(No Model.)

G. A. HOUSTON.

WATER HEATER.

No. 543,246. Patented July 23, 1895.

Fig 2.

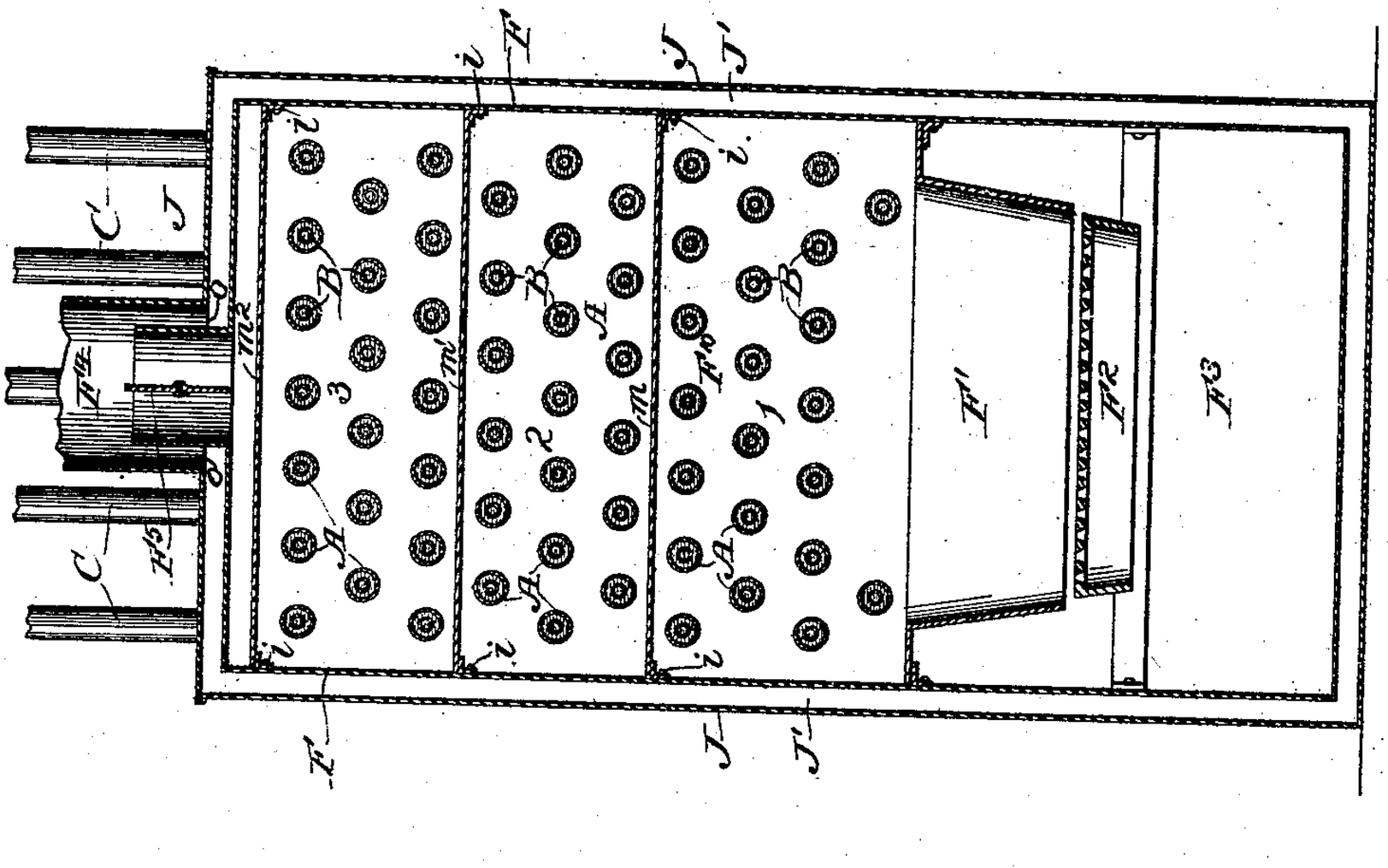
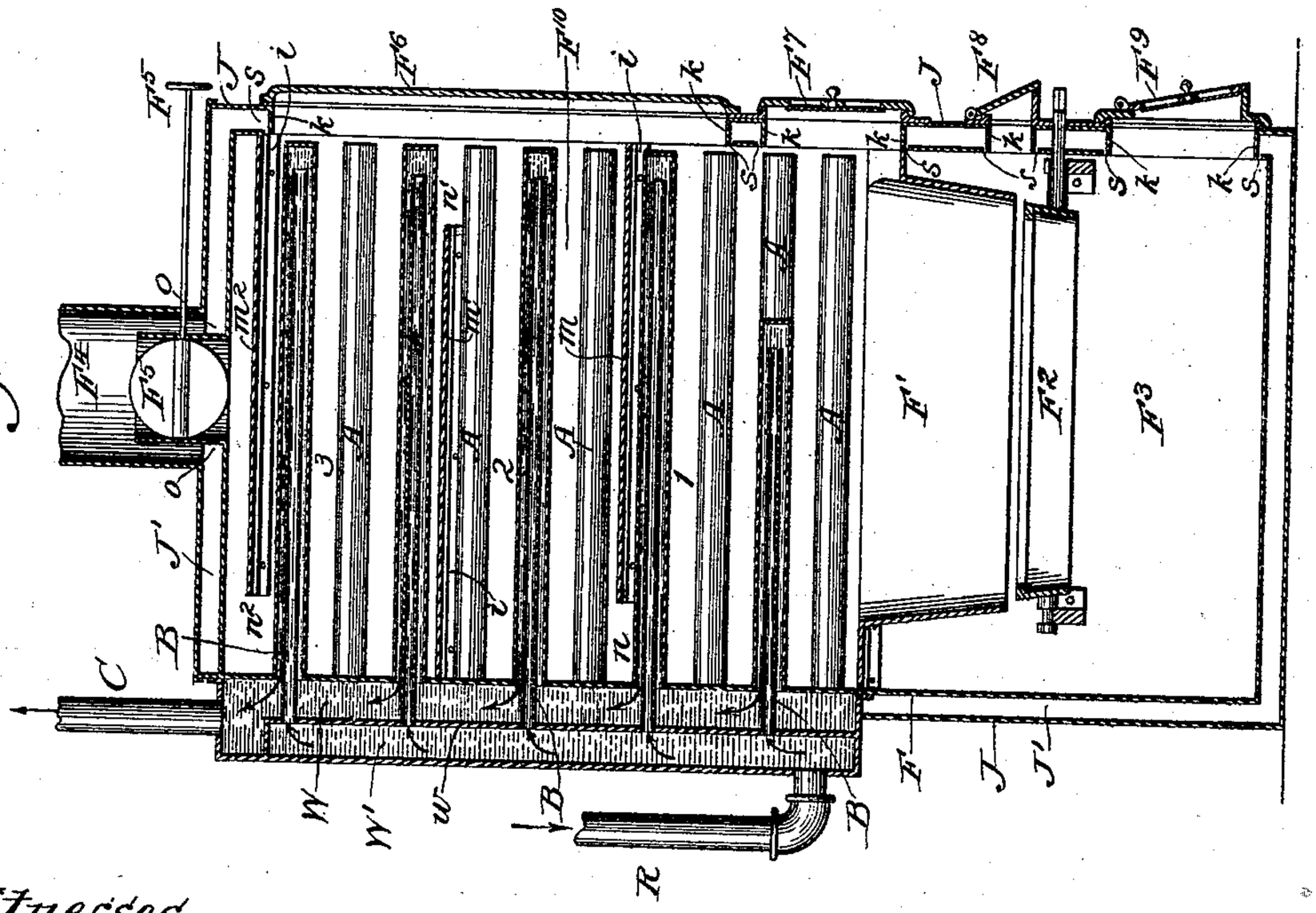


Fig 1.



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GEORGE A. HOUSTON, OF BELOIT, WISCONSIN.

WATER-HEATER.

SPECIFICATION forming part of Letters Patent No. 543,246, dated July 23, 1895.

Application filed August 1, 1892. Serial No. 441,823. (No model.)

To all whom it may concern:

Be it known that I, GEORGE A. HOUSTON, a citizen of the United States of America, residing at Beloit, in the county of Rock and State of Wisconsin, have invented certain Improvements in Water-Heaters, of which the following is a specification.

In the accompanying drawings, wherein like reference letters and figures indicate like parts, Figures 1 and 2 are vertical sections taken at right angles to each other.

This invention relates to that class of heaters which are employed to warm water and circulate it by means of pipes and radiators through the various apartments of a building; and it consists, first, in the means herein described for obtaining the maximum of water circulation with the minimum of fuel expenditure, and, secondly, in an improved means for preventing the escape of gas from the furnace into the building.

In the drawings, F indicates the walls of the furnace, which may be of any acceptable form, but preferably square in cross-section, as shown; C, the outgoing circulation pipe or pipes, carrying the water off to the radiators, (not shown;) R, the return pipe or pipes, bringing the cooled water back from the radiators to the furnace; F′, the fire-pot; F^2, the grate; F^3, the ash-box; F^4, the smoke-flue; F^5, the damper; F^6, F^7, F^8, and F^9, doors to the several parts of the furnace, and F^{10} the hot-air chamber of the furnace. Form is essential to none of these parts.

That part of my invention which relates to forcing a rapid water circulation with a minimum of fuel expenditure requires as its foundation a peculiarly-constructed system of water-passages arranged in a certain relation to the fire-pot and the smoke-flue, so as to compel the water in the lower passages to be forced more rapidly than in the upper ones.

My invention does not consist in the system of water-passages *per se*, but in combining this particular system with the fire-pot and with certain horizontal deflecting-plates, or, as I term them, "baffling-plates," arranged so as to divide the hot-air chamber into several sections, one over the other, and to compel the ascending hot air and gas from the fire-pot to force to the utmost the circulation in the pipes of the lower section before passing to the next section above, and then to use up as much as possible of the remaining heat in forcing the circulation in the section immediately over the lower one before passing to the next section above that, and so on from section to section from lowest to highest.

To explain the invention clearly it will be necessary to first describe the peculiar character and action of the circulating system and then explain the peculiar action of the baffling-plates in connection with such system.

The circulating system is as follows: I provide two separate vertical water-chambers W W′, the former communicating with the outflow-pipes C and the latter with the inflow-pipes R, dividing the two chambers from each other preferably by a partition *w*, so as to allow the heat of the furnace to radiate to the water in the proximate chamber W, but not to reach the water in the remote chamber W′.

A A A indicate a series of horizontal pipes screwed into the inner wall of chamber W, projecting into the hot-air chamber of the furnace, closed at their inner and open at their outer ends, and arranged in tiers at different elevations.

B B B indicate a corresponding number of smaller pipes open at both ends, screwed into the partition *w*, and extending through chamber W into the pipes A A A nearly to the inner closed end of the latter. In order to prevent interference with the fuel in charging the furnace I prefer to shorten some of the lower pipes in front of the fuel-door. With this arrangement cool water flows from pipes R into chamber W′, thence through pipes B to the inner end of pipes A, thence through the latter backward around pipes B to chamber W, and thence to the outflow-pipes C. The inflow may be regarded as ending and the outflow as beginning at the point where pipes B discharge their contents into pipes A; and it will be observed that the inflowing water is everywhere protected from exposure to the direct heat of the furnace and its expansion thus prevented, while the outflow water is everywhere exposed to such direct heat and its expansion thereby promoted to the utmost practicable extent, and that the expanding outflow water, finding a free escape in the direction of pipes C and an obstructed passage in the backward direction

into the small pipes B, takes the path of least resistance, and thus establishes a rapid circulation out through pipes C and back from the radiators through pipes B. It will also be observed that the lower pipes A, being exposed to the greatest heat, will force their circulation faster than the upper pipes, while both the upper and lower pipes A will receive their water at a substantially uniform temperature. This rapid changing of the contents of the lower pipes A causes the absorption of the major portion of the ascending heat by the lower tiers of pipes, leaving only a diminished temperature to act on the upper tiers; but the less the heat acting on the upper tiers the less active is their circulation, the longer their water is exposed to the heat before it escapes into chamber W, and hence the more complete their absorption of the remaining heat. The result is that the lower tiers control the rapidity of the circulation through the pipes C R and the radiators, while the upper tiers, taking a less active part in the circulation, perform the function of abstracting from the ascending air-currents more or less of the heat that is left in them after their action upon the lower tiers, and thus the conjoint action of all the pipes tends to the utilization of all the heat.

Now, while the system is capable of useful work with only the parts above described, I have discovered that a great improvement is effected in its operation by providing means for still further forcing the circulation in the lower tiers and retarding it in the upper ones. To this end I divide the hot-air chamber of the furnace, by means of horizontal plates $m\ m'\ m^2$, &c., into two or more compartments or sections, (marked 1 2 3,) one over another, communicating with each other, preferably, at alternately-opposite sides of the main chamber. For a furnace of ordinary size I prefer to use three of these baffling-plates, arranging them so that the lower plate m will leave a space n at its rear edge for the upward passage of the heated air, smoke, &c., the next plate m' will leave a similar space n' at its front edge, and the upper plate m^2 will leave a similar space n^2 at its rear edge, &c. It is not material that the passages $n\ n'\ n^2$ should be arranged exactly in this way; but it is material that they be out of vertical line with each other, so as to compel the heated air-currents to traverse the surfaces of the pipes in passing from one of said passages to another, and the greater the pipe-surface acted upon during such traverse the better the result.

In practice the currents ascending from the surface of the fire-bed, intensely heated, fill the lower section 1, and are detained by the lower plate m, slowly escaping through the passage n. While so detained they give up a large amount of their heat to the pipes A of section 1, forcing a powerful circulation through pipes A B of said section, which causes said pipes to receive and deliver the greater part of the return water which comes into chamber W′ from pipes R, preferably arranged directly in front of pipes B of said lower section. The activity of the circulation keeps down the temperature of the water in pipes A of section 1, practically preventing the formation of steam therein, while the rapid loss of heat from the air-currents immediately over the fire-bed is found to produce the unexpected effect of deadening the intensity of combustion in the upper layers of coal in the fire-bed, and thereby causing the fuel to last considerably longer than would otherwise be the case. The air-currents, thus robbed of a large portion of their heat, then enter section 2 and traverse the entire surface of all the pipes therein before escaping through passage n'. Having less heat to give up they are capable of exciting only a less active circulation than they had excited in section 1. The water supply of pipes B in section 2 is also less than that of pipes B of section 1, both because section 2 is (in the preferable arrangement) farther from the delivery end of the return-pipes R than is section 1 and also because the rapid circulation in the lower section nearly exhausts the capacity of pipes R to supply the water therefor. From all these causes, and because the air-currents are retarded by friction and by contraction from the loss of heat, the circulation both of hot air and water is considerably slower in section 2 than in section 1 and a large part of the heat remaining in the air-currents is consequently absorbed into the water. This additional water, forced into chamber W, even with moderate rapidity, reinforces and increases the already active movement of water induced in said chamber by the action effected in section 1. Passing next to the upper section 3, the hot-air currents are still further retarded and act upon pipes having a still slower circulation, with the result that the force of such circulation is added to the water in chamber W and that the air-currents finally pass off to the smoke-flue almost completely deprived of their heat, substantially all of which has gone into the water circulation. On the other hand, pipes C are nearly at boiling heat.

It will be seen that the increased effect hereinabove referred to results from dividing the horizontal pipes A B into separate groups or sections, one above another, so arranged that while the body of air in any one section is substantially uniform in temperature the degree of temperature common to that section is considerably below that of the next section beneath—using the lower section to dominate and control the water circulation and the upper section or sections to absorb from the air its remaining heat, and apply it in reinforcing and accelerating the water circulation effected by the lower section.

As a further improvement in construction, for the purpose of facilitating the cleaning of the pipes and baffling-plates, I provide a large door F^6 in the front side of the furnace,

through which said plates may at any time be inserted or removed, and I support the plates upon horizontal cleats *i* secured to the side walls of the hot-air chamber, upon which cleats the plates can be slid in or out.

Another improvement consists in means for preventing the escape of smoke and gases from the furnace into the room where it is situated while the furnace-damper is closed or the movement of the hot air and gases in the furnace otherwise obstructed. To this end I surround the entire furnace, except at the water-chambers W W′, with a jacket J, between which and the walls of the furnace there is an air-space J′ opening into the smoke-flue by a passage *o* not controlled by the damper. Any gas escaping from the furnace merely passes into said air-space, and thence to the smoke-flue, whether the damper F^5 be closed or open. This air-space is closed to the outside air and is not intended as an air-heating space nor for the purpose of preventing radiation of heat from the furnace, but merely to catch and conduct away any escaping gases. To facilitate its action when the damper is closed I arrange all the door-frames so as to leave around them, at their edges, a narrow slit, (shown at *s s*,) through which there is a slight draft from the hot-air chamber into the jacketed air-space when the damper is closed. The slight draft thus provided around the doors into the air-space draws away and carries off to the smoke-flue any gases that might otherwise escape through the joints of the doors into the building. These draft-slits are easily formed by casting the door-openings in the furnace-wall, attaching the doors to the jacket, and providing the jacket around each of its own door-openings with a flange *k* extending inward and nearly, but not quite, touching the walls of the furnace, as shown in Fig. 1. The gases are then able to draw between the inner edges of the flanges *k* and the edges of the furnace-wall into the air-space J′, and thence escape to the smoke-flue through the passage *o*.

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

1. In a water heater, the combination with the vertically arranged water chamber having the outflow pipe leading from the upper portion thereof, and the series of horizontal pipes A, closed at one end and all opening into the said chamber at the opposite end, and a fire pot beneath said parallel pipe A, of a vertically arranged inflow water chamber lying outside of and parallel with the outflow water chamber, a return flow water pipe connected with said chamber, a series of pipes passing from said chamber through the outflow water chamber into the series of pipes A and discharging near the ends thereof, and horizontal baffle plates extending through between the pipes A and separating them into relatively small distinct groups located at different levels, the openings in the baffle plates between the groups being located out of line with each other and at opposite sides of the heater, whereby a series of chambers are formed, the horizontal pipes A in each of which will be heated to a uniform temperature; substantially as described.

2. The combination of a furnace; a jacket surrounding it, and inclosing between itself and the furnace walls an air-space J′. closed to the external air, and communicating at its upper end with the smoke-escape flue through a passage always open and unobstructed; and narrow slits or passages *s. s.*, leading from the interior of the furnace into the air-space J′., and always open; substantially as described.

3. The combination of a furnace; a jacket surrounding it, and inclosing between itself and the furnace-walls an air-space J′., closed to the external air and communicating at its upper end with the smoke-escape flue through a passage always open and unobstructed; door-openings through the furnace-wall and jacket; doors attached to the jacket to close said openings; and flanges *k.* around said openings, arranged so as to nearly but not quite close communication between the interior of the furnace and the air-space J′.; substantially as described.

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