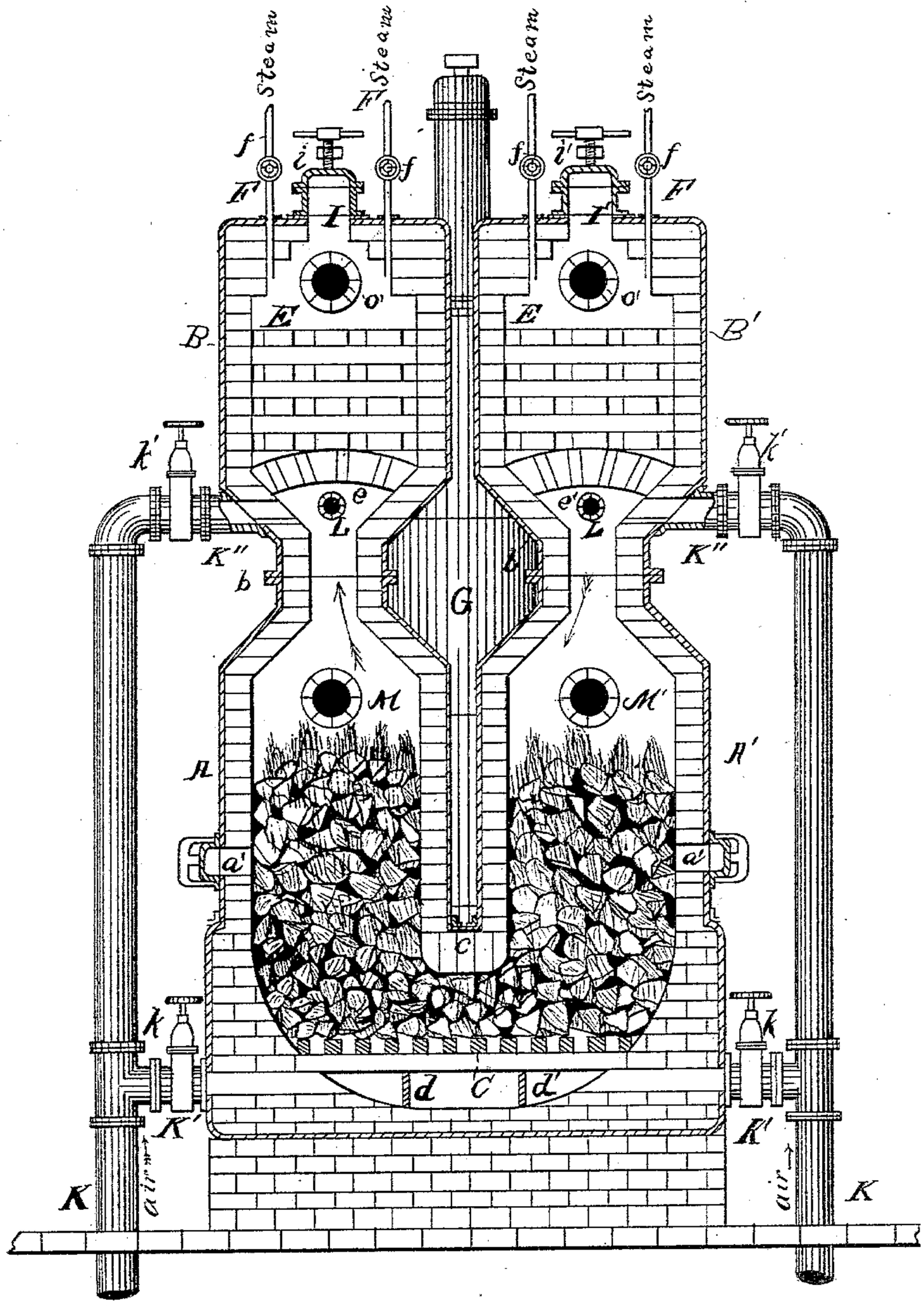
(No Model.) 5 Sheets—Sheet 1.

J. HANLON.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

No. 300,466. Patented June 17, 1884.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

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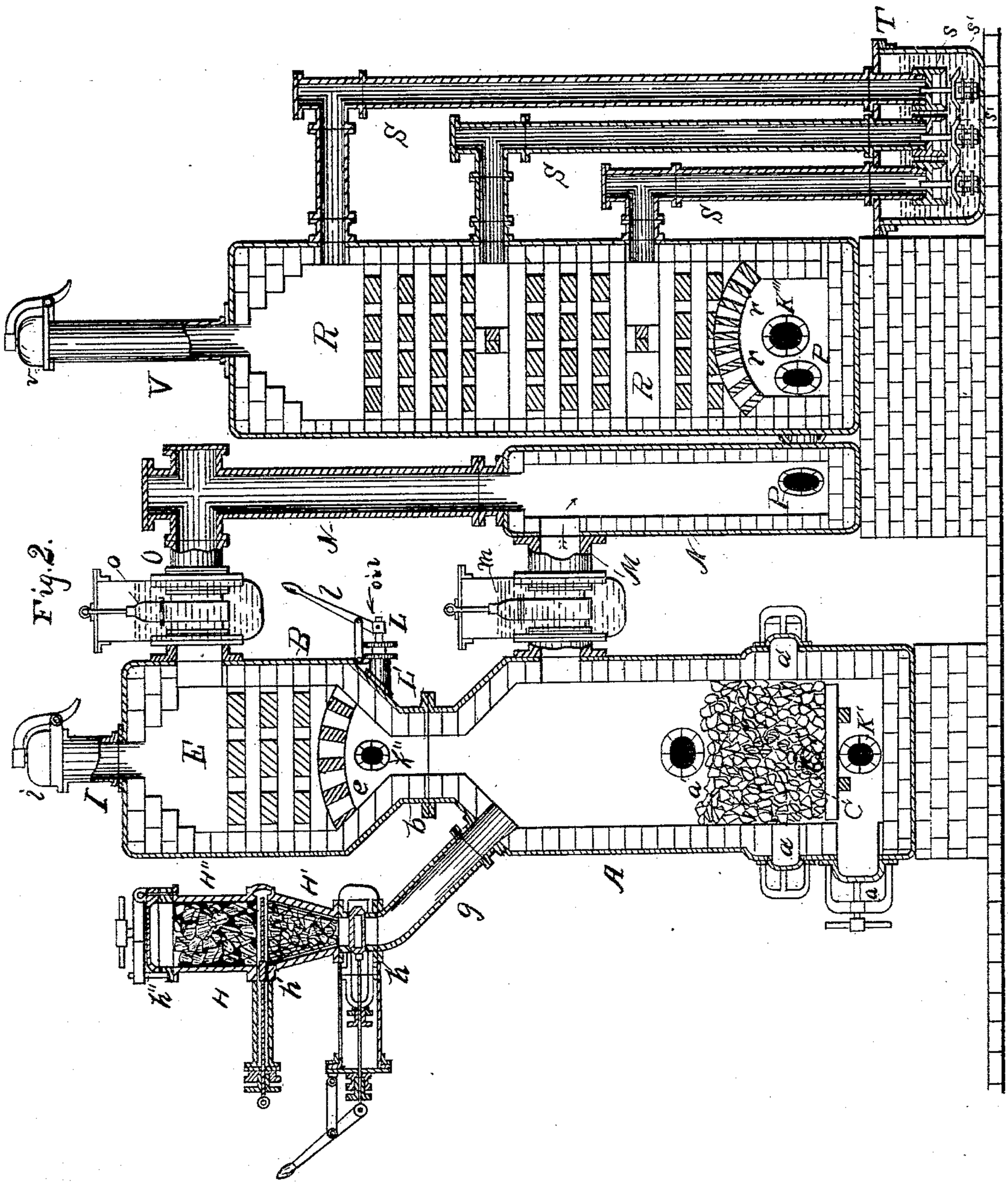

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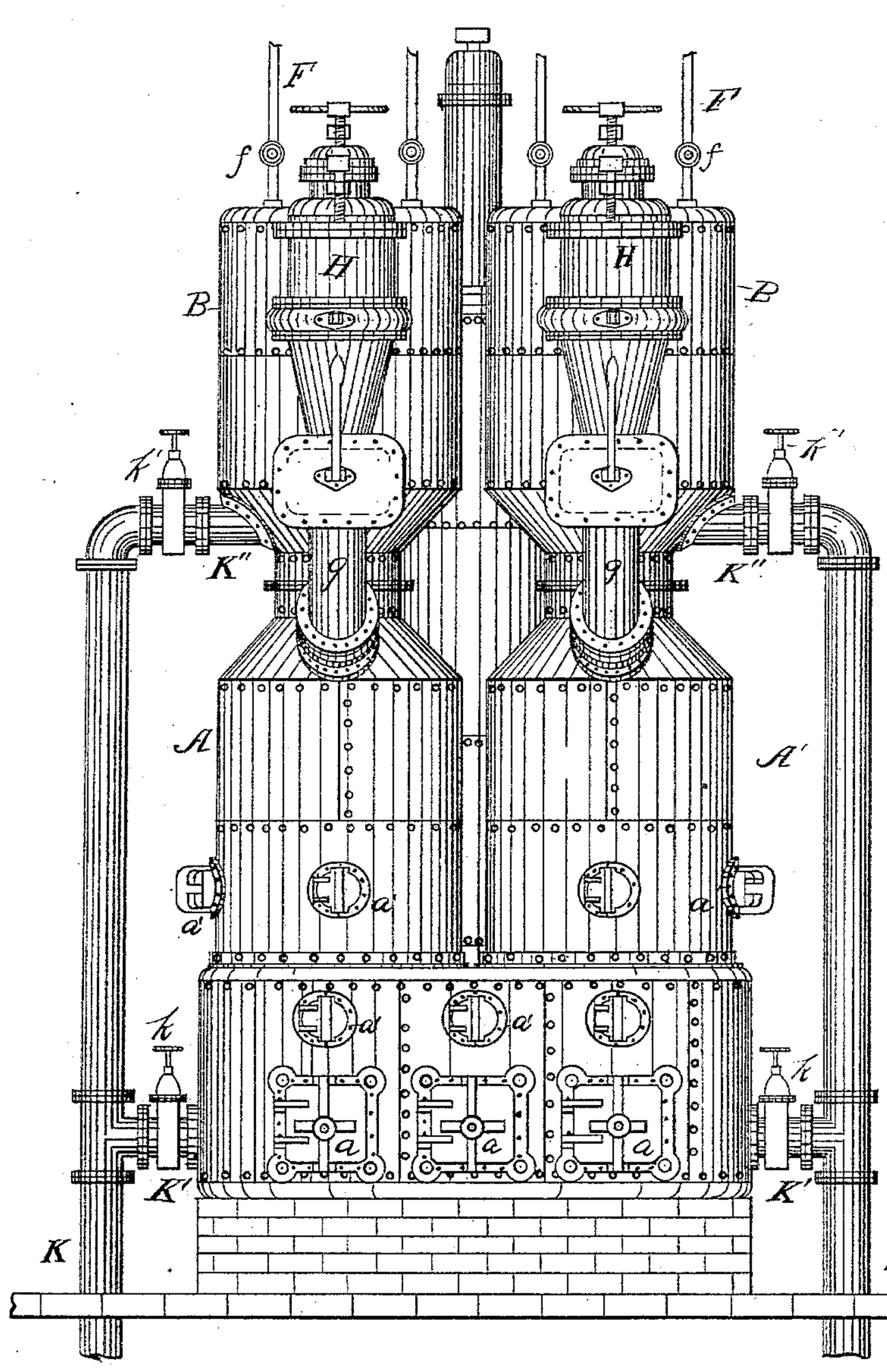
No. 300,466. Patented June 17, 1884.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

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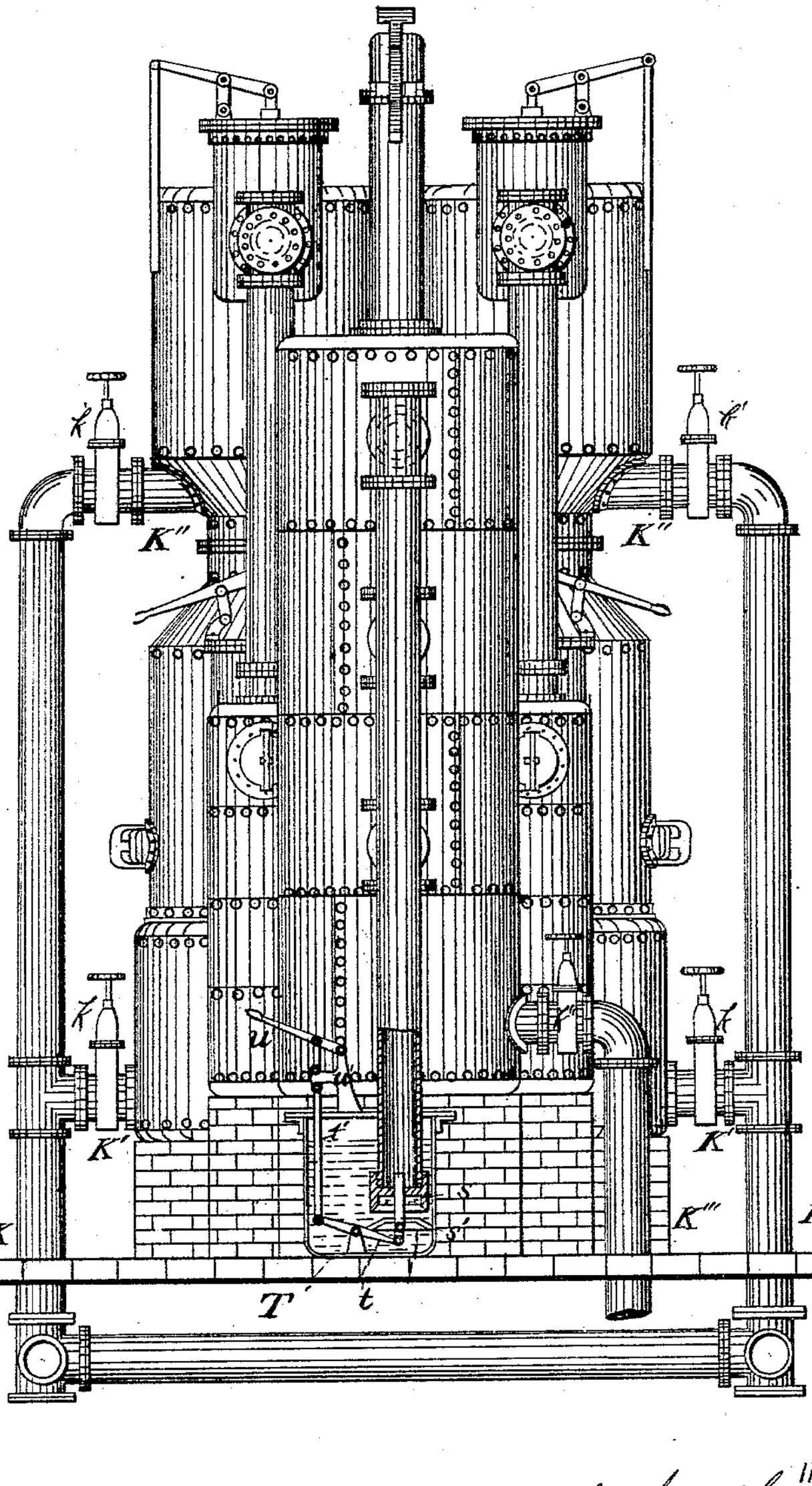
PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

No. 300,466. Patented June 17, 1884.

Fig. 4.



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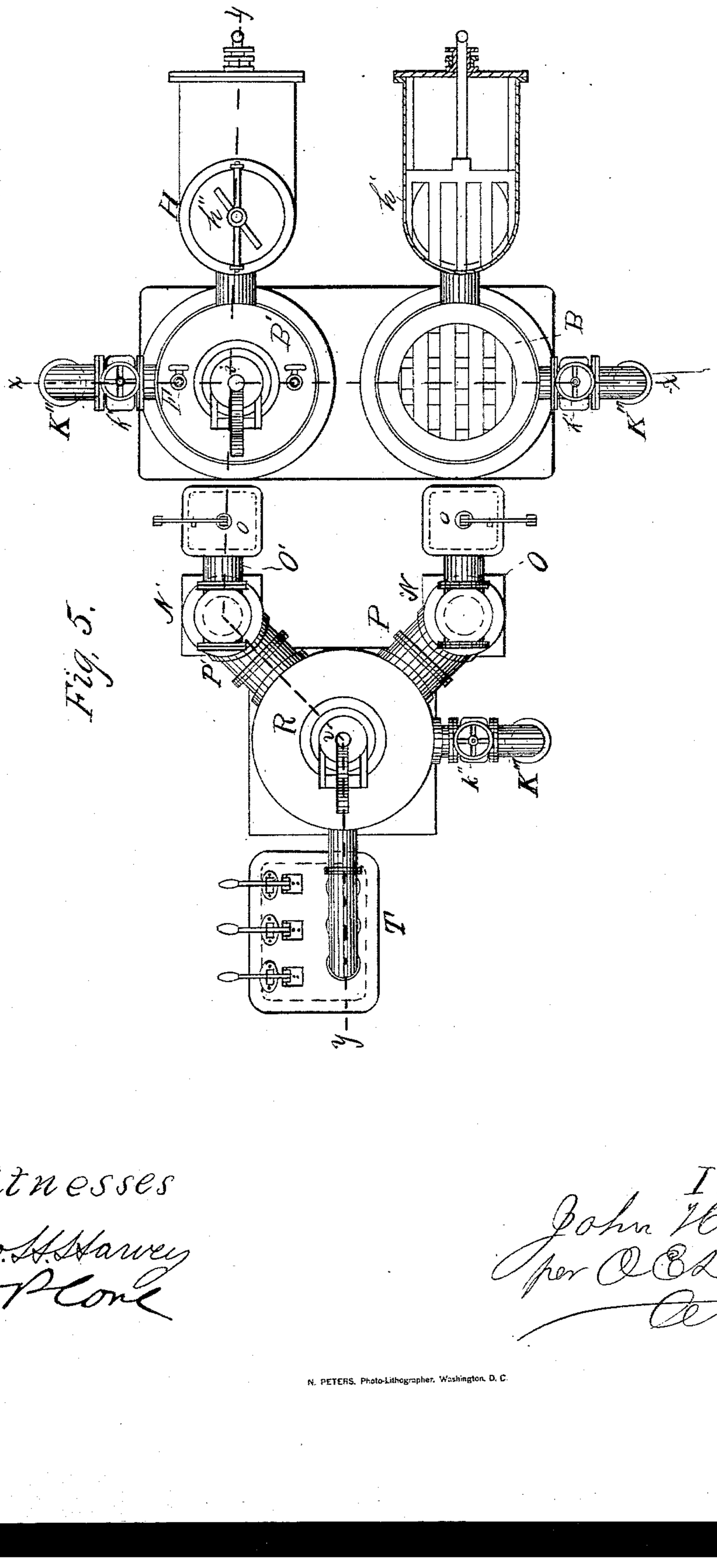

Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN HANLON, OF NEW YORK, N. Y., ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE UNITED COAL AND OIL GAS COMPANY, OF NEW YORK.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 300,466, dated June 17, 1884.

Application filed October 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN HANLON, of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Process of and Apparatus for Manufacturing Gas; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

This invention relates to the manufacture of illuminating and heating gas, and more particularly concerns that process and apparatus in which steam is decomposed, and bituminous or soft coal is distilled in the same cupola generating-furnace, in which hydrocarbon oil is vaporized either in the generator or in a connected fixing-chamber, which is heated by the waste gaseous products of combustion of the fuel in the generating-chamber; and in which the resulting gases and vapors are combined and converted into a fixed gas in the heated fixing-chamber.

The object of the invention is to improve the manufacture of illuminating-gas by so conducting the operation as to effect a great economy in the use of hydrocarbon liquid, by which the gas is carbureted—that is, to prevent destructive decomposition or reduction to lamp-black or solid carbon and consequent waste of the hydrocarbons, which impart the illuminating quality to gas. Another object is to improve the apparatus in such manner as to better preserve the grate-bars from the destructive action of steam and hot gases; to simplify and improve the coal-charging apparatus; and to provide a superheater so constructed and provided with discharge pipes and valves that the carbureted gas may be discharged immediately upon being fixed, whereby injuriously long exposure of the hydrocarbons to a large body of heated refractory material is avoided, and gas of more uniform quality and candle-power is produced.

My invention will now be described in connection with the accompanying drawings, in which Figure 1 represents a vertical cross-section through the two generating and steam-superheating chambers on the line *x x*, Fig. 5. Fig. 2 represents a vertical longitudinal section through one of the generating and steam-superheating chambers, the fixing-chamber, the coal-charger, the hydraulic-seal box, and the connecting-pipes, on the line *y y*, Fig. 5. Fig. 3 represents a front elevation of the apparatus. Fig. 4 represents a rear elevation with the seal-box and a dip-pipe in section. Fig. 5 represents a plan view with the top of one steam-superheating chamber and of the coal-charger removed.

The same letters of reference designate similar parts in the different figures of drawings.

The generating apparatus G is composed of two furnaces or chambers, A A′, connected by a common base and freely communicating with each other above the grate C, which is common to both, and they are surmounted by steam-superheating chambers B B′, connected by the necks *b b′*. The generators and superheaters are constructed of fire-brick, covered by jackets of plate-iron, and mounted on a brick or stone foundation.

The decomposing-chambers A A′ are represented as independent structures slightly separated from each other down to near their bases a short distance above the grate, each having a distinct inclosing wall and jacket down to the arch *c* above the grate-chamber; but it is obvious that they might both be built in one structure, inclosed in a common wall and covered by a single jacket, and separated by a division-wall resting upon the arch *c*. This division-wall might be strengthened and made tight by a central iron plate. This modification falls within the limits of my invention, though the construction shown is preferred. The chambers A A′ have their bottoms curved and sloping from their outer sides down to the bottom of the ash-pit, in order to reduce the grate-surface, and so that the chambers may be more readily cleaned. The ash-pit is divided into three separate compartments by the partition-walls *d d′*, extending from front to rear thereof, so that the gases from one generating-chamber are not allowed to pass down

through the grate and thereby corrode and burn it out, but are compelled to pass above the grate to the adjoining generating-chamber. Tight-fitting doors *a* close passages into each compartment of the ash-pit. The steam-superheating chambers B B′ are connected with the generating-chambers by contracted necks *b b′*, and have near their bases the arches *e e′* of masonry supporting the cellular brick-work E E′. They are also provided with short smoke-stacks or passages I I′, having tight-fitting lids or caps *i i′*. These passages also serve as man-holes to give access to the chambers for the purpose of laying, repairing, and cleaning the cellular brick-work. Steam-pipes F, having valves *f*, connect with the top of each super-heating-chamber. A coal-charging hopper, H, connects by a chute, *g*, with the upper portion of each generator, and the hopper has at its bottom a water-cooled valve, *h*, provided with a stem and operating-lever. The conical portion H′ of the hopper is constructed of sufficient size to hold a single charge of coal, and this chamber is separated from the main fuel-chamber H″ by a cut-off slide, *h′*, constructed with separated bars like a gridiron, as shown in Fig. 5. The fuel-chamber H″ should be made large enough to hold a number of charges of coal, and it is closed at the top by a tight-fitting lid, *h″*, which may be clamped down by a hinged bar, link, and screw, as shown. An air-blast pipe, K, connects by branch K′, having valve *k*, with the base of each generating-chamber below the grate, and by a branch, K″, having a valve, *k′*, with the base of each steam-superheating chamber. A sliding oil-supply pipe, L, having a pivoted operating-lever, *l*, passes through a stuffing-box and sleeve L′, near the base of each steam-superheating chamber, (see Fig. 2,) to supply oil for enriching the gases passed from each generating-chamber. When oil is admitted, the supply-pipe is projected some distance into the chamber, in order that the oil may drop freely through the passage in the neck *b* or *b′* down into the rising and outgoing current of hot gas. Each generating-chamber is provided with a number of openings, *a′*, closed by tight-fitting caps—one set just above the grate-bars and another set higher up, for the insertion of bars to break up the coal or coke and break down the clinker.

Gas-discharge pipes M M′, having water-cooled valves *m m′*, connect near the tops of the generating-chambers A A′ and with the vertical pipes N N′. Pipes M M′ are for the escape of gases resulting from the decomposed steam, the coal and the oil on their way to the fixing-chamber, and also for the escape of products of combustion. The superheaters have connecting, near their tops, the outlet-pipes O O′, having water-cooled valves *o o′*, leading to the stand-pipes N N′, for the escape of products of combustion. Stand-pipes N N′ connect at their lower ends by pipes P P′ with the base of the fixing-chamber R. Pipes P P′, however, may connect the upper ends of the stand-pipes directly with the top of the fixing-chamber R, if such arrangement is preferred. The lower ends of the stand-pipes from just above the connecting-pipes M M′ downward, and where they are exposed to the greatest heat, are lined with fire-brick, while the upper ends, through which but a small proportion of hot products pass, are simple iron pipes. The fixing-chamber R is constructed of fire-brick covered with a tight jacket of plate-iron, and is mounted on a brick or stone foundation. It is provided near the base with a perforated arch, *r*, for supporting the cellular brick-work filling. This brick-work is separated into three sections or bodies by intermediate spaces, and at each space above each body of brick-work there connects a gas-eduction pipe, S, leading to the hydraulic-seal box T. The pipes S, at their lower ends, where they project down into the box, are provided with valve-seat pieces *s*, screwed to them, which pieces have conical valve-seats and guide-bars for the stems of the conical valves *s′*, which may be operated to close the ends of the pipes, as desired. The stem of each valve is connected to one end of a lever, *t*, pivoted to a fulcrum in the bottom of box T, and to the other end of such lever is connected a rod, *t′*, passing up through the top of the cover of the box, and is pivotally connected to a lever, *u*, the inner end of which is pivoted to a standard, *u′*, secured to the top of the box. By means of the levers and rod any valve may be readily raised or lowered for closing or opening the mouth of any dip-pipe desired. An air-blast pipe, K‴, having a valve, *k″*, connects with the base of the fixing-chamber below arch *r*, for supplying air to produce complete combustion of gaseous products from the generator while heating up the apparatus. At the top of chamber R is a smoke-stack, V, having at the top a tight-fitting cap, *v*, which may be opened for the escape of products of combustion, while the apparatus is being heated, but which is closed while gas is being fixed in the chamber, and the gas is caused to pass down one of the dip-pipes, S, into the seal-box. The water-cooled valves in the different pipes have stems extending up through their water-boxes, to which are connected operating-levers.

Having described my apparatus I will now describe its operation and the process carried out therein of manufacturing gas.

The two generating-chambers are operated reciprocally, the superheated steam being passed alternately down into one and the resulting gases up through the other, while the fresh charge of bituminous coal is also distilled alternately first in one and then in the other chamber, but always being freshly charged into that chamber least highly heated and up through which the gases are passed on their way to the outlet-pipe and fixing-chamber. A fire is first kindled on the grate, and

it is urged by air-blasts admitted through pipes K′ by opening valves *k* on each side of the grate, while fuel, preferably anthracite coal or coke, is gradually fed in till a bed of highly-heated or incandescent fuel several feet thick is formed in each chamber. During the admission of the air-blasts below the grate the cap *v* of smoke-stack V is open, and at first the valves *m m′*, on outlet-pipes M M′, are opened for the escape of products of combustion into fixing-chamber R. Then, as the beds of fuel increase in the generators and carbonic oxide is given off, air is admitted through pipe K‴ by opening its valve *k″* to the base of fixing-chamber R, for causing complete combustion of the hot carbonic oxide, and thereby heating the refractory brick-work in the fixing-chamber. Near the end of the operation of heating up, valves *m m′* are closed and valves *o o′* are opened. Then valves *k′* are opened, and air-blasts are admitted by branch pipes K″ into the bases of chambers B B′, for burning hot products therein and heating the contained brick-work. The order of heating the chambers may be reversed—that is, chambers B B′ may be heated first and chamber R heated second—or they may be heated at the same time, by properly adjusting the valves; but it is preferred to heat the different chambers at separate periods. One of the generating-chambers and one steam-superheating chamber—as chambers A and B—are at first most highly heated by maintaining the air-blasts admitted to them and keeping their outlet-pipes open for the longer time, for in these chambers steam is first superheated and decomposed. The beds of fuel in the generators being raised to incandescence and all the chambers being properly heated, the valves of the air-blast pipes are closed, cap *v* is closed, both valves *o o′* are closed, valve *m*, on pipe M, leading from generator A, is closed, and the valves *s′* of the two upper and outer gas-outlet pipes, S, are also closed, while valve *m′*, in outlet-pipe M′, is left open. Steam is now admitted by pipes F into the top of superheating-chamber B, where it is superheated by passage down through the highly-heated brick-work contained therein, and is passed down into the incandescent fuel in chamber A, where it is decomposed, the resulting gases, hydrogen and carbonic oxide and, perhaps, a small per cent. of carbonic acid, passing below arch *c* and above the grate, up through the hot fuel in chamber A′, where any carbonic acid present is converted into carbonic oxide. The partitions *d d′* in the ash-pit prevent the current of gases from passing through and below the grate, whereby it is preserved from corrosion. About the time that steam is admitted to superheater B a charge of bituminous coal is dropped upon the bed of hot fuel in chamber A′, so that the gases resulting from the steam are passed up through the distilling charge of coal, and thereby combine with the rich hydrocarbon vapors and gas being evolved, and carry them into the fixing-chamber.

If a rich gas is desired for illuminating purposes, hydrocarbon oil is admitted by pipe L into chamber A′, where it is vaporized and the vapors mingled with the outgoing gas passing through pipe M′ to the fixing-chamber. If the heat in chamber A′ is so great as to be destructive of the oil, it may be admitted at any desired point in stand-pipe N, or even into the fixing-chamber R, for carbureting the gas. It is intended, however, that the generating-chamber in which coal is last fed, and up through and out of which the gas is passed, shall not be at such high temperature as to change the hydrocarbons of the coal or the liquid into lamp-black or hard carbon. The large volume of hydrogen entering from the adjacent chamber assists materially in carrying the hydrocarbons forward and preventing them from burning. The fixing-chamber is constructed and provided with eduction gas-pipes with special reference to the accomplishment of this same object—that is, so that the gases and vapors are at first conducted through a small portion only of the heated brick-work, and exposed only sufficiently long to combine and fix the gas. Therefore, the two upper and outer gas-escape pipes are at first closed by valves *s′ s′*, in the seal-box, the first one only being left open, and the gases and vapors are combined and converted into a fixed gas for the first period by passage simply through the first body of heated brick-work till the temperature thereof is so far reduced as to make this body inoperative to fully fix the gas; then the first pipe, S, is closed, and the second one opened, and the gases caused to pass up and through the second body of hot brick till it is cooled, when the second pipe is closed and the third one opened, and the gases to the end of the run are conducted through the third body of hot brick. By means of the improved construction of apparatus, and by the improved manner of conducting the operation just described, I prevent destructive decomposition and waste of the hydrocarbons and also obtain the important advantage of producing a uniform quality of gas throughout the whole operation.

The manufacture of gas by decomposing steam, distilling coal, &c., as above described, is continued till the temperature of the decomposing and distilling chambers and the fixing-chamber are reduced so low as to render them inoperative, when the steam and oil are shut off. Then the apparatus is reheated by admission of the air-blasts and by proper arrangement of the valves and cap of the smoke-stack, as at first described, only at this time the steam-superheater B′ and generating-chamber A′ are the most highly heated. After the apparatus is properly heated, the manufacture of gas by the operations above described is resumed, though steam and gases are now conducted in the reverse direction

through the two generating-chambers—that is, steam is superheated in chamber B′, decomposed in chamber A′, and the resulting gases passed up through chamber A, where the fresh charge of coal is now being distilled, and out of such chamber to the fixing-chamber. The charges of soft coal periodically dropped into the generating chambers yield sufficient coke to maintain the beds of fuel at the required height for decomposing the steam. Both chambers of the charging-hopper may be first filled with coal, the valve *h* being closed; then slide *h′* is run in to separate the main body of coal from the charge in the conical chamber, and then cover *h″* is closed and clamped down to the top of the large storage-chamber, so as to prevent the escape of gas up through the coal. When it is desired to drop a charge into the generating-chamber, valve *h* is drawn out and the charge contained in the conical chamber slid down the chute into the generator; valve *h* is then closed, and slide *h′* is drawn out to permit another charge to pass into the conical chamber, after which the slide is closed.

Instead of three dip-pipes S extending down into the seal-box, with valves at their lower ends, a single stand and dip pipe S might be provided, extending from near the top of the fixing-chamber, and connected with such fixing-chamber by three horizontal pipes, one connecting just above each body of brickwork, and each having a controlling-valve, so that gas could be passed from any desired section of the fixing-chamber, as with the construction and arrangement shown.

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

1. The process of manufacturing gas which consists in heating up the generating and fixing chambers by the combustion of fuel in the former and of products from such fuel in the latter, thereby heating a large body of refractory material in the fixing-chamber; then decomposing steam in the fuel, enriching the resulting gases with hydrocarbons; then combining and fixing the carbureted gas by passing it through a small portion of the heated refractory material and to the seal-box; then, as the first portion is cooled, passing the succeeding volume of gas through another heated portion of refractory material and out to the seal-box or main; and thus passing successive volumes of gas as produced through succeeding bodies of heated refractory material, whereby destructive decomposition of the hydrocarbons is prevented, and a uniform quality of gas as to candle-power is produced.

2. The closed generating-chambers having a single grate common to both and communicating with each other at their bases above the grate, in combination with a gas-discharge pipe connecting with the top of one of the chambers.

3. In combination with a gas-generator, the sleeve and the sliding oil-supply pipe fitting in such sleeve, so that the oil-pipe may be projected beyond the furnace-wall internally when oil is supplied and withdrawn when the supply of oil is shut off.

4. The two reciprocating generators having a connecting-base, in combination with the grate and one or more vertical partitions in the ash-pit for causing the gases to pass from one chamber into the other above the grate.

5. The two generating-chambers connected by a common base, in combination with steam-supply pipes connecting with their upper portions, the connecting air-blast pipes, and the gas-outlet pipes leading from the upper portion of each chamber.

6. The two generating-chambers connected at their bases, in combination with the steam-superheating chambers placed above them, the gas-outlet pipes leading from the generators below the steam-superheating chambers, and the air, steam, and oil supply pipes connected as described.

7. The two generating-chambers having a connecting-base, in combination with the steam-superheating chambers mounted above them, the gas-outlet pipes leading from the upper portions of the generators, the outlet-pipes for products of combustion leading from the superheating-chambers, and supply-pipes for air and steam, connected as and for the purposes described.

8. The two closed reciprocating gas-generating chambers having a connecting-base and an arch extending from front to rear above the bottom of the chamber, so as to form a passage from one chamber to the other and support the wall or walls separating the two generating-chambers, in combination with connecting air-blast pipes and gas-discharge pipes, as described.

9. The two gas-generating chambers connected at their bases, in combination with the steam-superheating chambers above them, the gas-outlet pipes from the upper portions of the generators, the outlet-pipes from the superheaters for products of combustion, a fixing-chamber, and pipes connecting the outlet-pipes from the generators and superheaters with the fixing-chamber.

10. A gas-generator, in combination with a fixing-chamber having gas-outlet pipes leading from it at different distances from the gas-inlet pipe, whereby a small portion of the fixing-chamber may be used at one period for fixing the gas and another portion used at a succeeding period, and destructive decomposition of hydrocarbons thereby prevented, and gas of a uniform candle-power produced.

11. A gas-fixing chamber containing a filling of refractory material, and having gas-outlet pipes provided with controlling valves or seals, and connecting therewith at different distances from the gas-inlet pipe, for the purpose described.

12. A gas-fixing chamber, in combination with a hydraulic-seal box, pipes connecting different sections or portions of the fixing-

chamber with the seal-box, and the valves for closing the pipes arranged in the seal-box, for the purpose described.

13. The combination of a gas-eduction pipe of a gas-apparatus with a hydraulic main or box, said pipe projecting into the box, a valve for closing the end of the pipe connected to one end of a pivoted lever in the box, and a rod connected to the other end of the lever and passing up through the top of the box, for operating the valve.

14. A gas-generator, in combination with a fixing-chamber containing refractory material separated into different sections or bodies by intervening spaces, gas-outlet pipes communicating with the spaces between the bodies of material, and a pipe connecting the generator with one end of the fixing-chamber, for the purpose described.

15. In combination with a gas-generator, a fuel-feeding hopper having a valve in its bottom, a charge-chamber holding a single charge of coal, a storage-chamber adapted to hold several charges of coal, a slide for separating its charge-chamber from the storage-chamber, and a tight-fitting lid or cover closing the top of the storage-chamber.

16. The charging-hopper having a water-cooled valve in its bottom, and a grated slide between the charge-chamber and the storage-chamber, in combination with a furnace.

17. The charging-hopper having a water-cooled valve at its bottom, a grated slide between its charge-chamber and its storage-chamber, and a tight-fitting lid closing its top, in combination with a gas-generator.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JOHN HANLON.

Witnesses:
ANTONIO C. GONZALEZ,
EMMET R. OLCOTT.