Dec. 19, 1939. J. KIRGAN 2,183,615

REFRIGERATING APPARATUS

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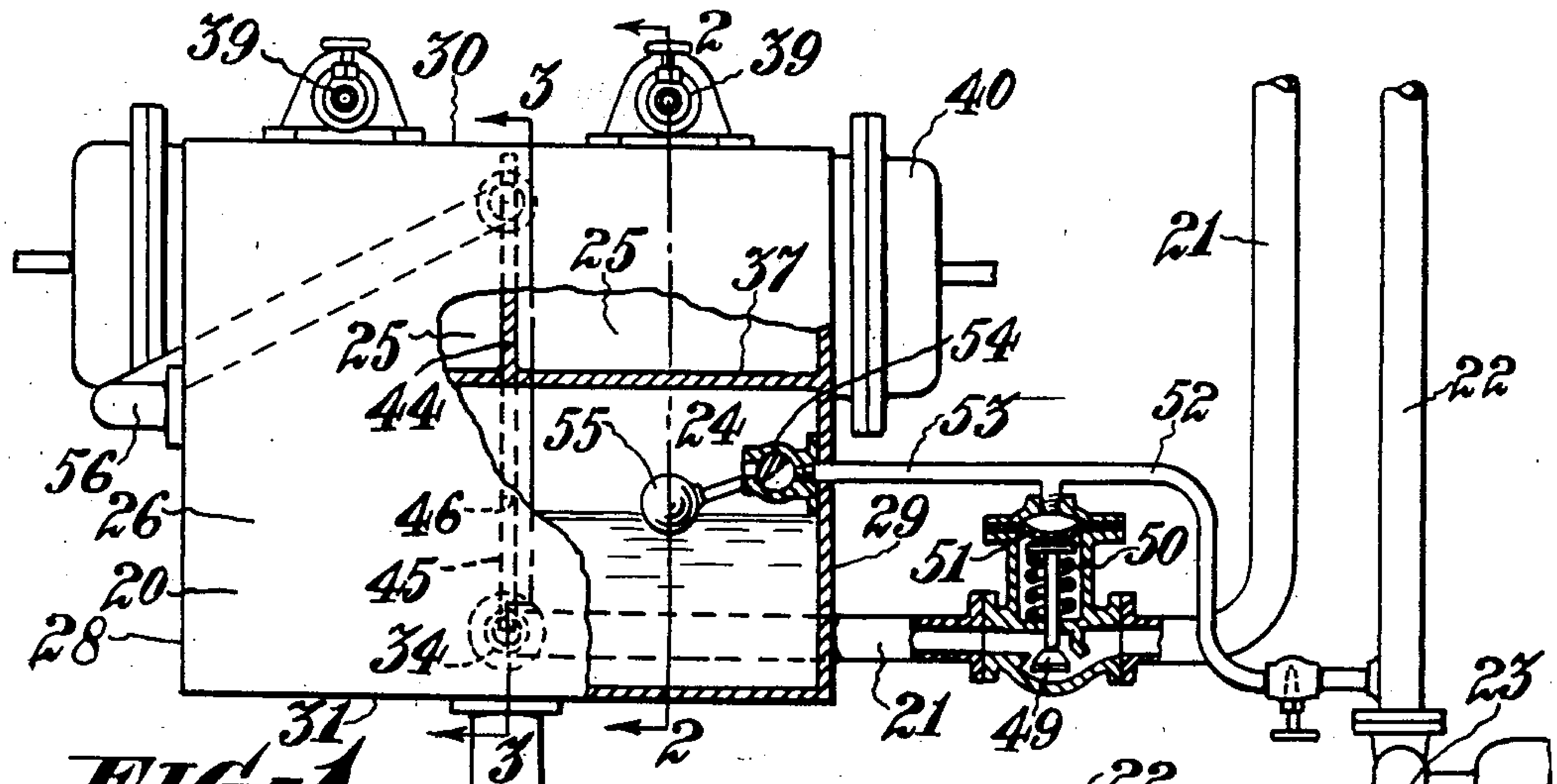

FIG.-1.

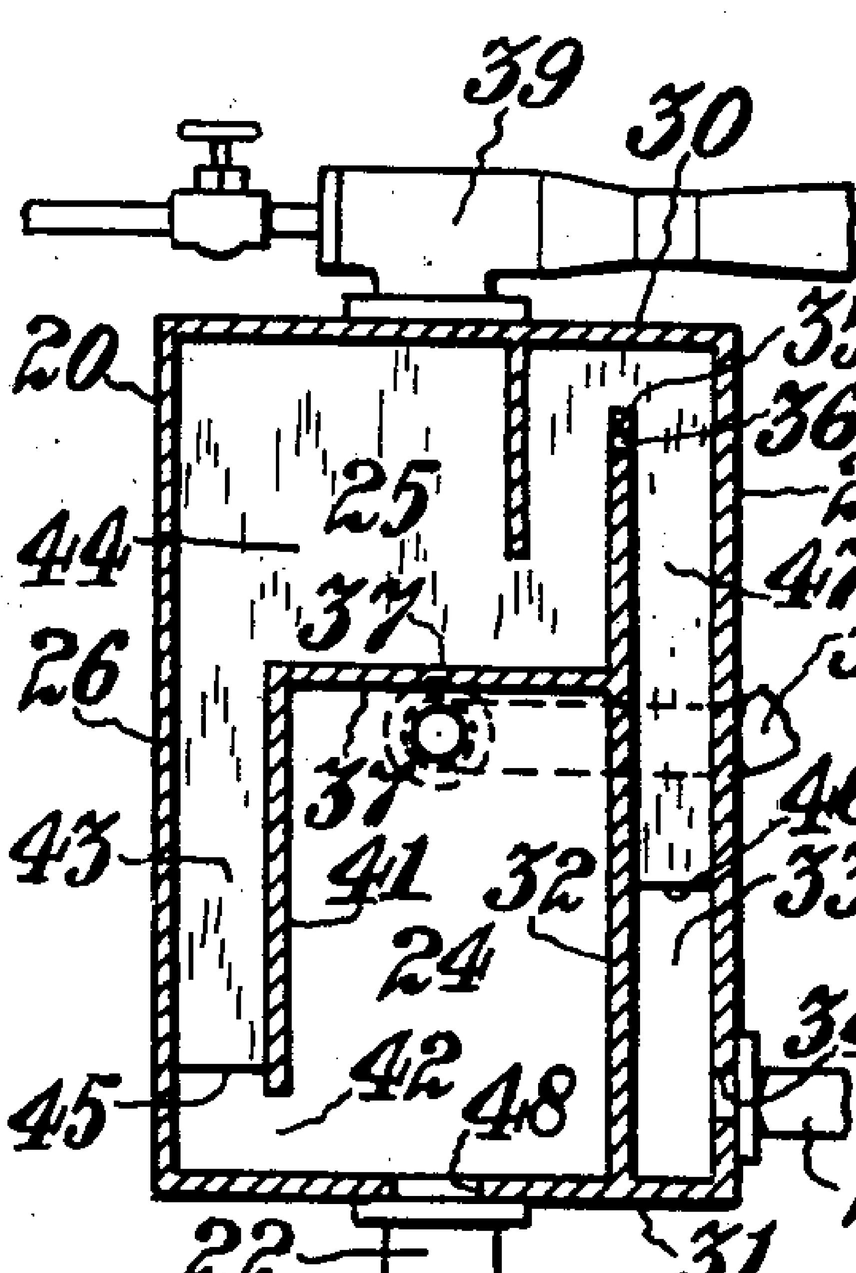

FIG.-3.

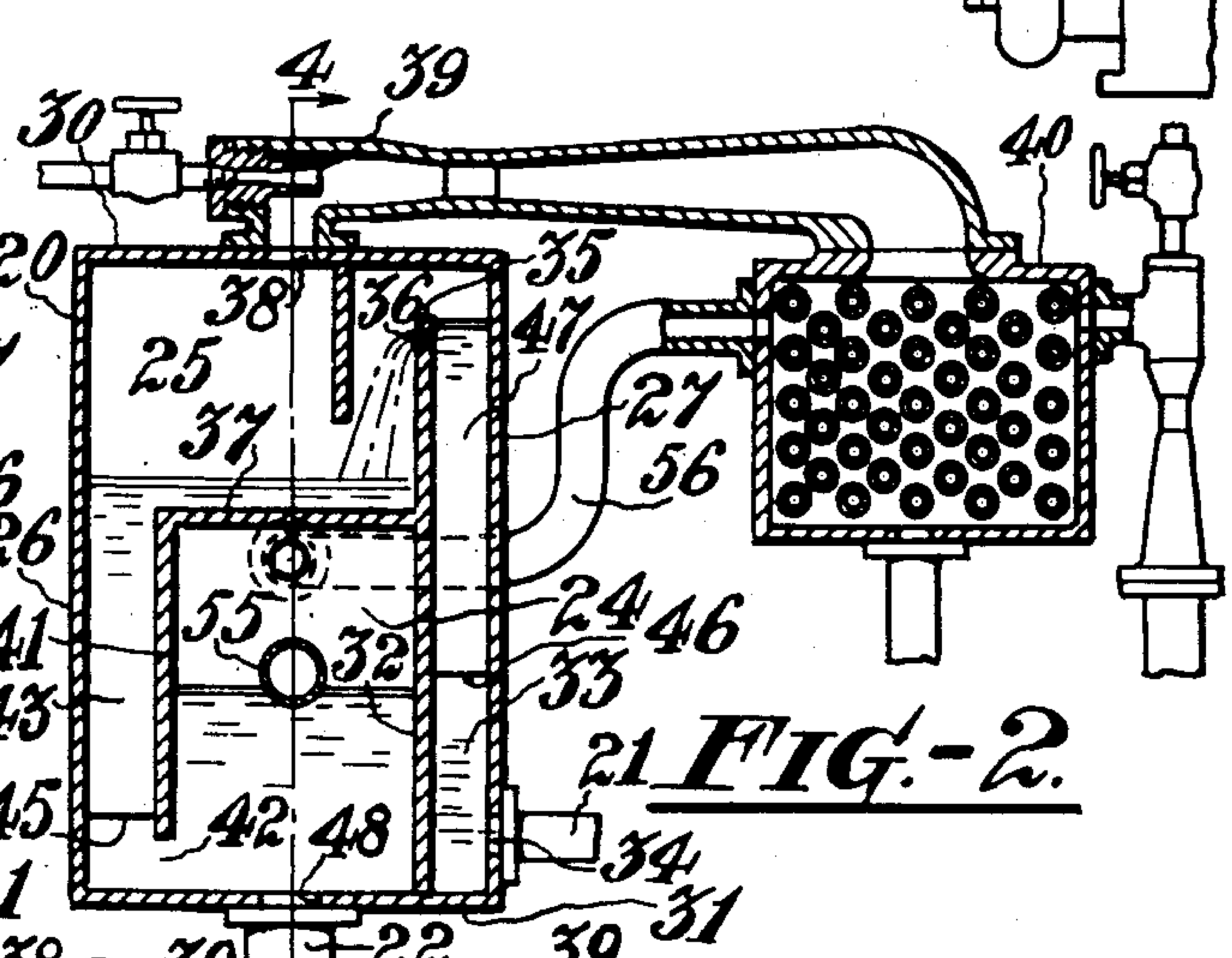

FIG.-2.

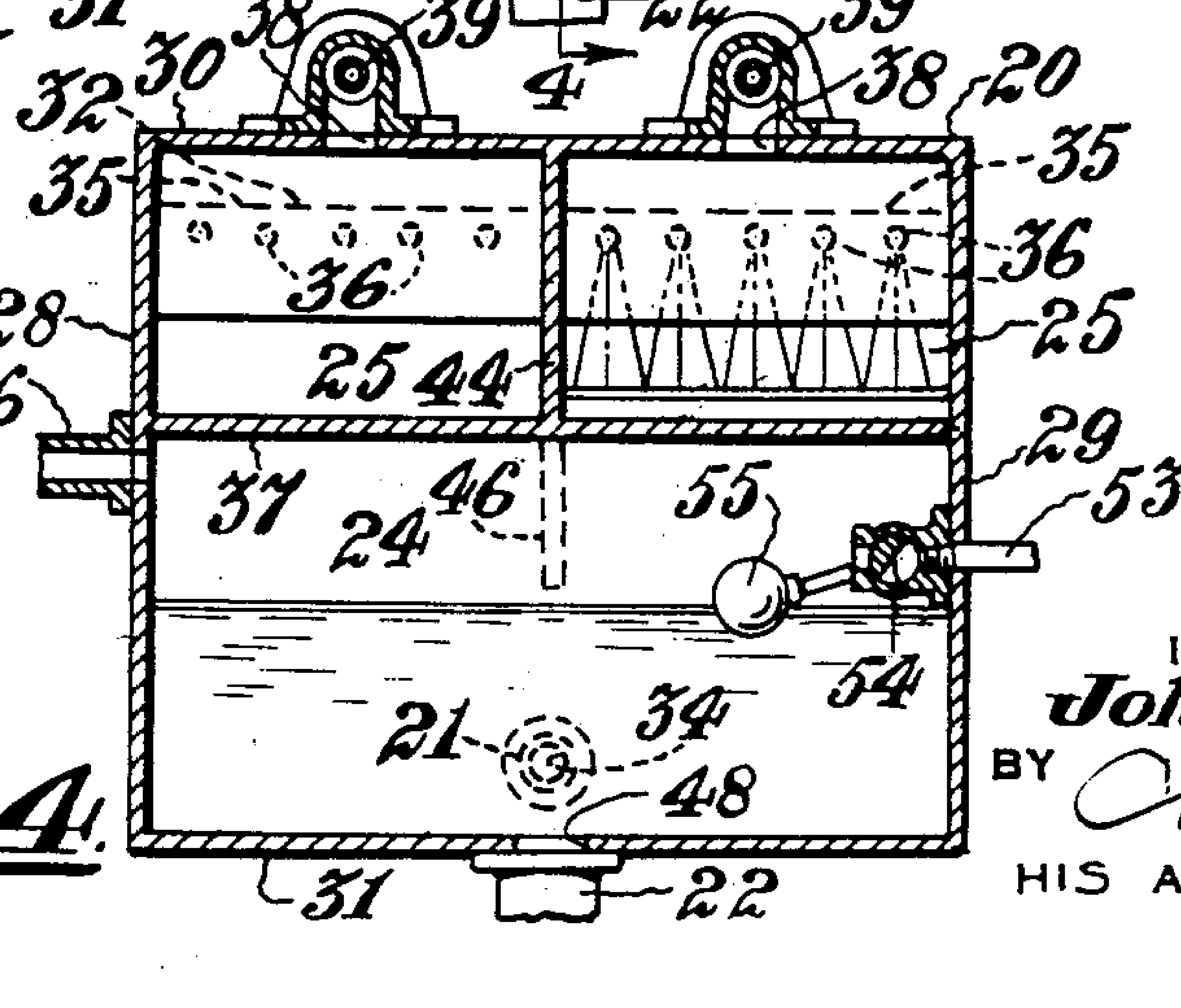

FIG.-4.

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REFRIGERATING APPARATUS

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4 Claims. (Cl. 62—2)

This invention relates to refrigerating apparatus, but more particularly to water-vapor refrigerating apparatus and the parts thereof through which the cold water flows from the evaporator to the circulating pump to be impelled to a place of use.

An object of the invention is to assure an adequate supply of liquid for the pump.

Another object is to reduce the frictional resistance of the passages leading to the pump.

A further object is to obviate erratic fluctuations in the flow of water through the evaporator to the pump.

Other objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawing in which like numerals denote the same parts,

Figure 1 is an elevation, partly in section, of refrigerating apparatus constructed in accordance with the practice of the invention,

Figure 2 is a sectional view of the apparatus taken through Figure 1 on the line **2—2**,

Figure 3 is a sectional view of the evaporator vessel taken through Figure 1 on the line **3—3**, and

Figure 4 is a sectional view of the evaporator vessel taken at right angles to Figure 3 and through Figure 2 on the line **4—4**.

Referring more particularly to Figures 1 and 2 of the drawing, **20** designates the evaporator vessel of a water-vapor refrigerating apparatus, and **21** and **22** its inlet and discharge conduits, respectively. At **23** is a motor-driven pump interposed in the discharge conduit **22**.

Only fragmentary portions of the inlet and discharge conduits are shown, for convenience of illustration, and it is to be understood that the discharge conduit **22** forms part of a refrigerant circuit including one or more units, such as air conditioners or the like, through which the passage of liquid may be controlled by suitable valves. The inlet conduit **21** may lead from any suitable source of liquid or may serve to return the warmed liquid from the air conditioners to the evaporator vessel **20**. It is also to be understood that the conduit system is of the "open type"; that is, at a point in its circuit from the pump **23** through the air conditioners and back to the vessel **20**, but preferably in the air conditioners or on the down stream side thereof, the liquid flowing in the conduits is exposed to atmospheric pressure.

In apparatus of this character the refrigerant liquid, which may be water, is discharged into the evaporator vessel and exposed to reduced pressure to be partially vaporized and cooled. The vapor is removed from the vessel **20** and the reduced pressure is maintained therein by suitable evacuators, shown as steam ejectors **39**, which discharge the vapor at somewhat increased pressure into a condenser **40**. The cold water is drawn off through the conduit **22**. Over a period of time, however, the requirements for the cold water may vary widely and some of the air conditioners may operate but intermittently. Obviously, when operating under these conditions, the output and capacity of the pump **23** vary over a considerable range and more or less in proportion to the number of units in operation. If, then one or more of the units is suddenly started or stopped, a severe change in the capacity of the pump occurs which, if not promptly compensated by a corresponding change in the flow of liquid to the evaporator vessel **20**, results in flooding or draining of the vessel, variations in the static head on the pump **23** and a general loss of pressure balance throughout the apparatus.

In order to overcome these undesirable effects, the present invention provides for an adequate supply of liquid for the pump, for an adequate control of the liquid flowing through the evaporator, and for a material reduction in the frictional resistance of the passages through the evaporator and leading to the pump.

In accordance with the practice of the invention, there is interposed in the discharge conduit **22** between the vaporization region of the evaporator vessel **20** and the pump **23**, a storage chamber or reservoir **24** through which all the cold water passes from the evaporator to the pump. This reservoir serves to store water in adequate amounts for temporarily supplying the needs of the pump **23** should its capacity increase and for temporarily absorbing excess water from the evaporator should the capacity of the pump decrease. The flow of liquid through the vessel **20** is preferably controlled by suitable means, more fully described hereinafter, in accordance with fluctuations in the level of the liquid in the reservoir **24**.

In the preferred construction, the evaporator vessel **20** houses one or more vaporization chambers **25** and the reservoir chamber **24**, and the chambers are so spaced and arranged that the passages to and from the chambers are large and the frictional resistance thereof is very low.

Referring more particularly to Figures 3 and 4 of the drawing, **26** and **27** designate opposite side walls of the vessel **20**, **28** and **29** designate opposite end walls thereof, and 30 and 31 designate its top and bottom walls, respectively.

A vertical partition 32 positioned between and parallel to the side walls 26 and 27, but nearest wall 27, extends upwardly from the bottom wall 31 to a point just below the top wall 30. This partition 32 cooperates with the end walls 28 and 29 and with the side wall 27 to define a compartment 33 into the bottom of which the inlet conduit 21 opens through a port 34 in the wall 27. The top of the partition 32 forms a weir 35 in each vaporization chamber 25 and may, if desired, have a series of openings 36 therein to deliver water in a more or less divided state from the compartment 33 into the chambers 25.

A horizontal partition 37 positioned between the top and bottom walls 30 and 31 is affixed to the partition 32 and the end walls 28 and 29 and extends from partition 32 toward but not quite to the side wall 26. The vaporization chambers 25 are in the region above this horizontal partition 37, and the partition serves as a shelf along which the water flows to be delivered to the reservoir chamber 24 which is beneath the partition. Ports 38 in the top wall 30 open from these chambers 25 into the vapor evacuators 39.

A vertical partition 41 depending from the end of partition 37 adjacent the side wall 26 is parallel to and spaced from wall 26, extends between end walls 28 and 29 and terminates short of the bottom wall 31 to define a space 43 and a passage 42 from the chambers 25 into the reservoir 24. The partitions 32, 37 and 41 and bottom wall 31 serve to define the reservoir chamber 24. The bottom of partition 41 is below the normal level of liquid in the reservoir 24.

Two vaporization chambers 25 are shown and these are separated by a vertical partition 44 positioned between and parallel to the end walls 28 and 29. The partition 44 extends between the side walls 26 and 27 from the top wall 30 to the partition 37 and adjacent walls 26 and 27 has two depending portions 45 and 46 of the same width as and projecting downward into the space 43 and compartment 33, respectively. These depending portions each terminate short of the bottom wall 31 and divide the space 43 into separate passages leading from each chamber 25 into the reservoir 24 and divide the upper part of compartment 33 into separate passages or inlet wells 47, one for each chamber 25. The liquid in these passages serves to seal one chamber from another and each of the passages is sufficiently deep that, when an ejector 39 is shut off to render a chamber 25 inactive, the pressure in the chamber may be increased at least to the discharge pressure of the vapor evacuators 39 without breaking these liquid seals.

An outlet 48 in the bottom wall 31 opens from the reservoir 24 into the conduit 22. The capacities of the passages 43 and reservoir 24 are large and the frictional resistance thereof is low. Furthermore the pump 23 may be placed directly adjacent the outlet 48 which materially reduces the friction of the pipe 22. The static head on the pump will, therefore, closely approach the actual submergence head thereon.

Referring again to Figures 1 and 2, the flow of liquid through the vessel 20 is arranged to be controlled in accordance with fluctuations in the level of the water in the reservoir 24. To this end, a pressure-responsive valve is interposed in the inlet conduit 21 and comprises a valve member 49 in a suitable casing, a spring 50 to urge the valve member 49 toward closed position, and a diaphragm 51 against which pressure is exerted to open the valve in opposition to the force of the spring 50. The source of pressure fluid for actuating the valve is preferably water discharged by the pump 23 and a pipe 52 leads from the conduit 22 at the discharge side of the pump to the valve for this purpose.

The pipe 52 has a branch 53 extending and opening into the reservoir chamber 24 preferably above the normal level of liquid therein, and within the chamber 24 is a valve 54 interposed in the branch pipe 53 for controlling the pressure of the liquid acting on the diaphragm 51. Connected to this valve 54 is a float 55 which rides on the surface of the liquid in the reservoir and actuates the valve 54.

Since all the chambers in the vessel 20 are in communication through the permanently open passages 43 and the chambers 25 are subjected to a very high vacuum, a means is provided for subjecting the reservoir chamber 24 to a somewhat higher pressure than the pressure in any vaporization chamber to enable liquid to fill the chamber 24 to the desired degree and to prevent further vaporization of the liquid in the reservoir 24. To this end the chamber 24 is vented by a pipe 56 to the condenser 40. The difference in pressure between a chamber 25 and the reservoir chamber 24 is manifested by the difference in liquid level therein and these levels are maintained more or less constant by the action of the float 55.

The operation of the apparatus is as follows: If it is first assumed that all the units supplied by the conduit 22 are in operation, liquid will course through the conduits 22 and 21 and chambers 25 and 24 in the normal manner, chambers 25 and 24 will be filled to normal operating levels, the liquid will be maintained at these levels by the action of the float 55 and valve 49, and the pump will operate at full capacity.

If then one or more of the units is stopped and liquid ceases to flow therethrough the output and capacity of the pump 23 will be reduced proportionately. This reduction occurs almost instantaneously and causes a reduction in the velocity of flow through the conduit 22 from the reservoir 24. The liquid in the conduit 21 being, however, under its own head, continues to flow momentarily at its original velocity and consequently attempts to fill the chambers in the vessel 20, raising the liquid levels therein. The float 55 rises, opens the valve 54 somewhat and relieves the pressure in the pipe 53 to cause the valve 49 to move toward closed position, thereby decelerating the flow of liquid to the vessel 20 to compensate for the change in the capacity of the pump 23.

The excess liquid which entered the vessel 20 during the brief interval required by the float 55 and valve 49 to decelerate the velocity of flow in the inlet conduit 21 is stored in the reservoir 24, but the large capacity thereof prevents any excessive change in liquid level or in the static head on the pump 23.

If the pump capacity increases, as when some of the units fed by the conduit 22 are started, the increased demand of the pump will be supplied momentarily from the reservoir 24, causing a lower liquid level therein and consequently an increased opening of the valve 49. The reservoir will continue to supply the needs of the pump during the brief interval required for the velocity of flow in the conduit 21 to accelerate to a value compensating for the change in pump capacity, but again the large capacity of the reservoir prevents any excessive change in liquid levels or in the static head on the pump.

Inasmuch as the reservoir 24 is interposed directly in the path of flow of the liquid from the chambers 25 to the pump 23, all of the cold or treated water must pass through the reservoir and directly act on the float 55 and be directly influenced by any change in the operating characteristic of the pump 23. Thus when any change in the capacity of the pump occurs, its entire effect is manifested by changes in the liquid level in the reservoir 24, but the large capacity of the reservoir obviates excessive fluctuations of the level therein, prevents sudden draining or flooding of the vessel 20 and enables the float 55 and the action of valve 49 to closely follow the variations in pump capacity.

I claim:

1. In refrigerating apparatus, an evaporator wherein liquid is treated, inlet means to admit liquid to the evaporator, a pump, conduit means for the treated liquid leading from the evaporator to the pump, means interposed in the conduit means and defining a reservoir in the path of liquid flow and through which all the treated liquid flows, pressure-responsive means actuated by liquid discharged by the pump to control the flow of liquid through the inlet means, and means acting responsively to variations in the level of the liquid in the reservoir to control the pressure of the liquid actuating said pressure-responsive means.

2. In refrigerating apparatus, a vessel having at least two evaporator chambers, inlet means to admit liquid to the evaporator chambers, means in said vessel defining a common reservoir to receive liquid flowing from each evaporator chamber, means to selectively render any evaporator chamber active, means to subject the reservoir to a pressure equivalent to the pressure of an inactive evaporator chamber to prevent removal of all liquid from an inactive evaporator chamber, means to control the inlet means in accordance with variations in the level of liquid in the reservoir, and outlet means for removing liquid from the reservoir.

3. In refrigerating apparatus, a vessel having at least two liquid vaporization chambers therein, a reservoir chamber in the vessel beneath and common to all the vaporization chambers, inlet means to admit liquid to the vaporization chambers, a vapor evacuator for each vaporization chamber to reduce the pressure therein, means to separately control actuation of each evacuator, open conduits for unvaporized liquid leading from each vaporization chamber and opening into the reservoir chamber below the normal level of liquid in the reservoir chamber, an outlet conduit for the reservoir chamber, a condenser to which the evacuators discharge, means to subject the reservoir chamber to the condenser pressure and to thus prevent all the liquid in a chamber whose evacuator has been rendered inactive from flowing out of the open conduit into the reservoir, and float and valve means for controlling the inlet means in accordance with variations in the level of liquid in the reservoir chamber.

4. In refrigerating apparatus, a vessel having a plurality of vaporization chambers in the upper part thereof and a reservoir chamber beneath the vaporization chambers, inlet means to admit liquid to the vaporization chambers, vapor evacuators for the vaporization chambers, a condenser to which the evacuators discharge, means extending into the reservoir chamber to convey all unvaporized liquid from the vaporization chambers into the reservoir chamber, an outlet conduit from the reservoir chamber, and a conduit connecting the condenser and common reservoir to subject the common reservoir to condenser pressure whereby a liquid seal may be maintained in said means extending into the reservoir chamber at all times.

JOHN KIRGAN.