

PROSPECTS OF APPLICATION OF THE AUTOMATED NON-DESTRUCTIVE TESTING SYSTEMS OF HEAT-MECHANIC EQUIPMENT OF THERMAL POWER PLANTS

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Introduction

The automation of processes of the control of thermal power plant equipment is one of the most perspective areas of industrial activity. The variety of objects of the control, wide range of electromagnetic parameters, surface conditions (including curvature), criteria of flaw detection and requirements of the Guidance Document does achievement of a similar problem rather difficult.

The direction of the activity connected with the development of automated systems of not-destructive control has been functioning and successfully developing in UralVTI for many years. Some of them are considered below.

System of the automated control of culvert apertures of high-pressure boiler drums «AQUA – 2»

In Russia the big park of high-pressure boiler drums is exploited. At regular inspection of drums various defects are found in them: cracks near trumpet apertures, on a surface of shell and bottoms, in the basic welded connections, in places of welding separation devices, etc. The system of the automated control of trumpet apertures of drums about presence in them superficial operational cracks is considered below.

Since 80th years in UralVTI simultaneously with the manual control the mechanized semi-automatic devices for eddy current testing of a surface of apertures, revealing, definition of a site and parameters of cracks were developed and applied. For the first time such device was applied at the long supervision and control of culvert apertures of the drum TGM-84 (Station Number 11) of the Ufa heat and power plant №4 (ТЭЦ-4). Specification of the main parameters of resistibility of metal of drums to development of cracks became the result of the carried out work.

Constant improvement of mechanical and electronic parts of the automatic system of control of culvert apertures of drums led to creation of the automated control complex "AQUA - 2". Original mechanical units and modern electronic blocks are applied in the device. The complex provides 100 % surface scanning of drums apertures with the help of eddy current probe with record of results of the control on the personal computer.

Automated complex "ROTOR-K" for testing turbine rotors from the axial bore

The turbine rotor is one of the main elements of modern thermal power plants. During the exploitation it is influenced by considerable static and dynamic loads, therefore it is important to find defects in rotor metal in time. According to the effective Guidance Document a turbine rotor should be subjected to control from the axial bore. Developed in UralVTI complex "ROTOR-K" is designed for automatic control of turbine rotors from the axial bore and permits of visual, eddy current and ultrasonic testing and measurement of the residual deformation.

A distinctive feature of the complex is the use of specially developed eddy current flaw detector. Defectoscope provides the formation of the excitation signal and the reception of an information signal from eddy current probe, the selection of useful information in various forms (amplitude, phase and complex). It permits of tuning from the "confounding factors" by the

automatic transfer of the origin of coordinates of the complex plane. Ultrasonic testing is carried out in the immersion variant of ultrasonic inlet. The scanning module contains 2 pairs of piezoelectric transducers installed in a special carriage for ringing out metal rotor on a "tandem" scheme. Ability to vary the tandem base allows the operator to "build" the desired threshold of sensitivity to the depth of cracks and reliably detect cracks that develop from the outer surface of the rotor.

The visual scanning module (SM) contains a videocamera of standard TV- resolution which in a combination with the eddy current SM allows to observe a zone of the control and to receive images of the defects revealed by the eddy current method.

The diameter measurement module is constructed on the basis of high-precision laser triangulation range finder and provides contactless diameter measurement of the bore along length of a rotor.

The automated complex «GIB – 3M» for the control of bends of not warmed pipes of boiler drum from their internal surface

The complex “ГИБ – 3М” was developed for the control of water circulators and culverts and its bands with eddy current and ultrasonic methods from an internal surface. Presence of the flexible connection between the transport and scanning mechanism provides device moving through straight and bent pipeline sites. The special mechanism provides unobstructed transition of the carriage with the converter through bottom spacing ring of welded connection. Thanks to it the complex can move through the pipeline from a drum to a collector and carry out visual and eddy current testing of their internal surface. The complex is entered into a pipe from a drum through culvert aperture. Removal of a heat insulation and cleaning of external surface of pipeline bends are not required.

Approbation under production conditions has shown the operability of a complex and expediency of its application for the control.

The automated complex «COLLECTOR - 1» for the control of collectors from an internal surface

Nowadays the standard endoscopes are used for visual control of an internal surface of a collector. First of all, it is necessary to carry limitation of a zone of the control to drawbacks of this method (besides number of drawbacks inherent in any manual method).

The developed complex «КОЛЛЕКТОР - 1» allows carrying out 100 % visual control of an internal surface of a collector. The complex place in a collector through one of branch pipes. Track-type driver provides moving of the device along the all collector. The special operated blacket permits to focus the videocamera arbitrarily and to receive the image and the photo of a controllable site.

Concluding part

All considered automated systems are successfully put into practice. More than 300 rotors were tested by the complex “ПОТОП-К”. At the same time at the UralVTI new developments are being designed, including systems of the automated testing of such elements of thermal power plant equipment as set of blades of a turbine rotor and bands of sharp steam pipeline.