(No Model.) 4 Sheets—Sheet 1.

J. W. HAYES.

APPARATUS FOR GAS MANUFACTURE.

No. 507,003. Patented Oct. 17, 1893.

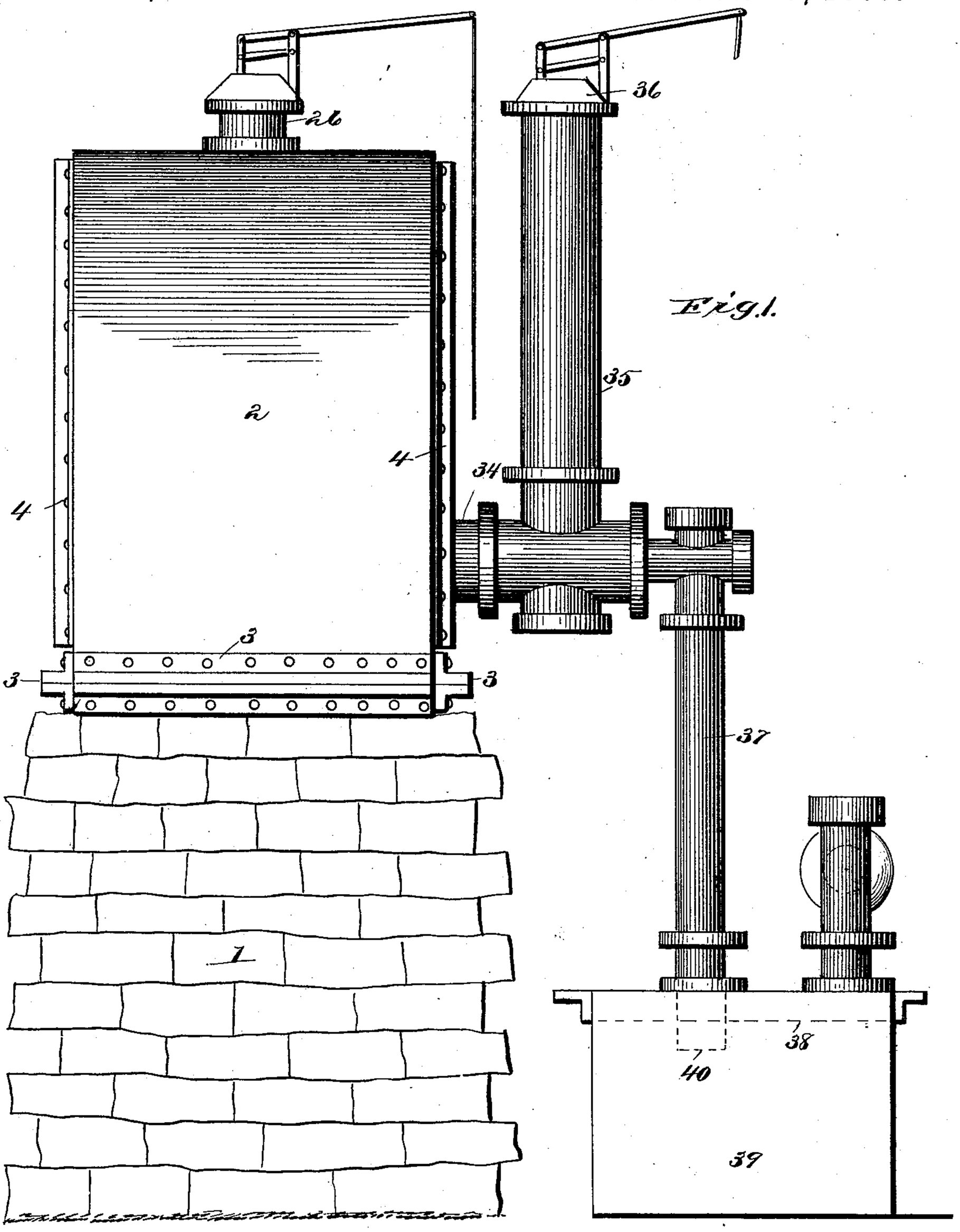

Fig. 1.

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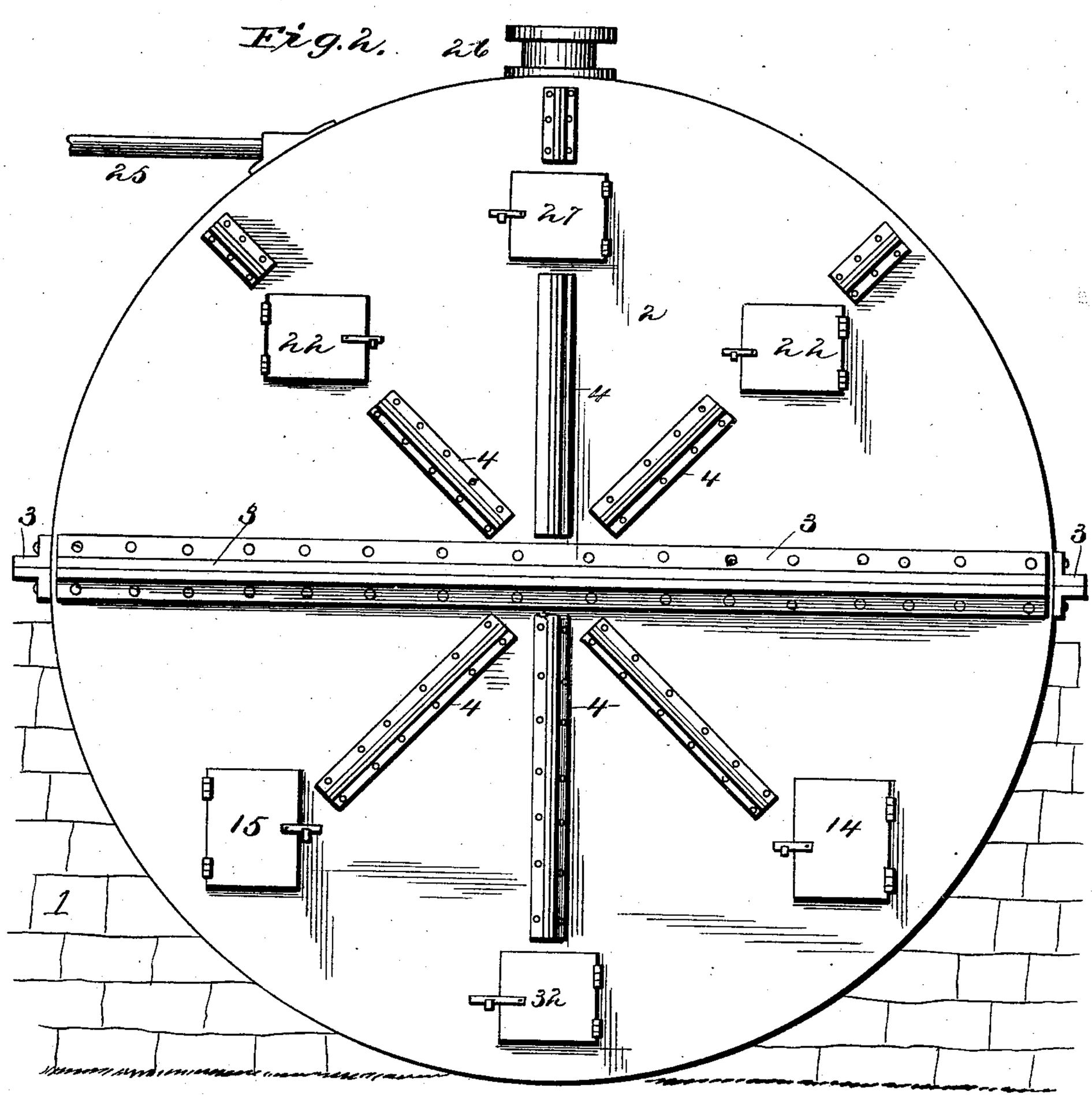
Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

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APPARATUS FOR GAS MANUFACTURE.

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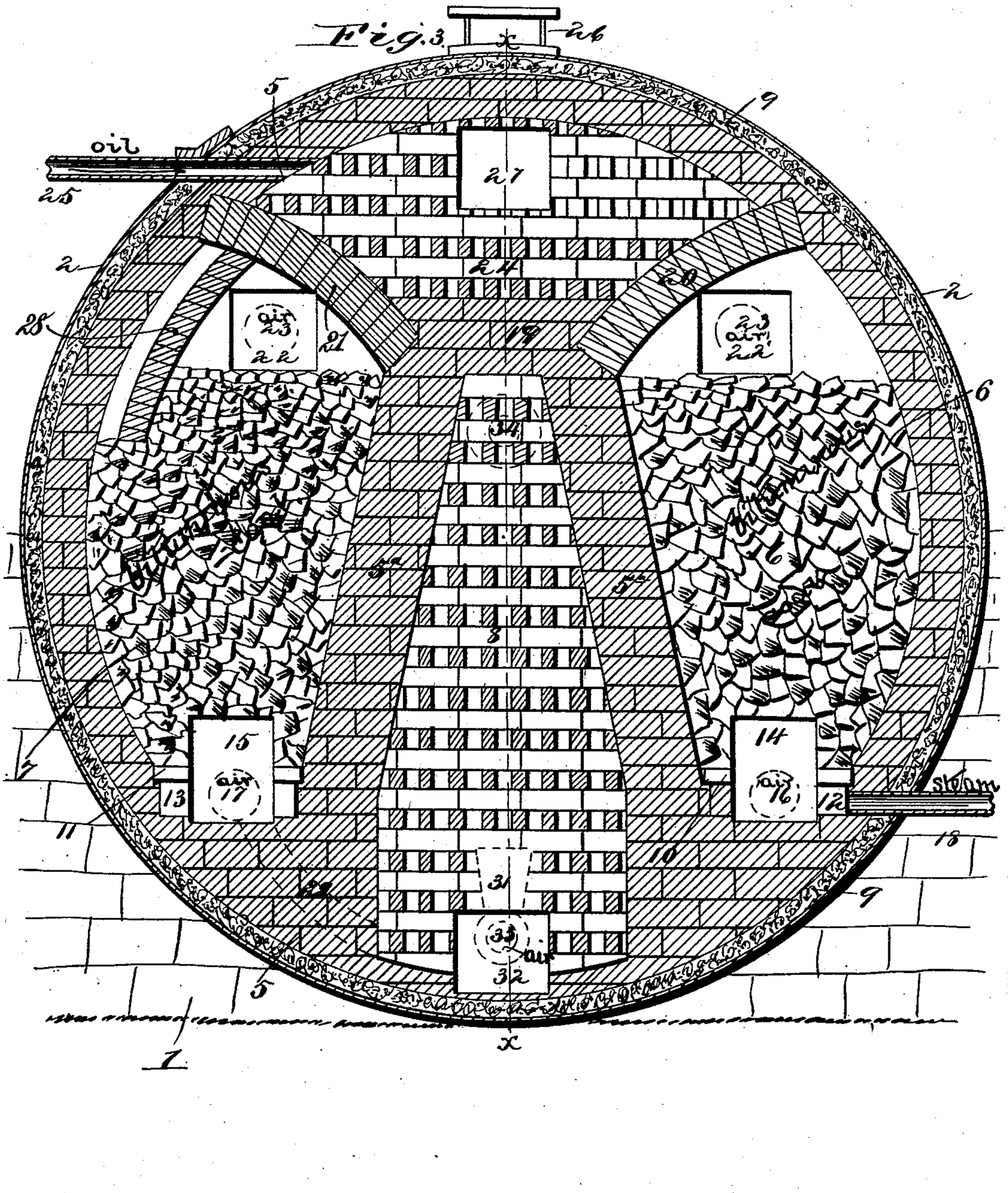
Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

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APPARATUS FOR GAS MANUFACTURE.

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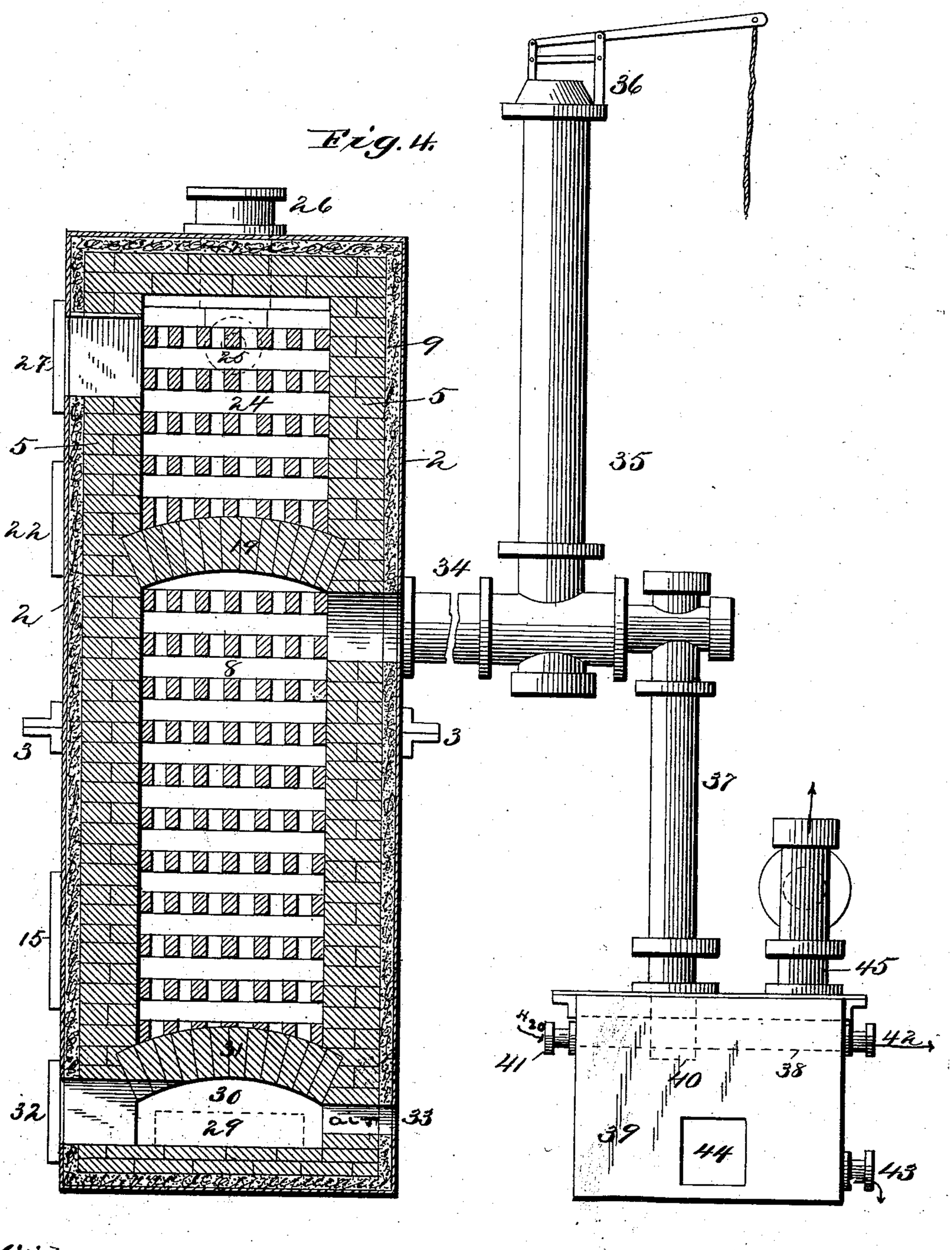
Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN W. HAYES, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR GAS MANUFACTURE.

SPECIFICATION forming part of Letters Patent No. 507,003, dated October 17, 1893.

Application filed March 11, 1893. Serial No. 465,581. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. HAYES, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Apparatus for Gas Manufacture, of which the following is a specification.

This invention relates to improvements in apparatus for the manufacture of water gas, carbureted water gas, or coal, water and oil gas, and consists in the construction, combination and relative arrangement of the several parts of a gas making apparatus as hereinafter described and claimed.

In the annexed drawings illustrating the invention—Figure 1 is a side elevation of my improved gas making apparatus. Fig. 2 is an end elevation of the same. Fig. 3 is a vertical longitudinal section of the gas making apparatus through the gas generators and super-heater. Fig. 4 is a transverse vertical section through the line *x x* of Fig. 3.

Referring to the drawings, the numeral 1 designates a solid foundation, preferably of brick masonry, on which the gas making apparatus is supported. The metal casing 2 is of circular form set on edge, or resting on its cylindrical periphery, upon the foundation 1, and is preferably composed of steel.

As shown in Figs. 1 and 2, the circular steel casing 2 is made in several sections that are securely connected by means of angle irons 3 riveted to the casing plates and to each other along the joints between the upper and lower portions of the casing. For the purpose of bracing and stiffening the casing plates they may have radially arranged angle irons 4 attached thereto wherever required. The foundation 1 is built to fit the lower half of the circular casing which is securely bolted thereto.

Within the metal casing 2 is constructed a fire brick lining 5 and 5ª, Fig. 3, which is so arranged as to form the inner walls of two gas making chambers 6 and 7 and a central gas superheating chamber 8 which is provided to complete the fixing of the gas after it has been generated in one of the gas making chambers and partly fixed in the other.

Between the casing 2 and the outer portion of the fire brick lining 5, on all sides, is a space having a width of about two inches and in which is placed a non-conducting packing 9, of mineral wool or other suitable material.

In the lower portions of the fuel chambers are grates 10 and 11 beneath which are ash-pits 12 and 13 as shown in Fig. 3. Doors 14 and 15 are provided at the bottoms of the respective chambers 6 and 7 to afford access to the grate bars and ash-pits. The ash-pits are provided with air inlets 16 17 for introducing air beneath the grate bars to support combustion of the fuel placed on the grates in starting the apparatus to work. Beneath the grate 10 of the first fuel chamber or gas making chamber 6 is inserted a steam inlet pipe 18 leading from a boiler or steam generator in any convenient location.

The walls 5ª that separate the fuel chambers 6 and 7 from the superheating chamber 8 are of the same material as the fire brick or refractory lining 5 and spring from the lower part thereof between the ash-pits 12 and 13 as shown in Fig. 3. These walls 5ª converge upwardly and are connected by a brick center arch 19 that forms the top of the superheating chamber. Springing from the upper ends of the walls or partitions 5ª are sectional keyed apart arches 20 and 21 that are extended across the tops of the fuel chambers 6 and 7 and connect with the main portion of the fire brick lining. In the upper part of each fuel chamber 6 and 7 is a charging door 22 and an inlet 23 for air.

The space above the brick center arch 19 and sectional keyed apart arches 20 and 21 constitutes a carburetor or carbureting chamber 24 which is filled with a checkerwork of brick or suitable refractory material. An oil pipe 25 enters one end of the carbureting chamber 24 at a conveniently elevated point. The top of the carbureting chamber communicates with a combustion relief valve 26 and, if desired, access to the chamber may be afforded through a door 27 in one side.

In the upper portion of the fuel chamber 7 toward its outer side is a brick fender or curved wing 28 that is set out from the lining 5 sufficiently to assist in throwing down such gases as may rebound from the fuel on the

grate in the lower part of the chamber. The gases thus thrown down and forced through the incandescent bed of fuel in the chamber 7, becoming thereby partly fixed, are conducted through a conduit 29 that leads from the ash-pit 13 to a chamber 30 below an open arch 31 that forms the bottom of the superheating chamber 8 in which the fixing of the gas is completed. Access to the chamber 30 is afforded through a door 32 in one side, and in the opposite side is an inlet 33 for air.

The superheating chamber 8 is filled with a checkerwork of fire brick or similar refractory material.

A gas outlet pipe 34 leads from the upper rear side of the superheating chamber 8 and communicates on one hand with a combustion relief pipe 35, having a relief valve 36, and on the other hand with a gas pipe 37 leading to a wash box and water seal. The gas pipe 37 is extended below the water line 38 in a wash box 39 a sufficient distance to form a water seal 40, and the wash box is provided with the usual water inlet 41, overflow 42, drain pipe 43, manhole 44 and an outlet 45 to a gas scrubber or holder.

In operating this apparatus wood fires are ignited on both grates 10 and 11 and are fed by dropping wood through the charging doors 22 from time to time, as required, while air is admitted through the inlets 16 and 17, below the grate bars, to support combustion. If desired, these air inlets may be connected with a blower. During this time the relief valve 26 is open and the relief valve 36 is closed. After the fires are well started, coal is fed to them by degrees, through the charging doors 22, and as the coal heats up the supply is further increased until the top of the coal bed is up to the level of the charging doors. For this fuel, I prefer to use bituminous coal or slack. When the fuel chambers or gas generating chambers 6 and 7 are thus filled up to the two charging doors and the coal is well ignited the relief valve 26 is closed and the relief valve 36 opened. The air inlet 17 below the grate 11 is now closed off and the air pressure at the inlet 16 below the grate 10 may be increased by running the blower faster. The products of combustion will now pass up from the chamber 6 through the spaced apart arches 20 and chamber 24 and thence downward through the spaced apart arches 21 and into and gradually through the body of fuel in the chamber 7, while any gases or products of combustion that rebound from this body of fuel, by reason of its being bridged, will be deflected and caused to pass between the brick fender 28 and lining 5 and thence downward into the body of hot coal below the bridged portion and thence on through the body of coke and coal and between the grate bars 11 to the conduit 29 that leads to the arched chamber 30 under the superheater. Into this chamber 30 air is admitted through the inlet 33 to burn the gases and thus heat up the brick checkerwork in the superheater 8, the products of combustion passing outward through the gas outlets 34 to the relief valve 36 which has meanwhile been opened. This operation is continued until both bodies of coal are raised to the proper temperature for making gas. The relief valve 36 is then closed so that there is now no outlet from the apparatus except through the water seal and wash box. Now in order to make gas the air inlet 16 is shut off, or the blower stopped, and steam is admitted through the steam pipe 18 to pass up through the body of incandescent coal and coke in the gas generating chamber 6, whereby the steam is decomposed and converted into water gas which is commingled at the top of the chamber with bituminous coal gas distilled from the coal. These commingled gases pass through the sectional arch 20 and across and through the checkerwork in the carbureting chamber 24 where they are mingled with hydrocarbon oil forced in preferably by means of a steam gas jet, through the oil pipe 25 that discharges into said carburetor. By contact with the heated checkerwork and surrounding hot gases the oil is rapidly vaporized or broken up into oil gas which combines or unites with the water gas and coal gas through a mutual re-action of the hydrogen, carbon and oxygen elements, in a well known manner. The gas or mixture of gases thus produced passes down through the sectional arch 21 into the top of the chamber 7 and onto a bridge of bituminous coal from which the gas rebounds and passes back and over the top of the fender 28 and thence downward between said fender and the lining 5 into the incandescent coke and coal below the bridge. In passing through this body of incandescent carbon the carbonic acid is converted into carbonic oxide, the tarry matters are arrested and broken up into gases and the fixing of the gas is commenced. Passing now between the grate bars 11 and downward into the conduit 29 the gas is conducted into the chamber 30 and thence upward through the arch 31 into the superheating chamber 8 in which, by contact with the highly heated checkerwork, the gas receives additional heat and becomes thoroughly fixed. Then it passes upward and rearward through the gas outlet 34 and pipe 37, the valve 36 being closed, into the wash box 39 and thence to a scrubber, or other purifier, or to a gas holder.

In the use of bituminous coal slack in an apparatus wherein the gases from one generating chamber are passed through another generating or fuel chamber much difficulty has been experienced to get the gases through the second body of fuel, because of the coal bridging over and preventing it. The peculiar construction of my improved apparatus overcomes this difficulty by reason of the arrangement of a wing wall or brick fender to conduct the gases between the wall and roof of the fuel chamber into the fuel bed

below the line of bridged or baked coal where the material is loose and the gas can proceed downward without hinderance.

By employing a superheating chamber located between two gas generating or fuel chambers which communicate at the top through a carburetor located above the superheater, whereby the gases generated in one fuel chamber are first carbureted, then passed from the carburetor downward into the second fuel chamber, in which the fixing of the gas is commenced, and then conducted into a superheating chamber in which the gas is thoroughly mixed before passing from the apparatus, a large economy is effected in the saving of heat and fuel and superior quality of gas obtained.

In using bituminous slack and fine coal about nine per cent. of carbonic acid is made, even with the greatest care, and I find it cheaper to heat up a separate body of cheap slack coal for the purpose of changing or reducing this carbonic acid to carbonic oxide than it is to try to take out the carbonic acid by other means or by adding oil to keep up the candle power; and besides in spraying the oil by steam the steam is wholly decomposed in passing down through the second body of heated slack and a further quantity of gas is thus made; so that the second body of slack pays for itself in the quantity of coal gas distilled and additional water gas produced besides the part it plays in the reduction of carbonic acid and arresting of tarry matters and other impurities.

What I claim as my invention is—

1. In an apparatus for making gas, the combination of a single casing containing two fuel chambers, a gas superheating chamber located between the two fuel chambers, a carbureting chamber arranged above the gas superheating chamber, communicating with the top portion of both fuel chambers, and through which the commingled gases flow in transit from one fuel chamber to the other, a gas-burning air chamber arranged below the gas superheating chamber, a descending conduit leading from the bottom of one fuel chamber to said gas-burning air chamber, a hydrocarbon supply pipe for delivering hydrocarbon into the carbureting chamber above the fuel and gas superheating chambers, a gas outlet pipe extending from the upper portion of the gas superheating chamber, a valved combustion relief pipe connected with the gas outlet pipe, and a water seal and washer with which the gas outlet pipe connects, substantially as described.

2. In an apparatus for making gas, the combination of two fuel chambers, a gas superheating chamber located between the two fuel chambers, a carbureting chamber arranged above the gas superheating chamber, communicating with the top portions of both fuel chambers, and through which the commingled gases flow in transit from one fuel chamber to the other, a relief valve for the carbureting chamber, a gas-burning air chamber located below the gas superheating chamber, a descending conduit extending from the bottom of one fuel chamber to said gas-burning air-chamber, a gas outlet pipe leading from the upper portion of the gas-superheating chamber, a valved-combustion relief pipe connected with the gas outlet pipe, and a water-seal and washer connected with the gas outlet pipe, substantially as described.

3. In an apparatus for making gas, the combination of a circular metallic casing supported on its periphery or circular edge and provided with a circular fire brick lining, and a non-conducting packing between the lining and the casing, two fuel chambers arranged within said casing, a gas-superheating chamber located between the two fuel chambers and separated therefrom by fire brick linings, a carbureting chamber arranged above the gas-superheating chamber, communicating with the top portion of both fuel chambers through fire brick arches, and through which the commingled gases flow in transit from one fuel chamber to the other, a hydrocarbon pipe for supplying hydrocarbon to the carbureting chamber above the fuel and gas superheating chambers, a gas-burning air chamber arranged below the gas superheating chamber, a descending conduit leading from the bottom of one fuel chamber to said gas-burning air chamber, a gas outlet pipe extending from the upper portion of the superheating chamber, a valved combustion relief pipe connected with the gas outlet pipe, and a water-seal and washer connected with the gas outlet pipe, substantially as described.

4. In an apparatus for making gas, the combination of two fuel chambers having grates and air inlets, one of said chambers being for the generation of gases and the other for commencing the fixing of gases passed down through it, a carbureting chamber having a filling of checkerwork and through which the upper ends of the fuel chambers communicate, an oil pipe leading into said carbureting chamber, a gas superheating chamber located between the fuel chambers and below said carbureting chamber and provided with a checkerwork filling and a gas outlet, a conduit through which the lower part of the superheating chamber communicates with the lower part of that fuel chamber in which the fixing of the gas is commenced and a single casing within which the several chambers are arranged, substantially as described.

5. In an apparatus for making gas, the combination of two fuel chambers having grates and air inlets, one of said chambers being for the generation of gases and the other for commencing the fixing of gases, a steam pipe for admitting steam beneath the grate of the gas generating chamber, a carbureting chamber through which the upper ends of said fuel chambers communicate, an oil pipe leading into said carbureting chamber, a fender supported in the upper part of the fuel chamber

in which the fixing of the gas is commenced, a superheating chamber located between the fuel chambers and provided with a gas outlet, a conduit through which the lower part of said superheating chamber communicates with the lower part of that fuel chamber in which the fixing of the gas is commenced and a single casing within which the several chambers are arranged, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOHN W. HAYES.

Witnesses:
DANIEL J. HAYES,
HENRY C. TRAPHAGEN.