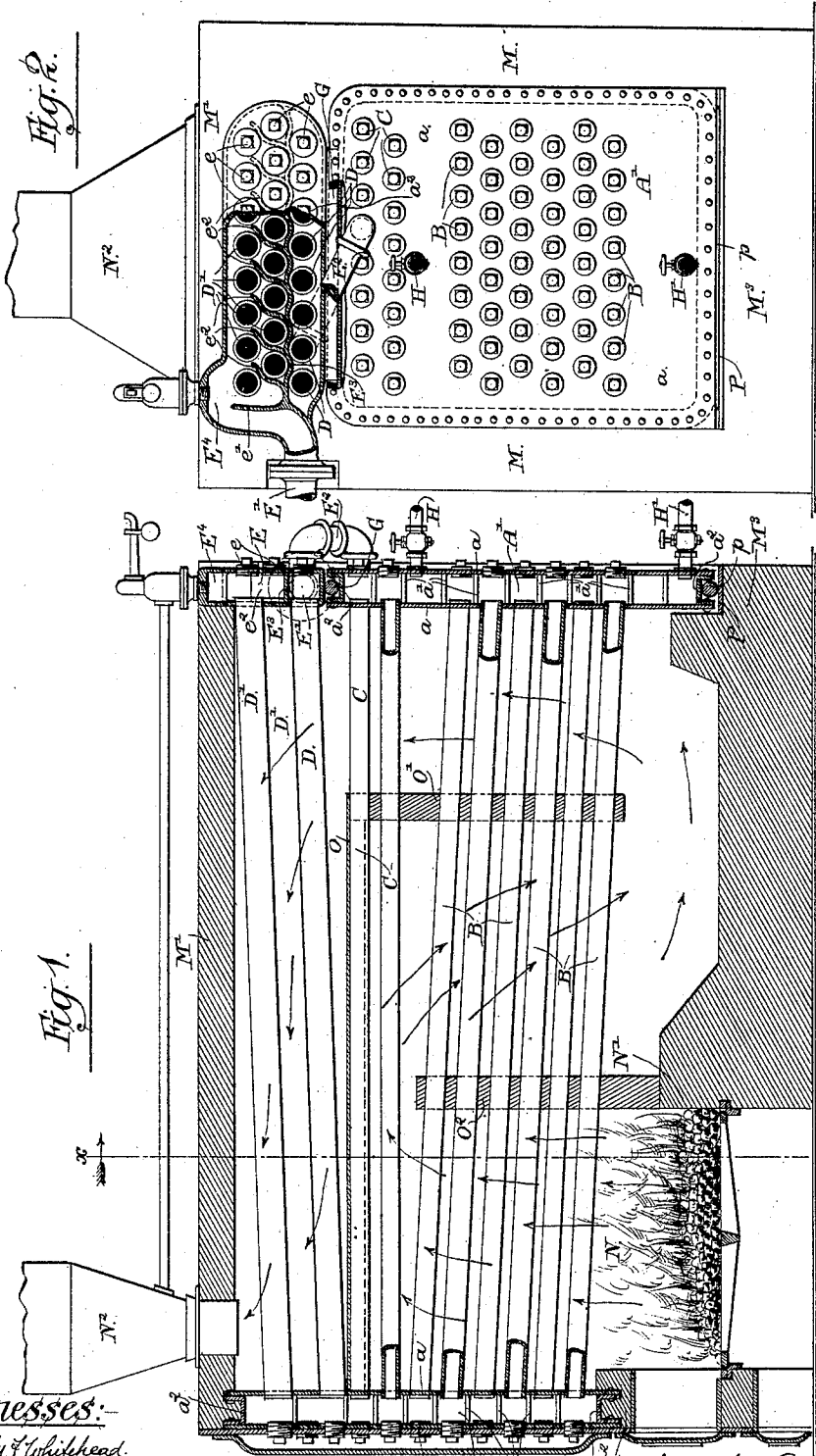


G. A. COLBY.
STEAM BOILER.

No. 391,583.

Patented Oct. 23, 1888.



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Fig. 3.

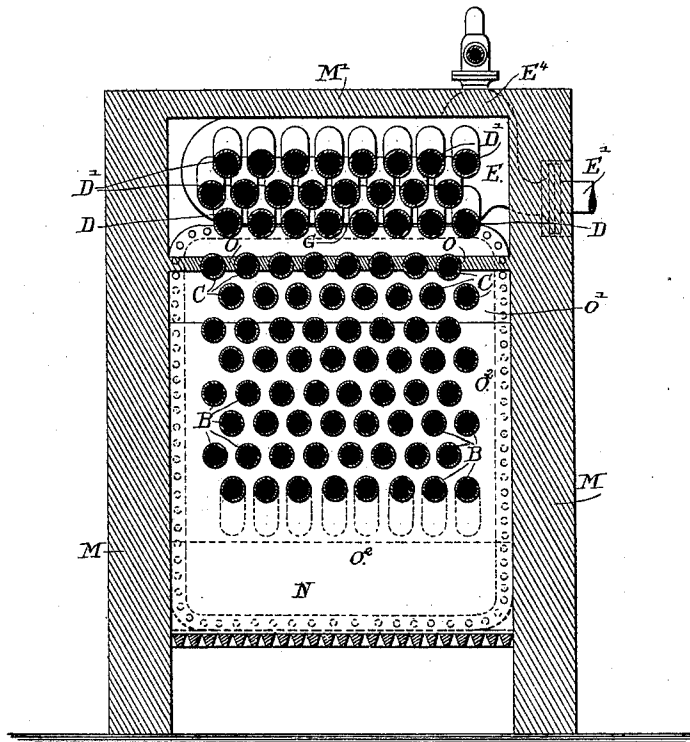


Fig. 3.

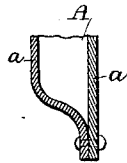
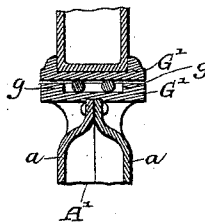


Fig. 4.



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UNITED STATES PATENT OFFICE.

GILBERT A. COLBY, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO M. COCHRAN ARMOUR, OF SAME PLACE.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 391,583, dated October 23, 1888.

Original application filed June 27, 1887, Serial No. 242,582. Divided and this application filed January 9, 1888. Serial No. 260,165. (No model.)

To all whom it may concern:

Be it known that I, GILBERT A. COLBY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to that class of steam-generators known as "water-tube boilers," or those in which the water is held in a plurality of tubes which are exposed to the action of the fire.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

The boiler herein shown as embodying my invention comprises as its principal features of construction a series of water-tubes arranged in a position slightly inclined from the horizontal and forming the main part or body of the boiler, a second series of horizontal tubes located above the inclined tubes mentioned, and two vertical water-heads with which the ends of the said several tubes are connected. The water-head at one end of the boiler is extended above the said water-tubes, and connected therewith is a third set of steam-heating tubes, the opposite ends of which are attached to a header, with which the exit steam-pipe communicates, as will hereinafter fully appear.

In the accompanying drawings, illustrating my invention, Figure 1 is a vertical longitudinal section of a boiler constructed in accordance with my invention. Fig. 2 is an end view of the boiler, showing the end thereof which is at the right hand side of Fig. 1. Fig. 3 is a cross-sectional view of the same, taken upon line *xx* of Fig. 1. Fig. 4 is a detail section taken upon line *xx* of Fig. 2, showing devices for supporting the steam-header from the water-head of the boiler. Fig. 5 illustrates a modified form of the steam-head.

As illustrated in the said drawings, *A A'* are two vertical water-heads arranged parallel with each other, or nearly so, at opposite ends of the boiler, and each consisting of parallel

plates *a*, connected by studs *a' a'* in a familiar manner.

B B B indicate a series of water pipes or tubes arranged in an inclined position, and connected at their opposite ends with and extending between the water-heads *A A'*. The tubes *B B* are located at the lower part of the boiler adjacent to the furnace, so that the water therein is exposed to the most intense heat from the furnace-fire.

Above the tubes *B B B* is located a second series of return water-tubes, *C C C*, which are arranged horizontally, and are also connected at both ends with the water-heads *A A'*. Said tubes *B B B* and *C C C*, together with the said water-heads *A* and *A'*, form a closed circuit, in which the water is adapted to freely circulate, the water in the inclined tubes *B B* rising as it is heated and flowing upwardly in said tubes to the water-head *A*, from which it passes through the horizontal tubes *C C* backwardly to the water-head *A'*, and then downwardly into the tubes *B B B*. The water-head *A'* terminates a short distance above the level of the pipes *C C C*; but the head *A* is extended considerably above said pipes, and connected therewith is a third series of pipes, *D D' D'*, located above the pipes *C C C*.

At the end of the boiler, adjacent to the water-head *A'*, is located a transversely-arranged horizontal steam chamber or header, *E*, with which the ends of the several steam pipes or tubes *D D' D'* are connected. The water-line of the boiler is located at or slightly above the upper water-pipes, *C C C*, and the space within the water-head *A* above said pipes *C C C*, together with the said pipes *D D'* and the header *E*, form the steam-space of the boiler, said pipes *D D'* being exposed to the products of combustion from the furnace and acting as heating-pipes to dry the steam. Steam is taken from the boiler by means of an exit-pipe, *E'*, connected with the header *E*, and a safety-valve, when employed, may be conveniently located upon and connected with the said header *E*.

In a boiler having water-tubes exposed to the action of the fire, and steam heating-tubes also exposed to the action of the fire or the

heated products of combustion, there is commonly a considerable difference in the degree of expansion which takes place in the water-pipes and steam-pipes when the fires are started, it being entirely obvious that the water-pipes will be kept practically at the temperature of the water within them, so that they will not expand to any considerable degree until the water becomes heated, while the steam-pipes will become heated and expanded as soon as the flames or heated gases from the fire come into contact therewith. One of the main features of my invention is embodied in the construction in which a horizontally-arranged header is employed in connection with the steam-heating pipes, said header being free to move relatively to the water-head at the end of the boiler adjacent to it, so that said header may freely change its position during the unequal expansion or contraction of the water and steam pipes.

In order to afford a direct passage for steam collecting in the upper part of the water-head A' to the steam-header E, I provide a pipe, E², which is arranged to connect the upper part of the said water-head A' above the water-line therein with the said header E. To afford the freedom of motion between the header E and the water-head A', required by the unequal expansion in the steam and water pipes of the boiler, I make the pipe E² of considerable length and dispose it in an inclined position, as clearly shown in Fig. 2, so that it may spring or yield to allow a considerable movement of the parts without bringing undue strain upon the main parts of the boiler or upon the said pipe or its connections.

The header E in the particular construction thereof herein illustrated is formed by an integral casting of rectangular cross-section, the inner vertical side wall of which is apertured to receive the pipes D' D' D', which are secured by being expanded therein in a familiar manner. Said header is provided at its outer surface with holes closed by removable screw-plugs e e, which afford access to the tubes for cleaning the same and other purposes.

In the particular construction herein shown in the header E and steam-pipes D' D' D' said parts are made as follows: The steam-pipes D D are arranged in three rows located one above another, the pipes being inclined downwardly from the header toward the water-head A, so that any water carried upwardly from the boiler into the header or pipes will flow by gravity into said water-head A. The header E is provided with a horizontal partition, E³, dividing the said header into two parts or chambers, the lower one of which is connected with the lower row, D, of steam-pipes and the upper with the two upper sets, D' D', of said pipes. The exit-pipe E' is connected with the upper part of the header at one end of the latter. Said header is provided at its end at which the exit-pipe is attached with an upwardly-extending part or dome, E⁴, beneath which is located a vertical partition, e', form-

ing an extension of the partition E³, said vertical partition being extended past the partition E³ downwardly to the bottom wall of the header. Said partition e' prevents the direct flow of steam toward the steam-exit pipe and causes the said steam to pass upwardly through the said elevated part or dome E⁴ before it passes out through said exit-pipe. The partition E³ extends to the end wall of the header at the end of the latter remote from the exit-pipe, so that the steam entering the lower part of the header E from the pipe E' is caused to pass through the lower row of steam-pipes, D, and backwardly through the upper rows of pipes, D' D', before it reaches the exit-opening, thereby preventing the passage into the steam-exit pipe E' of any water which may be carried upwardly through the pipe E² into the water-head A'. Steam from the water-head A in passing through the steam-pipes D' D' is thoroughly dried or partially superheated, and is therefore delivered in a dry state to the water-head. The lower row of pipes, D D, forms an additional steam-space and serves in connection with the upper row of pipes, D' D', to superheat or render dry the steam coming from the water-head A'.

As a further and special improvement I provide within the space or chamber of the header E, with which the pipes D' D' communicate, a series of cross walls or partitions, e² e², extending upwardly from the partition E³ (which forms the bottom wall of said chamber) between the open ends of the said pipes D' D', said partitions terminating below the top wall of the header a sufficient distance to leave an ample space at the upper part of the header for the passage of steam from the steam-pipes longitudinally through the header to the steam-exit pipe. The said partitions e² e² serve to arrest any water which may be carried through the steam-pipes D' D' by the rapid motion of the steam therethrough by foaming of the boiler or otherwise, and which may pass from the pipes D' D' into the header. Said partitions prevent the passage of such water outwardly through the steam-exit pipe, it being entirely obvious that any water entering the header with the steam will fall to the lower part thereof as the steam flows longitudinally through the header, and will be caught by the said partitions and flow by gravity backwardly through the lowermost of the pipes D' D' into the water-head A.

As illustrated in Figs. 1, 2, and 3, the water-heads consist of flat parallel sheets or plates, a a, connected at their edges by means of a channel-iron, a², to the outturned flanges of which the plates are riveted. In Fig. 4 a construction is shown in which the plates a a are bent or curved inwardly at their marginal parts and secured together by rivets passing through their meeting edges. In Fig. 5 a similar construction is shown, in which one of the plates a is bent or curved and the other is flat. The constructions in the water-heads shown in Figs. 4 and 5 afford the necessary connection between the

plates with only a single riveted joint. As far as the other features of the invention are concerned, however, said water-heads may be made in any manner found convenient or desirable.

5 I have herein shown the header E as located immediately over and as supported by the water-head A'. To provide for shifting or sliding of the header upon the water-head, as is liable to occur by reason of unequal expansion
10 of the tubes, as hereinbefore stated, I have herein shown as placed between said water-head A' and header E a roller, G, allowing free relative movement of the parts. Said roller G is shown in Figs. 1 and 2 as located between
15 the flanges of the channel-iron a^2 , which latter come close to the lower surface of the header E without touching the latter, so as to form close joints at these points.

In Fig. 4 is shown a construction in a supporting-roller adapted for use when the plates aa are bent inwardly and riveted at their edges. In this instance the roller G is placed between two flat plates or castings, $G' G'$, which latter are provided with flanges $g g$, and are held in
25 place upon the water-head A' and header E by being provided with suitable grooves or sockets to receive the flanges upon said parts, in the manner clearly shown in said Fig. 4.

H is a feed-water pipe, which I have herein shown as arranged to enter the water-head A' at a point above the tubes B B and below the tubes C C.

H' is a blow-off valve connected with the water-head A' at a point below the water-tubes
35 B B. The said water-head A' is desirably extended considerably below the water-tubes, so as to form a receptacle for mud and sediment, with which the blow-off valve is connected.

40 The boiler constructed in the manner described may be used in connection with a furnace constructed in any suitable or convenient manner. The furnace herein illustrated consists of side walls, M M, located at the sides of the several water and steam tubes, a top wall, M', extending over the top of the steam-heating tubes D D' D', and front and rear walls, M² M², sustaining the water-heads A A'. A fire-box, N, is formed by means of a bridge-wall, N'. The products of combustion from the furnace are caused to take a circuitous path through or about the tubes in their passage to the exit smoke-pipe N² by means of a horizontal partition, O, extending from the
55 front water-head, A, of the boiler backwardly over the upper water-tubes, C C, to a point near the rear water-head, A', where it is connected with a vertical wall, O', which extends downwardly to a point beneath the lowermost row of tubes B. A second vertical wall, O², extends from the top of the bridge-wall upwardly to a point near the horizontal partition O, spaces being left between the upper edge of the said wall O² and the
60 said partition O and between the bottom of the wall O' and the floor of the furnace

for the passage of the flames and heated products of combustion over or around the said walls in the direction indicated by the arrows, Fig. 1. After passing to the rear of the
70 wall O', the said products of combustion pass into the space above the partition O and then forwardly to the exit smoke-pipe N², which in this instance is located near the front of the boiler. In this construction the hottest part
75 of the flames and products of combustion coming directly from the fire is concentrated upon the water-tubes B and C, while the steam-heating pipes D D' D' are subjected to the action of the said heated products of combustion after the latter have passed over the
80 water-pipes, in the manner clearly shown in the drawings.

I have herein shown the water-head A' as sustained upon a metal plate, P, and as having
85 an anti-friction roller, p , beneath it, thereby allowing the said water-head to move freely upon the supporting-wall M² as the tubes B B and C C expand and contract, this roller being made substantially like that above described as being located between the said
90 water-head A' and the header E.

Some of the features of construction herein shown and described are illustrated in a separate application for patent, Serial No. 242,582,
95 filed in the United States Patent Office June 27, 1887.

I claim as my invention—

1. A steam-generator comprising two water-heads, A and A', arranged at opposite ends
100 of the generator and extending the full width of the same, a series of water-tubes located between and connected at their opposite ends with said water-heads, a second series of horizontal return water-tubes, also connected at
105 their opposite ends with the water-heads and located above said water-tubes, a series of steam-heating tubes located above the return water-tubes and connected with one of the said water-heads, a horizontally-arranged
110 steam-header connected with the ends of said steam-heating tubes, said steam-header being arranged horizontally over and adjacent to the said water-head A', and an obliquely-disposed steam-pipe connected at one end with the
115 upper part of the said water-head A' and at its opposite end with the said steam-header to allow for expansion and contraction of the several tubes, substantially as described.

2. A steam-generator comprising two water-heads, A and A', arranged at opposite ends of
120 the generator and extending the full width of the same, a series of water-tubes located between and connecting said water-heads, a series of steam-heating tubes located above said
125 water-tubes and connected with one, A, of said water-heads, and a horizontally-arranged steam-header located over and resting upon the said water-head A', and connected with the said steam-heating tubes and with the
130 steam-space of said water-head, said steam-header being movably supported upon the water-head,

whereby it may move independently thereof under the expansion and contraction of the steam-heating tubes, substantially as described.

3. The combination, with two water-heads, 5 water-tubes connected at their opposite ends with said water-heads, and two or more rows of steam-heating tubes located above the water-tubes and connected with one of the said 10 water-heads, of a horizontally arranged header connected with the ends of the said steam-tubes and provided with a horizontally-arranged dia- 15 phragm or partition located between the said rows of tubes and arranged to divide the said header into two separate chambers, a steam-pipe connecting the lowermost of said cham- 20 bers with the other water-head, and a steam-exit pipe connected with the uppermost of said chambers, substantially as described.

4. In a steam-generator having steam-heat- 20 ing tubes D' D', a horizontally-arranged steam-header, E, connected with said tubes and provided with a steam-exit opening at one end, with a raised part or dome, E¹, adjacent to the 25 steam-exit opening, and with a vertical partition, e', located within said dome, substantially as described.

5. In a steam-generator having steam-heating tubes D' D', a steam-header, E, connected with said tubes and provided with a horizontal par-

30 tition, E², and provided also with a steam-exit opening at one end and with a raised part or dome, E¹, adjacent to the steam-exit opening, and with a vertical partition, e', located within the said dome and connected with the partition 35 E², substantially as described.

6. In a steam-generator having steam-heat- 35 ing tubes D' D', a horizontally-arranged header, E, containing a steam-chamber communicating with said tubes, said steam-chamber being provided with an exit opening at one end, and 40 with substantially vertical partitions, e² e², located between the open ends of said tubes, substantially as described.

7. In a steam-generator having steam-heating 45 tubes D' D', a steam-header, E, provided with a horizontal partition, E³, and provided also with a steam-exit opening communicating with the space above the said partition, and with 50 transverse partitions e² e², extending from the partition E³ upwardly between the tubes, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

GILBERT A. COLBY.

Witnesses:

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O. N. WILLIS.