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Mplementation Of The Process Of High Temperature Diffusion Treatment

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Abstract: The test specimens and finished products were subjected to high-temperature diffusion treatment in low-melting metal melts. The final mechanically processed products, which reached a roughness of Rz40-Ra2.5, were degreased with alcohol and acetone before loading into the furnace. The working ampoules were made of grade 10 carbon steel and were solid metal, with an outer diameter of up to 85 mm, a height of up to 180 mm, and a wall thickness of up to 8 mm, allowing for maximum utilization of the working space of the SShV-1.2.5/25-I1 vacuum furnace. When studying the kinetics of the effect of melt composition on the HTAD process, smaller ampoule specimens with an outer diameter of 20 mm, a height of 35 mm, and a wall thickness of 3 mm were used.

Keywords: High-temperature diffusion treatment, Low-melting metal melts, Diffusion ampoule technique, Nickel diffusant, Vacuum furnace SShV-1.2.5/25-I1, Ceramic crucible melting.

INTRODUCTION:

The low-melting metal was melted in a ceramic crucible in a shaft electric furnace of the SShOL type and poured into a steel working ampoule containing a diffusing element—nickel—in an amount not exceeding 3% of the melt, in accordance with recommendations. After filling the working ampoule with the diffusing agent and low-melting metal, the ampoule was loaded into a vacuum furnace and annealed at a medium vacuum of D330-100 Pa at a temperature of 673-873 K for 1-2 hours to release gaseous impurities and dissociate unstable oxides in the low-melting transport melt.

Then annealing was carried out in an inert gas environment at a high-temperature diffusion treatment process temperature of 1273-1473 K for 3-4 hours until the diffusant was completely dissolved in the low-melting metal at this temperature.

The coating process was carried out at temperatures of 1173-1473 K using isothermal or thermocyclic processing mode for 1-24 hours as follows.

A pre-prepared ampoule containing a low-melting melt and the sample to be processed are placed in a furnace. To prevent high-temperature oxidation of the sample, melt, and ampoule, the furnace is evacuated to a residual pressure of 1.33 x 10'2 - 1.33 x 10'' Pa. Next, the furnace is filled with high-purity argon (according to GOST 10157-79) to normal pressure and heated to the operating temperature of the high-temperature diffusion coating process. Upon reaching the process temperature, the sample is loaded into the ampoule containing the low-melting melt and held for the specified time. After the coating application mode is completed, the processed sample is removed from the melt, and the furnace is cooled to an ambient temperature of 293 K. The cooled vacuum furnace is opened, and the coated sample is removed. As a result of wetting with the melt, a small number of melt droplets may remain on the surface of the product, requiring subsequent chemical or mechanical removal.

After removing the remaining melt, the products are rinsed in running water and dried. Coating quality control in accordance with GOST 9.302-88 is carried

out to detect porosity by applying filter paper. Static tensile tests of proportional cylindrical specimens (type IV) with and without diffusion coatings were carried out according to GOST 1497-84 on a certified universal test rig UIS-1. The rig was developed at the Materials Science Department of the D.F. Ustinov Belarusian State Technical University " Voenmekh " under the supervision of PhD in Engineering A.G. Sokolov [1] for comprehensive testing of materials for static and fatigue strength, static and cyclic crack resistance . The rig is equipped with interconnected independent elements in the form of blocks: control, information-measuring system and video recording system.

loading systems (HLS, MLS) are controlled by a control unit (CU), which manages the loading process and video recording. This unit is directly linked to the data-measuring system, a programmable load counter , and a video recording unit. The control unit allows mechanical testing in both manual and automatic modes with an accuracy of up to 1%. To improve the accuracy of loading parameter measurements , the UIS-1 utilizes a strain gauge system with sequential conversion of the strain gauge signal into a standard 1V GSP signal. PA-1 strain gauge signal converters serve as strain gauge amplifiers in the system, feeding the converted signal to the K200/7 data-measuring system.

digital information and measuring system enables sequential automatic measurement of electrical voltages of force and strain gauges, etc., with results displayed on the digital measuring instrument's display and recorded on a digital printer. A two-coordinate recording potentiometer, the PDP4-002, is used for graphically recording the loading diagram , receiving a signal directly from the strain gauge transducers. A video recording system is used to record the sample's fracture kinetics during fracture kinetic studies. The recording frequency is set by the control unit.

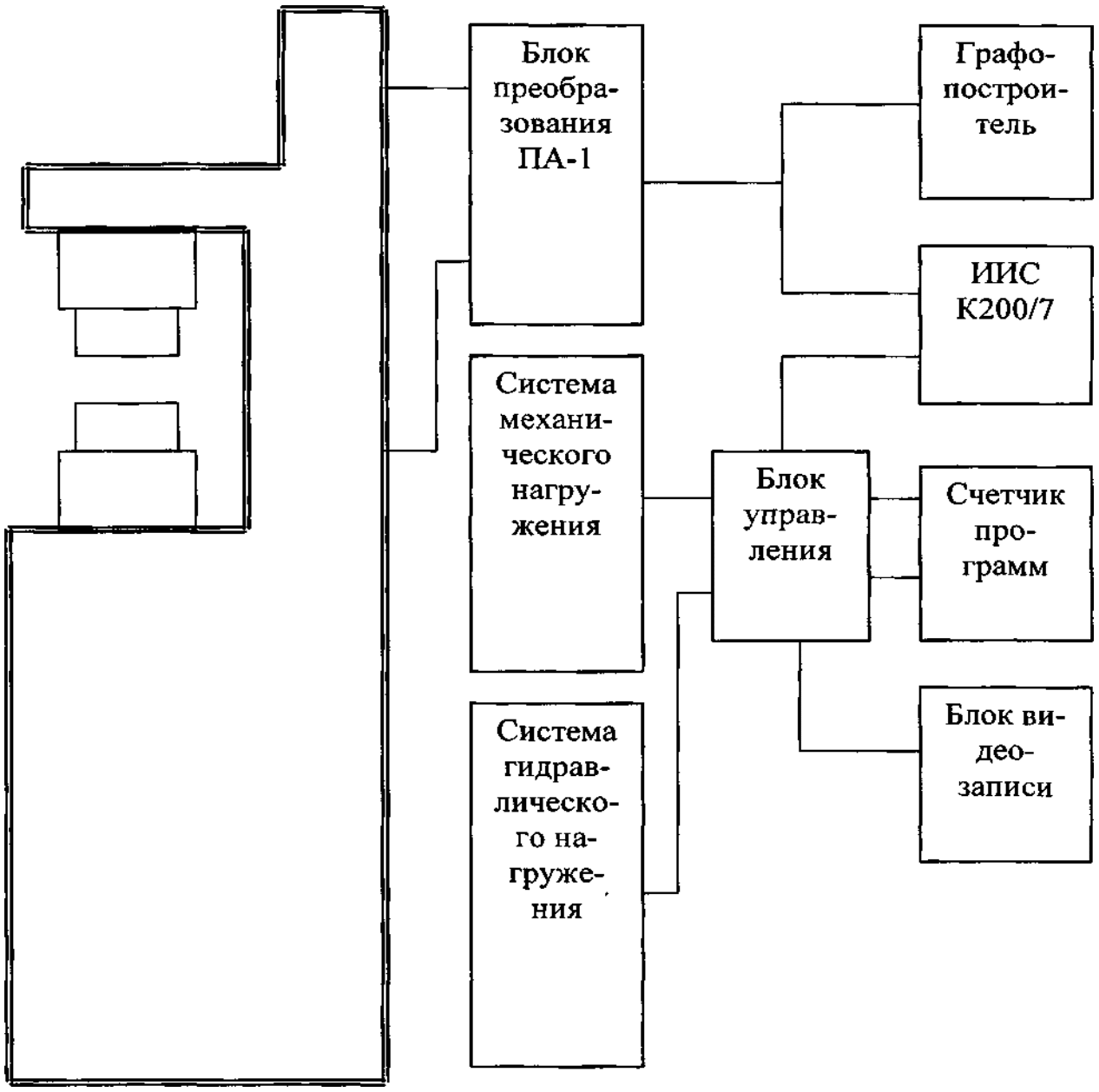

Fig. Block diagram of the universal stand UIS-1

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