



Feb. 7, 1933.

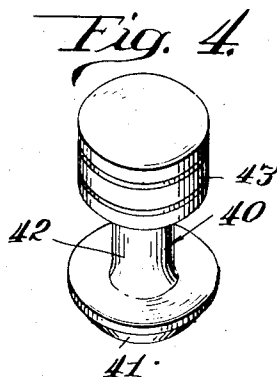
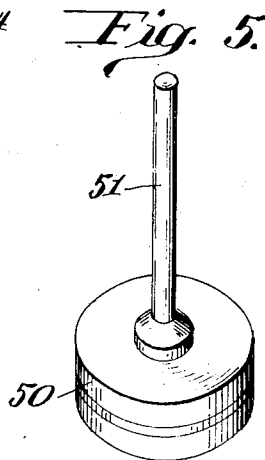
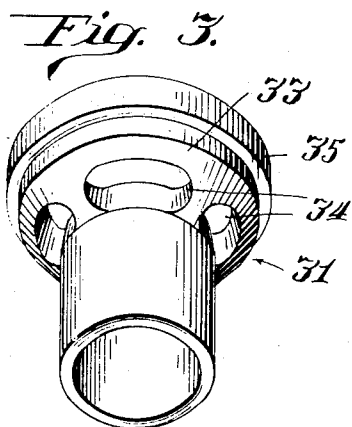
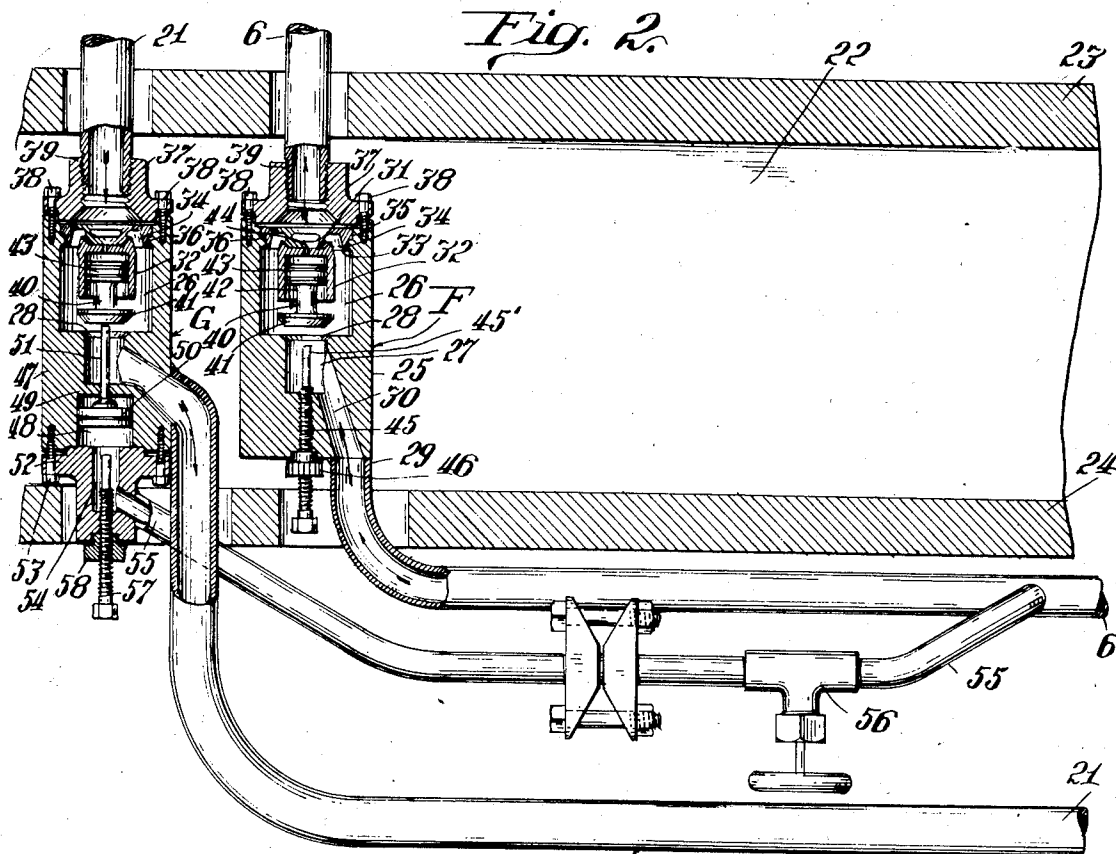
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1,896,673

SAFETY CUT-OFF VALVE FOR REFRIGERATOR CARS

Filed Nov. 6, 1930

2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

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## SAFETY CUT-OFF VALVE FOR REFRIGERATOR CARS

Application filed November 6, 1930. Serial No. 493,899.

This invention relates to certain new and useful improvements in safety cut-off valves for refrigerator cars, and more particularly to an improved set of valves adapted to prevent the loss of refrigerant from certain portions of the mechanical refrigeration system of a railway car in case the circulation system at one side of these valves becomes open or broken.

These improved cut-off valves are adapted for use with various types of refrigerating systems, or other circulating systems for fluids under pressure, but the valves have been especially designed for use with the mechanical refrigerating system of a railway refrigerator car of the general type disclosed in the reissue patent to Luhr, Reissue No. 17,660, May 13, 1930. In a refrigerator car of this type a compressor located beneath the car body is driven from the running gear of the car when the car is in motion. The compressed refrigerant is forced through a pressure pipe to a condenser positioned in an exposed position on top of the car where the refrigerant is condensed to liquid form and drains into a receiving tank within the car. The liquid refrigerant is then permitted to expand in refrigerating coils located in bulkhead compartments at the respective ends of the car, thus absorbing heat from the air within the car and the materials stored therein, the expanded refrigerant being then drawn back through a suction pipe to the compressor, thus completing the cycle. The main portion of the refrigerating system within and above the car, is connected with the compressor beneath the car by exposed runs of the pressure and suction pipes which extend up, usually adjacent to one another, through the floor of the car. These exposed sections of piping beneath the car are somewhat more apt to be broken off or otherwise injured so as to become opened to the atmosphere than are other portions of the system. In case of such breakage there would be a consequent loss of the circulating refrigerant.

According to the present invention a pair of self-closing but normally open cut-off valves are positioned in the pressure and suction pipes approximately at the position

where they pass upwardly through the floor of the car, these valves being adapted to automatically close whenever the lengths of piping beneath the car become broken off or opened, thus sealing the refrigerant into that portion of the refrigerating system located above the car floor. More specifically, the valves are positioned in the vertical runs of the two pipes and are of a gravity closing type, the valve in the pressure pipe being normally held open by the upward flow of compressed refrigerant that is forced through this pipe. Since the downward flow of refrigerant in the suction pipe would tend to close this valve, auxiliary means must be provided to normally hold the valve open. For this purpose a small fluid pressure operated piston is provided having a stem projecting upwardly so as to hold the valve open, the piston being normally held in this elevated position by fluid pressure conducted through a branch pipe from the pressure pipe in which the higher pressure fluid is confined.

The principal object of this invention is to provide improved cut-off valves for refrigerator cars, of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide a simple and effective safety cut-off mechanism for sealing the refrigerant within those portions of a mechanical refrigeration system positioned within a refrigerator car, in case the exposed piping beneath the car becomes broken off or injured.

Another object is to provide an improved fluid-pressure operated means for holding open a check-valve, which valve normally closes in the direction of fluid-flow through the valve.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of apparatus embodying the principles of this invention.

In the accompanying drawings:

Fig. 1 is a diagrammatic view, partially in longitudinal vertical section, illustrating the principal elements of a refrigerating sys-

tem of the type to which this invention is preferably applied.

Fig. 2 is a vertical central section through the assembled valves and piping connections.

Fig. 3 is a perspective view of one of the valve guides.

Fig. 4 is a perspective view of one of the movable valve members.

Fig. 5 is a perspective view of the valve-opening piston.

Referring first to Fig. 1, we will briefly describe the principal features of a refrigerating system in which these improved cut-off valves are especially adapted for use. The general outlines of the closed car body are indicated in dotted lines at 1, one of the car trucks is indicated at 2, and 3 indicates a pair of the car wheels. It will be understood that a similar truck is located at the other end of the car. The principal elements of the refrigerating system are the compressor A, the condenser B, a receiving tank C for holding liquid refrigerant, an expansion and distribution valve D, and two similar refrigerating units E and E', one located in each end portion of the car. All of these elements are connected in circuit, substantially in the order named.

The compressor A, of any suitable type, is carried in a housing 4 suspended beneath the car, and is driven from one of the car axles or wheels in any suitable manner, for example by the sprocket gearing indicated generally at 5.

The compressed vaporized refrigerant is forced through pipe 6 upwardly into and through the condenser B, which is carried in an exposed position outside of the car body, preferably on top of the car. The compressed refrigerant is condensed or liquefied in the condenser B and flows down through pipe 7 into the receiving tank C. From the supply in tank C, the liquid refrigerant is forced through pipe 8 to the expansion and distribution valve D, which is preferably located centrally in the storage compartment of the car so as to be responsive to the temperatures prevailing in this storage chamber. Preferably, a suitable reducing valve 9 is positioned in the pipe line 8 so that the liquid refrigerant will be delivered to the control valve D at a constant pressure regardless of pressure variation that may occur in that portion of the system between compressor A and reducing valve 9.

The control valve D is so designed as to perform two distinct functions, one of which is to permit the flow of the liquid refrigerant to the refrigerating elements in limited or restricted quantities only, so that the refrigerant can expand and vaporize in the low pressure side of the system, which extends from the valve D to and through the refrigerating elements E and E' and back to the compressor A. The other function of valve

D is to change the distribution or flow of the refrigerant in accordance with temperature changes in the space in which this valve is located. There are two outlets leading from valve D, designated as 10 and 11. When any temperatures above a predetermined maximum prevail in the car or in the space adjacent the valve D, the refrigerant will be discharged through pipe 10. When the temperature in the car has been lowered below this predetermined maximum, the flow of refrigerant will be changed to the outlet pipe 11, the flow through pipe 10 being cut off. The supply 10 has two branches 10 and 10' which extend to the two similar refrigerating elements E and E' respectively. In a similar manner the supply pipe 11 is provided with two branches 11 and 11' which also extend to the two refrigerating elements E and E'.

The two refrigerating elements E and E' are substantial duplicates and a description of one will suffice for both. One of these refrigerating elements will be positioned in each end of the car, preferably in a bulkhead compartment similar to those formerly employed for holding the ice supply, and through which a circulation of air from the central storage chamber is maintained. The refrigerating element E comprises a central brine tank 12 containing a supply of brine or other equivalent material having a low freezing point, there being a pipe coil 13 positioned within the brine tank 12. The object of this brine tank is to act as a storage reservoir for cooling energy, or in other words it provides a body of heat-absorbing material which will function as a refrigerating element in the same manner as a supply of ice would do when the mechanical refrigerating system is temporarily out of action. Positioned outside of brine tank 12, and preferably one at each side thereof, are two or more refrigerating pipe coils 15 and 16, these coils being connected together at their lower ends in open communication with the supply pipe 10, as indicated at 17. The upper ends of the two outside coils 15 and 16 are joined together at 18, from which connection leads a pipe 19 to the lower end of the pipe coil 13 within the brine tank 12. A discharge pipe 20 leads from the upper end of inside coil 13 down through the floor of the car and back to the compressor A. It will be noted that the two outside coils 15 and 16, in the example here shown, are connected in parallel, and both are in series with the inside pipe coil 13 so that the refrigerant when supplied through pipe 10 will first flow through the two outside coils, then through the inside coil, and the expanded and heated refrigerant from all of the coils will flow back through pipe 20 to the compressor A. Alternatively the outside coils 15 and 16 could be connected in series instead of in parallel,

both being in series with the inside coil 13.

Similar parts of the other refrigerating element E' are indicated by similar but primed reference characters, and it will be noted that the two discharge lines 20 and 20' are joined together within the car and continue as a common return pipe 21 leading back to the compressor A. The other supply pipe 11 leading from valve D extends to the connection 18, thus feeding the refrigerant directly into the inner coil 13 through pipe 19. At such times as the supply flows through pipe 11, the supply through pipe 10 will be cut off, so that coils 15 and 16 will be out of service.

In the general operation of a system of this type, whenever the car is in motion along the trackway, the compressor A will be driven and the refrigerant will be caused to circulate, the vaporized refrigerant will be compressed in compressor A and transferred under high pressure through pressure pipe 6 to the condenser B where it is relieved of a portion of its heat and condensed, and then flows into liquid form, still under high pressure, into the receiving tank C. This liquid refrigerant is forced to and through the control valve D, which delivers it in restricted quantities to the two refrigerating elements E and E' wherein the refrigerant expands and vaporizes and thus absorbs heat from the air circulating within the car. The control valve D is thermostatically operated, and as long as the temperature in the storage compartment of the car wherein this valve is located is above the predetermined temperature which it is desired to maintain in this portion of the car, the refrigerant will flow first through the outer coils 15 and 16 which directly absorb heat from the circulating air and then through the coil 13 within the brine tank so that any cooling energy remaining in the refrigerant is utilized to lower the temperature of the brine within tank 12. The expanded and somewhat heated refrigerant then returns through suction pipes 20 and 21 to the compressor A. When the temperature within the car has been lowered to the desired point, the valve D acts automatically to cut off the supply of refrigerant to the outer coils 15 and 16, but the refrigerant then flows through pipes 11 and 19 and directly through the inner coils 13 so as to continue to store cooling energy in the brine confined within tanks 12.

It will be noted that the refrigerant is always active to store cooling energy in the brine tanks as long as the car is in motion, but when the car has temporarily halted, as at a station, the entire circulation system will be, for the time being, inoperative. At such times the mass of cool brine stored up in the tanks 12 will act to absorb heat from the air flowing through the bulk-head compartments in which the tanks are located and

thus keep up the refrigerating process until the car is again put in motion and the circulation system again functions. The improved refrigerating system thus briefly described is disclosed more in detail and claimed in our copending application Serial No. 493,897, filed November 6, 1930.

It will now be apparent that those portions of the refrigerating system positioned within or on the car body may take a variety of forms, other than the one hereinabove described by way of example, but that in any such system the compressed vaporized refrigerant will be forced upwardly from the compressor A under rather high pressure through a pipe 6, which is herein referred to as the "pressure pipe", and that the expanded and vaporized refrigerant will be returned under a comparatively low pressure to the compressor through a pipe 21, herein referred to as the "suction pipe". Each of these pipes 6 and 21 will have exposed portions beneath the car connecting with the compressor A, and will have vertical runs (usually located adjacent one another) extending up through the floor of the car to connect with the remainder of the circulation system. It will be apparent that if these pipes 6 and 21 should be broken off beneath the car body, or otherwise opened to the atmosphere the refrigerant could escape from that portion of the refrigerating system within the car.

The particular object of the present invention is to provide an improved set of automatically acting valves positioned in the pipes 6 and 21 adjacent the floor of the car so as to seal up that portion of the system positioned within the car body and prevent the escape of refrigerant in case the pressure and suction pipes 6 and 21 beneath the car become broken or are otherwise opened to the atmosphere.

As shown in Fig. 1, these cut-off valves F and G are located in the vertical runs of pipes 6 and 21 respectively adjacent the location where these pipes extend upwardly through the floor of the car. Referring now more particularly to Figs. 2, 3, 4 and 5, it will be noted that the valves F and G can be conveniently positioned in the space 22 remaining between the upper and lower walls 23 and 24 of the double-walled insulated car floor.

The valve F, which is of the simpler construction, will first be described. This valve comprises a main casting 25 formed with a main valve chamber 26 from which opens downwardly a smaller chamber 27 at the upper end of which is a valve seat 28. The lower section of pressure pipe 6 is joined to valve casing 25 at 29 and communicates through passage 30 with the lower chamber 27. A valve guide 31 (shown in perspective in Fig. 3) comprises a downwardly projecting hollow cylindrical shell 32 which is sus-

5 depended within valve chamber 26 by means of  
 a spider 33 formed with a plurality of pas-  
 sages 34 to permit free passage of the va-  
 porized refrigerant. An annular collar 35  
 10 at the top of the spider 33 rests on an an-  
 nular shoulder 36 within the valve casing.  
 A closure member 37 is secured to the top  
 of casting 25 by any suitable means such as  
 15 screw bolts 38, and is internally threaded at  
 39 to join with the upper section of pres-  
 sure pipe 6. The movable valve assembly 40  
 (shown in perspective in Fig. 4), comprises  
 a lower valve disk 41 adapted to engage the  
 20 valve seat 28, which is connected by stem 42  
 with the piston 43 which is loosely guided  
 within the cylindrical guide shell 32. A  
 small passage 44 leading through the upper  
 portion of the guide member 31 prevents  
 25 the formation of a vacuum above the guide  
 piston 43 so that the movable guide member  
 will fall under the influence of gravity  
 against the valve seat 28 unless otherwise  
 supported. A screw 45 provided with a  
 30 lock nut 46 is threaded into the lower por-  
 tion of the casting 25, with its upper end  
 portion 45' normally out of engagement with  
 the valve disk 41. By loosening the lock  
 35 nut 46 this screw can be moved upwardly so  
 as to serve as an emergency means for rais-  
 ing the valve from its seat, should occasion  
 arise for thus opening the valve. Since fluid  
 under pressure normally flows upwardly  
 40 through this valve F, as indicated by the ar-  
 rows in Fig. 2, this fluid pressure will nor-  
 mally serve to hold the valve raised from its  
 seat and permit a free flow of refrigerant up-  
 wardly through the valve. However, should  
 45 the pipe 6 become broken off or opened below  
 the car, the fluid pressure supporting the  
 valve will be relieved and it will fall against  
 its seat 28, also being forced downwardly by  
 the fluid in the upper portion of pipe 6  
 50 which is under greater than atmospheric  
 pressure.  
 The upper portion of valve G, as used in  
 the suction pipe 21, is of similar construction  
 to the valve F. In addition to the features  
 already described in connection with valve F,  
 55 the main casting 47 of valve G is formed with  
 a pressure chamber or cylinder 48 located be-  
 low the chamber 47 and separated therefrom  
 by horizontal web 49. A piston 50 has a fluid  
 tight sliding fit in cylinder 48 and is pro-  
 60 vided with a valve stem 51 which projects  
 upwardly through an opening in web 49 and  
 is adapted to engage the lower surface of  
 valve disk 41. A cap or closure 52 is secured  
 to the lower end of casing 47 by means of  
 65 screw bolts 53, and is adapted to close the  
 lower end of pressure cylinder 48. The cap  
 52 is provided with a chamber 54 into which  
 leads a branch pipe 55 extending from the  
 high pressure pipe 6 and provided with a  
 normally open cut-off valve 56. An emer-  
 gency valve-opening screw 57 (similar to the

screw 45 previously described) and provided  
 with a lock nut 58 is threaded into the lower  
 end of cap or closure 52 and when screwed  
 upwardly will engage the piston 50 and  
 70 through this piston and stem 51 may raise  
 the valve 41 from its seat. Normally this  
 emergency screw 58 will be moved down to  
 the inoperative position shown in Fig. 2.

Under normally operating conditions, a  
 stream of vaporized refrigerant under rela-  
 75 tively low pressure will be drawn downward-  
 ly through suction pipe 21 as indicated by the  
 arrows. It will be apparent that this flow  
 of refrigerant would normally tend to assist  
 gravity in closing the valve 41. However,  
 80 fluid under high pressure from the pipe 6  
 flows through branch pipe 55 and exerts an  
 upward pressure on piston 50 so as to force  
 it up to the position indicated in Fig. 2 so  
 that stem 51 will hold the valve 41 open.

The normal operating position of the valves  
 F and G is indicated in Fig. 2, both valves  
 being open so that a free flow of refrigerant  
 is permitted through both pipes 6 and 21. In  
 90 case the lower portions of these pipes should  
 be broken away or otherwise opened to the  
 atmosphere it will be apparent that the up-  
 ward pressure through pipes 6 and 55 will be  
 dissipated, so as to no longer support the  
 valve disk 41 in valve F, and the piston 50  
 95 in valve G. As already described, the high  
 pressure fluid in the upper portion of pipe 6  
 will assist gravity in closing the valve F.  
 Although the fluid refrigerant in pipe 21 has  
 been described as under relatively low pres-  
 100 sure, this pressure is still higher than atmos-  
 pheric pressure which is now all that is  
 exerted against the lower side of valve disk  
 41 in valve G, so that this valve also will be  
 closed by the pressure of the refrigerant  
 105 tending to flow down through the upper por-  
 tion of pipe 21. Both valves F and G will  
 thus be closed, sealing in the refrigerant in  
 all of the upper portion of the refrigerating  
 system. Since the greater mass of this re-  
 110 frigerant is contained in those portions of  
 the system above the car floor, it will be ap-  
 parent that there will be only a small loss of  
 refrigerant, namely that portion which was  
 115 then present in the compressor A and the broken  
 off portions of pressure pipe 6 and suc-  
 tion pipe 21.

It will be noted that the valve assemblies 25  
 and 47 are quite rigidly secured to and sup-  
 120 ported by the upper runs of pipes 6 and 21 re-  
 spectively, whereas the lower runs of pipes  
 6 and 21, and auxiliary pressure pipe 55,  
 are merely soldered to the valve casings or  
 125 otherwise secured so as to form a permanent  
 but comparatively fragile connection so that  
 if the pipes break or become disconnected at  
 all, it will be below the valves rather than  
 above them, thus insuring the desired func-  
 130 tioning of the safety valves.

**We claim:**

1. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, automatically closing valves in each of the pressure and suction pipes, and means for holding both valves open automatically by the pressure of the fluid in the pressure pipe.

2. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, automatically closing valves in each of the pressure and suction pipes, means for holding both valves open automatically by the pressure of the fluid in the pressure pipe and manually operable screws for engaging and opening said valves.

3. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, automatically closing valves in each of the pressure and suction pipes, the valve in the pressure pipe being normally held open by the pressure of the fluid forced upwardly through that pipe, and fluid-operated means including a branch pipe extending from the pressure pipe for holding open the valve in the suction pipe.

4. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, automatically closing valves in each of the pressure and suction pipes, the valve in the pressure pipe being normally held open by the pressure of the fluid forced upwardly through that pipe, a cylinder positioned adjacent the valve in the suction pipe, a piston in said cylinder having an extension adapted to engage the valve and hold it open, and a branch pipe extending from the pressure pipe to the cylinder.

5. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, a pair of valves adapted to close by gravity and located one in a vertical run of each of the suction and pressure pipes, both valves being normally held open by the pressure of the fluid in the pressure pipe.

6. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the

compressor to the portions of the system within the car body, a pair of valves adapted to close by gravity and located one in a vertical run of each of the suction and pressure pipes, the valve in the pressure pipe being normally held open by the upward flow of fluid through that pipe, and fluid operated means for holding open the valve in the suction pipe including a branch pipe extending from the pressure pipe.

7. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, a pair of valves adapted to close by gravity and located one in a vertical run of each of the suction and pressure pipes, the valve in the pressure pipe being normally held open by the upward flow of fluid through that pipe, a cylinder positioned beneath the valve in the suction pipe, a piston in the cylinder provided with a stem projecting upward to engage and hold open the valve, and a branch pipe leading from the pressure pipe to the cylinder beneath the piston.

8. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, a pair of normally open but self-closing valves located one in a lower vertical run of each of the suction and pressure pipes, each valve comprising a casing, an upwardly facing valve-seat in the casing, a gravity-operated valve adapted to engage the seat, and a guide in the casing for directing the valve in its vertical movements, the upward flow of fluid through the pressure pipe serving to normally hold the valve in that pipe open, a cylinder positioned beneath the valve in the suction pipe, a piston in the cylinder, a stem projecting upwardly from the piston and adapted to engage the valve and hold it up from the valve-seat, and a branch pipe extending from the pressure pipe to the lower portion of the cylinder.

9. In combination with a refrigerating system for a railway car including a compressor mounted beneath the car body, and suction and pressure pipes leading from the compressor to the portions of the system within the car body, a pair of normally open but self-closing valves located one in a lower vertical run of each of the suction and pressure pipes, each valve comprising a casing, an upwardly facing valve-seat in the casing, a gravity-operated valve adapted to engage the seat, and a guide in the casing for directing the valve in its vertical movements, the upward flow of fluid through the pressure pipe serving to normally hold the valve in that pipe open, a cylinder positioned beneath

- the valve in the suction pipe, a piston in the cylinder, a stem projecting upwardly from the piston and adapted to engage the valve and hold it up from the valve-seat, a branch pipe extending from the pressure pipe to the lower portion of the cylinder and emergency valve-opening means comprising a screw mounted in the lower end of each valve casing.
10. The combination with a pair of pipe lines extending adjacent one another, a pair of automatically closing valves, one in each pipe line, one valve being held open by the normal flow of fluid therethrough, and the other valve tending to close with the normal flow of fluid therethrough, and means for holding said latter valve open actuated by fluid-pressure taken from the other pipe-line.
11. The combination with a pair of vertically extending pipe lines, a valve in each pipe-line adapted to close by gravity, the normal flow of fluid through one pipe being upwardly and through the other pipe downwardly, the upward flow of fluid through the first pipe normally holding the valve in that pipe open, and fluid pressure means actuated by fluid from the first pipe for normally holding open the valve in the second pipe wherein the normal flow of fluid is downward.

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