No. 728,847. PATENTED MAY 26, 1903.

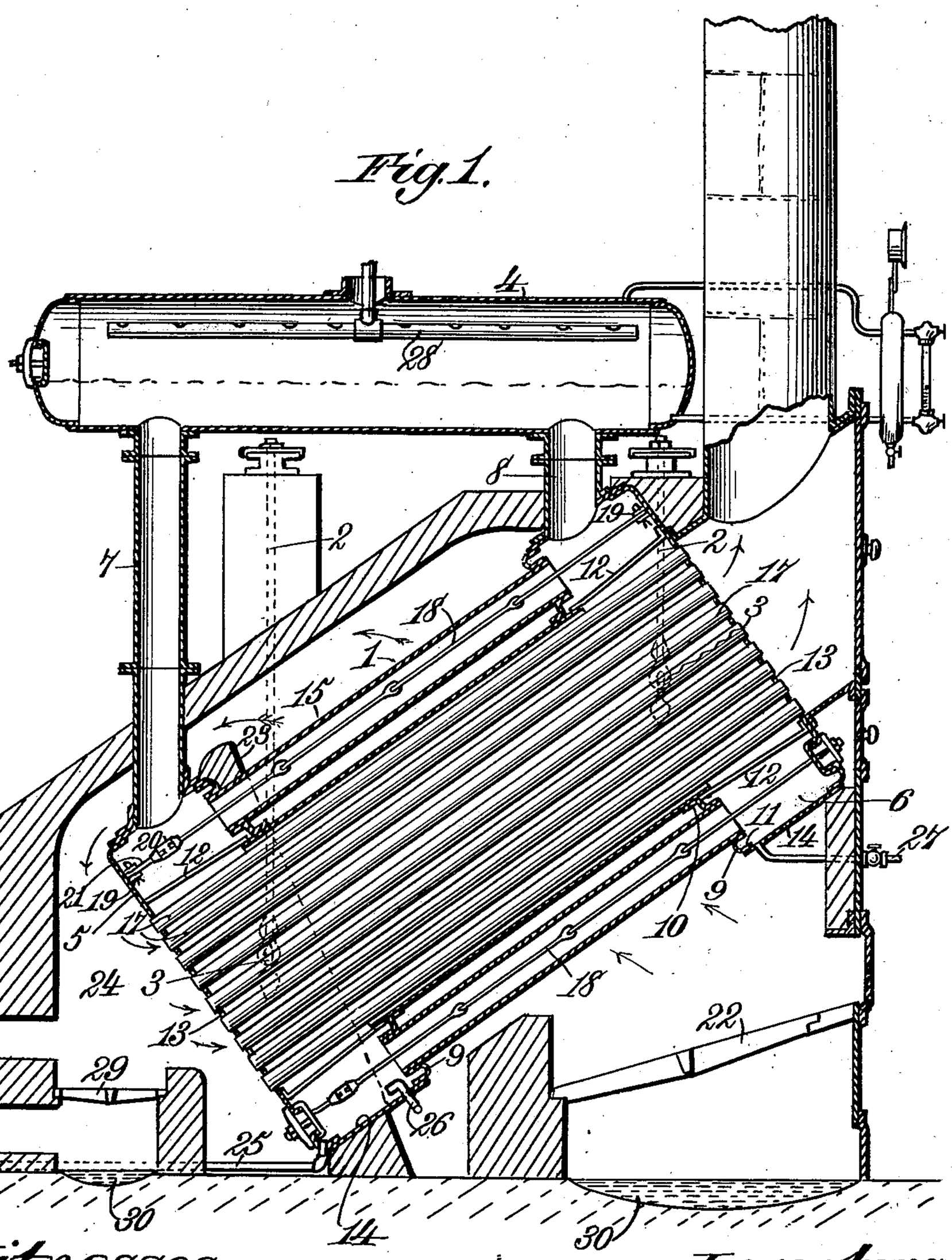
J. M. BRADLEY & J. F. SENTER.

STEAM BOILER.

APPLICATION FILED DEC. 4, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

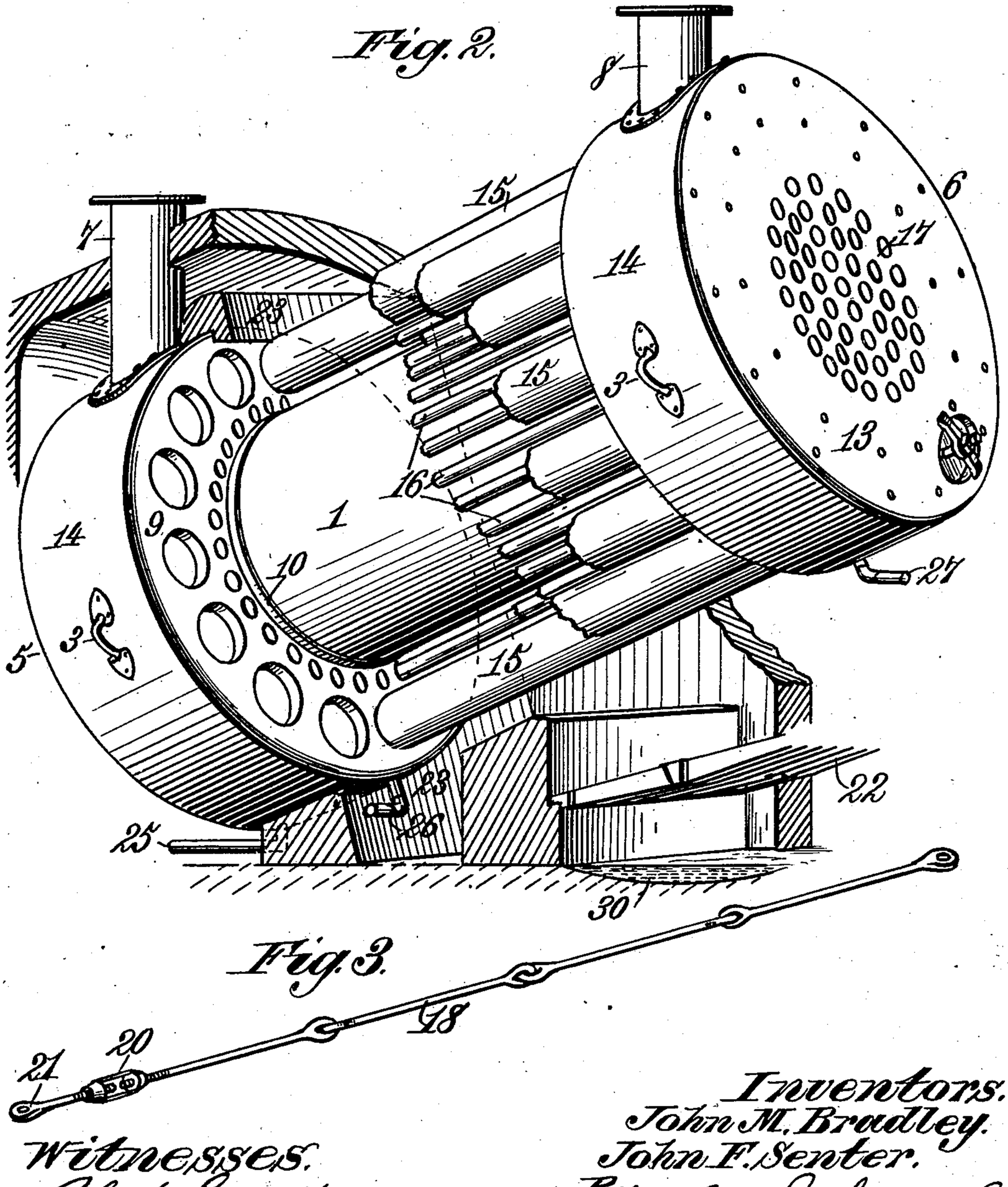

Fig. 3.

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UNITED STATES PATENT OFFICE.

JOHN M. BRADLEY AND JOHN F. SENTER, OF BIRMINGHAM, ALABAMA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 728,847, dated May 26, 1903.

Application filed December 4, 1902. Serial No. 133,865. (No model.)

To all whom it may concern:

Be it known that we, JOHN M. BRADLEY and JOHN F. SENTER, citizens of the United States of America, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification.

Our invention relates to a combined water and smoke tube boiler designed for simplicity, increased strength, and steaming capacity, wherein the boiler has riveted to either end and forming a continuous chamber therewith two enlarged circular water-legs suitably connected by vertical pipes with a steam and water dome disposed above the furnace-casing. The legs are concentric with the boiler-shell and are connected by one or more series of water-tubes disposed around said shell and outside thereof and riveted to the inwardly-disposed flanges of suitable openings placed at intervals in the inner walls of said legs and so arranged that the flames from the furnace-grate can pass around and between them and exert their influence on the boiler. The products of combustion are forced to pass entirely around the boiler and the tubes by a deflecting-wall which surrounds the inner water-leg and extends above the same and which also by reason of its proximity to the grate is maintained in so heated a state that it serves to ignite all the non-combusted gases among the products of combustion. These products pass over this wall into a combustion-chamber, from which they enter a series of smoke return-tubes and pass through the boiler to the stack. The boiler is suitably suspended within the furnace-casing and inclined at an acute angle greater than forty-five degrees to insure against the collection of sediment in the water-tubes and increase the draft of the furnace.

Our invention embodies certain other novel features of construction and arrangements of parts, all of which will be hereinafter more fully described, and particularly pointed out in the claims, reference being had to the accompanying drawings, illustrating our invention, in which—

Figure 1 is a longitudinal vertical section of the furnace and boiler provided with a single series of exterior water-tubes. Fig. 2 is a perspective view of the boiler and its water-legs, provided in this instance with a double series of exterior water-tubes, and also showing the furnace-grate and the deflecting-wall. Fig. 3 is a detail view of the sectional brace-rods which pass centrally through the larger water-tubes and connect the boiler ends.

In the drawings similar reference-numerals refer to similar parts throughout.

The boiler 1 is suitably suspended within the furnace-casing by rods 2, having hooks at their lower ends to engage loops or brackets 3, riveted to the sides of the boiler and at their upper ends passing through the furnace-casing and the upper stationary beams and threaded to engage adjusting-nuts, whereby the shell may be raised or lowered or its angle of inclination varied. The boiler is thus capable of a free expansion in all directions without strain to its setting or the furnace-casing. A steam and water dome 4, arranged horizontally above the furnace-casing, connects with the water-legs 5 and 6 of the boiler through the vertical pipes 7 and 8. These water-legs are substantially concentric with the boiler 1 and have their inner circular walls 9 stamped with oppositely-disposed flanges 10 and 11. The boiler-shell, which is riveted to the flanges 10, has its ends extending several inches beyond this point of connection into the water-legs, and a series of brace-rods 12, bolted to said ends and to the outer walls 13 of the legs, serve to materially strengthen and brace the same. The curved side walls 14 are riveted to the flanges 11 of wall 9 and similar flanges on wall 13. Suitable man-holes are provided in either end of the boiler for inspecting and cleaning the same. The water-legs and shell 1 form a continuous chamber through which the water freely circulates; but the principal circulation between the legs takes place through a series of enlarged water-tubes 15, disposed around the boiler-shell and connected at either end to the inner walls 9 of said legs. Suitable openings are stamped in said walls to receive the tubes and are provided with inwardly-disposed flanges, to which the ends of the tubes are riveted, by which arrangement the rivets are removed from the direct action of

the flames and the connection accordingly strengthened. In addition to this series of water-tubes we may provide a second series, numbered 16, as shown in Fig. 2, or any desired number of such series; but in this case it is necessary to increase the diameter of the legs sufficiently to enable such series to be arranged between the larger tubes and the boiler-shell. These inner tubes are much smaller in diameter than the outer tubes and are preferably staggered, so that they present a maximum heating and steaming area to the furnace-flames, which pass in and out among these tubes and around the boiler-shell before entering the combustion-chamber.

The smoke-return tubes 17 lead through the water-legs and the boiler to the stack and have their ends, which pass through suitable openings in the outer walls 13, expanded and beaded, so that they will serve to strengthen the boiler against longitudinal expansion. To further strengthen the boiler, we have provided brace-rods 18, which pass centrally through the large tubes 15 and are fastened by cotter-keys to suitable lugs 19, bolted to the inner side of the walls 13. Preferably these rods are made in several sections put together and welded eyebolt fashion and each of such a length that when desired the cotter-keys can be removed and the brace-rod drawn from the tube into the water-leg and out of the boiler through a manhole, thus enabling them to be replaced or repaired without it being necessary to remove the tube itself or the end plate of the boiler. One of the end sections is provided with a turnbuckle 20, welded thereon and having its other end engaging the screw-threaded shank of an eye 21, through which the cotter-key passes in securing the rod to the lugs 19, and by this means any variation or wear in the rods is compensated and they can be adjusted to an equal tension around the end wall. Thus in addition to the strengthening effect of the beaded tubes 17 we provide the brace-rods 12 and 18 and arrange them around said tubes, so that their strength is equally distributed over the whole end walls 13, and since all parts of the boiler and water-tubes are subjected to the direct action of the flames there will be no tendency of the boiler to warp from an unequal expansion or pressure strain and it will be impossible to blow off a head.

The boiler which we have thus fully described is suspended at an acute angle greater than forty-five degrees within the furnace-casing, which is arched and built to surround the boiler closely, so that the flames and gases will have their full effect on the tubes and that portion of the shell against which they do not directly impinge. The grate 22 of the furnace is inclined slightly in the same direction as the boiler, so that it will distribute its heat more evenly over the same. To cause the products of combustion to pass around the boiler and water-tubes, completely enveloping them before entering the smoke-tubes, we provide a deflecting-wall 23, which surrounds the lower water-leg and extends above the same until it forms, with the arched furnace-roof, an opening through which the products enter a combustion-chamber 24. This wall is located immediately behind the bridge-wall of the furnace and slants rearwardly to present less of an obstruction to the products of combustion in their passage over the same. This wall also serves another important function, for by reason of its proximity to the grate it is maintained in so highly heated a state that when the non-combusted gases in the smoke strike it in being deflected they are ignited, and in this condition they enter the combustion-chamber 24, from which they pass, still burning, through the smoke-tubes 17 and thence to the stack. When the furnace is worked at its maximum capacity, all of the non-combusted gases may not be completely ignited by the wall. So we find it of advantage under such circumstances to use a small auxiliary grate placed in the lower part of the combustion-chamber, so that it will not interfere with the draft to the smoke-tubes. Whenever it is necessary, a coke fire is lighted on this grate 29, which serves to ignite the gases and consume the smoke and at the same time to superheat the products that may have been somewhat chilled while passing around the boiler, so that active combustion at the same time surrounds the boiler and passes through it. By giving the boiler this angle of inclination we not only increase the furnace-draft by giving an almost vertical draw through the smoke-tubes from the combustion-chamber to the stack, but we prevent any sediment accumulating in the water-tubes, causing them to blister, for obviously all such sediment will settle in the bottom of the water-leg 5, where it can be conveniently blown off through the pipe 25.

We prefer to introduce water into the boiler at its coolest point. Therefore we arrange the feed-pipe 26 so that it enters the water-leg 5 at its lowest point, which is behind the furnace bridge-wall. This pipe has a downwardly-directed nozzle, which tends to deposit all sedimentary matter suspended in the feed-water directly over the blow-off pipe and to assist in the accumulaton of sediment from other points of the boiler at the same place. From the highly-heated tubes the water flows into the leg 6, through pipe 8, into the dome 4, and from thence through the pipe 7 down into the leg 5 and the boiler. A blow-off pipe 27 removes all sediment accumulating in the bottom of leg 6.

The steam-pipe 28 is disposed horizontally within the dome 4 and provided with a series of inlet-perforations in its upper side, so that only dry steam will be drawn off.

We also provide cement basins 30 beneath each grate and keep them filled with water, which has the effect of equalizing the heat of the grate-bars and prevents their warping.

By the construction of our boiler and its

increased strength we are enabled to use water-tubes of very large diameter, thus making the boiler easy to clean and inspect and also reducing to a minimum the clogging of the tubes by sedimentary deposits.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a combined smoke and water tube boiler, the combination of a boiler-shell, enlarged water-legs secured to either end thereof and communicating therewith, a series of water-tubes connecting said legs and arranged around said boiler-shell on the outside thereof, a series of smoke-tubes passing through said boiler, and means for causing the products of combustion to pass entirely around the boiler and water-tubes before entering the smoke-tubes in the manner substantially as set forth.

2. In a combined smoke and water tube boiler, the combination of a boiler-shell, enlarged water-legs secured to either end thereof and communicating therewith, a plurality of water-tubes communicating with said water-legs and disposed around the boiler-shell, a plurality of smoke-tubes passing through said boiler, and a deflecting-wall surrounding the lower end of the boiler.

3. In a combined smoke and water tube boiler, the combination of a boiler-shell, enlarged water-legs secured to either end thereof and communicating therewith, a plurality of water-tubes communicating with said water-legs and disposed in series around the boiler-shell, the tubes in the outer series being larger in diameter than those of the inner series, and a plurality of smoke-tubes passing through said boiler, substantially as described.

4. In a combined smoke and water tube boiler, the combination of a boiler-shell, enlarged water-legs secured to either end thereof and communicating therewith, a plurality of water-tubes communicating with said legs and disposed around the boiler-shell, a plurality of smoke-tubes passing through said boiler, the whole being freely and adjustably suspended within the furnace-casing and inclined at an acute angle greater than forty-five degrees, and means for causing the products of combustion to pass entirely around said boiler and water-tubes before entering the smoke-tubes, in the manner substantially as described.

5. In a combined smoke and water tube boiler, the combination of a boiler-shell, enlarged water-legs secured to either end thereof, means for establishing communication between said legs both inside and outside said shell, smoke-tubes passing through said boiler, the whole being suspended within the furnace-casing at an inclination, and a deflecting-wall surrounding the end of the lower water-leg substantially as described.

6. In a furnace, the combination of a boiler-shell, enlarged water-legs secured to either end thereof, a water circulation between said legs through the shell and through a plurality of tubes external to said shell and connected to said legs, smoke-tubes passing through said boiler, means for suspending the said boiler at an angle within the furnace-casing, a grate inclined in the same direction as the boiler, a deflecting-wall surrounding the lower leg of said boiler and inclined in the direction of the escape of the products of combustion, substantially as described.

7. In a furnace, the combination of a boiler-shell, enlarged water-legs communicating with said shell and secured to the ends thereof, a plurality of water-tubes arranged between said legs as a circulating means, bracing-rods passing through said tubes and means for detachably connecting said bracing-rods to the outer walls of said legs, substantially as described.

8. In a furnace, the combination of a boiler-shell, enlarged water-legs communicating with said shell and secured to the ends thereof, a plurality of water-tubes connecting said legs as a circulating means and disposed symmetrically around the boiler, and bracing-rods detachably secured at either end to the inner faces of the outer walls of said legs and passing through said water-tubes, substantially as described.

9. In a furnace, the combination of a boiler-shell, enlarged water-legs communicating with said shell and secured to the ends thereof, a plurality of tubes communicating with said water-legs and disposed in series around the boiler-shell, the tubes of the outer series being larger in diameter than those of the inner series, and brace-rods for the outer walls of said legs passing through said larger tubes, substantially as described.

10. In a furnace, the combination of a boiler having enlarged water-legs, and a plurality of water-tubes connecting said legs, with sectional brace-rods passing through said tubes and detachably connected within said legs to the outer walls thereof, said sections being flexibly connected.

11. In a furnace, the combination of a boiler having enlarged water-legs, and a plurality of water-tubes connecting said legs, and arranged around said shell on the outside thereof, with brace-rods composed of sections flexibly connected together and passing through said water-tubes, means for detachably connecting said rods to the outer walls of said legs, and means for adjusting them, substantially as described.

12. In a furnace, a boiler having enlarged water-legs, a plurality of water-tubes connecting said legs outside of the boiler-shell around which they are arranged in series concentric therewith, and means whereby the products of combustion are forced to pass entirely around the boiler and tubes giving an equal expansion of the same, before entering the combustion-chamber, in combination with a plurality of smoke-tubes leading centrally

through said boiler and having their ends beaded after passing through the end plates of said legs, a plurality of brace-rods bolted to the ends of the boiler-shell and to said end plates, and a plurality of brace-rods passing through said water-tubes and bolted to the respective end plates, and all arranged symmetrically about said smoke-tubes, substantially as described.

13. In a steam-boiler furnace, a grate, a bridge-wall therefor, a boiler suspended at an angle above said grate and having water-legs, a deflecting-wall surrounding the lower of said water-legs, a combustion-chamber, smoke-return tubes leading from said chamber through the boiler, and a feed-water pipe entering said lower leg at a point below and behind said bridge-wall, substantially as described.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

JOHN M. BRADLEY.
JOHN F. SENTER.

Witnesses:
ROBT. D. JOHNSTON, Jr.,
HUGH M. HARTON.