March 24, 1931. R. N. TRANE 1,797,535

RADIATOR

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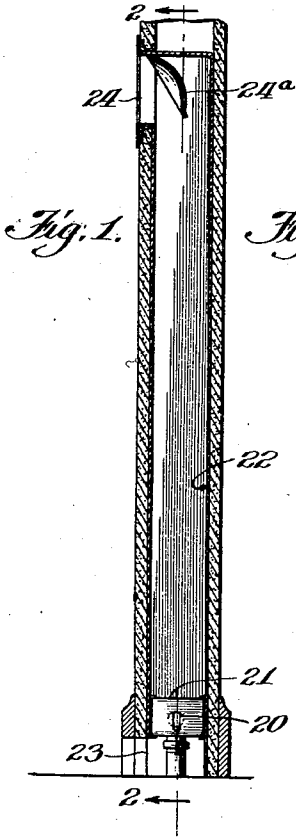


Fig. 1.

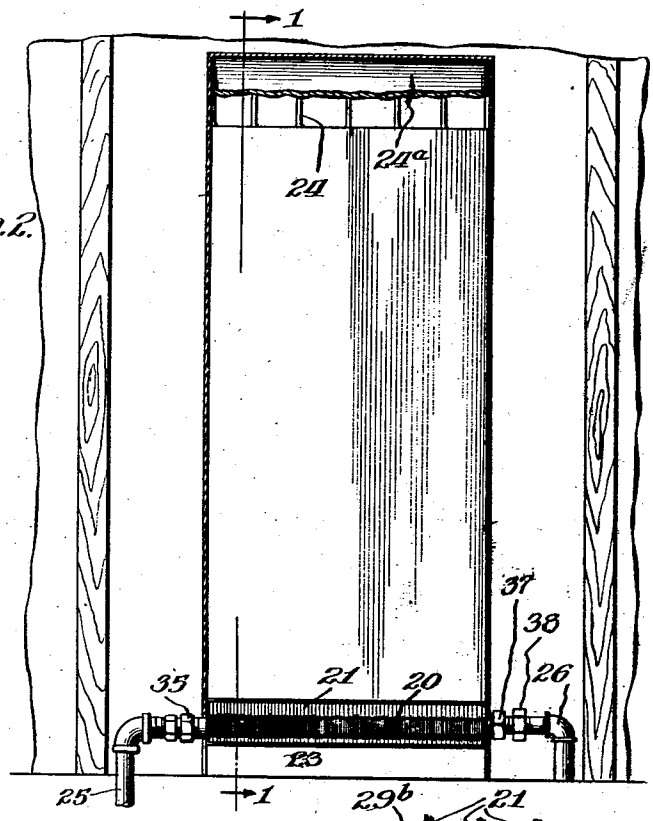


Fig. 2.

Fig. 8

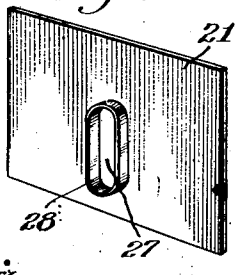


Fig. 11. [MODIFICATION]

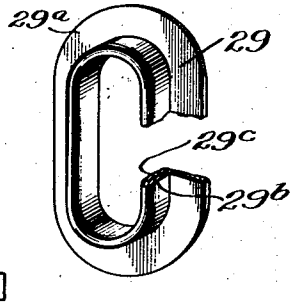


Fig. 9.

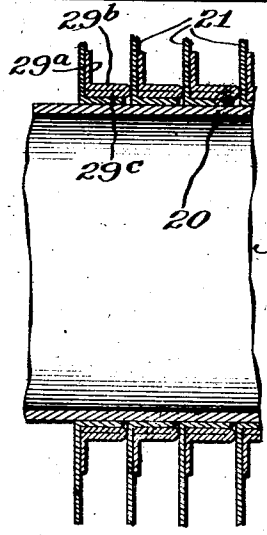
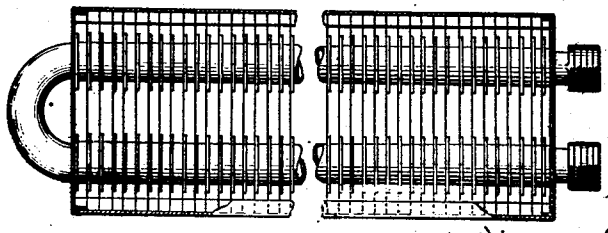


Fig. 10.



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Fig. 3.

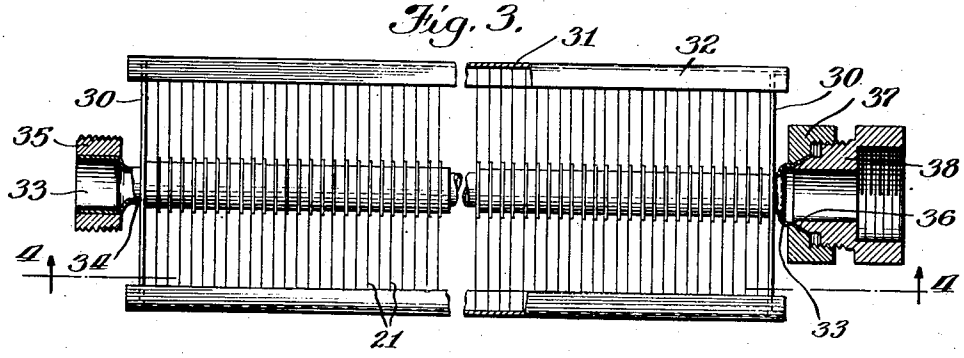


Fig. 4.

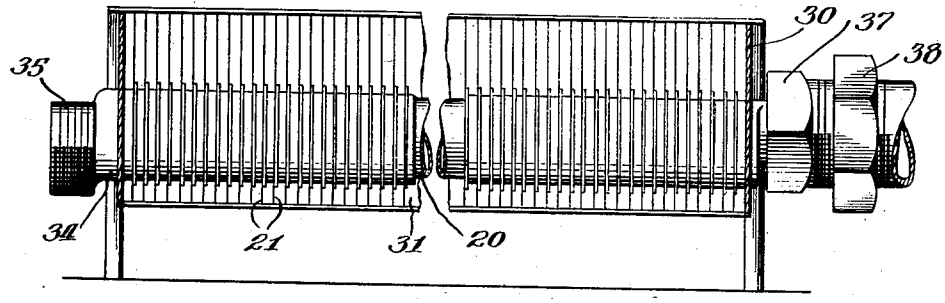


Fig. 7.

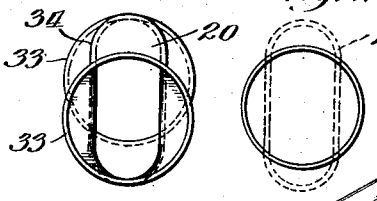


Fig. 6.

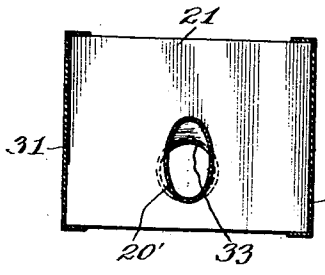


Fig. 12. [MODIFICATION]

Fig. 5.

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UNITED STATES PATENT OFFICE

REUBEN N. TRANE, OF LA CROSSE, WISCONSIN

RADIATOR

Application filed January 14, 1928. Serial No. 246,705.

My invention relates to radiators of the fin type wherein a multiplicity of spaced fins are mounted on a heat tube through which passes steam, vapor, hot water or other heating medium. Such radiators are intended primarily for use with blowers or other forced draft, or for use in stacks set within the walls of dwellings and buildings, or in cabinet-like stacks set out in the room to be heated.

The present application constitutes an improvement over the structure disclosed in my prior application Serial No. 104,196, filed April 23, 1926. In the former application the radiator units were specifically illustrated with the spaced heat radiating fins mounted on heat tubes of circular cross section, although an oval or elliptical modification was suggested in my prior application. The advantages of an oval tube construction are that where one is limited for width, the same area may be preserved for the tube and still the tube take up less space in the longitudinal sectional area of the unit, thereby obtaining the same space for air passage in a lesser overall width.

One of the objects of my present invention is the securing of a good heat conducting contact between the spaced radiating fins and a tube of oval cross section on which they are mounted.

Another and equally important object is a simple and economical provision for connecting the ends of the oval tubes with the usual circular pipe fittings. This I preferably accomplish by mounting the spaced fins on a length of oval tubing, and then deforming the ends of the tube into circular cross sections which can readily be connected, by any of the several usual methods, to circular pipe fittings. The economy of the radiator unit of my present invention lies in the elimination of the necessity of expensive or special fittings to adapt the end of an oval tube to the pipe connections standard in the heating trade, also in the lessened width of the unit with the consequential lessening of the amount of copper sheeting required.

Another feature of my invention is the provision for eliminating pockets in the tubes. It is naturally desirable that the sectional area of the rounded ends be approximately the same as the sectional area of the oval portion of the tube. This would make the vertical diameter of the oval portion greater than that of the rounded ends. The difference in these vertical diameters would ordinarily cause pockets—pockets which would trap air in the case of a hot water system, or condensate in the case of a steam system. I eliminate such traps or pockets preferably by arranging the uppermost (or lowermost) portion of the inner circumference of the circular ends at substantially the same horizontal plane as the uppermost (or lowermost, respectively) portion of the inner circumference of the oval part of the tube. If the top and bottom of the radiator unit are otherwise the same, these points of tangency between the circular ends and the oval intermediate portions of the tube, may be uppermost at both ends, or lowermost at both ends. Then when the unit is installed, the workman can, in the case of hot water, install the unit with the two points of tangency uppermost and the opposed pocket lowermost, or in the case of steam, with the two points of tangency lowermost and the opposed pocket uppermost.

But, especially where there is some additional reason why one side of the unit should always come uppermost, I prefer to form the tube with the point of tangency uppermost at one end and lowermost at the other end, so that each of the resulting upper and lower pockets is open at one end or the other. The workman has then only to turn the unit end for end if necessary to bring the open ended upper pocket to the inlet or outlet pipe connection, depending on whether it be a steam or hot water system.

An additional feature of my invention is the placing of the heat tube farther toward the anterior than the posterior edge of the radiating fins whereby a greater heating capacity is possible in proportion to the square inches of sheet copper per fin.

The foregoing, together with other objects, features and advantages of my invention, are set forth in the description which follows, wherein I refer to the accompanying drawings in which;

Fig. 1 is a cross section through a partition wall of a dwelling showing an exemplary installation of my radiator unit;

Fig. 2 is a vertical longitudinal cross section through the wall taken on the line 2—2 of Fig. 1;

Fig. 3 is a plan view of the unit shown in Fig. 2, but without the stack;

Fig. 4 is a vertical elevation of the radiator unit per se shown in Fig. 3 and taken on the line 4—4 thereof;

Fig. 5 is a perspective view of the oval heat tube after its ends have been deformed into circular section but with the fins and ferrules removed;

Fig. 6 is an end elevation of the tube with the circular ends, which may be considered as taken on line 6—6 of Fig. 5;

Fig. 7 is an end view of a round tube indicating how the oval tube may initially be formed therefrom;

Fig. 8 is a perspective view of one of the radiating fins showing the integral flange for surface engagement with the oval heat tube;

Fig. 9 is a perspective view of one of the ferrules used to hold the flange of the fin in heat conducting surface contact with the oval tube, the ferrule being broken into section to show its construction;

Fig. 10 is an enlarged and somewhat exaggerated detail showing the arrangement of the parts for obtaining heat conducting contact between the fins and the tube;

Fig. 11 is a plan view somewhat similar to Fig. 3 but showing a modification where the heat tube is rebent into a U-shape whereby each radiating fin is in effect mounted upon a pair of heat tubes; and

Fig. 12 is a transverse section through my radiator unit showing a modification wherein the heat tube has arched lateral walls and is more truly elliptical in section.

Referring to Figs. 1 and 2—as typical examples of the installation of my radiator unit—my radiator unit comprises a horizontal tube 20 of oval cross section on which are mounted a multiplicity of spaced heat radiating fins 21 secured on the tube in heat conducting contact therewith. This unit is near the lower end of a vertically extending sheet metal stack 22 which is mounted intermediate the studding and between the plaster of a conventional partition wall. The stack 22, plaster, and base-board are cut away substantially the length of the radiator unit along the floor and at one side to form a cold air intake opening 23 to the stack. The upper end of the stack is provided with a suitable grill 24 closed by an adjustable damper 24*a* and forming a hot air outlet. At its respective ends the heat tube 20 communicates with the usual inlet and outlet pipes 25 and 26 for conveying the heating medium which may be hot water, steam or vapor. The shut-off valves for the heating fluid, the radiator traps, and the like, are preferably located at a convenient point below the floor, thereby avoiding the necessity of an access panel which would otherwise be advisable were these valves placed immediately adjacent the radiator unit. It will be understood that the cold air is taken from the lower strata on the floor through the opening 23, between the fins 21 upwardly through the stack 22 and out through the discharge grill 24. The heat supplied to the room may easily be controlled by the damper 25 without the necessity of controlling the admission of heating fluid to the tube 20.

In the manufacture of my radiator unit here shown, I use a length of oval tubing 20 of thin copper or other ductile metal similar to the tube shown in Fig. 5 except that the ends are not circularly conformed. The oval tube may conveniently be formed from an initially round tube as suggested by Fig. 7. I mount a multiplicity of transversely arranged heat radiating fins in spaced relation upon the oval tube. Each fin 21 comprises a rectangular sheet—preferably of copper .005 to .010 inches thick. A central oval opening 27 is stamped therein with an offset inner marginal flange 28 formed integrally from the plane of the fin. The inner dimensions and conformation of the marginal flange 28 are such that the flange fits upon the exterior of the oval tube but not necessarily with a very snug fit. A suitable ferrule 29 is placed about each fin flange 28. For economy I prefer to stamp the ferrules 29 from sheet metal. As shown in Figs. 9 and 10 each ferrule comprises an annular disk portion 29*a*, a forwardly bent transverse flange 29*b* and a rearwardly rebent flange portion 29*c* folded back upon the flange 29*b*, thereby giving an offset flange of double thickness. If the transverse width of the ferrule 29*c* be made greater than the transversely offset width of the flange 28 of the fin 21, the ferrule will constitute a spacer and prevent any end strain on the flanges 28 which might tend to buckle them. The ferrules 29, of course, are ovally conformed to mate the flanges 28 over which they fit.

While any of the various expedients suggested in my former application may be used to pinch the tube, flanges 28 and ferrules 29 together radially of the tube, I prefer to do this in the present instance by an oval expanding tool passed through the tube 20 after the fins and ferrules are assembled thereon. I contemplate also that the flanges 28 struck from the fins may be so arranged by rebending as to sufficiently strengthen the flanges to make it feasible to omit the separate ferrules, as shown and claimed in my co-pending application Serial No. 117,266, filed June 21, 1926.

Relatively heavy end plates 30 are mounted adjacent the first and last fin on the oval

tube, and the lateral edges of these end plates 30 are joined by laterally extending shallow channel members 31 having horizontally offset flanges 32 which protect the corners of the fins. The assembled fins are thus protected by a frame or casing which envelopes all sides save the top and bottom.

After the assembled fins and ferrules and end plates have been secured in position, I deform the protruding ends of the oval tube 20 into cylindrically conformed portions 33. This may be done either by a spinning process or a stamping process; in practice I prefer the latter. The diameter of the cylindrical end portion thus formed is preferably such that its cross sectional area is substantially equal to that of the oval portion, and the interconnecting neck portion 34 is so formed as not to be restrictive. Any suitable arrangement of pipe fittings may be used to connect the cylindrical portions of the tube with the supply pipes. Preferably I employ an externally threaded brass bushing 35 secured on the cylindrical portion 33 at one end of the heat tube. At the other end of the tube I preferably bell the outer end of the cylindrical portion as indicated at 36 and use a standard tube connection comprising a tube nut 37 having a seat for the belled end 36 of the cylindrical portion of the tube, and a gland member 38 which threads into the tube nut 37 and seals against the belled end 36 of the tube. The outer end of the gland 38 may carry internal threads for the reception of a standard union or other fitting.

I contemplate that an alternative method of securing these circular ends of the heat tube of circular fittings would be by brazing, soldering or the like.

Where a greater width is permitted for the radiator unit, I prefer to use a double length heat tube in which the length of oval tube is bent through 180 degrees at its midpoint as shown in Fig. 11 and the two ends—which then come adjacent and at the same end of the radiator—are cylindrically conformed. This permits each fin to be penetrated by and mounted upon both legs of the U-shaped heat tube.

When the oval tube is so mounted that its long diameter extends vertically—as for example in the installations illustrated in Figs. 1 and 2—a concentric arrangement of the medial axes of the oval and cylindrical portions of the tube would leave a pocket at the bottom of the oval portion from which water would not readily drain and would also leave a similar pocket at the top of the oval portion which would entrap air. To avoid this situation I form the cylindrical portion at one end (the left, Fig. 5) somewhat eccentric to the oval portion so that the bottom of the cylinder comes tangent with the bottom of the oval. This eliminates one end of what would otherwise be a water pocket at the bottom. In a steam heating system the unit should be so installed that the steam flows from right to left (Fig. 5) so that all the condensate could readily be drained. At the other end (the right, Fig. 5) the axis of the circular end portion of the tube is offset above the medial axis of the oval tube so that the point of tangency comes on the top of the oval. This eliminates the end wall of what would otherwise be an air pocket at the top of the oval tube. In a hot water heating system the radiator unit should be so installed that the hot water flows from left to right (Fig. 5) so that air is led to an air relief beyond the end of the tube. This feature is especially valuable when the design of the radiator unit is such that it cannot be inverted, as, for example, in a design such as here shown where the tube is disposed toward the bottom edge of the fins.

The specific oval cross section of the tube which I have illustrated in Figs. 5, 6, 7 and 8 is one where the top and bottom ends are semi-circles connected by straight sides. This has the advantage of easier manufacture. I contemplate, however, that other cross sections, which may also be described generally as ovals, might be used, such, for example, as the strictly elliptical cross section illustrated in Fig. 12. An elliptical cross section would have the advantage that its sides also are arched so that the tube at the lateral sides has less tendency to buckle inwardly and relieve its pressure on the flanges 28 against the ferrules 29. Another alternative would be to form the tube with concave lateral sides, giving it a sort of dumb-bell shaped cross section.

As a practical manufacturing proposition, I prefer initially to start with a round tube, as indicated in Fig. 7, deform the entire length thereof into oval section, as indicated in dotted lines, and then after the assembly of the fins, return the ends of the length of tubing to circular section. I contemplate that as an alternative, a length of round tubing may be used, the circular ends preserved in their original form, but the intermediate portion of the tube deformed into the desired oval section.

The feature of locating the heat tube opening 27 and its marginal flange 28 nearer the anterior edge than the posterior edge of the fin—as confirmed by tests and experiments I have made—results in a greater capacity for the radiator in proportion to the area of the fins. This is because the cold air coming into the radiator unit receives heat so rapidly from the anterior edge of the tube that a given temperature cannot effectively be maintained so far out from the tube toward the anterior edge as can be maintained the same distance out from the tube toward the posterior edge where the heat gradient is less

because of the increased temperature of the air.

While I have described my invention as embodied in the specific form shown and described and have suggested only the specific alternatives, I contemplate that many changes may be made without departing from the scope or spirit of my invention.

I claim:

1. A radiator comprising a heat tube of oval cross section, and a plurality of spaced heat radiating fins mounted thereon, each fin comprising an integral flange encircled by a reinforcing ferrule between which and the wall of the tube, the flange is pinched into heat conducting contact, the lateral sides of the oval tubing being convex to arch it against buckling.

2. A radiator comprising a length of oval tubing bent into a U-shape with parallel legs, a plurality of heat radiating fins mounted on said parallel legs, integrally formed flanges on said fins held under compression in heat conducting contact with said legs, the adjacent ends of the tube being integrally formed from the oval section but being of circular section for the reception of circular fittings.

3. A radiator comprising a heat tube of oval cross section, a multiplicity of radiating fins mounted transversely thereon in spaced relation, integral flanges on said fins held in heat conducting contact with said tube, and integral circularly formed end portions on said tube, the axes of the circular portions being vertically offset relative to the medial axis of the oval portion to bring the uppermost edge of the circular portion in substantial alignment with the uppermost edge of the oval portion at one end, and at the other end to bring the lowermost edge of the circular portion in substantial alignment with the lowermost edge of the oval portion, for the purpose specified.

4. A radiator unit comprising a heat tube of oval cross section, a plurality of radiating fins mounted transversely thereon in spaced relation, flanges on said fins held in heat conducting contact with said tube under radial compression, the lateral walls of the oval tube being arched to resist the collapsing of the lateral walls inwardly and away from said flanges.

5. A radiator comprising heat exchange means, a multiplicity of rectangular heat radiating fins mounted thereon in spaced relation and penetrated thereby, plates extending along the lateral edges of said fins for protecting the same and confining air passing therebetween, said heat exchange means being nearer the anterior edges of the fins with respect to the direction of air flow therethrough than the posterior edges.

6. A radiator comprising heat exchange means, a multiplicity of rectangular heat radiating fins mounted thereon in spaced relation to each other, the posterior portion of the fins with respect to the direction of air flow between the fins, having greater radiating area than the anterior portion and end plates and side plates forming air confining means about said fins.

7. A radiator comprising heat exchange means, a multiplicity of rectangular heat radiating fins mounted thereon in spaced relation to each other, said fins being wider laterally than vertically, the distance traversed by air passing between said fins being less from the entrance edge of the fins to the near side of the heat exchange means than from the far side of the heat exchange means to the discharge edge, and channel parts forming confining walls along the lateral edges of said fins.

In witness whereof, I hereunto subscribe my name this 9th day of January, 1928.

REUBEN N. TRANE.