Oct. 15, 1929. T. E. MURRAY 1,731,472

RADIATOR

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Fig. 1.

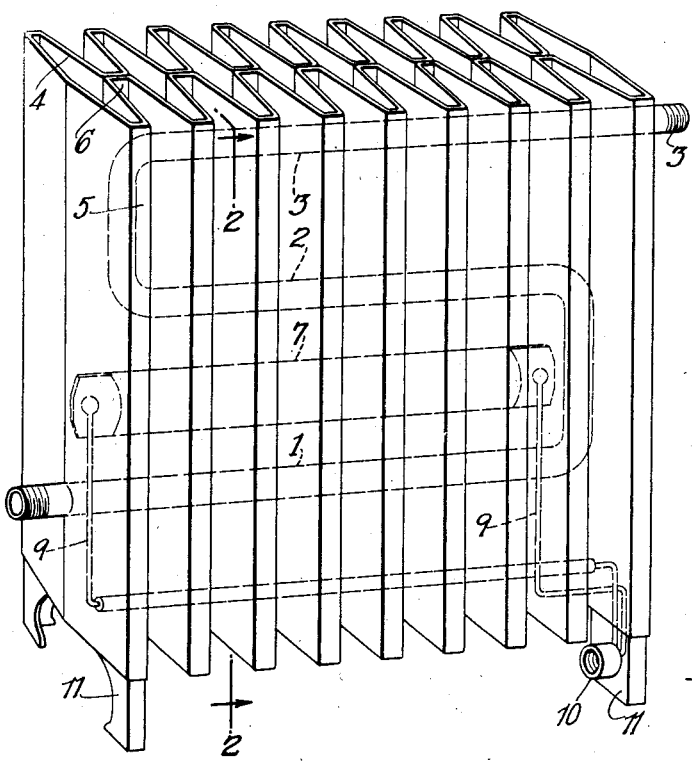

Fig. 2.

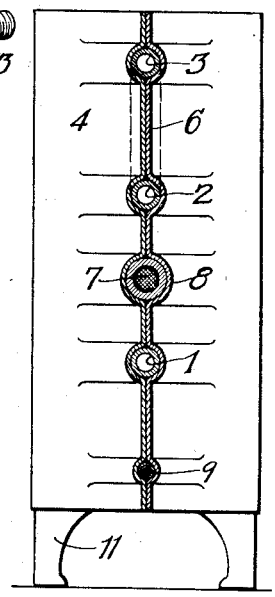

Fig. 3.

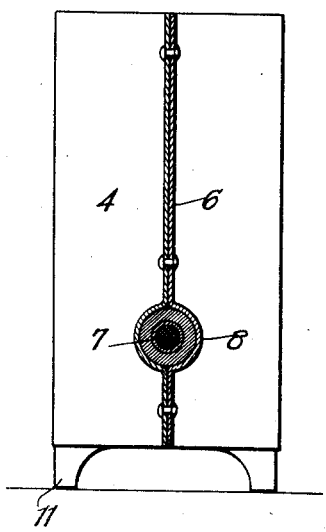

Fig. 4.

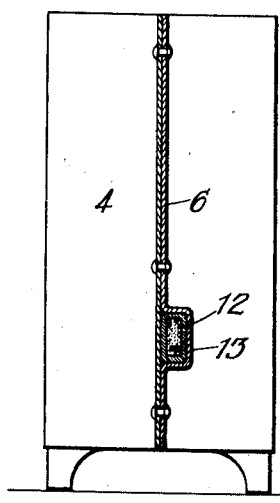

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Fig. 5.

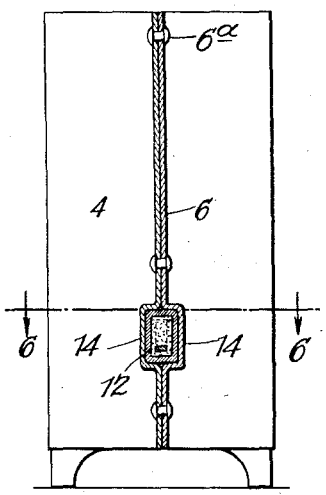

Fig. 6.

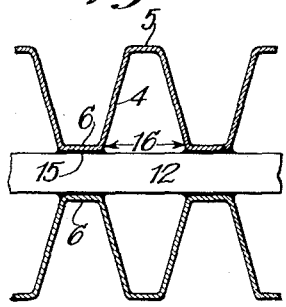

Fig. 7.

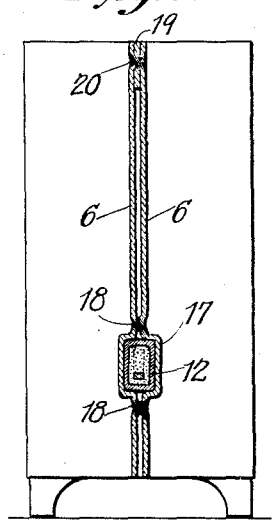

Fig. 8.

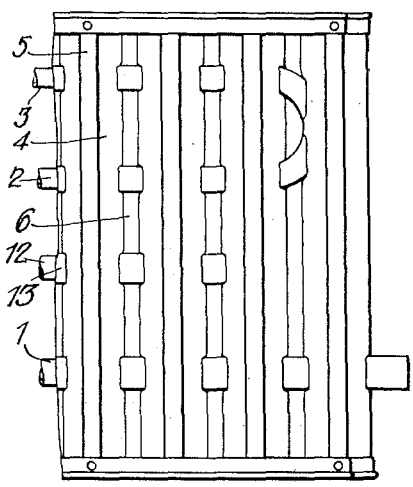

Fig. 10.

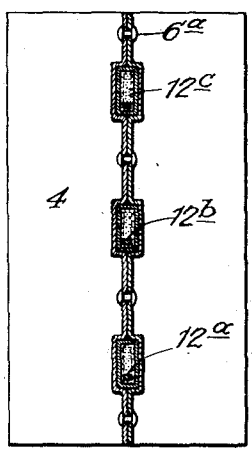

Fig. 9.

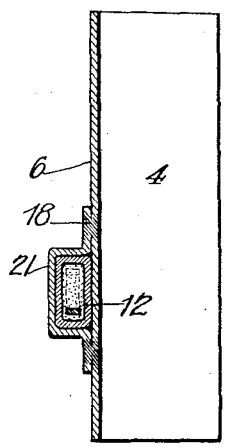

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Fig. 11.

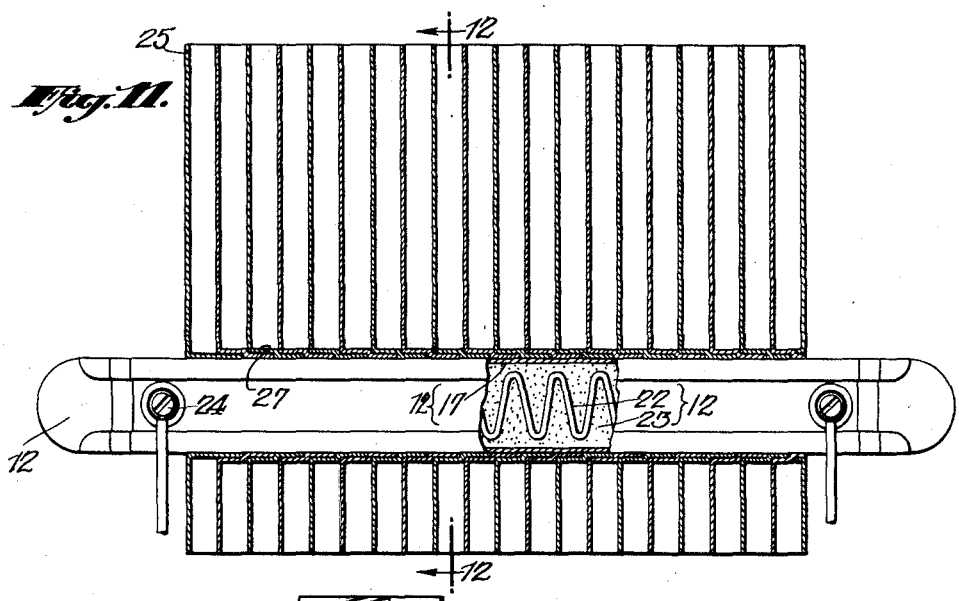


Fig. 12.

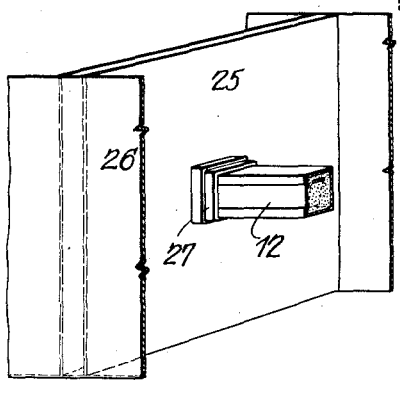


Fig. 14.

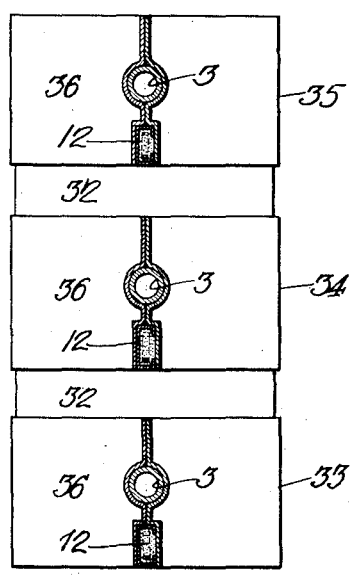
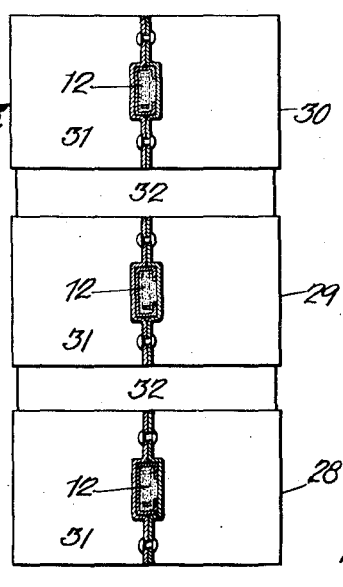


Fig. 13.



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Patented Oct. 15, 1929 1,731,472

UNITED STATES PATENT OFFICE

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RADIATOR

Application filed February 17, 1927. Serial No. 168,871.

In an application for Patent No. 96,699, filed March 23, 1926, I have described a radiator adapted to use as a heating medium either an electric heating element or steam or hot water, or a combination of these.

The present application is in part a division thereof, based on the electric heating (with or without additional means for heating by steam) of the radiator, and is in part based on certain further improvements.

The accompanying drawings illustrate embodiments of the invention.

Fig. 1 is a perspective view of a complete radiator using steam and electric heating;

Fig. 2 is a transverse vertical section of the same;

Fig. 3 is a similar view of the radiator designed for electric heating alone;

Figs. 4 and 5 are similar views of variants;

Fig. 6 is a partial horizontal section on the line 6—6 of Fig. 5;

Fig. 7 is a view similar to Fig. 5 of another variant;

Fig. 8 is a side elevation of a portion of the radiator shown in Fig. 4 with the addition of a steam pipe;

Fig. 9 is a view similar to Fig. 4 showing another variant;

Fig. 10 is a transverse vertical section of a modification;

Fig. 11 is a longitudinal section of another modification;

Fig. 12 is a sectional perspective on the line 12—12 of Fig. 11;

Figs. 13 and 14 are transverse vertical sections of other modifications.

In Fig. 1, there is shown a steam pipe bent to form three horizontal lengths, 1, 2 and 3 respectively, to provide a continuous passage for the steam, hot water or other heating medium. To this is applied a structure having an extended surface and formed of sheet metal corrugated to form transverse inclined plates 4 connected at their outer and inner edges respectively by short longitudinal plates 5 and 6. The inner edges of the corrugations, formed by the plates, are secured or bonded closely to the pipe lengths 1, 2, 3, by heat and pressure; being thus soldered, brazed or welded to the pipes to furnish a continuous metallic connection of high conductivity in the manner described in detail in the co-pending application of Murray & Hoffer, No. 91,023, filed February 27, 1926. The inner portions 6 of the corrugated plates are preferably brought together or nearly so and may be united directly to each other or to an interposed filler by any mechanical means such as riveting, bolting, clamping, welding, etc. Rivets are shown at 6a.

In addition there is provided, according to Figs. 1 and 2, an electric heating element 7. This may be any resistance or other usual or suitable style of cylindrical element generally carrying a coil of resistant material. I propose to arrange this element parallel to the lengths of pipe, between two such lengths as illustrated, or it may be below the lowest length of pipe; and to secure it to the inner edges of the corrugations by bending out the latter as at 8 (Fig. 2) to embrace the heating element, to which the plates are united in the same way as to the pipes, or by tightly clamping around the element 7 so as to provide a contact of high thermal conductivity. It thus increases the stiffness of the radiating structure and conveys its heat rapidly thereto. The wires 9 from its opposite ends are carried down to an electric socket 10 on one of the legs 11 of the radiator, for easy attachment to a base board socket. Electric heating elements are known with both terminals on the same end and these may be used instead of the style shown; and in fact are preferable from many standpoints. Or it might be permanently connected to the house wiring with a switch interposed.

The plates or parts of the extended surface structure are exposed to the atmosphere on the outside, and their inner faces form vertical flues closed in cross-section to facilitate circulation of the heated air. They may be made very thin and of considerable area and of copper or other metal of high conductivity. The bonding of them directly to the heating element or the casing thereof, or the mounting of them in close contact therewith enables them to rapidly take away the heat from the electric element so that this device never reaches an excessive temper-

ature, and thus insures a long life for same.

With a heating element brought to very high temperatures, it is a problem usually to distribute the heat rapidly and efficiently throughout a room. The present structure is particularly adapted to this use because of the good surface contact of the corrugated plates with the heating element, the large surface which heats the air by contact chiefly, and to some extent by radiation, and the small vertical flues which bring the surface into contact with practically every part of the air column and which cause the air to circulate upward with considerable velocity to carry off the heat very rapidly. In fact several such heating elements may be employed in a single radiator with great efficiency. Fig. 10 shows, for example, three heating elements 12^a, 12^b and 12^c.

The radiator may be equally used for cooling air by circulating cold brine or the like through the pipes so that the latter become a heating element only in the negative sense, that is, they extract heat from the radiating structure and induce a flow of the cool air downward through the flues similar to the upward circulation of air induced by the passage of steam through the pipes.

Where the electric current is cheap or other circumstances suggest its use alone, the steam heating element may be omitted. Fig. 3 shows such an arrangement in which the electric heating element 7 is made of sufficient capacity to secure the quantity of heat desired, the extended surface structure extending a considerable distance above the heating element so as to secure a good draft and a rapid circulation of the heated air. The electric connection may be made directly with the end of the heating element 7; or it may be carried like the wires 9 in Fig. 1 through a separate tube.

Fig. 4 shows the same idea applied to a rectangular electric heating element 12. In this case, the plates 6 at one side only are bent out as at 13 to provide recesses for the heating element. This leaves one side of the radiator, (the left side in the figure) smooth or free from any rib or other indication of the heating element. The smooth side may be arranged at the front in order to improve the appearance. Or the ribbed side may be the front if that is preferred.

In Fig. 5 the same type of heating element is used with shallow bends 14 in the plates 6 at both sides. This is easier to manufacture because it involves less bending of the plates and because the two sides of the structure are identical.

The preferred method of securing the plates or fins is by soldering them to the heating element. This simplifies the manufacturing operation. The parts may be assembled with a coating of solder between the heating element and the plates or fins and then pressed together and heated sufficiently to melt the solder and secure the parts together.

I have found that with such soldered joints, the spacing of the joints along the length of the heating element is important. If the joints be far apart, the solder is apt to be melted when the current is turned on. Fig. 6 illustrates the point. The soldered joints are indicated at 15. The electric element 12 in the spaces 16 between two joints releases a great quantity of heat and this is conducted away chiefly through the joints to the plates or fins 6 and 4. The longer the spaces 16, the greater the quantity of heat that has to pass through the soldered joint.

I have found that when the spaces between the joints or the exposed portions of the heating element substantially exceed an inch in length, there is danger of melting the solder with the ordinary high temperature electric heating element. For other styles of heating element and other metals than copper, this measurement will vary. But it can be readily determined by tests how far apart the soldered joints may be made in practice. The shape of the extended surface structure may be modified so as to shorten the spaces 16 to any desired extent by properly shaping the plates, or by inserting extra fins. The contact of the extended surface structure may extend continuously along the length of the heating element. See, for example, Figs. 11 and 12 hereinafter referred to.

Fig. 7 illustrates certain modifications any one or any combination of which may be used also in connection with the arrangements shown in the previous figures. The plates 6 in this case are provided with recesses 17 of approximately the depth required to accommodate the heating element 12 and are then pressed together above and below the heating element and welded by spot welds 18 (or by equivalent welding methods) to each other. The plates or parts 6 are spaced slightly apart from each other and are braced and fastened together at their upper end by the filler 19 located between and fastened to each of them by spot welds 20 passing through the three parts.

In Fig. 8, I have shown an elevation of the right-hand side of the radiator of Fig. 4 in connection with a steam pipe similar to that of Fig. 1.

In some locations it is desirable to use a heating element with an extended-surface structure on one side only. Fig. 9 shows one way in which this can be accomplished. The heating element 12 is applied to the plate 6 and is fastened thereon by straps 21 extending slightly above and below the heating element and fastened to the plates 6 by spot welds 18. A single strap 21 may be used extending the full length of the radiator or separate short

straps one for each of the plates 6 along the length of the heating element.

Figs. 11 and 12 illustrate one way of securing a continuous contact of the extended-surface structure with the heating element. This figure, in fact, illustrates several features of improvement, any one or any combination of which may be used also in connection with the arrangements shown in the previous figures. The heating element 12 is of the strip type described, for example, in the patent of Wiegand of January 18, 1927, No. 1,614,938. A corrugated strip 22 is encased in non-conducting material 23 in a long thin shell 17 of steel, with binding posts 24 at the ends projecting outside of the shell. Such strip heaters are adapted to become very hot in use, red hot in fact, and are dangerous when exposed to contact. But when embraced in the structures of extended area, herein described, the heat is removed from the strip heaters so fast as to keep the latter moderately cool and quite safe as far as the risk of fire or injury to persons is concerned. For the same reason the life of the heater is prolonged.

The structure of extended surface comprises flat fins or plates 25 separate from each other and spaced apart to provide flues of the desired width, and enclosed at their vertical edges by side plates or panels 26. Each of the plates 25 is apertured and drawn out to provide a flange 27 fitting closely on the heating element 12, the flanges of adjacent plates overlapping (or they might be merely contacting) so as to provide a continuous tube embracing the heating element. By the same means the plates are locked to each other. They may be soldered to the heating element and may be fastened to each other in various other ways as desired.

Fig. 13 shows a heater similar to that of Fig. 10 but divided into three separate units 28, 29, 30 each carrying one electric heating element 12 to which fins or plates 31 are united in any of the ways above described. These units are set only slightly above one another and joined and spaced apart by any suitable intermediate plates 32. This scheme simplifies the production of the radiators. It is simpler to make them in identical units as shown and unite any desired number of such units together than to make a radiator with a plurality of heating elements embraced by a single structure. This unit system also has advantages in use in admitting fresh air between the units 28 and 29 and between units 29 and 30 and thus increasing the capacity as compared with a radiator of the same number of heating elements and the same area of heating surface with a single inlet for fresh air at the bottom. Such a unit arrangement is shown and described more fully and claimed in another application co-pending herewith.

The same idea may be applied with steam heating elements instead of electrical heating elements. It may also be applied with the combination of steam and electrical heating elements as shown in Fig. 14. Here each of the units 33, 34 and 35 carries an electrical heating element 12 and the steam heating pipe 3 embraced by the plates 36. The units are united and spaced apart properly by plates 32 as in Fig. 13.

There are various other known or suitable designs of extended-surface structure which can be applied to the heating element and used in place of the design illustrated. There are also various types and styles of electric heating elements to which the invention can be applied. Any of the above mentioned structures may be encased in a sheet metal cover both for appearance and strength as well as to form a continuous wall or enclosure to promote a rapid flue effect. Such a cover may be in the form of a panel bent to fit the radiator and easily applied while the radiator is in place, or it may be a closed cabinet with grilled outlets on top or in front as shown in detail in certain co-pending applications.

Various other modifications may be made by those skilled in the art without departing from the invention as defined in the following claims.

What I claim is:—

1. A radiator including in combination an elongated horizontally extending electric heating element adapted to be excessively heated by the current and an extended surface structure adapted to take the heat away from said heating element so rapidly as to keep the latter safely cool, said extended surface structure including transverse plates and longitudinal plates fitted and bonded directly to the outside of the heating element in a continuous metallic path for conducting the heat rapidly away from the heating element to the transverse plates.

2. A radiator including in combination an elongated horizontally extending electric heating element adapted to be excessively heated by the current and an extended surface structure adapted to take the heat away from said heating element so rapidly as to keep the latter safely cool, said extended surface structure comprising a sheet corrugated in horizontal section to form inner longitudinal plates 6 and outer longitudinal plates 5 connected in alternating succession by transverse plates 4, said heating element having a casing and the inner plates 6 being fitted directly to the outside of the casing and bonded thereto in a continuous metallic path for conducting the heat rapidly away from the heating element to the transverse plates, the outer plates and the transverse plates guarding the intermediate portion of the heating element from accidental contacts.

3. A radiator including in combination an elongated horizontally extending electric heating element adapted to be excessively

heated by the current and an extended surface structure adapted to take the heat away from said heating element so rapidly as to keep the latter safely cool, said extended surface structure comprising a sheet corrugated in horizontal section to form inner longitudinal plates 6 and outer longitudinal plates 5 connected in alternating succession by transverse plates 4, said heating element having a casing and the inner plates being fitted and soldered to the heating element to form a continuous metallic path for conducting the heat rapidly away from the heating element to the transverse plates and being separated from each other by not more than about an inch so as to avoid becoming overheated.

4. A radiator including in combination an elongated horizontally extending electric heating element adapted to be excessively heated by the current and an extended surface structure adapted to take the heat away from said heating element so rapidly as to keep the latter safely cool, said extended surface structure comprising a thin sheet of metal corrugated in horizontal section, said heating element having a metal casing and the inner portions of the corrugations of said sheet being fitted directly to the outside of said casing and fastened firmly thereon to provide a metallic path of substantial extent for conducting the heat rapidly away from the heating element to the transverse portions of said sheet, the transverse portions and the outer portions of the sheet guarding the intermediate portions of the heating element from accidental contacts.

In witness whereof, I have hereunto signed my name.

THOMAS E. MURRAY.