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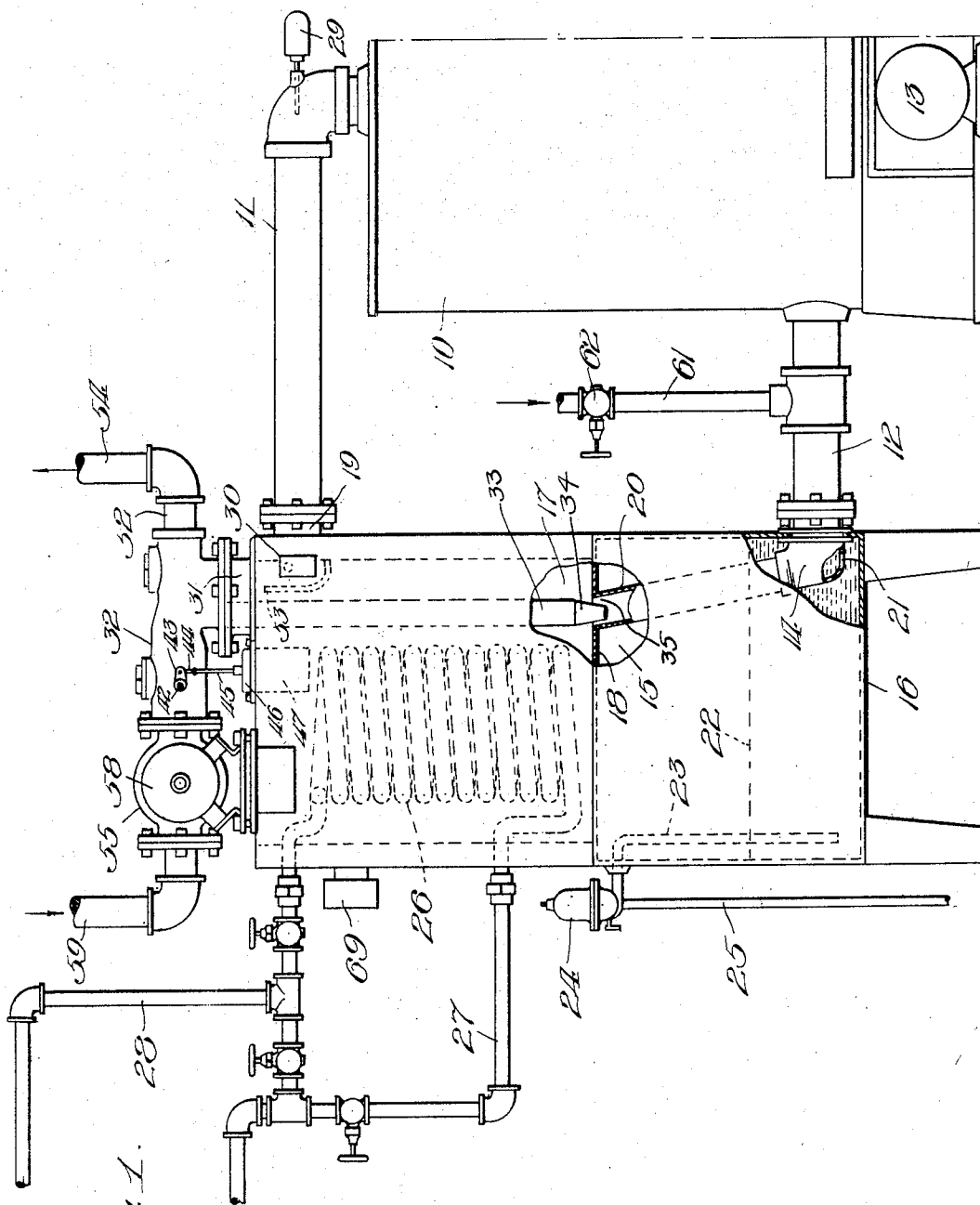
R. E. MOORE

2,081,831

HOT WATER HEATING SYSTEM.

Filed Nov. 11, 1935

4 Sheets-Sheet 1



Inventor:
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24/1/93

May 25, 1937.

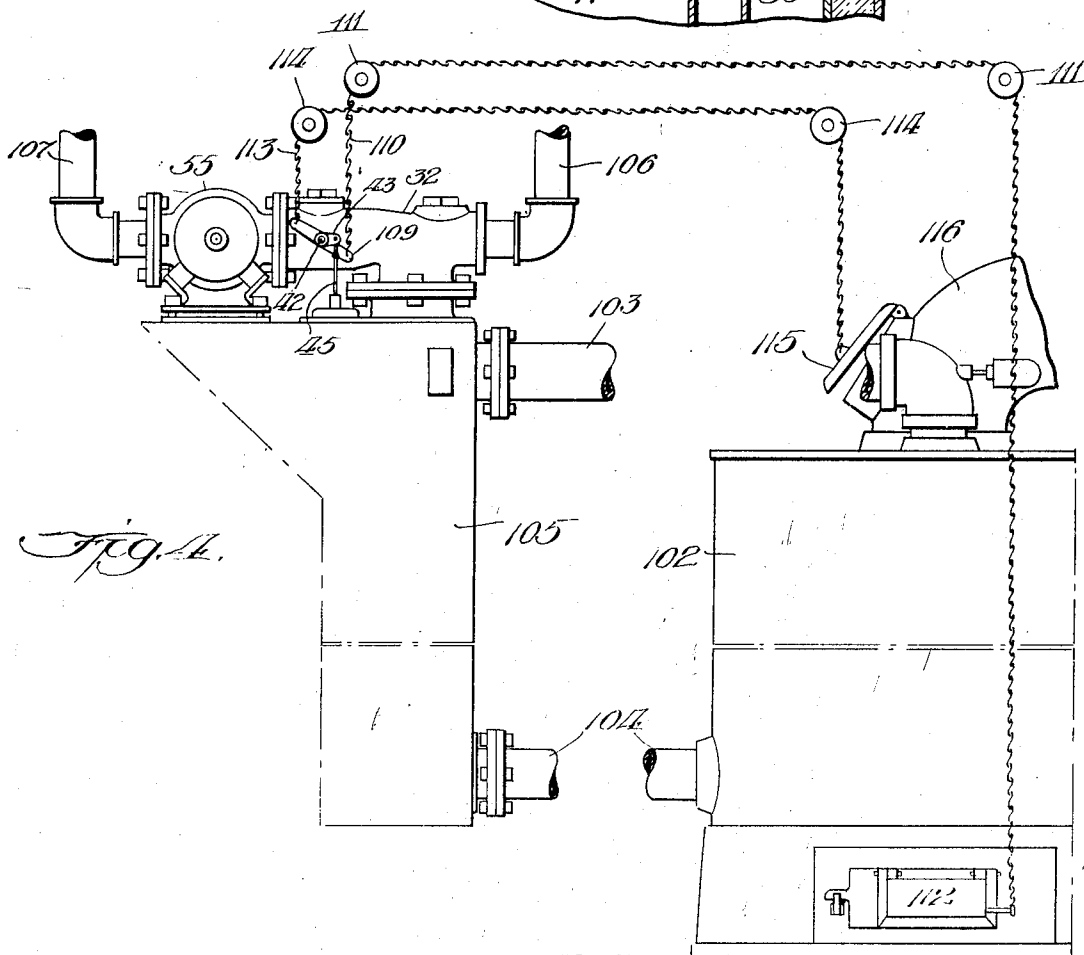
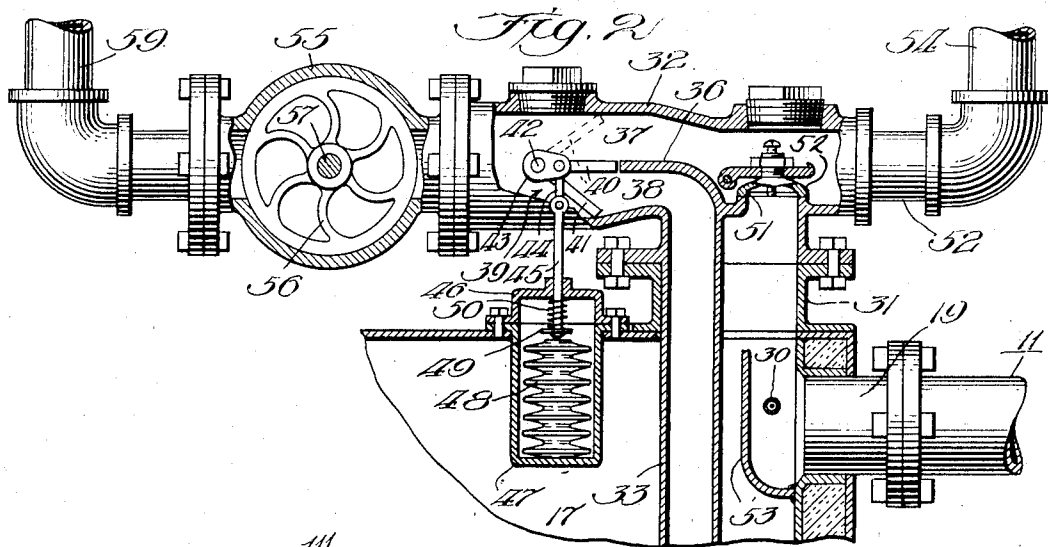
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HOT WATER HEATING SYSTEM

Filed Nov. 11, 1935

4 Sheets-Sheet 2



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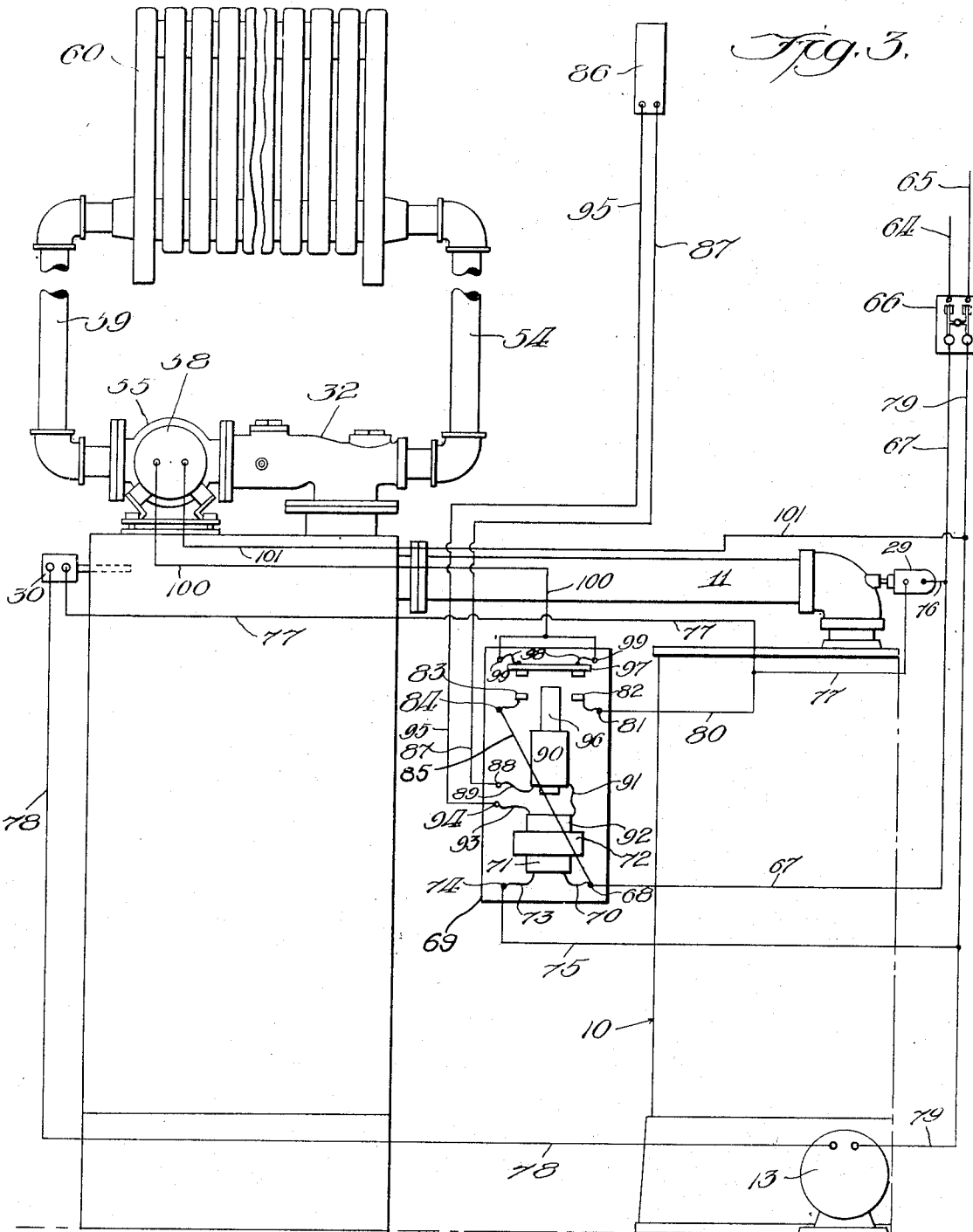
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HOT WATER HEATING SYSTEM

Filed Nov. 11, 1935

4 Sheets-Sheet 3



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May 25, 1937.

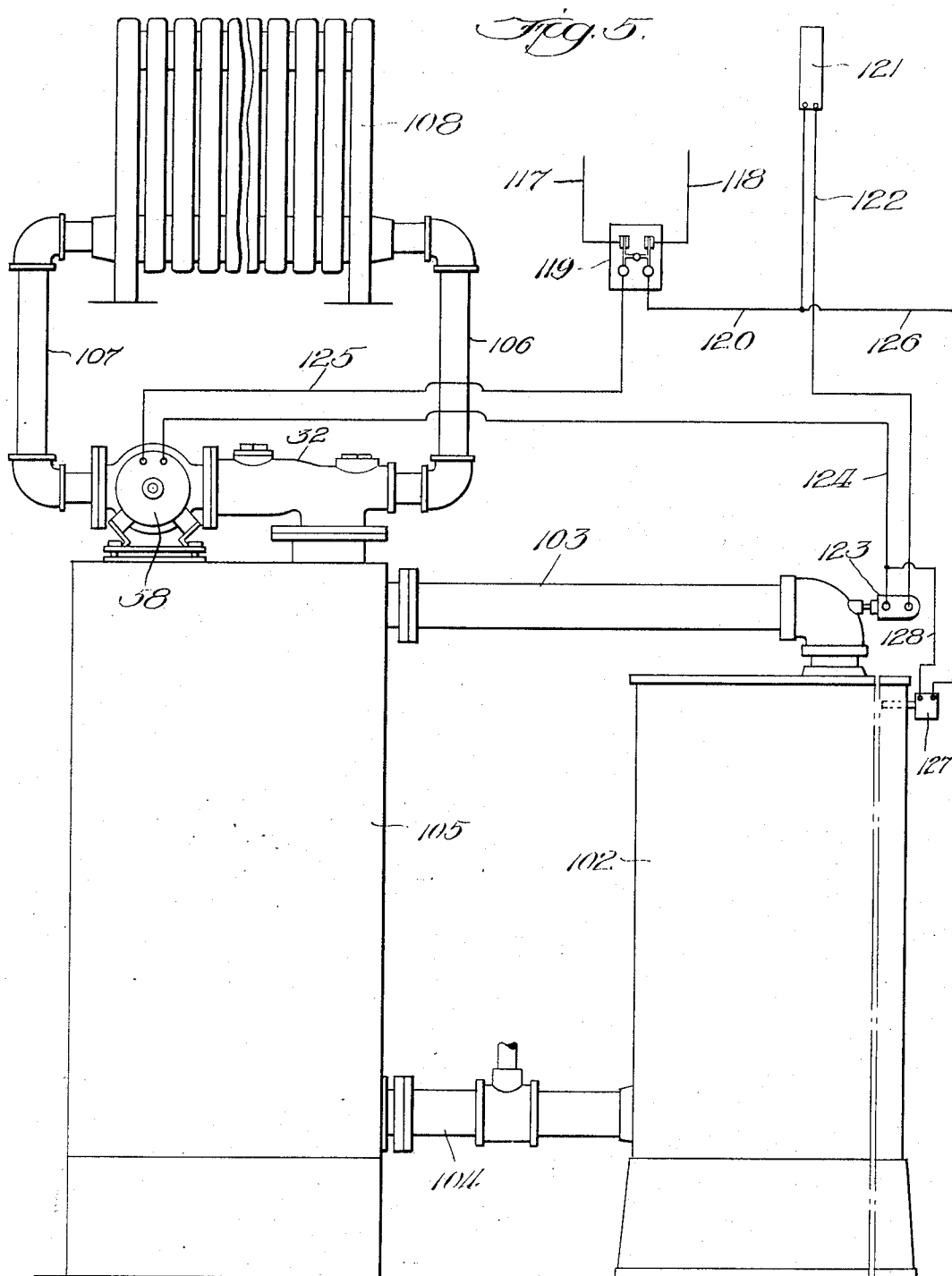
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HOT WATER HEATING SYSTEM

Filed Nov. 11, 1935

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,081,831

HOT WATER HEATING SYSTEM

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Application November 11, 1935, Serial No. 49,216

11 Claims. (Cl. 237—19)

My invention relates to hot water heating systems and more particularly to an arrangement for supplying hot water to radiators and for service or domestic use.

One object of my invention is to devise a system in which the amount of water that is maintained at boiler temperature is considerably larger than in existing installations of equivalent capacity, thereby enabling the system to respond to sudden demands for hot water in the radiators or for service water requirements without excessively lowering the temperature of the water in the boiler.

A further object is to provide a system in which hot water from the boiler is forced through the radiators and connecting pipes in response to demand of the room thermostat for heat only when the temperature of the boiler water is above a predetermined minimum, thus insuring an adequate supply of hot service water at all times and also a supply of hot water for the radiators when circulation is established, as well as preventing the return of cold water from the radiators to the boiler during times when the temperature of the boiler water is below the minimum which would otherwise delay the required rise in temperature of the water in the boiler.

A further object is the provision of a heating system in which, under certain conditions of operation, only a part of the cold water returning from the radiators is delivered back to the boiler, the temperature of the remainder being raised by mixing with hot water proceeding from the boiler, which mixture is then circulated through the radiators, thus providing for certain economies in the operation of the system where peak heat demands occur intermittently.

A further object is to devise a heating system having radiator and water-heating sections, the temperature of the water in the latter section being maintained above a predetermined minimum to insure a supply of hot water for domestic use, and devices being provided to place the water heating section in communication with the radiator section whenever the room thermostat calls for heat, provided that the temperature of the water in the water-heating section is at or above the indicated minimum, and to deny communication at all other times.

A further object is to provide a heating system characterized by the foregoing features and which is additionally constructed and arranged to establish a forced circulation of water through the radiator section, independent of the boiler

section, thereby overcoming the inertial resistance of the water in the radiator section and providing for rapid transfer of heat to all parts of the radiator section when communication between the radiator and boiler sections is established by the required rise in temperature of the boiler water.

A further object is to devise a self-contained unit which is adapted to be connected directly to a water-heating boiler for the purpose of increasing the space occupied by water at boiler temperature, and which includes a large capacity tank or tankless type of domestic water heating coil, circulating pump, controls and valve devices for providing a system having the characteristics noted above, thereby simplifying and lessening the costs of installation, eliminating the necessity for a separate, service storage tank, and enabling any water heating system to be transformed into a system having the above operating advantages.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawings,

Figure 1 is an elevation, partly in section, showing an oil-fired, water heating boiler and my improved self-contained unit connected thereto.

Fig. 2 is a structural elevation of the upper end of the unit, as viewed in Fig. 1, showing the circulating pump, and the valve devices which respectively prevent circulation of the water to the radiators during summer operation and which by-pass a portion of the water being returned from the radiators during winter operation.

Fig. 3 is a view corresponding to Fig. 1, but showing the electrical connections for the system and a single radiator connected to the supply and return lines, the radiator unit being intended to diagrammatically illustrate the system to which the boiler and the self-contained unit are connected.

Fig. 4 is a view corresponding to Fig. 1, and illustrates the application of my system to a coal-fired boiler.

Fig. 5 is a view showing the electrical connections used with the type of installation shown in Fig. 4.

Referring to Fig. 1, the numeral 10 designates a hot water heating boiler which may be of any

type and from the upper end of which leads a pipe 11 constituting the supply line from the boiler. A pipe 12 is connected to the lower end of the boiler and operates as a return line thereto, while the numeral 13 designates a burner for heating the boiler and is to be regarded as any type of automatically controlled burner, although in the present instance, it will be considered as an oil burner.

The left end of the return line 12, as viewed in Fig. 1, is connected to an elbow 14 which is located within an expansion chamber 15 formed in the lower end of my improved hot water heating unit 16. This unit is also provided with an upper chamber or hot water reservoir 17 which is separated from the expansion chamber by a wall 18.

The left end of the supply line 11 is connected by a fitting 19 with the upper end of the reservoir 17 and a pipe 20 connects the elbow 14 with the bottom of the reservoir 17 through the wall 18, thus forming a local boiler circuit as provided by the boiler, the supply and return lines 11 and 12, respectively, the reservoir 17, pipe 20 and elbow 14.

Communication between this local boiler circuit and the expansion chamber 15 is provided by a port 21 formed in the elbow 14, so that as the water in the heating system expands when heated, the required space will be provided by the ability of the water level, as generally indicated by the numeral 22 in Fig. 1, to rise in the expansion chamber against the air collected over the surface of the water therein. Positive relief is afforded by a pipe 23 whose lower end is always immersed in the water in the bottom of the expansion chamber and which is connected to the usual pressure relief valve 24 that is provided with a drain pipe 25. This construction is customary in hot water heating systems, but, in the present instance, it has been associated in a novel manner with my improved hot water heating unit.

A hot water heating coil 26 of any approved construction is located in the reservoir 17 and is connected to a cold water feed pipe 27 and a hot water supply pipe 28 that leads to the usual faucets or other water outlets. Since the reservoir 17 is always filled with water at substantially boiler temperature, it will be obvious that by locating the coil 26 in this reservoir, an adequate supply of hot water is always available for service use and without the necessity for the usual storage reservoir, the arrangement being substantially of the so-called instantaneous hot water type. However, the coil could, if desired, be connected to the usual type of hot water storage tank.

An operating aquastat 29 is mounted in some convenient location in the boiler supply line 11 and a safety aquastat 30 may be mounted in the unit 16, it being understood that both of these aquastats are of any desired commercial construction and are both continuously exposed to the boiler water. As hereinafter described, the aquastat 29 is intended to maintain the temperature of the boiler water above a predetermined minimum by being included in an electrical circuit with the oil burner 13, while the aquastat 30 is intended to break this circuit when the temperature of the boiler water exceeds a predetermined amount. Accordingly, these aquastats will maintain the temperature of the boiler water within a certain definite range.

Referring to Fig. 2, a short length of pipe 31 is bolted to the top of the unit 16 and resting on the upper end of this pipe and securely attached thereto is a special pipe fitting 32. A pipe extension 33 extends downwardly from the fitting 32 through the pipe 31 and completely through the reservoir 17, the lower end of this extension being tapered as at 34 and projecting for a short distance within the upper end of the pipe 20. By tapering the end of the extension 33, an annular passage 35 is formed therearound within the pipe 20, so that the local boiler circuit is not impeded by the projection indicated.

As indicated in Fig. 2, the principal axis of the fitting 32 is located generally in a horizontal plane and within the fitting is provided a wall 36 that defines a by-pass 37 and a boiler return passage 38 which is in communication with the interior of the pipe 33. Movement of water through these passages, as hereinafter described, is controlled by a two-part valve 39 having wings 40 and 41 which are preferably arranged with respect to each other in the manner of the limbs of the letter V and which are rigidly connected to a rock shaft 42 that extends without the fitting 32 and has affixed to its outer end a rock arm 43. The free end of the arm 43 is pivotally connected to one end of a link 44 whose opposite end is similarly connected to the upper end of a push rod 45 whose lower end extends through a cap 46 that is bolted to a casing 47 which extends within the reservoir 17 and is always subject to boiler water temperature. A thermostat 48 is located within the casing 47 and this element may be of the bellows type as illustrated, or generally any type of thermostat responsive to boiler temperature and connected to the valve 39 to control the latter's movement. For example, a bimetallic thermostat may be used, or a motor operated valve controlled by a thermostat could be employed. The upper end of the thermostat 48 is positioned in operative relation to the flanged lower end 49 of the push rod 45 and a coil spring 50 encircles this rod between the flange 49 and the cap 46, thereby tending to maintain the valve 39 in the position illustrated in Fig. 2 and also assisting in a return of the thermostat to its cold position. It will be understood that the by-pass 37 could be formed as a separate pipe without affecting the principle of operation and, in such a case, it may be necessary to divide the valve 39 into two separate valves which would be controlled by the same or individual thermostatic means responsive to the temperature of the water in the boiler.

The fitting 32 is also provided with a valve seat 51 which is normally closed by a weighted valve 52, the nature of the construction being such that the valve opens when subjected to a definite pressure as hereinafter described. This pressure is established by water passing upwardly through the pipe 31 from the boiler supply line 11, and a baffle wall 53 may be provided adjacent the delivery end of the supply pipe 11 in order to correctly deflect the moving water toward the valve 52.

One end of the fitting 32 is connected to a radiator supply pipe 54 and the opposite end to a pump housing 55, within which is rotatably mounted a pump impeller 56 that is fixed to one end of a motor shaft 57 that extends outwardly of the housing 55 and is drivably connected to a motor 58. The opposite end of the pump housing 55 is connected to a radiator return line 59

and the lines or pipes 54 and 59 are connected to the usual system of radiators as designated generically by the numeral 60 in Fig. 3. Replenishment of the supply of water in the heating system can be effected through the pipe 61, as determined by a valve 62, which may be either manually or automatically controlled in accordance with standard practice.

The electrical control for my improved system is more particularly illustrated in Fig. 3 wherein the numerals 64 and 65 designate line conductors that are attached to a suitable main control switch 66. From this switch leads a positive or "hot" wire 67 which is connected to a binding post 68 on a relay 69. A wire 70 connects the binding post 68 to the primary coil 71 of a transformer 72 and from this coil leads a wire 73 to a binding post 74 also mounted on the relay 69. A return or negative wire 75 connects the binding post 74 with the switch 66, so that as long as the switch 66 is closed, full line voltage is applied to the terminals of the primary coil 71.

A wire 76 is connected to the hot wire 67 and also to the operating or low limit aquastat 29. From this aquastat leads a wire 77 which is connected to the safety or high limit aquastat 30 and from this aquastat leads a wire 78 to the oil burner 13. A wire 79 connects the burner to the main return wire 75. The wires and parts just described comprise a burner circuit which is controlled by the aquastat 29 and the burner will operate as long as this aquastat is closed, but will be thrown out of operation when this aquastat is opened by a suitable change in temperature of the boiler water. For example, the operating aquastat 29 may be adjusted to close the indicated circuit whenever the boiler water temperature is reduced below 150° F., and it will remain closed until the water temperature reaches 170° F., when it will open, thus breaking the circuit and stopping the burner. This cycle is characteristic of summer operation.

The safety aquastat is normally closed but may be adjusted to break the circuit when the boiler water temperature reaches approximately 215° F. The foregoing temperatures are suggestive only for the aquastats may be adjusted as desired.

One end of a wire 80 is connected to the hot wire 77 of the aquastat circuit and the opposite end of the indicated wire is connected to a binding post 81 on the relay which is in turn connected to a contact 82. A contact 83 is also provided on the relay and is situated similarly to the contact 82 and the former is connected to a binding post 84 which is in turn connected to binding post 68 by a wire 85.

A thermostat 86 is located in some convenient position where it may be affected by the radiator 60 and it is connected by a wire 87 with a binding post 88 on the relay which is in turn connected by a wire 89 to a low voltage holding coil 90, also provided on the relay. This coil is in turn connected by a wire 91 to the secondary coil 92 of the transformer 72 and this secondary coil is connected by a wire 93 to a binding post 94 which is in turn connected by a wire 95 with the thermostat. The coil 90 encircles an iron core 96 which is magnetized by the indicated coil whenever the thermostat 86 is closed by a demand for heat. Under these conditions, an armature 97 is attracted downwardly by the core 96 and engages the contacts 82 and 83 but does not touch the core. The armature 97 is connected by a pair of wires 98 to a pair of binding posts 99 which are in turn connected by a common

wire 100 to the motor 58 which operates the circulating pump. The latter is in turn connected by a wire 101 to the return wire 79 leading to the main control switch 66.

In describing the operation of the system illustrated in Figs. 1 to 3, inclusive, it will be assumed that the bellows thermostat 48 is adapted to begin opening the valve 39, that is rotating this valve in a counterclockwise direction, as viewed in Fig. 2, when the temperature of the boiler water reaches approximately 200 degrees F., and that the valve 39 is full open when the temperature of the boiler water attains 210 degrees to 220 degrees F., or in other words, when the wing 40 of the valve is moved to the dotted position indicated in Fig. 2, thus closing the by-pass 37 and fully opening the passage 38.

If the system is started cold and with the switch 66 closed, both aquastats 29 and 30 will also be closed, the former being in this condition because the temperature of the boiler water is below the minimum range hereinbefore indicated. The oil burner circuit will thereby be completed and the oil burner 13 will commence firing the boiler and the temperature of the boiler water will slowly rise. At this time, the valve 39 will occupy the position shown in Fig. 2, or one in which the wing 41 thereof will completely close the passage 38. Accordingly, if at this time or at any time before the temperature of the boiler water reaches 200 degrees F., the room thermostat 86 calls for heat, the circulating pump 58 will be thrown into operation and will circulate cold water through the radiator system, but no portion of this water will be returned to the local boiler circuit, because of the interrupting position of the valve wing 41. Hence, the heating of the water in the boiler 10 and the hot water reservoir 17 will proceed rapidly and will not be unduly retarded by the constant return of cold water from the radiators.

The foregoing condition will obtain until the temperature of the boiler water reaches 170 degrees F. when the aquastat 29 will open and the burner will stop. As long as the temperature of the water remains above 170 degrees F. the burner can only resume operation when the thermostat 86 calls for heat, thus moving the armature 97 into engagement with the contacts 82 and 83 and enabling current to flow to the burner through the wires 67, 85, armature 97, wires 80 and 77, aquastat 30 and wire 78. When, in this manner, the temperature of the boiler water has been raised to 200 degrees F. for example, the thermostat 48 will rock the valve 39 upwardly to some extent, thereby placing the radiator return line 59 in communication with the pipe extension 33 and accordingly with the boiler return line 12.

If the thermostat 86 now calls for heat, the circulating pump 56 will set up a circulation of water through the radiator and local boiler circuits. However, as the water returning from the radiator through the pipe 59 reaches the valve 39, then in some intermediate position, only a portion of the water is returned directly to the boiler, the remaining portion being directed through the by-pass 37 for mixing with water proceeding directly through the radiator supply line 54, as permitted by the lifting of the weighted valve 52 by the pressure established by the pump. It will be understood that, whenever the circulating pump stops, the valve 52 automatically returns to the closing position indicated in Fig. 2, thus preventing any gravity cir-

culuation of hot water through the radiator portion of the system, this arrangement being particularly advantageous during summer operation when it is only desired to heat the boiler water sufficient for service water purposes. A reverse
 5 return of hot boiler water through the radiator return line 59 is also prevented during summer operation by reason of the annular passage 35 around the lower end of the pipe extension 33.
 10 If the temperature of the boiler water rises sufficiently to cause the thermostat 48 to so position the valve 39 that the by-pass 37 is completely closed, then all the water returning from the radiator is returned directly to the boiler.
 15 This mode of circulation, however, would only occur in response to exceptional demands for heat and in a majority of installations would be of a decidedly intermittent nature.

If the temperature of the boiler water rises to 215 degrees F. or above, the safety aquastat 30 will automatically break the aquastat circuit and so cause a stoppage of the oil burner 13. Under these conditions, however, if the thermostat 86 calls for heat, the circulating pump 56
 25 can still be thrown into operation because the wire 85 connects the binding post 68 to the binding post 84 and so enables the electrical current to pass along the wires 67 and 85 and thence to the contact 83 which at this time would engage the armature 97.

In Figs. 4 and 5 are illustrated the application of my improved hot water heating unit to a coal fired boiler designated generally by the numeral 102. This boiler is connected by supply and return lines 103 and 104, respectively, to a hot
 35 water heating unit 105 whose internal construction is identical with the unit 16, so that the numerical designations of the latter will be referred to in describing the operation of the present system. The unit 105 has also mounted on the top thereof the pipe fitting 32 whose internal construction, including the two-part valve and the manner of actuating the same is identical with that heretofore described, so that the same
 45 policy in referring thereto will be adopted. The fitting 32 is connected at one end to a radiator supply line 106 and at the opposite end to a radiator return line 107 through the usual pump casing 55, the lines 106 and 107 being connected to a radiator 108 which is generally indicative of a radiator system.

The shaft 42 of the two part valve 39 extends through the wall of the fitting 32 as above described and has secured on the end thereof the rock arm 43 which is attached to the push rod
 55 45 that is actuated by the bellows thermostat 48. Also fixedly mounted on the shaft 42 is a lever 109, the point of attachment being intermediate the ends of the lever and, when the valve 39 is occupying the position illustrated in Fig. 2, the lever 109 is generally parallel to the valve wing 41. The lower or right end of the lever 109 is connected by a cable or chain 110 that runs over suitable pulleys 111 with the ash pit damper 112,
 60 while the upper end of the same lever is connected by a chain 113 that operates over pulleys 114 with a flue damper 115 that is located in the usual smoke pipe 116.

The electrical control for the coal fired system is more particularly illustrated in Fig. 5 wherein the numerals 117 and 118 designate line conductors which are connected to a main control switch 119. From this switch a positive or "hot" wire 120 leads to a room thermostat 121 which is lo-
 75 cated to be affected by the radiator 108 and from

the thermostat a wire 122 is connected to a reverse action, low temperature aquastat 123 which may be mounted in any convenient location along the boiler supply line 103, or in any other position where it is exposed to the boiler water. From
 5 the aquastat 123, a wire 124 leads to the motor 58 which drives the circulating pump, and from this motor a wire 125 is connected to the switch 119. A wire 126 is connected to the wire 120 at one end and at the opposite end to a reverse
 10 action, high temperature safety aquastat 127, which in this diagram is illustrated as being mounted in the boiler 102 for exposure to the water therein, although the aquastat may also be mounted in the water heating unit 105, as in
 15 the system illustrated in Fig. 3. From the aquastat 127 leads a wire 128 which is connected to the wire 124.

In describing the operation of the system illustrated in Figs. 4 and 5, it will be understood that
 20 the low temperature aquastat 123 is arranged to break the circuit of which it is a part when the temperature of the boiler water is below 110 degrees F., approximately, thus preventing operation of the circulating pump when the thermostat
 25 121 calls for heat, an arrangement which would otherwise result in a circulation of cold water through the radiators. After the boiler water temperature has reached 110 degrees F. and above, the aquastat 123 remains closed and when
 30 the temperature reaches approximately 215 degrees F., the aquastat 127 will close and will thereby complete the motor circuit, regardless of the fact that the room thermostat may not
 35 be calling for heat.

Accordingly, if it is considered that the system is started in a "cold" condition, the firing of the boiler 102 will cause a gradual rise in temperature of the water in the boiler and in the unit 105 until the temperature has attained 110
 40 degrees F. or in excess thereof. At this time, as already stated, the aquastat 123 will close, so that when the thermostat 121 calls for heat, the circulating pump will immediately be thrown into action. This condition will obtain as long
 45 as the temperature of the boiler water does not exceed 215 degrees F., but in the latter instance the aquastat 127 will close and will cause the operation of the circulating pump, independently
 50 of the thermostat 121.

In the coal fired system, the operation of the valve 39 is identical with that already indicated in connection with the system shown in Fig. 3, so that further reference thereto is unnecessary, it being recalled that the valve 39 will not open
 55 until the temperature of the boiler water has reached 200 degrees F., approximately.

As the valve 39 opens, the rocking of the lever 109 will effect a gradual closing and opening of the dampers 112 and 115, respectively, thus exercising an automatic control on the fire. The dampers 112 and 115 may occupy different initial positions from those shown.

Both of the system above described are characterized by the important operating requirement
 65 that a relatively large reservoir of hot water is always available for use either in the heating of service water, or for rapid circulation to the radiators. Moreover, during certain seasons of the year, such as the spring and fall, when the
 70 demand for heat is intermittent and occurs at rather long intervals, the provision of establishing a forced circulation of water through the radiator portion of the system, wholly independent of the local boiler circuit, not only enables the
 75

water in the latter circuit to be quickly raised to the required temperature, but the period of time intervening between the instant when the room thermostat calls for heat and the time when the water has reached the required temperature enables the circulating pump to overcome the normal inertia of the mass of water in the radiators, so that when the by-pass valve is opened, the heated water may be passed rapidly to all parts of the system. By this arrangement, it is possible to avoid "cold spots" at the ends of the usual type of heating systems. Moreover, the by-pass valve serves to mix the hot boiler water with the return water from the radiators and thus provides for a mild heating of the radiators in spring and fall and a more even temperature control during these seasons of the year.

My improved water heating unit may be easily connected to any standard type of hot water heating boiler and hence existing installations may be readily changed to incorporate the operating advantages noted above. Moreover, the unit is self-contained, presents a neat appearance, is free of all expansion noises and avoids the usual difficulties resulting from a rusting of the separate service hot water tank.

I claim:

1. In a hot water heating system, the combination of a boiler, a tank closely adjacent the boiler, pipe lines connecting the boiler and tank for maintaining a circulation therebetween whereby the water in the tank is substantially at boiler temperature, a coil for heating domestic water positioned for immersion in the tank, a radiator, supply and return lines positioned to connect the boiler and radiator through the tank, a by-pass line bridged between the radiator supply and return lines, valve means located to control the flow of water through the return and by-pass lines and shiftable between limiting positions closing and opening the return line to the tank and the by-pass line, respectively, and opening and closing the return line to the tank and by-pass line, respectively, and including positions permitting simultaneous flow through said last named lines, and thermostatic means responsive to the temperature of the water in the tank for controlling the position of the valve means.

2. In a hot water heating system, the combination of a boiler, a tank closely adjacent the boiler, supply and return lines connecting the boiler and tank for maintaining a circulation therebetween whereby the water in the tank is substantially at boiler temperature, a coil for heating domestic water positioned for immersion in the tank, a radiator, a supply line connecting the radiator and tank, a return line from the radiator having an extension passing through the water space in the tank and connected to the return line between the tank and boiler, the extension separating the water contained therein from the water in the tank, a by-pass line bridged between the radiator supply and return lines, valve means located to control the flow of water through the extension and by-pass lines, and shiftable between limiting positions closing and opening the extension and by-pass lines, respectively, and opening and closing the extension and by-pass lines, respectively, and including positions permitting simultaneous flow through said last named lines, and thermostatic means responsive to the temperature of the water in the tank for controlling the position of the valve means.

3. In a hot water heating system, the combi-

nation of a boiler, a tank closely adjacent the boiler, supply and return lines connecting the boiler and tank for maintaining a circulation therebetween whereby the water in the tank is substantially at boiler temperature, a coil for heating domestic water positioned for immersion in the tank, a radiator, a supply line connecting the radiator and tank, a return line from the radiator having an extension passing through the water space in the tank and having its terminal extending within and spaced from the inlet end of the first named return line whereby the water in the tank and the water in the extension is delivered to the first named return line, a by-pass line bridged between the radiator supply and return lines, valve means located to control the flow of water through the extension and by-pass lines and shiftable between limiting positions closing and opening the extension and by-pass lines, respectively, and opening and closing the extension and by-pass lines, respectively, and including positions permitting simultaneous flow through said last named lines, and thermostatic means responsive to the temperature of the water in the tank for controlling the position of the valve means.

4. In a hot water heating system, the combination of a boiler, a tank closely adjacent the boiler having first and second chambers, supply and return lines connecting the first chamber with the boiler, the return line passing through and having a vent adjacent the lower portion of the second chamber whereby the last named chamber acts as an expansion tank, a coil for heating domestic water positioned for immersion in the first chamber, a radiator, and supply and return lines connecting the radiator and tank, the last named return line having an extension for delivering the water returned from the radiator directly to the first named return line.

5. In a hot water heating system, the combination of a boiler, a tank closely adjacent the boiler having first and second chambers separated by a wall extending completely across the tank, supply and return lines connecting the first chamber with the boiler, the return line having its inlet positioned in the wall and passing through and having a vent adjacent the lower portion of the second chamber whereby the last named chamber acts as an expansion tank, a coil for heating domestic water positioned for immersion in the first chamber, a radiator, supply and return lines connecting the radiator and tank, the last named return line having an extension passing through the water space in the tank with its terminal extending within and spaced from the inlet end of the first named return line whereby the water in the tank and extension is delivered to the first named return line.

6. In a hot water heating system, the combination of a boiler, a radiator, supply and return lines connecting the boiler and radiator, a by-pass line bridged between the radiator supply and return lines, valve means located to control the flow of water through the return and by-pass lines and shiftable between limiting positions closing and opening the return and by-pass lines, respectively, and opening and closing the return and by-pass lines, respectively, and including positions permitting simultaneous flow through said last named lines, an intermittently operated pump for forcibly circulating water through the system located in the return line on the inlet side of the valve means, and a valve for normally closing the supply line from the boiler

and adapted to be opened by pressure established by the pump, said valve being located in the supply line between the boiler and the junction of the supply and by-pass lines.

5 7. In a hot water heating system, the combination of a boiler, a radiator, supply and return lines connecting the boiler and radiator, a by-pass line bridged between the radiator supply and return lines, valve means located to control the
10 flow of water through the return and by-pass lines and shiftable between limiting positions closing and opening the return and by-pass lines, respectively, and opening and closing the return and by-pass lines, respectively, and including positions permitting simultaneous flow through
15 said last named lines, thermostatic means responsive to the temperature of the water in the boiler for controlling the position of the valve means, an intermittently operated pump for
20 forcibly circulating water through the system located in the return line on the inlet side of the valve means, and a valve for normally closing the supply line from the boiler and adapted to be opened by pressure established by the pump, said
25 last named valve being located in the supply line between the boiler and the junction of the supply and by-pass lines.

8. In a hot water heating system, the combination of a boiler, a radiator, supply and return
30 lines connecting the boiler and radiator, a by-pass line bridged between the supply and return lines, a two-part valve located at the junction of the return and by-pass lines, the parts being adapted to close and open, and open and close
35 the return and by-pass lines, respectively, and to also be positioned to permit simultaneous flow through said last named lines, thermostatic means responsive to the temperature of the water in the boiler for controlling the position of the
40 valve, an intermittently operated pump for forcibly circulating water through the system located in the return line on the inlet side of the valve, and a valve for normally closing the supply line from the boiler and adapted to be opened by
45 pressure established by the pump, said last named valve being located in the supply line between the boiler and the junction of the supply and by-pass lines.

9. In a hot water heating system, the combination of a boiler, a radiator, supply and return
50 lines connecting the boiler and radiator, a circulating pump in one of the lines, a fuel burner associated with the boiler for firing the same, means responsive to boiler water temperature
55 for placing the burner in operation when the boiler water temperature falls below a predetermined minimum, valve means shiftable to by-

pass a portion of the water returning from the radiator directly to the supply line, the other portion being delivered to the boiler, thermostatic means responsive to the temperature of the boiler water for controlling the position of the valve means and including a position of the valve means in which all returning water from the radiator is by-passed to the supply line when the temperature of the boiler water falls below said minimum, and a thermostat positioned to be affected by the radiator and arranged to control the operation of the pump.

10. In a hot water heating system, the combination of a boiler, a radiator, supply and return lines connecting the boiler and radiator, a circulating pump in one of the lines, a first electrical circuit comprising a source of electrical energy, an electrically controlled fuel burner associated with the boiler for firing the same, and an aquastat immersed in the boiler water, the aquastat closing the first circuit and placing the fuel burner in operation when the temperature of the boiler water falls below a predetermined minimum, and being adapted to open said circuit above said minimum temperature, a second electrical circuit in parallel with the first circuit comprising a motor for driving the pump and a relay, and a room thermostat positioned to be affected by the radiator and electrically connected to the relay for opening and closing the parallel circuit, a by-pass line bridged between the supply and return lines, valve means located at the junction of the return and by-pass lines, and thermostatic means responsive to the temperature of the boiler water for controlling the position of the valve means and including a position of the valve means in which all the returning water from the radiator is by-passed to the supply line when the temperature of the boiler water falls below said minimum.

11. A hot water heater unit comprising a tank, a separating wall extending across the interior of the tank to form first and second chambers therein, a coil for heating domestic water positioned in the first chamber and adapted for connection to a cold water supply and a service outlet, and a pipe having one end projecting through the wall and the opposite end being adapted for connection with the return line of a water heating boiler, said pipe including a vent opening within the second chamber adjacent the lower portion thereof whereby the second chamber is adapted to act as an expansion tank and the first chamber being adapted for connection to the supply line leading from the boiler.

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