(No Model.) 4 Sheets—Sheet 1.

E. W. HOWELL.

AUTOMATIC REFRIGERATING MACHINE.

No. 535,761. Patented Mar. 12, 1895.

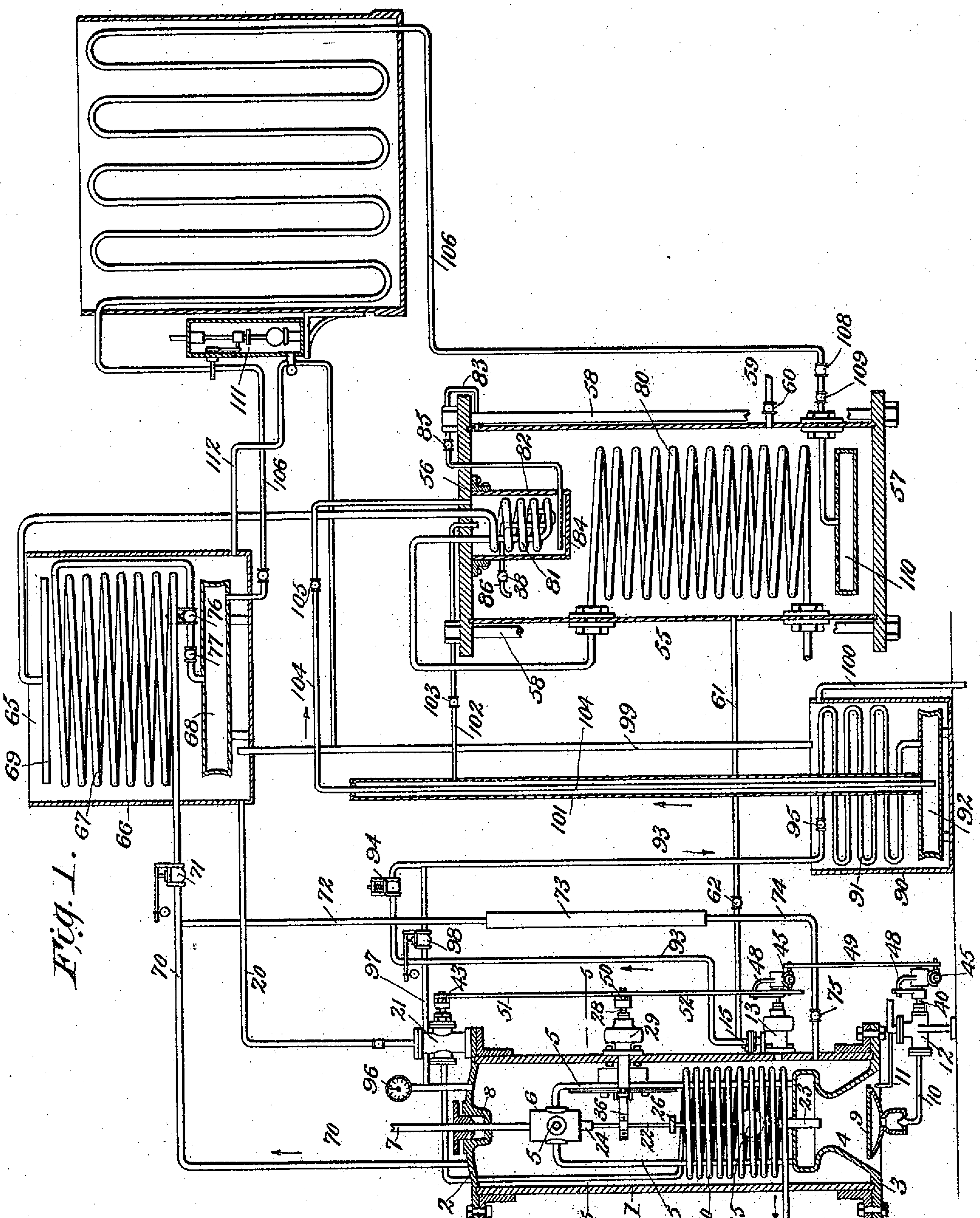

Fig. 1.

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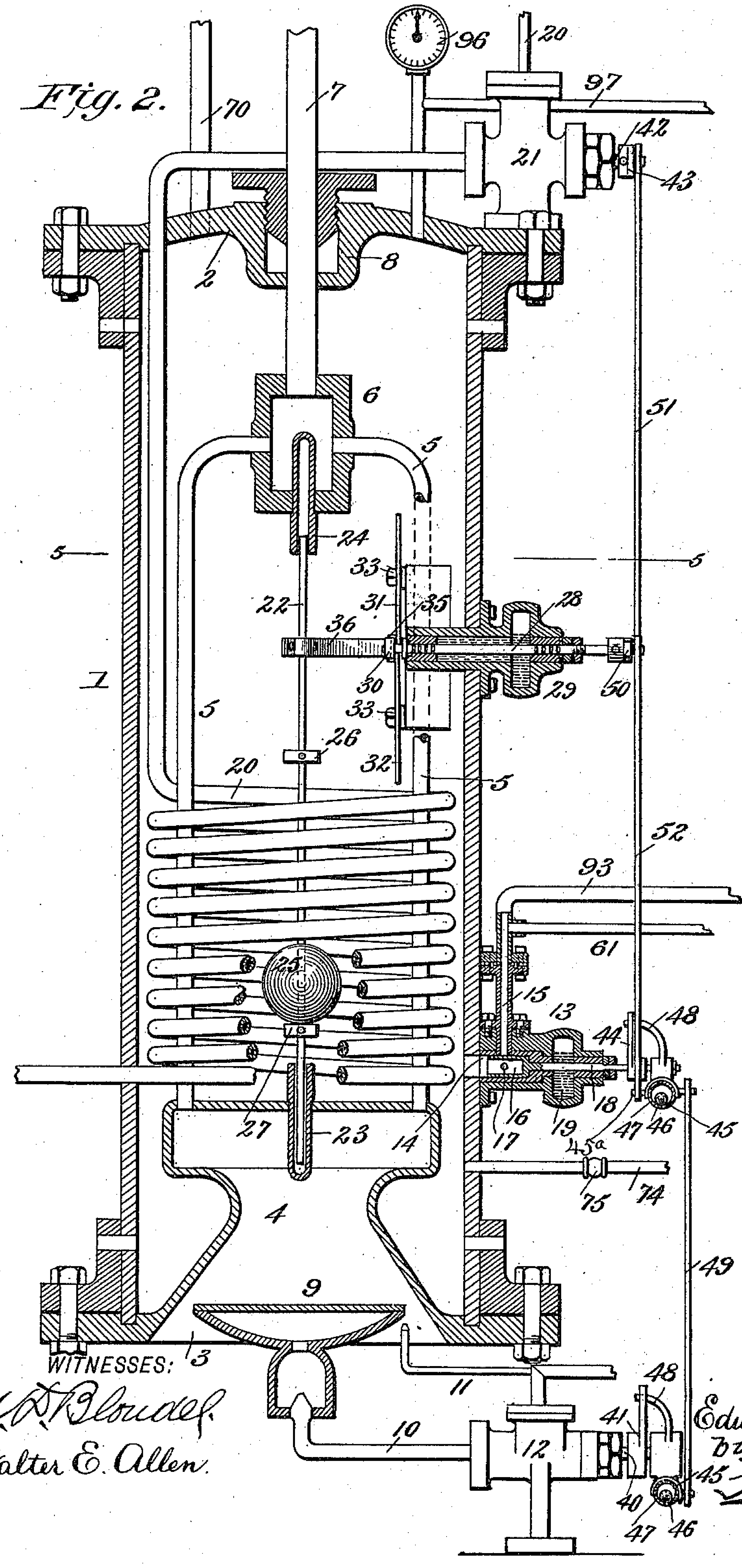
Fig. 2.



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(No Model.)

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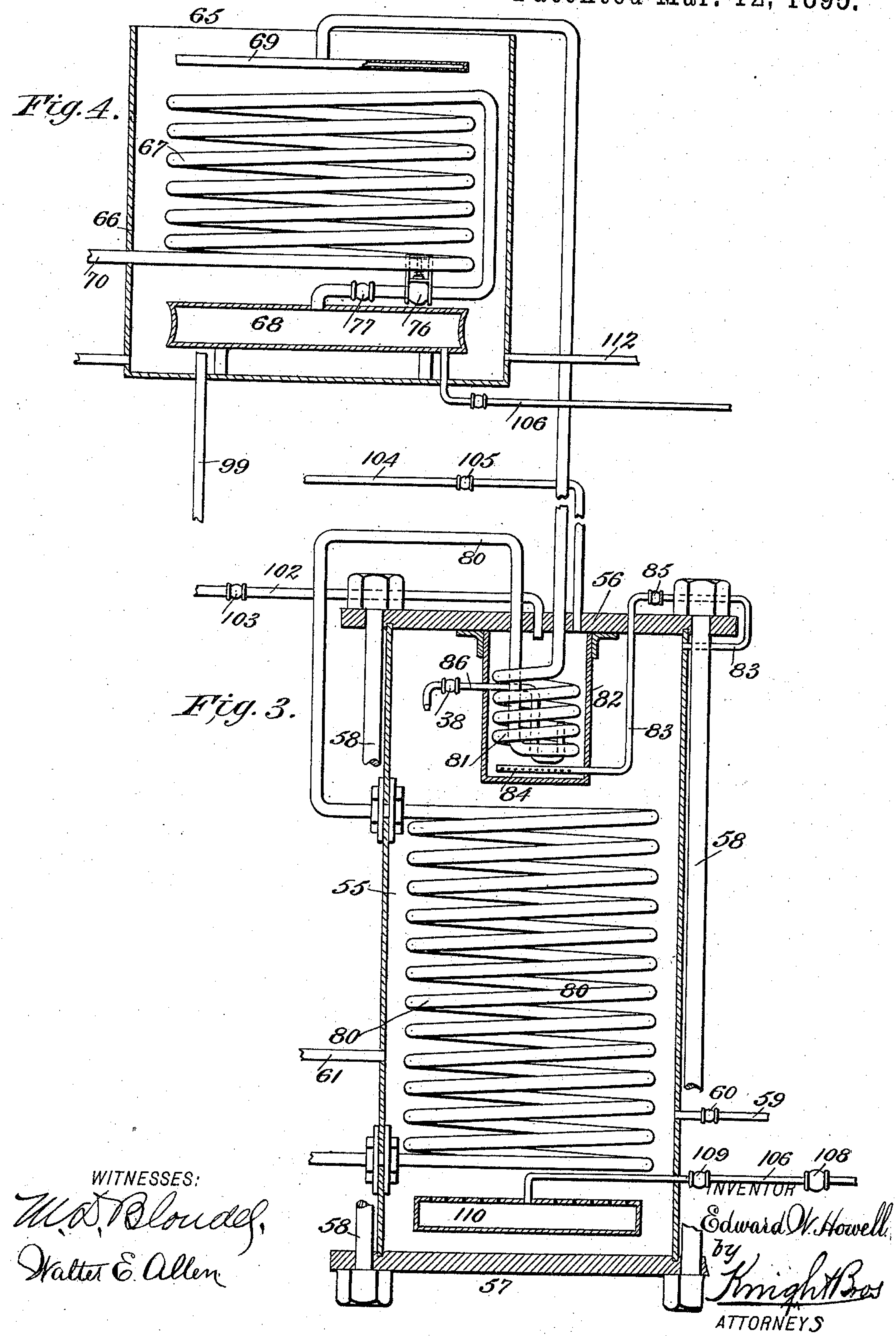

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AUTOMATIC REFRIGERATING MACHINE.

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Fig. 5.

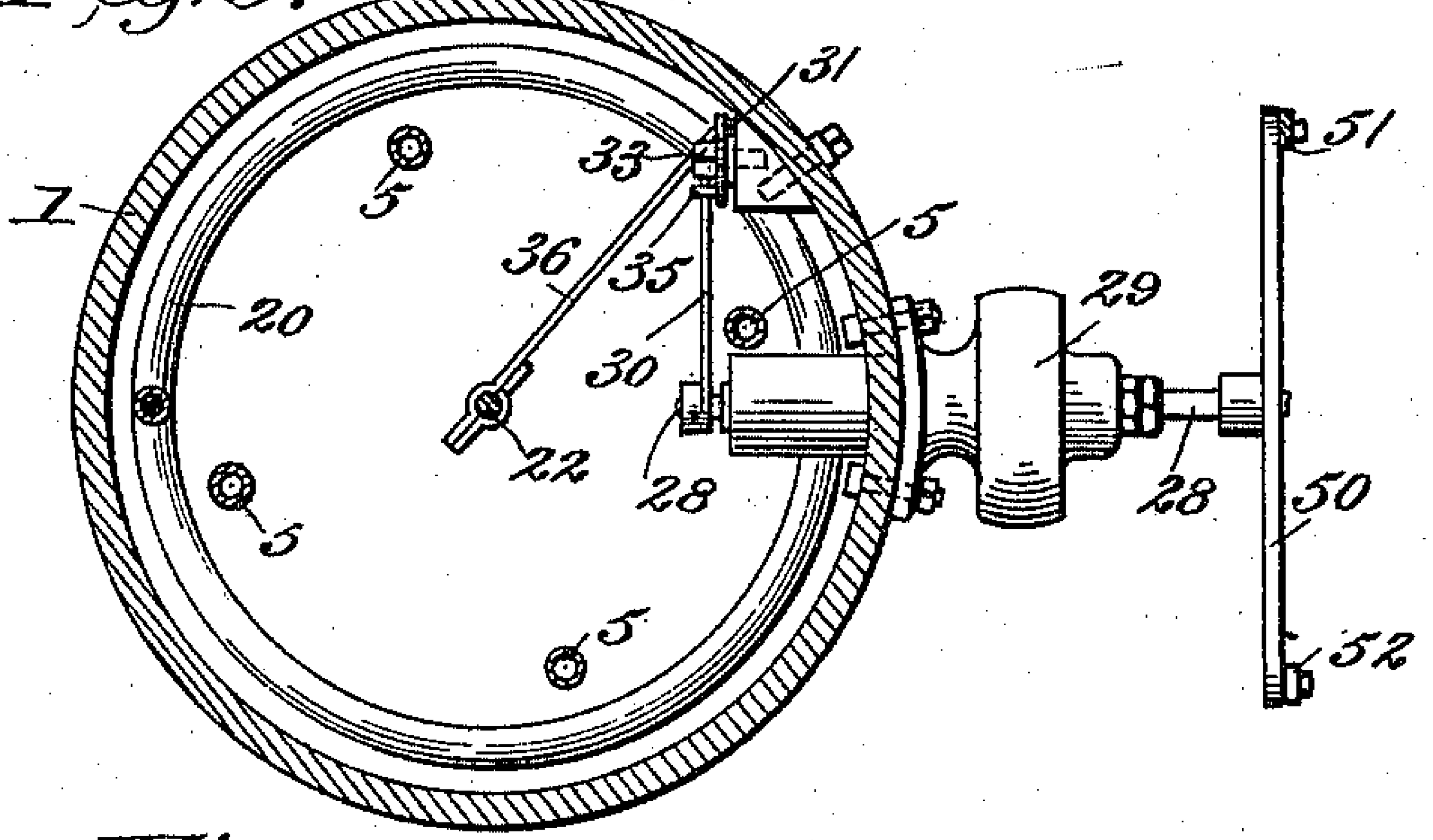


Fig. 8.

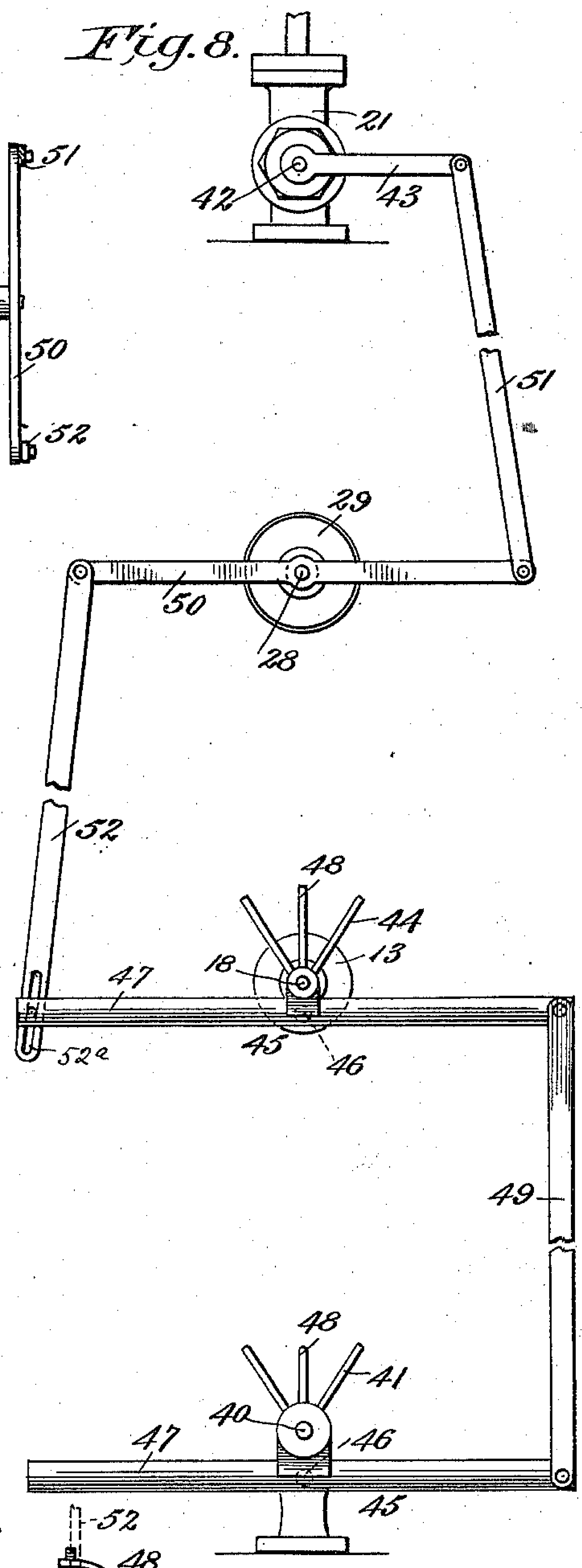


Fig. 6.

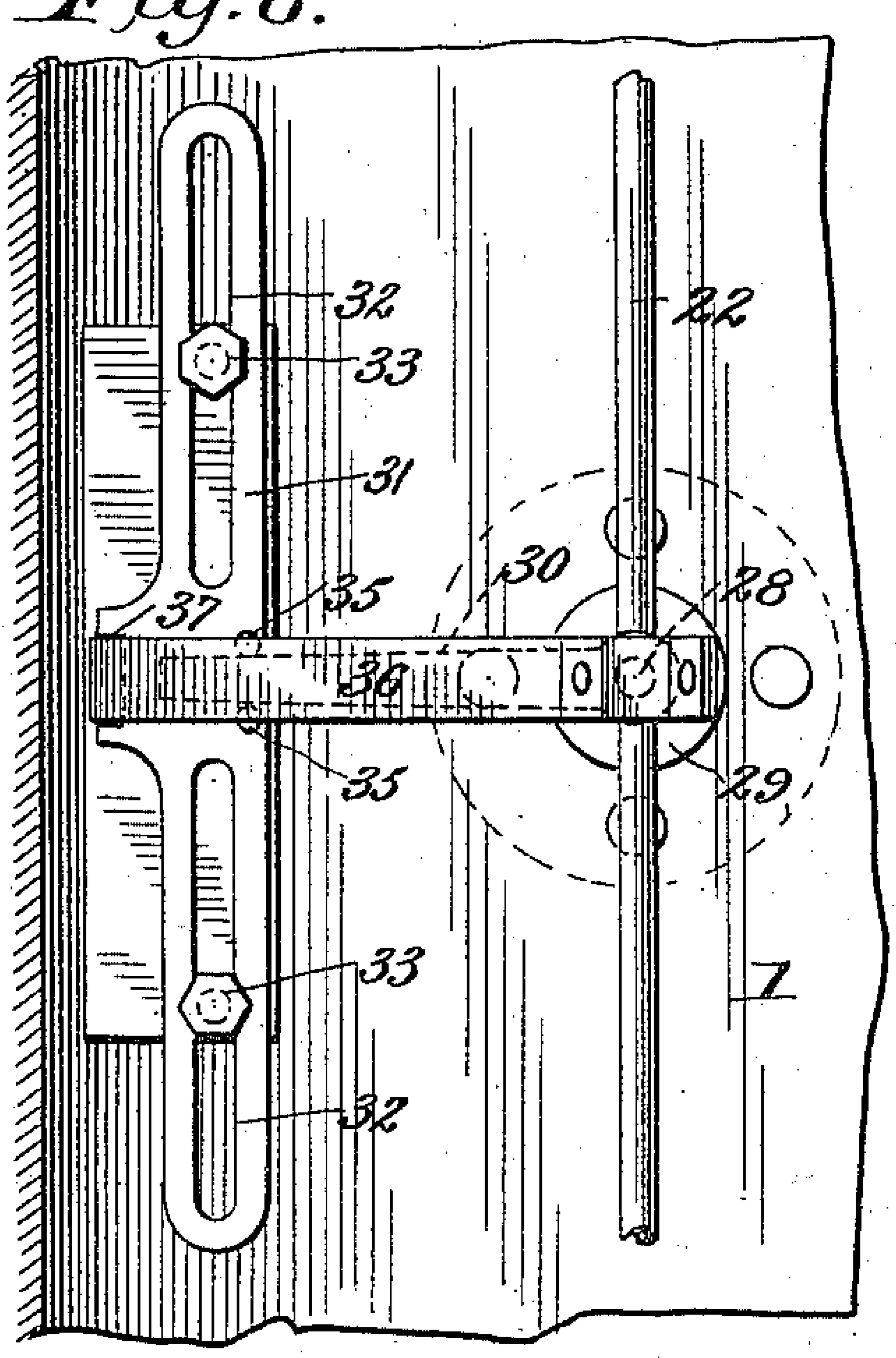
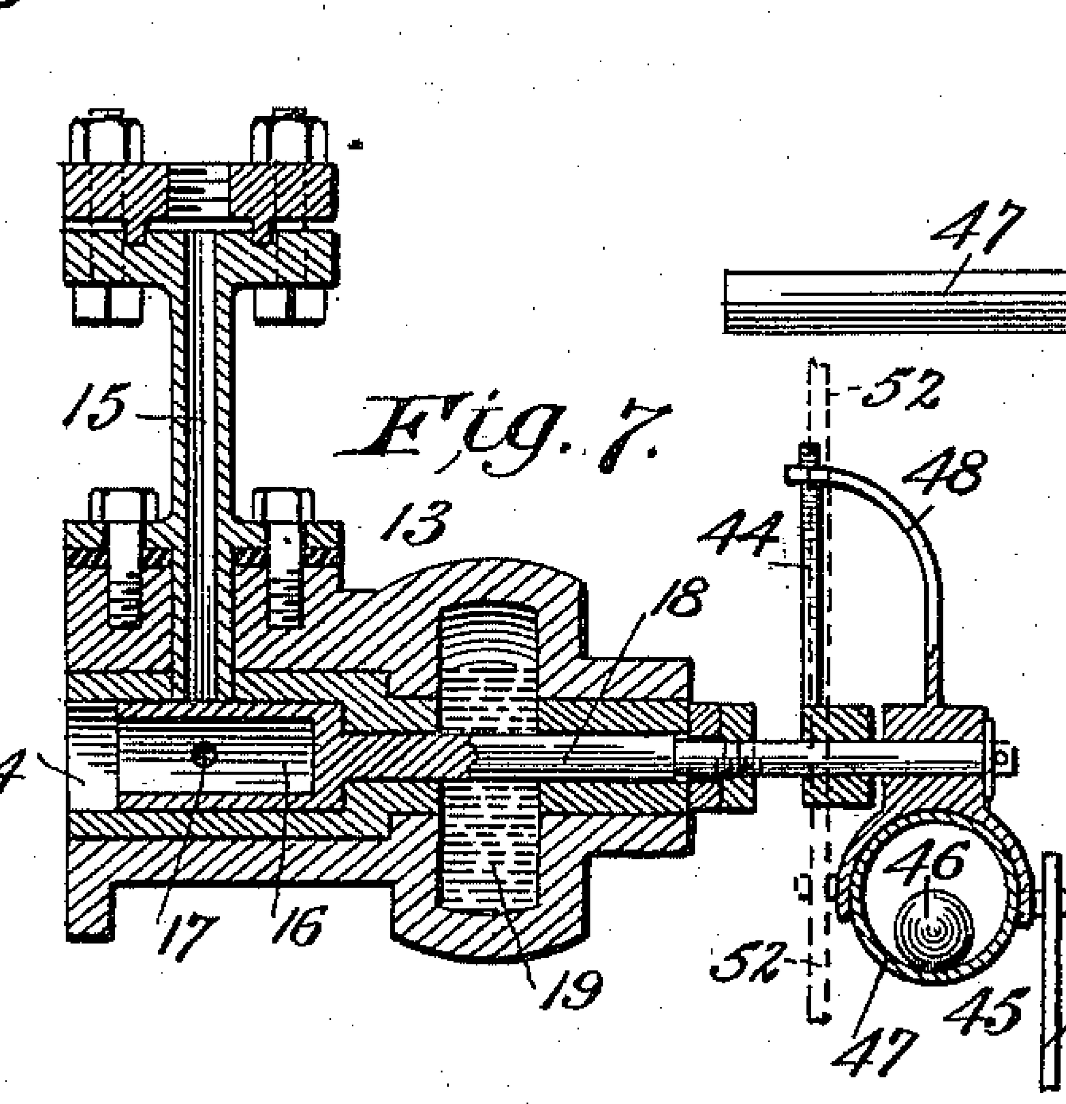


Fig. 7.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC REFRIGERATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 535,761, dated March 12, 1895.

Application filed August 31, 1894. Serial No. 521,844. (No model.)

To all whom it may concern:

Be it known that I, EDWARD W. HOWELL, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Automatic Refrigerating Machines; and I hereby declare that the following specification, taken in connection with the accompanying drawings which form a part thereof, is a full, clear, and exact description of my invention.

The great difficulty with the known types of automatic absorption refrigerating machines has been that the back pressure in the absorber and refrigerating coil has been sufficient to prevent the free movement of the ammonia in its several stages. This objection is removed by my improvements.

The object of my invention, therefore, is to produce a simple, compact and automatic absorption refrigerating machine suitable for use in hotels, dwellings, &c., which will continuously and effectively accomplish the processes of vaporizing, condensing, expanding and absorbing ammoniacal vapors for refrigerating purposes.

My invention comprises a suitable still, a condenser, a refrigerating coil, main and auxiliary absorbers arranged to receive the expanded gas from the refrigerating coil and the weak liquor from the still and adapted to prevent back pressure in the coil, and a novel construction of automatic valves; all the parts being so arranged with relation to each other as to continuously generate an anhydrous ammonia gas from the automatically supplied aqua-ammonia, through the refrigerating coil where it expands and takes up the heat from the refrigerating box, and finally pass it into the absorber where the expanded gas is taken up by the supply of aqua-ammonia and held in readiness to be again passed to the still. An automatic burner is provided for heating the still and the peculiar arrangement of passages and valves renders the machine automatic throughout.

My invention further consists of numerous features of construction which will first be described with reference to the accompanying drawings and afterward particularly pointed out in the annexed claims.

In said drawings: Figure 1 is a general elevation illustrating my improved refrigerating machine, the principal parts being shown in section for the purpose of illustrating the internal construction. Fig. 2 is an enlarged sectional elevation of the still. Fig. 3 is an enlarged sectional elevation of the absorber. Fig. 4 is an enlarged view of the condenser and cooler. Fig. 5 is a horizontal sectional view of the still taken on the line 5, 5, of Figs. 1 and 2. Fig. 6 is an enlarged detail elevation of the valve-operating mechanism. Fig. 7 is an enlarged longitudinal section of the main supply and blow-off valve of the still. Fig. 8 is an enlarged detail representation of some of the minor parts.

Similar numerals of reference indicate the same parts throughout the several views.

The entire machine is built of suitable metal preferably iron or steel, and is constructed of sufficient strength to stand the great pressure to which it is subjected.

1 is the cylindrical still formed with the upper head 2 and the lower head 3. The heads 2 and 3 are secured in place by suitable screw-bolts. The lower head 3 is formed with an inwardly projecting combustion chamber 4 from which extend the four hot air tubes 5 which unite adjacent to the top of the still in a coupling 6 from which extends the hot air tube or chimney 7.

8 is a stuffing box in the head 2 for forming a tight joint around the hot air tube 7.

9 is the gas burner of any suitable construction, supplied with gas through the pipe 10, from which also extends a smaller pipe terminating in a continuously burning pilot light 11.

12 is a cock interposed in the pipe 10 for regulating the flow of gas to the burner 9. The cock 12 is automatically operated by means which will presently be described.

13 is the combined automatic blowoff and filling valve tapped into the side of the still 1. The construction of this valve is clearly shown in Fig. 7. It consists of a suitable casting secured in the side of the still and having a main bore 14 leading out from the opening into the still, a vertical bore 15 communicating with the combined blow-off and filling tube, and a rotary hollow valve-plug 16 formed

with a suitable opening 17 and integral with an operating spindle 18. The operating spindle 18 passes through an oil chamber 19 and is provided on its projecting end with suitable means for automatically operating it. This means for operating the valve will be presently explained.

20 is a water coil inside of the still 1 and surrounding the hot air tubes 5. This water coil pipe leaves the still at one side and leads to the sewer or other suitable waste. The water pipe for supplying water to the coil passes from the pan of the condenser, which will presently be described, and enters the top of the still. A valve 21 is interposed in the water pipe 20 for admitting or cutting off the supply of water to the coil. The object of the coil 20 is to quickly cool off the still when it is desired. The valve 21 is automatically controlled in a manner which will now be described.

22 is a vertically movable rod supported centrally in the still 1 by the lower bearing 23 and upper bearing 24. 25 is a float adapted to move vertically on said rod, and 26 and 27 are collars adjustably secured to the rod 22 for limiting the movement of the float.

28 is a rock shaft journaled in a suitable bearing 29 which is tapped into the side of the still 1.

30 is a crank arm keyed to the inner end of the rock shaft 28.

31 is a vertically sliding plate formed with slotted guides 32 which engage with the bolts 33 by means of which the plate is supported. The plate 31 is provided with pins 35 which engage on opposite sides of the crank arm 30, so that a vertical movement of the sliding plate 31 will cause the rock shaft 28 to rock in its bearings.

36 is an arm rigidly secured to the rod 22 and engaging in an opening 37 in the plate 31, whereby any movement of the rod 22, by reason of the engagement of the float 25 with one of the collars 26 or 27, will cause the plate 31 to move vertically in its bearings and, through the crank arm 30, rock the shaft 28.

Keyed to the valve stem 40 of the gas-controlling valve 12 is a forked crank arm 41, and keyed to the valve stem 42 of the valve 21 is a crank arm 43. Keyed to the valve spindle 18 of the combined blow-off and filling valve 13, is a forked crank arm 44. Journaled on the outer end of each of the valve stems 40 and 18 is a rocking cradle 45, comprising a long cylindrical chamber 47 in which is carried a ball 46 for the purpose presently to be explained. 48 are operating pins which project from the cradles and engage with the forks 41 and 44 for operating the valves. The cradles 45 are journaled on the valve stems so as to move readily. 49 is a connecting rod connecting the cradles 45 of the valves 12 and 13 to insure said valves being operated in unison the valve 12 being open when valve 13 is closed, and vice versa. 50 is a double crank arm keyed to the outer end of the rock shaft 28. One arm of the double crank arm 50 is connected to the crank arm 43 of the valve 21 through the rod 51, while the other arm is connected to one end of the cradle 45 of the valve 13 through the connecting rod or pitman 52. The pitman is positively pivoted to the crank-arm 50 and is formed with an elongated slot 52^a in its opposite end which engages a lug 45^a on the cradle 45 of the valve 13.

The movement of the float on the rod 22 in the still 1 will cause said rod to move up or down (as the case may be) which in turn will oscillate the rock-shaft 28 through the arm 36, plate 31 and crank arm 30, and cause the valves 12, 13 and 21 to be simultaneously operated, the valve 12 being open while the valves 13 and 21 are closed and vice versa. In the operation of the valves 12 and 13, the initial movement is imparted by the connecting rod 52 acting on the lug 45^a, but as soon as the cradles have been moved slightly past the horizontal the balls 46 will roll to the opposite ends of the cylinders 47 and shift them suddenly so as to complete the opening or closing of the valves with a quick movement. This rapid opening and closing of the valves is very important.

55 is the main receiver for holding and supplying the aqua-ammonia to the still, and for absorbing the expanded ammonia gas after it has passed through the refrigerating coil. I will hereinafter speak of this receiver as the main absorber. The main absorber 55 is provided with heads 56 and 57 which are secured together by bolts 58 which pass through their projecting edges.

59 is an inlet pipe provided with a cock 60 through which the aqua-ammonia is supplied to the absorber.

61 is the main supply pipe leading from the side of the absorber to the vertical inlet bore 15 of the valve 13. 62 is a check valve interposed in said pipe 61. The check valve allows the passage of aqua-ammonia to the still but prevents the passage of the aqua-ammonia or gas back to the absorber.

65 is the condenser comprising a suitable cylindrical vessel 66 open at top, an ammonia gas coil 67, a receiver 68 into which the coil leads, and a water spray 69.

70 is the ammonia gas pipe leading from the upper head 2 of the still 1 and communicating with the ammonia gas coil 67. 71 is a safety valve interposed in said pipe 70.

72 is a small drip pipe communicating with the pipe 70 between the still and safety valve, and leading to an enlarged drip pipe 73 which communicates at its lower end with the still 1 through the tube 74. 75 is a cock interposed in said tube 74. Any water of condensation that is carried off with the ammonia gas will collect in the reservoir 73 and flow to the still.

76 is a low pressure valve and 77 is a check valve interposed in the ammonia gas coil 67 just above the receiver 68. As above stated, the water supply pipe 20 communicates with

the receptacle 66 of the condenser for supplying water to the cooling coil of the still. The gas in the coil 67 is constantly cooled by the spray 69 so that it is condensed by the time it reaches the receiver 68.

Returning to the structure of the main absorber 55 it will be observed that a water coil 80 leading from any suitable water supply, enters one side of the absorber near the bottom and coils around within the main part containing the aqua-ammonia, and passes out again near the top and up, and around and down through the upper head 56 of the absorber where it is formed into a smaller coil 81 which is embraced in the secondary absorbing chamber 82. From the secondary absorber 82 the water pipe passes up and communicates with the spray 69 of the condenser.

83 is a small pipe leading from the main absorber 55 near the top down through the absorber head 56 and into the secondary absorber 82, where it terminates in a perforated pipe 84. This is for the purpose of relieving the main absorber of pressure by collecting any gas or heat that may gather at the top of the main absorber and passing it over into the secondary absorber where it is taken up.

85 is a check valve interposed in the pipe 83.

86 is a siphon tube entering the secondary absorber 82 from the main absorber and passing down to a point near the bottom and then up to a point near the center of the secondary absorber. The inner open end of the siphon tube is always submerged. This siphon tube is provided with a check value 38, and is for the purpose of passing into the main absorber the surplus of the weak aqua-ammonia returned to the secondary absorber from the still. The surplus pressure in the secondary absorber is relieved through the pipe 104 which will presently be described.

90 is the cooler provided with a cooling coil 91 and a receiver 92 with which it communicates. The coil 91 also communicates with the vertical bore 15 of the valve 13 through an elongated U-shaped extension 93. 94 is a reducing valve interposed in said extension 93.

95 is a check valve interposed in the coil 91.

96 is a gage communicating with the still 1 through the head 2, and 97 is a cross pipe leading from the gage to the U-shaped extension 93 which leads to the cooling coil 91.

98 is a safety valve interposed in the cross-pipe 97.

The cooling receptacle 90 is supplied with water from the receptacle 66 of the condenser 65 through a pipe 99, the surplus water being carried off through the overflow 100 which communicates with the receptacle 90 adjacent to the top.

101 is an enlarged tubular column communicating with the ammonia reservoir 92 and extending up to a point higher than the top of the absorber.

102 is a pipe leading from the column 101 to the secondary absorber 82 for the purpose of allowing the escape of the weak aqua-ammonia into the secondary absorber. This pipe 102 has a check valve 103.

104 is a pipe passing up through the column 101 from a point near the bottom of receiver 92 out of the top of said column then over and down into communication with the secondary absorber 82. A check valve 105 is interposed in this pipe. The pipe 104 relieves the secondary absorber of all objectionable pressure.

Leading from the receiver 68 of the condenser 65 is a pipe 106 which is passed through the refrigerating coil and then back to the absorber 55, a check valve 108 and cock 109 being interposed in said pipe near the absorber for regulating the flow of the expanded ammonia gas. The pipe leading from the refrigerating coil passes into the absorber to a point near the center where it communicates with a perforated or slotted distributing chamber 110 from which the gas bubbles up through the aqua-ammonia and is absorbed thereby and serves to continually strengthen it.

111 is an automatic valve of peculiar construction for regulating the flow of condensed ammonia vapor from the condenser 65 to the refrigerating coil. This valve is operated by water which is supplied through the pipe 112 which leads past the valve and back to the vertical pipe 99. The construction of this automatic valve has been covered in another application filed by me February 20, 1895, Serial No. 539,131, and will not be further described here.

The operation may be briefly described as follows: Having first supplied the absorber 55 with a sufficient quantity of aqua-ammonia at 260° Fahrenheit, aqua-ammonia will flow from the absorber into the still 1, the valves being open for this purpose. The liquid will flow into the still until it has reached a sufficient height to lift the float 25 up into engagement with the collar 26, which will cause the rod 22 to move vertically and, through the mechanism above described, rock the shaft 28 in its bearings and close the valve 13 and open the valve 12. The burner 9 is then automatically lighted from the pilot light 11 and heat is generated in the still. The heat will soon cause the vapor of ammonia to rise and pass out through the pipe 70 past the safety valve 71 to the condenser. Here the gas is condensed and led to the refrigerating coil (through the automatic valve 111) where it expands and takes up the heat. From the refrigerating coil the expanded gas is led back to the absorber 55 and taken up by the aqua-ammonia therein. After a certain quantity of ammonia gas has been driven out of the still 1 the float will fall sufficiently to engage the lower collar 27 of the rod 22 which will cause a reversal of the movement of the rock-shaft 28 which controls the valves. This will shut off the gas to the main burner and open the exhaust valve 13 and cooling coil valve 21. The pressure in the still is now sufficient to force all of the weakened liquid out through the valve 13 and up through the U-shaped extension 93 down to the cooler coil 91. The pressure in the still and pipes prevents the flow of a fresh supply of liquid ammonia by reason of the action of the check valve, until the weak liquid has been blown out of the way. The spent liquor passes from the reservoir 92 up the column 101 and pipe 104 to the secondary absorber where it is taken up in the manner already described. While the still is exhausting the spent liquid the water from the condenser can be cooling it off by passing it through the coil 20, or if desired, the flow of water can be checked until after the spent liquid has been exhausted. After the still 1 is emptied of the spent liquor a partial vacuum is produced which will cause the new charge of aqua-ammonia to pass from the absorber 55 through the valve 13 into the still. When the still fills up with the aqua-ammonia the valves will be automatically shifted as above explained. Each charge of ammonia gas from the still will force the condensed charge forward from the condenser into the refrigerator, and each charge of the weak liquor exhausted from the still will force the preceding charge of weak liquor back into the main absorber.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In an automatic refrigerating machine, the combination of an absorber for containing aqua-ammonia, a still having weak liquor and strong liquor pipes and communicating with said absorber through the strong liquor pipe, a condenser communicating with the still, a refrigerating coil communicating with the condenser and absorber, and automatic means for controlling the passage of the ammonia from the absorber to the still, the exhaust of the weak liquor from the still and the heating of the still, whereby the ammonia is continuously vaporized, condensed, expanded and absorbed, substantially as set forth.

2. In an automatic refrigerating machine, the combination of an absorber, a still, a suitable burner for heating the still, valves for controlling the supply of ammonia to the still from the absorber and for controlling the supply of gas to the burner, automatic means for operating said valves in unison, whereby the ammonia valve will be closed when the burner valve is open, and vice versa, and a suitable condenser and refrigerating coil, substantially as set forth.

3. In an automatic refrigerating machine, the combination of an absorber, a still, a suitable burner for heating the still, a cooling coil passing through the still, valves for controlling the flow of ammonia to and from the still and for controlling the flow of gas to the burner and water to the cooling coil, automatic means for operating all of said valves in unison, and a suitable condenser and refrigerating coil, substantially as and for the purpose set forth.

4. In a refrigerating machine, the combination of a suitable still, a vertically movable rod supported in said still, a float mounted upon said rod, collars confining the float on said rod, an arm keyed to the vertically movable rod, a rock-shaft journaled in the wall of the still and adapted to be rocked by said arm, valves controlling the supply of ammonia to the still and gas to the burner, suitable connections between the rock-shaft and said valves, and a suitable absorber condenser and refrigerating coil, substantially as set forth.

5. The combination, in a refrigerating machine, of a still for vaporizing aqua ammonia, a burner for heating the still, hot-air tubes passing up from the burner through the still, a cooling coil surrounding the hot-air tubes in the still, a water supply connected to the cooling coil, valves controlling the supply of water through the cooling coil, and gas to the burner, and automatic means for controlling said valves, substantially as and for the purposes set forth.

6. The combination, in a refrigerating machine, of a still, an ammonia supply entering the still, a valve controlling the supply of ammonia, a burner for heating the still, a valve for controlling the supply of gas to the burner, a cooling coil supported in the still, a valve for controlling the passage of water through the cooling coil, and means for simultaneously operating said valves consisting of a rock-shaft suitably connected to the valves and a float in the still adapted to operate said rock shaft whereby the water valve and ammonia supply valve will be closed when the gas valve is opened and vice versa, substantially as set forth.

7. The combination, in a refrigerating machine, of the still, an ammonia supply to said still, a valve controlling said supply, a burner for heating the still, a valve for regulating the supply of gas to the burner, a vertically movable rod supported in the still, a float for actuating the rod, a rock-shaft journaled in the wall of the still and adapted to be operated by the vertically movable rod through suitable connecting devices, a cooling coil supported in the still, a valve controlling the passage of water through the cooling coil, and means connecting the water valve, ammonia valve and gas valve to the rock shaft, whereby they are simultaneously operated, substantially as set forth.

8. The combination, in a refrigerating machine, of the still, an ammonia supply to said still, a valve controlling said supply, a burner for heating the still, a valve for regulating the supply of gas to the burner, cradles carrying balls and adapted to actuate said valves, and automatic means for actuating said cradles, substantially as set forth.

9. The combination, in a refrigerating machine, of the still, an ammonia supply to said still, a valve controlling said supply, a burner for heating the still, a valve for regulating the

supply of gas to the burner, forked arms keyed to the valves, cradles loosely mounted on the valve stems and provided with cylindrical chambers, balls supported in the cylindrical chambers, a rod connecting the cradles, an automatically operated rock-shaft, a crank on said rock-shaft, a pitman pivoted to said crank and formed with a slotted end, and a lug on one of the cradles engaging in the slot of said pitman, substantially as and for the purpose set forth.

10. The combination, in a refrigerating machine, of a still, a condenser communicating therewith, an ammonia supply, a blow-off pipe communicating with the still, and a valve controlling the supply and blow-off, substantially as set forth.

11. The combination, in a refrigerating machine, of a still, a condenser communicating therewith, an ammonia supply pipe communicating with the still, a check valve in said ammonia supply pipe, a blow-off pipe communicating with the still at the same point as the supply, a valve in said blow-off pipe, a valve controlling both the supply and blow-off, a cooling coil communicating with the blow-off, and an absorber communicating with the ammonia supply and with the cooling coil, substantially as set forth.

12. The combination, in a refrigerating machine, of a still, an ammonia supply to the still, a blow-off pipe also communicating with the still, an inverted U-shaped extension of the blow-off pipe, a cooling coil communicating therewith, and an absorber communicating with the ammonia supply and with the cooling coil, substantially as set forth.

13. The combination, in a refrigerating machine, of a cooling coil, a receiving chamber at the bottom of the cooling coil, a stand pipe extending up from the receiving chamber, a small pipe extending up from the receiving chamber through the stand pipe, an absorber, and suitable communications between the absorber and the stand pipe and small pipe, substantially as and for the purpose set forth.

14. The combination, in a refrigerating machine, of an absorber for holding a supply of liquid ammonia and for absorbing the expanded gaseous ammonia which passes from the refrigerating coil, a cooling coil passing through the body of the absorber, a secondary absorber supported in the top of the main absorber, and a secondary cooling coil passing from the main coil and located in the secondary absorber, substantially as set forth.

15. The combination, in a refrigerating machine, of an absorber comprising a suitable vessel, a cooling coil, a pipe leading from the absorber for the passage of the ammonia to the still, a valved pipe for supplying the expanded ammonia gas which passes from the refrigerating coil, a distributing chamber at the bottom of the absorber with which said pipe communicates, a cooling coil, and means for preventing back pressure in the absorber, substantially as set forth.

16. The combination, in a refrigerating machine, of an absorber having a cooling coil and an ammonia gas supply, a secondary absorber supported in the top of the main absorber, a secondary cooling coil, a pipe communicating between the top of the main absorber and the bottom of the secondary absorber, and a siphon pipe leading from the secondary absorber to the main absorber, substantially as and for the purpose set forth.

17. The combination, in a refrigerating machine, of an absorber having a cooling coil and an ammonia gas supply, a refrigerating coil communicating with the absorber through the ammonia gas supply, a secondary absorber supported in the top of the main absorber and having a secondary cooling coil, a pipe communicating between the top of the main absorber and the bottom of the secondary absorber, a siphon pipe leading from the secondary absorber to the main absorber, a still communicating with the absorber, a condenser communicating with the still and the refrigerating coil, a blow-off from the still communicating with a cooling coil, a stand-pipe extending up from the cooling coil and communicating with the secondary absorber, and a small pipe extending up through the stand-pipe and also communicating with the secondary absorber, whereby back pressure in the refrigerating coil is avoided, substantally as set forth.

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