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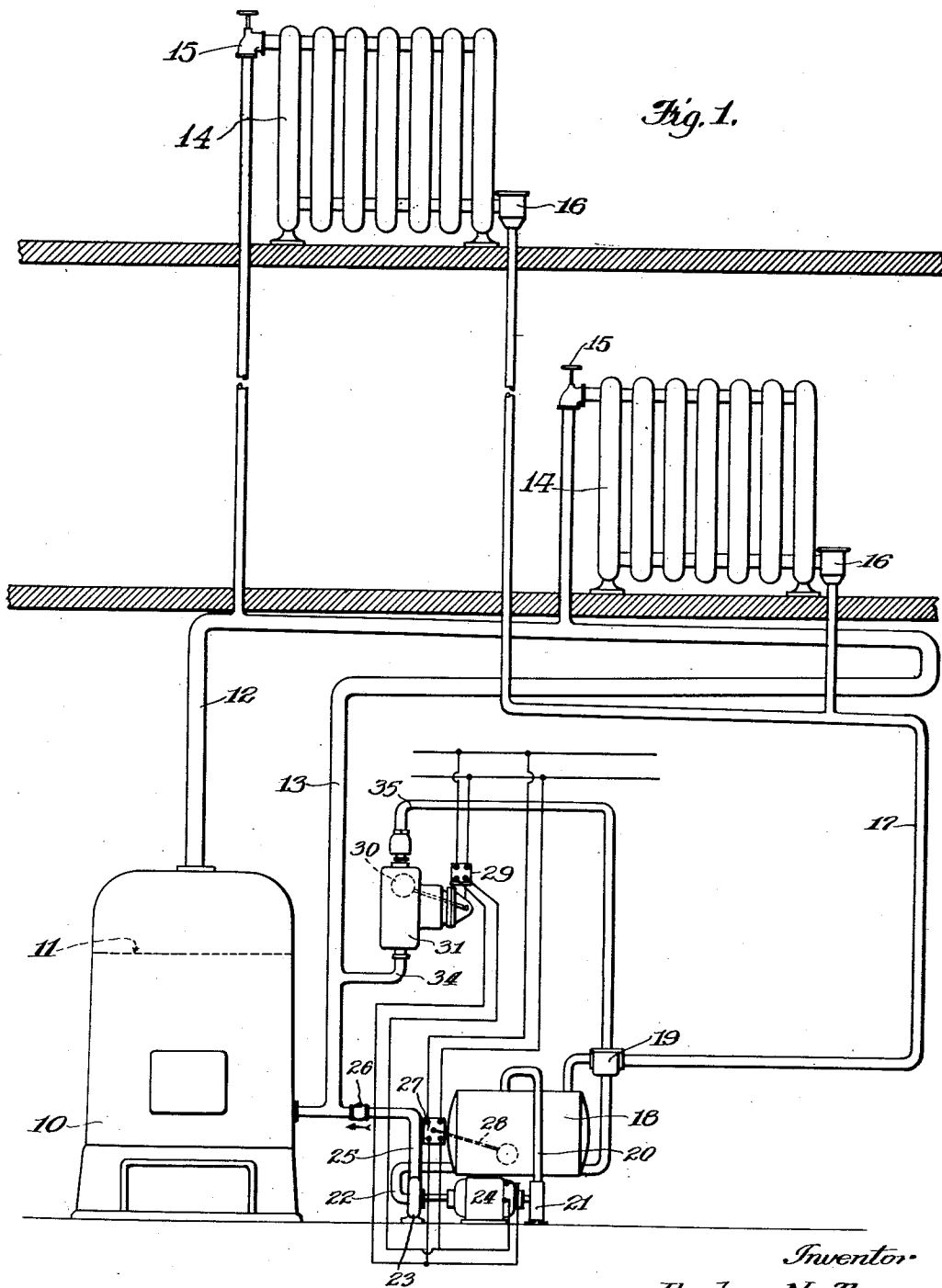
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1,828,302

VACUUM HEATING SYSTEM

Filed July 15, 1927

3 Sheets-Sheet 1



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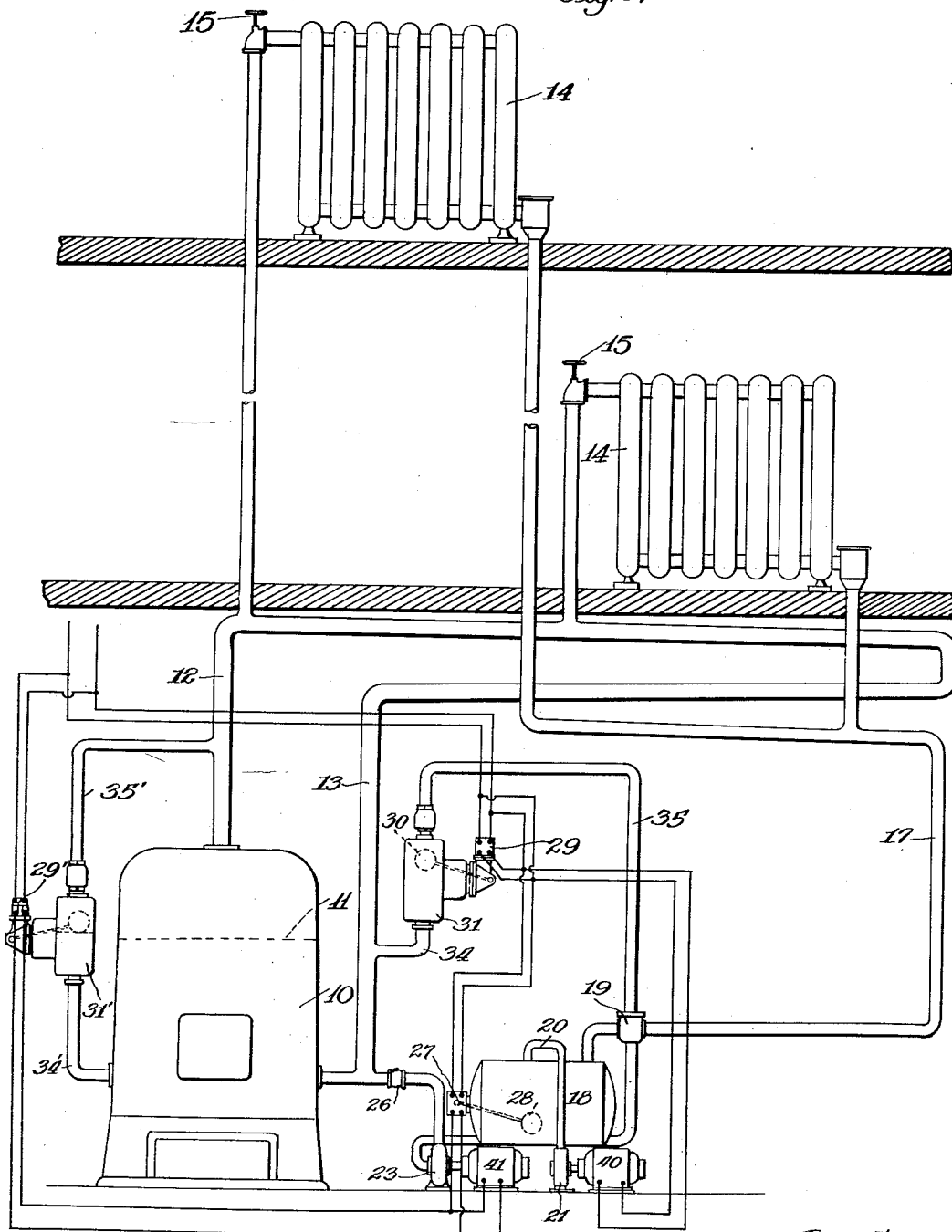
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Fig. 3.



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Fig. 4.

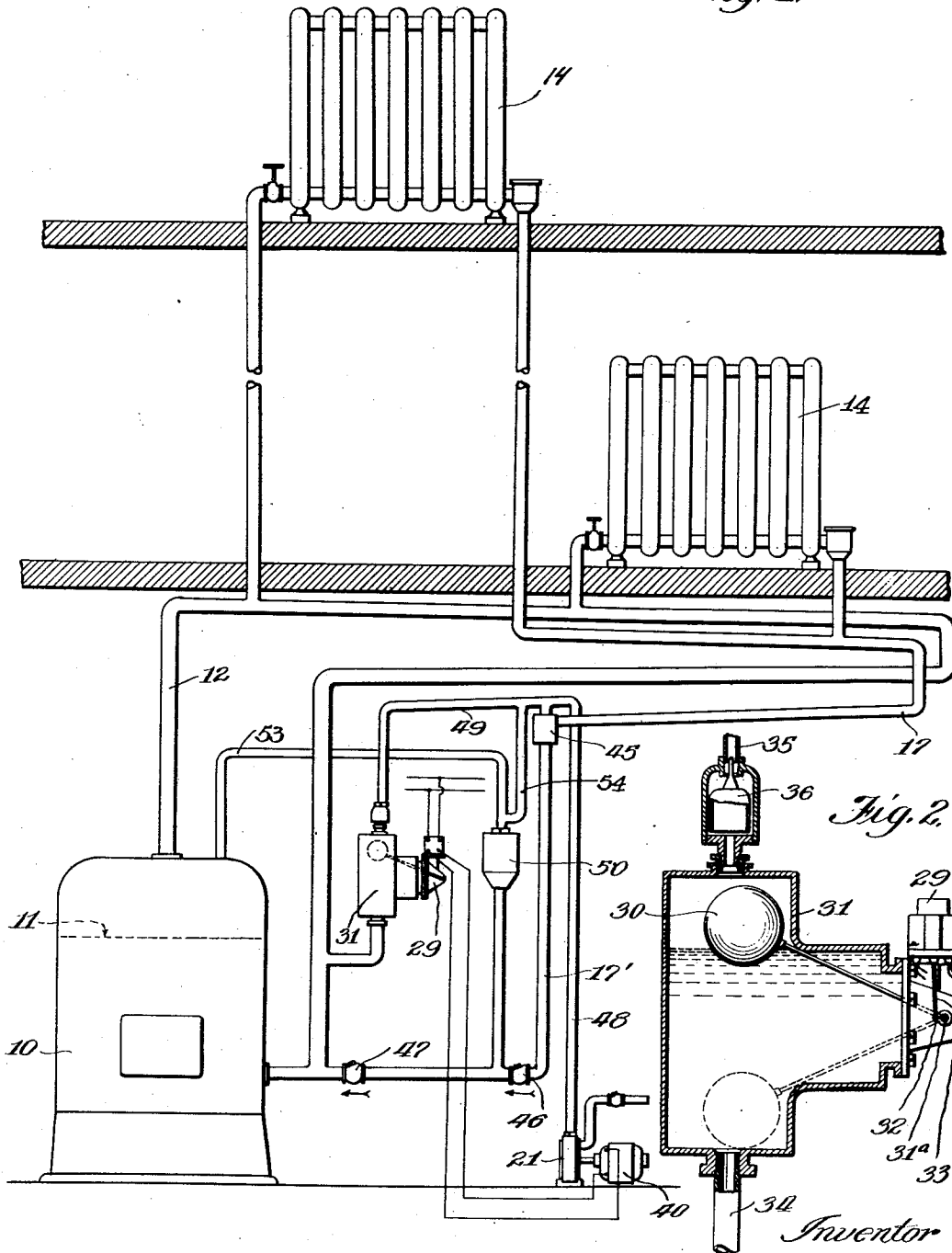


Fig. 2.

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UNITED STATES PATENT OFFICE

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VACUUM HEATING SYSTEM

Application filed July 15, 1927. Serial No. 205,918.

My invention relates to vacuum heating systems and the like and its principal object is to provide improved means of controlling the vacuum pump or other exhausting means whereby a predetermined pressure differential between the high and low pressure sides of the system may be more accurately maintained.

The common method of controlling the exhausting pump has been by a diaphragm arrangement subjected on one side to the return or low pressure side of the system and at the other side with atmosphere. Such a control arrangement, in attempting to maintain the ultimately desired predetermined pressure differential between the high pressure side and the low pressure side of the system, relied for its accuracy upon the premises that atmospheric pressure would remain substantially constant and also that the boiler pressure would remain substantially constant. There were also practical difficulties encountered in making the diaphragm control mechanism responsive to close limits and still have sufficient power to throw a sturdily constructed switch.

My invention contemplates the control of the exhausting pump by a motor switch or other control mechanism responsive directly to the differential between the boiler pressure and the return pressure as represented by a predetermined head of water above the water level of the boiler obtained by subjecting the lower end of the head to the boiler pressure and the surface of the head to the low pressure of the return line. Such a construction makes it entirely feasible to use a ruggedly constructed switch of generous dimensions and still keep the pressure variation within close limits, for the water head has a movement of about two feet for every pound change in pressure differential.

For convenience I prefer that the float chamber communicate with the boiler at a point below the water level of the boiler, although of course it may be arranged to communicate with some other point on the high pressure side, either the boiler above the water level or some desired place in the steam main.

The arrangement of my invention which I have above described presupposes, for its accuracy, that the water level in the boiler will remain approximately fixed. However, reasonable variations in the water level will not materially affect the accuracy of the differential pressure control, because of the relatively great height to which the water must rise in order to raise the head of water in the float chamber as much as a relatively small variation in pressure differential would raise it.

My invention is not particularly limited to any one type of vacuum heating system, and in the following description of my invention I have illustrated its adaptation to various types of vacuum heating systems.

Referring to the attached drawings where I have illustrated such adaptations,

Figure 1 shows more or less diagrammatically a layout of a vacuum heating system employing a receiver for the returns and a water pump and air pump driven by a common motor.

Figure 2 is a vertical cross-sectional detail of an illustrative form of float chamber.

Figure 3 shows a vacuum heating system similar to Figure 1 but employing a two-motor pump installation and also employing a second float control directly responsive to the water level in the boiler for controlling the water pump motor.

Figure 4 shows my invention applied to a gravity return vacuum heating system which dispenses with the necessity of a water pump.

Referring to Figure 1, I have shown a boiler 10 having a water level indicated at 11, which boiler supplies through the steam main 12 a plurality of radiators 14, 14 provided with the customary inlet valves 15 and steam traps 16. The latter are connected to a return line 17 communicating directly with a receiver 18. The return line 17 preferably includes a separator 19. The steam main 12 has a return 13 communicating with the boiler below its water level. The top of the receiver 18 communicates through a pipe 20 with the suction side of a vacuum pump 21 while the bottom of the receiver is connected through a pipe 22 with the suction side of a

water pump 23. Both pumps 21 and 23 are, in the particular installation shown, driven by a common motor 24. The discharge side of the pump 23 communicates through a pipe 25 and a check valve 26 with the boiler below its water level. The motor 24 is started and stopped by a two-pole switch 27 actuated by a float 28 in the receiver so that when the water level in the receiver rises above a predetermined height, the motor will be started to drive the water pump and pump the return water from the receiver back into the boiler. When the water has thus been pumped out down to the predetermined level in the receiver, the float opens the switch and shuts off the motor, in the usual manner. As Figure 1 shows a one-motor installation, the vacuum pump 21 will of course be driven whenever the motor is set in operation.

A second motor switch 29 is arranged in parallel with the first switch 27, rather than in series with it, and also controls starting and stopping of the motor 24. But this second switch is not actuated by a diaphragm responsive to the pressure differential between atmosphere and the return side, as has been customary. Instead it is controlled by a float 30 working in a float chamber 31 (see Fig. 2). The pivot shaft 31a for the float arm, of course, is arranged with suitable packed bearings to prevent leakage, and operates the switch 29—preferably a snap-switch—by any suitable connection with the shaft such as the crank arm 32 and link 33.

The lower end of the chamber 31 communicates through a pipe 34 with the boiler, either directly, or, by way of the steam main return 13. The upper end of the float chamber 31 is connected by a pipe 35 with some suitable point on the low pressure or return side such for example as the top of the separator 19, although of course it may run directly to the top of the receiver or directly to the return line 17. The water level in the boiler 11, because of the free communication between the boiler and the float chamber, will tend to seek its own level in the pipe 34 and float chamber 31. But in addition to this it seeks a higher level because the pressure on top of the float chamber is less than that on the water in the boiler. Consequently a head of water, counter-balancing the pressure differential between the high and low pressure sides of the system rises in the float chamber. The float switch 29, 30 is of course suitably adjusted to open and close the switch within close limits above and below a predetermined level which in practice is ten or twelve inches above the water level in the boiler. If desired, as a safeguard against abnormal pressures in the boiler, a float valve 36 may be interposed between the pipe 35 and the top of the float chamber 30 to shut off communication between the two in the event that the head of water in the

float chamber rises too high and threatens to overflow into the return line.

In the single motor installation shown in Figure 1, although the primary object of the switch 29 is to control the vacuum pump 21, it will nevertheless control the water pump 23 as well.

It will be appreciated that in the application of my invention it is of no material difference whether the boiler pressure be above or below atmosphere or the low pressure side be above or below atmosphere, for the entire system may be operated without reference to atmosphere, which of course is a distinct advantage over the use of controls employing diaphragms subject to atmospheric pressure on one side.

In the operation of the ordinary vacuum heating system the amount of water which is in steam or vapor form is negligible in proportion to the total amount of water in the system and as the liquid water is divided between the boiler and the receiver, it is generally true that maintaining a constant level in the receiver will correspondingly maintain a constant level in the boiler. However, if there should be any leakage of water from the system as a whole, or due to some other abnormal condition, it might happen that maintaining the water at a constant level in the receiver would not maintain the required water level in the boiler. As an additional insurance against such a situation, a second float chamber similar to that just described may be employed for the particular purpose of maintaining this water level in the boiler. Such an idea is shown in Figure 3 which shows a system otherwise similar to that shown in Figure 1 except that a two-motor installation is substituted for a single motor installation.

In Figure 3 the pressure differential controlled switch 29 starts and stops only the vacuum pump motor 40. The receiver float switch 27 controls the water pump motor 41 jointly, that is in parallel, with the switch 29' of a second float chamber 31'. The upper end of this float chamber is connected by a pipe 35' to the steam main or elsewhere above the water level in the boiler, while the lower end of the chamber is connected by a pipe 34' with the boiler below the water level. The float chamber 31' is mounted at a lower level than the float chamber 31 so that the former comes at the water level in the boiler. The level of the water in the float chamber 31' is not responsive to a pressure differential, as is that in the float chamber 31, but merely to the level of the water in the boiler. The switch 29' will act to start the water pump 23 even though the float of the switch 27 has reached its lowest limit by a low level of water in the receiver. It is also apparent that the float switch 27 may be entirely eliminated if desired and reliance be had only on

the switch 29' for operation of the water pump.

I also wish to point out, referring back to Figure 1, that the operation of the switch 29 in the single motor installation there shown, is such that, to a certain extent, it performs the function for which in Figure 3 I have provided the switch 29'. Let us assume that the water level 11 in the boiler has dropped below its required height. The pressure differential between the high and low sides of the system remaining undisturbed, the lowering of the water level 11 will mean a corresponding lowering of the water level in the float chamber 31 with the result that the float 30 will drop and close the switch 29, thereby starting the single motor 24 which drives not only the suction pump but also the water pump. The result will be that additional water is drawn from the receiver and put into the boiler notwithstanding the fact that for some reason or other the float 28 in the receiver may not have closed the motor circuit.

In Figure 4 I have shown a gravity return system which of course requires no water pump. The return line 17 discharges into the separator 45 leading, preferably through check valves 46 and 47, to the bottom of the boiler. From the top of the separator 45 a pipe 48 leads to the suction side of the air pump 21. The top of the separator 45 also communicates through a pipe 49 with the upper end of the float chamber 31. The usual direct return trap 50 may be arranged to discharge into the lower reach of the return line 17' between the check valves 46 and 47, with steam pressure connection through a pipe 53 with the boiler, and a connection with the return line through a pipe 54.

The incorporation of my invention in a vacuum heating system does not necessarily contemplate the omission of the usual boiler pressure regulators, for it is still often desirable to vary the boiler pressure according to various conditions, such for example as the general outdoor temperature. However, no adjustment of my float control switch is necessary for adjustments of setting for the boiler pressure regulator. It is not, however, necessary in the use of my invention to use a boiler pressure regulator for the purpose of maintaining the accuracy of the pressure differential between the high and low pressure sides, as is necessary when the exhausting pump is controlled by the difference between atmosphere and the return line pressure, and premises a constant boiler pressure to maintain the constant pressure differential between the return line and the boiler.

While I have thus described my invention and illustrated its application to these specific forms of systems, I do not consider my invention to be limited to them, but have shown them merely as illustrative of a large variety

of systems in which my invention may be incorporated.

I claim:

1. A heating system comprising a boiler, a steam supply main therefrom, radiators supplied by the main, a receiver, a return line from the radiators to the receiver, a vacuum pump and a water pump for exhausting the receiver, a driving means for the pumps, a float in the receiver responsive to the water level therein for controlling the driving means, a float chamber for containing water subjected at its bottom to the boiler pressure and at its top to the return line pressure and a float in the chamber responsive to variations in the level of the water in the chamber for controlling the driving means.

2. A vacuum heating system comprising a boiler, a steam main, radiators supplied therefrom, a return line from the radiators, a receiver for the water from the return line, a pump for pumping water from the receiver to the boiler, a control device for the water pump responsive to the level of water in the boiler, a vacuum pump communicating with the return line, an electric motor for actuating said vacuum pump and means for controlling the vacuum pump comprising a float chamber having a column of water therein subjected to boiler pressure at its lower end to and the return line pressure at its upper end, a float in said chamber responsive to fluctuations in the level of water in the chamber and a switch actuated by said float for starting and stopping said pump.

3. A heating system comprising a boiler, a steam supply main, radiators communicating therewith, a receiver, a return line from said radiators to said receiver, power actuated means for pumping water from the receiver to the boiler, power actuated pump means for evacuating said receiver, a float in said receiver responsive to the level of water therein for controlling the actuation of said water pumping means, a float chamber for containing a column of water subjected at its lower end to boiler pressure and at its upper end to return line pressure, and a float in said chamber responsive to variations in the level of water in said chamber for controlling the actuation of said evacuating pump means.

4. A heating system comprising a boiler, a steam supply main, radiators communicating therewith, a receiver, a return line from said radiators to said receiver, power actuated means for pumping water from the receiver to the boiler, power actuated pump means for evacuating said receiver, a float in said receiver responsive to the level of water therein for controlling the actuation of said water pumping means, a float chamber for containing a column of water subjected at its lower end to boiler pressure and at its upper end to return line pressure, a float in said chamber responsive to variations in the level of water

in said chamber for controlling the actuation of said evacuating pump means and means responsive to the level of water in said boiler for controlling the actuation of said water pumping means.

5 5. A heating system comprising a boiler, a steam supply main, radiators communicating therewith, a receiver, a return line from said radiators to said receiver, power actuated means for pumping water from the
10 receiver to the boiler, power actuated pump means for evacuating said receiver, a float in said receiver responsive to the level of water therein for controlling the actuation of said
15 water pumping means, a float chamber for containing a column of water subjected at its lower end to boiler pressure and at its upper end to return line pressure, a float in said chamber responsive to variations in the level
20 of water in said chamber, an electric motor for actuating said evacuating pump means, and a switch actuatable by said float in said float chamber for opening and closing the motor circuit for controlling the actuation
25 of said evacuating pump means.

6. A heating system comprising a boiler, a steam supply main, radiators communicating therewith, a receiver, a return line from said radiators to said receiver, power actuated means for pumping water from the
30 receiver to the boiler, power actuated pump means for evacuating said receiver, a float in said receiver responsive to the level of water therein, an electric motor for actuating
35 said water pumping means, a switch actuatable by said float in said receiver for opening and closing the motor circuit for controlling the actuation of said water pumping means, a float chamber for containing a column of
40 water subjected at its lower end to boiler pressure and at its upper end to return line pressure, and a float in said chamber responsive to variations in the level of water in said chamber for controlling the actuation of said
45 evacuating pump means.

7. A heating system comprising a boiler, a steam supply main, radiators communicating therewith, a receiver, a return line from said radiators to said receiver, power
50 actuated means for pumping water from the receiver to the boiler, power actuated pump means for evacuating said receiver, a float in said receiver responsive to the level of water therein, an electric motor for actuating said
55 water pumping means, a switch actuatable by said float in said receiver for opening and closing the motor circuit for controlling the actuation of said water pumping means, a float chamber for containing a column of
60 water subjected at its lower end to boiler pressure and at its upper end to return line pressure, a float in said chamber responsive to variations in the level of water in said chamber for controlling the actuation of said evacuat-
65 ing pump means, and means responsive to

the level of water in said boiler for controlling the actuation of said water pumping means.

In witness whereof I hereunto subscribe my name this 17th day of August, 1927.

REUBEN N. TRANE.

CERTIFICATE OF CORRECTION.

Patent No. 1,828,302.

Granted October 20, 1931, to

REUBEN N. TRANE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 96, claim 2, for "to and" read and to; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of December, A. D. 1931.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.