ACTA PHYSICA POLONICA Vol. XXXV (1969) Fasc. 6

HOLOGRAPHIC METHOD OF DETERMINING TEMPERATURE DISTRIBUTIONS

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(Received March 17, 1969)

The paper presents the results obtained in determinations of the temperature distribution around a heated wire by means of a double hologram.

In making a hologram the photographic plate records both the phase and the amplitude of the light wave scattered by the photographed objects. Reconstruction of the wave front enables us to reproduce this wave from the hologram, hence, to see the object with all of its spatial features [1]. This property of holographic recordings makes it possible to apply them in investigations of certain physical phenomena which are optically inhomogeneous [2–5].

This paper presents the results obtained in determinations of the temperature distribution around a hot wire in air. With the use of the arrangement shown in Fig. 1 a double

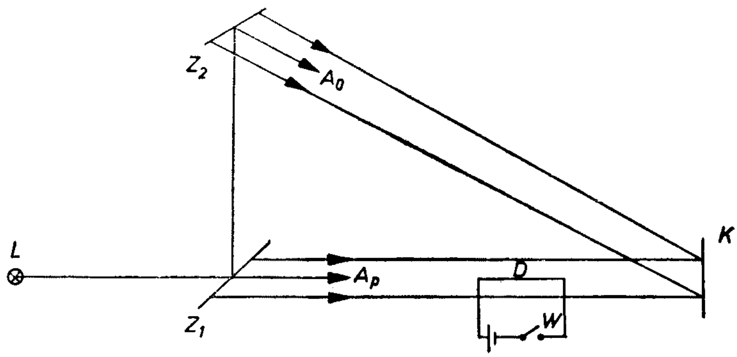

Fig. 1. Diagram of arrangement for recording holograms. L — He-Ne laser, Z_1 — 20% transmission mirror, Z_2 — 20% transmission mirror, D — wire, W — switch, K — photographic plate, A_p — scene beam, A_0 — reference beam

hologram was taken on a single photographic plate. In the first exposure, the scene beam A_p passed through the space surrounding the unheated wire and met with the reference beam at the plane of the photographic plate, which recorded the interference pattern due to these

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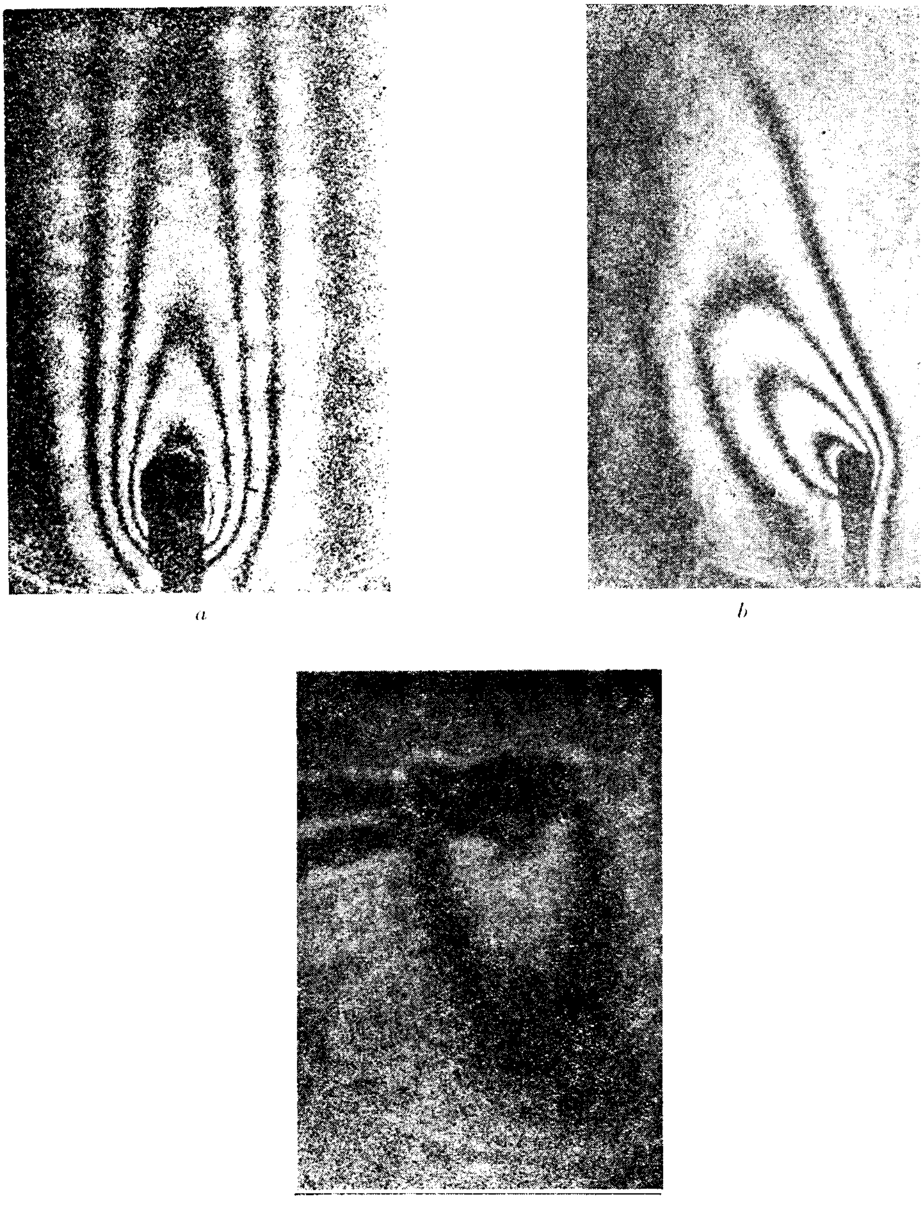

Fig. 2. Pattern of isothermal lines around heated wire aligned parallelly to scene beam (*a*, *b*, *c*)

two light beams. Subsequently, without changing the geometry of the experiment the wire was heated by passing direct current through it and a second hologram was taken on the same photographic plate. After heating, the space surrounding the wire became optically inhomogeneous owing to the temperature gradient. Because of this, the scene beam underwent a change of phase in this space during the second exposure as compared with the first beam, and interference with the reference beam gave a system of interference fringes on the photographic plate. Thus, in the two successive exposures the photographic plate recordeded two holograms.

In the process of wave front reconstruction both scene waves were reproduced from the hologram simultaneously. These waves, meeting in the first order of diffraction, gave an interference pattern. The shape of the interference fringes depicts the shape of the isothermal lines, and the density of these fringes depicts the temerature gradient.

The photographs on the Fig. 2a, b, c show the isotherms around the wire aligned parallelly to the scene beam. These isotherms were obtained in reproductions of different

Fig. 3. Temperature distribution when wire is perpendicular to scene beam

Fig. 4. Isotherm pattern around two parallel wires aligned parallelly to the scene beam

holograms. These holograms were made at different temperatures of the wire. Owing to the fluctuations of the air, the exposure times were 1/250 second. The slope of the isoterms in Fig. 2*b*,*c* is due to the currents perpendicular to the wire. Fig. 3 is the result obtained when the wire was placed perpendicularly to the scene beam.

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Figure 4 shows the temperature distribution around two parallel wires aligned parallelly to the scene beam.

Holograms were made with both parallel and slightly divergent beams. In both cases the results were satisfactory. A He-Ne laser of a power of approximately 4 milliwatts served as the coherent light source. The holograms were recorded on Agfa-Gevaert 31D65 photographic plates.

We wish to express our gratitude to Doc. dr M. D. Kunisz for the interest and help in the performance of this work.

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