O. H. ENSIGN.

GAS MAKING APPARATUS.

APPLICATION FILED FEB. 25, 1907.

907,688.

Patented Dec. 22, 1908.

3 SHEETS—SHEET 1.

Fig. 1.

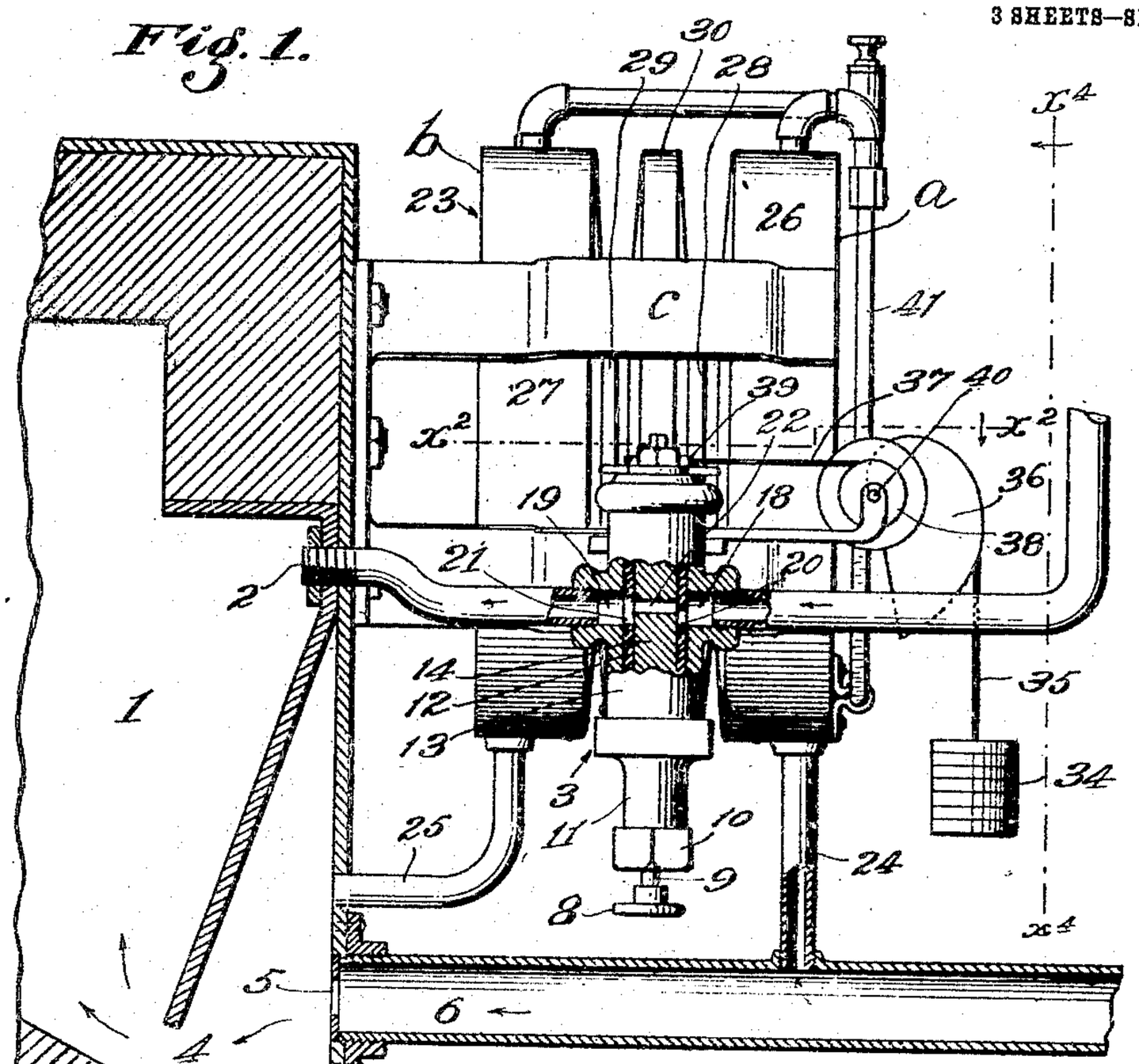


Fig. 3.

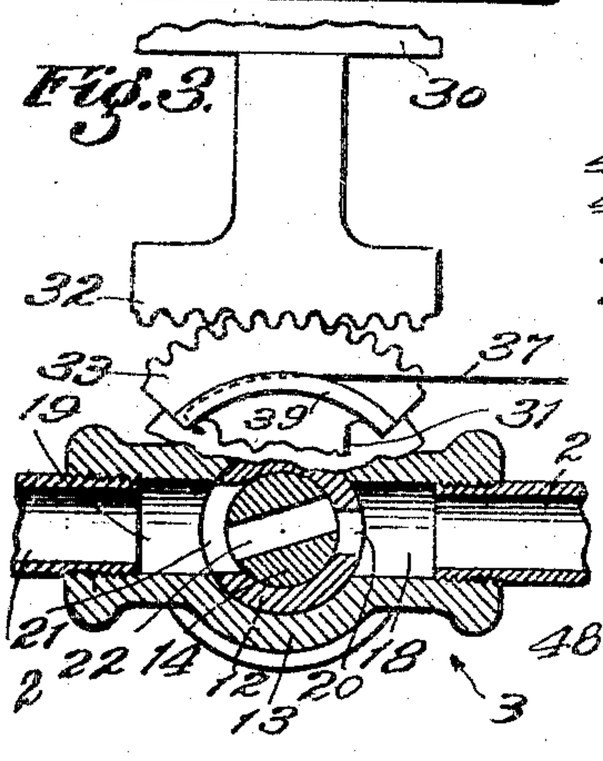
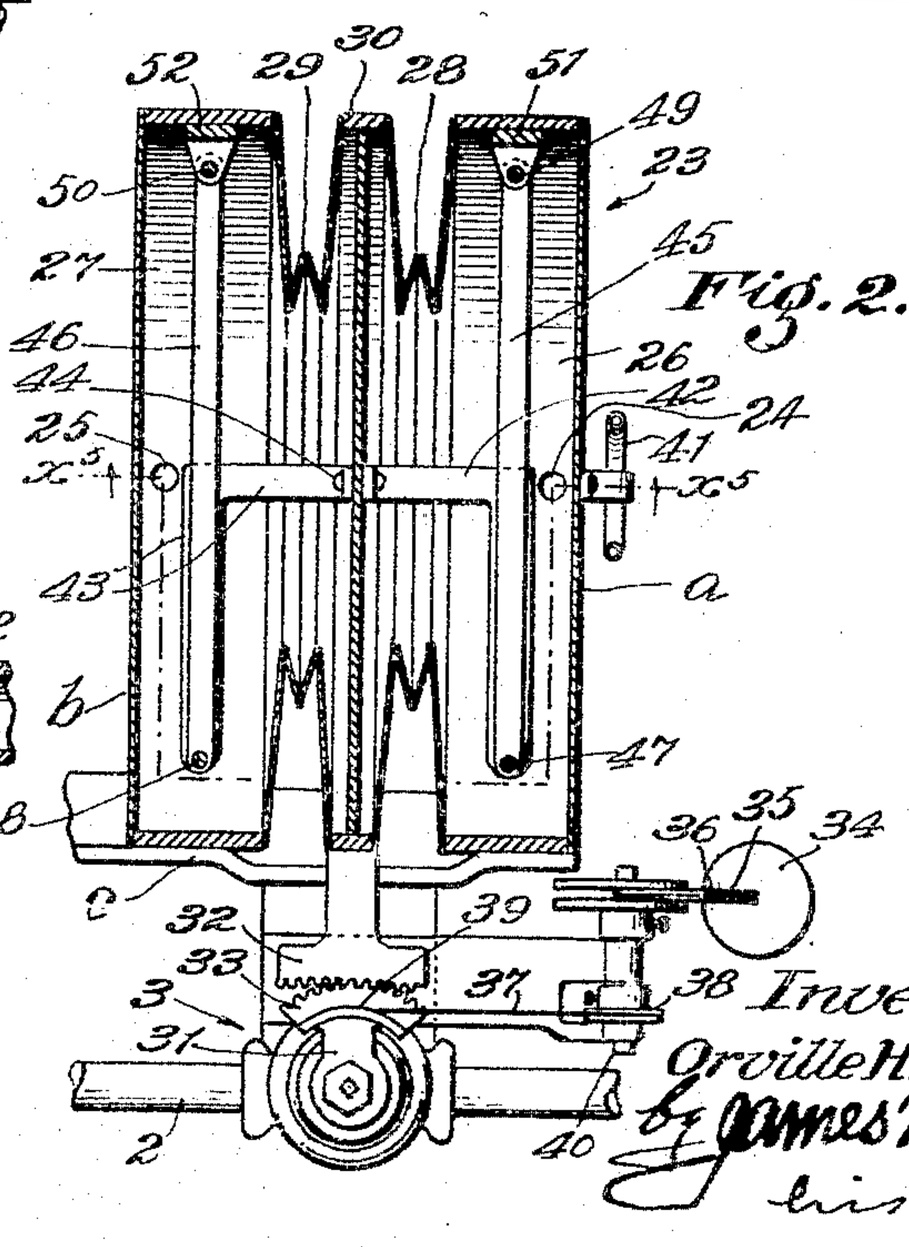


Fig. 2.



Witnesses

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3 SHEETS—SHEET 2.

Fig. 4

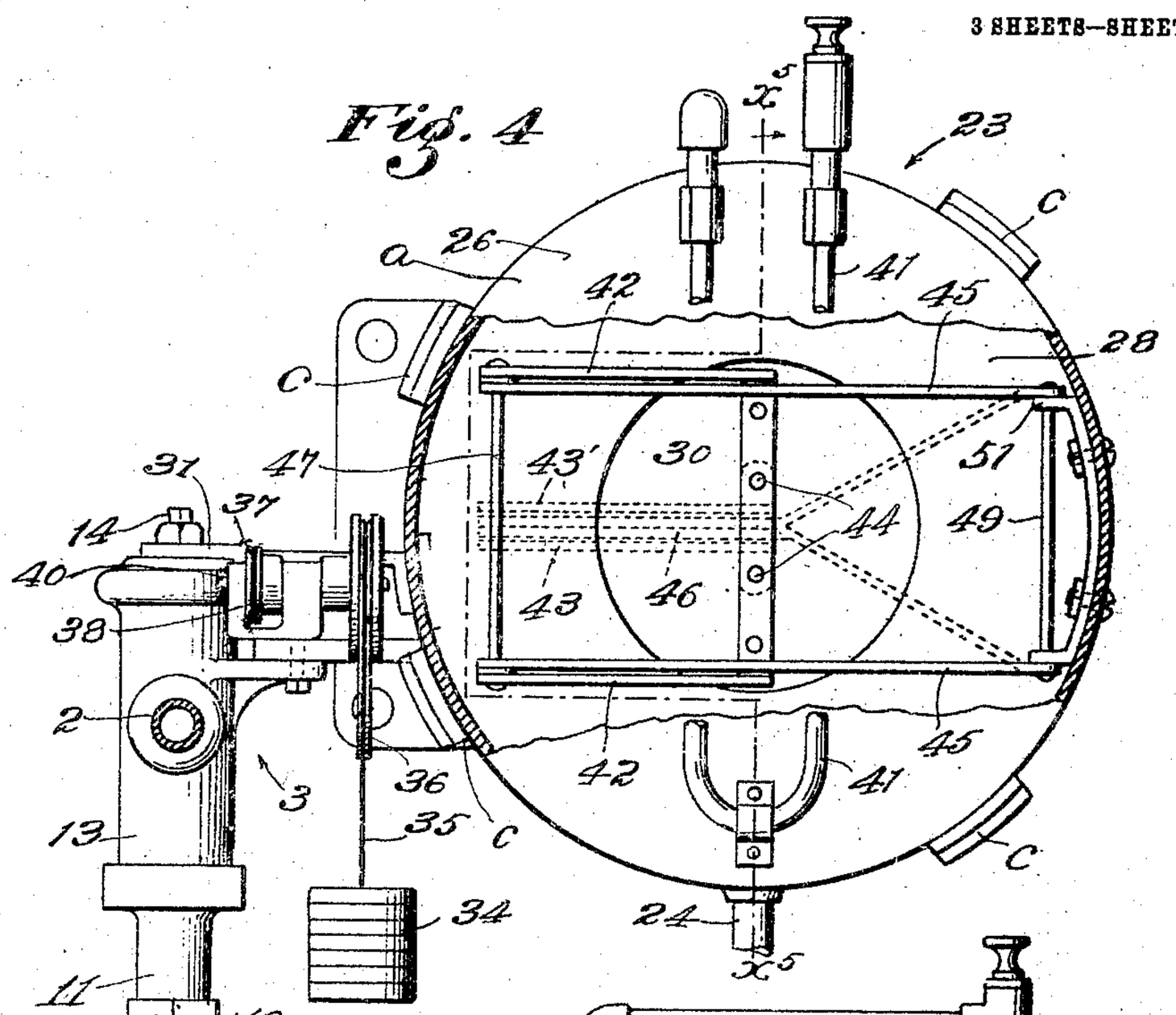
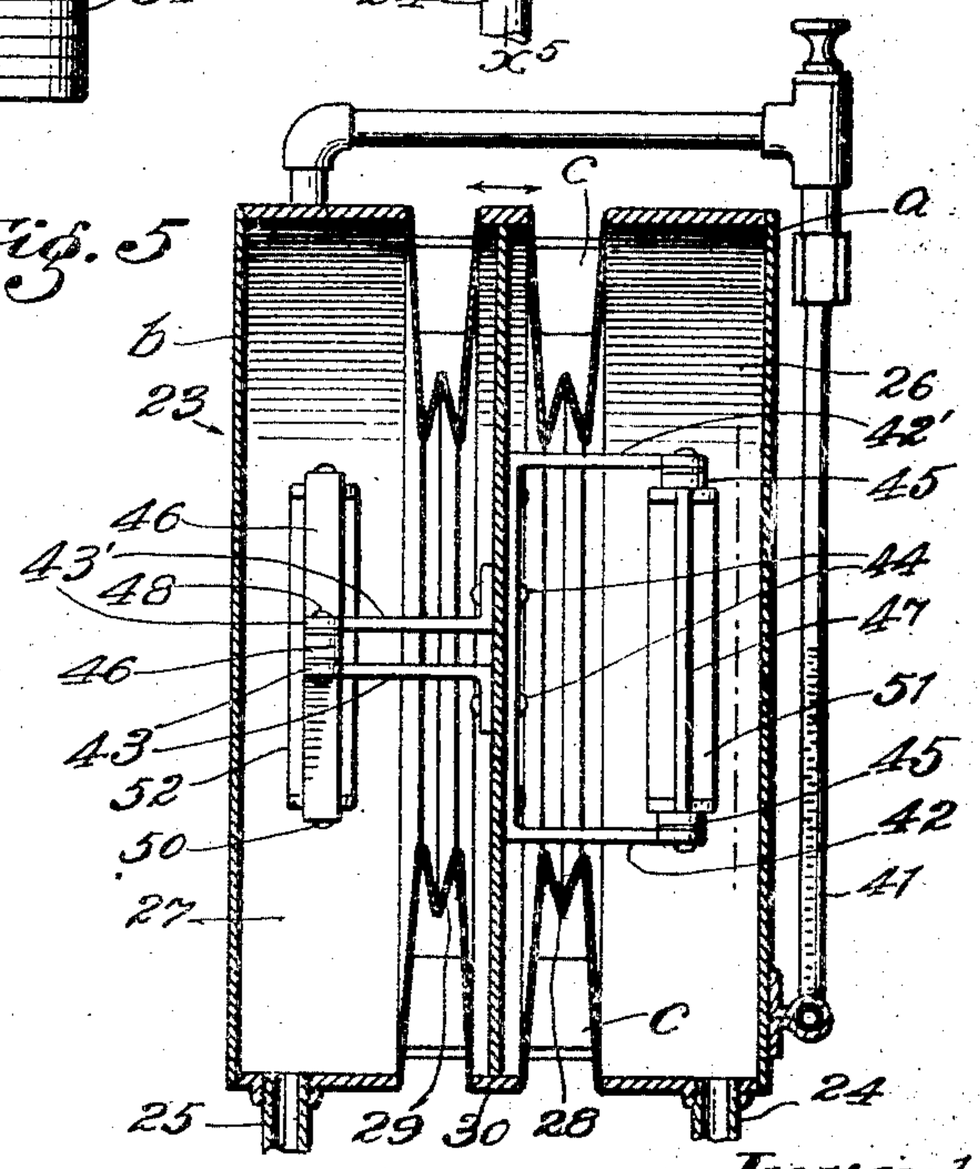


Fig. 5



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3 SHEETS—SHEET 3.

Fig. 6.

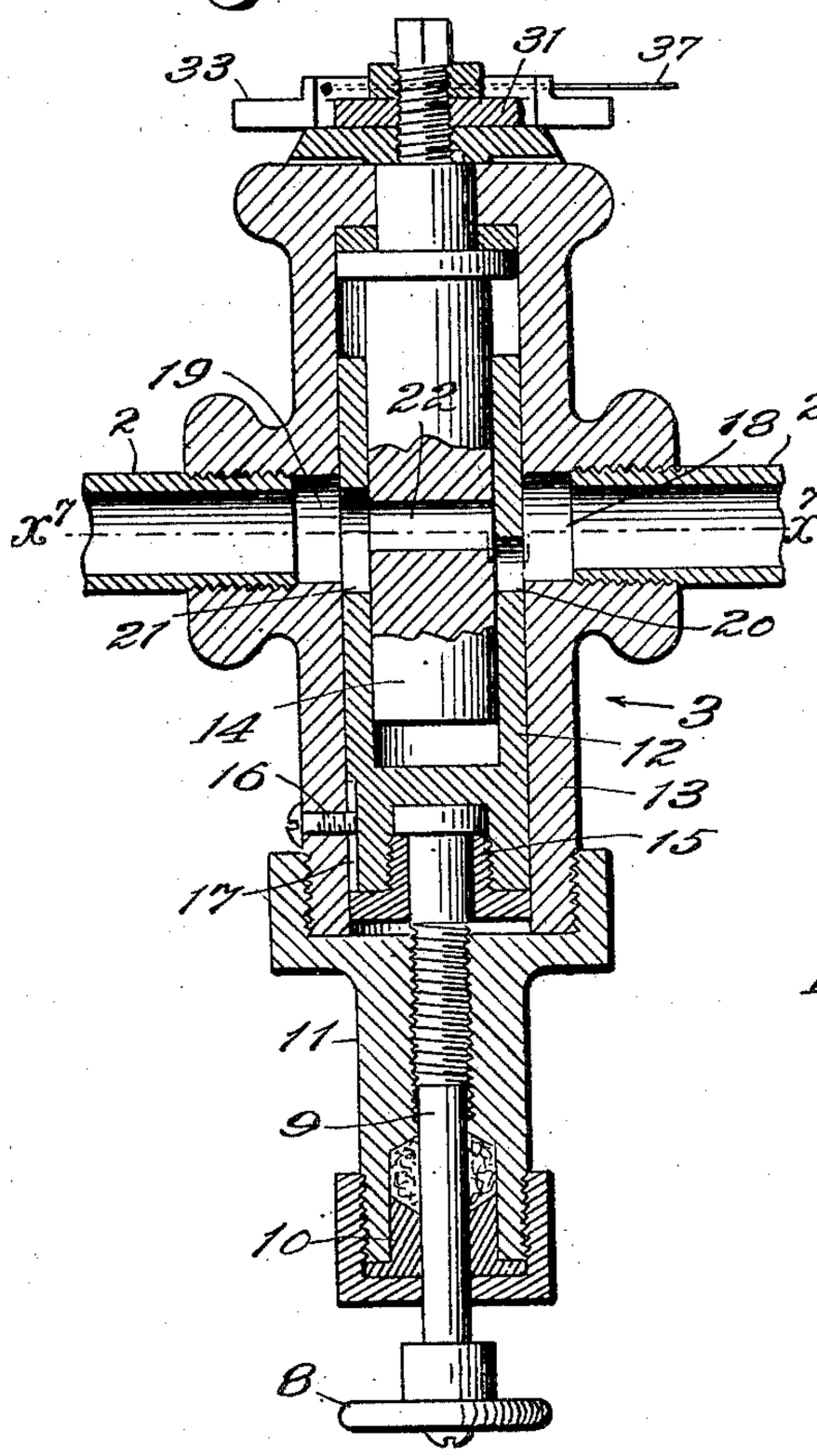


Fig. 7.

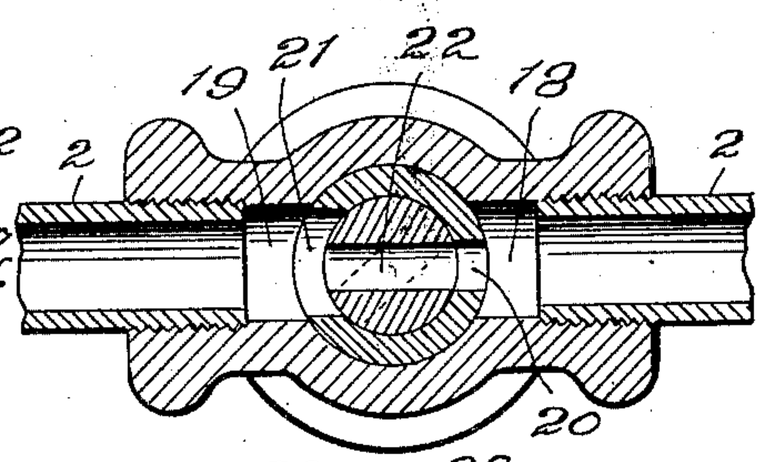


Fig. 9.

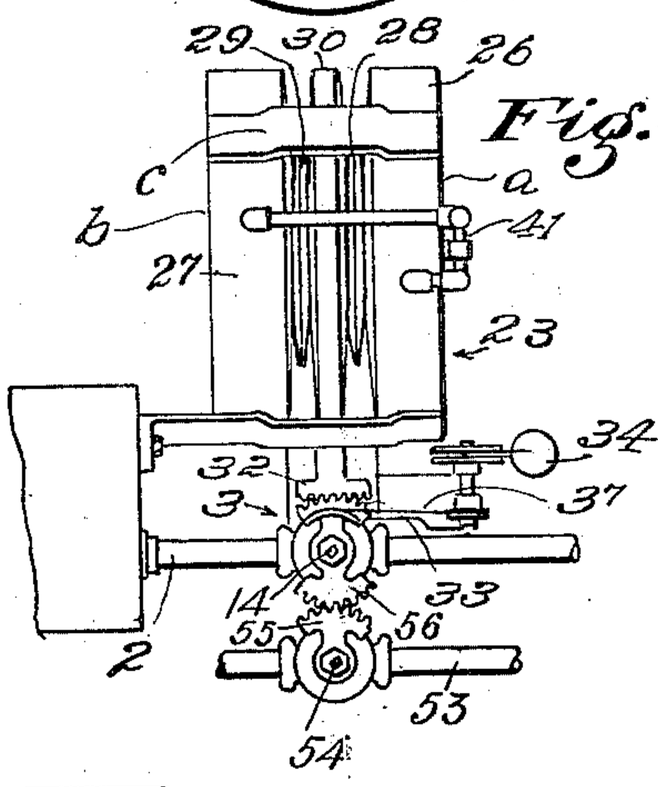
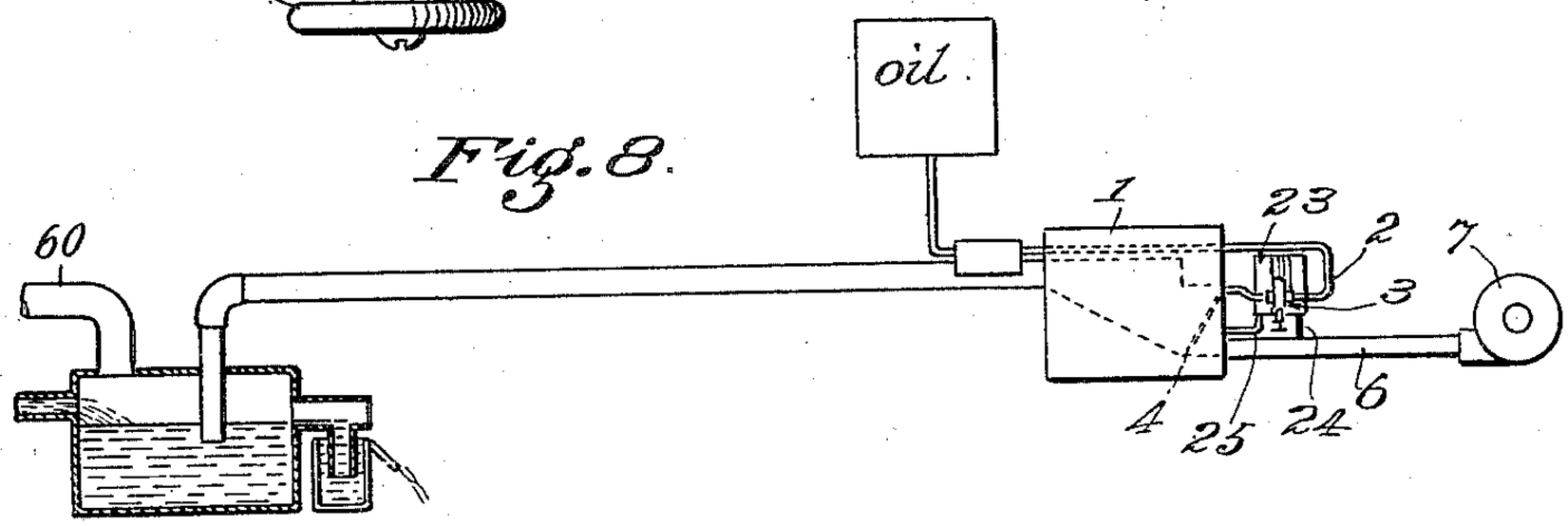


Fig. 8.



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UNITED STATES PATENT OFFICE.

ORVILLE H. ENSIGN, OF LOS ANGELES, CALIFORNIA.

GAS-MAKING APPARATUS.

No. 907,688. Specification of Letters Patent. Patented Dec. 22, 1908.

Application filed February 25, 1907. Serial No. 359,294.

To all whom it may concern:

Be it known that I, ORVILLE H. ENSIGN, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Gas-Making Apparatus, of which the following is a specification.

This invention relates to that class of gas making apparatus adapted to mingle oxygen with carbonaceous gas and in which the gas generator is continuously supplied with two or more readily flowing gas-making substances as liquid or pulverized fuel and air or the like.

An object of this invention is to provide means whereby a constant quality of gas for domestic and commercial use, for heat, light, power and other purposes, may be produced in the simplest and most economical way, and made ready for use or storage outside the producer.

The invention may be carried out in various ways and is not limited to specific contrivances or apparatus although it includes specific apparatus invented by me for the purpose as will hereinafter appear.

An object of this invention is to maintain proper quantitative relations between various materials as oil and air used in making the gas, so that a constant quality of gas may be made in spite of fluctuations in the demand for the gas, or variations in the air supply. This is accomplished by using the quantity of air delivered as a basis for the quantity of other material or materials; advantage being taken of the fact that the quantity of air which will pass through a given fixed orifice practically bears a determinable relation to the differences in pressure on the opposite sides of said fixed orifice. These differences in the quantities of air delivered vary approximately as the square roots of the different pressures on either side of the opening or orifice.

This invention embraces means for applying these different pressures on opposite sides of the orifice to opposite sides of a partition that is free to move at right angles to its plane, the movement of this partition being resisted by a weight operating on the periphery of a cam which is connected with the partition and makes an angular movement proportional to the lateral movement of the partition. The cam is so constructed and connected with the weight that it offers a resistance to the movement of the partition proportional to the quantity of air which will be delivered through the fixed orifice, under varying pressure, and the force applied therethrough tends to normally close the valve.

To obtain the correct mixture under any capacity of generator or under any conditions as to quantity of gas being made, the fuel valve operably connected with the partition and moving with it is opened and closed thereby so as to have an angular opening proportional to the quantity of gas being made which quantity is controlled by the quantity of air admitted as above described.

Means are provided for manual regulation of the fuel valve whereby the same may be set at the will of the operator, to determine the quantity of fuel that will be delivered at any definite position of the automatic means, so that the increase or decrease of flow caused by a determined movement of the automatic means may be greater or less, depending on the manual adjustment. For this purpose the valve seat or shell has a longitudinal movement so designed that the relations of air to fuel at any stage of the gas making process may be controlled by the operator and when once adjusted the angular movement of the valve controlled by the partition will maintain a constant mixture for all quantities of gas being made.

It is evident that various means for proportionally increasing and decreasing the valve closing force or resistance may be employed without departing from this invention. I prefer to use a weight and cam and a partition moved by the resultant of the air pressures in the apparatus on opposite sides of said fixed orifice.

The curve of the cam carrying the weight for resisting the movement of the partition and for closing the valve may be constructed by making various radii of the cam portion vary in length progressively approximately as the square roots of numbers running from 1 up. The exact curve may be determined empirically.

Any form of fuel that may move as a fluid may be employed in the process of

producing gas with apparatus embodying this invention, such fuel may be of various forms of crude petroleum or its distillate, hot asphaltum, coal tar, or other liquid substances known to the art for the production of gas.

The accompanying drawings illustrate the invention in a form I at present deem most advisable.

Figure 1 is a fragmental, sectional elevation of a gas apparatus embodying this invention. Fig. 2 is a plan partly in section on line x^2—x^2, Fig. 1. Fig. 3 is a fragmental sectional plan showing the valve on an enlarged scale and a part of the connection for automatic regulation. Fig. 4 is an elevation from line x^4—x^4, Fig. 1, partly broken. Fig. 5 is a sectional elevation on line x^5—x^5, Fig. 4, looking in the direction of the arrow. Fig. 6 is an axial section of the fuel adjusting valve. Fig. 7 is a section of the same on line x^7—x^7, Fig. 6. Fig. 8 is a view of portions of a gas plant provided with apparatus embodying the invention. Fig. 9 is a view on a small scale of the apparatus showing valves for feeding two gas forming materials.

1 in a general way represents a gas producer; 2, a fuel supply pipe controlled by valve means 3.

4 represents an air inlet to the generating chamber supplied through a determined or fixed orifice 5 from an air pressure pipe 6 which is supplied by any suitable means as blower 7 which produces an artificial pressure of air within said pipe 6, at said fixed orifice, greater than the atmospheric pressure to which the apparatus is subjected. The orifice 5 is of considerably less area than either the air inlet 4 or the pressure pipe 6, so that the throttling by the margins of the orifice 5 will practically be the only resistance to the air flow between the air supply and gas producer, and said resistance must remain constant for any given adjustment of the fuel-valve. Said orifice may be variously shaped. For moderate pressures and ranges the form shown will serve. The means for supplying air to the gas-producer through a fixed orifice may include the contracted end of the air-pipe, as indicated at the left of the character 6 in Fig. 1. Said orifice is shown opening directly toward the air-inlet 4.

The oil-regulating valve 3 has manual and automatic adjustments, the one being to determine the proportion of fuel to a given quantity of air, and the other to maintain such proportion under the varying pressures and therefore varying quantities of air delivered to the apparatus. These two adjustments are of divers characters, and in the form shown in the drawing the one is longitudinal and the other angular. The manual adjustment is accomplished by a hand wheel 8 and screw stem 9, the latter working through a stuffing box 10 and nut 11, and operating axially a valve sleeve 12 that is incased in valve body 13 and surrounds valve-plug 14.

15 is a nut by which the screw-stem 9 is swiveled in the valve-sleeve 12. Said valve sleeve 12 is kept from turning in the valve body 13 by means of a screw 16 in key-way 17 extending along the sleeve 12. The valve body 13 is provided with a transverse way constituting an inlet 18 and an outlet 19. The valve sleeve is provided on the inlet side with a restricted port 20 and on the outlet side with a free or much larger port 21. The valve-plug 14 is rotatable in the sleeve 12 and valve body 13, and is provided with a port 22 substantially corresponding in size to the restricted inlet port 20 of the valve-sleeve 12.

The port 22 in the valve-plug is adapted to be brought into angular adjustable relations with port 20 in the valve-sleeve, while port 20 in the valve-sleeve may be adjusted to longitudinal or axial relations with port 22. This adjustment of the two members may vary from a very small opening or no opening at all, up to a position where the two conincide, giving an extreme opening equal to the area of port 22 through both the plug and sleeve. By this means it is possible to adjust the flow of fuel to a nicety.

In order that the supply of fuel and air may be constantly maintained in proportions determined by the operator to be requisite for the production of the required gas, pneumatic means, generally indicated at 23 are provided and operably connected by pipes 24 and 25 with the air conduit on opposite sides of the fixed orifice 5. Said pneumatic means may comprise two variable air chambers 26 and 27, having extensible walls 28, 29, which are both connected to a movable partition 30 which is in turn connected by suitable mechanical means to rotate the valve to open and close the same in correspondence with the position of the partition or diaphragm 30. Said mechanical connection between the partition 30 and the valve-arm 31 may be in the form of a rack 32 attached to the partition and engaging a sector 33 fixed through valve arm 31, to the valve-plug 14. The heads a, b, of the chambers are held in fixed relation by supports c.

It is evident that in case the pressures on opposite sides of the partition 30 were the same, said partition would be free to move in either direction from any external force, and that in case the pressure in the pressure pipe 6 exceeds that of the air on the further side of the fixed orifice 5, the partition will be driven by such pressure to expand the

chamber subject to excessive air pressure, thus to rotate the valve.

34 is a counterbalance in the form of a weight connected by a line 35 with a cam 36 that has a definite involute curve varying as air velocities through the fixed orifice may vary, as will hereinafter be described, and is connected with the valve-plug 14 through line 37 attached to pulley segments 38 and 39 on cam shaft 40 and valve gear sector 33, respectively. The valve-plug and the connections between the same, the partition and the weight, are so arranged that the tendency of the weight is to draw the partition against the air pressure from the pressure pipe 6 and to totally close the valve. The curve of the cam is approximately formed so that the radii forming the sides of the angles subtending the successive arcs vary from the square root of 1 and so on to the square root of 2, 3, 4, etc., up to the number of divisions covering the portion of a complete revolution which it may be desired that the cam should be developed for.

41 represents a pressure gage indicating the differential of the pressures on either side of the differential fixed orifice, or the actual pressure operating to move the movable partition and thereby to move the valve and regulating the amount of fuel supplied. Said gage may be in the form of a manometer consisting of a bent glass tube as shown, having a charge of water in the bend.

The cam 36 is so constructed and connected with the weight that it offers such resistance to the movement of the partition that each different position of the partition will correspond to a different quantity of air delivered in a unit of time.

It is to be noted that the chambers 26 and 27 are reciprocally expansible and contractible, and that one face of the partition 30 forms a wall for one of said chambers and the other face forms a wall for the other of said chambers; consequently, each chamber has a wall that moves simultaneously with a wall of the other chamber, the movement of one wall tending at one instant to expand its chamber and the movement of the other wall tending to contract the other chamber, and vice versa. I do not limit the construction of the expansible and contractible chambers to the form shown, as various other ways may be devised in which the resultant force of the opposed pressure in the two chambers may be applied to operate the fuel-valve or valves.

In the construction shown it is necessary that the path of the partition 30 shall be at right angles to the plane of the partition so that the rack 32 may move in a right line to cause rotation of the toothed arc 33 without binding. For this purpose there is provided in each of the chambers an L-shaped arm as 42, 42′, 43, 43′, fixed by suitable means, as rivets 44, to the partition 30 and swung by links 45, 46, that are pivoted to the arms at the ends thereof, as shown at 47 and 48, and to the stationary walls *a*, *b*, of the chambers by pivots 49, 50, through brackets 51, 52, fixed to said walls. By supporting the partition, as shown, a limited movement thereof is allowed, the same being sufficient to fully open and close the valve at opposite ends of such movement. The resisting force applied to the cam is made adjustable by means of separable weights 34 so that a definite resultant of pressures on opposite sides of the partition 30 will hold the partition at its midway position illustrated in the several views, thus to hold the valve half open in its angular adjustment, as shown in Fig. 3.

In case no gas is being used, the pressures on opposite sides of the orifice 5 and partition 30 will be equalized and the weight 34 will bring the partition to rest in position to close the valve. In case a vent is opened to allow gas to escape from the usual holder, not shown, of the system, the pressure inside the system is relieved and the pressure in pipe 6 outside the fixed orifice 5 and in the chamber 26 moves the partition in opposition to the weight, and by reason of the cam, in exact relation to the volume of the escaping gas, thus opening the valve and admitting the required amount of fuel to the generator.

The operator may adjust the valve longitudinally so as to allow the requisite amount of fuel to pass into the generator with a determined amount of air. When once adjusted for a given quality of fuel, the automatic adjustment will operate to maintain the same proportions of air and fuel under the various demands made upon the generator, as the quantity of gas used increases and decreases, as the valve opens and closes, so that each definite position of the valve will correspond to a definite quantity of air delivered.

In Fig. 9, 53 designates a fuel pipe which may carry steam, the same being controlled by a valve 54 operated by segments 55 and 56, the latter being connected to turn with the valve plug 14; the steam pipe 53 being led into the gas producer at a suitable place for combining with the oil in the production of gas. From the broken nature of this view the connection between the steam pipe and the generator is omitted.

It is to be understood from Fig. 8 that the discharge pipe 60 at the left of the view leads to the usual washers, and scrubbers of a gas plant and from thence to any point of consumption requiring a variable supply, for example, gas engines or any commercial operations.

In practical operation a regular discharge for the gas will be provided for by opening

valves of the gas system, not shown. Oil is then supplied under pressure through oil pipe 2 and allowed to flow into chamber 1, where it is ignited, blower 7 is then started and a constant pressure of air supplied to pipe 6. The flow of oil necessary to produce the proper quality of gas is adjusted by manipulation of hand wheel 8. After the quality of gas has thus been fixed appropriately the valves through which the gas has been allowed to escape may be closed. Then the machine will proceed to operate automatically. During the process of regulating the quality of the gas, the regulator, the partition 30 and the corresponding valve plug 14, will have assumed a position corresponding to a difference in pressure on opposite sides of fixed orifice 5 and opposed by counterweight 34. Now the regulated outlet for the escape of a fixed quantity of gas above referred to is closed, which will prevent the escape of gas from chamber 1 and therefore will prevent any flow of air from the fixed orifice 5; pressures on opposite sides of fixed orifice 5 will come to the same value, and counterweight 34, operating through cam 36 and valve plug 14 will close port 20 and shut off all fuel. If it is desired to continue to make gas to meet the variable demand, such variable demand of gas will cause a variation of pressure in chamber 1, such a variation of pressure will be transmitted through air pipe 25 into chamber 27 acting upon the side of partition 30, which will allow partition 30 to move the plug 14 to regulate the supply of oil in proportion to the quantity of air delivered through fixed orifice 5 and this operation will continue automatically for an indefinite period.

I claim:—

1. In a gas-making apparatus, the combination with a gas producer, of means to supply fuel under pressure to the producer, means to supply air under pressure to said producer through a fixed orifice, and means for increasing and decreasing the flow of fuel to the gas producer proportionally as the volume of air supplied thereto increases and decreases, said means being operable by the resultant of the air pressures in the apparatus on opposite sides of said orifice.

2. A gas generator, means for supplying fuel thereto, fuel regulating means, means for supplying air to said generator, and pneumatic means operable by the force resulting from the differences of air pressures between the supply of air outside of, and the gas and air inside of the gas producer, said pneumatic means being operably connected with the fuel regulating means to maintain constant quantitative relations between the air and fuel admitted to the generator.

3. A gas producer, means for supplying air and fuel thereto, pneumatic means operable by the force resulting from the differences of air pressures inside and outside of the gas producer caused by the demand for a supply of gas at the outlet of the gas producer, and fuel supply regulating means operably connected with said pneumatic means to maintain quantitative relations between the air and fuel.

4. The combination with a gas producer, of means for supplying flowing fuel thereto under pressure, means for supplying air through a fixed orifice under pressure, a valve to control the flow of fuel to the producer, means operable by the force resulting from the differences of air pressure on opposite sides of said orifice, and means for applying power therefrom in a variable measure to operate the valve.

5. The combination with a gas producer, of means for supplying flowing fuel thereto under pressure, means for supplying air through a fixed orifice under pressure, a valve to control the flow of fuel to the producer, means operable by the force resulting from the differences of air pressure on opposite sides of said orifice, and means for applying power therefrom in a variable measure to operate the valve, said variable means having a variable coefficient varying with the velocity of the air through the fixed orifice due to the differences in pressure on opposite sides thereof.

6. A gas producer, means for supplying fuel thereto, a valve to regulate such means, means for supplying air to the producer through a fixed orifice, two collapsible and extensible chambers having fixed heads and a movable partition between said chambers, means connected with one of the chambers to supply pressure thereto from one side of the fixed orifice, means connected with the other chamber to supply pressure thereto from the other side of said fixed orifice, means operatively connecting said partition with said valve, and yielding means to normally close the valve when the pressures on opposite sides of said orifice are equal, and to resist the opening movement thereof.

7. A gas producer, means for supplying fuel thereto, a valve to regulate such means, means for supplying air to the producer through a fixed orifice, two collapsible and extensible chambers having fixed heads and a movable partition between said chambers, means connecting one of the chambers to supply pressure thereto from one side of the fixed orifice, means connecting the other chamber to supply pressure thereto from the other side of said fixed orifice, means operatively connecting said partition with said valve, and variable yielding means to normally close the valve when the pressures on opposite sides of said orifice are equal, and to resist the opening movement thereof.

8. A gas producer, means for supplying fuel thereto, a valve for regulating the supply of fuel, a movable partition connected with said valve to open and close the same, fixed heads on opposite sides of said partition, extensible and collapsible walls connecting one of said heads with one side of said partition, extensible and collapsible walls connecting the other head with the other side of said partition, said heads and walls forming two collapsible and expansible chambers; means for supplying air to said gas producer through a fixed orifice, means connecting one of said chambers with said air-supplying means on one side of said fixed orifice, means connecting the other of said chambers with the air-supplying means on the other side of said fixed orifice, and variable means to resist the opening movement of said valve and to normally close said valve when the pressure on opposite sides of said partition are equal.

9. Two reciprocally collapsible and expansible chambers provided with fixed heads and with walls formed of a movable partition between said heads, a gas producer, means for supplying fuel thereto, a valve to control said means, means connecting the partition with said valve to open and close the same, means for supplying air to the gas producer through a fixed orifice, a cam, means for transmitting motion between the cam and the valve to close the valve, a source of power, means for applying said power to the face of the cam to actuate the cam to close the valve and to resist the opening movement thereof, means connecting one of the expansible chambers with the air-supplying means on one side of the fixed orifice, and means connecting the other expansible chamber with the air-supplying means on the other side of the fixed orifice.

10. The combination with a gas generator, of means for supplying fuel thereto under pressure, means for supplying air to said generator under pressure through a fixed orifice, a valve to control the flow of the fuel, means to normally close the valve when all outlets to the generator are closed and no air entering the generator, and means to open the valve, the same being operable by the force resulting from the differences of pressure which may occur on opposite sides of the fixed orifice due to the gas being made and allowed to pass from the generator, thereby lowering the pressure in the generator sufficiently to allow the air to pass through the fixed orifice; the quantity passing depending upon the drop in pressure within the generator that causes the differences of pressures above referred to on opposite sides of the fixed orifice; said means to close the valve being variable and constructed to increase and decrease the force to resist the opening movement of the valve proportionally as the said resultant force increases and decerases.

11. A gas-making apparatus comprising a gas producer, means for supplying fuel thereto under approximately constant pressure, an air conduit provided with an orifice of fixed dimensions opening into the producer, means for supplying air to said conduit under pressure, means for controlling the quantity of fuel delivered to the producer, pneumatic means connected with said controlling means and connected with the air conduit and with the interior of the producer on opposite sides of the fixed orifice and operable by the resultant of the pressures in said conduit and producer, means for causing a variable resistance to the movement of the pneumatic means, such resistance increasing with the increase of said resultant, whereby the pneumatic means will move in proportion to the quantity of air delivered at any difference of pressure through the fixed orifice whereby the pneumatic means will assume a different position for any difference of pressure and will operate the fuel-controlling means to supply fuel at a rate corresponding to the rate at which air would be delivered through said fixed orifice at that particular difference of pressure.

12. The combination with a gas producer, of means to supply fuel thereto, means to supply air to the producer through a fixed orifice, a fuel-regulating valve having manual and automatic adjustments, one being to determine the proportion of fuel to a given quantity of air, and the other to maintain such proportions under the varying pressures, and means to operate said automatic adjustment, the same being operable by the differences of air pressures in said supply means on opposite sides of said fixed orifice.

13. The combination with a gas producer, of means for supplying fuel thereto, means for supplying air to the producer through a fixed opening, a valve for controlling the fuel, the same comprising a valve body provided with a transverse way, an axially movable non-rotary valve-sleeve in said body, the same being provided with a transverse way, a rotary valve-plug provided with a transverse way, means for adjusting the sleeve axially, means to rotate the valve-plug to close the way, the same comprising a cam having an involute face, a connection over said face of the cam, a weight on said connection, means connecting the cam with said valve stem to close the same as the weight descends, and pneumatic means operable by the resultant of the air pressures on opposite sides of said fixed orifice, the same being connected to open the valve as the difference in the pressures on opposite sides of said orifice increases, the curve of said cam being approximately formed so that the

radii forming the sides of the angles subtending the successive arcs vary from the square root of one and so on to the square root of two and so on, up to the number of divisions covering the portion of a complete revolution required.

In testimony whereof, I have hereunto set my hand at Los Angeles California this 15th day of February 1907

ORVILLE H. ENSIGN.

In presence of—
JAMES P. TOWNSEND,
M. BEULAH TOWNSEND.