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ADVANTAGES AND DISADVANTAGES OF USING TENSOMETRIC SENSORS IN SECURITY INFORMATION SYSTEMS

Tensometric detection means, as one of the components of security information systems of different type, are intended to form the appropriate signal on the device of reception-control security (DRCS) and ensure reliability of facts of movement from the place of installation of objects of protection or detection of moving objects.

All known means of detecting the tensometric principle of action are based on measuring the force using a tensoresistive, piezoelectric converter or measuring tension or pressure. The values obtained from the primary converters are compared by the device of reception-control security (DRCS) with the threshold value, which, under appropriate conditions, gives an alarm signal.

Tensoresistive sensors respond to change in the length of the sensitive element (tensoresistor), the force or pressure applied to it by changing its resistance.

The complexity of using of tensoresistive sensors lies in the significant dependence of resistance on temperature, which is associated with their temperature coefficient of resistance and temperature coefficient of expansion of the sensor and converter. Changing the temperature by several tens of degrees can lead to a similar change in the resistance of the sensitive element under the influence of the measurement force. The cost of this group of sensors can be significant, as it depends on their measurement accuracy.

The advantage of thermoresistive group sensors is variety. It allows to choose from the available spectrum the one that satisfied the conditions of weight control, starting from coins and ending with heavy equipment.

Piezoelectric sensors (point and linear) form an electric charge under the influence of an external force, the value of which is proportional to this force. They are used in security systems to fix vibrations.

Measurement of the force applied to the sensitive element by the piezoelectric sensor has its own peculiarities (characteristics):

– high level of guidance on the large input resistance (input circuits must be screened);

– growth of leakage in case of increase the humidity in the environment (megaomic circuits must be protected with varnish from moisture and the elements in these circuits shall be installed on the board via insulated racks);

– the connecting cable between the sensitive element and the first cascade of strengthen changes the capacity and generates its own charge during deformation (it is necessary to use special cables or place the first cascade of strengthen in close proximity to the sensitive element);

– piezoceramic sensitive elements are subject to change their capacity due to external factors and aging (minimization of errors is possible if the input capacity of the amplifier is stable and exceeds the capacity of the sensitive element several times);

– the operational amplifier of the first cascade must have a large input resistance, characteristic of field-effect transistors (two types of amplifiers are used to match the high output resistance of the sensor: voltage and charge amplifiers).

The advantage of using piezoelements in tensometric security systems is increased resistance to external influences due to their monolithic construction, a wide range of controlled force values and simplicity of construction.

In turn, tension measuring sensors have a thermal sensitive converter that controls the tension force of a thin string. This force must be fixed and correspond to the normalized value in accordance with the technical requirements for the product. The change in the tension value will lead to a change in the initial signal at the output and the actuation of the system DRCS as a result of touching it.

The presence of snow and the possibility of icing will interfere with the performance of the functions of sensors for measuring tension in the open air during the winter season.

Pressure sensors record the change in the surrounding situation due to the appearance of a foreign object (a person, vehicles, etc.) as a change in pressure on them, resulting from the perception of additional weight.

The field of application of tensometric detection means is quite large. It covers both security of individual small objects (jewelry, rare numismatic things laid out on shop windows or exhibition pavilions), middle-sized objects – valuable printed publications, paintings, cabinets, safes, and establishment of the fact of opening doors, windows, sieves, etc. Installation of sensitive elements of detectors directly under the object of protection or under the fastening elements of the cable on which it hangs is typical for the first case. The signal of the required value is generated when the object is removed. As for the second case, the tensometric security system sends an alarm when they are opened.

Tensometric detection means can be installed anywhere in the path of a potential intruder - under the floor covering, under the step of the stairwell, under the carpet, window sill, etc. They have no restrictions on indoor and outdoor use.

In general, tensometric protection information systems have the following advantages:

– high reliability and stability of operation;

– high level of masking due to visual imperceptibility of sensors and absence of any radiation in the environment;

– simplicity of installation and maintenance;

– high signal/interference coefficient (more than a hundred in the room), which determines high probability values of detecting facts of displacement from the place of installation of security objects or detection of moving objects and actuation up to false alarm;

– simplicity of the system operation algorithm and its construction leads to low cost, which, accordingly, implies wide application on various security objects.

The main disadvantages of tensometric protection systems include the loss of sensitivity of detectors in critical changes in ambient temperature and the difficulty of automatically checking the full health of the system, which is typical for many passive systems. In view of this, tensometric protection systems require periodic verification by directly affecting the sensitive element with the determining parameter of the determined value.

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DATA EXCHANGE BETWEEN ENGINEERING 3D MODELING PROGRAMS

Machine-building enterprises use software products of several global manufacturers to design three-dimensional models, such as CATIA, SolidWorks, Inventor Professional and others [1-3]. These professional automated design programs have their own data import and export functions.