RESEARCH OF STEEL-DIELECTRIC TRANSITIONS USING AN EXTRAMINIATURE VOLTAGE TRANSDUCERS

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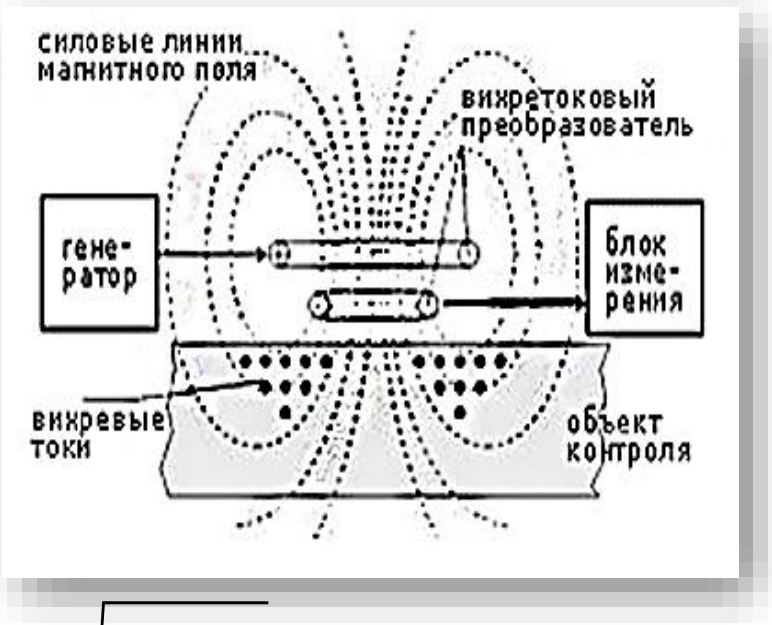
Eddy Current Method

The eddy current method is based on the analysis of the electromagnetic field of eddy currents under the influence of inhomogeneities of the object of control (OK) using an eddy current transducer (ETC).

Typically, one or more coils are used as an ECP. A sinusoidal current in the coils creates an electromagnetic field that excites eddy currents in an OK. In turn, the electromagnetic field of eddy currents acts on the transformer coils, inducing an emf with the opposite sign in them. By registering a change in the resulting EMF, one can obtain data about the object.



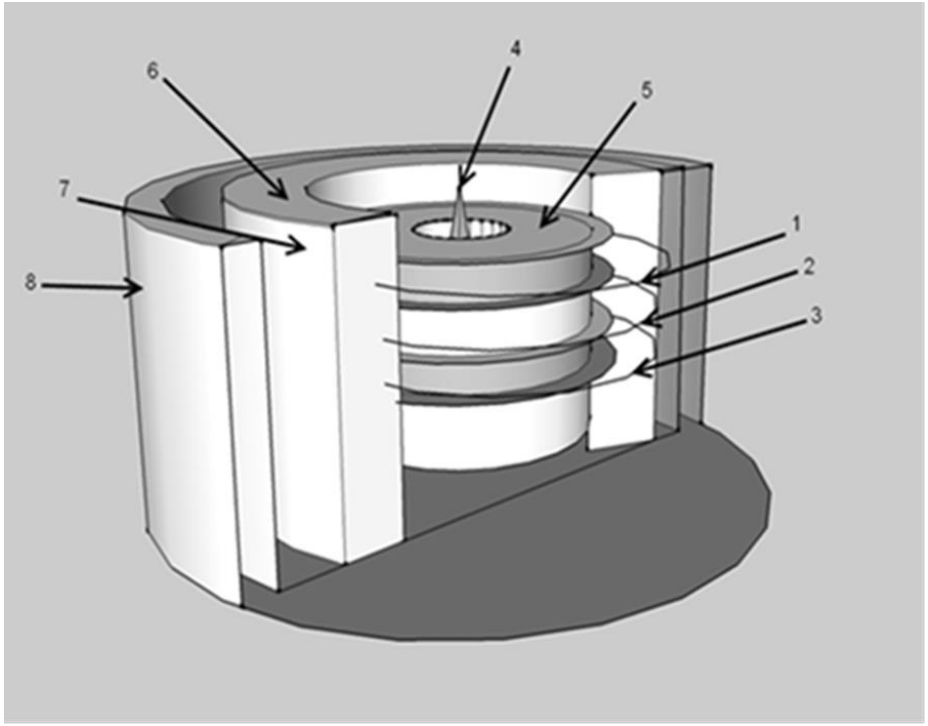
The penetration depth of the eddy currents in the studied object is calculated using the well-known formula:

$$\delta = \sqrt{\frac{2}{2\pi f \mu_0 \sigma}}$$

To describe the operation of an ETC, a special generalized parameter β is often introduced:

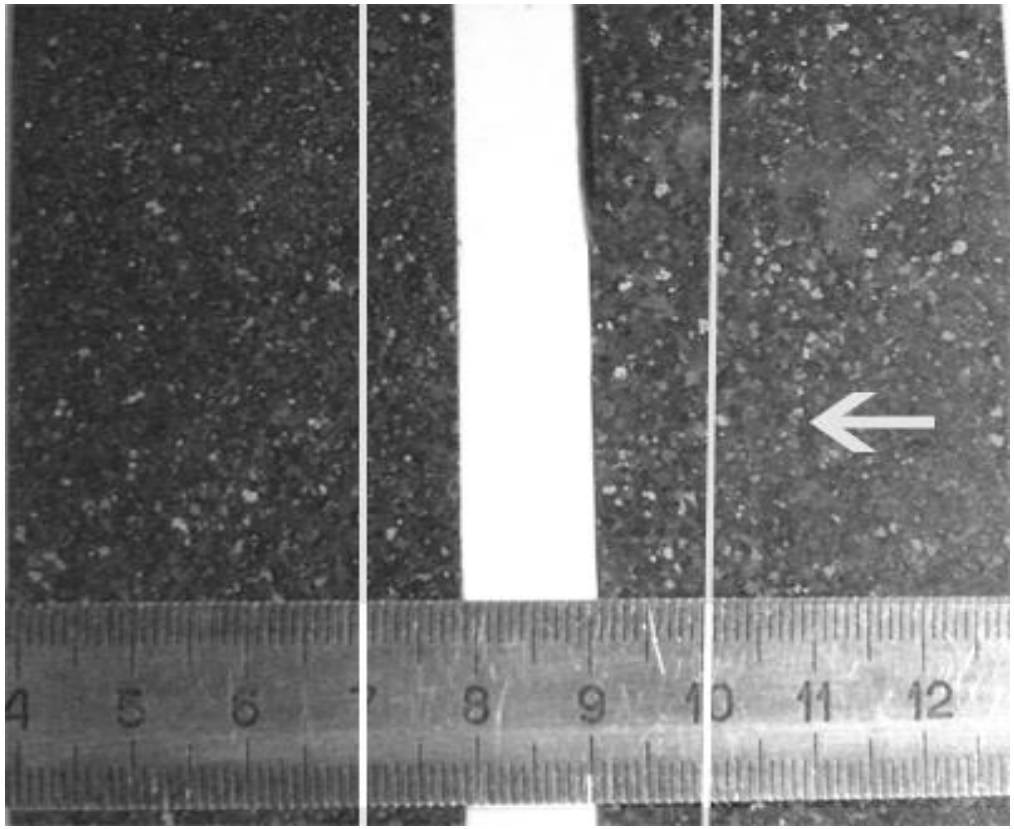
$$\beta = D_э \sqrt{\mu_0 \omega \sigma}$$

Transducers design



The exciting winding (1) is 10-100 turns, the diameter is 0.12 ÷ 1 mm.
Measuring winding (2) - 130-500 turns, diameter 0.05 ÷ 0.5 mm.
Compensation winding (3) - 20-200 turns.
A copper wire having a diameter of 5-50 microns is used for winding coils.
Windings are wound on a pyramidal or cone-shaped core (4).

Study of steel-insulator transitions

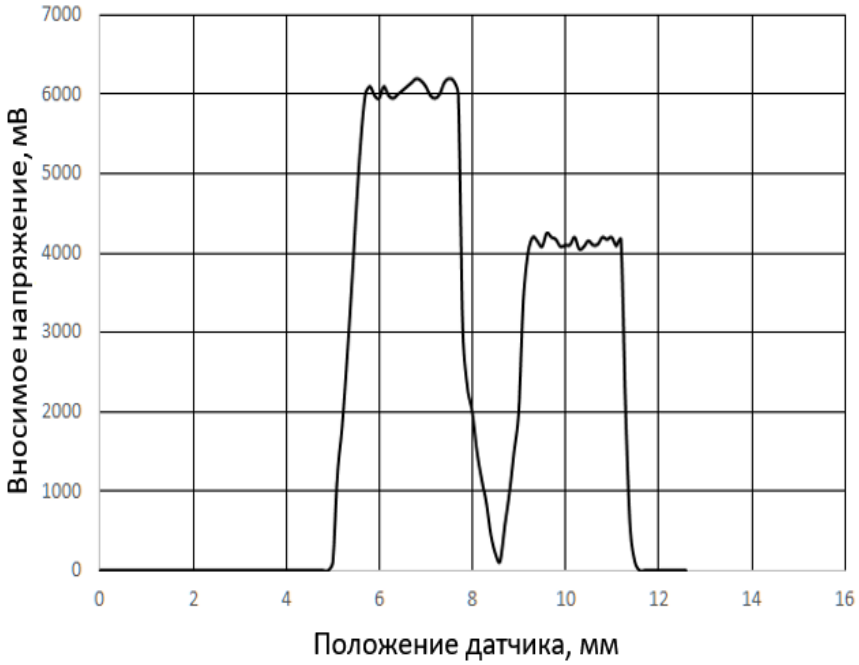


The experiment was carried out with the participation of two materials located at a distance of 1 cm from each other. Scanning measurements were carried out with electrical steel 1212 (sample No. 1), through a dielectric (paper) and ended on steel 3414 (sample No. 2).

The introduced voltage was measured both continuously (by moving the ECP at a constant speed of 1 mm / s) and discretely (the change in the position of the ECP was 0.1 mm per step, the measurement time for each step was 0.5 s).

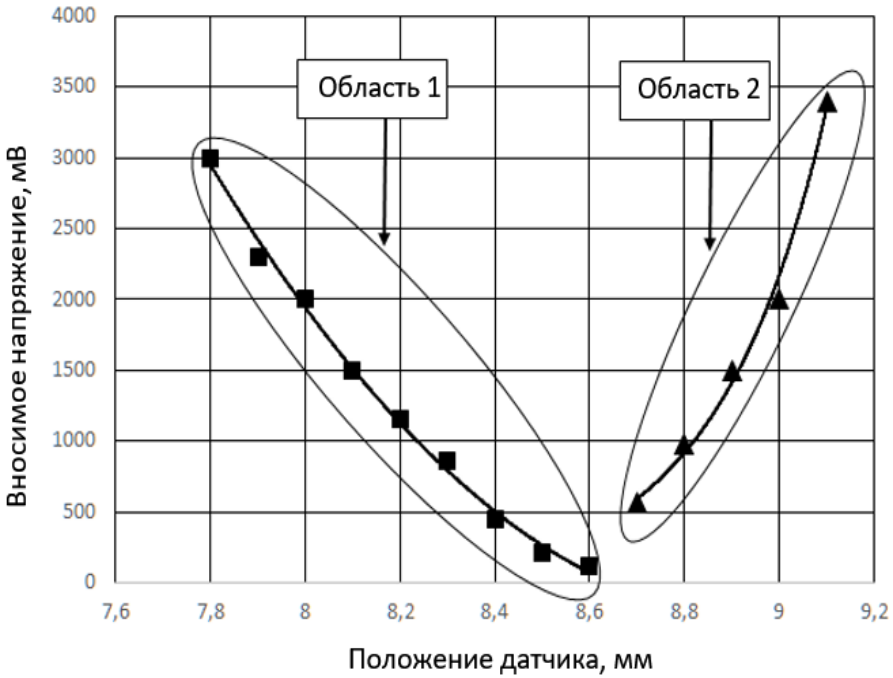
Results of a study of steel-insulator transitions (1000 Hz)

Continuous scan



In the dielectric region, the introduced voltage drops sharply from a value of 6000 mV to a value of 2000 mV and then gradually tends to zero.

Discrete scan



Region 1 (steel-insulator transition) - the amplitude decreases according to the quadratic law to 50 mV.
Region 2 (dielectric-steel transition) - the amplitude increases exponentially