structure formation and heat and mass transfer in the radiative—convective mode of drying of natural peat and peat modified by additions of surface-active substances and polyelectrolytes are being studied, which allows one to control processes of moisture transfer and the quality of products based on peat.

The problems of the national economy being solved by the CSRICUWR, connected with the development of methods for improving the filtration properties of heavy soils and grounds and of methods for predicting their properties in salinization and leaching processes, particularly when using mineralized water for irrigation, have required the performance of a number of scientific investigations involving the study of the adsorption and filtration properties of complicated disperse systems, consisting mainly of rock-forming clay minerals. This work is now being performed using IR-spectroscopic, x-ray-structural, electron-microscopic, and gas-chromatographic methods for the analysis of disperse systems.

The results obtained provide new information on the structure of bound water and the structure of disperse media in the surface layers of a solid phase and explain the mechanism (nature) of the permeability of finely disperse systems modified by exchange cations and water-soluble polymers during the filtration of liquids.

Research in the field of the development of the theory of interrelated processes of transfer of energy, momentum, and mass in rheologically complex media of the type of metal—polymer composites and thick lubricating filler materials, to increase the productivity, durability, reliability, and efficiency of components and details of machines and mechanisms with a simultaneous decrease in the metal content and cost of the articles, have been conducted in the last few years in the Scientific-Research Laboratory of Applied Physics Problems in the Department of Physics (SRL APP) of the Belorussian Institute of Railroad Transport Engineers (Gomel).

Research on the drying of grain and of food and vitamin preparations for the agricultural economy, for which a far-reaching development program was outlined by the July (1978) Plenum of the Central Committee of the Communist Party of the Soviet Union, is developing successfully in the jubilee year at the A. V. Lykov Institute of Heat and Mass Exchange, AS BSSR.

In the jubilee year, as always, the scientists of Belorussia who are specialists in the field of heat and mass exchange consider it their honorable duty to participate actively in the solution of the urgent problems formulated by the Communist Party.

SPATIAL—TEMPORAL PULSATIONS OF AN ARC PLASMA PINCH IN A PLASMATRON CHANNEL

V. D. Shimanovich, G. P. Lizunkov,
O. I. Yas'ko, N. F. Aleshin,
and A. F. Bublievskii

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The results of an investigation of the pulsation characteristics of the arc column in a plasmatron, based on a statistical analysis of emission traces, are presented.

The study of processes taking place in a plasmatron channel and the calculation of the electric-heater characteristics are impossible without knowledge of the parameters of the hottest zone of the plasmatron — the arc pinch. Plasma diagnostics in the channel is usually hindered by pulsations of the pinch in time and space, which requires an experiment with time resolution [1]. Spectroscopic methods of determining the parameters of a nonsteady arc plasma from the time-integral emission are described in [2-6]. The normal distribution law of transverse displacements of the pinch, required for the realization of this procedure, was established by the authors for a limited range of the working parameters, and it is generally postulated for the brightness pulsations of the pinch emission [6]. The present report is devoted to the further development of the methods of plasma diagnostics for electric heaters.

Institute of Physics, Academy of Sciences of the Belorussian SSR. A. V. Lykov Institute of Heat and Mass Exchange, Academy of Sciences of the Belorussian SSR, Minsk. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 35, No. 6, pp. 969-971, December, 1978. Original article submitted December 29, 1977.

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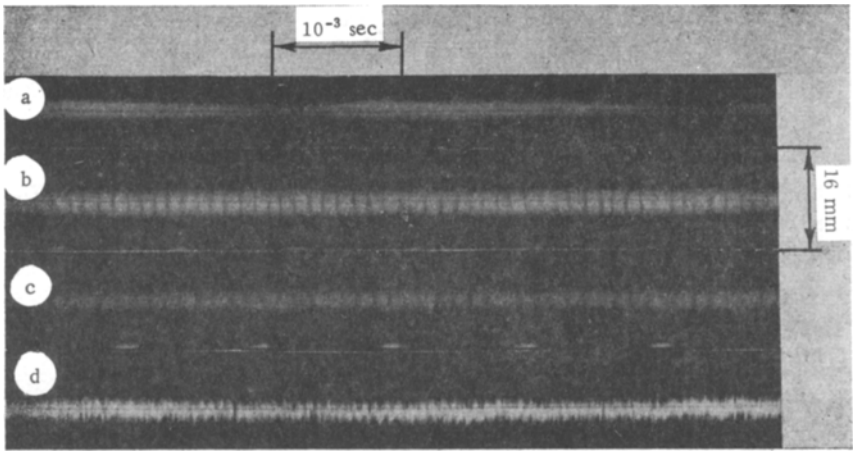

Fig. 1. Photographic traces of the plasma pinch: a) i = 60 A, G = 0.5 g/sec, L = 17 mm; b) 130 A, 0.5 g/sec, 17 mm, respectively; c) 175 A, 1 g/sec, 17 mm; d) 230 A, 2 g/sec, 64 mm.

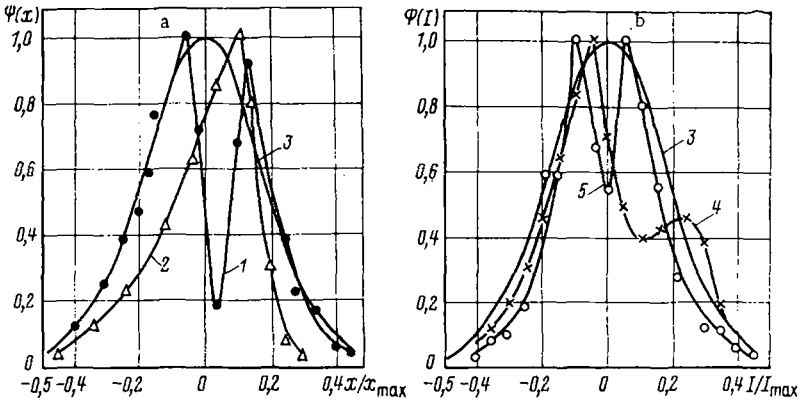

Fig. 2. Normalized distribution densities of probabilities of movements (a) and of brightness pulsations (b): 1) i = 60 A, G = 2 g/sec, L = 17 mm; 2) i = 130 A, G = 2 g/sec, L = 17 mm; 3) normal distribution; 4) i = 130 A, G = 0.5 g/sec, L = 17 mm; 5) i = 175 A, G = 1 g/sec, L = 64 mm.

The investigations were carried out on a sectioned arc plasmatron with an axially vortical supply of the working gas (Ar) and with stabilization of the average length of the arc by stepping in the range of currents i = 60-270 A and gas flow rates g = 0.5-2 g/sec. The plasmatron channel diameter is d = 0.8 cm. Continuous scanning of the emission in two cross sections was done with an SKS-1M movie camera by the procedure of [7]. The maximum time resolution achieved was $\sim 3 \cdot 10^{-6}$ sec. The SKS-grams were measured photometrically along two coordinates and the results obtained were quantified in accordance with the requirements of [8]. The duration of the traces was chosen as ~0.01 sec so as to obtain sufficient accuracy at the lowest oscillation frequency. The experimental data were treated on a Minsk-32 computer to obtain the main statistical characteristics of the pulsations: the probability distribution density, the correlation functions, the one-dimensional spectral power density, the dispersion, and the mean values of the quantities.

Typical SKS-grams of the emission of the plasma pinch are presented in Fig. 1. It is seen that the spatial—temporal structure depends strongly on the working mode of the plasmatron. The diameter of the plasma pinch increases both with an increase in the discharge current i and with a decrease in the gas flow rate G. At small currents and gas flow rates (Fig. 1a) the trace has a continuous character within the time limits conditioned by the brightness pulsations of the plasma emission (f = 300 Hz) owing to fluctuations in the voltage of the electric power supply. Strictly periodic brightness pulsations with a frequency f ≃ 8 kHz appear with an increase in current (Fig. 1b). This periodicity is retained with an increase in the gas flow rate and a higher current strength (Fig. 1c). With a further increase in the gas flow rate (Fig. 1d) the

plasma pinch contracts and moves stochastically relative to the axis of the discharge. A distinctive feature of the high-current modes at large gas flow rates is the presence in the frequency spectrum of transverse movements along with the high-frequency stochastic oscillations of the regular lower-frequency component.

The normalized distribution densities of the probabilities of transverse movements and of the emission brightness of the plasma pinch for individual operating modes are presented in Fig. 2. It is seen that the distribution density for these modes does not obey a normal law, which is different from the data of [1], obtained for an air plasma. A comparison of traces taken in different pinch cross sections shows that the average frequency and intensity of the pulsations grow somewhat with greater distance from the cathode.

The results presented indicate that the formation of a plasma pinch in a plasmatron channel is determined by a complex of physical processes. One can assume that a laminar mode of plasma flow is realized at low discharge currents and small gas flow rates (Re < 400-500 based on the average-mass parameters). A periodic structure, which may be caused by various factors such as a superheat instability [9, 10], appears on the SKS-grams with an increase in the current. With an increase in the gas flow rate, and hence with an increase in the Reynolds number to 800-2000, the plasma flow is turbulized, while the pinch itself contracts strongly owing to intense cooling of the peripheral zones. The appearance of transverse oscillations of the pinch, along with the high-frequency component as well as the low-frequency component, in the frequency spectrum can evidently be explained by the spiral form of the pinch [11, 12], which is undergoing stochastic transverse movements. The proposed interpretation of the experimental data obtained, using the above-indicated phenomena, does not rule out their interrelationship with the mechanism of shunting of the arc sections near the electrodes.

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