March 18, 1958 A. W. RUFF 2,827,266

VESTIBULE FOR COLD STORAGE WAREHOUSES

Filed Oct. 31, 1956 2 Sheets-Sheet 1

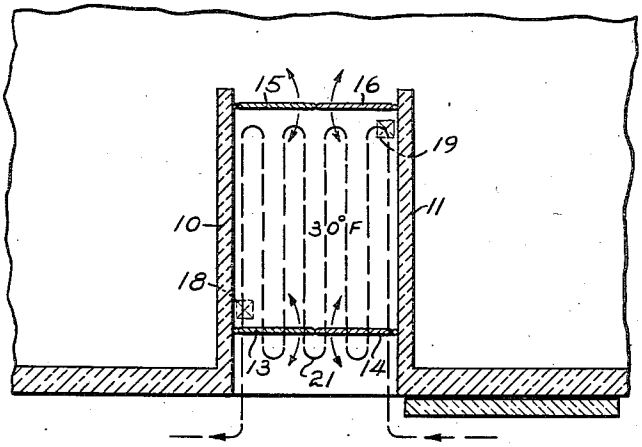

Fig. 1

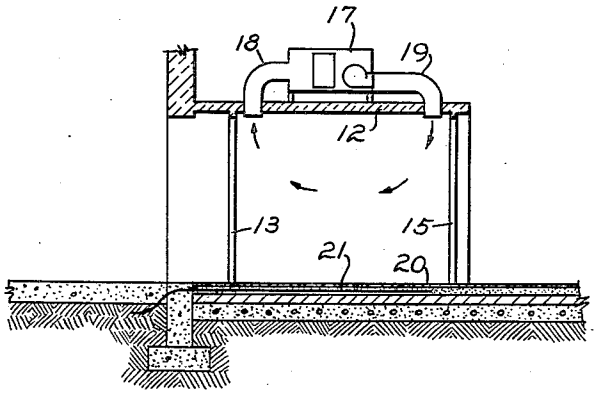

Fig. 2

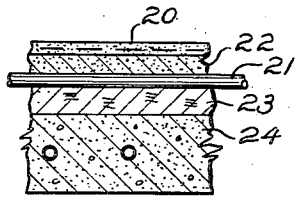

Fig. 3

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VESTIBULE FOR COLD STORAGE WAREHOUSES

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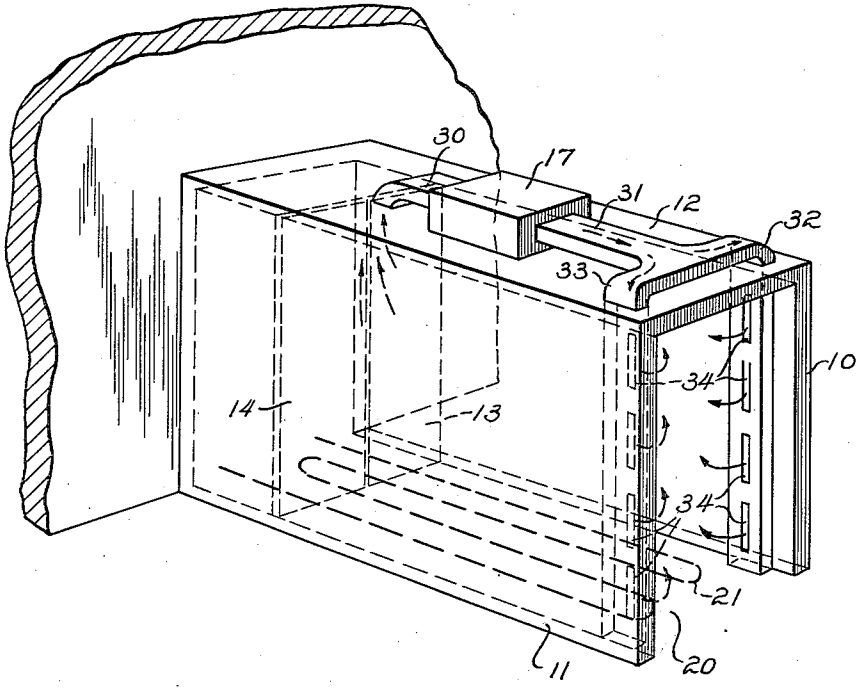

FIG. 4

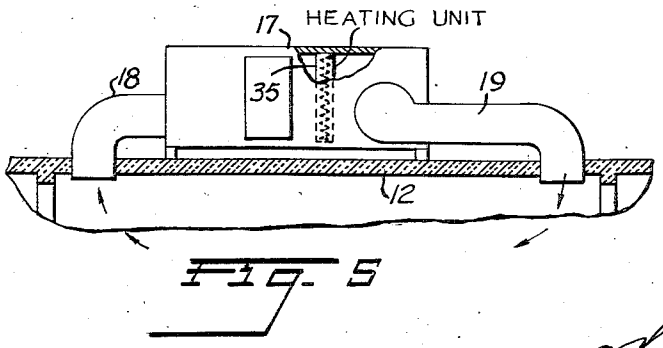

FIG. 5

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VESTIBULE FOR COLD STORAGE WAREHOUSES

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Application October 31, 1956, Serial No. 619,496

9 Claims. (Cl. 257—9)

This invention relates to cold storage warehouses, and more particularly to vestibles for structures of this type, through which trucks enter and leave the refrigerated storage space.

The present application is a continuation in part of my co-pending application, Serial No. 392,543, filed November 17, 1953, now abandoned.

With the greatly accelerated expansion of the frozen food industry, there has been a corresponding expansion in the demand for large scale cold storage facilities. In general, the demand is for large areas of storage in which the temperature is maintained at 0° F. or below.

In the actual day to day use of facilities of this type there is the necessity for frequent entry into and exit from the cold storage areas, from areas which assume temperatures substantially equal to the outdoor ambient temperature. The latter, particularly in the warmer months of the year, may well be of the order of 100° F. higher than the temperature of the cold storage space. Actual movement of produce into and out of the cold storage space, therefore, frequently involves crossing a temperature differential of the order of 100° F.

Initially, vestibules were provided having insulated walls and doors, and there was mounted in each end of the vestibule a pair of double-hung, double-swinging doors. Transport vehicles such as the conventionally used lift trucks were thus able to drive into and out of the cold storage space by simply bumping the swinging doors. Repeated and frequent opening and closing of these doors presented a number of unexpected problems. With each opening and closing, a certain amount of the high temperature and possibly high humidity air would enter the cold storage space. This resulted in a condition which was both annoying and dangerous to the operators of the trucks. The meeting of the two volumes of air at such widely separated temperatures occasioned surprisingly dense clouds of fog. The occurrence of the fog was sufficient to obstruct the truck driver's vision, and, therefore, formed an immediate hazard not only to the driver, but to the other drivers and employees within the cold storage space. This problem was first attacked by installing air conditioning means to cool and dehumidify the air within each vestibule. This provided at least a partial solution to the problem, but in so doing, raised others, some of which were perhaps even more objectionable than the fog problem. Chief among these was the condensation which took place along the doors, side walls, and floor of the vestibule. With the vestibule floor wet, the wheels of trucks entering the cold storage space would be wetted, and upon entry into the cold storage space the moisture would freeze on the tires to an extent which prevented proper traction. In addition, condensation running down the doors and walls and accumulating on the floor of the vestibule resulted in a build-up of ice on the floor. In addition to the driving hazard presented, the ice build-up tends to accumulate at that point on the vestibule floors covered by the swinging of the pairs of doors. Ultimately, this ice had to be manually removed to prevent interference with the operation of the doors.

The problem, therefore, has been to provide a vestibule for a cold storage warehouse which would be free of all of the above noted problems. In other words, the problem has been to provide a completely dry vestibule, that is, one which is free from condensation and icing, and also to prevent fog formation upon repeated opening and closing of the vestibule doors as the load carrying trucks pass therethrough.

A complete understanding of the invention may be had by reading the following specification in conjunction with the attached sheet of drawing in which:

Figure 1 is a top sectional view of a vestibule in accordance with this invention;

Figure 2 is a side view in section;

Figure 3 is a detailed sectional view of a portion of the vestibule floor;

Figure 4 is a perspective view of a modification of the vestibule illustrated in Figures 1–3; and

Figure 5 is a diagrammatic illustration of a modification of the air conditioning means.

In general, the objects of the present invention are achieved by providing in addition to means for air conditioning, that is, cooling and dehumidifying the air within the vestibule, a separate means for simultaneously applying heat to the vestibule floor. This combination of heat transfer means provides a satisfactory solution to the problems, and in actual practice, vestibules so designed and equipped, have proven to remain dry and free from condensation, ice build-up, and fog formation. The exact reasons for the success of this invention are not completely known. In general, it is believed that the application of heat to the floor serves a dual purpose. The floor is maintained at a temperature above the dew point of the vestibule atmosphere and the addition of heat to the atmosphere itself tends to aid the air conditioning means in effecting an overall reduction of relative humidity. Suffice to say, the problem has been solved.

Referring now to Figures 1 and 2 of the attached drawing, it will be seen that the vestibule comprises a pair of opposed thermally insulated side walls **10** and **11**, and a similarly insulated roof or ceiling member **12**, which is coextensive with and overlies the side walls. Disposed at opposite ends of the vestibule is a pair of double-hung, double-swinging doors **13**, **14**, **15**, and **16**. In Figure 2 there is shown schematically an air conditioning means **17** positioned exteriorly of the vestibule and preferably mounted on top of the ceiling member **12**. A pair of ducts **18** and **19** extends through the ceiling member **12** in order to provide means for circulating the air within the vestibule over a conventional evaporator, which forms part of the air conditioning means **17**. Disposed beneath the wear or exposed surface of the floor **20** is a radiant heating grid **21**. Figure 3 shows, in more detail, one preferred embodiment of the floor heating means. The uppermost layer **20** is the actual wear surface of the vestibule floor. Immediately below this surface is a second layer of material **22** which may conveniently be a grout. This latter layer provides an intermediate slab which may expand and contract with temperature changes without buckling the floor **20**. The pipes which form the heating grid **21** are set in the grout **22**. The grid **21** and grout **22** rest upon a layer of thermal insulating material **23** which overlies the footing **24**.

Heated fluid from any convenient source is continuously circulated through the grid **21** to effect application of heat by radiation and/or conduction to the floor **20**. In actual practice such fluid may be the same fluid which is used to cool the compressors forming a part of the re-

frigeration installation for the entire warehouse. The source is obviously not critical and could, in fact, be a separate boiler system or the like.

As an example of typical operating conditions wherein the heat source is fluid, circulated to the refrigerant compressors, the temperature of the fluid supplied to the grid 21 is of the order of 60° F., and the fluid returning to the compressors from the grid is at a temperature which is of the order of 52° F. This results in a temperature of the wearing surface of the floor 20 of about 45° F. These temperatures are predicated on use of an air conditioning means which maintains the vestibule air temperature at approximately 27° F. The latter figure is obviously variable with the degree of use of the vestibule, but the other temperatures noted above remain fairly constant.

Referring now to Figure 4, which shows a modification of the previously described invention, the parts which correspond to those in Figures 1–3 bear the same reference numerals. In this embodiment, doors 15 and 16 have been replaced by what is in effect an air curtain. The duct work used in connection with the air conditioning means 17 is modified to produce this structure. The inlet duct 30 in this embodiment is positioned substantially centrally of the vestibule and adjacent the inner end of entrance doors 13 and 14. The outlet duct in this embodiment includes a horizontal duct member 31 and a pair of vertical duct members 32 and 33. These latter members are positioned on opposite sides of the inner end of the vestibule along the side walls 10 and 11. Each of these ducts includes a plurality of slotted openings 34 which are disposed inwardly of the vestibule and in substantially corresponding positions on each of the duct members 32 and 33.

In operation, therefore, the air conditioning means 17 serves to force a blast of cool and dehumidified air through the duct member 31 and down duct members 32 and 33. This air in issuing from the slots 34 in effect forms an air curtain across the innermost end of the vestibule. While this may not be entirely as effective as the double hung swinging doors, it may prove more advantageous in some installations.

Since the original application was placed on file in the Patent Office, applicant discovered that the operation of either of the two previously described embodiments may be improved by adding a small amount of heat to the air as it leaves the cooling coil of the air conditioner.

Figure 5 illustrates this improvement in diagrammatic form. The source of heat is immaterial to the successful operation of the invention. Successful use has been made of electrical heaters, as well as hot gas heaters in which a portion of the condenser of the air conditioner is located in the air conditioner at a point where the air off the evaporator will be contacted and warmed. Still another convenient source of heat would be the fluid which is circulated in the radiant heating coils 21. In the drawings, the heating unit is indicated at 35.

The reason for the improved operation of a unit of this type which includes the air warming device, is that the warmer air has a greater capacity for absorbing moisture from the vestibule atmosphere.

From the foregoing, it will be apparent that there is herein shown and described a novel and useful vestibule for use in cold storage warehouses providing ready accessibility for load carrying vehicles to the cold storage space, which is free from all of the problems heretofore encountered. It will be further apparent that the air conditioning means may be disposed in any convenient location and the invention is not limited to the location shown on the attached drawings. Also, while a radiant heating means is a preferred embodiment of the invention as shown in the drawings, other obvious equivalents well known to the art would serve the purpose, although perhaps less efficiently.

The above and other equally obvious variations will all be within the scope of the appended claims.

I claim:

1. In combination with a refrigerated storage space, the temperature of which space is maintained at the order of 0° F., a vestibule communicating with the storage space and affording an entrance and exit for load carrying vehicles to and from said space, the air temperature in said vestibule being substantially higher than the temperature in said storage space, said vestibule being further characterized by a dry atmosphere and ice and frost free surfaces therein, comprising: opposed thermally insulated side walls, ceiling and floor; means for heating said floor to maintain the floor at a temperature above the dewpoint of the air in said vestibule; air conditioning means including inlet and outlet connections communicating directly with the interior of said vestibule for positively circulating the vestibule atmosphere through said air conditioner to refrigerate and dehumidify the vestibule atmosphere; and means forming a part of said vestibule, positioned at opposite ends thereof, effective to normally substantially isolate the atmosphere therein, but permitting the passage of load carrying vehicles therethrough.

2. A vestibule as defined by claim 1 in which the last mentioned means comprises two pairs of double hung swinging doors, one pair positioned at each end of said vestibule.

3. A vestibule as defined by claim 1 in which said last mentioned means comprises: a pair of double hung swinging doors positioned at the entrance of said vestibule; a pair of air ducts vertically positioned on opposite side walls at the other end of said vestibule, each of said ducts having corresponding opening therein on the inner surfaces thereof; and means for connecting said ducts to the outlet of said air conditioning means.

4. A vestibule as defined by claim 1 in which the means for applying heat to the floor comprises a radiant heating system.

5. A vestibule as defined by claim 1 in which the means for applying heat to the floor comprises a radiant heating grid of the type in which a warm fluid is circulated disposed beneath and closely adjacent to the floor.

6. In combination with a refrigerated storage space, the temperature of which space is maintained at the order of 0° F., a vestibule communicating with the storage space and affording an entrance and exit for load carrying vehicles to and from such space, the temperature in said vestibule being substantially higher than the temperature in said storage space, said vestibule being further characterized by a dry atmosphere and ice and frost free interior surfaces therein, comprising: an insulated room including opposed side walls, floor and ceiling; door means arranged at opposite ends of said room, said door means serving normally to close off said room from the refrigerated space at one end, and from the nonrefrigerated space at the other end of said room; radiant heating means disposed in the floor of said room to maintain the floor temperature above the dewpoint of the air in the vestibule; and air conditioning means spaced from said radiant heating means and including inlet and outlet connections communicating directly with the interior of said vestibule for positively circulating the vestibule atmosphere through said air conditioner to refrigerate and dehumidify the vestibule atmosphere.

7. In combination with a refrigerated storage space, the temperature of which space is maintained at the order of 0° F., a vestibule communicating with the storage space and affording an entrance and exit for load carrying vehicles to and from said space, the air temperature in said vestibule being maintained at substantially higher temperature, said vestibule being further characterized by a dry atmosphere and ice and frost-free surfaces therein, comprising: a pair of opposed insulated side walls; an insulated ceiling attached to, coextensive with, and extending between the upper ends of said side

walls; a floor for said vestibule comprising a concrete wear slab; a plurality of radiant heating coils positioned beneath and adjacent to said wear slab; an air conditioner, for refrigerating and dehumidifying, mounted exteriorly of said vestibule on the ceiling thereof; inlet and outlet ducts for said air conditioner extending through said ceiling to provide for circulation of the air in said vestibule through said air conditioning means; and a pair of normally closed, double-hung swinging doors positioned at each end of said vestibule.

8. In combination with a refrigerated storage space, the temperature of which space is maintained at the order of 0° F., a vestibule communicating with the storage space and affording an entrance and exit for load carrying vehicles to and from said space, the air temperature in said vestibule being substantially higher than the temperature in said storage space, said vestibule being further characterized by a dry atmosphere and ice and frost free surfaces therein, comprising: opposed thermally insulated side walls, ceiling and floor; means for heating said floor to maintain the floor at a temperature above the dewpoint of the air in said vestibule; air conditioning means including inlet and outlet connections communicating directly with the interior of said vestibule for positively circulating the vestibule atmosphere through said air conditioner to refrigerate and dehumidify the vestibule atmosphere, and further including means for adding a small amount of heat to the air as it leaves the evaporator coil and prior to the time that the dehumidified air re-enters the vestibule; and means forming a part of said vestibule, positioned at opposite ends thereof, effective to normally substantially isolate the atmosphere therein, but permitting the passage of load carrying vehicles therethrough.

9. In combination with a refrigerated storage space, the temperature of which space is maintained at the order of 0° F., a vestibule communicating with the storage space and affording an entrance and exit for load carrying vehicles to and from said space, the air temperature in said vestibule being substantially higher than the temperature in said storage space, said vestibule being further characterized by a dry atmosphere and ice and frost free surfaces therein, comprising: opposed thermally insulated side walls, ceiling and floor; means for heating said floor to maintain the floor at a temperature above the dewpoint of the air in said vestibule; means operable simultaneously with said floor heating means for lowering the temperature and humidity of the vestibule atmosphere; and means forming a part of said vestibule, positioned at opposite ends thereof, effective to normally substantially isolate the atmosphere therein, but permitting the passage of load carrying vehicles therethrough.

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