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Low-Temperature, Low-Metal Consumptıon Thermosıphone Heatıng Devıce wıth Intermedıate Heat Carrıer for Solar Heatıng Systems

(PhD) K.R. Aytbaev, Master's student D.A. Kadirbergenova

Karakalpak State University, Nukus city

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Currently, the rational use of energy resources in the world, as well as the creation of new energy-saving technologies and equipment that reduce the consumption of organic fuel for heating buildings through the use of low-temperature waste heat, heat from the environment and soil, solar radiation, and other alternative sources, is considered the most priority area of scientific research. In scientific research conducted in developed countries, special attention is paid to the creation of highly efficient heating equipment, as well as to reducing their cost and operating costs. Therefore, the development of a low-temperature self-regulating thermosiphon heating device with an intermediate heat carrier for solar heating systems is an urgent scientific and technical problem. Large-scale research activities are being carried out in our republic aimed at the widespread use of renewable energy sources and the creation of new technologies that contribute to increasing their efficiency and practical application. The New Uzbekistan Development Strategy for 2022-2026 defines tasks, including "Continuous provision of the economy with electricity and active introduction of "Green Economy" technologies in all sectors, increasing the energy efficiency of the economy by 20 percent." In the implementation of these tasks, in particular, it is important to conduct scientific research aimed at solving the issues in demand as a result of the construction of new and modernization of existing energy production sources based on renewable energy sources, including the development of a low-temperature self-regulating heating device for solar heating systems.

The purpose of our research is to develop a low-temperature self-regulating thermosiphon heating device with a low metal consumption for solar heating systems based on the intensification of one- and two-phase heat exchange processes of the intermediate heat carrier fluid inside the heating device housing.

When conducting the research, we set several tasks, including: taking into account the specifics of the effective use of solar heating systems.

analysis of modern designs of radiator heating devices; analysis of existing theoretical and experimental studies of evaporation and condensation processes in closed volumes for two-phase low-temperature heating devices in the form of a thermosiphon; development of new designs of low-temperature self-regulating thermosiphon heating devices with low metal consumption based on the intensification of one- and two-phase heat exchange processes of the intermediate heat carrier fluid inside the heating device housing; theoretical and experimental research of low-temperature self-regulating thermosiphon heating devices with low metal consumption with intermediate heat carriers and determination of the main criterion equations and calculation

formulas necessary to justify the design and creation of designs of low-temperature self-regulating thermosiphon heating devices with low metal consumption with intermediate heat carriers.

The scientific novelty of our research is as follows: based on the intensification of low-temperature single- and two-phase heat exchange processes of the intermediate heat carrier inside the heating device housing under natural thermosiphon circulation conditions, a method has been developed to increase the heat stress of the metal, ensuring a reduction in its internal pressure and wall thickness by hydraulic separation from the water heating system with high hydrostatic heat carrier pressure; a mathematical model of the low-temperature single-phase heat exchange process of the intermediate heat carrier inside the heating device housing has been developed, taking into account the ratio between the surface of the serpentine pipe and the area of the external surface of the heating device; taking into account the interdependence of the condensation and evaporation processes of superheated and saturated steam in the boundary layer, a mathematical model of the two-phase heat exchange during the evaporation of the intermediate heat carrier inside the heating device housing under thermosiphon circulation conditions and laminar layer condensation of steam has

The task is to create a heating device with high thermal efficiency and heat savings due to self-regulation and intensification of the heat exchange process depending on the air temperature in the heated room.

The developed heating device includes (Fig. 1): a hermetic housing 1, separated by a horizontal partition 2, partially filled with an intermediate heat carrier, with steam channels 3, installed in the form of confusors, and a condensate pipeline 4, consisting of evaporation compartments 5 and condensation compartments 6, in the first of which a heater 7 is installed, and the confusors face the condensation zone with their loaded ends. The hermetic housing 1 in the condensation compartment 6 is made in the form of a vertically profiled surface, periodically narrowing inwards on both sides of the housing and forming ejectors 8 at the location of the confusor outlets, and in the condensate pipeline 4 a thermoregulating valve 9 is installed, equipped with a thermostatic head 10, located horizontally outside the boundaries of the hermetic housing 1.

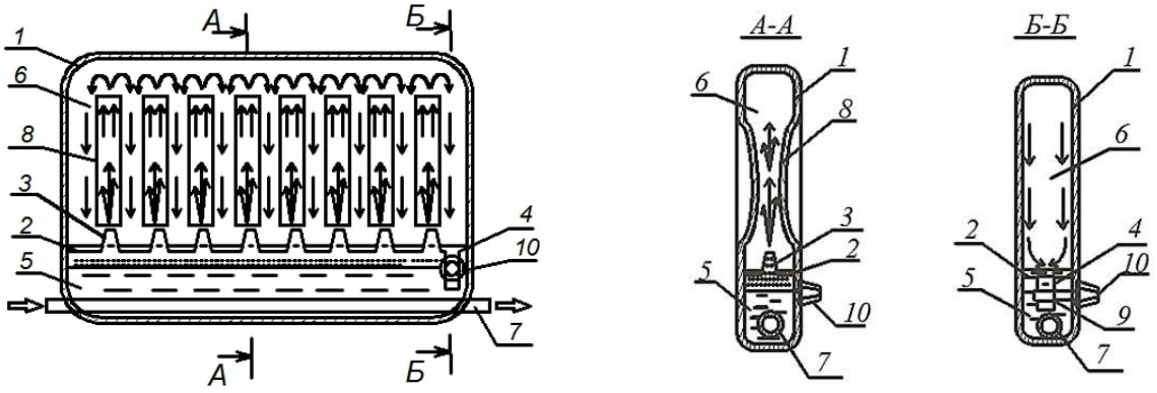

Figure 1. Design of a two-phase low-temperature self-regulating thermosiphon heating device with an intermediate heat carrier

The heating device works as follows. Heat is supplied to heater 7. The intermediate heat carrier evaporates, from the evaporation chamber 5 it passes through steam channels 3, made in the form of steam confusors, to the condensation chamber 6. In the confusors, the steam velocity increases, and it enters the ejectors 8, formed in the condensation chamber 6, with a vertically profiled surface periodically narrowing inward from both sides of the housing 1. In the ejectors, the kinetic energy of the steam coming from the confusors 8 carries out the suction of surrounding steam from the upper stable zones of the heating device housing, which contributes to better steam mixing and an increase in the intensity of the heat exchange process.

In the proposed heating device, the hermetic housing in the condensation section is made in the form of a vertically profiled surface, which periodically narrows inwards on both sides of the housing and forms ejectors at the location of the confusor outlets. In ejectors created in this way, the kinetic energy of the steam coming from the confusors carries out the suction of surrounding steam from the upper steaming zones of the heating device housing, which significantly accelerates its heat transfer process. Installation of a thermoregulating valve, equipped with a horizontally located thermostatic head outside the boundaries of the sealed housing, allows saving the heat consumption of the heating device by eliminating overheating of the room.

Based on the obtained results, we can draw the following conclusions. The capabilities of thermosiphones allow for the creation of fundamentally new solutions for adjustable devices capable of saving 3-4% of heat. The most promising technical solution developed at present is the regulation of drying part of the evaporator. The heating system with thermosiphon devices meets the basic requirements for modern systems, and the traditional scheme can be implemented, as a rule, without the use of closed sections. It is not recommended to use thermosiphon devices in two-pipe systems and in rooms with aggressive airborne agents.

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