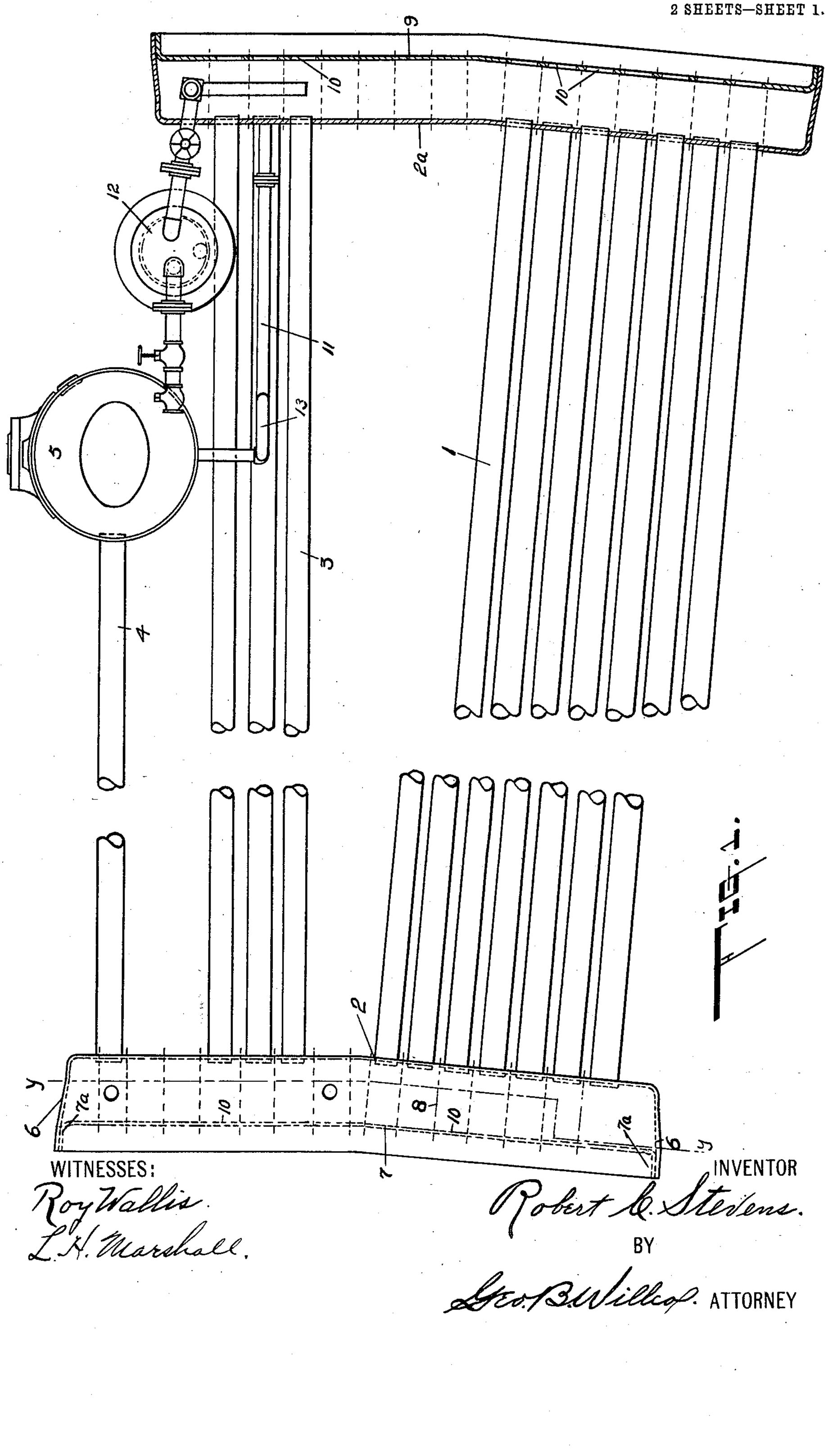
No. 861,774. PATENTED JULY 30, 1907.

R. C. STEVENS.

STEAM BOILER.

APPLICATION FILED MAY 11, 1906.

2 SHEETS—SHEET 1.



WITNESSES:

Roy Wallis.

L. H. Marshall.

INVENTOR

Robert C. Stevens.

BY

Geo. B. Willcox. ATTORNEY

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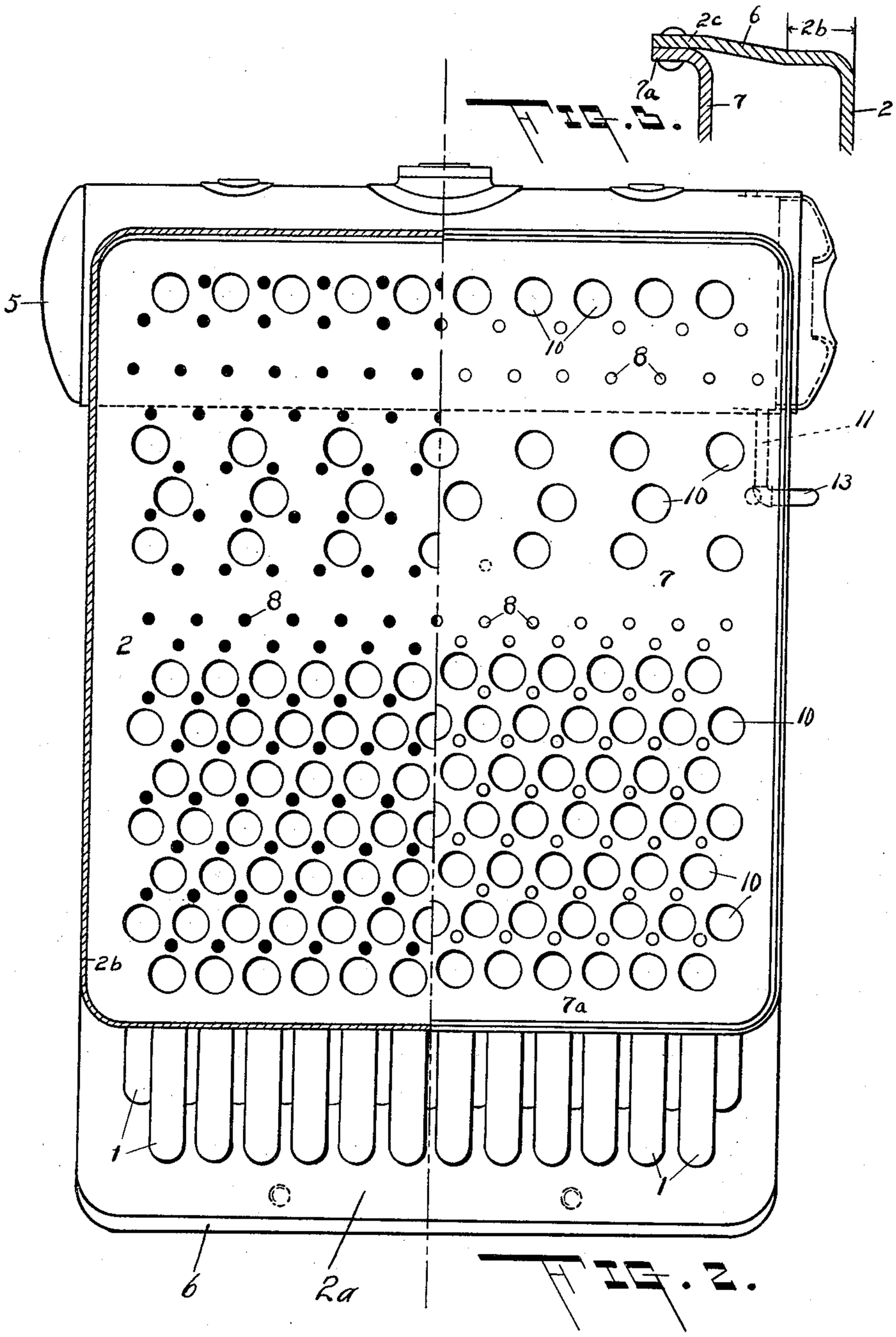

FIG. 2.

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UNITED STATES PATENT OFFICE.

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STEAM-BOILER.

No. 861,774. Specification of Letters Patent. Patented July 30, 1907.

Application filed May 11, 1906. Serial No. 316,351.

To all whom it may concern:

Be it known that I, ROBERT C. STEVENS, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention pertains to water tube boilers and relates more particularly to that class of water tube boilers in which are employed lower water tubes, upper water or equalizer tubes, and superheating tubes, the latter delivering steam to a steam drum. In this class of boilers the water tubes and equalizer tubes are expanded at their ends into water legs or headers.

The present improvements relate to the arrangement, construction and combination of the headers, tubes and steam drum.

The objects of the invention are to insure a high degree of superheat, quick and efficient steaming, free circulation, full throat area, economy and simplicity of construction, ease of cleaning and repairing and increased strength enabling the boiler to work with a high factor of safety for a given weight of metal, insuring both durability and lightness (considering allowable pressure) and safety.

Another object is to increase flexibility and reduce the liabilty of leakage in joints caused by expansion and contraction and to not only eliminate seams in contact with the hot gases, as is done in some boilers of this type, but also to render unnecessary any rivet heads in contact with gases.

With these objects in view, and certain others which will appear later in the specification, my invention consists in the devices and combinations illustrated in the accompanying drawings and the equivalents thereof.

Figure 1 is a part sectional side elevation, broken away in part, showing the headers, tubes and steam drum. Fig. 2 is a front elevation, the left hand side of which is a section on the line *y—y* of Fig. 1. Fig. 3 is an enlarged detail showing the manner of assembling the tube and handhole sheets.

As is clearly shown in the drawings, the boiler consists of a lower bank of straight water tubes (1), expanded at their ends into a front tube sheet (2) and a rear tube sheet (2^a); an upper bank of equalizer tubes (3), which may be located at the normal water line of the header or below it, to equalize the pressure and keep the water level constant,—these tubes being also expanded into the tube sheets (2) and (2^a)—a bank of superheating tubes (4) expanded at one end into the front tube sheet (2) and connected at the other end to the steam drum (5).

The water tubes (1) which are preferably inclined to assist circulation preferably enter the tube sheets (2) and (2^a) at right angles.

The equalizer tubes (3) are preferably horizontal, though they might be inclined; and are preferably straight and enter the tube sheets (2) and (2^a) at right angles.

The upper parts of tube sheets (2) and (2^a) are preferably vertical to receive the straight horizontal equalizer tubes and the lower parts are inclined to receive the inclined water tubes (1). The tube sheets are preferably made of a single sheet of metal to avoid exposing seams or rivet heads to contact with the hot gases, and are (if the equalizer tubes are horizontal) bent on the line between the tubes (1) and (3) to give the required inclination to the water tubes, and to permit the tubes to enter the sheets at right angles.

The front tube sheet (2) extends up above the equalizer tubes to receive the superheating tubes (4).

The manner of assembling the tube sheets and the handhole sheets is shown in Fig. 3, and the flanging thereof is also shown. The flange (7^a) of the hand-hole sheet 7 is identical with the flanged part (2^b) of the tube sheet (2). The extremity (2^c) of the tube sheet flange is formed parallel with the flange (7^a) of the hand-hole sheet to receive it snugly. The intermediate part (6) of the flange on sheet (2) is flared outwardly by an amount equal to the thickness of the material used. This construction enables both sheet (2) and sheet (7) to be formed on a single former and yet enables the sheet (7) to be cased within the flange of sheet (2) as shown in Figs. 1 and 3.

The cost of forming and assembling the headers is thereby greatly reduced and the cost of the dies and formers is also reduced by about one-half.

The joint between (2^a) and (7^a) may be easily riveted by means of a hydraulic riveter, or other suitable machine, greatly decreasing the cost of the construction of the header and increasing its strength and staunchness. The sheets (2) and (7) are stayed by suitable stay bolts (8) as in flat stayed surfaces of ordinary boilers.

The rear header is similar in construction to the front header.

Suitable hand holes (10) are provided in the front and rear sheets (7) and (9) opposite each tube, so that any tube may be withdrawn, renewed, plugged or cleaned through the hand-hole or inspected through the hand-hole by looking through the tube from end to end. This is true not only of the lower water tubes (1), but it is also true of the equalizer tubes (3) and the superheating tubes (4).

It has been common heretofore to make the upper ends of the front and rear headers in the form of a circular drum. Such a drum renders inspection of the equalizer tubes and the superheating tubes impractical.

In my present construction it will be noted that the equalizer tubes (3) and the superheating tubes (4) ter-

minate at their front ends not in a steam drum, as heretofore common, but in the upward extension of the front header, having its tube sheet (2) flat. The advantages of this construction over the former construction, in which cylindrical drums have been used, are numerous and important. The equalizer tubes enter the flat tube sheets at right angles, and are easily expanded and made tight. The front ends of the superheating tubes similarly enter the flat tube sheet (2) at right angles. The equalizer tubes and the superheating tubes are all removable through their hand hole openings without disturbing the brick work of the boiler setting. All the water and equalizer tubes may be of the same length, making it easier to secure repairs and rendering it unnecessary to keep more than one length of tubes in stock for both the water and equalizer tube renewals. The equalizer tubes and superheating tubes are as readily inspected and removed through their hand holes as are the water tubes.

Further advantages of the flat header construction are that no neck braces are required as is the case where the upper part of the water leg is in the form of a circular drum. The bracing by means of stay bolts, (8) can be accomplished inexpensively and efficiently, because the surfaces are flat; and the stay bolts are all straight and may be of the same length. The flat headers moreover are safer because they have less bulk of water in any one place than do boilers of the drum construction.

No man-holes are required in the headers, since the hand-holes serve the purpose. Since the headers can be easily made in a forming machine and the riveting can be done by machinery, the header can be manufactured without the necessity of peening with hammers, thereby weakening the sheets and leaving hammer marks on the plates.

It will be noted that the headers may be all practically uniform in depth throughout their height. The front and rear walls of the setting need therefore be only of sufficient thickness to receive the header and the side walls may be shortened, thus reducing the amount of brickwork required below that which would be required if steam drums were used.

In connection with the header construction it will be noticed that any header is suited for either right hand or left hand boilers, thereby reducing the number of headers that need be kept in stock.

Another important advantage this flat header construction has over drums or waterlegs with drums, is that a special design of header is not required for high pressures. Where drums are used, high pressures require specially designed drums because of the necessity of having the connecting ligament between the tubes of sufficient strength to resist the circumferential pull due to the steam pressure. With the drums, the equalizer and superheating tubes must be spread farther apart or decreased in number for high steam pressure with the same plate thickness, while with the flat or box header construction the same number of equalizer and superheating tubes may be retained for much higher pressures, or in other words, a larger number of tubes may be used with a box header than with a drum for the same steam pressure. Furthermore, no specially curved tubes are necessary with my construction, but are employed in boilers having drums.

The steam drum (5) and its arrangement relative to the superheating tubes (4) and the headers has several advantages of practical importance. It will be noted that there is no tube connection between the drum (5) and the rear header. The objects of this arrangement are to insure perfectly free expansion and contraction of the tubes (4) and the drum (5) which could not take place if the drum (5) were connected to the rear header by superheating tubes. The steam passes from the upper part of the header, which part I will term the steam liberating chamber, through the superheating tubes (4) into the drum (5). This arrangement insures that all the steam entering drum (5) shall pass through the superheating tubes (4) and become superheated. The liability of spraying in the rear header and the consequent carrying over of moisture into the drum (5) is eliminated since there is no direct connection between the rear header and the drum. I prefer in practice, however, to provide a small pipe (11) to carry the condensation (that might occur when boiler is not delivering steam) back into the rear header, said pipe being provided intermediate its ends with a loop 13 to permit movement of the superheating pipes and steam drum.

In practice I prefer to provide a feed water heater (12) arranged above the equalizer tubes (3) in the path of the hot gases, but independent of the boiler itself, except for the feed pipe construction. The heater (12) and pipe connected therewith is illustrated in Fig. 1, but it will be understood that any suitable form of heater may be employed if desired.

Having thus fully disclosed my invention, what I claim as new is:—

1. A header for boilers comprising a tube sheet, the edges of which are flanged outwardly, the flange being provided with an outward flare, a hand-hole sheet, the edge of which is flanged outwardly, the hand-hole sheet adapted to nest within the flared extremity of the flange of the tube-sheet, and means for securing the flanges of the tube-sheet and hand-hole-sheet together.

2. A header for boilers comprising a tube-sheet, a broad outwardly extending flared flange on the tube-sheet, the extremity of the flange being bent to lie in a plane substantially at right angles to the tube-sheet, a hand-hole sheet, and a narrow outwardly extending flange carried thereby and lying substantially at right angles to the hand-hole sheet, the hand-hole sheet adapted to nest within the bent extremity of the tube-sheet flange.

3. A header for boilers comprising a tube-sheet and a hand-hole sheet of corresponding area and size, and outwardly extending flanges on each sheet, the tube-sheet flange being flared outwardly by an amount equal to the thickness of the hand-hole sheet, the outer extremity of the tube-sheet flange being bent to lie parallel with and embrace the hand-hole sheet flange, the hand-hole sheet and flange adapted to nest within the outer extremity of the tube-sheet flange approximately at the junction of the flared portion and the bent extremity.

4. A header for boilers comprising a tube-sheet, an outwardly flaring flange on the tube-sheet, the edge of the flange being bent to lie in a plane substantially at right angles to the plane of the tube-sheet, a hand-hole sheet, and an outward flange on the hand-hole sheet coöperating with the edge of the outwardly flaring flange of the tube-sheet.

5. The combination with a boiler provided with front and rear box headers having flat tube sheets, one of the headers adapted to have a steam liberating chamber formed in the upper end thereof and lying in a plane above the upper end of the opposite header, a steam drum located opposite the liberating chamber, superheating tubes connecting the steam liberating chamber with the drum and a condensation pipe leading from the drum to the

opposite header, the condensation pipe being looped to permit movement of the superheating tubes and drum.

6. The combination with a boiler provided with front and rear box headers having flat tube sheets, one of the headers adapted to have a steam liberating chamber formed in the upper end thereof, and lying in a plane above the upper end of the opposite header, a steam drum located opposite the liberating chamber, horizontal superheating tubes connecting the steam liberating chamber with the drum, the superheating tubes arranged at right angles to the tube sheet and a condensation pipe leading from the drum to the opposite header, the condensation pipe being looped to permit movement of the drum and superheating tubes.

7. The combination with a boiler provided with headers, one of which is extended to form a steam liberating chamber, of a steam drum located opposite the liberating chamber, superheating tubes connecting the chamber with the drum, and a condensation pipe leading from the drum in such manner as to permit movement of the superheating tubes and drum.

8. A header for boilers comprising a flanged hand-hole sheet, a flanged tube sheet formed on a die of the same size as that on which the hand-hole sheet was formed, the flange of the tube sheet being flared outwardly by an amount equal to the thickness of the metal of the hand-hole sheet, the hand-hole sheet nesting into the outer extremity of the tube sheet flange, and means for securing the sheets together.

In testimony whereof, I affix my signature in presence of two witnesses.

ROBERT C. STEVENS.

Witnesses:
A. A. EASTERLY,
RALPH S. WARFIELD.