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CREATION OF HARDWARE AND X-RAY PROTECTION FOR TOMOGRAPH TOLMI 150-10

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At the moment, the Institute of Non-destructive Testing is commissioning radiation tomographic systems for finding defects in industry.

“In this complex we will combine different methods of non-destructive testing, but we will offer only the set that is optimally suited for our customers’ business needs. That means on our hardware we will test and define the methods which most effectively determine the defects in the products of our customers”, – citation of Non-destructive Testing Institute’s director, Borikov V.N., in interview for TPU News.

That means we need to improve the system of tomograph to obtain images of much more high quality with less time and reduce the size and weight of it.

The main concurrent we have in sphere of x-ray tomography is American company General Electric, supplying equipment to the European, and Russian markets.

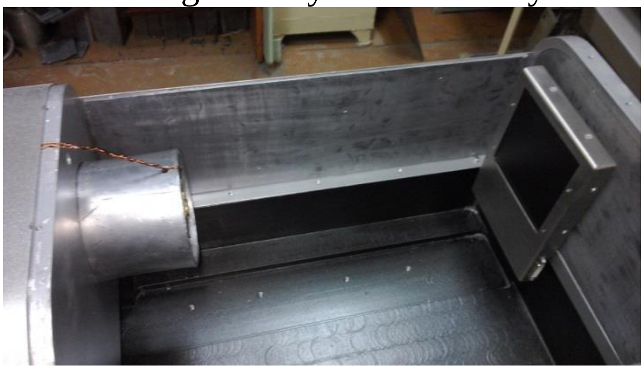
The main problem which we ran into in process of creation the tomograph on hardware level is the low accuracy in measurement of the controlled sample’s rotation angle. Used in tomographic complex rotator (Figure 1) or "turning station" allows you to rotate an object of control in increments of 1 degree. And the same minimum pitch is specified in the software for subsequent image reconstruction.

Figure 1 – Rotator of controlled sample

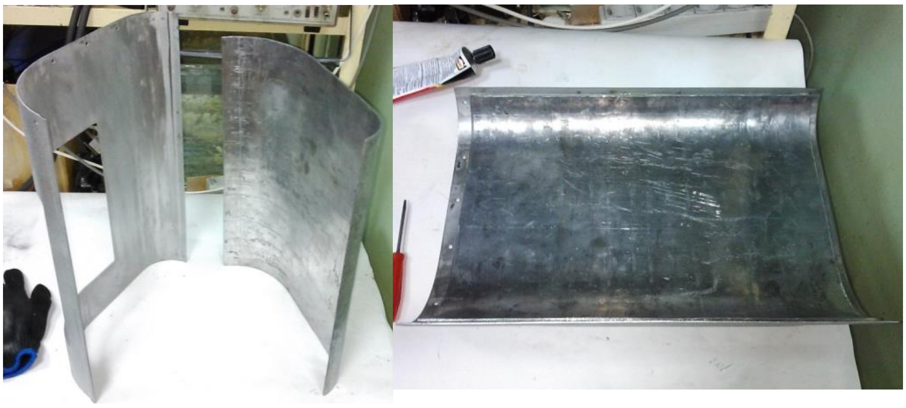
Thus, the rotation angle is not controlled in any way, but merely accepted "on faith" that the angle of rotation of the spinner will be equal to 1 degree. The practice requires the most accurate determination of the angle of rotation. This problem can be decomposed into two tasks:

1. To develop a device for determining the angle of rotation.
2. Create software that takes into account that the angle of rotation is determined by a separate device, and incorporate this information into the experiment.

The second problem is as follows: this tomograph is intended for work on tomography in relatively close contact with it, that’s why there is a need to create the radiation protection from X-rays. After calculating the required thickness of the protective layer, we concluded that it is necessary to attach three lead layers having a thickness of 4 mm each on the end face. On the sides is necessary to attach three lead layers thickness of 3 mm. At the source in order to prevent dissipation of strong radiation - 4 mm thick lead layer. The process of attaching lead layers to the body is in the figure 2.



a)

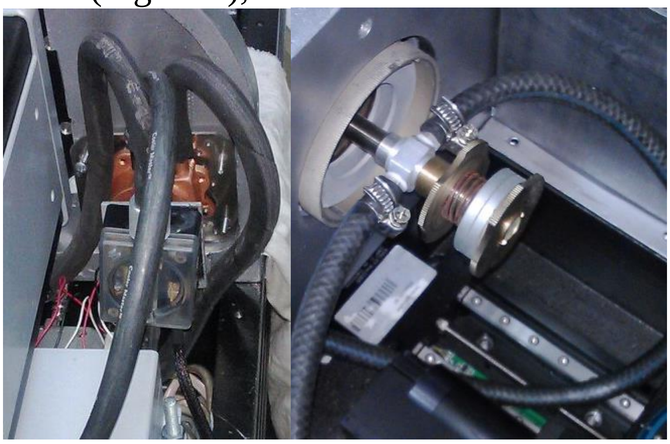


b) c)

Figure 2 – The process of attaching lead layers to the body: a) attaching to the sides and end face, b) attaching to the top part

After the protection was made there is no radiation coming out of the body of tomograph.

The third problem is connected with maintaining the temperature of the cathode ray tube at a desired level. This problem was sold easily. To reduce the temperature in process of obtaining the image we used pump and radiator with two coolers (Figure 3), connected it with the tube and turn on.



a) b)

c)

Figure 3 – Cooling system: a) pump; b) tube; c) cooler

After completing all these operations there was a need of a compact arrangement of all units within the body in accordance with the concept of tomograph work (Figure 4).

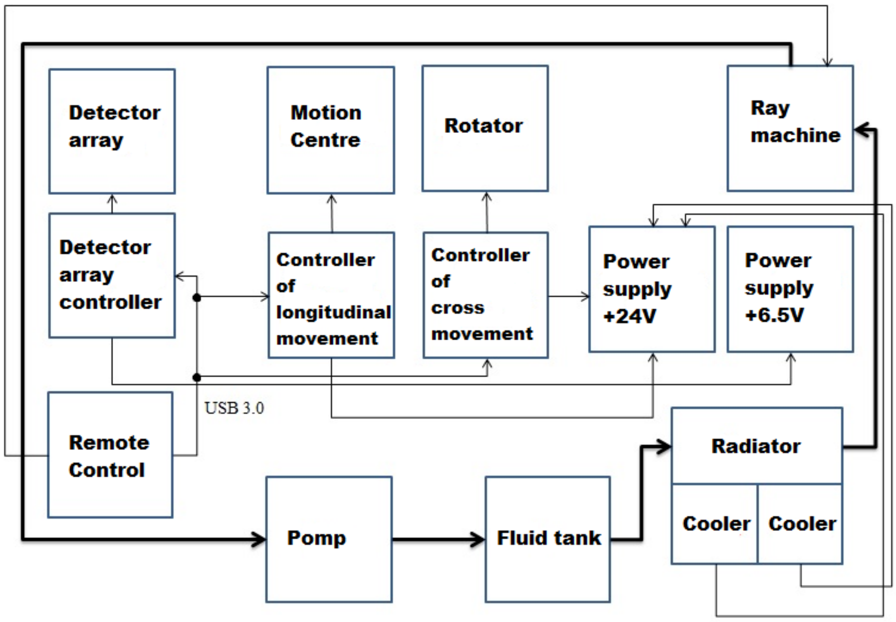


Figure 4 – Concept of tomograph work

As a result of the rational arrangement of all units within the body, manufacturing threaded holes and the installation of all blocks, tomograph took the form shown in Figure 5.

Figure 5 – The internal structure of tomograph

Conclusion

After performing all described operations, we have a working tomograph and everything is ready to perform basic tasks – to improve the system to obtain images of much more high quality with less time by creating a device for determining the angle of rotation and incorporate this information into the experiment.

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INVESTIGATION OF THE PARAMETERS OF THE ELECTRIC RESPONSE FROM HEAVY AND LIGHTWEIGHT CONCRETE

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Concrete is the main construction material, which is used in all construction areas. The quality of concrete structures depends on structural composition of concrete, and it is determined by the porosity of the cement stone, the quality of the contact between the cement matrix and the coarse aggregate, the size and composition of the coarse aggregate. Various technological factors in concrete manufacturing may make the concrete structural composition deviate from the design values. Therefore, the structural characteristics of concrete are to be monitored. This may solve the problem of safe operation of concrete structures.

To solve the problem of nondestructive testing of the concrete structural characteristics, we propose to use the phenomenon of mechanoelectrical transformations under elastic impact excitation of heterogeneous non-metallic materials [1–3]. The principle of the phenomenon of mechanoelectrical transformations implies that under elastic impact excitation, the acoustic waves are formed in the sample. The acoustic waves affect the sources of mechanoelectrical transformations, and as a result, alternating electric field arises. The electric field arises due to the charges occurring at the boundaries of piezoelectric quartz (the component of river sand and gravel) under its deformation and due to the shift of these charges and the charges of the electrical double layers (at the boundaries of the components in a heterogeneous material). The electric receiver is located near the sample surface, and it records the change in the summary electric field in the region of its location. Therefore, the parameters of the electric response should reliably trace the processes of transformation of the acoustic