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REFRIGERATING APPARATUS.

APPLICATION FILED SEPT. 10, 1913.

**1,161,937.** Patented Nov. 30, 1915.

Fig. 1.

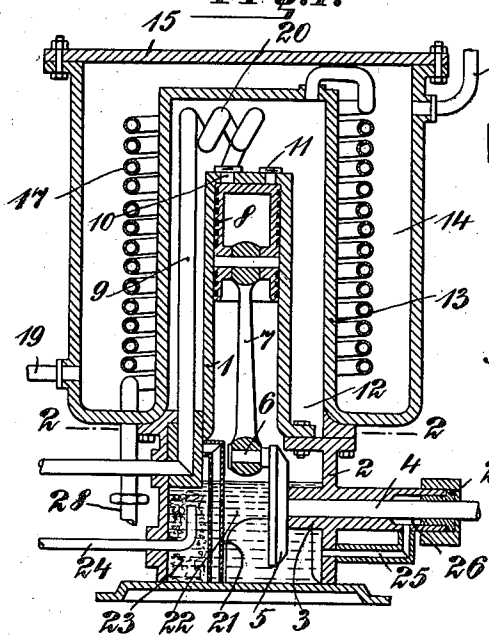



Fig. 3.

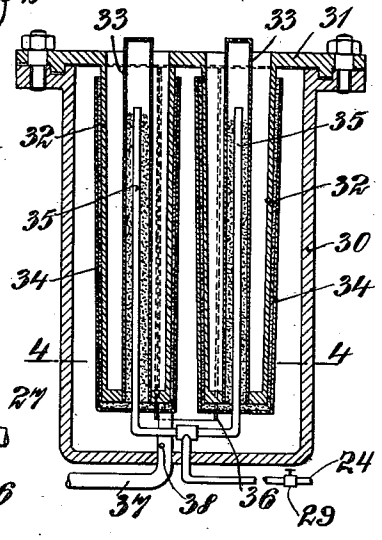



Fig. 2.

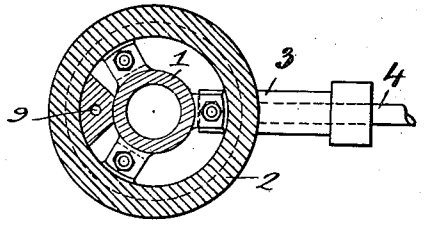
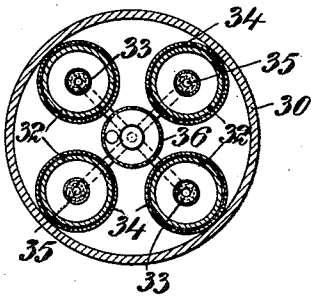



Fig. 4.




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# UNITED STATES PATENT OFFICE.

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## REFRIGERATING APPARATUS.

1,161,937. Specification of Letters Patent. Patented Nov. 30, 1915.

Application filed September 10, 1913. Serial No. 789,165.

*To all whom it may concern:*

Be it known that I, LUDWIG HORST, a citizen of the German Empire, residing at Hamburg, Germany, have invented certain new and useful Improvements in Refrigerating Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in refrigerating apparatus.

One of the objects of the improvements is to provide a refrigerating apparatus which is entirely automatic and requires little or no attention by an attendant, so that it is particularly adapted for use in households for producing the ice for daily use, cooling one or more refrigerators, or for other purposes.

With this and other objects in view my invention consists in the matters described hereinafter and particularly pointed out in the appended claims, reference being had to the accompanying drawing forming part of this specification and to the letters of reference marked thereon.

In said drawing Figure 1, is a vertical cross-section of the compressor and the condenser of the system, Fig. 2, is a horizontal cross-section taken on the line 2—2 of Fig. 1, Fig. 3, is a vertical cross-section of the apparatus for freezing water, and Fig. 4, is a horizontal cross-section taken on the line 4—4 of Fig. 3.

The same letters of reference have been uesd in all the views to indicate corresponding parts.

Referring now more particularly to the example illustrated in the drawing, the refrigerating apparatus consists of the apparatus for condensing a refrigerant and a refrigerating apparatus in which water or the like is frozen by vaporization of the condensed refrigerant.

As shown in Fig. 1, the compressor consists of a cylinder 1 which is secured by screw bolts to a casing 2 formed with a bearing 3 for a crank shaft 4 adapted to receive power from a suitable source, such for example as an electromotor. At its inner end the said crank shaft is equipped with a crank disk 5 having a crank pin 6 secured thereto. The latter is connected by a connecting rod 7 with a reciprocating plunger 8 located within the compressor cylinder 1. At its top the cylinder 1 is connected through a suction pipe 9 with the supply of the vaporized refrigerant which preferably consists of ethyl-chlorid, and at the inlet from the suction pipe to the compressor there is a suction valve 10. Furthermore the cylinder is provided at its top with a pressure valve 11.

On the casing 2, and concentrically of the cylinder 1, a condenser is mounted which is provided with an annular condensing chamber 14, and is closed at its top by a cover 15. The inner wall 13 of the condenser provides an annular chamber 12 surrounding the compressor at its top and at its sides and providing a pressure chamber which is adapted to receive the compressed refrigerant forced by the compressor. At its lower end the said pressure chamber communicates with the inner part of the casing 2. Within the annular chamber 14 a refrigerating coil 17 is located which is connected at its upper end with the upper part of the pressure chamber 12 and at its lower end with a pipe communicating with the refrigerator. A suitable cooling liquid such as water is circulated through the chamber 14, and the said liquid is admitted through a tubular stud 18 and withdrawn through a stud 19.

The suction tube 9 passes through the chamber 12 and it is formed at its upper end into a coil 20 providing a superheater for the refrigerant passing to the compressor. Within the superheating coil non-condensed particles are vaporized, so that only gaseous refrigerant gets into the compressor and the latter can not be injured by liquid blows which might otherwise be caused by condensed liquid being gathered within the compressor.

The casing 2 is divided by a partition wall 21 into two sections, the main section 22 providing a receptacle for the refrigerant and the section 23 providing a chamber for withdrawing the refrigerant and conducting the same to the freezer or refrigerator. The partition wall 21 is not in tight contact at its sides with the wall of the casing 2, so that the chambers 22 and 23 are in communication with each other. The chamber 23 is filled with metal shaving or the like, which shaving incloses the inner end of a pipe 24

through which the condensed refrigerant is conducted to the evaporating chamber provided within the freezer.

From the chamber 22 a pipe 25 is branched off through which liquid refrigerant or oil admixed thereto can be conducted to the bearing 3 of the shaft 4 or the stuffing box providing a tight closure of the chamber 22. As shown an annular space 26 is provided around the shaft 4 internally of the stuffing box 27.

The operation of the part of the refrigerating apparatus which has so far been described is as follows: The vaporized refrigerant which comes from the freezer passes through the pipe 9 and the superheater coil 20 within which any condensed particles are vaporized, so that only gaseous refrigerant gets into the compressor. This gas is drawn in by the downward stroke of the plunger 8. When the plunger moves upward, the gas inclosed within the cylinder is compressed and finally forced out of the compressor cylinder through the pressure valve 11 and into the pressure chamber 12. Within the latter it gives off part of its heat to the superheater coil 20, so that the condensed particles of the refrigerant passing through said coil to the compressor are vaporized. The main part of the heat of the compressed refrigerant is transmitted through the inner wall 13 of the condenser to the cooling liquid circulating through the chamber 14, so that the compressed refrigerant is condensed and falls downward into the chamber 22. From the chamber 22 the liquefied refrigerant flows into the chamber 23 which is filled with metal shavings, and it finally passes through the pipe 24 to the place of use, such as a freezer.

The part of the refrigerant which is not liquefied within the chamber 12 flows through the condensing coil 17 and is condensed therein. Also this part of the liquefied refrigerant is conducted to the place of use through the pipe 28 which is independent of the chambers 22 and 23. The part of the refrigerant passing through the coil 17 is very small, so that the cross-section of the pipe forming the said coil can be made very small.

As the main portion of the compressed refrigerant from the compressor is condensed within the chamber 12, the loss in pressure energy is much less than in condensers wherein all the condensation is effected within or upon a coil and wherein an appreciable amount of pressure energy is required to cause the fluids, whether cooling medium or vapors, to flow through the coil. The loss within the coil 17 is likewise very small, because the amount of gas passing through the coil is small. On the other hand also the cooling liquid flows through a chamber 14 of large cross-section, so that a minimum of pressure is required for causing a strong flow of cooling liquid through the condenser. It will therefore be understood, that by the combination of the condensing chamber 12 of large area, with the chamber 14 for the cooling liquid, and the condensing coil 17 for the small amount of refrigerant which has not been condensed within the chamber 12 the loss caused by the friction of the refrigerant and the cooling liquid is reduced to a minimum, so that the efficiency of the apparatus is high.

The liquid refrigerant which is gathered in liquefied form within the chamber 22 is at such a level that the shaft 4 and the crank disk 5 are immersed therein, so that the shaft and crank pin 6 are cooled and greased by the refrigerant which preferably consists of chlorethyl. By the rotation a part of the refrigerant is thrown upward and in contact with the inner wall of the cylinder 1, so that also the plunger is greased. In order to further improve the greasing of the operative parts I prefer to add glycerin to the refrigerant, the amount added to the refrigerant being about 10 per centum of the refrigerant. The said glycerin is gathered on the bottom of the chamber 22. As it is comparatively viscid, it is held back within the chamber 23 by the metal shavings, so that it can not get to the pipe 24 and a loss of the greasing material through the said pipe is avoided. The refrigerant which is comparatively fluid has an easy access to the said pipe.

As the pressure within the chamber 22 is considerably higher than that of the atmosphere, and the greasing of the shaft 4 through the passage 25 keeps the stuffing box 27 tight, no air can get into the inner parts of the machine, so that the apparatus is automatic for an unlimited time.

After the refrigerant has been liquefied, it is transmitted through the pipes 24 and 28 to the place of use which as shown in the drawing consists of a freezing apparatus for making ice. This freezing apparatus embodies various novel features not claimed in the present application. The liquid is caused to vaporize within the freezing apparatus itself, and in order to increase its action the vaporizing chamber is filled with a good conductor of heat preferably in the form of metal shavings, screens, or the like, so that the liquid flows slowly through the vaporizing chamber, and takes the heat directly from the said conducting material and from the freezing cell. Furthermore, in order to have a thorough and uniform cooling action on the cell, the cooling medium is so conducted that it is admitted to the cell from a central point, flows uniformly around the cell, and leaves the same through a concentric passage. In cases where several cells are located within a common freez-

ing chamber, special means are provided for assuring a central and uniform flow of the vaporizing refrigerant.

In the example shown in Figs. 3 and 4 of the drawing the freezing apparatus consists of a receptacle 30 of cylindrical form, which is closed at its bottom and provided with a cover or lid 31. Secured to or made integral with the cover 31 are freezing cells 32 which are open at their tops and closed at their bottoms. Centrally of each of the cells a pipe 33 extends through the bottom which is closed at its top and open at its bottom. The cell is inclosed within a tubular receptacle 34 the inner diameter of which is slightly larger than that of the outer diameter of the cell, and which is closed at its bottom and open at its top, the top of the receptacle being near the cover 31. Through the bottom of the receptacle 34 a pipe 35 extends centrally into the pipe 33. The pipes 35 of all the cells communicate through a reducing valve 29 with the pipe 24 which extends centrally through the bottom of the receptacle 30. The cells 32 are located eccentrically within the receptacle 30, and centrally between the same a pipe 36 is located which is secured at its top to the cover 31, and which is open at its bottom. Within the pipe 36 there is a pipe 37 which extends to a point near the upper end of the pipe 36 and passes through the bottom of the receptacle 30. The pipe 37 is connected with the suction pipe 9 of the compressor. The spaces provided between the pipes 33 and 35, the bottoms of the cells 32 and the receptacles 34, and the side walls of the cells 32 and the receptacles 34 are filled with metal shavings, screens, or the like.

In the operation of the freezing apparatus the liquid refrigerant is admitted through the pipe 24 and reducing valve 29, and it is distributed to the pipes 35 of the cells 32. From the pipes 35 the refrigerant is admitted at central points to the pipes 33 through which it descends in uniform currents. At the bottom of the pipe the refrigerant is uniformly distributed through the spaces provided between the cells 32 and the receptacles 34, a uniform flow of the refrigerant being assured by the pipe 36 which ends at the bottom part of the receptacle and centrally thereof, so that the suction caused by the said tube pipe is uniform throughout the receptacle 30. By withdrawing the vaporized refrigerant at the top end of the pipe 36 the flow of vaporized refrigerant is uniformly directed to the bottom end of the pipe 36. By passing through the filling of metal shavings or the like the vaporization of the refrigerant is made more uniform and the heat is rapidly transmitted from the cells to the refrigerant.

An important feature of the freezing apparatus consists in providing means for gradually withdrawing condensed refrigerant from the receptacle 30, as is necessary after the refrigerating system has been out of operation for some time. In such cases the liquid refrigerant is gathered at the bottom of the receptacle 30. If now the pipe 37 has its inlet end at or near the bottom of the receptacle, the whole mass of liquid refrigerant is at once conducted to the compressor, so as to endanger the operation of the latter. To avoid this the pipe 37 ends at the top of the receptacle 30 and it is provided near the bottom of the latter with a small bore or aperture 38 the function of which is to gradually withdraw the liquid refrigerant from the receptacle and to conduct the same to the compressor. This feature is important in automatic refrigerating systems, because even unskilled persons are able to properly operate the same.

While in describing the invention reference has been made to a particular example embodying the same, I wish it to be understood, that my invention is not limited to the construction and form shown in the drawing.

I claim herein as my invention:

1. In a refrigerating apparatus, the combination with the compressor, of a receptacle providing a condensing and a cooling chamber of large cross-sectional area, said condensing chamber communicating with the outlet from the compressor, means to direct a cooling medium through said cooling chamber, and an externally cooled condensing coil communicating with the condensing chamber.

2. In a refrigerating apparatus, the combination with the compressor, of a receptacle providing a condensing chamber and a cooling chamber of large cross-sectional area, said condensing chamber communicating with the outlet from the compressor, means to direct a cooling medium through said cooling chamber, and a condensing coil located within the cooling chamber and communicating with the condensing chamber.

3. In a refrigerating apparatus, the combination with the compressor, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and a cooling chamber surrounding the condensing chamber, a condensing coil located within the cooling chamber and communicating with the condensing chamber, and means to direct a cooling medium through said cooling chamber.

4. In a refrigerating apparatus, the combination with an upright compressor, and its driving mechanism located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compres-

sor and extending downward to inclose the driving mechanism and a cooling chamber surrounding the condensing chamber, and means to direct a cooling medium through said cooling chamber.

5. In a refrigerating apparatus, the combination with an upright compressor, and its connecting rod, crank, and crank shaft located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and extending downward to inclose the connecting rod, crank, and adjacent end of the crank shaft and a cooling chamber surrounding the condensing chamber, a tubular connection between the bottom part of the condensing chamber and the stuffing box of the crank shaft, and means to direct a cooling medium through said cooling chamber.

6. In a refrigerating apparatus, the combination with an upright compressor, and its driving mechanism located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and extending downward to inclose the driving mechanism and a cooling chamber surrounding the condensing chamber, said condensing chamber having at its bottom a mass of filtering material, a pipe for withdrawing the refrigerant from the condensing chamber and having its inlet end surrounded by said mass of filtering material, and means to direct a cooling medium through said cooling chamber.

7. In a refrigerating apparatus, the combination with an upright compressor, and its driving mechanism located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and extending downward to inclose the driving mechanism and a cooling chamber surrounding the condensing chamber, said condensing chamber being divided at its bottom into two sections, one of said sections being filled with filtering material, a pipe for withdrawing the refrigerant from the condensing chamber and having its inlet end surrounded by said mass of filtering material, and means to direct a cooling medium through said cooling chamber.

8. In a refrigerating apparatus, the combination with an upright compressor, and its driving mechanism located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and extending downward to inclose the driving mechanism and a cooling chamber surrounding the condensing chamber, said condensing chamber having at its bottom a mass of filtering material, a pipe for withdrawing the refrigerant from the condensing chamber and having its inlet end surrounded by said mass of filtering material, a condensing coil connected with the condensing chamber and with the pipe for withdrawing the refrigerant, and means to direct a cooling medium through said cooling chamber.

9. In a refrigerating apparatus, the combination with a compressor, of a condenser adapted to receive the refrigerant from the compressor, and a suction pipe connected with the compressor and having a superheating chamber located within the condensing chamber of the compressor.

10. In a refrigerating apparatus, the combination with an upright compressor, and its driving mechanism located below the same, of a casing inclosing said compressor and providing a condensing chamber between its wall and the wall of the compressor and extending downward to inclose the driving mechanism and a cooling chamber surrounding the condensing chamber, the lower portion of said casing forming a chamber for a refrigerant and greasing material, and means to direct a cooling medium through said cooling chamber.

11. In a refrigerating apparatus, the combination of a compressor having relatively movable parts contacting with each other, a vapor condenser, a casing for said compressor and having as a part thereof a liquid container in communication with said condenser, a body of commingled liquid refrigerant and lubricant in said container and subjected to the compressed vapor pressure, said liquid being agitated by and acting as a lubricant for said movable parts, and means within the casing for separating the refrigerant from the lubricant prior to the discharge of the refrigerant from the casing.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

LUDWIG HORST.

Witnesses:
ERNEST H. L. MUMMENHOFF,
IDA CHRIST HAFERMANN.