SIMPLE METHOD FOR TESTING DIFFERENTIAL-TRANSFORMER TRANSDUCERS

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Differential-transformer transducers are widely used in various instruments for controlling automatically and regulating technological processes. However, they have not been provided to date with a State Standard, and any research data about them is almost completely lacking. Such data is required particularly by the plants which manufacture these transducers and the secondary instruments attached to them (DS, ÉPID, ÉIV, et al.). These plants are particularly in need of a theoretically substantiated technique for acceptance testing of these transducers.

Experience has shown that almost 100% of the manufactured transducers should be submitted to acceptance testing, and, therefore, it is necessary to make this testing highly effective and at the same time simple and easy to apply.

This article describes a technique for automatic testing of differential-transformer transducers. The technique was developed by the author of this article at the Central Measuring Equipment Laboratory of the Ivan Franko Instrument-Making Plant with the participation of S. S. Sinishin.

The suggested technique for testing these transducers consists of the following. It is known that differential-transformer transducers which are widely used in secondary instruments DS, ÉPID, ÉIV, etc., as well as in primary converters, are not interchangeable and can be classified basically by the following characteristics. The sensitivity and maximum voltage developed within the range of their plunger's stroke, the effective stroke length of the plunger (core), the value of the opposing voltage (unbalance), and nonlinearity. The plunger's effective stroke is considered to be its displacement, which occurs near the magnetic neutral point and provides the instrument with a sensitivity and linearity within the set limits.

The sensitivity of the instrument depends on the turns ratio of its primary to its secondary (differential) winding, on the frequency and magnitude of the voltage feeding its primary winding, and the magnetic characteristics of the core and the screen. The transducer's linearity depends on the secondary winding sections being identical, on the precision of their winding, and on the magnetic uniformity of the plunger and the screen.

The lack of identity between the impedances of the series-opposing sections of the secondary winding leads to a phase difference between their voltages, thus producing at the output of the winding a difference voltage even when the middle of the plunger is at the magnetic neutral point. This is the so-called "residual unbalance voltage." Since it is at quadrature with the useful signal voltage, it does not produce a torque in the reversible motor of the secondary instrument, but it can saturate the voltage amplifier and lead to a reduction in the sensitivity of the secondary instrument. Thus, the lower the residual transducer voltage, the better it is. In practice it amounts to 2-10 mV.

The linearity of the differential-transformer transducer is defined as the maximum difference between the voltages produced in displacing the plunger by 20, 40, 60, 80, and 100% of its effective stroke and the corresponding 20, 40, 60, 80, and 100% of the difference between the voltages produced in the two extreme positions of the plunger, expressed in percentages of the maximum voltage developed by the transducer within the range of the plunger's effective stroke. The smaller the nonlinearity of the transducer, the easier it is to match it to the input of a secondary instrument. In practice, a nonlinearity not exceeding 1.5-2% is tolerated in differential-transformer
transducers with a maximum voltage of 500-550 mV developed in the effective plunger displacement range of 5 mm.

All the above-mentioned basic parameters of differential-transformer transducers can be tested according to the suggested technique on a special rack whose block schematic is shown in Fig. 1. The rack consists of carrier 3 into which the tested transducer is placed, plunger displacement unit 4, whose stroke is controlled by the dial of micrometer screw 5, converting unit 2 used for amplifying the signal obtained from the transducer's secondary winding and for detecting it linearly (the unit also serves to feed the 10-V ac supply voltage to the primary winding of the tested transducer), and of an automatic indicating and recording dc potentiometer 1, type PS or EPP-09. The plunger is displaced automatically by means of a reversible synchronous motor 6, type SD-54. The motor is connected to the plunger of the tested transducer through a reduction gear, a micrometer screw, and a unit for converting the rotational movement of the micrometer screw into a forward movement of the plunger. The rack is supplied from 220-V mains. The operation of the rack consists of the following.

The tested transducer is located in a special grip and the leads from its windings are fixed in four clamping terminals. Reversing switch 7 serves to select the direction of the plunger's displacement, and tumbler switch 8 connects motor 6. The voltage induced by the movement of the plunger in the secondary winding of the differential transformer is fed to the converting unit, and from there to the input of the automatic electronic potentiometer. The potentiometer records automatically on a tape chart the transducer's output voltage variations produced by the plunger's displacement between the extreme positions of its effective displacement range. Such a recording takes