

July 5, 1932.

R. V. FROST

1,865,511

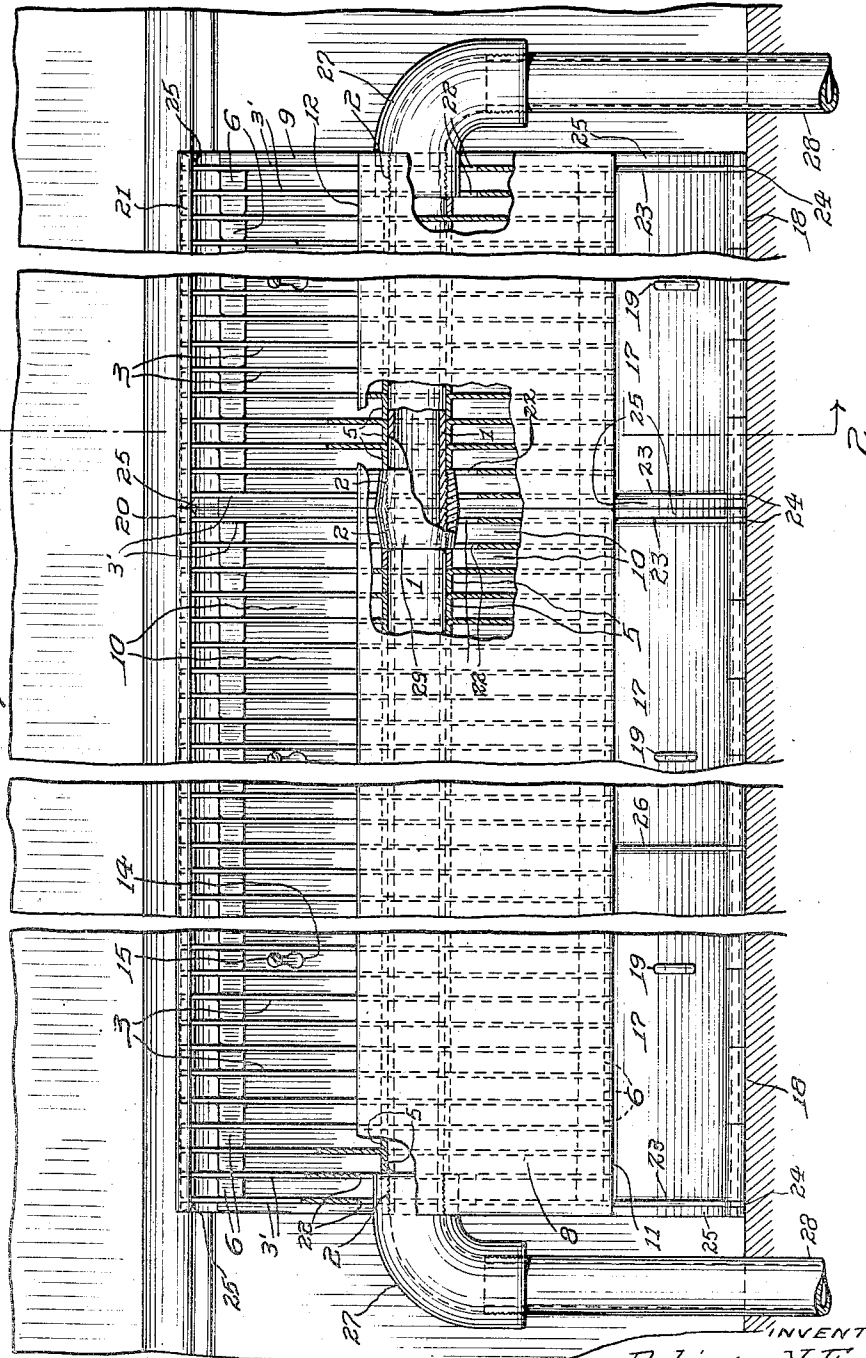
RADIATOR

Filed Aug. 3, 1928

2 Sheets-Sheet 1

Fig. 1.

2



WITNESS

H. J. Hartman,

BY

INVENTOR
Robinson V. Frost.
John W. Myers
ATTORNEY

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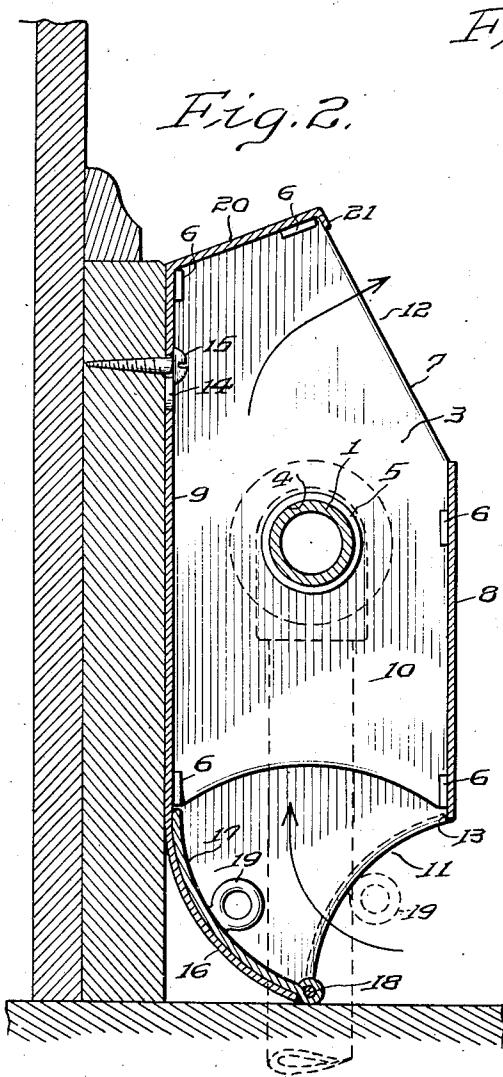
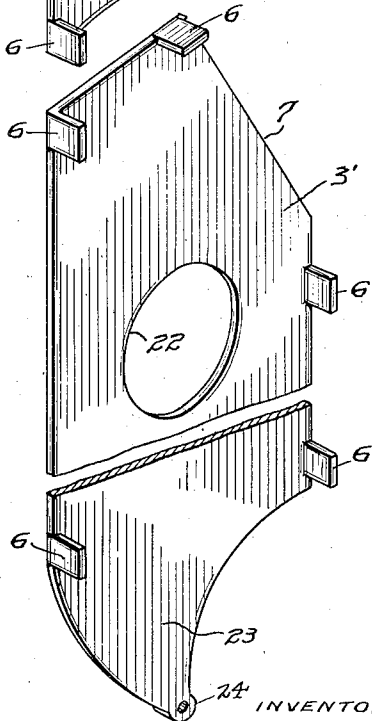
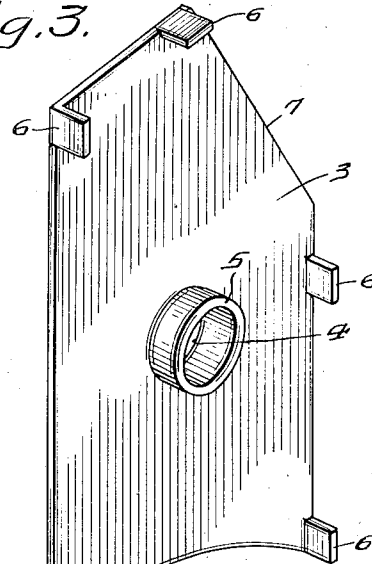


Fig. 3.



WITNESS
F. J. Hartman.

INVENTOR
Robinson V. Frost.
BY *John D. Myers*
ATTORNEY

UNITED STATES PATENT OFFICE

ROBINSON V. FROST, OF NORRISTOWN, PENNSYLVANIA, ASSIGNOR TO FROST RESEARCH
LABORATORY, INC., A CORPORATION OF PENNSYLVANIA

RADIATOR

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The present invention relates to heat exchange apparatus and particularly to an improved radiator for direct heating of rooms, of that type comprising a primary surface in the form of a pipe or other conduit for the circulation of a fluid heating medium, such as steam, and a secondary surface consisting of a series of diathermic fins mounted on the primary surface to conduct the heat therefrom and give it off rapidly to the air to maintain the room at the desired temperature.

The primary object of the invention is to provide an improved radiator of this character which has a high thermal efficiency both when rated in equivalent square feet and in heating effect, and which at the same time is compact in structure, occupies a minimum amount of space in the room, and comprises a minimum amount of material so as to be light in weight and inexpensive both in initial cost and in cost of operation.

Another object of the invention is to provide a radiator of this type having a casing which encloses the primary and secondary surfaces and coacts with the latter to form a series of separate, upwardly extending air-passages leading through the radiator from the inlet adjacent the bottom to the outlet adjacent the top thereof, which is rigidly secured to the secondary surface or fins and ties the same together to provide a strong, unitary structure, and which also serves both as a guard for the radiator and to support the same in proper position on the floor and against a wall of the room.

Another object of the invention is to provide one or more dampers extending along the bottom of the casing and movable across the inlet thereof and across the lower ends of the fins to control the flow of air from the room through the air-passages between the fins, to regulate effectively the heat transfer to the air of the room without the use of valves in the pipe or conduit for the fluid heating medium, the dampers being radially accessible for operation and yet at all times out of the way and substantially hidden from view, and serving in open position as deflectors to direct the air entering the radiator

at the floor level—where it is coldest—upwardly into the air-passages, and in closed position to prevent the circulation of air through the radiator and hence arrest its heating effect.

Another object of the invention is to provide a casing having the back thereof extended downwardly and forwardly underneath the fins to form a base or foot which is adapted to rest on the floor to assist in supporting and leveling the radiator, which provides a pivotal support for the air-controlling damper or dampers so that they are mounted as part of the unitary structure, and which also forms a closure extending across and sealing the angle or corner at the juncture of the floor and the wall to prevent the accumulation of dirt and dust therein and the carrying of such dirt and dust upwardly through the air-passages and its delivery with the heated air into the room.

A further object of the invention is to provide a casing having its back extended upwardly and forwardly to form an inclined top which overhangs the air-passages and constitutes a deflector or hood to direct the currents of heated air upwardly and outwardly into the room to effect a wider circulation and distribution of the heat in the zone of occupancy of the room and thereby increase the heating effect of the radiator, the top bearing upon and being supported by the upper ends of the fins and serving as a cover when the radiator is set back of the plaster line of the wall.

A further object of the invention is to provide a base-board radiator (that is, a radiator of substantially the height of the usual base-board of a room wall and adapted to be attached directly thereto), which delivers the heated air to the room at low level close to the floor-line, whereby to increase the heating effect and thereby obtain the maximum comfort in the room and at the same time effect a substantial economy in fuel consumption.

A further object is to provide a base-board radiator which is of narrow depth from front to rear, which when attached to the base-board will not occupy valuable room space, offer an obstruction to furniture nor obtrude

into the decorative scheme of the room, and which requires no special wall construction to accommodate it, although it may be installed, if desired, directly against the plaster or even back of the plaster line against the studding and the plaster carried down on the top cover, thus eliminating the base-board and causing the radiator to serve as a substitute therefor.

- 10 A still further object of the invention is to provide an improved radiator which may be efficiently assembled to provide not only a strong, durable and unitary structure, but also a metallic union between the parts which will insure a maximum heat conductivity.

15 With these and other objects in view, the invention comprises the features of construction, combinations of elements and arrangements of parts which will be exemplified in the apparatus hereinafter set forth.

Referring to the accompanying drawings, in which similar reference numerals indicate similar parts throughout the several views:—

- 25 Figure 1 is a front elevation, partly broken away, illustrating the installation of one embodiment of my improved radiator consisting of two radiator units;

Figure 2 is a transverse section on the line 2—2 of Figure 1, the arrows indicating the direction of the flow of the air currents through the radiator;

Figure 3 is a perspective view of one of the diathermic fins; and

- 35 Figure 4 is a similar view of one of the dummy fins.

My improved radiator is made in units or sections of standard lengths, say of one, two or three feet, which may be installed singly or any two or more of which may be coupled together to provide a continuous radiator of appropriate capacity for the room to be heated. The units or sections are substantially identical, although in connection with their differences in length they may differ in particulars hereinafter pointed out. According to the present embodiment of the invention each unit is constructed as follows:

There is a primary surface in the form of a horizontal pipe or conduit 1 for the fluid heating medium, which extends substantially centrally and longitudinally the full length of the unit with its ends preferably terminating flush therewith, the diameter of the pipe being relatively small so as not unduly to restrict or choke the air-passages, hereinafter referred to, through the radiator, but, on the other hand, being sufficiently large to permit the free flow of the heating medium so as to obtain a high thermal capacity, preferably at a low pressure. The ends of the pipe are externally screw threaded, as indicated at 2.

Mounted on the pipe between the threaded ends thereof is a series of diathermic fins 3, which are disposed vertically in parallel,

spaced relation to each other and constitute the secondary surface of the radiator. The fins are preferably stamped from or otherwise formed of relatively thin sheet-metal, such as black iron sheet, and are all of similar size, contour and construction, except as hereinafter noted.

Each fin is formed with a substantially central opening 4 around which is struck up a collar 5 that projects laterally from one face of the fin, is slipped over and fits tightly around the pipe 1 and is permanently and rigidly secured thereon in a suitable manner to provide a metallic union between the parts that afford a high degree heat conductivity and a free and unobstructed flow of heat from the primary to the secondary surface. At suitable intervals around its perimeter the fin is formed with marginal spacing-lugs 6 which are bent angularly to project laterally from the same face of the fin as the collar 5. The collar 5 and the lugs 6 are of equal length with their free ends terminating in the same plane and abutting against the next adjacent fin in the series, whereby to maintain a suitable spacing therebetween and insure uniformity in spacing throughout the series.

The fin is elongated vertically and has its side, or front and rear, edges parallel and disposed in vertical planes. The lower edge of the fin is concave and curved between the points where it joins the front and back edges, on an arc centered below the fin and preferably on the center or median line thereof. The rear edge extends upwardly above the height of the front edge while the upper edge or top of the fin is inclined upwardly and forwardly from its juncture with the rear edge, to the apex of the fin that is preferably located on the center or median line above referred to. Between its apex and its front edge the fin is mitered, as indicated at 7, the mitered edge forming an obtuse angle with the front edge, which is somewhat greater than the obtuse angle that the upper edge forms with the rear edge.

The pipe 1 and the series of fins 3 are enclosed by a casing forming a guard for the radiator and consisting of front and back plates, designated 8 and 9, respectively, which are formed of suitable sheet-metal, such as black iron sheet, extend longitudinally the full length of the unit, and are separately secured to the respective fins to tie the same together and thus provide a strong, unitary structure. The front and back plates coact with the fins to form a series of separate air-passages 10 extending upwardly therebetween and leading through the radiator from an air inlet opening 11 adjacent the bottom to an air outlet opening 12 adjacent the top of the casing. By this arrangement the dissipation of the air-currents circulating through the radiator is prevented

and they are confined between and in effective contact with the diathermic fins, whereby to insure the maximum heat transfer to the air therefrom.

5 The front plate 8 abuts against the front edges of the series of fins 3 and is rigidly and permanently secured in a suitable manner to the spacing-lugs 6 located at such edges, the plate being coextensive vertically with the
10 front edges of the fins, except that it projects slightly downwardly below the same to provide a rearwardly facing shoulder or abutment 13.

15 The back plate 9 is similarly secured against the rear edges of the fins and to the corresponding spacing-lugs 6, and is provided with suitable means for fastening the unit against the wall of the room, such as, one or more key-hole slots 14 permitting the back
20 plate to be engaged with the heads of screws 15 or the like driven into the base-board or the wall.

25 The back plate is extended downwardly and forwardly underneath the fins in a generally inclined direction but preferably on a curve to form a foot or base 16 which is adapted to rest upon the floor of the room to assist in supporting and leveling the radiator. The foot also forms a closure for extending across
30 and sealing the angle or corner at the juncture of the floor and the wall to prevent the accumulation of dirt and dust therein and the carrying of such dirt and dust upwardly through the air-passages and its delivery
35 with the heated air into the room. The lower edge portion of the foot, which bears upon the floor, is disposed on the center or median lines of the fins and on the centers of the arcuate lower edges thereof. There is a space
40 between the lower edge portion of the foot and the lower edge of the front plate 8, forming the inlet opening 11 which is elongated and extends the full length of the casing for admitting the air thereto at the floor level
45 where the air of the room is the coldest.

50 The foot also serves to support one or more dampers 17 for controlling the inlet opening 11 and thus the circulation of air from the room through the air passages 10, so that the heat transfer to the air and the heating effect of the radiator may be conveniently and effectively regulated without the use of valves in the pipe 1. Each damper is pivoted
55 along its lower edge to the lower edge of the foot, as for instance, by a continuous "piano" hinge 18, and is thereby mounted as part of the unitary structure. In closed position the damper is inclined forwardly and extends across the inlet opening with its upper edge
60 bearing against the shoulder or abutment 13, which thus serves as a stop to support it in such position. The damper is preferably curved or dished between its upper and lower edges and is mounted with its concave face
65 forward so that even in the closed position

thereof the damper is out of the way and substantially hidden from view. In open position the damper is inclined rearwardly and rests against and is supported by the foot 16, and serves as a deflector to direct the air entering the inlet opening 11 upwardly into the air-passages 10. The damper and the foot are similarly curved to permit the former to fit snugly within and against the latter in this position. Because of its pivotal mounting the damper may be freely swung from one position to the other, the upper or free edge of the damper sweeping across the arcuate lower edges of the fins during this movement by virtue of the pivot being located on the centers of such arcs. Any suitable means may be employed for operating the damper, such as, for instance, a knob 19 of of ring form provided on the front face thereof and readily accessible at all times for the convenient manipulation of the damper.

70 The back plate is also extended upwardly and forwardly over the fins to form an inclined top 20 for the casing, which projects over the air-passages 10 and constitutes a deflector or hood for directing the currents of heated air ascending therein, through the outlet opening 12 and forwardly and upwardly into the room, whereby to effect a wider circulation and distribution of heat in the zone of occupancy of the room and thereby increase the heating effect of the radiator, as well as to protect the surface of the wall of the room above the radiator from discoloration or other damage. The top further serves as a cover when the radiator is set back of the plaster line of the wall.

75 The top 20 extends forwardly to the apexes of the fins, and bears upon and is supported by the upper edges of the fins, being rigidly secured to the spacing lugs 6 provided at such edges, preferably adjacent to the said apexes. Along its front edge the top 20 is formed with a narrow, depending flange 21 which slightly overlaps the mitered edges 7 of the fins both to strengthen the structure and to hide the spacing lugs 6 just above mentioned and provide a finish.

80 The front edge of the top 20 and the upper edge of the front plate 8 are spaced apart to form the outlet opening 12 which is elongated and disposed longitudinally throughout the entire length of the casing. The mitered edges 7 of the fins extend across the opening 12 and are preferably located in the plane thereof. By having the fins mitered adjacent the opening 12 their superficial area is reduced at the delivery end of the air-passages 10, and thus the friction and drag on the air is reduced adjacent the deflector and at the point where the heated air-currents issue into the room.

85 It will be noted that in the present embodiment of the invention the inlet and outlet openings 11 and 12 lie in inclined planes

which converge forwardly in front of the radiator, and that this arrangement together with the bevelling of the fins, is desirable in keeping the radiator compact and in improving its appearance.

At each end of the radiator unit I provide one or more dummy fins 3', which are spaced similarly to the series of diathermic fins 3, so that the continuity of the series of fins as exposed to view through the outlet opening 12 is apparently unbroken and extends from end to end of the unit. These dummy fins are substantially identical with the diathermic fins, except as hereinafter noted, and are provided with marginal spacing-lugs 6 which are secured to the front and back plates 8 and 9 and to the top 20, to support the dummy fins in position as part of the unitary structure. The dummy fins have central openings 22 that are of somewhat larger diameter than the pipe 1, so that the latter passes freely therethrough out of thermal contact therewith and such fins encircle the threaded ends of the pipe in spaced relation thereto.

The extreme dummy fins at each end of the unit are formed with downward extensions 23 which close the ends of space or chamber in which the damper or dampers 17 operate. The rear edge of each such extension conforms to and fits snugly against the front surface of the foot 16, so that the extension serves to brace the foot and re-enforces it against strain. The front edge of the extension preferably conforms to the contour of the damper and is disposed so as to be flush with the outer surface thereof when the damper is in its closed position. At its lower extremity the extension 23 may terminate in an eye 24, through which the pintle of the "piano" hinge 18 passes, the eye thus becoming a part of the "piano" hinge whereby to afford the hinge additional support and to secure the extension 23 against lateral displacement.

By having the extreme dummy fins at each end of the unit inset from the plane of the end of the unit a distance equal to one-half of the uniform spacing between the fins, the uniform spacing of the fins is preserved when two units of my improved radiator are assembled together end to end and any break at the joint in the regular continuity of the fins is avoided. A suitable bead 25 may be provided on the inner surface of the casing between the extremity thereof and the extreme dummy fin in order to engage such dummy fin to assist in securing it in position, as well as to provide a finish when the end or ends of the radiator are exposed to view.

Where the radiator unit is of comparatively short length a single damper 17 is employed therein, but in the longer units two or more dampers may be provided so that they may be independently manipulated to regulate the heat more effectively. In the

latter instance one or more of the diathermic fins 3 is formed with a downward extension 26, similar to the extension 23 hereinbefore described, in order to form a partition between adjacent dampers.

My improved radiator is of substantially the height of the usual base-board of a room wall, and thus delivers the heated air to the room at a low level, close to the floor line. This increases the heating effect of the radiator in the room and minimizes the waste of heat (which is so objectionable in the ordinary radiators) so that the maximum comfort is obtained in the room and at the same time a substantial economy in fuel consumption is effected. The radiator is also of relatively narrow depth from front to rear, with the result that when installed it will not occupy valuable room space, offer an obstruction to furniture, nor obtrude into the decorative scheme of the room.

By virtue of its form and arrangement, no special wall construction is required to accommodate the radiator, but it may be set directly against the base-board, or if desired, directly against the plaster, or even back of the plaster line and against the studding with the plaster carried down on the top or cover 20. When set either against the plaster or against the studding, the usual base-board is omitted for a distance equal to the length of the radiator, and the radiator serves as a substitute therefor.

Single units of the radiator may be separately installed, or two or more units may be installed together, according to the conditions under which the radiator is to be employed and the capacity required for the room to be heated. When employed together, the adjacent ends of the units are united by a coupling or sleeve 29 which is screwed on the meeting threaded ends 2 of the pipes 1 of the respective units and is accommodated within the relatively large central openings 22 of the corresponding dummy fins 3'. In thus assembling the units, the coupling is first screwed on one of the threaded ends 2 and the other threaded end is then brought into registry with the coupling and screwed therein by turning one of the units relatively to the other until the meeting ends of the units are drawn together with the units in longitudinal alinement to form a continuous radiator.

To install the radiator it is merely necessary to drive screws or like fastening devices 15 into the baseboard or the wall and to engage the keyhole slots 14 therewith to secure the radiator in position with the foot or base 16 resting upon the floor. By means of elbows 27 screwed on the threaded ends 2 at the opposite ends of the radiator, the conduit 1 of the radiator is then coupled to pipes 28 connected to the source of supply of the fluid heating medium, and the installation is complete.

In view of the foregoing description the operation of the radiator will be obvious.

It is to be noted that by having the apex of the radiator and the lower extremity or bearing portion of the foot in substantial vertical alinement, the units of my improved radiator may, if desired, be mounted one above the other with the foot of the upper unit resting upon the top of the lower unit adjacent the apex thereof.

My improved radiator may be efficiently constructed in a suitable manner to provide not only a strong and durable unitary structure, but also a metallic union between the parts which will insure a maximum heat conductivity and thus increase the thermal efficiency of the radiator. This may be accomplished by welding the parts, or certain of them together.

According to this method the diathermic fins 3 are assembled, preferably one by one, on the pipe 1 of the unit, and their collars 5 fastened thereto by a spot or butt weld, so that the entire series of diathermic fins is integrally united to the pipe in the proper spaced relation, with a high degree of thermal conductivity between the primary and secondary surfaces of the radiator. The parts of the casing, that is, the back plate 9, top 20 and front plate 8 are then attached by a spot weld to the spacing-lugs 6 of the respective diathermic fins. The dummy fins 3' are then placed in proper position within the end portions of the unit and their spacing-lugs 6 secured by a spot weld to the back plate, top and front plate. The spaces between the fins, as well as the inlet and outlet openings 11 and 12, afford welding tools necessary access to the parts in the welding of the back plate, top and front plate to the diathermic fins and in the welding of the dummy fins to the back plate, top and front plate.

The welding of the parts not only affords a high degree of thermal conductivity therebetween, but obviates the likelihood of rust forming on the abutting surfaces as time goes on—which has a tendency to occur with other forms of joints and results in reducing the thermal conductivity. Moreover strong, durable and permanent connections between the parts are thus provided, so that they are integrally united in a rigid structure and enable the unit to withstand rough or careless handling without danger of breakage or bending. The welding also avoids the presence of fastening devices on the outer or exposed surface of the radiator, so as not to detract from its appearance and from any superficial ornamentation or finish which may be applied to it, such as, for instance, a coat of baked enamel or duco.

While other methods may be employed for constructing the units of my improved radiator, that above described and particularly the step thereof involving the welding of the

fins to the pipe is now believed to be the most efficient and is preferred for the reasons indicated.

It is to be understood that any suitable fluid heating medium, including electricity, may be used for heating the primary surface, and that various changes may be made in the form, arrangement and combinations of the parts of the radiator, without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States—

1. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals along the pipe and provided at corresponding edges with laterally disposed spacing-lugs, and a plate extending across such corresponding edges of the fins and separately secured to the respective lugs to tie the plurality of fins together into a unitary structure.

2. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals on the pipe, a back plate abutting against the rear edges of the fins and secured to each of such fins to tie the same together into a unitary structure, and a foot extending downwardly from the back plate below the fins and adapted to rest upon the floor to support the radiator.

3. In a radiator, the combination in a unitary structure, of a pipe for a fluid heating medium, a plurality of fins mounted at intervals on the pipe, a back plate extending across the rear edges of the fins and adapted to fit against a room wall, and a foot extended downwardly from the back plate and inclined forwardly beneath the fins and adapted both to rest on the floor to support the radiator and to seal the corner between the floor and the wall.

4. In a radiator, a pipe for fluid heating medium, a plurality of fins mounted at intervals on the pipe, a back plate extending across the rear edges of the fins and secured to each of such fins to tie the same together into a unitary structure, and a top extending forwardly from the back plate above the fins and constituting a deflector for air currents ascending between the fins.

5. In a radiator, a pipe for a fluid heating medium, a plurality of fins disposed at intervals along the pipe, a casing having inlet and outlet openings, enclosing said fins, certain of said fins being extended adjacent one of said openings, and a damper movably mounted between such extensions and controlling said last-mentioned opening.

6. In a radiator, a pipe for a fluid heating medium, a plurality of fins disposed at intervals along the pipe, a casing having inlet and outlet openings, enclosing said fins, certain of said fins being extended adjacent one

of said openings, and a plurality of dampers movably mounted between such extensions and controlling said last-mentioned opening, another of said fins being also extended to form a partition between said dampers.

7. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals along the pipe, front and back plates extending across the fins and secured to each of such fins to tie the same together into a unitary structure, a foot extending downwardly from the back plate beneath the fins and forming a base or support for the radiator, and a damper pivotally mounted on the foot and movable to control the flow of air through the radiator.

8. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals along the pipe, a casing having inlet and outlet openings, enclosing said fins, the fins being cut away adjacent the outlet opening to reduce the frictional resistance to the air passing through the radiator.

9. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals along the pipe, and a casing enclosing the fins and having inlet and outlet openings and provided adjacent the outlet opening with a deflector, the fins being mitered adjacent the deflector and in substantially the plane of the outlet opening.

10. In a radiator, a pipe for a fluid heating medium, a plurality of fins mounted at intervals along the pipe, a plate extending across the fins and secured to each of such fins to tie the same together into a unitary structure, and a foot extending downwardly from the plate, beneath the fins, and forming a support for the radiator, one or more of said fins being extended downwardly to engage the foot and brace the same against strain.

11. In a radiator, a pipe for a fluid heating medium, having its ends threaded, a series of diathermic fins mounted at intervals on the pipe, a casing having inlet and outlet openings, enclosing the series of fins with its ends extending lengthwise beyond the same and around the threaded ends of the pipe, the fins being exposed to view through one of said openings, and dummy fins secured within the respective end portions of the casing and encircling the adjacent threaded ends of the pipe in spaced relation thereto.

12. In a radiator, a pipe for a fluid heating medium, a series of fins mounted on the pipe, front and back plates extending across the front and rear edges of the fins, a top inclined forwardly and upwardly from the back plate and bearing upon the upper edges of the fins, the front edge of the top being spaced from the upper edge of the front plate to provide an outlet opening lying in an upwardly and rearwardly inclined plane, and the fins extending across such opening and being mitered in substantially the plane thereof.

13. In a radiator, a pipe for a fluid heating medium, a series of fins mounted on the pipe, front and back plates extending across the front and rear edges of the fins, and a foot inclined downwardly and forwardly from the back plate, underneath the fins, with its front edge in spaced relation to the lower edge of the front plate to provide an inlet opening lying in a downwardly and rearwardly inclined plane.

14. In a radiator, a pipe for a fluid heating medium, a series of fins mounted on the pipe, front and back plates extending across the front and rear edges of the fins, and a foot extending downwardly and forwardly from the back plate, underneath the fins, with its front edge in spaced relation to the lower edge of the front plate to provide an inlet opening lying in a downwardly and rearwardly inclined plane, one or more of the fins extending across the inlet opening and bearing upon the upper surface of the foot.

15. In a radiator, a pipe for a fluid heating medium, a series of fins mounted on the pipe, a back plate extending across the rear edges of the fins, a foot inclined downwardly and forwardly from the back plate, underneath the fins, a top inclined upwardly and forwardly from the back plate and bearing upon the upper edges of the fins, and a front plate extending across the front edges of the fins and spaced from the front edges of the foot and the top.

16. In a radiator, a pipe for a fluid heating medium, a series of fins mounted on the pipe, each of such fins having substantially vertical front and rear edges and having at its upper end oblique edges meeting substantially in a projecting angle, and one or more of such fins also having at their lower ends oblique edges meeting substantially in a projecting angle, a back plate extending across the rear edges of the fins, members disposed, respectively, above and below the back plate and extending across those of the oblique edges located between the rear edges of the fins and the vertices of said angles, and a front plate extending across the front edges of the fins with its lower and upper edges spaced from the front edges of the adjacent members to provide inlet and outlet openings opposite the other oblique edges of the fins.

17. In a radiator, a pipe for a fluid heating medium, a series of diathermic fins mounted on the pipe with the ends of the pipe projecting beyond the opposite ends of such series, a casing having inlet and outlet openings, enclosing the series of fins with its ends extending lengthwise beyond the same and around the projecting ends of the pipe, the fins being exposed to view through one of said openings, and dummy fins secured within the respective end portions of the casing and encircling the adjacent projecting ends

of the pipe in spaced relation thereto to afford clearance for coupling means.

18. In a radiator; a horizontal pipe for a fluid heating medium; a series of vertical fins mounted on said pipe; and a casing inclosing said fins and having air inlet and outlet openings terminating in forwardly converging planes; the forward edge of said outlet opening being at a level materially lower than the rearward edge of said outlet opening, and said outlet opening being of greater area than the air passageway in said casing, in which said pipe extends; whereby the upward flow of air through said casing, induced by convection, is facilitated and accelerated and directed, in said casing, forwardly from said pipe and, outwardly from said casing, in a substantially horizontal direction.

In testimony whereof, I have hereunto signed my name to this specification.

ROBINSON V. FROST.

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