
F. M. JONES
MEANS FOR PREVENTING FROSTING OF
EVAPORATOR HEAT EXCHANGERS
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FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FREDERICK M. JONES

By D. A. Whiteley

Attorney
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 Minnesota

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7 Claims. (Cl. 62—129)

My invention relates to means for preventing frosting of evaporator heat exchangers, and has as 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 that 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 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 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 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 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 par-
cularly pointed out in the claims.

The drawing illustrates 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 in-
vention.

Fig. 2 is a transverse sectional view taken on
line 2—2 of Fig. 1 and viewed in the direc-
tion 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 direc-
tion 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 18 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 applica-
tion Serial Number 404,599 now Reissue Patent
23,000, dated May 11, 1948. A part of the cas-
ing 11 is adapted to be positioned outside of wall
18 as shown in Fig. 1. Part 11 contains a com-
pres

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pressor, 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 instrumentalties 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 eva-
purator regardless of how the same may be mounted.

Within the chamber 20 to be cooled (not desig-
nated) 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 rectangu

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lar walls except the front wall
17, which is preferably curved inwardly, as
indicated at 18, below a wide passageway 19 ex-
tending between the top wall 12 and a wall 20.
This passageway 18, extends the full width
of the casing between the

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inlet to the blower by the damper 29 formed by a
horizontal construction and opens at its inner
end into a second passageway 21 which is formed
between top wall 12 and a transverse inner part-
tion wall 22. Wall 22 curves downwardly at
23 to form a vertical partition 24 parallel with
and spaced substantially from the rear wall 18.
At a point 25 the wall 24 curves inwardly to form
a second horizontal partition 26 extending be-
twixt 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 sur-
rrounded 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 herebefore pointed out, too rapid circulation
of air in such a chamber would result in too great
derivation of the contents subjected thereto.
In the practice of my invention, however, the
desired greater volume of air can be moved be-
cause 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 be-
ing cooled may be drawn. Branch passageway
21 opens through a passageway 36 extending
across between side walls 14 and 15. A fan 37 is
mounted in the passageway 36, and is adapted
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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 substantially prevent freezing 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 40 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 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, 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, 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 for 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.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,861,158</td>
<td>Hilger</td>
<td>May 31, 1932</td>
</tr>
<tr>
<td>2,198,449</td>
<td>Atkins</td>
<td>Apr. 23, 1940</td>
</tr>
<tr>
<td>2,236,190</td>
<td>Wolfert</td>
<td>Mar. 25, 1941</td>
</tr>
</tbody>
</table>