

Nov. 21, 1944.

A. D. SIEDLE

2,363,446

REFRIGERATION

Filed June 25, 1941

4 Sheets-Sheet 1

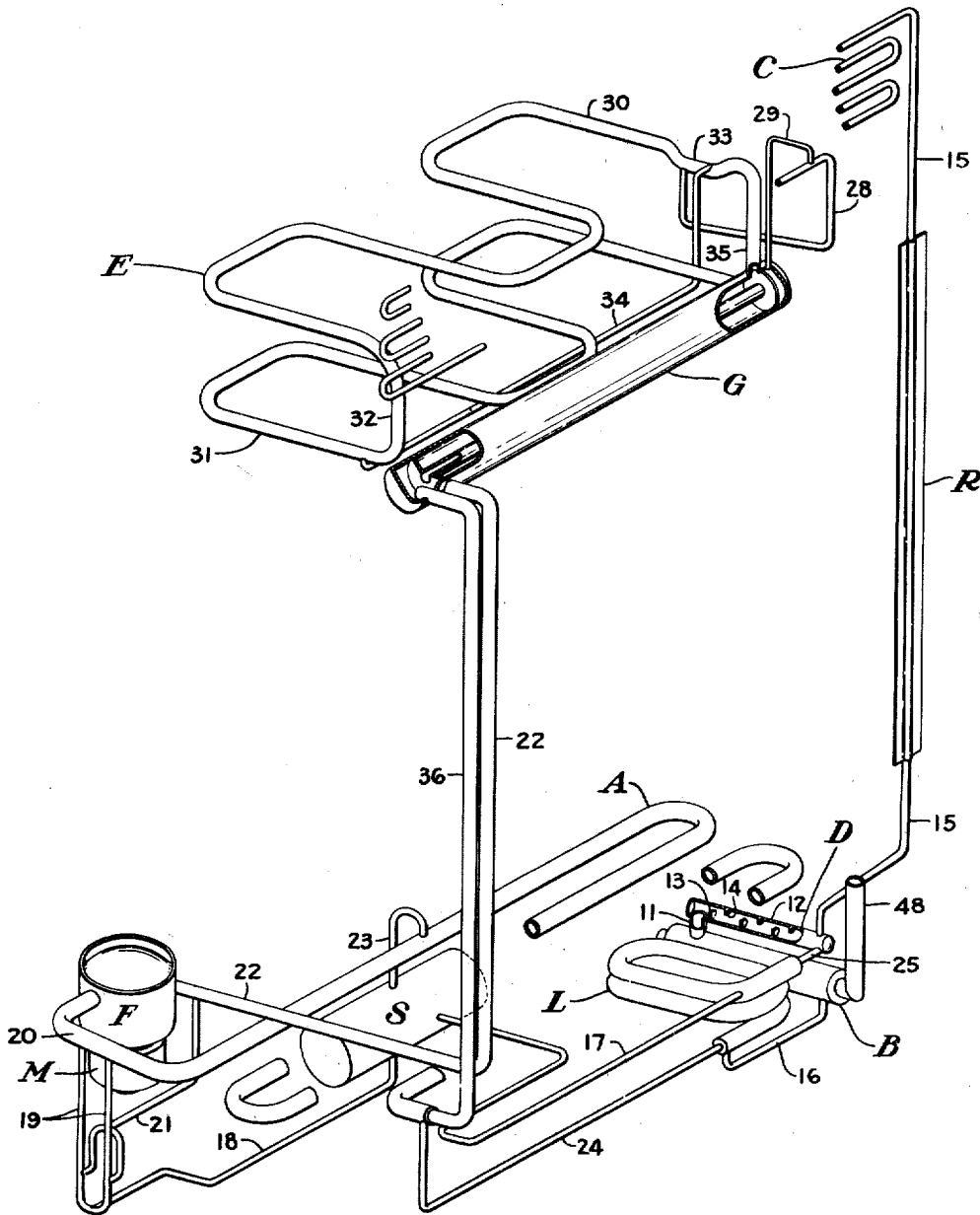


Fig. 1 .

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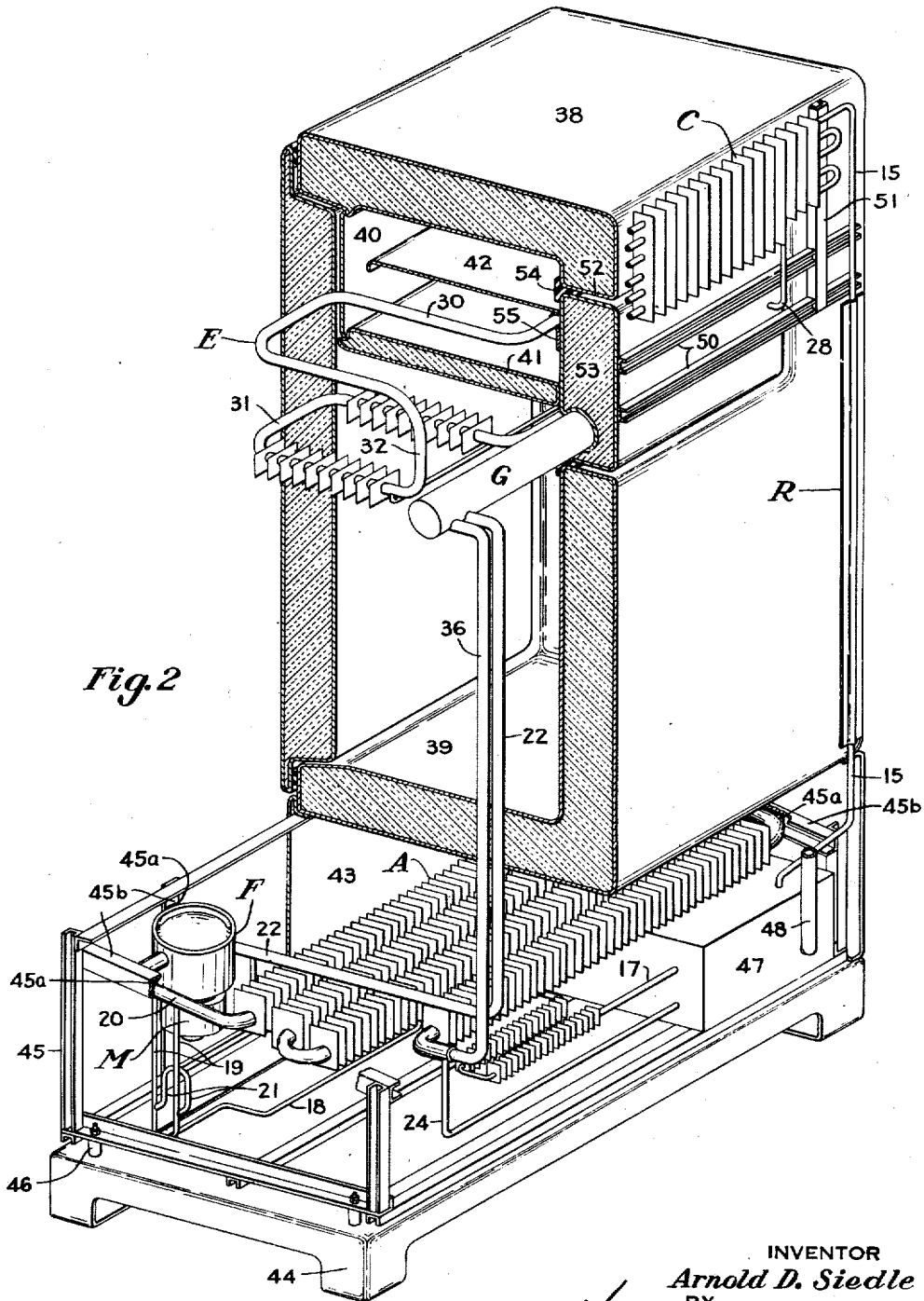
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4 Sheets-Sheet 2



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REFRIGERATION

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4 Sheets-Sheet 3

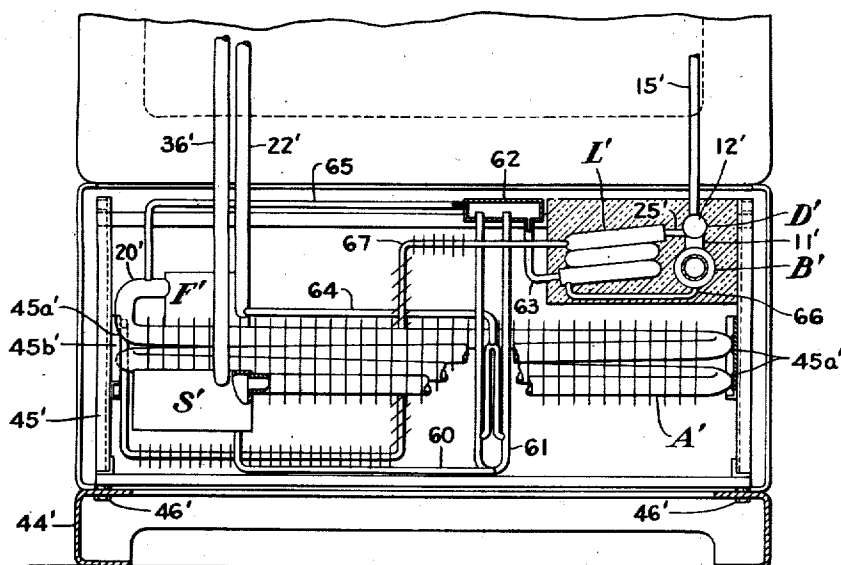


Fig. 3

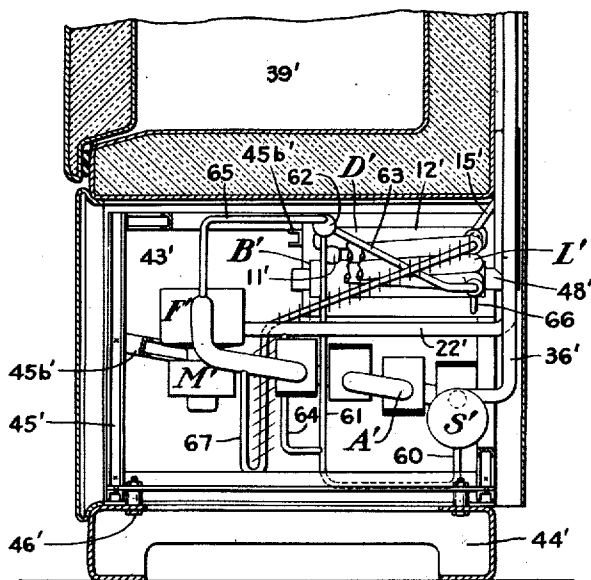


Fig. 4

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4 Sheets-Sheet 4

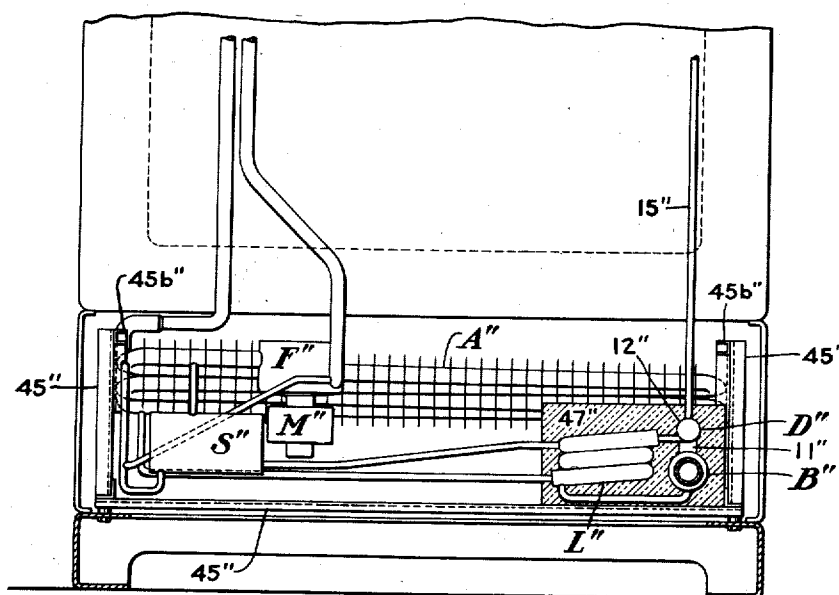


Fig. 5

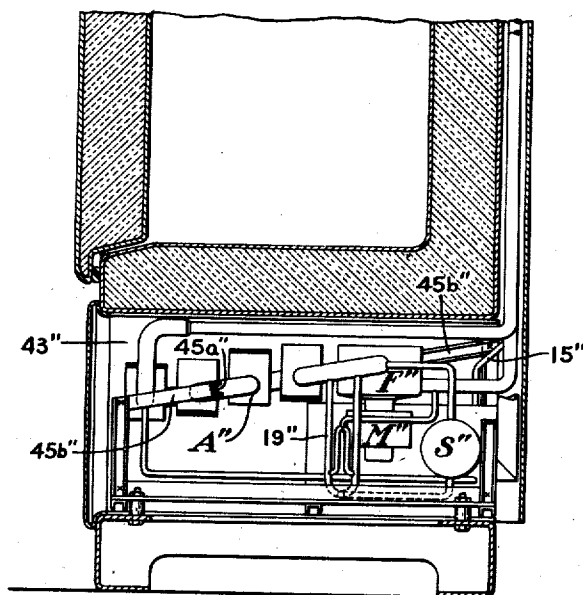


Fig. 6

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2,363,446

REFRIGERATION

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Application June 25, 1941, Serial No. 399,629

16 Claims. (Cl. 62—119.5)

This invention relates to the art of refrigeration and more particularly to an improvement in absorption refrigerating machines of the three-fluid type.

Previous three-fluid machines have certain inherent disadvantageous features of construction among which is the fact that previous machines are assembled on heavy, cumbersome steel supporting frames which extend through the mechanism compartment of the cabinet underlying the storage compartment and through the rear flue of the cabinet to the top wall thereof. Due to the arrangement of previous machines it is necessary to allow a depth of approximately 5" at the rear of the cabinet proper as a flue space to receive certain air-cooled portions of the apparatus and the vertically extending part of the supporting frame. The 5" space complicates the design of the machine because accepted standards of kitchen accessories provide a maximum depth for such devices. It is therefore of material importance to reduce the depth of the air flue in absorption refrigerating machines. Present absorption refrigerating machines are also characterized by great weight, a large part of which is directly attributable to the supporting frame for the mechanism.

Another factor tending to obstruct and to increase the depth of the cooling air flue in present absorption refrigerating machines is the necessity for allowing space for the gas heat exchanger within the flue or, failing that, to provide a rather complex cabinet structure which is constructed to receive a vertically extending heat exchanger in the rear wall thereof.

Accordingly, it is an object of the present invention to provide an absorption refrigerating machine construction which will eliminate the vertically extending portion of the machine supporting frame and which will allow the remaining portions of the frame structure to be light in weight.

It is a further object of the present invention to provide an absorption refrigerating machine structure so arranged that the space at the rear of the cabinet need be only approximately half the depth of prior constructions and which will be so arranged that this space need accommodate only a portion of the air-cooled parts of the machine and will be entirely free of cumbersome frame structure.

It is a further object of the invention so to arrange the refrigerating apparatus underlying the food storage compartment as to reduce the necessary cabinet space required to house such appa-

ratus and particularly to improve the cooling of the absorber.

It is a further object of the invention to provide an absorption refrigerating machine of the three-fluid type so constructed and arranged that the gas heat exchanger thereof may be housed within the window insert provided to close the evaporator receiving opening in the storage compartment and to eliminate special cabinet construction for the reception of the gas heat exchanger without requiring the provision of a deep air flue at the rear of the cabinet to provide space for the gas heat exchanger.

It is a further object of the present invention to provide an absorption refrigerating machine so constructed and arranged that the absorber may be positioned in the lowest portion of the apparatus below the level of the boiler whereby to improve the cooling of the absorber, to shorten the length of the waste products of combustion flue for the boiler and to shorten the connection between the boiler and the condenser.

Other objects and advantages of the invention will become apparent as the description proceeds when taken in connection with the accompanying drawings in which:

Figure 1 is a perspective view, partly in section, of the refrigerating mechanism per se.

Figure 2 is a perspective view, partly in section, illustrating the relationship of the refrigerating mechanism of Figure 1 to a cabinet structure with which it is to be associated.

Figure 3 is a partial rear elevational view, partly in section, of a modified arrangement of the mechanism with respect to the cabinet.

Figure 4 is a side elevational view, partly in section, of the construction illustrated in Figure 3.

Figure 5 is a broken rear elevational view, partly in section, of another form of the invention, and

Figure 6 is a sectional view of the mechanism illustrated in Figure 5.

Referring now to the drawings in detail and first to Figure 1 thereof, there is illustrated an absorption refrigerating mechanism comprising a boiler B, an analyzer D, an air-cooled rectifier R, a tubular air-cooled condenser C, an evaporator E, a gas heat exchanger G, a tubular inclined air-cooled absorber A, a liquid heat exchanger L, a solution reservoir S and a circulating fan F which is driven by a suitable electrical motor M. These elements are suitably connected by various conduits to form a plurality of gas and liquid circuits, to be more fully

described hereinafter, which define a complete refrigerating machine.

The above described apparatus will be charged with a suitable refrigerant, such as ammonia, an absorbent therefor, such as water, and a pressure equalizing medium which is inert with respect to the refrigerant and to the absorbent, preferably a dense inert gas such as nitrogen.

A suitable heater will be provided for heating the boiler B and electrical connections will be provided for energizing the circulating motor M.

The apparatus will be provided with a suitable control mechanism to govern the operation thereof by governing the energization of the boiler heater and the motor to control the production of refrigeration. A preferred control mechanism is disclosed in Patent No. 2,228,343, dated January 14, 1941, issued to Curtis C. Coons.

The application of heat to the solution in the boiler B liberates refrigerant vapor therefrom. The vapor so liberated passes from the boiler through the conduit 11 into the analyzer D. The analyzer comprises an elongated horizontal vessel or conduit 12 which is provided interiorly thereof with spaced lower baffles 13 and spaced upper baffles 14 positioned intermediate the lower baffles whereby strong solution flowing backwardly to the boiler passes over the baffles 13 and the vapors passing through the analyzer are baffled and directed toward the surfaces of the solution pools formed by the baffles 13. Alternately the baffles 14 may be arranged to project slightly into the solution pools formed by the baffles 13 whereby to cause the vapors repeatedly to bubble into and out of the rich solution.

After traversing the analyzer the resulting refrigerant vapors flow through the conduit 15 which includes the air-cooled rectifier R to the condenser C.

The lean solution formed in the boiler by the liberation of refrigerant vapor is conveyed therefrom to the solution reservoir S by way of the conduit 16, the liquid heat exchanger L and the conduit 17. The solution is then conveyed from the reservoir S to the absorber by means of the conduit 18 and the twin gas lift pump 19 which discharges into the suction conduit 20 of the circulating fan from which the solution may flow by gravity into the upper portion of the tubular air-cooled absorber A. Pumping gas for operating the pump 19 is supplied thereto by the conduit 21 which is connected between the discharge conduit 22 of the fan F and the pump 19 below the liquid level normally maintained in the reservoir S. The upper portion of the reservoir S is vented through the conduit 23 to the absorber suction conduit 20 in order that the gas lift pump may have the full pressure differential of the circulating fan available to operate the same.

The weak absorbing solution supplied to the absorber flows downwardly therethrough under the influence of gravity in counterflow relationship with a rich mixture of pressure equalizing medium and refrigerant vapor which is supplied to the lower end of the absorber in a manner to be described hereinafter. The solution absorbs the refrigerant vapor content of the mixture and the resulting heat of absorption is rejected to cooling air flowing across the exterior walls of the absorber conduit. The rich solution formed in the absorber drains to the lower portion thereof from which point it is conveyed to the end of the analyzer D remote from the

conduit 11 by means of the conduit 24, the liquid heat exchanger L, and the conduit 25, thus completing the absorbing solution circuit.

The refrigerant vapor supplied to the condenser is liquefied therein and flows from the bottom portion of the condenser to the evaporator through the U-shaped liquid sealing conduit 26. The condenser side of the sealing conduit 26 is vented to the inert gas circuit by means of a vent conduit 29.

The evaporator E comprises a substantially horizontal sinuous, elongated conduit 30 which is adapted to underlie and support ice freezing trays in a manner to be described hereinafter. The conduit 30 is serially connected to a similar subjacent air-cooling evaporator conduit 31 by means of a vertically extending connecting conduit 32. The conduit 30 is provided with a depressed portion 33 into which the conduit 28 discharges. A drain conduit 34 is connected between the top portion of the depressed part 33 of the conduit 30 and the portion of conduit 31 which joins the conduit 32 for a purpose to be described hereinafter.

The lean inert gas which discharges from the circulating fan into the conduit 22 is conveyed by said conduit to the gas heat exchanger G from which it is conveyed by way of the conduit 35 to the evaporator coil 30. The apparatus is so constructed and arranged that the inert gas traverses the evaporator conduit with a velocity and pressure sufficient to circulate liquid refrigerant through these conduits positively by the frictional dragging action of the inert gas on the liquid refrigerant.

The positive circulation of the liquid refrigerant by the inert gas improves the heat transfer between the fluids within the conduit and the walls thereof; it improves the evaporation of the liquid; it renders the apparatus independent of inaccuracies in leveling which may be present due to minor inaccuracies in manufacture and to installation of the apparatus upon a non-level surface.

The inert gas first propels the liquid refrigerant through the low temperature freezing conduit 30 and then through the air-cooling conduit 31. It will be appreciated that the concentration of the refrigerant vapor and inert gas mixture progressively increases as the same traverses the evaporator conduits wherefore the evaporator conduit 31 will operate at a higher temperature than the conduit 30. Further, the quantity of liquid refrigerant reaching the conduit 31 is limited due to evaporation occurring in conduit 30. It is preferred so to design the apparatus that the conduit 31 will operate at a temperature above the freezing point of water in order to prevent collection of frost thereupon.

After traversing the conduit 31 the rich mixture of inert gas and refrigerant vapor and any unevaporated material are discharged into the gas heat exchanger G from which they are conveyed by means of the conduit 36 to the lower end of the absorber A. The traverse of the inert gas through the absorber A and then to the circulating fan F has been described hereinabove.

Referring now to Figure 2 the arrangement of the refrigerating mechanism just described is illustrated as the same is installed in a domestic refrigerator cabinet. The cabinet comprises an insulated structure 38 which encloses a food storage chamber 39 and a superposed freezing chamber 40 which is separated from the chamber 39 by means of an insulated partition 41. It is read-

ily apparent from Figure 2 that the evaporator conduit 30 is positioned approximately at the mid-portion of the chamber 40 and supports a plate 42 which is constructed of heat conducting material and is adapted to underlie and support refrigerating receptacles and the like. The evaporator conduit 31 is finned to provide the same with a large heat abstracting surface and is positioned in the upper portion of the compartment 39 under the partition 41.

The cabinet structure also includes a mechanism compartment 43 which comprises a space beneath the chamber 39 and above the base structure 44 of the cabinet. The base structure 44 is open to allow free access of cooling air into the chamber 43 from the floor level.

A light weight metal box frame 45 rests upon and is secured to the base structure 44 by means of suitable cushion bolts 46.

The boiler, analyzer and liquid heat exchanger are enclosed in a suitable body of insulating material 47 which rests upon the frame 45 in the rear right hand corner thereof as is viewed in Figure 2. The finned pre-cooling conduit 17 extends laterally of the body 47. The finned absorber conduit extends upwardly and forwardly above the body 47 and beneath the lower wall of the chamber 39. Each absorber conduit is inclined oppositely with respect to the adjacent conduits though the absorber as a whole generally inclines downwardly from the front toward the rear portion of the cabinet. Thus, the absorber conduit which joins the conduit 30 is the lowest of the conduits and the absorber conduit joining the conduit 20 is the highest of the absorber conduits.

The motor circulator unit is positioned in the forward left hand corner of the chamber 43 as viewed in Figure 2, whereby the same is completely removed from the path of cooling air flowing across the absorber.

A suitable waste products of combustion flue 48 extends up the back wall of the cabinet structure; for convenience in illustration only the lower part of this flue is illustrated, in order to discharge the waste products adjacent the top portion of the cabinet and away from the path of cooling air for the condenser.

The absorber and motor-circulator unit are secured to the frame 45 by welds, indicated at 45a, and by short supporting bars, indicated at 45b, which are welded to the frame and to the supported elements.

A suitable sub frame 50 is arranged adjacent the upper portion of the cabinet on the back wall thereof. This sub frame may be attached to the cabinet by bolts, machine screws or the like. The condenser C is attached to the upwardly extending arms 51, only one of which is shown, or the frame 50 in any suitable manner.

The sub frame 50 is positioned around the periphery of the condenser C and its dimension normal to the rear wall of the cabinet is less than the dimension of the condenser fins normal to the rear wall of the cabinet.

The rear wall of the cabinet structure 38 is provided with an opening 52 to admit the evaporator, the plates 42 and the panel 41. The gas heat exchanger G is embedded in the lower front portion of an insulated closure element 53 which fits in the opening 52. The gas heat exchanger need not be completely embedded in the panel 53 though it may be so embedded if desired. As shown, the gas heat exchanger is partially ex-

posed to the atmosphere in the chamber 39 which is at a temperature close to the temperature of the gas heat exchanger. The panel 53 is also secured to the frame 50. A suitable sealing gasket 54 is provided to close the joint between the panel 53 and the walls of the opening 52.

The evaporator is very rigid because of the heavy conduit required to withstand the system pressure and is partially supported by the gas heat exchanger G. The rear portions of the evaporator conduit are further supported by suitable brackets 55 which are carried by the panel 53.

The rectifier R and conduit 15 extend upwardly along the right hand side of the rear wall of the cabinet and the conduits 22 and 36 extend upwardly along the left hand side of the rear wall of the cabinet as viewed in Figure 2.

The dimension of the conduits 15, 22 and 36 and of the rectifier R normal to the cabinet rear wall does not exceed the dimension of the condenser fins normal to the cabinet rear wall. Consequently, the air flow space at the rear of the cabinet need not have a depth greater than that required to accommodate the condenser fins.

By reason of this construction all framework with the exception of the sub frame is completely eliminated from the rear of the cabinet and the depth of the space which must be provided for cooling air flow and for housing the condenser and rectifier need be only approximately one-half that provided in prior machines. In assembling the apparatus a suitable fixture will be provided in order to hold the upper part of the refrigerating mechanism in position while it is inserted in the cabinet and the sub frame 50 is secured.

The cooling air will flow into the chamber 43 through the open bottom of the base structure 44 across the pre cooler and air cooled absorber and then upwardly along the back wall of the cabinet over the rectifier and air-cooled condenser. The narrow space provided at the rear of the cabinet is ample for the flow of cooling air. Though the condenser and rectifier may be exposed in the manner illustrated, they may also be enclosed by suitable light weight sheet metal panel structure which will surround the same and define a flue for cooling air flowing upwardly along the rear wall of the cabinet structure.

Referring now to Figures 3 and 4, a modified form of the invention is disclosed. Certain portions of this form of the invention are identical with that disclosed in Figures 1 and 2 and these portions are given the same reference characters primed.

In this form of the invention the conduit 36' opens into the solution reservoir S' which now connects directly to the bottom portion of the absorber A'. In this form of the invention the reservoir S' contains rich solution which has discharged from the absorber. The rich solution in the reservoir S' is conveyed therefrom into the analyzer by means of the conduit 60, the twin gas lift elevating pump 61, the gas separation chamber 62, conduit 63, liquid heat exchanger L', and conduit 25'. Pumping gas is supplied to the twin gas lift pump 61 by means of the conduit 64 which connects between the conduit 22' and the twin lift pump 61 below the liquid level of the reservoir S'. The pumping gas discharging from the pump 61 into the separation chamber 62 is conveyed therefrom to the suction conduit 20' of the fan by means of a conduit 65.

In this form of the invention the lean solution

flows by gravity directly from the boiler to the upper portion of the absorber by way of the conduit 66, the liquid heat exchanger L' and the finned air cooled pre-cooling conduit 67.

In this form of the invention it will be noted that the boiler-analyzer liquid heat exchanger assembly is positioned above the absorber circulator fan assembly, and that the absorber lies very close to the base frame 44' of the cabinet structure. The absorber A' is inclined upwardly and forwardly from the rear of the cabinet structure and the individual tubes thereof are of course inclined to provide for gravity flow of the absorption solution.

The boiler assembly, absorber and motor-circulator are supported on the frame 45' by welds 45a' and by welded bars 45b'.

The upper portions of the apparatus may be identical with that shown in Figures 1 and 2 and therefore has not been illustrated in Figures 3 and 4.

The form of the invention illustrated in Figures 3 and 4 has certain advantages among which are the fact that the absorber, being the lowest portion of the apparatus, has completely unobstructed air flow thereacross and is positioned to receive the relatively very cool air normally found along the floor of the space in which the refrigerator is placed. Moreover, by placing the absorber at the lowest possible level, the circulation of air over all the air-cooled portions of the apparatus is enhanced because the chimney effect is greater; that is, the warm air column ascending along the rear wall of the refrigerator cabinet structure is longer than that found in an arrangement such as that disclosed in Figures 1 and 2, for example. It is also possible to decrease the length of the flue 48' and the length of the conduit connecting the boiler and rectifier with the construction disclosed in Figures 3 and 4. It is also apparent from Figures 3 and 4 that the flow of air to and from the absorber is completely unobstructed.

Referring now to Figures 5 and 6 another modification of the invention is disclosed. This form of the invention is identical with that disclosed in Figures 1 and 2 except for the relative positions and locations of the parts. Therefore, all parts of the mechanism of Figures 5 and 6 are given the same reference characters as corresponding parts in Figures 1 and 2 double primed.

In the form of the invention disclosed in Figures 5 and 6, the absorber A'' is positioned in the front portion of the compartment 43'' and is positioned with the lowest portion thereof at the front of the compartment whereby the absorber as a whole is inclined upwardly and rearwardly in the compartment 43''. As is readily seen from Figures 5 and 6, the circulating fan motor assembly is positioned rearwardly of the absorber and laterally of the boiler liquid heat exchanger housing 47''.

The boiler assembly, absorber and motor-circulator are supported on the frame 45'' by welds 45a'' and by welded bars 45b''.

This form of the invention, like that disclosed in Figures 3 and 4, permits complete unobstructed flow of cooling air across the absorber. This form of the invention is also advantageous in that the same permits the height of the compartment 43'' to be reduced appreciably over the height required with the arrangement of Figures 1 to 4. This is due to the fact that the highest portion of the absorber in

the arrangement of Figures 5 and 6 is positioned adjacent the boiler analyzer assembly, whereas in the arrangement disclosed in Figures 1 and 2 the lowest portion of the absorber must be positioned at an elevation above the boiler-analyzer heat exchanger assembly and in the arrangement of Figures 3 and 4 the boiler-analyzer heat exchanger assembly overlies the highest portion of the absorber; that is, in the arrangement of Figures 5 and 6 the absorber and boiler-analyzer assemblies may be said to overlap vertically whereas they are spaced vertically in the arrangements of Figures 1 to 4.

It is also characteristic of the form of the invention of Figures 5 and 6 that the gas lift pump 19'' is not called upon to elevate the absorbing solution to a very great height. In the form of the invention illustrated in Figures 1 and 2 the absorbing solution must be elevated a distance equal to the combined height of the boiler-analyzer assembly and of the absorber, whereas with the arrangement of Figures 5 and 6 the pump need elevate the absorbing solution a distance equal only to the combined height of the boiler-analyzer and of one section of the absorber.

The arrangement of Figures 5 and 6 is particularly advantageous in certain types of cabinet in which it is desirable to reduce the space occupied by the machinery to the lowest possible value and to lower the bottom wall of the storage chamber as far as possible. Such a construction permits the net cubical content of the storage chamber to be increased without increasing the overall dimensions of the cabinet in any direction.

It will be appreciated that all forms of the invention herein disclosed provide a refrigerating mechanism of great compactness and high cooling efficiency. These mechanisms are further characterized by a construction which totally eliminates the heavy, cumbersome frame which extends along the back wall of the cabinet in prior constructions. This last results in an appreciable saving of weight and bulk and allows the air space at the rear of the cabinet to be reduced to approximately one-half its former value.

The arrangement of the gas heat exchanger herein disclosed eliminates the necessity for a complex construction of the rear cabinet wall and also eliminates the necessity for extra insulation of the heat exchanger. In the arrangement disclosed the heat exchanger simply fits in a recess in the inside wall of the closure element of the evaporator receiving opening of the cabinet.

It is a characteristic of the present invention that refrigeration will be produced in both coils of the evaporator substantially instantaneously with energization of the boiler heater and of the circulator motor. This last result is produced in the following manner: When the circulating fan and heater are de-energized at the end of any operative cycle of the apparatus, a certain quantity of refrigerant liquid is present in the coils 30 and 31 and in the condenser. The liquid discharging from the condenser fills the depressed portion 33 of the conduit 30 to the level of the overflow conduit 34 and then flows into the lower coil 31, thus providing an extra large discharge of refrigerant in the coil 31. Thus, when the apparatus is subsequently energized the refrigerant liquid in the coils 30 and 31 is sufficient to maintain the same in

operation until liquid refrigerant begins to discharge from the condenser anew.

While the invention has been illustrated and described herein in considerable detail, it is not to be limited thereto but various changes may be made in the construction, arrangement and proportion of parts without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Refrigerating apparatus comprising an insulated refrigerating chamber structure, a mechanism chamber underlying said refrigerating chamber structure and having no greater horizontal dimensions, an absorption refrigerating mechanism associated with said structure including an evaporator in said refrigerating chamber, a condenser positioned on a vertical wall of said structure, and a generator and an absorber in said mechanism chamber, a sub frame arranged to support said condenser on said structure, and a second sub frame arranged to support said absorber and said generator in said mechanism compartment.

2. In a refrigerator, a cabinet structure having an insulated refrigerating chamber and a mechanism chamber underlying and within the vertical projection of the horizontal dimensions of said refrigerating chamber, said refrigerating chamber having an evaporator receiving opening in a wall thereof and a removable closure in said opening, a refrigerating apparatus associated with said cabinet including an evaporator in said refrigerating chamber, an absorber in said mechanism chamber, a gas heat exchanger positioned in a recess in the inner face of said closure, means connecting said gas heat exchanger to said absorber and said evaporator for circulation of inert gas, a generator in said mechanism chamber, means providing for circulation of absorption solution between said generator and said absorber, a condenser positioned adjacent said closure and connected to receive refrigerant vapor from said generator and to discharge refrigerant liquid to said evaporator, and a shallow light weight frame securing said condenser, said closure and said evaporator to said cabinet structure.

3. In a refrigerator, a cabinet structure having an insulated refrigerating chamber and a mechanism chamber underlying said refrigerating chamber, said refrigerating chamber having an evaporator receiving opening in a wall thereof and a removable closure plate in said opening, a refrigerating apparatus associated with said cabinet including an evaporator in said refrigerating chamber, an absorber in said mechanism chamber, means providing for circulation of inert gas between said evaporator and said absorber, a generator in said mechanism chamber, means providing for circulation of absorption solution between said generator and said absorber, a condenser positioned adjacent said plate and connected to receive refrigerant vapor from said generator and to discharge refrigerant liquid to said evaporator and a shallow light weight frame terminating above said mechanism chamber securing said condenser, said plate and said evaporator to said cabinet structure, all the elements of said refrigerating apparatus except said condenser lying within said insulated refrigerating chamber structure or the vertical projection of the horizontal dimensions thereof.

4. In a refrigerator, a cabinet structure having an insulated refrigerating chamber and a

mechanism compartment underlying said refrigerating chamber, refrigerating apparatus of the absorption type associated with said cabinet including a generator and an absorber in said compartment and entirely underlying said refrigerating chamber structure, an evaporator in said chamber, a condenser consisting of a plurality of substantially horizontal tubes provided with vertically extending heat rejecting fins, said condenser being arranged along a vertical wall of said cabinet with the fins positioned normal to said vertical wall and closely adjacent thereto, means providing for circulation of absorption solution between said absorber and said generator, means lying against said vertical wall for conducting refrigerant vapor from said generator to said condenser, means for conveying refrigerant liquid from said condenser to said evaporator, and means providing for circulation of inert gas between said evaporator and said absorber including gas conveying means extending along said vertical wall and extending outwardly thereof a lesser distance than said fins, and means for securing said condenser to said cabinet having a dimension normal to said vertical wall less than the dimension of said fins normal to said vertical wall.

5. In a refrigerator, a cabinet structure having a refrigerating chamber and a mechanism chamber underlying said refrigerating chamber, absorption refrigerating apparatus associated with said cabinet structure including a generator and an absorber in said mechanism chamber connected for circulation of absorption solution therebetween, an evaporator in said refrigerating chamber connected with said absorber for circulation of inert gas, means for liquefying refrigerant vapor produced in said generator and for supplying the liquefied refrigerant to said evaporator, said absorber comprising a plurality of finned air cooled conduits positioned in said mechanism chamber adjacent the bottom thereof, said generator being positioned in the upper part of said mechanism chamber above said absorber, and said cabinet structure being constructed and arranged to provide for flow of cooling air into said mechanism chamber below said absorber.

6. In a refrigerator, a cabinet structure having a refrigerating chamber and a mechanism chamber underlying said refrigerating chamber, absorption refrigerating apparatus associated with said cabinet structure including a generator, a horizontally positioned analyzer and an absorber in said mechanism chamber connected for circulation of absorption solution therebetween, an evaporator in said refrigerating chamber connected with said absorber for circulation of inert gas, means for liquefying refrigerant vapor produced in said generator and for supplying the liquefied refrigerant to said evaporator, said absorber comprising a plurality of finned air cooled conduits positioned in said mechanism chamber adjacent the bottom thereof, said generator and said horizontally positioned analyzer being positioned in the upper part of said mechanism chamber above said absorber, and said cabinet structure being constructed and arranged to provide for flow of cooling air into said mechanism chamber below said absorber.

7. Absorption refrigerating apparatus of the three-fluid type embodying an evaporator, a condenser, a generator, an absorber and a power driven gas circulator connected in circuit, said apparatus being characterized by the fact that

said absorber comprises a plurality of air cooled conduits serially connected for flow of absorption solution therethrough by gravity, said generator being positioned above said absorber, said circuit including means for conveying absorption solution from said generator to said absorber by gravity, a gas lift circulator connected to elevate absorption solution from said absorber to said generator, means for supplying pumping gas to said gas lift pump, and means for conducting pumping gas which has traversed said circulator to a portion of the apparatus normally containing gas.

8. In a refrigerator, an insulated refrigerating chamber structure and a mechanism chamber underlying and within the vertical projection of the horizontal dimensions of said refrigerating chamber, absorption refrigerating apparatus associated with said structure including a generator and an absorber in said mechanism chamber connected for circulation of absorption solution therebetween, an evaporator in said refrigerating chamber connected with said absorber for circulation of inert gas, means for liquefying refrigerant vapor produced in said generator and for supplying the liquefied refrigerant to said evaporator, said absorber comprising a plurality of finned air cooled conduits positioned in said mechanism chamber and extending upwardly and rearwardly thereof, said generator being positioned in the lower portion of said chamber rearwardly of said absorber, said chamber, said generator and said absorber being so constructed and arranged that a free path of flow of cooling air is provided into said chamber generally vertically across said absorber and then generally horizontally above said generator to the rear of said structure.

9. In a refrigerator, an insulated refrigerating chamber structure and a mechanism chamber underlying and within the vertical projection of the horizontal dimensions of said refrigerating chamber, absorption refrigerating apparatus associated with said structure including a generator and an absorber in said mechanism chamber connected for circulation of absorption solution therebetween, an evaporator in said refrigerating chamber connected with said absorber for circulation of inert gas, an air cooled condenser positioned on the rear wall of said structure and connected to receive refrigerant vapor from said generator and to supply refrigerant liquid to said evaporator, a base frame positioned within said mechanism chamber and secured to said structure, said generator and said absorber being secured to said base frame, and a sub-frame supported on the rear wall of said structure for supporting said condenser and said evaporator.

10. In a refrigerator, a cabinet structure having a refrigerating chamber and a mechanism chamber underlying and within the vertical projection of the horizontal dimensions of said refrigerating chamber, absorption refrigerating apparatus associated with said cabinet structure including a generator and an absorber in said mechanism chamber connected for circulation of absorption solution therebetween, an evaporator in said refrigerating chamber overlying said generator and said absorber, power driven means positioned in said mechanism chamber under said evaporator connected to circulate an inert gas between said evaporator and said absorber, a condenser positioned adjacent the rear wall of said cabinet structure rearwardly of said gen-

erator and connected to receive refrigerant vapor from said generator and to supply refrigerant liquid to said evaporator.

11. In a refrigerator, a cabinet structure having an insulated refrigerating chamber and a mechanism compartment underlying and within the vertical projection of the horizontal dimensions of said refrigerating chamber, refrigerating apparatus of the absorption type associated with said cabinet including a boiler assembly in said mechanism compartment comprising a substantially horizontal generator and a substantially horizontal analyzer overlying said generator, a plurality of elongated finned absorber conduits in said compartment, means providing for circulation of absorption solution between said absorber and said boiler assembly, an evaporator in said chamber, a condenser positioned along a vertical wall of said cabinet and connected to said boiler assembly and to said evaporator, a sub-frame attached to said cabinet for supporting said condenser and said evaporator, and a base frame in said mechanism compartment supporting said absorber and said boiler assembly.

12. In a refrigerator, a cabinet having a refrigerating compartment and a mechanism compartment underlying said refrigerating compartment, an opening formed in a wall of said refrigerating compartment for insertion of an evaporator, a removable closure element in said opening, a substantially horizontal partition extending from said closure element and arranged to divide said refrigerating compartment into an upper freezing chamber and a lower food storage chamber, refrigerating apparatus of the three-fluid absorption type associated with said cabinet including an evaporator having a section in each of said chambers, a substantially horizontal gas heat exchanger positioned in a recess in said closure element facing inwardly of said refrigerating compartment, and means for supplying refrigerant liquid to said evaporator.

13. In an absorption refrigerating apparatus of the three-fluid type, a generator and an absorber connected for circulation of absorption solution, a condenser connected to receive refrigerant vapor from said generator, an evaporator having a freezing section and a space cooling section, means for circulating an inert gas through said freezing and space cooling evaporator sections with sufficient pressure and velocity to propel refrigerant liquid therethrough and for circulating inert gas through said absorber, said freezing evaporator section having a liquid trapping part, means for conducting refrigerant liquid from said condenser to said liquid trapping part of said evaporator, and means for conducting liquid above a fixed level in said liquid trapping part of said freezing evaporator section to said space cooling evaporator section.

14. In an absorption refrigerating apparatus of the three-fluid type, a generator and an absorber connected for circulation of absorption solution, a condenser connected to receive refrigerant vapor from said generator, an elongated evaporator conduit shaped to form a pair of vertically spaced substantially horizontal coils, one of said coils being formed with a section depressed below the plane of the remaining part thereof to form a liquid trap, means for circulating an inert gas through said evaporator conduit with sufficient force to circulate refrigerant therethrough and for circulating inert gas through said evaporator, means for conducting refrigerant liquid from said condenser to said

depressed section of said evaporator, and means for conducting refrigerant liquid collecting above a fixed level in said depressed section to the evaporator coil not including said depressed section.

15. In a refrigerator, a cabinet structure including an insulated refrigerating chamber and a mechanism chamber arranged entirely below said insulated refrigerating chamber, absorption refrigerating apparatus associated with said cabinet structure including an evaporator in said flat tubular air cooled refrigerating chamber, a generator and air cooled absorber in said mechanism chamber, a refrigerant liquefying element lying along and closely adjacent a vertical wall of said refrigerating chamber and having its minimum dimension normal to said vertical wall, and means connecting said generator, absorber, evaporator and liquefying means in circuit, said refrigerating apparatus being so constructed and arranged that no part thereof projects laterally of said cabinet structure beyond said liquefying means.

16. In a refrigerator, a cabinet structure in-

cluding an insulated refrigerating chamber and a mechanism chamber arranged entirely below said insulated refrigerating chamber, absorption refrigerating apparatus associated with said cabinet structure including an evaporator in said refrigerating chamber, a generator and an air cooled absorber in said mechanism chamber, a generator and an air cooled absorber in said mechanism chamber, a subframe supporting said generator and said absorber in said mechanism chamber, a flat tubular refrigerant liquefying element lying along and closely adjacent a vertical wall of said refrigerating chamber and having its minimum dimension normal to said vertical wall, a subframe supporting said liquefying means on said cabinet structure, and means connecting said generator, absorber, evaporator and liquefying means in circuit, said refrigerating apparatus and said subframes being so constructed and arranged that no part thereof projects laterally of said cabinet structure beyond said liquefying means.

ARNOLD D. SIEDLE.

CERTIFICATE OF CORRECTION.

Patent No. 2,363,446.

November 21, 1944.

ARNOLD D. SIEDLE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 7, first column, line 12, claim 15, strike out the words "flat tubular air cooled" and insert the same before "refrigerant", line 14, same claim; and second column, lines 7 to 9 inclusive, claim 16, strike out "a generator and an air cooled absorber in said mechanism chamber,"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of April, A. D. 1945.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.

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