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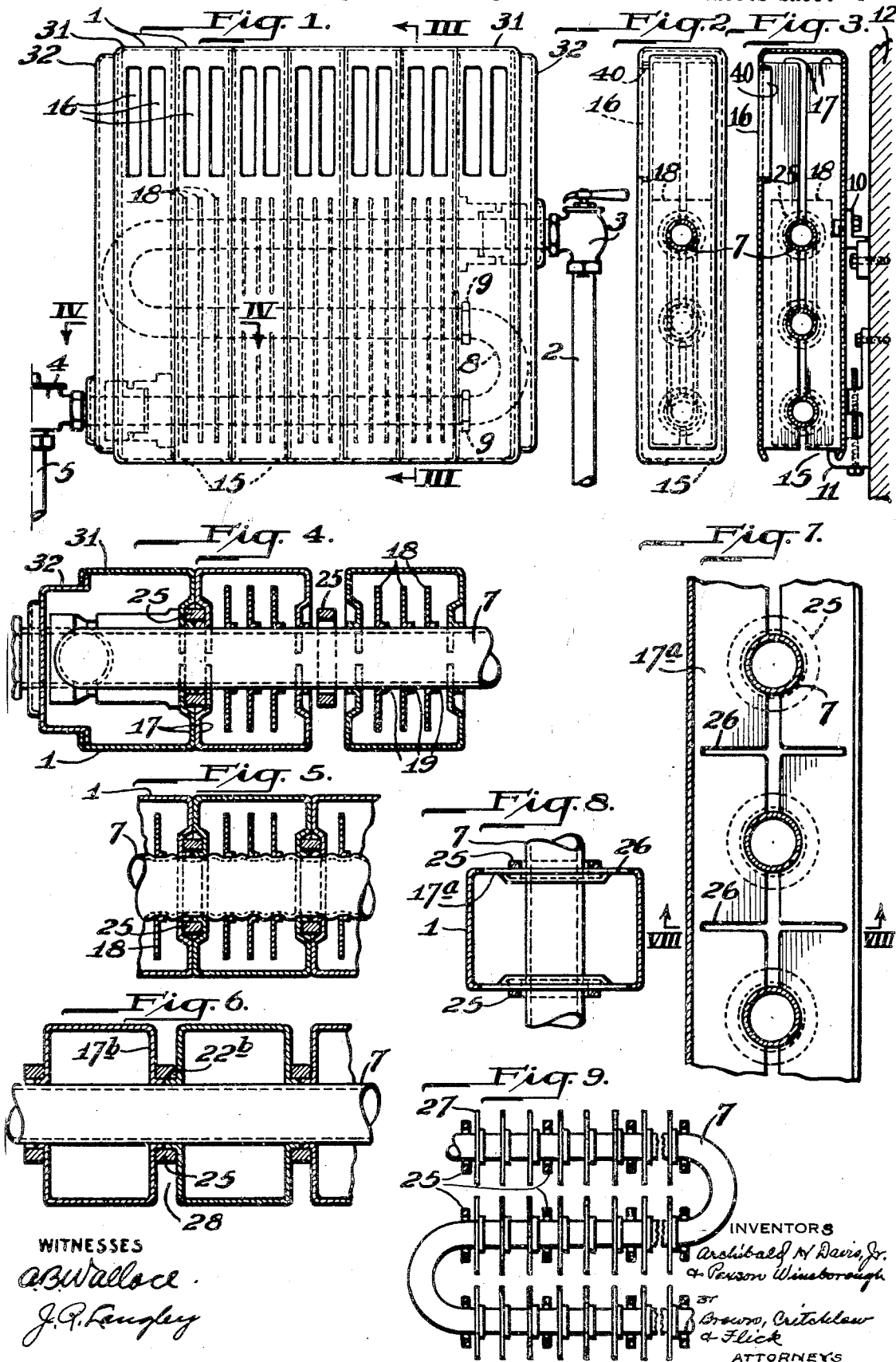
A. H. DAVIS, JR., ET AL

1,957,702

METHOD OF MAKING RADIATORS

Original Filed Sept. 11, 1931

2 Sheets-Sheet 1



May 8, 1934.

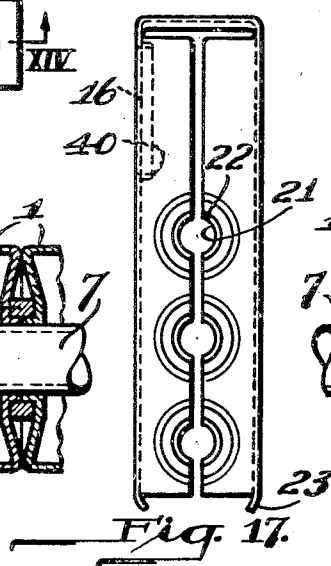
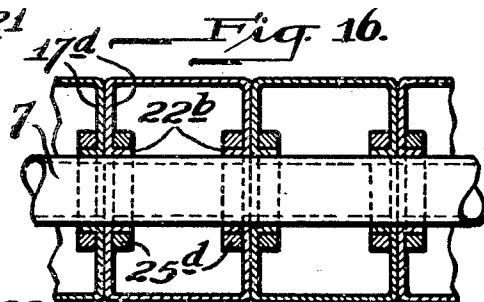
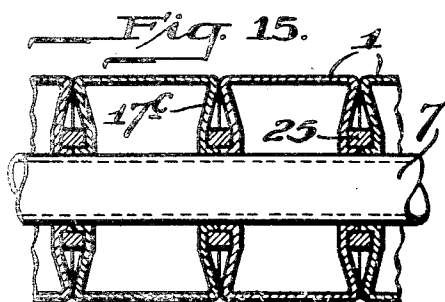
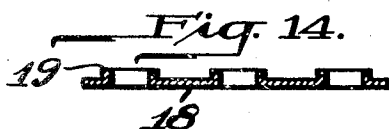
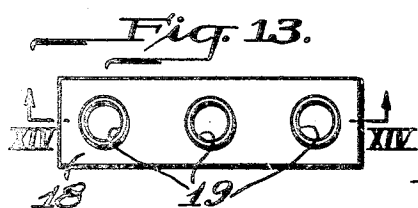
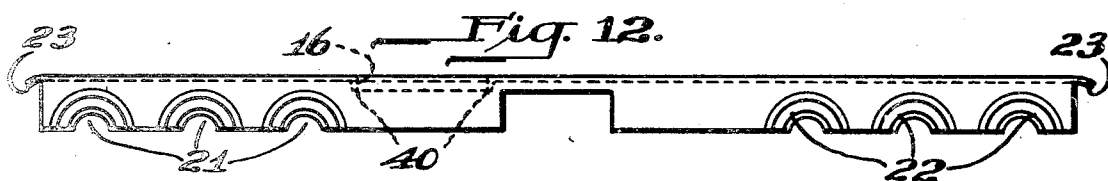
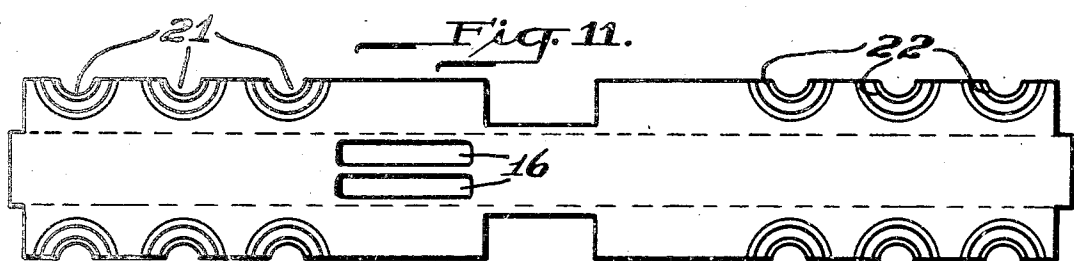
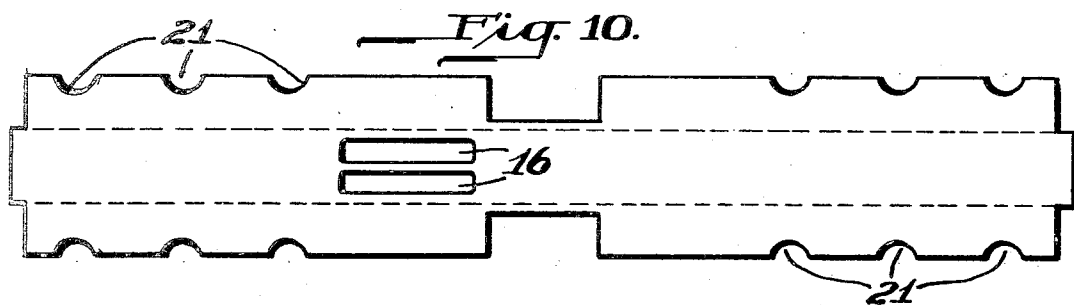
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2 Sheets-Sheet 2



WITNESSES

A. Wallace

J. P. Baughey

INVENTORS
*Archibald H. Davis, Jr.
Paxson Winstorouph*

BY

Brown, Critchlow & Flick

ATTORNEYS

UNITED STATES PATENT OFFICE

1,957,702

METHOD OF MAKING RADIATORS

Archibald H. Davis, Jr., New Castle, and Paxson Winsborough, Pittsburgh, Pa., assignors to Shaw-Perkins Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Original application September 11, 1931, Serial No. 562,307. Divided and this application May 15, 1933, Serial No. 671,072

15 Claims. (Cl. 113—118)

This invention relates generally to heat exchange apparatus, and particularly to improved radiators for heating the rooms of buildings.

The subject-matter of the present application is closely related to that of our copending application Serial No. 562,307, filed September 11, 1931, of which this application is a division, and is also closely related to that of our copending application Serial No. 671,073, filed May 15, 1933.

It is an object of our invention to provide improved methods whereby a unitary radiator structure that is rugged and effective in operation may be easily manufactured. Another object is to provide a novel method of fastening metal plates to tubular members in radiator construction.

In accordance with our invention, a unitary cabinet and radiating structure is formed about a heating element, usually a tube for conveying heated fluid, by suitably folding and securing a plurality of sections punched from flat sheet metal. The sections are folded at their edges to channel shape and each section folded upon itself to form a box-like element. The edges of the sections are provided with flanged semi-circular openings that engage the sides of the tube, and metal rings are provided for retaining the flanges in contact with the tubes. Any convenient number of sections may be utilized to form a complete radiator. Suitable openings are provided in the bottom and top of each section to permit circulation of air, and intermediate plates or fins may be applied to the tube within the sections for conducting heat to the air.

The foregoing and other objects of the invention that will become apparent upon further consideration of this specification may be achieved by the methods of making and assembling the specific structures described herein and shown in the accompanying drawings, in which

Fig. 1 is a view in front elevation of a radiator embodying our invention;

Fig. 2 is a view in end elevation of the radiator;

Fig. 3 is a view in vertical section taken on the plane represented by the line III—III in Fig. 1, showing means by which the radiator may be mounted;

Fig. 4 is a view in section taken on the plane represented by the line IV—IV of Fig. 1, showing a portion of the radiator in process of assembly to illustrate one manner in which it may be put together;

Fig. 5 is a view similar to Fig. 4, showing the heating tube expanded to lock the portions of the radiator in position;

Fig. 6 is a view, similar to Fig. 4, of a modification of the invention, showing another method of securing the sections of the radiator to the tube;

Fig. 7 is an enlarged view similar to Fig. 3, showing a portion of a modified main cross plate;

Fig. 8 is a view in section taken on the plane represented by the line VIII—VIII in Fig. 7;

Fig. 9 is a view in elevation of a continuous heating tube provided with individual fins on each run of the tube;

Fig. 10 is a plan view of a flat blank for one section of the radiator that has been cut from sheet metal;

Fig. 11 is a view similar to Fig. 10 of the blank after it has been pressed;

Fig. 12 is a view in elevation of the blank after it has been bent to channel shape;

Fig. 13 is a plan view of an intermediate plate;

Fig. 14 is a view in section taken on the plane represented by the line XIV—XIV in Fig. 13, showing the flanged openings in the intermediate plate;

Fig. 15 is a view in horizontal section, similar to Fig. 4, showing another method of securing the sections to the tube;

Fig. 16 is a view in section, similar to Fig. 4, showing a further modification of the joint between the sections and the tube; and

Fig. 17 is an end elevation of the blank of Fig. 12 folded upon itself to form a shell, or unit of a radiator cabinet.

In the general views in the drawings, particularly Figs. 1 and 2, the radiator is shown as a unitary structure made up of a plurality of individual sections 1, each of which has an integral front, top and back portion which with the other sections, constitutes a substantially smooth, paneled exterior surface for the radiator. At one end of the radiator is connected the usual supply pipe 2 for steam or other heating medium the admission of which may be controlled by a valve 3 in the usual manner. At the other end of the radiator is provided the usual trap 4 connected to a return pipe 5.

The heating fluid admitted through the valve 3 passes through a vessel or conductor 7 that is preferably a drawn copper tube, of circular section which makes one or more turns or runs lengthwise of the radiator and constitutes the heating element. As shown by the dotted lines

in Fig. 1, the tube 7 comprises three horizontal sections or runs that lie preferably in the vertical mid-plane of the radiator. The upper and the middle runs are joined by an integral bend, and the middle run is connected to the bottom run by a suitable return bend or elbow 8 joined to the ends of the tubes by brazed or other suitable joints 9.

As shown in Fig. 3, the radiator may be mounted on the wall of a room in any suitable position by means of a plurality of brackets 10 and 11 fastened to the wall 12 back of the radiator. Such fastening means may be adjustable to vary the height of the radiator, as shown. In some instances, it may be desirable to mount the radiator on legs in the usual manner, and in such case any suitable type of base member or legs may be applied.

To enable air to circulate upward through each of the sections 1, the bottom of each section is left open as shown in Fig. 3 to provide an inlet opening 15, and a suitable outlet opening 16 is provided near the top of each section preferably in the front face thereof, although it may be desirable to form the outlet openings in the tops of the sections in some instances.

Heat is transmitted to the air within the sections not only directly from the surface of the tube 7, which may be considered the prime heating surface, but also from transverse plates or partitions 17 that constitute the sides of each section 1, and that are heated by conduction from the tube. The transverse plates 17 closely engage the tubes 7 in heat transferring contact, as shown in Figs. 4 and 5, and function as secondary heating surfaces to transmit heat to the air stream within the sections and also to transmit heat to the exterior surfaces of the sections which function as radiating surfaces for radiating heat directly into the room.

In the event that steam or other high temperature heating medium is utilized within the tube 7, the tube itself will be shielded by the sections 1 to guard occupants of the room from being burned by it, and the exterior surface of the radiator will be heated only to a temperature substantially less than that of the heating medium and about equal to the temperature of a prime surface radiator heated by hot water.

In addition to the two side walls or transverse plates 17 in each section, a plurality of free intermediate plates 18 is provided within each section on the tube 7. As shown, these plates 18 are somewhat smaller than the interior dimensions of the sections and extend upwardly only to a position slightly below the bottom of the outlet openings 16, but they may be of any size which will fit within the sections. The intermediate plates 18 may be made from any suitable sheet metal, such as copper or aluminum. An inexpensive grade of sheet steel may be utilized with satisfactory results. These plates are made by punching them from sheet stock with spaced holes somewhat smaller than the tube 7 to be received in them, and then pressing them to form flanges 19, as shown in Figs. 13 and 14, for engaging the surfaces of the tubes.

The sections 1 may likewise be manufactured from any suitable sheet metal, but it has been found that sheet steel can be used most satisfactorily to provide an inexpensive and rigid structure. In manufacturing the sections 1, blanks are first cut from sheet stock in the shape shown in Fig. 10. The blanks are provided at their edges with semi-circular openings 21 for

engaging the sides of the tube 7 when the structure is assembled. The blanks are then pressed as shown in Fig. 11 to form offset flanges 22 at each of the openings 2 of such dimensions as to adapt them to accurately engage the exterior of the tube 7.

In the next operation, the blanks are bent to channel shape as shown in Fig. 12 in such manner that the corresponding semi-circular openings 21 at each side of the blanks are disposed in alignment. The metal between the bent-down portions of each blank constitutes a continuous strip or ribbon for forming the front, top, and back of the finished section.

To form finished sections from the channel-shaped blanks it is simply necessary to fold each blank upon itself in such manner that the semi-circular openings 21 at the edges of the blank are brought together to constitute circular openings as shown in Fig. 17. The folds are made on a radius of suitable curvature to give a rounded effect to the corners of the radiator, and the lower ends 23 of each section are likewise bent or rounded to match the bends at the upper end thereof.

For securing the sections together, suitable rings 25, preferably of steel, are disposed on the flanges 22 between adjacent sections. The rings 25 are of sufficient internal diameter to readily slip over the flanges 22, and are of sufficient width to engage the flanges of two adjacent sections. Inasmuch as the flanges 22 are offset, the transverse plates 17 may be brought together, thereby enclosing the ring 25 within an annular chamber, as shown in Fig. 4.

To assemble the radiator, a suitable number of intermediate plates 18 are placed in position in each section. The sections are then placed in juxtaposition with the rings 25 in engagement with the flanges 22 of adjacent sections. The tubes 7 may then be passed through the aligned openings 19 and 21 in the intermediate plates and the sections, respectively. After all of the sections and their intermediate plates have been thus assembled on the tubes 7, the lower and intermediate horizontal portions of the tube are joined by the elbow connection 8.

The tube is then blown up or expanded, preferably by introducing into it liquid under high pressure. When thus expanded the tube 7 will be deformed slightly, as shown in Fig. 5, and will securely grip the flanges 22 on the sections 1 between it and the rings 25. Likewise, the flanges 19 of the intermediate plates 18 will be closely engaged in such manner that the plates will be rigidly held in position.

In comparatively long radiators made up of many sections it is desirable to make provision for unequal expansion of the different runs of the tube 7. Such unequal expansion may occur when steam is first admitted to the radiator, as the top run of the tube, that is, the run to which the supply pipe 2 is connected, is heated by the entering steam before the other runs of the tube are filled with steam.

To permit the tube runs to expand individually, the plates 17a may be partially divided by transverse slots 26 as shown in Figs. 7 and 8, between consecutive tube runs. The part of the transverse plate adjacent each tube may deflect somewhat to accommodate longitudinal expansion of the tube without injuriously affecting the other parts or other portions of the sections.

To avoid the necessity of using separate pieces of tubing connected by return bends and brazed

joints, the tube 7 may be made in one piece, as shown in Fig. 9. In order to do this, the intermediate plates are made in sections constituting fins 27 mounted individually on each run of the tube 7. To make a heating element of this type, the fins 27 and the steel rings 25 are placed on a straight piece of tubing of suitable length and moved to predetermined positions. The tubing is then bent to form the U-shaped return bends as shown in the drawing, bringing the fins 27 substantially into vertical alignment, or, if desired, the fins may be staggered relative to each other.

After the tube has been bent, the sections 1 may be folded over the groups of fins 27, and the flanges 22 moved under the rings 25 to the position shown in Fig. 4. The tube 7 may then be expanded to lock the parts in position as before explained.

The details of construction of the radiator may be considerably varied without departing from the basic principles of the invention. For example, in Fig. 6 is shown a portion of a radiator having flanges 22b which are not offset but extend outwardly from the plane of the transverse plate 17b. In this construction the rings 25 are exposed and transverse openings 28 are left between adjacent sections. These openings provide additional heating surfaces as they permit air to flow past the outer sides of the transverse plates 17b.

A somewhat similar structure is shown in Fig. 15 in which the outside surfaces of the transverse plates 17c are exposed to the air stream. However, to make the outer surface of the radiator continuous, the plates 17c are bent in or dished in such manner that their outer edges are brought together as shown. This brings the outer faces of adjacent sections into juxtaposition and forms a radiator without transverse exterior openings. The passages enclosed by walls 17c extend from bottom to top of the radiator cabinet, thus forming additional flues about rings 25.

In Fig. 16 is shown a modification in which the flanges 22d are bent inwardly instead of outwardly. The transverse plates 17d are disposed in juxtaposition and a ring 25d is provided for holding the flanges of each transverse plate.

Special end sections 31 may be provided at each end of the radiator as shown in Fig. 4 for enclosing the bends and connections of the tube 7. The end sections are enclosed by smooth end plates 32 that may be pressed into them, and the regulating valve 3 and the trap 4 may be hidden from view by enclosing them within these sections, leaving only the operating handle of the valve 3 exposed.

To improve the heat conductivity across the joints between the tube 7 and the plates 17 and 18, the tube or the flanges of the plates, or both, may be tinned or galvanized and the metal thus deposited on their surfaces may be melted after the radiator is assembled by heating the tube 7 by electric means or otherwise to form a soldered joint therebetween.

The interior walls 17 of the shell member 1 extend all the way from top to bottom inside the cabinet formed thereby. Consequently, in viewing the radiator, one does not see light on the back wall except such as passes through the two grilled openings in each section or shell. That makes a dark interior and adds materially to the pleasing appearance of the radiator as compared to one that is formed from a single outer shell with no partitions inside it.

The attractive exterior appearance is further enhanced by providing an inturned, rounded flange 40, bounding the grilled openings 16. This not only reinforces and stiffens the sheet metal shell about those openings, but gives an appearance of thickness and finish that is quite different from that resulting from merely cutting the openings through the sheets.

From the foregoing description it will be apparent that we have provided simple and effective methods of manufacturing a radiator for use in heating buildings that is compact and efficient in operation, and that may be utilized in systems using high temperature and high pressure steam without danger of the radiator failing to withstand the pressure and without subjecting the occupants of the building to the danger of being burned by the high temperature prime surface of the radiator.

It will be understood that various other modifications may be made, by those skilled in the art, in the particular methods of construction of radiators embodying our invention without departing from the spirit and scope thereof defined in the appended claims.

We claim:

1. The method of making a unitary radiator and cabinet that comprises stamping and shaping from sheet metal a plurality of box-like members having flanged openings, disposing the members with their flanged openings in alignment, fitting rings on the flanges, moving the members into juxtaposition with each ring encircling the flanges of two adjacent members, inserting a fluid conducting tube through the openings and expanding the tube to clamp the flanges between the tube and the rings, thereby uniting the sections to constitute a unitary structure.
2. In radiator construction, the method of fastening a radiation plate to a fluid-conducting tube, comprising the steps of forming a semi-circular flange at the edge of the plate of curvature to fit the exterior of the tube, disposing the flange in engagement with the tube, fitting a ring over the tube and the flange, and expanding the tube to clamp the flange between it and the ring.
3. In radiator construction, the method of attaching two adjoining plates to a tube to form a substantially continuous wall, comprising the steps of forming a semi-circular flanged opening at the edge of each plate, fitting the flanges to the tube with the edges of the plates in abutting relation, fitting a ring over both flanges, and expanding the tube to clamp the flanges between the tube and the ring.
4. In radiator construction, the method of making a double wall partition disposed transversely of a tube, comprising the steps of forming in the edge of each of four plates a semi-circular opening having an offset flange extending normal to the surface of the plate with its edge substantially in the plane of the plate, fitting two of the plates with edges abutting and with the flanges engaging the exterior of the tube, disposing a ring over the flanges, fitting the other two plates to the tube with edges abutting and with the flanges encircling the tube with their edges disposed toward the edges of the flanges on the other plates, sliding the plates along the tube to bring them adjacent to the first plates with the flanges of all four plates under the ring, and expanding the tube to clamp the flanges between it and the ring.
5. The method of making a heating radiator that comprises the steps of cutting and folding

- a plurality of strips of sheet metal to form members of substantially channel shape with flanged openings, at the edges of the channels, folding each member on itself to form a box-like section
- 5 with the flanged openings in alignment to constitute cylindrical passageways, disposing rings to encircle the flanges at adjoining edges of the channel members, inserting a tube through the cylindrical passageways and the rings, and expanding the tube to grip the flanges between it and the rings.
6. The method of making a heating radiator which comprises cutting and folding a plurality of strips of sheet metal to form channel-like
- 15 members having openings with outwardly extending flanges along the edges thereof, folding each member upon itself to form a box-like section with the flanged openings in alignment to constitute cylindrical passageways, disposing rings to encircle said flanges, inserting a tube through the cylindrical passageways and the rings, and then expanding the tube to grip the flanges between it and the rings.
7. The method of making a heating radiator
- 25 which comprises cutting and folding a plurality of strips of sheet metal to form channel-like members having openings with inwardly extending flanges along the edges thereof, folding each member upon itself to form a box-like section with the flanged openings in alignment to constitute cylindrical passageways, disposing rings to encircle said flanges, inserting a tube through the cylindrical passageways and the rings, and then expanding the tube to grip the flanges between
- 35 it and the rings.
8. In radiator construction, the method of fastening a radiation plate to a fluid-conducting tube, comprising the steps of forming an outwardly extending semi-circular flange at the edge
- 40 of the plate of curvature to fit the exterior of the tube, disposing the flange in engagement with the tube, fitting a ring over the tube and the flange, and expanding the tube to clamp the flange between it and the ring.
9. In radiator construction, the method of fastening a radiation plate to a fluid-conducting tube, comprising the steps of forming an inwardly extending semi-circular flange at the edge of the plate of curvature to fit the exterior of the tube, disposing the flange in engagement with the tube, fitting a ring over the tube and the flange, and expanding the tube to clamp the flange between it and the ring.
10. In radiator construction, the method of
- 55 attaching two adjoining plates to a tube to form a substantially continuous wall, comprising the steps of forming a semi-circular opening having an outwardly extending flange at the edge of each plate, fitting the flanges to the tube with the edges of the plates in abutting relation, fitting a ring over both flanges, and expanding the tube to clamp the flanges between the tube and the ring.
11. In radiator construction, the method of attaching two adjoining plates to a tube to form a substantially continuous wall, comprising the steps of forming a semi-circular opening having an inwardly extending flange at the edge of each plate, fitting the flanges to the tube with the edges of the plates in abutting relation, fitting a ring over both flanges, and expanding the tube to clamp the flanges between the tube and the ring.
12. The method of making a heating radiator which comprises cutting and folding a plurality of strips of sheet metal to form channel-like members having semi-circular openings along the edges thereof, folding each member upon itself to form a box-like section with the openings in alignment to constitute circular passageways for a tube to be inserted therethrough, and connecting the adjacent edges of said members.
13. The method of making a heating radiator
- 100 which comprises cutting and folding a plurality of strips of sheet metal to form channel-like members having semi-circular openings along the edges thereof, folding each member upon itself to form a box-like section with the semi-circular
- 105 openings in alignment to form circular openings, inserting a heating element through said openings and securing the abutting edges of said sections to said heating element and to each other.
14. The method of making a radiator having a casing of continuous strips extending vertically on the sides and over the top thereof which comprises the steps of cutting and folding a plurality of strips of sheet metal to form members of substantially channel-shape with flanged openings
- 115 at the edges of the channel, folding each member upon itself to form passageways for a heating element and connecting the abutting edges of said members to engage said heating element.
15. In radiator construction, the method of attaching two adjoining plates to a heating element to form a substantially continuous wall, comprising the steps of forming a semi-circular flanged opening at the edge of each plate, placing the flanges over the heating element with the edges
- 125 of the plate in abutting relation, and connecting adjacent edge portions of said plates to cause said flanges to engage said heating element.
- ARCHIBALD H. DAVIS, JR.
PAXSON WINSBOROUGH.

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