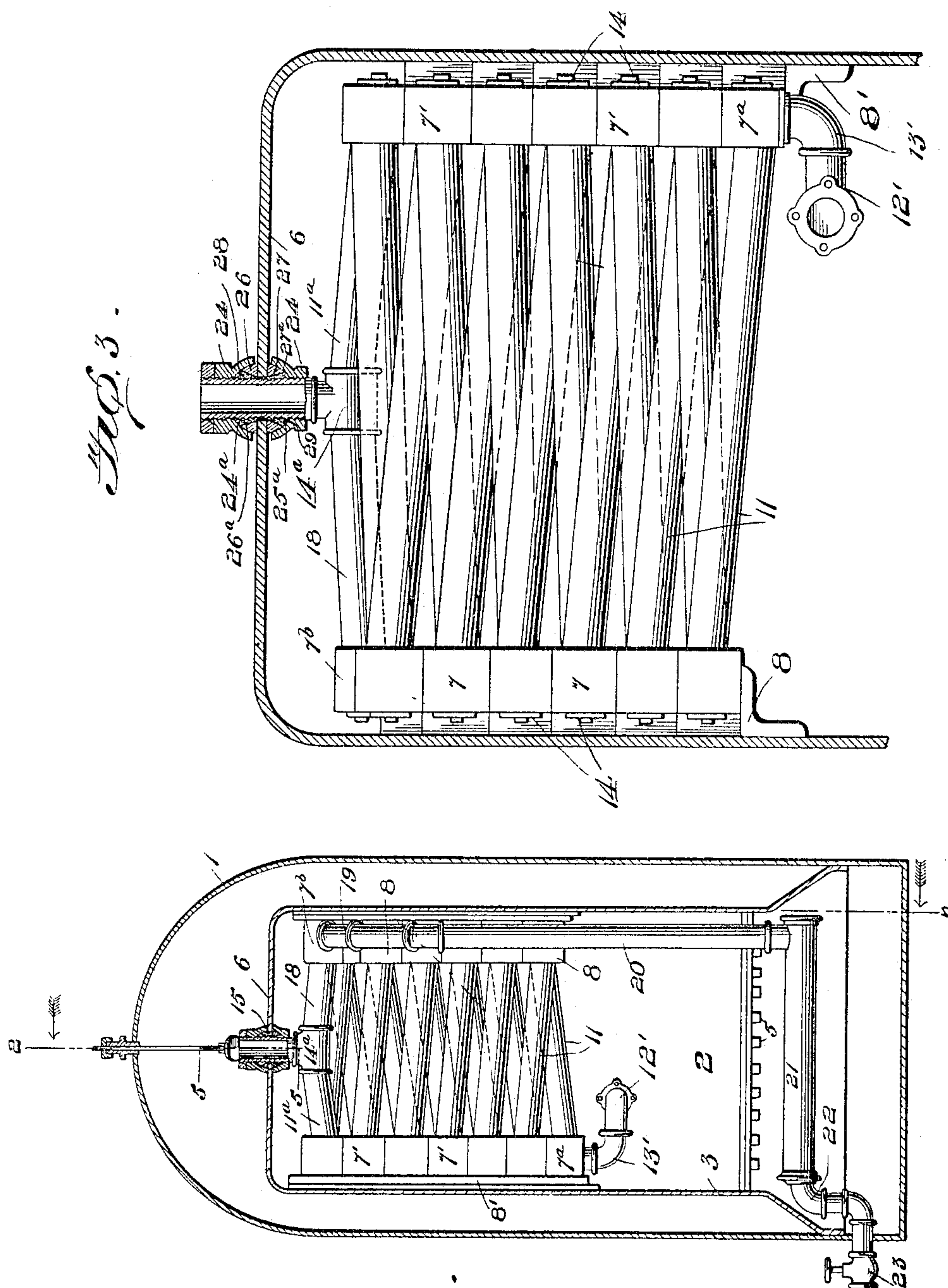


No. 798,684.

PATENTED SEPT. 5, 1905.

J. J. LE DUC.
STEAM BOILER FURNACE.
APPLICATION FILED OCT. 15, 1904.

2 SHEETS—SHEET 1.



Witnesses
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H. D. Shepard

Fig. 1.

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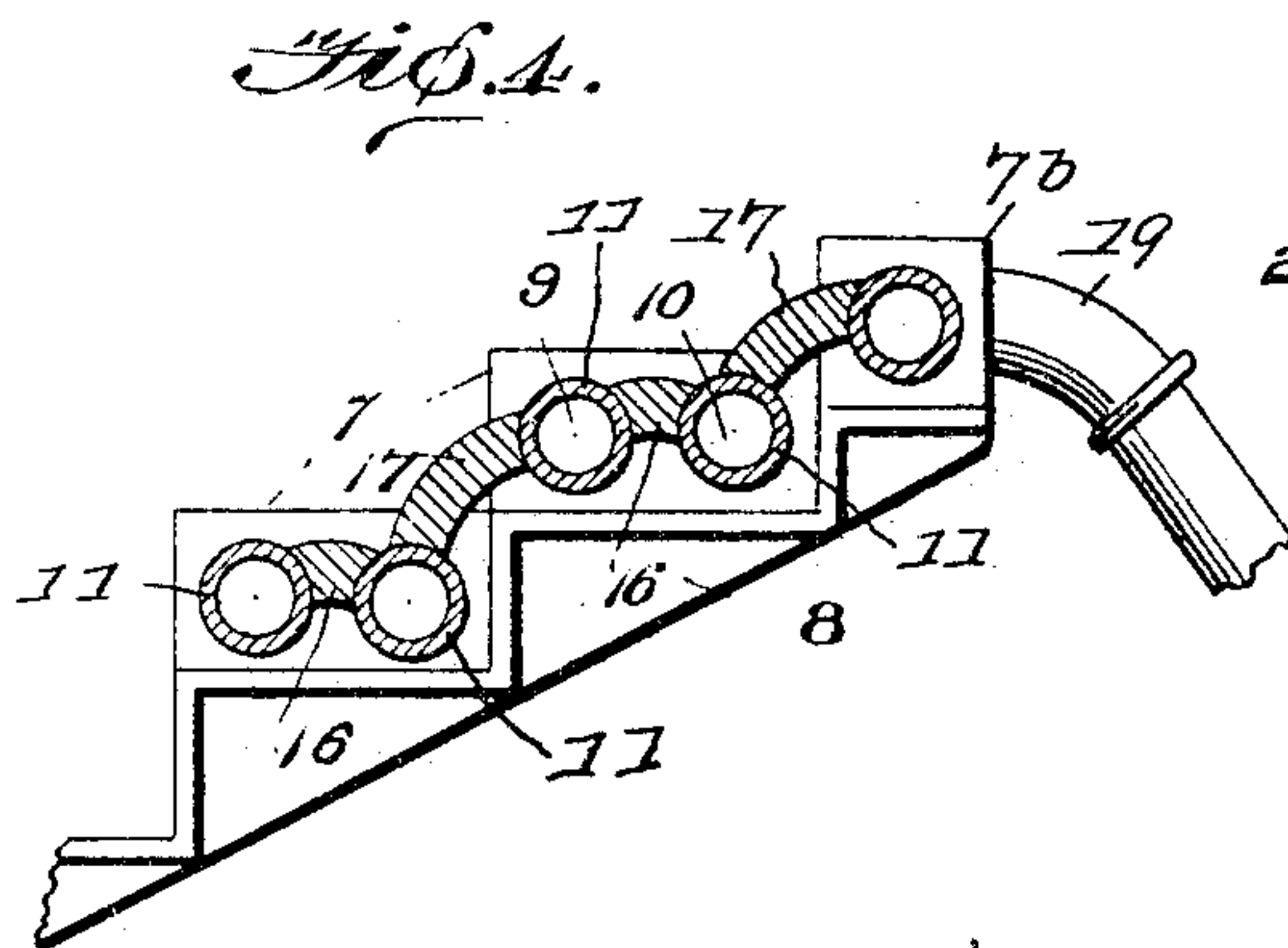
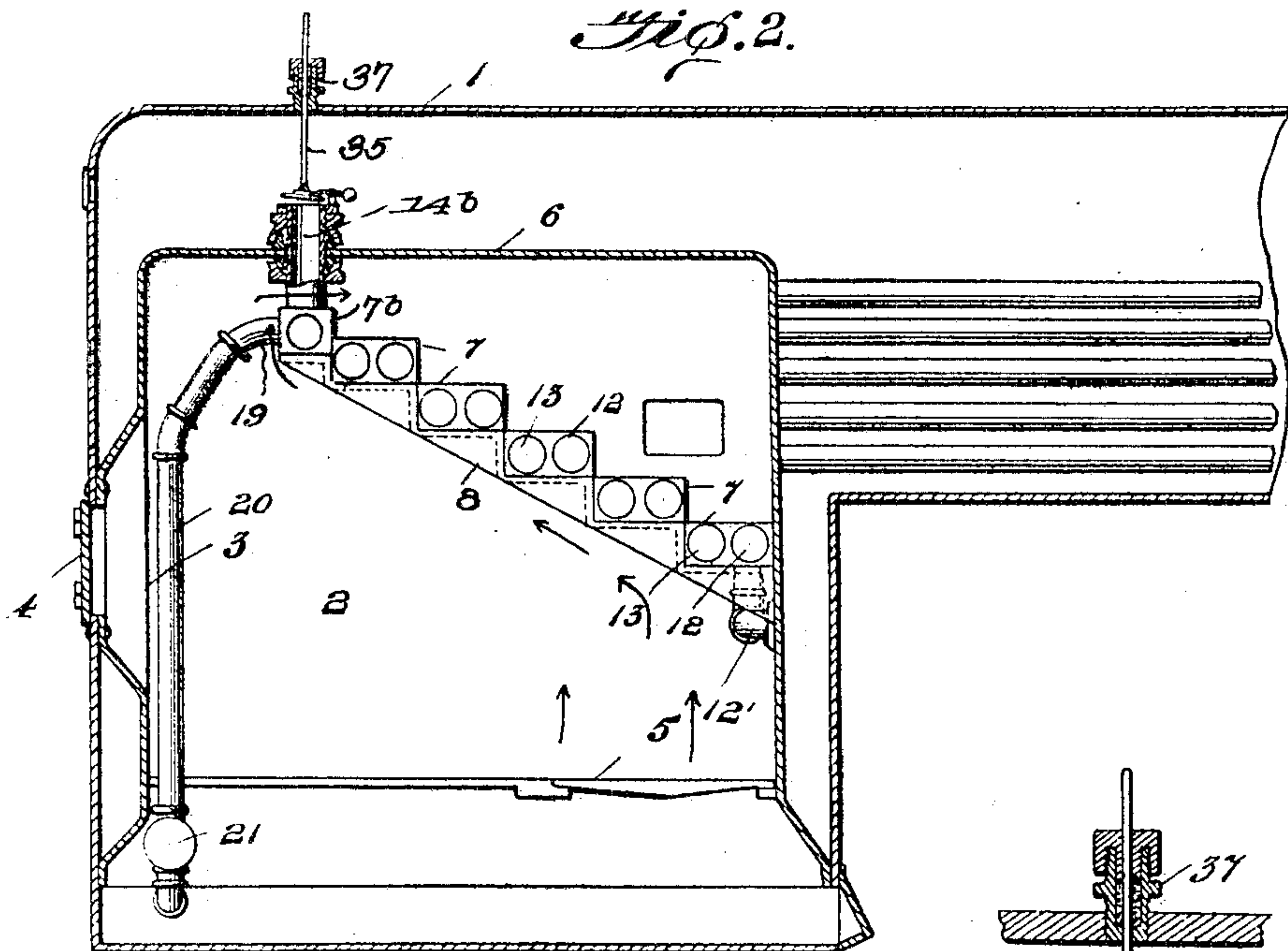
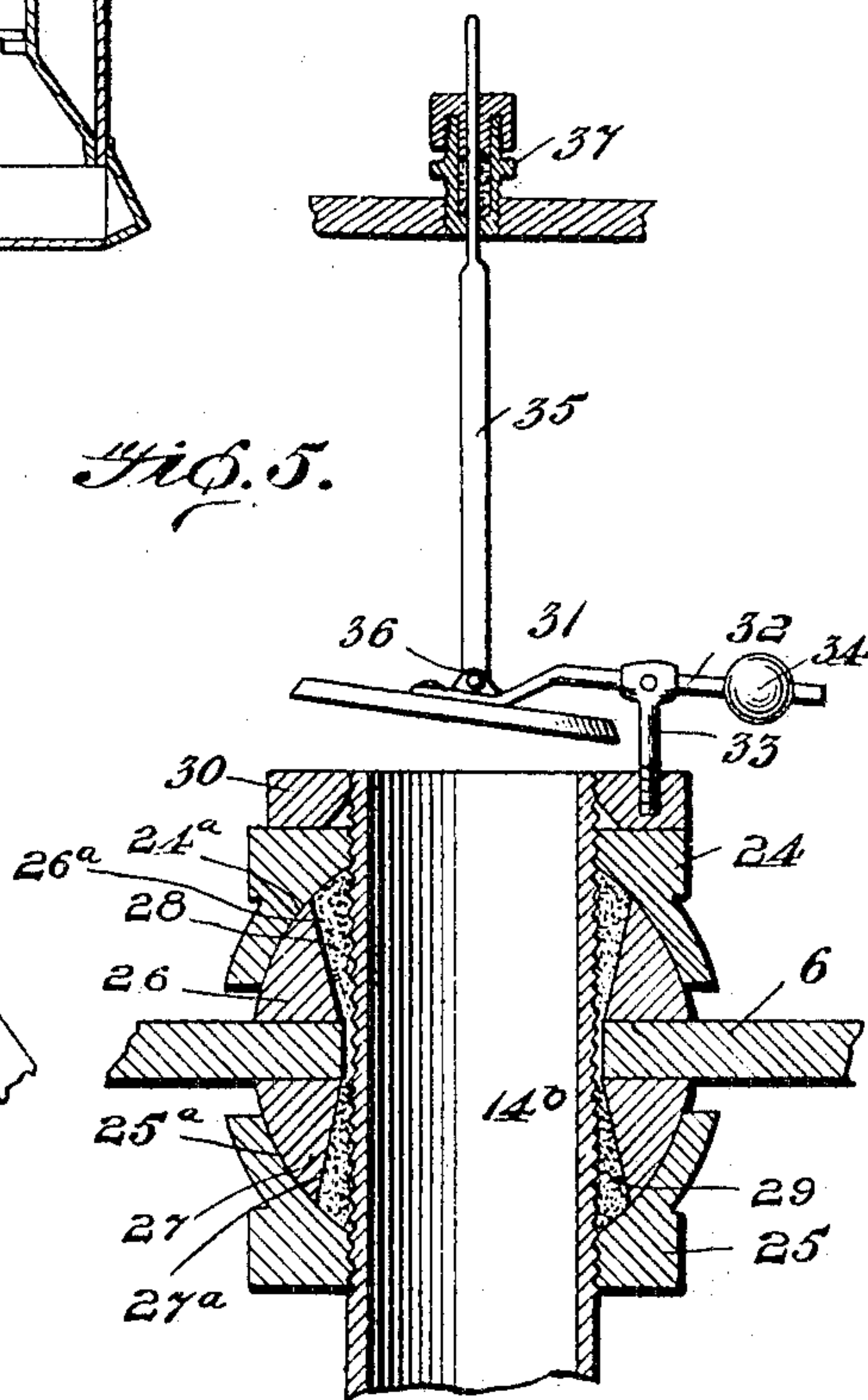


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN JAY LE DUC, OF MANKATO, MINNESOTA.

STEAM-BOILER FURNACE.

No. 798,684

Specification of Letters Patent.

Patented Sept. 5, 1905.

Application filed October 15, 1904. Serial No. 228,630.

To all whom it may concern:

Be it known that I, JOHN JAY LE DUC, a citizen of the United States, residing at Mankato, in the county of Blue Earth and State of Minnesota, have invented a new and useful Steam-Boiler Furnace, of which the following is a specification.

This invention relates to steam-boiler furnaces, and while it is applicable to stationary boilers it has been particularly designed for use in connection with traction-engines and other portable engines and boilers to prevent pocketing of the steam, to maintain an even water-level should the furnace be tilted, and to insure a smooth and regular circulation at all times, irrespective of the position of the furnace.

Another object of the invention is to provide a novel form of water-heating attachment capable of being readily fitted within the fire-box of a furnace, especially of locomotive, traction, and threshing engines, without requiring any material alteration therein and to arrange for the convenient removal of the device when it becomes necessary to scrape the flues thereof or to replace any of the flues. In this connection it is furthermore designed to arrange the flues of the water-heater in such a manner as to avoid pocketing of the steam therein should the furnace become tilted, especially in traction and threshing engines, where it is not always possible to locate the same upon level ground.

A still further object of the invention is to provide for removing sediment from the water-heater by blowing off the same and to effect the blowing off of the device in a simple and convenient manner.

With these and other objects in view the present invention consists in the combination and arrangement of parts, as will be hereinafter more fully described, shown in the accompanying drawings, and more particularly pointed out in the appended claims, it being understood that changes in the form, proportion, size, and minor details may be made within the scope of the claims without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings, Figure 1 is a cross-sectional view taken across the front of a steam-boiler furnace equipped with the water-heater of the present invention and showing the water-heater in elevation. Fig. 2 is a longitudinal sectional view thereof, taken on the line 2 2 of Fig. 1. Fig. 3 is a detail view of the water-

heater. Fig. 4 is a detail longitudinal sectional view thereof. Fig. 5 is an enlarged detail sectional view taken on the line 5 5 of Fig. 1.

Like characters of reference designate corresponding parts in each and every figure of the drawings.

In the accompanying drawings, 1 designates a portion of an ordinary steam-boiler having any preferred type of fire-box 2, including the usual inner wall or shell 3 to form the water-space around the fire-box. A door 4 gives access to the fire-box for the introduction of fuel, and a grate 5 is located at the back of the fire-box, while the crown-sheet is shown at 6.

The water-heater of the present invention has been constructed in the nature of a baffle-plate or flame-sheet which is disposed within the fire-box and inclined upwardly and forwardly over the grate, so as to confine the flames within the lower portion of the fire-box and also direct the same forwardly and upwardly, thereby to insure a quick and effective ignition of new fuel introduced through the door 4. This arrangement is especially advantageous when using straw or the like as fuel, for the reason that it prevents chaff and other light material from being carried by the draft directly into the tubes of the boiler without becoming ignited, which soon results in the choking of the tubes. This water-heater or flame-sheet is in the nature of a pipe-coil and includes two stepped series of hollow header-blocks 7 and 7', located at opposite sides of the fire-box and supported upon stepped flanges or brackets 8 and 8', respectively, suitably secured to the adjacent walls of the fire-box and inclined upwardly and forwardly from the back of the box with their upper ends terminated short of the front of the fire-box and the top thereof or crown-sheet 6. Each of these header-blocks has its inner wall pierced by two openings 9 and 10 for the reception of the ends of the water-tubes 11. The outer wall of the header is also provided with a pair of openings 12 and 13 in alinement with the openings 9 and 10, through which access may be had to the interior of the header and the tubes 11 when it becomes necessary to clean the same, said openings 12 and 13 being provided with suitable removable closures 14, so as to prevent the escape of water and steam when the device is in use.

As best indicated in Figs. 1 and 3 of the

drawings, it will be seen that the header members 7 and 7' are staggered vertically, whereby the flues or tubes 11, which connect the two series of headers, are inclined to the vertical and extend in a zigzag course from one end of the water-heater to the opposite end thereof. The lowermost header 7^a of the series 7' is preferably in the form of a cube, as only one of the tubes 11 connects therewith, while the other headers are each provided with two openings for the reception, respectively, of the upper end of the tube which leads from the next below header of the opposite series and for the connection of the lower end of the tube which leads to the next above header of said opposite series. In other words, two tubes connect with each of the intermediate headers, one tube being inclined downwardly and the other upwardly to preserve the zigzag arrangement throughout the length of the water-heater.

Communication is had between the back of the water-space which surrounds the fire-box by means of a suitable connection 12', which pierces the back of the fire-box, and another elbow connection 13' in communication with the elbow 12' and connected to the bottom of the single header 7^a, so as to supply the water to the lowermost portion of the heater from which it is designed to pass in a zigzag course through the tubes 11 and the two series of headers to the top of the heater.

At the upper end of the water-heater the uppermost tube 11^a is inclined upwardly in its regular order and is terminated substantially midway between the series of headers and is provided with an inverted upstanding T-coupling 14^a, the stem of which passes loosely through an opening 15 in the crown-sheet 6, so as to communicate with the water-space above the top of the fire-box, and thereby complete the circulation from the boiler through the water-heater and back to the boiler.

Between the members of each pair of tubes 11 there is a filler-bar 16, which is supported upon the tubes and fills the space between the same and the opposite headers, and other filler-bars 17 are fitted between adjacent pairs of tubes thereby to present an imperforate flame-sheet and compel the flames and products of combustion to pass upwardly and forwardly and thence over the top of the flame-sheet, as indicated by the arrows in Fig. 2 of the drawings, so as to insure an effective combustion of the fuel and to obtain the most effective heating of the water in the tubes of the combined flame-sheet and water-heater.

The uppermost header 7^b of the series 7 is a single header and is in communication with the T-coupling 14^a by means of a tube 18, and from the front of this header extends an elbow 19, which is connected to a vertical pipe 20, running downwardly in the adjacent front corner of the fire-box and into the ash-pit, where it connects with a substantially

horizontal mud-drum 21, extending transversely across the ash-pit and provided at its opposite end with an elbow discharge-pipe 22, piercing the adjacent wall of the furnace and provided with a blow-off valve 23, which, of course, may be located adjacent the furnace, as shown, or at any suitable point remote therefrom, as may be desired. Normally the valve 23 is of course closed, and whatever circulation may occur through the pipe 20 and the drum 21 will result in the deposit of mud, scale, &c., in the drum 21, so as to maintain the pipe-coil in a comparatively clean condition, it being possible to draw off the accumulation of sediment from the drum 21 by opening the valve 23 and permitting of the water being forced through the pipe 20 and the drum 21 by the steam-pressure within the boiler.

In order that a steam-tight joint may be maintained between the stem 14^b of the T-coupling 14^a at the top of the water-heater and the crown-sheet 6, I employ the form of connection shown in Fig. 5 of the drawings, which includes upper and lower nuts 24 and 25, located at opposite sides of the crown-sheet and fitted upon the screw-threaded portion of the T-coupling, said nuts being provided with internal concaved seats or sockets 24^a and 25^a, located at their inner ends for the reception of segmental washers 26 and 27, which have their central openings 26^a and 27^a flared away from the crown-sheet, so as to produce tapered annular spaces for the reception of suitable packing 28 and 29—as, for instance, asbestos-wicking—which is compressed between the washers and the tube 14^b by the action of tightening the nuts 24 and 25. While packing has been shown at the under side of the crown-sheet, it is not absolutely necessary, for the reason that there is no steam at the under side of the crown-sheet, and under ordinary circumstances the packing 28 above the crown-sheet is sufficient. A suitable locking-nut 30 may be fitted to the upper end of the tube 14^b, so as to lock the nut 24. In addition to forming a steam-tight joint between the pipe member 14^b and the crown-sheet 6 the construction just described also produces a ball-and-socket joint whereby the segmental washers 26 and 27 are capable of being concentrically shifted within the concaved seats of the nuts 24 and 25 by warping of the crown-sheet at either side of the opening 15 therein through which the pipe 14^b projects, thereby preventing unnecessary tension upon the pipe and the joint. Moreover, tilting movements of the crown-sheet occasioned by a traction or threshing engine passing over rough ground will be taken up by the washers 26 and 27, working in the concaved seats of the nuts, whereby strain will be relieved from the pipe, as the crown-sheet is capable of moving independently of the pipe by reason of the fact that

the opening 15 therein is slightly greater in diameter than the pipe to permit of such independent movement.

Located above the open top of the T-coupling 14 there is a combined baffle and valve 31 in the form of a flat disk or plate, which is carried at one end of a lever 32, fulcrumed intermediate of its ends upon a support or post 33, rising from the nut 30, there being a counterweight 34 upon the opposite end of the lever to balance the valve 31 and normally maintain the latter away from the top of the T-coupling in order that the latter may be normally opened to permit of the required circulation. Normally the steam-pressure being equal at opposite sides of the valve 31, it remains open, and as the water and steam rush out through the open top of the pipe 14^b they strike the valve 31, which is inclined upwardly and forwardly and are deflected thereby toward the front of the furnace, thus preventing a fountain action which would disturb the water-level.

An upright valve-stem 35 is hinged at 36 to the top of the valve 31 and has its upper end working through a suitable stuffing-box 37, provided in the top of the boiler-shell, the upper extremity of the valve-stem being projected above the stuffing-box and serving as a signal or indicator to indicate the position of the valve 31—that is to say, whether it is closed or open.

It will now be understood that when the blow-off valve 23 is open pressure is relieved from the under side of the valve 31, whereby the latter will be closed and the steam and water will rush through the tubes or flues of the heater, and thence outward through the pipe 20, the mud-drum 21, and the discharge-pipe 22. Immediately upon closing the valve 23 the pressure at opposite sides of the valve 31 will again become equal, whereby the latter will be opened and retained in an open position so long as the blow-off valve 23 is closed. It will here be explained that by reason of having the stem 35 projected through the top of the boiler-shell the area of the top surface of the valve 31 which is exposed to the steam-pressure is reduced in accordance with the cross-sectional area of the stem 35, and as the upper extremity of the stem is under atmospheric pressure only the area of the under face of the valve which is exposed to the upward pressure of the steam exceeds the area of the top of the valve by the cross-sectional area of the stem 35, wherefore the upward pressure upon the valve is somewhat in excess of the downward pressure thereon and the valve will therefore be normally elevated under the excess pressure upon the under surface thereof. The valve is counterbalanced by the weight 34, so as to insure a prompt operation of the valve when pressure is decreased at its under side by opening the blow-off valve 23 and to insure a prompt opening or eleva-

tion of the valve 31 when the blow-off valve 23 is closed and the pressure is increased upon the under side of the check-valve.

Among the advantages possessed by my invention, it will be noted that by reason of the zigzag inclination of the water-tubes of the water-heater there is always an upward inclination to the water and steam passage irrespective of any tilting of the furnace, wherefore there can be no pocketing of the steam and the latter may flow freely and smoothly through the heater without meeting with any obstructions. Moreover, the heater may be conveniently disconnected from the walls of the fire-box and then removed from the latter whenever it is necessary to repair the same or to scrape the tubes thereof, access being had to the interior of the tubes by removing the closures 14, thereby to facilitate the scraping of scale from the interior of the tubes and to permit replacing thereof. By locating the mud-drum 21 in the ash-pit it is not subjected to the fierce heat within the fire-box, wherefore any collection of sediment therein will not become baked, but will remain in a soft or slushy condition, and therefore will be carried off by the water and steam when the blow-off valve 23 is open. By reason of the fact that there is always water standing in the upright pipe 20 and comparatively little sediment is collected therein the heat of the fire-box will not produce any baking of sediment within the pipe 20, and thus the latter will not become choked.

Having thus described the construction and operation of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a steam-boiler furnace, the combination with a fire-box, of a hollow flame-sheet located within the fire-box and in communication at opposite ends with the water-space surrounding said fire-box, and means to blow off the hollow flame-sheet consisting of a valve controlling the communication between one end of the flame-sheet and the water-space, and a blow-off pipe leading from the same end of the flame-sheet.

2. In a steam-boiler furnace, the combination with a fire-box, of a hollow flame-sheet located within the fire-box and in communication with the water-space at the back of the fire-box and also with the space above the crown-sheet, a normally open check-valve controlling the communication between the hollow sheet and the space above the crown-sheet, a mud-drum located within the ash-pit, a blow-off pipe leading from the top of the hollow flame-sheet to one end of the drum, and a blow-off valve located externally of the furnace and in communication with the opposite end of the drum.

3. In a steam-boiler furnace, the combination with a boiler and the fire-box thereof, of a hollow flame-sheet located within the fire-

box and in communication at opposite ends with the water-space surrounding the fire-box, a check-valve for the upper end of the flame-sheet and provided with a stem carried by the
5 movable member and working through the top of the boiler-sheet, and a blow-off leading from the top of the flame-sheet.

4. A water-heating flame-sheet for steam-boiler furnaces having a zigzag water and
10 steam passage therethrough, the courses of said passage being disposed transversely of the sheet and inclined upwardly.

5. A water-heating flame-sheet for steam-boiler furnaces including two series of headers
15 arranged in staggered relation, and water-tubes extending between the corresponding headers of the two series, an inlet connection for one end of the device and an outlet connection for the opposite end thereof.

20 6. A water-heating flame-sheet for steam-boiler furnaces including a zigzag water-passage made up of connected tube-sections with each tube inclined upwardly from the next below tube.

25 7. A water-heating flame-sheet for steam-boiler furnaces including two upwardly-inclined series of headers arranged in staggered relation, each header being provided with an inlet and an outlet, and a series of tubes extending transversely between the corresponding
30 headers, each tube being inclined upwardly from the outlet of one header to the inlet of the other header.

8. A water-heating flame-sheet for steam-boiler furnaces including two series of stepped
35 headers, each header having an inlet and an outlet, and a series of water-tubes extending between the headers, each tube being inclined upwardly from the outlet of one header to the inlet of the next above header of the opposite
40 series of headers.

9. A water-heating flame-sheet for steam-boiler furnaces including two series of stepped
45 headers arranged in staggered relation, each header being provided with an inlet and an outlet, and a series of water-tubes extending between the corresponding headers of the two series, each tube being inclined upwardly from the outlet of one header to the inlet of
50 the next above header of the opposite series.

10. A water-heating flame-sheet for steam-boiler furnaces including two series of headers arranged in staggered relation, each header being provided with an inlet and an outlet in
55 its inner side, the terminal header of one series having its outlet in the inner side thereof and its inlet in another side, an inlet-coupling connected to the inlet of said terminal header, and a series of water-tubes extending
60 between the headers of the two series, each water-tube being inclined upwardly from the outlet of one header to the inlet of the next above header of the opposite series.

11. The combination with a fire-box having

a water-space surrounding the same, of opposite stepped brackets provided upon the inner walls of the fire-box and progressing upwardly and forwardly from the back thereof with the steps at one side staggered with respect to the steps at the opposite side of the fire-
70 box, headers supported upon the steps of the brackets, each header being provided with an inlet and an outlet, water-tubes extending between corresponding headers at opposite sides of the fire-box, each tube being inclined up-
75 wardly from the outlet of one header to the inlet of the next above header at the opposite side of the fire-box, an inlet connection between the lowermost header at one side of the fire-box and the water-space at the back
80 of the fire-box, and an outlet connection between the upper portion of the device and the water-space at the top of the fire-box.

12. A water-heating flame-sheet for steam-boiler furnaces including a zigzag series of
85 water-tubes each of which is inclined upwardly from its inlet to its outlet, an inlet connection for the lowermost tube, an inverted up-standing T-coupling for the uppermost tube, a check-valve for the upper end of said coup-
90 ling, and a blow-off in communication with the coupling.

13. A water-heating flame-sheet for steam-boiler furnaces including two series of head-
95 ers, each header being provided with an inlet and an outlet, a series of water-tubes extending between the headers with each tube inclined upwardly from the outlet of one header to the inlet of the next above header of the opposite series, the uppermost header of one
100 of the series having an inlet in one side and an outlet in another side, a blow-off leading from the outlet of said terminal header, and the tube which communicates between the two upper terminal headers being provided
105 with a discharge branch having a check-valve.

14. The combination with the fire-box of a steam-boiler furnace, of a hollow flame-sheet provided with a water-pipe loosely piercing the crown-sheet and having a loose steam and
110 water tight connection therewith to accommodate for warping of the sheet and for movement thereof independently of the flame-sheet.

15. The combination with the fire-box of a steam-boiler furnace, of a hollow flame-sheet
115 provided with a water-pipe loosely piercing the crown-sheet and having a steam and water tight ball-and-socket joint therewith.

16. The combination with the fire-box of a steam-boiler furnace, of a water-heating flame-sheet communicating at one end with the wa-
120 ter-space around the fire-box and having an outlet-tube at its upper end loosely piercing the crown-sheet, and a steam and water tight ball-and-socket connection between the water-
125 tube and the crown-sheet.

17. The combination with the fire-box of a steam-boiler furnace, of a hollow flame-sheet

having a passage leading through the crown-sheet to the space thereabove and including a universal connection with the crown-sheet.

18. The combination with the fire-box of a steam-boiler furnace, of a water-heating flame-sheet located within the fire-box and having one end in communication with the water-space surrounding the box, an outlet-tube at the opposite end of the flame-sheet and loosely piercing the crown-sheet, nuts fitted upon the tube at opposite sides of the crown-sheet and provided with concaved seats next the crown-sheet, and segmental washers fitting in the respective seats and bearing against opposite sides of the crown-sheet to form a ball-and-socket connection between the tube and the crown-sheet.

19. A water-heating flame-sheet for steam-boiler furnaces having an inlet at one end and an externally-screw-threaded upstanding outlet-tube at the opposite end, a pair of nuts

fitted upon the screw-threaded tube with their adjacent faces provided with concaved seats, and segmental washers fitted in the seats.

20. A water-heating flame-sheet for steam-boiler furnaces having an inlet at one end and an upstanding externally-screw-threaded outlet-tube at the opposite end, a pair of nuts fitted upon the screw-threaded part of the tube and having their adjacent faces provided with concentric concaved seats, and segmental washers fitted in the seats, one of the washers having its opening flared toward the back of the adjacent seat to form a wedge-shaped annular recess for the reception of packing.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JOHN JAY LE DUC.

Witnesses:

S. B. WILSON,
PEARL RUSSELL.