No. 720,370. PATENTED FEB. 10, 1903.

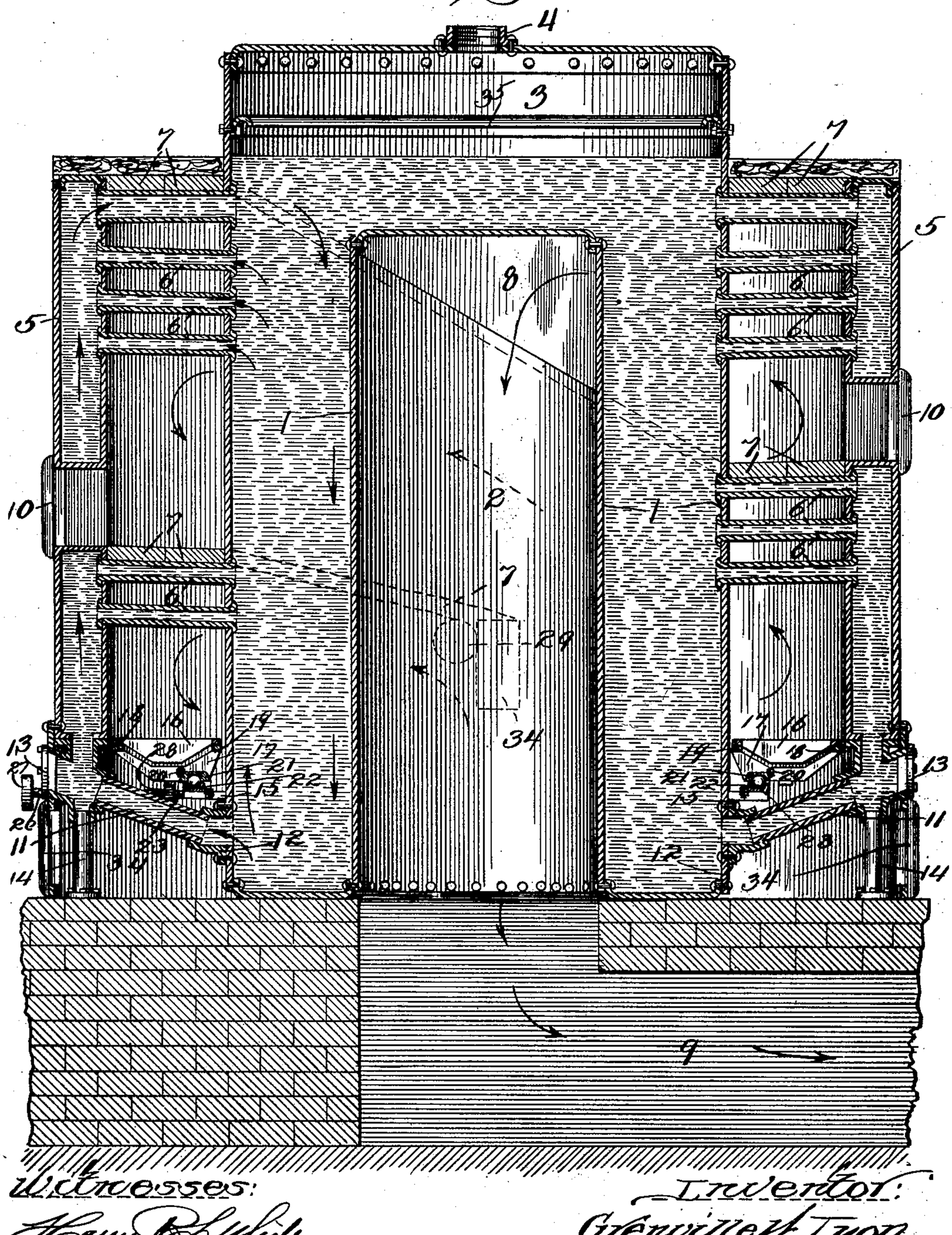
G. W. LYON.

FURNACE.

APPLICATION FILED APR. 16, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



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Ray White.

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By Toréé Bain & Kirby.

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NO MODEL. 4 SHEETS—SHEET 2.

FIG. 2.

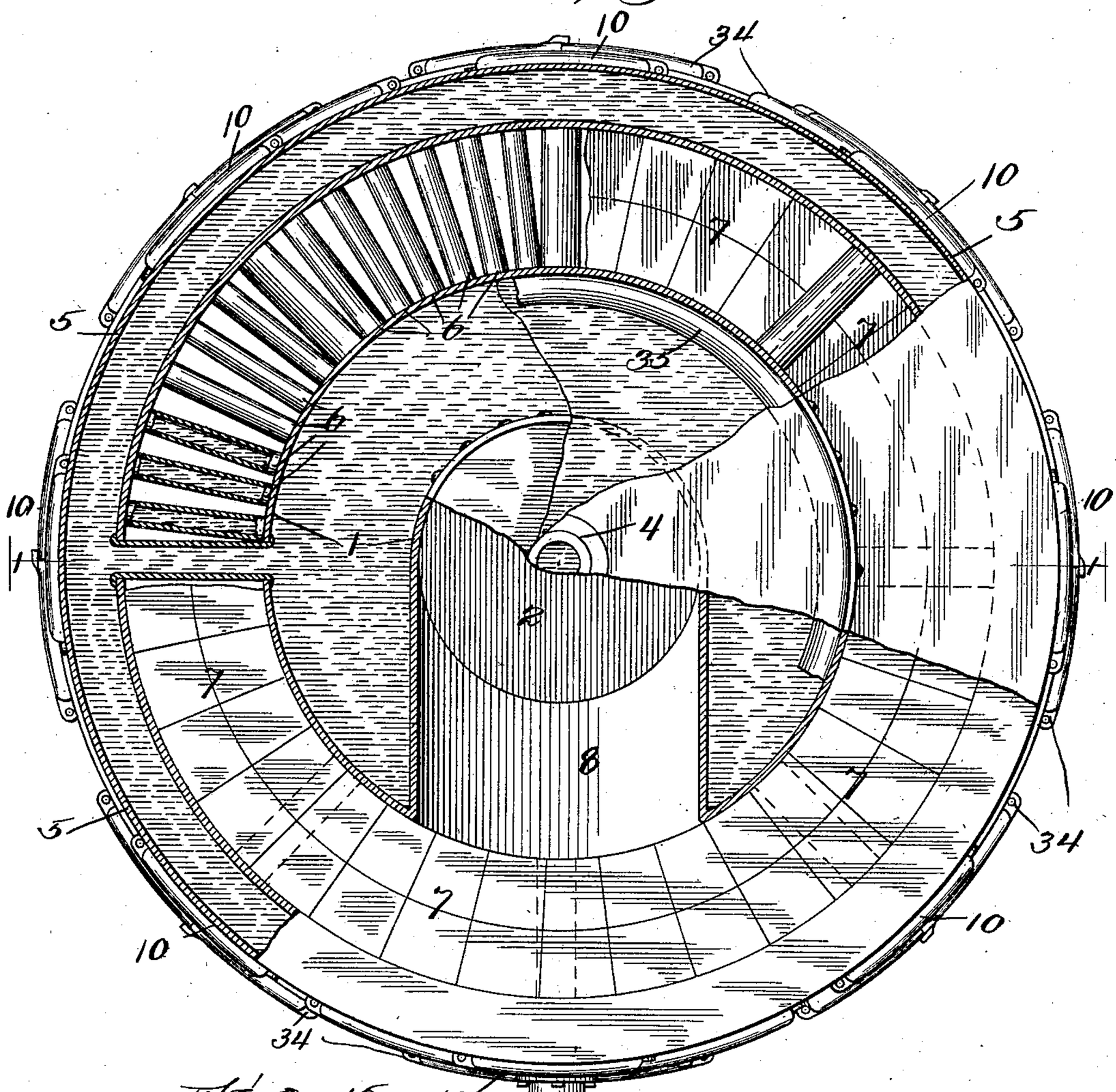
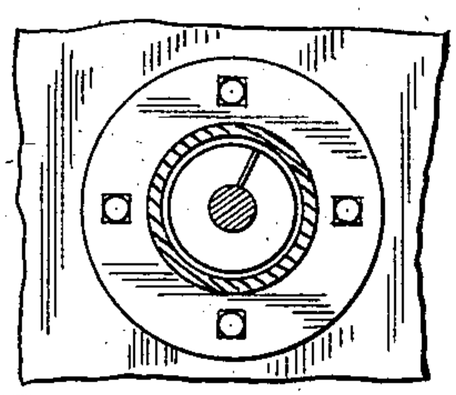


FIG. 15.



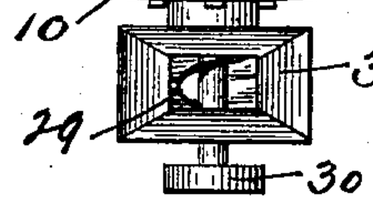
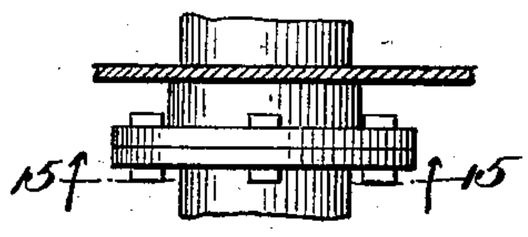


FIG. 16.



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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 3.

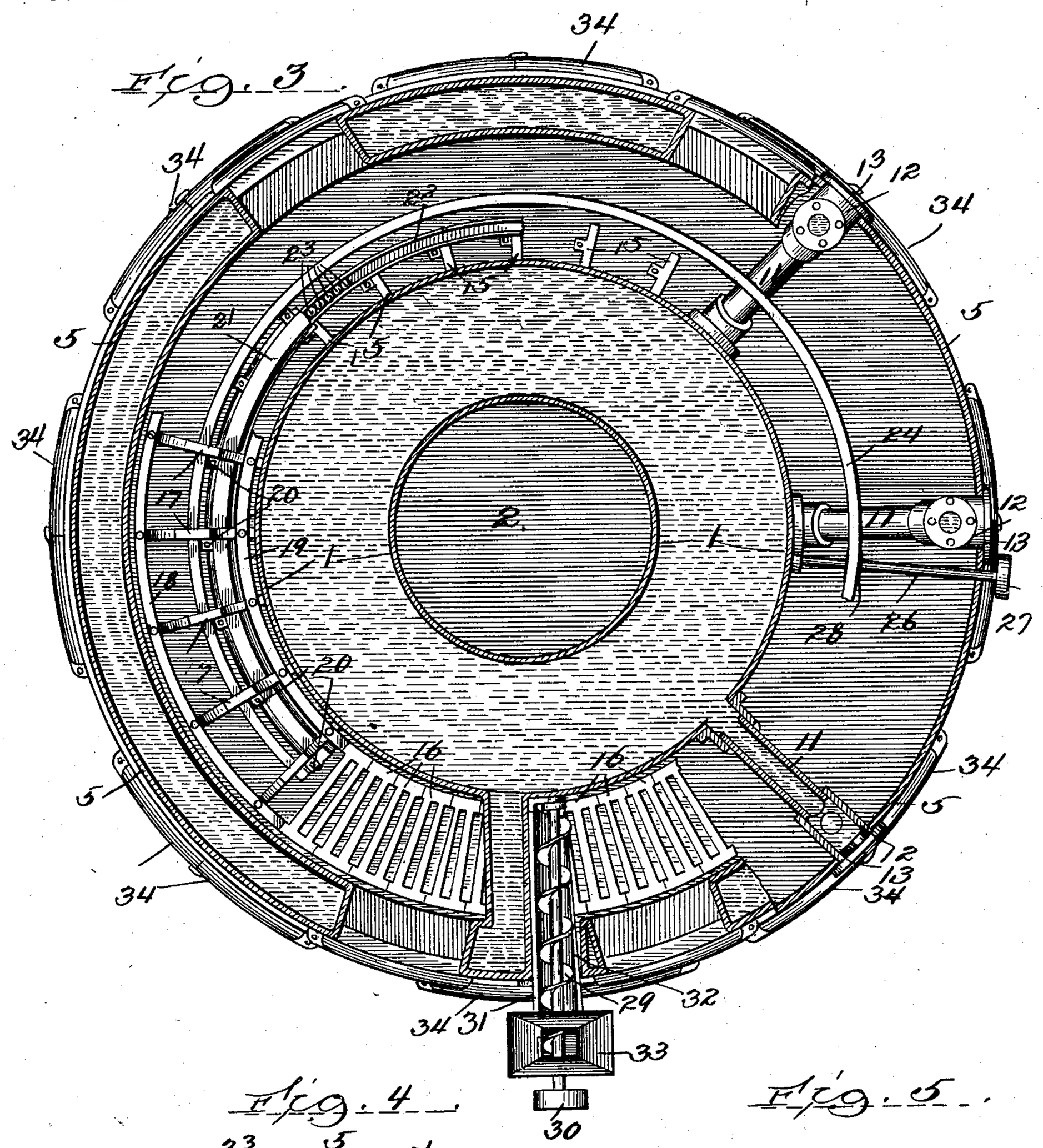
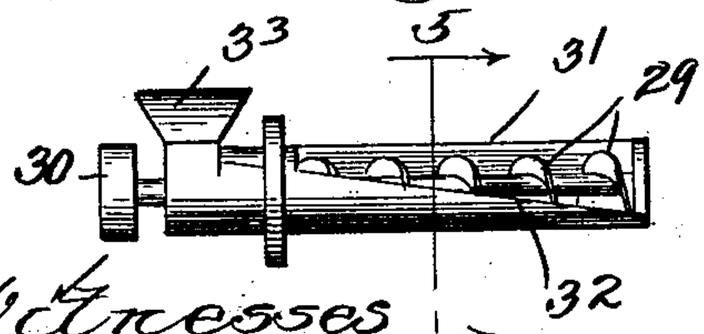
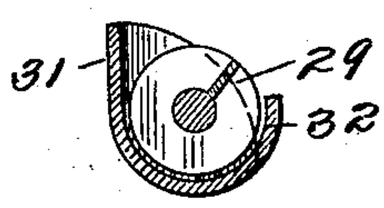


Fig. 4.



Witnesses
Harry Colville.
Ray White.

Fig. 5.



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No. 720,370. PATENTED FEB. 10, 1903.

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FURNACE.

APPLICATION FILED APR. 16, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

FIG. 6.

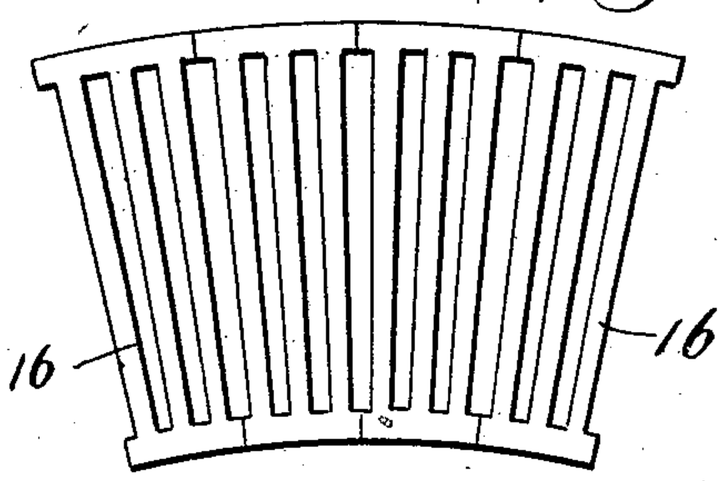


FIG. 7.

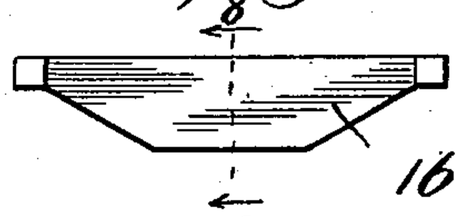


FIG. 8.

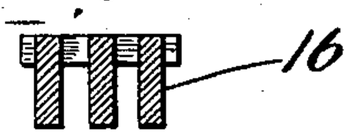


FIG. 9.

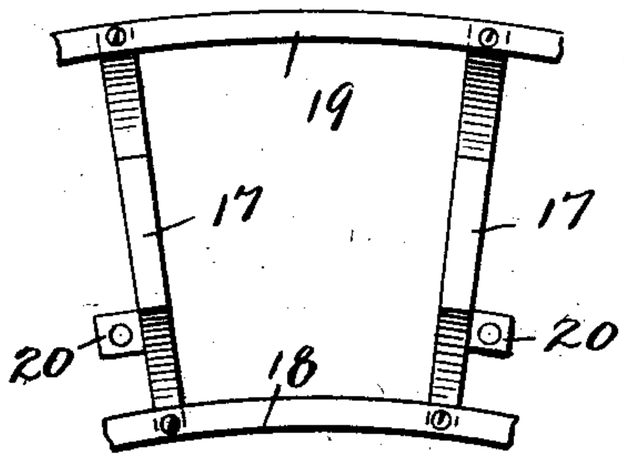


FIG. 10.

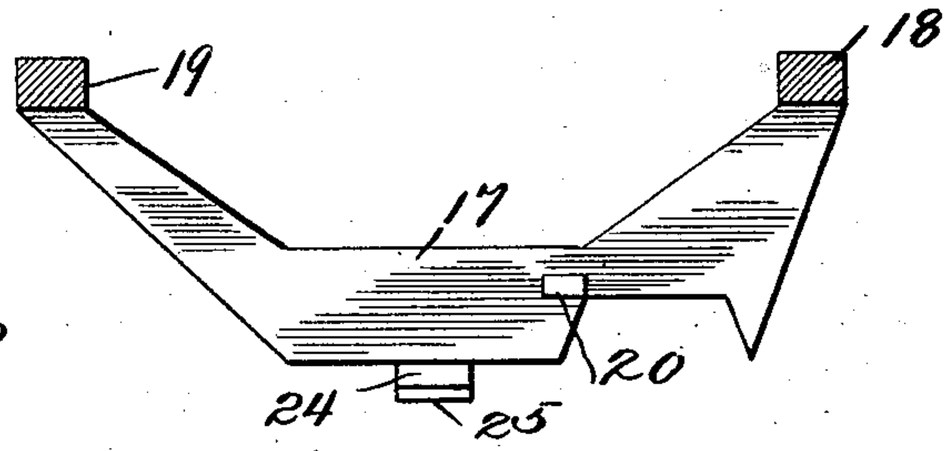


FIG. 11.

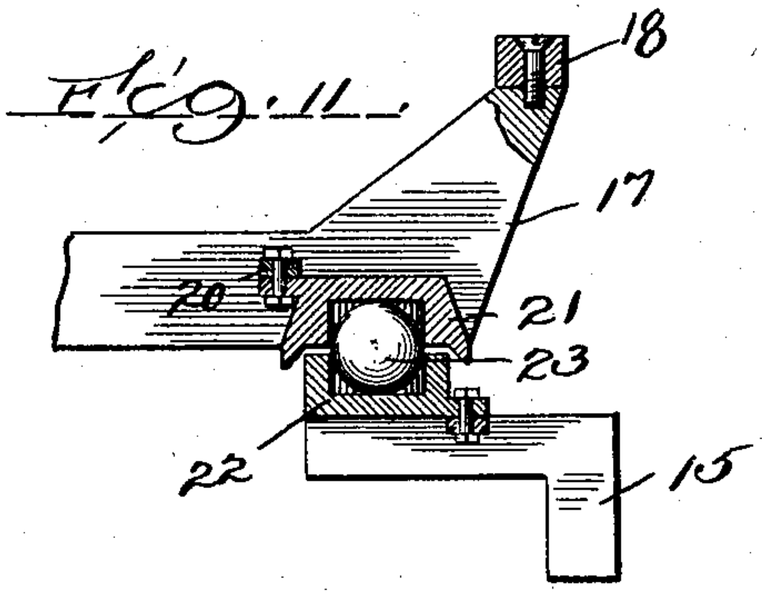


FIG. 12.

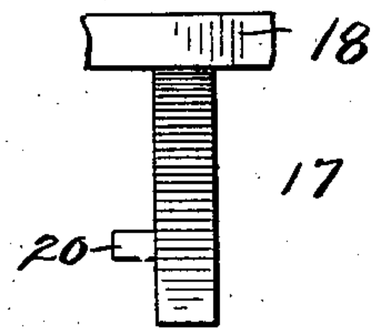


FIG. 13.

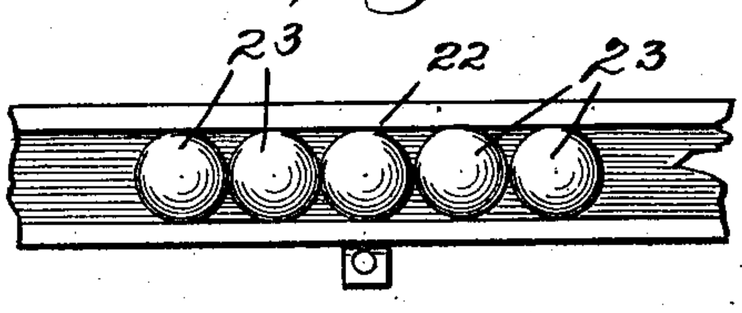
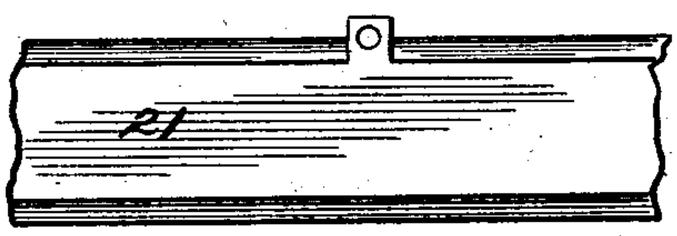


FIG. 14.



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Ray White.

Inventor:
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By Foré Bain
Atty.

UNITED STATES PATENT OFFICE.

GRENVILLE W. LYON, OF CHICAGO, ILLINOIS.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 720,370, dated February 10, 1903.

Application filed April 16, 1902. Serial No. 103,097. (No model.)

To all whom it may concern:

Be it known that I, GRENVILLE W. LYON, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnaces; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in furnaces.

The object of my invention is to provide a furnace which is highly efficient, in which comparatively all of the heat units arising from the combustion of the fuel in the furnace are utilized, providing complete combustion of the fuel and active circulation of the water when used in connection with a steam-generator.

With these and other objects in view, which may hereinafter appear, my invention consists in the features, arrangements, details of construction, and combination of parts, which will be hereinafter shown and described, and particularly pointed out in the appended claims.

In the drawings I have illustrated the embodiment of my invention in connection with a steam-generator, which will form subject-matter for a subsequent application.

Figure 1 is a side elevation in section of my furnace and steam-generator looking from the rear. Fig. 2 is a plan view, partly in section, showing the various parts of the generator. Fig. 3 is a similar view to Fig. 2, showing the various parts of the furnace and generator that are located at lower vertical positions than those shown in Fig. 2. Fig. 4 is a side elevation of a fuel-conveyer by means of which fuel is automatically conveyed to the furnace and evenly distributed over the grates. Fig. 5 is a transverse section through the same, taken on line 5 5 of Fig. 4. Fig. 6 represents several of the grate-bar sections as they appear when in position in the furnace. Fig. 7 is a side elevation of the grate-bar. Fig. 8 is a transverse section through one of the grate-bars, taken on line 8 8 of Fig. 7. Fig. 9 is a broken-away portion of the bearing-frame upon which the grate-bars rest, which is shown in transverse section in Fig. 10. Fig. 10 is a side elevation of one of the radially-placed brackets of the bearing-frame for supporting the grate-bars. Fig. 11 is a broken-away portion of the bearing-frame and one of the brackets upon which the bearing-frame rests. Fig. 12 is a broken-away end view of Fig. 10. Fig. 13 is the ball-bearing runway or track, which is fixed to the supporting-brackets shown in Fig. 11. Fig. 14 is the corresponding runway or track that is located immediately above the one shown in Fig. 13. Fig. 15 is an end view of the fuel-conveyer, showing a section through line 15 15 of Fig. 16. Fig. 16 is a broken-away part, showing the method by which the fuel-conveyer is removably attached to the structure.

In all of the views the same numerals of reference indicate similar parts.

1 1 represent a vertical annular shell or water-space provided with a cylindrical flue or chamber 2, extending through its bottom to a point near its top. The shell 1 is closed near its top, providing a steam space or drum 3, with an outlet-flange 4. A similar annular shell 5 of much larger diameter, open at both ends, is placed concentric with the inner shell 1 and is connected with the said shell by a series of water-circulating tubes 6 6, arranged spirally around and between the two shells and slightly elevated at their respective outer ends, so as to provide a means for directing the circulation from the inner shell to the outer one. A continuous baffle-plate 7 is placed above the tubes 6 6, providing a spirally-arranged smoke-flue between the successive convolutions around the inner shell and within the outer shell for conducting the heated gases from the furnace through the flue into contact with the heating-surfaces of the generator. An opening 8 is made through the inner shell for the escape of the gases from the spirally-constructed flue into the central vertical flue 2, through which they pass into the horizontal flue 9, that communicates with the stack or draft-conduit of the generator.

The larger arrows show the direction that the heated gases travel through the spirally-arranged flue just described. Clean-out doors 10 are made through the outer shell into the spirally-arranged smoke-flue for the purpose of cleaning or for entering the same for repairing the parts.

The outer shell 5 extends to a point in a plane even with the grate-surface at the lower end and to a point just below the water-line at the upper end of the generator.

Water-legs 11 are arranged at an oblique angle around the lower edge of the outer shell 5 for the purpose of promoting circulation and for the further purpose of connecting the outer shell 5 with the settling-chamber 12 in the inner shell 1.

A hand-hole 13 is an integral part of each of the respective water-legs and is so arranged that by removing the hand-hole plate the leg may be thoroughly cleaned or the tube removed and replaced from the exterior without interfering with the other parts of the construction.

Supporting-legs 14 are placed immediately under the water-leg for the purpose of supporting the same and the shell 5 in position.

A series of supporting-brackets 15 are arranged in a common horizontal plane at suitable intervals around the inner shell 1 for supporting the revoluble structure upon which the grate-bars 16 are supported. The grate-bearing frame for supporting the grate-bars is composed of a series of brackets 17, an inner ring 18, and an outer ring 19. Each bracket 17 carries a lug 20, to which an inverted grooved track-ring 21 is bolted. A correlated grooved track-ring of the same diameter as that of the grooved ring 21 is fixed to a series of fixed supporting-brackets 15. This track-ring is also grooved and is designed to carry a series of hardened balls 23, upon which the grate-bearing frame and the grate-bars carried thereby are rotated. An annular ring 24 is bolted to the brackets 17 and is provided on its lower surface with a series of gear-teeth 25, providing an annular gear-rack. A shaft 26 projects from the sides of the generator and is provided with a pulley 27, by which it may be revolved. On its inner end it carries a gear-pinion 28, which meshes into the gear-teeth of the annular rack 24 for the purpose of revolving the grate.

A fuel-conveyer for constantly feeding the fuel onto the grate is composed of a helical conveyer-screw 29, driven by a pulley 30, surrounded by a jacket 31. The jacket is cut away on one side on an oblique longitudinal line 32. The object of cutting away the jacket in an oblique line in the manner shown is to provide a means for effecting an equal distribution of the fuel upon the grate-surface. The conveyer is provided with a hopper 33, which is designed to contain the fuel to be fed into the furnace. For the purpose of protecting the fuel contained in the conveyer from the impingement of the hot gases directly thereon a water-leg 34 is placed at the side of the conveyer, intervening between the conveyer and the direct oblique draft of the hot gases arising from the grate-surface. If the conveyer were not protected, the fuel contained therein would be quickly distilled by the intense heat from the furnace, which effect would to a greater or less extent liquefy the fuel and clog the conveyer. The water-leg placed in the manner shown will protect the conveyer from the hot gases and will thereby prevent the disastrous results that would probably ensue without the intervention of the water-shield. I may place a water-tube of a similar nature under the conveyer and one above it. It will be further noted that the arrangement of the water-leg in rear of the fuel-feed with reference to the direction of rotation of the grate efficiently prevents the gases evolved from the fuel freshly introduced from passing directly to the smoke-flue, and thereby forces the gases to make a circuit of substantially the entire grate before escaping into the flue.

Fire-doors and grate-cleaning doors 34ª are arranged around the outside shell of the generator.

In the dome 3 of the generator I have shown an annular inwardly-curved ring 35, fixed to the inner surfaces thereof. The object of this ring is to prevent the creeping of the water around and up the surface of the dome and its final exit through the steam-opening 4. Water which usually runs up the inside surface of the shell of the dome and finds an exit through the steam-opening with the steam will by this construction be prevented from leaving the boiler as a result of the barrier interposed, consisting of the inwardly-curved ring, in a manner obvious to those skilled in the art.

The operation of my device is as follows: The annular grate is adapted to be rotated between the water-surfaces provided by the outside shell 5, the tubes 6 6, and the inside shell 1 by means of the shaft 26, acted upon by the pulley 27. A gear-wheel 28, carried by the said shaft, engages with the rack 24, which is fixed to the grate-frame for this purpose. Friction is minimized by the bearing composed of the balls 23, which are placed in the annular grooved channel 22 and a channel 21 of the same diameter immediately over it, upon the inner surfaces of which the balls engage. As the shaft 26 is rotated the gear 28, which engages the rack 24, rotates the grate-bearing frame and the grate upon the track composed of the guide-bearing rings 21 and 22 and the balls 23, which carry the grate and minimize the friction due to its rotation. The upper channel is provided with a depending rim on each side to prevent the channel from being filled with ashes. Fuel is placed in the hopper 33 and automatically fed into the grate by revolving the conveyer-shaft by means of the pulley 30. The oblique line 32 provides a means whereby the fuel is evenly distributed over the grate-surfaces. When the grate is revolved, as it passes under the fuel-conveyer fresh fuel is continually added in small quantities to the fire contained upon the grate-bars. The smoke-flue provided by the convolutions of the baffle-plate

7 7 is located between the water-surfaces 1 and 5 in a spiral direction, through which the gases arising from the fire upon the grate-bars will follow the grate in the same direction that it turns. By this means the gases are retained in contact with the fire for a longer time than has heretofore been usual in furnaces, and much better combustion is thereby obtained.

It is my intention to rotate the grate constantly and to also rotate the fuel-conveyer constantly and to vary the speed of the grate and the conveyer as may be required for the changing conditions.

It will be noticed that as a result of my construction the hotter gases of combustion come in contact with the water that is heated to the highest degree of temperature and that the cold gases as they leave the furnace are brought into contact with the surfaces against which the water of the lowest temperature is adjacent.

In the present embodiment of my invention I contemplate employing and revolving an annular grate and passing the heated gases over the fire and hot embers of said grate in the direction of rotation corresponding with that of the grate between surfaces designed to be heated, or, in other words, in the direction of the progression of combustion. As the grate is revolved the fuel is constantly fed thereto in small quantities, producing conditions for ideal and perfect combustion and the economic consumption of fuel.

The process of combustion is progressive in its nature with reference to the rotation of the grate. The most combustible gases are liberated at the time when fresh fuel first strikes the hot embers, when these gases arising therefrom will be carried forward almost a complete revolution immediately over and in contact with the incandescing fuel which has reached a state of more perfect combustion. These gases are thereby consumed and contribute intense activity to the heating effect of the fuel.

I have shown in the accompanying drawings the embodiment of my invention and the application thereof to a steam-generator. I do not by any means consider, however, that my invention is confined to this use. It may, for instance, be used in connection with any confining-surfaces to be heated, such as shown in the drawings as the vertical water-surfaces, and in the claims where water-heating surfaces are specified I desire it to be understood that any surfaces adapted to be heated are within the terms of my claims.

My invention may be used in connection with any steam-boiler, and the vertical surfaces shown in the drawings may be made in part or entirely of fire-brick or other material, and the furnace may be set out in front of the boiler, if desired, and the heated gases subsequently conducted under the heating-surfaces of the boiler, or the invention may be used in connection with burning-kilns or the like—such as those used for burning lime, baking clayware, or kindred devices—without departing from the scope and spirit thereof.

It will be noticed that the area of the spiral smoke-flue gradually increases from the point where the fuel is fed to the grate. This feature is important as a means for confining the gases near the incandescing fuel and subsequently providing a gradually-increasing area in the path of the gases practically proportional to their expansion.

Having described my invention, what I claim as new and useful, and desire to secure by Letters Patent of the United States, is—

1. In a furnace, a combustion-chamber, a rotary grate arranged therein, means for imparting rotation in one direction to said grate, and a spiral smoke-flue having its path of eduction in the same direction as the direction of movement of the grate.

2. A furnace comprising an annular grate adapted to be revolved, heating-surfaces on each side thereof, a smoke-flue between said heating-surfaces, and a means for revolving said grate in a direction corresponding with the direction of the gases through said smoke-flue.

3. In a furnace, an endless combustion-chamber, an endless grate therein, a fuel-feed inlet, means for effecting progressive relative movement between the grate and feed-inlet whereby the combustion is caused to progressively advance from the point of feed, a smoke-outlet definitely related to the feed-inlet and located in rear thereof, with reference to the progress of combustion, and means for directing the gases evolved from the fuel fed to the grate to the smoke-flue in the direction of the progress of combustion.

4. In a furnace, an annular combustion-chamber, an annular grate arranged therein, a fuel-feed device, means for effecting relative, rotative movement between said grate and feed device in one direction, whereby the combustion is caused to progressively advance from the feed device, a smoke-outlet arranged in rear of the feed devices, and means for directing the gases evolved from the fuel fed to the grate to the smoke-outlet in the direction of the progress of combustion.

5. In a furnace, an annular combustion-chamber, an annular grate mounted for rotation therein, means for rotating the grate in one direction, a fuel-feed inlet, a smoke-outlet arranged just in rear of the fuel-inlet, with reference to the direction of rotation of the grate, and means for directing the gases evolved from the fuel fed to the grate to the smoke-outlet in the direction of rotation of the grate, whereby said gases are caused to traverse substantially the entire annular combustion-chamber.

6. In a furnace, an annular combustion-chamber, an annular grate arranged therein, a fuel-feed device, means for effecting relative rotative movement between said grate

and feed device, whereby the combustion is caused to progressively advance from the feed device, a smoke-outlet arranged in rear of the feed device, means for directing the gases evolved from the fuel at the point of feed to the smoke-outlet in the direction of the progress of combustion, and means for preventing the flow of gases to said outlet in the opposite direction.

7. In a steam-generator, the combination with an annular, rotary grate, of concentric water-chambers inclosing said grate to form an annular combustion-chamber, a series of spirally-arranged water-circulating tubes bridging said chamber, and a series of plates supported upon said tubes to form a continuous, spiral smoke-flue above the grate.

8. In a furnace, an annular combustion-chamber, an annular grate therein, means for directing the course of the gases of combustion, an automatic conveyer for feeding fuel to the grate, and a water-leg arranged adjacent to said conveyer in the path of the gases of combustion.

9. In a furnace, an annular combustion-chamber adapted to support combustion throughout practically its entire extent, a grate within the casing, an automatic fuel-conveyer arranged to project within the combustion-chamber above the grate, means for directing the course of the gases, and a deflecting water-leg arranged adjacent to the conveyer in the path of said gases.

10. In a steam-generator, the combination of an annular combustion-chamber, an annular grate arranged therein, a water-chamber inclosed by said grate, a vertical flue within said chamber having a closed top located below the water-line, and an open base, and a spiral smoke-flue arranged above the grate to surround the water-chamber and communicate with the vertical flue near its upper end.

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

GRENVILLE W. LYON.

Witnesses:

FORÉE BAIN,

MARY F. ALLEN.