ON THE QUESTION OF NONSTATIONARY HEAT EXCHANGE IN UNDERGROUND CHANNELS AND PIPES

G. A. Mostovoi

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The article gives an analytic solution of the problem of the temperature variation in an incompressible liquid moving in an underground channel or pipe when the temperature of the liquid at the initial cross section varies according to a harmonic law.

The thermophysical properties of the material of the channel wall (or of the heat insulation of the pipe) are not identical with the thermophysical properties of the surrounding soil (the two-layer problem of nonstationary heat conduction).

The article considers the steady-state temperature conditions in the system, and therefore the initial conditions are irrelevant.

The problem is solved under the following assumptions:

a) at any cross section, the temperature of the liquid is the same throughout the entire cross section of the channel;

b) the coefficient of heat exchange from the air to the surface of the channel wall depends on the velocity of the air stream passing through the channel;

c) the heat flux in the soil along the axis of the channel is small in comparison with the heat flux perpendicular to the channel (pipe) axis and may be neglected.

As a result of the solution of a system of differential equations, the author obtains analytic functions for determining the amplitude of the oscillations and the displacement of the oscillations in phase along the length of the pipe (channel).

From the solution of the two-layer problem of nonstationary heat conduction, as a special case, we obtain E. V. Stefanov's well-known solution of the single-layer problem of nonstationary heat conduction.

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