No. 638,930. Patented Dec. 12, 1899.

E. INGRAHAM.

STEAM BOILER.

(Application filed Oct. 1, 1898.)

(No Model.) 2 Sheets—Sheet 1.

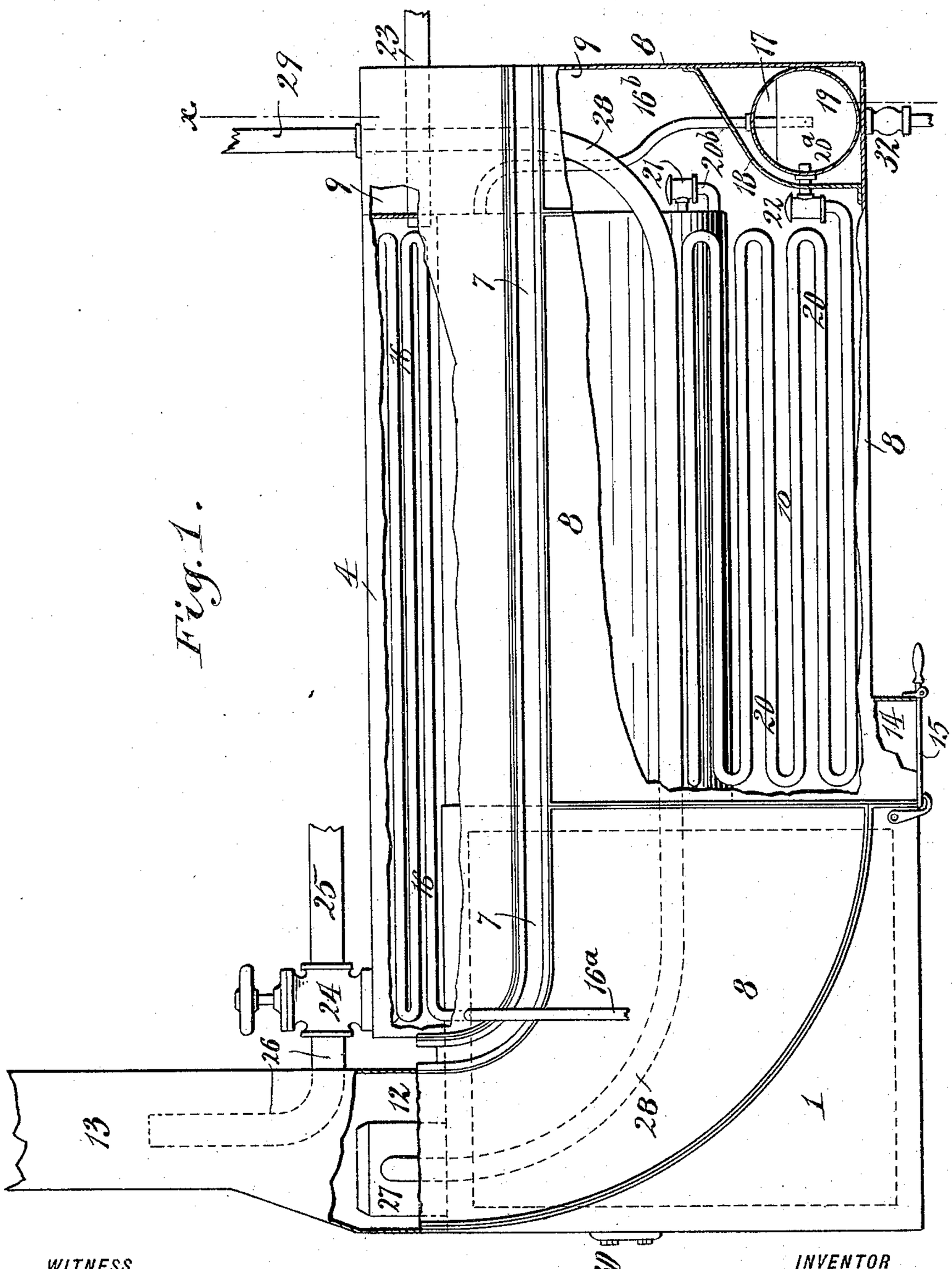

Fig. 1.

WITNESS

M. G. McLean,

Alvin K. Goodwin

INVENTOR

Edmunds Ingraham,

BY

Baxter Deemer & Co

ATTORNEYS

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Fig. 2.

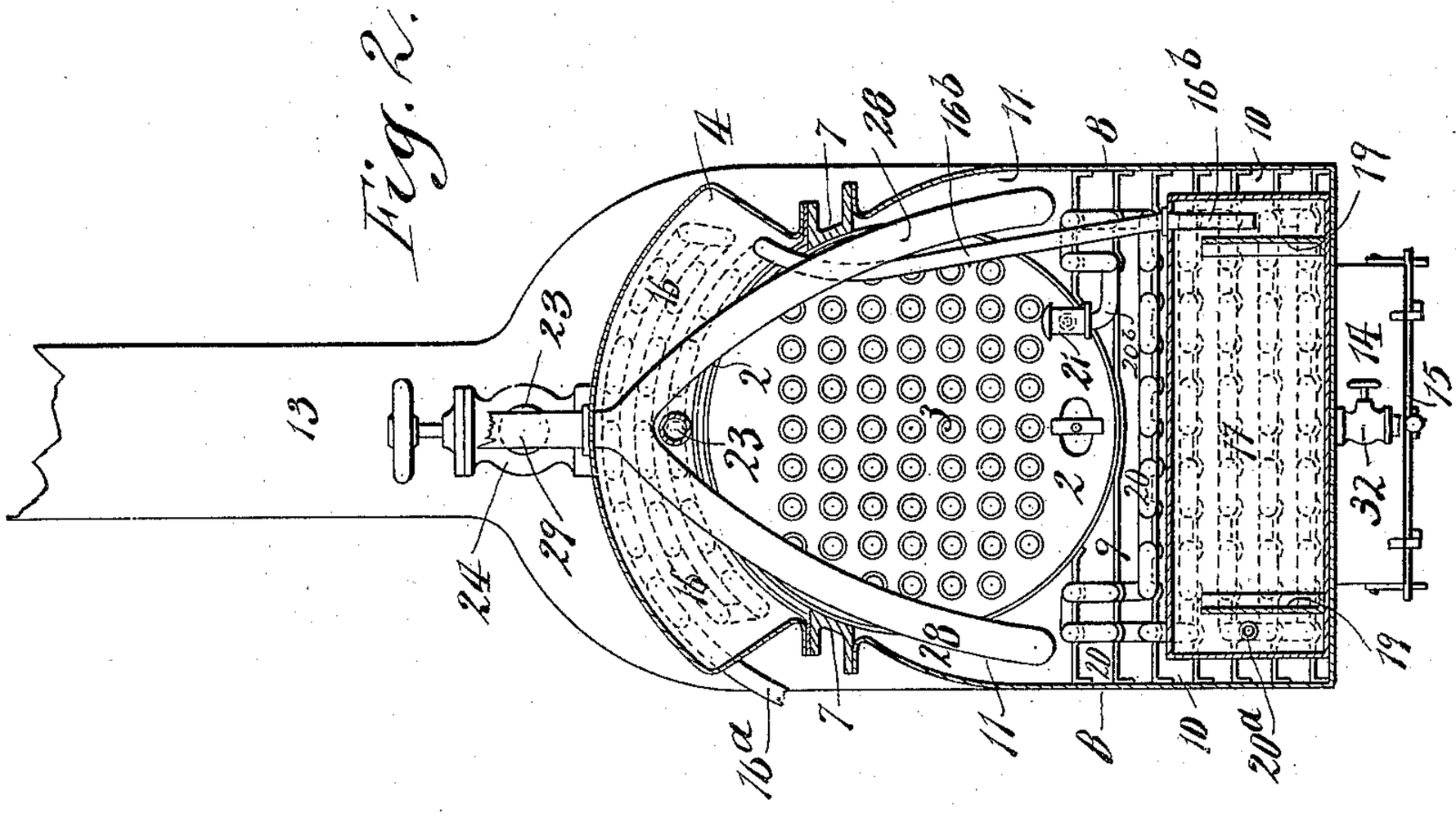
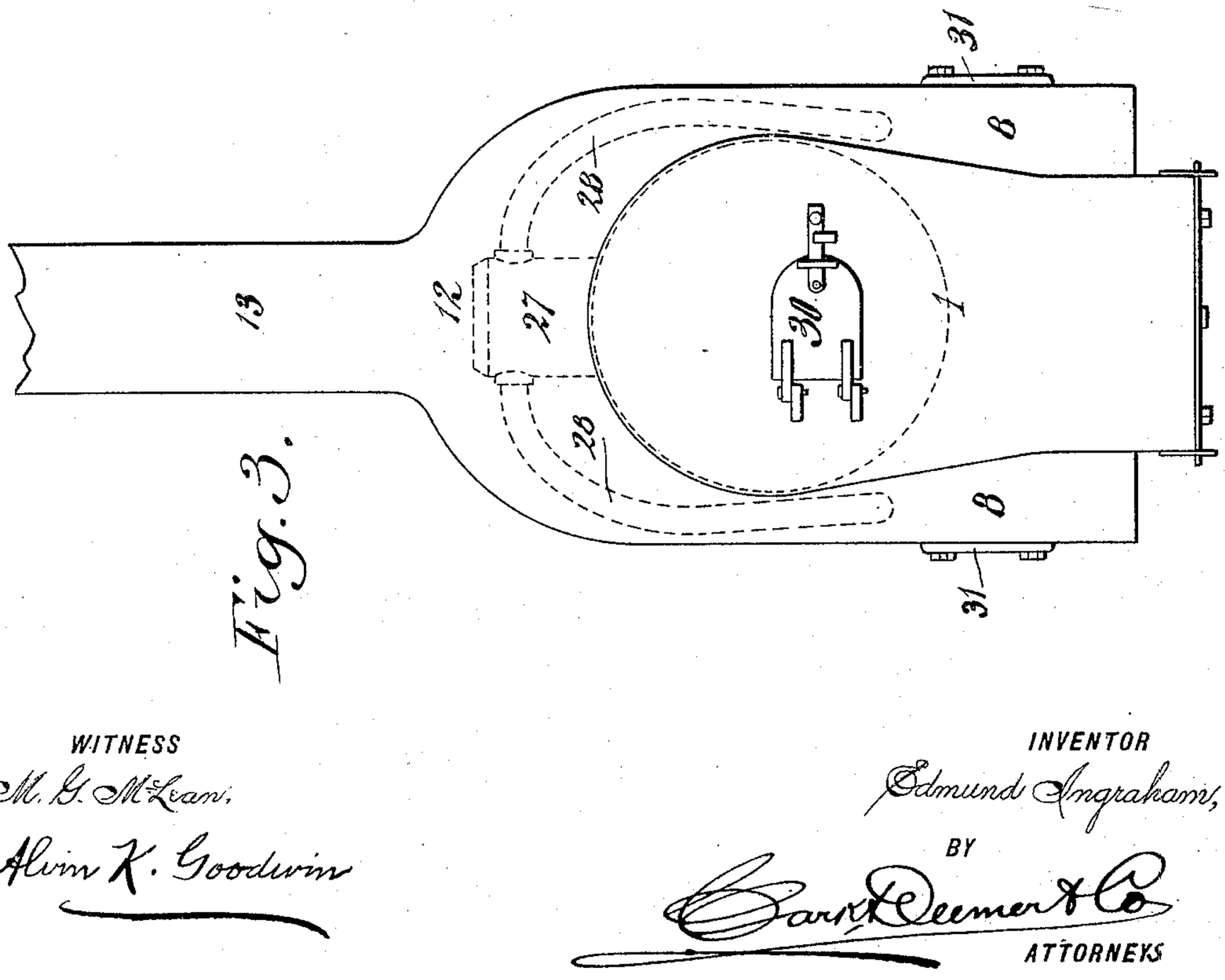


Fig. 3.



WITNESS

M. G. McLean.

Alvin K. Goodwin

INVENTOR

Edmund Ingraham,

BY

Baird Deeming & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

EDMUND INGRAHAM, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 638,930, dated December 12, 1899.

Application filed October 1, 1898. Serial No. 692,362. (No model.)

To all whom it may concern:

Be it known that I, EDMUND INGRAHAM, a citizen of the United States, and a resident of Philadelphia, (Frankford,) county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof, in which similar numerals of reference indicate corresponding parts.

This invention relates to steam-boilers of marine, locomotive, or stationary type, and has for its object to increase their efficiency and promote their durability.

The invention consists in certain improved means for heating the feed-water by specially utilizing the exhaust-steam from the engine and also the hot gases passing from the boiler fire-box on their way to the stack, the live steam also being superheated on its way to the engine, all as hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a side elevation of my improved steam-boiler with parts broken away and in section. Fig. 2 is a transverse vertical sectional view taken on the line *x x* in Fig. 1, and Fig. 3 is a front end elevation of the boiler.

The main boiler (shown in the drawings) is of the ordinary locomotive type, having a fire-box 1 and a body 2, containing fire-tubes 3. Above the fire-box and body is located an exhaust-steam chamber 4, which has its own independent bottom 5 separated from the main boiler by a layer 6 of asbestos. The chamber 4 is supported by its side flanges bolted to upper flanges of angle-irons 7 7, fastened along opposite sides of the main boiler. The top and side walls of chamber 4 and the angle-irons 7 extend rearward beyond the main boiler, and in connection with bottom, side, and end plates 8 form a casing, providing within it a combustion-chamber having communicating rear portion 9, bottom portion 10, and opposite side portions 11 11, the latter opening at 12 into the smoke-stack 13. The front ends of casing 8 preferably curve forward and upward to the stack, and the bottom of the casing is preferably dropped across the rear end of the fire-box to form a cinder-receiving pocket or trap 14, having a suitably hinged and latched door 15, permitting downward discharge of accumulated cinders too heavy to be drawn off through the smoke-stack. The casing 8 is preferably made in sections, facilitating its attachment to or removal from the main boiler.

Within the exhaust-steam chamber 4 is arranged a water-pipe coil 16, to the end 16^a of which a pump or injector feeding water to the boiler will be connected. The other end 16^b of this pipe-coil extends from chamber 4, through part 9 of the combustion-chamber, to the top of one end of a mud-drum 17, which I locate, preferably, at the rear bottom corner of the combustion-chamber and behind a plate 18, partitioning off a part of said chamber and guarding the drum from the direct high heat of the gases of combustion, and thereby preventing incrustation of sediment within the drum and facilitating its deposit at the bottom thereof. I make the mud-drum with a partial partition 19 near each end, thus dividing it into two small end compartments and a larger central one. The partitions fit the bottom and sides of the drum, but are cut away at the top for about one-fifth of their area to give water-passage only over them. The end 16^b of pipe-coil 16 enters one end compartment, and the end 20^a of a longer water-circulating pipe-coil 20 enters the other end compartment of the drum and preferably below the top of the adjacent partition 19. This pipe-coil 20 is disposed in the lower part 10 and in lower side parts 11 11 of the combustion-chamber and may more or less fill these portions of the chamber. The other end 20^b of pipe-coil 20 enters the casing of a check-valve 21, from which a nipple enters the body 2 of the main boiler to supply feed-water thereto from the pipe-coil 20. I prefer to locate another check-valve 22 at the water-inlet end of pipe-coil 20 to prevent "blowing back" in the mud-drum 14 or upper exhaust-steam chamber 4 should the generation of steam in the feed-pipe coil 20 have any such tendency.

A pipe 23 supplies exhaust-steam from an engine or other steam-using agent to one end of the chamber 4, to the other end of which is preferably connected a suitable valve 24, which is at the junction of a pipe 25, connecting with a steam-condenser and a pipe 26, leading into the stack 13, for increasing

the draft therein, and it may be also for relieving or cutting out the condenser when it is being repaired.

Live steam for use in engine-cylinders or otherwise is taken from the dome 27 above the boiler fire-box by two branch pipes 28 28, which pass rearward through the combustion-chamber in the casing 8 and again converge in the part 9 of said chamber to a common supply-pipe 29, leading to the engine.

The main boiler has the usual fire-door 30, and the casing 8 has doors 31, giving access to the combustion-chamber for clearing its inner walls from soot and ashes and for cleaning the water and steam circulation pipes in said chamber.

In operation feed-water forced by a pump or injector into the end 16^a of the pipe-coil 16 passes for a considerable distance through said coil, meanwhile being subjected to the heating effect of exhaust-steam entering chamber 4 from pipe 23 and leaving it through valve 24 to the condenser or stack. After passing through coil 16 the feed-water, now at a comparatively high temperature, passes into and through the end 16^b of the pipe-coil, which is directly subjected to the very high temperature of the hot products passing from the main-boiler fire-tubes 3 into the combustion-chamber and whereby the temperature of the feed-water is further increased. From conduit 16^b the feed-water passes to one small end chamber of the mud-drum 17, issuing below the top of the adjacent partition 19 therein. The pressure of the injector induces circulation of the feed-water through the mud-drum over the tops of the two or more partitions 19 therein to the end 20^a of the pipe-coil 20, which preferably is below the level of the last partition 19. On its way through the mud-drum the water deposits most of its sediment to the bottom of the drum, whence the sediment may be expelled occasionally through a blow-off cock 32, provided for this purpose. After entering at 20^a the feed-water circulates through the long pipe-coil 20 in the combustion-chamber and passes at 20^b into and through the check-valve 21 into the main boiler. Obviously the circulation of the already-heated feed-water through pipe-coil 20 greatly increases its temperature, and at times considerable steam may be evolved in this coil. Hence the use of check-valve 22 to prevent blowing back, as above described. Of necessity the feed-water passes very hot into the boiler—in fact, above the steaming-point—and the water is also quite free from sediment, whereby fuel is largely economized and quick scaly incrustation of the boiler is prevented. The steam easily generated in the boiler from the highly-heated feed-water is superheated in passing to the engine through the pipes 28, also traversing the combustion-chamber within the casing 8, and issues to the engine-cylinders in dry condition for most effective service.

Besides the advantages accruing from highly-heated feed-water and superheated steam I obtain the further great advantage of inclosing the main boiler for the most part in a heated jacket formed by the top exhaust-steam chamber 4 and the combustion-chamber within the casing 8, whereby the main boiler is protected to a degree, preventing undue expansion or contraction of its parts, thereby promoting its good steaming qualities and also its durability. Indeed, it may be said that the arrangement of the combustion-chamber assures a fuel consumption somewhat like that in a reverberatory furnace.

The water-circulation coils 16 20 need not be heavy, as they are not subjected to great pressure. Hence the coils add but little to the weight or size of a boiler of any standard size, and either alone or in conjunction with the live-steam-superheating pipes 28 will greatly increase the working capacity of such boiler, because it very largely increases its area of heating-surface.

My improved boiler is specially adapted for service as a marine boiler, as will readily be seen by those familiar with steam generating and using appliances.

As applied to stationary boilers my improvements make them entirely self-contained. Hence no expensive brick settings are necessary and large absorption of furnace heat by heavy masonry is obviated.

I do not herein claim the superheater mechanism nor the cinder-trap construction for cleaning out the lower or draft jacket, such parts forming the subject-matter of distinct and separate inventions, my present application being designed to cover the improved feed-water-heater construction for boilers.

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

1. A steam-boiler comprising the body portion having the fire-box, a chamber provided above said body portion and having exhaust-steam inlet and outlet, the stack, a condenser or utilizer of exhaust-steam, a feed-water-heating coil contained in said top chamber, a casing forming at the rear and bottom and sides of the main boiler a combustion-chamber, two discharge-pipes communicating with the top-chamber outlet, one of said pipes entering the stack and the other leading to the condenser or other utilizer of the exhaust-steam after its passage through the chamber for heating the feed-water coil, valve mechanism controlling outlet of the exhaust-steam to either of said discharge-pipes, a lower feed-water-heating coil in the combustion-chamber, and a pipe in line of communication between said lower and upper feed-water-heating coils.

2. A steam-boiler comprising the body portion having the fire-box, an exhaust-steam chamber provided above said body portion and having inlet and outlet, the stack, a feed-water-heating coil contained in said top cham-

ber, a casing forming at the rear and bottom and sides of the main boiler a combustion-chamber receiving hot products from the boiler-furnace and passing them forward to the stack, a lower feed-water-heating coil in said combustion-chamber connecting with the boiler, and a pipe in the line of communication between the latter coil and the upper feed-water coil in the exhaust-steam chamber and passing through the combustion-chamber to be heated therein.

3. A steam-boiler, comprising the body portion having the fire-box, an exhaust-steam chamber provided above said body portion and having inlet and outlet, the stack, a feed-water-heating coil contained in said top chamber, a casing forming at the rear, bottom and sides of the main boiler a combustion-chamber receiving hot products from the boiler-furnace and passing them forward to the stack, a lower feed-water-heating coil in said combustion-chamber connecting with the main boiler, a mud-drum in the combustion-chamber communicating with the lower feed-water coil, and a conduit from the upper feed-water coil passing through the combustion-chamber and entering the mud-drum and establishing circulation between the two feed-water coils, the drum and the boiler.

4. A steam-boiler having an upper exhaust-steam chamber containing a feed-water-heating coil, a casing forming a combustion-chamber at the rear, bottom and sides of the main boiler and carrying its furnace products forward to the stack, a lower feed-water coil in said combustion-chamber, a mud-drum in the combustion-chamber having two or more partial partitions open at the top only, a pipe passing through the combustion-chamber and delivering feed-water from the upper exhaust-steam-chamber pipe-coil to one end of the mud-drum below the top of the adjacent partition, and a pipe leading from the other end of the mud-drum below the top of the adjacent partition and connecting with the lower coil delivering the hot clarified feed-water to the boiler.

5. A steam-boiler having an exterior casing forming a combustion-chamber at its rear, bottom and sides and delivering its furnace products forward to the stack, an upper exhaust-steam chamber having inlet and outlet and containing a feed-water-heating coil, a lower feed-water-heating coil in the combustion-chamber, a mud-drum in the latter chamber, pipes connecting the drum and the upper and lower feed-water coils, and a check-valve at the lower coil preventing "blowing back" to the mud-drum and upper feed-water coil.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 26th day of September, 1898.

EDMUND INGRAHAM.

Witnesses:
JOSEPH R. EMBERY,
ALLAN J. CASSIDY.