No. 37,412. PATENTED JAN. 13, 1863.

W. G. VALENTIN.

COKING COAL AND GENERATING GAS.

4 SHEETS--SHEET 1.

Fig. 1.

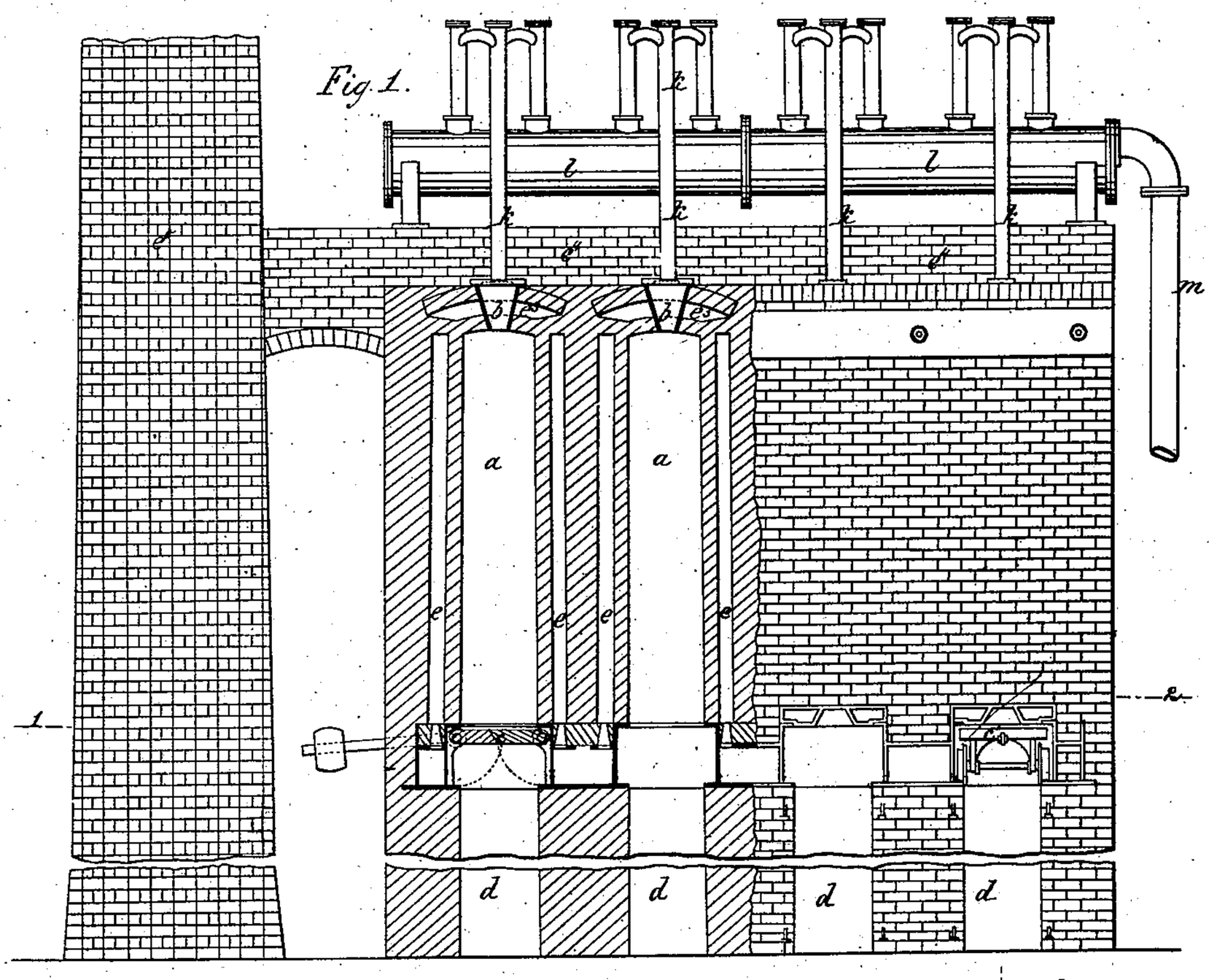
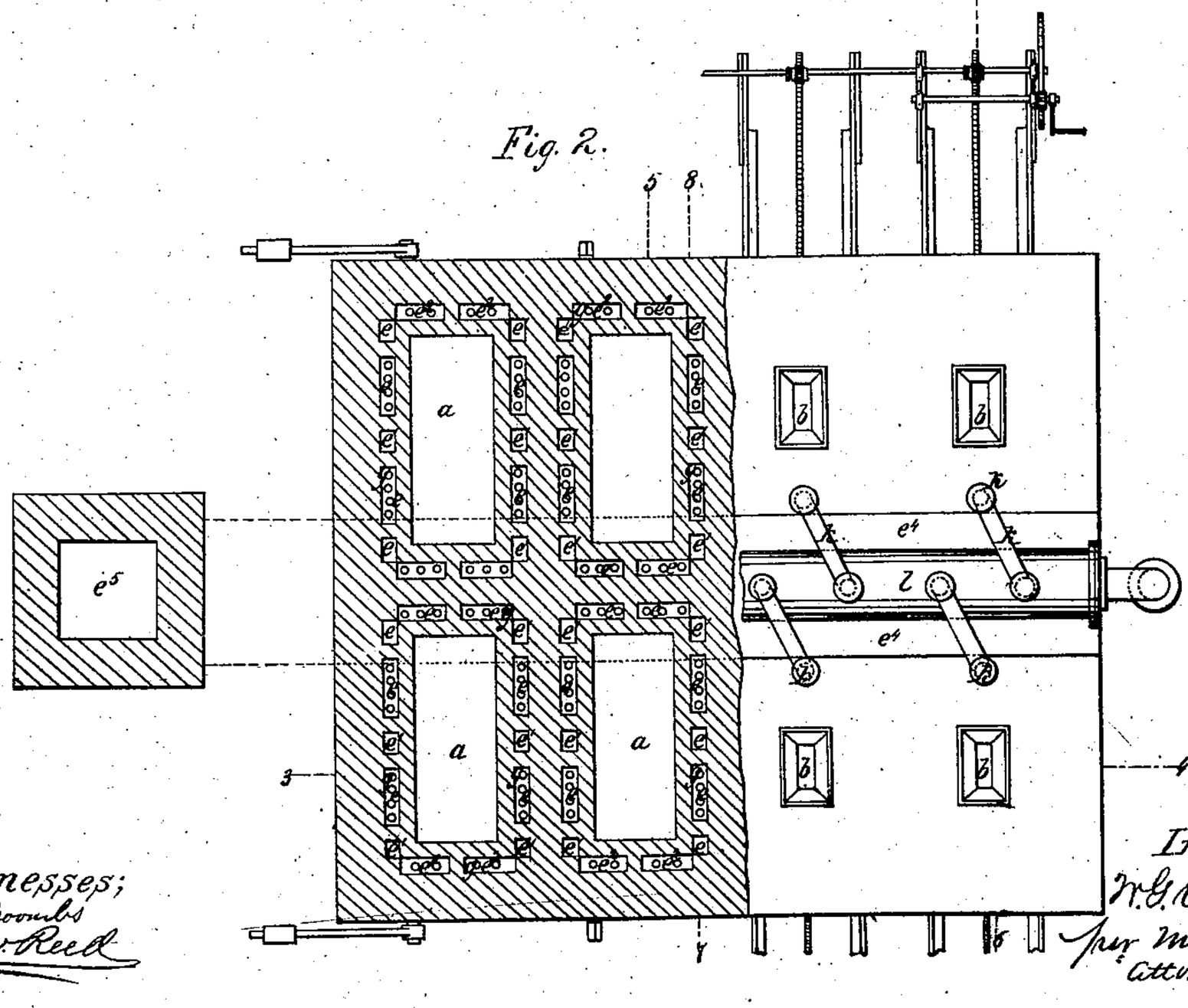


Fig. 2.



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4 SHEETS—SHEET 2.

Fig. 3.

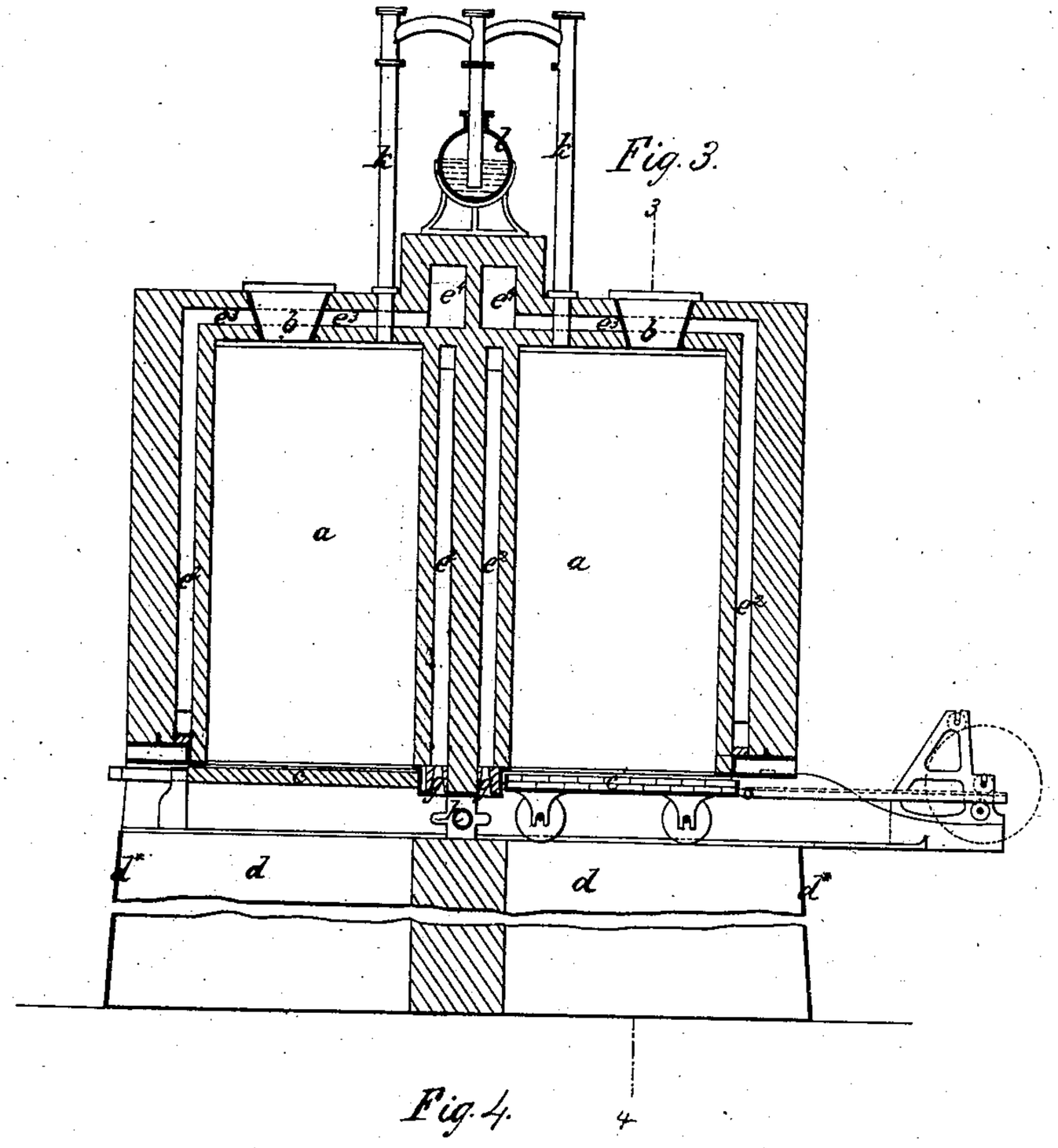
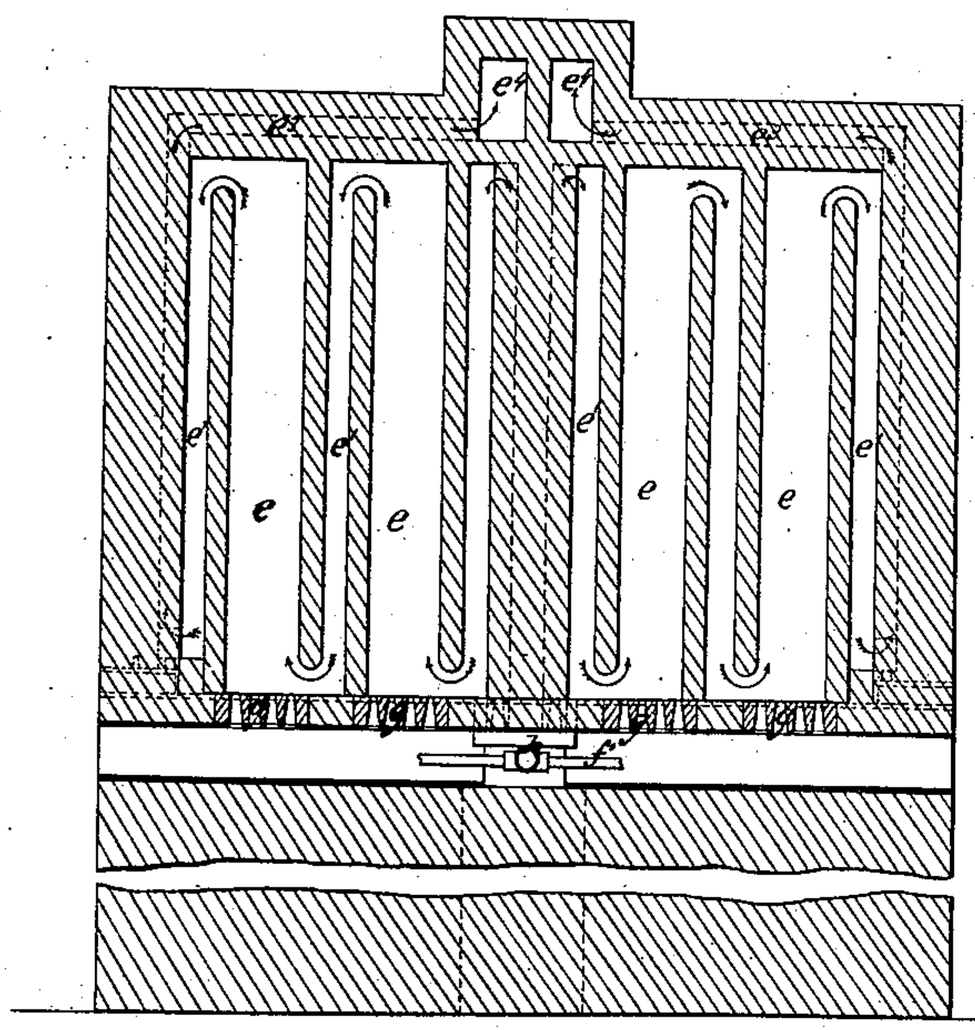


Fig. 4.



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4 SHEETS—SHEET 3.

Fig. 5.

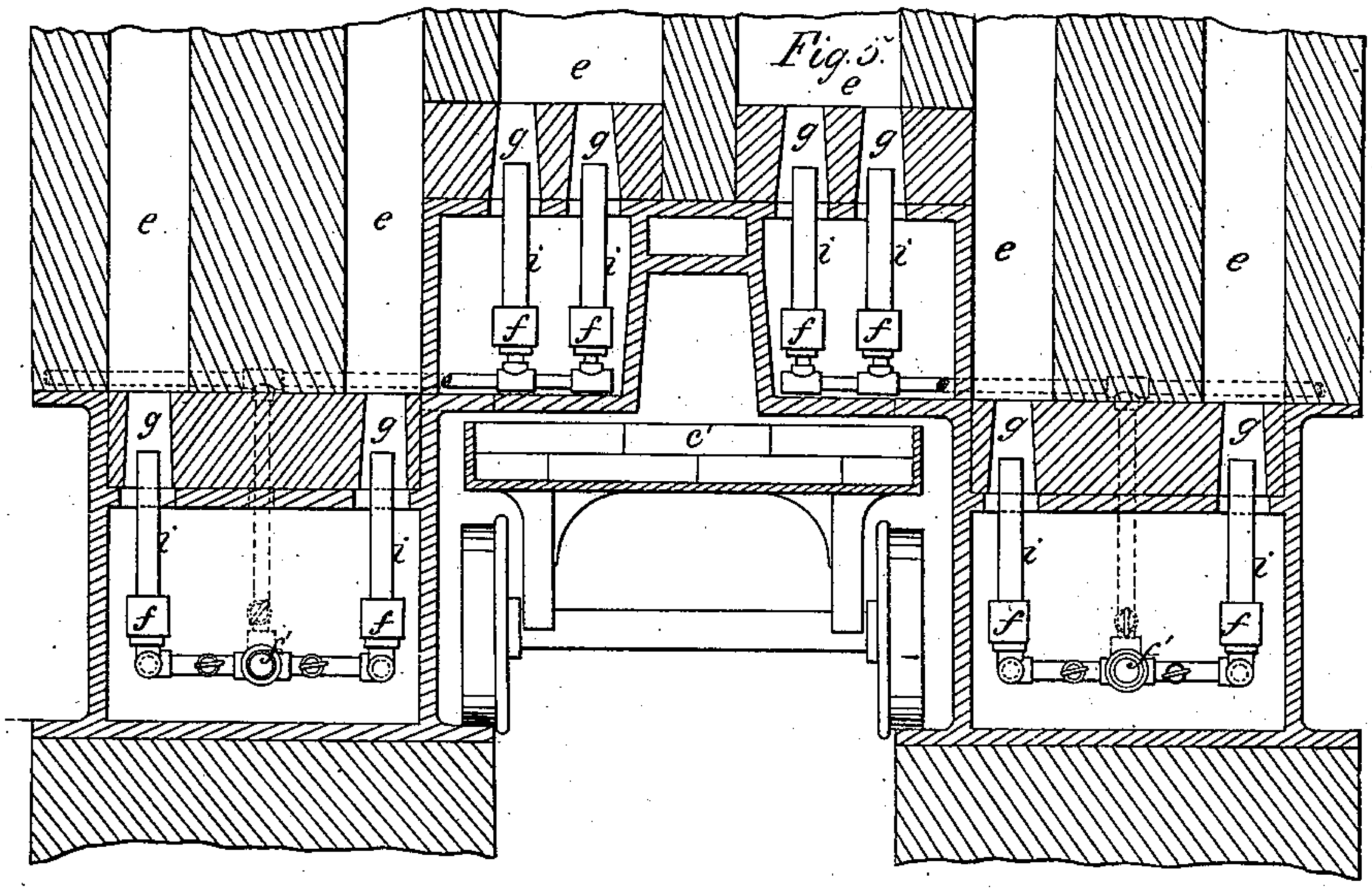


Fig. 8.

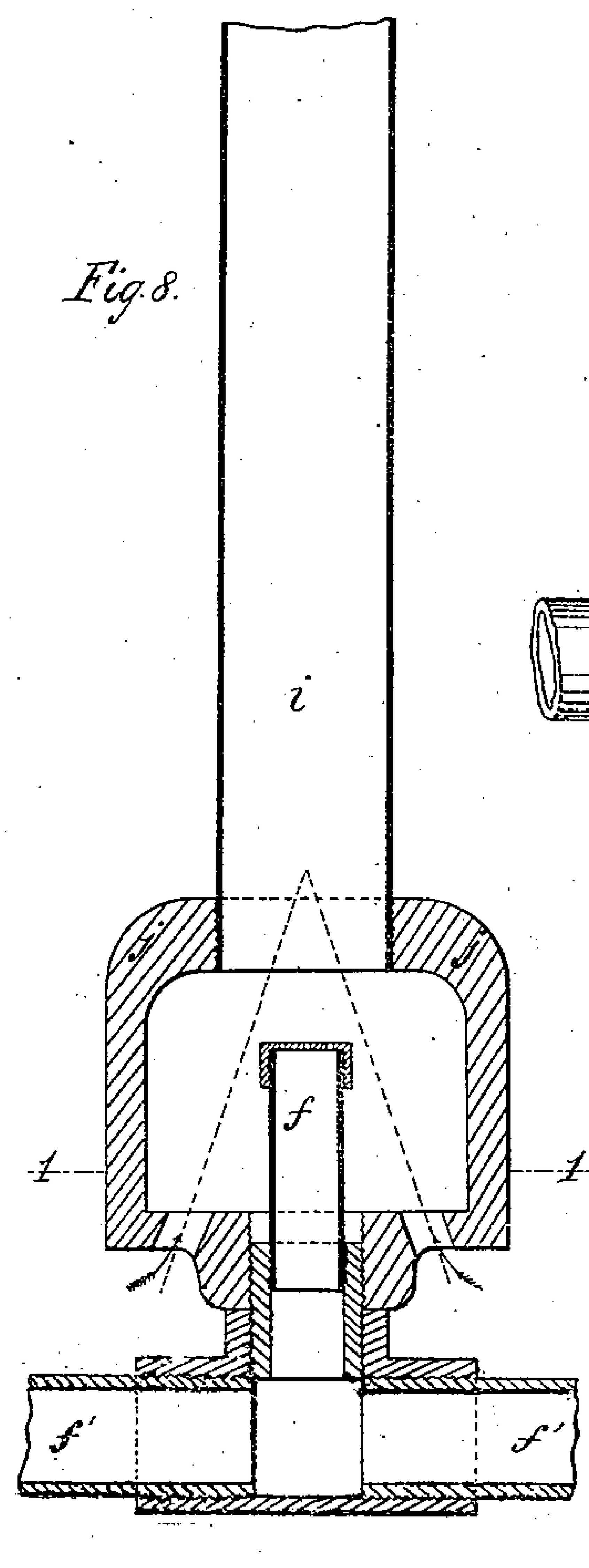
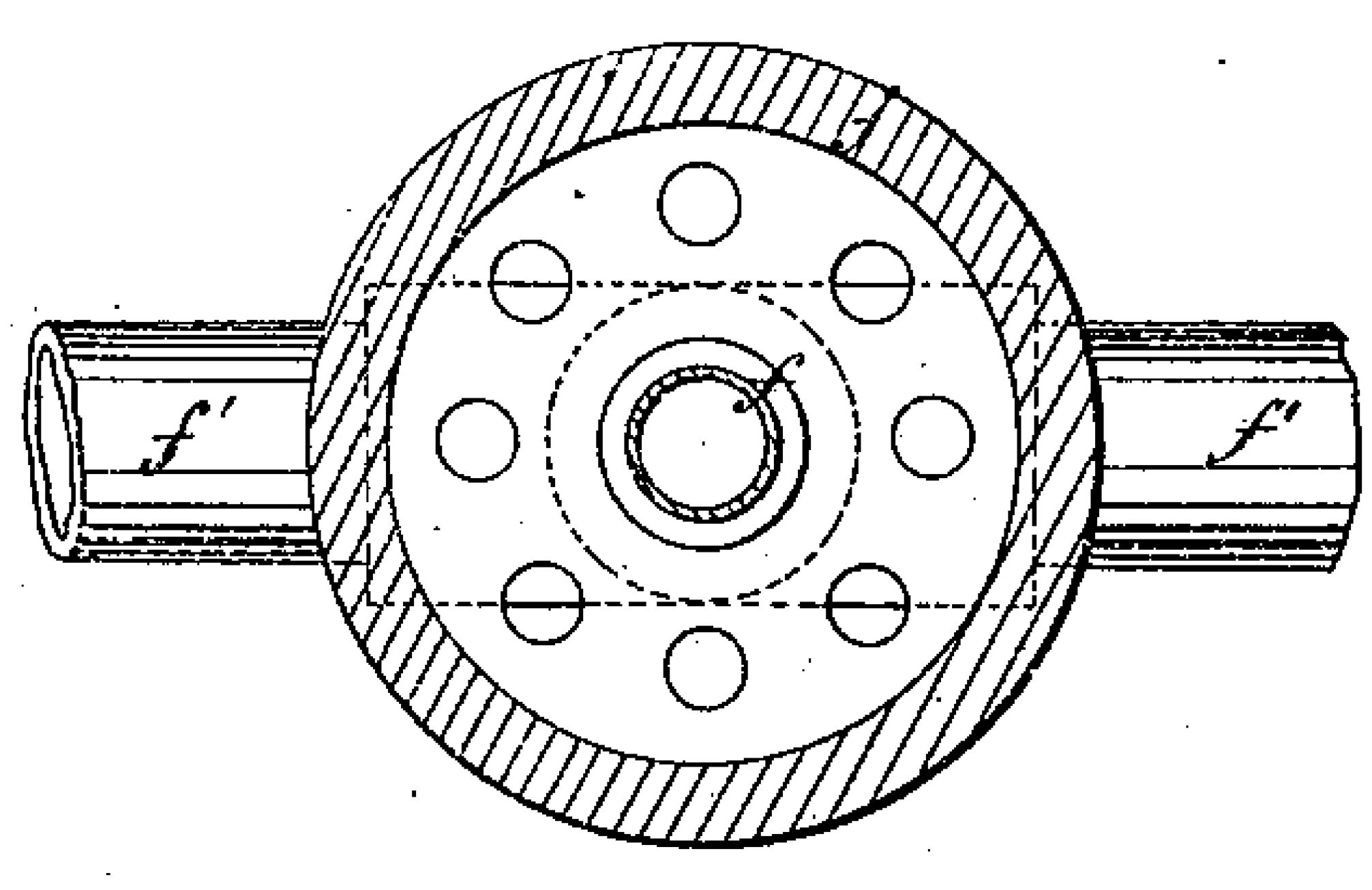


Fig. 9.



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4 SHEETS—SHEET 4

Fig. 6.

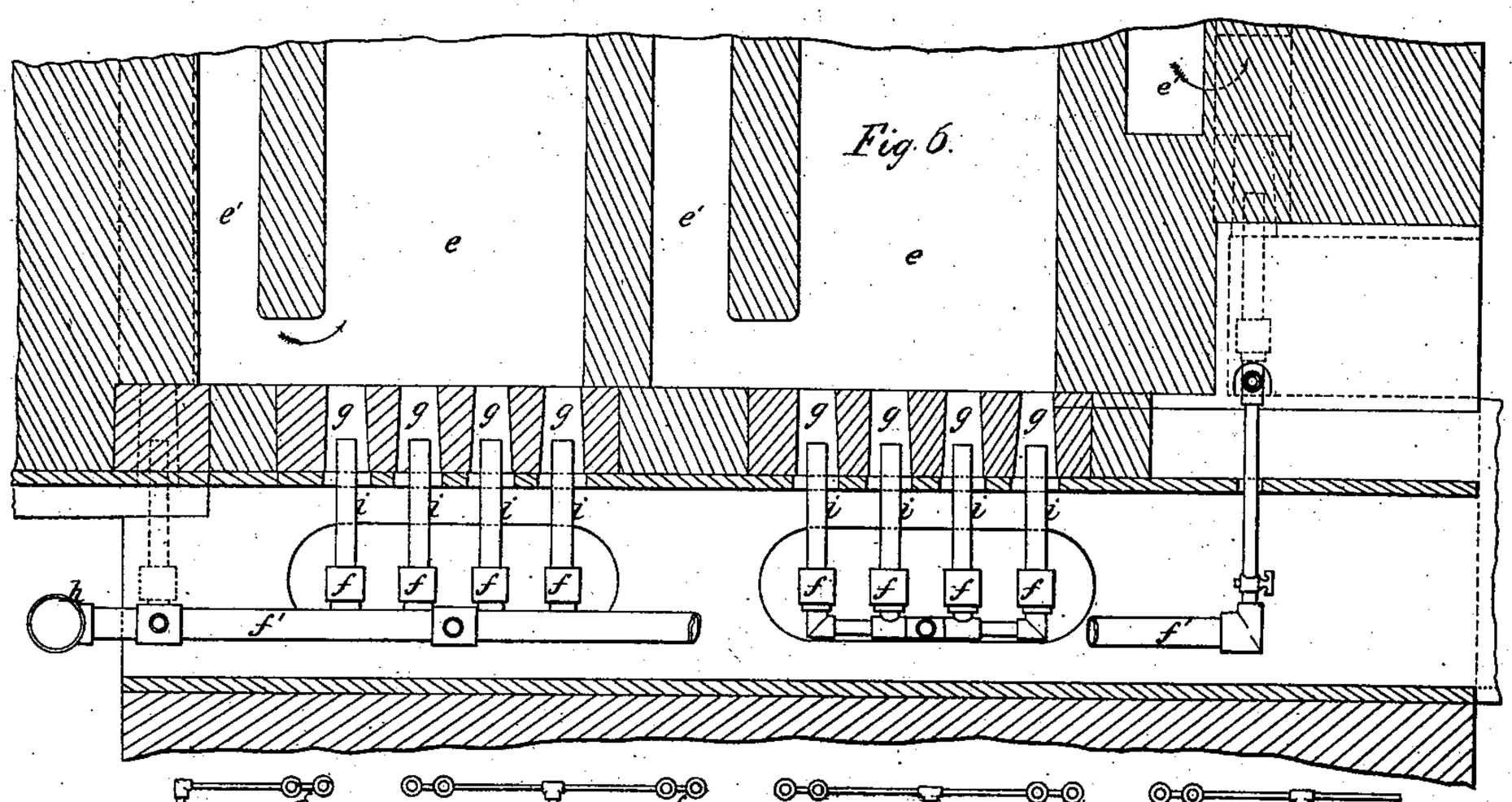
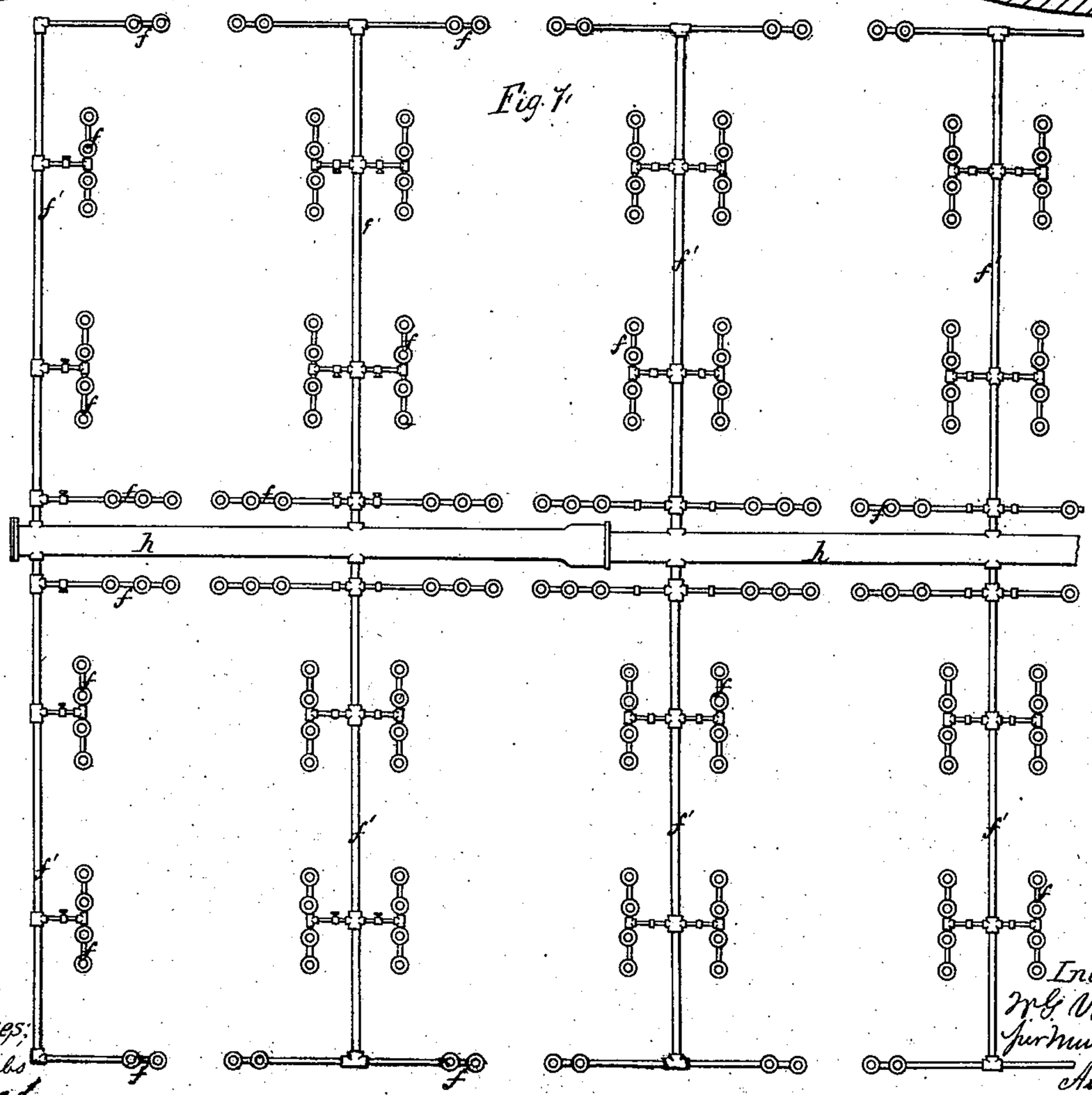


Fig. 7.



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UNITED STATES PATENT OFFICE.

WILLIAM GEORGE VALENTIN, OF OXFORD STREET, COUNTY OF MIDDLESEX, ENGLAND.

IMPROVEMENT IN COKING COAL AND GENERATING GASES.

Specification forming part of Letters Patent No. **37,412**, dated January 13, 1863.

To all whom it may concern:

Be it known that I, WILLIAM GEORGE VALENTIN, of the Royal College of Chemistry, Government School of Mines, Oxford Street, in the county of Middlesex, in that part of the United Kingdom of Great Britain and Ireland known as England, chemist, have invented an Improved Mode of and Apparatus for Coking Coal and Generating Combustible Gases for Heating and Lighting Purposes; and I do hereby declare that the following is a full and exact description of the said invention.

My invention of an improved mode of and apparatus for coking coal and generating combustible gases for heating and lighting purposes consists in submitting the coal to the coking operation in a close vessel or retort of a peculiar kind, and also in heating the retort by means of the combustible gas evolved from the coal during the coking operation.

In carrying out my invention any convenient number of close chambers or retorts may be combined in one set of apparatus. These chambers are by preference of rectangular form, but may, if desired, be made of an elliptical or other convenient shape. If rectangular, as shown in the accompanying drawings, they should be made long, narrow, and deep. They are to be closed at top, and provided with a hopper or funnel or other opening, through which they are to be charged with coal. The bottom of the chamber is movable, being made in the form of a trap or sliding door or other suitable contrivance, which, when let fall or opened, will allow the charge, after being properly coked, to drop into a vacant space below. The coking-chambers are heated by the combustible gases evolved from the coal during previous coking operations, and which gases must be collected and stored for the purpose. All the coking-chambers are surrounded by narrow passages or flues, into which the combustible gases, together with a suitable supply of atmospheric air to support combustion, are introduced through suitable burners communicating with a supply-pipe connected with the gas-reservoir. In order to prevent the heat generated by the combustion of the gases from passing off too rapidly, a number of partitions are placed in the flues, so as to make the heated vapors pass in a serpentine direction along the flues. When the heated cokes are discharged from the coking chambers or retorts into the space below, they are quenched by means of hydrochloric-acid gas or by a dilute solution of hydrochloric acid. This will have the effect of taking up and carrying off a certain portion of the sulphur contained in the coal. The gases and vapors evolved during the coking operation are conducted by a suitable arrangement of pipes from the coking-chambers to a receiver and condenser, where the tar and other solid or liquid matters may be separated from the incondensible gases, which are conducted to a gas-holder, so as to be ready for heating the retorts or coking-chambers in the manner above mentioned, or for other purposes for which they may be usefully employed—as for lighting, heating, or other purposes. The coking-chambers or retorts may also be advantageously employed as gas-generators. For this purpose the mode of operating will have to be slightly modified. I would also remark that in starting the coking operation, when no combustible gas has as yet been generated, I propose to light or ignite the charge in the retorts by igniting the coal at the bottom of the retorts and admitting a slow current of atmospheric air through the door in front of the retorts or chambers until the whole mass of coal is well ignited. I then close the air-hole entirely, and when a proper quantity of combustible gas has been obtained from the coking coal it is employed to heat the retort from the outside, as above mentioned, and hereinafter more particularly described. A further supply of gas, consisting, chiefly, of carbonic-oxide gas, (diluted and deteriorated by a certain amount of nitrogen gas,) may afterward be obtained by allowing a regulated supply of air to pass through the retorts, and this carbonic-oxide gas may be advantageously employed for heating the retorts. Atmospheric air and a little steam may be admitted with advantage during the whole of the time the coking operation lasts. The result of the decomposition of the steam and atmospheric air will be certain combustible gases—such as carbonic-oxide and hydrogen gas—together with a certain amount of incombustible nitrogen gas from the air. Steam alone (by preference superheated) or common steam may be passed over or through a mass of ignited coke, when the steam will undergo a decomposition at the expense of a

certain amount of carbon, and will be converted into two highly-combustible gases—viz, carbonic-oxide and hydrogen gas. In order to carry on this decomposition of steam for any length of time, external heat is required to keep up the temperature of the coke at which the chemical change in the steam and carbon can take place. This can be effected by means of the heating arrangement above referred to, and hereinafter more particularly described.

The gases resulting from the action of steam upon ignited carbon are not deteriorated by the presence of nitrogen gas, as in the two previous instances, and are therefore capable of producing the very highest temperature when burned with the proper admixture of atmospheric air. By means of some suitable apparatus superheated steam may be generated in the ordinary manner, and caused to pass through coal-tar before entering the retorts, chambers, or ovens. The heavier hydrocarbons taken up by the steam in passing through the coal-tar would, under the influence of great heat and the presence of nascent hydrogen gas, undergo a change and form hydrocarbons of a simpler composition and of intense illuminating power, (olefiant gas.) This process would be applicable when it is desired to obtain combustible gases for illuminating purposes rather than for the purpose of generating the greatest heat.

In the accompanying drawings, Figure 1, Sheet I, is a sectional elevation of a coking apparatus constructed according to my invention. Fig. 2 is a sectional plan view of the same. The part shown in section in Fig. 2 is taken on the line 1 2 of Fig. 1, and the part shown in section in Fig. 1 is taken on the line 3 4 of Fig. 2 and 3 4 of Fig. 3, which is a longitudinal vertical section of the apparatus, taken in the line 5 6 of Fig. 2—that is, longitudinally through two of the coking-chambers or retorts. Fig. 4 is a transverse vertical section taken in the line 7 8 of Fig. 2—that is, through the side flues and hot-air channels, whereby the coking-chambers or retorts are heated.

a a a a are the coking-chambers or retorts, which, it will be seen, are made long, deep, and narrow, and are charged with coal from above through the hoppers *b b*. The bottoms of the retorts or coking-chambers are made movable, and are constructed either in the form of trap-doors, as seen at *c c*, and which may be let fall on their hinges, as indicated by the dotted lines in Fig. 1, for the purpose of discharging the contents of the chambers *a a*, or the lower open ends of the chambers or retorts *a a* may be closed by a movable plate, *c'*, lined with fire-brick and mounted on wheels, which run on rails, as shown at *c'*, Figs. 1 and 3, and on an enlarged scale at Fig. 5, Sheet II. This movable plate or bottom *c'* may be drawn out by a chain and windlass, or by the rack-and-pinion motion shown in Fig. 3.

The contents of the chambers or retorts *a*, when sufficiently coked, are (by withdrawing the movable bottoms *c* or *c'*) discharged into the vacant space *d* below. This space is closed by suitable doors, so as to convert it into a close chamber, for the purpose hereinafter mentioned.

The chambers or retorts *a a* are heated by combustible gases, which are supplied through suitable burners, *f f*, to the heated flues or channels *e e*, as shown in the enlarged sectional view, Fig. 6, Sheet II. These burners are constructed in such a manner that air to support combustion is supplied with the gases to the heating-flues *e e* through openings *g g*, constructed of fire-brick, as seen best in the enlarged sectional views, Figs. 5 and 6, Sheet II. These burners are shown detached and drawn full size at Figs. 8 and 9, Sheet II, and will be hereinafter more fully described.

Fig. 7 is a plan view representing a convenient method of arranging the burners when several coking-chambers or retorts are combined in one apparatus. The burners belonging to the several chambers or retorts are adapted to branch pipes *f' f'*, which communicate with a central supply-pipe, *h*. The gases and air from the burners *f f* are supplied to the flues *e e*, where they are burned, while the incombustible gases and the heated vapors pass in the direction indicated by the arrows down the narrow flues *e' e'*, and up the adjoining flues *e e* in a serpentine direction, as seen in Fig. 4, and from thence into the upward front flues, e^2 e^2, Fig. 2, into an arched horizontal flue, e^3, Figs. 1, 2, and 3, above the chambers or retorts *a a*, and ultimately into the longitudinal flue e^4, which terminates in the chimney or stack e^5. It will be seen that by this arrangement of flues the heated gases will have time to part with the principal portion of their caloric before reaching the chimney or stack e^5.

Fig. 8, Sheet II, is a vertical section drawn full size of one of the burners, and Fig. 9 is a horizontal section of the same, taken in the line 1 1 of Fig. 8. The socket of the burner is screwed and is adapted in any convenient manner to the branch supply-pipe *f' f'*. The burner itself is composed of a metal tube, *f*, which is screwed into its socket, and is provided at its upper end with a perforated cap-piece, through which the combustible gases issue and pass up the chimney *i*, which is screwed into a chamber, *j*. This chamber is screwed onto the socket and incloses the burner *f*, and has a number of diagonal holes made in it for the purpose of admitting air to the interior, as indicated by the arrows in Fig. 8. The air and gases commingle in the chamber *j* and chimney *i*, up which they pass and through the openings *g g* into the heating-flues or channels *e e*, Figs. 5 and 6, where they are burned in the manner already described.

During the coking operation a considerable quantity of combustible gases is given off from the coal in the chambers or retorts *a a*, and these gases are drawn off from the chambers or retorts *a* by the pipes *k k*, Figs. 1, 2, and 3, and are conducted to the hydraulic main *l*, from whence they pass down the pipe *m* to the

condenser, purifier, or gas reservoirs or holders, so as to be ready for being used for heating the coking-chambers, as already described, as well as for other heating purposes, and also for lighting. When the charge in any of the chambers or retorts *a* has been sufficiently coked, the removable bottoms *c* or *c'* are removed and the incandescent coke is discharged into the chambers *d* below, which are by preference to made capacious enough to receive the whole charge. The coke may then be quenched in the usual way by water, or by employing a dilute solution of hydrochloric acid, and this should be done with the doors of the chamber *d* closed. By this means a large portion of the sulphur contained in the coke will be absorbed, and as the air will be prevented from coming into contact with the incandescent coke there will be little or no loss of carbon from oxidation.

In conclusion I claim as my invention—

1. Coking coal in close chambers or retorts heated externally by the combustion of gases generated from similar previous coking operations, and applied in the manner herein set forth.

2. The use of the vertical close chambers or retorts *a*, in combination with the external flues or heating-channels supplied with combustible gases and air from the burners *f*.

3. The use and application of the combination of parts, whether for coking coal or generating combustible gases for heating and lighting purposes.

In witness whereof I, the said WILLIAM GEORGE VALENTIN, have hereunto set my hand and seal this 3d day of October, 1862.

WM. G. VALENTIN. [L. S.]

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