Feb. 19, 1935. O. JOHNSON 1,991,557

WATER HEATER

Filed Feb. 6, 1933

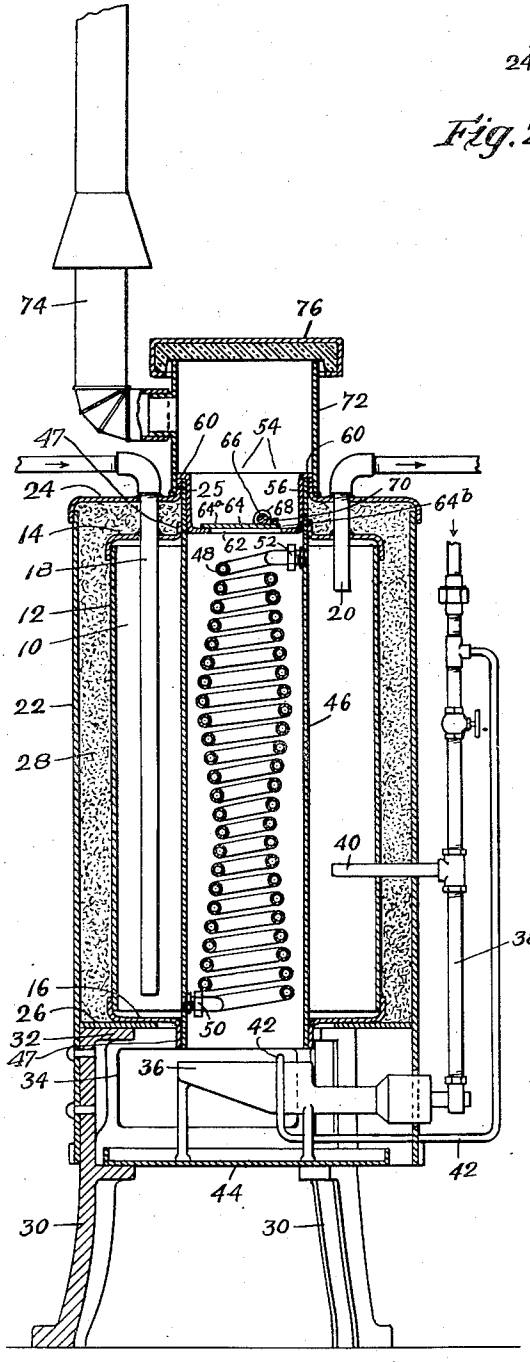



Fig. 1.

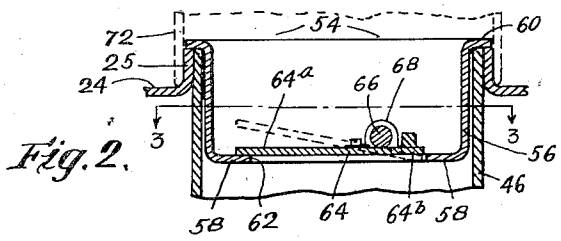



Fig. 2.

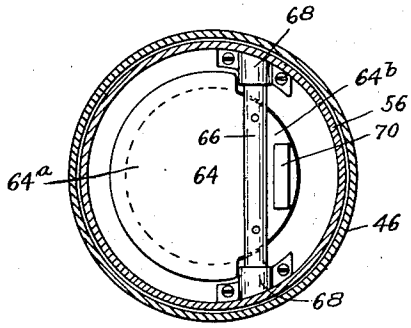



Fig. 3.

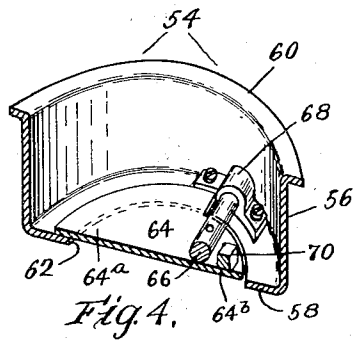



Fig. 4.

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# UNITED STATES PATENT OFFICE

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## WATER HEATER

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7 Claims. (Cl. 122—14)

This invention relates to water heaters of the type wherein the water is heated in a water coil by a gas or other flame, usually thermostatically controlled and the heated water is stored in an insulated storage tank.

An object of the present invention is to improve the efficiency of water heaters of this type by locating the water coil in a heat-conducting tube that is disposed within the tank and in intimate heat-transferring relation with the heating flame and with the stored water so that the flame not only heats the water in the water coil but also directly heats the water in the tank whereby considerably more heat can be abstracted from the flame than with the usual heater, having an external water coil.

A further object of the present invention is in the provision of a flame-controlled damper in the top of the coil-containing tube and so arranged that when the flame is out, it substantially closes the outlet of the tube and thus prevents the cooling of the tube and the water by cool air that would otherwise flow up the tube by natural draft, the damper also being so arranged that it automatically opens in response to the buoyancy of the heated gas under it in the tube, when the flame is burning and so provides an exhaust opening for the gases. The damper is arranged, however, to throttle the hot gases so that they have time to give up most of their heat to the tube and the water coil before escaping from the tube.

A further object is generally to improve the construction and performance of water heaters.

Fig. 1 is a sectional elevation through a water heater embodying the present invention.

Fig. 2 is an enlarged sectional elevation of the automatic damper of Fig. 1.

Fig. 3 is a section taken along line 3—3 of Fig. 2.

Fig. 4 is a perspective sectional detail of the damper of the previous figures.

As herein illustrated, the water heater embodying the present invention comprises a vertical water storage tank 10 having a cylindrical shell 12, a top head 14, and a bottom head 16. Cold water enters through a pipe 18 and hot water is withdrawn through a pipe 20. The water in the tank is usually under the pressure of the water system to which the inlet pipe 18 is connected. The tank is enclosed within a suitable heat-insulating casing comprising a vertical cylindrical shell 22, an upper head 24, and a lower supporting plate or washer 26 upon which the tank 10 is supported. The space between the heat insulating casing and the tank contains a suitable heat-insulating medium 28. The outer shell 22 extends below the washer 26 and is secured to suitable supporting legs 30 which have shelves 32 at their upper ends upon which said washer is supported. The lower portion of the shell, below said washer, is provided with a door 34 by which access may be had to a burner 36, here shown as a gas burner, located under the bottom head of the water tank and supplied by gas by a pipe 38, the flow of gas through which is automatically controlled by a thermoresponsive device 40 immersed in the water in the lower part of the storage tank. A gas pilot 42, continuously burning, serves to ignite the gas at the burner when the gas is turned on by the operation of the thermoresponsive device in response to a lower water temperature. A drip plate 44 is located under the burner and serves to catch any condensate that may form as a result of the burning gas. Said plate is peripherally spaced from the outer shell 22 so as to provide sufficient air for the combustion of the gas.

In accordance with this invention the water tank 10 is provided with a relatively large diameter metal tube 46 that extends axially through the tank and the upper and lower heads 14 and 16 thereof and is secured in a pressure-tight manner therewith, the heads having axially-extended necks 47 which closely surround and engage said tube and are riveted, welded or otherwise connected therewith. The upper end of the tube extends through and is terminated at the top of a neck 25 of the top head 24 of the insulating casing. The burner 36 is disposed immediately under the lower open end of said tube so that the flame issuing therefrom is caused to pass upwardly within the tube. The diameter of the tube preferably is about four-tenths or five-tenths of that of the water tank or the shell 12 thereof and so has a large area of surface in contact with the water in the tank. The tube is of suitable thickness to resist the pressure in the tank. The water in the tank is in intimate contact and heat-exchanging relation with the outer surface of the tube. A water coil 48, consisting of a long length of pipe or tube, wound in a succession of axially closely-spaced convolutions of different diameters in double hour-glass configuration is disposed axially within said tube and extends practically the full length of the tank and is spaced closely from the inner wall of the tube. The lower end 50 of the coil is fixed to the lower part of the tube and is open therethrough to the

bottom part of the water space in the tank and the upper end 52 of the coil is similarly connected to the upper part of the tube and is open to the top part of the water space in the tank. The flame from the burner 36 passes upwardly through the tube 46 and around and through the coil 48 and between the convolutions thereof and so directly heats the water in the coil and also in the tank.

With this arrangement the gas is in intimate contact on all sides with water heating surfaces so that efficient heating of the water is obtained and the large surface area of the tube greatly increases the total heat-transmitting area. The tube 46 causes the water in the tank to be heated directly and the water in the tank is caused to circulate between the top and bottom thereof and thereby to break up the stratification between the hot and cold bodies of water caused by the coil 48. Hence, practically all of the water in the tank is at the same temperature and thus the present tank can hold a greater quantity of hot water, before the thermoresponsive device 40 shuts off the flame, than if the water was heated by an external water coil.

The efficiency of the heater is further enhanced by a flame-controlled damper which, while providing a free gas passage through the tube 46 when needed, normally operates to place the heated gases in the tube under some pressure and to hold the gases in contact with the tube and the water coil long enough for the gases to give up almost all of their available heat to the water. Said damper includes a damper support in the form of a cup 54 having a cylindrical side wall 56, a horizontal bottom wall 58 which has a diameter about equal to that of the tube 46, and an oustanding flange 60 at its upper end. The cup is located in the upper end of the tube 46 and supported removably therein by the flange 60 which is seated upon the upper end of the tube, the depth of the cup preferably being such that the bottom wall is disposed about in the plane of the top head 14 of the water tank. The cup thus forms a closure for the top of the tube. The bottom wall 58 of the cup has a circular opening 62 therein of relatively large diameter through which the gas from the burner 36 is adapted to flow. The flow of gas through said opening is controlled by a damper comprising a generally circular plate or disc 64 which is secured to the underside of a shaft 66 pivoted at its ends in bearings 68 carried by the bottom wall of the cup. The shaft is offset from the diametrical line of the disc, say about halfway between the center and the edge thereof so that the disc is provided with two sections of unequal area the portion 64*a* being large and the portion 64*b* being small in area and the portion 64*a* overbalancing the weight of the portion 64*b*. The portion 64*a* overlies the opening 62 and seats upon the wall 58 and the portion 64*b* is of such reduced diameter that it can swing through said opening 62 when the disc pivots about its shaft bearings 68. A counterbalancing mass 70 is carried by the part 64*b* and has such weight as almost to balance the excess weight of the part 64*a* of the damper, say within half an ounce. Hence the damper is normally closed and the only passage for gas is through the clearance space between the part 64*b* of the damper and the side wall of the opening 64, which is sufficient to ventilate the tube of the gases of the pilot 42. When the burner 36 is in operation, however, the pressure or buoyancy of the heated gases on the damper causes the damper to tilt upwardly as indicated by the dotted lines, Fig. 2, and thereby uncover the opening 64 and permit the gases to escape. The amount of opening of the damper is such that the heated gases are under some pressure in the tube 46 and the flow of the gases through the tube is not rapid and hence the gases are given good opportunity to impart their available heat to the water in the coil 48 and in contact with the tube 46. The damper can open widely to relieve any pressure developed in the tube as a result of an explosive combustion of the gaseous mixture in the tube. When the burner 36 is shut off and the flame goes out, the damper closes and prevents the natural draft from passing a current of cool air through the tube and cooling off the heated water. The closed damper also keeps in the warm combustion gases from the continuously burning pilot; and it has been found that the pilot flame though small, with the closed damper, assists materially in keeping the water hot.

An open-ended cylindrical shell 72 is seated upon the top head 24 of the insulating casing, around the open end of the tube 46, and has a lateral connection with a chimney pipe 74 through which the products of combustion are exhausted. The open top of the shell is closed by a heat-insulated cover 76 which is removable and, when it and the damper cup are removed, provides free access to the interior of the tube 46 and to the water coil 48 for cleaning purposes.

Tests on a heater constructed as above described have indicated a high efficiency; and the hand can be held upon the exhaust pipe 74 without discomfort when the burner is in operation, thereby indicating that most of the available heat in the burning gases is imparted to the water in the tank.

I claim:

1. A water heater comprising a water storage tank having a metal tube extended therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, and a damper removably located in the upper end of said tube having means normally biasing it toward a closed position and means responsive to the presence of a heated gas in said tube for opening it, a removable support for said damper, and means providing a locating seat between said support and said tube by which the position of said damper within said tube is determined.

2. A water heater comprising a water storage tank having a vertical metal tube extending therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a removable plate located in and extended horizontally across the upper end of said tube and having an opening therethrough, a damper eccentrically pivoted on said plate and overlying and normally closing said opening and arranged to pivot and uncover said opening in response to the presence of a heated gas in said tube, said plate and tube having cooperating members providing a seat which support said plate removably

within said tube and defines the location of said damper.

3. A water heater comprising a water storage tank having a metal tube extended therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a plate located within the upper end of said tube and extended thereacross, means extended longitudinally of said tube and removably seated upon the top end thereof for supporting said plate removably in said tube, said plate having an opening therethrough, and a damper pivotally connected with said plate and normally overlying said opening and seated on said plate, said damper being eccentrically pivoted and having the parts on opposite sides of its pivotal axis so relatively weighted that said damper can pivot to an open position in response to the presence of a heated gas in said tube.

4. A water heater comprising a water storage tank having a metal tube extended therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a damper cup located removably within the open upper end of said tube and having a cylindrical side wall, a bottom wall provided with an opening therethrough and an outstanding flange at the top of said side wall which overlies and is seated removably upon the top of said tube, and a damper plate eccentrically pivoted on said bottom wall and normally seated thereon and overlying said opening, said plate having unequal areas on opposite sides of its pivotal axis and being so weighted on opposite sides of its axis that it can swing to an open position in response to the presence of a heated gas in said tube.

5. A water heater comprising a water storage tank having a metal tube extended therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a damper cup located removably within the open upper end of said tube and having a cylindrical side wall, a bottom wall provided with an opening therethrough and an outstanding flange at the top of said side wall which overlies and is seated removably upon the top of said tube, and a damper plate eccentrically pivoted on said bottom wall and normally seated thereon and overlying said opening, said plate having unequal areas on opposite sides of its pivotal axis and being so weighted on opposite sides of its axis that it can swing to an open position in response to the presence of a heated gas in said tube, an open-ended cylindrical shell surrounding and extended above the top of said tube and having a lateral gas outlet, and a removable cover on the open top of said shell, said damper cup being removable through the open top of said shell.

6. A water heater comprising a water storage tank having a metal tube extended therethorugh in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a damper plate located removably within the top of said tube and having an opening therethrough, a damper pivoted on said plate and normally overlying and closing said opening and having parts of unequal area on opposite sides of its pivotal axis and being so weighted on opposite sides of its axis that it can open in response to the presence of a heated gas in said tube, an open ended shell surrounding and upstanding above the open top of said tube and having a lateral gas outlet, and a removable cover on the open top of said shell, said damper plate and said damper thereon being removable through the uncovered open top of said shell.

7. A water heater comprising a water storage tank having a metal tube extended therethrough in free contact with the water in the tank, a pipe coil in said tube having its ends in communication with the top and bottom parts of the water space in the tank, a burner in communication with the bottom end of said tube, a heat-insulating casing enclosing said tank, the top of said tube being extended through the top of said casing, an open-ended shell surrounding and upstanding above the top of said tube and carried by said casing and having a lateral gas outlet, a removable cover on the open top of said shell, a damper support located within the open top end of said tube and under said cover, and a damper pivoted to said support and arranged to open automatically when said burner is in operation, said damper support being removably located within said tube and being smaller than the open top of said shell so that it can be withdrawn therethrough when said cover is off.

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