No. 869,464. PATENTED OCT. 29, 1907.

G. E. STEVENS.

ELECTRIC HEATER.

APPLICATION FILED MAY 23, 1904.

2 SHEETS—SHEET 1.

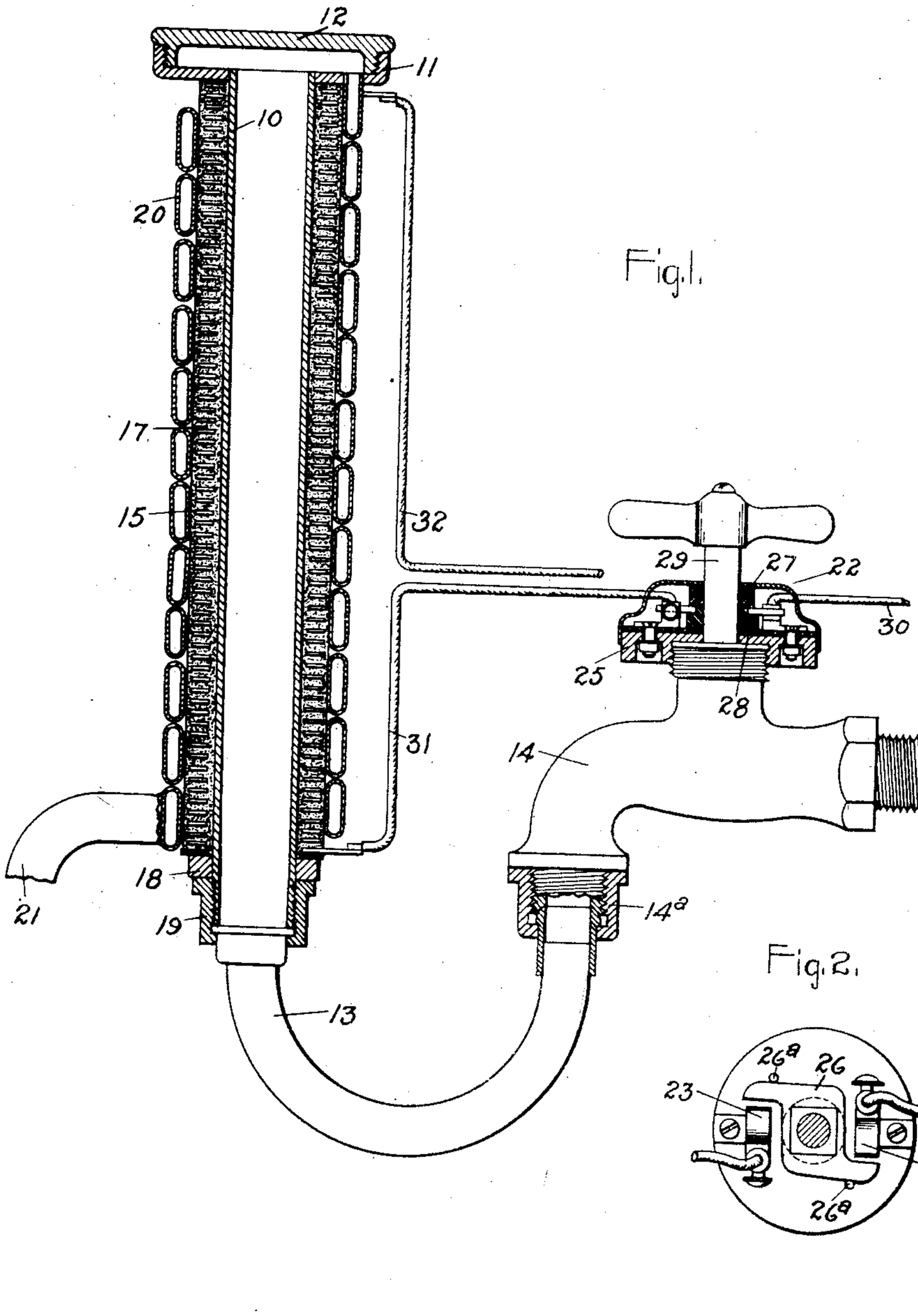

Fig. 1.

Fig. 2.

WITNESSES:

Robt. C. Lothrop

Helen Alford

INVENTOR:

George E. Stevens.

by Albert G. Davis

Atty.

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2 SHEETS—SHEET 2.

Fig. 3.

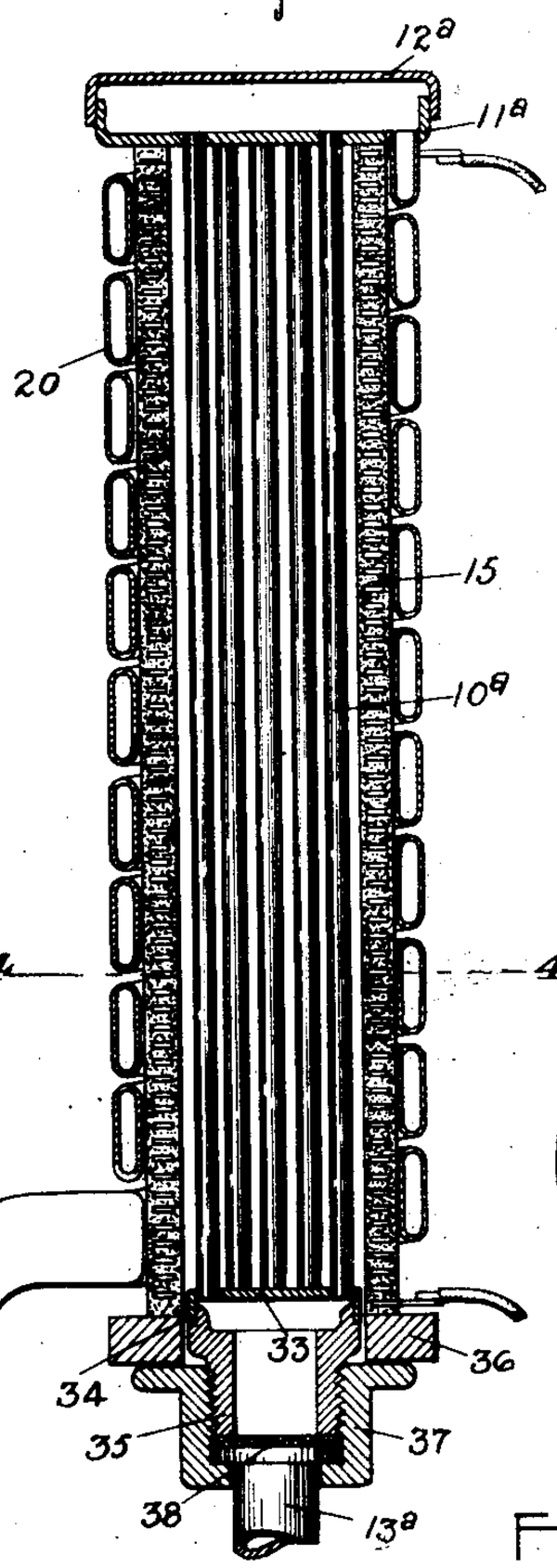


Fig. 5.

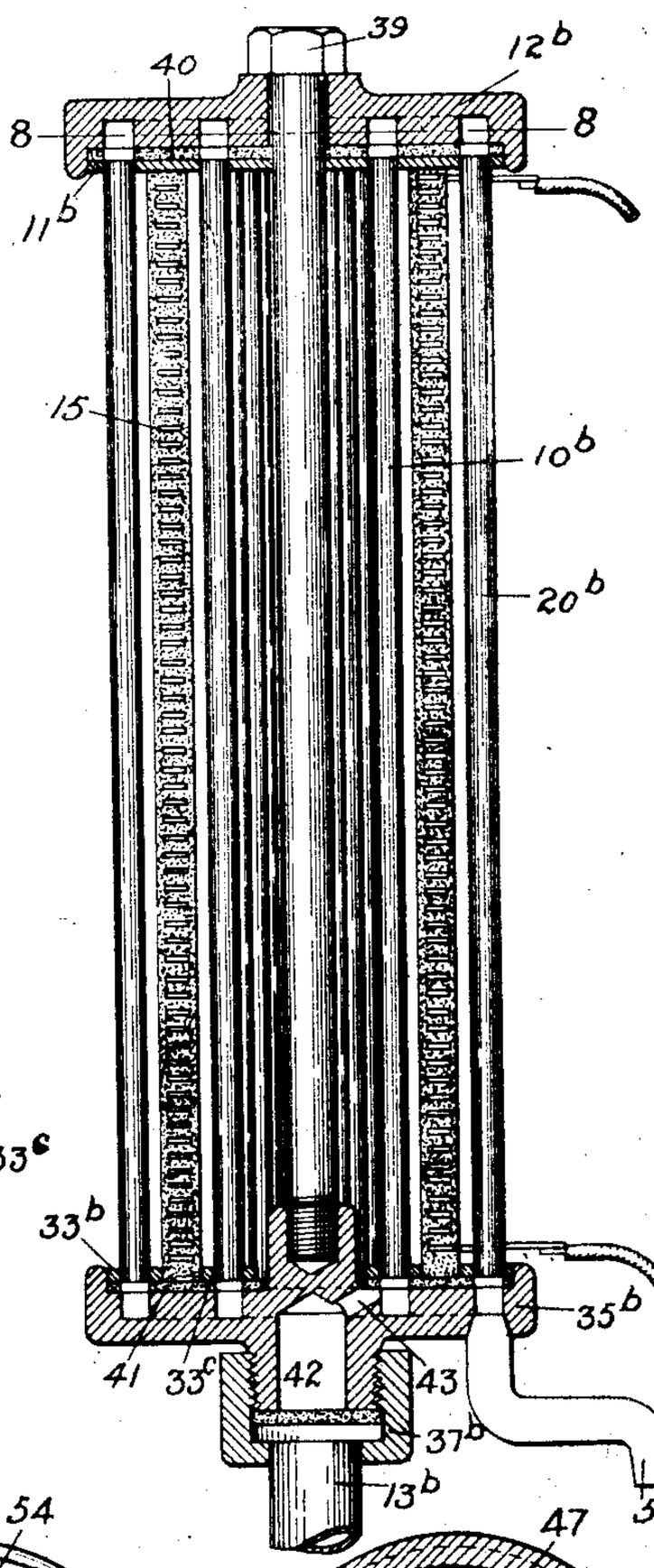


Fig. 6.

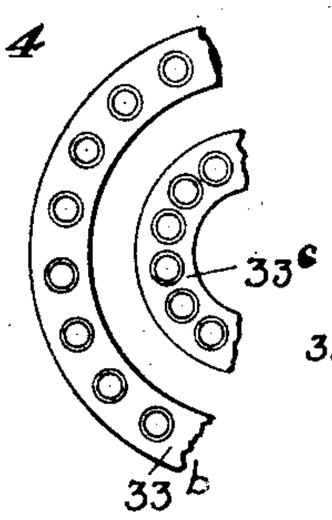


Fig. 4.

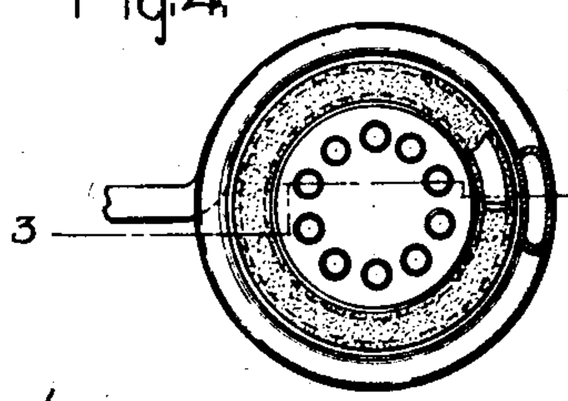


Fig. 7.

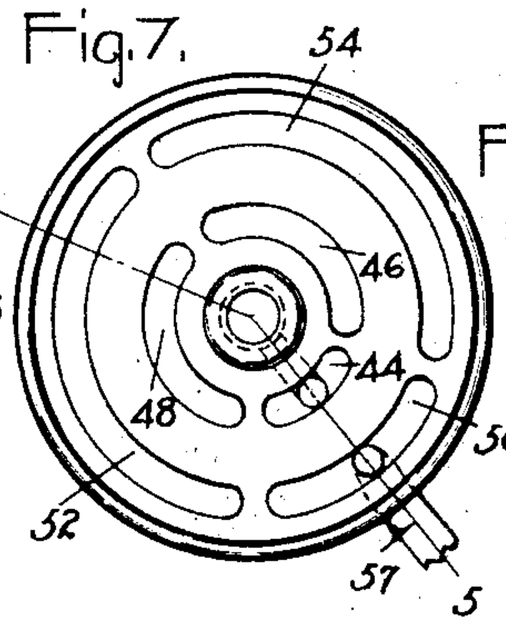
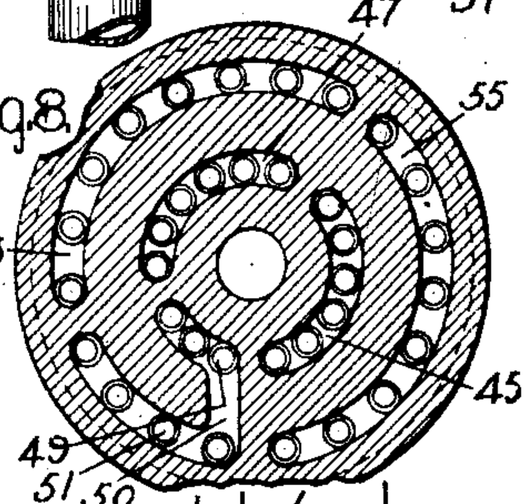


Fig. 8.



WITNESSES:

Robt. C. Lehmann

Helen Alford

INVENTOR:

George E. Stevens

by Albert G. Davis

Atty.

UNITED STATES PATENT OFFICE.

GEORGE E. STEVENS, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC HEATER.

No. 869,464. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed May 23, 1904. Serial No. 209,258.

To all whom it may concern:

Be it known that I, GEORGE E. STEVENS, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Electric Heaters, of which the following is a specification.

My invention relates to electric heaters for water or other fluids and has particular reference to that type in which an electric resistance conductor is employed as the source of heat in contradistinction to the electrolytic type in which the fluid is heated by passing the current through it.

The principal object of the invention is to provide a heater which will be efficient in operation, compact in structure, and cheap to manufacture.

In carrying out my invention I employ a novel organization in which the heating unit is provided with a central open space and is preferably composed of a spirally-arranged resistance conductor having its convolutions in close mechanical relation and insulated from each other and in which the fluid passages are arranged so as to bring the fluid into convective or heat conductive relation with both the interior and exterior of the walls of the unit. The heater is also preferably designed for direct connection to a fluid supply pipe and so proportioned that the fluid will be heated while it passes through the heater in an uninterrupted stream. This heater may also be constructed as an attachment to be applied directly to a faucet and when so used I employ a controlling switch which is arranged so as to close the circuit through the heater when the faucet is turned on, and to break the circuit when the faucet is turned off.

The specific character of the invention will be best understood upon reference to the following detailed description taken in connection with the accompanying drawing in which I have illustrated the invention in three different forms.

In said drawings, Figure 1 is a sectional view of the simplest form of the invention shown directly connected to a faucet; Fig. 2 is a plan view of the switch controlling the heater circuit; Figs. 3 and 4 illustrate vertical and horizontal sections, respectively, of a modified heater provided with a plurality of central conducting tubes, the planes of section being indicated by the lines 3 3 in Fig. 4 and 4 4 in Fig. 3, respectively; Fig. 5 is a vertical section of the third form of heater; Fig. 6 is a detailed view of a portion of the connecting rings located at the lower ends of the tubes of this heater; Fig. 7 is a plan view of the lower cap; and Fig. 8 is a horizontal section of the upper cap, the plane of section being indicated by the line 8 8 in Fig. 5.

Throughout these figures like characters refer to like parts

Referring in detail to that form of the invention illustrated in Fig. 1, 10 designates a central tube or pipe which opens at its upper end into a chamber formed between the head 11 and the cap 12, and communicates at its lower end through any suitable connection, as the tube 13, with the faucet 14 from which water or other fluid supply is obtained, the connection between the tube 13 and the faucet being in the present instance a union coupling 14^a. Located just exteriorly of the tube 10 is the heating unit 15. This unit preferably consists of a spirally-arranged resistance conductor composed of a thin strip of ribbon of iron, steel or other suitable resistance material wound on edge into a spiral with its convolutions in close mechanical relation but separated and protected by a thin film of insulation 17. This insulation may be of any desired kind but preferably I employ a refractory insulating compound composed of kaolin and silicate of soda. This unit 15 need not be more fully described in the present case since it constitutes no part of the present invention except in so far as it coöperates and combines with the other elements of the heater. It is made the subject-matter of a separate application, Serial Number 193,713, filed by me February 15, 1904. The heating unit 15 is held in place by a ring 18 pressed against its lower end by the coupling nut 19 which connects the tubes 10 and 13. In direct communication with the passage at the upper end of the tube 10 formed between the parts 11 and 12 is a flattened spiral tube 20 which passes around the exterior of the unit 15 in close proximity thereto and terminates at the lower end of the tube in an outlet spout 21.

For the purpose of cutting in and out of circuit the resistance unit 15 a switch 22 is employed. This switch is located directly upon the faucet 14 and comprises essentially two fixed terminal clips 23 24 and a movable bridging contact 26. The clips 23 24 are firmly mounted on and insulated from a supporting base 25 screwed onto the body of the faucet adjacent to the valve spindle and handle. The bridging contact 26 is frictionally held between two insulating pieces 27 and 28 fixed to the spindle 29 so that it is free to rotate therewith when unobstructed. The clips 23 24 and coöperating stops 26^a limit the movement of the contact 26. The switch is connected in circuit with any suitable source of supply and the resistance unit 15 by the leads 30 31 32 as clearly illustrated in Fig. 1.

In the operation of the device, when the faucet is opened or closed the switch contact 26 moves with the spindle to close or open the circuit through the heater and as a result of the frictional engagement between the blade 26 and the insulating blocks 27 and 28 when the spindle is rotated far enough to operate the switch its rotation in the same direction may be continued to fur-

ther increase the supply of fluid when turning the faucet on or to further cut off the supply when turning the faucet off.

In the heater illustrated in Figs. 3 and 4 the central tube 10 of the first form is replaced by a plurality of small tubes 10^a located in close proximity to the interior of the heating unit 15. These tubes pass through and are fitted in heads 11^a and 33. The upper head 11^a is provided with cap 12^a and the construction is such as to furnish a communicating passage between the central tubes 10^a and the outer return tube 20. The lower head 33 is provided with an annular flange 34 which is firmly secured to the upper end of an exteriorly threaded tube 35. After the heating unit has been slipped into position between the interior tubes 10^a and the exterior tube 20, a ring 36, forced upward by a flanged coupling nut 37, holds it in position. This nut bears against the under side of the ring 36 and is screwed on to the exterior of the tubular member 35; it also draws the supply pipe 13^a up against the lower end of the tube 35, and by this means and the interposed gasket 38 a fluid-tight connection is provided.

As in the heater shown in Fig. 1, the course of the fluid in passing from the supply pipe 13^a to the outlet 21 is up through the tubular member 35 and the central pipes 10^a, thence through the passage at the upper end of the heater and finally down through the exterior pipe 20 to the outlet 21. With this construction the fluid is brought nearer to the heat unit in its passage upwards through the heater than in the preceding form and the fluid is more rapidly heated with the same expenditure of energy.

In the form of the invention illustrated in Figs. 5 to 8 inclusive, central tubes 10^b similar to the tubes 10^a are employed and as in the preceding case are located in close proximity to the heating unit, but the exterior coiled tube 20 of the preceding form is replaced by a plurality of straight tubes 20^b. In this form of the invention the course of the fluid is much longer than in the preceding forms, and the fluid is thereby retained in convective relation to the heating unit a considerably longer time than in the preceding forms. This increased length of flow is accomplished by the pipe end connections through the channeled caps 12^b and 35^b located at the upper and lower ends of the tubes respectively. The upper ends of the tubes are passed through and firmly secured to a flat head or plate 11^b as in the preceding case; while the lower ends of the tubes are similarly passed through and secured to flat concentric rings 33^b and 33^c. The space between the rings 33^b and 33^c is provided for the passage of the heat unit 15 in the assembling of the parts. When this unit has been positioned, the caps 12^b and 35^b are set in place and drawn together against the head 11^b and rings 33^b and 33^c by a bolt 39 which passes through the cap 12^b and head 11^b and is screwed at its lower end into a suitable interiorly threaded boss on the upper side of the lower cap 33^c. These caps, as previously indicated, are provided with channels which constitute communicating passages between the various tubes of the heater and a water-tight joint is insured between the caps and the head 11^b in one case, and the rings 33^b and 33^c in the other, by suitable gaskets 40 41 provided with openings to register with the channels in the caps so as to provide an unobstructed passage between the tubes and the channels in the caps. The underside of the lower cap 35^b is provided with an exteriorly-threaded boss against the lower end of which the supply pipe 13^b is held by a clamping nut 37^b. This boss is provided with a central opening 42.

From the inspection of Fig. 8 it will be seen that there are fifteen central or interior tubes and twenty exterior tubes. These are arranged in concentric circles and for the purpose of tracing the flow of the fluid through the heater may be considered as divided into ten groups. Of these there are five interior groups of three tubes each; and five exterior groups of four tubes each. As the fluid passes from one end of the heater to the other it passes through all the tubes of any one group in parallel. This will be best understood by tracing the course of the fluid through the heater. This course is as follows: supply pipe 13^b passages 42 43 to lower channel 44, up through the groups of tubes communicating therewith to upper channel 45, down through the remaining group of tubes communicating with the channel 45 to the lower channel 46, thence up through the remaining group connecting therewith to upper channel 47, thence down to lower channel 48 and up to upper channel 49, thence from the inner set of tubes to the outer set by the channel 50 to the channel 51, thence down through the tubes communicating therewith to channel 52, thence up to upper channel 53, down to lower channel 54, up to upper channel 55, down to lower channel 56, and thence to the outlet pipe 57. From this course of the fluid it will be seen that it is carried throughout the length of the heating unit five times by the tubes located interiorly of the unit, and five times by those located exteriorly. By this arrangement a large heating surface is provided which may be utilized to give a wide temperature variation with a relatively small flow of fluid or a smaller temperature variation with a greater flow.

From the above description of these different forms of my invention it will be seen that by using a heating unit having a central open space and utilizing both the interior and exterior surfaces of it a very compact and efficient heater is obtained.

Many alterations and modifications may be made in the constructions illustrated and described herein without departing from the spirit and scope of my invention. For example, I may employ heating units of other cross-sections than the circular cross-sections illustrated, and certain portions of the wall or walls may also be omitted altogether and many other changes in the form and shape of the heat unit may be made. I therefore do not wish to be limited to the specific forms or to the specific matter illustrated but wish to cover by the terms of the appended claims all legitimate alterations and modifications.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a fluid heater, the combination of a resistance unit having a central opening, fluid conducting tubes extending lengthwise of said unit through said opening and over the outer walls of the unit, and suitable inlet and outlet openings and end connections.

2. A fluid heater comprising an electric resistance unit, a plurality of fluid conducting pipes located in heat conductive relation thereto, and means for removably clamping said unit in said heat conductive relation.

3. A fluid heater comprising a helical resistance conduc-

tor, a plurality of fluid conducting pipes located in heat conductive relation thereto, and means for removably clamping said conductor in place.

4. A fluid heater comprising a heating unit consisting of a helical edgewise wound resistance ribbon conductor having its adjacent turns insulated from each other, a plurality of fluid conducting pipes located in heat conductive relation thereto, and clamping means engaging the opposite ends of said helix to hold the same in place.

5. A fluid heater comprising a central fluid conducting pipe, a laterally projecting head at one end thereof, an electric resistance unit associated with said pipe and bearing against said head, and means operatively connected to the other end of said pipe for pressing said unit against said head and holding it in place.

6. A fluid heater comprising one or more fluid conducting pipes, heads located at the opposite ends thereof, an electric resistance unit associated with said pipes and engaging one of said heads, and means comprising a threaded connection with the other head for pressing said unit against said head and holding it in place.

7. A fluid heater comprising one or more fluid conducting pipes, members located at opposite ends thereof, an electric resistance unit associated with said pipes in good heat conductive relation thereto, and means for clamping said unit between said members.

8. A fluid heater comprising one or more fluid conducting pipes, end members providing communication passages between said pipes, an electric resistance unit associated with said pipes in good heat conductive relation thereto, and a bolt for drawing said heads into firm engagement with said unit.

9. A fluid heater comprising an electric resistance unit having a central opening, fluid conducting tubes extending lengthwise of said unit through said opening and over the outer walls of the unit, suitable inlet and outlet openings therefor, and end members providing connecting passages between said tubes so arranged that the fluid as it passes through the heater passes throughout the length of the unit a plurality of times both interiorly and exteriorly thereof.

In witness whereof I have hereunto set my hand this 21st day of May, 1904.

GEORGE E. STEVENS.

Witnesses:
DUGALD McK. McKILLOP,
JOHN J. WALKER.