

Oct. 28, 1952

W. S. PATTERSON ET AL

2,615,434

HEADER AND TUBES OF A FORCED CIRCULATION STEAM GENERATOR

Filed July 21, 1948

3 Sheets-Sheet 2

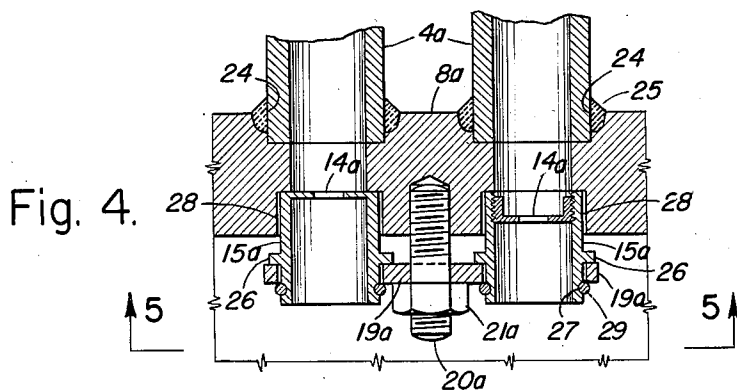


Fig. 5.

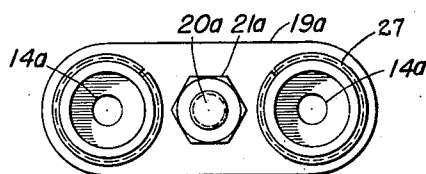


Fig. 6.

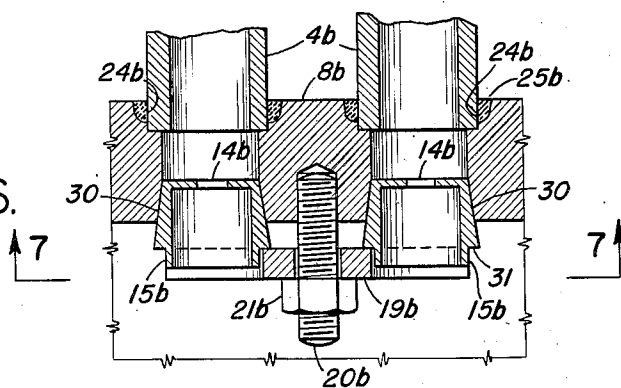
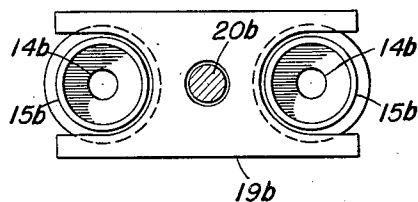


Fig. 7.



INVENTORS

Ward S. Patterson

Ernest C. Witzke

BY

Kurt J. Janssen

Oct. 28, 1952

W. S. PATTERSON ET AL

2,615,434

HEADER AND TUBES OF A FORCED CIRCULATION STEAM GENERATOR

Filed July 21, 1948

3 Sheets-Sheet 3

Fig. 9.

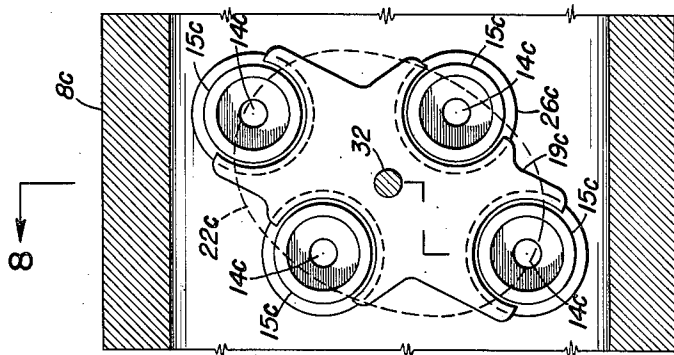
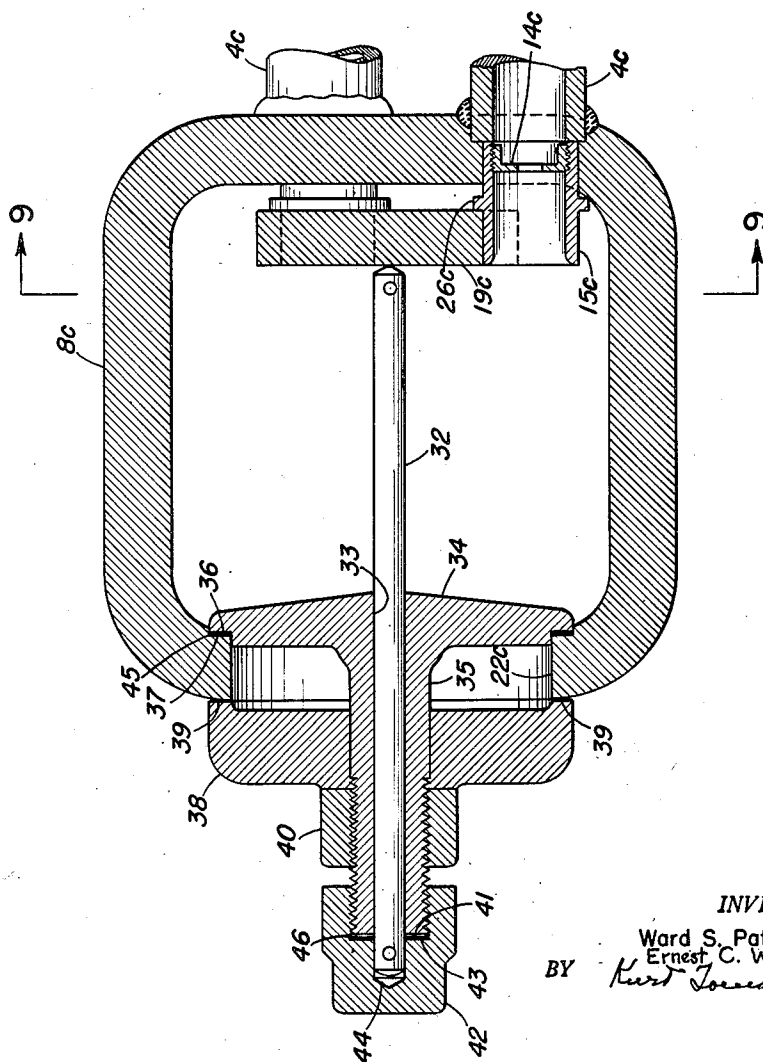


Fig. 8.



INVENTORS

Ward S. Patterson

Ernest C. Witzke

BY

Kurt J. Janssen

UNITED STATES PATENT OFFICE

2,615,434

HEADER AND TUBES OF A FORCED CIRCULATION STEAM GENERATOR

Ward S. Patterson, Chappaqua, and Ernest C. Witzke, Bayside, N. Y., assignors to Combustion Engineering-Superheater, Inc., a corporation of Delaware

Application July 21, 1948, Serial No. 39,966

5 Claims. (Cl. 122—360)

1

This invention relates to apparatus for generating steam and particularly to a steam generator in which there is a controlled forced circulation of the fluid through the steam generating tubes.

In steam generators constructed to operate in this manner, a multiplicity of steam generating tubes are connected to a common header from which they receive their supply of water thereby forming a multiplicity of parallel tube circuits in which steam is generated. The common header may be connected to the discharge of a pump which receives its water from a steam and water separating drum. The tube circuits discharge the steam and water mixture into the steam and water separator.

It is essential to distribute the water from the common header into the steam generating tube circuits in sufficient quantity so that each of the tubes will be sufficiently cooled by the water to protect it against overheating and consequent damage under all rates of steaming.

A preferred way of accomplishing such desirable distribution of water to all of the tube circuits which are connected for parallel water flow therethrough to a manifold or distribution header, has been to provide orifices or resistances at the entrance to each of the tubes. These orifices are of smaller diameter than the tube, the diameter being chosen to present a substantial resistance to the flow of water. Variations in the water resistance through the tube will then have a reduced influence upon the total resistance of orifice and tube and consequently upon the flow of water through the tube as governed by the orifice.

It is essential that the orifice remain unobstructed by foreign matter such as scale particles or sludge during operation because the amount of water flow through the tube and the tube's safety depends upon it. For this purpose screens or strainers have been provided within the distribution header at each of the orifices. The screen openings are smaller than the orifice so as to stop the flow of foreign matter into the orifice which otherwise might obstruct it. Another means for preventing obstruction of the orifices has been to provide one or more large strainers between the header containing the orifices and the pump for delivering water to the header.

The orifices whether provided with individual strainers or with a common outside strainer or strainers must be mounted within the header adjacent each tube entrance in such a manner that it may readily be removed for cleaning or replacement.

2

It is an object of this invention to provide improved means for mounting orifices within a header for supplying water to the tube circuits of a controlled forced circulation steam generator.

How the foregoing, together with other objects and advantages as may hereinafter appear or are incident to our invention are realized, is illustrated in preferred form in the accompanying drawings, wherein:

Figure 1 is a diagrammatic representation of a forced circulation steam generator.

Figure 2 is a cross section through a header taken on line 2—2 of Figure 3, showing improved means of mounting and retaining a multiplicity of orifices and their individual strainers opposite a single handhole plate.

Figure 3 is a section taken on line 3—3 of Figure 2.

Figure 4 is a cross section through a fragment of a header showing improved means of mounting and retaining a multiplicity of individual orifices within a header opposite a single handhold plate as shown in Figures 2 and 3.

Figure 5 is an end view of a yoke shown in Figure 4.

Figure 6 is a cross section through a fragment of a header showing another form of improved means for mounting and retaining a multiplicity of individual orifices within a header opposite a single handhole plate as shown in Figures 2 and 3.

Figure 7 is an end view of a yoke shown in Figure 6.

Figure 8 is a cross section through a header showing another form of improved means for mounting and retaining a multiplicity of orifices within a header opposite a single handhole.

Figure 9 is a cross section taken on line 9—9 of Figure 8 showing a fragment of the header containing a group of orifices.

Figure 1 illustrates an embodiment of the invention arranged for steam generation. The steam generator illustrated comprises a furnace chamber 1 within which fuel is burned by means such as an oil burner 2 arranged to deliver oil for combustion in the furnace in a well known manner. The boiler 3 having its heating surface within the furnace comprises a horizontal cylindrical steam and water drum 5 to which water may be supplied through feed pipe 6 and steam may be withdrawn through pipe 7.

The heating surface within the furnace comprises a multiplicity of tubes 4 in parallel arrangement connected to a common distribution header 8 and passing thence upwardly along a

3

wall of the furnace 1 and thence in back-and-forth passes upwardly through the upper portion of the furnace to connect to the steam and water drum 5. A downcomer 9 is connected at its upper end to the bottom portion of drum 5 and at its lower end to the inlet of a circulation pump 10. The pump is connected at its discharge end to distribution header 8 by connections 11, 11a through strainer 12. The pump 10 is driven as by a motor (not shown) and circulates the water from drum 5 into header 8 through strainer 12, thence through all of the tubes 4 and back into drum 5. An offtake 13 removes the products of combustion from the furnace.

In order to insure a proper distribution of the water among all of the tubes 4 of the heating surface which are connected in parallel between the header 8 and drum 5, it is essential to provide means such as orifices 14, 14a, 14b, 14c (as shown in Figs. 2, 5, 7 and 9 respectively) for restricting the flow of water at the entrance end of each tube. In the absence of a common strainer 12, individual strainers may be provided in each orifice mounting 15 as shown in Figure 2.

The present invention is concerned with improved means for mounting orifices within the header and means for retaining groups of said orifices in place, said groups being accessible through a single hand hole in the opposite side of the header.

Figures 2 and 3 show a preferred embodiment of the invention arranged within the distribution header 8. In Figure 2 the distribution header 8 is rectangular in cross-section and the steam generating tubes 4 are connected to the header as by rolling with the inner ends 16 flared out as shown. Fitted into each inner tube end 16 is a cylindrical tubular orifice mounting 15 containing an orifice 14 adjacent the tube end 16 and a plug 17 at the opposite end. Spaced around the circumference of said tubular structure 15 are slots 18 which serve as a screen for preventing foreign matter from obstructing the orifice 14.

In this disclosure there are four such members *a*, *b*, *c* and *d* associated with a group of four adjoining tubes 4. A pair of yokes 19—19' having arms held against the plugs 17 of the four members *a*, *b*, *c* and *d* as shown serve to maintain those members in position with respect to the associated tube ends. The two represented yokes 19—19' are held against the members *a*, *b*, *c* and *d* by means of individual stud bolts 20 each of which is fastened at one end to the wall of header 8 between a group of tubes and provided at the other end with a nut 21 which bears against the yoke.

Preferably each stud 20 is located at a point corresponding to the centre of gravity of the area enclosed by the triangle formed by the centres of members *a*, *b* and *c* or *c*, *b* and *d* of Fig. 3. However in practicing our invention under certain conditions stud 20 can desirably be located outside of said centre of gravity but within said respective triangle at a point which results in the most economical diagonal ligament between said stud hole and a pair of tube holes located at the vertexes of its corresponding triangle; such location also resulting in the most economical header wall thickness for any given design pressure.

The group of tubes 4 together with the members *a*, *b*, *c* and *d* and yokes 19—19' is located opposite a single hand hole 22 which is so constructed and arranged as to permit access to all of the members *a*, *b*, *c* and *d* and tube ends 16 and the yokes 19—19', and permits their removal through the hand hole.

4

Figures 4, 5; 6, 7; 8, 9, show orifice mountings 15a, 15b and 15c respectively in which the individual strainer to each orifice (as shown in Figure 2) is omitted and a common strainer 12 (as shown in Figure 1) is provided. The strainer 12 as is well known may deliver water from pump 10 into the inside of a tubular screen 23 whence the water passes through the screen into the housing of strainer 12 surrounding the screen and thence be delivered via pipe 11a into the header 8.

In Figures 4, 6 and 8 the wall of each header 8a, 8b receiving the ends of tubes 4a and 4b respectively is thicker than that shown in Figure 2 and the steam generating tubes 4a, 4b, project into a shallow bore 24 and 24b respectively and may be welded to the header as shown at 25 and 25b. The orifice mounting 15a in Figure 4 is cylindrical in shape and is provided with a flange 26 and a snap ring groove 27 adjacent its outer end. A shallow bore 28 is provided in the wall of header 8a in concentric alignment with the bore 24 of the associated tube. The orifice mounting 15a projects into bore 28. The yoke 19a engages in this instance two adjacent orifice mountings 15a and is spaced from the wall of header 8a. The yoke 19a is held against the flanges 26 of the orifice mounting 15a by means of stud bolt 20a and nut 21a. A snap ring 29 engages the snap ring groove 27 and bears against the outer end of yoke 19a thereby holding the yoke in fixed position with respect to the orifice mounting 15a. The orifice plate may be formed integrally with the orifice mounting or may be a separate member screwed into the orifice mounting so that it may be replaced.

In Figures 6 and 7 orifice mounting 15b adjacent the welded end of each tube 4b is substantially the same as shown in Figures 4 and 5 except that the bore in the wall of header 8b which receives the orifice member 15b is tapered and the outer wall 30 of orifice mounting 15b is similarly tapered so as to seat in the tapered bore. The orifice mounting 15b is provided with a shoulder 31 which receives yoke 19b. By tightening nut 21b of stud bolt 20b the yoke 19b is pressed against shoulder 31 of orifice member 15b and thereby holds said member firmly in the tapered bore of header wall 8b.

In Figures 8 and 9 the orifice member 15c is provided with a shoulder 26c as shown in Figures 4 and 5 against which a yoke 19c bears. Yoke 19c is loosely retained in position by a rod 32 which projects through an opening 33 in the hand hole closure plate 34 and its stem 35. The hand hole plate 34 forms a closure for the hand hole opening 22c located in the wall of header 8c opposite a group of four steam generating tubes 4c and their orifices 14c. The opening 22c in header wall 8c is of such shape and size that it provides access to the four associated orifice mountings 15c and provides an opening through which the yoke 19c and the orifice mountings 15c may be removed from the header.

The hand hole plate 34 is provided with a finished surface 36 which bears upon a gasket in turn resting against a finished seat 37 in the wall of header 8c. To maintain pressure on said gasket a yoke 38 spans the stem 35 of the hand hole plate and bears against the outside of the header at 39. A nut 40 engaging the thread on stem 35 is screwed tightly against yoke 38 and thereby compresses the gasket 45 between surfaces 36 and 37 to form a tight joint. According to the invention we provide an extension of

5

the thread on stem 35 and a finished surface 41 at the end of said stem. A cap nut 42 engages the thread on stem 35 and is provided with a finished surface 43 which engages a gasket 46 bearing against the stem end surface 41. Cap nut 42 is provided with a bore 44 for receiving the end of rod 32. In order to insure a tight seal between the surfaces 41 and 43 rod 32 is made of such length that it will allow a slight clearance at its end projecting into the bore 44 of cap nut 42 while the other end touches yoke 19c.

By the construction shown in Figures 8 and 9 the necessity for tapping holes inside of header 8 for receiving studs 20 as shown in Fig. 2 is avoided as well as the exposure of the threads of studs 20 to corrosion. The finished surface 41 on the end of stem 35 of closure plate 34 may easily be applied during the operation of machining the closure.

From the foregoing it will be seen that our inventive improvements are extensive in their adaption and are not to be restricted to the specific forms here disclosed by way of illustration.

What we claim is:

1. In a controlled forced circulation steam generator, an inlet header, means to supply water under pressure to the header; a plurality of steam generating tubes having their inlet ends connected to the header and including groups of three tubes each group of whose entrance locations are arranged in the pattern of a triangle; means forming a flow-restricting orifice mounted at the entrance end of each tube; a common yoke for retaining three of said orifices in respective engagement with the ends of the aforesaid three tubes which are included in said triangular grouping; a single member supported from the header wall at a point within the triangular pattern of said grouping and substantially at the center of gravity of its enclosed area, for maintaining said yoke in the orifice retaining position; and means forming in the header opposite said groups of orifices a handhole which is adapted to receive a handhole closure, said handhole being constructed and arranged to permit access to and removal both of said yoke and of each of said three grouped orifices out of the header.

2. In a controlled forced circulation steam generator, an inlet header, means to supply water under pressure to the header; a plurality of steam generating tubes having their inlet ends connected to the header and including groups of three tubes each group of whose entrance locations are arranged in the pattern of a triangle; means forming a flow-restricting orifice and screen therefor mounted at the entrance end of each tube; a common yoke for retaining three of said screens and orifices in respective engagement with the ends of the aforesaid three tubes which are included in said triangular grouping; a single member supported from the header wall at a point within the triangular pattern of said grouping and substantially at the center of gravity of its enclosed area, for maintaining said yoke in the screen and orifice retaining position; and means forming in the header opposite said groups of orifices a handhole which is adapted to receive a handhole closure, said handhole being constructed and arranged to permit access to and removal both of said yoke and of each of said three grouped screens and orifices out of the header.

3. In a controlled forced circulation steam

6

generator, an inlet header, means to supply water under pressure to the header; a plurality of steam generating tubes having their inlet ends connected to the header; means forming a flow restricting orifice mounted at the entrance end of each tube; a first common yoke for retaining a first triangular group of three of said orifices adjacent their tube ends, said first group comprising orifices *a*, *b* and *c*; a second common yoke for retaining a second triangular group of said orifices adjacent their tube ends, said second group comprising orifices *d*, *b* and *c*, whereby orifices *b* and *c* are retained both by said first yoke and by said second yoke; two single retaining members supported from the header, one retaining member at a point within the triangle of said first orifice group and substantially at the center of gravity of its enclosed area for maintaining said first yoke in the orifice retaining position, and the other retaining member at a point within the triangle of said second orifice group and substantially at the center of gravity of its enclosed area, for maintaining said second yoke in the orifice retaining position; and means forming in the header opposite said two groups of orifices a handhole which is adapted to receive a handhole closure, said handhole being constructed and arranged to permit access to and removal of both said yokes and each of said groups of said orifices out of the header.

4. In a controlled forced circulation steam generator, an inlet header, means to supply water under pressure to the header; a plurality of steam generating tubes having their inlet ends connected to the header; means forming a flow restricting orifice and screen therefor mounted at the entrance end of each tube; a first common yoke for retaining a first triangular group of three of said orifice and screen members adjacent their tube ends, said first group comprising orifice and screen members *a*, *b* and *c*; a second common yoke for retaining a second triangular group of said orifice and screen members adjacent their tube ends, said second group comprising orifice and screen members *d*, *b* and *c*, whereby orifice and screen members *b* and *c* are retained both by said first yoke and by said second yoke; two single retaining members supported from the header, one retaining member at a point within the triangle of said first orifice group and substantially at the center of gravity of its enclosed area, for maintaining said first yoke in the orifice retaining position, and the other retaining member at a point within the triangle of said second orifice group and substantially at the center of gravity of its enclosed area, for maintaining said second yoke in the orifice retaining position; and means forming in the header opposite said two groups of orifices a handhole which is adapted to receive a handhole closure, said handhole being constructed and arranged to permit access to and removal of both said yokes and each of said groups of said orifice and screen members out of the header.

5. In a controlled forced circulation steam generator, an inlet header, means to supply water under pressure to the header; a plurality of steam generating tubes having their inlet ends connected to the header and including groups of three tubes each group of whose entrance locations are arranged in the pattern of a triangle; means forming a flow-restricting orifice mounted at the entrance end of each tube; a common yoke for retaining three of said orifices in respective engagement with the ends of the aforesaid three

tubes which are included in said triangular grouping; a single member supported from the header wall at a point within the triangular pattern of said grouping in the vicinity of the center of gravity of its enclosed area for maintaining said yoke in the orifice retaining position; and means forming in the header opposite said groups of orifices a handhole which is adapted to receive a handhole closure, said handhole being constructed and arranged to permit access to and removal both of said yoke and of each of said three grouped orifices out of the header.

WARD S. PATTERSON.
ERNEST C. WITZKE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,103,531	Niclausse	July 14, 1914
1,154,194	Meier	Sept. 21, 1915
1,231,928	Miller et al.	July 3, 1917
1,364,272	Geer	Jan. 4, 1921
1,988,659	Lamont	Jan. 22, 1935

FOREIGN PATENTS

Number	Country	Date
278,099	Great Britain	Oct. 6, 1927
590,176	Germany	Dec. 27, 1933