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EXCITEMENT TEM-HORN ANTENNA BY IMPULSIVE RELATIVISTIC ELECTRON BEAM

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In the given operation the opportunity of reception powerful electromagnetic irradiation (EMI) is observationally explored by excitation by a impulsive relativistic electronic beam (IREB) of a TEM-horn antenna. It is revealed, that at such expedient of excitation of the TEM-horn antenna, the signal of radiation of the antenna contains three various components caused by oscillation of radiation by forward front IREB, high-voltage discharge between plates irradiation of TEM-horn antenna a and resonant properties of the antenna device.

INTRODUCTION

The reception nonsinusoidal ultrabandwidth (UBW) of pulsing signals is a urgent problem of a modern relativistic electronics. Such impulses find wide application in modern systems of a radiolocation and radio communication. They can be used for underground of sondage, study of action powerful UBW of electromagnetic impulses on objects natural and artificial of an origin and series of other applications [1].

The methods of oscillation powerful shortimpulseve of microwaves-signals based on the traditional schemes of transformation of intensive relativistic electronic beams in energy of an electrîmagnetic field (EMF) , are characterized by enough low efficiency [2-4]. In middle 80- years observationally was the opportunity of coaxial structure is shown [5], and later in operations [6-7] the effective enough excitation of radiating systems was shown at the expense of energy reserved in Marx-generator of direct transformation of energy IREB in energy of a TEM-wave.

The purpose of the given work is the experimental study of an opportunity of radiation powerful nanosecond of impulses EMF at excitation of a TEM-horn antenna by shortimpulsive IREB, without its previous modulation.

EXPERIMENTAL PART

The experimental studies on oscillation powerful UBW of electromagnetic impulses by direct excitation of the TEM-horn antenna by a impulsive relativistic electron beam, were carried out similarly [8] on the high-current accelerator "TEMP-A". The parameters of a beam varied in limits (Å≈ 500 ÷700 êeV, I≈3 ÷5 kÀ, duration $\tau_{1|2}$ ≈15 ns), the steepness of forward front thus did not exceed 1,5 ns. The scheme of experiment is shown in a fig. 1.

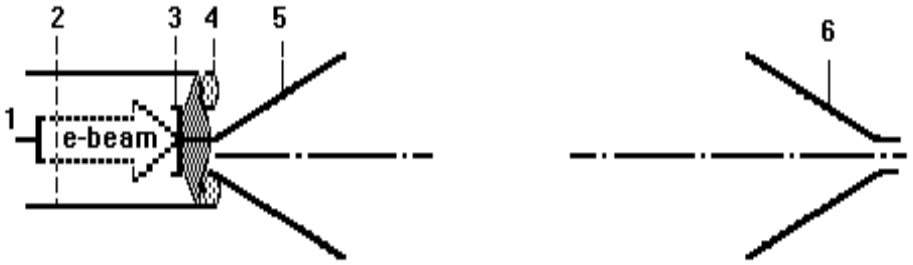

Fig.1.

The excitation of the TEM-horn antenna occurs by an electron beam formed in the cathode-anode gap of the accelerator (pos. 1-2, fig. 1), which impinges on a collector (3), connected with one of plates of a TEM-horn antenna (5) - another plate was grounded. The current of a beam was measured by Rogovsky coil (4).

The TEM-horn antenna represents system from two trapezoidal of plates located under an angle 30° to each other. The minimum cross size of plates - 4 ñm, maximum - 40 cm. Length of plates 2 m, sizes at the outlet of an antenna 40×40 cm. Radiating antenna was correlated on inlet with the impedance of a beam, and on outlet - with the resistance of free space. For diminution of reflections ~1/4 lengths of a plate on outlet of the antenna covered with an absorbing material. As a receiving antenna the similar TEM-horn (6) was used. Distance between radiating and receiving antennas was equal 3 m.

The results of experimental studies are given on oscillograms of a fig. 2.

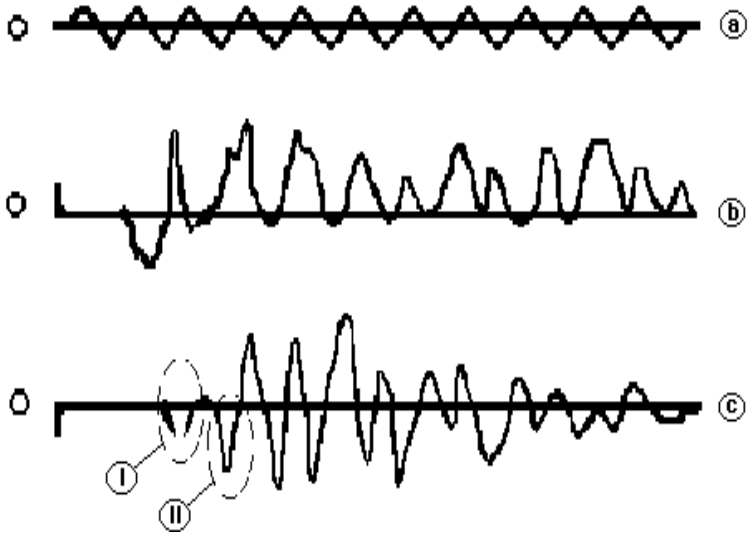

Fig.2.

For time correlation of fixed processes in a fig. 2à the oscillogram of sine oscillations with frequency 50 Ì Hz, and in a fig. 2b - oscillogram of a signal from Rogovsky-coil are given. The radiation filed measured by the receiving TEM-horn antenna (an attenuator with impairment 25 dB), is given in a fig. 2ñ. As it is visible from this oscillogram, in the beginning it there is a disrupture (pos. I, fig. 2c), duration less than 4 ns, showing about large amplitude of radiation caused high growth rate of a current (dI/dt) on forward front (fig. 2b), and the time of its occurrence is caused in physical and geometrical parameters of the radiating device. Confirming these assumptions testify gauge of duration of fluctuations on an oscillogram of a current and time of their occurrence. The numerical estimations of capacity of a radiating horn give quantity ≈18pF , taking into account requirements of experiment (U ≈ 500 ÷700 keV, I≈ 3÷5 kÀ) quantities of a charge and time, for which the plates of a horn will get it, makes q ≈$6\cdot10^{-6}$ ÷$12{,}6\cdot10^{-6}$ Q and t ≈2 ÷3 ns ÷ 2,5÷4,2 ns. These estimations are in good enough agreement with experimental results (see time of a beginning of development of fluctuations on an oscillogram of a current of a fig. 2â).

Further on an oscillogram of radiation (fig. 2ñ) there is one more intensive enough outburst of amplitude of radiation (pos. II,). The oscillation of this radiation can be caused by a disruption of an air gap between two plates of a TEM-horn antenna.

More low-frequency oscillations are caused by resonant properties antenna of devices. The estimation of an emitting power can be carried out on quantity of amplitude of a signal from a receiving antenna.

CONCLUSION

As a result of experimental studies the opportunity of oscillation of powerful UBW-radiation is shown, by immediate excitation of the TEM-horn antenna by a high-current relativistic electron beam.

It is revealed, that at such expedient of excitation of a TEM-horn antenna the signal of radiation contains three various components by way of following on time:

- Oscillation of radiation by forward front of a beam;
- Radiation at a high-voltage discharge between plates of a horn antenna;
- Oscillations caused resonant by properties of the antenna device.

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