June 8, 1954 O. M. OLSEN 2,680,429

VERTICAL INDIRECT WATER HEATER

Filed June 23, 1950

2 Sheets-Sheet 1

Fig. 2

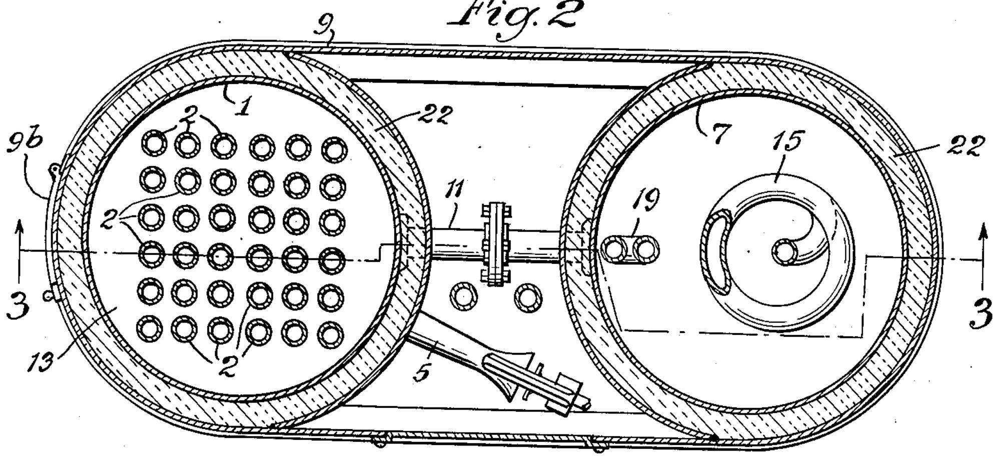
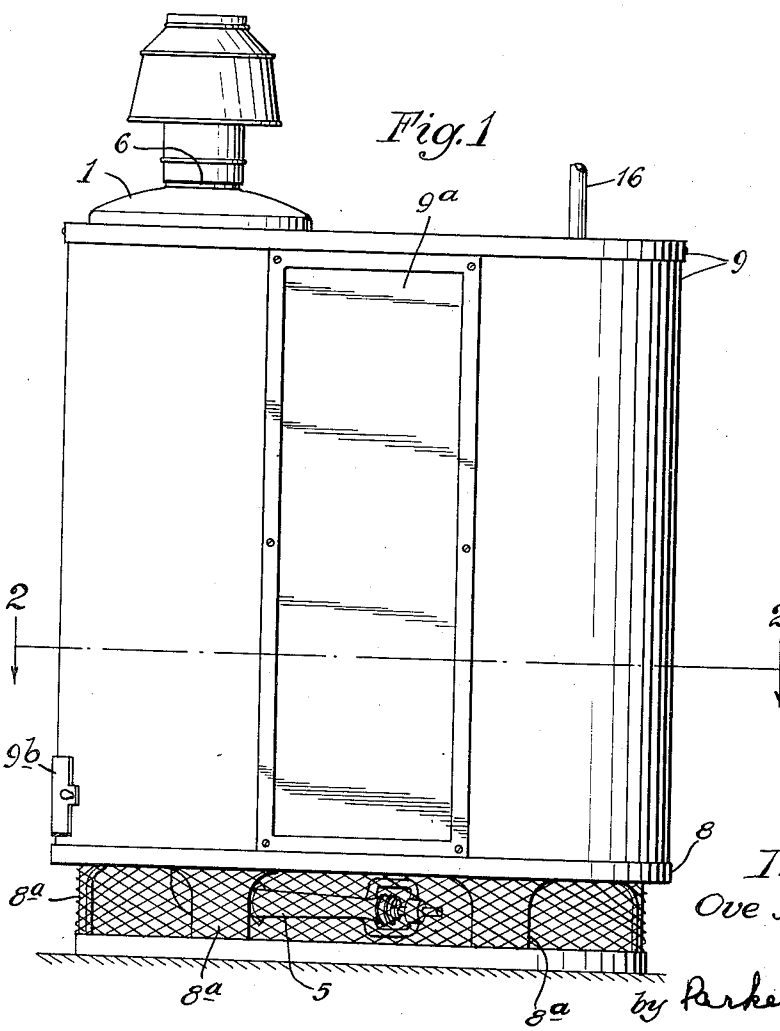


Fig. 1



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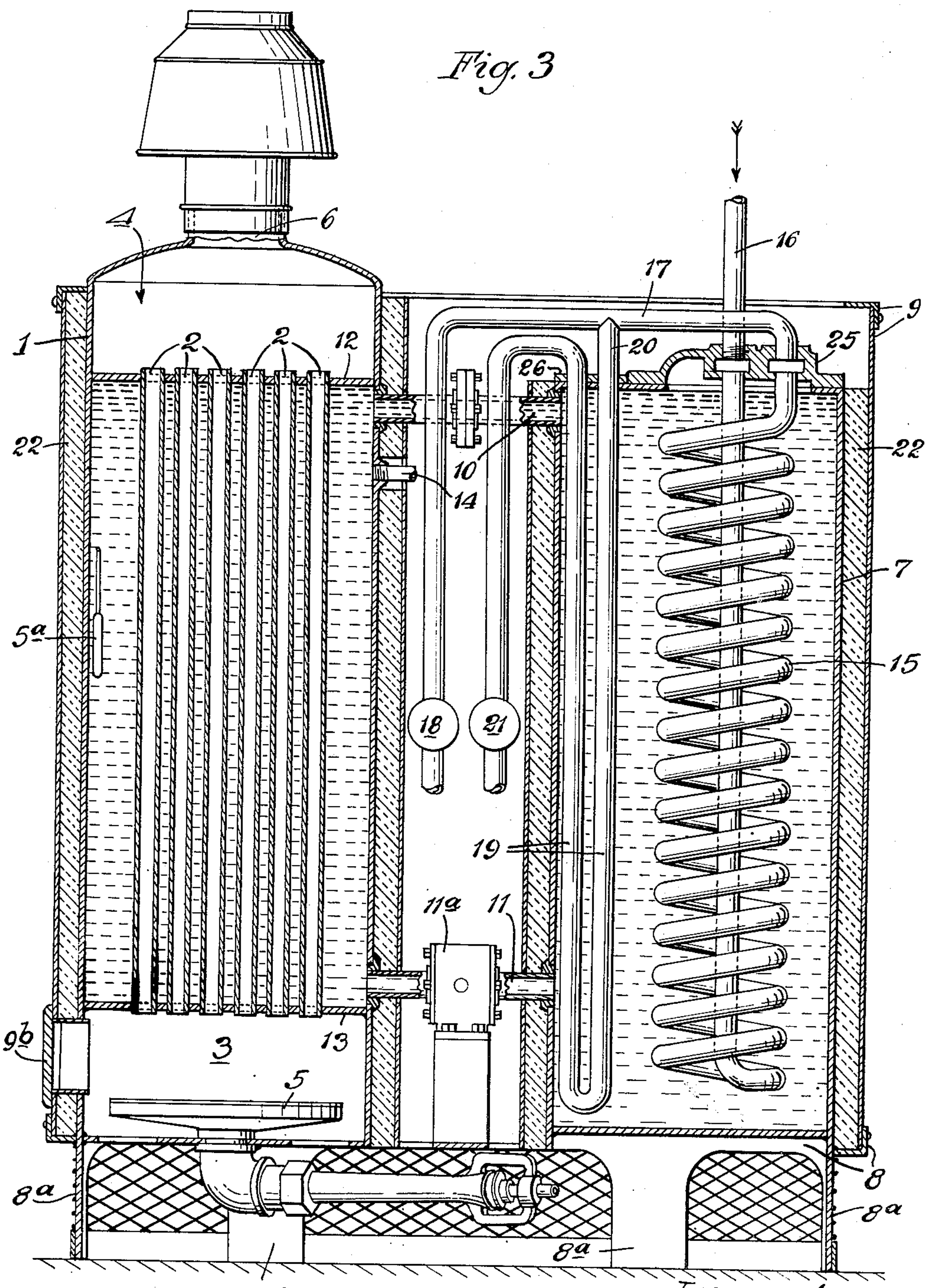
2 Sheets-Sheet 2

Fig. 3



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UNITED STATES PATENT OFFICE

2,680,429

VERTICAL INDIRECT WATER HEATER

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Application June 23, 1950, Serial No. 169,796

1 Claim. (Cl. 122—32)

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My invention relates to an improvement in water heaters, and has for one purpose to provide a heater adapted to heat water in large volume, for general commercial and industrial use.

Another purpose is to provide such a heater in which water is indirectly heated, for example by means of a copper tube heat exchanger located in an auxiliary tank, with the water being heated in contact only with the copper and not drawn directly from the heater proper.

Another purpose is to provide a heating apparatus and method to permit the heating of corrosive waters without rapid corrosion and destruction of the heater.

Another purpose is to provide such a heater in which water softened by Zeolite or other forms of water softeners can be heated without active corrosion or destruction of the heater.

Another purpose is to provide a heater adapted to deliver water in substantial quantities at at least two different temperatures.

Another purpose is to provide an improved heat exchanger assembly in combination with a water heater.

Another purpose is to provide a heating apparatus and method in which a "fly wheel effect" is employed through the use of heat exchangers of materials the heat-absorbing capacity of which is substantially greater than would be required to absorb the heat provided by the burner used with the heater.

Other purposes will appear from time to time in the course of the specification and claim.

I illustrate the invention more or less diagrammatically in the accompanying drawings wherein:

Figure 1 is a side elevation of the device;

Figure 2 is a section taken on the line 2—2 of Figure 1 on an enlarged scale; and

Figure 3 is a vertical cross section taken on the line 3—3 of Figure 2.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, 1 generally indicates a hot water boiler or heater, herein shown as vertical, and normally filled with water. The water in the heater surrounds a group or battery of firing tubes 2 in communication with a lower burner-receiving space 3 and an upper discharge space 4. 5 diagrammatically indicates any suitable burner. For convenience, I have illustrated a gas burner the details of which form no part of the present invention but it will be understood that any suitable burner may be employed, and any suitable fuel. Under some circumstances, an electric heater may be provided, but I find a gas burner practical. The ducts or firing tubes 2 carry the hot gases to the upper space 4, from which they are exhausted through any suitable flue or outlet 6 at the top of the heater.

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Located adjacent the main burner or tank 1 is a storage tank or element 7. I illustrate the units 1 and 7 as of substantially the same size and vertical extension, arranged with parallel upright axes on a common base 8, on spaced ground or floor engaging supports 8a. The tanks are shown as connected or surrounded by any suitable housing element 9. 9a indicates an access door to the space between the tanks, and 9b an access door for the burner space 3. It will be understood, that the details and proportions of the above-described elements may be widely varied.

The space within the tank or heater 1, which surrounds the firing tubes 2, is connected at top and bottom with the interior of the storage tank 7. I illustrate, for example, a top duct or pipe 10 and a bottom duct or pipe 11, which are located adjacent the horizontal top partition 12 and the horizontal bottom partition 13, respectively. The space between the partitions 12 and 13, and surrounding the fire tubes 2, is thus put in communication with the space within the storage tank 7, both spaces being normally filled with a suitable heat storage liquid, such as water. As will later appear, this water is not exhausted for use but serves as a heating and heat storage medium for the below described heat exchange elements within the storage tank 7. 14 indicates any suitable cold water inlet for admitting water to the interior of the boiler or heater 1. It will be understood, of course, that any suitable means, passages or connections, may be employed for admitting or removing water from the interior of each tank.

It will be understood that as the liquid in the heater 1 increases in temperature, due to the action of whatever burner is employed, a rapid circulation of water is thereby set up between the interiors of the heater 1 and of the storage tank 7. The storage water moves rapidly upwardly in the tank 1, and rapidly downwardly in tank 7, with what approximates a piston action. This continues until the contents are at approximately the same temperature. Any suitable thermostatic means may be employed for cutting off the main burner 5 when the temperature of the common body of storage water reaches a predetermined maximum. I illustrate the bulb 5a which may be appropriately connected to the burner 5. For example, it may be set at or about, or between 210 degrees to 220 degrees Fahrenheit.

Located within the storage tank 7 I employ one or more heat exchangers of any suitable design and material. I prefer to employ copper, because of the superior heat-transfer capacity of that material, but I do not wish to be limited specifically to the employment of copper, since other materials of high heat-transfer capacity may, under some circumstances, advantageously be employed.

Considering the exemplification of my invention as shown in the drawings, I illustrate a spiral copper tube heat exchanger 15 having an inlet pipe 16 and an outlet pipe 17 extending to any suitable water mixer or blender 18, the function of which is below discussed. 19 indicates a second heat exchanger in the form of a U-shaped tube, one arm of which is connected, as by the pipe 20, with the outlet 17 of the heat exchanger 15. The outlet temperature of the water from the heat exchanger or coil 19 is controlled by means of a second water mixer or blender 21. The blenders may be thermostatically controlled, such controls not of themselves forming part of my invention. The water boiler 1 and storage tank 7 may be surrounded with any suitable insulation as indicated at 22.

It will be realized that, whereas, I have described and illustrated a practical and operative method and device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my precise showing. For example, whereas I illustrate a multiple tank system, I do not wish to be so limited.

The use and operation of the invention are as follows:

Let it be assumed as an illustrative example that a temperature of from 210 degrees to 220 degrees Fahrenheit is maintained in the heat storage liquid contained in the heater tank 1 and in the storage tank 7. The incoming water entering the heat exchange coils or elements 15 and 19 rapidly becomes heated by absorbing heat from the liquid in the storage tank 7. It may be heated to a temperature somewhat in excess of the desired outlet temperature, but the outlet temperature may be controlled by any suitable thermostatically controlled mixers or blenders 18 and 21, which add cold water from any suitable connections to bring about the desired operating or delivery temperature.

In the embodiment of my invention herein shown I take advantage of the heat-absorbing capacity of the copper tube heat exchangers which is several times greater than would be required to absorb the heat provided by the burner and which thus produces what I may call a "fly wheel" effect. The heat stored in the body of liquid contained in the two tanks is available for absorption by the heat exchanger coils 15 and 19, in addition to the heat which is currently being put into the water in the tanks by the burner. The user thus has available the heat stored in the water contained in the two tanks, and the use of copper tube heat exchangers of sufficient capacity to absorb this stored heat, as well as the burner-delivered heat, increases the efficiency of the heater. Thus, instead of storing

heated water available for use, I store heat, and make the heat of a liquid heat storage body available to the user. An outstanding advantage of my structure and method rests in the fact that the water being used does not contact the interior of the tank 1 or of the storage tank 7. On the contrary, it flows only through the coils 15 and 19 which are resistant to corrosion, and which, after a proper life period, may readily be removed and replaced by removal of the cover elements or closure caps 25 and 26, respectively.

Another highly advantageous feature of my system is that although the second coil or heat exchange member 19 draws heated water which has already been pre-heated in the coil or heat exchange member 15, it does not normally interfere with or reduce the heat-absorbing capacity of the heat exchange member 15. It is only when there is a demand for the more highly heated water produced by the heat exchange member 19 that it draws on the coil or heat exchange member 15. Except when there is a call for the more highly heated water, a static supply of heated water is maintained in the heat exchange member 19, with no flow into it or out of it. By thermostatically controlling the two blenders, and by setting one blender at, for example, 140 degrees Fahrenheit, and the other at, for example, 180 degrees Fahrenheit, I maintain adequate delivery of water at two temperatures.

While I do not wish to be limited specifically to the forms and relationships of tank shown, I find it highly advantageous to employ a vertical heater with a vertical storage tank mounted adjacent to it, with the interiors of the tanks connected to bring about a rapid circulation of liquid between the two tanks in response to heating the liquid in one of the tanks, the two tanks being arranged, side by side, and at about the same level. For convenience of mounting, the tanks may be made of the same, or substantially the same, size, as well as shape.

With my structure I easily supply water at two different temperatures without the need of using any booster heater. This is of advantage in restaurant installations, where the proportions of low and high temperature water vary continually during the period of use. High temperature water may be used in the rinse sprays of dishwashing machines. Low temperature water may be used for various miscellaneous purposes, such as pre-rinsing dishes before they enter the washing machine, cleaning pots and pans in scullery sinks, and for general use in lavatories, etc. When the washing machines are not being used, and there is no call for high temperature water, the entire capacity of the main heat exchanger is available for supplying water at the lower temperatures. It is only when higher temperature water is called for that water is drawn through the supplemental or booster coil 19. Otherwise, there is no flow of water along the pipe or connection 20, and the entire delivery of water along the pipe 17 flows through the main heat exchanger coil 15. A requirement of dishwashing machines is that a high rate of flow of high temperature water is necessary for a period of approximately ten seconds out of every minute of operation. This momentary, but high, output may be in a volume of from one-half to three gallons of water. The capacity provided by my temperature coil is such that all, or a large part, of the necessary volume of high temperature water is stored within the coil, and is thus available for instant use. Since the requirement for high temperature water at the high rate is for a period of approximately ten seconds, with a stand-by period of approximately fifty seconds in each cycle of operation, the contents of the coil are brought up to the desired temperature during the stand-by period, and the necessary volume of high temperature water is available when the call for high temperature water comes.

The equipment shown has the advantage of occupying a small amount of floor space, due to its compact assembly and arrangement. I employ large-diameter copper tubes in the heat exchangers, which materially reduces the likelihood of scale formation in the tubes when used on hard water. The probability of scale formation is further reduced, as compared with the direct fire instantaneous type of copper water coil heater. In my unit the temperature differential between the water on the outside of the coils 15 and 19 and the water being heated on the inside is very low, approximately 10 degrees to 70 degrees Fahrenheit. In direct-fire instantaneous heaters, on the contrary, the differential may frequently be as high as 2,000 degrees Fahrenheit, due to the high temperature of the gas flame on one side of the coil and the low temperature of the water being heated on the other side of the coil wall. This high differential greatly accelerates the formation of scale inside the coils, a factor which is entirely avoided by my structure.

I diagrammatically illustrate, in Figure 3, a pump 11*a*. In most instances, it is not necessary to use such a pump, but, under some circumstances, in order to accumulate a control circulation, such a circulating pump in the line or pipe 11, connecting the two tanks, is of value. It may serve the dual purpose of maintaining a substantially absolute uniformity of temperature throughout the entire system, and of increasing the heat transfer rate or capacity of any given heat exchanger. For example, velocity of the liquid surrounding a copper coil is an important factor in determining the rate at which heat is transferred through the coil.

I claim:

In a water-heating system, a heat storage unit divided into two generally upright containers, each having a chamber adapted to receive and contain a body of liquid, the chambers being interconnected for liquid transfer generally adjacent their tops and bottoms respectively to

form a closed circulating system, a heater for heating the liquid in one of the said containers, generally upright flue elements passing through the chamber in the said one container to facilitate the heating of the liquid in that chamber, and an elongated heat exchange member positioned in the other container and extending into its chamber in the path of the closed circulating system and having a substantial amount of heat exchange area for contact with the liquid, the liquid in the closed circulating system generally flowing upwardly in the chamber of the said one container and downwardly in the chamber of the said other container, the elongated heat exchange member being insertable and withdrawable through the top of the said other container, said elongated heat exchange member having an inlet adapted to be connected to a source of water supply to be heated and an outlet connection for the delivery of heated water, the elongated heat exchange member extending from the top of the chamber of the said other container approximately to the bottom and including two heat exchange elements, one of the elements including the inlet connection adapted to be connected to the source of water to be heated and the outlet connection for the delivery of heated water and the other heat exchange element having an inlet connection from the outlet connection of the said one heating exchange element and a separate outlet connection for the delivery of heated water from the other heat exchange element, the said one heat exchange element having a substantially greater amount of heat exchange area than the other.

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