Three paradoxes of the traditional electrodynamics

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Abstract

At present not all electrodynamic phenomena yield to the explanation within the framework of the traditional electrodynamics and special theory of relativity (STR). One of such paradoxes is described in the sixth volume of Feynman lectures on physics, where it is shown that with the examination of interaction of the charges, which move along the lines, which are intersected at right angle, third Newton's law is disrupted. Paradoxical is the fact that this phenomenon, as the electric pulse of the nuclear explosion, when the tension of electrical pour on the earth's surface it reaches several ten thousand volt per meters, until now, did not find single-valued explanation, and in regard to this to the output of work none of the scientific journals published article on the explanation of this phenomenon. In STR charge is the invariant of speed; therefore the motion of charges in the conductors, where the positive and negative charges are compensated, there must not lead to their electrization. But in the experiments with the superconductive windings and the tori, into which the current is introduced by induction method, around them is formed static electric field. These paradoxes find their explanation that also it will be shown below in the concept of scalar- vector potential.

1. Paradox with the charges, which move along the being intersected lines

Let us examine the situation, depicted by Feynman in Fig. 1 in the sixth volume of its lectures, when charges move along the lines, which are intersected at the right angle [1]. The copy of this figure is given below. Feynman shows that in this case the first charge acts on the second not with this force, as acts the second charge on the first, i.e., third Newton's law is disrupted. It discusses as follows: “Visualize two electrons, speeds of which are perpendicular, so that their ways intersect; however, electrons do not encounter; one of them manages to rush by before another. At some moment of time their relative attitude will be such, as it is represented on Fig. 1, A. Let us examine now forces, with which g_2 acts on g_1 and vice versa. To g_2 from the side g_1 acts only electric force, since g_1 on the line of its motion it does not create magnetic field. However, on g_1, besides electric field, acts still magnetic, so that it moves still and in the magnetic field, created by the charge g_2. All these forces are shown on Fig. 1, B. The electric forces, which act on g_1 and g_2, are equal in magnitude and are opposite in the direction. However, on g_1 still acts the lateral (magnetic) force, whose there are no *and in the mention do not have* g_2. Is equal whether here action to opposition? Break the head above this question". (end of the quotation).

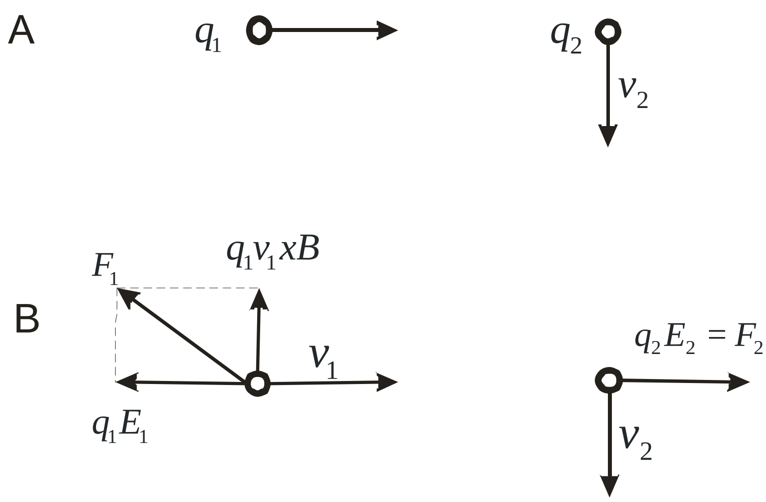

Fig. 1. Forces between two moving charges are not always equal and opposite.

"Action", occurs, it is not equal "to opposition".

By the way, itself Feynman did not give the explanation to this paradox. Yes it in the concept of magnetic field and there does not exist. Let us note that still then when the ampere introduced magnetic field, between it and weber was the large controversy apropos of the origin of the forces, which act between the moving charges. Weber point out on what these forces are the consequence of a change in the properties of charges themselves, but not by the consequence of the appearance of some hypothetical magnetic field. But then weber they did not listen to, we here and have now paradoxes.

Let us examine this situation from the point of view of the concept of the scalar-vector potential, where the dependence of the scalar potential of charge on the speed is determined [2-5]

$$\varphi'(r,v_{\perp}) = \varphi(r) ch \frac{v_{\perp}}{c} \qquad (1.1)$$

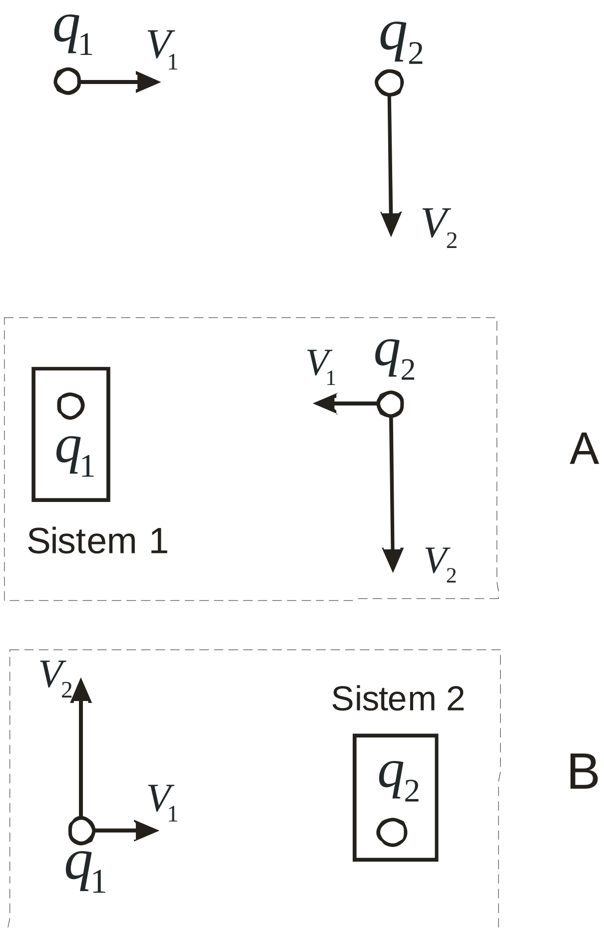

Fig. 2. Interaction of the moving charges in the concept of scalar- vector potential.

In the upper part of the figure is depicted the same situation, as in the sixth volume of Feynman lectures on physics. The direct measurement of the force, which acts on the charge, possibly only in that system, in which this charge rests.

We pass in Sistem 1, in which the charge g_1 is fixed. The components of the charge rates g_2 with respect to the charge g_1 appear in this case, as shown in Fig. 2 A. In this case the force, which acts from the side of the charge g_2 to the charge g_1, will be written down:

$$F_{21} = -\frac{g_1 g_2}{4\pi\varepsilon r^2} ch \frac{v_2}{c}. \tag{1.2}$$

We pass in Sistem 2, in which the charge g_2 is fixed (Fig. 2 B). In this case, the force, which acts on this charge from the side of the charge g_1, can be written as

$$F_{12} = -\frac{g_2 g_1}{4\pi\varepsilon r^2} ch \frac{v_2}{c}. \tag{1.3}$$

As we see relationships (1.2) and (1.3) they give the identical force, which does not depend on value and sign of charges. Thus, third Newton law is not disrupted.

Let us examine an analogous example of the measurement of gravitational force, which acts on the body, which is located on the orbital station, when its antennas or illuminators must look always in the direction of the earth. For this starting it is not enough to give station the speed, with which the centrifugal force will balance gravitational force. In this case it is necessary to ensure still and its rotation around the axis, normal to the vector, which connects satellite with the earth. The angular velocity of this rotation must be equal to angular velocity of its orbital motion. An example of this Earth satellite is the moon, whose condition indicated is carried out with the high accuracy and from the earth is always visible its only one side.

Of force can be divided into two forms. The gradient of scalar potential ensures static (potential) forces, dynamic forces occur with the acceleration of the bodies, which have mass. Gravitational force regarding is potential force. With the orbital flight gravitational force, which acts on the body, is balanced by dynamic centrifugal force. It is easy to measure gravitational force, for this it is necessary to have support and spring balances (dynamometer). But what is to be done, if should be determined gravitational force, which acts on the body, which is located on the orbital station?

Let us examine a question about how to accomplish a direct measurement of the force, which acts on the body, which is located on the space station (Fig. 3).

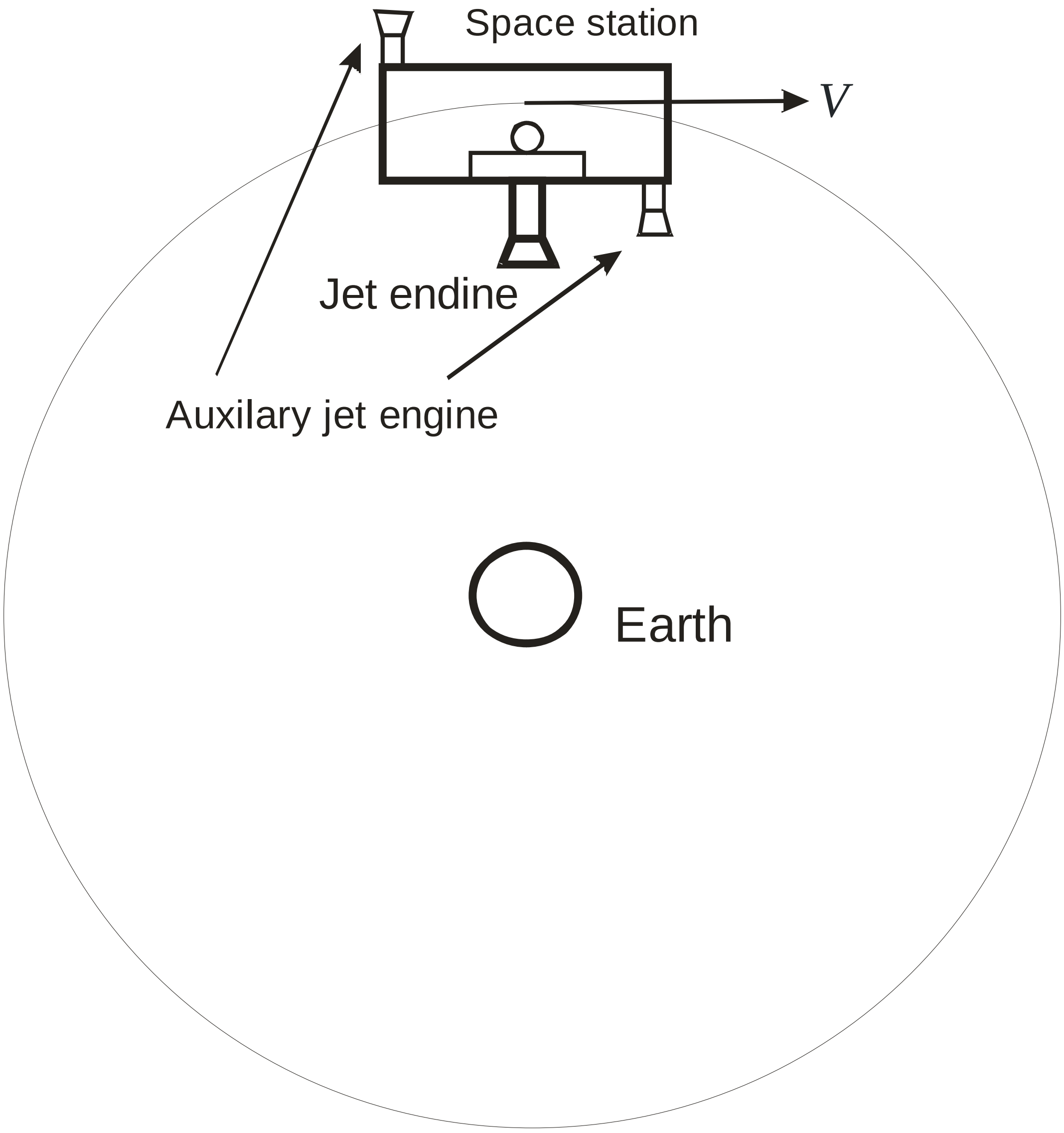

Fig. 3. Mission profile of space station.

In the station is located the sphere, which concerns the bed of the spring dynamometer (it is shown by square under the sphere). It is assumed that the mass of station is considerably more than the mass of sphere. In this state the sphere is weightless and to the bed does not press dynamometer. In order to accomplish a direct measurement of gravitational force, which acts on the sphere at the assigned point of orbit, necessary, beginning from this point, to convert station into the inertial system, which is moved rectilinearly and to stop its rotation. It is for this purpose necessary to include jet engines. Main engine in this case must ensure thrust equal to the weight of station and sphere at the assigned point of orbit, and pilot engines must ensure the absence of its rotation around the axis, passing through the center of sphere. In this case the sphere will remain at the previous place, but it will press to the bed of dynamometer with the force, the wound to its weight.

2. Experimental confirmation of the dependence of the scalar potential of charge on its relative speed

The diagram of experiment is shown in Fig. 4. [6] Inside the torus-shaped conducting screen is placed the superconductive torus, made from niobium. When charge will appear inside the screen, a potential difference will appear between the internal and external screen. In the experiment, as external screen 1, the yoke of transformer, made from transformer steel, was used. On the central rod of this yoke was located primary winding with 2, wound by niobium-titanium wire, which contains 1860 turns. Torus-shaped metal screen 3, made from copper, was located on the same rod. Torus 4, made from niobium, is located inside this screen. The outer diameter of niobium torus composed 76 mm, and internal 49 mm. Transformer was placed in the tank of helium cryostat and was cooled to the helium temperature, in this case the yoke of transformer and helium tank were grounded. The current was induced during the introduction of direct current into the primary winding of transformer in the superconductive torus, and electrometer fixed the appearance between screen 3 and yoke of transformer a potential difference U. This means that the niobium torus, located inside screen 3 during the introduction into it of direct current ceases to be electrically neutral. The constant value current in the superconductive torus 1860 times exceeded the current, introduced into the primary winding of transformer.

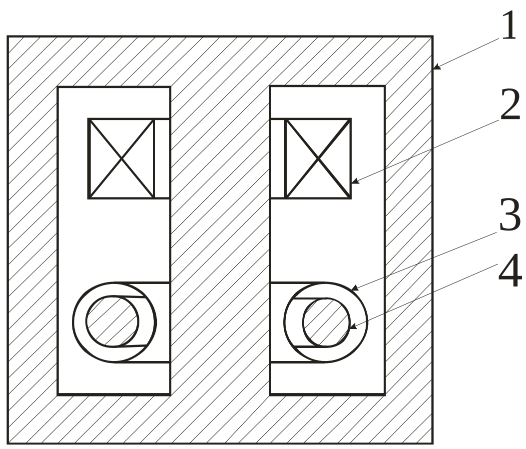

Fig. 4. Diagram of experiment with the superconductive torus.

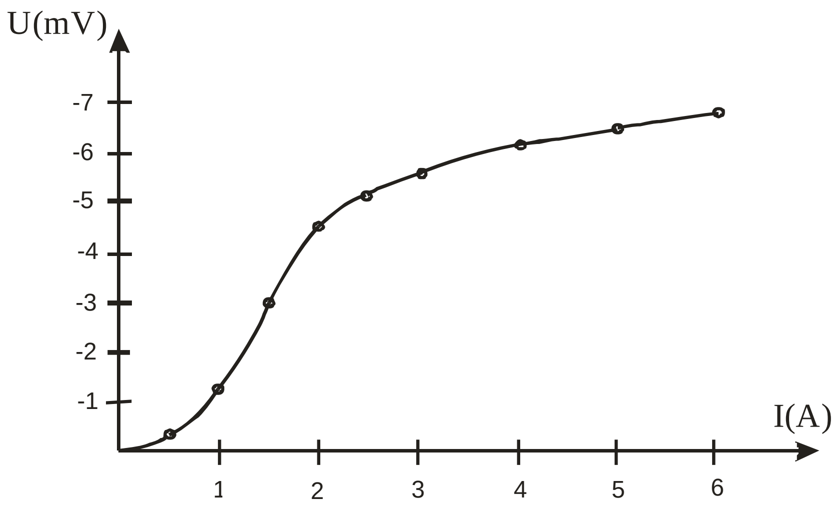

Fig. 5. Dependence of a potential difference boundary by screen 3 by the yoke of transformer on the current, introduced into the primary winding of transformer.

The dependence of a potential difference U on the current I, introduced into the primary winding of transformer, it is shown in Fig. 5.

The obtained values of a potential difference, in comparison with the case of the superconductive wire winding, proved to be considerably smaller, this is connected with the considerably smaller surface of torus, in comparison with the surface of wire winding. The form of the dependence of a potential difference on the introduced current also strongly differs. Quadratic section is observed only in the very small initial section up to the values of currents into 2 amperes, introduced into the primary winding. Further this dependence becomes almost rectilinear with small angle of inclination. It was not observed moreover of stalling the indications of electrometer in this case.

With which are connected such differences in the behavior of a potential difference in comparison with the wire version? In the case of wire solenoid the superconductive current is evenly distributed over the surface of wire and reaches its critical value in all its sections of surface simultaneously, with which and is connected the simultaneous passage of the entire winding of solenoid into the normal state, with the reaching in the wire of the critical value of current.

In the case of torus the process of establishing the superconductive current on its surface occurs differently. That introduced into the direct current superconducting torus is very unevenly distributed over its surface. Maximum current densities occur on the internal surface of torus, and they are considerably less on the periphery. With this is connected the fact that the internal surfaces of torus begin to convert to normal state earlier than external. The process of passing the torus into the normal state occurs in such a way that with an increase of the current in the torus into the normal state pass the first interior and normal phase begins to be moved from the interior to the external. Process lasts until entire torus passes into the normal state. But why in this case up to the moment of passing the torus into the normal state does not occur the discharge of current, as it takes place in the case of wire solenoid? This niobium is connected with the fact that the superconductor of the second kind, and it does not convert abruptly to normal state. It has the sufficiently significant region of current densities, with which it is in the mixed state, when the Abrikosov vortices penetrate inside the massive conductor. The circumstance that the indications of electrometer do not have a discharge of indications, he indicates that the superconductive torus is in the mixed state, but the presence of the vortex of the structures in it, which also present the superconductive currents, they lead to the fact that the torus ceases to be electrically neutral. From this it is possible to draw the conclusion that the vortices bear on themselves not only magnetic-flux quanta, but still electric charges. It is observed strong hysteresis. This is connected with the fact that the vortices, which penetrated into the depths of the superconductor, they are attached on the stacking faults, falling into potential wells, that also leads to hysteresis.

Thus, the results of the carried out experiments unambiguously indicate the dependence of scalar potential and magnitude of the charge from their speed, which was predicted still in the work [2-5] and it is experimentally confirmed in the works [6].

3. Electric pulse of space thermonuclear explosion

According to the program *"Starfish"* USA exploded in space above Pacific Ocean H-bomb. This event placed before the scientific community many questions. It is earlier into 1957 year future Nobel laureate doctor Hans Albrecht Bethe (Hans A. Bethe), being based on the theory of dipole emission, predicted that with a similar explosion will be observed the electromagnetic pulse (EMI), the strength of field of which on the earth's surface will comprise not more than 100 V/m. Therefore entire measuring equipment, which had to record electromagnetic radiation, was disposed for registering such tensions pour on. 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. Electric pulse had not only very large amplitude, but also very short duration on the order of 50 ns. Since doctor Bethe forecast did not justify, it was subsequently advanced a number of the theories, intended to explain experimental data.

The greatest reputation obtained the theory, in which it is assumed that the pulse shaping is obliged to the relativistic Compton electrons, which the rigid X-radiation knocks out from the molecules of air. Such electrons simultaneously with gamma-radiation move with the relativistic speeds in the direction of propagation of electromagnetic wave. It assumes this model that the process of the pulse shaping is not the property of explosion itself, but is the second effect, connected X-radiation it with the fact that knocks out from the molecules of air Compton electrons. It follows that the pulse is extended from the ionosphere into the lower layers of the atmosphere, and its field higher than ionosphere, directly in space itself, they be absent from it. But, if we with the aid of the theories examined even somehow possible explain the presence of electrical pour on in the visibility range of explosion, then the fact of strong ionospheric disturbances at large distances from the explosion, which it accompanied, to explain difficultly. Thus, after explosion in the course of several ten minutes there is no radio communication with Japan and Australia, and even at a distance into 3200 km of from the epicentre of explosion were fixed ionospheric disturbances, which several times exceeded those, which are caused by the most powerful solar flares. Explosion influenced also the automatic spacecraft. Three satellites were immediately disabled. The charged particles, which were appeared as a result explosion, were seized by the magnetosphere of the Earth, as a result of which their concentration in the artificial Earth radiation belt it increased by 2-3 orders. The action of radiation belts led to the very rapid degradation of solar batteries and electronics in seven more satellites, including in the first commercial telecommunication satellite Tele-Star. On the whole explosion derived from system third of the automatic spacecraft, which were being found in low orbits at the moment of explosion.

With the explosion of nuclear charge according to the program “*Program K”*, which was realized into the USSR, the radio communication and the radar installations were also blocked at a distance to 1000 km of. As a result these tests it was established that the high-altitude nuclear explosions are accompanied by the emission of the powerful pulse, which considerably exceeds in the amplitude the value of the pulse, which occurs with the surface explosions of the same power. It was discovered, that the registration of the consequences of space nuclear explosion was possible at the large (to 10 thousand kilometers) distances from the point of impact.

From the point of view of the existing concepts of classical electrodynamics Compton models cause serious questions. For example, why all Compton electrons must move cophasal with the front of gamma-radiation with the relativistic speed. In Compton electrons the velocity vector has spatial distribution, in connection with this it is not possible to obtain such short of the pulse rise, as it takes place in actuality. In the electrodynamics such mechanisms, which give the possibility to obtain the single-pole pulse of electric field without the three-dimensional separation of charges in this place theoretically be absent. But in the pulse rise time, which is calculated by tens of nanoseconds, to obtain the three-dimensional separation of charges, which will ensure the field strength obtained during the experiment, it is impossible. Compton ionization itself leaves entire system as a whole of electrically neutral. In addition to this, the ionosphere does not have sharp boundary;

therefore its ionization by X-radiation will pass gradually in proportion to the advance of the wave of emission, which will lead to an increase in the duration of terminal impulse up to several milliseconds.

Is known that the problem of this phenomenon attempted together with his students to solve and academician Zeldovich [7]. However, in the existing sources there is no information about the fact that it solved this problem. Consequently, the everything indicates that within the framework existing classical electrodynamics the results, obtained with the tests according to the program *"Starfish" of* and *"Program K"* cannot be explained thus far.

In what does consist the danger of the forecasts, which does give the model of Compton electrons? Problem in the fact that this model excludes the possibility of the presence pour on pulse in space. The let us assume that indicated model is accurate, and, relying on it as in the past for the predictions of doctor Bethe, will be produced sequential nuclear explosion in space, which will put out of action a large quantity of satellites. Moreover this explosion can be both the planned and realized for terrorist purposes. Then be justified already is late.

Let us undertake the attempt, using a concept of scalar- vector potential, to explain obtained experimental data, and let us also show that with the explosion of nuclear charge in space, there there are not fields of electromagnetic pulse (EMI), but pulse electric fields (IEF), in which the magnetic field is absent. The fields IEF in space having much more significant magnitudes, than in the atmosphere and on the earth's surface.

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 of plasma is subordinated to the distribution of Boltzmann. Let us assume that the temperature of the plasmoid at the initial moment formed with the explosion composes ~ 10^{8} K, and the total weight of bomb and head part of the rocket, made from metal with the average electron density ~5× of 10^{22} of 1/sm^3, composes 1000 kg. General 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 ~ of 8 g/cm^3 , will comprise ~ 5×10^{27} . The most probable electron velocity at the temperature indicated let us determine from the relationship:

$$v = \sqrt{\frac{2k_Б T}{m}},$$

where $k_Б$ - Boltzmann constant, and m - mass of electron.

Now, using Eq. (1.1) for enumerating the increase scalar -vector potential and taking into account only terms of the expansion ~ $\frac{v^2}{c^2}$, we obtain

$$\Delta\varphi \cong \frac{Nek_Б T}{4\pi\varepsilon_0 rmc^2} , \tag{3.1}$$

where e- electron charge, and r- distance from the burst center to the observation point. We determine from the formula the tension of radial electric field, which corresponds to this increase in the potential:

$$E = \frac{Nek_Б T}{4\pi\varepsilon_0 r^2 mc^2} = \frac{\Delta q}{4\pi\varepsilon_0 r^2}, \tag{3.2}$$

where

$$\Delta q = \frac{Nek_Б T}{mc^2} \tag{3.3}$$

is an equivalent charge of explosion. By this value it is necessary to understand exceeding the charge of electron gas in comparison with its equilibrium value in the metal.

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.

In accordance with Eq. (3.2) the tension of radial electric field in the epicentre of explosion with the assigned above parameters will compose ~ 7×10^5 V/m. 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. With resolution of this question should be considered also the screening effect of the ionosphere.

Let us first examine the case, when the ionosphere is absent (Fig. 6). For simplification in the task we will consider that the ideally conducting limitless plane represents by the earth's surface. The solution of allocation problem pour on for the charge, which is been located above this plane, well known [1].

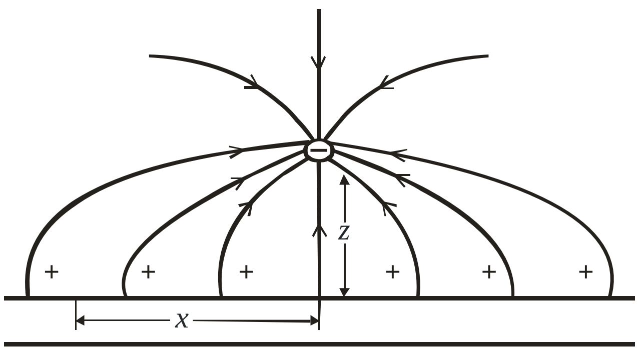

Fig. 6. Negative charge above the limitless conducting plane.

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

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

where q - magnitude of the charge, z - shortest distance from the charge to the plane, x - distance against the observation points to the point of intersection of vertical line, lowered from the point, where is located charge, to plane itself.

Lower than conducting plane electric fields be absent. 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 charge from the coordinate x can be determined from Eq.

$$\sigma(x) = \varepsilon_0 E_{\perp} = \frac{1}{2\pi}\frac{zq}{\left(z^2 + x^2\right)^{\frac{3}{2}}}. \qquad (3.4)$$

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. Let us examine from these positions the screening effect of the ionosphere (Fig. 7).

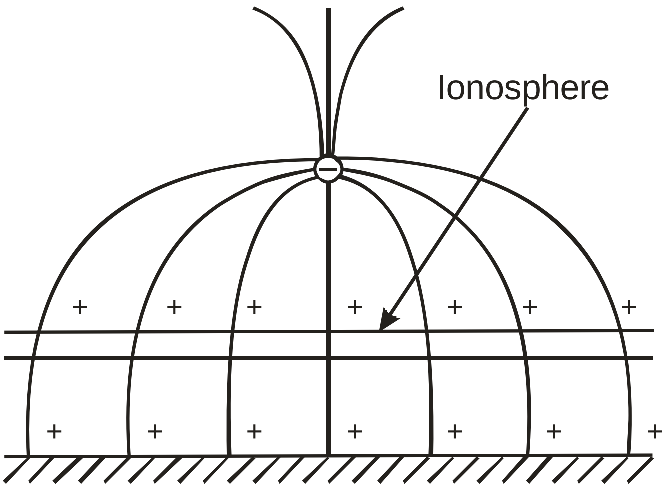

Fig. 7. Negative charge above the earth's surface with the presence of the ionosphere.

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 quantity of free positive charges in the ionosphere will be less than first, which is necessary for the complete compensation for the equivalent charge of explosion, then its 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. 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.

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. 8.

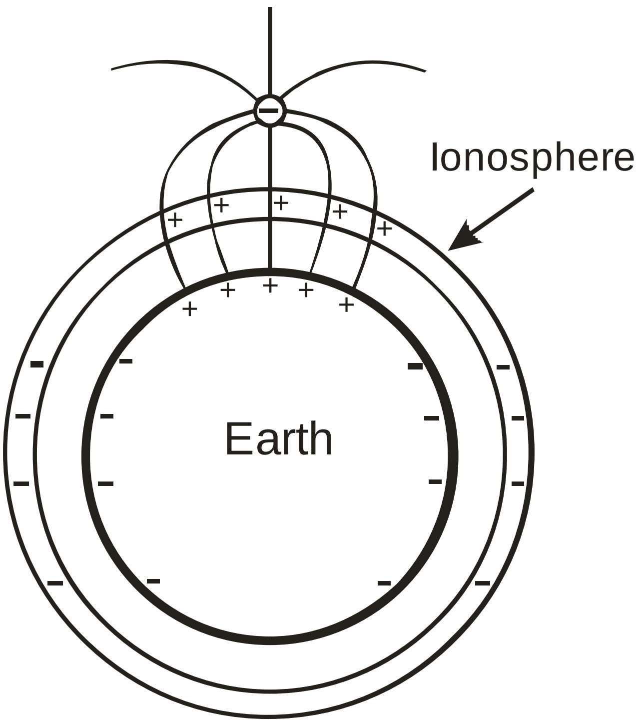

Fig. 8. Negative charge above the earth's surface with the presence of the ionosphere.

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 chargex will be located in the ionosphere directly in the straight visibility under the charge and here them it will be in the surplus, while beyond the line-of-sight ranges in the surplus they will be negative charges. And entire system charge - the ionosphere - the earth will obtain additional dipole moment. The distribution of induced charge in the ionosphere will depend on the height, at which is located the charge, and also from the position of the sun with respect to the charge, since the degree of ionization of the ionosphere depends on its position.

With the nuclear explosion is synchronous with the electrical radial fields, which are moved from the plasmoid with the speed of light, moves the front of X-radiation. This emission will ionize the atmosphere, increasing its conductivity, while this will, in turn, increase the shielding functions of the atmosphere from the penetration into it of the pulses of the subsequent explosions, if such arise. Furthermore, since the negative potential of plasmoid at the initial moment of the explosion of very large, from the cluster will be temporarily rejected some quantity of electrons, which also after a certain time will fall into the ionosphere. The partial neutralization of the electrons, which fell into the ionosphere, will occur, when the positive ions of plasmoid will also reach the ionosphere. But this will concern only those ions, the radial component of speed of which was directed to the side of the ionosphere. The same electrons and ions, whose radial component was directed to the side from it, will leave the limits of the earth's gravity and they will present the similarity of that solar wind, which is the consequence of the evaporation of the solar corona or flashes on the solar surface. Those complex processes, which accompany nuclear explosion, now are only schematically outlined, and is in prospect still extensive work, on the recreation of these processes for the actual conditions. It is obvious that to make this is possible only numerical methods.

The model examined speaks, that nuclear explosion will lead not only to the appearance IEF in the zone of straight visibility, but also to the global ionospheric disturbance. It is known that the explosions according to the program *"Starfish"* and according to the program *"Program K"* led to the presence of large interferences with radio-technical and radar systems at large distances from the epicentre of explosion. Certainly, the electric fields in space, generated by this explosion, have very high values and present the major threat for the automatic spacecraft.

Now let us return to the horizontal component of electrical pour on on the earth's surface, generated with the explosion. It is understandable that these fields represent the tangential component of radial pour on, that go from the point of explosion. Specifically, these fields cause the compensating currents, which create the compensating surface charges. It is possible to calculate the order of the summed currents, which will have radial directivity with respect to the epicentre of explosion. For this let us calculate summary compensating grain surface on the earth's surface, which must be formed with the explosion of nuclear charge. This charge is equal to the charge of plasmoid with the opposite sign of

$$q = 4\pi\varepsilon_0 r^2 E .$$

After conducting calculations according to this formula, on the basis of the actually measured vertical tensions of electrical pour on in the epicentre of explosion (5.2×10^{4} V/m), with the distance to the explosion of 400 km of we obtain the charge ~ 10^{6} coulomb. However, the value of charge, calculated according to formula (3.3) they will compose ~ 1.2×10^{7} coulomb. This divergence, as it is already said, can be connected with the screening effect of the ionosphere. If the building-up of electric field it is ~ 50 ns, then the summed current, directed toward the epicentre of explosion, must compose ~ 10^{12} A. Certainly, this number is somewhat overstated, because the compensating charges are attracted not to one point, which is been the epicentre of explosion, but to the sufficiently extensive region in its environment. But even if this value decreased several orders, previous the strength of compensating currents will be very large. It is now understandable, why on Oahu island, that is been located at a distance of 1300 km of from the epicentre of explosion, burnt 300 street lamps, and near Dzheskazgan in the air telephone line with the extent 570 km of arose the currents ~ 2.5 kA, which burnt in it all safety fuses. Even to the power cable by extent is more than 1000 km of, which connects Almaata and Akmola, and the having armored screen from lead, braiding from the steel tape, and located on the depth 0.8 m of, such focusings arose, that operated the automata, after opening from the cable power station. Certainly, the pulse of tangential currents, although the less significant than on the earth's surface, will be also in the ionosphere, which will lead to its disturbance on global scales.

Entire process of formation IEF with the explosion of charge in space can be described as follows. At the moment of explosion in the time of the detonation of nuclear charge, which lasts several nanoseconds, is formed dense plasmoid with the temperature in several ten and even hundreds of millions of degrees. This cluster generates the powerful gamma emission, which is extended in different directions from the cluster with the speed of light. Simultaneously is generated the radial electric field, which also is extended in the radial direction from the cluster with the speed of light. Radial electric fields IEF and gamma-radiation reach the ionosphere simultaneously. During its further motion to the side of the earth's surface, if explosive force for this it is sufficient, X-radiation begins to ionize and the layers of the atmosphere, which are been located lower than the ionosphere. The process of the ionization of upper air and the penetrations in them of radial electric field will simultaneously occur. In the ionized layers due to the presence of radial electric field will arise the radial currents, which will lead to the stratification of charges and to the vertical polarization of conducting layers. The processes of the polarization of the atmosphere will last as much time, as will exist radial field, and also conductivity of ionized air. Since the ionosphere will not be able to ensure the charge, necessary for the complete compensation for the radial field of plasmoid, these fields, although in the weakened form, they will continue to be extended in the direction of the earth's surface, and electric fields will create powerful radial currents. The process of propagation of X-radiation and radial pour on through the ionosphere it will lead to its additional ionization and polarization, and also to the appearance of a pulse of tangential currents. The pulse of tangential currents in the ionosphere will apply to distances considerably greater than the visibility range of explosion, which will lead to the global ionospheric disturbances.

Up to that moment, when the flow of rigid gamma emission and ionization of atmosphere cease, the part of the atmosphere, ionized lower than the existing boundary of the ionosphere, will cease to be conductor, and is, therefore, the three-dimensional divided charges will prove to be closed in it. The electrons closed in the atmosphere will as before create some static potential difference, which will slowly relax to the extent of the presence of the residual conductivity of the atmosphere. It should be noted that the polarity of this field will be opposite to the polarity of initial IEF, that also is observed in actuality. This means that the radial electric field, observed on the earth's surface, will be first directed from the earth toward the epicentre of explosion, but at some moment of time it will change its polarity.

Becomes clear and that, why after space nuclear explosion an even longer time is observed the residual glow of the atmosphere under the point of impact. This glow is obliged to those electrons, which during the first stage development IEF were displaced of the ionosphere into the denser layers of the atmosphere, and then, after the termination of the ionized effect of gamma emission, they remained closed in the little conducting atmosphere, continuing to ionize it.

Thus, the appearance IEF with the nuclear explosion are the properties of explosion itself, but not second phenomena. Its properties and characteristics can be explained within the framework to the concept of scalar- vector potential. Studying topology IEF on the earth's surface, it is possible to judge also the subsequent processes of polarization and depolarization of the ionosphere, atmosphere and earth's surface. With the explosion in the atmosphere very process of formation IEF and its development are connected with the presence of the atmosphere, and also by the presence of conductivity on the earth's surface and this will also superimpose its special features on shaping pour on IEF. With the explosions in immediate proximity from the earth's surface the equivalent charge of the cloud of explosion will see its mirror reflection under the earth's surface, forming the electric dipole. For this reason the region of propagation pour on IEF it will be strongly reduced, since the fields of dipole diminish according to the cubic law.

Now should be made one observation apropos of term itself the electromagnetic pulse EMI, utilized in the literary sources. From this name should be excluded the word magnetic, since this process presents the propagation only of radial electrical pour on, and in this case magnetic fields be absent. 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.

Would seem, everything very well converges, however, there is one basic problem, which is not thus far examined, it concerns energy balance 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. If we consider that the time of detonation is equal to 50 ns, then explosive force composes $\sim1.3\times10^{23}$ W. Let us say for an example that the power of the radiation of the Sun of $\sim3.9\times10^{26}$ W. Let us examine a question, where how, in so short a time, can be the intake, isolated with this explosion.

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

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

where $\sigma = 5.67\cdot10^{-8}\ \frac{Bm}{м^2K^4}$ - the Stefan-Bolzman constant, and s - area of radiating surface.

If we take the initial temperature of the plasmoid $\sim 10^8$ K, then with its initial diameter 1 m (in this case the surface area of cluster it is ~3 m^2) entire explosive energy will be radiated in the time ~ 0.4 ns. But if we take the initial temperature $\sim 10^7$, then this time will be already ~ 400 ns. Thus, one should assume that the initial temperature of plasmoid to be located somewhere between the undertaken values. Wavelength, on which will be radiated a maximum quantity of energy, is determined by the Win law

$$\lambda_{макс} = \frac{0,28975}{T} \ \frac{см}{K} .$$

If we substitute here the value of the temperature 5×10^7 K, then we will obtain the wavelength on the order 6 Å, which corresponds to rigid X-radiation. Its temperature will begin to fall in proportion to cooling cluster and $\lambda_{макс}$ will begin to be shifted into the visible part of the spectrum.

But the mechanism of losses examined is not only. Since with the temperature of cluster are unambiguously connected its electric fields, immediately after detonation they will be maximum, and then with a temperature drop of cluster they will begin to decrease proportional to temperature. However, the energy, necessary for their creation, will fall not as rapidly as energy necessary for creating the X-radiation.

Appears one additional important question about which a quantity of electrons it will leave plasmoid. In order to answer it, let us examine the condition of the electricneutral of plasma. At that moment when metal is converted into the plasma, occurs not only the passage of substance from one state of aggregation to another, but also changes the statistics of the description of electron gas. In the solid state statistician Fermi-Dirac's this, while in the state of plasma - statistician Boltzmann's this. When electron gas was located in the steadfast conductor, then in the state of electricneutral to each ion it was fallen along one free electron. Let us determine from the point of view of the concept of scalar- vector potential, what relationship must be observed between the electrons and the ions in the plasma so that it would also remain electrically neutral. Before solid became plasma, the electron density and ions was identical and, therefore, the absolute values of their charges were equal

$$eN_e = eN_{np},$$

After the transformation of substance into the plasma general equivalent electron charge increased, to the value, determined by Eq. (3.3), and in ions it remained practically before. Now already for observing the electricneutral must be observed the relationship:

$$N_{e(nл)}\left(1+\frac{k_Б T}{m_e c^2}\right) = N_{np},$$

where of $N_{e(nл)}$ - equilibrium quantity of electrons in the plasma.

Is evident that this equilibrium quantity is less than to the passage of substance into the state of plasma. Difference composes

$$\Delta N = N_{np}\left(1-\frac{1}{1+\frac{k_Б T}{m_e c^2}}\right), \tag{3.5}$$

For example, at a temperature ~10^8 the value, which stands in the brackets, will compose approximately 0.13. This means that at the temperature indicated, for retaining of the electricneutral of plasma, 13% a total initial quantity of electrons had to it leave. We will call this effect the effect of temporarily excess electrons. Word “are temporarily " used by in the sense that temporary they appear as long as plasma is hot. In this connection clear to become that, from where, for example, on the surface of the sun appear powerful magnetic fields, especially when at it appear spots. These fields are induced by those currents, which overflow between the regions of plasma, which have a different temperature.

We in sufficient detail examined the behavior of the static charge above the conducting plane. But in actuality there is not a static charge, but a charge, which lives only several hundred nanoseconds. If in the origin of coordinates is located the charge $Q(t)$, depending on time, then the electric fields, created by it in the surrounding space, can be found from Eq.

$$\varphi(r,t) = \frac{Q(t)\left(t-\frac{r}{c}\right)}{4\pi\varepsilon r}, \tag{3.6}$$

twhich correspond the being late longitudinal electric fields:

$$E(r,t) = \frac{Q(t)\left(t-\frac{r}{c}\right)}{4\pi\varepsilon r^2}. \tag{3.7}$$

In accordance with relationships (3.6, 3.7) the short-lived charge generates so short-term a pulse of longitudinal electrical pour on, which in the space are extended with the speed of light and is formed the spherical layer, whose thickness is equal to the lifetime of charge, multiplied by the speed of light. If we consider that for our case the time of life of charge composes the half-width of pulse IEF (somewhere about 100 ns), then the thickness of this layer will be about 30 m.

As was already said, analyzing the topology of pulse IEF, it is possible to judge about the temperature of plasma and the processes of proceeding in it. This method can be used also for diagnostics of other forms of plasma. For plasma itself there is no difference whatever in by what form of its energy they ignite, is important only quantity of free electrons, i.e., the degree of ionization, which depends on the final temperature of plasma.

Laser warming is considered as the promising method of its warming for realizing of thermonuclear fusion. In this case the samples under investigation undergo the action of powerful laser pulse. Model in short time is converted into the high-temperature plasma, i.e., there is a certain similarity of the behavior of plasma with the nuclear explosion. For these purposes it suffices to surround sample under investigation by two conducting screens and to connect between them high-speed oscillograph with the high input resistance. External screen in this case should be grounded. At the moment of the warming-up of plasma will arise IEF. Moreover a potential difference between the screens will arise much earlier than the material particles of plasma they will reach the walls of the first screen. Studying the topology of the recorded pulse, it is possible to judge the temporary energy processes of the warming-up of plasma. It is not difficult to calculate the expected potential difference between the screens depending on the temperature and quantities of free charge carriers. After using relationships (3.5) and (3.7), for the case, when $k_Б T \ll mc^2$ we obtain:

$$U = \frac{Nek_Б T}{4\pi\varepsilon_0 mc^2}\left(\frac{1}{r_1^2} - \frac{1}{r_2^2}\right),$$

where r_1 and r_2 - radius of external and internal screens respectively, and N - quantity of free electrons in the heated plasma.

The fact of the presence of excess electrons should be considered, also, with realizing of controlled thermonuclear fusion, since this phenomenon must influence also the stability of plasma with its warming.

It should be noted that despite the fact that nuclear explosions are studied already sufficiently long ago, however, until now, not all components of the development of this process obtained its explanation. Such processes include the so-called cable tricks (rope of trick).

In Fig. 9 and Fig. 10 are represented the photographs of such it is special effect. These photographs removed American photographer Harold Edgerton by automatic camera, which is been located at a distance of 11.2 km of from the epicentre of explosion with the periodicity of survey 100 ms.

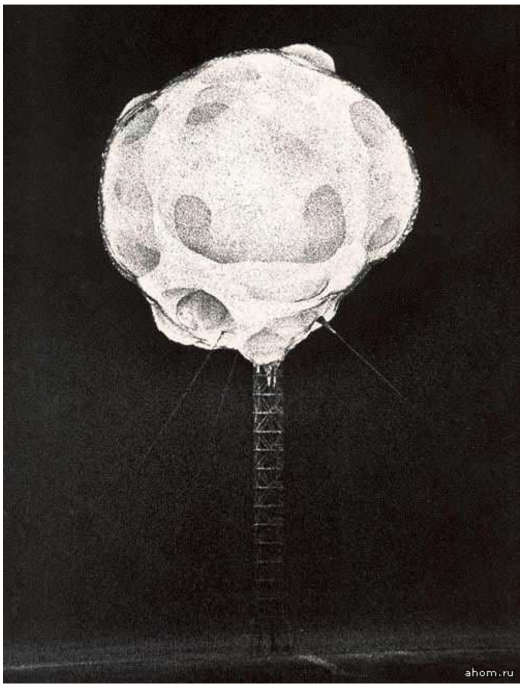

Fig. 9. Initial phase of the development of the cloud of explosion.

In Fig. 9 is presented the initial phase of the development of the cloud of the explosion of charge, located on the metallic tower with the stretchings from the wire cables. Already it is evident on the initial phase of explosion that in the upper part of the cloud of explosion are three spinous formations.

The same shafts is especially well visible in the upper photograph (Fig. 10). Towers in this photograph already barely it remained, but it is evident that the shaft of large diameter, which exits to the earth, pierces it. Smaller two shafts are extended in the direction of the stretching ropes.

In the photographs is evident that the diameter of shaft grows with an increase in the volume of the cloud of explosion. Especially good this is evident in the lower photograph Fig. 10, when the cloud of explosion already touched the earth. The shaft, located in the lower left side of the cloud of explosion, which exits to the earth, has already considerably larger diameter, than in the upper photograph.

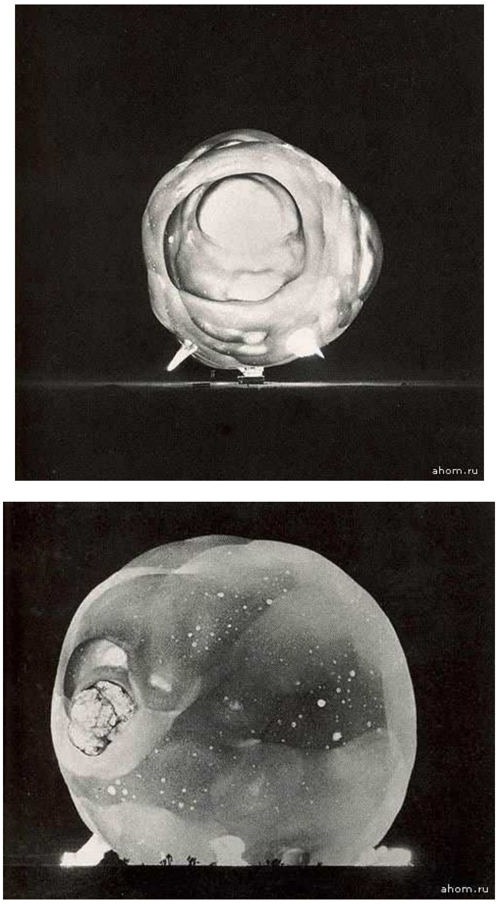

Fig. 10. Subsequent phases of the development of the cloud of explosion.

This phenomenon attempt to explain by the fact that powerful gamma-radiation of the cloud of explosion melts ropes, converting them into the plasma. But this idea is not very productive, since the ropes of stretchings go practically in parallel to light rays; therefore they cannot be heated strongly by emission.

Is certain that the ropes and tower are guiding elements for the appearance of shafts, it is clearly evident in upper Fig. 10. Moreover, this photograph finally removes version about the fact that the ropes ignite by the emission of the cloud of explosion. It is evident in the photograph that the luminosity of shafts is higher than in cloud itself, and means their temperature also higher. But, if they ignite by the emission of cloud itself, then their temperature cannot be higher than its temperature. Consequently, must be some additional sources of the warming-up of ropes.

Even the more impressive photograph of the formation of the cloud of explosion and shafts is shown in Fig. 11.

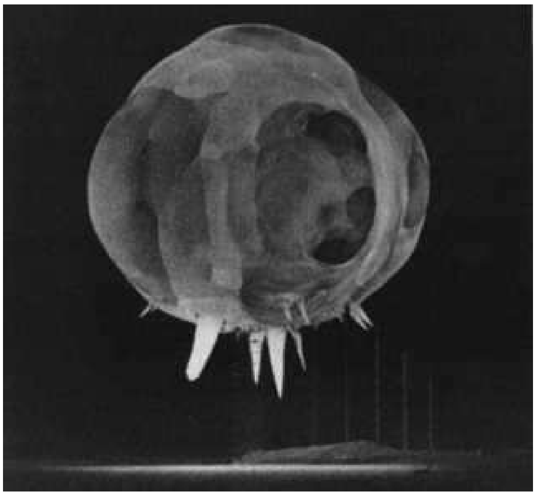

Fig. 11. Cloud species of explosion after 1 ms after the detonation of nuclear charge.

Therefore follows to assume that the warming of ropes it is connected with the advent of the equivalent charge of the explosion, which as along the lightning conductor departs through the ropes to the earth, ignite them. Since the part of the rope closest to the plasmoid is hottest, specific resistance in this part is more than in the remaining parts of the rope. Therefore a basic voltage drop will precisely fall in this section, and, therefore, and to be melted it will begin from this place. Moreover, those sections of rope and tower itself, which are converted into the plasma, also add some quantity of excess electrons, which must be somewhere rejected. Therefore this phenomenon is connected with the appearance of the equivalent charge of the explosion, which through the ropes and tower departs to the earth.

The appearance of the induced equivalent charge of explosion, and it, is as shown higher, it has very high value, it will melt not only the ropes of stretchings and tower. Very high currents will be induced on the earth's surface radial with respect to the epicentre of explosion, and also in the conducting elements of those located above the earth's surface and buried into the earth, which presents the specific danger with the ground-based or air nuclear explosion.

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