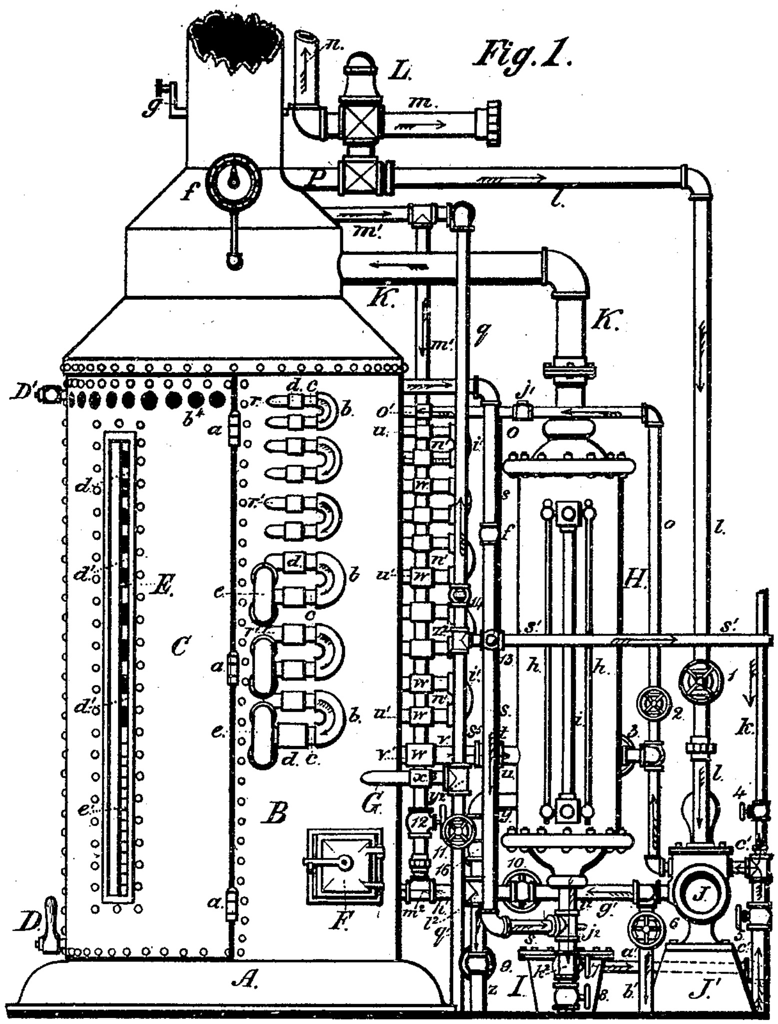
(No Model.) 6 Sheets—Sheet 1.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.

Fig. 1.



Witnesses:-
R. Sylvani
W. A. Brown

Inventor:-
Wm. Frank Browne

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

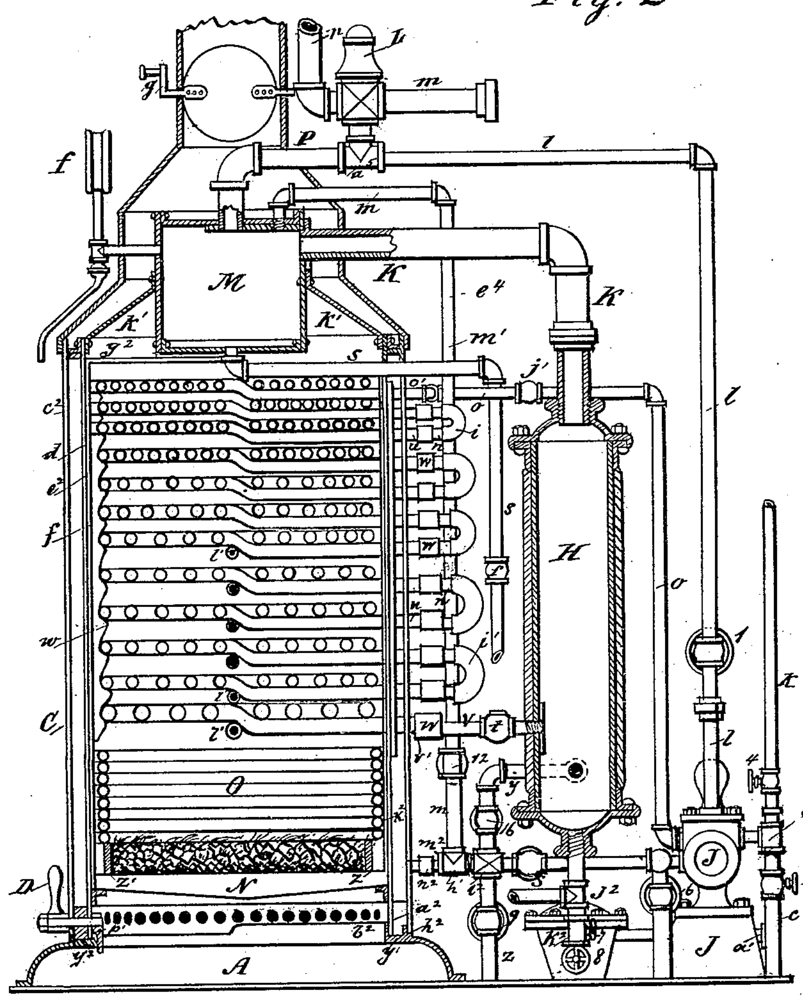
6 Sheets—Sheet 2.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.

Fig. 2



Witnesses:—
L. Sylvane
M. A. Brown

Inventor
Wm. Frank Brown
by O. E. Duffy
Att'y.

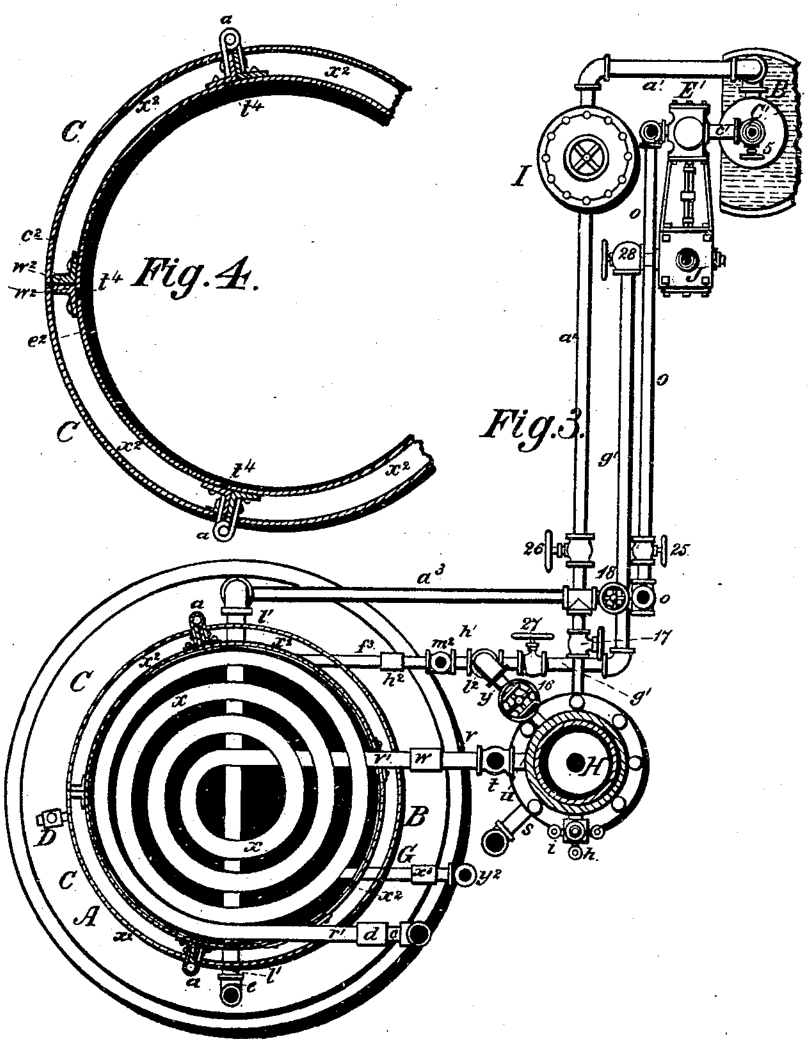
(No Model.)

6 Sheets—Sheet 3.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.



Witnesses:-
R. Sylvan
W. F. Brown

Inventor:-
Wm Frank Browne
O. E. Duffy Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

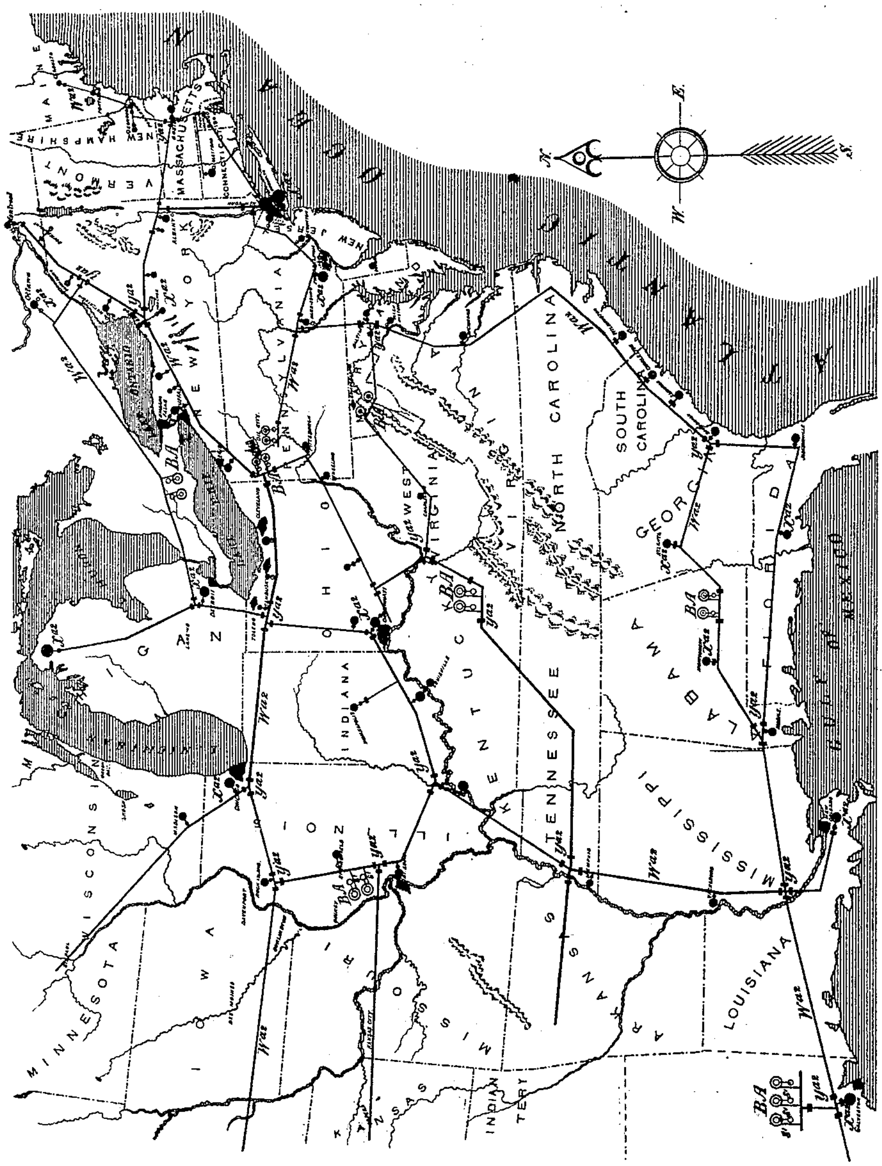
(No Model.) 6 Sheets—Sheet 4.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.

Fig. 5.



Witnesses:-
R. Sylvain
E. A. Legrand

Inventor:-
Wm. Frank Browne

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 5.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.

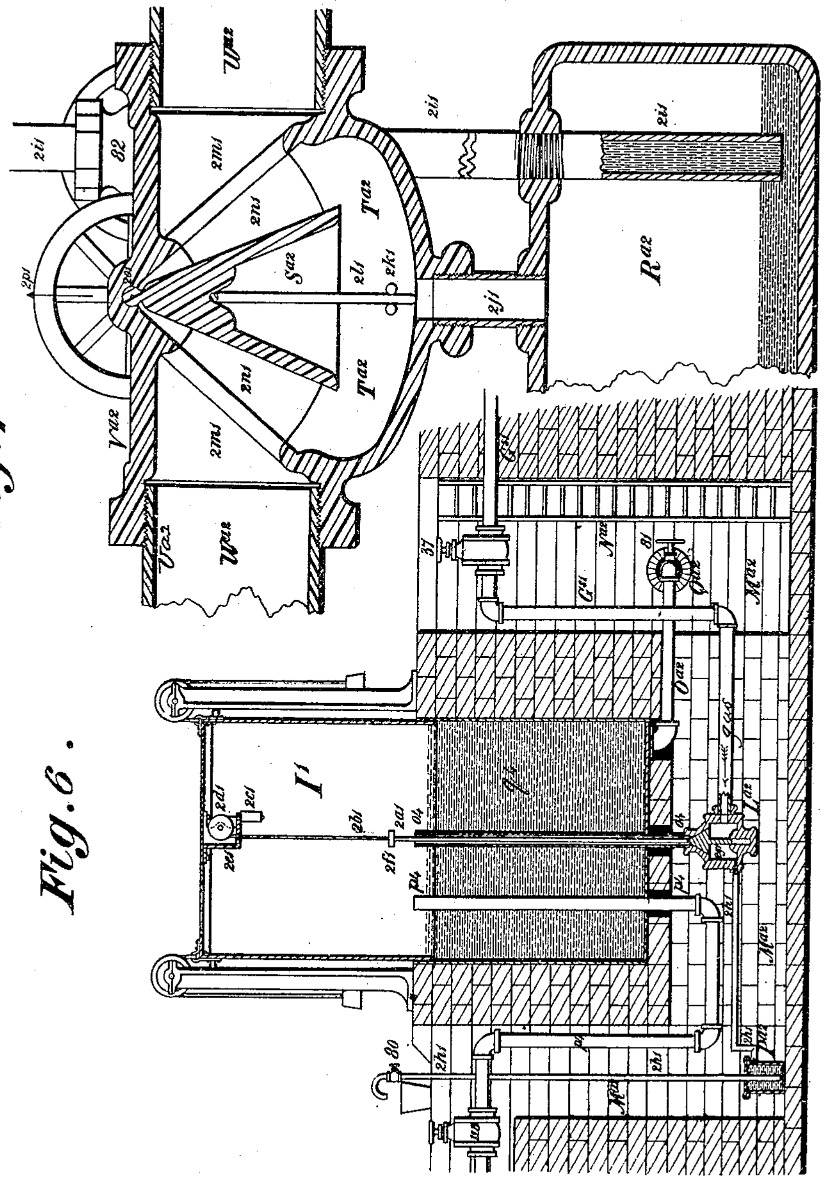


Fig. 7.

Fig. 6.

Witnesses:-
R. Sylvaye
E. H. Legrand

Inventor:-
Wm Frank Browne

(No Model.) 6 Sheets—Sheet 6.

W. F. BROWNE.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH PRESSURE GAS.

No. 263,315. Patented Aug. 29, 1882.

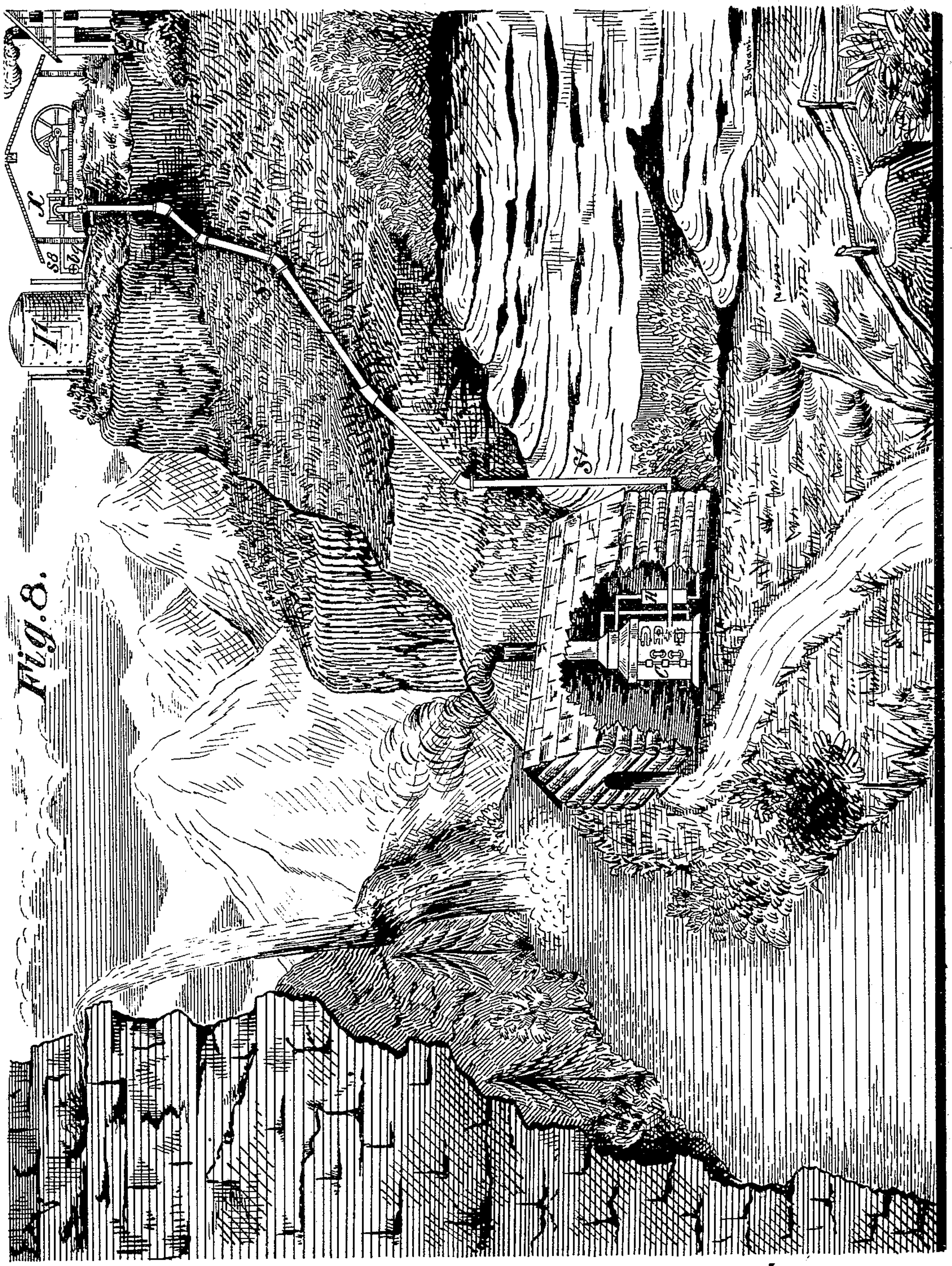


Fig. 8.

WITNESSES:

E. A. Legrand
R. Sylvain

INVENTOR:

Wm. Fran. Browne,

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM FRANK BROWNE, OF NEW YORK, N. Y.

APPARATUS FOR GENERATING AND DISTRIBUTING HIGH-PRESSURE GAS.

SPECIFICATION forming part of Letters Patent No. 263,315, dated August 29, 1882.

Application filed December 22, 1881. (No model.)

To all whom it may concern:

Be it known that I, WM. FRANK BROWNE, of the city, county, and State of New York, have invented an improvement in Apparatus for Generating and Distributing High-Pressure Illuminating, Heating, and Motive-Power Gases; and I do hereby declare that the following is a clear and full description thereof, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to a new apparatus for generating or manufacturing and distributing illuminating, heating, and motive-power gases from a central location or locations contiguous to the material from which said gas is generated, through pipes which may extend to any desired distance, whereby cities or towns and villages can be supplied with gases for light, heat, and motive power.

The invention consists, first, in the construction of a gas-holder and the means and arrangement thereof for automatically filling and discharging gas from said holder under a given pressure, while the said holder is filled from a pipe which contains gas at a greater pressure than is required in said holder; second, in a balanced valve for attachment to the high-pressure-gas pipes at suitable intervals along the lines of pipe which lead from the gas-generating apparatus to whatever location desired for the purpose of closing automatically wherever a leak or break may occur, in combination with a gas-holder or other source of supply.

Figure 1 is the right-hand side elevation of a high-pressure gas or gaseous-vapor generator to be used for generating and distributing high-pressure illuminating, heating, and motive-power gases. Fig. 2 is a vertical central section of the high-pressure gas or gaseous-vapor generator, showing the arrangement of the sectional generators in which the high-pressure gas or gaseous vapor is generated and the device for forcing the material from which the gas is made into the generator. Fig. 3 is the sectional plan view of the generator and separator into which the high-pressure gas or gaseous vapor is discharged, showing the form and arrangement of one of the conduits, the water and inner shell surrounding said conduit, and also a plan view of the pump, trap, and connecting-pipes. Fig. 4 is an enlarged broken horizontal section of the shell or casing, showing the space between the outer and inner shells and the arrangement of the doors therewith. Fig. 5 is a map representing a method of conducting gas for either heating, illuminating, or motive-power purposes by means of suitable pipes extending over a country or countries, and high-pressure-gas generators located at or near oil-wells or coal mines, or at other convenient locations in which gas is generated under high pressure and forced to whatever place or places desired. Fig. 6 is a central vertical section of a gas-holder and its foundation. The holder is filled with the high-pressure gas from the main pipes; but when filled the floating holder raises the valve and closes the communication between the pipe and said holder, and when the holder sinks or settles to near the bottom the weight thereof opens the valve, thus filling and refilling as long as the high pressure is kept up in the pipes. Fig. 7 is a sectional view of an automatic valve and trap to be used in connection with the underground high-pressure-gas pipes. Fig. 8 is a mountain scene, on which is shown a high-pressure-gas generator located at the base of a mountain, in which gas is generated under high pressure and forced through a suitable pipe or pipes to the top of the mountain, where an engine is driven thereby, the exhaust-gas being used for light and fuel.

Like letters of reference designate corresponding parts in all of the figures.

The base A, which is shown in several of the figures, is made preferably of cast-iron, and when of large diameter or for transportation it should be made in two or more sections with suitable flange-connection thereon, which, when put together, are held securely in place by suitable bolt-fastenings.

The stationary portion of the shell B is mounted upon the base A, and firmly secured thereto by bolts or rivets, and when the base is made in sections the shell portion B can be made to conform thereto, and the parts or sections properly secured by any well-known mechanical device or devices. One side or one section of the stationary part of the shell contains the feed-door F of the furnace. The remaining portion of the shell is divided into two doors, C, which swing upon the hinges *a*, and are kept closed by the fastening devices D, D′, and *p*′, as shown in Figs. 1 and 2. These devices will hold the upper and lower ends of the doors firmly in place, while the center can be held by a suitable clasp or other device. One of the doors is provided with a window, E, which extends nearly the length of the door. The frame of the window is made preferably of cast metal and riveted to the shell or casing of the door, and is provided with mica or suitable glass covering, through which the interior of the shell and the internal parts thereof are observed. The frames of the doors E are made from suitable angle-iron, either rolled from wrought-iron or made from cast metal. When made from cast metal the pattern can be formed into all of the necessary curvatures, projections, rivet and bolt holes thereto. To this frame the outer and inner casings of metal, $c^2 c^2$, are riveted, thus forming a clear space, x^2, which extends from the top to the bottom of the body of the generator. The outer casing of metal is provided with corresponding apertures, b^2, at the bottom thereof. These apertures are for the purpose of admitting the air at the top of the shell into space x^2, where it becomes heated on its downward passage, and is drawn through the bottom apertures, b^2, into the ash-pit, and thence upward between the grate-bars, where in its heated condition it mingles with the fuel and supports the combustion thereof. The draft can be accelerated by a jet of steam or air within the stack, or by suitable connections and devices arranged at the top of the shell, whereby air can be forced in and downward into the ash-pit, and thence upward.

In the broken horizontal sectional view, Fig. 4, it will be observed that at the joint between the two doors C C the frame or angle-iron w^2 w^2 and also the edge t^4 of the inner shell, e^2, overlap and cover the joint formed by the frame or angle-irons to which the hinges a are secured. By this arrangement a tight or close joint is obtained. It will also be observed in Figs. 3 and 4 that the doors do not occupy quite one-half of the diameter of the shell, although one-half may be so occupied; but when made as represented in the drawings the stationary portion will be much firmer than if it did not pass the central line. The width of the door is determined by the diameter of the coil or conduits within the shell. The top of the shell or body of the generator is provided with a suitable bonnet and stack thereto.

The interior of the shell is provided with conduits or coils x, mounted or supported upon suitable supporting devices, w', as shown in Fig. 2, and upon pipe or tubing l', as shown in sectional views, Figs. 2 and 3. These pipes project through the shell, and are connected by return-bend fittings e, and in such manner that a free circulation of liquids can be maintained through the series, and as cool liquid is forced through these pipes they cannot become heated to a red heat. Consequently they serve the double purpose of supporting the coils and heating the liquid which may pass through them. These supporting-pipes can continue under each coil or each section of the generator; but as the heat is not great enough to heat the sections above the fifth or sixth lower ones to a red heat it is not necessary to continue them above the fifth or sixth coil or conduit; but if, when a gas-flame is employed, the flames should fill the coil chamber or shell it might be necessary to introduce several more of the supporting-pipes. Those sections which are unsupported by pipes must be kept in position by straps or bars of iron secured to the turns of the coils by clips or other suitable contrivances. The coils or conduits are coiled from pipe which is drawn to the required length, or from short lengths of pipe which are welded at their ends until the required length is obtained. The first or inner turn should be made as small as possible without flattening the pipe. After the section is completed the two ends of the pipe should project tangentially to the inner and outer circle, and parallel, or nearly so, to each other. These projecting ends should be long enough to project through the outer shell and receive suitable fittings thereon. The external projecting end lies within the plane of the coiled section, while the inner end is bent at the commencement of the turn, and after the coil is completed it is heated and bent until it comes in contact with the surface of the coiled section, as shown in Fig. 2, where it will be observed that one-half of the coiled section rests upon said projecting inner ends. The coiled section should be made of pipe of different diameters. The section or sections containing pipe of the largest diameter should be placed at the bottom of the series, while the smallest pipe should be at the top. A good rule to adopt in making these sections would be to allow the space between each turn to equal the internal diameter of the pipe. Thus a good and free flue-space is obtained. The size or diameter of the pipe should be greater or less, or in accordance with the different diameters of the shell, and also the number of the sections should increase with an increased diameter of the said shell.

The superheating-coil O is located in the fire-box for the purpose of gaining additional heating-surface and utilizing heat. The two ends of this coil project through the shell or wall, as shown in Figs. 2 and 3. This coil is shown resting upon the grate-bars. Consequently the complete turns cannot extend below the top of the door, while the remaining turns are provided with return-bends on each side of said door, whereby a continuous circulation is obtained through the entire length of pipe forming the superheater. When gas is to be burned in the furnace in lieu of other fuels the superheating-coil can be coiled in continuous turns until completed, thus avoiding the return-bends, and also the superheating-coil O can be dispensed with, and the place now occupied with said coil and fuel can be filled with a suitable number of spiral conduits, which can serve the purpose of a superheater.

In sectional view, Fig. 2, a fire-brick, z', is shown, which is for the purpose of protecting the bottom of the superheater, and also a lining of asbestus board or of asbestus cement, f^2, or other material of an analogous nature, is introduced between the inner casing or shell and the coils or conduits, whereby protection is given to the shell and radiation of heat retarded.

The ends r' of the external turns of the coiled sections (shown in Figs. 1 and 3) are connected by right and left couplings d and nipples c to return-bends b, while the inner ends, u', with the exception of the upper and one or more of the lower ends, are connected by right and left couplings w and nipples n' to return-bends i'. The end of the upper coil, o', is connected by right and left couplings to the pipe o, which is provided with a check-valve, j', and valve 2, which controls or regulates the flow of the liquid as it is being forced by the pump into the upper conduit, whence it circulates by force through the entire length of said conduit, and is discharged through the lower end, v', coupling w, nipple v, check-valve t, and nipple u into separator H, wherein the steam, vapor, or gas separates from the condensations or from the liquids which may be discharged therein without evolving into steam, vapor, or gas. The separator is kept free from said liquid matter by the trap I, which forces or discharges the liquid through pipe a' into a device whereby it will be returned to the generator for subsequent evaporation.

The dome M (shown in Fig. 2) is supported by braces k', and is provided with the necessary pipes for conducting away steam, vapor, or gas to places of use.

The safety device L is connected to pipe P by a suitable fitting, and also the safety device is provided with the blow-off pipe n and a pipe, m, which can be used for conducting steam, vapor, or gas to a motor or other required place or places. To the T-fitting a^5 the pipe l is attached for conducting steam, vapor, or gas to the force-pump J. The flow through the pipe is controlled by valve 1.

O^2 is a T-fitting, to which the induction-pipe c' of the pump is connected, valve 5 being the controlling-valve thereto. The T-fitting is connected to the pump by the nipple d^5. To the run of the T a small pipe, k, is connected for conducting the products of petroleum or liquid combustibles to the pump, the flow of which is controlled by valve 4. Therefore, by means of the two induction-pipes c' and k and their valves, water and the liquid combustibles can be conducted and drawn into the pump in any proportion required. Thus heating or illuminating gas can be made in the same apparatus at will or as occasion requires; and, also, by closing valve 4, with valve 5 remaining open, steam can be generated for any required purpose.

The pressure of the apparatus is indicated by the gage f. The draft to the furnace can be controlled by the damper g.

Steam, vapor, or gas is conducted from the dome through pipe m' to the T-fitting m^2, which connects to or with the projecting end of the lower turn of the superheater. The flow of the steam, vapor, or gas into said superheater is controlled by valve 12, and the exit therefrom is through pipes s^5 and s'. These pipes are connected to the superheater by the right and left couplings x^3, a close nipple, and T-fitting y^2. The upper end of the long nipple s^5 is provided with a T-fitting z^2. To the outlet of this fitting the discharge-pipe s' is connected. This pipe is provided with a plug-cock, 13, for controlling the outflow of the superheated steam or gas.

To the upper end of the T-fitting z^2 the conducting-pipe q is attached, while the other end is connected with pipe m' by means of elbows, nipples, and a T-fitting. The flow in the pipe q is controlled by stop-cock 14, and the purpose whereof is to convert the superheater into a hot-water circulator or a steam-generator when not employed as a superheater for superheating steam or for the fixing of the gas.

The pipe y connects the separator with the superheater O by means of nipples, elbows, and a cross-fitting, l^2. The flow of the liquid from the separator to the superheater is controlled by valve 16. A blow-off pipe controlled by valve 9 is connected to the cross-fitting l^2, which can be employed to drain the superheater, and also other connecting-pipes.

The exhaust-pipe g' connects the exhaust-ports of the engine or motor with the cross-fitting l^2, whereby the exhaust from the engine is conducted into and through the superheater. Valve 10 is for the purpose of arresting the flow of the exhaust which passes through the conducting-pipe b on opening valve 6.

The dome M and separator H are connected by pipes s and i^2, T's j^2 k^2, and nipple i^3 to the trap I for the purpose of conducting the condensation and liquid not evolved into steam, vapor, or gas away. The valve 7 is introduced between the trap, dome, and separator for the purpose of stopping the flow of liquid matter when the trap is to be cleaned or any of the parts connected to or with the trap may get out of order. In case this does occur, valve 8 can be opened, thereby allowing the trap-liquid to escape to a waste-pipe or to some other place until the repairs are effected.

A glass gage, i, with protecting-rods h, is attached to the side of the separator H to determine the height of the liquid in said separator.

The heavy black lines on the map of a part of the United States and Canada (shown in Fig. 5) represent a net-work of gas-pipe, W^{a2}, passing through the principal towns and cities of the two above-mentioned countries. This net-work of pipe should be connected at all points of intersection by suitable pipe-fittings, while each pipe radiating from each intersection should be provided with a suitable automatic valve, Y^{a2}, which should also be connected with the pipe at the lowest point of depression, when practicable, between the said intersections. This net-work of pipe is designed to conduct gas from a location or locations where the material from which gas is generated exists in natural formations, or from some central point or depot to which the said material may be transported to the towns or cities in the country or countries in which the pipe is laid.

The gas which is distributed through the net-work of pipe is made in the high-pressure-gas generator shown in Fig. 1.

The high-pressure-gas generating apparatus should be located at or near coal formations and natural reservoirs of petroleum, (shown in Fig. 5,) in which the locations are indicated by the high-pressure-gas generating apparatus B A, which are distributed over the country or countries where the above-mentioned formations and reservoirs exist, and which do exist in Western Pennsylvania, Southern Canada, Western Maryland, Eastern Alabama, and Kentucky, Texas, and Illinois, and numerous other places which are not indicated on the map.

The high-pressure-gas generating apparatus is connected to the net-work of pipe wherein the gas is forced by the generative force which has been produced by the heat required to decompose and recompose the elements constituting water, solid and liquid combustibles, and generate a fixed gas therefrom. This pressure can be raised above one thousand pounds to the square inch, if necessary, whereby the gas could be forced any desired distance. Therefore it is highly practical to establish high-pressure-gas generating apparatuses in close contiguity to natural store-houses and generate gas from the hydrocarbonaceous solids and combustible liquids stored therein, and by its own generative force transmit it through pipes laid to every town or city in the country or countries in which the above-mentioned method is adopted. There need no fear or doubt arise in regard to quantity, quality, and cost of the gas generated, for its quality is as good as gas can be made by the action of heat and any of the purifiers now known.

Gas is made in the high-pressure generator in a very rapid manner, and as it is possible to make five million cubic feet of gas with one apparatus in one day of twenty-four hours it will be readily seen that with a distribution of five hundred high-pressure generators among the various coal-fields throughout the United States the enormous amount of two billions five hundred millions of cubic feet of gas can be generated daily and forced through the net-work of pipe laid throughout the said United States. When this gas is made for the triple purpose of light, heat, and motive power there should be an extra set of pipes and also of gas-holders; but the gas can be generated in the same apparatus in alternating periods of time, while the gas at each period can be discharged into its respective set of pipes, though the better way would be to employ separate generators for each kind of gas.

It will be observed that by the use of the above-described method the cost of transporting fuel from the field containing the hydrocarbonaceous deposits to the towns and cities of the country will be reduced to a cipher. Thus the enormous expenditure for freighting coal and petroleum to various parts of the country will be dispensed with, for the reason that the enormous power which is developed in the generation of the gas can be utilized to force the gas through the pipes to any distant point required without any further attention than is required to attend to the apparatuses which are generating the gas.

The net-work of pipe, however extended it may be, can be kept supplied with gas under a high pressure at all times or while the generators are at work making the gas. This high-pressure gas can be used for motive power to run motors, and the exhaust therefrom can be stored in a gas-holder for subsequent use for domestic purposes and for all classes of furnaces used in the mechanical arts.

Whenever motive power is required in factories, foundries, and all classes of workshops and all other places where motive power is needed, the motor can be run by high-pressure gas, and the exhaust thereof can be discharged into all classes of furnaces above alluded to; and also when the power is required and the furnaces not in operation the exhaust-gas from the engines throughout the towns or cities can be conducted and discharged into pipes or street-mains, and forced from thence into the gas-holders which are in connection with said pipe or street-main. The gas in these mains which distribute gas for domestic purposes is under but a very slight pressure—seldom exceeding ten inches of water. Therefore the back-pressure would be of no appreciable account.

In case the high-pressure heating-gas is used as a motive power in towns and cities, the supply-pipes would have to be laid the same as the present pipes for conducting illuminating-gas. If the illuminating-gas is used to run the motors with, the exhaust therefrom might cause pulsation of the gas-flame. If so, the evil can be remedied by attaching an equalizing-valve to the induction-pipe leading to the meter or to the eduction-pipe leading therefrom; and, furthermore, an extra set of pipes can be laid for the purpose of receiving the exhaust-gas and connect with the gas-holder, wherein said exhaust-gas can be forced by the constantly-discharging exhaust. The pipes which conduct the exhaust-gas to the main should be provided with check-valves to prevent the back-pressure of the gas from escaping when repairs of the engines have to be made.

The gas-holders X^{a2}, which are distributed over the United States and Canada, are indicated by black dots.

An application of the high-pressure-gas generator is shown in Fig. 8. The generator is located on the bank of a mountain stream and where fuel is easily obtained. A fixed water-gas is generated in the generator and forced through a pipe, s', which extends from the valley to the top of a mountain where mining operations are carried on. This gas is used for motive power to run motors x, while the exhaust therefrom can be discharged into a gas-holder, I′, for subsequent use, or into furnaces for immediate use. Gases for heating, illuminating, and motive power, and all other purposes for which fuel is used in and about mines located on the top of high mountains and other places, can be generated in the valleys below and forced through pipes to the elevated place or down into mines, whereby the great expenditure incurred in transporting fuel and water up the elevated places, which is now being done, can be entirely obviated. Therefore it will be observed that by the application of the high-pressure-gas generator, as above set forth, motive power would be cheap when compared with the present cost for its equivalent in steam-power.

In consequence of the non-condensability of the gas the above-described method of transmitting power under very high pressure is rendered feasible or practical when by no other method can fuel for heat, light, and motive power be transmitted so cheaply as by the herein-described method.

So far as the supply and demand are concerned, the amount of gas to be made can be regulated and controlled by the pressure-indicator at the generator. The discharge-pipe s' should be provided with a check-valve to prevent the back-pressure in the conducting-pipe in case of an accident to the generating apparatus. Should any accident occur, the said check-valve would stop the backward flow during any temporary absence of the engineer. Two or more generators should be in use as a relay and properly connected to the main pipe, so that in case of accidents the operation of making gas can be continued without detriment to the consumer.

Suitable connections and trapping devices can be attached to all depressions of the pipes, which will occur over undulating surfaces, for the purpose of trapping off any liquid of condensation that may arise, and which will gravitate to the lowest point of the depression.

Reasoning from a theoretical standpoint, it might be inferred that the amount of condensation would remain an unknown quantity, for the highly-heated high-pressure water-gas will be inducted into the main pipe in a thoroughly fixed state or condition, the velocity of which will be determined by the eduction at the terminal point or points. Now, therefore, if the demand for gas equals the supply, said velocity will be so great that all condensed matter will be forced along in the current and be discharged at the said terminal point or points; and, furthermore, as the velocity of gases through an open pipe is about one hundred miles in five minutes it is not unreasonable to infer that with the velocity obtained, after deducting the coefficient of the friction upon the interior of the pipe, a portion of the heat acquired in the generator would be transmitted many miles among the mountains. Consequently, if such action would be the result, there would be no danger from congealation or aggregation on the interior of said pipe.

The gas-holder I′ (shown in Fig. 6) is designed to be used, in connection with the distributing-pipe W^{a2}, (shown in Fig. 5,) when at remote distances from where the gas is generated, or whenever the said holder is filled from a pipe charged with gas under high pressure, which may be at or near the works or at any distance therefrom. The receiver q^4 is constructed of suitable masonry containing a passage, M^{a2}, into which a person can descend by the way of the ladder N^{a2}, and pass underneath the receiver and attend to the various parts when out of order. The gas holder is intended to be automatic in its operation, or to be filled from a pipe charged with high-pressure gas and discharge the same into street-mains under the pressure required for illuminating purposes. This holder is filled through induction-pipe $G^{s'}$, which is connected to the high-pressure main-pipe W^{a2}. The end of pipe $G^{s'}$ terminates in the valve-fitting L^{a2}, from whence the gas ascends through pipe o^4 and discharges into the holder until the holder becomes filled, after which communication is cut off by means of valve $2^{g'}$, which is raised by means of the valve stem or rod $2^{a'}$ and cord $2^{b'}$. This cord passes over a pulley, $2^{d'}$, that turns in the bracket $2^{e'}$, while to its end the weight $2^{c'}$ is attached for the purpose of counterbalancing the rod $2^{a'}$ and valve $2^{g'}$, in conjunction with the pressure on the under side of the valve, and for affording a means whereby the valve can be raised when the holder is filled. The eduction from the holder is through pipe p^4 and gate-valve u^8 into the street-main. The trap P^{a2} is for receiving the condensation from the pipe $G^{s'}$ and valve L^{a2}, which is discharged through pipe $2^{h'}$ into the trap, from whence it is discharged on opening valve 80. The water in the receiver q^4 can be discharged through pipe O^{a2} into the sewer Q^{a2} on opening valve 81. When the holder descends the bracket $2^{e'}$ strikes the hub $2^{f'}$ and forces the valve $2^{g'}$ down, thus allowing the gas to flow into the holder, and when it is nearly full it pulls on the cord and raises the valve to its seat. This operation continues until the demand and supply cease.

The balanced automatic swinging valve shown in Fig. 7 is to be used in connection with the net-work of pipe shown in Fig. 5. The ends U^{a2} of the main pipe are secured to the valve in any suitable manner. The gas flows into and through the chamber $2^{m'}$ and $2\ n'$, but it passes around the bottom of the valve S^{a2} through the connecting-chamber T^{a2}. The spring $2^{l'}$ is secured at its lower end and passes between two fulcrum-points $2^{k'}$, while the other end plays loosely in a recess in said valve. This spring keeps the valve in place, as shown, during the ordinary flow of gas; but when in case of a break in the pipe W^{a2} (shown in Fig. 5) the flow of the highly-compressed gas will close the valve to its seat, where it will remain until the nesessary repairs are made, after which the gas, on being let into the unfilled pipe, will equalize the pressure upon each side of the valve, thus allowing it to swing to its vertical position by the aid of the spring, as shown in the figure. This valve swings or turns upon the shaft $2^{o'}$. To this shaft a wheel, V^{a2}, is secured, and can be used to operate the valve when required. An indicator, $2^{p'}$, is attached to the wheel for the purpose of indicating which side of the valve the break in the pipe has occurred. The trap R^{a2} receives all condensation from the pipe, which is discharged therefrom through pipe $2^{i'}$ by the pressure of gas on opening valve 82. A trap that will fill and discharge automatically can be used in lieu thereof and require no attention.

What I claim, and desire to secure by Letters Patent, is—

1. In combination with a high-pressure-gas generator, a main for conducting high-pressure gas, a valve-casing, an automatic balanced valve, a trap connected with the valve casing or main, and a discharge-pipe having a valve.

2. In combination with a high-pressure-gas generator, a main or conduit for the transmission of high-pressure gas, a double-seated valve-chamber, and a balanced automatic double-faced valve suspended therein, whereby the flow of gas is automatically shut off in case of a break in the main.

3. In combination with a high-pressure-gas generator, a main or conduit for the transmission of high-pressure gas, a valve-casing having two valve-seats—one at each side or end—and an automatic balanced valve having a double face for closing, fitting against each seat, whereby the flow of gas is automatically shut off in case of a break on either side of the valve.

4. In combination with a high-pressure-gas generator, a main or conduit for the transmission of high-pressure gas, a valve-chamber having two seats, as described, a double-faced balanced valve adapted to said seats, and an operating-wheel outside of the chamber, connected with the valve and provided with an index for showing on which side of the chamber the break in the main has occurred when the valve is closed and forced to one or the other side.

5. In combination with a high-pressure-gas generator and main, and a valve-box connected therein, and having two seats, as described, and a balanced double-faced valve suspended in the box between the seats, and an actuating-spring bearing thereon for throwing the valve in either direction corresponding with a change in the pressure of gas on either side thereof.

6. In apparatus for generating and distributing high-pressure gas, the combination of the high-pressure generator, a main or conduit, a governing-holder, a valve in the inlet-pipe thereof, a pulley secured to the top of the holder on the inside, and a cord or chain connecting to the stem of the valve, and having a counterbalancing-weight connected to the end passing over the pulley, as described.

WM. FRANK BROWNE.

Witnesses:
R. SYLVANI,
E. A. LEGRAND.