

July 22, 1952

L. J. HENC
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FLUE BOILER HAVING RETURN FIRE TUBES.

2,604,081

Filed July 5, 1950

2 SHEETS—SHEET 1

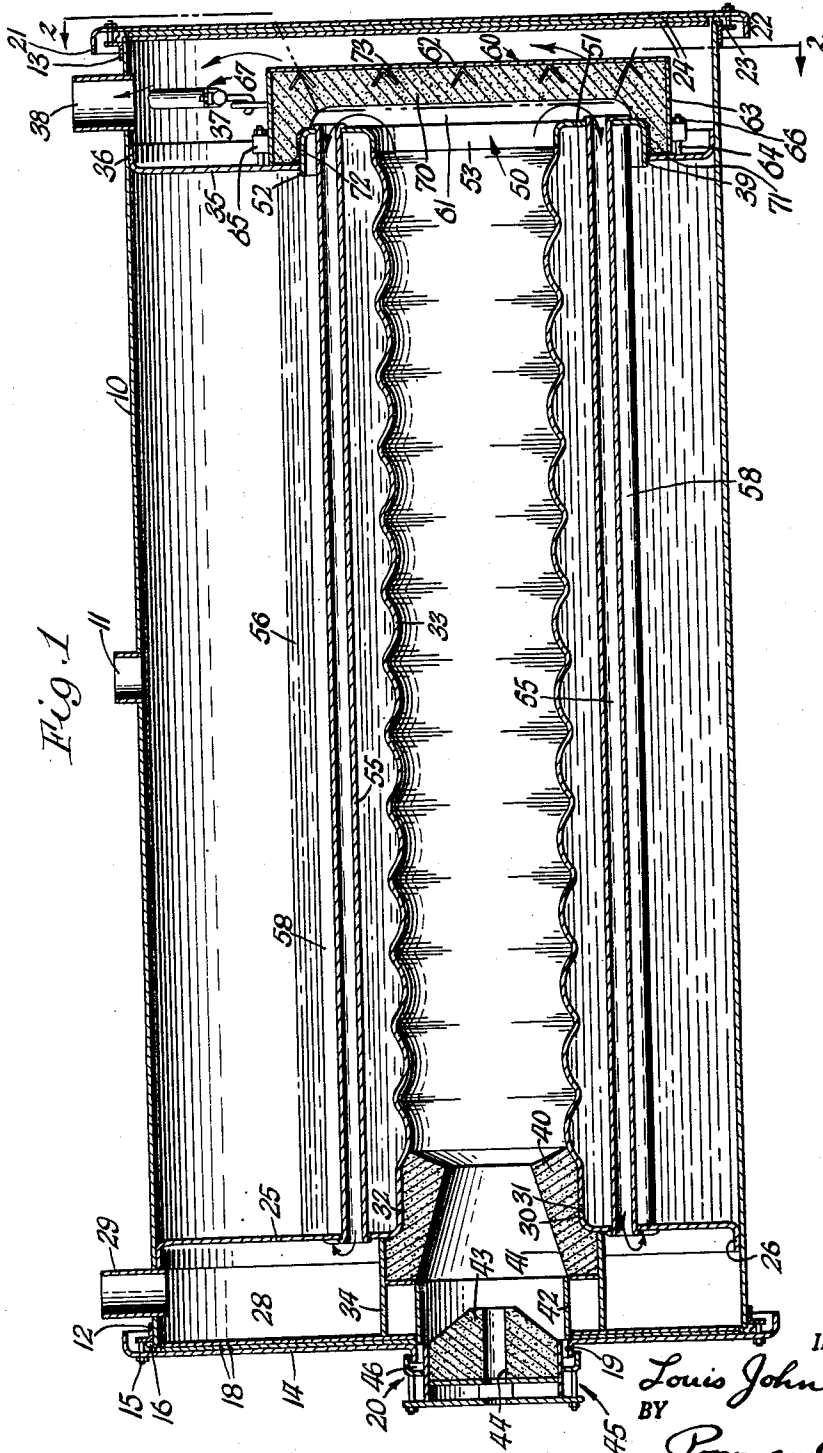


Fig. 1

INVENTOR.

Louis John Henc

BY

Popp and Sommer
ATTORNEYS

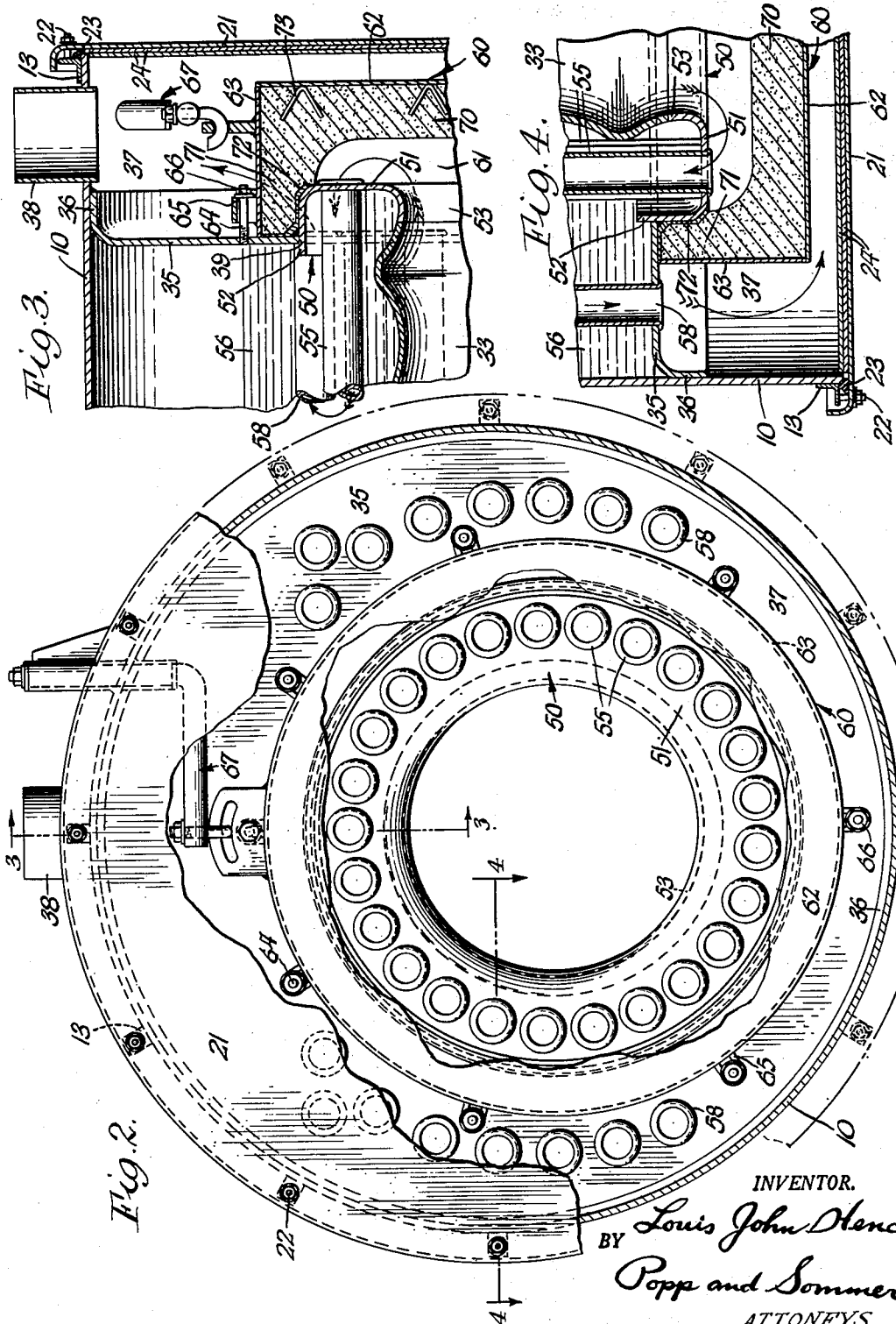
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2 SHEETS—SHEET 2



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TUBE SHEET AND SMOKE BOX FOR HORIZONTAL FLUE BOILER HAVING RETURN FIRE TUBES

Louis John Henc, Titusville, Pa., assignor to
Struthers-Wells Corporation, Titusville, Pa., a
corporation of Maryland

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1 Claim. (Cl. 122-149)

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This invention relates to a boiler construction for steam generators and the like and is more particularly shown as embodied in a horizontal fire tube type of boiler.

This application is a companion to my co-pending application, Serial No. 179,931, filed August 17, 1950, now Patent No. 2,595,523, for Removable Smoke Box Closure.

One of the principal objects of the invention is to provide a boiler construction in which a cover provides a gas transition chamber from the main combustion tube to a surrounding series of counterflow boiler tubes and in which the cover will last longer than similar covers heretofore used, such greater life being achieved in part by water cooling the rim of the cover.

Another object is to provide a boiler construction in which a refractory lined cover provides such a transition chamber from the main combustion tube to a surrounding series of counterflow boiler tubes and in which a stronger and tighter joint is obtained by using higher joint pressure in applying the cover, such stronger and tighter joint being a function both of water cooling the rim of the cover at the joint and also through fitting the rim of the cover around a projecting annular subhead connecting one end of the main combustion tube with the adjacent main transverse end head or tube sheet and forming a water cooled annular protuberance or extension of the main combustion tube.

Another object is to provide a joint between such a refractory lined cover and projecting annular subhead which is of labyrinth form in cross section thereby to inhibit the leakage of gas past the joint. The joint shown has three right angle turns which not only act to prevent leakage but also greatly reduce the velocity of any gas which does escape past the joint thereby to eliminate the harmful high temperature "blow-torch" effect of gases escaping at high velocity.

Another object is to increase the efficiency of operation of a boiler having such a gas transition chamber and to reduce the possibility of structural failures.

Other objects and advantages of the invention will be apparent from the following description and drawings in which:

Figure 1 is a vertical longitudinal section through a horizontal fire tube type of boiler embodying the present invention.

Figure 2 is an enlarged fragmentary sectional view taken generally on line 2-2, Figure 1.

Figure 3 is a fragmentary vertical longitudinal section taken on line 3-3, Figure 2.

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Figure 4 is a fragmentary horizontal section taken on line 4-4, Figure 2.

The invention is shown as embodied in a horizontal fire tube type of boiler having a cylindrical boiler shell 10 provided with a steam outlet 11 and having annular rows of external angles or lugs 12 and 13 welded to its front and rear ends, respectively.

The front end of the boiler shell 10 is closed by a circular front cover or cap 14 which is shown as secured to the front row of angles 12 of the boiler shell by a series of stud bolts 15, a suitable sealing gasket 16 being interposed between the front cover or cap and the front end of the boiler shell. The front cover or cap 14 is shown as lined with two layers 18 of insulating material and is provided with an outwardly necked opening 19 through which the burner equipment, indicated generally at 20, projects.

The rear end of the boiler shell 10 is closed by a circular rear cover or cap 21 which is shown as secured to the rear row of angles 13 of the boiler shell by a series of stud bolts 22, a suitable sealing gasket 23 being interposed between the rear cover or cap and the rear end of the boiler shell. The rear cover or cap 21 is shown as lined with two layers 24 of insulating material.

As best shown in Fig. 1, a front main transverse end head or tube sheet 25 is welded in the front end of the boiler shell, this main transverse end head being shown as having a forwardly projecting peripheral flange 26 welded to the inside of the boiler shell 10 in spaced relation to the front cover or cap 14 so as to provide a gas return chamber 28 at the forward end of the boiler. This gas return chamber is shown as provided with a gas relief vent 29. Coaxially with the opening 19 in the front cover or cap 14, the front main transverse end head or tube sheet 25 is provided with a rearwardly necked opening 30, the flange of which is indicated at 31. To the end of this flange 31 is welded, as at 32, the forward end of the tubular internal furnace shell or combustion tube 33. This combustion tube 33 can be of plain cylindrical form but is illustrated as having conventional corrugations. A sleeve 34 is shown as arranged concentric with the openings 19 and 30 and interposed between the front cap or cover 14 and the front main transverse end head or tube sheet 25 to house the burner equipment 20.

A rear main transverse end head or tube sheet 35 is welded to the rear end of the boiler shell, this main transverse end head being shown as having a rearwardly projecting peripheral flange

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36 welded to the inside of the boiler shell 10 in spaced relation to the rear cover or cap 21 so as to provide a last gas or gas outlet chamber 37 at the rear end of the boiler. This gas outlet chamber is provided with a gas discharge outlet flue 38. The rear main transverse end head or tube sheet 35 is provided with a circular opening 39 which is concentric with the internal furnace shell or combustion tube 33 but is of considerably larger diameter than this combustion tube.

The burner equipment 20 can be of any conventional form and is shown in Fig. 1 as comprising a block 40 of refractory material fitted within the sleeves 34 and front end of the combustion tube 33 and having a coaxial conical bore 41 converging toward and opening into the combustion tube 33 and forming a primary combustion chamber. This bore or combustion chamber 41 is shown as extended forwardly by a metal sleeve 42 interposed between the block 40 and the front cap or cover 14 of the boiler. A second block 43 of refractory material projects through the forwardly necked opening 19 of the front cap or cover 14 of the boiler into the metal sleeve 42. This second block 43 is provided with a bore 44 for reception of the usual fuel nozzle (not shown). The refractory block 43 can be supported by any conventional supporting structure, indicated generally at 45, and preferably in such manner as to leave an annular air inlet space 46 to the combustion chamber 41.

The invention is primarily directed to the projecting subhead indicated generally at 50 and which is disposed, as best shown in Figs. 1 and 4, in the opening 39 through the rear tube sheet or transverse end head 35 and which connects this tube sheet with the adjacent end of the tubular internal furnace shell or combustion tube 33. This projecting subhead is in the form of an annular shell which is U-shaped in cross section, having a vertical annular rear wall 51, an outer flange 52 which projects axially forwardly through the opening 39 in the rear tube sheet or transverse end head 35, and an inner annular flange 53 which projects axially forwardly into engagement with the rear edge of the internal furnace shell or combustion tube 33. The abutting edges of the combustion tube 33 and inner flange 53 of the subhead are butt welded, and the edge of the opening 39 in the rear tube sheet 35 can be welded to the outer flange 52 of the subhead. The subhead 50 thereby is in the form of a rearwardly extending annular protuberance from the combustion tube and rear tube sheet of the boiler.

Inner or forward pass boiler tubes 55, as best shown in Fig. 1, connect the projecting subhead 50 with the front main transverse end head or tube sheet 25. These boiler tubes are arranged in an annular row around the combustion tube 33 and are immersed in the body 56 of water surrounding this combustion tube. The rear ends of these boiler tubes 55 extend through and are secured to the vertical annular rear wall 51 of the projecting subhead 50 and the front ends of these boiler tubes extend through and are secured to the front tube sheet 25. Accordingly the products of combustion leaving the rear end of the tubular internal furnace shell or combustion tube 33 travel radially outwardly around the projecting subhead 50 and enter the inner or forward pass boiler tubes 55 and are conducted to the chamber 28 between the front cover or cap 14 and front tube sheet 25. From this chamber 28 the products of combustion are conducted rear-

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wardly through outer or rearward pass boiler tubes 58 which, as best shown in Figs. 1, 2 and 4, connect the main transverse end heads or tube sheets 25 and 35 and discharge the products of combustion into the gas outlet chamber 37.

It will be seen from Fig. 1 that the body of water 56 contacts and hence water cools the boiler shell 10; main transverse end heads or tube sheets 25 and 35; main combustion tube 33; the two series of boiler tubes 55 and 58; and also the projecting subhead 50. It will particularly be noted that the latter is water cooled.

A feature of the invention resides in the construction of a cap or cover, indicated generally at 60, which is fitted to the projecting subhead 50 and which, as best shown in Figs. 1 and 2, forms a gas transition chamber 61 between the rear end of the combustion tube 33 and the rear ends of the inner or forward pass tubes 55. This cap or cover comprises a circular metal plate 62 having a forwardly projecting metal rim 63 which engages the rear face of the rear main transverse end head or tube sheet 35 in outwardly spaced relation to the projecting subhead 50. This rim can be secured to this rear tube sheet 35 by stud bolts 64, best shown in Figs. 2 and 3, projecting rearwardly from this tube sheet through loops 65 provided by welding U-shaped straps to the exterior of the cover rim 63. Nuts 66 on the ends of the stud bolts 64 are tightened against these loops 65 to draw the cap or cover 60 tightly against the rear tube sheet 35. For convenience in removal the cap or cover 60 can be supported by a davit 67 of any suitable construction.

The cap or cover 60, as shown in Figs. 1, 3 and 4, is lined with refractory material 70 which is hollowed out at its center to provide the gas transition chamber 61. This refractory material 70 is formed to provide a forwardly projecting rim 71 which lines the metal rim 63 and which is shaped to conform generally to the outer flange 53 of the projecting subhead 50 as well as to the rear face of the rear tube sheet 35 and the rear face of the vertical metal rear wall 51 of the subhead. To insure a tight seal at this joint of the cover or cap 60, a ring 72 of sealing material is provided, this ring being interposed between the rim 71 of the refractory lining 70 and the rear main transverse end head or tube sheet 35; between this rim 71 and the outer flange 53 of the projecting subhead 50; and between this rim 71 and the outer part of the vertical rear wall 51 of this subhead 50.

To retain the refractory lining 70 in the sheet metal shell of the cover, the conventional short lengths 73 of V-shaped wire are shown in Figs. 1 and 3 as welded at their apices to the metal shell and as embedded in the refractory.

In the operation of the boiler the products of combustion generated in the combustion chamber 41 travel longitudinally along the main combustion tube 33 toward the right hand end thereof as viewed in Figure 1. On leaving this combustion tube 33 the gases enter the gas transition chamber 61 and travel radially outwardly into the annular series of inner boiler tubes 55 where these gases travel countercurrent to the flow of gas in the main combustion tube 33, that is to the left as viewed in Figure 1. At the front end of the boiler the gases leaving the inner boiler tubes 55 enter the chamber 28 between the front cover or cap 14 and the front main transverse end head or tube sheet 25. From this chamber 28 the gases enter the outer series of boiler tubes 58 which connect the front tube sheet 25 with

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the rear tube sheet 35 and are discharged into the gas outlet chamber 37 at the rear of the boiler and escape through the stack or gas discharge 38.

The gas transition chamber 61 is provided by the cap or cover 60 and the present invention is essentially concerned with providing a labyrinthian and water cooled joint at the rim of this cap or cover 60 so as to prevent the escape of hot products of combustion from the gas transition chamber 61 directly to the gas outlet chamber 37. To this end the projecting subhead 50 is provided which connects the rear end of the main combustion tube 33 with the rim provided by the larger opening 39 in the rear main transverse end head or tube sheet 35. It will particularly be noted that the axially extending flanges 53 and 52 of this projecting subhead 50 are connected to the main combustion tube 33 and rear tube sheet 35 in such manner that this subhead 50 protrudes rearwardly beyond the main combustion tube and rear tube sheet, that is, toward the rear end of the boiler shell 10. The rim 71 of the refractory line 70 of the cap or cover 60 is formed to fit the rear face of the rear main transverse end head or tube sheet 35; the outer flange 52 of the projecting subhead 50, and the vertical rear wall 51 of this projecting subhead. Accordingly, it will be seen that in order to escape from the gas transition chamber 61 to the gas outlet chamber 37, it is necessary for the gases to make three right angle turns. Such escape is, of course, prevented by the ring 72 of sealing material, but, in the event this seal gives way, it will be seen that the requirement that the escaping gases make three right angle turns would materially slow down the velocity of such leaking gas and prevents "blow torch" action of this escaping gas.

Even more important is the fact that not only is the gas, so escaping, cooled by the water containing projecting subhead 50 but also that the entire refractory rim 71 of the cover or cap 60 is also water cooled by the projecting subhead 50. This water cooling of the refractory rim 71 of the cover or cap 60 insures that the joint of this cap or cover will last much longer than if it were left uncooled. Further, a much higher joint pressure can be employed where this joint is so cooled, this being effected by drawing up the nuts 66 to a greater degree. With such higher joint pressure, a tighter joint is obtained for the cover or cap 60 so as to further insure against the escape of gas. Also, as previously indicated, any gas which does escape is water cooled by the projecting subhead 50 so that in addition to having a low velocity these gases also have a lower temperature thereby to reduce their destructive effect.

From the foregoing, it will be seen that the present invention provides a boiler construction in which the joint between the cap or cover

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forming a gas transition chamber and the adjacent metal parts of the furnace is adequately water cooled and also of labyrinthian form so as to stand up under conditions of severe and constant use without danger of rapid deterioration. It will also be seen that if leakage of gas does occur from the transition chamber the destructive effect of such leakage is very materially reduced by the practice of the present invention.

I claim:

In a boiler, a boiler shell, a main transverse end head across one end of said shell in spaced relation to said one end of said shell, a combustion tube within said shell and having one end arranged adjacent an opening in said main transverse end head and projecting toward said one end of said shell, said opening being of larger size than said combustion tube, an annular subhead of U-shaped form in cross section at each side and having an inner annular flange projecting away from said one end of said shell toward said one end of said combustion tube and joined thereto and having an outer annular flange projecting axially away from said one end of said shell toward said main transverse end head and joined to said main transverse end head around said opening whereby said subhead provides an annular protuberance projecting from said main transverse end head toward said one end of said shell, boiler tubes extending through and secured to said subhead to conduct the gases from said combustion tube in counterflow relation to the gases passing through said combustion tube, a cover forming a gas transition chamber between said corresponding end of said combustion tube and said boiler tubes and comprising a metal cover shell having a rim projecting axially into engagement with the outer face of said main transverse end head and embracing said subhead in spaced relation thereto, a lining of refractory material in said metal cover shell, said lining including a rim portion generally conforming to said outer flange of said subhead and the adjacent part of said end head and a ring of sealing material interposed contiguously between said rim portion of said lining and at least one of the surfaces provided by said end head and said subhead, and means securing said rim to said main transverse end head.

LOUIS JOHN HENC.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,950,756	Sharp	Mar. 13, 1934
2,126,417	Sharp	Aug. 9, 1938
2,264,226	Toner	Nov. 25, 1941
2,464,701	Lyke	Mar. 15, 1949