No. 827,081. PATENTED JULY 31, 1906.

P. I. COHEN.

APPARATUS FOR MANUFACTURING GAS.

APPLICATION FILED NOV. 7, 1905.

2 SHEETS—SHEET 1.

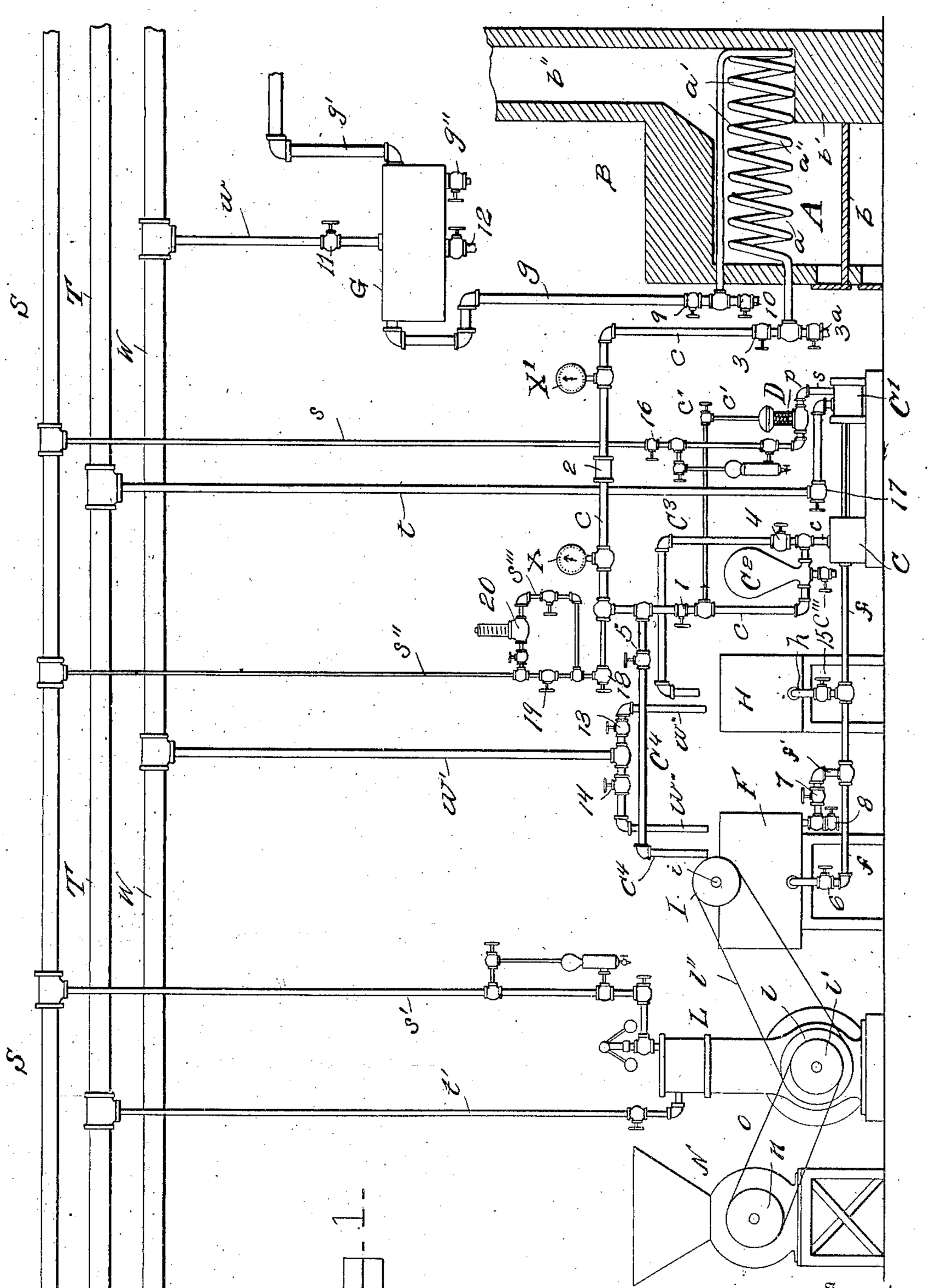

Fig. 1.

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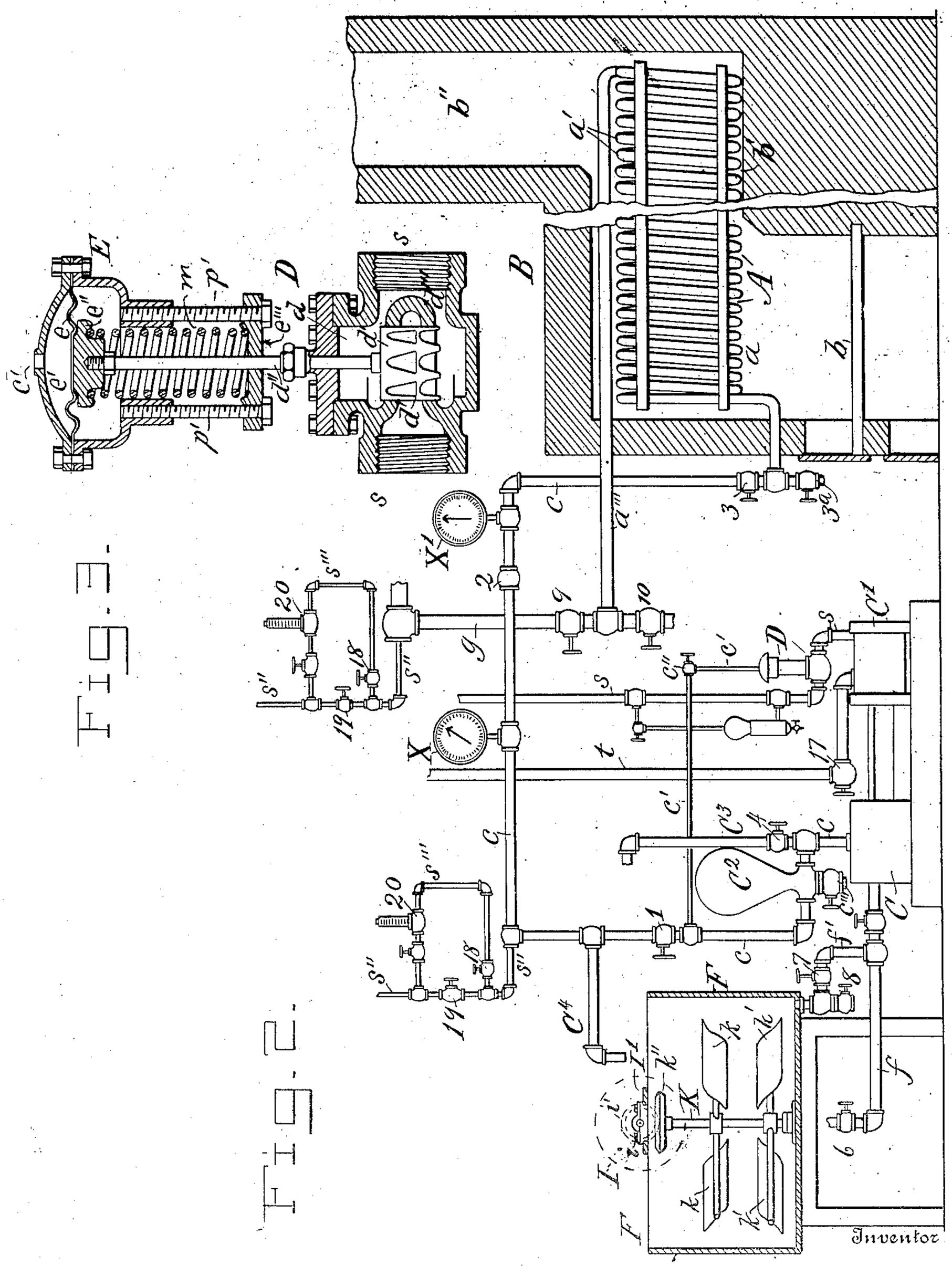
2 SHEETS—SHEET 2.

FIG. 2.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR MANUFACTURING GAS.

No. 827,081. Specification of Letters Patent. Patented July 31, 1906.

Application filed November 7, 1905. Serial No. 286,314.

*To all whom it may concern:*

Be it known that I, PHILIP I. COHEN, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Apparatus for Manufacturing Gas, of which the following is a specification.

This invention relates to apparatus for manufacturing illuminating and heating gas from a liquid, such as hydrocarbon oil or an emulsion of oil and water or a semiliquid emulsion containing oil, peat, and water or other desired composition.

The object of my invention is to provide an apparatus which is simple in construction and operation and which is adapted for rapidly and economically generating gas at a single operation by forcing a liquid or semiliquid gas-yielding material under a constantly maintained and controlled pressure through heated coils or conduits maintained at the proper temperature for making fixed gas.

A special object of my invention is to provide for automatically and constantly controlling the pressure in the liquid-supply pipe and generating-coil, so that the pressure in the coil shall be substantially uniform and of the proper degree to permit the gas-yielding material to be converted into fixed gas while passing through the coil or conduit, whereby a uniform quality of fixed gas is made without undue strain or injury to the apparatus.

The matter constituting my invention will be defined in the claims.

I will now describe my improved gas-generating apparatus and the manner of operating the same by reference to the accompanying drawings, in which—

Figure 1 represents a diagrammatic view in elevation of apparatus embodying my invention, including certain associated devices used in a gas-making plant. Fig. 2 represents an elevation of my gas-making apparatus, on enlarged scale. Fig. 3 represents a sectional elevation of the governor and connections for controlling the pressure of feed liquid in the supply-pipe and generating-coils.

The principal parts of my apparatus consist of a gas-generating coil A, set in a furnace, a pumping-engine C C′, a governor or pressure-regulator D for controlling the flow and pressure of gas-yielding liquid in the supply-pipe and generating-coils, a reservoir or tank F for oil or emulsion, and suitable connecting pipes and valves, as described below.

The generating-coil A is made of two sizes of pipe, which may be respectively one inch and one and a quarter inches diameter and about three hundred and ten feet long. The inlet end *a* of the coil, comprising about two-thirds of its length, is of one-inch pipe and connects at joint *a″* with the enlarged pipe one and a quarter inches, forming the expanding and gas-fixing part *a′*, about one-third of the entire coil. The size of pipe and length thereof in a generating-coil are only given as an example which is efficient in practice, and I do not limit myself either to the size of pipe or length of coil or to any particular arrangement thereof in the furnace. It may be placed horizontally, as shown in a heating-furnace B, having a grate *b*, a supporting-ledge *b′*, and chimney *b″*. The furnace will be heated by means of any suitable fuel on the grate or otherwise, so as to heat the generating-coil to a temperature of from 1,200° to 2,000° Fahrenheit.

I have found in practice that a great length of generating-coil is not necessary, it only being important to have a sufficient length of the smaller pipe to provide for heating the gas-yielding liquid up to 1,200° or 1,500° Fahrenheit and a sufficient length of the larger pipe to provide for expanding the liquid and vapor and converting it into fixed gas at a temperature ranging from about 1,500° to about 1,800° or 2,000° Fahrenheit.

The pumping-engine comprises the pump-cylinder C and the steam-cylinder C′ and may be any well-known style of high-pressure pump suitable for forcing a liquid or semiliquid under pressure into the generating-coil. A liquid-supply pipe *f* connects with the cylinder C, and a discharge-pipe *c* leads therefrom to the inlet end of coil A and is provided with controlling-valves 1 and 3, a check-valve 2, and a blow-off valve 3ª below the connection with the coil. In the steam-supply pipe *s*, leading to cylinder C′, is connected the governor or pressure-regulator D, Figs. 2 and 3, and with the diaphragm-chamber of this governor is connected the liquid-pipe *c′* from the discharge-pipe *c* and is provided with a valve *c″*. An air-pressure chamber C², provided with a blow-off valve *c‴*, is connected in the discharge-pipe *c* to make the flow of liquid more even and free from pulsations. A pipe C³, having a valve 4, connects with pipe *c* near the pump and extends to a

water-tank H, and a second pipe $C^4$, having a valve 5, connects pipe *c* with the storage-tank F for returning oil or emulsion when valve 3 at the coil is closed.

The governor D is shown on enlarged scale in Fig. 3. It is constructed with a valve-chamber *d*, in which is seated a balanced valve *d'*, which is seated in the opening of the plate *d'''*. The valve *d'* is provided with a stem *d''*, which extends upward into the diaphragm-chamber E. This chamber is constructed of upper and lower plates or heads, connected by flanges and bolts, as shown, and provided with a flexible diaphragm *e*, dividing it into two compartments, the upper one *e'* of which is the fluid-chamber which connects by fluid-pipe *c'* with the discharge-pipe *c* from the pump. To the under side of the diaphragm is connected the metallic hub and bearing-plate *e''*, having a screw-threaded opening to which is connected the valve-rod *d''*. The chamber E is supported on the valve-chamber *d* by the connecting-rods *p*. A lower bearing-plate *e'''* is connected by the adjustable rods *p'* with the lower head of chamber E and supports a coiled spring *m*, which bears upward against the plate *e''*. Steam is supplied from the main S through pipes *s*, the valve-chamber *d* of governor D to the steam-cylinder C', and the exhaust-steam is discharged through pipes *t* to the main exhaust-pipe T. The supply and exhaust pipes *s* and *t* are provided with valves 16 and 17.

The tank F for oil or emulsion is provided with an outlet-pipe *f*, having a valve 6, which connects with the pump-cylinder C and is also provided with a second outlet-pipe *f'*, having a valve 7 and a blow-off valve 8. Within the tank F is suitably mounted a central vertical shaft K, having radial agitating-blades *k k'*, and at its upper end a beveled gear-wheel *k''*, which meshes with a beveled pinion *i'* upon the horizontal shaft *i*, arranged in journal-boxes on the cross-pieces I', said shaft *i* having at its outer end a belt-wheel I, over which passes a driving-belt *l''* from the belt-wheel *l* of the engine L. The shaft K may be provided with two sets of agitating-blades, as shown. The tank H for wash water is preferably provided and connects by pipes *h*, having a valve 15, with pipe *f*, leading to the pump. This water-supply is simply for washing out the pump and pipes after the operation of making gas has ceased. To the engine L is connected a steam-supply pipe *s'* and an exhaust-pipe *t'*. To the driving-shaft of the engine are connected the belt-wheels *l* and *l'*, over which are passed the belts *l''* and *o*. In the plants as usually constructed is provided a peat-pulverizing mill N, to the shaft of which is connected a belt-wheel *n*, over which is passed the belt *o*.

The cooler or condenser G may be of any well-known kind and is provided with an inlet-pipe *g*, having a controlling-valve 9 and a blow-off valve 10. The outlet-pipe *a'''* of the coil connects with pipe *g*. The outlet gas-pipe *g'* leads from the condenser to the gas-holder. A blow-off pipe and valve *g''* connects with the gas-pipe at the condenser. A water-supply pipe *w* leads from the main pipe W to the condenser G and is provided with a valve 11 to supply the necessary cooling-water. A discharge-pipe and valve 12 takes off water from the condenser. A water-supply pipe *w'* leads from the main W and is provided with two branch pipes *w''*, having valves 13 and 14 and discharging into the water-tank H and the emulsion-tank F.

The supply-pipe *c* for oil or emulsion is provided with a pressure-gage X between the pump and the check-valve 2 and with a second pressure-gage X' between the check-valve 2 and the inlet of coil A. A branch steam-supply pipe *s''*, provided with valve 18, connects at one of the angle-joints with the supply-pipe *c* for injecting steam when desired, either to mix with the oil or emulsion or to clean out the pipe and coil when oil and emulsion are shut off. A by-pass pipe *s'''*, having a reducing-valve 20, connects with the pipe *s''* on both sides of a valve 19, as shown in Fig. 1, so as to supply steam at any desired pressure to the pipe *c*. The pipe *s'''* is also provided with controlling-valves on each side of the reducing-valve 20.

The tank F being supplied with hydrocarbon oil—such as gas-oil or fuel-oil or an emulsion of peat, oil, and water or other suitable composition for making gas—the agitator is put in operation for keeping the ingredients thoroughly mixed, and the valve 6 is opened for supplying the liquid through pipe *f* into the pump-cylinder C. The pumping-engine is put in operation, and liquid is forced to the generating-coil A. The coil at this time should be heated to the desired temperature for generating gas. At first as the coil is gradually heated up the vapors may be blown off or passed into the condenser and the condensed products drawn off through valve *g''*. The coil will be heated to a temperature ranging from about 1,200° to 2,000° Fahrenheit, and in the rear end, composed of the enlarged pipe, the vapor will be expanded and fully converted into fixed gas which passes off through pipe *g* into the condenser, where a small percentage of by-products is separated while the fixed gas is passed off through pipe *g'* to the gasometer or holder.

In practice the governor is adjusted and set so that the pump will deliver liquid at any desired pressure from twenty pounds up to sixty or eighty pounds to the square inch. At whatever pressure the governor is set to work such pressure will be uniformly maintained in the liquid-supply pipe and generating-coil. In practice I maintain a pressure

in the coil at which the oil or emulsion will first be highly heated, then vaporized, and finally the vapor converted into fixed gas without permittting any deposit of tar or lamp-black or hard carbon on the interior wall of the pipe. The pressure is such that the liquid and vapors scour the inside of the pipe, but permit the liquid to be converted into fixed gas. The governor may be adjusted to work at different pressures corresponding to the degree required to gasify different kinds of liquid or different gravities of oil. If it is desired to generate gas more rapidly with a given gravity of oil or emulsion, the governor is set to maintain a higher pressure in the coil, and a higher heat is maintained in the furnace and coil. The governor under all circumstances keeps the pressure even and uniform throughout the coils and supply-pipe, so that a uniform quality of fixed gas is made. Without the governor the pressure might run up to several hundred pounds to the square inch and be so irregular that no definite quality of gas could be generated. I preferably operate at a pressure of from twenty-five to sixty pounds and produce fixed high-candle-power gas which is delivered at the outlet of the coil. The two pressure-gages X and X′ indicate any variations of pressure that may occur on opposite sides of the check-valve 2, either in the coil or pump. When the apparatus is working normally, both gages show the same pressure.

When an emulsion composed of peat, oil, and water, is used to make gas, the agitator K *k* is kept in operation, so as to keep the emulsion well mixed and uniform, and therefore produce a uniform quality of gas throughout the run or period of manufacture.

When it is desired to reduce the candle-power of the gas generated in the coils or add an increased percentage of hydrogen to the gas as it is generated, the valve 18 in pipe *s″* and the valves in the by-pass pipe *s‴* are opened, while valve 19 is closed, thereby passing steam through the pressure-reducing valve 20 into the liquid-discharge pipe *c*, leading from the pump to the generating-coil. By means of the valve 20 the pressure of steam is reduced from the boiler-pressure approximately to the pump-pressure or pressure of liquid flowing from the pump through pipe *c*. The steam thus supplied may be superheated or simply live steam from the boiler and mingles uniformly with the gas-yielding liquid without reducing or changing the pressure of the same either in the pipe or the generating-coils. This added steam will be decomposed in the coil, reacting with the carbon in the oil or emulsion to liberate hydrogen. It will thus be seen that the gas generated will be diluted, so as to reduce the candle-power thereof, without in any way changing the oil or emulsion in the supply-tank F. This operation is quite important in practice, since the candle-power of the finished gas can be readily varied without changing the pump-pressure or the quality of the gas-yielding liquid supplied thereto.

I also find it desirable to inject steam into the gas-discharge pipe, and for that purpose provide a steam-supply pipe and reducing-valve connecting with the gas-outlet pipe *g*, Fig. 2.

It will thus be seen that with my apparatus I can in one operation make high-candle-power gas for illuminating purposes and by introducing steam, as above described, instantly change the quality of gas to lower candle-power suitable for heating purposes or for use as a motive power in gas-engines. The candle-power of the gas will be regulated by the quantity of steam which is introduced.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination with a gas-generating coil or conduit, of a pumping-engine, a governor connecting with the steam-supply pipe of the steam-cylinder of said engine and with the outlet-pipe of the pump, which outlet-pipe connects with the coil, for forcing liquid or semiliquid material under a constantly maintained and uniform pressure into the coil, and a suitable supply for the gas-yielding material and connecting-pipes, substantially as described.

2. The combination with a gas-generating coil of a pumping-engine comprising a steam-cylinder and pump-cylinder, a governor connecting with the steam-supply pipe and with the liquid-discharge pipe, a pipe leading from the pump to the coil containing a check-valve and a pressure-gage and a supply-pipe for liquid or semiliquid gas-yielding material connecting with the pump, substantially as described.

3. The combination with a gas-generating coil or conduit, of a pumping-engine, a governor connecting with the steam-supply pipe of the steam-cylinder and with the outlet-pipe of the pump which outlet-pipe connects with the coil, for forcing liquid or semiliquid material under a constantly-maintained and uniform pressure into the coil, a supply-tank for the gas-yielding material having an agitating device and connecting-pipes, therefrom to the pump, substantially as described.

4. The combination with a gas-generating coil of a pumping-engine comprising a steam-cylinder and pump-cylinder, a pressure-regulating and reducing device connecting with the steam-supply pipe to the steam-cylinder, a pipe leading from the pump to the coil containing a check-valve, a pressure-gage between the pump and check-valve and a second pressure-gage between said valve and

the coil and a supply-pipe for liquid or semi-liquid gas-yielding material connecting with the pump, substantially as described.

5. The combination with a gas-generating coil of a pumping-engine having a pressure-regulating device, for forcing a liquid or semi-liquid into said coil under a substantially uniform pressure, a supply-pipe for liquid or semiliquid material to the pump, a discharge-pipe leading therefrom to the coil, and a valved steam-supply pipe connecting with said liquid-discharge pipe, substantially as described.

6. The combination with a gas-generating coil, of a pumping-engine having a pressure-regulating device, for forcing a liquid or semi-liquid into said coil under a substantially uniform pressure, a tank for oil or emulsion, a pipe leading therefrom to the pump, a discharge-pipe leading from the pump to the coil, a steam-supply pipe, having a pressure-reducing valve, connecting with said discharge-pipe, whereby the candle-power of the gas generated may be reduced without changing the oil or emulsion in the supply-tank, substantially as described.

7. The combination with a gas-generating coil, of a pumping-engine having a pressure-regulating device, for forcing a liquid or semi-liquid into said coil under a substantially uniform pressure, a supply-pipe for liquid or semiliquid material leading to the pump, a discharge-pipe leading therefrom to the coil, a steam-supply pipe, having a pressure-reducing valve, connecting with said liquid-discharge pipe, and a valved steam-supply pipe connecting with the gas-discharge pipe from the generating-coil, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

PHILIP I. COHEN.

Witnesses:
C. C. SANDERS,
JAMES A. VINCENT.