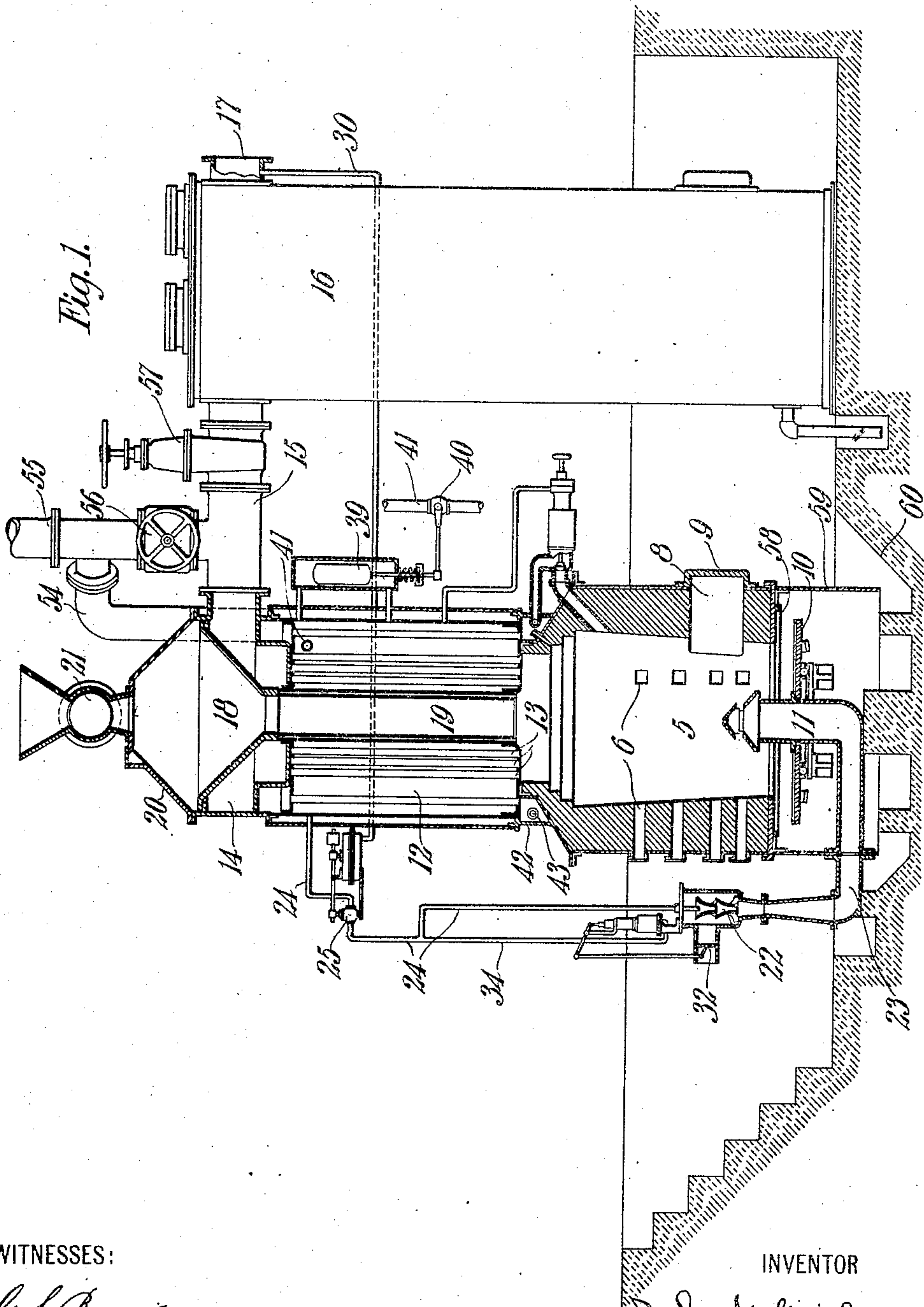


J. H. STRINGHAM.  
GAS GENERATING APPARATUS.  
APPLICATION FILED MAR. 13, 1905.

935,283.

Patented Sept. 28, 1909.

3 SHEETS—SHEET 1.



WITNESSES:

G. L. Ryder.  
E. W. McAllister

INVENTOR

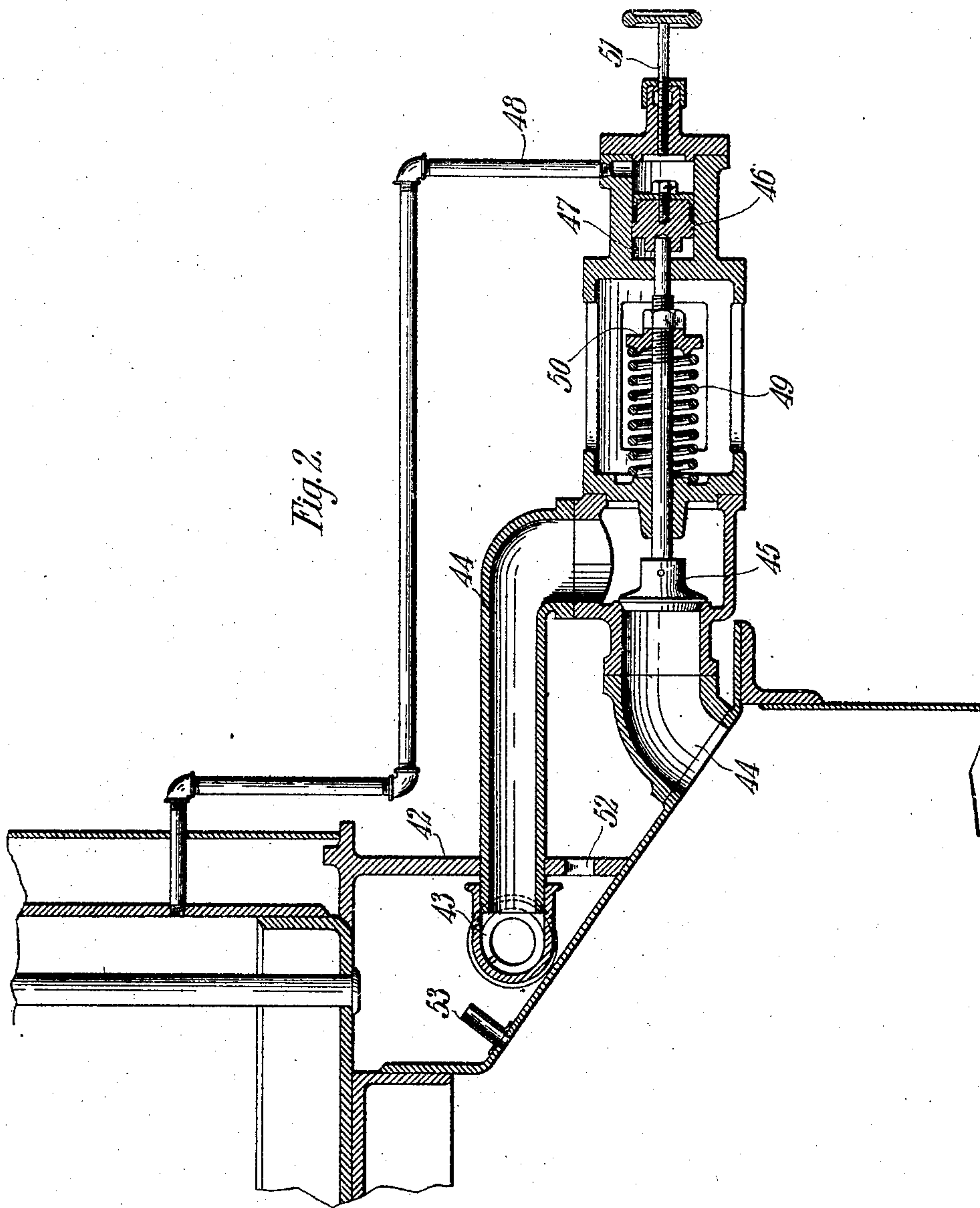
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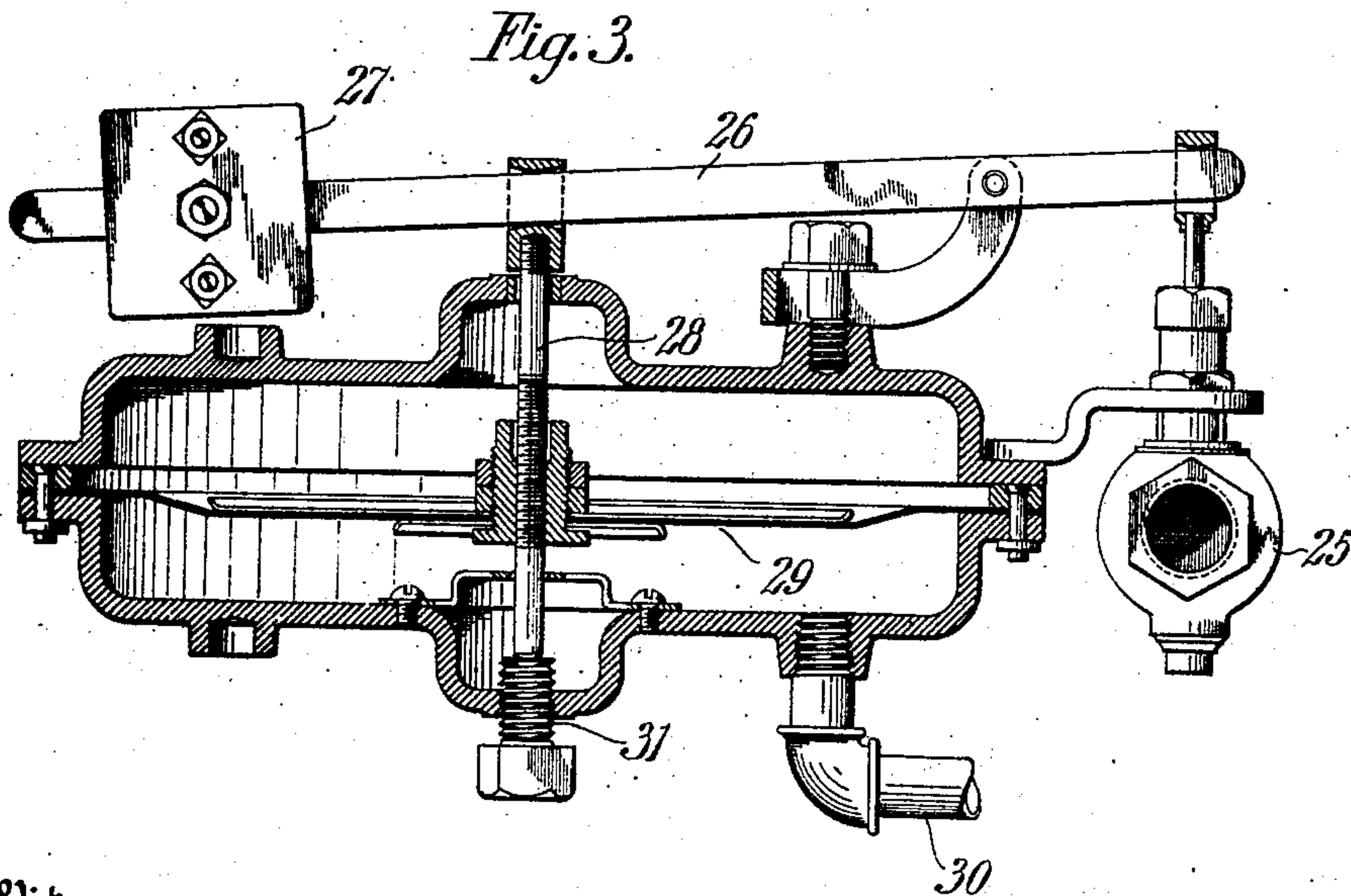
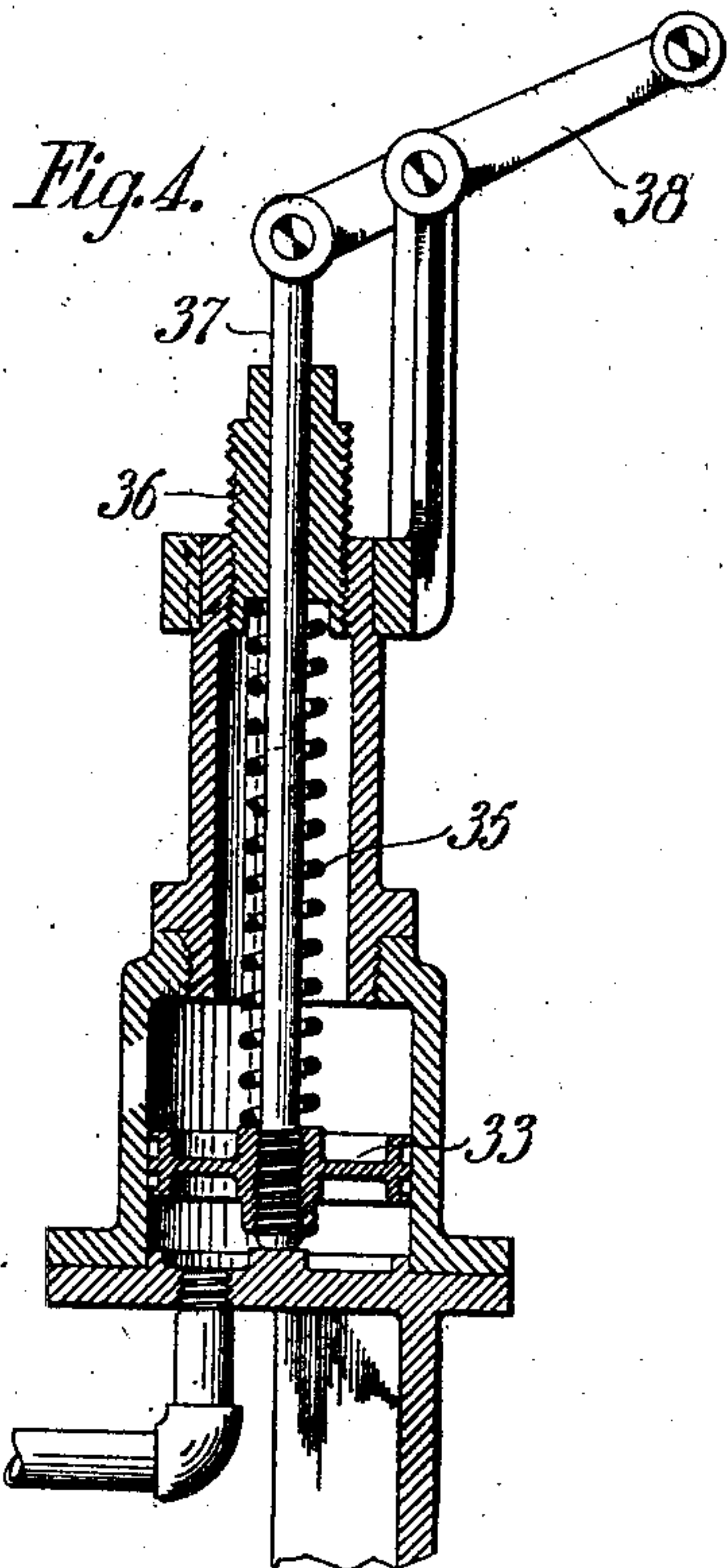
INVENTOR

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3 SHEETS—SHEET 3.



Witnesses  
*E. L. Ryder.*  
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Inventor  
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By his Attorney *Wm. S. Green*



# UNITED STATES PATENT OFFICE.

JOHN H. STRINGHAM, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

## GAS-GENERATING APPARATUS.

935,283.

Specification of Letters Patent.

Patented Sept. 28, 1909.

Application filed March 13, 1905. Serial No. 249,774.

*To all whom it may concern:*

Be it known that I, JOHN H. STRINGHAM, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented a new and useful Improvement in Gas-Generating Apparatus, of which the following is a specification.

This invention relates to gas generating apparatus, and more especially to apparatus for the commercial generation of what is now commonly known as "producer-gas".

An object of this invention is to provide a simple, compact, organized apparatus, by means of which "producer gas" of an uniformly good quality may be produced under varying load conditions.

A further object has been to provide, in such a gas generating apparatus, agents whereby the water, steam and air supplies necessary, are automatically controlled and varied, and whereby the cost of operation, the necessary attention, as well as the consumption of fuel for a given quantity of gas of the desired quality, are reduced to the minimum.

These as well as other objects which will readily appear to those skilled in the art to which this invention pertains, I attain by means of apparatus constructed as described in this specification and illustrated in the accompanying drawings throughout which similar elements are denoted by like characters.

The apparatus consists of a suitable gas generating chamber constructed and arranged to hold the fuel bed; a steam generator utilizing the sensible heat of the gases generated, and through which said gases pass, and suitable scrubbing and purifying apparatus.

In order to attain the objects of this invention, and as the quantity of gas produced is dependent upon the steam-and-air fuel-bed-blast, I have provided means whereby said blast automatically varies as the load conditions vary; the operation of said means being dependent upon the gas pressure at the gas outlet of the apparatus, which pressure varies as the load conditions vary, and said means is so constructed and arranged that during all the variations of said blast,

the proportions of air to steam remain substantially constant. This is a novel and most important point.

As the sensible heat of the gases generated, when certain classes of fuels are utilized, is not sufficient at all times to maintain the required steam pressure in the steam generator to supply the fuel-bed-blast, without unduly increasing the percentage of CO<sub>2</sub>, I have provided a burner beneath a portion of the steam generator, utilizing gas taken from the gas generating chamber, and I have made the amount of gas fed to this burner dependent upon the steam pressure in the steam generator, and, as it is an object of this invention to reduce to a minimum the attention necessary in the operation of this apparatus, I have provided means for automatically maintaining a constant water level in the steam generator.

In the drawings, Figure 1 is a view of this organized apparatus, the gas generating portion of which is shown in sectional elevation, while the scrubbing and purifying portion, which in themselves form no part of this invention, are shown merely in outside elevation: Fig. 2 is an enlarged detail view of a portion of the apparatus and illustrates the auxiliary steam-generator-heating-means, and the mechanism whereby the same is rendered automatic and the amount of gas fed to the burner thereof is made dependent upon the steam pressure in the steam generator: Fig. 3 is a detail view of the device for automatically controlling the steam entering into the make-up of the fuel-bed-blast, and shows means whereby the volume of the steam is made dependent upon the gas pressure at the outlet of the apparatus, and therefore upon the variations in the load demands: Fig. 4 is a detail view of the mechanism whereby the amount of air entering into the make-up of said fuel-bed-blast is varied in proportion to the variations in the amount of steam supplied to said blast.

The gas generating portion of the apparatus consists of a gas generating chamber 5, which may be formed in any suitable manner and of any desired material. Suitable sight holes 6, provided with proper sealing means, extend through the walls of



the generating chamber, and, if desired, these may be utilized for poke holes. A passage or doorway 8, provided with a suitable door or cover 9, leads into the interior of the chamber at a suitable point above the fuel-bed supporting grates 10, and this doorway, which will be closed during the operations of the producer, is utilized for initially charging the generating chamber besides being utilized as a man-hole whereby access to the interior of the chamber is gained. A twyer or blast-pipe 11, the upper end of which is properly flanged and protected, extends up into the generating chamber through the center of the supporting grate 10 and terminates at a point which is slightly below the zone of combustion.

A super-imposed tubular boiler or steam generator 12 is supported by the walls of the gas generating chamber, and a number of rows of tubes 13 thereof serve as outlet passage-ways for the gas generated within chamber 5. These tubes 13 lead to a common chamber 14 above the boiler or steam generator, and from this common chamber the gas passes out of the gas generating portion of the apparatus through a pipe 15 and into the scrubbing and purifying portion 16, from which it leaves through an outlet 17, to be conducted to the place to be utilized.

Located above the boiler 12 and forming the upper wall of gas chamber 14, is a fuel hopper 18 which extends down into the gas generating chamber in the form of a pipe 19, passing centrally through the steam generator, which is formed to accommodate the same. The fuel hopper 18 is provided with a cover 20 and a fuel valve 21 leading into the same, through which the fuel for forming the fuel-bed in the gas generating chamber is fed. A steam jet blower 22, of any desired construction, connects with twyer 11 by means of a pipe 23, and receives its steam from the steam generator through a pipe 24.

Located adjacent to pipe 24 and controlling a valve 25 included in said pipe, is the device for automatically controlling the volume of steam flowing through pipe 24 and entering the steam jet blower. This device preferably consists of a pivoted lever arm 26, which engages the stem of valve 25, and is provided with a counterpoise weight 27 adjustably movable longitudinally of said lever. Contacting with lever 26 is a movable rod or member 28 secured to a yielding diaphragm 29 which is subjected to the gas pressure at the outlet of the apparatus by means of a pipe 30. The position of member 28, by means of a set screw 31, may be adjusted in order to calibrate the device. The movements of the yielding diaphragm 29 in opposition to weight 27 vary the position of the stem of valve 25 as the gas pressure at the outlet of the apparatus varies, and the device is so constructed that when

the gas pressure drops, the steam valve 25 will be opened more or less to increase the steam flow to the jet blower, whereby the combustion of the fuel in the fuel bed, and therefore the yield of gas, will be increased until the predetermined pressure at the gas outlet has been attained.

In order to maintain proper proportions of air to steam in the fuel-bed-blast, I provide a valve 32 in the air inlet to the steam jet blower, and I vary the position of this valve, and therefore the effective air opening leading to the blower, as the volume of steam flowing through pipe 24 varies. In order to accomplish this, I provide a valve operating motor which consists of a movable piston 33 which is subjected to the steam pressure in pipe 24 through a branch pipe 34. The device is calibrated by means of a spring 35 which operates in opposition to the steam pressure, and is capable of being adjusted by means of a screw-plug 36. The piston, through a piston-rod 37 and lever 38, is connected to the stem of valve 32.

It will be seen that, if desirable, the stem of valve 32 may be connected to lever 26 of the steam flow regulating device, and the air valve regulating device may be dispensed with, thus allowing the movement of diaphragm 29 to control both the steam and air flows. If desirable, a steam jet blower may be substituted for the one shown, which is so constructed as to maintain substantially constant proportions of air and steam under varying steam flows, provided the initial steam pressure is maintained constant in pipe 24 between the steam generator and the steam regulating device. The water level in the steam generator is maintained at a constant level by means of any suitable float device 39 arranged to control a water valve 40 in the water line 41 leading to the steam generator. It will be understood that pipe 41 connects with some suitable source of water supply of a pressure exceeding that under which the boiler is to work.

In order to utilize fuel, the sensible heat of the gas from which is not sufficient to maintain the desired steam pressure in the steam generator—without unduly increasing the percentage of  $\text{CO}_2$ —for supplying the steam jet blower without the necessity for deriving steam from an outside source, as is now common, I cut out or segregate one or more of the outer rows of the boiler tubes from communication with the gas generating chamber and the gas passages leading therefrom, and within a suitable housing 42 below the steam generator, I place a burner pipe 43. This burner pipe, as shown in the drawings, may consist of a single annulus of pipe suitably perforated to form a burner for the gas below the segregated tube. Gas is supplied to this burner from the gas generating chamber through a gas conduit 44,



which is supplied with a valve 45 for varying the flow of gas through said conduit. The stem of valve 45 is connected to a piston 46 located within a cylinder 47 and subjected to the pressure within the steam generator through a pipe 48. A spring 49, the tension of which is adjustable by means of an adjustment nut 50, tends to yieldingly hold said valve from its seat in opposition to the steam pressure. In order to manually close the valve, a screw threaded rod 51, provided with a hand-wheel, is utilized.

Within the burner housing 42, which derives its air through openings 52, a pilot light 53 is situated, which consists of a pipe communicating with the interior of the gas generating chamber, and the outer end of which is in line with the burner openings in the burner pipe 43.

The products of combustion from burner 43, which pass up through the segregated rows of tubes, are carried away through a pipe 54, to a suitable stack 55. This stack communicates with the gas outlet pipe 15 between the generating portion of the apparatus and the purifying portion, and a valve 56 is provided whereby, during the starting period of the apparatus, the products of combustion within the gas generating chamber can be carried off through the stack. A valve 57, in pipe 15, is provided whereby, during the starting period, the purifying and scrubbing portion of the apparatus may be cut out of communication with the generating portion.

The fuel bed supporting grate 10, which is located below a mantle ring 58, carrying the walls of the gas generating chamber, is rotatably mounted, and by means of rotating this grate, the ash below the fuel bed may be discharged.

Below the walls of the gas generating chamber, supporting the mantle ring and therefore said walls and forming an ash-pit, is a steel casing 59, and the lower end of this casing, which is suitably supported in any desirable manner, lies below the level of water contained in a water-pan 60. The water contained in the water-pan acts as a seal, as is now common practice, and the water-pan provides easy means for the removal of the ash which collects therein without interfering with the operation of the apparatus.

It will be understood that many and various changes may be made in the construction of the apparatus, and in the various elements entering into its make-up, without departing from the spirit of this invention, and having described one form and illustrated the same, what I claim as new and useful and desire to secure by Letters Patent of the United States is:—

1. In a gas generating apparatus, a gas producer, a steam generator arranged to de-

rive heat from said producer, a fuel bed blast and means whereby the delivery of the separate components forming said blast is independently controlled by the gas pressure generated within said producer.

2. In a gas generating apparatus, a producer chamber, a blast twyer for the fuel bed of said producer chamber, means for delivering two fluids to said twyer and means, dependent on the gas pressure generated within said producer chamber, for independently controlling the delivery of each of said component fluids to said twyer.

3. In a gas generating apparatus, a gas generating chamber, a steam generator arranged to derive heat from the gases generated in said chamber, a fuel bed blast for said generating chamber, comprising two component fluids, and means, dependent on the pressure generated within said generating chamber, for independently controlling the components of said blast.

4. In a gas generating apparatus, a gas producer, a steam generator, a blower between said steam generator and said producer, and an agent dependent upon the gas pressure for independently controlling the steam supply and the air supply to said blower.

5. In a gas generating apparatus, a gas producer, a steam generator, a blower between said steam generator and said producer, and an agent provided with a movable element subjected to the gas pressure at the outlet of the apparatus and arranged to independently control the steam and air supply to said blower.

6. In a gas generating apparatus, a gas producer, a steam generator arranged to derive heat from said producer, a steam and air fuel bed blast, and means whereby both the air and steam forming said blast are independently controlled by the gas pressure generated by said producer.

7. In a gas generating apparatus, a gas producer, a boiler arranged to derive heat from said producer, a fuel bed blast twyer connected to said boiler, an air passage communicating with said twyer, a valve in said passage and means, dependent upon the pressure of the gas generated, for controlling the amount of steam delivered to the blast and for operating said valve to control the amount of air delivered to the blast.

8. In a gas generating apparatus, a gas producer, a boiler arranged to derive heat from said producer, a fuel bed blast twyer communicating with said producer, a steam passage communicating with said boiler and connected with said twyer, an air inlet communicating with said twyer, a valve in said inlet and means, dependent upon the pressure of the gas generated, for controlling the operation of said valve, and thereby the amount of air admitted to said producer.



9. In a gas generating apparatus, a gas producer, means for delivering separate fluids to said producer to blast the fuel bed contained therein, agents whereby the amount of one fluid delivered is controlled by the gas pressure at the outlet of said apparatus and means whereby the amount of the other fluid delivered is controlled by the amount of the first fluid delivered.
10. In a gas generating apparatus, a gas producer, a steam boiler arranged to derive heat therefrom, a blast twyer for blasting the fuel bed of said producer, a steam passage communicating with said boiler and delivering steam to said twyer, an air passage provided with an admission valve communicating with said twyer, an agent, dependent on the gas pressure at the outlet of said apparatus, for controlling the delivery of steam to said twyer and means, dependent upon the amount of steam delivered, for operating said valve to vary the amount of air delivered to said twyer in accordance with the amount of steam delivered to the blast.
11. In combination in a gas producer provided with a gas generating chamber, a blast twyer communicating with said chamber, a steam delivery passage and an air inlet passage communicating with said twyer, a valve in said air passage, an agent, dependent on the pressure of the gas generated, for controlling the amount of steam entering the producer and means, dependent on the amount of steam delivered to the producer, for operating said valve and thereby maintaining a substantially constant ratio of

gas and air delivered to the blast of the producer.

12. In a gas generating apparatus, the combination with a gas producer, a steam generator deriving heat from said producer, a fuel bed blast twyer communicating with said producer and receiving steam from said generator, an air inlet passage communicating with said twyer, a valve within said passage, means, dependent on the gas pressure at the outlet of said apparatus for controlling the delivery of steam to said blast twyer and for operating said valve, and thereby controlling the delivery of air to said blast twyer, a supplemental heating agent for said generator and means, dependent on the pressure within said generator for controlling the operation of said agent.

13. In a pressure gas generating apparatus, a gas producer, means for delivering separate fluids to said producer to blast the fuel bed contained therein, self-contained means whereby the amount of one fluid delivered is controlled by the gas pressure at the outlet of said apparatus, and means whereby the amount of the other fluid delivered is controlled by the volume of the first fluid delivered.

In testimony whereof, I have hereunto subscribed my name this 24th day of February, 1905.

JOHN H. STRINGHAM.

Witnesses:

DAVID WILLIAMS,  
JNO. S. GREEN.