

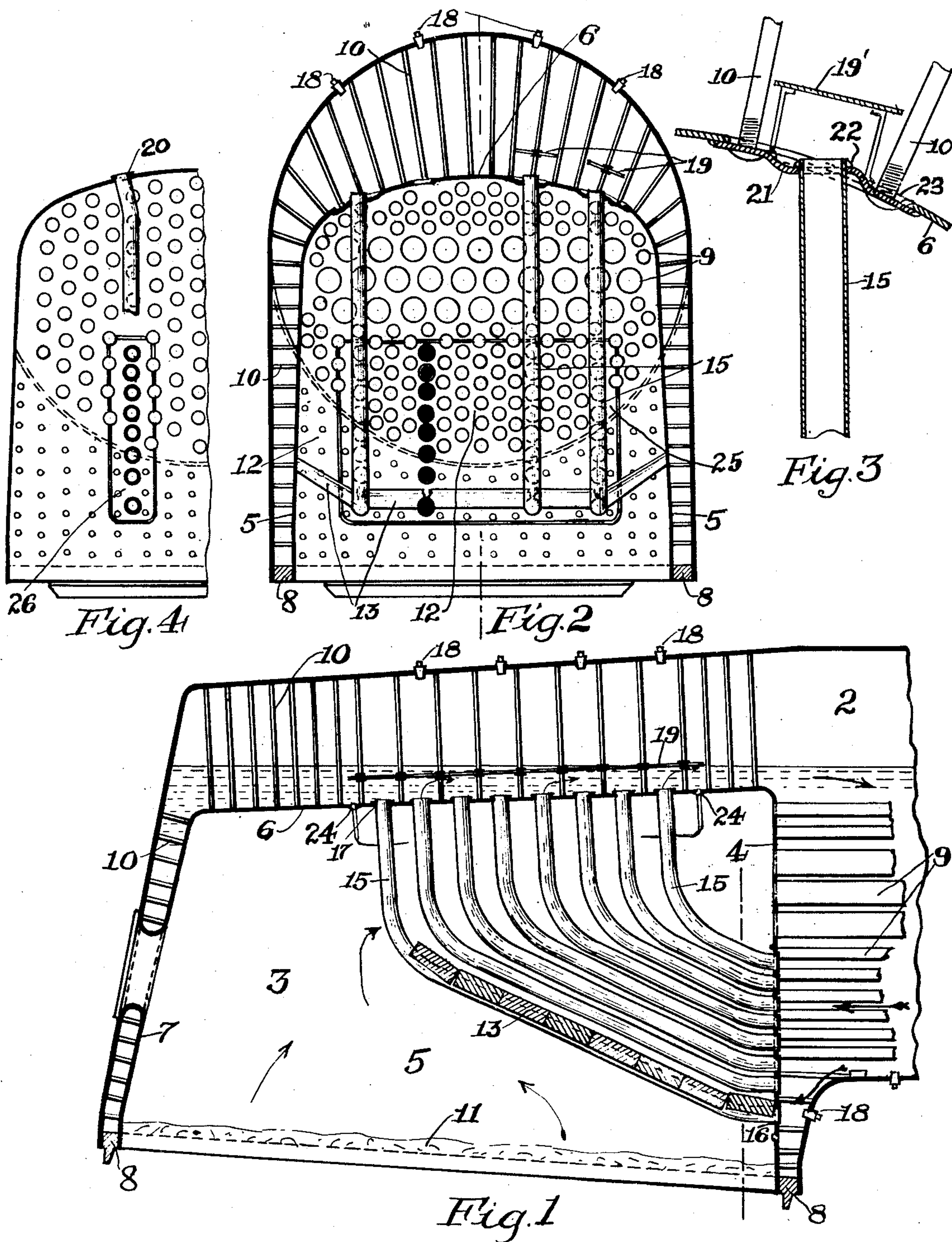
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C. G. HAWLEY

LOCOMOTIVE BOILER FIRE BOX

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C. G. Hawley
Inventor.

UNITED STATES PATENT OFFICE.

CHARLES GILBERT HAWLEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO LOCOMOTIVE FIRE-BOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

LOCOMOTIVE-BOILER FIRE BOX.

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My invention relates to improvements in steam boilers of the several types which have internal fireboxes. I have chosen herein to depict my invention as embodied in an internally fired locomotive boiler, which will serve as an example of all types of my present invention.

The object of the invention is to construct or equip an internal firebox with water-steaming-and-circulating members which shall have the effect of increasing the effective heating surface of the firebox, which shall avoid any suppression of combustion in the firebox, which shall serve to promote and maintain a rapid and voluminous circulation of all of the water in the boiler and which members may be availed of as supports for a refractory fire arch or baffle of any desired form. With these objects in view my invention comprises a boiler and internal firebox in combination with a plurality of water-circulating tubes disposed in a single vertical plane in said firebox, one end of each said tubes being fastened in a vertical wall of the firebox and the upper end being secured in the crown sheet of the firebox. My invention comprehends the employment of either one or several of the vertically disposed groups of water-circulating-and-steaming tubes and, as above indicated, comprehends the combination of a fire arch therewith, the fire brick finding supports upon the said tubes and the sides or vertical walls of the firebox. All this and the several novel details of my invention will be clearly understood on reference to the accompanying drawings, in which Fig. 1 is a vertical longitudinal section of a locomotive boiler and firebox embodying my invention. Fig. 2 is a vertical cross section thereof. Fig. 3 is an enlarged detail showing the preferred manner of securing the upper ends of the water tubes in the crown sheet of the fire-box, and Fig. 4 illustrates a modified construction to be compared with Fig. 2.

The locomotive boiler 2 herein shown is of a common shape or type. The internal firebox 3 thereof is likewise of a common or representative form. It is composed of the flue sheet 4, the side sheets 5—5, the crown sheet 6 and the back sheet 7, the lower edges of the sheets being united to the shell or wrapper of the boiler by the usual mud ring 8. The flues of the boiler are marked 9. As a whole, the firebox is connected to the shell

of the boiler by a large number of stay-bolts 10, those at the top being longer and known as crown stays. The fuel bed is represented by the lines 11, Fig. 1.

The firebox appearing in Figs. 1 and 2 is shown as equipped with four of the before-mentioned groups of water-circulating tubes. The tubes of each group or set occupy the same, or substantially the same, vertical longitudinal plane within the front and upper part of the firebox. The several groups are spaced apart as well shown in Fig. 2 in order that workmen may enter between the groups and do all needed work on the flue sheet and other sheets of the firebox. For part of the distance rearward and upward of the flue sheet the spaces 12 between and at the sides of the four groups are normally occupied by longitudinal rows of fire brick 13, which together constitute a very effective fire arch or baffle. These brick find direct support upon the lowermost tubes in the four groups after the manner in which arches are commonly supported upon arch tubes. Indeed the lower tube of each group may comprise an ordinary cambered arch tube.

Conveniently, I have shown each group as comprising eight of the tubes 15. No two of these tubes are of the same length or shape. The lowermost tube extends from a point 16 in the flue sheet, rearwardly and upwardly and terminates at a point 17 in the crown sheet, well toward the back end of the firebox. The next tube parallels, or substantially parallels the first tube, directly above it. By preference the front ends of the tubes are placed more closely together than are the upper ends, for reasons about to be explained in connection with the preferred method of installing the tubes in the flue sheet and in the crown sheet.

Before turning to the installation details of the invention, it should particularly be noted that these vertical and longitudinal bodies or groups of tubes divide the forward and upper part of the firebox into a plurality of longitudinal passages. Only a single grate is used in the firebox, but nevertheless the single body of flame rising therefrom is in this manner successfully sub-divided during the passage of the gases to the flues; thus the superficial area of the radiant flame body is markedly increased. Next, it is to be observed that the tubes in themselves present

a very great increase in the heat absorbing surfaces of the firebox. It is, of course, now understood that the water from the body of the boiler enters the lower ends of the tubes, and rising therethrough, is discharged above and upon the top of the crown sheet 6 of the firebox. Hence, it will be seen that the heating surfaces added through this medium are of the most advantageous sort and most advantageously positioned or disposed within the firebox. Incidentally, it should be apparent that these parallel vertically disposed bodies of water tubes can at no time interfere with the free propagation and maturing of the flames of combustible gases rising and passing between them. Though filled with water, they do not tend to suppress the flame bodies. Yet every square inch of every tube is plainly and fully exposed for the absorption of both radiant and convected heat.

The ends of the water tubes may be secured in the flue sheet and in the crown sheet in accordance with best present boiler practice. Numerous wash-out plugs 18 provided in the shell of the boiler facilitate the cleaning and washing of the water tubes.

The water rises through the tubes with a velocity proportional to the quantity evaporated therein and preferably I suppress the fountains of steam and water jetting upward from the tubes by super-imposing a dash-plate 19 over each row of tubes. However, this is only rarely required, for usually the depth of boiler water over the crown sheet is sufficient to take up or absorb the thrust of the fountains from the tubes, and thus the danger of priming the steam in the steam space of the boiler is avoided.

By preference I assemble these groups of tubes and definitely secure them in their proper relations before placing the group in the firebox. In other words, I construct the groups separately and then raise them into the firebox and secure them therein. To facilitate this operation, I utilize what may be termed parts of both flue sheet and crown sheet. In these parts or plates I secure the ends of the tubes and after so securing them I, so to speak, replace the parts in respective flue sheet and crown sheet. In constructing a new boiler the lower forward ends of the tubes will be accommodated directly in the flue sheet, which, after equipment, may be readily assembled with the crown, side and back sheets. But in every case, rather than to place the end of the tube directly in the original crown sheet as shown at 20 in Fig. 4, I prefer that the upper ends of the tubes of each group shall first be secured in a separate plate or part 21, as well shown in the other figures of the drawings. The tube ends may be expanded in the openings in this part 21, or they may be welded therein as shown at 22. To ac-

commodate the plate, a correspondingly large opening 23 is made in the crown sheet 6. At the time of installing the group the edges of the part 21 are welded to the edges of the crown sheet at the opening 23. By preference, I make the part 21 large enough to receive the adjacent rows of crown bolts 10. The part 21 may be secured by a lap-weld, as shown in Fig. 3, or by a butt-weld, as shown at points 24 in Fig. 1.

In dealing with an existing engine, the plate or part receiving the forward ends of the tubes 15 may be large enough to receive the ends of all of the groups as in the case of the large plate or patch 25 of Fig. 2, or each group may be provided with its own flue sheet patch 26, as shown in Fig. 4. In both cases the patch is preferably butt-welded to the edges of the complementary opening in the flue sheet, and after being placed in position may receive as many of the flues 9 as may be required or prove convenient.

In Figs. 1 and 2 I have shown the dash plates 19 as supported by the crown bolts 10. A better method is illustrated in Fig. 3, wherein the dash plate 19' is erected directly upon the patch plate 21, so that it may be put into position or taken out along with the plate 21 and the group of tubes attached thereto.

Through the addition of heating surfaces obtained in this manner and the tremendously rapid circulation thereby imparted to the boiler water, the efficiency of the whole boiler is so improved as to result in a very great saving of fuel and a marked increase in the capacity of the boiler, as well as an improvement in the life or durability of the boiler as a whole. As before stated, this invention is not restricted or limited to locomotive boilers, for it is applicable to all boilers which present vertical flue sheets and crown sheets.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A steam boiler having an internal fire box including a flue sheet at one end and a crown sheet at the top, and a group of water tubes all arranged in the same longitudinal vertical plane in the fire box and opening at one end through the crown sheet and opening at the other end through the flue sheet with some of said tubes communicating with the front water leg of the boiler above said water leg, the tube ends in the crown sheet being spaced a greater distance apart than the tube ends in the flue sheet.

2. A steam boiler having an internal fire box including a flue sheet at one end and a crown sheet at the top, said flue sheet and said crown sheet each having an elongated opening therein arranged in the same longitudinal vertical plane of the boiler, plate

members fixed in said openings, and a group of water tubes all arranged in said longitudinal vertical plane, said tubes having inclined mid portions with ends disposed at substantially a right angle to said plate members in said openings and to which said tube ends are attached, the tube ends in the plate members in the crown sheet being spaced a greater distance apart than the tube ends in the flue sheet.

10 3. A water circulating element for steam boilers and adapted for location in the internal firebox thereof, said element comprising a plurality of water tubes all arranged

in the same common plane, each tube having an inclined middle portion and top and bottom end portions arranged at an angle thereto and at substantially a right angle to each other, a plate associated with the top ends of said tubes and in which they are secured in spaced relation and a second plate associated with the bottom ends of said tubes and in which they are secured in a closer spaced relation than are said top ends.

In testimony whereof, I have hereunto set my hand this 6th day of May 1922.

CHARLES GILBERT HAWLEY.