TO THE PROPERTIES OF A TEMPERATURE PERTURBANCE IN A NONLINEAR MOVING MEDIUM

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In this paper we consider one of the problems of nonlinear thermal conductivity considering convective transfer when the transfer speed depends on the time; for it found an exact analytical solution analysis which reveals a number of characteristics of thermal processes in nonlinear media.

Keywords: nonlinearity, quasilinear, thermal conductivity, thermal energy, unsteady.

In the study of energy transfer processes in high-temperature environments should take into account a number of their special properties. For example the dependence of the heat capacity and thermal conductivity of the medium on the temperature, you must take into account the contribution to the energy balance of the volume of radiation , exothermic and endothermic processes of ionization, chemical reactions , combustion, convective transfer and others.

Consideration of these factors leads to the nonlinearity of the transfer of energy equation. Along with this we can also take into account the convective heat transfer with time depending velocity of and its impact on the evolution of the process under study. Intensive development of the non-linear transfer theory stimulated research in plasma physics [1- 3] . There were obtained fundamental results in recent years and found a number of non-linear effects that determine the properties of inertia, and localization of thermal processes [2-6] . Author of the work [1] consider the problem on the effect of instant concentrated heat source in an incompressible nonlinear medium with power dependence of thermal conductivity on temperature in the presence of her bulk absorption of thermal energy, the power of which depends on the temperature and explicitly on the power law of time.

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In this paper we consider one of the problems of nonlinear thermal conductivity in view of the variability of density; for she found the exact analytical solution, the analysis of which reveals a number of characteristics of thermal processes in nonlinear media. Consider the following problem on the effect of instant concentrated heat source in an incompressible nonlinear medium with power dependence of thermal conductivity on temperature with variable density in the presence of her bulk absorption of thermal energy, the power of which depends on the temperature and explicitly on the power law of time.

This unsteady heat conduction process described by the following Cauchy problem for a quasilinear parabolic equation

$$\frac{\partial u}{\partial t} = \nabla(u^{\sigma}\nabla u) + div(v(t)u) - b(t)u^{q},\ u(0,x) = u_0(x) \geq 0,\quad (t>0, x \in R^N)$$

in $Q = \{(t,x) : (t>0, x \in R^N)\}$,

here $u(x,t)$ - the temperature σ - the parameter of nonlinearity $b(t)$ -the coefficient of a volume absorption of a heat;

In [1] when $u_0(x) = P\delta(x)$,where P - the value of which determines the energy of the heat source at the initial time; $\delta(x)$- delta function characterizing the initial temperature distribution concentrated heat source placed in the origin were established arising to the following nonlinear effects: an inertia effect of finite velocity propagation of the thermal perturbation, the effect of a spatial localization of heat and the effect of a finite life time of the thermal structure in medium with absorption.

In this work we find an exact solution of the problem (1) for sufficiently arbitrary function $b(t)$ and $v(t)$ based on the conditions finite speed of temperature perturbation (FSTP), a condition of a spatial localization of heat, the effect of a finite life time of the thermal structure in medium with absorption including case of

$u_0(x) = P\delta(x)$. The behavior of the temperature front (a free boundary) is analyzed. An estimate of the solutions of the Cauchy problem (1) is established.

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