# Ferrites and Ferromagnetics Free Energy Generation

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*There is proposed the way of ferrites and ferromagnetics free energy generation, which is based on the ability of inductance to exchange by temperature with medium.*

For practical aims the quality of ferromagnetic as materials of inductive systems is assessed by specific loss (Wt/kg) appearing in the process of magnetic reversal at frequency ratio f and induction $B$=const. For example, if f=50 Hz there are 50 cycles of magnetic reversal and 100 cycles of magnetization-demagnetization (MD) for 1 second. In Electro-technological steel of 1100 type there is 7.5 Wt/kg loss if $B$=1.5 T, i.e. the specific loss of steel is 7.5 kWt/t, 64.5 kWt/m$^3$. One magnetic reversal takes 20 milliseconds and in this case temperature of steel heating is $36 \cdot 10^{-6}$ °C higher for this period of time. Hysteresis loop is the integral power universal indicator of the sign reversal MD cycles. Its area is in proportion to the energy loss spent for Joulean heat, which is generated by whirling currents, by magnetic reversal, i.e. by the reversal of $B_r$ (residual induction) sign. The classical definition of magnetic permeability is following:

$$\mu = \frac{B}{\mu_0 \cdot H} \tag{1}$$

where $\mu_0$ is permeability of vacuum. Then we need just to change it:

$$\mu = \frac{B \cdot H}{\mu_0 \cdot H^2} \tag{2}$$

and it becomes obvious that this equation is the quotient of magnetic energy to the energy inserted into inductance at magnetization. This energy is generated, induced by magnetic energy, and accompanied by heating. As usually $\mu$ >> 1 then energy source

$$\left( \frac{B \cdot H}{2} - \frac{\mu_0 \cdot H^2}{2} \right)$$

is not the source of current but energy of magnetic itself. It becomes magnetic because of ferromagnetic ability to increase spontaneously the orientation ordering of electron (or domain) spins and to change simultaneously the heat capacity at formation of magnetization. Specific quantity of the appearing magnetic energy is

$$A_1 = \frac{B \cdot H}{2} - \frac{\mu_0 \cdot H^2}{2} = \frac{1}{2}\mu_0 \cdot H^2 (\mu - 1) \frac{J}{m^3} \tag{3}$$

As the process of magnetization begins with $\mu_1 > 1$ (since the residual induction $B_r$ > 0) then the available for picking energy is equal to:

$$A_2 = \frac{1}{2}\mu_0 \cdot \mu_1 \cdot \left( \frac{\mu_{\max}}{\mu_1} - 1 \right) \cdot H^2 \frac{J}{m^3} \tag{4}$$

Its absolute value is

$$A_2 = \frac{1}{2}\mu_0 \cdot \mu_1 \cdot \left( \frac{\mu_{\max}}{\mu_1} - 1 \right) \cdot V_0 \cdot \frac{\omega^4 \cdot i^2}{l^2} J \tag{5}$$

if $V_0$ is the magnetic volume, $\omega$ is the number of turns of inductance winding and $l$ is the average length of ferromagnet magnetic line. Obviously, $A_m > \frac{1}{2} H^2 \cdot \mu_0$ since magnetizing current spents part of its energy to Joulean heat $\Theta_J$ in such a way that

$$A_m = 0.5 \cdot \mu_0 \cdot H^2 \cdot V_0 + R \int_0^{t_m} i^2 dt \tag{6}$$

where $R$ is the resistance of circuit of magnetizing current $i_m$, and $t_m$ is the magnetizing time. The efficiency of picking of available energy should be assessed as multiplying of $A_m$

$$\varphi = \frac{A_d}{A_m} = \frac{0.5 \cdot \mu_0 \cdot \mu_1 \cdot \left( \frac{\mu_{\max}}{\mu_1} - 1 \right) \cdot V_e \cdot \frac{\omega^4 \cdot i^2}{l^2}}{0.5 \cdot \mu_0 \cdot \frac{\omega^4 \cdot i^2}{l^2} \cdot V_e + R \int_0^t i^2 \cdot dt + \Theta_F} \tag{7}$$

where $\Theta_F$ is the loss of whirling currents. Only if $\Theta_J \to 0$, then $\Theta_F \to 0$

$$\varphi_{\max} \cong \mu_1 \cdot \left( \frac{\mu_{\max}}{\mu_1} - 1 \right) \tag{8}$$

$\mu_1$ value is in the range of $\sim 100 \div 10000$, $\Theta_F$ is nondescript. Since $\Theta_J >> 0$, then $\varphi$ depends on 8 parameters in (7) and can have larger value. Geometric volume of magnetic $V_0$ is rarely used totally; effective volume $V_e = V_0 \cdot \beta$, $\beta < 1$. Since the power volume density of conversion cycles is assessed only by $V_0$, i.e. by $W_d = f \cdot \left( \frac{A_d - A_m}{V_0} \right)$, then from (7) we can see the ways to multiply this power.

Since "non-current-source" (which makes only *H*) is accepted then internal energy is generated by exterior forces, which make energy exchange with the magnetic. The following expression can be proposed [1] for the unit of isotropic dielectric volume, if designations are changed:

$$U = U_0(T) + \frac{1}{2}\mu_0 \mu H^2 + \frac{1}{2} \cdot \left| \begin{array}{l} \left[ \frac{\mu_0 \cdot \partial \mu}{\partial T} H^2 \right] \cdot T \\ or \\ \mu_0 H^2 \left[ \frac{\partial \mu}{\partial T} \cdot T \right] \end{array} \right| \qquad (9)$$

The very last member shows that the energy type can be either thermal $\left[ \frac{\mu_0 \cdot \partial \mu}{\partial T} H^2 \right] \cdot T$ or electric $\mu_0 \cdot H^2 \left[ \frac{\partial \mu}{\partial T} \cdot T \right]$. It is an extreme value, but in fact they are mixed and represent a conglomerate. Inductance and medium are Opened Systems from the point of view of thermodynamics. It must be proved by the fact of their free energies generation.

Firstly it is necessary to choose "minimally" possible comparison energy $A_I$ which is $0.5 \cdot 10^{-6}$ sec., current and resistance choice depends on circumstances. Choosing $t_i = 0.5 \cdot 10^{-6}$ sec. we have extremely minimized ($A_I$) without deterioration of measuring possibility. Secondly we need to interpret the response. The repeated impulse initiated by the initial one would be shown at the oscillograph screen as an exponential curve. It stops at zero scale division when kinetic energy changes into potential one. It is very important. We are not interested in their behavior any more: they can stop right here or make some damped oscillations. The energy of the repeated impulses can be described by the following expression:

$$A_{II} = \frac{\Delta t}{R_{II}^2} \sum_i U_i^2 \qquad (10)$$

and energy of the initial impulses can be described by the following one:

$$A_I = a \cdot \frac{0.5 \cdot 10^{-6}}{r} U \qquad (11)$$

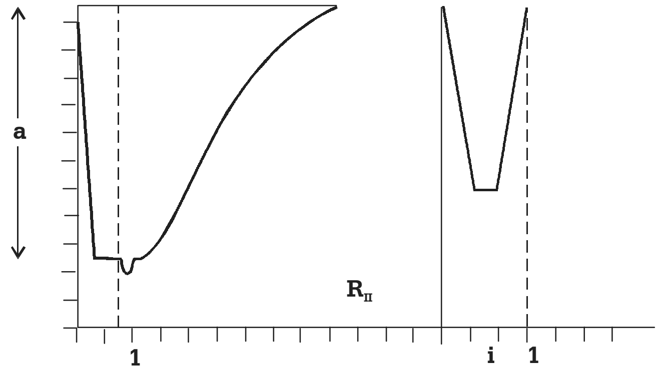


Fig.1

Circuits of the device are shown on the Fig.2. There are a double-beam oscillograph S1-96, a frequency generator G5-54, and a switch on a transistor 2T827A. Input capacitance is 25pF and resistance is 1m Ohm. All inductances are in the maximal magnetic permeability conditions Measuring was made for the frequency of 30 kHz. The accuracy was about 8%. Free energy for this approach is true free and it is limited only by above Curie point. It is the same everywhere below the Curie point (i.e. in air, vacuum or space)

Example: Material is 65 NM, a=2V,

$$A_{II} = \frac{1 \cdot 10^{-6}}{11 \cdot 10^3} \cdot 15.33 = 1.3936 \cdot 10^{-9} J.$$

$$A_I = 2 \cdot \frac{1 \cdot 10^{-6}}{510} \cdot 0.3 = 0.588 \cdot 10^{-9} J, \text{i.e. } \lambda = 2.37.$$

Certainly, there is a question what is the value of cooling effect? From the example it is seen that 65 NM material shows $1.3936 \cdot 10^{-9} \cdot 30 \cdot 10^3 = 41.808 \cdot 10^{-6}$ J/sec, it is impossible to observe such a value experimentally.

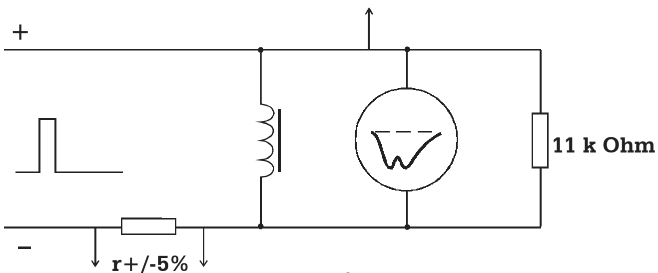


Fig.2

The results are shown in the Table 1:

**Table 1**

| Material | $H_c$, A/m | L, Henry, $10^{-3}$ | R, Ohm | U, V | r, Ohm | $\frac{\mu_{min}}{\mu_{max}}$ | $V_0$, $cm^3$ | $\lambda$ | Curie point |
|---|---|---|---|---|---|---|---|---|---|
| **81 NM** | 2.07 | 495 | 5.4 | 1.16 | 2200 | $\frac{50000}{139 \cdot 10^3}$ | 6.15 | 16.3 | 260°C |
| **79 NM** | 2.0 | 10.2 | 0.2 | 1.27 | 510 | $\frac{30000}{130 \cdot 10^{-3}}$ | 17.9 | 2.96 | 430°C |
| **65 NM** | 3.2 | 100 | 0.7 | 1.63 | 510 | $\frac{1500}{150 \cdot 10^3}$ | 5.91 | 2.37 | ____ |
| **50 N** | 7.9 | 51.9 | 4.1 | 21 | 510 | $\frac{3000}{45180}$ | 30 | 0.984 | 500°C |
| **2500NSM-1** | 16 | 15 | 0.15 | 28.5 | 510 | $\frac{2500}{4500}$ | 242 | 3.25 | >200°C |

These data are compared with those data, which were obtained before by another method. That method was a comparison of $A_d$ ("demagnetization") and $A_m$("magnetization") with the same materials. The experiment with 50Ncore was astonishing because it demonstrated nothing but ~1 magnetic generation index. It turned out that its $\lambda$ is equal to ~1 too. The method of generation is closely connected with hysteresis loop that is the reason of magnetic energy.

The ratio $\varphi \approx \mu_1 \cdot \left( \frac{\mu_{max}}{\mu_1} - 1 \right)$ allows to rely on the increase of the coefficient of generation $\lambda$ , for example $t_i << 0.5 \cdot 10^{-6}$ sec., since value of $\mu_1$ is still rather high.

Conclusions. The generation of the magnetics has been made:

| | | |
|---|---|---|
| 81 NM | with the index | 16.3 |
| 79 NM | with the index | 2.96 |
| 65 NM | with the index | 2.37 |
| 50 N | with the index | ~1 |
| 2500NSM-1 | with the index | 3.25 |

Nature gives us an opportunity to solve the problems of power engineering. Will we use the opportunity?

**References**

1. B.B. Golitsyn "Izbrannye trudy", AH CCCP, M., 1960, p. 119-129