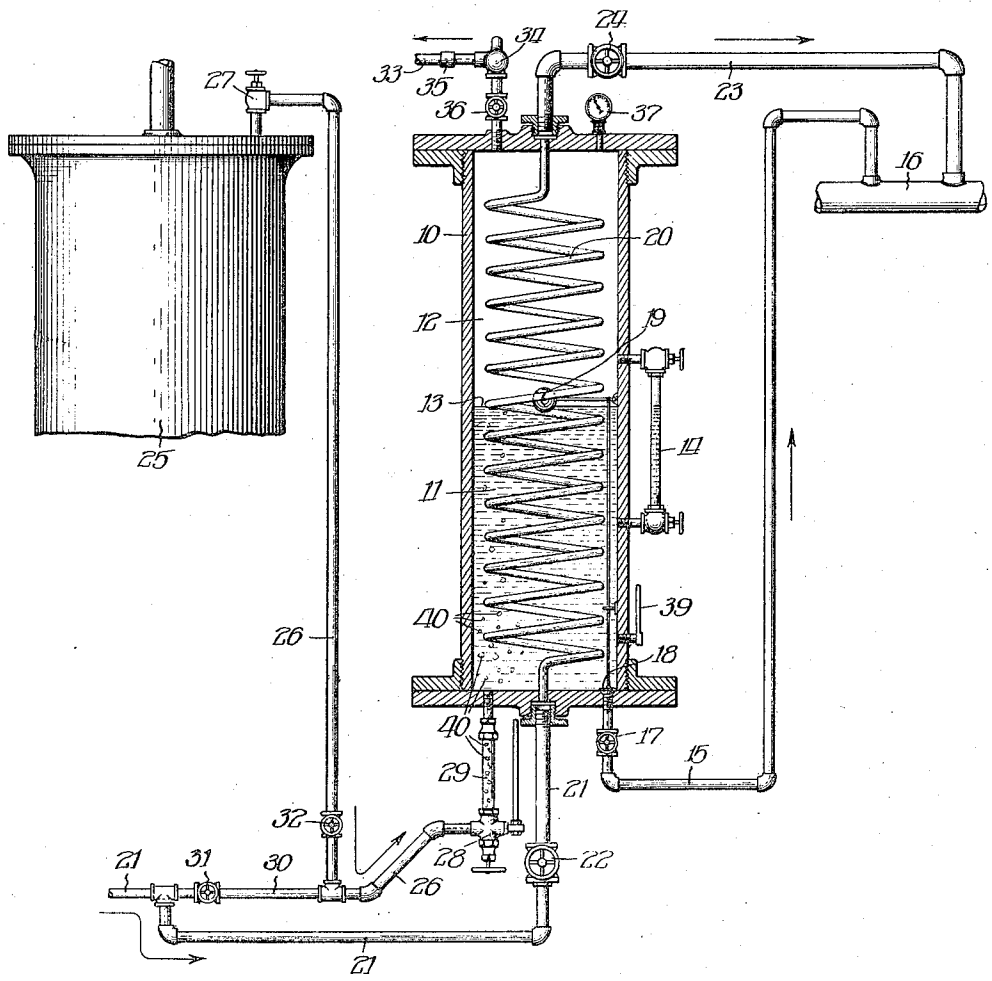
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APPARATUS AND PROCESS FOR REMOVING NONCONDENSIBLE GASES

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APPARATUS AND PROCESS FOR REMOVING NONCONDENSIBLE GASES.

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To all whom it may concern:

Be it known that I, BERT EUGENE HILL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus and Processes for Removing Noncondensible Gases, of which the following is a specification.

This invention is concerned with improvements in the art of mechanical refrigeration, and has to do particularly with the disposition of the non-condensible gases which accumulate in refrigeration systems employing as a refrigerating medium ammonia or a similar fluid.

The principal object of the invention resides in the provision of a novel apparatus and process for removing the non-condensible gases from a refrigeration system of the above mentioned character without either interruption to the operation of the system or waste of the refrigerating medium entrained with the gases.

While the foregoing statement is indicative in a general way of the nature of the invention, other objects and advantageous features not specifically referred to in this disclosure will be obvious upon a full understanding of the construction of the apparatus and process as set forth in the following description and accompanying drawing, wherein is delineated a preferred embodiment of the apparatus for practicing the process. It will be understood, however, that this particular structural embodiment of the invention is chosen primarily for the purpose of exemplification, and is not intended to restrict in any way the spirit of the invention or to limit unnecessarily the scope of the appended claims.

In the drawing are illustrated those portions of a refrigeration system with which this invention is associated, the particular apparatus embodying the invention being shown for the most part in vertical section.

The general construction and operation of mechanical refrigeration systems is well known, and it is accordingly unnecessary to go into the details of such a system in this disclosure. The fluids adapted for use in refrigeration systems include ammonia, carbonic acid, sulphurous oxide and the like. Of these, ammonia is most commonly employed, and the present disclosure will refer for convenience to ammonia as the refrigerating fluid handled by the separator of this invention.

During the operation of a mechanical refrigeration system non-condensible gases accumulate in the system and materially impair its efficiency. In order to effect the removal of these non-condensible gases, the common practice employed at present, and for many years past, is to pump all of the ammonia out of the system and into the ammonia condenser, then shut down the system, flow cold water into or over the condenser for a period of several hours, and then purge the condenser of the non-condensible gases by opening valves which are generally located in the tops of the condenser coils. The disadvantages of this practice are obvious, but the removal of these non-condensible gases is necessary from the standpoint of economy because the presence of the gases creates an excessively high pressure in the condenser which the compressor must work against, and from the standpoint of safety because the high pressure decreases the factor of safety and loss of property and life may, and does often times, occur.

In accordance with the present invention, the removal of all forms of so-called permanent or non-condensible gases from the refrigeration system is effected automatically while the system is in full operation. The non-condensible gases are removed in sight of the operating engineer; the waste of ammonia gas is eliminated; the hazards of excessive condenser pressure are removed; the system is kept in operation to its maximum capacity and without interruption; the operating cost is kept at a minimum; and the losses of time and ammonia which necessarily accompany the old practice of purging periodically is eliminated.

Referring now with more detail to the view of the apparatus shown in the drawing, it will be observed that the numeral 10 designates a closed cylindrical tank which forms the nucleus of the separator. The tank 10 is adapted to contain a quantity 11 of the liquefied ammonia employed in the system; the quantity of the liquefied ammonia being such relative to the capacity of the tank as to leave the unoccupied space 12 in the tank above the level 13 of the liquefied ammonia. It is desirable that the level 13 of the liquefied ammonia remains substantially constant during the operation of the separator in order to maintain in the

tank a sufficient quantity 11 of liquefied ammonia and a sufficient unoccupied space 12 above the liquid. A sight glass 14 may be connected with the tank for the purpose of permitting observation of the level 13.

An outlet conduit 15 extends from the bottom of the tank to some point in the main suction line 16 of the system, and is provided, intermediate its length, with a valve 17 for regulating the flow of liquefied ammonia from the tank. The conduit 15 may also be provided, at its point of junction with the tank, with another valve 18 which is automatically actuated by a float 19 to open upon a rise of the level 13 of the liquefied ammonia due to the accumulation in the tank of additional ammonia that has been salvaged by the apparatus, thereby preventing the level from rising above the location desired for the same.

In order to maintain the quantity 11 of liquefied ammonia at a temperature below its ebullition point with respect to the pressure within the tank, an expansion coil 20 or other means of a similar character is positioned within the confines of the tank. The lower end of the coil 20 is connected with a conduit 21 which communicates with some point (not shown) in the system containing liquefied ammonia and is provided, adjacent the coil, with an expansion valve 22 for expanding the liquefied ammonia as it enters the coil to effect a cooling of the same. The upper end of the coil 20 is connected with a conduit 23 which communicates with some point in the main suction line 16 and serves to discharge the vaporized ammonia from the coil. A valve 24 may be placed, if desired, in the conduit 23 for the purpose of regulating the rate of discharge therethrough.

The non-condensible gases and entrained vaporized ammonia which the separator of this invention is adapted to handle are led off from some point in the refrigeration system on the high-pressure side of the compressor—preferably from the receiver 25 into which the condenser discharges—and passes through a conduit 26 to a point in communication with the bottom of the separator tank. This conduit includes a shut-off valve 27, a regulating valve 28 for controlling the flow of the gases into the tank, and a vertically elongated sight glass 29 which is located between the valve 28 and the tank at a point just under the latter. The conduits 21 and 26 are provided with a connection 30 and associated shut-off valves 31 and 32; enabling the flow of gases through the conduit 26 to be interrupted temporarily while liquefied ammonia is run through a portion of the conduit 26 from the conduit 21 to fill the tank initially to its operating level.

The non-condensible gases accumulate in the unoccupied space 12 of the tank during the operation of the apparatus and are intermittently discharged therefrom through a conduit 33 which contains a pop valve 34 adapted to open when the pressure of the gases in the tank exceeds for example 100 pounds. The conduit 33 also contains a venturi 35 adapted to maintain quiescence of the gases in the tank when the valve 34 opens, whereby to prevent vaporization of the liquefied ammonia in the tank due to agitation of the gases thereabove. For emergency purposes a shut-off valve 36 may also be included in this conduit. The pressure of the gases in the tank may be ascertained by a gauge 37 on the tank, and the temperature of the liquefied ammonia in the tank may be ascertained by a thermometer 39.

The operation of the separator is as follows:

The tank 10 is first filled to about the level 13 with liquefied ammonia which may be obtained by connecting the conduit 26 with the conduit 21 through the closing of the valve 32 and the opening of the valves 28 and 31. When a sufficient quantity of the ammonia has entered the tank, the valve 32 is opened and the valve 31 closed, leaving a column of the liquid in the sight glass 29 and the quantity 11 thereabove in the tank. The valves 22—24 are then opened, and the valve 22 regulated to expand properly the liquefied ammonia passing into the coil 20.

The valves 27—28 are then opened, whereupon the mixture of non-condensible gases and vaporized ammonia will commence to percolate upwardly in bubbles 40 through the column of cold liquefied ammonia in the sight glass and in the tank. As the gases pass upwardly towards the surface of the liquefied ammonia, the vaporized ammonia previously entrained in the gases is condensed into a liquid form, and the remaining non-condensible gases are collected above the top of the liquefied ammonia in the space 12 to be discharged intermittently therefrom through the conduit 33 when the pressure of the collected gases exceeds the 100-pound operating pressure of the pop valve 34. The operation of the separator is continuous, and, as its consumption of liquid ammonia is negligible, it has no appreciable effect upon the concurrent full capacity operation of the refrigeration system.

It will of course be understood that the pressure in the system at the point from which the mixture of non-condensible gases and vaporized ammonia is initially led off to the separator is materially in excess of the pressure maintained within the separator tank; and that as the vaporized ammonia is salvaged in the separator tank and added to the liquefied ammonia, the valve 18 will be automatically actuated by the float 19 to discharge the excess liquefied

ammonia again into the system through the conduit 15.

The separator of this invention requires very little attention during its operation, and the operating engineer may observe the functioning of the apparatus through the sight glass 29.

I claim:

1. A separator for removing from a refrigeration system the non-condensible gases, which comprises a closed pressure structure adapted to contain as essential to the operation of the separator a quantity of the refrigerating fluid in liquefied form, means associated with the structure and opening into the same at a point spaced a substantial distance below the top thereof for introducing into the liquefied fluid at a point below its surface the non-condensible gases and any of the refrigerating fluid entrained in vaporized form with the gases, means associated with the structure for maintaining the liquefied fluid at a temperature below its ebullition point, means associated with the structure at a point spaced a substantial distance above the first-mentioned means for permitting the non-condensible gases to pass off from above the liquefied fluid, and means associated with the structure at a point spaced a substantial distance below the last-mentioned means for withdrawing liquefied fluid from the structure to compensate for the liquefied fluid that is therein salvaged from the gases by condensation and added to the liquefied fluid already present in the structure.

2. A separator for removing from a refrigeration system the non-condensible gases, which comprises a closed pressure structure adapted to contain as essential to the operation of the separator a quantity of the refrigerating fluid in liquefied form, means associated with the structure and opening into the same at a point spaced a substantial distance below the top thereof for introducing into the liquefied fluid at a point below its surface the non-condensible gases and any of the refrigerating fluid entrained in vaporized form with the gases, means associated with the structure for maintaining the liquefied fluid at a temperature below its ebullition point, means associated with the structure at a point spaced a substantial distance above the first-mentioned means for permitting the non-condensible gases to pass off from above the liquefied fluid, means associated with the structure at a point spaced a substantial distance below the last-mentioned means for withdrawing liquefied fluid from the structure to compensate for the liquefied fluid that is therein salvaged from the gases by condensation and added to the liquefied fluid already present in the structure, and means associated with the first-mentioned means for permitting observation of the presence and quantity of gases entering the separator from the system for the guidance of the operator in making any adjustments that may appear necessary.

3. A separator for removing from a refrigeration system the non-condensible gases, which comprises a closed pressure structure adapted to contain as essential to the operation of the separator a quantity of the refrigerating fluid in liquefied form, means associated with the structure and opening into the same at a point spaced a substantial distance below the top thereof for introducing into the liquefied fluid at a point below its surface the non-condensible gases and any of the refrigerating fluid entrained in varporized form with the gases, means associated with the structure for maintaining the liquefied fluid at a temperature below its ebullition point, and automatically operating relief valve associated with the structure at a point spaced a substantial distance above the first-mentioned means for permitting the non-condensible gases to pass off from above the liquefied fluid in the structure whenever the pressure of such gases exceeds a predetermined amount, and means associated with the structure at a point spaced a substantial distance below the said relief valve for withdrawing liquefied fluid from the structure to compensate for the liquefied fluid that is therein salvaged from the gases by condensation and added to the liquefied fluid already present in the structure.

4. A separator for removing from a refrigeration system the non-condensible gases, which comprises a closed pressure structure adapted to contain as essential to the operation of the separator a quantity of the refrigerating fluid in liquefied form, means associated with the structure and opening into the same at a point spaced a substantial distance below the top thereof for introducing into the liquefied fluid at a point below its surface the non-condensible gases and any of the refrigerating fluid entrained in vaporized form with the gases, means associated with the structure for maintaining the liquefied fluid at a temperature below its ebullition point, means associated with the structure at a point spaced a substantial distance above the first-mentioned means for permitting the non-condensible gases to pass off from above the liquefied fluid, and automatic means for permitting liquid to escape from the structure when the level rises beyond a certain height.

5. A separator for removing from a refrigeration system the non-condensible gases, consisting of a closed chamber, a non-condensible gas inlet leading into the lower part of said chamber, means for conducting a cooling medium into heat-exchanging re-

lation with the contents of said chamber, a liquid outlet leading from the lower part of said chamber, and a non-condensible gas outlet leading from the upper part of said chamber.

6. A method for removing from a refrigeration system the non-condensible gases, which includes the steps of withdrawing from the system the non-condensible gases and any of the refrigerating fluid entrained in vaporized form with the gases, passing the same upwardly through a liquefied column of the refrigerating fluid whereby the refrigerating fluid carried by the gases is condensed and removed from the same, permitting the non-condensible gases to pass off from above the liquefied column of the refrigerating fluid, and maintaining the temperature of the liquid and the pressure of the gases at such points as to prevent ebullition of the liquid.

In testimony whereof I have hereunto subscribed my name.

BERT EUGENE HILL.