Oct. 19, 1937. H. J. LONG 2,096,697

WATER HEATER

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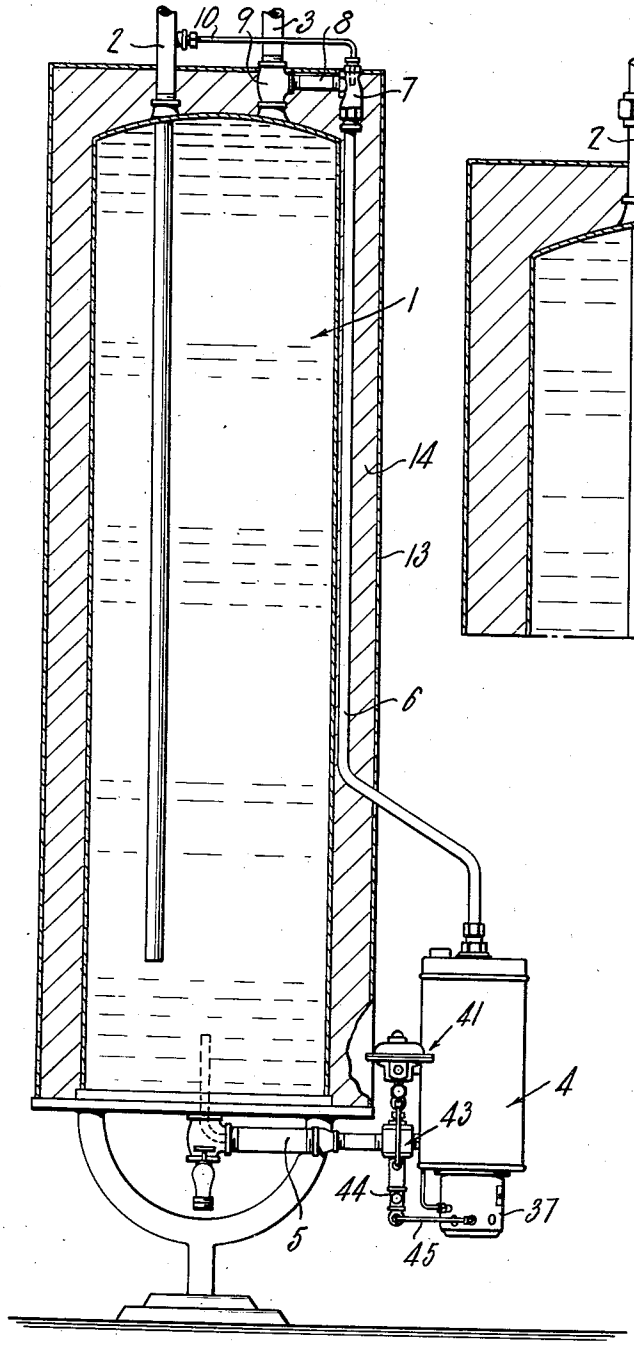
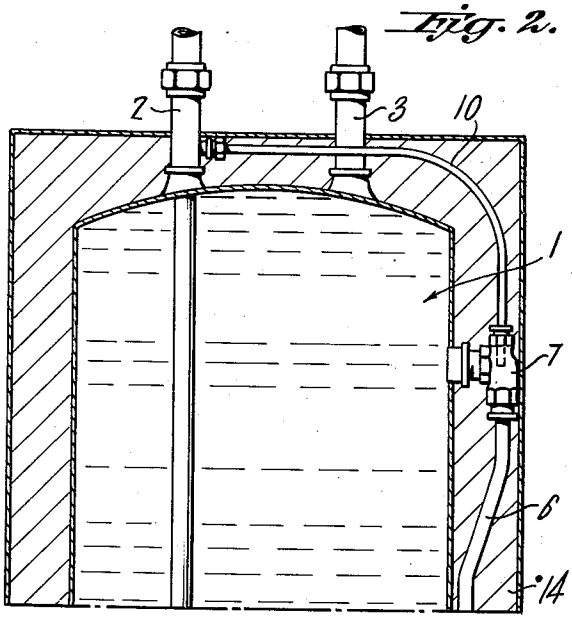


Fig. 1.

Fig. 2.



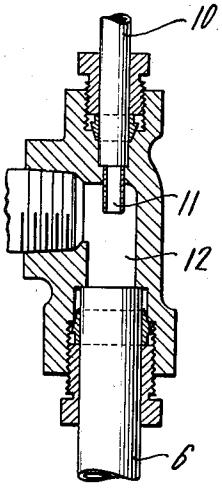


Fig. 3.

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Fig. 4.

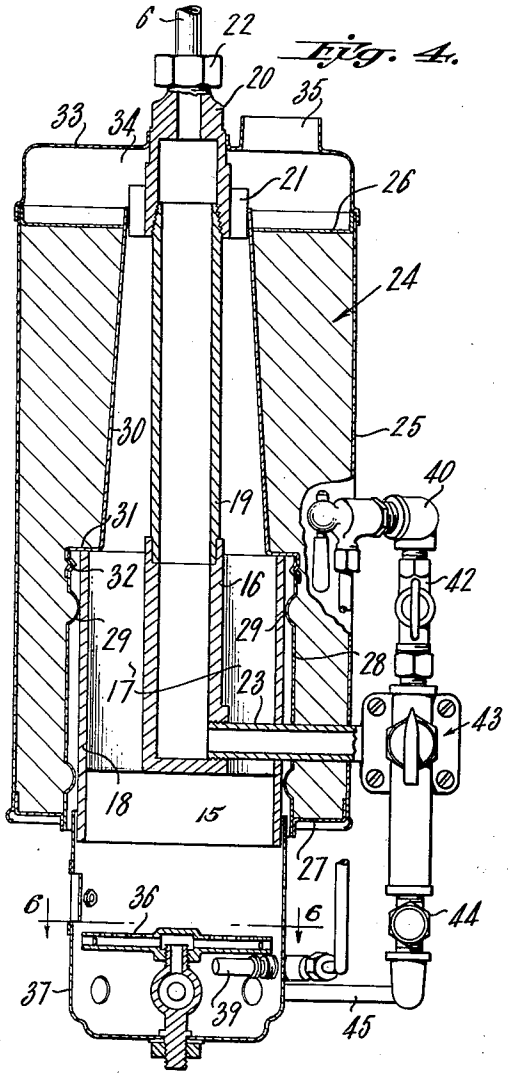
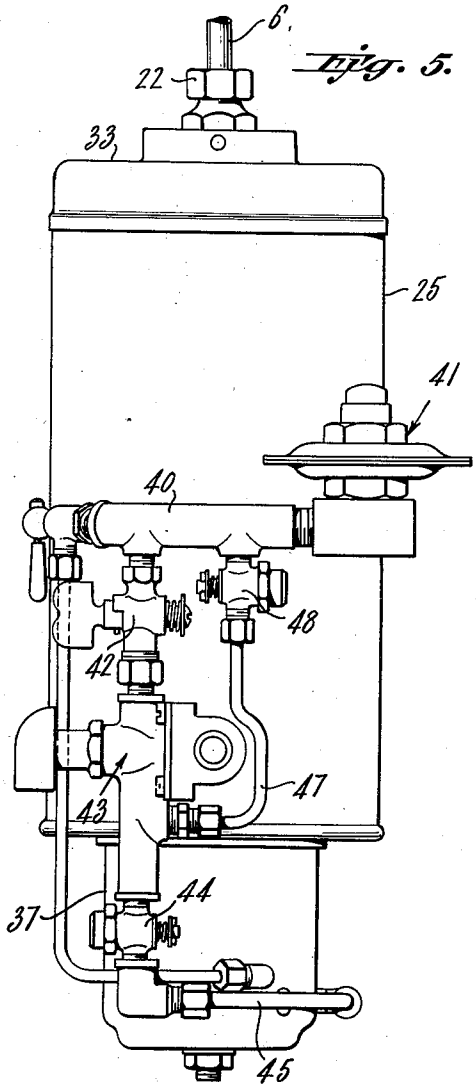


Fig. 5.



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Fig. 6.

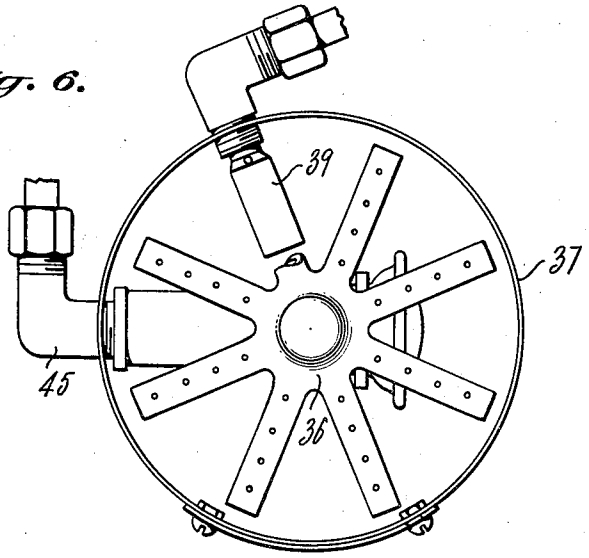
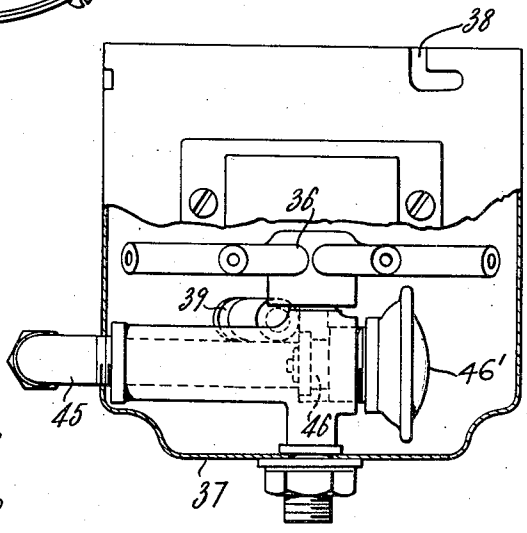


Fig. 7.



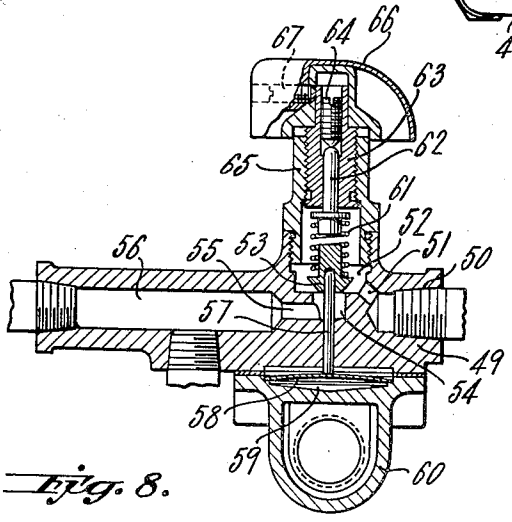


Fig. 8.

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WATER HEATER

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Application June 27, 1936, Serial No. 87,703

3 Claims. (Cl. 126—362)

This invention relates to water heaters of the type having a storage tank and a heating unit separate therefrom for heating the contents thereof.

In water heaters of this type as heretofore constructed, the heating unit, usually consisting of a coil, is liable to become clogged due to sediment or scale collecting therein. This is particularly true where the heating unit is designed for relatively low capacity since the tube forming the heating element is of small diameter and therefore more likely to become clogged.

It has heretofore been proposed to overcome this defect by providing for a reverse flow of water through the heating unit during the period when hot water is being drawn from the tank, and to this end an automatic valve has been interposed in the connections between the tank and the heater, which valve in response to the opening of the hot water tap automatically reversed the flow through the heater. Such valves, however, if operated long in one position, are likely to stick in that position thus seriously interfering with the normal operation of the heater.

It is a primary object of the present invention to overcome the above mentioned defect and to this end a device is provided for the reversal of flow through the heater without the interpositioning of any valves or other movable members.

It is a further object of this invention to provide an improved control system for water heaters of the automatic storage type which will insure the full utilization of the entire storage capacity of the tank, but which will also insure against overheating.

A further object of the invention is to provide a structure which is easily constructed and assembled and is therefore of relatively low cost.

The above and other objects and details of the invention will be more fully apparent to those skilled in the art from a consideration of the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view, with parts shown in side elevation, of a hot water storage tank having circulation fittings disposed in accordance with this invention; Fig. 2 is a similar view taken through the upper portion of a storage tank and showing a modified arrangement of certain connections and fittings; Fig. 3 shows a detail on an enlarged scale of one of the fittings; Fig. 4 shows a longitudinal sectional view, with parts in side elevation, taken through a heating unit constructed in accordance with the invention; Fig. 5 shows a side elevation of the heating units shown in Fig. 4; Fig. 6 is a horizontal section taken on line 6—6 of Fig. 4, parts being removed for clearness; Fig. 7 is a side view of a detachable combustion chamber with a portion thereof removed to show the enclosed burner; and Fig. 8 is a longitudinal section through a thermostat assembly.

Referring to the drawings, reference numeral 1 indicates a storage tank having a cold water supply pipe 2 and a hot water discharge pipe 3. A heater 4 is connected at its lower end with the lower portion of the tank by way of pipe 5 while a pipe 6 leads from the upper end of the heater to a fitting 7 which is connected by a nipple 8 to one arm of a T 9, the other arms of which are connected to the discharge pipe 3 and the tank 1. A by-pass tube 10 extends between the cold water supply pipe 2 and the fitting 7. The tube 10 has an extension 11 which projects for a short distance into a passage 12 of fitting 7. It will be understood that it is not essential for the extension 11 to project into the passage 12 in all instances, and in some cases this member may be omitted.

In the form shown in Fig. 1 the heater is connected to the tank through the T 9 which also serves as a connection for the hot water outlet 3. The device is equally applicable to other arrangements of such connections. Fig. 2 shows the application of the device to a tank having separate openings for the hot water outlet and heater connections. The construction and operation of this form will be readily understood from the description of the form shown in Fig. 1.

Since the fitting 7 has no moving parts and is therefore unlikely to require servicing, it may be placed within the jacket 13 surrounding the tank and embedded in the heat insulating material 14 therein.

While it will be understood that the above described arrangement is desirable in connection with any side arm or conversion type heater it is particularly advantageous in conjunction with certain features of the heater herein disclosed for reasons which will be apparent from the following description.

Referring particularly to Figs. 4 and 5, the heater 4 includes a heating unit which consists of a casting 15 having a central tubular member 16 connected by fins 17 with an outer cylindrical portion 18. A tube 19 extends upwardly from the tubular member 16 and carries at its upper end a reduction joint 20. Studs 21 project radially from the lower portion of the reduction joint 20 providing a spacing means between said joint and

the heater casing. The reduction joint is connected to the pipe 6 by a nut 22 while the lower end of the heating unit is connected by way of a short tube 23 which passes through an opening in the cylindrical member 18 and is screw-threaded into an opening in the side wall of the central tube 16.

When the heating unit consisting of the casting 15, tube 19 and reduction joint 20 is assembled the unit so formed may be slipped easily into a separately formed jacket structure 24. The jacket structure is of thin sheet metal and includes an outer cylindrical casing 25, having annular end sheets 26 and 27 welded thereto and forming top and bottom plates. An inner cylindrical casing 28, of slightly larger diameter than the outer cylindrical portion 18 of the casting 15 and having inwardly projecting corrugations 29 thereon, is welded to and extends upwardly from the annular bottom sheet 27 for a distance which is equal to or slightly less than the length of cylindrical member 18. A frusto conical member 30 having its largest diameter slightly less than the internal diameter of cylindrical member 18 is provided with a base 31 which extends outwardly to the inner casing 28 and is crimped thereto at 32. Each of the parts 25 to 31 are of relatively light sheet metal and at each of the joints therebetween one of the members has a flange projecting therefrom in such a direction as to provide a surface parallel to the adjoining member to provide overlapping surfaces which may be easily crimped or stitch welded. A cover 33 fits snugly upon but is detachable from the upper end of the outer casing 25. The cover 33 is cup shaped to provide a chamber 34 therebelow. A central opening in the cover 33 permits the upper end of reduction joint 20 to project therethrough, and the cover is also provided with a discharge passage 35 spaced between said central opening and its outer rim.

A gas burner 36 is positioned below the heating unit in a cup 37 which encloses the lower end of cylindrical member 18. Bayonet slots 38 are provided in the upper rim of the cup 37 which slots coact with suitable studs on the outer surface of said cylindrical member to hold the cup in position while permitting it to be readily detached for servicing. A lighting torch 39 is disposed within the cup 37 below the burner 36 to facilitate the lighting of the burner.

It will be apparent from the above description that the heating unit, the jacket structure and the burner assembly may each be separately constructed and that their assembly may be easily effected by inserting the heating unit into the jacket structure where it will be rigidly held by the insertion of the tube 23 through an opening in the jacket structure and in member 18 and screwing it tightly in the opening provided therefor in the central member 16. The burner assembly may then be quickly attached to the member 18 by means of the bayonet slots 38 and the resulting heater is ready for connection to the gas fittings and to the tank. The ease with which these parts may be assembled and disassembled results in considerable savings in manufacture and in servicing.

Gas is supplied to the burner 36 and to the lighting torch 39 from a gas manifold 40, the flow to which is controlled by a pressure regulator 41. From the manifold 40 the gas flows by way of a stop cock 42, a thermostatic control device 43 (which will be hereinafter more particularly described), a flow cock 44, and a burner tube 45, to a safety cut-off valve 46 positioned immediately below the burner. The valve 46 is actuated by a conventional disk thermostat in housing 46' which is also positioned below the burner. This thermostat is therefore responsive to heat conducted downwardly from the burner to the housing 46' through the metallic path afforded by the connections therebetween. By this arrangement the thermostat is not exposed to high temperatures such as are present when the burner flame impinges directly upon some portion of the thermostat housing. The thermostat may be sensitive and will respond quickly should the flame at the burner become extinguished. This arrangement is also free from the vagaries attending the operation of thermostats having a thin conducting strip exposed to the burner flame which strip may become corroded or the exposed part of which may burn away. The thermostat housing is more exposed to the heat of the lighting torch 39 but this is not detrimental since the lighting torch is only in use for short periods at infrequent intervals. The thermostat will soon open the valve 46 after the lighting torch is operated, permitting fuel to flow to the burner 36 where it is ignited by the torch.

A pipe 47 is connected by way of flow cock 48 to manifold 40 and extends to the fuel line of the main burner at a point beyond the control valve of the control device 43. A by-pass is thus provided around this device to maintain a low pilot flame at the burner 36.

The thermostatic control device 43 which regulates the flow of fuel to the burner 36 in accordance with the temperature of the water comprises a casting 49 having at one end a short bore 50 which is internally threaded to receive a connection leading from gas cock 42. An angular bore 51 affords communication between the inner end of bore 50 and a valve chamber 52. A valve 53 in chamber 52 controls a passage formed by an enlarged portion of a bore 54 extending centrally from valve chamber 52. A longitudinal bore 56 in an extension of the casting 49 has a reduced portion 55 connecting with the passage formed by bore 54. A lateral opening provides for a connection between by-pass tube 47 and bore 56. A stem 57 which extends through the bore 54, making a sliding fit with the reduced portion of the latter, carries the valve 53 on one end thereof and its opposite end rests on a disk thermostat 58. This disk is clamped in a chamber 59 formed between casting 49 and a member 60 which forms a union between the lower tank connection 5 and tube 23. A spring 61 between the valve 53 and a plunger 62 urges the valve toward closed position. The plunger 62 has a sliding fit in sleeve 63 within which it is longitudinally adjustable by means of a screw 64. The sleeve 63 is externally threaded to coact with internal threads on an outer surrounding sleeve 65. A cap 66 fits on the upper, reduced end of sleeve 63 and is prevented from movement relative to the sleeve by means of a set screw 67. The arrangement of these parts is such that adjustments of the thermostat, such as those made while the heater is first tested or while it is being serviced, may be made by removing cap 66 and adjusting screw 64. Adjustments such as the user may desire to make in changing from warm to hot water are made by twisting the cap 66.

In operation, assuming that the burner has

been ignited and that no water is being drawn, cold water from the bottom of the tank passes by way of lower connection **5**, member **60** and tube **23**, to the heating unit. It is therein heated and rises through pipe **6**, fitting **7** and thence passes to the upper end of the tank either by way of the T **9** in the hot water discharge line, as shown in Fig. 1, or by a direct connection to the tank, as shown in Fig. 2. Heating continues until the water passing from the lower end of the tank to the heating unit is hot enough to heat the member **60**, as it passes therethrough, sufficiently to cause the disk thermostat **58** to flex outwardly permitting the valve **53** to close. The main supply of gas to the burner **36** is thus cut off but a low flame is maintained thereon due to the fuel supplied thereto by way of the by-pass **47**. This low pilot flame is sufficient to maintain the safety cut-off valve **46** open, this valve being closed only when the pilot flame is extinguished, in which event the entire gas supply to the burner is cut off. If hot water is drawn from the tank cold water flows through the supply pipe **2** to the tank and a portion thereof is by-passed through tube **10** to the fitting **7**. The momentum of this portion causes it to continue to flow in the direction in which it enters the passage **12** and thence downwardly through the connection **6**, the heating unit, and the member **60**. As it passes through this member it cools the same and the thermostat disk **58** flexes inwardly thereby opening valve **53** and thus supplying gas to the burner **36**. The downward flow of the cold water entering the fitting **7** at this time is somewhat facilitated by the fact that there is now a column of cold water in the connection **6** which is heavier than the balancing column of hot water in the tank. The weight of this cold column therefore aids in maintaining a flow through the heating unit in the reverse direction to the normal flow when no water is being drawn. This reversal of flow sweeps any sediment or other foreign matter which has collected at the base of the heating unit out through the tube **23** into the bottom of the tank from which it can be drained by the usual drain tap commonly provided with such tanks. The rate of flow of the cold water downwardly through the heating unit due to the combined forces of momentum and convection as above described is much faster than the rate of flow in the opposite direction when no water is being drawn from the tank and when the water circulates due to convection alone. A forceful flushing action is thus provided which, it will be understood, is desirable in connection with all types of side arm heaters. Such flushing is particularly desirable in heaters of low capacity where the heating unit is small, and it is especially desirable where the passage through the heating unit involves a sharp turn such as occurs at the juncture of the tube **23** and tube **16**. It is at such bends that sediment is most likely to collect.

Further advantages of the above described invention will be obvious to those skilled in the art and although only two different arrangements of the fittings which effect the flushing action are shown, other arrangements will be obvious.

Having thus described the invention, what is claimed as new is:

1. In a water heater, the combination of a storage tank, a heating unit, connections between said heating unit and said tank, one of said connections leading to the upper portion of said tank and another to the lower portion thereof, a cold water inlet for said tank, and a by-pass connection between said cold water inlet and said upper connection, said by-pass connection entering said upper connection in a direction to reverse the direction of the flow of water through said heating unit.

2. In a water heater, the combination of a storage tank, a heating unit, connections between the upper end of said heating unit and the upper portion of said tank, a second connection between the lower end of said heating unit and the lower portion of said tank, a cold water inlet for said tank, and a valveless connection forming a by-pass between said cold water inlet and said upper connection, said valveless connection opening into said upper connection in a direction opposed to the normal circulation of water therethrough whereby on drawing water from the tank the momentum of the cold water entering the connection from said by-pass will reverse the direction of flow through said heating unit.

3. In a water heater the combination of a storage tank, a cold water supply pipe leading thereto, a hot water discharge pipe leading therefrom, a heating unit, a burner for heating said unit, connections between said tank and said heating unit for circulating water from the lower portion of said tank through said heating unit and then to the upper portion of said tank, a thermostat responsive to the temperature of the water in the connection between the lower portion of said tank and said heating unit for controlling the flow of fuel to said burner, means to reverse the normal flow of water through said heating unit while water is being withdrawn through said discharge pipe, whereby said thermostat is responsive to the temperature of water flowing to said heating unit during normal operation and responsive to the temperature of water flowing from said heating unit during periods of withdrawal of water from said tank.

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