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Gardom

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[54] **ELECTRIC INSTANTANEOUS WATER HEATER**

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[73] Assignee: **Gardom & Lock Limited,** West Bromwich, Staffordshire, England

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[52] **U.S. Cl.**..... **219/309,** 200/81.9, 219/307, 219/328, 219/332, 219/496

[51] **Int. Cl.**..... **H05b 1/02,** F24h 1/10

[58] **Field of Search**.....219/296–309, 332, 496; 200/81.9

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Attorney—Neil F. Markva et al.

[57] **ABSTRACT**

An instaneous water heater includes a main electrically insulating body having an inlet and an outlet. A flow duct means extends between the inlet and outlet and includes an inlet bore, an outlet bore, a heater bore means, a first flexible, electrically insulating tube extending between the inlet bore and the heater bore means and a second flexible, electrically insulating tube extending between the heater bore means and the outlet bore. The inlet bore, outlet bore and the heater bore means are formed in the main body while the first and second tubes are formed separately and independently of the main body and each other. A clamping plate connects the ends of the tubes with respect to inlet bore, outlet bore and heater bore means. The tubes together with the inlet and outlet boers define a length sufficient to provide a resistance path which minimizes leakage current flow from an electric heater disposed within the heater bore means. A flow responsive switch means controls current flow the electric heater. A thermostat may be provided in series with the flow responsive switch.

23 Claims, 6 Drawing Figures

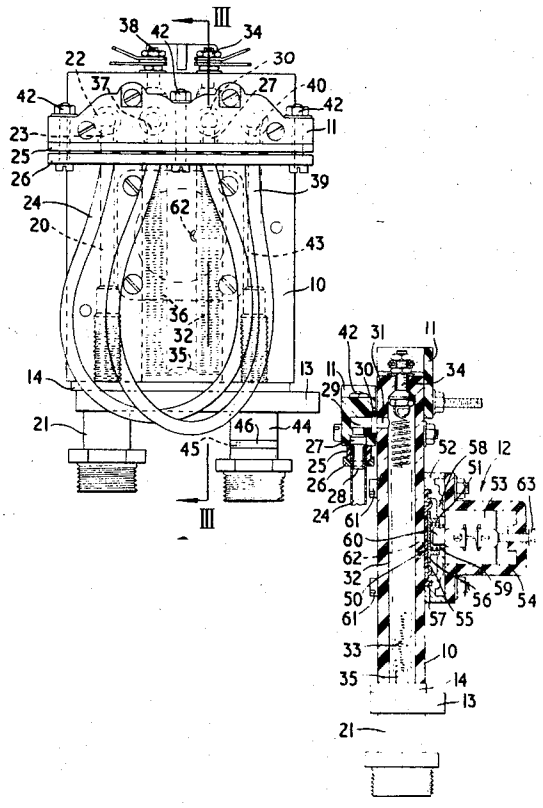


FIG. 1.

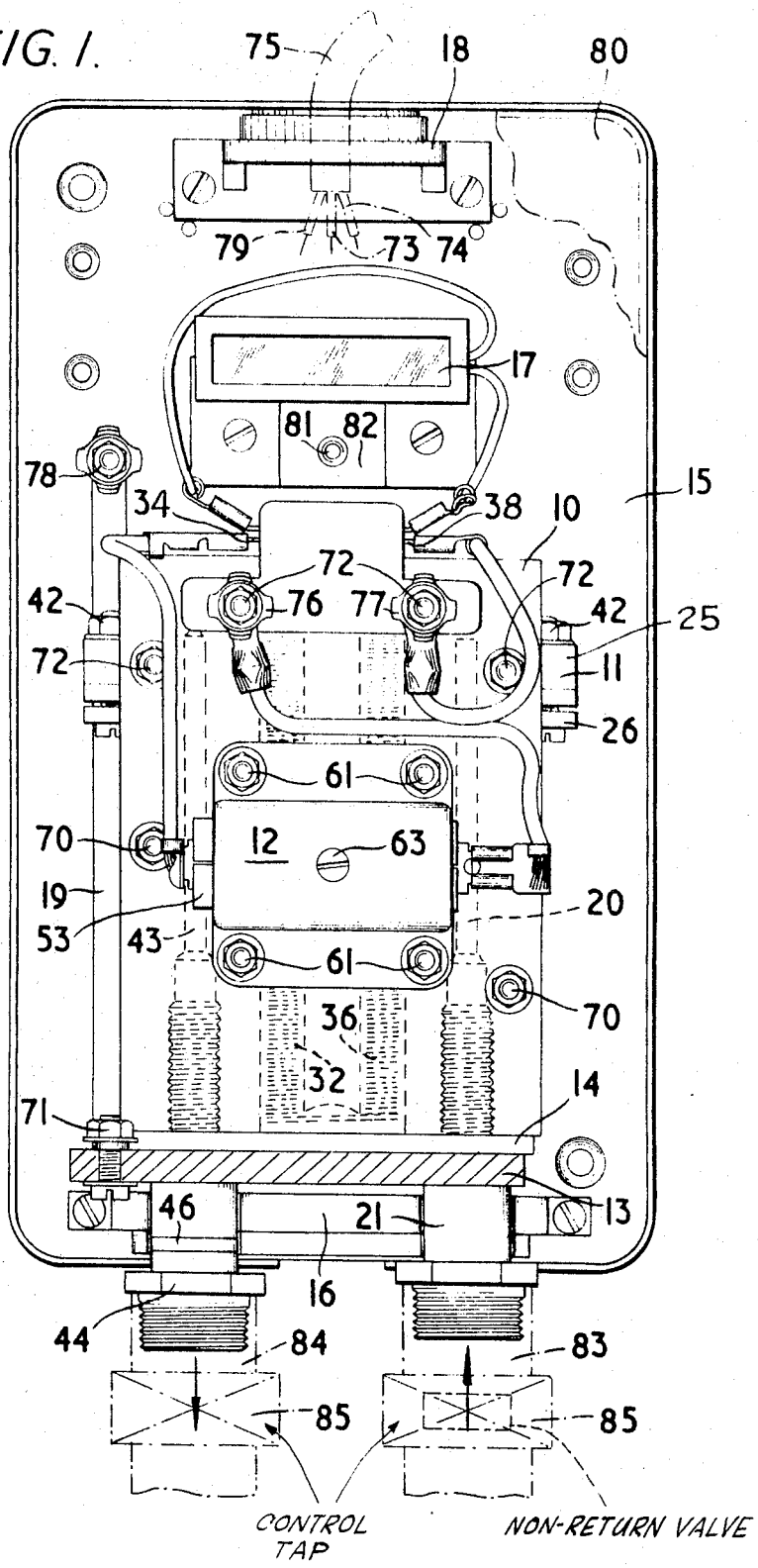

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11
26
61
70
12
63
19
20
53
43
61
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16
44
84
83
85
85
CONTROL TAP
NON-RETURN VALVE

FIG. 2.

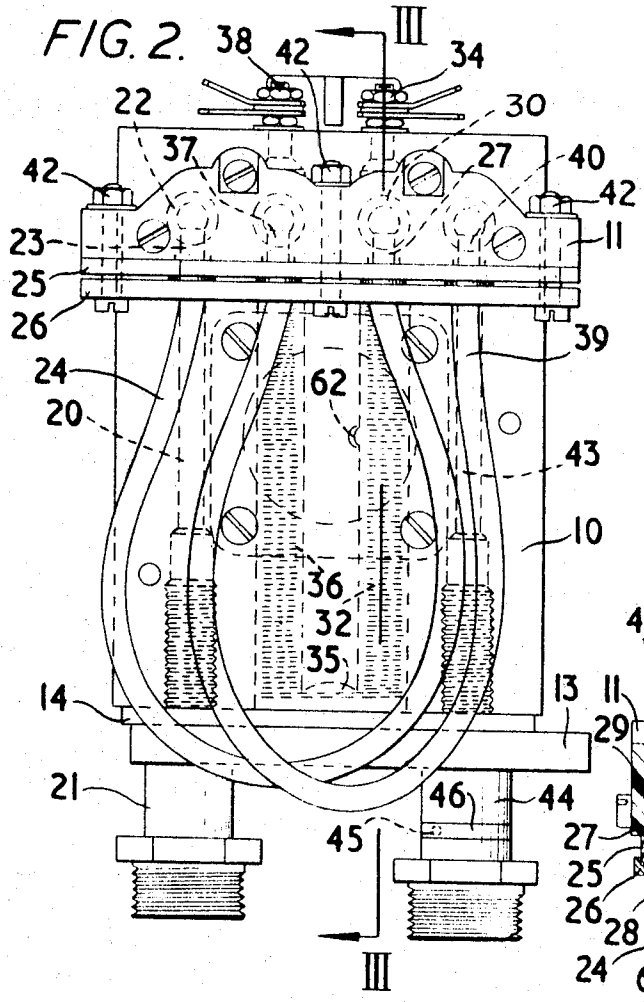


FIG. 4.

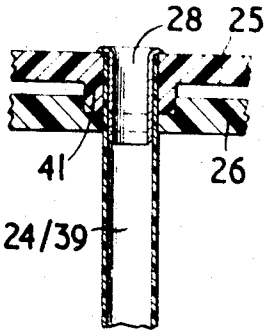


FIG. 3.

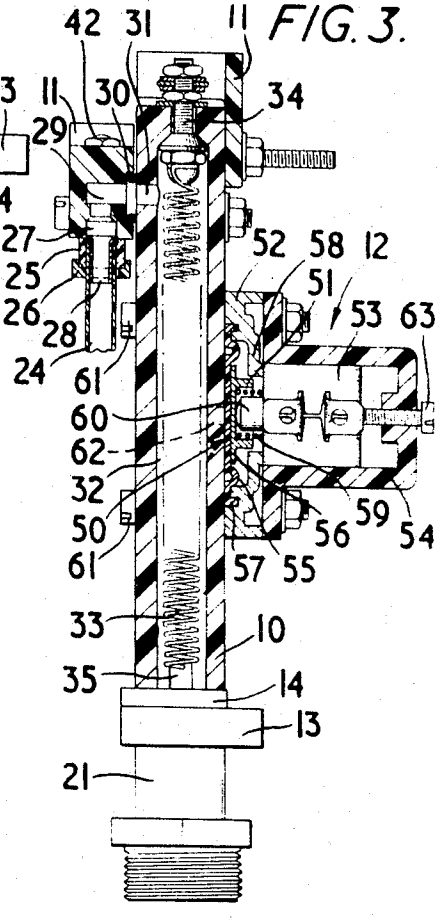


FIG. 5.

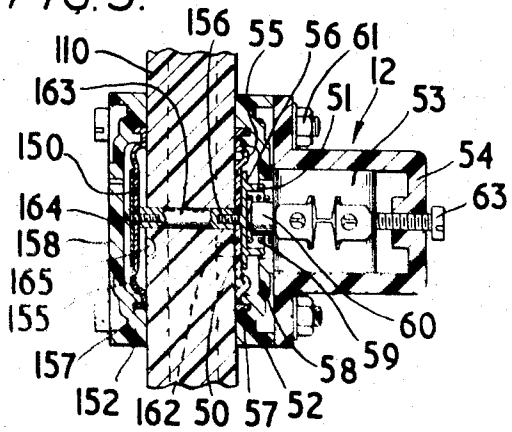
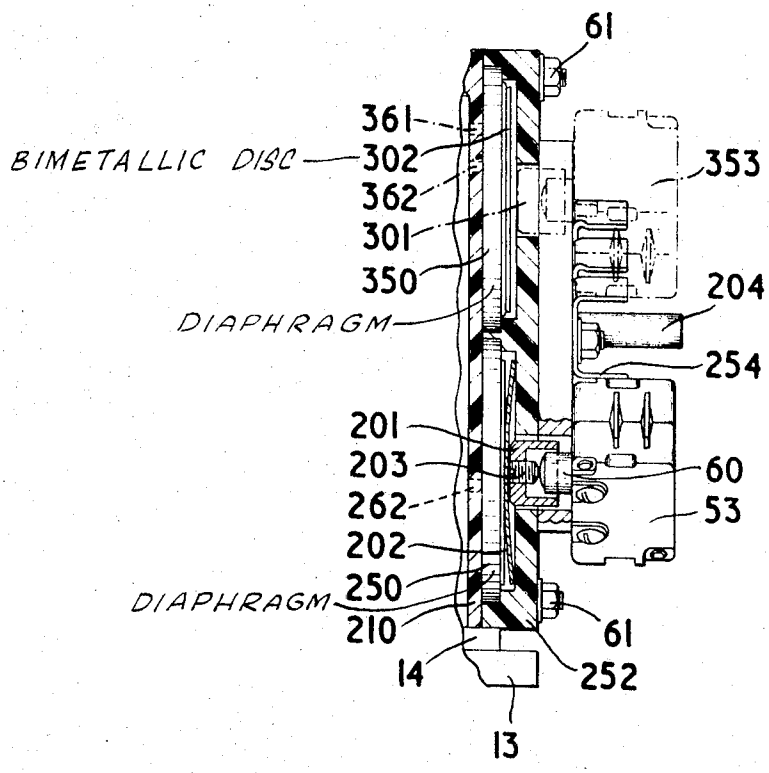


FIG. 6.


61
361
BIMETALLIC DISC
302
362
301
350
DIAPHRAGM
353
204
254
201
203
262
202
DIAPHRAGM
250
210
14
13
60
53
61
252

ELECTRIC INSTANTANEOUS WATER HEATER

BACKGROUND OF THE INVENTION

This invention concerns instantaneous water heaters, and in particular water heaters of the kind which employ a heating element or elements disposed in a heater bore or bores in an insulating body, which body is also provided with water inlet and outlet bores connected to a water inlet and a water outlet, wherein the inlet and outlet bores are connected to said heater bore or bores to permit water to flow through said heater bore or bores in contact with the element or elements.

In, for example, the heater which we manufacture and sell under our Trade Mark "Alflow," the body is provided with a labyrinth of bores comprising an inlet portion, an outlet portion and a central portion in which the heating elements are disposed, said bores together constituting a flow duct from the water inlet to the water outlet within the body.

Such labyrinths are costly to produce, and, while under most circumstances the labyrinths provide for sufficient electrical resistance in the paths between the inlet and outlet and the elements, when the water supply has a high mineral content, the increased electrical conductivity thereof can reduce the resistance below the level which we desire.

One method of overcoming the problem of sufficient electrical resistance is to increase the size of the body to take further bores to extend the inlet and outlet portions of the labyrinth, but this would increase the cost, size and complexity of the heater, and an object of the invention is to provide a more utilitarian and economical solution to the problem.

SUMMARY OF THE INVENTION

Therefore, according to a first feature of the present invention, the body of the heater is constructed so that the heater bores and the inlet and outlet bores are connected to ports, and external tubes of the desired length are connected to the ports to complete a flow duct from the inlet to the outlet of said body via said bores, such that the flow duct provides sufficiently long resistance paths. The tubes are preferably flexible so that they can be accommodated easily in a confined space by being bent or looped.

Preferably, at least that tube carrying hot water from the heater bores to the outlet bore is of temperature stable material of a type suitable for carrying not water, but both or all the tubes may be of similar but differently coloured material to simplify production.

The body may comprise a clamped on portion or cross-member, into which the ends of the tubes may be secured e.g. during moulding thereof.

It has further been found that, by means of the invention, body of the heater may be simplified to a considerable extent by providing such external tubes of a sufficient length, to the extent wherein the body provides merely those bores required for the heater element or elements, for connecting the inlet to one of said ports and the outlet to another of said ports, and for taking water from these said ports to means for controlling the electrical heating current, and thereby the production of the body may be greatly simplified. For example, in the heater which we at present manufacture there are some fourteen upright bores, six longitudinal bores and seven transverse bores in the labyrinth (excluding bores to said controlling devices) disposed in several

planes, and this number may be reduced to four axially co-planar upright bores with respective transverse bores to the ports. This enables the body of the heater of the invention to be made by moulding, whereas the prior body has to be made by machining from a solid block and stopping the unwanted drill access holes. Furthermore, this may be achieved without materially altering the existing heaters casing, fittings, back plate, or controlling devices, and a simplified base plate may be used.

Furthermore, in this aforesaid heater which we at present manufacture there are several further ducts and bores to permit water to flow to or through several devices for controlling the electrical heating current and the rate of water flow. Such devices are, to some extent, required because of the nature of the labyrinth in the body and the high cost thereof, and, to some further extent due to the nature of the devices themselves. For example, a pressure sensitive device is provided to switch on the heating current when the water pressure is high enough for the heater to operate. This device includes a diaphragm with a metal backing dish of robust form which operates a switch, and, due to the relatively insensitive nature of the device, the device has to be connected to the inlet bore so that the whole of the back pressure generated by the labyrinth to the flow of water therethrough is available to actuate the device. Of course, if the labyrinth becomes blocked the heating element would burn out if a thermostat device were not provided, and, therefore, such a device is connected by further bores to the heater bores to safeguard the expensive body. The provision of these devices and adapting the body to receive the necessary seals and mounting devices thereof, further increases the already high cost of the known body.

However, further cost savings may be made by taking advantage of the simplified form of body of the present invention, in combination with a preferred further feature of the invention.

According to this preferred feature of the invention the heater has means, for automatically controlling the heating current, comprising a single pressure sensitive switch device having a sensitive resilient diaphragm arrangement which is exposed to water pressure via a duct leading preferably, for example, to the heater bore.

This feature further simplifies the body, to the extent where it is inexpensive enough to be considered to be an expendable item, and since the heater cannot be switched on until there is a sufficient water pressure in the heater bores, the possibility of the heater element burning out is made extremely unlikely and the need for a thermostat is removed.

The pressure sensitive switch device is preferably formed, according to another feature of the invention, so that the working stroke of the diaphragm is sufficiently large that the on and off switch positions lie well within said working stroke, whereby to remove the need for the hitherto usual initial switch setting up and adjusting proceedures. To this end the diaphragm is preferably formed with an annular corrugation, so that a flanged head of a piston may nestle against a central portion of the diaphragm and be surrounded by said corrugation. The head and the diaphragm are preferably located by a cap member which provides an annular abutment for the flange of the head and the peripheral portions of the diaphragm. A switch having an operat-

ing plunger is preferably clamped onto said cap member so that the plunger extends into the piston. A spring is preferably located about the plunger within the piston. The diaphragm is preferably provided with a peripheral lip which sockets into an annular recess provided by the cap member.

In an alternative embodiment the diaphragm arrangement further comprises a supplementary diaphragm which is tied to the aforesaid or main diaphragm by a link, each diaphragm being exposed to the water pressure in a respective part of the flow passage, so as to work in opposition and be responsive to the pressure drop caused by a flow of water through the heater to switch on the heating current when a predetermined minimum flow is achieved. This adaptation permits the heater to be incorporated into a water supply system before the water tap, as the heater will switch off when the tap is turned off.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be describedd in further detail, by way of example, with reference to the accompanying drawings which show an embodiment of the heater of the invention, and wherein:

FIG. 1 shows the body and associated parts of the heater, in front elevation, as installed upon a mounting plate;

FIG. 2 shows the body in rear elevation;

FIG. 3 shows a partial cross section of said body and parts corresponding to the line III—III in FIG. 2, showing also a first embodiment of pressure sensitive switch device;

FIG. 4 is an enlarged transverse section showing a detail of the end of one of the tubes shown in FIG. 2;

FIG. 5 is a partial vertical cross section showing a second embodiment of the pressure sensitive switch device; and

FIG. 6, is a further partial vertical cross section showing a third embodiment of the pressure sensitive switch device.

DESCRIPTION OF SPECIFIC EMBODIMENTS

As shown in the drawings the heater has a body, of "Perspex" (a Trade Mark) or a like electrically insulating material, which comprises a main portion **10** and a cross member or portion **11**. Current control means **12** is secured to the side of the main portion **10** remote from the cross-portion **11**, and a metal bass plate **13**, superimposed by a rubber gasket **14**, is secured at the bottom of the main portion **10**.

A plastics mounting plate **15** and locator block **16** are provided to carry the body **10, 11** an on/off indicator light **17**, a electrical supply cable support **18** and an earth terminal bar **19**.

The main portion **10** is provided with an inlet bore **20** having an enlarged threaded lower end in which a metal inlet member **21** is secured through the base plate **13**. The upper end of the inlet bores terminates at a port in register with a matching port in the cross-portion **11**, said ports being sealed together by a ring seal **22**. Said matching port opens into a stepped socket **23** in which one end of a flexible tube **24** is held by means of a ring seal strip **25** and a clamp plate **26**.

This tube **24** leads to a similar socket **27** and is secured therein by said ring seal strip **25** and said plate **26**. As shown in FIG. **3**, a metal liner **28** is provided in the tube ends, which figure also shows the port **29** of said socket **27** sealed by ring seal **30** to a port **31** of a first heater bore **32** which contains one coil of a heater element **33**. The upper end of the coil is connected to a sealed terminal **34** extending upwardly out of the body, and the lower end is connected through a cross bore **35** to the other coil of said element **33** disposed in a second heater bore **36**. The upper end of bore **36** lead through matched registering sealed ports to socket **37**. The upper end of the other coil of the element **33** is connected to terminal **38**. A second tube **39** of nylon material connects the socket **37** with a similar socket **40** which is connected via ports to the upper end of an outlet bore **43** having an enlarged threaded lower end into which an outlet member **44** is secured. The outlet member **44** has a small blow-off port **45** which is normally closed by a plastics cover ring **46**. As is evident, the insulating flexible tubes **24** and **39** are formed separately and independently with respect to the main portion **10** and with respect to each other.

In an unclamped condition as shown in FIGS. **3** and **4**, the ends of the tubes **24** and **39**, each internally supported by the respective liner **28**, are located through respective apertures in the ring seal strip **25** and plate **26**. The ring seal strip **25** is shaped to provide tubular extensions **41** which extend into recesses provided in the plate **26**. When clamping bolts **42** are tightened, the plate **26** is drawn towards the cross-portion **11** thereby compressing the extensions **41** to form tight compression seals about the tube ends, which tube ends are forced some small distance into the stepped sockets **22, 27, 37** and **40**, this clamped condition, is shown in FIG. **2**.

The first embodiment of heating current control means **12**, as shown in FIGS. **2** and **3** is in the form of a switch device responsive to water pressure in heater bore **36**,and comprises a diaphragm **50**, a piston **51**, a cap member **52**, a switch **53** and a switch holder **54**.

The diaphragm **50** has an annular corrugation **55** about a central portion thereof which is abutted by a flanged head **56** of the piston **51**, and a peripheral lip **57** which is located in an annular recess provided in the cap member **52**. The cap member **52** is also shaped to provide an annular abutment **58** for the head **56** and corrugation **55**. A spring **59** is located within the hollow piston **51** about an operating plunger **60** of the switch **53**. Through bolts **61** are used to clamp the switch holder **54**, cap member **52** and body **10** together so that the central portion of the diaphragm **50** overlies a port **62** in the body **10** leading to the heater bore **36**. A screw **63** ensures that the switch is securely held in position, and the dimensions of the cap member **52** and outer part of the diaphragm **50** are such as to ensure that the outer part forms a seal against the body **10**.

In the second embodiment of heating current control means **12** shown in FIG. **5** there are two diaphragms, namely a main diaphragm **50** and a supplementary diaphragm **150** in the switch device which is responsive to the pressure differential between the inlet bore **20** and the outlet bore **43**. The main diaphragm **50** is similar to the diaphragm shown in FIG. **3**, as are the parts **51** to **61**, except in that the head **56** has a screw extension **156** which passes through the center of the main diaphragm **50** into a tie bar **163**. The supplementary diaphragm **150** and its cap member **152** are similar to the diaphragm **50** and cap member **52**, a screw and washer assembly **164** being used to secure the diaphragm **150** to the other end of the tie bar **163**.

The body **110** is identical to the body **10, 11** shown in FIGS. **1** to **4**, except in that the port **62** is omitted and instead a port **162** extends from the inlet bore **20** to the front face of the body adjacent the diaphragm **50** and a port **165** extends from the outlet bore **43** to the rear face of the body adjacent the diaphragm **150**, and except in that a cross bore is provided in the body to receive, slidably, the bar **163**.

The only other exception is that the blow-off port **45** is omitted in this embodiment.

Referring again to FIG. **1**, the body **10, 11** or **110, 11** is merely secured upon the mounting plate **15** by means of two bolts **70** and a connection **71** between the base plate **13** and the earth terminal bar **19**, so that the inlet and outlet members repose in recesses provided in the locator block **16** and are electrically connected to earth as a safety precaution.

Two of the four bolts **72** used to clamp the body portions **10** or **110** and **11** together serve as terminals **76** and **77** to which the live and neutral wires **73** and **74**, respectively of a mains electrical supply lead **75** can be connected. The internal wiring of the heater is such that the live terminal **76** is connected via the normally open switch **53** to the heater terminal **38** and the heater terminal **34** is connected to the neutral terminal **77**, the indicator light **17** being connected in parallel with the heater element **33** via terminals **38** and **34**. An earth terminal **78** is provided on the bar **19** to receive the earth wire **79** of the lead **75**.

A cover **80**, part of which is shown, is provided to enclose the internal parts of the heater, and a cover locating screw socket **81** is provided in the bracket **82** of the indicator light **17**.

In use, a main electrical lead **75** is connected as aforesaid and pipework comprising water supply pipe **83** and a discharge pipe **84** are connected to the inlet and outlet members **21** and **44**, respectively. In the case of the embodiment of FIGS. **2** to **4** a control tap **85** is connected into the supply pipe **83**, and when turned on, the water pressure closes switch **53**. In the embodiment of FIG. **5**, the tap **85** may alternatively be connected into the discharge pipe **84**, and when turned on, the flow of water causes the pressure drop across the heater which closes switch **53**.

An automatic non-return valve may be incorporated, for example, into the tap **85**, or into the heater.

In the modified embodiment shown in FIG. **6**, the internal wiring is such that the live lead **73** is connected via a normally closed thermostat controlled switch **353** and a normally open pressure controlled switch **53** of the automatic control means.

The plunger **60** of switch **53** is actuated by a diaphragm **250** via an adjuster **201**, which is required because the diaphragm has a metal backing disk **202** which snaps from the concave normal condition to a convex operative condition when the diaphragm **250** is exposed to sufficient water pressure through a port **262** leading to the inlet bore **20**, the screw **203** of the adjuster being pre-set to ensure that the switch operates within the working stroke of the disk.

The switch **353** has a similar adjuster **301** because the diaphragm **350** has a bimetal disk **302** which snaps from its normal condition to the outwardly convex actuating condition when the diaphragm **350** is subjected to an excessive temperature. The diaphragm **350** is subjected to the flow of hot water through ports **361, 362** which interrupt the outlet bore **43**. In this embodiment the cap member **52** is replaced by a clamp plate **252** which clamps both diaphragms to the main portion **210** of the body, and the switches are located thereon by means of a bracket **254**.

A variable flow restrictor **204** is provided so as to intersect the flow duct, whereby to permit the resistance to flow of water through the body to be varied, to vary the flow and therefore the discharge temperature of the water.

It should be noted, that, due to the great electrical resistance provided by the tubes, it is no longer necessary for a central tapping to be provided on the element for connection to the "live" side of the mains electricity supply.

The invention is not confined to the precise details of the foregoing example, and many variations are possible within its scope. For instance, the number of elements and heater bores may be varied as desired, as may be the configuration of the bores in the body. The body may comprise several clamped together or otherwise secured sections or portions e.g. an inlet section, an outlet section and a heater section whose bores are connected together by said tubes. The body may have further bores to provide labyrinth portions in addition to the tubes to further increase the electrical resistance.

The ends of the tubes may be molded into the sockets during molding of the cross portion or member, or alternatively could be molded into the ports of the main portion or portions during molding thereof, thereby dispensing with the seals and the clamp plate.

A thermostat may, of course, be optionally provided for all embodiments, even though the invention enables such a device to be omitted.

I claim:

1. An instantaneous water heater comprising:

a. a main rigid insulating body having an inlet and an outlet,

b. a flow duct means extending between the inlet and outlet and including an inlet bore, an outlet bore, a heater bore means, first insulating flexible tube means extending between the inlet bore and the heater bore means and a second insulating flexible tube means extending between the heater bore means and the outlet bore,

c. said inlet bore, said outlet bore, and heater bore means being disposed within said main insulating body,

d. electrical heating means disposed in the heater bore means,

e. said tube means together with the inlet bore and outlet bore defining a length sufficient to provide a resistance path which minimizes current flow from the electrical heating means to said inlet and said outlet, and

f. a clamped on portion including a rigid insulating cross member secured to one end of said insulating body,

g. said clamped on portion being removably attached to the insulating body with the ends of the tube means being secured to said clamped on portion,

h. said clamped on portion including first registering port means connecting one end of said inlet bore with one end of said first flexible tube, a second registering port means connecting one end of said heater bore means with the other end of said first flexible tube, third registering port means connecting the other end of said heater bore means with

one end of the second flexible tube and fourth registering port means connecting one end of said outlet bore with the other end of said second flexible tube.

2. An instantaneous water heater comprising:
a. a main rigid insulating body having an inlet and outlet,
b. a flow duct means extending between the inlet and outlet and including an inlet bore, an outlet bore, a heater bore means, first insulating tube means extending between the inlet bore and the heater bore means and second insulating tube means extending between the heater bore means and the outlet bore,
c. said inlet bore, outlet bore, and heater bore means being disposed within said main insulating body,
d. said first and second tube means being formed separately and independently with respect to the main body and with respect to each other,
e. electrical heating means disposed in the heater bore means,
f. said tube means together with the inlet bore and outlet bore defining a length sufficient to provide a resistance path which minimizes current flow from the electrical heating means to said inlet and said outlet, and
g. means for connecting said first and second tube means externally with respect to the main insulating body,
h. said connecting means including a rigid insulating cross member secured to one end of the insulating body and a clamping plate mounted for sealing engagement with respect to the cross member,
i. said cross member including port means registered with the inlet and outlet bores to allow fluid flow through said flow duct means,
j. said clamping plate including openings to receive the ends of the tube means and register said ends with openings located in the cross member and communicating with the port means.

3. A heater as defined in claim 2 wherein
said connecting means includes a sealing strip disposed between the cross member and clamping plate.

4. An instantaneous water heater comprising:
a. a main rigid insulating body having an inlet bore, an outlet bore and a heater bore means, an
b. a pipe inlet union rigidly secured in said inlet bore of said body,
c. a pipe outlet union rigidly secured in said outlet bore,
d. heater element means disposed in the heater bore means,
e. a rigid insulating cross member secured to one end portion of said main body,
f. a first insulating flexible tube external of the main body and connected by its ends into said cross member, and
g. a second insulating flexible tube external of the main body and connected by its ends into said cross member,
h. said main body and said cross member porviding first registering port means connecting one end of said inlet bore with one end of said first tube, second registering port means connecting one end of said heater bore means with the other end of said first tube, third registering port means connecting the other end of said heater bore means with one end of said second tube, and fourth registering connecting one end of said outlet bore with the other end of said second flexible tube,
i. the length of the flexible tubes and said inlet and outlet bores being sufficient to provide a minimum resistance path which minimizes current flow from the heater element means to said inlet and outlet unions.

5. A heater as defined in claim 4 wherein
said rigid inlet and outlet unions secure a metallic base plate against one end of the insulating body, and
grounding means for said heater is electrically connected to the base plate.

6. A heater as defined in claim 4 wherein
an automatic control means is attached to the insulating body and is responsive to a change in pressure within said bore means for controlling the electric heating current to said electrical heating means.

7. A heater as defined in claim 6 wherein
said control means includes a diaphragm clamped to one side of said body, a duct extending through the wall of said body between said diaphragm and one of said inlet and outlet bores or heater bore means, and an electrical switch secured to said body and actuatable by said diaphragm.

8. A heater as defined in claim 6 wherein
said automatic control means includes a non-return valve which controls the flow of water through said flow duct means.

9. A heater as defined in claim 6 wherein
said automatic control means includes a pressure sensitive switch and a thermostat wired in series to control the electric heating means.

10. A heater as defined in claim 6 wherein
said automatic control means includes a duct extending through the wall of said body, an electrical switch, a movably mounted, spring biased piston member which actuates said electrical switch, a sensitive resilient diaphragm exposed on one side to pressure within said heater bore means via said duct,
said piston member being responsive to movement of said diaphragm, and
the on and off positions of the electrical switch lie within the working stroke of the diaphragm.

11. A heater as defined in claim 6 wherein
said automatic control means includes a single pressure sensitive switch responsive to pressure in said flow duct means.

12. A heater as defined in claim 11 wherein
said pressure sensitive switch includes a resilient diaphragm, a piston means and an electrical switch member,
said control means includes a duct extending through the body between said diaphragm and one of said inlet and outlet bores or said heater bore means,
said diaphragm is exposed on one side to pressure by way of said duct and the piston means is located on the other side of the diaphragm,
said piston means actuates the electrical switch member in response to movement of the resilient diaphragm,
said piston means being spring biased toward said resilient diaphragm.

13. A heater as defined in claim 12 wherein

said resilient diaphragm includes an annular corrugation and

said piston member has a flanged head which nestles within said annular corrugation.

14. A heater as defined in claim **12** wherein

said resilient diaphragm has a flanged rim and

said control means includes a cap member which contacts said flanged rim and sealingly engages said insulating body.

15. An instantaneous water heater comprising:

a. a main rigid insulating body having an inlet and an outlet,

b. flow duct means extending between the inlet and the outlet and including an inlet bore, an outlet bore, a heater bore means, first insulating flexible tube means extending between the inlet bore and the heater bore means, and second insulating flexible tube means extending between the heater bore means and the outlet bore,

c. said inlet bore, outlet bore and heater bore means being disposed within said main insulating body,

d. said first and second tube means being formed separately and independently with respect to the main body and with respect to each other,

e. electrical heating means disposed in the heater bore means,

f. said tube means together with the inlet bore and outlet bore defining a length sufficient to provide a resistance path which minimizes current flow from the electrical heating means to said inlet and said outlet,

g. a clamped on portion being removably secured to one end of said insulating body and forming port means therewith to allow fluid flow through said flow duct means,

h. means for securing the ends of said tube means to said port means.

16. An instantaneous water heater comprising:

a. a main rigid insulating body having an inlet and an outlet,

b. flow duct means extending between the inlet and the outlet and including an inlet bore, an outlet bore, a heater bore means, first insulating flexible tube means extending between the inlet bore and heater bore means, and second insulating flexible tube means extending between the heater bore means and the outlet bore,

c. said inlet bore, outlet bore and heater bore means being disposed within said main insulating body,

d. said first and second tube means being formed separately and independently with respect to the main body and with respect to each other,

e. electrical heating means disposed in the heater bore means,

f. said tube means together with the inlet bore and outlet bore defining a length sufficient to provide a resistance path which minimizes current flow from the electrical heating means to said inlet and said outlet,

g. a clamped on portion being removably secured to one end of said insulating body and forming port means therewith to allow fluid flow through said flow duct means,

h. means for securing the ends of said tube means to the clamped on portion, and

i. automatic control means attached to the insulating body for controlling the electrical heating current to said electrical heating means in response to the fluid flow through said flow duct means.

17. An instantaneous water heater as defined in claim **16** wherein

said automatic control means includes a diaphragm disposed on one side of said body, a duct extending through the wall of said body between said diaphragm and one of the inlet and outlet bores or heater bore means and an electrical switch secured to said main body and actuatable by said diaphragm.

18. A heater as defined in claim **16** wherein

said control means includes first and second resilient diaphragm members, first and second ducts extending through the wall of said body, and an electrical switch secured to said body,

said first duct extending between the inlet bore and the first diaphragm member which is thereby exposed on one side to pressure within the inlet bore,

said second duct extending between the outlet bore and the second diaphragm member which is thereby exposed to pressure with the outlet bore, and

said first and second diaphragm members being mechanically tied together,

whereby the control means is responsive to the pressure differential between the inlet and outlet bores.

19. A heater as defined in claim **18** wherein

said electrical switch has an off and on position which lies within the working stroke of said first and second diaphragms.

20. A heater member as defined in claim **18** wherein

each diaphragm has a flanged rim and

a first cap member contacts the flanged rim of said first diaphragm and sealingly engages a first side of the insulating body and a second cap member contacts the flanged rim of said second diaphragm and sealingly engages the other side of the insulating body.

21. A heater member as defined in claim **18** wherein

the first and second diaphragm members are located on the same side of the insulating body.

22. An instantaneous water heater having an inlet and an outlet and comprising:

a. an insulating body having a clamped on portion and a main portion, said main portion defining an inlet bore connected to said inlet, an outlet bore connected to said outlet and a heater bore means,

b. an electrical heating means disposed in said heater bore means,

c. said inlet bore, outlet and heater bore means being connected to ports in said clamped on portion to which external tube means are secured whereby to connect said heater bore means to said inlet and outlet bores to form a flow duct means running from said inlet to said outlet,

d. said tube means being composed of flexible, electrical insulating material, and

e. housing means defining a confined space around the insulating body,

f. said external tubes being looped into the confined space to provide a length of flexible tube means together with the inlet bore or the outlet bore sufficient to form the required long electrical resistance paths between the heating element means and the inlet and outlet.

23. An instantaneous water heater having an inlet and an outlet and comprising:

a. a back plate,

b. a main insulating body secured to said back plate,

c. a cover secured to said back plate to enclose said body,

d. a flow duct means extending between the inlet and outlet and including an inlet bore, an outlet bore, a heater bore means, first insulating flexible tube means extending between the inlet bore and the heater bore means, and second insulating flexible tube means extending between the heater bore means and the outlet bore,

e. said inlet bore, outlet bore, and heater bore means being disposed within said main insulating body,

f. said first and second tube means being formed separately and independently with respect to the main body and with respect to each other,

g. electrical heating means disposed in the heater bore means,

h. said tube means together with the inlet bore and the outlet bore defining a length sufficient to provide a resistance path which minimizes current flow from the electrical heating means to said inlet and said outlet,

i. a clamped on portion being removably secured to one end of said insulating body annd forming port means therewith to allow fluid flow through said flow duct means,

j. means for securing the ends of said tube means to said port means, and

k. switch means mounted on said body to control the flow of electric current to said electrical heating means.

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