G. E. STARN.

WATER HEATER.

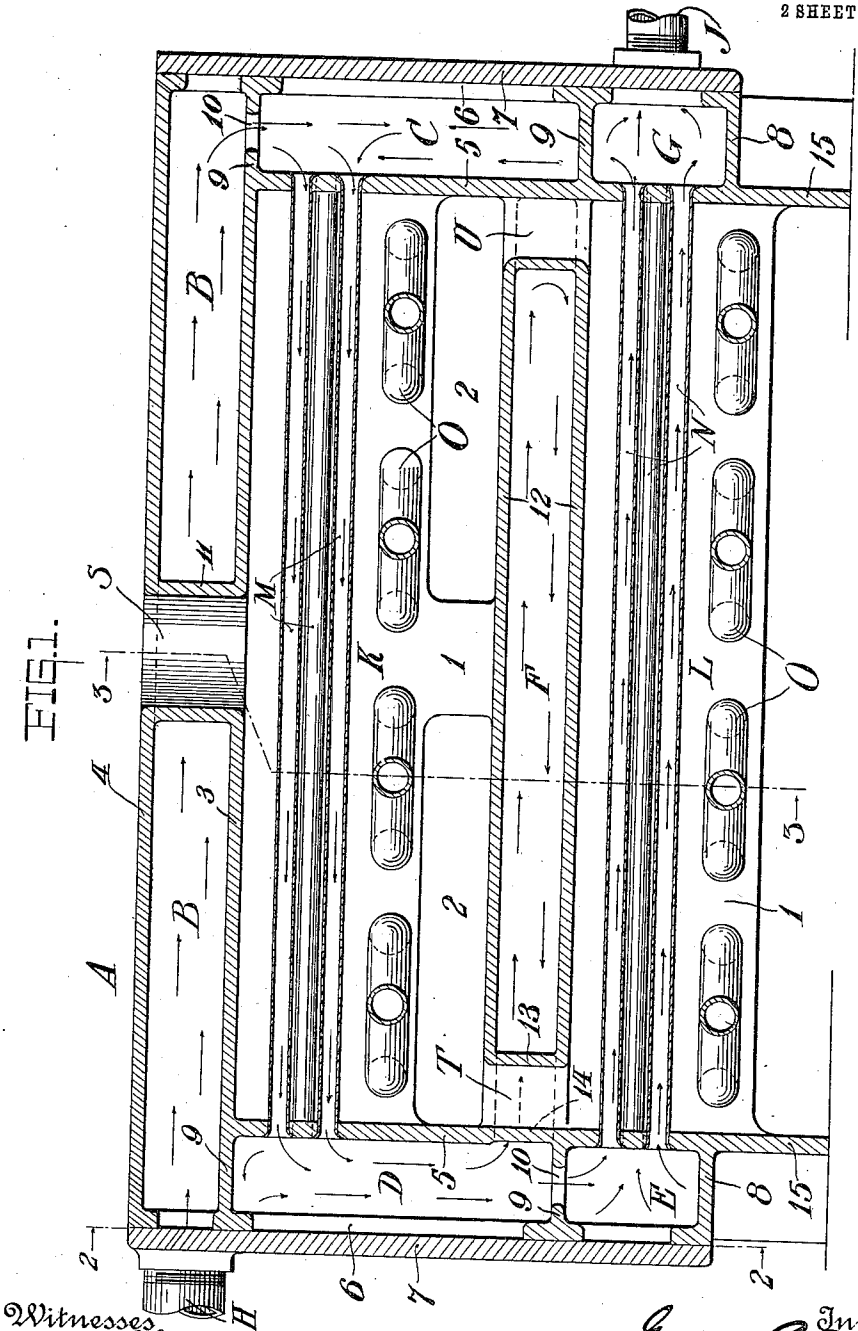
APPLICATION FILED MAY 3, 1910. RENEWED APR. 18, 1911.

1,009,198.

Patented Nov. 21, 1911.

2 SHEETS—SHEET 1.

FIG. 1.



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2 SHEETS—SHEET 2.

FIG. 3.

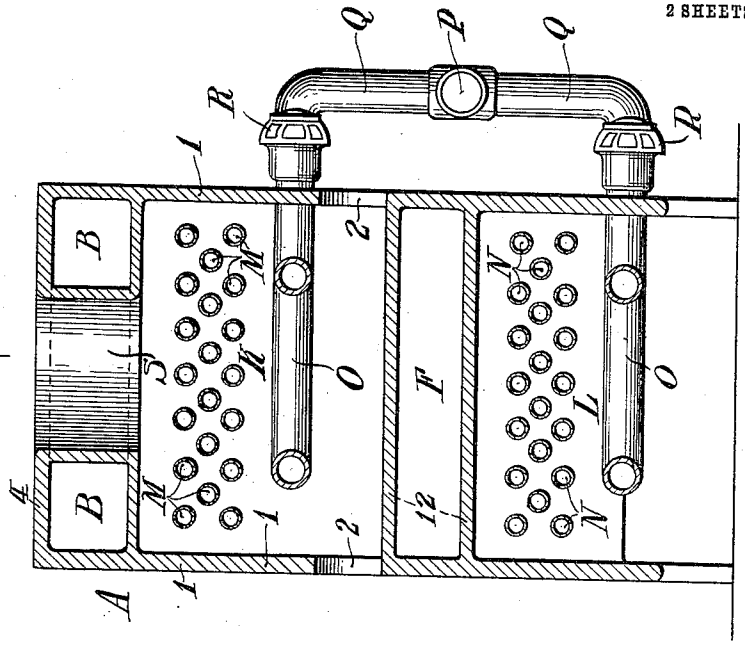
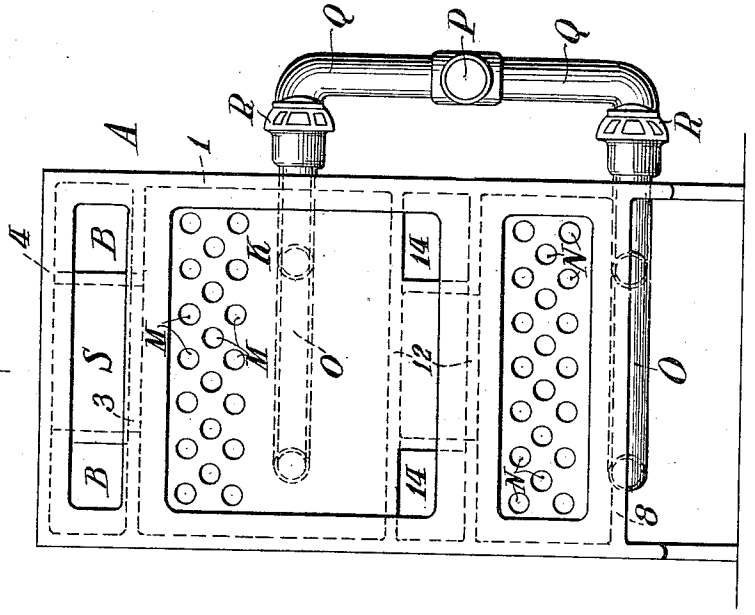


FIG. 2.



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UNITED STATES PATENT OFFICE.

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WATER-HEATER.

1,009,198. Specification of Letters Patent. Patented Nov. 21, 1911.

Application filed May 3, 1910, Serial No. 559,129. Renewed April 18, 1911. Serial No. 621,871.

To all whom it may concern:

Be it known that I, GEORGE E. STARN, a citizen of the United States, residing at Camden, in the county of Camden and State of New Jersey, have invented certain new and useful Improvements in Water-Heaters, of which the following is a specification.

My invention relates to water-heaters adapted for connection with a cold water supply pipe, and in which the water is quickly heated as it flows through the apparatus.

The object of the invention is to provide a practicable and highly efficient apparatus of this character.

I have illustrated a preferred form of water-heater embodying my invention in the accompanying drawings, in which:

Figure 1 is a longitudinal sectional elevation. Fig. 2 is a cross section on line 2—2 of Fig. 1. Fig. 3 is a cross section on line 3—3 of Fig. 1.

The heater comprises a body A having water-chambers therein surrounding heat-chambers which inclose water-tubes and gas-burners. Said water-chambers are arranged as follows: At the top of the apparatus, and extending over the full length thereof, is a horizontal water-chamber B. At one end there are non-communicating water-chambers C and G, the upper one C of which is in communication with the water-chamber B. At the opposite end there are communicating water-chambers D and E. There is also an intermediate horizontal water-chamber F which is in communication only with the water-chamber D. Said water-chamber F provides a partition inside the body of the heater. The heater may have no bottom. The upper water-chamber B has a cold water inlet H connected or adapted for connection with a supply pipe; which inlet is preferably located at the same end of the apparatus as the water-chambers D and E. The water-chamber G has a hot water outlet J which may be provided with a faucet or connected with a pipe for conducting off hot water for use where desired.

K and L are the heat chambers, inclosed by the water-chambers and separated by the intermediate horizontal water-chamber F. Through the upper heat-chamber extend a series of water-pipes M connecting and establishing communication between the water-chambers C and D. Likewise, through the lower heat-chamber extend a series of water-pipes N connecting and establishing communication between the water-chambers E and G. Said water pipes consist preferably of thin copper tubes having an inside diameter of one-half inch. Each series of water-pipes comprises superimposed horizontal rows or tiers of pipes, the pipes of one row being preferably arranged in staggered relation to those of the adjacent row or rows, so as to more effectively receive the heat from the subjacent gas-burners O. There is a series of said gas-burners under each bank or series of water-pipes, and the burners are or may be respectively supplied by branch pipes Q from a gas supply pipe P. There is preferably provided for each burner, outside the heater, an air-shutter or air intake and regulating valve R to effect and regulate the necessary admixture of air and gas for the burners.

Both heat-chambers, K and L, are provided with suitable draft openings. The upper heat-chamber has preferably a central draft hole S extending through the top water-chamber B. The lower heat-chamber has preferably two draft-holes T and U at its opposite ends, extending through the water-chamber F.

The structural form of the body of the heater to provide the several chambers aforesaid is or may be as shown; that is the body of the heater comprises a skeleton-like shell having side walls 1, in which openings 2 are or may be left in the sides of the heat-chamber K, and having spaced inner and outer top walls 3 and 4 and spaced inner and outer end walls 5 and 6; the outer end walls 6 being open or skeleton-like as shown in Fig. 2 and having end plates 7 affixed thereon. The inner and outer walls 5 and 6 are connected by bottom webs 8 and by webs 9 between the several water-compartments, those between the chambers B C and D E being provided with openings 10 for the passage of water. There is also a connecting web 11 between the walls 3 and 4 around the top draft-hole S. The side walls 1 are connected by horizontal partitions 12 to provide the intermediate water-chamber F, which partitions are connected by the webs 13 around the draft-holes T and U; and the two branches of the water-chamber F at either side of the draft-hole T are in communication with the water-chamber D

through openings 14 provided in the inner end wall 5. At the ends of the heater, the side walls 1 and inner end walls 5 are extended down to provide angle shaped legs 15 as shown.

While I claim the structural improvement embodied in the body of the heater, I do not limit my invention thereto, and the body may be modified in construction; for instance it may be constructed substantially as an inner and outer shell having connecting webs.

Assuming that the several water-chambers and pipes are filled and the burners lighted, the operation is as follows: Cold water from the supply pipe enters at H into the receiving chamber B where the chill is taken off and the water is partially heated by radiation from the upper series of burners O. The water flows into the chamber C, which I term a distributing chamber, and thence through the series of pipes M wherein it is subjected to a primary heating by the subjacent series of burners. The water then flows into the chamber D, which I term a mixing chamber, in which the quantities of water coming from the several tubes, that have been subjected to different degrees of heat, are brought to a common temperature. The water-chamber D being in communication with the water-chamber F, a certain circulation of water through the latter chamber, from and back to the chamber D, may also take place, subjecting the water to the heat rising from the lower series of burners; but the water-chamber F serves principally as a water storage chamber partitioning the upper from the lower heat compartment, thereby obviating the danger of explosion by protecting the upper gas burners from the heat of the lower burners, as the heat from the latter not expended upon the water-tubes N will be largely taken up by the said water storage chamber F. The protection of the upper burners is also promoted by the provision of the openings 2 in the sides of the heater shell. From the mixing chamber D the water flows into the distributing chamber E which again distributes it into the second series of water-pipes N, flowing through which the water is subjected to a second or final heating, and finally flows into the hot water chamber G. By distributing the volume of water flowing through the heater into a multitude of small tubes, there is stored in the heater a large quantity of water, greatly facilitating the desired end of instantaneous heating with a comparatively low consumption of fuel; and the heating surface for the water coming from the inlet is increased in proportion to the number of tubes into which it is distributed; and by running the water through the second series of tubes and over a second series of burners, the water is superheated or subjected to an additional heating in its passage through the many tubes; furthermore, the burner chambers being surrounded by the water chambers, a very large heating surface is exposed and the heat from radiation is effectively used; thus securing a maximum utilization of the heat units developed from the fuel.

The hot water outlet is preferably smaller than the cold water inlet, which results in keeping the apparatus always filled and under full pressure, and storing in the system a certain quantity of what may be called dead water, greatly aiding the desired result of instantaneous heating. Thus if a one-inch pipe supplies the cold water, the hot water may be conducted off through a $\frac{3}{4}''$ pipe; and the water supplied from the $1''$ pipe being distributed into a multiple of $\frac{1}{2}''$ tubes, the smaller tubes by their multiple of diameter as compared with the outlet pipe will have at all times a storage of water, that is the water will flow at a very slow rate through the individual tubes, resulting in a great saving of gas; and the quantities of water flowing through the small tubes, being heated to different temperatures by reason of their various distances from the flames, will be commingled in the mixing chamber D, and again in the hot water chamber G, and brought to a common temperature. The cold water inflow being greater than the hot water outflow results in the water being supplied to the cold water chamber B with an extra pressure, which keeps the tubes and various water-chambers under full pressure; so that the apparatus can be successfully used in connection with a water-supply system in which the water is or may be supplied under various pressures.

As the apparatus is susceptible of various changes in details of construction and arrangement of parts, without departing from my invention, I do not desire to be understood as restricting myself to the particular construction herein shown and described.

The water-chamber F might be made to communicate with the chamber G, and the chambers D E made non-communicating, and the chamber E provided with the hot water outlet, so as to cause the whole body of water to flow through the chamber F before flowing through the lower series of water tubes N.

I claim as my invention and desire to secure by Letters Patent:

1. A water-heater having a plurality of water-chambers and heat-chambers one above another inclosed thereby, one of said water-chambers forming a partition between said heat-chambers, a series of water-tubes extending through each heat-chamber and connecting the water-chambers at the opposite ends thereof, and a series of gas-burners under each series of water-tubes; one water-

chamber having a cold water inlet and another having a hot water outlet; and the several water-chambers having communication for circulating the water from said inlet successively through the water-chambers to said outlet, communication between water-chambers at the opposite ends of the heat-chambers being established by the series of water-tubes aforesaid.

2. A water-heater comprising a chambered body having heat-chambers inclosed thereby, said body having separate water-chambers, including one provided with a cold water inlet and one provided with a hot water outlet, and also having a water-chamber partitioning said heat-chambers, a series of water tubes extending through each heat-chamber and connecting separate water-chambers, and burners under each series of tubes, said water-chambers being connected for communication in series, such communication between the water chambers at opposite ends of the heat-chambers being established by the respective series of water-tubes aforesaid.

3. A water-heater comprising a body having two adjacent water-chambers at each end, and having intermediate heat-chambers and a water-chamber partitioning them and in communication with some of the other water-chambers, burners in each heat-chamber, one of the end water-chambers receiving water from a cold water supply and one discharging hot water, two of the end water-chambers being non-communicating and two having direct communication, and a series of water tubes in each heat-chamber, each series connecting one of the non-communicating water-chambers with one of the communicating water-chambers.

4. A water-heater comprising a chambered body having heat-chambers, one above another, inclosed thereby, a part of said chambered body extending between and providing a water-chamber partitioning said heat-chambers, a series of water-tubes extending through each heat-chamber and connecting water-chambers of the body, and burners under each series of water-tubes, there being a central draft-hole in the upper part of the chambered body, and draft-holes through the end portions of the water-chamber partitioning said heat-chambers, and the upper heat-chamber having lateral openings in its side walls, below the upper series of burners.

5. A water-heater comprising a chambered body having superposed heat-chambers inclosed thereby, said chambered body providing a cold water inlet chamber over the upper heat-chamber, non-communicating water-chambers at one end of the heat chambers the upper one of which communicates with the top water-chamber, communicating water-chambers at the opposite end of the heat chambers neither of which communicates with the top water-chamber, a series of water-tubes extending through each heat-chamber, each series connecting one of the non-communicating water-chambers with one of the communicating water chambers, and burners under each series of water-tubes.

6. A water-heater comprising a body having chambered ends and top, and non-chambered sides, the chambered ends being partitioned to provide a plurality of vertically disposed water-chambers, the chambers at one end being communicating, and the chambers at the other end being non-communicating, the upper one of the latter chambers communicating with the top water-chamber, a plurality of series of water-tubes, each series connecting one of the communicating chambers with one of the non-communicating chambers, a water inlet and a water outlet, one of which communicates with the top water chamber and the other communicates with the remote non-communicating water-chamber, and a series of burners under each series of water tubes.

7. A water-heater comprising a chambered body having a heat space inclosed thereby, said body providing a top cold water chamber and a plurality of water-chambers at each end, said top water-chamber having a cold water inlet and one of the lower end water-chambers having a hot water outlet, a plurality of series of water-tubes extending through said heat-space, each series connecting separate end water-chambers, and burners under said water-tubes, all the water-chambers being connected for communication and circulation of the water therethrough in series, such communication between the opposite end water-chambers being established by the respective series of water-tubes aforesaid.

In testimony whereof I affix my signature, in presence of two witnesses.

GEORGE E. STARN.

Witnesses:

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WM. G. TAYLORS.