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TWO-STAGE HEAT PUMP INSTALLATIONS FOR HEAT SUPPLY

Abstract: The problem of energy saving becomes one of the most important in power engineering. It is caused by exhaustion of world reserves in hydrocarbon fuel, such as gas, oil and coal representing sources of traditional heat supply. Conventional sources have essential shortcomings: low power, ecological and economic efficiencies, that can be eliminated by using alternative methods of power supply, like the considered one: low-temperature natural heat of ground waters of on the basis of heat pump installations application. The heat supply system considered provides an effective use of two stages heat pump installation operating as heat source at ground waters during the lowest ambient temperature period. Proposed is a calculation method of heat pump installations on the basis of groundwater energy. Calculated are the values of electric energy consumption by the compressors' drive, and the heat supply system transformation coefficient μ for a low-potential source of heat from ground waters allowing to estimate high efficiency of two stages heat pump installations.

Keywords: *heating loading, freon, two stages heat pump installation, low-potential source of heat, energy efficiency*

During periods of highest temperature gap between the low potential heat source and the heating systems' heat carrier (especially in the sever climatic regions) to cover the full heating load, the two-stage heat pump installations (HPI) are used (Fig. 1) [1, 2].

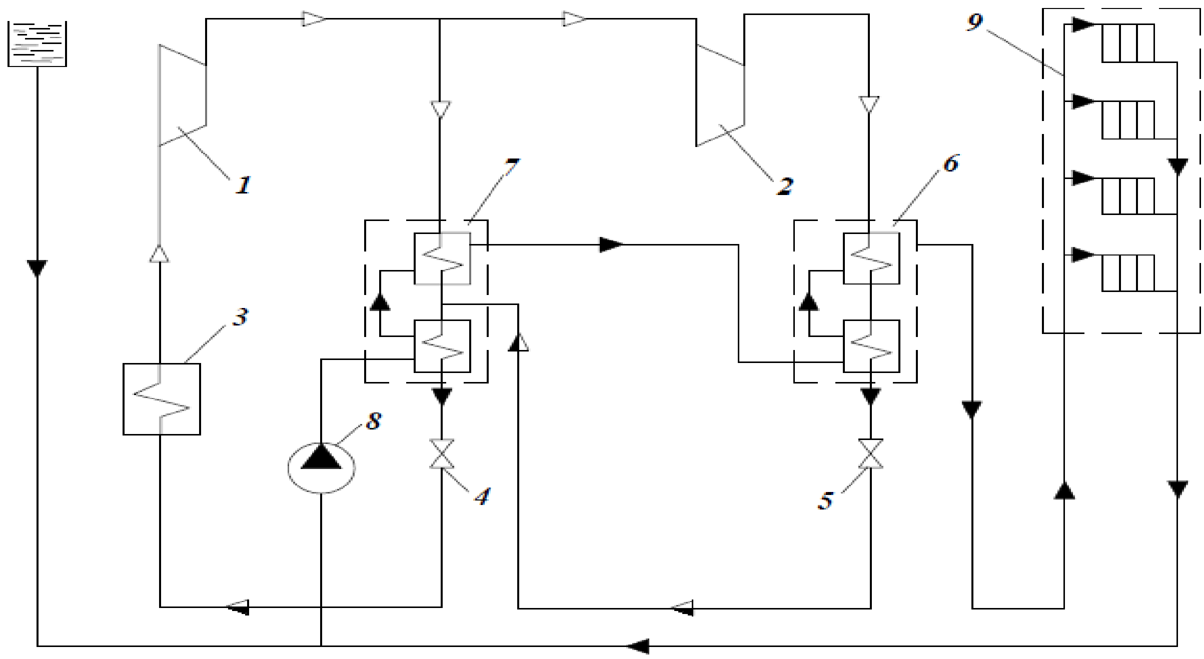

Fig. 1. Two stages HPI principal diagram

In order to analyze the considered two-stages HPI energy efficiency the method [3, 4], implemented with the auxiliary of the Cool Pack program is used (Fig. 2) [5]. A comparative analysis of the considered two-stages HPI energy efficiency schemes using environmentally friendly refrigerant R152a for heating systems, with low-potential heat source represented by ground water [6], for a full coverage of the heat load on the heating system when the outdoor temperature t_0=–18 °C is carried out.

Results of numerical simulation for HPI heating systems in the temperature chart 95...50 °C with a temperature of cutting 80 °C by using ground water with temperatures 4...12 °C shows that the less is temperatures drop between the low-potential heat source and the coolant being supplied to the heating circuit, the higher is HPI efficiency. It was determined that more efficient is the heating system based onto low-potential groundwater heat source using the two-stage HPI, rather than a system based onto single-stage HPI that is demonstrated with average productivity increase of 19 %, as evidenced by the heat transformation coefficient μ.

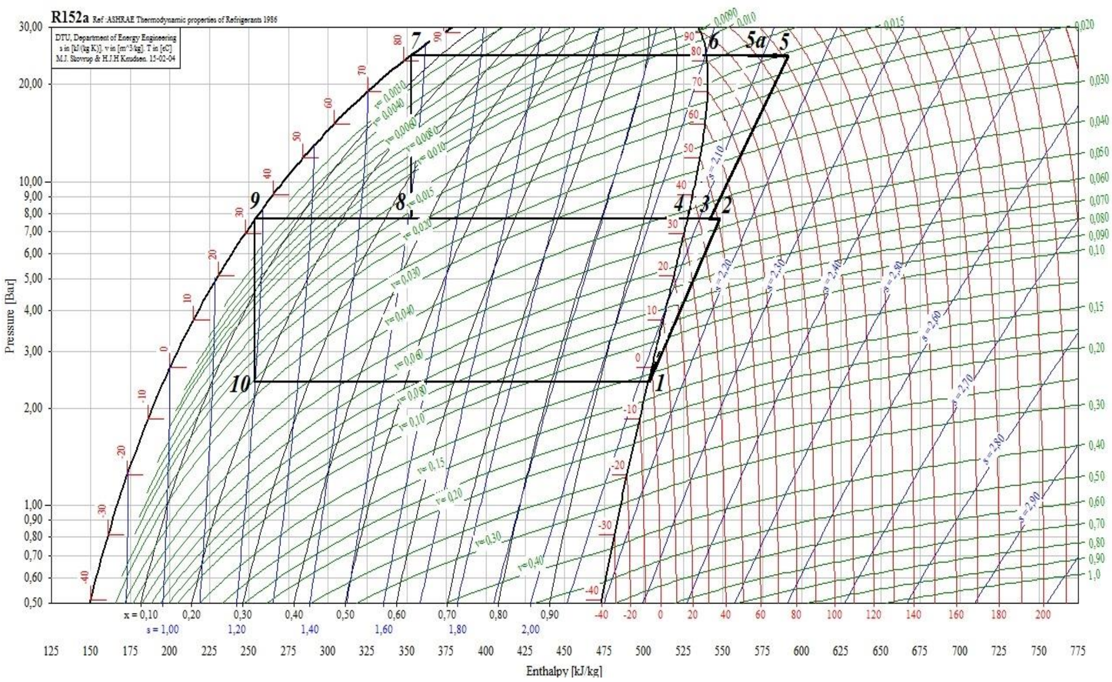

Fig. 2. Cycle of two-stage HPI operating with ground water for heating system at t_0= –18 °C

The two stages HPI can almost 1.3 times reduce the average energy consumption, that represent their indisputable advantage when compared to single stage installations. This is of high actuality for the climatic conditions, when necessary is to completely cover the heating load, particularly at ambient temperature below –18 °C. Results of numerical simulation shows that improving efficiency of HPI is possible by using underfloor heating instead traditional sectional radiators. This result is achieved through lower temperature coolant supplied to the intrahouse system, thereby reducing the power consumption by the compressor drive for compression of refrigerant to the condensing pressure. This is because the underfloor heating system cowers the whole surface of the floor, and thus, the heat transfer occurs from the larger surface at relatively less than low temperature. In addition, to maintain the required evaporator capacity must be rational distribution and the amount of intake boreholes. For example, using less than three deep wells compared with one deep borehole can be reduced energy consumption by 1.7 times, resulting in faster payback HPI.

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