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REGENERATIVE AIR-WATER HEAT EXCHANGER

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The strategic objective of the state energy policy in the field of formation of a rational fuel and energy balance is to optimize the structure of production, domestic consumption and export of energy resources to meet the requirements of energy security, economic and energy efficiency, strengthen the external position. At the same time the first place in its implementation in the "Energy Strategy of Russia until 2030" defined the growing importance of renewable energy in ensuring the energy needs of society. Without the introduction of technologies to displace fossil fuel from the fuel balance of the country, it is impossible to perform the main provisions of the strategy, providing the most efficient use of natural energy resources and the potential of the energy sector for sustainable economic growth and quality of life of the population. For the majority of regions of Russia the most promising renewable energy is the energy of the sun.

The purpose of research - a substantiation of parametres of the regenerative water-air heat exchanger.

Materials and methods of research. Now developed a number of different schemes Solar energy hot water systems and water heating. Space heating with warm air on the basis of various types of heat sources makes it possible in many cases to significantly reduce the capital and operating costs. Application gelionagreva using various types of solar collectors in the air heating systems will significantly increase the effectiveness of such systems, as well as increase the degree of substitution of the traditional sources of heat. In such systems, heated, depending on the temperature, water or air, or carried out a joint heating water for domestic hot water and the air for heating. As our ultimate goal - the heating of air in the room, it is such complexes can achieve maximum efficiency by eliminating all intermediate processes and transformations. The heat source may be used as the heat of combustible fuel and heat from solar collectors.

Universal system causes a wide scope of applications, from home heating to the cottage type of giant industrial buildings and greenhouses.

The advantages of air heating include:

1) efficiency, since the heat is obtained directly in the heated room;

2) improvement of the conditions of being in the premises, as the heating of the air by 40-70 0 C is sufficient for ventilation;

3) low inertia as air heating system allows you to fully warm up the room for 1.5-2 hours;

4) the absence of an intermediate coolant that would eliminate the construction of water heating. In winter, the system eliminates the risk of thawing;

5) The high degree of automation allows to generate heat exactly need.

Most of the benefits of this scheme is only possible when using solar collectors freezing liquids. Heating of air can be made both in the intermediate heat exchanger by the liquid, heated in a reservoir or directly in it. Fig. 1 shows the use of the heat of the sun, which allows to combine these methods.

Use of this scheme will allow the benefits of heating the air in the implementation of solar collectors of the combined type (with the joint heating of the air and the heat transfer fluid), and also to reduce the temperature of the beam-receiving plate and, as a consequence, losses from radiation.

The essence of the proposed scheme is that the solar collector for heating medium is connected to a duct connected to a heated area and antifreeze circulating in the circuit: tank battery - solar collector. The air through solar radiation and forced convection in the flow tubes and the plate is heated, then sent to the heating duct, passing it, it is sent to the air heating system. Storage tank for the coolant is accumulated is connected to the cold water supply and source-side heat included through immersed heating surface. The scheme of inclusion and method of operation of the solar installation shown in Figure 1.

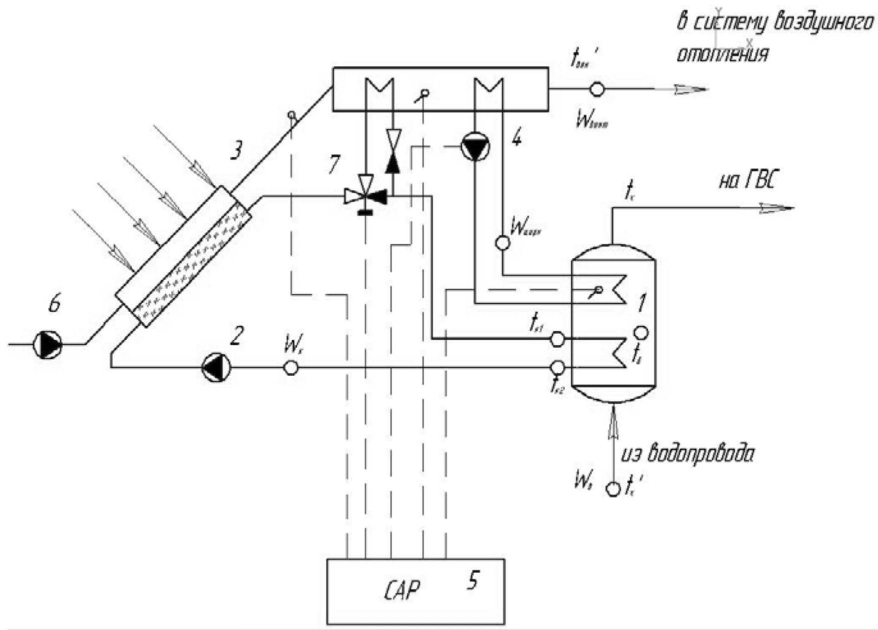

Fig. 1. System helio-air heating:

1 - storage tank; 2 - solar circuit pump; 3 - geliovozdushny solar collector; 4 - heater; 5 - automatic control system; 6 - supply air fan; 7 - three-way valve solar circuit

The effectiveness of the collector (see. Figure 1) can be greatly improved by the intensification of heat transfer on surfaces with hemispherical depressions by increasing the heat transfer area.

Back in the 90s of the last century in the works of RA Serebryakov, GI Kiknadze, JK Krasnov et al. Studied a new class kvazipotentsionalnyh swirling flows of gases and liquids, the formation of which is achieved either by merging specially designed jets operating continuum, or in the flow of its three-dimensional "holes" (the so-called "vortex generators") in the energy-exchange carrier, or surfaces.

Highly practical use of such flows was made possible by large-scale thermodynamic research and development activities. Thus, according to experimental data stream eddy formed in accordance with the exact solutions of the equations of hydrodynamics, increase the flow rate by half a gas or liquid flows in comparison with other structures with equal sets in the lines of the same size and shape. Such swirling flow organize themselves in the coolant flow, flowing around the energy-exchange surface, to form special profiles "vortex generator" significantly intensify heat and mass transfer at decreasing flow resistance, energy-exchange channels.

The results of research. To determine the efficiency of an intensification was calculated daily flat water-air heat absorption to the manifold hole and without intensification .

Climatological data: Chita: length - 113 hours, 23 minutes, latitude -52 hours 6 min, the date of October 1, 2013

The direction of the surface: the angle of the horizon - 45 deg., 180 deg azimuth direction.

Plate: the size of the plate taken: 1000 · 100 · 10 mm, material - copper, the wall thickness of 2 mm.

Tubes: 10 pcs., Diameter 25 mm, the material - copper, wall thickness 1 mm, the percentage of coverage of 50%, the thermal interface material - Tin, thickness 500 microns.

Absorber: color - matt black paint (extent of absorption of 95, black 5, the selectivity of 0.4).

External insulation: glass - two layers, the thickness of 1 mm, the attenuation coefficient of 0.4 1 / mm, the size of the air passage 30 mm.

Options Air inlet air temperature 0 0 C, the air flow rate - 1000 m3 / h.

When calculating the daily water-air heat absorption of regenerative heat exchanger with high efficiency heat exchange obtained by standard methods of heat transfer coefficients are increased in proportion to the average (over the surface of the hole) the relative heat transfer coefficient. To account for the increase in heat transfer area is necessary to estimate its relative increase and incorporate it into a standard procedure.

For the proposed geometrical parameters hemispherical indentations is from 1.09 to 1,116, depending on the packing density (for preliminary assessment are taken into account). The calculations showed that the turbulent flow regime: Re = 696,364. For such a regime with the intensification intensifier take on spherical

(Fig. 2).

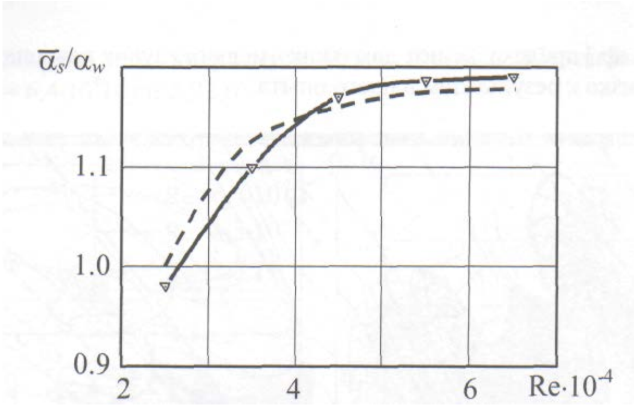

Fig. 2. Mean (on the surface of the wells), the relative heat transfer coefficients for spherical holes

Intensification showed 2.43% increase in efficiency. Annual efficiency of an intensification of the reservoir will be 106 kW / m2.

At the current rate in the district heating system Chita 1925 rub. / Gcal economic impact of 175.5 rubles / m2.

Conclusions

Calculation of economic efficiency showed a significant economic effect from the introduction of the proposed methods.