

J. FEHRENBATCH.  
APPARATUS FOR MAKING GAS.

No. 564,512.

Patented July 21, 1896.

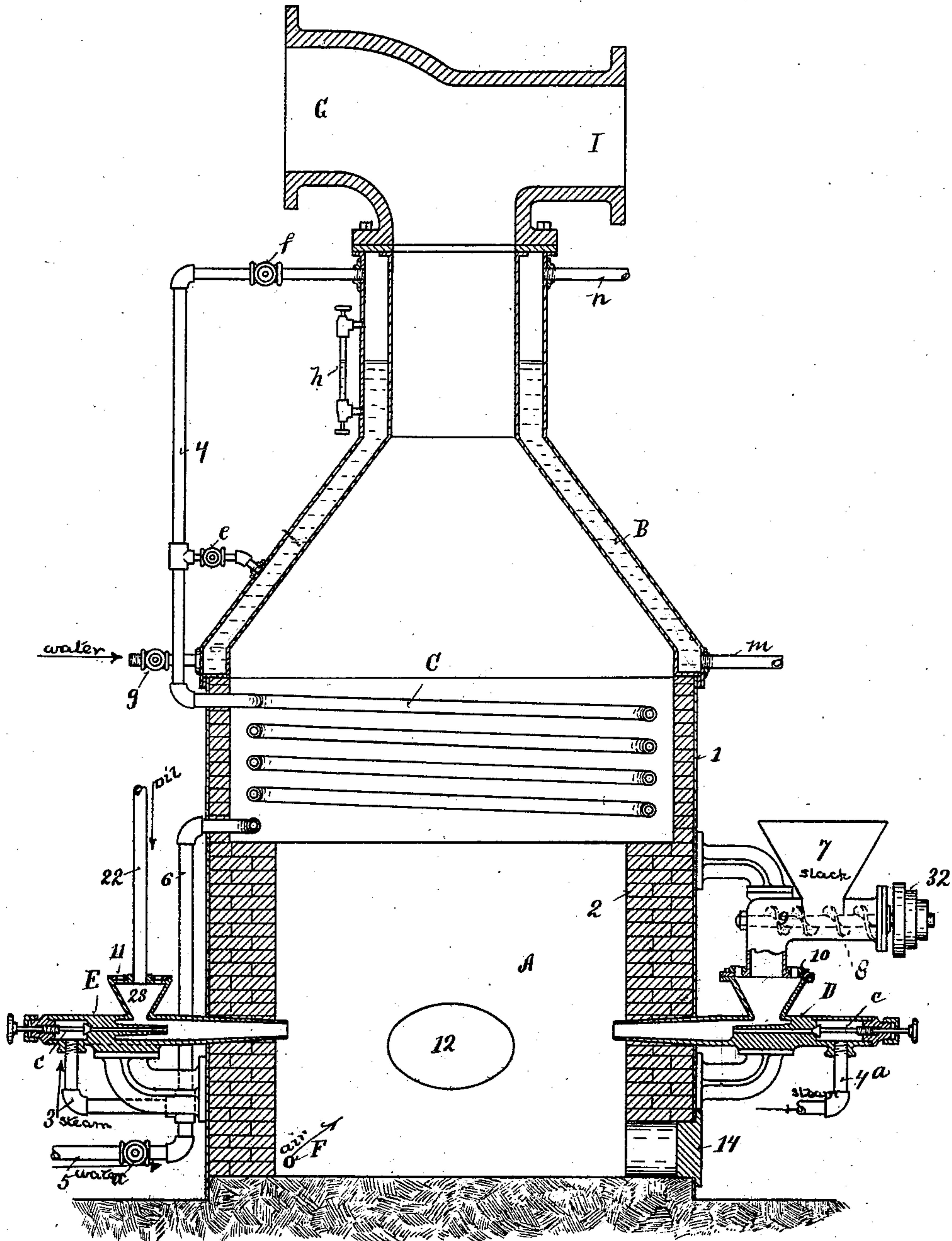


Fig. 1 -

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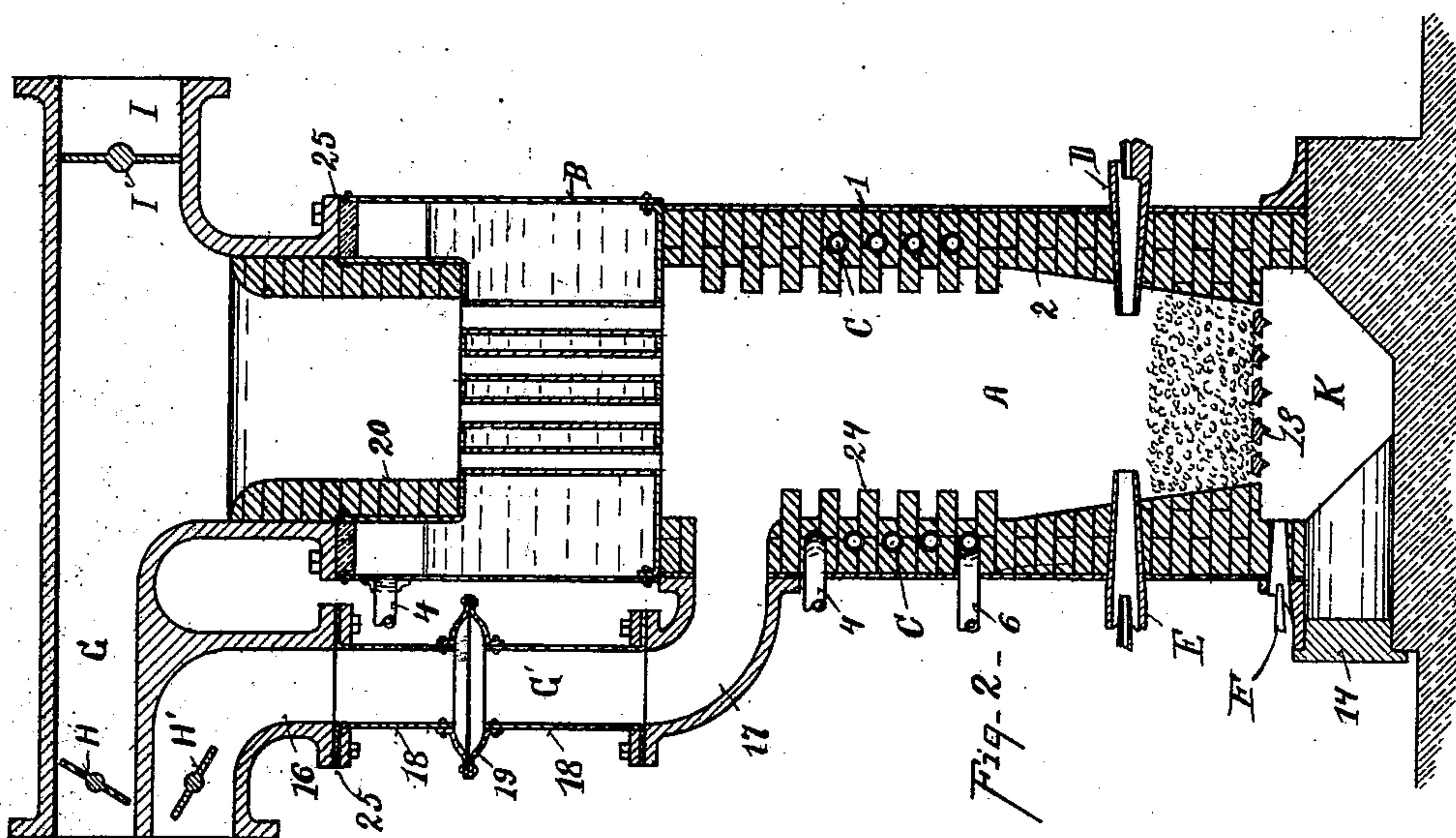
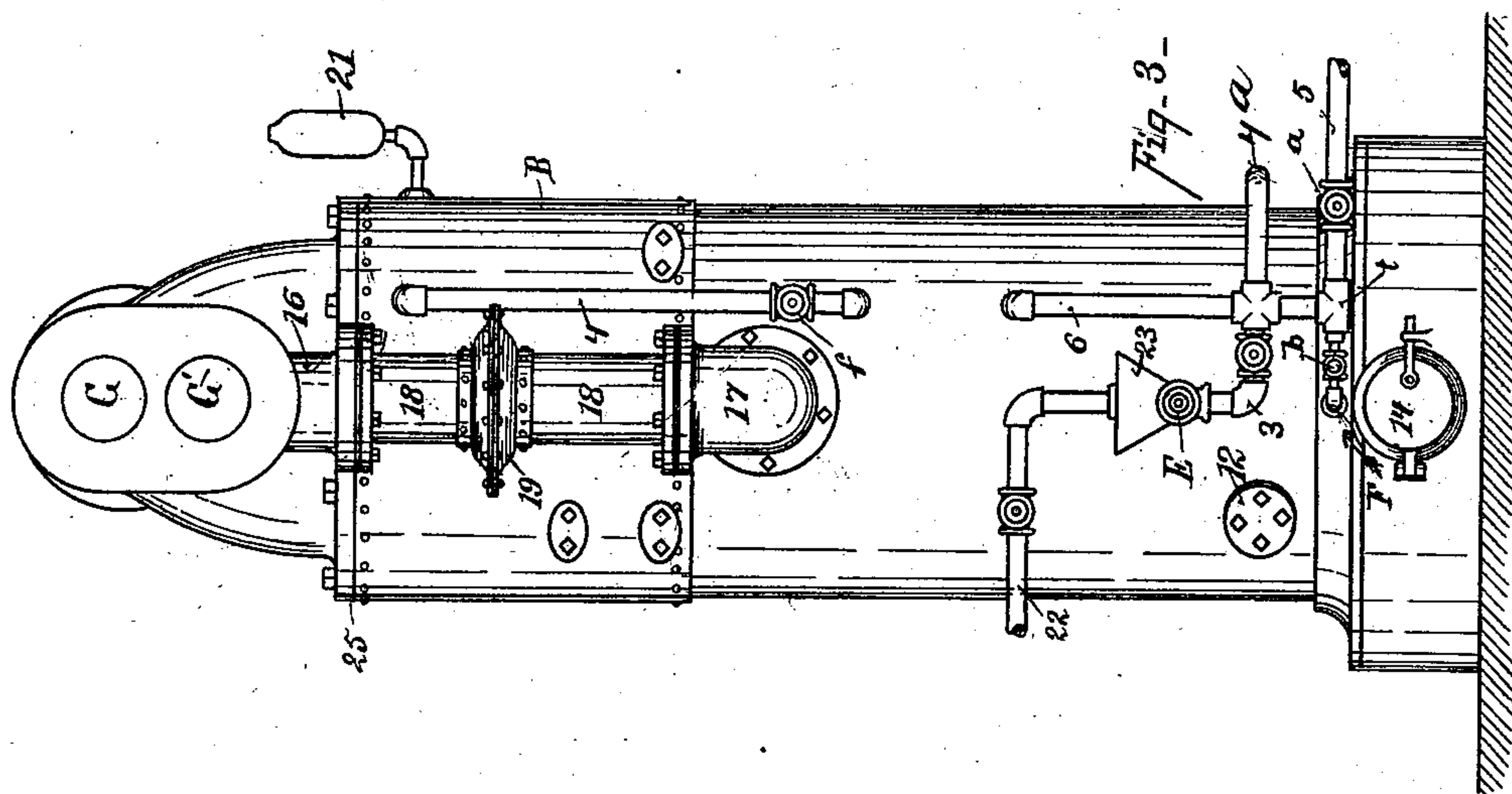
(No Model.)

2 Sheets—Sheet 2.

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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR MAKING GAS.

SPECIFICATION forming part of Letters Patent No. 564,512, dated July 21, 1896.

Application filed August 27, 1892. Serial No. 444,317. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN FEHRENBATCH, residing at Cincinnati, (Avondale,) in the county of Hamilton and State of Ohio, have  
5 invented certain new and useful Improvements in Apparatus for Making Gas, of which the following is a specification.

This invention relates to an improved apparatus for the production of a continuously-  
10 uniform quality of highly-combustible gas from the decomposition of steam and coal, with or without the addition of a liquid hydrocarbon, a bed of incandescent coal within a single generating and fixing chamber being  
15 continuously replenished through a forced and positively-regulated feed, while steam and air, or mingled steam, air, and oil, are injected into the gas-generating chamber above the bed of incandescent fuel, whereby  
20 the steam, or steam and oil, are continuously decomposed and immediately mingled with the gaseous products of the burning coal and the mingled gases and vapors at once fixed or rendered permanent within said generating-chamber, the intense heat thus developed  
25 being utilized to heat the boiler that is located immediately above the gas-generating chamber.

The several features of the invention are  
30 fully set forth in the following description and illustrated in the accompanying drawings making a part of this specification.

Figure 1 is a central vertical section of my improved gas-generator. Fig. 2 is a vertical  
35 section of a modified form of gas-generator. Fig. 3 is a side elevation of the same.

Referring to Figs. 1 and 2, the letter A designates the gas-generating chamber, which is also the combustion-chamber for the fuel employed in making gas. In this chamber also  
40 the disassociated elements of coal, steam, and hydrocarbon vapors become thoroughly mixed and recombined and then fixed into a permanent gas under the influence of the intense heat to which the gases and vapors are subjected within said chamber. The  
45 chamber A is therefore a combined fuel-combustion and gas generating, mixing, and fixing chamber, in which all the operations necessary for the manufacture of a superior qual-

ity of fuel-gas, ready for immediate use, are continuously accomplished. This gas-generating and fixing chamber A has an outer shell 1, composed of sheet metal and lined with a fire-brick wall 2.

Above the chamber A is a steam-boiler B,  
55 which may be of any suitable form. In Fig. 1 is shown a single-flue boiler having the form of a frustum of a cone terminating in a hollow cylinder at its upper end. The form  
60 shown in Fig. 2 is a multiple-flue boiler terminating in an annular cylinder at the top. These boilers, or any other suitable form, should be so set and arranged as to be exposed to the heat of the gas-generating chamber, preferably by conducting first the hot  
65 products of combustion through the boiler flue or flues during the preliminary heating of the apparatus and subsequently conducting the hot gases through said flues while the  
70 apparatus is in full operation for making gas.

A steam-coil C may be located in the upper part of the gas generating and fixing chamber A, as shown in Fig. 1, or the said coil may be embedded in the fire-brick wall 2,  
75 below the boiler, as shown in Fig. 2. The coil C communicates with the boiler B through a pipe 4, Figs. 1 and 2, and pipes 5 and 6 are provided, through which the coil and the boiler are supplied with water. The pipe 5  
80 is connected to the pipe 6 by a branch coupling *t*, Fig. 3, that is also arranged for supplying superheated steam from the pipe 6 for feeding air to the gas-generator. This  
85 pipe 6 has other branches 3 and 4<sup>a</sup> to supply superheated steam for feeding hydrocarbon oil and fine coal into the gas-generator.

D, Fig. 1, represents a steam-injector with which the branch steam-pipe 4<sup>a</sup> connects for continuously feeding slack coal or crushed  
90 carbon into the gas-generator while the apparatus is engaged in making gas.

E, Fig. 1, is a steam-injector with which the branch steam-pipe 3 connects for feeding  
95 liquid hydrocarbons.

F is a similar injector for feeding air below the grate.

The steam-injector D is provided with a hopper 7, which is to be kept filled with carbon, such as crushed coal or slack. From  
100



this hopper 7 the crushed carbon passes continuously to a worm-shaft 8, mounted in a cylindrical casing 9, communicating with the injector, so that by continual rotation of the worm-shaft the slack or crushed carbon will be continuously delivered in suitably-regulated quantity to the action of the steam-injector D, whence the mingled steam and crushed carbon are continuously fed to the gas-generator during the operation of gas-making. The worm-shaft 8 is driven by power applied thereto through a cone-pulley 32, so that by shifting the power-belt the speed of the worm-shaft can be readily varied in order to regulate the feed of the crushed carbon as required.

10 represents a register-valve for regulating the quantity of air to be fed into the steam-injector D.

The steam-injector E, Fig. 1, is provided with a hopper 23, having a register-valve 11 for admitting air, and a pipe 22, through which hydrocarbon oil is received. Each injector D and E is provided with a needle-valve *c* for controlling the admission of steam.

12, Figs. 1 and 3, represents a door through which access may be had to the gas-generating chamber for the purpose of supplying fuel.

13, Fig. 2, represents the grate.

14 represents a door leading to the ash-pit or chamber K below the grate.

Above the boiler B, and communicating with the gas-generating chamber through the boiler flue or flues, is arranged an uptake 1 for carrying off the products of combustion in the preliminary heating of the apparatus. A gas-uptake G also communicates with the boiler flue or flues. After the preliminary heating of the apparatus has been accomplished a valve or damper I' in the uptake I is to be closed, and a valve H in the gas-uptake G should then be opened to permit the passage of the gas to the place of consumption or elsewhere as required.

In Fig. 2 I have shown an additional gas-uptake G', arranged as a by-pass, and which may be employed with any other form of boiler as well as with the forms shown in the drawings. This uptake G' leads directly from the upper part of the gas-generating chamber below the boiler and is provided with a valve or damper H', as shown. By a proper manipulation of the valves H and H', closing one and opening the other, or only partly opening each, the gas that passes from the generating-chamber may be diverted from the boiler-flues or only a part of the gas be allowed to pass therethrough. The hot gas can thus be made to control the heating of the boiler and prevent the making of an unnecessary quantity of steam, so that the blowing off of steam can be avoided when it is being made too rapidly. The preferred form of constructing the by-pass uptake G' is to provide elbows 16 and 17, connected by interme-

diating pipes 18, that are united by an expansion-joint 19.

The annular portion of the boiler (shown in Fig. 2) is lined with fire-brick 20 to protect the top joint of the boiler.

21, Fig. 3, designates a safety-valve.

The uptakes G, G', and I are preferably made of metal and securely bolted to the top of the boiler by a flanged joint 25.

In Fig. 2 I have shown the upper part of the fire-brick lining 2 arranged to form irregular projections 24, that will break and distribute the currents of vapors and gases impinging against the highly-heated walls of the generator and thus assist in effecting a thorough mingling of said gases and vapors within the gas-generating chamber and the production of a fixed gas therein.

To prepare the apparatus for making gas, the valves H and H' in the uptakes G G' will be closed and the valve I' in the uptake I will be opened. The boiler is preferably supplied with water through the coil C by means of the pipe 5, stop-cocks *a* and *e*, Fig. 1, being open. By having the coil C filled with water before starting a fire the coil will be protected until steam has been generated. *f* represents a stop-cock in pipe 4, by which the flow of steam from the boiler can be regulated. *g* represents another pipe for use in filling the boiler direct. *h* represents a water-gage. *m m* represent pipe connections for a boiler-feeder to be used while the apparatus is making gas. The boiler B and coil C having been supplied with water, the cocks *a* and *e* may be closed and the cock *f* opened. The doors 12 and 14 may be opened and coal fed into the generating-chamber through the former and air supplied through the latter to support combustion. The fuel being ignited, the door 12 will be closed and combustion continued until a steam-pressure of, say, seventy pounds is obtained in the boiler. Then the door 14 will be closed and both doors 12 and 14 sealed; the valve or damper I' in the uptake I will be closed and the valve H in the uptake G will be opened. The stop-cock *a* is opened to blow off the wet steam in coil C and then closed, and cock *b* is opened to supply steam to the air-injector F, which may be provided with a register-valve (not shown) to regulate the quantity of air admitted to the chamber K and thence to the chamber A through the grate. Slack or crushed coal may now be constantly fed into the hopper 7 of the steam, air, and coal injector D, the needle-valve *c* being turned to admit steam and the air-register valve 10 opened to supply air. By the constant rotation of the screw 8 at a regulated speed, obtained through the cone-pulley 32, the fine carbon will be continually fed forward in the injector and, mingled with air and steam, will be continuously injected into the gas generating and fixing chamber A upon the



top of the incandescent bed of fuel therein. At the same time oil or liquid hydrocarbon mingled with steam and air may be forced into said gas-generating chamber by the injector E.

I prefer to arrange the injectors D and E in such manner that they will pierce the gas generating and fixing chamber A from opposite sides and in such relative positions that the incoming currents of steam will cause a rapid whirling motion within the generator above the bed of incandescent fuel. By this action and the intense heat of the gas-generator the steam, coal, and liquid hydrocarbon are rapidly decomposed or gasified and the hydrogen, carbon, and oxygen recombined into a fixed or permanent gas, which is highly combustible if too much air is not admitted. By proper care a very rich gas can be obtained and fixed directly in the single generating-chamber.

I prefer to feed the coal in a crushed condition and mixed with superheated steam in the injector, for as the coal is then somewhat heated by the steam before entering the generating-chamber it more quickly gasifies and its gases will more readily combine with the decomposed steam. By the continuous and positive feed of the crushed coal to the generator and the means for definitely varying the speed of the feed devices as required the quantity of solid carbon supplied to the generator can be readily controlled without interrupting the continuous operation of the apparatus. I am thus enabled to produce and fix in a single chamber a continuously-uniform quality of highly-combustible gas in readiness for immediate use, without any necessity of employing a gasometer or holder.

By means of the injecting devices employed with the gas-generator the feeding of the coal or crushed carbon and the regulating of proportional quantities of steam and air to a given quantity of carbon can be easily effected, so as to control the quantity as well as the quality of gas produced, which may be enriched by the use of liquid hydrocarbons in suitable proportions.

When lean gas is to be made, little or no hydrocarbon is needed. Cannel coal may be used in connection with bituminous coal and a rich gas produced without any liquid hydrocarbon.

It will be observed that by continuously replenishing the bed of fuel with crushed coal introduced above the top of the incandescent mass of fuel by a constantly-operating forced

feed and in positively-regulated quantities, at the same time injecting steam into the generator above the incandescent fuel and introducing air below the grate to support combustion, I am enabled to produce rapidly and economically a continuously-uniform quality of gas that can be conducted at once, and with great advantage, to the place of consumption, such as a steam-boiler furnace. By this process, therefore, the great expense of a gasometer or gas-holder or other means for mixing and equalizing the quality of successive runs of gas is entirely obviated, so that the cost of a plant is very largely reduced, and the process can be practiced continuously for long periods without any interruption to the manufacture of a constantly-uniform quality of gas.

What I claim as my invention is—

1. In a gas-making apparatus, the combination with a combined combustion, gas generating and fixing chamber, and a steam-boiler located directly above said chamber and heated thereby, of a superheating steam-coil located in the upper part of the gas generating fixing chamber and having one end connected with the steam-space of the boiler and the other provided with one or more steam-jets tapping the generator, and means for positively and continuously feeding air, superheated steam and fuel to the closed generator, substantially as specified.

2. In a gas-making apparatus, the combination of a combined combustion, gas generating and fixing chamber, a steam-boiler located directly above and heated from said chamber, a superheating steam-coil located in the upper part of said chamber and having one end connecting with the steam-space of the boiler and the other end communicating with steam-injectors located above and below the fuel-bed, means for positively and continuously feeding coal to the fuel-bed, and means for regulating the admission of air and superheated steam into the combustion and gas-generating chamber, whereby a continuous generation of gas is maintained and the surplus heat utilized in the generation and superheating of steam, substantially as described.

In testimony whereof I have hereunto set my hand.

JOHN FEHRENBATCH.

Witnesses:

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O. KAISER.