July 3, 1934. W. C. CARR 1,965,218

ELECTRICAL HEATING SYSTEM

Filed March 6, 1933 3 Sheets-Sheet 1

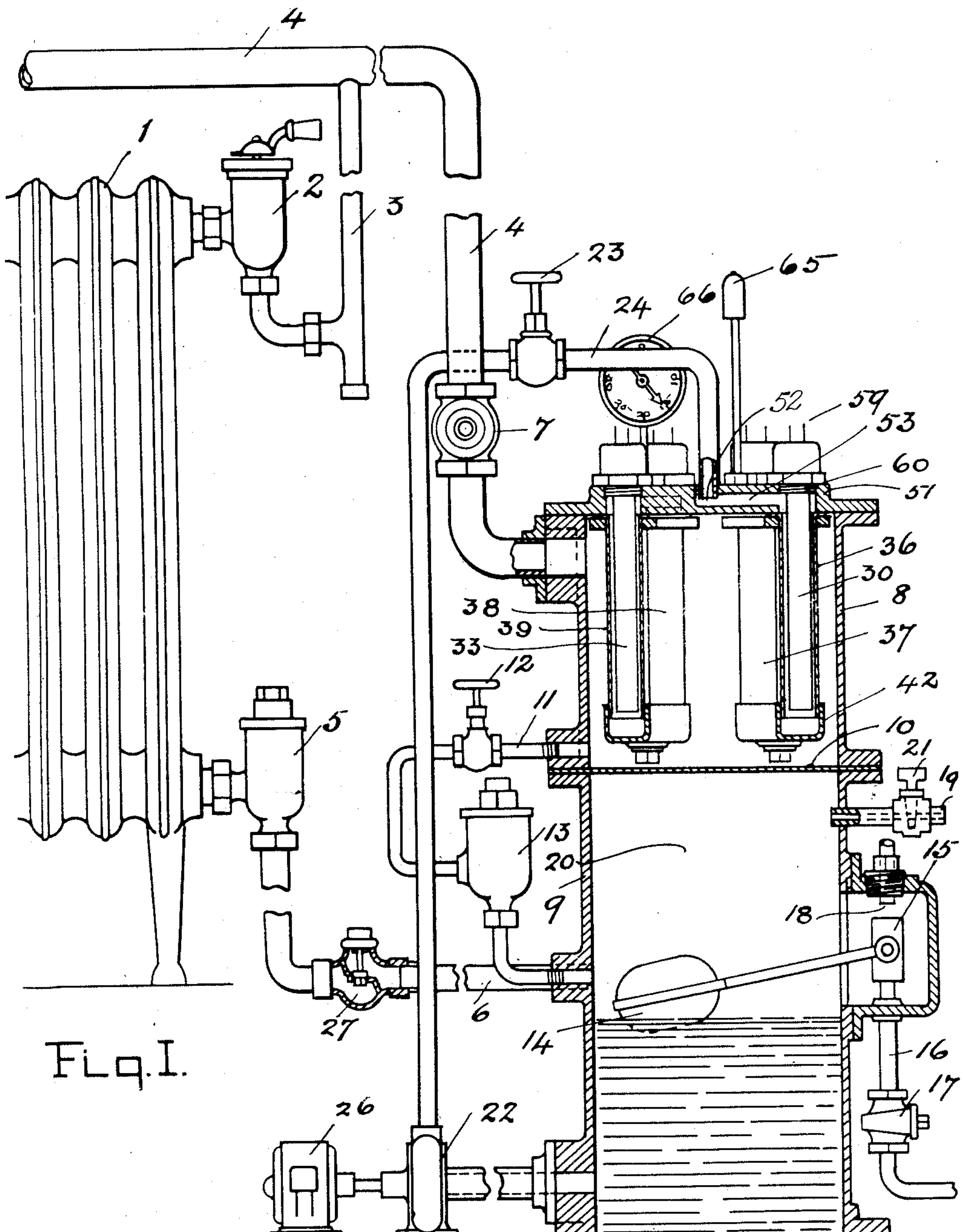

Fig. I.

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Fig. II.

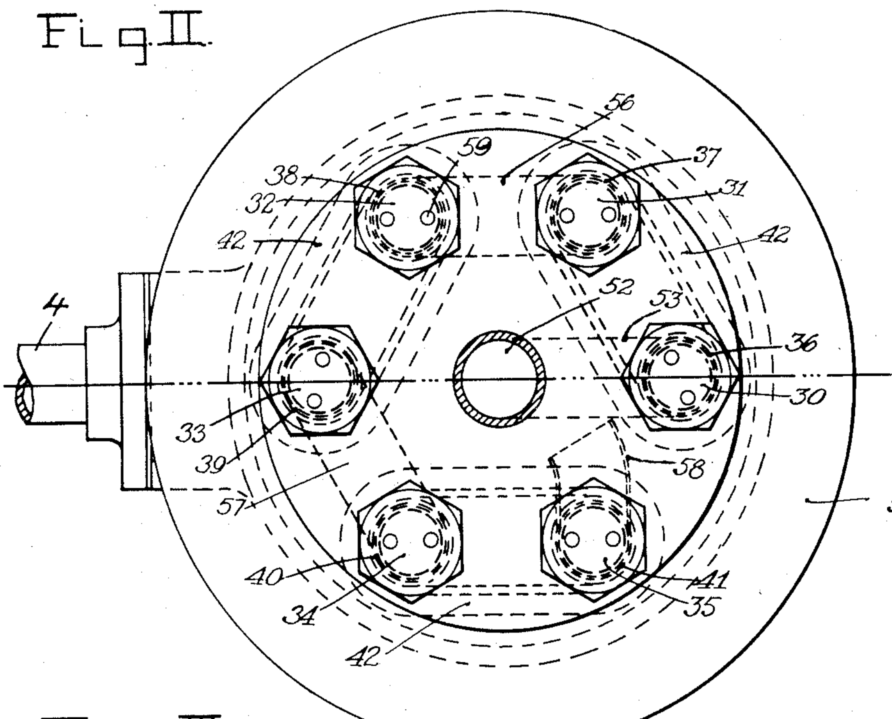
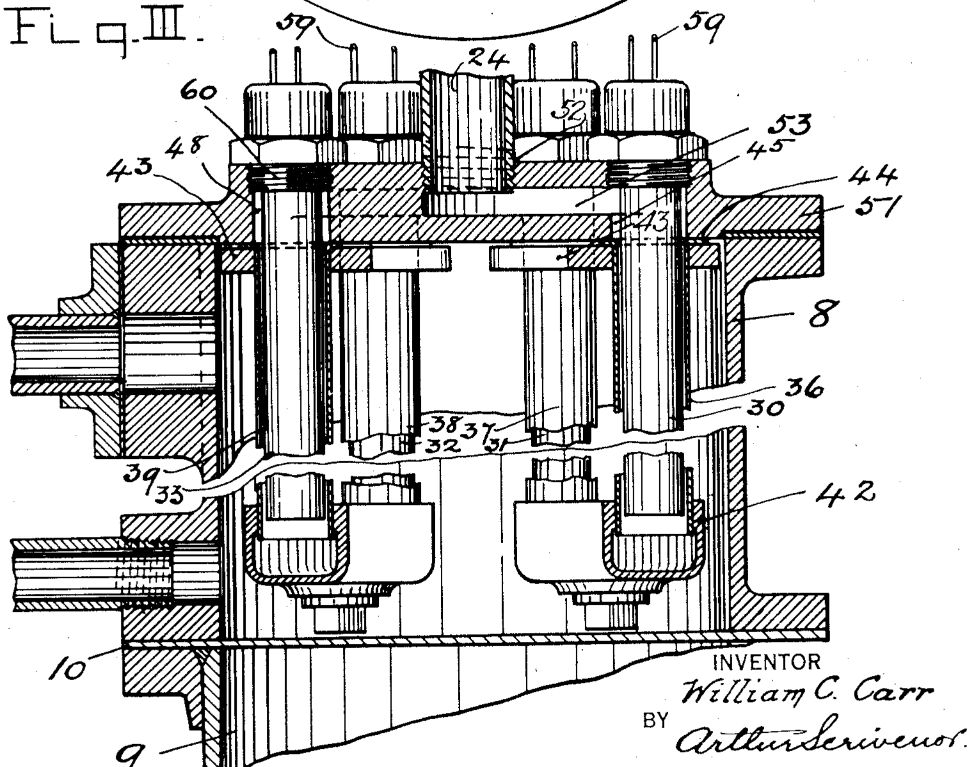


Fig. III.



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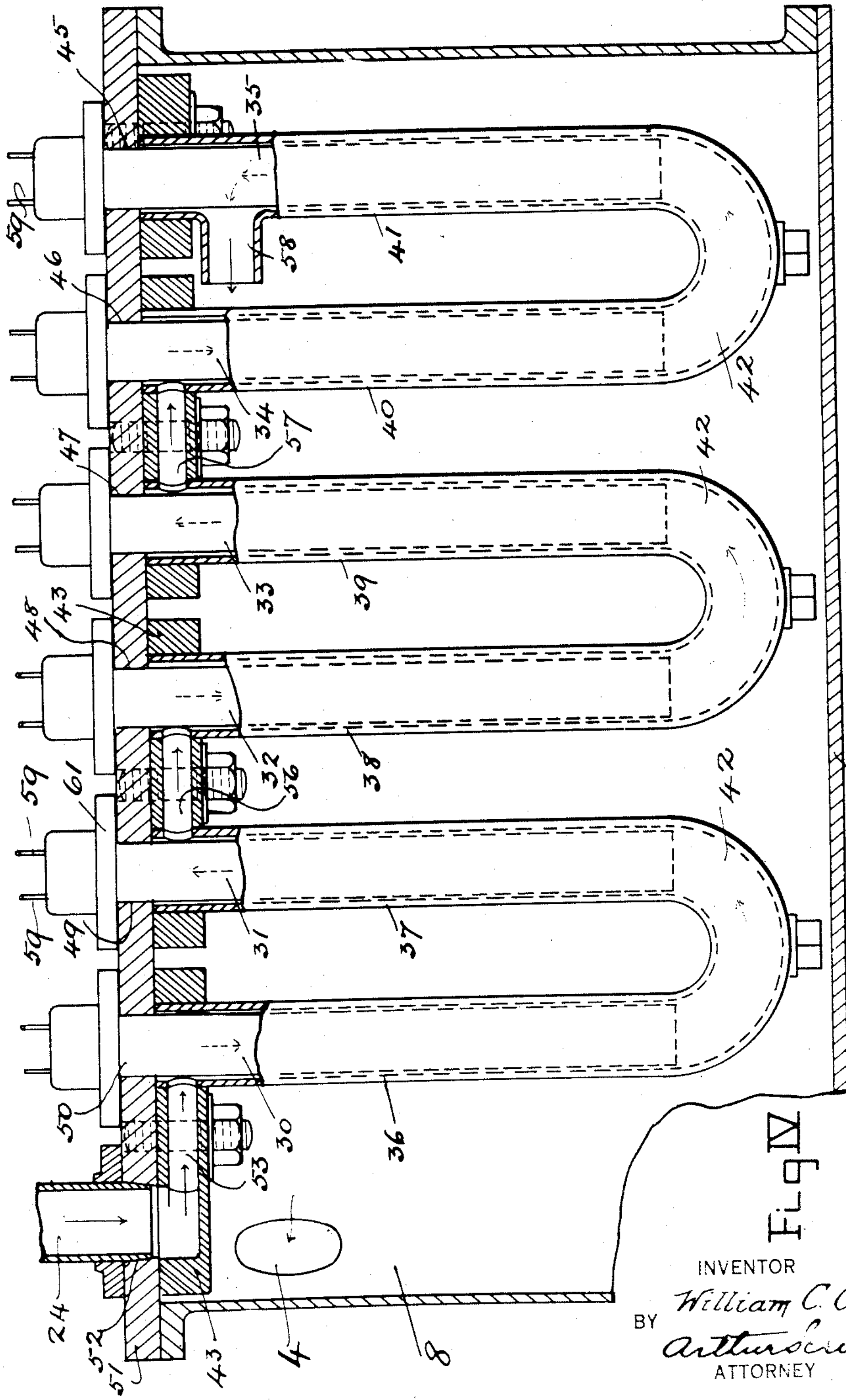

Fig IV

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UNITED STATES PATENT OFFICE

1,965,218

ELECTRICAL HEATING SYSTEM

William C. Carr, Richmond, Va.

Application March 6, 1933, Serial No. 659,680

4 Claims. (Cl. 219—38)

My invention relates to heating systems, and particularly to systems in which electricity is the source of heat, and in which liquids or vapors or gases are the media employed for transmitting the heat to the point of application.

The object of my invention is to provide a system which may be easily installed; which may be easily transferred from one location to another; in which the heat may be readily and closely controlled; which may be used continuously or intermittently with a very small loss of heat; and one in which the heat generating equipment takes up very small space. A further object is to provide a heating system which shall be clean in operation, which shall require the minimum of attention, in which there will be practically no cost for repairs, and in which replacements when necessary may be promptly and inexpensively made. It is also my object to provide a comparatively inexpensive system both in first cost and also in operation.

In the drawings, Figure I illustrates the general arrangement of my heating system, in elevation and partly in section. Figure II shows in plan the heating vessel or pot. Figure III is a broken view, in vertical section, showing the heating vessel. Figure IV shows diagrammatically the arrangement of the heating elements.

In Figure I the numeral 1 represents the end of a standard steam radiator; 2 the steam control valve; 3 the branch steam connection from the steam main 4; and 5 a thermostatic valve controlling the flow of condensate from the radiator 1 to the return main 6. The steam main 4 is connected through the valve 7 with the interior of the heating vessel 8, which for the sake of brevity and distinction I hereafter call the "pot". The pot stands upon a return tank 9. In the drawings the bottom plate 10 of the pot 8 forms the top of the tank 9; but it may be a separate part entirely; that is to say, the closed pot 8 and the closed tank 9 may each be complete in itself. From the inside of the pot a drain connection 11 is made to the inside of the tank 9; and this connection is controlled by a cut-off valve 12 and by a thermostatic valve 13. If condensate or drip collects in the pot 8 it will be drained through the valve 13 into the tank 9. If it is desired to positively cut off the connection between the interior of the pot and the interior of the tank, the cut off valve 12 is closed. Also, by adjusting the opening of the valve 12, the rate of the flow from the pot to the tank may be controlled. A ball-float 14 is used and adjusted to control the normal water level within the tank 9. The level may be high or low, making a wet or a dry return. The ball-float valve 15 is connected by the pipe 16, through the cock 17, with the regular water supply. When the condensate is returning too slowly from the heating system, the float drops, the valve 15 opens, and the deficiency is made up. An overflow 18 may be connected to take care of surges; but it is not necessary if the volume of the tank 9 is made sufficient. It is best to arrange a vent at 19 or at some other convenient place to control the air pressure in the upper part 20 of the tank 9. This vent is controlled by a small valve 21, so that the upper part 20 of the tank may be used to confine air to form a cushion, which is desirable if a reciprocating pump should be used to pump water from the tank. I have shown a centrifugal pump 22, by means of which I raise water drawn from the tank 9 through the cut-off valve 23 and through the connection 24 to the cover 51 of the pot 8. The pump 22 is driven by the motor 26. The rate of discharge of the pump is readily controlled by adjusting the opening of the valve 23.

As before stated, the radiator drains into the tank through the valve 5, and by way of the piping 6. In the connection I place one or more check-valves 27, to prevent pressure from within the tank acting upon the thermostatic valve 5, and perhaps building up in the radiation 1.

Arranged within the pot 8 are a number of heating elements, 30, 31, 32, 33, 34, and 35. These heating elements may be of any suitable form and type. Those shown are of the round stick type and are known as Chromolax. The elements are arranged in pairs in sheaths 36, 37, 38, 39, 40 and 41. See also Figure IV. The sheaths are joined at their lower ends by the bends 42. Their upper ends are held in the flange-plates 43, into which they may be rolled or expanded, or brazed, or welded. Or the upper ends of the sheaths themselves may be flanged, as shown in Figure III at 44. The upper faces of the flange-plates 43 are machined so that a tight joint may be made between the sheath openings and the openings 45, 46, 47, 48, 49 and 50 in the cover plate 51 of the pot 8. These flange-plates are bolted up to the under face of the cover plate. The discharge line 24 from the pump is connected to an opening 52 in the top of the cover plate 51. This opening is connected by a channel 53 to the inside of the first sheath 36.

In the drawings Figure IV shows the arrangement of the sheaths and heating elements and water channels extended in a row for the sake of clearness. The arrangement of the water channels is in Figure IV somewhat different from that shown in Figure I. In the latter these connecting channels are shown formed in the cover plate 51 itself. In Figure IV I show them formed in the flange-plates 43. The difference is a matter of construction; strength; and to some extent, convenience. These flange-plates 43 can also be cast integral with the cover plate 51, and the channels either cored or bored. They are preferably bored, and their ends plugged.

Assuming that no electric circuit is completed, and that the elements 30 to 35 are not heated: on operating the pump 22 water will be drawn from the tank 9, and it will be discharged through the line 24 into the opening 52 in the cover-plate 51. The water then passes from the line 24, through the channel 53 to sheath 36, down which it flows, and then up sheath 37, through channel 56, down sheath 38, up sheath 39, through channel 57, down sheath 40, up sheath 41, from which it discharges freely at the opening 58 into the interior of the pot 8. Thence the water would flow into the heating main 4. If I am operating the system as a hot-water heating system, I either close the valve 12 to prevent any flow of liquid and possible pressure from the pot to the tank or vice versa; or I adjust the opening of the valve 12 so that I may by-pass a part of the water through the tank, and so that I may regulate the rate of flow through the radiation 1. The temperature of the water may be rapidly built up by by-passing the water through the short loop consisting of the heating elements, the pot, the connection 11, the tank, the pump, and again the heating elements. If we close the valve 12 the water passes around the longer loop, in which the radiation 1 is interposed between the heating elements and the tank. By varying the opening of the valve 12 we can vary the volume and also the temperature of the hot water flowing to the main 4. This can be done manually, or automatically with the aid of one of the well known thermostatic valves, replacing the valve 12.

The temperature of the water may also be controlled by varying the volume of heat delivered by the heating elements 30 to 35; and this again is readily done through automatic temperature controlled switches, such as the "Mercoid". Such switches are arranged to cut in or out one or more of the heating elements as the temperature of the water falls or rises.

A double control can be had by varying the volume of heat delivered by the heating elements, and also by varying the volume of water flowing to the main 4.

Note that the hot water issuing from the opening 58 in the last sheath of the series envelopes the sheaths themselves; and consequently all heat radiated from the sheaths is absorbed by the water enveloping them, until the temperatures are equal. Then as the temperature of the enveloping water increases, heat is given off by the hotter water to the cooler water in the first sheaths of the series.

The bodies of the pot 8 and of the tank 9 are thoroughly lagged to prevent loss of heat as much as possible. The lagging is not shown in the drawings. It may be of asbestos block, covered with canvas.

When I desire to use my system for heating by means of vapor or steam I first control the flow of water to the pot by adjustment of the pump discharge valve 23. The water flows by the same course as noted above; and during its passage through the sheaths it is converted into steam, the point in the series at which the conversion takes place depending upon the temperatures of the elements and upon the rate of flow of the water. I am able to so control these temperatures and volumes that I may have issuing into the pot at the sheath opening 58 saturated steam at any practicable pressure and temperature, or superheated steam at like pressures and at any practicable superheat.

Note also that the final saturated or superheated steam issuing from the opening 58 envelopes the sheaths, and gives up heat to the water or steam flowing through the sheaths, producing a regenerative effect. Considered from the opposite point of view: there are practically no losses of heat by radiation, convection, or conduction, except what may be transmitted through the lagging on the body of the pot.

In the drawings I have shown only six heating elements. The number may be more or less than six. The size of each element is preferably one of the smaller standard sizes; for instance, one having a cylindrical body one and a quarter inches in diameter. This is a convenient size for the average domestic heating system. With an element body having a diameter of one and a quarter inches I use a sheath having an inside diameter very little more than the outside diameter of the element, such as a seamless drawn tube of a nominal inside diameter of one and a quarter inches, the actual inside diameter of which is 1.368 inches. At the bottom of the U tube formed by each pair of sheaths and the connecting bend I put a clean-out plug, so that any sediment which collects in the U tube may be removed.

The heating elements are wired in the usual way to the control board. The terminal wires on the elements are indicated at 59. The elements may be held in place on the cover plate by means of threaded parts as at 60, or by flanges 61 screwed to the cover plate. Any one of the heating elements can be removed without disturbing any other part.

In Figure I a pressure gauge is shown at 66; and a relief valve at 65.

My heating system can be put to many economical uses in the industries, as well as to the heating of houses, and public halls or buildings. For instance, there are in some industries demands for intermittent supplies of superheated steam, or of high pressure saturated steam. To provide for such supplies in the regular heating systems in common use to-day would require expensive equipment which would take up much space, and it would result in high operating costs. In such cases my heater can be used with great advantage; costing little in comparison to the coal or gas or oil burning heater; the upkeep being very small; operation being simple; and the usually higher cost per thermal unit being offset by many advantages, such as cleanliness, portability, small space occupied.

In the claims I have referred to the vessel or pot 8, which contains the heating units, and which forms a small holder in the system, as the heater for the sake of brevity.

I claim:

1. A heater unit comprising a closed vessel divided into a heating chamber and a returns chamber, and connected to a fluid heating system, the heating chamber to the supply line, and the returns chamber to the returns line; a trap controlled pipe connection between the heating

chamber and the returns chamber for the purpose of draining the heating chamber into the returns chamber; a series of connected U tubes within the vessel, one end of which series is arranged for connection to a fluid heating circuit, and the other end of which series discharges within the vessel; electric heating elements suspended in the U tubes and connected in an electric circuit; and pumping means for pumping returns from the return chamber to and through the series of U tubes.

2. A heater unit comprising a closed vessel divided into a heating chamber and a returns chamber, and connected into a fluid heating system, the heating chamber to the supply line and the returns chamber to the returns line; a trap controlled pipe connection between the heating chamber and the returns chamber for the purpose of draining the heating chamber into the returns chamber; a series of connected U tubes within the vessel, one end of which series is arranged for connection to a fluid heating circuit, and the other end of which series discharges within the vessel; electric heating elements suspended in the U tubes and connected in an electric circuit; pumping means for pumping returns from the return chamber to the series of U tubes; and means for adding make-up fluid to the returns chamber.

3. A heating system comprising radiation, a heater, a heating element, and a fluid heating medium; and a thermostatically controlled by-pass system around the heater by which, when the temperature of the heating medium in the heater is below a certain level, the fluid medium is drained from the heater body and immediately recirculated to the heating element without traversing the heating system.

4. In a heating system, a heater consisting of a closed vessel having an inlet and an outlet for fluid; electric heating elements arranged within the vessel; connected conduits for fluid disposed about the heating elements, one of the connected conduits being connected to the vessel inlet, and the discharge end of the connected conduits being free to discharge inside the closed vessel; and a thermostatically controlled by-pass around the heater so that insufficiently heated medium is re-circulated through the heater.

WILLIAM C. CARR.