W. E. McKEE.

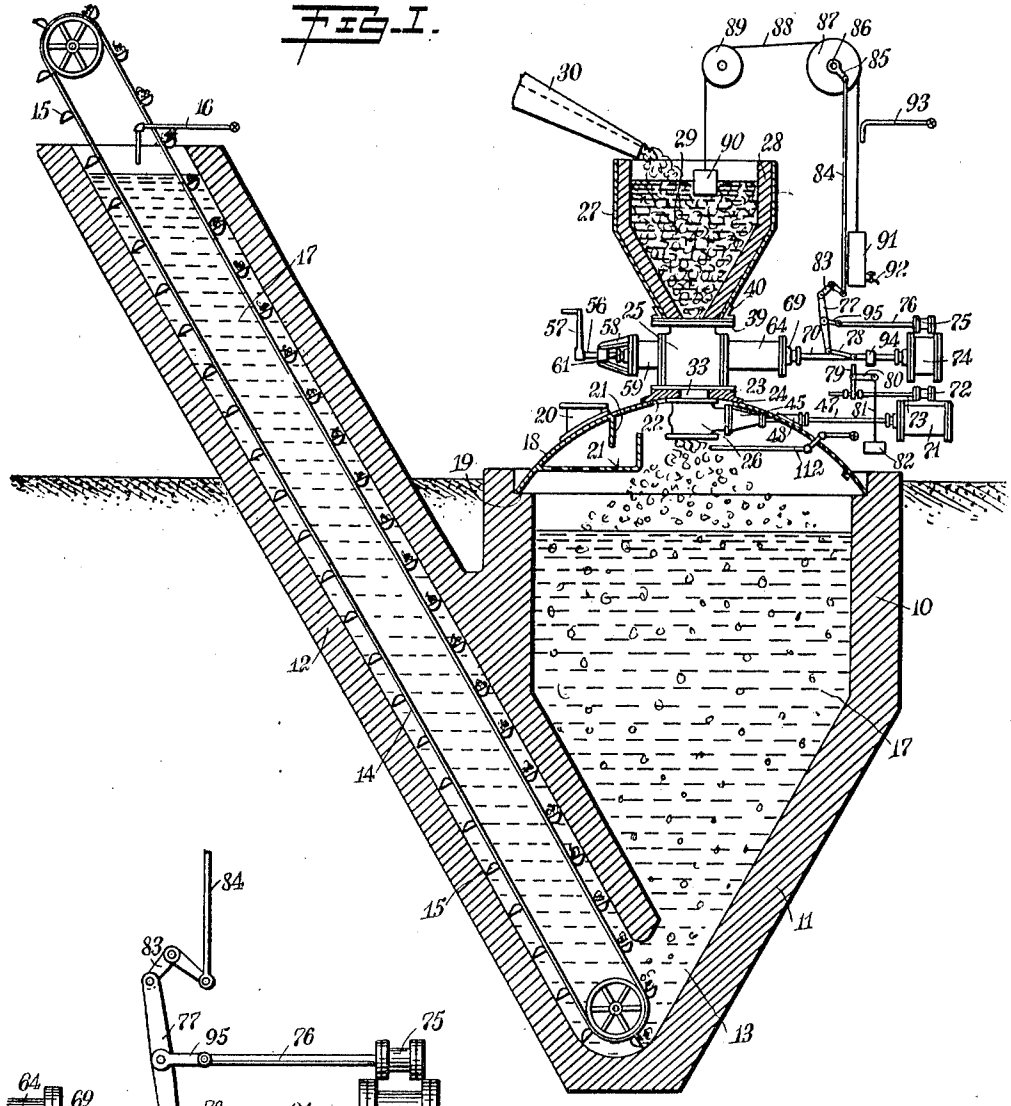
STEAM GENERATOR.

APPLICATION FILED MAY 6, 1910. RENEWED APR. 7, 1911.

1,001,290. **Patented Aug. 22, 1911.**

5 SHEETS—SHEET 1.

FIG. 1.



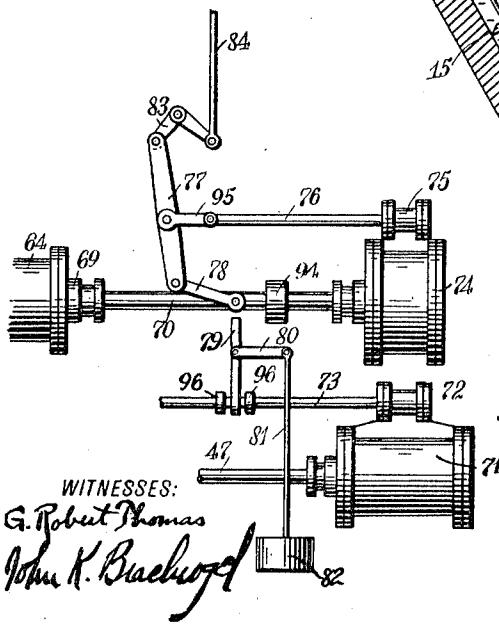


FIG. 2.

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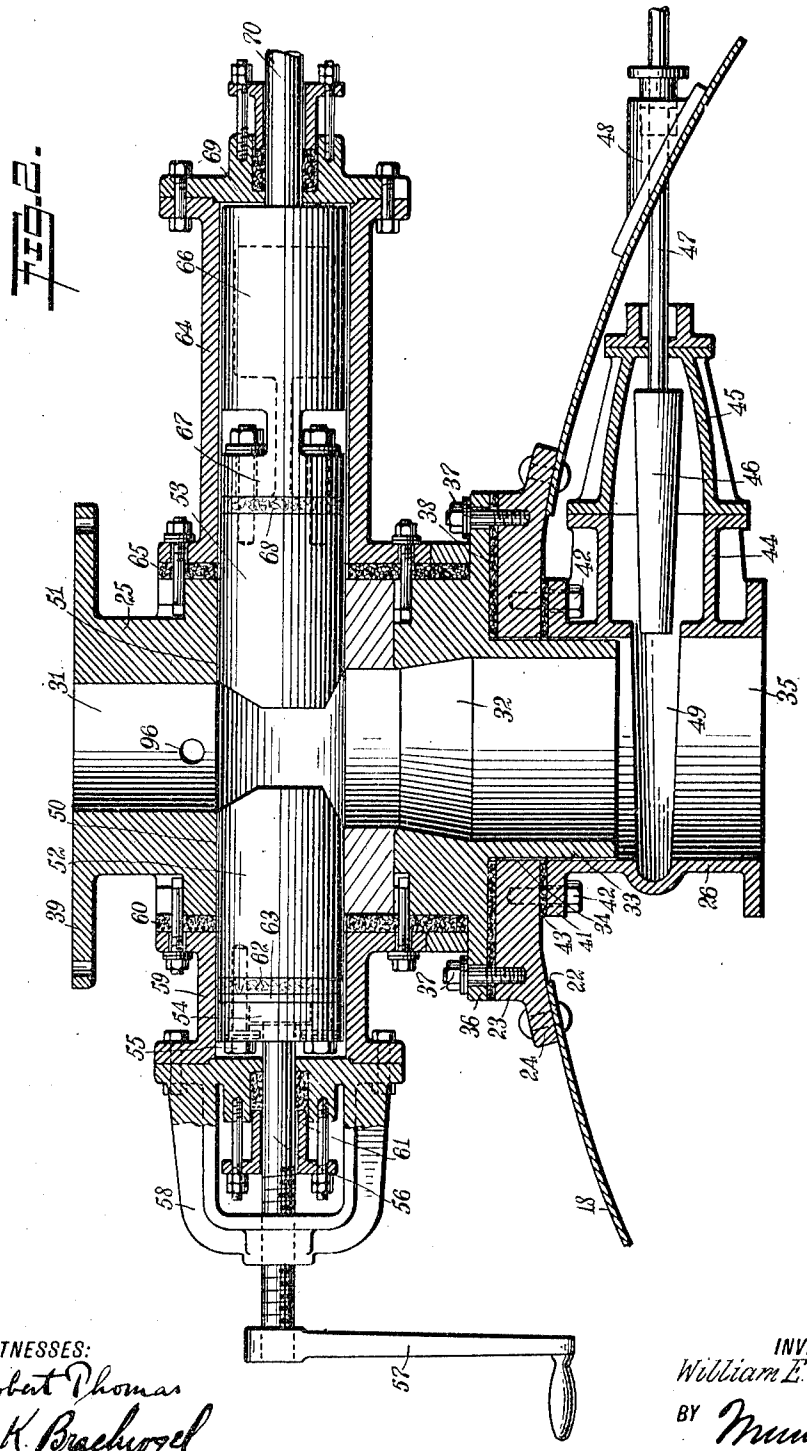
5 SHEETS—SHEET 2.

FIG. 2.



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5 SHEETS—SHEET 3.

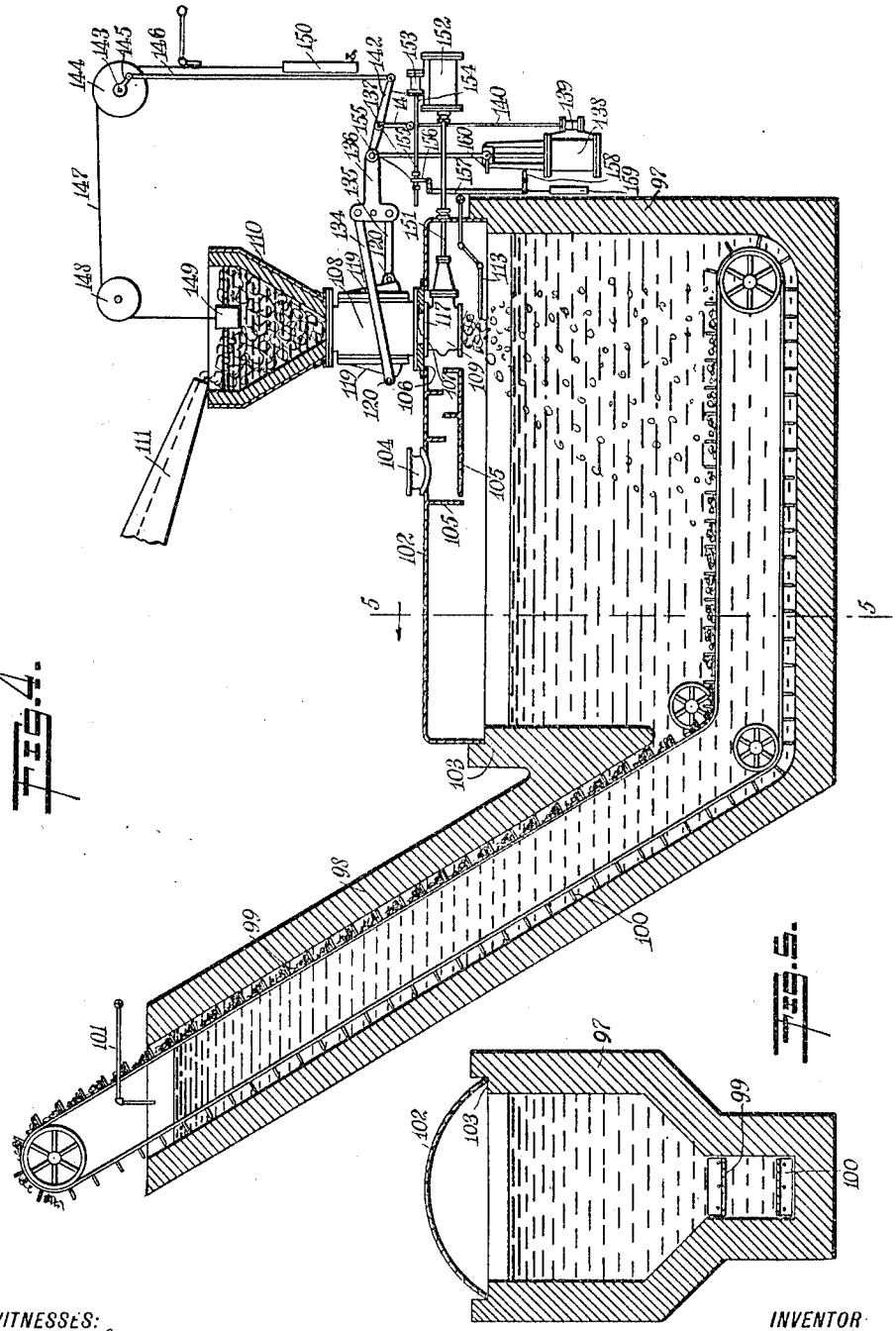

FIG. 4.

FIG. 5.

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5 SHEETS—SHEET 4.

Fig. 6.

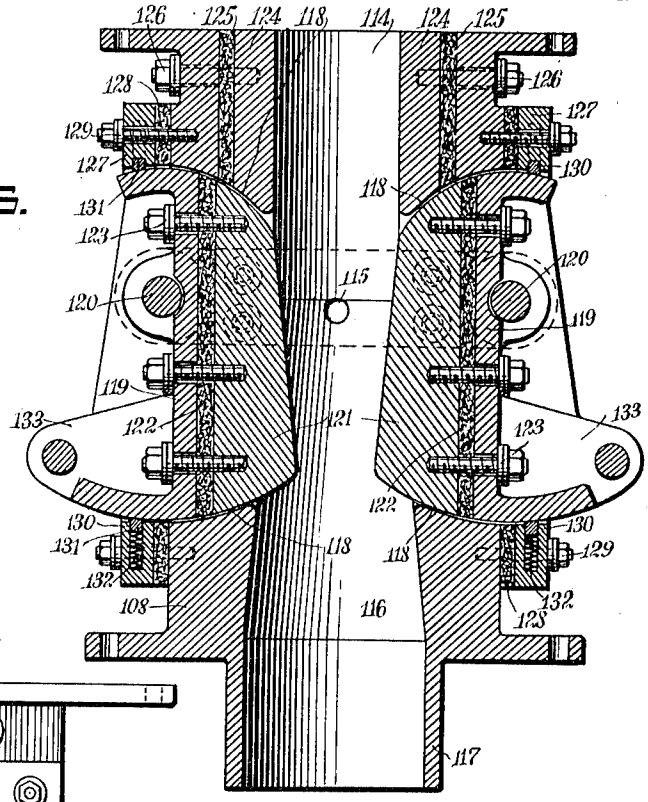


Fig. 7.

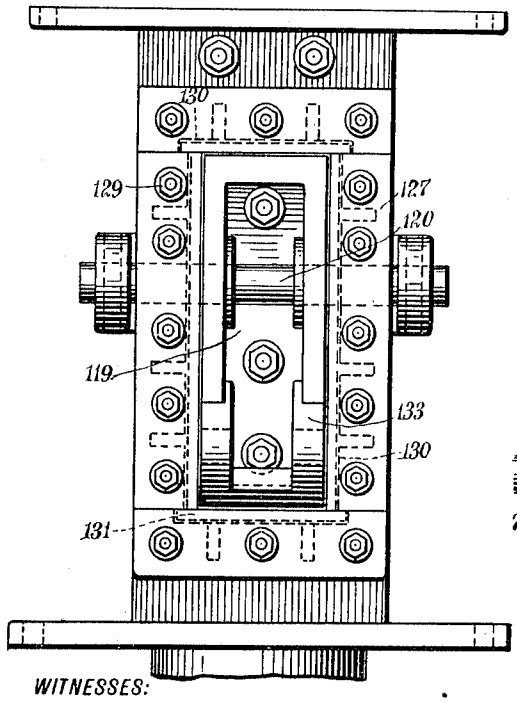
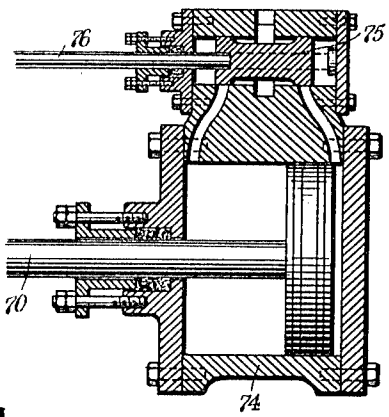


Fig. 8.



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1,001,290. Patented Aug. 22, 1911.

5 SHEETS—SHEET 5.

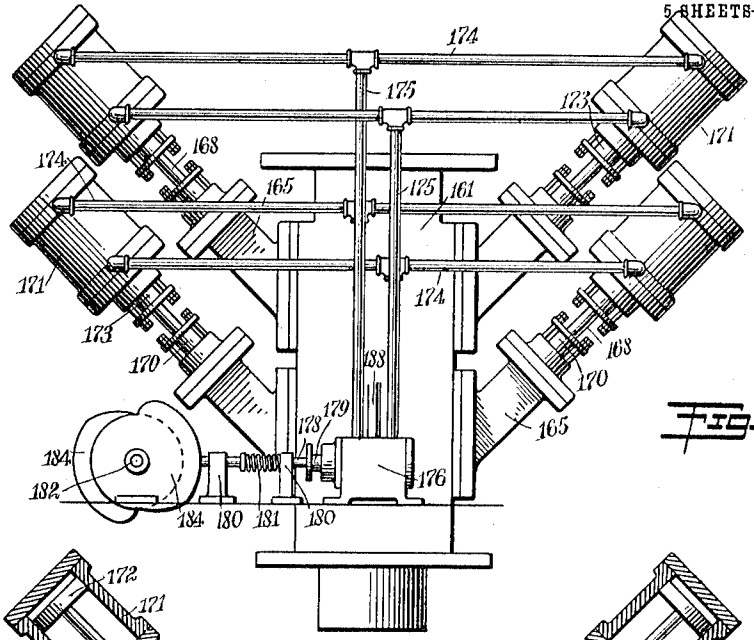

Fig. 9.

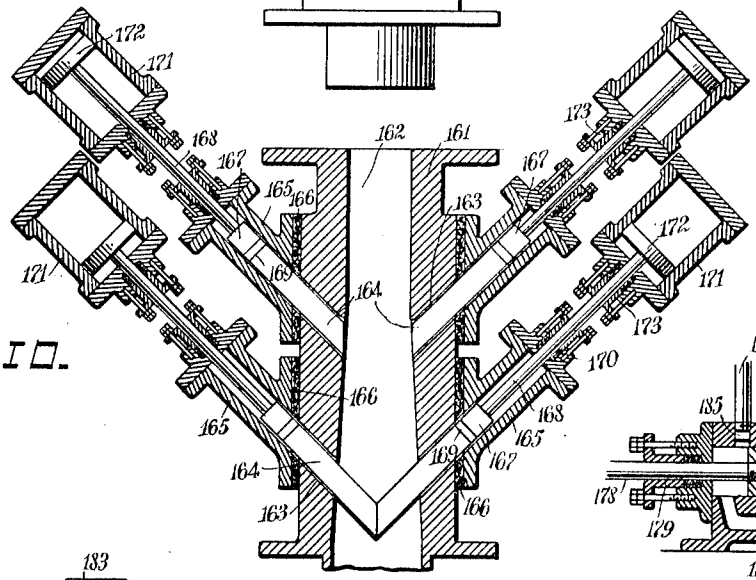

Fig. 10.

Fig. 12.

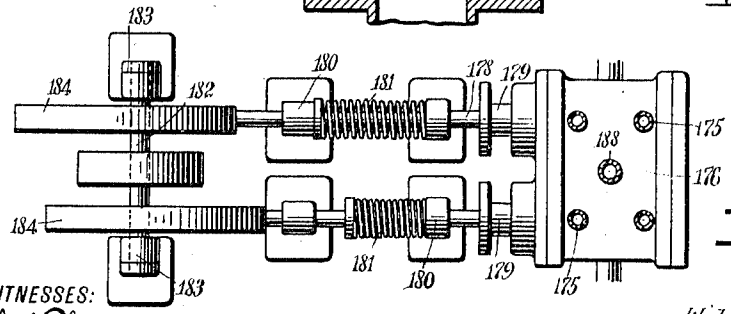

Fig. 11.

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STEAM-GENERATOR.

1,001,290. Specification of Letters Patent. Patented Aug. 22, 1911.

Application filed May 5, 1910, Serial No. 559,451. Renewed April 7, 1911. Serial No. 619,600.

To all whom it may concern:

Be it known that I, WILLIAM E. McKEE, a citizen of the United States, and a resident of Bisbee, in the county of Cochise and Territory of Arizona, have invented a new and Improved Steam-Generator, of which the following is a full, clear, and exact description.

This invention relates to steam generators, and has reference more particularly to a generator for producing steam from water heated by the introduction into the water of molten slag or like material, the steam being preferably employed at low pressure in turbines or other prime movers designed for the use of low pressure steam, the generator having a suitable valve-controlled inlet for the introduction of the molten slag, and having a water-sealed outlet, through which a conveyer or similar device can remove the slag.

An object of the invention is to provide a simple and efficient generator for the production of steam from molten slag and other similar waste material, which can be delivered to the generator in a highly heated condition, in which the inlet valve, through which the material enters the generator, is automatically-controlled, in accordance with the flow of the material, which is so constructed that steam cannot escape from the generator through the valve, and air cannot enter into the generator, through the inlet, in which the material can be removed from the generator without the simultaneous escape of steam from the same, and in which heat losses are reduced to a minimum.

A further object of the invention is to provide a steam generator for the production of steam from water, by the heating of the water through the introduction of molten slag from blast furnaces, in which the slag is thoroughly granulated, to facilitate the removal of the slag from the generator continuously, or intermittently, in which the feed water is to a certain extent preheated, and in which the inlet is so constructed that it can be easily cleared of lumps or concretions of slag, by barring or by any other method for breaking up and removing the solidified slag in the inlet.

The invention consists in the construction and combination of parts to be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views, and in which—

Figure 1 is a vertical section of an embodiment of my invention; Fig. 2 is an enlarged vertical section of the inlet or gate valve and the stop valve, for regulating the flow of the slag into the generator; Fig. 3 is a side elevation of part of the mechanism for controlling the valves; Fig. 4 is a vertical section of a modified form of the steam generator; Fig. 5 is a transverse section on the line 5—5 of Fig. 4; Fig. 6 is an enlarged vertical section of the inlet valve of the form of generator shown in Fig. 4; Fig. 7 is a side elevation of the inlet valve; Fig. 8 is a longitudinal section of part of the controlling mechanism for the inlet valve shown in Figs. 6 and 7; Fig. 9 is a side elevation of a modified form of inlet valve; Fig. 10 is a vertical section of the valve shown in Fig. 9; Fig. 11 is a plan view of part of the controlling mechanism for the valve shown in Figs. 9 and 10; and Fig. 12 is a longitudinal section of a portion of the device shown in Fig. 11.

Before proceeding to a more detailed explanation of my invention, it should be understood that while the generator is designed particularly for the utilization of molten slag from furnaces for smelting iron, copper, or lead ores, it can also be employed for the production of steam from the heat contained in other waste material which is of such nature that it can flow into the generator, and can be removed therefrom by a suitable conveyer, first giving up its heat to the water in the generator, to turn the same into steam. Slag from one or more furnaces can be run directly into the generator, or through a storage container or "settlers", into the same. The steam generated is at a low pressure, and of course must be utilized in a prime mover properly designed for low pressure steam. By utilizing the same at a low pressure it is possible to construct the inlet valve so that no steam can escape from the

generator, and also to prevent the escape of steam at the conveyer, which removes the granulated slag. To insure the latter action, the conveyer is arranged wholly or partly in a water-sealed conduit or "leg", the difference of level between the water in the generator proper and in the leg, depending upon the steam pressure. I have found that a difference of two feet for every pound of steam pressure in the generator is sufficient to prevent the escape of the steam. I prefer to introduce the feed water into the water-sealed leg so that the granulated slag leaving the generator, and still containing some heat, serves to preheat the feed water. In this way almost the entire heat in the slag can be utilized.

I make use of the "regenerative" principle in the operation of the boiler. When the flow of slag is interrupted, the inlet valves are closed securely, to prevent the escape of steam from the boiler, and to prevent the flow of air into the same in case the steam pressure falls below atmospheric pressure. As the boiler contains a large quantity of water, it will continue to evaporate for a considerable period after the flow of slag is stopped, owing to the amount of heat contained in this large body of liquid, and the continued production of steam is due to evaporation of the water, consequent upon the fall in pressure and the drop in temperature. The construction of the valves is such that the inlet passage is always drained of slag before the inlet is completely closed. This serves to prevent the aggregation of cooled slag in the passage, with the consequent obstruction of the same.

Referring more particularly to the drawings, I have shown for example, in Fig. 1, a generator which is substantially cylindrical in form. The body 10 is constructed from concrete, masonry, or any other suitable material, and if so desired, can be even fashioned from metal plates. It can be partly buried in the ground, to save room. The body has the lower part 11 inwardly tapered, so that the cool slag will slide to the apex at the bottom of the boiler. The conduit 12, which forms the water-sealed tube for the leg of the conveyer, extends upwardly at an angle from the lower end of the boiler body, and communicates therewith through an opening 13. The conveyer 14 is of any suitable type and is mounted in the conduit 12. The buckets 15 are perforated so that the water can drain freely from them when the conveyer is operated. The conveyer leg extends above the boiler, to a point such that a difference in level results, which is about two feet for each pound of pressure in the boiler. A feed water inlet pipe 16 supplies water to the boiler at the open, upper end of the conveyer leg. The water 17 in the boiler, when the same is operating at normal pressure, extends to nearly the top of the conveyer leg. The conveyer is driven in any suitable manner, preferably from a prime mover supplied with steam from the boiler itself.

The head 18 of the boiler is preferably fashioned from metal, and is of any suitable form of curvature. It is shown as spherical and mounted on a shelf 19 of the boiler body, and has a suitable steam outlet 20 through which the steam escapes to the point of utilization. Perforated baffles 21 are provided adjacent to the outlet, to drain the steam of moisture. At the top the boiler head has an opening 22 over which is positioned the saddle 23, riveted or bolted by means of a laterally extended and suitably formed flange 24 at the lower end of the opening. The gate valve 25 is mounted upon the saddle, and the stop valve 26 is located under the same, within the generator. A hopper 27, fashioned from sheet metal, and having a lining of fire-brick or other refractory material 28, is located upon the body of the gate valve. It receives the slag 29 from the slag-delivering chute 30, which is connected with the supply container. The gate valve body 25 has a substantially vertical, preferably circular passage 31 therethrough, which at the lower end has an enlargement 32. The gate body, at the lower end terminates in an extension sleeve 33, which forms a continuation of the passage enlargement 32, and extends through the opening 34 of the saddle, into the generator. It is received within the passage 35 extending through the body 26 of the stop valve. The valve body 25, at the lower end, has a flange 36 which is secured by means of bolts or screws 37 upon the saddle. A sheet or gasket 38 of asbestos board, or other heat-insulating material, is positioned between the saddle and the valve body. At the upper end, the valve body has a flange 39, which is bolted or otherwise fastened to a corresponding flange 40 of the hopper, so that the same can be securely mounted upon the valve.

The valve body 26 has at the upper end a flange 41 which is secured by means of bolts 42 or the like, at the under side of the saddle. A gasket 43 of asbestos or the like is introduced between the valve body 26 and the saddle. At one side, the valve body 26 has an extension 44, the sides of which are spaced, and which has associated therewith a tapered guide frame 45. The valve 46 is movably positioned between the sides of the extension 44 and the guide frame 45, and is secured at the end of a valve stem 47, which guidingly moves in a suitable opening at the end of the guide frame. The valve stem extends through the head of the boiler, into

a suitable stuffing box 48. The valve 46 is tapered, and is formed to slide in correspondingly tapered grooves 49, so that it tightly closes the opening through the valve body. When the valve is retracted as shown in Fig. 2, slag can pass freely from the lower end of the passage 32 through the passage 35, without coming in contact with the valve itself. As the passage 31 is enlarged, the slag will pass freely through the stop valve body, without coming in contact with the sides thereof, so that there is practically no danger of having particles of the slag clog the grooves 49, or otherwise interfere with the operation of the valve 46.

The valve body 25 has opposite, lateral openings 50 and 51, which are at substantially right angles to the passage 31, and which have movably arranged therein, gates 52 and 53. The gates have the inner ends beveled or tapered, and serve to close the opening 31 when they are in engagement. The gate 52 has associated therewith a head 54 secured at the outer end by means of bolts 55 or the like, and mounted at the end of a threaded stem 56. The latter has a crank 57 by means of which it can be rotated, and extends through a correspondingly threaded opening of a bracket 58. The bracket is bolted or otherwise secured at the outer flanged end of an extension sleeve 59. The sleeve 59 is bolted or otherwise secured at the side of the valve body and forms an extension of the opening 50. A gasket 60 of asbestos or the like is introduced between the sleeve 59 and the valve body. The bracket 58 has a suitable stuffing box 61, through which the stem 56 passes. Interposed between the head 54 and the gate 52, is a heat-insulating disk or plate 62, and a wear plate 63. It will be understood that when the gate 52 becomes worn or injured, it can be easily removed and replaced. The parts controlling the gate 52 are practically immune from injury by the great heat of the slag, as they are thoroughly insulated both from the valve body and from the gate. The position of the gate 52 can be exactly regulated by means of the crank 57. This permits the amount of gate valve opening to be controlled with exactness.

A sleeve 64 is bolted by means of an end flange at the opposite side of the valve body, and a suitable gasket 65 is interposed between the sleeve and the body, to insulate the former from the heat of the slag. The gate 53 has associated therewith at the outer end, an enlarged head 66, which is bolted or otherwise secured to the gate by means of an extension 67. An insulating plate 68 is interposed between the extension 67 and the gate 53. At the outer end the sleeve has mounted thereon a stuffing box 69, through which a valve stem 70, rigid with the head 11 passes. The valve stem 47 is piston-controlled by means of a cylinder 71 which has a slide valve 72 operated by a slide valve stem 73. The stem 70 is also piston-controlled by means of a cylinder 74 having a slide valve 75 operated by a slide valve stem 76. The latter is pivotally connected by means of a link 95, with a floating lever 77, the lower end of which is pivotally secured at a fixed point by means of a link 78. A rod 79 is pivoted intermediate its ends upon a support, and has an arm 80, at the end of which is movably secured a depending hanger 81. A counter-weight 82 is supported by the hanger. A bell crank lever 83 is pivoted upon a suitable support, and is operatively connected with the upper end of the lever 77. A link rod 84 is pivoted at the other arm of the bell crank, and is connected with a crank 85 of a shaft 86 having a pulley 87. A line 88 passes over the pulley 87 and over a second pulley 89 located above the hopper 27. At one end the line 88 has a float 90, consisting of fire brick or the like, which is adapted to be controlled by the molten slag in the hopper. At the other end, the line 88 has a container 91, constituting a liquid-controlled counterweight, and provided with a cock 92, by means of which it can be emptied. A supply pipe 93 is located above the container and serves for the introduction of water or other liquid into it.

Upon the stem 70 is a tappet 94 which is adapted to engage the upper end of the rod 79, to actuate the valve stem 73, which has tappets 96 adapted to be engaged by the lower end of the rod 79. When the hopper is filled with molten slag and the gates 52 and 53 are opened, and the valve 46 is retracted, a continuous flow of slag ensues, into the generator. If the supply of slag decreases and the level thereof falls in the hopper, the float 90 operates the shaft 86, which in turn, through the connecting members, moves the valve stem 76 to admit steam or other fluid under pressure, from a suitable source of supply, into the cylinder 74. The result is that the rod 70 is moved in the direction of its length, to force the gate 53 against the gate 52, to close the passage 31. The engagement of the tappet 94 with the rod 79 operates the valve 72, so that the valve 46 is also closed. It will be understood that by closing the valves successively, the inlet passage is completely drained of slag before the valve 46 is closed, and no slag can therefore fall upon the latter.

I find it necessary to employ the gate valve and the stop valve, as the gates 52 and 53 are subject to warping, owing to the intense heat resulting from the use of the molten slag, and consequently, they cannot

operate to close the inlet passage exactly. The valve 46 can always close completely, as it is not subject directly to the action of the slag, and therefore remains unwarped. It will be remembered also that the slag does not come into contact with the grooves 49.

I provide in the passage 31 a port or taphole 96, which can be opened so that through it the remnants of slag can be drained off after the gate valve is closed. This is for the purpose of preventing the slag from hardening and aggegating in the passage, owing to the cooling of the walls thereof. The port is left open for a brief time after the furnace is started again. A pipe 112 extends through the boiler head, and its discharge or outlet end is under the valve 26, so that a jet or spray of water can be forced against the slag flowing from the inlet. This assists in granulating the slag, and renders the operation of the boiler more efficient. The water may be drawn from the boiler itself, or may be drawn from any other suitable source.

In Figs. 4 and 5 I have shown a modified form of the generator, in which the body 97 thereof is substantially horizontal, and has at one end an upwardly disposed conduit 98, constituting the water-sealed leg for the conveyer. The conveyer 99 is positioned in the conduit 98 and extends horizontally from the lower end thereof, into the body of the generator. The latter has the sides inwardly offset and inclined, so that the granulated slag must of necessity settle upon the horizontal portion of the conveyer. This has suitable buckets 100 which are perforated, so that the water can drain therefrom. A feed pipe 101 serves for the introduction of the feed water into the open end of the conveyer leg. This form of the boiler has a head 102 of suitable curved form, the rim of which seats in an internal edge recess 103. A steam outlet 104 is provided in the boiler head and has associated therewith baffles 105 to drain the moisture from the steam escaping through the outlet.

The boiler head has an opening 106 over which is secured the saddle 107. The gate valve 108 is fastened upon the saddle, and under the same is mounted a stop valve 109, similar to the valve 26 of the preferred form of the boiler. The hopper 110 is mounted upon the valve 108 and receives slag from a suitable spout or chute 111. The spray pipe 113 similar to the pipe 112 is positioned under the valve 109.

The valve 108 has a passage 114 therethrough, provided with a port 115 and having the lower part 116 enlarged. It terminates at the lower end in a sleeve 117 which extends through the opening 106 of the head 102, into the passage of the valve 109. At the opposite side, the valve body has openings 118, the upper and lower terminals of which are rounded. Gates 119 are mounted to swing upon pivots 120 within the openings, and have the upper and lower ends rounded to correspond to the form of the openings 118. The curvature of the rounded portions is circular, with the pivots as centers, to permit the gates to swing inward and outward freely. The gates have inner face plates 121 separated therefrom by insulating sheets 122, secured in position by means of screws or bolts 123. Above the openings 118, the passage 114 has removable facing plates 124, separated from the valve body by insulating plates 125, and secured in position by means of screws or bolts 126. About the openings, at the outside of the valve body, are frames 127, separated from the valve body by insulating gaskets 128, and secured in position by screws or bolts 129. The frames have recesses 130 in which packing strips 131 are movably held. The packing strips are projected into engagement with the gates, by springs 132 and serve to form tight joints to prevent the escape of steam, or the entrance of air around the gates.

The gates have ears 133 to which are pivotally secured links 134 and 135. These are operatively connected with a pivoted double-armed lever 136, connected to a piston rod 137, controlled by a cylinder 138. The latter has a valve 139 operated by a valve stem 140. The latter is connected by a link 141, with a pivoted lever 142, which in turn is connected with the double-armed lever 136. A shaft 143 has a pulley 144, and a crank 145. The latter is connected by means of a rod 146, with the lever 142. A line 147 passes over the pulley 144 and a pulley 148 positioned above the hopper 110. The line, at one end, has within the hopper a float 149, and at the other a counterweight 150 similar to the counterweight 91 of the other form of the generator. The valve stem 151 of the valve 109 is piston-operated by a cylinder 152. The latter has a valve 153 actuated by a valve stem 154, provided with tappets 155 controlling a bell crank lever 156. The latter is connected by means of a link 157 with a pivoted lever 158 and has a counterweight 159. The piston rod 137 has a tappet 160 adapted to engage the lever 158.

When the hopper is filled with slag, the float 149 is in an elevated position. Should the slag fall in level, the lever 142 is operated through the connecting elements, to operate the valve 139. The cylinder consequently, receives fluid pressure from a suitable source of supply, to operate the lever 136 to close the gates. A movement of the piston rod 137 brings the tappet 160 into engagement with the lever 158, with the result

that the valve stem 154 is operated to admit fluid pressure to the cylinder 152. The resulting action is the closing of the valve 109. When slag again enters the hopper, the float rises, and the cylinder 138 is operated through its valve 139 to open the gates. At the same time, the movement of the piston rod 137 releases the lever 158 so that the counterweight 159 returns the bell crank 156 to its original position, whereupon the cylinder 152 is operated to open the valve 109.

In Figs. 9, 10, 11 and 12, I have shown a further modified form of gate valve. The body 161 of the valve has a passage 162 therethrough, the lower portion of which is enlarged. At opposite sides, the valve body has superposed, inclined openings 163, in which are movably arranged gates 164 adapted to engage at an angle to close the valve passage. Guide sleeves 165 are mounted at the sides of the valve body and are separated therefrom by insulating plates or gaskets 166. Each gate has a head 167 rigid with a stem 168. The heads are separated from the gates, by insulating plates 169. The sleeves, at the outer ends, have stuffing-boxes 170, through which the stems pass. The cylinders 171 have pistons 172 therein, which are carried at the end of the stems 168. These pass through stuffing-boxes 173 of the cylinders. The cylinders are supplied with fluid pressure from a suitable source of supply, by means of pipes 174, each of which has an end discharging at one of the cylinders, and is connected by a pipe 175, with a controlling-valve cylinder 176. The latter has slides 177, each operated by a stem 178 passing through a stuffing box 179.

The stems 178 pass through guides 180, and are held in normal positions by means of springs 181. A shaft 182 journaled in bearings 183, is continuously driven from any suitable prime mover, and has a pair of cams 184, each adapted to engage at the end of one of the stems 178, and to operate the same against the tension of the springs 181. The controlling valve cylinder has ports 185 communicating with pipes 175; and ports 186, into which the fluid pressure can enter through an inlet 187. It also has an exhaust outlet 188. The arrangement is such that the shaft 182 operates the cams 184 to actuate the slides 177 alternately. The result is that the gates 164 are alternately closed and opened. A quantity of slag enters the passage 162 when the lower gates 164 are closed, and cannot pass into the generator until the gates are opened. Thereupon the upper gates are closed and the lower gates are opened. Consequently, only so much slag at one time can enter as can fill the valve passage between the upper and lower sets of gates. By regulating the speed of operation of the shaft 182, the amount of slag fed into the generator can be controlled without difficulty.

It should be noted that the gates of the last-described form of valve, as well as the others, will not be clogged or choked by the slag which might enter at the edges of the openings in which the gates move. It is well known that slag when entering small crevices or openings of this character at once cools, and as it is very brittle, will easily be broken out when the gates are operated. As it hardens immediately upon entering the crevices, but a slight quantity can in each instance collect in the crevice.

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

1. A steam generator comprising a container for water provided with a slag inlet, a valve controlling the slag inlet and means responsive to the flow of slag for controlling the operation of said valve.

2. A steam generator comprising a container for water provided with a slag inlet, a valve for controlling the delivery of slag through said inlet and automatic means controlled by the amount of slag delivered to the inlet for controlling said valve.

3. A steam generator of the class described, comprising a container for water, a conduit communicating therewith at the bottom thereof and extending above the same, said container having its sides inclined toward the bottom, to direct slag to said conduit, a conveyer in said conduit, a feed water inlet at the upper end of said conduit, and a valve-controlled slag inlet for said body.

4. A steam generator of the class described, comprising a container for water, a water-sealed conveyer for removing slag from the bottom of said container, a valve-controlled slag inlet for said container, and automatic means for operating said inlet.

5. A steam generator of the class described, comprising a container, a water-sealed conveyer for removing slag from said container, a valve-controlled slag inlet for said container, a slag container communicating with said inlet, and float-controlled means operable by the slag in said container, for operating said inlet.

6. A steam generator of the class described, comprising a container, a water-sealed conveyer for removing slag from said container, a valve-controlled slag inlet for said container, means for automatically operating said inlet, and means for spraying water against the slag entering the generator.

7. A steam generator of the class described, comprising a container for water, a water-sealed conveyer for removing slag from said container, a valve-controlled slag inlet

for said container, means for operating said inlet, said means being controlled by the slag entering the generator, and means for introducing feed water into the generator through the water-seal of said conveyer.

8. A steam generator of the class described, comprising a container for water, a water-sealed conveyer for removing slag from said container, a slag inlet for said container, having a gate for closing the same, a second gate for closing said inlet, and automatic means for successively operating said gates.

9. A steam generator of the class described, comprising a container for water, a water-sealed conveyer for removing slag from said container, a slag inlet for said container, a gate for closing said inlet, a second gate for closing said inlet, a slag container communicating with said inlet, and means controlled by the level of the slag in said container, for successively operating said gates.

10. A steam generator of the class described, comprising a body having the sides inclined toward the bottom, a conduit communicating with said body at the bottom thereof, and extending upwardly beyond the same, a conveyer in said conduit, whereby said conveyer is water-sealed, means for introducing feed water into said conduit, a slag inlet for said body, said inlet having a gate valve and a stop valve, a slag container communicating with said inlet, means for closing and opening said gate valve and said stop valve, and a float-operable device controlled by the level of the slag in said container for controlling said valve-operating means.

11. A steam generator of the class described, comprising a body having the sides inclined toward the bottom, a conduit communicating with said body at the bottom thereof and extending upwardly beyond the same, a conveyer in said conduit and provided with perforated buckets, for removing slag from said body, means for introducing feed water into said conduit, a slag inlet for said body, said inlet having a gate valve, a stop valve, a slag container communicating with said inlet, means for closing and opening said gate valve and said stop valve, said means serving to operate said valves successively, a device for controlling said valve operating means, and a float for operating said device and controlled by the level of the slag in said container.

12. A steam generator of the class described, comprising a body, a conveyer for removing slag from said body, a slag inlet for said body, having a passage therethrough, a movable gate for closing said passage, a stop valve communicating with said inlet and having a movable valve member, means for operating said gate, means for operating said valve, said first means controlling said second means, a slag container communicating with said inlet, a float operable by the level of slag in said container, and an operative connection between said float and said gate-operating means.

13. A steam generator of the class described, comprising a body, a water-sealed conveyer for removing slag from said body, a head on said body having an opening, an inlet mounted upon said head at said opening and having a passage therethrough, said inlet having lateral openings communicating with said passage, an adjustable gate in one of said openings and adapted to be projected into said passage, a movable gate in the other of said openings and adapted to be moved toward and away from said first-mentioned gate, a stop valve communicating with said inlet and positioned under said gates, said stop valve having a movable valve member, means for operating said movable gate, means for operating said valve member, a slag container communicating with said inlet, a float operable by the level of slag in said container, an operative connection between said float and said means for operating said movable gate, said last-mentioned means serving to operate said means controlling said valve member, whereby said movable gate and said valve member are closed successively, and means for opening said valve member.

14. A steam generator comprising a container for water provided with a slag inlet, a container for slag communicating with said inlet, a valve for controlling the delivery of slag through said inlet and means controlled by the level of the slag in said slag container for controlling the operation of said valve.

15. A steam generator comprising a container for water provided with a slag inlet, a slag container communicating with said inlet, a valve for controlling the delivery of slag through said inlet and float-controlled means responsive to the variations of slag level in said slag container for controlling the operation of said inlet valve.

16. A steam generator comprising a container for water provided with a slag inlet, two valves for controlling the delivery of slag through said inlet and means for successively operating said valves automatically.

17. A steam generator comprising a container for water provided with a slag inlet, two valves for controlling the delivery of slag through said inlet and means responsive to the flow of slag to said inlet for successively operating said valves.

18. A steam generator comprising a container for water provided with a slag inlet, a slag container communicating with said

inlet, two valves for controlling the delivery of slag through said inlet and means responsive to the variations of slag level in said slag container for successively operating said valves.

19. A steam generator comprising a container for water provided with a slag inlet, a container for slag communicating with said inlet, two valves for controlling said inlet and float-controlled means responsive to the variations of slag level in said container for successively operating said valves.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM E. McKEE.

Witnesses:
B. T. VIALL,
FIELDER SLOCUM.