

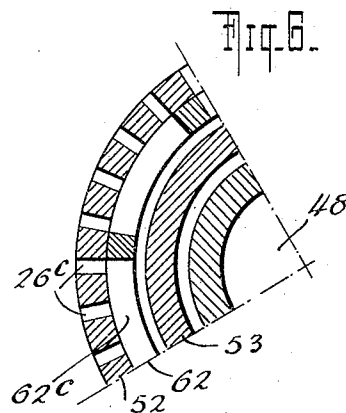
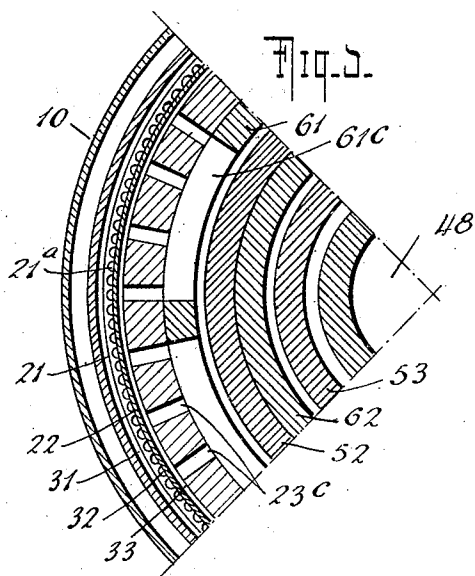
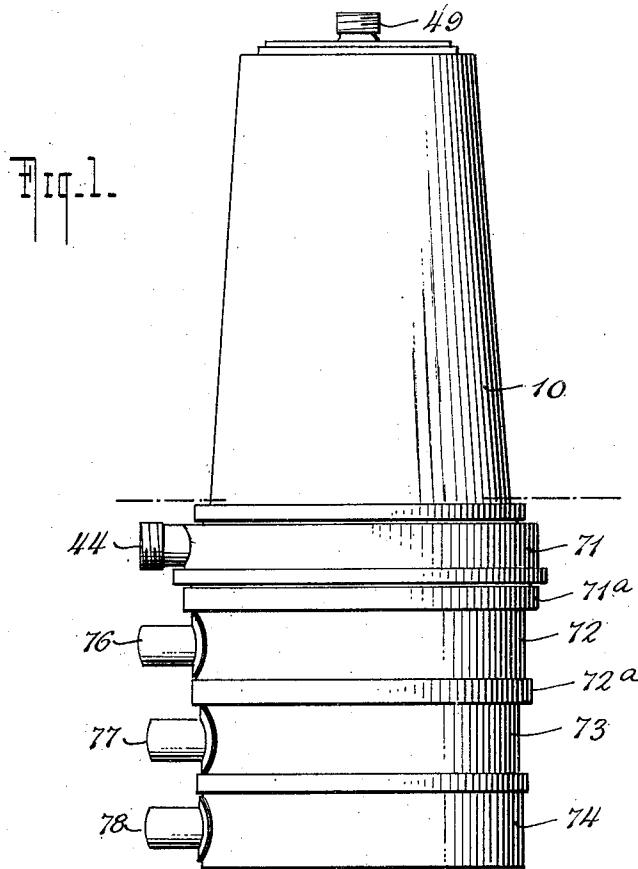
June 24, 1930.

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1,766,480

LIQUID HEATER

Original Filed April 5, 1926 6 Sheets-Sheet 1



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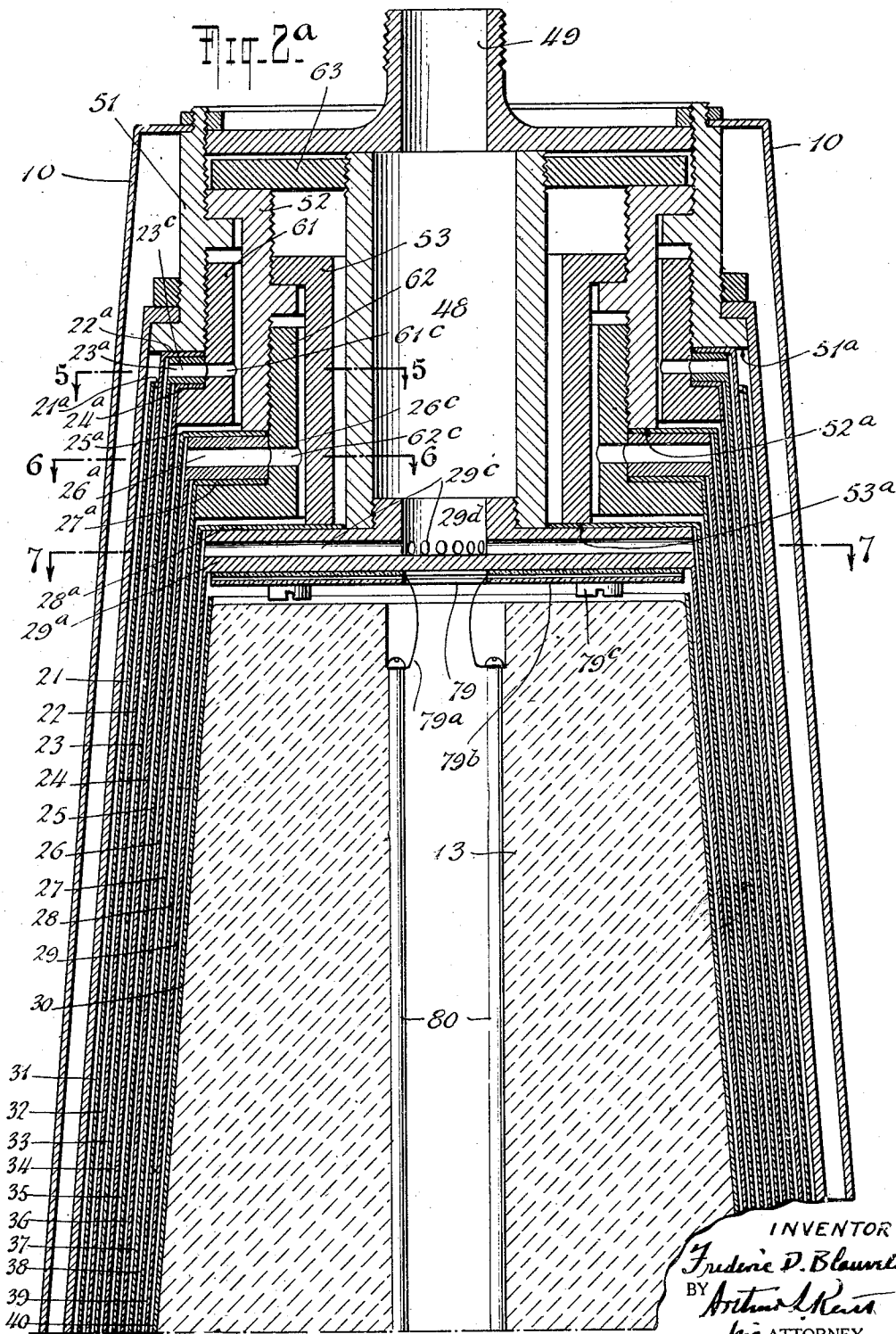
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LIQUID HEATER

Original Filed April 5, 1926 6 Sheets-Sheet 2



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LIQUID HEATER

Original Filed April 5, 1926

6 Sheets-Sheet 3

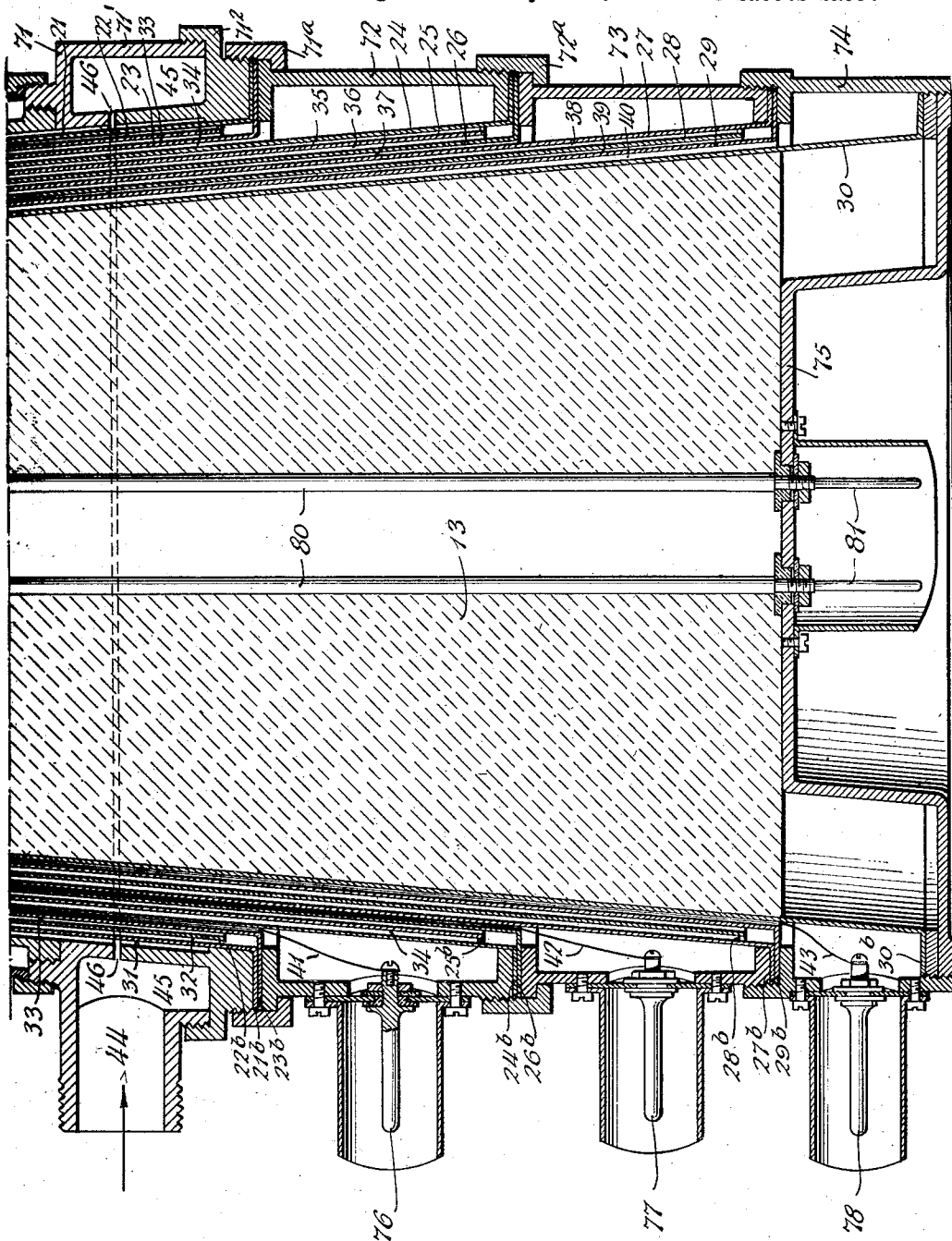


Fig. 2b

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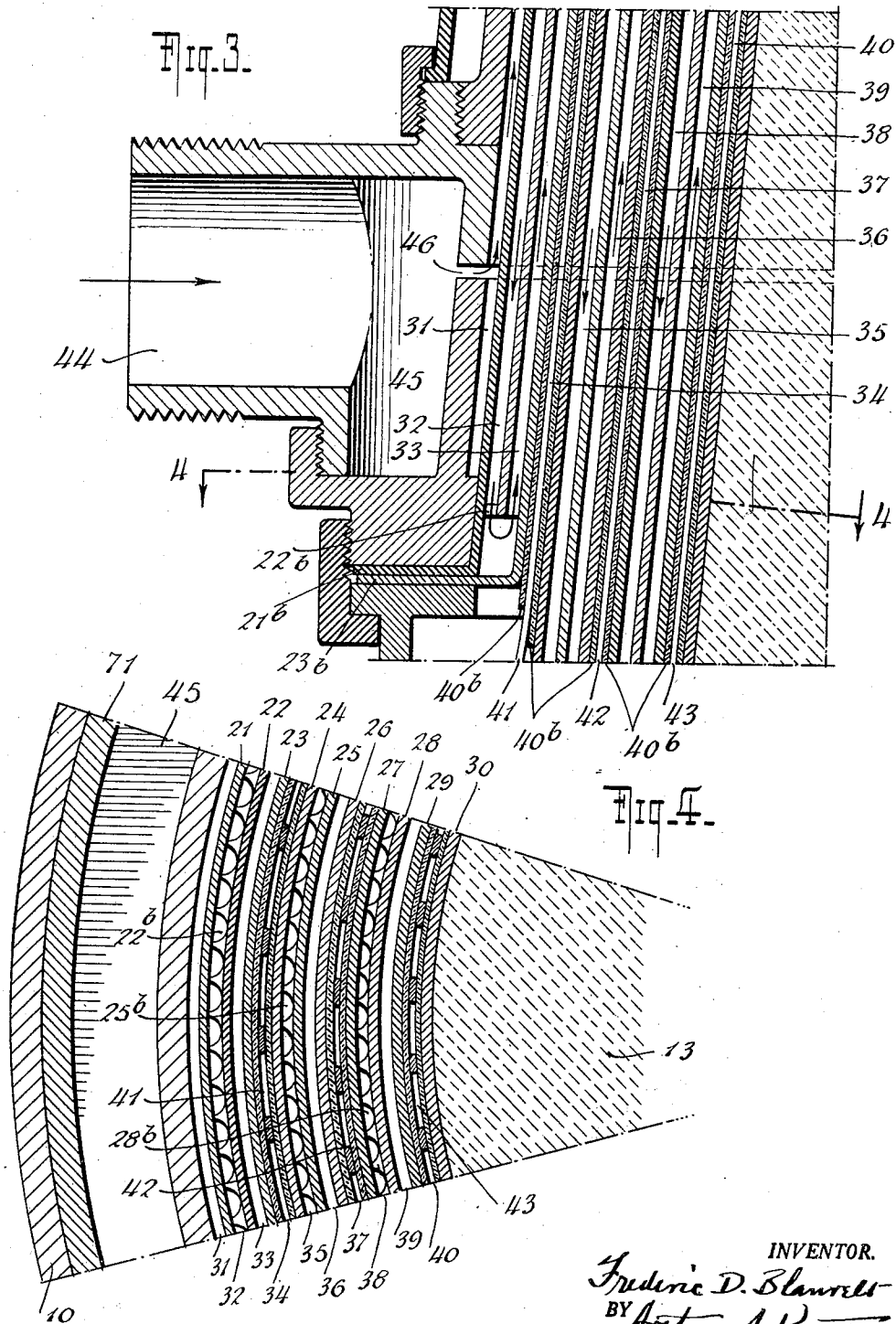
June 24, 1930.

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LIQUID HEATER

Original Filed April 5, 1926 6 Sheets-Sheet 4



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LIQUID HEATER

Original Filed April 5, 1926 6 Sheets-Sheet 5

Fig. 8.

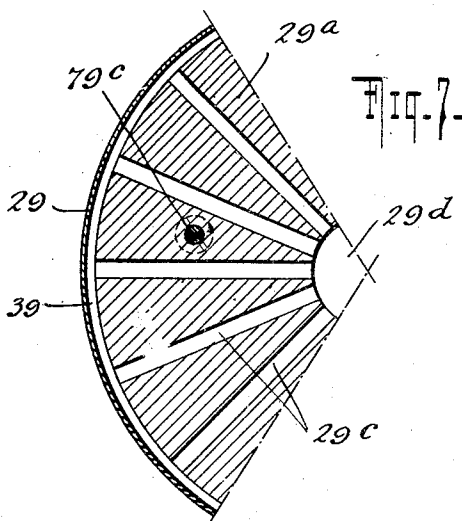
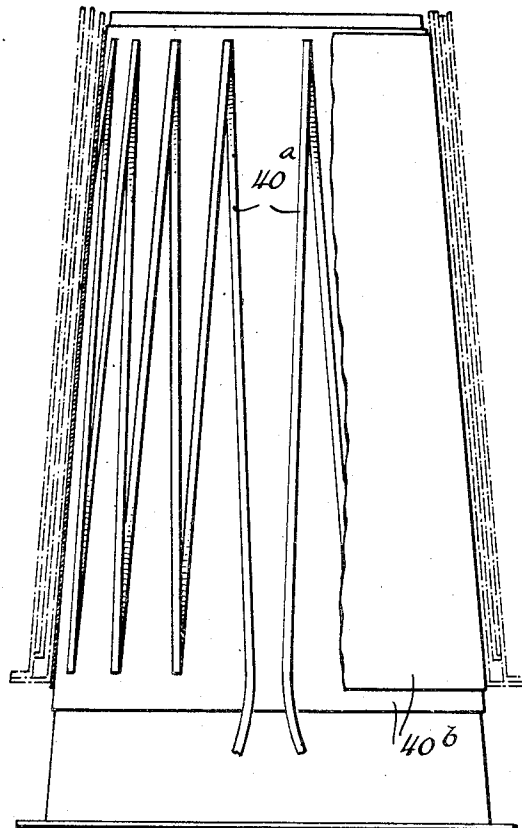


Fig. 7.

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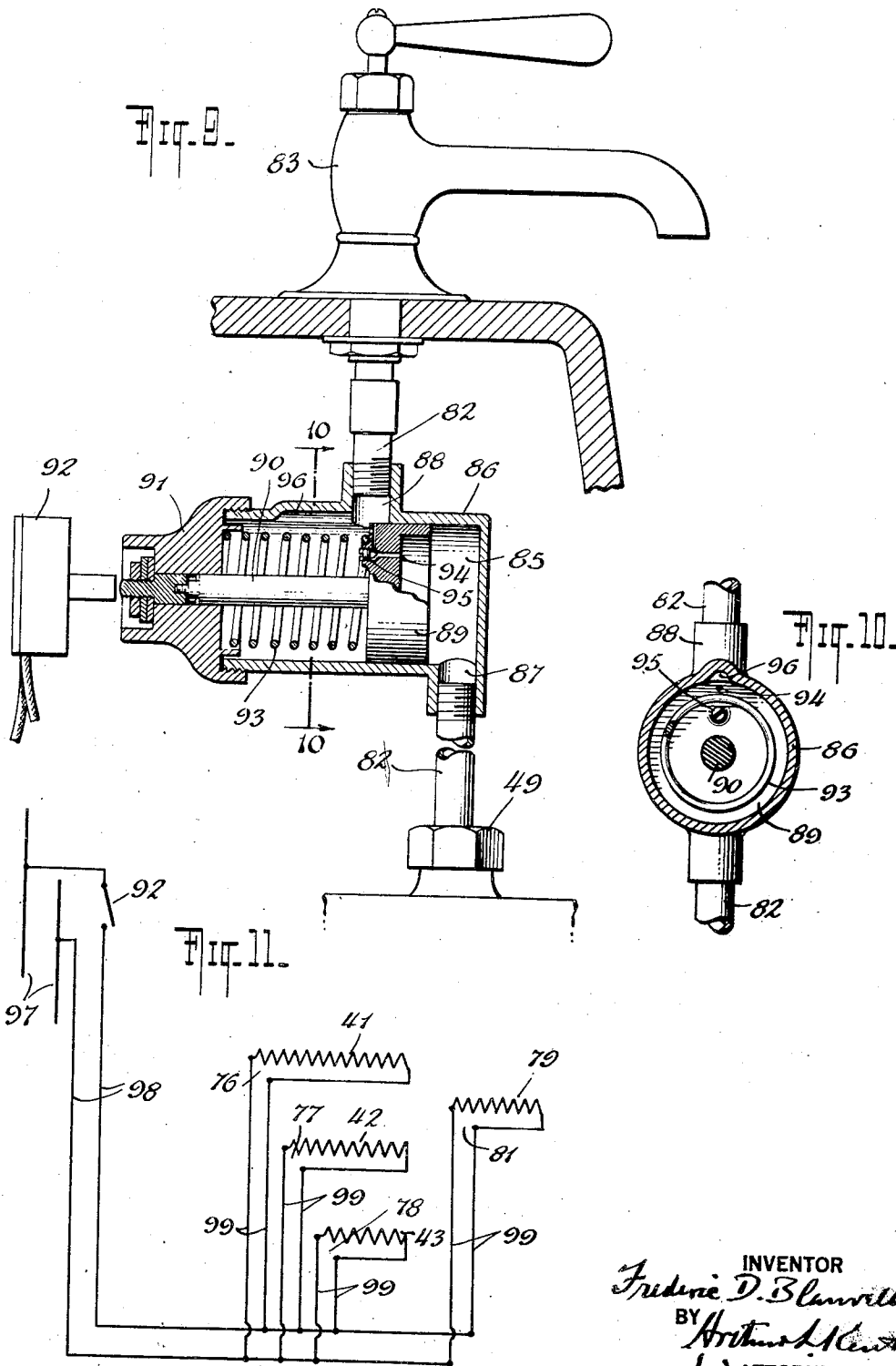
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LIQUID HEATER

Original Filed April 5, 1926 6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

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LIQUID HEATER

Application filed April 5, 1926, Serial No. 99,798. Renewed May 3, 1929.

This invention relates to liquid heaters, and aims to provide a rapid and efficient means for heating water or other liquid.

The invention has been made especially with the object of providing an improved "instantaneous" electric water heater which may be connected in the supply pipe leading to a faucet in a bath room or other place where hot water is desired. The heater is brought into operation on the opening of the faucet, and the water is heated as it flows to the faucet so that a supply of hot water is available almost immediately. When the faucet is closed the operation of the heater is stopped. This fact, coupled with the insulation of the heater by means of the flowing water, prevents loss of heat and waste of electricity.

A feature of the invention consists in heating the water rapidly by forming it into a very thin stream which is caused to flow over an extended heating surface. This is effected without retarding the flow of water by making the thin stream of such width that its cross-section is at least as large as that of the delivery pipe.

A further feature of the invention consists in providing a very thin heating element with extended heating surfaces over which the wide thin stream of water may be passed.

A further feature of the invention consists in avoiding loss of heat and preventing injury to the apparatus through a sudden chilling of the heating elements, by forming the stream of incoming water into an envelope surrounding the water which is in contact with the heating elements, so that the heat radiated from the water which is in contact with the heating elements is absorbed by the envelope of incoming water and serves to preheat the water.

A further feature of the invention consists in providing means whereby the supply of electricity to the heater is controlled by the flow of water through the heater.

An approved form of heater embodying the invention is provided with a number of thin concentric walls which are spaced apart so as to provide between them concentric spaces or passages which are annular in

cross-section. For the sake of brevity I shall throughout this application designate such spaces and passages by the word "annular," indicating thereby that their cross-sections have the general form of annulæ. Thin annular heating elements are provided in alternate spaces between the concentric walls in the inner portion of the heater. The two outer spaces and the alternate inner spaces not occupied by the heating elements are connected in series to form a flow passage for the water which enters at one end of the outer annular passage and flows out through one end of the inner annular flow passage.

An important feature of the invention consists in making the concentric walls which enclose the annular spaces in the form of conical frusta. This not only increases the efficiency of the heating, as hereinafter explained, but greatly facilitates the construction of the heating elements and of the whole heater.

Other features and advantages of the invention are hereinafter set forth in connection with a detailed description of a practical heater embodying the invention which is shown in the accompanying drawings, in which:—

Fig. 1 is an external elevation of the heater;

Figs. 2^a and 2^b are an axial section of the heater on a larger scale;

Fig. 3 is a fragmentary section taken on the same section plane as Figs. 2^a and 2^b, and showing the portion of the heater adjacent to the water inlet on a scale larger than Fig. 2^b.

Fig. 4 is a fragmentary transverse section on the line 4—4 of Fig. 3 drawn on the same scale as Fig. 3.

Figs. 5, 6 and 7 are partial horizontal sections taken on the lines 5—5, 6—6, 7—7 of Fig. 2^a respectively;

Fig. 8 is an elevation of a part of the heater with the outer parts omitted to show one of the heating elements and with a part of the outer insulation of this heating element broken away to show the resistance wire thereof;

Fig. 9 is an elevation of the outlet con-

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nections of the heater showing in axial section the device for controlling the supply of electricity to the heater by means of the flow of water therethrough;

Fig. 10 is a section on the line 10—10 of Fig. 9; and

Fig. 11 is a diagram of the electric circuits and connections of the heater.

The heater illustrated has an outer casing 10, and a core 13 of refractory heat insulating material such as infusorial earth. Between the outer casing and the core are a series of spaced concentric walls 21, 22, 23, 24, 25, 26, 27, 28, 29 and 30 which with the outer casing enclose long thin annular spaces 31, 32, 33, 34, 35, 36, 37, 38, 39 and 40. In order that the heat may pass through them quickly, the walls 21 to 30 are made thin and of material which is a good heat conductor, such as copper or brass. In the annular spaces 34, 37 and 40 are heating elements 41, 42, 43, each of which consists of a zig-zag ribbon resistance wire 40^a enclosed between two sheets 40^b of insulating material such as mica.

The water to be heated enters the heater through an intake nipple 44 into an annular chamber 45 which communicates through a circumferential slit 46 in the outer casing 10 with the outer annular space 31 near the lower end thereof. The annular spaces not occupied by the heating elements are connected at their ends in series by passages hereinafter described so that the water entering near the lower end of the annular passage 31 flows up in the passage 31, down in the passage 32, up in the passage 33, down in the passage 35 (thus passing on both sides of the heating element 41 in the space 34), up in the passage 36 and down in the passage 38 (thus passing on both sides of the heating element 42 in the space 37), up in the passage 39 (passing over the outer side of the heating element 43 in the space 40), and escapes through a central pipe 48 leading to an outlet nipple 49 at the center of the top of the heater.

It will be noted that the water flowing through the annular passages is spread out into a very thin annular stream which brings it effectively into contact with the extended heating surfaces provided by the walls which enclose the heating elements. A very rapid heating of the water is thus assured. At the same time a normal flow of water is secured by making the cross-area of the annular passage at its smallest point, that is to say, at the upper end of the passage 39, as great as, and usually slightly greater than, that of the discharge nipple 49, so that it shall have, most desirably, a flow capacity substantially equal to that of the discharge nipple, so as not to materially retard the rate of flow of water through the heater, or through the conduit in which the heater is inserted.

Loss of heat is prevented by the large internal insulating core 13 and by the envelope of incoming water provided in the annular passages 31 and 32. It will be noted that the incoming water is compelled to pass all the way up through the passage 31 and down through the passage 32 before striking the first heating surface, the wall 23. The heat passing outwardly from the heating elements and the parts of the stream of water in contact with them is therefore absorbed by the incoming envelope of water in the passages 31 and 32 so that instead of being wasted it serves to preheat the incoming water. In addition to saving heat, this prevents injury to the apparatus through too rapid expansion or contraction of any of the walls since the water is warm before it strikes the first hot wall 23.

The physical construction of the heater will now be described in detail. It may be noted that the most difficult problem in constructing a heater to function in the manner above described lies in providing a practical method for assembling the thin concentric walls so that the annular spaces between them may be of uniform thickness both circumferentially and longitudinally, and so that the heating elements may be compressed within the narrow spaces allotted to them. This problem has been solved by making the walls 21 to 30 frusto-conical and mounting and connecting them in the manner now to be described.

The frusto-conical walls 21 to 30, hereinafter termed "cones" for the sake of brevity, are provided with internal flanges 21^a, 22^a, etc. at their smaller upper ends and with external flanges 21^b, 22^b, etc., at their larger lower ends, except that the innermost cone 30 has no flange at its upper end. The flanges 21^a, 22^b, 25^b and 28^b of the four cones which have water passages on both sides are short spacing flanges which are scalloped or otherwise cut away so as not to obstruct the flow of water through them (see Figs. 4 and 5). The internal flanges 23^a, 26^a, 29^a of the three cones which lie directly outside the three heating elements 41, 42, 43 are of much greater thickness than the cones and contain radial passages 23^c, 26^c and 29^c which form part of channels for passing the stream of water around the upper edges of the three heating elements. These thick flanges 23^a, 26^a and 29^a are formed separately from the cones 23, 26 and 29 and integrally secured thereto by welding. All the other flanges of the cones are of the same thickness of the cones and are formed integral therewith.

Means are provided for clamping the upper and lower flanges of the cones (other than the spacing flanges 21^a, 22^b, 25^b and 28^b) to secure the cones in position within

the outer frame 10 of the heater. In the upper part of the heater are three concentric spaced sleeves 51, 52, 53 whose lower ends provide annular abutments 51^a, 52^a, 53^a, spaced radially and longitudinally, against which the upper flanges of the cones are clamped by means of flanges 61^a, 62^a on draw sleeves 61, 62, and the outlet pipe 48 and a disk 63.

The lower portion of the outer wall 10 of the heater is constructed of separate rings 71, 72, 73, 74 between which the lower flanges of the cones are clamped. The ring 71 consists of two parts 71' and 72² which cooperate in forming the annular chamber 44 and in providing an inlet slit 46.

Before the cones are placed in position the abutment sleeves 51, 52 and 53 are secured together in a manner indicated in Fig. 2^a and are connected with the upper ring 71 by means of a double cone 80 forming part of the outer wall 10 of the heater. The three outer cones 21, 22 and 23 are then nested one within the other and inserted within the ring 71 and the double cone 80. The heating element 41 is then placed around the fourth cone 24, the second ring 72 is placed around the lower portion of this cone, and the cone and heating element are then inserted within the cone 23. The draw sleeve 61 is then inserted within the cone 24 and screwed into the sleeve 51 so as to clamp the flanges 22^a, 23^b and 24^a against the abutment 51^a, thus drawing the cones firmly one within the other and compressing the heating element 41 between the cones 23 and 24 so as to flatten down its resistance ribbon and force the ribbon against the mica cones and the mica cones against the cones 23 and 24.

The cones 25 and 26 are then nested and inserted within the cone 24. The ring 73 is placed about the lower portion of the cone 27, the heating element 42 is placed about the upper portion of this cone, and the cone and heating element are then inserted within the cone 26. The draw sleeve 62 is then inserted in the cone 27 and screwed into the sleeve 52, clamping the flanges 25^a, 26^a, 27^a against the bottom 52^a, drawing the three cones together and compressing the heating element as before.

The cones 28 and 29 are then nested and inserted in the cone 27 after screwing the pipe 63 to the flange or disk 29^a. The flange 28^a and the disk 29^a are then forced against the abutment 53^a by screwing down a disk 63 on the pipe 48.

The rings 71, 72 and 73 are then secured together by screw collars 71^a, 72^a, and the ring 74 is then screwed on the ring 73, thus clamping the lower flanges 21^b, 23^b, 24^b, 26^b, 27^b and 29^b.

The third heating element 43 is then placed around the cone 30. The core 13 is

placed within the cone 30 and seated on a bottom plate 75 which is then screwed into the lower ring 74, forcing the cone 30 up into the cone 29 and compressing the third heating element.

The drawing of the cones firmly one within the other when the device is assembled bring the spacing flanges 22^a, 25^b, 28^b which extend across the water passages into firm engagement with the cones adjacent to those on which they are formed and accurately centers these cones so as to make each water passage of uniform width. At the same time the drawing in of the cones compresses the heating elements 41, 42, 43 between the cones adjacent to them, flattening and smoothing the ribbon resistance wires 40^a, and eliminating from between these wires and the mica sheets 40^b and between the mica sheets and the cones all air spaces which would otherwise delay the transmission of the heat generated in the resistance wires to the metal cones the water surrounding them.

When the assembly has been completed, water passages are provided around the upper end of the cone 21 and lower ends of the cones 22, 25, 28; a water passage around the upper end of the heating element 41 is provided by the radial passages 23^c, registering radial holes 61^c in the draw sleeve 61, and the annular space between the draw sleeve 61 and the sleeve 52 and the space between the lower end of the sleeve 61 and the upper surface of the flanges 25^a; a water passage around the upper end of the second heating element 42 is provided by the radial passages 26^c in the flange 26^a, registering holes 62^c in the draw sleeve 62, and the annular space between the draw sleeve 62 and the sleeve 53 and the space between the bottom of the draw sleeve 62 and the top of the flange 27^a; and an outlet from the space 39 is provided by the radial passages 29^c and central opening 29^d in the disk 29^a.

As will be seen from Fig. 2^b, the inner one of the pair of cones surrounding each of the heating elements 41, 42, 43 extends below the lower end of the outer one of the pair providing a free space into which the ends of the resistance wire 40^a of the heating element extends. In the embodiment shown the ends of the resistance wires of the three heating elements are connected to terminals 76, 77, 78 inserted in the rings 72, 73 and 74, respectively.

A final heating of the water may be secured by a flat heating element 79 consisting of a resistance wire 79^a enclosed between two mica disks 79^b and secured to the lower side of the disk 29^a by screws 79^c which enter the disk 29^a between the radial water passages 29^c therein. The ends of the resistance wire 79^a of this heating element are connected by means of rods 80 extending through a hole

in the center of the insulating core 13 to terminals 81 at the bottom of the heater.

Outlet water connections which may be used with a heater are illustrated in Fig. 9, wherein it may be seen that the outlet nipple 49 of the heater is connected by a short pipe 82 to means for withdrawing the water for use, such, for example, as a faucet 83. In the pipe 82 is inserted the control device 85 illustrated in Figs. 9 and 10. This device includes a cylinder 86 having a water inlet 87 at one end and an outlet 88 at one side. In the cylinder is a piston 89 having a stem 90 extending through the cylinder head 91 and terminating adjacent to a push button switch 92 controlling the supply of electric current to the heater. The plunger and stem are normally urged away from the switch by the spring of the switch and a compression spring reacting between the plunger and the piston head. The portions of the cylinder at opposite sides of the plunger are connected by a small by-pass passage 94 which may extend through the plunger as shown. The effective size of this passage may be varied by an adjustable screw valve 95.

The operation of the controlling device is as follows:—When the faucet 83 is closed the water pressure in the two ends of the cylinder 86 is equalized by leakage through the by-pass passage 94 so that the piston and plunger assume their normal positions shown in Fig. 9 under the effect of the compression spring 93. In this position the plunger obstructs the flow of liquid from the entrance opening 87 to the outlet opening 88.

When the faucet 83 is opened the pressure at the inner end of the cylinder is at once reduced so that the water supply pressure in the outer end of the cylinder forces the plunger 89 inward, uncovering the outlet 88 and permitting a flow of water through the heater and to the faucet. During the drawing of water the plunger remains in retracted position owing to the fact that a passage 96 connecting the inner end of the cylinder with the outlet 88 prevents the building up of any pressure in the inner end of the cylinder. As soon as the faucet is closed, however, the pressures in the two ends of the cylinder are equalized, and, as the liquid passes through the by-pass 94, the plunger 89 is returned to its normal position by the springs. Throughout the time that water is being drawn and the plunger remains in its inner position the end of the stem pushes in the button of the switch 92 causing electric current to be supplied to the heater.

The electrical connections are shown in Fig. 11 where it will be seen that when the switch 92 is closed electric current is taken from the main supply lines 97 and passed through the resistance wires of the heating

elements 41, 42, 43, 78 in parallel. Each of the pairs of terminals 75, 76, 77, 78, 81 is connected to leads 98 through a separate pair of wires 99 so that the wires 99 may be made comparatively small and easy to handle. The amount of heat generated in the heater may be regulated by disconnecting the wires from one or more of the terminals 76, 77, 78, 81, so that when the water supplied to the heater is already comparatively warm no more electricity need be used than is necessary to raise it to the desired temperature.

What I claim is:

1. A water heater having an outer casing containing a circumferential slit and a central opening at one end, means for introducing a liquid through said circumferential slit and withdrawing it through said central opening, and means within the casing providing concentric annular flow passages connected in series, the outer passage communicating with said circular slit, and the inner annular passage with said central outlet.

2. A water heater, comprising a plurality of frusto-conical walls, means forming part of the heater structure for forcing said walls one within another and holding them in spaced relation, said means containing flow passages connecting spaces between said walls.

3. A water heater, comprising a set of frusto-conical walls some of which have internal flanges at their smaller ends, means at one end of the heater for providing spaced annular abutments, and means for forcing the internal flanges of said walls against said abutments.

4. In a water heater, a series of spaced concentric sleeves providing spaced abutments at their lower ends, a set of frusto-conical walls some of which have internal flanges at their smaller ends, and draw sleeves threaded to said spaced sleeves and having external flanges adapted to engage the flanges of the walls and draw them against the abutments.

5. A heater, comprising a set of frusto-conical walls having internal flanges at their smaller ends and external flanges at their larger ends, means at one end of the heater for clamping said internal flanges, a set of rings forming part of the wall of the heater for clamping the external flanges of said walls, and a wall connecting the internal clamping means with the one of said rings.

6. In a water heater, three spaced concentric frusto-conical walls, and an open flange at one end of the middle wall engaging the inner surface of one of the other walls, to provide a flow passage extending between said walls and through said open flange.

7. In a water heater, the combination of

three frusto-conical walls of which the two outer walls have external flanges at their lower ends, means for clamping said flanges together, and an open flange at the lower end of the middle wall engaging the inner surface of one of the other walls so as to position it between them.

8. In a water heater, two frusto-conical walls, an electrical heating element between said walls, and means forming part of the heater structure and adapted to force the inner wall within the outer wall and toward the smaller end thereof to compress the heating element between them.

9. In a water heater, two frusto-conical walls, an electrical heating element between said walls, and means for drawing the inner wall within the outer wall and toward the smaller end thereof to compress the heating element between them, the drawing means providing a flow passage extending across the top of the heating element.

10. In a heater, the combination of two frusto-conical walls, a ribbon resistance wire between said walls, insulating sheets between the resistance wire and each wall, and means forming part of the heater structure and adapted to force the inner wall toward the smaller end of the outer wall to flatten the resistance wire and force it against the insulating sheets and these sheets against the walls.

11. In an electric heater, two frusto-conical walls, an electric heating element between said walls, an internal flange at the smaller end of the outer wall containing a radial flow passage, an internal flange at the smaller end of the inner wall, and means for clamping said flanges together, said means containing a flow passage communicating with the flow passage in the flange of the outer wall and extending around the flange of the inner wall.

12. In a water heater, two concentric frusto-conical walls, an electric heating element between them, external flanges at the larger ends of said walls, a spacing ring between said flanges, means for clamping the flanges against the ends of the spacing ring, and electrical conductors extending to said heating element through an opening in the spacing ring.

13. In a water heater, two concentric frusto-conical walls, an electric heating element between them, external flanges at the larger ends of said walls, a spacing ring between said flanges, electrical conductors extending to said heating element through an opening in the spacing ring, internal flanges at the smaller ends of said walls, and means for clamping said flanges together and providing a flow passage around the upper end of the heating element.

14. In a water heater, two concentric frusto-conical walls, an internal flange at the

smaller end of the outer wall, a disk at the smaller end of the inner wall containing a radial passage and a central opening, means for clamping the flange of the outer wall against said disk to provide a flow passage between said walls and through the passages and opening in said disk, an annular electrical heating element adjacent to one of said walls, and a flat electrical heating element adjacent to one side of said disk.

15. In a water heater, a frusto-conical insulating core, an electric heating element surrounding said core, a frusto-conical wall surrounding said heating element, and means for forcing said core into said wall to compress said heating element.

16. In a water heater, a set of concentric frusto-conical walls having internal flanges at their smaller ends and external flanges at their larger ends, electrical heating elements in each third space between said walls, spacing rings between the external flanges of the pair of walls surrounding each heating element, a pair of electrical conductors for each heating element entering it through an opening in one of said rings, means for clamping the internal flanges of the walls, such means providing flow passages extending across the top of each heating element.

In testimony whereof I have hereunto set my hand.

FREDERIC D. BLAUVELT.

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