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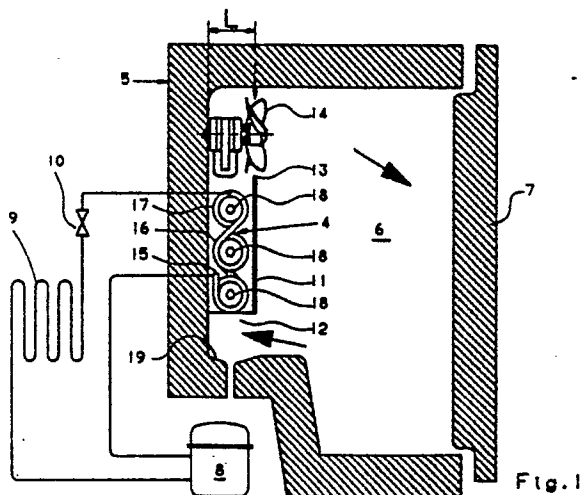
(71) Applicant: **INDUSTRIE ZANUSSI S.p.A.**
Via Giardini Cattaneo 3
I-33170 Pordenone(IT)

(72) Inventor: **Marega, Paolo**
Via Monte Pelmo 6
I-33170 Pordenone(IT)
Inventor: **Patron, Oscar**
Via Pastrengo 33
I-33074 Fontanafredda Pordenone(IT)

(74) Representative: **Patentanwälte Grünecker,**
Kinkeldey, Stockmair & Partner
Maximilianstrasse 58
D-8000 München 22(DE)

(54) **Ventilated evaporator for automatic defrost refrigerating appliances.**

(57) Ventilated evaporator for an automatic defrost refrigerating appliance comprising a heat-exchange surface located in a forced air flow and housed in a box-like frame (11) provided with inlet and outlet apertures (12, 13) for said forced air. The heat-exchange surface consists of only one refrigerant fluid feeding pipe shaped with a plurality of coils (15-17) which are hydraulically connected in series and arranged successively with their relevant axes transverse to the direction of flow of said forced air inside the box-like frame (11).



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VENTILATED EVAPORATOR FOR AUTOMATIC DEFROST REFRIGERATING APPLIANCES

The present invention relates to a ventilated evaporator for a refrigerating appliance, particularly for domestic use, of the type provided with an automatic defrosting system.

Refrigerating appliances of this kind, usually called "No-Frost" appliances, are preferably used for freezing purposes and include at least a refrigerating circuit which is provided with a compressor, a condenser, a throttling device and an evaporator.

This latter, in particular, is associated with a fan, as well as with defrost heating means, and usually consists of a finned coil, as described for instance in Italian utility model application No. 34056 B/86, filed on 4th September 1986 in the name of the same Applicant.

The finned evaporator substantially takes up for a given length the flow section of air which is forced by the fan and which, after being chilled by the evaporator, is circulated in a closed loop within at least one compartment for freezing and/or refrigerating goods.

As it is known, moisture inside the refrigerated compartment tends to condense upon the ventilated evaporator, whereat frost builds up rapidly with the consequent risk of a complete occlusion of the flow section of the forced air.

In order to prevent such an occlusion, the "No-Frost" refrigerating appliances are commonly provided with an automatic control device, for instance of the kind described in Italian patent application No. 45734 A/86, filed on 3rd July 1986 in the name of the same Applicant, capable of cyclically defrosting the evaporator.

This latter usually consists, as stated above, of a tubular coil, acting as a primary heat-exchange surface, inside which a refrigerating fluid is circulated, as well as of a plurality of fins protruding from the outer surface of the coil and acting as a secondary heat-exchange surface (which is much larger than the primary surface) having the task of enhancing the refrigerating capacity of the evaporator.

Of course, the evaporator must be so constructed as to meet two opposite requirements: on one hand the heat exchange surface must be large enough to confer a sufficient refrigerating capacity to the evaporator, and on the other hand it must be suitably reduced in order to prevent the frost which builds up on the evaporator from obstructing the flow path of the forced air too rapidly, with the consequent need of undesirably frequent defrost cycles to be performed.

At any rate, the manufacture of the finned evaporator is complicated and expensive, as many

welding operations for joining the pipe fittings of the coil, as well as fixture of a great number of fins are required.

It is the scope of the present invention to provide a ventilated evaporator for automatic defrost refrigerating appliances which is effective in operation, is of simple and quick manufacture and does not suffer from substantial problems of obstruction caused by frost build-up.

According to the invention, this scope is attained in a ventilated evaporator for an automatic defrost refrigerating appliance comprising a heat-exchange surface which is located in a forced air flow and housed in a box-like frame provided with inlet and outlet apertures for said forced air. The evaporator is characterized in that the heat exchange surface consists of only one refrigerant fluid feeding pipe shaped with a plurality of coils which are hydraulically connected in series and arranged successively with their relevant axes substantially transverse to the direction of flow of said forced air inside the box-like frame.

Preferably, the ratio between the pitch of the turns of said coils and the outer diameter of said pipe ranges between 1,2 and 3.

Furthermore, the ratio between the outer diameter of the coils and the pitch of their turns preferably ranges between 2 and 4,5.

The characteristics and advantages of the invention will be more apparent from the following description, given only as a non-limiting example, with reference to the accompanying drawings, in which:

Figures 1 and 2 diagrammatically show a side view and a front view, respectively, of a preferred embodiment of the evaporator according to the invention;

Figure 3 diagrammatically shows another embodiment of the evaporator as in Fig. 1.

With reference to Figs. 1 and 2, the ventilated evaporator 4 according to the invention is applied in a refrigerating appliance 5 having at least one freezer and/or storage compartment 6 which is accessible through at least one door 7. The evaporator 4 is located inside compartment 6 and forms part of a traditional refrigerating circuit including also a compressor 8, a condenser 9 and a throttling element 10.

The refrigerating appliance is of the so-called "No-Frost" type and comprises an automatic device for controlling defrost of evaporator 4 which is not shown for simplicity sake and which may be arranged as described for instance in EP-A-0 250 909.

The ventilated evaporator 4 comprises a heat-exchange surface which will be better described hereinafter and which is housed in a box-like frame 11 of which a wall may be defined by the rear wall of compartment 6, for example.

The box-like frame 11 is provided with at least one inlet opening 12 and at least one outlet opening 13 for an air flow (indicated by the arrows in Fig. 1) which is forced by a motor-operated fan 14 preferably housed inside the same frame 11, adjacent to the outlet opening 13.

According to a feature of the invention, the heat-exchange surface of the evaporator 4 consists of only one pipe for feeding refrigerant fluid from the throttling element 10 to the compressor 8 of the refrigerating circuit.

In particular, the pipe (which is made of copper, for instance) is shaped with a plurality of coils, which in the drawings are shown for example in the number of three and are indicated with 15, 16 and 17, respectively. The coils are hydraulically connected in series and are arranged successively, preferably aligned and positioned one over the other, along the flow-path of the forced air through the box flow-like frame 11. Moreover, the axes of the coils 15 - 17 are transverse with respect to the direction of the air-flow inside the frame.

As it is apparent, the heat-exchange surface of the evaporator 4 is only made of a primary heat-exchange surface which is relatively large, so as to operatively counterbalance the total absence (in comparison with the traditional solutions) of a secondary heat-exchange surface.

It is apparent that the evaporator 4 according to the present invention may be manufactured automatically and in a very simple way for obtaining the same performances as with the traditional solutions. In fact, the evaporator does not need any welding operation or fixture of components to be carried out; on the contrary, it is only necessary to wind relevant portions of a rectilinear pipe in order to obtain the coils 15 - 17 and then to bend the same pipe so as to obtain the structural configuration which is illustrated and shown in the enclosed drawings.

With regard to operation, one should bear in mind that frost build-up on a primary heat-exchange surface is enhanced, compared with a secondary heat-exchange surface.

Hence, according to another feature of the invention, in order to prevent the air-flow section inside the frame 11 from being obstructed by the frost build-up too fast, it was also experimentally found that the ratio between the pitch A of the turns of coils 15 - 17 and the outer diameter of the pipe forming the coils themselves advantageously ranges between 1,2 and 3.

For the same purposes, and also in order to

obtain an evaporator having adequate thermal performances, it is preferable that the ratio between the outer diameter D of the coils 15 - 17 and the pitch A of their turns ranges between 2 and 4,5.

In order to limit the obstruction of the air-flow section inside the frame 11, which is caused by frost build-up, it is advisable that also the inner width L of the box-like frame 11, measured in a direction normal to the axes of the coils 15 - 17, be appropriately dimensioned. According to a further feature of the invention, the optimum ratio between said width L and the outer diameter D of the coils 15 - 17 ranges between 1,1 and 1,5.

At any rate, it is obvious that the ventilated evaporator 4 has to be cyclically defrosted in a way known per se. To this purpose at least an electrical heating resistance 18, or the like, is provided, having a substantially tubular shape and placed inside at least one of the coils 15 to 17. Such a resistance may be coaxial with the associated coil (as it is shown in Figs. 1 and 2) so as to heat it by radiation, or it may be arranged (and possibly shaped with a proper configuration) in contact with the associated coil, so as to heat it by radiation and/or by conduction.

In a per se known manner, the defrost water from evaporator 4 may be collected in a basin 19 below, from which the water is conveyed by gravity to the top of the compressor 8 where it is evaporated.

Preferably, a resistance 18 is provided inside each one of the coils 15 - 17, but the evaporator 4 may be defrosted effectively even by means of one single heating resistance, as it is shown in Fig. 3.

According to such an embodiment, the ventilated evaporator 4 is provided with a defrost resistance 21 which is arranged outside the coils 15 - 17, preferably underneath, and which is preferably associated with a protecting tile 20 made of heat-reflecting material such as aluminium.

As a result, the resistance 21 can heat by direct and/or indirect radiation not only the coils 15 - 17 but also the basin 19.

Obviously, the ventilated evaporator described above may undergo many modifications without departing from the scopes of the invention.

For instance, each coil 15 - 17 may have a different turn pitch A. Preferably, pitch A decreases progressively along the air-flow direction inside the frame 11; in this way, frost automatically builds up evenly on the different coils 15 - 17. Otherwise, the major part of frost build-up would occur on that portion of the heat-exchange surface which most lies upstream with respect to the air flow, in this way obstructing the air-flow section more quickly.

Anyway, the ventilated evaporator according to the present invention may be applied in a refrigerating appliance of whatever kind, either for freezing and/or chilling goods.

Claims

1. Ventilated evaporator for an automatic defrost refrigerating appliance comprising a heat-exchange surface which is located in a forced air flow and housed in a box-like frame provided with inlet and outlet apertures for said forced air, characterised in that the heat-exchange surface consists of only one refrigerant fluid feeding pipe shaped with a plurality of coils (15-17) which are hydraulically connected in series and arranged successively with their relevant axes substantially transverse to the direction of flow of said forced air inside the box-like frame (11).

2. Ventilated evaporator according to claim 1, characterised in that the ratio between the pitch (A) of the turns of said coils (15-17) and the outer diameter of said pipe ranges between 1, 2 and 3.

3. Ventilated evaporator according to claim 2, characterised in that the ratio between the outer diameter (D) of said coils (15-17) and the pitch (A) of their turns ranges between 2 and 4, 5.

4. Ventilated evaporator according to claim 2, characterised in that the ratio between the inner width (L) of the box-like frame (11), measured in a direction normal to the axes of the coils (15-17), and the outer diameter (D) of the coils ranges between 1,1 and 1,5.

5. Ventilated evaporator according to claim 2, characterised in that said pitch (A) of the coils decreases progressively for each coil (15-17) along the air-flow direction inside the box-like frame (11).

6. Ventilated evaporator according to claim 1, characterised in that it further comprises at least one electrical defrost resistance (18), known per se, which is arranged inside at least one of said coils (15-17) and is capable of heating it by radiation and/or conduction.

7. Ventilated evaporator according to claim 1, characterised in that it further comprises at least one electrical defrost resistance (21), known per se, which is arranged outside said coils (15-17) and is associated with heat-reflecting means (20, 19, 11) for heating the evaporator (4) by radiation.

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