

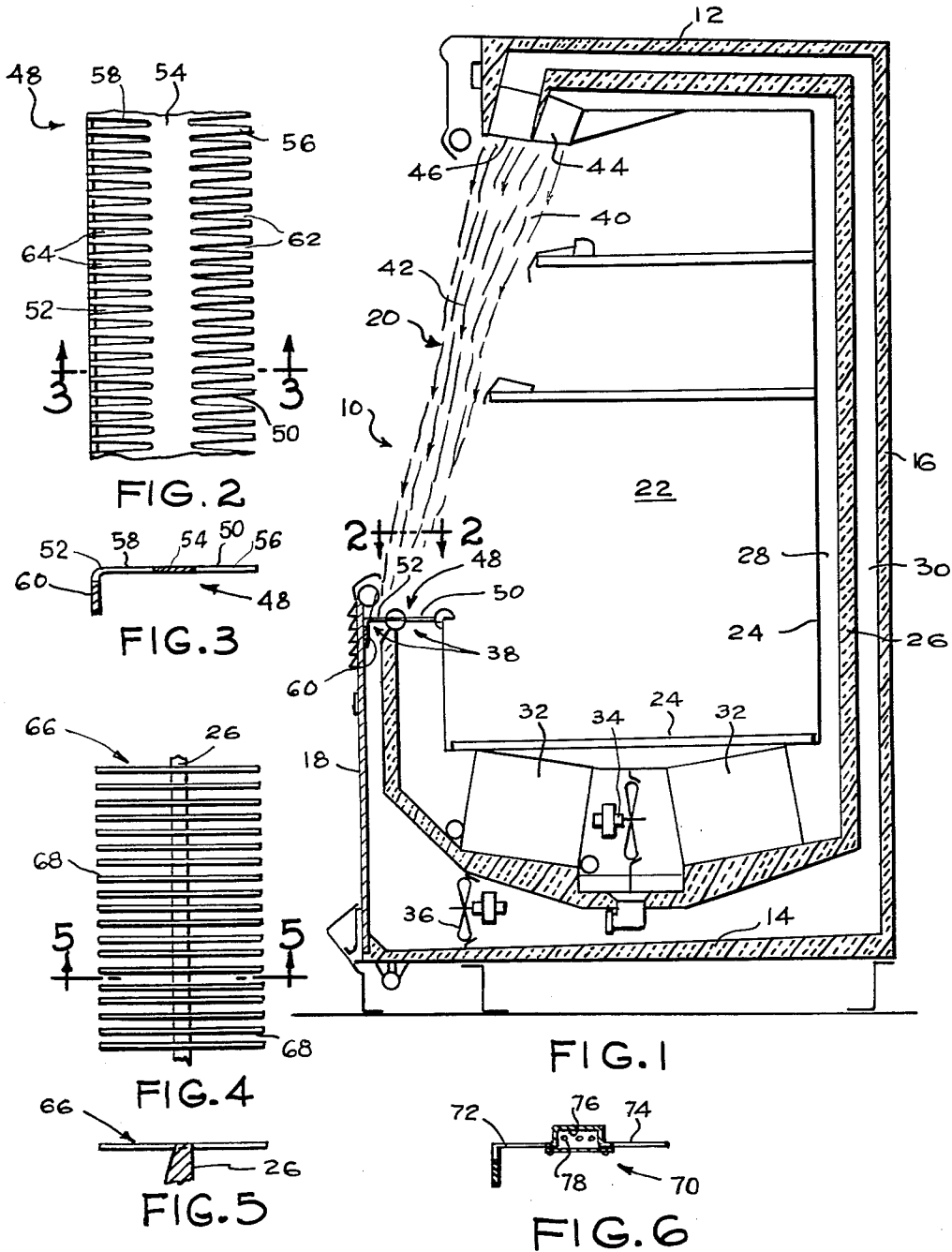
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MEANS FOR REDUCING FROST BUILD-UP

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MEANS FOR REDUCING FROST BUILD-UP
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The present invention relates to improved means for use in constructions of the type designed for handling two or more air curtains which are to be moved in side-by-side relationship. Constructions to which the instant invention is directed provide for the refrigeration of at least one air curtain and also provide for movement of the air curtains in an unconfined state for at least part of their travel in the operation of the construction.

In refrigerated cabinet constructions, air curtains are moved across an access opening whereby individuals can reach into the construction while refrigeration can, at the same time, be maintained. The instant invention will be described with reference to refrigerated cabinet constructions; however, it will be understood that the novel structures referred to herein can be utilized for the handling of air streams in other constructions where the necessary characteristics of the streams are similar to the characteristics required of streams in refrigerated cabinets.

In an application of Hagen et al., Serial No. 54,077, filed September 6, 1960, now Patent No. 3,134,243 granted May 26, 1964, and in the issued Simons Patent No. 2,862,369, there are described refrigerated display cabinets which are provided with access openings exposed to the atmosphere while still being capable of maintaining the contents in a refrigerated state. Loss of refrigeration from the enclosed space through the access opening is reduced in a highly effective manner in these construction by the use of a gaseous, preferably air, curtain which is continuously advanced across the open side from one edge of the opening to the opposite edge. The air curtain in these constructions is adapted to be formed of adjacent panels of air, with the innermost panel comprising a refrigerated cold air panel, and with one or more outer panels having temperatures approaching the ambient temperature. It has been found that it is desirable to recirculate the inner cold air panel and to provide means for circulating the adjacent guard panels, to conserve the refrigeration and to maintain the enclosed space in a satisfactory refrigerated state.

In these constructions there are described assemblies which include nozzles extending across the bottom edge of the access opening to direct the air panels upwardly across the opening towards inlets which extend across the top side of the access opening. As an alternative, the nozzles are located across the upper edge for projecting the air panels downwardly toward inlets arranged across the bottom edge. It is also contemplated that the air nozzles be located across one of the lateral edges of the opening for directing the corresponding air panels across the opening toward inlets in the opposite edge. Because of the more desirable effect of gravity on the higher density cold air, it has been found preferable to provide the air curtain with a downward movement from nozzles across the top to inlets across the bottom. The following description will refer to this preferred construction, although it will be understood that the concepts to be described are also applicable to other directions of flow.

In the use of cabinets of the type described, it is, of course, desirable to provide maximum efficiency insofar as the amount of power consumed is concerned. In refrigeration systems of this type, the consumption of power is partly due to the need for refrigeration of the moving air streams which pass over the access opening for the

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cabinet. In addition, power is consumed during defrosting cycles and due to the driving of fans for circulation of the streams. As far as the refrigeration of the streams is concerned, a major factor contributing to the amount of power consumption is the loss of refrigeration (or intake of heat) through the access opening.

The present invention is specifically concerned with improved means which are designed for reducing the power consumption in the operation of a refrigerating structure. The structures to be described herein are adapted to reduce the build-up of frost accumulation in such refrigerating constructions, and it is this reduction in frost accumulation which permits a saving in power consumption. It is recognized that frost build-up increases power consumption due to the fact that the frost tends to constrict the passages through which the circulating streams must be driven. In order to achieve a desired speed in the air streams, it is necessary to impart more power to the circulating fans. On the other hand, if the power to the circulating means is not increased, then a less efficient operation insofar as the speed of the streams is concerned will result. Accordingly, a greater load will be placed on the refrigeration coils. Finally, the amount of frost build-up in a construction of the type described is directly proportional to the frequency of the defrosting operations. Accordingly, the power consumed in operating the defrosting means will be reduced if the frost accumulation can be reduced.

It is an object of this invention to provide a refrigerated cabinet construction which includes means for reducing frost accumulation whereby a corresponding reduction in power consumption can be realized.

It is a more particular object of this invention to provide a structure which can be readily included in existing refrigerated cabinet constructions and which is adapted to reduce frost accumulation by contacting the air streams circulating in said cabinet.

It is a further object of this invention to provide elements capable of achieving the foregoing objects, and also being of a relatively simple design whereby they can be efficiently manufactured and easily installed in refrigerated cabinet constructions.

These and other objects of this invention will appear hereinafter and for purposes of illustration but not of limitation, specific embodiments of this invention are shown in the accompanying drawings in which:

FIGURE 1 is a vertical sectional view of a refrigerated cabinet characterized by the features of this invention;

FIGURE 2 is an enlarged fragmentary view of the one form of the specific means of this invention as it appears when looking along the line 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view taken about the line 3—3 of FIGURE 2;

FIGURE 4 is an enlarged fragmentary view illustrating an alternative form of the invention;

FIGURE 5 is a cross-sectional view taken about the line 5—5 of FIGURE 4; and,

FIGURE 6 is a cross-sectional view of a further alternative form of the invention.

As discussed above, the improvements of this invention are directed to constructions which employ air curtains moving in side-by-side relationship in an unconfined manner. These improvements are specifically directed to refrigerated enclosures of the type which define an access opening in one wall whereby communication with the space within the enclosure can be accomplished. The enclosures or cabinets of this invention are provided with a plurality of nozzles arranged in side-by-side relationship across one edge of an access opening and corresponding inlets are located across the opposite edge of the access opening. The inner nozzles and inlets are provided for the passage of a refrigerated stream across the

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access opening while the adjacent outer nozzles and inlets circulate progressively warmer air panels. The inner refrigerated stream is circulated through a passage having refrigeration coils located therein and one or more of the outer adjacent streams may also be refrigerated.

In accordance with the practice of this invention, heat conductive means are located in the passages through which the circulating air streams are moved. These heat conductive means are such that one portion thereof will be located for contact with the air circulating in one passage while a separate portion thereof is located for contact with air circulating in an adjacent passage. The portions of the heat conductive means are connected in a manner such that the heat transfer can be accomplished from one portion to the other. This arrangement is best accomplished by forming the heat conductive means as integral elements and locating them in the construction whereby an intermediate portion straddles the barrier between the adjacent passages.

In the following specific description of the invention, reference is made to a cabinet having an inner refrigerated air stream and an outer guard stream which is driven for circulation in the construction but is not directly refrigerated. It will be understood, however, that the heat conductive elements which extend into the respective passages could extend across more passages or the heat conductive means could be utilized without the provision of a circulating guard stream.

The accompanying drawing illustrates in FIGURE 1 a refrigerated cabinet 10 having nozzle means characterized by the features of this invention. The cabinet 10 includes a top wall 12, a bottom wall 14, a back wall 16 and a front wall 18. The front wall 18 defines an opening 20 which provides access to the interior 22 of the refrigerated cabinet. An inner wall 24 defines the extent of the refrigerated space.

A partition 26 is formed to define an inner passage 28 and an outer passage 30 in the construction. The inner passage 28 carries a refrigerating means 32 and a circulating fan 34 provides for movement of air past the refrigerating means and through the passage 28. A similar circulating fan 36 is provided for the outer passage 30.

Inlets 38 are provided for each of the passages 28 and 30. The streams 40 and 42 which cross the access opening pass into these inlets and are driven through the passages to outlet nozzles 44 and 46. Screens may be included over the inlets 38 to prevent entry of insects or other foreign material into the passages.

The heat conductive means in the construction of FIGURE 1 comprise an element 48 which is located adjacent the inlets 38. This element 48 includes a first portion 50 which extends across the inlet opening for the inner refrigerated stream and a second portion 52 which extends across the inlet opening for the guard stream.

The particular design of the element 48 is best shown in FIGURES 2 and 3. This element includes an intermediate base portion 54 and a plurality of spaced-apart fingers 56 extend outwardly from one side of said base portion. Additional members 58 extend outwardly from the opposite side of the base portion, and these members include a bent-over portion 60. In the illustrated embodiment, the portions 56 and 58 extend substantially completely across the respective inlets 38, and the openings 62 and 64 defined between the members 56 and 58, respectively, provide for the free movement of the air streams. It will be understood when considering the function of the element 48, that they could be designed to terminate short of the walls which define the respective passages.

The bent-over portion 60 of the element 48 comprises a highly effective means for achieving the results of this invention. As will be explained, it is the purpose of the element 48 to conduct heat from the outer portions of the construction to the inner portions thereof whereby the refrigerated air stream will come into contact with

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the fingers 56. The portion 60 of the element 48 can engage the front wall 18 of the cabinet, which wall will be at a higher temperature than interior cabinet portions. Alternatively, the portion 60 may be free of contact with the wall whereby it will be contacted merely by the warmer air circulating in the outer passage. Heat picked up by the portion 60 will be conducted to the cold air passage. To provide a substantial surface for heat transfer, the portions 60 are formed wider than the adjacent portions 58.

The location of the elements 48 at the inlets for the construction is desirable since these elements can be easily mounted by supporting the elements on the barrier wall 26. It is also preferred to locate the elements 48 in a position whereby they will be contacted by the moving streams subsequent to passage across the access opening and prior to contact with the refrigerating coils.

FIGURE 4 illustrates a somewhat modified form which can be assumed by the elements of this invention. The elements 66 shown therein comprise individual members 68 which are mounted on the barrier wall 26 with portions thereof extending on either side of the barrier wall. As shown in FIGURE 5, recesses may be formed in the barrier wall and the elements 66 can be fitted into these recesses to provide for their support. It will be understood, however, that various arrangements will be available for supporting the elements on the barrier wall. It should also be appreciated that the elements 66 could be provided with downwardly extending portions corresponding to the portion 60 of the elements 48.

In FIGURE 6, the element 70 is also provided with fingers 72 and 74. However, in this case, the center portion of the element defines a conduit 76 carrying heating elements 78. This arrangement provides cooperation with the thermal conduction system above described.

It will be apparent that the use of elements which are spaced-apart from each other comprises a preferred embodiment of this invention. These arrangements permit the flow of the air streams in a manner such that substantially all portions of the streams will contact the elements. When considering the nature of the instant invention, it will nevertheless be understood that elements without openings and which extend only part way across the passages could be employed although a lesser degree of contact would be achieved with this arrangement. It should also be noted in this connection that where reference is made to air streams, it is also contemplated that other gaseous streams be included since the characteristics of the stream are not a critical factor of the invention.

With regard to the use of downwardly extending members for providing more desirable heat conducting surfaces, it will be understood that such members can be employed for contact with various walls in the construction or merely for contact with warmer portions of an air stream. This is particularly true where more than two passages are employed.

The structures described herein are primarily designed for the purpose of reducing the tendency toward frost build-up, and it has been observed that such results are attainable with the disclosed structures. Although the invention is not to be limited to any particular theory of operation, it is nevertheless believed that the reduction in frost accumulation is attributable to the contact of the refrigerated air stream with the heat conductive means which are maintained at a slightly higher temperature. Thus, the portions of the heat conductive means which contact warmer portions of the structure, or which are contacted by a warmer air stream, provide for a transfer of heat into the portions of the heat conductive members in the refrigerated air stream. A slight temperature differential between this portion of the heat conductive means and the refrigerated air stream is responsible for the improved results of this invention.

It is contemplated that the fingers contacting the streams have rounded or tapered cross sections to provide less resistance to flow and maximum heat conductivity. Furthermore, the fingers 64 could be twisted 90° whereby the same surface area can be utilized with less flow resistance.

It will be understood that various changes and modifications may be made in the above described constructions which provide the characteristics of this invention without departing from the spirit thereof particularly as defined in the following claims.

That which is claimed is:

1. In a construction of the type defining an open side and including air inlet means and a plurality of air nozzles extending in side-by-side relationship across opposite edges of said open side, passages defined in said construction communicating each of the corresponding inlets and nozzles, and circulating means located in at least one of the inner ones of said passages for driving air streams through said passage and across said open side between corresponding inlets and nozzles, said air streams crossing said open side in side-by-side contacting relationship, the improvement comprising heat conductive means extending across said passages whereby said heat conductive means are contacted by the air streams circulating in said passages, said heat conductive means comprising members having a plurality of extending portions and a common intermediate base, said extending portions extending outwardly from said base at least part way into each of said adjacent passages, one extending portion of said heat conductive means being located for contact with the air circulating in an outer passage, and a further extending portion of said heat conductive means being located for contact with air circulating in an adjacent inner passage whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means contacting said colder air stream.

2. A construction in accordance with claim 1 wherein a single one of said members extends completely across said construction.

3. In a construction of the type defining an open side and including air inlet means and a plurality of air nozzles extending in side-by-side relationship across opposite edges of said open side, passages defined in said construction communicating each of the corresponding inlets and nozzles, and circulating means located in at least one of the inner ones of said passages for driving air streams through said passages and across said open side between corresponding inlets and nozzles, said air streams crossing said open side in side-by-side contacting relationship, the improvement comprising heat conductive means extending across said passages whereby said heat conductive means are contacted by the air streams circulating in said passages, said heat conductive means comprising members having a plurality of extending portions and a common intermediate base, said extending portions comprising members formed integrally with said base and being spaced apart whereby they define openings for the passage of air therethrough, said extending portions extending outwardly from said base at least part way into said adjacent passages, one extending portion of said heat conductive means being located for contact with the air circulating in an outer passage, and a further extending portion of said heat conductive means being located for contact with air circulating in an adjacent inner passage whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means contacting said colder air stream.

4. In a construction of the type defining an open side and including air inlet means and a plurality of air nozzles extending in side-by-side relationship across opposite edges of said open side, passages defined in said construction communicating each of the corresponding inlets and

nozzles, a barrier wall dividing said passages and circulating means located in at least one of the inner ones of said passages for driving air streams through said passages and across said open side between corresponding inlets and nozzles, said air streams crossing said open side in side-by-side contacting relationship, the improvement comprising heat conductive means located at said inlets and extending across said passages whereby said heat conductive means are contacted by the air streams circulating in said passages, said heat conductive means comprising members having a plurality of extending portions and a common intermediate base, said extending portions extending outwardly from said base at least part way into said adjacent passages, with said intermediate base being carried by said barrier wall in the area of said inlets, one extending portion of said heat conductive means being located for contact with the air circulating in an outer passage, and a further extending portion of said heat conductive means being located for contact with air circulating in an adjacent inner passage whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means contacting said colder air stream.

5. A construction in accordance with claim 4 including a front wall in said construction exposed to ambient temperature, said heat conductive means including outwardly extending portions contacting said front wall to pick up heat from said front wall.

6. In a refrigerated cabinet of the type which defines an access opening in one wall communicating an otherwise enclosed space with the ambient atmosphere, said cabinet being provided with a plurality of air inlets and a plurality of air nozzles, said inlets and nozzles extending in side-by-side relationship across opposite edges of said access opening, passages communicating each of the corresponding inlets and nozzles, a barrier wall dividing said passages, a front wall in said construction exposed to ambient temperature, refrigeration means disposed in at least the innermost one of said passages to refrigerate at least the innermost stream passing through said passages and across said access opening, and circulating means included in said innermost passage and in an adjacent outer passage for moving the streams of air through said passages, the improvement comprising heat conductive means located at said inlets and extending across said passages whereby said heat conductive means are contacted by the air streams circulating in said passages, said heat conductive means comprising an intermediate base portion with a plurality of spaced-apart outwardly extending elements formed on either side of said base portion, one portion of said outwardly extending elements being located for contact with the air circulating in an outer passage, and a further portion of said outwardly extending elements being located for contact with air circulating in an adjacent inner passage whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means contacting said colder air stream, and wherein the elements extending into said outer passage define contact members formed at their ends and extending angularly outwardly therefrom, said contact members being adapted to engage one of said walls of said construction to pick up heat therefrom.

7. A construction in accordance with claim 6 wherein said contact members are of a greater width than the elements associated therewith whereby said contact members define a relatively large surface area.

8. In a construction of the type defining at least two adjacent passages for the circulation of air streams with the air streams being maintained at different temperatures, and wherein one of said air streams is refrigerated, the improvement comprising means for preventing the build-up of frost in said passages and on structures disposed therein, said means comprising a heat conductive means adapted to be contacted by the streams circulating

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in said passages, one portion of said heat conductive means being located for contact with the stream in one passage, and a further portion of said heat conductive means being located for contact with the refrigerated stream circulating in the adjacent passage, whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means in contact with said refrigerated stream, said heat conductive means including a central section with said portions extending on either side thereof, and including heating elements located in said central section adapted to maintain the temperature of said section at a point slightly above the temperature of said refrigerated stream.

9. In a construction of the type defining at least two adjacent passages for the circulation of air streams with the air streams being maintained at different temperatures, and wherein one of said air streams is refrigerated, the improvement comprising means for preventing the build-up of frost in said passages and on structures disposed therein, said means comprising a heat conductive means adapted to be contacted by the streams circulating in said passages, one portion of said heat conductive means being located for contact with the stream in one passage, and a further portion of said heat conductive means being located for contact with the refrigerated stream circulating in the adjacent passage, whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means in contact with said refrigerated stream, said portion of said heat conductive means comprising a plurality of spaced-apart fingers, each of said fingers defining a tapered cross section with the apex of the fingers being located for initial engagement by the moving streams.

10. In a construction of the type defining at least two adjacent passages for the circulation of air streams with the air streams being maintained at different temperatures, and wherein one of said air streams is refrigerated, the improvement comprising means for preventing the build-up of frost in said passages and on structures disposed therein, said means comprising a heat conductive

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means adapted to be contacted by the streams circulating in said passages, one portion of said heat conductive means being located for contact with the stream in one passage, and a further portion of said heat conductive means being located for contact with the refrigerated stream circulating in the adjacent passage, whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means in contact with said refrigerated stream, said portions of said heat conductive means comprising a plurality of spaced-apart fingers having circular cross sections.

11. In a construction of the type defining at least two adjacent passages for the circulation of air streams with the air streams being maintained at different temperatures, and wherein one of said air streams is refrigerated, the improvement comprising means for preventing the build-up of frost in said passages and on structures disposed therein, said means comprising a heat conductive means adapted to be contacted by the streams circulating in said passages, one portion of said heat conductive means being located for contact with the stream in one passage, and a further portion of said heat conductive means being located for contact with the refrigerated stream circulating in the adjacent passage, whereby heat from the warmer air stream will be conducted by said heat conductive means to the portion of said heat conductive means in contact with said refrigerated stream, said portions of said heat conductive means comprising a plurality of spaced-apart fingers, each of said fingers taking the form of a flat strip and wherein said fingers are bent to present the side edges of said strips to the oncoming streams.

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WILLIAM J. WYE, *Primary Examiner.*