Jan. 4, 1927. 1,613,253

F. H. STOLP

RADIATOR

Filed Feb. 7, 1920 2 Sheets-Sheet 1

Fig. 1

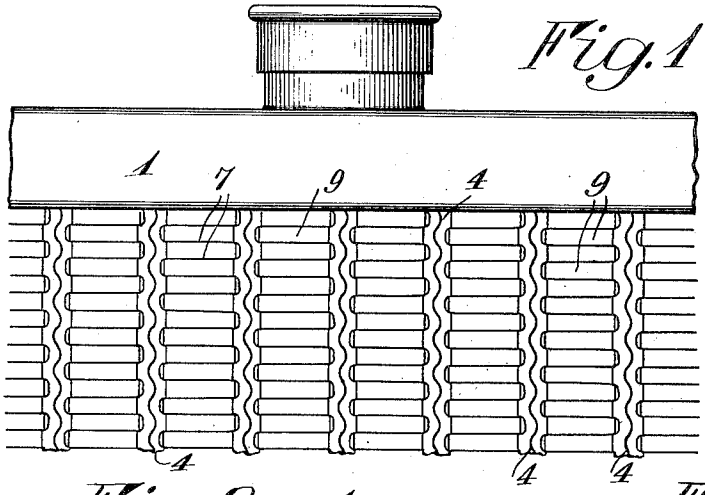


Fig. 2

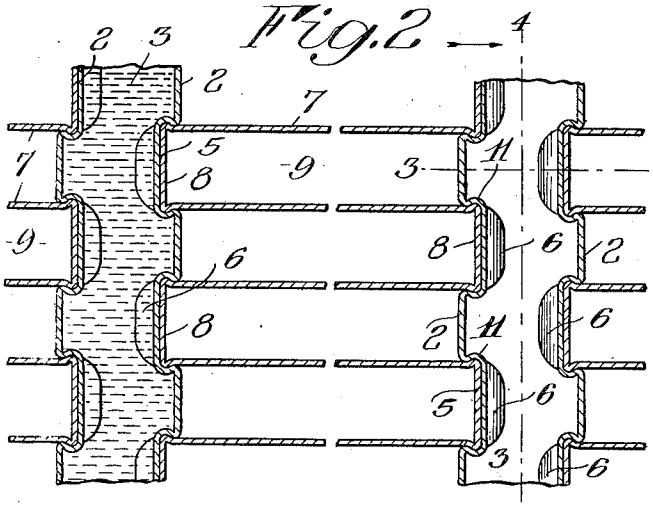


Fig. 3

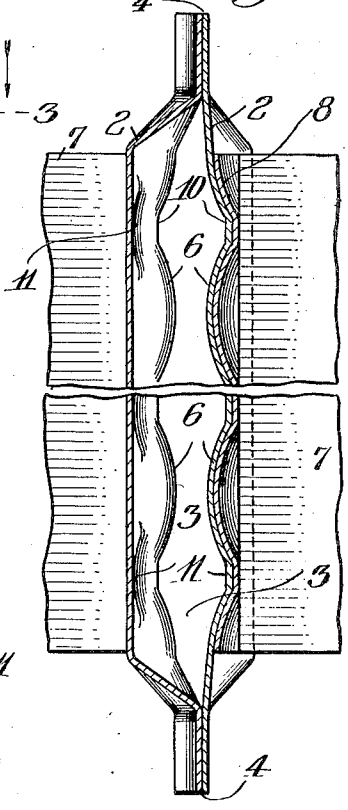
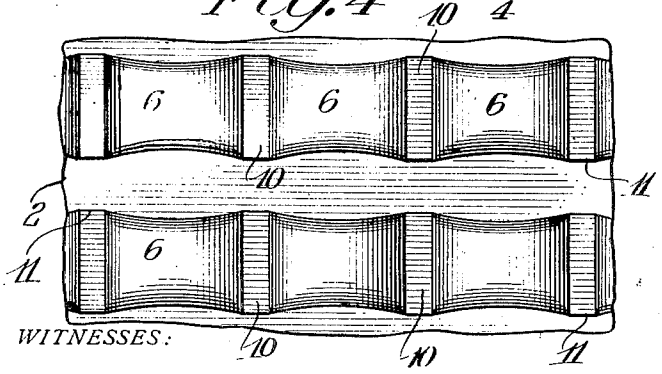


Fig. 4



WITNESSES:

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Fig. 5

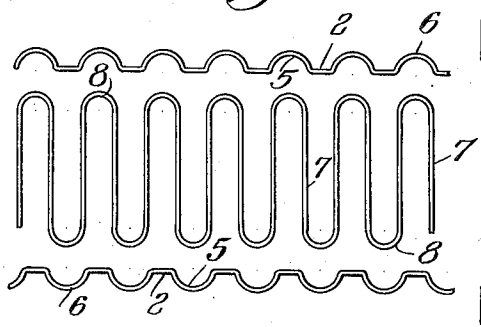


Fig. 6

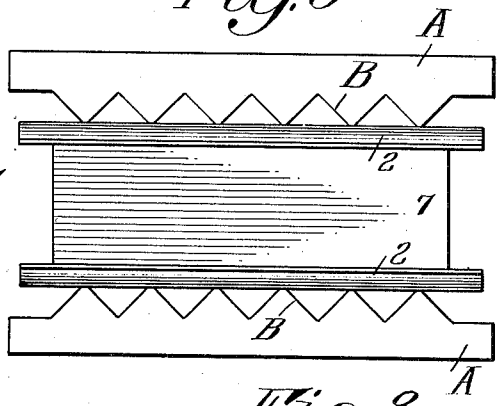


Fig. 7

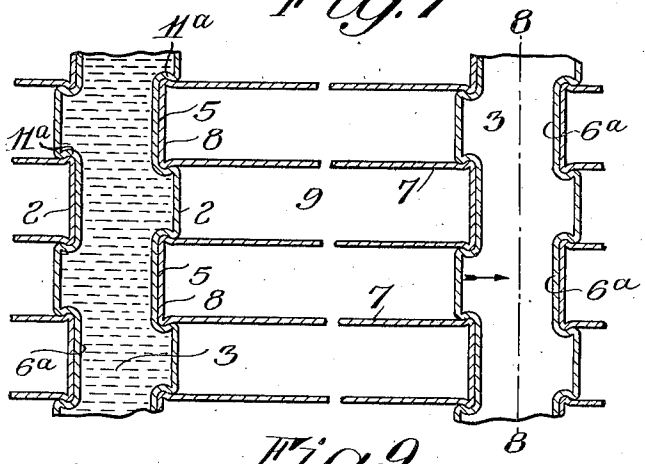


Fig. 8

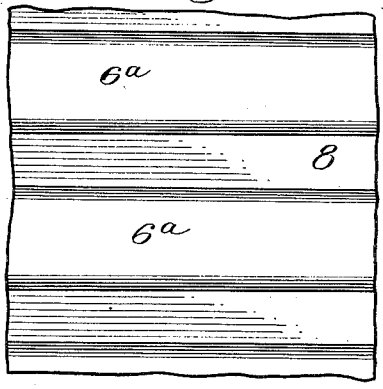


Fig. 9

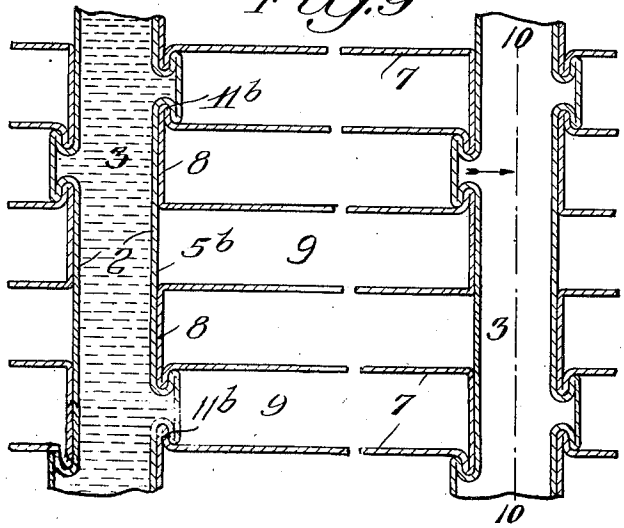
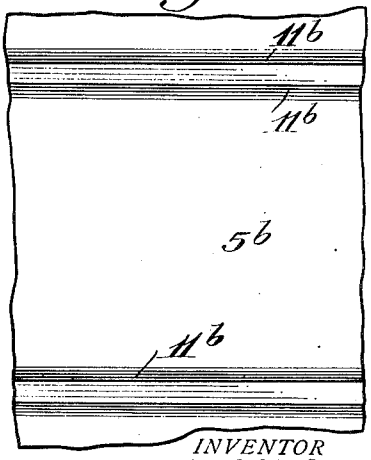


Fig. 10



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UNITED STATES PATENT OFFICE.

FRANK H. STOLP, OF GENEVA, NEW YORK.

RADIATOR.

Application filed February 7, 1920. Serial No. 356,917.

My present invention relates to the radiation of heat and more particularly to the manufacture of radiators such as those used in connection with water-cooled internal combustion engines and it has for its object to provide a simple and economical radiator of the so-called "indirect" type where extended heat distributing surfaces conduct the heat away from those surfaces with which the heated body is in direct contact, my invention, in the specific application thereof, embodying improvements in the mode of forming the air and water walls with relation to the manner in which they are mechanically and thermally held together. The improvements are directed in part toward obviating the necessity of using solder to join the parts to the extent that it has heretofore been used whereby a wider choice of materials is permitted for the radiator parts. To these and other ends the invention resides in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Figure 1 is a fragmentary front view of an automobile radiator constructed in accordance with and illustrating one embodiment of my invention;

Figure 2 is an enlarged fragmentary transverse section through a group of water and air walls;

Figure 3 is a section on the line 3—3 of Figure 2;

Figure 4 is a section on the line 4—4 of Figure 2 showing one of the water walls in elevation;

Figure 5 is a collective view showing the air wall and water wall materials prior to their being joined together;

Figure 6 is a side view of the elements shown in Figure 5, showing the manner in which the bumping tools clinch them together;

Figure 7 is a view similar to Figure 2 but showing a modified construction;

Figure 8 is a section on the line 8—8 of Figure 7;

Figure 9 is also a view similar to Figure 2 of a further modification, and

Figure 10 is a section on the line 10—10 thereof.

Similar reference numerals throughout the several views indicate the same parts.

One of the usual ways of making cellular radiators for direct radiation has heretofore been to bind together a multiplicity of metal tubes the interiors of which constituted the air cells and the exteriors of which were spaced from each other to provide the water cells which water cells were sealed by dipping or otherwise soldering together the ends of the tubes which were in contact or inserted in crown plates or the interstices filled with solder or other material. With this construction, direct radiation results from the fact that the water and air contact surfaces, the one yielding heat and the other absorbing it, are always on opposite sides of the same metal wall and hence substantially equal in area, whereas the conductivities of the two fluid mediums are far from equal and their heat transmitting opportunities are thus rendered disproportionate unless an impracticable volume of air is driven through. The alternative and rectifying practice consists in the provision of the indirect system of radiation wherein the air walls are greatly extended beyond the areas of the connected water walls, usually by providing a series of plates or fins exposed to air contact on both sides and collectively pierced by water tubes of limited water contact area and distributing heat to the fins to which they are usually soldered. Both of these methods of construction practically limit the manufacture to the use of brass or copper as a material because it demands a solderable metal likewise resistant to corrosion by water. Disadvantage lies in the fact that copper and brass are expensive and heavy and the amount of solder required adds further to the weight, while the tubular indirect radiator last described is structurally weak and the fins or plates are easily bent and damaged.

In the practice of my present invention, I employ but few water passages of considerable capacity but having continuous and preferably one-piece walls of large area that are joined together by solder or otherwise only at their ends or edges and between the walls of adjacent passages I form air passages, the walls of which are joined to the water walls by an interlocking arrangement which makes the use of solder unnecessary and permits the use of aluminum, zinc, steel or other material for the formation of these air passages or fins. In this way I derive the benefits of the extensive but narrow water

passage of the cellular direct radiator with its attendant strength and rigidity but with only a fraction of the soldering and at the same time I produce the extensive air passages of the tubular radiator and correct thermal contact with the water walls without using solder at all.

Referring more particularly to the drawings and to Figure 1 thereof, 1 indicates the upper reservoir of an automobile radiator to the under side of which are secured the top edges of two substantially parallel spaced water walls or plates 2 forming the water passage shown at 3 in Figure 2. These walls are preferably made each of a single sheet or strip of copper or zinc the front and rear edges of which are brought together as shown at 4 in Figures 1 and 3 and soldered or otherwise tightly connected. The spacing of the walls 2, of course, regulates the water capacity of the radiator. In the form shown in Figures 1 to 6, each wall 2 is provided with a series of channels 5 on its exterior, the channels being parallel and disposed transversely to the seamed edges 4 of the walls. In the manufacturing process, these channels are first formed up in the wall sheet and produce a continuous rounded rib 6 on the interior of the wall, as shown in Figure 5. A continuous strip or ribbon of sheet metal is then looped or doubled back and forth into a series of parallel walls or radiating plates 7 and the bends or folds 8 joining adjacent plates are seated in the channels 5 to have good thermal contact at all points. The plates 7 thus divide the space between adjacent water passages 3 into a plurality of air passages 9 having a greater or less radiating area according to the distance between the proximate walls of adjacent water passages and the consequent length of the wall plates 7. When these water passage walls and air passage walls so formed, as shown in Figure 5, are brought together, suitable mandrels are inserted in the air passages and the projecting ribs 6 on the water wall plates 2 forming the channels 5 are bumped or compressed by suitable tools A provided with spaced die faces B at intervals thereon. This flattens out the ribs 6 at intervals, as shown at 10 in Figure 4, upsetting the fold or bend 8 occupying each channel 5 and creasing the channel and bend together at localized points, as shown at 11 in Figure 2, so that the material forming the water wall and the material forming the air wall are clinched together. This being the case and there being a continuous and complete thermal contact between the two elements at all points the transfer of heat from the water walls to the radiating plates of the air passages is efficient and no soldering is required for the connection. Hence, the plates or air walls 7 may be made of very thin metal and may be made, for instance, of aluminum which is desirable because of its light weight and its heat conductivity. The only soldering required, if solder be used at all, is at the joint edges 4 of the water walls 2 which, if desired, may be lap seamed.

It is preferable to alternate the ribs 6 formed by the channels 5 on the interior of each water wall 2 with those on the opposite wall, as shown in Figure 2, so that the water passage will be sinuous but of uniform capacity or cross sectional area.

In Figures 7 and 8 I have shown a modification in which the creases indicated at 11^a are continuous along the corners of the channels 5 and the folds 8 of the air cooled strip are thereby clinched at all points so that they are, in effect, dovetailed into the channels and the rib 6^a on the interior of the water wall is continuously flat instead of waved, as will be seen from a comparison of Figures 4 and 8.

Figures 9 and 10 show a still further modification of the clinching of the air walls by the water walls, one corner only of each fold 8 of the air cooled strip being creased at 11^b within a wide channel 5^b in the wall 2 that embraces three air passages 9 instead of one.

While I have described my invention as applied to the air cooling of water in the circulatory system of an internal combustion engine, it is obviously applicable in other ways and with other fluid mediums and independently of which medium is to be cooled and which heated, the essentials of the invention having to do merely with the transfer of heat between fluid acting through walls or plates thermally and mechanically joined in a certain way.

I claim as my invention:

1. A radiator comprising air passages and water passages, the air passages being formed of a continuous strip of sheet metal folded back and forth upon itself and having the bends of the folds clinched by the walls of the water passages.

2. A radiator comprising water passages having walls each composed of a single strip of sheet metal and air passages formed by folding a continuous strip of sheet metal back and forth between the said walls, the walls of the water passage being clinched over the bends of the air passage strip.

3. A radiator comprising air passages and water passages, one set of passages comprising walls having channels therein and the other set of passages having walls which have bends clinched in said channels.

4. A radiator comprising water passages embodying walls having channels therein, and air passages formed of separate pieces of sheet metal clinched within said channels.

5. A radiator embodying water passages having substantially parallel walls formed

of one body of material and air passages formed separately therefrom of another body of material and between the water passages, the walls of the air passages being mechanically interlocked by clinching with the walls of the water passages in such intimate relationship as to readily transmit heat.

6. A radiator embodying water passages having substantially parallel walls formed of continuous strips of sheet metal having channels therein, and intermediate air passages formed of a continuous strip of sheet metal doubled back and forth between adjacent water passage walls, the bent or folded portions of said last mentioned strip being clinched within the channels of the water passage walls.

7. A radiator embodying a plurality of units arranged in spaced relationship to form water passages between them, each unit embodying a pair of substantially parallel walls having transverse channels formed therein and a metallic sheet doubled back and forth between said walls, the bent or folded portions of the sheet being clinched within the channels of the walls.

8. A radiator embodying a plurality of units arranged in spaced relationship to form water passages between them, each unit embodying a pair of substantially parallel walls having transverse channels formed therein and a metallic sheet doubled back and forth between said walls, the bent or folded portions of the sheet being clinched within the channels of the walls by upsetting said channels at laterally spaced intervals from the inside of the water passage.

9. A radiator comprising spaced elements forming water passages, and sheet metal strips extending back and forth between the walls of adjacent elements and extending lengthwise of the latter for a material distance at the points of contact with the water passage walls so as to provide areas of contact between the said walls and the strips sufficient to readily transmit heat, the walls of said water passage elements being clinched to the strips at the edges where the strips separate from one element in extending across to the other.

10. A radiator comprising spaced elements forming water passages, and sheet metal strips extending back and forth between adjacent elements and extending lengthwise of the latter for a material distance at the points of contact with the water passage walls so as to provide areas of contact between the said walls and the strips sufficient to readily transmit heat, said strips and the walls of the water passages being clinched together at the edges where the strips separate from each water passage element in extending across to the adjacent one.

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