Analysis of Convective Finns to Increase the Efficiency of Radiators used in Heating Systems

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ABSTRACT

This article discusses ways to improve the heating efficiency of panel radiators used in heating systems. The term panel radiator is commonly used to refer to panel and panel convector radiators. It is currently the most widely used solution in construction and industry. Panel radiators are made of steel, into which metal plates are welded to form small channels for water flow. The power of the radiator can be increased by attaching it to the panel in the form of corrugated sheets, which increases the heat transfer surface area and therefore the heat transfer of the radiator. Such a device is called a panel convector or panel convection radiator.

KEYWORDS: *Panel radiators, convection blades, convectors, convective fins, heat transfer, turbulence.*

Introduction

As you can see from the article, in panel radiators, water is usually distributed evenly over each panel. In addition, water flows through the panel to the first row, facing the bezel distribution channel, room and back towards the outside wall. The temperature of this panel will be low, which will reduce heat loss. Due to this, radiation makes up a large proportion of the heat transfer process. On the other hand, series connection of panels requires a high flow resistance. However, the practical significance of these questions is not great, and the difference between the numerical values obtained for both solutions is very small [1]. The difference in the temperature of the panels is not so great that the water flows through the distribution channel first, and then the flow of the next one does not cool too much. If a second panel is installed, the differences will be significant. The temperature of the water from the distribution channel to the radiator will already be significantly lower than the height of the first collector of the fully closed panels.[1,2]

This article is devoted to the design of convection blades of panel radiators and suggestions for their improvement. The use of steel as a building material allows the freedom to process and shape the product, including precision surface treatment. Panel radiators are often used in medical centers and hospitals. Manufacturers usually refer to them as hygienic radiators.[3]

Main body

A wide range of panel radiator options are available in different sizes and colors. General principle of a panel radiator The marking refers to the number of panels and fins as well as the height of the radiator. For example, a radiator marked 22-50 has two panels, both with ribs (on one inner side), the panel height is 50 cm. Panel radiators can also be made in special designs that provide increased resistance to external surface corrosion. This makes it possible to use them indoors. With high air humidity or in places where the device can come into direct contact with water. [4]

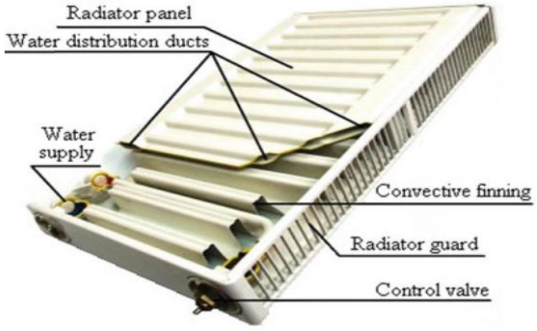

Figure 1: Structural structure of a modern panel radiator[3]

Figure 2. shows the design of panel and panel-convector heating radiators and typical marking of the most common models of such devices.

Panel radiators have many advantages, the most important of which are:

- small unit of mass
- small water capacity (approximately 3-4 times less compared to a cast iron column) radiators) and low thermal inertia,
- the possibility of obtaining any finish and surface shape,
- small geometric dimensions of the unit (for a given heating capacity),
- the possibility of achieving thermal power with a high proportion of thermal power is formed due to radiation heat transfer,
- easy access to heating surfaces and ease of cleaning (in the case of radiators without convective fins). [5]

The disadvantages include:

- relatively high hydraulic resistance,
- sensitivity to corrosion.

The aforementioned advantages of panel and panel convectors have: made them very popular - now they are the most common type of radiators used. Their disadvantages seem to be significant only in the case of gravitational and open installations, which are very rare nowadays. In a typical, well-functioning 2 systems, they are of little importance.

Steel panel radiators are welded from two stamped corrosion-resistant sheets with a thickness of 1.4 ... 1.5 mm using a contact welding, a device of small depth and different lengths is formed. For increase the heating surface of the device is provided with convective ribbing. The profile of the radiator blocks can have flat vertical channels 1, united by horizontal collectors 2 of SRV-1 type single-row design (Fig. 2.a) and double-row design type 2 SRV-1 (Fig. 2. b).

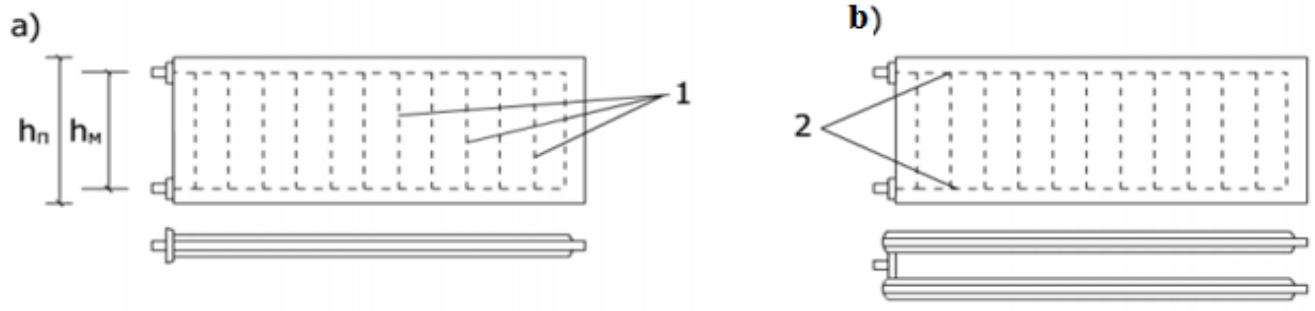

Figure. 2. Steel panel radiators, SRV type: a - type SRV-1 in a single-row design; b - type 2 SRV-1 in two-row design; 1 - vertical channels; 2 - horizontal collectors

There is a variety of radiators of the SRV type, made of low-carbon cold-rolled steel with a thickness of 1.4 ... 1.5 mm, produced by the SRV-9 type in single-row and SRV-9 type 2 in a double-row version without ribbing and with ribbing (2 SRV-9-K, 2 SRV-9-KK) (Fig. 3).

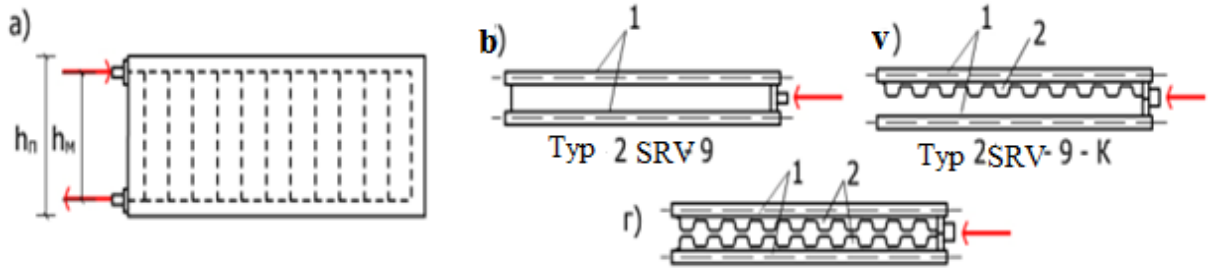

Figure. 3. Heating steel panel radiators SRV-9 type: a - general view of the panel; b - two-row type 2 SRV-9; v - double row with convective ribbing on two blocks of type 2 SRV-9-KK; 1 - radiator block; 2 - convective ribbing

Currently, five types of steel radiators are produced panel models SRV-3 (Fig. 4) type 10, 11, 20, 21, 22. For example, type 22 device has two flat blocks (the first number is 2) and two rows ribbing (second digit - 2), etc.[6]

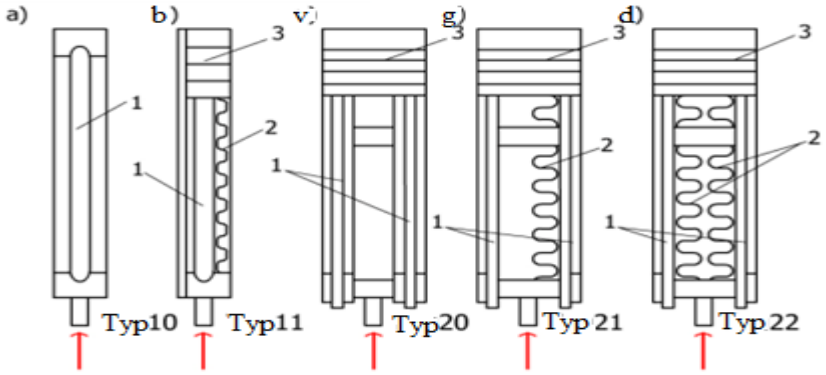

Figure. 4. Steel panel radiators, SRV-3 type: a - single-row type SRV-3-10; b - single row with convection ribbing SRV-3-11 type; c - two-row type SRV-3-20; g - two-row with one ribbing of the SRV-3-21 type; d - double-row with two fins of the SRV-3-22 type; 1 - radiator block; 2 - convective ribbing; 3 - air outlet (louvered) grille

From the above, it can be seen that radiators and convectors are used as the main heating means in the heating system. Summarizing the type of heating means, at the same time it is possible to increase the heat transfer capacity and reduce energy consumption by using renewable energy sources energy sources.

One way to increase the heat transfer coefficient is to convert natural convection to forced convection. [7,8]

However, to improve the heat transfer of panel radiators, thermal efficiency can also be achieved by changing the geometry of the convection blades installed in the panel radiators.[9]

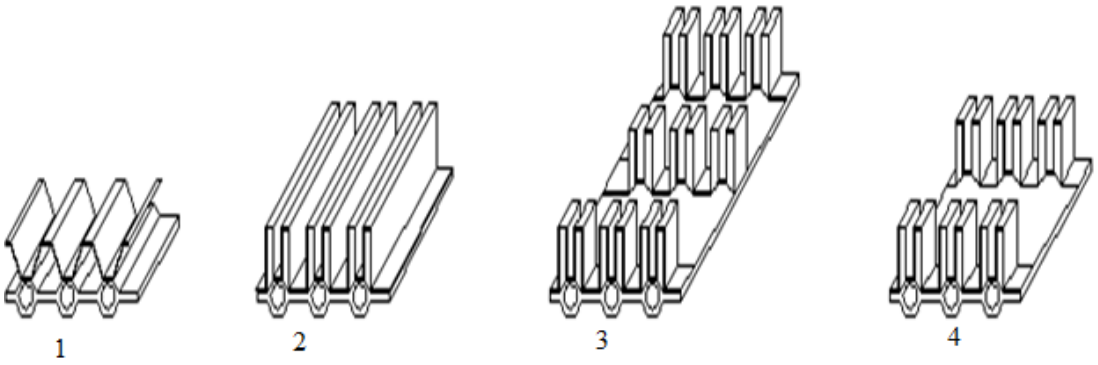

Figure. 5. Design of convection blades used in panel radiators

1. Conventional convection fenders
2. Changed geometry of convection wings
3. Staggered convection wings.
4. Mixed convection wings

Figure. 5. Above: sections of radiator panels with different arrangement of convection fins (second surfaces), obliquely viewed from above.

Bottom: Typical flow patterns as air rises between vertically heated convection fins, matching the geometry shown immediately above (not to scale) Hydrodynamically smooth duct walls were assumed. A third alternative (design 3 in Figure 4) was to have staggered convection fins. For example, the center of the rib array is offset from the ribs at the top and bottom. With participation in this arrangement, the cold ventilation air cores will be divided into two parts, where the air passes from one section of the vertical rib to another, so the coldest air will flow closer to the heated surfaces. In addition, the insulating viscous sublayer close to the heated surface will be destroyed, as in a mixing chamber.

This design can even cause turbulence as a side effect. Consequently, the average heat transfer coefficient will increase, resulting in a higher supply air temperature at the top of the radiator where the air has been discharged into the room. However, this design meant significant pressure to drip every time air passed from one section to another. [10,11,12]

Conclusion

In conclusion, given the variety of types and shapes of panel radiators in use today, one of the most effective ways to increase the heat transfer capacity of these radiators can be seen by changing the geometry of the convective fenders mounted on the inside of the radiator. Taking this into account, we can consider the constructive solutions proposed in this article and proposed for study. After examining the existing designs in the article, you can choose one of a specific type of form. It is possible to enhance the convection process. heat transfer using the above geometric shapes. At the same time, we can see in which geometric shapes the heat is dissipated.

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