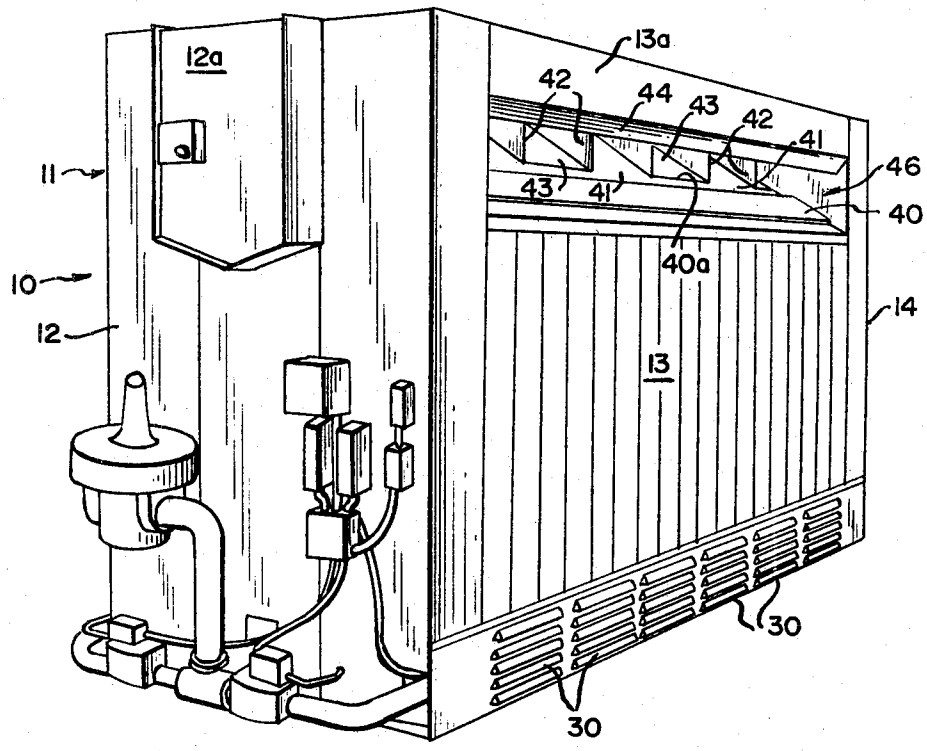
June 4, 1968 J. C. CLEAVER ET AL 3,386,420

ATMOSPHERIC FIRED BOILER

Filed May 19, 1966 2 Sheets-Sheet 1

FIG. 1



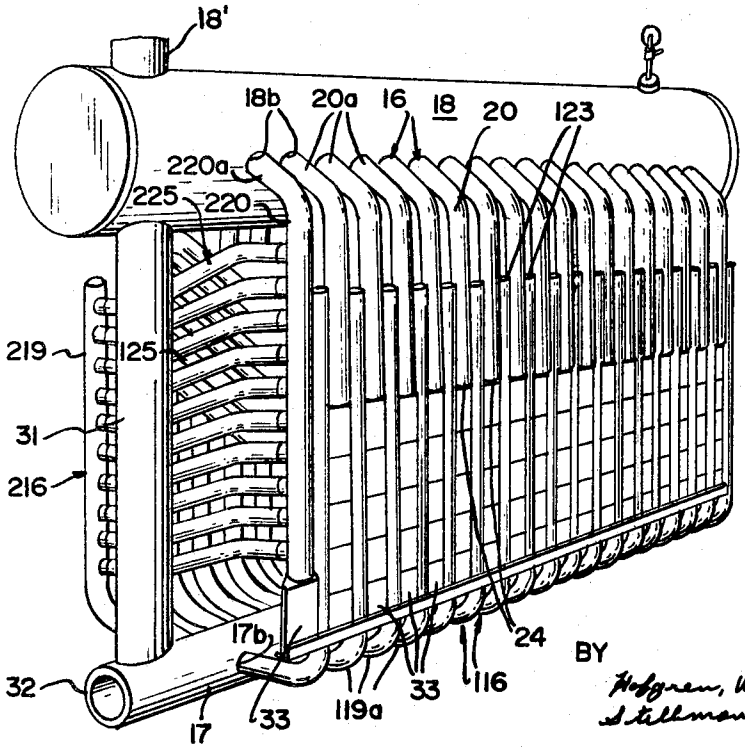


FIG. 2

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June 4, 1968 J. C. CLEAVER ET AL 3,386,420

ATMOSPHERIC FIRED BOILER

Filed May 19, 1966 2 Sheets-Sheet 2

FIG.3

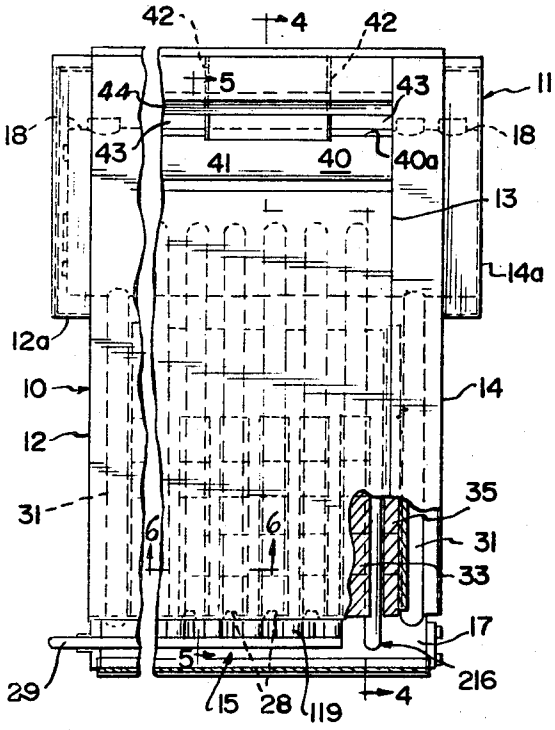


FIG.4

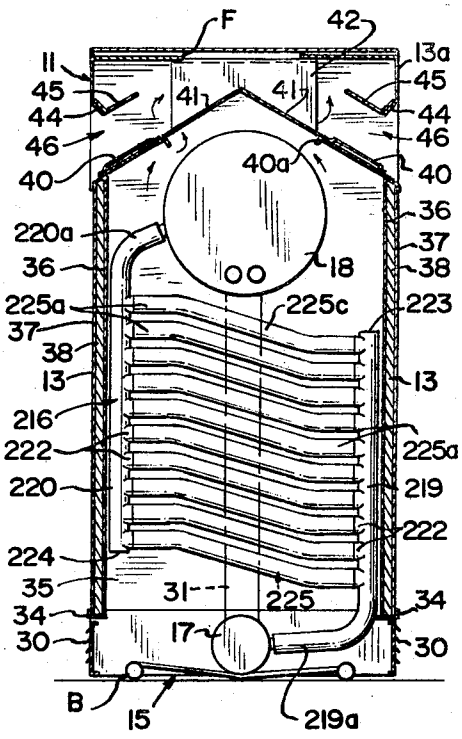


FIG.5

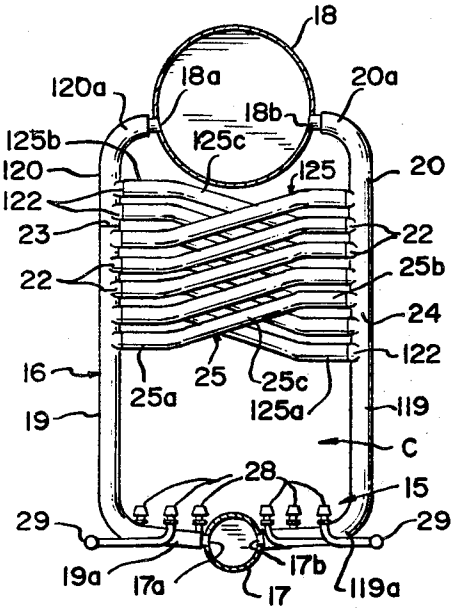


FIG.6

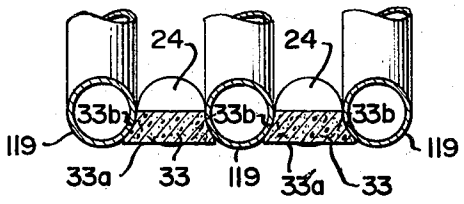
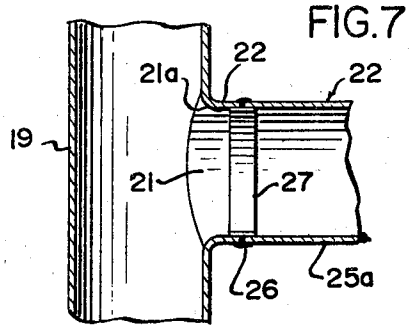


FIG.7



United States Patent Office

3,386,420
Patented June 4, 1968

3,386,420

ATMOSPHERIC FIRED BOILER

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Filed May 19, 1966, Ser. No. 551,361
12 Claims. (Cl. 122—235)

ABSTRACT OF THE DISCLOSURE

An atmospheric fired boiler including a cold water inlet drum and a hot water-steam outlet drum, with a plurality of heat exchange panels extending between the cold water inlet drum and the hot water-steam outlet drum. Each panel includes a plurality of vertically spaced connecting members extending between an inlet header that communicates with the cold water inlet drum and an outlet header that communicates with the hot water-seam outlet drum. Each connecting member includes generally horizontally disposed outer end portions, and an upwardly inclined intermediate portion.

This invention relates in general to an improved atmospheric fired boiler, and more particularly to an atmospheric fired boiler construction which may be used as a hot water boiler or a steam boiler.

In the prior art, many problems have been experienced by boiler designers in providing a consistent circular pattern throughout the boiler. Very often the circular pattern would change in response to changing loads on the boiler, so that water would be moving upwardly at one firing rate of the boiler, downwardly at another firing rate, and standing still at a still further firing rate. The present invention obviates this problem by providing a unique riser and downcomer arrangement which produces a continuous, unimpeded circulation pattern, and wherein all heated surfaces carrying water going up, while unheated surfaces carrying water coming down.

In known types of watertube steam generating boilers, it has been necessary to provide complex and costly steam separators to prevent water from carrying over into the steam line. The novel downcomer and riser panel structure of the present invention and the unchanging circulation pattern resulting therefrom completely eliminates the necessity of providing steam separators. Prior art atmospheric fired boilers have also been relatively time consuming and difficult to fabricate, and thus have been relatively high in cost. Accordingly, the general purpose of the present invention is to provide an improved and simplified atmospheric fired boiler construction, which is relatively inexpensive to manufacture, and which has operating characteristics which exceed those of known devices.

An object of the invention is to provide an atmospheric fired boiler with a plurality of heat exchange panels or risers formed of tubular members.

Another object of the invention is to provide an atmospheric fired boiler with a novel riser construction having an expanded heat transfer surface to enhance the heat exchange between the flue gases and the water passing through riser structure.

A further object of the invention is to arrange the tubular members of riser structure as described above in such a manner as to provide a tortuous path for the flue gases.

Still another object of the invention is to arrange the riser members of an atmospheric fired boiler in a manner

such as to provide water cooling at the ends of the bottom of the boiler.

Yet another object of the invention is to provide riser members as described above with the means for positively directing water from an inlet drum to a hot water-steam outlet drum.

A still further object of the invention is to provide an atmospheric fired boiler as described above with a novel downcomer arrangement, wherein the downcomer means is spaced from the heating area of the boiler.

These and other objects of the invention will become more fully apparent from the following specification, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a front perspective view of a preferred embodiment of the invention;

FIG. 2 is a front perspective view of the embodiment of FIG. 1, with the housing removed;

FIG. 3 is a fragmentary side elevational view of the embodiment illustrated in FIG. 1, with certain parts broken away from clarity of illustration;

FIG. 4 is a sectional view taken generally along line 4—4 of FIG. 3 with the refractory material removed to more clearly illustrate the end riser panel structure;

FIG. 5 is a sectional view taken generally along line 5—5 of FIG. 3, with certain parts broken away to clearly illustrate the intermediate riser panel structure;

FIG. 6 is an enlarged, fragmentary sectional view taken generally along line 6—6 of FIG. 3; and

FIG. 7 is a central sectional view through a riser, showing the junction between one of the vertically extending headers and one of the generally horizontally extending connecting members.

While this invention is susceptible of embodiment in many different forms, the is shown in the dawings and will herein be described in detail a preferred embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplificaton of the principles of the invention as is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring to the drawings in greater detail, a steam generating atmospheric fired boiler is shown generally at **10**, and includes a housing **11** having a front wall **12**, side walls **13**, and rear wall **14**. Boiler **10** is supported on a base B extending longitudinally of the boiler between housing front and rear walls **12** and **14**. Heating means **15** is provided at the lower portion of the housing **11** (FIGS. 3–5), and a plurality of longitudinally spaced heat exchange panels or risers **16**, **116** and **216** extend between housing walls **12–14**, and are connected between a cool water inlet drum **17** at the lower portion of the housing and steam outlet drum **18** at the upper portion of the housing. Lower drum **17** is supported on base B, and is preferably secured to the lower portion of housing front and rear walls **12** and **14**, while the upper drum **18** is supported by the risers with the outer ends of upper drum **18** being positioned in enlarged extensions **12***a* and **14***a* in the housing front and rear walls, respectively. One or more steam outlets **18'** is provided in upper drum **18**.

As can be best seen in FIG. 5, intermediate panels **16** each include a generally vertically extending inlet header **19** and a generally vertically extending outlet header **20**. Durms **17** and **18** are tubular cylindrical members, and drum **17** includes a plurality of longitudinally spaced openings **17***a* and **17***b* in opposite sides thereof, while drum **18** is provided with a plurality of longitudinally spaced holes **18***a* and **18***b* in opposite sides thereof. Holes **17***a* and **18***a* are longitudinally offset from holes **17***b* and **18***b*, and holes **17***a* and **18***b* are positioned in a common vertical plane, while holes **17***b* and **18***a* are also posi-

tioned in a common vertical plane, as will hereinafter appear. Sealing plates are bolted, or otherwise suitably secured, to opposite ends of drums **17** and **18**.

The inlet headers **19** of each panel **16** are positioned on one side of drums **17** and **18**, while the outlet headers **20** are positioned on the opposite side of drums **17** and **18**. Each inlet header **19** includes a laterally extending, horizontally disposing lower portion **19***a* which communicates with drum **17** through opening **17***a*, while each outlet header **20** includes a laterally extending upper portion **20***a* which communicates with drum **18** through opening **18***a*. Header portions **19***a* and **20***a* are preferably secured to drums **17** and **18** around openings **17***a* and **18***b*, respectively, by welding. The inlet headers **19** and outlet headers **20** are each provided with a plurality of vertically spaced openings **21**, which are identical with that shown in FIG. 7. As shown therein, a peripheral flange **22** extends outwardly from the generally vertically disposed header portion **19**, at right angles with respect thereto. The flanges **22** around the openings **21** are preferably fabricated by first forming an elliptical opening in the header wall, and then drawing a semi-spherical object through the opening. This provides rounded corners **21***a* at the junction between the header **19** and the flange **22**, which minimizes the entrance losses of water flowing outwardly of the header through the openings **21**.

As can be clearly seen in FIG. 5, the upper end of inlet header **19** terminates at **23** a substantial distance below steam drum **18**, while the lower end **24** of outlet header **20** is positioned a slight distance above the lowermost opening in the inlet header **19**. Suitable closure members are secured, as by welding, to the header end portions **23** and **24**. A plurality of generally transversely extending connecting members **25** extend between corresponding openings in the inlet header **19** and the outlet header **20** to provide an expanded heat exchange area. Connecting members **25** each include an upwardly extending central portion **25***c* with generally horizontally extending portions **25***a* and **25***b* at the outer ends thereof. The end portions **25***a* and **25***b* of connecting members **25** are positioned in alignment with the flanges **22** on headers **19** and **20** respectively, and are secured thereto as by welding at **26**. An annular back up ring **27** extends partially into each flange **22**, and into the adjacent end portion of the connecting member **25** to reinforce welded connection **26**.

Adjacent intermediate heat exchange riser panels are reversed throughout the length of the boiler, and the effect of this arrangement can be best visualized from FIGS. 2 and 5, where corresponding elements of the riser adjacent to riser **16** have been increased by the sum **100**. With this arrangement, the lower portions **119***a* of the inlet headers **119** communicate with the openings **17***b* inlet drum **17**, while the upper portions **120***a* of the outlet risers **120** communicate with the openings **18***a* in steam drum **18**. The inclined portions **125***c* of connecting members **125** are inclined upwardly in an opposite direction from the inclined portions **25***c* of connecting members **25**, and the inclined portions **25***c* and **125***c* cooperate to effectively define a tortuous flow path for the flue gases emanating from the heating means **15**. The vertical headers **19**, **20**, **119** and **120** define a heat exchange space which is generally rectangularly in cross section, and the connecting members **25** and **125** are spaced a substantial distance above the heating means **15** to define a combustion chamber C therebelow.

In the illustrated embodiment, the heating means **15** includes a plurality of longitudinally and transversely spaced gas burning nozzles **28**, which are connected to a suitable gas supply by manifold lines **29**. Nozzles **28** are preferably of the type disclosed in the copending application of Stiefel, Ser. No. 351,804, filed Mar. 13, 1964, and having the same assignee as the present application. As is clear from FIG. 5, nozzles **28** extend upwardly above the lower header portions **19***a* and **119***a* into the combustion chamber C. Air for combustion is drawn into the combustion chamber C through louvers **30** in the lower portion of the side walls **13** of the boiler housing. The flue gases, resulting from the gas combustion within combustion chamber C, flow upwardly around the expanded heat exchange area provided by connecting members **25** and **125**. The flue gases contact the connecting members **25** and **125** on both sides thereof, and flow in and around the tubes through the tortuous path created by the crossing inclined portions **25***c* and **125***c* to heat and evaporate the water flowing upwardly in the risers. Since the nozzles **28** are positioned above the lower horizontally disposed header portions **19***a* and **119***a*, the bottom of the boiler is water cooled by water flowing into the header portions **19***a* and **119***a* from the inlet drum **17**.

The endmost riser panels are similar to the intermediate riser panels **16**, and accordingly, similar reference numerals have been utilized to indicate corresponding elements, and have been increased by the sum **200**. End panels **216** include generally vertically disposed inlet headers **219** having generally horizontally disposed lower portions **219***a* communicating with water inlet drum **17**, and also include outlet headers **220** having laterally extending upper portions **220***a* communicating with steam drum **18**. Connecting members **225**, having upwardly inclined central portions **225***c*, extend between corresponding openings in the inlet headers **219** and **220**, and horizontal portions **225***a* and **225***b* at opposite ends of members **225** are secured to flanges **222** surrounding the header openings. Panels **216** differ from panels **16** and **116** primarily in the number of connecting members **225**. As is clear from FIG. 4, the end panels **216** include a substantial number more connecting members than the intermediate panels, and in the illustrated embodiment, the intermediate panels have five connecting members, while the end panels have ten connecting members. Because of the greater number of connecting members in the end panels, an effective wall of water is provided at each end of the boiler which provides a degree of cooling at each boiler end.

The water entering the vertical riser portions **19**, **119** and **219** flows into the respective connecting members **25**, **125** and **225** through the openings **21**, and then outwardly through the openings **21** into the vertically extending hot water outlet header portions **20**, **120** and **220**. The water is heated and evaporated in the connecting members **25**, **125** and **225**, and because of the inclination of central portions **25***c*, **125***c* and **225***c*, the heated, less dense water and steam flows freely upwardly into the outlet headers and into the steam drum **18**. The outlet headers **20**, **120** and **220** are larger in diameter than inlet headers **19**, **119** and **219** to accommodate the steam. One or more steam outlets **18'** is provided in the steam drum **18**.

Downcomer means, in the form of vertical tubular members **31**, communicates with opposite ends of the steam drum **18** and with the ends of water inlet drum **17**. Condensed steam is circulated from the drum **18** through the downcomer tubes **31** to the inlet drum **17**, from whence it again passes upwardly through the riser panels **16**, **116** and **216**. The condensed steam in downcomers **31** is denser than the water being heated in the riser connecting portions **25**, **125** and **225**, so that a differential pressure head is established to create natural circulation of the water through the boiler. It should be understood, of course, that pump means may be provided to create forced circulation, if desired. An inlet tube **32** communicates with water inlet drum **17** to provide make up water. As is clear from FIGS. 2 and 3, the downcomer members **31** are spaced outwardly of the end riser panels **216**, so that the downcomer members are clearly spaced from the heating area of the boiler. In this connection, it should be noted that the outermost of the burner nozzles **28** are spaced inwardly of the end panels **216**, so that the end panels **216** provide a degree of insulation for the downcomers **31**. Additional insulation is provided by

refractory material outwardly of the end panels **216**, to be hereafter described.

As may be best seen in FIGS. 2, 3 and 6, refractory members **33** are bonded between the vertically extending header portions **19**, **119** and **219** of the riser panels. The refactory is formed of a suitable firebrick material, which is somewhat T-shaped in cross section, as can be best seen in FIG. 6. The members **33** include a generally planar outer face **33***a*, and arcuate side faces **33***b* positioned against the adjacent surfaces of the headers **19**, **119** and **219**. Refractory members **33** can be conveniently carried by metal flanges **34** at the lower portion of side walls **13**, and the refractory material preferably extends upwardly to the lower ends **24** and **124** of the outlet headers **20** and **120**, respectively. Additional refractory material **35**, preferably in the form of a slidable panel, is provided outwardly of the endmost panels **216**, inwardly of the downcomers **31**, so that the heat of combustion is effectively retained within the combustion chamber C. As can be best seen in FIG. 4, side walls **13** are formed of two spaced sheet metal members **36** and **37**, and an insulating material **38** is provided between members **36** and **37** to prevent the housing walls **13** from being heated to any appreciable amount. Side walls **13** are also preferably supported on flange **34** outwardly of refractory members **33**.

Baffle means are provided at the upper portion of the housing **11** for directing the flue gases outwardly of flue openings F in the top of the housing **11**. As is best seen in FIG. 4, upwardly inclined surfaces **40** extend inwardly from the upper ends of side walls **13**, and downwardly inclined portions **44** extend inwardly from the lower portion of the upper side wall portions **13***a*. Upwardly inclined portions **45** extend inwardly from the lower end of portions **44** in general parallelism with portions **40**, to define a longitudinally extending opening **46** therebetween. Upwardly inclined portions **40** terminate at **40***a*, to define openings **43** which establish communication between the interior of the housing **11** and the atmosphere. Further inclined portions **41** extend upwardly and inwardly from the end portions **40***a* of inclined portions **40**, and inclined portions **41** are positioned beneath flue opening F, with vertical panels **42** being provided at opposite sides of the members **41**. Thus, the flue gases are free to pass upwardly around inclined portions **40** at the sides of members **41**, and then upwardly between members **42** outwardly of the flue opening F into a suitable stack, not shown. If a downdraft occurs, the baffle means provided by the inclined members **41** will prevent the downdraft from extinguishing the gas flame provided by nozzles **28**, and the flue gases will pass outwardly of the housing through the openings **46**.

From the foregoing it is believed clear that each of the objects of the invention have been fully achieved. Although the boiler structure disclosed above has been described in terms of a steam generating boiler, it will be readily apparent to those skilled in the art that the same general structure will function equally well for a hot water boiler. When used as a hot water boiler, a smaller upper drum **18** may be utilized, and in preferred embodiments, when used as a steam generating boiler the drum **18** is 20" in diameter, while when used as a hot water generating boiler, the upper drum **18** is 12" in diameter. In each of the embodiments mentioned above, the lower drum **17** is approximately 6" in diameter, while the inlet header tubes and connecting member tubes are 2" in diameter and the outlet header tubes are 2½" in diameter. The inlet and outlet headers are preferably spaced apart approximately 28" in each of the embodiments mentioned above, and the lowermost connecting members are spaced approximately 17¾" above the nozzles **28**, so that the combustion chamber *c* is rectangularly shaped in cross section, having dimensions of 17¾" by 28.

We claim:

1. A panel for use in a boiler comprising; a vertical inlet header; a plurality of vertically spaced outlet openings in said inlet header; a vertical outlet header; a plurality of vertically spaced inlet openings in said outlet header, each outlet header inlet opening corresponding to one inlet header outlet opening and being spaced vertically thereabove; and a tubular connecting member extending between each inlet header outlet opening and each outlet header inlet opening, each connecting member having a generally horizontally disposed portion at one end communicating with its respective inlet header outlet opening, an intermediate portion inclined upwardly from said end portion toward the outlet header inlet opening, and a generally horizontally disposed portion at the opposite end communicating with its respective outlet header inlet opening.

2. A panel as set forth in claim **1** wherein said inlet header includes a generally laterally extending lower inlet end directed toward said outlet header, and said outlet header includes a generally laterally extending upper outlet end directed towards said inlet header.

3. A panel as set forth in claim **1** wherein said outlet header is larger than said inlet header.

4. A panel as set forth in claim **1** wherein an outwardly extending peripheral flange is provided around each of the inlet and outlet openings in alignment with and secured to the adjacent end of the respective connecting member.

5. A panel as set forth in claim **4** wherein a back up ring extends partially into each header flange and into the adjacent connecting member end, so as to be positioned under the connection between the connecting member and flange.

6. A boiler comprising: a housing; a water inlet drum at the lower portion of said housing; a hot water-steam outlet drum at the upper portion of said housing; a plurality of adjacent, longitudinally spaced heat exchange panels in said housing, each panel including a vertical inlet header having a lower portion communicating with said water inlet drum, a vertical outlet header having an upper portion communicating with said hot water-steam outlet drum, and a plurality of vertically spaced connecting members inclined upwardly between said inlet header and said outlet header to define an expanded heat exchange area, the outermost of said panels including more connecting members than the panels therebetween to provide water cooling at the ends of the boiler; downcomer means connected between said hot water outlet drum and said water inlet drum for recirculating water to said panels; and means within said housing for heating said panels.

7. A boiler as set forth in claim **6** wherein said downcomer means is spaced from said heat exchange panels.

8. A boiler as set forth in claim **6** in which the lower portion of each inlet header is generally horizontally disposed, and wherein said heating means is positioned above said inlet header lower portions, whereby water cooling is provided at the bottom of the boiler.

9. A boiler as set forth in claim **6** wherein the inlet header of each panel is positioned on one side of said drums and the outlet header of each panel is positioned on the opposite side of said drums, so that said inlet header lower portions communicate with said water inlet drum at said one side thereof and said outlet header upper portions communicate with said hot water-steam outlet drum at said opposite side thereof.

10. A boiler as set forth in claim **9** wherein adjacent panels are reversed throughout the length of said boiler, so that the communicating portions of adjacent panel headers engage opposite sides of said drums and the connecting members of adjacent panels are oppositely inclined, whereby a tortuous path is defined for heating gases emanating from said heating means.

11. A boiler as defined in claim **6** wherein said heating

means includes a plurality of heating elements spaced longitudinally and transversely throughout said boiler.

12. A boiler comprising: a housing; a water inlet drum at the lower portion of said housing; a hot water-steam outlet drum at the upper portion of said housing; a plurality of adjacent, longitudinally spaced heat exchange panels in said housing, each panel having hot water riser means communicating with the water inlet drum and with the hot water-steam outlet drum, and each panel having means providing an expanded heat exchange area; downcomer means connected between said hot water outlet drum and said water inlet drum for recirculating water to said panels; means within said housing for heating said panels; said housing including insulated side and end walls enclosing said drums, panels, and heating means therewithin, said housing having a gas outlet opening in the top thereof with baffle means in the upper portion of the housing for directing gases from said heating means passing upwardly through said panels to said opening, said baffle means including means communicating with the atmosphere and means for preventing extinguishing of said heating means.

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KENNETH W. SPRAGUE, *Primary Examiner.*

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,386,420 Dated June 4, 1968

Inventor(s) JOHN C. CLEAVER et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 1, the designation of the assignee which reads "Cleaner-Brooks Company" should read --Aqua-Chem, Inc.--

SIGNED AND
SEALED

NOV 25 1969

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents