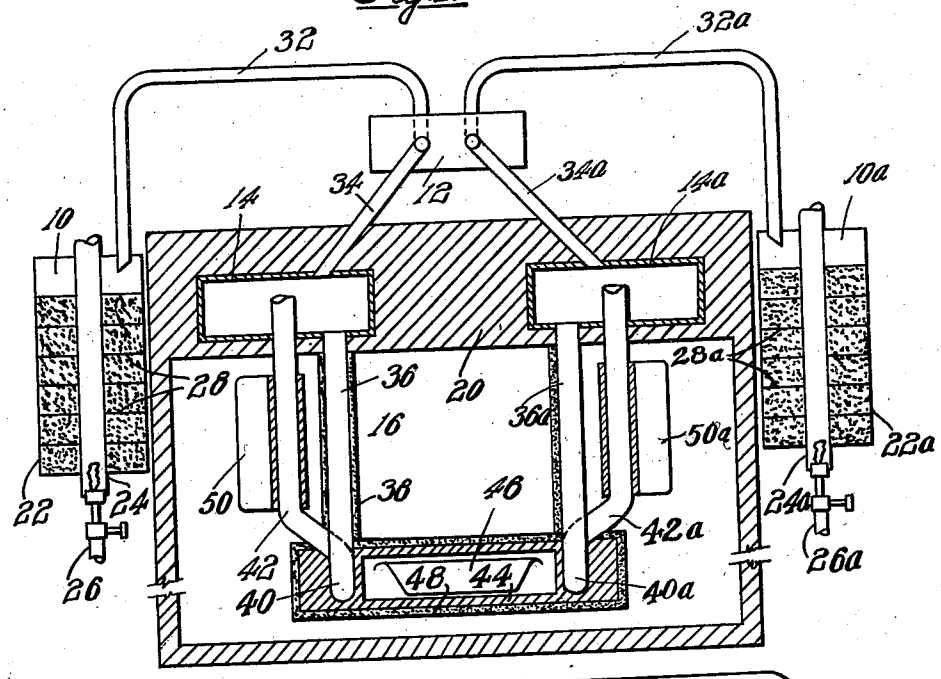
May 25, 1943. N. ERLAND AF KLEEN 2,319,806

ABSORPTION OR ADSORPTION REFRIGERATING APPARATUS

Filed Sept. 5, 1939 2 Sheets-Sheet 1

Fig. 1.



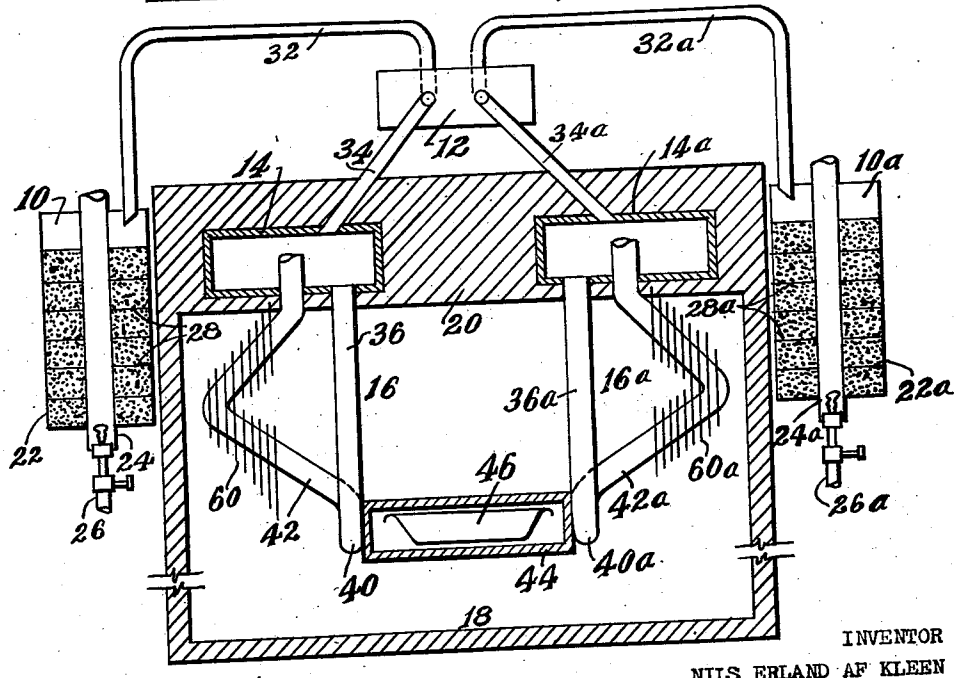


Fig. 1a.

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Fig. 2.

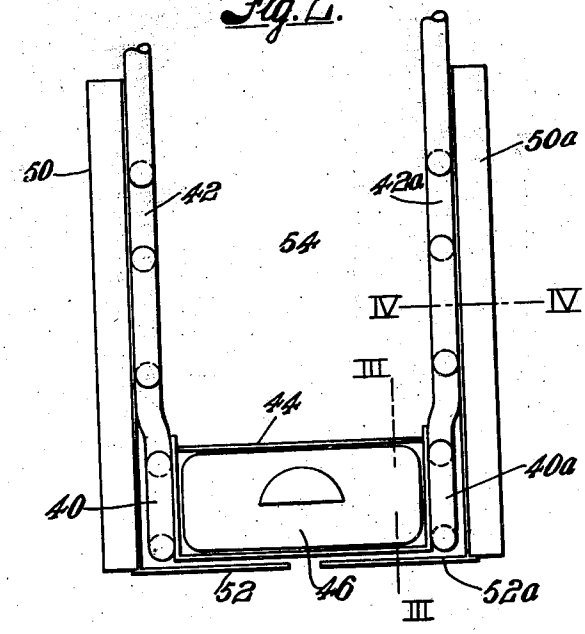


Fig. 3.

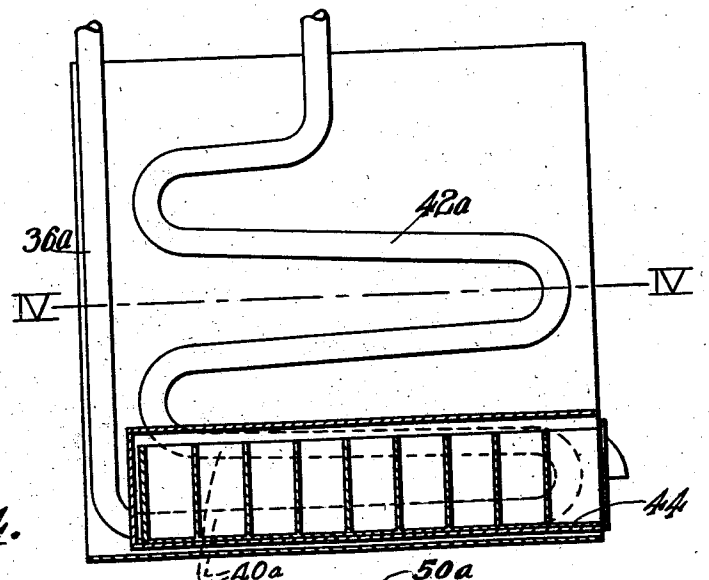
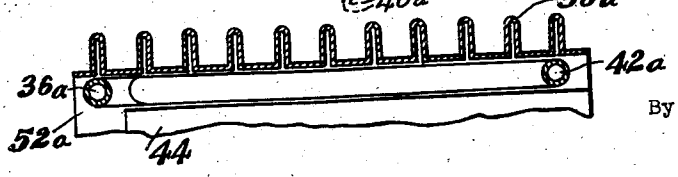


Fig. 4.



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ABSORPTION OR ADSORPTION REFRIGERATING APPARATUS

Nils Erland af Kleen, Stockholm, Sweden

Application September 5, 1939, Serial No. 293,477
In Germany April 19, 1939

20 Claims. (Cl. 62—118)

The present invention relates to absorption or adsorption refrigerating devices which consist of two or more units operating periodically, each of which includes a boiler absorber, a condenser and an evaporator and wherein the boiler absorber or adsorber contains dry salt or other substances which are capable of absorbing or adsorbing the refrigerating medium during the absorption or adsorption period, when the refrigerating medium is gaseous and of releasing the same during the generating period.

According to the invention the evaporators each comprise two parts one of which is in good heat-conducting communication with an ice freezing chamber common to the evaporators whilst the other is adapted to cool the air in the surrounding space and is arranged so that the air cooling parts of the evaporators are separated from one another in a heat-conducting respect. During the alternate operation of the evaporators an unchanged low temperature is in this manner maintained in the ice freezing chamber, whilst the parts of the evaporators adapted to cool the air alternately assume comparatively high and comparatively low temperatures. These parts are therefore alternately coated with frost and thawed, which results in an extremely favourable periodic change of the moisture contained in the refrigerating chamber for preserving stored foodstuffs.

The invention also comprises a particularly effective construction or arrangement of evaporators each comprising two parts as aforesaid according to which the parts of the evaporators adapted for the air cooling are arranged upon opposite sides of the ice freezing chamber and above the level thereof, preferably in zig-zag form in two vertical planes located one on each side, whilst at the middle above the ice freezing chamber there is formed a free space between the evaporators which is suitable for storing goods which require a lower temperature than that obtaining in the remaining part of the refrigerating chamber or which are required to be cooled quickly.

Examples of constructions in accordance with the invention, in the description of which there will be set out further features, are shown in the accompanying drawings, wherein:

Figure 1 shows diagrammatically a refrigerating apparatus with an evaporator arrangement according to the invention.

Figure 1*a* is a diagrammatic view similar to Figure 1 but showing a slightly modified constructional form of evaporator arrangement.

Figures 2 to 4 show a preferred practical construction of the evaporating device, Fig. 2 being a front elevation, Figure 3 being a section on the line III—III of Figure 2 and Figure 4 being a section on the line IV—IV of Figures 2 and 3.

As shown in Figure 1 the refrigerating device consists of two units operating periodically and alternately which in combination give an uninterrupted refrigeration. For the sake of clearness the same reference numbers are used herein to indicate corresponding parts of the right and left hand units, the numerals which refer to the right hand unit being distinguished by the addition of an *a*.

Each of the units consists of a boiler absorber 10, 10*a*, a condenser 12, which may be common to both units, a collecting container 14, 14*a* and an evaporator which as a whole is indicated by 16, 16*a* and is arranged in a refrigerating box or cooling chamber 18 with insulated walls. The collecting condensers 14, 14*a* are located in the upper insulated wall 20 of the refrigerating box. The boiler absorbers consist of a cylindrical vessel 22, 22*a* with a cylindrical flue 24, 24*a* for the purpose of heating by a heating source which, in the example shown, is formed by a gas burner 26, 26*a*, but may naturally be of any other suitable type, for example it may consist of an electrical heating element. In the vessel 22, 22*a*, are arranged one above the other a number of annular trays 28, 28*a* which contain a dry salt. A pipe 32, 32*a* connects the upper part of the boiler absorber 10 or 10*a* to a common fin condenser 12 which is connected by a pipe 34, 34*a* to the collecting containers 14, 14*a*. To the latter is connected an evaporating pipe coil which is provided with a downwardly extending branch 36, 36*a* which, as shown in Figure 1, may be surrounded by insulation 38, 38*a*, a lower part 40, 40*a* and a rising part 42, 42*a*. The lower parts 40, 40*a* serve for ice freezing and are therefore in heat-conducting connection with a common ice freezing chamber 44 containing an ice container 46. The ice freezing chamber 44 preferably consists of metal of which the walls are so thick that they are capable of storing a considerable quantity of cold or it is surrounded for this purpose by a separate heat-storing body. As shown in Figure 1*a* the lower parts 40, 40*a* of the evaporator tubes may bear against the walls of the ice freezing chamber, or, as shown in Figure 1, said lower parts of the evaporator tubes may be embedded into the end walls of the ice freezing chamber which walls are thickened for this purpose. The ice freezing chamber 44 may, if necessary, be

covered with insulation 48. The rising branches 42 and 42a of the evaporator coils serve to cool the air in the refrigerating chamber 18 and for this purpose are provided with cooling ribs which for example may be constructed as radial flanges 50, 50a extending from the rising pipes 42, 42a (Figure 1), or may be in the form of parallel fins 60, 60a as shown in Figure 1a on the pipes 42, 42a which are shown bent at an angle. The parts 42 and 42a of the evaporator pipes serving for air cooling are not connected together directly so that heat can be transmitted directly from one pipe to the other pipe but their sole metal connection extends indirectly through the parts 40, 40a and the ice freezing chamber 44. This long path is a poor conductor of heat as the parts 40 and 42, 40a and 42a are only connected together in a heat conducting manner by the material of the evaporator pipes but otherwise have no mechanical contact. As a result the parts 42 and 42a of the two evaporators, adapted for air cooling, are separated from one another in a heat conducting respect so that one part may have a comparatively low temperature and the other part a comparatively high temperature.

As shown in each of Figures 1 and 1a of the drawings, the right hand unit is in the absorption phase and the left hand unit in the expelling phase. The right hand evaporator coil effects cooling. Its part 40a maintains the ice freezing chamber cooled, whilst the air in the refrigerating chamber 18 is cooled by passing over the cooling ribs of the evaporator part 42a. The moisture of the air is deposited as frost on the right hand evaporator. During the next working period the left hand gas flame is shut off and the right hand flame ignited whereby the left hand evaporator effects cooling and its temperature decreases. The temperature of the right hand evaporator then rises so that it is gradually thawed and the moisture is deposited on the left hand evaporator as frost. This traveling of the moisture is combined with powerful fluctuations of the moisture contained in the refrigerating chamber, which has been found extremely suitable for preserving foodstuffs, especially vegetables.

The evaporator device shown in greater detail in Figures 2 to 4 can be used in a refrigerating device of the construction shown in Figure 1. In these figures the same references have been used as in Figure 1.

The rising parts 42, 42a of the evaporator pipes are arranged as in the form of construction in Figure 1 above and on opposite sides of the ice freezing chamber and are bent in zig-zag form and located in two vertical planes located on the two sides of the ice freezing chamber. In the said planes there are also located the branches 36, 36a of the evaporator pipes, which conduct the refrigerant from the collecting container. The lower parts 40, 40a of the evaporator pipes bear against the end surfaces of the ice freezing chamber 44. The cooling ribs on the parts of the evaporator adapted for air cooling are in this case formed by plates 50, 50a with deep gutters, which bear against the outsides of the evaporator parts 42, 42a and are secured thereto for example by welding or soldering. These plates extend downwardly to the lower part of the ice freezing chamber without touching the parts 40, 40a of the evaporating pipes, which for this purpose are bent somewhat inwardly. 52 and 52a indicate two projecting plates which are secured to the lower parts of the plate 50 and 50a and serve to screen the ice freezing chamber, which is at a lower temperature, so that convection air streams in the refrigerating chamber do not pass over it and heat it.

Between the evaporator parts 42 and 42a there is formed, above the ice freezing chamber 44, a free space which is confined on three sides by cooling surfaces and which is therefore excellent for storing goods which are to be maintained at a lower temperature than that obtaining in the remaining part of the refrigerating chamber or which are to be cooled quickly.

It will be understood that in the construction in Figures 2 to 4 it is also possible to allow the corrugated plates 50, 50a to terminate on a level with the top side of the ice freezing chamber and to extend the protecting plates 52, 52a upwardly at the sides. It is also possible to make other modifications in the construction shown. Further, two or more evaporator coils, arranged in parallel, may extend from a single collecting container, which are either of the same construction and may therefore serve both for ice freezing and also for air cooling, or which are so arranged that at least one serves for ice freezing and is in heat conducting connection with the ice freezing chamber, whilst the other or others are not in heat conducting connection therewith but only serve for cooling the air. In this case the rising branch of the coil serving for ice freezing may if necessary be provided with cooling ribs so that also this part effects a cooling of the air.

From the foregoing it is believed that the construction, operation and advantages of the invention will 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 the invention as set out in the following claims.

I claim:

1. In absorption refrigerating apparatus of the intermittent type; an evaporator system having two different portions arranged in series for the passage of the refrigerant, and heat conducting means in heat exchange relation with the first of said portions, said heat conducting means being capable of accumulating the cold produced intermittently by the refrigerant evaporating in the first portion, whereby said evaporator system operates to produce substantially continuous cold at the first of said portions, and intermittent cold at the second of said portions.

2. In absorption refrigerating apparatus of the type having at least two intermittently and alternately operating units; the improvement which consists in an evaporator system including separate parts operatively connected to the different units, in one portion of the evaporator system, the parts operatively connected to the different units being in heat exchange relationship with one another to produce substantially continuous low temperature, and in another portion of the evaporator system, the parts operatively connected to the different units being separated from one another to produce intermittent low temperature.

3. The combination with absorption refrigerating apparatus of the intermittent type having a plurality of alternately operating units and at least two alternately operating evaporator systems separated from one another, each evaporator system having one portion through which the refrigerant flows, and a separate portion for the passage of the refrigerant subsequent to its flow through the first-named portion; of heat

nducting means connecting the first-named ortions of said evaporator systems together, hereby said first-named portions of each evaprator system operate to produce a substantially ontinuous low temperature at a common region, nd each of said second-named portions operates o produce intermittent low temperatures.

4. The combination with absorption refrigerting apparatus of the intermittent type having plurality of alternately operating units and at least two alternately operating evaporator systems separated from one another, each evaporator system having a downwardly extending inlet portion for the passage of the refrigerant, a second portion at the lower end of said inlet portion, and an upwardly extending return portion through which the refrigerant flows subsequent to its passage through said second portion, and heat transferring means on the return portion of each evaporator system; of heat conducting means connecting the second named portions of said evaporator systems together, whereby said second-named portions operate to produce a substantially continuous low temperature at a common region, and each of said return portions having heat transferring means operates to produce intermittent low temperatures.

5. In absorption refrigerating apparatus of the intermittent type having a plurality of units operating in out of phase relation to one another, the combination with a plurality of evaporator ssytems separated from one another, each evaporator system having a downwardly extending inlet portion for the refrigerant; a second portion at the lower end of said inlet portion, and a return portion extending upwardly from said second portion, said return portion having heat transferring members; of heat conducting means connecting the second named portions of said evaporator system together, said heat conducting means being capable of storing the cold produced alternately by said evaporator system, whereby a continuous low temperature is maintained in said heat conducting means, the return portions of the evaporator systems being separated from one another and being alternately heated and cooled during the generating and absorption phase operations, respectively, of the corresponding units, whereby each of said return portions operates to produce intermittent low temperatures.

6. In absorption refrigerating apparatus of the intermittent type having a plurality of units operating in out of phase relation to one another, the combination with two separate evaporator systems, each having a downwardly extending portion, a second portion extending upwardly from said first named portion and provided with heat transferring members; of heat conducting means connecting the lower ends of the first named portions of said evaporator systems together, said heat conducting means being capable of storing the cold produced alternately by said evaporator system during the alternate absorption phase operations of the units, whereby said first named portions operate to produce a continuous low temperature at a common region, the second named portions of the evaporator systems being separated from one another, whereby each is alternately heated and cooled during the generating and absorption phase operations, respectively, of the corresponding units to produce intermittent low temperatures at regions separate from said common region.

7. The combination with a refrigerator cabinet having insulating walls arranged to provide a food storage space, a freezing chamber in said cabinet insulated from said food storage space, and a plurality of intermittent type absorption refrigerating units operating in out of phase relation to one another; of at least two evaporator systems separate from one another and supplied with refrigerant liquid intermittently and in out of phase relation to one another for producing low temperatures in said freezing chamber and in said food storage space, each evaporator system having a downwardly extending inlet portion for the refrigerant, a second portion arranged at the lower end of said inlet portion and in heat exchange relationship with said freezing chamber, and an upwardly extending return portion for the refrigerant, separate from said inlet portion, and arranged in said food storage space, heat transferring means on the return portions of each evaporator system, and heat conducting means surrounding said freezing chamber and connecting said second-named portions of the evaporator systems together, whereby said second-named portions of said evaporator systems operate to produce substantially continuous cold through said heat conducting means to maintain a predetermined low temperature in said freezing chamber, and each of said return portions with the heat transferring means operates to produce intermittent low temperatures to cool said food storage space.

8. In combination with a refrigerator cabinet having insulating walls arranged to provide a food storage space, and a separate freezing chamber in said cabinet arranged adjacent the top of the latter; an absorption refrigerating device of the intermittent type having a plurality of units operating in out of phase relation to one another and at least two evaporator systems for delivering substantially continuous cold to said freezing chamber and said food storage space, each evaporator system including an inlet portion for the refrigerant extending downwardly from the top of the cabinet to a point adjacent said freezing chamber, a second portion at the lower end of said inlet portion arranged in heat exchange relationship with said freezing chamber, and a return portion for the refrigerant extending upwardly from said second portion and into said food storage space, the inlet, second, and return portions of one evaporator system being separated from the corresponding portions of the other evaporator system, separate heat transferring means on each of said return portions, each of said heat transferring means being alternately heated and cooled during the generating and absorption phase operations, respectively, of the corresponding units, and heat conducting means connecting the second portions of the evaporator systems together whereby said second portions operate to produce a substantially continuous low temperature to maintain a predetermined low temperature in said freezing chamber.

9. In combination with a refrigerator cabinet having insulating walls arranged to provide a food storage space, and a separate freezing chamber in said cabinet arranged adjacent the top of the latter; an absorption refrigerating device of the intermittent type having a plurality of units operating in out of phase relation to one another and at least two evaporator systems for delivering substantially continuous cold to said freezing chamber and said food storage space, each evaporator system including an inlet portion for the refrigerant extending downwardly from the top

of the cabinet to a point adjacent said freezing chamber, a second portion at the lower end of said inlet portion arranged in heat exchange relationship with said freezing chamber, and a return portion for the refrigerant extending upwardly from said second portion and into said food storage space, the inlet, second, and return portions of one evaporator system being separated from the corresponding portions of the other evaporator system, separate heat transferring means on each of said return portions, each of said heat transferring means being alternately heated and cooled during the generating and absorption phase operations, respectively, of the corresponding units, heat conducting means connecting the second portions of the evaporator systems together, whereby said second portions operate to produce a substantially continuous low temperature to maintain a predetermined low temperature in said freezing chamber, and screening means around said freezing chamber for preventing convection air streams from passing over said freezing chamber from said food storage space.

10. In combination with a cabinet having insulating walls arranged to provide a food storage space; a plurality of intermittently operating units, each consisting of a generator absorber, a condenser, a receiver, and an evaporator, a freezing chamber in said cabinet common to said evaporators and having heat conducting walls and located below said receivers, each of said evaporators having a heat exchange portion in contact with the wall structure of said freezing chamber to cause evaporation to take place in heat exchange therewith, a heat insulated conduit for conducting liquid refrigerant from the receiver to said heat exchange portion, said conduit being out of contact with said freezing chamber wall, and a return portion for conducting refrigerant vapor from the heat exchange portion to said receiver and arranged in spaced relation to said conduit, said return portion extending upwardly from said heat exchange portion to said receiver and having heat transferring members thereon, whereby said return portions are alternately cooled dependent upon the intermittent operation of the units, with said heat exchange portions being substantially continuously cold for maintaining the temperature in said freezing compartment at a predetermined degree.

11. Refrigerating apparatus of the intermittent absorption type having at least two units operating in out of phase relationship, each unit including an evaporator formed with at least two cold producing sections, and heat conducting means connecting one of said cold producing sections of one evaporator to the corresponding cold producing section of the other evaporator, whereby substantially continuous low temperature is maintained by said connected cold producing sections through said means, the other cold producing sections of the evaporators being separated from one another, whereby each of said separated sections is intermittently coated with frost and alternately defrosted during the operation of the corresponding unit.

12. Refrigerating apparatus of the intermittent absorption type having at least two units operating in out of phase relationship, the evaporator of each unit being formed with at least two cold producing sections, and a low temperature compartment having heat conducting walls connecting one of said cold producing sections of the evaporators together, whereby substantially continuous low temperature is maintained in said compartment by said thermally connected cold producing sections, the other cold producing sections of the evaporators being separated from one another, whereby each of said separated sections is intermittently coated with frost and alternately defrosted during the operation of the corresponding unit.

13. In absorption refrigerating apparatus of the intermittent type having at least two units operating in out of phase relationship, the evaporating system of each unit consisting of at least two cooling sections, one cooling section of one system being in thermal exchange relation with the corresponding cooling section of the other evaporating system, whereby a substantially continuous low temperature is maintained by cold produced intermittently and alternately by said cooling sections in thermal exchange relation, and the other cooling sections of the evaporating systems being separated from one another in a heat conducting respect, whereby each of said last named cooling sections is intermittently coated with frost and alternately defrosted during the operation of the corresponding unit to maintain a relatively high humidity in a thermally insulated storage space.

14. In absorption refrigerating apparatus of the intermittent type having at least two units operable in out of phase relationship, each unit having an evaporating system producing cold during its absorption periods, each evaporating system having at least two cold producing parts, a low temperature chamber having heat conducting walls in thermal exchange relation with one cold producing part of each of said systems whereby substantially continuous low temperature is maintained in said chamber during the phase operation of the units, and heat transferring members on the other cold producing parts of said systems, said other cold producing parts with the heat transferring members being spaced from the walls of said low temperature chamber and being separated from one another, whereby each of said last named cold producing parts with the heat transferring members is intermittently coated with frost and alternately defrosted during the operation of the corresponding unit.

15. In a refrigerating cabinet having a storage space, the combination of refrigerating apparatus of the intermittent absorption type including at least two separate cooling elements producing intermittent cold in phase relation to one another and arranged to provide a low temperature cooling unit in which refrigeration is produced substantially continuously, and at least two other separate cooling elements producing intermittent cold in phase relation to one another and arranged in spaced-apart relation to one another and to said first-named cooling elements to cool the air in said storage space substantially continuously.

16. In a refrigerator cabinet having a storage space, the combination of refrigerating apparatus of the intermittent absorption type including at least two separate cooling elements producing intermittent cold in phase relation to one another and arranged to provide a low temperature cooling unit in which refrigeration is produced substantially continuously, and at least two other separate cooling elements producing intermittent cold in phase relation to one another and arranged in spaced-apart relationship to form a

higher temperature cooling unit to cool the air in said storage space substantially continuously.

17. In a refrigerator cabinet having a storage space, the combination of means including at least two separate cooling elements producing intermittent cold in phase relation to one another and providing a low temperature cooling unit in which cold is produced substantially continuously, and separate means including at least two cooling elements producing intermittent cold in phase relation to one another and arranged in spaced-apart relationship to cool the air in said storage space substantially continuously.

18. In a refrigerator cabinet, the combination of a plurality of compartments adapted to be cooled, separate cooling means for each of said compartments, each cooling means including at least two separate refrigerant evaporating elements, the separate refrigerant evaporating elements in at least one of said compartments being arranged in spaced-apart relationship with respect to one another, and means to flow refrigerant liquid to each of said evaporating elements intermittently and in phase relation to one another for the production of substantially continuous cold in each of said compartments.

19. In a refrigerator cabinet, the combination of a low temperature compartment and a higher temperature storage compartment, separate cooling means for each of said compartments, each of said cooling means including at least two separate refrigerant evaporating elements, the separate refrigerant evaporating elements in said higher temperature storage compartment being arranged in spaced-apart relationship with respect to one another, and means to flow refrigerant liquid to each of said evaporating elements intermittently and in phase relation to one another for the production of substantially continuous cold in each of said compartments.

20. In a refrigerator cabinet, the combination of a low temperature zone and a higher temperature storage zone, separate cooling means for each of said zones, each of said cooling means including at least two separate refrigerant evaporating elements, and means to flow refrigerant liquid to each of said evaporating elements intermittently and in phase relation to one another for the production of substantially continuous cold in each of said zones, the refrigerant evaporating elements of said higher temperature storage zone being arranged in spaced-apart relationship with respect to one another and with respect to the refrigerant evaporating elements of said low temperature zone, whereby each refrigerant evaporating elements of said higher temperature zone is intermittently coated with frost during its cold-producing periods and alternately defrosted to maintain a relatively high humidity in said higher temperature storage zone.

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