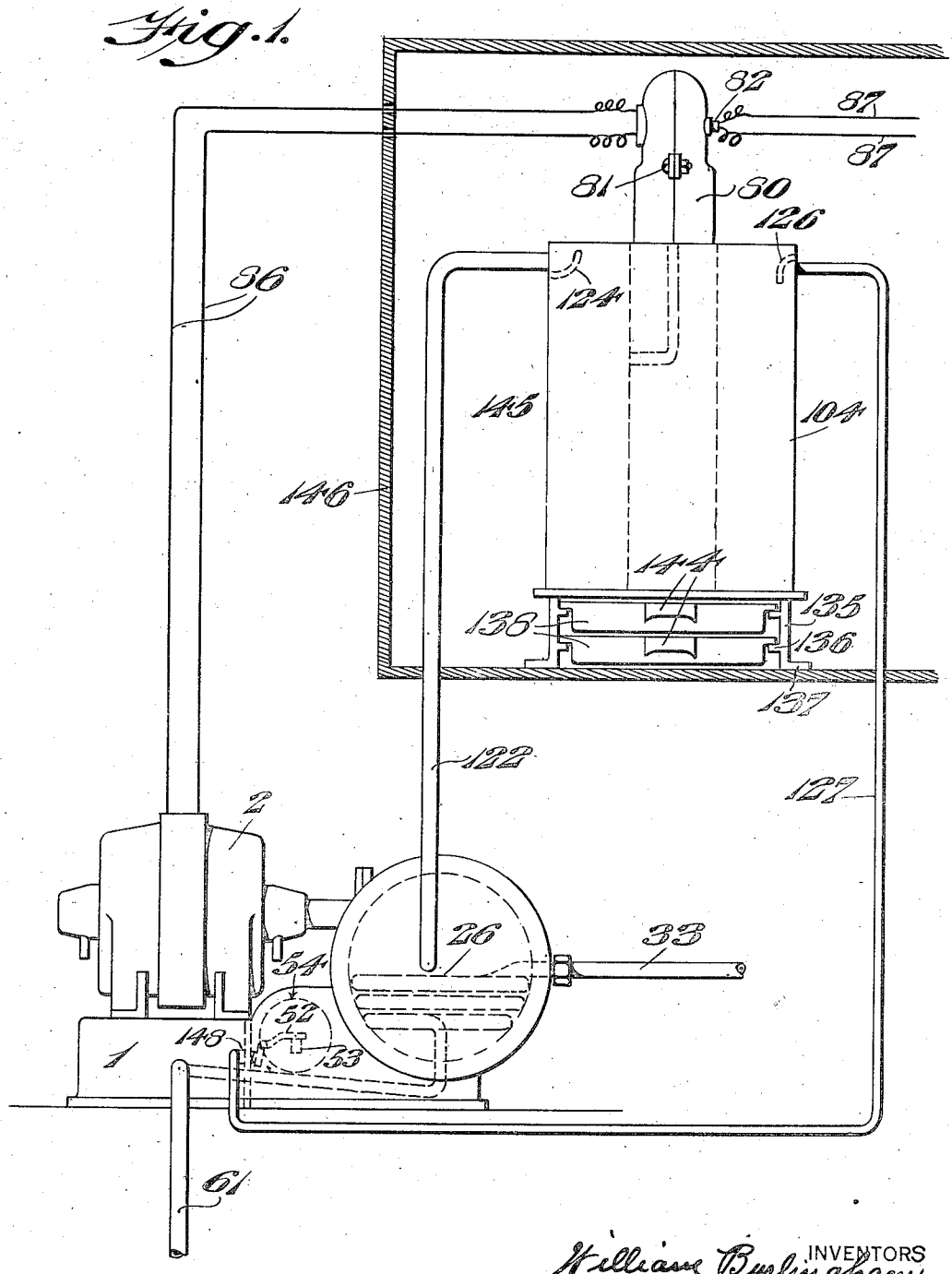
April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 1.



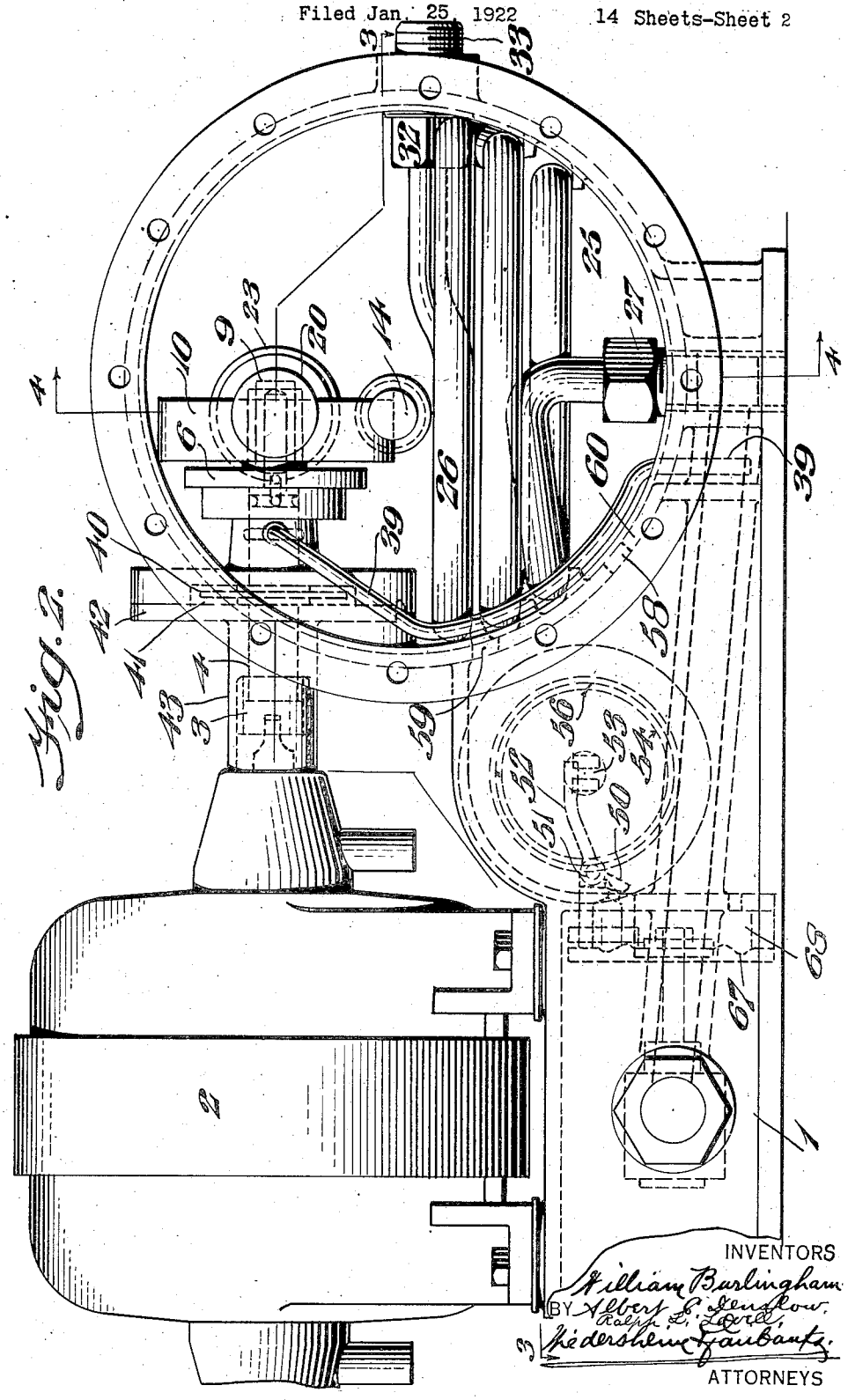
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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

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W. BURLINGHAM ET AL.

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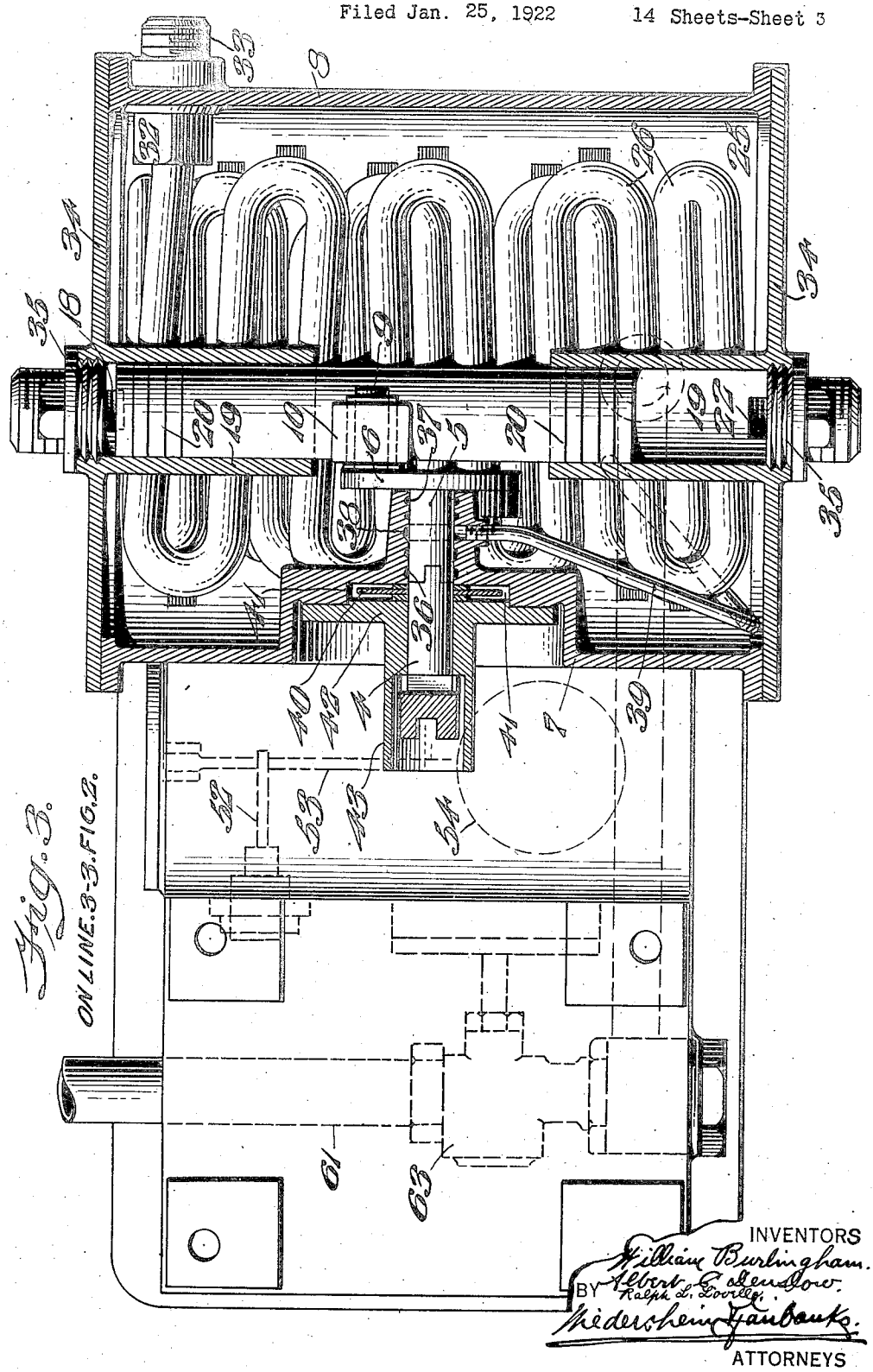


Fig. 3.
ON LINE 3-3. FIG. 2.

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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 4.

ON LINE 4-4 FIG. 2.

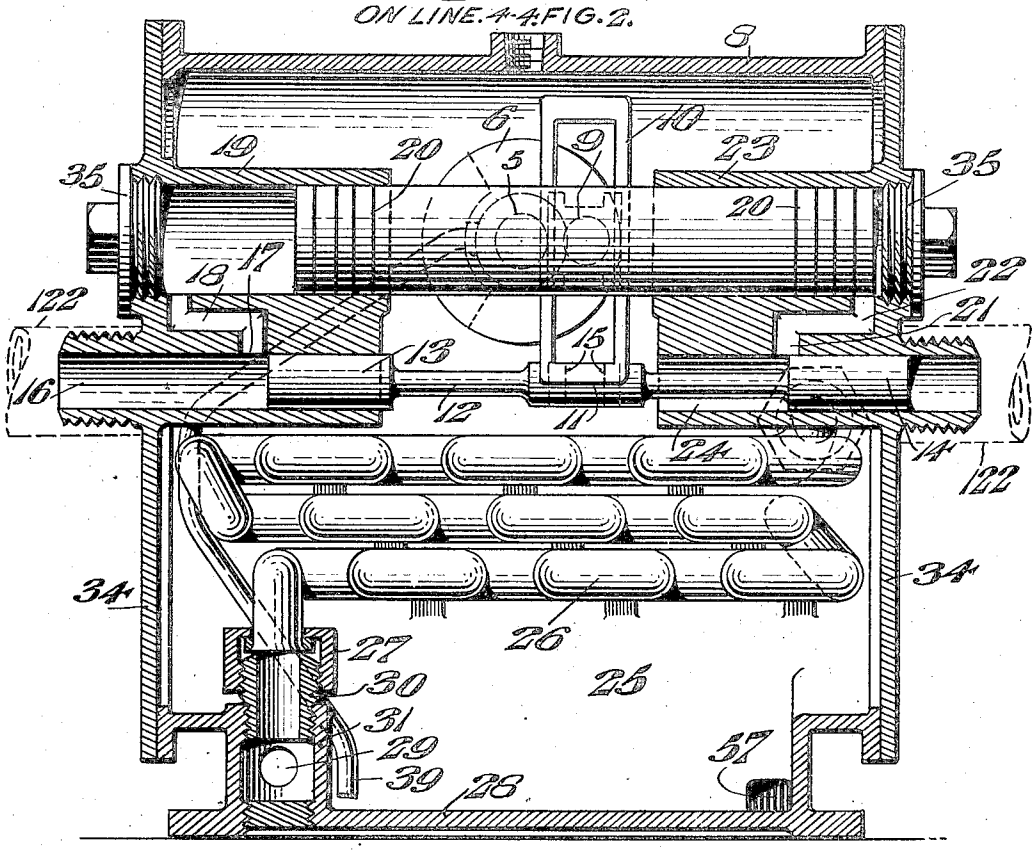


Fig. 5.

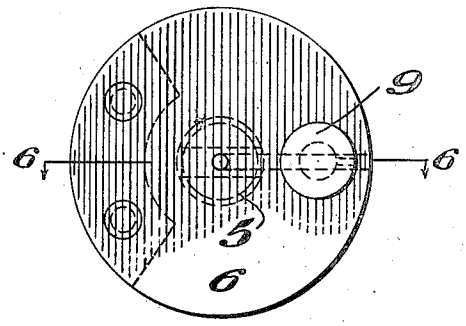
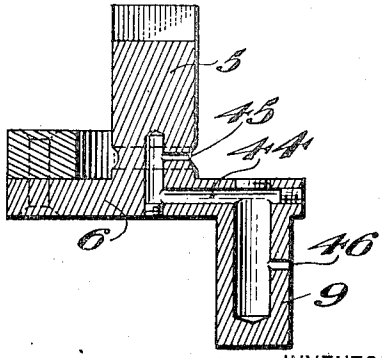


Fig. 6.

ON LINE 6-6 FIG. 5.



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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 7.

ON LINE 7-7. FIG. 6.

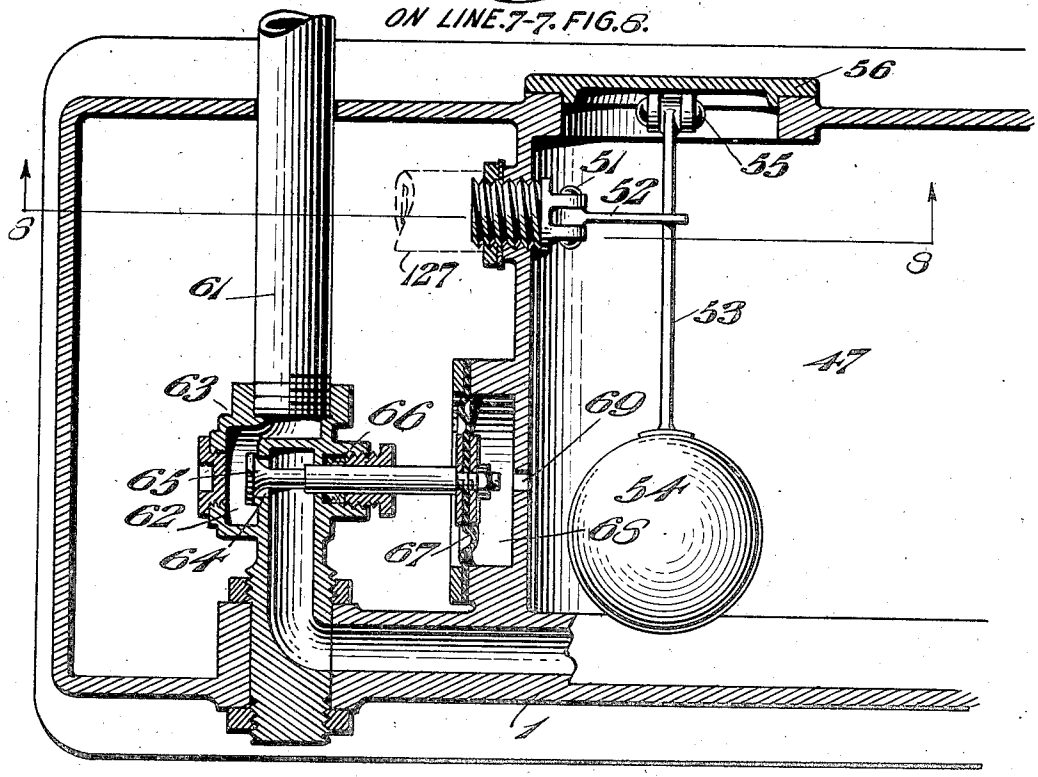
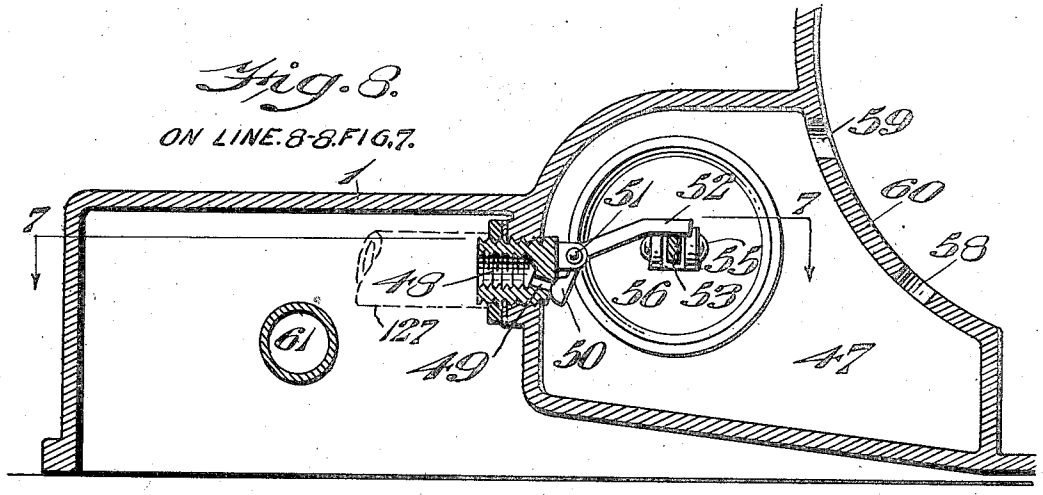


Fig. 8.

ON LINE 8-8 FIG. 7.



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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 9.

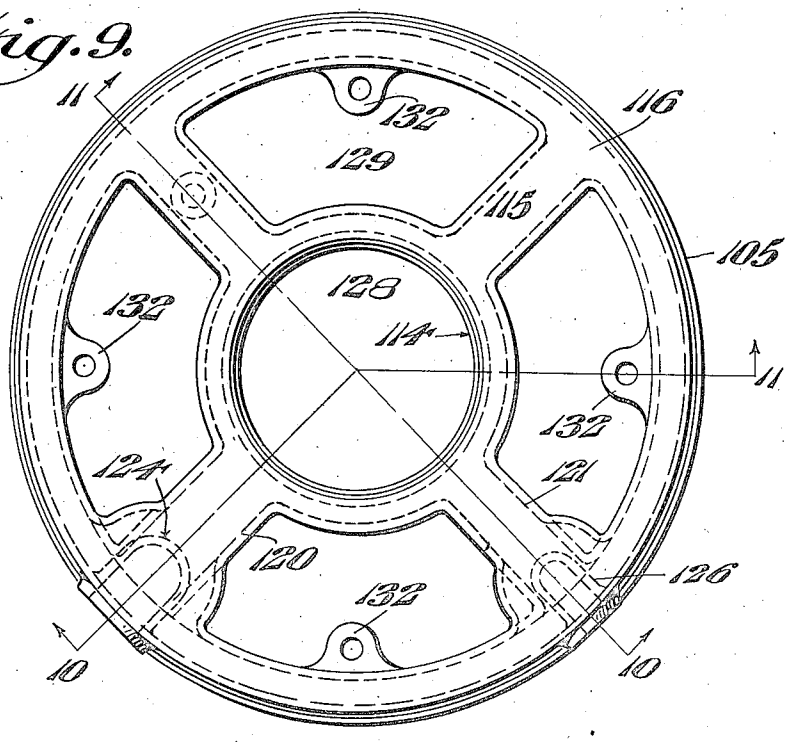
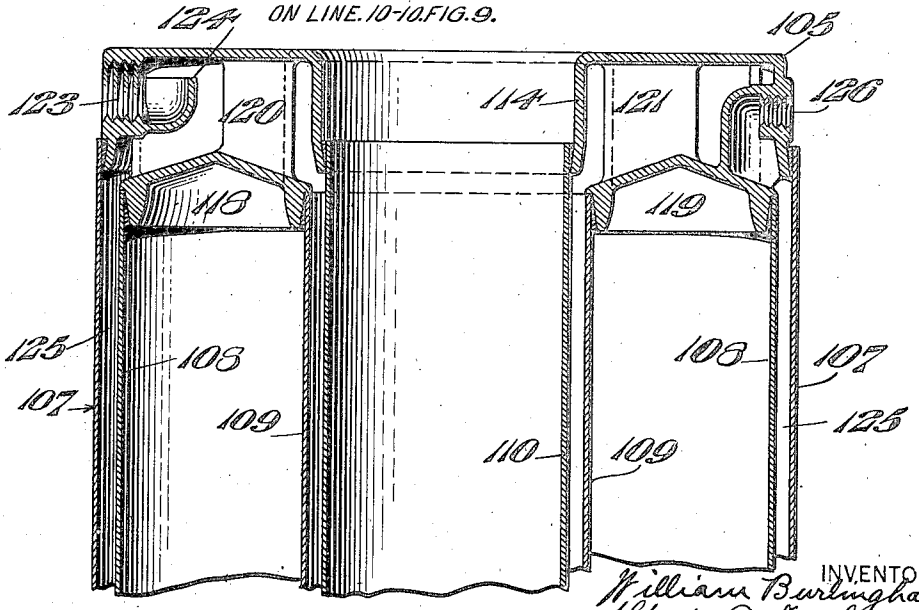


Fig. 10.



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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

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Fig. 11.

ON LINE 11-11. FIG. 9.

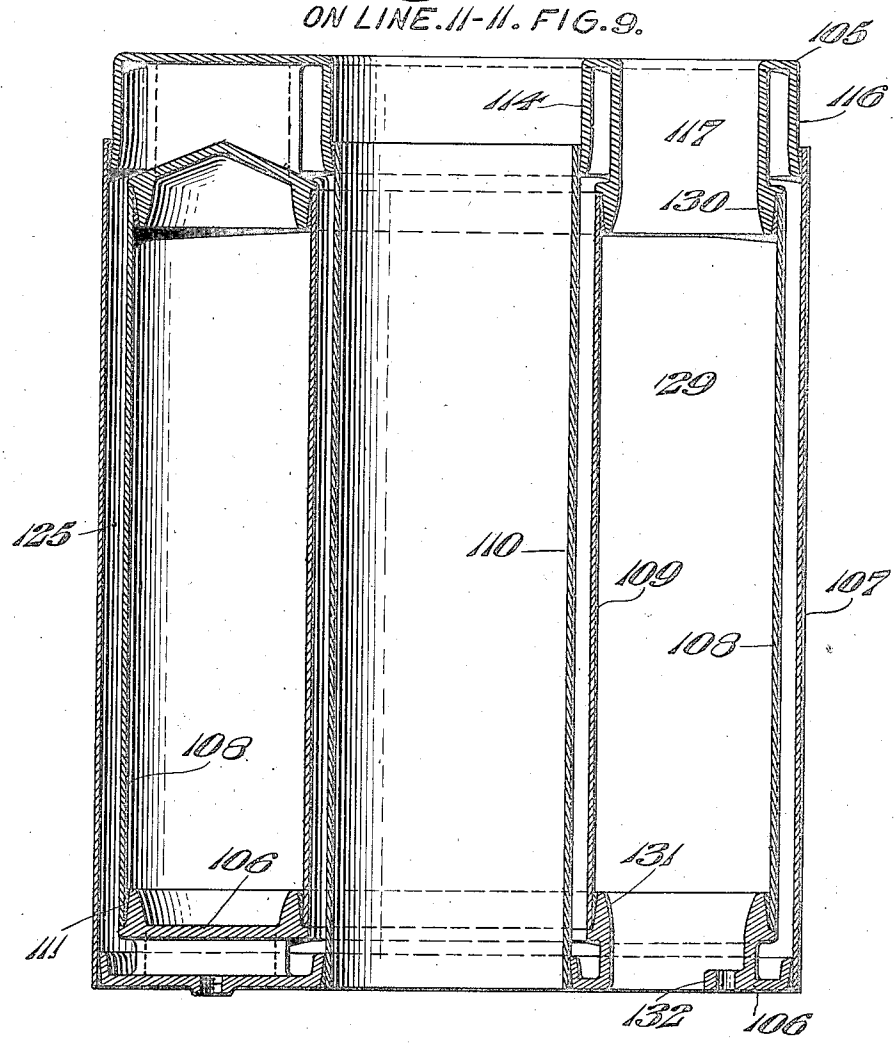
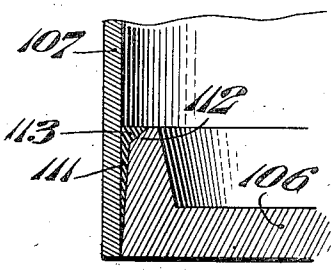


Fig. 12



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April 27, 1926. 1,582,633

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Fig. 13.

ON LINE 13-13. FIG. 15.

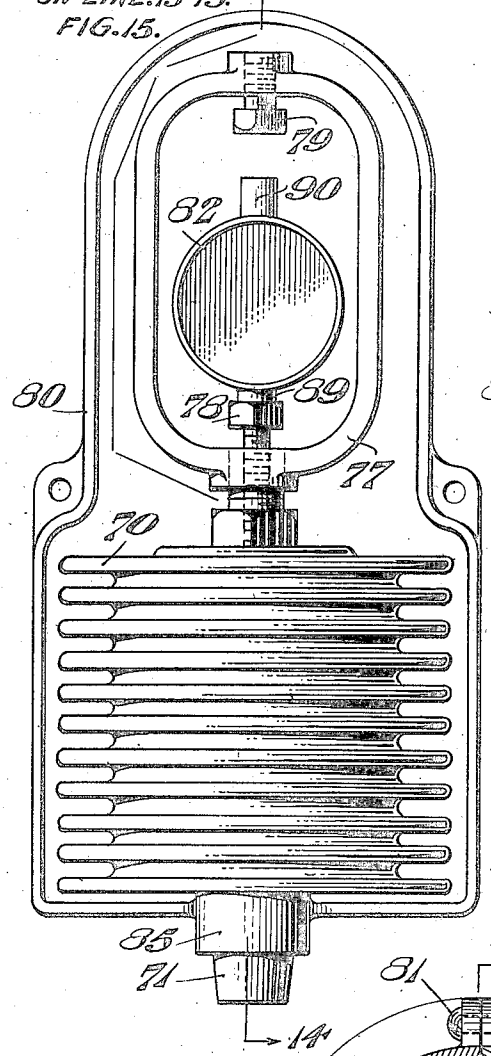


Fig. 14.

ON LINE 14-14. FIG. 13.

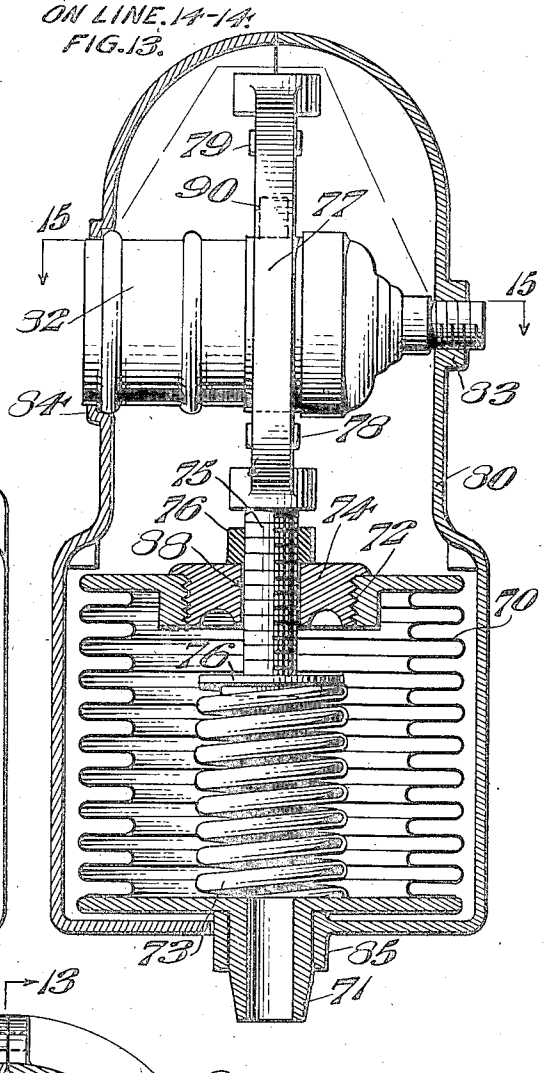
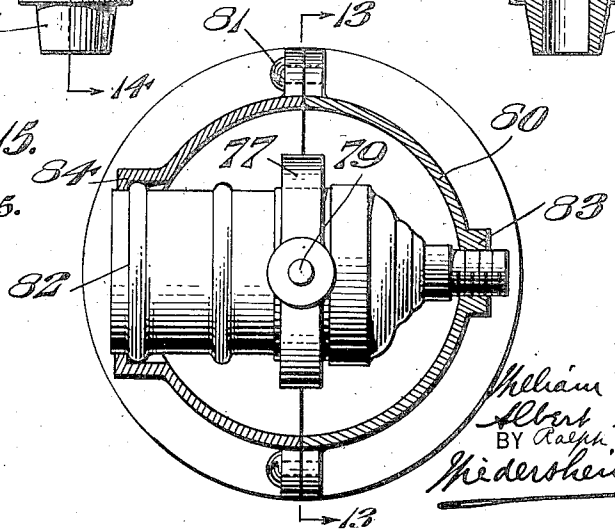


Fig. 15.

ON LINE 15-15. FIG. 14.



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Fig. 16.

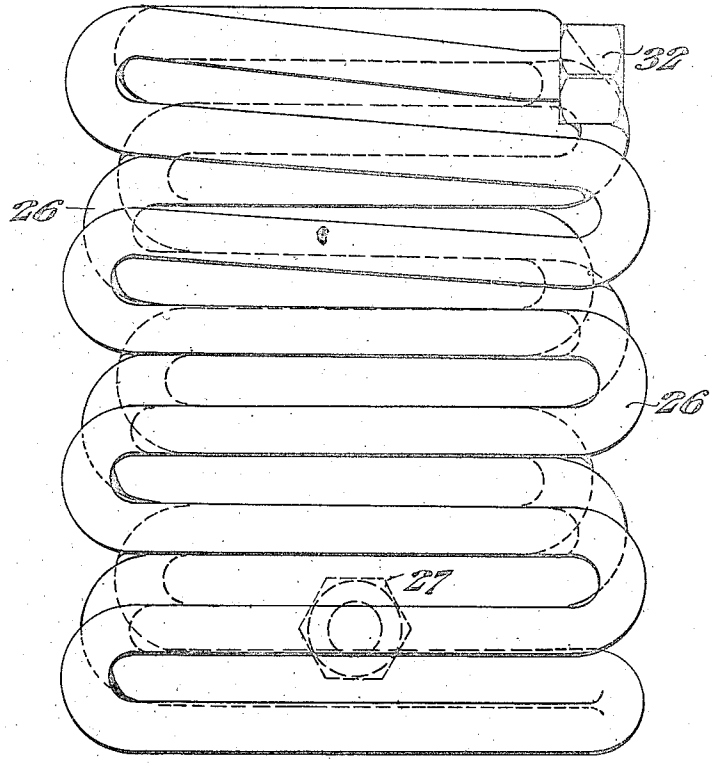


Fig. 17.

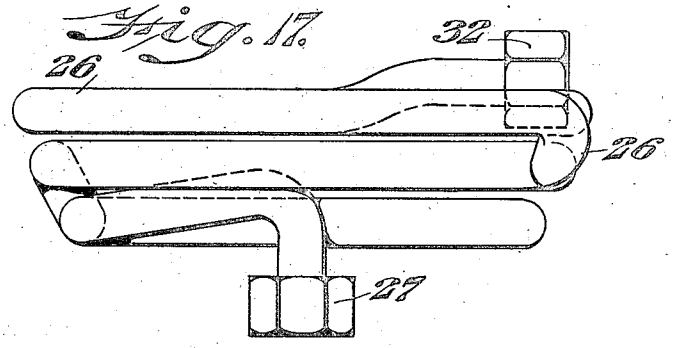
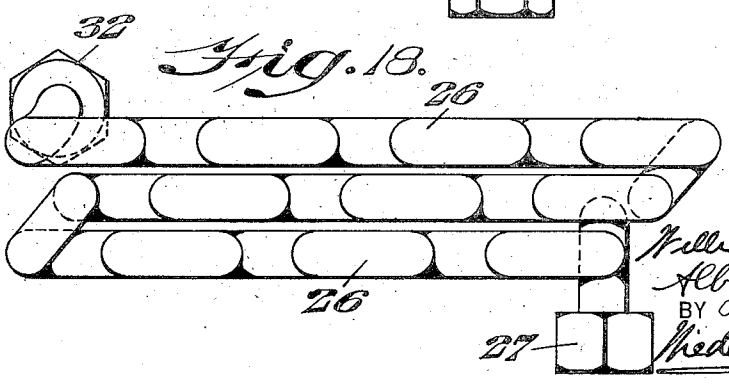


Fig. 18.



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April 27, 1926. 1,582,633

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Fig. 19.

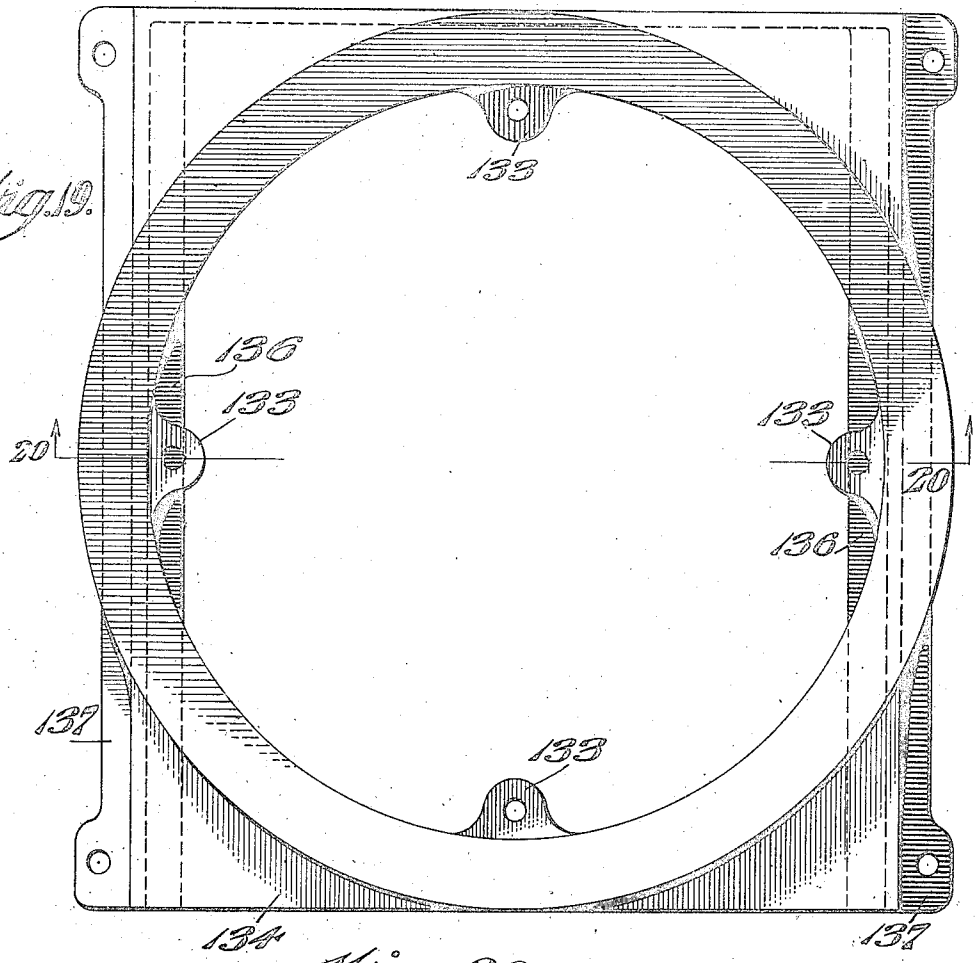
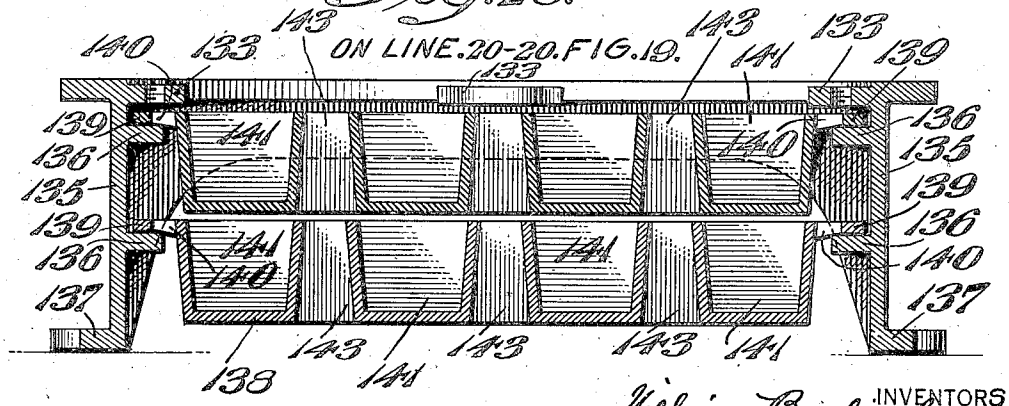


Fig. 20.



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April 27, 1926. 1,582,633

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Fig. 21.

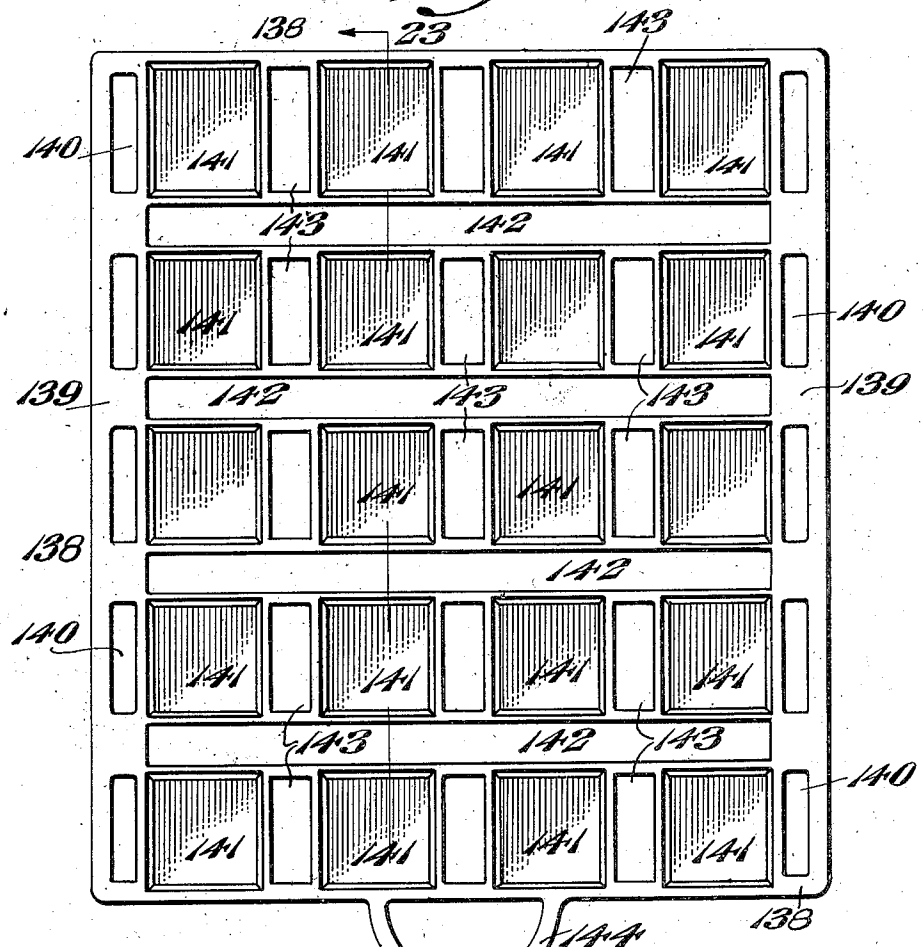


Fig. 22.

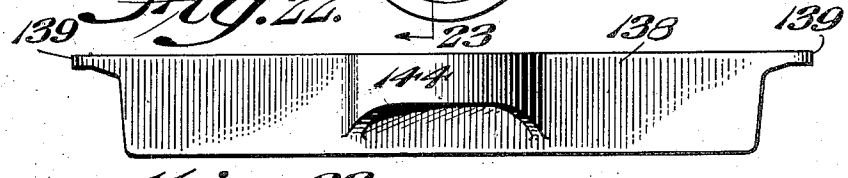
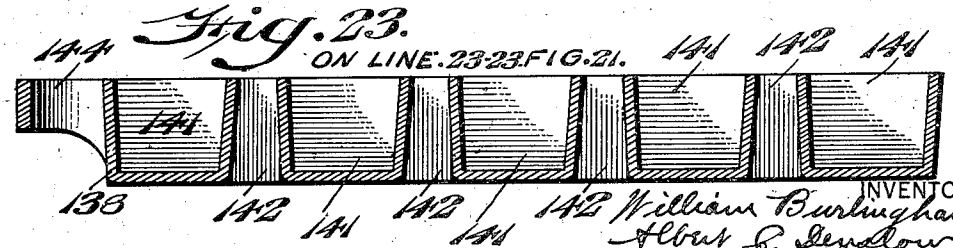


Fig. 23.

ON LINE 23-23 FIG. 21.



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REFRIGERATING APPARATUS

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Fig. 24.

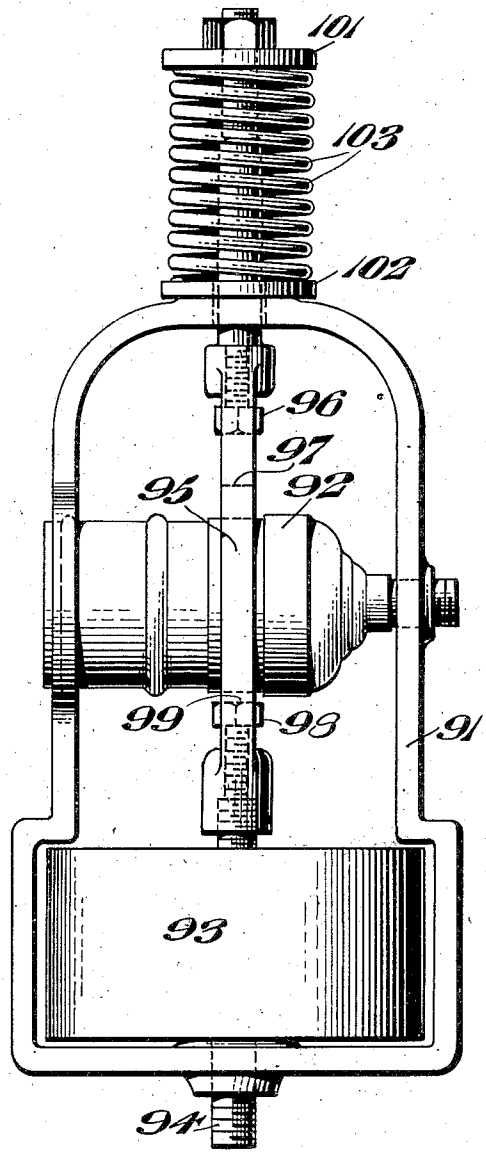
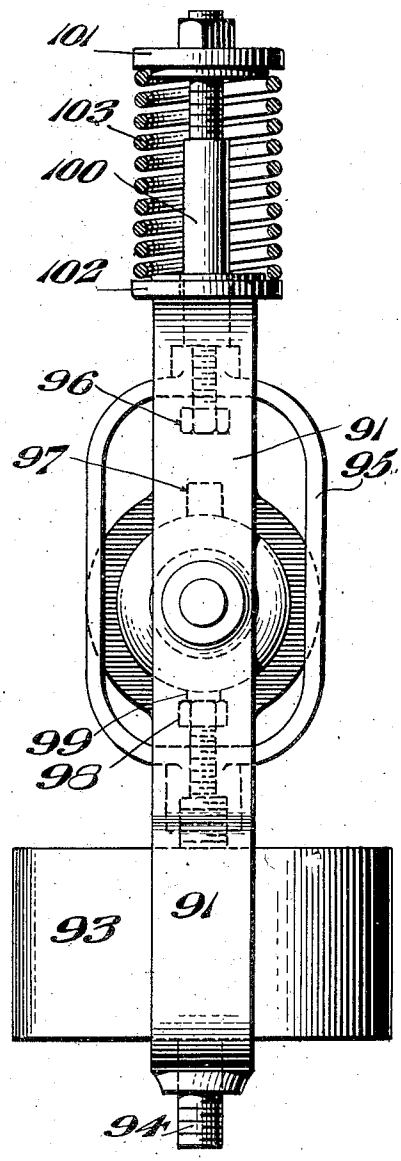


Fig. 25.



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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 26.

ON LINE 26-26. FIG. 27.

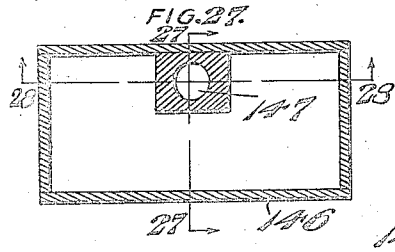


Fig. 27.

ON LINE 27-27. FIG. 26.

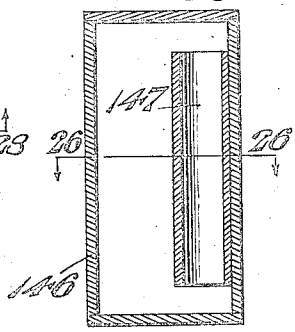


Fig. 28.

ON LINE 28-28. FIG. 26.

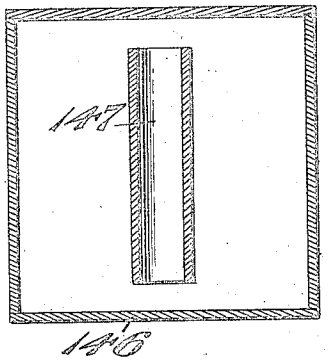


Fig. 29.

ON LINE 29-29. FIG. 30.

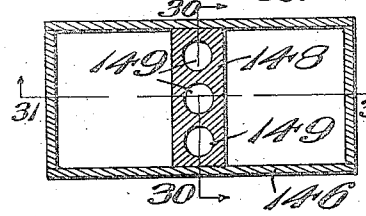


Fig. 30.

ON LINE 30-30. FIG. 29.

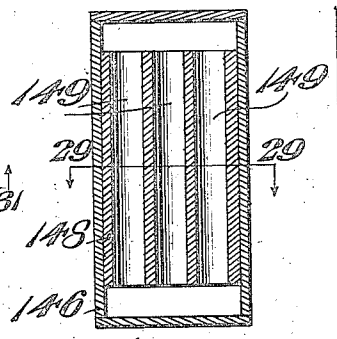


Fig. 31.

ON LINE 31-31. 146 FIG. 29.

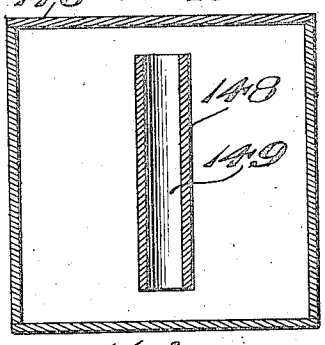


Fig. 32.

ON LINE 32-32. 33 FIG. 33. 150

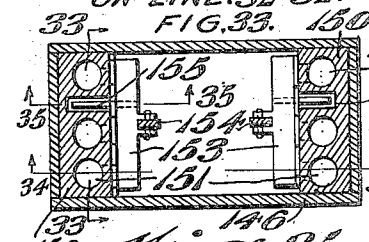


Fig. 33.

ON LINE 33-33 FIG. 32.

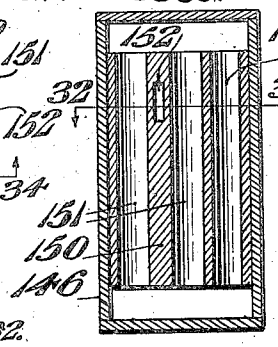


Fig. 34.

ON LINE 34-34 FIG. 32.

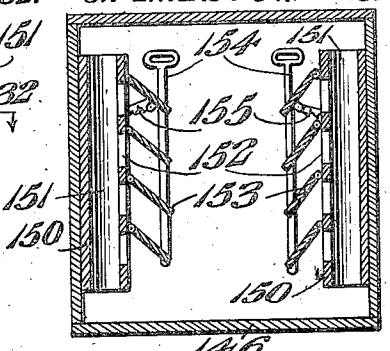
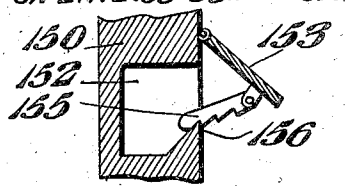


Fig. 35.

ON LINE 35-35 FIG. 32.



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April 27, 1926. 1,582,633

W. BURLINGHAM ET AL

REFRIGERATING APPARATUS

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Fig. 36.

ON LINE 36-36 FIG. 37.

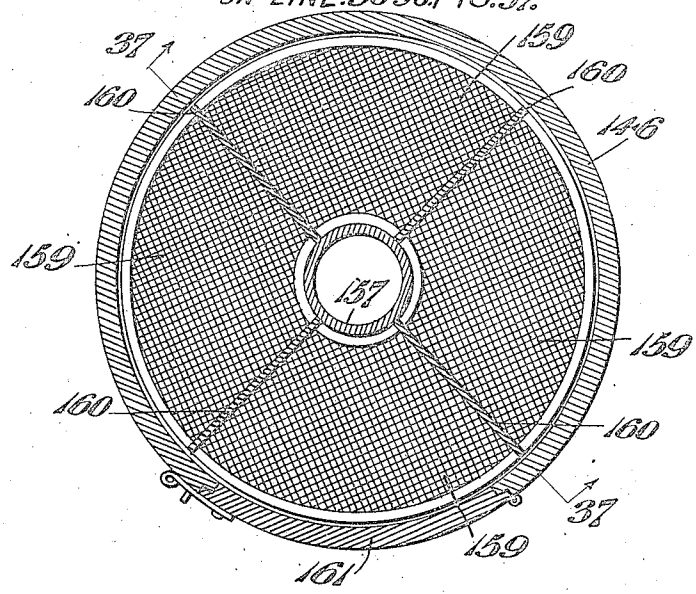
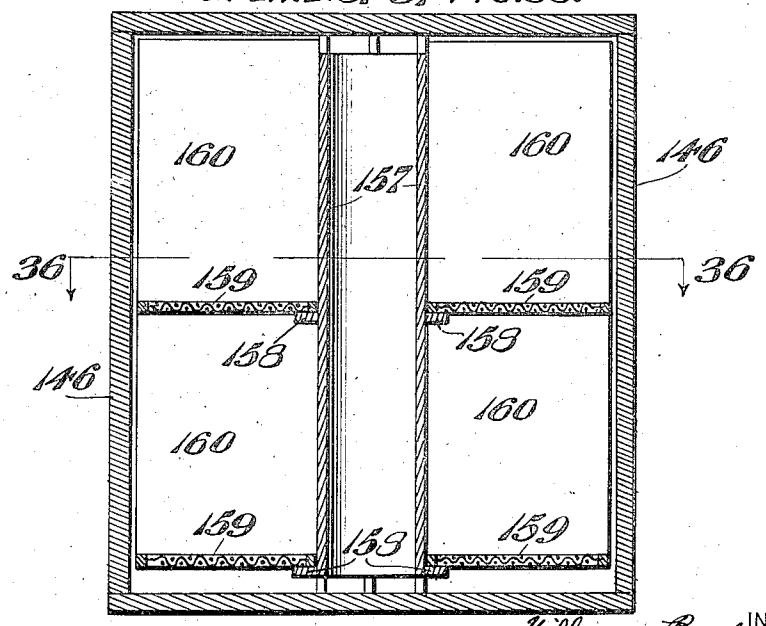


Fig. 37.

ON LINE 37-37-FIG. 36.



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Patented Apr. 27, 1926. 1,582,633

UNITED STATES PATENT OFFICE.

WILLIAM BURLINGHAM, OF TENAFLY, AND RALPH L. LOVELL, OF CRANFORD, NEW JERSEY, AND ALBERT C. DENSLOW, OF NEW YORK, N. Y., ASSIGNORS TO ADAMS, LOVELL, BURLINGHAM, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REFRIGERATING APPARATUS.

Application filed January 25, 1922. Serial No. 531,607.

To all whom it may concern:

Be it known that we, WILLIAM BURLINGHAM, a citizen of the United States, residing at Tenafly, county of Bergen, State of New Jersey, and RALPH L. LOVELL, a citizen of the United States, residing at Cranford, county of Union, State of New Jersey, and ALBERT C. DENSLOW, a citizen of the United States, residing at New York, county of New York, State of New York, have invented a new and useful Refrigerating Apparatus, of which the following is a specification.

In all households, the problem of economical refrigeration is a question of prime necessity and the high cost of ice and the dependence upon the ordinary iceman has become a vexing question. The requirements to which all refrigerating machinery are subjected are unusually severe owing to the character of fluids employed, and a refrigerating apparatus designed for household use cannot receive the skilled and constant attention of a large refrigerating installation. A household device is often not in use for long periods of time, the result of which is that the refrigerant instead of remaining in a liquid state becomes gasified and a very high internal pressure is created. Owing to the character of fluids employed, it is essential that no leakage occur and that the apparatus will be ready for operation whenever desired, and that the machine will not only be fool proof, but will not require the operation of a skilled attendant or frequent repairs.

In the household refrigerating apparatus now on the market, the cost of installation, of operation and of the amount of refrigerants required has been very great, and it has also been impractical to utilize the household refrigerator which the householder usually already has in his possession.

With the above in view, our invention comprehends a novel construction of a household mechanical refrigerating apparatus which can be installed and operated at a minimum cost, which is automatic in action, and in which the working parts are all inclosed in order to render it fool proof.

It further comprehends a novel construction of a refrigerating apparatus wherein the compressor is located in the chamber which receives the discharge from the condenser so that the compressor discharges directly against the cooling coil of the condenser.

It further comprehends a novel construction and arrangement of a compressor, a novel construction and arrangement of an evaporator, a novel construction and arrangement of a condenser, a novel construction of a casing and novel means for connecting the various mechanisms so that the ultimate objects sought are obtainable.

It further comprehends a novel construction and arrangement of valve mechanism, novel lubricating means and novel means for causing the lubricant to form a seal to prevent the escape of gas.

It further comprehends a novel construction and arrangement of ice pan.

It further comprehends a novel construction and arrangement of automatic controlling mechanism whereby a desired temperature may be maintained within the refrigerator.

Other novel features of construction and advantage will hereinafter more fully appear in the detailed description of the invention.

For the purpose of illustrating our invention, we have shown in the accompanying drawings typical embodiments thereof which are at present preferred by us, since these embodiments will be found in practice to give satisfactory and reliable results. It is, however, to be understood that the various instrumentalities of which our invention consists can be variously arranged and organized and that our invention is not limited to the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents diagrammatically a refrigerating apparatus, embodying our invention.

Figure 2 represents a side elevation of the apparatus with the cover removed.

Figure 3 represents a section on line 3—3 of Figure 2.

Figure 4 represents a section on line 4—4 of Figure 2.

Figure 5 represents in end elevation a crank disc employed.

Figure 6 represents a section on line 6—6 of Figure 5.

Figure 7 represents a section on line 7—7 of Figure 8.

Figure 8 represents a section on line 8—8 of Figure 7.

Figure 9 represents a top plan view of the refrigerating casing, certain parts having been removed for the sake of illustration.

Figure 10 represents a section on line 10—10 of Figure 9.

Figure 11 represents a section on line 11—11 of Figure 9.

Figure 12 represents, in section, a detail on an enlarged scale of the construction seen in Figure 11.

Figure 13 represents a section on line 13—13 of Figure 15 a portion of the casing having been removed.

Figure 14 represents a section on line 14—14 of Figure 13.

Figure 15 represents a section on line 15—15 of Figure 14.

Figure 16 represents a plan view of the condensing coil.

Figure 17 represents an end view of the condensing coil.

Figure 18 represents a side elevation of the condenser coil.

Figure 19 represents a top plan view of the evaporator base which carries the ice pan.

Figure 20 represents a section on line 20—20 of Figure 19, showing a plurality of ice pans in assembled position with respect to said base.

Figure 21 represents a top plan view of an ice pan, in detached position.

Figure 22 represents an end elevation of an ice pan.

Figure 23 represents a section on line 23—23 of Figure 21.

Figure 24 represents a side elevation of a modified form of temperature regulator which can be employed.

Figure 25 represents an end elevation of the construction seen in Figure 24.

Figure 26 represents a section on line 26—26 of Figure 27 of another form of refrigerator, embodying our invention.

Figure 27 represents a section on line 27—27 of Figure 26.

Figure 28 represents a section on line 28—28 of Figure 26.

Figure 29 represents a section on line 29—29 of Figure 30 of another embodiment of refrigerator, embodying our invention.

Figure 30 represents a section on line 30—30 of Figure 29.

Figure 31 represents a section on line 31—31 of Figure 29.

Figure 32 represents a section on line 32—32 of Figure 33, showing another form of refrigerator embodying our invention.

Figure 33 represents a section on line 33—33 of Figure 32.

Figure 34 represents a section on line 34—34 of Figure 32.

Figure 35 represents a section on line 35—35 of Figure 32.

Figure 36 represents a section on line 36—36 of Figure 37.

Figure 37 represents a section on line 37—37 of Figure 36.

Similar numerals of reference indicate corresponding parts.

Referring to the drawings:

1 designates a casing the contour of which may vary widely in practice, and on which is preferably mounted a motor 2, which is preferably an electric motor. The shaft of the motor 2 is connected by means of a coupling 3 with a crank shaft 4 having a tongue and slot connection therewith and also having a tongue and slot connection with a shaft 5 extending from the balanced crank disc 6 and journalled in the end wall 7 of the casing 8 of the condenser. The crank disc 6 is provided with a crank pin 9 which is connected with a cross head 10, see more particularly Figures 2, 3 and 4. The cross head 10 seats in the recess 11 of the compressor valve rod 12 which latter is provided at one end with a valve head 13 and at its opposite end with a valve head 14. The valve rod is secured to the cross head 10 by means of fastening devices 15. The valve head 13 reciprocates within an aperture 16 having a port 17 which communicates by means of the passage 18 with the rear end of a compressor piston chamber 19 in which reciprocates one end of a compressor piston 20. In a similar manner the valve head 14 controls a port 21 which communicates with a passage 22 which opens into an end of the compressor cylinder 23 in which reciprocates the opposite end of the compressor piston 20. The valve head 14 reciprocates in an aperture 24, see Figure 4.

When the piston head in a compressor cylinder is at the end of its compression stroke, its corresponding valve uncovers, for example, the admission port which also forms a discharge port, so that the compressed fluid is discharged into the condenser chamber 25 in close proximity to the condensing coils 26 therein. The condensing coils 26 are provided with an inlet fitting 27 carried by the bottom 28 of the condenser casing which is provided with an inlet port 29 communicating with the nipple 30 which is in threaded engagement with the fitting nut 27 and with the apertured lug 31 which rises from the bottom 28. The outlet end of the condenser coil 27 is provided with the nut 32 which enables it to be connected with a nipple 33, see Figure 2, which latter is connected by a flexible or other hose which leads to a desired point of discharge of the cooling water. The condenser coil 26 is folded or lapped

upon itself with the coils in overlapping relationship, as will be best understood by reference to Figures 16 to 18 inclusive. The compressor cylinders 19 and 23 are formed in the end castings 34 by drilling therethrough and closing the outer ends of the apertures thus formed by means of threaded plugs 35.

In order to provide for the proper lubrication of the crank shaft 4, the hub of the side walls 7 is provided with spiral or helical grooves 36 and 37 directed in opposite directions which lead from the annular groove 38 said annular groove being in communication with a lubricant in the bottom of the condensing chamber 25 by means of a pipe 39. The crank shaft 4 has mounted on it a disc 40 which rotates in a chamber 41 formed between the end wall 7 and the disc 42 of the sleeve 43 see Figure 3 said disc 42 being secured to the wall 7 of the condenser casing in any desired manner.

In this manner, owing to the provision of the disc wheel 40, the chamber in which it is located will be maintained full of oil when such disc wheel is in motion thereby preventing leakage, and when the disc wheel 40 is not running the surface of the oil is above the top of the shaft thereby preventing egress of the gas. The oil is fed towards the crank disc 6 and due to the oil passage 44 and ports 45 and 46 the crank pin 9 will be properly lubricated, as will be apparent. The casing 1 is provided with a supply chamber 47 from which liquid chemical is admitted through the inlet fitting 48 having a port 49 which is controlled by means of a valve 50 pivoted to the fitting 48 as at 51 and having an arm 52 which extends over the float arm 53, one end of the float arm 53 being connected to a float 54 in the supply chamber 47, and the other end of said float arm 53 being fulcrumed at 55 to a wall of the chamber 47 formed by the removable cap 56.

The fluid contents of the condenser and supply chamber are arranged in three layers, first the lubricant, then the liquid chemical and on top the gas chemical. The corresponding layers in the condenser chamber 25 and the supply chamber 47 are connected with each other, respectively, by the apertures 57, 58 and 59 which open through the wall 60 which forms a partition between such chambers. The circulating water enters through the pipe 61, see more particularly Figure 7, into the passage 62 of the valve casing 63 which is provided with a port 64 controlled by a valve 65 the stem of which passes through a stuffing box 66 and is connected to a diaphragm 67 which closes one end of a chamber 68 which communicates by means of an aperture 69 with the supply chamber 47.

It will be seen that one side of the diaphragm is under atmospheric pressure and the opposite side is under the gas pressure in the chamber 47 and condenser chamber 25, which are in communication through the apertures 59. When this pressure increases to a certain point the diaphragm is pressed outwardly opening the water valve 65 and thus admitting water to the condenser coils 26 with which the valve casing 63 is in communication.

In mechanically cooled refrigerating apparatus, it is essential to keep the temperature in the refrigerating chamber within certain definite ranges. The regulator which we employ is operated by the change in pressure in the gas chamber of the evaporator due to the change in temperature of the gas. The inner face of the operating diaphragm of the regulator is connected to and forms a part of the volume of the gas chamber and may be located either inside or outside of a refrigerator or connected to the gas chamber of the evaporator by means of a pipe. The temperature of the gas increases as the heat units are withdrawn from the air being cooled and as this gas is withdrawn from the gas chamber by the suction of the compressor, the liquid chemical is admitted to the evaporator. It is evident that the temperature of the gas in the gas chamber will vary before the air passes over the surface of the evaporator, as such variation is the cause of the air temperature variation. In accordance with our apparatus, a considerable pressure per square inch is obtained for a degree difference of temperature and we are thus enabled to operate a switch of sufficient capacity to carry the entire current required by the motor, without rendering it necessary to use relays or other delicate mechanism.

Referring to Figures 13 to 15 inclusive, it will be seen that a diaphragm 70 is employed, the base of which is provided with a tap 71 while its outer end is provided with an opening 72 to provide for the insertion of a spring 73 said opening 72 being closed by an apertured closure 74 through which passes a threaded boss 75 having a head 76 against which bears one end of a spring 73, the opposite end of said spring 73 bearing against the base of the diaphragm 70. 76 designates a nut which locks the threaded rod 75 in position. The threaded rod 75 is in threaded engagement with a yoke 77 which carries at opposite ends the adjusting screws 78 and 79, respectively.

80 designates a sectional frame, the sections of which are secured together by means of fastening devices 81, said frame carrying a standard lamp socket switch 82, the rear end of which is in threaded engagement as at 83 with one of the casing sections, while the opposite end abuts against an annular flange 84 of the other casing section. The

casing 80 surrounds the yoke in the diaphragm and is provided at its lower end with the hub 85 in which the tap 71 is slidable. The manner in which the temperature regulator is connected will be understood by reference to Figure 1, from which it will be seen that the lamp socket switch 82 is connected by means of the conductors 86 with the motor, while the conductors 87 lead from the source of electric supply.

The rod 75 is sealed in the closure 74 by means of packing 88. 89 and 90 designate push buttons.

In Figures 24 and 25, we have shown another form of temperature regulator embodying our invention and in which a standard lamp socket switch can be employed. The main difference between this form and the form described in Figures 13, 14 and 15 is the location of the spring. 91 designates the frame which carries the lamp socket 92. 93 designates the diaphragm having a cap 94 for connection with the source of gas supply or the gas chamber. The diaphragm 93 carries the yoke 95 which is provided with an adjusting screw 96 to cooperate with the push button 97 and with an adjusting screw 98 to co-operate with the push button 99. The yoke 95 is provided with an upwardly extending rod 100 to which is adjustably connected a stop nut 101 between which and a washer 102 abutting against the frame is interposed a spring 103. It will be understood that the interior of the diaphragm is in free communication with the gas in the gas chamber of the evaporator or condenser. The to and fro movement of the diaphragm, due to changes of temperature in the evaporator causes a corresponding movement of the yoke and the pressure of the adjusting screw against the push button of the lamp socket switch, thereby throwing the spring switch in said lamp socket and cutting the motor in or out as required. The pressure exerted by the spring is regulated to balance the atmospheric pressure on the outside of the diaphragm against its upper head minus one-half the difference in pressure between the pressure due to the highest and lowest temperatures of the desired operating range of the regulator and also minus the pressure due to the gas pressure at the lowest temperature. We thus have a resultant downward pressure when the temperature is lowest of the atmospheric pressure plus one-half the difference between the pressures on the diaphragm due to the maximum and minimum temperatures minus the resistance of the spring and the pressure due to the minimum pressure, and a resultant upward pressure when the temperature is highest due to difference between a downward pressure of the atmosphere plus one-half the pressure difference in the diaphragm as above noted and an upward pressure of the spring plus the internal pressure against the diaphragm due to the maximum temperature of the gas.

It will be apparent that the regulator operated from the lower pressure in the evaporator as compared with the air in the refrigerator will have a longer range of temperatures and pressure.

We will next describe the construction of the evaporator reference being directed more particularly to Figures 1, 9 to 12 inclusive and 19 to 23 inclusive. The evaporators in use at present are usually composed of coils of small pipe located either in a brine or calcium chloride tank, or the cooling effect is accomplished directly on the air in the refrigerating space without the interposition of the brine tank. The ordinary coiled pipe interferes with the flow of air, and in addition the gas bubbles in the pipe are more or less hindered in their passage through the liquid chemical by reason of the pipe friction and the horizontal disposition of the coils. The evaporator or cooling device which we employ is of such shape as to afford a minimum resistance to the upward passage of the gas bubbles and to the downward flow of the cooled air on the outside of the evaporator surface. The circulatory flow of the cooled air is accelerated by the nozzle effect of the annular spaces in the evaporator, and the molecules of gas rising from the liquid chemical have uninterrupted passage to the gas dome at the top of the evaporator. The gas dome is made of such capacity as to reduce the variation in pressure due to the suction of gas from it and the discharge of chemicals to it in order that the pressure in the pipe leading to the temperature regulator will be as free as possible from surging due to the abstraction of gas or addition of liquid chemical. The suction nozzle in the evaporator is arranged in such a manner as to prevent the ingress of liquid chemical to the suction pipe and the delivery end is arranged to deliver liquid chemical without danger of its mingling with the gas in the gas chamber and so as to direct its flow downward into the liquid chemical.

104 designates the evaporator which is provided with a top casting 105 which forms a gas dome, a bottom casting 106 and the spaced pipes or tubes 107, 108, 109 and 110 which are soldered or otherwise secured to the top and bottom casting so as to form a fluid tight joint.

In Figure 12, we have shown one manner of forming a fluid tight joint between the bottom casting 106 and the outer tube or shell 107. A side wall of the bottom casting 106 inclines upwardly and inwardly, as indicated at 111, and its top wall is beveled, as indicated at 112, and the sealing material 113 fills the space between such sur-

faces of the bottom casting and the outer shell 107. The top casting 105 has the centrally located downwardly extending annular flange 114 which is connected by the ribs 115 with the outer annular portion 116.

The ribs 115 are deflected downwardly to form the nozzles 117 except certain of them which are deflected downwardly and form the heads 118 and 119, respectively, see more particularly Figure 10, from which it will be seen that above the head 118 is a passage 120 and above the head 119 is a passage 121. The condenser chamber 25, see Figure 2, for example, communicates by means of a conduit 122, see Figure 1, with the passage 120, it being seen from Figure 10 that the top casting 105 is provided with a threaded aperture 123 to receive the conduit 122 and that the conduit 122 discharges against the internal upturned wall 124 which is open at its top.

The refrigerant passes from the supply chamber 47 through the pipe 127 to the evaporator through the fitting 126 and from the evaporator through the chamber 125 and fitting 124 to the pipe 122. It will be understood from Figures 9, 10 and 11 that the air circulates through the evaporator through the central passage 128 and the surrounding passages 129. The passages 129 are formed in such a manner that a downwardly directed nozzle 130 is formed and an upwardly directed nozzle 131 in the lower casting 106. The lower casting 106 is provided with apertured lugs 132 in order that it can be secured to the apertured lugs 133 of the evaporator base 134, see Figures 11, 19 and 20. The evaporator base 134 is provided with the standards 135 having the superimposed ribs or lugs 136 and provided with the apertured base flanges 137, whereby it can be secured in position within the refrigerator if desired.

138 designates the ice pans which are provided with the side flanges 139 which are slidable on the lugs 136. The side flanges 139 are provided with the elongated apertures 140. The ice pans are of skeleton formation in order to obtain the maximum freezing effect and so that a cooling surface over the top and the four sides of each pocket 141 in the ice pans is obtained. It will be clear from Figures 20 to 23 inclusive that the body portion of the ice pans is provided with the apertures 142 between two adjoining rows of pockets, and two juxtaposed pockets have an aperture 143 between them. Each pan at its forward end is provided with a grasping handle 144 by means of which it can be inserted into place and withdrawn therefrom. The cold air flows downwardly and passes between the walls of the pockets which contain the water to be frozen. The evaporator is contained within the chamber 145 of the refrigerator 146 which is to be cooled, see Figure 1. It will thus be seen that it is simply necessary to insert the evaporator into the cooling space of the refrigerator and the rest of the mechanism can be located at any desired distance from the refrigerator itself.

When a refrigerating system constructed in accordance with our present invention is employed, substantially the entire interior of the refrigerator can be employed instead of utilizing the ordinary ice receiving chamber for the reception of the evaporator, and in Figures 26 to 37, we have illustrated different constructions of refrigerators which may be advantageously employed. In all of these embodiments 146 designates the casing portion of the refrigerator, the shape and contour of which will vary in accordance with conditions met with in practice.

In Figures 26 to 34 the outer casing is shown as being of rectangular contour while in Figures 36 and 37 it is shown as circular.

Referring first to the embodiments seen in Figures 26, 27 and 28, a wall of the cooling space has connected to it in any desired manner a tube 147 open at each end and spaced from the top and bottom of the refrigerator. In Figures 29, 30 and 31, we have shown a partition 148 spaced from the top and bottom of the refrigerator and having a plurality of apertures 149 through it. In Figures 32 and 34 inclusive, we have shown a block 150 at each end which is spaced from the top and bottom of the refrigerator and provided with a plurality of apertures 151 therethrough. These apertures have ports 152 in their side wall which are controlled by the shutters 153 pivotally connected to their respective block 150 and provided with an actuating handle 154 whereby they can be opened or closed, the extent of such opening being controlled by a ratchet 155 hinged to one of the shutters so that it will lock against the wall 156 and retain the shutters in the position to which they have been opened.

In the embodiments seen in Figures 36 and 37, the refrigerator is provided with a central tube 157 open at its top and bottom and provided with the supporting rings 158 which carry the partitions 159. The evaporator is spaced within the tube 157 and the tube 157 is provided with the radial plates 160 so that different chambers are formed which can be brought into register with the door 161 by revolving the tube 157 and its adjuncts.

The operation of our novel refrigerating apparatus will now be readily apparent to those skilled in this art and is as follows:—

The apparatus works on the well known principle of evaporation of a gas to produce a low temperature and after evaporation the gas is compressed and cooled until it reaches a liquefied condition. The apparatus is en-

tirely automatic in its action and any desired type of refrigerant may be employed.

Assuming now that the various parts are operatively connected, the regulator being connected with a source of electric supply, the condenser being connected with the water supply and the apparatus having been supplied with the requisite lubricant and chemical refrigerant.

The automatic regulator, see more particularly Figures 1 and 13 to 15 inclusive, is operated by change in pressure in the gas chamber of the evaporator due to the change in temperature of the gas. The inner face of the operating diaphragm of the regulator is connected to and forms a part of the volume of the gas chamber and may be located either inside or outside of the ice chest and connected to the gas chamber of the evaporator by a suitable length of pipe, see Figure 1. The temperature of the gas in the gas chamber of the evaporator increases as the heat units are withdrawn from the air being cooled. The temperature of the gas in the gas chamber will vary prior to the variation in temperature of the air passing over the surface of the evaporator.

Assuming now that the temperature of the gas in the gas chamber of the evaporator has increased, thereby increasing the pressure, the diaphragm 70 will move outwardly thereby actuating the push button 89 to throw the switch and close the circuit through the motor 2. This causes the compressor to create a suction in the pipe 122 and a discharge of the liquid chemical through the pipe 127, see Figure 1.

When the pressure in the gas chamber is reduced to a predetermined point, it will be apparent that the contraction of the diaphragm 70 will draw inwardly the yoke 77, thereby actuating the push button 90 to close the circuit. The motor 2, as before explained, is operatively connected with the pistons 20 to effect their reciprocation, and the proper actuation of the valves 13 and 14. The ends of the compressor cylinders are closed by the cap nuts 35, see Figures 3 and 4, which can be screwed in or out to vary the volume or end clearance in the cylinders, thereby varying the pressure and volume of the discharged gases. The compressor is located in the chamber 25 and the fluid is drawn in alternately through the ports 17 and 21 into the compressor cylinders and is compressed and discharged from said cylinders through the same ports. In the position of the parts seen in Figure 4, the gas in the chamber 25 is being drawn through the nozzle 16, ports 17 and passage 18 into the compressor cylinder 19 and after being compressed, is discharged into the chamber 25 upon the cooling coils of the condenser 26 which condenses it into liquid form and it falls to the top of the lubricant which is at the bottom of the condenser chamber 25. The condenser and supply chamber are intercommunicating as before explained by means of the ports 57, 58 and 59, so that in these chambers the contents are arranged in three layers, first the lubricant then the liquid chemical and on top the gas chemical.

Whenever the level of the liquid chemical in the supply chamber 47 rises, the ball float 54 is raised, opening the valve 50, and allowing the liquid chemical to enter through the pipe 127 leading to the evaporator wherein it expands into gas in which process it extracts heat from the atmosphere in the refrigerating space. After it has extracted the requisite amount of heat from the refrigerating space, it is pumped back into the compressor thus completing the cycle. When the desired temperature in the ice chest is attained, the motor is shut down in the manner explained until the temperature in the ice chest has risen above the desired standard of temperature. When the motor and compressor are stopped, the circulating water in the coils of the condenser 26 should be shut off. The water valve 65, see Figure 7, is controlled by the diaphragm 67 one side of which is under atmospheric pressure and the opposite side is under the gas pressure in the supply chamber 47 and the condenser chamber 25. When this gas pressure increases to a certain point the diaphragm 67 is moved outwardly thereby opening the water valve 65 and permitting the cold water to pass from the intake pipe 61 to and through the overlapping coils of the condenser 26. When the pressure in the condenser falls, the diaphragm returns to its normal position, closing the valve 65 and shutting off the supply of water to the condenser coils, see more particularly Figures 2, 7 and 16 to 18 inclusive. The upper part of the evaporator forms a gas dome and is of such capacity as to reduce the variation in pressure due to suction of gas from it and the discharge of chemical to it in order that the pressure in the pipe leading to the temperature regulator will be as free as possible from surging due to the abstraction of gas from the gas chamber of the evaporator or the addition of liquid chemical thereto. The suction nozzle 123, see Figure 10, is arranged at the upper end of the gas chamber so as to prevent the ingress of liquid chemical to the suction pipe, and the delivery nozzle 126 is arranged to deliver the liquid chemical to the gas chamber of the evaporator without danger of its commingling with the gas in the gas chamber but direct its flow downward into the liquid chemical, as will be understood by reference to Figure 10.

The evaporator is constructed in such a manner that it is comparatively small in

size so that it can be readily inserted into the space of the refrigerator which is to be cooled without interfering materially with the storage capacity of the refrigerator. The evaporator is of such shape as to afford a minimum resistance to the upward passage of the gas bubbles and to the downward flow of the cooled air, the cooled air being accelerated by the action of the nozzles in the annular spaces of the evaporator. The molecules of gas arising from the liquid chemical in the chamber 125 have an uninterrupted passage to the gas dome at the top of the evaporator. The cool air passes around the top, sides and bottom of the pockets of the ice pan so that the ice is formed in a minimum amount of time.

The operation of the modified form of regulator seen in Figures 24 and 25 will it is thought be apparent without further description. It will be apparent that the evaporator can be readily inserted in any of the different types of refrigerators as illustrated in Figures 26 to 37 inclusive so that the refrigerator will be automatically maintained at a desired temperature.

It will be apparent from Figures 2 and 3 that when the motor shaft revolves the disc 40 will be revolved thereby creating a flow of the lubricant through the pipe 39 to the grooves 36 and 37 so that the moving parts will be properly lubricated without requiring any attention whatever.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In a device of the character stated, a casing constituting a condenser chamber, a cooling coil in said chamber, a supply chamber adjacent thereto, said chambers having a common wall between them, ports at different levels in said wall, a compressor comprising a double ended compressor piston located within said condenser chamber, compressor chambers in which said piston works, ports between said last named chambers and said condenser chamber, said ports opening to discharge directly against said cooling coil, and an evaporator having its suction end communicating with said compressor and being in valved controlled communication with said supply chamber.

2. In a device of the character stated, a casing constituting a condenser chamber, a supply chamber adjacent thereto, a cooling coil in said condenser chamber, said chambers having a common wall between them, ports at different levels in said wall, a compressor comprising a double ended compressor piston located within said chamber, compressor chambers in which said piston works, ports between said last named chambers and said condenser chamber, said ports opening to discharge directly against said cooling coil, a pipe leading from said supply chamber at a point below the lowest port in said wall to said compressor, and an evaporator having its suction end communicating with said compressor and being in valved controlled communication with said supply chamber.

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