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Is there a Magnetic Field and a Vector Potential of the Electric Field

By F. F. Mende

Abstract- The beginning to electrodynamics assumed such put outting themselves of physics as amperes, Faraday, Veber, Maxwell. These scientists on the primitive research equipment established those laws, which we use to the these rapids. They were geniuses and they could examine in the dark of prejudices and superstition the top of that huge iceberg, which the electrodynamics is. But those contradictions and disagreement, which occur in the electrodynamics and today, they speak, that not all problems are already solved. In Maxwell's equations is not contained the information about power interaction of the current carrying systems, but the Lorentz force, which defines such an interaction, it is introduced as hotel experimental postulate. Therefore electrodynamics itself consists as of two not connected together parts. From one side this of Maxwell's equations, which give the possibility to obtain wave equation for the electromagnetic waves, while another – postulate about the Lorentz force, which makes it possible to calculate power interaction of the current carrying systems. Magnetic field is also introduced not on the basis experimental facts and does not be founded upon basis.

Keywords: *electrodynamics, maxwell's equation, ampere law, magnetic field, equation of induction, magnetic vector potential, electrical vector potential, lorentz force.*

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Keywords: electrodynamics, maxwell's equation, ampere law, magnetic field, equation of induction, magnetic vector potential, electrical vector potential, lorentz force.

I. Introduction

In the existing classical electrodynamics unavoidable crisis phenomena still at the beginning of past century were outlined. Already then it was clear that Maxwell's equations do not include the rules of conversion fields on upon transfer of one inertial system (IS) into another. And there was no understandable as in the limits of electrodynamics existing on that day such conversion to obtain. This a question was solved by volitional method by the way of introduction into the electrodynamics of two postulates of the special theory of relativity (SR). Quotation from the work reflects well the characteristic of this theory [1]: "The theory of relativity arose as a result the prolonged accumulation of the experimental material, which led to the deep conversion of our physical ideas about the forms of material and motion. And other physical quantities to the newly open experimental facts it was revealed after the whole series of the attempts to adapt previous ideas about the space, time that for these purposes it is necessary to reconstruct all these concepts radically. This task was executed in basic a. By Einstein in 1905 (special theory of relativity) and in 1915 (general theory of relativity). In other the task was executed was only in the sense that given the ordered formal mathematical description of new state of affairs. The task of the deep, really physical substantiation of this mathematical diagram still stands before physics".

In Maxwell's equations also is not contained the information about power interaction of the current carrying systems, but the Lorentz force, which defines such an interaction, it is introduced as hotel experimental postulate. Therefore electrodynamics itself consists as of two not connected together parts. From one side this of Maxwell's equations, which give the possibility to obtain wave equation for the electromagnetic waves, while another – postulate about the Lorentz force, which makes it possible to calculate power interaction of the current carrying systems.

Since in the electrodynamics are units logic not connected together and other omissions, i.e. it is not possible to consider as the united final science, in which there are united beginnings, from which follow all its laws. But for this difficult and to design. The beginning to electrodynamics assumed such put outting themselves of physics as amperes, Faraday, Veber, Maxwell. These scientists on the primitive research equipment established those laws, which we use to the these rapids. They were geniuses and they could examine in the dark of prejudices and superstition the top of that huge iceberg, which the electrodynamics is. But those contradictions and disagreement, which occur in the electrodynamics and today, they tell us, that is similar, in spite of its brilliance, they in the electrodynamics of something did not notice.

II. Interaction Of Electronic Fluxes And Bias Currents

In the classical mechanics the force, which acts on the fixed body is determined the gradient of scalar potential φ , which it presents potential energy of body in the assigned field

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$$\mathbf{F}_{\Pi} = -grad\ \varphi .$$

In the case of the rectilinear inertial motion of body a change in its energy is connected with the action on it of the force

$$\mathbf{F}_K = m\mathbf{a} .$$

In this case a velocity increment is always connected with this force coincides with it in the direction. And we know in the mechanics not of one such example, if in the case of rectilinear motion a velocity increment led to the appearance of forces, normal to the direction of motion.

But in the electrodynamics this example is located. This is Lorentz force

$$\mathbf{F}_L = e[\mathbf{v}\times\mathbf{B}] = e\mu[\mathbf{v}\times\mathbf{H}] .$$

This force even during the inertial motion of charge, for example in the superconductors, is directed normal to the direction of the motion of charge. And arises question, is actual whether this some new law, or this incomprehension of physical nature of this force. Let us immediately point out that the introduction of Lorentz force is not the consequence of some generalizations, based on the laws of mechanics or electrodynamics, but it is introduced as the separate experimental postulate, which generalizes experimental data.

Magnetic field was introduced by ampere by phenomenological way on the basis of the observation of power interaction between the conductors, along which flows the current. The Ampere law, expressed in the vector form, determines magnetic field at the point

$$\mathbf{H} = \frac{1}{4\pi}\int \frac{I[d\mathbf{l}\ \mathbf{r}]}{r^3} ,$$

where I - current in the element $d\mathbf{l}$, $\mathbf{r}$ - vector, directed from to the point $d\mathbf{l}$ (Fig.1) .

It is possible to show that

$$\frac{[d\mathbf{l}\mathbf{r}]}{r^3} = \left[grad\left(\frac{1}{r}\right)d\mathbf{l}\right] ,$$

and, besides the fact that

$$\left[grad\left(\frac{1}{r}\right)d\mathbf{l}\right] = rot\left(\frac{d\mathbf{l}}{r}\right) - \frac{1}{r}rot d\mathbf{l} .$$

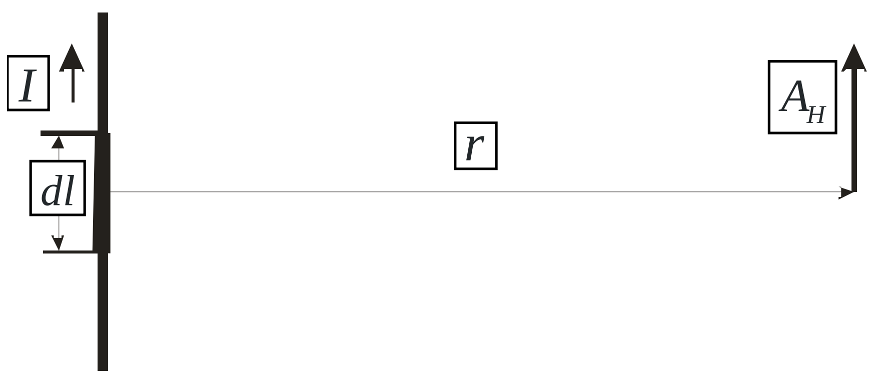

Fig. 1: The formation of vector potential by the element of the conductor dl , along which flows the current I .

But the rotor $d\mathbf{l}$ is equal to zero and therefore is final

$$\mathbf{H} = rot\int I\left(\frac{d\mathbf{l}}{4\pi r}\right) = rot\mathbf{A}_H ,$$

where

$$\mathbf{A}_H = \int I\left(\frac{d\mathbf{l}}{4\pi r}\right) \qquad (1.1)$$

vector potential of magnetic field.

It was also established that the scalar product of vector potential and charge rate, which moves in the field of this potential, presents the potential energy

$$W_{\Pi} = e\mu(\mathbf{v}\mathbf{A}) .$$

The gradient of this energy gives the force, which acts on the charge

$$\mathbf{F}_{\Pi} = -grad\ W_{\Pi} = e\mu\ grad(\mathbf{v}\mathbf{A}) . \qquad (1.2)$$

In this posing of the question one should recognize that the field of scalar potential possesses special property to convert the kinetic motion of charge into the potential energy, which also does not tally to the fundamental laws of mechanics.

We already indicated that the introduction and magnetic fields and Lorentz forces are the generalization of experimental facts and are in fact the postulates, which are introduced without the proper understanding of physical nature of these parameters.

However, one essential inaccuracy is allowed during the formal introduction of these values. Looking at the given relationships to easily see that they are recorded for the secluded flow of the charged particles. And here we immediately encounter an unavoidable deficiency in the concept of magnetic field. Two parallel electronic fluxes, charges in which move with the identical speed, besides Coulomb repulsion must still and be attracted in accordance with it. That this so, it is not difficult to show, if we use ourselves the relationships (1.1, 1.2). But if we pass into the inertial system, which moves with the electron velocity, then vector potential will there be absent and only Coulomb repulsion will remain. This nonconformity of the conclusions, which follow from the relationships (1.1, 1.2), connected with the fact that the experiments, on basis of which was introduced the magnetic field and the vector potential they were carried out not on the secluded electronic fluxes, but on the conductors, along which it flows current. Such conductors, besides the moving electrons have positively charged crystal lattice (Fig. 2), which in the existing theory is not considered.

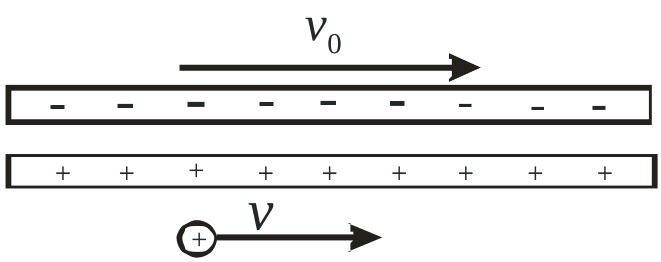

Fig. 2: Conductor with the current, along which moves the observer

In the conductors the density of positive and negative charges is identical, therefore they are neutral and electric field in them is absent. In the figure for larger convenience in the examination the system of positive and negative charges is moved on the vertical line. If electron stream moves with speed v, that for the fixed observer current will be determined by the relationship

$$I = nev_0 \pi r^2,$$

where e and n - charge and electron density, and r - a radius of conductor.

If observer moves, the like to relation to it will move the charges of the positively charged lattice, which is equivalent to reverse electron motion. The full current for the moving observer will be written down taking this into account.

$$I_\Sigma = ne(v_0 - v)\pi r^2 + nev\pi r^2 = nev_0 \pi r^2$$

Thus, full current for the fixed and for the moving observer proves to be identical. And again this conclusion does not correspond to reality, since. the Lorentz force acts on the moving charge, while no to – the fixed.

In the classical electrodynamics there exists two completely equivalent situations, which at the experimental level give different results. The concept of magnetic field consists in the fact that any flow of the moving charged particles generates around itself axial magnetic field. If in this magnetic field another flow of the same particles moves with the same speed, then besides Coulomb repulsion must occur and the attraction of such flows to each other. If we examine the motion of charges in the conductors, then the effect indicated occurs. In connection with this in its time experimental postulate about the Lorentz force was accepted.

This postulate made possible to correctly explain all power effects, connected with the flow of currents in the conducting systems, including the ponderomotive (mechanical) forces, applied to the surface of conductors, over which flows the current.

However, with the examination of power interaction of the unidirectional electronic fluxes, in which the charges move with the identical speed, this approach gives failure. If we examine power interaction of such flows that in the concept of the magnetic field between them, besides Coulomb repulsion, must occur and attraction. However, if we pass into the frame of reference, which moves together with the flows with the speed of the motion of charges in the flows, then in this system magnetic fields be absent and, therefore, there remains only Coulomb repulsion. It is considered that the magnetic field is this the form of material, but is obtained so that with the aid of the selection of frame of reference this form of material it can be destroyed.

Analogous situation is observed also with the bias currents. If bias currents possess magnetic field, then this must lead to the transverse compression of the changing in the time electrical fields on. Furthermore, if bias currents have magnetic field, then such fields in accordance with the relationship (1) must in a power manner act on the charges, which move in this field. But in accordance with third Newton's law to any acting force must occur the counterforce of reaction. But in this case there is no that material object, as, for instance, wire or electronic flux, which would ensure reacting force. Therefore in this case appear the large doubts apropos of existence of magnetic fields on around the bias currents.

The second Maxwell equation connects the presence of magnetic field with existence of the flows of the charged particles, such as electronic fluxes, and also with the bias currents

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$$rot\mathbf{H}=\mathbf{j}+\varepsilon_0\frac{\partial \mathbf{E}}{\partial t}=ne\mathbf{v}+\varepsilon_0\frac{\partial \mathbf{E}}{\partial t},$$

where n and $\mathbf{v}$ - the charge density in the electronic flux and their speed respectively.

Taking into account the considerations given above, it is necessary to recognize that the introduction of magnetic field in accordance with the second Maxwell equation does not be founded upon soil. But this means that and the first equation of Maxwell also becomes meaningless, since. in it the magnetic field also is present. Therefore a question about stands, from the electrodynamics generally excluding of this concept as magnetic field.

III. Induction Equations, Recorded in the Total Derivatives

Main reaching SR should be considered that the fact that it predicted the dependence of the scalar potential of charge on its relative speed, and also the connection of this potential with the magnetic vector potential. Specifically, this circumstance made it possible obtain the conversions fields on from which one should the phase aberration and the transverse Doppler effect, which cannot be explained within the framework classical electrodynamics. However, these results were obtained by the price of colossal physical victims by the way of the introduction of the covariant conversions, from which follow absurd from the physical point sight results. For example, material bodies with reaching of the speed of light must be compressed to the zero sizes in the direction of their motion.

Question arises, can the principles of classical electrodynamics give correct results regarding fields on in the moving coordinate systems at least in some approximation, and if yes, then as the equations of electromagnetic induction must appear in this case.

Lorentz force

$$\vec{F}'=e\left[\vec{V}\times\vec{B}\right]. \qquad (2.1)$$

therefore is named Lorent's name, that it follows from its conversions, with the aid of which the fields in the moving coordinate systems can be recorded, if fields in the fixed system are known. We will note fields and forces, which appear in the moving coordinate system, by prime subsequently.

Of indication of how can be recorded fields in the moving coordinate system, if they are known in the fixed, there are already in the Faraday law, if we use ourselves the substantional derivative. For the study of this problem let us rewrite Faraday law in the precise form:

$$\oint \vec{E}'\,d\,\vec{l}'=-\frac{d\,\Phi_B}{d\,t}. \qquad (2.2)$$

The refinement of law, is more accurate than its record, it concerns only that circumstance that if we determine contour integral in the moving (prime) coordinate system, then near $\vec{E}$ and $d\vec{l}$ must stand primes. But if circulation is determined in the fixed coordinate system, then primes near $\vec{E}$ and $d\vec{l}$ be absent, but in this case to the right in expression (1.2) must stand particular time derivative. Usually this circumstance in the literature on this question is not specified.

The substantional derivative in relationship (2.2) indicates the independence of the eventual result of appearance electromotive force in the outline from the method of changing the flow, i.e., flow can change both due to the local time derivative of the induction $\vec{B}$ and because the system, in which is measured $\oint \vec{E}'d\,\vec{l}'$, it moves in the three-dimensional changing field $\vec{B}$. In the relationship (2.2)

$$\Phi_B=\int \vec{B}\,d\,\vec{S}', \qquad (2.3)$$

where the magnetic induction $\vec{B}=\mu\vec{H}$ is determined in the fixed coordinate system, and the element $d\,\vec{S}'$ is determined in the moving system. Taking (2.3) into account, we obtain from (2.2)

$$\oint \vec{E}'d\,\vec{l}'=-\frac{d}{d\,t}\int \vec{B}\,d\,\vec{S}', \qquad (2.4)$$

and further, since $\frac{d}{d\,t}=\frac{\partial}{\partial\,t}+\vec{V}\,grad$, let us write down

$$\oint \vec{E}'d\,\vec{l}'=-\int\frac{\partial\,\vec{B}}{\partial\,t}\,d\,\vec{S}-\oint\left[\vec{B}\times\vec{V}\right]\,d\,\vec{l}'-\int \vec{V}\,div\,\vec{B}\,d\,\vec{S}'. \qquad (2.5)$$

In this case contour integral is taken on the outline $d\,\vec{l}'$, which covers the area $d\,\vec{S}'$. Let us immediately note that entire following presentation will be conducted under the assumption the validity of the conversions of Galileo, i.e., $d\,\vec{l}'=d\,\vec{l}$ and $d\,\vec{S}'=d\,\vec{S}$. From (2.5) follows the well known result

$$\vec{E}'=\vec{E}+\left[\vec{V}\times\vec{B}\right], \qquad (2.6)$$

from which follows that during the motion in the magnetic field the additional electric field, determined by last term of relationship appears (2.6). Let us note that this relationship we obtained not of the conversions of Lorenz, but altogether having only refined Faraday law. Thus, Lorentz force is the consequence of this precise law.

From relationship (2.6) it follows that during the motion in the magnetic field to the charge acts the force perpendicular to direction of motion. However, physical nature of this force nowhere is examined. Specifically, with this is connected that confusion, which occurs with the explanation of the operating principle of unipolar generator, and also the impossibility of explanation from the point of view of Maxwell's equations the appearances of electrical fields on out of the infinitely long solenoid.

For explaining physical nature of the appearance of last term in relationship (1.6) let us write down $\vec{B}$ and $\vec{E}$ through the magnetic vector potential $\vec{A}_B$:

$$\vec{B}=rot\ \vec{A}_B, \qquad \vec{E}=-\frac{\partial\ \vec{A}_B}{\partial\ t}. \tag{2.7}$$

Then relationship (2.6) can be rewritten

$$\vec{E}'=-\frac{\partial\ \vec{A}_B}{\partial\ t}+\left[\vec{V}\times rot\ \vec{A}_B\right] \tag{2.8}$$

and further

$$\vec{E}'=-\frac{\partial\ \vec{A}_B}{\partial\ t}-\left(\vec{V}\ \nabla\right)\vec{A}_B+grad\ \left(\vec{V}\ \vec{A}_B\right) \tag{2.9}$$

The first two members of the right side of equality (2.9) can be gathered into the total derivative of vector potential on the time, namely:

$$\vec{E}'=-\frac{d\ \vec{A}_B}{d\ t}+grad\ \left(\vec{V}\ \vec{A}_B\right) \tag{2.10}$$

From relationship (2.9) it is evident that the field strength, and consequently also the force, which acts on the charge, consists of three parts.

The first of them is obliged to purely temporary changes in the magnetic vector potential. The sense of second term of the right side of relationship (2.9) is also intelligible. It is connected with a change in the vector potential, but already because charge moves in the three-dimensional changing field of this potential. Other nature of last term of the right side of relationship (2.9). It is connected with the presence of potential forces, since. potential energy of the charge, which moves in the potential field $\vec{A}_B$ with the speed $\vec{V}$, is equal $e\ \left(\vec{V}\ \vec{A}_B\right)$. The value $e\ grad\ \left(\vec{V}\ \vec{A}_B\right)$ gives force, exactly as gives force the gradient of scalar potential.

Relationship (2.9) gives the possibility to physically explain all composing tensions electric fields, which appears in the fixed and that moving the coordinate systems. If the discussion deals with the appearance of electrical fields on out of the long solenoid, where there are no magnetic fields on, then in this case first term of the right side of equality works (2.9). In the case of unipolar generator in the formation of the force, which acts on the charge, two last addend right sides of equality (2.9) participate, introducing identical contributions.

In the work [3] is indicated that the unipolar generator is an exception to the rule of flow, but this conclusion incorrect, since rule of flow is this totality of all three components. Taking rotor from both parts of equality (2.10) and taking into account that *rot grad* ≡ 0, we obtain

$$rot\ \vec{E}'=-\frac{d\ \vec{B}}{d\ t}. \tag{2.11}$$

If there is no motion, then relationship (2.11) is converted into the first Maxvell equation. Certainly, on its informativeness relationship (2.11) strongly is inferior to relationship (2.2), since. in connection with the fact that *rot grad* ≡ 0, in it there is no information about the potential forces, designated through $e\ grad\ \left(\vec{V}\ \vec{A}_B\right)$. Therefore, if us interest all components of electrical fields on, that act on the charge both in the fixed and in that moving the coordinate systems, we must use relationship (2.2).

Summing up the preliminary sum, it is possible to say that with the more careful examination of Faraday law (2.2) it is possible to sufficient clearly understand all special features of the work of unipolar generator, it is possible to also assert that the operating principle of unipolar generator is not an exception to the rule of flow (2.2), but it is its consequence. The assertion of Feynman about the fact that the rule $\left[\vec{V}\times\vec{B}\right]$ for "moving outline" and $\nabla\times\vec{E}=-\frac{\partial\ \vec{B}}{\partial\ t}$ for "changing field" they are two completely different laws it does not correspond to reality. Exactly that united basic principle, absence of which indicates Feynman , and is Faraday law. Is repeated one additional treatment of Feynman which should be refined, namely: "The observations of Faraday led to the discovery of new law about the connection of electrical and magnetic fields on: in the field, where magnetic field changes in the course of time, is generated electric field". This formulation is accurate, but incomplete, since. we already indicated that the electric field can be generated and, where magnetic fields be absent, namely, out of the infinitely long solenoid. More complete formulation escapes from relationship (2.9), and for the vortex fields on by more complete it appears the relationship of $\vec{E}=-\frac{d\ \vec{A}_B}{d\ t}$, than the relationship of $rot\ \vec{E}=-\frac{\partial\ \vec{B}}{\partial\ t}$.

Consequently, we must conclude that the moving or fixed charge interacts not with the magnetic field, but with the field of magnetic vector potential, and only knowledge of this potential and its evolution they give the possibility to calculate all force components, which act on the charges. However, magnetic field appears altogether only of the gradient of such vectorial field.

From the aforesaid it follows that the record of Lorentz force in the terms of the magnetic vector potential:

$$\vec{F}' = e\,\vec{E} + e\,[\vec{V}\times rot\,\vec{A}_B] = e\,\vec{E} - e(\vec{V}\,\nabla)\vec{A}_B + e\,grad\,(\vec{V}\,\vec{A}_B) \qquad (2.12)$$

is more preferable, since the possibility to understand the complete structure of this force gives.

Faraday law (2.2) is called the law of electromagnetic induction in connection with the fact that it shows how a change in the magnetic fields on it leads to the appearance of electrical fields on. However, in the classical electrodynamics there is no law of magnetoelectric induction, which would show, how a change in the electrical fields on, or motion in them, it leads to the appearance of magnetic fields on. The development of classical electrodynamics followed along another way. Was first known the Ampere law

$$\oint \vec{H}\,d\,\vec{l} = I\,, \qquad (2.13)$$

where *I* - current, which crosses the area, included by the outline of integration. In the differential form relationship (2.13) takes the form:

$$rot\,\vec{H} = \vec{j}_\sigma\,, \qquad (2.14)$$

where $\vec{j}_\sigma$ - current density of conductivity.

Maxwell supplemented relationship (2.14) with bias current

$$rot\,\vec{H} = \vec{j}_\sigma + \frac{\partial\,\vec{D}}{\partial\,t}\,. \qquad (2.15)$$

However, if Faraday conducted measurements with the changing flows of electrical induction, thus I could establish the following law

$$\oint \vec{H}'d\,\vec{l}' = \frac{d\,\Phi_D}{d\,t}\,, \qquad (2.16)$$

where of the flow of electrical induction.

$$\oint \vec{H}'d\,\vec{l}' = \int \frac{\partial\,\vec{D}}{\partial\,t} d\,\vec{S} + \oint [\vec{D}\times\vec{V}]d\,\vec{l}' + \int \vec{V}\,d\,iv\,\vec{D}\,d\,\vec{S}'. \qquad (2.17)$$

In contrast to the magnetic fields, when $div\vec{B} = 0$, for the electrical fields $div\vec{D} = \rho$ and last term in the right side of relationship (2.17) it gives the conduction current and from relationship (2.16) the Ampere law immediately follows. From relationship (2.17) follows also the equality:

$$\vec{H} = [\vec{D}\times\vec{V}]\,, \qquad (2.18)$$

which earlier could be obtained only from the Lorenz conversions.

As shown in the work [4], from relationship (2.18) follows and Bio-Savara law, if for enumerating the magnetic fields on to take the electric fields of the moving charges. In this case the last member of the right side of relationship (2.17) can be simply omitted, and the laws of induction acquire the completely symmetrical form

$$\oint \vec{E}'\,d\,\vec{l}' = -\int \frac{\partial\,\vec{B}}{\partial\,t} d\,\vec{S} - \oint [\vec{B}\times\vec{V}]d\,\vec{l}',$$

$$\oint \vec{H}'d\,\vec{l}' = \int \frac{\partial\,\vec{D}}{\partial\,t} d\,\vec{S} + \oint [\vec{D}\times\vec{V}]d\,\vec{l}'. \qquad (2.19)$$

$$E' = \vec{E} + [\vec{V}\times\vec{B}],$$

$$H' = \vec{H} - [\vec{V}\times\vec{D}]. \qquad (2.20)$$

Let us note that previously relationships (2.20) could be obtained only from the covariant Lorentz conversions, i.e. within the framework the special theory of relativity (SR). Thus, with an accuracy down to the terms $\sim \frac{V}{c}$ results SR follow from the laws of the induction within the framework of the conversions of Galileo. Further we will show that they follow from conversions (2.19) and results SR with an accuracy $\sim \frac{V^2}{c^2}$. However, before this we will introduce one additional vector potential, which in the classical electrodynamics was not introduced. For the vortex fields on let us accept [2]

$$\vec{D} = rot\,\vec{A}_D\,, \qquad (2.21)$$

where $\vec{A}_D$ – the electrical vector potential. Then from (1.19) follows

$$\vec{H}' = \frac{\partial\,\vec{A}_D}{\partial\,t} + [\vec{V}\,\nabla]\vec{A}_D - grad\,[\vec{V}\,\vec{A}_D]\,, \qquad (2.22)$$

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or

$$\vec{H}'=\frac{\partial \vec{A}_D}{\partial t}-[\vec{V}\times rot\ \vec{A}_D] \tag{2.23}$$

or

$$\vec{H}'=\frac{d\ \vec{A}_D}{d\ t}-grad\ [\vec{V}\ \vec{A}_D]. \tag{2.24}$$

These relationships are the writing of the law of magnetoelectric induction in the terms of electrical vector potential.

The importance of the introduction of electrical vector potential consists of the following. Let us visualize situation similar to that, which occurs with the infinitely long solenoid with the only difference that now the place of the vectors $\vec{B}$ we must engage the vectors $\vec{D}$. This situation exists. This is the case, when space between the plates of parallel-plate capacitor is filled with dielectric with the large ε. In this case practically entire displacement flux is located inside the dielectric. If we in this case attempt ourselves to calculate magnetic field out of the space, occupied with dielectric, i.e. there where $\vec{D}\cong 0$, then we will encounter the same difficulty, as in the case with the infinitely long solenoid with the calculation outside of him fields on $\vec{E}$. Introduction of electrical vector potential gives the possibility to correctly solve this task. And again arises question, which is primary, and that for a second time. Certainly, electrical vector potential is primary, and vortex electric fields exist only, where the rotor of this potential it is different from zero.

The relationship (2.20) attest to the fact that in the case of relative motion of frame of references, between the fields $\vec{E}$ and $\vec{H}$ there is a cross coupling, i.e., motion in the fields $\vec{H}$ leads to the appearance fields on $\vec{E}$ and vice versa [5,6]. These special features lead to the additional consequences, which within the framework classical electrodynamics previously were not examined. For their illustration let us examine two parallel conducting planes, between which there is an electric field $\vec{E}$ and, correspondingly, the surface charge ρ_S which falls per unit of the area of each plate, is equal εE. If we in parallel to plates in the field E begin to move with the speed ΔV another frame of reference $\Delta H = \Delta V\varepsilon E$. Then in it will appear the additional field E. If we now with respect to the already moving frame of reference begin to move third frame of reference with the speed ΔV, then already due to the motion in the field ΔH will appear the additive $\Delta E = \mu\varepsilon\Delta V^2 E$,, which will be added to the field E. Thus, the field E' in this moving system will prove to be greater than in the fixed. Consequently, we are right to consider that not only increased the field E, but also surface charge on the planes of reference system increased by the value $\mu\varepsilon^2\Delta V^2 E$.

The process of calculation fields on thus it is described in work [2]. If we designate $\vec{E}_{||}$ and $\vec{H}_{||}$ as components fields on, parallel to direction speeds, and $\vec{E}_\perp$ and $\vec{H}_\perp$ as components perpendicular to it, then end value fields on with reaching of the speed V they will be written down

$$\begin{aligned}
&\vec{E}'_{||} = \vec{E}_{||},\\
&\vec{E}'_\perp=\vec{E}_\perp ch\frac{V}{c}+\frac{Z_0}{V}[\vec{V}\times\vec{H}_\perp]sh\frac{V}{c},\\
&\vec{H}'_{||}=\vec{H}_{||},\\
&\vec{H}'_\perp = \vec{H}_\perp ch\frac{V}{c}-\frac{1}{Z_0 V}[\vec{V}\times\vec{E}_\perp]sh\frac{V}{c},
\end{aligned} \tag{2.25}$$

where $Z_0=\sqrt{\frac{\mu}{\varepsilon}}$ - impedance of space, $c=\sqrt{\frac{1}{\mu\ \varepsilon}}$ - speed of light in the medium in question.

Conversions (2.25) they bear the name of the Mende conversions [7-9].

These conversions give the results, which coincide with SR already with an accuracy down to the terms $\sim\frac{V^2}{c^2}$. The corrections of the following orders with results SR do not coincide. However, it should be noted that and experimental check SR is carried out up to now not more precise than the terms $\sim\frac{V^2}{c^2}$.

We show how, for example (2.25) it is possible to explain the phenomenon of phase aberration, which did not have within the framework existing classical electrodynamics of explanations.

We will consider that there are components of the plane wave H_Z and E_X, which is extended in the direction x , and primed system moves in the direction of the axis of with the speed V_X. . Then components fields on in the prime coordinate system will be written down:

$$\begin{aligned}
&E_X{}' = E_X,\\
&E_Y{}'=H_Z sh\frac{Vx}{c},\\
&H_Z{}' = H_Z ch\frac{V_X}{c}.
\end{aligned} \tag{2.27}$$

thus, the summary field E in the moving system will be written down

$$E' = \left[\left(E_X' \right)^2 + \left(E_Y' \right)^2 \right]^{1/2} = E_X \; ch \; \frac{V_X}{c} \; . \qquad (2.28)$$

The Poynting vector now also directed no longer along the axis *y*, but being located in the plane *xy*, it is inclined toward the axis oy to the angle, determined by relationships (2.27). However, the relation of the absolute values of the vectors *E* and *H* in both systems they remained identical. This is a phenomenon of phase aberration in the classical electrodynamics.

IV. Conclusion

The beginning to electrodynamics assumed such put outting themselves of physics as amperes, Faraday, Veber, Maxwell. These scientists on the primitive research equipment established those laws, which we use to the these rapids. They were geniuses and they could examine in the dark of prejudices and superstition the top of that huge iceberg, which the electrodynamics is. But those contradictions and disagreement, which occur in the electrodynamics and today, they tell us, that not all problems are still solved. In Maxwell's equations is not contained the information about power interaction of the current carrying systems, but the Lorentz force, which defines such an interaction, it is introduced as hotel experimental postulate. Therefore electrodynamics itself consists as of two not connected together parts. From one side this of Maxwell's equations, which give the possibility to obtain wave equation for the electromagnetic waves, while another – postulate about the Lorentz force, which makes it possible to calculate power interaction of the current carrying systems. Magnetic field is also introduced not on the basis experimental facts and does not be founded upon basis. Both Maxwell and Amper considered that the magnetic field is material field, but this point of view cannot be accepted, since this field can be destroyed by the way of the selection of frame of reference. In the article it is shown that the introduction of magnetic field this altogether only the convenient mathematical device, without which it is possible to manage. In the article also is introduced the concept of the vector potential of electric field, which gives the possibility to write down the equations of induction in the symmetrical form.

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