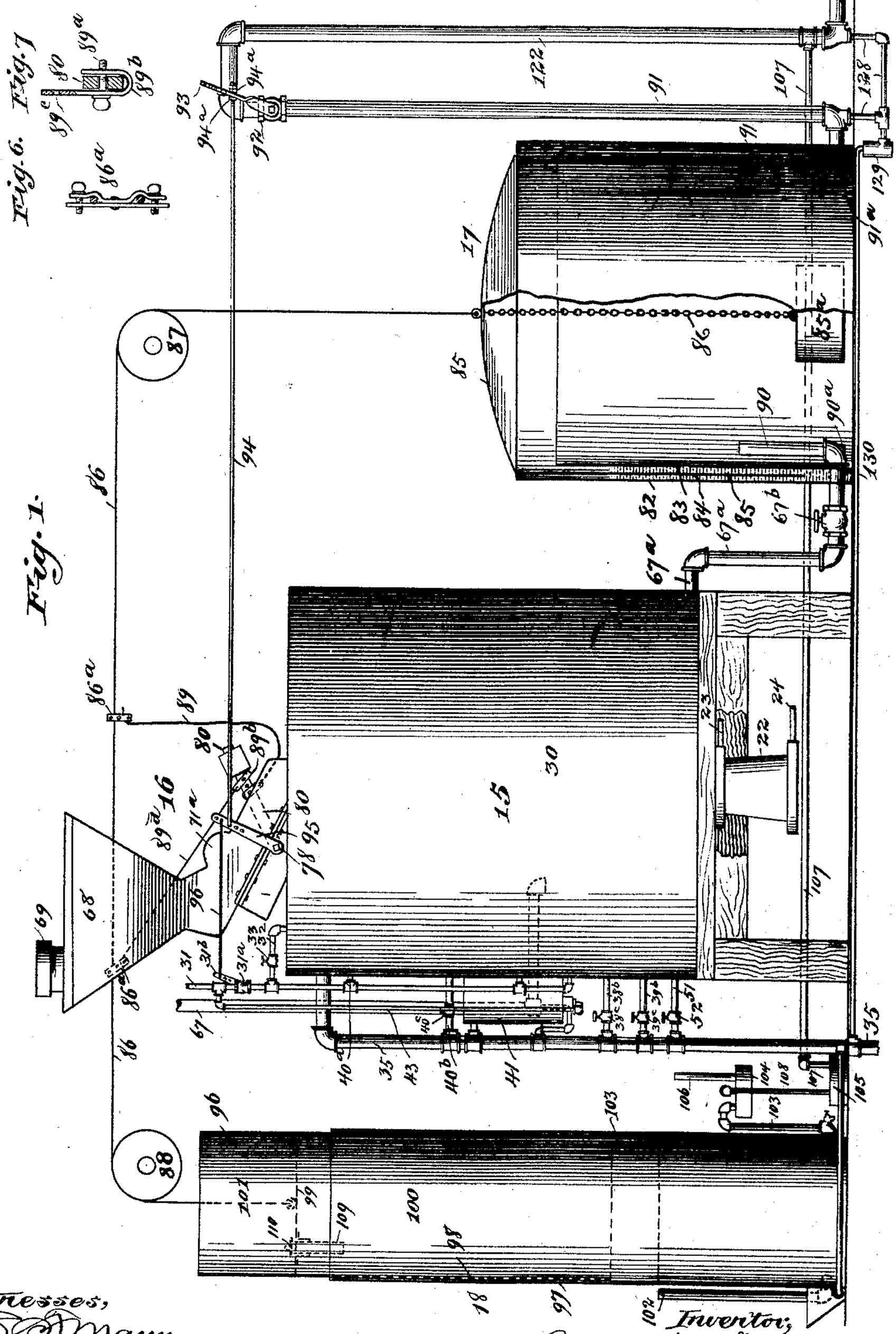
No. 719,570. PATENTED FEB. 3, 1903.

A. DAVIS.

ACETYLENE GAS GENERATOR.

APPLICATION FILED DEC. 8, 1897.

NO MODEL. 5 SHEETS—SHEET 1.



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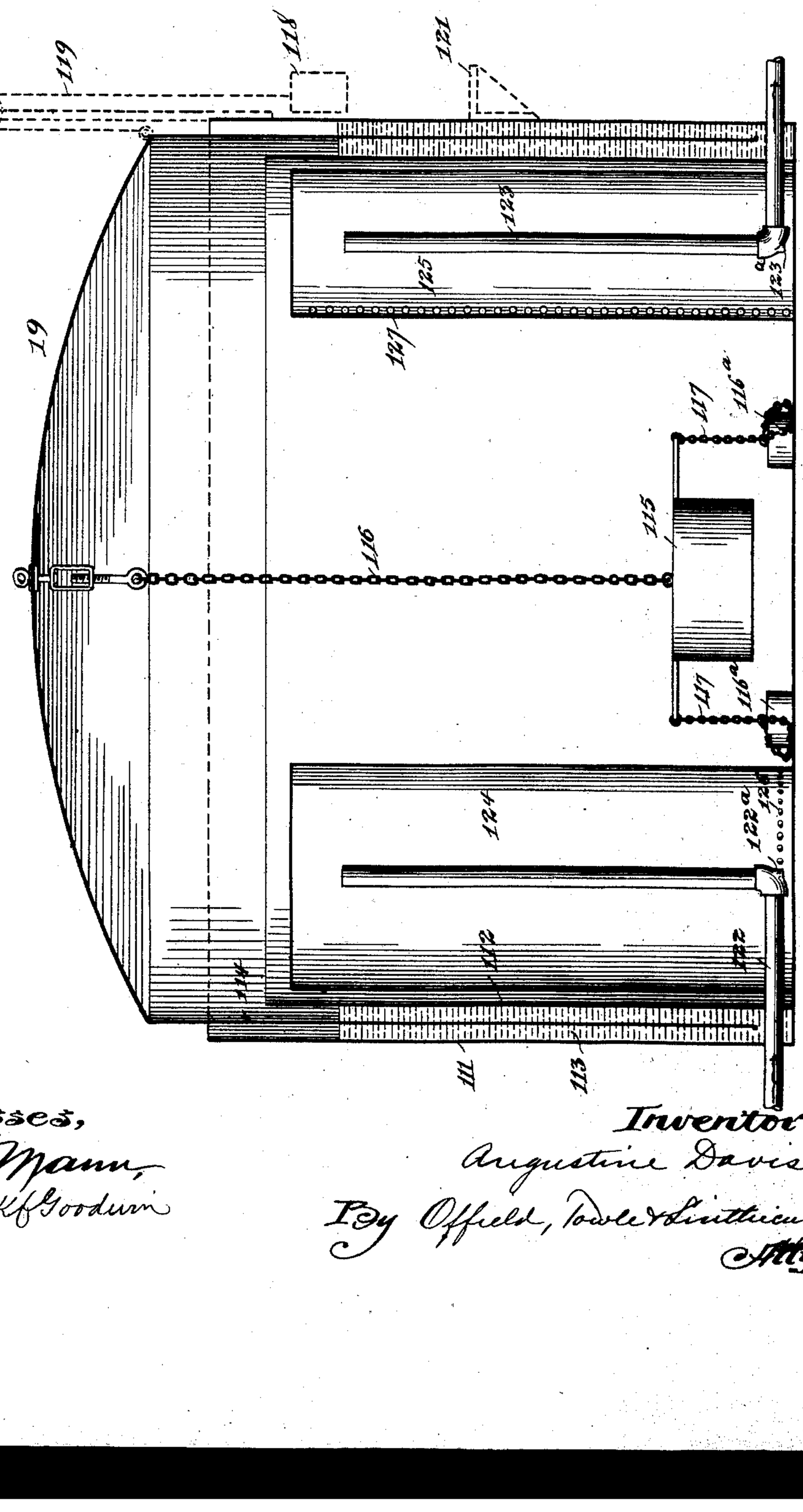
NO MODEL. 5 SHEETS—SHEET 2.

Fig. 1a.



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NO MODEL. 5 SHEETS—SHEET 3.

Fig. 7. Fig. 8. Fig. 9.

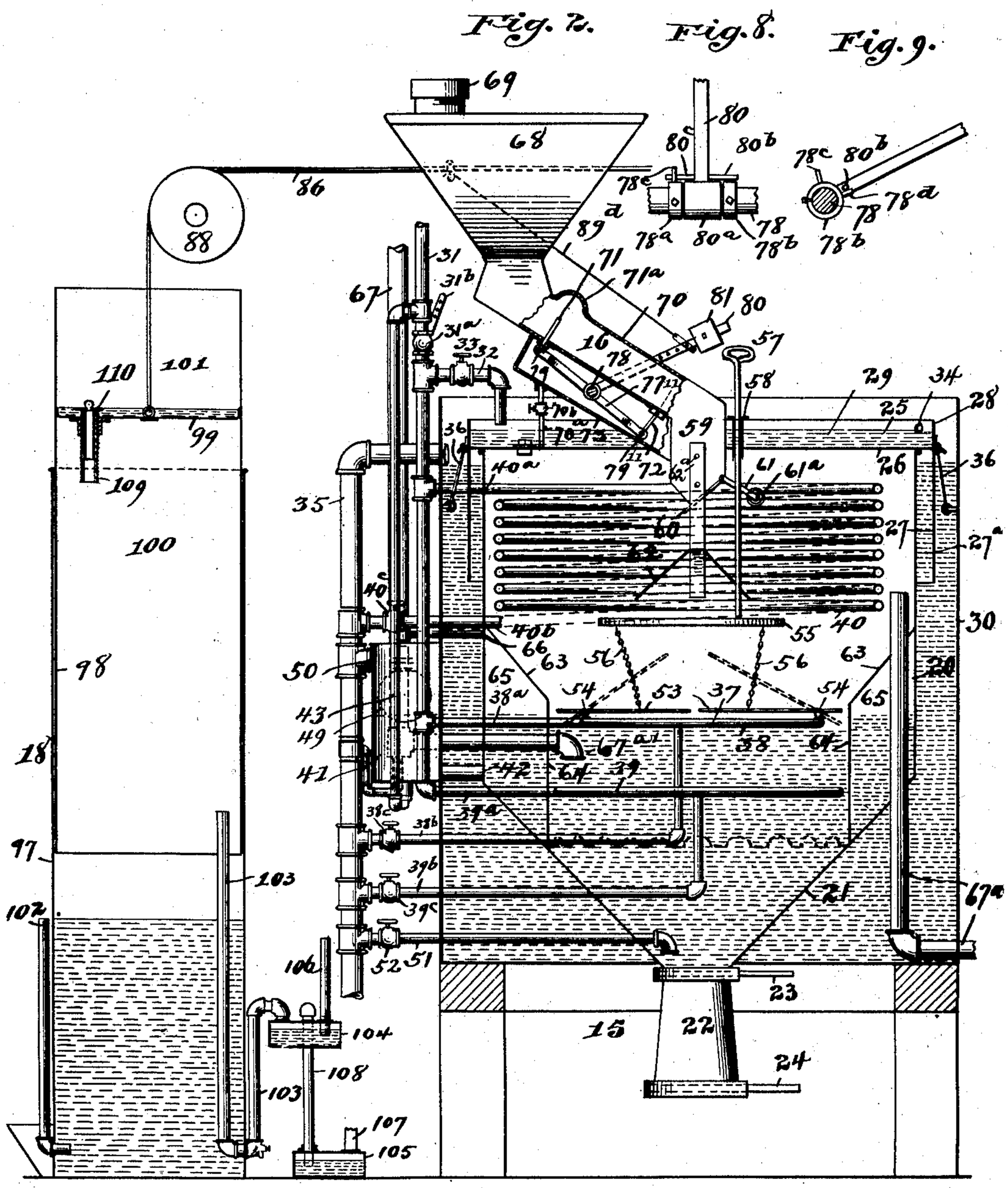
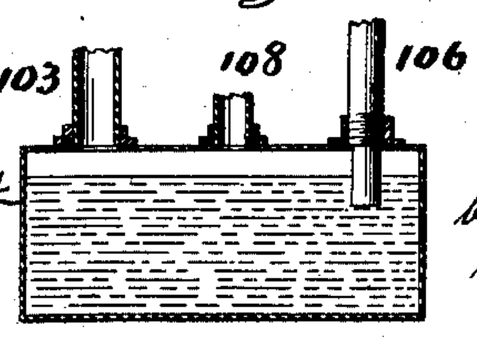


Fig. 10.



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NO MODEL. 5 SHEETS—SHEET 4.

Fig. 3.

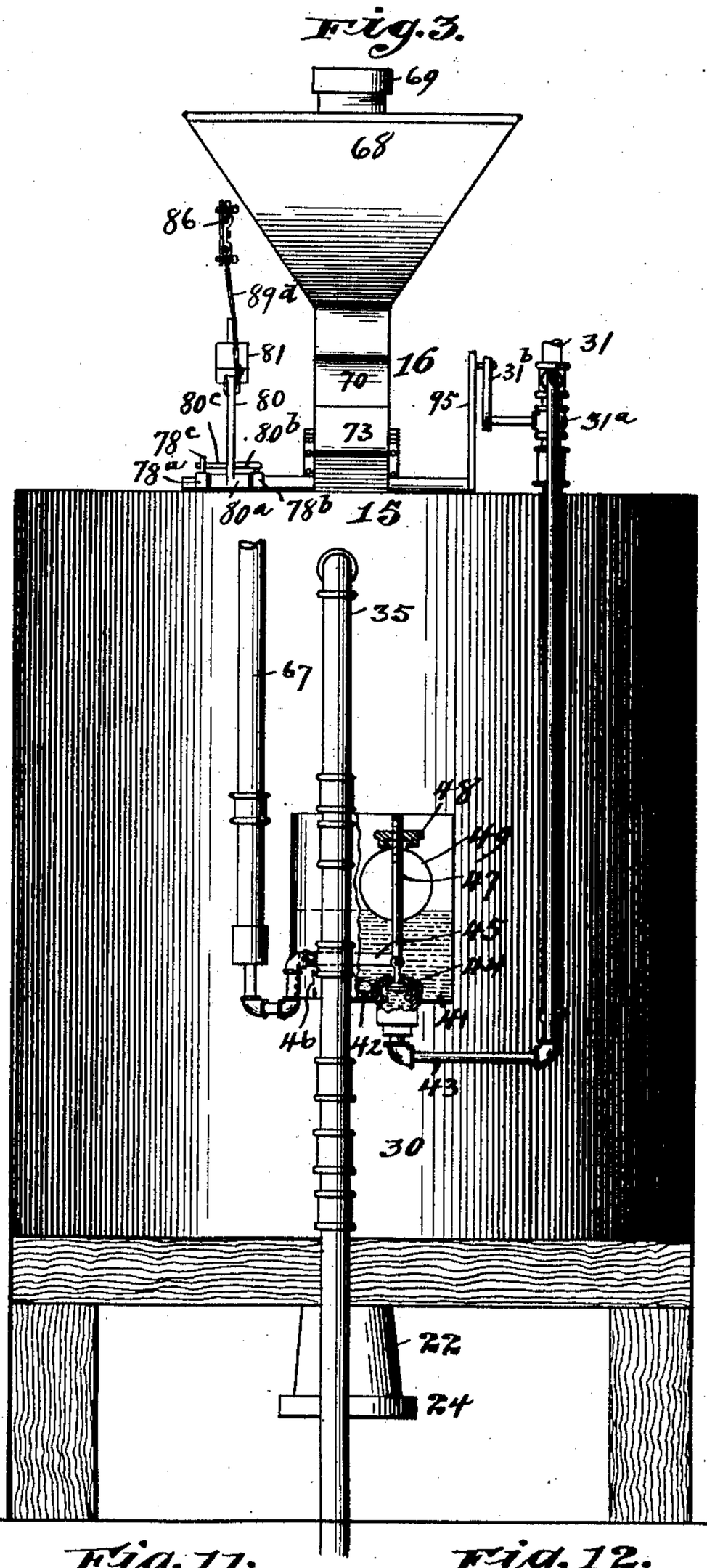


Fig. 11.

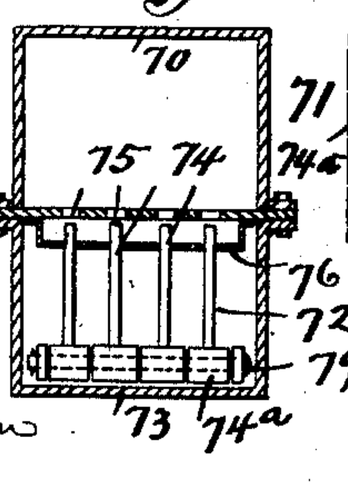
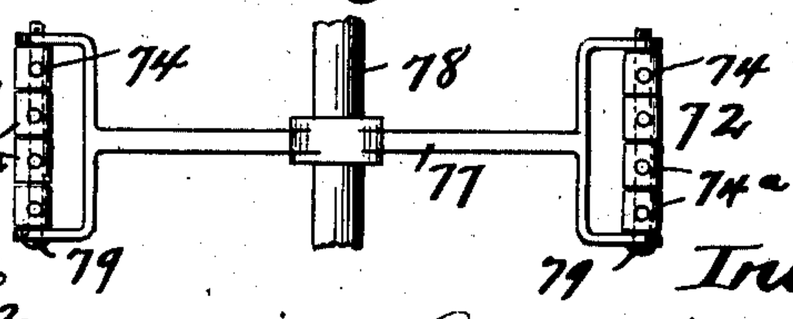


Fig. 12.



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No. 719,570. PATENTED FEB. 3, 1903.

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ACETYLENE GAS GENERATOR.

APPLICATION FILED DEC. 8, 1897.

NO MODEL. 5 SHEETS—SHEET 5.

Fig. 4.

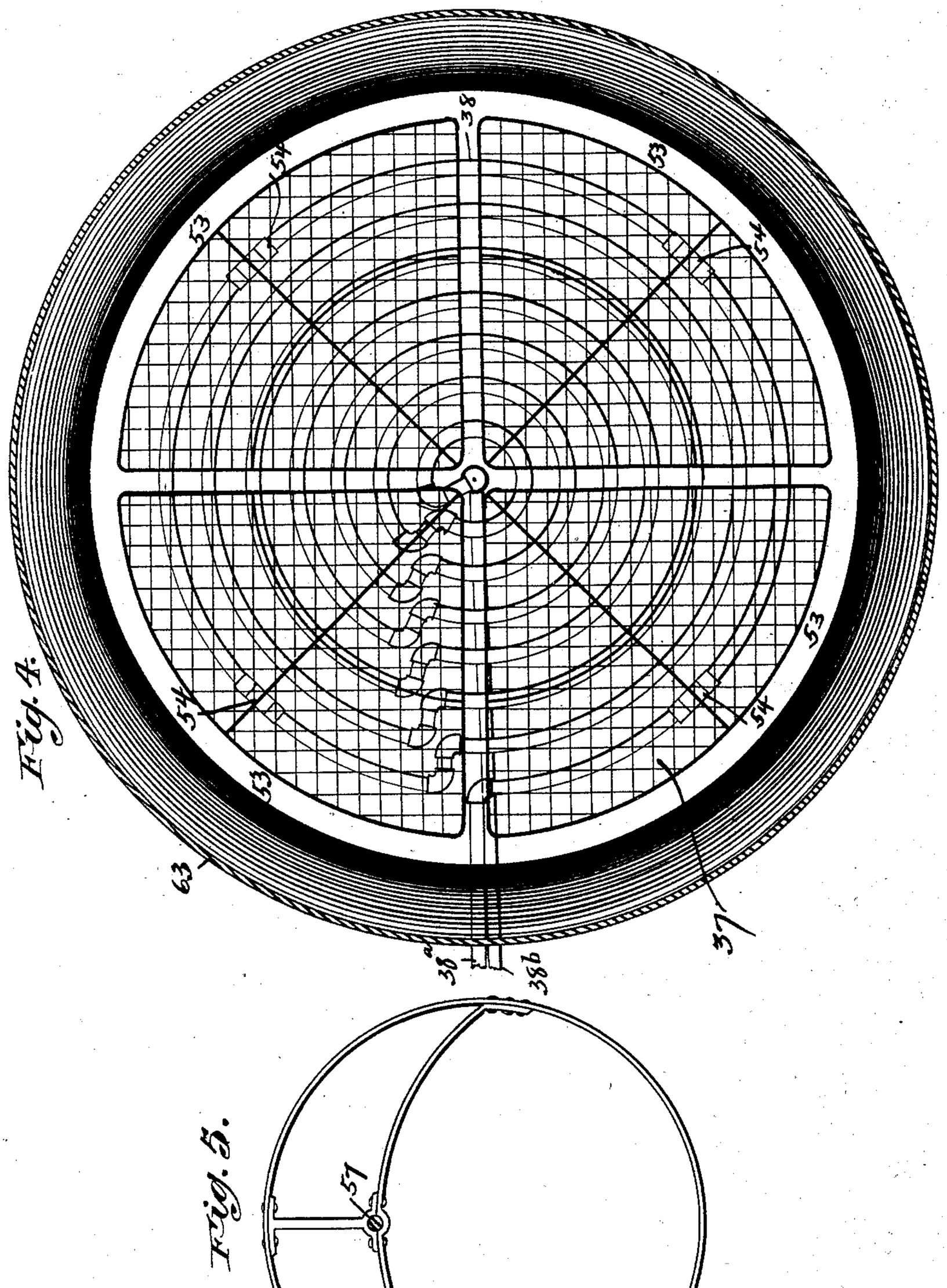

Fig. 5.

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UNITED STATES PATENT OFFICE.

AUGUSTINE DAVIS, OF CHICAGO, ILLINOIS.

ACETYLENE-GAS GENERATOR.

SPECIFICATION forming part of Letters Patent No. 719,570, dated February 3, 1903.

Application filed December 8, 1897. Serial No. 661,121. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTINE DAVIS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Generators, of which the following is a specification.

This invention relates to gas-generators, and more particularly to that class in which the gas is generated by the bringing into contact with each other of a solid—such, for instance, as calcium carbid—and a liquid, such as water.

The apparatus is devised more particularly as a generator for use in connection with a plant of considerable capacity, such as is required for large buildings or for towns.

The object of my invention is to provide an automatic continuous generator which will be certain, safe, and economical in its operation and of high efficiency. To these ends my invention consists in certain novel features which will be first described and then specifically pointed out in the claims.

In the accompanying drawings, Figures 1 and 1ª, the latter figure being a continuation of the former, show a view in elevation of an apparatus embodying my invention in one form, the motor being shown partially, and the storage-tank or gas-holder being shown wholly, in vertical section. Fig. 2 is a vertical sectional view through the generator proper, its feeding device, and the combined counterweight and air-pump. Fig. 3 is a side elevation of the generator proper, the water-supply-controlling devices being shown partly in section. Fig. 4 is a plan view of my preferred form of supporting-grate, the adjacent wall of the generator-chamber being shown in section. Fig. 5 is a plan view of the supporting-frame from which the movable grate-sections are suspended. Figs. 6 and 7 are detail views of the adjustable end connections of the connecting ropes or cables. Figs. 8 and 9 are respectively a side elevation and an end elevation showing the connection of the weighted lever with its shaft. Fig. 10 is a detail sectional view through a portion of the air-pump valve system. Fig. 11 is an enlarged detail sectional view through the feeding apparatus, taken on the line 11 11 of Fig. 2; and Fig. 12 is a detail plan view of the vibrating frame of the feeding apparatus detached.

In the said drawings, referring first to Figs. 1 and 1ª, the apparatus therein shown as a whole comprises a generator proper, 15, a feeding apparatus thereof, 16, a motor 17, controlling the feeding apparatus, a combined counterweight and air-supply pump 18, connected and operating in conjunction with the motor and feeding apparatus, and a storage-tank or gas-holder 19.

I will first describe the generator proper, which comprises a closed vessel or chamber 20, having a conical or inclined bottom 21, terminating in a residuum-chamber 22, provided with a valve 23 at its end adjacent to the bottom of the generator-chamber and a second valve 24 at its lower end, provision being thus made for the removal of the residuum from the generator-chamber without interrupting the process of manufacture of the gas and without material loss of the gas.

The generator-chamber 20 is closed at its top by a cover 25, comprising a diaphragm 26, which rests upon the upper edge of the generator-chamber 20 and is provided with a downwardly-extending flange 27 and an upwardly-extending flange 28. The flange 27 is of greater diameter than the external diameter of the generator-chamber 20, so as to leave a space 27ª between the two, and the upwardly-extending flange 28 forms, in conjunction with the diaphragm 26, a water-chamber 29, extending over the top of the generator-chamber 20.

The generator-chamber 20 is surrounded by or located within a tank or vessel 30, adapted to contain water and form a water-jacket therefor, and water is supplied to this tank with a water-supply pipe 31, which has a branch 32, controlled by a valve 33 and extending over and discharging into the water-chamber 29, from which the water is permitted to overflow into the water-jacket tank 30, one or more outlet-openings 34 being provided in the flange 28 for this purpose, if desired. The water is maintained at a constant height in the water-tank 30 by means of a drain or outlet pipe 35, which opens into said tank at or near the upper end of the generator-chamber 20. The water in the tank 30 entering the

space 27ª between the flange 27 and the body of the generator-chamber 20 forms a water seal, which will prevent the escape of gas from the generator-chamber. The cover 25 of the generator-chamber is held in place by any suitable means, and I have shown as one means for that purpose hooks 36, which connect the tank 30 and said cover and which may be readily disconnected for the purpose of permitting the removal of the cover.

Within the generator-chamber 20 I provide, at a point slightly below the normal water-line thereof, a perforated support (designated as a whole by 37) to receive the carbid or other solid employed in the generation of the gas. This support is preferably so constructed as to render it possible to pass through the lower element thereof a current or currents of water or other fluid for the purpose of preventing too high a degree of heat in this part of the generator. To these ends I prefer to construct the body or main portion of said support of a hollow material, such as piping, and preferably in the form of a flat spiral coil 38, lying in a horizontal plane, as shown in detail in Fig. 4, in which 38ª indicates the inlet end of the coil connected to the water-supply pipe 31, and 38ᵇ the outlet end of the coil connected to the waste-pipe 35 and provided with a controlling-valve 38ᶜ. This device constitutes the grate-support for the sectional grate, hereinafter described, and by this construction a current of cold water or other fluid cooling medium may be continuously passed through the body of the support and an excessive temperature at this point thereby prevented. As an additional means for preventing too high a temperature within the generator proper I locate within said generator at a point below the grate-support 38 a coil of pipe 39, which may be similar in construction to the coil 38 and which is connected at one end with the water-supply pipe 31 by means of a pipe 39ª, said coil being connected at its other end with the waste-pipe 35 by means of a pipe 39ᵇ, provided with a regulating-valve 39ᶜ. The coils 38 and 39 are located within the generator-chamber below the normal water-line thereof and serve to reduce the temperature of this portion of the apparatus during the generation of the gas. As a means for reducing the temperature of the gas itself and of the upper portion of the generator-chamber I locate therein a pipe 40, which is preferably a spiral coil of cylindrical form, its inlet end 40ª being connected with the water-supply pipe 31 and its outlet end 40ᵇ being connected with the waste-pipe 35 and provided with a controlling-valve 40ᶜ.

It is obvious that the controlling-valves of the several cooling devices described may be located at points adjacent to the supply-pipe, as in the case of the water-jacket, instead of adjacent to the waste-pipe, as in the case of the coils, the purpose of these valves being merely to regulate the amount of the flow and not to cut off or open up the supply of water. This latter feature—to wit, the cutting off and opening up of the supply of water to the several cooling devices described—is accomplished by means of a valve 31ª, located in the water-supply pipe 31 at a point nearer the source of supply of water than the connection therewith of any one of said cooling devices, but farther from the said source of supply than the connection with said pipe 31 of the pipe, hereinafter described, which provides for the water-supply to the interior of the generator-chamber. The valve 31ª is provided with a lever 31ᵇ, by means of which it may be operated, and it will be seen that when said valve is open water is supplied to all of the cooling devices and when said valve is closed the supply of water to said cooling devices is cut off, while at the same time the opening and closing of this valve in no wise affects the supply of water to the interior of the generator-chamber.

Water is supplied to the interior of the generator-chamber 20 from a regulating-tank 41 through a pipe 42, extending between the said tank and chamber. A water-supply pipe 43, leading from the main water-supply pipe 31 at the point hereinbefore described, opens into the bottom of said tank and is there provided with a valve 44, adapted when moved upward to close said water-supply pipe and to open the same when moved in the opposite or downward direction. This valve has its stem pivoted to a lever 45, which is itself pivoted at its other end to a support 46 in the tank and which carries at its free end a float-rod 47, threaded to receive an adjusting-nut 48, which carries a float 49 and by means of which said float may be adjusted vertically upon the float-rod.

50 indicates a waste or overflow pipe for the tank 41, connecting with the main waste-pipe 35, and 51 indicates a waste-pipe leading from the lower part of the generator-chamber to the main waste-pipe 35 and provided with a valve 52, by means of which water may be drawn from the generator-chamber at any desired rate for the purpose of renewing the water in said chamber or for other purposes.

I have found in practice that the solid material employed in generators of this class is unequal in character and sometimes dissolves only partially, leaving large lumps of the material undissolved, which lumps, if allowed to remain, would soon clog the perforated support 37. For the purpose of removing this debris or residuum from the perforated support I construct this latter so that portions of it may be tilted at an angle to the normally horizontal position. In the construction shown in Figs. 2 and 4 I have shown as a means for accomplishing this a grate disposed above the coil 38 and composed of sections 53, which sections are in the shape of separate or independent sectors, pivoted at 54 to the pipe of which the coil is composed, so as to be capable of being tilted into the inclined position indicated in dotted lines in Fig. 2. These

sectors are composed of any suitable perforated or foraminous material, and in the construction shown they are constructed of wire gauze or netting supported on a metallic framework. In order to operate these sections simultaneously from the exterior of the generator, I employ any suitable means—such, for instance, as those shown in the drawings, in which 55 indicates a frame annular in form, from which the several sections are suspended by means of flexible connections 56, and 57 indicates a rod secured at its lower end to the frame 55 and extending upward through a suitable stuffing-box 58 in the top of the generator-chamber, said rod being provided externally with a hand-grasp or other suitable means whereby it may be operated. The rod 57 is located eccentrically with respect to the generator-chamber, as indicated in Figs. 2 and 5, in order that the central part of said chamber may be left free for the feeding apparatus and its adjunctive devices. It will be seen that by pulling upward on the rod 57 the several sections of the grate may be inclined or tilted, so as to cause the large lumps of residuum to roll off of said sections and be discharged, while by lowering said rod the grate-sections will return to their normal horizontal position after having been thus cleared.

The carbid or other solid is fed into the generator-chamber from above at about the center of the same by the means hereinafter described through a suitable chute 59, which is normally closed by means of a hinged valve or door 60, provided with an arm 61, having a counterweight 61ª for the purpose of holding said valve closed. The counterweight is adjustable, so as to regulate the operation of the valve to permit the passage of the charges of carbid. Below the mouth of the chute 59 there is located in the generator-chamber 20 a conical distributer 62, upon which the solid falls from said chute and by means of which it is distributed over the grate, said distributer being supported by rods or stays 62ª or the like. Coöperating with this distributer is an inclined deflector 63, extending inward and downward from the wall of the chamber below the distributer and above the grate, and from the lower edge of this deflector there extends downward an annular wall 64, which forms, in conjunction with said deflector and with the wall of the generator-chamber, an annular chamber 65, which extends below the lowest normal water-level within the generator-chamber and which is adapted to receive the water from the body of the generator-chamber upon the increase of gas-pressure therein. For the purpose of permitting the water to rise and fall in the chamber 65, said chamber is connected with the outer air by means of a pipe 66, which forms a vent for said chamber and which is preferably connected with the safety escape-pipe 67. This latter is a pipe of comparatively large diameter, having a downwardly-opening mouth 67ª, located at a point in the generator-chamber a suitable distance below the normal water-line thereof and extending in the present instance first laterally outward and then upward to a suitable point of discharge. In case of an abnormal or sudden increase of pressure in the generator-chamber, owing to too rapid or extensive generation of gas, the water in the generator-chamber will be depressed below the level of the mouth of this pipe, and the excess of gas will at once escape through said pipe, thus relieving the generator-chamber and obviating an excess of pressure therein.

67ª indicates the gas-outlet pipe, by means of which the gas is conducted from the generator-chamber under normal conditions.

The feeding apparatus whereby the solid is automatically fed to the generator comprises a hopper or reservoir 68, adapted to receive the carbid or other solid, which is charged therein in lumps of a suitable size. The hopper 68 is provided with a suitable gas-tight closure 69, through the opening of which it may be charged.

70 indicates an inclined chute connected at its upper end with the hopper 68 and at its lower end with the chute 59. In the chute 70 operate two alternately-acting cut-off gates 71 and 72, arranged a suitable distance apart, so that the space between them within the chute will contain the quantity of carbid or other solid proper to constitute the desired amount for a single charge for the generator. In the construction shown these cut-off gates operate from below through the inclined bottom of the chute 70, and there is provided below said inclined bottom a casing 73, in which the actuating mechanism of the gates is contained. I prefer to construct these gates in the manner shown in detail in Figs. 11 and 12 of the drawings, in which each gate is composed of a plurality of pins or fingers 74, adapted to be projected and withdrawn through apertures 75 in the bottom of the chute 70 and passing through guides 76 below said apertures to insure their engagement therewith when raised. These gates are mounted on opposite ends of a vibrating frame 77, which is itself secured on a rock-shaft 78, mounted in suitable bearings in the casing 73 and actuated in the manner hereinafter described. When the gates are composed of pins or fingers in the manner illustrated in the present instance, I prefer to connect them pivotally to the frame 77, and for this purpose I provide at each end of the frame a transverse shaft or axis 79, on which the hubs 74ª of the pins or fingers 74 are pivotally mounted. The rock-shaft 78 has mounted on it a lever 80, provided with a weight 81, adjustable thereon and sufficiently heavy to operate not only the feeding apparatus, but the other parts hereinafter specified.

In practice I prefer to effect the connection between the lever 80 and the rock-shaft 78 in the manner indicated in detail in Figs. 8 and 9 of the drawings, in which the lever is shown

as having a hub 80^a, by means of which it is loosely mounted on the shaft 78 and is provided with laterally-projecting pins 80^b and 80^c. The rock-shaft 78 has adjustably secured on it at each side of the hub of the lever 80 collars 78^a and 78^b, provided, respectively, with pins 78^c and 78^d, the position of which may be adjusted as desired by the adjustment of the collars around the rock-shaft. These pins are respectively in the path of the pins 80^b and 80^c of the lever 80, so that the lever in its movement in one direction will engage one of said pins during the latter portion of said movement and operate the rock-shaft in one direction, while during the latter portion of its movement in the opposite direction it will engage the other of said pins, and thereby move the rock-shaft in the other direction.

A small pipe 70^a, controlled by a valve 70^b, connects the generator-chamber and the chute 70 and serves to equalize the pressure on the opposite sides of the valve or door 60, so as to permit it to open and allow the passage of the charges of slag.

In order to prevent the operation of the gates 71 and 72 from being arrested by clogging of the chute 70, I provide in the upper wall of said chute, above the gate 71, a recess or bay 71^a, into which any excess of material which may lodge on top of the gate 71 may pass, so as to permit said gate to rise and complete its upward movement.

The lever 80 is operated by means of the motor 17, which comprises an outer cylinder 82 and an inner cylinder 83, forming between them a water-space 84 to receive the inverted bell or piston 85 of the motor, said bell or piston being provided, if necessary, with a suitable weight 85^a, suspended therein, and being connected by a suitable connection and preferably, as shown, by means of a cable, rope, chain, or other flexible connection 86 passing over pulleys 87 and 88 to the counterweight and air-pump 18 and intermediately to the lever 80 by means of a connecting device 89, such as a cable, rope, cord, wire, or other flexible connecting device. In the construction shown the connection between the parts 86 and 89 is an adjustable one, and in Fig. 6 of the drawings I have shown a double clamp 86^a for connecting these two parts, the construction of which will be readily understood without detail description, and which clamp may be readily connected to either of the two parts at any desired point. The connection between the part 89 and the lever 80 is also an adjustable one, and in Fig. 7 I have shown a simple construction for effecting this adjustment, the lever 80 being provided with a plurality of apertures to receive a bolt 89^a, by means of which a clip 89^b may be secured thereto at any desired point, its other end being apertured, as shown at 89^c, to receive the end of the rope or cord 89. In practice I prefer to employ a double connection between the lever 80 and the cable 86, and in the drawings I have shown a second connecting device 89^d, similar to the flexible connecting device 89 and adjustably connected to the lever 80 and cable 86 by the same means set forth in describing the connections of the part 89.

90 indicates the gas-inlet pipe of the motor, which is connected to and forms a continuation of the gas-outlet pipe 67^a of the generator-chamber, and there is provided at a point between said motor and generator-chamber a valve 67^b in said pipe, by means of which the connection between said generator-chamber and motor may be regulated or entirely cut off. The inlet-pipe 90 is provided at its bottom with an opening 90^a, by means of which any moisture or water of condensation in said pipe or in the pipe 67^a may be permitted to escape into the motor-cylinder.

91 indicates the gas-outlet pipe of the motor, which is provided at its lower portion with an opening 91^a, through which any moisture or water of condensation in the motor-cylinder may pass into the pipe 91, from which it will be drawn in the manner hereinafter described. The gas-outlet pipe 91 is provided with a controlling-valve 92, which is operated by means of a lever 93, connected by a rod 94 to a lever 95 on the rock-shaft 78. The connections of the rod 94 are adjustable at both ends, the lever 95 being provided with a plurality of apertures, with either one of which the adjacent end of the rod 94 may engage, and the lever 93 being similarly provided with a series of apertures, with either one of which the other end of the rod 94 may be engaged. This end of the rod 94 is threaded, as shown in Fig. 1, and provided with nuts 94^a, which are located on opposite sides of the lever 93 and by means of which the length of the rod 94 between the levers 93 and 95 may be adjusted.

96 indicates a rod, one end of which is connected to the lever 95 on the rock-shaft 78, while its other end is connected to the lever 31^b of the valve 31^a in the water-supply pipe 31, the end connections of the rod 96 being also adjustable in the manner indicated.

The combined air-pump and counterweight 18 comprises a cylinder 97, within which slides vertically a second cylinder 98, which is open at its lower end and is provided some distance below its upper end with a transverse diaphragm 99, forming in said cylinder 98 an air-chamber 100 below said diaphragm and a water-chamber 101 above said diaphragm. The inner cylinder 98 is connected with the cable 86, so as to move in unison with the bell of the motor 17, for which it forms a counterweight. The cylinder 97 is adapted to contain water, the height of which is determined by means of an overflow or waste pipe 102 and which serves to seal the open lower end of the cylinder 98 during the principal part of its air-forcing movement.

103 indicates an air inlet and outlet pipe, the mouth of which within the cylinders 97

and 98 is above the level of the water in the cylinder 97 and which is provided externally of said cylinders with water-seal valves 104 and 105. One of these water-seal valves connects with the air-inlet pipe 106 and the other with the air-outlet pipe 107, the former of which is open to the atmosphere, while the latter extends to the gas-holder or to a pipe in open connection therewith. In Fig. 10 I have shown in detail the water-seal valve 104. In this construction it will be seen that the body of said valve comprises a chamber containing water or other suitable liquid at such a height therein as to leave an air-space between the said liquid and the top of the chamber. The pipe 103 opens into the top of said chamber above the water-line thereof and the air-inlet pipe 106 extends down into said chamber below the water-line thereof.

108 indicates a pipe which extends from the air-space in the water-seal valve 104 downward to the water-seal valve 105, while the air-outlet pipe 107 opens into the air-space of said last-mentioned valve-chamber.

It will be seen that upon the upward movement of the cylinder 98 the air will be exhausted or partially exhausted in the valve-chamber 104, and air will be drawn into said chamber through the pipe 106 and thence through the pipe 103 into the interior of the cylinders 97 and 98. The vertical distance of the chamber 104 above the chamber 105 is such that the exhausting of the air in the chamber 104 will not be sufficient to raise the water in the connecting-pipe 108, the air entering through the pipe 106 at a less pressure than is necessary to effect this lift. Moreover, back pressure of the gas through the air-outlet pipe 107 is resisted by the column of water rising in the pipe 108 and prevents backflow of the gas, the water-seal valve 105 thus acting as a check-valve and being efficiently gas-tight. Downward movement of the cylinder 98 forces the air through the pipes 103 and 108, which are connected by the air-space in the valve-chamber 104, the pipe 106 being sealed by the immersion of its end in the liquid contained in the valve-chamber 104, and the air which is forced down through the pipe 108 rises through the water in the valve-chamber 105 and is forced out through the outlet-pipe 107 to the gas-holder.

In the diaphragm 99 there is mounted so as to be vertically adjustable therein an outlet-pipe 109, which by the adjustment of its height above said diaphragm determines the amount of water contained in the water-chamber 101 above said diaphragm, this amount being sufficient to normally counterbalance the moving parts of the gas-motor. This outlet-pipe is controlled by a valve 110, and by closing said valve the amount of water in the water-chamber 101 may be increased by any desired quantity, this increase being readily got rid of when desired by opening said valve 110, when the amount of water in the chamber 101 will again become normal.

The gas-holder or storage-tank 19 comprises an outer cylinder 111 and an inner cylinder 112, forming between them a water-space 113 to receive the bell 114 of the holder. These parts may, however, be constructed in any well-known manner, so as to provide an efficient gas seal for the vertically-movable valve. In case of a bell of light weight I add to the normal weight of the bell by suspending therein a weight 115 by means of a chain 116 or in any other suitable manner, and I provide for adding an excess of weight to the bell of the gas-holder when it has reached a predetermined point by means of additional weights 116ª, which may be suspended from the weight 115 by means of chains or other flexible connections 117 or which may be suspended directly from the bell by flexible connections of such length that the weights will be picked up at the desired time. In the case of a bell of large dimensions, and consequently of sufficient weight to require counterbalances, I effect the same result of increasing the weight of the bell or its resistance to the internal pressure at a given point in the manner shown in dotted lines at the right hand of Fig. 1ª. In this construction the bell is provided with the usual counterweights 118, provided with flexible connections 119, passing over pulleys 120 to the bell. In the line of travel of a portion or all of these counterweights I provide brackets 121, upon which said counterweights will rest when the bell has reached the point in its upward motion for which the apparatus is adjusted.

122 indicates the gas-inlet pipe of the gas-holder, which is connected to or forms a continuation of the gas-outlet pipe 91 of the motor. There is provided in the lower portion of this inlet-pipe, within the gas-holder, an opening 122ª to permit any moisture or water of condensation in the holder to pass into the pipe 122, from which it is drawn in the manner hereinafter set forth.

123 indicates the gas-outlet pipe of the holder, by means of which the gas is withdrawn therefrom as required for use and from which it passes, either directly or through a suitable purifier, to the service-pipe.

The interior of the gas-holder is provided with chambers 124 and 125, surrounding and inclosing the gas inlet and outlet pipes, respectively, and preferably formed by means of cylinders closed at their upper ends, as shown in Fig. 1ª. Outlet-openings 126 in the lower portion of the chamber 124 cause the incoming gas to pass into the body of the gas-holder at the lower portion thereof, and similar openings 127 in the wall of the chamber 125, at various heights therein, permit the gas to pass from the body of the gas-holder into said chamber at various points between its top and bottom. By this means a proper circulation of the gas within the holder during its passage from the inlet to the outlet pipe is assured. The gas-outlet pipe 123 is provided in its lower portion with an aper-

ture 123ª, by means of which any moisture or water of condensation in the said pipe may escape into the gas-holder.

It will be observed that the pipes 91 and 122 are carried upward a suitable distance in order to bring the valve 92 into a position where its operating mechanism may be readily connected thereto. I connect the bottom of these pipes by means of drain-pipes 128 to a liquid-sealed trap 129, from which a drain-pipe 130 leads to the main waste-pipe 35 of the system, as shown in Fig. 1. It will be seen that all of the pipes of the system which connect with the motor and gas-holder, as well as the motor and gas-holder themselves, are drained through the pipes 128 and 130 and the water-sealed trap 129 in such manner that the accumulations of water in the system are properly disposed of, while at the same time the escape of gas is prevented.

The apparatus thus constructed operates in the following manner: The carbid of calcium or other solid material to be employed is placed in the hopper or reservoir 68, and this latter is closed by means of its closure 69, so as to prevent escape of the gas. The material will pass down through said hopper until arrested by the gate 71, if this latter be elevated, in which case the feeding mechanism is operated by hand until the gate 71 is depressed and the gate 72 raised, so that the space in the chute 70 between said gates becomes filled with the solid material. The frame 77 is then again vibrated by hand, whereupon the charge of material lying in the chute 70, between the two gates thereof, will pass down through said chute and through the chute 59 into the generator-chamber. When the gate 72 is lowered, the gate 71 is elevated, and thus cuts off the material above said gate and permits only the predetermined charge to pass to the generator-chamber. When the charge passes down through the chute 59, the valve 60, opening automatically for the purpose of allowing the charge to enter the generator-chamber and closing automatically by reason of the weight 61ª after the charge has passed, thereby prevents moisture from the generator-chamber from having access to the carbid contained in the feeding-chutes and reservoir. The charge falls upon the distributer 62 and by means of it and of the deflector 63 is distributed over the grate. The water in the generator-chamber stands at such a height as to cover the grate and extend a short distance above the same, this height being controlled in an obvious manner by means of the float 49 in the tank 41 operating the valve 44 of the water-supply pipe 43. When the carbid comes in contact with the water in the generator-chamber, generation of gas immediately takes place, and as this proceeds a gas-pressure is obtained in said chamber, which as it increases lowers the level of the water in the body of said chamber with relation to the grate therein, and thus decreases the rapidity of generation. When the water is lowered in the body of the generator-chamber by reason of the increase in gas-pressure therein, the excess of water is forced upward into the annular chamber 65, and upon a decrease in the pressure in the body of the generator-chamber this water returns to the body of the generator-chamber. Any excess of water in the tank 41 due to the pressure in the generator will escape through the waste-pipe 50, and any deficiency in the water-supply due to such escape or to other causes will be supplied by the opening of the valve 44 when the float 49 descends by gravity below the predetermined water-line. The gas thus formed in the generator-chamber and occupying the upper portion thereof is cooled by means of the coil 40 therein, while the temperature at the point of contact of the water and carbid is kept at a low point by the passage of water through the hollow grate-support and through the coil 39 below said grate-support. A further cooling is effected by means of the water-jacket surrounding the generator-chamber and contained in the water-chamber 29 in the top of the generator-chamber. It should be stated that at the time when the charge is fed into the generator-chamber the parts are in such a position that the controlling-valve 31ª of the water-supply pipe 31 is open, so that during the actual generation of the gas water is being continuously supplied to the several cooling devices of the generator. During this period the valve 92 of the outlet-pipe of the motor 17 is closed. The gas passes from the generator-chamber through the pipes 67ª and 90 into the interior of the motor 17, and since the valve 92 of the outlet-pipe of said motor is closed the bell or piston 85 of said motor will move upward, and at the same time the counterweight at the other end of the cable 86 will move downward, and by means of the connection 89ª the lever 80 will be carried upward until it reaches a position slightly beyond the vertical, whereupon its weight 81 will carry said lever over into a position the reverse of that shown in the drawings. This movement of the lever by reason of the engagement of one of its pins with the pin on one of the collars of the rock-shaft 78 will oscillate said rock-shaft, so as to depress the gate 71 and raise the gate 72, whereupon the material in the reservoir 68 will pass down along the chute 70 and fill the space between the two gates with another charge of the material. The oscillatory movement of the rock-shaft 78 serves also to simultaneously open the gas-outlet valve 92 of the motor and to close the water-valve 31, which controls the water-supply to the cooling devices. It will be understood, of course, that the outlet-pipe 109 of the water-chamber 101 has been so adjusted as to retain in said chamber a sufficiently great quantity of water to counterbalance the weight of the moving parts of the motor, and during the downward movement of the cylinder or bell 98 this portion of the

apparatus acts as an air-pressure pump, the air in the chamber 100 thereof below the diaphragm 99 being forced out through the pipes 103, 108, and 107 to the gas-holder. The amount of air thus supplied at each stroke may be regulated by the height of the waste-pipe 102, which controls the height of the water in the cylinder 97, and consequently the capacity of the air-chamber 100. When the valve 92 has been opened in the manner hereinbefore described, the gas in the motor 17 passes through the pipes 91 and 122 to the gas-holder, and during this escape of the gas from the motor the piston or bell thereof moves downward, while at the same time the bell or cylinder 98 of the counterweight moves upward, thereby drawing a fresh supply of air into the air-chamber 100 thereof through the inlet-pipe 106 in the manner hereinbefore described. This downward movement of the motor continues until by reason of the connection 89 between the cable 86 and the lever 80 this latter has been carried up again to a vertical position and slightly beyond said position, whereupon said lever falls back into its original position, which is that shown in the drawings. This movement of the lever closes the gas-outlet valve 92 of the motor, opens the water-supply valve 31^a for the cooling devices, and at the same time depresses the gate 72 to permit another charge of carbid to pass into the generator-chamber, and raises the gate 71 to cut off the flow of carbid from the reservoir 68. The parts are now in their original position, and the cycle of operations just described will continue to be automatically performed by the apparatus until sufficient gas has accumulated in the gas-holder to raise the bell thereof to the point previously determined upon, at which time resistance is increased either by the picking up of the additional weights 116^a or by the arresting of the downward movement of its counterbalance-weights 118 by the brackets 121. Upon this increase in the resistance of the bell of the gas-holder the pressure of the gas in said holder will be increased to a point in excess of the weight of the bell or piston of the motor, and the latter will remain stationary at its upper limit of motion, thereby arresting the further operation of the feeding mechanism, and consequently the generation of gas, until the pressure of the gas in the holder has been reduced to the predetermined point by consumption or otherwise, whereupon the bell or piston of the motor will again descend, and the cycle of operations and generation of gas will proceed in the manner already described. When the supply of material in the reservoir or hopper 68 has become exhausted and it is necessary to recharge the same, this recharging may be accomplished without permitting the escape of gas during said operation by effecting this recharging when the bell or piston of the gas-motor is at its lowest point, when by closing the pipe 109 by means of the valve 110 and filling the water-chamber 101 of the cylinder 108 with water sufficient to overcome the weight of the bell or piston of the gas-motor this latter will be caused to move upward and during its upward movement will partly exhaust the gas in the generator-chamber, so that when the closure 69 of the reservoir 68 is open for the purpose of recharging said reservoir a current of air will pass inward through the said reservoir and its connecting-chutes, thereby preventing the escape of gas during the operation of recharging the machine. The valve 110 is then opened and the surplus water in the chamber 101 allowed to flow out. Any residuum which gathers upon the grate may be discharged therefrom by tilting the sections thereof by means of the mechanism provided for that purpose, whereupon the large debris, which would otherwise tend to clog the grate by accumulating thereon, will be discharged and fall to the bottom of the generator-chamber, and the valve 23 being opened the residuum will collect in the chamber 22, from which it may be withdrawn at any time without interrupting the operation of the apparatus by closing the valve 23 and opening the valve 24.

It will be seen that by reason of the provision made for preventing excess of temperature at the point of generation I am enabled to keep the generation under control, since it is not necessary in the use of my apparatus to drop the solid material directly into the water to prevent too high a temperature. Moreover, the gas thus produced at a comparatively low temperature is further cooled by the other provisions made to that end, and it is therefore not only of high efficiency, but is very pure, and therefore not liable to clog the pipes and burners nor to explode, while at the same time it is very economically produced. The apparatus is automatic in its action, regulating and adjusting itself to the demand or consumption and the various parts thereof being capable of such adjustments as are required by the varying circumstances under which the apparatus may be required to operate. The variations in pressure due to the controlling of the motor by the gas-holder are so slight as to be practically imperceptible and do not affect the pressure in the service-pipes to a materially disadvantageous extent.

I have hereinabove described an apparatus which embodies my invention in one form; but I do not wish to be understood as limiting myself to the details of construction described, and shown in the drawings, as it is obvious that various structural features may be modified and even entirely omitted without departing from the principle of my invention.

I claim—

1. In an apparatus of the character described, the combination, with a generator-chamber containing a liquid, a feeding mechanism for automatically supplying the solid to said liquid in predetermined quantities, and

a motor actuated by the variations of the volume of gas generated for operating said feeding mechanism, of a counterbalance moving in conjunction with said motor and adapted to supply air under pressure to the gas-holder, substantially as described.

2. In an apparatus for generating gas by the union of a solid and a liquid, the combination, with a generator-chamber containing the liquid, of a grate-support located therein, a grate mounted on said grate-support to receive the solid, said grate-support being composed of hollow members, and means whereby water or other cooling medium may be caused to flow through the interior of said members, substantially as described.

3. In an apparatus for generating gas by the union of a solid and a liquid, the combination with a generator-chamber containing the liquid, of a grate-support located within said generator-chamber comprising a hollow body portion, pivoted grate-sections disposed above the same and adapted to receive the solid, means for rocking said grate-sections, and means for circulating a cooling medium through the interior of said hollow body portion, substantially as described.

4. In an apparatus for generating gas by the union of a solid and a liquid, the combination with a generator-chamber containing the liquid, of a grate-support located within said generator-chamber comprising a coil of pipe connected to a water-supply and provided with a water-discharge, a grate supported thereon consisting of a plurality of perforated sector-shaped sections pivotally mounted near their outer edges, and means accessible at the exterior of the generator-chamber for tilting said sections, substantially as described.

5. In an apparatus for generating gas by the union of a solid and a liquid, the combination with a generator-chamber containing the liquid, of a grate and a hollow support located therein slightly below the liquid-level, a coil of pipe located within the generator-chamber immediately below said grate-support, and means whereby a cooling medium may be caused to pass through said grate-support and said coil, substantially as described.

6. In an apparatus for generating gas by the union of a solid and a liquid, the combination with a generator-chamber containing the liquid in its lower portion, of a grate and a hollow support therefor located in said chamber slightly below the liquid-level, a coil of pipe located within the generator-chamber above the liquid therein, and means whereby a cooling medium may be caused to pass through said grate-support and said coil, substantially as described.

7. In an apparatus for generating gas by the union of a solid and a liquid, the combination with a generator-chamber containing the liquid, of a grate located therein to receive the solid and a grate-support composed of hollow members, a coil of pipe located within the generator-chamber below said grate and its support and below the liquid-level, a coil located in the upper portion of the generator-chamber above the liquid-level, and means whereby water or other cooling medium may be caused to flow through the interior of said grate-support and said coils, substantially as described.

8. In an apparatus of the character described, the combination, with the generator-chamber and reservoir, of an intermediate inclined feed-chute, separated cut-off gates or valves, each composed of a plurality of pins or fingers, the bottom of the chute having apertures through which said pins or fingers may be projected and withdrawn, and an oscillating frame on which said pins or fingers are pivotally mounted, substantially as described.

9. In an apparatus of the character described, the combination, with the reservoir and generator-chamber and the intermediate chute, of separated cut-off gates or valves adapted to be projected into and withdrawn from said chute, an oscillating frame on which said cut-off gates or valves are mounted, a rock-shaft carrying said oscillating frame and provided with projecting pins, a weighted lever having pins to engage those of the rock-shaft, and means controlled by the variations in the volume of the gas generated for actuating said lever in opposite directions, substantially as described.

10. In an acetylene-gas generator, the combination of a vessel adapted to contain water, a gasometer which receives the gas, a feed device for supplying the generator at intervals with carbid, a chute which connects the feed device with the generator, and a valve within said chute a distance below the feed device and above the water-line, adapted to be opened by the weight of the entering carbid but normally closing the chute to prevent the escape of gas and rising of moisture from the generator, substantially as described.

11. In an apparatus for generating gas by the union of a solid and a liquid, the combination, with a generator-chamber containing the liquid, and mechanism for feeding the solid thereto in predetermined quantities, of a motor for said feeding mechanism actuated by the pressure of the gas generated, a reservoir or holder, a connecting-pipe between the motor and gas-reservoir, and a valve in said connecting-pipe controlled by the movement of the motor, substantially as described.

12. An apparatus for generating gas by the union of a solid and a liquid, comprising a generator-chamber containing a liquid, feeding mechanism for automatically feeding the solid to said liquid, a motor operatively connected to said feeding mechanism and actuated by the variations of the volume of the gas generated, and a counterbalance provided with a water-chamber and a vertically-adjustable outlet-pipe controlling the minimum amount of water in said chamber, substantially as described.

13. In an apparatus of the character described, the combination, with the generator-chamber, a feeding mechanism therefor, and its motor, of a combined counterbalance and air-pump, comprising a fixed cylinder containing a liquid, a vertically-adjustable outlet-pipe for determining the height of said liquid, and a valved air inlet and outlet pipe, and a movable cylinder actuated from the motor, mounted in said fixed cylinder and provided with a diaphragm forming an air-chamber below and a water-chamber above, substantially as described.

14. An apparatus for generating gas by the union of a solid and a liquid, comprising a generator-chamber containing a liquid, feeding mechanism for automatically feeding the solid to said liquid, a motor operatively connected to said feeding mechanism and actuated by the variations of the volume of the gas generated, and a counterbalance provided with a water-chamber, a vertically-adjustable outlet-pipe controlling the minimum amount of water in said chamber, and a valve controlling said outlet-pipe, substantially as described.

15. In an apparatus of the character described, the combination, with a generator-chamber containing the liquid and provided with cooling devices, of feeding mechanism for intermittently supplying the solid to said generator-chamber, a water-supply pipe for said cooling devices provided with a controlling-valve, and connecting mechanism between said controlling-valve and the feeding mechanism, whereby said valve is opened to supply water to the cooling devices when the feeding mechanism discharges its supply and is closed upon the return movement of the feeding mechanism, substantially as described.

16. In an apparatus of the character described, the combination, with a generator-chamber containing the liquid and provided with cooling devices, of feeding mechanism for supplying the solid to said generator-chamber, a motor actuated by the variations of the volume of the gas generated for operating said feeding mechanism, and a water-supply pipe for the cooling devices provided with a controlling-valve connected and operating in unison with the motor and feeding mechanism, substantially as described.

17. In an apparatus of the character described, the combination, with the generator-chamber and its feeding mechanism, of the motor having an outlet-pipe provided with a controlling-valve, and an oscillating shaft provided with a weighted arm and operatively connected with the feeding mechanism and said controlling-valve to positively operate the two in unison, substantially as described.

18. In an apparatus of the character described, the combination, with the generator-chamber and its feeding mechanism, of the motor and its counterbalance, said motor having an outlet-pipe provided with a controlling-valve, and an oscillating shaft provided with a weighted arm connected to the motor and counterbalance, and operatively connected with the feeding mechanism and controlling-valve, substantially as described.

19. In an apparatus of the character described, the combination, with the generator-chamber provided with cooling devices having a water-supply pipe provided with a controlling-valve, feeding mechanism for feeding the solid to the generator-chamber, and a motor for actuating said feeding mechanism adapted to be operated by the variations of the volume of the gas generated, and having an outlet-pipe provided with a controlling-valve, of an oscillating shaft rotating in opposite directions in unison with the reciprocations of the motor, and operatively connected with the feeding mechanism and with the controlling-valves of the water-supply pipe and the gas-outlet pipe of the motor, substantially as described.

20. In an apparatus of the character described, the combination, with a generator-chamber, a feeding mechanism therefor, and a motor for said feeding mechanism adapted to be operated by the variations of the volume of the gas generated, of a reservoir or storage-tank connected with the motor by a pipe or conduit and provided with a vertically-moving bell or inverted cylinder, and means for automatically increasing the weight or resistance of said bell at a predetermined point to prevent the escape of gas from the motor, and thereby arrest its operation, substantially as described.

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Witnesses:
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