

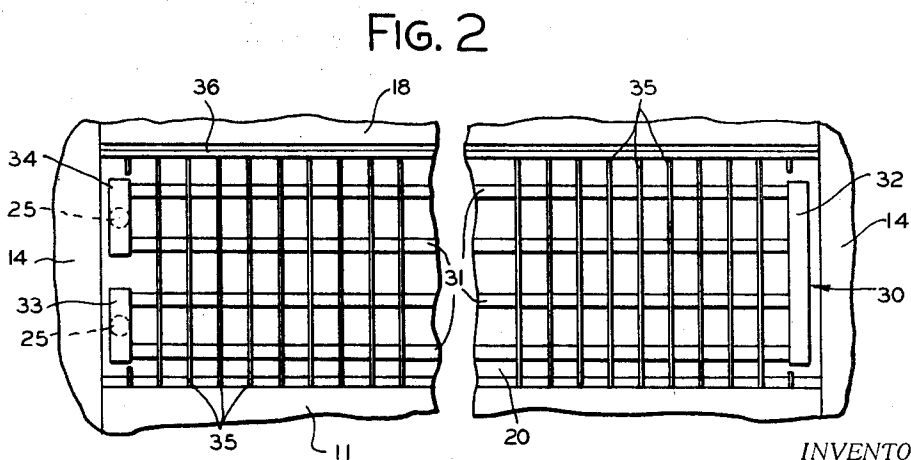
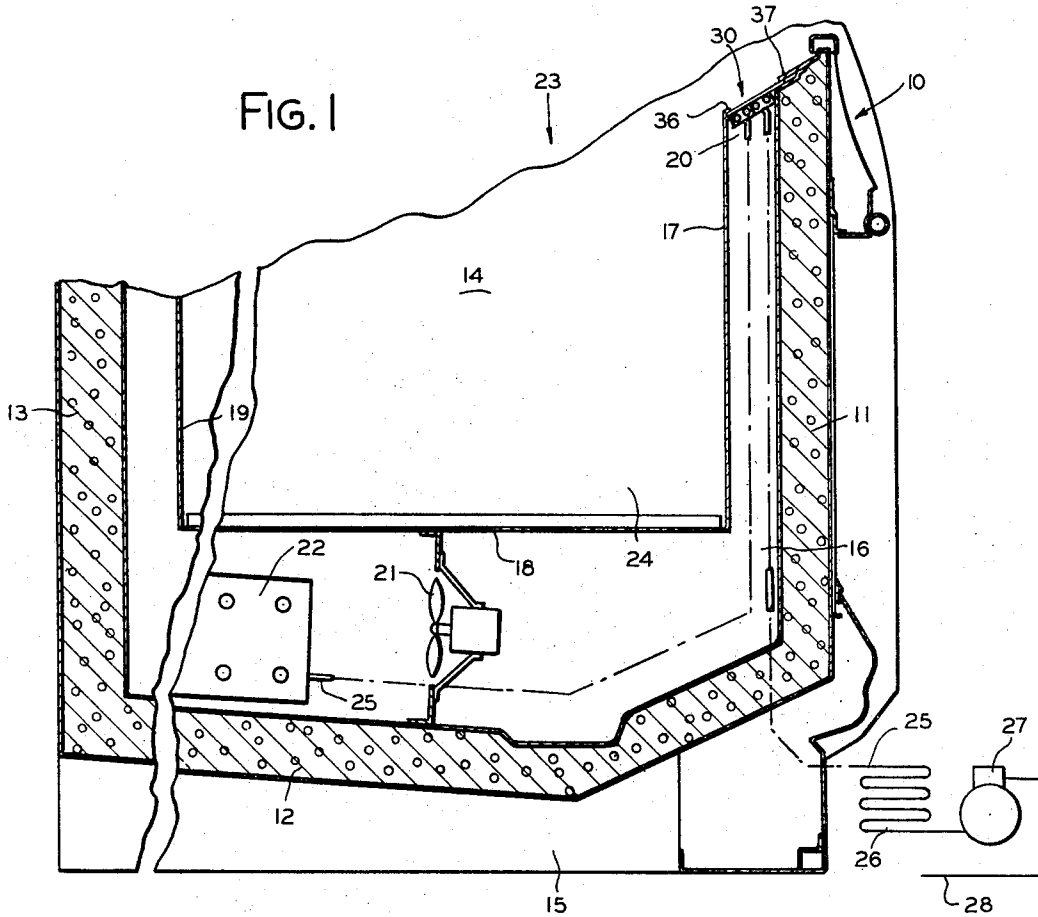
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REFRIGERANT LINE GRILLE STRUCTURE

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REFRIGERANT LINE GRILLE STRUCTURE

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ABSTRACT OF THE DISCLOSURE

The invention provides a grille structure formed of a portion of a fluid refrigerant supply conduit across which a plurality of rods are secured. The grille is disposed at one side of an opening affording access to the interior of a refrigerated case, along a return aperture of duct means by which refrigerating air is circulated in the case and over the access opening to warm the air sufficiently by means of the warmer refrigerant to avoid frost deposits on the grille and adjacent portions of the case. The grille prevents entry of objects into the duct, yet is sufficiently open to avoid excessive warming of the air with resultant inefficiency due to the need to remove the excess heat. In addition, subcooling of the refrigerant flowing through the grille improves refrigeration efficiency.

The present invention relates to a grille construction for the return aperture of air duct means by which refrigerating air is circulated in a refrigerated case of the commercial type to flow across an opening in a wall of the case affording access to the products displayed. The grille is provided to extend over the return aperture to prevent entry into the duct means of objects of fairly large size, and at the same time to transfer heat from the refrigerant to the air. The air is warmed only enough to prevent frost formation on the grille and the case portion adjacent thereto and reduce frosting within the duct means sufficiently to prevent undesirable restriction of air flow therethrough. This avoids uneconomical and inefficient increase in the air temperature, and effects subcooling of the refrigerant to increase refrigeration efficiency. The grille is formed of a portion of the line or conduit through which refrigerant is supplied to the case, together with means secured thereon to provide the desired grille. In the particular embodiment disclosed, the supply conduit portion employed in the grille has a plurality of parallel runs extending along the return aperture, with a plurality of parallel rods or similar elements secured to the runs transversely thereof. The runs may be connected in various ways to provide a suitable flow path for the refrigerant. The refrigerant flowing through the supply line is at a temperature above that of the case structure adjacent the return aperture, and thus warms the grille and the air passing therethrough sufficiently to avoid frost formation on the grille, and within the adjacent portion of the duct means. Reduction of efficiency of the case by reason of too great a warming of the air, requiring correspondingly more energy to reduce its temperature to the desired level, is avoided by so forming the grille that only a portion of the air passing therethrough comes into direct warming contact with the grille. Frost which may accumulate on the interior of the duct means does not reach sufficient proportions to interfere with air flow to an appreciable extent, at least not until defrosting is required by reason of frosting on other components of the refrigeration system. The grille improves the efficiency of the case. Passage of the refrigerating air over the refrigerant supply conduit ahead of the evaporator coil or other refrigerating means effects subcooling of the refrigerant, so that it has a greater capacity for absorption of heat than it otherwise would.

It is among the objects of the invention to form a por-

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tion of the refrigerant supply line of a refrigerated case into a grille guarding against entry of larger objects into the return aperture of circulating air duct means, while preventing frost formation on and adjacent the grille; to provide such a grille structure which limits the input of heat into the refrigerating air to a degree substantially just adequate for effecting the desired frost prevention, avoiding unnecessary increase in the heat load on the refrigeration system; and to provide a grille effecting subcooling of the refrigerant by the refrigerating air, so as to increase refrigerating efficiency.

Other and further objects, advantages and features of the invention will be apparent to those skilled in the art from the following description, taken with the accompanying drawings, in which:

FIG. 1 is a fragmentary cross-sectional view through a refrigerated case incorporating the grille of the present invention; and

FIG. 2 is an enlarged plane view of the grille shown in FIG. 1.

Referring to the drawings, there is shown in FIG. 1 a portion of a refrigerated case generally designated 10, comprising an insulated vertical front wall 11, an insulated bottom wall 12, and a vertical insulated rear wall 13, which together with any suitable end walls 14 (FIG. 2) define the body of the case 10. A base 15 of any suitable construction may be provided to support the case body.

An air circulating duct 16 is defined in the case by panels 17, 18 and 19 of any appropriate sheet material, respectively spaced inwardly from the walls 11, 12 and 13 and extending between the end walls 14. The forward vertical portion of the duct 16 defined between the panel 17 and front wall 11 is open to atmosphere through a return aperture 20 adjacent the top of the front wall. Air is drawn into the duct 16 through the return aperture by means of a fan or other suitable air-moving means 21, to flow over an evaporating coil 22 and to the rear vertical portion of the duct defined between the panel 19 and rear wall 13. The rear wall 13 may, in well-known manner, have a forward extension into which the rear duct portion extends. This rear portion of the duct is provided with any desired air outlet or discharge opening, not shown, which may be located either in the rear wall proper or in such extension. The case body 10 is open between the return aperture 20 and the discharge opening or aperture, so as to provide an unobstructed opening indicated at 23, affording access to the contents of the case, at least a portion of which may be disposed in a well defined by the panels 17, 18 and 19. Air discharged from the rear portion of the duct 16 brings the case interior to the desired refrigerating temperature, moving about and past the contents and over the access opening 23 to flow back through the return aperture 20 for recirculation and cooling by the fan 21 and coil 22. The fan and coil are shown as disposed in a widened portion of the duct 16 defined between the case bottom wall 12 and bottom panel 18. More than one fan and coil may be provided.

The evaporating coil receives refrigerant through a refrigerant supply conduit 25 from a condenser 26 in which it is condensed to a liquid form after being compressed in a compressor 27 which draws the expanded gaseous refrigerant from the coil 22 through a return or suction line 28, as diagrammatically shown. The case 10 may be of either the self-contained type, with the compressor and condenser located within it, or the remote type, with the compressor and condenser located exteriorly of the case. The refrigerating system comprising the compressor, condenser and evaporator with the connecting lines and conduits, will, of course, also include the usual control elements and other components as well as means for removing frost accumulating on the evaporating coil

or in the duct, but these do not form part of the invention and therefore are not illustrated.

The grille of this invention, generally designated 30, is disposed in or at the return aperture 20 of the duct 16. A portion of the supply conduit 25 between the condenser 26 and the evaporator coil 22 is employed to form the grille. As best shown in FIG. 2, this portion of the conduit 25 is provided by a plurality of runs of tubing 31 extending longitudinally of the return aperture 20, or in other words, lengthwise of the case 10. In the specific embodiment disclosed, four such lengths or runs of tubing are employed, all connected at one end by a common header 32, and two of the runs being connected at the opposite ends by header 33, communicating with the portion of conduit 25 connected to the condenser 26. At the corresponding ends, the other two runs are connected by a header 34, communicating with the portion of conduit 25 extending to the evaporating coil 22. Thus, condensed refrigerant flowing from the condenser passes through the header 33 and its associated runs 31 to the common header 32, through which it passes to the other tubing runs and header 34 into the portion of conduit 25 leading to coil 22. After evaporation in coil 22 to produce its cooling effect, the refrigerant returns through conduit 28 to the compressor 27 for recycling as required. The grille is completed by a plurality of rods 35 welded or otherwise secured on the runs 31, at right angles thereto and parallel to each other. The grille may be supported in any suitable manner, in the present instance by means of the inner and outer ends of the rods 35 being received in channel formations 36 and 37 of the panel 17 and front wall 11, respectively.

The temperature of the refrigerant flowing in the line 25 and grille 30 is higher than that of the refrigerating air entering the return aperture 20 through the grille, which again is higher than the portion of the case 10 adjacent the aperture. While the refrigerating air is largely dehumidified by passage over the evaporating coil 22, on which it deposits a large proportion of this moisture in the form of frost, it becomes mixed with and entrains some of the warmer and more humid ambient air in its passage from the discharge opening of the duct 16 to the return aperture 20. Upon contact of this air with the case structure adjacent the aperture 20, in the absence of frost-inhibiting means, some of the moisture is condensed and forms a frost deposit adjacent the top of the front wall 11. This is undesirable because purchasers in reaching into the case may contact the frost, and also because frost may accumulate within the duct 16 to such an extent as to interfere with the flow of air therethrough, so that even if the refrigerating air is brought to the desired low temperature, it is not sufficient in volume to produce the desired refrigerating effect.

By the provision of the grille 30, the grille itself is warmed by the refrigerant to a temperature such that no frost is deposited thereon, that is, it is warmed to a point above freezing, the rods 35 conducting the heat from the conduit portion runs 31 over the entire grille and to the adjacent case structure. In addition, the grille serves to warm the refrigerating air passing therethrough to a temperature such that its relative humidity is too low for condensation and freezing of any appreciable volume of moisture on the inner portion of the duct adjacent the return aperture 20, and for at least some distance below the aperture. As the air passes downwardly in the forward portion of the duct, its temperature again decreases, and its moisture tends to condense and freeze, some falling like snow into the lower portion of the duct 16, and the remainder forming a frost deposit on the interior of the forward duct portion. Such frost deposition, however, is sufficiently reduced or inhibited by reason of the grille 30 that it does not interfere with circulation of a sufficient volume of refrigerating air for maintaining the desired refrigerating temperature. Put another way, defrosting of the case is required before the frost accumulation in the

duct 16 from the air entering through the grille 30 becomes sufficiently great to restrict the air flow through the duct. Defrosting is provided for in accordance with the accumulation of frost on the evaporating coil 22, which reduces the refrigerating efficiency both by restricting the flow of air through the duct 16 and by interfering with heat transfer between the air and the coil. Several effective methods and devices for effecting defrosting are known, from which one may be chosen as desired for application in the present instance.

It will be appreciated that the grille might be employed substantially to eliminate frost deposition in the forward portion of the duct 16, by raising the temperature of the refrigerating air to a sufficiently high level. This, however, would require the removal of additional heat from the air by the evaporating coil 22, imposing a greater load on the refrigerating system and requiring the expenditure of more energy than otherwise needed to lower the temperature of the refrigerating air to the required level. The grille 30 is specifically constructed to avoid unnecessary warming of the refrigerating air, so as to avoid the inefficiency resulting from the necessity of removing from the air the heat previously added. This is accomplished by forming the grille so that only a portion of the air passing therethrough comes into contact with the grille surface. Only such rise in the air temperature is effected as will prevent frost deposition sufficient to prevent proper refrigeration by reducing air flow through the duct. In one embodiment of the invention, the runs 31 are formed of tubing having an external diameter of not more than about $\frac{3}{8}$ inch, and the rods 35 are of $\frac{1}{16}$ inch diameter. The rods are spaced apart substantially $\frac{1}{2}$ inch on centers, while the runs 31 are spaced apart a greater distance. Thus, the openings in the grille defined by the rods and the runs are relatively large, and the grille is a very open one, although the combined area of the surfaces of the runs 31 and rods 35 may be greater than the total area of the grille openings. The proportions of open grille area and grille surface presented to the air may, of course, vary from this specific example, depending, among other factors, on the temperature of the refrigerating air and that of the refrigerant flowing through the grille.

It will be appreciated that the rods 35 need not be arranged parallel to each other, nor at right angles to the runs 31, and furthermore, that other aperture-defining means than the rods 31 may be employed if desired. For example, any suitable sheet material perforated to provide the desired proportion of open grille space to the surface of grille material presented to the incoming air might be secured in heat-transfer relation to the runs 31. It will also be appreciated that the number of runs 31 may be varied, that the runs might extend otherwise than longitudinally of the return aperture 20, and that instead of employing headers or like means for connecting the runs in the specific manner disclosed, the runs might be connected by return bends or formed by reversely bending the conduit 25, so as to provide an unbranched continuous zig-zag path for the refrigerant.

In addition to providing the foregoing advantageous results, the grille 30 effects subcooling of the refrigerant by reason of the heat it gives up to air flowing through the grille. This improves the efficiency of the refrigerating system, in effect increasing the refrigerating capacity.

The embodiment of this inventive concept illustrated herein is exemplary and not exhaustive, the invention not being limited thereto since modifications and variations thereof may be made through a wide range without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. In a refrigerated case for refrigerated products having wall structure providing an unobstructed opening for access to the interior of said case, duct means for circulation of refrigerating air across said access opening

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and provided with an air return aperture at one side of the opening and a supply conduit for fluid refrigerant warmer than said air, the improvement comprising a portion of said conduit extending adjacent said return aperture, and aperture-defining means secured in heat-transfer relation with said conduit portion to define therewith a grille extending completely across the return aperture, the surface area of said aperture-defining means and conduit portion relative to the over-all area of the grille being such as to contact only such portion of the air passing through the return aperture as required for limiting formation of frost adjacent the aperture sufficiently to avoid interference with the flow of air.

2. The improvement defined in claim 1, in which said conduit portion comprises a plurality of runs.

3. The improvement defined in claim 1, in which said aperture-defining means comprises a plurality of rod-like elements extending across said conduit portion.

4. The improvement defined in claim 3, in which said conduit portion comprises a plurality of runs.

5. The improvement defined in claim 3, in which said conduit portion extends substantially longitudinally of the return aperture, and said elements are disposed substantially at right angles thereto.

6. The improvement defined in claim 5, in which said conduit portion comprises a plurality of runs.

7. The improvement defined in claim 3, in which said

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conduit portion has an external maximum dimension of not more than about $\frac{3}{8}$ inch, and said elements have a diameter of approximately $\frac{1}{16}$ inch and are spaced to define with each other and with the conduit portion a plurality of grille openings having a minimum dimension of about $\frac{1}{2}$ inch.

8. The improvement defined in claim 7, in which said conduit portion extends longitudinally of the aperture, and said elements are disposed substantially at right angles thereto.

9. The improvement defined in claim 7, in which said conduit portion comprises a plurality of runs.

10. The improvement defined in claim 9, in which said conduit portion runs extend substantially parallel longitudinally of the aperture, and said elements are disposed substantially at right angles thereto.

References Cited

UNITED STATES PATENTS

20	2,706,387	4/1955	Swanson	62—255
	2,911,799	11/1959	Guyton	62—256
	3,128,609	4/1964	Beckwith	62—256
	3,229,475	1/1966	Balk	62—256
25	3,333,437	8/1967	Brennan	62—256

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