July 12, 1938. J. KIRGAN 2,123,735

REFRIGERATING APPARATUS

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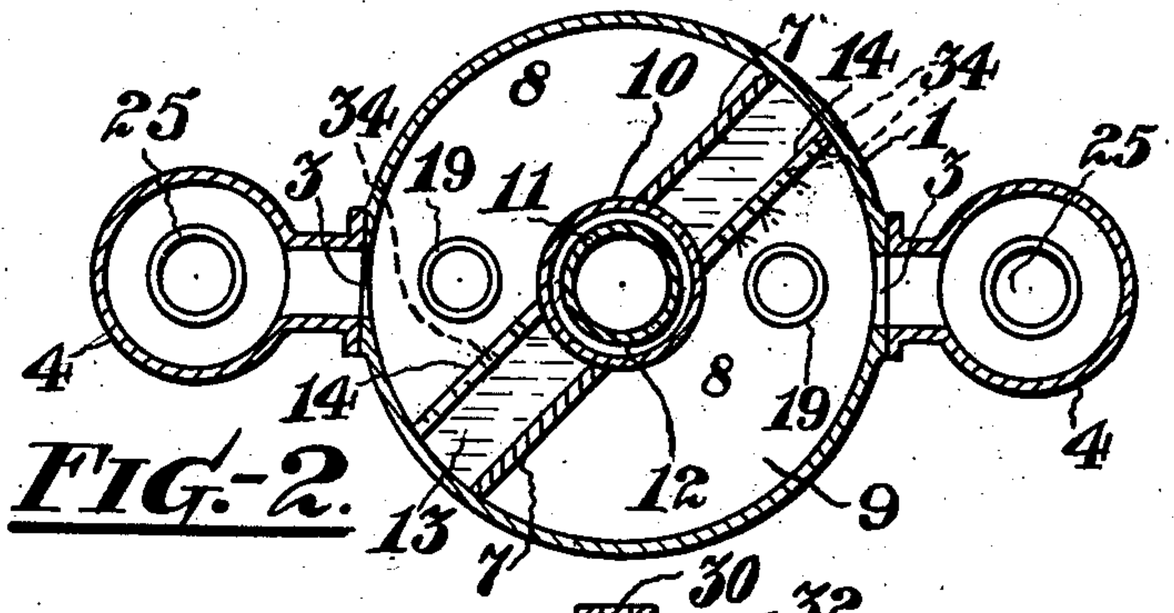

FIG.-2.

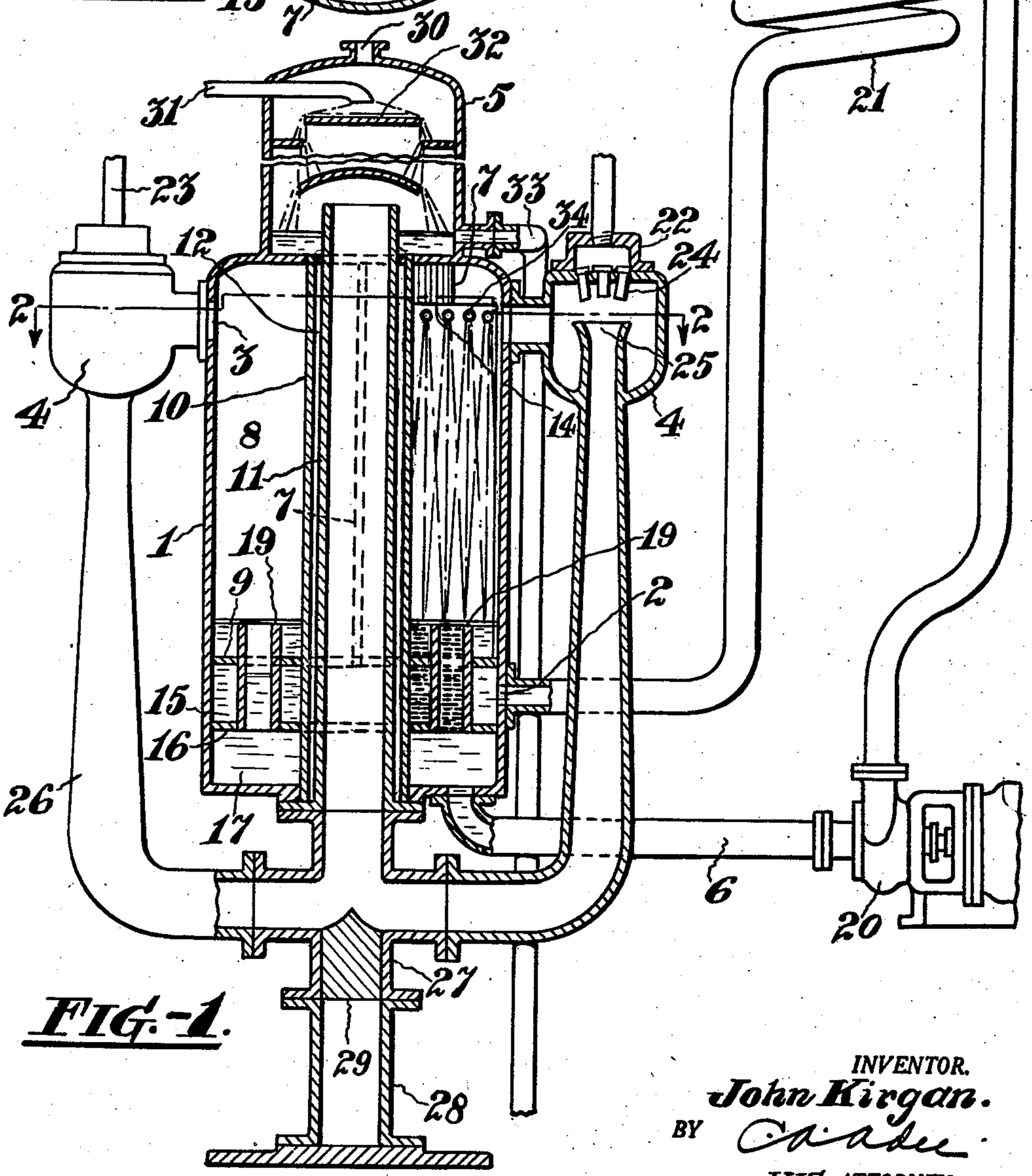

FIG.-1.

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REFRIGERATING APPARATUS

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10 Claims. (Cl. 62—115)

My invention relates to refrigerating apparatus, and especially to refrigerating apparatus comprising a vessel in which a liquid refrigerant is cooled by vaporizing part thereof and evacuator means of the thermo-compressor type to remove from said vessel the vapor so formed and transfer it to a suitable condenser.

An object of the invention is to provide refrigerating apparatus of this kind that is compact in design to enable space to be saved both horizontally and vertically wherever it is installed. It is also an object to provide refrigerating apparatus having an evaporator vessel and a condenser disposed one above the other, with the evacuator means so connecting said parts as to reduce the size of the whole to a minimum. In the preferred construction the condenser is at the top, and the evacuator means couples the condenser to the upper part of the evaporator where the vapor is created; and, without adding to the total height, still has the requisite length for efficient operation.

Another object is to provide refrigerating apparatus having evacuator means arranged to carry off vapor from the evaporator through a discharge flue that passes through the evaporator, but is insulated therefrom, to prevent transference of heat thereto.

An additional object is to provide in a refrigerating apparatus built as set forth above with a central flue to deliver the vapor to the condenser, an evaporator containing multiple chambers and simple means for controlling the inflow and outflow of the refrigerant to permit easy and quick adjustment for full load or part load output.

A further object of the invention is to provide refrigerating apparatus which is easily assembled and the various parts whereof are so disposed that the entire unit is strong and rigid and braced by the various members constituting same.

With these and other objects and advantages the invention consists in the arrangement illustrated in the drawing and pointed out in the appended claims; and though only a single form of the improvement is disclosed, I may of course make various changes in the embodiment set forth without departing from the principle of the invention, or exceeding its scope and spirit.

In the drawing Figure 1 is a vertical sectional view through the refrigerating apparatus according to this invention, and

Figure 2 is a horizontal section on the line 2—2 of Figure 1.

In the form shown in the drawing the numeral 1 indicates an evaporator vessel or tank to which the liquid refrigerant, such as water, to be cooled is admitted at the side near the lower end through an inlet port 2. In this vessel some of the refrigerant is vaporized and the vapor is withdrawn through one or more outlet ports 3 in the sides at the top by means of steam ejectors or evacuators 4. These ejectors create and maintain a vacuum of the desired degree in the evaporator 1 so that the formation of vapor is accomplished. The vapor withdrawn from the evaporator is transmitted to a condenser 5, which is above the evaporator, and liquefied, while the main body of the liquid which is cooled is drawn out through the bottom of the evaporator 1 by way of a conduit 6. The refrigerant entering the evaporator by way of the inlet 2 is at such temperature that part of it will be vaporized at once, the vacuum in the evacuator being maintained high enough for this purpose.

To enable the system to operate efficiently at less than full load the evaporator is divided by spaced vertical partitions 7 into a plurality of separate chambers 8. The lower extremities of these chambers 8 are determined by the false bottoms 9 located at the same level near the lower end of the evaporator, and the evaporator has a central sleeve 10 extending through it from top to bottom. A discharge pipe or flue 11 for the evacuators, passes up through this sleeve into the condenser 5. These evacuators are at no point higher than the top of the condenser, and they extend away from the condenser to provide sufficient length of discharge conduit 25 without increasing the overall height of the structure. The evacuators are connected to the flue 11 below the evaporator. This flue is somewhat smaller in diameter than the bore of the sleeve so that a space 12 lies between the two and this space may be an air space or be filled with insulation so that there is a minimum transfer of heat between the parts 10 and 11. Within the chambers 8 are vertical partitions 14 similar to the partitions 7 which are spaced around and extend from the sleeve 10 to the side wall of the evaporator 1. In the construction shown the partitions 7 extend from the bottom 9 to the top of the evaporator 1, whereas the partitions 14 extend from the bottom 9 but terminate short of the top of the evaporator tank. Hence, since for each partition 7 there is a corresponding partition 14, a pair of wells 13 are formed which are bounded by the partitions 7 and 14, the wall of the evaporator vessel

1, and the sleeve 16. The wells 13 are open at the bottom since each section of the false bottom 9 has the same general shape as the cross section of one of the chambers 8 and is secured to a partition 7 on one side and to a partition 14 on the opposite side. Just below the false bottoms 9 is a transverse compartment 15 which is normally full of water or other liquid refrigerant coming in through the inlet 2, this compartment being formed by the false bottoms 9 and a second false bottom 16 that is above the lower end of the evaporator and forms a compartment 17 which is drained by the outlet conduit 6. The wells 13 are in open communication through the open bottom thereof with chamber 15. Thus the wells 13 are supplied with liquid refrigerant from the chamber 15 which rises in the wells and flows over the tops of the partitions 14 to the chambers 8 where the refrigerant is cooled. The second bottom 16 is in the form of an annular ring and completely encircles the sleeve 18. Both bottoms are pierced by the tubular members 19 through which the chilled liquid is conveyed from the chambers 8 to the lower compartment 17. Of course if desired the partitions 14 may have openings 34 therein below the top edges thereof to divide the water entering the chambers 8 into a number of sprays or jets.

In operation when the evaporator receives a liquid refrigerant, such as water, through the inlet 2 the water will rise from the compartment 15 through the wells 13 and will flow over the upper edges of the partitions 14 and downward into the two chambers 8. Part of the water is vaporized and the vapor is drawn out through the outlets 3 while the remainder of the water remains liquid and is cooled, flowing out through the passages 19 into the compartment 17, and is drawn off by the pipe 6. The pump 20 causes the cooled water to circulate and forces it into a cooling coil 21 located at a place where a refrigerating effect is desired. The refrigerant in this cooling coil absorbs heat and after being warmed is returned through a connection from one end of this cooling coil to the inlet 2 and cooled over.

Each of the ejectors 4 comprises a steam chest 22 which receives steam through a pipe 23. At 24 are the steam nozzles which direct a jet of fluid into the mouths 25 of tubular casings 26 connected to the ejectors 4, these casings being L-shaped and communicating with the central flue 11 at their lower ends. By way of example, I show only two evacuators and two chambers, and use in this case a four-way fitting indicated at 27 beneath the evaporator 1, this fitting resting upon a tubular pedestal 28. One way through the fitting is connected to the conduit 11 and two more are joined to the lower end of each of the casings 26. The fourth way is sealed by a closure 29 so that steam and vapor in the casings 26 must pass upward through the conduit 11 into the condenser 5.

The ejectors 4 are secured to the sides of the evaporator by suitable flanges and other fastening means and the lower end of the conduit 11 may be flanged so as to enable the evaporator to rest thereon. The fitting 27 and the pedestal 28 are likewise flanged to enable the pipe 11, the casings 26 and this pedestal to be easily connected together. Of course more chambers and evacuators may be employed, and the fitting 27 will then have more than four ways through it. If necessary the member 27 may of course be provided with proper draining facilities (not shown) for the removal of any liquid which may collect therein or flow down the flue 11.

The condenser 5, preferably of the barometric type, has an opening 30 in its top to be connected to an evacuator for withdrawing air and non-condensible gases from the condenser and a cooling liquid is supplied to the interior of the condenser through a pipe 31. Within the condenser are deflector plates 32 which are staggered so that the water coming in through the pipe 31 is divided and the vapors entering the condenser from the conduit 11 are caused to mingle with the water and give the greatest liquefying effect. The water and liquefied steam are drained out from the condenser by pipe 33.

With this construction it will be seen that the apparatus is very compact and strong and the parts are disposed so that effective operation under varying working conditions is facilitated. If it be desired to run at part load, the steam for one of the ejectors 4 can be cut off by shutting a suitable valve (not shown) in the pipe 23. In the chamber 8 which is connected to a non-operating ejector the pressure will rise until it equals the pressure in the condenser, and the level of the refrigerant in the associated well 13 will then automatically sink so that it will no longer flow over the top of the partition therein. Also the pressure in that chamber will force down the level of the water in the passage through the member 19 thereof. The non-operating chamber, shown at the left in Figure 1, is thus sealed by the refrigerant in the compartment 17 and in its well 13, while the other chamber or chambers continue to refrigerate. Hence no valves except the valves for the steam pipes 23 are needed. At the same time the construction is very simple and can be assembled and set up or taken down merely by removing the bolts or other fastenings (not shown) which hold the evaporator 1, evacuators 4, casings 26 and the parts 27 and 28 together.

It will be seen that the warm refrigerant returning from the coil 21 to the wells 13, which it reaches by passing through the compartment 15, makes contact with the false bottoms 9 and 16 which are also in contact with the chilled water. Some heat is of course transferred through these bottom plates from the warmed returned water to the outflowing chilled water, but this transfer does not constitute a loss of refrigeration because any heat given to the chilled water by the return water reduces the quantity of heat which must be removed from the return water in the evaporator 1. Such heat as may be taken up by the chilled water is not enough to materially raise its temperature. To prevent other heat losses the barometric condenser 5 on top of the evaporator may be so mounted on the evaporator 1 that an air space (not shown) can be enclosed between the top of the evaporator and the bottom of the condenser; or the condenser may be separate and any suitable heat insulating material may be placed between the bottom thereof and the evaporator. In practice the top of the evaporator will always be filled with vapor caused by vaporization of the refrigerant, and even if the influence of the condenser heats this vapor slightly, it will not have any noticeable effect on the normal operation of the evaporator or to reduce the capacity of the steam jet boosters.

I claim:

1. Refrigerating apparatus comprising an evaporator tank, a condenser, evacuator means for the tank, and means forming an insulated

passage through the tank into the condenser, said evacuator means being connected to discharge into the condenser through the said passage.

2. Refrigerating apparatus comprising an evaporator vessel, a condenser vessel, one vessel supporting the other, an insulated discharge flue extending through the evaporator vessel into the condenser vessel, and evacuator means connecting the evaporator vessel to said flue.

3. Refrigerating apparatus comprising an evaporator tank, an insulated discharge flue extending through the tank, a fitting connected to one end of said flue, said fitting also supporting the tank, and ejector means connected to said fitting and to the tank to withdraw vapor from the tank and discharge same into said flue.

4. Refrigerating apparatus comprising a pedestal, a fitting on said pedestal and having a closure in line with the pedestal, an evaporator tank mounted on said fitting, a condenser above the evaporator tank, said evaporator having an insulated conduit extending through the tank, said conduit being connected to the fitting and extending into the condenser, and ejector means communicating with the evaporator tank and coupled to said fitting to discharge into said conduit.

5. Refrigerating apparatus comprising an evaporator tank having a condenser supported thereby, an insulated flue extending centrally through the tank into the condenser, upright spaced partitions in the tank at each side of said flue forming wells between them and dividing the tank into separate vaporization chambers, and means for discharging vapor from the chambers into the flue.

6. Refrigerating apparatus comprising an evaporator tank having a condenser supported thereby, an insulated flue extending centrally through the tank into the condenser, means in the tank forming inlet wells and dividing the tank into separate vaporization chambers, the tank having means forming two compartments one above the other near the bottom of the tank, the upper compartment communicating with said wells and having a connection to admit a liquid refrigerant to the compartment, and the lower compartment being connected with the chambers to enable unvaporized refrigerant to be withdrawn from the chambers, and means for discharging vapor from the chambers into the flue.

7. Refrigerating apparatus comprising an evaporator tank, a condenser supported by the tank, a discharge flue extending through the tank and into the condenser, means insulating the flue from the tank, and ejector means connecting the upper part of said evaporator with said flue to discharge vapor from the evaporator into said flue.

8. Refrigerating apparatus comprising an evaporator tank, a condenser superposed on the evaporator, a discharge flue extending through the tank and into the condenser, means insulating the flue from the tank, and ejector means connecting the upper part of the tank with said flue below the tank.

9. Refrigerating apparatus comprising an evaporator tank, a condenser superposed on the tank in axial alignment therewith, ejector means connected to the tank and extending away from said condenser, an insulated flue connected to receive the discharge of said ejector means and extending centrally through the tank to convey such discharge into said condenser, and means axially aligned with the tank, condenser and flue to support the same.

10. Refrigerating apparatus comprising an evaporator tank, a condenser, an insulated flue extending through the tank into the condenser, spaced partitions in the tank forming wells between them and dividing the tank into separate vaporization chambers, and means for discharging vapor from the chambers into the flue.

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