No. 646,911. Patented Apr. 3, 1900.

G. S. KNOX.

ELECTRIC HEATER.

(Application filed Jan. 30, 1899.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

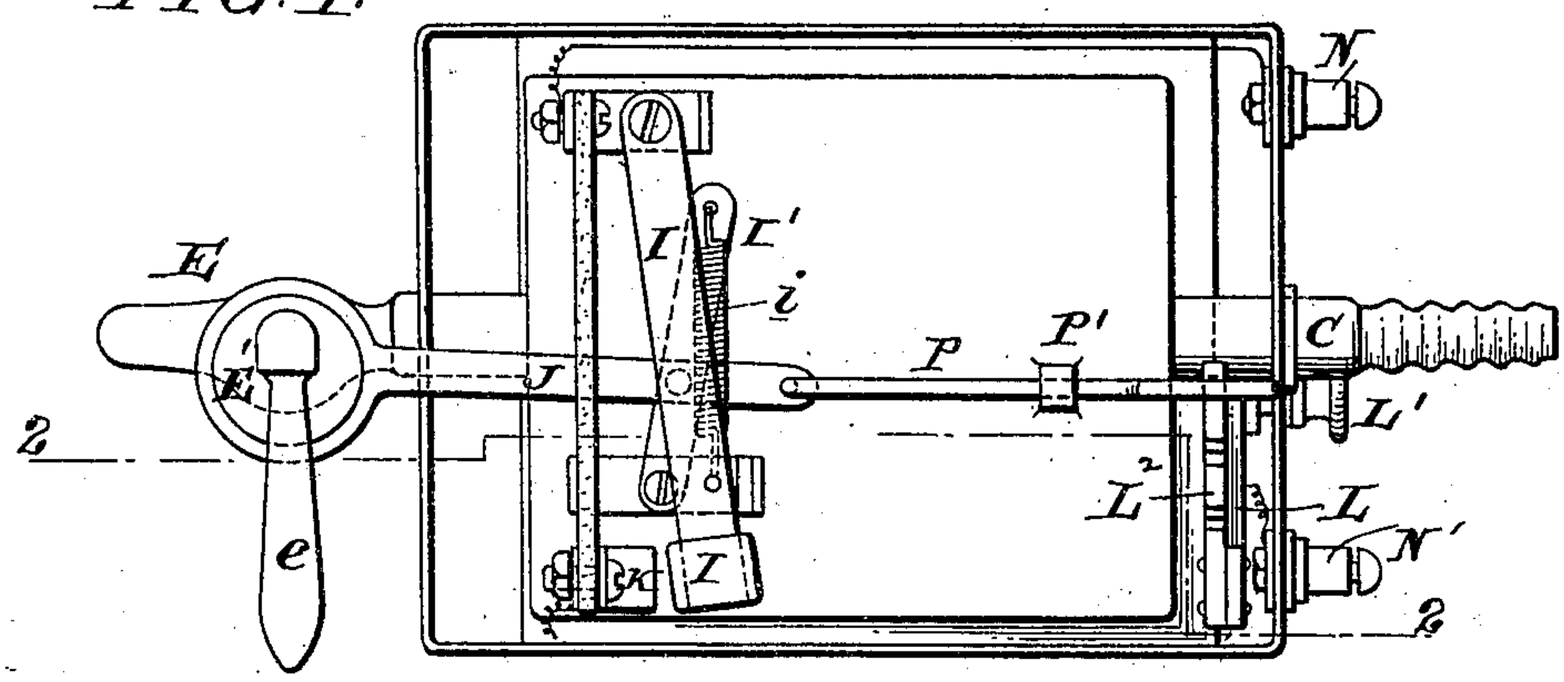
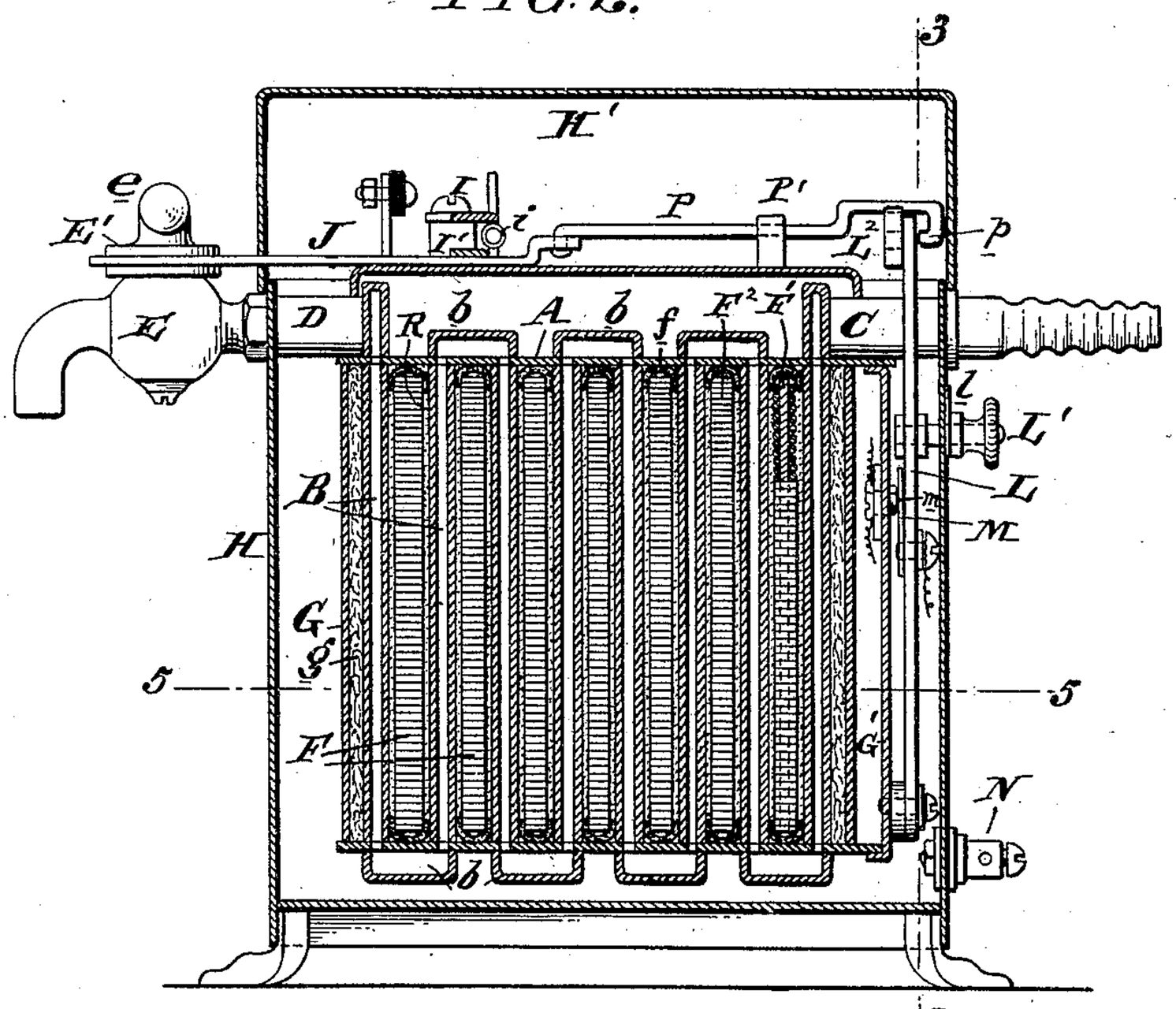


FIG. 2.



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(No Model.) 2 Sheets—Sheet 2.

FIG. 3.

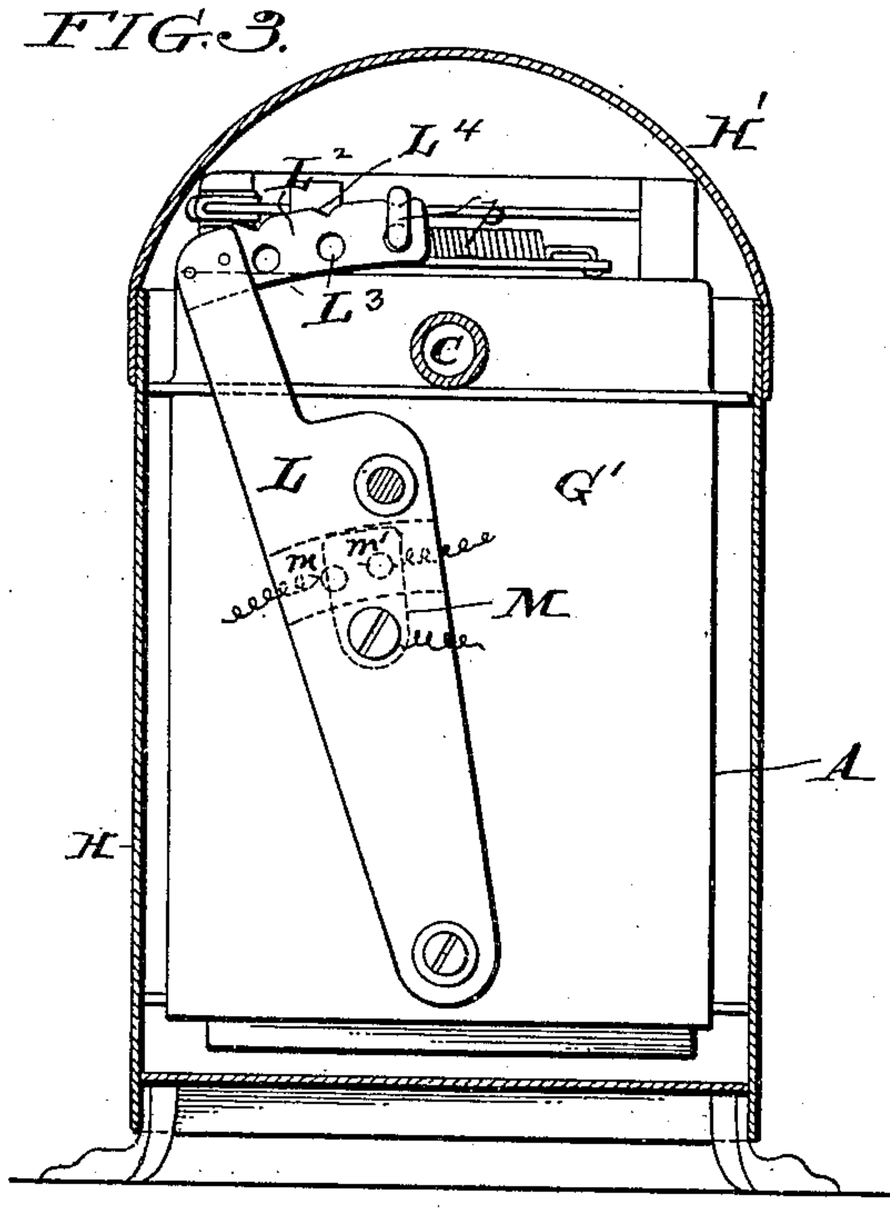


FIG. 4.

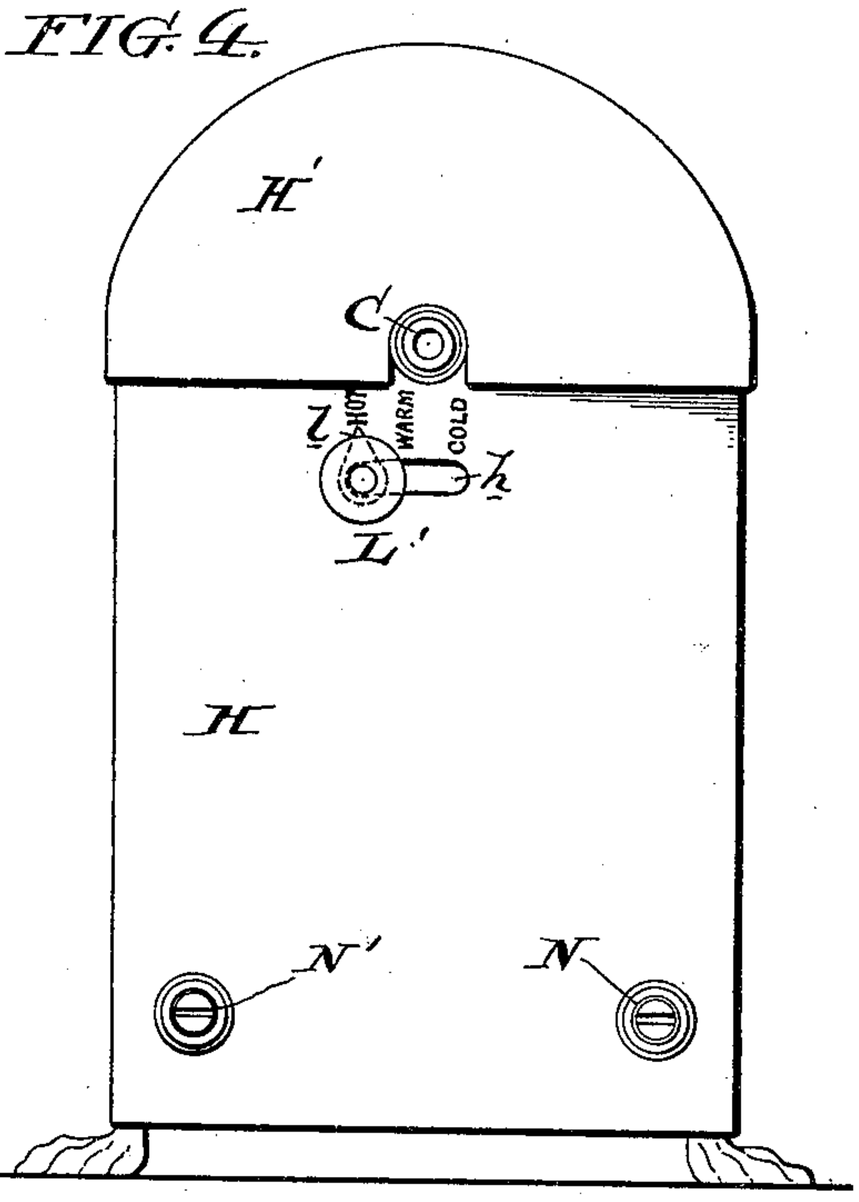


FIG. 5.

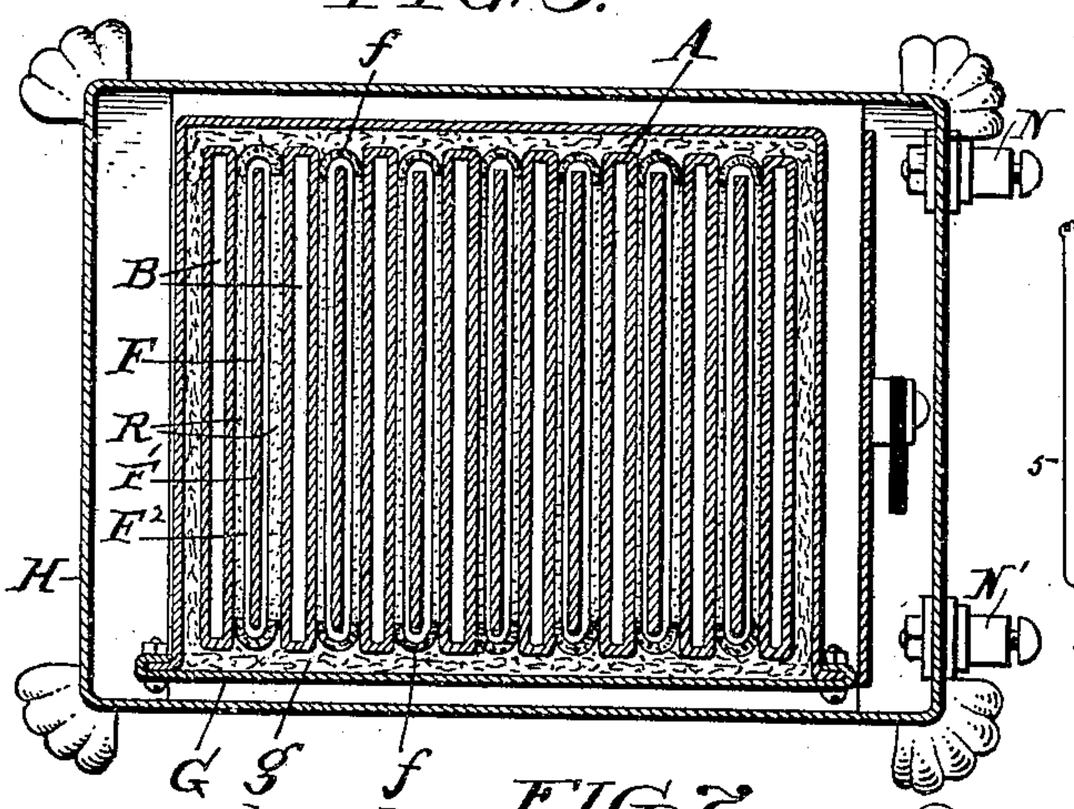


FIG. 6.

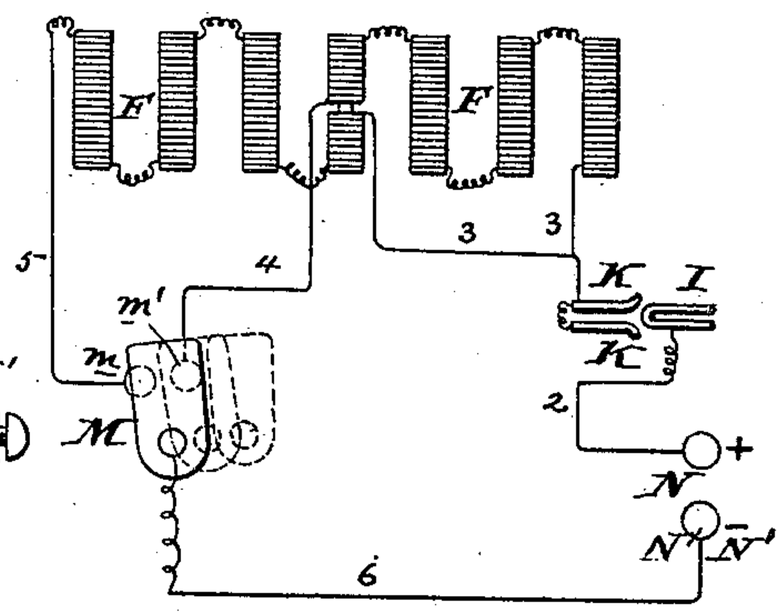
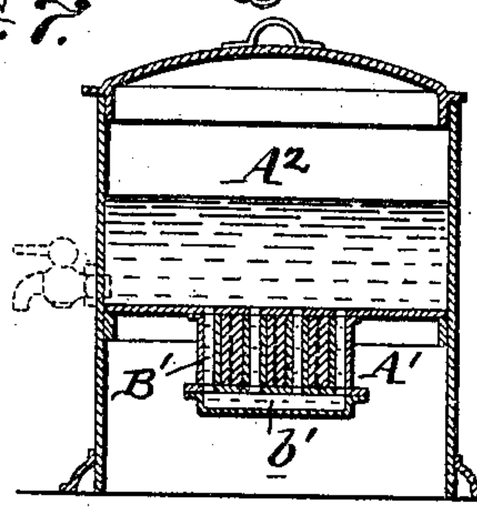


FIG. 7.



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[illegible]

UNITED STATES PATENT OFFICE.

GEORGE S. KNOX, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO ARTHUR H. FOWLER, OF SAME PLACE, AND GURDON G. WOLFE, OF TROY, NEW YORK, TRUSTEES.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 646,911, dated April 3, 1900.

Application filed January 30, 1899. Serial No. 703,814. (No model.)

To all whom it may concern:

Be it known that I, GEORGE SCOTT KNOX, of the city and county of Philadelphia, State of Pennsylvania, have invented an Improvement in Electric Heaters, of which the following is a specification.

My invention has reference to electric heaters; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

One object of my invention is to provide a construction of electric heater which shall secure the most rapid heating effect upon a fluid caused to circulate in proximity to the electric-heater structure proper.

My object is, further, to so construct the apparatus that the least possible expense will be necessary to secure the greatest efficiency and also to insure provision for easy repair of the heater-circuits whenever the same shall be necessary.

Another portion of my improvement relates to the controlling-circuits, wherein I may vary the temperature as desired; but such variation of temperature cannot be changed except when the main switch has interrupted the circuit leading to the source of electric energy to avoid the possibility of sparking or burning out the apparatus.

In carrying out my invention I provide a series of flat parallel tubes arranged comparatively close together and connected in multiple or series and through which any fluid, such as water or air, is permitted to pass. Interposed between these flat tubes I arrange heating-coils formed in a flat shape, whereby the heating-wire on opposite sides of the form upon which it is wound shall come into close proximity or juxtaposition with the said walls of two adjacent flues, but formed electrically independent thereof, preferably by a suitable packing of fire-clay in the dry condition.

In the preferred form of my heater the several tubes are arranged in series by connecting top and bottom flue-heads or return-bends, and one end of said series of flues is adapted for connection with the city water-main or a source of water-supply under pressure and the other end is connected with a suitable spigot or valve. The main switch for controlling the current supplied to the resistance is preferably operated by the said valve or spigot, so that when it is desired to turn on the water the main switch is closed. I further provide a second switch which controls the number of heating-resistances maintained in electric circuit, the said second switch being so arranged that it may cut all of the resistances out of circuit or throw more or less of the resistances into circuit. This switch will therefore control the temperature to be given to the fluid. It is preferable, however, that this switch shall be locked against movement by the main switch whenever said main switch is closed, so that the regulating-switch must be adjusted before the current is circulating through the heater.

My improvements furthermore comprehend detailed constructions, all of which will be better understood by reference to the accompanying drawings, in which—

Figure 1 is a plan view of my improved water-heater with the top of the casing removed. Fig. 2 is a vertical sectional view through Fig. 1 on line 2 2. Fig. 3 is a transverse sectional elevation of same on line 3 3 of Fig. 2. Fig. 4 is an end elevation of my improved heater. Fig. 5 is a sectional plan view of same on line 5 5 of Fig. 2. Fig. 6 is a diagram illustrating the electric circuits; and Fig. 7 is a sectional elevation of a modification of my improved heater, such as would be employed when the water was to be boiled without running it off.

A is the electric heater proper, and comprises a series of flat tubes B, arranged parallel to each other and of exceedingly-great width as compared to their thickness, so that the water which passes through said tubes is in the form of a thin sheet, thereby reducing to a minimum the depth of water through which the heat is required to penetrate. These tubes are connected by suitable slitted or perforated top and bottom plates into a rigid grid-like structure, and may be connected on the principle of return tubes or series by head or return bends *b*, as shown in Fig. 2, or they may be connected in parallel, as shown in Fig. 7. When connected in series,

one end of the series of tubes terminates in a supply-pipe C, which in use is connected to the source of water-supply, and the other end of the series of tubes is connected by a pipe D with a spigot or valve E, having a movable handle *e*.

Interposed between the adjacent tubes B and filling the space between them are a series of flat resistances F, which consists, essentially, of a plate F′, of glass or other refractory material, around which is wound suitable coils of German silver or other poor conductor of electricity, so as to form a long continuous path, as is well known in electric heaters. Three edges of such prepared plate and resistances have asbestos strips *f* bent over them, and they are then pushed into the flat spaces between the tubes B, as clearly shown in Figs. 2 and 5. The space between the wire coils F^2 and the sides of the water-tubes is then packed with powdered fire-clay in a dry condition. When this is done, asbestos may be wrapped over the remaining edge or said edge may be left exposed, as desired. When the heater has been thus prepared, it is wrapped around with asbestos sheets *g*, and this is held in position by an outer casing G, as clearly shown in Figs. 2 and 3. It will thus be seen that the building up of this concrete structure is exceedingly simple and inexpensive, and at the same time secures the most desirable proximity of the heating-wires with the entire body of water or other media to be heated, and at the same time enables the repairing of any of the resistances to be readily accomplished by simply pushing said resistances bodily out of their pockets, and after the repairs being made again inserting them. In making such repairs it is evident that there is no dismantling or injury done to the circulation pipes or tubes, which is a feature of the greatest importance in electric heaters for fluids. The terminals from these heating-resistances F are properly insulated, as indicated in Fig. 6. It will be observed that the current enters by a terminal N, and thence passes to a main switch I K by a circuit 2. The current is then divided over circuits 3 3, each including a portion of the resistance F, the said resistances being properly wound to consume a certain amount of energy on a main circuit of a given voltage. The other terminals of the said resistances connect by conductors 5 and 4 with contacts *m m′*, respectively. A second switch-contact M by being shifted in the three positions indicated will either put both sets of resistances into circuit or only one of said sets of resistances in circuit, or will cut both of the sets of resistances out of circuit, as desired. This contact M connects by a circuit 6 with the negative terminal N′. I will now describe the structure of these switches, the contact portions of which I have just referred to.

The main switch is best shown in Figs. 1, 2, and 6. It consists of two contacts K K, before referred to, between which a circuit-closing knife-switch I passes with more or less frictional contact. The knife-switch is pivoted at the opposite end. I′ is a lower pivoted lever having its free end directed toward the pivot of the knife-switch I, and the two levers are connected by a coil-spring *i*. The operating-lever I′ is connected to an eccentric-rod J, which is reciprocated by an eccentric E′, connected with the valve-handle *e* of the spigot. When the spigot is turned into the position shown in Fig. 1, the water is shut off and the knife-switch I held away from the contacts K. When, however, the valve of the spigot is turned, the eccentric moves the bar J forward, so as to bring the free end of the lever I′ beyond a line through the pivots of the knife-switch I and lever I′, in which case the spring *i* causes the knife-switch to snap upon the contacts K to close the circuit. In closing the spigot the reverse of this action takes place and the knife-switch I is caused to quickly snap open by the time the water is completely shut off. It will thus be seen that the main switch is operated by the water-controlling valve and obviates the necessity of the manipulation of an additional handpiece. It furthermore prevents the current being accidentally left on when no water is being drawn off. This is important, because if the pressure from the city main is excessive the generation of steam within the heater would either burst the heater or would drive the water back into the main and possibly loosen the soldered joints, so as to make the heater leak. Broadly considered, it is immaterial what form of switch or valve or connection between the two be employed, so long as the operation of the valve regulates the movement of the main switch.

Referring now to the switch for regulating the temperature, this consists of a pivoted arm L, of insulating material, having upon it a contact M. This contact is sufficiently wide to form electrical connection with both of the terminals *m m′* of the resistance-coils F. When in the positions shown in Figs. 3 and 6 the current is flowing through both heating-coils, but upon moving the switch slightly to the right one half of said heating-coils is cut out of circuit, and by moving it still farther to the right all of said heating-coils are cut out of circuit. The switch L is moved by a handle L′ and is furnished with a pointer *i*, which points to the words "Cold," "Warm," and "Hot" on the case, as shown in Fig. 4, to indicate what the result of the adjustment of the switch shall be. The upper or free end of the switch L is provided with a locking-bar L^2, having three holes L^3 and three notches L^4 at the top. A sliding bar P, connected at one end of the eccentric-rod J and moved thereby, is employed to lock the switch L in the position assumed, so that it cannot be moved when the main current is turned on. This rod P is guided in a suitable guide P′, and its free end presses over the upper edge and into the notches L^4 under

its elasticity, so that when the switch L is moved to either of its three positions the operator knows when such positions are reached. The extreme free end of the bar P is turned over and under, as at *p*, so that it shall enter the holes L^3, and thus lock the lever L whenever the main switch is thrown on. I do not limit myself to the specific construction of this regulating-switch L, nor to the means connecting the spigot and said switch for locking the latter when turning on the water, as this may be greatly varied without departing from the essence of this invention.

The various parts making up the heater may be inclosed in a suitable case, in which H represents the lower part, and H′ the upper removable cap or cover. This case may be made in any other way desired or of any design.

In place of making the water circulate by means of connecting the tubes B in series said tubes may be coupled in multiple, as shown at A′ in Fig. 7, in which B′ are the tubes, and *b′* the connecting-chamber at the bottom. A^2 represents the interior of the vessel adapted to contain the water or fluid to be heated and which has free access to the tubes B′ in the bottom. Broadly considered, it is immaterial to my invention what the relation of the various tubes B may be with regard to being arranged in series, multiple, or series multiple, as these modifications would be employed according as to the temperature or volume of water required. In all cases the tubes would be flat and the heating-coils also be made flat and placed between adjacent tubes in the manner herein shown.

While I prefer the construction shown, it is to be understood that I do not limit myself to the minor details, as they may be modified in various ways without departing from the spirit of my invention.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an electric heater, the combination of heating-tubes through which water is required to flow, heating coils or devices arranged adjacent to that on the outside of said tubes, a valve to control the flow of water through the tubes, a switch to control the current passing through the heating-coils, and connecting means between the valve and the switch, whereby the latter is automatically closed or opened when turning on or off the valve, said connecting means comprising spring-actuated devices directly moved by the valve for causing the said circuit-closing switch to snap open with a quick movement when the valve has been partly moved in closing off the water, whereby the switch operates quickly at time of action and the valve may be operated to vary the flow of water while the switch is closed.

2. In an electric heater, the combination of heating-tubes through which water is required to flow, heating coils or devices arranged adjacent to said tubes, a valve to control the flow of water through the tubes, a switch to control the current passing through the heater-coils, connecting means between the valve and the switch whereby the latter is automatically closed or opened when turning on or off the valve, a second or regulating switch to control the amount of the heating coils or devices in electric circuit, and a locking device for locking said regulating-switch in its adjusted positions operated by the valve so as to lock said switch against movement when the water is turned on and the main switch closed.

3. In an electric heater, the combination of heating-tubes through which water is required to flow, heating coils or devices arranged adjacent to said tubes, a valve to control the flow of water through the tubes, a switch to control the current passing through the heating-coils, connecting means between the valve and the switch whereby the latter is automatically closed or opened when turning on or off the valve, said connecting means comprising spring-actuated devices for causing the said circuit-closing switch to snap open with a quick movement after the valve has been partly moved in closing off the water, whereby the switch operates quickly at the time of action and the valve may be operated to vary the flow of water before opening the switch, a controlling-switch for regulating the temperature by varying the amount of the heating-coils in circuit, and a locking device operated by the connecting mechanism whereby the said regulating-switch is locked in its adjusted position before the spring-actuated main switch is closed.

4. In an electric heater, the combination of tubes through which a fluid is adapted to circulate, heating-coils adjacent to said tubes, a controlling-switch for varying the amount of the heating-coils in electric circuit to control the temperature, a spring-actuated main circuit-closing switch, and hand-controlled devices for locking the regulating-switch and closing the main or circuit-closing switch whereby the regulating-switch cannot be adjusted when the current is flowing through the heating-coils.

5. In an electric heater, two parallel end plates, having a series of parallel slits or openings therein, a series of connecting flat tubes of great width relatively to their thickness connecting the said end plates and communicating with the slits therein and forming a grid-like structure containing a series of thin parallel flat spaces interposed between the adjacent tubes, in combination with a series of heating-coils each formed of a thin flat structure interposed between the tubes and occupying the spaces of the grid-like structure.

6. In an electric heater the combination of two parallel plates each provided with a series of parallel slits of great length compared to their width, a series of thin flat tubes con-

necting said plates and forming vertical passage-ways or flues through which water may circulate, compartments inclosing the tubes at top and bottom, a series of upright removable flat resistance-coils interposed between the upright flat tubes and insulated therefrom by a refractory material, and an inclosing packing of non-conducting material on each side of the spaces between the vertical flat tubes for covering the ends of the resistance-coils and holding them in place.

In testimony of which invention I have hereunto set my hand.

GEORGE S. KNOX.

Witnesses:
R. M. HUNTER,
CHARLES F. WEST.