June 17, 1930. R. N. TRANE 1,764,187

RADIATOR

Filed June 21, 1926 2 Sheets-Sheet 1

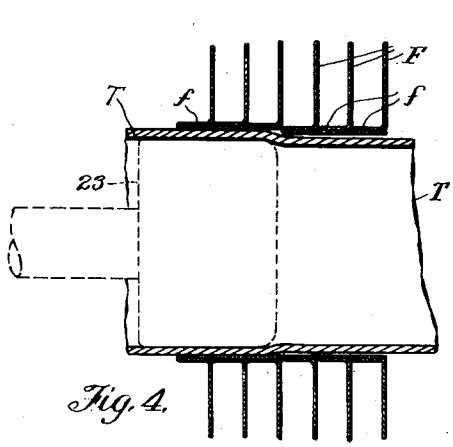


Fig. 4.

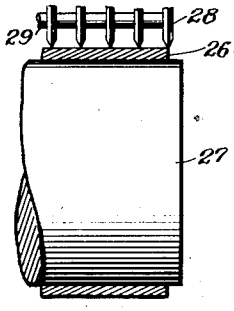


Fig. 11.

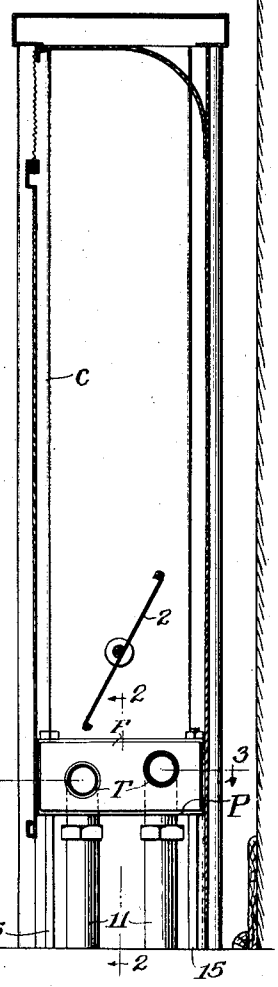


Fig. 1.

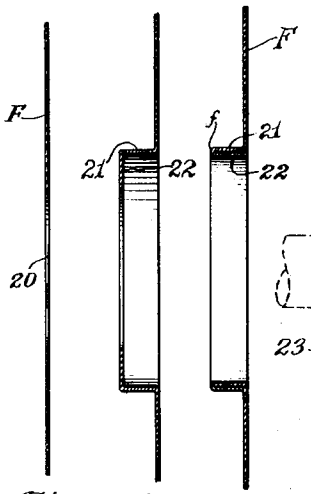


Fig. 5. Fig. 6. Fig. 7.

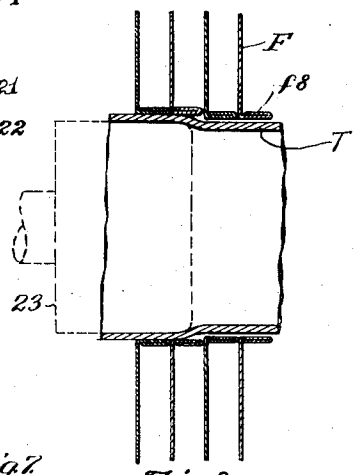


Fig. 8.

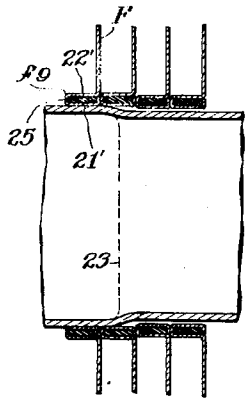


Fig. 9.

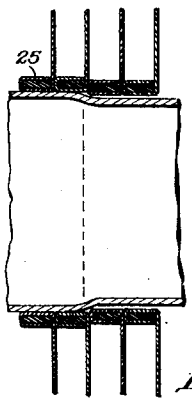


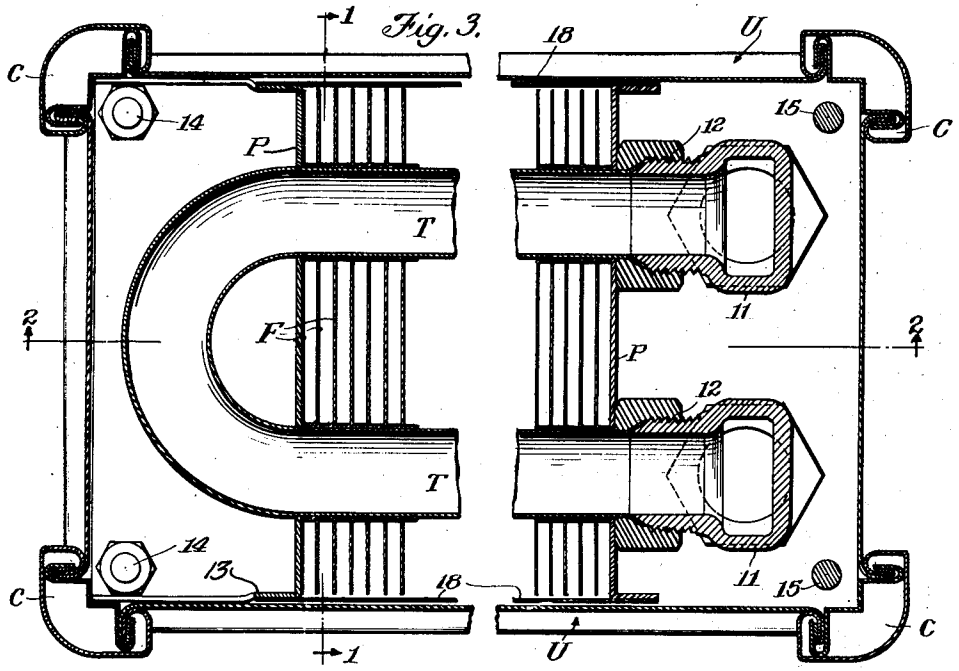
Fig. 10

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RADIATOR

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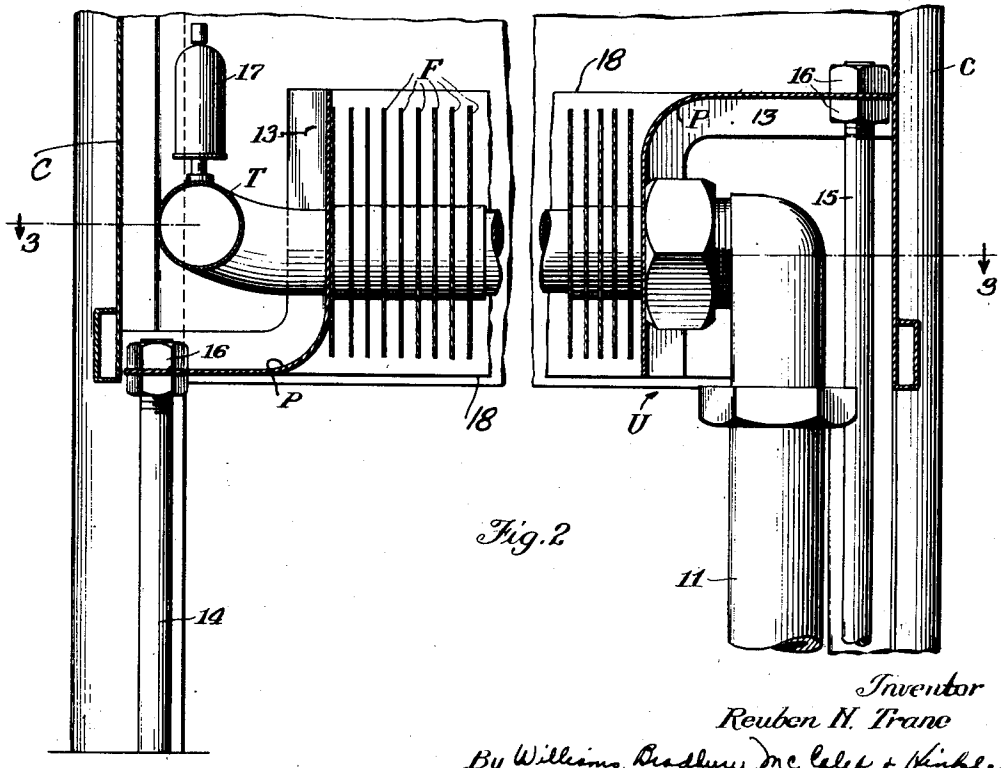


Fig. 2.

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Patented June 17, 1930

1,764,187

UNITED STATES PATENT OFFICE

REUBEN N. TRANE, OF LA CROSSE, WISCONSIN

RADIATOR

Application filed June 21, 1926. Serial No. 117,266.

My invention relates to that type of heating radiator which uses spaced radiating fins mounted on a heat tube, and the object is improved means for effecting good heat conduction contact between the fins and the heat tube.

It is self evident that in a radiator of the type indicated, the heat radiated by any given fin must pass to the fin from the heat tube, and that this passage takes place through an annular region having a circumference only that of the heat tube. The heat flow is most concentrated at the periphery of the heat tube, and for this reason an imperfect contact between the fin and tube, if it restricts the heat conduction, will preclude a utilization of the maximum radiating capacity of the fins themselves.

Instead of providing the fins with annular flanges about the openings through which the heat tubes passed and surrounding these flanges with separate ferrules or rings which held the flanges in firm contact with the tubes, I prefer, in my invention, to make these flanges rebent flanges, and by using a slightly heavier gauge of sheet copper for the fins, I can dispense with the ferrules or rings, for the rebent flanges have sufficient strength to withstand the pressure between them and the tube necessary to maintain a good heat conducting contact. The flange is further strengthened by the rebending of the flange, because the working of the copper gives it a greater stiffness.

While, with the use of the rebent flange alone, the ferrule may be dispensed with and the cost of the radiator decreased by the weight of the copper employed for the ferrules, the fins themselves must be made heavier so that their rebent flanges will have the necessary strength and will not break under the working of the metal in stamping out the flanges.

An additional object of my present invention, therefore, is to arrive at the most economical ratio between the weight of the fin and the weight of the ferrule, if any ferrule is used, taking into consideration also the cost of manufacturing operations.

Another object is to reduce the weight of the fin and also avoid the necessity for sharp rebending of the flanges with the attendant danger of splitting the metal. I accomplish this object by inserting rings of strong metal in annular pockets formed by rebending the annular flanges of the fins. When such reenforcing rings are placed in these annular pockets and completely surrounded by the thin sheet copper metal, there is so little opportunity for them to come in contact with moisture that they may safely be made of steel or iron without undue danger of corrosion, and by thus substituting iron for copper the cost of the radiator may materially be reduced.

A still further object is the provision of an improved end plate and frame construction for the radiator unit.

The foregoing and further objects, features and advantages are set forth in the following description of specific embodiments of my invention and are illustrated in the accompanying drawings thereof in which:

Figure 1 is a transverse vertical section through the radiator unit taken on the line 1—1 of Figures 2 and 3:

Figure 2 is a vertical, longitudinal section taken along the lines 2—2 of Figures 1 and 3.

Figure 3 is a plan section through the radiator taken on the lines 3—3 of Figures 1 and 2;

Figure 4 is an enlarged detail longitudinal section of a heat tube of the radiator unit with the radiating fins mounted thereon illustrating a method of construction;

Figures 5, 6 and 7 are a series of figures showing successive developments of the fin in forming the flange thereon;

Figure 8 is a view similar to Figure 4 but showing a modified form of flange construction;

Figure 9 is a view similar to Figure 4 but showing rebent flanges of the fins encasing iron rings;

Figure 10 is a view similar to Figure 9, but following the flange construction of Figure 8 rather than of Figure 4;

Figure 11 is a diagrammatical illustration of a tool for cutting rings from tubing for use in the devices of Figures 9 and 10;

The radiator unit U comprises in general

a heat tube T bent into a U-shape upon which are mounted a multiplicity of spaced fins F. The free ends of the U-shaped tube T are connected respectively to the inlet and outlet steam pipes 10 and 11 through couplings 12. The first and last fin F each abut an end plate P. The plates P are bent at right angles to form vertical and horizontal portions and at their end edges carry flanges 13. The outer corners of the horizontal flanges support legs in the form of rods 14 and 15 clamped to the plates by nuts 16. The plates are substantially identical, except that one is inverted in respect to the other. Thus the plate at the elbow end of the U-shaped tube T has its horizontal portion lowermost, to provide room for the customary air valve 17. The other plate P which is adjacent the inlet and outlet ends of the tube T has its horizontal portion uppermost so that the steam pipes may be led up to the tube. Necessarily the rods 15 are longer than the rods 14. The object in making the legs for the radiator unit in this manner is that they may readily be separated from the unit so that the latter may be packed in a shipping carton of minimum dimensions.

As shown in Figure 1 and indicated in Figure 2, one leg of the tube T is a little higher than the other leg, so that there will be proper drainage for condensate. The end plates P are held a fixed distance apart and the radiator unit as a whole is strengthened and protected by side plates 18, which extend along the sides of the unit, that is at the ends of the fins F, and are spot-welded or otherwise secured at their ends to the flanges 13 on the plates P. The side plates 18 and the end plates P together form a light but rigid frame for the unit, and, of course, the unit is further strengthened by the U-shaped tube.

In addition to forming attachment means for the rods 14 and 15, which are preferably located at the extreme corners of the radiator unit, the horizontal portions of the plates P serve to block off all air passage within the perimeter of the unit, except between the heat radiating fins F. While the radiator unit per se may be used alone or in connection with any suitable conduit means to increase the speed of the air flow, I prefer to augment the draft by using a cabinet C having four vertical walls which snugly encase the perimeter of my radiator unit, so that all air flow through the cabinet must be past the fins F. The cabinet is open below the radiator unit, and extends preferably to some 24 inches above the top of the radiator unit, whence it is discharged outwardly into the room.

Referring now to Figure 4, I have shown on an enlarged scale a section through a fragment of the heat tube T, together with portions of the fins F mounted thereon. Each fin carries two spaced openings—one for each leg of the U-shaped tube T, as shown in Figure 1. The fins F are provided with rebent flanges *f* about the margins of these heat tube openings. The preferred manner of forming these flanges is shown in Figures 5, 6 and 7. The flat fin F (Figure 5) is provided with a relatively small opening 20. The margin of this opening is depressed outwardly to form a cylindrical flange 21 and a second flange 22 in a plane parallel to that of the fin, as shown in Figure 6. The second flange 22 is then rebent inwardly along the first flange 21 to form the final doubled flange of Figure 7. During this latter operation the first flange 21 remains intact. The advantage of this method of stamping the flanges is that the strain on the metal is minimized for no portion has to be worked more than once.

As is shown in an exaggerated way on the right hand part of Figure 4, these fins F with their rebent flanges *f* are slipped on to the legs of the heat tube T with rather snug, but not necessarily driving fits. The heat tube T is then expanded internally either by hydraulic pressure or a spinning head 23 indicated at Figure 4. This expands the periphery of the heat tube into firm engagement with the rebent flanges *f* of the fins, and holds them permanently under radial expansion. Any variation between the sizes of the tubes is thus, to a large extent, overcome, because the heat tube, when expanded, becomes plastic to the extent that it will fit itself quite perfectly against the flanges *f*.

It is obvious that the flanges *f* must have sufficient strength to withstand the radial force of the expanding of the heat tube T, and also sufficient strength to maintain a contact upon the heat tube. By using a rebent flange, two thicknesses of metal are provided for this purpose, which, of course, gives substantially twice the strength of the single flange. It will be understood also that in the operation of stamping the rebent flanges the copper metal is given a certain amount of temper which adds to its strength and hardness.

When making the fins in this manner, I prefer to use fins made from sheet copper of .010 or .015 inch thickness, so that, even though the external rings or ferrules are omitted, the strength of the rebent flanges *f* will be comparable to that secured with the use of a comparatively light ferrule. However, I contemplate that by properly forming the flanges even lighter sheet copper may be used. As previously pointed out, even though a heavier gauge of copper is used for the fins, a net saving in weight is still had, because the weight of the ferrules is entirely omitted, which, due to the fact that the ferrules had to be struck from fairly heavy metal, makes a considerable saving. On the other hand, the copper sheets must not be too thin or the

metal will tend to break in forming the rebent flanges. From experiments I have found that an economical design, considering all of these factors, is to use .012 to .015 inch thick copper for the fins and a copper heat tube having a shell about .020 inches thick.

In Figure 8 I have shown an alternative method of bending the flanges f^8. Here the inner flange is first formed and then the rebent flange is struck back from it, leaving the margin of the material metal on the outer flange, instead of the inner flange, as in the form of Figure 6. This has the objection that it works the metal somewhat more than the other form shown.

One objection to using ferrules about a plain single flange on the fins is that the ferrules or rings must be made from copper or similar metal which does not tend to rust or corrode, because these parts of the radiator are subjected to more or less moisture, either by leakage from the steam or hot water piping, leakage from a humidifier on the radiator, moisture taken in with cold air from the outside exposure to the rain, etc.—which would rust iron or steel.

On the other hand, there is some objection to making the rebent flanges shown in Figures 4 or 8, in that the sharp rebending of the flange upon itself tends to crack it. I avoid both of these difficulties by the construction of Figure 9, wherein the rebent portions 22′ of the flanges f^9 are not bent back closely upon the primary flanges 21′, but instead are bent around a ring 25. This avoids the necessity for making such a sharp corner in rebending the flange, with the result that, although the metal is given temper by working, there is not the danger of cracking it. If the ring 25 be made from iron or steel, the secondary flange 22′ is brought up into contact with the body of the fin, so that an annular practically sealed pocket is formed, in which the ring 25 is encased.

In Figure 10 I have shown the idea of Figure 9 adapted to the reverse of the rebent flange according to the method of Figure 8.

Figure 11 shows a convenient way of forming the rings 25. Here a tube 26 is mounted on an arbor 27 and engaged by a plurality of cutting wheels or rotary knives 28 arranged on a shaft 29 to cut the tube into rings. When soft iron or copper tubing is used to form the rings 25, the cutters 28 may act merely as knives so that no stock is lost by forming a kerf.

While I have suggested the use of a cheaper material, such as iron, for the ring 25, I contemplate that the rings may be made from copper, for, although more expensive, copper has the advantage of not corroding, and when copper is used for the fins and heat tube, has the same coefficient expansion so that heating of the radiator will have no opportunity to disturb in the slightest degree the firm heat conducting contact between the fin flanges and the heat tube. When using copper rings 25, I prefer to cut them from a tube of copper having a fair amount of temper, so that, although the thickness of the rings 25 be no greater than that of the shell of the heat tube, the rings will be able to withstand an expansion force which is great enough to expand the heat tube itself. Still greater strength for resisting this strain is, obviously, secured by the strength of the rebent flanges.

While securing rigidity for the flanges f by making them integral rebent flanges on the fins, has the advantage of simplicity, in assembly and reduces the number of parts of the radiator, it does have the disadvantage of requiring, in general, a somewhat heavier sheet copper for the fins.

While I have thus described certain specific embodiments of my invention, I contemplate that many other changes may be made therein without departing from the scope or spirit of my invention.

What I claim is:

1. A radiator unit comprising a horizontal heat tube, a plurality of spaced vertical radiating fins mounted thereon, and end plates mounted on the tube adjacent the first and last fins respectively, one horizontal edge of each plate being extended outwardly in a horizontal plane, and vertical supporting legs for the radiator unit detachably secured to the remote corners of the horizontal extensions of the end plates.

2. In a heating unit the combination with a radiator comprising a horizontal heat tube bent into a U-shape, a multiplicity of spaced vertical radiating fins mounted upon the legs of the U-shaped heat tube, an end plate also mounted upon the heat tube at each end of the radiator and adjacent the first and last fins respectively, the end plates having outwardly extending flanges forming horizontal baffles at the regions of the bight of the U-shaped tube and of couplings at the free ends of the tube, legs for the radiator unit supported by the end plates,—of a cabinet for augmenting the air draft through the radiator set over the radiator, the outer margins of the end plates abutting the end walls of the cabinet to confine the air flow therethrough to the region of the fins.

3. As an article of manufacture an end plate for a radiator of the type described comprising a vertical portion apertured to receive a heat tube, and an integrally formed horizontal portion extending from a horizontal edge thereof and provided at its outer corners with means for supporting legs for the radiator unit.

4. In a fin type radiator the combination of a heat tube of ductile metal, a multiplicity of heat radiating fins mounted thereon in spaced relation, the fins being formed respec-

tively of integral thin sheets of ductile metal and each having a heat tube opening with a rebent marginal flange comprising an inner cylindrical portion in direct contact with the periphery of the tube and an outer cylindrical portion in contact with the periphery of the inner cylindrical portion and longitudinally coextensive therewith, the fins being mounted on the heat tube with their flange portions set end to end and in juxtaposition, the heat tube and the flange portions being maintained in radial tension by the heat tube being pressed into firm uniform heat conducting contact with the inner cylindrical portion, and said inner portion in turn with the outer cylindrical portion, and the bore of the tube is left of uniform cross section.

In witness whereof, I hereunto subscribe my name this 16th day of June, 1926.

REUBEN N. TRANE.