CALCULATION OF THEIR POWER AND HEATING SURFACE IN IMPROVING THE EFFICIENCY OF AIR HEATING SYSTEMS

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Abstract. *This article presents the formulas used in the selection of air heaters used in the heating systems of residential and public buildings according to their parameters, their structural structure, capacity, and calculation of the heating surface. In addition, the advantages and disadvantages of heating with heaters are also described.*

Keywords: *heaters, heat, bladder, density, flow, power, coolant, water, steam, pipe, air flow, air density.*

РАСЧЕТ ИХ МОЩНОСТИ И ПОВЕРХНОСТИ НАГРЕВА ПРИ ПОВЫШЕНИИ ЭФФЕКТИВНОСТИ СИСТЕМ ВОЗДУШНОГО ОТОПЛЕНИЯ

Аннотация. *В данной статье представлены формулы, применяемые при выборе воздухонагревателей, применяемых в системах отопления жилых и общественных зданий, по их параметрам, конструктивному устройству, мощности, расчету поверхности нагрева. Кроме того, также описаны преимущества и недостатки отопления обогревателями.*

Ключевые слова: *нагреватели, тепло, камера, плотность, расход, мощность, теплоноситель, вода, пар, труба, расход воздуха, плотность воздуха.*

INTRODUCTION

Heaters are devices designed for air heating. According to the type of coolant used, there are the following groups of these devices: water-electric and steam

It is logical to use electrical equipment for rooms whose area does not exceed 100 m². A more reasonable choice for buildings with large areas are water heaters, which work only when there is a heat source.

MATERIALS AND METHODS

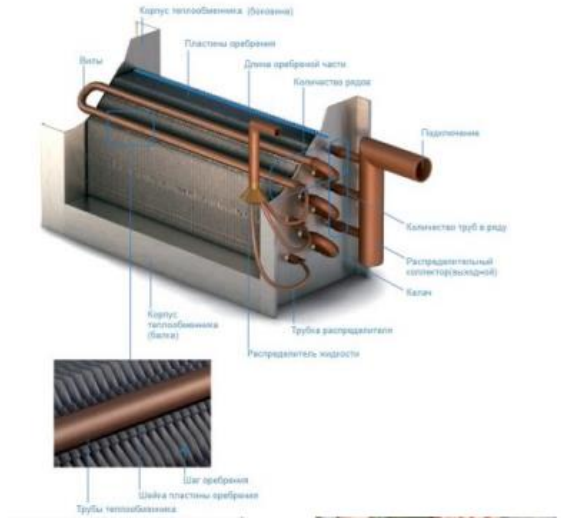
The most popular steam and water heaters, surfaces of the first and second form are divided into 2 subtypes: ribbed and smooth tube. According to the geometry of the ribs, the lamellae and spiral are wound on the ribbed heaters.

The operation of heaters operating on a refrigerant such as steam is regulated by means of special valves installed in the inlet pipe.

By design, these devices can be disposable. If the cooling water in them moves through pipes, it will follow a constant direction and will be multi-pass. There are divisions in their cover, as a result of which the direction of movement is determined. And the cooling water is constantly changing.

Figure 1.

Smooth tube heaters



During operation, water heaters can withstand large temperature changes. That is: 70-110ºC. For this type of heater to work well, the water circulating in the system should be heated to a maximum of 180ºC. In the hot season, the heater can also be used as a cooler to cool the rooms of the building.

The smooth tube design consists of heating elements in the form of hollow thin tubes with a diameter of 20 to 32 mm, located at a distance of 0.5 cm from each other. Cooling water circulates through them. The air washing the heated surfaces of the tubes is heated due to convective heat exchange.

Pipes in the air heater are arranged in a checkerboard or corridor pattern. Their ends are welded to the collectors - upper and lower. The coolant enters the distribution box through the inlet pipe, then after passing through the pipes and heating them, it leaves the outlet pipe in the form of condensate or chilled water.

RESULTS

More stable heat transfer is provided by devices that arrange pipes in series, but here the resistance to air flow is higher. To know the real capabilities of the device, it is very important to calculate the power of the device.

Certain requirements are imposed on the air - there should be no fibers, suspended particles, sticky substances. The amount of fixed dust is less than 0.5 mg/m. The inlet temperature should be at least 20ºC

Calculation of heater power.

The calculation of the heater is carried out in several stages.

The following are defined in sequence:

Determining the size of the front part, choosing a ready-made device

- Calculation of carrier consumption

- Since the air flow is known from the characteristics of the ventilation system, it is not necessary to calculate it. The formula for determining the heat capacity of the device:

$$\boldsymbol{Q_m = L \cdot P_в \cdot C_в \cdot (t_{вн} - t_{нар})} \quad (1)$$

$\boldsymbol{Q_m}$— heat output of the heater

$\boldsymbol{L}$ — air flow (value of supply flow)

$P_в$ — air density, table value

$C_в$ —SNiP specific heat capacity of air available in the tables

$(t_i - t_o)$ — difference between indoor and outdoor temperature

The indoor temperature is the sanitary norm for a given room, and the outdoor temperature is determined by the average value of the five coldest days of the year for a given area.

We define the front part:

$$F = \frac{L \cdot P}{V} \quad (2)$$

F — front part.

L — air flow.

P — air density.

V — a mass flow rate of about 3-5 kg/m2•s is assumed.

Then we find the coolant flow rate:

$$G = \frac{3.6 \cdot Q_m}{C_в \cdot (t_{вн} - t_{нар})} \quad (3)$$

here:

G - coolant flow rate

3.6 is a correction factor to obtain the required units of measurement

Q_m - heat capacity of the device

$C_в$ -specific heat capacity of the medium

$(t_i - t_o)$) - temperature difference of cooling water at the inlet and outlet of the device

Knowing the flow rate of the carrier, it is possible to determine the diameter of the pipes and choose the necessary equipment.

Calculation of the heating surface **1- table**

Марка калорифера	Производительность		Площадь поверхности теплообмена, м^2	Площадь фронтального сечения, м^2	Площадь сечения (среднее значение) для прохода теплоносителя, м^2	Число ходов по теплоносителю, м^2	Масса, кг
	по воздуху, м^3/ч	по теплу, кВт					
КСк-2-1	2000	24,2	6,7	0,197			19
КСк-2-2	2500	31,0	8,3	0,244			22
КСк-2-3	3150	39,5	9,9	0,290	0,00056		25
КСк-2-4	4000	49,8	11,5	0,337			27
КСк-2-5	5000	65,4	14,8	0,430			33
КСк-2-6	2500	32,9	9,0	0,267			25
КСк-2-7	3150	42,8	11,2	0,329		4	28
КСк-2-8	4000	54,7	13,4	0,392	0,00076		32
КСк-2-9	5000	68,4	15,6	0,455			35
КСк-2-10	6300	90,0	20,0	0,581			42
КСк-2-11	16000	241,2	58,7	1,660	0,00156		114
КСк-2-12	25000	374,0	88,7	2,488	0,00236		166

The area of the heating surface determines the efficiency of the device. The larger it is, the higher the heat transfer coefficient, the stronger the device heats the air flow.

It is determined by the following formula:

$$F_k = \frac{Q}{k \cdot (t_{cp.m} - t_{cp.в})} \quad (4)$$

Here:

Q - **heat capacity**

k - coefficient

$t_{cp.m}$ −average coolant temperature (between the values at the inlet and outlet of the device)

$t_{cp.в}$ − average air temperature (outdoor and indoor).

The obtained data is compared with the passport characteristics of the selected device. Ideally, the difference between the actual and calculated values should be 10-20% more than the actual value.

Pros and cons of heating with a heater.

The home heating system, which is based on the direct delivery of heated air to the specified temperature, is of particular interest to the owners of their houses.

This design of the heating system consists of the following important components:

-a heater that works as a heat generator that warms the air

- channels through which heated air masses enter the house (air ducts)

- a heater that directs well-heated air throughout the entire volume of the room

DISCUSSION

The advantages of this type of system are many. These include high efficiency and the absence of auxiliary elements for heat exchange in the form of radiators, pipes, and the ability to combine it with the climate system and low inertia, as a result of which large volumes are heated very quickly.

CONCLUSION

In the improvement of heating systems of residential and public buildings, it is possible to reduce excess energy consumption as a result of the correct selection of heating equipment and its use taking into account its technical parameters.

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