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The device for determining the achievement of the target-Missile of the required level of flight altitude

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ABSTRACT

The article raises the question of further use of military equipment removed from service, namely anti-aircraft guided missiles. Anti-aircraft guided missiles that have served their intended service life take up large storage areas and distract personnel to perform additional functions (accounting, storage, security, etc.). Disposal of anti-aircraft guided missiles is not of economic interest to business organizations. Further operation is possible when using anti-aircraft guided missiles for a different purpose. Another purpose is to use anti-aircraft guided missiles as targets to improve the quality of combat training of air defense calculations. The use of anti-aircraft guided missiles as missile targets frees personnel from non-essential functions (storage, accounting, protection) and reduces the financial resources of the Ministry of defense for the disposal and acquisition of targets. For conversion to a target, it is proposed to use a radio-detonator of an anti-aircraft guided missile for a different purpose. The principle of operation of the radio detonator allows for minimal changes in its design (replacement of electronic element ratings) to use as a device for determining the achievement of a missile target of the required flight level, that is, to create conditions for controlled flight. This device allows the use of anti-aircraft guided missiles as a missile target.

Key words : guided missile, missile target, radio detonator, time selector, delay line, delay time

1. INTRODUCTION

Military equipment that has served its service life is removed from service and disposed of using the Vtorchermet technology. Used-up anti-aircraft guided missiles occupy large storage areas, distract personnel to solve additional functions (accounting, storage, security, etc.). it is Necessary to solve the question of further operation or disposal of these products. Disposal of anti-aircraft guided missiles is not of economic interest to business organizations. Further operation is possible when using anti-aircraft guided missiles for another purpose.

Components of anti-aircraft guided missiles were designed and manufactured with a large reserve of technical resources [1]. Operation at all stages of the life cycle of the SDMS was strictly regulated. Decommissioned anti-aircraft guided missiles can be used for other purposes according to their technical condition and the laid-down reserve of technical resources. In addition, the Armed Forces have the opportunity to assess the technical condition of anti-aircraft guided missiles that have been decommissioned, for use in a new capacity, as other countries do [2].

The use of decommissioned anti-aircraft guided missiles as missile targets is implemented in advanced countries of the world. The existing military-industrial complex in the Republic of Kazakhstan, scientific and technical potential and material and technical base allows creating target missiles.

Purpose of research. Development of technical solutions for the conversion of an anti-aircraft guided missile, in particular, the radio fuse of an anti-aircraft guided missile, into a missile target.

The conversion of an anti-aircraft guided missile into a missile target is possible when some units of the missile's onboard equipment are modified. One of the units that can be modified is a pulse radio fuse [3]. Modification of the pulse radio fuse will change its purpose. It will be used as a device for determining whether a missile target reaches the required flight level, and for controlling the flight of a missile target by altitude.

2. MATERIALS AND METHODS

The research material is a radio-detonator of an anti-aircraft guided missile and the development of a technical solution for its use in a missile target in another capacity. To achieve the research goal, statistical methods, system analysis and modeling were used.

3. RESULTS AND DISCUSSION

A pulsed radio fuse consists of an antenna system 1, a transmitter 2, and a receiver 3. a Simplified functional diagram of a pulsed radio fuse is shown in figure 1

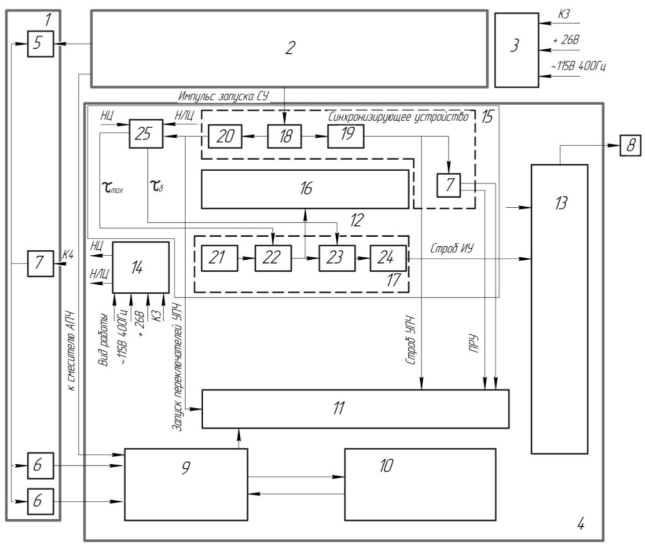

Figure 1: Simplified functional diagram of a pulsed radio fuse

The pulse radio fuse is part of the onboard equipment of an anti-aircraft missile. It is designed to generate a trigger pulse (initiation) to detonate the warhead of an anti-aircraft missile when it approaches the target at a time when the maximum damage to the target is provided by the elements of the warhead.

The antenna system1 is designed to emit radio pulses in the direction of the target and receive signals reflected from it. The directional pattern of the radio-fuse antenna system for transmission and reception has the form of a funnel with a changing angle depending on the duration of the command "K4" at the vertex φ. the total DN of the radio-fuse antenna system is shown in Fig.2.The command "K4"is issued from the ground control point to the rocket in flight. The duration of the command depends on the relative speed of the missile's approach to the target.

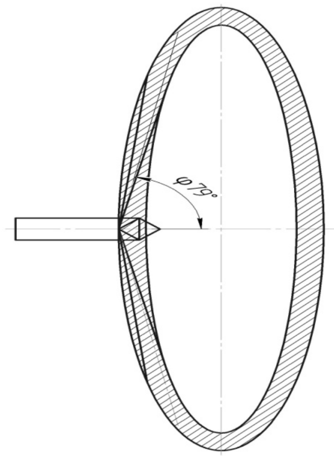

Figure 2: Total radiation pattern of the antenna system

Transmitter 2 is designed to generate high-frequency pulses emitted by the transmitting antenna into space. It begins to work on the command " K3 " (command of cocking the radio fuse), which is issued from the ground control point to the rocket in flight.

Receiver 3 receives and amplifies the signal reflected from the target, generates a trigger pulse and outputs it to the safety-actuating mechanism. The safety-actuating mechanism 4 ensures the safety of the explosive device during operation, launch and on the flight path until the end of cocking and serves to issue a detonation pulse to the initiating charge of the warhead. The receiver consists of a high-frequency block 5, an automatic frequency adjustment of the heterodyne block 6, intermediate frequency amplifiers 7, a video block 8, and an Executive device 9.

A special role in the use of a radio fuse as a device for determining whether a target missile reaches the required flight level is played by the video unit 8 and the antenna system 1.Video block 8 consists of a syncing device 10 and a video channel 11.

The synchronizing device is designed to generate and generate pulses to control the sensitivity of the receiver depending on the range of the radio fuse and to control the switching of channels for receiving the radio fuse. The synchronizing device functionally consists of a delay line of the synchronization pulse 12, an intermediate frequency amplifier gate generator 13, and a video amplifier gate generator 14.

The video channel is designed to amplify signal pulses coming from an intermediate frequency amplifier and limit the range of the radio fuse. The video channel functionally consists of a video amplifier 15, the first time selector 16, the second time selector 17, and the gate generator of the Executive device 18 [3, p. 55-57].

The Executive device 9 is designed to generate a trigger signal in the safety-actuating mechanism, when a certain number of pulses are accumulated coming from the video channel 11[4, p.63-64].

The principle of operation of the pulse radio fuse is based on the use of the pulse method of active radar. When the command "K3" is received from the ground control station on

Board the rocket in flight, the transmitter is turned on. Through the transmitting antenna, energy is radiated to the surrounding space in the form of short high-frequency pulses. In case of contact with targets in the radiation pattern of the antenna system to the input of the receiver receives reflected from the target signals. The signals reflected from the target are processed in the receiver and start the executing device. The radio fuse is triggered, i.e. gives an impulse to detonate the warhead of the missile through the safety-Executive mechanism to hit the target.

A attack on low-flying targets (low-flying mode) in order to exclude the operation of radio controlled fuses from the ground, and ground targets (a surface goal) to reduce the height of the operation of radio controlled fuses from the ground and thus cause maximum damage to the target. These modes are implemented by the delay line of the video amplifier gate 19 and two time selectors 16, 17 of the video channel.

One of the possible cases of a missile meeting with a target is shown in figure 3.

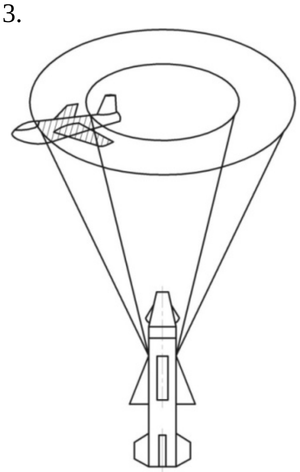

Figure 3: the case of a missile meeting with a target

When shooting at such targets, before the launch of an anti-aircraft missile, the command "NLC" or "NC"is issued on Board the missile. The corresponding commands arrive at the gate delay line and switch it, changing the pulse delay, which is implemented by the low-flying or ground target modes.

VS-1 (time selector 1) and VS-2 (time selector 2) together without switching (in the absence of the command "NLC" or "NC") implement the normal mode, which is characterized by the fact that the joint selection band of both time selectors is greater than in the low-flying target and ground target modes. The operation of the mode selection scheme can be explained using time diagrams (figure 4).

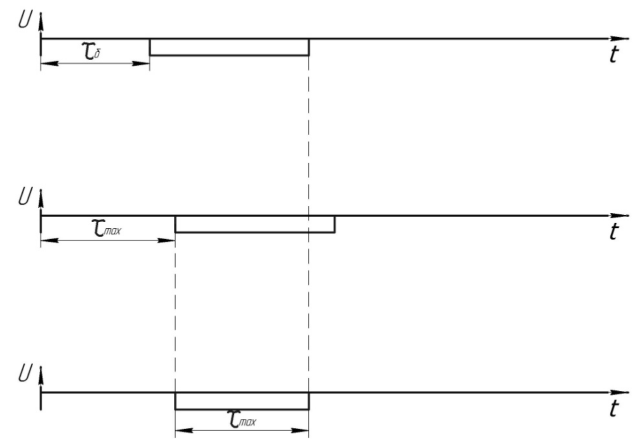

Figure 4: Time diagrams of operation of the mode selection scheme

In normal mode, the VU 20 gate generator pulse is fed to the VS-2 with a base delay of τ_b, and to the VS-1 with a maximum delay of τ_max. The time interval t_max, in which both pulses act simultaneously, and determine the maximum range of the radio fuse.

If there is a low-flying target mode, a pulse is sent from the delay line to

VS-1, delayed for the time of τ_nlc<τ_b, and the time of the open state of the radio fuse will be equal to t_nlc<t_max.

In the presence of the ground target mode, a pulse is transmitted from the delay line to the VS-1, delayed for the time of τ_nc<τ_nlc, and the time of the open state of the radio fuse will be equal to t_nc<t_nlc.

Figure 5 shows a schematic diagram of the delay line of the video amplifier gate [4]. When sending commands "NLC" or "NC" to the delay line of the video amplifier gate, relays P1, P2 switch the outputs of the delay lines LZ1÷LZ4. As a result, the pulse delay of the video amplifier is reduced, and, consequently, the operating range of the radio fuse is also reduced.

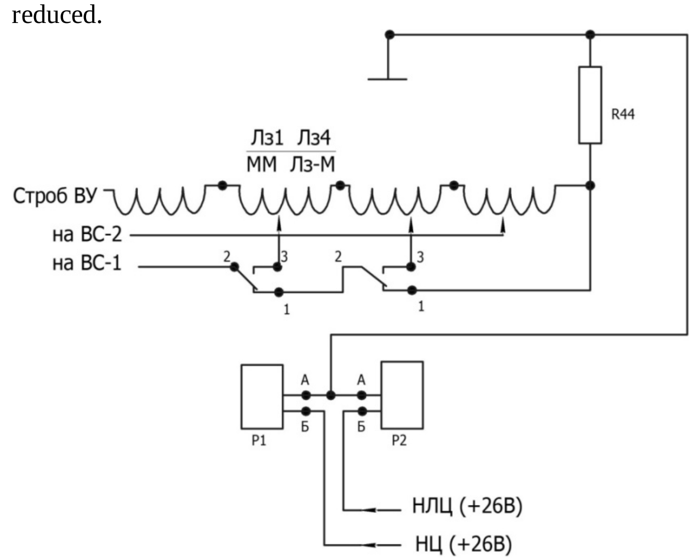

Figure 5: Schematic diagram of the delay line of the video amplifier gate

The principle of implementing range limitation is the basis of the device for determining whether the radio fuse reaches the required flight level.

By changing the values of τ_b on the time selector VS-2, as well asτ_max on the time selector VS-1, it is possible to form the gate of the Executive device at any range limited by the potential capabilities of the radio fuse.

For example, to receive a reflected signal with a fixed range d-300m, under the conditions that the duration of the probing pulse is 0.1 MS, the delay time of the reception is 0.5 MS, and the duration of the strobe Is 1 MS:

1. Determine the time of reception, from the moment of radiation, of the reflected signal of the transmitter of the radio fuse from the target located at a distance of 300 m according to the known formula 4[6]:

$$t = \frac{2D}{c} = \frac{2*300м}{3*10^8 мс} = 2\ мкс \quad (1)$$

2. Determine the base delay(τ_b)on the VS-2 pulse of the strobe generator. The gate of the video amplifier, taking into account the reception delay time (t_ (rear PR)=0.5 MS), must be issued on VS-2s with a delay of τ_b=t-t_ (rear PR)= 1.5 MS.

3. Determine the maximum delay (τ_max) on the VS-1 pulse of the strobe generator of the video amplifier 20.

To form a joint bandwidth of VS-1 and VS-2, the delay of the video amplifier gate on VS-1 (τ_max) must be created in the range of 0.6 – 2.4 microseconds. Thus, when τ_max=1.5 MKS, the joint selection band of both time selectors will be equal to 1 MKS, which corresponds to a distance of 150 meters.

Thus, the delay gate amplifier, the delay line video amplifier, 1.5 µs VS-1 to VS-2, generator gate actuators will form the gate actuator from the goals that are at a distance of 300÷450метров.

You can select the desired delay time. In the scheme of radio controlled fuses are used micromodule delay lines MMLS. To change the delay time of the video amplifier gate, you can use MMLS with the appropriate parameters. Table 1 shows the technical characteristics of MMLZ [7].

Table 1: Technical characteristics of MMLZ

Type	Main classification parameters			
	Delay time (мкс), T	Wave resistance (Ом), S	Gain	The designation of the micromodule
MMLZ	0,5±10%	300±10%	0,9	MMLZ -0,5/300
	0,5±10%	600±10%	0,9	MMLZ -0,5/600
	0,5±10%	1200±10%	0,9	MMLZ -0,5/1200
	1,0±10%	600±10%	0,9	MMLZ -1,0/600

Thus, there is a choice of the required value of the delay time by replacing the corresponding MLS.

Setting the maximum angles of the radiation pattern of the radio blast antenna system (φ_max), allows you to determine the required flight level of the radio blast from the earth's surface (Fig. 2). the radiation pattern of the radio blast antenna system for transmission and reception changes depending on the duration of the command "K4".For an altitude level of 300 meters, if_m=79□(for anti-aircraft guided missiles of the s-75 anti-aircraft missile system), the error in the flight altitude will be approximately 6 m., because, SOS (90□– 79□) = 0.98.

Reflected signals from the earth's surface will be used as received signals.

5. CONCLUSION

The solution of the technical problem of determining whether a missile target reaches the required flight level is implemented by:

-selection of the pulse delay of the strobe of the video amplifier of the video block of the radio fuse by the amount corresponding to the selected flight level;

- changing the angle of the radiation pattern, receiving and transmitting antennas of the radio fuse relative to the longitudinal axis of the target rocket, to receive reflected signals from the earth's surface.

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