R. E. SCHURTZ.

AUTOMATIC CONTINUOUS REFRIGERATOR.

APPLICATION FILED MAY 16, 1916.

1,414,527.

Patented May 2, 1922.

3 SHEETS—SHEET 1.

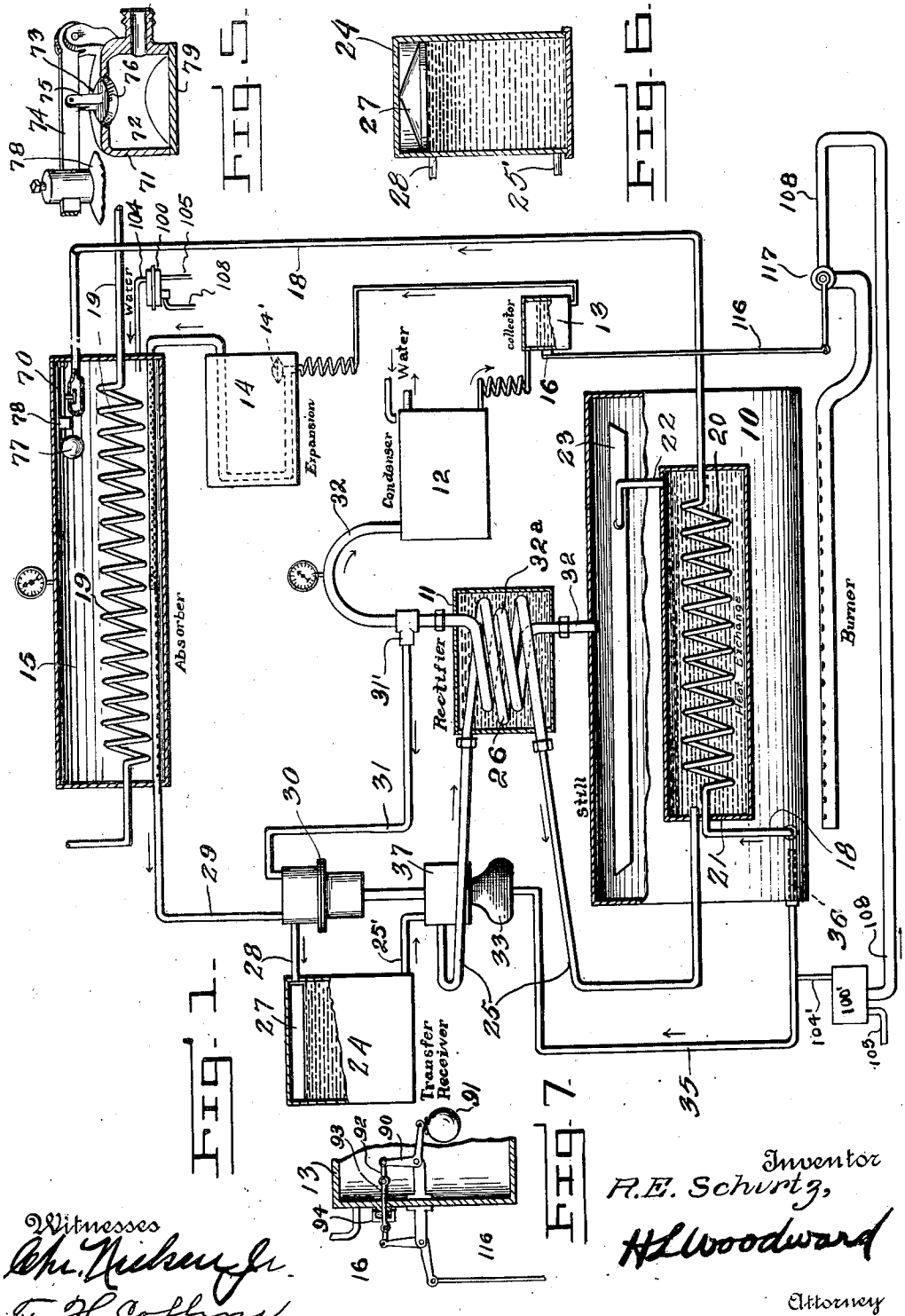


Fig. 1.

Fig. 5.

Fig. 6.

Fig. 7.

Witnesses

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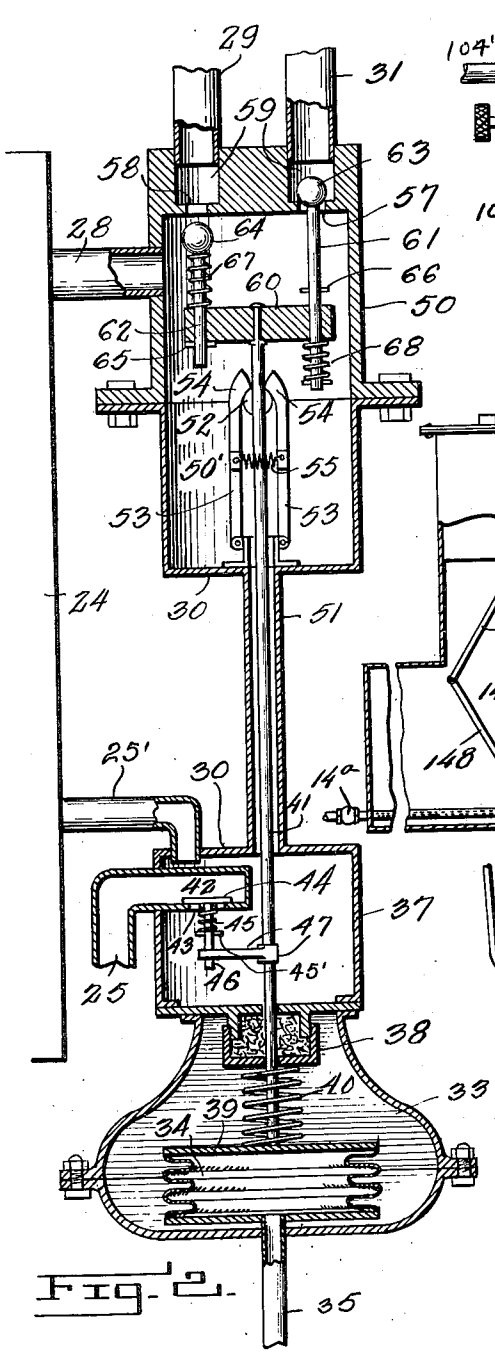


Fig. 2.

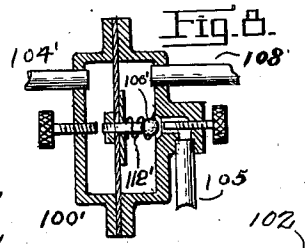


Fig. 5.

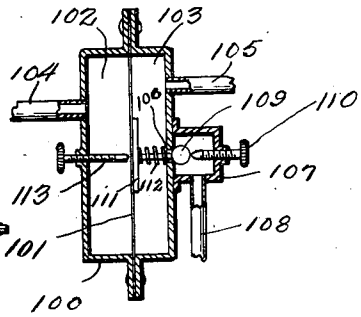


Fig. 10.

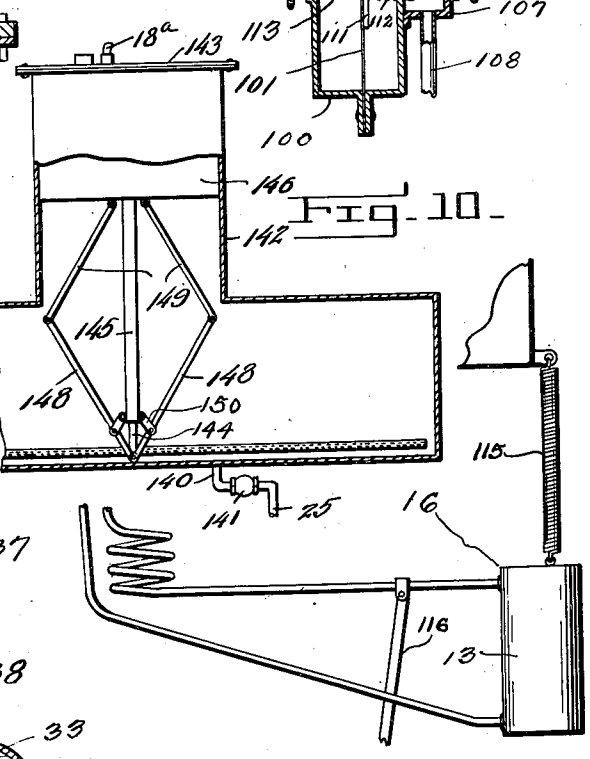


Fig. 4.

Witnesses.
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3 SHEETS—SHEET 3.

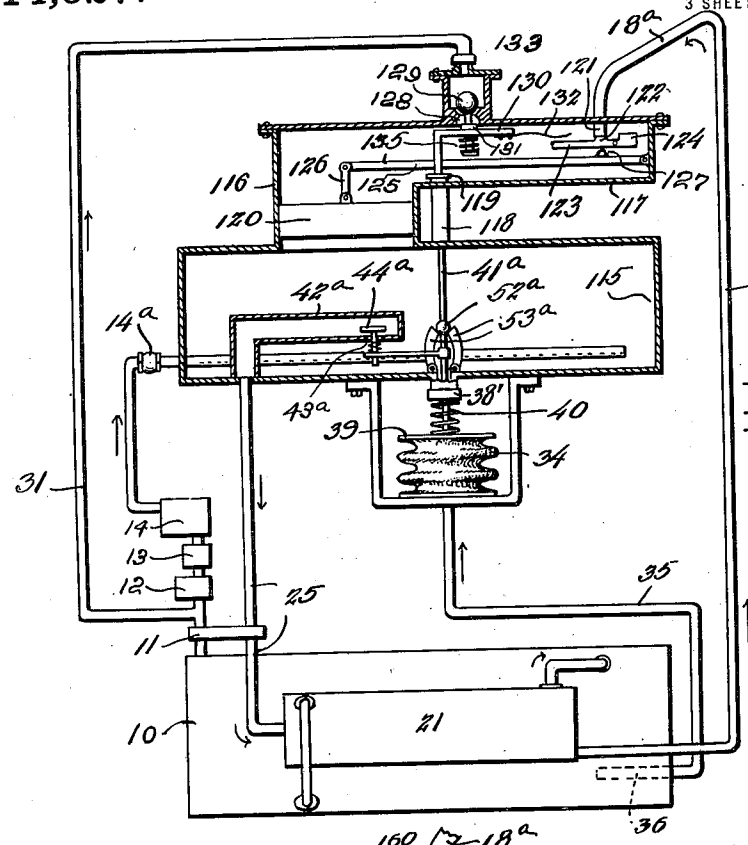


Fig. 9.

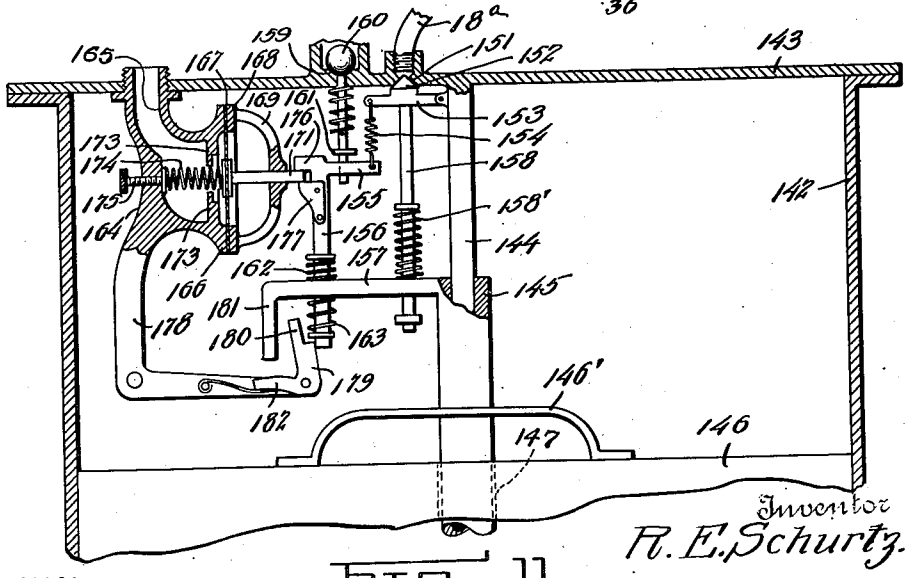


Fig. 11.

Witnesses

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UNITED STATES PATENT OFFICE.

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AUTOMATIC CONTINUOUS REFRIGERATOR.

1,414,527. Specification of Letters Patent. Patented May 2, 1922.

Application filed May 16, 1916. Serial No. 97,927.

To all whom it may concern:

Be it known that I, RALPH E. SCHURTZ, a citizen of the United States, residing at Alamogordo, in the county of Otero and State of New Mexico, have invented certain new and useful Improvements in Automatic Continuous Refrigerators, of which the following is a specification.

The invention has for an object to enable the continuous and uninterrupted operation of the still in a refrigerating system of the absorption type, where a single still and a single absorber are used, without involving the necessity for mechanical devices in maintaining the necessary circulation. It is an important end to attain the automatic operation of such a system. A further important purpose is to enable the attainment of the ends in view with an extremely simple and inexpensive equipment. Additional objects are: to provide a desirable construction of valve for controlling the alternate intermittent establishment of pressure equilibrium between the still and a strong liquor collector chamber and between the still and an absorber chamber; to present a desirable construction in an automatic controller means for apparatus adapted to intermittently balance pressure in a still and collecting chamber for weak liquor in systems of the character indicated; to give a simple and efficient means for regulating the discharge of liquor from the still to the absorber under the pressure developed in the still; and to simplify the circulatory connections from the absorber to the still.

It is another purpose to give a plant of this character in which the costs of heat production in the still will be minimized.

Additional objects and advantages will appear, the invention consisting largely in the elements combined and their arrangement and cooperative relation, but also involving specifically new structure necessary to the attainment of the ends in view.

In the drawings,

Figure 1 is a diagrammatic view of a system laid down in accordance with my invention,

Figure 2 is a detail view of the automatic duplex valve for control of the circulating system,

Figure 3 is a similar view of a back pressure actuated fuel valve associated with the absorber,

Figure 4 is a detail of a form of heat control,

Figure 5 is a detail of the still to absorber transfer valve,

Figure 6 is a detail of the receiver,

Figure 7 is a detail of a further form of heater control,

Figure 8 is a detail view of a means for controlling the fuel by excessive heat and pressure in the still,

Figure 9 is a view partly diagrammatic and partly in detail section of a modified construction for transfer of liquor from the absorber to the still, the mechanical details being enlarged,

Figure 10 is a detail of a construction of absorber and float connections suitable for use in transferring liquor directly from the absorber to the still, operating on the same principle as the foregoing.

Figure 11 is a detail of the valve connections therefor.

As the details of construction of stills, absorption tanks, containers for liquors and gas, thermostatic devices, and heat exchanger devices somewhat similar to parts involved in my invention are well known, such structures will not be illustrated in detail except where new structure is involved by my invention.

There is illustrated an absorption refrigerator system operating on the well known principles of such systems heretofore developed, including the still 10, which may be heated in any well known manner. An ammonia circuit extends therefrom through the separator 11, condenser 12 and ammonia collector 13 to the expansion chamber 14, from which in turn connection is extended to the absorber 15. These parts as far as described comprise any well known construction suitable for the purpose. The expansion chamber 14 may include any well known or suitable form of expansion valve, indicated at 14'. An automatic flame regulator 16 is preferably incorporated in the collector 13 by which when the collector is filled to a predetermined level the heat supplied to the still will be diminished, and

when used in conjunction with well known automatic thermostatic regulators in the refrigerating chamber, and other parts to be described, the production of gas will be constant and proportionate to the requirements. (See Figs. 3, 4, and 7.) This is of advantage in cases where large new stocks of material are introduced into the refrigerating chamber periodically with intervals of one or more days. Upon introduction of a stock of supplies the work required of the system is much greater than is necessary to maintain the stock at a required temperature after it has been cooled.

A transfer line 18 extends directly from the still to the absorber, with any desired cooling means 19 for the absorber. The cooling is also largely effected by means of a coil 20 in the line 18 within a closed tank 21 through which strong cool liquor from the absorber is passed to the still, as will be described. This tank is in open communication with the still at all times through a pipe 22 extending from its top part into the upper part of the still. The top of the tank 21 itself is preferably about at the normal liquor level in the still. In the still there is mounted a large shallow pan 23, above the level of the main body of liquor, into which the pipe 22 discharges, this pan serving as an analyzer to some extent, for the reason that any newly admitted liquor will serve to cool the outgrowing gas partly and be itself partly heated before passing into the body of liquid in the still. The liquor passes from the pan by simply overflowing at the edges. Liquid is passed into the tank 21 from a receiver 24, (Fig. 6) located above the still, through a pipe 25 leading indirectly from the bottom of the receiver. In the receiver there is a float 27 conforming closely to the shape of the receiver in horizontal section, and fitting as snugly therein as possible while permitting its free vertical movement with change of the surface level of the liquid in the receiver. The loose fit necessary to permit free movement of the float will also permit passage of liquor from above the float to the lower part of the receptacle, past the edges of the float. The float preferably has a conical top to prevent undue accumulation of liquor thereon. A pipe 28 is fitted in the top of the receiver leading from a valve device 30 to be described.

It should be noted that the absorber is to be located at a height well above the still, and the receiver 24 at an intermediate level between the two.

Liquor is led to this receiver from the absorber 15 through pipes 29 and 28, the latter having been mentioned. The former leads from the bottom of the absorber to the valve devices 30 to which the pipe 28 is also connected. This valve also has connected thereto a pipe 31 leading from the gas circuit immediately adjacent the rectifier, or a separate connection may be formed at the top of the still. The connection as shown consists of a T 31′ in the main gas duct 32 leading from the rectifier, the pipe 31 being led from the T.

The device 30 (Fig. 2) includes a chamber 33 at its lower part having the expansion device or bellows 34 mounted therein. A pipe 35 leads to the bellows or expansion device from the lower part of the still, where it terminates in a container tube 36 closed at its inner end and holding a liquid such as will vaporize at a predetermined temperature to which the liquor in the still tends to rise as the ammoniacal content is exhausted. The chamber 33 is mounted upon the underside of a chest 37 having a packing box 38 thereon within the upper part of the chamber 33. Through this box 38 there is slidable a rod 41 connected to the top plate 39 of the bellows, the rod being normally held at the lower limit of its movement by a helical spring 40 thereabout seated on the plate 39 and bearing against the packing box 38. The chest 37 has unobstructed communication with the lower part of the receiver 24 by means of a short pipe 25′, and the pipe 25, before mentioned leads into the chest, terminating in a suitable valve chamber element 42 having a port therein at the lower side, opening into the chest 37 within which port is seated the valve 44, normally seated by pressure from the still. A spring 45 is engaged around the outwardly projecting stem 46 of this valve confined between the valve head and a pin 45′ engaged through the stem a distance from the lower end. An arm 47, carried by the rod 41 is positioned to bear upon the outer end of the stem 46 and lift the valve under upward movement of the rod.

The chest has a valve housing 50 mounted thereon by a tube 51 through which the rod 41 extends into the housing 50. The housing is formed with a chamber 50′ into which the rod 41 extends. The rod is provided with oppositely disposed enlargements 52 within the lower part of this chamber 50′, each enlargement having inclined upper and lower sides, and mounted on the floor of the chamber there are two retarding levers 53, having inturned ends 54 bevelled upper and lower parts adapted to ride over the respective enlargements 52, and borne against the rod 41 by a spring 55 connected between the levers beside the rod 41. The enlargements are so positioned that with the rod at the normal lower limit of its movement, they will lie immediately below the ends 54 of the levers, the enlargements being so proportioned that when the rod is at the normal upper limit of its

movement they will lie above the ends 54 of the levers. Initial movement of the rod from either limit of its movement will thus be retarded but free movement permitted after the enlargements pass the bevelled surfaces by which they are opposed.

From the chamber 50′ leads the pipe 28 before mentioned, forming free communication between the chamber and the upper part of the receiver 24. In the upper part of the chamber there are formed gas and liquor ports 57 and 58 adjacent opposite sides of the housing, with enlarged passages 59 extending outwardly therefrom, in which terminations of the pipes 31 and 29 respectively are engaged. The rod 41 carries a cross block 60 at its upper end in which there are slidably mounted vertical valve stems 61 and 62, the former alined with the port 57 and projecting therethrough, having a valve 63 thereon seating over the port in the passage 59. The stem 62 is provided with a valve 64 seating in the port 58 within the chamber 50′. The stem 62 is provided with a stop 65 thereon below the head 60 to be engaged by the head to positively open the valve 64 under downward movement, and the stem 61 provided with a stop 66 above the head 60 for positive opening of the valve 63 under upward movement of the rod 41. Between the valve 64 and the head 60 there is a spring 67 to hold the valve yieldably at the upper limit of its movement with respect to the head 60, while a suitable spring 68 is connected to the lower end of the stem 61 and seated against the under side of the head 60 to hold the valve 63 yieldably at the lower limit of its movement with respect to the head. The head 60 is spaced slightly below the stop 66 when the valve 44 is seated, compressing the spring 68 slightly after the valve 63 is seated. When the enlargements 52 are above the ends 54 of the levers 53, the valve 64 is seated with the spring 67 slightly compressed, while the stop 66 will be engaged by the head 60, with the valve 63 unseated. The arm 47 is positioned to open the valve 44 after the valve 64 is seated when the rod 41 moves upward.

In the absorber there is mounted a weight and float controlled valve 70 by which flow from the still through the pipe 18 is regulated and permitted only when the level of liquor in the absorber falls below a given height. The valve may be of any of the familiar forms used for similar purposes, and as shown, includes a casing 71 having a chamber 72 therein and ported at the upper side as at 73, a lever 74 being pivoted on the casing to one side of and above the port and extending thereacross. It is connected pivotally to the stem 75 of a valve 76 within the casing, and adapted to seat upwardly in the port 73. At the outer end of the lever there is a float 77 arranged to lift the lever so as to close the valve when the level of liquor in the absorber has reached the desired height. A sliding weight 78 may also be provided on the lever to regulate its action. The chamber 72 is closed by a removable plate 79 at the lower side permitting access to and replacement of the valve.

In Figure 3 I have illustrated a device for controlling the fuel supply in a simple manner, which may be actuated by the back pressure in the absorber, and so used alone to control the heater, or used in conjunction with a device actuated by the quantity of liquid ammonia in the collector 13. As developed it comprises a chamber 100 made in two parts with a diaphragm 101 held therebetween and dividing the interior into two compartments 102—103. The pipe 104 connects one side of the device with the upper part of the absorber 15. The fuel feed is led through the opposite side, an inlet connection 105 being provided, and an outlet port 106 formed centrally of the body at that side covered by a small chest 107 from which the burner supply connection 108 is led. In the chest there is a poppet valve 109 for closing the port 106, opening of which is adjustably limited by means of a small hand screw 110. The stem of the valve extends into the compartment 103 and is provided with a terminal plate 111 in close juxtaposition with the diaphragm 101. Between the plate 111 and the adjacent side of the chamber 100 there is confined a light spring 112. Through the opposite side of the chamber there is engaged a hand screw 113 impinging on the diaphragm so that closing action of the valve 109 may be limited. In this way, the valve 109 will be always kept open so that a certain amount of flame will be maintained, and excessive burning of fuel obviated by proper adjustment of the screw 110. This method eliminates the necessity for moving connections, such as links or levers.

In Figure 4 an arrangement is illustrated and also suggested in the diagram, whereby the weight of the liquid in the collector 13 is utilized to control the heat. The collector is here supported by a spring 115′ of a strength to hold the collector at the upper limit of its movement until the weight of the liquid ammonia therein exceeds a predetermined figure. The pipes leading to and from the collector have suitable coils or other configurations to permit the vertical reciprocation of the collector without damage to the conduits. Connected to the collector tank there is a link 116′ extended to the valve 117′ by which flow of fuel to the burner is controlled in any familiar way.

In Figure 7 there is illustrated a detail of the automatic heat control 16 by which the operation of the still is regulated by the level

of the liquid accumulated in the collector 13. Since suitable burners and valves adapted to be controlled by reciprocating rods are well known in the art, the details of the heater are not shown. In this instance the device 16 for controlling the heater consists of a bell-crank lever 90 pivotally mounted in the collector 13 and having a float 91 at one extremity, positioned to be lifted by the liquid ammonia when it rises to a predetermined height. The other arm of the lever is connected by a link 92 to a small rod 93 engaged slidably through a suitable packing box 94 in the side of the collector, the outer part of which rod may be connected in any well known manner to the valve by which the heat supplied to the still is regulated.

The action is as follows—assuming the still to be properly supplied with liquor, and the receiver 24 filled with a supply of strong liquor ready for transfer when required, and the still heated by some suitable valve-controlled means (as, steam or burner):

Gas will be produced and passed through the circuit in the familiar way, any excess of production being prevented by the controlling device 16. The ready distillation of the vapor at first will keep down the temperature, but as the gas is driven off, the temperature of the liquor rises. The proper material being supplied to the tube 36, when the heat of the liquor in the still reaches the predetermined temperature, the liquid in the tube 36 will be vaporized developing pressure in the bellows 34. After being resisted by the levers 53 for a time this will move the stem 41 upward, the valve 64 seating so as to close communication between the receiver 24 and absorber 15 and the valves 44 and 63 being opened admitting gas from the still and balancing the pressures in the receiver and still, permitting the strong liquor in the former to gravitate through the rectifier into the tank 21 where it will take up heat from the weak liquor passing through the coil 20 from the still. A previous charge of strong liquor in the tank 21 is at the same time forced into the still, lowering its temperature and permitting the liquid in the tube 36 to condense, the rod 41 being then returned by the spring 40 to initial position. Thereby communication between the still and receiver 24 is closed by seating of the valves 63 and 44, the spring 68 being compressed; and the valve 64 is opened. Any remaining gas under pressure greater than that in the absorber quickly passes into the latter and is taken up by the liquor therein. The pipe 29 from the valve 30 to the absorber extends some distance into the latter and is suitably perforated to facilitate absorption. As soon as pressure in the receiver 24 is relieved, liquor from the absorber begins to gravitate into the receiver, the gas remaining in the receiver after discharge of liquor to the still being absorbed by the liquor entering the receiver from the absorber, so that back pressure does not prevent operation of the apparatus.

Whenever the level of liquor in the absorber falls below the desired height, the falling of the float 77 will permit the valve 76 to open (Fig. 5) with resultant replenishment from the still. Under the well known characteristic of the rich liquor in tending to rise to the upper part of the body in the still, the weakest liquor will always be supplied to the absorber, since the supply is taken from the lower part of the still. For the same reason the incoming rich liquor is not liable to be carried directly to the absorber from the still, since it has been largely heated and will pass through the pan 23 and be so evenly distributed over the upper part of the still that its richness in ammonia will keep it at the upper level. The liquor passing from the still is considerably cooled in the exchanger 21, giving up heat to the cold liquor from the absorber.

In the operation of the receiver, when gas is admitted from the still, excessive absorption thereof by the liquor in the receiver while gravitating to the still is prevented by the float 27, which covers the surface of the liquor and prevents the necessary contact over most of its area. It will be understood that when all liquor has drained from the receiver 24, and consequent cooling of liquor in the still has permitted the opening of the valve 64, the gas in the receiver 24 will thereby be permitted to escape through the pipe 29 into the absorber, until its pressure is sufficiently reduced to prevent further escape in that way. It will at that time be still quite warm, but will quickly cool, and the resultant contraction will draw liquor from the absorber and by the absorption of the remainder of the gas in the receiver 24, filling of the receiver will be permitted, through the pipe 29, as will be understood.

The valves described for controlling the passage of liquid it will be observed are all so constructed as to provide a liquid seal therein when closed.

In this application, the several elements, such as the still, separator, collector, etc., which are connected, may be said to be in a circuit with each other, and the term circuit will be understood as applying to the pipe connections or any number of parts or elements connected by pipes, as may be indicated by the context. The connections by which the gas is carried from the still to the expansion chamber may be termed the gas circuit, and from the expansion chamber to the still, the return circuit; the connection between the still and the absorber by which liquor is transferred direct, may be broadly termed the liquid transfer circuit.

It will be apparent from the foregoing that the plant practically is self tending, and will need a minimum of supervision. It is quite safe, and free from liability of development of dangerous conditions.

In the claims the term "of the character described" is intended to refer broadly to systems using the principle of the still, expansion chamber, and absorber in a circuit including, or not, any cooperating elements besides those named in the claims, and does not necessarily include the specific devices or arrangements shown in the system herein embodied.

In view of the fact that the liquor moves in a continuous circuit from the still to the absorber and back again, and in order to designate this character of circuit briefly and broadly, it will be designated by the term "orbital circuit" in the claims.

As I regard it important to guard against accidents in the operation of the system, such as shutting off of water to the condenser, or of any other occurrence tending to develop excessive heat and pressure in the still, I have shown at 100′ in Fig. 8, connected with the pipe 35 a safety device to cut down the flow of fuel or shut off heating medium under conditions developed by an accident, such as indicated. This device is the same as shown in Figure 3, except that the valve 106′ seats on an increase of pressure. The pipe 104′ is connected to the pipe 35, and the fuel connections are the same as mentioned, but the valve 106′ is connected to the diaphragm so as to seat at the inner side of the port 106 under pressure acting through the pipe 104′. The spring 112′ in this device is proportioned to prevent the valve from seating until the pressure exceeds a certain degree.

In the rectifying of the vapor passing from the still, I make use of the liquor passing from the receiver 24 to the still. For this purpose the pipe 25 has a coil extension 26 in the tank 11, through which the liquor is carried from the valve 30, and the pipe 32 is connected to the lower end of a helical coil 32^a in this tank. The tank 11 is filled with water which aids to retain heat absorbed from gas passing the coil 32^a, which is transferred to liquor passing through the coil 26 from the absorber. In this way I am assured of a temperature which will properly liquefy the water vapor, without liability of liquefying of the gas itself, which passes from the coil to the condenser 12, where it is reduced promptly to liquid form.

The pipe 32 forms a continuation of the coil 32^a from the lower end of the latter and water condensed in the rectifier may drain back to the still through this pipe by this arrangement, obviating necessity for special trap construction or drain connection. This form of exchange device may be used in connection with the weak liquor return, in place of the device illustrated at 20, as will be readily understood.

The system and apparatus are not limited necessarily to use with ammonia and water, and other suitable agents may be employed.

I do not regard the invention as limited to the use of an intermediate receiver between the absorber and still as now shown at 24 herein, and in Figures 9 to 11, I illustrate constructions by which liquor may be passed directly from the absorber to the still. In this case pressure in the absorber must be equalized with that in the still for a time, preventing ingress of gas from the expansion circuit. But I find it possible to cause the operation of transfer to occur in such a short time and to relieve pressure in the absorber so quickly that the momentary interruption will not detrimentally affect proper continuous refrigeration in the expansion chamber. In the figures mentioned the rectifier 11, condenser 12, ammonia collector 13 and expansion chamber 14 are shown diagrammatically in proper sequence, and parts corresponding to those first described are similarly numbered.

The circuits and controlling devices may be the same as before described except for the omission of the receiver 24 and the modification of the devices 30 and 37 and their relocation as will be described, and all other elements except the absorber and those therein may be of the same construction, and in the same cooperative relation as before described.

In Figure 9 the absorber is constructed with a transverse enlarged lower part 115 providing sufficient space within which the necessary absorption action may take place readily, and from this in a convenient situation there is extended vertically a suitable well portion 116, which may be cylindrical, the upper part of which has been shown as extended at 117 laterally a considerable distance, principally for convenience in illustration of mechanical elements to be mounted adjacent the upper part of the well. Gas from the expansion chamber enters the absorber at 14^a, where a check valve is provided to prevent gas or liquor from blowing back to the expansion circuit. In the bottom of the absorber 115 there is located a packing box 38′ corresponding to the one 38 before described (Fig. 2), through which there extends a valve rod 41^a connected at its lower end to the bellows 34, and spring 40 enclosed in the casing 33^a secured to the bottom of the absorber. The pipe 35 from the thermostatic tube 36 leads to the bellows as before indicated.

The movement of the rod 41^a is retarded by spring pressed arms 53^a mounted on the bottom of the absorber, although they may

be located in any other convenient situation. They correspond to the arms 53 before described and engage a suitable enlargement 52^a on the rod 41^a for that purpose. A small valve chamber 42^a corresponding to the chamber 42 shown in Fig. 2 is located in the absorber adjacent the rod 41^a. The rod 41^a carries a valve 44^a operative to close the port 43^a forming communication between the absorber and the duct 25, the latter being suitably connected to the chamber 42^a. The valve 44^a and rod 41^a have the same relation as the valve 44 and rod 41.

The rod 41^a is extended into the portion 117 of the absorber either through the well 116 or by being extended through the top of the portion 115 and the lower side of the extension 117, as shown. A section of pipe 118 is fitted in the space between the extension 117 and the lower part of the absorber, through which the rod is carried. A packing 119 may be provided at one end of the pipe. In the well 116 there is a float 120 fitted as snugly therein as possible without interfering with its free movement. The function of this float is similar to that of the float 27 before mentioned, in protecting the surface of liquid thereunder from direct contact with gas above, while yet permitting slow passage of liquid past the float into the space therebeneath, at times. The pipe 18 from the still for carrying weak liquor to the absorber is extended some distance above the extension 117 in order that the return reach 18^a may be provided, entering the upper side of the extension and having its end provided with a valve seat 121 presented downwardly next the top of the extension. A valve 122 is mounted intermediately of an arm 123 pivoted intermediately of its length a distance from the valve 122, the arm having a weight 124 at the opposite side of the pivot from the valve tending to seat the valve. A long lever 125 is pivoted on the wall of the extension 117 and passes beneath the arm to a point over the float 120 to which it is connected by a link 126. A lug 127 is properly located on the lever 125 to engage the under side of the arm 123 and bear the valve 122 to its seat when the float is at the upper limit of its movement. A port 128 is provided in a suitable manner at the top of the extension 117 opening thereinto and closed at the outer side by a valve 129 having a stem engaged slidably through an arm 130 on the rod 41^a, a stop 131 being formed on the upper part of the stem to engage the arm when at the upper limit of its movement, and unseat the valve 129.

Between the lower side of the arm 130 and the lower end of the stem of the valve 129 a spring 135 is confined. The arm 130 has a leaf spring 132 thereon extended and positioned to bear downwardly upon the arm 123 when the rod 41^a is at the lower limit of its movement. This construction is such that when the rod 41^a is at the upper limit of its movement the valves 44^a and 129 are open, and the spring 132 is lifted from the arm 123, so that the valve 122 may be closed by the weight 124. At the lower limit of movement of the rod 41^a the valves 44^a and 129 are closed, and the spring 132 bears on the arm 123 tending to open the valve 122, permitting closure thereof however by the float 120. A chamber 133 is formed outwardly of the port 128, with which there is connected the pipe 31 from the gas circuit next the rectifier.

By the last described construction, it will be seen that as the ammonia content of the still is exhausted, increased temperature therein will develop pressure in the bellows 34 opening the valves 44^a and 129 by which pressures in the still and absorber are equalized and strong liquor permitted to flow to the still until the temperature is sufficiently reduced to lower pressure in the bellows and permit return of these valves to closed positions by the spring 40. The liquor will be lowered in the absorber so as to cause the lug 127 to move from the arm 123 while the transfer of liquor to the still is being made, but the pressure within the absorber and the weight 124 will maintain the valve 122 closed until lowering of the rod 41^a and closing of the valves 44^a and 129. The spring 132 will then bear the arm 123 downward and unseat the valve 122, permitting the weak liquor in the reach 18^a to enter the extension 117, which will very quickly absorb the gas and remove all pressure such as might prevent proper entrance of gas from the expander circuit to the absorber. Pressure in the still will also force in a fresh supply of weak liquor until the float is returned to its high position, closing the valve 122.

Figures 10 and 11 illustrate another embodiment of the direct liquor transfer method. The absorber tank is enlarged at the lower part, and has the connection 14^a from the expansion circuit, and a direct connection 140 to the duct 25, a check valve 141 being interposed between the absorber and still in this duct at a suitable point. A central well 142 is formed on the absorber tank, closed at the upper part by a plate 143 upon which all the transfer mechanism is mounted, and which may be removed with the plate when necessary. Fixed centrally upon this plate and concentric with the well 142 there is a guide post 144 having a sliding sleeve 145 thereon corresponding to the rod 41 before described. The post 144 extends close to the bottom of the absorber as shown, although this is not essential and the sleeve 145 extends over the major part of its length. A float 146 is mounted in the well, provided with a handle 146′ and having a

central opening 147 therethrough receiving the sleeve 145 loosely. This loose fit permits passage of liquid downwardly through the float. Links 148 are connected to the lower end of the post 144, and their outer ends are connected by links 149 of equal length to the bottom of the float 146. The links are so proportioned that they will not strike the sides of the well under downward movement of the float and as illustrated extend outward in the large part of the tank when the float is at the lower part of its movement. Near their inner ends, the links 148 have short links 150 pivoted thereon and connected to the lower end of the sleeve 145, whereby movement of the float vertically will produce a lesser movement of the sleeve 145, in the same direction.

The pipe 18 has the return bend 18ª terminating at a port 151 where a suitable connection is made, the port being closed at the inner side by means of a valve 152 pivoted on the post 144. The valve has an arm 153 extended outwardly therefrom connected by a spring 154 to an arm 155 of a vertical sliding bolt 156 carried by a horizontal arm 157 formed on the sleeve 145. A spring supported push pin 158 is also mounted vertically in the arm 157, disposed to bear yieldingly against the under side of the valve 152 and tending to seat it, when the float is at the upper limit of its movement. A gas inlet port 159 is formed in the plate 143 closed by a spring seated valve 160, the stem of which passes slidably through the arm 155 and is formed with a shoulder which the arm engages under upward movement, to open the valve. The sliding bolt 156 has engaged therewith two springs 162 and 163 bearing against respective sides of the arm 157.

A diaphragm fitting 164 is carried by the top plate 143, including the cored stem 165 having threaded engagement with the plate and projecting therethrough for communication with the atmosphere. This fitting includes an annular flange 166 upon which the diaphragm 167 is secured by means of a ring 168 suitably secured to the flange 166 nd having a bracket 169 thereover through which there is slidably engaged a bolt 171 attached to the diaphragm. The movement of the diaphragm within the flange 166 is limited by a stop portion 173 which is open at the center for passage of a spring 174 bearing against the outer side of the diaphragm and adjustable by means of a screw 175 engaged through the back of the fitting 164. The bolt 171 engages under a shoulder 176 on the bolt 156 to limit its downward movement, and a spring pressed detent 177 is mounted on the bolt 156 to engage under the bolt 171 to prevent upward movement of the bolt 156 at times. This detent is bevelled on the lower part to permit the bolt to ride thereover at certain times as will appear. An arm 178 is formed on the fitting 164 having a horizontal lower part the extremity of which is located near the line of the bolt 156 and a distance therebelow. On this arm there is pivoted a spring pressed check 179 tending to engage beneath the bolt 156 to hold it at the upper limit of its movement, and suitably constructed for that purpose when the bolt passes above a certain position. While the bolt is at the lower limit of its movement, however, the check bears against the side of the bolt. The check is formed with an offset extension 180 to stop it in proper position to support the bolt 156. The arm 157 is formed with a downward extension 181 disposed to pass without the check and engage a release arm 182 thereon by which it is borne laterally from the path of the bolt 156 when the sleeve moves downward a certain distance.

The operation of the last described construction is as follows: The still and absorber being supplied with a proper amount of liquor and the absorber being filled to the normal high level, when the pressure in the absorber rises by reason of increase of the strength of the liquor to a predetermined degree, and continued admission of gas from the expansion circuit, the diaphragm 167 will be flexed and the position of the device will be substantially as shown in Figure 11. The valve 152 will be closed by reason of compression of the spring 158′ of the push pin 158; the valve 160 will be closed; the bolt 156 will be at its lowermost position, permitting closing of the valve 160 and putting the spring 154 under slight tension tending to open the valve 152. The detent 177 will be engaged beneath the bolt 171, which is extended; and the spring 162 at the upper side of the arm 157 will be compressed tending to raise the bolt 156, while the check 179 will rest against the side of the lower end of the bolt 156.

When the pressure in the absorber rises, by reason of increase of the strength of the liquor to a predetermined degree, and continued ingress of gas from the expansion circuit, the diaphragm 167 will be flexed, retracting the bolt 171, which will permit the bolt 156 to slide to the upper limit of its movement. This compresses the spring 154, causing closure of the valve 152 securely, and opens the valve 160, at the same time permitting the check 179 to pass beneath the bolt 156. Opening of the valve 160 balances the pressure in the absorber with that in the still, and the weight of liquor in the absorber and pipe 25 will open the check valve 141 and permit flow of liquor to the still.

Removal of liquor from the absorber causes the float to lower, and it carries the sleeve 145 downward, relieving the valve

152 from pressure by the push pin 158 and compressing the spring 163 at the lower side of the arm 157. The check 179 prevents any change in conditions otherwise, however, until the extension 181 of the arm 157 engages the arm 182 of the check, when the compressed spring 163 quickly forces the bolt 156 downward, assisted by the spring of the valve 160 and the spring 154, the bolt 171 riding over the detent 177 until it engages the shoulder 176. The valve 160 is permitted to seat and the spring 154 caused to draw the valve 152 open also. The small quantity of weak liquor in the portion 18ª of the pipe 18 thus admitted quickly absorbs the exposed gas above the float, permitting resumption of the absorption function and free flow of liquor from the still through the pipe 18 raising the float. This causes the sleeve to rise to normal position compressing the spring 158′ and closing the valve 152 so that the device will be ready for a repetition of the operation.

Considering the three elements—still, absorber and collector it is evident that if the fluid quantity is maintained in two of these elements, the quantity in the third will be maintained. It is also evident that to maintain a constant strength of fluid in either absorber or still, the strength in the other will remain constant, if the quantity of fluid in the collector remains constant. It is thus evident that the still and absorber are in balanced relation,—as strength in the still becomes less, the strength, also pressure of fluid in absorber becomes stronger. Thus means actuated by back pressure from absorber is an equivalent of thermostatic means operated from still. Thus, the equalizing valve arrangement of Fig. 1 could as well be operated by back pressure from absorber. Also, the safety valve shown in Fig. 1 could be so operated instead of by connection with the thermal tube in the still. For the same reason, such mechanism in Fig. 9 could also be operated from absorber, and the control shown in Figures 10 and 11 could be operated by being connected to thermal tubes in the still as well as absorber pressure.

From the foregoing it may be stated that maintaining approximate normal conditions in two of the three elements (still, absorber and collector), the third must remain approximately constant. Normal condition in the still and absorber refers to both quantity of liquor and strength of same and constant condition in collector refers to liquid quantity.

Liquor level in absorber and still in Fig. 1 is maintained by float in absorber. The level can be regulated by an overflow pipe in absorber, which would feed fluid to a trap between the absorber and still, the flow of weak fluid from the still to the absorber being regulated by automatic means actuated by conditions in one of the containers, (in accordance with the methods herein indicated,) such as back pressure from the absorber, or thermostatic means associated with the still.

Assuming constant level of fluid in absorber and still, it is evident that means operated by any one of the three elements (still, absorber or collector) can be made to control or regulate circulation of liquor through the circuit and means operated by either of the other two named elements can be made to regulate the heating means.

Means for returning fluid from absorber to still might include such means as in Fig. 1, or trap, or the usual pump.

What is claimed is:

1. In a refrigerating system, a liquor container in the return circuit, a connection between the gas circuit and the container, means normally closing the last named connection and for closing the return circuit outwardly of the container and normally inoperative to close said circuit, means to prevent outward movement of liquor from the still to the container, and means operatively associated with the still to operate said means first named to close the circuit and open said connection under operation of the still as described.

2. In a refrigerating system of the character described, an absorber above the still, a liquid transfer connection between the still and absorber, means associated with the circuit normally operative to close the connection under a certain condition in the system, a strong liquor receiver connected to the absorber and still at an intermediate level, means to prevent back pressure from the still to the receiver, a separate valve closed connection from the gas circuit to the receiver, normally inoperative means to open said last named connection and close the connection between the absorber and receiver, and thermostatic actuating means for said normally inoperative means operatively associated with the still.

3. In a refrigerating system of the character described, a liquid level-controlled device in the ammonia collector operatively associated with the heater for diminishing the action of the latter when the liquid level rises beyond a predetermined height, the absorber in the system being located above the still, a liquid transfer connection between the still and return circuit, means associated with the circuit operative to close the connection under a certain condition in the system, a liquor container in the return circuit, means to prevent back pressure from the still to the container, connection between the gas circuit and the container, means normally closing the last named connection and for closing the return circuit outwardly of the container and normally inoperative in the

last named respect, and means operatively associated with the still to operate said means next last named to close said circuit and open said last named connection by operation of the still in the condition described.

4. In a refrigerating system, the combination of a still, a heating means, a controller therefor, a gas circuit including a liquefied gas collector, a controller operating device constructed and associated with the collector for actuation by variation of the quantity in the collector, and operative connections between the operating device and heat regulator for decreasing the heat supplied to the still upon accumulation of liquefied gas beyond a predetermined quantity.

5. In a system of the character described, a liquor receiver, outlet connections therefrom to the still, including a back pressure check for the purpose described, means for establishing communication between the gas circuit and the receiver, and a cover float in the receiver conforming to the shape and size thereof for the purpose described, and means to establish connection between the absorber and receiver alternately with said communication between still and receiver.

6. In a system of the character described, an absorber, a still, an intermediate receiver, a connection between the receiver and the still, a check therein for the purpose described, a chambered member having separate communication with the absorber, the gas circuit and receiver, the last named connection being normally open, oppositely seating valves operative to respectively close communication between the chamber and the absorber and the chamber and the gas circuit, a movable member in the chambered member, lost motion connections between the movable member and the valves for alternate seating thereof, the connection with one valve at least including resilient means tending to hold it at one limit of relative movement with respect to the movable member, and means to operate the movable member.

7. In a system of the character described, an absorber, a still, an intermediate receiver, a connection between the receiver and the still, a check therein for the purpose described, a gas conduit between absorber and still, a connection between the receiver and gas conduit, a connection between the receiver and absorber, valves in said connections, means movable under heating of liquor in still above a predetermined temperature, and operative connections between said means and valves for alternate opening thereof, and normally operative to maintain the connection between the receiver and the absorber open under low temperature conditions.

8. In a system of the character described, a still, an absorber, a connecting conduit including an intermediate receiver, a valve device in the conduit including a pressure operated element having a reciprocable part, a thermostatic device in the still operatively associated with the pressure operated element, for movement of the reciprocating part in one direction under effect of high temperature in the still, yielding means to oppose movement of the reciprocating part, an outlet connection from the absorber to the receiver, two valves on the reciprocating member, a valve seat in said conduit between the absorber and receiver positioned to be engaged by one valve under operation of the thermostatic device, a connection between the gas circuit of the system and the said conduit having a terminal port formed with a seat facing to be engaged by the other of said valves alternately with engagement of the first named valve and seat, and a check in the conduit between the valve device and the still.

9. In a refrigerator of the character described, means to maintain an approximately constant condition in the system, comprising the combination of a still, an absorber, means for transferring liquor from the absorber to the still, a controlling device therefor including a thermostatic element located in the still, a liquid transferring connection between the still and absorber for passage of liquor from the still to absorber and a valve therein, and means operatively associated with the absorber to operate the valve.

10. In a refrigerating system of the character described, the combination of a still, an absorber, a direct connection between the interior of the still at its lower part and the interior of the absorber, a valve in the connection, fluid quantity actuated means operatively associated with the absorber to operate the valve, and means for returning liquor from the absorber to the still.

11. In a refrigerating system of the type indicated the combination of a still, an absorber and a liquefied gas collector, means for regulating the passage of liquefied gas from the collector, a liquid level control in the absorber and separate respective control means co-actively associated with two of said three elements first named, said control means actuated by the respective elements associated and constructed to control action of the said three elements first named whereby a predetermined mean condition in the whole system will be attained.

12. In a refrigeration system the combination of a still element, an absorber element, orbital circuit connections therebetween including a receiver element below and communicating with the absorber below the liquor level therein, a separate gas circuit between still and absorber, a branch duct from the gas circuit communicating with the receiver above the liquor level therein, valves

operative to permit flow in one direction only in said circuits, and automatic devices for operating the valves operatively associated with certain of the three elements so named respectively.

13. In a refrigerating system, a still element, an absorber element, a liquefied gas collector element, circuits connecting said elements, means for controlling the flow of liquefied gas from said collector element, and automatic means associated with certain of the three above-named elements susceptible to change of condition in said certain elements and tending to, approximately, maintain a normal level of liquid in the still and absorber elements, and an, approximately, constant quantity of liquefied gas in the collector.

14. In a refrigerating system, a still element, an absorber element, a liquefied gas collector element, circuits connecting said elements, and automatic means associated with certain of the three above-named elements susceptible to change of condition in said certain elements and tending to, approximately, maintain a constant strength of liquid in the still and absorber elements, and an, approximately, constant quantity of liquefied gas in the collector.

15. In a refrigerating system, a still element, an absorber element, a liquefied gas collector element, circuits connecting said elements, means for controlling the flow of liquefied gas from said collector element, and automatic means associated with certain of the three above-named elements susceptible to change of condition in said certain elements and tending to, approximately, maintain a normal quantity and strength of liquid in the still and absorber elements, and an, approximately, constant quantity of liquefied gas in the collector.

16. In a refrigerating system, a still, an absorber arranged above the level of said still, a liquor receiver between said absorber and still, a single combined equalizing and liquid transit conduit leading from the absorber to said receiver, and pressure equalizing and liquid conducting means between the receiver and the still.

17. In a refrigerating system, a still, an absorber arranged above said still, a liquor receiver arranged at an elevation intermediate the level of the absorber and the still, a single combined pressure equalizing and liquid conducting conduit leading from said liquor receiver to the absorber, one pressure equalizing connection between the receiver and the still, and one liquid connection between the receiver and said still.

18. In a refrigerating system, a still, a burner for heating said still continuously operative normally to produce a constant heat, a fuel pipe for supplying said burner, and a safety device for cutting off the fuel to the burner, operatively associated with the system and operative by abnormal conditions developed in the system.

In testimony whereof I have affixed my signature in presence of two witnesses.

RALPH E. SCHURTZ.

Witnesses:
F. G. FISCHER,
L. J. FISCHER.