Nov. 26, 1935. J. M. LE GRAND 2,022,048

REFRIGERATING MEANS

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Fig. 1

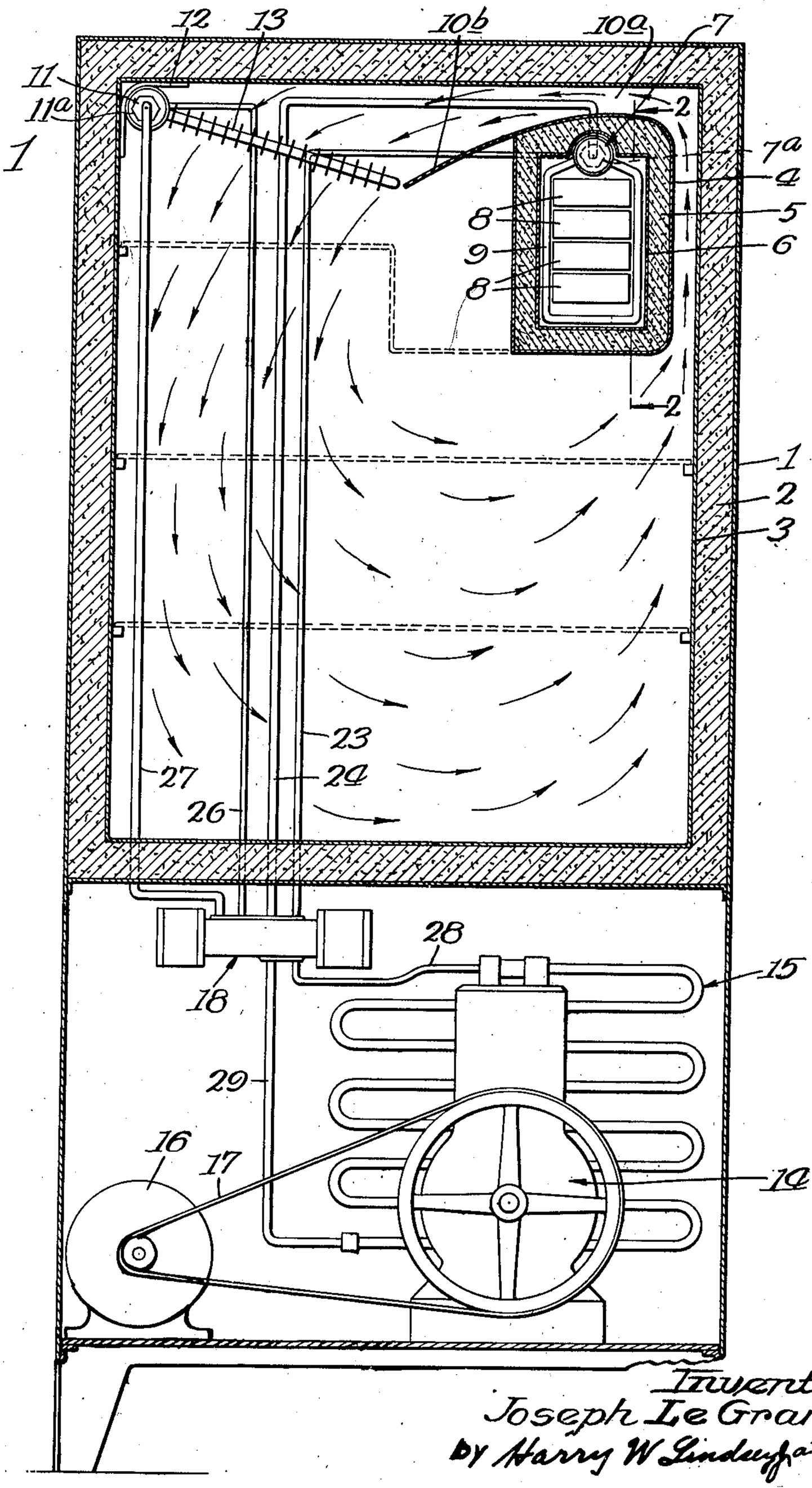

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Fig. 2

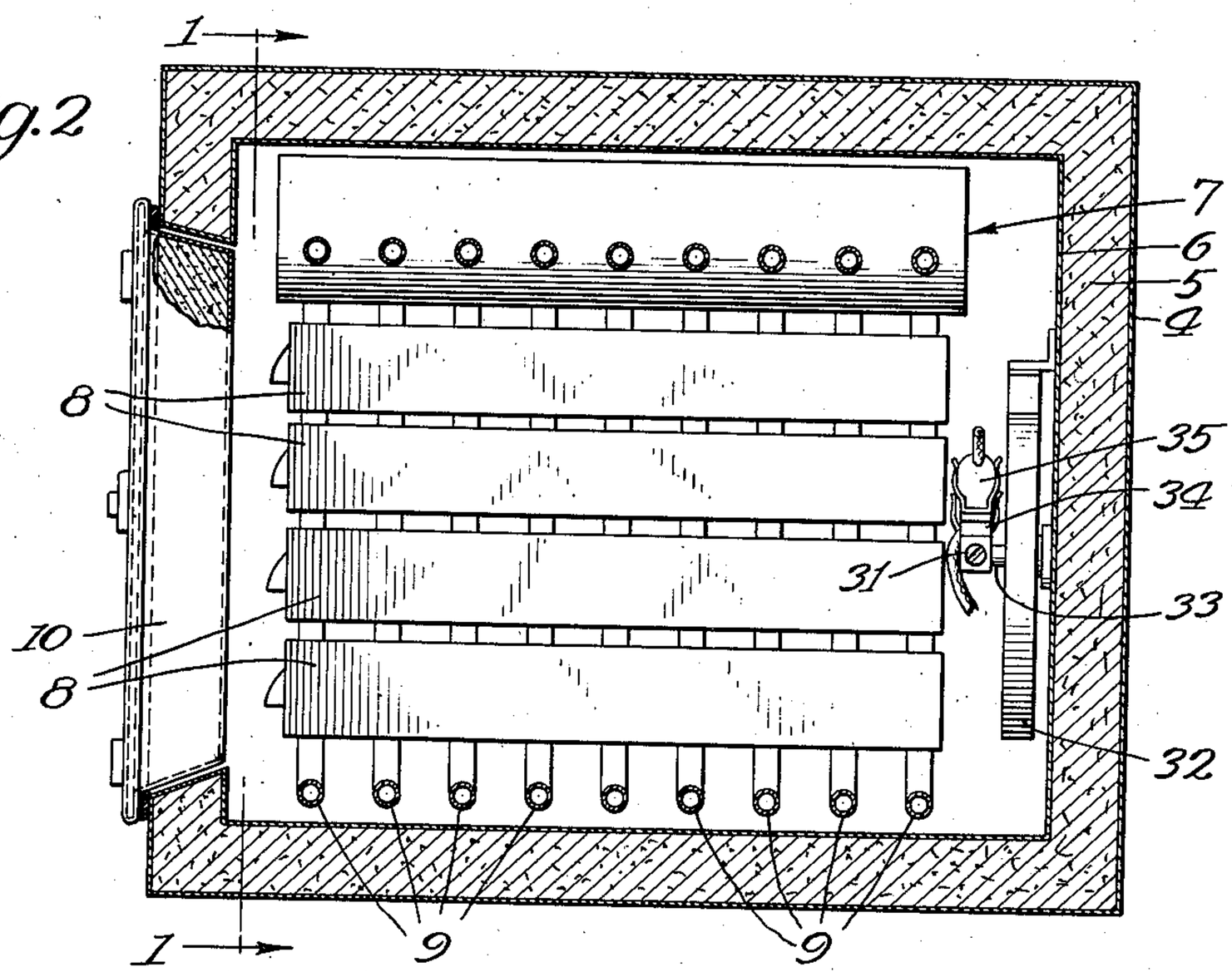

Fig. 3

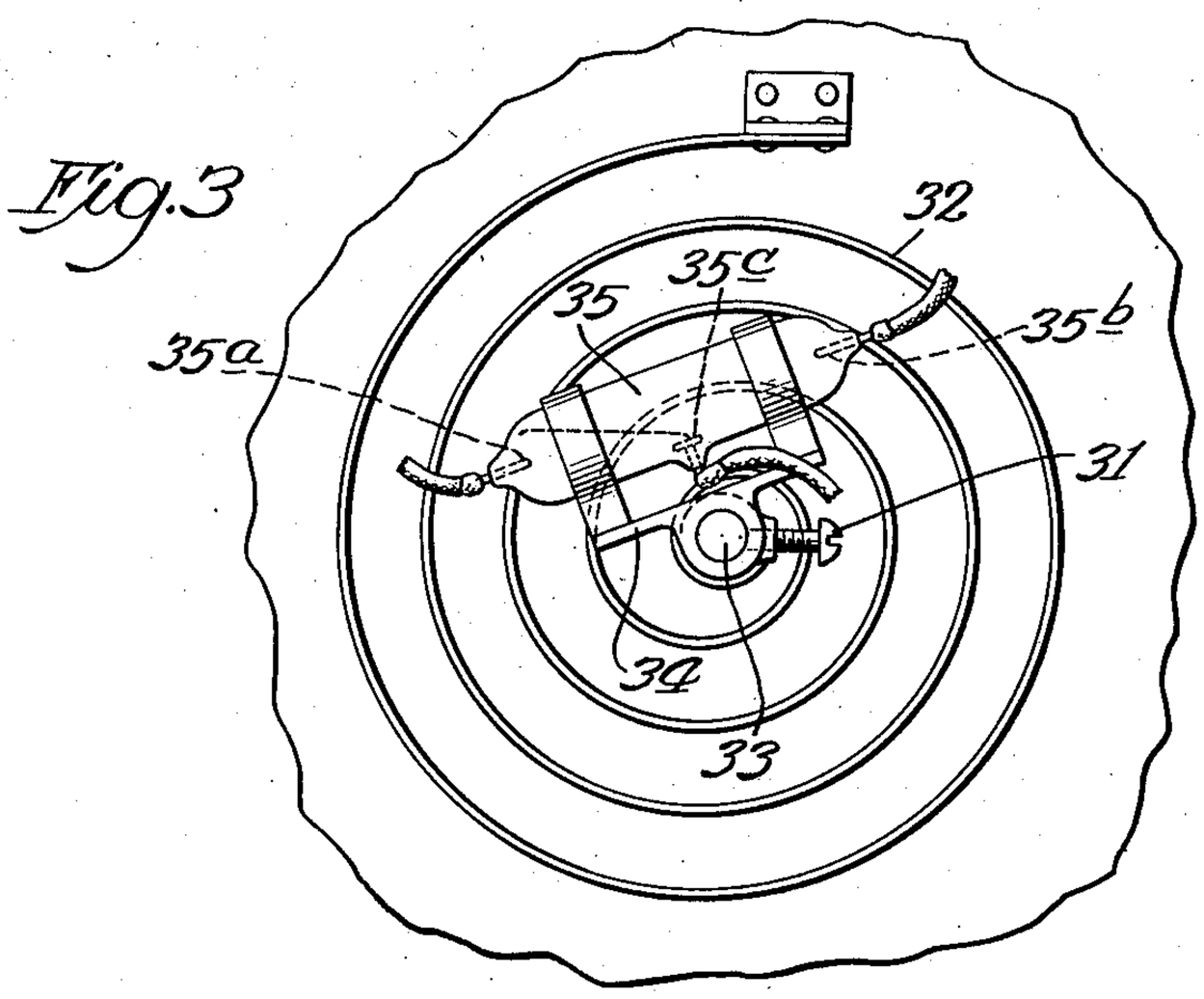

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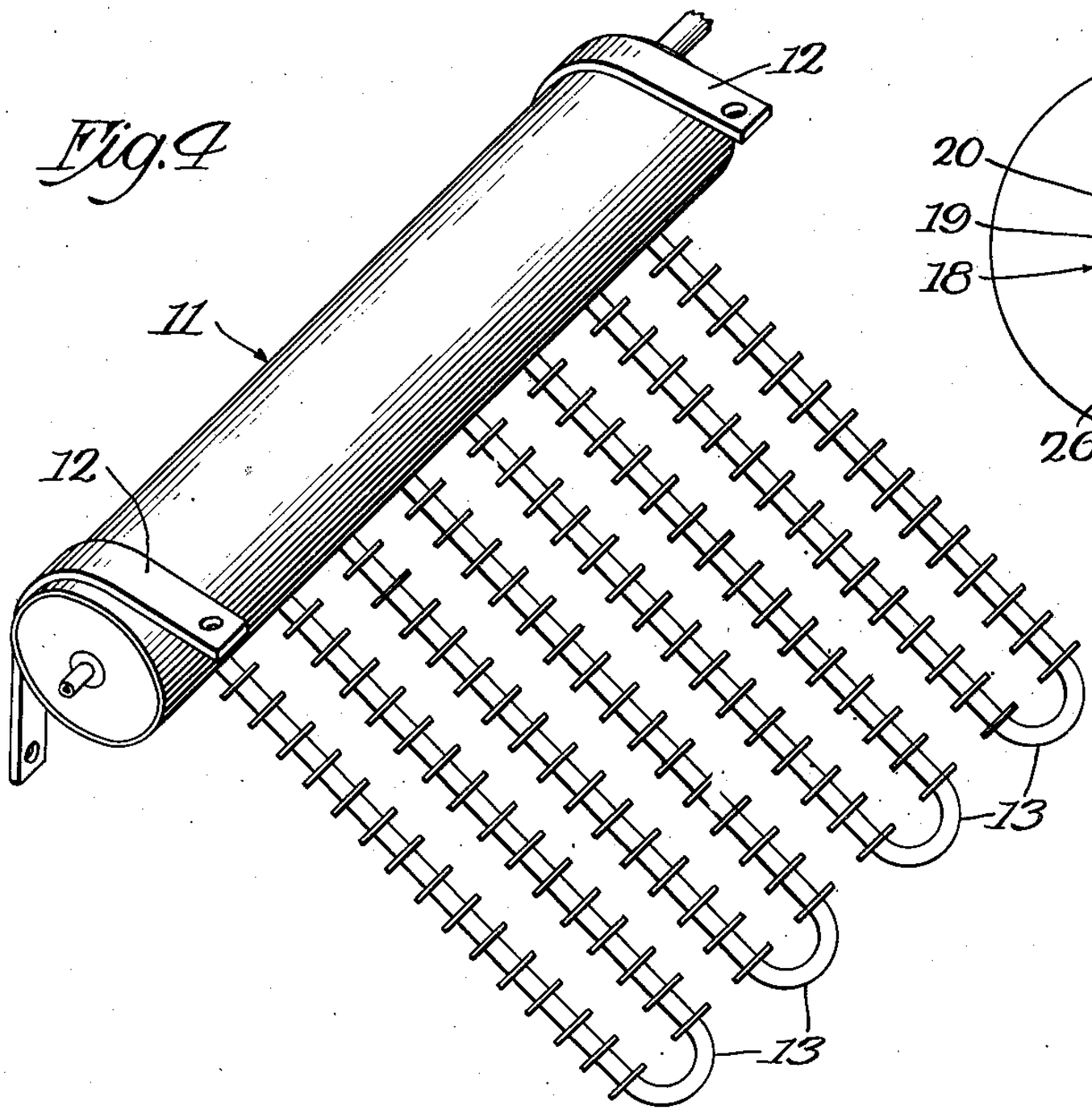
Fig. 4



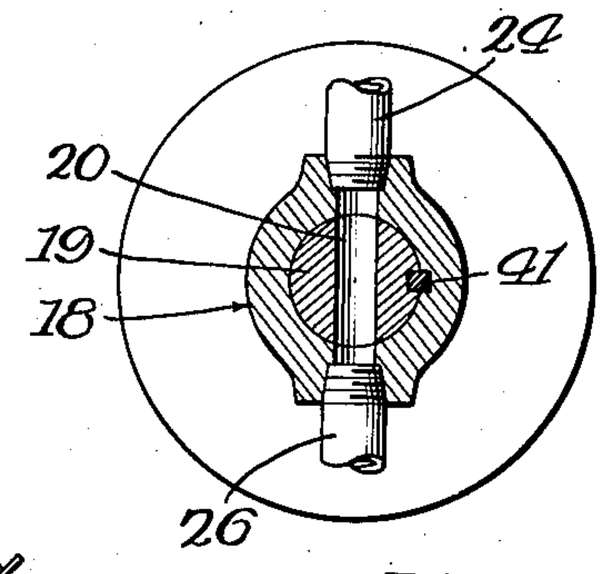
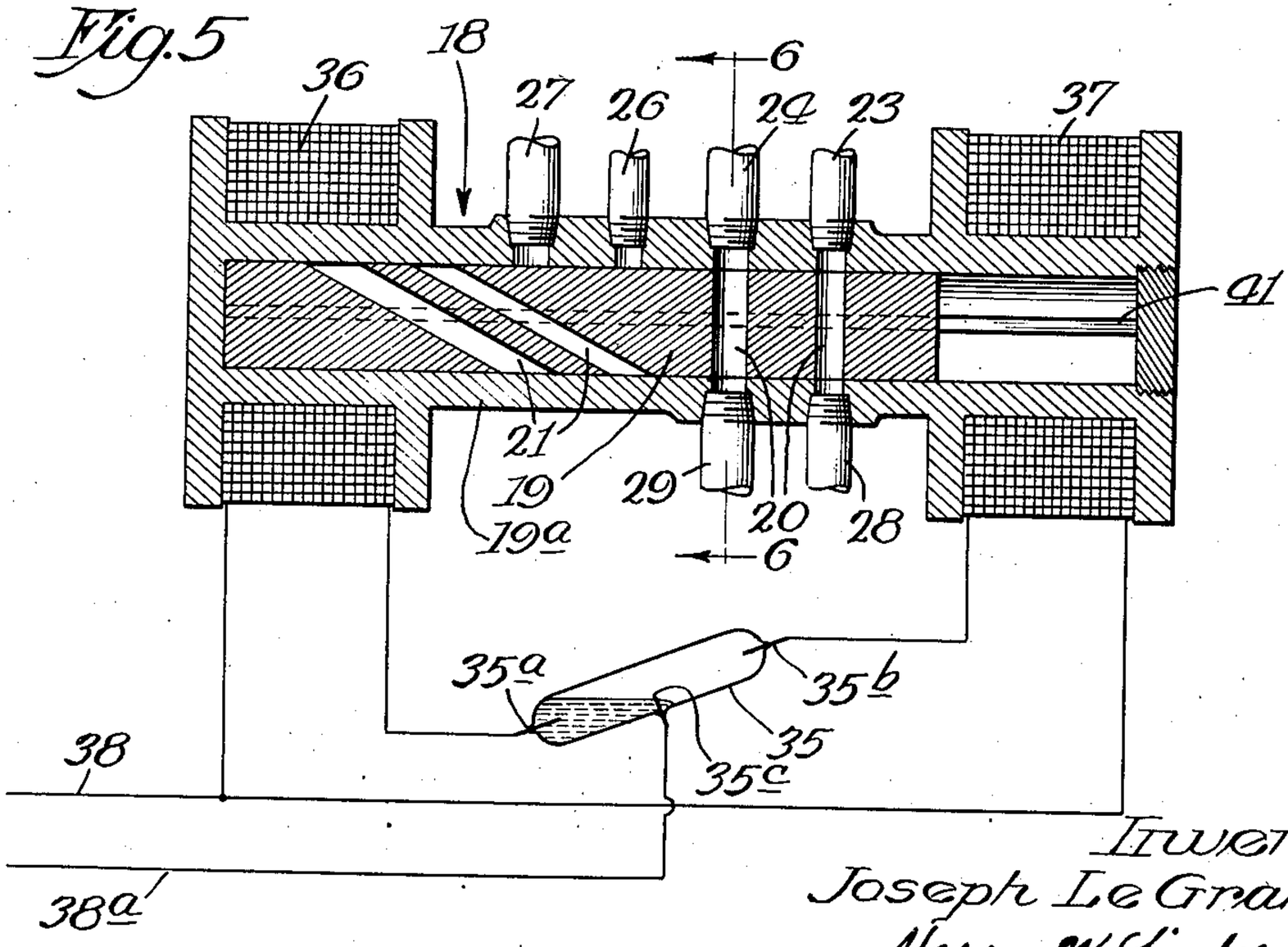


Fig. 6

Fig. 5



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Patented Nov. 26, 1935

2,022,048

UNITED STATES PATENT OFFICE

2,022,048

REFRIGERATING MEANS

Joseph M. Le Grand, Chicago, Ill.

Application June 5, 1933, Serial No. 674,330

9 Claims. (Cl. 62—116)

My invention relates generally to refrigerators, and it has to do more particularly with novel means for improvement in efficiency and the more rapid freezing of ice.

One of the objects of my invention is to provide a novel arrangement of evaporators which may be used alternately.

Another object of my invention is to provide an automatic device for connecting and disconnecting a plurality of evaporators to and from the refrigeration cycle.

Still another object of my invention is to provide an improved evaporator of high efficiency as a heat interchanger for the transfer of heat from air within a refrigerator cabinet to the fluid within the evaporator.

A further object of the invention is to accomplish improved air circulation within refrigerator cabinets.

An important object of my invention is to provide novel and improved means for the rapid freezing of ice.

A further object of the invention is to provide a novel and improved freezing chamber of high efficiency as a heat interchanger for the transfer of heat from water to the fluid within the evaporator of said freezing chamber.

It is well known that practically all domestic refrigerators require an exceptionally long time to freeze only one or two pounds of water. The principal reason for this is due to the fact that the refrigerating capacity of the refrigerating unit of the refrigerator is required to cool the entire refrigerator cabinet while the freezing of ice cubes is in progress. In my invention the cooling of the cabinet food compartment is temporarily discontinued during the process of freezing ice thus permitting the entire capacity to be directed to the purpose of making ice. When the water is frozen into ice the freezing chamber is disconnected automatically, preferably by thermostatic electrical mechanism, from the refrigeration cycle and the evaporator in the food compartment, which is used exclusively for cooling air, is again put into service. In order to fully understand the principles of my invention, it is pointed out that in a small domestic refrigerator the outer case temperature is generally about 75 degrees F. and the inside wall about 45 degrees F. resulting in a mean temperature of 60 degrees F. In the case of a refrigerator cabinet insulated with two inches of insulating material with a thermal conductivity of 0.32 B. t. u. per hour per degree F. per sq. ft. per inch thick, the heat loss through the cabinet walls would be 0.16 B. t. u. per degree per square foot of surface, not including the loss through door fittings, breaker strips and the like. The freezing chamber of my invention is located within the food compartment (which has already been reduced to an air temperature of 45 degrees F.) and this chamber is insulated in a similar manner to the refrigerator, but the operating conditions are considerably different. On the outer wall of this chamber the temperature is approximately 40 degrees F. while the inner wall may be 10 degrees F., resulting in a mean temperature of 25 degrees F., and when insulated with the same insulation as the cabinet the heat transmission through the chamber walls is considerably less, due first to the fact that the temperature difference is approximately a third of that in the case of the main cabinet and, secondly, due to the additional fact that the exposed area for the transmission of heat is only a small fraction of the surface of the main cabinet. I have found in practice that this arrangement gives first class practical results, freezes in a small fraction of the customary time, and that the temperature rise of the air in the refrigerator cabinet occasioned while the unit is occupied in making ice is negligible, being only a few degrees, which is more than compensated for by the increased efficiency due to the novel arrangement provided for the cooling of the cabinet air.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings wherein,

Figure 1 is a vertical sectional view of a refrigerator cabinet having my invention applied thereto, the ice freezing chamber also being shown in section as on the line 1—1 of Fig. 2;

Fig. 2 is a sectional view through the freezing chamber as on the line 2—2 of Fig. 1;

Fig. 3 represents the thermostat and electric switch employed for the purpose of operating the electromagnets shown in Fig. 5;

Fig. 4 is a perspective view of the evaporator in the food compartment;

Fig. 5 is a longitudinal section through the automatic valve for alternately connecting and disconnecting the evaporators; and

Fig. 6 is a cross sectional view taken through the automatic valve substantially on line 6—6 of Fig. 5.

In the drawings, I have illustrated my invention as applied to a domestic electric refrigerator as one embodiment of the invention, but my invention may be applied to other forms of refrigerators, for example, an absorption system of re-

frigeration, mercury vapor system, ejector system, or any other system using an evaporator or refrigerant boiler.

Now referring particularly to drawings, Figure 1 shows a mechanical electrically operated domestic refrigerator, wherein 1 is the outer shell of the cabinet, 2 the cabinet insulation and 3 the inner shell of the cabinet. The freezing chamber, located in the upper right-hand corner is formed of inner and outer walls or shells 4 and 6, which may be formed of metal, and any suitable insulating material 5 between the shells. An evaporator 7 with the expansion valve 7a are mounted within the freezing chamber. The evaporator has tubes 9 which support ice trays 8 which may be of metal or other substance and partitioned to form cubes of ice. The freezing chamber has a door 10 Fig. 2 through which the trays 8 are inserted and withdrawn. The top of the freezing chamber is peculiarly rounded to form, in effect, a Venturi-shaped passage 10a between it and the refrigerator wall above it. A plate 10b projecting from the freezing chamber extends this passage.

The expansion valve 11a and the air cooler or evaporator 11 for cooling the refrigerator food compartment are shown mounted by brackets 12 in the upper left-hand corner of the cabinet in Fig. 1. The evaporator comprises in part a cylindrical tank and tubes or loops 13 provided with fins (Figs. 1 and 4). The compressor 14 of the refrigeration unit, the condenser 15, and an electric motor 16 and belt 17 for operating the compressor are shown mounted beneath the food compartment.

An electrically operated by-pass valve 18 (Figs. 1 and 5) is mounted below the food compartment. The valve comprises a cylindrical casing 19a and a slidable plunger 19 provided with two cross ports 20 and two slanting ports 21. The refrigerant line 23 extends from the valve casing to the evaporator 7 and 24 is the return line from evaporator 7. The refrigerant line 26 runs to evaporator 11 and 27 is the return line from the latter. A pipe 28 connects the valve casing and compressor and a pipe 29 connects the valve casing with one end of the condenser.

The thermostat shown in Figs. 2 and 3, comprises a bimetallic coil 32 secured at its outer end by a bracket to the rear wall of the freezing chamber and is adjustably connected at its inner end by a screw 31 to a bracket 34 which is fast to a shaft 33 journaled in the rear wall of the freezing chamber. The bracket 34 supports a mercoid switch 35.

Mounted at the ends of the valve (Fig. 5) are electric coils 36 and 37 connected to the main line 38 and to the contact members 35a and 35b, respectively, of the switch. The central contact member 35c of the switch is connected to a return line 38a. The coils 36 and 37 are mounted on the ends of the valve casing 18 which is formed of any suitable material. The valve plunger 19, is formed of iron or steel and is keyed to the casing by a key 41 to prevent the plunger from rotating.

In view of the foregoing detailed description, a brief statement of operation should suffice. With the valve plunger 19 in the position shown in Fig. 5, the evaporator 7 in the freezing chamber is in the refrigerating cycle and the water in the ice trays is being frozen. As the temperature in the freezing chamber falls the thermostatic coil 32 tends to unwind and rock or tilt the mercoid switch 35 toward the right. When a low temperature, say 10° F. predetermined by the adjusting of the thermostatic coil, is reached the mercury in the switch moves out of contact with the terminal 35a and into contact with the terminal 35b. Thus the coil 37 will be energized and the coil 36 deenergized so that the valve plunger 19 will shift to the right and bring the ports 21 into position to connect the pipes 26 and 28 and pipes 29 and 27 and thus complete the refrigerating cycle through the evaporator in the food chamber and disconnect the evaporator in the freezing compartment from the refrigerating cycle. As the temperature in the freezing chamber rises, while the evaporator 7 is cut out of the refrigerating cycle, the thermostatic coil tends to wind up and when the high temperature of 32° F., for example, is reached the mercoid switch will be back to the position shown in Figs. 3 and 5 to energize the coil 36 and deenergize the coil 37, whereupon the valve plunger 19 shifts back to the left to its normal position shown in Fig. 5 to disconnect the evaporator in the food compartment and connect the evaporator in the freezing chamber.

The food compartment is only disconnected for a relatively short period of time as the water freezes very quickly. Though the temperature in the food compartment rises slightly during the freezing operation, the efficiency of the refrigeration in the food compartment is not materially lowered because of the novel arrangement which improves the air circulation. This is accomplished by the Venturi passage 10a and the position of the evaporator coils 13. The Venturi passage increases the air circulation and directs the air against the evaporator coils 13.

Modifications may be made without departing from the spirit of my invention.

I claim:

1. In a refrigerator having a cabinet providing a food compartment, an evaporator in said food compartment, an enclosed freezing chamber located within the food compartment and spaced from the walls thereof, an evaporator within the freezing chamber, refrigerating mechanism common to said evaporators, means for alternately connecting and disconnecting the separate evaporators and refrigerating mechanism, and thermostatic means within said freezing chamber for controlling said connecting and disconnecting means to maintain the desired temperature within the freezing chamber.

2. In a refrigerator having a cabinet providing a food compartment, an evaporator in said food compartment, an insulated freezing chamber located within said food compartment, an evaporator within said freezing chamber, refrigerating mechanism common to the two evaporators, and an automatic device for connecting one or the other evaporator to said refrigerating mechanism.

3. In a refrigerator having a cabinet providing a food compartment, an evaporator in said compartment, a casing within said cabinet, an evaporator within said casing, a refrigerating mechanism, a valve for placing one evaporator or the other in the refrigerating cycle, and a thermostatic device for controlling said valve to maintain the desired temperature within the freezing chamber.

4. In a refrigerator having a cabinet providing a food compartment, an evaporator in said compartment, a relatively small insulated chamber in said food compartment, an evaporator in said chamber, ice trays associated with said last mentioned evaporator, a refrigerating mechanism, a valve for alternately placing said evaporators in

the refrigerating cycle, electrical means for operating said valve, and a device controlled by the temperature in said chamber for controlling said electrical means.

5. In a household refrigerator having an insulated cabinet providing a food compartment, an evaporator in said compartment, a relatively small insulated chamber within said food compartment, an evaporator in said chamber, ice trays in said chamber, a refrigerating mechanism, a valve mechanism associated with said refrigerating mechanism, a refrigerant line and a return line between said valve and each evaporator, and means controlled by the temperature within said insulated chamber for operating said valve to alternately open and close the refrigerant and return lines of the two evaporators to maintain the desired temperature within said insulated chamber.

6. In a refrigerator having a cabinet providing a food compartment, an evaporator in said food compartment, an enclosed freezing chamber located within the food compartment, an evaporator within the freezing chamber, refrigerating mechanism common to said evaporators, and means for alternately connecting and disconnecting the separate evaporators and refrigerating mechanism, said freezing chamber being spaced from the interior wall of the cabinet and arranged with respect to the evaporator in the food compartment to enhance the circulation of air around the last mentioned evaporator.

7. In a refrigerator having a cabinet providing a food compartment, an evaporator in said food compartment, an insulated freezing chamber located within said food compartment, an evaporator within said freezing chamber, refrigerating mechanism common to the two evaporators, and an automatic device for connecting one or the other evaporator to said refrigerating mechanism, said freezing chamber being spaced from the interior wall of the cabinet and arranged with respect to the evaporator in the food compartment to enhance the circulation of air around the last mentioned evaporator.

8. In a refrigerator having an insulated cabinet providing a food compartment, an exposed evaporator located in the upper part of said cabinet, a chamber located in the upper part of said cabinet and spaced from the walls of the latter, the top of the chamber being shaped and spaced with relation to the top of the compartment as to form a Venturi-shaped passage between the same, and an evaporator within said chamber.

9. In a refrigerator having an insulated cabinet providing a food compartment, an exposed evaporator mounted in one of the upper corners of the compartment and extending at an angle toward the center of the compartment, a relatively small chamber mounted adjacent the other upper corner of the food compartment and spaced from the walls thereof, the top of the chamber being shaped to provide a Venturi-shaped passage between it and the top of the food compartment, and an evaporator in said chamber.

JOSEPH M. LE GRAND.