1.6.4. OPTIMAL SCHEMES AND METHODS OF DETECTING PLACES OF LEAK

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Provision of leak tightness of technological equipment, pipelines and fittings is one of the most important requirements of many manufacturing processes, especially, in potentially hazardous production conditions.

Through defects of second group formed in the result of assembling of parts and subassemblies by means of welding are the most common reason of article leakness. Determination of leak places (their localization) in welded structures is quite labor-intensive operation. Determination of total flow through the article walls has better methodological support than technology of leak localization.

Studies in the paper cover the group of gas analyzing method for leak recording implementing the method of probe. Study results were validated by means of mass leak detector of spectrometric type using helium as a tracer gas.

Paper discusses schemes of formation of the tracer gas concentration field in the area of leak accumulation: with available limiting plane; in the medium of protective gas; in conditions of static position of the leak accumulation area and with its movement along the weld seam. Mathematical model describing the character of tracer gas distribution in the vicinity of a leak is proposed for every scheme. Method used to determine the tracer gas concentration in analyzed sample at the input of device for sample transportation from probe to leak detector is described.

Processes of transfer of the analyzed sample from probe to leak detector in the mode of frictional and molecular flow are examined. For frictional flow, conditions are determined in capillary providing approximated mode of displacement. This attenuates in considerable degree the decrease of tracer gas concentration at the input of leak detector.

As a means for the high-vacuum pumping out of mass-spectrometric chamber, turbo-molecular vacuum pump (TMP) of VMN-150M type was applied. Main characteristics of this pump are: action speed with dry air – $170 \cdot 10^{-3}$ m^3**/s**; limit residual pressure – $6.65 \cdot 10^{-7}$ Pa; number of rotor rotations – 100 – 500 rev/s.

Counter and direct flow schemes of analyzed sample supply were examined; mathematical models describing variation of the tracer gas partial pressure in the leak detector chamber are presented. In the result of theoretical and experimental researches, following dependences were obtained: transit process time vs. TMP rotor rotation speed; increment of output signal of mass-spectrometric chamber vs. forevacuum pressure; admissible gas load vs. TMP rotor rotation speed; sensitivity threshold vs. TMP rotor rotation speed.

In order to obtain data on places of leak location, method for processing the flaw detection peak on the basis of formalization, i.e. determination of its characteristic parameters, is developed. Central moments of n order are such parameters in sufficient degree. Initial zero moment features the area of flaw detection signal. First moment indicates the signal arrival time. It is used to calculate the leak place in the probe movement direction. Ratio of peak area to its height fixes the distance from leak to the probe movement path. Assembly of formalized parameters makes it possible to distinguish actual flaw detection signals from the peak of background signal.