ABSTRACT: A water heater comprising a tank, a generally cylindrical burner can positioned in the tank with its long axis extending in an upward direction, water inlet means at the upper portion of the burner can for flowing water from the tank into the burner can, gas injection means communicating with the upper portion of the burner can for introducing a combustion fluid and air mixture to the burner can, and fluid extraction means communicating with the lower portion of the burner can for evacuating gases and water from the burner can. The gases and water extracted from the burner can are injected back into the water of the tank, and the gases bubble up through the water.
SUBMERSIBLE WATER HEATER

BACKGROUND OF THE INVENTION

When heating water and other liquids for commercial use, it is desirable to have a heating system which will raise the temperature of the water supply at a rapid rate to the desired temperature level and to supply the heated water in large volumes and at varying flow rates to its point of use. The varying flow rate of the heated water usually requires that a large volume of the water be heated and stored to compensate for peak flow periods, while the rapid heating of the water would normally require that only a small volume of water be heated. While some commercial systems have been developed which do not require the storage of the large volume of water to provide the continuous flow of hot water at varying rates, these systems have proven to be inefficient in that large heat losses occur, especially during the time when only a low volume of water is drawn from the system.

SUMMARY OF THE INVENTION

Briefly described, the present invention comprises a water heater which functions at a high level of efficiency to rapidly heat varying amounts of water or other liquids. The water heater comprises a storage tank, a burner can submerged in the storage tank, an injection system for providing a combustible mixture of gas and air to the burner can, an annular opening extending around the burner can to admit water from the tank to the inside of the burner can, and a pump communicating with the lower portion of the burner can for extracting the heated water and the gases of combustion from the burner can and injecting these fluids back into the tank below the normal water level. The arrangement is such that the water flowing into the burner can directly contacts the flame and is rapidly heated. When the fluids extracted from the burner can are injected back into the water in the tank, the heat from the gases will dissipate in the body of water, so that this heat will not be lost to the atmosphere.

Thus, it is an object of this invention to provide a water heater for rapidly and efficiently heating large volumes of water, or other liquids.

Another object of this invention is to provide a commercial water heater which is economical to manufacture and operate.

Another object of this invention is to provide a submerged flame water heater which makes maximum advantage of the heat emitted from the flame.

Other objects, features and advantages of the present invention will become apparent upon reading the following specification, when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

The sale FIGURE is a schematic side elevational view of the water heater.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in more detail to the drawing, water heater 10 comprises tank 11, water inlet conduit 12 and control valve 13. Water inlet conduit 12 enters tank 11 above the normal water line 14 and then extends in a downward direction toward the bottom of the tank. Control valve 13 is a conventional float control valve. Water under pressure communicates with water inlet conduit 12, and when the level 14 of the water in tank 11 recedes, control valve 13 opens water inlet conduit 12 to resupply tank 11. Water delivery conduit 15 is positioned on the opposite side of tank 11 at a level below the normal water level 14.

Burner can 16 is positioned within tank 11 and comprises movable upper portion 18 and stationary lower portion 19. Burner can 16 is generally of cylindrical configuration, and its lower portion tapers to an outlet opening 20 which communicates with conduit 21. The upper edge 22 of the burner portion 18 of burner can 16 mates with the lower edge 25 of the upper portion 18 of the burner can, and internal annular sleeve 25 is connected to the internal surface of upper portion 18 of burner can 16 and extends down into telescoping relationship into lower portion 19. Electric motor 26, or an equivalent mechanical device, is supported on the top surface of tank 11 and functions to rotate positioning screw 28. Positioning screw 28 is threaded and extends through the upper portion 18 of burner can 16 in such a manner that when it is rotated it functions to lift or depress upper portion 18 of burner can 16 away from or toward the lower portion 19. Thus, lower edge 23 of upper portion 18 of burner can 16 will form a variable opening annular aperture 30 external to internal annular sleeve 25. Annular aperture 30 and internal annular sleeve 25 function as a weir to admit the water from tank 11 to the lower portion 19 of burner can 16.

Gas injection conduit 31 is generally L-shaped with its horizontal leg 32 projecting through the side of upper portion 18 of burner can 16 and with its vertical leg 33 extending down from upper portion 18 toward the burner can 16 in the vicinity of the weir formed by annular aperture 30 and internal annular sleeve 25. A flexible extension 36 is present in the horizontal leg 32 of conduit 31 to compensate for the vertical movement of upper portion 18 of burner can 16. Gas line 38 is controlled by solenoid 39 and communicates with conduit 31.

Air compressor 40 also communicates with conduit 31 and functions to provide a combustible mixture of gas and air to conduit 31. Nozzle 35 is connected to the internal surface of burner can 16 and functions to disperse the combustible mixture within the inner portion 19 of burner can 16. Spark 41 is positioned adjacent nozzle 35 and functions to ignite the combustible mixture emitted from nozzle 35. Photoelectric eye 42 is positioned in upper portion 18 of burner can 16 to determine the presence or absence of the flame emitted from nozzle 35.

Pump 44 is located externally of tank 11, and the inlet of the pump communicates with conduit 21. The outlet of pump 44 communicates through conduit 45 with tank 11 at a low level within the tank. Pump 44 is of a type suitable for pumping both liquids and gases simultaneously, and has a capacity sufficient to extract the fluids from burner can 16 at a rate faster than the flow of water and the gas mixture into the burner can, so that a pressure below atmospheric pressure is normally maintained within the burner can. Conduit 45 extending from pump 44 back into tank 11 terminates in nozzle 46 so that the fluids flowing back into the water of the tank are finely dispersed, and the gases will be broken up into relatively small bubbles 48. When the gases rise to water level 14, they are allowed to pass through vent 49 to the atmosphere to maintain tank 11 under pressure so that water delivery conduit 15 does not require a pump to pressurize the delivery system, vent 49 includes a conventional pressure bleed valve 50 which opens only after the pressure in tank 11 exceeds a predetermined value, a pressure only slightly below the line pressure from water inlet conduit 12. As an alternate arrangement, a pump connected to conduit 15 will allow the system to be operated at atmospheric pressure, and bleed valve 50 can be eliminated.

OPERATION

An electric circuit (not shown) is provided to energize the electrical components of the system. When water heater 10 is placed in operation, pump 44 is energized to evacuate burner can 16. After a predetermined time delay, motor 26 is energized to open annular aperture 30 and position conduit 15 to the lower portions 18 and 19 of the burner can 16, to create the curtain of water in burner can 16. Solenoid 39 and pump 40 are energized simultaneously with motor 26 to provide a combustible mixture of gas to burner can 16, and spark 41 is energized to ignite the combustible mixture. The flame created within burner can 16 directly contacts the curtain of water flowing down the internal surfaces of burner can 16, and rapidly heats the water. A portion of the water will flash into
steam, and the steam, gases and water flows toward the bottom of burner can 16 where it reaches outlet opening 20 and flows through conduit 21 to pump 44. Pump 44 urges the heated water and gases from burner can 16 back into the lower portion of tank 11 through nozzle 46. The gas is dispersed in small bubbles 48 which eventually flow to water level 14, and through vent 49. When the gas is dispersed through nozzle 46 into the water of tank 11, the heat from the gas is further transferred to the water, so that by the time the gas reaches the water level 14 it is at substantially the same temperature as the surrounding water. Furthermore, some of the fluid emitted through nozzle 46 will be steam, and by the time this fluid reaches the surface of the water, the steam will have condensed.

When the water in tank 11 has been heated to the desirable level, thermostat 51 functions to terminate the operation of the water heater, by deenergizing pump 44, closing gas line 38, deenergizing compressor 40, and operates motor 26 until it closes annular aperture 30 between upper and lower portions 18 and 19 of burner can 16. As the water is dissipated from tank 11 through water delivery conduit 15, make up water enters through water inlet conduit 12 by control valve 13 opening this conduit. Of course, the water entering tank 11 is cool and lowers the temperature within tank 11, which eventually causes thermostat 51 to reenergize the system.

The opening of annular aperture 30 is controlled by limit switch 52, which allows motor 26 to operate for a time period sufficient to open annular aperture 30 to the extent necessary for creating the desired volume of water flow through burner can 16. The opening of annular aperture 30 can be adjusted by adjusting limit switch 52. When the opening is adjusted to create a smaller volume of water flow through the burner can, the burner can becomes hotter and a large amount of steam is generated in the burner can. This causes the water passing through the system to heat at a faster rate but the efficiency of the system is reduced by a greater heat loss through more and hotter gas passing through vent 49.

While motor 26 and limit switch 52 have been disclosed as controlling the opening of annular aperture 30, annular aperture 30 can remain open when water heater 10 is not in operation, if desired, which allows motor 26 and limit switch 52 to be eliminated from the structure. With this arrangement, when the system is energized by thermostat 51, pump 44 will be energized for a time period sufficient to evacuate burner can 16 prior to the opening of gas line 38 and the initial operation of compressor 40. The time delay in this arrangement is not significant.

Bleeder valve 50 of vent 49 functions to maintain the pressure in tank 11 to a pressure only slightly below the line pressure of water inlet conduit 12, so that no booster pump is required in water delivery conduit 15. With this arrangement a check valve (not shown) is utilized with outlet conduit 15 to positively pump the water from tank 11, the tank will not be pressurized and valve 50 and the check valve of conduit 31 can be eliminated from the system.

While pump 44 has been disclosed as the type suitable for simultaneously pumping both gas and liquid, two pumps can be utilized if desired, one for pumping the water and the other for pumping the gas.

While this invention has been described in detail with particular reference to preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinbefore and as defined in the appended claims.

1. A water heater or the like comprising a water tank, means for maintaining water in said water tank up to a normal water level, an elongated burner can member positioned in an upright attitude within said tank with a major portion of said burner can member located below the normal water level of said water tank, liquid inlet means defined in said burner can member at a level below the normal water level of said water tank for flowing liquid from said water tank in a downward direction through said burner can member, injection means communicating with said burner can member for introducing a combustion fluid and air mixture to said burner can member, and fluid extraction means communicating with the lower portion of said burner can member for flowing fluids from said burner can member to said water tank at at a level below the normal water level of said water tank.

2. The invention of claim 1 wherein said fluid extraction means comprises means for pumping both liquid and gas from said burner can member.

3. The invention of claim 1 wherein said liquid inlet means comprises a weir constructed to flow liquid over substantially all of the portion of the inside surface of said burner can member located below said weir.

4. The invention of claim 1 wherein said burner can is generally of cylindrical configuration with its long axis extending vertically, and with the liquid inlet means comprising an annular opening defined about said burner can member.

5. The invention of claim 1 wherein said liquid inlet means comprises at least one aperture in said burner can member and means for varying the opening of said aperture.

6. The invention of claim 1 wherein said burner can member is positioned on one side of said tank, said fluid extraction means comprises a conduit extending from said burner can through the other side of said tank, and pump means positioned outside said tank having its inlet communicating with said conduit and its outlet communicating with said tank.

7. A water heater or the like comprising a tank, a burner can member positioned in said tank on one side of said tank, liquid inlet means at the upper portion of said burner can member for flowing liquid from said tank into said burner can member, injection means communicating with said burner can member for introducing a combustion fluid and air mixture to said burner can member, and fluid extraction means comprising a conduit communicating at one of its ends with the lower portion of said burner can member and extending from said burner can member through the other side of said tank, and pump means positioned outside said tank and having its inlet communicating with said conduit and its outlet communicating with said tank.
CERTIFICATE OF CORRECTION

Patent No. 3,568,658 Dated March 9, 1971
Inventor(s) James Donald Brock

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Claim 7 delete the redundant portion of the claim by deleting in line numbered 56 "conduit and its outlet connecting with".

Signed and sealed this 15th day of June 1971.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR. WILLIAM E. SCHUYLER, J.
Attesting Officer Commissioner of Patent