# 1.2.22. STUDY OF METHOD FOR TESTING INTERNAL LAYERS OF FERROMAGNETIC OBJECTS AND DEVELOPMENT OF AN INSTRUMENT TO IMPLEMENT THIS METHOD USING LOW-FREQUENCY ELECTROMAGNETIC FIELD

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Article discloses results of studying possibility to use low-frequency electromagnetic field for testing internal layers of objects of ferromagnetic steels and, in particular, for detecting corrosive damages on the inner side of tested sheets or pipes. Purpose of study:

- to select design and main parameters of the electromagnetic field source;
- to select frequency range and required power of source;
- to determine functional relationships between measured informative signals and sheet thickness, depth and dimensions of the corrosive damage;
- to evaluate the influence of structural imperfections in ferromagnetic steel.

Methods to carry out studies and parameters of measuring instruments are described. Two field sources – in the form of inductance coil with ferromagnetic core and electromagnetic П-shaped source – are studied. Main obtained results are disclosed. Structurally, electromagnetic field source is implemented in the form of П-shaped magnet with the side of square pole equal to (1.2 – 1.5) $t$, where: $t$ – is the tested sheet thickness, while distance between poles is $l$ = (4 – 6) $t$. Test coil is located between poles at the $1/2l$ distance from each of them and measures longitudinal component of field. Depth of electromagnetic field penetration into ferromagnetic medium is influenced strongly by two factors: field frequency and character of the field spatial distribution (geometric factor). Frequency factor is attenuated for the account of selection of the respective frequency of exciting primary field, while geometric one – for the account of respective geometry of field source. When magnetic component of field is measured with П-shaped electric magnet with above indicated dimensions, geometric factor is suppressed almost completely. Field frequency $f$ = 70 – 250 Hz. Minimal power $W$ = 7.5 – 10 Wt allows testing of articles with thickness $t$ = 15 – 20 mm.

Measured signal depends on sheet thickness non-linearly. Linearization of function $U = f(t)$ is performed under piecewise linear method. Measurement error does not exceed 10%. Studies have shown that high demands are imposed on measuring channel of technical means during testing of thick-wall ferromagnetic objects: compensation degree for initial voltage must be not less than 10–3, bandwidth $\Delta f = (1 - 2) f$ for suppression of third and higher harmonics. Gain factor of measuring channel must vary from 10 to 100 dB. Obtained results of studies are implemented in software controlled flaw detector VD-10NN. Dimensions of detected corrosive damage: 20 × 20 mm at depth of 20 mm.