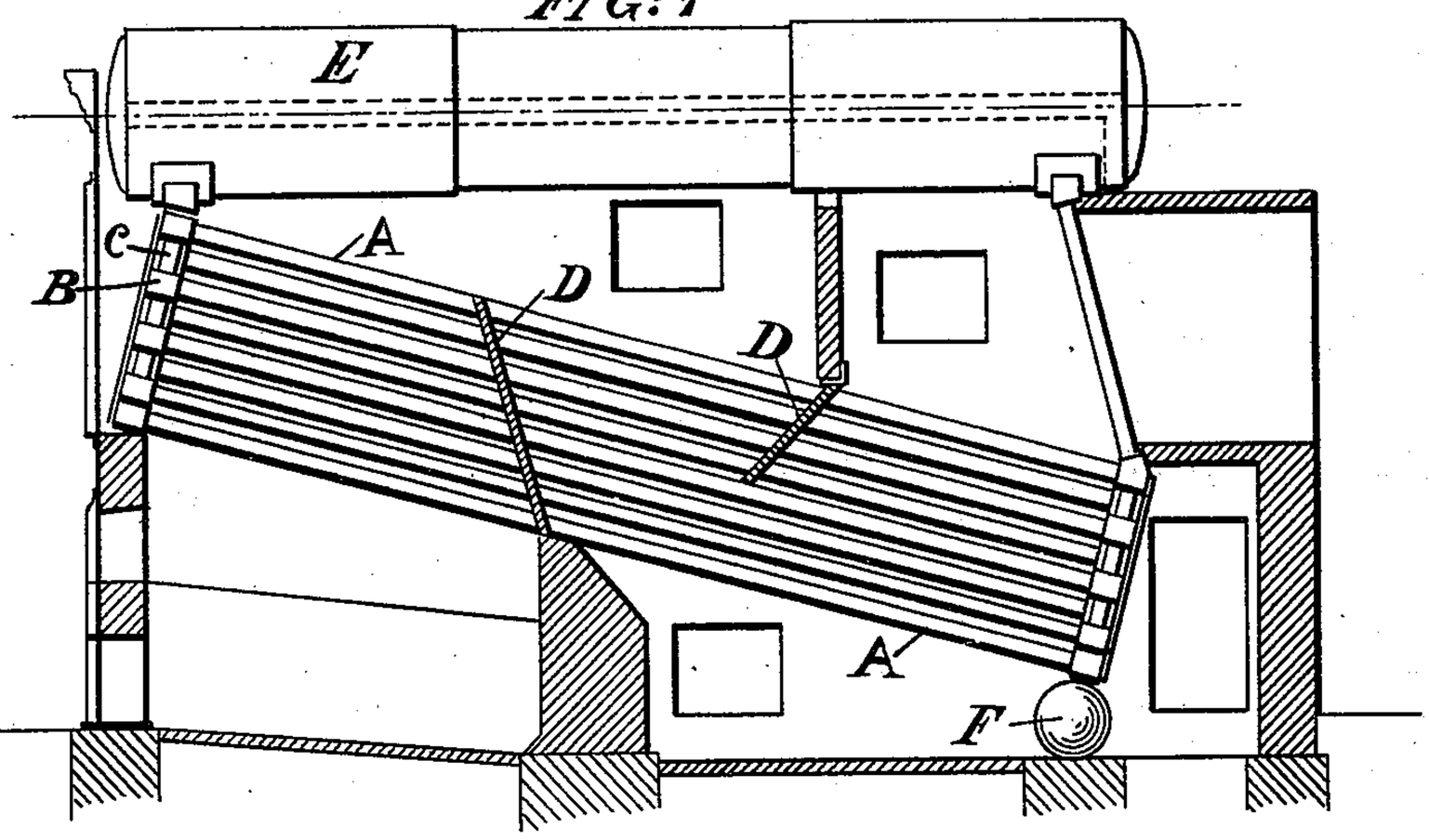
(No Model.) 2 Sheets—Sheet 1.

# W. D. EWART.

## STEAM BOILER.

No. 545,464. Patented Sept. 3, 1895.

FIG: 1



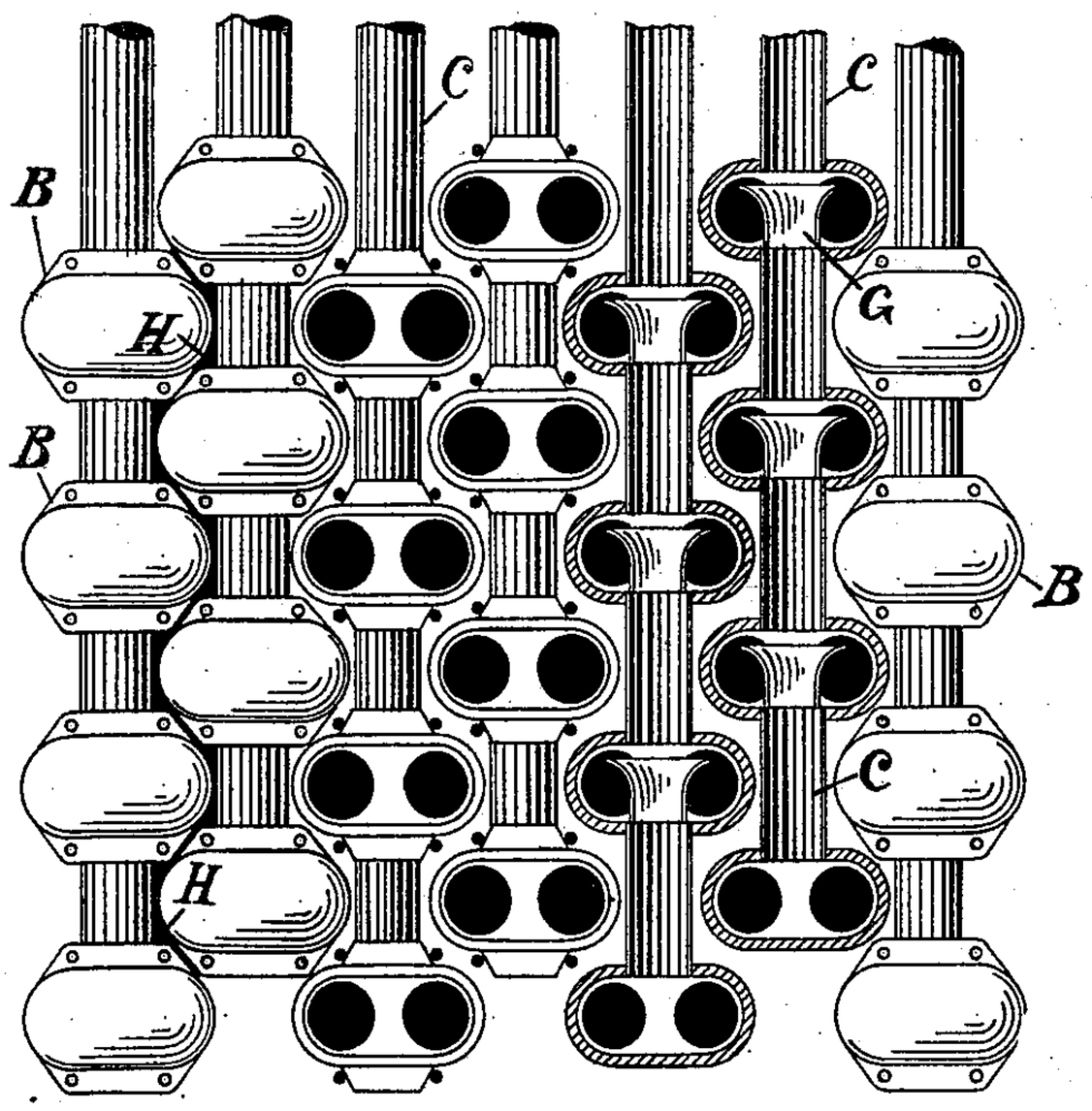




FIG: 2.

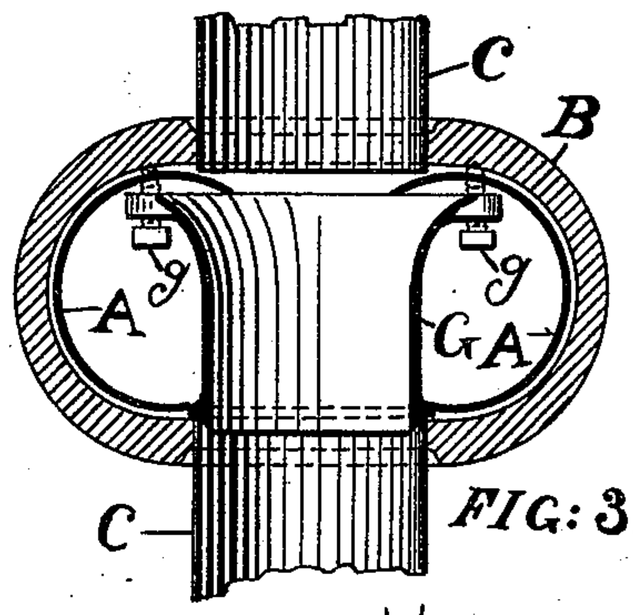



FIG: 3.

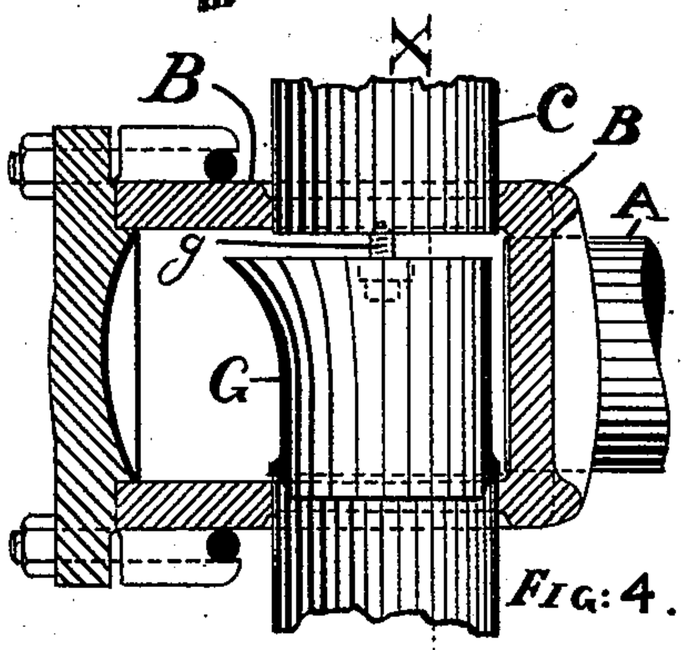



FIG: 4.

X

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(No Model.) 2 Sheets—Sheet 2.

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## STEAM BOILER.

No. 545,464. Patented Sept. 3, 1895.

FIG: 5.

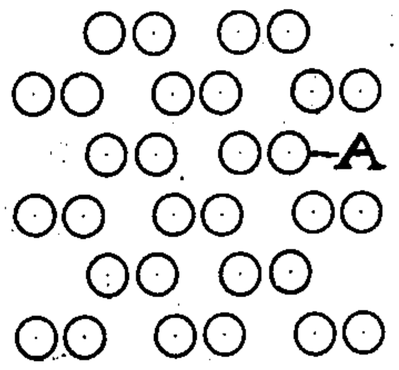
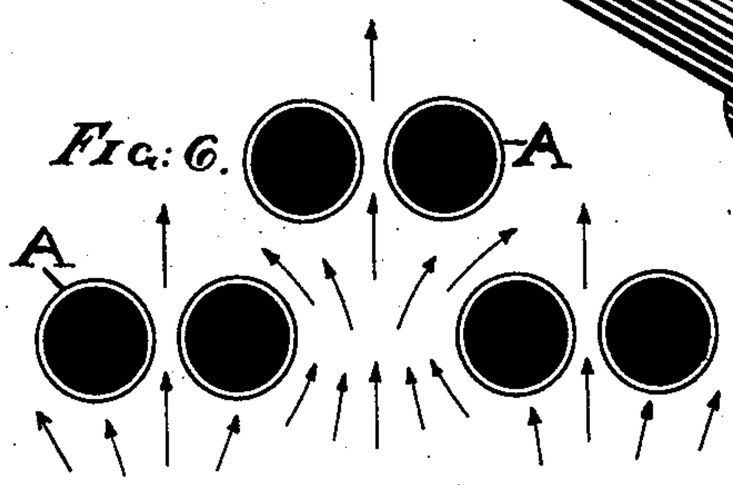



FIG: 6.



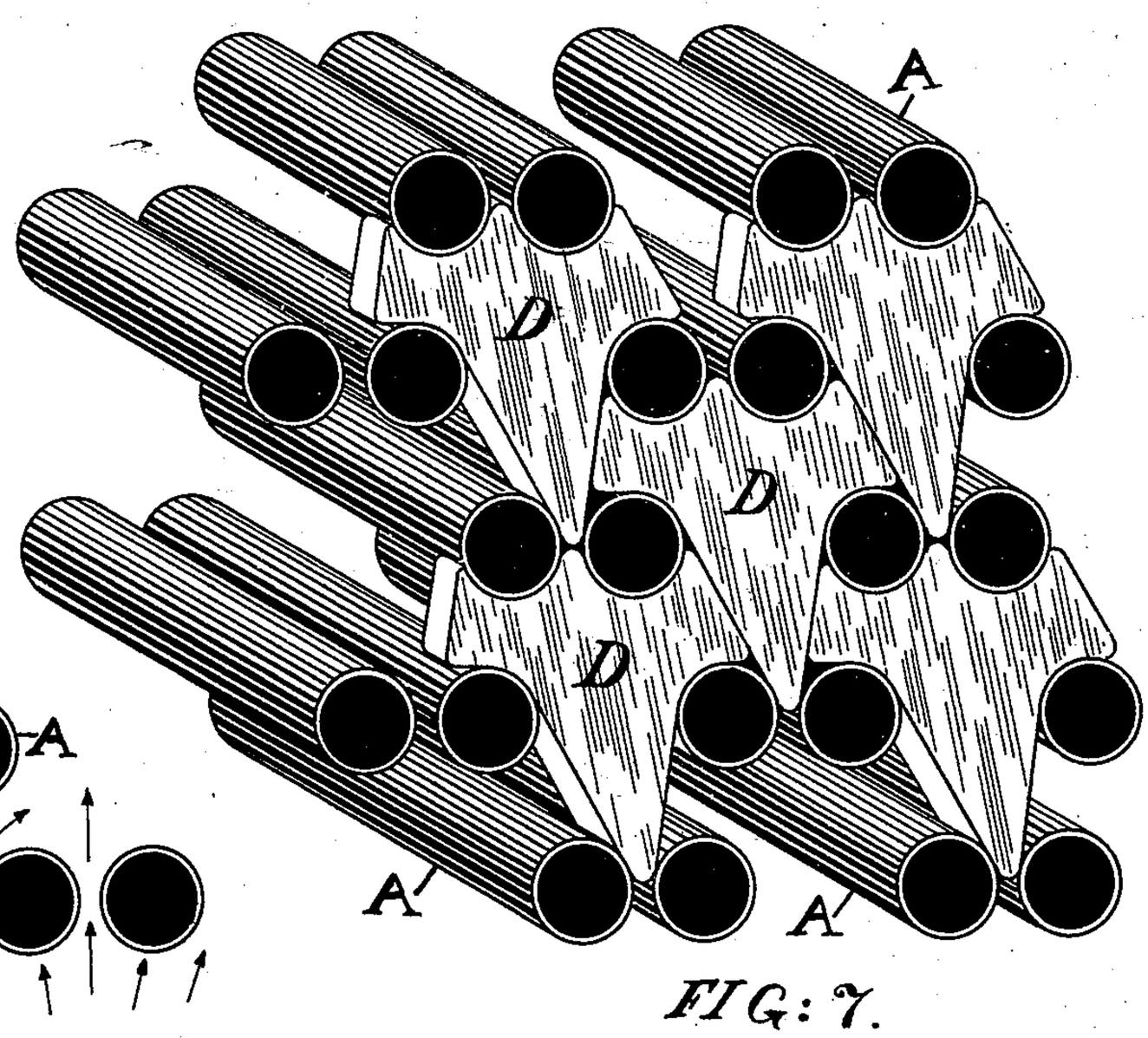




FIG: 7.

FIG: 8.

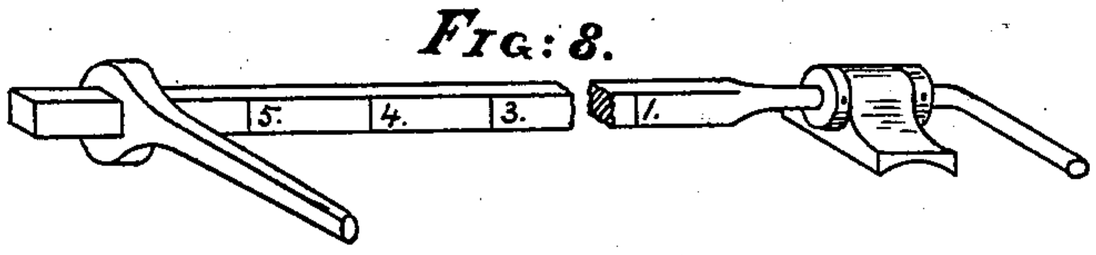
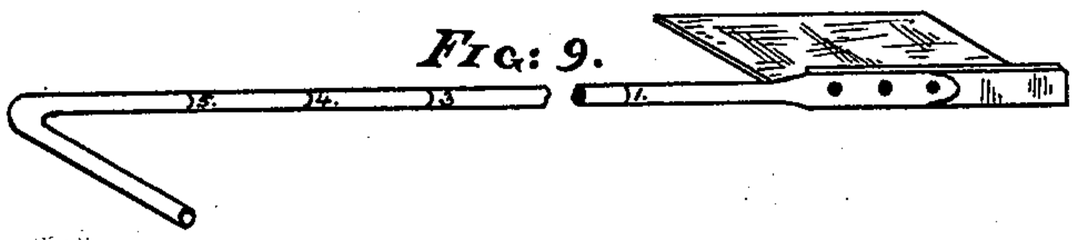



FIG: 9.

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# UNITED STATES PATENT OFFICE.

WILLIAM D. EWART, OF CHICAGO, ILLINOIS.

## STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 545,464, dated September 3, 1895.

Application filed May 15, 1894. Serial No. 511,312. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM D. EWART, a citizen of the United States, residing at Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification.

The principal objects of my improvements are to secure a more thorough circulation of the heat-gases, increasing the efficiency of the heating-surface, besides a better circulation of the water and separation of the steam from same, and a self adjustability or flexibility of parts to allow for unequal expansions and contractions under varying degrees of heat, with provision for settling, ready repairs, &c.

To these ends my invention consists in details of arrangement and construction of parts, as fully set forth hereinafter.

To enable those skilled in the art to which my improvements relate to understand and practice the same, I will now proceed to describe my invention more fully, referring to the accompanying drawings, which form part of this specification, and in which similar letters of reference designate similar parts throughout the several views.

Figure 1 is a side elevation of a boiler, showing some of my improvements. Fig. 2 is a front view, partially sectional and on a larger scale, of a series of my header-sections forming what is often called a "water-leg." Fig. 3 is a front sectional view, and Fig. 4 a side sectional view, of one of my headers, illustrating also my steam and water separator therein, all on a still larger scale than in the previous figures. Fig. 5 is a small sectional view across a battery of water-tubes grouped in accordance with my plan, as described hereinafter; and Fig. 6 shows six of these tubes on a larger scale with arrows indicating the course of the hot gases. Fig. 7 is a perspective view illustrating the relations of my deflector-bricks to the water-tubes and to each other, this being practically a rear view on the same scale as Fig. 6 and cut on the inclined line that the bricks assume in forming the deflector-wall. Fig. 8 is a perspective view of a hook or reaching device; and Fig. 9 is a similar view of a shovel-like device, both of which are employed for handling the bricks which compose my deflector-wall, as set forth hereinafter.

A A are water-tubes.

B B are headers connected with the water-tubes in the usual manner and with each other in substantially vertical header-sections by nipples or thimbles C C.

D D are fire bricks or plates formed with T-heads, which are adapted to rest on the water-tubes, and with bodies which will swing down across the main spaces between tubes and divert the gases into lines which cross the tubes, thus causing them to impinge on parts of the heating-surface which might otherwise receive too little heat, or, when used in a series, the bricks form a solid deflecting-wall, as shown in Fig. 1.

E is a steam and water drum connected in the usual manner with the water-tubes at front and rear.

F is a mud-drum at the bottom of the back water-leg.

G is a steam and water separator which combines with the thimbles C C to form an almost continuous vertical channel or passage-way through the header for the rising steam, so located as to prevent the rush of water from the water-tubes into the path of the ascending steam, and yet having open space favorably located for the steam formed in the upper portions of the water-tubes to rush in comparatively free from water.

*g g* are adjusting-screws to hold separator G in place in the header.

H H in Fig. 2 are spaces left between headers and adjacent thimbles through which the nozzle of a hose can be inserted to blow off accumulations of dust, soot, &c. In this figure I show at the left two header-sections with the covers on the headers, while the next two header-sections have the covers and steam and water separators removed. The next two header-sections are shown in cross-section, as on the line *x x* of Fig. 4.

In water-tube boilers as heretofore constructed the tubes, while variously grouped in the headers, have been arranged with relation to each other in practically one of two general plans—namely, in uniform vertical and horizontal rows or else "staggered," as it is called, making diagonal rows and giving

the gases a longer path to travel. Where regular vertical rows are employed they are often provided with baffle bricks or plates variously arranged in lines parallel to the tubes to avert the hot gases from ascending too directly. It will be seen that in my grouping the tubes which enter one header are so close together that the gases will be considerably retarded in passing between them and largely diverted, so as to pass around the outside of them. It will also be noticed that the horizontal space between the groups presents an area substantially equal to the sum of the outlet-spaces most nearly above. These features are shown most clearly in Figs. 5 and 6. One good effect of this grouping of tubes is that it causes the gases to move in a zigzag or circuitous path, imparting as much of their heat as possible to the tubes before escaping and impinging on as much of the surface of each tube as possible, thus obtaining all the advantages of staggered tubes or of baffle-bricks without their disadvantages. This arrangement also admits of the use of headers or casings sufficiently small to leave ample clearance between them for lateral and vertical play in expansion and contraction. The thimbles connecting, as they do, alternate rows of header-casings vertically are relatively long, and as they are made of tubing slightly elastic the whole front and rear header-sections form flexible water-legs or batteries of water-tube supports and connections, which will admit of different tubes expanding, contracting, warping, or settling, independently or in groups, without straining, shearing, causing leaks, or interfering with the vertical steamways or disturbing by pressure adjoining parts. Sufficiently-large openings are also formed between adjacent header-sections for the insertion of a nozzle at various points, as at H, to blow the accumulations off of the tubes from the front or rear when desired.

The fire-walls or deflector-walls which obstruct the passage of the hot gases and divert them back and forth against the water-tubes in their journey from the grate to the stack I prefer to construct of separate fire bricks or plates which are thin enough to admit of being passed in and out between the rows of tubes in a substantially-horizontal position. I usually make the vertical space between rows about two inches and insert the bricks sidewise, lying flat on a shovel-like device, such as shown in Fig. 9. I form the bricks with a sort of T-head and with the center of gravity below the T, so that when the branches of the T rest on two opposite tubes and the shovel is withdrawn the brick swings down across the open space, the form being such as to fit the tubes and match other bricks which are preferably duplicates and arranged to close the entire space and form a solid wall, about as shown in Fig. 7. These bricks can also be inserted singly or in small groups at any point at which it is desired to change the course of some of the hot gases and effect a more perfect impingement on the tubes, and their location or arrangement in walls can be originally adapted or subsequently changed to suit different types of furnaces that may be introduced. I prefer to make the lengths of the bricks such that they will rest against the lower tubes in a position which will not be directly transverse to the tubes, as in other boilers, but usually at an angle of sixty degrees. When the tubes heat, warp, or settle unevenly, no permanent injury is done to a wall composed of bricks so placed, for they accommodate themselves to the situation and avoid the crushing and breaking incidental to a wall built around and between the tubes at right angles to them. Furthermore, any brick can readily be removed and replaced without disturbing the rest of the wall in case it is desired to repair the wall or remove a tube. I provide suitable openings (not shown) in the side walls of the boiler at locations opposite the deflector-walls, making these wide enough to admit of handling the bricks in and out from the sides with simple shovel-like devices or reaching-irons, one form of each on which will be seen in Figs. 8 and 9. So far as I know deflector-walls, however formed—whether, for instance, of brick or of asbestos in solid plaster—have heretofore been placed directly transverse or at right angles to the tubes, so that they were liable to be injured by any change in the relative position of any of the tubes, however caused. The bricks forming my deflector-walls, resting, as they do, by gravity above and below and at such an angle, are free to move with the tubes farther apart or nearer together within reasonable bounds without disturbing their neighbors or disrupting the wall as a whole. I therefore attach great importance to placing them at an angle and constructing them in the manner described.

In water-tube boilers as heretofore constructed difficulty has been experienced in the front header-sections or water-legs, owing to the fact that in the substantially-vertical steamways the rapidly-rising steam must come directly into contact with the water at the end of each tube and pass across its path and receive all the impulses due to steam being generated in such water. The steam acts practically as an injector, sucking the water out of the tube and driving it into the steam-drum before it is sufficiently hot or ready to be converted into steam. This action compels the water to circulate repeatedly and too rapidly for economy in fuel, dissipating the heat, besides producing wet steam. To prevent this I construct independent vertical connecting-channels which I call "steam" and "water" separators, as G, forming an almost continuous path for the steam from one vertical thimble to the next, arranging each in relation to the header so that a water-channel is formed around the separator connecting the ends of the two adjacent tubes. The separator forms

a wall which keeps the body of the water back, but at its top I leave an open space which forms a transverse steamway in the header above the main line or plane of the tubes connected by the header, thus permitting any steam generated to rise into the steam-path, and at the same time admitting of a small flow of water in either direction under the influence of gravity. This prevents the steam from sucking or pushing the water out of the tubes, which would cause them to become superheated and burst, and at the same time it prevents the water which surges from the end of an upper tube into its header forming a serious interruption to steam arising from a lower tube and passing through on its way to the steam-drum, and the general effect is the production of dry steam with the utmost economy of fuel.

In the drawings and description given herewith I have set forth the forms in which I prefer to carry out my invention under ordinary circumstances; but it is evident that some of the details could be varied within reasonable limits without departing from the spirit of my improvements. For instance, the headers and tubes can be so arranged that more than two tubes will constitute a baffling group with small spaces between the individual tubes to permit the impingement of hot gases on their sides and allow some of the gases to pass through, while other groups are separated from them by more open spaces, and baffling groups are placed above the said open spaces which are left between the different groups. The shape and size of the bricks or plates forming the deflector-walls can of course be varied and more than one thickness used in the same wall, if desired. The angle between the bricks and the tubes may be varied considerably, and the inclination may be forward or backward, as the circumstances direct. In fact, some of the advantages of my invention could still be obtained with the bricks at right angles to the tubes; but I prefer a sufficient divergence from a right angle to permit self-adjustability of the bricks, as hereinbefore described. The form and arrangement of the steam and water separators may be varied within reasonable limits so long as they are so disposed as to act in combination with the other parts of the header-section to form an almost continuous ascending passage-way for the steam, while preventing the forcible rush of water into the steamway, and at the same time presenting openings favorably located for receiving steam at suitable intervals along the upward course. I therefore do not wish to be limited to the exact arrangements, proportions, &c., shown in detailed description; but,

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a water tube boiler the grouped water tubes having spaces between the members thereof, and the groups having larger spaces between them, the said groups being so disposed with relation to each other that baffling groups will be above the spaces between the groups, substantially as described.

2. In a water tube boiler, the tubes arranged in groups in horizontal rows with spaces between the members thereof, and the groups having larger spaces between them, the said groups being so disposed with relation to each other that the narrow spaces in one horizontal row are over the wide spaces in the next lower horizontal row, substantially as described.

3. In a water tube boiler, the combination of a number of groups of water tubes arranged in pairs side by side with narrow spaces between the tubes of each pair, and supported in headers the said groups having larger spaces between them, and being so arranged that the spaces between the tubes of the pairs will come between or above the larger spaces between the groups of tubes, substantially as described.

4. In a water tube boiler, the combination of substantially horizontal rows of water tubes, headers connecting water tubes in horizontal groups, and relatively long thimbles connecting the headers in alternate horizontal rows, and forming substantially upright header sections, whereby great flexibility is secured to allow for expansion and contraction of parts without interference between adjoining header sections, substantially as set forth.

5. In a water tube boiler, the combination of substantially horizontal rows of water tubes arranged in pairs, individual headers for each pair, and relatively long upright thimbles connecting the headers of alternate horizontal rows, substantially as and for the purpose set forth.

6. In a water tube boiler, the combination of water tubes, a substantially vertical header section connecting same, and a steam and water separating device providing an upward channel for the steam, and obstruction against the ready entrance of the body of the water from the water tubes into the steam passage way formed in the said header section, said passage way having openings at intervals in its length located favorably for the entrance of steam liberated in the water tubes or headers, substantially as and for the purpose set forth.

7. In a water tube boiler, headers connected upwardly by thimbles, water tubes connected with said headers, and obstructing devices located substantially opposite the water tube openings within the said headers, said devices being arranged to form with the said thimbles upward steam ways in the header sections, substantially as and for the purpose described.

8. In a water tube boiler, headers connected with pairs of water tubes in alternate horizontal rows, upright thimbles connecting said headers, channels within said headers forming with the said thimbles almost continuous

upright steam passage ways, and openings in said passage ways for the entrance of steam at intervals in the upward course, substantially as shown and described.

9. In a water tube boiler, the combination of the water tubes with deflector bricks provided with gravitating or self-adjustable T heads adapted to rest on the tubes and with bodies adapted to hang down between the tubes and close the space against movements of the hot gases in lines parallel to the tubes, substantially as and for the purpose set forth.

10. In a water tube boiler, the combination of the water tubes with deflector bricks provided with gravitating or self-adjustable T heads adapted to rest on the tubes and with bodies adapted to hang down between the tubes and close the space against movements of the hot gases in lines parallel to the tubes, said bricks being of such a configuration that a series of them will form a practically solid deflector wall, substantially as and for the purpose set forth.

11. In steam boilers, water tubes suitably supported and grouped in substantially horizontal or slightly inclined positions, in combination with deflector walls composed of self-adjustable bricks or plates, each of which is supported in a substantially upright position by lateral projections adapted to engage with adjacent tubes, said bricks or plates having their centers of gravity below the lines of their supports, substantially as and for the purpose set forth.

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