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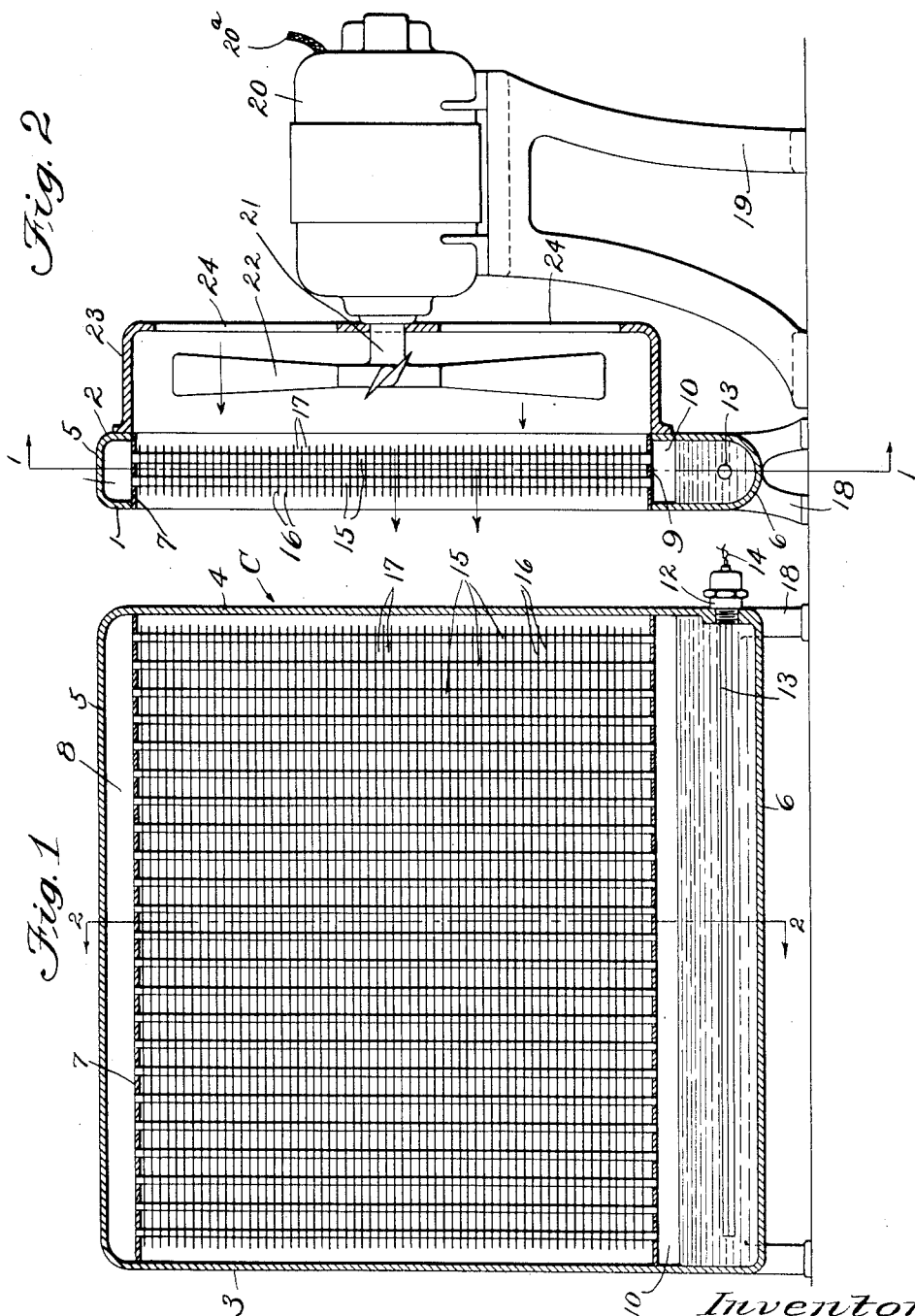
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AIR HEATING APPARATUS

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# UNITED STATES PATENT OFFICE

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## AIR HEATING APPARATUS

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This invention pertains to heating appliances and more particularly to a self-contained device, preferably of portable character, comprising in combination heating, radiating and diffusing elements.

The modern tendency in house heating is, so far as possible, to employ a type of fuel or a heating medium which is free from undesirable by-products or waste resulting from the burning of solid fuels, for example, wood or coal. Oil and gas are superior to solid fuels in this respect, but they also require large amounts of free oxygen for their combustion and necessitate the provision of a flue through which the gaseous products of combustion, (incidentally carrying a large percentage of the heat evolved) may escape. On the other hand, electricity, while at present somewhat costly as a source of heat has many advantages over other heating mediums, among which may be mentioned its ease of distribution and control, the entire absence of waste products (gaseous or otherwise) so that connection of the heating appliance to a flue is unnecessary, and the fact that such heating means does not consume oxygen in the process of heating so that it can be used in a closed apartment without vitiating the air, and with absolute economy of heat.

I am well aware that certain types of electrical heaters have been used to some extent but believe that all such devices, so far as they are known to me, fail to meet the requirements of a heater designed for domestic use. Most such devices depend for their heating effect upon a resistance wire or coil, usually heated to redness or nearly to incandescence, with which the air of the room comes directly into contact. While I strongly suspect that this super-heating or "burning" of the air which comes into contact with the hot coil may to a certain extent lessen its fitness for human breathing by reason possibly of the evolution of minute quantities of metallic vapors or vapors of metallic oxides from the heated resistance wire, I know it to be a fact that the air in the immediate vicinity of the coil is too hot for breathing and in some instances is so

hot as to constitute a serious fire hazard. Moreover, the heating coil exposes but a small surface to the air so that but a minute proportion of the air of the room is in contact therewith at any one time, and if natural convection currents are relied upon to distribute the heated air, the action of the device is necessarily very slow even when, as has been suggested, a reflector is provided to assist by its radiating effect in the diffusion of heat.

In accordance with the present invention I secure all of the advantages of electrical heating with extremely rapid and effective diffusion of the heat throughout the room and particularly through the lower portion thereof, (which is often inadequately heated whatever the heating apparatus employed); I obtain complete safety, so far as fire hazards or undue heating of the air are concerned together with simplicity of construction; and embody all of these features in a self-contained, preferably portable, apparatus.

In the accompanying drawings in which I have disclosed certain preferred embodiments of the invention;

Fig. 1 is a transverse vertical section of my improved heating apparatus substantially on the line 1—1 of Fig. 2;

Fig. 2 is a vertical section substantially on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 but illustrating a modified construction; and

Fig. 4 is an elevation of the right hand side of the device shown in Fig. 3.

Referring to Figs. 1 and 2 the letter C designates a hollow casing, preferably of metal, for example, cast iron or aluminum, or sheet copper or steel, comprising the front wall 1, the rear wall 2, the side walls 3 and 4, the top wall 5, and the bottom wall 6. As here shown this main casing is of substantially rectangular contour, although the bottom wall 6 is preferably, although not necessarily, concave.

The front and rear walls 1 and 2 are provided at their central portions with large apertures, and above these apertures the walls 1 and 2 are connected by means of a

horizontal partition 7 forming the bottom of an upper chamber 8 which is hereinafter referred to as the vapor chamber. Likewise below the apertures in the walls 1 and 2, these walls are united by a horizontal partition 9 forming the upper wall of a chamber 10 in the lower part of the casing, this chamber hereinafter being referred to as the heating chamber or boiler. The end wall 4 is provided with a threaded opening extending into the chamber 10, such opening receiving a plug 12 supporting an electrical heating unit 13 of any usual construction which receives electrical energy through the conductor 14.

The chambers 8 and 10 are connected by series of substantially vertical tubes 15 which collectively constitute a steam chamber and which are spaced laterally and are preferably provided with substantially horizontal radiating fins 16. As shown, these fins are thin plates extending transversely of the tubes being spaced vertically to form the upper and lower walls of a series of horizontal air passages 17 extending from front to rear through the casing and terminating at the apertures in the walls 1 and 2 of the latter. While the structure comprising the tubes and fins hereinabove described constitutes one efficient form of radiator, being similar in general to automobile radiators of a well known type, I contemplate that other radiator construction of efficient character, for example, the well known honeycomb type of radiator, may be substituted therefor.

The casing C is provided with supports or legs 18. I also provide a motor support, which may if desired be attached to the main casing, but which is here shown as having independent legs 19. This support carries an electric motor 20 furnished with a shaft 21 carrying a fan 22 disposed immediately behind the aperture in the rear wall 2 of the casing. This fan is adapted to impel a current of air through the passages 17 and discharge it from the front ends of said passages to the exterior of the casing. Preferably I house the fan 22 in a supplementary casing 23 attached to the rear wall 2 of the main casing, such supplementary casing having openings 24 for the admission of air. While this casing may be of sheet metal construction, as shown, it is obvious that it might as well be of wire or other openwork form.

The motor 20 is furnished with electrical energy through a suitable conductor 20<sup>a</sup> which may be connected, if desired, to the conductor 14 so that by manipulation of one switch the motor may be set into operation and the heating unit energized.

The boiler chamber 10 is furnished with a suitable quantity of liquid, for example water, and as this chamber has no outlet

other than the tubes 15, any steam or vapor rising from the liquid must necessarily pass up into the tubes 15, and if not previously condensed may rise into the chamber 8. The steam or vapor rising from the liquid in the boiler 10 thus transfers its heat directly to the tubes 15, a portion of such heat being taken up by conduction by the fins 16. The current of air delivered by the fan, flowing through the passages 17, rapidly takes up heat from the extended heated metallic surfaces with which it contacts, thus condensing the vapor or the steam in the tubes so that it returns to the boiler 10 in the form of liquid ready for further heating. The liquid thus passes through a closed cycle, none of it being lost by escape from the casing, during which all of its heat becomes available for heating the room or apartment in which the device is located. As the radiating surface thus provided is very effective as a means for transferring heat and as the air is forcibly impelled through this radiating structure, the heat from the heated fluid is very rapidly delivered to the room and quickly diffused throughout the entire room. As the device is of portable character it may be set up at the most convenient point in the apartment, and since it is so effective in its heat transferring action, it is possible to make it of relatively small dimensions so that it occupies but little space in the room. The boiling point of the fluid in the chamber 10 substantially determines the maximum temperature to which the air may be subjected, thus avoiding overheating; and since the heating element itself is entirely enclosed, there is no possibility that objectional odors resulting from overheating will be delivered into the air of the room.

Referring to Figs. 3 and 4 I have shown the invention embodied in a slightly different form, the casing 25 comprising the front and rear walls 26 and 27 respectively, the side walls 28 and 29, the top and bottom walls, together constituting a substantially rectangular enclosure.

The end wall 29 is provided with an elongate opening, and at a point just above the upper end of this opening a horizontal partition 30 sets off a vapor chamber 31 from the main body of the casing.

At the lower end of the opening in the wall 29 I provide a horizontal partition 32 forming the upper wall of a heating or boiler chamber 31<sup>a</sup>. This heating chamber 31<sup>a</sup> does not extend the entire width of the casing but is provided with an end wall 33 spaced from the wall 28, while the bottom of this chamber is provided by a horizontal partition 34. Preferably the wall 29 is furnished with an outstanding boss having a screw-threaded opening for the insertion of the plug 36 which supports the electrical

heating element 37 within the chamber 31<sup>a</sup>. This heating element receives electrical energy through a suitable conducting wire 38.

The chambers 31 and 31<sup>a</sup> are connected by one or more series of thin-walled tubes 39 and such tubes are preferably provided with heat radiating fins or plates 40 in the same way as the tubes 15 of the previously described modification. These fins or plates 40 define horizontal air passages 41, and preferably the ends of the fins or plates 40 are extended into the opening in the side wall 29 of the casing and may be turned downwardly, as shown, or upwardly, if desired, to form air directing louvres.

Beneath the partition 34 I provide a chamber 43 which preferably extends rearwardly into an extension 43<sup>a</sup> at the lower rear part of the main casing, and within this chamber 43 I mount an electric motor 44 which drives a fan 45. The wall of the casing is furnished with a suitable opening 46 for the intake of air, and the air delivered by the fan passes up through the space 47 at the rear of the boiler chamber 31<sup>a</sup> and thence up into a plenum chamber 48 at the left-hand side of the radiator. As illustrated in Fig. 3 I prefer to extend the fins 40 into the chamber 48 so as to provide air-guiding channels, preferably gradually increasing the length of these fins upwardly of the series so as to produce a more uniform distribution of air over the entire radiator.

The device shown in Figs. 3 and 4 operates in substantially the same manner as that previously described, it being understood that liquid, for example water, is placed in the chamber 31<sup>a</sup> and that the vapor or steam rising from this liquid passes up through the tubes 39 where its heat is transferred to the air flowing through the passages 41, such air being delivered through the opening 49 into the room. By employing the louvres 43 the direction of the air may be determined, and I contemplate that as an alternative arrangement these louvres may be separate from the fins 41 and pivotally mounted so that they may be adjusted to change the direction of the air current delivered from the apparatus.

In the arrangement shown in Figs. 3 and 4 the air is constrained to move in a longer path while in contact with the heated surfaces of the radiator device than in the device of Figs. 1 and 2, so that, if desired, the air current may be driven through the apparatus at higher velocity while still taking up the desired amount of heat.

It is evident that the boiler, heat dissipating tubes, and upper chamber together comprise a closed system and that formation of steam tends to raise the gaseous pressure within the boiler compressing the gas in the upper portions of the tubes and in the cham-

ber connected thereto. The heat conductive tubes being of comparatively small cross-sectional area and having heat dissipating fins of comparatively large capacity are adapted to dissipate widely varying amounts of heat, thus when the current is applied to the heating means a small amount of steam will be generated, the pressure within the closed system being only slightly raised and the heat being dissipated in the lower parts of the tubes. As the supply of energy to the heating unit is continued a much greater amount of steam may be generated and the tubes become filled to a great height with the same. In the meantime the air in the upper part of the closed system is further compressed and the internal pressure thereof is raised. Due however to the small area of the ducts relative to their large heat dissipating capacity, they are adapted to give up a comparatively large amount of heat and thus avoid the development of excessive internal pressures even when the supply of heat is greatly increased. Furthermore substantially all of the steam is condensed in the tubes, even when the heater is working at its maximum capacity, so that an undue rise in the temperature of the noncondensable gases, and consequently in the pressure of the same, is avoided. Thus the present invention provides a closed system adapted to operate with widely different amounts of heat supplied thereto to cause boiling of the contained liquid, and yet to avoid the development of excessive internal pressures.

While I have shown certain desirable embodiments of the invention, I wish it to be understood that it is not necessarily limited to such embodiments but that the broad principle of the invention is capable of application in other ways and in apparatus having different proportions and differing in structural detail from the device as here illustrated.

I claim:

1. A portable heater of the class described having a casing comprising means defining a heating or boiler chamber in the lower part of the casing, means defining a steam or vapor chamber in the upper part of the casing, a plurality of tubes of small diameter extending upwardly within the casing and providing passages connecting the boiler chamber with the vapor chamber, heat radiating elements on the tubes, said elements providing a large heat transfer surface as compared with the cross-sectional area of the tubes, and means within the casing for forcibly impelling a flow of air over said heat radiating elements, said boiler chamber, tube passages, and vapor chamber forming a closed system wherein the boiling point of the liquid in the boiler chamber substantially determines the maximum tem-

perature to which said air flowing over the heat radiating elements may be subjected.

2. In a heat exchanger of the class described, the combination of upper and lower chambers, a nest of tubes extending between the chambers, fin members spaced longitudinally of the tubes and extending continuously therebetween across the tube nest, the fin members being disposed substantially perpendicular to the tubes, and means for delivering a forced draft of air to the tube nest in a direction substantially parallel to the tubes, the fin members being arranged to extend for progressively greater distances into the path of the draft for distributing the same longitudinally of the tubes.

3. A portable heat exchanger of the class described comprising means defining a heating or boiler chamber, means defining a steam or vapor chamber, a nest of tubes disposed between and in direct communication with both chambers, said chambers having free and unobstructed communication with all of the tubes, fin members spaced longitudinally of the tubes and extending continuously therebetween across the tube nest for dissipating heat from the tubes and for directing air directly across the tube nest in a path substantially normal to the tubes, means for delivering a forced draft of air to the tube nest in a direction which is substantially parallel to the tubes, the fin members being arranged to extend for progressively greater distances into the path of the draft for distributing the same longitudinally of the tubes, whereby to produce a substantially uniform distribution of air among the several passages formed by the fin members.

Signed by me at Westfield, Massachusetts this 8th day of January 1927.

CLARENCE K. PRINCE.

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