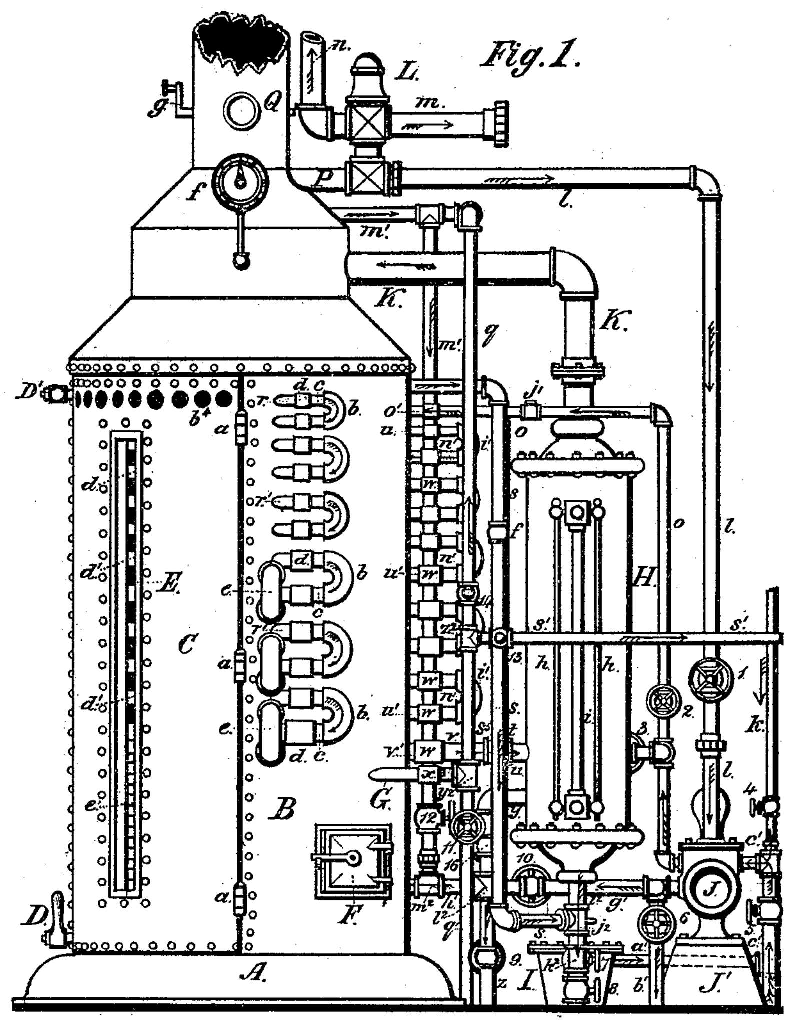
(No Model.) 5 Sheets—Sheet 1.

W. F. BROWNE.

APPARATUS FOR SUPPLYING GASEOUS FUEL TO METALLURGICAL FURNACES.

No. 263,309. Patented Aug. 29, 1882.

Fig. 1.



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(No Model.)

5 Sheets—Sheet 2.

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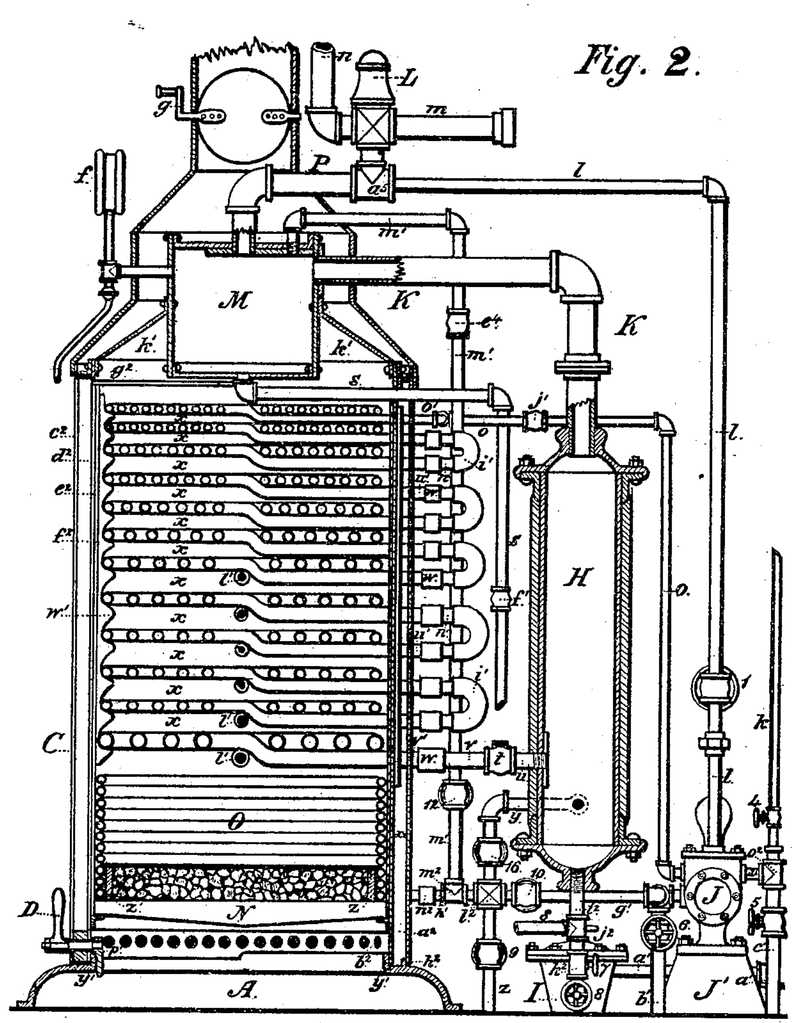
Fig. 2.



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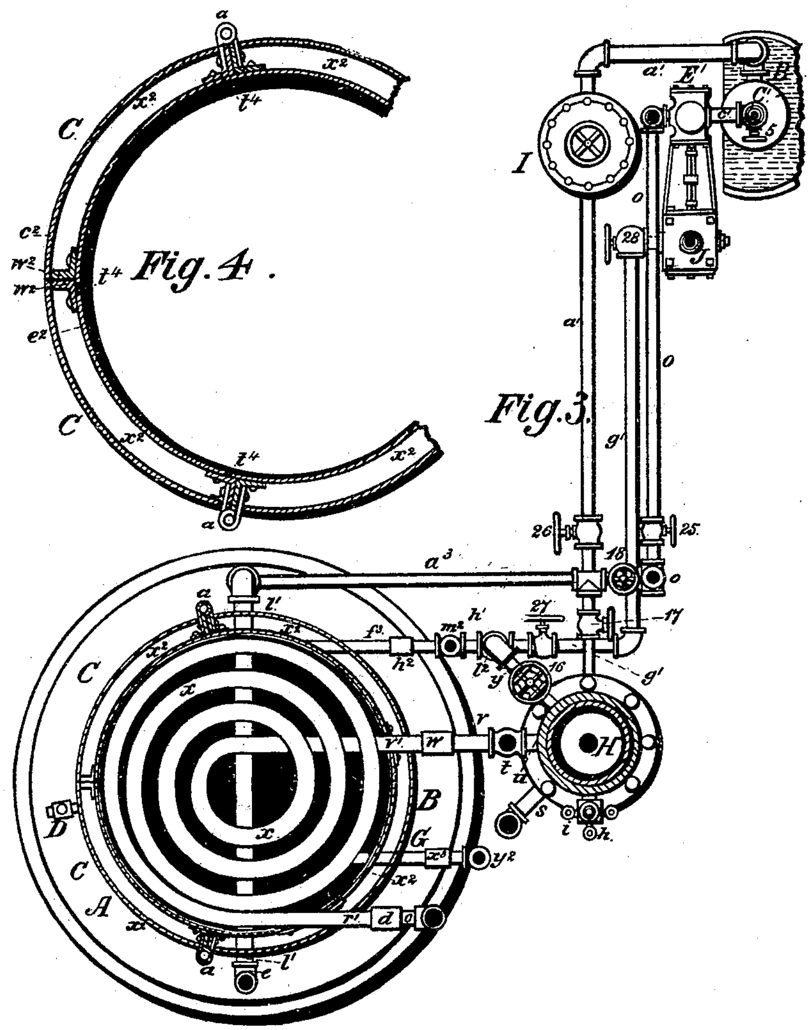

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5 Sheets—Sheet 4.

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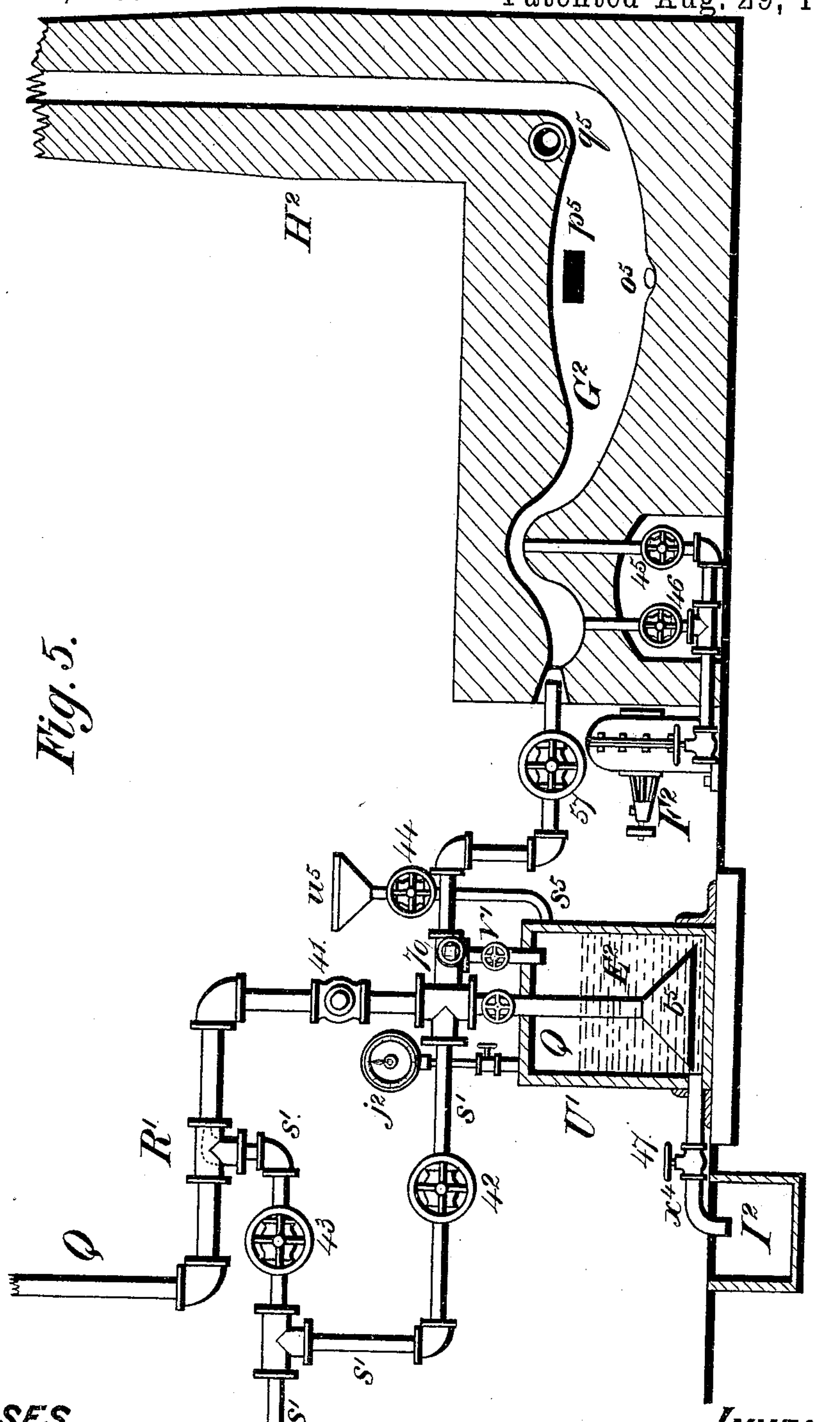

Fig. 5.

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APPARATUS FOR SUPPLYING GASEOUS FUEL TO METALLURGICAL FURNACES.

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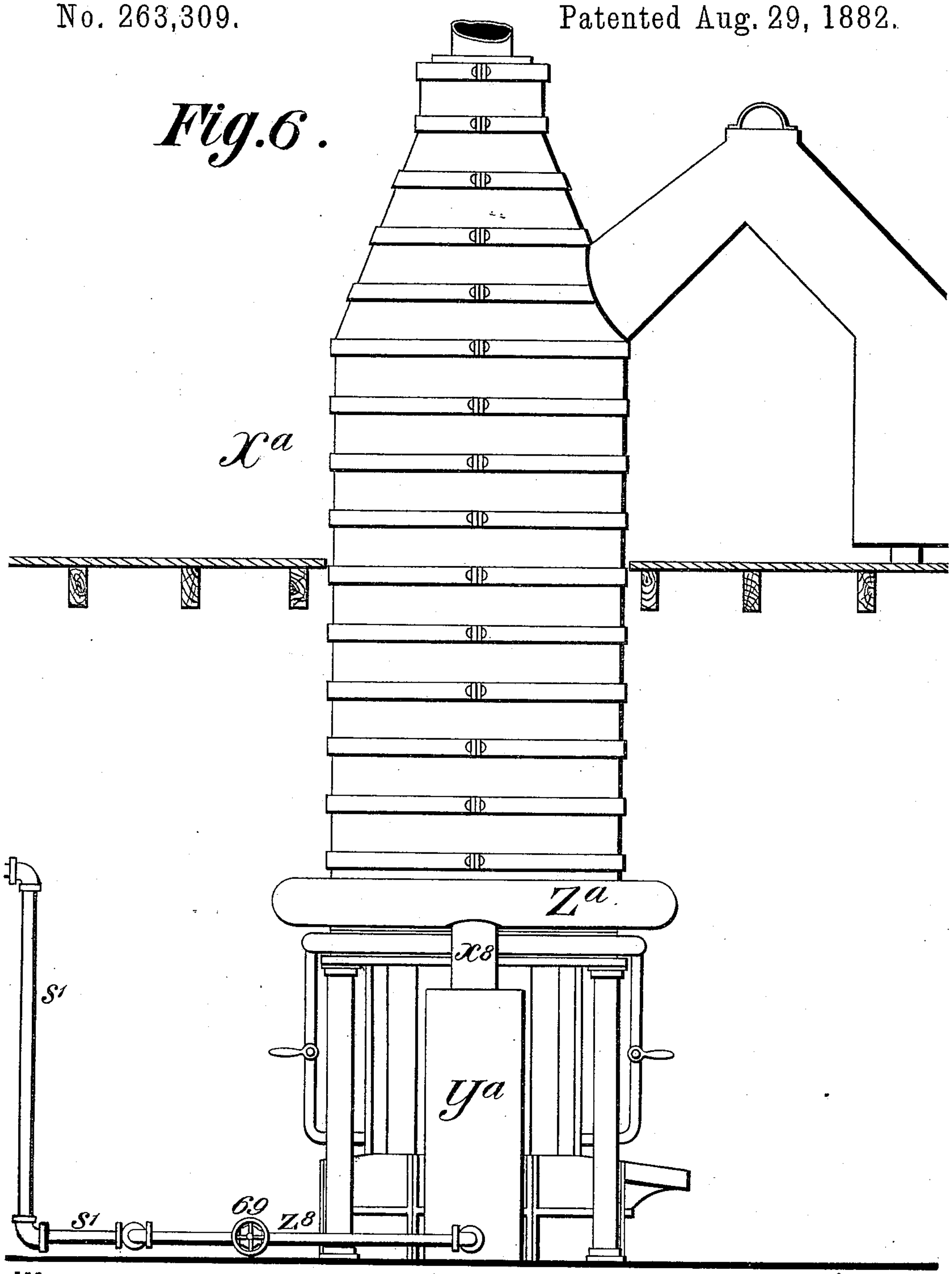
Fig. 6.



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UNITED STATES PATENT OFFICE.

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

APPARATUS FOR SUPPLYING GASEOUS FUEL TO METALLURGICAL FURNACES.

SPECIFICATION forming part of Letters Patent No. 263,309, dated August 29, 1882.

Application filed December 19, 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 certain new and useful Improvements in Apparatus for Supplying Gaseous Fuel to Metallurgical Furnaces; 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 mode and means for the production of gaseous fuel under high or low pressure, and the application thereof to all classes of high or low pressure metallurgical furnaces.

The invention consists in the combination of a gas-generator with a receiver containing combustible liquids through which the gas is forced, and thereby carbureted, and in suitable connections with a metallurgical furnace into which the carbureted gas is forced and burned.

Figure 1 is the right-hand side elevation of a high-pressure gas or gaseous-vapor generator to be used in connection with all classes of metallurgical furnaces. 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 outer 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 sectional view of a reverberatory furnace, fan-blower, tank, or reservoir for holding combustible liquids into which the products of combustion and gas are forced by the force generated in the gas-generator shown in Fig. 1, and from thence into the reveratory furnace. Fig. 6 is an elevation of a blast-furnace or smelting-furnace in which metals are smelted by heat generated from the combustion of gases which are generated in a high-pressure-gas generator, as shown in Fig. 1.

Like letters of reference designate corresponding parts in 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, 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 in all of the necessary curvatures, projections, rivet and bolt holes thereto. To this frame the outer and inner casings of metal, c^2 e^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 apertures b^4 at the top, while the inner 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, Fig. 2. 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 coil 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 *l'*. 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 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 brace 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^5 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.

In Fig. 1 a high-pressure-gas generator is shown, in which a heating gas or gaseous vapor can be made, which gas may be stored for subsequent use; or the gas can be discharged from the generator directly into a furnace for immediate use, and also an illuminating-gas can be made in the same generator, when desirable or when the heating-gas is not required for the furnace. The change from a heating-gas is made simply by turning valve 4 on pipe k. By turning this valve the requisite amount of combustible liquid will enter the forcing device and be forced therefrom into the generator, wherein a fixed gas is formed, the quality of which can be determined by a test-light. If not enough carbon, valve 4 should be turned a little more open, and the reverse if too much carbon appears in the gas-flame.

Heretofore heating or illuminating gas has been made for metallurgical furnaces, but at first stored in gas-holders, and thence conducted therefrom to said furnaces. The reason why this method has not been adopted for general use is that no ordinary gas-works can produce gas fast enough to supply an ordinary smelting or blast furnace for continuous work, for the gas is at first made and stored in large holders, after which it is discharged into the furnace and burned, and as the demand exceeds the supply an intermittent action in the furnace is the result. Consequently a great amount of heat is lost from the cooling and reheating of the furnaces, and also the heat required to generate the gas has radiated therefrom prior to filling, or while in the gas-holder. In consequence of these defects, and the great cost of works for the production of the gas, the use of this agent for a fuel in metallurgical furnaces has become almost obsolete. Now, to obviate these defects the new method and means for making gas under high pressure has been invented.

The apparatus shown in Fig. 1 is of special construction for generating high-pressure gas, gaseous vapor, or steam, and in alternating periods of time. A highly important advantage derived from the method of making gas under high pressure is that the gas so generated can by its own generative force be discharged through pipes to any distance required, and thence be discharged therefrom into furnaces for immediate use, or to gas-holders for subsequent use; and, also, where a furnace is constructed to withstand a high pressure the gas can be forced by its own generative force therein, and under such pressure that any intensity of heat required can be obtained. The quantity, quality, and pressure of gas will not be found wanting. The gas is at all times under perfect control. It can be increased or diminished simply by turning a valve, and the supply to the furnace can be entirely cut off within five seconds by simply closing a valve; and, furthermore, the apparatus can be making steam within five minutes after closing valve 4 on pipe k.

When power is required at the reduction or smelting works, which is always required to produce the air-blast, the generative force of the high-pressure gas or gaseous vapor can be used to run the motor with, and the exhaust-gas from said motor can be discharged into the furnace, where it will be burned, thus acquiring a double use of the high-pressure gas or gaseous vapor; and, furthermore, the heat that is within the gas when being discharged into the furnace is equal in effect to the same amount of heat derived directly from an amount of fuel required to generate the said gas. Consequently that amount of fuel is saved, or, in other words, an equal amount of fuel would have to be consumed to produce the same heat were the gas to be discharged into the furnace in a cold state. Therefore when the high-pressure-gas generator is located near by a furnace a saving of fuel is effected by transferring the heat within the gas to said furnace, which will equal the amount of heat lost by radiation from the high-pressure generator, while the effect of the heat in the furnace will equal the transmitted heat plus the heat derived from a perfect combustion of the gas. This double use of a fuel is an important factor in an economical point of view when taken in connection with all classes of metallurgical furnaces, and also in all other furnaces where great heat is required.

In Fig. 5 a sectional view of a reverberatory furnace is shown. G^2 is the furnace. p^5 is the opening where the furnace is charged with metals or ore, and o^5 is where the molten metals are drawn off. A pipe, q^5, through which water is circulated, is placed across the furnace to support the masonry at the angle where the uptake in stack H and furnace unite. Air is driven into the furnace by blower F^2 through pipes and controlling-valves 45 and 46. The carbureting device shown in the figure may or may not be used in connection with the high-pressure-gas generator; but when the products of combustion are to be utilized it will be found desirable to carburet the same, which may be done in the following manner: The tank U' is charged with a suitable amount of combustible liquid, E^2, after which gas or gaseous vapor is forced from the high-pressure generator through pipe s', on opening valve 43, into the injector R', when on its passage therefrom it draws and forces the products of combustion through pipe Q into the carbureting-tank, wherein the products of combustion, in combination with the gas or gaseous vapor, becomes carbureted, and thence discharged therefrom through pipe v', on opening valve 57, into the reverberatory furnace G^2. When the products of combustion are not utilized the gas or gaseous vapor can pass through pipe s', on opening valve 42 and closing valve 41, into the tank U', and from thence, as above described, into furnace G^2. When it is found nessary to conduct the gas direct without passing through the carburetor to the furnace the valve in pipe Q, leading to the carburetor, is closed, and also the valve in pipe r', leading from the carburetor, and valve 70 opened. The tank can be filled through cup u^5 on opening valve 44. The pressure in the tank is known by gage j^2. The tank can be drained through pipe x^4, on opening valve 47, into tank I^2.

A smelting-furnace, X^a, is shown in Fig. 3. Air is forced into the annular pipe Z^a and distributed by pipe x^8, from which the air is discharged into the furnace. Two pipes, z^8, one of which is not shown, conduct and discharge gas into the furnace on opening valve 69. These two pipes connect with pipe s', which conducts the gas or gaseous vapor from the high-pressure generator. The carbureting device shown in Fig. 5 can be interposed between the smelting-furnaces and the high-pressure-gas generator, as and for the purpose above described.

The application of the high-pressure-gas generator shown in Fig. 1 to all classes of metallurgical furnaces is similar to what is shown and described in the foregoing specification.

The gas-generator shown in this application is not claimed *per se*, as it forms the subject of a separate application.

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

1. The combination of a high-pressure-gas generator, a separate carbureting-tank, a connecting-pipe opening in the carburetor below the surface of the carbureting-liquid, an eduction-pipe, and a metallurgical furnace, connected as described, and for the purpose set forth.

2. A gas-generator, a pipe, Q, connecting with the stack for conveying the products of combustion, and a pipe, s', for conveying gas under pressure, and a carburetor, connected as described, in combination with a metallurgic furnace, as set forth.

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