscilloscope arranged in parallel to ACK-2022 Aktakom standard oscilloscope and PX120 multimeter, which is not shown in the diagram (see Fig. 156).
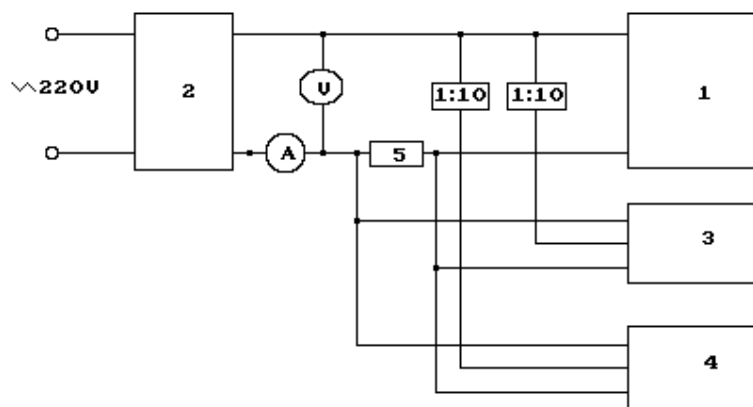

Fig. 156. Metering equipment connection diagram: 1- cell of the water electric generator of heat; 2- pulse generator; 3- ACK-2022 oscilloscope;
4- PCS-500 oscilloscope; 5 - P-3 Wheatstone bridge

Instruments and equipment used during the experiment

Special experimental cell of the water electric generator of heat (Fig. 137); M2004 voltmeter of the highest accuracy class (accuracy class of 0.2, GOST 9711-78); M20015 ammeter of the highest accuracy class (accuracy class of 0.2, GOST 9711-78); electronic scale with scale division value of 2.0 g; stop watch with scale division value of 0.1 s; ACK-2022 and PCS-500 oscilloscopes.

Thereto, we should note that a switch of the voltage measurement range of M2004 voltmeter corresponded to the maximal voltage value of 30 V, and a switch of M20015 ammeter corresponded to the maximal current value of 1.5 A. The pulse amplitudes of these values were 300 V (Fig. 131) and 50 A (Fig. 132), respectively.

In order to reduce heat losses, which were not taken into account in the experiment, temperature difference of the solution was kept small prior to its heating in the cell and after heating.

Table 51. **Calculation of power of the heated solution**

Indices	1	2	3
1 - mass of the solution, which has passed through the sell m, kg.	0.798	0.376	0.257
2 - temperature of solution at the input of the sell t_1, degrees	20	20	20
3 - temperature of the solution at the output of the sell t_2, degrees	30	41	50
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	10	21	30
5 - durability of the experiment $\Delta\tau$, s	300	300	300
6 - heat capacity of KOH solution with density of 1020 kg/m³ C, kJ/kg/grad*	3.99	3.99	3.99
7 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	31.84	30.00	30.76

*Spravochnik chimika, izd. Chimia, M., L., 1964

Measurement with the help of the voltmeter and the ammeter

As the measurements were carried out with the help of various instruments, which backed up each other, Table of measurement results and calculations was made for each set of the instruments.

The measurement results of electric energy consumed by the cell carried out with the help of the voltmeter and the ammeter are given in Table 52.

Table 52.

Indices	1	2	3
1 - mass of the solution, which has passed through the sell m, kg.	0.798	0.376	0.257
2 - temperature of solution at the input of the sell t_1, degrees	20	20	20
3 - temperature of the solution at the output of the sell t_2, degrees	30	41	50
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	10	21	30
5 - durability of the experiment $\Delta\tau$, s	300	300	300
6 - reading of voltmeter U, V	6.0	6.0	6.0
7 - reading of ammeter I, A	0.47	0.47	0.47
8 - electric power consumption according to the readings of voltmeter and ammeter, $E_1 = I \cdot U \cdot \Delta\tau / 1000$, kJ	0.85	0.85	0.85
9 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	31.84	30.00	30.76

10 - COP of the sell according to the readings of voltmeter and ammeter, $K = E_2 / E_1$	**37.46**	**35.30**	**36.19**

Measurements with the help of ACK-2002 oscilloscope

The voltage pulse oscillograms are given in Figs 157 and 158. An oscillogram of one voltage pulse is given in Fig. 159. The current oscillograms are given in Figs 160, 161 and 162.

Pulse scale is equal to 10. Average amplitude of voltage (Figs 157, 158 and 159): Uacp = (29 + 31 + 8 + 33+ 32+40+40)x10/7 = 304.3 V. Current value was determined as voltage drop across the resistor with resistance of 0.1 Ohm. Taking this into account, average current amplitude (Figs 7, 8 and 9) is equal to I_{acp} = (1.7+0.8+1.7+2.1+3.2+0.7+2.1+1.3+2.4+1.4+1.4) x 0.2x10/(11x0.1) = 34.18 A. Pulse repetition period is T = 7.25 ms.

Pulse duration was determined according to an oscillogram in the microsecond range (Fig. 159). The pulse form was reduced to a triangular form in such a way that the area of the triangle was equal nearly to the area circumscribed by a complex form of the pulse curve. In this case, pulse duration is equal nearly to t_p=0.14 ms. Pulse frequency f = 1000/7.25 = 137.9 Hz. Relative pulse duration S = 7.25/0.14 = 51.78. If we accept a triangular form of the pulse (0.5), we'll get a value of duty ratio Z = 0.5/51.78 = 0.01. Average value of pulse voltage U_{cp} = 304.3 x 0.01 = 3.04 V. Average value of current in pulses I_{cp} = 0.01 x 34.18 = 0,34 A.

Average values of voltage and current can be determined as values of voltage and current corresponding to one second. Taking into account the triangular form of pulses (0.5), duration of one pulse (0.00014 s) and pulse frequency (137.9), we'll have U_{cp} = 304.3 x 0.5 x 0.00014 x 137.9=2.94 V, I_{cp} = 34.0 x 0.5 x 0.00014 x 137.9 = 0.33 A. Let us pay attention to the fact that the values of average voltage and current being determined with the help of ACK-2022 oscilloscope are less than the values being determined with the help of the voltmeter and the ammeter.
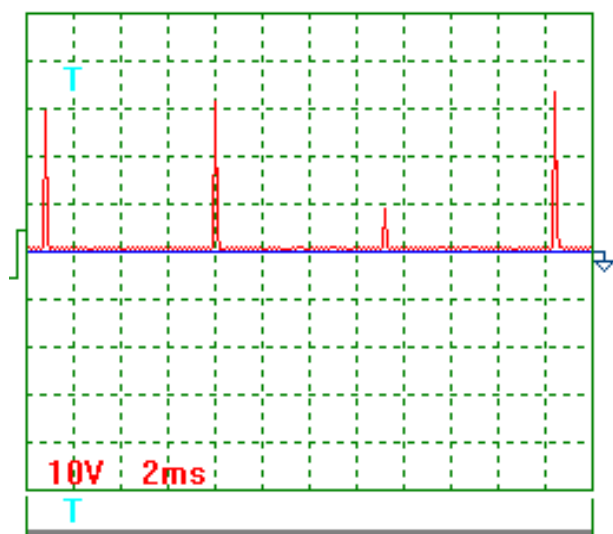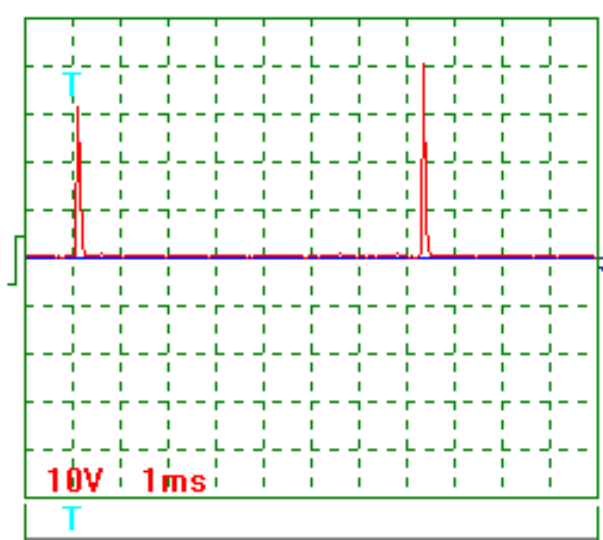

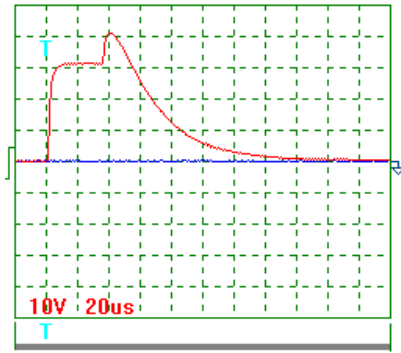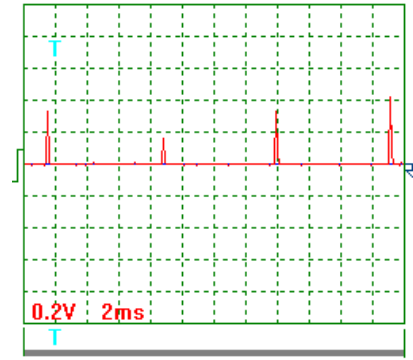Fig. 157. Voltage

Fig. 158. Voltage

Fig. 159. Voltage pulse in µs range
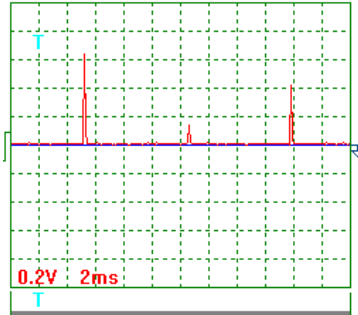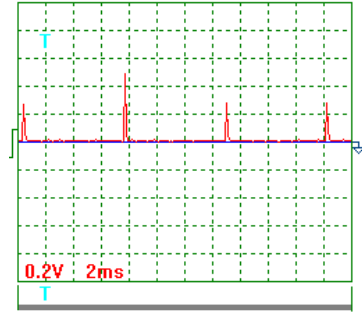

Fig. 160. Current

Fig. 161. Current

Fig. 162. Current

The experimental results being obtained with the help of the voltmeter, the ammeter and ACK-2022 oscilloscope are given in Table 53.

Table 53.

Indices	1	2	3
1 - mass of the solution, which has passed through the sell m , kg.	0.798	0.376	0.257
2 - temperature of solution at the input of the sell t_1 , degrees	20	20	20
3 - temperature of the solution at the output of the sell t_2 , degrees	30	41	50
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	10	21	30
5 - durability of the experiment $\Delta\tau$, s	300	300	300
6 - reading of voltmeter U , V	6.0	6.0	6.0
6' - readings of oscillograph **ACK-2002** U ', V	2.94	2.94	2.94
7 - reading of ammeter I , A	0.47	0.47	0.47
7' - readings of oscillograph **ACK-2002** I ', A	0.33	0.33	0.33
8 - electric power consumption according to the readings of voltmeter and ammeter, $E_1 = I \cdot U \cdot \Delta\tau /1000$, kJ	0.85	0.85	0.85
8' - electric power consumption according to the readings of oscillograph **ACK-2002** , $E_1^{'} = I^{'} \cdot U^{'} \cdot \Delta\tau /1000$, kJ	0.29	0.29	0.29
9 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	31.84	30.00	30.76

10 - COP of the sell according to the readings of voltmeter and ammeter, $K = E_2 / E_1$	**37.46**	**35.30**	**36.19**
10' - COP of the sell according to the readings of oscillograph ACK-2002, $K' = E_2 / E_1'$	**109.8**	**108.6**	**106.1**

It is easy to see that the form of the pulses of voltage, current and power to a rectangular form. Pulse duration turned out to be equal to 0.00007 s, pulse repetition period was 0.00725 s, pulse frequency was 1000/7.25=137.9, pulse voltage amplitude was 300 V, current pulse amplitude was 50 A and power pulse amplitude was 15 kW.

Relative pulse duration will be equal to S=0.00725/0.00007=103.6. If the pulse form is considered to be a rectangular one, duty ratio will be equal to Z=1/103.6=0.01. The authors of this calculation have assumed that the voltage pulse value is equal to 300 V and current pulse value is 50 A. Taking it into consideration, average voltage value will be 300x0.01=3 V, and average current value will be 50x0.01=0.5 A.

Let us pay attention to the fact that average values of voltage and current being determined with the help of the voltmeter and the ammeter as well as with the help of both oscilloscopes have close values.

The experimental results being obtained with the help of the voltmeter and the ammeter and ACK-2022 and PCS500A oscilloscopes are given in Table 54.

Table 54.

Indices	1	2	3
1 - mass of the solution, which has passed through the sell m, kg.	0.798	0.376	0.257
2 - temperature of solution at the input of the sell t_1, degrees	20	20	20
3 - temperature of the solution at the output of the sell t_2, degrees	30	41	50
4 - temperature difference of the solution $\Delta t = t_2 - t_1$, degrees	10	21	30
5 - durability of the experiment $\Delta \tau$, s	300	300	300
6 - reading of voltmeter U, V	6.0	6.0	6.0
6' - readings of oscillograph **ACK-2002** U', V	2.94	2.94	2.94
6'' - readings of oscillograph **PCS500A** U'', V	3.73	3.73	3.73
7 - reading of ammeter I, A	0.47	0.47	0.47
7' - readings of oscillograph **ACK-2002** I', A	0.33	0.33	0.33
7'' - readings of oscillograph **PCS500A** I'', A	0.50	0.50	0.50
8 - electric power consumption according to the readings of voltmeter and ammeter, $E_1 = I \cdot U \cdot \Delta \tau / 1000$, kJ	0.85	0.85	0.85
8' - electric power consumption according to the readings of oscillograph **ACK-2002**, $E_1' = I' \cdot U' \cdot \Delta \tau / 1000$, kJ	0.29	0.29	0.29
8''- electric power consumption without the taken into account average voltage and current values, kJ	36.11	35.98	35.42
8'''- electric power consumption according to the readings of oscillograph **PCS500A**, $E_1'' = I'' \cdot U'' \cdot \Delta \tau / 1000$, kJ	0.45	0.45	0.45

	31.84	30.00	30.76
9 – heated solution energy $E_2 = 3.99 \cdot m \cdot \Delta t$, kJ	31.84	30.00	30.76
10 - COP of the sell according to the readings of voltmeter and ammeter, $K = E_2 / E_1$	**37.46**	**35.30**	**36.19**
10' - COP of the sell according to the readings of oscillograph ACK-2002 $K' = E_2 / E_1'$	**109.8**	**108.6**	**106.1**
10''- COP of the sell without the taken into account average voltage and current values	0.88	0.83	0.87
10''' - COP of the sell according to the readings of oscillograph PCS500A $K'' = E_2 / E_1''$	**70.75**	**70.00**	**68.36**

The representatives of the company SITIS think that power being used in this experiment should be calculated according to the formulas (457) or (458), the erroneousness of which has already been proved by us.

The above-mentioned facts give an opportunity to make the following resumptive conclusion.

CONCLUSION

1. The contradictions between the processing computer programs of the oscillograms of voltage, current and power and the readings of all devices as well as the methods of their manual processing are eliminated only in case if the formulas (455), (456) are used.

2. The cell of the water electric generator of heat converts electric energy into thermal energy with an energy efficiency index of more than 50. The law of conservation of energy is not fulfilled.

3. Energy efficiency of the cell is not realized with the help of the electronic pulse generator.

4. Energy efficiency of the cell is realized only with the help of the energy source, which is similar to magneto.

14.6. Electric Energy Saving during Conventional Water Electrolysis

The well-known ways of a reduction of the electric energy expenses for water electrolysis are directed to a perfection of materials of the cathode and the anode as well as to a perfection of electrical parameters of the electrolyzer power supply circuits.

An electrolyzer is a container where an aggregate of the anodes and the cathodes is arranged; each pair is called a cell. Direct or rectified mains voltage of 1.6…2.0 V being supplied to each cell of the electrolyzer is a power source of the electrolyzers.

It is known that all electrolyzers being charged at the beginning of the operation acquire constant potential V_P, which is appropriate of a capacitor. A value of this potential is increased with the increase of a number of the cells in the electrolyzer (Fig. 163).

Thus, when the electrolyzer operates for a long time, it is sufficient to charge it with additional voltage pulses 1, which amplitude should exceed a value of average potential by 5-10%, and average value of such pulse can be 5-10% of total constant potential depending on duration and duty ratio (Fig. 163).

Fig. 163. Oscillogram of voltage and supply current of the electrolyzer: 1 – voltage pulse; 2 – current pulse;

V_P - average value of constant potential

As electric network of the electrolyzer is connected with the whole electric mains, the devices measuring power consumed by the electrolyzer give the readings, in which a value of constant potential V_P and an average value of electric current being formed are taken into account. In such system of electric energy supply to the electrolyzer, the measuring instruments register a complete value of constant potential V_P, which exceeds a value of potential being necessary for electrolyzer charging, 10fold or 15-fold, not a value of voltage, which is necessary for its charging. All modern electrolyzers operate in such a way, and all variants of improvement of this method of its power supply have already been used.

The best modern industrial electrolyzers consume 3 to 7 kWh of electric power for a production of one cubic metre of a mixture of hydrogen and oxygen. It exceeds energy, which is released during combustion of this mixture. A value of 4 kWh/m³ of hydrogen is considered to be an optimal one. But if we take into account a distortion ratio of the secondary devices, which give a value of 4 kWh/m³, the actual energy expenses for production of hydrogen from water are significantly smaller.

It is known that binding energy between the oxygen atom and the hydrogen atoms in the water molecule is decreased when the temperature is increased. For example, at the temperature of 540°C or 813 K the wavelength of the photons, which provide such temperature, is

$$\lambda = \frac{C'}{T} = \frac{2.989 \cdot 10^{-3}}{813} = 3.7 \cdot 10^{-6} m \ . \tag{468}$$

It means that the temperature of 540°C is formed by the photons of the infrared range (Table 1). They have energy being equal to

$$E_{ph} = \frac{C \cdot h}{\lambda} = \frac{2.998 \cdot 10^8 \cdot 6.626 \cdot 10^{-34}}{3.7 \cdot 10^{-6} \cdot 1.602 \cdot 10^{-19}} = 0.34 eV \ . \tag{469}$$

As there are one oxygen atom and two hydrogen atoms in the water molecule, it has two bindings. Energy of one binding will be equal to 0.34/2=0.17 eV, and we can determine the energy level of the electron of the hydrogen atom, on which it is in the given moment.

According to the hydrogen atom spectrum (Appendix 1), in this moment its electron has binding energy with the nucleus, which is equal to 0.17 eV when it is on the ninth energy level. If this energy corresponds to reality, energy expenses for hydrogen mole production with the help of electroplating technique will be as follows

$$E_{mol} = \frac{0.17 \cdot 2 \cdot 6.02 \cdot 10^{23} \cdot 1.602 \cdot 10^{-19}}{1000} = 32.9 \cdot kJ \qquad (470)$$

Energy expenses per liter of hydrogen is

$$32.9/22.4 = 1.47 \text{ kJ or } 1.47/3600 = 0.4 \text{ Wh.} \qquad (471)$$

At this moment, the water molecule is under thermal voltage, which is replaced by electrostatic voltage being formed by constant potential V_P during electrolysis (Fig. 163). The existing energy record keeping systems for water electrolysis take into account constant potential V_P, which belongs to the electrolyzer, not to the electric mains. We have already shown how this drawback is eliminated; owning to it, energy expenses for water electrolysis are reduced considerably.

At this moment, the water molecule is under thermal voltage, which is replaced by electrostatic voltage being formed by constant potential V_P during electrolysis (Fig. 163).

The existing energy record keeping systems for water electrolysis take into account constant potential V_P, which belongs to the electrolyzer, not to the electric mains. We have already shown how this drawback is eliminated; owning to it, energy expenses for water electrolysis are reduced considerably.

We have come to an analysis of energetics of the decomposition process of water into hydrogen and oxygen during photosynthesis, which takes place under the influence of the thermal infrared photons. The information being given shows that in order to produce one litre of hydrogen 0.4 Wh of electric power is enough. If electrolysis is carried out with voltage of 2 V per cell, an average magnitude of current will be 0.4/2=0.2 A. It is close to a magnitude of current, which accompanies the water electrolysis process during photosynthesis, and we have every reason to believe that the photosynthesis process is a low current process.

14.7. Low Current Process of Water Electrolysis

17.7.1. Introduction

Low voltage process of water electrolysis is known from Faraday's times. It is widely used in modern industry. Voltage of 1.6-2.3 volts is operation voltage between the anode and the cathode of the electrolyzer; current strength is tens and hundreds of amperes. In accordance with Faraday's law, energy consumption for production of one cubic meter of hydrogen is nearly $4 kWh/m^3$ in this case. When one cubic meter of hydrogen is burnt, 3.55 kWh of energy is released [199].

An interest to hydrogen energetic is being increased of late years. It is explained by the fact that hydrogen is an inexhaustible and environmental-friendly energy carrier. But the implementation of these properties is slowed down by large energy consumption for its production from water. Many laboratories in the world are busy solving a problem of a reduction of energy consumption for hydrogen production from water, but there are no significant results. In the meantime, a money-saving process of decomposition of water molecules into hydrogen and oxygen exists in the Nature. This process takes place during photosynthesis. Hydrogen atoms are separated from water molecules and are used as connecting links while forming organic molecules, and oxygen is released into the air.
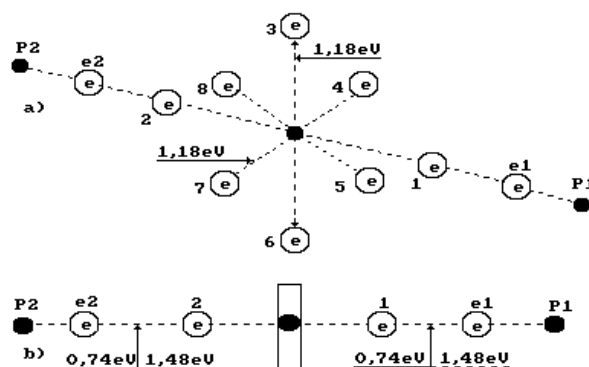
Fig. 167. Water molecule diagram: 1,2,3,4,5,6,7,8 are numbers of the electrons of the oxygen atom; P_1, P_2 are the hydrogen atom nuclei (the protons); e_1 and e_2 are the electron numbers of the hydrogen atoms

It is known that carbon dioxide CO_2 is absorbed during photosynthesis. It is supposed that carbon C of the molecule CO_2 is used for plant cell construction, and oxygen O_2 is released [46]. We have every reason to be in doubt and to suppose that the molecule CO_2 is used for plant cell construction completely. Water molecules release oxygen; the hydrogen atoms of the water molecules are used as connecting links of the molecules, which are employed for plant cell construction.

A question emerges: is it possible to model an electrolytic process of water decomposition into hydrogen and oxygen, which takes place during photosynthesis?

The analysis of the water molecule structure (Fig. 167) worked out by us shows the possibility of water electrolysis at minimal current and even without it. The protons of the hydrogen atoms in water molecules can be combined with each other and can form clusters. As a result, an orthohydrogen molecule is formed (Fig. 68). A question emerges: is it possible to separate this molecule from such cluster?
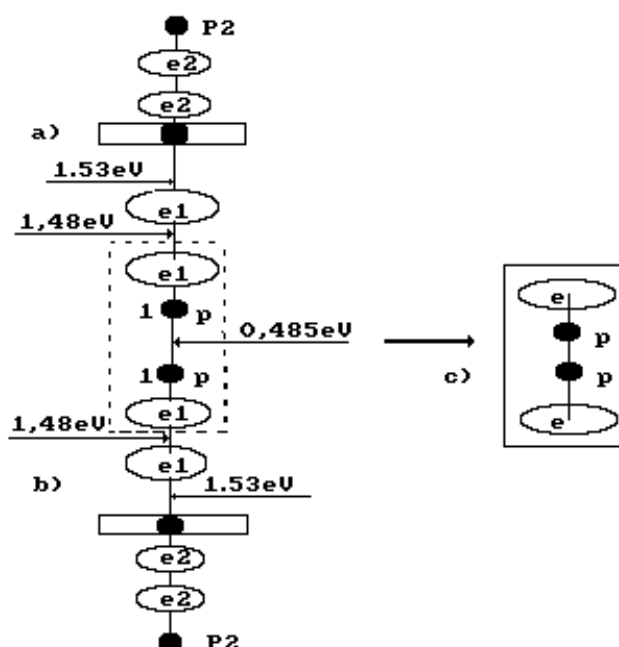

Fig. 168. Formation diagram of the second model of orthohydrogen and b) water molecule diagrams;
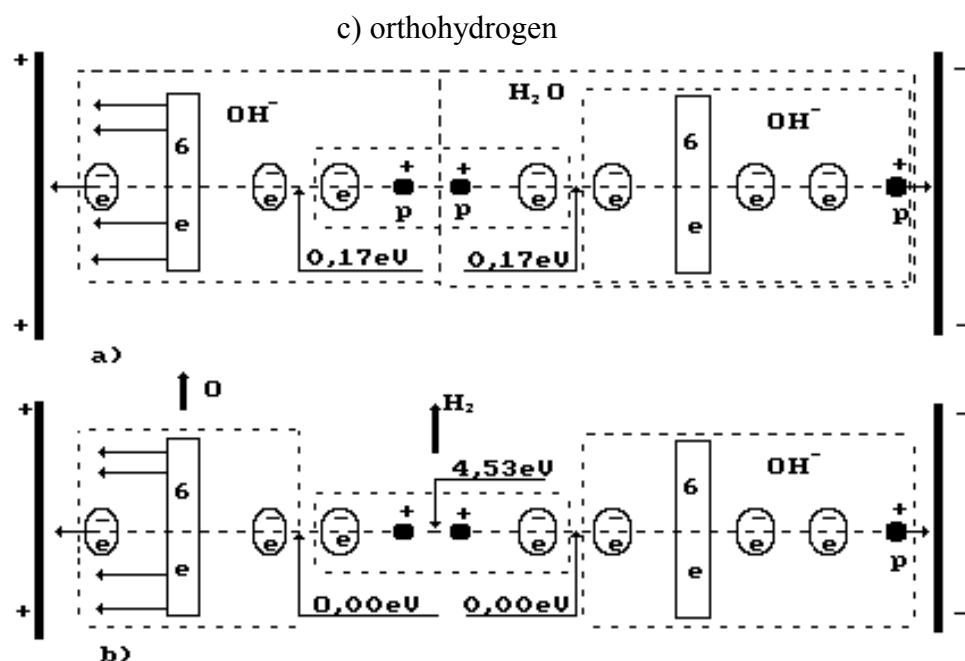
c) orthohydrogen

Fig. 169. Diagram of low current electrolysis process

In Fig. 169, the anode is shown leftward and the cathode is shown rightward. The proton P of the hydrogen atom in water molecule is oriented to the cathode (-); another proton of this molecule is connected with the proton of the ion OH^- (leftward). As a result, a cluster chain is formed; rightward, the water molecule H_2O is situated; leftward, the ion OH^- is situated (Fig. 169, a); the orthohydrogen molecule H_2 is in the center (Fig. 169, a, b).

Thus, the complex cluster chains with strict orientation between the anode and the cathode are formed in the electrolytic solution under the influence of the electrostatic field.

Let us pay attention to the fact that the axis electron of the oxygen atom (see Figs. 128 and 169, a left).

Electrostatic forces attracting six ring electrons to the anode deform electrostatic field in such a way that the axis electron comes close to the nucleus of the oxygen atom, and six ring electrons recede from the atomic nucleus. In this case, binding energies between the protons and the electrons in the hydrogen molecule being formed in such a way are distributed in such manner that binding energy between the hydrogen atoms in its molecule is increased up to 4.53 eV; binding energies between the electrons of the oxygen atoms in the ions OH^- and the electrons of the hydrogen atoms become equal to zero, and the hydrogen molecule is discharged from a cluster chain. Two oxygen atoms form its molecule, and it is discharged as well. Certainly, it is a simplified scheme. If the process is more complicated, the hydrogen dioxide molecules can be formed prior to oxygen molecule formation. The smallest violation of an optimal combination of the electrolysis process parameters results in it.

Now let us consider the reactions, which take place near the anode. It is known that the hydroxyl ion (Fig. 128) has the negative charge OH^- and moves to the anode (Fig. 169, a). Each of two hydroxyl ions gives one electron to the anode; they are linked with each other and form hydrogen dioxide H_2O_2 (Fig. 170, b).

It is known that the hydrogen dioxide formation process is an endothermic one and oxygen molecule formation process is an endothermic one. In order to produce one cubic metre of hydrogen, the hydrogen dioxide formation process absorbs 22.32x109.00=2432.88 kJ. Due to this fact, the solution temperature in the anode area remains low even in case of the plasma electrolytic process.
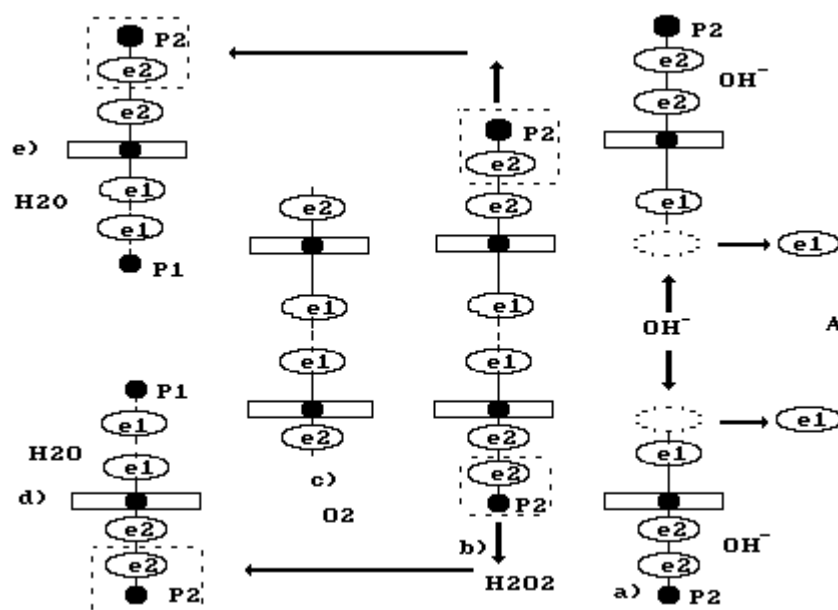
Fig. 170. Diagrams: a) a transfer of the electrons e_1 by the ions OH^- to the anode A; b) formation of hydrogen dioxide H_2O_2; c) formation of the oxygen molecule O_2 and of two water molecules d) and e)

If the oxygen molecule fusion process existed, 22.32x495.00=11048.40 kJ would be released during production of one cubic metre of hydrogen in the anode area. If we take energy being absorbed during the hydrogen dioxide fusion from this value, we'll get 11048.40-2432.88=8615.52 kJ. When we add this energy to hydrogen molecule fusion energy 19463.00 kJ, we'll get 28078.52 kJ. In this case, total index of energy effectiveness K_0 should be K_0=28078.52/14400=1.95. As there is no this energy actually, this fact confirms a hypothesis of absence of the hydrogen molecule fusion process in the cathode area and the oxygen molecule in the anode area during low voltage electrolysis. The hydrogen molecule (Fig. 168, c) and the oxygen molecule (Fig. 170, b) are formed in the cluster chains before their release in a free state; that's why energy of their fusion is not generated.

After two electrons are transferred to the anode by two ions of hydroxyl (Fig. 170, a), a hydrogen dioxide molecule is formed (Fig. 170, b), which is decomposed and forms the oxygen molecule (Fig. 170, c) and two hydrogen atoms; they are combined with hydroxyl ions and form two water molecules (Fig. 170, d, e). Taking it into consideration, the chemical reaction in the anode area is written in the following way

$$4OH^- - 2e \rightarrow H_2O_2 + 2OH^- \rightarrow O_2 + 2H_2O. \tag{472}$$
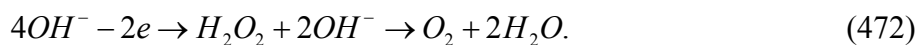
14.7. Experimental Check of Hypothesis of Low Current Water Electrolysis

A search of a reply to the question: is it possible to model an electrolytic process of water decomposition into hydrogen and oxygen, which takes place during photosynthesis? The answer on this question has resulted in a simple structure of a cell (Fig. 171), in which the process takes place by voltage of 1.5-2.0 V between the anode and the cathode and amperage of 0.02 amperes.
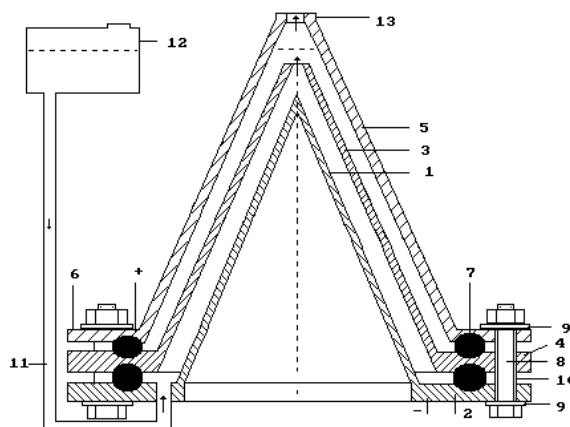
Fig. 1. The Low current electrolyzer (Patent № 2227817)

First of all, we should note that the anode and the cathode are made of one and the same material: steel. It excludes the possibility of formation of a galvanic cell. Nevertheless, at the cell electrodes a potential difference of nearly 0.1 V takes place in complete default of electrolytic solution in it. When the solution is charged, the potential difference is increased. The positive sign of the charge appears on the upper electrode always, and the negative sign appears on the lower one. If a direct current source generates pulses, gas output is increased.

We should note a very important thing. A gap between the electrodes of low voltage electrolysis can be compared with a size of the gas bubbles; that's why when the gas bubbles rise they promote a mechanical destruction of bindings between the atoms in the molecules and clusters. For it, less energy is spent than for a thermal destruction of these bindings. The low current electrolysis process can consist of two cycles; in one cycle, the electrolyzer is connected to electric main; in another cycle it is disconnected (Tables 53, 54).

A gas generation process can be easily traced by a discharge of the bubbles being formed. Their discharge goes on when the electrolyzer is disconnected from the mains. Certainly, when the electrolyzer is disconnected from the mains, gas discharge intensity is reduced, but it is not stopped within many hours. It proves the fact the electrolysis takes place due to potential difference on the electrodes.

Gas discharge after an electrolyzer disconnection from the mains during a long period of time proves the fact that the formation of the molecules of oxygen and hydrogen takes place without the electrons emitted by the cathode, i.e. on account of the electrons of the water molecules itself.

As a laboratory model of the cell of the low current electrolyzer generates small quantity of gases, the most reliable method of the determination of their quantity is a method of the determination of a solution mass change during the experiment and a further calculation of the discharged hydrogen and oxygen.

It is known that a gram atom is equal to atomic mass of substance; a gram molecule is equal to molecular mass of substance. For example, the gram molecule of hydrogen in the water molecule is equal to two grams; the gram-atom of the oxygen atom is 16 grams. The gram molecule of water is equal to 18 grams. Hydrogen mass in a water molecule is 2x100/18=11.11%; oxygen mass is 16x100/18=88.89%; this ratio of hydrogen and oxygen is in one liter of water. It means that 111.11 grams of hydrogen and 888.89 grams of oxygen are in 1000 grams of water.

One liter of hydrogen weighs 0.09 g; one liter of oxygen weighs 1.47 g. It means that it is possible to produce 111.11/0.09=1234.44 liters of hydrogen and 888.89/1.47=604.69 liters of oxygen from one liter of water. It appears from this that one gram of water contains 1.23 liters of hydrogen. Energy consumption for production of 1000 liters of hydrogen is 4 kWh and for one liter 4 Wh. As it is possible

to produce 1.234 liters of hydrogen from one gram of water, 1.234x4=4.94 Wh is spent for hydrogen production from one gram of water now.

Instruments and equipment used during the experiment

Special experimental low current electrolyzer (Fig. 171); voltmeter of the highest accuracy class (accuracy class of 0.2 GOST 9711-78); ammeter of the highest accuracy class (accuracy class of 0.2 GOST 9711-78); electronic scale with scale division value of 0.1 and 0.01 g; stop watch with scale division value of 0.1 s; oscillograph ACK-2022.

In Table 39, the results of the experiment are given when no additional frequency has been generated by the power supply.

Table 53.

| Indices	Amount
1 – period of service of the electrolyzer connected to the line, in six cycles τ, min	6x30=180.0
2 – voltmeter readings V, volts	3.750
3 – ammeter readings I, ampere	0.022
4 – energy consumption (P=VxIxτ/60), Wh	0.247
5 – period of service of the electrolyzer disconnected from the line, in six cycles, min	6x30=180.0
6 – solution mass change m, grams	0.45
7 – evaporating water mass m', grams	0.01x6=0.06
8 – mass of water passed into gases, m''=m-m', grams	0.39
9 – energy consumption per gram of water passed into gases P'=P/m'', Wh/gram of water	0.63
10 – existing energy consumption per gram of water passing into gases P'', Wh/gram of water	4.94
11 – reduction of energy consumption for hydrogen production from water K=P''/P', fold	**5.84**
12 - released hydrogen quantity ΔM=0.39x1.23x0.09=0.043, gram	0.043
13 – energy content of produced hydrogen (E=0.043x142/3.6) =1.70, Wh	1.70
14 – energy effectiveness of water electrolysis process (Ex100/P), %	**689.0**

In Table 54, the experimental results are given when the electrolyzer is supplied with the pulses of rectified voltage and current (Figs 172-176).

Table 54. Low current water electrolysis process indices

Indices	Amount
1 – period of service of the electrolyzer connected to the line, in six cycles τ, min	6x10=60.0
2 – voltmeter readings V, volts;	11.40
2' – oscillograph readings V', volts;	0.062
3 – ammeter readings I, ampere;	0.0228
3' – oscillograph readings, I', ampere;	0.01978
4 – energy consumption according to the voltmeter and ammeter (P=VxIxτ/60), Wh;	0.220

4' – energy consumption according to oscillograph readings (P'=V'xI'x τ/60) Wh;	0.00124
5 – period of service of the electrolyzer disconnected from the line, in six cycles, min	6x50=300.0
6 – solution mass change m, grams	0.60
7 – evaporating water mass m', grams	0.06
8 – mass of water passed into gases, m''=m-m', grams	0.54
9 – energy consumption per gram of water passed into gases according to the readings of the voltmeter and ammeter E=P/m'', Wh/gram of water	0.420
9' – energy consumption per gram of water passed into gases according to oscillograph readings E'=P'/m'', Wh/gram of water	0.0023
10 – existing energy consumption per gram of water passing into gases E'', Wh/gram of water	4.94
11 – reduction of energy consumption for hydrogen production from water according to the readings of voltmeter and ammeter K=E''/P, fold	**11.76**
11' – reduction of energy consumption for hydrogen production from water according to the oscillograph readings K'=E''/P', fold	**2147.8**
12- released hydrogen quantity ΔM=0.54x1.23x0.09=0.06, gram	0.06
13 – energy content of produced hydrogen (W=0.06x142/3.6) =2.36, Wh	2.36
14 – energy effectiveness of water electrolysis process according to the readings of the voltmeter and the ammeter (Wx100/P), %	**1035.1**
14' - energy effectiveness of water electrolysis process according to the oscillograph readings (Wx100/P'), %	**190322.6**

In Figs 172-176, the oscillograms of voltage and current across the input into the electrolyzer are shown.

Fig. 172. Voltage   Fig. 173. Voltage   Fig. 174. Voltage
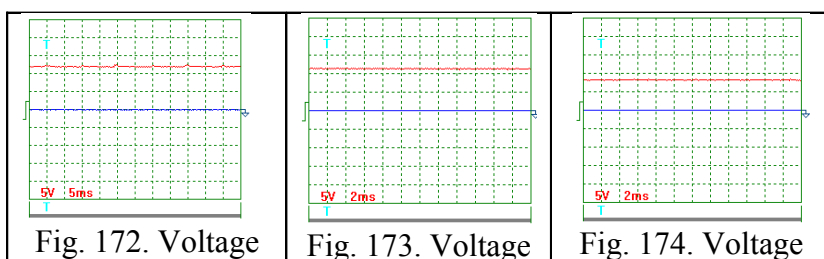
In Fig. 172, the oscillogram of voltage with pulse frequency of nearly 200 Hz is shown. The record scale is 1:1. The pulses are invisible, because their amplitude is negligibly small. The measurements show that voltage of nearly 11.5 V was registered on the oscillogram. The voltmeter showed 11.4 V at that time.

Fig. 173 shows the oscillogram of voltage across the input into the electrolyzer in 1 second after it is disconnected from the mains.

As it is clear, the low current electrolyzer has a constant component of electrical potential. It is a very important fact, which explains a gas discharge cause during a long period of time after the electrolyzer is disconnected from the mains.

Fig. 176 shows the oscillogram of voltage across the input into the electrolyzer in 3 seconds after it is disconnected from the mains. The oscillograms in Figs 173 and 174 show that when the electrolyzer is disconnected from the mains, the process of its discharge takes place. It should be noted that voltage is reduced, but it does not become equal to zero. It means that the electrolyzer is not only a capacitor, but it is an energy source as well.

As it is clear, in the initial moment after the electrolyzer disconnection from the mains (Fig. 173) there remains a potential being close to the mains potential, which has been formed during an electrolyzer charge in the process of its connection to the mains and an adjustment to a specified operation mode. We should note that current within the charging process exceeded its operating value of 0.02 A.

In 3 seconds after a disconnection from the mains (Fig. 174), potential at the input into the electrolyzer is reduced from 11.4 V to nearly 8 V. No voltage pulses are seen in the oscillogram (Fig. 172), because their amplitude is inappreciably small. If scale is increased (record with an open input), the pulses are as follows (Figs 175 and 176).
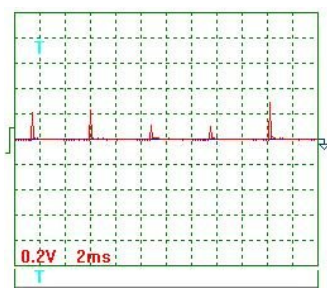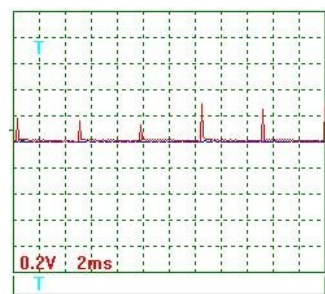

Fig. 175. Voltage

Fig. 176. Voltage

Voltage oscillogram processing results (Figs 175 and 176). Taking into consideration the scale factor, which is equal to 10, we'll find a mean value of voltage pulse amplitude

U'_{cp} =[(0.20+0.24+0.12+0.10+0.30+0.18+0.16+0.12+0.30+ 0.24+0.30)/11] x10=2,05 V .

Pulse period T=(24x2)/10=4.8 ms.
Pulse duration τ =(2x1.45)/10=0.29 ms.
Pulse frequency f =(1/0.001x4.8)=208.3 Hz.
Pulse period-to-pulse duration ratio S =48/0.29=16.55.
Duty factor Z =0.5/16.55=0.0302.
Equivalent mean component of voltage pulses calculated according to the oscillograph readings U =2.05x0.0302=0.062 V. At that time, the voltmeter readings were 11.4 V.

Thus, there is every reason to believe that the low current electrolyzer has the properties of a capacitor and an electric source at the same time. It has been charged at the very beginning; then it is discharged gradually under the influence of the electrolytic processes, which take place in it. Quantity of electric power generated by it is insufficient for the electrolysis process support, and it is discharged gradually. If it is charged with the help of voltage pulses, which compensate for power consumption, the charge of the electrolyzer as the capacitor will remain constant, and the electrolysis process will remain stable.

A value of potential being necessary for the electrolyzer discharge compensation is registered on the oscillograms (Figs 175 and 176). This value should be used when calculating power expenses for hydrogen production from water during its low current electrolysis.

Thus, according to the readings of the voltmeter and the ammeter, capacity of power source of the laboratory model of the low current electrolyzer is P=I·U=0.02·11.4=0.228 W. But the analysis of the oscillograms shows that this power is necessary only to put the electrolyzer in operation. After starting, when it is charged, capacity for its charging is P=I·U=0.02·0.062=0.0012 W, i.e. 190fold less (Table 54).

Availability of a constant component of electric potential across the input into the electrolyzer shows that in order to calculate power consumption for the electrolysis process it is necessary to use not the voltmeter readings, but the oscillograph readings, which register the electrolyzer charge potential originating from the oscillograms given in Figs 175 and 176.

It is natural that this effect is realized only in case of the use of a magneto as a power source for such electrolyzer.
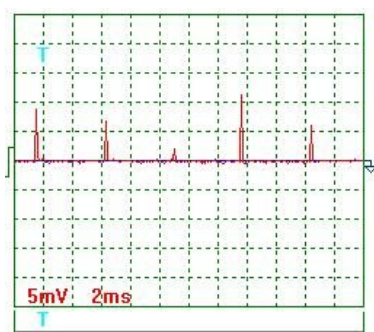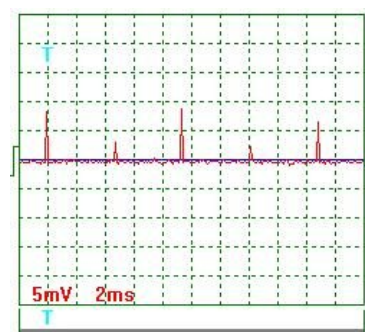

Fig. 177. Current   Fig. 178. Current

In Figs 177 and 178, the oscillograms of current are shown when the electrolyzer power supply source generates pulses with frequency of nearly 200 Hz.

Current oscillogram processing results (Figs 177 and 178). Taking into consideration the scale factor, which is equal to 10, and resistance of 0.1 Ohm resistor we'll find a mean value of current pulse amplitude I'_{cp}={[(9.0+7.0+2.0+11.5 +6.0+8.5+3.5+9.0+2.5+6.5)/10]x10}/0.1=655мА =0.655 A. Mean current in the electrolyzer supply circuit is I_{cp}=0.655x0.0302=0.01978A =0.02A. The ammeter readings are 0.02 A.

Note: voltage pulse oscillograms in the microsecond range were not recorded in this experiment. There is every reason to suppose that a voltage pulse duration record in the microsecond range will show that actual duration of this pulse is twice as little. As a result, voltage and current will be reduced twofold approximately. Actual energy consumption for low current process of electrolysis will be threefold or fourfold less than consumption given in Table 54.

Thus, the voltmeter indicates a voltage value of the charged electrolyzer as a capacitor, which keeps discharging constantly; the voltage pulses being registered by the oscillograph show a value of its recharge, which characterizes energy being consumed by the electrolyzer from the mains. It appears from this that for a calculation of energy consumption taken by the low current electrolyzer from the mains it is necessary to use voltage being recorded by the oscillograph, not by the voltmeter. As a result, energy expenses for hydrogen production from water during the low current electrolysis are reduced hundredfold if the magneto is used as an energy source.

Conclusion

There have been obtained the convincing theoretical and experimental evidences of existence of a technique, which reduces energy expenses for hydrogen production from water hundredfold and more. Such reduction of energy consumption for hydrogen production from water gives every reason to suppose that low current water electrolysis is similar to its electrolysis, which takes place during photofusion.