Aetherodynamica Foundations of Electromagnetism – as per Atsukovsky's book

Audio-video recording at https://www.fuzemeeting.com/replay_meeting/5f20f4f5/8444418

See also (for the book and other partially translated parts)
https://www.dropbox.com/sh/b320a0is6fdc2e2/AADfjs_LnbRBSaNXfxjPkTaqa?dl=0

7.8. The physical essence of electrical and thermal conductivity of metals

The physical essence of electrical and thermal conductivity is well explained by the electronic theory developed by the German physicist P. Drode [73, 74] and the Dutch physicist GA Lorentz [75-76].

In metals, atoms are connected to each other by electronic clouds/shells, forming a continuous system of the large molecule type within one domain, such bonds are called metallic and are closest to the covalent bond type [77]. This leads to the fact that when the atoms are combined, the length of the aether flow in a molecule consisting of only two atoms turns out to be less than the sum of the lengths of the paths of the aether flows within the atoms before their compounding. Therefore, when atoms are combined into a molecule, a part of the compressed, screwed/whirled aether gets thrown out of the formed molecule. In contrast to the usual covalent bond, in the formation of which the ejected part of the ether stream/flow closes in itself, in metals this flow stimulates the organization of the electron on account of aether flows that appeared (were present) between the atoms (Fig. 7.16).

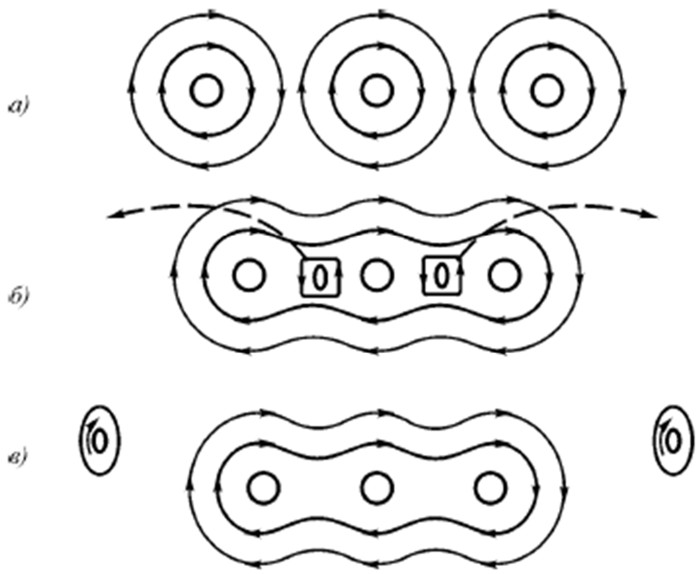

Fig. 7.16. Metal bond in atoms and the formation of free electrons in a metal

The free electron formed begins to move chaotically in the intermolecular space within domains of the Van der Waals shell/cloud, colliding with the electron shells of molecules and exchanging energy with them. At the same time, some share of the electrons reaches the surface of the metal and, in a staggered manner, antiparallel to each other, forms the so-called "Fermi surface" (Fig. 7.17).

According to the electronic theory, free electrons in metal conductors form an electron gas. Moving chaotically in the interatomic space of the conductor's body, electrons collide with the surfaces of atoms and molecules, exchanging with them impulses and thereby maintaining a common for the whole body temperature. It is the presence and mobility of the electron gas that provides high thermal conductivity of metallic conductors. However, this raises questions about what presents itself the solid-state body heat, what is the mechanism of the temperature of a solid, which is a carrier of heat in a solid body and by what the heat of a solid physically differs from the heat of the gas.

In accordance with the electron theory, free electrons moving chaotically between the molecules of the body continuously exchange with them by (im)pulses, that enable and promote leveling of temperature in metal with high speed, which does distinguish metals from non-metals - high value of thermal conductivity.

The thermal velocity of electrons in a metal is determined by expression

$$v_e^2 = \frac{3k\,T}{m_e}, \qquad (7.46)$$

where m_e = 0.9108 · 10^{-30} kg is the electron mass, from which we find that at temperature of 20°C (293,3°K) the average speed of thermal movement of electrons will be 115.45 km / s.

Bearing in mind that the number of electrons in the metal must be equal to the number of atoms, then their number per unit volume, as well as of atoms, is of the order of n = 10^{28}-10^{29} m^{-3}. If the electron gas existed by itself, then the mean free path of the electrons would be equal to

$$\lambda = \frac{1}{\sqrt{2}\, n\, \sigma_e}, \qquad (7.47)$$

where σ_e is the cross-sectional area of the electron, the value of which is about 10^{-30} m^2. Consequently, the mean free path would have to be of the order of a few meters, while the distance between the centers of the molecules is of the order of 10^{-10} m. This means that electrons in the metal do not interact in any way among themselves, and each continuously collides with the surfaces molecules around which it is located, and moves between molecules.

In accordance with the same electron theory, the thermal conductivity of metals and alloys can already be estimated in the present exposition using the Wiedemann-Franz law [78]

$$k_т = L_o \sigma T, \qquad (7.48)$$

where L_o = 2.445 · 10^{-8} W·Ω/ K^2 - the Lorentz number; σ is the electrical conductivity,

Ω · m^{-1}; T is the absolute temperature.

That ratio, which confirms the proportionality of the thermal conductivity and conductivity of metals and their alloys, is confirmed by wide practice and included in the reference books as a basis, although not always accurate. Since there are also other factors affecting this relationship. Nevertheless, it can be argued that the electronic theory of metals is confirmed. In accordance with this theory, the electrical conductivity is

$$\sigma = \frac{ne^2\tau}{m_e}, \tag{7.49}$$

or for the specific resistance

$$\rho = \frac{m_e}{ne^2\tau}, \tag{7.50}$$

where n is the electron concentration per unit volume; e is the electron charge; τ is the mean free time, m_e is the electron mass. With increasing temperature, the frequency of electron collisions with the surfaces of molecules increases and the mean free time decreases accordingly. Hence the decrease in conductivity, and the corresponding increase in the resistivity of metals.

Thus, the joint representations of the electronic theory and aetherodynamics make it possible to understand the mechanism of electrical conductivity of metals and its relation to thermal conductivity. To this basic process, as elsewhere, additional processes are imposed, leading to deviations from the basic law, which must be considered separately.

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8.2. The physical essence of electromagnetism

8.2.2. The structure of a free electron

As was shown above, when the ether flows/streams that make up electronic shells of metal atoms join the general structure, a part of the screwed/whirled and densified aether in the structure of these shells turns out to be superfluous and gets ejected into the external space. The screwing/helical thread/stream cannot be preserved in such form, because one end moving forward is the source of the gas, and the opposite end - the drain. The front end of the trickle must necessarily close to the rear end, resulting in a new screw/spiral toroid of aether of a small mass - a free electron. In principle, the number of such electrons in a metal must be equal to the number of atoms, i.e. of the order of $10^{29}m^{-3}$, since each atom ejects a trickle of ether forming a free electron when combined into a common structure.

On the element of the surface of the newly formed toroidal helical vortex - electron, there exists a difference in forces: on the outside, acts the pressure of the free ether; from the inner side, the sum of the internal pressure forces, which is substantially less than the external pressure, since by rotation the gas is thrown from the central region to the periphery of the vortex, and centrifugal force. Such a system is unstable and begins to contract spontaneously, since in the interatomic region the ether flow velocity is smaller than in the electron shells of the atom, the velocity gradients are smaller, hence the ether pressure is higher here.

For a free vortex, the angular momentum of toroidal and circular rotation must be preserved, which, during compression, will lead to spontaneous increase in the linear and angular velocities of both motions, of the linear velocity being proportional to the first compression degree and of the angular velocity - to the square. The process of spontaneous compression of the gas vortex and the energy relationships of this process were considered before.

The compression of the vortex and the increase in the rotational speed will continue until the density of the vortex increases to a certain critical value, presumably the same as for the proton, i.e. up to a value of the order of 10^{17}-10^{18} kg / m^3. As a result, the produced vortex spiraling ring will acquire dimensions substantially smaller than were those of the original vortex. This will be a free electron.

The described mechanism for the formation of free electrons in a metal's crystal is caused by the restructuring of the outer shell of metal atoms in connection with the formation of a common crystal lattice. The combination of external adjoined vortices of atoms in a single structure should lead to the release of free vortices - electrons, which begin to wander over the crystal in the form of a so-called "electronic gas". Something analogous was discovered by the author and confirmed experimentally in covalent reactions in which each pair of interacting molecules liberates a part of the screwed/spiraled compressed ether, which immediately forms a toroidal vortex of the aether.

Thus, a free electron presents a helical vortex ring of compressed ether, in which the sign of the screw motion, i.e. the orientation of the ring motion relative to the toroidal, is opposite to the sign of the helical motion of the ether in the body of the proton, but the amount of ring motion is the same. Consequently, it carries within it a charge of the same magnitude as the proton, but the charge sign is not positive, like with the proton, but negative.

The presence of circular motion within an electron is confirmed by the fact that at an electron has been determined spin – the moment of the amount of rotational motion (the angular momentum), equal to ½ in units of $\hbar$. The main axis of the electron is the axis of circular rotation (Figure 8.1).

Fig. 8.1. The structure of a free electron: *a* – in a metal; *б* - in free space

If the electron in free ether has the same density as the proton, then the radii of the electron and proton are related to each other, as the cubic root from the ratio of their masses, i.e.

$$r_e/r_p = (m_e/m_p)^{1/3} = (\ 9.1.10^{-31}/1,67.10^{-27})^{1/3} = 0,082 \qquad (8.2)$$

and, consequently, the radius of an electron is:

$$r_e = 0,082 r_p = 0,082.1,12.10^{-15} = 9.10^{-17}\ \text{м}. \qquad (8.3)$$

The area of the electron's surface is

$$S_{e\ \text{пов.}} = 4\pi r_e^2 = 4\pi\ (9.10^{-17})^2\ = 1,1.10^{-31}\ \text{м}^2, \qquad (8.4)$$

and its circular velocity is determined from its charge

$$e = \rho v_\text{к} S_e = 1,6.10^{-19}\ \text{Кл} \qquad (8.5)$$ (Coulomb)

wherefrom

$$v_\text{к} = e/\rho S_e\ = 1,6.10^{-19}/8,85.10^{-12}.\ 1,1.10^{-31}\ = 1,64.10^{24}\ \text{м.с}^{-1}. \qquad (8.6)$$ (m/s)

The amount/value of angular momentum is determined as

$$(\text{circ})_e = 2\pi\ r_e v_\text{к} = 2\pi.9.10^{-17}.1,64.10^{24} = 9,\ 27.10^8\ \text{м}^2.\text{с}^{-1} \qquad (8.7)$$ (m^2/s)

The area of electrons cross-sectional surface is

$$S_{e\ \text{сеч.}} = \pi r_e^2 = \pi\ (9.10^{-17})^2\ = 2,75.10^{-32}\ \text{м}^2 \qquad (8.8)$$

It should be noted that within the metals the electrons are not in the environment of the free aether. There also exist other associated vortices, which can be conditionally called the Van der Waals shells/clouds and which provide interatomic bonds of a non-chemical (non-electronic) nature. An electron inside such vortices will experience a pressure less than in free ether and its dimensions will be much larger. Moreover, moving around in the space between the metal atoms, the electron all the time passes from one area of the van der Waals shell to the other, the velocity of the aether flows and the velocity gradients in them are different, hence, the pressures in them are different, so the electron cannot retain its dimensions unaltered, they all the time change, the ring-radius of the electron is not constant and varies depending on external factors.

The concept of an electron as a vortex ring with a variable radius was introduced by V.F. Mitkevich [36, 37]. The main objection to the Mitkevich model was the assertion that the charge and the magnetic moment of an electron are spherically symmetric. However, the subsequent work of Wu and some other physicists have shown that the electron behaves like a rotating vortex ring whose spin is directed along its axis of motion. This fact removes those objections.

As is known, and electron possesses energy of

$$E\ =\ h\nu\ =\ m_e c^2, \qquad (8.9)$$

and the spin – the mechanical rotational moment

$$s = ½\, h = m_e r_к v_к = m_e r_к^2\, \omega_к = J_к\, \omega_к \qquad (8.10)$$

The spin reflects only the mechanical moment of rotation of the circular motion, while the energy is the total internal energy of the electron, taking into account both ring and toroidal motion. For circular motion

$$E_к = J_к \omega_к / 2. \qquad (8.11)$$

If, in accordance with the Maxwell principle, the energies over the degrees of freedom are uniformly distributed, then

$$E_к = E_т \qquad (8.12)$$

and, at least, for the first case - the existence of an electron in free aether - it can be argued that the linear velocities of the ring and toroidal motions of the aether on the surface of the electron are equal and, consequently, the ether particles in the body of the electron move along the helical line with the slope of the screw about 45°.

<u>If an electron falls into an area where there are any ether streams/flows, then, as the velocity gradient increases, the pressure on the electron surface reduces, and the vortex ring increases in size.</u> (this might be of importance for the explanation of the Faraday's wheel induction – remarked and underlined, SN)

8.2.3. The physical essence of the electric field

From a comparison of the expressions for the energy density of an electric field in a vacuum

$$w_e = \frac{\varepsilon_0 E^2}{2},\ \text{Дж/м}^3, \qquad (8.13)$$

(Joul/m^3)

where ε_0 is the dielectric permittivity of vacuum, in F / m; E is the electric field strength, in V / m, and the corresponding energy expression for the ring/circular motion of the aether

$$w_к = \frac{\rho_э v_к^2}{2},\ \text{Дж/м}^3 \qquad (8.14)$$

(Joul/m^3)

where $\rho_э$ is the density of the medium, in kg · m^{-3}; v_k is the velocity of the medium at the equator of the proton, in m/s, it immediately follows that the electric field strength has the dimensionality of the velocity. By definition, the strength of an electric field is a force acting on a unit electric charge, so that

$$E = \frac{F}{q}. \qquad (8.15)$$

However, any force can arise as a result of the appearance of a pressure gradient, which, in turn, can arise as a result of the gradient of the aether flow rates in the electric field and on the surface of the particle interacting with it. Given the transverse nature of the propagation of the electric field vector, it should be assumed that the interaction of the electric field and the particle involves the aether flow oriented not in the direction of the particle but in the perpendicular direction. In that case, interaction occurs at the expense (on the account) of velocity gradients, the vector of which is directed toward the particle. Such an interaction is possible if within the structure of the electric field itself exists not only the longitudinal but also the transverse flow of the aether.

When an electric charge appears on the surface of an electrode, i.e. when electrons exit to the surface, in its vicinity an electric field is established.

From Fig. 8.2 it can be seen that when helical vortex toroids - electrons or protons enter (exit to) the electrode surface, they create helical vortex tubes of the moving ether in the space outside the electrodes. In a vortex tube formed in a medium by a helical toroidal ring, the ether flows (move) not only along the ring in a plane perpendicular to the axis of the tube, but also parallel to this axis. In the central part of the vortex tube, the ether moves from the helical/screwing toroid, and along the periphery towards (into) the toroid, so that the total amount of translational motion of the ether along the tube is on average equal to zero. This translational movement is of great importance, since, being different in magnitude and direction at different distances from the axis of the tube, this motion creates different values of the screw/helical factor, in that along the axis of the tube the screw motion has one sign, and along the periphery of it the opposite one (Figure 8.2) .

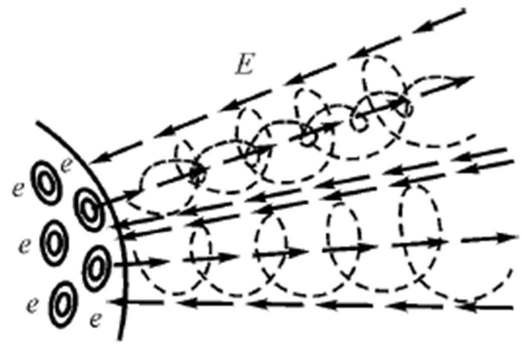


Fig. 8.2. The vortex field created by screw/helical toroidal vortexes (electric field)

As shown in [40, 41], only helic(oid)al flows can be added together, for which the screw-factor is constant and the same along the entire length of the vortex. Such a helical motion must satisfy equation

$$\mathrm{rot}\, v = \lambda v; \tag{8.16}$$

$$\frac{\omega}{v} = \frac{\omega_x}{v_x} = \frac{\omega_y}{v_y} = \frac{\omega_z}{v_z} = \frac{\lambda}{r},$$

whereby

$$v \text{grad}\, \lambda / r = \text{const}. \qquad (8.17)$$

There is no such thing for vortex tubes of electric induction, therefore the flows/streams of these vortex tubes cannot be summed up, but can only develop/emanate/move in the longitudinal direction, sliding along the surface of each other, and be getting shifted (displacing) in the transverse direction under the pressure of adjacent vortex tubes.

Thus, the electric field lines - electric induction - exist as separate vortex tubes ("Faraday tubes"), however not whole of this movement corresponds to the electric induction, but only its ring component.

The electric field is a set of helical/screw vortex tubes of the aether ("Faraday tubes") with the cross-sectionally varying crewing-factor.

The strength of the electric field is determined by its intensity, i.e. the number of tubes per unit cross-sectional area of the conductor and, correspondingly, cross section of each tube: the higher the electric field strength, the greater the number of tubes per unit area and the smaller (is) the cross-section of each tube, which is in full accord with the theory of gas vortices. For a gas vortex with constant gas circulation along the vortex, the strength and linear velocity of rotation are the greater, the smaller its cross section.

For a single charge, the total angle occupied by the circular motion is 4π, hence for n tubes the angle occupied by each of them is

$$\theta = 4\pi/n, \qquad (8.18)$$

whereby for each tube, in accordance with the Helmholtz's theorems, throughout all its length, circulation and angular momentum are preserved for each of the elementary stream:

$$\Gamma = 2\pi r v; \quad L = mvr = \text{const}. \qquad (8.19)$$

As was shown above, the value of a single charge is determined as

$$e = \rho_э v_к S_p.$$

Since the toroidal motion blurs (smears-, spreads-out) the ring motion over the entire sphere of space, the mass flow of circular motion through the sphere is determined from expression

$$\int \rho_э v_к \, dS = n\rho_э v_к S_p, \qquad (8.20)$$

or

$$\int \mathrm{D dS} = \mathrm{q}, \qquad (8.21)$$

where q is the entire charge inside the sphere; D = $\rho_э\, v_k$ is the flux of the ring velocity of the aether density, or, otherwise, the flux of electrical induction. This expression corresponds to the Gauss theorem.

The process of the appearance of an electric field when ordered charges appear on the electrode surface is that the vortex motion of each tube begins to propagate along the axis of the tube. By that, at the head-end of the tube the movement of the aether lies in a plane perpendicular to the axis of the tube, and therefore the velocity of propagation of the electric field in vacuum is equal to the velocity of the second sound in the aether - the velocity of propagation of the transverse motion facilitated by the viscosity of the aether, this being the speed of light. The propagation velocity of an electric field in a material is less (by) k_ρ times,

$$k_\rho = \sqrt{\rho_м/\rho_э} \qquad (8.22)$$

$\rho_М$ is the density of the aether involved (engaged) in the motion of the electric field in the material; $\rho_Э$ is the aether density in free space.

In optical media, $k_\rho = n$, i.e. it is equal to the refractive index. Usually the refractive index is in the range of 1.4-1.6, therefore the density of the ether involved in the motion in the electric field is 2-2.5 times higher than the density of free ether, i.e., it is about $2 \cdot 10^{-11}$ kg. m^{-3}.

Comparing it with the mass density of the very optical glasses being of the order of (2.65-3) $\cdot 10^3$ kg $\cdot$ m^{-3}, we see that a very small part of the aether is involved in the motion in the electric field, on the order of 10^{-14} of the total mass of the aether , which forms the material. In metals, perhaps this proportion is larger.

8.2.4. Condenser (electrical capacitance)

Consider a charged capacitor, on one of the plates of which a charge q is placed, and on the other -q. The presence of equal and opposite charges means that on the inner surface of one of the plates the number of concentrated elementary charges is

$$n = q/e, \qquad (8.23)$$

creating a field of n vortex tubes, the ends of which all enter the second plate, i.e. the number of tubes emerging from one plate is equal to the number of the same tubes entering the second plate. If the charges were not equal or they had the same sign, there would be no such equality.

The cross-sectional area of one tube will be (on average)

$$S_o = S_к/n, \qquad (8.24)$$

where S_K is the area of the condenser plate, and the velocity of circular motion along the periphery of the tube is

$$v_o = \Gamma/2\pi r_o, \qquad (8.25)$$

where Γ is the intensity of the aether circulation in the tube.

When the tube area is changed due to the increase in the number of these tubes - the increase in charge on the plates - the density of the aether in the tubes ρ will vary in comparison with the ether density in the free medium ρ_e:

$$\rho/\rho_э = S_o/S = r_o^2/r^2. \qquad (8.26)$$

As shown in [42-44], the Bernoulli's equation is applicable to the helical flow as a whole. The pressure difference in the elementary stream at the periphery of the vortex and in the free aether is

$$\Delta P = \rho_э v^2/2, \qquad (8.27)$$

and for a vortex tube of circular cross section, on the average, the pressure drop along the tube is [16, p. 115]

$$\Delta P = \rho_э v^2/4, \qquad (8.28)$$

and for tubes on non-circular cross-section

$$\Delta P = k\rho_э v^2 = \frac{k\rho_э \Gamma^2}{4\pi^2 r^2}. \qquad (8.29)$$

Here k is the proportionality coefficient, accounting for the shape of the tube's cross-section.

Since the gas' expenditure/loss/consumption(?) in each tube (is)

$$v_o\rho_o = v\rho = \text{const}, \qquad (8.30)$$

we get

$$\Delta P = k\rho v^2 = k\frac{v_o^2\rho_o^2}{\rho} = k\frac{\Gamma^2\rho_o^2}{4\pi^2 r^4\varepsilon}, \qquad (8.31)$$

where ε is the relative density of the aether in the vortex tube in the dielectric.

The total force acting on the capacitor plate is

$$F = \Delta PS = k\frac{\Gamma^2\rho_o^2 S}{4\pi\ r^2\varepsilon^4} = k'\frac{\Gamma^2\rho_o^2 S}{4S\varepsilon^2} = k\frac{\Gamma^2\rho_o n^2}{4\varepsilon S} = \frac{q^2}{2\varepsilon_o\varepsilon S}. \qquad (8.32)$$

In such way, the physical meaning of the relative permittivity ε is the ratio of the ether density in the vortex tubes in the medium (dielectric) to the ether density in the vortex tube in a vacuum (in the aether-substrate free from matter).

The following important circumstance should be noted for the passage of the vortex tubes of the electric field through the dielectric. The streams of ether in these vortex tubes represent a steady motion of the ether, which can only lead to a constant displacement of the ether vortices, of which the very substance of the dielectric is composed, by some amount, and to a transient process, i.e. on the elastic displacement of molecules, some energy will be expended. In the rest, the presence of a stationary vortex flow of ether in the dielectric can not lead to any vibrations of the particles of matter. This means that the vortex energy is not consumed and has a reactive character (the energy does not go into heat - the energy of vibrations of atoms).

8.2.5. Free electron in an electric field

Let us consider the motion of an electron - a helical vortex ring of densified aether in the helical field of the aether - the electric field. Once fallen in the vortex field, created also by screwing/helical toroidal formations of the ether, the electron is forced to rotate so that the plane of its circular motion coincides with the plane of the ring movement of the aether in the tubes. Since there is no collision with matter's molecules in the vacuum, the orientation of the electron unfolding (declining?, turning-over?) over the field will remain indefinitely long. After this, under the action of the difference in pressure acting on the electron, the latter must begin its motion along the axis of the vortex tube.

When the directions of the circular/ring motion of the vortex field $v_п$ and the one of the electron v_k coincide on the side of the particle that faces the field-forming vortices, the gradient of the velocity of the circular motion will be smaller than from the opposite side, and therefore the aether pressure on the side facing the source of the field will be greater than on the opposite one (Figure 8.3).

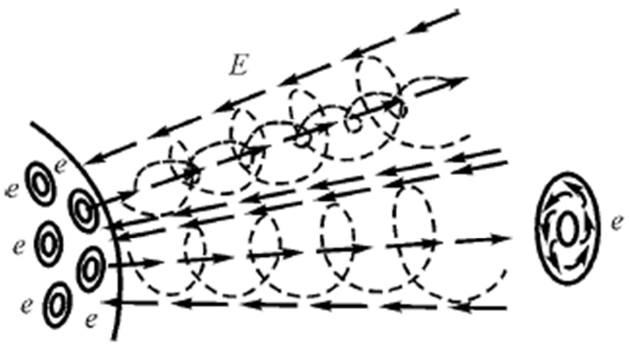


Fig. 8.3. Electron in an electric field tube.

In accordance with the Bernoulli equation, these pressures are determined by the expressions:

in the area *a: (this and other areas have been marked on the figure 8.4 … remark by SN)*

$$P_a = P_o - \rho_э(v_e - v_п)^2/2; \qquad (8.33)$$

in the area *b:*

$$P_b = P_o - \rho_э (v_e + v_п)^2/2; \qquad (8.34)$$

in the area *c:*

$$P_c = P_0 - \rho_э[v_e - (v_п - b\partial v_п/\partial r)]^2/2; \quad (8.35)$$

in the area *d:*

$$P_d = P_0 - \rho_э[v_e + (v_п - b\partial v_п/\partial r)]^2/2. \quad (8.36)$$

Here *b* is the thickness of the electron's body; v_e is the velocity of the ring motion of the electron body; $v_п$ is the velocity of the circular/ring motion of the electric field; $\partial v_п/\partial r$ is the gradient of the circular/ring velocity of the field.

Carrying out the appropriate calculations and neglecting small terms, we obtain the values of the pressure difference that create the turning moment to the electron, always in the direction of alignment of the axis of the conductor and the vector of the toroidal motion of the electron:

$$\Delta P = v_e\rho_э b\,\partial v_п/\partial r = v_e\rho_э E. \quad (8.37)$$

where $E = b\,\partial v_п/\partial r$.

The force acting on the element of the area of the electron will be

$$dF = \Delta PE\sin\alpha = \rho_э v_e v_п \sin\alpha dS_т, \quad (8.38)$$

where S_T is the circular/ring cross-sectional area of the electron, α is the angle between the main axis of the electron and the axis of the electric field tube; E is the electrical tension.

On the entire area of the electron, the constant component of the field's circular/ring velocity creates no force, since the increase in pressure on those sections, where the directions of the flows of the ring velocities of the electron and those of the field coincide, are balanced by a decrease in pressure in those sections where they have the opposite direction. Therefore, the additional pressure on the electron is created not by the actual flow rate of the ether vп, but by the circulation of the velocity around the contour and, consequently, the force acting on the electron from the side of the electric field is determined as

$$F = \rho_э v_e \iint(\partial v_п/\partial r)\sin\alpha dr dS_e = qE\sin\alpha, \quad (8.39)$$

where

$$E = \int_0^b(\partial v_п/\partial r)dr. \quad (8.40)$$

Thus, the electric field strength, i.e. force acting on part of the electric field on a unit charge

$$E = F/q, \quad (8.41)$$

as its origin the gradient of the ring velocity of the ether, multiplied by the size of the electron. Hence the physical meaning of the electric induction D can be determined as the amount of the ring motion of the ether in/per unit volume:

$$D = \varepsilon_0 E = \rho_э \int_0^b (\partial v_п / \partial r) dr. \qquad (8.42)$$

For an electron moving in the free space in the direction of the force E, sinα = 1 (the main axis of the electron coincides in direction with the direction of the axis of the electric field tube). Since the pressure is the potential energy proportional to the square of the velocity of the molecules, the force acting on the element of the electron will decrease by an amount proportional to the square of the relative velocity of the electron v_q to the velocity of propagation of the circular motion in the free medium, the speed of light *c*, i.e. by the amount $(v_q/c)^2$, therefore,

$$E = E_0 [1 - (v_q/c)^2] \qquad (8.43)$$

and at the particle velocity equal to the speed of light, i.e. for v_q = c, E = 0, no matter how (much) the value of Eo varies.

The latter means that as the velocity of the particle approaches the speed of light, the force acting on the particle decreases, in the same way as with a decrease in the slipping(/sliding?) of the rotating magnetic field relative to the rotor in an asynchronous machine decreases the torque developed by the rotor. This can in principle explain the fact that it is impossible to accelerate a charged particle by the electric field of any, the greatest possible intensity to the speed of light, and not at all because the speed of light is in principle insurmountable.

In that way is obtained the expression for the electric field strength as force acting on a unit charge. Assuming that the rotational velocity of the vortex toroidal rings - the electrons - is constant, we find that the electric field strength is proportional to the strength of the vortex field, which is proportional to the number of tubes of the vortex field per unit area of the field.

If in the free space the electron is left to itself, then the electron, like any gaseous toroidal vortex, will start to accelerate in the direction of the flow/stream emanating from its central hole. However, unlike ordinary gas vortices, due to the special sparseness of the aether and a low coefficient of its viscosity, and also due to the fact that in the body of an electron the ether density is tens of orders higher than the ether density in free space, the time constant of the electron acceleration is very large and amounts to tens and hundreds of years. This explains the nature of the cosmic rays, but under the conditions of the usual experiment the electron remains practically immobile, since its surface area is small, the viscosity of the aether is also small, and therefore the repulsion force of the electron from the surrounding medium is small, and the acceleration time is correspondingly large.

8.2.6. The physical essence of an electric current in a metal

In the absence of an electric field, electrons in the metal perform a chaotic (unordered) thermal motion and have a chaotic, i.e., uniformly distributed orientation in space.

Under the influence of an electric field, the chaotic motion of electrons in a conductor is somewhat ordered. This ordering manifests itself in two ways: firstly, during the free movement-path, the electrons begin to orientate along the field, that is, the direction of their axes acquires a common component along the direction of the electric field; secondly, the electrons acquire some acceleration in the general direction along the field, increasing the velocity and thereby their kinetic energy. Therefore, in spite of the fact that the collisions of electrons with the electron shells of the conductor atoms anew disorient them, a stream of electrons is formed on the whole, already having a certain common/general orientation along the direction of the electric field (Fig. 8.4).

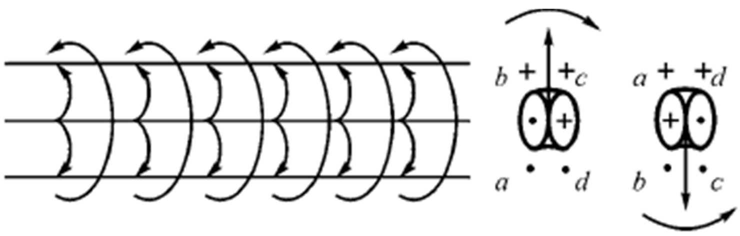


Fig. 8.4. Orientation of electron spins along an electric field.

This orientation of electrons gets lost after each collision with the surfaces of the metal molecules, but then partially restored during the run time between collisions. As a result, on the average, the entire set of electrons in the metal is displaced along the axis of the conductor and, in addition, turns out to be unfolded at some common angle with respect to the plane perpendicular to the axis of the conductor. The magnitude of this angle can be determined on the basis of the features of the structure of the magnetic field that arises around the conductor when an electric current passes through it.

The magnitude of the current flowing through the conductor will be

$$I = eNSv_q = edn/dt = dq/dt, \qquad (8.44)$$

where e is the electron charge equal to $1.6 \cdot 10^{-19}$ Coulombs; N is the number of electrons per unit volume of the conductor; S – the conductor's cross-section; v_q - velocity of electron displacement along the axis of the conductor; n is the number of electrons in charge q flowing through the conductor cross-section.

The velocity of electrons moving along the wire through the cross section $S_{пр}$ is determined by expression

$$v_{пр} = \frac{I}{eNS_{пр}}. \qquad (8.45)$$

If we assume that the number of electrons *N* in a conductor is equal to the number of metal atoms, then the unit volume contains about 10^{30} m^{-3} electrons, hence, the average distance between electrons is d = 10^{-10} m and for a conductor cross section in *Spn* = 1 mm^2, we obtain that in its cross section are contained $n_s = 10^{14}$ electrons, which corresponds to the charge

$q_п = n_s \cdot e = 10^{14} \cdot 1{,}6 \cdot 10^{-19} = 1{,}6 \cdot 10^{-5}$ Кл. (Coulombs)

At a current of 1 A through a cross section of the conductor in 1 sec, a charge of 1 Coulombs has to pass, and therefore 6.25 * 10^4 charges $q_п$. Taking into account that the average distance between electrons is 10^{-10} m, we obtain the average velocity of electrons moving along the conductor

$$v_{e\,пр} = d\,q_п = 10^{-10} \cdot 6{,}25 \cdot 10^4 = 6{,}25 \cdot 10^{-6} \text{ м/с} = 6{,}25 \text{ мкм/с}.$$

The electric field strength E is the force acting on a unit electric charge. The force acting on an electron is defined as the product of E·e, where e is the electron charge. Under the action of this force, an electron having a mass m will acquire the acceleration equal to

$$a = Ee/m \qquad (8.46)$$

and during the time *Δt* between collisions with the surfaces of atoms it will acquire an additional speed *Δv*. If *λ* is the distance traveled by the electron between two collisions and $v_{t.cp}$ is the electrons velocity, then the value of this time interval will be equal to

$$\Delta t = \lambda \,/\, v_{тср}; \qquad (8.47)$$

The conductivity of the conductor is the larger the higher the charge concentration per unit volume of the metal, the larger the charge quantity and the higher the mobility of the charge, that is, the increment of the velocity related to the force acting on the charge,

$$\sigma = Neм;\;\; м = \Delta v_q/E;\;\; \Delta v_q = a\Delta t = \frac{Ee\,\lambda}{m\,u}, \qquad (8.48)$$

and consequently

$$\sigma = \frac{Ne^2 \lambda}{mu}. \tag{8.49}$$

The above formula for calculating the conductivity of metals was first deduced/derived by Drude in 1900 [26]. However, it should be noted that the very mobility of electrons depends on the density and viscosity of the ether in the van der Waals envelopes, within which a free electron moves.

Calculation of the mean free path of an electron in various metals on the basis of reference data gives a good agreement in the orders of magnitude with those expected in theory. So at a temperature of zero degrees Celsius for copper $\lambda = 2.65 \cdot 10^{-10}$ m; for aluminum $1,64 \cdot 10^{-10}$ m ; for tungsten $0,84.10^{-10}$ m; for bismuth $3.7 \cdot 10^{-13}$ m. The latter fact indicates a very small value of the interatomic space in bismuth, in which free electrons can move.

Acquiring additional kinetic energy, electrons with greater force hit the electronic shell of the atoms of the conductor, which explains the increase in the temperature of the conductor when an electric current passes through it. And since the amplitude of the vibrations of the surface of the electron shell of atoms increases, the number of collisions of electrons with atoms increases, which is the reason for the increase in electrical resistance of the conductor when heated.

When the conductor is heated up, its resistance increases due to the increase in the amplitude of the vibrations of the electron shells of atoms and the decrease in the mean free path of the electrons in connection with this. For copper, the relative reduction in the mean free path is $4.33 \cdot 10^{-3}$ K^{-1}, for aluminum - $4.6 \cdot 10^{-3}$ K^{-1}, and with a temperature change by 10 degrees the mean free path of electrons is $2.54 \cdot 10^{-10}$ m and $1.56 \cdot 10^{-10}$ m, respectively.

The current density flowing along the conductor is determined from expression

$$j = Ne\Delta v, \tag{8.50}$$

since it is proportional to the voluminous density of electrons in the metal, the value of the elementary charge, and the average velocity of electrons along the axis of the conductor. Substituting the corresponding values of the quantities, we obtain:

$$j = \frac{Ne^2 \lambda}{mu} E = \sigma E, \tag{8.51}$$

which expresses Ohm's law in differential form.

Multiplying the left and right sides of the expression by the volume of the conductor $V = SL$, where S is the cross-sectional area of the conductor and L is its length, we obtain

$$jSL = \sigma ESL. \tag{8.52}$$

Since the (value/intensity) of current in the conductor is

$$I = jS, \tag{8.53}$$

and the voltage (tension, potential difference?) drop across the conductor is

$$U = EL, \tag{8.54}$$

we get

$$I = \sigma \frac{US}{L} = \frac{U}{R}, \tag{8.55}$$

where

$$R = \frac{1}{\sigma}\frac{L}{S} = \frac{\rho L}{S} \tag{8.56}$$

is an active resistance of the entire conductor, and $\rho = 1 / \sigma$ is its specific resistance.

The power spent on creating a current in the conductor will be:

$$P = F\Delta v V, \tag{8.57}$$

where $F = EeN$ is the force acting on the electrons; Δv is the electrons velocity increment; $V = SL$ is the volume of the conductor. Substituting the corresponding values, we obtain

where U - voltage drop on the conductor, I - current in the conductor.

This expression reflects the amount of the active power that must be expended in a conductor having a resistance R for passing the current I. That power is expended on the heating of the conductor and does not return back to the circuit.

The mechanism of superconductivity can also be considered from the foregoing stand-points.

As the temperature decreases, not only the thermal velocity of the electrons themselves decreases, but also the amplitude of the waves on the surfaces of the electron shells of the molecules. Starting with a certain value, the electrons of the metal, trapped in the tubes of electric tension, can not overcome the retarding force of the gradient flows of the tubes and cease to interact with the electron shells of the atoms. The resistance disappears.

All of the above does not explain why the motion of electrons along the conductor is accompanied by a magnetic field around it. But for this it is first necessary to conceive the essence of the magnetic field itself.

8.2.7. The physical essence of the magnetic field

The specific energy of the magnetic field is

$$w_м = \frac{\mu_o H^2}{2} = \frac{B^2}{2\,\mu_o} = \frac{\varepsilon_o c^2 B^2}{2} = \frac{\rho_э (Bc)^2}{2}, \text{ Дж/м}^3, \qquad (8.59)$$

(Joules per m^3)

where μ_o is the magnetic permeability of vacuum; H is the intensity/strength of the magnetic field; B is the magnetic induction; ε_o is the permittivity of vacuum, $\rho_э$ is the ether density in 'vacuum', and c is the speed of light. From this it is immediately evident that the magnetic induction B must formally be dimensionless. In fact, the magnetic induction is not at all dimensionless, but (it) is the ratio of the velocity of the ether flow, $v_п$, in the structure of the magnetic field lying in the *xy*-plane, to the speed of light, i.e. to the speed of the second sound in the aether in the z direction. These two speeds are perpendicular to each other, and they cannot be reduced in a ratio(nal?)-expression:

$$B = \frac{v_м}{c}, \text{ м}_{xy}/\text{м}_z . \qquad (8.60)$$

In such way, *the physical essence of magnetic induction is the velocity of the aether flow in the structure of the magnetic field, expressed in fractions of the speed of light.*

Since the strength of the magnetic field is

$$H = B/\mu_o, \qquad (8.61)$$

then

$$H = v_м/\mu_o c = \rho_э v_м c. \qquad (8.62)$$

From this it is seen that *the physical essence of the intensity of the magnetic field is the translational velocity of the ether density in the structure of the magnetic field, i.e. the specific amount of ether movement* – the specific moment/impulse of aether (?!). (*Looks as doubled aether specific kinetic energy !?! – remark by SN*)

From the obtained expression it can be directly determined:the rate of ether flow in the structure of the magnetic field corresponding to the value of the magnetic field strength of 1 A / m as:

$$v_м = H/\rho_э c = 1/\ 8{,}85 \cdot 10^{-12} \cdot 3 \cdot 10^8 = 376{,}65\ м.с^{-1}. \qquad (8.63)$$

To the value of the magnetic induction of 1 Tesla corresponds the ratio of the velocity of the ether stream to the speed of light (of)

$$\mathrm{B} = \mu_0 H = 4\,\pi 10^{-7} = 1{,}256 \cdot 10^{-6}\ м_{хл}/м_z \qquad (8.64)$$

A conductor of 1 mm^2 cross section has a radius of $r_{пр}$ = 0.564 mm, its surface area is 3.54 × 10^{-3} m^2. On one electron of the conductor comes (the cross-sectional) surface area of 3.54 × 10^{-27} m^2, which exceeds the (the cross-sectional) conductor area by

$$\frac{3{,}54 \cdot 10^{-27}}{2{,}75 \cdot 10^{-32}} = 1{,}4\ .10^5\ раз.$$

(times)

If the electron were oriented with its plane parallel to the plane of one of the (cross-)sections of the conductor surface, then this would correspond to the velocity of

$v_{пов} = v_e/1{,}4 \cdot 10^5 = 1{,}64 \cdot 10^{24}/1{,}4 \cdot 10^5 = 1{,}17 \cdot 10^{19}\ м.с^{-1}$. ($v_{пов}$ meaning v_{areal})

If a current flowing through(/over?) the conductor in 1 A, then on its surface arises/appears a magnetic field, the intensity of which is

$$H = \frac{i}{2\pi r_{пр}} = \frac{10^3}{2\pi \cdot 0{,}564} = 282\ А/м, \qquad (8.65)$$

which corresponds to the speed of 1,06215 · 10^5 m/s.

And this means that the electrons are reoriented only by an angle of

$$\alpha = \frac{2 \cdot 1{,}06215 \cdot 10^5}{1.17 \cdot 10^{19}} = 1{,}8 \cdot 10^{-14}\ рад.$$

As shown in the previous paragraph, under the influence of the electric field, all the electrons, in whatever position they are, unfold/reorient their axes so that some common component of the projections of their spins on the axis of the conductor is/gets formed (Figure 8.5).

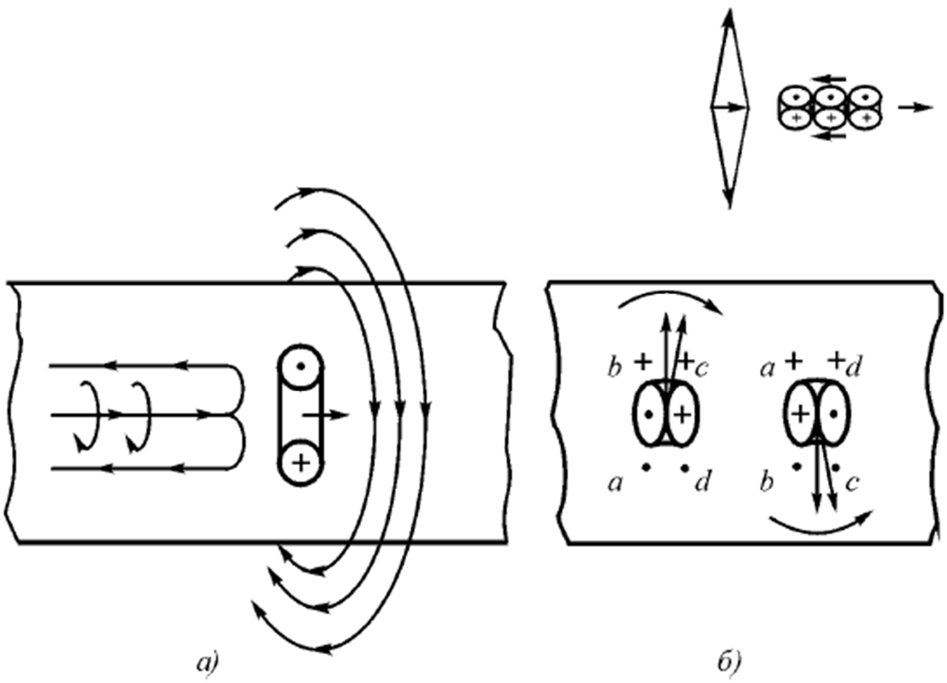


Fig. 8.5. Formation of a magnetic field around the conductor: *a* - orientation of the spin vector of the electron parallel to the axis of the conductor; *б* - summation of helical flows outside the conductor.

With respect to any portion of the surface of the conductor, half of the electrons are turned to this surface, half to the opposite surface, so that the circulation from each pair of electrons will give a total circulation whose axis will be oriented along the conductor.

Outgoing from the fact that when moving through space no additional magnetic fields are detected, as confirmed by specially set-up experiments, and also taking into account the experience of Oersted who showed that the magnetic needle gets positioned perpendicularly to the conductor with current, the practically uniquely possible structure of the magnetic field line gets established as a tube in which the aether flows in one direction over the surface, and inside the tube it returns in the opposite direction, while the tube itself rotates, so that on its surface ether flows through the helix-line with/under an angle of 45 ° w.r.t. to the tube's axis. Thereby, since the formation of the magnetic field line is made by electrons, which themselves are helical toroids, as the most likely structure of the magnetic field force-line appears/arises a set of helical toroids. The interaction of the helical flows of the aether is shown in Fig. 8.6.

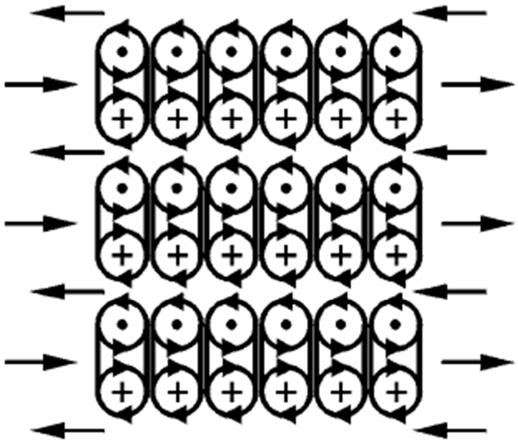


Fig. 8.6. Structure of magnetic lines of force

In such way, the structures of the lines of force of the magnetic field and the electric field are in many respects identical, but they also have differences. The electric field has a source of screw motion in the head-end, and the magnetic field from the surface of the entire tube, so the magnetic tube can be structured into a set of helical/screw-like toroids, and the electric tube cannot. However, all that requires clarification/refinement(further elaboration).

From the expression

$$H = v_м/\mu_o c \tag{8.66}$$

and the law of total current

$$i = \int Hdl; \;\; H = i/2\pi R \tag{8.67}$$

it follows

$$v_м = \frac{i\mu_o}{2\pi R}, \tag{8.68}$$

and if in a material the velocity of the helical flow is higher, then

$$v_м = \frac{i\mu_o\mu}{2\pi R}, \tag{8.69}$$

where μ is the relative velocity of the ether flow in the material compared to the density of the same flow in vacuum.

The change in the speed of the ether flow in the material is provided by a change in the orientation of the domains, which by flows located on their periphery either increase the total flow velocity (paramagnetics and ferromagnetics) or reduce it (diamagnetics).

Let's compare (this?) with the dependence obtained the law of Ampere for the force interaction of conductors:

$$dF = \frac{\mu_0\mu\, i_1 i_2}{2\pi R} dl \qquad (8.70)$$

and present it in the form

$$\frac{dF}{dl i_2} = \frac{i_1 \mu_0 \mu}{2\pi R}, \qquad (8.71)$$

wherefrom is visible/seen the complete identity of the expressions for the speed of the helical aether flow and the Ampère's law of the force interaction of the conductors.

As follows from the law of total current, a decrease in the intensity/strength of the magnetic field around a rectilinear current conductor must occur according to a hyperbolic dependence and, consequently, the ratio of the strengths must correspond to the expression

$$H_1/H_2 = R_2/R_1, \qquad (8.72)$$

where R2 and R1 are, respectively, the distance from the center of the conductor to the points of measurement of the magnetic field strengths. However, the ether is compressible, hence, for a magnetic field this circumstance should have an appreciable effect. The above relation is valid only for small values of the magnetic field strengths, for which its compression can be neglected. With the increase in tension/intnsity, deviations from this law should be observed. This circumstance was the subject of experimental studies, which confirmed this assumption.

If the magnetic field has the compressibility property, then the above dependence must be violated, the more the greater the tension/voltage or current flowing in the conductor. By analogy with a compressible liquid, this can be explained in the following way: the liquid emerging from the turntable (Figure 2.5 at the top) is under a greater voltage than the liquid at some distance from the turntable. This means that, as you move away from the turntable/whirligig/propeller, the liquid will expand and add/convert its energy into motion, that is, the velocity of the compressible fluid far from the center will be greater than (would be) velocity of the incompressible fluid.

In Fig. 8.7 shows the experimental dependences of the ratio *H/Ho* on the relative distance to the center of the conductor for different current values.

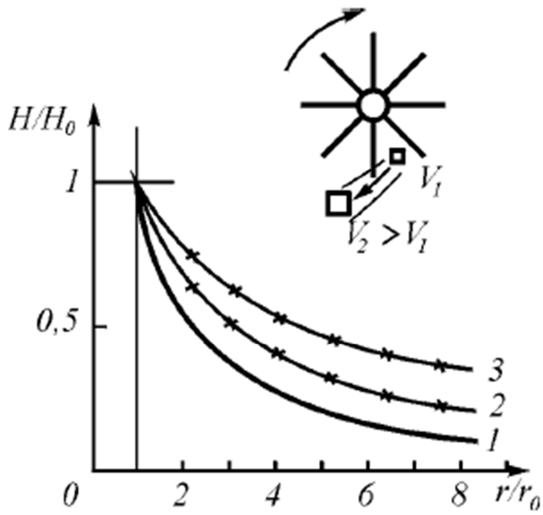


Fig. 8.7. Experimental studies of the law of total current:

a - mechanical analogy (the upper part, not marked-up – SN) - change in the flow velocity of a compressible fluid driven by a turntable with blades; *б* (the lower part, not marked-up – SN) -change in the strength of the magnetic field as a function of the distance from the axis of the conductor; 1 - theoretical curve, calculated from the condition of constant magnetic field circulation; 2 - experimental results for a current I = 1 A; 3 - experimental results at a current I = 10 A. Measurements were carried out at frequencies of 50, 400 and 1000 Hz

As can be seen from the measurement results, as the current in the primary conductor increases, the deviation of the magnetic field strength from the value determined by the total current law becomes larger. With increasing distance from the conductor, i.e., with a decrease in the absolute value of the magnetic field strength, the dependence of the decrease in the magnetic intensity approaches the hyperbolic, defined by the total current law, and the more so, the lower this ‘tension’. At the same time, it would seem that the role of edge effects would have to increase, but in practice it has turned out that the edge effects are/get leveled off.

The interpretation of the magnetic field strength as the laminar flow rate of the ether can cause certain objections.

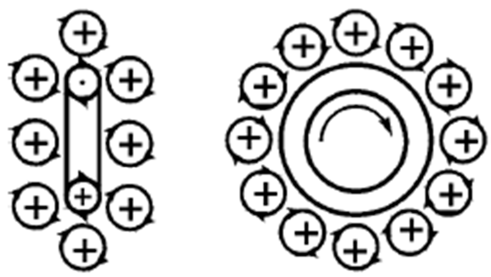
Firstly, as is known, Maxwell preferred to treat the magnetic field not as a translational motion, but as a rotational motion in connection with the Faraday magnetic field property to rotate the plane of light polarization in some crystals. However, Maxwell did not take into account that the gradient of the translational velocity of the aether can have the same effect.

Secondly, the magnetic field is not necessarily a purely translational movement of the aether. It may contain a component of rotation, and in different physical phenomena the relationship between the spins of the translational and rotational movements may be different. This possibility requires a separate consideration, but this variant will not contradict neither the above ideas about the electric field as a set of helical tubes with a screw-factor that is varying over cross-section, nor the stated ideas about the strength of the magnetic field as the speed of the translational motion of the aether. Nevertheless, such modeling will allow us to (be) accurate(ing) the concept of the physical nature of the magnetic field and its manifestations in different phenomena.

8.2.8. Free electron in a magnetic field

Let us consider the behavior of an electron in a magnetic field. The magnetic field alone can not in any way affect the orientation of the electron due to the mutual balancing of all forces acting on the electron from the field side, regardless of the structure of the magnetic field itself and the predominance of the circular or translational component of the ether movement in it. (*This might be very relevant for the explanation of the Faraday's monopolar induction, in particular regarding explanation of the situation when there is no induced 'EMF'/current in situation when only the cylindrical magnet is rotating – remarked and underlined by SN.*)

In fact (Figure 8.8), in region 1 (*apparently,* а) *- SN*), attraction of vortices takes place due to ether flows in the plane of the figure, but repulsion due to the rotation of the gas, since the direction of the conjugate gas flows is the same - to the side perpendicular to the plane of the figure. In region 2 (*apparently,* б)*- SN*), all the opposite: the repulsion of the vortices occurs due to the rotation of the aether streams in the plane of the figure, and the attraction due to the opposite direction of the gas movements in the plane perpendicular to the plane of the figure. Thereby, the components of the forces caused by the translational motion of the aether are balanced with each other, just as are the components of forces caused by the rotational motion of the aether are also balanced with each other.



а) б)

Fig. 8.8. Equilibration of the pressures acting on an electron in a magnetic field

The situation changes significantly if an external force, for example an electric field, gives the electron translational motion with a velocity v. In this case, to the velocity of the ether flow $v_п$ over the surface of the ring is added the velocity of the translational motion of the electron. The difference in velocities lying in the plane of the drawing in region 1 (*apparently, а) - SN*) is

$$\Delta v_1 = v_e + v_п + v, \tag{8.73}$$

and in region 2 (*apparently, б)- SN*), respectively

$$\Delta v_2 = v_e - v_п + v. \tag{8.74}$$

The squares of them are, respectively, equal

$$(\Delta v_1)^2 = v_e^2 + v_п^2 + 2v_e v_п + v^2 + 2v_e v + 2v_п v; \tag{8.75}$$

$$(\Delta v_2)^2 = v_e^2 + v_п^2 - 2v_e v_п + v^2 + 2v_e v - 2v_п v. \tag{8.76}$$

The difference of the squares of velocities in the direction perpendicular to the plane of the figure is, respectively,

$$\Delta v'_1 = v_e - v_п; \ \Delta v'_2 = v_e + v_п. \tag{8.77}$$

Here, the squares of the velocity differences are

$$(\Delta v'_1)^2 = v_e^2 - 2v_e v_п + v_п^2; \tag{8.78}$$

$$(\Delta v'_2)^2 = v_e^2 + 2v_e v_п + v_п^2; \tag{8.79}$$

The sum of the squares of velocities in each region will be

$$(\Delta v_1)^2 + (\Delta v'_1)^2 = 2v_e^2 + 2v_п^2 + v^2 + 2v_e v + 2v_п v; \tag{8.80}$$

$$(\Delta v_2)^2 + (\Delta v'_2)^2 = 2v_e^2 + 2v_п^2 + v^2 + 2v_e v - 2v_п v; \tag{8.81}$$

and their difference is

$$[(\Delta v_1)^2 + (\Delta v'_1)^2] - [(\Delta v_2)^2 + (\Delta v'_2)^2] = 4\, v_п v. \tag{8.82}$$

In accordance with the Bernoulli's equation, we have

$$P = \rho_э C - \rho_э v^2/2 \tag{8.83}$$

and, consequently

$$\Delta P = 2\rho_э v_п v. \tag{8.84}$$

The force acting on the equivalent surface of the electron $S_{экв}$ is determined as

$$F = \Delta P S_{экв} = 2\rho\, S_{экв}\, v_п v = [Bv], \qquad (8.85)$$

which corresponds to the Lorentz's law for an electron moving in a magnetic field. In this case, as can be seen from Fig. 8.9, the direction of the force is perpendicular to the direction of motion of the electron.

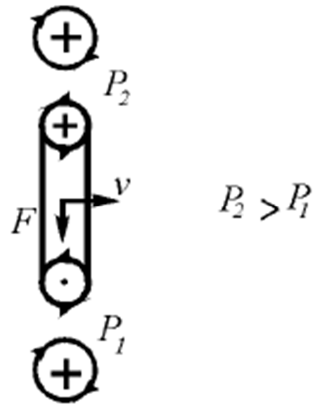


Fig. 8.9. The appearance of a deflecting force during the motion of an electron in a magnetic field

8.2.9. Inductance. Mechanism of self-induction phenomenon

The adjoined ethereal streams are likened to a compressed spring, which stores the potential energy and tends to move the electrons away from each other. In this case, the pressure increment will be proportional to the magnitude of the current passing through the conductor.

For a solenoid such a pressure will be proportional to the number of ampere-winds *iw* per its unit length *l* :

$$p = \frac{iw}{l}. \qquad (8.86)$$

In the system of MLS units, the unit for current *i* is [kg·s^{-2}], for the length *l* is [m] and, therefore, the pressure unit of the adjoined jets is [kg·m^{-1}·s^{-2}] or [N] (Newton) that is, the same as for ordinary pressure.

The work done when compressing the adjoined ether streams is defined in the same way as the work done when compressing an ordinary spring. If for a conventional spring the force of compression is proportional to the deformation,

$$F = kx, \qquad (8.87)$$

where *k* is the elasticity coefficient, and the work performed is determined by the expression

$$W = \int_{o}^{x_o} F dx = \frac{kx_o^2}{2} = \frac{F_o^2}{2k}, \qquad (8.88)$$

where F_O is the compression force of the spring, then for compressed ether flows on an unit length of the solenoid we will have

$$w = \frac{p^2}{2k} = \frac{k'}{2} \cdot \frac{(iw)^2}{l^2} \qquad (8.89)$$

Comparing the expression obtained with the known expression for the energy of a solenoid

$$w = \frac{\mu\,(iw)^2}{2\ l^2}, \qquad (8.90)$$

we find that the physical meaning of the magnetic permeability of vacuum corresponds to the coefficient of elasticity of the aether.

In the presence of iron in the core of the coil, the magnetic field created by the coils of the solenoid - the ordered streams of the aether - spends its energy on the declinations of domains - the conglomerates of iron molecules. Such conglomerates in the core are in an unordered position, oriented in space in all possible directions relatively evenly. But under the influence of a magnetic field - the ordered ring-like streams/flows of ether resulting from the ordered orientation of electrons in the current carrying wire, - the domains also unfold and form the magnetic field of the core. <u>Here already/though the magnetic field is a set of helical vortex tubes, and its structure is thus different from the magnetic field created by the current. (</u>*This might be of importance for the 'anomalous' Faraday-induction explanation - SN*)

Thus, there is a successive chain of events: the electric field in the conductor of the coil of the solenoid causes the conductor electrons to unfold by the main axes in the direction of the axis of the conductor, thereby creating flows of ring-like aether motion around the conductor. Aether flows penetrate into the iron core and force the domains to unfold in the common direction, respectively, so that the axes of the helical magnetic field tubes created by the domains are oriented partially in the common direction, perpendicular to the direction of the external flow acting on them.

Since each such helical tube is tied with a corresponding domain being in connection with the rest of the core material, these bonds get strained like a spring, and if the external flow disappears, they will return the domain to its original position. The magnetic field created by the core will disappear. This is the case with soft the magnetic material.

For magnetically hard material, the situation is different. If the resistance of the domain bonds in the material can be overcome by an external flow, then they may not return the domain to its original state. Then the magnetic field will be preserved even after the current has been cut off from the coil of the solenoid.

But the simplest way of weakening the bonds of domains with the material is, as is known, heating the magnetically solid material until it melts. Then the external magnetic field easily directs the domains in the due direction, and then, after cooling of the material, intermolecular bonds fix the domain in that position. The material becomes a permanent magnet.

If there is iron in the solenoid's throttle, the total stored energy of the magnetic field will be proportional to the volume of iron:

$$W = \frac{\mu \mu_0 (iw)^2}{2 \quad l_ж{}^2} V_ж. \qquad (8.91)$$

Since the volume of the solenoid/choke's iron is $V_ж = S_ж l_ж$, where $S_ж$ is the cross section of the core, and $l_ж$ is the length of the magnetic field line in the core, we get

$$W = \frac{\mu \mu_0 (iw)^2}{2 \quad l_ж{}^2} S_ж l_ж, \qquad (8.92)$$

where μ is the relative magnetic permeability of iron. After the ‘cross-cancelling’ we will have:

$$W = \frac{\mu \mu_0}{2} S \frac{(iw)^2}{l_ж} = \mu \mu_0 \frac{Sw^2 i^2}{2} = L \frac{i^2}{2} , \qquad (8.93)$$

where

$$L = \mu \mu_0 \frac{Sw^2}{l_ж} = \frac{w^2}{R_м}; \quad R_м = \frac{l_ж}{\mu \mu_0 S_ж}. \qquad (8.94)$$

Here, $R_М$ is the magnetic resistance of the core.

In this way, the simple formula for the inductance of a coil with an iron core is obtained.

From the foregoing it is clear that the role of the iron core in the inductance reduces to the fact that the reactive energy of the magnetic field is stored in it. But in order to create this energy in it, it is necessary to do the work, i.e., to make the rotation/sway-away of the domains of the iron core and, for this, to overcome the elastic resistance of their bonds. This work is done by increasing the pressure in the space between the conductor and the iron. This very pressure is created by an electric current flowing over/through(?) the conductor. Therefore, the total stored energy is proportional to the square of the current.

The ring-like (circular) movement of the aether around the conductor is perceived as a magnetic field. The energy of the translational velocity of the ether around the conductor, which does not have an iron core, is the energy of this field. If there is an iron core, then the potential energy of the elastic rotation of the core domains is added here. The entire system is stressed and held in a state of tension of the conductor's electrons turned in a common direction along the axis of the conductor. The electrons themselves are kept in this state by the electric field strength.

If the electromotive force in the conductor disappears, then the cause that holds the electrons in the commonly oriented direction disappears as well as the pressure that holds the streams/flows in the stressed state. Equilibrium is broken, and the whole process turns in the opposite direction. Now external streams of aether press on internal, and lines of a circular current of an aether, being reduced, enter into a conductor. Their energy is spent on increasing the thermal velocity of the electrons of the conductor. This is the mechanism of self-induction. (*Those vortexes do not necessarily enter the conductor, but rater move around/along it, SN !?!*)

The reverse process leads to the fact that the EMF on the conductor, created by the aether flows moving inside the conductor, acquires the opposite sign; this EMF will be proportional to the stored inductive energy, i.e. to the value of the inductance, and if the current does not break off immediately, then the electrons of the still preserved current continue to hold part of the pressure. Thus, at a qualitative level, a well-known formula for the EMFof self-induction can be justified: (*At this place, I am not sure if – by abrupt change - the flow would not have same direction(for example, the induction coil and/orTesla's Magnifying Tranmitter'principles' - SN?*)

$$e = -L\, di/dt. \qquad (8.95)$$

8.3 Electromagnetic interactions

8.3.1 Force interaction among conductors with current.

As is known, when over two parallel conductors currents flow in the same direction, the conductors experience mutual attraction, or repulsion - if the directions of currents are opposite. In accordance with the Ampère's law, the force of interaction of parallel conductors with a current in a vacuum is given by

$$F = -\mu_o \frac{I_1 I_2 l}{4\pi d}, \qquad (8.96)$$

where $\mu_o = 4\pi \cdot 10^{-7}$ Gн $\cdot$ m^{-1} is the magnetic permeability of vacuum; I_1 and I_2 - the magnitude of the currents in the first and second conductors; l - length of conductors; d is the distance between their axes.

The given well known expression corresponds to the experimental data, does not however express the physical essence of the interaction of the wires with current. To understand the physical essence, let us consider the interaction of two electrons -the compacted toroidal vortex helical rings of a spherical shape, located each in one of two wires arranged parallel to each other.

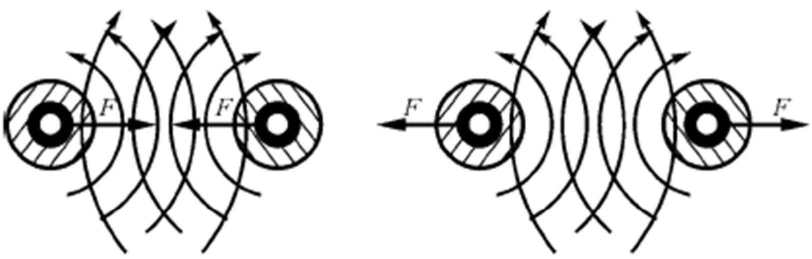
An electron within the first wire unfolds under the influence of the toroidal component of the electric field motion, so that the main axis of the electron is at an angle to the longitudinal axis of the wire smaller than π / 2. For simplicity of inference, we assume that the principal electron axes and the axis of the wires coincide in direction, while the actual rotation angle will be taken into account in the future.

In accordance with the Biot-Savart law, the toroidal component of the helical velocity of the aether flow decreases in proportion to the cube of the distance, and the circular component in accordance with the Gauss theorem is proportional to the square of the distance. Therefore, in the sequel the toroidal component of the velocity is not accounted for, and we can assume that the interaction of electrons is realized only under the influence of the ring component of the aether flows around the electrons.

The velocity of electrons displacing along the wire - at constant current intensity I, A, of the cross section of the wire $S_{\text{пр}}$, of the content of free electrons in the metal N, m^{-3}, with the charge of one electron e - is:

$$v_{\text{епр}} = \frac{I}{eNS_{\text{пр}}}. \qquad (8.97)$$

The physical interaction between conductors is due to the fact that the electrons aligned in space create helical aether streams around the conductors, which are manifested as a magnetic field of currents (Fig. 8.10).



а) б)

Fig. 8.10. Interaction of electrons in parallel conductors: *a* - when currents flow in one and the same direction; *б* - when currents flow in opposite directions. *(direction of arrows related to M-field of the left-most conductor on the left-hand side figure has to be reversed … remark by SN)*