July 18, 1944. N. ERLAND AF KLEEN 2,353,714

ABSORPTION REFRIGERATING APPARATUS

Filed Dec. 17, 1940 2 Sheets-Sheet 1

FIG. 1

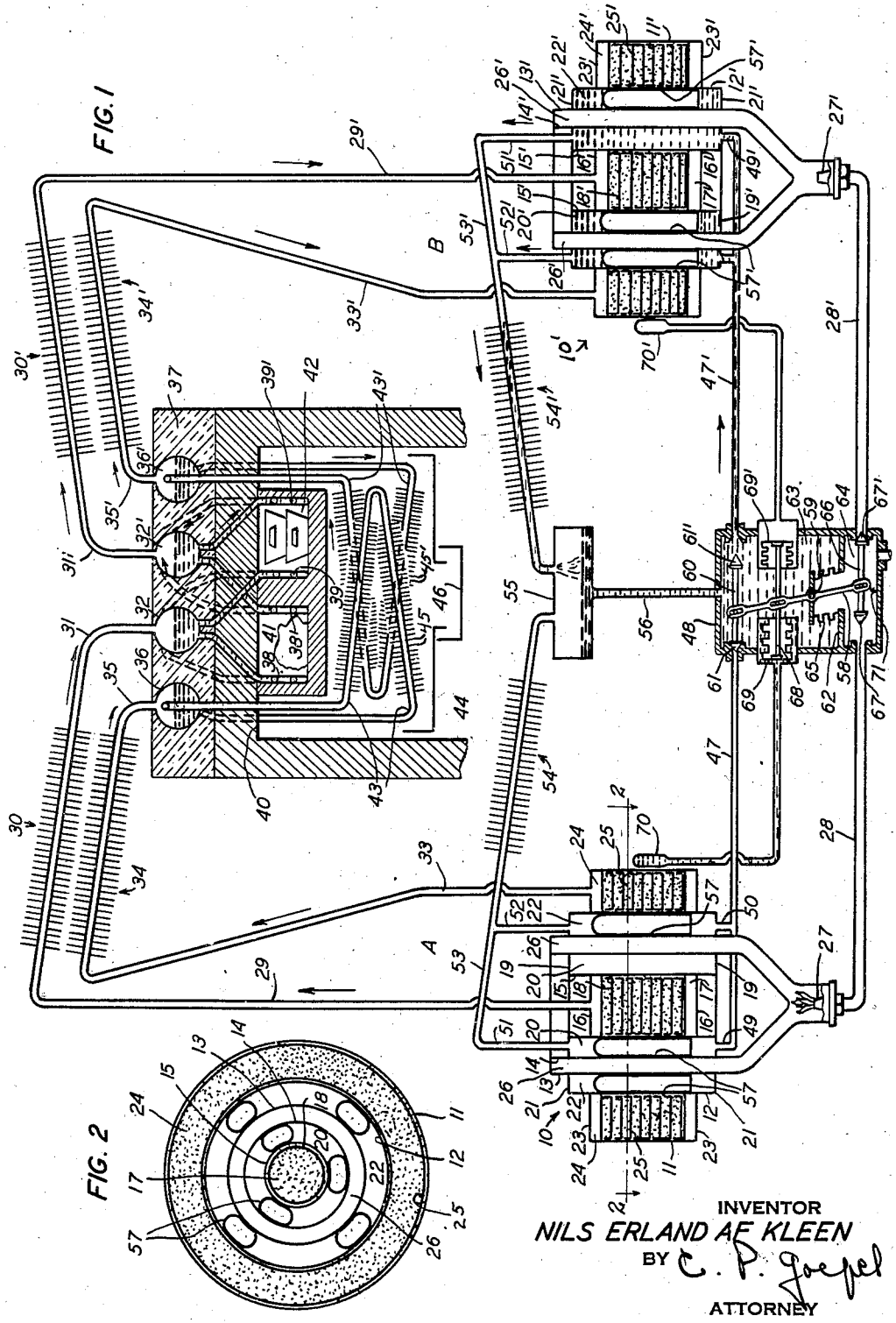


FIG. 2

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ABSORPTION REFRIGERATING APPARATUS

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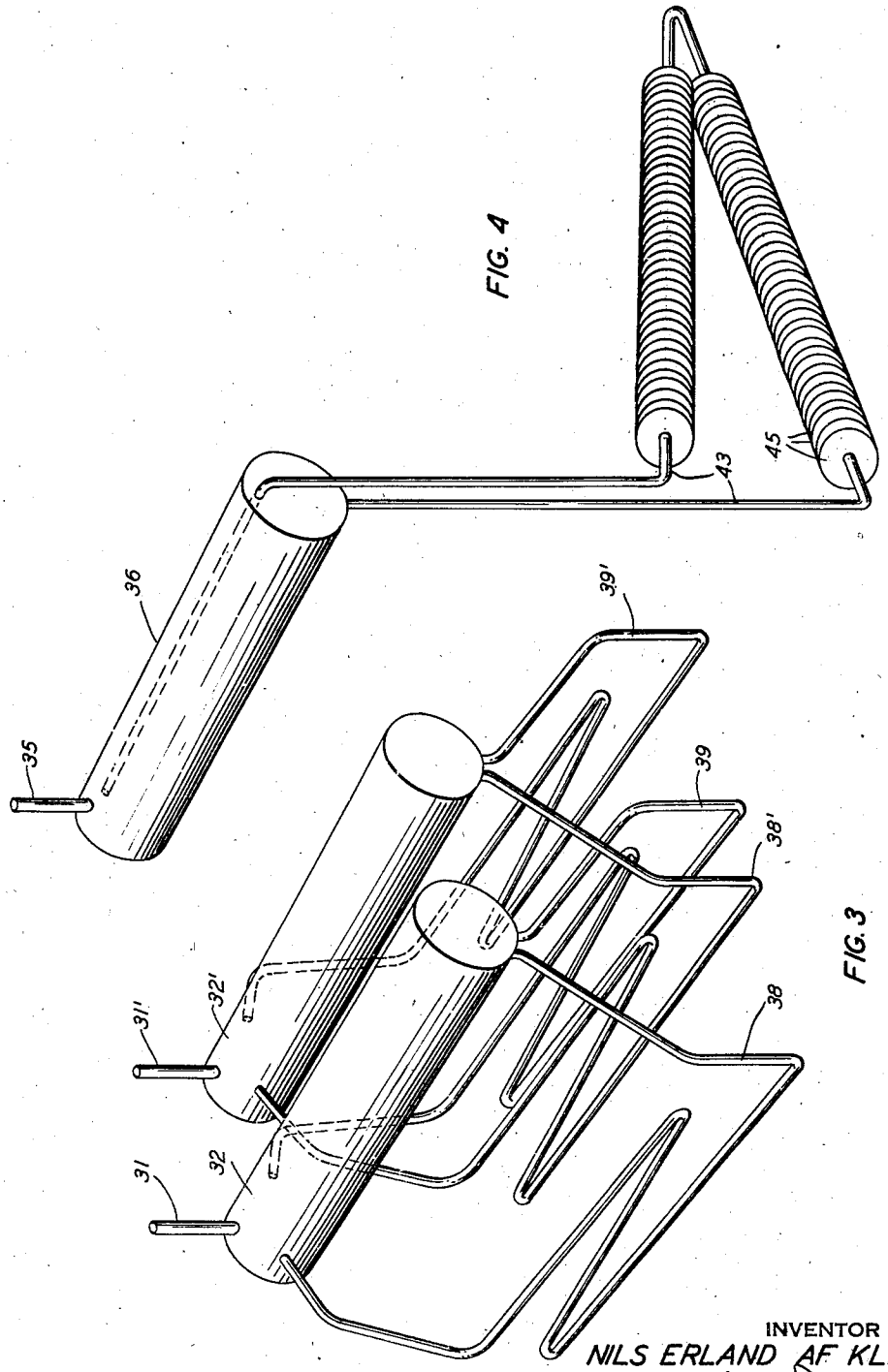


FIG. 4

FIG. 3

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ABSORPTION REFRIGERATING APPARATUS

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Application December 17, 1940, Serial No. 370,431

17 Claims. (Cl. 62—118)

This invention relates to new and useful improvements in absorption refrigerating apparatus having one or more intermittently operating units and is directed more particularly to a boiler absorber for generator-absorber construction where each unit includes a plurality of separate circulating systems for cooling respectively different zones or regions, such for example, as the ice tray compartment and the storage compartment in a refrigerator cabinet.

In my co-pending application, Serial No. 293,477, filed September 5, 1939, for Absorption or adsorption refrigerating apparatus, patented May 5, 1943, under No. 2,319,806, there is disclosed an evaporator system having one portion for freezing ice in an ice tray compartment, or the like, and another portion for cooling a food storage space. Due to the difference in the amount of refrigeration required for cooling a storage space and for freezing ice, the amount of refrigerant evaporated in the evaporators and reabsorbed in the generator-absorbers must be increased over that normally used in refrigerating apparatus of this type. As a consequence, the capacity of the boiler absorber assembly must be increased to take care of the increased quantity of solid absorbent necessary.

The absorbent material is usually contained in annular trays in the boiler absorber and in another co-pending application, Serial No. 286,011, filed July 22, 1939, for Refrigerators, now Patent Number 2,326,130, certain dimensions are given for the construction of these trays which are essential to a proper operation of the refrigerating unit. In order to remain within these limits and yet provide a boiler absorber capable of absorbing the increased amount of refrigerant required for cooling the different zones, the longitudinal dimension of the boiler absorber must correspondingly be augmented to take care of additional trays. Because of the limited space afforded in refrigerator cabinets for the refrigerating equipment, especially where two units are used to produce substantially continuous refrigeration, the increased longitudinal dimension required renders the boiler absorber impractical for use in standard-sized refrigerator cabinets.

The present invention overcomes the above noted disadvantages and consists of a boiler absorber assembly having inner and outer absorbent chambers each preferably constructed in accordance with dimensions set out in my above mentioned co-pending application Serial No. 286,011, whereby the over-all dimensions of the boiler absorber assembly is reduced to take care of the increased amount of refrigerant.

The invention consists also in a boiler absorber assembly having one absorbent chamber for a refrigerant used to cool one zone, and another absorbent chamber for a refrigerant used to cool another zone.

The new and novel features of the invention will be hereinafter more fully set forth in the following description, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

Referring to the drawings in which numerals of like character designate similar parts throughout the several views—

Fig. 1 is a diagrammatic view of a refrigerating apparatus having two intermittently operating units, each embodying my new boiler absorber assembly, certain parts being shown in section and certain parts broken away;

Fig. 2 is a horizontal transverse section through the boiler absorber assembly of one of the units taken on line 2—2 of Fig. 1;

Fig. 3 is a detailed perspective view of the two evaporator systems of the two units for the freezing compartments of the cabinet, and

Fig. 4 is a similar view of one of the other evaporator systems of the units, for the storage chamber in the cabinet.

In the drawings, referring more particularly to Fig. 1, the refrigerating apparatus illustrated comprises a pair of intermittently operating units generally indicated as A and B, and inasmuch as both of these units are similar in all respects to one another, only the parts of unit A will be described in detail by reference to one set of numerals, the corresponding parts of unit B being distinguished by the prime of the numerals used in describing unit A. This unit includes my improved boiler absorber assembly generally represented by the numeral 10 consisting of five concentric cylindrical shells 11, 12, 13, 14 and 15, spaced radially inwardly from one another. Intermediate its longitudinal extremities, the inner shell 15 has welded or otherwise suitably secured thereto a pair of transverse walls 16 spaced longitudinally from one another to form a closed inner circular chamber 17 having a series of trays 18 containing solid absorbent material capable of absorbing a gaseous refrigerant during the absorption period of operation of the unit and of giving up such refrigerant during the generating period of operation thereof.

The longitudinal extremities of the inner shell

15 terminate in radially outwardly extending walls 19 welded to the cylindrical shell 14 intermediate the longitudinal extremities of the latter to form a closed annular jacket 20 surrounding and in heat exchange relation with the circular chamber 17. The cylindrical shell 12 terminates at its longitudinal extremities in radially inwardly extending walls 21 welded to the cylindrical shell 13 intermediate the ends of the latter to form a second closed annular jacket 22. Similarly, the longitudinal extremities of the outer shell 11 terminate in radially inwardly extending walls 23 secured to the cylindrical shell 12 adjacent the ends of the latter to form an outer annular chamber 24 surrounding and in heat exchange relation with annular jacket 22. As in the case of the inner chamber 17, outer annular chamber 24 is also provided with a series of trays 25 containing solid absorbent material.

The trays 18 in chamber 17 and the trays 25 in chamber 24 are preferably constructed in accordance with the dimensions set out in my co-pending application Ser. No. 286,011; namely, the radial width of trays 25 and the diameter of trays should be 30–35 mm. at the utmost, while the axial distance between the trays in each of chambers 24 and 17 should not exceed 5 mm.

The cylindrical shells 13 and 14 form an annular flue 26 for the passage of a heating medium, such for example, as hot gases generated by any suitable gas burner or the like 27, disposed below the double boiler absorber 10.

Fuel is admitted to the gas burner 27 through pipe conduit 28 during the generating period of operation of the unit to heat the boiler absorber assembly 10 and expel the gaseous refrigerant from both the inner and outer absorbent chambers 17 and 24, respectively. From the inner chamber 17, the gaseous refrigerant passes upwardly through conduit 29 leading to a condenser 30 where the refrigerant is condensed and is delivered through pipe 31 into a collecting vessel 32 disposed in the upper portion of the refrigerator cabinet. The gaseous refrigerant expelled from the outer chamber 24 passes upwardly through a conduit 33 into a condenser 34 and is delivered through pipe 35 to a second collecting vessel 36 arranged adjacent vessel 32.

When the burner 27' of unit B becomes active to heat the boiler absorber assembly 10', the gaseous refrigerant from the inner chamber 17' passes upwardly through conduit 29' into condenser 30' and is delivered through pipe 31' into a collecting vessel 32', while the gaseous refrigerant from the outer chamber 24' passes upwardly through conduit 33' into condenser 34' and is delivered through pipe 35' into a second collecting vessel 36'. The four vessels 32, 32', 36 and 36' are all preferably surrounded by a block 37 of any suitable insulating material to prevent evaporation of the condensed refrigerant from occurring therein.

Each collecting vessel 32 and 32' has associated therewith a pair of evaporator coils 38, 39, and 38', 39', respectively, as clearly shown in Fig. 3. One end of each of these evaporator coils extends downwardly from the bottom of the respective vessels through the top wall 40 of the cabinet (Fig. 1), and the opposite end of each of these evaporator coils is connected to the upper portion of the respective vessels. Evaporator coil 38 of vessel 32 is arranged in one side of a freezing compartment 41 in the cabinet, while evaporator coil 38' of vessel 32' is arranged in the opposite side of this freezing compartment. Similarly, evaporator coil 39 of vessel 32 is arranged in one side of an ice-tray compartment 42 adjacent freezing compartment 41, while evaporator coil 39' of vessel 32' is arranged in the opposite side of said ice-tray compartment.

From the bottom of the vessel 36, the condensed refrigerant enters one end of an evaporator coil 43 which extends downwardly through the top wall 40 of the cabinet into the food storage space 44 of the cabinet, the other end of this evaporator coil extending upwardly and terminating in communication with the upper portion of vessel 36 as shown in Fig. 4. A similar evaporator coil 43' extends downwardly at one end from the bottom of accumulator 36' into the food storage compartment 44 and terminates at its other end in communication with the upper portion of accumulator 36'. Each portion of the evaporator coils 43 and 43' arranged in the storage compartment 44 is preferably provided with cooling fins 45 and 45', respectively, for increased efficiency. Any condensation forming on the evaporator coils 43 and 43' and dripping therefrom is collected in a suitable tray 46 which may be removed and emptied when necessary.

For the absorption period of operation of each unit when the refrigerant evaporated in the various evaporator coils 38, 38', and 39, 39' returns to the respective inner absorbent chambers 17 and 17', and the refrigerant evaporated in the evaporator coils 43 and 43' returns to the respective outer absorbent chambers 24 and 24', the boiler absorber assemblies 10 and 10' are cooled by any suitable means. In Fig. 1, there is shown a secondary system for the circulation of a cooling medium through the annular jackets 20, 22, and 20', 22' of the respective units A and B. The cooling medium enters the jackets 20 and 22 of boiler absorber assembly 10 through a pipe 47 leading from one side of a valve chamber 48 and terminating in two branch conduits 49 and 50, the former being connected to the bottom of jacket 20 and the latter to the bottom of jacket 22. The cooling medium leaves the upper portion of the respective jackets 20 and 22 by way of branches 51 and 52 connected to a pipe 53 leading to a condenser 54, and is delivered to a collecting tank 55 from which it returns to the valve chamber 48 through pipe 56.

In unit B, the cooling medium enters the bottom of the jackets 20', 22' by way of the branch conduits 49' and 50', respectively, of pipe 47' leading from the opposite side of the valve chamber 48, leaves the upper portion of the jackets through branch lines 51', 52' connected to the conduit 53' leading to a condenser 54', and is delivered to the collecting tank 55.

In order to speed up the circulation of the cooling medium through the secondary system, each of the jackets 20 and 22 of unit A and jackets 20' and 22' of unit B is provided with a plurality of vertically disposed tubular members 57 and 57', respectively, open at their lower ends and closed at their upper ends to form vapor pockets for the periodic reception and discharge of the cooling medium as fully disclosed in my co-pending application, Serial No. 318,148, filed February 9, 1940, now Patent No. 2,331,898. These tubular members 57 and 57' are secured in place in the respective jackets preferably by welding the same to the adjacent cylindrical shells forming the side walls of each jacket.

Units A and B operate intermittently but alternately with respect to one another, the operation from generation to absorption and vice

versa being automatically controlled by a switch device comprising a vertical switch lever 58 pivoted intermediate its ends as at 59 in the valve chamber 48. The upper end of the lever 58 is operatively connected to a transverse valve rod 60 carrying valves 61 and 61' at its opposite extremities, respectively, the former adapted to cooperate with a complementary seat in the valve chamber to control the flow of the cooling medium through line 47, and the latter adapted to cooperate with a complementary seat to control the flow of the cooling medium through line 47'.

The lower end of lever 58 extends through an opening provided in a transverse partition 62 which divides valve chamber 48 into an upper valve compartment 63 for the cooling medium of the secondary system, and a lower valve compartment 64 for the fuel admitted to the gas burners 27 and 27' of the respective units A and B through conduits 28 and 28'. The opening in the partition 62 is sealed by a bellows diaphragm arrangement 65 to prevent communication between the upper and lower compartments. A transverse valve rod 66 is operatively connected intermediate its ends to the lower end of switch lever 58 and carries valves 67 and 67' at its opposite extremities adapted to cooperate with complementary valve seats to control the passage of fuel into the respective conduits 28 and 28'.

Switch lever 58 is rocked on its pivot 59 from one position to another and vice versa by means of a transverse rod 68 operatively connected thereto intermediate its ends and arranged in the upper compartment 63 of the valve chamber 48. A bellows diaphragm 69 arranged in one side wall of the valve chamber 48 and responsive to a fluid pressure system 70 in thermal contact with the boiler absorber assembly 10, cooperates with one end of the rod 68 to move the latter in one direction, while a similar bellows diaphragm 69' in the opposite side wall of the valve chamber 48 and responsive to a fluid pressure system 70' in thermal contact with the boiler absorber assembly 10' cooperates with the other end of rod 68 to move the latter in the opposite direction. A snap spring 71 secured at one end to the bottom wall of the valve chamber 48 cooperates with the lower end of switch lever 58 to yieldably maintain the latter in either of its extreme positions so that when the pressure in the corresponding fluid pressure system 70, or 70' rises sufficiently, the switch lever 58 will be rocked from one operating position to the other with a snap action.

The operation of the refrigerating apparatus is believed obvious without further description, it being clear from Fig. 1 that when unit A is being heated for its generating period by the gas burner 27, unit B will simultaneously be cooled for its absorption period by the secondary cooling system, and the refrigerant from the inner and outer absorbent chambers 17 and 24 of unit A will flow to the respective vessels 32 and 36 and evaporator coils 38 and 39 associated with the first vessel and evaporator coil 43 associated with the second vessel, while the refrigerant in unit B will evaporate in the evaporator coils 38' and 39' associated with vessel 32' and evaporator coil 43' associated with vessel 36' and return to the respective inner and outer absorbent chambers 17' and 24' to be absorbed by the absorbent material therein.

It will be seen from the foregoing that I have provided a multi-compartment vessel or boiler absorber from which it is possible to build up a refrigerating unit having enough refrigerant to cool a plurality of zones. Furthermore, due to its construction, I provide a boiler absorber assembly having less iron weight for given dimensions than previously known boiler absorber constructions, thereby obtaining greater efficiency.

It will be noted further that for a given amount of refrigerant in circulation to cool a plurality of zones, I have provided a boiler absorber assembly of considerably less overall dimensions than heretofore known.

While I have shown and described the inner absorbent chambers 17 and 17' of the boiler absorber assemblies 10 and 10', respectively, for refrigerant circulating systems operating to cool the freezing compartments in a refrigerator cabinet, and the outer absorbent chambers 24 and 24' for refrigerant circulating systems operating to cool the food storage space of the cabinet, the invention is not to be confined to this particular illustration as the arrangement and relationship of the refrigerant circulating systems with respect to the inner and outer absorbent chambers may obviously be varied. Furthermore, the invention may be applied to any refrigerating apparatus of the intermittent type employing either a single unit, or any number of units.

Finally, the invention is equally applicable to adsorption refrigerating apparatus, and the use of the terms "absorption," "absorbing," "absorbent" and "absorber" in the above description, as well as in the following claims, is intended to include also "adsorption," "adsorbing," "adsorbent" and "adsorber."

No claim is made in the present application to the specific cooling means or cooling coils 38, 38'; 39, 39'; and 43, 43' shown and described for the different compartments of the refrigerator cabinet, or to the particular arrangement of such cooling coils with respect to the compartments as the same form the subject matter of my co-pending application Serial No. 431,208, filed February 17, 1942.

From the foregoing it is believed that the construction and advantages of the present invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of my invention as set out in the following claims.

What I claim and desire to secure by Letters Patent is:

1. In absorption refrigerating apparatus of the intermittent type having a plurality of circulating systems for a normally gaseous refrigerant to cool different zones, the combination with a boiler absorber assembly having a closed annular chamber charged with absorbent material capable of absorbing the gaseous refrigerant of certain of said plurality of systems during one period of operation of the apparatus and of expelling such refrigerant during the other period of operation thereof; of a second closed chamber in said boiler absorber assembly concentric with said first named chamber and spaced radially therefrom, said second closed chamber charged with absorbent material capable of absorbing the gaseous refrigerant of certain other of said plurality of systems during one period of operation of the apparatus and of expelling such refrigerant during

the other period of operation thereof, and separate conduit means connecting said annular chamber and said second chamber to the respective circulating systems.

2. In absorption refrigerating apparatus of the intermittent type having a plurality of circulating systems for a normally gaseous refrigerant to cool different zones, the combination with a cylindrical boiler absorber assembly having a closed chamber disposed centrally thereof, said chamber being charged with absorbent material capable of absorbing the gaseous refrigerant of certain of said plurality of systems during the absorption period of operation of the apparatus and of expelling such refrigerant during the generating period of operation thereof; of a closed annular chamber in said cylindrical boiler absorber assembly spaced radially from said first named chamber, said annular chamber being charged with absorbent material capable of absorbing the gaseous refrigerant of certain other of said plurality of systems during the absorption period of operation of the apparatus and of expelling such refrigerant during the generating period of operation thereof, and separate conduits connecting said central chamber and said annular chamber to the respective circulating systems.

3. In a boiler absorber assembly for use in refrigerating apparatus of the type operating intermittently in the absorption and generating periods, respectively, wherein said apparatus includes a plurality of circulating systems for a normally gaseous refrigerant to produce low temperatures at different regions; a closed cylindrical casing, a plurality of separate concentric compartments in said casing, each of said compartments containing a charge of absorbent material capable of absorbing a gaseous refrigerant during the absorption period of operation and of expelling such refrigerant during the generating period of operation of the apparatus, and conduit means from each of said compartments for connection to said plurality of circulating systems.

4. In a boiler absorber assembly for use in refrigerating apparatus of the type operating intermittently in the absorption and generating periods, respectively, wherein said apparatus includes a plurality of circulating systems for a normally gaseous refrigerant to produce low temperatures at different regions; a closed cylindrical casing, a compartment disposed centrally in said casing, a separate annular compartment in said casing spaced radially from said central compartment, each of said compartments containing a charge of absorbent material capable of absorbing a gaseous refrigerant during the absorption period of operation and of expelling such refrigerant during the generating period of operation of the apparatus, a conduit from said central compartment for connection to certain of said plurality of circulating systems, and a conduit from said annular compartment for connection to certain other of said plurality of circulating systems.

5. In refrigerating apparatus of the type operating intermittently in the absorption and generating periods, respectively, said apparatus having a plurality of circulating systems for a normally gaseous refrigerant to produce low temperatures at different regions; a boiler absorber assembly comprising a plurality of concentric cylindrical shells radially spaced from one another, transverse walls longitudinally spaced from one another extending across certain of said shells and secured thereto to form separate closed chambers spaced radially from one another, certain of said chambers containing a charge of absorbent material capable of absorbing the gaseous refrigerant of said plurality of said circulating systems during the absorption period of operation and of expelling such refrigerant during the generating period of operation of the apparatus, conduit means from each of said absorbent chambers for connection to said plurality of circulating systems, conduit means from certain other of said chambers for connection to a cooling system to cool the boiler absorber assembly during the absorption period of operation of the apparatus, and a flue formed between two of said cylindrical shells and extending longitudinally through said boiler absorber assembly for a heating medium to heat said absorbent containing chambers during the generating phase operation of the apparatus.

6. In refrigerating apparatus; the combination of a vessel divided into a plurality of chambers including one chamber containing absorbent material and forming the generator-absorber of an intermittent absorption type refrigerating system and another chamber containing absorbent material and forming the generator-absorber of another intermittent absorption type refrigerating system, and means for alternately heating and cooling said vessel.

7. In refrigerating apparatus; the combination of a vessel divided into a plurality of chambers including one chamber containing absorbent material and forming the generator-absorber of an intermittent absorption type refrigerating system, a second chamber containing absorbent material and forming the generator-absorber of another intermittent absorption type refrigerating system, and a third chamber forming the vaporizing portion of a vaporization-condensation heat transfer system operating to cool said vessel intermittently for the operation of said first named and second named chambers as absorbers, and means for heating said vessel intermittently but in out-of-phase relation to the cooling for operation of said first named and second named chambers as generators.

8. In refrigerating apparatus; the combination of a vessel divided into a plurality of chambers including one constructed and arranged to form that part of a refrigerating system in which a refrigerating fluid is generated intermittently and another constructed and arranged to form that part of another refrigerating system in which a refrigerating fluid is generated intermittently, and means for heating said vessel intermittently for generation of the refrigerating fluids in said first-named and second-named systems, respectively.

9. In refrigerating apparatus; the combination of a vessel divided into a plurality of chambers including one constructed and arranged to form that part of an absorption refrigerating system in which a refrigerating fluid is absorbed intermittently and another constructed and arranged to form that part of another absorption refrigerating system in which a refrigerating fluid is absorbed intermittently, and means for cooling said vessel intermittently for absorption of the refrigerating fluids in said first-named and second-named systems, respectively.

10. In refrigerating apparatus; the combination of a vessel divided into a plurality of chambers including one chamber constructed and arranged to form that part of an absorption re-

frigerating system in which a refrigerating fluid is absorbed, another chamber constructed and arranged to form that part of another absorption refrigerating system in which a refrigerating fluid is absorbed, and other chambers constructed and arranged to form the vaporization portions of a vaporization-condensation heat transfer system to cool said first and second chambers for absorption of the refrigerating fluids in said first-named and second-named systems, respectively.

11. In refrigerating apparatus; the combination of a unitary assembly comprising means forming a plurality of chambers including one chamber constructed and arranged to form the generator-absorber of an absorption refrigerating system having alternate generating and absorbing periods, a second chamber constructed and arranged to form the generator-absorber of another absorption refrigerating system having alternate generating and absorbing periods, and other chambers constructed and arranged to form the vaporization portions of a vaporization-condensation heat transfer system to cool said first and second chambers during each absorbing period of said first-named and second-named refrigerating systems, and means forming a passage for a heating fluid in thermal exchange relation with said first and second chambers to heat the latter during each generating period of said first-named and second-named refrigerating systems.

12. Refrigerating apparatus comprising, in combination, two vessels each having a plurality of chambers including one constructed and arranged to form the generator-absorber of an intermittent type absorption refrigerating system and another constructed and arranged to form the generator-absorber of another intermittent type absorption refrigerating system, heating means for each vessel, cooling means for each vessel, and means cooperating with said heating means and cooling means to control the alternate heating and cooling of each of said vessels in out-of-phase relationship with respect to one another.

13. In absorption refrigerating apparatus of the intermittent type, a generator-absorber comprising absorbent containing parts arranged in a unitary assembly, cooling means extending through said unitary assembly and separating said generator-absorber parts from one another, and means for operating said cooling means intermittently.

14. In absorption refrigerating apparatus of the intermittent type; the combination of a generator-absorber comprising two absorbent containing parts arranged in a unitary assembly, means including two evaporator coils in fluid communication with said two-named generator-absorber parts, cooling means extending through said unitary assembly and separating said two-named generator-absorber parts from one another, heating means for said last-named generator-absorber parts, and means for operating said heating means and cooling means alternately.

15. In a refrigerator, a pair of intermittent absorption refrigerating systems each including a generator-absorber, a condenser and an evaporator part, a low temperature refrigerating chamber and a high temperature refrigerating chamber, the evaporator part of one of said systems being arranged to refrigerate said low temperature refrigerating chamber and the evaporator part of the other of said refrigerating systems being arranged to refrigerate said high temperature refrigerating chamber, means for heating said generator-absorbers in common, means for cooling said generator-absorbers in common, and means controlling said heating and cooling means for operating said refrigerating systems alternately on generating and absorbing periods in in-phase relation with each other.

16. In a refrigerator; a plurality of units each including two intermittent absorption refrigerating systems, each of said intermittent refrigerating systems including a generator-absorber, a condenser and an evaporator part connected in circuit; a cabinet structure associated with said units having a plurality of compartments including a low temperature refrigerating compartment and a high temperature refrigerating compartment; each of said units having the evaporator part of one of its refrigerating systems arranged to refrigerate one of said compartments and having the evaporator part of its other refrigerating system arranged to refrigerate another one of said compartments, common cooling means for the generator-absorbers of the refrigerating systems of each unit, heating means for the generator-absorber parts of the refrigerating systems of each of said units, and means for alternately operating said heating means and cooling means of each of said units in out-of-phase relation with each other.

17. In absorption refrigerating apparatus of the intermittent type, a generator-absorber comprising absorbent containing parts arranged in a unitary assembly, heating means extending through said unitary assembly and separating said generator-absorber parts from one another, and means for operating said heating means intermittently.

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