

June 30, 1931.

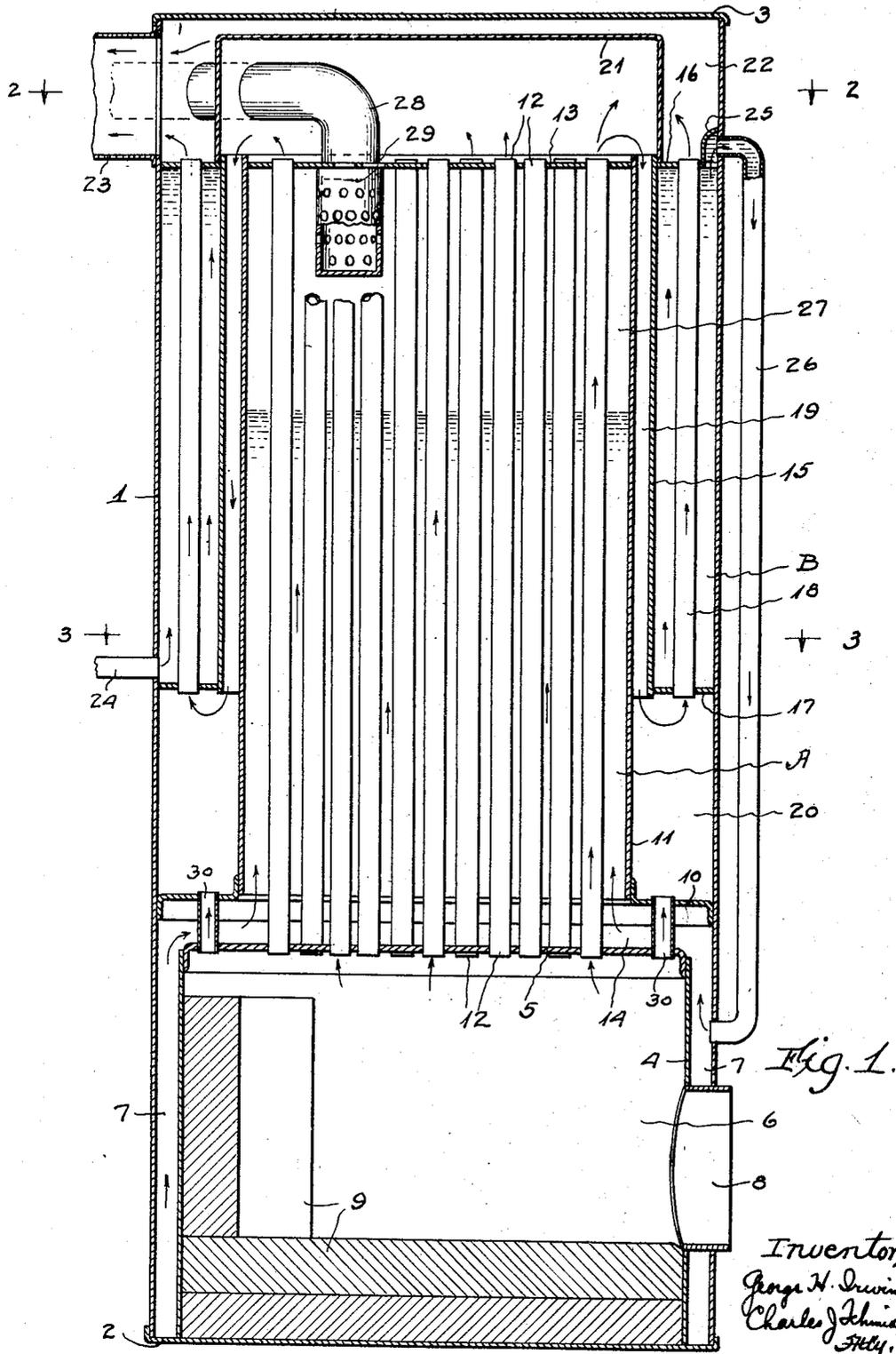
G. H. IRWIN

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BOILER

Filed Nov. 26, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

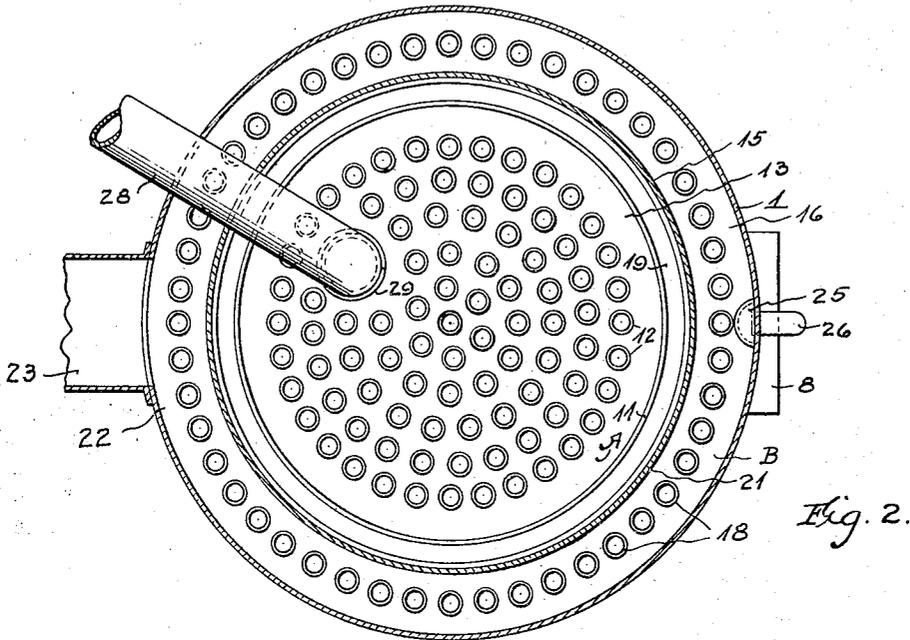


Fig. 2.

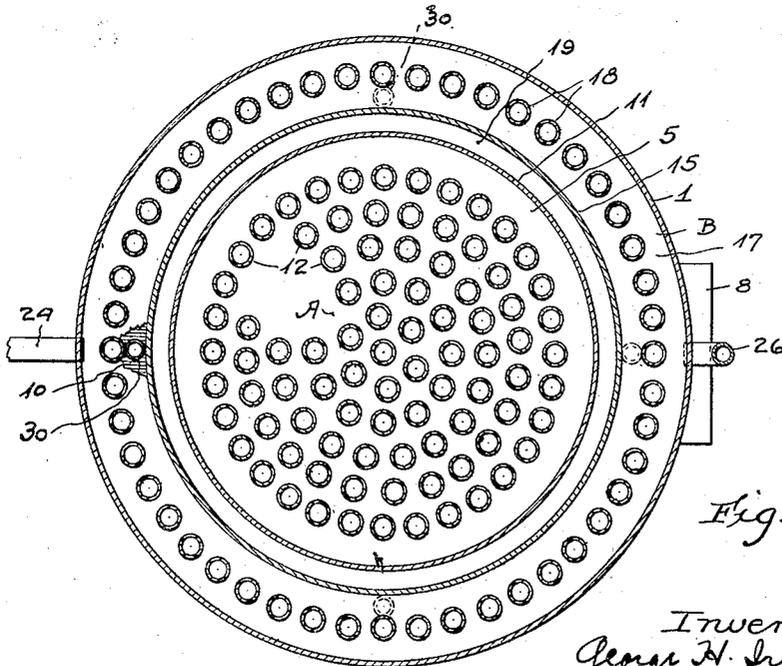


Fig. 3.

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UNITED STATES PATENT OFFICE

GEORGE H. IRWIN, OF CHICAGO, ILLINOIS

BOILER

Application filed November 26, 1928. Serial No. 321,865.

My invention relates to boilers, particularly to vertical tube boilers in which the fuel is natural or artificial gas, and the invention may be considered as an improvement over the structure disclosed in my copending application Serial No. 226,563 filed October 17, 1927, in which structure a main boiler section is concentrically surrounded by an economizer boiler section but detached and separated therefrom by a concentric flue passage.

One of the important objects of the invention is to produce a three pass boiler, the first passage of the combustion gases being upwardly through the central or main boiler section tubes, the second passage being downwardly through the separating space between the central boiler section and the economizer section, and the third passage being upwardly through the economizer section tubes, such as serial three pass flow permitting the maintenance of a very high temperature in the fire box with a low stack temperature and without unnecessary condensation when burning artificial gas.

Another important object of the invention is to provide passage way from the firebox directly to the economizer flues so that where a boiler is operated intermittently, as in domestic heating with artificial gas, convected heat from the fire brick in the firebox may flow directly to and through the economizer flues to heat the water in the economizer section while the main boiler section is cooling down.

The above and other features of my invention are incorporated in the structure shown in the drawings, in which

Fig. 1 is a vertical diametral section of the boiler structure.

Fig. 2 is a section on plane 2—2, Fig. 1, and

Fig. 3 is a section on plane 3—3, Fig. 1.

The boiler structure comprises the outer shell (1), supported on a base (2) and closed at its upper end by a top or cover (3). Within the lower part of the shell 1 is the shell 4 of smaller diameter which extends between the base 2 and the tube sheet 5 to form the combustion chamber 6 and the surrounding water leg 7. Through the opening 8, gaseous

fuel may be charged into the firebox which is preferably heavily lined at its base and rear side by fire brick or other suitable material to form a heat accumulating and flame baffling structure 9.

Above the tube sheet 5 an annular wall 10 extends across the outer shell 1, and supports the inner shell 11, concentric with the shell 1, and which forms the side wall of the main boiler section "A" whose tubes or flues 12 extend from the tube sheet 5 to the tube sheet 13, closing the upper end of the shell 11. The space 14 above the lower tube sheet 5 communicates with the water leg 7 and the water space of the main boiler section surrounding the tubes 12.

The economizer boiler section B is formed by the outer shell 1, the intermediate shell 15 and the upper and lower annular tube sheets 16 and 17 between the shells, the tubes or flues 18 extending between the tube sheets. The economizer section is entirely separated from the main boiler section by the annular space or passage 19, and terminates above the wall 10 to leave the annular gas chamber 20 with which the passage 19 and the tubes 18 communicate at their lower ends.

A hood or cap 21 is mounted over the upper ends of the main boiler section tubes 12 and the upper end of the passage 19 so that the products of combustion flowing upwardly from the fire box thru the tubes 12 must flow downwardly through the passage 19 into the space 20, and then upwardly through the tubes of the economizer boiler section into the space 22 between the tube sheet 16 and the top 3, this space communicating with a stack 23. The passage area of the passage way 19 and of the economizer tubes is suitably proportioned relative to the passage area of the main boiler tubes 12, so that the products of combustion can flow freely serially from the firebox to the stack.

The water inlet pipe 24 connects with the lower end of the economizer section at one side thereof. At the opposite side and above the top of the economizer water space a wall 25 forms an outlet connected by a pipe 26 with the water leg 7. The economizer section "B" is thus always completely filled

with water, the water flowing upwardly therein and then from the top thereof through the pipe 24 and into the water leg from where it flows upwardly into the main boiler section. The steam space 27 above the water level in the main boiler section connects with a distributing header 28, which extends from the tube sheet 13 and passes through suitable openings in the hood 21 and shell 1 for connection with the system to be supplied. Preferably a perforated baffle cap 29 is applied to the inlet end of the pipe 28 for holding back and preventing water particles from escaping with the steam.

When combustion mixture—gas and air—is blown into the fire box, this pressure, together with the stack draft, will cause the hot combustion products to flow upwardly through the main boiler tubes to heat the water and to dry the generated steam, the combustion products, still at considerable high temperature, then flowing down through the passage 19 to further heat the main boiler section and to primarily heat the economizer section. As the products then flow upwardly through the tubes 18, the remaining heat is practically all absorbed by the economizer section. Tests have shown that with a fire box temperature of from 1600° F. to 2000° F., the gases leave the main boiler section at about 400° F. to 500° F., are reduced to about 250° by their passage through the space 19, and leave the stack at about 175° F. The economizer water thus receives considerable heat but not enough to raise steam, and this preheated water flows through the water leg 7, where it is further heated before reaching the main boiler section. The space 19 not only increases the heating surface of the main boiler section but insulates it from the atmosphere and the cold water entering the economizer section.

To assist in heating the water in the economizer during operation of the boiler, and particularly to heat this water during intermissions when the boiler is operating intermittently as in domestic heating with natural gas, I provide for the flow of heat from the firebox directly to the economizer section. Such flow is through a number of tubes 30 extending through the tube sheet 5 and wall 10 to connect the firebox with the space 20 below the economizer. The passage area of the tubes 30 is considerably less than the tube area of the boiler sections so as not to interfere with the circulation of the boiler when it is in full operation, but is of sufficient capacity to permit enough flow of convected heat from the hot fire brick into the space 20 and through the economizer tubes. This convection heat will keep the economizer water hot while the main boiler is cooling down after a period of operation, and will also keep the boiler walls dry against condensation. During such idle periods of the boiler

there is very little draft circulation through the main boiler section tubes and the down passage 19 so that practically all of the convected heat is taken up by the economizer water.

The described three pass serial flow of the gases through the boiler structure at a comparatively high rate of travel permits the maintenance of a very high fire box temperature with a low stack temperature and a consistently even range of temperature in the main boiler section, and short circuiting or dead pockets where condensation might occur will be prevented.

It will be noted that the economizer section is entirely detached from the main boiler section, and is always entirely full of water so that no steam is generated therein. The water is taken off therefrom at its highest point so that no air can remain therein to create either corrosion or incrustation at the upper ends of the tubes or the tube sheet.

I do not desire to be limited to the exact structure shown as changes and modifications are possible which would come within the scope of the invention.

I claim as follows:—

1. In a vertical fire tube boiler, the combination of a main boiler section having up-draft tubes, an economizer boiler section entirely surrounding said main boiler section concentric therewith and having draft tubes extending therethrough, a continuous annular down-draft passage separating said boiler sections, a fire box below said main boiler section, means for conducting the products of combustion from the upper ends of the main boiler section tubes to the upper end of said down draft passage, means for conducting the products of combustion from the lower end of said passage to the lower ends of said economizer section tubes, and a stack communicating with the upper ends of said economizer section tubes.

2. In a vertical fire tube boiler, the combination of a main boiler section having up-draft tubes, an economizer boiler section entirely surrounding said main boiler section and having up-draft tubes, a continuous annular down draft passage separating said sections, a fire box below said main boiler section, a stack communicating with the upper ends of said economizer section tubes, and means for causing all the products of combustion passing through said main section tubes to flow down through said passage and then up through said economizer section tubes.

3. In a vertical fire tube boiler, the combination of a main boiler section having up-draft tubes, an economizer boiler section surrounding the upper part of said main section and concentric therewith and having up-draft tubes, an annular down draft passage separating said sections, a passageway connecting the upper ends of the main sec-

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tion tubes with the upper end of said passage, a passageway connecting the lower end of said passage with the lower ends of said economizer section tubes, a firebox below said main section tubes, and a stack receiving the products of combustion from the upper ends of said economizer section tubes.

draft tubes, an economizer boiler section surrounding said main section and having up draft tubes, an annular down draft passage separating said sections and connected to conduct the products of combustion from the main section tubes to those of the economizer section, a water inlet for said economizer section, and a water outlet from the top of said economizer section connected with the main boiler section below the water level therein.

In witness whereof, I have hereunto subscribed my name this 23rd day of Nov., 1928.

GEORGE H. IRWIN.

4. In a vertical fire tube boiler, the combination of a main boiler section having up-draft tubes, an economizer section surrounding said main section concentric therewith and having up-draft tubes, an annular down draft passage separating said sections, a firebox below the lower ends of said main section tubes, means for causing all the products of combustion passing through said main section tubes to flow downwardly through said passage, means for causing the products of combustion to flow from the lower end of said passage upwardly through said economizer section tubes, a stack receiving the products of combustion from the upper ends of said economizer section tubes, a water leg surrounding said fire box and communicating with the water space of said main boiler section, a water inlet at the lower end of said economizer boiler section, and means for conducting the water from the top of the economizer boiler section to said water leg, said economizer boiler section being at all times entirely full of water.

5. In a vertical fire tube boiler the combination of a main boiler section having up-draft tubes, an economizer boiler section surrounding the upper part of said main section and having up-draft tubes, an annular down draft passage entirely separating said sections, a firebox below said main boiler section, means for causing all the products of combustion passing through said main section tubes to flow down through said passage, an annular space below said passage and the economizer section for conducting the products of combustion from said passage to the economizer section tubes, a stack receiving the products of combustion from the upper ends of the economizer section tubes, and limited passageway from said firebox to said annular space for the flow of heat from said firebox directly to said economizer tubes.

6. In a vertical fire tube boiler, the combination of a main boiler section having up draft tubes, an economizer boiler section having up draft tubes, an annular down draft passage between said sections communicating at its upper end with the upper ends of said main section tubes and at its lower end with the lower ends of the economizer section tubes, a fire box below the main boiler section tubes, and a direct passage of limited area between said fire box and the economizer section tubes.

7. In a vertical fire tube boiler, the combination of a main boiler section having up

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