2 Sheets—Sheet 1.

W. E. PRALL.

Means for Heating and Ventilating Buildings.

No. 208,633. **Patented Oct. 1, 1878.**

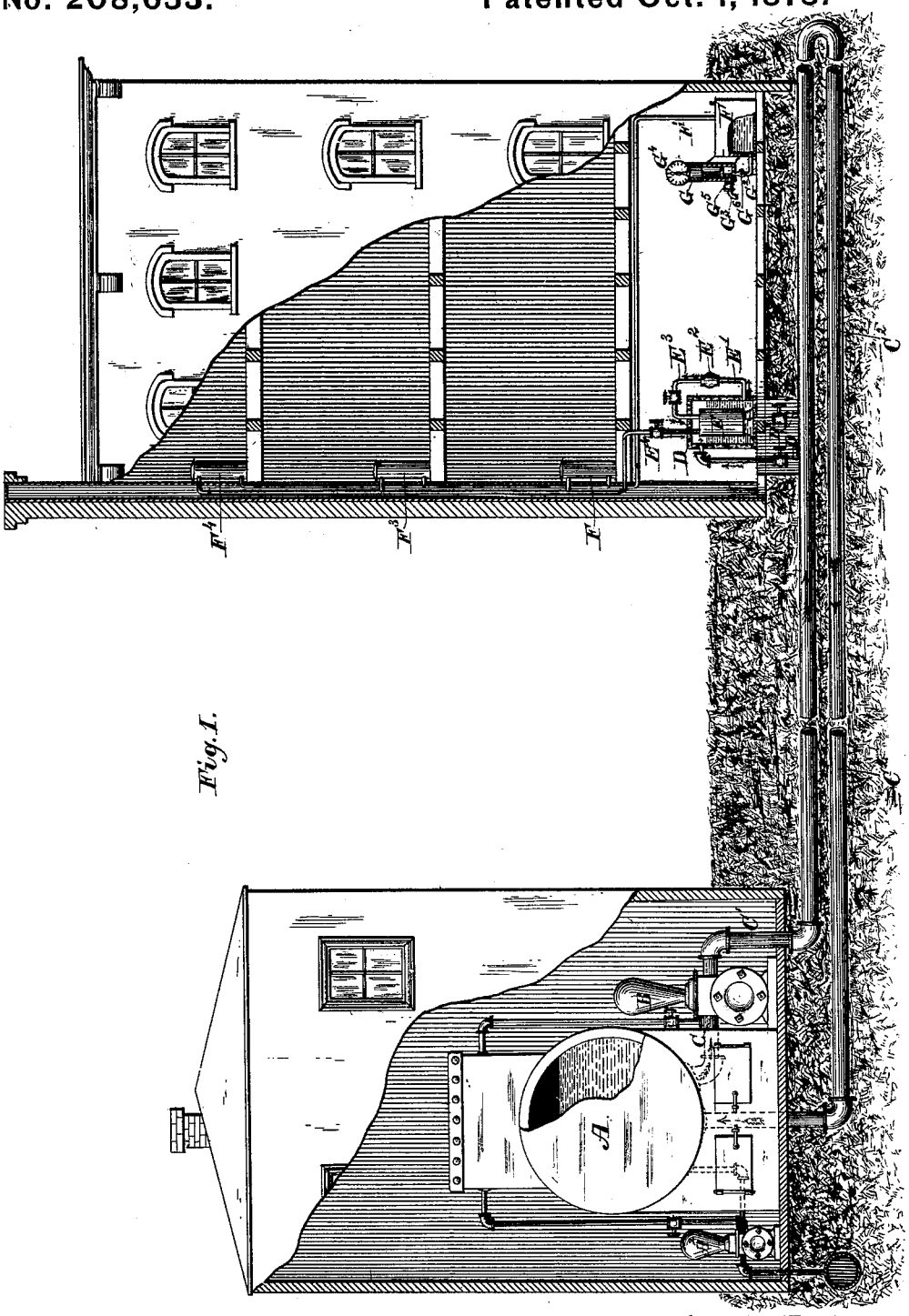

Fig. 1.

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2 Sheets—Sheet 2.

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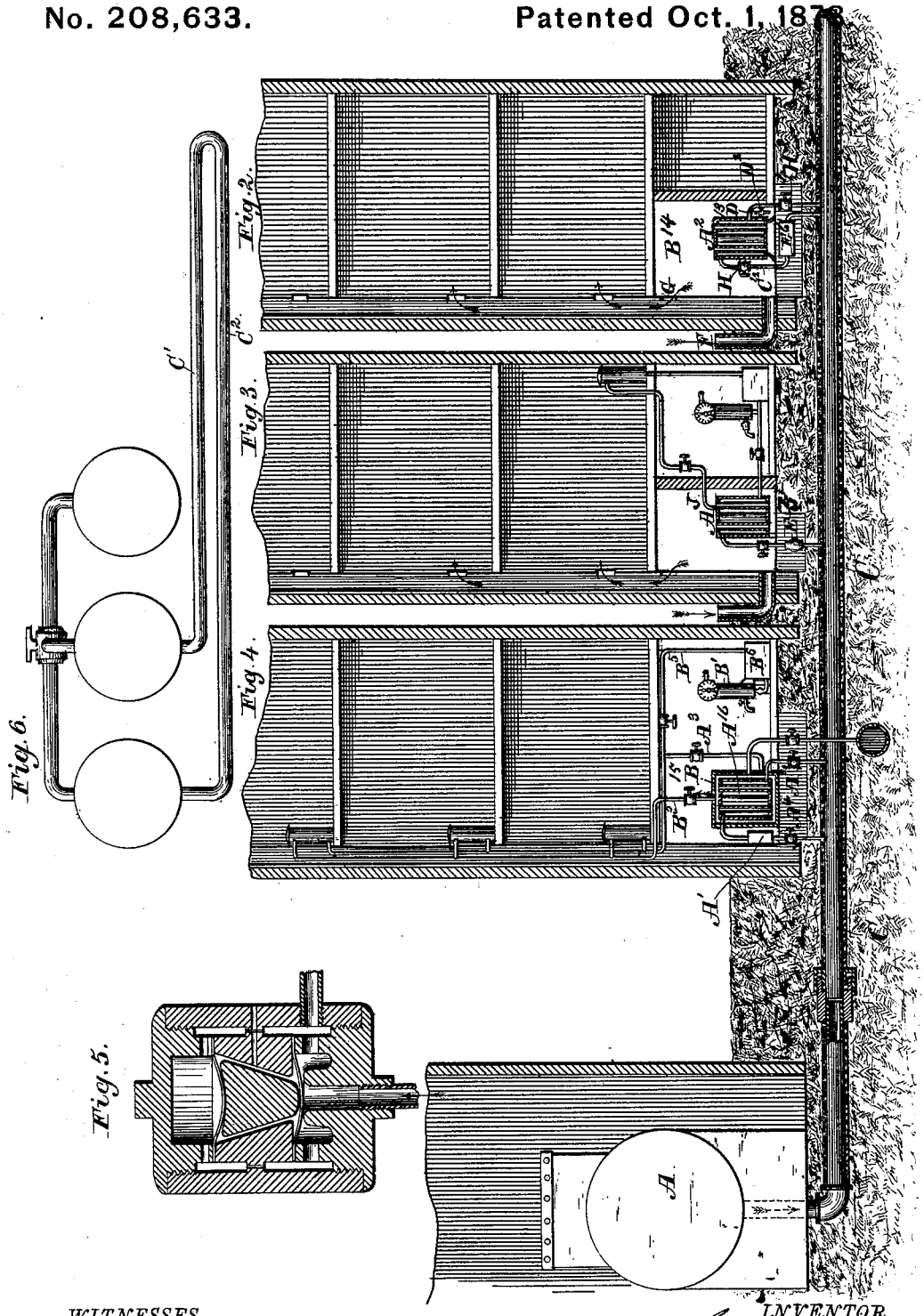

WITNESSES

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IMPROVEMENT IN MEANS FOR HEATING AND VENTILATING BUILDINGS.

Specification forming part of Letters Patent No. **208,633**, dated October 1, 1878; application filed September 17, 1878.

To all whom it may concern:

Be it known that I, WM. E. PRALL, of Washington, District of Columbia, have invented a new and useful Improvement in a System for Heating and Ventilating Large Districts of Buildings in Cities and Towns, of which the following is a specification:

My invention relates to a novel method of conveying heat for the purpose of warming large districts of buildings in cities and towns, and to the manner of utilizing and distributing the same from one common source of supply, and embodies a safe, economical, convenient, and heathful system of delivering and controlling the heat in each and every building and compartment therein; and, furthermore, it embraces the means of supplying motive power for propelling street-cars and stationary engines.

Figures 1, 2, 3, and 4 illustrate, in part, sectional views, various modes of heating buildings in accordance with the general principles of this system; Fig. 5, a detached sectional view of a differential valve; Fig. 6, a detached view of generators and circulating-pipes.

In Fig. 1, A represents a hot-water tank or heater, and should be of sufficient capacity to furnish all the hot water that would be required for supplying heat to the district reached by the circulating pipe or main C, C^1, and C^2, said pipes being connected thereto at or near the bottom, certainly below the water-line.

The heater is provided with a constant supply of water by means of the pumping-engine A^2, in such quantities as is needed to keep up the waste from the main pipe which may be drawn from it for any purpose whatever. The power for driving the pumping-engine may be taken from the steam generated in the water-heater, or it may be taken from any other boiler erected for that purpose. It is evident that there may be several of the water-heaters employed for the purpose of supplying water for circulation, and they may all be connected; or they may be separated by means of cocks placed in the connecting-pipes, so that one or more of them may be used independent of the others.

In the practical operation of my invention, the water-heaters should be located in a suitable building convenient to the district to be supplied with heat, and the circulating-pipe C connected with the force-pump B, said pump being also connected with C^1, which is, in fact, the same from its connection with the heater A, extending through the force or circulating pump B, and from thence through one street, and returning through another, as represented in C^1 and C^2, and terminating again in the heater, the purpose of the force-pump B being only that of circulating the hot water, taking it from the heater under pressure, and returning it again for the purpose of reheating, and the pump will be kept operating with sufficient rapidity to cause the flow of water to be rapid enough to convey heat without much reduction of temperature along the entire length of the pipe.

Other means may be employed to circulate the water through the pipes—as, for instance, the two ends may be connected with different heaters having a different pressure, and thus the hot water may be forced from the one having the greater pressure through the pipe connecting it with the heater of lesser pressure.

It is evident that various means may be employed for circulating water; hence I do not confine myself to any particular manner; and in some places, where the amount drawn from the pipe was sufficiently great, the flow might be enough to keep the temperature high at the farthest end without the necessity of returning it to the heater, and in that case no return-pipe or force-pump would be required; but the evident advantage of circulating the water is so apparent as to make the adoption of a single pipe only a possibility.

In this figure is shown one method of transferring the heat from the street-main into a building and the manner of utilizing the same for heating the different apartments therein; and it is evident that many buildings may in the same manner be supplied with heat from the same main pipe.

In this illustration, D represents a strong tank, surrounded by some non-conducting material, and connected with the hot-water street-main by means of pipes D^1 and D^2. E is another tank, similarly constructed, but smaller,

which is placed within the tank D, leaving a space between the two. E^1 and E^3 are pipes connected with the differential valve E^2, and also with the outer tank, D, and the inner tank, E. E^4 is a pipe connected with the tank E, and extended to the radiators F, F^3, and F^4, placed in the different parts of the building to be heated. F^1 is a condense-water pipe, extending from the bottom of the radiators to the water-tank F^2. G represents a pump, connected with tank F^2 by pipe G^2, and provided with discharge-pipe G^3 and with the valves G^5 and G^6. G^4 represents a registering apparatus, which records the number of revolutions of the pump-handle, the purpose of which will hereinafter be described.

The street-main is to be covered with some non-conducting substance, to prevent as much as possible the radiation of the heat therefrom, and is also provided with expansion and contraction joints, to allow for the movement of the main pipe longitudinally. If the heater A be now filled with water, or partially so, and, by means of the fire in the furnace, be heated to a high degree—for example, say 332° Fahrenheit, which would give a pressure of about one hundred pounds to the square inch—and be kept at that point, which would be one hundred and twenty degrees above the steam-generating point, and if the connections at both ends of the circulating-water main be opened, the pressure upon them and the water therein will be the same as upon the water in the heater; and if the force-pump be put in motion it will cause the water to be forced through the pipe by taking it hot from the heater and discharging it again into the same through the return-pipe. The result will be to give a temperature of about the same degree to the water in the main pipe its entire length as that in the heater. If, now, the cocks in pipes D^1 and D^2 be opened, the hot water under pressure will flow from the main pipe C^2 into the outside tank, D, and surround the inner tank, E; and if the differential valve E^2 be constructed so as to establish a ratio of difference, as 10:100, the water from between the tanks D and E will flow into E through the valve and pipe E^1 and E^2; but as soon as a small quantity has entered tank E the great reduction of the pressure established by the differential valve will cause the hot water so admitted to be converted into steam, as it contains many degrees of heat above the boiling-point, as before mentioned. So soon as the small quantity of hot water thus admitted, however, has been evaporated into steam the space in the tank E will be filled with steam under pressure, which will act upon the differential valve E^2, and close it, preventing the further admission of hot water. The steam from tank E will force its way through pipe E^4 into the different radiators connected thereto, and heat the same; but the cool air surrounding them conveys away the heat, and the steam therein will be condensed, and thus the amount of water first admitted into tank E will all be converted into steam and conducted into the radiators. The condense-water therefrom will be conducted by its own gravity through the pipe F^1 into the receiving-tank F^2, placed on the lower floor of the building.

As soon as condensation has reduced the steam-pressure below ten pounds per square inch in the tank E and connecting-pipes and radiators, more hot water will be admitted through the differential valve E^2 into tank E, and thus the supply will be kept constant. The water admitted into tank E will not all be converted into steam by its own specific heat, and hence the purpose of surrounding the converting-chamber E with the hot-water in tank D, the heat of which will cause all the water admitted into tank E to evaporate.

The purpose of the connecting-pipes D^1 and D^2 is to unite tank D at both top and bottom with the main pipe C^2, and thus produce circulation; for it will be seen that as the water in said tank transmits its heat into the water which is admitted into the interior tank, E, its temperature will thereby be proportionately lowered, and hence heavier, and the circulation will thus be established between the hot-water pipe C^2 and the tank D through pipes D^1 and D^2, and by means of this circulation a temperature will be maintained in said tank nearly the same as in pipe C^2.

The manifold advantages of thus conveying heat great distances will be easily comprehended. Because the weight or body of a cubic foot of water (or any given quantity) is, at the boiling or steam-generating point, seventeen hundred (1700) times as great as the steam thrown off at that temperature, it follows that it contains a far greater number of units of heat.

Thus it will be seen that a much larger amount of heat may be delivered through a pipe a great distance without loss from condensation than could be effected by means of steam; and the hot water may, by this process, be converted into steam or otherwise used for the purpose of heating buildings at the point where required, and overcome the great difficulty which has heretofore prevented the heating of buildings located at a distance from the generator, at the same time affording a much more convenient and economical means of heating than by separate fires and generators located in each building, and also avoiding much risk from danger by fire.

For the purpose of determining the exact amount of heat consumed by each customer, I propose, as one means, the employment of the registering-pump G, which is to connect with the condense-water tank F^2 by means of pipe G^2. The valves G^6 and G^5 are to be of the ordinary kind, (check-valve,) and placed in the suction and discharge pipes G^3 and G^2. The pump-barrel and piston are also of the usual kind employed in pumps. The rod connecting the movable piston is attached to a crank, which is turned by a handle, and by gearing is connected to a registering apparatus in such

a manner as to cause the same to act upon the fingers of a dial, and thereby record each revolution that is given to the handle of the pump; and as the amount of water discharged at each turn of the handle is accurately determined, it follows that the exact quantity of condense-water thus removed from the tank F^2 will be registered. As the condense-water thus discharged will always bear the same unvarying relation to the amount of steam it produced in tank E under a given pressure, it will be an easy matter to calculate thereby the number of cubic feet of steam or units of heat consumed.

As a substitute for the force-pump B, I contemplate the use of different hot-water tanks or boilers, placed conveniently near to each other, and connected by means of pipes and cocks or valves, which may be opened and closed either by hand or by some automatic arrangement, whereby the water may be forced from one tank to the other through the connecting-pipe or hot-water main C and C^2, as shown in Fig. 6.

It is evident that if the pressure in one tank were permitted to become greater than in the other, or if an additional pressure were admitted from an independent generator, the water would be forced from such high-pressure tank through the connecting-pipe C^1 and C^2 into the tank of lesser pressure connected therewith, and thus alternately the water could be forced from one to the other; but it is very questionable whether it would be found as practicable as the employment of a forcing-pump for the purpose.

In Figs. 2, 3, 4, I have shown several other means of controlling the heat and utilizing the same in the heating of buildings, which I will describe in succession.

In Fig. 2, A^2 represents a tubular hot-water tank, (or it may be a coil of pipe,) placed within an inclosure, B^{14}, which is erected in the basement of the building to be heated. Pipes C^{12} and D^{13} are made to connect the hot-water main C with the top and bottom of the coil or radiator A^2.

E represents a water-meter of any approved plan, which may be placed in either pipe D^{13} or C^{12}. H and H^2 are cocks or plugs, made to control the opening and closing of the pipes in which they are placed. A represents the hot-water tank, to which the pipe C is connected.

In the operation of this apparatus, if the cock H be opened and communication thereby established with the hot-water main C and the heater or radiator A^2, the water under pressure will be forced through pipe C^{12} into the heater until it is filled. If the air-passages F and G in the hot-air chamber B^{14} are opened, and the cold air thus permitted to enter through opening F, it will come in contact with the pipes containing the hot water, and will thereby become heated, and in that condition made lighter, and will consequently pass upward through the opening or flue G into the various rooms connected therewith. The effect of this will be to cool the water in the heat-radiator A^2; and if the exhaust-cock D^2 in pipe D^{13} be opened a very little, the water which has become cooled, and hence heaviest, will be forced out from the bottom of the radiator A^2, and in its passage through the meter E the quantity of water permitted to enter the radiator, or permitted to escape, will determine the amount of hot water used, and from that may be computed the quantity of heat consumed. As the water cools, other things being equal, just in proportion to the time consumed in its passage through the radiator, it is evident that the heat thus radiated and conveyed by the air into the apartments may be registered and controlled to a nicety, and may be easily adjusted to suit the varying conditions of the weather.

If cock D^2 be closed and cock H^2 be opened, the water would be returned to the main pipe C. The recording-meter E^6 may be placed in either the pipe C^{12} or D^{13}, and the result would be the same.

In Fig. 3, A^5 represents a radiator and steam-evaporator in one, and it may be constructed similarly to the one just described, as it consists of a tubular tank or a coil of pipe surrounded by an air-heating room, as appears in the drawing. It differs, however, very materially in some respects. The hot water is admitted into it from the main pipe C through a differential or reducing valve, E^5, which is intended to reduce the pressure to such an extent as to cause the water so introduced into the tank A^5 to be evaporated in a like manner as described in connection with Fig. 1. It differs, however, from that one in that it is not provided with a surrounding water-jacket, and the water which is not evaporated by its own specific heat is drawn off into the condense-water tank, and there collected for measurement, which may be done by the registering-pump before described.

In Fig. 4 I have shown a plan in which no water is taken from the hot-water pipe C, except for the purpose of evaporating water taken from some other source, which is admitted into the evaporating-tank B^{15}. The cocks in pipes A^4 and A^3 being opened, an immediate circulation of hot water will begin, and as it is much above the steam-generating point, and is brought in close proximity to the cold water in the exterior tank, B^{15}, which communicates also with the interior of the flues or tubes that pass through the interior tank, A^{16}, steam will be immediately generated, which will enter the pipe B^3, and thus be conducted to the radiators, and the condense-water may be returned to the evaporator through branch pipe A^3 and re-evaporated, or be deposited in tank B^6 through pipe B^5, from which it may be removed, as before described, by recording-pump B^7, and the amount of heat consumed from the main pipe C may be easily approximated by means of the water thus evaporated, or by the meter A^1.

The differential valve (shown in detached view) is one form that may be used, but it is evident that any kind of reducing-valve could be employed for the purpose with like results.

I contemplate the use of this system of conveying heat and power for the purpose of propelling street-cars, by charging receiving-tanks on the same with hot water at intervals along the road by means of flexible hose to convey the same from the main pipe to such tanks. The water first admitted into a tank may be forced out to make room for a new charge by means of a movable piston operating from one end of the tank to the other, cocks being opened for the discharge of the water in front of the moving pistons. I do not, however, make any claim to this arrangement in connection herewith.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an apparatus for heating buildings, the heating-tank A, the hot-water street-main C, C^1, and C^2, connected therewith, the circulating-pump B, and a heat-radiator, F, and a meter, substantially as shown and described.

2. In an apparatus for heating buildings, a hot-water tank, a hot-water street-main, a circulating-pump, a differential or pressure-regulating valve, and a heat-radiator of a building, as set forth.

3. In an apparatus for heating buildings, one or more hot-water reservoirs and one or more hot-water pipes connected therewith, having branch pipes connected with a pressure-reducing valve, and with an evaporating-chamber, and with heat-radiators, and with a meter, substantially as shown and described.

4. In an apparatus for heating buildings, the hot-water-generating tank and a street-main, connected thereto at a point below the water-line, branch pipes connecting said main-pipe with a circulating-chamber arranged in connection with a steam-generating chamber, as specified, and in such manner as to transmit the heat from the circulating-water chamber to the evaporating-chamber, substantially as set forth.

5. In an apparatus for heating buildings, the heating-tanks and the pipe or pipes for conveying hot water connected therewith, branch pipes for conveying hot water to a radiator, an exhaust-opening to convey the water from the radiator, and a meter for measuring the water passed through the radiator, constructed and operating substantially as shown and described.

6. In an apparatus for heating buildings, the heating-tanks and the pipes connected thereto, as specified, in such manner as to convey the water therefrom, a force-pump, or its equivalent, for circulating the water therein, and a radiator connected thereto, in combination with an air-heating chamber, provided with inlet and outlet openings for receiving and delivering the air, and with a meter, substantially as set forth.

7. In an apparatus for heating buildings, the heating-tanks and the hot-water street-main connected thereto, provided with expansion and contraction joints and with a covering of non-conducting material, a branch pipe for conveying the hot water to a building, a pressure-regulating valve for reducing the pressure, an evaporating-tank for converting the water into steam, and a heat-radiator of a building provided with a condense-water receiver, and with a registering-pump for removing the water, constructed and operating substantially as shown and described.

8. In an apparatus for heating buildings, the heating-tank and the hot-water street-main pipe connected therewith, a circulating-pump for forcing the water through the pipe and branch pipes, and the meter for connecting the main street-pipe with a circulating-heater arranged to transmit heat to a steam-generating tank or hot-water tank, substantially as described, said tank being constructed to be supplied with a liquid, and provided with return-pipes for conveying the condensation to the generating-tank for reheating, substantially as shown and described.

9. In an apparatus for heating buildings, a water-evaporating chamber adjacent to a chamber adapted to circulate water of a higher temperature, the radiator arranged to receive steam from the evaporating-chamber, and the whole provided with cocks and valves, substantially as shown and described.

10. The within-described method of conveying, by means of a pump or its equivalent, hot water through underground street-mains, provided with branch pipes and with meters, for the purpose of delivering and measuring said hot water used for heating purposes in buildings having radiators, with connected cocks or valves for controlling the heat in the same, substantially as set forth.

WM. E. PRALL.

Witnesses:
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