while the directly measured values (see Fig. 2) were $M_s = 18.5, 17.5, \text{ and } 16.5 \text{ G.}$. Similar results were obtained with the second sample.

I thank V. B. Samoilov for measuring the magnetization of the fluid.

LITERATURE CITED


SUPERCRITICAL CONVECTIVE MOTIONS IN A SHORT HORIZONTAL CYLINDER

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As a result of the breakdown of mechanical equilibrium in a fluid in a closed cavity heated from below a monotonic convective motion arises, its spectrum being determined by the shape of the cavity. With increasing Rayleigh number, the stationary motion becomes unstable, and periodic convective oscillations arise in the fluid; with increasing supercriticality, these are replaced by irregular fluctuations. In some cases [1, 2], the irregular oscillations are established directly after the monotonic motion. The investigation of the time characteristics of these oscillations, which occupy an intermediate position between ordered motion and developed turbulence, is of interest for understanding the nature of turbulence [3–5]. In accordance with the Landau–Hopf model, the resulting oscillations are quasiperiodic in nature, and in accordance with the model first proposed by Lorenz are stochastic with a strange attractor (random attracting set) in the phase space.

In the present work we have investigated the development of supercritical motions and the nature of the irregular convective oscillations of a fluid in a horizontal cylinder of diameter $30.9 \pm 0.1 \text{ mm}$ and length $4.7 \pm 0.1 \text{ mm}$. The cylinder was bounded at its ends by two vertical brass plates measuring $110 \times 90 \times 9 \text{ mm}$, between which there was a piece of Plexiglas with a circular part cut out which determined the size and shape of the cavity. The plates had a heater at the bottom and a refrigerator at the top, and the temperature difference between them was specified by means of two jet ultrathermostats. The vertical temperature gradient in the plates was measured by thermocouples. To ensure homogeneity of the gradient, the model was placed in a protective jacket in the form of a rectangular parallelepiped made of sheet copper $1 \text{ mm}$ thick. At the top, the jacket was connected to the refrigerator, and at the bottom to the heater. The air gap between the walls of the jacket and the brass plates was about $1 \text{ mm}$. To reduce the heat transfer, the jacket was placed in a foam-plastic block. The junctions of 11 copper–constantan thermocouples were placed along the horizontal diameter of the cavity at equal distances from each other. The width of the junctions did not exceed $0.25 \text{ mm}$. The common junction was in the central horizontal section of one of the brass plates. The electromotive force of the thermocouples, which was measured by mirror galvanometers, was recorded continuously on moving photographic paper.

All the measurements were made in a stationary regime at a constant mean temperature.

Fig. 1

of the fluid in the cavity. The majority of the experiments was made with distilled water. For visual study of the structure of the convective motions, the model was filled with transformer oil with light-scattering aluminum powder particles, and one of the vertical brass plates was replaced by transparent Plexiglas.

In this cavity, convective motion of the fluid arises at the Rayleigh number $R = 13.1 \pm 0.2$ (the Rayleigh number was determined by the half-width of the cavity and the vertical temperature gradient). The first critical motion is a two-cell motion (fragment 2 in Fig. 1). In this, the fluid rises or sinks along the vertical diameter and moves in the opposite direction at the side walls of the cylinder. We also observed three- and four-cell motions (fragments 3 and 4 in Fig. 1), which occurred when $R$ was increased to 23.0 and 35.0, respectively. The direction of circulation of the fluid in the cells was established randomly for each of the motions. It should be noted that with decreasing $R$ the reverse transitions from the four-cell to the three-cell and from the three-cell to the two-cell motions occur at smaller Rayleigh numbers: 26.7 and 20.1.

The temperature distribution along the horizontal diameter for the critical motions is shown in Fig. 1, in which $t$ is the departure of the temperature from the equilibrium value divided by the temperature difference between the ends of the vertical diameter, and $x$ is the distance from the center of the cavity divided by the cylinder radius. The maximal amplitude $t_m$ of the temperature profile increases as the Rayleigh number increases to $R \approx 45$, and then slowly decreases.

The single-cell motion, which determines the lowest level of the instability of a fluid in a long horizontal cylinder [6], is not critical for the short circular cylinder and with a strictly vertical temperature gradient was not observed in the experiments. If the model was turned through a certain angle $\alpha$ about the horizontal axis of the cylinder, so that a horizontal component of the temperature gradient is produced, the thermocouples detected a temperature distribution characteristic of single-cell motion when $R < 13.1$. For $R > 13.1$ the two- and three-cell motions go over with increasing $\alpha$ into the single-cell motion, the critical angle $\alpha$ at which the rearrangement of the structure takes place being much smaller for the two-cell motion than for the three-cell motion. With increasing angle $\alpha$, the four-cell motion is replaced by the three-cell motion. As the angle is decreased, one observes the reverse transitions, but these take place at smaller values of the angles. The temperature distribution in the case of