

May 31, 1949.

F. M. JONES
MEANS FOR PREVENTING FROSTING OF
EVAPORATOR HEAT EXCHANGERS
Filed Jan. 2, 1943

2,471,692

FIG. 1.

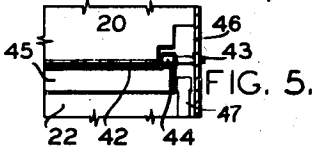
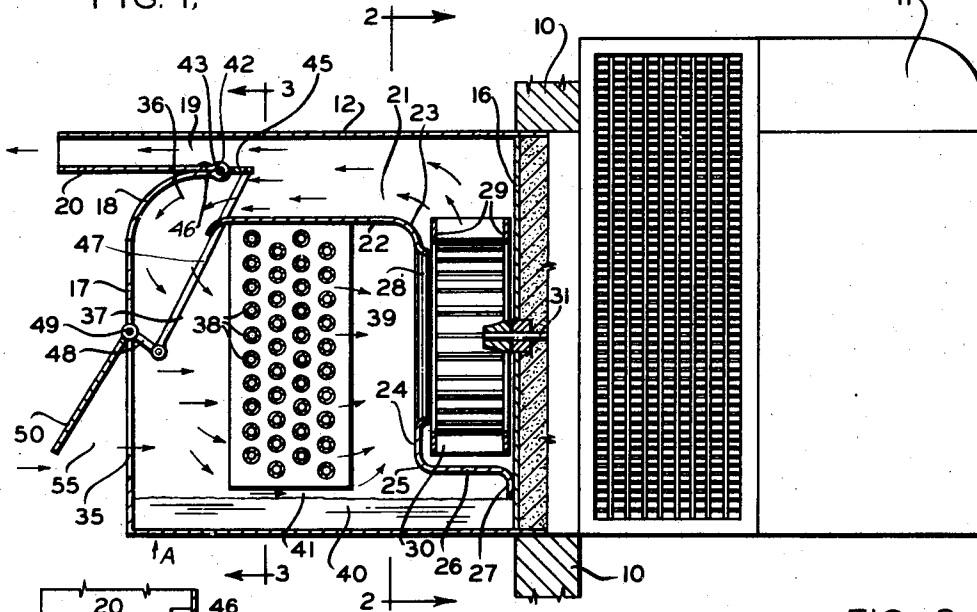


FIG. 3.

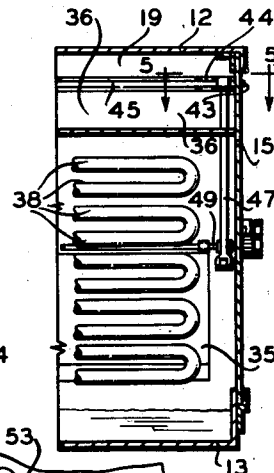


FIG. 4.

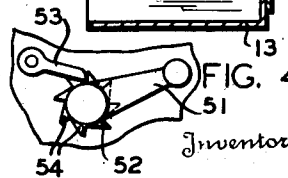
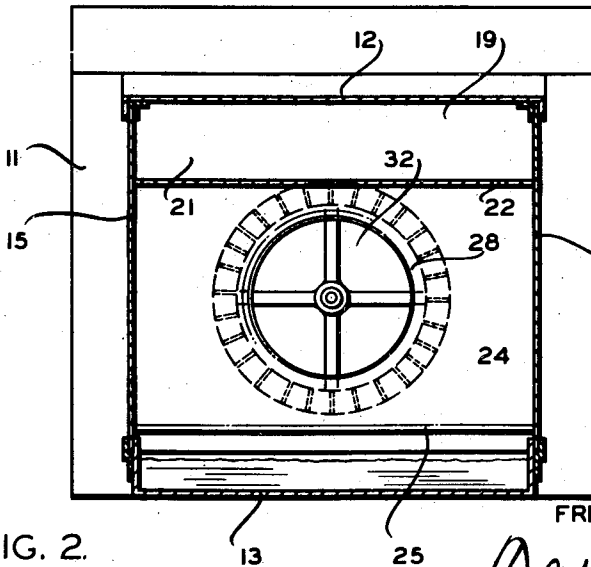


FIG. 2.



FREDERICK M. JONES

By *F. A. Whiteley*

Attorney

UNITED STATES PATENT OFFICE

2,471,692

MEANS FOR PREVENTING FROSTING OF
EVAPORATOR HEAT EXCHANGERS

Frederick M. Jones, Minneapolis, Minn., assignor,
by mesne assignments, to U. S. Thermo Control
Co., Minneapolis, Minn., a corporation of Min-
nesota

Application January 2, 1943, Serial No. 471,206

7 Claims. (Cl. 62—129)

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My invention relates to means for preventing frosting of evaporator heat exchangers, and has for its object to provide, in combination with the blower or fan for moving air through an evaporator heat exchanger, means for controlling the flow of air after it is drawn through the heat exchanger so that desired amounts of the cooled air may be returned through the heat exchanger and thus a large volume of air be kept constantly moving through the heat exchanger, which, since the temperature of the whole mixture of air will be above the freezing point, will result in preventing the formation of frost on the heat exchanger coils.

In general practice in refrigerating compartments such as those of domestic refrigerators, and of commercial storage compartments including compartments for the transportation of perishables, the air is drawn from the compartment and passed through the evaporator heat exchanger and thereafter forced back into the compartment. This circulation of air normally carries all of the air moved from and back into the compartment. In practice the stream of air returning has been limited in volume so that even though when it enters the evaporator heat exchanger it is at a higher temperature than the surfaces of the coils, the contacting films of it are sufficiently cooled on said surfaces to deposit moisture and produce frost. I have discovered that the volume of air moved through the coils of the evaporator heat exchanger may be very greatly increased by driving a portion of the already cooled air directly back through the coils of the evaporator heat exchanger. In this way, many times, in practice five or six times, the volume of air which it is practical to send through the heat exchanger from the compartment can be caused to go through the evaporator heat exchanger. This is because too great a circulation of air in the compartment which is being cooled will have a correspondingly too great tendency to dehydrate the contents of the compartment. Only a limited flow, limited by the need of preventing dehydration of contents is practical to be moved into and from the compartment through the evaporator heat exchanger, but with the use of my invention any amount of air can be moved through the coils, and a sufficient amount and at sufficient speed to continually wipe all the surfaces of the cooling coils with fresh volumes of air so that the formation of frost is prevented.

It is a principal object of my invention, therefore, to arrange a casing about an evaporator heat exchanger and the air-moving means therefor so

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that a large part of the air drawn through the evaporator heat exchanger will be returned directly to the heat exchanger and only a relatively minor part of the air drawn through will circulate in the compartment.

It is a further object of my invention to provide a blower or fan having a capacity for moving air greatly in excess of that required to circulate air in the compartment, together with means in the air passages such that a large part of the air moved can be recirculated directly through the evaporator heat exchanger.

It is a further object of my invention to form about an evaporator heat exchanger a casing having its walls spaced from said heat exchanger and provided with inlet and outlet passageways and forming a branch passageway leading from the outlet passageway to the front of the evaporator heat exchanger, and provide a blower for moving air in said casing to cause the smaller part of said air moved to be drawn through the inlet passageway and discharged through the outlet passageway and the larger part of the air moved to go through the branch passageway and be recirculated through the evaporator heat exchanger.

It is a further object of my invention to provide a casing surrounding the heat exchanger and forming inlet and outlet passages therefor with damper means for varying the area of inlet and outlet whereby more or less of the air moved by the blower may be caused to pass through the evaporator heat exchanger.

It is a further object of my invention to provide hand-controlled means for regulating the aforesaid damper means.

It is a further object of my invention to provide means for causing a part of the air passing to the heat exchanger from the compartment and being recirculated through the heat exchanger to go over suitably wet surfaces so that the moisture content thereof will be increased and may be caused to approach saturation.

It is a further object of my invention to arrange the evaporator heat exchanger and blower in a cabinet closed excepting for the openings into the outlet and inlet passages to and from the outside and to arrange passages in said cabinet suitably proportioned and positioned for carrying out my invention.

The full objects and advantages of my invention will appear in connection with the detailed description thereof which will be given in the appended specification, and the novel features of my invention by which the aforesaid highly ad-

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vantageous results are obtained will be particularly pointed out in the claims.

In the drawings illustrating an application of my invention in one form—

Fig. 1 is a part sectional elevation view of an assemblage of devices for carrying out my invention.

Fig. 2 is a transverse sectional view taken on line 2—2 of Fig. 1 viewed in the direction of the arrows and including the cross-section of the whole device.

Fig. 3 is a similar sectional elevation view taken on line 3—3 of Fig. 1 and viewed in the direction of the arrows, but, as shown, covering but half of the width of the completed cabinet.

Fig. 4 is a detail side elevation view of means for holding the dampers in position.

Fig. 5 is a fragmentary sectional view taken on line 5—5 of Fig. 3.

My invention is here shown as applied to a self-contained air-conditioning unit adapted to be put in a wall 10 of a compartment such, for example, as the compartment of a truck or of a meat storage compartment of a butcher shop, such as is shown and described in my application Serial Number 404,596 now Reissue Patent 23,000, dated May 11, 1948. A part of the casing 11 is adapted to be positioned outside of wall 10 as shown in Fig. 1. Part 11 contains a compressor, a condenser, a motor to operate the compressor and means to move air through the condenser and for cooling the compressor, none of which is shown in detail for the reason that of themselves these instrumentalities form no part of my invention. It will be apparent also that the invention may be employed in connection with any type of means for getting compressed refrigerant to the evaporator coils of the evaporator regardless of how the same may be mounted.

Within the chamber to be cooled (not designated) and within the limiting confines of its walls 10 is a casing A having upper and lower walls 12 and 13, side walls 14 and 15, rear wall 16 and front wall 17. All of these walls are plane surface rectangular walls except the front wall 17, which is preferably curved inwardly, as indicated at 18, below a wide passageway 19 extending between the top wall 12 and a wall 20. This passageway 19, extends the full width of the casing between side walls 14 and 15. It is of horizontal construction and opens at its inner end into a second passageway 21 which is formed between top wall 12 and a transverse inner partition wall 22. Wall 22 curves downwardly at 23 to form a vertical partition 24 parallel with and spaced substantially from the rear wall 16. At a point 25 the wall 24 curves inwardly to form a second horizontal partition 26 extending between side walls 14 and 15 and secured to rear wall 16 by means of a flange 27. A funnel-shaped annular rim 28, Figs. 1 and 2, supports the frame 29 of a blower 30 mounted on a shaft 31 driven by the source of power in casing part 11. The blower 30 is of standard construction and moves air drawn through opening 32 surrounded by annular rim 28 and discharges it into the passageway 21.

In the practice of my invention the blower 30 will have very much greater air-moving capacity than has been customarily employed merely for circulating air in the chamber being cooled, since, as heretofore pointed out, too rapid circulation of air in such a chamber would result in too great dehydration of the contents subjected thereto. In the practice of my invention, however, the

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desired greater volume of air can be moved because only a minor part of it circulates in the chamber being cooled.

The front wall 17 is provided with an opening 35 through which air from the compartment being cooled may be drawn. Branch passageway 21 opens through a passageway 36 extending across between side walls 15 and 16 into a chamber 37 formed in front of the evaporator heat exchanger 38. The back of the evaporator heat exchanger is spaced a distance, indicated at 39, from the opening 32 into the chamber of blower 30. On the bottom wall 13 is a mass 40 of wet material spaced at 41 below evaporator heat exchanger 38. This space permits some of the circulated air to pass under the evaporator and over the wet surface of the material 40 to pick up additional moisture so as to keep the air within the evaporator chamber and the chamber being cooled in a substantially saturated condition.

The curved portion 18 of front wall 17 and the bottom wall 20 of duct 19 are carried back to form a loop at 42. This loop carries a shaft 43 upon which is mounted a hub 44 of a damper 45 adapted to be swung to a greater or less degree across branch passageway 19 or across passageway 36, according to whichever direction it is turned. An arm 46 on shaft 43 is connected by a link 47 to an arm 48 on a shaft 49 journaled on the front wall 17 above opening 35. Upon shaft 49 is rigidly connected a damper 50, Fig. 1. Upon shaft 49 is a handle member 51, Fig. 4, and a ratchet wheel 52, the latter being engageable with a pawl 53. The weight of damper 50 is sufficient to keep the ratchet teeth 54 in engagement with pawl 53.

In operation, when the parts are as shown in Fig. 1 and the blower 30 is in operation, the damper 45 will be in a neutral position in line with the bottom wall 20 of air passageway 19 and air drawn into the blower will come simultaneously through opening 35 and from branch passageway 36 to the chamber 37 in front of the evaporator heat exchanger 38 for recirculation of the air that has gone through the evaporator heat exchanger and is being driven through passageway 21 by the blower.

In this position the cross-sectional area of the inlet to branch passageway 36 will be substantially double that of passageway 19, and flow of air through branch passageway 36 will be further aided by the fact that there are both positive pressure behind the air in passageway 21 and negative pressure in front of the air in chamber 37. The result will be that something like three or four times as much air will be recirculated within the evaporator chamber, and will be passed across the coils of evaporator 38 and under the evaporator through passageway 41 as will be circulated in the chamber to be cooled. This means that with a sufficient amount of air circulating in the chamber to be cooled three or four times that volume will be added to the air passing through the coils of the evaporator heat exchanger. This procedure causes the large volume of air which is being recirculated to be cooled to a temperature which is substantially equal to that of the surface of the evaporator and thus minimize the formation of frost on the evaporator since recirculation will cause the air to be in a saturated condition at the temperature of the evaporator. While the incoming air may deposit some moisture on the coils or pick up moisture from the wet surface 41 it will be in a saturated

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condition before returning to the storage space to prevent dehydrating the products carried in the compartment. However, the large volume of recirculated air continuously flowing through the evaporator will perform a wiping action and will maintain itself in a saturated condition at the temperature of the evaporator and thus substantially prevent frosting of the evaporator.

If it is desired to increase the amount of recirculated air within the evaporator casing the dampers 45 and 50 are turned so that damper 45 reduces the entrance opening into chamber 19 and damper 50 simultaneously reduces the entrance 55 to the opening 35 through which air from the chamber being cooled will go to the heat exchanger. This has the effect of decreasing circulating air in that chamber and increasing recirculation within the evaporator chamber. If, however, the reverse is desired and the damper 45 is swung in the opposite direction it will narrow the entrance opening into branch passageway 36 and increase the width of opening 55, resulting in a greater relative amount of air circulated in the chamber to be cooled and less air recirculated in the evaporator chamber.

The primary and fundamental advantage of my invention resides in the fact that there is a sufficient volume of air passed over the cooling coils of the evaporator heat exchanger, most of it recirculated, to keep the surfaces of those coils in a condition such as to prevent the formation of frost. At the same time this makes possible a result of cooling the chamber with a minimum circulation of air therein.

A further advantage resides in the fact that due to recirculation within the evaporator chamber the air delivered to the chamber to be cooled will be at a more uniform and lower temperature than would otherwise be the case, and, therefore, a very small circulation of air will be as effective in cooling the chamber as a larger circulation of higher temperature cooled air, such as takes place in present practice.

I claim:

1. In combination with a room to be air-conditioned, a casing in said room enclosing a chamber, an evaporator heat exchanger in the casing, an opening in the front of the casing for admitting air from the room into the chamber, means for varying the area of the inlet opening, an outlet passageway permitting air to be forced from the chamber into the room, means for varying the cross-sectional area of the outlet passageway, a blower for causing air to move through the evaporator heat exchanger and to and through the outlet passageway, and a second passageway connected with and of greater cross-sectional area than the outlet passageway connected with the part of the chamber in front of the heat exchanger for directing a larger part of the air moved by the blower to cause it to pass back to the front of the evaporator heat exchanger and to be recirculated therethrough and through the blower for greatly increasing the volume of air passing through the evaporator heat exchanger relative to the volume of air delivered to the room.

2. In combination with an evaporator heat exchanger, a casing in which it is positioned forming an enclosure having its front and rear ends and top and bottom enclosing and spaced from said heat exchanger to form interconnected front, rear, top and bottom chambers, an air inlet opening to said front chamber, an air outlet opening and passageway from said top chamber of much

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less cross-sectional area than that of the top chamber, the connection between the top chamber and the front chamber being of greater cross-sectional area than that of the air outlet opening, and a blower in the rear chamber for drawing air through the evaporator heat exchanger from the front chamber and discharging it into the top chamber, whereby a large volume of the air moved by the blower and cooled in passing through the heat exchanger will go into the front chamber from which it will be recirculated through the heat exchanger.

3. In combination with an evaporator heat exchanger, a casing in which it is positioned forming an enclosure having its front and rear ends and top and bottom enclosing and spaced from said heat exchanger to form interconnected front, rear, top and bottom chambers, an air inlet opening to said front chamber, an air outlet opening and passageway from said top chamber of much less cross-sectional area than that of the top chamber, the connection between the top chamber and the front chamber being of greater cross-sectional area than that of the air outlet opening, and a blower in the rear chamber for drawing air through the evaporator heat exchanger from the front chamber and discharging it into the top chamber, said blower being of a size large enough to move several times the volume of air normally circulated through said air inlet and air outlet opening, whereby a large part of the air moved by the blower and cooled by the heat exchanger will go into the front chamber, to be recirculated through the heat exchanger.

4. In combination with an evaporator heat exchanger, a casing in which it is positioned forming an enclosure having its front and rear ends and top and bottom enclosing and spaced from said heat exchanger to form interconnected front, rear, top and bottom chambers, an air inlet opening to said front chamber, an air outlet opening and passageway from said top chamber of much less cross-sectional area than that of the top chamber, the connection between the top chamber and the front chamber being of greater cross-sectional area than that of the air outlet opening, a blower in the rear chamber for drawing air through the evaporator heat exchanger from the front chamber and discharging it into the top chamber, whereby a large volume of the air moved by the blower and cooled in passing through the heat exchanger will go into the front chamber from which it will be recirculated through the heat exchanger, and an interconnected damper system to simultaneously open or close more or less of the air inlet and air outlet openings.

5. In combination with a refrigerant evaporator, a casing having its walls spaced from the evaporator so as to form a chamber surrounding the evaporator, part of said chamber in front of the evaporator being an inlet passageway to the evaporator, said casing having an opening into the inlet passageway, said casing having an outlet opening, another part of said chamber forming an outlet passageway from the rear of the evaporator to the outlet opening, said outlet passageway being divided into two portions, a first of said portions being of substantially greater cross-sectional area than the remaining portion, a branch passageway connecting the first portion of said outlet passageway and the inlet passageway, and a blower positioned behind the evaporator and operative to draw air from the inlet passageway through the evaporator and to discharge the same to the outlet passageway.

6. In combination with a refrigerant evaporator, a casing having its walls spaced from the evaporator so as to form a chamber surrounding the evaporator, part of said chamber in front of the evaporator being an inlet passageway to the evaporator, said casing having an opening into the inlet passageway, said casing having an outlet opening, another part of said chamber forming an outlet passageway from the rear of the evaporator to the outlet opening, said outlet passageway being divided into two portions, a first of said portions being of substantially greater cross-sectional area than the remaining portion, a branch passageway connecting the first portion of said outlet passageway and the inlet passageway, a blower positioned behind the evaporator and operative to draw air from the inlet passageway through the evaporator and to discharge the same to the outlet passageway, a first damper for controlling the flow of air from the outlet passageway to the outlet opening, a second damper for controlling the inlet opening in the casing, and means for simultaneously operating said dampers.

7. In combination with an enclosure forming a storage space, a compartment having an inlet and an outlet communicating with the space within said enclosure, a refrigerant evaporator within said compartment and intermediate the front and rear surfaces of said compartment so as to be spaced therefrom, air moving means within said compartment between the inlet and the outlet and on one side of said refrigerant evaporator, an intermediate passage forming

communication between the discharge of said air moving means and the outlet, a branch passage forming communication between said intermediate passage and the side of said evaporator opposite the air moving means for recirculating a portion of the discharged air into contact with the evaporator, the cross-sectional area of said branch passage being substantially greater than the cross-sectional area of the outlet whereby a major portion of the discharged air is returned through the branch passage for recirculation in contact with the evaporator, and air flow control means carried in said intermediate passage having a first extreme position relative to the outlet to substantially completely terminate the flow of discharged air through the outlet, said air flow control means having a second extreme position relative to the branch passage for diminishing the volume of the discharged air which is recirculated in contact with the evaporator whereby a residual portion of air is always recirculated into contact with the evaporator.

FREDERICK M. JONES.

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