

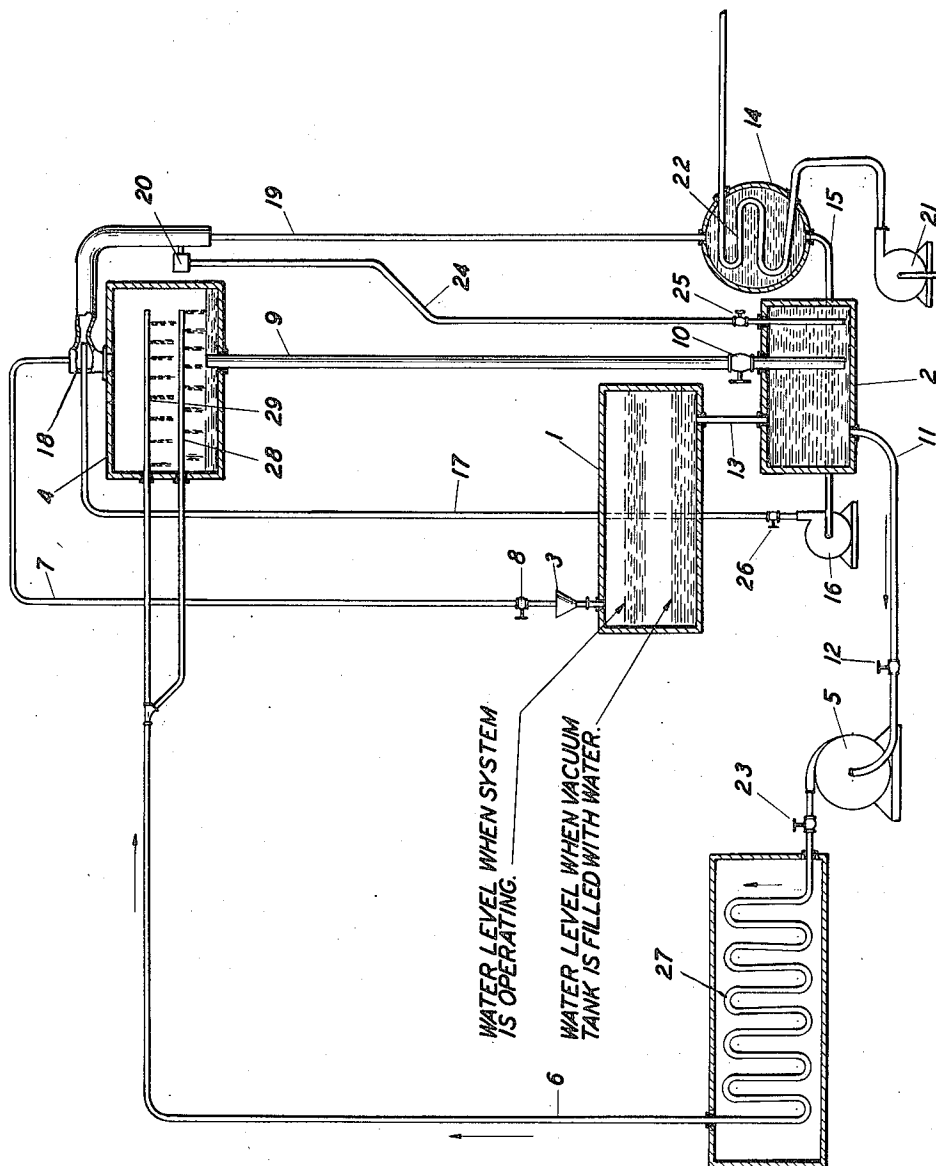
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REFRIGERATING SYSTEM

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REFRIGERATING SYSTEM

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My invention relates to refrigerating systems of the vacuum type and more particularly to a system in which the vacuum is created in a sealed system in which the vacuum tank is located at a height corresponding to at least the absolute vacuum required for the fluid used. The system might correctly be described as a gravity vacuum producing refrigeration system.

Primarily the vacuum is created by filling the tank previously mentioned with water until it overflows and as a consequence entirely dispels all of the air in it. The water is then permitted to flow by gravity from this tank through a system of pipes and valves to a plurality of other tanks which are located at a lower level so that the water will flow from the upper or vacuum tank by gravity into the lower tanks.

The lowest of these tanks is suitably connected to the intake of a circulating pump, the outlet pipe of which leads to the top or vacuum tank. The top of the vacuum tank is provided with a suitable overflow pipe which discharges into an intermediate tank so that when the water is pumped from the lowest tank into the vacuum tank it will overflow and pass through the pipe connected adjacent its top. A suitable air valve is mounted on this pipe adjacent this discharge for the escape of the air.

The interior of the vacuum tank is also connected by means of a vertical stand pipe to the lowest tank. This stand pipe is provided with a suitable valve which is closed at the time that the pump is started.

After filling the system in the manner described, the pump is stopped and the air valve is closed, then the valve in the stand pipe is opened and the liquid, if water, will flow by gravity through the stand pipe into the lowest tank. This tank is connected to the intermediate tank by a very small pipe and the water will continue to flow up into the intermediate tank until the level of the water in the stand pipe will be at a height above the level of the water in the intermediate tank which corresponds to the atmospheric pressure.

If we assume that the entire system is tight it will be obvious to persons skilled in the art that practically all of the air will be eliminated from the vacuum tank and a substantially complete vacuum will be created in the system. If the circulating pump is again started the water will be drawn from the lowest tank and pumped into the vacuum tank where it is discharged in the form of spray.

Owing to the vacuum created as above de-

scribed, this spray will boil and give off a vapor as will also the water contained in the vacuum tank. This vapor remains in the tank until it is, as hereinafter described, drawn out by an ejector.

A second circulating pump designed to deliver water at high pressure and velocity, is provided to draw water from the condenser. This pump has its outlet or discharge connected to a pipe which leads to the interior of the ejector chamber at the top of the vacuum tank. The water from this second circulating pump is discharged at a high velocity through a nozzle located in the ejector chamber. This has the effect of drawing the vapors in the vacuum tank with it through the ejector chamber. As the combined water and vapor is impinged upon the walls of the ejector chamber, from that point and down to the water level in the pipe, it has the effect of creating a higher pressure which produces condensation of the vapor which is at a lower temperature. This raises the level of the water in the pipe to the extent of the condensed vapor and the excess water escapes through a trap provided for that purpose, the trap being connected to the lowest tank, thus maintaining a constant water level in the pipe.

In this manner I am able to obtain a very satisfactory refrigeration system with a maximum efficiency and a minimum of actuating parts.

In the drawing which accompanies this application and which is hereunto annexed and made a part thereof, I have illustrated a form of apparatus for the utilization of my improved method of refrigeration. It should, however, be understood that this drawing is more or less diagrammatic in form and not in any sense employed as a limitation upon the invention but merely for the purpose of furnishing an illustration of specific means whereby my system may be employed.

As shown in the drawing the apparatus for utilizing my improved system comprises an intermediate tank 1 which should be of sufficient size so that when the system is filled there will still be some water in it. This tank 1 is connected to a tank 2. A funnel 3 is provided for filling the tank 1 with water. The vacuum tank 4 is mounted above the tank 1. If water is to be used for refrigeration purposes, the water level in this tank 4 must not be less than 36 ft. in height above the water level in tank 1 when the system is in operation. A circulating pump 5 has its discharge outlet connected by means of a pipe 6 to the interior of the vacuum tank 4. Suitable valves 12 and 23 are mounted in this pipe adjacent the pump 5. The vacuum tank 4 is provided

with an overflow pipe 7 which leads to a point just above the funnel 3. The pipe 7 is provided with an air valve 8 adjacent its discharge, to permit the escape of air when the system is being filled.

The lowest tank 2 is connected by means of a stand pipe 9 to the vacuum tank 4. This pipe extends down into the tank 2 to a point adjacent its bottom wall and extends up into the vacuum tank 4 a sufficient distance to form a water chamber. It being well known that the more exposed surface there is of water the quicker it will vaporize. Therefore it is desirable to provide a considerable surface in the vacuum tank for this purpose, in addition to the vapor given off by the spraying of the water in the vacuum tank. By mounting the pipe 9 in the manner described, it will be apparent that I maintain a constant water level in the vacuum tank 4 at all times so that it will boil and give off the desired vapors. This stand pipe 9 is provided with a suitable valve 10 adjacent the lowest tank 2. The bottom of the tank 2 is connected by means of a pipe 11 to the intake side of the circulating pump 5. The tanks 1 and 2 are connected by means of a pipe 13. This pipe is preferably small in diameter and mounted at the top of the tank 2 and the bottom of the tank 1. The reason for this being that in this manner I confine the disturbed water to the lower tank, it being known that disturbed water more rapidly absorbs air than water which is at rest as it is in tank 1. Moreover air would have to not only pass through the water seal in tank 1, but it is apparent from an inspection of the drawing that only a minute portion of the air would pass through the connecting pipe 13. By thus sealing the system with water I am enabled to produce an almost perfect vacuum.

A condenser 14 is provided which is suitably connected by means of a pipe 15 to a circulating pump 16. The discharge side of this pump is connected by means of a pipe 17 which has a valve 26 therein. This pipe leads to the interior of an ejector 18 at the top of the vacuum tank 1, the vapor ejector is connected by means of a pipe 19 to the condenser 14. A trap 20 is provided in the pipe 19 adjacent its point of connection to the vapor ejector for the purpose of trapping off the excess water which will accumulate in the pipe 19 due to the condensation of the vapors when the pressure is raised by the vapors contacting the walls of the ejector. This trap 20 is connected by means of a suitable pipe 24 to the lowest tank 2. A valve 25 is mounted in the pipe 24 adjacent the tank 2. If desired a circulating pump 21 may be provided for the condenser and a cooling coil 22 may be mounted therein.

Operation

When it is desired to utilize the apparatus thus described for refrigerating purpose, the first thing to do is to open the valves 8, 10, 12, 23, 25, and 26. Water is then poured into the tank 1 through the filler funnel 3 until the intermediate tank 1 and the lowest tank 2 are filled with water. Valves 10 and 25 are then closed and pump 5 is started. This draws water from the tanks 1 and 2 and discharges it into the vacuum tank 4 until it is full of liquid as are all of the connecting pipes. The operation is continued until the water will overflow through the pipe 7 where it will be discharged into the filler funnel 3 until all of the air is out of the vacuum tank 4. Air valve 8 is then closed and the pump is stopped.

Valves 10 and 25 are then opened. This will permit the water in the vacuum tank 4 to run down through the stand pipe 9 into the tanks 1 and 2 until water in the stand pipe 9 will find a level at a height above the level in tank 1 which will correspond to the atmospheric pressure.

Pump 5 is then started again and it will draw the water from tank 2 through pipe 6 and will discharge it through cooling coils 27 and pipe 6 into the vacuum tank 4. The vacuum formed in tank 4 will cause the water discharged in the form of a spray to be to a large extent vaporized.

Pump 16 is then started, this draws the liquid from the condenser 14 through pipe 15 and discharges it at a high velocity through a nozzle at the end of pipe 17 into the ejector chamber. This serves to draw the vapors, produced by the boiling of the water in tank 4 as well as the spray from pipes 28 and 29, and pass it to pipe 19. In this passage the vapors will be condensed to a liquid due to the higher pressure caused by its being brought into contact with the walls of the ejector chamber. As the vapor from the tank 4 is condensed in the vapor ejector chamber, it will cause the level of the water in pipe 19 to rise to the extent of such condensation. All of the excess water will be drained off through pipe 24 into the lowest tank 2 by means of the trap 20.

It will be obvious to persons skilled in the art that while the system is operating, a condensing medium must be circulated through the condenser 14 to carry off the heat absorbed by the liquid from the vapor in the vacuum tank. This may be done by any suitable means. As illustrated I show a condenser circulating pump 21 connected to a coil located in the condenser 14. It will be apparent from the foregoing description that I have provided a method whereby certain long established physical laws may be utilized in the production of a refrigeration system without the complications so frequently found in systems for this purpose. Although I have referred to water as constituting the medium employed in the system, it will be obvious that my invention is not confined to the use of that fluid and I may find it desirable to use other liquids, hydrocarbon, alcohol, ethers, etc. which may be more suitable where it is desired to obtain a lower temperature.

Having described my invention what I regard as new and desire to secure by Letters Patent is:

1. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said overflow pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity through a nozzle into said vapor ejector chamber causing it to contact the walls thereby raising the pressure and condensing the vapor, pipe connections connecting said vapor chamber to a condensing chamber which is connected to said circulating means.

2. In a refrigeration system, a fluid supply,

three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, a pipe of smaller diameter to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank, a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air escape valve in said overflow pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity into said vapor ejector chamber thereby increasing the pressure and condensing the vapor, pipe connections connecting said vapor ejector chamber to a condensing chamber which is connected to said circulating means.

3. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said overflow pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity into said vapor ejector chamber thereby raising the pressure and condensing the vapor, pipe connections connecting said vapor ejector chamber to a condensing chamber which is connected to said circulating means.

4. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity into said vapor ejector chamber thereby causing it to contact the walls of said ejector chamber and condensing the vapor, pipe connections connecting said vapor ejector chamber to a condensing chamber which is connected to said circulating means, and means to permit the excess condensed fluid to pass to the lowest tank, a valve in said means.

5. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a

point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, an ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity into said ejector chamber thereby raising the pressure and condensing the vapor, pipe connections connecting said ejector chamber to a condensing chamber which is connected to said circulating means, a trap connected to said last named pipe, a pipe to connect said trap to the lowest tank and a valve in said pipe.

6. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, located at a height corresponding at least to the absolute vacuum required, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said pipe, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity and pressure into said vapor ejector chamber thereby condensing the vapor, pipe connections connecting said vapor chamber to a condensing chamber which is connected to said circulating means, a trap connected to said last named pipe, a pipe to connect said trap to the lowest tank and a valve in said pipe.

7. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, an intermediate tank, and a lower tank respectively, means to connect said lower tank to said intermediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said pipe adjacent its outlet, a circulating pump, the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank, circulating means to discharge a fluid at a high velocity into said ejector chamber thereby condensing the vapor, pipe connections connecting said ejector chamber to a condensing chamber which is connected to said circulating means, a trap connected to said last named pipe, a pipe to connect said trap to the lowest tank and a valve in said pipe, cooling coils in said condensing chamber and means to circulate a cooling fluid through said coils.

8. In a refrigeration system, a fluid supply, three tanks in spaced vertical relation being, a vacuum tank, located at a height which will permit the level of the fluid to be not less than 36 ft. above the level of the fluid in the intermediate tank when the system is in operation, an intermediate tank, and a lower tank, respectively, means to connect said lower tank to said inter-

mediate tank, a stand pipe which connects said vacuum tank to said lower tank, said pipe extending into said vacuum tank a short distance and into the lower tank to a point adjacent its bottom, a valve in said stand pipe, an overflow pipe leading from said vacuum tank to said intermediate tank, an air valve in said pipe adjacent its discharge, a circulating pump the inlet side of which is connected to said lower tank, connections to discharge the fluid employed into the vacuum tank in a spray, a vapor ejector chamber at the top of said vacuum tank,

circulating means to discharge a fluid at a high velocity into said ejector chamber thereby drawing the vapor from said vacuum tank and contacting it with the walls of said ejector which raises the pressure of the fluid thereby condensing it, pipe connections connecting said ejector chamber to a condensing chamber which is connected to said circulating means, a trap connected to said last named pipe, a pipe to connect said trap to the lowest tank and a valve in said pipe.

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