Feb. 12, 1935. H. G. ULLMAN 1,991,339

HEAT EXCHANGE APPARATUS

Filed June 29, 1932 2 Sheets-Sheet 1

Fig. 1.

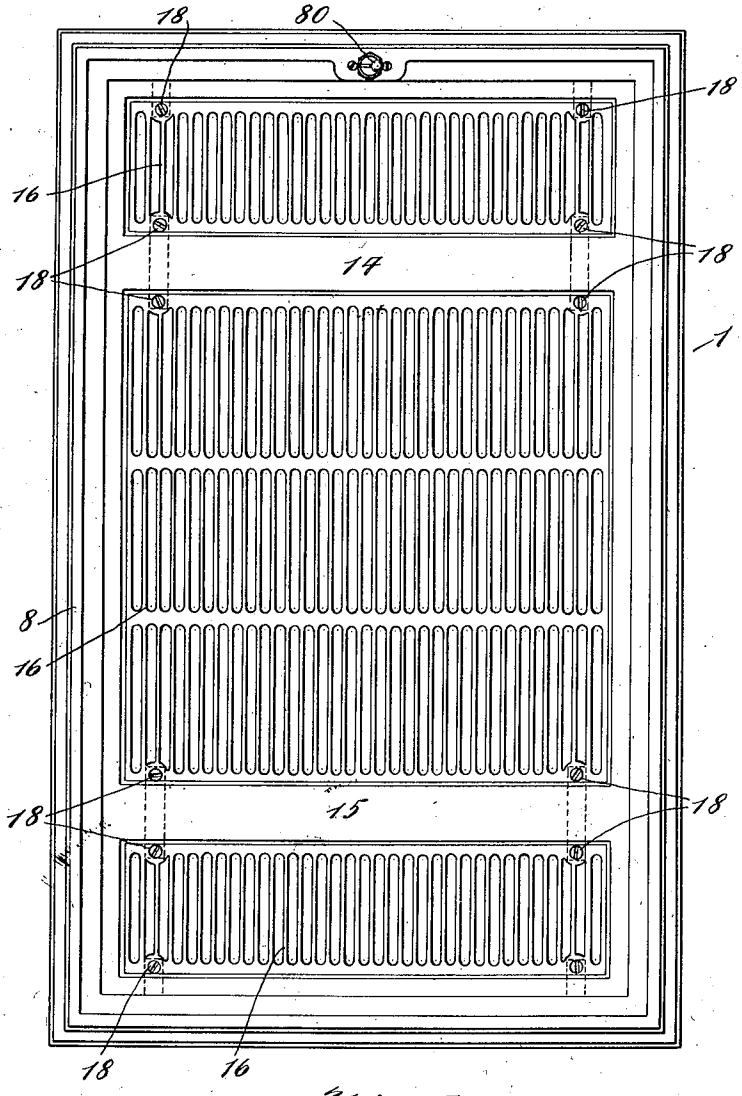
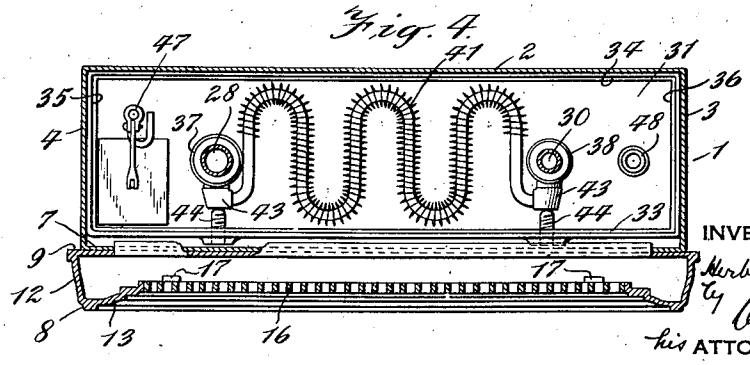


Fig. 4.



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Fig. 2.

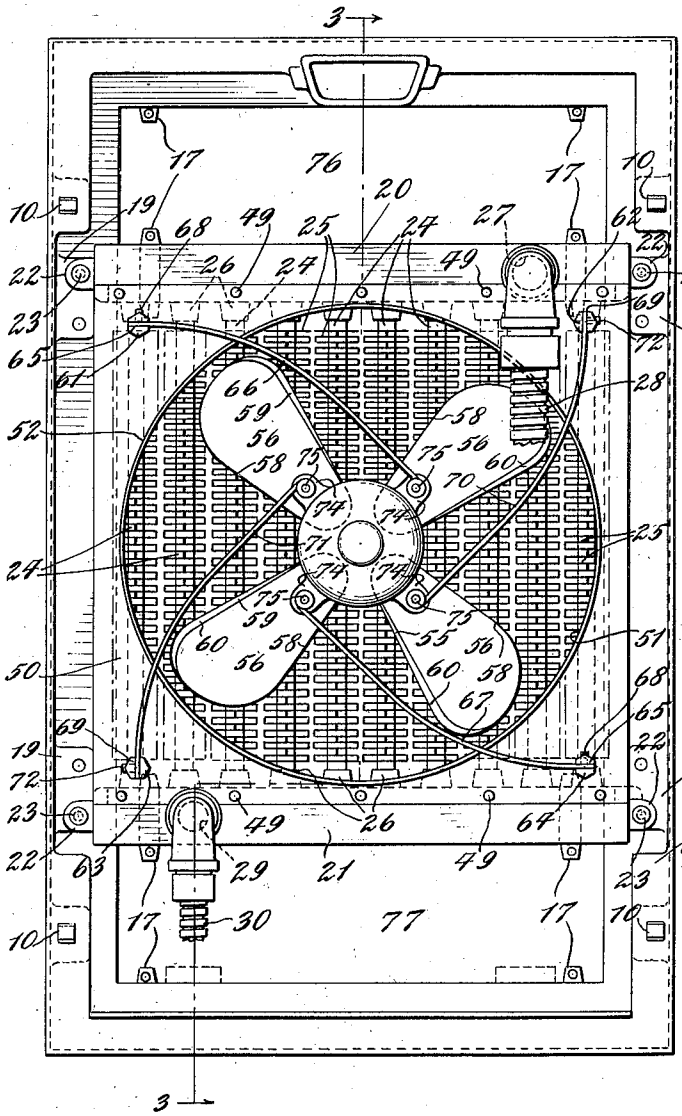


Fig. 3.

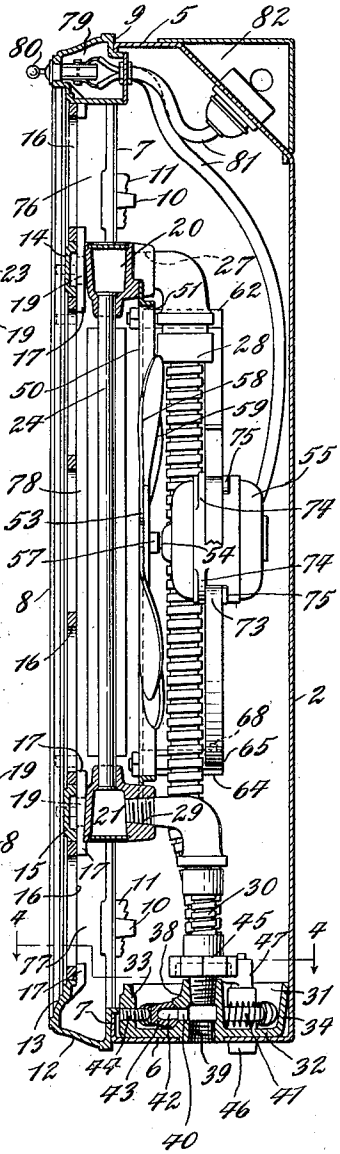
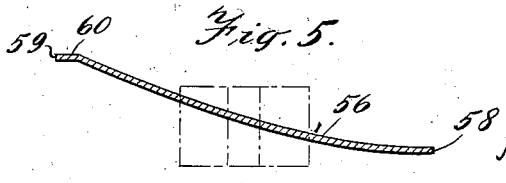


Fig. 5.



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UNITED STATES PATENT OFFICE

1,991,339

HEAT EXCHANGE APPARATUS

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Application June 29, 1932, Serial No. 619,840

7 Claims. (Cl. 257—137)

My invention relates to new and useful improvements in heat exchange apparatus, and more particularly to an apparatus for treating or conditioning air supplied to a room or the like.

An object of my invention is to provide an apparatus in which air to be supplied to the room or space will be passed into intimate heat exchanging relation to heat exchange means.

Another object is to provide a unit heat exchanger having a fan or impeller for discharging the air over the surface of the heat exchange means.

The invention consists in the improved construction and combination of parts and their aggroupment in operative relation, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Figure 1 is a view in front elevation of an apparatus embodying my invention;

Fig. 2 is a view in rear elevation with the rear part of the casing removed to show the internal construction;

Fig. 3 is a view in section on the line 3—3 of Fig. 2;

Fig. 4 is a view in section on the line 4—4 of Fig. 3, and

Fig. 5 is a detail section taken transversely to the length of a fan blade.

Referring to the drawings by characters of reference, 1 designates a hollow casing, preferably substantially rectangular, having a rear wall 2 with forwardly extending side walls 3, 4 and top and bottom walls 5, 6. The front of the casing is open and provided with an inturned surrounding flange 7 to which is secured a surrounding frame 8, preferably rectangular, which extends somewhat beyond the margin of the top, bottom and side walls to provide a rearward facing shoulder 9 adapted to seat against the surface of a wall or the like into which the casing 1 is to be set. The flange 7 is preferably apertured to receive lugs or ears 10 projecting rearwardly from the frame 8, and the flange is clamped to the frame by wedges 11 passed through the lugs 10 and overlying the flange. The frame 8 has a forwardly directed, continuous surrounding flange 12 provided at its front edge with a lateral, inwardly directed, continuous flange 13 at the front edge of flange 12. Extending horizontally between the side frame members in the plane of flange 13, there are upper and lower cross bars or frame members 14, 15, respectively, which are spaced vertically from the top and bottom of the frame and casing. Perforate plates or grille panels 16 serve as closure means for the open front of the casing and are fitted into the openings formed by the rectangular frame and the cross frame members. The flange 13 and cross bars or members 14, 15 have lugs 17 projecting therefrom and against which the panels 16 seat. The panels are secured removably in position by screws or the like 18 passed through the panels and screw threaded into the lugs 17.

The side members of the frame 8 are provided with vertically spaced, horizontally alined, upper and lower bosses 19 projecting rearwardly from the flange 13 and positioned at the ends of the cross frame members 14, 15. Located behind the members 14, 15 there are upper and lower hollow headers 20, 21, respectively, which lie in the horizontal planes of and are substantially concealed by the members 14, 15. The headers have at their ends laterally extending, apertured lugs or ears 22 which overlie and seat against the bosses 19, to which the lugs 22 are secured by screws or the like 23, such that the headers are rigidly fixed to the frame. The headers are communicatively joined by a row of laterally spaced, vertical heat exchange tubes or conduits 24, preferably provided with extended surface or fins 25 which may be of any well known construction. The tubes 24 are fitted and sealed at their opposite ends into alined upper and lower rows of hollow nipples 26 opening into the hollow headers. The upper header is provided adjacent one end with a port 27 in its rear wall, the port having an internally threaded nipple which receives one end of a conduit 28. The lower header has a port 29 in its rear wall and adjacent its other end, so that the ports are spaced laterally of each other. A conduit 30 is connected at one end to port 29, and is preferably threaded into a nipple surrounding said port.

Within the casing and supported on the bottom wall thereof, there is a humidifier pan or open-topped reservoir 31, preferably substantially rectangular, which extends rearward from the frame 8. The reservoir has a bottom wall 32 from which rise side walls 33, 34 and end walls 35, 36. The bottom wall 32 has upstanding hollow coupling members 37, 38 which are preferably substantially vertical beneath the ports 27 and 29, respectively. Each member 37, 38 has a vertical bore 39 therethrough which opens through the bottom wall 32 and which is internally threaded at its upper and lower ends. Each of the members 37, 38 is provided adjacent the bottom wall of the reservoir with a lateral port 40 facing the side wall 33. Within the reservoir and preferably resting on the bottom wall, there is a by-pass conduit 41, preferably of finned tubing and of serpentine form positioned between members 37, 38, and having one end communicating with one of said ports 40 and its other end communicating with the other of said ports 40. The ends

of the conduit 41 are secured and sealed into the bores 42 of head or block members 43 having substantially conical faces through which the bores 42 open and which seat in the conically flared outer ends of the ports 40. Through the side wall 33 there are adjustably screw-threaded securing screws 44 which engage and hold the head members 43 tightly seated and clamped against the members 37, 38. The free ends of the conduits 28 and 30 are provided with unions or the like 45 by which the conduits are connected to the upper ends of the bores 39. The reservoir 31 has an inlet conduit 46 for connection to a source of water supply, the conduit being controlled by a float valve 47 within the reservoir and preferably opening through the bottom wall 32 adjacent one end of the reservoir. A drain or overflow outlet pipe 48 opening through the bottom wall 32 is provided at the other end of the reservoir and has its inlet above the plane of the bottom wall to determine the maximum level of water in the reservoir.

Secured, as at 49, to the upper and lower headers behind the tubes, there is a baffle or orifice plate 50 which extends between the side frame members and the headers. Through the plate 50 there is a circular aperture 51 having a marginal rearwardly extending, continuous flange 52. A fan or impeller 53 is positioned in the aperture 51 and is mounted on the shaft 54 of a motor 55 supported within the casing. The fan has a plurality of radially extending blades 56 which are rigidly secured at their inner ends to a disc or hub 57 fast on the motor shaft. The motor shaft 54 is preferably normal to the plane of the tubes 24, so that the blades rotate in a plane substantially parallel to the plane of the tubes. The front or driving faces of the blades are inclined to the direction of rotation so that the leading edges 58 of the blades are spaced from the tubes a greater distance than are the trailing edges 59. Each of the blades has a trailing edge portion 60 which is preferably substantially parallel to the plane of rotation, such that the angle of inclination of the portions 60 to the direction of rotation is less than the angle of inclination of the body of the blades and is preferably substantially zero degrees. The portions 60 are tapered longitudinally of the blades, the width of the portions increasing uniformly toward the outer free ends of the blades such that the increase in width is substantially proportional at a given rotational shaft speed to the linear velocity of predetermined points of increasing radius on the trailing edge of a blade. This construction of the fan blades renders the fan quiet in operation, eliminating the noise resulting from the operation of a fan positioned close to a perforate wall through which air is forced by the fan.

The baffle plate 50 is provided with a plurality of rearwardly projecting, substantially horizontal posts, preferably four in number and designated 61, 62, 63 and 64, which are rigidly fixed in apertures in the plate 50. The posts are preferably spaced equidistantly from each other and from the motor shaft, the posts 61, 62 being positioned closely adjacent the opposite ends of the upper header and the posts 63, 64 being positioned closely adjacent the opposite ends of the lower header. The posts 61 and 64 are each provided with a substantially horizontal end slot 65. Positioned in the slots 65 are resilient blade members or leaf springs 66, 67, which are secured in the slots by set screws 68 or the like. The posts 62, 63 are provided with vertical end slots 69 in which are positioned resilient blade members or leaf springs 70, 71 which are secured in the slots by set screws 72 or the like. The springs which are of substantially equal length are positioned in a substantially common vertical plane and are provided at their free ends with bearing loops or sleeves 73. The motor casing has a plurality of lugs or ears 74, preferably four in number, positioned in a vertical plane and equally spaced about the periphery of the casing. Projecting rearwardly from the ears 74 are bearing or pivot pins 75 which receive the spring loops or sleeves 73 to resiliently support the motor. The springs are flexed or bowed inwardly toward the motor and are held under tension so that the motor casing is resiliently supported against clockwise and counterclockwise turning movements and against displacement in a vertical plane. It will be seen that the springs are bowed or flexed in a plane normal to the axis of rotation of the motor shaft.

The cross frame members 14, 15 together with the headers 20, 21, respectively, divide the front portion of the casing into upper and lower flow passages or spaces 76, 77, respectively, and an intermediate discharge passage 78 for the fan. The fan motor is controlled by a switch 79 supported within the casing at the top of the frame and having an operating lever 80 projecting through the frame. The switch is inserted in the motor lead wires 81 which are adapted for connection to a source of current supply at an outlet box 82 in the casing.

In operation, the casing is preferably set into a wall recess with the shoulder 9 abutting the face of the wall and with the conduit boxes 39 connected to supply and return pipes (not shown) for a fluid heat exchange medium. The apparatus is adapted for either heating or cooling a room or compartment and when employed for heating, the conduit 29 is connected to a source of steam or other heating medium, while conduit 30 serves as the return line from the heat exchanger. If steam is now supplied to the tubes 24 of the heat exchanger, air will flow by convection through the casing, entering at and through the lower opening or passage 77 and leaving or discharging from the upper flow opening or passage 76 and be heated in its passage through the casing by the heat exchanger. When the switch 79 is closed to start the motor, the fan will draw air into the casing through the passages 76 and 77 and discharge the air over and between the finned tubes 24 and out of the casing through the discharge passage 78. The discharged air is passed into intimate heat transfer relation to the tubes 24, which by reason of their extended surface efficiently heat the air prior to its discharge into the room. By employing the above described trailing edge portions on the fan blades, the unit may be made more compact, as the fan may be positioned very close to the exchanger without causing windage and air noise. The resilient support for the fan motor absorbs starting and stopping torque and eliminates transmission of operating vibration to the frame and casing. Steam passing through conduit 28 will have a portion thereof by-passed through conduit 41 within the humidifier reservoir, which will heat the water in the reservoir and increase the evaporation thereof. The moisture rising from the open top of the reservoir is picked up by the air stream entering the lower flow opening 77 and is discharged therewith through either the upper

flow opening 76 or the fan outlet 78, depending on whether or not the fan is in operation.

When the apparatus is to be employed for cooling the space or room in which it is situated, the tubes 24 are supplied with refrigerant or other fluid cooling medium, the conduit 30 preferably being connected to the source of supply and the conduit 28 serving as the return line from the heat exchange means. When the apparatus is so employed, the water supply to the reservoir inlet passage 41 is cut off. With the fan stopped, air flow will take place through the casing by convection, the air entering the casing at the upper flow opening 76 and passing downward therethrough and out of the casing through the lower flow opening 77. As the air passes through the casing, it will be cooled by the heat exchange means which will absorb heat from the air. When the switch 79 is closed to start the motor, the fan 53 will draw air into the casing through both the upper and the lower flow passages, and discharge the indrawn air into intimate heat exchange relation to and over and between the cooled finned tubes 24 and thence from the discharge opening 78 into the room or space to be cooled.

What I claim and desire to secure by Letters Patent of the United States is:

1. An apparatus of the character described, comprising a supporting frame, upper and lower spaced headers rigidly secured to said frame, heat exchange tubes interconnecting said headers, conduits connected to said headers for passing a heat exchange medium through said tubes, posts rigid with said frame and extending rearwardly therefrom, a motor, leaf springs secured to said posts and to said motor to support said motor, said springs being bowed and held flexed under tension whereby said motor is resiliently supported, and a fan driven by said motor for forcing air between and over said tubes.

2. An apparatus of the character described, comprising a supporting frame, upper and lower spaced headers rigidly secured to said frame, heat exchange tubes interconnecting said headers, conduits connected to said headers for passing a heat exchange medium through said tubes, posts rigid with said frame and extending rearwardly therefrom, a motor and motor shaft, a plurality of leaf springs, each of said springs having one of its ends secured to one of said posts and having its other end pivotally secured to said motor, said springs being bowed in a plane normal to the axis of rotation of said shaft, and a fan driven by said motor shaft for forcing air between and over said tubes.

3. An apparatus of the character described, comprising a hollow casing having an open front, a supporting frame secured to said casing and surrounding said open front, heat exchange means within said casing and secured to said frame, said exchange means being positioned intermediate the top and bottom of said casing to provide upper and lower flow passages, means to supply a heat evchange medium to said exchange means, a baffle plate extending across said frame at the rear of said exchange means and having a discharge aperture therethrough, a fan in said aperture operable to draw air through said flow passages into said casing and discharge the indrawn air through and over said exchange means, and a motor in said casing operatively connected to said fan.

4. An apparatus of the character described, comprising a hollow casing having an open front, a supporting frame secured to said casing and surrounding said open front, heat exchange means within said casing and secured to said frame, said exchange means being positioned intermediate the top and bottom of said casing to provide upper and lower flow passages, means to supply a heat exchange medium to said exchange means, a baffle plate extending across said frame at the rear of said exchange means and having a discharge aperture therethrough, a fan in said aperture operable to draw air through said flow passages into said casing and discharge the indrawn air through and over said exchange means, a motor in said casing operatively connected to said fan, and means on said plate supporting said motor.

5. An apparatus of the character described, comprising a hollow casing having an open front, a supporting frame secured to said casing and surrounding said open front, a pair of vertically spaced substantially parallel cross bars providing flow openings at the top and bottom of said casing and a discharge opening intermediate said flow openings, grille panels secured to said frame and closing said openings, upper and lower headers positioned behind said cross bars and rigidly secured to said frame, laterally spaced fluid conducting tubes extending between and communicating with said headers, a conduit connected into each of said headers, said conduits serving to supply and withdraw a heat exchange medium to and from said headers and opening through a wall of said casing, a motor in said casing positioned centrally of said tubes, and a fan on the motor shaft operable to force air between and over said tubes and from said casing through said discharge opening.

6. An apparatus of the character described, comprising a hollow casing having an open front, a vertically positioned heat exchange means extending across said open front and spaced above the bottom wall of said casing to provide an inlet passage, a fan in said casing operable to draw air into said casing through said inlet and discharge the indrawn air over said exchange means, an open-topped reservoir in said casing having means to supply water thereto, an inlet conduit and an outlet conduit for said exchange means operable to supply heating medium thereto, said reservoir having a by-pass conduit communicating with said first-named conduits whereby to increase evaporation of water in said reservoir.

7. An apparatus of the character described, comprising a hollow casing having an open front, a supporting frame secured to said casing and surrounding said open front, said frame including transverse cross bars providing an air inlet opening at the bottom of said casing, and a discharge opening above said inlet opening, grille panels secured to said frame and closing said openings, upper and lower transverse headers positioned behind certain of said cross bars and rigidly secured to said frame, said lower header being above said inlet opening, spaced fluid conducting tubes communicatively connecting said headers and extending across said discharge opening, a conduit connected to each of said headers and serving respectively to supply and withdraw a heat exchange medium to and from said headers, and a fan and fan motor supported on said frame and operable to draw air through said inlet into the casing and propel the air through the spaces between said tubes and out of said discharge opening.

HERBERT G. ULLMAN.