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Abstract- Near the conductor, along which flows the current, are formed electrical induction fields, these fields are formed is only is when to the conductor applied a potential difference and charges in it are accelerated. But, unfortunately, physics of this process is not thus far clear. In the work on the basis of the concept of scalar- vector potential is revealed the physical mechanism of formation fields on inductions.

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I. Introduction

Near the conductor, along which flows the current, are formed electrical induction fields, these fields are formed is only is when to the conductor applied a potential difference and charges in it are accelerated. But, unfortunately, physics of this process is not thus far clear. In our view, the reason for this state of affairs consists of the imperfection of very equations of Maxwell. Is exponential quotation from [1]: but "in what does consist the basic initial reason for the discrepancy of the built by Maxwell electrodynamics? For the single-valued answer to this question… it should be noted that even in its time of amperes, Grossman, Gauss, Lentz, Neumann, Veber, Riemann and other they stood on the point of view, that, without being turned to the concept "of magnetic field", any magnetic interactions can be reduced to usual interactions of current elements or moving charges… in the electrodynamics repossessed then the point of view of Faraday and Maxwell, that the electrical and "magnetic" fields are the independent physical essences, although connected together. In the prevailing then historical situation given, erroneous from a physical point of view, assumptions predetermined by themselves entire further motion of the development of electrodynamics with the deliberately placed into it insoluble contradictions and the paradoxes". And further there: "for the non contradictory reflection of the physical essence of the laws of electromagnetism necessary to completely forego any concepts "magnetic field" as certain independent physical essence… for determining the forces of interaction of moving in the physical vacuum of real space electric charges completely sufficient to consider the deformation of electrical fields on these charges, caused by the trivial effects of the being late potentials… To there remains only be surprised at the sagacity of the ampere, which warned that if we in the electrodynamics do not forego ourselves the concept "magnet", then subsequently this threatens by incredible confusion in the theory".

As already mentioned, in the classical electrodynamics be absent the rule of the conversion of electrical and magnetic fields on upon transfer of one inertial system [IRS] to another. The special theory of relativity (STR) removes this deficiency, substituting the conversions of Galileo by the Lorenz transformation, whose physical essence with the entire mathematical validity is not explained [2]. However, specialists (first of all, by experimenters) discovered, that the classical electrodynamics and STR, in spite of already more than 100- summer myth, are located in the contradiction to each other [3,4]. However, contemporary experiences on the measurement of the speed of light in one direction (but the not averaged speed "back and forth" as, for example, in Fizeau's experiments and to them analogous) [5] contradict postulate STR about the constancy of the speed of light and is brought into question the physical validity of the Lorenz transformation.

II. Concept of Scalar- Vector Potential

The fields, which are created in this IRS by moving charges and moving sources of electromagnetic waves, we will call dynamic. Can serve as an example of dynamic field the magnetic field, which appears around the moving charges.

By the first step in the direction of the location of the physically substantiated ways of obtaining the conversions fields on and the determination of dynamic potentials appeared the introduction of the symmetrical laws of the magnetoelectric and electromagnetic induction [6, 7]. They are obtained within the framework the conversions of Galileo with the use in the equations of induction by the substantional derivative and are written as follows [8-12]:

$$\oint \mathbf{E}'d\mathbf{l}' = -\int \frac{\partial \mathbf{B}}{\partial t}d\mathbf{s} + \oint [\mathbf{v}\times\mathbf{B}]d\mathbf{l}', \qquad (2.1)$$

$$\oint \mathbf{H}'d\mathbf{l}' = \int \frac{\partial \mathbf{D}}{\partial t}d\mathbf{s} - \oint [\mathbf{v}\times\mathbf{D}]d\mathbf{l}'$$

or

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$$rot\mathbf{E}' = -\frac{\partial \mathbf{B}}{\partial t} + rot[\mathbf{v}\times\mathbf{B}]$$
$$rot\mathbf{H}' = \frac{\partial \mathbf{D}}{dt} - rot[\mathbf{v}\times\mathbf{D}] \qquad (2.2)$$

For the constants fields on conversions (2.2) they take the form:

$$\mathbf{E}' = [\mathbf{v}\times\mathbf{B}]$$
$$\mathbf{H}' = -[\mathbf{v}\times\mathbf{D}] \qquad (2.3)$$

In relationships (2.1-2.3), which assume the validity of the Galilei transformations branded and not branded values present fields and elements in moving and fixed IRS respectively. Previously conversions (2.3) were derived only from the Lorenz transformation.

The laws of induction (2.1)–(2.3) do not indicate the reason for appearance fields on in initial fixed IRS, but is described only propagation fields on their conversions upon transfer to another IRS. Of relationship (16.3) attest to the fact that in the case of relative motion of frame of references, between the fields of and there is a cross coupling, i.e., motion in the fields of leads to the appearance fields on and vice versa. Consequences of (2.3) are for the first time examined in [13]. If in parallel to the axis of rod in its g electric field charged with the linear charge $E = \frac{g}{2\pi\varepsilon r}$ (r – distance from the axis of rod to the observation point) moves with IRS with speed Δv, that in it the additional magnetic field will appear $\Delta H = \varepsilon E \Delta v$. If we now with respect to already moving IRS begin to move third frame of reference with the speed Δv, then already due to the motion in the field ΔH will appear additive to the electric field $\Delta E = \mu\varepsilon E(\Delta v)^2$. This process can be continued and further, as a result of which can be obtained the number, which gives the value of the electric field $E'_v(r)$ in moving IRS with reaching of the speed $v = n\Delta v$, when $\Delta v \to 0$, and $n \to \infty$. In the final analysis in moving IRS the value of dynamic electric field will prove to be more than in the initial and to be determined by the relationship:

$$E'(r,v) = \frac{g\,\mathrm{ch}\frac{v}{c}}{2\pi\varepsilon r} = E\,\mathrm{ch}\frac{v}{c}.$$

The created by the moving point charge e transverse electric field (here and throughout this there is that component of the electric field of charge, whose tension is directed normally the charge rate in the same plane, at which the vector, which connects the moving charge and observation point lies) of signs the form:

$$E'(r,v) = \frac{e\,\mathrm{ch}\frac{v}{c}}{4\pi\varepsilon r^2},$$

where v - the velocity of charge.

The created by the same charge longitudinal electric field (here and throughout this is that component of the electric field of charge, whose tension it is collinear charge rate) on charge rate does not depend.

The scalar potential of transverse electric field takes the form:

$$\varphi'(r,v) = \frac{e\,\mathrm{ch}\frac{v}{c}}{4\pi\varepsilon r} = \varphi(r)\,\mathrm{ch}\frac{v}{c}, \qquad (2.4)$$

where $\varphi(r)$ - scalar potential of fixed charge. The potential $\varphi'(r,v)$ can be named scalar- vector potential, since it depends not only on the absolute value of charge, but also on speed and direction of its motion with respect to the observation point. The scalar potential of created by the same charge longitudinal electric field on charge rate does not depend. The electric fields, induced by the quickly moving charge, can be calculated also.

The same result for the charged rod can be obtained by another method. Let us write down the formulas of mutual induction fields on in the mobile frame of reference:

$$dH' = \varepsilon E' dv, \qquad (2.5)$$

$$dE' = \mu H' dv \qquad (2.6)$$

or, otherwise,

$$\frac{dH'}{dv} = \varepsilon E' \qquad (2.7)$$

$$\frac{dE'}{dv} = \mu H', \qquad (2.8)$$

where (2.7) it corresponds (2.5), and (2.8) it corresponds (2.6).

After dividing equations (2.7) and (2.8) on E, we will obtain respectively:

$$\frac{d(H'/E)}{dv} = \varepsilon\frac{E'}{E}, \qquad (2.9)$$

$$\frac{d(E'/E)}{dv} = \mu\frac{H'}{E}. \qquad (2.10)$$

Differentiating both parts (2.10), we have:

$$\frac{d^2(E'/E)}{dv^2} = \mu\frac{d(H'/E)}{dv}. \qquad (2.11)$$

After substituting (2.9) in (2.11), we will obtain:

$$\frac{d^2(E'/E)}{dv^2} = \mu\varepsilon\frac{E'}{E}. \qquad (2.12)$$

The function is the general solution (2.12) of differential equation

$$\frac{E'}{E} = C_2\,\mathrm{ch}\left(\frac{v}{c}\right) + C_1\,\mathrm{sh}\left(\frac{v}{c}\right), \qquad (2.13)$$

where C_1 , C_2 – arbitrary constants.

Since with $v=0$ must be made $E'=E$, that from (2.13) we will obtain:

$$\frac{E'}{E} = \mathrm{ch}\left(\frac{v}{c}\right) + C_1\,\mathrm{sh}\left(\frac{v}{c}\right).$$

Selecting $C_1 = 0$, we have:

$$E' = E\,\mathrm{ch}\left(\frac{v}{c}\right).$$

If we apply the obtained results to the electromagnetic wave and to designate components fields on parallel speeds IRS as $E_\uparrow$, $H_\uparrow$, and $E_\perp$, $H_\perp$ as components normal to it, then conversions fields on they will be written down:

$$\mathbf{E}'_\uparrow = \mathbf{E}_\uparrow,$$
$$\mathbf{E}'_\perp = \mathbf{E}_\perp ch\frac{v}{c} + \frac{Z_0}{v}[\mathbf{v}\times\mathbf{H}_\perp]sh\frac{v}{c},$$

$$\mathbf{H}'_\uparrow = \mathbf{H}_\uparrow,$$
$$\mathbf{H}'_\perp = \mathbf{H}_\perp ch\frac{v}{c} - \frac{1}{vZ_0}[\mathbf{v}\times\mathbf{E}_\perp]sh\frac{v}{c}, \qquad (2.14)$$

where $Z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}}$ - impedance of free space, $c = \sqrt{\frac{1}{\mu_0\varepsilon_0}}$ - speed of light.

Conversions (2.14) are usually called the Mende transformation[14]. A strict mathematical foundation they obtained in [14] within the framework the trans-coordinate formulation of Maxwell's equations [15], by that generalizing the traditional formulation of Hertz-Heaviside in the direction of more adequate passage from one IRS to another due to the improvement of the mathematical apparatus for differential calculus of the field functions within the framework of giperkontinualnykh ideas about the space and in the time [16], of those generalizing relativistic ideas.

III. The Formation of Electrical Fields on the Inductions

This concept makes it possible to obtain the laws of electro-electrical induction for the wave process not only in the free space, but also in the long line.

let us examine the diagram of the propagation of current and voltage in the section of the long line, represented in Fig. Voltage on incoming line grows from zero to its nominal value in transit time $t = \frac{z_2}{c}$, where z_2 – the length of the front of wave, i.e., the transition section, to which applied the voltage of the power source and in which the charges are accelerated from the zero speed to the values, necessary for creating the rated current in the line.

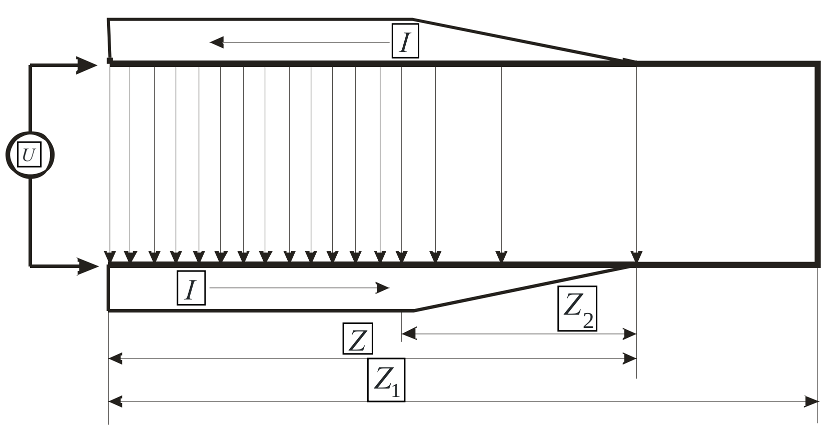

Fig. 1: Diagram of the propagation of voltage and current in the section of long line

This time depends on the law of an increase in the voltage on incoming line after the connection to it of the voltage source. Actually it can be any, but for simplicity let us accept its linear. Then in time Δt (in the line this transient process engages section $z_1 = c\Delta t$) stress it grows from zero (more to the right section z_1) to maximum final value U , and charge rate – from zero to

$$v = \sqrt{\frac{2eU}{m}},$$

where e and m – charge and the mass of current carriers.

The speed of current carriers in the section z_1 depends on coordinate (see Fig. 2):

$$v^2(z) = \frac{2e}{m}\frac{\partial U}{\partial z} z = \frac{2e}{m} E_z z,$$

where $E_z = \frac{\partial U}{\partial z} = \frac{U}{z_2}$ -field strength, which accelerates charges in the section z_1.

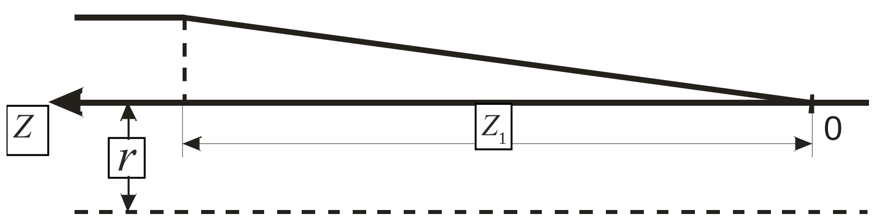

Fig. 2: Current wave front, which is extended in the long line

Scalar potential $\varphi(z)$ and the field strength E_z' r from the line let us at a distance write down, using only first two members of the expansion of hyperbolic cosine in the series (prime it here indicates the motion of field along the conductor of line with the speed of light):

$$\varphi(z) = \frac{e}{4\pi\ \varepsilon_0 r}\left(1 + \frac{1}{2}\frac{v^2(z)}{c^2}\right) = \frac{e}{4\pi\ \varepsilon_0 r}\left(1 + \frac{eE_z z}{mc^2}\right),$$

$$E_z' = -\frac{\partial \varphi(z)}{\partial z} = -\frac{e^2 E_z}{4\pi\varepsilon_0 rmc^2} = -\frac{ea_z}{4\pi\varepsilon_0 rc^2}, \quad (3.1)$$

where $a_z = \frac{eE_z}{m}$ – the acceleration, experienced by charge e in the field E_z'.

Thus, the charges, accelerated in the section of the line z_1, induce at a distance r from this section the electric field. Direction of the induced field and induction currents to the conversely inducing fields and to currents. The obtained law of electro-electrical induction is called to replace Farrday law as the fundamental law of induction, since passing field- mediators (magnetic field or vector potential) establish the reason for the appearance of induction electrical fields on around the moving charge it gives straight answer about the place of the application of force of interaction between the charges.

Equality (3.1) can be written down with the use of the vector potential A_H :

$$E_z' = -\frac{e}{4\pi\varepsilon_0 rc^2}\frac{\partial v_z}{\partial t} = -\mu\frac{\partial A_H}{\partial t},$$

from where, integrating by the time, we obtain the known determination of the vector potential:

$$A_H = \frac{ev_z}{4\pi r}.$$

Vector potential and magnetic field – is this the useful mathematical device of the solution of number of electrodynamic problems; however, fundamentals – scalar- vector potential.

IV. Conclusion

Near the conductor, along which flows the current, are formed electrical induction fields, these fields are formed is only is when to the conductor applied a potential difference and charges in it are accelerated. But, unfortunately, physics of this process is not thus far clear. In the work on the basis of the concept of scalar- vector potential is revealed the physical mechanism of formation fields on inductions.

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