

March 6, 1951

L. F. WHITNEY ET AL

2,544,408

HOT-WATER SYSTEM

Filed June 19, 1947

4 Sheets-Sheet 1

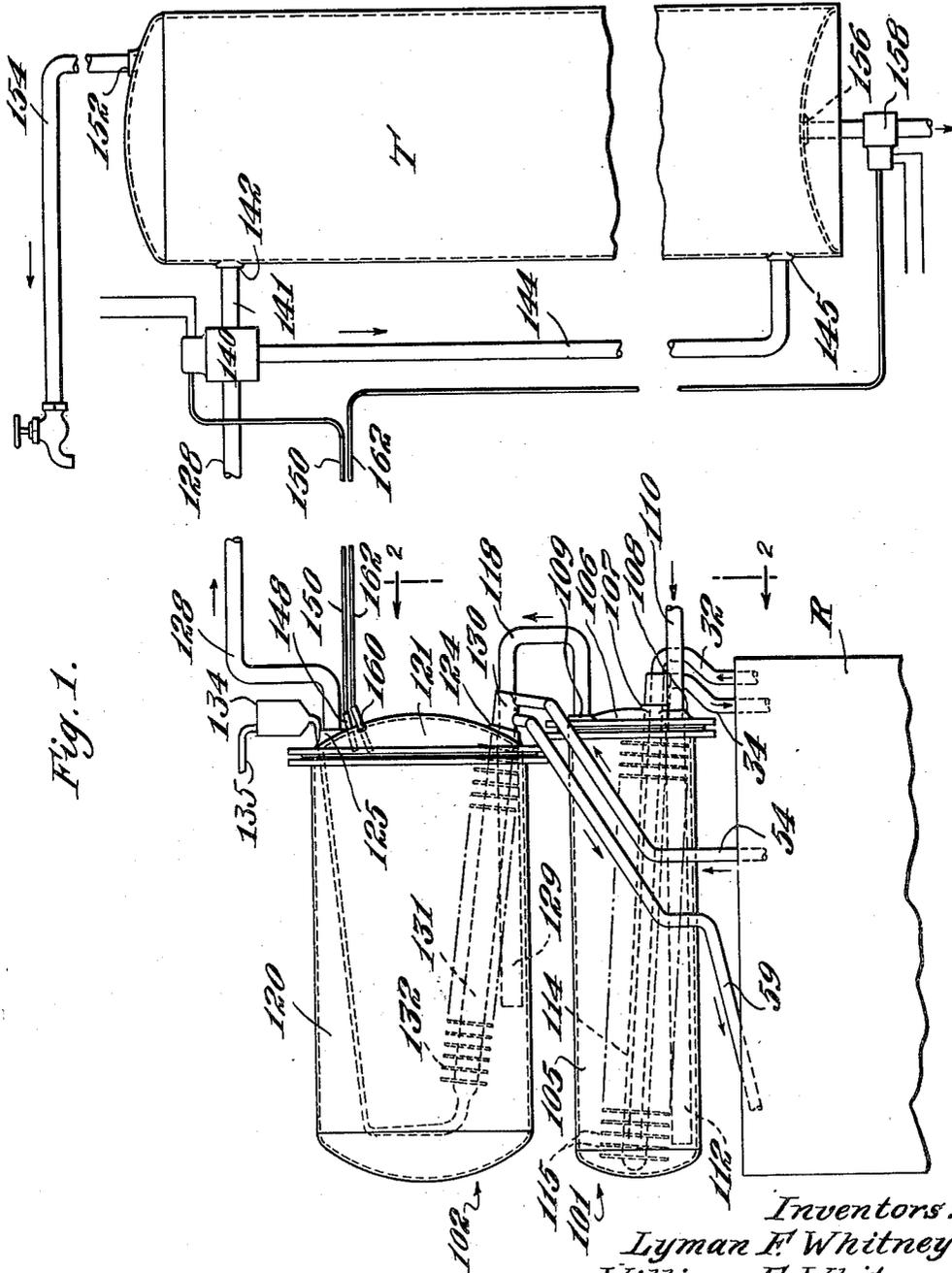


Fig. 1.

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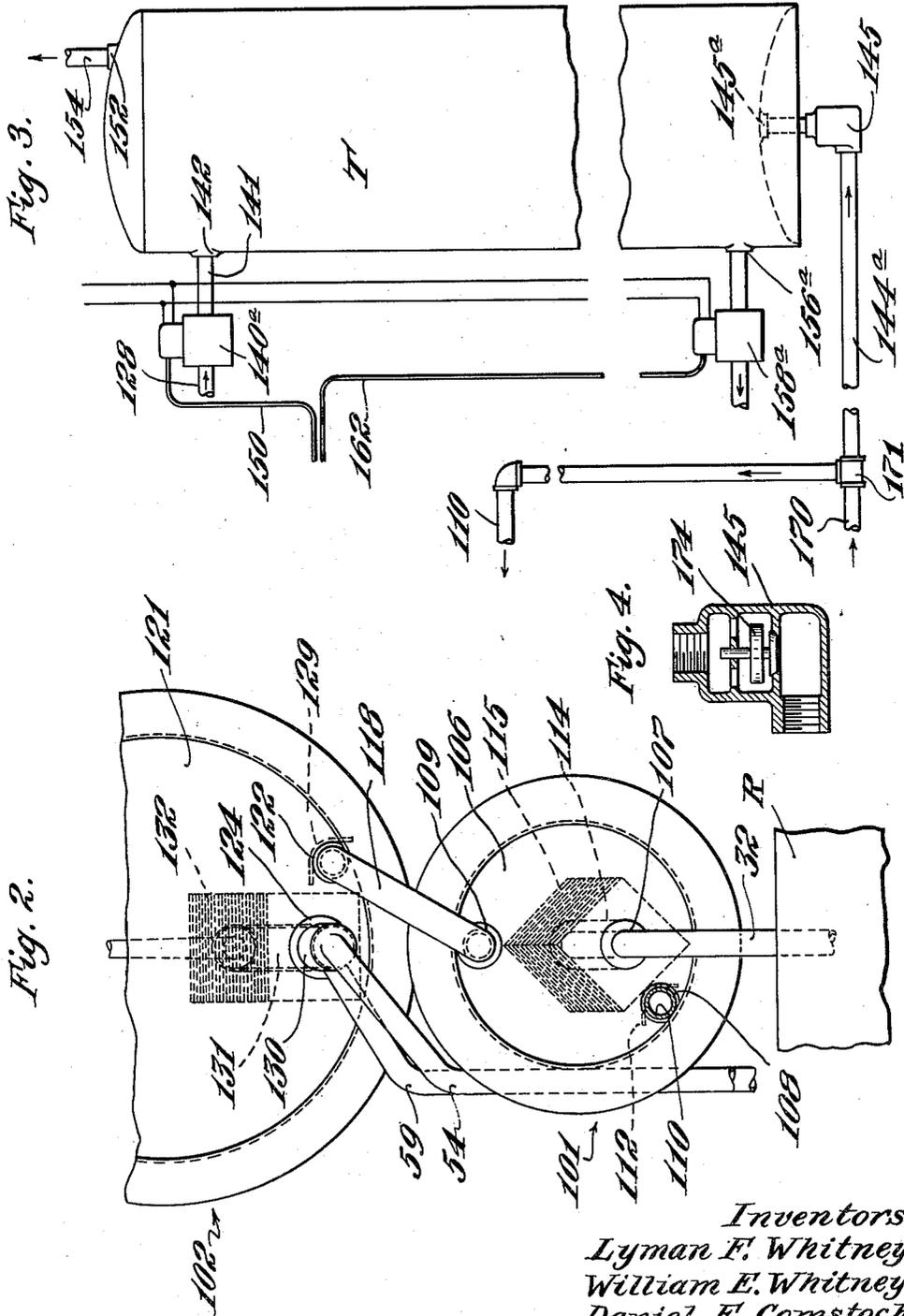


Fig. 3.

Fig. 2.

Fig. 4.

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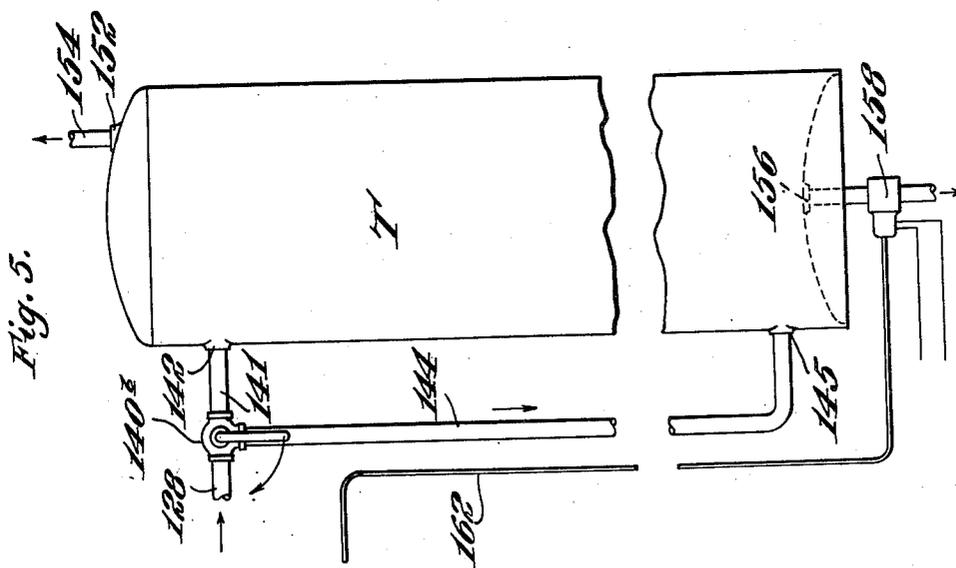
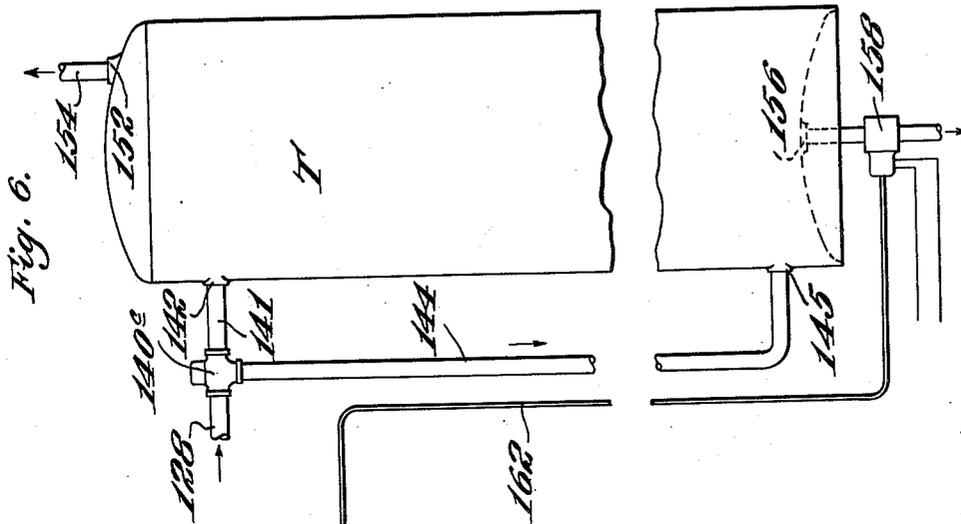
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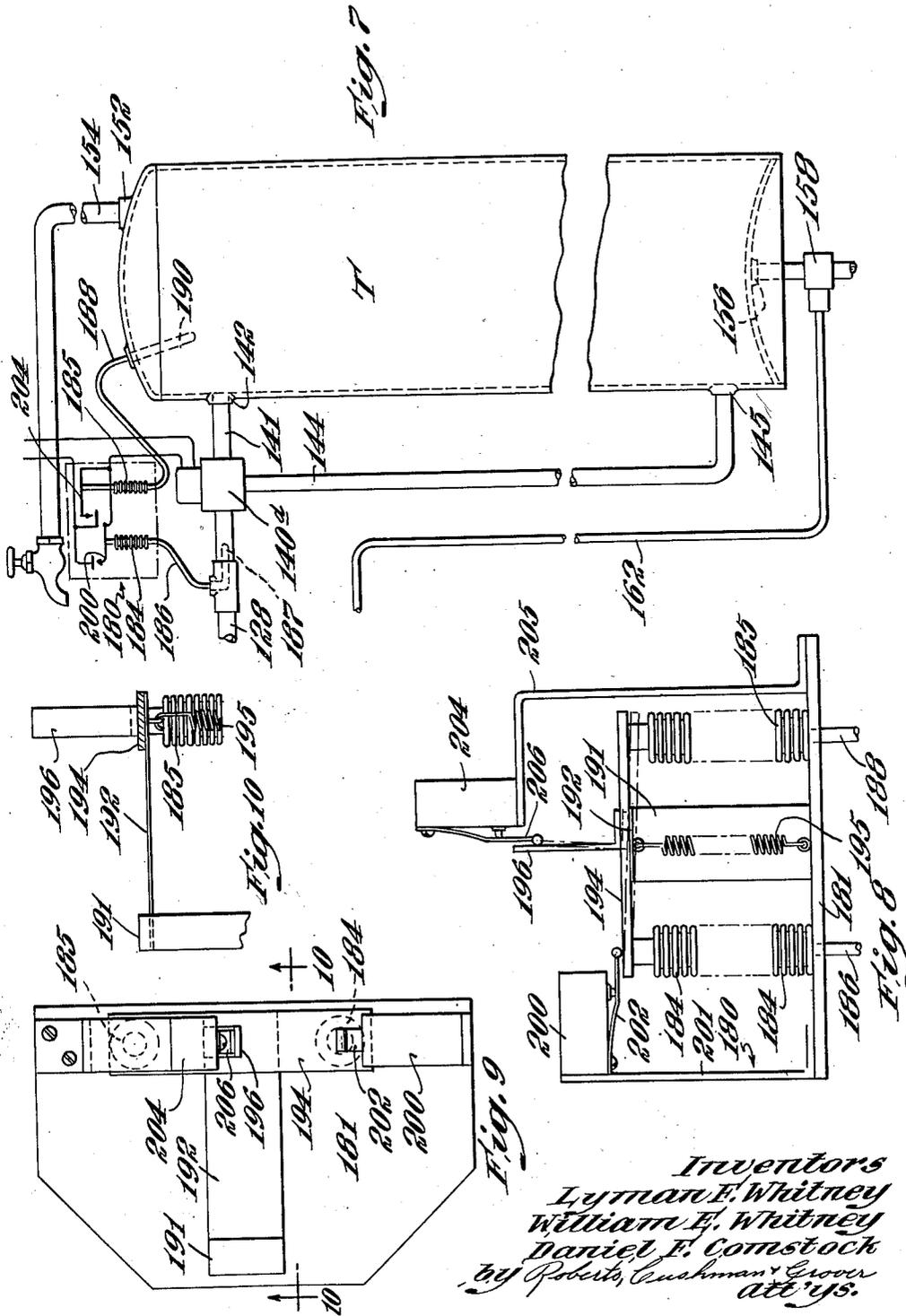
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HOT-WATER SYSTEM

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# UNITED STATES PATENT OFFICE

2,544,408

## HOT-WATER SYSTEM

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Application June 19, 1947, Serial No. 755,776

8 Claims. (Cl. 126—362)

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This invention relates to a hot water system associated with a substantially continuously operating hot water generator of relatively low heat-generating rate and its principal objects are to provide an efficient and reliable system wherein hot water may be automatically drawn from the generator into a suitable storage tank when the water in the generator reaches a predetermined temperature, and to provide a system wherein the water in the generator may be passed through the supply line to the storage tank so as to be discharged for use only when at or above a preselected temperature, otherwise the flow of water is either arrested or directed to the bottom of the storage tank so as not to cool the hot water therein.

A further object is to provide a system which is of simple design, completely automatic in operation, and relatively inexpensive to manufacture and install.

Other objects will be apparent from the consideration of the following description and the accompanying drawings, wherein:

Fig. 1 is a side elevation showing schematically a hot water system constructed in accordance with the present invention associated with a preferred type of hot water generator;

Fig. 2 is an end elevation of the hot water generator;

Fig. 3 is a side elevation illustrating a modified system;

Fig. 4 is an enlarged vertical section of the pressure valve connected with the cold water inlet of the storage tank shown in the embodiment of Fig. 3;

Figs. 5 and 6 are elevations illustrating further modifications.

Fig. 7 is an elevation of a storage tank, similar to that of Fig. 1, but showing a dual thermostatic control for the hot water supply line;

Figs. 8 and 9 are enlarged end and side elevations of the dual control device; and

Fig. 10 is section on the line 10—10 of Fig. 9.

In accordance with the present invention, our hot water system is associated with a substantially continuously operating hot water generator having a cold water inlet and a hot water outlet and which may advantageously be of the type disclosed in the copending application of Lyman F. Whitney, Serial No. 749,661 filed May 22, 1947, although it is to be understood that any other type of hot-water generator may be used. The hot water system comprises a suitable reservoir such as a large storage tank preferably capable of receiving and storing the output of the hot

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water generator over a period of eight hours or more, depending on the character of the demand, the storage tank being provided with a hot water inlet, preferably at its upper part, a hot water discharge line, a cold water inlet and a waste-discharge port both preferably at its lower part. The hot water inlet is connected through a hot water supply line to the outlet of the hot water generator and the cold water inlet is connected either to the same hot water supply line or to a cold water supply line, but in either case means are provided so that either hot or cold water may flow into the tank when the discharge line is open. A thermostatically-operated normally closed valve is connected with the waste-discharge port and this valve includes a thermostatic element such as a bulb containing fluid or a bimetallic element or other temperature-responsive member disposed in or otherwise associated with the hot water generator or hot water supply line so that when the water therein reaches a preselected temperature, the thermostatic element is operative to open the waste-discharge valve, thereby to cause cold water to be admitted to the generator and simultaneously pass hot water from the generator to the tank preferably through the hot water inlet.

With this construction and arrangement hot water may normally pass from the generator through the tank to the discharge line when the latter is open, but if the hot water demand on the system should slacken or cease for any appreciable period of time, then as the generator continues to operate, the hot water therein is periodically automatically transferred to the storage tank by the operation of the thermostatically operated waste-discharge valve. Hence, the generator may be set for its most efficient operation and may operate continuously, if desired, without danger of overheating or undue waste of water or heating medium.

Such a system, particularly when associated with a hot water generator constituting a part of a refrigerating apparatus, may advantageously be employed in homes, restaurants and other establishments which not only require continuous refrigeration, but also periodically consume quantities of hot water. In such installations the system may be so designed that sufficient hot water will be generated and stored during the periods between demand to take care of the major portion, if not the entire hot water demand, thereby eliminating the necessity for installing a costly hot water system adequate to satisfy the usual demands.

Referring to Figs. 1 and 2, the reference char-

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acter R indicates a refrigeration apparatus of the type shown in Fig. 1 of Patent No. 2,174,302, reference numerals 32, 34, 54 and 59 respectively referring to the refrigerant vapor duct, refrigerant return duct, alcohol (or other heat-transfer fluid) pipe, and the alcohol return pipe, to which parts the same numerals are applied in the above-mentioned patent. Since the refrigerating apparatus R is substantially identical with that shown in Fig. 1 of the above-mentioned patent (except for the parts 33 and 55), reference thereto may be had for a more complete disclosure of the system. In place of the condensers 33 and 35 shown in the above-mentioned patent, there is provided two separate condensers 101 and 102, respectively associated with the refrigerant ducts 32, 34 and the heat-transfer fluid pipes 54, 59. The refrigeration apparatus R and associated condensers 101 and 102 constitute the hot water generator which is the subject matter of the aforesaid copending application of Lyman F. Whitney and, as above noted, is herein shown and described as being illustrative of the preferred type of hot water generator.

The condenser 101 comprises an elongate shell or cylinder 105 suitably supported above the refrigeration apparatus R and is provided with a head or closure plate 106 which is formed with a lower central opening 107 and inlet and outlet openings 108 and 109 at its top and bottom parts respectively. A cold water supply line 110 is connected with the inlet 108 and an elongate baffle 112 is secured to the closure plate 106 above and to one side of the inlet 108 and extends along and in spaced relation to the lower wall of the cylinder 105 so as to stratify the incoming water. The refrigerant vapor duct 32 projects through the opening 107 in spaced telescopic relation to a return tube 114 having a closed inner end and provided with heat dissipating fins 115. The duct 32 and tube 114 are preferably inclined and the outer end of the tube 114 extends through the opening 107 and is connected with the refrigerant return duct 34. The water outlet 109 is connected by a pipe 118 with a condenser 102, hereinafter described.

With this construction and arrangement the refrigerant duct 32 and return tube 114 constitute the hot fluid passage of the condenser in heat exchange relation with the cold fluid passage defined by the baffle 112 and the interior of the cylinder 105, and hence the hot refrigerant vapor passing up through duct 32 into return tube 114 and back to return duct 34 gives up heat to the water in the cylinder 105 so that the water is preheated before passing into the condenser 102 and the refrigerant is condensed and returned to the refrigeration system at a relatively low temperature.

The condenser 102 comprises a larger shell or cylinder 120 suitably supported above the cylinder 105 and is provided with a closure plate 121 having at its lower part a water inlet 122 (Fig. 2) and a heat-transfer fluid inlet 124. The upper part of the closure plate is formed with a hot water outlet 125 beneath which are two small openings for receiving the bulbs or other thermostatic elements of valves associated with the storage system. The upper end of the pipe 118 is connected with the inlet 122 and a hot water supply line 128 is connected with the outlet 125. A baffle 129, supported by the closure plate 121 above and at one side of the inlet 122, extends along and in spaced relation to the lower wall of

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the cylinder 120 so as to stratify the incoming preheated water from the condenser 101.

The upper end of the heat-transfer fluid pipe 54 is connected with a coupling member 130 connected with a condenser tube 131, constituting the hot fluid passage of the condenser, which extends through the opening 124 into the interior of the cylinder 120 and being supported in any suitable manner preferably in an inclined position. The condenser tube 131 is provided with spaced heat-dissipating fins 132 and its inner end is connected with an air chamber 134 which is connected to a small pipe line 135 which provides a connection by means of which the circuit may be initially evacuated, as described in the aforesaid Whitney Patent No. 2,174,302.

The operation of the system thus far described is as follows:

Assuming that water from supply line 110 fills the cylinders 105 and 120 and that the refrigeration apparatus R is normally operating, the hot refrigerant vapor from the aspirator passes up through pipe 32 into the tube 114 of the condenser 101 and the hot alcohol vapor (or other heat-transfer fluid) from the aspirator jackets passes up through pipe 54 into the condenser tube 131 of the condenser 102. The condensing refrigerant vapor transfers heat to the water in the cylinder 105, thereby preheating the water therein, and likewise the condensing alcohol vapor in the tube 131, being hotter than the refrigerant vapor, transfers additional heat to the water in the cylinder 120. When water is drawn off through supply line 128, the preheated water in condenser 101 passes through pipe 118 into the cylinder 120 where it receive additional heat from the condensing alcohol in tube 131. The water in the condenser 101 effects condensation of the refrigerant vapor and the condensate is returned through pipe 34 to the evaporator trap of the refrigeration system.

The condensed alcohol in the tube 131 is returned through pipe 59 to the interstage jacket of the aspirator. The thermostatic elements, as hereinafter described, operate periodically to effect the discharge of hot water through the supply line 128 so that the temperature of the water in the cylinder 120 does not rise to the point of inefficient operation of the refrigeration system. When water is drawn off through supply line 128, a corresponding amount of cold water enters the lower condenser 101 through the line 110 and the preheated water from the condenser 101 passes into the condenser 102 and in this way sufficient cold water enters the hot water generator to insure efficient operation of the refrigeration apparatus.

In the embodiment shown in Fig. 1 the supply line 128 is connected to a thermostatically controlled, electrically operated two-way valve 140 which is always open to one of the two branches, but closed to the other. One branch is connected through high temperature supply line 141 to the inlet 142 at the top part of a storage tank T and the other branch is connected by a lower temperature supply line 144 to the lower temperature inlet 145 located at the lower part of the tank T. The valve 140 is preferably of the electrically actuated type and includes a thermostatic element or bulb 148 received in one of the small openings in the closure plate 121 of the top condenser 102, the bulb communicating with the operating mechanism of the valve by a capillary line 150. The valve and associated parts are so set or adjusted that the valve opens to pass water

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through the line 141 into the top of the tank T when the water in the condenser 102 is at or above the selected minimum temperature at which the system is required to deliver water, e. g., 120° to 180° F., but when below the selected minimum temperature the valve is operated to pass water through the line 144 into the lower part of the tank.

The upper part of the tank is provided with an outlet 152 connected with a discharge line 154 and the lower part of the tank is provided with an opening 156 connected with a normally closed thermostatically operated waste-discharge valve 158. The valve 158 is also of the electrically actuated type and is associated with a thermostatic element or bulb 160 disposed in the other of the openings in the closure plate 121 of the condenser 102, the bulb being connected with the operating mechanism of the valve 158 by a capillary line 162. The valve 158 and associated parts are so set or adjusted that the valve opens to discharge water from the bottom of the tank when the water in the condenser 102 reaches a selected temperature above which the operation of the refrigeration apparatus R becomes inefficient, which may be of the order of 170 to 210° F.

In operation hot water from the generator normally passes through the valve 140 and inlet 142 into the upper part of the tank T when the discharge line 154 is open, so long as the temperature of the water is at or above the aforesaid prescribed minimum. Should hot water be withdrawn from the tank at a rate greater than the capacity of the generator to replenish it, then the temperature of the water in the condenser 102 drops below the prescribed minimum, thereby causing the thermostatic element 148 to operate valve 140 so as to close the line 141 and pass the cooler water to the line 144 so that it enters the bottom of the tank and hence does not cool the hot water in the top of the tank. Should the demand for hot water slacken or cease, the generator, nevertheless, continues to operate and when water in the condenser 102 reaches the prescribed temperature for operating the waste-discharge valve 158, the cool water in the bottom of the tank T is discharged and the hot water flows from the condenser 102 through valve 140, line 141 into the top of the tank T. Simultaneously cold water enters the generator from the supply line 110, as above-described, and the temperature of the water in the condenser 102 drops sufficiently to effect closing of the waste-discharge valve 158. This operation continues periodically so that a supply of hot water builds up in the tank T.

It will be noted that so long as there is hot water available in the generator it is automatically passed to the upper part of the tank T, but if the water in the generator is not sufficiently hot for use, it is automatically passed into the bottom of the tank. Since the tank T has a capacity sufficiently great to receive the output of hot water from the generator for a period of a number of hours, an adequate supply of hot water may be built up without danger of overheating or impairing the efficiency of the associated refrigeration apparatus.

The embodiment shown in Fig. 3 is, in principle, the same as the embodiment of Fig. 1 and the same or similar reference characters are applied to like parts. In this embodiment the thermostatically-controlled, electrically-operated valve 140a is a normally closed one-way valve, operative when the water in the generator reaches a

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selected temperature to open so as to pass the hot water through inlet 142 into the upper part of the tank T, but otherwise to arrest the flow of water to the top of the tank. The valve 140a is of a size sufficiently large to prevent an appreciable drop in pressure within the tank when either line 154 or valve 158a is open.

A cold water supply line 170 is connected by a T 171 to the line 110 leading to the inlet 108 of the condenser 101 and to a line 144a leading to the lower temperature water inlet 145a of the tank T. A pressure valve 145 is connected in line 144a, and, as shown in Fig. 4, is provided with a weighted head 174 operative normally to maintain the valve closed when the pressure in the line 144a is approximately the same as or less than that in the tank T, and to permit the valve to open so as to pass cold water from the line 170 into the lower part of the tank when the pressure therein drops appreciably below that in the line 144a.

In operation hot water above a selected minimum temperature in the generator maintains the valve 140a open. When the valve 140a and the discharge line 154 are open, hot water passes into the upper part of the tank at a rate sufficient to prevent a pressure drop which would cause the valve 145 to open. Likewise, when the waste-discharge valve 158a opens in response to an accumulation of excess hot water in the generator, hot water passes through the valve 140a to the upper part of the tank; but should the demand be such as to draw off hot water from the generator so that the temperature in the condenser 102 drops below the selected minimum, then the valve 140a closes; and when the discharge line 154 is opened, thereby causing an appreciable drop in pressure within the tank T, the valve 145 automatically operates to admit cold water from line 170 through line 144a into the lower part of the tank to replenish water drawn off through line 154. Closing the discharge line 154 reestablishes the pressure within tank T to close valve 145.

The embodiments of Figs. 5 and 6 are substantially identical to that of Fig. 1, except for the two-way valve 140. In Fig. 5 the valve 140b is a manually-operated valve and hence must be set in one of two positions. In operation the valve 140b would be set so as to divert water through the line 144 into the lower part of the tank throughout that part of the day during which hot water is being used faster than it is heated by the generator, and would be set so as to direct hot water through the line 141 into the upper part of the tank T throughout the period during which hot water is not being used.

In the embodiment of Fig. 6 the valve 140c is of the type having a self-contained thermostatically operative element effective to open the valve to line 141 when the water flowing therethrough is at or above a selected temperature, and in all other particulars the operation is identical to that of the embodiment of Fig. 1.

Each of the above-described embodiments may, under certain conditions of operation, be wasteful of heated water. For example, if all of the hot water in the storage tank has been used and the tank is full of cold water and the water in the generator is warm, but below the preselected minimum temperature, it would be wasteful to send this warm water to the bottom of the storage tank where it would be unavailable for use. In order to prevent this difficulty, we may use a thermostat located in the top of the storage tank cooperating with a thermostat located either in

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the generator or in the supply line to the storage tank so that the water from the generator not only passes to the top of the storage tank when it is at or above the preselected minimum temperature, as described in the preceding embodiments, but also passes to the top of the storage tank whenever it is warmer than the water in the top of the storage tank; otherwise it is diverted to the bottom of the storage tank. This may be accomplished in a manner presently to be described.

Referring to Figs. 7 to 10; the storage tank T is substantially identical to that of the embodiment of Fig. 1, except that the electrically-operated two-way valve 140d is associated with a dual control device 180 which operates the valve 140d to pass the incoming water from the generator to the top of the tank T either when it is at or above a preselected temperature, or when it is above the temperature of the water in the top of the tank T.

The device 180 comprises a base 181 which supports a pair of bellows 184 and 185; the bellows 184 being connected by a capillary line 186 to a bulb 187, which may be located either in the hot water generator (as in the previously described embodiments) or in the supply line 128 adjacent to the valve 140d, as shown in Fig. 7. The bellows 185 is connected by a capillary line 188 to a bulb 190 located in the top of the tank T. A bracket 191 is secured to the base 181 and supports a resilient horizontal arm 192 adapted to be readily flexed both longitudinally and transversely. Mounted on the end of the arm 192 is a cross bar or follower 194, the opposite ends of which are held in contact with the upper ends of the bellows by a tension spring 195, as shown in Fig. 8. Centrally mounted on the upper face of the follower 194 is a vertical extending arm 196 which is supported either in a "dead center" or vertical position when the bellows hold the follower in a horizontal position, or in one or two positions to the right or left of the vertical position, depending upon the position in which the bellows hold the follower. Thus, expansion of the bellows 184 and 185 not only varies the level of the follower 194 but also the position of the arm 196.

A normally open micro-switch 200 is mounted on a bracket 201 so that its operating arm 202 is engageable with one end of the follower 194 and a normally open micro-switch 204 is mounted on a bracket 205 so that its operating arm 206 is engageable with the upper end portion of the arm 196. The switches 200 and 204 are connected in parallel with each other in the control circuit for the electrically actuated valve 140d, as shown in Fig. 7.

The construction and arrangement of parts are such that when the water in the supply line 128 is at or above a preselected temperature, the bellows 184 is extended sufficiently to hold the adjacent end of the follower 194 in its uppermost position, wherein it engages the operating arm 202 so as to close switch 200, and when the water in the supply line 128 is below the said preselected temperature, the bellows 184 contracts so as to support the adjacent end of the follower 194 at a level below that required to close switch 200; and when the water in the top of the tank T is at or above a preselected temperature (which may be the same or somewhat less than the preselected temperature causing the bellows 184 to close switch 200), the bellows 185 is extended sufficiently to support the adjacent end of the follower 194 at its uppermost position, in which the arm

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196 is held either in "dead center" or to the left of dead center, in either of which positions the switch 204 remains open.

It is apparent that so long as the water in the line 128 is at or above the preselected temperature the bellows 184 will hold the switch 200 closed, thereby operating valve 140d to pass hot water through the line 141 into the top of the tank T, but should the temperature of the water passing through the line 128 drop below the preselected temperature, the bellows 184 would contract sufficiently to permit spring 195 to pull or tilt the adjacent end of the follower downwardly to open switch 200, thereby operating valve 140d to pass the cooler water through line 144 into the bottom of the tank, provided that the water in the top of tank T is warmer than that passing through line 128. So long as the water in the tank T is at or above the preselected temperature, the bellows 185 remains extended so as to hold the arm 196 either in vertical position, or tilted toward the left in event that the bellows 184 is not fully extended, and in both instances the switch 204 remains open. Should the water in the tank T drop below the temperature of the water in the line 128, then the bellows 185 would contract relative to the bellows 184, thereby causing the follower 194 and arm 196 to tilt toward the right, as indicated by the dot and dash lines of Fig. 8, so as to close switch 204, thus operating valve 140d to pass water to the top of the tank T, even though the incoming water was below the preselected temperature necessary to close switch 200, it being noted that the arm 196 remains operative to close switch 204 when the follower 194 is appreciably below the horizontal level necessary to operate switch 200.

It is apparent from the foregoing that with this system water will pass from the generator to the top of the tank T when (a) the temperature of the water coming from the generator is above the desired preselected temperature, or (b) when the temperature of the water coming from the generator is higher than the temperature of the water in the top of the tank T, even though the water in the generator is below the preselected temperature.

While we have shown and described different desirable embodiments of the invention, it is to be understood that this disclosure is for the purpose of illustration and that various changes and modifications, as well as the substitution of equivalent elements for those herein shown and described, may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having hot water and lower temperature water inlets and a hot water discharge line, valve means associated with said inlets and operative to close one inlet when the other is open, a hot water supply line connecting the hot water inlet with the hot water outlet of said generator so that hot water from said generator flows into said tank when said discharge line is open and the lower temperature water inlet is closed, and a thermostatically operated, normally closed, waste-discharge valve connected to said tank for discharging water therefrom, said thermostatically operated waste-discharge valve including a thermo-

static element associated with said generator and operative to open said waste discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

2. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having hot water and lower temperature water inlets and a hot water discharge line, valve means associated with said inlets and operative to close one inlet when the other is open, a hot water supply line connecting the hot water inlet with the hot water outlet of said generator, said supply line including a thermostatically operated valve operative only when the water passing from said generator into said supply line is above a selected temperature to pass hot water from said generator to said tank when said discharge line is open, a water supply line connected with the lower temperature water inlet and operative to admit water to said tank when said thermostatically operated valve arrests the flow of hot water through said hot water inlet, and a thermostatically operated waste discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

3. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having hot water and lower temperature water inlets and a hot water discharge line, a hot water supply line connected with the outlet of said generator, a two-way valve in said supply line connected with two branches, one branch being connected to the hot water inlet of said tank and the other branch being connected to the lower temperature water inlet of said tank so that when said discharge line is open water may flow through one of said branches into said tank, and a thermostatically operated normally closed waste-discharge valve connected to said tank for discharging water therefrom, said thermostatically operated valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

4. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having hot water and lower temperature water inlets and a hot water discharge line, a hot water supply line connecting the hot water inlet with the hot water outlet of said generator, a thermostatically operated valve in said supply line having a thermostatic element associated with said generator and effective to operate the valve when the water in said generator reaches a selected temperature so that hot water from said generator flows into said tank when said discharge line is open, a supply line connected with the lower temperature water inlet for admitting water to said tank when said discharge line is open and when thermostatically operated valve arrests the flow of hot

water to said hot water inlet, and a thermostatically operated, normally closed, waste-discharge valve connected to said tank for discharging water therefrom, said thermostatically operated waste-discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

5. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having hot water and lower temperature water inlets and a hot water discharge line, a hot water supply line connected with the outlet of said generator, a thermostatically operated two-way valve in said supply line connected with two branches, one branch being connected with the hot water inlet of said tank so as to pass water from said generator through the hot water inlet of said tank when the temperature of the water flowing through said supply line is above a selected temperature and the other branch being connected to the lower temperature water inlet of said tank so as to pass water from said generator through the lower temperature water inlet of said tank when the temperature of water flowing through said supply line is below said selected temperature, and a thermostatically operated normally closed waste-discharge valve connected to said tank for discharging water therefrom, said thermostatically operated waste-discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

6. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water system comprising a storage tank having at its upper part a hot water inlet and a hot water discharge line and having at its lower part a lower temperature water inlet and a waste-discharge port, a hot water supply line connected with the outlet of said generator including a thermostatically operated valve having two branches, one branch being connected with said hot water inlet and the other branch being connected with said lower temperature water inlet, said valve having a thermostatic element associated with said generator and operative to actuate said valve so as to pass water through said hot water inlet when the water in said generator is above a selected temperature and to pass water through said lower temperature water inlet when the water in said generator is below said selected temperature, and a thermostatically operated normally closed waste-discharge valve connected to said port for discharging water therefrom, said thermostatically operated waste-discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

7. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot

water system comprising a storage tank having at its upper part a hot water inlet and a hot water discharge line and at its lower part a cold water inlet and a waste-discharge port, a cold water supply line having two branches, the first branch being connected with the cold water intake of said generator and the second branch being connected with the cold water inlet of said tank, a pressure operated valve in said second branch effective to pass cold water through said cold water inlet when the pressure of the water in said tank falls appreciably below that in said cold water supply line, a hot water supply line connecting the hot water outlet of said generator with the hot water inlet of said tank, a thermostatically operated normally closed valve in said hot water supply line operative to open so as to admit water to said tank when the water from said generator is above a selected temperature, and a normally closed thermostatically operated waste-discharge valve connected with said waste-discharge port and adapted to discharge water from said tank at a rate preventing an appreciable pressure drop in said tank, said thermostatically operated waste-discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

8. In combination with a substantially continuously operating hot water generator having a cold water intake and hot water outlet, a hot water-system comprising a storage tank having at its upper part a hot water inlet and a hot water discharge line and having at its lower part a lower temperature water inlet and a waste-discharge port, a hot water supply line connected with the outlet of said generator and including a valve having two branches, one branch being connected

with said hot water inlet and the other branch being connected with said lower temperature water inlet, control means for said valve including thermostatic elements conjointly responsive to the temperature of the water in the upper part of said tank and with the temperature of the water supplied from said generator to actuate said valve so as to pass water through said hot water inlet when the water passing through said valve is above the temperature of the water in the upper part of said tank and to actuate said valve to pass water through said lower temperature water inlet when the water passing through said valve is below both a preselected temperature and the temperature of the water in the upper part of said tank, and a thermostatically operated normally closed waste-discharge valve connected to said port for discharging water therefrom, said thermostatically operated waste-discharge valve including a thermostatic element associated with said generator and operative to open said waste-discharge valve when the water in said generator reaches a selected temperature, thereby to admit cold water to said generator and simultaneously pass hot water from said generator to said tank.

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2,207,057	Gulick	July 9, 1940
2,255,967	Collins	Sept. 16, 1941
2,271,449	Whitney	Jan. 27, 1942