

July 21, 1936.

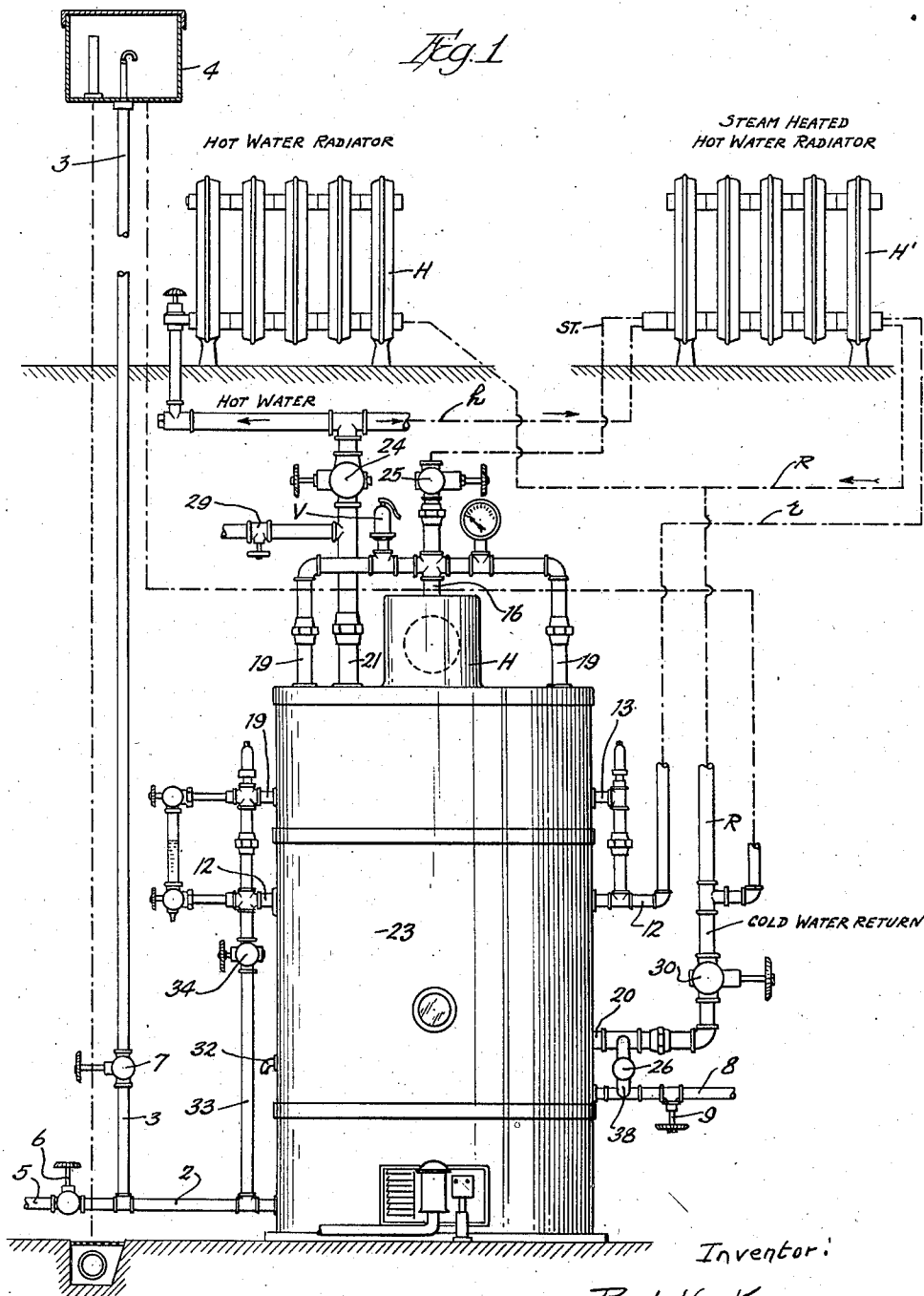
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TRIPLE SERVICE WATER HEATER AND BOILER

Filed March 16, 1936

3 Sheets-Sheet 1



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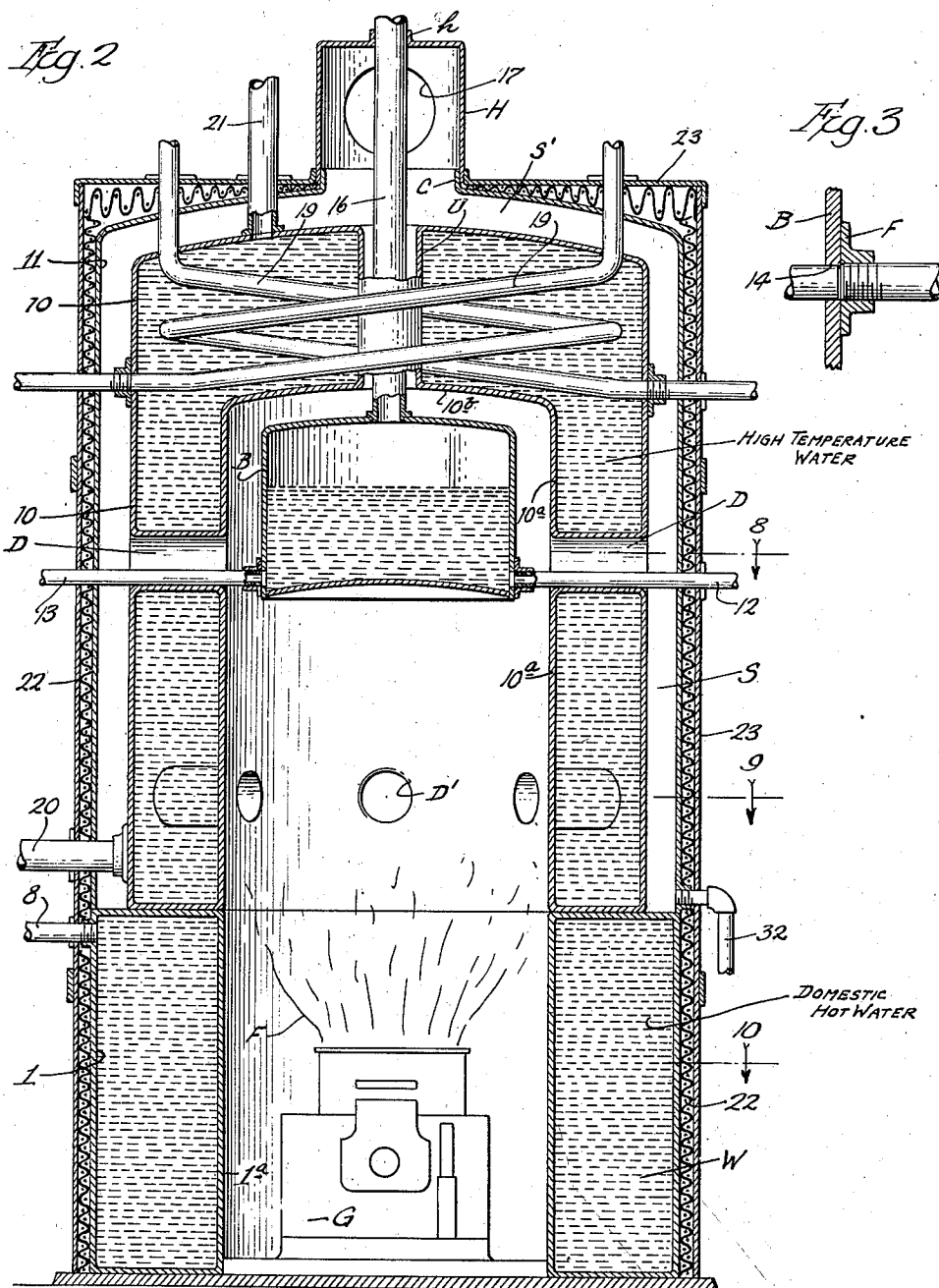
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3 Sheets-Sheet 2



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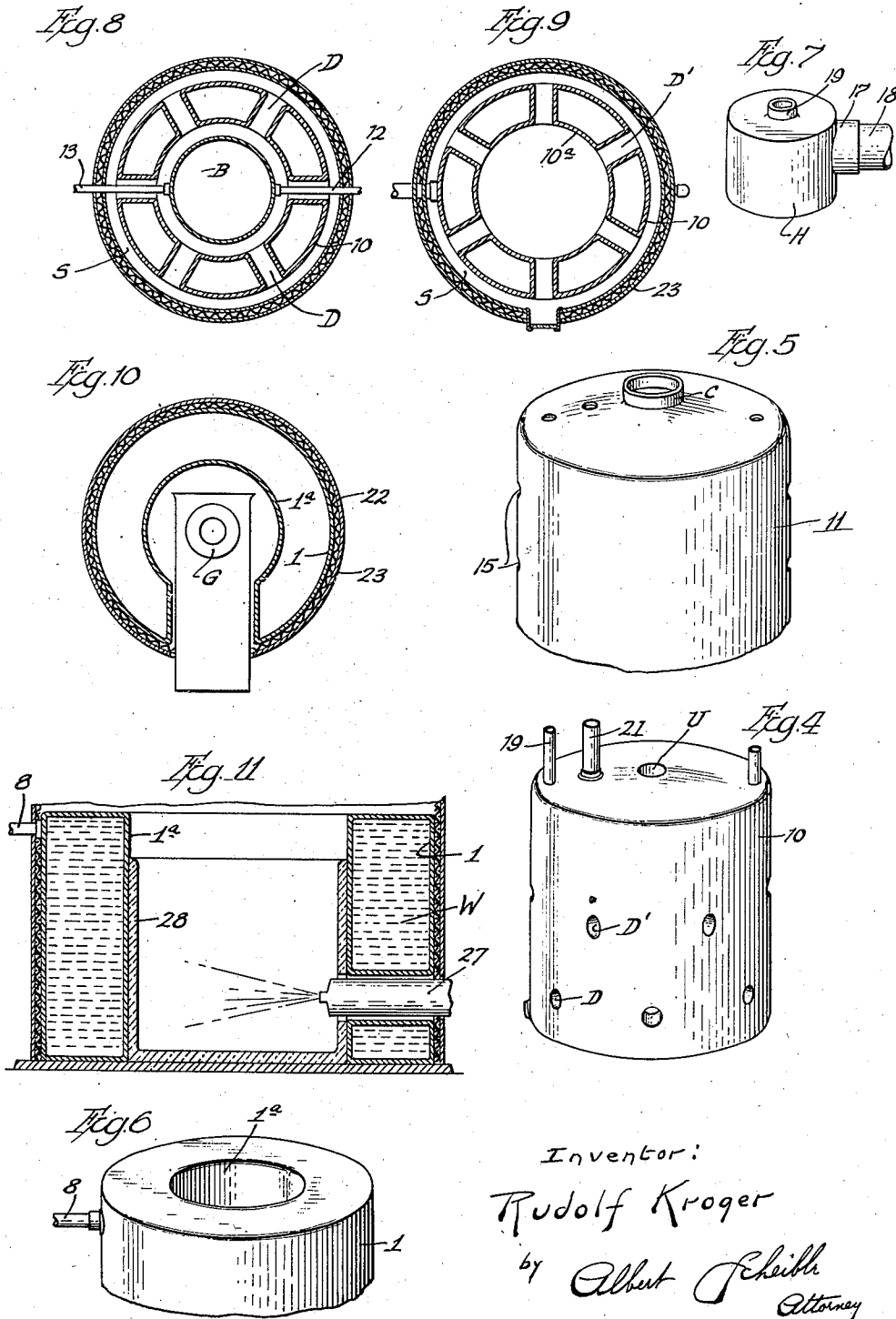
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TRIPLE SERVICE WATER HEATER AND BOILER

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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TRIPLE SERVICE WATER HEATER
AND BOILER

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Application March 16, 1936, Serial No. 69,095

18 Claims. (Cl. 122—37)

My invention relates to a combined boiler and hot water heater using either gas or oil as the fuel, its general objects being those of providing a compact, durable and relatively inexpensive apparatus of this class which will be both speedy and highly efficient both in cold weather for supplying low pressure steam and a relatively much larger quantity of hot water, and in summer for supplying hot water only. Furthermore, my invention aims to provide a heating appliance of the above characteristics which will afford both a supply of quite hot water (suitable for use in ordinary hot water radiators) and a supply of water at somewhat lower temperature for bath tubs and other domestic uses.

More particularly, my invention aims to provide an oil or gas burning combined boiler and hot water heater suitable for use in dwellings and other modest sized buildings which will afford the following advantages in comparison with the heretofore commercial apparatus of the same general class:

(1) Providing a heating apparatus for such use in which each of the four separately manufactured major parts—namely, a low temperature water heater, a high temperature water heater, a low-pressure steam generating boiler, and a draft-confining shell or jacket—can be separately manufactured and thereafter can readily be assembled by any steam fitter.

(2) Designing the apparatus so that, in a size adequate for 700 square feet of hot water radiation, each of these parts can readily be taken through a three-foot doorway to facilitate the installation of the apparatus in an already completed building.

(3) Arranging the parts so that heat will be conveyed upwards from the upper (and hence hottest) portion of the low temperature water heating compartment to the lowest portion of the high temperature water heating compartment.

(4) Providing controllable connections between the said two compartments whereby they can serve jointly as a domestic water heater in the summer months when only a low flame is maintained.

(5) Utilizing part of the steam generated in the boiler compartment for expediting the heating of water in the high temperature water heating compartment.

(6) Arranging the said major parts so that the flow of combustion gases is mainly upwards, and never downwards, and so as not to permit such gases to collect in any pockets when the flame is low.

(7) Providing simple means for equalizing the distribution of these gases over the exterior of the high temperature water heating section.

(8) Arranging the said major parts so that the high temperature water heating section will have exceedingly large surface areas (in proportion to the water content of that section) traversed by the combustion gases, thereby utilizing by far the greater portion of the heat of these gases.

(9) Utilizing part of the steam generated by the boiler section for warming the combustion gases issuing from the appliance, so that the stack draft will be adequate at low barometric pressures even when the heat of the gases has been so effectively utilized within the appliance.

(10) Employing a high temperature water heating section of a hollow cap shape, the interior of which forms the upper part of the combustion chamber of the apparatus, and providing an upright gas passage through the cap portion of this section to prevent combustion gases from accumulating under that cap portion.

(11) Utilizing certain pipe connections to the steam generating boiler for supporting this boiler.

(12) Providing convenient means for draining off any condensate, produced with gas as the fuel, which collects between the high temperature water heating section and the draft-confining jacket, so that neither condensed water nor other products of combustion will clog the space through which combustion gases flow upwards along the exterior of that section.

(13) Proportioning the major parts so that the excess of steam generating capacity, which is needed in the boiler compartment to expedite the heating of the high temperature water, can be utilized in steam-heated hot water radiators while the high temperature water heating section can supply the requirements of a much larger proportion of ordinary hot water radiators.

(14) Arranging a triple-service fluid heating appliance of the recited characteristics so that only a quite small part of it needs to be constructed of non-corrosive metal.

(15) Providing an appliance of these characteristics which will require only relatively small changes in its lower portion to adapt it for use with gas, or with oil as the fuel.

Illustrative of the manner in which I accomplish the above recited objects, Fig. 1 is an elevation of a fluid heating appliance embodying my invention, including partly diagrammatic connections both to a hot water heated radiator and

a steam-heated hot water radiator, and to an expansion tank.

Fig. 2 is an enlarged central and vertical section through the heating appliance alone, taken in the general plane of the drawing of Fig. 1 but looking from the opposite direction, and showing the use of a gas burner.

Fig. 3 is an enlargement of the lower right-hand corner of the boiler section of the appliance in Fig. 2, showing the provision for connecting one of the boiler-supporting tubes to the boiler after the boiler has been suitably positioned within the hollow-walled cap-like upper water-heating section.

Fig. 4 is a reduced perspective view of the upper water-heating section.

Fig. 5 is a similarly reduced perspective view of the draft-confining shell which freely houses the upper water-heating section to afford a draft space around and above that section.

Fig. 6 is a similarly reduced perspective view of the upper portion of the lower water-heating section.

Fig. 7 is a perspective view of the header through which the combustion gases pass to a flue pipe, including a portion of this pipe.

Figs. 8, 9, and 10 are reduced horizontal sections taken respectively along the correspondingly numbered lines in Fig. 2.

Fig. 11 is a central and vertical section through the lower water-heating section, taken in a plane at right angles to that of Fig. 2, showing the changes needed when the same appliance is to be used with an oil burner.

In the embodiment of Figs. 1 to 10 my appliance comprises an axially upright and annular lower (low-temperature) water-heating section 1 which is continually kept filled with water supplied by a pipe 2 (Fig. 1) to the lower portion of that section from a riser pipe 3 connected to an expansion tank 4. Water can also be supplied to the said section, both initially and for replenishment purposes, from a water main 5 controlled by a valve 6, when a valve 7 in the said riser pipe is closed; and hot water can be withdrawn from the upper portion of this lower section through a domestic water supply pipe 8 controlled by a valve 9.

Seated on the top of the said lower section and in heat-conducting relation to the latter is a hollow-walled cap-like upper (and high-temperature) water-heating section 10 which preferably has its inner and cylindrical riser wall 10a aligning with the bore 1a of the annular lower section, but which is considerably smaller in exterior diameter than the said lower section. Freely housing this upper section and coaxial with it, is a cap-like draft shell 11, shown in Fig. 2 as having its cylindrical riser wall of the same outside diameter as the outer wall of the said lower section. This draft shell is seated upon and desirably welded to the lower section, and is sufficiently taller than the said upper section 10 to leave a draft space S¹ above the top of the upper section, the height of this space as well as the radial width of the tubular space S between the draft shell and the upper water-heating section being desirably at least 2½ inches when the diameter of the said shell is about 32 inches.

To carry combustion gases to the said draft spaces, I provide the hollow tubular riser portion of the upper water section with a plurality of radial gas ducts (D and D¹) which desirably have horizontal axes and which preferably are ar-

ranged in two superposed sets, with the ducts of each set equally spaced about the axis of the said section, and with the ducts of the two sets in relatively staggered relation. Thus Fig. 8 shows the six upper horizontal gas ducts D and Fig. 9 the lower gas ducts D¹, all leading from the interior of the cap-like upper water section to the tubular draft space S.

With a flame produced within the bore 1a of the lower water heating section 1 as by the gas burner G of Fig. 2, that bore as well as the interior of the cap-like upper section together constitute the combustion chamber of the appliance, and by providing the said radial gas ducts D and D¹ I cause the hot gases to engage the entire exterior as well as the interior face of the said upper section 10. However, if the cap-top portion of this upper section were imperforate, so that all of the combustion gases would have to flow through the said gas ducts, a part of such gases would collect under the said cap top when the flame is turned low (as for example by the action of a control mechanism operated by a thermostat at a distance from my appliance), so that heavier constituents of these accumulated or pocketed gases would then descend to smother the flame.

To avoid this I also provide an upright gas duct U extending through the hollow top portion of the cap-like upper water heating section and leading to the said upper draft space S¹, this upright duct being preferably coaxial with the said section and also with a tubular draft outlet collar C formed on the top of the draft shell 11. This upright duct U preferably has its bore area a quite small fraction of the total area of the radial gas ducts G and G¹, so that only a quite small portion of the combustion gases will flow directly upward through that duct, while by far the greater part of such gases will flow through the radial ducts D and D¹, then upwards in the tubular draft space S and thereafter radially inward within the upper draft space S¹.

To furnish steam also, I dispose a boiler B within the upper portion of the said combustion chamber and desirably support this boiler coaxial with that chamber but freely spaced (by a relatively short distance) both from the bottom of the cap portion of the upper water heating section and from the riser bore wall 10a of that section. This boiler can conveniently be supported by horizontal water pipes 12 and 13 connected to the lower portion of the boiler at the same elevation, which pipes extend respectively through aligned gas ducts D (as shown in Fig. 7) and each of which seats on the bottom of the bore through which it extends.

To permit a convenient assembly for this purpose, I initially weld two pipe flanges F (Fig. 3) to suitably positioned lower side portions of the boiler in axial alignment with perforations 14 in the boiler side, and also provide the draft shell 11 at a suitable elevation with two perforations 15 corresponding in their bores to the outside diameters of the said pipes. I also screw to the top of the boiler a riser pipe 16. Then, before the upper water-heating section and the said draft shell are set down on the lower section, and while the said upper section is disposed with its axis horizontal, I insert the boiler B within the bore of the upper section so that the said steam pipe extends through the upright gas duct U.

The outwardly projecting part of the steam pipe can then be gripped by any suitable means to

support this pipe and the boiler, with the boiler at a slightly higher elevation than shown in Fig. 2 when the upper section is set down on the lower section. When the draft shell 11 then is also set into position and rotated so that each shell opening 15 aligns both with one of the upper horizontal gas ducts D and with one of the said pipe flanges F, the several supporting pipes, such as 12 and 13 can readily be inserted from the exterior of the said shell and screwed into the corresponding flange. The temporary means for supporting the riser (or main) steam pipe 16 are then relaxed until the said boiler-supporting pipes 12 and 13 rest on the bores of the gas ducts through which they extend, so as to support the boiler thereafter.

Fitted upon the riser collar C on the draft shell 11 is a header H which has a lateral outlet collar 17 fitted to a flue-pipe 18, as shown in Fig. 7. This header has its top provided with a collar h through which the main steam pipe 16 extends and to which the exterior of that pipe is sealed, and the exterior connections to this main steam pipe preferably include at least one pipe coil 19 extending through the upper (or cap top) portion of the upper water section. Thus the drawings show two such coiled branch steam pipes 19, each leading from the main steam pipe downwardly into the top of the said upper water section, and each having its outlet portion extending through a side wall of that section at a relatively lower level so that each such coil slopes continuously downward.

The upper water section has an inlet pipe 20 (Fig. 2) leading to its lower portion and a discharge pipe 21 leading upwardly from its upper portion, and a sheathing 22 of heat-insulating material houses the outer riser sides of the lower water section and the draft shell as well as the top of that shell, this sheathing being desirably protected against mechanical injury by an outer metal casing 23 through which the numerous inlet and outlet pipes extend.

For economically utilizing substantially all of the heat of the flame produced by a burner in the lower part of the combustion chamber, I preferably make the upper water section of much larger water capacity than the lower section and also make the said upper section much taller than the lower section. With the various parts proportioned approximately as shown in Fig. 2, I have obtained the following results:

Since the flame F does not directly impinge against a considerable portion (if any) of the height of the lower section I, so that the latter is warmed only by the general heat in the combustion chamber and by radiation from metal parts of the burner, the water W in this lower section is warmed only to the moderate degree suitable for use in kitchens and bath rooms, while the upper portion of the water in the upper section 10 is raised to its boiling point so as to be highly suitable for use in ordinary hot water radiators.

When my appliance has cooled—as at night in a home—the effective resumption of its action speedily raises steam in the boiler B, since the latter is disposed in the upper and hottest part of the combustion chamber and has substantially its entire exterior exposed to the hot gases. Consequently, steam flowing through the pipe coils 19 in the upper water section also quickly raises the temperature of water in that section so as to start a circulation of hot water to hot water radiators H (such as the one shown in Fig. 1) to which the outlet pipe 21 of the said upper section is connected.

However, when thus disposed for raising steam quickly, the boiler will need to have a considerable steam-generating capacity in excess of that needed for additionally warming the water in the upper water section, so that a large portion of the steam would be emitted through the usual safety valve V. To utilize this excess of steam economically in a residence building or the like, I desirably connect the main steam pipe 16 also to steam-heated radiators of much less total radiating capacity than the hot-water radiators, as for example by using such steam-heated hot-water radiators H¹ (namely radiators filled with hot water and each heated by a steam pipe extending through its lower portion).

For efficient use, each such steam-heated hot water radiator H¹ desirably also has its main and water-filled portion connected to the upper water-heating section, so that water warmed in that section will flow along the dot-dash line h in Fig. 1 into one end of the radiator H¹ and rise in the entry end of that radiator, thereby forcing cooler water out of the other end of the radiator into a water return pipe R connected to the inlet pipe 20 which leads to the lower portion of the upper water section. At the same time, steam flowing from the main steam pipe 16 along the dash-dot line St flows through a pipe immersed in the lower part of the water in the said radiator H¹, and the condensate of this steam flows back to the lower portion of the boiler along the dash-dot line R through one of the boiler-supporting pipes (12).

In practice, and with ordinary hot water radiators used for five-sixths of the radiator capacity, my above disclosed appliance has shown the following results:

Since the boiler overhangs the flame and is in the upper portion of the combustion chamber, to which the hottest combustion gases speedily rise, and since this boiler has its entire exterior exposed to these hot gases, steam can be generated within a few minutes after a hot flame is started. This steam thereupon promptly starts warming the water in the steam-heated hot water radiators H¹, and part of the steam also warms the water in the top part of the upper water section 10 so that a portion of the thereby heated water issues into the ordinary hot water radiator to start warming the latter also. Consequently, the heating effect in an entire home or the like can be started (even in quite cold weather) within an unusually short time. At the same time, the water in the lower compartment is heated, both by direct radiation from the burner and by the general heat in the combustion chamber, so that this stores up hot water for domestic uses.

With the fuel supply controlled through a thermostatic regulator in a suitable portion of the house, a throttling of the flame by the action of the regulator leaves the upper water section still filled with hot water so that convection currents will continually replenish the cooling water in the hot water radiators for a long period of time, thus effectively utilizing the stored heat.

Since the entire interior as well as exterior of the cap-like upper section is exposed to the combustion gases, and with the radial (over all) thickness of the riser portion of this section quite small in proportion to its height, as shown in Fig. 2, the transfer of heat to water in that section through the large surface areas exposed to these gases is so effective that the flue pipe 18 would be heated only to about 110 degrees,

even with the burner fully operating, if the main steam pipe 16 did not extend through the header H to increase the temperature of the combustion gases emitted by my appliance. However, with a part of this pipe extending both through the upright combustion gas duct U and through the said header, the flue pipe temperature was raised to about 185 degrees, which usually suffices for producing an adequate stack draft and which is only about half the temperature commonly found in the lower portion of a chimney with the heretofore used heating appliances of the same general class.

Moreover, the initially separate manufacture of the main constituent parts (shown separately in Figs. 4 to 7) and the ease of assembling these greatly reduces the total manufacturing cost. So also, since only the boiler is subjected to the hottest combustion gases, this alone needs to be of a non-corrosive metal, while both of the water-heating sections as well as the draft shell can be of steel, and the comparatively small size of the boiler section as well as the simplicity of that section makes its cost a modest one.

During the warmer months of the year, the valves 24 and 25 (Fig. 1) which respectively control the supply of water and of steam to the radiators are shut off, as is also a valve 30 through which cold water from the radiators returns to the upper water section. Likewise, the valve 26 in the pipe 28 connecting the upper portion of the lower section 1 with the lower portion of the upper water-heating section 10 is opened, as also a valve 29 leading from the upper water outlet pipe 21, which last named valve is closed in the winter. These two sections then operate as a single unit for supplying the needed domestic water (through pipe connections not here illustrated, but which can readily be made by any steam fitter) during the months when a low operation of the burner suffices.

When my appliance is to be used with oil as a burner, I construct the lower part of the appliance substantially as shown in Fig. 11, namely with an oil burner 27 projecting the air and oil into the lower portion of the bore of that chamber, and in this case I provide the said bore with a lining of refractory material 28 to prevent the steel of the bore wall 1a of that section from being corroded by moisture in the oil and air. However, when the oil burner has its axis considerably below the midheight of such a lower section, this lining desirably does not extend for the full height of the said bore, so as to expose the upper part of this bore directly to some of the hot combustion gases, as also shown in Fig. 11.

Regardless of the nature of the fluid fuel, I also provide a drain outlet 32 leading from the lower portion of the tubular draft space S, for draining off the condensate resulting from the cooling of the moisture content of combustion gases in the said space, which would otherwise collect in that space.

Since the co-operative action of all parts of my appliance above the top of the (annular) lower water-heating section would also occur if that section were merely an annulus of fire-brick or the like (as should be understood without further illustration), many of the advantages of my appliance could also be obtained without utilizing this lower (burner-housing) part for heating water in addition to that which fills the upper section. Hence I do not wish to be limited to the conjoint use of the water-heating capacity

of this lower section along with what is above that section.

So also, while I have illustrated and described my triple-service water heater and boiler in connection with illustrations showing such an appliance with its various parts proportioned for having five-sixths of the radiator of an ordinary hot water radiator type, I do not wish to be limited either in this respect or to other details of my present disclosure, since many changes might obviously be made without departing either from the spirit of my invention or from the appended claims.

I claim as my invention:

1. A heating appliance for heating water and for converting a relatively smaller quantity of water into steam, comprising a normally completely water-filled cap-shaped section of greater height than diameter; an upright tubular member on which the said section is seated, the bore of the said member and of the said section conjointly forming the combustion chamber of the appliance; means for producing a flame of fluid fuel within the bore of the said member; a cap-like draft shell freely housing and coaxial with the said section to afford an upright tubular draft space around the outer riser wall of the said section, as well as an upper draft space above the said section into which the said upper space opens; the cap-side portion of the said section having combustion gas passages leading from the bore of that section to the said tubular draft space, and the draft shell having a combustion gas outlet in its top; and a steam boiler supported within the upper portion of the bore of the said section and freely spaced from the latter.
2. A heating appliance as per claim 1, in which the said ducts are distributed uniformly about the upright axis of the said section.
3. A heating appliance as per claim 1, in which the said ducts are distributed uniformly about the upright axis of the said section, and in which the said ducts comprise two sets disposed at relatively different elevations, the ducts of the said sets being in relatively staggered relation.
4. A heating appliance as per claim 1, in which the said ducts are distributed uniformly about the upright axis of the said section and are all below the mid-height of the boiler.
5. A heating appliance as per claim 1, in which the cap-top portion of the said section also has an upright combustion gas duct extending through it, and in which the appliance includes a main steam pipe extending freely upwardly through the said upright duct and through the said combustion gas outlet.
6. A heating appliance as per claim 1, including a drain pipe leading from the lower portion of the said tubular draft space, through which condensate within that space can be drained off.
7. A heating appliance as per claim 1, including a steam pipe system leading from the top of the boiler, the said system including at least one branch pipe extending through the water in the cap-top portion of the said section for expediting the heating of the water in the upper portion of that section.
8. A heating appliance as per claim 1, including a steam pipe system leading from the top of the boiler, the said system including at least one branch pipe extending through the water in the cap-top portion of the said section for expediting the heating of the water in the upper portion of that section, the said branch pipe having a coiled

portion disposed within the said cap-top portion and sloping continuously downward toward its outlet end.

9. A heating appliance as per claim 1, including a vent cap fitted upon the said top outlet of the draft casing and having a flue connection in a side thereof, and also including a main steam pipe extending upwardly from the top of the boiler through the said top outlet and vent cap, the said pipe being sealed to the top of the vent cap and the portion of the pipe within the vent cap serving for increasing the temperature of the gases passing through the vent cap.

10. A heating appliance as per claim 1, plural boiler-supporting members fastened to relatively low side portions of the boiler, each of the said members extending into and being seated on the bottom of one of the combustion gas passages which lead to the said tubular draft space.

11. A heating appliance as per claim 1, plural boiler-supporting members fastened to relatively low side portions of the boiler, each of the said members extending into and being seated on the bottom of one of the combustion gas passages which lead to the said tubular draft space, at least one of the said members being a supply pipe through which water is supplied to the boiler.

12. A heating appliance as per claim 1, in which the bottom of the boiler is above the mid-height of the boiler.

13. A heating appliance as per claim 1, including a hot water outlet pipe extending upwardly from the top of the said water-filled section through the adjacent draft space and the said shell, and a hot water inlet pipe leading laterally through the said shell to the lower portion of the said section.

14. A heating appliance for affording a supply of steam together with supplies of water at two different temperatures, comprising in axially vertical alinement a lower and axially upright annular water-heating section and an upper cap-like water heating section superposed upon the said lower section, the bore of the lower section together with the space housed by the upper section serving conjointly as the combustion chamber of the appliance; means for producing a flame

of fluid fuel within the bore of the said lower section; a cap-like draft shell coaxial with and freely housing the said upper section to afford a draft space therebetween, and said shell having a combustion gas outlet in its top; the upper section having horizontal combustion gas ducts leading from the interior of its cap-side portion to the space between that portion and the draft shell, and the upper section also having an upright combustion gas duct extending through its cap-top portion; and a steam-generating boiler supported within the upper part of the said combustion chamber, the said boiler being freely spaced from both the cap-top portion and the cap-side riser portion of the said upper section.

15. A heating appliance as per claim 14, including a water pipe connecting the upper portion of the lower section with the lower portion of the upper section, and a valve accessible from the exterior of the appliance for controlling the flow of water through the said pipe.

16. A heating appliance as per claim 14, in which the inner riser walls of the upper and lower sections aline with each other, and in which the outer riser wall of the lower section is of greater diameter than that of the upper section, so that the top of the said lower section includes an annular portion underhanging the draft space into which the horizontal gas ducts open.

17. A heating appliance as per claim 14, in which the inner riser walls of the upper and lower sections aline with each other, and in which the outer riser wall of the lower section is of greater diameter than that of the upper section, so that the top of the said lower section includes an annular portion underhanging the draft space into which the horizontal gas ducts open; and in which the lower end of the draft shell is seated upon and sealed to the top of the lower section.

18. A heating appliance as per claim 14, including a filler pipe including two portions respectively leading to the lower portions of the lower section and of the boiler, and also including a riser pipe connecting the aforesaid two pipe portions; and a valve controlling the flow of water through the said riser pipe.

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