

[54] **RESIDENTIAL WATER HEATERS**
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[58] Field of Search 219/296-309, 332,
219/496; 137/492, 341; 200/81.9 R, 81.9 HG

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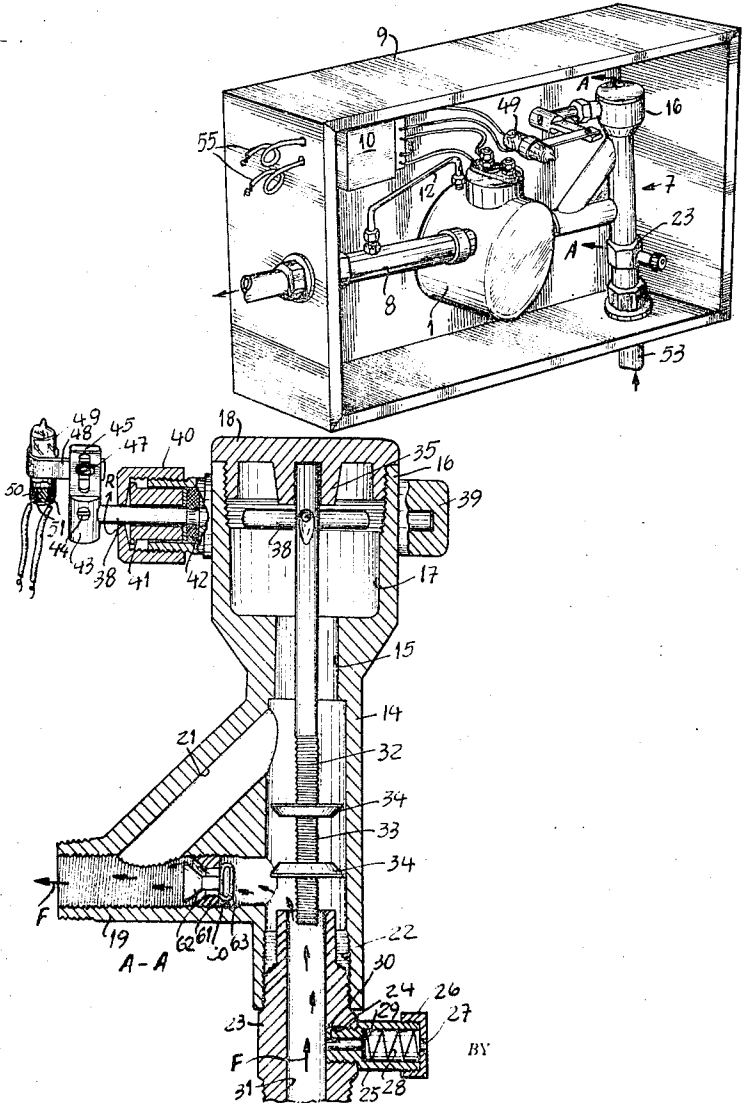
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[57] **ABSTRACT**
Water from a cold water feed pipe passes through a control valve assembly to a small container which is provided with an electric resistance heater. The control valve assembly has a member which occupies a rest position in the water flow path and is movable to a displaced position outside the flow path to energize the electric heater when water is flowing toward a tap outlet. The displaceable member moves in a vertical tubular body, and its movement is transmitted to a heater-actuating liquid metal switch by a linkage which includes an axially movable rod connected to the displaceable member, a pin which engages the rod, said pin extending from a shaft which is pivoted in and extends outside the tubular body. The liquid metal switch is supported by the shaft outside the chamber. Return of the displaceable member to its rest position is by gravity and by fluid pressure applied to the displaceable member through a counterflow conduit.

6 Claims, 7 Drawing Figures



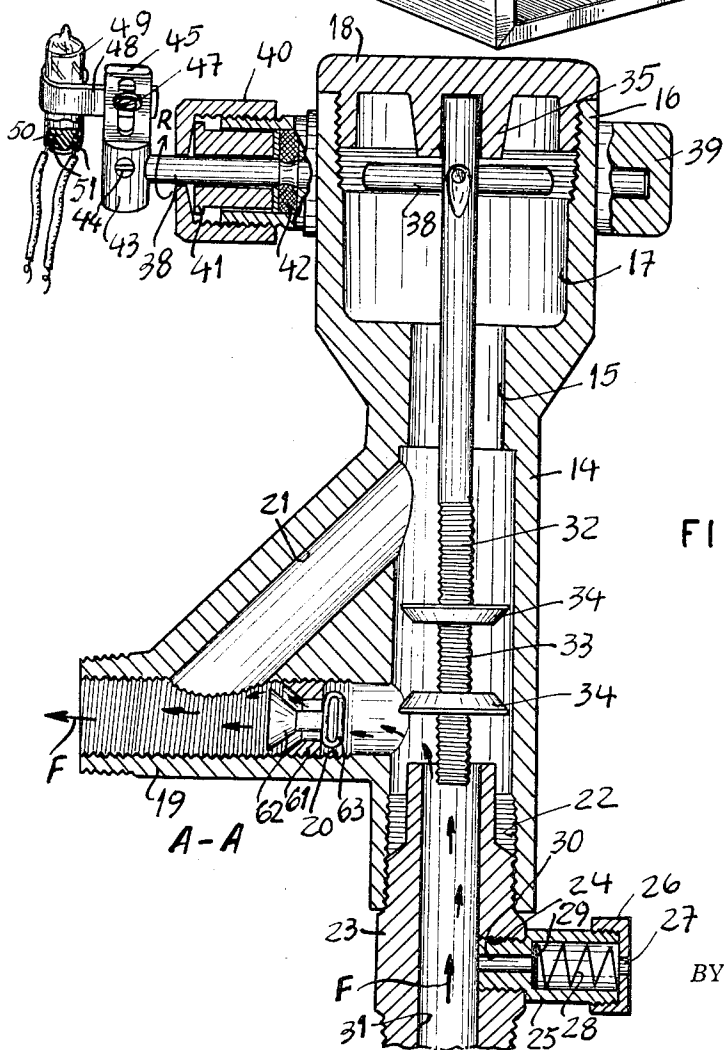
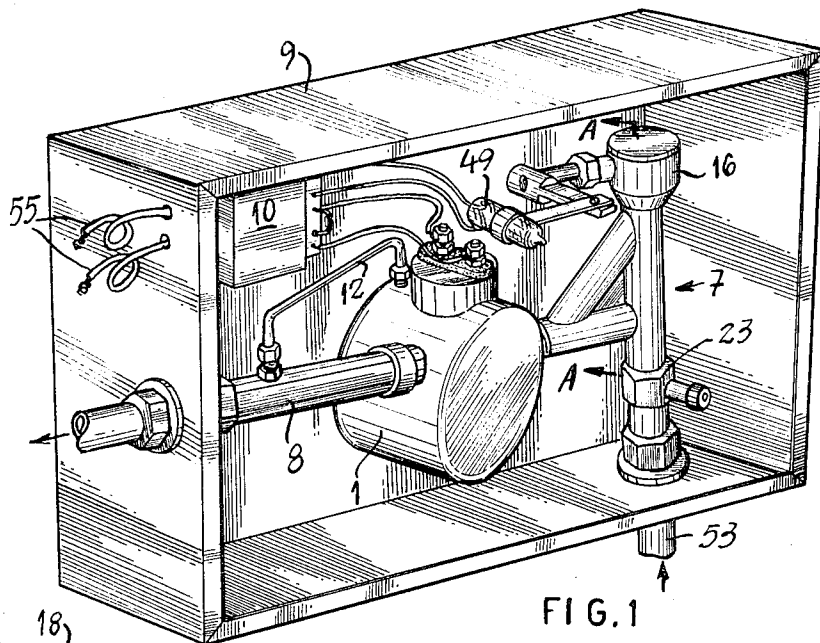


FIG. 3

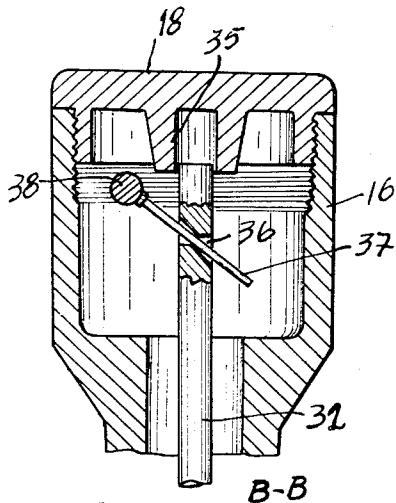
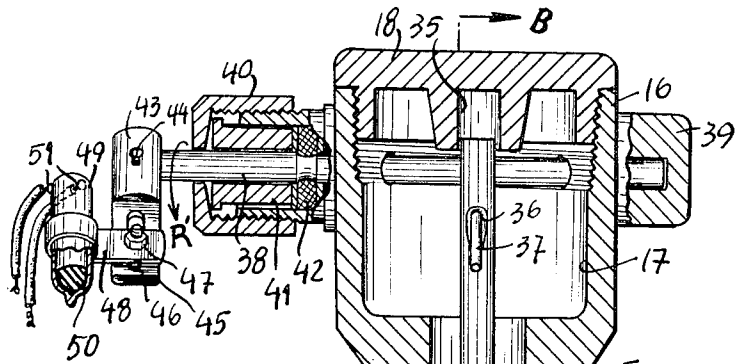


FIG. 4

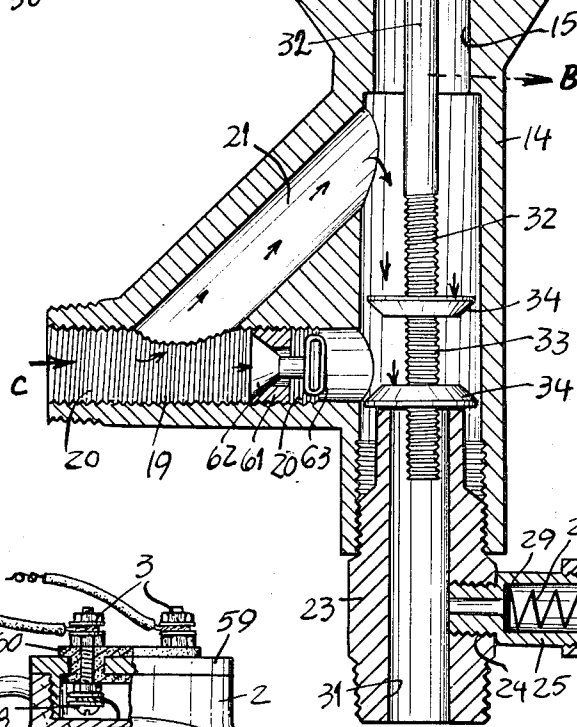


FIG. 5

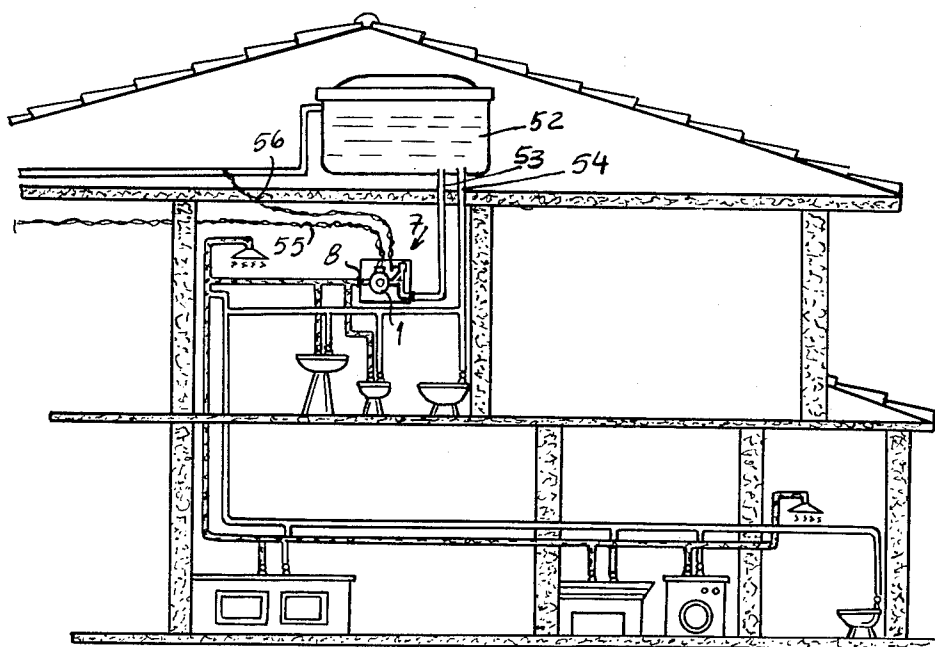


FIG. 6

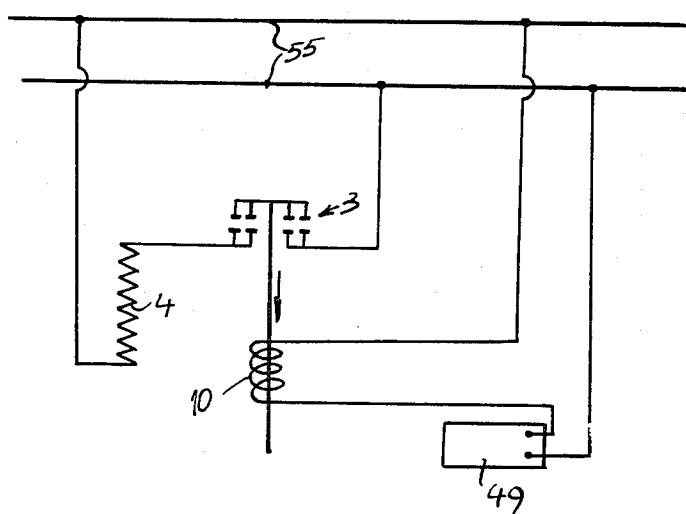


FIG. 7

RESIDENTIAL WATER HEATERS

This invention is related to an improved electric water heater, of the type applied to domestic use, being more particularly concerned with an electric device for central heating of water, in order to supply hot water to residences and small buildings.

It is well known that up to now there are several types of equipment used for the central heating of water in residences, apartments and general dwelling places, all of them presenting serious disadvantages which restrict their application and use.

In fact, there exist some heating devices equipped with a bulky reservoir, within which the water is heated on a use-and-replace basis, all of them being disadvantageously featured by a high operational cost in addition to requiring a considerable area, which complicates their installation in the interior of residences.

Other known heating devices have a small capacity and are directly installed connected with the sanitary equipment, basin or tank, which receive hot water, or they are an integrant part of taps and showers, thus requiring the use of several heaters increasing the over-all cost of installation and maintenance and presenting a great incidence of functional drawbacks because of their comparatively weak construction and the high temperature to which they are subjected.

Furthermore, in the case of small capacity heaters usually adapted to taps and showers, it is not possible to construct them to sustain electric currents more than 25 or 30 watts. Accordingly, when the tap is in its full-flow condition, the desired regularity of water heating is not reached.

Also, other inconveniences are known by experts in the art, such inconveniences being related to the means of controlling the heating device. The use of thermostatically operated valves is justified only for heaters of great capacity in view of the high cost of such parts. Diaphragms have been used but these are made of flexible material of reduced thickness, so they do not last long and they require continued replacement which, when the heaters are located inside the walls, is difficult and expensive.

The invention herein provides an improved heater to be used as a central heating unit, on which all previously mentioned disadvantages have been eliminated, with the addition of a number of improvements, as will be evident from the following description.

According to one aspect of the invention, an improved sealed interconnection is provided between a heater-actuating switch and a displaceable member initially positioned in the liquid flow path. This involves a tubular body in which the displaceable member moves, an axially slidable rod connected to and movable with the displaceable member, a liquid metal switch outside the tubular body and mounted on a shaft which extends into and is pivoted on the tubular body, and a pin on the shaft which engages the axially slidable rod.

The invention also involves the return of the displaceable member to its initial position in the fluid flow path. This is achieved gravitationally and by means of a counterflow conduit which applies fluid pressure to the displaceable member.

The advantages resulting from this invention will be obvious from the following description and from the attached drawings in which:

FIG. 1 is a perspective view of the water heating unit of the present invention;

FIG. 2 is a longitudinal section of the control valve assembly when water is flowing and the electrical circuit to the heater is energized;

FIG. 3 is the same view of FIG. 2, but shows the condition of the control valve assembly when the flow of water is stopped;

FIG. 4 is a partial sectional view along line B—B of FIG. 3;

FIG. 5 is a partially broken elevational view of the heating tank and the resistance;

FIG. 6 is a schematic view, illustrating in cross section a practical example of a system which has the heater of this invention, and

FIG. 7 shows the electric circuit of the system shown in FIG. 6.

FIGS. 1 and 5 show the water heater of this invention which includes a container 1 provided with an upper cylindrical projection 2 fitted with the terminals 3 of the electric resistance 4. Such a container 1 is provided with external water connections 5 and 6 for admitting cold water in one side and discharging hot water into the outlet pipe 8 on the other side.

The assembly can be housed in a box 9 together with the elements of the electric circuit, thus allowing it to be built into walls and provided with outside decorative covers for the aesthetic integration of this unit in residential areas.

The previously mentioned container 1 is internally provided with a pipe 10', the free end 11 of which opens near the top of the container, following the wall of said container and emerging laterally where it is coupled by piece 6 to the outlet and distributing pipe 8.

To permit steam to escape from the interior of the container 1, a small tube 12 extends from the upper part of the tank to the outlet pipe 8 where it is attached by the connecting piece 13.

FIGS. 2 and 3 illustrate in vertical sections the valve assembly 7 which provides the hydraulic and electric control of the heater. The valve assembly includes a vertical tubular body 14 which is interiorly narrowed at 15 and interiorly widened at 16 to form a cylindrical chamber 17 which is closed on its upper end by a threaded cap 18.

The aforementioned tubular body 14 has a lateral conduit 19 internally threaded at 20 and an angular counterflow conduit 21 which together form a hydraulic system in triangulation.

The lower end of the tubular body 14 is threaded at 22 to receive a double connecting fitting 23.

The fitting 23 is provided with a safety-valve radially threaded into the hole 24. The safety valve consists of a hollow cylindrical body 25 provided with a threaded cover 26, having a spy-hole 27. The cover 26 compresses the helical spring 28 which pushes the gasket 29 against a seat to obstruct the passage 30 to the water passage 31 and the inner cavity of the valve 25. The mentioned gasket operates as a safety plug, being made of thermoplastic material which decomposes under overheating conditions.

Inside the tubular body 14 a slidable rod 32 is provided with a threaded lower section 33 on which two frusto-conical metallic discs 34 are threaded, duly spaced and having the larger bases turned to opposite directions. The rod 32 is guided at its upper end by a fixed bearing 35 on the cover 18. The upper end of the

rod 32 has a passing hole 36 angularly related to the axis of the said rod 32 to permit the reception of a pin 37 which protrudes from the shaft 38. The shaft 38 is rotatively supported by bearings 39 and 40, the latter also having a seal provided by the flanged pressure sleeve 41 which is operable on a gasket 42.

The shaft 38 crosses the chamber 17 orthogonally to the rod 32 and is provided on its projecting free end with a compact cylindrical body 43 held in place by the setscrew 44. A plate 45 with a longitudinal slot 46 acts as a guide to the bolt and washer assembly 47. The bolt 47 retains electric current switch 49 of the type having liquid metal movable contacts, where the mercury element 50 assumes a circuit-opening position (FIG. 2) or a circuit interruption position (FIG. 3) depending on whether the electric switch 49 is turned with terminals 51 in downward or upward directions by movement of the shaft 38.

FIG. 6 shows by way of example an application of the water heating equipment of this invention as a central unit, directly connected to the reservoir 52 through a cold water feed pipe 53 which is connected to the joint 23 of the heater control valve assembly 7.

The outlet pipe 8 branches off to feed hot water to the sanitary equipment and the rooms of the house where a hot water tap is required. Cold water is supplied by pipe 54.

The heater is electrically connected through wires 55 to the internal heating system, and the wire 56 is a ground connection therefore.

One purpose of this invention is to provide an electric water heater with electro-mechanical features which permit an instantaneous activation of the resistance water heating circuit 4 with an electric current of a minimum intensity of 30 Amps, to guarantee the heating of water at any flow rate, taking into consideration that the capacity of tank 1 is only on the order of 60 cubic inches.

For such a purpose the conventional means of control, such as diaphragms, pressure switches or floats have been avoided to eliminate any direct contact between water and the control mechanical elements.

FIG. 7 shows a solenoid 10 energized by the mercury switch 49 to activate the resistance 4 through its multi-terminals 3, this circuit being connected to the house electric system by means of wires 55.

The metallic discs 34 and 34' of valve assembly 7 are spaced apart approximately three-eighths inches (1 cm) to provide an entire contact surface ample enough to guarantee that rod 32 will be displaced axially by the flow of water, causing rotation of the shaft 38 actuation of the electric circuit, and opening or closing of the water passage 31 to permit or prevent cold water from draining into the heating tank 1.

In apartments where hydraulic pressure is generally higher than in residences, the mentioned pair of discs 34 will have both their mutual spacing and their spacing from the free lower end of the rod 32 duly regulated.

On the horizontal branch 19, a unidirectional check valve is provided. This includes a guide and seat body 61 threaded to the interior wall of the lateral conduit 19. The body 61 has a frusto-conical section to receive the head 62 of a complementary form on a stem 63 which extends through said body 61.

In operation, the opening of the tap 63 or any other unit of hot water consumption, the water flow in pipe

53 will enter the passage 31 of the coupling 23 and act on the lower surface of the disc 34'; this will displace the disc 34' upwardly from its sealing position on passage 31 and out of the flow path and cause the rod 32 to raise. Cold water then circulates in the direction of arrow F (FIG. 2), entering the smaller lateral conduit branch 19, crossing unidirectional valve 61 and entering heating tank 1, where it absorbs heat irradiated by resistance 4 before being ejected through pipe 10 and distributed by tubing 8 to the consumption area.

Resistance 4 has been activated at the same moment when water pressure acted on discs 34' and 34 to make the rod 32 slide upwardly and cause the angular rotation of pin 37 in chamber 36 and consequent rotation of shaft 38 in the direction of arrow R. This caused the switch 39 to turn, causing mercury element 50 to fall to its bottom to effect contact between the terminals 51 and closing the solenoid 10 circuit which energizes the resistance 4. As long as conditions of cold water flux through passage 31 remain unchanged, the rod 32 will be displaced in its upward position.

When tap 63 is entirely closed, hydraulic flow may occur in the direction of arrows C which will reach the unidirectional valves on straight branch 19, forcing the frusto-conical stem body 62 into its housing 61, blocking water feed passage and diverting the counterflow to the oblique counterflow branch 21. The counterflow reaching the narrow portions 15 of the cylindrical body will turn downward toward the larger base of the disc 34 to permit axial displacement of rod 32 downwards thereby closing the passage 31 with the lower disc 34'.

Axial displacement of the rod 32 will produce movement of pin 37 and rotation of shaft 38 in the direction of arrow R (FIG. 3), returning switch 49 to its lower position where the mercury element 50 accumulates at the end opposite to terminals 51, hence opening solenoid circuit 10 and deactivating resistance 4.

From the construction of the heater as described and illustrated, a safety margin is provided to prevent energization of the heating resistance in the event of a small water flow as will happen when a tap is either leaking or partially closed.

The reliability of the control valve assembly 7 for both electric and hydraulic systems results from two factors. One factor is the effect of return pressure of water produced by interruption of its flow. Another factor is the utilization of gravity force resulting from the weight of rod 32, discs 34 and 34' and counterweight 43 to overcome the resistance of the cold water feeding flow, the closing of passage 31 occurring whenever said entrance flow is equivalent to a drainage lower than 30 percent of tap capacity.

Obviously, such a figure can be changed at will, causing the heater to be proportionally more or less sensitive, because of smaller or greater radial spacing between the outside diameter of 34 and 34' discs and inside diameter of tubular body 14.

An installation constructed according to this invention, equipped with a tank having a capacity of 60 cubic inches, was submitted to hydraulic pressure and electric tests to determine the amount of power consumed. The following results were obtained:

The maximum hydraulic pressure supported with no deformation was 50 Kg/sq. cm.

The normal working pressure was 2 Kg/sq. cm. The power consumption for two applied voltages was as follows:

Idle Voltage	220 V.	234.5 V.
Load Voltage	208.5 V.	220.0 V.
Current input	32.3 Amp.	34.2 Amp.
Power input	6625 Watt	7350 Watt
Energy input	6.62 Kw/h	7.35 Kw/h

The relationship between water flow rates and water temperatures was as follows:

Flow Liters/h	Temperature in °C.
112	76
157	64
277	50
302	45
371	41.
426	37.5
537	34.5
588	34

We claim:

1. A water supply system comprising
 - a cold water feed pipe,
 - a container receiving water from the cold water feed pipe,
 - an electric heating means located in the container for heating water therewithin,
 - a heater control assembly located between the cold water feed pipe and the container, said control assembly affording a principal flow path from the cold water feed pipe to the container, said control assembly having a vertical tubular body, a rod axially slidable within the tubular body and displaceable means attached to and movable with the rod, said displaceable means being movable under the influence of flowing water from a rest position in the principal flow path to a displaced position outside the principal flow path, said displaceable means having a first surface confronting the principal flow path and a second surface facing in an opposite direction than the first surface,
 - a pivoted shaft extending through and projecting outside the tubular body, means connecting the rod to the shaft to rotate the shaft upon axial movement of the rod, and a liquid metal switch means supported on the end of said shaft externally of said body for energizing the heating means in response to movement of the displaceable means to its displaced position and for deactivating the heating means in response to movement of the displaceable means to its rest position, and
 - a counterflow conduit means connected between a location downstream of the displaceable means and the second surface of the displaceable means to permit fluid pressure to restore the displaceable means to its rest position.
2. The apparatus according to claim 1 wherein the displaceable means is gravitationally urged toward its

rest position.

3. The apparatus of claim 1 wherein the displaceable means is a pair of spaced apart frusto-conical disks mounted on the rod.
4. The apparatus of claim 1 having counterweight means mounted on the shaft outside the tubular body to move the displaceable means to its rest position upon cessation of flow of water through the principal flow path.
5. The apparatus of claim 1 having check valve means positioned in the principal flow path downstream of the displaceable means and upstream of the connection between the principal flow path and the counterflow conduit means, said check valve means being oriented to permit the flow of water from the control assembly to the container.
6. A water supply system comprising,
 - a cold water feed pipe,
 - a container receiving water from the cold water feed pipe,
 - an electric heating means located in the container for heating water therewithin,
 - a heater control assembly located between the cold water feed pipe and the container, said control assembly affording a principal flow path from the cold water feed pipe to the container and having a displaceable means which is movable under the influence of flowing water from a rest position in the principal flow path to a displaced position outside the principal flow path,
 - said displaceable means having a first surface confronting the principal flow path and a second surface facing in an opposite direction than the first surface,
 - actuating means having an electrical switch for energizing the heating means in response to movement of the displaceable means to its displaced position and for deactivating the heating means in response to movement of the displaceable means to its rest position,
 - a counterflow conduit means connected between a location downstream of the displaceable means and the second surface of the displaceable means to permit fluid pressure to restore the displaceable means to its rest position and,
 - check valve means positioned in the principal flow path downstream of the displaceable means and upstream of the connection between the principal flow path and the counterflow conduit means, said check valve means being oriented to permit the flow of water from the control assembly to the container.

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