THE PROTECTION CONCEPT OF THE AIR DEFENSE WEAPON OF THE GROUND FORCES AGAINST A POWERFUL ELECTROMAGNETIC IMPULSE

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The spread of technologies, used for the creation of electromagnetic weapons and the availability of elements of devices for generating an electromagnetic pulse of ultra-short duration puts on the agenda the protection of radio-electronic equipment of anti-aircraft weapons of the Ground Forces, control systems of energy and information means, and people from the effects of electromagnetic factors of natural and man-made origin, and domestic terrorism, capable of causing great economic damage due to the failure of electronic systems, communication devices, explosions and fires of flammable substances, and electrical wiring short-circuits, therefore the protection of radio-electronic equipment from the effects of electromagnetic weapons is an urgent problem today.

Known samples of electromagnetic weapons, which are in service with the Russian Federation and are widely used during the Russian-Ukrainian war, are the mobile automated complex "Leer-2" based on the armored car "Tigr", "Shypovnyk-AERO", "Krasukha-4", "Peresvet", R-330M1P "Diabazol" system, automated jamming station R-330Zh "Zhitel", complex "Judoist". This weapon systems significantly interferes with the normal functioning of anti-aircraft weapons of the Ground Forces air defense and are capable of disabling radio-electronic equipment, so the enemy is left without radio-electronic means, weapons and control [1; 10].

These weapons can track radiation sources in the frequency range from 30 to 2700 MHz, has a radiation power of 200 W, this indicates that the enemy has the ability to influence the electromagnetic pulse of ultra-short duration on the radio-electronic equipment of anti-aircraft weapons of the Ground Forces, which significantly hinder to the normal functioning of anti-aircraft weapons of the Ground Forces.

Today, the protection of radio-electronic equipment is one of the main directions, which includes the full modern modernization of weapons and military equipment by implementing the latest, more stable radioelements or partially replacing the old radioelement base with modern radioelements.

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It is no exception that the radio-electronic equipment of anti-aircraft weapons of the Ground Forces has problems with its operation.

Such elements as resonance dischargers are used in samples of anti-aircraft weapons of the Ground Forces for protection against the destructive effects of electromagnetic radiation. The RR-173 resonant discharger protects the input devices of the receiving system of the target detection station. It is used to protect the receiving system from powerful probing pulses of the transmitter and signals reflected from inhomogenities of the high-frequency energy path in the transmission mode [3; 6]. The RR-185 resonance discharger is used to protect the input devices of the receiving system of the target tracking station and missile sighting stations. The reliability of the protection of the input devices of the missile sighting stations and the target tracking stations by the RR-185 dischargers from the leaking pulses of the transmitter of the command transmission station is ensured by the fact that the RR-185 discharger as bandpass filters in the wave range of the command transmission station have an additional energy attenuation of approximately 20-30 dB [4; 6].

The impulse breakdown characteristic of gas dischargers was considered to be 10 kV/ns, and for idealized electric network lines, it is 3 to 10 times more.

Disadvantages of protective dischargers are a long operating time and insufficient resistance to the energetic action of an electromagnetic pulse of ultra-short duration. It is known that electromagnetic weapons have time characteristics of an electromagnetic pulse of an ultra-short duration of less than 5 ns, which does not allow resonant dischargers of anti-aircraft weapons of the Ground Forces to protect the receiving tracts.

Protection of the object at the stage of its operation is possible only based on the application of construction methods [9]. The shielding method based on the absorption or reflection (removal) of damage energy is considered as the main construction method [5; 7].

The main requirements for anti-aircraft defense equipment of the Ground Forces against the influence of electromagnetic weapons are [8]:

1. The range of working wavelengths is from 1 mm to 100 km.

2. Reducing the energy level of electromagnetic radiation at the entrance to the access points in the radio electronic equipment to 10^{-8} J.

3. Operation time is less than 10^{-9} s to protect against powerful electromagnetic pulse of ultra-short duration.

4. The ability to work in a wide temperature range (240-2000 K).

5. Workability, taking into account the possibility of artificial pressure changes within a wide range of physical application conditions (air pressure up to 4000 mm Hg).

6. Minimum mass per unit area.

7. High strength characteristics.

Taking these into account, the most comprehensive requirements for the means of protection of anti-aircraft weapons of the Air Defense of the Ground Forces against the influence of electromagnetic weapons will allow to reduce the influence of electromagnetic weapons on the radio-electronic equipment of the anti-aircraft weapons of the Air Defense of the Ground Forces [2].

Thus, an analysis of existing electromagnetic weapons was carried out, and it was determined that electromagnetic weapons have the ability to generate an electromagnetic pulse of ultra-short duration from 10^{-5} to 10^{-19} s. An analysis of anti-aircraft armament of the Ground Forces and existing means of protection against an ultra-short duration electromagnetic pulse was carried out, and it was found that they are not sufficiently fast-acting than the ultra-short-duration electromagnetic pulse of modern electromagnetic weapons. The necessity to create modified means and methods of protecting the radio-electronic equipment of anti-aircraft weapons of the Ground Forces from the destructive influence of electromagnetic weapons is substantiated. The requirements for protection means against the destructive influence of electromagnetic weapons have been developed, by following which it is possible to ensure the normal (under the influence of electromagnetic weapons) functioning of anti-aircraft weapons, taking into account the operational efficiency with the artificial change in pressure, which is a further task for research.

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