

Rise in accuracy of gas stream spectral analysis in mechanical engineering technology

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Abstract. The submitted method of rise in accuracy of gas stream spectral analysis in mechanical engineering technology by controlling the chemical composition of the exhaust gas streams by means of a six-jet electric-arc plasmatron is available.

To provide the quality of products manufacturing operating procedure in mechanical engineering technology the chemical composition controlling using various methods such as chemical, X-ray spectral and emission spectral analyses is widely used. One of the most commonly used and short-time is emission spectral analysis. In the world practice the rise in the atomic-emission spectral analysis accuracy with the outgoing gas streams is being achieved by using various types of plasmatrons. Their disadvantage is the low efficiency of particles thrown away from the high temperature zone penetration into plasma. A high-voltage six-electrode flare discharge lacks this disadvantage due to highly effective gas-dynamic capture of the supplied particles. However, it is characterized by insufficiently high excitation temperature - 4 800°C [1 – 3].

The objective of this work is to increase the accuracy of materials atomic emission spectral analysis by means of controlling the chemical composition of the exhaust gas streams generated during the products manufacturing or under the direct chemical composition control.

The use of a new plasma flow generator - a six-jet electric arc plasmatron [4] has been proposed in order to achieve this goal. This one makes it possible to control the plasma flow temperature in the range of 6 000°C to 12 000°C. For this problem solution a physical model of a six-jet electric arc plasmatron has been developed, that makes it possible to use this temperature interval as a source of the gas flow spectrum excitation under the circumstances of a highly efficient capture of its particles.

The image of a six-jet electric-arc plasmatron is shown in Fig. 1, 2.



Plasma-forming copper heads 1 mounted on dielectric plateaus 2 are rigidly attached to brackets 3 with the ability to move along the axes of heads 1 in a direction perpendicular to tubular struts 4. A

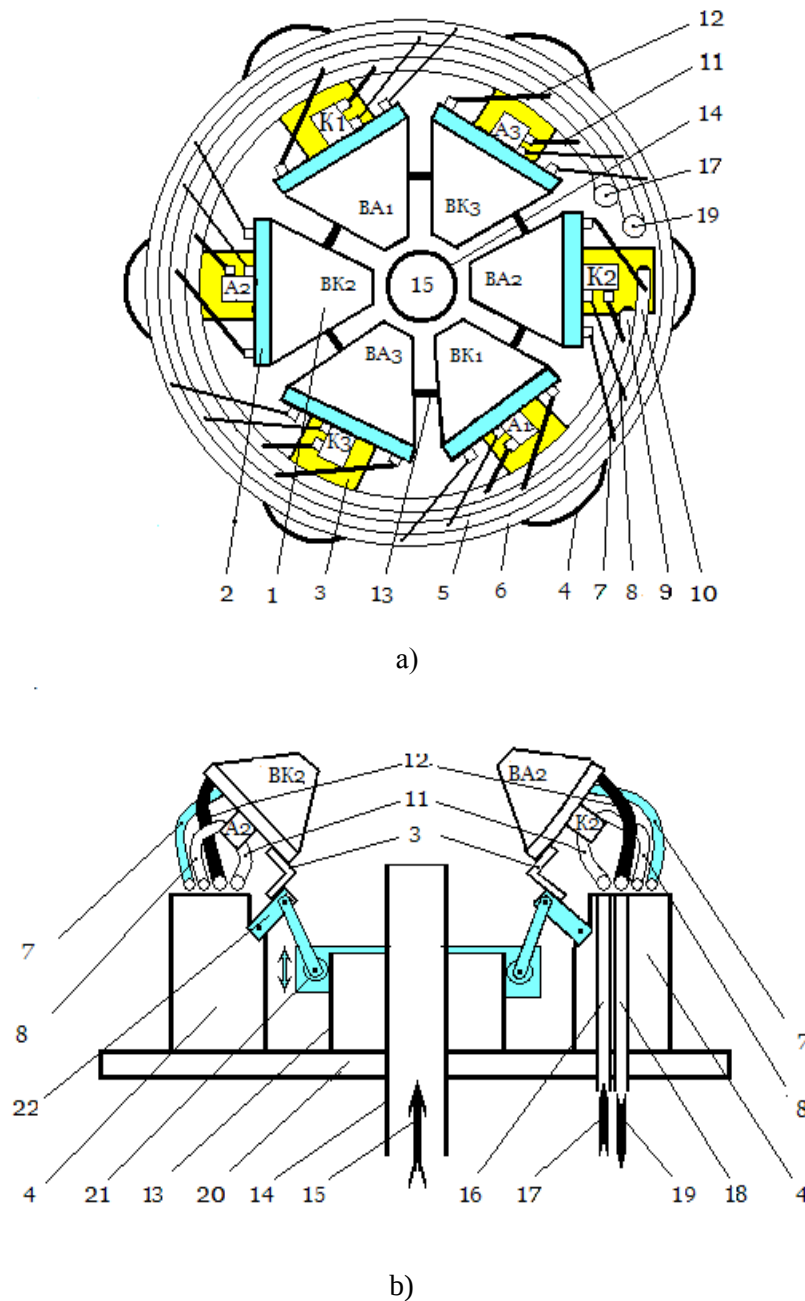


Fig.1 – Scheme of a six-jet electric arc plasmatron a) top view; b) side view: 1 – copper heads; 2 – plateau; 3 – brackets; 4 – tubular posts; 5, 6, 9, 10 – chamber; 7, 8, 11, 12 – hoses; 13, 14 – a branch pipe; 15 – powder material; 16, 17, 19 – channel; 20 – mounting table; 21 – hinged system; 22 – plateau.

tubular chamber 5 for argon supplying to heads which protects the electrodes from oxidation and chamber 6 for distributing the working gas (air) by means of flexible hoses 7 are annularly placed above them. The protective gas is supplied to copper anodes with contacts A1, A2, A3 and tungsten cathodes with contacts K1, K2 and K3 by means of flexible hoses 8.

The cooling water inlet chamber 9 and chamber 10 discharging water into channel 19 are placed above posts 4 axially to chambers 5 and 6. The cooling water inlet in the head section is made from the vertical channel 17 (see Fig. 2, which shows the vertical plasmatron section along the flat-bone, passing through the pair of heads axes, powered from one of the phases of the in Use three-phase rectifier, in particular, connected to the anode head with electrode A2 and auxiliary cathode BK2, and a cathode head with cathode K2 and auxiliary anode A2). There is chamber 10 discharging water into channel 19 next to the annular chamber 9. Chambers 9 and 10 connections with the head sections is carried out by means of flexible hoses 11 and 12. The water stream 19 warmed up during the plasmatron operation is directed to be cooled in a radiator (not available in Fig.2), from which the cooled water returns to channel 16. Posts 4 are located on amounting table 20, there is a rigidly mounted branch pipe 14 between, which is forming the analyzed gas stream or the processed powder



Fig. 2 – Six-jet electric-arc plasmatron.

material 15 [5]. Cylinder 13 is placed axially to branch pipe 14 for synchronizing the change in the angle of six heads convergence by means of a hinge system 21, which provides a synchronic change in the gradient angle of heads relatively to the table plane 20. System 21 comprises a plateau 22 with movable brackets 3, thus providing a change in the magnitude of an interelectrode gap between plasma-forming heads of the plasmatron.

As you can see in Fig.2, the plasma flow is directed vertically upwards during the process of this physical model operation as a source of spectral excitation.

At present, the pilot-industrial plasmatron has been manufactured and is being planned for commissioning at "KamAZ-Metallurgy" PTC in order to control in real time the quality of the alloy being prepared [6].

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