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THE PERSPECTIVE SCHEMES OF SAMPLING LOW-GRADE HEAT OF OPEN WATERCOURSES FOR HEATING LOW-RISE BUILDINGS

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In the current circumstances, it is highly advisable to use foreign experience of using a heat pump heating systems (heat pumps), which are characterized by high energy efficiency.

In such systems, 1 kW • h of electricity consumed You can get 3-6 kW • h of thermal energy. In its cost-effectiveness of such systems are second only to heating systems based on natural gas, far exceed the efficiency of heating systems based on the use of electricity, fuel oil, diesel and coal. Therefore, they are widely used for heating autonomous, remote objects.

The purpose of research - study the possibility of heating of low-rise buildings with heat pump systems based on the use of low-grade heat of small watercourses.

Materials and methods of research. The most common, simple and cheap to install heat pumps are air in which to produce high-grade heat that is suitable for heating and hot water supply of buildings, low-grade heat is used, selected from the outdoor air. Unfortunately, these settings become ineffective at lower ambient temperatures below -5 ..- 10 ° C and therefore can not act as a reliable source of heat for the regions, which are characterized by low peak temperatures in the cold.

Today, a large widespread installation with ground heat exchanger in which the heat near the surface (and sometimes deeper) layers of the Earth used to generate hot water with the given parameters, which is then used for heating and hot water supply. For the selection of low-grade heat from the ground in such plants are used vertical or horizontal ground heat exchangers, collectors (Figure 1).

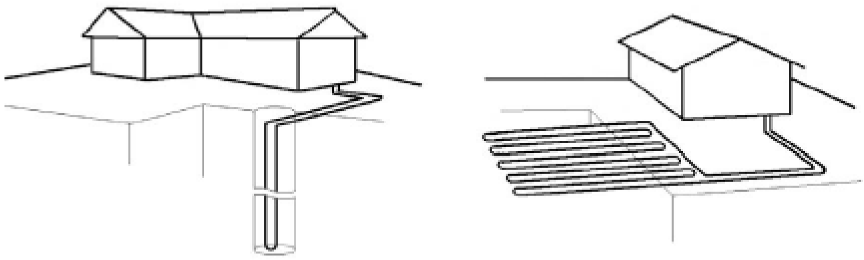

Fig. 1. Heat pump heating system with a vertical (a) and horizontal (b) a heat exchanger-collector

In Sweden, almost 90 % of new buildings heated by heat that is extracted from wells drilled at the house. In Germany in 2005, developers have submitted about 12 thousand. Applications for geothermal installation, a year later the number of applications for drilling totaled 28.5 thousand. And continues to grow (the data of the Federal Union of German Geothermal).

The disadvantage of geothermal heat pump systems is their high cost due to the need for installation of expensive systems of selection of underground heat, due to the large volume of excavation (drill) works.

More promising are teplonanosnye district heating system based on the use of heat and surface water environments, in particular, small watercourses, such as canals and small rivers.

Inadequate dissemination of such systems compared to systems with ground heat exchangers due to the fact that their implementation requires a watercourse as a source of low-grade heat. It should be noted that as these streams may also act as channels of reclamation systems, which often form a developed network in irrigated agriculture.

Systems using the heat of watercourses in their effectiveness are not inferior to the above-described heat pump with ground heat exchangers, and even surpass last at much lower capital cost.

Technology use low-grade heat of surface water is not worked to a degree, as the technology of geothermal heat. In Russia, such a system, despite their simplicity, have not been spread, and research in this area are poorly developed.

Scheme direct abstraction of water from ponds and waterways with its subsequent cooling in the heat pump evaporator and reset back to the pond or stream, although it is the most obvious solution, but has significant drawbacks, especially high probability of freezing and fouling of the system, therefore is not suitable in most cases.

Known selection scheme of heat from the surface water body or watercourse at which the bottom of the pond or watercourse sinking folded loops of long pipes, usually polyethylene, cemented by a variety of ways and is equipped with additional weights to hold the bottom. Through the pipe by means of the circulation pump the heated heat transfer fluid is pumped. However, these technical solutions, although simple to implement, but show enough high efficiency, and are often completely unsuitable for placement in small streams. The main drawback of the scheme as a whole is low, the heat transfer between the aqueous medium and the pipe, which entails the following consequences:

- Increased material consumption because of the need for pipes of great length and, in some cases, production of frames for her large or multiple frames, as well as a significant amount of coolant required to fill the pipeline;

- The need to have sufficient size available to accommodate the construction site of the watercourse;

- Increased energy costs for pumping the coolant due to the large length of the tube;

- Large discrepancy between the water temperature at the outlet of the pipe and the average temperature of the watercourse, which is especially evident in the presence of the bottom layer of silt, limiting convective heat transfer and increase the temperature gradient between the pipe immersed in these deposits, and the bulk of the water in the upper part of the reservoir.

The latter figure is of great importance, since the maximum approximation of the coolant temperature to the temperature of the source of low-grade heat allows to achieve the highest performance and efficiency of the heat pump.

Because of these drawbacks of the above scheme as the most important is the need for a substantial amount of coolant, antifreeze, the required volume is measured in the hundreds and thousands of liters. As the coolant currently use either an aqueous solution of ethylene glycol or propylene glycol. When this ethylene glycol is toxic and poses a risk to humans and the environment, and is characterized by a relatively high viscosity and corrosive, and propylene glycol, although it is safe, but it has extremely high viscosity at low temperatures and has a high cost, which makes its use circuit selection low-grade heat is extremely unprofitable. Thus, the cost of coolant based on propylene glycol required to fill given above constructions of polyethylene pipe, substantially higher than the cost themselves polyethylene pipes and other components. Thus, the use of heat transfer fluids used today greatly increases system cost and, owing to high viscosity, significantly reduces the efficiency of its operation.

The results of research. Our studies have concluded that the most promising is the use as a coolant solution of calcium chloride, which is characterized by low viscosity, low cost and environmental safety.

Increasing the efficiency of selection of heat from the watercourse can be achieved through the use of the natural movement of water in the direction of flow for the enhancement of heat transfer. We have concluded that the alternative to currently used methods for the selection of heat from the watercourse could be submerged metal heat exchangers water-brine several designs, among which the most obvious is the design in the form of a flat coil of metal pipes of circular cross section, or as a multi-row tube lattice (Fig . 2).

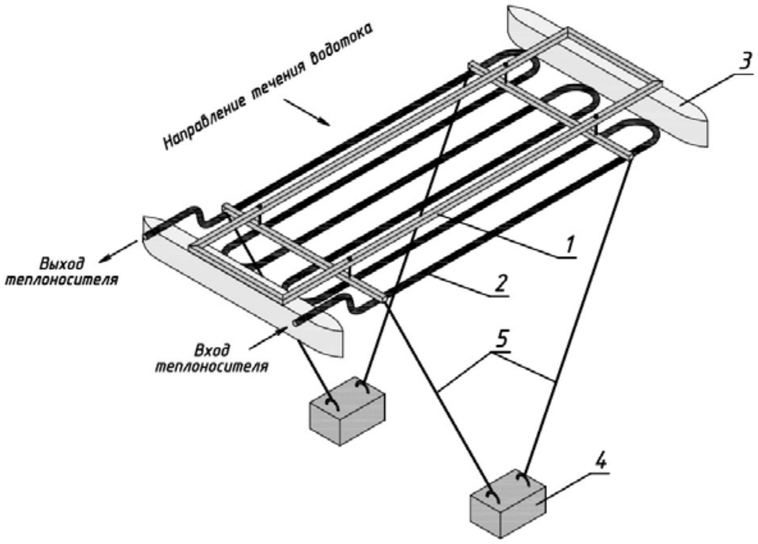

Fig. 2. Schematic diagram of the heat exchanger for a small floating watercourse:

1 -rama; 2 - pipe; 3 - floats; 4 - cargo-anchor; 5 - cables

Improved heat transfer parameters achieved by using the natural movement of water in the direction of flow for the enhancement of heat transfer. It is known that the rate of water flow in an open channel takes the highest values near the surface, and in the event of ice flow zone of maximum velocity is shifted in depth, closer to the middle of the stream. To enable the location of the heat exchanger in the area of highest flow rate it is equipped with floats, giving it buoyancy, as well as ropes and weights, anchors, whereby the heat exchanger can be positioned and held in the best possible heat exchange area (Fig. 3.4). Improving heat exchange performance and is due to the fact that in this construction and arrangement of the heat exchanger is provided in line with the transverse flow stream of water straight sections of the pipe coil, which intensifies the process of heat transfer.

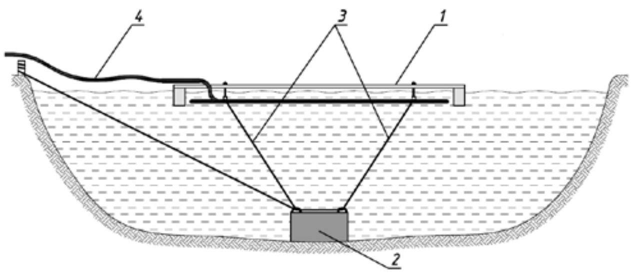

Fig. 3. Location of the floating coil in line watercourse:

1 - heat exchanger; 2 - cargo-anchor; 3 - cables; 4 - flexible hoses

When using the device in a freezing of the watercourse for the period of the presence of ice it is expedient to pull the cables close to the bottom (see. Fig. 4b, d), and in the rest of the time to keep the surface of the watercourse (see. Fig. 4, A, B) . Thus, the coil will be in the areas of highest flow rate and will not appear frozen into the ice. However, even a significant decrease in the level of water in the channel will not lead to the drainage pipes of the coil, as the device will start to fall after the water level.

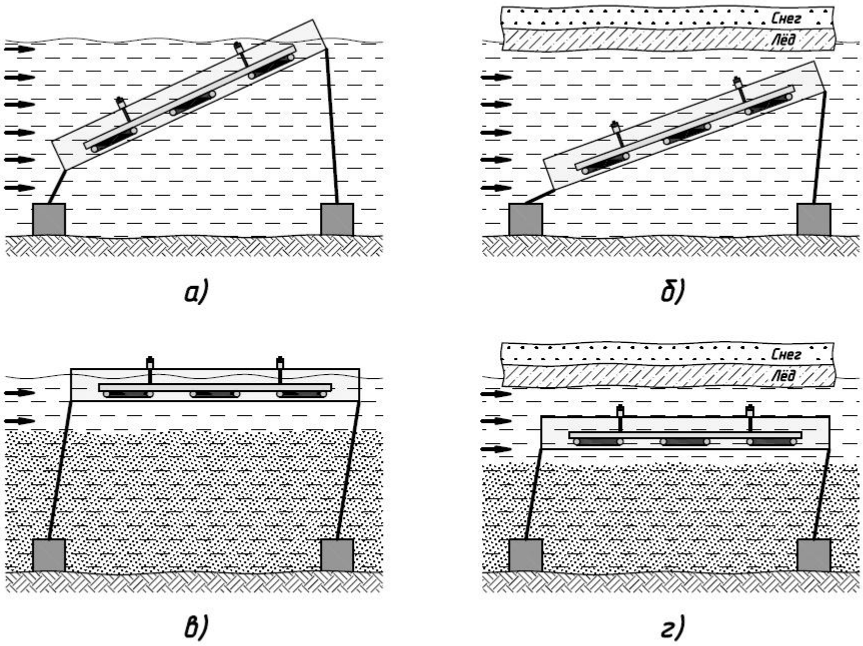

Fig. 4. Examples of arrangement of the heat exchanger in line depending on the conditions:

and - clean channel; b - the presence of ice; in - silting of the channel; g - the presence of bottom sludge and ice

To test this method of selection of heat from the watercourse, as well as to check for other technical solutions aimed at improving the technical and economic characteristics of heat pump installations, it was assembled experimental unit, which is a heat pump heating and air conditioning apartment building a water-to-air heat output up to 7 kW (Fig. 5), which includes a water-brine heat exchanger described structure (Fig. 6).

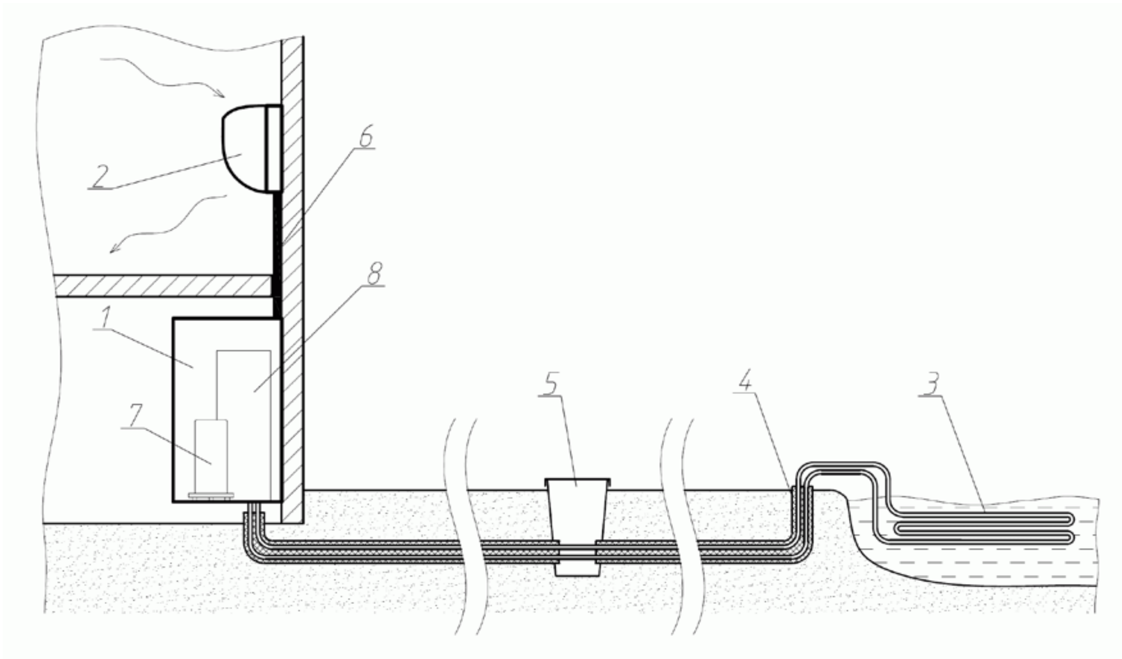

Fig. 5. Schematic diagram of the experimental setup:

1 - external power VT; 2 - inner block TN; 3 - exchanger water-brine; 4 - warmed underground pipeline; 5 - Inspection well, the point of connection of additional sources of NTP; 6 - Refrigerant; 7 - compressor TN; 8 - heat the brine-freon

Fig. 6. The experimental sample of the floating coil

Conclusions

The first tests have shown high efficiency of this system. The implementation in practice of this and other solutions to reduce the cost of heat pump installations and payback period, contributed to the proliferation of such systems.