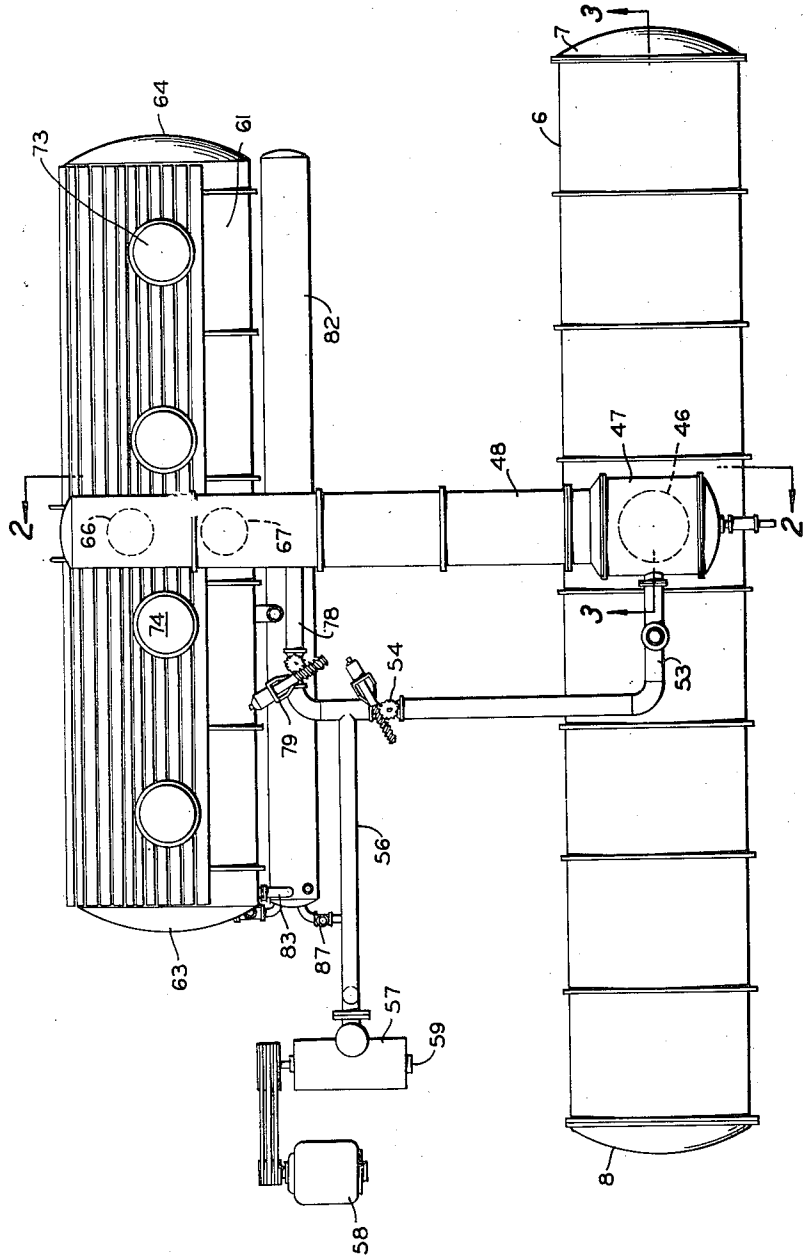
Nov. 13, 1956 F. J. HIBBS, JR 2,770,110

VACUUM PRODUCE COOLER

Filed Oct. 10, 1955 4 Sheets-Sheet 1

FIG. 1



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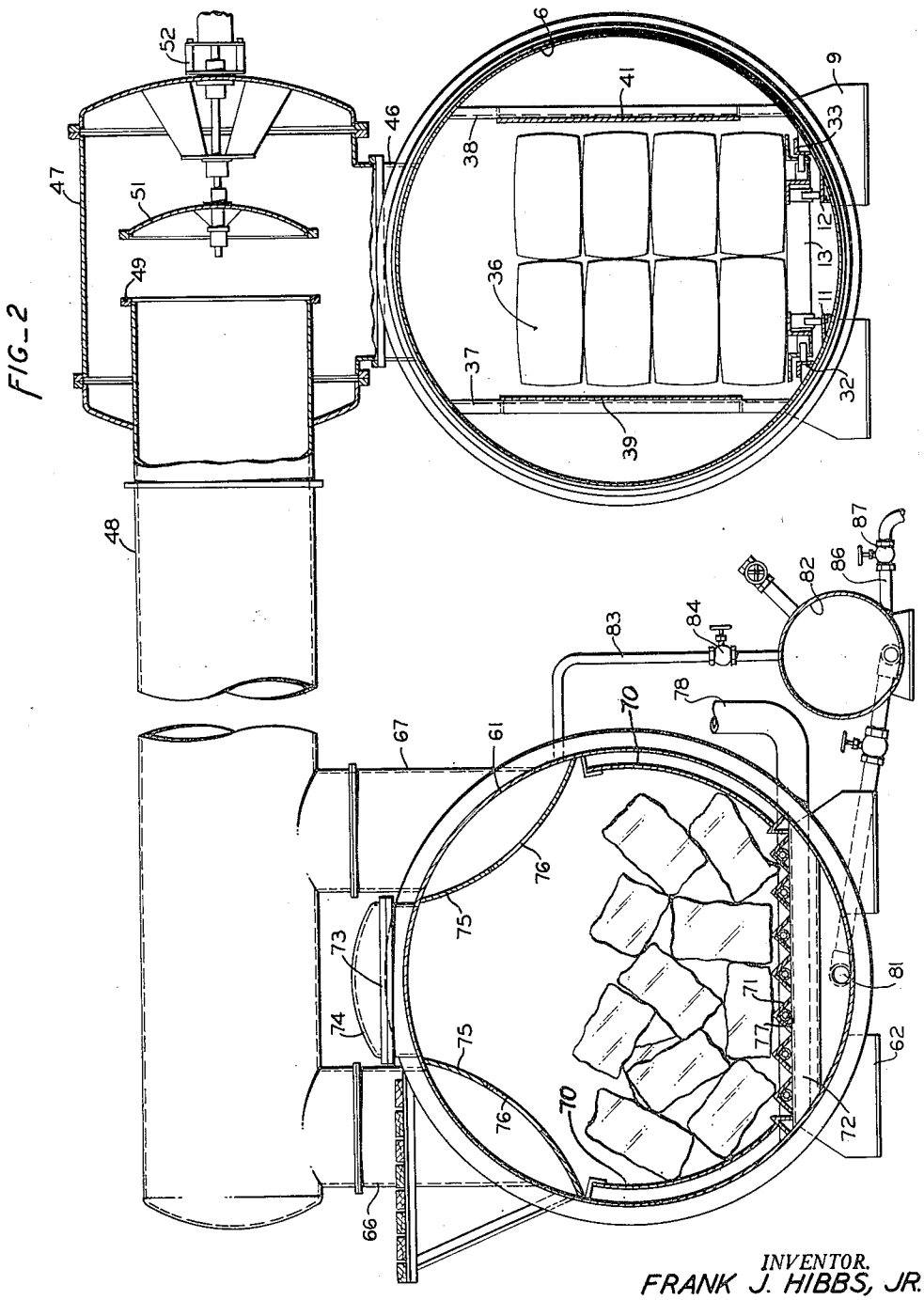
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VACUUM PRODUCE COOLER

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FIG_2



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VACUUM PRODUCE COOLER

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FIG_3

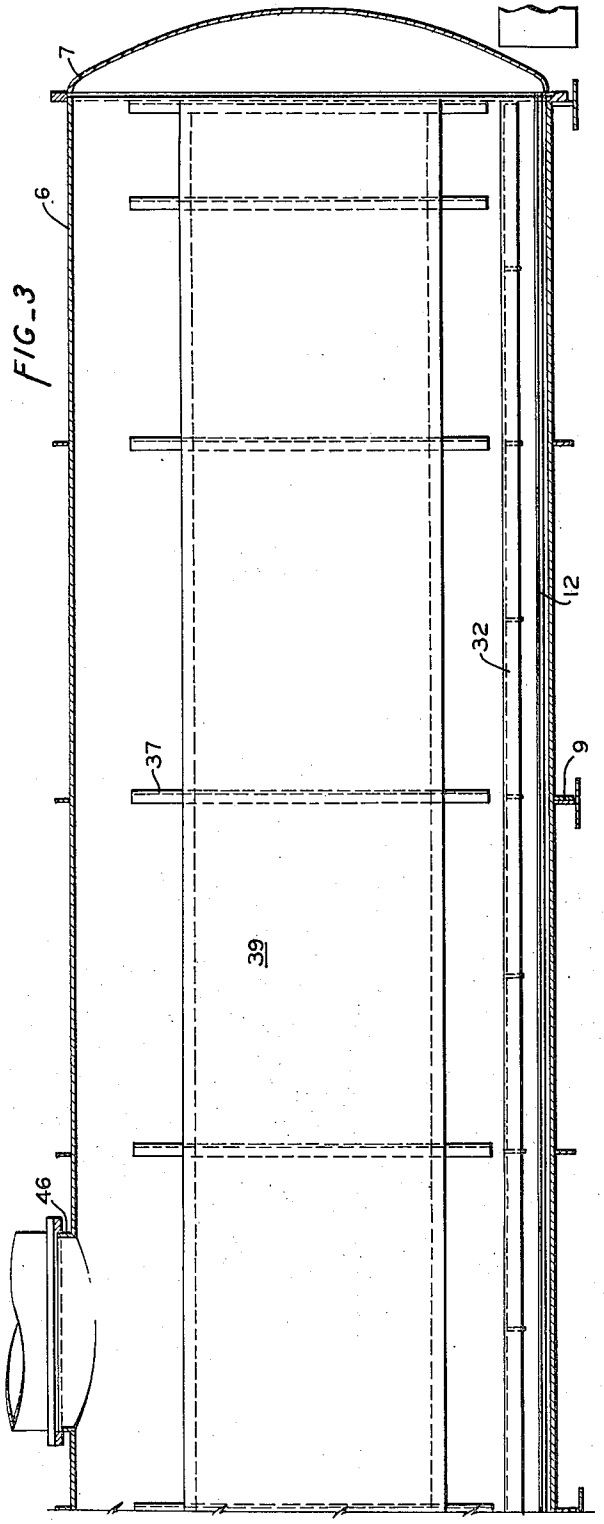
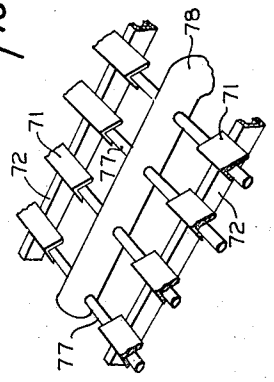


FIG_4



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VACUUM PRODUCE COOLER

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FIG_5

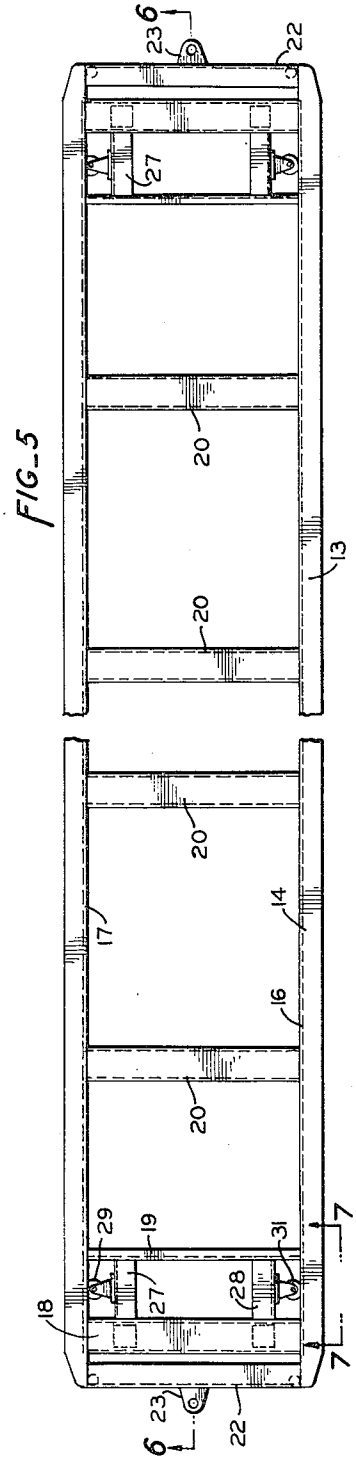


FIG_6

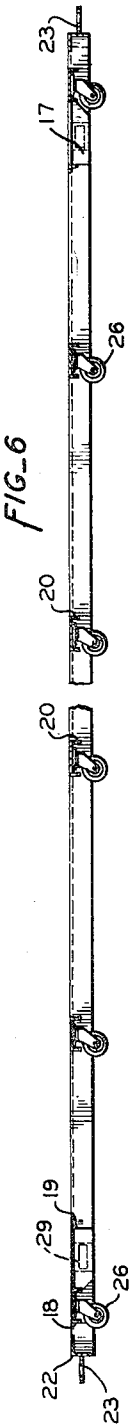


FIG_8

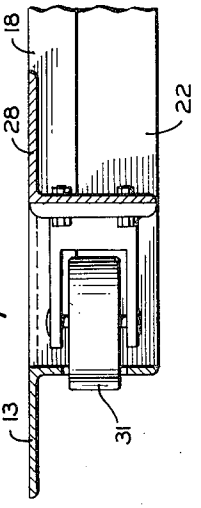
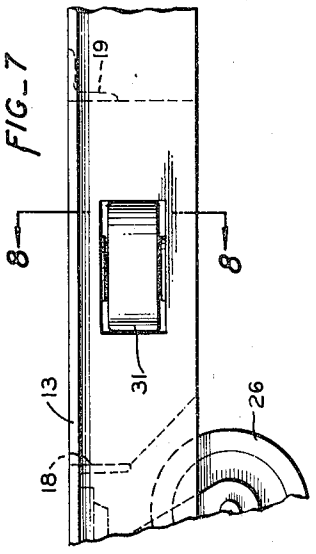


FIG_7



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United States Patent Office 2,770,110 Patented Nov. 13, 1956

2,770,110

VACUUM PRODUCE COOLER

Frank J. Hibbs, Jr., Inglewood, Calif., assignor to Associated Refrigerating Engineers, a corporation

Application October 10, 1955, Serial No. 539,334

4 Claims. (Cl. 62—169)

My invention relates particularly to devices for cooling produce such as lettuce, corn, cauliflower and the like by a reduction in the ambient pressure so that moisture near, on or in the produce in evaporating extracts heat from the produce. While various different means for effectuating this operation have appeared in the patent literature and in practice, the present development is especially concerned with the utilization of water ice as a part of the pressure reduction mechanism. When moisture is removed in the form of steam from articles being refrigerated, it is economically necessary to condense the steam into liquid form and withhold it from the vacuum pumps in order not to overload the vacuum pumps. Otherwise, if the pumps must handle the condensible as well as the non-condensible fluid, they must be so large that the process is not commercially feasible. Brine coils or refrigerator coils of some sort are utilized as condensers for such purposes and water ice has been proposed. Difficulties have arisen in practical application, however, since it is difficult to utilize the ice properly. Furthermore, in order to make sure that the time consumed in cooling the produce is not economically excessive, it is necessary to reduce the time of loading and unloading the produce from the evacuating mechanism and to make sure that the produce is disposed in an economically satisfactory manner.

It is therefore an object of my invention to provide a vacuum produce cooler operating with an ice condenser and which is satisfactory commercially.

Another object of my invention is to provide a vacuum produce cooler in which the produce is effectively handled and disposed.

Another object of my invention is to provide a vacuum produce cooler in which the produce can readily be introduced into and withdrawn from the evacuating mechanism.

Another object of my invention is to provide a vacuum produce cooler in which the produce is uniformly and satisfactorily cooled.

Another object of my invention is, in general, to provide an improved, practical vacuum produce cooler.

A still further object of my invention is to provide a vacuum produce cooler in which the produce containing element can appropriately be related to the vacuum refrigerating elements.

Other objects, together with the foregoing, are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawings, in which

Figure 1 is a plan of a vacuum produce cooler constructed in accordance with my invention.

Figure 2 is a cross section, the plane of which is indicated by the line 2—2 of Figure 1 but drawn to an enlarged scale with some parts of the structure being broken away to reduce the size of the figure.

Figure 3 is a cross section, the plane of which is indicated by the line 3—3 of Figure 1.

Figure 4 is an isometric view of a fragment of the ice grid and adjacent structure.

Figure 5 is a plan of a produce dolly, portions being broken away to reduce the length of the figure.

Figure 6 is a cross section, the plane of which is indicated by the line 6—6 of Figure 5.

Figure 7 is a fragmentary side elevation to an enlarged scale, the view being indicated by the line 7—7 of Figure 5.

Figure 8 is a cross section, the plane of which is indicated by the line 8—8 of Figure 7.

The vacuum produce cooler of the invention can be incorporated in a number of different forms and, for one variation, reference is made to the co-pending related application of James C. Rear, filed October 10, 1955 with Serial Number 539,309. Some of the subject matter disclosed in this application, and not claimed herein, is claimed in the mentioned Rear application.

In the customary installation, there is provided on a suitable ground area or platform, a produce tube 6 which, preferably, is made of a circular cylindrical metallic member closed at one end 7 and having a door 8 at the other end. The produce tube 6 is conveniently mounted on structural members 9 so that it is substantially horizontal and so that a pair of tracks 11 and 12 disposed within the tube adjacent the bottom thereof are approximately level with the surrounding ground area. This is for the purpose of receiving a dolly 13.

The dolly includes a frame 14 having side members 16 and 17 substantially as long as the clear interior dimension of the produce tube 6 and having tapered guide ends. The members 16 and 17 are conveniently angles with their upper flanges turned outwardly. At appropriate intervals, the side members 16 and 17 are spanned by cross members 18, 19 and 20 to afford a generally rectangular frame. At the ends, the frame side members 16 and 17 are joined by cross bars 22 having fittings 23 for the reception of conveying or propulsion mechanisms. The arrangement is such that the upper surface of the frame is substantially planar.

To support the frame on the ground surface or on the tracks 11 and 12, the frame is provided, particularly on the cross members 18 and 20, with pairs of ground engaging wheels 26 preferably in the form of caster wheels. The load on the frame is well distributed over the entire assemblage of wheels and the dolly can readily be maneuvered. The lateral spacing between the wheels 26 is substantially the same as that afforded by the tracks 11 and 12.

In order to keep the relatively long dolly in a straight course when it is being introduced into or removed from the tube, the frame cross members 18 and 19 are spanned by beams 27 and 28, each of which carries one of a pair of side wheels 29 and 31. These wheels are spaced apart so that they fit readily between longitudinally extending angles 32 and 33, extending throughout the length of the produce tube 6 and preferably conveniently nested just below the angular side members 16 and 17 of the dolly, thus making economical use of the space near the bottom of the circular tube 6.

With this construction, the dolly is readily drawn or pushed into the produce tube with the side wheels 29 and 31 engaging the angle guides 32 and 33 to preclude excessive lateral movement of the dolly while the weight on the dolly is supported through the various wheels 26 on the tracks 11 and 12. The weight of the lading is not only distributed evenly throughout substantially the entire length of the dolly but because of the numerous wheels 26, this weight is transmitted uniformly to the tracks 11 and 12 and, thus, is uniformly borne through the produce tube by the supporting structure

therefor. The structure is not locally overloaded and so can be relatively light.

The lading 36 on the dolly is usually a plurality of packages. In the present instance, there are illustrated lettuce cartons. These are bulge packed and are not entirely stable, nor are they always loaded on the dolly exactly in geometrical fashion. Consequently, to confine the lading to the dolly as it is going into and out of the tube and to make sure that the lading is not dislodged enough to interfere with the vacuum operation, the tube is preferably provided at intervals throughout its length with a number of upright pairs of bars 37 and 38. Extending throughout substantially the entire length of tube and supported on the bars are side plates 39 and 41. These are effective to contact the packages on the dolly in the event they become slightly dislodged and to retain them well enough in place for cooling. The plates do not extend entirely to the upper part or the lower part of the tube and hence allow adequate openings both above and below for the free withdrawal of steam emanating from the lading 36.

In addition to their function in confining the lading packages, the bars 37 and 38 also serve as interior supports for the tube 6 and strengthen it against implosion. They are preferably arranged in close juxtaposition with the members 9 so that the produce tube 6 is extraordinarily strong against collapse not only because of its circular cross sectional shape but also because of the internal bracing afforded by the bars 37 and 38. The location of the various bars and the positioning of the tracks 11 and 12 and guide rails 32 and 33 disposes the lading within the produce tube so as to afiord a substantially even egress for the steam from all parts of the lading and throughout the entire length of the lading on the dolly.

The lading either contains sufficient natural moisture or has been sufficiently moistened so that some or all of such moisture evaporates at a lowered ambient pressure. The evaporating moisture withdraws sufficient heat from the produce to reduce its temperature from the undesired high value when the produce is entered into the tube to the desired low value when the produce is withdrawn therefrom. Cooling time, in practice, is about 20 minutes to an hour or so for most items.

Since it is desired to remove substantially all of the atmosphere from the produce tube 6; that is, to establish a satisfactory vacuum therein, the tube 6 adjacent its upper portion has a connection 46 to a valve housing 47 into which an outlet duct 48 extends. There is a suitable seat 49 on the end of the duct 48 and opposite the seat within the casing 47, there is provided a valve 51. This is conveniently operated by servo mechanism 52 between an open position, as shown in Figure 2, and a closed position with the valve 51 abutting the seat 49.

Also joined to the valve body 47 between the seat 49 and the connector 46 is a vacuum line 53. This extends through a control valve 54 into a pipe 56 leading to a vacuum pump 57. This is preferably a mechanical, positive displacement pump appropriately driven by an electric motor 58. When the valve 51 is closed and the motor 58 is energized, the pump 57 is effective to withdraw fluid from within the produce tube 6 and to discharge the withdrawn material through an outlet 59 to the atmosphere. The rate at which the pump 56 can reduce the pressure with the mechanism so far described is relatively slow, too slow for practicality. For that reason, there is provided additional mechanism to speed up the operation. The conduit 48 extends to a refrigeration tube 61. This tube is likewise a circular cylindrical, metal vessel suitably supported on feet 62 and is closed at its opposite ends by pressure resisting heads 63 and 64. The conduit 48 is connected into the refrigerator tube 61 by a pair of ducts 66 and 67 symmetrically arranged on opposite sides of the vertical center line of the tube and opening into the upper part of the refrigerator tube 61.

Disposed within the tube 61 along the side walls are lining plates 70 and adjacent the bottom portion thereof is an ice grid 71. This is preferably a somewhat open supporting platform conveniently fabricated of a number of structural shapes, such as angle irons disposed substantially from one end of the tube to the other. At appropriate intervals, the grid angles 71 are supported by cross beams 72 so that a sturdy, foraminous grid is provided.

Since it is desired to utilize water ice as a refrigerating medium, the refrigerator tube 61 along its uppermost portion and at appropriate intervals is provided with a number of icing hatches 73. Each of these is a relatively large opening into the interior of the tube 61 and is normally closed by a pressure cap 74. The cap, or cover, is so mounted that it can be swung completely out of the way when access is to be had to the interior of the tube 61 through the hatches 73. Suitably sized pieces of ice are dumped through the hatches onto the ice grid 71 so that substantially the entire length of the refrigerating tube 61 is filled from the grid to a relatively high point therein.

To avoid short circuiting of vapor through large free paths in the ice, there is provided on the interior of the tube 61 over the intersection of the connections 66 and 67 with the tube a pair of manifold plates 75 extending for nearly the full length of the refrigerator tube 61 and fastened tightly to the walls of the tube to provide ducts. At appropriate intervals, the manifold plates 75 are pierced by openings 76. Thus, fluid flowing into the tube 61 through the connections 66 and 67 is necessarily distributed quite evenly along the length of the tube.

Additionally, there is provided means for withdrawing gases from the tube 61 in a uniform fashion. Preferably disposed beneath the ice grid 71 is a plurality of perforated tubes 77. These lead into and can be considered as part of a suction manifold 78. This leads through a control valve 79 to a junction with the vacuum pipe 56. With the manifold arrangement underneath the ice grid, gases within the tube 61 are uniformly and evenly withdrawn from all portions of the tube and are eventually delivered to vacuum pump 57 for discharge to the atmosphere.

The operation of the structure melts some of the ice on the grid and the resulting water flows through a pipe 81 in the very bottom of the tube 61 into a tank 82 disposed in a location for the most part below the pipe 81. The tank 82 at its upper portion is connected by a pipe 83 having a valve 84 therein to the upper portion of the tank 61. Additionally, the tank 82 is provided with a drain pipe 86 having a valve 87 therein and leading to the atmosphere or any equivalent drain.

In the use of this structure, the valve 51 is closed, the produce tube is connected to the atmosphere and the door 8 is opened. Lading to be cooled is wheeled in on the dolly 13 in stacked or otherwise packed form and the door 8 is hermetically closed. The valve 54 is opened and the vacuum pump 57 reduces the pressure within the produce tube 6 to a reasonable value whereupon the valve 51 is opened. Simultaneously, the valve 54 is closed and the valve 79 is opened. The vacuum pump 57 then draws the atmosphere; that is air, "steam" or water vapor, and various other condensible and non-condensible gases from the produce tube 6 through the conduit 48 and through the distributing manifolds defined by the plates 75 into the refrigerator tube 61. The evenly distributed flow continues down over the ice on the grid 71 and much of the vapor within the pumped atmosphere is condensed onto the ice, thereby reducing the volume of the gases substantially. Condensation of the vapors results in the melting of some of the ice and the resulting water flows through the pipe 81 into the sump tank 82 which, at that time, is connected to the interior of the tube 61 not only through the pipe 81 but also through the pipe 83 since the valve 84 is open.

The valve 87, at this time, is closed. Later, when the tube 61 is open to atmospheric pressure, the valve 87 is opened and the tank 82 is drained.

The remaining non-condensible gas, after having travelled over the ice and through the grid 71, enters the perforations in the tube 77 and flows through the pipe 78 and the pipe 56 into the vacuum pump 57 and from thence into the atmosphere through the discharge pipe 59. The pumping continues until such time as the evaporating moisture or steam from the packages of produce on the dolly 13 has withdrawn sufficient heat from the produce to reduce its temperature to the selected value. At that time, the valve 51 is closed and the interior of the tube 6 is subjected to atmospheric pressure by an appropriate valving mechanism. The door 8 is opened and the dolly 13 and its contained produce are withdrawn in cooled condition. Either this dolly is unloaded and then loaded for a subsequent cycle or another produce dolly, fully loaded, is introduced for repetition of the described cycle.

It has been observed in practice that with this structure the produce is cooled with unusual effectiveness. Apparently the large condensing surface of the ice chunks, in the refrigerator tube 61 is effective to assist the vacuum pump very quickly to lower the pressure on the produce. This is augmented by the symmetrically disposed produce on the dolly 13 with adequate and substantially uniform flow area surrounding the entire length of the lading on the dolly. If the produce is like letture or cauliflower, some physical expansion of the produce takes place during the rapid lowering of the pressure. This gives a somewhat freer path for gas flow to release the interior moisture and permits free "breathing" of gases from interior portions of the produce. There is a much more marked effect from the large ice surface than is obtained by any normal or practical installation of refrigerating coils utilizing brine or ammonia or the like. The resulting, cooled produce is, therefore, somewhat superior in appearance and since it is initially somewhat expanded, it cools to the desired temperature in a somewhat shorter cycle. In general, the arrangement of the produce tube together with the refrigeration tube is such as to afford a highly practical commercially successful way of vacuum cooling produce and comparable items.

What is claimed is:

1. A vacuum produce cooler for use with a produce tube comprising a refrigerator tube, means for supporting a heat absorber in said refrigerator tube, a drain tank, means for connecting said drain tank to said refrigerator tube near the bottom thereof and to the atmosphere, valves in said connecting means, a vacuum pump, a suction manifold in said refrigerating tube on one side of said heat absorber supporting means, means for connecting said suction manifold to said pump, an inlet manifold in said refrigerating tube on the other side of said heat absorber supporting means, and means for connecting said inlet manifold to said produce tube.

2. A vacuum produce cooler for use with a produce tube comprising a refrigerator tube, means for supporting a heat absorber extending longitudinally within said refrigerator tube, a drain tank, means for connecting said drain tank to said refrigerator tube near the bottom thereof and to the atmosphere, valves in said connecting means, a vacuum pump, a suction manifold extending longitudinally of said refrigerating tube on one side of said heat absorber supporting means, means for connecting said suction manifold to said pump, an inlet manifold extending longitudinally of said refrigerating tube on the other side of said heat absorber supporting means, and means for connecting said inlet manifold to said produce tube.

3. A vacuum produce cooler for use with a produce tube comprising a refrigerator tube, means for supporting a heat absorber extending longitudinally within said refrigerator tube and spaced from the top and the bottom of said refrigerator tube, a drain tank, means for connecting said drain tank to said refrigerator tube near the bottom thereof and to the atmosphere, valves in said connecting means, a vacuum pump, a suction manifold extending longitudinally of said refrigerating tube beneath said heat absorber supporting means, means for connecting said suction manifold to said pump, an inlet manifold extending longitudinally of said refrigerating tube above said heat absorber supporting means, and means for connecting said inlet manifold to said produce tube.

4. A vacuum produce cooler for use with a produce tube comprising a refrigerator tube, a horizontal grid extending transversely of and from end to end of said tube adjacent the bottom thereof, means for conducting atmosphere from said produce tube into said refrigerator tube above said grid and at substantially uniformly distributed points thereover, means for withdrawing atmosphere from said refrigerator tube beneath said grid and at substantially uniformly distributed points thereunder, means substantially at the bottom of said refrigerator tube for draining water therefrom, and means substantially at the top of said refrigerator tube for introducing a refrigerant thereto.

References Cited in the file of this patent

UNITED STATES PATENTS

2,621,492 Beardsley ---------- Dec. 16, 1952