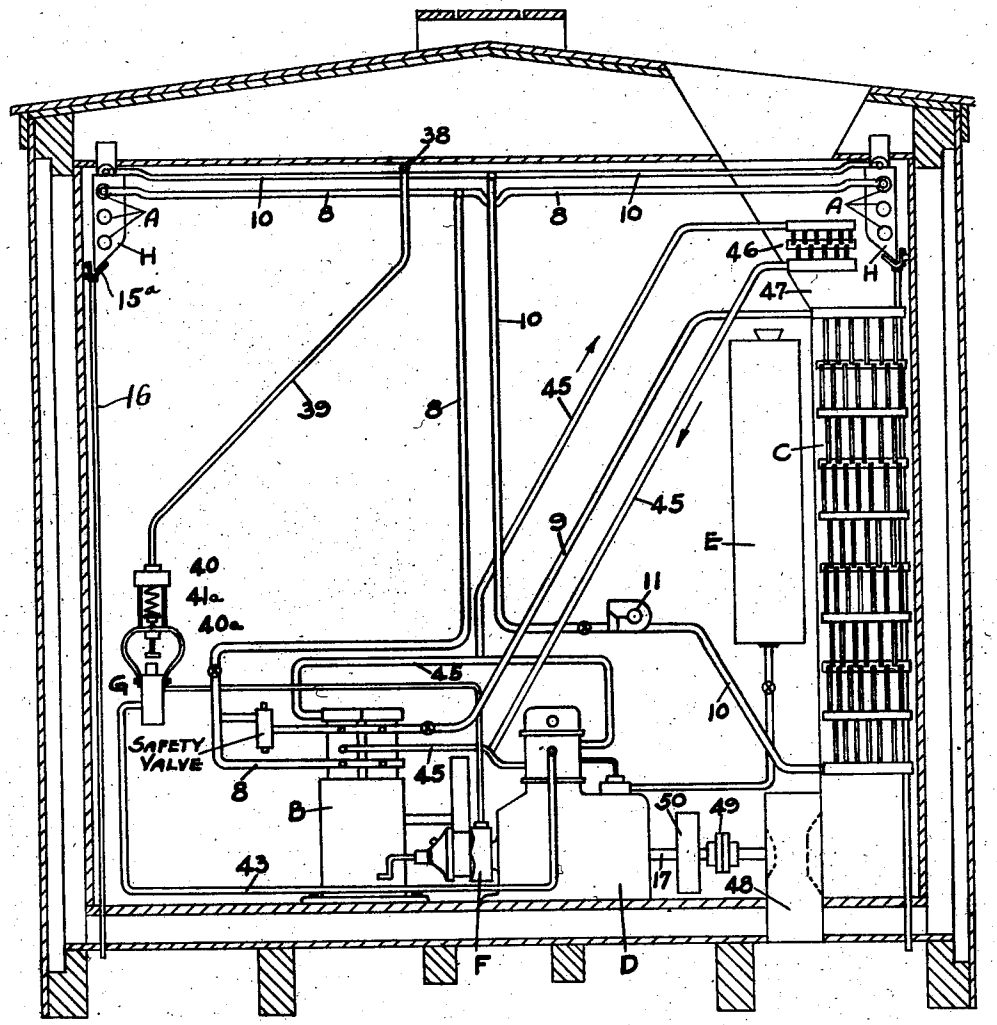
July 9, 1935. R. KILLINGSTAD 2,007,719

MECHANICAL REFRIGERATION SYSTEM OR APPARATUS

Filed March 5, 1932 4 Sheets-Sheet 1

FIG. I



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MECHANICAL REFRIGERATION SYSTEM OR APPARATUS

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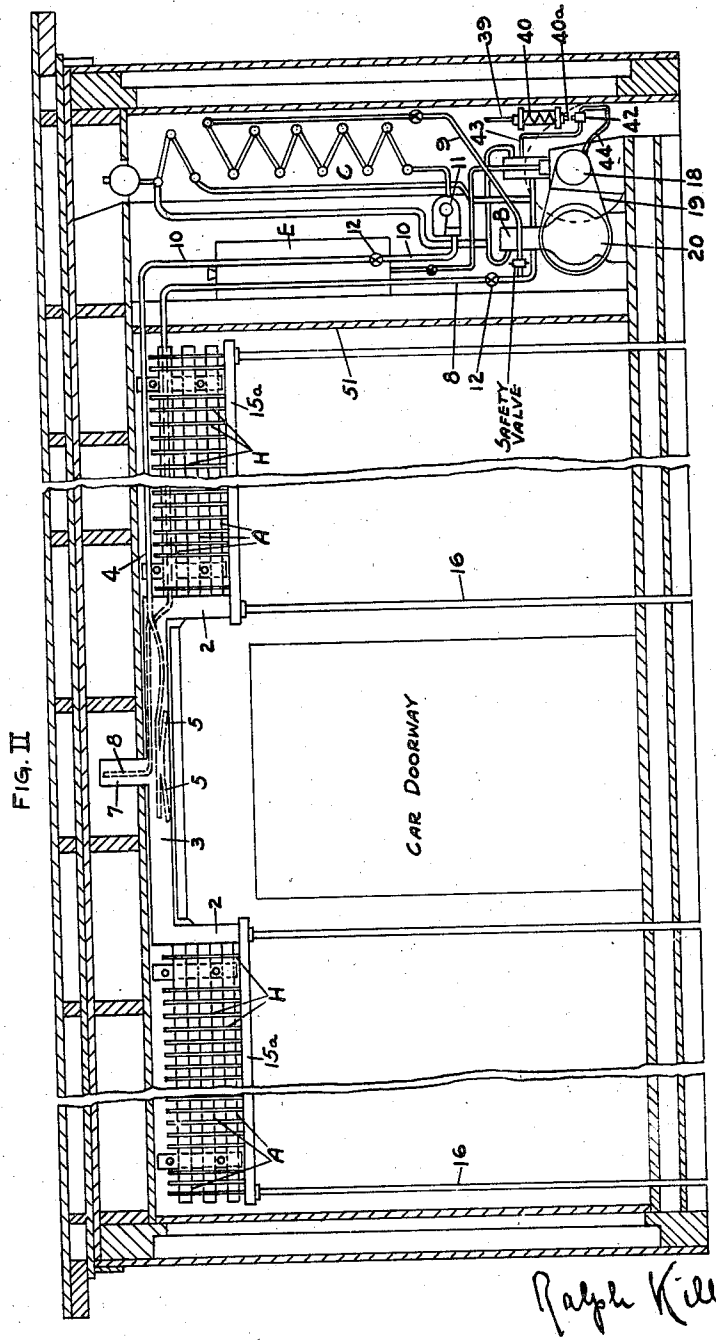


FIG. II

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MECHANICAL REFRIGERATION SYSTEM OR APPARATUS

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FIG. III

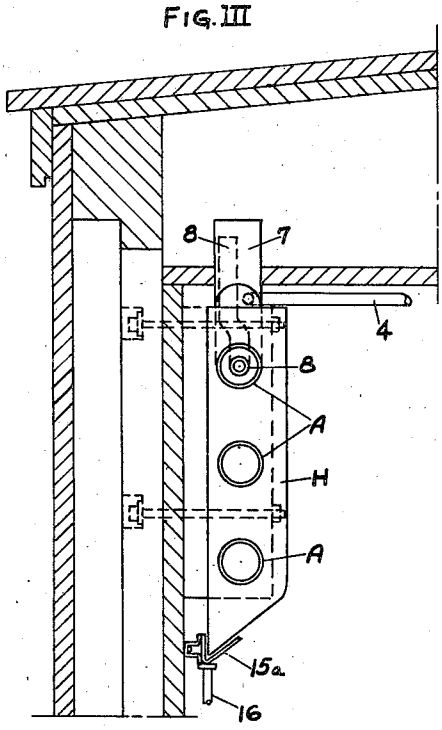


FIG. IV

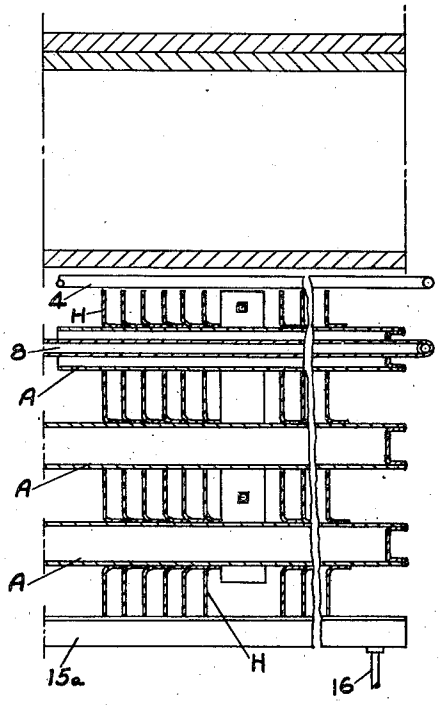
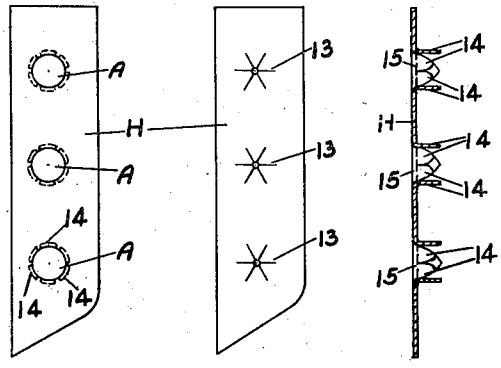


FIG. VII



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MECHANICAL REFRIGERATION SYSTEM OR APPARATUS

Filed March 5, 1932 4 Sheets-Sheet 4

FIG. V.

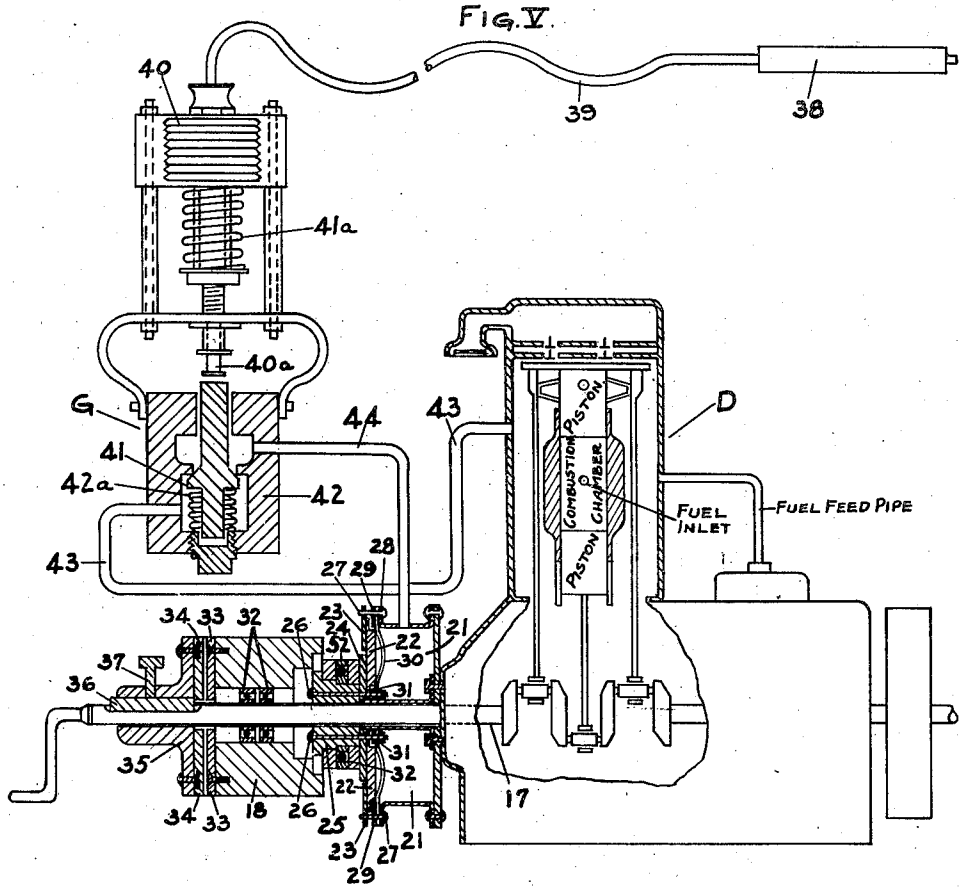
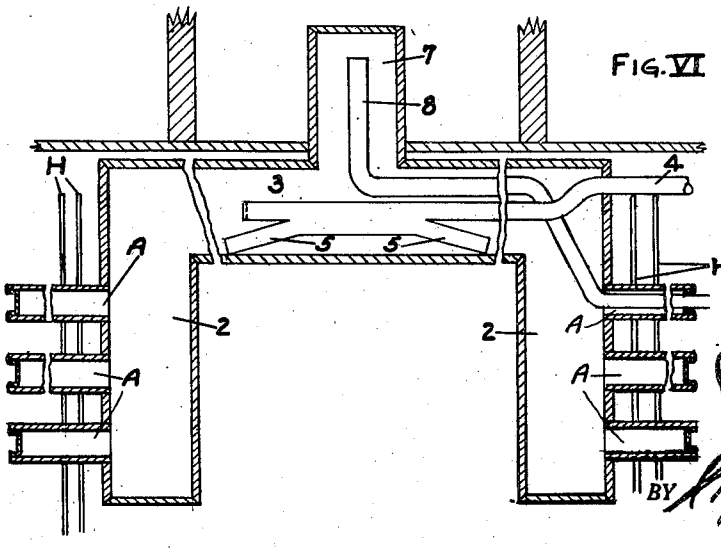


FIG. VI



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Patented July 9, 1935 2,007,719

UNITED STATES PATENT OFFICE

2,007,719

MECHANICAL REFRIGERATION SYSTEM OR APPARATUS

Ralph Killingstad, Alexandria, Va.

Application March 5, 1932, Serial No. 597,024

16 Claims. (Cl. 62—117)

The invention relates to a refrigeration system in which is used a refrigerant liquid for extracting heat for lowering the temperature of an enclosure for refrigerating purposes. The system is designed more particularly for refrigerator cars and to insure distributing and maintaining the liquid refrigerant throughout the loading area of the car under different grades to which the car may be subjected on the route of its travel. Ordinarily if the car assumes an inclination due to the grade in the roadway, or other cause, the refrigerant liquid flows and stands in the lowermost portion of the evaporator unit leaving the other portions of the evaporator practically without a supply of the liquid, with the result that the portion of the car or chamber in which the refrigerant stands is refrigerated while the other portion is without refrigeration, and thus the refrigeration is to that extent inefficient. One object of the invention therefore is to provide for distribution of the refrigerant so that different portions of the chamber will be supplied with the refrigerant even though the car at times be at an inclination and thus provide for maintaining efficient refrigeration under the varying conditions mentioned. Another object is to provide for the more efficient removal of the vapors evolved from the refrigerant liquid and their condensation and return to the refrigerating pipe line.

Another object is to provide for the automatic supply of the refrigerant liquid to the evaporator unit and removal of the vapors evolved in the system and return of the condensate to the evaporator.

Another object is to provide for the disposition of the evaporator for a better distribution of the refrigerant liquid and also avoid making the car top-heavy. Also to provide the evaporator unit with elements that increase the evaporator heat absorbing surface area. Also to provide for materially lessening the obstruction to the most efficient circulation of the cooled air throughout the commodity-containing chamber of the car. Also to provide a construction wherein the moisture or condensate forming on the refrigerating surfaces of the evaporator will be taken care of with the minimum obstruction to the circulation of the cooled air.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, the invention consists in the method and means hereinafter particularly described as an embodiment of the invention and then sought to be defined in the appended claims, reference being had to the accompanying drawings illustrating the preferred embodiment of the invention, and in which:

Figure I is an end elevation through a car, showing in elevation various parts of the apparatus;

Figure II a longitudinal section through a car showing various parts of the apparatus in elevation;

Figure III a cross section through portions of a car, showing in end elevation, enlarged scale, one set of evaporator tubes and fins;

Figure IV a view at right angles to Figure III, showing the evaporator tubes and fins, in section;

Figure V a side view, partially in section, showing the engine, fluid pressure clutch, and thermostatic valve mechanism;

Figure VI a longitudinal section, through the evaporator tubes or pipes, their end headers, and cross header, on an enlarged scale;

Figure VII is an end view, a side view, and a vertical section, respectively, of one of the fins, with its detail features, and in the end view showing the cooling tubes or pipes secured to the fin.

In the system, illustrated diagrammatically in Figure I of the drawings, A represents cooling tubes or pipes of an evaporator for a vaporizable refrigerant liquid; B a compressor for pumping the refrigerant to the tubes or pipes and conducting or carrying off the resulting gas or vapor; C a condenser from which the condensate is returned to the cooling tubes or pipes of the evaporator; D an engine, preferably of the Diesel-Junkers type; E a tank for the engine fuel which is injected or sprayed into the engine cylinder between oppositely movable pistons; F a fluid pressure operated friction clutch, the diaphragm chamber of which is connected with the engine to receive air or exhaust gases from it to actuate the clutch; G a thermostatic operated valve constituting a control for operating the compressor to suck or exhaust the refrigerant vapors from the cooling tubes or pipes of the evaporator for condensation and return of the liquid to the evaporator.

Ordinarily refrigerator cars of the liquid refrigerant type have cooling tubes, pipes or coils extending longitudinally of the car, substantially from end to end of the car with the tubes, pipes or coils positioned at the top of the car, along the roof or ceiling. With the cooling tubes or pipes or coils so positioned, the car is top heavy. An objection to having the pipes or coils of a length to extend substantially from end to end of the car is that when the car is standing or running on an incline or grade the liquid re-

frigerant drains or runs to the lowermost end of the tubes, pipes or coils so that the high end is left practically without refrigerant and consequently the refrigeration is not uniform or substantially so throughout the loading compartment of the car and hence efficient refrigeration is not obtained. To remedy the objections mentioned, the refrigerating tubes or pipes A are disposed at opposite sides of the car, and extend substantially from each end to a point substantially midway between the ends of the car, or substantially to the car doorway, and at their adjacent ends open into a header 2, one for each group, of which there may be four, two at each side of the car as illustrated, and the header of one group is connected to the header of the next adjoining group by a cross-header 3 in communication with the headers of the two adjacent groups of the evaporator, the cross-header spanning the top of the doorway as indicated in Figure II of the drawings. By the arrangement of the tubes or pipes as specified the refrigerant cannot drain from one end of the car to the other and leave a portion of the loading space of the car practically without any refrigerant when the car is either standing or running on grade whatever may be the grade, but to the contrary the liquid refrigerant, will be distributed practically throughout the length of the tubes or pipes of each evaporator regardless of grade, and the loading space of the car will consequently be more uniformly and efficiently refrigerated, and loss or damage to perishable commodities under transportation minimized. The liquid refrigerant, which preferably is methyl chloride, is conducted by a pipe 4 to a point within the cross-header 3, say preferably midway thereof, where it delivers into branch pipes 5 extending at a downward inclination in the direction of the oppositely disposed headers 2 and discharge the refrigerant into the cross-header 3 from which it flows into the headers 2 and from these headers into the tubes or pipes of the groups of tubes or pipes of each evaporator, the inclination of the branches 5 tending to direct the flow towards the oppositely disposed headers 2. The refrigerating tubes or pipes A are disposed at opposite sides of the car, usually two groups at each side, with headers 2 and cross-headers 3 at each side next the car doorway, and the refrigerant liquid feeding through the delivery pipe 4 is distributed by the branches 5 so as to supply the refrigerant to both sets of cross-headers 3 and from thence to each group of the refrigerating tubes or pipes of the evaporator.

Each cross-header 3 is formed with a stand-pipe or dome 7 to receive the gases or vapors evolved from the refrigerant liquid in the several refrigerating tubes or pipes. A suction pipe 8 is in communication with the stand-pipe 7 and has its other end connected with the suction side of the compressor B so that the gases or vapors will be sucked or exhausted from the stand-pipes by the compressor and by it passed through pipe 9 to the condenser C and the condensate returned through pipe 10 to pipe 4 and thence into the end headers 2 and thence to the refrigeration tubes or pipes of the evaporator A for another cycle of operation. The return condensate pipe 10 is provided with a float valve 11 to insure the return of only liquid from the condenser to the liquid refrigerant pipe 4 for the refrigeration tubes or pipes. The pipes 8, 9 and 10 may be also provided with hand controlled valves 12 as illustrated in Figure II of the drawings, not essential to the operation of the system, but for the purpose of disconnecting it in making repairs. It will be observed from Figure III of the drawings that the inlet to the vapor or gas exhaust pipe 8 in the stand-pipe 7 is above any level of the refrigerant liquid in the refrigerating tubes or pipes no matter what be the incline or grade of the car, thus insuring that only vapors or gases are exhausted from the evaporators of the system and that the refrigerant liquid remains in the best possible condition and for distribution throughout the length of the tubes or pipes of each evaporator for most efficient refrigeration.

The refrigerating or cooling tubes or pipes are provided with heat conduction fins which make it possible to lessen the number of cooling tubes or pipes compared with constructions heretofore employed, and also lessen the volume of refrigerant employed because of the smaller number of coils and size of each necessary for efficient refrigeration, while at the same time materially lessening the weight of the car which is increased proportionately with the number and extent of the cooling tubes, pipes or coils employed, and the matter of weight is an important desideratum. Under the construction embodying the present invention the weight of the car is materially reduced, and the evaporator construction devised affords the minimum obstruction to the freest distribution of the cooled air through the loading space of the car. The heat absorbing or conducting fins are shown most clearly in Figures IV, V, VI and VII of the drawings. The fins are indicated by the letter H and may consist of relatively thin metallic strips slitted at appropriate points 13 and spread laterally to form clips 14 around openings 15 through which the tubes or pipes of the evaporator pass, the clips serving to secure the strips to the tubes or pipes and to space the strips from one another so as to form spaces or passages between and around them for air circulation. The air circulating in the loading compartment will come in contact with the flat faces of the metal strips which by conduction will extract heat units from the air and tend to further lower the temperature in the loading space of the car. These strips will not obstruct the downward movement of the air from the cooling tubes, pipes or coils as would be the case if additional cooling tubes or pipes were employed, and as a result the fins afford greater heat extracting surfaces and promote rather than retard circulation of cooled air and afford a more efficient cooling atmosphere for the loading space of the car. Another advantage of these fins is that moisture that may condense on their surfaces, as well as the moisture condensing on the surfaces of the tubes or pipes, will trickle down the sides of the fins and be deposited at the inclined lower ends of the fins into a drip pan or trough 15a which will be suitably supported from say a wall of the car and extend beneath the fins from one end to the other of the series, and the condensate will be conducted off by drain pipes 16 and discharged through the bottom of the car, or otherwise, as desired. Under some previous evaporator constructions, a drip pan or pans were disposed beneath the cooling coils and covered a substantially wide area of the loading space beneath the coils so that they obstructed to a material extent the downward free flow of cooled air from the coils through the loading space, and the condensate collected by the pans would drip from the pans down onto the com-

modities in the loading space, and when positioned adjacent to the car ceiling, above the loading space, tended to make the car undesirably top heavy.

The compressor B, diagrammatically illustrated, may be of any suitable approved type, for sucking from the evaporator the vapors or gases evolved from the volatile refrigerant and passing them on to a suitable condenser for liquefying the vapors and returning the liquid to the evaporator, in successive cycles. The compressor is actuated from a suitable engine, preferably of the Diesel-Junkers engine type which makes use of a single working cylinder provided with oppositely movable pistons between which the engine gaseous fuel received from a supply tank is injected for combustion, and in which the pistons control valveless inlet and exhaust ports in the cylinder. Such type of engine is well known in the art and therefore a more detailed description is unnecessary. Under the present invention the engine crank shaft 17 is provided with a fluid pressure controlled clutch for clutching and unclutching a drive pulley 18 from which a belt 19 will at times transmit motion to a pulley 20 on the driven shaft of the compressor B. The pressure fluid controlled clutch preferably comprises a chamber 21 suitably supported in a non-rotatable relation to the engine shaft 17. One side of this chamber has a diaphragm which may consist of members 22, 23, and 24 and a block 25, secured together by bolts 26, or otherwise, and movable axially of the shaft 17 and held non-rotatively in relation to the shaft by threaded bolts 27 passing through members 23 and a flange 28 to the peripheral wall of the chamber 21 and through an annular plate or ring 29. A flexible member 30 may be clamped between ring 29 and flange 28 and between rings 31 so as to form a joint against leakage of air from the air chamber 21. A thrust bearing 32 will be mounted on block 25 and will move axially of the shaft with the block and may rotate thereon when brought into contact with face of drive pulley 18. The drive pulley has anti-friction bearings 52 between it and engine shaft 17 and is rotatable in relation to the shaft. One face of the pulley is preferably provided with a facing 33 of suitable frictional material for frictional engagement with a similar facing 34 on a block 35 attached to the engine shaft 17 by a key 36 and set screw 37 so as to rotate with the engine shaft. Air pressure within chamber 21 will force the movable diaphragm outwardly and bring thrust bearing 32 and block 25 into contact with drive pulley 18 so as to move the pulley axially of shaft 17 so as to clutch the pulley to its associate clutch disk member 35 and thus rotate the pulley so as to drive the compressor pulley from the drive pulley on the engine shaft. When the clutch is released say by reduction of pressure in the air pressure chamber, the engine will continue to run but the compressor will stop as the clutch pulley will then run idle. While the clutch construction described has been found very effective in actual practice yet any other suitable clutch construction functioning for periodically operating the compressor without stopping operation of the engine would come within the scope of such feature of the present invention.

The operation of the parts is preferably under thermostatic control as follows. A thermostatic bulb 38 is suitably supported, preferably midway of the car loading space, at or near the car ceiling. This bulb contains a gas that expands and contracts under rise and fall in temperature surrounding the bulb, and the gas under conditions of expansion and contraction is utilized to actuate a valve mechanism which governs the operation of the compressor for exhausting evolved vapors from the refrigerant in the evaporator and their condensation for return in liquefied condition to the evaporator. The valve mechanism is preferably of the type illustrated in Figure V of the drawings, and in which a tube or pipe 39 connects the thermostat bulb to a bellows-like expansible chamber 40 of the valve mechanism for actuating through a tappet stem 40a a valve 41 in a casing 42 which receives scavenging air through pipe 43 from the engine D and which is conducted by a pipe 44 to the fluid pressure chamber 21, so that the air pressure in such chamber may be utilized to set and release the previously described clutch from which the compressor is operated. When the temperature surrounding the thermostatic bulb lowers sufficiently to cause contraction of the content of the bulb, the reduced gas pressure on the control valve 41 permits the valve, which is under spring pressure, to close and cut-off the supply of air to chamber 21 through pipe 44 and permit air in the chamber to escape by way of valve casing 42, and release the fluid actuated clutch so that the pumping action of the compressor stops until the temperature surrounding the thermostatic bulb rises sufficiently to open valve 41 when the pumping operation of the compressor is again started. It will be noted from the foregoing that the exhaust or sucking of vapors from the evaporator and return of the refrigerant, in a liquid condition, to the evaporator tubes or pipes is under thermostatic control, and thus a more equable temperature in the loading space of the car is produced and maintained. By adjusting tension of springs 41a and 42a in the thermostatic mechanism the mechanism may be set for action under predetermined temperatures. The thermostatic mechanism is not illustrated and described in all its details as no claim is made herein to the details of its mechanical elements, which also are possible of various modifications, and the same is claimed herein only generically when associated for cooperation with the other features to constitute the apparatus functioning as indicated in a refrigerating system or method for refrigerator cars as explained.

In Figure I of the drawings, there is illustrated diagrammatically, in end elevation, the major elements of the apparatus and their relationship to one another and also showing the disposition of the cooling water system of the engine and the compressor as well as the condenser for the vapors of the refrigerant from the evaporator, and also a fan for cooling the condenser coils. In this figure, 45 indicates the pipe lines for conducting water from the water jackets of the engine and the compressor to a cooling condenser coil 46 and return to the water jackets, while 8 indicates the vapor pipe line leading from the cooling coils to the suction side of compressor B, and 9 the line pipe from the discharge side of the compressors to the condenser coil C, and 10 the liquid return pipe line from the condenser to the evaporator. The condenser coils C and 46 are preferably located in a casing or duct 47 which may open at the top through the roof of the car and be provided with a closure which may be such as usually employed for closing the hatchway opening through which ice is introduced in an ice refrigerator car. The

casing or duct at its lower end communicates with an opening through the car floor. A fan 48 has a suitable flexible coupling 49 with the engine crank shaft on the end carrying the fly wheel 50, and this fan draws air over the condensing coils in the duct 47 to assist in cooling the coils and condensing the vapors from the evaporator of the apparatus and cooling the water from the jackets of the compressor and the engine. The engine, and compressor and thermostatic valve mechanism are located in an end compartment of the car, separated from the loading space by a suitable insulating partition 51, and to which access may be had through a man-hole in the roof of the car (not shown).

While the preferred details of the elements have been illustrated and described it is to be understood that the parts may be modified or changed without departing from the scope of the invention as sought to be defined by the appended claims.

Among some of the advantages obtained by the invention may be summarized the following: Reduction in weight of the car as a whole by use of a smaller number of cooling coils and a relatively smaller diameter for the tubes or pipes of the evaporator due to a smaller body of refrigerant liquid required for efficient refrigeration; better distribution of the refrigerant liquid throughout the loading space of the car because the refrigerant is more uniformly distributed and maintained practically throughout the whole length of the cooling area, from end to end of the evaporator, regardless of the level or grade at which the car stands or rolls, as the construction of the evaporator prevents the liquid from draining or flowing and settling at the low end of the tubes or pipes of the evaporator with the high end of the evaporator tubes practically without liquid refrigerant which if permitted to occur would result in a material area of the loading space being deprived of refrigerant liquid, with inefficient refrigeration resulting throughout the loading space of the car; an increase in the heat absorbing area afforded by the fins associated with the evaporator tubes or pipes and with least obstruction to downward flow of cold air from the evaporator tubes or pipes; lessening obstruction to flow of cold air, and reduction in weight, by requiring only one drip pan or trough for each group of coils instead of a separate drip pan for each tube or pipe of each group. The evaporator construction also makes it possible to arrange the evaporator along the sides of the car, near to the ceiling, and at opposite sides of the door-way, so as to occupy the minimum of the loading space and avoiding location of the evaporator tubes or pipes along the ceiling which is undesirable as it makes a car top-heavy.

Under the method of refrigeration involved, in the present invention, the vapors evolved from the volatile refrigerant are collected at a point always above the level of the liquid in the evaporator tubes or pipes, and by suction conducted to the suction side of a compressor and conducted through a pipe from the compressor to a condenser and returned in a liquid condition through a pipe to the cross header 3 of the evaporator and to the cooling tubes or pipes of the evaporator, the steps specified being repeated in successive cycles, and the cycle of steps being controlled or governed by temperature changes in the loading space of the car which, acting through a valve mechanism influenced by such temperature changes, serve to start the compressor when a predetermined temperature is produced in the car loading space so as to suck or exhaust the vapors from the evaporator and pass them to a condenser from which they are returned in a liquefied state to the cooling coils. Upon another predetermined temperature being produced in the loading space, which may be a lower temperature, the valve mechanism will be influenced by it so as to stop the working of the compressor until another predetermined temperature is created in the loading space, whereupon the working of the compressor will again be started for sucking the vapors from the evaporator. The predetermined temperatures for the two operations may be regulated by adjustment of parts of the valve mechanism so that one operation will take place under one predetermined temperature in the loading space and the other operation take place at another predetermined temperature fixed by the setting of the valve mechanism for action under different temperatures. This temperature controlled operation of the steps in the method is an important factor in the method feature of the invention.

It will be observed that the apparatus illustrated in the drawings embodies a compressor system for exhausting vapors evolved from a volatile refrigerant and supplying the refrigerant in a liquefied condition to the evaporator, the compressor being mechanically operated, so that a mechanically operated refrigerating system is provided, free from objectionable features of an adsorbtion system, and with the result that greater efficiency in the cooling system is obtained.

In the adsorbtion system, the same quantity or level of liquid refrigerant is not maintained at all times in the evaporator of the system because no liquid refrigerant is returned to the evaporator during the adsorbtion period. This leaves the evaporator unit, for a greater or lesser period, in a state of non-performance, and during such period the temperature in the loading space, especially of a refrigerator freight car, has a relatively wide range, which is likely to seriously damage the commodity under transportation. Especially is such the case where the commodity is fruit, for instance, bananas, which require a relatively high temperature, say approximately not lower than 55° F. and in the case of some other commodities, commonly designated as "frosted" products, for which a substantially zero, say approximately not higher than 12° F., is considered best for safety. The degree of temperature for each of the two classes of products mentioned lies within a relatively narrow range in order to prevent damage to the product. Hence, the necessity of maintaining, so far as possible, a substantially uniform temperature suitable for the products under transportation.

Under the adsorbtion system, there is danger of a relatively wide range of difference in temperature, owing to the liquid refrigerant flowing to the lower-most level of the evaporator containing the refrigerant, thus leaving the other portions of the refrigerant unit practically without, or with very little refrigerant in it, with the result that only a portion of the loading space of the car is supplied with the refrigerant for cooling its temperature, or in other words, the loading space is not given a substantially uniform temperature throughout its area. This is more especially true in refrigerator freight cars for transportation of perishable commodities, and where the level of the refrigerant liquid is subject to changes due to the grade on which the

car stands or over which it travels, and also curves in the roadway. The factors mentioned all tend to cause lack of uniformity in the temperature of the loading space of the car, with detrimental effects.

With the view of overcoming the disadvantages recited, and other disadvantages, the apparatus illustrated and described in this application has been devised, and under which a smaller volume of the liquid refrigerant is needed for obtaining a uniform temperature in the loading space of a car; the refrigerant is prevented from flowing or draining to the lowermost portion of the evaporator under changes in the grade of the road-bed, and is maintained practically throughout the length of the evaporator, and also the loading space of the car, so as to produce a uniform temperature throughout the whole loading space area; and the exhaust of the vapors evolved from the refrigerant and replenishment of liquid refrigerant resulting from condensation of the vapors, are effected and under the control of pressure created by a mechanically operated compressor, thus giving to the refrigerant and the vapors a positively controlled regulation. Other advantages resulting from this invention have been enumerated and need not be repeated.

The drawings illustrate the exhaust vapor pipe as extending through a refrigerant containing pipe of the evaporator unit, and the liquid return pipe is shown as located outside of a refrigerant containing pipe of the evaporator unit, except as the liquid return pipe lies partially within the cross-header of the unit, but it is to be understood that the position of said pipes may be transposed, provided however that the inlet of the suction pipe is above the level of the refrigerant in the evaporator, but in either case the vapor exhaust pipe will be connected with the suction side of the compressor, and the liquid return pipe with the discharge side of the compressor. Accordingly, the invention is not confined to the particular location of the two pipes as illustrated in the drawings.

Having described my invention and set forth its merits what I claim is:

1. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in its members substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which the car may stand or travel, and also formed so as to prevent continuous through travel of the liquid refrigerant from one of said members to another member in each group of members.

2. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members, positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in the members substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which the car may stand or travel, and a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from refrigerant in the evaporator.

3. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members, positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in the members of the group, substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which the car may stand or travel, and a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from refrigerant in the group members, and a suction pipe in the stand-pipe or dome with its inlet above the level of the refrigerant in the evaporator, and means for exhausting the vapors through said suction pipe.

4. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members, positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in the liquid refrigerant containing members substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which the car may stand or travel, a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from refrigerant in the evaporator, and a suction pipe in the stand-pipe or dome with its inlet above the level of the refrigerant in the evaporator, means for exhausting the vapors through said suction pipe, and a condenser to receive the exhaust vapors and from which the vapors in a liquid state are returned to the said members.

5. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in the evaporator substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which the car may stand or travel, a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from refrigerant in the evaporator, a suction pipe in the stand-pipe or dome with its inlet above the level of the refrigerant in the evaporator, a compressor with which the said vapor suction pipe is connected for exhausting the vapors through such suction pipe, a condenser to receive such vapors and from which the vapors in a liquid state are returned to the evaporator, an engine, a driving connection between the engine and compressor, and a temperature controlled clutch operatively associated with the compressor and engine to receive gases from the engine to actuate the clutch for operating the compressor to exhaust vapors from the evaporator under one temperature in the loading space of the car and checking the exhaust under another temperature.

6. In a refrigerator car, an evaporator including a group of liquid refrigerant containing members positioned at the sides of the car, adjacent to the car ceiling, and extending lengthwise of the car, each group formed to maintain a head of refrigerant in the evaporator substantially throughout the length of each group to insure a head of the refrigerant throughout the loading space of the car regardless of the grade on which

the car may stand or travel, a stand-pipe or dome chamber in communication with the liquid refrigerant containing members and positioned above the level of the refrigerant to receive vapors evolved from refrigerant in the evaporator, a suction pipe in the stand-pipe or dome with its inlet above the level of the refrigerant, a compressor with which the said vapor suction pipe is connected for exhausting the vapors through such suction pipe, a condenser to receive such vapors and from which the vapors in a liquid state are returned to the evaporator, an engine, a fluid pressure operable clutch for effecting a driving connection between the engine and compressor, a valve mechanism operable from changes of temperature in the loading space of the car for controlling delivery of air from the engine to the pressure chamber of the clutch to actuate the clutch to start the compressor to exhaust vapors from the liquid refrigerant containing members in the loading space of the car under one temperature in the loading space and checking the exhaust of vapors under a change in temperature in the loading space.

7. In a refrigerator car, an evaporator including groups of liquid refrigerant containing members in the loading space of the car, extending lengthwise along the sides of the car, end headers for the refrigerant containing members of adjacent groups of the evaporator, a cross-header connecting said end-headers, means for supplying a volatile refrigerant to the cross-header for passage to the refrigerant containing members of the groups, the end-headers of the groups preventing the refrigerant passing from one group to the other and maintaining a head of the refrigerant substantially throughout the length of each group of the evaporator regardless of the grade on which the car may stand or travel, and means including a compressor for exhausting the refrigerant vapors from the evaporator.

8. In a refrigerator car, an evaporator including groups of liquid refrigerant containing members in the loading space of the car, extending lengthwise along the sides of the car, end-headers for the refrigerant containing members of adjacent groups of the evaporator, a cross-header connecting said end-headers of adjacent groups, means for supplying a volatile refrigerant to the cross-header for passage to the refrigerant containing members of the groups, the end-headers of the groups preventing the refrigerant passing from one group to the other and maintaining a head of the refrigerant substantially throughout the length of each group of the evaporator regardless of the grade on which the car may stand or travel, means including a compressor for exhausting the refrigerant vapors from the evaporator, a stand-pipe or dome in communication with the cross-header to receive refrigerant vapors from the evaporator.

9. In a refrigerator car, an evaporator including groups of refrigerant containing members in the loading space of the car, extending lengthwise of the car, end-headers for the refrigerant containing members of adjacent groups of the evaporator, a cross-header connecting said end-headers, means for supplying a volatile refrigerant to the cross-header for passage to the refrigerant containing members of the groups, the end-headers of the groups preventing the refrigerant passing from one group to the other and maintaining a head of the refrigerant substantially throughout the length of each group of the evaporator regardless of the grade on which the car may stand or travel, means including a compressor for exhausting the refrigerant vapors from the evaporator, a stand-pipe or dome in communication with the cross-header to receive refrigerant vapors from the evaporator, a pipe for returning vapors in a liquefied state to the cross-header, said pipe having branches leading therefrom and directing the refrigerant towards oppositely disposed groups of the evaporator.

10. In a refrigerator car, an evaporator including refrigerant containing members positioned at opposite sides of the car, adjacent to the car ceiling, and disposed substantially in vertical alinement, one above another and closed at one end to prevent through-circulation of a cooling agent from one refrigerant containing member to another of the group; fins composed of relatively thin heat conducting strips pendant from the refrigerant containing members and spaced apart from each other for the down-flow of cold air from about the refrigerant containing members and serving to extract heat from the loading space and functioning to supplement the heat absorbing area of the evaporator.

11. In a refrigerator car, an evaporator including groups of liquid refrigerant containing members, each group formed to maintain a head of refrigerant in the refrigerant containing members substantially throughout the length of each group to insure a head of the refrigerant throughout a major portion of the loading space of the car regardless of the grade on which the car may stand or travel; a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from the refrigerant, a suction pipe having its inlet for vapors above the level of the refrigerant, a pipe for supply of a liquid refrigerant to the evaporator, a compressor having one of said pipes connected with the suction side and the other pipe connected with the discharge side of the compressor, a motor for operating the compressor for exhaust of vapors from the evaporator and their return in a liquefied state to the evaporator, and temperature controlled means for starting the motor to operate the compressor to exhaust vapors from the evaporator under one temperature in the loading space and check the exhaust of vapors under a change in temperature in the loading space.

12. In a refrigerator car, an evaporator including groups of liquid refrigerant containing members, each group formed to maintain a head of refrigerant in the group substantially throughout the length of each group to insure a head of the refrigerant throughout a major portion of the loading space of the car regardless of the grade on which the car may stand or travel; a stand-pipe or dome chamber in communication with the evaporator and positioned above the level of the refrigerant to receive vapors evolved from the refrigerant, a suction pipe having its inlet for vapors above the level of the refrigerant, a pipe for supply of a liquid refrigerant to the evaporator, a compressor having one of said pipes connected with the suction side and the other pipe connected with the discharge side of the compressor, at least one of said pipes passing through a refrigerant containing member of the evaporator, a motor for operating the compressor for exhaust of vapors from the evaporator and their return in a liquefied state to the evaporator, and temperature controlled means for starting the motor to operate the compressor to exhaust vapors from the liquid refrigerant containing

members in the loading space of the car under one temperature in the loading space and check the exhaust of vapors under a change in temperature in the loading space.

13. In a refrigerator car, an evaporator including liquid refrigerant containing members positioned at opposite sides of the car adjacent to the car ceiling, fins composed of relatively thin heat conducting strips pendant from and surrounding the refrigerant containing members in substantially vertical planes, the said fins being spaced apart from each other for the down-flow of cold air from about the refrigerant containing members, each said fin being shaped and disposed to form a downwardly inclined lower edge connecting oppositely disposed upwardly extending edges of the fin, the downward inclination of the lower edge of the fins having such slope that condensate forming on side faces of the fins will be directed to the point of convergence of the downwardly inclined edge with an upwardly extending edge of the fin.

14. In a refrigerator car, an evaporator including liquid refrigerant containing members positioned at opposite sides of the car, adjacent to the car ceiling, fins composed of relatively thin heat conducting strips pendant from and surrounding the refrigerant containing members in substantially vertical planes, the said fins being spaced apart from each other for the down-flow of cold air from about the refrigerant containing members, said fins each being shaped and disposed to form a steep downwardly inclined lower edge connecting oppositely disposed upwardly extending edges of the fin, whereby condensate forming on side faces of the fins will be directed to the point of convergence of the lower downwardly inclined edge with an upwardly extending edge of the fin, and a narrow drip pan or trough of less width than the fins, supported beneath the lower end of the heat extracting fins, to minimize obstruction to the down flow of cold air from the evaporator.

15. In a refrigerator car, a group of liquid refrigerant containing members in the car, means for supplying a vaporizable refrigerant to said members, a compressor to remove vapors evolved from the refrigerant, an internal combustion engine operatively associated with the compressor for operating the same to exhaust vapors evolved from the refrigerant, a source of fluid pressure for use in the operation of the engine, a fluid pressure actuated clutch for controlling the drive connection between the engine and compressor, and thermostatically operating means responsive solely to temperature within the car for controlling a supply of fluid pressure from said source to the clutch to establish the drive connection between the engine and compressor for exhausting vapors from the liquid refrigerant when the temperature within the car rises above a predetermined maximum value.

16. The combination of a vehicle and a refrigerating circuit mounted thereof, said circuit comprising means for compressing and liquefying a volatile refrigerant; and an evaporator structure in circuit therewith, said evaporator structure including a gas and liquid separator from the upper portion of which the evaporated refrigerant is withdrawn, and a plurality of partially flooded evaporator units connected at their upper portions with said separator, said evaporator units being fed by gravity flow from the separator and being so arranged that flow of liquid refrigerant from one to the other is precluded by changes in the road gradient over which the vehicle is operated.

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