

April 13, 1948.

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2,439,487

METHOD OF PRECOOLING THE LADING OF REFRIGERATOR

CARS COMPRISING THE REVERSAL AIR FLOW

Filed March 16, 1945

2 Sheets-Sheet 1

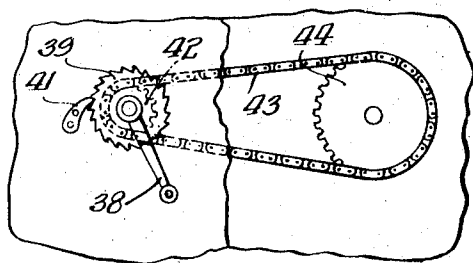
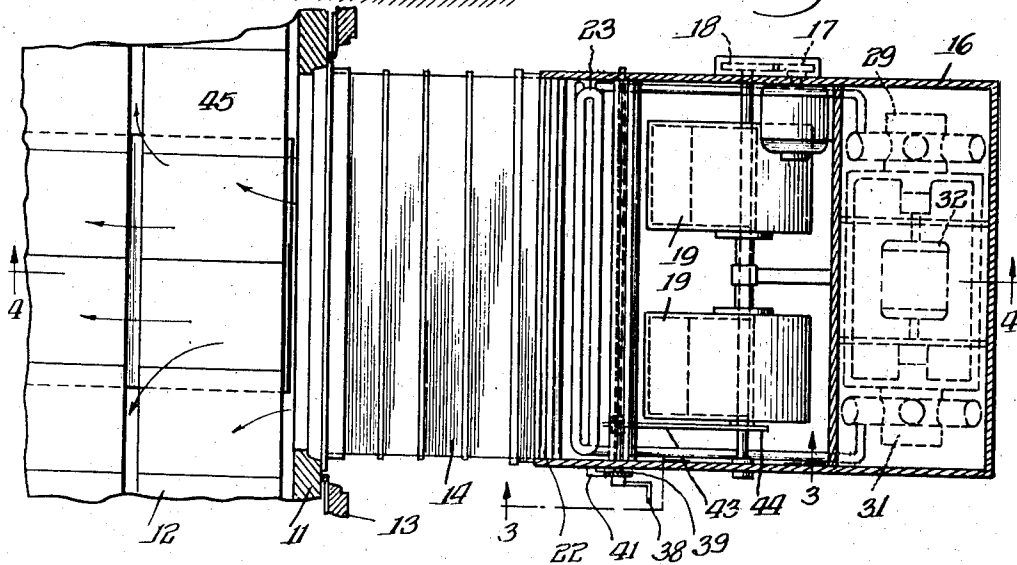
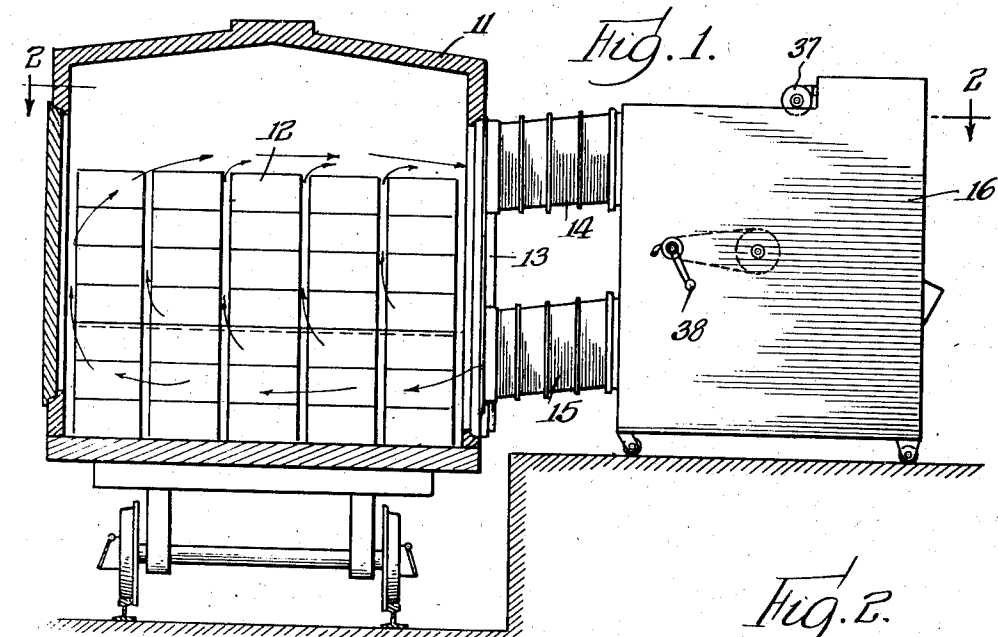


Fig. 3.

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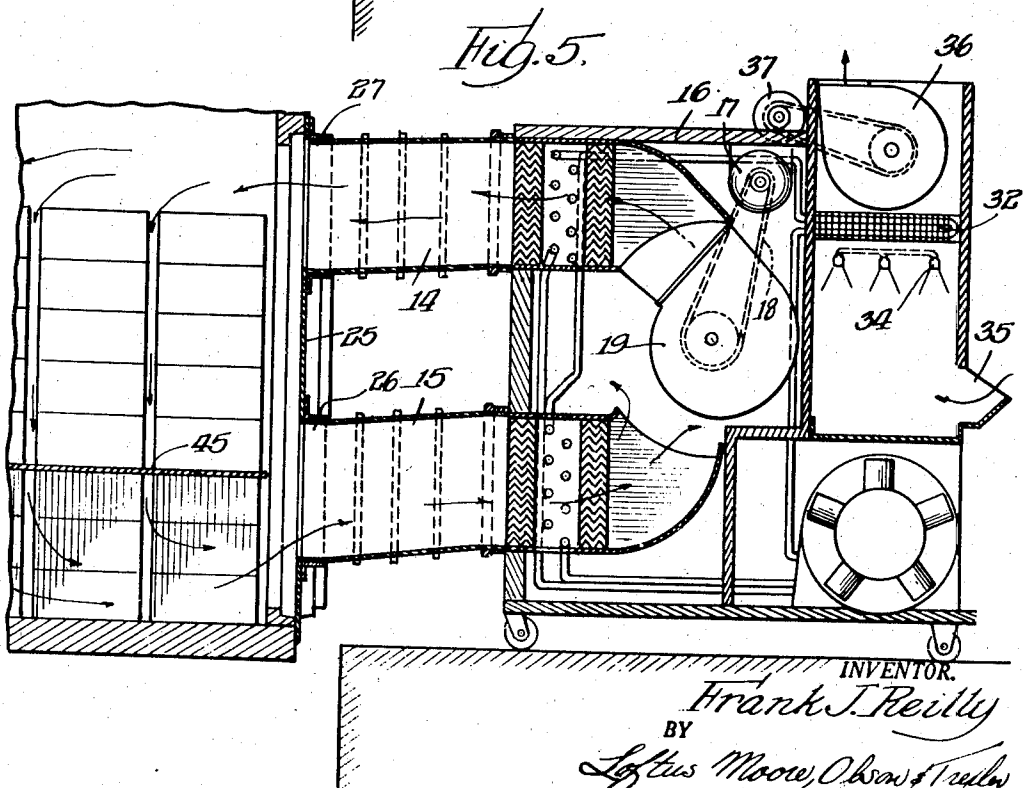
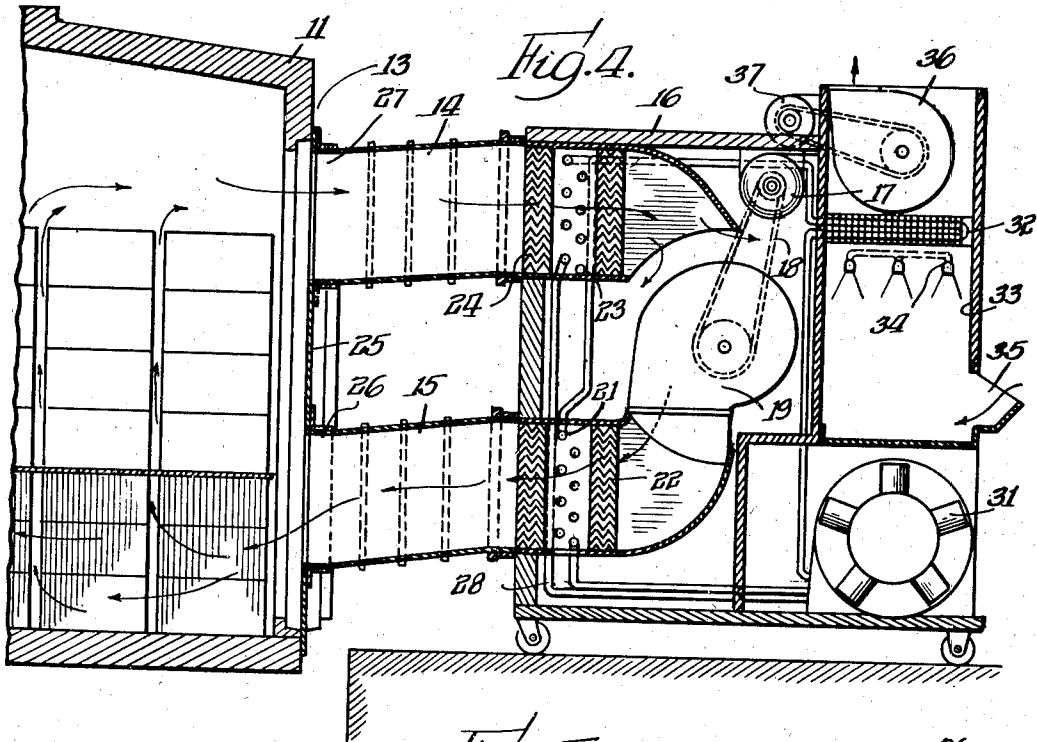
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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METHOD OF PRECOOLING THE LADING OF
REFRIGERATOR CARS COMPRISING THE
REVERSAL OF AIR FLOWFrank J. Reilly, Daytona Beach, Fla., assignor of
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Application March 16, 1945, Serial No. 583,097

2 Claims. (Cl. 98-6)

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The present invention relates to an air conditioning system, and more particularly to an air conditioning system adapted for conditioning of commodities in a chamber.

Heretofore it has been recognized that it is desirable to condition commodities loaded in a chamber such as a freight car or a chamber in a ship. It has been recognized that pre-cooling of such commodities, particularly fruits and vegetables which are to reach the consumer in fresh condition is highly beneficial. Such pre-cooling reduces the amount of cooling required during shipment of the commodity, by lowering the pulp temperatures. Such lowering of pulp temperatures prevents deterioration of the fruit or commodity thereby producing a saving in shipment.

At present pre-cooling is used quite extensively, and the typical procedure involves loading a freight car and the connecting to the door of the freight car by means of a false door an air conditioning unit. Air is introduced at one level of the car and removed at the other. At the present time the maximum height of lading in the car body has been increased twenty-five per cent thereby increasing the time required for pre-cooling. Such increased lading also shows that an appreciable temperature difference occurs between the commodity adjacent the incoming air with respect to the commodity adjacent the outgoing air.

Thus for example, where the pre-cooled air is introduced and passed through the load in one direction, part of the load may be nearly twenty degrees cooler than the balance. After a period of time, the temperatures will equalize, but the equalization of the temperature may be higher than is desired for the best condition of transportation of the commodity. If the air conditioning operation is stopped too soon, part of the load at least will be at an excessively high temperature, thus resulting in a deterioration in the freshness or quality of the produce by the time that the produce reaches its destination.

The above mentioned conditions have increased the time required for pre-cooling the lading with the result that it has become more difficult to meet shipping schedules. It is not possible to lower the temperature of the incoming air since the freezing point of practically all produce so shipped lies between $28\frac{1}{2}^{\circ}$ F. and 30° F.

The heretofore mentioned problems and disadvantages are readily overcome by my invention, which affords an initial pre-cooling of the contents of the car to a substantially even predetermined temperature throughout without

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over-cooling or under-cooling any appreciable part thereof, for with my invention the contents are so pre-cooled by introducing and passing through the contents of the car a forced stream of pre-cooled air continuously but intermittently in opposite directions during the initial pre-cooling period.

My invention materially reduces the amount of time required for initial pre-cooling, since the reversal of air changes the air pattern of the distribution of air through the car. Thus the effective surface of the load to be cooled is increased. An increase in the efficiency of operation is obtained since the rate of cooling is maintained relatively high.

It is an object of my invention to provide a pre-cooling method and system whereby the contents of a refrigerator car or the like may be rapidly pre-cooled uniformly throughout to a predetermined temperature without overcooling or undercooling any appreciable part of the load or contents of the car.

Another object of the present invention is to provide an air conditioning system wherein the direction of the flow of the air is periodically reversed.

Still another object of the present invention is to provide an improved pre-cooling system wherein the effective surfaces exposed to the air conditioning medium are increased by periodically reversing the direction of the flow of the air medium.

Still another object of the present invention is to provide an air conditioning system which will maintain the maximum temperature difference between the incoming air and the produce to be sealed in a chamber.

A still further object of the present invention is to provide in an air conditioning system an arrangement for the reversal of the direction of air flow without changing the impeller fan.

Still another object of the present invention is to provide an improved air conditioning system which will be suitable for achieving different classes of refrigeration, heating, dehydrating, ventilation, gasing and other services desired by the shipper.

Other and further objects of the present invention subsequently will become apparent by reference to the following description taken in connection with the accompanying drawing wherein

Figure 1 is a schematic representation of the application of the present invention to a freight car;

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Figure 2 is a cross sectional view seen in the direction of the arrows along the line 2—2 of Figure 1;

Figure 3 is a detailed view of a portion of the mechanism shown in Figures 1 and 2;

Figure 4 is an enlarged view of the apparatus seen in Figure 2 in the direction of the arrows along the line 4—4; and

Figure 5 is similar to Figure 4 showing the apparatus in a different operating condition.

Referring more particularly to Figure 1 there is shown a refrigerator car 11 having therein a through lading load 12 of perishable produce which is to be pre-cooled prior to shipment. As will be seen from both Figures 1 and 2, the lading preferably consists of crates or other similar containers which are placed in rows such that vertical air spaces are left between the several rows of containers. One door 13 of the refrigerator car is opened so that a plurality of flexible ducts 14 and 15 may be associated therewith. The ducts 14 and 15 are connected to an air conditioning apparatus housed in a cabinet 16 which may be mounted so as to be readily movable. By referring to Figures 2 and 4 it will be seen that the housing or cabinet 16 contains a motor 17 connected by a belt 18 to an impeller fan 19. The fan 19 as shown in Figure 4 supplies air to the duct 15. Interposed between the duct 15 and the fan 19 are a plurality of cooling or refrigerating pipes 21 which may have associated therewith on either side dehydrating apparatus 22. Similar apparatus is interposed between the duct 14 and the outlet located just above the housing of the fan 19. Thus air conditioning refrigerating or cooling pipes are provided together with the dehydrating apparatus 24. The outer ends of the ducts 14 and 15 are connected to a false door 25 having a lower opening 26 and an upper opening 27. The fan 19 is housed within a chamber 28 so that the fan 19 circulates and recirculates the air through the housing 28, the ducts 14 and 15, and the interior of a refrigerator car 11.

In order that the cooling pipes 21 and 23 may cool the air by absorbing heat therefrom, the cabinet 16 is provided with a compressor or compressors such as the compressors 29 and 31 which may be driven from a suitable motor 32. The compressors 31 are connected to a suitable condenser 32 mounted within a chamber 33. The condenser may constitute any suitable apparatus or configuration of pipes which is to be air cooled. In order to facilitate the cooling of the condenser 32, the chamber 33 is provided with a plurality of water cooling jets 34 which together with the air passing through the chamber 33 dissipate the heat in the condenser tubes. The chamber 33 is provided with an air inlet 35 from which air passes upwardly past the spray jets 34 and through the coils of the condenser 32 whereupon the air is forced outwardly from the chamber by a fan 36 driven by a suitable motor 37. The apparatus utilized for supplying a cooling medium to the air conditioning pipes 21 and 23 may be of any suitable type since the details of such an arrangement do not constitute a part of the present invention.

As may be seen from Figures 1, 2, and 3 there is mounted exteriorly of the cabinet 16 a crank 38 connected to a ratchet wheel 39 arranged for cooperation with a pawl 41. The ratchet wheel 39 is keyed to a sprocket wheel 42 which engages the endless chain or belt 43 connected to drive a sprocket wheel 44. The sprocket wheel 44 is connected to suitable means for orienting the hous-

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ing 19 of the blower fan. From Figure 2 it will be seen that while only one fan has been mentioned actually two or more fans 19 may be used, and both housings for these fans are connected together so that the outlet may selectively be arranged for operation either into the lower duct 15 or the upper duct 14. In Figure 4 the fan 19 is directing the air outwardly through the duct 15 whereas in Figure 5 the fan 19 is directing the air outwardly to the upper duct 14.

In accordance with the present invention it is intended to supply an air conditioning fluid medium such as air, gas, or the like to the lading so that the cool air moves in one direction toward the lading for a predetermined time and thereafter the direction of the air is reversed so that the cool air moves in the opposite direction toward the lading. It is immaterial whether the cycle of operation starts from the top or the bottom of the lading.

This operation may be repeated until the load cools down evenly and rapidly. To illustrate this reversal in the direction of the flow of the air conditioning medium, the manually operable crank 38 has been shown for moving the outlet of the fan 19 to either of the positions shown in Figure 4 or Figure 5, since other reversing means may be employed. It is within the scope of the present invention to provide automatically operable means for producing this reversal of the flow of air either in accordance with a predetermined time cycle or in response to temperature differences between the air and the produce. Such operation may be obtained by the proper location of thermostats positioned within the refrigerator car 11.

Proper precooling of a load requires the lowering of all pulp temperatures in a car of lading to approximately 40° F. The temperature mentioned has been accepted as the most desirable temperature for commercial usage since the insulation values of standard refrigerator cars do not permit lower temperatures. If a reversal of the flow of the circulating air is not provided, a typical operation might be as follows. Assuming that the produce or fruit is loaded in the car at a temperature of 85° F., and air entering the car from an air conditioning unit is at 30° F. at the end of six hours' operation, the cooler portion of the load may be at 45° F. whereas the hotter portion of the load may be as much as twenty degrees higher. If only fifteen degrees difference is found between the hotter and cooler portions of the load, it will be found that after three hours after the termination of cooling, the average temperature will be about 55°.

In order to avoid this rise of temperature, periodic reversal of the flow of air is provided so that in the arrangement such as shown in the drawing both the top and bottom of the load may be reduced to the lower temperature mentioned. Preferably in the practice of the invention, the car is so loaded that by means of a grating or other suitable support 45 a passageway is formed from the lower duct 15 to the opposite side of the refrigerator car 11. This structure forms a plenum in the lower part of the load between such structure and the bottom of the car at and adjacent the car door opening to provide an air chamber and permit a through lading load; that is, the car is loaded from end to end above the structure 45 and through the car except for the air chamber below which will produce a pressure on the longitudinal spaces between the crates or containers from the center of the car to the

bunker walls. Such an arrangement obviates the necessity of any baffle on the top of the load to prevent short circuiting of the air entering the car doorway in either cycle of circulation, and the air will contact the extreme top and bottom containers in the load.

Another advantage obtained from the reversal of the flow of the cooling medium through the refrigerator car is that the pattern of the air distribution is changed so that those portions of the load which might not be contacted by as great an air flow in one direction will be contacted to a greater degree when the air flow is in the opposite direction. Thus the total surface presented to the cooling air is increased. Furthermore the rate of cooling is dependent upon the difference of the temperature between the incoming air and the load which the incoming air strikes. By reversing the flow of the air through the refrigerator car, the warmer portion of the load is periodically subjected to the cooler air flow.

While the invention has been shown and described as being particularly adapted for use as a pre-cooling unit for the reduction of temperature of lading in refrigerator cars, the unit may be used for other purposes. As was previously mentioned, the apparatus and the system employed thereby may be used for the achievement of different classes of pre-cooling, refrigeration, heating, dehydrating, ventilation, gasing, and other services desired by the shipper.

For example where produce such as potatoes are loaded in a car, the apparatus may be used for even dehydration or drying of the potatoes which frequently are loaded in the car with moisture still adhering to the individual potatoes due to the washing of the potatoes prior to loading. By removing the excess moisture, the potatoes will arrive at their destination in a better condition. In the instance of certain other fruits, it has been desirable to sterilize the lading by the introduction of certain disinfectant gases which will prevent spoilage of the load due to the formation of fungus, mold, and the like.

From the foregoing it is apparent that it is possible to perform the pre-cooling work within the limitation of railroad schedules since produce is loaded and sold for specific delivery dates based on such schedules. Since in cooling the products in a room or car with a cooling unit operating to discharge the air in only one direction, it would be desirable to turn or rearrange the packages to be cooled in order to expose surfaces and reduce the cooling time, the same results may be obtained in accordance with the present invention by merely reversing the direction of the air flow.

While for the purpose of illustrating and describing the present invention, a certain embodiment has been schematically shown and a particular application has been described, it is to be understood that the invention is not to be limited thereby, since such variations and applications are contemplated as may be commensurate with the spirit and scope of the invention set forth in the following claims.

The invention is hereby claimed as follows:

1. A method of precooling a load within the usual side-door refrigerator car having side doors midway the ends thereof to a predetermined and substantially uniform temperature throughout the load during the initial precooling period without over-cooling any appreciable part of the load,

comprising through lading loading of the car with crates of perishable products and arranging said crates substantially the entire length of the car in the upper part thereof so as to provide for a relatively shallow air chamber as compared with the depth of the load extending across the car in the lower part of the load near the floor adjacent to the door opening, said chamber being further arranged in a substantial line with said side door openings, and arranging said crates to provide a multiplicity of vertical air passages in open communication with said air chamber extending throughout the load and around the crates, cooling the air at substantially less than that of the perishable load by forcibly and rapidly driving streams of air so cooled through the side door into said chamber, thence through the multiplicity of air passages formed in the load and forcibly drawing the air out of the car, and intermittently reversing during the pre-cooling operation the direction of travel of the streams of precooled air through the load and the multiplicity of air passages whereby the pattern of the precooled air distribution is intermittently changed, so that those portions of the load not being effectively contacted in one direction will be contacted to a greater degree upon the reversal of the air current.

2. A method of providing and pre-cooling through lading loads in the usual transportation cars having side doors midway the ends thereof which comprises the steps of loading the car from end to end with crates of perishable products and arranging and supporting such crates substantially across the entire length of the car in the upper part thereof so as to provide for a relatively shallow air chamber as compared to the depth of the load extending across the car in the lower part of the load near the floor adjacent to the door opening said chamber being further arranged in a substantial line with said side door openings, and arranging said crates to provide a multiplicity of vertical air passages in open communication with said chamber extending throughout the load and around the crates so as to permit streams of air to pass in either direction through the load and providing a structure in the load at the top of said air chamber to support a through load above said space and forcibly passing streams of precooled air from the center of the refrigerator car into, through and out the load and refrigerator car intermittently in opposite directions during the pre-cooling period, for initially uniformly pre-cooling the load throughout.

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