Sept. 25, 1951 A. E. WATTS 2,568,781

VERTICAL BOILER

Filed March 11, 1948 2 Sheets-Sheet 1

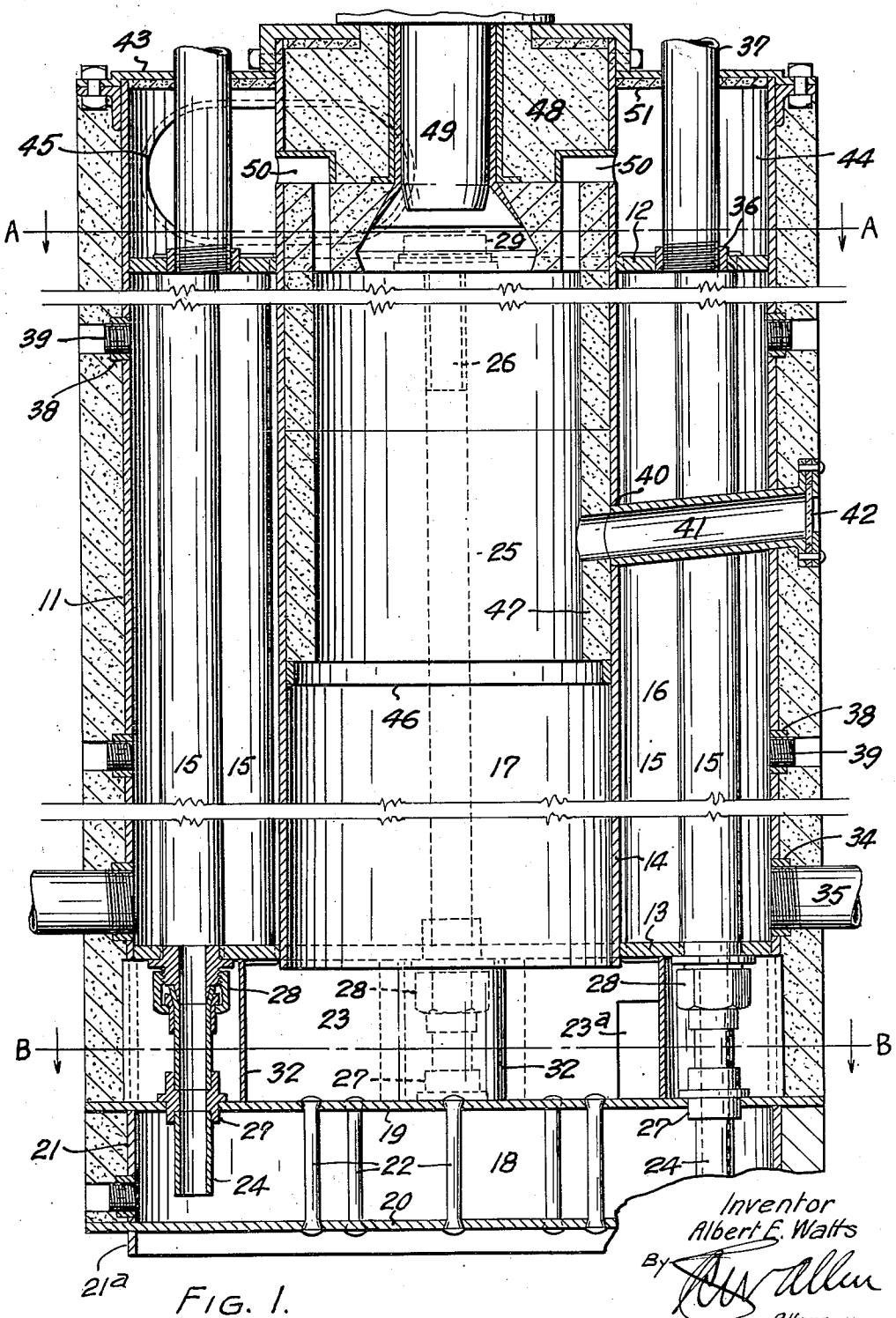

FIG. 1.

Inventor
Albert E. Watts
By
Attorney

Sept. 25, 1951 A. E. WATTS 2,568,781

VERTICAL BOILER

Filed March 11, 1948 2 Sheets-Sheet 2

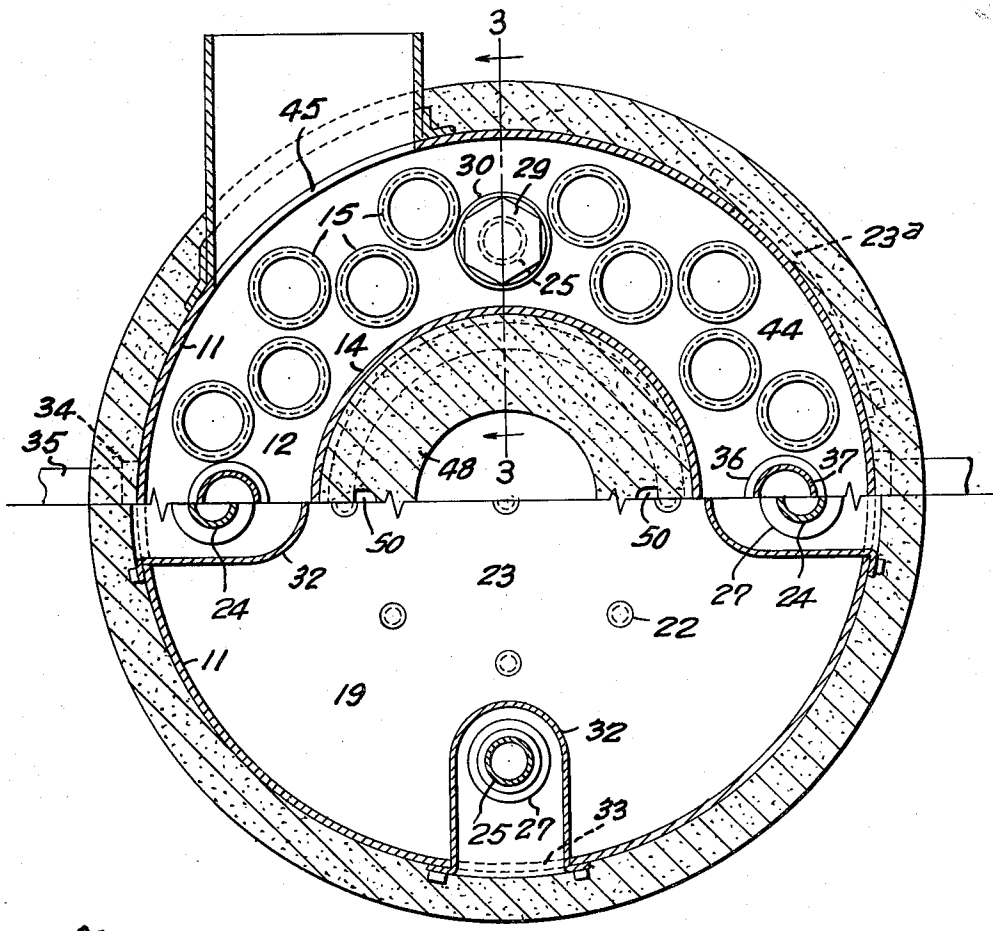

FIG. 2

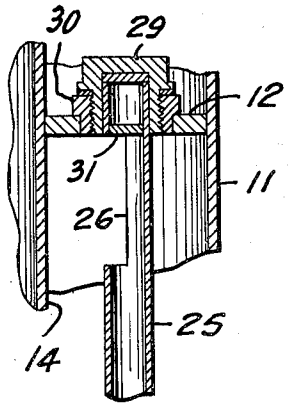

FIG. 3

Inventor
Albert E. Watts
By
Attorney

Patented Sept. 25, 1951 2,568,781

UNITED STATES PATENT OFFICE

2,568,781

VERTICAL BOILER

Albert E. Watts, Montreal, Quebec, Canada; Anna Carolina Anderson Watts and Montreal Trust Company, executors of said Albert E. Watts, deceased, assignors to Anna May Watts Sergent

Application March 11, 1948, Serial No. 14,379

4 Claims. (Cl. 122—182)

1

This invention relates to improvements in vertical boilers for water heating and steam generating and the primary object of the invention is to provide a boiler which will be highly efficient in operation and which will heat water very rapidly. A further object is to provide a boiler of simple and inexpensive construction and which may be very quickly manufactured. A still further object is to provide a boiler having very large heating capacity in proportion to its size. Another object is to provide a vertical boiler especially designed to be heated by combustion of oil, gas or powdered coal. Various other objects and the advantages of the invention may be ascertained from the following description and the accompanying drawings.

The invention consists, broadly speaking, in a vertical boiler having an upper water space surrounding a central, axially vertical, combustion chamber, and vertical return flues passing through said water space; and a lower, shallow, water space or chamber spaced below the upper water space and straight, vertical down take and riser pipes, respectively connecting the bottoms of said chambers and the tops of said chambers; the space between said upper and lower water chambers serving as a combustion products expansion chamber connecting the lower end of the combustion chamber to the lower ends of the flues, said boiler being adapted for introduction of fuel in a downward direction at the top of the combustion chamber.

In greater detail, the invention consists in the features and combinations of features herein disclosed, together with all such modifications thereof and substitutions of equivalents therefor as are within the scope of the appended claims.

In the accompanying drawings, which illustrate that embodiment of the invention now preferred but to the details of which the invention is not limited—

Fig. 1 is a central, vertical sectional view of my boiler.

Fig. 2 is a cross-sectional view of the boiler, the upper half being at the line A—A, and the lower half at the line B—B, of Fig. 1.

Fig. 3 is a vertical sectional view of the upper portion of a riser pipe, at the line 3—3 of Fig. 2.

Referring more particularly to the drawings, 11 designates an axially vertical boiler shell, which is preferable cylindrical but may be of any other desired form, while 12 and 13 designate upper and lower annular flue sheets connected to the shell below its upper end and above its lower end, respectively. A large, axially vertical, preferably cylindrical flue 14 passes through both flue sheets, centrally thereof, and extends at its upper end somewhat above the top of the shell 11. The lower end of this central flue is located at substantially the lower surface of the lower flue sheet. A plurality of preferably cylindrical flues 15 extend between and through the upper and lower flue sheets and are preferably arranged in banks, spaced apart to accommodate elements hereafter described, and in staggered relation, as shown in Fig. 2. The shell, flue sheets and center flue enclose an upper water space 16 of tubular form, through which the flues 15 pass. The center flue defines a combustion chamber 17.

2

A lower water space 18 is defined by upper and lower head plates 19 and 20, respectively, and a circumferential shell plate 21, preferably of the same contour and diameter as the shell 11, connected to the upper and lower head plates. Stay bolts 22 may be provided connecting the upper and lower head plates. The structure thus provided is connected in any suitable way to the lower end of the shell 11 and is preferably mounted on a base ring 21a to space the lower head plate above the foundation on which the boiler will stand. The lower part of the shell 11, the lower flue sheet 13 and the upper head plate 19 enclose an expansion chamber 23 which serves to communicate the center flue 14 to the outer flues 15. This chamber may have a clean out door 23a.

The upper and lower water spaces are connected by downtake and riser pipes 24 and 25 respectively, there being preferably a plurality of each, and the downtakes and risers being alternated around the boiler and located between the banks of flues, as shown in Fig. 2. The downtakes extend from the bottom of the upper water space to nearly the bottom of the lower water space, so as to separate incoming water from that in the upper part of the lower water space. The risers 25 extend from the top of the lower water space to substantially the top of the upper water space, where the risers are formed with outlet openings 26, preferably facing the center flue 14.

The downtakes and risers may be connected to the head plate 19 and to the flue sheet 13 in any suitable way. As now preferred, the downtakes and risers each comprises aligned pipe sections and connecting fittings including a sleeve 27 passing through and welded to the upper head plate, into which sleeve the pipe sections enter and are brazed or welded; and a union connec-

tion 28 including a part passing through and welded to the lower flue sheet, said union connections engaging the pipe sections extending upwardly from the sleeves 27. The upper end of each riser is held in a recessed plug 29 screwed into a bushing 30 welded into the upper flue sheet. The riser may be blocked immediately above its outlet 26, by a plug 31 welded or brazed into it.

Where the downtakes and risers pass through the expansion chamber 23, they are protected by U-shaped shield plates 32, the extremities of which pass through openings 33 in the shell 11 and are connected to the shell. The openings 33 and the arrangement of the shields afford access to the unions 28.

Bushings 34 are welded into the shell 11 close to the bottom of the water space 16 for reception of water inflow pipes 35. Similar bushings 36 are welded into the upper flue sheet, between adjacent banks of flues, for reception of outflow pipes 37. Bushings 38 are welded into the shell at locations convenient for attachment of usual boiler fittings, and such as are not in use may be closed by plugs 39 screwed thereinto. One such bushing and plug is located as near as possible to the bottom of the lower water space and may serve for draining water out of the boiler.

The flue 14 is formed with an opening 40, into which one end of a pipe 41 is welded, the pipe inclining upwardly toward the shell 11 and passing therethrough and being welded thereto. The pipe constitutes an inspection port for the combustion chamber and the outer end of the pipe is closed, preferably by a sheet of transparent material 42, such as heat proof glass, to prevent escape of combustion products.

A cover plate is mounted on the top of the shell and extends from it to the center flue 14 to complete enclosure of the collecting chamber 44 above the upper flue sheet, into which chamber the flues 15 open and from which combustion products may escape through an opening 45.

A ring 46 is welded to the inner surface of the center flue, a suitable distance down from the upper end thereof and supports a refractory lining 47 for the combustion chamber. Above the lining, the center flue is closed by a centrally apertured refractory closure 48, through the aperture of which a fuel injecting device 49, such as an oil or gas burner, projects and is adapted to inject fuel in downward direction into the combustion chamber. Vents 50 are provided leading through the closure 48 from the upper end of the combustion chamber into the collecting chamber 44, to relieve pressure in the event of a "blow back" or explosion of fuel in the combustion chamber. The closure 48 is held in place by a cap plate 51 bolted to the upper end of the flue 14. The cover plate 43 may be protected by a lining 52 of refractory or insulating material.

The various parts of the boiler may be connected together in any suitable way, but I now prefer to connect them by welding, as this simplifies construction and reduces the cost thereof.

In operation, fuel is injected in downward direction at the top of the combustion chamber and the products of combustion pass out of the bottom of the combustion chamber into the expansion chamber 23, through which they flow radially outward to the flues 15 and upward through the flues to the collecting chamber 44 and thence through the outlet 45 to a stack. The combustion products, in expanding in the chamber 23 bathe the whole top surface of the upper head plate 19 with hot, slow flowing gases, so that water in the top of the lower water space is very quickly heated and rises through the risers 25 and is conducted to the upper part of the upper water space, without dilution by, or appreciable loss of heat to, cooler water in the lower part of the lower water space, or to water in the upper water space. Water in the upper water space is heated by contact with the central flue 14 and with the outer flues 15. The hot water from both water spaces is drawn off through the outlets 37. Cool water enters the lower part of the upper water space through the inlets 35 and some of this cool water flows through the downtakes 24 directly to the lower part of the lower water space without diluting or appreciably cooling the hot water in the upper part of this space. As the downtakes 24 and risers 25 are spaced circumferentially of the boiler, the cool water entering the lower water space is forced to flow laterally in contact with the large diameter, heated head plate 19 and is thereby rapidly heated. The outflow from the risers is directed toward the combustion chamber so that water emerging from the risers immediately contacts this heating surface and is additionally heated, thereby to replace any heat lost through the walls of the risers to water in the upper water space.

As water in the large diameter lower water space is heated only at the top and escapes immediately from the top of the space, there are none of the usual convection currents in the water in the lower chamber. Consequently, the depth and volume of water in the chamber below the said film may be disregarded in considering the operation and effects. The volume of this film is much less in proportion to the heating surface thereof than is the volume of water in the upper chamber in proportion to the heating surface thereof. The higher ratio of heating surface of the aforesaid film of water results in the water of this film being heated more rapidly, and circulating more rapidly, than the water in the upper chamber. Since the water supply of the lower chamber is from the bottom of the upper chamber and the water discharge of the lower chamber is to the top of the upper chamber, the rapid circulation in the lower chamber is imposed on water in the upper chamber and serves to increase the rate of circulation in the upper chamber, beyond that which would result from heating effect in the upper chamber and from the operation of the system in which the boiler is connected. This increased rate of circulation in the upper chamber causes the boiler to have an unusually large heating capacity in proportion to its size and to be very quickly responsive to increases of fuel input.

The arrangement providing for two parallel circulations of water, in one of which water is heated more rapidly than in the other and imposes its consequent higher flow velocity on the other circulation, including the heating of the upper surface of a body of water at the bottom of a boiler and its transfer, undiluted by cooler water, to the top of the boiler, are believed to be new principles in vertical boilers.

As regards heating in the upper water space, it will be observed the water flow therein is current to the flow of gases in the combustion chamber and therefore most efficient. Provision of the expansion chamber between the combustion chamber and the flues 15 causes reduction in the velocity of combustion products, with consequent

increase of time for heat exchange with the water. By suitable regulation of the rate of gas escape to a stack, the hot gases may be held in contact with the boiler heating surfaces long enough to secure a high percentage heat exchange, with resulting high efficiency. The whole arrangement of introducing fuel downwardly at the top of the boiler and allowing the combustion products to expand and lose velocity before entering the flues **15**, largely overcomes one of the great disadvantages of vertical boilers.

While the operation has been heretofore described as for the supplying of hot water, it will be understood the boiler may be used equally well for generating steam. In such case, it is preferred that the water level be maintained somewhat below the riser outlets.

Having thus described my invention, I claim:

1. A vertical boiler including an upper and a lower water chamber; a central combustion chamber and vertical flues passing through said upper chamber; a hot gas chamber between said water chambers communicating said combustion chamber and said flues; riser and return conduits connected to the top and bottom, respectively, of said upper chamber whereby in operation of the boiler a first circulation of water will be established from bottom to top of the upper chamber; downtake conduits leading vertically downward from the bottom of the upper chamber to near the bottom of the lower chamber and within the chamber; risers leading vertically upward from the top of the lower chamber to near the top of the upper chamber and within the chamber whereby in operation of the boiler a second circulation of water will be established throughout the volumes of both water chambers, with hot water rising from the bottom chamber excluded from the water of the first said circulation to nearly the top of the upper chamber and in proximity to said first named riser, and cool water from said return conduit and from the bottom of the upper chamber excluded from water in the lower chamber except at the extreme bottom thereof.

2. A vertical boiler comprising upper and lower vertically spaced water chambers; an axially vertical combustion chamber passing centrally through said upper water chamber; water conduits extending downwardly from the bottom of said upper chamber to nearly the bottom of said lower chamber; water conduits extending vertically upward from the top of said lower chamber to and through the upper head of said upper chamber and each having a lateral opening extending a short distance downwardly from the top of the chamber, facing said combustion chamber whereby water rising from the lower chamber is discharged against the combustion chamber wall with additional heating effect; bushings in said upper head plate encircling the upper ends of said last named conduits and plugs in the said bushings embracing the upper ends of said last mentioned conduits and holding them rigidly in place and closing their upper ends, said plugs being removable from the exterior of the chamber to afford access to the interiors of the conduits for inspection and cleaning; and means blocking said conduits at the level of the chamber head plate.

3. A vertical boiler comprising an upper water chamber having an integral skirt portion depending therebelow; a combustion chamber passing axially through said water chamber; vertical flues passing through the water chamber around the combustion chamber, arranged in banks spaced circumferentially of the boiler; a lower water chamber spaced from the upper water chamber by said skirt; a hot gas expansion chamber enclosed by said water chambers and said skirt, communicating the lower ends of said combustion chamber and said flues; vertically extending straight water conduits leading from the bottom of the upper chamber between adjacent flue banks to nearly the bottom of the lower water chamber; vertically extending straight water conduits leading from the top of said lower chamber to nearly the top of the upper water chamber and passing between adjacent flue banks; said conduits including separable connections in said expansion chamber permitting separation of the upper and lower water chambers; said skirt being formed with openings opposite said separable connections to give access to the connections; and means within the expansion chamber spaced substantially from said separable connections and shielding the connections from hot gases in the expansion chamber; each said shielding means extending from edge to edge of a skirt opening and from top to bottom of the expansion chamber and being in register with the spaces between flue banks whereby they serve to direct hot gases into the flues.

4. A hot water heater comprising upper and lower water chambers; water take-off and water return conduits connected to the top and bottom, respectively, of the upper chamber; water conduits leading from the bottom of the upper chamber adjacent the return conduits to near the bottom of the lower chamber, whereby the return water is divided and caused to flow partly upwardly in the upper chamber and partly downwardly into the lower part of the lower chamber; and water conduits leading upwardly from the top of the lower chamber to nearly the top of the upper chamber, whereby water heated in the lower chamber is isolated from cooler water in the lower part of the upper chamber and is united with water rising in the upper chamber at a point adjacent the take-off conduits and only after the water rising in the upper chamber has been heated.

ALBERT E. WATTS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
66,438	Young	July 2, 1867
338,670	Johnson	Mar. 23, 1886
424,377	Taylor	June 10, 1890
452,502	Tonns	May 19, 1891
1,656,222	Oakley	Jan. 17, 1928
1,712,543	Bayer	May 14, 1929
1,749,909	Dyar	Mar. 11, 1930
1,924,209	Kilgour	Aug. 29, 1933
1,986,914	Avery	Jan. 8, 1935
2,174,663	Keller	Oct. 3, 1939
2,383,924	Way et al.	Aug. 28, 1945