Aug. 4, 1936. J. C. ARMOR 2,049,793

REFRIGERATING APPARATUS

Filed July 26, 1932 2 Sheets-Sheet 1

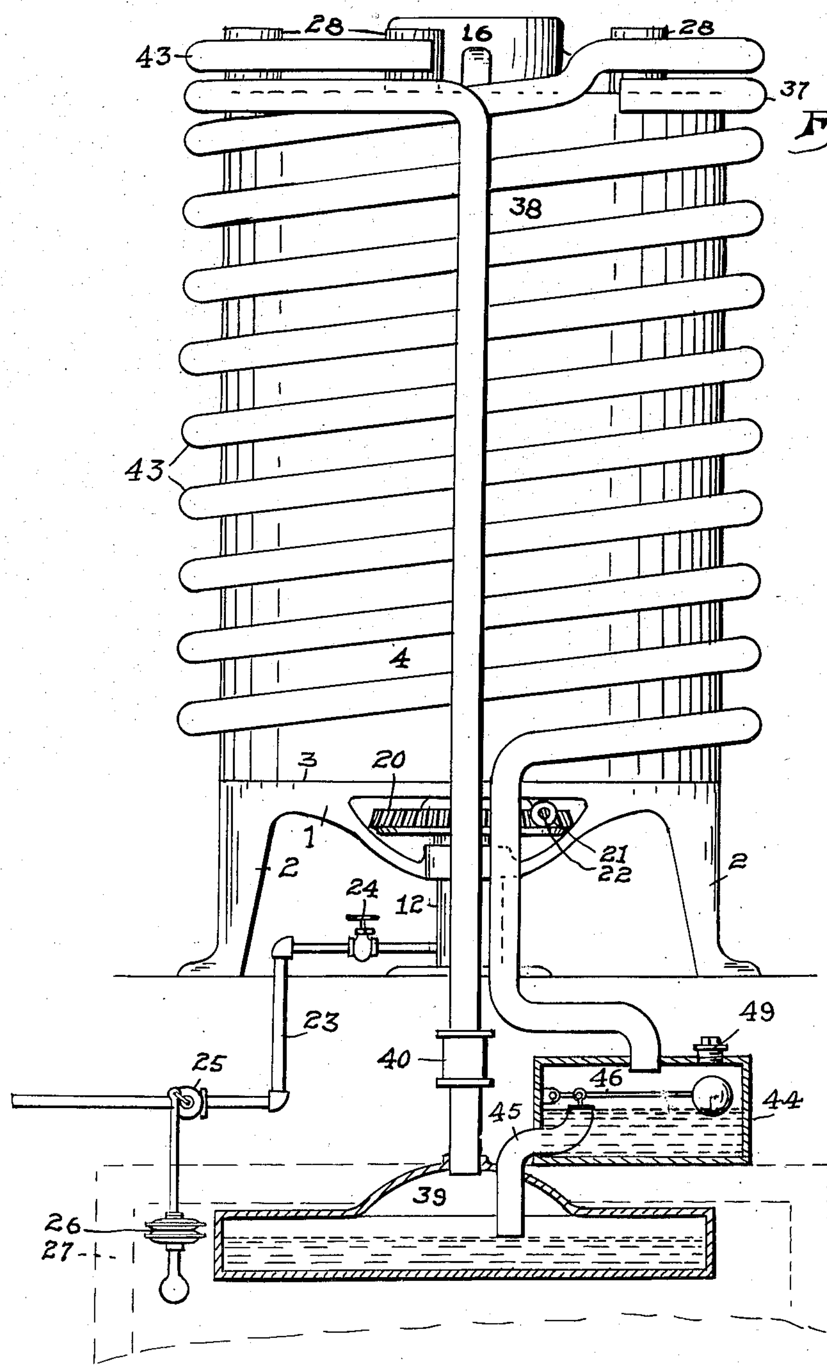

Fig. 1

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Fig. 2

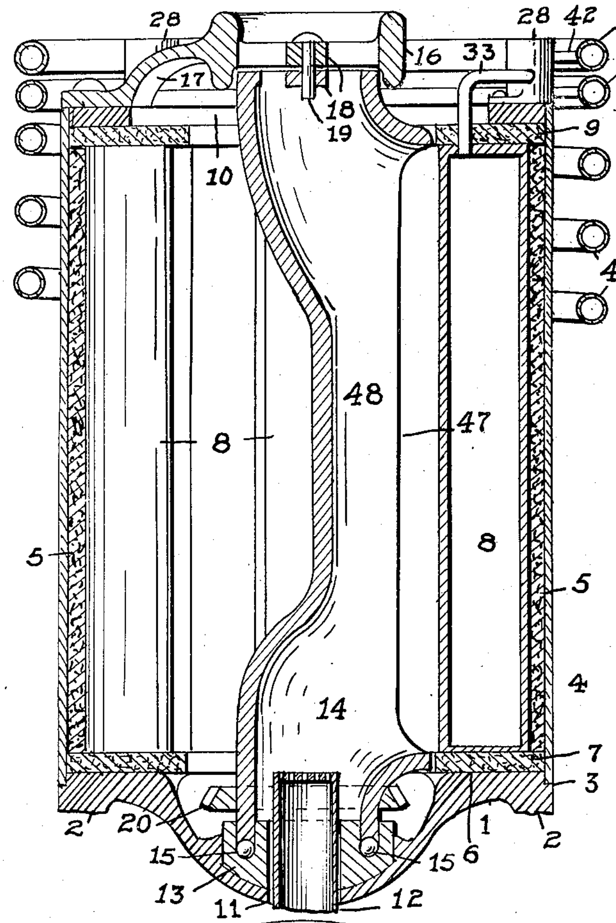


Fig. 4

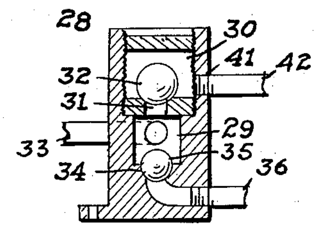
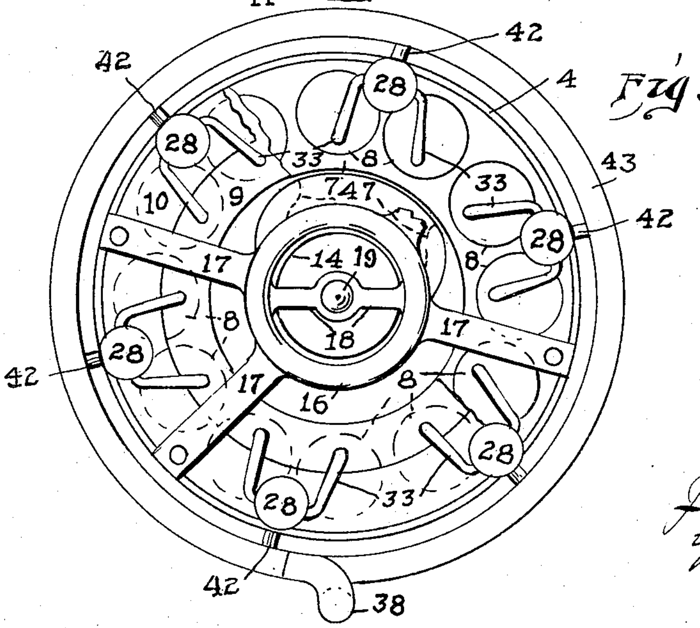


Fig. 3



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UNITED STATES PATENT OFFICE

2,049,793

REFRIGERATING APPARATUS

James C. Armor, Bellevue, Pa.

Application July 26, 1932, Serial No. 624,761

7 Claims. (Cl. 62—118)

My invention relates to apparatus which operates by the absorption or adsorption method wherein heat-compression is employed.

For the sake of brevity I use herein the terms absorption and absorbent as inclusive of the terms adsorption and adsorbent.

One of the novel and characteristic features of my invention is an improved absorbing and compressing unit wherein the absorbent is contained in a plurality of containers to which in turn heat is applied by means of a heater, such for instance as a gas-burner, relative movement being provided for between the containers and the heater whereby heat is applied in turn to the containers or groups thereof to distill the refrigerant while the absorbing process is proceeding in the case of the remaining containers.

Another novel and characteristic feature is the combined absorbent, distilling and condenser unit.

Other novel features of construction and arrangement of parts will appear from the following description.

In the accompanying drawings, wherein I have illustrated a practical embodiment of the principles of my invention, Fig. 1 is a view, partly in elevation and partly in vertical section, of the refrigerating apparatus.

Fig. 2 is a vertical section of the absorption, heating and condensing unit.

Fig. 3 is a top plan of the unit.

Fig. 4 is an enlarged sectional detail of one of the double check valves.

Referring to the drawings, 1 represents a base which is preferably circular and provided with legs 2. The base is provided with an annular perimetral seat 3 in which is stepped the lower end of a tubular metallic casing 4 which is provided with an inner lining 5 of heat-insulating material, such as asbestos.

The base 1 is provided with an annular flat surface 6 which is provided with a covering 7 of heat-insulating material.

8 represents a plurality of containers arranged in annular series on the surface 6 and shown as twelve in number. These containers are preferably tubular and set on end. An annular covering 9 of heat-insulating material is superimposed on the tops of the containers.

10 represents a metal ring which is fixed in the upper end of the casing 4 and bears on the covering 9.

The central portion of the base 1 is dished downwardly and provided with a circular axial opening 11 through which the gas burner 12 protrudes upwardly.

13 represents an annular bearing block mounted in the dished portion of the base 1 and concentrically surrounding the gas burner.

The annular lower end of a heat deflector 14 is stepped in the bearing block 13, with antifriction members such as balls 15 interposed between the parts. The annular upper end of the deflector 14 registers with a ring 16 which is supported from the ring 10 by means of the upwardly converging legs 17. The deflector 14 and the ring 16 are provided with cross struts 18 with a connecting pin 19 at their centers, so that the deflector is rotatably mounted in place.

The lower tubular end of the deflector 14 is provided with a bevelled ring gear 20 which meshes with a small bevelled pinion 21 mounted on and driven by the shaft 22.

Power to rotate the deflector may be applied to the shaft 22 from any convenient source. Thus an electric or water motor may be used or a motor driven by the pressure of the gas supply.

Gas or other suitable fuel is supplied to the burner 12 through the pipe 23 provided with a shut-off valve 24 and a second pressure adjustment valve 25 which is operated by the thermostat 26 contained in the refrigerator chamber or other compartment to be cooled. Such chamber is indicated in dotted lines at 27.

28 represents double ball valves which are mounted on the ring 16, there being one valve to each pair of containers. However, a valve for each container may be provided if desired.

Each of the valves 28 has two chambers, a lower chamber 29 and an upper chamber 30 connected by a port 31 which is closed by an upwardly opening ball valve 32.

The lower chamber is connected by tubes 33 with the top interior of the corresponding pair of containers.

The lower chambers 29 of the valves 28 are provided with ports 34 guarded by inwardly opening ball valves 35 and said ports are connected by a small tube 36 with the convolution 37 which forms the upper end of the riser tube 38. The lower end of the riser tube is connected with the top of the evaporator chamber 39 located in the refrigerator 27 or the compartment to be refrigerated. The tube 38 is preferably provided with an upwardly opening check valve 40.

The upper chambers 30 of the valves 28 are provided with ports 41 which are connected by the tubes 42 with the top convolution of the condenser tube 43 which is coiled about the casing

4 and it has its lower end communicating with the top of the float valve chamber **44**. A tube **45** connects said chamber **44** with the evaporator **39**, the intake end of the tube extending upwardly into the chamber **44** and being provided with a float valve **46**.

The float valve controls the supply of condensed refrigerant to the vaporator **39**.

It will be understood that an expansion valve of any approved type may be substituted for the float valve mechanism above described.

The deflector **14** is preferably of cast metal and of substantially the contour illustrated in the drawings, having its front side opened with out-turned vertical edge portions **47** which pass in close proximity to the walls of the containers **8** as the deflector rotates. The open front of the deflector is preferably of sufficient width to span two of the containers **8** at one time. If desired the open front of the deflector may be of proper width to span but one container, but a better action is obtained by coupling up a pair of the containers to each double ball valve **28**.

To better direct the products of combustion against the containers the closed seat or rear wall of the deflector is bowed forwardly intermediate of its ends, as illustrated at **48**, thus forcing the rising products of combustion to impinge against and flow around the walls of the containers.

The deflector **14** is so arranged that while it revolves it directs the products of combustion against and in contact with the containers **8** in turn while shielding the remainder of the containers from the impact and effect of the heat.

The float valve chamber **44** is preferably provided with a filling opening in its top for the introduction of the refrigerant, said opening being closed by a gas-tight screw plug **49**.

Any suitable absorbent for the refrigerant may be used, such, for instance, as calcium chloride or silver chloride or an adsorbent such, for instance, as charcoal, may be used. There are many substances which may be used as the refrigerant. Thus I may and prefer to use ammonia.

With the use of calcium chloride as an absorbent and ammonia as a refrigerant the action of my apparatus is as follows.

The containers **8** are filled with the calcium chloride and ammonia gas is passed through the apparatus until all the air has been displaced by the ammonia and the calcium chloride has absorbed all of the latter which it will take up. The float valve chamber may then be partly filled with liquid ammonia.

Before lighting the gas burner and starting the deflector to rotate, for initiating the refrigerating cycle, the ammonia is at the same pressure throughout the whole apparatus and is distributed as follows. A considerable part of the total amount is absorbed by the calcium chloride in the containers **8** and there is a little liquid ammonia in the float valve chamber **44**, while the rest of the apparatus is filled with ammonia gas.

When the burner is lighted and the deflector is started to rotate the products of combustion pass up the deflector and are caused to impinge on and circulate around the container or containers adjacent to the open front of the deflector. Thus such containers are heated and the ammonia is distilled out of the absorbent, thereby increasing the pressure in the container and causing the ammonia gas to flow out through the tubes **33** to the double check valve **28** and past the ball valve **32** into the chamber **30**, whence it passes through the small tube **42** into the condenser **43**. Within the condenser the ammonia gas is condensed into a liquid and flows by gravity into the float valve chamber **44** where it accumulates until there is sufficient depth of liquid ammonia to open the float valve **46** and permit the liquid to overflow through the tubes **45** into the evaporator **39**.

In the meantime the deflector is slowly revolving and by the time a sufficient amount of ammonia has been distilled out of the first pair of containers the deflector is moved to the next container and the ammonia gas is now being distilled out of the second container. In this manner part of the ammonia is distilled out of all of the containers in turn.

As soon as the open front of the deflector passes a container the latter begins to cool and when the temperature of the calcium chloride falls sufficiently the pressure in the container is lowered below that in the evaporator and the ammonia gas rises from the evaporator through the riser **38**, the small tube **36**, past the ball valve **35** and through the tube **33** to the container where it is absorbed by the calcium chloride.

The deflector is rotated at a slow rate so that the above described action will take place. In the refrigerating apparatus shown in the drawings, a full rotation of the deflector may be accomplished in a period of substantially three hours.

During the normal operation of the apparatus the containers are heated one after the other as the deflector slowly revolves, and as a container is heated the pressure of the ammonia increases until it is sufficient to condense the ammonia in the condenser to liquid form. The float valve allows the liquid to pass into the evaporator where the ammonia is returned to gaseous form and as the calcium chloride in the containers cools the pressure in the containers falls below that in the evaporator, so that the ammonia gas is delivered to the containers and is again absorbed. Thus the pressure in the condenser is higher than in the evaporator and the ammonia is condensed to liquid form at the higher pressure and evaporated again at the lower pressure in the evaporator, the process being continuous.

The intensity of the heat applied in turn to the containers **8** is automatically controlled by the thermostat valve **25**, the operation of which is in turn controlled by the temperature in the refrigerator **27**. As the temperature falls the valve **25** and the gas pipe **23** are turned so as to reduce the fuel supply, and as the temperature rises in the refrigerator **27** the valve **25** is automatically opened to a greater degree to increase the fuel supply and thus intensify the heat in the revolving deflector **14**.

The ratio of the teeth of gear **20** to those of the pinion **21** is such that the desired rate of rotation of the containers is obtained. Such rotative movement may be continuous or step by step as may be desired.

It will be understood that instead of the heat-deflector being moved, the burner may be moved, or the containers may be moved relative to the heat-deflector or to the burner.

I claim:—

1. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, of a plurality of absorbent containers connected in parallel to the evaporator to receive refrigerant from the latter, heating means for distilling the absorbed refrigerant from

the containers, means for producing relative movement between the containers and the heating means, an insulating casing surrounding the containers, and a condenser coil having one end communicating with the containers and the other end with the evaporator, said coil being wound about the casing.

2. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, of a plurality of absorbent containers arranged in annular series and connected in parallel to the evaporator to receive refrigerant from the latter, a single heating means to distill the absorbed refrigerant from the containers and located at the center of said series, means for producing relative movement between the heating means and the containers, and a condenser coil connecting the containers to the evaporator, said coil being wound about the containers.

3. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, of a plurality of absorbent containers arranged in annular series and connected in parallel to the evaporator to receive refrigerant from the latter, a single heating means to distill the absorbed refrigerant from the containers and located at the center of said series, means for producing relative movement between the heating means and the containers, an insulated casing for the containers, and a condenser coil wound about the casing and connecting the containers to the evaporator.

4. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, a condenser and a plurality of absorbent containers arranged in annular series and connected in parallel with the evaporator and condenser, of a tubular heating flue mounted axially of said series and having a heat-escape opening in its side wall, means for relative rotary movement between the tubular heating flue and the series of containers whereby the latter are in turn alternately heated and allowed to cool for the purpose described, said opening being of such limited width circumferentially of the flue that materially less than one-half of the total number of the containers are heated simultaneously, and a continuously effective source of heat supply disposed axially of said flue.

5. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, a condenser and a plurality of absorbent containers arranged in annular series and connected in parallel with the evaporator and condenser, of a tubular flue mounted axially of said series and having a heat escape opening in its side wall, a source of heat located at the lower end of said flue, and means for relative rotary movement between the series of containers and the flue whereby the containers are in turn alternately heated and allowed to cool for the purpose described, said opening being of such limited width circumferentially of the flue that materially less than one-half of the total number of the containers are heated simultaneously.

6. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, a condenser and a plurality of absorbent containers arranged in annular series and connected in parallel with the evaporator and condenser, of a tubular flue mounted axially of said series and having a heat escape opening in its side wall, a source of heat at the lower end of the flue, and means to rotate the flue on its longitudinal axis whereby the containers are in turn alternately heated and allowed to cool for the purpose described, said opening being of such limited width circumferentially of the flue that materially less than one-half of the total number of the containers are heated simultaneously.

7. In refrigerating apparatus to be operated on the absorbent principle, the combination with an evaporator, of a plurality of absorbent containers connected in parallel to the evaporator to receive refrigerant from the latter, heating means for distilling the absorbed refrigerant from the containers, means for producing relative movement between the containers and the heating means, and a condenser coil having one end communicating with the containers and the other end with the evaporator, said coil being wound around the containers.

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