Oct. 10, 1933. R. S. WENTWORTH 1,929,618

RADIATOR

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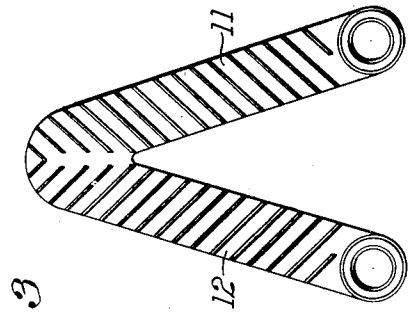

Fig. 3

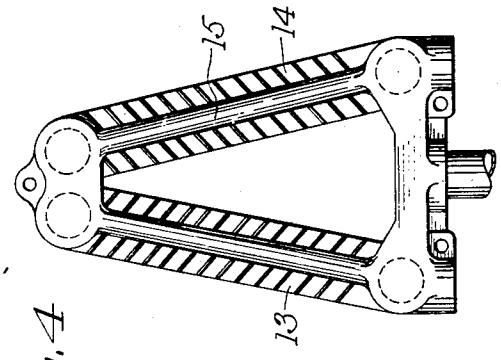

Fig. 4

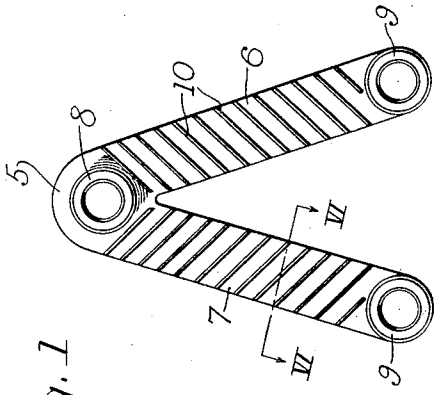

Fig. 1

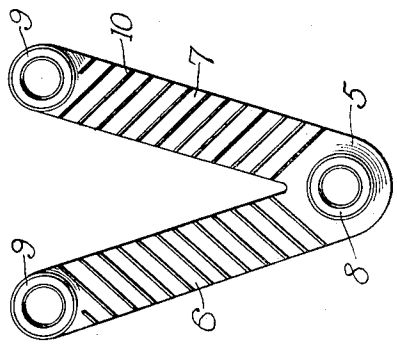

Fig. 2

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RADIATOR

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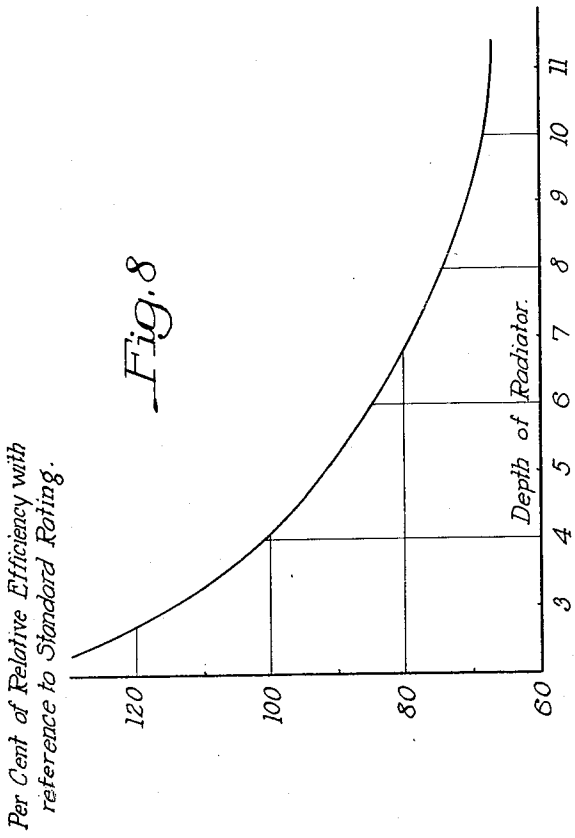

Fig. 8

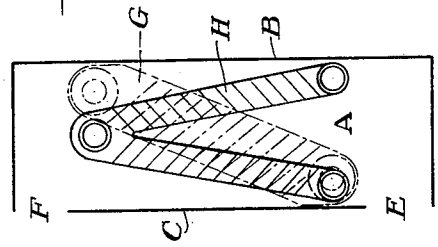

Fig. 7

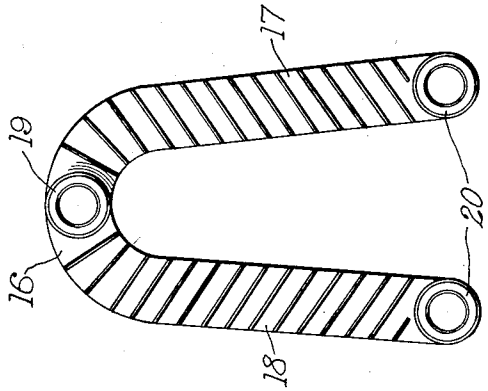

Fig. 5

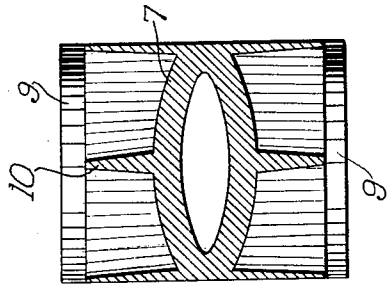

Fig. 6

INVENTOR

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UNITED STATES PATENT OFFICE

1,929,618

RADIATOR

Robert S. Wentworth, Johnstown, Pa., assignor to National Radiator Corporation, Johnstown, Pa., a corporation of Delaware

Application February 10, 1931. Serial No. 514,757

4 Claims. (Cl. 257—136)

This invention relates to heating radiators, particularly the type of radiators known in the art as "convectors".

Convectors are especially adapted for use in radiator enclosures or cabinets. Sometimes the cabinet is in the form of an enclosure that sits in the room, but more frequently the cabinet is built into the wall, often under a window sill. Such cabinets have an opening adjacent the floor level through which air from the room is induced, and a discharge opening or grille adjacent the top of the enclosure through which the heated air is discharged. The convector is located in the enclosure, and the heating of the air sets up a natural draft which keeps the air in constant circulation.

In my copending application Serial No. 513,883, filed February 6, 1931, I have disclosed a convector comprising a plurality of sections having a header portion at the top and a header portion at the bottom, the headers being connected by a barrel which has straight sloping fins thereon, the fins being set at an angle to both the longitudinal and transverse axes of the barrel. The radiator sits at an angle with respect to the vertical plane, it being sloped diagonally across the flue within the cabinet or enclosure. The advantage of this arrangement is in the fact that there is a relatively large heating surface over which the air may flow, but the air has only a short travel in contact with this heating surface.

In my copending application Serial No. 601,194, filed March 25, 1932, I have disclosed an improvement which comprises two pairs of radiating fins on each side face of the barrel instead of one, one series being staggered with respect to the other.

The purpose of the constructions disclosed in both of these applications is to provide a relatively large surface area in a convector with a relatively short travel of air in contact with the radiator. The limited dimensions of the cabinet make it necessary, in order to secure efficient heating, to utilize the space to the very best advantage.

While the constructions shown in my said copending applications constitute marked improvements in convector heating, particularly as applied to cast metal radiator sections, the present invention provides an arrangement wherein an even more effective disposition of heating surface is secured.

The invention may be readily understood by reference to the accompanying drawings in which

Figure 1 is a more or less conventional illustration of one type of convector embodying my invention, the view representing an elevation of the side face of a single section;

Figure 2 is a view similar to Figure 1 with the section inverted;

Figure 3 is a view similar to Figure 1 showing a slight modification wherein there are no ports or headers at the top of the section;

Figure 4 is an end view of still a further modified form of radiator incorporating the same principle;

Figure 5 is a view similar to Figure 1 representing still another modification;

Figure 6 represents a transverse section in the plane of line VI—VI of Figure 1;

Figure 7 is a diagrammatic view comparing the disposition of a section embodying the present invention with a section similar to that disclosed in my said copending applications; and

Figure 8 is a curve showing the decrease in the rate of heat transfer from the radiator to the air through a range of travel of several inches.

Referring first to Figure 8, the curve represents graphically the falling off in the relative efficiency of the surface of a radiator with the increase in the length of time or travel that the air is in contact with the radiator. The numbers at the side of the graph represent the degree of efficiency of each unit of surface of a radiator with respect to a known standard of rating. A heating surface is rated as having 100% efficiency when it will condense one-quarter of a pound of steam per square foot per hour in a room temperature of 70° and the steam at a temperature of 215° F., or at two pounds pressure. This is the equivalent of a heat liberation of 240 B. t. u's. per square foot per hour. The number 100 at the side of the graph indicates this standard.

The numbers along the bottom of the graph indicate the inches of air travel over the radiator surface. From the graph it will be seen that in the first two inches of travel there is a very high degree of efficiency for each unit of surface of the radiator. In other words, if the radiator were but two inches high, every bit of surface would be operating way above the standard rating of 100. Even if the radiator is four inches high the efficiency is 100% with reference to the fixed standard explained above. However, after the first four inches of travel in contact with the radiator the temperature difference between the air and the radiator is very much diminished with the result that the air does not continue to absorb heat at the same rate and if the radiator is,

for instance, eleven inches high, the upper seven inches have a very low efficiency as compared with the bottom four inches. As shown by the chart, at eleven inches a unit of surface functions at only 70% of the normal rating. From this it is evident that an ideal radiator must provide for a very short air travel in contact with the radiator, but there must be a large surface with which the air can initially contact.

My invention contemplates the use of a section, the mid portion of which is out of horizontal alinement with the end portions, whereby the barrel portion of the section is no longer than it is where the barrel extends in a straight line between the two ends. More especially, the invention contemplates arching the section into the form of a V, or a U, or an inverted V, or an inverted U, providing in effect two barrels in the same space where only one has been used before, but with each barrel of only approximately half the thickness in a vertical direction of the straight sloping barrel of my said copending applications.

This is best explained by reference to Figure 7 in which A designates a cabinet or enclosure having a continuous back wall B and a front wall C. Adjacent the floor line is an air inlet port E and at some point adjacent the top of the cabinet is an air outlet or grille F. In dot-and-dash lines I have shown the contour of a straight sloping fin section of the type disclosed in my said copending applications and which is marked G. The distance from the center of the nipple port at the bottom of this section to the center of the nipple port at the top of this section may, for the purpose of illustration, be assumed to be 10½ inches. The transverse thickness of the barrel from the upper edge to the lower edge is four inches. This means that the air rising up through the flue A has to pass through the radiator G and in doing so flows in contact with the radiator for a distance slightly in excess of four inches.

In the same figure I have shown in full lines a section embodying the present invention and marked H. This section is shown as being in the form of an inverted V, and the thickness through each barrel is just half the transverse thickness through the barrel G.

Assuming the same spacing of fins on the two sections, the section H will have just about the same area as the section G. In the case of section G, however, the air remains in contact with the radiator through four inches of travel, whereas in section H the air is in contact with the radiator only during two inches of travel.

Referring to Figure 8, it will be seen that each unit of area on the section H will function at a much higher efficiency than each unit of area on the section G. This means that in the improved section H there will be a greater rate of heat transfer per pound of metal in the radiator than there is in the section G.

My invention affords, therefore, a greater efficiency per pound of metal or per unit of surface than has been heretofore obtainable. In Figure 7 I have shown the sections G and H as being of the same height and having, therefore, substantially the same surface area. Because, however, of the greater efficiency of the V-shaped type, the section H may actually be made shorter than the section G in vertical height and consequently lighter. By making the sections shorter a still greater advantage obtains because there is a greater mean effective draft head in the flue A for the shorter section with a consequently higher velocity, and the rate of heat dissipated from the radiator increases almost directly with the increase in the velocity of the air travel over its surface.

In the construction shown in Figure 1, I have shown a radiator section 5 having two legs or barrels 6 and 7 which converge into a common header 8, this header 8 having nipple ports therein for registration with the nipple ports of other sections correspondingly constructed, the idea being that a radiator unit will be comprised of several of these sections secured together in face-to-face relation as disclosed in my said copending application Serial No. 513,833. At the lower end of each of the barrels 6 and 7 is a header portion 9, the header portions 9 also having nipple ports therein.

On each of the barrels 6 and 7 are laterally projecting sloping fins 10. The fins on the barrels slope away from each other, i. e., outwardly and upwardly from the center of the V. The fins are set at an angle to both the longitudinal and transverse axes of the legs or barrels, the angles of these fins preferably being within the range specified in my said copending applications, i. e., at an angle ranging between 27 and 45° to the plane of the transverse axis of the barrel, and preferably at an angle of 33° with respect thereto.

The section shown in this figure corresponds to the section H illustrated in Figure 7. The cold air entering the enclosure flows up into the crotch of the V, escaping to the upper sides of the radiator by flowing through the channels between the fins.

In Figure 2 I have shown a section similar to Figure 1 and have used corresponding reference numerals to indicate the corresponding parts. The only difference, however, is that the section is inverted with respect to the section shown in Figure 1.

In the arrangement shown in Figure 3 the section is also V-shaped and may be inverted or upright. It has two legs 11 and 12 and differs from the arrangement shown in Figure 1 only in the fact that no header 8 is provided at the apex of the section. Sections of this type can be used in certain steam heating installations.

The arrangement shown in Figure 4 provides a radiator having diverging barrels 13 and 14, which barrels are provided with the sloping fins as described. The barrels 13 and 14 may comprise single straight sections similar to the sections G and similar to the sections disclosed in my said copending applications. Instead of being used in the single arrangement as disclosed in my said applications, they are arranged in downwardly diverging pairs as shown. A special end fitting 15 at each end of the radiator thus fabricated establishes communication between all of the sections. This special end fitting 15 constitutes the subject matter of a copending application in which it is specifically described and claimed, and which is Serial No. 601,325, filed March 26, 1932.

The advantage of the arrangement shown in Figure 4 is that it permits the use of the single straight sections disclosed in my said copending applications, and the barrels 13 and 14 can be adjusted to any angle of divergence that the depth of the cabinet will permit of. The end members 15 would, of course, have to be specially made to suit any divergence from that shown in Figure 4. The advantage of the arrangement shown in Figure 1 is that, because of the single

header for the two diverging legs and consequently the single nipples for connection with other sections, the weight of a radiator assembled from sections of the type shown in Figure 1 is less than the weight of a radiator assembled as shown in Figure 4, although the area of the two would be practically the same.

It is not necessary that the barrels should be straight, and in Figure 5 I have shown a section 16 having two legs 17 and 18, the section being in the form of an inverted U. A header may be provided at the top of the bend in the U, as indicated at 19, or the header at this point can be dispensed with similar to the arrangement shown in Figure 3. The lower ends of the barrels 17 and 18 are provided with headers 20. The section shown in Figure 5 may of course be inverted to a position corresponding to the position of the section shown in Figure 2. This, in effect, is secured by providing a section substantially in the form of an arch which is either upright or inverted.

Obviously, various other changes and modifications may be made in the particular construction and disposition of various elements of the section without departing from the spirit of my invention. As explained, the invention has the advantage of providing a section in which every unit of surface functions at an efficiency much higher than has been obtainable in any other type of radiator with which I am familiar.

I claim:

1. A convector of the class described comprising a unit formed of a plurality of sections in side-by-side relation, each section having leg portions diverging from a mid portion which is out of horizontal alinement with the end portions and having radiating fins on the lateral face thereof, said fins being sloped at an angle to a horizontal and vertical plane, the fins at one side of the mid portion being sloped in a direction opposite to the fins at the other side of the mid portion, a header portion on the free ends of the legs and at the mid portions, and an enclosing flue structure in which the unit is set, the sections being disposed transversely in the flue and spanning the distance between the front and the back walls of the flue.

2. A convector comprising a unit formed of a plurality of oppositely sloped barrels connected to communicate with each other at their ends, the barrels having heat radiating fins on the lateral faces thereof which are sloped at an angle with respect to the longitudinal axes of the barrels, and an enclosing flue in which the units sits, the spread of the unit being substantially the same as the depth from the front to the back of said flue, whereby substantially all air flowing vertically in the flue passes through the said unit.

3. A convector installation comprising, in combination, an enclosure having a vertical flue, and a substantially inverted V convector in the flue spanning the depth thereof, said convector having the legs of the V comprised of a plurality of barrels having radiating fins thereon sloping upwardly and outwardly from the crotch of the V.

4. A convector installation, comprising, in combination, an enclosure having a vertical flue with an opening at the bottom thereof and an opening adjacent the top thereof, and a substantially V-shaped convector in the flue between the top and bottom openings and spanning the depth thereof, said convector having the legs of the V comprised of a plurality of barrels having radiating fins thereon inclined with respect to the transverse and longitudinal axes of the barrels, the fins sloping in the general direction of the travel of air through the flue.

ROBERT S. WENTWORTH.