

June 29, 1943.

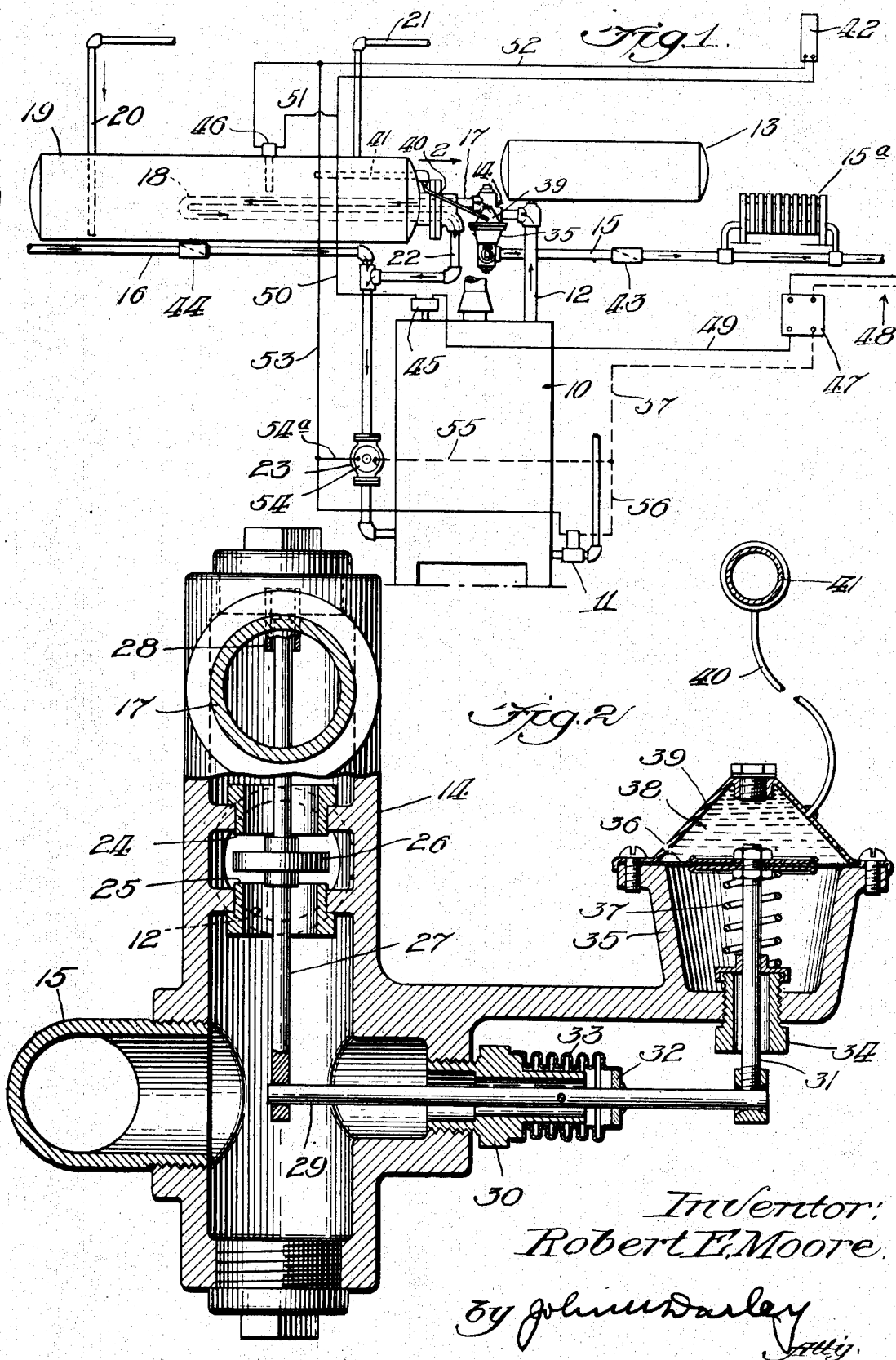
R. E. MOORE

2,322,872

HEATING SYSTEM

Filed Oct. 8, 1941

4 Sheets-Sheet 1



June 29, 1943.

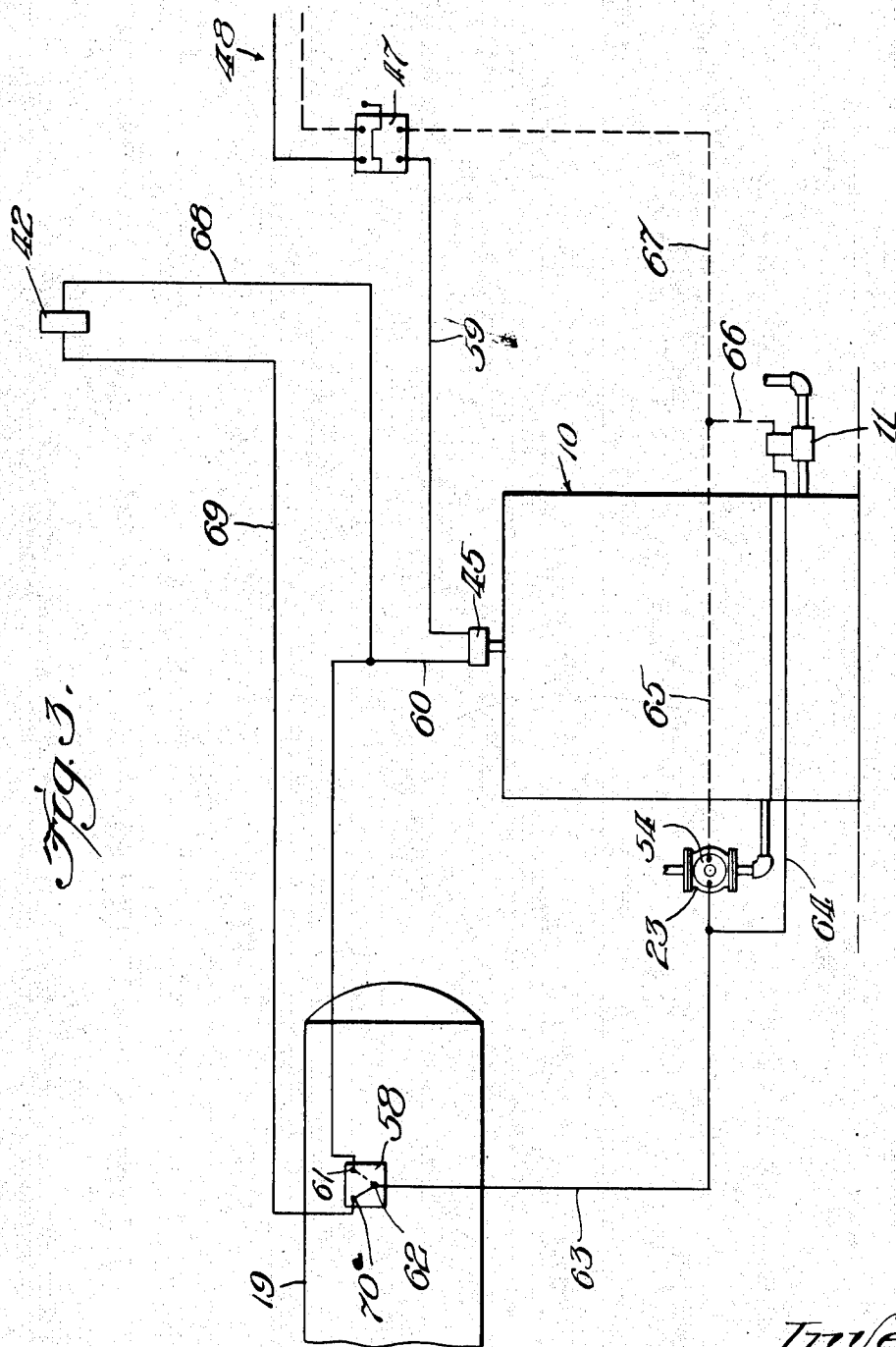
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HEATING SYSTEM

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4 Sheets-Sheet 2



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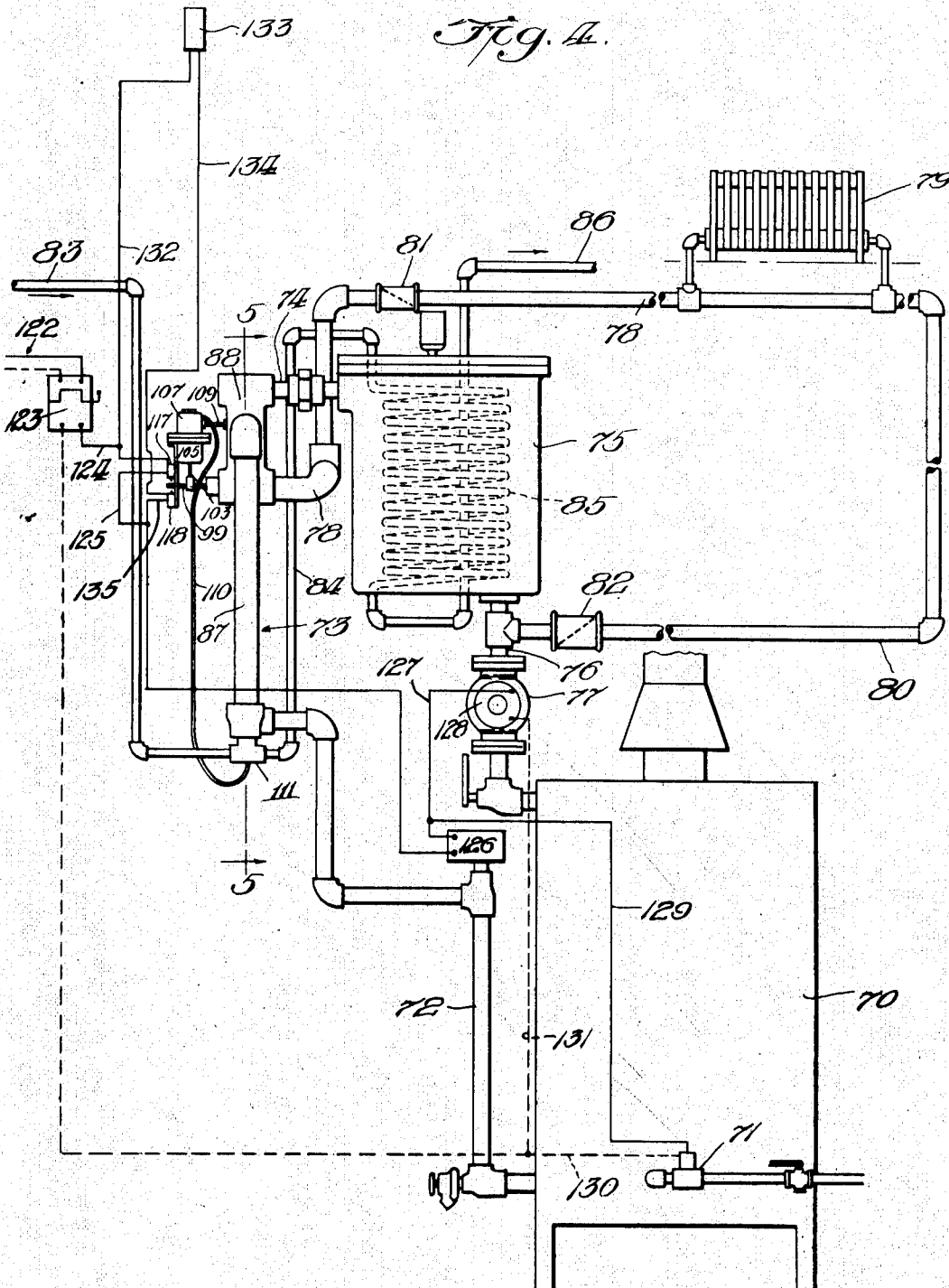
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HEATING SYSTEM

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Fig. 4.



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HEATING SYSTEM

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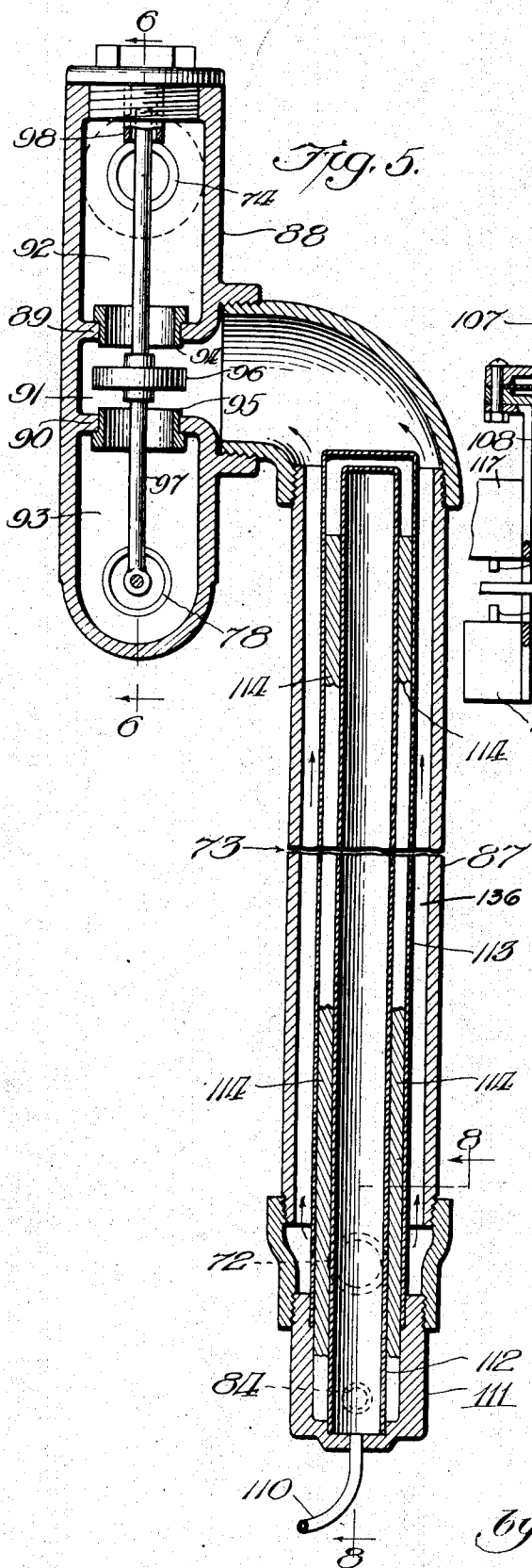


Fig. 5.

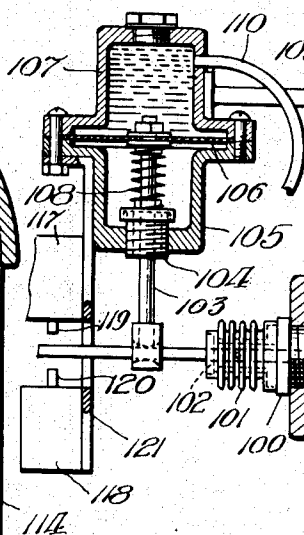
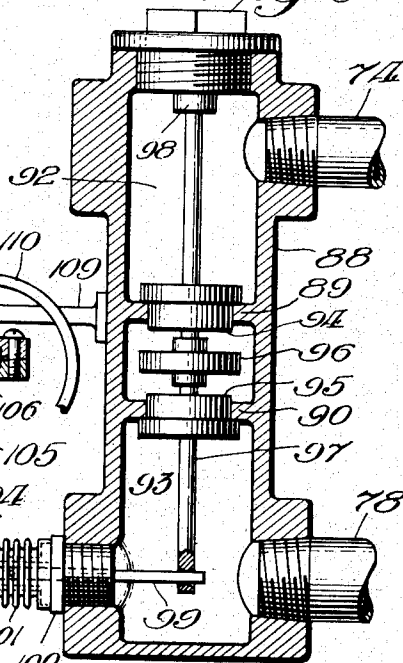


Fig. 6.



UNITED STATES PATENT OFFICE

2,322,872

HEATING SYSTEM

Robert E. Moore, Park Ridge, Ill.

Application October 8, 1941, Serial No. 414,127

9 Claims. (Cl. 237-8)

My invention relates to hot water heating systems and more particularly to an arrangement for supplying hot water to the radiators and hot water for service or domestic use in quantities limited only by boiler or water heater capacity and in which the boiler is only required to satisfy either one of these demands at any one time.

In hot water heating systems which are intermittently and automatically fired by gas or oil, a characteristic hookup includes a main circuit leading to the radiators having one or more flow control valves operated by a circulating pump which is responsive to the demands of a room thermostat and a parallel service water heating circuit through which boiler water flows continuously and thermogravitationally and therefore at a slow rate when the pump is not operating. It has been recognized that while a system of this type possesses simplicity of arrangement which is reflected in certain installation advantages, it is objectionable in other respects, namely, a heating efficiency that is lower than it should be and longer "on" periods of the pump and burner under conditions of sustained demand by either the room thermostat or for service water or both.

For example, if after a sustained draw of service water with a consequent reduction in the temperature of the boiler water, the room thermostat should demand heat, there will obviously be a considerable lag in supplying adequate heat to the radiators, since the boiler is at the same time trying to restore the temperature of the service water. This condition is due to the relatively low initial temperature of the boiler water at the instant of demand and also because the cold water from the radiators is continuously circulated through the boiler and over or through the heating coil so that the temperature of the boiler rises slowly. On the other hand, if the demand for service water follows a heavy radiator demand, the supply of hot spigot water will be inadequate and where both kinds of demands are made simultaneously, neither the radiator nor the service requirements are satisfactorily met. Moreover, due to the slow movement of the boiler water across the hot water heating coil during inactive periods of the pump, the exchange of heat is relatively inefficient. Further, difficulties arise in installations of the foregoing character due to lack of control over the temperature of the service water. In certain localities where the service water is indirectly heated by the boiler water to a temperature in excess of 140° F., deposits of lime and sediment

are formed rapidly in the storage tank or the coils of the heater, thus reducing the rate of heat exchange and lowering the temperature of the water available at the service outlets. This limiting condition is continuously aggravated by recurrent periods of overheating. Problems of the foregoing nature are frequently encountered in apartment, restaurant, garage and hotel heating systems, with their particularly heavy and all year round demands for hot water, but they are not uncommon in domestic installations.

If initial costs are not a factor, a partial solution of the foregoing is possible if boilers larger than the ordinary oversize boilers are used with corresponding sizes of heating coils and hot water storage tanks. Such costs, however, must usually be considered. The initial investment required with such a system is not only prohibitive but the fuel costs and heat losses are excessive and there is an extremely wasteful standby heat loss when there are no demands for radiator and service water. The latter condition is especially true with boilers that are built for gas firing, since such boilers are designed with large heating surfaces and relatively small water capacity. Accordingly, such boilers cool rapidly when the burner stops due to the sweep of cold air across the heating surfaces in its passage to the chimney and the temperature of the service water likewise falls.

It is therefore the principal object of my invention to devise a heating system which utilizes a boiler, economical in size and fuel consumption, and so related to the remainder of the system that copious quantities of hot service water are immediately available within a shorter time than is possible with existing equipment and in which hot water for the radiators is furnished more quickly.

A further object is to devise a system which is characterized by a high heating efficiency, both space and service water heating, because the mass of water whose temperature provides the fundamental control is heated by boiler water which has a short circulatory path to and from the boiler so that it may be quickly brought to the desired operating temperature.

A further object is to provide a system in which water from the boiler is forced through the radiators in response to the demand of the room thermostat for heat only when the temperature of the service water is above a predetermined maximum, thus insuring an adequate supply of hot service water and also quickly raising the temperature of the water for the radi-

ators when circulation is established, as well as preventing the return of cold water from the radiators to the boiler at times when the temperature of the service water is below the maximum which would otherwise delay the required rise in temperature of the water in the boiler.

A further object is to devise a system having radiator and service water heating portions, passage of water to the radiators being controlled by the demand of a room thermostat for heat and effective only when the temperature of the service water is at a predetermined maximum.

A further object is to devise a system of the foregoing character in which the same pump forces water through the radiators and also through the service water heater thus increasing the circulatory rate through the heater and facilitating the exchange of heat.

A further object is to provide a heating system of the character indicated in which the flow of water to the radiators is at all times subordinate to the service water being raised to a predetermined temperature.

A further object is to devise a hot water heating system incorporating a tankless or instantaneous heater for service water in which the flow of water through the heater coil and to the radiators never occurs simultaneously whereby the full heating capacity of the boiler is applied to either duty.

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:

Fig. 1 is an elevation of my improved heating system, including one type of electrical circuit employed therewith.

Fig. 2 is an enlarged sectional elevation, looking in the direction of the arrow 2 in Fig. 1, of a thermostatic power unit which is used with the system.

Fig. 3 is a diagram of a modified electrical circuit that may be utilized in connection with the heating system shown in Fig. 1.

Fig. 4 shows a modified system employing a tankless heater in which a draw of service water conditions the system to heat service water only, the supply to the radiators occurring when demanded only between periods of service water draws.

Figs. 5 and 6 are sections along the lines 5—5 and 6—6 in Figs. 4 and 5, both respectively, showing the thermostatic control and valve for determining the flow direction of the boiler water.

Figs. 7 and 8 are sections along lines 7—7 and 8—8 in Figs. 4 and 5, both respectively, showing certain structural details.

Referring to Figs. 1 and 2, the numeral 10 designates a gas fired boiler, generally representative of any automatically fired heating unit, which is provided with the usual gas valve 11 for controlling the flow of the gas to the burner (not shown). A riser 12 extends upwardly from the top of the boiler 10 and communicating therewith is the usual compression tank 13 which traps a portion of the air in the system, providing pressure for the system, and allowing for expansion of the water when heated.

The delivery end of the riser 12 is connected to an intermediate portion of a hollow casing 14 and leading from the lower portion of the casing is a supply pipe 15 which may be con-

nected to any desired number of radiators 15a, the water being circulated back to the boiler 10 by a return pipe 16. For purpose of illustration a one-pipe system is illustrated, although the radiators may be bridged between the pipes 15 and 16 if desired. In the case of a one-pipe system, the connection of the radiators to the pipe 15 may be effected by fittings of the type disclosed in Patent No. 1,663,271.

The portion of the system just described may be regarded as the radiator circuit, as distinguished from the service water heating circuit to which reference will now be made.

One end of a pipe 17 is connected to the upper portion of the casing 14 so that the pipe 12 is disposed between the pipes 15 and 17. The other end of the pipe 17 is connected to a heating coil 18 that is submerged in heat exchanging relation within a service water storage tank 19 to which cold water is supplied by a pipe 20 and from which hot water is drawn through a pipe 21 to any desired number of service outlets. The tank 19 is preferably disposed at a higher elevation than the boiler. The outlet end of the coil 18 is connected by a pipe 22 to the return pipe 16 and interposed between the connection of these two pipes and the boiler is a circulating pump 23.

From the foregoing, it will be understood that boiler water circulation to the radiators is effected through the pipes 15 and 16 and to and from the heating coil through the pipes 17 and 22. Instead of passing boiler water through the coil 18, it is considered to be within the range of my invention to employ the equivalent and commonly used arrangement of circulating the boiler water around a coil through which the service water flows.

My invention contemplates that water will be pumped through the radiator circuit only when the service water in the tank 19 is at or exceeds a predetermined temperature, preferably not less than 140° F., and whenever the temperature of the service water falls below the indicated minimum, flow to the radiator will be interrupted until the temperature of the service water is again brought up to 140° F. notwithstanding that the room thermostat may then be demanding heat. For this purpose, there is interposed in the system a thermostatically controlled valve that is responsive to the temperature of the water in the tank 19 and this valve is illustrated in detail in Fig. 2.

A pair of spaced valve seats 24 and 25 is symmetrically disposed with reference to the outlet end of the riser 12 and located between the seats is a reciprocable valve 26 that is secured to a valve stem 27 whose upper end is guided in a sleeve 28 provided in the casing 14 while the lower end is substantially pivotally connected to one end of a lever 29 intermediately pivoted in a bushing 30 that is threaded tightly in the casing 14 and extends outwardly of this bushing for connection to the lower end of an operating rod 31. In order to prevent loss of water through the bushing 30, a disk 32 is soldered or otherwise leakproof secured to the lever 29 and extending between the disk and the bushing is an impervious bellows or flexible sleeve 33. With this arrangement, the lever 29 can be freely rocked as hereinafter described without loss of liquid from the casing 14.

The rod 31 extends upwardly through a nipple 34 that is threaded in the bottom of a cup 35, preferably integrally formed with the casing 14 and the open end of the cup is closed by a diaphragm 36 whose central portion is secured to

the upper end of the rod 31. A helical spring 37 encircles the rod 31 between the diaphragm and nipple 34 and acts to move the diaphragm upwardly when displaced therefrom as hereinafter described.

A chamber 38 is formed above the diaphragm 36 by means of a cover 39 that is secured to the cup 35, the diaphragm 36 being clamped between the cover and cup. The chamber 38 is filled with any desired liquid, water or oil being suitable for the purpose. One end of a flexible tube of small diameter 40 is secured to the cover 39, while the opposite end is connected to a thermostatic casing 41, which may be cylindrical in shape and which is submerged in the water in the tank 19. The casing 41 may be filled with air at atmospheric pressure and the parts are so arranged for the particular system shown in Fig. 3 that when the temperature of the water in the tank reaches 140° F., the expansion of the air within the casing 41 applies pressure to the liquid in the chamber 38 which flexes the diaphragm 36 downwardly to thereby move the valve 26 into contact with the seat 24, thus preventing flow of boiler water to the coil 18 and permitting the water to flow to the radiators if the room thermostat 42 is then demanding heat. However, when the temperature of the water in the tank 19 falls below 140° F., the pressure on the liquid in the chamber 38 is correspondingly reduced and the spring 37 then moves the diaphragm 36 upwardly shifting the valve 26 into contact with the seat 25 whereupon the boiler water flows through the coil 18 and none can pass to the radiators. The thermostatic power unit, including the casing 41 and allied parts, in and of itself forms no part of the present invention but has been adopted as providing a very efficient arrangement for determining the direction of flow of the boiler water. In one installation, the casing 41 was formed as a copper cylinder having a length of 18 inches and an outside diameter of 1 inch. The air was originally introduced into the casing 41 at atmospheric pressure and under test, it was ascertained that a temperature rise of 80° F. of the service water provided an effective push at the end of such rise of about 9 pounds on the lever 29. Other gases than air may be employed and at pressures other than atmospheric. The usual flow control valves 43 and 44 operable by the pump 23 may be interposed in the pipe 15 and in the pipe 16, respectively, anterior to the connection of the pipe 22 therewith to prevent thermogravitational flow to the radiators when the valve 26 contacts the seat 24.

In order to provide for the automatic control of the system, there is mounted in the boiler a high limit or safety control 45 which is only diagrammatically shown in the drawing, but which it will be understood breaks the electrical circuit presently discussed when the boiler temperature exceeds, for example, 220° F., while there is mounted in the storage tank 19 a direct acting aquastat 46 that is included within the indicated electrical circuit and which is closed whenever the temperature of the water in the tank drops below 140° F. and opens above this temperature. The room thermostat 42 is also included in the above circuit and is located to be effected by the radiators.

A main switch 47 provides a connection to a power line generally indicated by the numeral 48 and leading from the switch is a hot wire 49 which is connected to the control 45. A hot wire 50 leads from the control 45 to the room thermostat 42 and also by means of a wire 51 to the aquastat

46. The aquastat and room thermostat are also connected by a wire 52, while a wire 53 connects the wire 52 with the gas valve and is also connected by a wire 54a to a motor 54 which drives the pump 23. Ground wires 55 and 56 connect the motor 54 and gas valve 11, respectively, with a ground wire 57 which in turn is connected to the switch 47.

In describing the operation of my improved system, it will be assumed that the temperature of the water in the tank 19 is below 140° F. Under these conditions, the aquastat 46 is closed and the pressure in the casing 41 is such that the spring 37 has flexed the diaphragm 36 upwardly to move the valve 26 into contact with the seat 25. The circuit through the motor 54 and gas valve 11 being completed, the boiler is subjected to heat and hot water is continuously circulated by the pump 23 through the coil 18 to heat the water in the tank 19.

This situation continues notwithstanding that the room thermostat 42 may demand heat, until the temperature of the service water has reached 140° F., when the aquastat 46 opens. If at the instant of opening, the room thermostat 42 demands heat, the circuit through the motor 54 and gas valve 11 is completed and since the thermopower unit shown in Fig. 2 becomes operable at the interrupting temperature of the aquastat 43, the pressure set up in the casing 41 flexes the diaphragm 36 downwardly thus moving the valve 26 into contact with the valve seat 24 and permitting all boiler water to be pumped to the radiators. Obviously in an arrangement of this character the temperature of the boiler water can be raised more quickly than in a system where the boiler water is simultaneously circulated through the radiators and heating coil.

If at any time during the pumping of water through the radiators, there should be a demand for service water sufficiently heavy to cause the water temperature in the tank 19 to drop below 140° F., the valve 26 is immediately moved downward to prevent flow to the radiators and to cause all water to be pumped through the coil 18 due to the closing of the aquastat 46. Circulation through the radiators is resumed when the temperature of the service water is again raised to 140° F., if the room thermostat is then demanding heat.

In Fig. 3, there is illustrated a modified electrical circuit in which only a fragmentary portion of the heating system is shown and in which the numeral 10 designates the gas fired boiler, while the service water storage tank, circulating pump, pump motor, gas valve and room thermostat, are indicated, respectively, by the numerals 19, 23, 54, 11 and 42. The principal distinction between this circuit and that illustrated in Fig. 1 resides in the use of a three-wire aquastat 58 which is submerged in the tank 19. In this system, the line wires 48 are connected through the switch 47 to the remainder of the circuit and in the latter a hot wire 59 connects the switch to one terminal of the high limit control 45, while the other terminal is connected by a wire 60 to one terminal 61 of the aquastat 58. The common terminal 62 of the aquastat is connected by a wire 63 to the pump motor 54 and also through a wire 64 to the gas valve 11. The motor 54 and valve 11 are in turn connected by ground wires 65 and 66 to a common ground wire 67 leading back to the main switch 47. The room thermostat 42 is connected by a wire 68 to the wire 60

and also by a wire 69 to the third terminal 70^a of the aquastat 58.

The aquastat 58 is internally arranged so that whenever the temperature of the water in the tank 19 falls below 140° F., the circuit is completed between the terminals 61 and 62 to thereby operate the pump 23 and open the gas valve 23 and whenever the service water temperature exceeds 140° F., the circuit is broken between terminals 61 and 62 and completed between the terminals 62 and 70^a so that when the room thermostat 42 demands heat, its closure results in an opening of the gas valve 11 and operating the pump motor 54 to thereby cause a forced circulation of water through the radiators.

It will be understood that the remainder of the system shown diagrammatically in Fig. 3 is identical with that illustrated in Fig. 1.

In Figs. 4 to 8, inclusive, there is illustrated a modified heating system employing a tankless or instantaneous service water heater in which the several parts are arranged so that draws of service water and a flow of hot water to the radiators can never occur simultaneously. In this modification, the numeral 70 designates a gas fired boiler having the usual gas valve 71 for supplying fuel to the boiler. In this particular instance, the boiler is indicated as being of that type wherein the water flows downwardly across the heating surfaces of the boiler as distinguished from the upward flow illustrated in Fig. 1.

Accordingly, from the lower portion of the boiler extends a supply pipe 72 whose delivery end is connected to a thermostatically controlled valve structure generally indicated by the numeral 73 in Fig. 4. The internal construction of this unit, will be hereinafter described, but for the present, it will be understood that it contains devices for controlling the flow direction of hot water issuing from the boiler 70 through the pipe 72. This water may be either directed through a pipe 74 into a service water heating tank 75 and thence through a return pipe 76 to the boiler 70, the pipe 76 including the usual circulating pump 77, or the hot water may be directed through the radiator supply pipe 78 to one or more radiators 79, which may be connected to the system as described for the system illustrated in Fig. 1, and thence by a return pipe 80 which connects with the return pipe 76 on the inlet side of the pump 77. Preferably, the pipes 78 and 80 are provided with flow control valves 81 and 82 which open only when the pump is operating and the valve structure 73 is conditioned to pass water through the pipe 78 and are closed at all other times. As is well understood in the art, these valves perform another function during the summer season in that they prevent thermogravitational flow of hot boiler water through the radiators.

Cold water is supplied by a pipe 83 which may be connected to any source of water, such as a city main, and this cold supply is passed through the valve structure 73 in order to exercise a certain control on the operation of the system as hereinafter described and thence through the pipe 84 to a service water heating coil 85 which is immersed in the water in the tank 75. The delivery end of the coil 85 is connected by a pipe 86 to any desired number of service outlets. As presently described, the tank 75 contains water substantially at boiler temperature whenever the valve structure 73 is conditioned to pass boiler water through the pipe 74.

The thermostatically controlled valve struc-

ture 73 constitutes an essential element of my invention in that it exercises prompt control on the flow direction of the hot boiler water. This structure is more particularly illustrated in Figs. 5 to 8, inclusive, to which reference will now be made. It comprises a tubular member 87 (see Fig. 5) whose upper end is connected to an elongated valve housing 88 having spaced transverse walls 89 and 90 which divide the interior of the housing into an intermediate chamber 91 and upper and lower chambers 92 and 93, respectively. Valve seats 94 and 95 are mounted in the walls 89 and 90, respectively, in spaced and opposed relation and these seats are engaged by a reciprocable valve 96 that is secured to a stem 97, the upper end of the stem being guided in a sleeve 98 secured to the upper end of the housing 88.

As indicated in Fig. 5, the delivery end of the supply pipe 72 from the boiler is connected to the lower end of the member 87 so that hot boiler water courses upwardly through the member 87 and thence into the chamber 91 where the direction of the water, either into the chamber 92 or the chamber 93, is controlled by the position of the valve 96. For purpose of easy illustration, the valve 96 is shown in an intermediate position between the seats 94 and 95, but it will be understood that it normally occupies a position in contact with either one of the seats depending upon conditions occurring in other parts of the system. The inlet end of the pipe 74 communicates with the chamber 92, while the inlet end of the pipe 78 communicates with the chamber 93.

The lower end of the valve stem 97 is pivotally connected to one end of a lever 99 which is intermediately pivoted in a nipple 100 that is threaded in the lower portion of the housing 88. As in the case of the structure shown in Fig. 2 the lever extends without the housing 88 and leakage is prevented by means of a bellows 101 whose ends are connected to the nipple 100 and to a disk 102 that may be welded or otherwise secured to the lever 99. Beyond the bellows, the lever 99 is pivotally connected to the lower end of an operating rod 103 which extends freely upwardly through a bushing 104 mounted in the bottom of a cup 105 whose open end is closed by a diaphragm 106. The periphery of the diaphragm is clamped against the cup 105 by a cover 107 formed as an inverted cup. The upper end of the rod 103 is secured to the diaphragm and interposed between the diaphragm and bushing 104 is a helical spring 108 which serves to move the diaphragm 106 upwardly when downwardly displaced as hereinafter described. The unit comprising the cup 105 and cover 107 may be supported from the housing 88 by a bracket 109.

The cover 107 may be filled with water or any desired liquid and one end of a small tube 110, the internal diameter of which may be of the order of $\frac{1}{8}$ of an inch, is connected to the interior of the cover 107, while the opposite end is mounted in a cup 111 that is secured to the lower end of the member 87 (see Fig. 5). The lower end of a casing 112 is supported by the cup 111 and may contain air or any gaseous medium which communicates with the water in the casing through the tube 110. The casing 112 is preferably coaxial with the member 87 and it extends for substantially the length thereof. Also coaxial with the member 87 and disposed therebetween and the casing 112 is a tube 113 whose lower end is rested on a shoulder provided in the cup 112 and whose upper end is closed, the

upper ends of the casing 112 and tube 113 being spaced from each other as indicated in Fig. 5.

A pair of diametrically arranged baffles 114—114 are disposed between the casing 112 and tube 113 with their lower ends resting on the bottom wall of the cup 111 and the upper ends terminating close to the upper end of the casing 112. This construction provides a pair of passages 115 and 116 between the casing 112 and the tube 113 so that cold water flowing through the pipe 83 is caused to traverse upwardly and downwardly the full length of the casing 112 before passing into the pipe 84 for delivery to the coil 85. This arrangement insures that when a faucet is opened, the cold water flows along the surface of the casing 112 and exercises an almost instantaneous effect on the gas in the casing to thereby insure a prompt shifting of the valve 96 as hereinafter described.

The lever 99 extends beyond its pivotal connection with the rod 103 into operative relation to electric switches 117 and 118 which are located in opposed relation on opposite sides of the lever 99 and which, respectively, are provided with fingers 119 and 120 which are engaged by the rocking movement of the lever to close the switches. The internal construction of these switches form no part of the present invention and have not been illustrated in detail, but it will be understood that the switch 117 is closed when the finger 119 is moved upwardly and the switch 118 is closed when the finger 120 is pushed downwardly. The switches may be conveniently carried by an arm 121 depending from the cup 105.

The switches 117 and 118 form part of an electrical circuit which will now be described. Referring to Fig. 4, the numeral 122 designates a power line which is connected to the remainder of the circuit by a main switch 123. From the latter switch leads a hot wire 124 to one terminal of the switch 117 and from the other terminal of this switch leads a hot wire 125 to a high limit or safety control 126 conveniently mounted in the supply line 72, the control 126 possessing the same characteristics as the control 45 in Fig. 1. A hot wire 127 connects the control 126 with one terminal of a motor 128 which is drivably connected to the pump 77 and a hot wire 129 connects the wire 127 with the gas valve 71. A ground wire 130 connects the gas valve with the main switch 123 and a similar wire 131 connects the pump motor 128 with the wire 130.

A wire 132 connects the wire 124 with a room thermostat 133 positioned to be affected by the radiator 79 and a wire 134 connects the thermostat with one terminal of the switch 118. The other terminal of the switch is connected by the wire 135 to the wire 125.

In describing the operation of this system, it will be assumed that one of the service outlets (not shown) is open so that cold water is flowing through the passages 115 and 116 to the heating coil 85. Under these conditions, the cold water chills the air or gas within the casing 112 sufficiently to enable the spring 106 to move the diaphragm 106 upwardly and cause the valve 96 to engage the seat 95, thereby diverting water from the boiler 70 into the pipe 74 and thence through the tank 75.

This clockwise rocking of the lever 99, as viewed in Fig. 6, engages the finger 119 and closes the switch 117 which completes the electric circuit through the motor 128 and the gas valve 71. Accordingly, the boiler 70 is fired and all water is

continuously circulated downwardly through the boiler and upwardly through the pipe 72, the annular passage 136 surrounding the tube 113 and thence through the pipe 74, tank 75 and return pipe 76 to the boiler. This condition persists as long as a faucet is open so that the full capacity of the boiler 70 is directed to satisfying the demand for hot service water.

When the faucet is closed, cold water no longer flows through the passages 115 and 116 and the water then contained in these passages is heated by the hot water in the passage 136 which is substantially at boiler temperature. The heating of the water in the passages 115 and 116 raises the temperature of the air in the casing 112 so that the diaphragm 106 is moved downwardly, thus rocking the lever 99 in a counterclockwise direction and opening the switch 117, thus breaking the circuit to the pump motor and gas valve. The last noted rocking of the lever 99 engages the valve 96 with seat 94, whereupon the device is conditioned to supply hot water to the radiators whenever the room thermostat 133 demands heat, and also engages the pin 120 and closes the switch 118. Therefore, when the thermostat 133 demands heat, the electric circuit is again closed through the pump motor 127 and gas valve 71 so that the full capacity of the boiler 70 is utilized to supply heat to the radiators. If at any time during the period when the radiators are being supplied with hot water, a faucet should open, the ensuing flow of cold water through the passages 115 and 116 chills the air in the casing 112, whereupon the lever 99 is rocked in a clockwise direction to engage the valve 96 with the seat 95 and close the switch 117. The first noted operation of heating the service water will then be resumed.

I have ascertained that after all the faucets have been closed, the valve 96 is shifted from a position engaging the seat 95 to one in contact with the seat 94 in approximately five seconds so that even though there should be a demand by the room thermostat 133 immediately after the closing of the faucets, only a very short time is required to condition the system for radiator supply. From a temperature standpoint, a variation of 25° F. in the temperature of the gas in the casing 112 is sufficient to shift the valve 96 from one position to another if the pump is not operating. Ordinarily, water from a city main would enter the passage 115 at approximately 60° F. and since the water in the boiler is never below 140° F. a surplus of thermopower is available to effect each operation of the valve 96.

During summer operation, when hot water is not desired in the radiators, the system may be operated in the usual manner, i. e., by setting the thermostat 133 to a point such that it can never demand heat. Hence regardless of the closing of the switch 118 the pump motor 123 will not function because the thermostat 133 is then open, while the valves 81 and 82 prevent thermogravitational flow to the radiators during times when the valve 96 is in contact with the seat 94.

I claim:

1. In a hot water heating system, the combination of a boiler, a radiator circuit, a service water heating circuit, the circuits communicating with the boiler, a service water container in heat exchanging relation to the service circuit, and means common to both circuits and responsive to the temperature of the service water for directing the flow of boiler water through the service circuit below a predetermined temperature of the

service water and through the radiator circuit above said temperature.

2. In a hot water heating system, the combination of a boiler, a radiator circuit, a service water heating circuit, the circuits communicating with the boiler, a service water container in heat exchanging relation to the service circuit, valve means for controlling flow through both circuits, and thermostatic means responsive to the temperature of the service water and operable to actuate the valve means to direct the boiler water through the service circuit below a predetermined temperature of the service water and through the radiator circuit above said temperature.

3. In a hot water heating system, the combination of a boiler, a radiator circuit and a service water heating circuit each communicating with the boiler, a service water container in heat exchanging relation to the service circuit, a reciprocable valve common to both circuits and shiftable between positions directing the flow to one circuit while denying flow to the other, and means responsive to the temperature of the service water for actuating the valve to direct the boiler water through the service circuit below a predetermined temperature of the service water and through the radiator circuit at or above said temperature.

4. In a hot water heating system, the combination of a boiler, a radiator circuit and a service water heating circuit each communicating with the boiler, a service water container in heat exchanging relation to the service circuit, a reciprocable valve common to both circuits and shiftable between positions directing flow to one circuit while denying flow to the other, and thermostatic means immersed in the service water and lever connected to the valve for moving the same to admit boiler water only to the service circuit below a predetermined temperature of the service water and only to the radiator circuit at or above the said temperature.

5. In a hot water heating system, the combination of a boiler, a radiator circuit and a service water heating circuit each communicating with the boiler, a service water container in heat exchanging relation to the service circuit, a room thermostat positioned to be affected by the radiator circuit, an aquastat responsive to the temperature of the service water, a circulating pump common to both circuits, electrical connections between the pump and thermostat and aquastat, respectively, whereby the pump operates in response to the demand of the thermostat or the

aquastat, and valve means for directing boiler water to one circuit or the other.

6. In a hot water heating system, the combination of a boiler, a radiating circuit and a service water heating circuit each communicating with the boiler, a service water container in heat exchanging relation to the service circuit, a room thermostat positioned to be affected by the radiator circuit, an aquastat responsive to the temperature of the service water, a circulating pump common to both circuits, electrical connections between the pump and thermostat and aquastat, respectively, whereby the pump operates in response to the demand of the thermostat or aquastat, valve means for directing boiler water to one circuit or the other, and thermostatic means responsive to the temperature of the service water for actuating the valve means to direct the boiler water through the service circuit below a predetermined temperature of the service water and through the radiator circuit above said temperature.

7. In a hot water heating system having a boiler and a radiator circuit and a service water heating circuit each communicating with the boiler, a valve common to both circuits, and thermostatic means responsive to the temperature of the service water for actuating the valve to direct the boiler water only to the service circuit below a predetermined temperature of the service water and only to the radiator circuit above said temperature.

8. In a hot water heating system, the combination of a boiler, a radiator circuit, a service water heating circuit, the circuits communicating with the boiler, a service water container in heat exchanging relation to the service circuit and means responsive to the temperature of the service water for directing the flow of boiler water through the service circuit below a predetermined temperature of the service water and through the radiator circuit above said temperature.

9. In a hot water heating system having a boiler and a radiator circuit and a service water heating circuit each communicating with the boiler, valve means for controlling flow through both circuits, and thermostatic means responsive to the temperature of the service water for actuating the valve means to direct the boiler water only to the service circuit below a predetermined temperature of the service water and only to the radiator circuit above said temperature.

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