

March 22, 1938.

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2,111,774

REFRIGERATION

Filed July 7, 1934

5 Sheets-Sheet 1

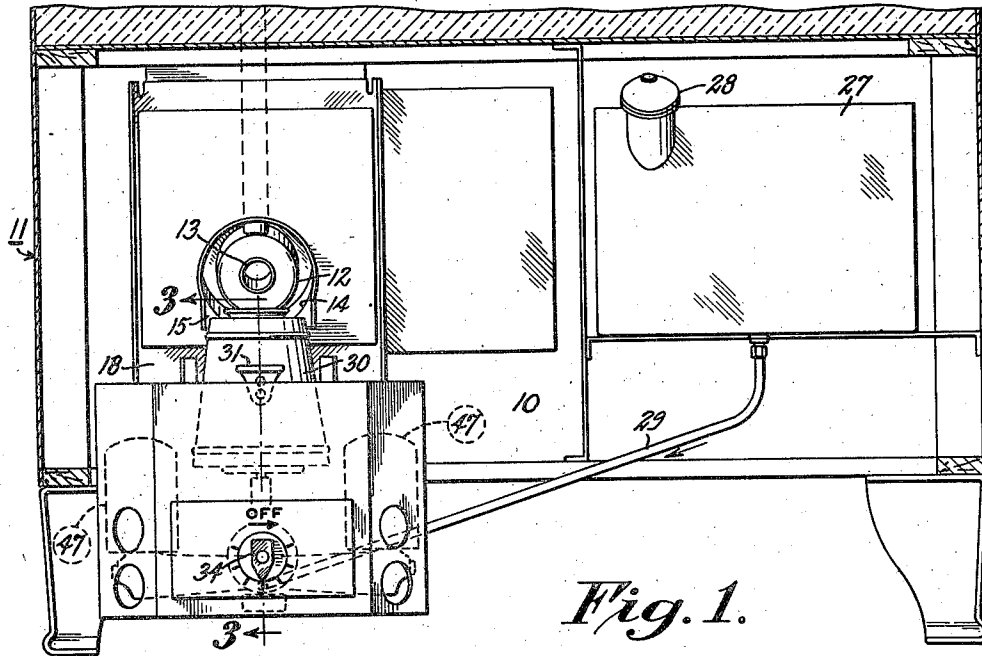


Fig. 1.

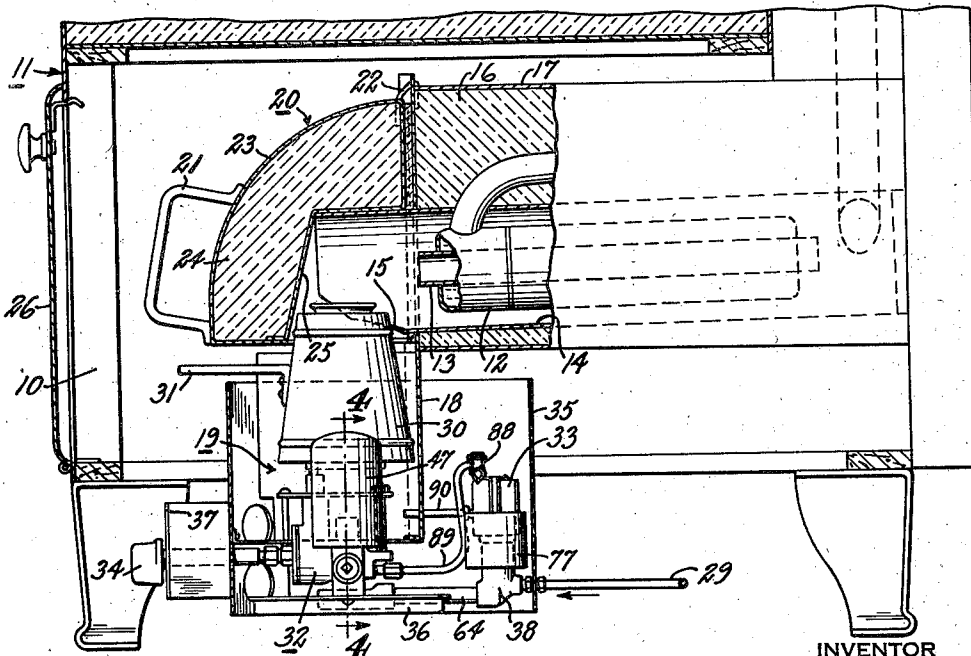


Fig. 2.

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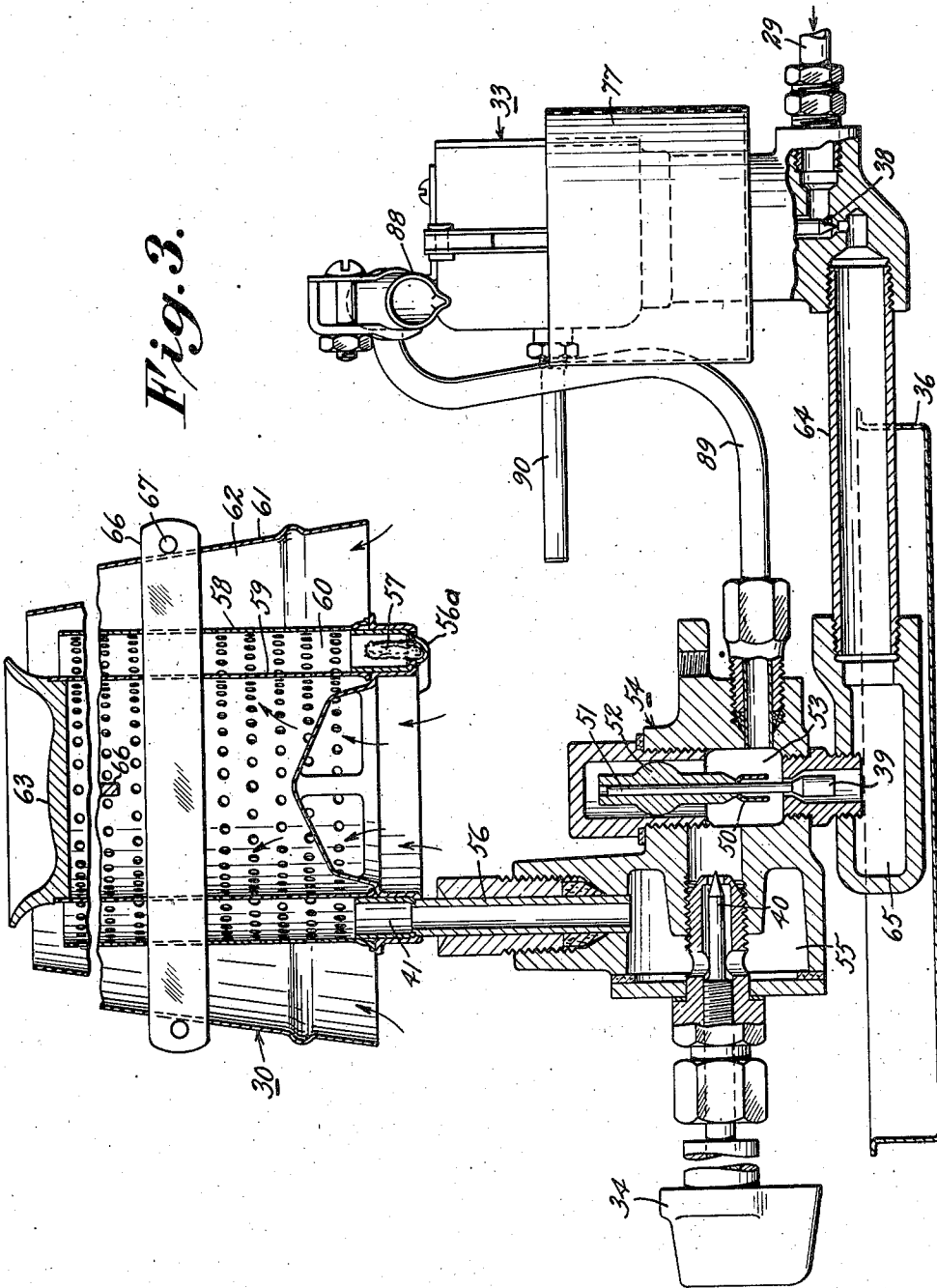
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Fig. 3.



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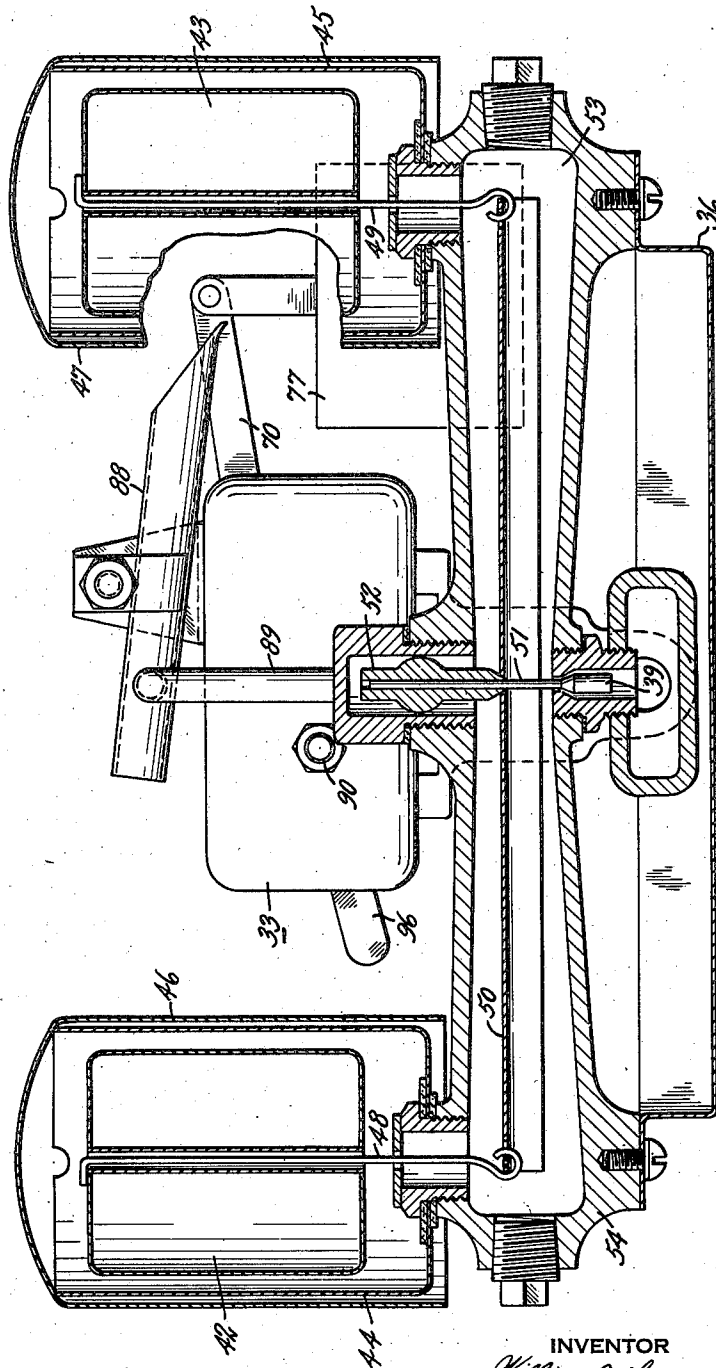
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Fig. 4.



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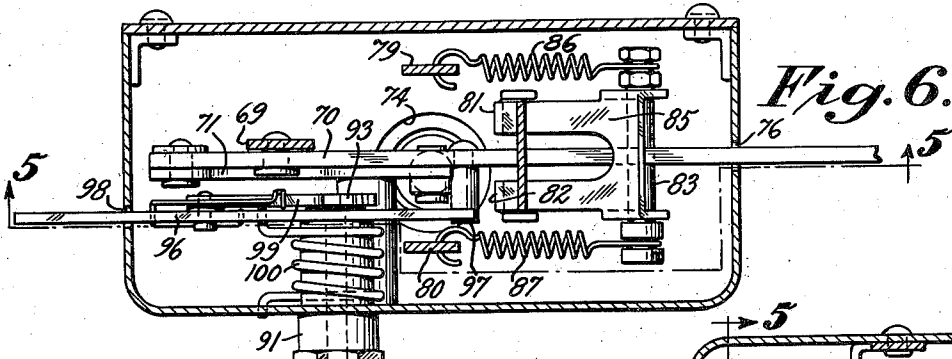


Fig. 6.

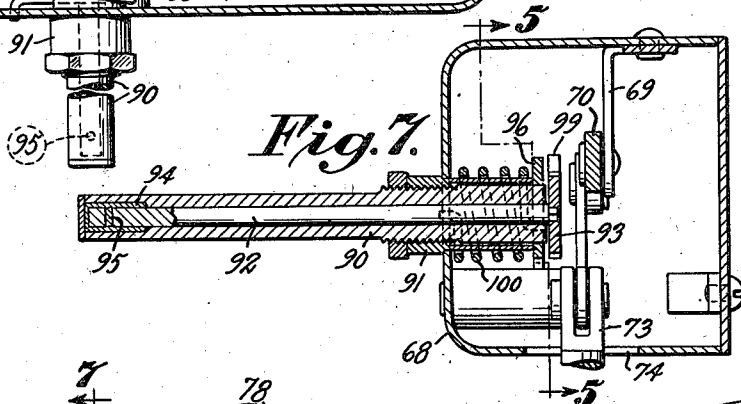


Fig. 7.

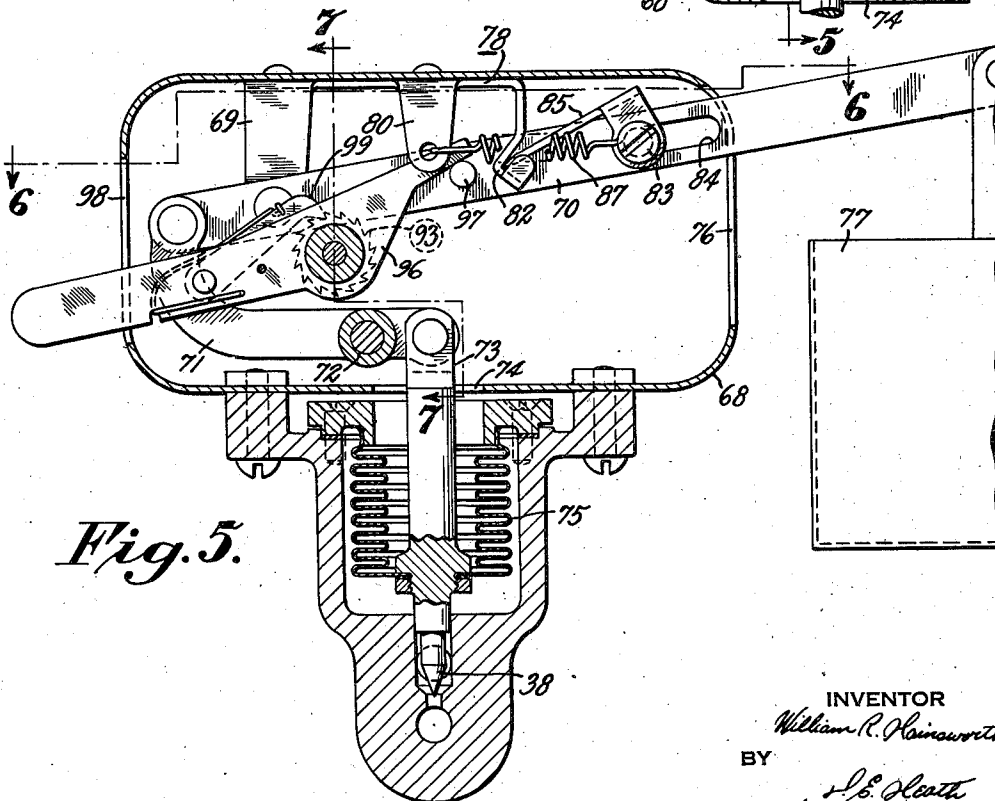


Fig. 5.

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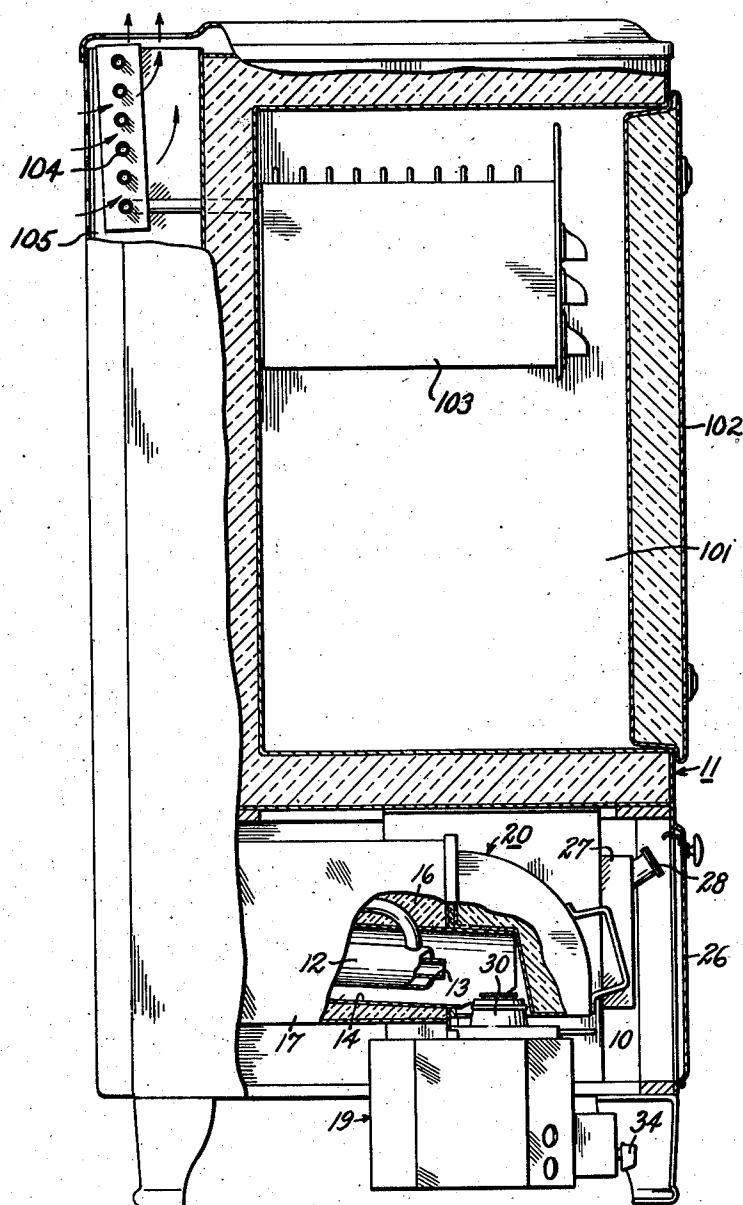


Fig. 8.

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UNITED STATES PATENT OFFICE

2,111,774

REFRIGERATION

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Application July 7, 1934, Serial No. 734,075

10 Claims. (Cl. 62—119.5)

My invention relates to the production of refrigeration by means of liquid fuel such as kerosene.

It is an object of my invention to provide a refrigerator driven by combustion of liquid fuel having no mechanical moving parts in the refrigerating system, no need of an operator, and which is a complete entity, requiring no replenishment other than of liquid fuel and no connections to an external source of energy, and which, therefore, may be located anywhere that it may be desired, especially in localities beyond the distribution of electricity, gas, and water.

It is a further object of my invention to provide a kerosene heated refrigerator having uniformity of operation and requiring a minimum of attention. It is a further object to provide a kerosene refrigerator which needs replenishment of kerosene only after a relatively long period of operation and wherein the refrigerative effect is not adversely affected by the decline of quantity of kerosene supply during such period.

It is another object of my invention to provide an absorption type refrigerator operated by a liquid fuel burner in which the burner is readily accessible for lighting and cleaning.

Another object is to provide an absorption type refrigerator having a horizontal type generator or boiler heated by a liquid fuel burner which is readily accessible.

A further object is to provide a refrigerator of the above type having temperature adjustment means accessible to the user.

In achieving the above objects, I produce refrigeration from energy supplied by vaporization of liquid fuel, such as kerosene, in an open well and combustion of the resulting vapor; and I effect control of the refrigeration produced by employing an absorption refrigeration system in which heat is transferred to an available cooling medium, such as the atmosphere, from a lower temperature place of cooling, such as a thermally insulated food storage compartment, at a rate responsive to the input of heat energy to the system, and provide for controlling the supply of liquid fuel to the vaporizing well by structure hereinafter described, whereby the heat input, the rate of heat transfer, and, therefore, the temperature of the place of cooling is controlled.

My invention, together with the objects and advantages thereof will be more fully understood from consideration of the following description and the accompanying drawings forming a part of this specification and of which:

Fig. 1 is a front view, partly in vertical section,

of the lower portion of a refrigerator embodying my invention;

Fig. 2 is a side view, with parts broken away, of that portion of the refrigerator shown in Fig. 1;

Fig. 3 is a detail vertical section of a burner on line 3—3 in Fig. 1;

Fig. 4 is a detail vertical section of a float control for the burner taken on line 4—4 in Fig. 2;

Fig. 5 is a detail vertical section of a safety device taken on line 5—5 in Figs. 6 and 7.

Fig. 6 is a horizontal section of the safety device taken on line 6—6 in Fig. 5;

Fig. 7 is a detail vertical section taken on line 7—7 in Fig. 5; and

Fig. 8 is a side view, with parts broken away, of a whole refrigerator embodying my invention.

Referring to Figs. 1, 2, and 8 of the drawings, there is shown a refrigerator cabinet 11 having a thermally insulated storage compartment 101, accessible by means of a door 102, and a lower apparatus compartment 10 accessible at the front by means of a door 26. I preferably utilize a refrigeration apparatus generally of the uniform pressure absorption type disclosed in Patent No. 1,609,334 to Von Platen et al, and more particularly an air cooled apparatus of the type disclosed in my application Serial No. 722,640 now Patent No. 2,037,782, granted April 21, 1936. In Fig. 8 may be seen a cooling element or evaporator 103 located in the storage compartment 101, and an air cooled condenser 104 located in an upright portion 105 of the apparatus compartment. For a complete description of the refrigeration apparatus and assembly of the cabinet and apparatus, reference may be had to my said earlier application.

The generator is of the horizontal type, as described in my said earlier application, and includes a substantially horizontal vessel 12 located within the lower apparatus compartment 10 and provided with an inner heating flue 13 extending longitudinally therethrough. In accordance with my invention, I further provide an outer heating flue 14 located concentrically around the generator 12 in spaced relation therewith and projecting forwardly beyond the generator 12 and the inner flue 13. The inner and outer flues join at the rear of the generator and communicate with an upwardly extending flue portion, as indicated in dotted outline in Fig. 2, having an outlet at the upper part of the refrigerator cabinet. The lower part of the forwardly projecting portion of the outer flue 14 is cut away and the sides bent outwardly (Fig. 1) to form a recess 15 for a purpose which will hereinafter appear. The generator 12

is thermally insulated, and this is accomplished in the present embodiment by surrounding the outer flue 14 with suitable thermal insulation material 16, such as mineral wool, which is retained in position by a light sheet metal casing 17. On the front of the insulation retaining casing 17 is a plate 18 which may be referred to as a mounting plate. The latter extends downwardly below the generator and provides a mounting for the burner assembly as hereinafter described. The forward end of the outer generator flue 14 projects through a suitable opening in the front plate 18.

Below the forwardly projecting end of the generator outer flue 14 is mounted a liquid fuel burner generally indicated by the reference numeral 19. The burner 19 is mounted on the lower part of the front plate 18 and projects upwardly and substantially perpendicularly into the forwardly projecting end of the outer generator flue 14. It will now be understood that the cutaway portion or recess 15 of the outer generator flue 14 permits location of the upper end of the burner within the forward end of the flue.

To enclose the front end of the outer generator flue 14 and form a continuous enclosed passage from the upper end of the burner into the flue 14, I provide a removable closure member or hood 20 provided with a suitable handle 21 and suspension hooks 22. The hood 20 comprises a sheet metal casing 23 filled with a suitable thermal insulating material 24 and is formed with a recess 25. One side and the bottom of the hood 20 are substantially flat and mutually perpendicular and the recess 25 opens on both of these sides. The hood 20 is readily manipulated by the handle 21 from the front of the cabinet 11, the lower apparatus compartment 10 being accessible by means of a downwardly opening door or other closure member 26. In position, the hood 20 is suspended from the top of the front plate 18 by the suspension hooks 22, or other suitable means, and the recess 25 contains the forwardly projecting end of the outer generator flue 14 and the upper end of the burner 19.

The above described generator and burner assembly is located at one side of the apparatus compartment 10 and in the other side of this compartment, above the top of the burner 19 is located a liquid fuel reservoir or storage tank 27 having a filling cap 28 also accessible by means of the door 26 in the front of the apparatus compartment 10. Liquid fuel, such as kerosene, is supplied to the burner, as hereinafter described, from the reservoir 27 through a supply conduit 29.

The burner assembly 19 includes a removable combustion shield assembly or chimney 30 provided with a suitable handle 31, a float control assembly 32, a safety device 33, and an adjustment knob 34. The burner assembly 19 is laterally surrounded by a sheet metal casing 35 and below the burner is a suitable drip pan 36. The adjustment knob 34 is on the outside of the casing 35 and accessible from the front of the refrigerator cabinet 11. A sheet metal extension 37 provides a journal for the adjustment member 34 and also may be suitably inscribed with a dial or other desired index as indicated in Fig. 1.

The burner construction will be more fully understood by reference to the detail sectional views in Figs. 3 and 4. In Fig. 3, the section is taken on line 3—3 in Fig. 1 and includes only the safety cut-off valve 38, the control valve 39, the adjustment valve 40, the burner well 41, and the burner shield assembly 30. The safety cut-off valve 38 is normally open and adapted to be closed to shut

off the supply of liquid fuel, such as kerosene, to the burner upon the occurrence of hazardous conditions such as high temperature or overflow of liquid fuel. This safety device will be hereinafter more fully described. The control valve 39 is adapted to be operated by floats 42 and 43 which may be seen in Fig. 4. Fig. 4 is a detail section taken on line 4—4 in Fig. 2 for the purpose of illustrating the floats and the connection of the floats to the control valve. The floats 42 and 43 are contained in respective float vessels 44 and 45, these float vessels having covers 46 and 47. The floats 42 and 43 are connected by suitable light rods 48 and 49 to opposite ends of a beam 50. The control valve 39 is connected to the center of the beam 50 by means of a valve stem 51 which is provided with a guide member 52. The beam 50 is thus suspended from the floats and is located within a chamber 53 formed by a suitable casing 54. The float vessels 44 and 45 communicate at their lower portions with the beam chamber 53 forming therewith what will herein be referred to as a float chamber.

Referring more particularly to Fig. 3, the casing 54 is also formed to provide a chamber 55. Communication between the portion 53 of the float chamber and the chamber 55 is controlled by the adjustment valve 40 which is operated by the adjustment knob 34 previously referred to in connection with Figs. 1 and 2. Upwardly from the chamber 55 there extends a conduit 56. The upper end of the conduit 56 is connected to the bottom of the annular burner well 41.

Within a depression 56a in the burner well 41 is located a wick 57. This wick extends only a relatively small distance around the circumference of the burner well and is only for the purpose of lighting the burner, as will hereinafter appear.

The burner chimney 30 comprises a pair of perforated cylinders 58 and 59 having diameters substantially equal to the outside and inside diameters of the burner well respectively and arranged concentrically above the burner well to provide what may be referred to as an annular combustion chamber 60 extending upwardly from the burner well 41. Concentrically around the perforated cylinders 58 and 59 and in spaced relation thereto is located an imperforate frusto-conical shell 61 which may be referred to as a shield. The space 62 between the shield 61 and the cylinder 58 is open at the bottom and at the top. The space 60 between the concentric cylinders 58 and 59 is open at the top. The space within the inner cylinder 59 is open at the bottom and closed at the top by a member 63. The burner chimney assembly 30 is secured by mutually perpendicular bars 66 penetrating the perforated cylinders 58 and 59 and the shell 61, and retained by pins 67 at the outer ends of the bars.

I will now describe the operation of the structure so far described, making reference to Figs. 1 to 4 inclusive. Kerosene or other liquid fuel flows from the reservoir 27 through the supply conduit 29, which may be seen in Fig. 1, through the safety cut-off valve 38, which is normally open, through a pipe 64, through a valve chamber 65, and through the control valve 39 into the portion 53 of the float chamber. The kerosene rises in the float chamber until it reaches such a level that the floats 42 and 43 raise the beam 50 and close the control valve 39. The control valve 39, operated by the floats 42 and 43, functions to maintain a constant level of kerosene in the float chamber at all times. From the portion 53 of

the float chamber, kerosene flows through the adjustment valve 40, chamber 55, and conduit 56 into the annular burner well 41. When combustion is not taking place, kerosene stands in the conduit 56 and burner well 41 at a level corresponding to that in the float chamber.

To light the burner, the depression 56a may be primed with kerosene and a flame applied to the wick 57. For easily accomplishing this, the burner shield assembly 30 may be removed by means of the handle 31 shown in Fig. 2, it being assumed that the hood 20, previously described, is removed. Due to the increased temperature produced by the burning of kerosene from the wick 57, general combustion of kerosene in the burner well 41 is instigated. The shield assembly 30 is then placed in position over the burner well, and the area of combustion is then more or less confined to the annular space between the perforated cylinders 58 and 59. Air is supplied for combustion from the space 62 under the shield 61 and the space within the inner cylinder 59, the air entering the bottom of these spaces as indicated by arrows in Fig. 3. The closure member 20 is then placed in position and the heat is directed from the upper end of the burner, between the outer shield 61 and the member 63, into the generator heating flues 13 and 14. In order to regulate the size of the burner flame, the adjustment knob 34 may be turned to operate the adjustment valve 40. This adjustment controls the flow of liquid kerosene from the float chamber to the burner well while combustion from the burner well is taking place, and therefore controls the liquid level of kerosene in the burner well 41 or conduit 56 and, consequently, the size of the burner flame.

For a given position of knob 34, the flow through valve 40 is constant because of the maintenance of a constant head of liquid fuel on the side of the orifice of valve 40 remote from the combustion device including parts 41, 58 and 59.

For the purpose of shutting off the flow of kerosene to the burner in case of fire outside of the burner, as in the drip pan 36, or in case of overflow of kerosene from the burner, which might occur due to faulty operation of the control valve 39, I provide a safety device 33 for operating the shut-off valve 38. The construction of the safety device 33 may best be understood by reference to the detail Figs. 5 to 7.

As shown in Fig. 5, the safety device mechanism is housed principally in a casing 68 mounted on the casing of the cut-off valve 38. On a suitable post 69 within the casing 68 is pivoted what is herein referred to as a bucket lever 70. The short end of the bucket lever 70 is pivotally connected to one end of a lever 71 which is pivoted within the casing 68 at 72 and has its other end operatively connected to the cut-off valve 38 by a stem 73. The stem 73 extends through an opening 74 in the lower part of the casing 68 and into the cut-off valve casing, the entrance of the stem 73 into the valve casing being sealed by a suitable bellows 75. The long end of the bucket lever 70 extends through a slot 76 in one end of the casing 68 and from the end of the lever, outside the casing there is suspended a bucket 77. Within the casing 68 there is mounted, on the upper part thereof, a bracket 78, providing a pair of depending tabs 79 and 80 on opposite sides of the bucket lever 70, and a pair of more closely spaced pivot posts 81 and 82, as best shown in Figs. 5 and 6. Pivoted on a rod 83 extending through a slot 84 in the bucket lever

70 is a substantially U-shaped lever 85. The legs of the U-shaped lever 85 rest in V-shaped portions of the pivot posts 81 and 82. Springs 86 and 87 are connected between the outer end of the rod 83 and the tabs 79 and 80, respectively, of the bracket 78. The bracket 78, U-shaped lever 85, rod 83, and springs 86 and 87 provide a snap action toggle leverage on the bucket lever 70 so that the long end thereof, to which is attached the bucket 77, may be moved upwardly or downwardly with a relatively quick action.

The long bucket end of the lever 70 is normally in its upper position, in which position the cut-off valve 38 is open, and flow of kerosene from the reservoir to the burner is unobstructed. As may be seen in Fig. 2, and in more detail in Figs. 3 and 4, the bucket 77 is positioned under the discharge end of a tube or spout 88. One end of an overflow tube 89 is connected to the portion 53 of the burner float chamber and the other end is connected to the tube or spout 88 at a level just above the maximum liquid level intended to be maintained in the burner by the floats. If, for any reason, the level of kerosene in the burner should rise beyond the intended maximum level, kerosene will overflow through conduit 89 and the spout 88 into the bucket 77. When the weight of liquid in the bucket 77 is great enough to overcome the resistance of the previously described toggle on the bucket lever 70, the bucket end of the lever 70 will be carried to its lower position, and, due to the snap action of the toggle arrangement, the cut-off valve 38 will be snapped closed, cutting off the flow of kerosene from the reservoir to the burner.

Referring again to Figs. 5 to 7, I further provide a resettable thermal responsive device for moving the bucket lever 70 to its valve closing position. Referring to Fig. 7, a tube 90 is threaded through a bushing 91 in one side of the safety device casing 68. Within the tube 90 is journaled a rod 92 having secured on its inner end a ratchet wheel 93. The outer end of the tube 90 is closed and is formed with a slightly enlarged chamber which is filled with a fusible material 94. At ordinary temperatures the fusible material 94 functions as a bond between the tube 90 and the rod 92, preventing rotation of the latter. If desired, the end of the rod 92 may be provided with a small passage 95 to effect a more positive bond.

Referring now to Figs. 5 and 6, a lever 96 is pivoted within the safety device housing 68 on the inner end of the stationary tube 90, with one end overlying a stop or post 97 on the bucket lever 70 and the other end extending through a slot 98 in the housing 68. A spring-pressed pawl 99 on the lever 96 engages the ratchet wheel 93. A spring 100, coiled about the inner end of the bushing 91, has one end secured in the casing 68, and the other end is secured to the thermal trip lever 96. The spring 100 is coiled in such a direction as to exert a torque on the thermal trip lever 96 in a clockwise direction as viewed in Figs. 5 and 6.

Normally, the thermal trip lever 96 is detained from movement by the pawl 99 engaging the ratchet wheel 93 on the rod 92, which latter is held immovable by the bond of fusible material 94 at the outer end of the stationary tube 90. As may be seen in Fig. 2, the tube 90 extends from the safety device 33 through the mounting plate 18 into the vicinity of the burner and above the drip pan 36. Upon increase in temperature, as

upon ignition of kerosene in the drip pan or other part of the burner assembly in the general vicinity of the safety device, the fusible material 94 melts and releases the rod 92. Upon release of the rod 92, the ratchet 93 and the thermal trip lever 96 revolve clockwise, as seen in Figs. 5 and 6, under the action of the spring 100. The latter is sufficiently strong so that the lever 96, overlying the stop 97 on the bucket lever 70, overcomes the resistance of the previously described toggle, and the bucket lever 70 snaps downwardly, closing the cut-off valve 38 as previously described.

When the safety device has been operated by filling of the bucket 77, it may be reset by emptying the bucket and raising the outer end of the bucket lever. After the safety device has been operated by the thermal responsive arrangement as just described, it may be reset by pressing down the projecting end of the lever 96 and raising the bucket lever 70. The thermal responsive device cannot be reset until the temperature has decreased and the fusible material 94 again established a bond between the rod 92 and the tube 90. However, when the bond is reestablished, pressing down the projecting end of the lever 96 rewinds the spring 100 and replaces the pawl 99 on the ratchet wheel 93, whereupon the bucket lever 70 may be raised and the device is again ready for its protective operation.

Various changes and modifications will be apparent to those skilled in the art, wherefore my invention is not limited to that which is shown in the drawings and described in the specification but only as indicated in the following claims.

What I claim is:

1. The combination with a refrigeration system having a generator adapted to be heated, a condenser, an absorber, an evaporator and interconnected conduits forming a closed system for circulation of fluids, expulsion of refrigerant and evaporation of refrigerant to produce refrigeration, said system being so constructed and charged that the quantity of refrigeration produced is a function of the quantity of heat supplied to the generator; of a liquid fuel combustion device for heating said generator by vaporization of fuel oil to supply heat to the generator in proportion to supply of oil to the combustion device, and apparatus for feeding oil to said combustion device including a supply conduit, means having an orifice for controlling flow through said supply conduit, and means for maintaining a constant head of liquid fuel on the side of the orifice of the control means remote from the combustion device in the line of flow whereby the production of refrigeration is maintained in relation to the setting of the control means by means of the constant head of liquid.

2. A method of producing refrigeration which includes applying heat to expel a refrigerant from solution, condensing the expelled refrigerant, evaporating the condensed refrigerant, carrying out the foregoing steps in unison in such a manner that the quantity of refrigeration produced is a function of the quantity of heat applied to expel the refrigerant from solution, burning liquid fuel oil to supply said heat, flowing fuel oil to the place of combustion, and both imposing a certain restriction to the flow of fuel oil and maintaining a certain head of liquid fuel oil acting against the restriction to cause said flow of oil to the place of combustion whereby a desired quantity of refrigeration is produced by

the relation of the amount of restriction to the head of liquid.

3. The combination with a refrigeration system having a generator adapted to be heated, a condenser, an absorber, an evaporator and interconnected conduits forming a closed system for circulation of fluids, expulsion of refrigerant and evaporation of refrigerant to produce refrigeration, said system being so constructed and charged that the quantity of refrigeration produced is a function of the quantity of heat supplied to the generator; of a liquid fuel combustion device for heating said generator by vaporization of fuel oil to supply heat to the generator in proportion to supply of oil to the combustion device, and apparatus for feeding oil to said combustion device including a supply conduit, means having an orifice for controlling flow through said supply conduit, and liquid level control means for holding a head of liquid fuel of given height on the side of the orifice of the control means remote from the combustion device in the line of flow whereby the production of refrigeration is maintained by the relation of the setting of the control means to said head of liquid.

4. Absorption refrigeration apparatus including a generator having a substantially horizontal portion, means for heating said generator including an inner flue extending substantially horizontally through said horizontal portion of the generator, an outer flue around said horizontal portion and inner flue, a liquid fuel burner adjacent one end of said outer flue, and a removable member forming a passage from said burner into said outer flue.

5. Absorption refrigeration apparatus including a generator having a substantially horizontal portion, means for heating said generator including an inner flue extending substantially horizontally through said horizontal portion of the generator, an outer flue around said horizontal portion and inner flue, one end of said outer flue projecting beyond said generator portion and inner flue and having an opening in the lower part thereof, a liquid fuel burner adjacent the projecting end of said outer flue and having a removable portion extending into said opening, and a removable hood over said burner and the projecting end of said outer flue.

6. Absorption refrigeration apparatus including a generator having a substantially horizontal portion, means for heating said generator including an inner flue extending substantially horizontally through said horizontal portion of the generator, an outer flue around said horizontal portion and inner flue, thermal insulation material around said outer flue, one end of said outer flue projecting beyond said insulation and having an opening in the lower part thereof, an upright liquid fuel burner adjacent the projecting end of said outer flue and having a removable portion extending into said opening, and a removable thermally insulated hood over said burner and the projecting end of said outer flue.

7. In a refrigerator, a cabinet having an apparatus compartment in the lower part thereof, refrigeration apparatus of the absorption type including a generator, a flue for heating said generator and having the lower end thereof at the forward part of said apparatus compartment, a kerosene burner adjacent the lower end of said flue, and a removable member having a passage adapted to form a communication from said burner into said flue.

8. In a refrigerator, a cabinet having an ap-

paratus compartment in the lower part thereof, refrigeration apparatus of the absorption type including a generator, a flue for heating said generator and having a lower end in said apparatus compartment, a kerosene burner adjacent said flue, and a movable member forming a passage for products of combustion from said burner into said lower end of the flue.

9. A refrigerator including absorption type refrigeration apparatus having a generator, a flue for heating said generator, a liquid fuel burner fixed in position with respect to said flue,

and means forming a passage from said burner to said flue and constructed and arranged to be opened to permit access to the burner.

10. In a refrigerator, absorption type refrigeration apparatus including a generator having a generally horizontal portion, a flue having a horizontal portion for heating said generator, a liquid fuel burner, and means forming a passage from said burner to said flue and constructed and arranged to be opened to permit access to the burner.

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