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CALCULATION AND EXPERIMENTAL RESEARCH OF STATIC AND DYNAMIC VOLT-AMPERE CHARACTERISTICS OF ARGON ARC WITH REFRACTORY CATHODE*

V.N. SYDORETS, I.V. KRIVTSUN, V.F. DEMCHENKO, I.V. KRIKENT, D.V. KOVALENKO, I.V. KOVALENKO and **A.G. PAVLOV**

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Well-grounded selection of optimum modes of non-consumable pulse-arc welding requires investigation of dynamics of pulsed arc burning. Proposed earlier model of nonstationary arc with distributed parameters, due to large computing expenses, allows considering effect on arc of only single current pulse. Whereas, investigation of dynamic characteristics of the arc in supply of batches of high-frequency pulses of welding current is of practical interest. In this connection, it is interesting to develop an arc dynamic model with lumped parameters, which does not have limitations from point of view of amount of computations and allows high accuracy tracing of the dynamics of change of characteristics in arc with refractory cathode at high-frequency current modulation. The same data were received for comparison using calculation method based on the model with distributed parameters. Arc column time constant was determined based on calculation data of dynamics of arc voltage change, received employing the model with distributed parameters. In total complex of carried research and experimental investigations allowed working out an algorithms of application of the model with lumped parameters and identifying them. The results are given on expemental investigations of dynamics of change of current and arc voltage in high-frequency non-consumable pulse-arc welding, which are matched with the results of calculations using the model with lumped parameters. 14 Ref., 1 Table, 8 Figures.

Keywords: *pulse-arc welding, non-consumable electrode welding, high-frequency pulses, dynamic characteristics of arc, nonstationary arc, arc column, argon arc, refractory cathode*

Non-consumable inert gas arc (TIG) welding is widely used in manufacture of critical structures in nuclear and chemical machine building, aircraft and rocket construction, food and other branches of industry. The disadvantage of TIG welding is low efficiency promoted by insufficient penetration capability of the arc. In order to eliminate this disadvantage different methods of activation of processes of energy transfer in arc plasma and weld pool, namely welding over activating flux layer (A-TIG process) and hybrid welding (TIG + laser) etc., are currently used [1–4]. Work [5], employing the methods of mathematical modelling of arc with refractory cathode, states an effect of significant increase of current density at pulse leading edge and density of heat flow at anode in supply of welding current pulse with high rate of its change in comparison with corresponding characteristics of stationary arc. A technological consequence, which can be expected as a result of intensification of heat and dynamic impact of pulsed arc on melt, can be an increase of penetration depth and rise of molten metal volume in comparison with direct current welding.

Indicated peculiarity of dynamics of arc burning in the pulse mode indicate that high-frequency modulation of welding current can be used as one more method for activation of processes of energy transfer in arc plasma and metal being welded at corresponding selection of mode parameters. This promotes for an interest in further investigations of dynamic characteristics of the arc with refractory cathode in pulse mode. The primary instrument, which is widely used in welding arc analysis, is its volt-ampere characteristic (VAC). Investigation of relationship between current and voltage in non-consumable electrode welding is of interest in the case of direct current welding as well as in the case of high-frequency current pulse modulation, at which described above dynamic processes are observed. Present work is dedicated to experimental and theoretical investigation of static and

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