No. 795,464. PATENTED JULY 25, 1905.

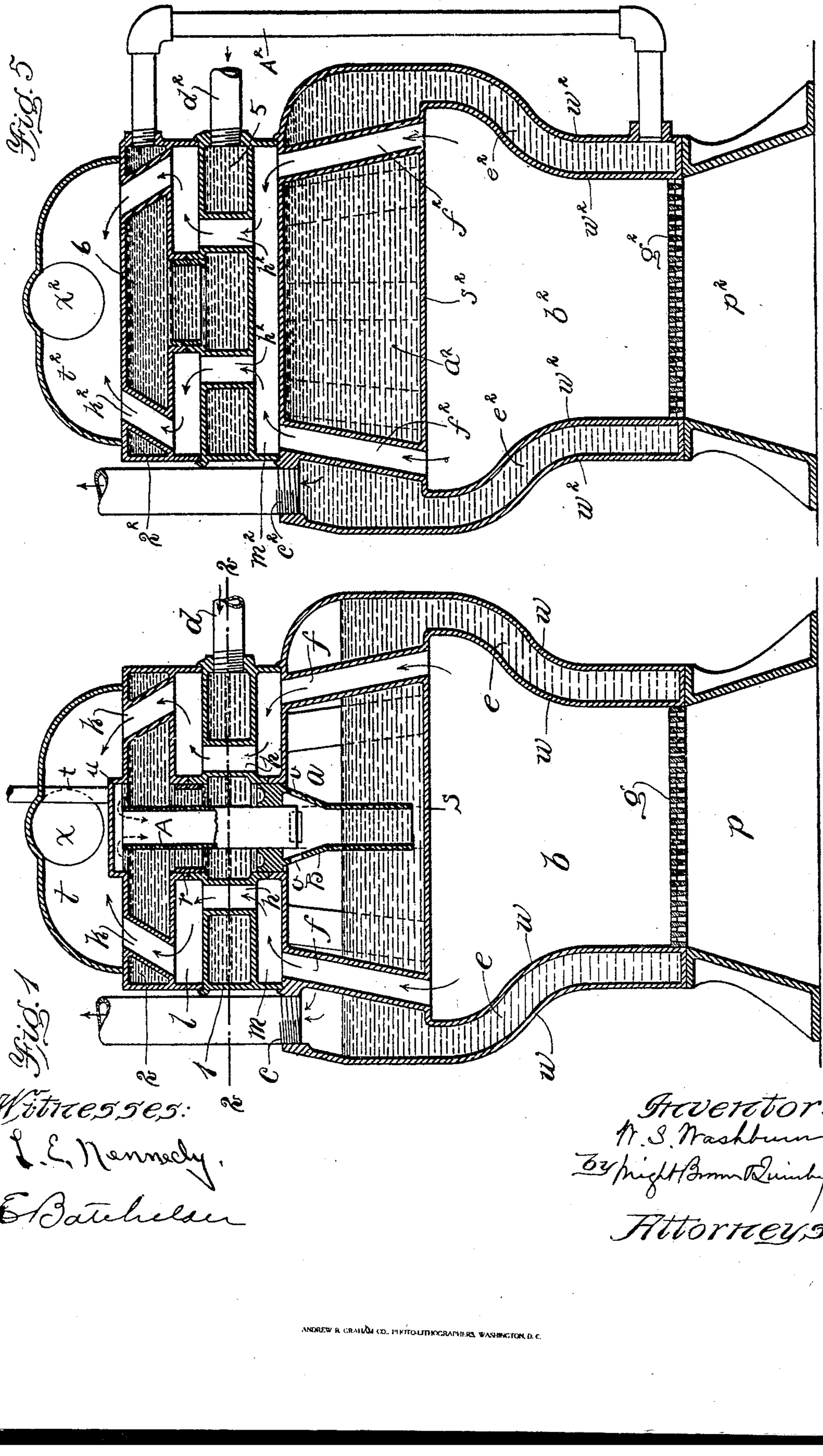
W. S. WASHBURN.

HEATING APPARATUS.

APPLICATION FILED AUG. 26, 1904.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses:
L. E. Kennedy.
E. Batchelder

Inventor:
W. S. Washburn
By Wright Brown Quinby
Attorneys.

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2 SHEETS—SHEET 2.

Fig. 2

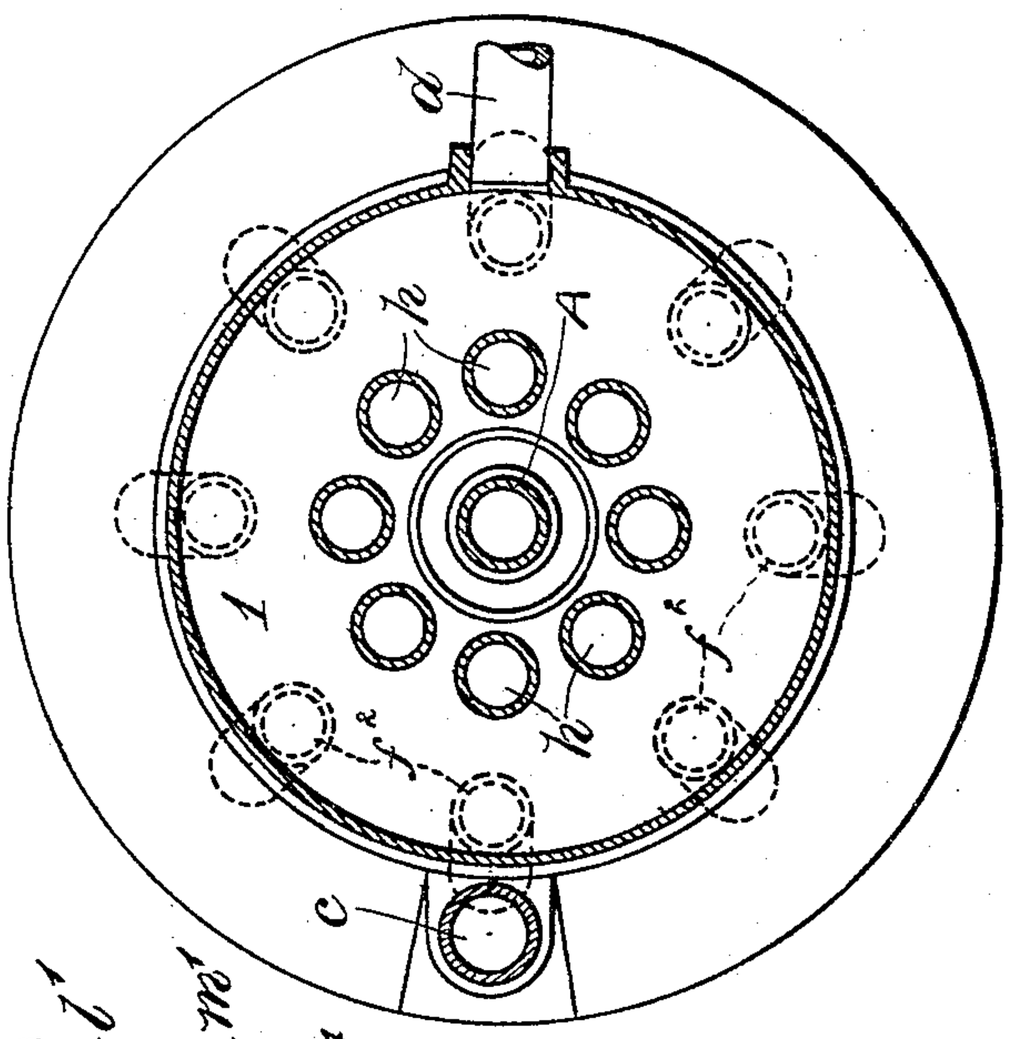


Fig. 4

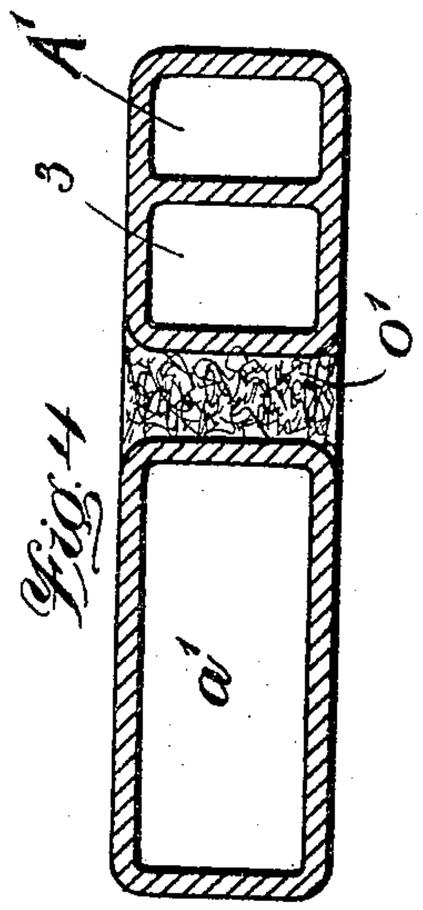
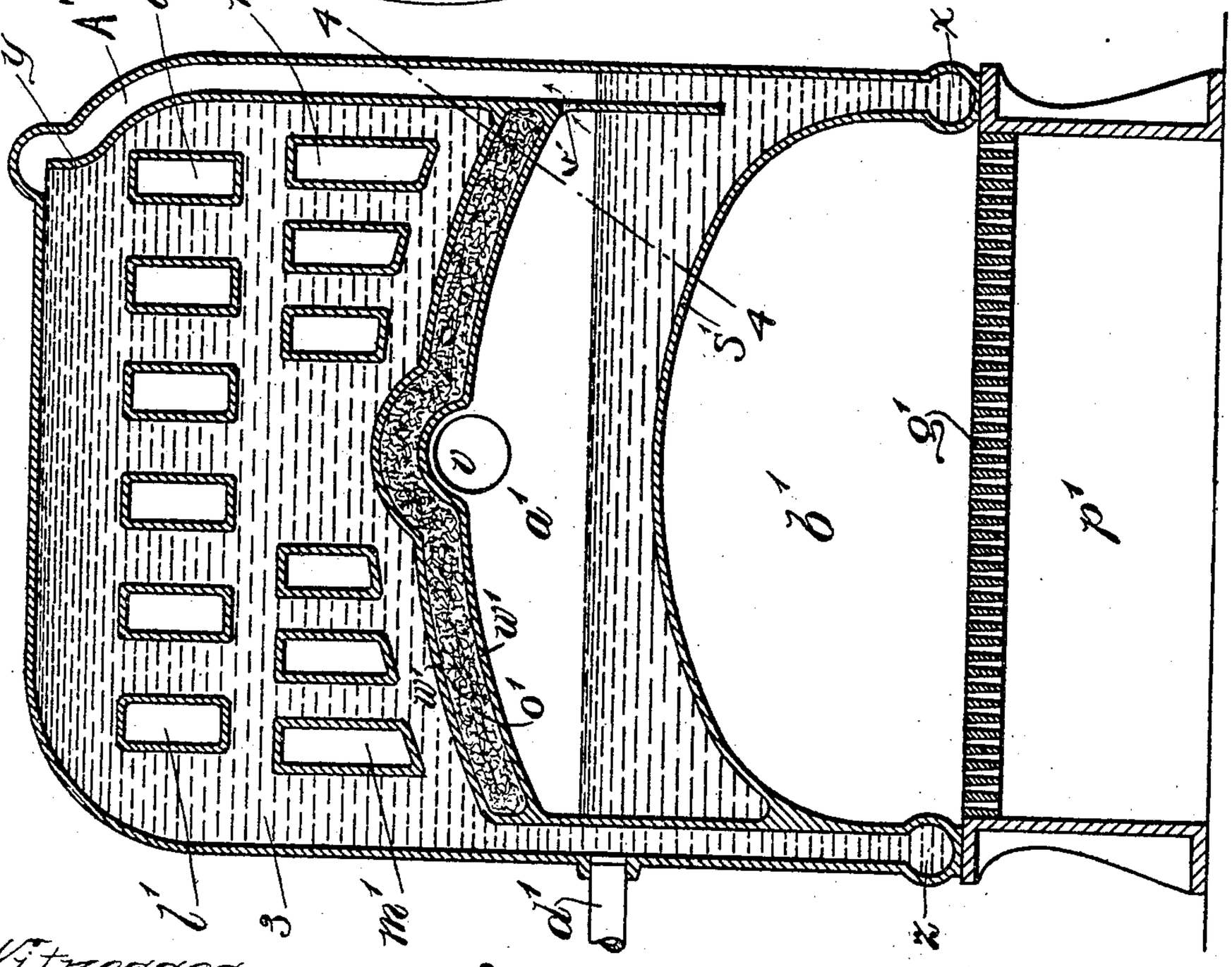


Fig. 3



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By Wright Brown & Quinby
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM S. WASHBURN, OF BROCKTON, MASSACHUSETTS.

HEATING APPARATUS.

No. 795,464. Specification of Letters Patent. Patented July 25, 1905.

Application filed August 26, 1904. Serial No. 222,257.

To all whom it may concern:

Be it known, that I, WILLIAM S. WASHBURN, of Brockton, in the county of Plymouth and State of Massachusetts, have invented certain new and useful Improvements in Heating Apparatus, of which the following is a specification.

This invention relates to heating appliances, and particularly to that class of appliances used to generate steam or to heat, water to supply the heating systems of buildings; and its object is to produce a water heater or boiler which will deliver hot water or steam from a point directly over the hottest part of the fire and which will utilize the heat remaining in the waste products of combustion for heating the return water before the latter passes into the steam-chamber or main heating portion of the boiler or heater.

In all types of boilers and furnaces now used for heating purposes the steam or hot water is taken from the part of the heater farthest removed from the source of heat and therefore the coolest part, and the returning cool water is fed into the hottest portion of the heater, with the result that in the case of a steam-generator the greater part of the heat given off by the fire is used up in bringing the cool water to the boiling-point, while the steam in the upper part of the generating-chamber, being acted on only by the products of combustion which have lost most of their heat, is delivered at a comparatively low temperature, ready to be quickly condensed in the pipes and radiators and immediately return to increase the burden put on the boiler, while the water in the steam-chamber is unnecessarily chilled, and in the case of a hot-water heater water at a temperature less than the maximum is delivered to the heating system with resulting loss of efficiency, whereas in my improved apparatus the water is fed into chambers above the steam-chamber or main heating portion into contact with the cooler gases, and is then, after being heated thereby, caused to pass into a chamber directly over the fire-box, where it is quickly evaporated or heated in the case of a hot-water heater.

By the construction and arrangement of the parts of my improved apparatus less of the heat of the fire is wasted, and steam is generated or water heated more quickly and delivered at a higher temperature, with less expenditure of fuel, than is the case with any of the contrivances hitherto known.

In the drawings forming a part of this specification, Figure 1 is a vertical central section of a steam-boiler embodying the preferred form of my invention. Fig. 2 is a horizontal cross-section on line 2 2 of Fig. 1. Fig. 3 is a vertical section of a modified form of my invention, showing one of the parts of a sectional boiler. Fig. 4 is a cross-section on the line 4 4 of Fig. 3. Fig. 5 is a view similar to Fig. 1, showing my invention applied to a hot-water heater.

The same reference characters indicate the same parts in all the figures.

The boiler constituting the preferred form of my invention is constructed with a chamber *a*, into which water is fed and in which steam is generated. The chamber *a* therefore constitutes a steam-generating chamber or steam-dome, or, more broadly, a main heating-chamber. Directly beneath the steam-generating chamber is a fire-box *b*, at the bottom of which is placed a grate *g*, and beneath the latter is the ash-pit *p*.

The side walls *w* of the fire-box are preferably formed double, with a space *e* between them opening into the chamber *a*, constituting a water-leg, by virtue of which the water in the boiler is caused to surround the fire, and thereby receive the greatest possible proportion of the heat given off by the fire. The upper portion of the fire-box is preferably enlarged and the crown-sheet *s* of greater area than the grate-surface, a construction which increases the heating-surface and allows the hot products of combustion to expand and more efficiently communicate heat to the water in the steam-generating chamber. A number of flues *f* extend through the chamber *a*, opening at their ends into the fire-box and into passages hereinafter described, leading to an outlet to the chimney, through which the products of combustion pass. An outlet *c* is formed in the upper part of the steam-chamber *a*, through which the steam passes to the pipes and radiators of the heating system.

Above the steam-chamber is a water-chamber 1, having an inlet *d*, through which the water formed by condensation of the steam in the heating-pipes is caused to flow into the chamber, and above the chamber 1 is a second water-chamber 2. The chambers 1 and 2 constitute together a water-receiving portion. In the form of my invention shown in Fig. 1 the water-chambers are made of short cylindrical boxes provided with flues *h k*, extending through them from top to bottom and so

mounted that an air-tight space *l* is provided between them and a similar space *m* between the lower water-chamber 1 and the steam-chamber *a*. Openings are formed in the top of the chamber 1 and the bottom of the chamber 2 and are joined by a water-tight connection, forming a passage *r*, through which water may pass freely. A pipe A leads from the upper part of the upper water-chamber downward into a pipe B, which is connected to the top of the steam-generating chamber *a* and extends to the lower part thereof, its lower end being normally submerged in the water of the steam-chamber. If desired, the pipe B may be omitted and the pipe A allowed to discharge directly into the steam-generating chamber.

The products of combustion pass upward through the flues *f*, *h*, and *k* and spaces *m* and *l* to a smoke-box *t*, from which they are discharged through a pipe *x* into the chimney. The water formed by condensation of steam in the heating-pipes flows through the inlet *d* into the water-chamber 1, wherein it circulates and is heated by the hot smoke and gases passing about and through the said chamber, thence through the passage *r* into the upper water-chamber 2, where it is further heated in a similar manner, and finally through the pipes A and B into the steam-generating chamber.

The precise form and arrangement of parts shown are not essential to my invention, the essential features being the location of the generator or main heating-chamber near the hottest part of the fire and of the return-water chambers in a position to be acted on by the gases which have already expended a part of their heat in generating and heating the steam; nor is the precise number of water-chambers shown essential, as any number arranged in any desired fashion which may be necessary to absorb most effectively the greatest possible amount of heat from the waste gases may be used.

Minor changes may be made in the structure illustrated, as by taking the steam for the heating system from above the pipe A or leading a vent-pipe from over the pipe A to the steam-main, if desired, without affecting the invention. If desired, ribs may be formed in the crown-sheet *s* for increasing its effective heating-surface.

In Fig. 1 I show a pipe *t*, which communicates with the dome *u* above the pipe A. Said pipe may extend to the supply end of the heating system for the purpose of liberating any steam or air that may collect in the preliminary heating portion.

The modification shown in Figs. 3 and 4 illustrates a form of my invention in which the boiler is formed of a number of thin flat vertical sections connected together, one of such sections being here shown. The section is formed with two legs, between which is left a space *b'*, which with similar spaces formed in the other sections with which it is used forms the fire-box. In the central part of the section is the steam-generating chamber *a'*, and in the upper part of the section is the return-water chamber 3. Openings *l' m'* extend through the chamber 3 from side to side of the section, and through these openings the products of combustion pass on their way to the chimney. The water of condensation is let into the chamber 3 by the inlet *d'* and circulates about this chamber, overflowing the inner wall *y* thereof into the passage A', and so down into the generating-chamber *a'*. The steam or main heating chamber *a'* is separated from the return-water chamber 3 by a wall *w'*, which may be a single wall, but is preferably formed double, with a space *o'* between the portions of the wall, which space may be filled with some suitable non-conducting material or with air for the purpose of insulating the chamber *a'* from the chamber 3 and preventing loss of heat from the steam in the heating-chamber by conduction to the cool water in the return-water chamber. The steam generated in the chamber *a'* flows through the outlet *v*, which leads to the steam-main. The sections are placed closely together side by side and connected in such manner that the steam-outlet *v* of each of them communicates with the outlets of all. There are also passages at *x* and *z* at the bottom of the water-legs of the chambers *a'* and 3, respectively, connecting all the sections through which water is free to flow to maintain the water-level uniform in all the sections of the boiler. The products of combustion pass through the fire-box to the rear of the boiler, being there deflected upward and forward and caused to pass forward through the openings *m'* to the front of the boiler, where they may be again deflected and caused finally to pass through the openings *l'* to the chimney, or they may be caused to pass forward through all the openings *m'* and *l'* and go directly to the chimney.

It will be noted that as a result of the construction described the steam is generated in and delivered to the heating system from that portion of the apparatus which is nearest the hottest part of the fire, while the returning water of condensation instead of directly entering the generator and cooling the water therein is brought into a cooler part of the apparatus, where it is enabled to absorb part of the heat remaining in the waste products of combustion, and it is not delivered to the generator till it has reached a temperature approximating the boiling-point. Thus I am enabled to utilize most efficiently the greatest heat of the fire to produce steam of high temperature and to save much of the heat, which would otherwise be wasted, remaining in the products of combustion, thus greatly increasing the efficiency of my boiler over

those heretofore known, in which the cool water is brought directly in contact with the hottest gases, while the steam in the upper part of the generator is acted on only by gases which have lost a great proportion of their heat.

The boiler of the form shown in Figs. 3 and 4 is adapted to be used without alteration as a heater for the water of a hot-water heating system, the only difference in operation being that when used as hot-water heater the entire heater is filled with water, no steam-space being reserved, and the chamber a' becomes a main water-heating chamber instead of a steam-generator; otherwise the operation is the same, the hot water flowing out of the outlet v to the heating system and the cool return water entering the chamber 3 by the inlet d' and there overflowing the wall y to the chamber a'.

In Fig. 5 is shown a heater for heating water to be used instead of steam in a heating system, embodying a modified form of the boiler shown in Fig. 1. The construction and operation of this form of the invention are substantially the same as that shown in Fig. 1, except that the pipes A and B are omitted and an external pipe A^2, leading from the upper water-receiving chamber 6 to the heating-chamber a^2 substituted therefor. The returning cool water enters through the inlet d^2, circulates through the chambers 5 and 6, as in the steam-generator, and passes through the pipe A^2 into the heating-chamber a^2, where it is heated to the required degree instead of being converted into steam, and finally flows out by means of the outlet c^2 to the heating system.

A great advantage resides in my invention by reason of the fact that as a result of the efficiency with which the heat given off by the fire is utilized and also on account of the comparatively small bulk and shallowness of the body of water contained in the main heating-chamber steam may be generated in the apparatus when used as a boiler or water heated to the desired degree when used as a water-heater much more quickly and with less expenditure of fuel than with the heaters now in use. This is particularly desirable in moderate weather, especially when the apparatus is used as a steam-boiler, as steam may be generated from a low fire, resulting in great economy of fuel. With all other boilers a comparatively hot fire is necessary to make any steam at all, whether in cold or mild weather, and as a consequence nearly as much fuel must be used to run them when the temperature is just low enough to make a fire necessary as when it is very severe.

The arrangement of the inlet and outlet passages to and from the water-receiving chambers or space, with the former near the bottom while the latter is at the top thereof and the outlet-passage from the water-receiving space extending near the bottom of the main heating-chamber, causes the water to circulate in a natural manner, entering the lowest part of the receiving-space and there coming into contact with the hot gases passing by this chamber, flowing upward therein as it becomes heated and of less specific gravity until it overflows into the outlet-passage, then being conducted to the lowest part of the heating-chamber, from which it rises in the same manner as it becomes further heated; and as the heater is open to both ends of a closed system of pipes the pressure at all points in the heater and pipes is substantially the same, so that the return water is free to flow naturally back into the heater under the influence of gravity and without the necessity of external forcing means. By this means as soon as a fire is started a circulation of water in the heater, and thereby a flow through the pipes of the system, is set up which causes the latter to become warmed in the minimum of time.

v v, Fig. 1, represent vent-openings formed in the pipe or passage B, and v', Fig. 3, represents a vent-opening formed in the passage A'. Said vent-openings communicate in each case with the steam-space of the main heating portion and prevent a siphonic flow of water from the primary heating portion through either the passages A B, Fig. 1, or the passage A', Fig. 3.

I claim—

1. In a heating system for buildings, a heating apparatus comprising an outer shell subdivided internally to form a main heating portion located in close proximity to the source of heat, and having means at its upper part for connection with the supply end of a system of heating-pipes, a preliminary heating portion located farther from the source of heat than the main heating portion, and having means at its lower part for connection with the return end of the system, and a passage connecting the upper part of the preliminary heating portion with the lower part of the main heating portion, whereby the water supplied by the return-pipe is caused to rise in the preliminary heating portion, and then to flow through said passage to the lower part of the main heating portion, in which the water again rises.

2. In a heating system for buildings, a heating apparatus comprising an outer shell subdivided internally to form a main heating portion located in close proximity to the source of heat, and having means at its upper part for connection with the supply end of a system of heating-pipes, a preliminary heating portion located farther from the source of heat than the main heating portion, and having means at its lower part for connection with the return end of the system, and a passage connecting the upper part of the preliminary heating portion with the lower part of the

main heating portion, the preliminary heating portion having also at its upper part means for connection with the supply end of the heating system, whereby steam or air accumulating in the said preliminary heating portion may be liberated.

3. In a heating system for buildings, a heating apparatus comprising an outer shell subdivided internally to form a main heating portion located in close proximity to the source of heat, and having means at its upper part for connection with the supply end of a system of heating-pipes, a preliminary heating portion located farther from the source of heat than the main heating portion, and having means at its lower part for connection with the return end of the system, and a passage connecting the upper part of the preliminary heating portion with the lower part of the main heating portion, said passage having a vent-opening communicating with the steam-space of the main heating portion, whereby a siphonic flow of water from the preliminary heating portion to the main heating portion is prevented.

4. In a heating system for buildings, a heating apparatus comprising an outer shell having its interior divided into a main heating-space and a water-receiving space, the former being located nearer the source of heat than the latter, a connection between the upper part of the main heating-space and one end of the pipe system, a connection between the lower portion of the water-receiving space and the return end of the pipe system, and a passage leading from the upper part of the water-receiving space to the lower portion of the main heating-space and contained within the shell of the apparatus.

In testimony whereof I have affixed my signature in presence of two witnesses.

WILLIAM S. WASHBURN.

Witnesses:
A. H. Brown,
C. F. Brown.