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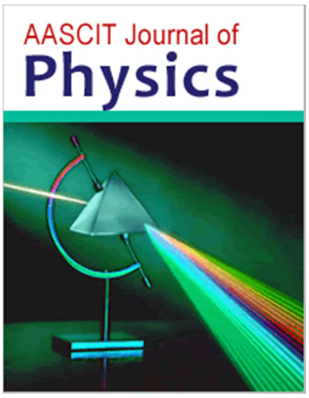

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Concept of Scalar-Vector Potential and Its Experimental Confirmation

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Abstract
According to the program "*Starfish*" 9 July 1962 of the USA exploded in space above Pacific Ocean H-bomb. Explosion was produced at the height 400 km, the TNT equivalent was 1.4 Mt. With the explosion it was discovered, that it is accompanied by the appearance of the electric pulse, the tension of electrical pour on which for the elongation 1000 km from the epicentre of explosion and it further reaches several ten thousand volt per meters. Electric pulse is formed also with the explosions of nuclear charges at the low heights, but damping pulse depending on distance to the cloud of explosion is much larger than with the space explosions. The existing laws of electrodynamics cannot explain the fact that incandescent cloud of plasma it is possible to lead to similar effects; therefore up to now in the scientific journals there are no publications, capable of explaining this phenomenon. But the cloud of plasma is formed also with the explosions of other charges, therefore, although the temperature of the cloud of explosion in this case much lower than with the nuclear explosions, one should expect that also in this case the explosion must be accompanied by the formation of electric pulse. However, in spite of the long-standing history of the study of the properties of such explosions, this question earlier was not investigated. This article fills the gap indicated in, we showed that the electric pulse, which appears with the nuclear and trotyl explosions, is the consequence of the dependence of the scalar potential of charge on the speed. Are given the conversions of electromagnetic pour on upon transfer of one inertial reference system into another, which are obtained within the framework the Galileo conversions and substantional derivative during writing of the equations of induction. The constructions of the generators of electric pulses are given.

1. Introduction

According to the program "*Starfish*" 9 July 1962 of the USA exploded in space above Pacific Ocean H-bomb. Explosion was produced at the height 400 km, the TNT equivalent was 1.4 Mt. This event placed before the scientific community many questions. In 1957 future Nobel laureate doctor Hans Albrecht Bethe (Hans A. Bethe) gave the forecast of the consequences of such of explosion. It predicted that with this explosion on the earth's surface will be observed the electromagnetic pulse (EMI) with the tension not more than 100 V/m. But with the explosion of bomb discomfiture occurred, pour on the tension of electrical, beginning from the epicentre of explosion, and further for the elongation of more than 1000 km of it reached several ten thousand volt per meters. IN the USSR for *"Program K"* not far from Dzhezkazgan at the height 290 km was exploded H-bomb with the TNT equivalent 0.3 Mt. Electric pulse is formed also with the explosions of nuclear charges at the low heights, but damping pulse depending on distance to the cloud of explosion is much larger than with the space explosions.

The existing laws of electrodynamics cannot explain the fact that incandescent cloud of plasma it is possible to lead to similar effects; therefore up to now in the scientific journals there are no publications, capable of explaining this phenomenon. The first scientific publication, where this phenomenon found its physical explanation, is article in the periodical engineering physics [1], where the phenomenon indicated is explained within the framework the concept of scalar- vector potential, which assumes the dependence of the scalar potential of charge on the speed. In this work it is shown that use of the concept indicated gives the possibility to obtain a good agreement with the experimental data. Further this question is examined in the publications of contributor [2-6].

But the cloud of plasma is formed also with the explosions of other charges, therefore, although the temperature of the cloud of explosion in this case much lower than with the nuclear explosions, one should expect that also in this case the explosion must be accompanied by the formation of electric pulse. However, in spite of the long-standing history of the study of the properties of such explosions, this question earlier was not investigated. This work fills this gap.

The concept of scalar- vector potential, which explains nature of the electric pulse of nuclear explosions, is represented in works [7-13].

2. Concept of Scalar-Vector Potential

The Maxwell equations do not give the possibility to write down fields in the moving coordinate systems, if fields in the fixed system are known. This problem is solved with the aid of the conversions of Lorenz, however, these conversions from the classical electrodynamics they do not follow. Question does arise, is it possible with the aid of the classical electrodynamics to obtain conversions fields on upon transfer of one inertial system to another, and if yes, then, as must appear the equations of such conversions. Indications of this are located already in the law of the Faraday induction. Let us write down Faraday law:

$$\oint \vec{E}' d\,\vec{l}' = -\frac{d\,\Phi_B}{d\,t}. \tag{2.1}$$

As is evident in contrast to Maxwell equations in it not particular and substantive (complete) time derivative is used.

The substantional derivative in relationship (2.1) indicates the independence of the eventual result of appearance emf 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 of and because the system, in which is measured , it moves in the three-dimensional changing field . The value of magnetic flux in relationship (2.1) is determined from the relationship

$$\Phi_B = \int \vec{B}\, d\,\vec{S}', \tag{2.2}$$

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 into account (2.2), we obtain from (2.1)

$$\oint \vec{E}' d\,\vec{l}' = -\frac{d}{d\,t}\int \vec{B}\, d\,\vec{S}', \tag{2.3}$$

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

$$\oint \vec{E}' d\,\vec{l}' = -\int \frac{\partial\,\vec{B}}{\partial\,t}\, d\,\vec{S} - \int \left[\vec{B}\times\vec{v}\right]\, d\,\vec{l}' - \int \vec{v}\ div\ \vec{B}\, d\,\vec{S}'. \tag{2.4}$$

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 Galileo conversions, i.e., $d\,\vec{l}' = d\,\vec{l}$ and $d\,\vec{S}' = d\,\vec{S}$. From relationship (2.6) follows

$$\vec{E}' = \vec{E} + \left[\vec{v}\times\vec{B}\right]. \tag{2.5}$$

If both parts of equation (2.6) are multiplied by the charge, then we will obtain relationship for the Lorentz force

$$\vec{F}_L' = e\,\vec{E} + e\,\left[\vec{v}\times\vec{B}\right]. \tag{2.6}$$

Thus, Lorentz force is the direct consequence of the law of magnetoelectric induction.

For explaining physical nature of the appearance of last term in relationship (2.5) 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 (2.5) 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:

$$\vec{E}' = -\frac{d\,\vec{A}_B}{d\,t} + grad\,\left(\vec{v}\,\vec{A}_B\right). \qquad (2.10)$$

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.

First term is obliged by local time derivative. 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 $e\,\left(\vec{v}\,\vec{A}_{\mathbf{B}}\right)$. The value $e\ grad\ \left(\vec{v}\,\vec{A}_B\right)$ gives force, exactly as gives force the gradient of scalar potential.

Taking rotor from both parts of equality (2.10) and taking into account that $rot\ \ grad \equiv 0$, we obtain

$$rot\ \vec{E}' = -\frac{d\,\vec{B}}{d\,t}\ . \qquad (2.11)$$

If there is no motion, then relationship (2.11) is converted into the Maxwell first equation. Relationship (2.11) is more informative than Maxwell equation

$$rot\ \vec{E} = -\frac{\partial\,\vec{B}}{\partial\,t}.$$

Since in connection with the fact that $rot\ grad\ \equiv 0$, in Maxwell equation there is no information about the potential forces, designated through $e\ grad\ \left(\vec{v}\,\vec{A}_B\right)$.

Let us write down the amount of Lorentz force in the terms of the magnetic vector potential:

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

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, however this is terminological error. This law should be called the law of magnetoelectric induction, since the appearance of electrical fields on by a change in the magnetic caused 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. Ampere law was first introduced:

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

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

Maxwell supplemented relationship (2.14) with bias current

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

If we from relationship (2.15) exclude conduction current, then the integral law follows from it

$$\oint \vec{H} d\,\vec{l} = \frac{\partial\,\Phi_D}{\partial\,t}\,, \qquad (2.16)$$

where $\Phi_D = \int \vec{D}\ d\vec{S}$ the flow of electrical induction.

If we in relationship (2.16) use the substantional derivative, as we made during the writing of the Faraday law, then we will obtain [1-10]:

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

In contrast to the magnetic fields, when $div\vec{B} = 0$, for the electrical fields on $div\vec{D} = \rho$ and last term in the right side of relationship (2.8) it gives the conduction current of and from relationship (2.7) the Ampere law immediately follows. In the case of the absence of conduction current from relationship (2.17) the equality follows:

$$\vec{H}' = \vec{H} - [\vec{v}\times\vec{D}]\,. \qquad (2.18)$$

As shown in the work [27], 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 [7-13]

$$\begin{gathered}\oint \vec{E}' dl' = -\int \frac{\partial \vec{B}}{\partial t} d\vec{s} + \oint \left[\vec{v}\times\vec{B}\right] dl' \vec{H} \\ \oint \vec{H}' dl' = \int \frac{\partial \vec{D}}{\partial t} d\vec{s} - \oint \left[\vec{v}\times\vec{D}\right] dl' \vec{H}'\end{gathered}\ , \qquad (2.19)$$

or

$$\begin{gathered}rot\vec{E}' = -\frac{\partial \vec{B}}{\partial t} + rot\left[\vec{v}\times\vec{B}\right] \\ rot\vec{H}' = \frac{\partial \vec{D}}{dt} - rot\left[\vec{v}\times\vec{D}\right]\end{gathered}\ . \qquad (2.20)$$

For dc fields on these relationships they take the form:

$$\vec{E}' = \left[\vec{v}\times\vec{B}\right]$$
$$\vec{H}' = -\left[\vec{v}\times\vec{D}\right] \quad . \qquad (2.21)$$

In relationships (2.19-2.21), which assume the validity of the Galileo conversions, prime and not prime values present fields and elements in moving and fixed inertial reference system (IS) respectively. It must be noted, that conversions (2.21) earlier could be obtained only from the Lorenz conversions.

The relationships (2.19-2.21), which present the laws of induction, do not give information about how arose fields in initial fixed IS. They describe only laws governing the propagation and conversion fields on in the case of motion with respect to the already existing fields.

The relationship (2.21) 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. From these relationships escape the additional consequences, which were for the first time examined in the work [10].

The electric field $E = \frac{g}{2\pi\varepsilon r}$ outside the charged long rod with a linear density g decreases as $\frac{1}{r}$, where r is distance from the central axis of the rod to the observation point.

If we in parallel to the axis of rod in the field E begin to move with the speed Δv another IS, then in it will appear the additional magnetic field $\Delta H = \varepsilon E \Delta v$. If we now with respect to already moving IS 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 IS with reaching of the speed $v = n\Delta v$, when $\Delta v \to 0$, and $n \to \infty$. In the final analysis in moving IS the value of dynamic electric field will prove to be more than in the initial and to be determined by the relationship:

$$E'(r,v_\perp) = \frac{gch\frac{v_\perp}{c}}{2\pi\varepsilon r} = Ech\frac{v_\perp}{c} \ .$$

If speech goes about the electric field of the single charge e, then its electric field will be determined by the relationship:

$$E'(r,v_\perp) = \frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r^2} \ ,$$

where $v_\perp$ is normal component of charge rate to the vector, which connects the moving charge and observation point.

Expression for the scalar potential, created by the moving charge, for this case will be written down as follows:

$$\varphi'(r,v_\perp) = \frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r} = \varphi(r)ch\frac{v_\perp}{c} \ , \qquad (2.22)$$

where $\varphi(r)$ is scalar potential of fixed charge. The potential $\varphi'(r,v_\perp)$ can be named scalar-vector, 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. Maximum value this potential has in the direction normal to the motion of charge itself. Moreover, if charge rate changes, which is connected with its acceleration, then can be calculated the electric fields, induced by the accelerated charge.

During the motion in the magnetic field, using the already examined method, we obtain:

$$H'(v_\perp) = Hch\frac{v_\perp}{c} \ .$$

where $v_\perp$ is speed normal to the direction of the magnetic field.

If we apply the obtained results to the electromagnetic wave and to designate components fields on parallel speeds IS as $E_\uparrow$, $H_\uparrow$, and $E_\perp$, $H_\perp$ as components normal to it, then with the conversion fields on components, parallel to speed will not change, but components, normal to the direction of speed are converted according to the rule

$$\vec{E}'_\perp = \vec{E}_\perp ch\frac{v}{c} + \frac{v}{c}\vec{v}\times\vec{B}_\perp sh\frac{v}{c} \ ,$$
$$\vec{B}'_\perp = \vec{B}_\perp ch\frac{v}{c} - \frac{1}{vc}\vec{v}\times\vec{E}_\perp sh\frac{v}{c} \ , \qquad (2.23)$$

where c is speed of light.

Conversions fields (2.23) they were for the first time obtained in the work [7].

However, the iteration technique, utilized for obtaining the given relationships, it is not possible to consider strict, since its convergence is not explained

Let us give a stricter conclusion in the matrix form [14-15].

Let us examine the totality IS of such, that IS K_1 moves with the speed Δv relative to IS K, IS K_2 moves with the same speed Δv relative to K_1, etc. If the module of the speed Δv is small (in comparison with the speed of light c), then for the transverse components fields on in IS K_1, K_2, we have:

$$\vec{E}_{1\perp} = \vec{E}_\perp + \Delta\vec{v}\times\vec{B}_\perp \qquad \vec{B}_{1\perp} = \vec{B}_\perp - \Delta\vec{v}\times\vec{E}_\perp / c^2$$
$$\vec{E}_{2\perp} = \vec{E}_{1\perp} + \Delta\vec{v}\times\vec{B}_{1\perp} \qquad \vec{B}_{2\perp} = \vec{B}_{1\perp} - \Delta\vec{v}\times\vec{E}_{1\perp} / c^2 \quad . \qquad (2.24)$$

Upon transfer to each following IS of field are obtained increases in $\Delta\vec{E}$ and $\Delta\vec{B}$

$$\Delta\vec{E} = \Delta\vec{v}\times\vec{B}_\perp, \qquad \Delta\vec{B} = -\Delta\vec{v}\times\vec{E}_\perp / c^2 \ , \qquad (2.25)$$

where of the field $\vec{E}_\perp$ and $\vec{B}_\perp$ relate to current IS. Directing Cartesian axis x along $\Delta\vec{v}$, let us rewrite (4.7) in the components of the vector

$$\Delta E_y = -B_z \Delta v, \qquad \Delta E = B_y \Delta v, \qquad \Delta B_y = E_z \Delta v / c^2 . \qquad (2.26)$$

Relationship (2.26) can be represented in the matrix form

$$\Delta U = AU\Delta v \qquad \begin{pmatrix} 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 1/c^2 & 0 & 0 \\ -1/c^2 & 0 & 0 & 0 \end{pmatrix} \qquad U = \begin{pmatrix} E_y \\ E_z \\ B_y \\ B_z \end{pmatrix}.$$

If one assumes that the speed of system is summarized for the classical law of addition of velocities, i.e. the speed of final IS $K' = K_N$ relative to the initial system K is $v = N\Delta v$, then we will obtain the matrix system of the differential equations of

$$\frac{dU(v)}{dv} = AU(v), \qquad (2.27)$$

with the matrix of the system v independent of the speed A. The solution of system is expressed as the matrix exponential curve $\exp(vA)$:

$$U' \equiv U(v) = \exp(vA)U, \qquad U = U(0) \qquad (2.28)$$

here U is matrix column fields on in the system K, and U' is matrix column fields on in the system K'. Substituting (2.28) into system (2.27), we are convinced, that U' is actually the solution of system (2.27):

$$\frac{dU(v)}{dv} = \frac{d[\exp(vA)]}{dv} U = A\exp(vA)U = AU(v) \cdot$$

It remains to find this exponential curve by its expansion in the series:

$$\exp(va) = E + vA + \frac{1}{2!}v^2A^2 + \frac{1}{3!}v^3A^3 + \frac{1}{4!}v^4A^4 + ...$$

where E is unit matrix with the size 4×4. For this it is convenient to write down the matrix A in the unit type form

$$A = \begin{pmatrix} 0 & -\alpha \\ \alpha/c^2 & 0 \end{pmatrix}, \qquad \alpha = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}, \qquad 0 = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}.$$

then

$$A^2 = \begin{pmatrix} -\alpha^2/c^2 & 0 \\ 0 & -\alpha/c^2 \end{pmatrix}, \; A^3 = \begin{pmatrix} 0 & \alpha^3/c^2 \\ -\alpha^3/c^4 & 0 \end{pmatrix},$$

$$A^4 = \begin{pmatrix} \alpha^4/c^4 & 0 \\ 0 & \alpha^4/c^4 \end{pmatrix}, \; A^5 = \begin{pmatrix} 0 & -\alpha^5/c^4 \\ \alpha^5/c^6 & 0 \end{pmatrix} \; .....$$

And the elements of matrix exponential curve take the form

$$[\exp(vA)]_{11} = [\exp(vA)]_{22} = I - \frac{v^2}{2!c^2} + \frac{v^4}{4!c^4} - ....,$$

$$[\exp(vA)]_{21} = -c^2[\exp(vA)]_{12} = \frac{\alpha}{c}\left(\frac{v}{c}I - \frac{v^3}{3!c^3} + \frac{v^5}{5!c^5} - .....\right),$$

where I is the unit matrix 2×2. It is not difficult to see that $-\alpha^2 = \alpha^4 = -\alpha^6 = \alpha^8 = ... = I$, therefore we finally obtain

$$\exp(vA) = \begin{pmatrix} Ich\ v/c & -c\alpha sh\ v/c \\ (\alpha sh\ v/c)/c & Ich\ v/c \end{pmatrix} =$$

$$\begin{pmatrix} ch\ v/c & 0 & 0 & -csh\ v/c \\ 0 & ch\ v/c & csh\ v/c & 0 \\ 0 & (ch\ v/c)/c & ch\ v/c & 0 \\ -(sh\ v/c)/c & 0 & 0 & ch\ v/c \end{pmatrix}.$$

Now we return to (4.10) and substituting there $\exp(vA)$, we find

$$E'_y = E_y ch\ v/c - cB_z sh\ v/c, \qquad E'_z = E_z ch\ v/c + cB_y sh\ v/c,$$
$$B'_y = B_y ch\ v/c + (E_z/c) sh\ v/c, \quad B'_z = B_z ch\ v/c - (E_y/c) sh\ v/c,$$

or in the vector record

$$\vec{E}'_\perp = \vec{E}_\perp ch\ \frac{v}{c} + \frac{v}{c}\vec{v}\times\vec{B}_\perp sh\frac{v}{c},$$
$$\vec{B}'_\perp = \vec{B}_\perp ch\ \frac{v}{c} - \frac{1}{vc}\vec{v}\times\vec{E}_\perp sh\frac{v}{c}, \qquad (2.29)$$

This is conversions (2.23).

Earlier has already been indicated that solution of problems interactions of the moving charges in the classical electrodynamics are solved by the introduction of the magnetic field or vector potential, which are fields by mediators. To the moving or fixed charge action of force can render only electric field. Therefore natural question arises, and it is not possible whether to establish the laws of direct action, passing fields the mediators, who would give answer about the direct interaction of the moving and fixed charges. This approach would immediately give answer, also, about sources and places of the application of force of action and reaction. Let us show that application of scalar- vector potential gives the possibility to establish the straight laws of the induction, when directly the properties of the moving charge without the participation of any auxiliary fields on they give the possibility to calculate the electrical induction fields, generated by the moving charge.

Let us examine the diagram of the propagation of current and voltage in the section of the long line, represented in Fig. 1.

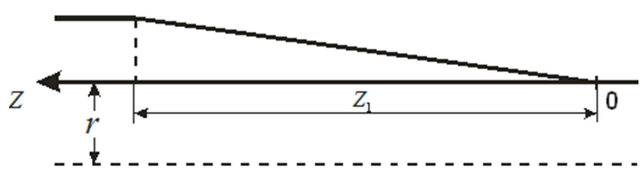

Fig 1. *Current wave front, which is extended in the long line.*

In this figure the wave front occupies the section of the line of the long z_2 , therefore, the time of this transient process equally $t = \frac{z_2}{c}$. This are thing time, for which the voltage on incoming line grows from zero to its nominal value. The duration of transient process is adjustable, and it depends on that, in which law we increase voltage on incoming line. In this case linear law is accepted. Let us show how is formed electrical induction field near the section examined. This exactly are that question, to which, until now, there is no physical answer. Let us assume that voltage on incoming line grows according to the linear law also during the time Δt it reaches its maximum value U , after which its increase ceases. Then in line itself transient process engages the section $z_1 = c\Delta t$. In the section z_1 proceeds the acceleration of charges from their zero speed (more to the right the section z_1) to the value of speed, determined by the relationship

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

where e and m are charge and the mass of current carriers, and U is voltage drop across the section z_1 . Then the dependence of the speed of current carriers on the coordinate will take the form:

$$v^2(z) = \frac{2e}{m} \frac{\partial U}{\partial z} z \,. \tag{2.30}$$

Since we accepted the linear dependence of stress from the time on incoming line, the equality occurs

$$\frac{\partial U}{\partial z} = \frac{U}{z_2} = E_z \,,$$

where E_z is field strength, which accelerates charges in the section z_1. Consequently, relationship (2.30) we can rewrite

$$v^2(z) = \frac{2e}{m} E_z z \ .$$

Using for the value of scalar-vector potential relationship (2.22), let us calculate it as the function z on a certain distance r from the line

$$\varphi(z) = \frac{e}{4\pi\ \varepsilon_0 r}\left(1+\frac{1}{2}\ \frac{v^2(z)}{c^2}\right) = \frac{e}{4\pi\ \varepsilon_0 r}\left(1+\frac{eE_z z}{mc^2}\right). \tag{2.31}$$

For the record of relationship (2.31) are used only first two members of the expansion of hyperbolic cosine in series.

Using the formula $E = -grad\ \varphi$, and differentiating relationship (2.31) on z , we obtain

$$E_z{}' = -\frac{e^2 E_z}{4\pi\ \varepsilon_0 rmc^2} \,, \tag{2.32}$$

where E_z' is the electric field, induced at a distance r from the conductor of line. Near E we placed prime in connection with the fact that calculated field it moves along the conductor of line with the speed of light, inducing in the conductors surrounding line the induction currents, opposite to those, which flow in the basic line. The acceleration a , tested by the charge e in the field E , is determined by the relationship $a_z = \frac{eE_z}{m}$. Taking this into account from (2.32) we obtain

$$E_z' = -\frac{ea_z}{4\pi\ \varepsilon_0 rc^2} \ . \tag{2.33}$$

Thus, the charges, accelerated in the section of the line z_1, induce at a distance r from this section the electric field, determined by relationship (2.33). Direction of this field conversely to field, applied to the accelerated charges. Thus, is obtained the law of direct action, which indicates what electric fields generate around themselves the charges, accelerated in the conductor. This law can be called the law of electro-electrical induction, since it, passing fields mediators (magnetic field or vector potential), gives straight answer to what electric fields the moving electric charge generates around itself. This law gives also answer about the place of the application of force of interaction between the charges. Specifically, this relationship, but not Faraday law, we must consider as the fundamental law of induction, since specifically, it establishes the reason for the appearance of induction electrical fields on around the moving charge. In what the difference between the proposed approach and that previously existing consists. Earlier we said that the moving charge generates vector potential, and the already changing vector potential generates electric field. Relationship (2.33) gives the possibility to exclude this intermediate operation and to pass directly from the properties of the moving charge to the induction fields. Let us show that relationship it follows from this and the introduced earlier phenomenologically vector potential, and, therefore, also magnetic field. Since the connection between the vector potential and the electric field is determined by relationship (2.7), equality (2.33) it is possible to rewrite

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

from where, integrating by the time, we obtain

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

This relationship corresponds to the determination of vector potential. It is now evident that the vector potential is the direct consequence of the dependence of the scalar potential of charge on the speed. The introduction also of vector potential and of magnetic field this is the useful mathematical device, which makes it possible to simplify the solution of number of electrodynamic problems, however, one should remember that by fundamentals the introduction of these fields on it appears scalar- vector potential.

3. Electrical Impulse of Nuclear Explosion

According to the program *Starfish* USA exploded in space above Pacific Ocean H-bomb. Actual chart area and value of tensions fields on given in Fig 1

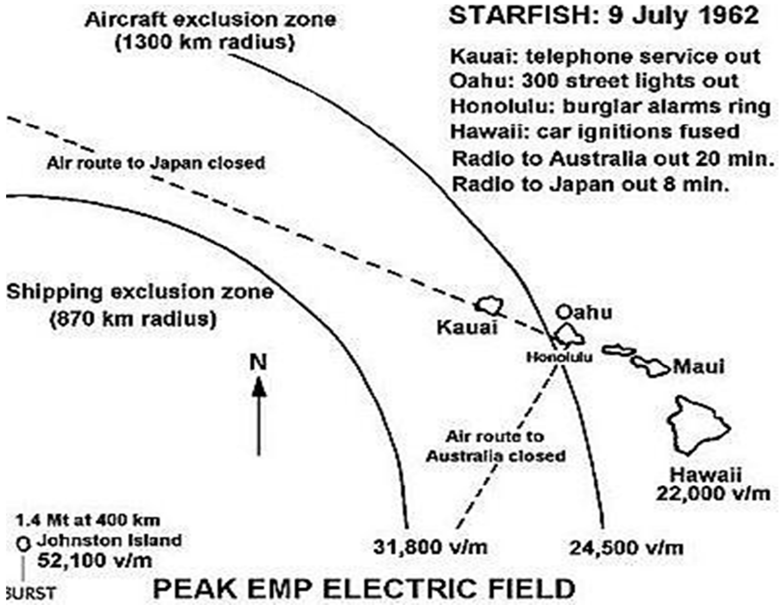

Fig 2. *Map of tests according to the program Starfish.*

IN the USSR for *Program K* not far from Dzhezkazgan at the height of 290 km was exploded H-bomb with the TNT equivalent 0.3 Mt. Actual chart area with the indication of the values of tensions pour on, obtained with this explosion, it is shown in Fig. 3 comparing data with respect to the tensions pour on, given on these two maps, it is possible to see that the values of tensions pour on in Fig. 2 diminish with an increase in the distance from the epicentre of explosion, while on the map, depicted in Fig. 3, these values grow. From this it is possible to draw the conclusion that on the second map are cited the data on the measurement by the horizontal intensity of electrical fields on.

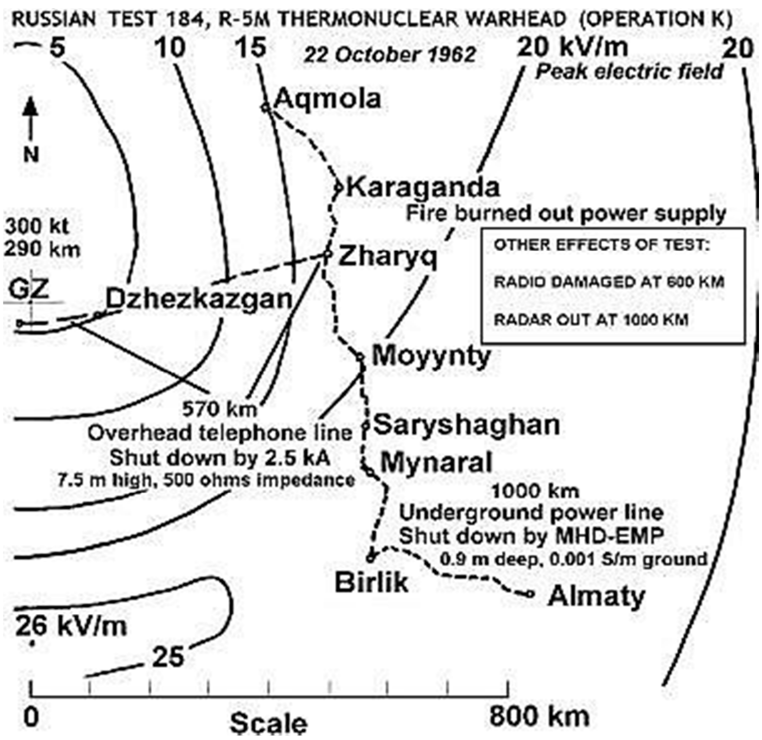

Fig 3. *Map of tests according to the program Program K.*

To Fig. 4 is given the graph of EMP, recorded at a distance 1300 km from the epicentre of explosion, obtained with the tests according to the program *Starfish.* It is evident from the given figure that EMP has not only very large amplitude, but also very short duration.

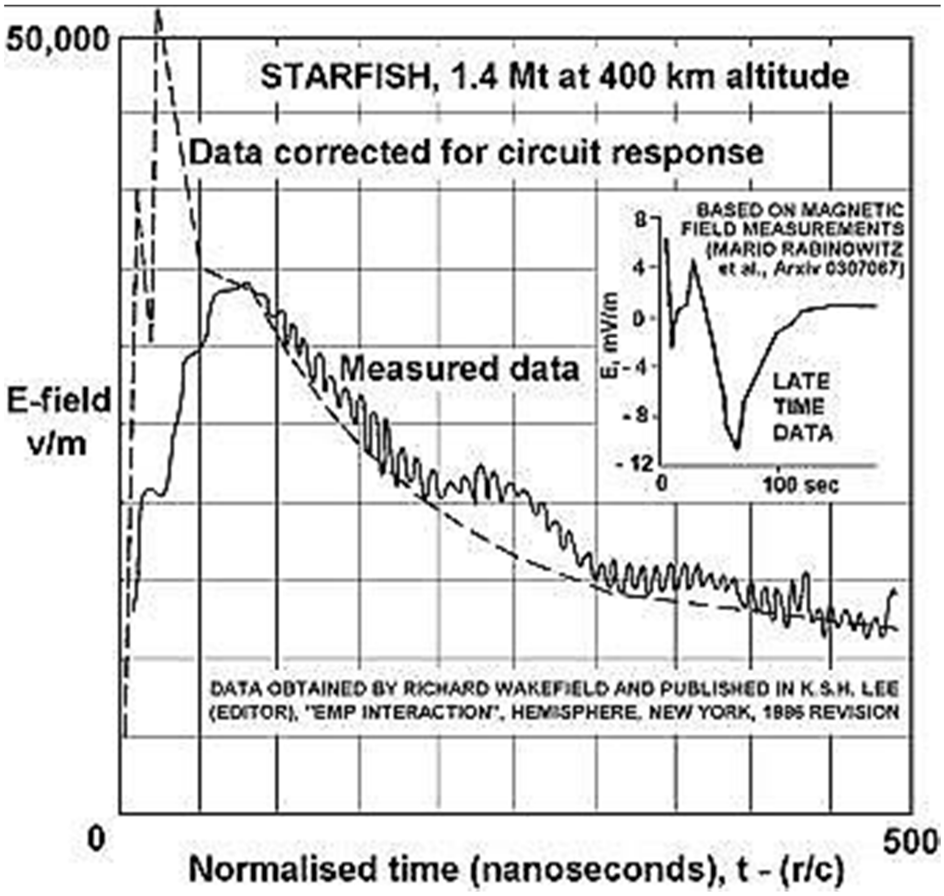

Fig 4. *Experimental dependence of amplitude EMP on the time, obtained with the tests according to the program Starfish.*

It is known that problem EMP together with my students attempted to solve academician I. B. Zeldovich [16]. However, in the scientific literature there is no information about the fact that this problem was solved by it. And only in 2013 in the periodical Engineering physics appeared the first publication, in which was given an attempt at the explanation of the phenomenon [6]. In the paper it is shown that as a result nuclear explosion appears not the electromagnetic, but electric pulse, the vector of electric field of which is directed toward the point of impact. For explaining physical nature of electric pulse are used the concept of scalar-vector potential, the assuming dependence of the scalar potential of charge on its relative speed.

In the introduction in Fig. 3 solid line showed the dependence of the pulse amplitude on the time, recorded on the oscilloscope face, obtained with the tests according to the program *Starfish*, and dotted line showed the shape of pulse, corrected taking into account the parameters of the input circuits of oscillograph.

With the detonation the products of explosion heat to the high temperature, and then occurs their gradual cooling, during which the explosive energy returns to environment. The dependence of the pulse amplitude on the time repeats the process indicated, and possible to assume that precisely the temperature of plasma determines its amplitude. In the time of the detonation of the charge $\sim$ 25 ns is a sharp increase in the pulse amplitude, and then there is a slower process, with which in the time $\sim$ 150 ns the amplitude decreases two. We will consider that the sum of these times represents the time, for which it occurs the emission of a basic quantity of energy, obtained with the explosion.

If we consider that one ton of trotyl is equivalent 4.6×10^{9} J, then with the explosion of bomb with the TNT equivalent 1,4 Mt are separated 6.44×10^{15} J. Consequently explosive force in the time interval indicated will compose $\sim 3.7\times10^{22}$ W. For the comparison let us point out that the power of the radiation of the Sun $\sim 3.9\times10^{26}$ W.

Let us examine a question, where how, in so short a time, can be the intake, isolated with this explosion. With the explosion in the atmosphere the energy is expended on the emission and on the creation of shock wave. In space shock wave is absent; therefore explosive energy is expended on the electromagnetic radiation.

In accordance with Stephan-Boltzmann equation the power, radiated by the heated surface, is proportional to the fourth degree of its temperature

$$P = \sigma S T^4 ,$$

where σ is Stephan-Boltzmann constant, and S is area of radiating surface.

In order to calculate temperature with the known radiated power it is necessary to know the surface of radiating surface. As this surface let us select sphere with the surface ~ 3 m^2. Knowing explosive force and size of radiating surface, we find the temperature of the cloud of the explosion

$$T = \sqrt[4]{\frac{P}{\sigma S}} .$$

With the explosive force ~ 3.7×10 ^{22} W we obtain the value of temperature equal to ~ 8.6×10^6 K.

In the concept of scalar-vector potential, the scalar potential of charge g it is determined from the relationship

$$\varphi(r) = \frac{g \ ch\frac{v_\perp}{c}}{4\pi \ \varepsilon_0 r} \tag{3.1}$$

where, r is the distance between the charge and the observation point, $v_\perp$ is the component of the charge, normal to the vector $\vec{r}$, ε_0 is dielectric constant of vacuum.

According to the estimations at the initial moment of thermonuclear explosion the temperature of plasmoid can reach several hundred million degrees. At such temperatures the electron gas is no longer degenerate and is subordinated to of the Boltzmann distribution. The most probable electron velocity in this case is determined by the relationship

$$v = \sqrt{\frac{2k_B T}{m}} , \tag{3.2}$$

where T is temperature of plasma, k_B is Boltzmann constant, m is the mass of electron.

Using Eqs. (3.1) and (3.2), and taking into account with the expansion in the series of hyperbolic cosine the terms ~ $\frac{v^2}{c^2}$, we obtain the value of increase in the scalar potential at the observation point

$$\Delta\varphi \cong \frac{Nek_B T}{4\pi\varepsilon_0 rmc^2} , \tag{3.3}$$

where N is quantity of electrons in the cloud of explosion, e is electron charge. We determine from the formula the tension of radial electric field, which corresponds to this increase in the potential

$$E = \frac{Nek_B T}{4\pi\varepsilon_0 r^2 mc^2} = \frac{\Delta q}{4\pi\varepsilon_0 r^2} \tag{3.4}$$

where

$$\Delta q = \frac{Nek_B T}{mc^2} \tag{3.5}$$

is an equivalent charge of explosion.

One should say that with the warming-up of plasma the ions also acquire additional speed, however, since their mass considerably more than the mass of electrons, increase in their charges can be disregarded.

For enumerating the quantity of electrons it is necessary to know a quantity of atoms, which with the warming-up formed the cloud of explosion. Let us assume that the total weight of bomb and launch vehicle, made from metal with the average density of the atoms ~ 5×10^{22} 1/sm^3, is 1000 kg. General of a quantity of free electrons in the formed plasma, on the assumption that all atoms will be singly ionized with the specific weight of the metal ~ 8 g/cm3 , will comprise ~ 5×10^{27}.

In accordance with Eq. (7.4) the tension of radial electric field at a temperature of the cloud of the explosion ~ 8.6×10^6 K will comprise: in the epicentre of the explosion ~ 6.9×10^4 V/m, at a distance in 870 km from the epicentre ~1.2×10^4 V/m and at a distance 1300 km from the epicentre ~ 6×10^3 V/m. It is evident that in the epicentre the computed values of electrical pour on the earth's surface they are close to the experimental values. The ratio of calculated values to those measured they comprise: in the epicentre of explosion is 13.5, at a distance 870 km from this place is 4.5, at a distance 1300 km is 2.4. Certainly, are unknown neither the precise initial of the temperature of plasmoid nor mass of bomb and launch vehicle, in which it undermine nor materials, from which are prepared these elements. Correcting these data, it is possible sufficiently simply to obtain values pour on those being approaching experimental values. But calculated three-dimensional dependence pour on strongly it is differed from experimental results. Let us attempt to explain the reason for such divergences.

Let us first examine the case, when charge is located above the metallic conducting plane (Fig. 5). The distribution of electrical fields on above this plane well known [17].

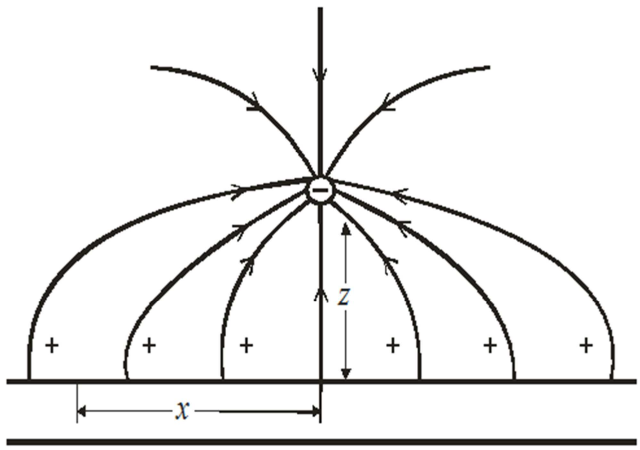

Fig 5. *Negative charge above the limitless conducting plane.*

The horizontal component of electric field on the surface of this plane is equal to zero, and normal component is equal

$$E_\perp = \frac{1}{2\pi\varepsilon_0} \frac{zq}{\left(z^2+x^2\right)^{\frac{3}{2}}} \tag{3.6}$$

where q is magnitude of the charge, z is distance from the charge to its epicentre, x is distance against the observation points to the epicentre.

Lower than conducting plane electric fields be absent, but this configuration pour on equivalent to the presence under the conducting plane of the positive charge of the same value and at the same distance as initial charge. The pair of such charges presents the electric dipole with the appropriate distribution of electrical pour on. This configuration pour on connected with the fact that charge, which is been located above the conducting plane, it induces in it such surface density of charges, which completely compensates horizontal and vertical component of the electric field of charge in the conducting plane and lower than it. The dependence of the area of the charge density from the coordinate x also is well known [17].

$$\sigma(x) = \varepsilon_0 E_\perp = \frac{1}{2\pi}\frac{zq}{\left(z^2+x^2\right)^{\frac{3}{2}}}\ . \qquad (3.7)$$

If we integrate $\sigma(x)$ with respect to the coordinate x , then we will obtain magnitude of the charge, which is been located above the conducting plane. In such a way as not to pass the electric fields of the charge q through the conducting plane, in it must be contained a quantity of free charges, which give summary charge not less than the charge q . In this case two cases can realize. With the low charge density, which occurs in the poor conductors, it will arrive to move up to the significant distances significant quantities of charges. But in this case of charges it can and not be sufficient for the complete compensation. With the high charge density, it is possible to only insignificantly move charges in the plane. This case realizes in the metallic conductors.

If we periodically draw near and to move away charge from the plane, then in it will arise the periodic horizontal currents, which will create the compensating surface charges. The same effect will be observed, if charge at the particular point can be born and disappear. If at the assigned point above the plane charge suddenly in some time arises, then, so that the fields of charge would not penetrate through the conducting plane, in the same time on the conducting plane the compensating charges, which correspond to relationship must appear (3.7). The surface density of these charges corresponds to relationship (3.7). This means that the strength of currents, which create the compensating charges, there will be the greater, the greater charge itself and the less the time of its appearance. However, with the low charge density can realize another case. With a very rapid change in the electric field the charges will not have time to occupy the places, which correspond to the complete compensation for electrical pour on, and then the fields of external charge partially will penetrate through conductor, and compensation will be not complete. Then the fields of external charge partially penetrate through conductor, and compensation will be not complete. Specifically, this case realizes in the case of the explosion of nuclear charge in space, since between it and earth's surface is located the ionosphere, which possesses not too high a conductivity (Fig. 6).

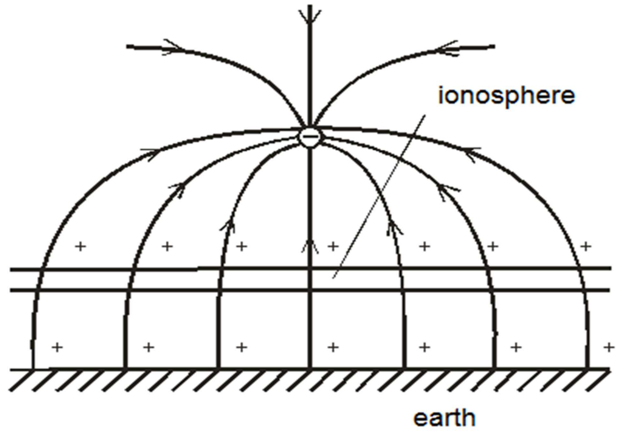

Fig 6. *Negative charge above the earth's surface with the presence of the ionosphere.*

If charge will appear at the indicated in the figure point, thus it will gather under itself the existing in the ionosphere free charges of opposite sign for compensating those pour on, which it creates in it. However, if a total quantity of free positive charges in the ionosphere will be less than the value of charge itself, or their displacement is insufficient in order to fall into the necessary point at the assigned moment, then their quantity will not be sufficient for the complete compensation pour on the appearing charge and its fields will penetrate through the ionosphere. In this case the fields will penetrate through the ionosphere. In this case the penetrated fields, in view of the screening effect of the ionosphere, can be less than the field above it. In this case maximum compensation pour on it will occur in the region, situated directly under the charge. This process will make the dependence of electrical pour on from the distance by smoother, that also is observed during the experiment. Entire this picture can be described only qualitatively, because are accurately known neither thickness of the ionosphere nor degree of its ionization on the height.

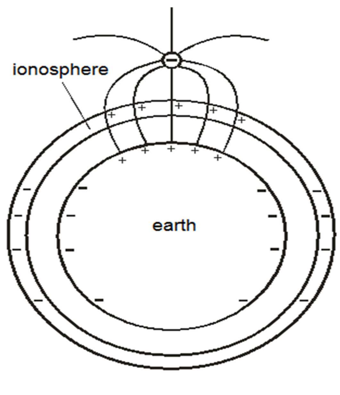

Fig. 7. *Negative charge above the earth's surface with the presence of the ionosphere.*

The sphericity of the ionosphere also superimposes its special features on the process of the appearance of the compensating surface charges. This process is depicted in

Fig. 7.

The tendency of the emergent charge to gather under itself the compensating charges will lead to the longitudinal polarization of the substantial part of the ionosphere. The compensating positive charges in the ionosphere will in essence appear directly in the epicentre, where they will be in the surplus, while beyond the line-of-sight ranges in the surplus will be negative charges. And entire system the ionosphere - the earth will obtain additional dipole moment.

The model examined speaks, that nuclear explosion will lead not only to the appearance in the zone of straight visibility, but also to the global ionospheric disturbance. Certainly, electric fields in space in the environments of the explosion, where there is no screening effect of the ionosphere, have high values and present large danger to the automatic spacecraft.

In accordance with Eq. (3.4) the pulse amplitude is proportional to the temperature of plasma. Consequently, according to the graph, depicted in Fig. 3, it is possible to judge the knocking processes of nuclear charge and the subsequent cooling of the cloud of explosion. From the figure one can see that two peaks are visible in the initial section of the dependence of the amplitude of electric field. The first peak presents nuclear blast, which ignites thermonuclear charge, the second peak presents the knocking process of thermonuclear fuel. The rapid decrease, which characterizes the process of cooling cluster, further goes. It is evident that it occurs very rapidly. Naturally to assume that this is that period, when basic energy losses are connected with the radiant losses caused by the rigid X-radiation.

Thus, the presence of the pulse indicated they are the properties of explosion itself, but not second phenomenon.

Now should be made one observation apropos of term itself the electromagnetic pulse EMP, utilized in the literary sources. From this name should be excluded the word magnetic, since this process presents the propagation only of radial electrical fields on, and in this case magnetic fields be absent. It is known that the amplitude of the electric field of pulse can reach values ~ 50000 V/m. But if pulse was actually electromagnetic, then the tension of magnetic field would compose ~ 1.3×102 A/m. For obtaining this value should be the tension of electric field divided into the wave drag of free space. In this case the power, determined by the Poytning vector would be ~ 5 MW, which is commensurate with the power of small power station.

It is not difficult to calculate that energy, which with the nuclear explosion is expended on obtaining of electric pulse. The pulse duration is ~ 150 ns. If we consider that the pulse is extended with the speed of light, then its extent in the free space composes d=45 m. At a distance R=400 km from the point of impact the tension of electric field was ~ 50000 V/m. Specific electric field energy composes

$$W = \frac{1}{2}\varepsilon_0 E^2 .$$

The total energy U of the electric field of pulse we obtain by the way of the multiplication of specific energy by the volume of the spherical layer $4\pi r^2 d$

$$U = 2\pi r^2 d\varepsilon_0 E^2 .$$

Substituting in this formula the values indicated, we obtain energy ~ 10^{12} J. If we consider that with the explosion is separated energy ~ 6.4 ×10^{15} J, then energy of electric pulse composes ~ 0.016% of the general explosive energy.

It is another matter that electric fields can direct currents in the conducting environments, and these currents will generate magnetic fields, but this already second phenomenon.

Since the tension of electrical pour on near the nuclear explosion it is great it can reach the values of the breakdown tension of air (300000 V/m), with the explosions, achieved in immediate proximity from the earth's surface, this can lead to the formation of lightning, that also is observed in practice.

The concept of scalar-vector potential can serve and for explaining the cable is special effect. Actually, if in the process of the appearance of the cloud of explosion in it excess charge is formed, then this charge on the ropes must flow into the earth, and this in turn will lead to their additional warming-up.

4. Electric Pulse of the Explosions of the Trotyl Charges

In accordance with relationship (2.4) the motion of charges in the plasma it must lead to the appearance of external electrical pour on (2.4). This means that with the formation of plasma must be formed the electric pulse, whose amplitude will depend on a quantity of free charges and their speed, and the pulse duration will depend on the rate of cooling of the cloud of explosion.

The disintegration of the molecule of trotyl with its detonation occurs according to the following diagram[6]:

$$C_7H_5O_6N_3 = 2H_2O + 3.5CO + 1.5N_2 .$$

if each of the molecules, that was released during explosion will be singly ionized, then upon decay the molecule of trotyl will be isolated 7 free electrons. Consequently, with the detonation of one mole of trotyl will be isolated $7N_A = 4.2\times10^{24}$ of the electrons, where N_A is Avagadro's number. With the explosion of trotyl the temperature of the cloud of explosion reaches 3500K. If all molecules of disintegration obtain single ionization, then the maximum strength of field of electric pulse composed

$$E = 3.7\times10^9 \frac{1}{r^2} \text{ V/m} \tag{4.1}$$

At a distance 100 m of the point of impact the tension of electric field there will be the wound of 3.7×10^5 V/m. However, with the explosion of trotyl charges is formed the cold plasma, in which the degree of ionization composes ~ 0.1%. The summary tension of electric field in this case will comprise The importance of this method consists in the fact that by studying the topology of pulse, it is possible to judge the knocking processes and subsequent relaxation of the cloud of explosion. Obviously, electric pulse must accompany the entry of projectile into different solid obstacles, since. in this case strong local warming-up to target with the formation of plasma occurs. Consequently, it is possible to draw the conclusion that in those places, where the plasma of any form is formed, must appear electric pulse.

In the scientific literature there are no communications about the appearance of electric pulse with the explosions of conventional explosives, but this can be connected with the fact that this question no one was investigated.

It is known that the electro-welding creates the strong radio reception disturbances, but these interferences very rapidly diminish with the distance. Micro-bursts it is possible to consider sparking in the poor contacts in the electrical networks, in the contact systems of electric transport means or the collectors of direct-current motors. But, since the amplitude of electric pulse rapidly diminishes with the distance, electric transport does not present special interferences for the radio reception.

The lightning also warm plasma to the high temperature and are created the radio reception disturbances. There is an opinion that very channel of lightning serves as the antenna, which radiates the radio waves over a wide range of frequencies. But so whether this? With that length, which represents the track of lightning, this antenna must have excellent characteristics and reliably emit not only in the short-wave, but also in the long-wave radio-frequency band. But this would mean that with any lightning stroke in any place of the terrestial globe in our receivers the interferences would appear. But since they second-by-second in the world beat hundreds of lightning, entire ether would be oppressed by interferences. This it does not occur for that reason, that the plasma cylinder of lightning emits not radio waves, but electric pulses from all its sections. In this case the excess charges, which arose in different sections of the channel of lightning, see their mirror reflection under the earth's surface, forming the appropriate dipoles, whose fields diminish inversely proportional to the cube of distance.

Is that which is written in this paragraph, thus far only theoretical prerequisites. But if they will be confirmed experimentally, then will be not only just once confirmed the viability of the concept of scalar- vector potential, but also will be opened way for developing the new procedures of a study of the processes, proceeding with different explosions.

5. Pulse Generator of the Radial Electric Field

Being based on the given results it is possible to propose the construction of the pulse generator of radial electric field, it is represented in Fig. 8. Generator consists of the massive metallic sphere, inside which is located the small spherical cavity, which approach two capillaries. Through the capillaries the cavity is filled up with nitroglycerine. The size of internal cavity and the thickness of the walls of sphere is selected in such a way that with the explosion nitroglycerine sphere it would not tear. The detonation of nitroglycerine is accomplished by an acoustic method by the way of sharp impact on the wall of sphere. After the detonation of charge the temperature in the internal cavity reaches value on the order of 10 thousand degrees and more, that also causes the appearance of radial electric pulse. Then, the gases emergent in the cavity slowly leave through the capillaries, and after cooling of sphere generator is again ready to work.

Let us point out that they can be recorded by a similar method and underground nuclear explosions, since the radial electric fields can without difficulty penetrate through any media.

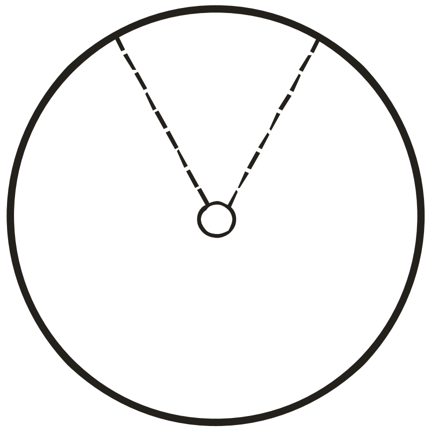

Fig 8. *Pulse generator of the radial electric field of.*

It is easy to calculate the tension of electric field, generated by this generator, using the procedure, examined in the fourth division.

a generator of radial electric field can be carried out, using an electrical discharge in the ionized medium, for which should be used the charged capacitor, which they discharge through the space, connected by the thin wire (Fig. 9).

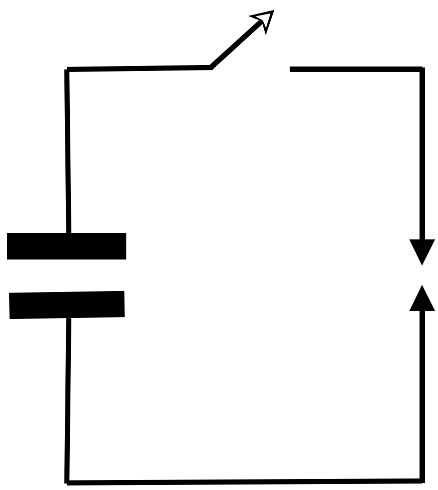

Fig 9. *Schematic of capacitor discharge.*

During the discharge wire is melted, forming the plasma, which is compressed because of the pinch effect. The compression of plasma leads to its warming-up to the high temperature. General oscillator circuit is given in Fig. 10.

In the metallic capacity, which has upper lid, is located the unit of capacitors, key and discharger. The unit of capacitors is placed in the metal casing, which with the aid of the tube is suspended to the upper lid. Cover must have a good contact with the capacity. Through the tube in the upper lid is passed the dielectric rod, with the aid of which is accomplished closing key. At the moment of closing the key in the discharger appears the plasma, which generates the electric pulse, whose electric fields through the metallic capacity penetrate outside. These fields are fixed with the aid of the dipole antenna. For the visual observation and the record of pulse is used the oscillograph, which is connected to the antenna.

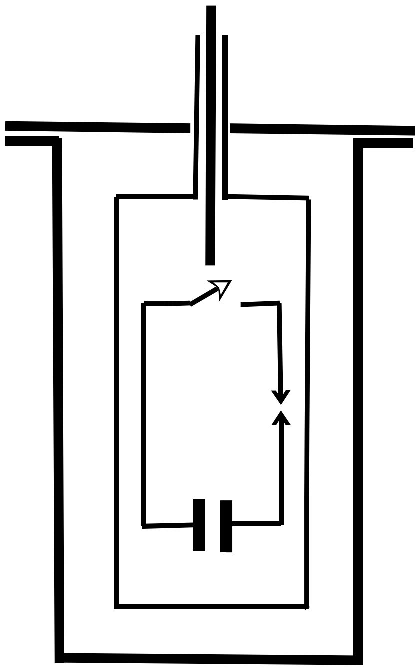

Fig 10. *General oscillator circuit of electric pulses.*

Let us examine the parameters of the separate elements of generator. The capacitance of capacitor and the potential difference, to which it should be loaded, is selected on the basis of the following considerations. Of the energy, accumulated in the capacitor must be sufficiently for the warming-up of the cloud of plasma, which is formed with the capacitor discharge to temperature on the order 10000 K.

As the wire, which is undergone melting in the discharger, let us take the copper wire with a diameter of 0.1 mm and with a length of 1 mm. The specific weight of copper is equal to 8.94 g/sm^3 , therefore the mass of the section of wire indicated is equal ~7x10^{-5} g, and its volume is equal ~8x10^{-6} cm^3 . The heat capacity of copper composes ~4x10^{-1} J/g, and melting point is equal to 1350 K. Therefore in order to heat wire to the melting point it will be required ~4x10^{-2} J. Heat of fusion of copper composes ~2x10^{2} J/g, therefore in order to melt wire it will be necessary ~1.4x10^{-2} J. Heat of vaporization of copper is equal ~4.8 J/g; therefore for evaporating the wire to be required still ~3.5x10^{-4} J. Therefore, in order to heat wire to the melting point, to melt it and to convert to vaporous state, to be required to spend ~5x10^{-2} J. Atom density of copper composes ~5x10^{22} 1/sm^3 ; therefore into the gaseous state will be transferred ~4x10^{17} of atoms. Energy of the atom of gas composes $k_B T$, where k_B is the Boltzmann constant. Therefore in order to heat the quantity of atoms to the temperature of 10^4 K indicated necessary to spend ~6x10^{-2} J. Thus the total quantity of energy, necessary for the realization of the process examined, will compose 10^{-1} J. Using relationship (3.4) it is possible to calculate the tension of electric field, created by this discharge. If we consider that iron atoms are completely ionized, then at a distance 1 m of the discharger the tension of electric field will compose ~10^{-2} V/m. This level of the tension of electrical is completely measured by the proposed method.

The energy, stored up in the capacitor, is determined from the relationship

$$W = \frac{1}{2} CU^2$$

If we load capacitor to a potential difference 400 V, then for obtaining the energy of the discharge of ~10^{-1} J is necessary capacitor with a capacity $\sim 1\mu F$.

The given calculation is tentative, since. with its fulfillment the factors, which are yielded to calculation, were taken into account only at the same time, there is a whole series of the factors, which to consider is impossible.

6. Conclusions

According to the program "*Starfish*" 9July 1962 of the USA exploded in space above Pacific Ocean H-bomb. Explosion was produced at the height 400 km, the TNT equivalent was 1.4 Mt. With the explosion it was discovered, that it is accompanied by the appearance of the electric pulse, the tension of electrical pour on which for the elongation 1000 km from the epicentre of explosion and it further reaches several ten thousand volt per meters. Electric pulse is formed also with the explosions of nuclear charges at the low heights, but damping pulse depending on distance to the cloud of explosion is much larger than with the space explosions. The existing laws of electrodynamics cannot explain the fact that incandescent cloud of plasma it is possible to lead to similar effects; therefore up to now in the scientific journals there are no publications, capable of explaining this phenomenon. But the cloud of plasma is formed also with the explosions of other charges, therefore, although the temperature of the cloud of explosion in this case much lower than with the nuclear explosions, one should expect that also in this case the explosion must be accompanied by the formation of electric pulse. However, in spite of the long-standing history of the study of the properties of such explosions, this question earlier was not investigated. This article fills the gap indicated in, we showed that the electric pulse, which appears with the nuclear and trotyl explosions, is the consequence of the dependence of the scalar potential of charge on the speed. Are given the conversions of electromagnetic pour on upon transfer of one inertial reference system into another, which are obtained within the framework the Galileo conversions and substantional derivative during writing of the equations of induction. The constructions of the generators of electric pulses are given.

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