INVESTIGATION OF THE EFFECT OF HIGH TEMPERATURES ON THE OPERATION OF THE RADIO PROXIMITY SENSOR

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The paper describes the research stand on the impact of very high temperatures on the operation of the radio proximity sensor placed in a missile. The requirements for such type of sensors designed for missiles in the aspect of applicable military standards were also characterized.

Keywords: radio proximity sensor, missile, pyrotechnic path.

The parameters of the electronic and mechanical systems used determine the reliable operation of the radio proximity sensor used in missiles. The sensor's working conditions have a significant impact on these parameters. To assess them, simulation tests were carried out, followed by studies in the wind tunnel. The starting data for the tests were flight parameters characteristic of missiles:

- distance: 4000—42000 m;
- total flight time of missiles: 10—200 s;
- linear acceleration at the moment of shooting: <800 m/s^2;
- angular velocities: 7200—32400 rad/s;
- final speed of missiles: 220—400 m/s;
- fall angle of missiles: 10—75^O.

The obtained test results have shown that for the above data a missile flight can last about 200 seconds. At this time the missile's face can heat up to around 400°C, so the proximity sensor systems can be exposed during a flight to soaring temperatures to very large values. The theoretical analysis showed that the pyrotechnic path is the most sensitive to the very high temperatures (Fig. 1).

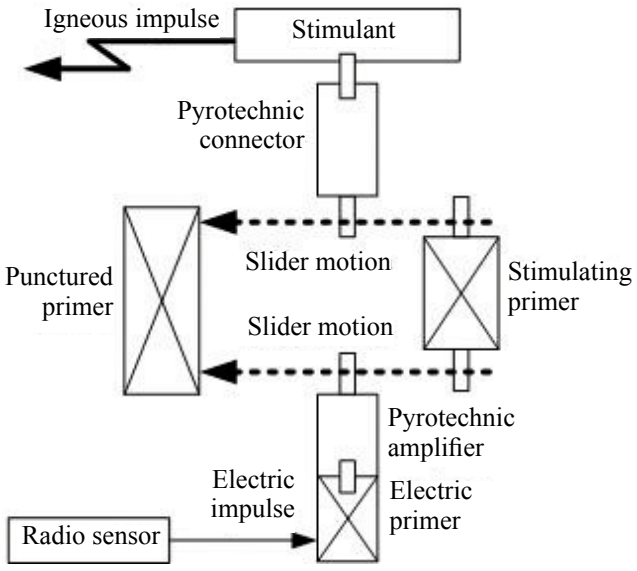

Fig. 1. Diagram of a pyrotechnic path

The path includes: electric primer, pyrotechnic amplifier, puncture priming, stimulation primer, pyrotechnic connector and actuator. Operation of any of the elements of the pyrotechnic path may cause the projectile to explode on its track, which precludes the use of a proximity sensor in the projectile. On the other hand, damage to other elements of the sensor under the influence of high temperature will result in lack of proximity operation, which also eliminates the possibility of its use.

The aim of the work was to estimate which of the elements of the proximity sensor is the most susceptible to very high temperatures and to develop a method to measure this vulnerability. Such tests were carried out at the stage of model development, during which the sensor systems and the entire proximity sensor were subjected to high temperatures. They were to determine whether in the proximity of the proximity sensor for a certain time at a temperature of 400°C, the pyrotechnic path elements will not be activated and any of the sensor systems will not be damaged. The tests were carried out using a POK furnace at the measuring station shown in Fig. 2.

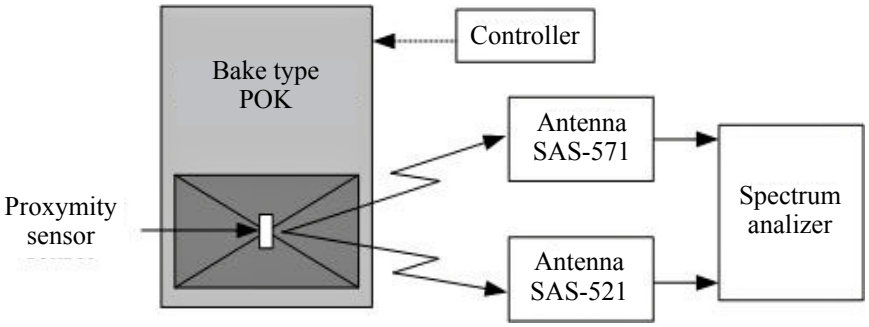

Fig. 2. Measuring stand

After heating the furnace to a temperature of approx. 400°C, the radio proximity sensor, previously placed in a special basket, was placed into the furnace for 200 seconds. While the sensor was heating, auditory and visual inspection was carried out to activate the elements of the pyrotechnic path. After 200 s, the sensor was removed from the furnace and then cooled to ambient temperature, while a visual assessment of the damage was performed. Next, the sensor power was turned on and using a spectrum analyzer equipped with a set of antennas, the operation of the transmitter was checked by comparing whether the spectrum of the generated signal corresponds to the spectrum before the furnace test. The final resistance of the receiver systems and pyrotechnic path to high temperature was evaluated after the sensor was initiated using the keyed antenna. In all cases, a positive result was obtained. It was found that the developed method can be used to test the radio immunity of a proximity sensor to the effects of high temperatures.

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Исследование влияния высоких температур на работу радиоэлектронного датчика сближения

Описан разработанный исследовательский стенд, предназначенный для исследования влияния очень высоких температур на работу электронного датчика сближения, размещенного в ракете. Представлены результаты исследований, а также требования к датчикам такого типа, соответствующие военным стандартам.

Ключевые слова: радиоэлектронный датчик сближения, ракета, пиротехническая полоса