April 29, 1958 R. THOME ET AL 2,832,320

GAS-FIRED BOILER, MORE PARTICULARLY FOR CENTRAL HEATING PLANTS

Filed Dec. 14, 1953 3 Sheets-Sheet 1

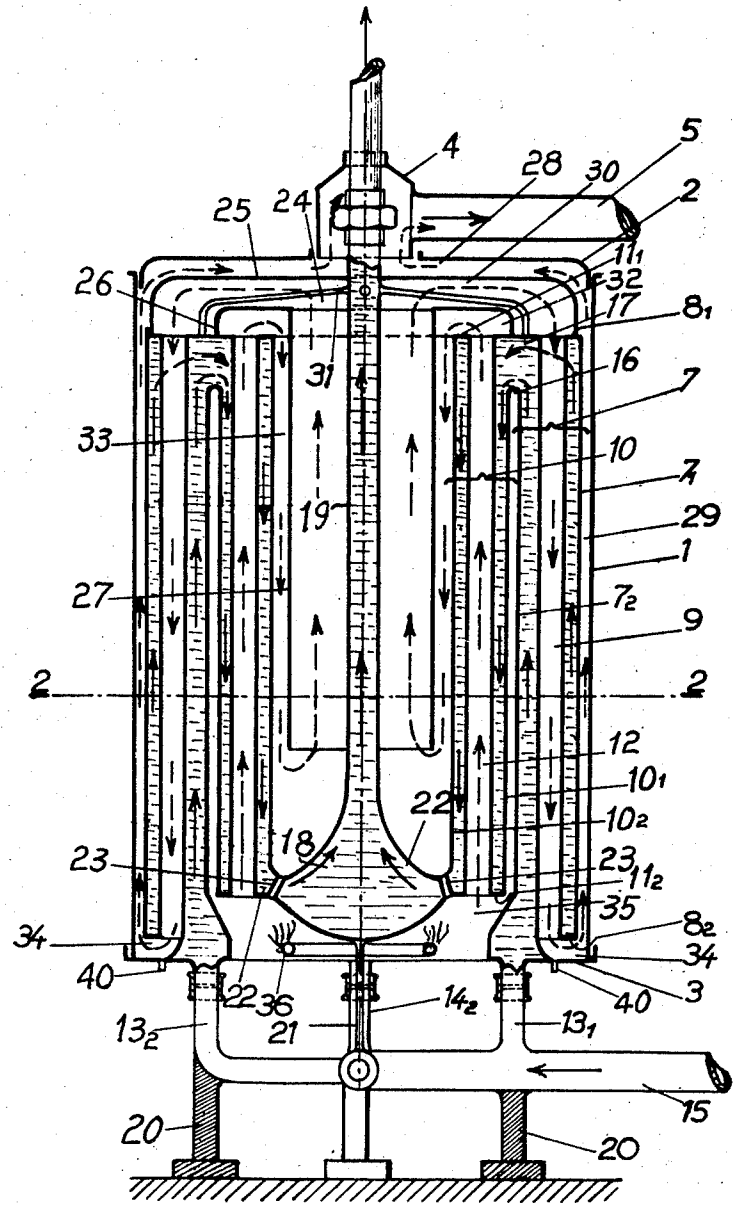



FIG.1

INVENTORS:
ROBERT THOME
ALBERT GODFRIN
BY Nelson M. Straus
AGT.

April 29, 1958 R. THOME ET AL 2,832,320

GAS-FIRED BOILER, MORE PARTICULARLY FOR CENTRAL HEATING PLANTS

Filed Dec. 14, 1953 3 Sheets-Sheet 2

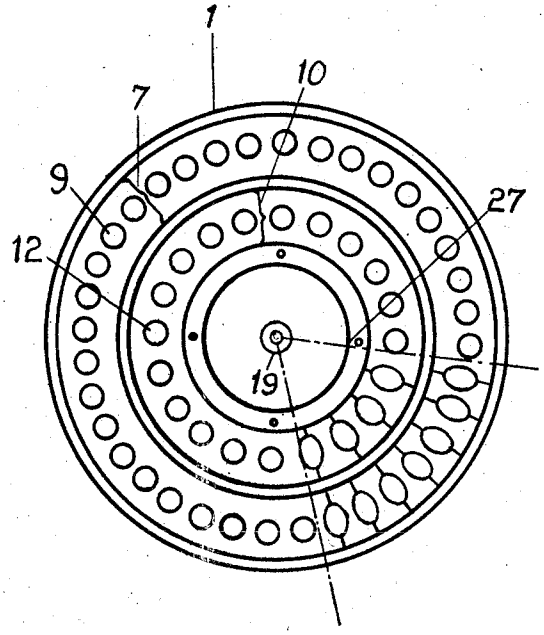



FIG.2

INVENTORS:
ROBERT THOME
ALBERT GODFRIN
BY Leon M. Strauss
ATT.

April 29, 1958 R. THOME ET AL 2,832,320

GAS-FIRED BOILER, MORE PARTICULARLY FOR CENTRAL HEATING PLANTS

Filed Dec. 14, 1953 3 Sheets-Sheet 3

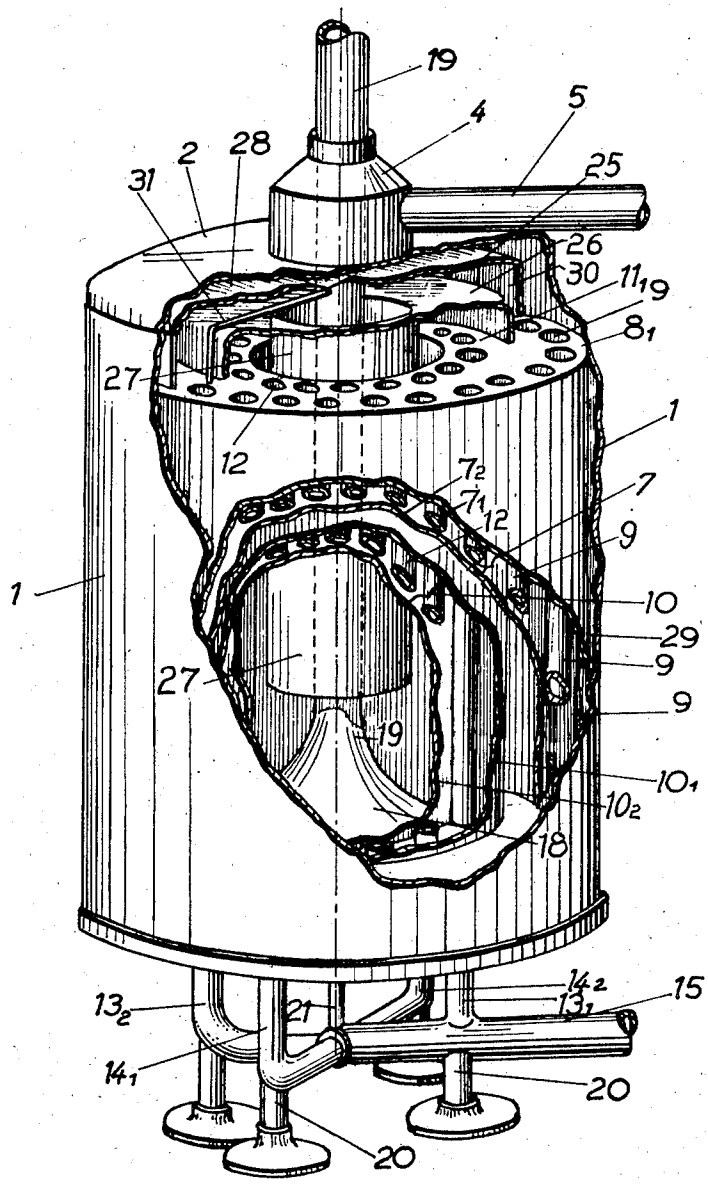



FIG.3

INVENTORS.
ROBERT THOME
ALBERT GODFRIN
BY Leon M. Strauss
AGT.

United States Patent Office 2,832,320
Patented Apr. 29, 1958



2,832,320

# GAS-FIRED BOILER, MORE PARTICULARLY FOR CENTRAL HEATING PLANTS

Robert Thome, Metz, and Albert Godfrin, Longeville-Les-Metz, France

Application December 14, 1953, Serial No. 398,154

6 Claims. (Cl. 122—121)

The present invention relates to novel gas-fired boilers for central heating plants.

In most of the gas-fired boilers that are known, the combustion gases charged with moisture leave the boiler at a high temperature.

In the first place, this causes an important loss of calories, by an appreciable heat of the gases at the exit, and a reduction in the output of the boiler.

In the second place, the moisture contained in these gases from combustion condenses when the temperature of these gases drops in the chimney and wets this conduit, which leads to speedy deterioration.

The object of the present invention is to obviate these disadvantages.

It relates to a gas-fired boiler characterized in that it has a symmetrical shape in relation to a vertical axis and water circuits that alternately rise and fall developing from the exterior of the boiler towards this axis, which enables already hot water to be conveyed over the furnace arranged on this axis, the water thus leaving the boiler at a high temperature.

According to one characteristic of the invention, the alternately rising and falling water circuits terminate in a bulb provided in the axis of the boiler above the furnace, from whence the hot water escapes by an axial pipe into the installation to be supplied.

According to another characteristic of the invention, the alternately rising and falling water circuits are achieved in the co-axial annular cylindrical shells, the one outside, the other inside the preceding one, and communicating with the latter by its upper part.

According to one characteristic of the invention, the co-axial annular cylindrical shells are separated from each other by an annular space communicating at its lower part with the furnace and owing to this fact filled with stagnant hot gas and which forms an insulation resisting any thermic exchange between these cylindrical shells.

According to one embodiment of the invention, the aforementioned annular cylindrical shells are pierced by tubes for the passage of the combustion gases in these shells while thus affording a large heating surface.

According to one characteristic of the invention, the tubes of the tubular shells have either a: (a) circular, or (b) elliptical, section.

According to another characteristic of the invention, the tubes of the tubular shells are provided with ribs on the outside, which press against the adjacent tubes, or against the walls of these shells, which enables the rigidity of these tubular shells and their resistance to water pressure to be increased.

The invention also relates to the characteristics hereinafter described and to their various possible combinations.

A gas-fired boiler, according to the invention, is shown, by way of example, in the attached drawing, in which:

Figure 1 is an axial vertical section of the boiler,



Figure 2 is a horizontal section of this boiler, through the line 2—2 of Figure 1.

Figure 3 is a perspective view of the whole of the boiler, with parts cut away.

The boiler shown in Figures 1 and 2 comprises a vertical cylindrical shell **1** forming an external casing and closed by the upper and lower boiler-heads, **2** and **3**.

The upper boiler-head **2** comprises a dome **4** in its central part for collecting the combustion gases, this dome being connected to a lateral gas-pipe **5** which conveys these gases to the chimney.

The external casing **1** contains two co-axial tubular shells of annular shape:

An external tubular shell **7**, formed of two thimbles $7_1$, $7_2$ which are co-axial and connected by the annular boiler-heads $8_1$, $8_2$ which form flue sheets for a series of gas pipes **9** spaced at regular distances between the thimbles $7_1$, $7_2$.

An internal tubular shell **10** co-axial and inside the preceding one, formed by two co-axial thimbles $10_1$, $10_2$ joined together by the annular boiler heads $11_1$, $11_2$ forming flue sheets for a series of gas pipes **12** spaced at regular distances between the thimbles $10_1$, $10_2$.

The gas-pipes **12** and **9** can be of circular or elliptical section (right part of Figure 2). Those of elliptical section as shown in Figure 2 can be provided with ribs which press on the adjacent pipes or against the walls of the cylindrical shells, so as to produce, in several directions, a metallic continuity inside the tubular shell. These shells thus possess great rigidity for resisting considerable water pressure.

The external tubular shell **7** communicates at its lower part, by four diametrically opposed pipes in pairs, $13_1$, $13_2$, $14_1$, $14_2$ with the water return pipe **15** of the installation. The legs **20** of the appliance can be fixed to these pipes.

This external tubular shell **7** communicates at its upper part with the internal tubular shell **10**, for example, by forming the upper flue sheets $8_1$ and $11_1$ in a single piece and by joining the thimbles $7_2$, $10_1$ together at a certain distance from these flue sheets, by means of an annular joining sheet **16**. Thus, an upper annular passage **17** is made between the tubular shells **7**, **10**.

The internal tubular shell **10** communicates at its lower part along an annular passage **22** with a bulb **18** for collecting very hot water, connected by its upper part to an axial column **19** from which hot water proceeds, traversing in a tight-fitting manner the dome **4** for collecting burnt gases and connected to the departure pipe of the installation. This bulb **18** communicates, by its lower part, with the return pipe **15**, by means of a pipe **21** of small section.

In the annular passage **22** there are four pipes **23** of small section diametrically opposed in pairs and effecting communication from the chamber situated above the bulb collector **18** with the space situated below this bulb.

At the upper part of the apparatus, a chamber **24** is provided between the upper boiler-head **2** of the casing **1** and the upper tubular flue sheet $8_1$, $11_1$ of the tubular shells **7**, **10**. In this chamber there are two intermediary boiler heads, the one **25** forming a joint at its central part with the axial departure pipe **19** and connected by its periphery to the external edge of the upper flue sheet $8_1$, $11_1$. The other intermediary boiler head **26** forms a joint by its central part with the cylinder **27** forming a baffle, and is connected by its periphery with the upper flue sheet $8_1$, $11_1$ between the two tubular clusters **9**, **12**.

On this intermediary boiler head the cylindrical shell **27** that forms a baffle is fixed, open at its bottom part and emerging at its upper part across this intermediary boiler head **26**.

The boiler heads 25, 26 divide the space 24 separating the boiler head 2 of the casing of the flue sheet $8_1$, $11_1$ into three chambers:

An upper chamber 28 effecting the communication of the collector dome for burnt gases 4 with the annular space 29 provided between the external tubular shell 7 and the thimble 1 of the casing;

An intermediary chamber 30 effecting the communication of the upper openings, the pipes of the external tubular shell 7, with the interior of the cylinder 27. In this intermediary chamber 30 there are radially disposed pipes 31 effecting the communication of the axial pipe 19 with the annular passage 17 connecting the two tubular shells 7, 10 at their upper part.

A lower chamber 32 effecting the communication of the upper openings of the pipes 12 of the internal tubular shell 10 with the space 33 comprised between the cylindrical baffle 27 and the internal tubular shell 10.

At their lower part, the pipes 9 of the external tubular shell 7 emerge in the space 29 provided between the external casing 1 and the external tubular shell 7, by the lateral ears 34.

The tubes 12 of the internal tubular shell 10 emerge at their lower part, in a combustion chamber 35 surrounded by the external tubular shell 7 and open at its lower part.

This combustion chamber 35 contains the gas burner 36, for example of the crown type.

The above-mentioned boiler operates in the following manner:

The combustion gases of the gas escape from the combustion chamber 35 by the vertical tubes 12 of the internal tubular shell 10, traveling along these tubes from bottom to top in the direction shown by the arrows with dotted lines, emerging at the upper part of the tubes 12. These gases pass into the lower chamber 32, descend into the annular space 33 provided between the baffle 27 and the lower tubular shell 7, then ascend in this cylinder 27 which forms a baffle.

At the upper part of this baffle cylinder 27, the gases emerge in the intermediary chimney 30 and are conducted by this chamber 30 towards the upper openings of the tubes 9 of the external tubular shell 7. They travel along these tubes 7 from top to bottom to emerge at the lower part of these tubes 9 through the ears 34, into the annular space 25 provided between the casing 1 and the external tubular shell 7. The gases travel along this annular space from bottom to top and emerge in the upper chamber 28 which conducts them into the collector dome 4, from whence they escape to the chimney by the pipe 5.

The installation water arriving by the return pipe 15 comes by the pipes $13_1$, $13_2$, $14_1$, $14_2$ to the lower part of the external tubular shell 7, rises in this shell in the direction of the arrows with a solid line, then reaches the upper part of this external tubular shell 7, and passes into the internal tubular shell 10 by the annular passage 17.

The water then travels along the internal tubular shell 10 from top to bottom, to emerge, at the lower part of this shell, in the bulb 18 by the annular passage 22. From this bulb 18 the water rises in the axial departure pipe 19 and from there, reaches the installation.

Thus, in the above-mentioned boiler, the combustion gases traveling along the tubes 9 or 12 of a tubular shell circulate in the opposite direction to the water traveling along this tubular shell around these tubes, which is favorable to the output, according to the well-known principle of heat exchanges between two fluids circulating on either side of a partition.

More particularly, owing to this rational circulation of the already cooled combustion gases traveling along these tubes 9 and the space 29, said gases are in contact with the shells that separate them from the cooled water coming back. This water is at a distinctly lower temperature than that of the gases (30° centigrade, for example, for this water, as against 200° centigrade, for example, for the combustion gases). This leads to an important heat exchange, in spite of the relatively low temperature of these combustion gases.

On the other hand, the very hot combustion gases contained in the combustion chamber 35 are separated by the wall of the bulb 18, from the already very hot water, which enables the temperature of this water to be still further raised, owing to the very high temperature of the combustion gases and flames.

The apparatus of the invention thus enables optimum conditions to be obtained for heat exchanges between the gases and the water.

The steam pipes 31 connecting the upper part 17 common to both tubular shells 7 and 10 to the central hot water departure pipe 19, have a triple purpose:

(*a*) When filling takes place during the time that the apparatus is being operated, they enable the air to be evacuated from the two tubular shells 7, 10 into the central pipe 19, and from there to the expansion vessel or pet cock of the installation.

(*b*) When the installation is being emptied, these steam pipes 31 enable the air to reach the upper part of the tubular shells 7 and 10 and hence facilitate complete emptying of these shells.

(*c*) In the case of an installation where the boiler is placed at a higher level than that of the radiators, circulation by thermosiphon cannot take place and the installation of a circulating pump setting up a propulsive load is necessary. In a case of this kind, the boiler according to the invention can operate without a circulating pump. Actually, in the absence of circulation, the steam produced accumulates in the tubular shell 10 and the collector bulb 18.

When this steam reaches a certain pressure, it escapes through the steam pipes 31 into the central pipe 19 and produces, in this pipe and in the ascending column of the installation, an ascending flow of water which primes circulation throughout the distributing system. The steam passes at the upper part of this installation into the expansion vessel or pet cock.

The release of this steam in the departure pipe 19 sets up the ascensional power of the water and primes the circulation of this water in the installation.

Owing to this particular feature, the boiler according to the invention ensures a characteristic starting up for the installation supplied, which is as follows:

The tubular shells 7, 10 are filled with cooled water. There is no circulation in the installation. The water in the bulb 18, the axial pipe 19 and the tubular shell 10, heats up and vaporises. The steam escapes through the steam pipes 31 and speedily sets up an accelerated circulation in the departure pipe and throughout the installation. This speedy circulation continues until the hot water from the tubular shell 10 is replaced by the cooled returning water.

The circulation speed then rapidly decreases, to fall to zero.

The water contained in the tubular shell 10, the bulb 18 and the pipe 19 again heats up, vaporises, and the same process recommences.

But the return water coming back to the boiler hotter and hotter each time, the pulsations come quicker, whilst of shorter duration, and after a certain time, the boiler operates with practically no formation of steam, the water circulating in a continuous manner and throughout the installation supplied.

This arrangement thus enables the circulation to be primed even in the case of a negative propulsive load.

It is quite obvious that in the case of a positive propulsive load, even a very small one, circulation priming takes place immediately, in a continuous manner and without the slightest vaporisation.

The drain pipes 23 provided in the lower part of the boiler in the connecting member between the bulb 18

and the internal tubular shell, enable the condensation water which becomes deposited on the cooled walls to flow into the combustion chamber **35**, to be collected on a collector plate connected to a discharge piping. For the same purpose, small pipes **40** can traverse the bottom **3** of the casing by the ears **34** and discharge outside, for example, in a discharge piping, the water resulting from condensations against the cold walls of the external tubular shell **7** and the external casing **1**.

The boiler described above affords more particularly the following technical advantages:

(1) Owing to its counter-current operation, it enables optimum heat exchanges to be effected. Its output is thus high.

(2) The combustion gases escape from the boiler at low temperature, which enables the prevention of their cooling in the chimney and the condensations arising therefrom. Deterioration of the piping owing to moisture is thus avoided.

(3) The boiler is made solely of cylindrical parts which are relatively easy to manufacture.

(4) The boiler is symmetrical with regard to a vertical axis. The gas and water circuits are themselves symmetrical in relation to this axis. This arrangement enables circuits to be made of the same length and resistance with a minimum of load losses in the boiler.

(5) The dome **4**, the upper boiler head **2**, the baffles **25**, **26**, **27** of the external casing **1**, are kept in position by simple gravity, by means of tight-fitting housings, without it being necessary to assemble these parts by such means as screws, bolts or rivets. It is thus very easy to clean the inside of the boiler. With the removal of the afore-mentioned parts, the tubular shells can be cleaned outside, the tubes **9**, **12** being accessible from above. The central chamber of the boiler around the axial departure pipe **19** can be cleaned with a dust extractor.

The withdrawal of the external casing **1** enables the external surface of the external tubular shell **7** to be cleaned.

The lower part of the tubular shells **7**, **10** is accessible from below.

Inspection and servicing of the burner is also done through the lower opening of the combustion chamber **35**.

It is quite obvious that the boiler which forms the subject of the present invention can operate on town gas, butane, propane, methane and any other combustible gas.

This boiler can be fitted with any known control device, such as an aquastat regulating the operating of the burner in relation to the temperature of the water coming out of the boiler, a pyrostat effecting this control in relation to the temperature of the combustion gases, or a thermostat acting in relation to the external temperature or of heated premises.

Various changes and modifications may be made without departing from the spirit and scope of the present invention and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent, is:

1. In a gas-fired boiler having a vertical axis of symmetry: a first external annular cylindrical shell pierced with longitudinally extending tubes for the passage of combustion gases; a second coaxial annular cylindrical shell disposed within said first shell and pierced by longitudinally extending tubes for the passage of combustion gases; the two shells defining therebetween a first annular space; means affording communication between said shells at their upper part and defining an upper annular second space closing off said first space; a combustion chamber provided adjacent the base of the axis and communicating with said tubes of said second shell and with said first annular space; a bulb disposed axially above said combustion chamber and communicating with the lower part of said second shell; an axial pipe adapted to be connected with said bulb and the installation to be supplied; means for conducting the water to the lower part of said first shell; and means for guiding the ascending gases leaving said tubes of said second shell into said tubes of said first shell through which said gases pass from top to bottom.

2. In a gas-fired boiler with symmetrical vertical axis; a first external annular cylindrical shell pierced with tubes for the passage of combustion gases; a second annular cylindrical shell coaxial and inside the former, and pierced with tubes for the passage of combustion gases, these two cylindrical shells communicating with each other by their upper part; a combustion chamber provided on the axis, at the lower part of the boiler; a bulb provided in the axis of the boiler, over the combustion chamber; an axial departure pipe adapted to be connected with said bulb and to the installation to be supplied; water circuits alternately rising and falling developing outside the boiler towards the axis to conduct previously heated water over this combustion chamber; a cylindrical baffle provided in the internal annular cylindrical shell, an upper boiler head connected to this cylindrical baffle and forming an intermediary partition to lead the gases escaping from the gas pipes of the internal annular cylindrical shell around the axial departure pipe.

3. In a gas-fired boiler having a vertical axis of symmetry: a first external annular cylindrical shell pierced with longitudinally extending tubes for the passage of combustion gases; a second coaxial annular cylindrical shell disposed within said first shell and pierced by longitudinally extending tubes for the passage of combustion gases; the two shells defining therebetween a first annular space; means affording communication between said shells at their upper part and defining an upper annular second space closing off said first space; an envelope disposed about said first shell and defining therewith a third annular space, said envelope defining above said shells an upper space communicating with a chimney; a combustion chamber provided adjacent the base of the axis and communicating with said tubes of said second shell and with said first annular space; a bulb disposed axially above said combustion chamber and communicating with the lower part of said second shell; an axial departure pipe adapted to be connected with said bulb and with the installation to be supplied; means for conducting the water to the lower part of said first shell; a cylindrical baffle disposed within said second shell; a first upper head communicating with said baffle and forming an intermediate partition in said upper chamber for directing gas from said tubes of said second shell around said axial departure pipe; and a second upper head forming an intermediate partition in said upper chamber above said first head and for directing gas from the upper portion of said baffle into said tubes of said first shell.

4. In a gas-fired boiler with symmetrical vertical axis; a first external annular cylindrical shell pierced with tubes for the passage of combustion gases; a second annular cylindrical shell coaxial and inside the former, and pierced with tubes for the passage of combustion gases, these two cylindrical shells communicating with each other by their upper part; a combustion chamber provided on the axis, at the lower part of the boiler; a bulb provided in the axis of the boiler over the combustion chamber; an axial departure pipe adapted to be connected with said bulb and to the installation to be supplied; water circuits alternately rising and falling developing from the outer portion of the boiler towards the axis to conduct previously heated water over this combustion chamber; conduits effecting the communication between the axial departure pipe and the upper part common to both annular cylindrical shells to evacuate into the axial departure pipe the air or steam that collects at the upper part of these cylindrical shells and to set up propulsive pulsations in this axial departure pipe.

5. In a gas-fired boiler having a vertical axis of sym-

metry: a first external annular cylindrical shell pierced with longitudinally extending tubes for the passage of combustion gases; a second coaxial annular cylindrical shell disposed within said first shell and pierced by longitudinally extending tubes for the passage of combustion gases; the two shells defining therebetween a first annular space; means affording communication between said shells at their upper part and defining an upper annular second space closing off said first space; a combustion chamber provided adjacent the base of the axis and communicating with said tubes of said second shell and with said first annular space; a bulb disposed axially above said combustion chamber and communicating with the lower part of said second shell, said bulb being provided with passageways providing communication between the area in which said combustion chamber is lodged and the lower portion of the space encompassed by said second shell; an axial departure pipe adapted to be connected with said bulb and with the installation to be supplied, said passageways permitting the escape of water condensed out of said combustion gases about said axial pipe; means for conducting the water to the lower part of said first shell; and partition means for guiding the ascending gases leaving said tubes of said second shell into said tubes of said first shell through which said gases pass from top to bottom.

6. In a gas-fired boiler having a vertical axis of symmetry: a first external annular cylindrical shell pierced with longitudinally extending tubes for the passage of combustion gases; a second coaxial annular cylindrical shell disposed within said first shell and pierced by longitudinally extending tubes for the passage of combustion gases; the two shells defining therebetween a first annular space; means affording communication between said shells at their upper part and defining an upper annular second space closing off said first space; an envelope disposed about said first shell and defining therewith a third annular space, said envelope defining above said shells an upper space communicating with a chimney; a combustion chamber provided adjacent the base of the axis and communicating with said tubes of said second shell and with said first annular space; a bulb disposed axially above said combustion chamber and communicating with the lower part of said second shell; an axial departure pipe adapted to be connected with said bulb and with the installation to be supplied; means for conducting the water to the lower part of said first shell; a cylindrical baffle disposed within said second shell; a pair of spaced upper heads forming intermediate partitions in said upper chamber, said upper heads being joined at their peripheries to said shells, respectively, for directing gas from said tubes of said second shell about said cylindrical baffle and then through said tubes of said first shell; and a further head above said pair of upper heads and closing off the top of said envelope; said envelope, said pair of upper heads and said further head being maintained in position through their weight.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 621,350 | Klugh | Mar. 21, 1899 |
| 1,356,098 | Trumble | Oct. 19, 1920 |
| 1,406,044 | Lindberg | Feb. 7, 1922 |
| 2,259,373 | Goodale | Oct. 14, 1941 |
| 2,617,247 | Mercier et al. | Nov. 18, 1952 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 6,220 | Great Britain | 1832 |
| 11,377 | Denmark | Oct. 10, 1908 |