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WATER HEATER.

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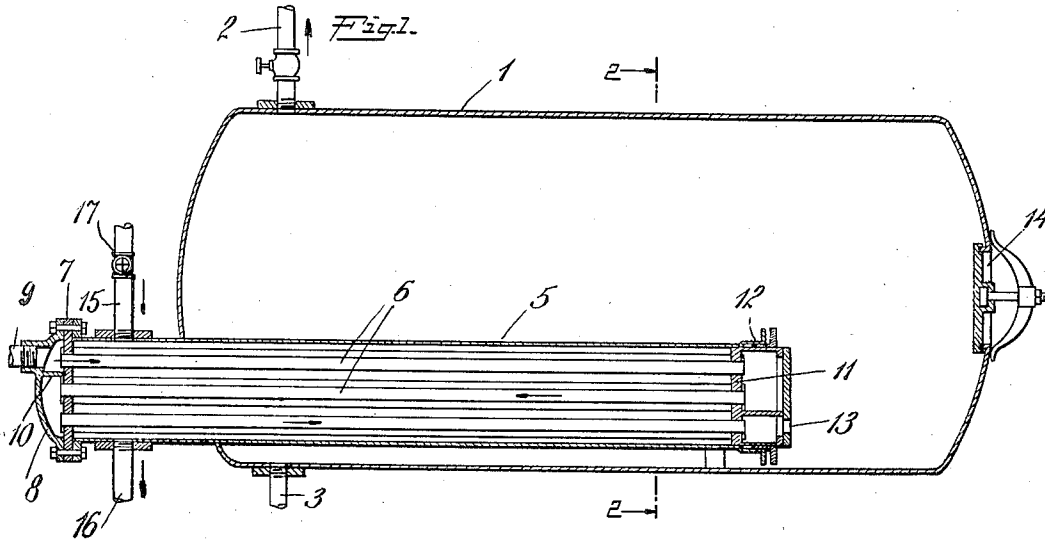


Fig. 2.

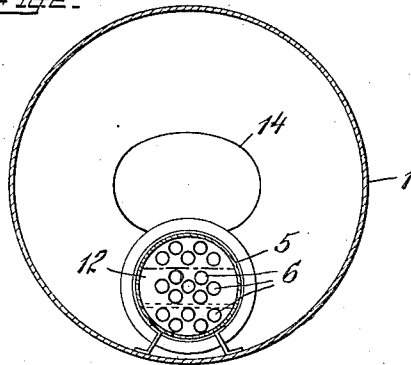
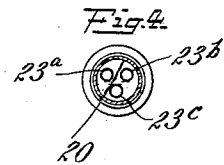
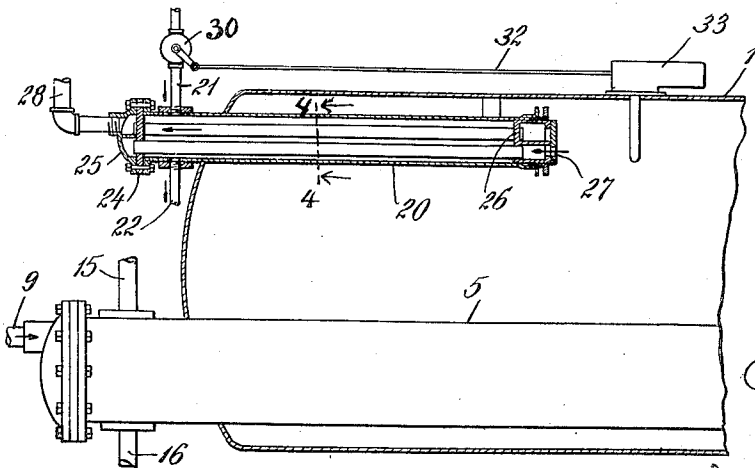


Fig. 3.



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WATER HEATER.

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To all whom it may concern:

Be it known that I, ROBERT J. PABODIE, a citizen of the United States, residing at Maywood, in the county of Cook, State of Illinois, have invented certain new and useful Improvements in Water Heaters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to heaters for water or other liquids of the kind commonly known as storage heaters, that is, a heater which maintains within itself a considerable quantity of water at the desired temperature with heating means to replace the heat units lost by radiation and to heat the incoming cold water which replaces the hot water drawn off from time to time. Heaters of this kind are used where the requirements for hot water are not constant, the large storage capacity permitting the temperature to be built up gradually while permitting a large quantity to be used at one time. Such heaters as now constructed are not as efficient as so-called instantaneous heaters which are generally employed where the use of hot water is more or less uniform, due largely to the fact that in storage heaters as now constructed the velocity of the water through the heating path is low and the rate of heat absorption correspondingly small.

The object of the present invention is to provide a heater of the storage type which is as efficient in its action as an instantaneous heater, that is, one in which the heat transferred per unit of surface will be as large or larger than in the ordinary instantaneous heater and in which the other advantages of a high velocity flow, such as scouring effect, freedom from scaling, etc., will be obtained.

A further object of the invention is to provide a heater of this class in which the size of the apparatus necessary for the given demand and fluctuation in output is reduced, due to the more rapid and efficient operation of the heater, whereby the incoming water will be to a large extent heated during its flow into the reservoir.

A further object of the invention is to provide a device of simple and cheap construction in which the heating surface may

be readily withdrawn for cleaning or repair.

In the accompanying drawings I have illustrated two different embodiments of my invention, and in the said drawings,

Figure 1 is a longitudinal section through one form of my improved heater;

Fig. 2 is a transverse section on line 2—2 of Fig. 1;

Fig. 3 is a longitudinal section of the second form of heater; and

Fig. 4 is a transverse section through the auxiliary heating element shown in Fig. 3.

Referring to the drawings, particularly to Figs. 1 and 2, 1 indicates the shell or container for the water to be heated and stored, the capacity of the shell depending upon the quantity of water which it is desired to maintain on hand, which in turn depends upon fluctuations in demand to be met and also upon the rapidity with which the heating elements can restore to the replenishing water the necessary heat to restore the entire contents of the shell to the desired temperature.

As shown, the shell is of the ordinary cylindrical horizontal type with an outlet 2 for the heated water at the top and a drain or blowdown outlet 3 at the bottom for the removal of sediment. The water in the shell is heated by the heating element comprising, as shown, a cylindrical or tubular shell of thin metal supported in the container in the manner shown with a series of tubes for the passage of the water to be heated, the tube surface being so proportioned that the heating element is in effect an instantaneous heater and delivers the water to the storage shell at approximately the temperature which it is desired to maintain.

As shown, the tubes themselves are grouped to provide a triple pass for the water through the shell. All the tubes are supported at the outboard end of the shell in a header or tube plate 7 attached to the shell and clamped to the flange of the shell by a cover plate 8 containing the water inlet port 9 and provided with a partition 10 separating the upper group of tubes from the two lower groups. The other ends of the tubes are supported by a floating head or drum 11 mounted to slide axially in the shell, the head being surrounded by a packed joint 12 which permits the sliding

movement of the head as effected by the expansion and contraction of the tubes. The floating head is divided by a transverse partition into an upper compartment connecting the two upper groups of tubes and a lower compartment for the bottom group of tubes whereby the incoming water is caused to successively traverse the three groups of tubes before it is discharged through the outlet opening 13 in the cover plate of the floating head.

The preferred heating medium for the water in the tubes of the heater is the exhaust steam from the auxiliary engines if the heater is used on shipboard or from any other suitable source, for instance the driving engine of an industrial plant or the steam heating system of the building, when the heater is used in an office building or similar place. The steam is admitted to the shell through a steam inlet 15 at the top of the shell and a drain 16 is provided at the lower side of the shell for draining off the water of condensation.

When exhaust steam is employed as the heating medium and is condensed in the shell 5 the packed joint 12 is particularly efficacious for the reason that the pressure in the storage reservoir exceeds that in the shell 5 and the joint is therefore self-packing. Where the heater water is to be used for drinking or other purposes where purity is required, this self-packing joint is particularly important as the exhaust steam usually contains oil etc., which would contaminate the water.

The rear end of the storage shell is provided with the usual man-hole 14 giving access to the interior of the reservoir, and the various inlet and outlet ports will be provided with pipes having the usual valves, not shown, for controlling the intake and delivery of the water. Also, there is preferably provided an intake valve 17 for the exhaust steam which may, if desired, be thermostatically controlled by any suitable means, not shown.

The operation of the apparatus will be obvious from the above description. When there is no water being drawn from the tank there will be no flow through the tubes 6, but the shell 5 will furnish sufficient heating surface to supply all the heat necessary to make up for losses through radiation. When, however, the water is being drawn off there will be a rapid inflow through the tubes 6, so that the tube surfaces will act at their maximum efficiency as heat-absorbing surfaces, delivering the water through the outlet 13 into the tank at a temperature almost, if not quite, that desired for water drawn off from the reservoir. Hence, when the outlet is again cut off the temperature will be quickly built up to the desired maximum.

With this form of apparatus the heat transfer efficiency of the instantaneous type of heater is obtained alone with the advantages of the storage heater, that is, a supply of water maintained on hand and the constant utilization of the exhaust steam which in the ordinary instantaneous heater is utilized only while the water is running. Also, in the instantaneous heater there are considerable heat losses from the surface of the shell of the tubes which in my improved heater serves as a heat transfer surface to the water in the storage reservoir. Over the usual storage heater my improved heater has the advantage, in addition to the greater efficiency, that there can be no possible short circuit of water from the cold water inlet to the outlet when the water is drawn off.

In Figs. 3 and 4 I have shown a modified apparatus designed to take care of wide fluctuations in the demand for water without unduly increasing the size of the storage reservoir. To this end, in addition to the main heater whose shell is indicated at 5, and which occupies the same position in the main take 1 as the previously described construction, I provide an auxiliary or supplemental heater comprising a small cylindrical shell 20 positioned in the reservoir near the top thereof and provided with inlet and outlet pipes 21, 22 for the admission and discharge of the steam from the shell. Contained within the shell are three tubes 23^a, 23^b and 23^c, respectively, the tubes being supported at their outer ends in a tube sheet 24 covered by a cap 25 having a web dividing the chamber formed with the tube sheet into two compartments, one of the compartments connecting with the tube 23^a while the other compartment is connected to tubes 23^b and 23^c. The other end of the tubes are supported in a floating head 26 which is also divided into two compartments, one compartment connecting tubes 23^a and 23^b while the other connects tube 23^c with an inlet port 27 in the cover plate of the floating head.

The outlet 28 for the water heated by the auxiliary heater is attached to the chamber of the head 25 which connects with the pipe 23^a so that the water entering the inlet 27 traverses all three pipes before reaching the outlet.

It is not intended that the auxiliary heater, or "booster", shall be used at all times, but only when the consumption of water from the tank is too rapid for the main heater to maintain the desired temperature. The steam inlet to the auxiliary heater will therefore be provided with a cut-off valve 30 so that the steam may be turned on and off as desired.

I preferably employ thermostatic control for the valve 30. The thermostat, which is indicated diagrammatically at 33, has its

control element projected into the reservoir and operates to shift the valve rod 32 to open the valve 30 when the temperature of the water falls below a desired minimum so as to turn on the steam and add the heating effect of the booster to that of the main heater. When, however, the demand for water is not excessive, the temperature in the reservoir will be built up beyond the limit for which the thermostat is set and the thermostat will act to close the valve 30 and render the auxiliary heater ineffective.

I have shown both the main heater and the booster as arranged to provide a triple pass for the water before its discharge, but it will of course be understood that the tubes may be arranged to provide any odd number of passes, or in fact an even number of passes may be provided by having the inlet and outlet to the tubes at opposite ends of the tubes.

In the foregoing specification I have described the details of construction of my improved heater in the form which I have so far found most practical for commercial use. It is to be understood, however, that the invention is not limited to the details described and shown but that it may be varied in many particulars without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. In a liquid heater, the combination of a storage reservoir, a heating element in said storage reservoir adapted to receive a fluid heating medium, said heating element having a heat transferring surface in contact with the liquid in said reservoir, and means for heating the liquid admitted to said reservoir, said means comprising a passageway for the liquid in heat exchanging relation with said heating fluid.

2. In an apparatus of the class described, the combination of a reservoir for water to be heated, a heater projecting into said reservoir comprising a heat conducting shell for receiving a fluid heating medium, a series of tubes in said shell in heat exchanging relation with said heating medium, a discharge outlet from said tubes to said reservoir and an inlet port for the water to be heated connected to said tubes.

3. In an apparatus of the class described, the combination of a reservoir for water to be heated, a heater projecting into said reservoir comprising a heat conducting shell for receiving the heating medium, said shell being in contact with the water in the reservoir, a plurality of tubes in said shell, said tubes being connected in series; and a discharge outlet for some of said tubes whereby the water delivered to said reservoir will pass more than once through the shell before entering the reservoir.

4. In an apparatus of the class described,

the combination of a reservoir for water to be heated, a heater projecting into said reservoir comprising a heat conducting shell for receiving the heating medium, a series of tubes in said shell, a discharge outlet from said tubes to said reservoir and an inlet port for the water to be heated connected to said tubes, the outer surface of said shell constituting a heating surface for the water in the reservoir.

5. In an apparatus of the class described, the combination of a reservoir for water to be heated, a heater therefor comprising a shell of heat conducting material projecting part way into said reservoir near the bottom thereof, said shell being in contact with the water in the reservoir, a plurality of tubes within the shell, an inlet chamber at the outer end of said shell of heat conducting material, a discharge chamber connected to the other end of said shell having a port connecting with the interior of the reservoir and connections to said shell without the reservoir for admitting the heating medium to the interior of the shell to heat the water passing through the tubes.

6. In an apparatus of the class described, the combination of a reservoir for water to be heated, a heater therefor arranged at the bottom of said reservoir, said heater having a pair of compartments separated by heat-transferring surfaces, means for admitting the water to be heated to one of said compartments, a discharge outlet from said compartment into said reservoir, means for admitting a heating medium to the other compartment, said last mentioned compartment having a portion of its surface in heat-transferring contact with the water in the reservoir.

7. In a water heater, the combination of a reservoir for the water to be heated, and a heating element comprising a cylindrical shell of heat conducting material projecting into said reservoir in substantially horizontal position with one end projecting through the wall of the reservoir, a plurality of tubes in said shell, said tubes and said shell forming, one the chamber for the heating medium and one the chamber for the water to be heated, the latter chamber having a discharge opening in said reservoir and connections to said chambers without the reservoir for the heating medium and the water to be heated, respectively.

8. In a water heater, the combination of a reservoir, a heat conducting shell projecting into the reservoir, a series of tubes in the shell, said tubes being divided into three groups, a head at the outer end of the shell divided into two chambers, one of said chambers connecting two of said groups, a head at the opposite end of said shell and within said reservoir, said head being also divided into two compartments with one compart-

ment connected to two groups of said tubes, the arrangement being such that the three groups of tubes are connected in series, an inlet port for the chamber at the outer end of said shell which is connected to the single group of tubes, a discharge port from the compartment at the inner end of said shell which is connected to the other single group of tubes, and means for admitting a heating fluid to the shell.

9. In a heater, the combination of a stor-

age reservoir, a heating element in said storage reservoir, comprising a chamber for containing the heating vapor and a passage for the liquid to be heated in heat exchanging relation therewith, and connections for passing the liquid supplied to the reservoir through said passage before admission to the reservoir.

In testimony whereof I affix my signature.

ROBERT JEWETT PABODIE.