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Comparative Analysis of the Main Characteristics of Movement Contributors

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Annotation: *This paper provides a comparative analysis of the basic characteristics of displacement measurement variables. Rheostat converter, electrostatic measuring converter, inductive measuring converter and transformer measuring converters were analyzed from the types of displacement switching converters. The optimal variant of the measuring transducer was selected based on the requirements for the displacement measuring transducers for the control and management systems*.

Keywords: rheostat converter, electrostatic measuring converter, inductive measuring converter and transformer measuring converter.

Introduction

There is a great need to measure linear and angular displacement in industry, agriculture and water management, transportation and other sectors of the economy. For this purpose, displacement measuring transducers are used. Depending on the measuring range, they are small (2-3 mm and 2-3 (up to)), medium (0.1 m and 360 (up to)) and large (several meters and 25-40 turns). are divided into

The need for displacement gauges is further illustrated by the fact that most non-electric quantities (velocity, acceleration, pressure, torque, force, etc.) are first converted to displacement and then displacement measured using gauges.

Rheostat, electromagnetic, capacitive, piezoelectric, galvanomagnetic, optical, acoustic, pneumohydraulic and other measuring transducers are used to measure linear and angular displacement. The choice of which type of measuring transducer will depend on the measuring range, the level of accuracy required, the operating requirements and other characteristics.

We make a comparative analysis of the models of displacement measuring transducers and their corresponding constructions are very diverse.

The main requirements for control system converters are: high dynamic accuracy - the shape of the signal with minimal distortion; high static accuracy; reliability under conditions set by high technical requirements; allowable small dimensions and weight; sufficiently high conversion factor (sensitivity); sufficiently high magnitude of the output signal;

In addition, depending on the location of the converter, it should be simple and inexpensive. To do this, it is necessary to analyze the advantages and disadvantages of each measurement variable, taking into account the above.

Rheostatic converters consist of a variable resistor whose moving contact moves under the influence of a non-electric magnitude (Figure 1).

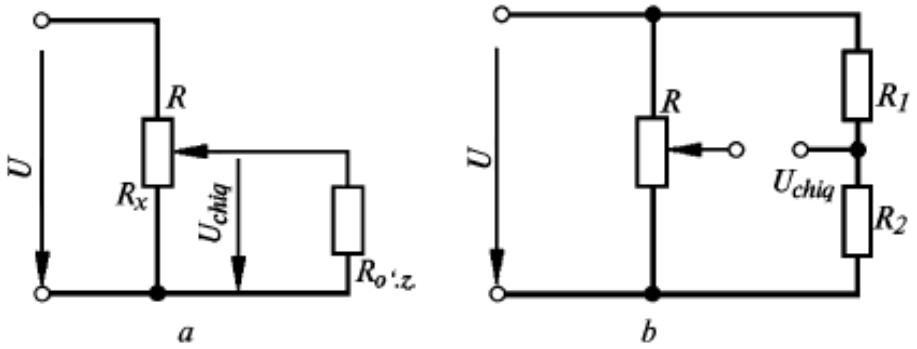

Figure 1. Potentiometric (a) and bridge (b) circuit rheostat transducers.

The input size of rheostat converters can be linear or angular displacement, and the output size can be an electrical resistance or current flowing through it, the voltage drop across it.

Rheostat converters are made in the form of wire wrapped around an insulating base. It uses mainly magnesium constant, nichrome, and in some cases platinum-containing wires. The carcass is made of textolite, glass textolin or other heat-resistant insulating material.

The moving contact (brush) of the converter is made of a mixture of platinum with iridium or beryllium. The switching function of the rheostat converter is in the form of a voltage drop across the resistor depending on the input size. The linearity of this function depends on the ratio of the resistance of the converter to the resistance of the measuring circuit.

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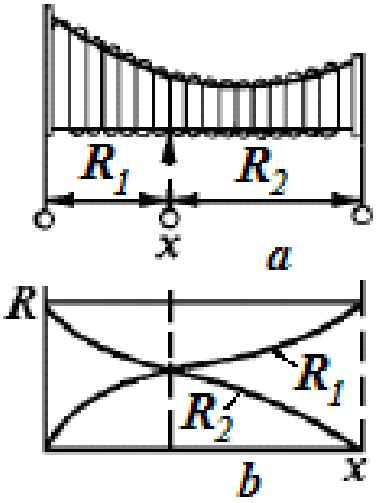

Figure 2. Rheostat converter structure (a) and resistance change graphs (b)

To ensure that the above-mentioned modification function (static characteristic) of the rheostat transducer changes linearly with a certain regularity (Figure 1, a), select the resistance of the measuring circuit or o It is necessary to connect a nonlinear element to the output circuit of the switch, the volt-ampere characteristic of which changes with the required regularity (Fig. 2, b). In addition, ((((()))))) in order to reduce the nonlinearity of the function, the rheostat resistors are connected according to the bridge circuit (Fig. 1, b).

The rheostat converter has the ability to operate on alternating and alternating current, has a number of advantages such as simplicity of structure, large output power, small mass and overall dimensions, wide width of the measuring range.

However, the nonlinearity of the switching function, the discreteness of the output signal (the output signal changes discretely when the contact passes from one winding to another), the appearance of thermo EYK, the sensitivity of the ambient temperature, resistance to mechanical impact, contact contamination and oxidation, oxidation of contact paths, friction in windings or failure of sliding contacts due to bending of the slide, the presence of noise complicates use in control and management systems.

The basis of operation of electrostatic measuring transducers is based on the proportional change of electric field parameters under the influence of non-electric quantities. The simplest form of a converter is a simple capacitor.

The distance between the simplest electrostatic converter coatings (Fig. 3, a), the dielectric constant (Fig. 3, b), or the active surface of the coatings (Fig. 3, c) depends on the measured non-electric capacitor. can be made in the ring.

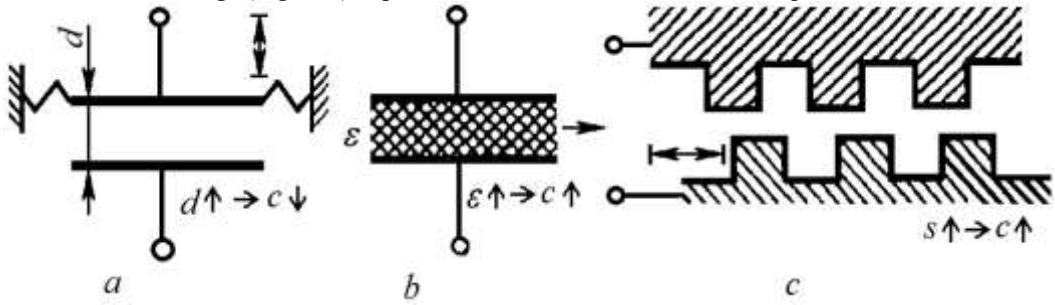

Figure 3. Constructions of electrostatic measuring transducers

It can be seen from the above expressions that in electrostatic converters the capacitance of the capacitor is linearly related to the change in the active surface of the coatings and to the change in the distance between them. Therefore, in most cases, a differential scheme is used to ensure the linearity of the static characteristics of these variables.

Capacitance transducers are used in bridge circuits and resonant circuits to measure displacement, velocity, acceleration, water level, pressure, humidity, and other non-electrical quantities.

Electrostatic converters have advantages such as high sensitivity, small mass and external dimensions, speed, high speed, low power required to move moving parts in capacitive sensors, reliable and simple structure in operation, durability. However, it is difficult to use in control systems due to the relatively small coefficient of variation, the influence of external electric field, temperature and humidity on the parameters of the converter, low output power, small output surface.

The operation of inductive converters is based on the conversion of the measured non-electrical quantity into an inductance proportional to it.

The inductive measuring transducer is widely used in mechanical, transport and agro-industrial production to measure linear and angular displacement, velocity and acceleration.

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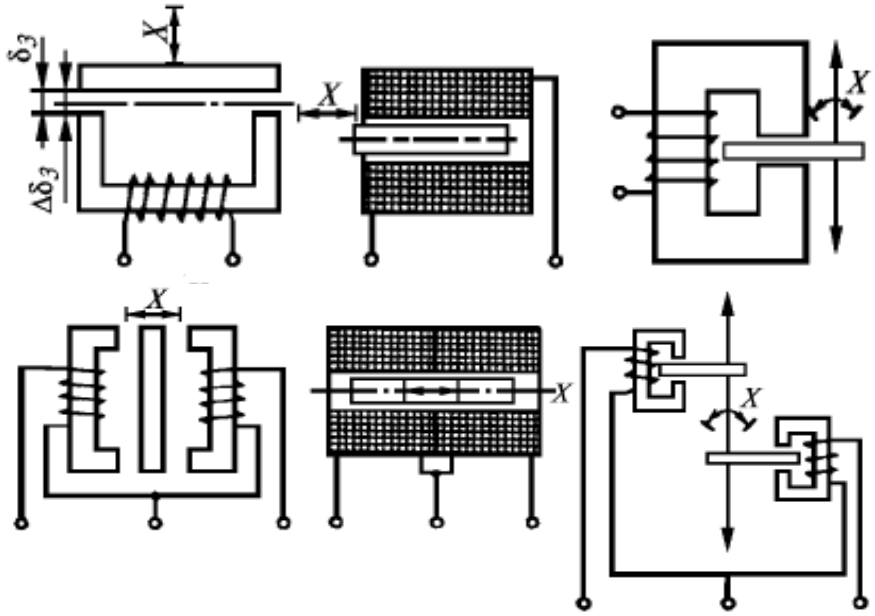


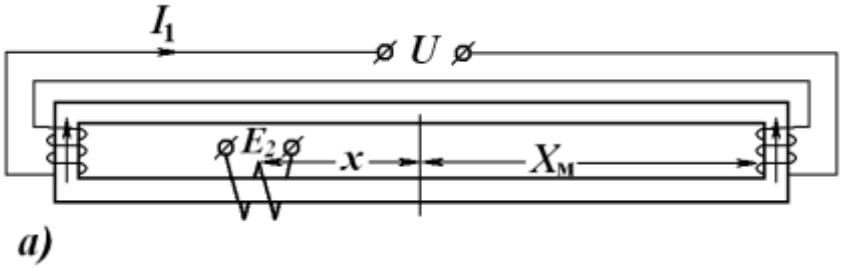
Figure 4 Constructions of inductive converters.

Advantages of inductive converters: Practically independent of atmospheric conditions, use in extremely aggressive environments, relatively large output power (up to 10 W) without the use of an amplifier, very high accuracy and linearity, no sliding contacts, high sensitivity, high accuracy, unlimited service life in practice, small size and small mass in high frequency voltage supply, high FIK compared to rheostat sensor.

However, it also has the following disadvantages: The armature displacement characteristic is small in the small range, the presence of electromagnetic gravity and salt current between the stator and armature, the effect of power supply on amplitude and frequency oscillation The input forces that balance the electromagnetic gravitational forces are high, the processing of received signals is complex and expensive, requires a stable sinusoidal voltage power supply, difficult to adjust (difficult to obtain zero value of the output voltage in the neutral position of the armature), only variable operates on current, in a limited range of linear static characteristics (due to the saturation of the magnetic conductor);

The frequency of the converter depends on the frequency and amplitude of the power supply; the need for shielding;

A transformer is a transformer with a moving part, the mutual inductance of which depends on the coordinates of the moving part, ie ((((()))). Transformer converters, like inductive converters, are divided into types with moving magnetic cores, coils, and electromagnetic screens (Figure 5, a, b, and c).



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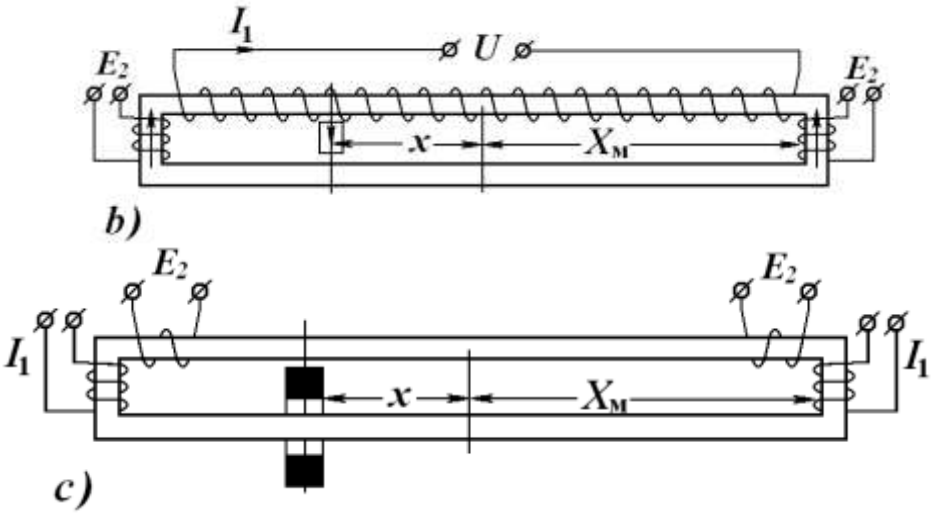

Figure 5 Designs of transformer transformers

Among the types of displacement transducers are rheostat converters, electrostatic measuring transducers, the advantages and disadvantages of inductive measuring transducers, the magnitude of the output power of transformer converters in the measurement of displacements in control and management systems, reliability in operation, characterized by the moderation of the parameters in different operating conditions.

Conclusion

Based on the requirements for the transducers in the control and management systems, it was concluded that the transformer measuring transducer is the most suitable of the types of displacement transducers.

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