

May 8, 1928.

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1,668,771

FLUID OPERATED REFRIGERATING DEVICE

Filed March 9, 1925

2 Sheets-Sheet 1

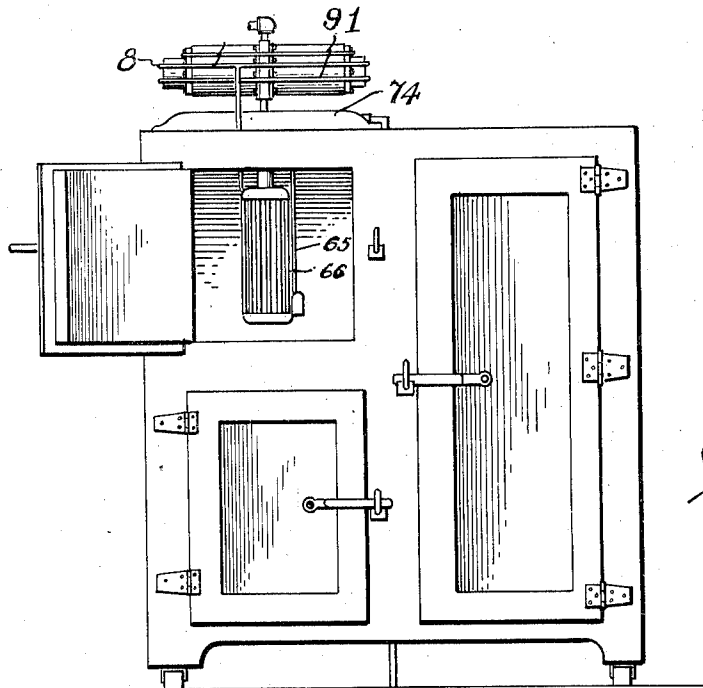


Fig. 1

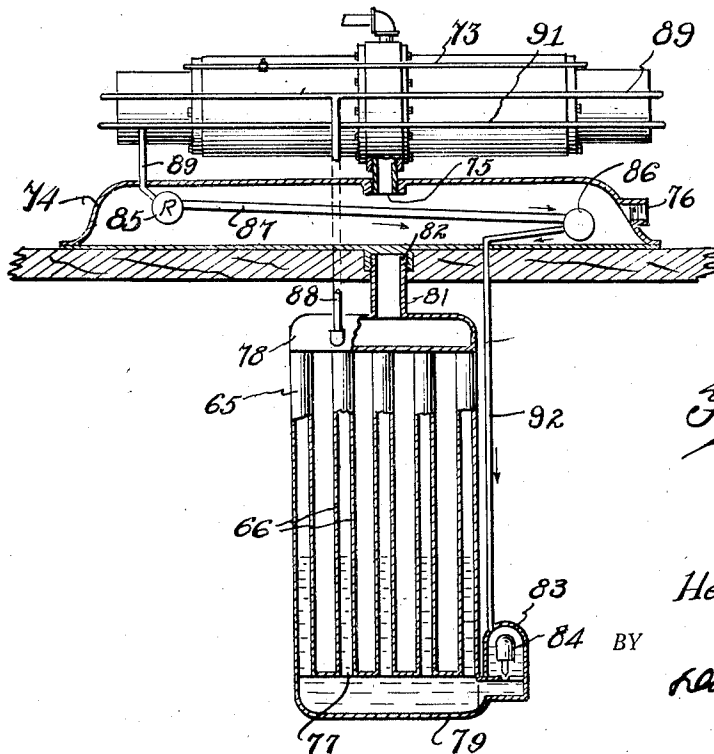


Fig. 2

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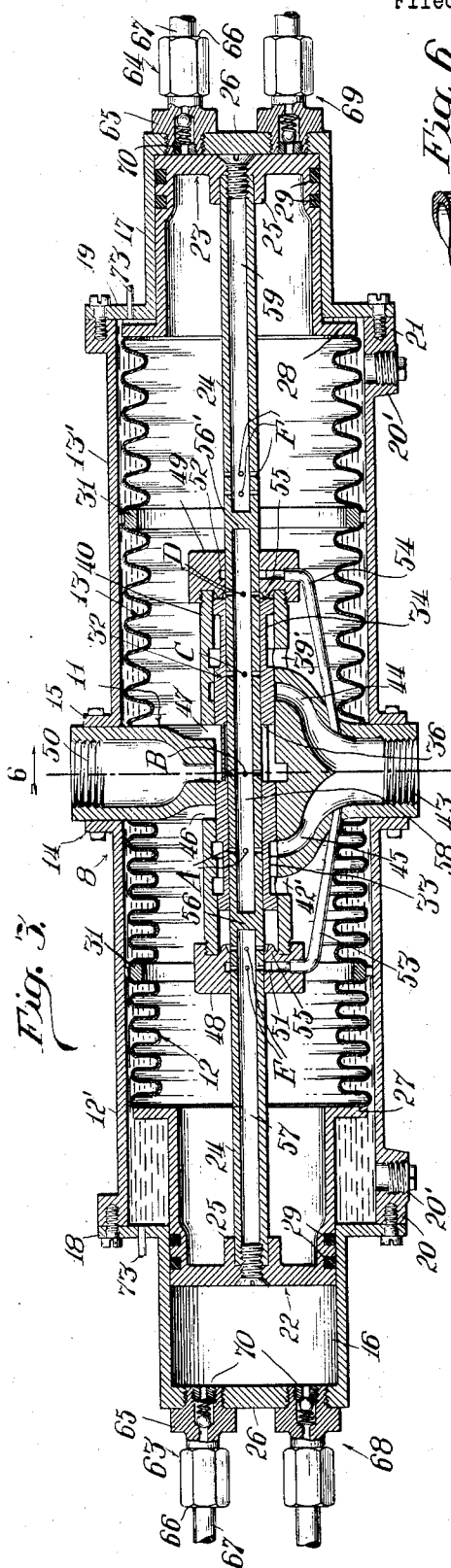
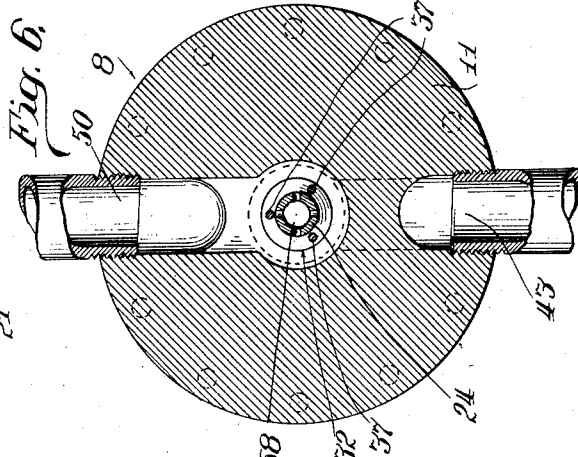
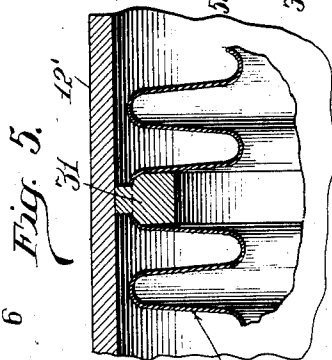
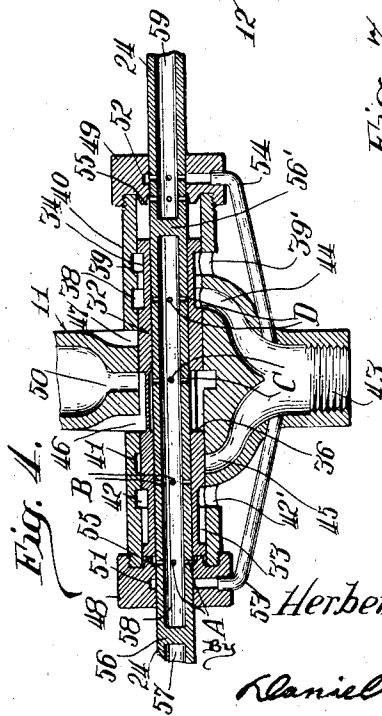
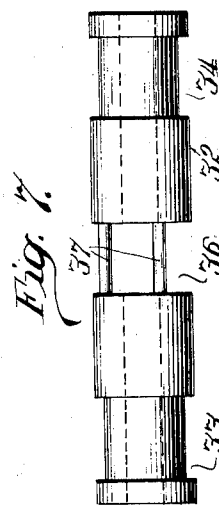
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FLUID OPERATED REFRIGERATING DEVICE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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FLUID-OPERATED REFRIGERATING DEVICE.

Application filed March 9, 1925. Serial No. 14,180.

The invention relates generally to improvements in fluid operated refrigerating devices adapted to be installed in ice boxes, for domestic and commercial purposes, and particularly to devices of this class operable from city water supply pressure.

An object of the invention is to construct a refrigerating device, that is self-contained, simple of manufacture and operation and is completely assembled and charged before leaving the factory and ready for easy installation in an ice box or the like, by any plumber or other artisan, without the aid of a specialist or expert skilled in the refrigerating art as is necessary in prior devices.

Another object of the invention is to construct a refrigerating device, in which means are provided to utilize running water to operate the compressor unit and also to utilize this water exhausting from the compressor unit as a cooling medium for the condenser unit, thereby effecting an economical method of refrigeration.

Another object of the invention is to construct a compact refrigerating machine, having a self-contained automatic double acting hydraulically operated and hermetically sealed compressor to eliminate separate motor and compressor units.

Another object of the invention is to provide a self-contained refrigerating device in which stuffing boxes are entirely eliminated, thus saving any loss of efficiency due to friction, or leaks, or time spent in adjusting the stuffing boxes.

Another object of the invention is to eliminate the leaking of the refrigerant out of the cooling system or the leakage of air into the system, either of which situations would result in a disabling of the machine if allowed to continue.

Another object of the invention is to construct a refrigerating machine having the motive power mechanism for operating the compressor unit within the machine, thus eliminating all external mechanical power transmitting connections, and reducing the number of working parts to a minimum.

These and other objects will become more apparent from the following description of a preferred embodiment of the invention. In the drawings accompanying this description:

Fig. 1 is a front view of the device of

the present invention shown installed in an ice box.

Fig. 2 is a side elevation of the compressor showing it mounted in place, with the cooling base, the condenser, a fragment of the ice box and evaporator shown partly in section.

Fig. 3 is a central longitudinal section in a vertical plane through the compressor and motor unit.

Fig. 4 is a detail section of the cylindrical slide valve, showing the ports in another position.

Fig. 5 is a longitudinal section showing a fragment of the flexible metallic bellows member, and shell wall and the guide ring.

Fig. 6 is a transverse section shown on an enlarged scale and taken on the line 6—6 of Fig. 3 and

Fig. 7 is a detail elevational view of the piston valve.

The entire refrigerating device comprises the compressor unit 8, the cooler or condenser 74 and the evaporator 65. Fig. 1 illustrates a typical installation with the compressor unit and condenser mounted on the top of the refrigerator and the evaporator supported inside the cooling chamber or the compartment which normally receives the ice.

Referring now to the construction of the compressor unit, the unit is constructed about a transverse dividing member or valve housing 11 (Fig. 6) to each end of which are secured water receiving cylindrical shells 12' and 13'. These shells are secured by bolts or the like extending through apertures in external flanges 14 and 15 formed preferably integral with the shells, and engaging in tapped holes in said valve housing 11.

Compressor cylinders 16 and 17 of a smaller diameter than the shells, are secured to the opposite ends of the shells 12 and 13 respectively, by cap screws or the like passing through apertures in external flanges 18 and 19 formed on the ends of said compressor cylinders and engaging in tapped holes in external flanges 20 and 21 on the water retaining shells 12 and 13. Tapped bosses 20' are provided on the bottom of each shell and carry a pipe plug to permit drawing of the oil.

The outer end of each of the compressor

cylinders is closed by a wall 26 preferably formed integrally therewith as shown, but a separate head may be provided if desired. In each of said walls or heads two tapped holes are provided, one to receive a gas inlet valve and the other to receive a gas outlet valve which will later be described.

A pair of pistons 22 and 23 are securely fixed to the opposite ends of a hollow piston rod 24 in any approved manner, but as here illustrated a boss 25 is formed on the rear side of each piston having a central bore concentric with the outer diameter of the piston to surround said piston rod. Each piston is held in place securely against axial displacement by a counter sunk machine screw extending through the end wall or head 26 of the piston and threading into said piston rod.

The two pistons 22 and 23 are each provided with external flanges 27 and 28 respectively and are also provided with piston rings 29 to prevent leakage of the gas into the water cylinders or oil compartments.

Confined between the two pistons 22-23 and the central valve housing 11 are annular bellows members 12 and 13, forming a flexible enclosing casing. Each bellows member has guiding support intermediate its ends on a reciprocable guide ring 31 having sliding motion in the cylindrical shells 12' and 13'. These guide rings are provided with spaced guide projections between which occur spaces to permit the oil to pass freely from one side to the other of these guide rings. The ends of the bellows member are secured to the flanges 27 and 28 of the pistons 22 and 23 and to the walls of the valve housing 11, so as to be free to expand and contract alternately with the reciprocation of the pistons, thus forming a hermetic seal for preventing the contents of the various compartments escaping.

A substantially hollow cylindrical piston valve 32 is reciprocatingly mounted in a longitudinal bore in the operating fluid chest 40 of valve housing 11. The end portions of the piston valve 32 are turned down to a reduced diameter to form annular grooves 33 and 34 adapted to register with ports in the cylindrical fluid chest 40 formed integral with the valve housing 11. The central portion of said piston valve is turned down to form a central annular groove 36 which communicates at spaced points with its central bore, or which may be made in halves and joined together by connecting rods 37 as illustrated in Figs. 6 and 7.

A pair of internal annular grooves 38, 39 are formed in the cylindrical chest 40 adjacent one end, and another set of internal annular grooves 41 and 42 are provided adjacent its other end. The grooves 39 and 42 both open downwardly through ports 39'

and 42' to the power chambers defined within the bellows 30.

The outlet nozzle 43 is formed in the bottom of the valve housing 11 and has a branch 44 leading to one side of the center line of the housing to the fluid chest 40 and another branch 45 leading to the opposite side of the center line of said chest to open into the internal grooves 38 and 41 respectively. When the slide valve is in the position shown in Fig. 3 the groove 33 will place both grooves 41 and 44 in communication, thereby discharging the left hand power chamber while when the slide valve is in the position shown in Fig. 4 it will discharge the right hand power chamber.

Slots 46 and 47 are formed in the fluid chest 40, one at each side of the inlet nozzle 50, to alternately admit fluid under pressure from the inlet nozzle 50 through the central groove 36 to the power chambers 12 and 13.

The heads 48 and 49 are each provided with internal threads to engage external threads on the ends of the valve chest 40. A central bore is provided in each head to slidably admit the hollow piston rod 24. Bores 51 and 52 are also provided in the heads 48 and 49 respectively and outlets from each of said bores connect to pipes or tubes 53 and 54 which lead to the outlet nozzle 43.

Small lugs 55 are provided on the inner sides of heads 48 and 49 to provide clearance and give sufficient area for the passage of the fluid, to and from the hollow piston rod compartments, when the piston valve is in its extreme positions.

The hollow bore of the piston rod 24 has two dividing walls 56 and 56' dividing it into three compartments 57, 58 and 59. The central compartment 58 has a plurality of small holes drilled through it in the same vertical plane to form the series of ports B. To the left of the series of ports B a similar series A is provided and to the right of series B two more series C, D are provided. Each compartment 57 and 59 has adjacent its inner end two closely spaced series of ports E-E' and F-F' to provide passages for the exhausting of the working fluid from the ends of the valve chest 40.

The gas generated in the evaporator 65, which will be later described, enters the compressor cylinders alternately through inlet valve 63 and 64. Each inlet valve comprises a valve housing 65 having one end of reduced diameter threaded to engage a tapped hole in the cylinder end wall. The other end of said housing is of reduced diameter and is externally threaded to engage the internally threaded cap 66 which forms a pressure joint between the housing portion 65 and the tube 67. The spring and ball check are held in position by a bushing 70 which screws into the end of the valve housing.

The compressed refrigerant leaves the cylinders 16 and 17 respectively through outlet valves 68 and 69. These exhaust valves 68 and 69 are of similar construction to the inlet valves except that the spring in these valves is at the opposite end of the ball exerting a pressure inwardly.

With the parts of the device in the position indicated in Fig. 3 fluid under pressure enters the valve housing 11 through admission port 50 which may be connected with the city water supply or the like, and flows around the central annular groove 36 of the slide valve 32, and out through inlet port 47 in the valve chest 40, into the right hand expansion chamber 13 until the piston 23 has been forced to the end of its stroke. At this time the piston 23 has completed a compression stroke and the piston 22 has completed an intake stroke.

When the pistons move to this position the central compartment 58 of the piston rod 24 is placed in position to apply water pressure to the right hand end of the piston valve. The compartment 58 will be filled with water from the central groove 36 of the piston valve communicating with the series of ports B. The water will pass through the piston rod and out through port D, which is in position to register with the space between the right hand end of the piston valve 32 and the head 49 maintained by the lugs 55. As this space fills with water it forces the piston valve 32 to the extreme left hand position shown in Fig. 4. This reciprocation of the piston valve to the left is permitted at this time because the left hand end of the valve chamber is being vented through the ports E-E'. These vent this end of the valve chamber into the pipe 53 and permit movement of the piston valve in this direction.

When the pistons reach the end of their movement in this direction the series of ports F' in piston rod compartment 59 is thereupon placed in registry with the bore 52 in the head 49, and the other series of ports F is placed in communication with the space formed between the end of the valve 32 and said head 49. The fluid in this space enters compartment 59 through the ports F and drains out through the other ports F' passing to the outlet nozzle 43 through the tube 54 provided for that purpose. Simultaneously therewith, the working fluid is admitted to the other end of the piston valve, through the series of ports A and consequently the piston valve is reciprocated to the right.

This movement of the valve operates to admit the working fluid to the right hand chamber 13 through ports 50 and 47 to exhaust the working fluid from the left hand chamber 12 through ports 42' and 45 which results in the two pistons 22 and 23 mov-

ing to the right. This brings us back to the point at which we started and completes a cycle of the compressor.

A supply of oil is provided between the bellows 12 and 13 and their respective enclosing shells 12' and 13' and a pipe connection 73 connects both shells to permit the oil to be transferred from one shell or the other as the pistons reciprocate, thus forming a seal to prevent escape of the refrigerant, an absorbing medium for any small leakage of refrigerant and a source of lubricant for the pistons. A T connection closed by a pipe plug is provided in said line to provide means for filling these shells with oil.

The compressor is mounted on a hollow base or cooler 74 by a pipe connection 75, thus forming a passage for the water leaving the compressor housing to enter said base or cooler 74. A threaded outlet nozzle 76 is provided to receive a connection leading to an exhaust outlet for the spent water.

An evaporator 65 comprising a series of tubes 66 connecting with headers 78 and 79 at the top and bottom respectively, is supported below the cooler or condenser 74. The upper header 78 is hung from the cooler 74 by a threaded extension 81 engaging with a tapped boss 82 formed on the lower side of the cooler.

The lower header 79 is connected with a float chamber 83 separated by a wall 84 having a small aperture therein to engage a tapered point on the float 84', to keep the refrigerant liquid level constant. It will be seen that as long as there is sufficient liquid in the float chamber, the aperture will be unobstructed.

The condenser mounted in the cooler 74 comprises a pair of drums or manifolds 85 and 86 to which a plurality of pipes 87 are connected. A pipe line 88 leads from the header 78 and connects with a pipe line 89 which communicates with both of the inlet valves 63 and 64 to permit the vapor to be directed alternately to that side of the compressor which is making its suction stroke.

Another pipe line 89 connected with a pipe line 91 communicates with the two outlet valves 68 and 69 and with the manifold 85 of the condenser to permit the compressed refrigerant to flow into the condenser, from where it is led by pipe line 92 to the float chamber 83, still under pressure.

As the refrigerant evaporates in the evaporator 65 it rises carrying the heat with it to the compressor, where it is compressed and fed to the condenser 74. Here this heat is withdrawn, whereupon the cooled and condensed refrigerant is still under pressure ready for use again.

I do not intend to be limited to the particular details herein shown and described, as it will be obvious that the foregoing is

merely an exemplary embodiment of the invention:

I claim:

1. In combination, fluid containing shells,
5 compressor cylinders secured to the ends of
said shells, pistons reciprocatingly mounted
in said cylinders, a piston rod connecting
said pistons, valve means thru which said
10 piston rod extends and adapted to admit
motive fluid within said shells to actuate the
pistons in the compressor cylinders and to
discharge the exhaust fluid to a cooler, an
evaporator connected to inlet valves of said
15 cylinders, a condenser connected to the out-
let valves of said cylinders, said cooler car-
rying said condenser, and a float valve in
said evaporator adapted to keep the liquid
level in said evaporator constant.
2. In combination, a fluid motor and com-
20 pressor unit including a housing having an
inlet and outlet nozzle, a fluid operated
valve mounted in said housing, compressor
cylinders mounted from said housing and
having inlet and outlet valves, pistons
25 mounted in said cylinders and adapted to be
reciprocated therein upon actuation of said
fluid operated valve to admit fluid to the
motor, an evaporator connected with said
inlet valves, a cooler receiving cooling fluid
30 from said outlet nozzle, a condenser in said
cooler connected with said outlet valves, a
float valve chamber on said evaporator hav-
ing a connection with said condenser, and a
float valve therein whereby the liquid level
35 in the evaporator is maintained constant.
3. In a refrigerating machine the combina-
tion of an evaporator having a liquid level
control, a cooler from which said evaporator
is supported, a condenser mounted in said
40 cooler delivering to said evaporator, and a

self contained compressor and fluid motor
operatively connected with said evaporator
and condenser and mounted on said cooler.

4. In a refrigerating machine, the combi-
nation with a refrigerator, of evaporating
45 means therein supported from a cooler
mounted on said refrigerator, a condenser
mounted in said cooler having a connection
to said evaporating means, a fluid motor and
compressor in one unit operatively connect-
50 ed with said evaporator and condenser and
mounted on said cooler, and a valve housing
in operative relation to said motor and com-
pressor unit having a fluid inlet and outlet
valve, said outlet valve being connected with
55 said cooler.

5. In a refrigerating machine, the combi-
nation of evaporating means, cooling means,
condensing means mounted in said cooling
means and operatively connected with said
60 evaporating means, and a self-contained
combined fluid motor and compressor
mounted on said cooling means and com-
prising a valve housing having ports, one of
which communicates with said cooling
65 means, a valve slidingly mounted in said
housing, a piston rod mounted in said valve
and adapted to be reciprocated upon actua-
tion thereof to admit fluid to said motor, a
piston secured to each end of said piston
70 rod, cylinders adapted to receive said pis-
tons and in communication with said evap-
orating and condensing means, and means
controlled by said valve admitting exhaust
fluid from the motor to said cooling means.
75

In testimony whereof I affix my signature
at 1609 First National Bank Building, De-
troit, Michigan.

HERBERT C. KELLOGG.