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HEAT PUMPS AS AN ENERGY EFFICIENT HEATING KIND

In the modern world, the rational use of fuel and energy resources is one of the global problems of the world. One of the most expensive types of utilities is heating of the building. The cost of heating in comparison with the total cost of utilities can be 60-85%. In this regard, it is important to reduce the consumption of fuel and energy, and as a result, reduce the cost of utilities.

One of the promising ways to solve this problem is the use of new energy-saving technologies that use unconventional renewable energy sources, which in turn divideinto low-potential sources and high potential warmth [1].

One of the modern technologies of heat supply is heat pumps using unconventional energy sources.

Currently, more than 18 million large heat pumps are using in the world. In the US, about 30% of residential buildings are equipped with heat pumps. More than 60 firms are engaged in research and production of heat pumps. In Japan, the annual release of heat pump installations exceeds 500 units. In Germany, more than 5,000 installations areintroduced annually. On the largest scale, they are using in Sweden, where the total installed heat output of heat pumps exceeded 1,200 MW. In Sweden in only 3 years, from 1984 to 1987, 74 heat pump stations with a power from 5 to 80 MW were commissioned [2]. In Sweden and the Scandinavian countries mainly large heat pump installations operate. By the year 2000, more than 110,000 heat pump stations were operating in Sweden, 100 of which had a power of about 100 MW and more.The most powerful heat pump system of 320 MW operates in Stockholm.

To date, Ukraine has already implemented a series of projects with the inclusion of a heat pump installation as a variant of the technical solution for the heat supply of a cottage , an apartment building , an "energy efficient house" [3]. However, these projects do not affect by tons of municipal power system, and have a private character.

Heat pumps differ in mean energy transfer heat, in turn, by heat source, by type of coolant, input / output circuit [4].

By the form of energy transfer, heat pumps are of two types:

1. Compression. The main elements of the installation are the compressor, condenser, expander and evaporator. The cycle of compression-expansion of the heat carrier with the release of heat is used. This type of heat pump is simple, highly efficient and most popular.

2. Absorption. These a new generation heat pumps that use a pair of absorbent refrigerant as the working fluid. The use of absorbent material increases the efficiency of the heat pump.

Heat source emit heat pumps:

1. Geothermal. Thermal energy take from the soil or water.

2. Air. Heat extract from the atmosphere.

3. Using secondary heat. Air, water, sewage use as a heat source.

By type of input / output circuit coolant:

1. Air-to-air heat pumps. This type of heat pump take heat from more of cold air, further lowering its temperature, and giving it away to a heated the room.

2. Water-to-water heat pumps. Groundwater heat use, which is transferred to water for heating and hot water.

3. Water-to-air heat pumps. Use probes or wells for water and air heating system.

4. Air-to-water heat pumps. Atmospheric heat use for water heating.

5. Ground-water heat pumps. Pipes laid underground, and water circulate through them, which takes heat from the ground.

6. Heat pumps "ice-water". For heating water in the heating system and hot the water supply use heat energy that is released when ice is received. Freezing 100-200 liters of water can provide an average home with heating for an hour.

The general principle of the heat pump is very easy, and itconsists of that the heat pump takes heat energy from one place, transfers (pumps) it, and gives it to another place. For example, in a fridge, the heat is takes by the freezer from the fridge and released into the kitchen. At the same time, the products in the freezer cool, and the back wall of the fridge becomes hotter.

Heat pumps have several advantages over traditional heating methods [5]:

1. Economy;

2. Environmental friendliness. No emission of harmful substances;

3. Safe operation. The absence of open flame, fire hazardous storages for fuel; gas leakage is excluded;

4. Reliability. Minimum moving parts, virtually maintenance free. The lifetime of the heat pump is 15 - 25 years;

5. Comfort. Heat pumps work very silent (not louder than the fridge), and automation and multi-zone climate control create comfort and coziness on the premises;

6. Flexibility. Heat pumps s compatible with any circulation heating system and modern the design allows you to install it in any room;

7. Versatility in view energy used (electrical or thermal);

8. Wide power range (from fractions to tens of thousands of kilowatts).

In addition, for even greater savings, it is possible to connect solar panels to the concept of the heat pump, thereby reducing the cost of electrical energy or making the system autonomic.

For comparison energy efficiency heat pumps isuseded COP ratio (coefficient of performance), which reflects the ratio of the energy produced to the expenditure. In practice, the coefficient of COP depends on the characteristics of the equipment of heat pumps, and varies from 2.7 to 4,5 units, although in theory it can reach 7.

The most common in the world are air-to-air, water-to-water and ground-to-water heat pumps, but they also have a series of flaws.

The principle of operation of the air-to-air heat pump consists of taking heat from the surrounding air, accumulating it in the storage tank and transferring the heat directly to the heated environment. The biggest flaws of this system is that when the temperature drops below 5 ° C, its energy efficiency drops, since the refrigerant has a low boiling point and the heat of the object starts with electricity. This type of pump used more for cooling or for heating in countries with hot climates.

Water-to-water heat pumps are very common in Scandinavia (Sweden, Finland, Norway and Denmark). Source of low-grade heat serve in the mainly treated wastewater, seawater, air environment of mines, wastewater of industrial enterprises, as well as thermal springs. The principle of operation of this type of pump is taking heat energy from the aquatic environment and transfering it to the heated medium. At the Institute of Engineering Thermophysics of the NAS Ukraine, in conjunction with the firm Fitikon, developed two heat transfer systems for hot water supply based on the use of sewage heat in Vinnitsa and the Svyatoshinosewage pumping station in Kiev [6]. The disadvantage of this type of heat pump is that it requires the presence of water bodies, seas, hot springs to generate a large amount of useful thermal energy.

A ground-water heat pump is less common than the types listed above. The principle of operation is to deepen the geothermal contour into the ground, to the calculated depth, and take thermal energy from the ground and transfer it to the consumer. The disadvantage of this heat pump is that when a large amount of heat energy drawn from the soil, it does not have time to recover before the next heating season, which leads to its icing. If we take the calculated amount of thermal energy, then the period for the restoration of the normal temperature of the soil is equal to the period of consumption of thermal energy.

General and the biggest flaws of heat pumps is the high cost of the equipment, its installation and the payback period, which can be up to 20 years for residential buildings [7].

In conclusion, we can say that heat pumps offer many advantages over traditional heating methods.They are much cheaper, and most importantly, clean. To use them, there is no need to extract liquid or solid fuels, and the problem with the consumption of electrical energy can solve by introducing solar panels into the system. However, their use is more suitable for a massive residential complex than for private houses, since the period pays off for private houses is equal to the lifetime of the heat pump, which is 15-25 years.

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