

V. MacKAY.

BOILER.

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Patented June 20, 1911.

2 SHEETS—SHEET 1.

995,544.

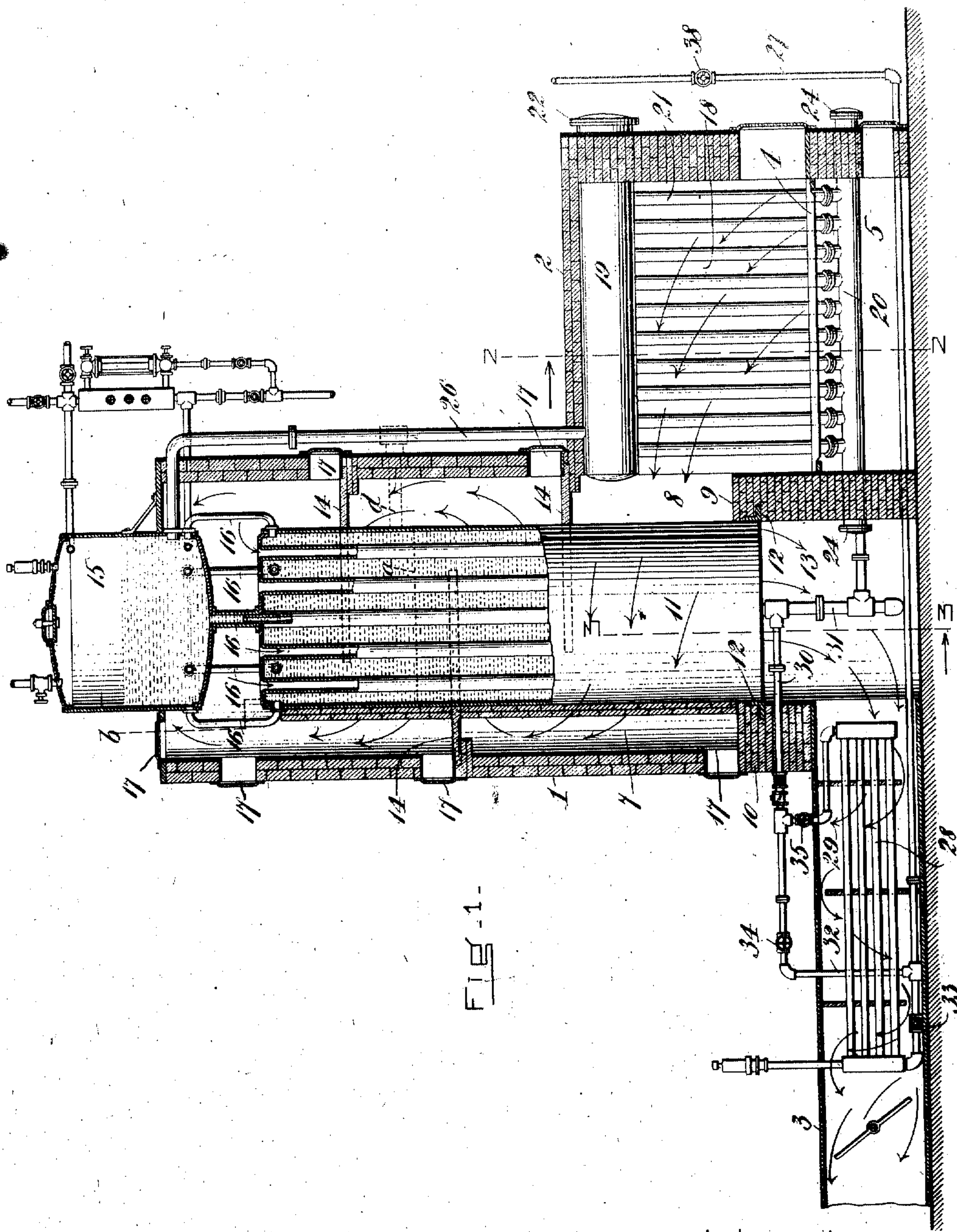


Fig. 1.

WITNESSES:

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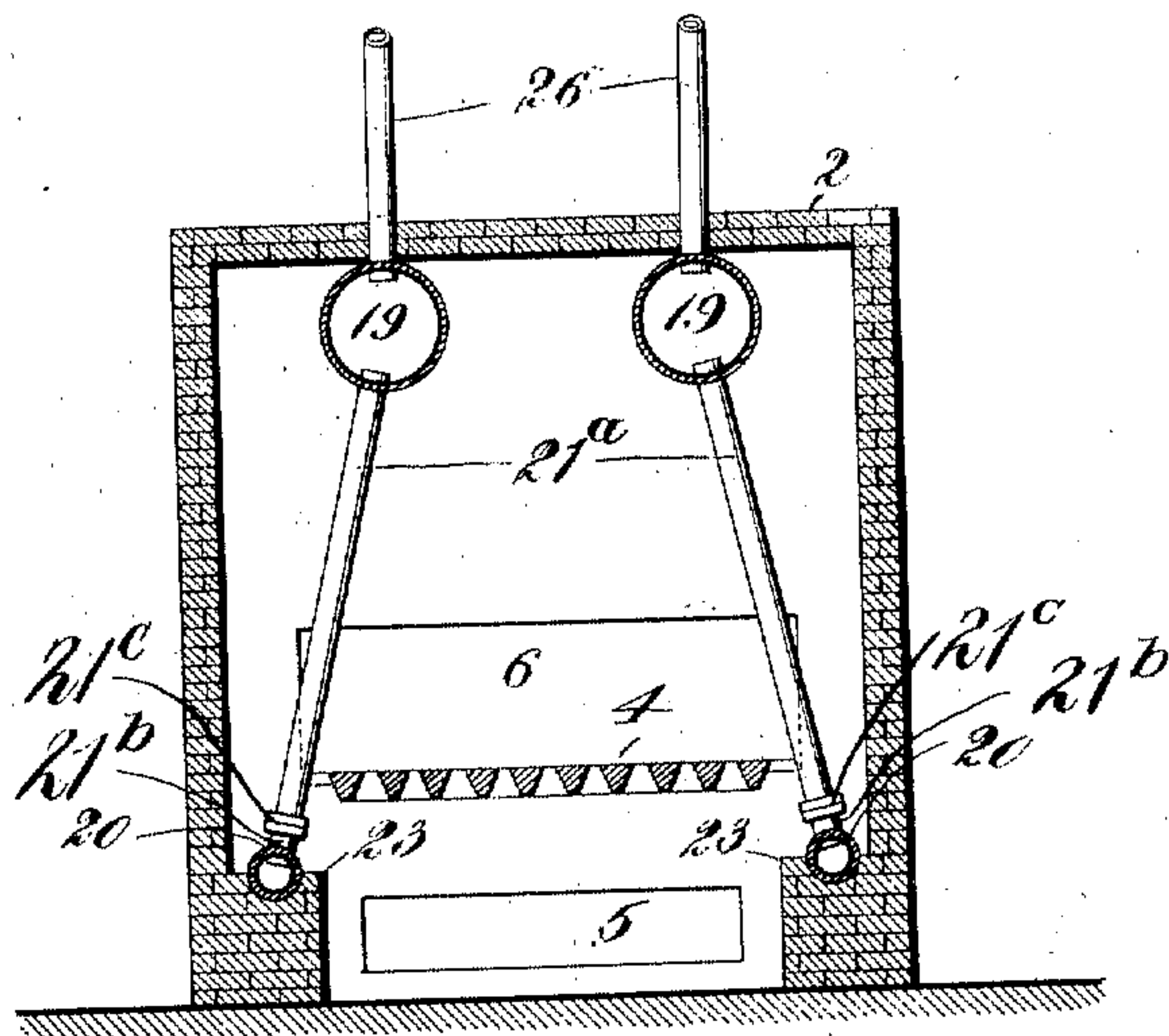


Fig. 2.

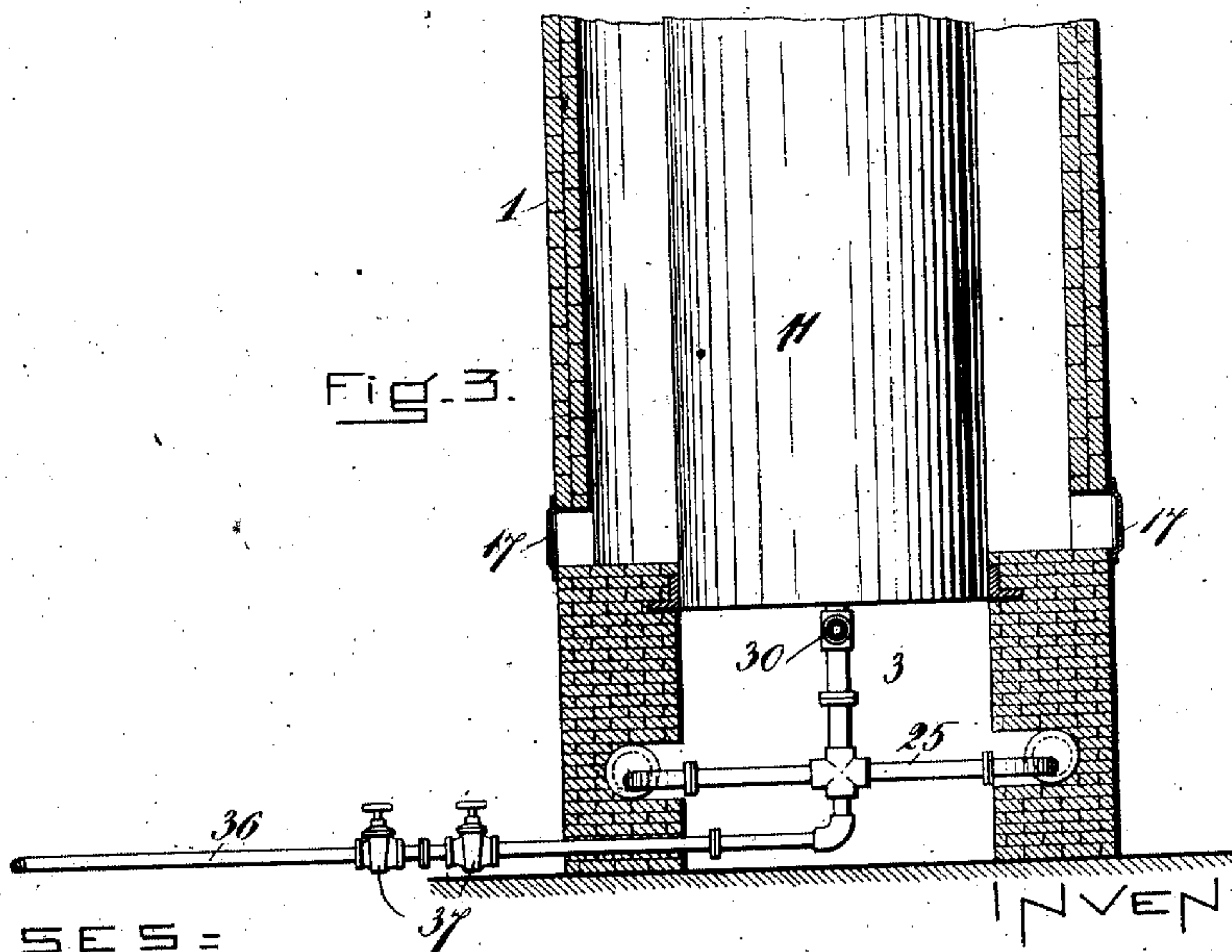


Fig. 3.

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UNITED STATES PATENT OFFICE.

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BOILER.

995,544.

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To all whom it may concern:

Be it known that I, VASIL MACKEY, of Boston, in the county of Suffolk and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Boilers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

It is the object of my invention to provide a boiler having among other advantages the following essential advantages, viz: a relatively large extent of heating surface, uniform application of heat thereto, effective absorption of heat units from escaping gases, effective water distribution, durability and safety in the sense that intense heat is kept from those parts in which sediment might accumulate, freedom and uniformity of expansion, accessibility of parts.

The improved boiler comprising my invention can best be seen and understood by reference to the drawings, in which—

Figure 1 shows the improved boiler in cross vertical section. Fig. 2 is a cross section taken on the line 2—2 of Fig. 1, and Fig. 3 is a cross section on the line 3—3 of Fig. 1.

Referring to the drawings:—The exterior of the boiler comprises what may be termed a primary setting 1 and a forward extension setting 2. From the rear bottom end of the setting 1 there extends a conduit or escape pipe 3. It is within the extension setting 2 that combustion is primarily effected. Inside the setting is arranged a grate 4 below which is an ashpit 5 both accessible from the front end of the setting. Above the grate is what may be termed a primary combustion chamber 6 communicating with a chamber 7 or secondary combustion chamber within the primary setting 1 and which secondary chamber extends above said primary chamber. Communication is had between the primary and secondary combustion chambers by way of a connecting passage 8 over a bridge wall 9 which forms a part of a foundation or pier 10 on which the primary setting is mounted.

Arranged within the primary setting in-

side the secondary combustion chamber 7 is an upright fire-tube boiler 11. The boiler extends by the connecting passage 8 through which the products of combustion are directed from the primary combustion chamber into the secondary, and thence for a short distance into the hollow of the pier or foundation 10 which acts to support the boiler by a lug or flange 12 arranged at the bottom end of the boiler and which flange extends outwardly to rest upon or in said pier. Above the foundation or pier 10 the size of the boiler in relation to the primary setting 1 inclosing it is such that an annular passage will be formed between the boiler and the interior wall of its setting. This passage extends from the pier or foundation adjacent the connecting passage 8, where the products of combustion enter the secondary combustion chamber from the primary chamber, up to the top of the secondary combustion chamber at which point sufficient clearance is left between the top end of the boiler and the head of the primary setting for the products of combustion to enter at the point of the top end of the boiler and pass downwardly through the same to the outlet or escape pipe 3, the interior passage of which connects with a chamber 13 formed by the pier or foundation 10 below the base of the boiler. Preferably interposed between the boiler and the setting 1 are a series of baffle plates 14. One of these plates is arranged at a point just adjacent the connecting passage 8 in order that the products entering at this point may be directed to course around and by the sides of the boiler to the rear side thereof where they are permitted to rise and by the arrangement of the other plates be directed to course upwardly back and forth over and around the sides of the boiler to the top end thereof where they enter to pass downwardly through the boiler as aforesaid.

I prefer to provide the boiler with a steam drum 15 located in the head of the primary setting and contained partly within the secondary combustion chamber and partly outside the same, or in other words, so that the products of combustion rising within the secondary combustion chamber

will when they reach the top end thereof contact with the bottom side of the drum before entering the boiler. I prefer to employ a drum with the boiler inasmuch as it may be desirable under certain circumstances for purposes of safety to keep the boiler filled with water. Under other circumstances, however, the drum may be dispensed with, a water line being maintained within the boiler at about the point indicated in dotted lines *a*, any suitable pipe connection then extending from the head of the boiler as indicated by the dotted line *b*. The drum 15 as shown connects with the head of the boiler by a series of pipe connections 16.

Access is had to the interior of the secondary combustion chamber and to the boiler by way of flue openings 17 formed in the wall of the inclosing setting. These openings are formed at points just adjacent where deposits might accumulate, as at a point adjacent the top edge of the pier 10 on which the boiler rests, also, at the points of the respective baffle plates 14 and at a point just adjacent the top of the boiler though there is but slight chance for deposits to collect at this point owing to the openings through the boiler.

In addition to the main boiler 11 I have provided also an auxiliary boiler 18 located within the primary setting below the water line of said main boiler. This boiler comprises an association of drums 19—19 and 20—20, each pair of drums 19—20 being connected by a series of tubes 21. The drums 19—19 are arranged above the grate and in the upper part of the primary combustion chamber. They are preferably located to extend longitudinally from the front to the rear end of the chamber with the front end of the drums preferably extended through the front wall of the setting so that the forward ends of the drums will lie outside the combustion chamber, the forward end of each drum being preferably provided with a detachable head 22 bolted thereto. The drums 20—20 are arranged below the grate resting on ledges 23 formed in the side walls of the setting on either side of the ashpit. These drums are preferably parallelly arranged with respect to the drums 19—19 and their length is preferably such that the drums will extend through the forward and rear walls of the setting with the ends of the drums located outside the setting with heads 24 attached thereto.

Inasmuch as the drums 19—19 are preferably arranged nearer the longitudinal center of the primary setting than the drums 20—20 the connecting tubes 21 will accordingly assume a slightly inclined position within the combustion chamber extending from points over the grate in the upper part

of the chamber to points below the grate on either side thereof. It will also be observed that the tubes 21 are set quite close together. Each of the pipes or tubes 21 is made sectional in character and comprises an upper section 21^a, a lower section 21^b and a joint 21^c. The upper sections 21^a extend into the drums 19 and preferably have an expanded connection therewith. The lower sections 21^b connect with the drums 20 and have preferably either a threaded or an integral connection therewith. The joints 21^c are located below the grate. The drums 20—20 are connected at the rear ends thereof by the back connections 25 (see Fig. 3). From each drum 19—19 there extends a pipe 26. The pipes 26 connect with the steam drum 15. In case a steam drum is not used, as it might be under some circumstances as before described, then the pipes 26 will connect directly with the boiler as indicated in dotted lines by their extension *d*.

Water is fed to the respective boilers by a feed pipe 27. I prefer that the water be heated before entering the boilers and for this purpose there is located within the conduit or escape pipe 3 a primary feed water heater 28 with which the feed pipe 27 connects, the heater in turn connecting by a pipe 29 with a pipe 30 which connects with a pipe 31 connecting with the bottom end of the main boiler 11 and with the back connections 25 of the respective drums 20—20 of the auxiliary boiler.

If desired water may be fed to the respective boilers direct, cutting out the primary heater 28. For this purpose there is provided a pipe 32 which connects with the feed pipe 27 at a point therein before its connection with the primary heater and extends to connect with the pipe 30 beyond the point of the primary heater. Valves are provided in the respective pipes; a valve 33 in the feed pipe 27 beyond the point where the pipe 32 connects therewith; a valve 34 in the pipe 32 and a valve 35 in the pipe 29. By opening the valve 34 and closing the valves 33, 35 it is obvious that water may be fed directly to the boilers cutting out the primary heater.

Connecting with the pipe 31 by extension therefrom is a blow-off pipe 36 having in it a valve 37. By closing the feed pipe 27 by a valve 38 therein and by opening the valve 37 of the blow-off pipe the boilers may be blown as occasion may require.

In the operation of the boiler the hot gases and products of combustion from the fuel burning on the grate 4 will first contact in the primary combustion chamber with the drums 19—19 and tubes 21 of the auxiliary boiler. They will then pass out of the primary chamber over the bridge wall 9 and by way of the connecting passage 8 into the sec-

ondary combustion chamber 7, first contacting with the boiler at a point removed from the bottom thereof. They will then be directed by the respective baffle plates to course upwardly and around the outside of the boiler to the top end of the chamber 7 where they will encounter the bottom of the steam drum 15. The gases will then enter the top end of the boiler and pass downwardly through the tubes thereof to the chamber 13 and thence outwardly through the escape pipe in which they will contact with the pipes or tubes of the primary water heater 28 located within the escape pipe.

During the operation of the boiler the water adjacent the sides of the main boiler will become more highly heated than the water at the point of the center of the boiler inasmuch as the primary heat is applied first to the outside of the boiler. The tendency accordingly will be for the water to circulate upwardly into the drum 15 through the pipes 16 which, as will be noted by reference to Fig. 1, connect the upper side portions of the main boiler with the bottom outer portions of the drum. At the same time the water at about the center of the boiler will tend to circulate downwardly toward the bottom thereof by reason of the upward displacement of the water along the sides. A pipe 16^a is shown connecting the bottom center of the drum with the top center of the boiler. Accordingly the water in the drum will as the water at the center of the boiler circulates downwardly act to pass downwardly through the pipe 16^a causing a continuity of circulation from the outside of the boiler through the drum to the inside thereof. Owing to the tendency of the water to a downward circular through the pipe 16^a and center of the main boiler from the drum, there would be little tendency for water circulating upwardly on the outside of the boiler to pass into the drum by way of the central pipe 16^a. To avoid any difficulty of this kind, however, I prefer that the pipe 16^a be extended into the boiler to a point below where the pipes 16 connect therewith.

In the auxiliary boiler the hot water contained in the drums 19 and tubes 21 will tend to circulate upwardly through the pipes 26 into the drum 15, the pipes 26 as shown connecting with the side of the drum. As before explained, the drums 20 of the auxiliary boiler through their back connection 25 and the pipe 31 connect with the bottom of the boiler at about the center thereof with the effect that as the hot water circulates upwardly through the auxiliary boiler and connections 26 a part of the water circulating downwardly through the center of the main boiler, as before explained, will circulate also through the pipe 31 and back

connection 25 into the drums 20 and upward again. Accordingly there is obtained a continuous circulation of water in both boilers from the hotter to the cooler heating surfaces thereof.

In addition to the advantage of effective water distribution as above described attention is directed to the large extent of heating surface presented by the main and auxiliary boilers, the water being broken up to be contained within a multiplicity of tubes and drums. An effective absorption of heat units is obtained in the sense that the arrangement and continuity of the passages is such as to allow the hot gases and products of combustion to escape only at a relatively low temperature. Durability and safety are obtained in the sense that intense heat is kept from those parts in which sediment might collect. Around the shell of the main boiler is ample space for inspection and cleaning. On account of the down draft the soot will collect in the chamber 13 under the bottom of the boiler where it can be easily removed. Easy access is had to both drums of the auxiliary boiler. In this connection it may be explained that in practice the drums 19 are large enough to allow one to enter and expand the water tubes connecting therewith.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler, said flue passage rising from the outlet to said primary chamber and in communication also with the top end of said boiler, said upright tubular boiler being arranged in said secondary chamber whereby the lower portion thereof will lie just adjacent the outlet from said primary chamber, and means for closing the bottom end of said boiler from said outlet and flue passage.

2. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, an ashpit below said grate, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler, said flue passage rising from the outlet to said primary chamber and in communication also

with the top end of said boiler, said boiler being arranged in said secondary chamber whereby the bottom end thereof will lie above the line of said grate and the lower portion of said boiler will lie just adjacent the outlet from said primary chamber, means for closing the bottom end of said boiler from said outlet and flue passage, and an escape pipe from the bottom end of said boiler lying back of said ashpit and substantially in the same horizontal plane therewith.

3. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, a bridge wall located at the rear of said primary chamber, an upright tubular boiler located within said secondary chamber and forming between it and the interior wall of said chamber a flue passage around said boiler rising from said outlet and in communication also with the top end of said boiler, a setting for the lower end of said boiler and of which setting the said bridge wall forms a part, for supporting said boiler and cooperating therewith in a manner whereby the lower portion thereof will lie just adjacent the outlet from said primary chamber and the bottom end of said boiler will be closed from said outlet and flue passage.

4. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler, said flue passage rising from the outlet to said primary chamber and in communication also with the top end of said boiler, a setting for said boiler arranged to the end that the lower portion of said boiler may lie just adjacent the outlet from said primary chamber and the bottom end of said boiler be closed therefrom, said setting providing also a chamber below the bottom end of said boiler and escape pipe leading therefrom.

5. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around

said boiler, said flue passage rising from the outlet to said primary chamber and in communication also with the top end of said boiler, means for supporting and arranging said boiler whereby the lower portion thereof may lie just adjacent the outlet from said primary chamber and the bottom end of said boiler be closed from said outlet, an escape pipe connecting with the bottom end of said boiler, and a feed water pipe leading into said boiler at the bottom thereof at about the center.

6. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, a grate located in said primary chamber below the outlet from said chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler, said flue passage rising from the outlet to said primary chamber and in communication also with the top end of said boiler, means for supporting and arranging said boiler whereby the lower portion thereof will lie just adjacent the outlet from said primary chamber and the bottom end of said boiler be closed from said outlet, a drum located above said boiler, pipes interposed between the head of said boiler and said drum, said pipes being arranged to provide a passage for water contained in said boiler adjacent to the sides thereof, into said drum, and a passage also for water contained in said drum, into said boiler at about the center of the top thereof whereby water in said boiler may circulate upwardly along the sides thereof into said drum and thence downwardly from said drum into said boiler at about the center thereof.

7. The combination with an upright boiler having flue passages extending longitudinally through the same, of a drum located above said boiler, pipes interposed between the head of said boiler and said drum, said pipes being arranged to provide a passage for water contained in said boiler adjacent to the sides thereof into said drum and a passage, also, for water contained in said drum into said boiler at about the center thereof, means whereby heat generated and applied to said boiler may be confined and directed to pass upwardly alongside the outer heating surface thereof to contact with the bottom surface of said drum and thence be directed to pass downwardly through said boiler by way of the flue passage therein.

8. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber, an upright tubular boiler located within said secondary chamber, means whereby heat generated in

said primary chamber may be directed to encounter said boiler at a point above the bottom end thereof and thence be directed to pass upwardly through said secondary chamber alongside said boiler to enter the top end thereof and thence pass downwardly through said boiler, an escape pipe leading from the lower end of said boiler, an auxiliary boiler located in said primary chamber below the water line of said tubular boiler, means connecting the head portion of said auxiliary boiler with said tubular boiler, and means connecting the lower portions of said boilers.

9. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber, an upright tubular boiler located within said secondary chamber, means whereby heat generated in said primary chamber may be directed to encounter said boiler at a point above the bottom end thereof and thence be directed to pass upwardly through said secondary chamber alongside said boiler to enter the top end thereof and thence pass downwardly through said boiler, an escape pipe leading from the lower end of said boiler, a drum located above said boiler, pipes interposed between the head of said boiler and said drum, said pipes being arranged to provide a passage for water contained in said boiler adjacent the sides thereof, into said drum and a passage also for water contained in said drum, into said boiler at about the center thereof, an auxiliary boiler located within said primary chamber below the water line maintained in said drum, means connecting the upper portion of said auxiliary boiler with said drum, and means connecting the lower portions of said boilers.

10. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler in communication with the top end thereof, means for supporting and arranging said boiler within said secondary chamber whereby the lower portion thereof will be just adjacent the outlet from said primary chamber and the bottom end of said boiler will be closed from said outlet and flue passage, an escape pipe leading from the lower end of said boiler, an auxiliary boiler located within said primary chamber below the water line of said tubular boiler, said auxiliary boiler comprising upper and lower drums and a series of pipes connecting said drums, a pipe connection between the upper ones of said drums and said boiler and a pipe connection between said

tubular boiler from a point about the center of the bottom thereof and the lower ones of said drums.

11. A boiler having primary and secondary chambers, said secondary chamber rising above said primary chamber and said primary chamber having an outlet into the base portion of said secondary chamber, an upright tubular boiler located within said secondary chamber and forming between it and the wall of said chamber a flue passage around said boiler in communication with the top end thereof, means for supporting and arranging said boiler within said secondary chamber whereby the lower portion thereof will be just adjacent the outlet from said primary chamber and the bottom end of said boiler will be closed from said outlet and flue passage, a drum located above said boiler, pipes interposed between the head of said boiler and said drum, said pipes being arranged to provide a passage for water contained in said boiler from along the sides thereof, into said drum and a passage, also, for water in said drum from a point about the center thereof, into said boiler, at or about the center of the top of said boiler, an auxiliary boiler located within said primary chamber below the water line of said tubular boiler, said auxiliary boiler comprising upper and lower drums and a series of pipes connecting said drums, a pipe connection between the upper ones of said drums and the drum above said boiler and a back connection between the lower ones of said drums and a pipe connection between said tubular boiler from a point at about the center of the bottom thereof and said back connection.

12. In a boiler, a setting having located therein a grate and forming a combustion chamber above said grate, drums located within said combustion chamber above said grate and extending through the front wall of said setting, drums located outside the combustion chamber below said grate and extending through the front and rear walls of said setting, and a series of pipes extending through said combustion chamber and connecting the upper and lower sets of drums.

13. In a boiler, a setting having located therein a grate and forming a combustion chamber above said grate, a drum located within said combustion chamber above said grate, and a drum located outside said combustion chamber below said grate, and a series of pipes connecting said drums, each of said pipes being sectional in character one section of which connects with the upper of said drums and the lower section with the lower of said drums, and a joint connecting said sections, which joint is located below said grate.

14. In a boiler, a setting having located therein a grate and forming a combustion chamber above said grate, a drum located within said combustion chamber above said grate, and a drum located outside said combustion chamber below said grate, and a series of pipes connecting said drums, each of said pipes being sectional in character one section of which extends into said upper

drum and is expanded into the same and 10 the other section of which connects with said lower drum, and a joint connecting said sections and located below said grate.

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Witnesses:

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