1.2.3. MODERN METHODS OF IMPROVEMENT OF EFFICIENCY AND TRUSTWORTHINESS OF FLAW DETECTION EDDY-CURRENT AUTOMATED ONLINE TESTING OF HIGH-VOLUME METAL PRODUCT

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Sever technical requirements are imposed on the flaw detection equipment in the process of on line testing of rolled product and tubes. That is why, in addition to commonly used testing methods, electromagnetic methods (i.e. eddy current and magnetic) are widely used in the process of metal products fabrication. Most widely are used the flaw detectors with encircling eddy current transducers (ECT). Continuously increasing quality requirements towards testing procedures and equipment explain necessity to develop new examination methods and instruments.

In the paper will be presented a few methods on enhancement of signal-to-noise ratio ($K = Ud/Un$) as well new design of combined transducer (encircling type exciting winding and rotating measuring winding of attached type) providing reliable detection of long longitudinal defects. The coefficient K increase is achieved due to use of special shape metal screen (used for tubes diameters 100 – 200 mm) or additional noise suppression channel. As a signal source for the last one used is an additional differential pair of measuring winding with dia. D noise bigger than one of the basic winding used for defect evaluation ($\varnothing D$ noise >> $\varnothing D$ defect). Signals generated by noise on both winding are aligned and subtracted on summator while signals from defects induced only in basic winding are separated for further processing. In discussed case the defects can be revealed for SNR-K << 1.

The technique is based of different dependences between signal and noise as well as a defect of radial direction. Electromagnetic scattering field from defect is mainly concentrated near the defect zone approximately, 1–2 mm under pipe surface. The scattering field arouned the defect is concentrated in a narrow zone and field force curves feature significant slope. When the distance to the pipe increases, the defect field spreads out, i.e. the field force distributes smoother along scanning direction. The field force distribution from structural discontinuities along the scanning direction at 5 – 10 mm above the pipe surface changes insignificantly. When differentiated by scanning directions via differential measuring coils, the signal amplitude will depend on the field dissipation shape at the measuring distance. The lower the field gradient is, the lower out signal is.

The technique is directed to leap of sensitivity to longitudinal defects with smooth lead-in zones. The classical differential encircling ECT is scarcely capable to detect such defects. The use of an absolute measuring coil is inefficient due to low reliability of testing (high influence of noise from structural discontinuities in metal and cross movement of object). The use of combined ECT appears to be more effective. The transducer consist of stator and rotor hubs. The rotor hub is moved by an electric engine. The stator hub carries the excitation coil and two couples of differencial measuring coil. The rotor hub carries two differencial couples of coil of a encircling type and four-couple of laid-on differential coil. These coil are winded around the longitudinal ferrite robs and are placed into the couple longitudinal grooves with the distance between them being equal to the diameter of the ferrite rod. The differential couples of encircling measuring coil are corresponding winded around the stator and rotor hubs. They form rotating transformers and

serve as signal transmitters from the rotor hub to the stator one. Short defect are detected be the encircling coils.

In eddy-current flaw detectors with encircling ECT's, a tested object is magnetized by constant longitudinal magnetic field up to the state close to the magnetic saturation of a ferromagnetic ($B \sim 1$ Tesla), that reduced noise from both structural and mechanical stresses in ferromagnetic material. This field can be used for thickness measurement of pipes and detection of corrosion on both the external and internal surfaces by meant of it. For this purpose of classical eddy – current flaw detector should be additionally supplied with a set of Hall transducers located by the perimeter of a encircling ECT and multichannel circuit to measure longitudinal component of magnetic fore Hz. Depending on the mini mal size (by an angle coordinate) of corrosion area to be detected the number of Hall transducers and the correspoding number of channels can be equnal to 4, 8, 16, 32 with the size of corrosion area along the perimeter, namely $\frac{\pi D}{4}; \frac{\pi D}{8}; \frac{\pi D}{16}; \frac{\pi D}{32}$, where D – diameter of tested pipe.