Dec. 28, 1937. D. J. MOSSHART 2,103,789

DOMESTIC HEATER

Filed Sept. 30, 1935 6 Sheets-Sheet 1

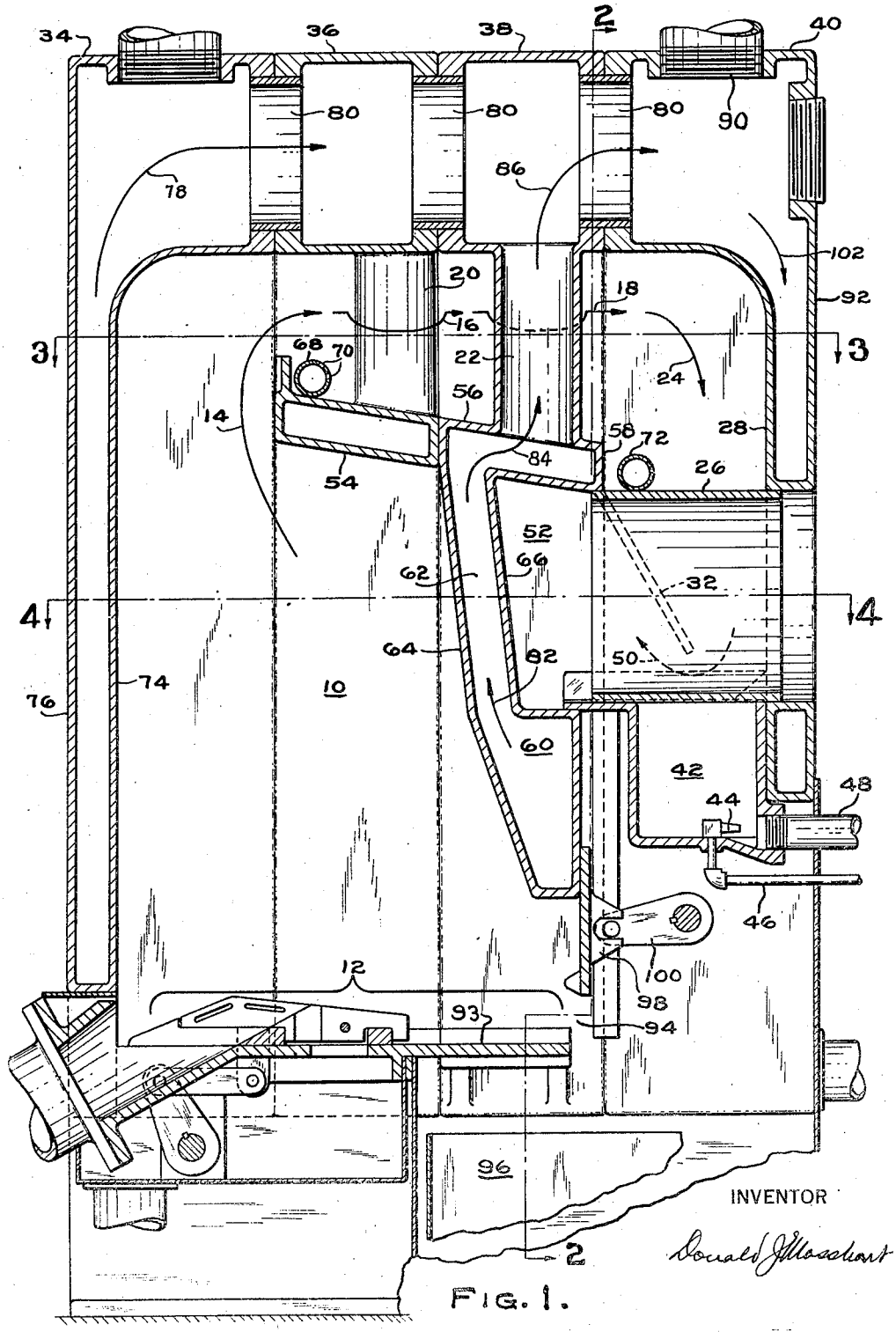


FIG. 1.

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DOMESTIC HEATER

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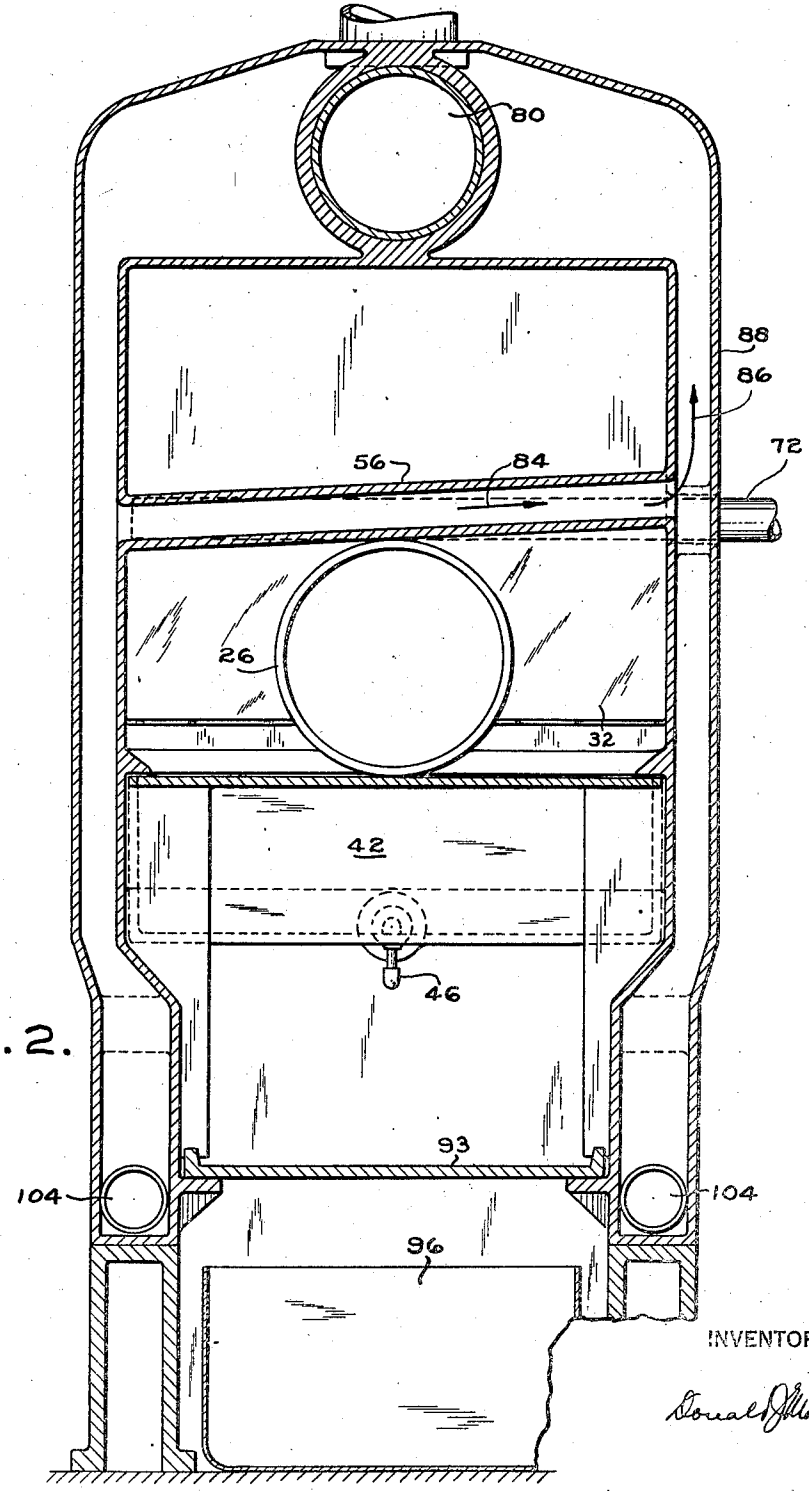


FIG. 2.

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DOMESTIC HEATER

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FIG. 4.

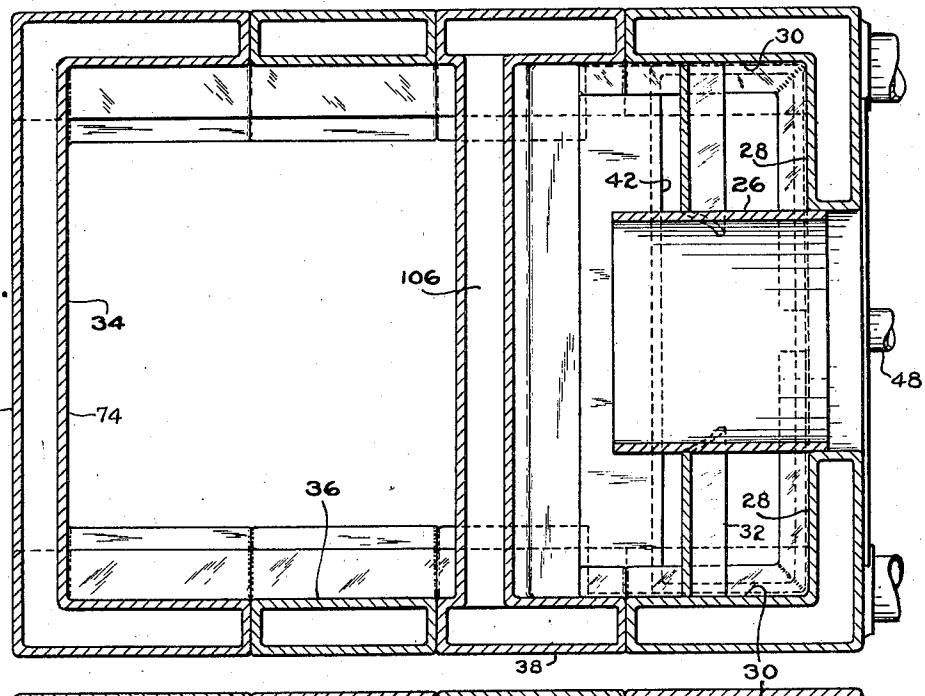
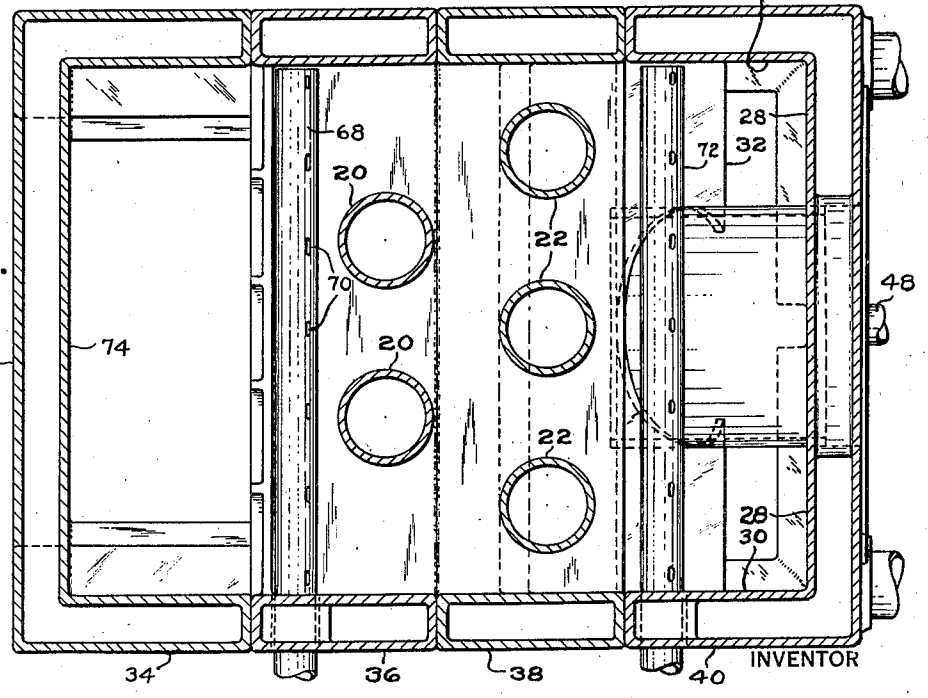


FIG. 3.



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DOMESTIC HEATER

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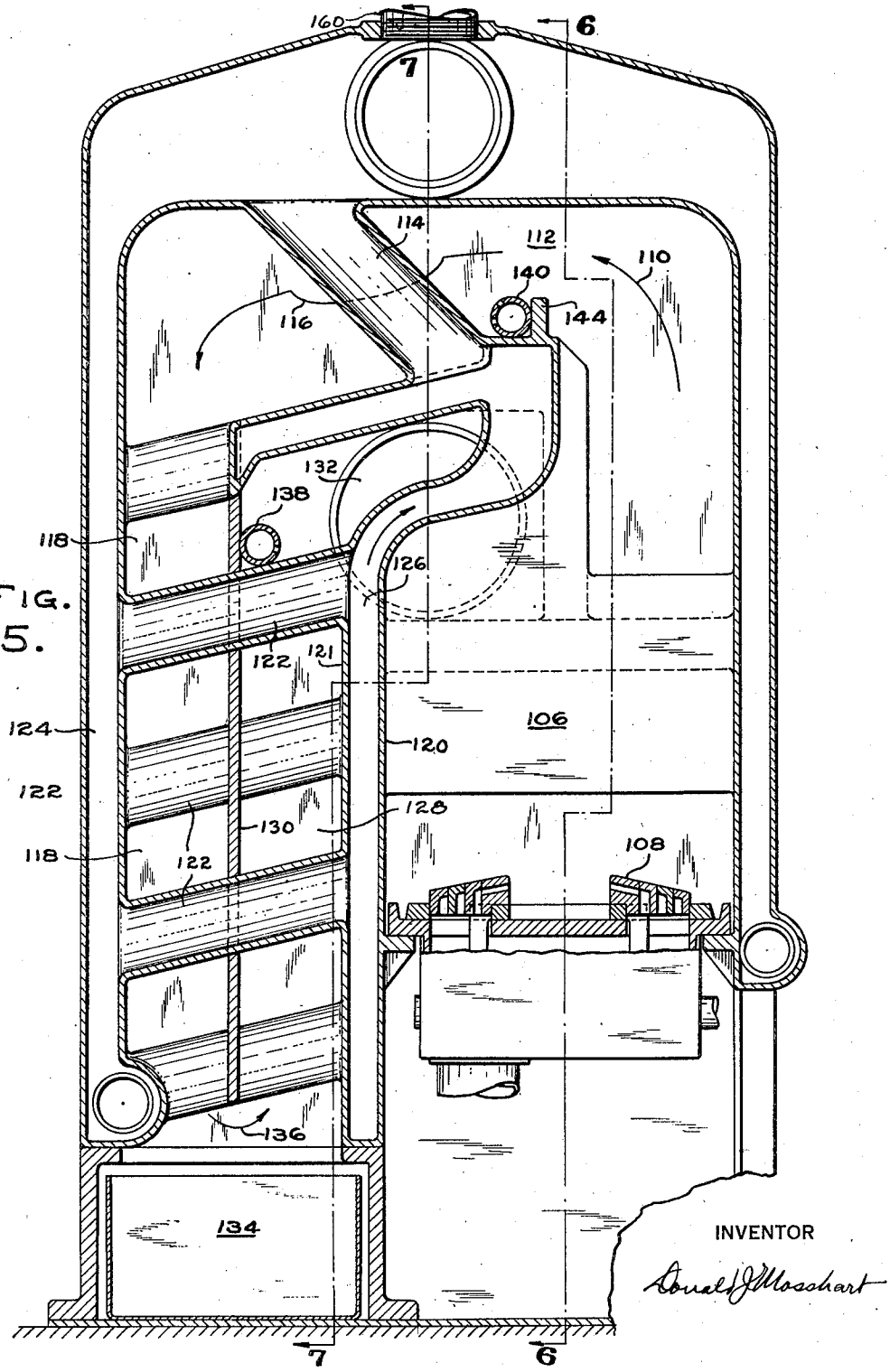


FIG. 5.

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DOMESTIC HEATER

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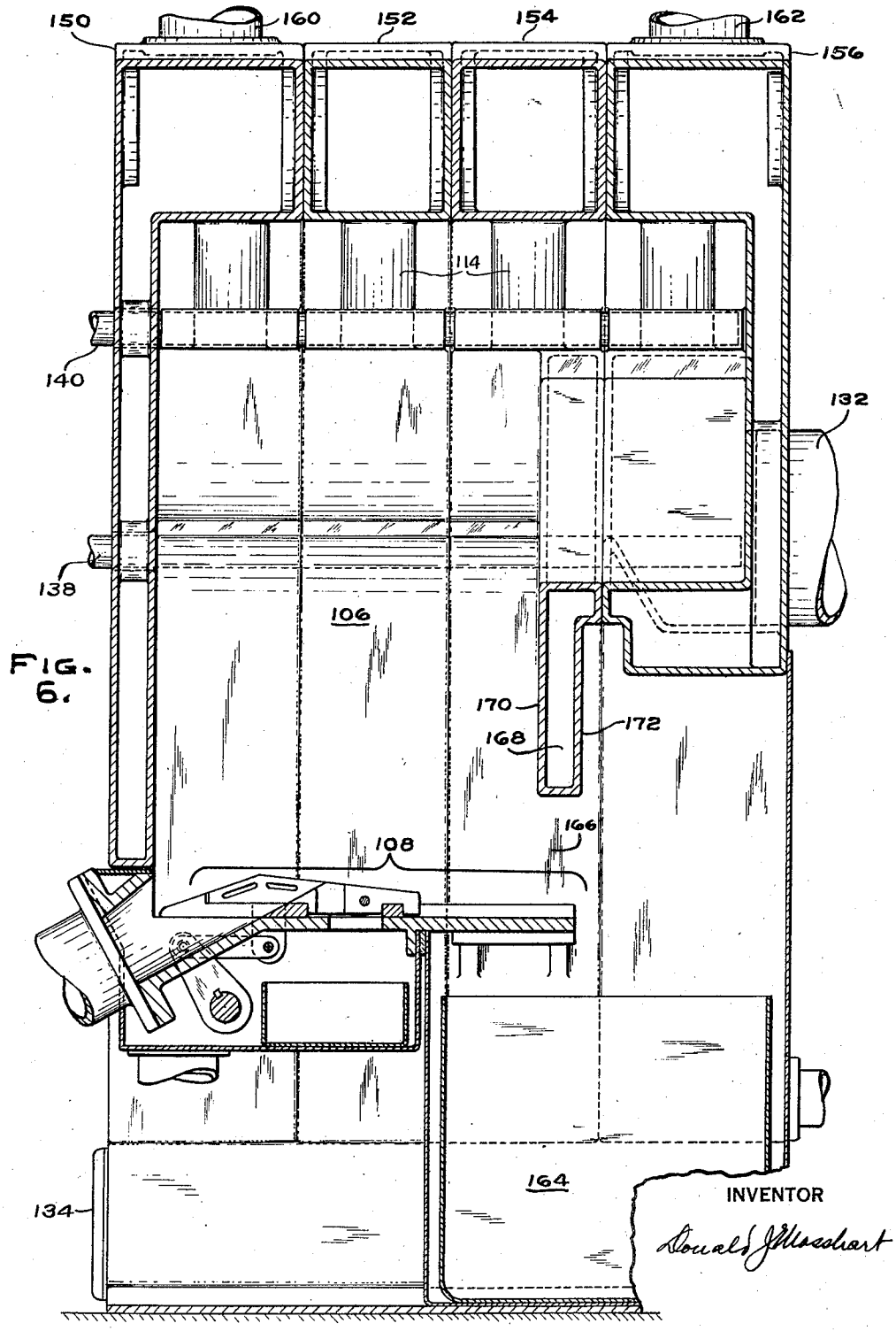


FIG. 6.

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DOMESTIC HEATER

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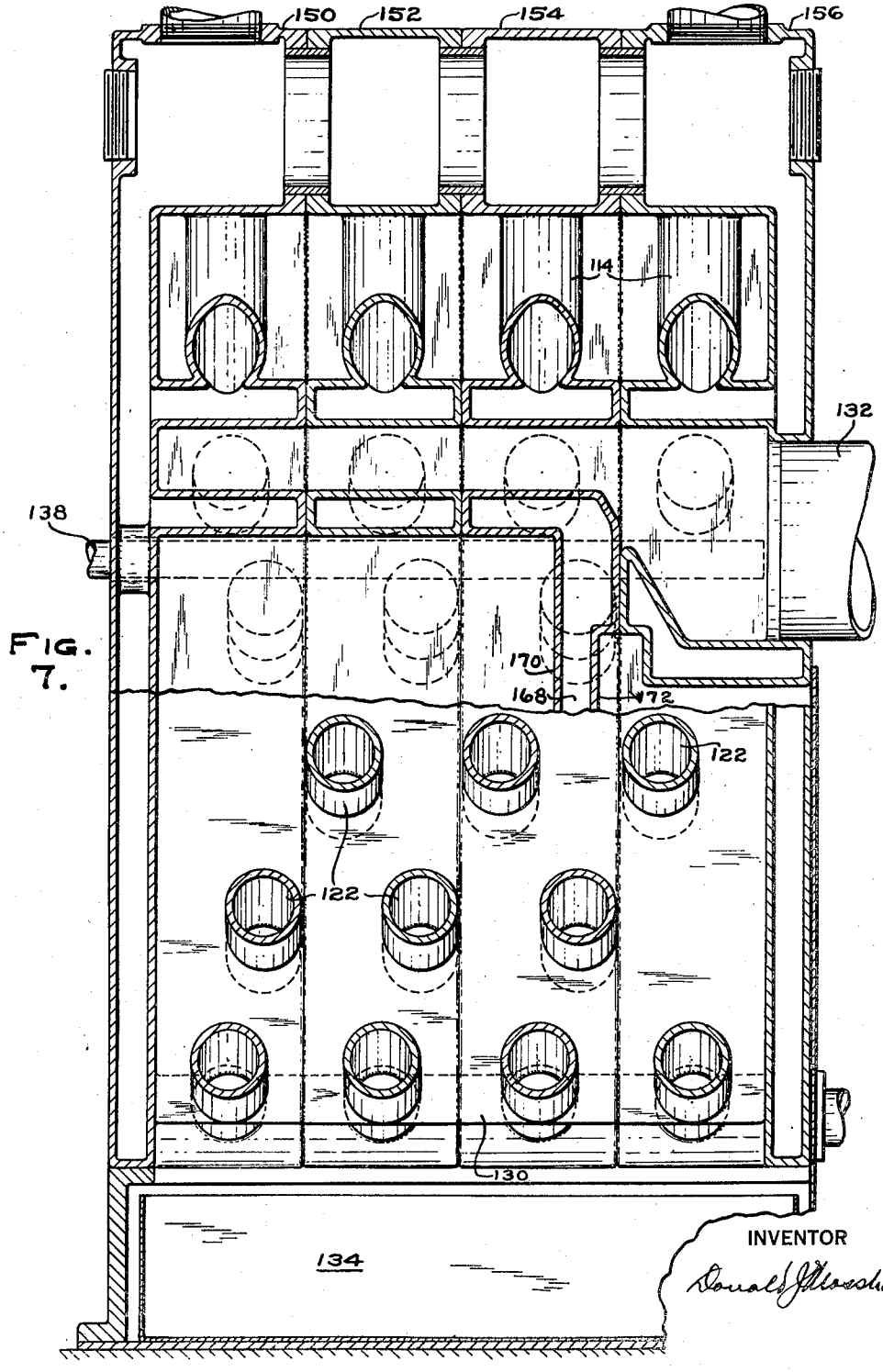


FIG. 7.

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Patented Dec. 28, 1937 2,103,789

UNITED STATES PATENT OFFICE

2,103,789

DOMESTIC HEATER

Donald J. Mosshart, Springfield, Pa., assignor of one-half to Harold F. Hildreth, Mansfield, Ohio

Application September 30, 1935, Serial No. 42,787

13 Claims. (Cl. 122—225)

This invention relates to fluid heat exchange apparatus, and more particularly to fluid heaters of the domestic type, such, for example, as sectional cast iron boilers.

According to one form of my invention, I provide a fluid heater in which a furnace combustion chamber is enclosed by hollow metallic sections which not only promote effective transfer of heat to the enclosed fluid, but provide such a combustion chamber and flue construction that low cost fuels can be employed to advantage.

It is an object of the invention to provide a heater of the type referred to above, in the operation of which the furnace gases move in such a path that the separation and removal of fly ash within the heater is facilitated and ash pick up by the furnace gases minimized.

A further object of the invention is to provide a furnace and fluid heater in which there is an increased amount of heat absorption by convection in gas pass zones beyond a radiant absorption zone. The latter is provided by the combustion chamber, and the convection absorption takes place mainly in a plurality of gas passes beyond the combustion chamber and communicating therewith.

A more specific object is the provision of a fluid heater of the domestic type, in which the furnace gases are exhausted therefrom at a central position so related to the gas passes that the latter may be said to have a spiral, or cyclone action around their point of exit from the heater.

Again, the invention comprehends a fly ash collection zone substantially tangentially related to the cyclone movement of the furnace gases to the end that the cyclone movement promotes ash deposition and minimizes ash pick up.

Other objects of the invention will appear from the following description which has reference to the attached drawings.

In the drawings:

Fig. 1 is a vertical section through one embodiment of the invention selected here for the purposes of illustration.

Fig. 2 is a transverse section taken on the section line 2—2 of Fig. 1.

Fig. 3 is a horizontal section of the boiler shown in Fig. 1, taken on the line 3—3 of Fig. 1.

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 1.

Fig. 5 is a vertical section through another embodiment of the invention.

Fig. 6 is a vertical section taken transversely of the section shown in Fig. 5 and on the line 6—6 of Fig. 5.

Fig. 7 is a transverse vertical section of the Fig. 5 embodiment taken on the line 7—7 of Fig. 5.

In the drawings I have chosen to show my invention as embodied in a cast iron sectional boiler suitable for domestic use, but it is to be observed, however, that insofar as certain of the broader aspects of my invention are concerned, it may be embodied in other types of heaters of modified construction, for example, certain features of my invention may be embodied in both hot water and hot air heaters of various types.

Referring to the boiler shown in Fig. 1 of the drawings, the furnace having a combustion chamber 10 may be fired by a stoker 12 preferably constructed in accordance with the teachings of the inventions described in my co-pending application Ser. No. 17,162 filed on April 19, 1935 and having the title Combustion apparatus. This stoker is equipped with suitable means to provide a forced draft to increase the rate of combustion of the fuel often resulting in the delivery of fly ash to the flues. The combustion chamber has a top outlet, and the furnace gases proceed under the forced draft through this outlet as indicated by the arrow 14. They then continue substantially horizontally as indicated by the arrows 16 and 18 around and in between upright water circulating parts of the boiler 20 and 22. Thence they proceed downwardly as indicated by the arrow 24. In their downward course they are caused to turn about a flue construction 26 which is interposed with reference to the second gas pass. These turns of the gases, in conjunction with their attendant loss in velocity, cause fly ash particles to be projected against the walls 28 and 30 of the first gas pass and thereby promote their separation from the gases.

The flue construction 26 is circular in cross section as indicated in Fig. 2 and it is embraced by a downwardly extending baffle 32 which is indicated in dotted lines in Fig. 1. The configuration of this baffle is illustrated in Figs. 3 and 4 wherein the baffle is shown as extending from the upper side of the flue construction 26 to a position below its center. In this case the baffle is placed in position around the flue 26 before the boiler sections 34, 36, 38, and 40 are secured together in their operative positions.

In conjunction with the rear wall 28 of the boiler the baffle 32 forms a downwardly tapering gas pass below which there is a fly ash receiving zone wherein the fly ash may be collected in a chamber 42, or discharged from that chamber by a fluid nozzle 44 supplied with a

fluid under pressure by a fluid pressure line 46 and discharging into a conduit 48. When such fluid operated ash discharge means is not used the fly ash may be collected in a removable receiver which may conveniently slide into the chamber 42.

The fly ash receiving chamber is advantageously located in a position somewhat tangential to the turn of the furnace gases around the lower end of the baffle 32 indicated by the arrow 50. Thus, there is an additional turn of the gases which promotes fly ash collection in the chamber 42. The arrangement of elements causing this gas travel also minimizes fly ash pick-up adjacent the collection zone.

After passing around the lower end of the baffle 32 the gases pass upwardly underneath the baffle and into the discharge chamber 52 which communicates with the gas outlet formed by the flue construction 26.

In connection with the above described movement of the furnace gases it will be noted that they may have several turns about the elements 20 and 22, to further promote ash deposition. It will also be noted that the general flow of the gases is first around the exterior of the gas confining passages of the boiler and then into the interior location provided by the chamber 52. This arrangement results in a substantially spiral, or cyclonic gas flow which promotes complete combustion and minimizes the quantity of fly ash discharged by the furnace gases into the atmosphere.

Fly ash deposits upon the surface forming the gas passes may be periodically removed by flushing them into the chamber 42. To this end, the lower wall 56 of the horizontal section of the first gas pass above the combustion chamber 10 slopes downwardly, as shown in Fig. 1, towards the flue construction 26. These sloping surfaces are provided by transverse parts of the boiler sections 36 and 38. The latter is indicated at 54 and it will be noted that the lower walls of this transverse portion form a part of the roof of the combustion chamber 10 while the upper walls form the lower rearwardly sloping surface of the upper part of the first gas pass. This sloping wall is substantially continuous with the upper wall 56 of a transverse part of the section 38 and it will be understood that this sloping surface continues around the connecting portions 20 and 22. It terminates at a position rearwardly of the forward end of the flue construction 26, as indicated at 58. In this connection it will be seen that the transverse connection portion of the section 38 also forms chambers 60 and 62, the forward wall 64 of which constitutes a part of the water cooled wall surface of the combustion chamber while the rearward wall 66 forms a wall of the gas outlet chamber 52.

The fly ash deposits upon the forward surfaces of the first gas pass may be removed by fluid streams emerging from the pipe 68 which is connected externally of the boiler with a source of fluid under pressure. When water is used for this purpose it discharges through openings 70 in the pipe 68 and causes the ash deposits to be sluiced into the rearward part of the first gas pass and over the flue construction 26, and into the ash receiving chamber 42. Ash deposits in the rearward part of the first gas pass and on the surfaces of the baffle 32 and the flue 26 may be removed by fluid streams emerging through openings in the tube 72 which, like the tube 68, is connected to a source of fluid under pressure. Because of the fact that the gas passes are arranged as shown, the fly ash deposits on the walls of the gas passes may be removed while the boiler is in operation, and without interrupting the continuous burning of fuel in the combustion chamber 10.

A relatively high degree of radiantly transmitted heat is absorbed by the water or other fluid in the boiler sections 34, 36, and 38 in a radiant heat absorption zone around the combustion chamber 10. To this end, and to prevent the burning out of furnace portions adjacent the stoker 12, the walls of the furnace chamber are all water cooled. The front wall 74 is indicated in Fig. 1 as a part of the boiler section 34 which is hollow as shown. This section not only includes the wall 74 but a parallel outer wall 76 permitting water to continuously move upwardly along the front wall of the furnace and to move in the direction of the arrow 78 through one of the openings 80 which connect the boiler sections at the top of the boiler. The rearward wall of the furnace is formed by the parts of the boiler section 38 which include the chambers 60 and 62. Through these chambers water moves continuously upward to the top of the rear section 40 of the boiler. The flow of water in this case is indicated by the arrows 82, 84 and 86. This part of the circulation of the water is promoted by the inclination of the transverse connection portion of the boiler section 38 as it is indicated in Fig. 2 of the drawings. This view, in connection with Fig. 1 shows that the surface 56 provided by this connection portion not only slopes rearwardly of the boiler toward the ultimate gas discharge in the flue construction 26 but also slopes upwardly as shown toward the boiler wall 88.

In connection with the flow of gases in the first gas pass and the flow of water or other fluid as indicated by the arrows 82 and 84, it will be seen that there is a counterflow relation, the gases moving generally downward to a position below the lower end of the baffle 32, and the contained fluid flowing upwardly along the walls of the gas pass and toward the boiler outlet 90 which may be connected with the heating system of a dwelling or other building.

The boiler sections also form water cooled side walls for the furnace, as clearly indicated in Figs. 3 and 4. In the former figure the positions of the upright fluid circulating parts of the sections 36 and 38 are well indicated. The portions here referred to are those indicated at 20 and 22. The rear wall of the boiler is water cooled by fluid circulation between the walls 28 and 92 of the rear boiler section 40.

In the operation of the stoker 12 a fuel bed is moved rearwardly of the furnace along its floor 93 and through an opening 94 through which ash may be discharged into an ash receiver 96, the continuous and advantageous burning of a low cost fuel being facilitated by the action of the stoker and the action of the elements 98 and 100 on clinker formed by the fuel.

The circulation of fluid within the boiler may be such that there is a downward movement in the rear section 40 as indicated by the arrow 102. Water or other fluid moving downwardly at this position is supplied to the other sections of the boiler through connecting passages 104 formed at the lower parts of the boiler sections, and positioned as indicated in Fig. 2.

The upright fluid connectors 22 communicate with the side wall fluid passages of the boiler

section 38 through the transverse connectors having an upper water wall 56 and a rear wall 58. The transverse passage formed thereby is indicated at 106 in Fig. 4.

In the embodiment of the invention indicated in Fig. 5 of the drawings, the combustion chamber 106, fired by the stoker 108 is positioned at one side of the boiler, and the gases rise upwardly and make a turn indicated by the arrow 110, in proceeding through the combustion chamber outlet 112. From this point they proceed around the inclined fluid circulation passages 114 as indicated by the arrow 116. After the second turn they pass downwardly through a part of the first gas pass 118 which is preferably spaced from the wall 120 of the combustion chamber. In passing downwardly through this gas pass the gases are divided so that they turn and pass around tubular connections 122, forming inclined water passages connecting the downward water flow in the passage 124 to the upward water flow and passage 126 which is formed between the wall 120 and other wall 121 formed in the boiler sections.

The first gas pass 118 is separated from the second gas pass 128 by an upright baffle 130 which terminates above a fly ash receptacle 134. The gases pass around the lower end of this baffle 130 and then upwardly through the second pass 128. From the outlet of the latter the gases proceed to a flue 132. It will thus be seen that the gas flow in this embodiment of the invention is similar to the gas flow in the Fig. 1 embodiment, at least to the extent that there is a generally spiral, or cyclonic gas flow with the last gas pass and the ultimate gas outlet enveloped or embraced by the first gas pass which is generally U-shaped. Thus, effectively complete combustion is promoted without increasing fly ash pick-up. Also, relatively complete fly ash deposition and collection within the receiver 134 is promoted by the location of the receiver at the bottom of the downward gas pass 118, and its arrangement whereby it is substantially tangentially arranged with reference to the turn of the gases at the bottom of the second gas pass, as indicated by the arrow 136.

It will also be seen, in connection with the embodiment of the invention shown in Figs. 5, 6, and 7 that provision is made for the sluicing of fly ash deposits while the furnace is in operation. The means for accomplishing this is similar to that shown in connection with the Fig. 1 embodiment, and it includes the water spray tubes 138 and 140 connected with a source of fluid under pressure, and so positioned with reference to the inclined surfaces provided by the walls of the passages 122 and other surfaces in the gas passes that all of the water used for ash removal, and the deposited ashes are sluiced into the chamber 134. The upper tube 140 may be held in position by an upward wall extension 144, which also prevents the sluicing water or other fluid from flowing into the combustion chamber 106.

In general, the boiler of the embodiment indicated in Figs. 5, 6, and 7 is a sectional boiler such as that indicated in the other embodiment. The extent of these sections is clearly indicated in Figs. 6 and 7, the sections being designated by the numerals 150, 152, 154, and 156. The walls of the combustion chamber of this embodiment are water cooled by reason of the hollow construction of these sections, and the furnace is fired by a stoker 108, similar to the stoker mechanism used in connection with the Fig. 1 embodiment.

As a result of the spiral movement of the gases, fly-ash and dust carried in suspension by the gases are thrown by centrifugal force to the outer walls of the gas passes, and the particles thus thrown against the rear wall of the down pass are moved directly toward the ash receiving zone by gravity and the movement of the gases. Forwardly of this zone, and toward the gas pass, the gases make a sharp turn so that gravity, loss of velocity, and centrifugal force further promote separation of the solid particles, and their collection in the receiving zone. An important feature of this construction is that the ash particles separated from the stream move to the outside walls of the gas passes and enter the ash receiving means without again entering the stream.

Referring again to its circulation and heat absorption features, the illustrative boiler includes connected boiler sections forming a water circulation system which presents zones of primary and secondary heat absorption characteristics. In the primary zone, immediately adjacent the furnace walls, the water receives its heat directly from the fire by radiation and convection. This is the more active part of the boiler and it includes water uptake passages around the combustion chamber, with a steam liberation space above. The boiler surfaces and the water passages (including additional downcomer passages) are so arranged that water heated in the more active part of the boiler can rise directly to the steam liberating space. Water heated in the more active zone is replaced by cooler water flowing from a less active boiler part (convection heated) directly to the lower portion of the more active zone.

The less active portion of the boiler receives heat from the cooler products of combustion, mainly by convection. It acts somewhat as an economizer section, and the water passages connect this section to the more active boiler section so that the combined effect of heating the water at different rates in the two sections and directing the flow through the sections produces a positive unidirectional flow through each section. "Priming" and "water hammer", and their deleterious effects are thereby prevented.

The illustrative boiler may be connected to the heating units of a domestic heating system by means of such tubular conduits as those indicated in Fig. 6 at 160 and 162. They communicate with the fluid circulating space of the boiler, and when the boiler is used in a steam heating system they are in communication with the steam liberation space.

In further reference to the Fig. 6 boiler, it is to be noted that there is a receiver 164 positioned below the stoker and the ash exit opening 166 at the rear of the stoker. Above this opening, there is a transverse heating fluid chamber 168 formed preferably as an integral part of the furnace section 154 which includes the water cooled wall 170. Mechanisms similar to that shown at 98 and 100 in Fig. 1 may be employed at a position adjacent the rear wall 172 of the chamber 168.

While I have shown my invention in but two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior

art or as are specifically set forth in the appended claims.

What is claimed is:

1. In a domestic fluid heater, in combination, water cooled walls including side walls, a front wall and a back wall, a transverse wall extending from side to side and forming with the front and parts of the side walls a combustion chamber, a deflector wall extending forwardly and rearwardly from the top of said transverse wall, a top wall spaced from said deflector and defining with it a substantially horizontal gas pass, a flue extending through said rear wall below said deflector wall level and forward toward said transverse wall, a baffle depending from the rear edge of said deflector wall, being pierced by said flue and defining with the back wall a substantially vertical downward gas pass, gas from the last mentioned pass entering said flue after turning sharply beneath said baffle and a fly-ash receiving zone below the lower edge of said baffle and substantially tangential to the direction of gas flow at said turning.

2. In a domestic fluid heater, in combination, water cooled walls including side walls, a front wall and a back wall, a transverse wall extending from side to side and forming with the front and parts of the side walls a combustion chamber, a deflector wall extending forwardly and rearwardly from the top of said transverse wall, a top wall spaced from said deflector and defining with it a substantially horizontal gas pass, a flue extending through said rear wall below said deflector wall level and forward toward said transverse wall, a baffle depending from the rear edge of said deflector wall, being pierced by said flue and defining with the back wall a substantially vertical downward gas pass, gas from the last mentioned pass entering said flue after turning sharply beneath said baffle and a fly-ash receiving zone below the lower edge of said baffle and substantially tangential to the direction of gas flow at said turning, said deflector wall being inclined downwardly toward said rear wall to retard the rate of gase movement.

3. In a domestic fluid heater, in combination, water cooled walls including side walls, a front wall and a back wall, a transverse wall extending from side to side and forming with the front and parts of the side walls a combustion chamber, a deflector wall extending forwardly and rearwardly from the top of said transverse wall, a top wall spaced from said deflector and defining with it a substantially horizontal gas pass, staggered water tubes connecting said top and deflector wall water spaces and arranged in said horizontal gas pass, a flue extending through said rear wall below said deflector wall level and forward toward said transverse wall, a baffle depending from the rear edge of said deflector wall, being pierced by said flue and defining with the back wall a substantially vertical downward gas pass, gas from the last mentioned pass entering said flue after turning sharply beneath said baffle and a fly-ash receiving zone below the lower edge of said baffle and substantially tangential to the direction of gas flow at said turning.

4. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall extending transversely of said compartment for a part of the height thereof to divide it into a combustion chamber and space for passages with convection-heated surfaces, a deflector wall on top of said transverse wall extending over the chamber and oppositely beyond said transverse wall, means in the vertical passage behind said transverse wall and below the deflector wall to split the gas stream and reduce its total cross-section and increase its velocity, a baffle for each section of the split stream and having a substantially horizontal lower edge, means to turn the gas streams sharply beneath said lower edge, said splitting means comprising a flue for merging and carrying off said streams and a fly-ash receptacle beneath said baffle edge.

5. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall extending transversely of said compartment for a part of the height thereof to divide it into a combustion chamber and space for passages with convection-heated surfaces, a deflector wall on top of said transverse wall extending over the chamber and oppositely beyond said transverse wall and inclined away from said combustion chamber, means in the vertical passage behind said transverse wall and below the deflector wall to split the gas stream and reduce its total cross-section and increase its velocity, a baffle for each section of the split stream and having a substantially horizontal lower edge, means to turn the gas streams sharply beneath said lower edge, said splitting means comprising a flue for merging and carrying off said streams, a fly-ash receptacle beneath said baffle edge, and a fly-ash wash pipe adjacent the high edge of said deflector wall and having nozzles directed away from the combustion chamber.

6. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall extending transversely of said compartment for a part of the height thereof to divide it into a combustion chamber and space for passages with convection-heated surfaces, a deflector wall on top of said transverse wall extending over the chamber and oppositely beyond said transverse wall and inclined away from said combustion chamber, means in the vertical passage behind said transverse wall and below the deflector wall to split the gas stream and reduce its total cross-section and increase its velocity, a baffle for each section of the split stream and having a substantially horizontal lower edge, means to turn the gas streams sharply beneath said lower edge, said splitting means comprising a flue for merging and carrying off said streams, a fly-ash receptacle beneath said baffle edge, a fly-ash wash pipe adjacent the high edge of said deflector wall and having nozzles directed away from the combustion chamber, and a second wash pipe adapted to spray the baffle and adjacent areas, the drainage from both pipes being received into said receptacle.

7. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a water cooled wall extending transversely of said compartment for a portion of the height thereof to divide it into a combustion chamber and a space having vertical passages with convection-heated surfaces, a deflector wall on top of said transverse wall and inclined downwardly away from the combustion chamber toward a portion of the passages, a fly-ash receptacle at the bottom of said portion and water spray means to clean all of the said passage walls, said deflector inclination directing water into said receptacle and away from the combustion chamber.

8. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall transverse to said compartment dividing

the lower part thereof into a combustion chamber and a space having passages with convection-heated surfaces, an inclined deflector wall on top of said transverse wall sloping away from the combustion chamber, a steeply inclined baffle extending from the lower edge of said deflector wall into the said space behind the transverse wall, a flue extending horizontally through said baffle and having a gas entrance in front of said baffle, and a fly-ash receptacle beneath the lower edge of said baffle and flue.

9. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall transverse to said compartment dividing the lower part thereof into a combustion chamber and a space having vertical passages with convection-heated surfaces, an inclined deflector wall on top of said transverse wall sloping away from the combustion chamber, a steeply inclined baffle extending from the lower edge of said deflector wall into the said space behind the transverse wall, a flue extending horizontally through said baffle and having a gas entrance in front of said baffle, and installed means to spray water for cleaning fly-ash from substantially all passage walls, said inclined deflector wall directing the used water and ash toward said space.

10. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall transverse to said compartment dividing the lower part thereof into a combustion chamber and a space having vertical passages with convection-heated surfaces, an inclined deflector wall on top of said transverse wall sloping away from the combustion chamber, a steeply inclined baffle extending from the lower edge of said deflector wall into the said space behind the transverse wall, a flue extending horizontally through said baffle and having a gas entrance in front of said baffle, a fly-ash receptacle beneath the lower edge of said baffle and flue, and means to spray water for cleaning fly-ash from substantially all passage walls, said deflector wall diverting used water and ash toward said receptacle.

11. In a fluid heater of the type described, in combination, a combustion chamber, means forming water-cooled radiant heat absorbing surfaces immediately about the combustion chamber and more remote, water-cooled, convection-heated surfaces enclosing gas passages, means for burning a fly-ash forming fuel in the combustion chamber, and passing the products of combustion through said gas passages, perforated water spray pipes built permanently into said gas passages so as to be completely surrounded by convection-heated surfaces, the spray from the said pipes being directed to wash fly-ash from all of the surrounding convection-heated surfaces, the lower of such surfaces being inclined away from the combustion chamber and the sprays so directed that water may be sprayed over substantially all of the convection-heated surfaces to clean them while the fuel is burning without quenching its fire.

12. In a domestic fluid heater, in combination, water cooled walls forming a closed compartment, a wall extending transversely of said compartment for a part of the height thereof to divide it into a combustion chamber and space for passages with convection-heated surfaces, a deflector wall on top of said transverse wall and inclined away from said combustion chamber, a substantially horizontal flue open at the front in the space behind said transverse wall and below the deflector wall to split the downcoming gases into two streams of reduced total cross-section, a baffle for each section of the stream and having a substantially horizontal lower edge, means to turn the gas streams beneath said baffles and merge and direct them into said flue, a fly-ash receptacle beneath the baffle edges and fly-ash wash means adjacent the high edge of said deflector wall.

13. In a domestic fluid heater in combination, a combustion chamber, a plurality of connected gas passages defined by convection-heated walls, a flue, said walls being so disposed that the gas passages extend from the combustion chamber to said flue in the form of a cyclonic dust collector wherein the dust is deposited on the outer walls of the passages, means for burning a fly-ash forming fuel under forced draft in said combustion chamber and water spray means mounted adjacent the inner walls of said passages and having nozzles directed toward the outer walls thereof to wash away the fly-ash, a fly-ash receptacle, said inner walls being so disposed as to drain all water away from the combustion chamber and toward said receptacle.

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