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# Electrification of Plasma with its Rapid Heating

By F. F. Mende

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## I. Introduction

The concept of scalar- vector potential provides for the dependence of electrical pour on the moving charge from its speed [1-6]. In this concept the charge is not the invariant of speed. Up to now only indirect experiments, connected with the appearance of electric pulse with the space thermonuclear explosions testified in favor indicated concept [7]. In the proposed article are carried out the straight experiments, which attest to the fact that in the process of the warming-up of plasma it acquires unitary charge. These experiments were carried out by the way of the micro-burst of the thin metallic wires, through which was passed the current from the capacitor bank of great capacity.

## II. Examination of The Electrization of Plasma with its Rapid Warming-up

In the experiments for the warming-up of plasma the micro-bursts with the discharge of the chemical capacitors of the great capacity through the discharger or with the discharge of such capacitors through the lamp of photoflash were used. In the discharger was used the copper wire, with the connection to which the charged capacitors it was melted and evaporated, being converted into the plasma.

In Faraday's cell, which serves the continuous metal screen (on the figures it is depicted as dotted line) are placed the chemical capacitors of great capacity, the discharger and the key, which makes it possible to connect to the discharger the charged capacitors. The chains of outline, which include capacitor, key and discharger did not have galvanic contact with the screen of Faraday's cell. Faraday's cell surrounds one (Fig. 1) or two (Fig. 2) metallic of screen.

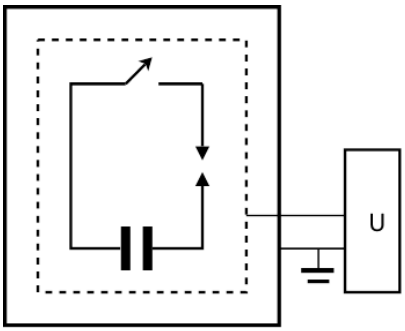


*Fig. 1:* Diagram of experiment with one external screen.

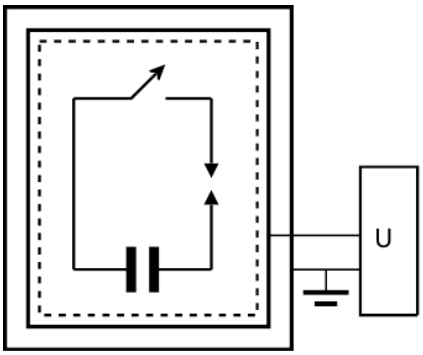


*Fig. 2:* Diagram of experiment with the intershield.

Characteristic measurement of electric pulse it was achieved with the aid of the digital memory oscillograph SIGLENT SDS 1072CNL.

In the first case (Fig. 1) oscillograph was connected between the screen of the Faraday's cell and the external screen. In the second case (Fig.3) the oscillograph was connected between the external screen and the intershield, located between the screen of the Faraday's cell and the external screen. The schematic of experimental installation is shown in Fig. 3 Composite stock consists of two parts. Brass stock is fastened to the upper textolite bushing with the aid of the pins. Between the lower part of the stock and the brass plate there is a spring, which ensures the electrical contact between the brass part of the stock and the brass plate. To the partition inside the screen of Faraday's cell is fastened the insulating plate with the contact washer to it. The unit of capacitors is connected between the brass plate and the contact washer. To the lower part of the stock are attached thin copper wire, gauge 0.2 mm, its length, which comes out from the stock – 5 mm. During lowering of stock the wire concerns contact washer, and the charged capacitors

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are connected to it: wire is melted and evaporates, being converted into the plasma. The collection of the chemical capacitors with a total capacity 6000 mcF was charged up to the stress 300 v. Fastening bolts and pins are shown by the fatty sections of lines. Are not shown joints for the connection of the oscillograph between the screen of the Faraday's cell and the external screen, between the external and intershield and joints for the charging of capacitors. The charging cable of capacitors from Faraday's cell was disconnected with the measurements.

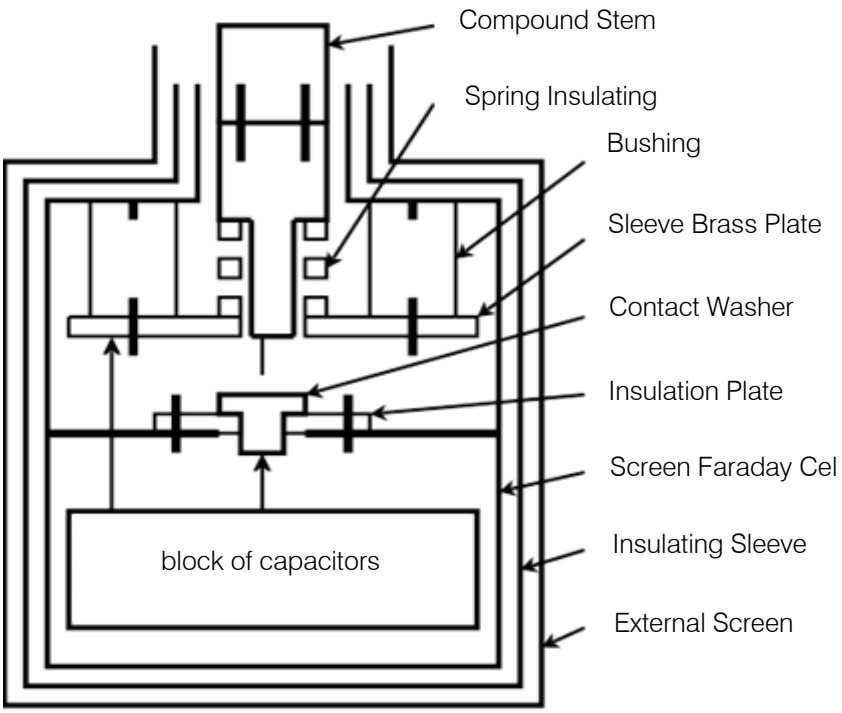


*Fig. 3:* The schematic of experimental installation is

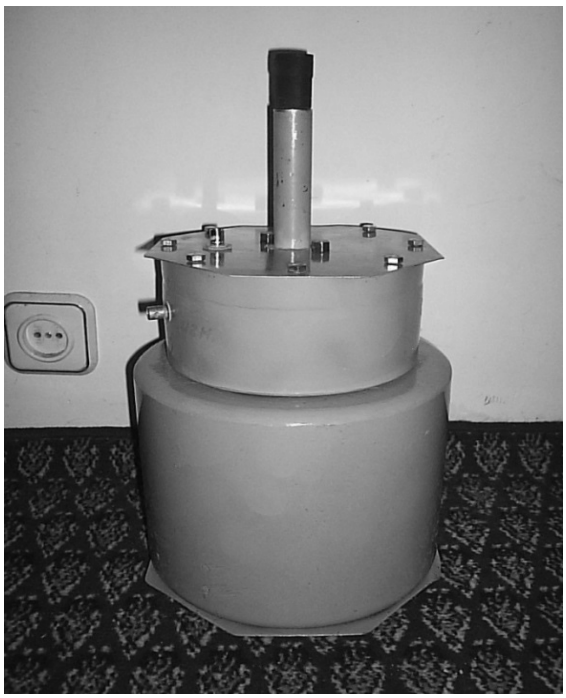

*Fig. 4:* Photograph of the cell Faraday in the collection

*Fig. 5:* Photograph of the experimental installation in the dismantled form

The photograph of the screen of Faraday's cell it is shown in Fig. 4. Diameter of the upper and lower part of the screen of the Faraday's cell 180 mm and 220 mm respectively.Height of the upper part 80 mm, and lower – 220 mm. The upper part of the screen is capped, to which is attached the tube, into which is put composite stock. The screen of Faraday's cell is covered with three layers of acrylic auto-enamel. Above can stick copper foil – intershieldin Fig. 5 the separate parts of installation are depicted. The lower part of the photograph presents external screen. Its diameter 300 mm, and a height 600 mm. On top on the external screen, closed with cover, stands Faraday's cell. In the installation in the assembled form Faraday's cell is located inside the external screen on the insulating table.

In the process of experiments it was established that the surge voltage appears with the capacitor discharge through the discharger between the screen of the Faraday's celland the external screen. In order to be certified in the fact that with the warming-up of plasma in Faraday's cell actually is formed the unitary charge, was carried out the following experiment. After rubbing by the fur of model from the amber (in this case on it it is formed negative charge), it through the tube in the upper lid was rapidly introduced into Faraday's cell. On the oscillograph, connected between the screen of Faraday's cell and the external, is registered the pulse (Fig. 6). Shape of pulse with the rapid withdrawal of the model of the charged amber from Faraday's cellis shown in Fig. 7. If we the charged model from the amber rapidly introduce into the cell and to immediately just as rapidly tzyat it from there, then is observed pulse shown in Fig. 8. Between the negative and positive parts of pulse there is a region of the reduction of the derived amplitude of pulse on the time, since. with introduction and withdrawal of the model of amber from Faraday's cell it is not possible to instantly change the speed of stock, at which is fixed the model, to the reverse.

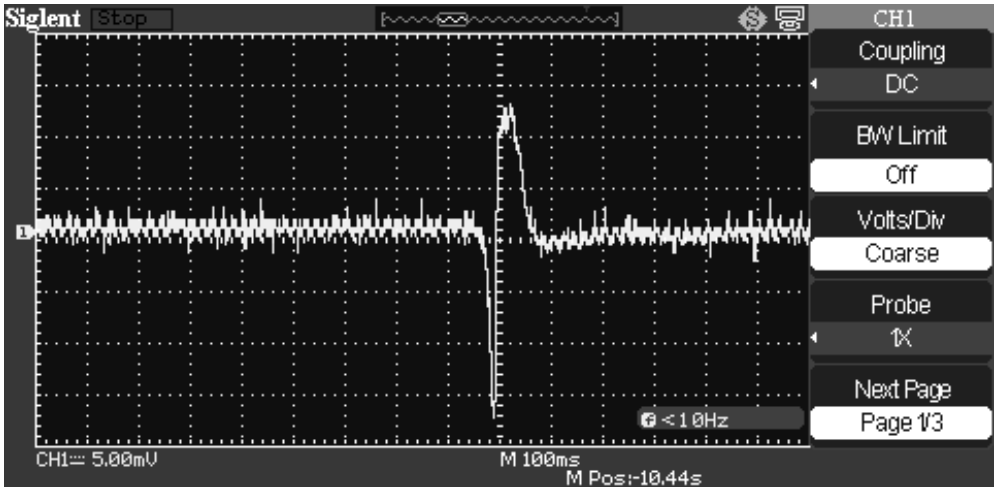


*Fig. 6:* Shape of pulse with the rapid withdrawal of the model of the charged amber from Faraday's cell

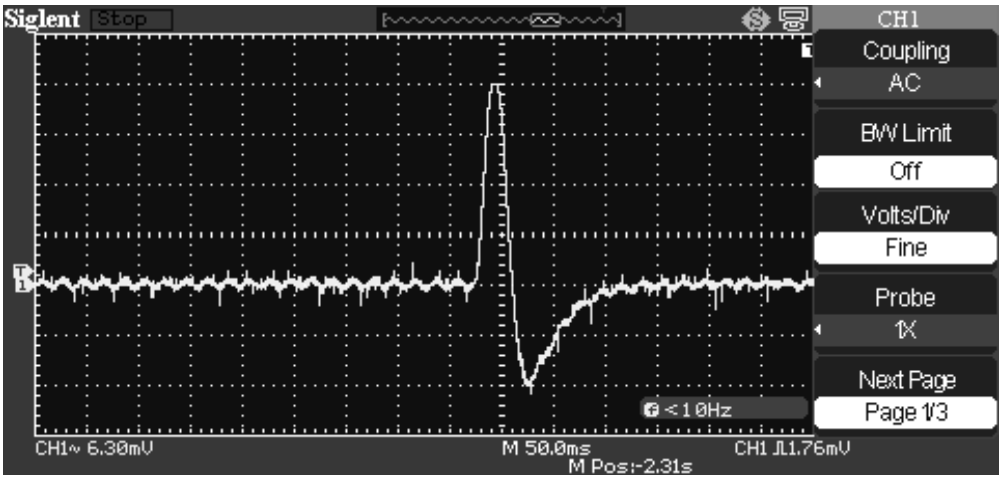


*Fig. 7:* Shape of pulse with the rapid withdrawal of the model of the amber

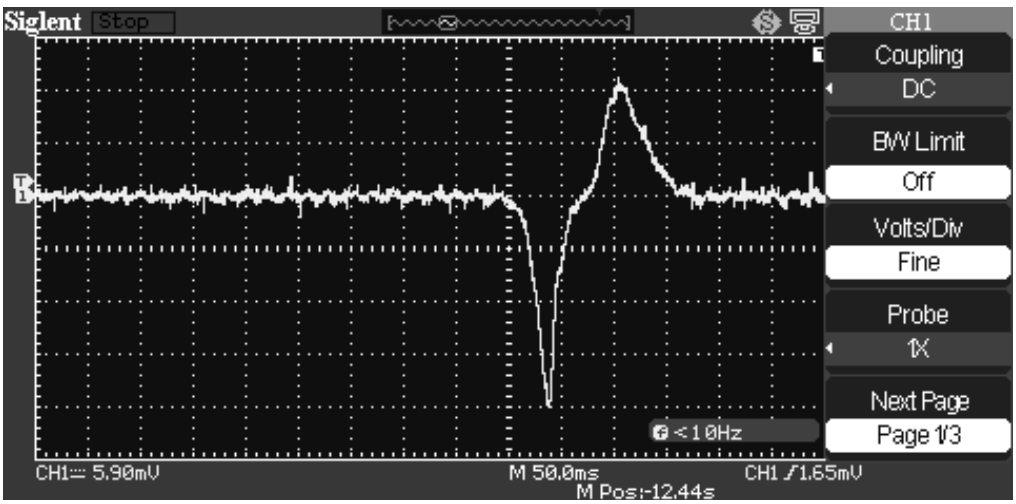


*Fig. 8:* Voltage pulse, obtained with the rapid introduction and the subsequent withdrawal from the Faraday's cell of the charged model of amber

In Fig. 9 the oscillogram of transient process with the capacitor discharge through the discharger is represented. In discharge time approximately one 600 s voltage across capacitors falls s 300 v to 50 v, and the energy of capacitors – on 162 J; therefore the average power of micro-burst 270 kW. The form of the voltage pulse between the external screen and the screen of Faraday's cell, obtained with the discharge through the discharger of the capacitors with a capacity 6000 of F, charged to the stress 300 v, it is shown in Fig. 10 (scale value according to axis X 2.5 ms) and Fig. 11 (scale value 1ms). Formation of the negative part of the pulse (Fig. 11) approximately it coincides with the capacitor discharge time (Fig. 9). This is the time of the greatest warming-up of plasma, since. with the high current the warming-up is connected not only with its effective resistance, but also with the pinch effect. Shapes of pulses in Fig. 6 and Fig. 10 it is very similar. The difference only in the fact that with the mechanical introduction and the withdrawal of amber from the cell it is not possible to ensure this pulse time and the steepness of its fronts as with the electrical discharge.in Fig. 10 the stages of warming-up and cooling of plasma are well visible, evident also that its heating occurs much faster than cooling.

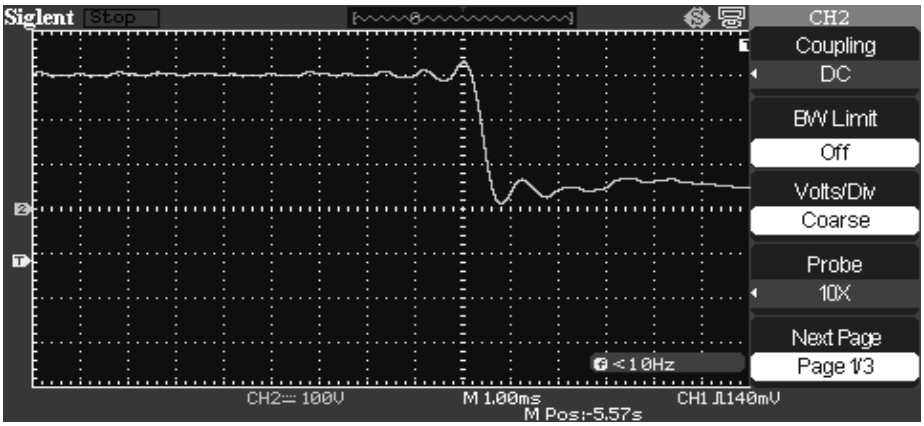


*Fig. 9:* Oscillogram of the transient process

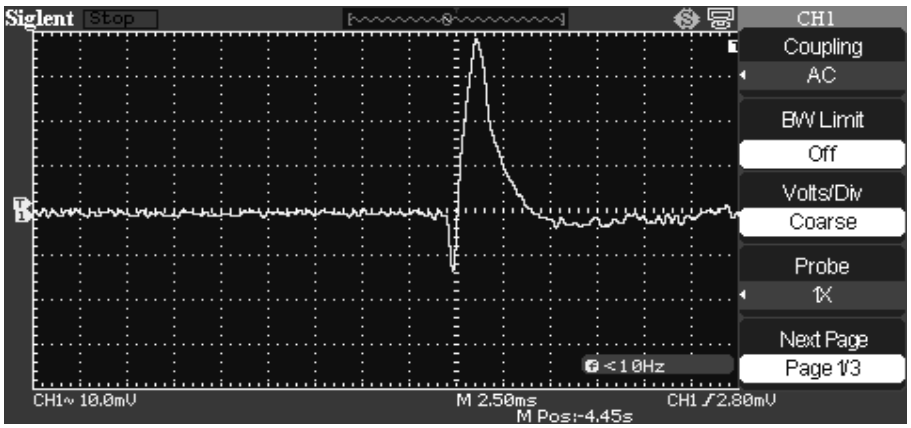


*Fig. 10:* Form of the voltage pulse

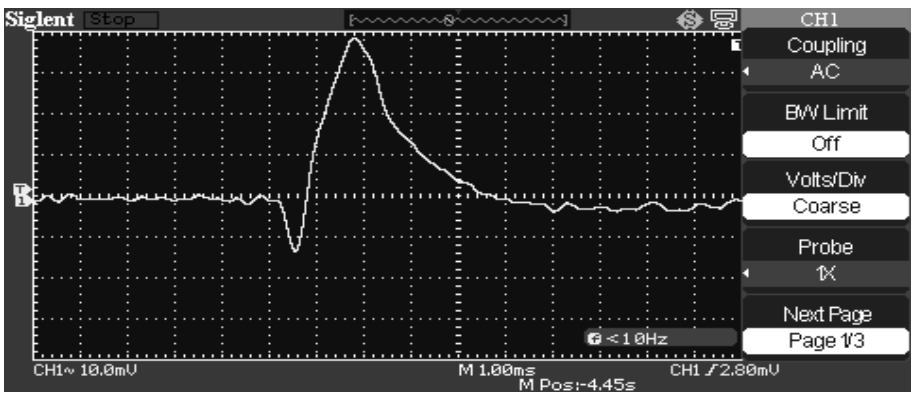


*Fig. 11:* Form of the voltage pulse

The total capacitance of the input circuit of oscillograph and capacity between the screen of the Faraday's cell and the external screen is 204 pF, and the resistance of the input circuit of oscillograph equally by 1Mom, therefore, the input circuit of oscillograph is differentiating.

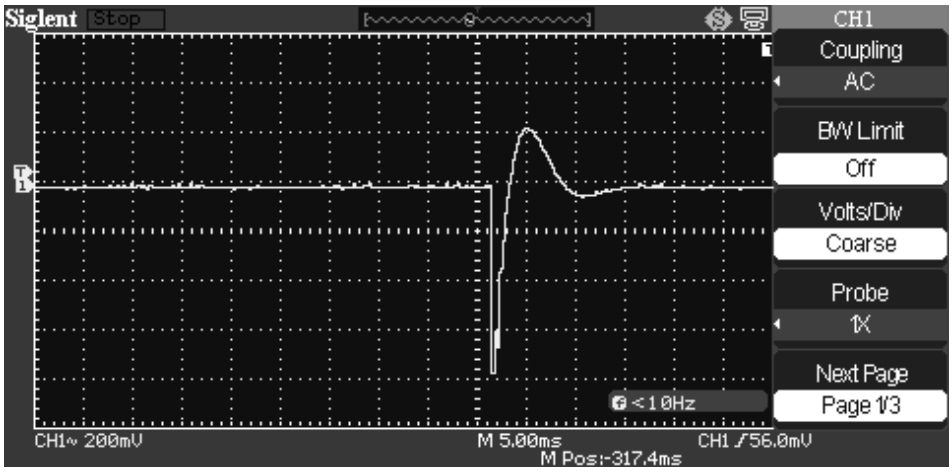


*Fig. 12:* Derivative of the current, which flows through the plasma

Therefore oscillogram in Fig. 10 and Fig. 12 they present the derivative of the voltage pulse, which appears between the screen of the Faraday's cell and the external screen. Naturally to assume that the temperature of plasma, since it has effective resistance, it is proportional to the current, which flows through it. Derivative of the current

The derivative of the current, which flows through the plasma was removed with the aid of the chain, inductively connected with the conductors of the outline, along which flows the current of discharge. Pulses in Fig. 10 and Fig. 12 they are identical. This means that in the case in question we deal concerning the generation and the disappearance in the Faraday's cell of the unitary charge, connected with the electron motion. In the formed plasma the number of electrons and positive ions is equal, but electrons have high speed, than ions.

Given experimental data are the proof of the fact that in the process of the warming-up of plasma with an equal quantity in it of electrons and ions in the plasma is formed the not compensated by positive ions unitary negative charge, but this means that the charge is not the invariant of speed. Experiment directly confirms that the fact that the invariant of speed is only the polarity of the moving electric charge, and its absolute value depends on speed.

## III. Conclusion

Experiments on the rapid warming-up of plasma by the way of the transmission of the high currents through the thin copper wire, that leads to its micro-burst, they showed the presence of unitary charge in the composition of the plasma, obtained thus. These results testify in favor the concept of scalar- vector potential, from which follows this behavior of plasma with its warming-up.

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