1.12.26. AUTOMATED EQUIPMENT “LOPATKA-2” FOR DECTION CRACKS UNDER STELLITE PLATES OF STEAM TURBINES

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Nowadays equipment functioning at the stations has fulfiled its park resource and needs qualitative and timely diagnostics. The most critical device of heat-and-power engineering equipment of thermal power plants is a steam turboset, which emergency stop leads to loss of many millions. The breakdown of set of blades is one of the reasons for emergency stop.

Blades of steam turbines work in heavy conditions: resonant fluctuations in which process the acute tensions appear; influence of damp steam and as the result an erosive wear of entrance edge of blades; corrosion.

There are various methods of protection of entrance edges of blades of last turbine stages from these influences. The most popular method is the method of soldering antierosion stellite plates.

Practice of using turbines with blades strengthened in this way shows that in some cases cracks start to develop on entrance edges of blades in the area of soldering antierosion stellite plates. Similar not-through defects cannot be revealed with existing methods of control because of absence of direct access.

In connection with this the development of automated system for detection such defects at an early stage of their development is an important and actual task.

Eddy current and magnetic-flaw methods of testing in automatic mode of scanning with computer operation and analysis of the testing results are used in the complex.

The complex "Lopatka-2" is designed for revealing of cracks in blades of steam turbines both in joints of stellite plates and under plates at an early stage of their development.

The complex consists of scanning transfer mechanism (STM), control and transducing block (CTB).

STM bears eddy current probe (ECP); the flash magnetizing device (FMD); magnetic transducer based on Hall elements (HE 1, 2, 3). Hall elements allow to fix a normal and tangential component of a field of dispersion over a crack. ECP fixes crack presence in a joint of plates.

There is the basic kinematic scheme of the scanning mechanism on fig. 1.

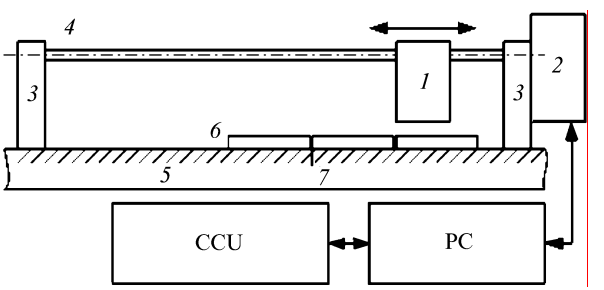

Fig. 1. Principal cinematic scheme of scanning mechanism:
1 – carriage with unit of primary probes and pulse magnetization device;
2 – drive; 3 – magnet locks; 4 – carriage guide; 5 – test object; 6 – stellite plates;
7 – crack CCU – control and conversion unit; PC – palmtop computer

The automated complex "Lopatka-2" works as follows.

Scanning mechanism is set on the blade and kept on it by magnet locks. The carriage moves the transducers fixed on it along an edge of a feather of a blade with the set backlash and distance from edge. The driver of the scanning mechanism is made on the basis of the step motor that gives the chance to define co-ordinates of transducers with demanded accuracy and position them in a necessary place.

Control and transducing block together with a palmtop and the software carry out the following functions:

– control of the step motor of the scanning transfer mechanism
– synchronization of movement of the carriage of the scanning mechanism with frequency and duration of flash magnetizing device switching on. Synchronization provides interrupted movement of the carriage and realization of the following set of consecutive operations:

1. Moving on a blade on the set size – the first step.
2. Measurement of eddy current parameters with ECP, their transfer on eddy-current flaw detector ВТД and then through ADC to microcontroller (fig.1 see).
3. On a signal from the microcontroller control block of magnetizing device (CBMD) with the help of flash magnetizing device (FMD) magnetizes a zone of the control of object – blades; signals from measuring elements of Hall HE1-3 arrive on MK through normalizing amplifiers NA 1-3 and ADC 1-3.
4. MK relays the received information from eddy current and magnetic converters and the data of current condition of STM through interface converter to the palmtop.
5. The palmtop analyzes received information of a current step, gives this information to the operator in a graphic form and saves it in the database.

By developing this complex parameters which the mechanical scanning system should satisfy with have been defined.

Eddy current method:

– Backlash fluctuations Δz no more ±0.1 mm;
– Fluctuations of an angle of slope $\Delta\alpha$ no more ±1.5 degree;
– Fluctuations of distance to blade edge ΔL no more ±1 mm.

Magnetic-flaw method:

– Base of the magnetizing device (distance between poles) b = 20 mm;
– Magnetizing force 700 ampere-turns.

The complex "Lopatka-2" has following parameters:

– The minimum depth of revealed defect in a joint of two plates – 0.3 mm;
– The minimum depth of revealed defect under a plate – 0.5 mm.
– The control of one blade – 30 seconds;
– Taking into account an installation time – 60 seconds;
– Productivity of the control – 60 blades per hour.