

(No Model.)

4 Sheets—Sheet 1.

O. D. ORVIS.

SMOKE CONSUMING FURNACE.

No. 313,611.

Patented Mar. 10, 1885.

Fig. 2.

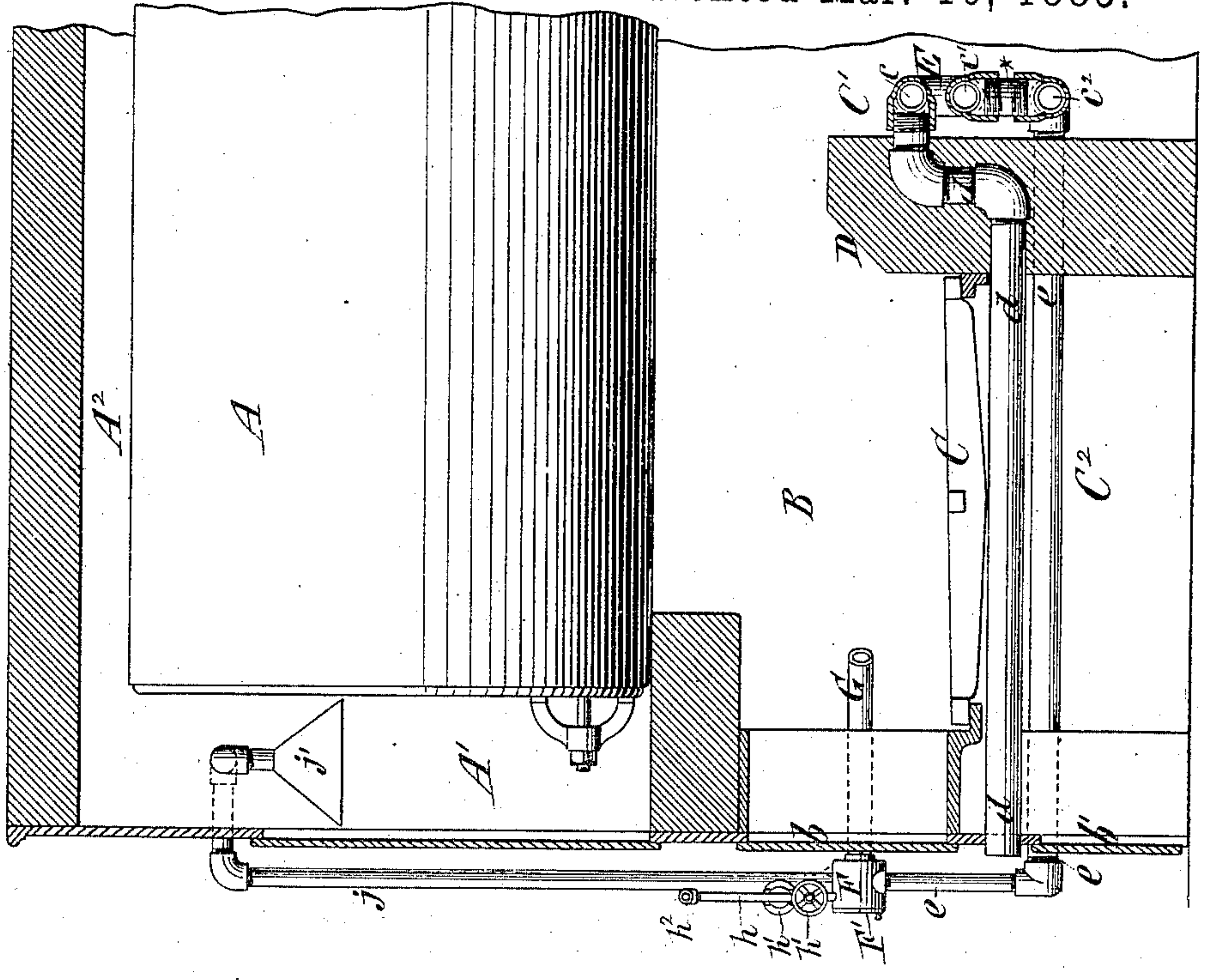
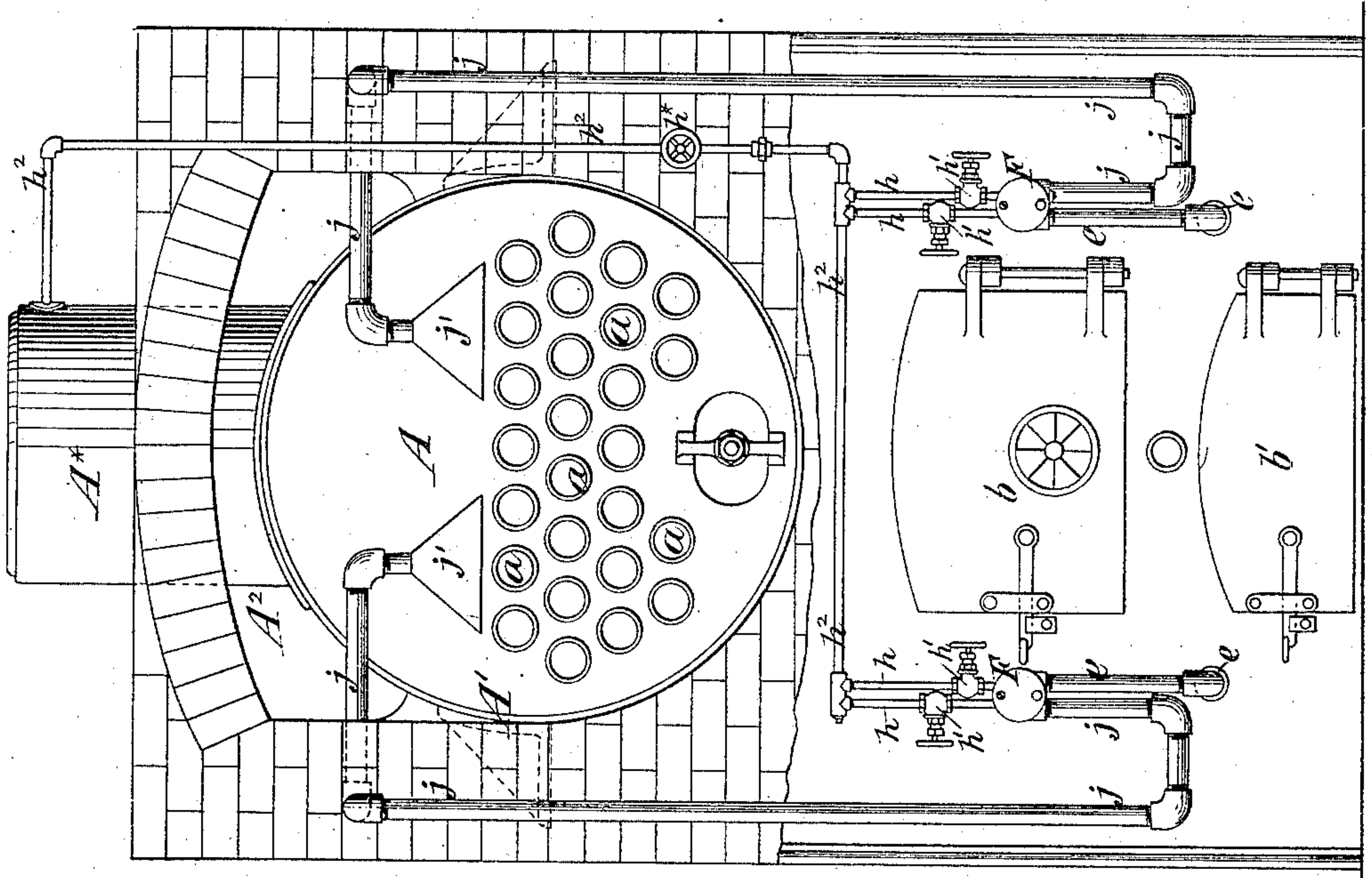


Fig. 1.



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Inventor:
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(No Model.)

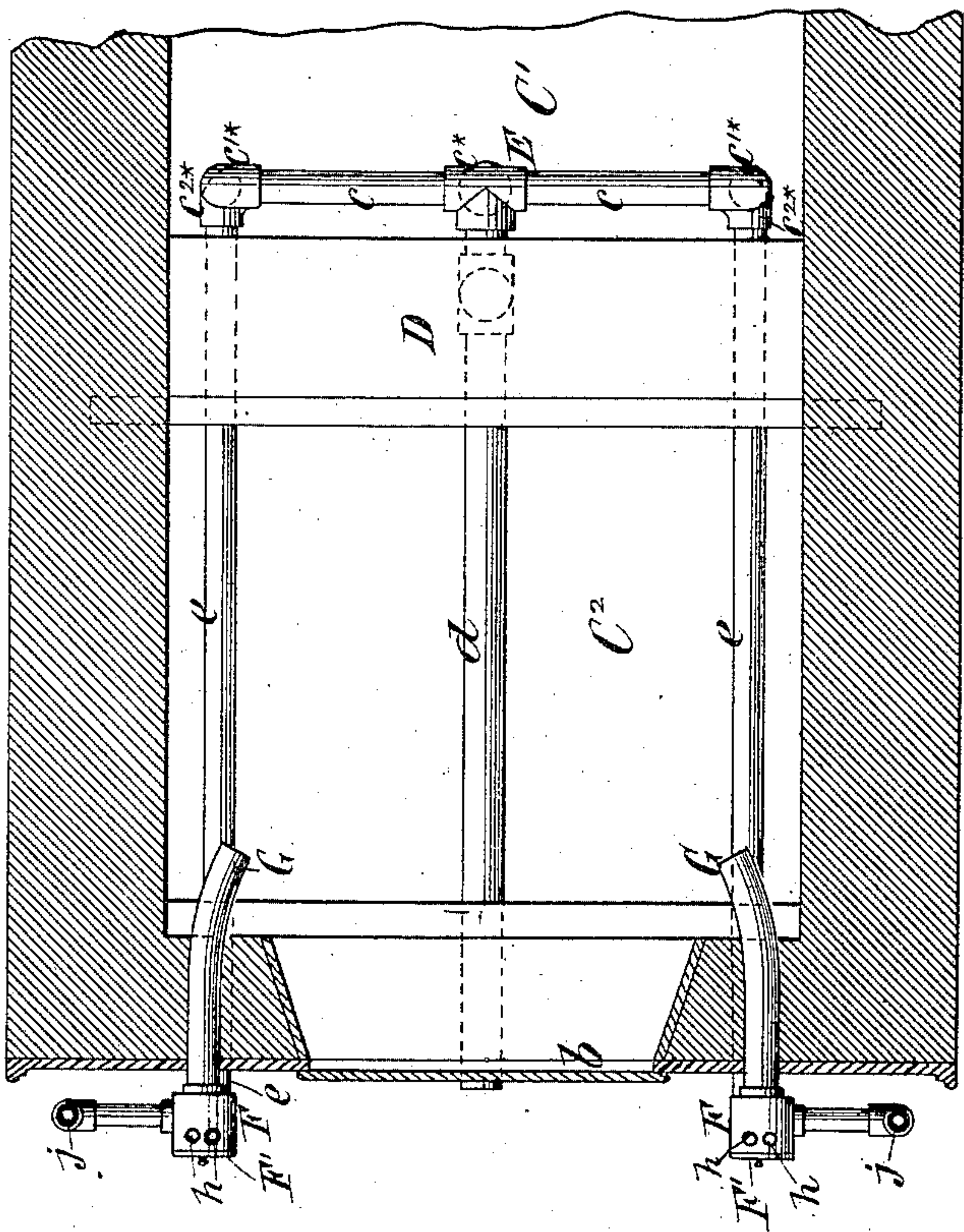
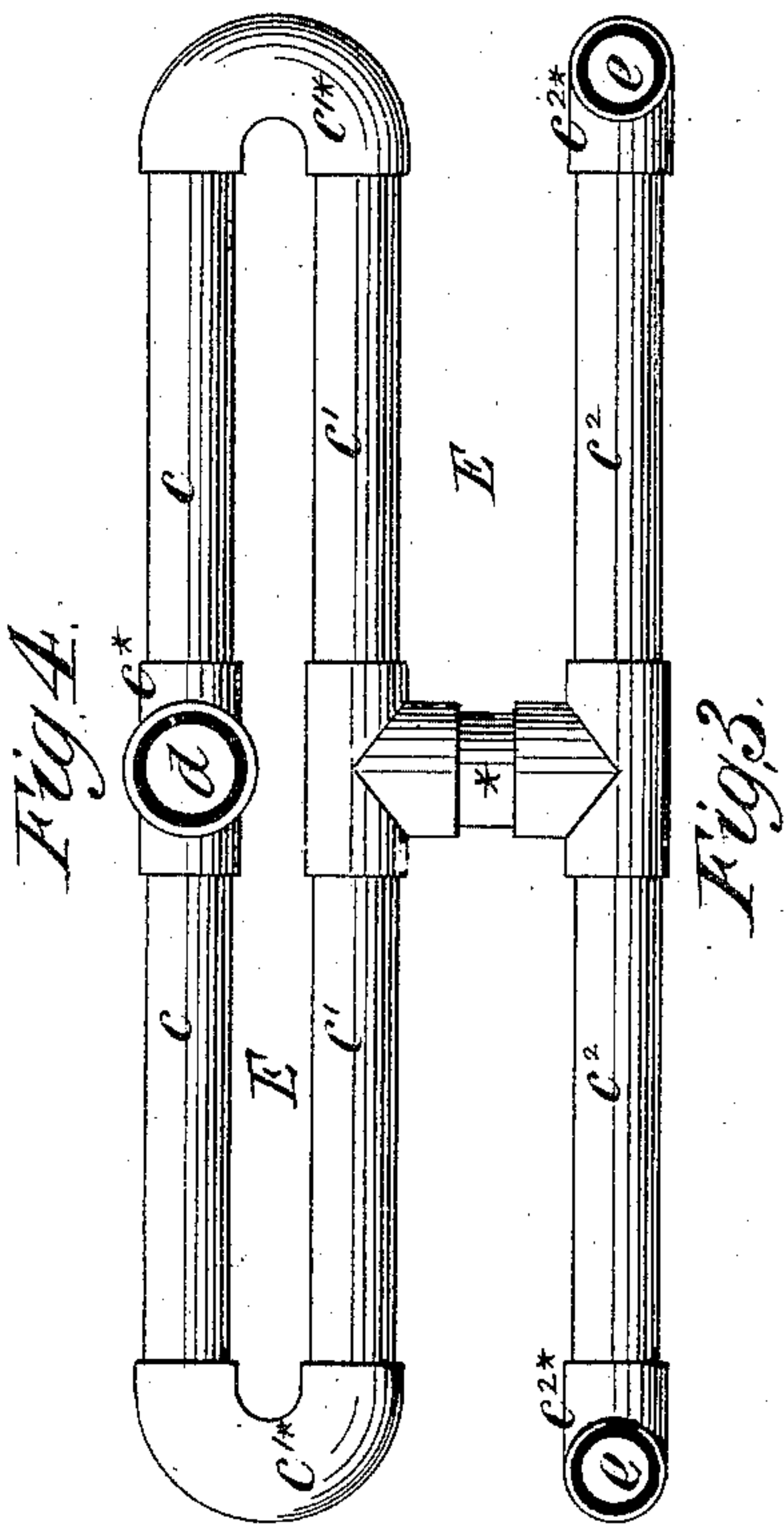
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O. D. ORVIS.

SMOKE CONSUMING FURNACE.

No. 313,611.

Patented Mar. 10, 1885.



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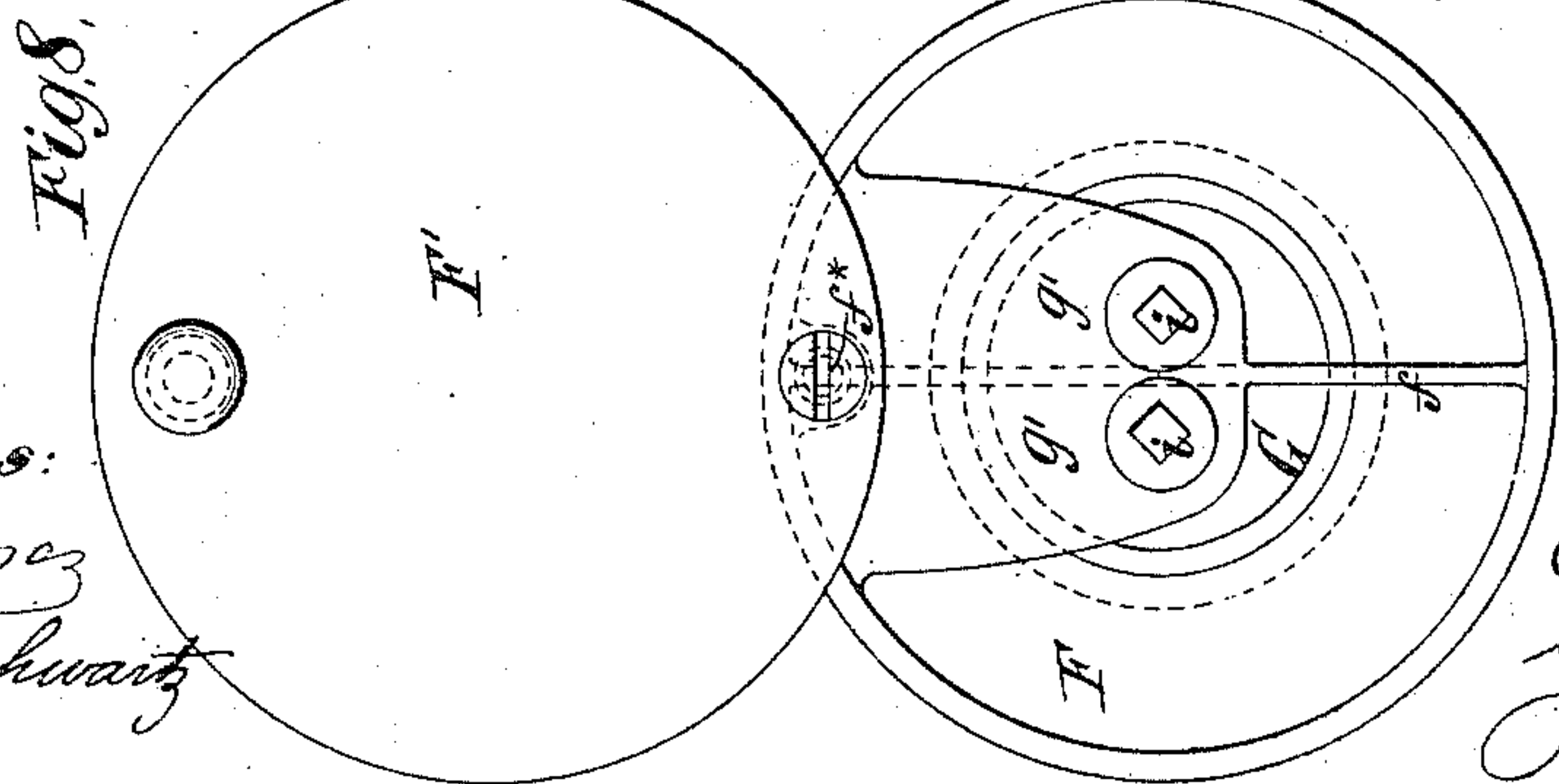
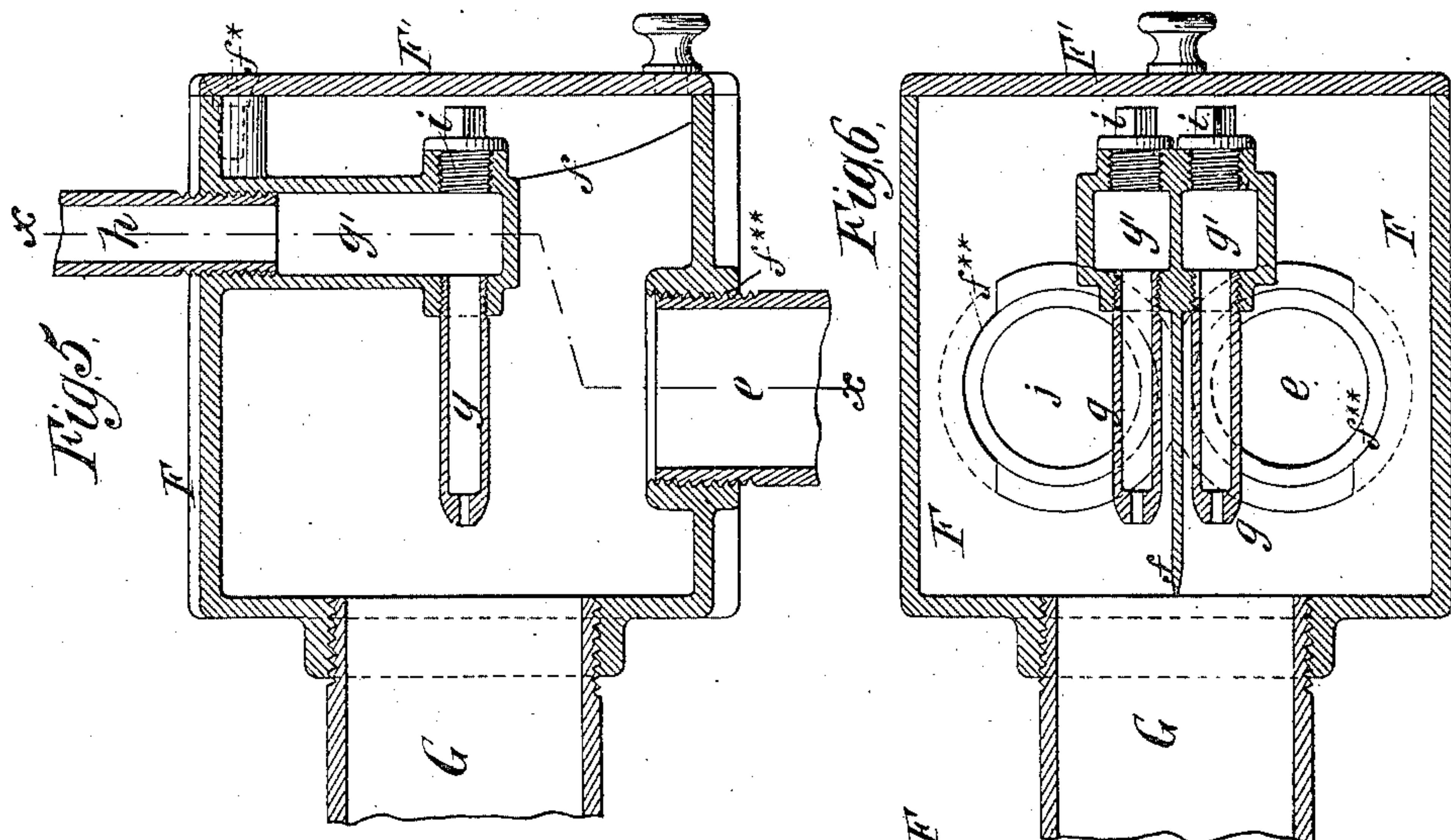
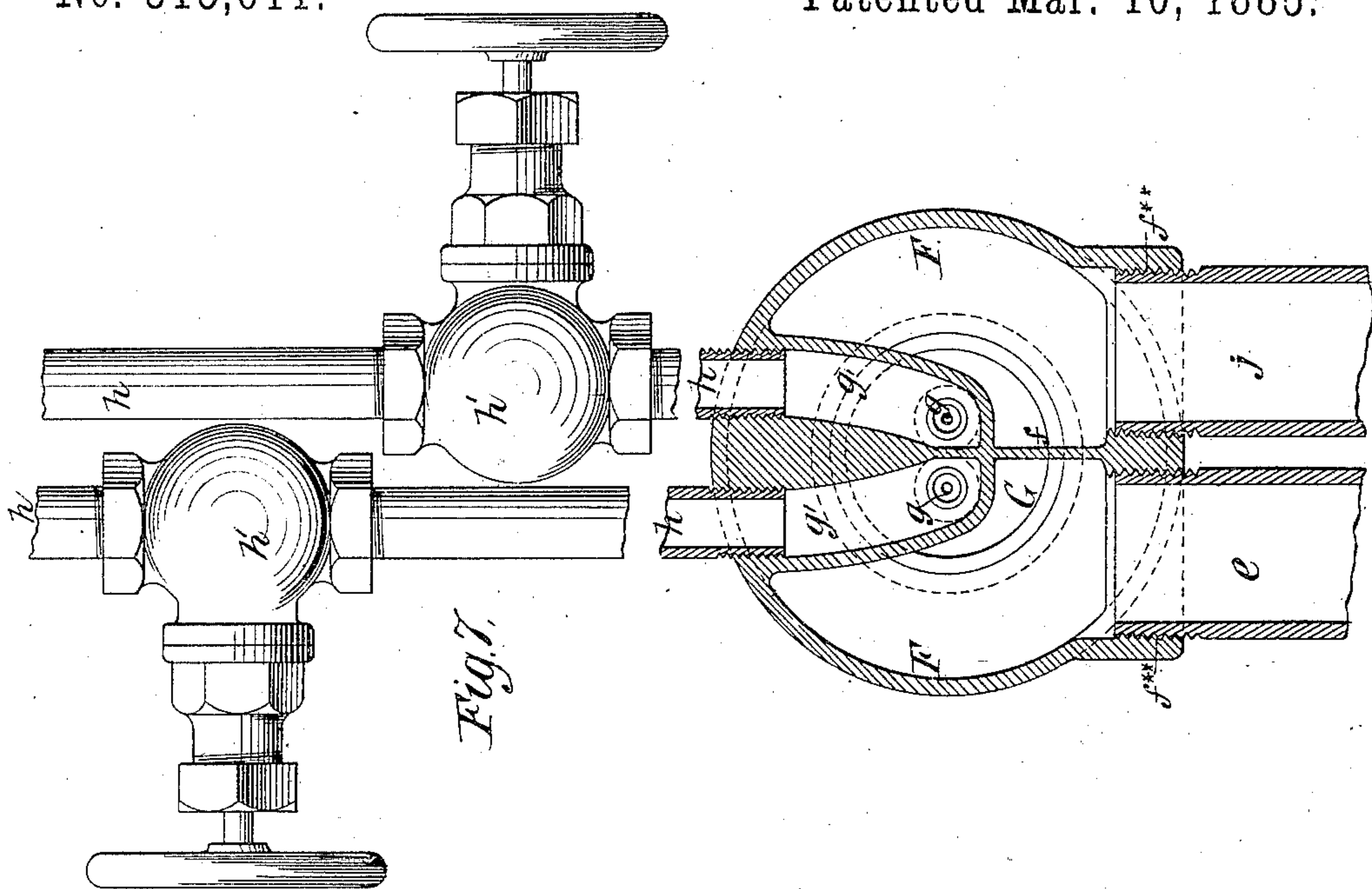
4 Sheets—Sheet 3.

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SMOKE CONSUMING FURNACE.

No. 313,611.

Patented Mar. 10, 1885.



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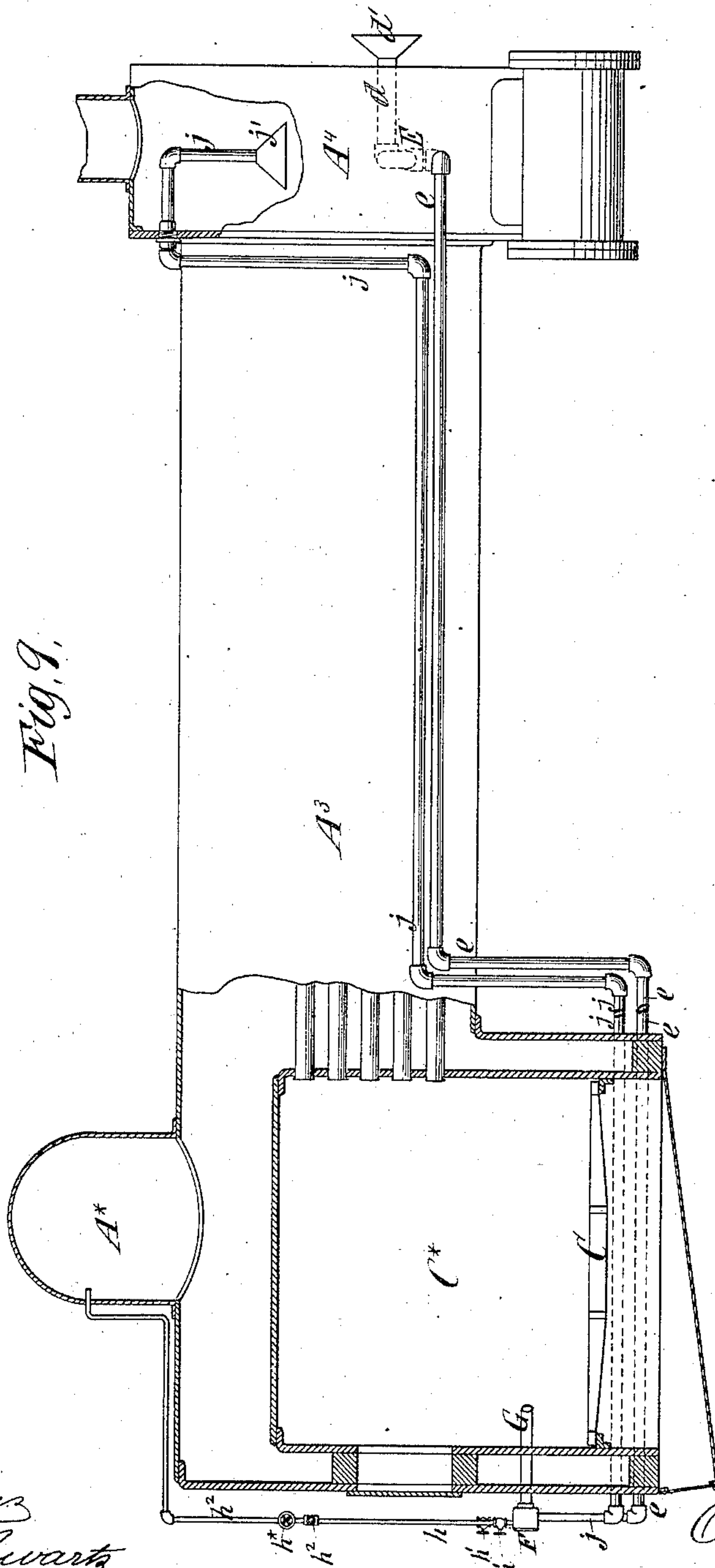
4 Sheets—Sheet 4.

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SMOKE CONSUMING FURNACE.

No. 313,611.

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UNITED STATES PATENT OFFICE.

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SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 313,611, dated March 10, 1885.

Application filed October 21, 1884. (No model.)

To all whom it may concern:

Be it known that I, OREL D. ORVIS, of the city and county of New York, in the State of New York, have invented a new and useful Improvement in Smoke-Consuming Furnaces, of which the following is a specification.

My invention is more especially applicable to steam-boiler furnaces; but it may also be applied to and operated in connection with other furnaces.

The object of the invention is to produce a more complete combustion and consumption of the smoke and gases which are commonly allowed to escape from the chimney, and thereby to effect not only a saving of fuel, but also the avoidance of the nuisance caused by the discharge of smoke and furnace-gases in thickly-populated neighborhoods.

My invention may be advantageously employed whatever be the fuel used; but when bituminous coal is burned its utility in consuming the smoke is more apparent.

The escape of unconsumed and combustible gases from a furnace is caused by the supply of oxygen being too small to effect their combustion, or by reason of the gases being hurried from the furnace before the oxygen can combine with them. In any case the smoke and gases taken from the breeching or an escape-flue have not the oxygen necessary for their combustion, and I have found by experiment that their ignition and combustion cannot be successfully accomplished by withdrawing them from the breeching or other escape-flue and discharging them by an injecting-current of steam into the furnace above the fire therein. I have also found that the desired result cannot be accomplished by mingling cold air with the gases and smoke so injected into the furnace.

In order to insure the ignition of gases thus introduced into the furnace, they must be at a high temperature; but when mingled with cold air, as described, the result is that the mixture of gases and air is of so low a temperature that they are not ignited, and again escape unconsumed from the furnace. Such a method of operation amounts to no more, therefore, than producing a continuous circulation of the smoke and gases through the furnace

and flues of the boiler, and instead of promoting combustion tends to cool the fire. The conditions, therefore, necessary to accomplish the desired result are that a sufficient quantity of oxygen and hydrogen shall be mingled with the unconsumed gases to insure their perfect combustion, and that the mixture of gases, oxygen, and hydrogen shall be discharged into the furnace above the fire, and shall be of such temperature that they will readily ignite, and will not chill the fire.

The invention consists in the combination, with a steam-boiler having heating tubes or flues extending through it and a furnace, of an air-heater arranged within the furnace, a pipe for supplying cold air to the heater, a steam-injecting apparatus having a discharge-outlet entering the furnace above the fire, an air-suction pipe leading from such air-heater to the injecting apparatus, and a suction-pipe for combustible gases leading from the end connection of the boiler, into which the smoke and gases enter after passing through the said tubes or flues, and communicating with the injecting apparatus. By this combination of parts all the smoke and gases are allowed to pass through the heating tubes or flues and there perform their work of heating the boiler, and then as they are about to escape to the chimney they are withdrawn, mingled with highly-heated air and steam, and then discharged directly into the furnace, above the fire, where they are immediately consumed.

The invention also consists in the combination, with a furnace, of an air-heater arranged in the furnace, a pipe for supplying cold air to the heater, a steam-injecting apparatus having its discharge communicating with the furnace, and having two steam jets and valves for separately controlling them, an air-suction pipe leading from the air-heater to the injecting apparatus, and a suction-pipe for gases leading from an escape flue or passage of the furnace to the injecting apparatus.

The invention also includes the combination, with a furnace, an air-heater arranged therein, and a pipe for supplying cold air to the heater, of a steam-injecting apparatus comprising a vacuum drum or casing and a

partition therein, and steam-jets on opposite sides of said partition, a single discharge-pipe leading from the vacuum-drum into the furnace, and suction-pipes leading, respectively, from the air-heater and an escape-flue or passage of the furnace and entering said vacuum-drum on opposite sides of the partition therein.

The invention also includes other novel combinations of parts, which are hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a partly sectional front elevation of a boiler and furnace embodying my invention. Fig. 2 is a side elevation of a portion of the boiler and a sectional elevation of the furnace. Fig. 3 is a horizontal section of the furnace. Fig. 4 is an elevation, on a larger scale, of an air-heater which I may employ. Figs. 5 and 6 are respectively a vertical and a horizontal section, on a larger scale, of a steam-injector which I prefer to employ. Fig. 7 is a sectional elevation of the injecting apparatus, on the irregular dotted line $x x$, Fig. 5, and including pipes and valves for supplying and controlling the supply of steam thereto. Fig. 8 is a front view of the injecting apparatus, showing a door which closes the front of the vacuum-drum as swung upward to expose the interior thereof, and Fig. 9 is a partly sectional elevation of a locomotive-boiler having my invention applied thereto.

Similar letters of reference designate corresponding parts in all the figures.

The boiler A (a part of which is here represented) is of the return tubular type, a designating the tubes thereof.

B designates the part of the furnace which contains the grate C, and at the back of which is the bridge-wall D, and in rear of the bridge-wall is the combustion-chamber C', which also constitutes a part of the furnace. Below the grate is the ash-pit C², and above and below the grate and in the front of the setting are the usual fire and ash-pit doors, $b b'$.

The course of the smoke and gaseous products of combustion in boiler-furnaces of this class is well understood, and I therefore have not thought it necessary to show the entire boiler. The products of combustion pass through the furnace rearwardly under the boiler, thence upward through the uptake or passage at the rear of the boiler, and forward through the tubes a into the breeching or space A' at the front of the boiler. The smoke and highly-heated gases, therefore, perform all their ordinary work of heating the boiler by passing under the same and thence through the tubes a .

From the breeching or end connection A' the passage or flue A² leads to the chimney.

In some suitable part of the furnace, either above or below the grate, and in front of or behind the bridge-wall D, I arrange an air-heater, which may be of any suitable construction. The heater E here shown is arranged behind or back of the bridge-wall and in the

combustion-chamber C'. The construction of this heater will be understood by reference to Figs. 2, 3, and 4. It consists, essentially, of three ranges of tubes or pipes, $c c' c^2$. The upper tube or pipe, c , has at about the middle of its length a T-fitting, c^* , with which is connected an air-supply pipe leading from the external atmosphere. I have here shown a supply-pipe, d , as leading from the front of the furnace under the grate C and connected with the fitting c^* . The upper and middle tubes, $c c'$, are connected at the ends by return-bends c^* , and the tubes c' communicate by T-fittings and a nipple, $*$, at about the middle of its length with the lower tube, c^2 . From elbows c^{2*} at the ends of the lower tube c^2 air-suction pipes e extend forward to the front of the boiler. The arrangement of the pipes $d e$ is clearly shown in Fig. 3. This form of heater is advantageous, because the arrangement of tubes is such as to produce positive circulation of air from the pipe d through the heater and out at the pipes e , so long as there is a suction on these latter pipes, and hence the upper tube, c , which is the most exposed to the heat, will be prevented from being overheated and burned out by the entrance of cold air into it.

At the front of the furnace I arrange one or more steam-injecting apparatus, which may be of any suitable kind adapted to the situation; but in Figs. 5 to 8, inclusive, I have shown a form of apparatus which I find it advantageous to employ, and the manner of arranging and connecting such apparatus for operation is shown in Figs. 1, 2, and 4.

Each apparatus comprises a vacuum-drum, F, which may be in the form of a cylinder or ellipse, or square, if desired, and which is divided by a partition, f . From one end of the drum extends a discharge-pipe, G, which is common to the compartments on both sides of the partition f , and the front end of the drum is closed by a cover, F', which is here shown as pivoted at f^* , so that it may close the open end of the drum, as shown in Fig. 5, or be swung upward, as shown in Fig. 8, to enable any one to look through the drum and discharge-pipe into the furnace. At the bottom of the drum are inlet-apertures or screw-threaded sockets f^{**} , which are on opposite sides of the partition f ; and g are steam jets or nozzles, which are fixed on opposite sides of the partition f , and receive their supply of steam through ducts or passages g' , formed in the drum, and into which are screwed steam-pipes h , which are separately controlled by valves h' .

In the front of each duct or passage g' , and in line with the nozzle or jet g , is a hole closed by a screw-plug, i , and by removing this plug the nozzle may be cleaned out, if stopped up.

I have here shown two injecting devices as arranged at the opposite sides of the fire-door b , and their pipes h are connected with a common steam-supply pipe, h^2 , which preferably

leads from the top of the steam-dome A*, so that dry steam may be obtained for operating the injecting devices. In this steam-supply pipe h^2 is a valve, h^* . The pipes e , which lead from the air-heater E, and constitute the air-suction pipes, are connected with the two drums F, at one side of their partitions f ; and with the drums on the opposite sides of their partitions are connected suction-pipes j , which extend from the breeching or space A', and are provided at the ends with funnels or bell-mouths j' , which enable them to draw in a large proportion of the gases passing through the tubes a . By the currents of steam issuing from the jets g of each drum the combustible gases are drawn through the pipe j , and heated air is drawn through the pipe e , and these are thoroughly commingled with each other and with the steam as they pass through the pipe G into the furnace.

As shown in Fig. 3, the discharge-pipes G are bent or curved inward or toward each other, and the currents discharged from them meet in the hottest part of the fire, the gases being burned in the presence of the oxygen supplied by the air and the hydrogen resulting from the decomposition of steam, and producing a very hot fire. The valves h' afford provision for separately and accurately regulating the relative proportions of combustible gases and highly-heated air which are passed through the discharge-pipes G, so as to produce the best result, and effect the consumption of all or nearly all of the combustible gases, which would otherwise be discharged into the atmosphere.

Referring now to Fig. 9, A³ designates a boiler of the locomotive type, in which is the fire-box C*, containing the grate C. At the forward end of the boiler is the smoke-chamber or uptake A⁴ for smoke and gas, and therein is arranged an air-heater, E, similar to that before described, or of any other suitable construction. This heater is supplied with fresh air through a pipe, d , which is shown as provided at the forward end of the boiler with a funnel or bell-mouth, d' , for "catching" air as the locomotive moves. At the front of the boiler are vacuum-drums F, only one of which is shown in the drawings, and from which a discharge-pipe, G, enters the fire-box C*. The construction of the vacuum-drums may be as above described, and with each one is connected an air-suction pipe, e , leading from the heater E, and a suction-pipe, j , for combustible gases, provided at the end which enters the smoke-chamber or uptake A⁴ with a funnel or bell-mouth, j' . Steam is supplied to the nozzles or jets of each vacuum-drum F by separate pipes h with valves h' , as before described, and from a common supply-pipe, h^2 , provided with a valve, h^* , and leading from the steam-dome A*.

The operation of the apparatus in this example of the invention is the same as above described.

It will be observed that in all the examples of my invention shown the smoke and unconsumed gases are not drawn back and again discharged into the furnace until they have passed through the tubes or flues of the boiler and have been made to perform their work of heating the boiler. It will also be observed that after having obtained the mixture of highly-heated air, steam, and smoke and combustible gases I do not allow them to cool before reaching the fire, as would be the case were they discharged into the ash-pit, but discharge them directly above and into the hottest part of the fire.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with a steam-boiler having heating tubes or flues extending through it and a furnace, of an air-heater, arranged in the furnace, a pipe for supplying cold air to the heater, a steam-injecting apparatus having a discharge-outlet entering the furnace above the fire, an air-suction pipe leading from said air-heater to the injecting apparatus, and a suction-pipe for combustible gases leading from the breeching or end connection of the boiler, into which the smoke and gases enter after passing through the tubes or flues, and communicating with the injecting apparatus, substantially as herein described.

2. The combination, with a furnace, of an air-heater arranged in the furnace, a pipe for supplying cold air to the heater, a steam-injecting apparatus having its discharge communicating with the furnace, and having two steam jets and valves for separately controlling them, an air-suction pipe leading from the air-heater to the injecting apparatus, and a suction-pipe for gases leading from an escape flue or passage of the furnace to the injecting apparatus, substantially as herein described.

3. The combination, with a furnace, an air-heater arranged therein, and a pipe for supplying cold air to the heater, of a steam-injecting apparatus comprising a vacuum drum or casing and a partition therein, and steam-jets on opposite sides of said partition, a single discharge-pipe leading from the vacuum-drum into the furnace, and suction-pipes leading, respectively, from the air-heater and an escape flue or passage of the furnace, and entering said vacuum-drum on opposite sides of the partition therein, substantially as herein described.

4. The combination, with a furnace, an air-heater arranged therein, and a pipe for supplying cold air to the heater, of a vacuum-drum, F, having a partition, f , and steam-jets and supply-ducts $g g'$ on opposite sides of said partition, steam pipes and valves $h h'$ for separately supplying said jets, an air-suction pipe, e , leading from said heater to the vacuum-drum on one side of said partition, a suction-pipe, j , for gases, provided with a collector or funnel, j' , and connected with the vacuum-drum on the other side of said partition, and

a discharge-pipe, G, common to both steam-jets *g*, substantially as herein described.

5 The combination, with the vacuum-drum F, having a dividing-partition, *f*, and steam-jets and supply - ducts *g g'* on opposite sides thereof, of the discharge - pipe G, the drum being open at the end opposite the discharge-

pipe, and the swinging cover F', for closing the open end of the vacuum-drum, substantially as herein described.

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Witnesses:

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