April 22, 1924.

1,491,534

M. G. HUBBARD

STEAM HEATING

Filed Jan. 28, 1922 2 Sheets-Sheet 1

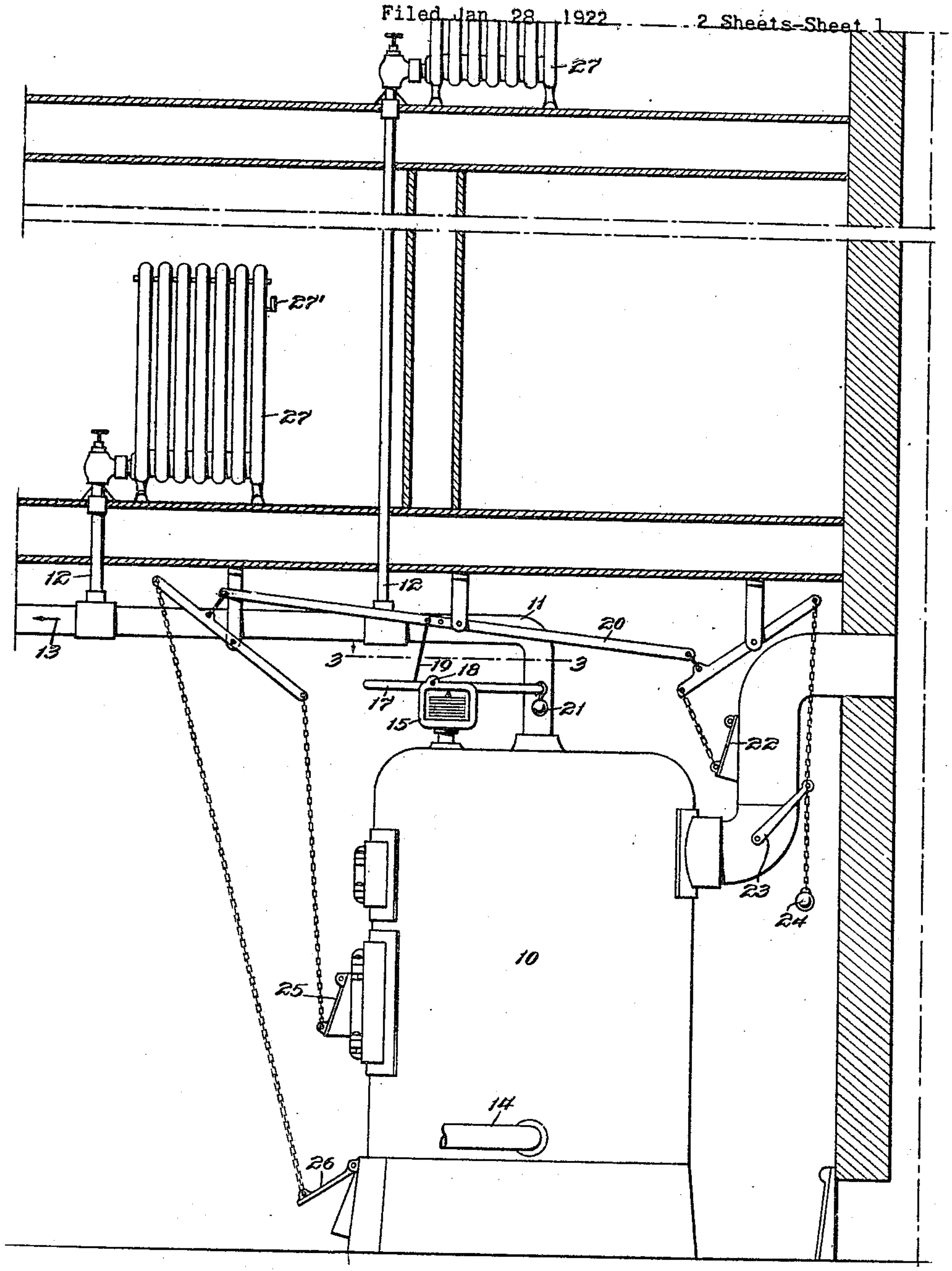

Fig.1.

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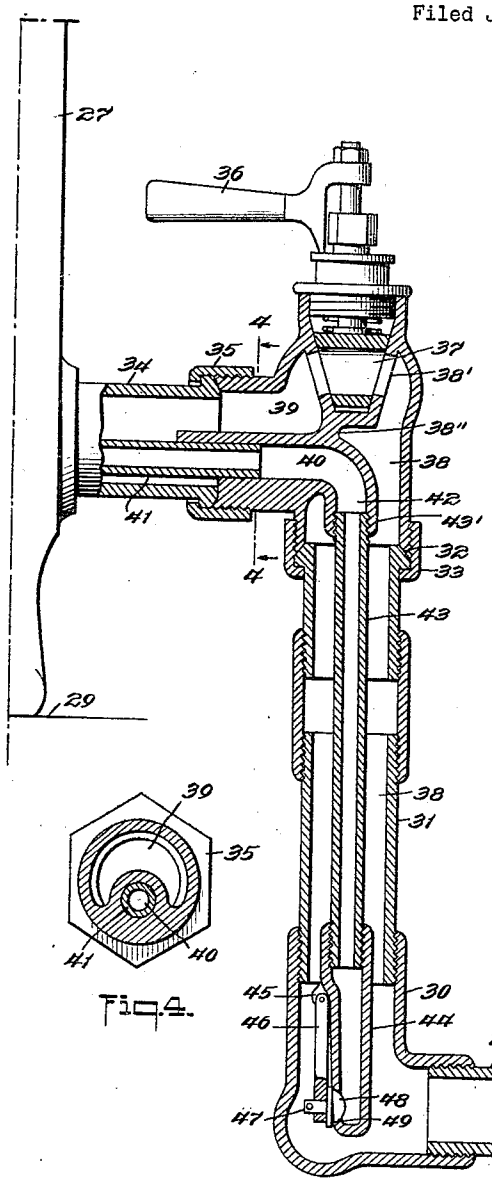

Fig. 2.

Fig. 4.

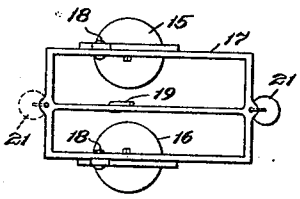

Fig. 3.

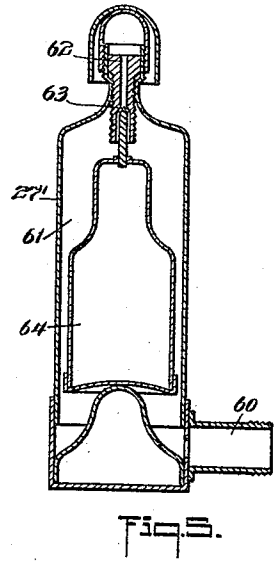

Fig. 5.

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UNITED STATES PATENT OFFICE.

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STEAM HEATING.

Application filed January 28, 1922. Serial No. 532,360.

To all whom it may concern:

Be it known that I, MOSES G. HUBBARD, a citizen of the United States, residing at Chatham, county of Morris, and State of New Jersey, have invented a new and useful Improvement in Steam Heating, of which the following is a specification.

My invention relates to improvements in steam heating systems, to methods of steam heating, and to a valve mechanism designed more particularly for use in such a system.

The most common steam heating system uses radiators whose sections are connected at the bottom only. These radiators are provided with automatic air valves which permit air to enter or to pass out of the radiator while preventing the escape of steam, and are connected to the steam mains by a single pipe through which the steam and condensate both flow, valves being located near the radiators to open or close the steam passage to this pipe. With radiators so connected, it is practically impossible to vary the surface subjected to the steam, or to secure modulation. The radiator when functioning must be subjected to the full pressure of the steam line, else the water will not flow back from the radiator into the pipe. This is the cheapest system to install, but it is expensive to operate, and by no means entirely satisfactory.

Another common system, known as a modulating system, designed to be operated by vapor, uses radiator sections connected at both top and bottom, at a cost of about 30% more per section. Owing to the lower heat value of the vapor, the radiators must have about 50% more sections than those for use in a single pipe pressure system. A return line with thermostatic valves and other special fittings, pumps, etc., must be provided to return the condensate.

All of these parts, taken together, require about twice the investment that the single pipe system would require. The system is, however, more economical and satisfactory in operation.

The principal object of my invention is to bring together the advantages of the two systems, so that the economical and satisfactory operation of the modulating system may be had from an investment which is substantially that for a single pipe system. In fact, I can use the same kind and size of radiator, and same size and amount of piping, as is used in the single pipe system, and can install it at the same expense for labor.

Another object of my invention is to provide such a mechanism that, without change in boiler or radiators, the intense heat of live steam, or the mild heat of low pressure vapor, may be had at will, and also such a mechanism that the supply of vapor may be modulated.

Another object of my invention is to so design and arrange the parts that they may be incorporated in existing single pipe systems by the substitution of a small number of new parts.

In the accompanying drawings forming part of this specification, I have shown a preferred embodiment of my invention. I realize that this is but one of the many possible embodiments in which my invention may take form, and desire that the drawings shall be considered as illustrating the invention rather than limiting the same.

In these drawings,

Figure 1 shows a complete layout of a steam heating system according to my invention;

Fig. 2 is a sectional view of a valve mechanism;

Fig. 3 is a view taken on the line 3—3 of Fig. 1, showing the pressure-control mechanism;

Fig. 4 is a section on the line 4—4 of Fig. 2; and

Fig. 5 is a sectional view showing a typical air valve.

A boiler 10 is connected with a supply pipe 11 to furnish steam to the radiators by means of risers 12 and suitable runouts. The condensate from the radiators may be conducted either directly back to the boiler through the pipe 11 or may be caused to flow in the direction of the arrow 13 through suitable pipes to the return connection 14.

On top of the boiler I preferably arrange two pressure regulators which may be of the metal diaphragm type. These regulators 15 and 16 are connected to a frame 17 suitably pivoted as at 18. This frame is connected by a link 19 to a long rocker arm 20 which is adapted to operate the dampers, and thereby control the fire under the boiler. A balance weight 21 is removably fastened to the frame 17 either at the right or at the left according to the pressure desired. One

end of the lever 20 is connected as shown to operate the check damper 22 and the choke damper 23, a balance weight 24 being provided to balance this part of the lever system. The other end of the lever 20 is connected through levers and chains, as shown, to operate the check damper 25 in the fire door, and the draft damper 26 in the ash-pit door. With the system of dampers and pressure regulator above described, I am able to operate the furnace to give any pressure up to, say 5 pounds per square inch with the weight 21 in the position shown. When, however, the weight is moved to the other end of the frame 17, the fire will be immediately choked and the boiler will then operate to deliver a vapor under a pressure of 5 ounces or less.

The risers 12 or the runouts are connected through a special valve mechanism to radiators 27. These radiators are the ordinary type used in single pipe systems, are bottom connected and have automatic air valves 27′. They are adapted to receive the full pressure of 5 pounds, as is customary in single pipe pressure systems when the boiler is delivering this pressure.

In Fig. 5 I have shown a cross section of a suitable air valve 27′. The form of valve illustrated has a hollow threaded stem 60 which is threaded into the radiator, a chamber 61, and a vent 62. Air may flow in and out of the radiator through these passages. It is also provided with a movable element 64 which is responsive to the presence of steam to move a device 63 to close the vent 62. When the valve is cold the air passages are automatically opened so that air at atmospheric pressure may fill all or a part of the radiator. When steam reaches the valve, the air passage is automatically closed. Any form of air valve which permits air to enter or pass out of the radiator, while preventing the escape of steam, may be used.

One form of radiator valve mechanism is shown in detail in Fig. 2. A horizontal pipe or runout 28 is shown beneath the floor 29 which supports the radiator 27, and the usual elbow 30 is connected at one end to this horizontal pipe. This elbow is not necessary where the steam is supplied to the radiator from a vertical pipe such as the riser indicated in Fig. 1, as leading to the second floor. The other end of the elbow provides the means for the introduction of steam to the valve mechanism and for the reception of the condensate formed in the radiator after it has passed through the valve mechanism. The valve is connected to the radiator 27 by means of a spud 34 and a nut 35, which are parts of the valve and are used in the usual manner.

The extreme upper part of the valve mechanism includes a variable opening valve 37 provided with an external handle 36 and adapted to vary the flow of steam from a steam passage 38 on the steam supply side through an aperture 38′ in a diaphragm 38″ in the valve casing into a passage 39 which communicates with the radiator.

The diaphragm also provides a lower passage 40 which is underneath the steam passage 39 and is adapted to receive the condensate from the radiator, a short tube 41 being provided if desired. The intermediate part of the condensate passage is curved as shown at 42 where it passes underneath the valve 37 so as to communicate with a vertical tube 43 connected to a perforate projection 43′ in the diaphragm, the tube being adapted to continue the separation of the returned condensate from the incoming steam. The lower end of the tube 43 of the condensate passage is connected with a fitting 44. The movable parts 46 and 47 of a pendulum valve are pivoted at 45 on this fitting. The member 47 is loosely mounted in the pendulum 46, and has a cone head 48 adapted to rest in a conical seat 49 in the fitting 44.

The separate steam passage 38 of the valve mechanism continues downwardly as far as the condensate passage, that is, there is no contact between the heating medium and condensate throughout a distance determined by the length of the condensate passage. The lower portion of the valve mechanism may comprise any suitable means to connect elbow 30, or the riser, with the mechanism above the floor. In the form shown in the drawings, a suitable fitting 31 having a spud 32 is shown as being coupled to the upper mechanism by means of a nut 33.

By merely loosening the nuts 33 and 35 all parts of the valve mechanism are accessible for inspection or repairs.

When the boiler is delivering steam at an appreciable pressure, and the valve 37 is fully opened to permit the radiator to become heated, steam at full pressure fills the steam passages 38 and 39, the radiator 27, tube 41, and condensate passage 40, except for the space required by the condensate formed in the radiator. The air in the radiator escapes through the valve 27′. This condensate will flow freely through the tube 41, passage 40, tube 43, and pass through the hole 49 into the steam pipe 28. There will be no accumulation of this condensate because pressure balance maintains without any such accumulation.

When the valve 37 is closed, the steam pressure will operate against the left side of the pendulum valve and close it. No steam can then be admitted to the radiator.

The above operation is substantially the same as that of the single pipe pressure system now in common use, the whole radi-

ator being filled with steam at full pressure, or being cold.

When, however, the boiler is delivering a vapor, and in my system this state can be readily attained by merely shifting the balance weight 21, the system has all the advantages of the modulating two-pipe system. The valve 37 may be partly closed so as to throttle the vapor as it passes through the valve to a sufficient extent to fill any desired portion of the radiator with vapor, the balance of the radiator being filled with air admitted through the air valve 27'. The air and vapor are substantially at atmospheric pressure. The condensate which collects in the radiator will pass through the tube 41, passage 40 and into the tube 43, when it will accumulate and form a water column of sufficient height to compensate for the difference between the vapor pressure in the runout 28 and atmospheric pressure which now exists in the radiator.

When a state of equilibrium has been reached, the pendulum valve will open sufficiently to allow the condensate to pass into the runout 28 as the valve 37 admits the vapor to the radiator.

The standard construction of radiators and buildings allow an installation in which the distance from the center of the pendulum valve to the top of the passage 40 may be at least ten and one-half inches. A $10\frac{1}{2}$ inch water column will develop a pressure of about $5\frac{1}{2}$ ounces, and this pressure is comparable to that now used in vapor-heating systems. It is a pressure at which great economies in operation are available.

With an installation such as I have described in detail, when starting up the fires in the morning, I place the weight 21 in the position shown. The boiler will then deliver steam at 5 pounds pressure which will quickly heat the building to the desired temperature. When this temperature has been reached, I place the weight 21 on the other end of lever 17 as indicated in dotted lines in Fig. 3, so that the boiler will deliver a vapor at about 5 ounces pressure. This permits modulating or regulating the amount of vapor to be supplied to the radiator and the consequent amount of heating surface in operation. This modulation is attained by simply moving the valve handle precisely as in the high-priced two-pipe modulating systems now in general use. The device takes care of itself so that there is no accumulation of water to cause an annoying hammering in the radiators.

I claim:

1. The method of heating by low pressure steam vapor, which comprises throttling the steam vapor to fill a part of a radiator with vapor, the remainder of the radiator containing air, both the vapor and air being at atmospheric pressure, and collecting the condensate formed in the radiator to thereby restore a portion thereof to a pressure equal to that of the low pressure steam vapor.

2. The method of heating by steam which comprises, first, supplying a radiator, which is open to the atmosphere when not fully heated, with live steam under considerable pressure by means of a pipe, and returning the condensate at the same pressure through said pipe, and thereafter supplying steam vapor under low pressure, throttling the steam vapor to fill part of the radiator with vapor at atmospheric pressure, and collecting the condensate formed in the radiator to thereby restore a portion thereof to a pressure equal to that of the low pressure steam vapor, the flow of heating medium and condensate being in opposite directions in said pipe.

3. The method of heating by steam, which comprises supplying a radiator, which is open to the atmosphere when not fully heated, with live steam at an appreciable boiler pressure by a single pipe, and then choking the fire under the boiler so that a mere vapor is given off, and then varying the supply of vapor to thereby modulate the heating surface of the radiator, all condensate being returned to the boiler through said pipe.

4. The method of steam heating which comprises throttling steam vapor between a steam supply chamber and a radiator, which is open to the atmosphere when not fully heated, to thereby subject a portion of the radiator to steam vapor at substantially atmospheric pressure, collecting the condensate formed in the radiator, and returning the condensate into the steam supply chamber against the pressure of the vapor therein.

5. The method of steam heating which comprises throttling steam vapor between a steam supply chamber and a radiator, which is open to the atmosphere when not fully heated, to thereby subject a portion of the radiator to steam vapor at substantially atmospheric pressure, collecting the condensate formed in the radiator in a column of sufficient height to develop hydrostatic pressure equal to the pressure of the steam vapor in the chamber, and returning condensate from the bottom of this column into the steam supply chamber when the hydrostatic pressure exceeds the steam chamber pressure.

6. In a steam heating system; a boiler; a radiator having means to permit the automatic filling of parts thereof with air at atmospheric pressure; a valve having a variable opening therein for admitting steam to the radiator; a single pipe connection between the valve and the boiler; and devices associated with the aforesaid elements whereby, when the boiler is delivering va-

por, air and vapor may fill the radiator in desired proportions at atmospheric pressure.

7. In a steam heating system; a boiler; a radiator having means to permit the automatic filling of parts thereof with air at atmospheric pressure; a valve having a variable opening therein for admitting steam to the radiator; a single pipe connection between the valve and the boiler; and devices associated with the aforesaid elements whereby, when the boiler is delivering vapor, air and vapor may fill the radiator in desired proportions at atmospheric pressure, said devices including a valve adapted to be balanced by the pressure of the vapor and a column of condensate, and connections for trapping the condensate.

8. In a steam heating system; a boiler having means to control the operation thereof so that either live steam or vapor may be had at will; a radiator; a single pipe connecting the radiator and boiler; and means whereby the entire radiator may be filled with live steam when the boiler is delivering steam, or whereby, when the boiler is delivering vapor, air and vapor may fill the radiator in desired proportions at atmospheric pressure.

9. In a steam heating system; a boiler having means to control the operation thereof so that either live steam or vapor may be had at will; a radiator; a single pipe connecting the radiator and boiler; and means whereby the entire radiator may be filled with live steam when the boiler is delivering steam, or whereby, when the boiler is delivering vapor, air and vapor may fill the radiator in desired proportions at atmospheric pressure, said last mentioned means including a variable opening admission valve, a valve adapted to be balanced by vapor pressure and a column of condensate, and connections for trapping the condensate.

10. The combination with a steam boiler, a radiator and a single pipe connection therebetween, of means whereby the entire radiator may be filled with live steam or whereby the whole or any desired portion of the radiator may be filled with vapor, the remainder being filled with air at atmospheric pressure, said means including a device for returning condensate to the pipe.

11. The combination with a steam boiler, a radiator and a single pipe connection therebetween, of means whereby the entire radiator may be filled with live steam or whereby the whole or any desired portion of the radiator may be filled with vapor, the remainder being filled with air at atmospheric pressure, and whereby condensate may be returned to the pipe, said means including an admission valve having a variable opening and a pendulum valve adapted to be balanced by vapor pressure and a column of condensate, and connections for trapping the condensate.

12. The combination with a steam boiler, a radiator, and a single pipe connection therebetween, of means associated with the boiler to permit the same to deliver live steam or vapor, and means associated with the radiator whereby it may be subjected to either live steam or vapor and whereby the supply of vapor to the radiator may be regulated to fill portions of the radiator with vapor at atmospheric pressure, the remainder of the radiator being filled with air at atmospheric pressure.

13. The combination with a floor of a building; a radiator on the floor; means to permit the automatic filling of parts of the radiator with air at atmospheric pressure; a pipe underneath the floor for supplying steam and returning condensate; and a valve mechanism, one end of which is connected to the radiator, the other end being connected to the steam supply pipe; of means comprising the latter mentioned portion of the valve mechanism and instrumentalities enclosed therein whereby modulation of the heating surface of the radiator is possible by an adjustment of the valve mechanism.

14. A single pipe heating system, comprising single pipe radiators, each having means to permit the automatic filling of parts thereof with air at atmospheric pressure, and means for returning the water of condensation from said radiators to the steam supply line when the pressure in the steam supply line is slightly above atmospheric pressure.

15. A single pipe heating system, comprising a boiler, heating radiators having means to permit the automatic filling of parts thereof with air at atmospheric pressure, a single pipe feeder system for supplying steam vapor to said radiators and for returning the water of condensation therefrom to the boiler, modulating valves for said radiators, and means for delivering the water of condensation from any of said radiators into said single pipe feeder system when the pressure in the steam supply line is slightly above atmospheric pressure.

16. The combination with a single pipe steam distributing system in which the steam vapor is supplied to radiators and the water of condensation is returned to the boiler through substantially the same line of pipe, of means for delivering water of condensation from said radiators into said line of pipe when the pressure in the steam supply line is slightly above atmospheric pressure and the pressure in the radiators is substantially atmospheric.

17. A heating system, comprising a supply main, a steam supply line extending therefrom, heating radiators connected to the steam supply line by modulating valves interposed therein, and means for returning condensate to said supply main through said steam supply line in a direction contrary to the flow of steam vapor therein when the pressure in the steam supply line is slightly above atmospheric pressure and the pressure in the radiators is substantially atmospheric.

18. In a single pipe heating system, radiators having means to permit the automatic filling of parts thereof with air at atmospheric pressure, a modulating valve associated with each radiator and comprising means for regulating the supply of steam to the associated radiator, and means for automatically delivering the condensate into the supply pipe when the pressure in the supply pipe is slightly above atmospheric pressure.

19. In a single pipe modulating steam vapor heating system in combination, a radiator, an air valve, having means to automatically allow air to escape from the radiator as steam vapor enters the radiator, and to automatically close to prevent the escape of steam vapor from the radiator through said valve, and to automatically open to permit air to flow into said radiator when the steam vapor has receded from any part of the radiator, a modulating valve for varying the supply of steam vapor to said radiator at will, and a device associated with the modulating valve to collect a water column to compensate for the difference in pressure between the radiator when partly filled with steam vapor and partly filled with air at atmospheric pressure and the pressure in the steam supply pipe whereby the condensate may be returned from the radiator through said device into said supply pipe.

MOSES G. HUBBARD.