**Khmelnik S. I., Khmelnik M. I.**

# Analysis of Energy Processes in Searle's Generator

## Annotation

The Searle's generator is treated from the point of view of energy transformation processes. On the base of experimental data and heat exchange theory, it is shown that the interaction of constant magnets with the environment may serve as an energy source. Based on this fact a detailed analysis of energy process is performed in this article, with construction of an appropriate differential equation. The methods of its solution are considered, as well as the results of working calculations of the known experimental device.

## Contents



## 1. Introduction

The Searle's generator is known from internet publications [1-3]. As a first approximation, the Searle's generator can be envisioned as a structural unit reminding a ball-bearing – metal cylinders rolling around a metal rim. Its design is based on the discovery of *Searle's technological effect,* the essence of which is that the magnetizations of a certain material by direct current "with a touch" of high-frequency component creates a multitude of magnetic poles on the surface of this material. The rim-stator is magnetized in such a way that on each of its boundary circles there is a multitude of one-sign magnetic poles. The rotor's cylinders are also magnetized in such way that there is a multitude of magnetic poles on their circle. *The Searle's kinematic effect* lies in the fact, that after the rotor's acceleration with the aid of external motor and after the latter's switching-off, the rotor continues to accelerate to a high speed.

First experiments with these generators were conducted already in 1946. The experiments with Searle's generator and with similar devices of Roshchin-Godin are described in detail in [1-6]. However, the source of energy and the sources of driving forces in the generator haven't been discovered till today.

So, in the analysis of the experiments with the Searle's generator, [1-6] two main questions emerge: 1) What is the origin of the driving force and 2) where the generator takes the energy from? In [7] we have shown that the driving force cannot be a result only of force interaction between the constant magnets of the rotor, and so the first question remains an open issue. Here we are analyzing the second question and give an answer to it. The results of works [8, 9] are being generalized and further developed.

Before considering the Searle's generator we must call attention to some other facts which rank with it from the point of view of the raised question.

It may be assumed that constant magnet in certain conditions can be a transformer of internal energy of the environment into other forms of energy. It becomes most evident in light of the existence of magnetocaloric effect – MCE [10]. MCE is the capacity of any magnetic material to change its temperature under of a magnetic field impact. The maximal magnitude of MCE is reached in ferromagnetic materials. Some materials (for instance, gadolinium) increase their temperature quite substantially. At present this effect is being used even for home refrigerators manufacturing. The estimates show [10], that the use of "magnetic" fridges allows to reduce the USA energy consumption by 5%.

According to the law of energy conservation we should recognize that

1) or the constant magnet is a certain catalyst, aiding to ferromagnetic material (for instance, to gadolinium) to accumulate the internal energy of the environment;

2) or that the magnetic energy of a constant magnet transforms into internal energy of ferromagnetic materials; in this case we must also assume that

| | |
|---|---|
| The energy of constant magnet is replenished at the expense of the internal energy of the environment | (A) |

In any case

| | |
|---|---|
| The energy of environment is being transformed (in addition to heat exchange) by the constant magnet into the internal energy of ferromagnetic materials | (B) |

## 2. The Energy Transformation in the Searle's Generator

By analogy with the above said it may be assumed that in Searle's generator

| | |
|---|---|
| The internal energy of environment is being transformed by the constant magnets to the kinetic energy of the rotor, | (C) |

This means that the Searle generator is a transformer of the internal energy of the environment into kinetic energy. It may be confirmed by the fact that in the experiments of Searle, Roshchin-Godin [1, 2, 6] temperature decrease by 6-8 grades has been marked. Further we shall refer to the experiment with Searle's generator described in [6], to substantiate one or other assumptions, because there we found the fullest data.

From the assumption (C) it follows that in the analysis of Searle's generator the following forms of energy should be considered:

1. magnetic energy of constant magnets $W$ ,
2. internal energy of constant magnets $U$ ,
3. kinetic energy of rotor $K$ ,
4. energy consumption of starting motor and the generator's loading $A$ ,
5. internal energy of the environment; its variation will be denoted as $Q$ .

The following energy transformations take place here

$Q \Rightarrow \Delta U$ : heat transmission from the environment to Searle's generator, which is confirmed by the existence of the observed temperature difference;

$\Delta U \Rightarrow \Delta W$ : this transformation we assume to exist, without proposing any specific mechanism of such transformation; the further described experiments will substantiate it; evidently the constant magnets, when cooling, have had lost some part of their internal energy as a result of processes taking place in the crystal lattice of the constant magnet materials; this is precisely the energy that was transformed into magnetic energy of constant magnets.

$\Delta W \Rightarrow \Delta K$ , $\Delta W \Rightarrow A$ : we should accept the existence of these transformations simply for the reason that the rotor of Searle's generator rotates, and <u>constant magnets</u> are an indispensable component of this generator.

Thus, there exists the following succession of energy transformations: $Q \Rightarrow \Delta U \Rightarrow \Delta W \Rightarrow K + A$. To simplify the quantitative analysis we shall exclude the intermediate transformations of magnetic energy in constant magnets, and so this succession will take the form: $Q \Rightarrow \Delta U \Rightarrow K + A$.

## 2. Differential Equation of Energy Process

Based on these energy transformations we shall further deduce a differential equation describing the energy processes in the generator. This equation permits to analyze the generator's behavior in various circumstances, and to perform some "virtual" experiments.

For a small time period $dt$ the energy conservation law may be written as the following equation:

$$dA_p + dU + dQ = dK + dA_n, \tag{1}$$

where

$dA_p$ - the starting motor energy variation,

$dA_n$ - the load energy variation,

$dU$ - the constant magnets internal energy variation,

$dK$ – the rotor kinetic energy variation,

$dQ$ - the variation of energy received in the process of heat exchange with the environment

Further we have:

$$dA_p = Gdt, \tag{2}$$

$$dU = c \cdot m \cdot dT, \tag{3}$$

where

$m$ - the mass of generator's constant magnets,

$c$ - the specific heat of constant magnets material,

$T$ – the absolute temperature of generator's constant magnets,

$G$ – the power of **motor speeding up the rotor**.

From the Fourier's formula for convective heat exchange [11] with the environment we have

$$dQ = \alpha \cdot S \cdot (T_o - T)dt, \tag{4}$$

where

$S$ – the constant magnets surface,

$T_o$ – the absolute temperature of the environment,

$\alpha$ - the heat emission coefficient, depending on the environment characteristics and on the process of motion around the generator (for instance, on the room's ventilation).

The energy **contributed by the rotor to the load** is equal to

$$dA_n = Pdt\,. \tag{5}$$

The kinetic energy variation is equal to

$$dK = d\left(0.5 m_r v^2\right) = m_r \cdot v \cdot dv\,. \tag{6}$$

Here

$P$ – the load power of the rotor shaft,

$m_r$ – the rotor mass,

$v$ – the rotor rollers linear velocity.

Then

$$dK = m_r \cdot v \cdot dv\,. \tag{7}$$

From (1-6) we get the following differential equation of the process

$$\left\{\begin{array}{l} G(t)dt + cm\dfrac{dT(v)}{dv}dv + \alpha S\left(T_o - T(v)\right)dt \\ -m_r \cdot v \cdot dv - P(t)dt \end{array}\right\} = 0\,. \tag{8}$$

All intermediate transformation involving magnetic energy was excluded from this equation. However we must take into account, that the generator's energy cannot exceed the magnetic energy of the rotor's and stator's constant magnets, which may be computed by the formula

$$W_m = \frac{V_m B H_m}{2}\,.$$

The intensity $H_m$ in the body of constant magnet with rectangular hysteresis loop may vary in a wide range for a constant induction $B$. Consequently, the constant magnets energy may vary in a wide range for a constant induction $B$.

It is convenient to study the equation (8) when written in non-dimensional variables. To do this we shall introduce certain etalon time $t_o$ and velocity $v_o$:

$$v_o = \sqrt{cT_o}\,, \tag{9}$$

$$t_o = R / v_o\,, \tag{10}$$

where $R$ is the rotor's radius. Then we shall introduce non-dimensional time and velocity

$$\tau = t/t_o , \qquad (11.1)$$

$$\xi = v/v_o \qquad (11.2)$$

or

$$\xi = \pi \cdot n \cdot R \big/ 30 v_o , \qquad (11.3)$$

where $n$ – revolutions per minute.

Each item in (8) has the dimension of energy. Therefore we shall introduce etalon energy

$$Q_o = mcT_o \qquad (12)$$

and divide by it all the terms of the equation (8). Then the equation (8) will take the form

$$\left\{ \begin{aligned} & \overline{G}(\tau)d\tau + \frac{dk_1(\xi)}{d\xi}d\xi + k_2\left(1 - \overline{T}(\xi)\right)d\tau \\ & - k_4\xi \cdot d\xi - \overline{P}(\tau)d\tau \end{aligned} \right\} = 0 , \qquad (16)$$

where

$$\overline{T}(\xi) = \frac{T(v)}{T_o}, \quad k_2 = \frac{\alpha S t_o}{mc}, \quad \overline{G}(\tau) = \frac{t_o G(t)}{Q_o},$$

$$k_4 = \frac{m_r v_o^2}{Q_o}, \quad \overline{P}(\tau) = \frac{t_o P(t)}{Q_o}. \qquad (17)$$

The non-dimensional constants $k_2$ and $k_4$ depend only on the constant parameters of generator and environment. They may be called "critical numbers" of this process, by analogy with critical numbers in other spheres (for example, Reynolds number in hydrodynamics, Mac number in aerodynamics etc.). The number $k_2$ describes heat exchange between the constant magnets and the environment, and the number $k_4$ characterizes the rotor's inertia.

Equation (16) allows to determine the dependence $\xi(\tau)$. After that we will be able to find the dependence of $v(t)$ by (11).

Let us denote

$$\overline{T}'(\xi) = \frac{d\overline{T}(\xi)}{d\xi}$$

and from (16) we shall find

$$\frac{d\xi}{d\tau}=H(\xi,\tau)=\left\{\frac{\overline{G}(\tau)+k_2\left(1-\overline{T}(\xi)\right)d\tau-\overline{P}(\tau)}{k_4\xi\cdot d\xi-\overline{T}'(\xi)}\right\}. \quad (19)$$

## 3. About the Choice of Dependence $\overline{T}(\xi)$

In the equation (19) the speed and the time are unknown. Therefore it should be supplemented by another equation. For this purpose we shall consider a function $\overline{T}(\xi)$, corresponding to the dependence $T(v)$. The form of this function is not known. We know only the minimal value $T_{\min}$ of $T$, i.e. maximal value of $\Delta T=T_o-T_{\min}$. This value of $\Delta T$ corresponds to minimal value of $\overline{T}(\xi)$, which will be denoted as

$$\overline{T}_{\min}=1-\delta,$$

where

$$\delta=\Delta T/T_o, \quad (20)$$

as $\overline{T}_{\min}=\dfrac{T_{\min}}{T_o}=\dfrac{T_o-\Delta T}{T_o}=1-\delta$.

We shall choose the function $\overline{T}(\xi)$ so as to satisfy the following conditions

1) $\overline{T}=1-\delta$ for $\xi=\infty$,
2) $\overline{T}(0)=1$ and $\overline{T}(\xi)$ is monotone decreasing.

Since the number of such functions in unlimited, we shall choose only most simple dependences $\overline{T}(\xi)$ and among them – those that agree better with the experimental data. We shall take the following function in this capacity

$$\overline{T}(\xi)=1-\delta+\delta\big/(\delta\gamma\xi+1)^{\beta}. \quad (21)$$

Wherefrom we can find:

$$\overline{T}'(\xi)=-\left(\gamma\beta\delta^2\right)\big/(1+\gamma\delta\xi)^{\beta+1}. \quad (22)$$

The constants $\beta$, $\gamma$ will be chosen by comparing the calculations results with experimental data.

Taking also into account (20, 10, 11, 17) and

$$n=\frac{30v}{\pi R} \quad (22.1)$$

we shall find

$$T(n) = T_o\left(1 - \delta + \delta / (\delta\gamma\xi + 1)^{\beta}\right). \qquad (22.2)$$

Figure 0 shows the dependence (22.2) for various values of the constants $\gamma$, $\beta$.

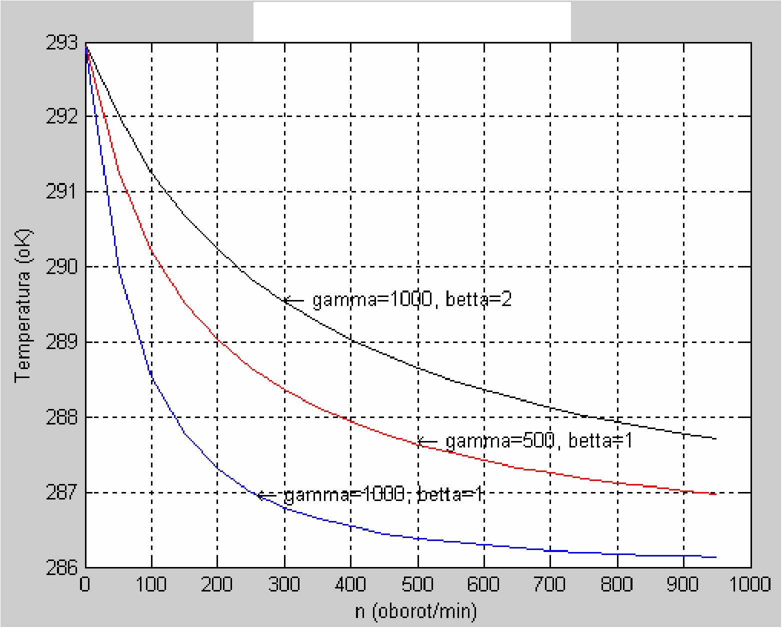


Fig. 0.

In particular, for $\beta = 1$ from (22.2) we have:

$$\left(\frac{T}{T_o} - 1 + \delta\right) = \delta / (\delta\gamma\xi + 1)$$

or, taking into account (9, 11.3),

$$n = \left(-\frac{1}{\delta} + 1 \middle/ \left(\frac{T}{T_o} - 1 + \delta\right)\right)\frac{30 v_o}{\pi R \gamma}, \qquad (22.4)$$

$$T = T_o\left(1 - \delta + \delta \middle/ \left(1 + \frac{\delta\gamma\pi R}{30\sqrt{cT_o}} \cdot n\right)^{\beta}\right), \qquad (22.5)$$

Let us now consider the power balance equation. From (8) we find:

$$G + cm\frac{dT}{dt} + \alpha S(T_o - T) - m_r \cdot v\frac{dv}{dt} - P = 0, \qquad (22.6)$$

or, taking into account (22.1),

$$G + cm\frac{dT}{dt} + \alpha S\left(T_o - T\right) - \frac{m_r \cdot \pi^2 R^2 n}{900} \cdot \frac{dn}{dt} - P = 0 \text{ ,(22.7)}$$

where

$G$ – the power of **motor speeding up the rotor**.

$P$ – the load power of the rotor shaft,

$m_r \cdot v\frac{dv}{dt}$ – «kinetic» rotor power,

$\alpha S\left(T_o - T\right)$ - the power of convective heat exchange with the environment

$cm\frac{dT}{dt}$ - power of the magnets internal energy.

So, the generator dynamics is described by two equations (22.5, 22.6) with unknown variables $T$, $n$. The dependence of $T$ on $n$ -according to the given dependence of $\overline{T}$ on $\xi$.

## 4. The Solution of Differential Equation in Analytical Form

Let us now consider a particular (but fairly general) case, when the main equation (19) may be solved in analytical form. It will be the case when the external power $G = \text{const}$ till a certain moment $t_n$ and $G = 0$ for $t > t_m$, and the load power $P$ is constant with respect to time. Therefore, in this case $\overline{G}$, $\overline{P}$ are constants. Then the equation (19) may be written in the following form:

$$\frac{d\tau}{d\xi} = L\left(\overline{G}, \xi\right) = \left\{\frac{k_4\xi - \overline{T}'(\xi)}{\overline{G} + k_2\left(1 - \overline{T}(\xi)\right) - \overline{P}}\right\}. \qquad (23)$$

In this case the dependence $\tau(\xi)$ can be found by finite integration.

All the process of motion may be divided in two stages

1) acceleration process under the influence of external force $\left(\overline{G} \neq 0\right)$,

2) process of spontaneous motion $\left(\overline{G} = 0\right)$.

<u>On the first stage</u> from (23) we have

$$\tau = \int_0^{\xi} L(\overline{G},\xi)d\xi = \Phi(k_3,\xi), \ \ \xi \le \xi_m, \tag{24}$$

where $\xi_m$ is the value of $\xi$ for $\tau = \tau_m$ (corresponding to $t = t_m$). From that we can find the dependence $\xi(\tau)$ in implicit, but analytical form. The value of $\xi_m$ may be found by solving numerically the equation

$$\Phi(k_3,\xi_m) = \tau_m, \tag{25}$$

On the second stage $\tau > \tau_m$ the equation (19) will take the following form

$$\tau(\xi) = \tau_m + \int_{\xi_m}^{\xi} L(0,\xi)d\xi = \Phi(0,\xi). \tag{26}$$

If for $\xi > \xi_m$ the equation (26) gives the values $\tau < \tau_m$, this means that the speed after acceleration decreases, and the calculations by (26) should be performed with $\xi < \xi_m$. The same conclusion may be reached in the case of $L(0,\xi) < 0$ for $\xi < \xi_m$.

## 5. The Solution of Differential Equation in Parametric Form

If $\overline{T}(\xi)$ is defined by (21), then from (23) we shall get:

$$\frac{d\tau}{d\xi} = \frac{k_4\xi(1+\delta\gamma\xi)^{\beta+1} + \gamma\beta\delta^2}{(\overline{G} - \overline{P} + k_2\delta)(1+\delta\gamma\xi)^{\beta+1} - k_2\delta(1+\delta\gamma\xi)}. \tag{27}$$

and $\frac{d\tau}{d\xi}$ is equal to a fraction, whose numerator and denominator are polynomials of the variable $\xi$. Now it will be more convenient to turn to the variable

$$u = (1+\delta\gamma\xi). \tag{28}$$

then we shall have

$$\frac{d\tau}{d\xi} = A(\overline{G})\frac{(u-1)u^{\beta+1} + B}{u^{\beta+1} - D(\overline{G})u} = H(\overline{G},u), \tag{29}$$

where

$$A(\overline{G}) = \frac{k_4}{\gamma^2 \delta^2 (\overline{G} - \overline{P} + k_2 \delta)},$$

$$B = \frac{\gamma^2 \delta^3 \beta}{k_4},$$

$$D(\overline{G}) = \frac{k_2 \delta}{(\overline{G} - \overline{P} + k_2 \delta)}.$$

The formulas (28) and (29) give the dependence $\frac{d\tau}{d\xi}$ on $\xi$ in parametric form. Then the dependence $\xi$ on $\tau$, defined by the formulas (24) and (26) may be written in parametric form as follows:

<u>in the speeding section</u>

$$\tau(u) = \int_1^u H(\overline{G}, u) du = \Psi(\overline{G}, u), \qquad (30)$$

<u>in the section of spontaneous motion</u>

$$\tau(u) = \tau_m + \int_{u_m}^u H(0, u) du. \qquad (31)$$

These formulas together with (28) define the dependence $\tau(\xi)$. The value $u_m$ may be found similarly to (25) from the equation

$$\tau_m = \Psi(\overline{G}, u_m). \qquad (32)$$

Let us consider now a particular case of $\beta = 1$. Then

$$\frac{d\tau}{d\xi} = H(\overline{G}, u) = A(\overline{G}) \frac{u^3 - u^2 + B}{u(u - D(\overline{G}))} \qquad (33)$$

and after integrating we shall get

<u>in the speeding section</u>

$$\tau = A(\overline{G}) \left[ \frac{u^2 - 1}{2} + (D - 1)(u - 1) - \frac{B}{D} \ln(u) + \left( D^2 - D + \frac{B}{D} \right) \ln \frac{u - D}{1 - D} \right], \qquad (34)$$

in the section of spontaneous motion

$$\tau = \tau_m + A(0)\left[ \begin{array}{l} \dfrac{u^2 - u_m^2}{2} + (D-1)(u - u_m) - \dfrac{B}{D}\ln\dfrac{u}{u_m} \\ + \left( D^2 - D + \dfrac{B}{D} \right)\ln\dfrac{u - D}{u_m - D} \end{array} \right]. \quad (35)$$

## 6. System without Magnets

Of some interest is also the comparison between the performance of Searle's generator on the speeding section with the same device's performance with demagnetized magnets. For such comparison we must calculate with the aid of the above cited formulas the speeding time $t_m$ for Searle's generator and the similar values of $t_{om}$ for the compared device with the same number of rotations per minute after speeding $n$.

Hence due to the absence of cooling under the influence of magnetic field $\overline{T} = 1, \quad \overline{T}' = 0$ and the equation (23) will take the form

$$\frac{d\tau}{d\xi} = \frac{k_4 \xi}{\overline{G} - \overline{P}}. \quad (36)$$

From this, after integration, we get

In the speeding section $\left(\overline{G} \neq 0\right)$

$$\xi = \sqrt{\frac{2\tau\left(\overline{G} - \overline{P}\right)}{k_4}}, \quad (37)$$

In the section of spontaneous motion $\left(\overline{G} = 0\right)$

$$\xi = \sqrt{\xi_m^2 - \frac{2\overline{P}}{k_4}(\tau - \tau_m)}. \quad (38)$$

so we see that in the section of speeding the rotor's motion will be accelerated (but with decreasing acceleration), and in the section of spontaneous motion it will be slowing down. Notice that for constant speeding power $G$ the force exerting on the rotor will be decreasing with increasing speed, as $G = Fv$.

## 7. Steady State Mode

Let us consider the steady state mode, when speed and temperature do not change, and the speeding-up motor is switched off. In this case the load power is equal to generator power. From (22.6) we have

$$P = \alpha S(T_o - T). \tag{41}$$

Using the formulas (22.5, 41) we shall be able to derive the dependence of temperature $T$ and load power $P$ on the number of rotations per minute $n$.

The above used method of calculation of self-excitation mode dynamics is suited for the case when the load power is constant. It is shown that in this case the speed increases infinitely. But actually the load power increases with rotation speed enhancement. It means that at a certain moment the steady state mode sets in. This is the mode for which the formulas (22.5, 41) may be used. Let us consider now the transition to steady state mode for variable load power, increasing (as was noted above) with the rotation speed growth. For this the equation system (22.5, 22.7) may be used, with power $P$ given as a dependence on the number of rotations per minute $n$. The equation (27), may also be used where $\xi$ is defined according to (11.3), and

$$\frac{d\tau}{d\xi} = \frac{30v_o}{\pi R t_o} \cdot \frac{dt}{dn}, \tag{42}$$

which follows from (11.1, 11.3). In this case the power $P$ may also be defined as a dependence on the number of rotations per minute $n$. Solving the equations system (27, 11.3, 42) will permit to build a graph of dependence of $\frac{dn}{dt}$ rotations number $n$ on time $t$ and dependence of $\frac{dn}{dt}$ on rotation number $n$ for variable power.

## 8. Experiments

In [3, 4, 5] the designs of Searle's generator and experiments with them are described. However in this description some constructive data necessary for our analysis are lacking. In [8] these experiments are being analyzed and completed by the necessary parameters. Further we shall use the data from [8], namely:

$$G = 7000\text{вт},\ \ m = 225\text{кг},\ \ \Delta T = 7\text{К},\ \ m_r = 4m,$$

$$T_o = 293K = 20^\circ C,\ \ c = 125\,\text{Дж}/(\text{кг}\cdot\text{К}),$$

$$\rho = 8000\,\text{кг}/\text{м}^3,\ \ R = 0.5\text{м},\ \ S = 1.44\text{м}^2,$$

$$\gamma = 1000,\ \ n_{\max} = 550\,\text{об}/\text{мин},\ \ \alpha = 222.$$

For these parameters

$$\delta = 7/293,\ \ v_o = 191\,\text{м}/\text{сек},\ \ t_o = 0.26\text{сек}.$$

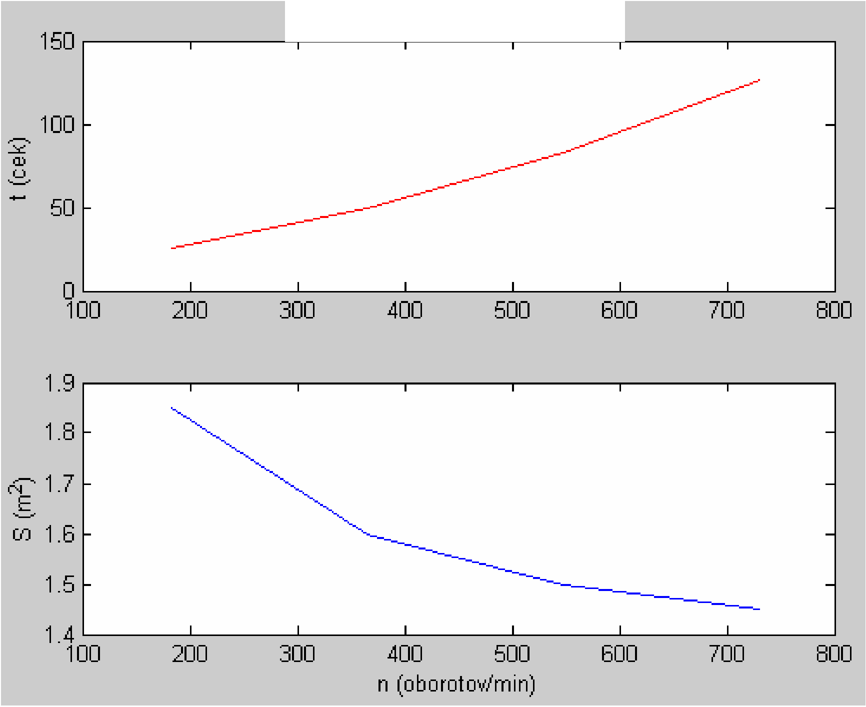


Fig. 1

Let us consider the modes of generator's operating

<u>Acceleration mode</u>

In this mode P=0, and the dependence of speed on time takes the form (34). Figure 1 shows the results of virtual experiments used to define the conditions of the generator's self-excitation. Figure 1 shows the values of the square $S$ and of the necessary minimal speeding time (at this moment the speeding motor is disconnected) for a given value of $S$, and also the number of rotations achieved by the generator. The calculations were done by formula (34), and the moment of speeding motor disconnection (i.e. setting $G = 0$) was determined by formula (29), when acceleration (for $G = 0$) changed its sign from «minus» to «plus». At this moment $\xi = \xi_{max}$. In this way it was discovered that for each value of magnets square $S$ there exist such minimal speeding velocity and rotation speed, that for their smaller values the self-excitation mode of a generator does not exist.

Self-excitation Mode.

In this mode $G = 0$ and the dependence of speed on time has the form (35). Figure 2 shows the dependence of speed on time and the inverse dependence.

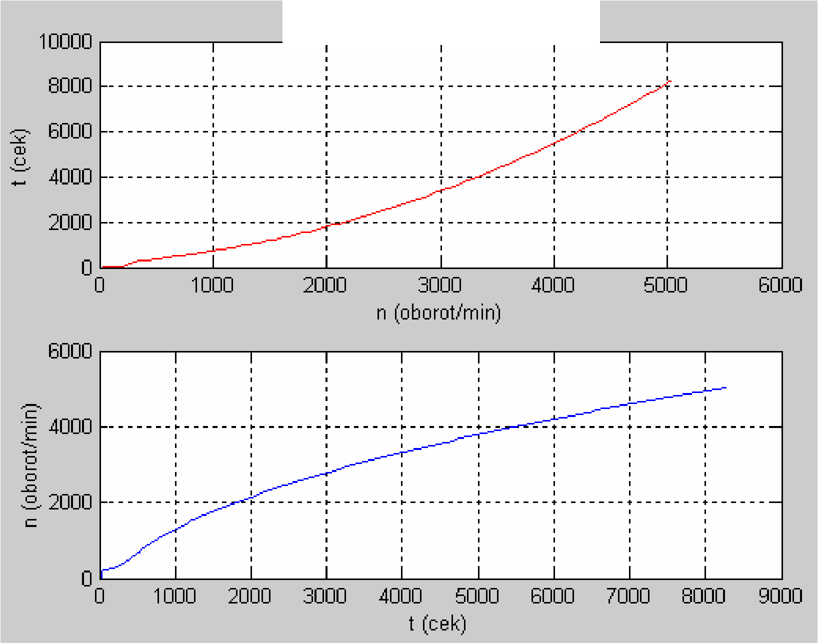

Fig. 2

Steady State Mode.

If it is known that the mode became steady state for a given rotations number $n$, then the temperature $T$ and the load power $P$ for this mode may be found from the equations (22.5, 22.7). Figure 3 shows the dependences of temperature $T$ and load power $P$ on the number of rotations per minute $n$ for the steady state mode.

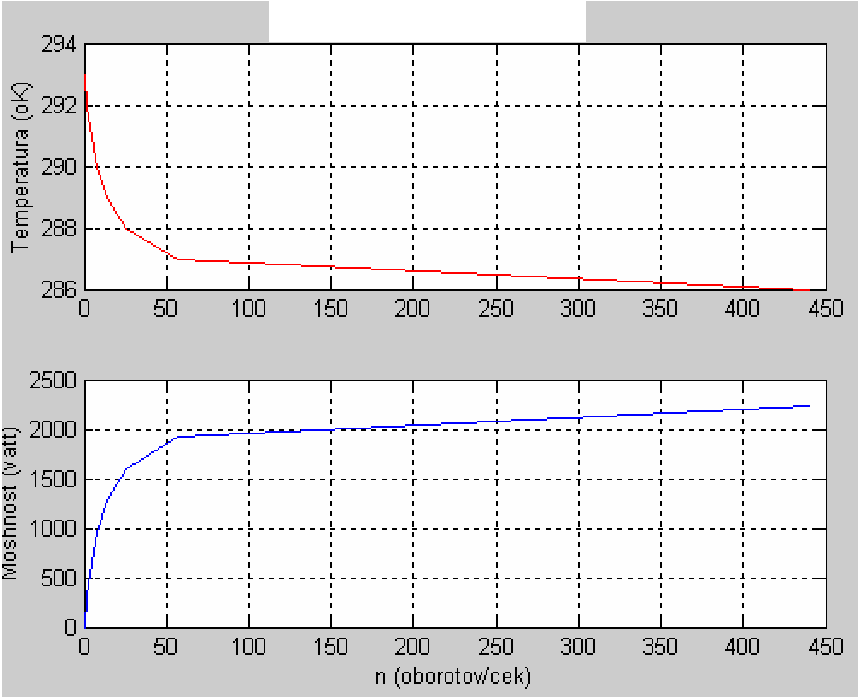


Fig. 3.

Let us assume now that the load power increases with the growth of rotations number. In the Fig. 4 an example of such dependence is shown4 in the lower right window. There the notation **GP** is used for the number **(G-P),** i.e. the case considered is such where the speeding motor changes from a motor mode to a power consumer mode. If it is known that the mode became steady state at the given rotation number per minute $n$, for this case then from the equations (22.5, 22.7) we may find the load power $P$ and acceleration $\frac{dn}{dt}$ as depending on rotation number and on time that passed from the moment of speeding motor start. Fig. 4 shows that the steady state mode starts at P=2000 and n=650, if the stated dependence of power on rotation number is actually valid.

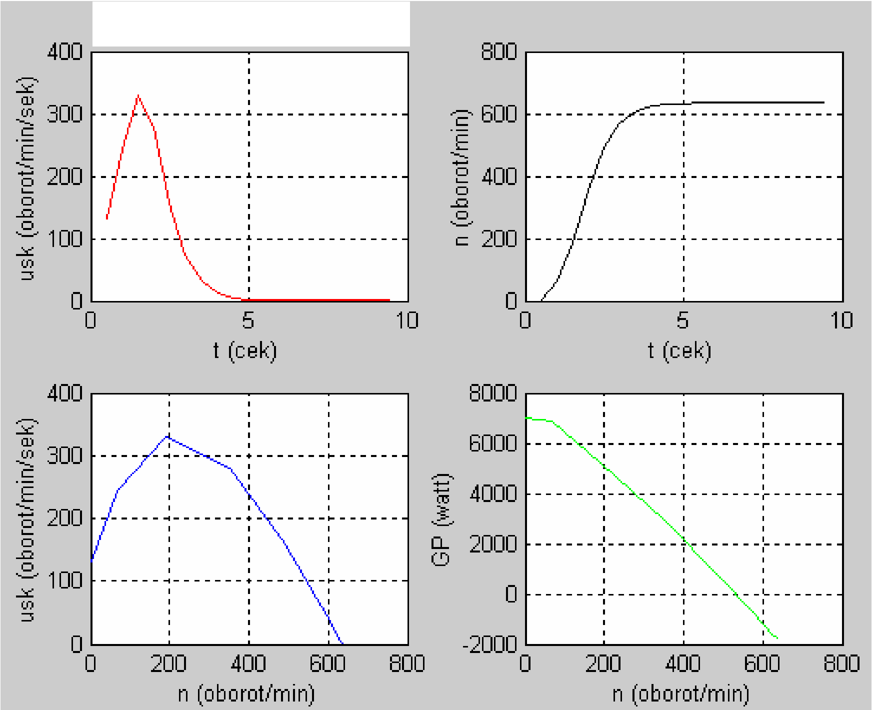


Fig. 4.

# References

1. Generator Based on Searle's Effect. SUSSEX University. Faculty of Engineering and Applied Sciences. Report SEG-002. (in Russian) http://ntpo.com/invention/invention2/23.shtml
2. S. Gunner Sendberg. Antigravitation. Searle's Effect. (in Russian)http://www.ufolog.nm.ru/artikles/searl.htm
3. Searl International Space Research Consortium http://www.sisrc.com/e.htm
4. John Searl Solution, http://www.searlsolution.com/investing.html
5. Roshchin V. V., Godin S. M. A Device for Mechanical Energy Production and a Method of Mechanical Energy Production, Patent of RF, H02N11/00, F03H5/00, 2000. (in Russian) http://macmep.h12.ru/roshin.htm
6. Roshchin V. V., Godin S. M. Experimental Investigation of Physical Effects in Dynamic Magnetic System. Letters to Journal of Theoretical Physics, 2000, volume 26, iss. 24_(in Russian). http://www.ioffe.rssi.ru/journals/pjtf/2000/24/p70-75.pdf

7. Khmelnik S. I. And Khmelnik M. I. To the Question of the Driving Force Source in the Searle's Generator. "Independent Authors Reports", publ. «DNA», printed in USA, Lulu Inc., ID 322884. Russia-Israel, 2006, issue 4 (in Russian).
8. Khmelnik S.I. and Khmelnik M.I. To the Question of the Source of Driving Force in the Searle's Generator. "Independent Authors Reports", publ. «DNA», printed in USA, Lulu Inc., ID 859217. Russia-Israel, 2007, issue 5 ISBN 978-1-4303-2444-7 (in Russian).
9. Khmelnik S.I. and Khmelnik M.I. Energy Processes in the Searle's Generator. "Independent Authors Reports", publ. «DNA», printed in USA, Lulu Inc., ID 1146081. Russia-Israel, 2007, issue 6, ISBN 978-1-4303-0843-0 (in Russian).
10. Tishina E.N. Magnetic cooling is already a reality. http://www.ndfeb.ru/articles/refreg.htm
11. Isaev S.I, Kozhinov I.A., et al The Heat Exchange Theory. M., «Vysshaya Shkola», 1979, 495 pages.