

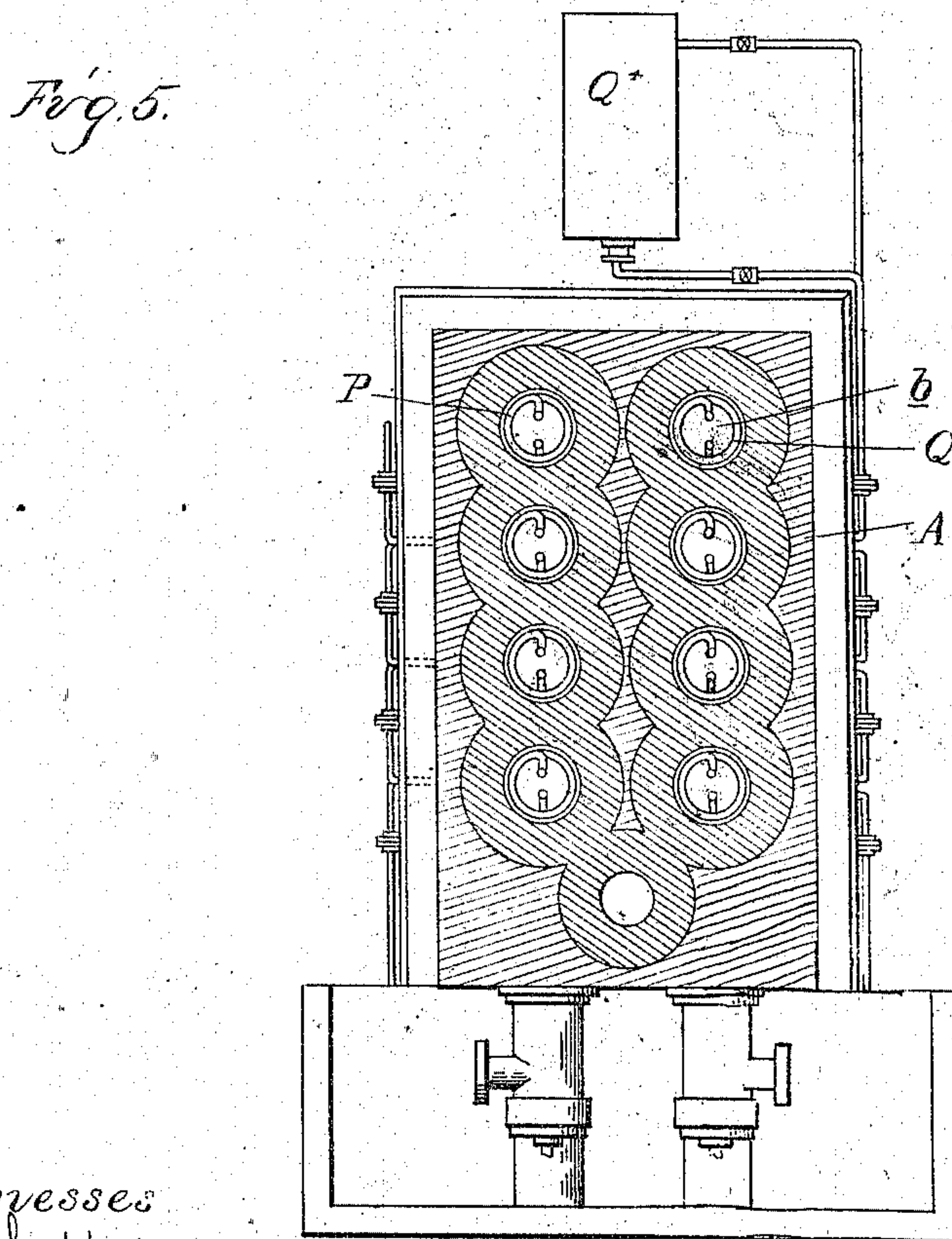
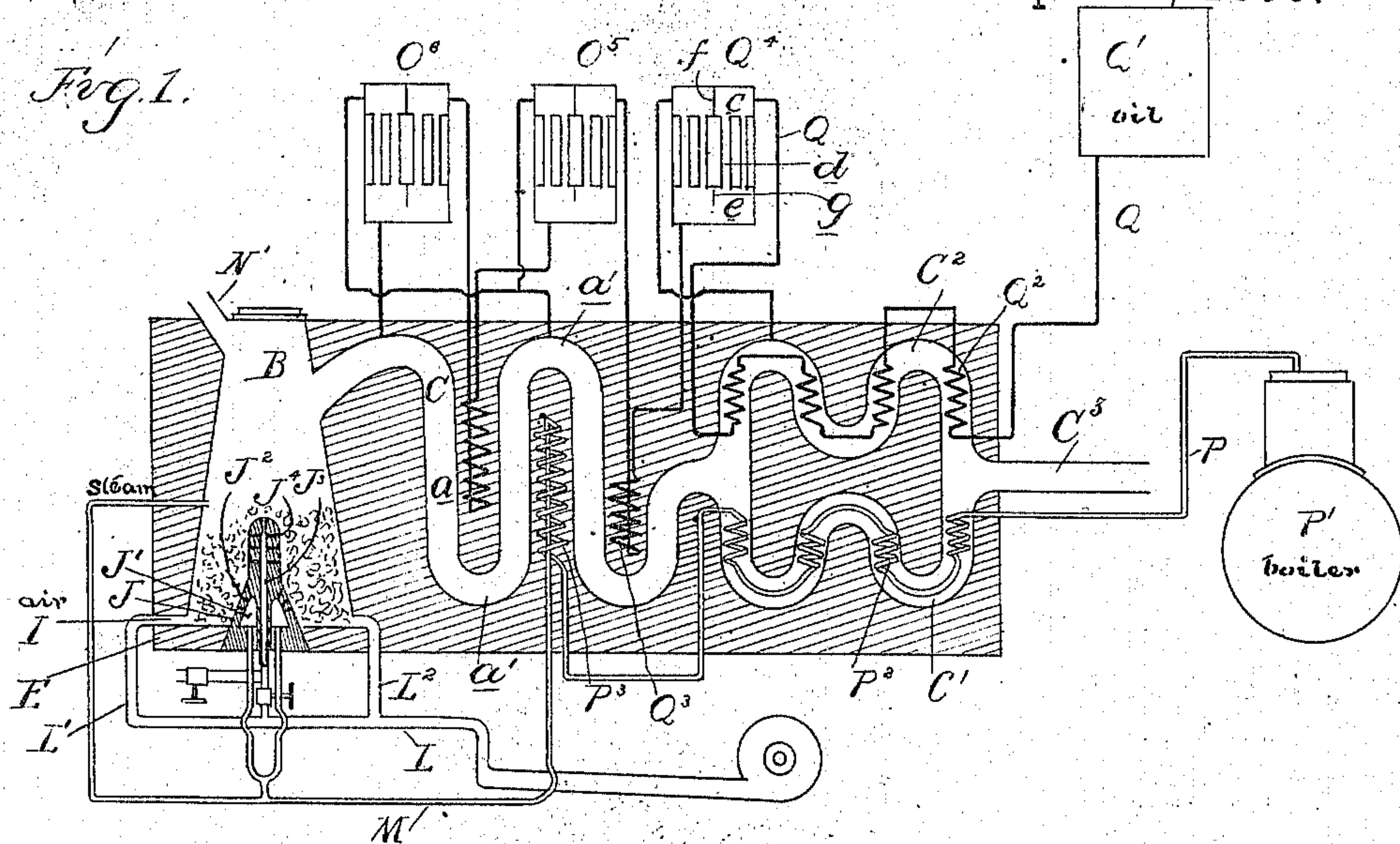
(No Model.)

3 Sheets—Sheet 1.

E. S. HOYT & G. F. SPEER.
APPARATUS FOR MANUFACTURING GAS.

No. 559,287.

Patented Apr. 28, 1896.



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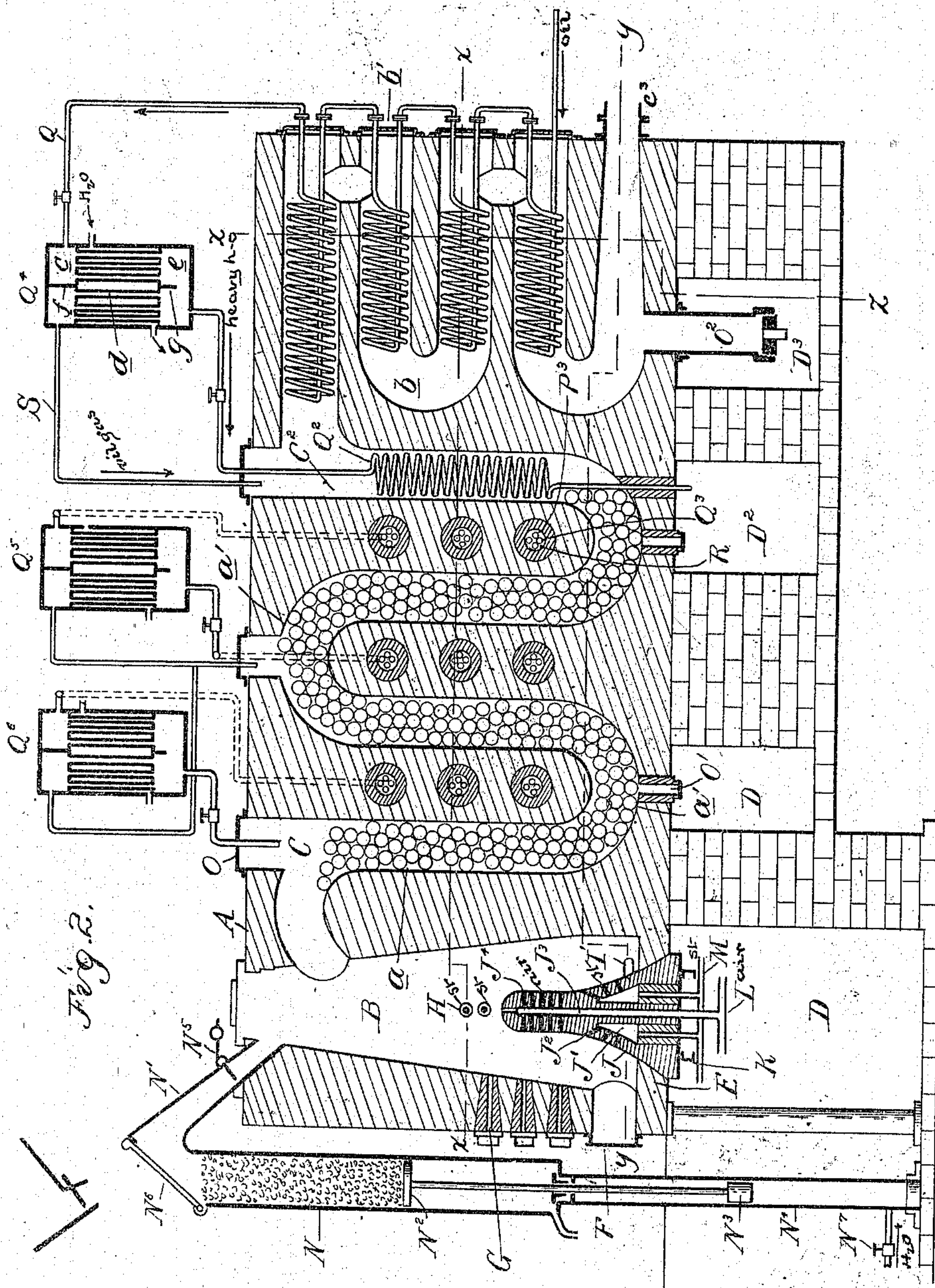
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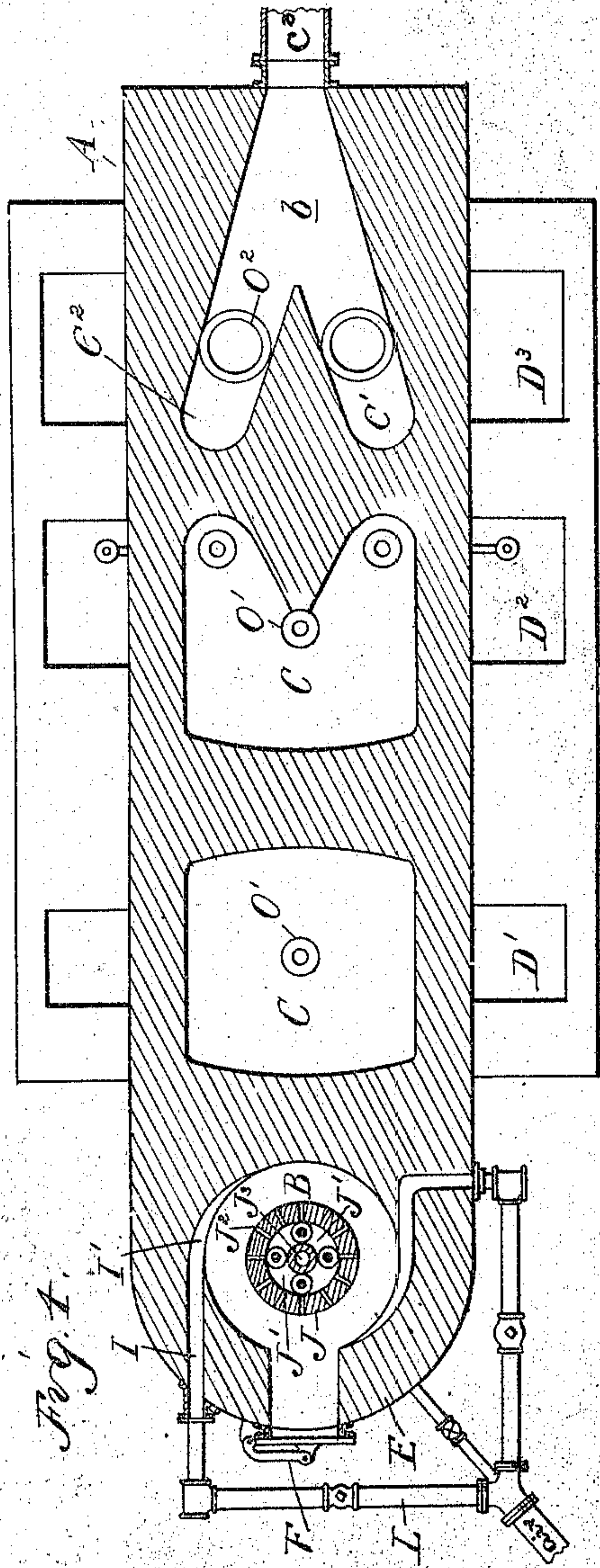
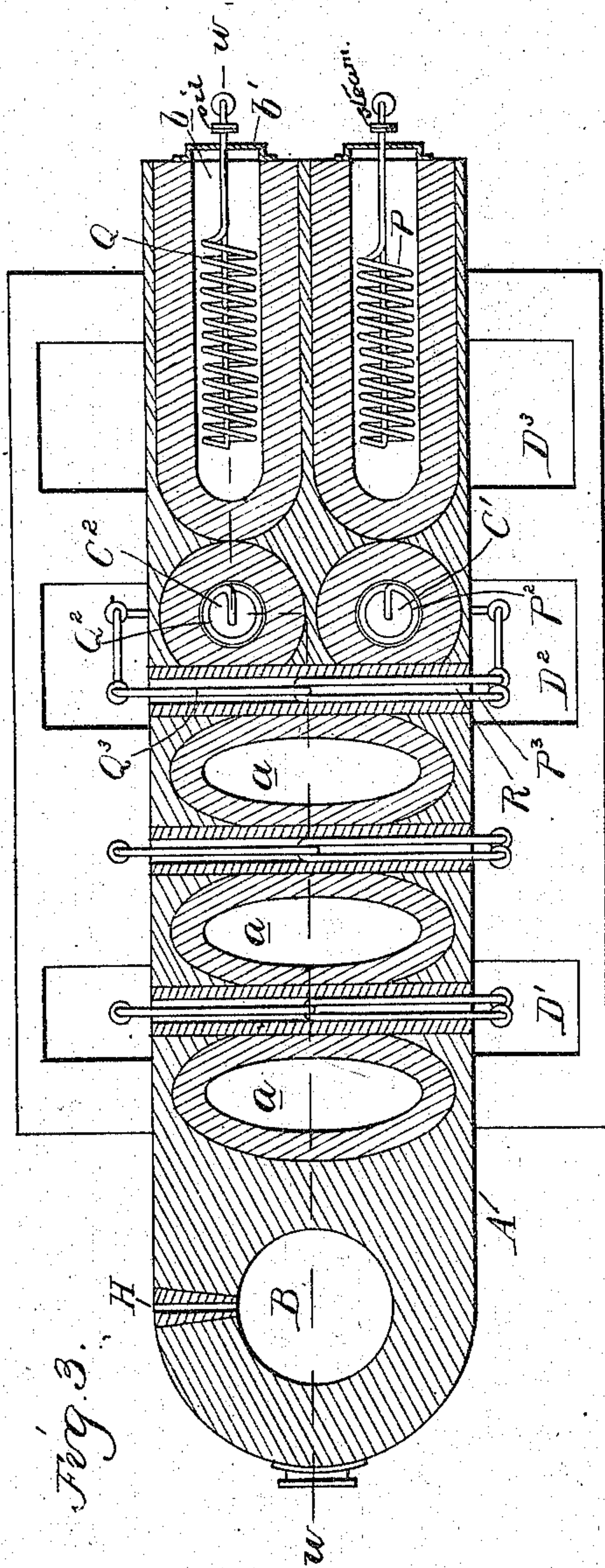
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UNITED STATES PATENT OFFICE.

EZRA S. HOYT, OF DETROIT, MICHIGAN, AND GARRET F. SPEER, OF CANISTEO, NEW YORK, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO THE HOYT-SPEER COMPOUND GAS COMPANY, LIMITED, OF DETROIT, MICHIGAN.

APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 559,287, dated April 28, 1896.

Application filed December 1, 1894. Serial No. 530,537. (No model.)

To all whom it may concern:

Be it known that we, EZRA S. HOYT, residing at Detroit, Wayne county, Michigan, and GARRET F. SPEER, residing at Canisteo, in the county of Steuben and State of New York, citizens of the United States, have invented certain new and useful Improvements in Apparatus for Manufacturing Gas, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improvement in apparatus for the manufacture of gas by decomposing steam in contact with carbonaceous fuel, and is specifically designed to generate fuel-gas rapidly and in a continuous manner by means of a generator having a single generating-chamber arranged for the continuous generation of gaseous products from air, steam, and coal, and from petroleum-oil, and for combining the various products to form a homogeneous gas free from condensable products.

To this end our invention consists in the improved construction, arrangement, and combination of the various parts of the generator for carrying on the manufacture of fuel-gas according to this process on a large commercial scale, which insures efficiency, economy, and cheapness of the gas produced, all as more fully hereinafter described, and specifically pointed out in the claims.

In the drawings, Figure 1 represents a diagrammatic vertical section of the complete apparatus for manufacturing gas according to the process described. Fig. 2 is a vertical central longitudinal section of the apparatus constructed for practical use. Figs. 3 and 4 are horizontal sections substantially in planes on lines xx and yy in Fig. 2. Fig. 5 is a cross-section on line zz , Fig. 2.

A represents the generator, which is a rectangular structure of fire-brick forming a single generating-chamber B in one end and a regenerating-conduit C, which extends in a serpentine path from near the top of the generating-chamber through the entire brickwork. This conduit forms a series of vertical passages α , which are alternately united at top and bottom by curved bends α' , and

then it divides into two branches C' C^2 , which again reunite into a single discharge-outlet C^3 . The branches C' and C^2 in the construction shown in Figs. 2, 3, 4, and 5 extend on opposite sides of the longitudinal center of the brickwork, and each forms a vertical series of horizontal chambers b , the rear ends of which open out through the brickwork and are closed by suitable covers b' .

D D' D^2 are area-ways constructed in the foundation of the structure for the purpose of convenient access to different parts of the structure.

E is the generator-hearth made of fire-brick. F is a door convenient for kindling the fire and removing the ashes from the generating-chamber.

G are peep-holes in the inclosing wall of the generating-chamber at different heights.

H are twyers through which superheated steam is introduced near the top of the fuel.

I are twyers to which air is introduced into the fuel. They extend partially around the inner wall of the chamber, in the form of eccentric channels I' , whereby the air is delivered circumferentially and tangentially to the body of the fuel in the lower part of the generating-chamber.

J is an air and steam distributing cone extending up centrally from the bottom of the generating-chamber. It is preferably formed of fire-clay and with an annular steam-chamber J' , from which the steam is discharged through perforations J^2 , while the air is led up through a central passage J^3 and is discharged through perforations J^4 in the top of the cone.

K is a platform supporting the cone J removably in position by means of suitable devices for raising and lowering the platform.

L is an air-supply pipe connecting through suitable valved branches L' L^2 with the twyers I and with the central passage J^3 in the cone.

M is the steam-supply pipe, having suitable valve-controlled connections with the twyers H and with the steam-chamber J' in the cone.

N is a fuel-magazine provided with an inclined discharge-spout N' and a piston N^2 , which is operated by a hydraulic piston N^3 in

the cylinder N^4 . The hydraulic cylinder is provided with suitable means for admitting water under pressure to raise the piston N^3 at any desired degree of motion, and thereby raise the fuel in the magazine to discharge the desired quantity of fuel through the spout N' into the generating-chamber. A self-closing valve N^5 may be placed in the spout to keep it closed when no fuel is passing into the generator. When the magazine is empty, the piston N^2 is lowered by letting out the water, and fresh fuel is supplied into the magazine through a suitable feed-door N^6 .

By regulating the admission of the water by a suitable valve N^7 the feeding of coal can be accurately regulated to suit the requirements, and the whole arrangement not only forms a great labor-saving device, but produces superior results in the operation of making gas, as will be explained hereinafter.

The regenerating-chamber is filled with refractory material, preferably in the form of spheres, to afford to the gases passing through it an extended surface with numerous small openings. The single conduit C is of elliptical cross-section and that of the branches C^1 C^2 is circular, which permits of building the whole conduit as a continuous arched structure, imparting strength and stability to the brickwork.

The regenerating-conduit is provided with suitable manholes O , conveniently located at the top for access to the chambers a , and at the bottom there are outlets O' , conveniently located over the areas for the removal or discharge of any accumulated matter. The chambers b of the branches C^1 C^2 are accessible through the doors b' . The lower chamber is preferably formed with a slightly-inclined base, so that tar or other liquid substance accumulating therein will find its way to the bottom into a receptacle O^2 , provided with means for removing its contents.

P and Q are pipes which supply a constant current of steam and one of oil, respectively, from suitable sources of supply P' and Q' to heating devices exposed to the heat of the hot gases from the regenerator C' . To this end the chambers b of the branch contain suitable pipe-coils P^2 for the steam to pass through, and the branch C^2 is correspondingly provided with pipe-coils Q^2 for the oil. In addition there are loops of pipe P^3 for the steam and Q^3 for the oil, which loops are located in heating-chambers R , constructed in the brickwork between the chambers a , extending transversely through the structure.

The superheating devices P^2 P^3 for the steam are connected in series in such manner that the steam entering at the rear end is exposed to gradually-increasing heat until it is heated to the temperature required for its decomposition in the generator-chamber. The heating devices Q^2 Q^3 for the oil are arranged in the same manner, except that a number of condensers Q^4 Q^5 Q^6 are intermediately connected in series with them. These condens-

ers may be of any suitable construction adapted to condense the oil-vapors generated in the heating devices and separate the non-condensable from the condensable vapors. Those shown in the drawings are of known form and consist of a closed vessel divided by two horizontal diaphragms into three chambers c d e . The chambers c and e are connected by vertical pipes. A partition f vertically divides the upper chamber c , and a partition g in the lower chamber converts the same into a trap. The middle chamber d is provided with suitable means to carry a stream of cold water through it, while the upper chamber connects on one side of its vertical partition with the pipe Q , through which the heated vapors are carried in, and on the other side with the pipe S , through which the fixed vapors are carried off, while the liquified products pass off from the chamber e .

The arrangement of the heating-coils and the condensers is such that in the heating-coils intermediate between the different condensers the oil is subjected to the respective temperatures required to convert the constituents of the oil successively into fixed vapors, so that the condensers separately receive the fixed vapors of the different volatile constituents in the order in which such constituents are converted by the increasing temperatures, while the condensers separate the fixed vapors thus generated from the vapors of other constituents which have not yet been heated up to the temperature at which they become fixed, and which by cooling become liquid and have to be heated to higher temperature to become fixed vapors in their turn.

According to circumstances the whole of the heated current of the oil may be allowed to pass through the condensers, or the condensers are placed in branch connections with the heaters, which branch connections are so arranged that the vapors alone pass into the condensers through one branch, while the liquid oil passes directly from one heating device to the other. In this manner all the volatile constituents of the oil that can be converted into fixed vapors by this process of fractional gasification at different degrees of temperature are removed from the oil and the residue is then directly discharged into the generator or into the regenerating-chamber at a point where the heat is sufficient to convert them into gaseous product by destructive distillation.

The fixed vapors separated in the different condensers are either collectively combined with the hot gases in the conduit or the fixed vapor of each constituent is separately conducted into the conduit and combined with the gases at such prescribed temperatures, which, while sufficient to combine it with the hot products, will not be high enough to decompose it, as the different vapors in this respect cannot stand the same degree of heat.

In Fig. 1 the steam-coils P^2 are shown as

inclosed in the lower branch C', while the coil P³ is below the passage *a* in the wall. The oil-heating coils Q² are shown as located in the upper branch C², while the coils Q³ are incased in the walls above the passage *a*.

The mode of operation of the apparatus as a whole is as follows: Before any gas can be made it is necessary to raise the regenerating-conduit, its inclosing walls, and the material contained therein first to a high degree of heat by the active combustion of fuel in the generating-chamber by the application of the air-blast through the twyers I and the perforations J² in the cone. When the proper conditions for gas-making have been established, the steam and oil are also turned on, and the generating of gas may then be commenced and carried on continuously. The body of coal in the generating-chamber is maintained at about the height of the upper twyers II, and the supply of fresh bituminous coal, by means of the hydraulic lift, is so regulated that it operates as a continuous feed. This has the great advantage that the distilling off of the hydrocarbon gas and the subsequent coking of the fresh coal proceed continuously without causing any fluctuation in the operation, and, besides, the fine coal-dust is all burned up instead of being carried over the generating-chamber, as is the case when a large body of the fuel is supplied intermittently, as heretofore, and where the dust is carried by the draft into the conduit and causes constant trouble by choking up the interstices in the regenerating material. The peculiar arrangement of the twyers I compels the blast to assume a spiral course, of which the air is mainly directed into and distributed through the lower portion of the charge, which is thereby maintained in a state of active combustion, and the heat generated maintains the upper portion of the charge with which the steam is brought into contact through the twyers II in a constant state of incandescence, so that the steam is continuously decomposed without slackening the fire. The use of the interior cone with its means for introducing steam and air greatly increases the output of the apparatus, as it brings additional steam and air in a number of small jets and highly heated into the very center of the glowing mass. The steam being introduced near the base of the cone at the same time prevents the formation of clinkers and cakes without slackening the fire, while the air gives enough life to the coal where it is needed to produce the heat for coking the fresh fuel added. The products of this coking of the bituminous coal, together with the products of combustion and of the decomposition of steam, become immediately and thoroughly mixed with the superheated steam injected through the twyers II just above or at the top of the fuel where it gives off its greatest heat and where the walls are also very highly heated, and by this intermingling of the products the steam and the volatilized

products of the fuel are decomposed and the gases are enriched, and, as a result, a mixture of permanent gases is formed, which constitutes what is termed a "fuel-gas," and may be used without further enriching it with oil-gas. As the products of mixed gases from the generating-chamber pass directly into the regenerating-conduit they impart a high degree of heat to the refractory material contained therein, and constantly maintain it at a temperature sufficient to effect the thorough incorporation and mixing of the gaseous products derived from the oil with the hot products from the generator, so that the final product forms a permanent and homogeneous gas.

The apparatus is particularly designed to utilize all the heat produced by the fuel not only for the generation of gases, but also for accomplishing the regenerating and the heating of the steam and oil, so that the process can be carried on continuously, and to this end the arrangement of the chamber is particularly advantageous in affording a large amount of surface to the contact of the heated gases in a very compact structure. The apparatus also affords particular facilities for cleaning and repairing the interior and all other parts liable to need repair from time to time, and with this end in view the cone has been constructed as a segregable piece and made easily removable, as are also the various twyers, the heating-chambers R, peep-holes, and other openings, which are of molded fire-brick and made slightly conical.

What we claim as our invention is—

1. In a gas apparatus, the combination of a generator, a regenerating-conduit extending therefrom, two branches C' C² thereof, oil-superheating coils in one of said branches, steam-superheating coils in the other branch, and connections from said oil-coil into the conduit, and from the steam-coil to the generator, substantially as described.

2. In a gas apparatus, the combination of a generator, a regenerating-conduit extending therefrom in a serpentine path through brickwork, transverse serpentine conduits in the brickwork between the loops of the regenerating-conduit, superheating-coils for oil and steam in said transverse conduits.

3. In a gas apparatus, the combination of a generator, a regenerating-conduit extending therefrom in a serpentine path through brickwork, branches at the end of said conduit, vertical serpentine conduits formed in each of said branches, oil-superheating coils in one of said branch conduits, steam-superheating coils in the other branch thereof, and discharge connections from the coils leading into the generator and the conduit.

4. In a gas apparatus, the combination of the generator the serpentine regenerator-conduit extending therefrom a series of transverse serpentine heating-chambers between the loops of the regenerator-conduit, oil-heating coils in such transverse chambers, a series of condensers, oil-pipes leading from the

coil in said transverse heating-chambers to
the condensers, and pipes leading from the
gas-chambers of the condensers to interme-
diate portions of the regenerator-conduit, and
5 a pipe leading from the oil-chamber of the last
condenser, to at or near the generator, sub-
stantially as and for the purpose described.

In testimony whereof we affix our signa-
tures in presence of two witnesses.

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Witnesses:

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