April 17, 1934. F. M. OPITZ 1,954,946

RADIATOR CORE AND METHOD OF MAKING SAME

Filed May 11, 1931 2 Sheets-Sheet 1

Fig. 1

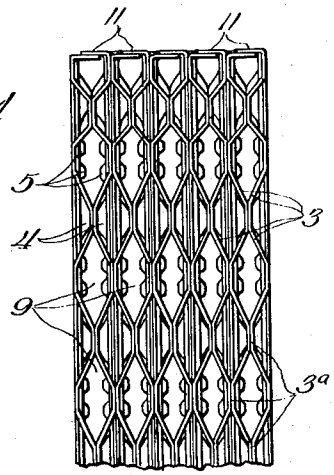


Fig. 2

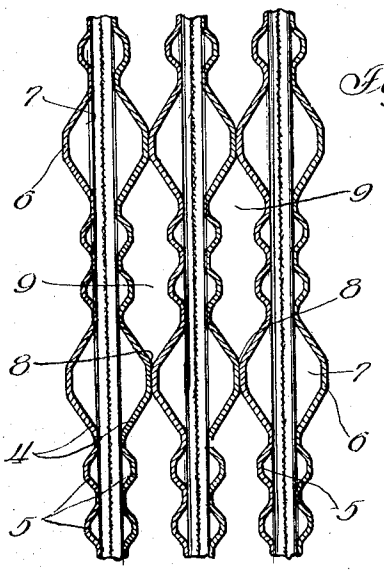


Fig. 4

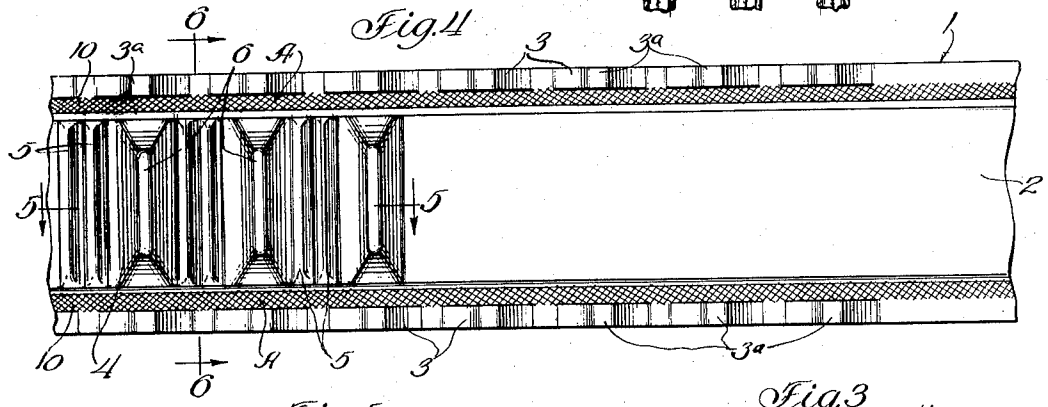


Fig. 5



Fig. 3

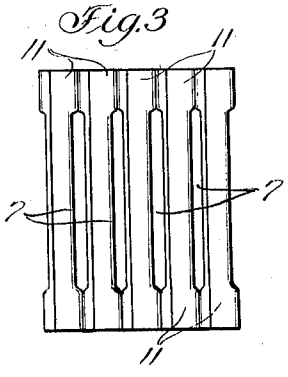
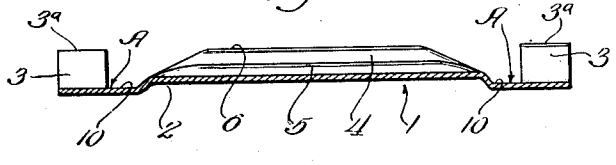


Fig. 6



Inventor:
Fred M. Opitz

By Brown Jackson Boettcher & Dunner

Attys.

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RADIATOR CORE AND METHOD OF MAKING SAME

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Fig. 7

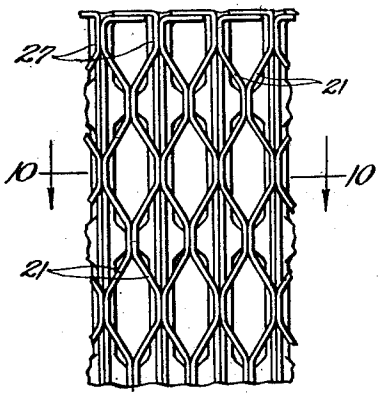


Fig. 8

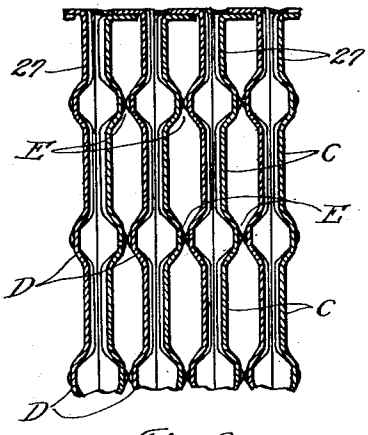


Fig. 11

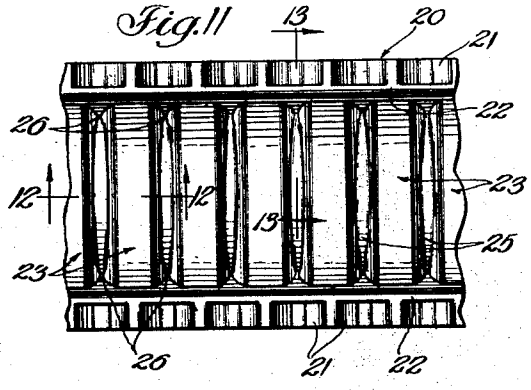


Fig. 9

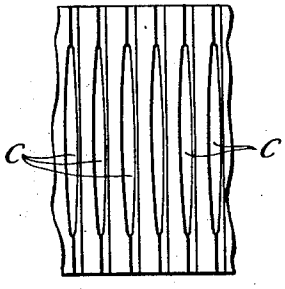


Fig. 12

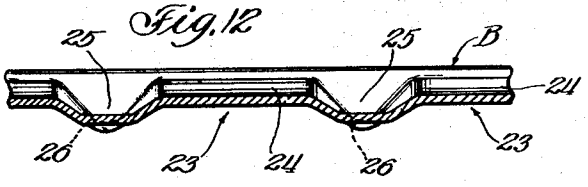


Fig. 10

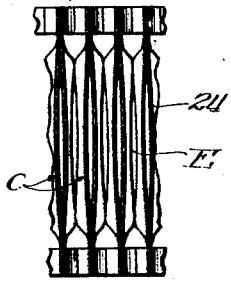
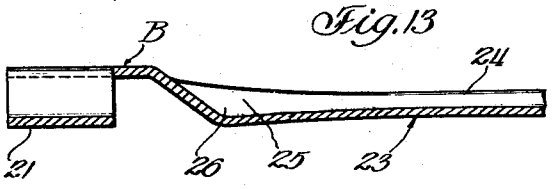


Fig. 13



Inventor:
Fred M. Opitz

By Brown Jackson Boettcher & Dunner

Attys.

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UNITED STATES PATENT OFFICE

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RADIATOR CORE AND METHOD OF MAKING SAME

Fred M. Opitz, Milwaukee, Wis., assignor to Hexcel Radiator Company, Milwaukee, Wis., a corporation of Wisconsin

Application May 11, 1931, Serial No. 536,329

16 Claims. (Cl. 113—118)

My invention relates to radiators and the like, and is more particularly concerned with the method or process of forming the sheet metal of which the radiator core is constructed, and further relates to the structure resulting from the assemblage of the sheet metal constructed and manipulated in accordance with the provisions of my present invention.

The radiator made by my present invention is covered by my prior Patent No. 1,404,160 of January 17, 1922, upon which the present invention is an improvement.

One of the objects of the present invention is to convert a flat strip of sheet metal, preferably of brass, copper, bronze, or other similar workable metal, into a suitably formed half tube with a minimum number of operations to simplify the manufacture thereof.

The strips may be formed into half tubes in any suitable type of press or stamping machine, preferably in machines of the type disclosed in my prior Patents Nos. 1,341,721 and 1,618,219 of June 1, 1920 and February 22, 1927, respectively.

The finished radiator is made up of a plurality of strips or sheets all of which are of like shapes. They are, however, placed face to face or back to back to form alternately the water tubes or water legs and the air spaces through which the air passes to dissipate the heat. The strips or sheets are first channeled to strengthen them and then they are provided with marginal loops for the purpose of spacing the sheets properly and to hold them together in their proper relations when solder is applied. The loops further constitute an ornamental and protective facing for the water tubes.

The strips constructed in accordance with the present invention are provided, after the channels are formed, with two sizes of corrugations extending transversely thereof. When two of the strips are placed face to face a generally straight water tube is formed. The water channel through the tube, as determined by the strip corrugations, is composed consecutively of enlarged spaced pockets and smaller pockets therebetween, with restrictions formed between all of the foregoing pockets.

The heretofore mentioned marginal loops are so related to the corrugations of the strips that when a plurality of the complementary strips are assembled face to face, the enlarged water pockets formed by the corrugations are disposed in alignment with the openings formed by the loops at the front and the back of the assembled radiator core. The smaller pockets are similarly disposed in line with the openings formed by the loops on adjacent tubes.

Another object of the present invention is to provide a strip for forming a radiator half tube, which when assembled with other like strips into a radiator core, will form vertical air passages through the core in addition to the usual horizontal air passages provided therein.

Other novel features and advantages relating to my improved radiator construction will hereinafter appear in the following detailed description having reference to the accompanying drawings.

In the drawings:—

Figure 1 is a fragmentary front elevational view of one of my improved forms of radiator cores;

Figure 2 is a vertical cross sectional view through the mid-section of the radiator taken parallel to the front face thereof;

Figure 3 is a top plan view of the portion of the radiator core illustrated in Figure 1 showing the water entrance or exit ports;

Figure 4 is a face view of one of the strips of sheet metal, the various steps in the process of forming the strip into its final shape being here illustrated;

Figure 5 is a longitudinal cross sectional view of a portion of the strip shown in Figure 4 taken centrally thereof;

Figure 6 is a transverse cross sectional view of the strip taken substantially along line 6—6 of Figure 4;

Figure 7 is a front elevational view of a fragmentary portion of an assembled radiator core of modified construction;

Figure 8 is a vertical cross sectional view through the mid-section of the radiator core taken parallel to the front face thereof;

Figure 9 is a top plan view of a fragmentary portion of the assembled radiator core showing the water entrance or exit ports;

Figure 10 is a horizontal cross sectional view taken substantially along line 10—10 of Figure 7;

Figure 11 is a face view of a fragmentary portion of the modified form of strip utilized in the construction shown in Figure 7 and showing the portion of the strip forming one of the interior walls of the water tube;

Figure 12 is a longitudinal cross sectional view through the strip taken substantially along the line 12—12 in Figure 11; and

Figure 13 is a fragmentary transverse sectional view on the radiator strip taken substantially along the line 13—13 of Figure 11.

Referring now to Figures 1 to 6, I have illustrated a strip 1 of brass, bronze, copper or other malleable material, which constitutes a half tube of the radiator core. Strip 1 may obviously be formed to the particular shape I employ for my present radiator construction in any desired manner but preferably I do so in the following steps. The flat stock or blank is fed through forming rolls which roll a longitudinal gutter or trough 2 into the strip. This gives the strip appreciable column strength and provides sufficient rigidity to keep the strip in shape for the subsequent operations, particularly those involving stretching portions of the strip. Thereafter the marginal loops 3 are formed by striking or pressing out the edges of the strips. Preferably I keep the overall length of the strip the same by stretching the blank metal into the form of the loops 3.

The next step is to stamp the transverse corrugations of the strip out of the trough portions therein. This operation may be accomplished with a successive die stamping operation, the dies being so shaped as to form a plurality of corrugations or pockets 4 and a number of relatively smaller corrugations or pockets 5 disposed between the former substantially as shown to the left in Figure 4, both sets of corrugations being formed on the same side of the plane of the original flat material or stock. The blank metal is likewise stretched in the corrugation-forming operation so that the overall length of the strip remains substantially the same as the length of the original blank or strip.

The larger corrugations 4 are expanded by the dies to such a height above the original surface A of the blank so that the ridges 6 of these corrugations are on the same level or in the same plane as the ridges or flattened crests 3*a* of the marginal loops. These ridges 6 are also flattened at their edge portions to form substantially flat contact area.

When two of the strips 1 are placed face to face a water tube 7 is formed, as best illustrated in Figure 2 wherein three such tubes are shown. When a plurality of the tubes so formed are assembled, the flattened ridges 6 of the corrugations of the adjacent tubes abut one another, as at 8 in the manner shown in Figure 2. This portion of the ridges being flat, a firm contact is assured. The intermediate corrugations 5 and the adjacent portions of the corrugations 4 define the air passages 9 and give the same an irregular contour to increase the available area and hence the efficiency of heat dissipation in a radiator core of the present construction. The flat portions 3*a*, of adjacent marginal loops are likewise in abutting engagement with each other because of their relation in height to ridges 6 as appears in Figure 1.

The radiator core may be assembled in any known manner. I prefer to place the strips alternately face to face and back to back in a jig or other holding means. Each complementary pair of strips for forming one of the water tubes is properly aligned in the jig with the next adjacent pairs of strips so that the ridges or crowns of the loop are brought into abutment in the manner illustrated in Figure 1. When the strips are assembled in the jig, the marginal edges 10 of each of a pair of complementary strips will lie adjacent each other and when solder is applied these edges will seal the front and rear extremities of the respective individual tubes. After the sheets are thus assembled the ends are suitably cut to lengths and overlapped as indicated at 11 in Figures 1 and 3. Each face of the radiator core is then dipped into acid, followed by dipping the same to a predetermined depth into molten solder to join the individual sheets or strips together into a rigid and well constructed radiator core.

After soldering, the marginal loops will be united to form the ornamental and protective facing of the radiator for the protection of the water tubes or water legs. It is also to be noted that corrugations 4 which constitute the larger water pockets of the tubes, are disposed in their length in direct line with certain of the aligned openings formed by the marginal loops fore and aft of the radiator core. This relation is obtained by virtue of the fact that the corrugations 4 are formed into the sheet in direct transverse alignment with the marginal loops on the opposite edges of the strip. This same relation places the smaller corrugations 5 in line with the air passages defined by the next adjacent loops, this relation being best illustrated in Figure 1.

In Figures 7 to 13, a modified form of strip 20 is utilized and it is manufactured in much the same manner as the strip embodied in the preferred form of radiator core. This strip is provided with marginal loops 21 adjoining the straight edge portions 22 of the strip and struck up therefrom. As in the preferred form of strip, a channel is first provided with transverse corrugations or pockets such as 23 which are pressed out of the surface of said channel. These corrugations or pockets are comparatively shallow or narrow and are formed by arching the strip outwardly from the water side thereof as at 24, and at the same time forming transverse troughs 25 in the arched portion at spaced intervals and preferably in alignment with oppositely disposed marginal loops. The bottoms of the troughs 25 are arched in a reverse direction relative to the original arching 24 of the strip in the manner best shown in Figure 13. The deepest portions of troughs 25 are located substantially at the extremities of the troughs as at 26, and these portions of the troughs are of such a depth below the original surface B of the strip as to lie in the same plane in which the ridges of the marginal loops 21 are disposed (see Figure 13). These troughs or transverse grooves 25 form pockets larger than the pockets 23.

In this form of radiator core, the straight edges 22 of complementary strips are likewise soldered together to seal the front and rear extremities of the water tubes adjacent the loops, while the latter are soldered together to form the protective and ornamental covering for said tubes.

When strips of this type are assembled water tubes 27 are formed having certain portions C in the form of water channels shown in Figures 8, 9 and 10, with spaced water pocket portions D located at intervals therealong. A vertical air passageway is also obtained between adjacent water tubes as at E because of the arched bottoms of the adjacently disposed troughs 25, see Figure 10. This forms a honeycomb radiator having unlimited air circulation passageways which efficiently encourages the heat exchange from the water to the air.

In the preferred form of water tube, the marginal edges 10 have been roughened in the manner best illustrated in Fig. 4. This may be accomplished simultaneously with any one of the steps employed for forming the tube, but is preferably done in the process of rolling the channel

2 into the strip, by using knurled means in connection with the channel forming rolls.

The inherent advantages in roughening the marginal edges of the strips are threefold. First, the roughened surfaces tend to maintain the tube halves in proper position relative to each other while they are being united in the jig or other holding means. Second, it sometimes happens that the edges of adjacent strips are too firmly pressed together when a plurality of such strips are united in the jig or other holding means prior to the soldering thereof, and if the contacting surfaces were flat there might be such intimate contact between the two tube halves of each tube that the solder may not flow between the edges or about the edges to form a perfect tube seal, and even though it may at times appear that the edges have been perfectly joined, there may only be a thin film of solder connecting the edges which might be easily broken thereafter at the slightest jar. It is for the purpose of insuring that a perfect seal will result, that the marginal edges 10 have been roughened, so as to prevent too perfect a contact between joining margins of the respective strips. The solder will readily flow between the roughened portions to form an effective seal regardless of how much pressure is imparted thereto by the jig or other holding means.

The third advantage gained is that the roughened surfaces of edges 10 have increased rigidity as compared to edges having perfectly smooth surfaces. This is apparent from the fact that the surface is provided with a large plurality of raised and depressed portions forming a large number of strengthening ribs therein.

It is to be understood that although the accompanying drawings may show the corners, where the sheet is bent into the particular configuration, I employ, as being sharp, that I avoid as much as possible all sharp corners and even if the inner side of a bent portion of the strip is sharp it will be understood that the outer surface thereof does not assume an absolutely sharp corner. Furthermore, extreme accuracy is not necessary when assembling the sheets. The absolute meeting of the edges such as 10 and 22 and the loops 3 and 21 respectively, is not essential since all of the edges are dipped in solder which joins and seals these edges regardless of a certain amount of variation of the edges or of spaces therebetween.

Although a preferred method of procedure in making up the sheets of a radiator core and the assemblage thereof has been described, it is to be understood that the order of the steps may be considerably varied without departing from the metes and bounds of the present invention. It is also possible to vary the configuration of the strips or sheets as is evident from the modification herein disclosed and described. Therefore, I do not intend to be strictly limited to the specific description herein set forth nor to the disclosure illustrated in the accompanying drawings, but only in so far as the appended claims are so limited.

What I claim is:

1. The method of forming a radiator half tube out of a strip of sheet metal which comprises forming a channel longitudinally of the strip to strengthen the same, forming a plurality of uniformly spaced slits along both margins, pressing the marginal material adjacent the slits out of the plane of the strip and stretching the same to form a half loop with a flattened crown, and forming intermediate the slitted portions a plurality of transverse communicating pockets of different size in the central portion of said strip.

2. The method of forming a radiator half tube out of a strip of sheet metal which comprises, rolling a channel in the central portion of said strip leaving margins at either side thereof, forming a plurality of uniformly spaced slits along both margins, pressing the marginal material adjacent the slits out of the plane of the strip to form a half loop with a flattened crown, and forming a plurality of transverse communicating pockets of different size in the channel portion of said strip, the large pockets and small pockets being alternately arranged.

3. The process of forming a radiator half tube from a flat strip of sheet material which comprises first forming a shallow channel longitudinally of the flat strip in the central portion only thereof to strengthen the strip, leaving a flat marginal portion on either side of the channel in the plane of the original strip, then projecting portions of the material from the channel and from said margins on opposite sides of said flat marginal portions, and forming said projections with exterior contacting portions lying in a plane parallel with said first named plane.

4. The process of forming a radiator half tube from a strip of sheet material which comprises first forming a shallow channel longitudinally of the strip to strengthen the same, leaving a flat marginal portion on either side of the channel in the plane of the original strip, then forming soldering loops on said marginal portions, and lastly curving the invert only of the channel away from the plane of the strip to form pockets.

5. The method of making a water tube for radiators which consists in forming in a portion of each of a pair of sheet metal strips a plurality of transverse communicating grooves and forming in another portion connecting loops, leaving marginal longitudinal portions substantially flat and in the plane of the original strip to strengthen the same and to form contacting edges to define the water channel and roughening said contacting surfaces, and soldering said surfaces together.

6. A radiator comprising, in combination, a plurality of tubular water passages, each of said passages including a pair of complementary radiator half tubes having flat unbroken planar meeting edges and joined together thereby, said half tubes also provided with a plurality of communicating water pockets of different sizes, and means for securing said pairs together as a unit.

7. A radiator comprising, in combination, a plurality of tubular water passages, each of said passages including a pair of complementary channeled radiator half tubes having flat unbroken meeting edges and joined together thereby, said meeting edges lying in a plane extending throughout the length of said passage, said half tubes also provided with a plurality of communicating water pockets, certain of said pockets having portions projecting away from the plane of the strip farther than the other pockets, said projecting portions of each tube adapted to contact with the corresponding portions of adjacent tubes.

8. As an article of manufacture, a water tube for a radiator or the like comprising a pair of separate complementary members, each member being identical and having a central channel portion and marginal edges, the channel portion being provided with transverse grooves and the marginal portion being provided with loops

of approximately the same dimension as said grooves.

9. As an article of manufacture, a water tube for a radiator or the like comprising a pair of separate complementary members, each member being identical and having a central channel portion and marginal edges, the channel portion being provided with a plurality of spaced transverse grooves and the marginal portion being provided with loops of approximately the same dimension as said grooves, there being shallow grooves intermediate said first mentioned grooves.

10. A radiator comprising, in combination, a plurality of tubular water passages, each of said passages including a pair of complementary radiator half tubes having central reinforcing channels with flat continuous marginal portions disposed substantially in the original plane of the strip from which the half tube is formed, said flat continuous marginal portions being joined together in substantial abutting relation, loops disposed at the edges of said marginal portions and formed from the material thereof by slitting a portion of the material and by stretching the same to dispose a portion of each of the loops in a plane spaced from the original plane of the strip, and a plurality of transverse communicating pockets of different size formed in the central portion of said tubes intermediate the flat continuous marginal portions thereof.

11. A radiator comprising, in combination, a plurality of tubular water passages, each of said passages including a pair of complementary radiator half tubes having slot continuous marginal portions by which the tubes are joined together, the central portion of each of the tubes being channeled to strengthen the same and the channel portion only being corrugated to provide a plurality of transversely communicating pockets of different size in said channel portion, the large pockets and small pockets being alternately arranged, said marginal portions being slitted uniformly along the lengths thereof and substantially opposite each of the larger pockets above mentioned and the severed sections of said margins being distended away from the plane of said joined flat continuous marginal portions in opposite directions to form loops with flattened crowns, the crowns of one radiator tube being secured to the crowns of the adjacent tubes.

12. A radiator comprising a plurality of tubular water passages, each of said passages comprising a pair of complementary radiator half tubes, each tube being formed of a flat strip of material with a continuous channel formed in the central portion thereof to give the tube column strength, leaving flat continuous marginal portions substantially in the original plane of the strip, transverse corrugations formed in the central channel portion only of said strip, and a plurality of loops disposed at the edges of said flat marginal portions, said loops being formed by slitting said marginal portions adjacent said transverse corrugations and stretching the severed marginal sections to secure sufficient material for said loops.

13. A radiator comprising a plurality of tubular water passages, each of said passages including a pair of complementary radiator half tubes secured together and each of said tubes comprising a strip of material having a channel formed longitudinally thereof with marginal portions on opposite sides of said channel left flat and continuous and in the original plane of said strip, said longitudinal channel being provided with transverse corrugations formed therein subsequent to the formation of the channel, said corrugations being in the nature of truncated pyramidal sections having the base portions thereof disposed in the plane of said channel and the apices thereof disposed in the plane spaced from said channel portion opposite the plane of said continuous marginal portions, the apices of the corrugations of one tube being adapted to contact with the adjacent apices of adjacent tubes, whereby the area of contact between adjacent tubes is limited, and means for holding said tubes together.

14. A radiator comprising a plurality of tubular water passages, each of said passages including a pair of complementary radiator half tubes secured together and each of said tubes comprising a strip of material having a channel formed longitudinally thereof with planar marginal portions on opposite sides of said channel left flat and continuous and in the original plane of said strip, said longitudinal channel being provided with transverse corrugations formed therein subsequent to the formation of the channel, said corrugations being in the nature of truncated pyramidal sections having the base portions thereof disposed in the plane of said channel and the apices thereof disposed in the plane spaced from said channel portion opposite the plane of said continuous marginal portions, the apices of the corrugations of one tube being adapted to contact with the apices of adjacent tubes, whereby the area of contact between adjacent tubes is limited, and means for holding said tubes together.

15. A radiator comprising a plurality of tubular water passages, each of said passages consisting of a pair of complementary radiator half tubes and each of said half tubes including a strip having a longitudinal channel formed in the central portion thereof forming angularly disposed sections giving the strip a substantial amount of strength against distortion, the channel being formed with flat continuous marginal portions on either side of said channel portion and in the original plane of the strip, transverse corrugations formed in the channeled portion of said strip, the crests of said corrugations having reentrant portions intermediate the ends of the corrugations, whereby the end portions of said corrugations are spaced farther from the original plane of the strip than said reentrant portions, and loops pressed from said flat continuous marginal portions of the strip and serving as means for holding all of said radiator tubes in position with said end portions of the corrugations in contact with those of adjacent tubes and with the reentrant portions thereof disposed in spaced relation.

16. A radiator comprising a plurality of tubular water passages, each of said passages consisting of a pair of complementary radiator half tubes and each of said tubes being formed from a strip with an intermediate channel formed therein and flat continuous marginal portions disposed in the original plane of the strip, transverse corrugations formed in said channeled portion, each of said transverse corrugations having its mid section reversely arched with respect to the main body of the corrugation, thereby providing for point contact between adjacent radiator tubes, and means for holding said radiator tubes in position and maintaining said point contact therebetween.

FRED M. OPITZ.