

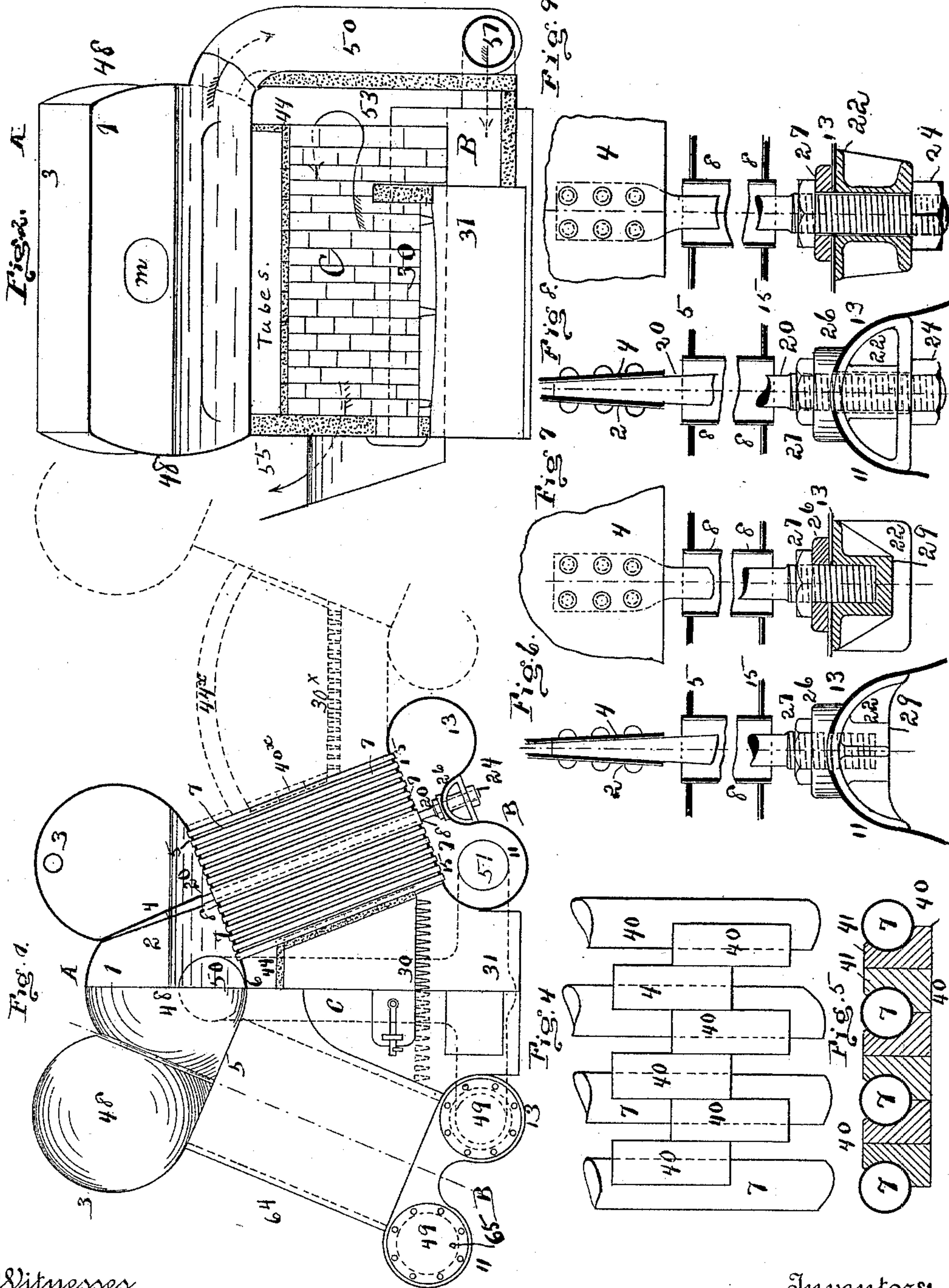
(No Model.)

3 Sheets—Sheet 1.

N. B. CLARK & F. B. KING.
STEAM BOILER.

No. 465,082.

Patented Dec. 15, 1891.



Witnesses
W. Johnson.
J. R. Nottingham

Inventors:
Frank B. King
N. B. Clark
By their Attorney
W. A. Bartlett

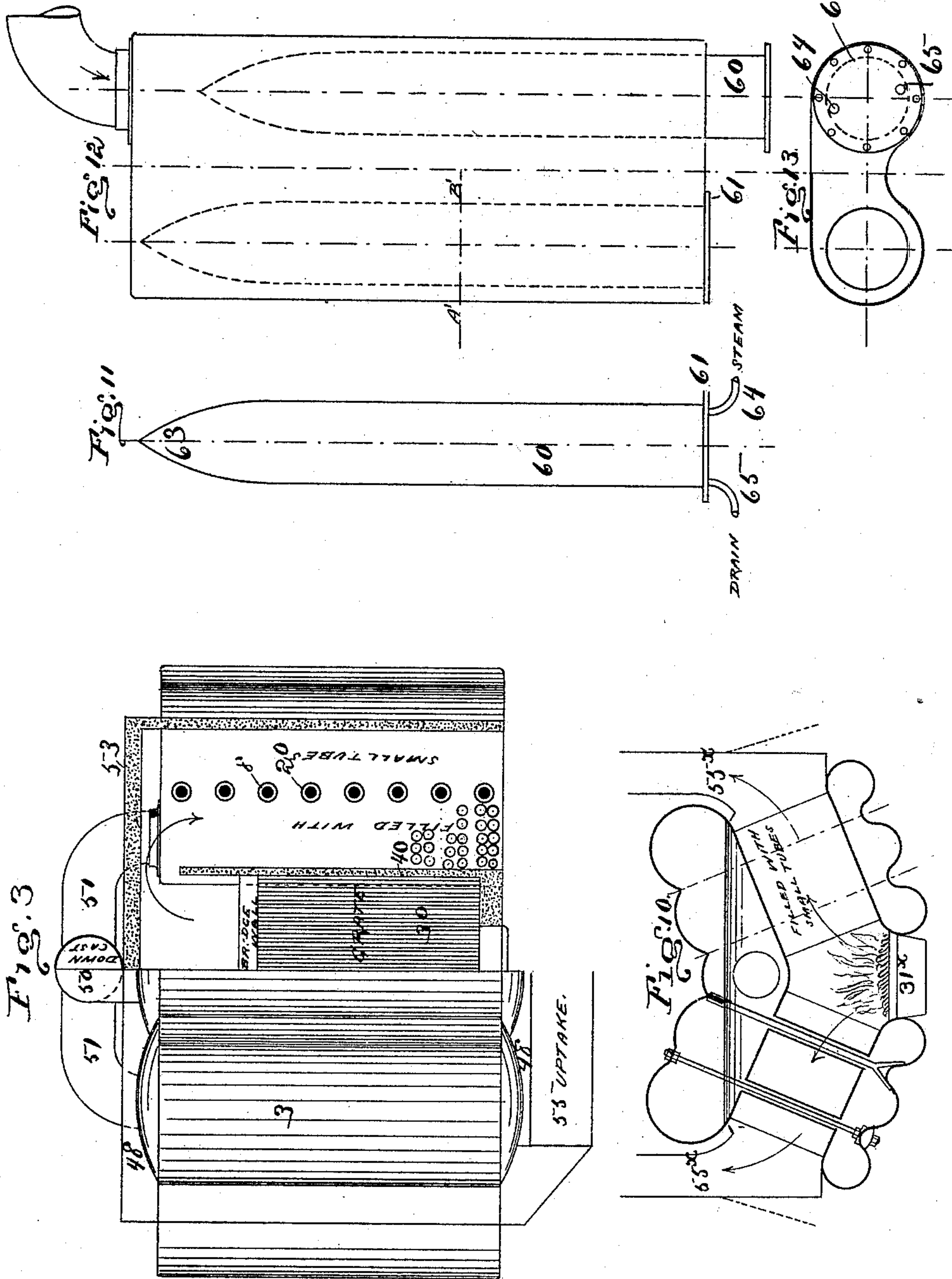
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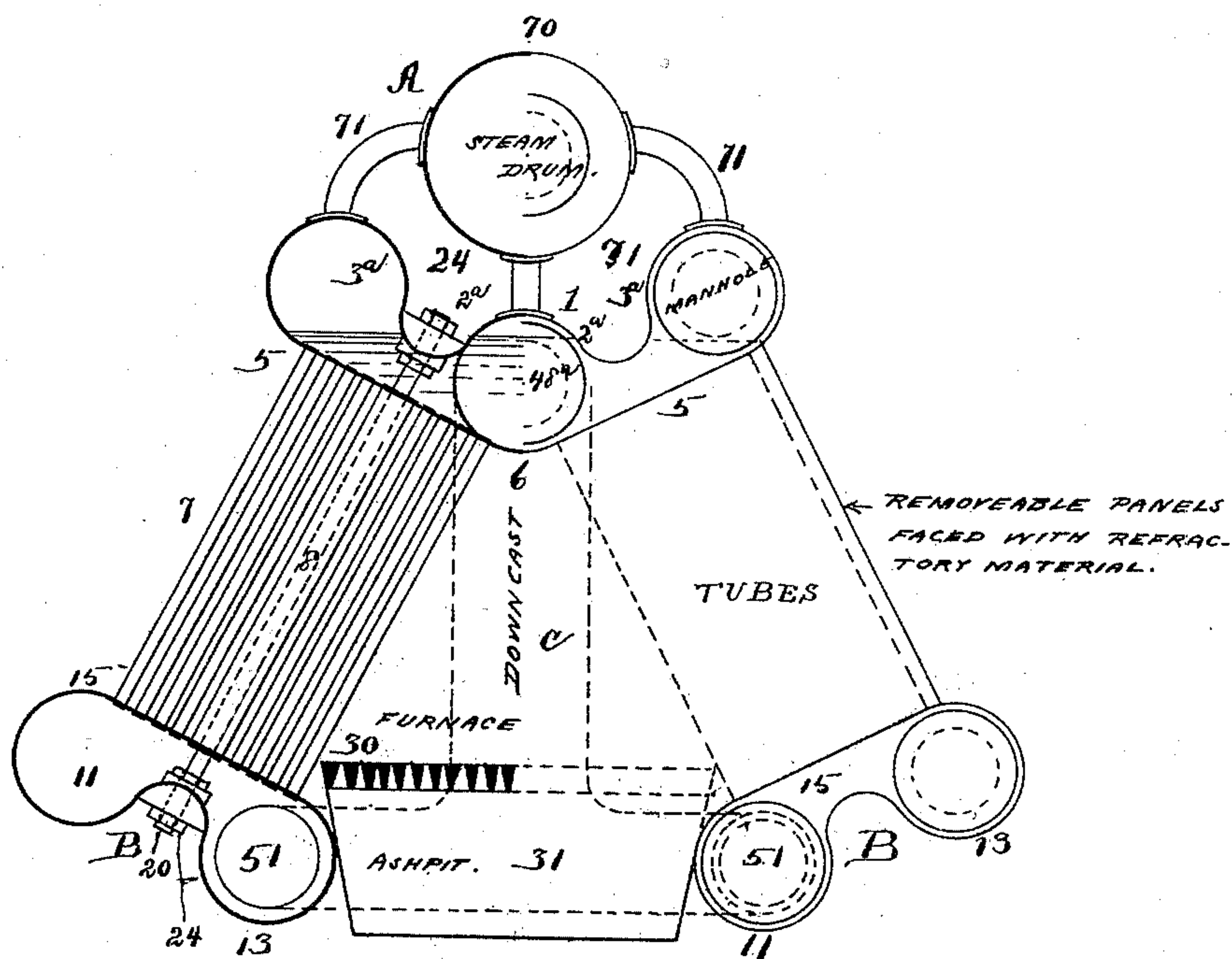


Fig. 14.

WITNESSES:

O. W. Johnson
J. R. Nottingham

Frank B. King
N. B. Clark
INVENTORS

BY

W. A. Bartlett
ATTORNEY

UNITED STATES PATENT OFFICE.

NATHAN B. CLARK AND FRANK B. KING, OF WASHINGTON, DISTRICT OF COLUMBIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 465,082, dated December 15, 1891.

Application filed October 4, 1890. Renewed November 14, 1891. Serial No. 411,843. (No model.)

To all whom it may concern:

Be it known that we, NATHAN B. CLARK and FRANK B. KING, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to steam-boilers of the kind which have water-tubes for a considerable extent of the heating-surface.

The object of the invention is to produce a steam-boiler of the general character described, in which the plates forming the shell of the water and steam chambers, or either of them, shall merge into the tube-sheets tangentially, so as to secure great strength of structure without imposing awkward stress on the outer rows of tubes or the employment of stays to relieve such stresses; also, to stay the boiler internally in a convenient manner; also, to reduce the quantity of water in a shell of large size; also, to improve the construction of the boiler in various ways.

Figure 1 is a partial end elevation and partial section of a steam-boiler embodying this invention. Fig. 2 is a central vertical longitudinal section of the boiler, Fig. 1. Fig. 3 is a top view and horizontal section just above the grate of Fig. 1. Fig. 4 is a side elevation, and Fig. 5 a section, of the series of tubes next the fire, with their protecting fire-bricks. Figs. 6 to 9 are sectional details of fastenings for the stays which connect the top and bottom members of the boiler. Fig. 10 is a cross-section of a modified boiler. Fig. 11 is an elevation or plan of an "excluder" used in the boiler-chamber. Fig. 12 is a plan, and Fig. 13 an end elevation and section on line A B, Fig. 12, of boiler member with excluder applied. Fig. 14 is a modification showing connection of steam-drum to top member.

The letter A indicates the top member of the boiler. The shell of this member is composed of a central arched plate 1, turned down at its sides, as at 2, and there connected to the inner edge of the side arch 3. Arch 3 has a turned-in edge 4, proximate to the part 2 of plate 1, and the edges are secured to-

gether and to stays leading to the lower boiler member. There will be a man-hole *m* through plates 2 4. The arch 3 is continued and merged in and secured to a straight, or nearly straight, tube-sheet 5, which tube-sheet is tangential to the curve of the arch, the tube-sheets extending at an angle from the horizontal.

The two sides of the boiler are alike, and the two tube-sheets 5 connect across the median line 6 of the boiler under arch 1 by a curved surface, preferably swept by the same radius and from the same center as the arc A, the same radius being preferably that of arc 3 also. The plates or tube-sheets 5 extend tangentially downward and toward the center. Water-tubes 7 extend from these to tube-sheets 15 of the lower boiler members B. Along the central or other convenient line of the tube-sheets a series of large tubes 8 connect the tube-sheets 5 and 15, and the ties pass through these large tubes, leaving space around the ties for the passage of water.

The bottom members B of the boiler have the shell-plates 11 arched or curved, and then by a reflex curve the plates are brought round to form a second arch 13. Both arches are continued until merged into the tangential tube-sheet 15.

The stays 20 may be rods with flattened ends riveted to or between the plates 2 and 4 in the upper member and connected to suitable supports outside the lower boiler member. These supports may be bow-plates 22, having a flat side 23 resting in the reflex curve of the bottom member B.

The stay-rods 20 pass through the bottom plate of the boiler member B, and, as shown in Figs. 8 and 9, nuts 24 are applied to the threads on the rods outside the flat bars of the bow-plates. The passages round rods 20 are closed by grommets 26, held down by nuts 27.

As a modification, the bow-plates 22 may have internal threads or nuts 29, into which the rods 20 are secured before the upper ends are riveted. (See Figs 6 and 7.)

The tube-sheets 5 5 are inclined and parallel to the sheets 15. The tubes 7 and 8 connect the sheets 5 and 15 at right angles

to each sheet and are therefore inclined inwardly at their upper ends, and a space C is left between the tubes of the right and left hand boiler-section. This space C receives the fire-grate 30 and the ash-pit 31. (See Fig. 1.)

The intense heat of the fire would soon burn out the row of tubes 7 next the fire if the same were not protected. We therefore cover the inner row of tubes 7 with fire-bricks 40 to form a shield and to establish a circulation of gases to the back of the furnace, returning among the tubes. These fire-bricks are made with a flat front and are hollowed at one side. The cut-away portion corresponds with the inclosed side of tube 7. Two bricks turned together, as in Fig. 5, will fill the space between two of the tubes 7. The bricks do not reach to the top of the tubes 7 when the boiler is complete, as shown in Figs. 1 and 2, but may be entered at the top of the tubes and passed down. Two bricks placed between the pipes, as in Fig. 5, will lock each other, so that neither can be removed; but by lifting one brick up, so that its extension 41 is above the similar extension of its fellow, the bricks can be readily removed.

The top of the furnace will be covered with a shield or layer of fire-bricks 44 some little distance below the plates 5, to protect said plates from the intense heat of the flame. The end plates 48 and 49 of the top and bottom members A B are portions of spherical surfaces. The central portion of the top member A is connected by a downcast pipe 50 with both the bottom members B, pipe 50 having two branches 51, leading, respectively, to the proximate sides of the two lower members B. This downcast will take water from the deep body of water at the middle of the top member and convey it to the bottom member, and the water will pass up through tubes 7 and 8, when the boiler is heated, on principles of circulation well known in this art.

The parts so far described go to make up a single boiler. Any number of boilers of this kind may be arranged in battery, a convenient arrangement being shown in Fig. 1, dotted lines. The outer tubes of each boiler may be protected by bricks 40^x, and a furnace 30^x, covered by an arch 44^x, may be arranged between each pair of boilers. Otherwise the sides of the boiler will be inclosed with any suitable casing, such as removable metal panels faced with asbestos and placed against the outer rows of tubes, and the rear of the boiler will have a casing 53 between the boiler and the downcast.

The fire from the grate 30 passes back and around the wall or shield formed by bricks 40, and then passes to the front of the boiler among the tubes 7 and 8, (see arrow, Fig. 2,) and out at the uptake 55, there being an uptake at each side of the boiler, preferably leading to a single stack.

In the modification Fig. 10 an arrangement

is shown in which the fire passes from the central grate 31^x to both sides between the small tubes and so to uptake 55^x. The top and bottom members of the boilers have more than two arches at each side of the center, which is within the spirit of the invention.

It is desirable that the members A and B of the boiler be large enough to admit a man, and man-hole plates are provided for the purpose; but for some uses this gives an excess of water-space to the boiler. When desirable to reduce weight, we insert in the sections B (and in the lower part of section A) very thin metallic cylinders or excluders 60, attached to the man-hole plates 61 and extending nearly to the rear of the water-chambers. The rear ends 63 of these excluders are preferably rounded or pointed, so as not to interfere with the flow of water from or to the downcast. The excluders are each provided with a small steam-pipe 64, leading to the steam-space in the boiler, and a drain-pipe 65, leading to the feed-suction pipe or any convenient place where there is a reduced pressure. By this construction the steam-pressure within the excluder equals the water-pressure outside thereof. Consequently the shell of the excluder may be made very light, yet the water will be excluded from the boiler member to an extent equal to the size of the excluder. When the man-hole plate is removed from the boiler, the excluder will be removed with it, so that free access may be had to the interior of the boiler.

The outer or inner tubes 7 may be readily removed and replaced when the casing or bricks next them are removed. Tubes nearer the tubes 8 can be removed and replaced by first removing the outer tubes in the row until the defective tube is reached; or the tubes may be arranged in double columns with alternate spaces, as shown in Fig. 3, and tubes may be passed in the spaces and swung into position to be expanded in the tube-sheets.

We consider the merging of the shell into the tube-sheet tangentially as particularly valuable in boilers of this class. This prevents tensile stress on the outer row of tubes, which connect the boiler members, and obviates the use of external stays parallel to the tubes.

It will be understood that the claims are intended to cover equivalent construction.

In Fig. 14 the top member is shown as nearly a duplication of the bottom member. The top sheets 2^a are made to join the sheets 3^a by a reflex curve, as in the bottom member. This permits the stays 20 to pass through both top and bottom members, and nuts 24 may be applied on both ends of the rod.

The construction in Fig. 14 provides steam room at top of the boiler by connecting a steam-drum 70 with each arch of the upper member of the boiler by pipes 71, as many in number as may be necessary.

Steam will be taken from the steam-dome

in usual manner, and the steam-drum will have arched ends, as do the arched sections forming the boiler members.

What we claim is—

5 1. In a steam-boiler, a single top member composed of arched cover-plates and flat tube-sheets and two bottom members of arched shells and flat tube-sheets and inclined water-tubes connecting the proximate faces of the
10 tube-sheets, substantially as described.

2. The boiler member composed of arched shell-plates and a flat tube-sheet merging with and tangential to the shell-plates and water-tubes connecting said member to another
15 boiler member, substantially as described.

3. The combination of the top and bottom members of the boiler connected by tubes, a furnace next the tubes, and fire-bricks alternately cut away on opposite sides lying between the tubes and interlocking therewith,
20 substantially as described.

4. The combination of the top member having its shell composed of arched plates and a tangential tube-sheet, the bottom member
25 composed of reflex curved plates and a tangential tube-sheet, tubes connecting said tube-sheets, bow-pieces resting in the reflex curve of the bottom member, and stays passing through said tubes and secured to said
30 bow-pieces and to the top member, substantially as described.

5. The combination of the top member having its shell composed of reflex curved plates and a tangential tube-sheet, a bottom member of similar construction, connecting water-tubes, and a stay passing through both boiler members and a connecting-tube and secured outside the boiler members.
35

6. The combination of the top member having a reflex curve in its shell, a bottom member having a reflex curve in its shell, water-tubes connecting these members, bow-pieces resting in the curve of the shell, and stays passing through both boiler members and
40 having nut engagement with the bow-pieces, substantially as described.

7. The combination of the upper boiler

member having a series of arches arranged side by side and communicating with each other, as described, with a steam-drum above
50 the arches and connected to each arch by a suitable pipe, substantially as described.

8. The combination, with the top shell and the reflex curved bottom plate, of the bow-piece resting in said curve outside the shell,
55 and a stay having nut engagement with said bow-piece and passing inside the shell, substantially as described.

9. The combination of the top member and the bottom boiler member having arched
60 plates connected by a reflex curve, the bow-plate resting in said curve, the stay secured to the bow-plate and passing through the shell, and a nut and grommet around said stay, substantially as described. 65

10. The combination, with the water-chamber, of a closed shell therein acting as a water-excluder, said shell having a steam-pipe to admit steam-pressure therein.

11. The combination, with the water-chamber, of a boiler, a man-hole forming a cover therefor, and a shell forming a water-excluder attached to said plate, substantially as described. 70

12. The combination, with the water-chamber of a boiler, of a man-hole plate, a metallic shell attached to said plate and extending into the water-space of the boiler, and a steam and a drain pipe connected to said shell, substantially as described. 75

13. The combination, with the boiler member having an arched shell and a flat tube-sheet and suitable ends, of a man-hole plate at one end of said member, a cylindrical vessel attached to said plate and extending into
80 the boiler member, and a steam and a drain pipe connected to said vessel.

In testimony whereof we affix our signatures in presence of two witnesses.

NATHAN B. CLARK.

FRANK B. KING.

Witnesses:

J. H. WHEELWRIGHT,

W. A. BARTLETT.