No. 742,306. PATENTED OCT. 27, 1903.

O. S. GARRETSON.

BOILER.

APPLICATION FILED NOV. 20, 1902.

NO MODEL. 8 SHEETS—SHEET 1.

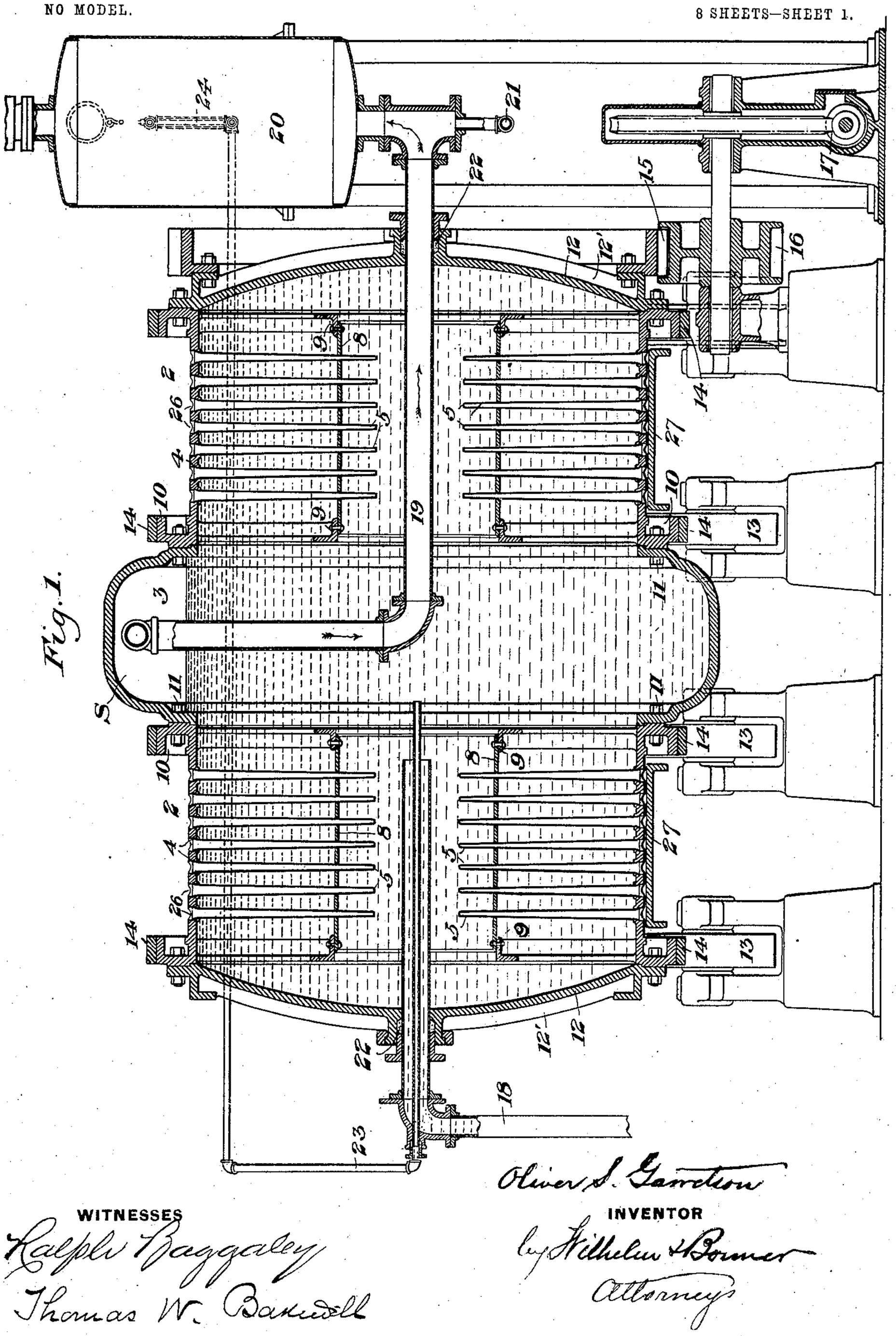

Fig. 1.

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NO MODEL. 8 SHEETS—SHEET 2.

Fig. 3.

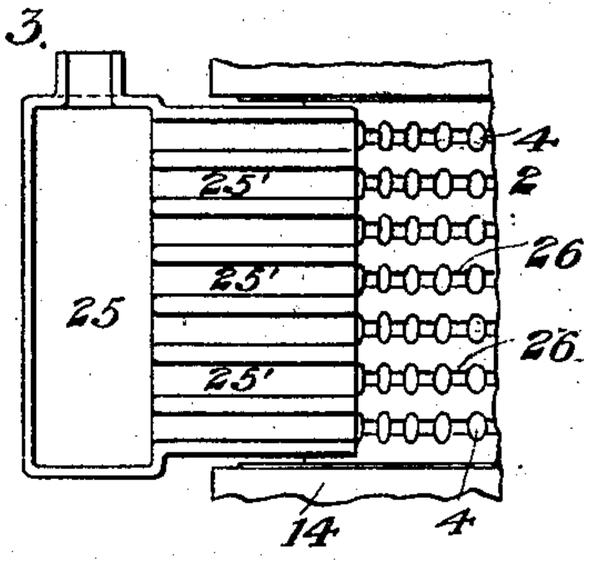
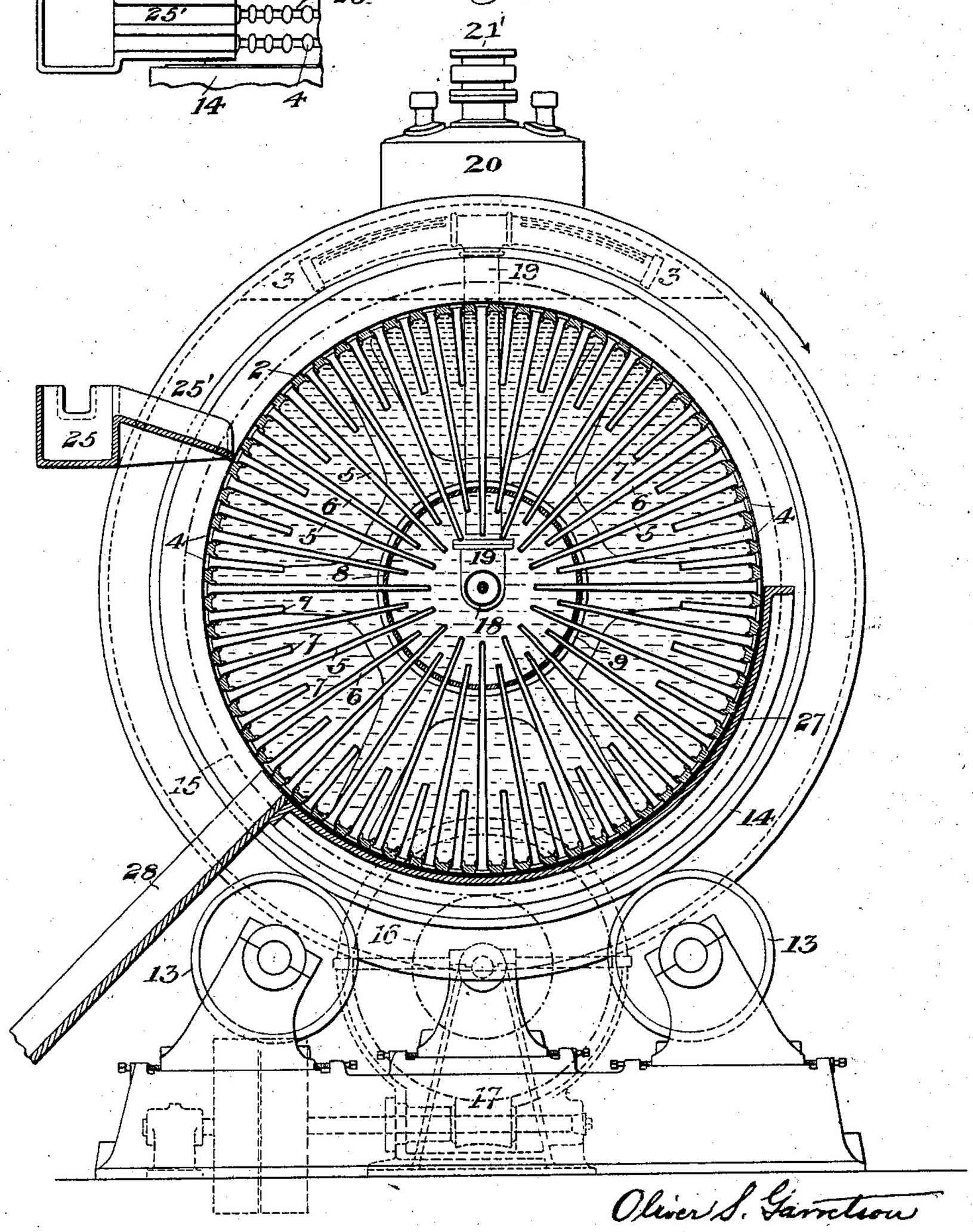


Fig. 2.



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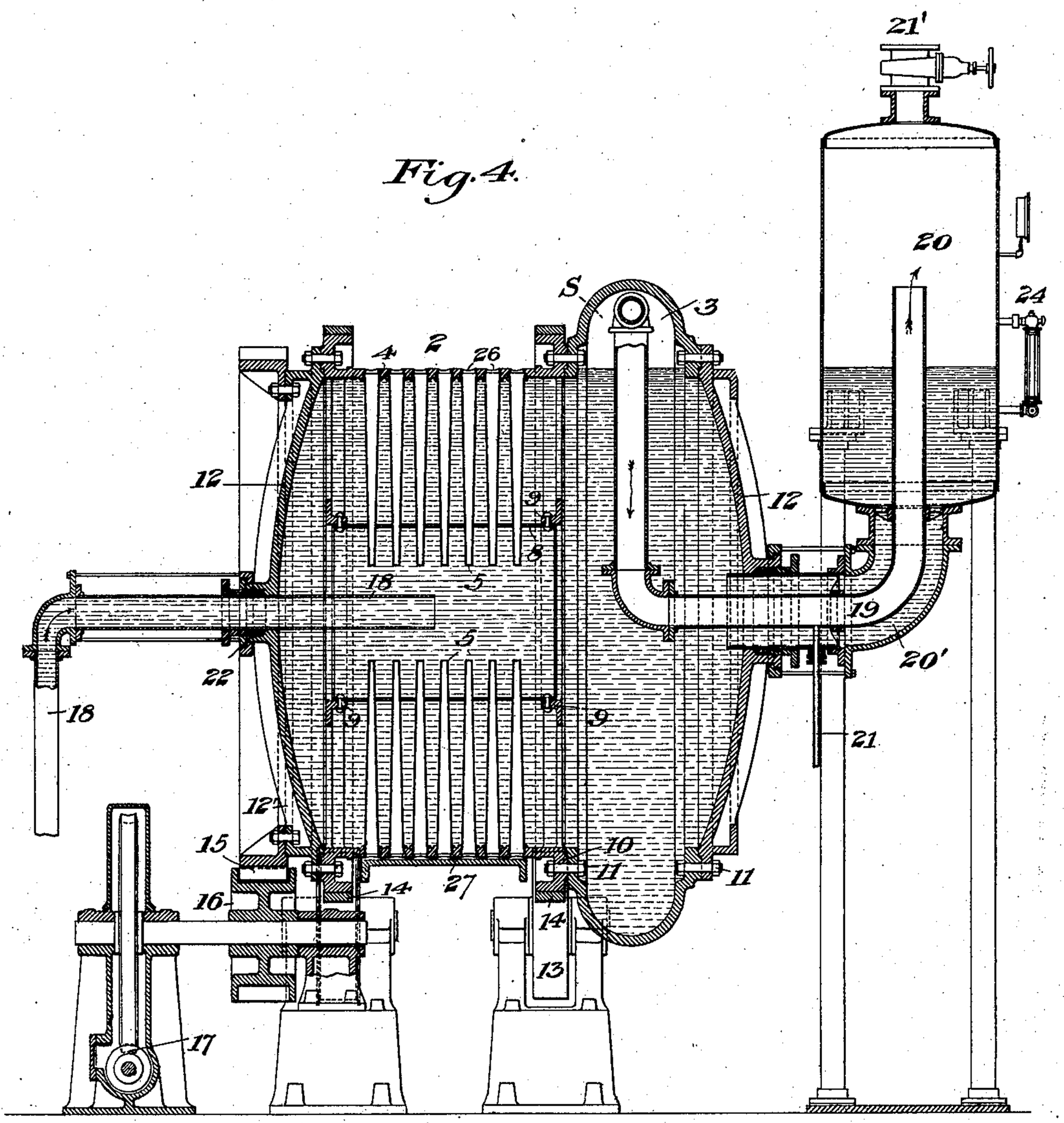
NO MODEL. 8 SHEETS—SHEET 3.

Fig. 4.



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NO MODEL. 8 SHEETS—SHEET 4.

Fig. 5.

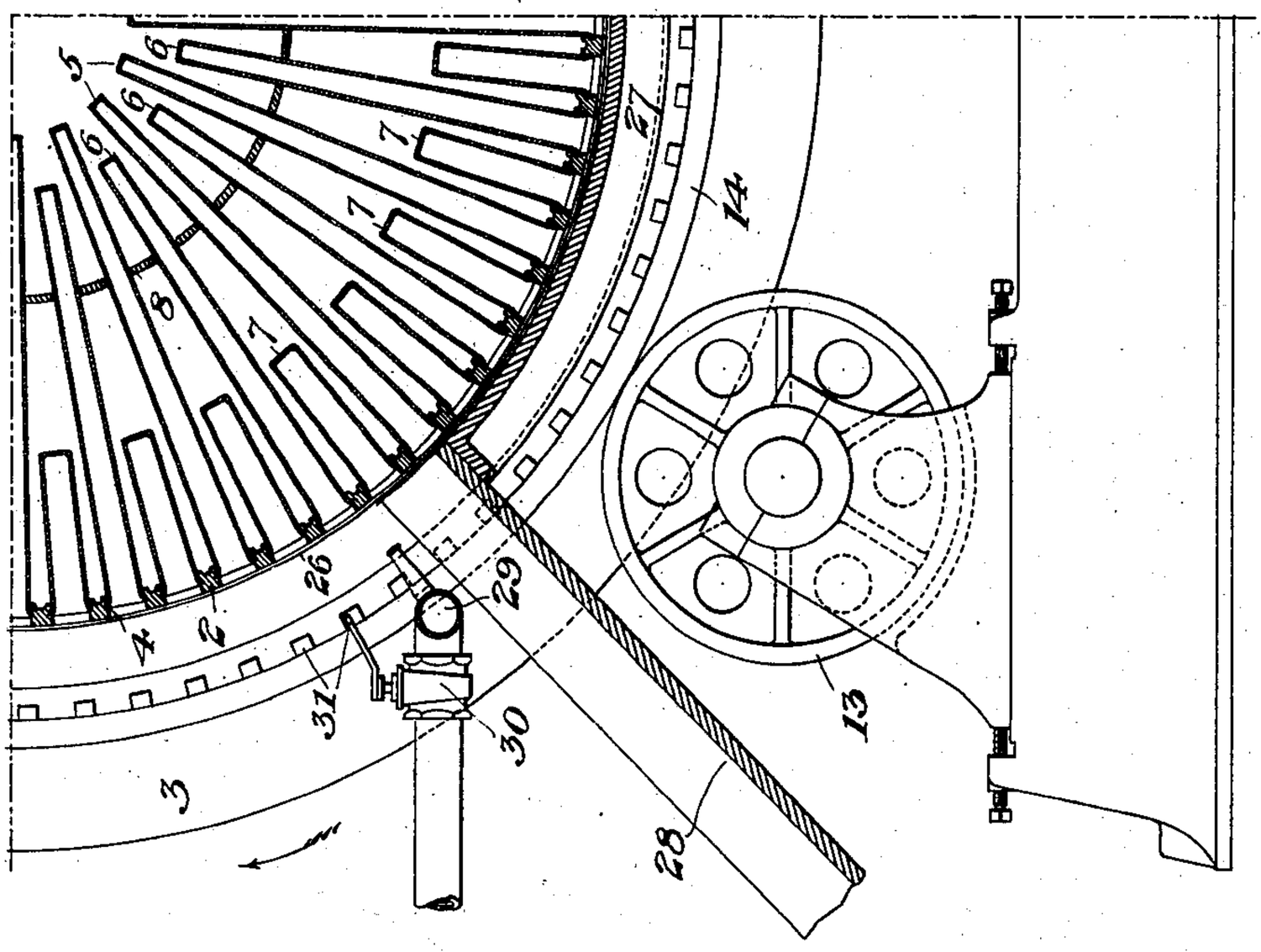
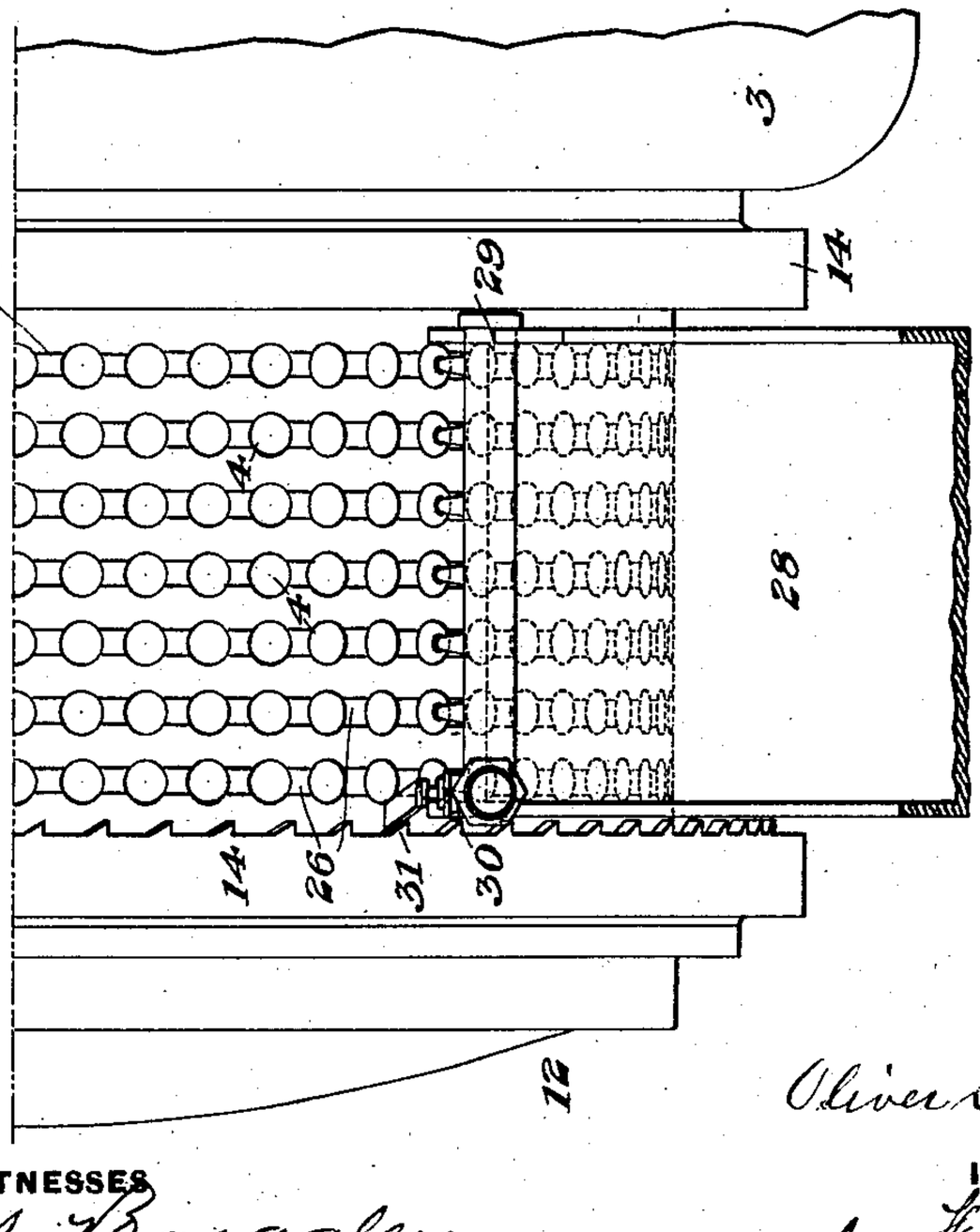


Fig. 6.



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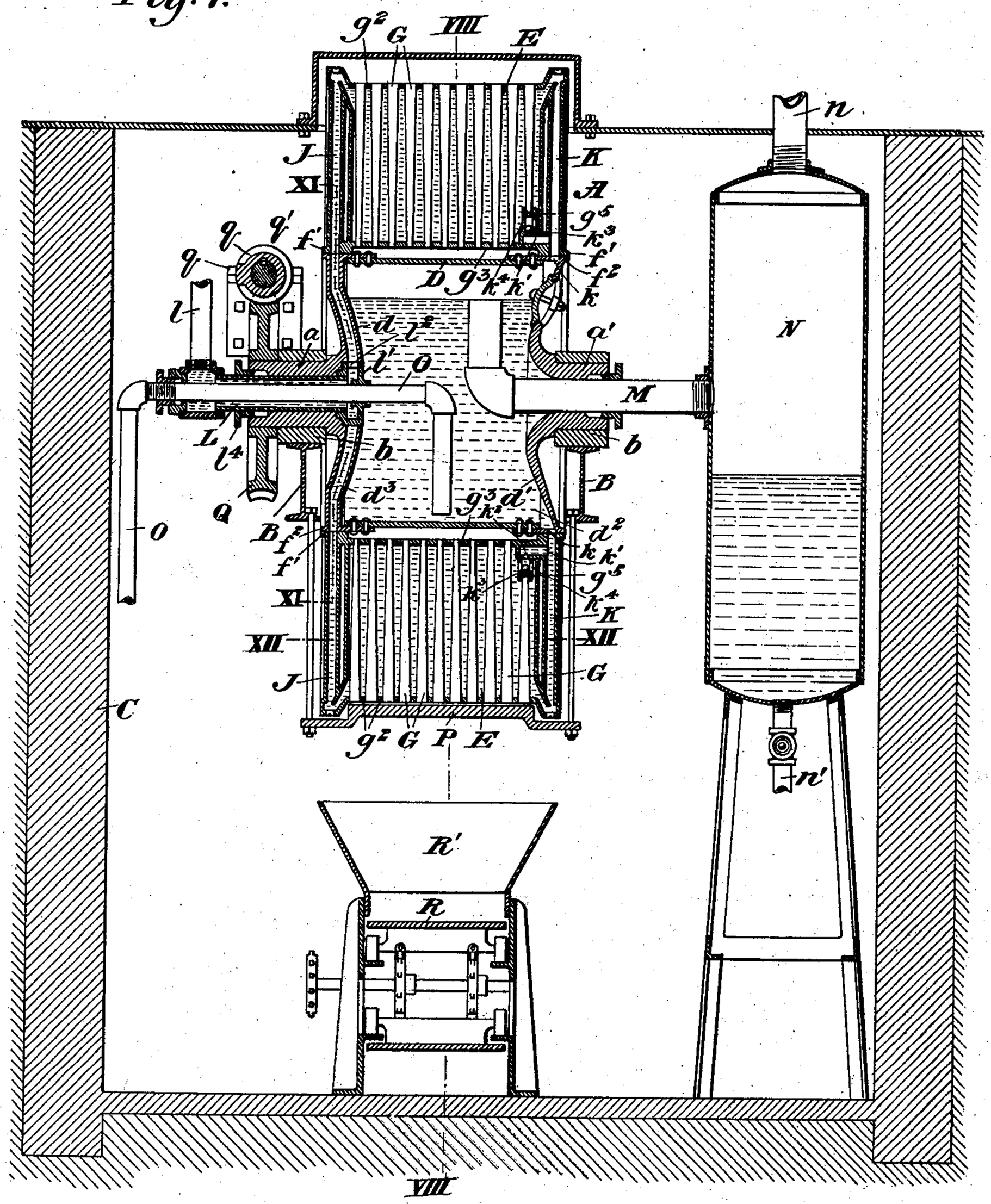
NO MODEL. 8 SHEETS—SHEET 5.

Fig. 7.



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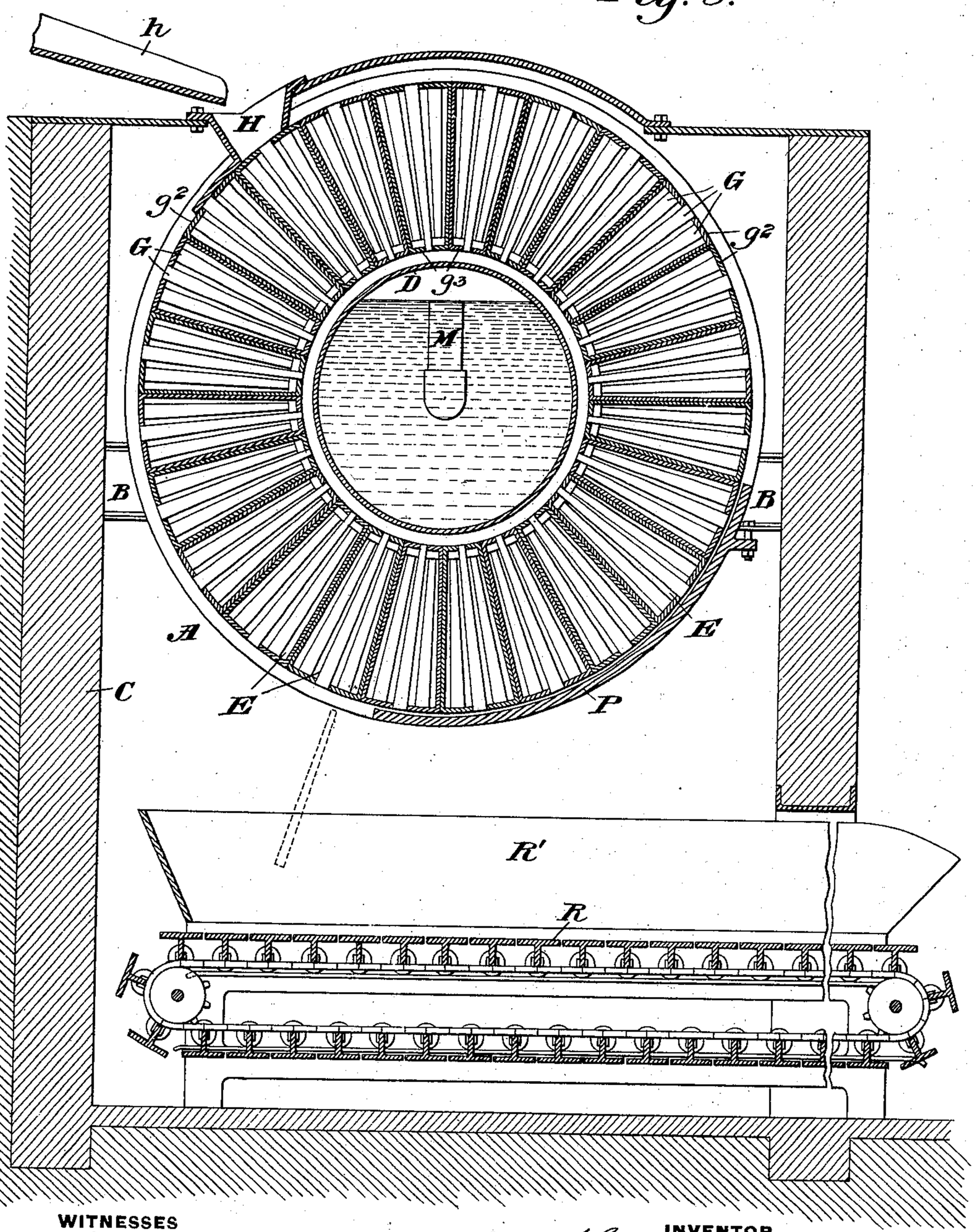
NO MODEL. 8 SHEETS—SHEET 6.

Fig. 8.



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NO MODEL. 8 SHEETS—SHEET 7.

Fig. 9.

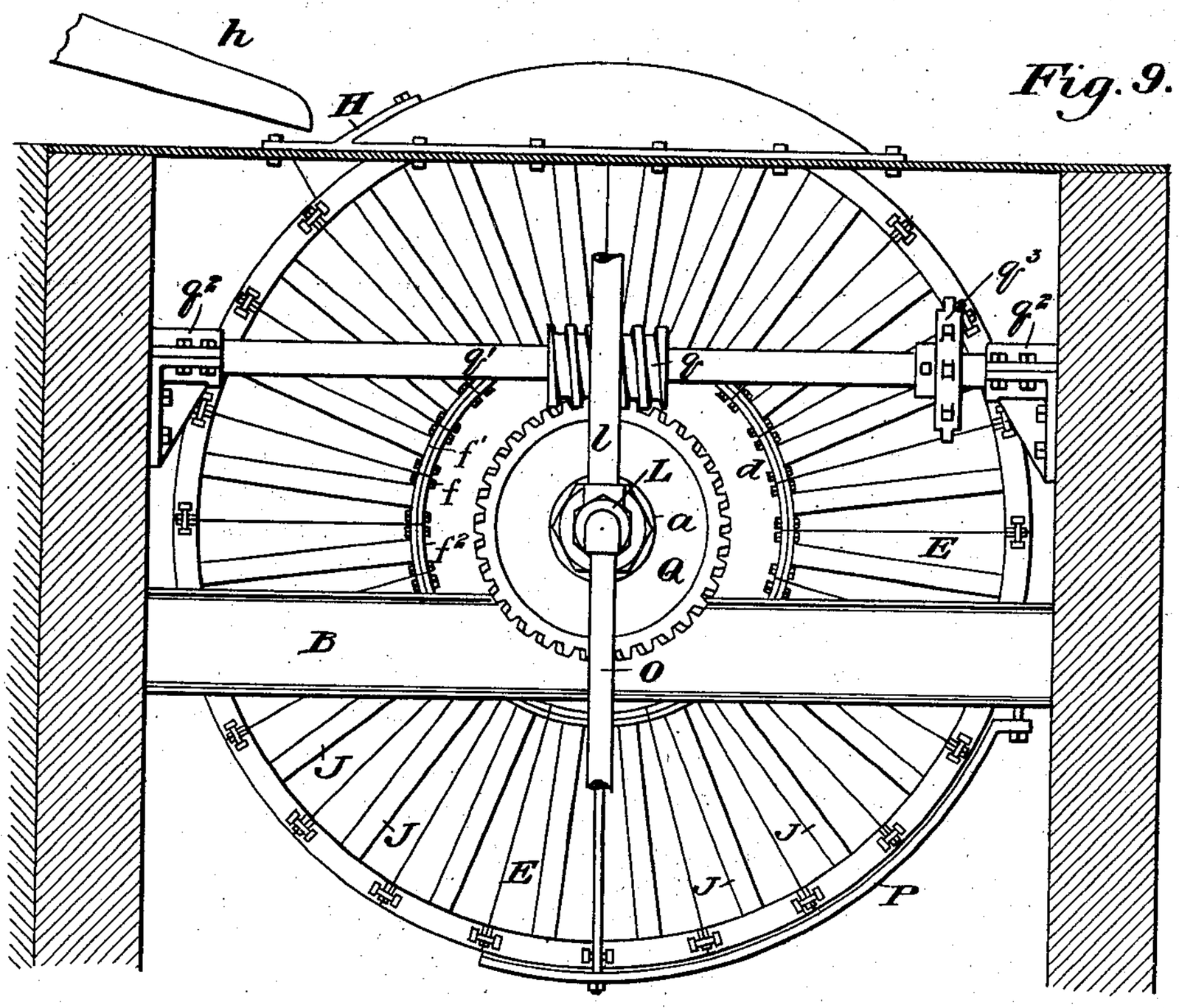
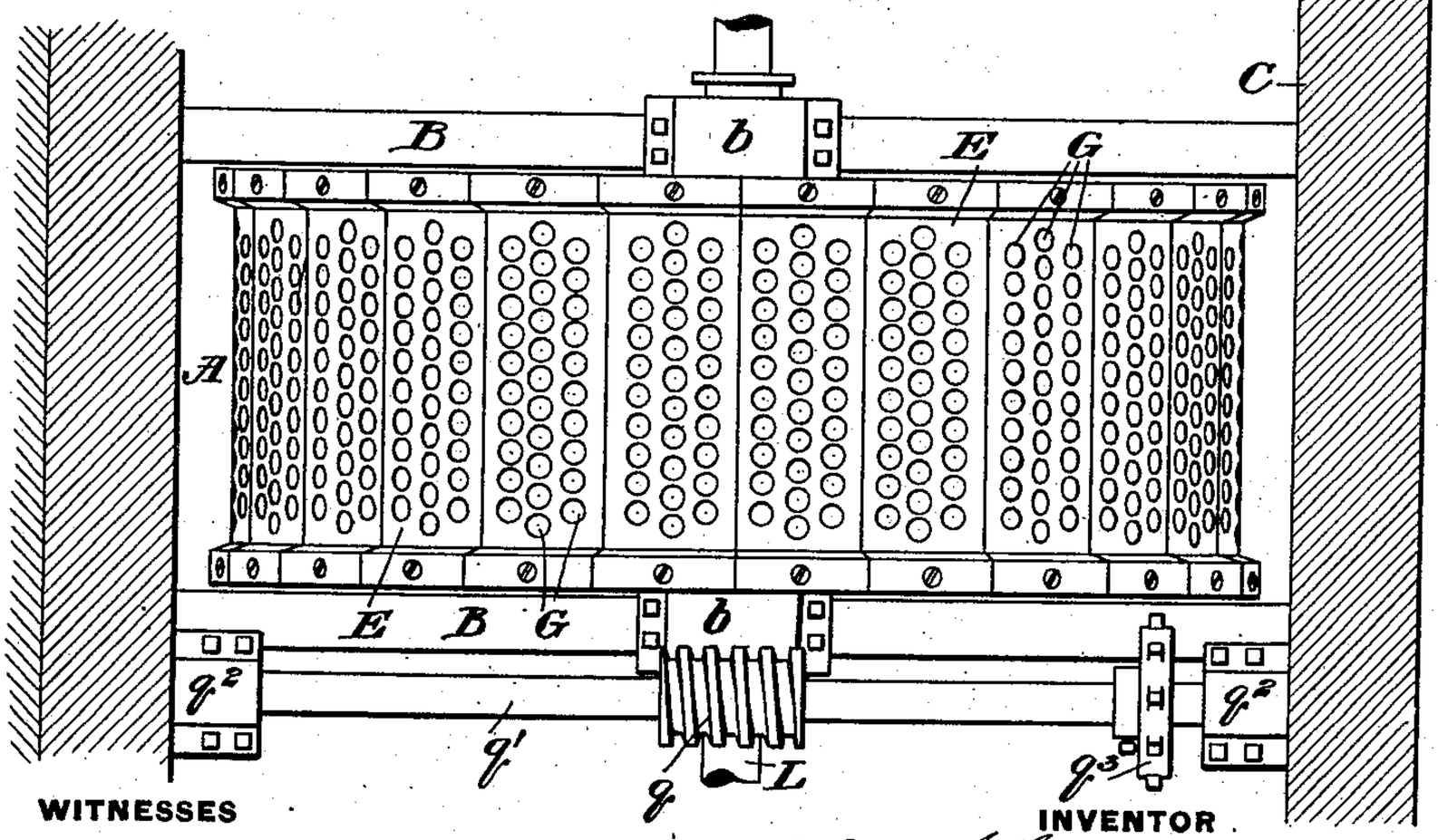


Fig. 10.



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NO MODEL. 8 SHEETS—SHEET 8.

Fig. 11.

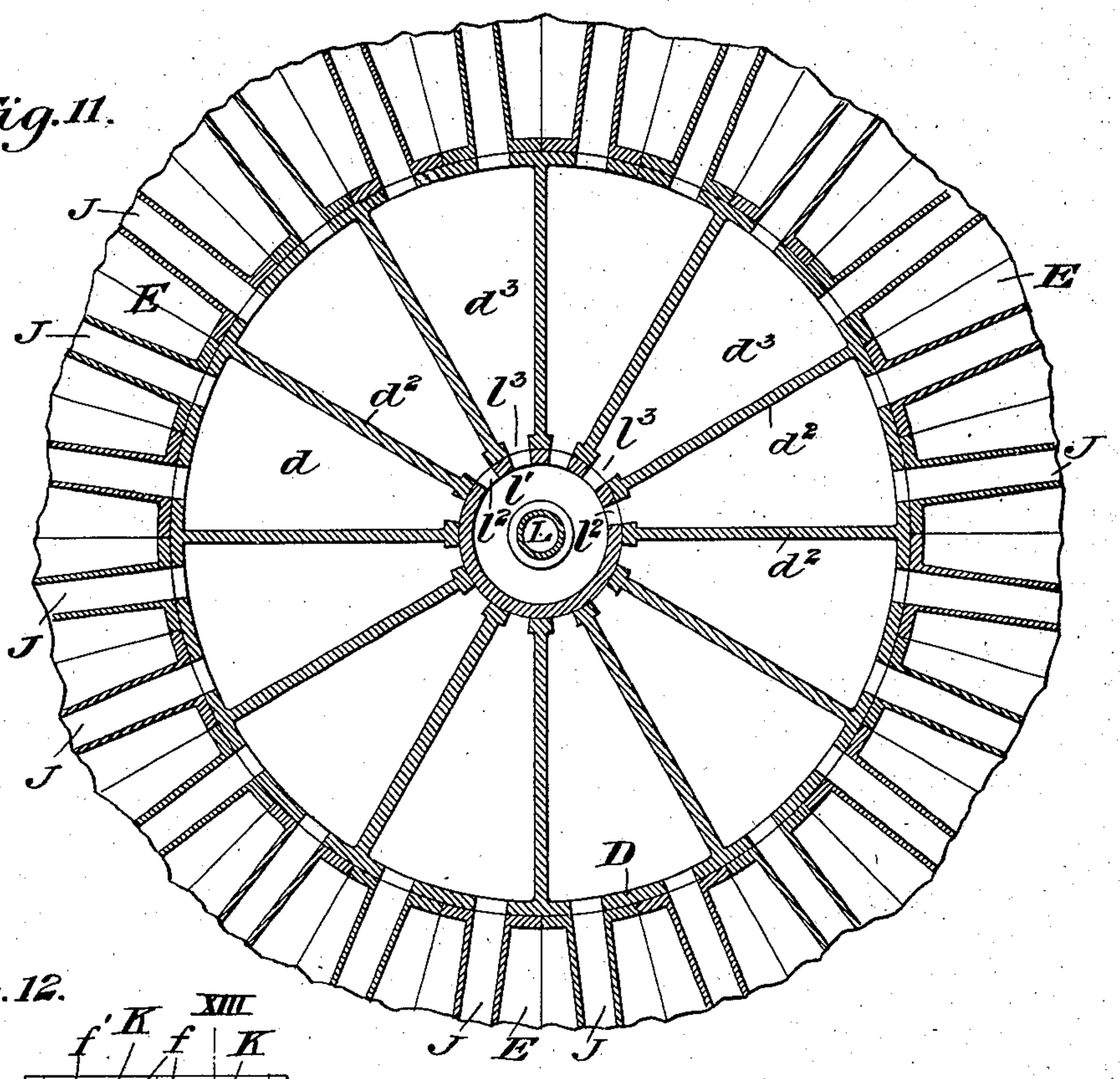
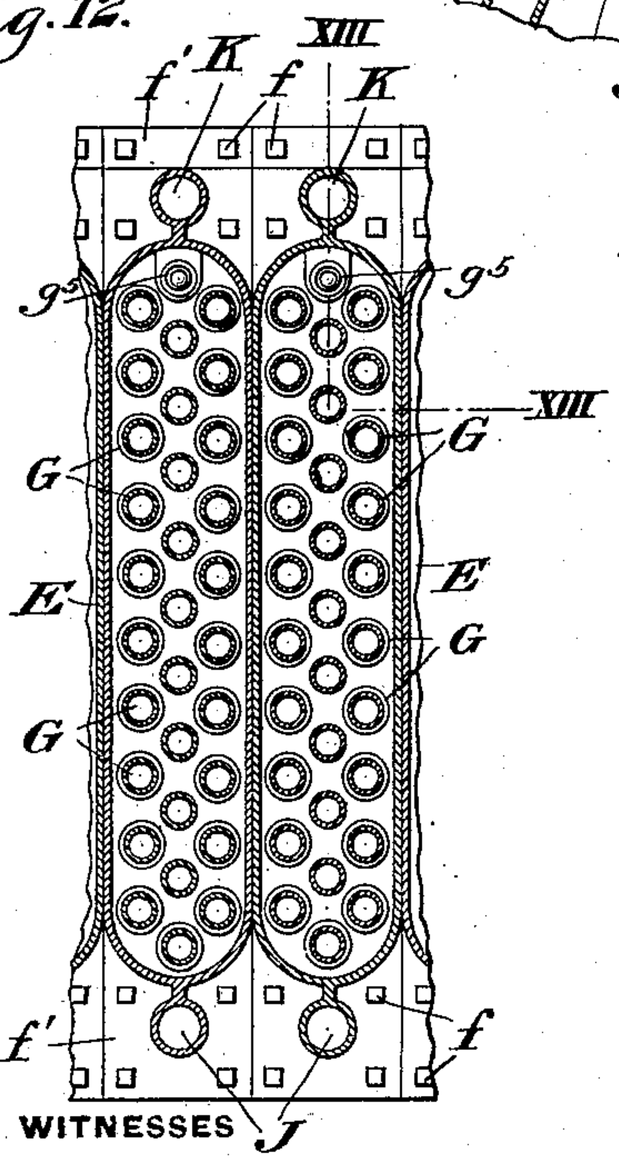


Fig. 12.



WITNESSES

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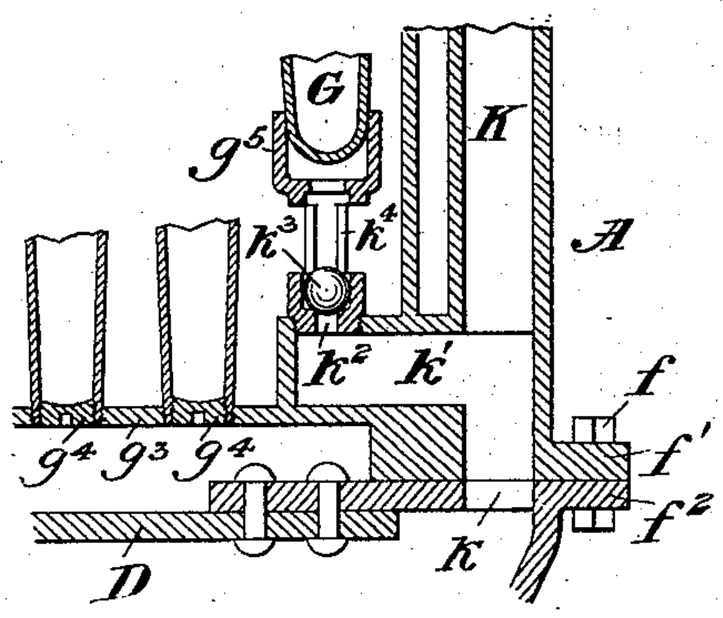
Fig. 13.



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No. 742,306. Patented October 27, 1903.

UNITED STATES PATENT OFFICE.

OLIVER S. GARRETSON, OF BUFFALO, NEW YORK.

BOILER.

SPECIFICATION forming part of Letters Patent No. 742,306, dated October 27, 1903.

Application filed November 20, 1902. Serial No. 132,109. (No model.)

To all whom it may concern:

Be it known that I, OLIVER S. GARRETSON, of Buffalo, Erie county, New York, have invented a new and useful Boiler, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional side elevation of the preferred form of boiler. Fig. 2 is a cross-section of the same. Fig. 3 is a partial top plan view. Fig. 4 is a sectional side elevation of a modified form of boiler. Fig. 5 is a cross-section of part of the boiler, including the slag-discharging apparatus; and Fig. 6 is a side elevation of this portion of the apparatus. The figures on Sheets 5, 6, 7, and 8 illustrate another form of boiler embodying my invention. Fig. 7 is a vertical longitudinal section of the boiler. Fig. 8 is a transverse vertical section on the line VIII VIII of Fig. 7. Fig. 9 is a fragmentary transverse vertical section showing the boiler in end elevation. Fig. 10 is a plan view of the parts shown in Fig. 9. Fig. 11 is an enlarged fragmentary section through the water-head on the line XI XI of Fig. 7. Fig. 12 is an enlarged detail section on the line XII XII of Fig. 7. Fig. 13 is an enlarged detail section on the line XIII XIII of Fig. 12, showing the steam-escape valve of one of the section.

The purpose of my invention is to provide a steam-boiler in which the heat is supplied by molten slag, such as is derived from smelting-furnaces, and the purpose which I accomplish is to provide a boiler in which the mechanical construction is simple and strong and in which efficient means are provided for the supply and discharge of the slag and the liberation of steam and in which corrosion of the boiler by the slag is prevented.

The invention consists in its main features, briefly stated, of a rotary boiler or other heating apparatus having in its peripheral wall tubes, pockets, or other suitable slag-receivers which receive the molten slag at the upper side of the apparatus and hold it for a greater or less period of time until by the rotating movement of the apparatus the slag-receivers are inverted and the congealed slag is discharged therefrom.

Referring to Figs. 1, 2, 3, 5, and 6, the boiler is constructed with two tube-carrying sections 2 2 and an intermediate steam-section 3, each of annular form. The sections 2 2 may be steel castings or may be of plate metal, such as is ordinarily used in the manufacture of boilers, and are formed with openings 4 for the insertion of the slag-tubes 5, 6, and 7. These slag-tubes taper in form and are closed at the inner smaller end. They are inserted radially in the sections 2 2 and are secured at the outer ends by expanding into the holes 4. I prefer to employ several sets of tubes of different lengths, so that a large number of them can be arranged in the boiler, and for the purpose of bracing the longer tubes 5 6 laterally I prefer to employ annular bracing-shells 8, concentric with the sections 2 2 and held therein by annular brackets or flanges 9. The tubes project through these shells and are braced thereby, but are free to expand and contract longitudinally. The middle steam-section 3 of the boiler is of greater diameter than the sections 2 2 and may be clamped thereto by flanges 10 and bolts 11, and the ends or heads of the boiler 12 12 may be similarly secured to the ends of the sections 2 2 and may be formed with strengthening-flanges 12′. The boiler thus constituted is supported on a cradle composed of rollers or wheels 13, bearing upon annular rims or tires 14, which may be applied to the boiler-shell, preferably to the flanges thereof, or the rollers may be caused to bear directly upon suitable portions of the boiler-shell itself. These wheels render the boiler rotary on its longitudinal axis, and for the purpose of rotating it or controlling its speed of rotation the boiler-shell is provided with an annular series of gear-teeth 15, meshing with a pinion 16, connected by worm-gearing 17 with a suitable motor. The roller at one end of the boiler is flanged to serve as a guiding-roller, which is preferably at the end of the boiler next to the gearing; but the other rollers are unflanged and permit free longitudinal expansion and contraction of the shell.

By supporting the boiler upon rotary surfaces instead of supporting it on trunnions the difficulties incident to heating of the bearings and destruction of lubricant are avoid-

ed and many other advantages are obtained.

The feed-water pipe 18 and the steam-eduction pipe 19 extend axially through the ends of the boiler. The inner end of the steam-eduction pipe extends vertically to the upper portion of the section 3, and its outer end extends into a steam dome or receiver 20, which is provided with a drain-pipe 21 for withdrawing the water of condensation. The pipes 18 and 19 do not rotate with the boiler, and at their passage through the ends of the boiler they are provided with stuffing-boxes 22.

23 is a pipe which extends axially through the feed-pipe and communicates with a water-gage 24.

The water-level of the boiler is shown in Fig. 1 and should be high enough to keep the tube-sections 2 2 full of water and the slag-tubes 5, 6, and 7 submerged throughout their length; but the use of the middle section 3 of larger diameter enables me to maintain this water-level and at the same time to afford a sufficient steam-space S in the upper portion of the boiler.

To supply the slag-tubes with slag for the purpose of heating the water, a spout 25 is employed, through which the slag may be poured from a ladle or discharged from the furnaces. Its delivery-nozzle is at the periphery of the boiler, somewhat above the horizontal axis. It has a series of gutters 25′, one for each of the rows of tubes, and on the periphery of the boiler there are short gutters 26, extending between the openings of the tubes, so the slag which fails to run into or overflows from one tube will flow into the next succeeding one.

The operation is as follows: The boiler having been filled with water to the normal water-level, it is rotated slowly in the direction of the arrow—say at the rate of one revolution per hour, more or less—and slag is charged into the spout 25 and flows from the gutters 15′ into the open ends of the tubes. Each line of tubes as it comes opposite to the slag-spout receives a charge of slag which communicates its heat to the water through the walls of the tubes and solidifies and shrinks therein, so that the congealed body is of less cross-section than the bore of its tube. As the slag is poured into the tubes before they arrive at the vertical position, it will enter gradually and will not be apt by sudden heating to injure or corrode the metal. By placing the slag-spout at the side the slag flows into the tubes while they are inclined, so that the tubes will receive the slag readily and will not be filled above the level of the water at the inner surface of the boiler-shell. Burning of the ends of the tubes is thus prevented. As the tubes reach the level of the axis of the boiler on the opposite side from the slag-spout, they come opposite to a shield 27, which extends concentrically with the periphery of the boiler and terminates at a slag-discharge chute 28. This shield retains the solidified blocks of slag until they reach the discharge 28; but at that place they drop from the tubes and fall into a suitable receptacle or conveyer.

To facilitate the discharge of the solidified slag from the tubes and to provide against sticking thereof, the apparatus shown in detail in Figs. 5 and 6 may be used, which, however, I do not specifically claim. Opposite to each annular line of tubes near the discharge-chute 28 is a jet-pipe 29, connected with a source of air, steam, or water, preferably water. Each pipe has a valve 30, which as the tubes come in succession opposite to the pipe is engaged by a projection 31 on the boiler and being opened thereby discharges a cooling-jet under pressure into the mouth of the tube against the slag. The rapid contraction of the slag which this occasions causes it to drop in pieces from the tube into the chute. As the tube moves on, the valve is closed automatically by a spring or other suitable means and shuts off the jet; but, if desired, the valves may be dispensed with and the jets rendered continuous.

The motor for rotating the boiler need only be used as a driving-motor at the beginning of the operation when the tubes are empty, for when the tubes are filled with slag, there being more charged tubes on one side of the boiler than on the other or slag-discharge side, the boiler will be rotated by the weight of the slag and the engine need only be employed to regulate the speed of rotation.

Fig. 4 shows a modified construction in which only one tube-section 2 is employed, the steam-section 3 of larger diameter being applied to the end of the section 2 and the heads 12 12 being applied to the outer ends of the sections 2 and 3, respectively. An external steam-drum 20 is made to communicate not only with the steam-space, but also directly with the water-space of the boiler through an annular passage 20′, surrounding the steam-pipe 19. The construction otherwise may be the same as shown in Fig. 1. The steam-section 3 and the ends of the boiler may be covered by suitable heat-insulating material. The advantages of this boiler will be appreciated by those skilled in the art. It possesses high efficiency, the slag is easily fed to and discharged from it, and it is so constructed as to prevent corrosion or destruction of the tubes, which are at all times in contact with the water. The boiler is therefore very durable, and being supported on a cradle, as above described, it is not subjected to mechanical strain and its rotation is rendered easy. By varying the speed of rotation or the supply of slag the rate of generating the steam may be regulated as desired.

In the modification shown on Sheets 5 to 8 of the drawings, A represents the rotary steam-boiler, provided centrally of its front and rear sides with hollow trunnions *a a′*, which

are journaled in bearings *b*, supported on horizontal beams B, which rest in the walls of the inclosing casing or housing C. The rotary boiler is composed mainly of a central cylindrical drum D and an annular series of chambers E, which surround said drum and primarily receive the water to be evaporated and the molten slag for heating the same and discharge the steam and the excess of unevaporated water into the central drum. The latter is provided at its front or feed side with a hollow or double head *d*, to which the trunnion *a* is secured, and at its rear side with a single head *d'*, to which the trunnion *a'* is secured. The hollow head *d* is divided by radial partitions or webs d^2 into an annular series of segmental water-spaces d^3, which receive the water at their inner ends and deliver it to the sections E at their outer ends. The chambers or sections E are arranged with their flat radial sides circumferentially side by side or against each other and are secured to the drum by any suitable means—for instance, by bolts *f*, which pass through front and rear flanges *f'* on the bases or inner ends of the heating-chambers and through annular flanges f^2 on the front and rear heads of the central drum. Each of the heating-chambers E is provided with a suitable number of slag tubes or receivers G, which open in the peripheral wall of the chamber and taper from the outer wall g^2 toward the inner wall g^3 of the chamber to readily discharge the congealed slag. The slag-receivers are closed at their inner ends, as shown in Fig. 13, and are preferably arranged in longitudinal rows. The inner ends of some of the tubes or receivers—for instance, the central row of tubes—may be secured to the inner wall g^3 of the chamber in any suitable manner—for instance, by screwing the screw-threaded inner ends of the slag-tubes into the screw-threaded openings in the inner wall of the chamber. The inner ends of these slag-tubes are closed by screw-plugs g^4 or other suitable devices. These tubes being connected to the inner and outer walls of the chambers brace and stiffen the same and greatly increase the strength thereof. The remaining greater number of slag-tubes in the chamber engage loosely in sockets g^5, provided on the inner wall of the chamber and are closed at their inner ends by welding or otherwise. The major number of slag-tubes which are free at their inner ends are capable of expanding or contracting without straining the water-chamber. Each of the water-chambers is provided at one end with a radially-arranged water pipe or passage J and at the other end with a radially-arranged steam pipe or passage K. The outer end of each water-pipe communicates with the adjacent end of the water-chamber at the outer portion thereof, as shown clearly in Fig. 7. The inner end of each water-pipe communicates with the radial water-space d^3 in the hollow head *d* of the central drum by means of holes provided in the outer circular wall of the hollow head, Figs. 7 and 11. Thus a waterway is provided for each water-space of the hollow head *d* of the central drum to one or more of the water-chambers. Water is supplied to the rotary hollow head *d* of the drum in any suitable or convenient manner. As shown in the drawings, Fig. 7, a stationary water-pipe L is arranged axially in the hollow trunnion *a*, which is secured to the hollow head of the drum. This pipe communicates at its outer end with a feed-pipe *l*, and at its inner end the pipe is provided with a circular hollow head *l'*, which fits in a corresponding circular depression or hub in the center of the hollow rotary head *d*. The peripheral wall of this stationary head is provided in its upper portion with one or more ports l^2. The circular wall of the depression or hub in the hollow rotary head turns on the fixed pipe-head and is provided with ports l^3, each of which communicates with one of the water-spaces d^3 in the rotary head. As the boiler rotates the ports of the hollow head are successively brought into register with the ports in the fixed pipe-head, and the feed-water is admitted to each water-space and to the water-chamber communicating therewith only when the latter are carried by the rotation of the boiler to the upper portion of the apparatus.

l^4 represents a stuffing-box of ordinary construction between the fixed water-pipe and the rotating trunnion.

K represents a steam-pipe extending from the outer end of each water-chamber inwardly and communicating at its inner end by an opening *k* with the hollow central drum D. The inner end of each steam-pipe K also communicates by a passage *k'* and a port k^2 with the inner end of the water-chamber. The port k^2 is controlled by gravity ball-valve k^3, which is confined in a radially-arranged cage k^4 in the water-chamber. In the water-chambers which lie in the upper half of the boiler the valves seat themselves by gravity and close the ports k^2, so that water cannot escape from the water-chambers, while in the water-chambers which lie in the lower half of the boiler the valves drop away from their seats and open the ports k^2, so that any steam which may be formed in the lower water-chambers will rise and escape through the ports k^2 to the central drum D.

M represents a steam-pipe which extends axially through the other hollow trunnion *a'* of the boiler and is provided at its inner end with an upturned portion which extends nearly to the top of the hollow drum D and is open at its upper end. The steam-pipe M communicates at its outer end with a steam receiver or drum N, of any suitable construction. The steam-drum N shown in the drawings is arranged in an upright position and is provided at its upper end with a steam-pipe *n*, through which the steam is delivered, and at its lower end with a water-pipe *n'*.

The latter may, if desired, be connected to the feed-pipe for the boiler and a pump may be provided for circulating the water from the steam-drum to the feed-pipe, so that the water which accumulates in the steam-drum can be returned to the boiler.

O represents a blow-off pipe which extends axially through the feed-water pipe into the hollow drum and is provided at its inner end with a downturned portion which opens at its lower end in the hollow drum D near the lower portion thereof.

The molten slag is fed by any suitable means to the tubes or slag-receivers of the several water-chambers successively as the latter are brought by the rotation of the boiler to a position in which the molten slag can flow into the tubes or receivers. In the drawings a hopper H is shown at the upper portion or top of the inclosing case for the boiler. This hopper fits closely with its open bottom against the peripheral wall of the boiler formed by the outer walls of the water-chambers. The molten slag is supplied to the hopper by a slag-spout *h* from the smelting-furnace. As the slag-tubes are carried beneath the open bottom of the hopper the molten slag flows from the latter into the open outer ends of the tubes and fills the same.

P represents the segmental shield, which is arranged beneath the lower portion of the boiler, at one side thereof. (See Figs. 8 and 9.)

The boiler rotates slowly about its axis, and the filled slag-tubes are thereby slowly carried from the upper to the lower side of the boiler. During the slow rotative movement the slag in the tubes gives off its heat to the water surrounding the tubes, and when the lower side of the boiler is reached, where the tubes are inverted, the slag has parted with the bulk of its heat and has become congealed. In the inverted portion of the tubes the congealed slag tends to drop from the open outer ends of the tubes, but is prevented from doing so by the shield P until the tubes pass the lower end of the shield, when the pigs of congealed slag drop from the tubes, as indicated by dotted lines in Fig. 8.

The means shown in Fig. 9 for regulating or retarding the rotation of the boiler consists of a worm-wheel Q, with which meshes a worm *q*, which is secured to a transverse horizontal shaft q', mounted at its ends in suitable bearings q^2 on the side walls of the inclosing casing or housing for the boiler. The shaft q' is provided with a sprocket-wheel q^3 or with any other suitable driving connection which through suitable instrumentalities may be held so as to permit the shaft to rotate only with the desired slow speed.

R is a conveyer which travels beneath a hopper R′, arranged under the boiler. It receives and carries the discharged slag to the place of discharge. The steam which is formed in the outer or upper ends of the chambers escapes therefrom through the steam-pipes K, which conduct the steam, together with any accompanying water, from the outer ends of the chambers to the central hollow drum D of the boiler. The steam passes from the drum through the steam-pipe M to the stationary steam-drum, from which it is drawn for consumption. If the water accumulates and rises in the hollow drum D, it enters the end of the steam-pipe M and passes therethrough to the steam-drum, from which it may be drawn off or returned to the feed-pipe.

I am aware of the application filed by Ralph Baggaley on November 20, 1902, Serial No. 132,131, describing and claiming certain parts of the apparatus herein shown and broadly claimed by me, and I do not make specific claim to the matters claimed in said application.

Within the scope of my invention as defined in the claims the skilled mechanic will be able to vary the construction in many ways, since I believe I am the first to devise a rotary boiler, or a boiler in which the slag is discharged by inverting the boiler.

I claim—

1. A rotary boiler rotatively mounted on its supports and having slag-receivers which are open at one end for receiving the molten slag and which are inverted by the rotary movement of the apparatus for discharging the congealed slag; substantially as described.

2. A rotary boiler having slag-receivers which open in the peripheral wall of the apparatus and which are inverted by the rotary movement of the apparatus for discharging the congealed slag at the lower side of the apparatus, and means for supplying the molten slag to the receivers above the axis of rotation; substantially as described.

3. A rotary boiler, rotatively mounted on its supports and having slag-receivers which are open at one end for receiving the molten slag and which taper inwardly and are inverted by the rotary movement of the apparatus for discharging the congealed slag; substantially as described.

4. The combination of a movable heating-chamber provided with one or more slag-tubes open at one end, means for supplying molten slag to said tubes, and means for inverting said chamber to discharge the congealed slag; substantially as described.

5. The combination of a heating-chamber mounted to rotate, and provided with one or more slag-tubes open at one end, means above the axis of rotation of said heating-chamber for supplying molten slag to said tubes, and means for retaining the slag in said tubes during the rotation of said chamber until the point of discharge is reached; substantially as described.

6. The combination of a heating-chamber mounted to rotate and provided with one or more slag-tubes open at one end, means for supplying molten slag to said tubes at a point above the axis of rotation of said heating-

chamber; and a segmental shield which prevents the slag from escaping from said tubes until they have passed the shield; substantially as described.

7. The combination of a rotary boiler or other heating apparatus having a circumferential series of slag-receivers, means for supplying molten slag successively to the receivers above the axis of rotation, means for retaining the slag in each receiver until the point of discharge below the axis of rotation is reached, and means for controlling the rotary effect of the weighted side of the apparatus which contains the filled slag-receivers; substantially as described.

8. A steam-boiler rotary on a horizontal axis and having inwardly-projecting receptacles for the reception and discharge of slag, and a steam-space extending outwardly beyond the receptacles; substantially as described.

9. A steam-boiler rotary on a horizontal axis and having receptacles for the reception and discharge of slag, said boiler being mounted on rotary supporting-surfaces; substantially as described.

10. A steam-boiler rotary on a horizontal axis and having receptacles for the reception and discharge of slag, said boiler being mounted on rotary supporting-surfaces, and a motor in gear with the boiler; substantially as described.

11. A rotary steam-boiler rotatively mounted on its supports and comprising a hollow rotary shell adapted to be charged with water, slag-tubes attached to the shell and projecting thereinto, and a steam-space above the water-level; substantially as described.

12. A steam-boiler rotary on a horizontal axis and comprising a hollow rotary shell composed of laterally-adjoined sections; substantially as described.

13. A steam-boiler rotary on a horizontal axis and comprising a hollow rotary shell composed of laterally-adjoined sections, one of which extends outwardly beyond the other and constitutes a steam-space; substantially as described.

14. A rotary steam-boiler rotatively mounted on its supports and comprising a hollow shell, and slag-tubes expanded in the shell and projecting thereinto; substantially as described.

15. A rotary steam-boiler rotatively mounted on its supports and comprising a hollow shell, and slag-tubes expanded in the shell and projecting thereinto, said tubes being of different lengths and arranged radially; substantially as described.

16. A rotary steam-boiler comprising a hollow shell, slag-tubes expanded in the shell and projecting thereinto, and an internal brace holding the tubes and adapted to permit longitudinal expansion; substantially as described.

In testimony whereof I have hereunto set my hand.

OLIVER S. GARRETSON.

Witnesses:
EDWARD WILHELM,
H. M. CORWIN.