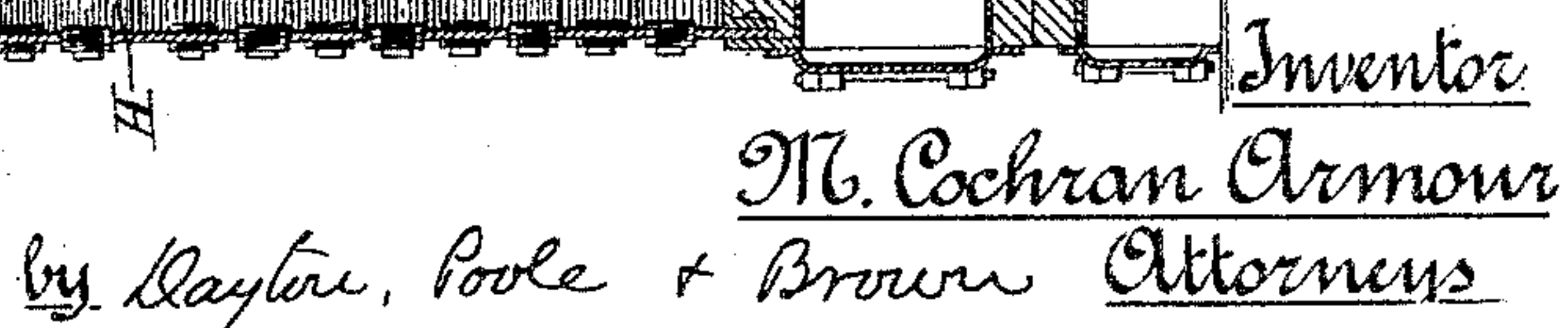


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UNITED STATES PATENT OFFICE.

MICHAEL COCHRAN ARMOUR, OF CHICAGO, ILLINOIS.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 401,102, dated April 9, 1889.

Application filed May 7, 1888. Serial No. 273,011. (No model.)

To all whom it may concern:

Be it known that I, MICHAEL COCHRAN ARMOUR, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Generators; 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 steam-generators, and more especially to that part thereof in which the steam is stored and reheated or dried preparatory to its delivery to the engine or elsewhere for use.

The invention is herein illustrated as applied to a water-tube boiler, or one in which the water is held in a plurality of tubes which are exposed to the action of the fire.

The main features of the invention may, however, be applied to other kinds of boilers, as will hereinafter more fully appear.

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

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 a cross-sectional view of the same, taken upon line 2 2 of Fig. 1. Fig. 3 is a sectional view of one of the steam-headers, taken upon line 3 3 of Fig. 1.

As shown in the several figures of the drawings, A A' are two vertical water-heads arranged parallel with each other, or nearly so, at opposite ends of the boiler. Each of said water-heads comprises two parallel plates, *a a*, connected by studs *a' a'* in a familiar manner.

B B B are water pipes or tubes arranged in an inclined position between the water-heads A A', and connected at their opposite ends with the latter. Said tubes B B B are located at the lower part of the boiler adjacent to the furnace.

C C C are other water-tubes arranged horizontally above the tubes B B B, and also connected at both ends with the water-heads A A'. Said water-heads A A', together with the tubes B B B and C C C, form a closed circuit in which the water is adapted to freely

circulate, in a manner well understood. The water-head A' terminates a short distance above the level of the pipes C C, but the head A is extended considerably above said pipes, thereby forming in its upper part a separating-chamber or steam-dome, A², from which the steam is delivered to steam-heating tubes or passages arranged within the furnace or boiler-casing, in a manner hereinafter described.

In the form of the steam-heating pipes or passages shown in Figs. 1, 2, and 3 said pipes are made as follows: D D' are two transverse steam-headers located at opposite ends of the boiler above the level of the water-tubes C, and connected with each other by a series of horizontally or slightly inclined pipes, E E. The steam-header D is connected with the upper part of the separating-chamber A² by means of a steam-pipe, F, while the opposite header D' is provided with an exit steam-passage, F', through which steam is delivered to the supply-pipe leading to the engine or elsewhere.

The pipes E E E are exposed to the flames and heated products of combustion in the upper part of the boiler-casing, so that the steam passing therethrough or remaining therein is thoroughly dried; or, in other words, any water remaining in the steam and carried into said pipes from the water-space of the boiler is vaporized and converted into steam, thereby rendering the steam entirely dry.

The steam-headers D and D' are herein shown as divided by a series of vertical partitions, *d d d' d' d'*, into a plurality of separate chambers, D² D⁴ D⁶ D⁸ D³ D⁵ D⁷ D⁹, with which the ends of the several steam-pipes E E E communicate. The said steam-pipes are divided into several groups, the drawings showing three pipes in each group. One group of said pipes communicates with the compartment D², into which leads the steam-pipe E, while the opposite ends of the pipes comprising the same group enter a compartment, D³, which is wider than the compartment D², and with which are connected the ends of a second group of pipes. The said second group of pipes communicate with the second chamber, D⁴, of the header D, which also communicates with a third group of pipes,

which enter the second compartment, D⁵, of the header D'. The several groups similarly connect the several compartments until the compartment D⁹ is reached, from which the steam makes its exit through the exit-pipe F'. In the operation of the boiler thus constructed steam entering through the pipe F to the first compartment or chamber of the header D passes through the first group of pipes to the opposite compartment of the header D', then through the next group of pipes back to the header D, and so on until it passes from the exit-pipe F'. The steam is thus caused to pass backward and forward in a zigzag or tortuous course through the several pipes E E E, thereby subjecting the steam for a relatively long period to the action of the heat and insuring the perfect drying of the steam. The relatively large space or area afforded by the said several steam-heating pipes and the headers D and D' furthermore provides an ample storage-space for steam in the boiler.

In order to afford a direct passage of steam collecting in the upper part of the water-head A' to the steam-space or separating-chamber of the water-head A, I provide a pipe, G, which is connected with the upper parts of the water-heads A and A' in the manner shown.

The headers D and D', in the particular construction shown, are formed by integral castings rectangular in cross-sectional form, the inner vertical side walls of which are apertured to receive the pipes E E E, which are secured in place by being expanded in the walls in a familiar manner. Said headers are provided in their outer walls with removable screw-plugs d² d², affording access to the interior of the tubes.

I have herein shown the header D as supported upon a transverse girder, H, extending over the tubes C near the front of the boiler, and the header D' as sustained upon a similar girder, H', located near the rear water-head, A'. To provide for the shifting or sliding of the headers upon the supporting-girders, as is liable to occur by reason of unequal expansion of the several steam and water tubes and the expansion and contraction of the pipe F, I place between the steam-headers D and D' and the said girders rollers h h, allowing free relative movement of the parts, in a manner heretofore common and well understood.

The unequal expansion of the steam and water tubes, above referred to, is liable to occur, for the reason that there is a considerable difference in the degree of expansion taking place in the water-pipes and steam-pipes when the fires are started, it being entirely obvious that the water-pipes will remain practically at the temperature of the water within them, so that they will not expand to any considerable extent until the water becomes heated, while the steam-pipes will become heated and expand as soon as the flames or heated gases come into contact therewith.

A boiler constructed in the manner described and shown in Figs. 1 and 2 may be

used in connection with a furnace made in any suitable or convenient manner. The furnace herein illustrated consists of side walls, I I, a top wall, I', extending over the steam-heating tubes E E and the steam-headers D D', and a top wall, I², filling the space between the water-head A and the girder H, which supports the steam-header D. A wall, I³, fills the space between the top of the rear water-head, A', the girder H', and the water-tubes C C C. A front wall, I⁴, and a rear wall, I⁵, sustain the front and rear water-heads, while the fire-box is formed by a bridge-wall, I⁶, which is extended upwardly between the water-tubes B B, to form a partition, i. i' is a horizontal partition extending rearwardly from the girder H, and connected at its rear end with vertical partition i², located at the rear of the partition i. The partitions i, i', and i² give a tortuous course to the flame and products of combustion around and between the several pipes before the same make their exit through the exit smoke-pipe I', which is herein shown as located in the forward part of the top wall, I'.

I am aware that it has been common heretofore to employ steam-heating pipes for drying the steam passing from the water-space of a tubular boiler to the exit-opening of the boiler, and I am also aware that a steam-storage chamber has been used in connection with such steam-heating tubes. Such storage-chamber has, however, been arranged to receive the steam after it has passed through the steam-heating tubes, so that such chamber is not adapted to act as a separating-chamber.

A boiler embodying the main features of my invention differs from those above referred to in the important particular that a chamber in which the water may become separated from the steam is provided adjacent to the water-space of the boiler and between such water-space and the steam-heating pipes. The water is thus separated from the steam before it enters the pipes, and thereby obviates liability of the water being carried into and through the pipes and insuring the passage of perfectly dry steam only from the generator, it being entirely obvious that if water in any considerable quantities enters the steam-heating tubes the latter become steam-generators, and must necessarily fail to perform perfectly their function of steam-driers. Water entering the steam-heating tubes is liable to be carried or blown rapidly through said tubes, so that it may or may not all become vaporized therein, and in case it is not all vaporized before reaching the exit-opening of the boiler the delivery of wet steam or the passage of much water to the engine is the inevitable result.

I claim as my invention--

1. The combination, with a steam-generator comprising two water-heads arranged at opposite ends of the generator and extending the full width of the same, a series of inclined

water-tubes located between and connected at their opposite ends to said water-heads, and a second series of horizontal water-tubes located above the same, one of said water-heads being extended above the horizontal water-tubes to form a separating-chamber, of a plurality of separate steam-headers arranged at opposite ends of the boiler, and steam-heating pipes connecting said headers with each other and one of said headers with the top of said separating-chamber, one of said headers being provided with an opening forming the steam-exit of the boiler, substantially as described.

2. The combination, with a steam-generator provided with a steam-space or separating-chamber, of steam-headers D D', divided into a series of chambers or compartments by transverse partitions, steam pipes or tubes E E, connecting said headers, and a pipe or passage connecting one of the headers with

the steam-space of the generator, substantially as described.

3. The combination, with a steam-generator comprising two water-heads and intermediate water-tubes connected therewith, two steam-headers, D and D', and a plurality of steam-heating pipes, E E E, communicating with the said headers, and a pipe connecting said headers and steam-heating pipes with the steam-generator, of transverse girders located over the water-tubes of the boiler and sustaining said steam-headers D and D', substantially as described.

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

M. COCHRAN ARMOUR.

Witnesses:

C. CLARENCE POOLE,
EDWD. B. ELLIAS.