

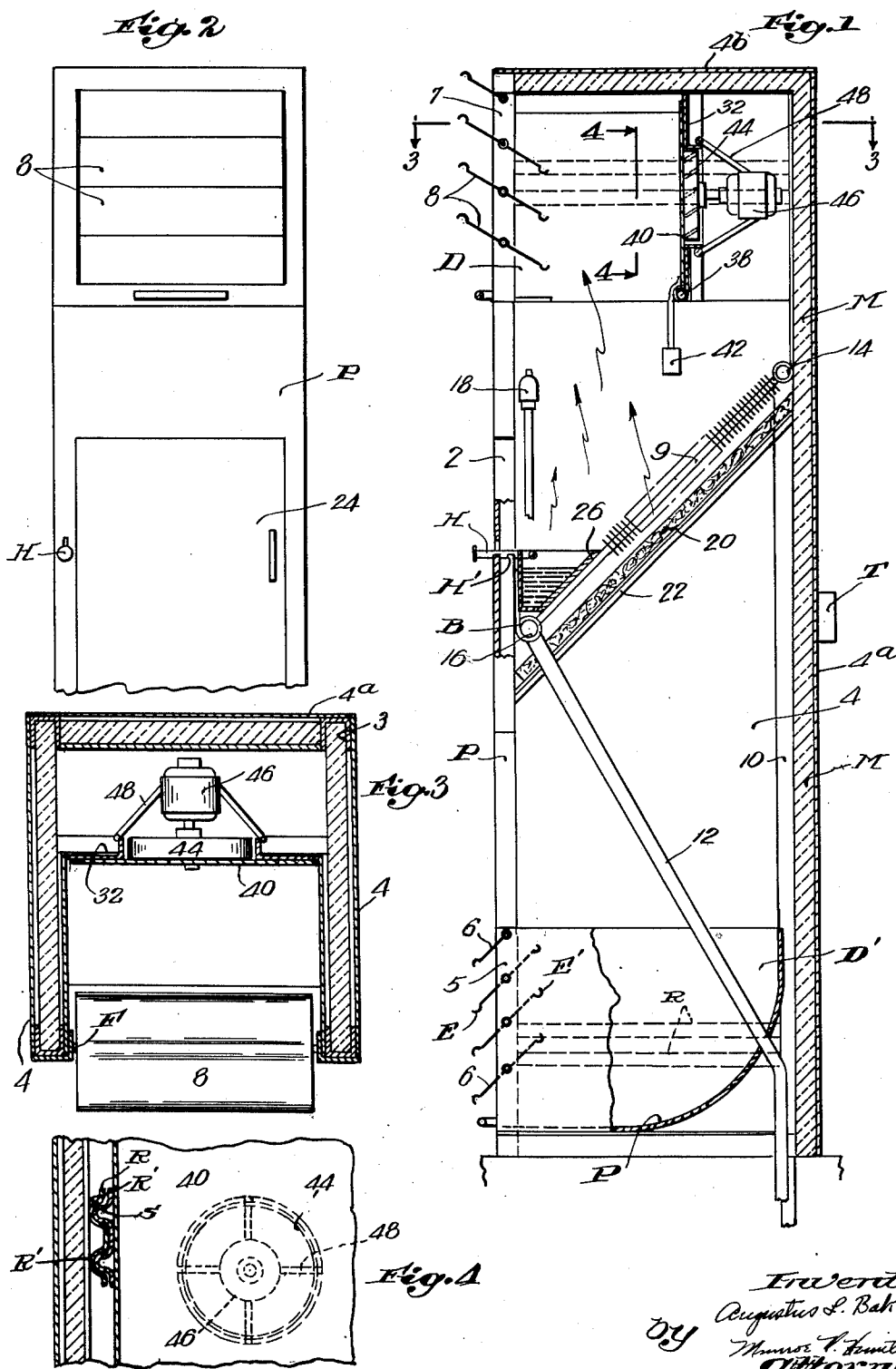
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FAN TYPE HEAT EXCHANGER

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FAN TYPE HEAT EXCHANGER

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This invention relates to an improved heating apparatus of the type in which heating is carried out with the aid of convection currents employed to transfer heat from a heating unit to the interiors of homes, offices, and various other buildings and locations where rapid and efficient heating is desired.

It is an object of the invention to devise an improved convector type heating apparatus which will be highly efficient and which may be easily and cheaply constructed and installed as a complete operating unit occupying a relatively small amount of space. It is also an object of the invention to provide means for furnishing heat in a uniform manner with elimination of noise, dirt, and the like, as well as making provision for suitable humidifying of air which is heated. Still another object of the invention is to combine with a convector type heating apparatus means for making it possible to utilize the apparatus as a cooling unit, as well as a heating unit.

These and other objects and novel features will be more fully understood and appreciated from the following description of a preferred embodiment of the invention selected for purposes of illustration and shown in the accompanying drawings, in which

Fig. 1 is a vertical, cross-sectional view illustrating the apparatus of the invention with some of the parts of the device in an operative position for heating purposes;

Fig. 2 is a fragmentary front elevational view further illustrating the outer casing of the apparatus;

Fig. 3 is a plan cross-section taken on the line 3—3 of Fig. 1; and

Fig. 4 is a cross-section taken on the line 4—4 of Fig. 1.

Referring more in detail to the structure shown in the drawings, the heating apparatus shown generally includes a casing or cabinet which is designed to have air circulated therethrough in accordance with well-known principles of convection of heat. The casing preferably extends from the floor to the ceiling of the room where it is to be disposed, although the casing need not necessarily be of any particular height. In constructing the casing I may employ any suitable material, such as wood, sheet metal, and the like, as well as combinations of these materials.

As will be observed from an inspection of Fig. 1, the casing is of a generally rectangular construction including a frame made up of vertical corner pieces 3 which may conveniently be of a U-shaped cross-section arranged in the manner

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shown, and having secured thereto outer side walls 4, a rear wall 4a, and a top 4b. The front side of the casing is formed with a panel P in which is mounted a door 2, as shown in Fig. 2.

Rigidly secured to the inner sides of the frame pieces 3 in parallel spaced relation to the side walls 4 at both the upper and lower ends of the casing, are transverse rails R, more clearly shown in Figs. 1 and 4. As noted therein each rail is formed with spaced-apart ribs or corrugations R' which may be pressed or formed into the rails to constitute reinforcing guides.

It is also desirable in a casing of this type to provide for heat insulating layers of material and I have found that I may conveniently locate rigid layers or sheets M of fibrous insulating material in the space included by the U-shaped frame corners lying between the outer sides of the casing and the supporting members which are attached to the inner surfaces of the U-shaped corner members. This arrangement of insulating material has been further illustrated in Figs. 3 and 4 and, as shown therein, occurs on three sides of the casing.

The front side of the casing at points above and below the panel P is formed with openings through which are slidably received two drawer-like structures D and D' which are slidably supported on the guide ribs of the rails R. This may be conveniently accomplished, for example, by providing at the side portions of each drawer-like member guide strips S which are formed with complementary guide rib portions which are adapted to rest snugly within guide rib portions R' of the rails R. Also, the drawer-like members D and D' are formed with outer front sides which, in a closed position of the drawer-like structures in the casing, constitute a part of the front side of the casing when the latter member is viewed in the position shown in Fig. 2.

In the front side of the lower drawer-like structure D' I have provided an opening, the edges of which are turned inwardly to form a flanged portion F'. Horizontally disposed through two opposite sides of this flanged portion F' are pins which carry individually adjustable louvres 6, these louvres being formed with curved edges E and E' which are adapted to interlock with one another. When the louvres are opened they define air passageways 5, and in this open position they extend downwardly, as shown in Fig. 1. In such a position the open louvres function to collect air and guide it into the casing.

Similarly, in the front side of the drawer-like structure D I have provided an opening with the

same flanged and pinned louvre construction above described, in which the louvres are denoted by the numeral 8 and the openings defined by the louvres in an open position by the numeral 7. The principal point of difference in the arrangement of the louvres, in the case of the drawer-like structure D, is that the louvres extend upwardly as shown in Fig. 1, and in this position may serve to collect warm air and guide it downwardly of the casing where a cooling operation is carried out, as will be described hereinafter.

With the arrangement described, and with the louvres in the open position shown in Fig. 1, a flow of air will normally be introduced through the bottom of the casing upwardly between its walls and up through the air outlets 7. Moreover, by adjusting the position of the louvres, either in part or in whole, a considerable range of control of the volume of air circulated through the casing may be realized. Alternatively, the drawer-like structure after suitable rearrangement as hereinafter described, may be used to guide warm air downwardly through the casing and provide cooling, where this is desired.

In accordance with the invention I combine with the casing structure described a novel heating unit, together with means for converting the drawer-like structure D into a special air conduit member having two air conduit sections through which heated air passing from the heating unit may be selectively guided in order to greatly enhance the efficiency and heating value of convection currents circulating through the casing.

The two air conduit sections include a free flow air conduit section comprised by the front part of the member D and a forced flow air conduit section comprised by the rear part of member D, which latter section communicates with the free flow air conduit section. Both of these sections are located above the heating unit in such relative position that free flowing heated air passing from the heated unit will normally rise and seek to pass through the free flow conduit section and then out of the openings 7. However, when a forced flow of air is required to provide more heat, the free flow section can be closed at its bottom side and the heated air from the heating unit will then be directed through the forced flow conduit section without loss of heating efficiency.

The heating unit of the invention is denoted by the numeral 9 and is arranged so as to aid materially in directing the flow of air in the manner described. Thus the heating unit 9 preferably comprises a plurality of tubular members adapted to be heated by means of steam, hot water, or other fluids. The tubular members are arranged in an inclined manner so chosen that each tubular member extends from a point just inside the front wall or panel P of the casing rearwardly and upwardly to a point just in front of the rear wall 4a of the casing, as will be seen.

With an inclined arrangement of the tubular members, such as noted, I have found that a substantially increased heating area is developed for any given size of casing body and, as a result, very beneficial changes are realized. Air is caused to move into contact with this relatively greater contact heating area and develops increased efficiency in operation of the heating unit. This desirable feature is further enhanced by constructing the tubular members of the heating unit with a plurality of spaced-apart fins of

the type which are customarily fixed to the outer periphery of heating tubes and which, in the present arrangement of the invention, not only extend at right angles to the axes of the tubes but actually lie in planes adapted to deflect heated air in the general direction of the free flow air conduit section. The combined effect of an inclined arrangement of the tubes and the fins extending at right angles from the inclined tubes is to also produce a desired baffling action by which heated air is deflected from substantially all over the surface of the heating unit and then circulated upwardly to the free flow air conduit section, as noted.

Feed and return pipes 10 and 12, respectively, are connected to the inclined tubes 9 to supply heating fluid thereto. This is preferably accomplished with the aid of horizontal header and return pipes 14 and 16 which extend along the respective rear and front walls of the casing, as shown. Numeral 18 denotes a vent pipe connected at one end of the return pipe 16.

Located in the casing in an inclined position and in spaced relation to the under side of the heating unit 9 to cooperate therewith, is an air deflecting member 20 which acts somewhat as a filter and which may, for example, comprise a layer of fibrous material, such as steel wool, or other similar fibrous substances. The member 20 operates to baffle and slow flow of air throughout a relatively greater surface area of the heating unit 9. This prevents flow of air through the heating unit at a localized point such as might otherwise occur and destroy its efficiency. The air deflector member 20 is preferably supported on inclined rails 22 which are mounted between the front and rear walls of the casing, and with this arrangement the air deflecting member may, when desired, be removed from the casing by opening the door 2 at the front side of the casing and then sliding the member 20 outwardly along the rails.

Pivotaly mounted on the return pipe 16 is a humidifying unit 26 which essentially comprises a trough or container for receiving and holding water to be vaporized by heat transferred from the heating unit 9 through the walls of the trough or container 26. To facilitate this vaporizing action the humidifier 26 is formed with an inner sloping side which is adapted to be manually moved into and out of contact with the inclined tubes of the heating unit 9 by means of a handle H. To facilitate heating of the humidifier the fins at the lower ends of the tubes of heating unit 9 have been left off, thus allowing the inclined side of the humidifier in one position to rest directly upon the pipes, as shown.

In making an adjustment of the humidifier relative to the pipes by means of the handle H, I may employ some convenient bearing means for rotatably mounting the humidifier on the return pipe 16. Two sleeve bearings may be used for this purpose, and one of these bearings has been illustrated in Fig. 1 and denoted by the letter B. The under side of the handle may, if desired, be formed with notch portions H' which allow the handle H to engage with an edge of the casing and thus adjustably support the humidifier in different positions with respect to the heating tubes. It is pointed out that humidified air rises directly upward toward the bottom of the free flowing conduit section and becomes mixed with relatively drier air from the heating unit 9 at points just below the conduit section.

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Considering in greater detail the structure of the member D', it will be observed that this member is formed with two sides and a rounded bottom plate P which serves to deflect air upwardly through the open side of the member D'. Each of the two sides of member D' are formed with guide ribs spaced one above another in a manner corresponding to that of the member D shown in Fig. 4, with the exception that the guide ribs are reversed so as to enable the drawer D' to be inverted and then inserted in the space normally occupied by drawer-like member D. Similarly, member D may, by being turned over upon itself, be inserted in the space occupied by drawer D'. That is, the drawer-like structures are interchangeable and are slidably supported on the rails R, but the guide ribs on each drawer structure are spaced from the bottom edges of each drawer structure a distance so chosen that the bottom drawer D' can only be inserted in the space of the top drawer D when drawer D' is in an inverted position. Likewise, top drawer D can only be inserted in the space normally occupied by drawer D' when drawer D is inverted.

As shown in Fig. 1, the drawer-like structure D is constructed somewhat differently from member D' and includes a front, two sides, and a top, all of which are preferably welded together to form an integral body. As has been pointed out in an earlier point in the specification, the sides of the member D have attached thereto guide strips S which slide in the corrugations of the rails R. It is pointed out that the guide strips S extend all the way back to a point closely adjacent to the rear wall of the casing. However, the sides of the drawer-like structure extend rearwardly only part way and terminate at a point approximately intermediate the front and rear sides of the casing. The space included by the drawer sides and the top is substantially closed by special partition means which include an annular bracket 32 and four corner pieces which cooperate with the bracket to provide for substantial closing of the space between the drawer sides. The annular bracket is of a diameter approximately corresponding to the space between the sides of the drawer-like structure and at two opposite points thereon the bracket is welded to the drawer to provide a rigid supporting body. The corner pieces preferably are welded to the edges of the drawer and to the annular bracket, although other desirable fastening means may be employed, if desired.

Solidly mounted to the annular bracket are inwardly converging arms 48 which support between their inner extremities a motor 45 in the manner shown in Figs. 1 and 3. The motor drives a shaft on which is mounted a fan 44, the blades of which turn in the opening included by the annular bracket 32. Since the motor and annular bracket are all a part of the drawer-like structure, it will be observed that the entire assembly may be moved in and out of the casing, at will, by sliding on the rails R. Moreover, the drawer may be completely removed from the casing and when turned over upon itself may be inserted at the opening occupied by the drawer D', as earlier described.

Pivotaly mounted between the two sides of the drawer-like structure D is a horizontal shaft 33 bearing thereon a shutter 40 and also attached centrally to one edge of the shutter is a counterweight member 42, more clearly shown in Figs. 1 and 4. The shutter normally assumes a vertical position when at rest, as shown in Fig. 1, and is

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adapted to lie directly in front of the opening in the annular bracket 32 so that it may be swung forwardly in a counter-clockwise direction, as shown in Fig. 1, to close the opening formed in the drawer-like structure D.

It will be observed that the shutter 40 in the vertical position described, lies in a substantially sealing relation with the partition means comprised by the annular bracket 32 and its adjacent corner pieces. In this position the shutter occurs just in front of the fan member 44 which is driven by the electrical motor in response to a thermostat control T. The blades of the member 44 project through and are free to rotate in the opening of the annular bracket 32, and when the fan 44 is operated it produces a current of air adapted to force the shutter 40 downwardly into a closed position with respect to the bottom of the drawer-like structure D.

It is pointed out that with the shutter in a raised position, as shown in Fig. 1, there is a free flow air conduit section formed by the top and sides of the drawer-like structure. In this raised position of the shutter, air currents passing upwardly from the heating units 9 will all pass through this free flow air conduit section. When, however, the shutter is closed, a second force-flow air conduit section is comprised by the rear portion of the drawer-like structure and immediately adjacent parts of the casing illustrated at the extreme right-hand side of this member in Fig. 1.

In this case air currents from the heating unit 9 are drawn upwardly through an opening directly through the motor and fan assembly and in response to the drag of the fan, air is pulled or drawn through the opening in the annular bracket 32 and then passed outwardly through the free flow air conduit section to be finally discharged through the air outlets 7.

From the foregoing description it will be seen that I have provided a novel and efficient convective type of heating apparatus in which a relatively large heating area is exposed to the flow of air and heated air thus produced can be selectively routed in accordance with the demand dictated by outside ambient temperatures, and irrespective of which one of the two air flow conduit sections is in operation at any given time there may be always maintained a sufficient degree of humidification to satisfy any desired condition. In this connection it is again pointed out that moist air and heated air are constantly mixed together at a point just below the free flow air conduit section. If the latter section is open the mixture will immediately be routed through the section and out of the openings 7. If the shutter is in a closed position the mixture of air is then guided rearwardly and upwardly around the motor and fan unit through the opening in the annular bracket 32 and then through the free flow air conduit section and out of the openings 7. By adjusting the position of the humidifier this mixture of moist and dry air may be varied, as desired. It will be apparent that by interchanging the drawer-like structures in an inverted position a substantial cooling effect may be introduced through the casing in order to take warm air and cool it.

While I have shown a preferred embodiment of the invention it will be understood that various changes and modifications may be resorted to in keeping with the spirit of the invention as defined by the appended claims.

I claim:

1. An apparatus of the character described

comprising an upright casing member, said casing being provided with lateral air openings in its upper and lower portions, a heating unit mounted in said casing between the lateral openings, said heating unit exposing a relatively large area for contact with air flowing from one of the openings to the other, air conduit means supported at the upper end of the casing and including a free flow air conduit section, and a forced flow air conduit section communicating with the free flow air conduit sections, and means for selectively controlling flow of air through the said air conduit sections.

2. A structure as defined in claim 1, in which the means for controlling the flow of air includes a power driven fan and a shutter operative in response to movement of the fan to close one side of the said free flow air conduit section and cause air to enter the said air conduit means through the forced flow conduit section.

3. A structure as defined in claim 2, in which the shutter is mounted on a shaft pivoted in the free flow air conduit means, and a counter weight is attached to the shaft to normally hold the shutter in a raised position.

4. A structure as defined in claim 2, in which the power driven fan is mounted in the forced flow section of the said air conduit means.

5. A structure according to claim 4, in which the air conduit means and the power driven fan mounted therein are slidably received in the casing.

6. An apparatus of the character described comprising an upright casing, said casing being provided with lateral air openings in its upper and lower end portions, a heating unit in said casing between the lateral openings, said heating unit exposing a relatively large area to contact with air flowing from one of the openings to the other, air conduit means supported in the upper end of the casing, said air conduit means including a drawer-like structure which is open at its under side and which has mounted therein a transversely disposed partition, said partition being arranged to form a free flow air conduit section and a forced flow air conduit section communicating with the said free flow conduit section, said partition being formed with a fan aperture, a fan mounted for rotation in the opening, a motor for driving the fan, and a shutter operative in response to movement of the fan to close the opening at the bottom of the free flow air conduit section and cause air to flow through the forced flow air conduit section.

7. A device as described in claim 1, in which the casing is formed at its lower end with a compartment in which the said air conduit means may be received to produce a reverse flow of air downwardly through the casing, and a drawer-like structure normally located in the said compartment and adapted to be interchanged and received in the space occupied by the air conduit means at the top of the casing.

8. A structure according to claim 1, in which the casing is constructed with guides on which the said air conduit means is mounted for movement in to and out of the casing.

9. An apparatus according to claim 6, in which the casing is formed at its lower end with a compartment in which the said drawer-like structure may be received to induce a flow of air downwardly through the casing, spaced-apart guide means located on the sides of the drawer-like structure, and cooperating guide rails in the casing for slidably receiving and locating the drawer-

like structure in the said compartment in an inverted position.

10. An apparatus as described in claim 6, in which the drawer-like structure is constructed with a front side which includes a plurality of individually movable louvre panels.

11. An apparatus according to claim 1, including an air deflecting member located in the casing below the said heating unit in a position to distribute air throughout the surface area of the heating unit.

12. An apparatus according to claim 11, including air humidifying means located in the casing at one side of the heating unit.

13. An apparatus of the character described comprising a casing constructed to extend substantially from the floor to the ceiling of a room and provided with lateral air openings in its upper and lower end portions, a heating unit arranged in an inclined position in said casing between said openings, said unit exposing a relatively large area to contact with air flowing from one of said openings to the other, an air circulating assembly comprising a fan, a motor for driving the fan, and a drawer-like structure on which said fan and motor are supported, said casing being provided with recesses near its top and bottom, in either of which said assembly may be mounted selectively to force air through said casing either up or down, as desired.

14. An apparatus of the character described comprising a casing constructed to extend substantially from the floor to the ceiling of a room and provided with lateral air openings in its upper and lower end portions, an inclined heating unit in said casing between said openings, said unit exposing a large area to contact with the air flowing from one of said openings to the other, an air humidifying member disposed at one side of the heating unit, an air circulating assembly comprising a fan, a motor for driving said fan, a support on which said fan and motor are mounted, said assembly being positioned in said casing substantially in alignment with one of said lateral openings to force air therethrough, and said casing having guides on which said support is mounted for the sliding movement of said assembly into and out of said casing.

15. An apparatus according to claim 1, in which the heating unit is supported in an inclined position in the casing to provide a relatively great area of contact with air flowing therearound.

16. A structure according to claim 15, including an air deflecting member arranged in parallel spaced relation to the under side of the heating unit to distribute air flowing through the casing throughout substantially the entire contact surfaces of the heating unit.

17. An apparatus as described in claim 15, in which the heating unit is of the convactor tube type including a plurality of tubes having fins arranged in spaced-apart relation and extending at right angles to the axis of the tubes, and an air deflecting member supported in the casing in spaced-apart relation to the under side of the heating unit to distribute air throughout substantially all of the contact surfaces of the fins of the heating unit.

18. An apparatus according to claim 1, in which the heating unit extends from the front wall of the casing inwardly and upwardly to form a relatively large inclined heating surface, said heating unit including a plurality of tubular members, and fins arranged at right angles to the axis of the tubular members, the lower end of

the tubular members being free from the said fins, and a humidifier element rotatably supported in the casing and arranged to lie in contact with the said tubes.

19. An apparatus as defined in claim 18, including means for moving the humidifying element into and out of contact with the said tubes.

20. An apparatus as described in claim 1, including means for automatically actuating the selective control means.

21. A structure as defined in claim 2, in which the shutter is mounted on a shaft pivoted in the free flow air conduit means, and a counterweight attached to the shutter and cooperating therewith to normally hold the shutter in substan-

tially sealed relationship with respect to the said forced flow air conduit section.

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