Sept. 25, 1962 R. W. FINK 3,055,194

CIRCULATION APPARATUS FOR REFRIGERATION SYSTEM

Filed May 3, 1960 2 Sheets-Sheet 1

Fig. 1.

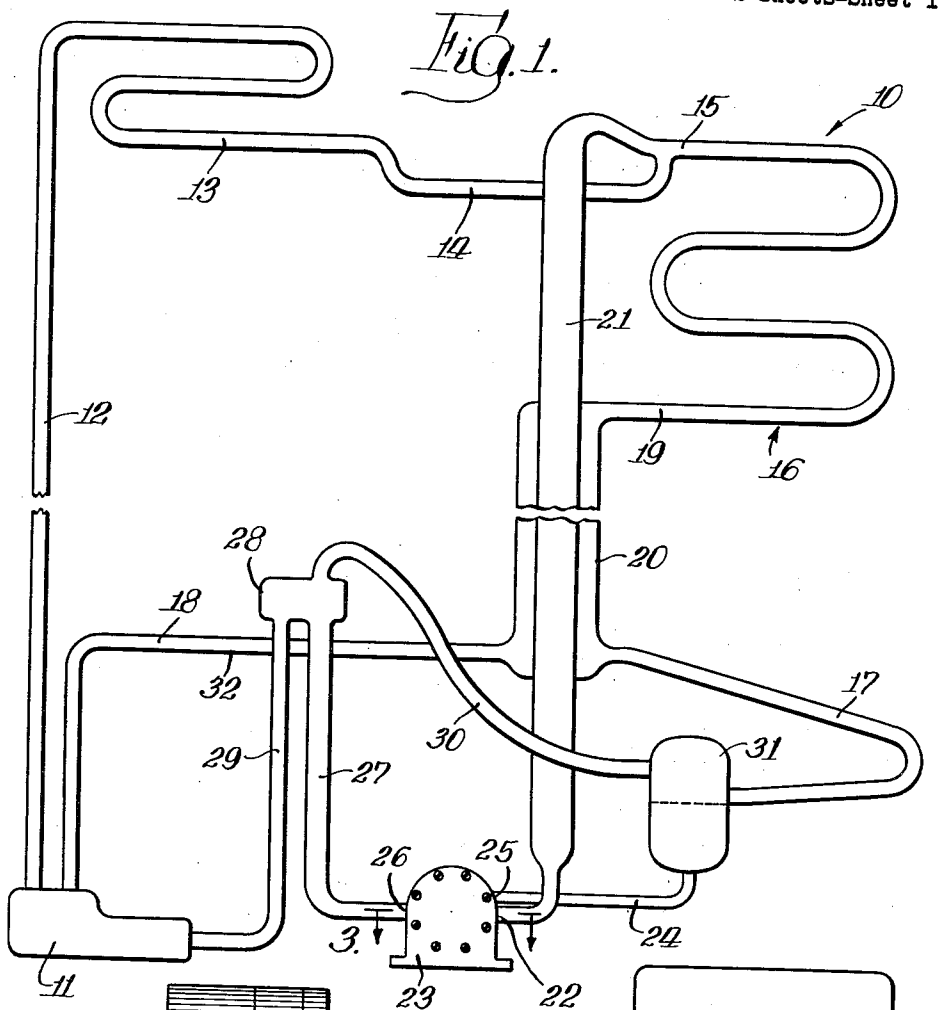
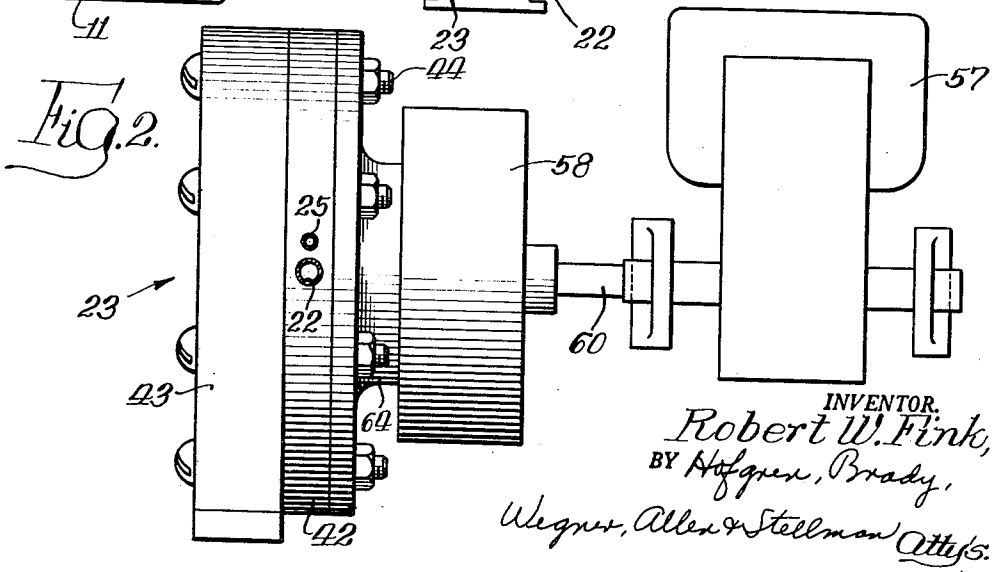


Fig. 2.



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Fig. 3.

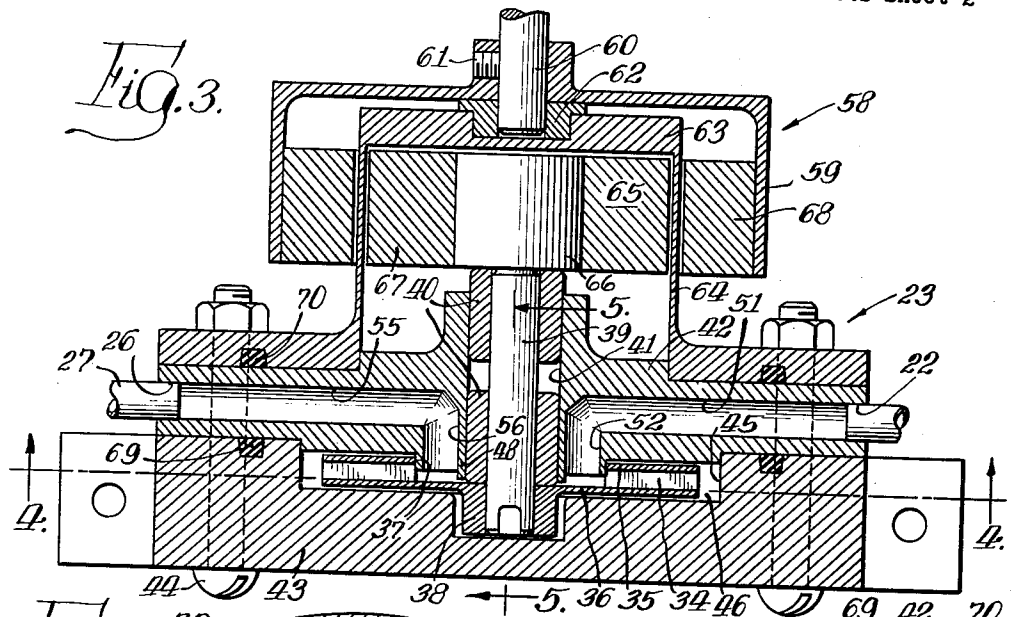


Fig. 4.

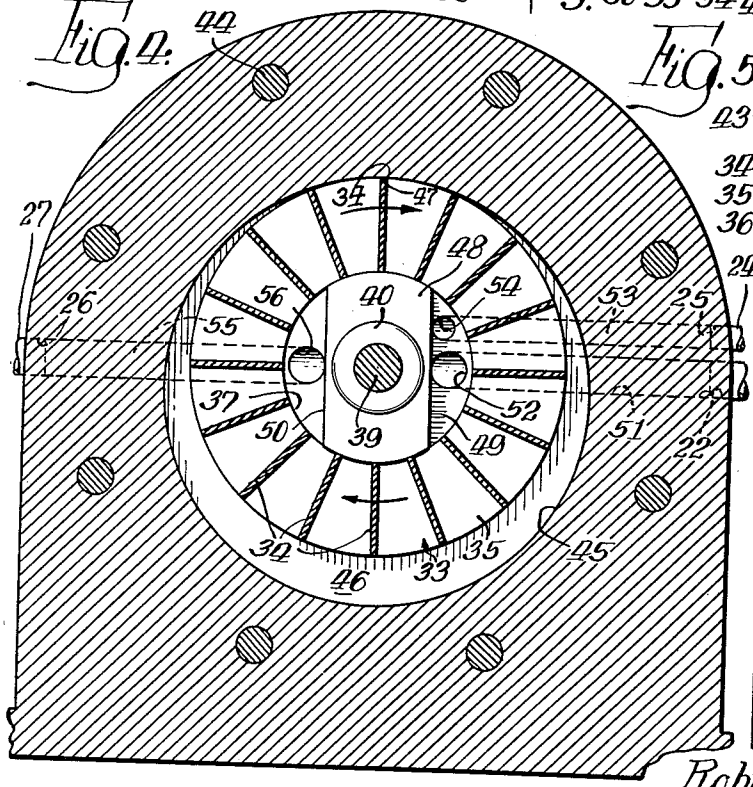
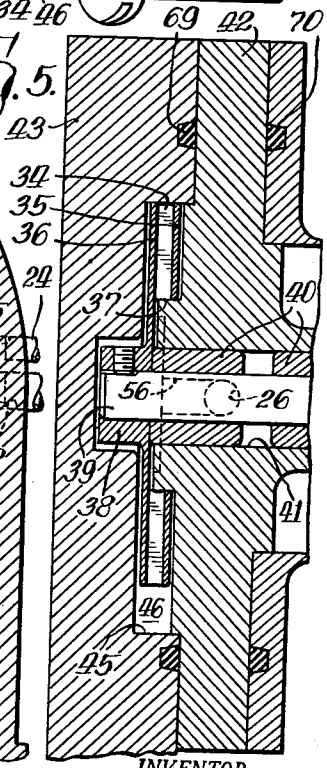


Fig. 5.



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CIRCULATION APPARATUS FOR REFRIGERATION SYSTEM

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This invention relates to refrigeration systems and in particular to pump means for circulating a liquid and a gas in an absorption refrigeration system.

In the conventional single pressure absorption refrigeration systems, fluids are circulated by means of the joint effect of heat applied to a generator thereof and gravity. As such circulation is impositive, the conduits and other components defining the flow passages of the system must be relatively large. The refrigeration capacity of the system is limited by the limited efficiency of the absorber with such impositive circulation therethrough. Further, as the gravity circulation requires asubstantial vertical head, disposition of low temperature chambers, such as freezer chambers, at the bottom of the refrigerator is effectively precluded. The required positioning of the absorber relative to the generator precludes disposition of these elements below the refrigerator to permit a substantial reduction in the height of the refrigerator cabinet. Still another problem encountered in such refrigeration systems where the refrigerant is impositively circulated is the tendency toward wide variation in operational characteristics of different refrigerators in the mass production thereof.

The present invention comprehends the provision of a novel pump means for use in a single pressure absorption refrigeration system eliminating the above-discussed disadvantages of the conventional systems. A principal feature, therefore, of the present invention is the provision of a new and improved pump for use in a refrigeration system.

Another feature of the invention is the provision of such a pump arranged for circulating concurrently a liquid and a gas in a refrigeration system.

A further feature of the invention is the provision of such a pump having an extremely simple and economical construction.

Still another feature is the provision of such a pump providing improved positive circulation of the fluids in such a refrigeration system.

A still further feature of the invention is the provision of such a pump providing improved desired mixing of a gas and a liquid in such a refrigeration system providing improved efficiency thereof.

Yet another feature is the provision of such a pump arranged for facilitated drive, requiring low power input, and being extremely quiet in operation.

Other features and advantages of the invention will be apparent from the following description, taken in connection with the accompanying drawing wherein:

FIGURE 1 is a schematic elevation of an absorption refrigeration system provided with a pump embodying the invention.

FIGURE 2 is a side elevation of the pump and drive motor.

FIGURE 3 is an enlarged horizontal section taken substantially along the line 3—3 of FIGURE 1.

FIGURE 4 is a vertical section taken substantially along the line 4—4 of FIGURE 3.

FIGURE 5 is a fragmentary vertical section taken substantially along the line 5—5 of FIGURE 3.

In the exemplary embodiment of the invention as disclosed in the drawing, a single pressure absorption refrigeration system generally designated 10 includes a generator 11 in which is heated by suitable means (not shown) rich liquid comprising a refrigerant, herein ammonia, and an absorbent, herein water. As the result of the heating of the rich liquid in the generator, the ammonia is vaporized and is delivered through a duct 12 to a condenser 13 wherein the ammonia vapor is cooled and resultingly condensed. The liquid ammonia is delivered from the condenser through a duct 14 to an upper portion 15 of an evaporator 16.

As a result of the vaporization of the ammonia from the rich liquid in generator 11, the rich liquid is converted to a weak liquid wherein a reduced amount of ammonia remains in solution in the water. This weak liquid is delivered to an absorber 17 from generator 11 through a conduit 18. Conduit 18 is in communication with the lower end 19 of evaporator 16 through a duct 20 which conducts an inert gas, herein hydrogen, from absorber 17 and conduit 18 to evaporator end 19. The countercurrent flow of the hydrogen upwardly through the evaporator 16 and the flow of liquid ammonia downwardly through evaporator 16 and the absorption of heat cause the ammonia to evaporate into the hydrogen atmosphere. The mixture of the ammonia and hydrogen gases, referred to as rich gas, is delivered from evaporator upper end 15 through a duct 21 extending coaxially through duct 20, to an inlet 22 of a new and improved pump 23. The lower end of the absorber 17 is connected through a duct 24 to a second inlet 25 of the pump to deliver rich liquid from the absorber to the pump. An outlet 26 of the pump is connected through a duct 27 to a separator tank 28 which is also connected to generator 11 by a duct 29. A duct 30 connects the top of separator tank 28 to the top of the pot 31 of absorber 17. Pump 23 concurrently pumps rich liquid from the absorber pot and rich gas from the evaporator to separator tank 28 from which the rich liquid is delivered through duct 29 and to generator 11 and the rich gas is delivered through duct 30 to the absorber pot 31. As best seen in FIGURE 1, the separator tank 28 is disposed above the level of the bottom 32 of the horizontally extending uppermost portion of duct 18 to assure the delivery of the rich liquid to the generator and the delivery of the weak liquid from the generator to the absorber.

Referring now more specifically to FIGURES 2 through 5, pump 23 may be seen to comprise an impeller 33 having a plurality of radial blades 34 secured in an annularly spaced configuration concentrically between a pair of parallel spaced circular plates 35 and 36. Plate 35 is provided with a central, circular opening 37 defining the inner radius of the annular spaced blade configuration and plate 36 is provided with an axial hub 38 for securing the impeller to a shaft 39 journalled in a pair of bearings 40 mounted in a cylindrical bore 41 extending axially through a pump housing body 42. A housing cover 43 is secured to body 42 by suitable means such as bolts 44 and is provided with a cylindrical recess 45 confronting body 42 and defining therewith an impeller chamber 46. As best seen in FIGURE 4, the radius of recess 45 is slightly

greater than the outer radius of the impeller 33 and the recess 45 is eccentrically related to the impeller so that at the uppermost point 47 of chamber 46 the impeller is substantially tangent to the wall of recess 45.

As best seen in FIGURE 4, body 42 is provided with a central, segmentally cylindrical projection 48 having a pair of opposed chordal surfaces 49 and 50. Inlet 22 is defined by a bore in body 42 having a first portion 51 extending radially inwardly through the body to adjacent bore 41, and a turned inner end portion 52 opening into chamber 46 horizontally of the axis of shaft 39 immediately adjacent surface 49 and slightly radially inwardly of the inner ends of the blades 34. Inlet 25 comprises a bore through body 42 including a first radially inwardly extending portion 53 and a turned end portion 54 opening into chamber 46 slightly above portion 52 of the inlet 22. Outlet 26 is defined by a bore through body 42 having a first radially extending portion 55 diametrically opposed to inlet bore portion 51 and having a turned inner end portion 56 opening into chamber 46 diametrically opposite inlet end portion 52. As best seen in FIGURE 4, projection 48 defines a barrier between the inlet bore ends 52 and 54 and the outlet bore end 56 requiring fluid entering chamber 46 through either of the inlets to pass radially outwardly to between the blades 34 to be carried therewith around the projection to the outlet.

Pump shaft 39 is rotated herein by an electric motor 57 acting through a coupling 58 including a housing 59 secured to one end of the shaft 60 of motor 57 by suitable means such as set screw 61. As best seen in FIGURE 3, the outboard end of shaft 60 is journalled in a bearing 62 carried by a housing extension 63 secured to housing body 42 by bolts 44 oppositely of cover 43. The housing extension includes a thin walled cylindrical portion 64 defining a cylindrical space 65 in which a radially enlarged end 66 of shaft 39 is disposed. A coupling rotor 67 is carried on shaft end 66 concentrically within housing extension portion 64 and is driven rotatively by a plurality of magnets 68 secured to housing 59 for annular movement circumjacent extension portion 64.

Cover 43 is sealed to housing body 42 by means of an annular seal ring 69 carried by the cover and urged into sealing engagement with the confronting surface of the body. Similarly, housing extension 63 is sealed to housing body 42 by an annular seal 70 carried by the extension and engaging the confronting surface of the body 42. Thus, the impeller chamber 46 and space 65 are hermetically sealed within the enclosure defined by the housing body, cover and extension.

The operation of pump 23 is as follows. When the pump is started, rich liquid remaining in the lower portion of chamber 46 is driven around the cylindrical wall of the recess 45 by the rotating blades 34. The centrifugal forces developed cause the rich liquid to form a ring adjacent the wall of recess 36 and outwardly bounding the spaces between the successive blades 34. Motor 57 herein rotates the impeller in a clockwise direction as seen in FIGURE 4 so that as the blades move from point 47, the volume between successive blades within the ring of rich fluid increases, reaching a maximum diametrically opposite the point 47. This increase in the free volume between the blades causes a suction pressure to develop therein drawing rich liquid from inlet 25 into the chamber 46 and rich gas from inlet 22 into chamber 46.

As the blades continue to move in a clockwise direction, i.e., back toward point 47 from the point diametrically opposite thereof, the free volume between the successive blades decreases thereby forcing both the rich liquid and the rich gas carried by the impeller outwardly through outlet 26.

In passing through the impeller, the rich liquid is dispersed in highly divided droplet form thereby facilitating the dissolving of the gas into the liquid, the resulting superabsorption of the rich gas in the liquid thereby increasing substantially the efficiency of the refrigeration system.

From outlet 26, the mixture is delivered to separator tank 28, wherein the rich liquid settles and becomes separated from the rich gas permitting delivery of the rich liquid to the generator and the rich gas to the absorber.

Thus, pump 23 provides a unitary pumping means for circulating both a liquid and a gas in a fluid system, herein the rich liquid and rich gas in an absorption refrigeration system. The novel construction of the pump provides an improved mixing of the liquid and gas whereby the fluids are forced to flow through the system at a controlled rate that is uniform under constant conditions in the system.

Having described my invention as related to the embodiment shown in the accompanying drawing, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. In a single pressure absorption refrigeration system having an absorber, an evaporator, and a generator, means for circulating concurrently rich liquid from the absorber to the generator and rich gas from the evaporator to the absorber, comprising: a pump including means defining a pump chamber, an impeller rotatable eccentrically in said chamber, means defining a first inlet for delivering rich liquid from the absorber to the suction side of the impeller in the chamber, and means defining a second inlet for delivering rich gas from the evaporator to the suction side of the impeller in the chamber, said pump being arranged to cause the rich liquid to be dispersed as droplets in the rich gas within said pump chamber; a tank above the liquid level of the absorber and generator, said pump further including means defining an outlet for delivering the rich liquid and rich gas conjointly from the pump chamber to said tank; and means for delivering the rich liquid from the tank to the generator and the rich gas from the tank to the absorber.

2. In a single pressure absorption refrigeration system having an absorber, an evaporator, and a generator, means for circulating concurrently rich liquid from the absorber to the generator and rich gas from the evaporator to the absorber, comprising: a pump for intimately mixing and pumping the resultant mixture of a gaseous fluid and a liquid fluid; means providing rich gas from the evaporator to said pump; means providing rich liquid from the absorber to said pump; and means conducting the resultant mixture of rich liquid and rich gas from the pump for delivery of the rich liquid to the generator.

3. The refrigeration system of claim 2 wherein said pump comprises: means defining a pump chamber; an impeller rotatable eccentrically in said chamber; means defining a first inlet for delivering liquid to the suction side of the impeller in the chamber; means defining a second inlet for delivering gas to the suction side of the impeller in the chamber; means for rotating the impeller at a substantial rate for causing the liquid and gas to be drawn into the chamber and the liquid to be dispersed as droplets in the gas; and means defining an outlet for discharging the resultant mixture of liquid and gas from the chamber.

4. The refrigeration system of claim 2 wherein said pump comprises: a hermetically sealed enclosure defining a cylindrical pump chamber and a rotor chamber; a shaft extending from said rotor chamber ecentrically into said pump chamber; an impeller secured axially to said shaft in said pump chamber to be peripherally substantially tangent to the chamber means at one point thereof; a rotor secured coaxially to said shaft in said rotor chamber; power means magnetically coupled through said enclosure to said rotor for driving the rotor and thereby

rotate the impeller; means defining a first inlet for delivering liquid to the chamber adjacent the center of the impeller at a position of the blades shortly after they pass said point; means defining a second inlet for delivering gas to the chamber adjacent the first inlet; and means defining an outlet for delivering liquid and gas conjointly from the chamber adjacent the center of the impeller and at a position of the blades shortly before they reach said point.

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