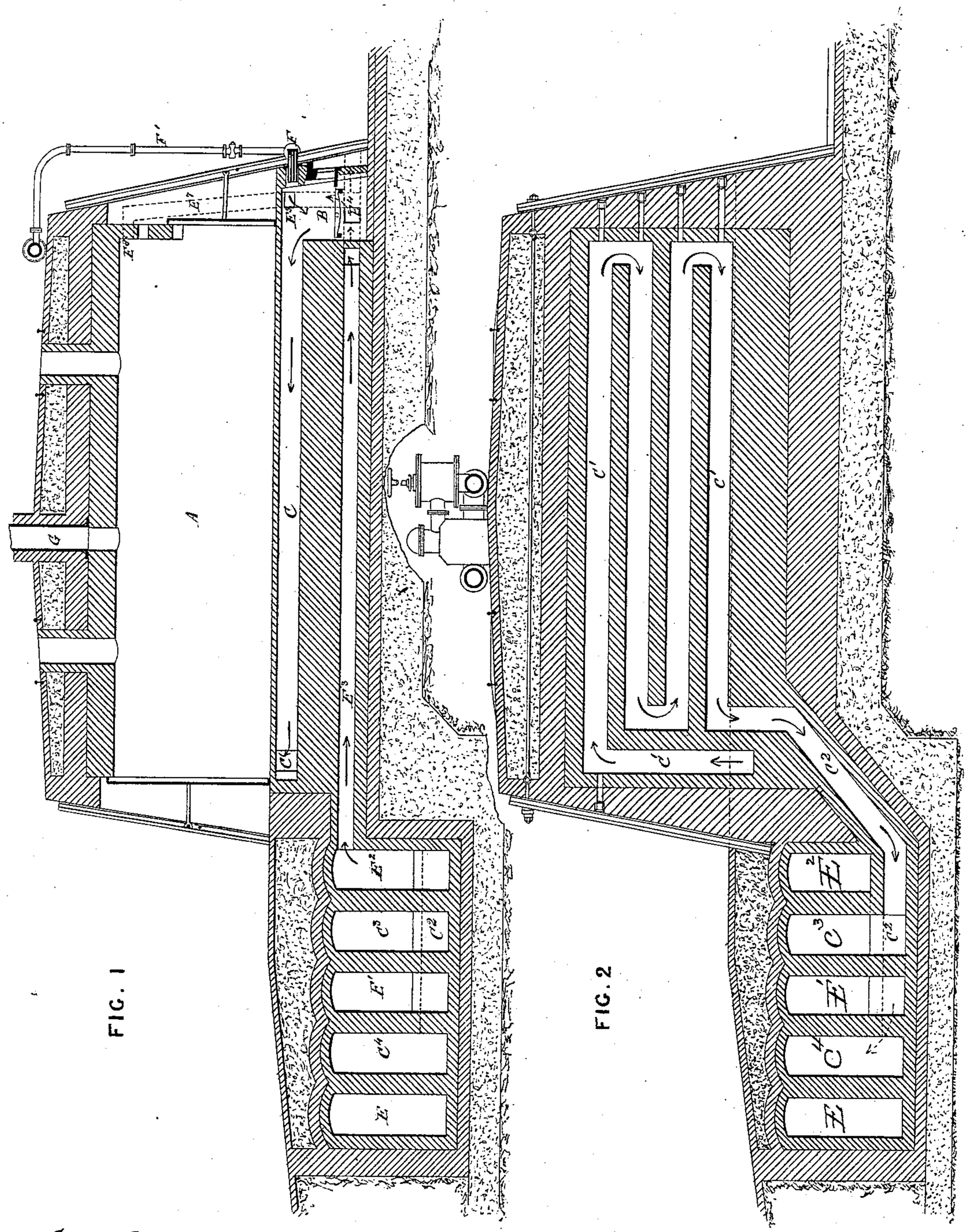
(No Model.)

7 Sheets—Sheet 1.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.



Attest:

Edwd. C. Downs

F. W. Howard

Inventor

Francois Carves

C. S. Whitman

Atty.

(No Model.) 7 Sheets—Sheet 2.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.

FIG. 3

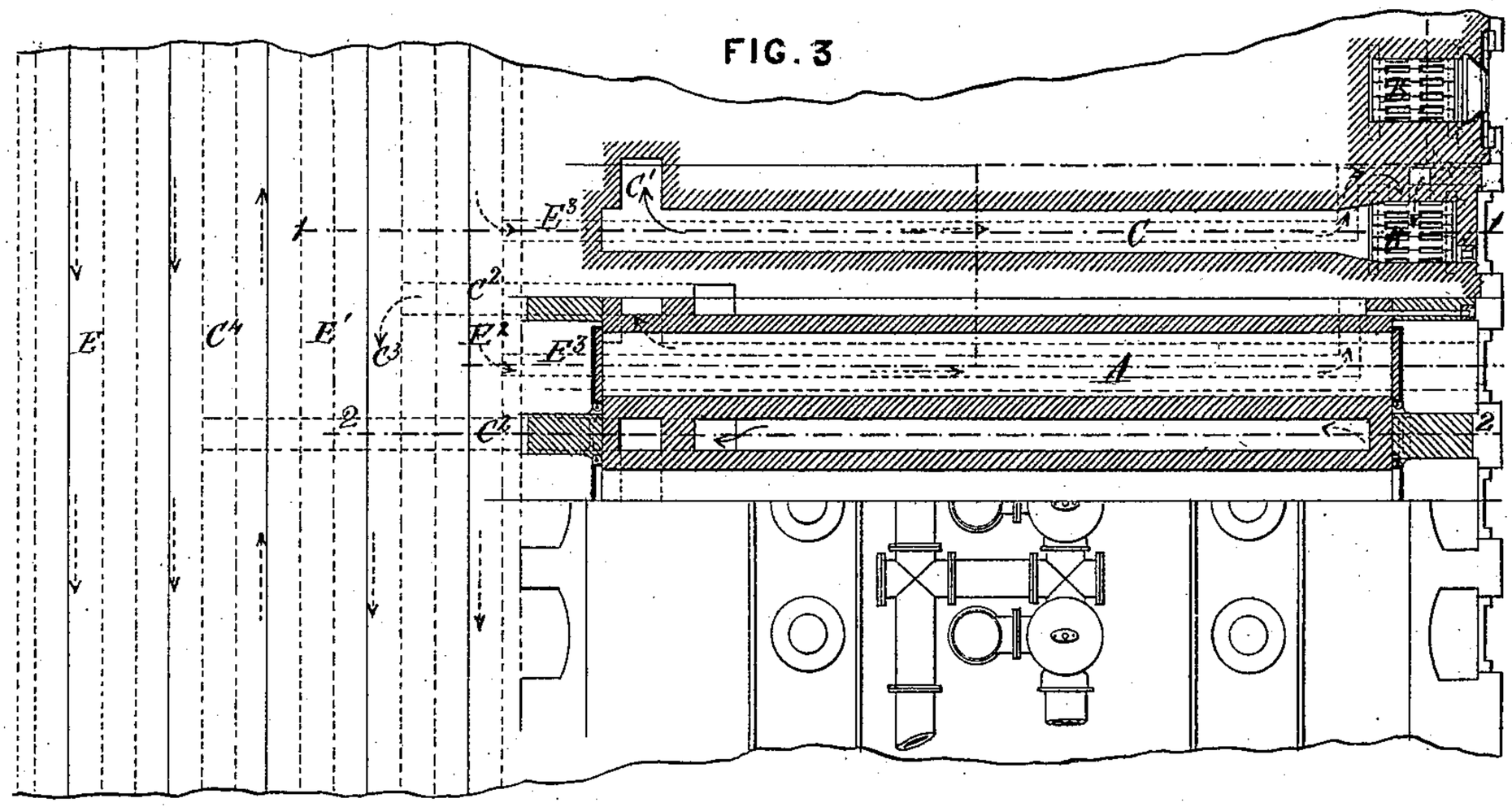
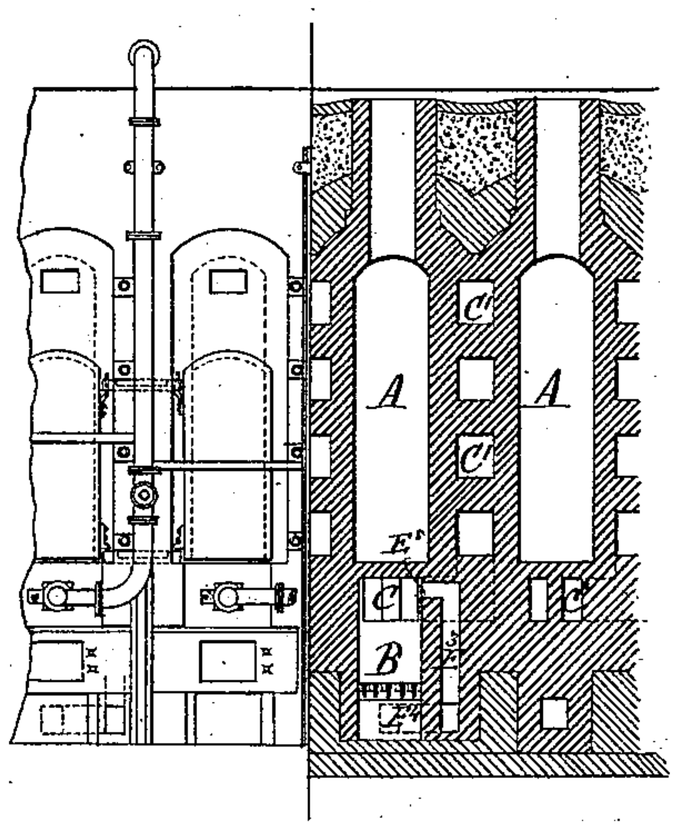


FIG. 4



Attest:

Edw.d H. Downs.

F. W. Howard

Inventor

François Carves

C. S. Whitman

(No Model.)

7 Sheets—Sheet 3.

F. CARVES.

COKE OVEN.

No. 308,133.

Patented Nov. 18, 1884.

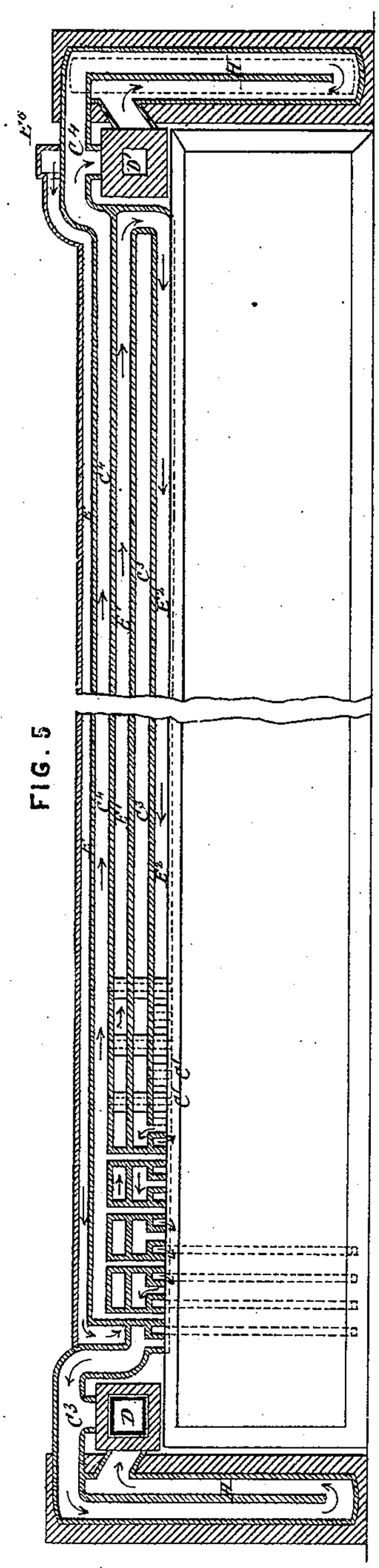


FIG. 5

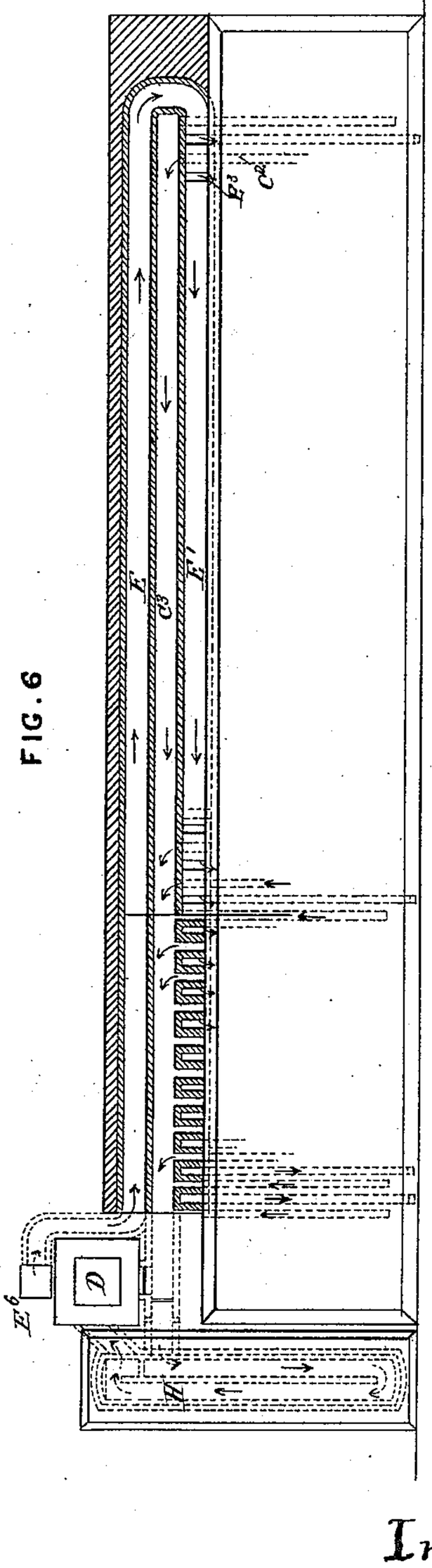


FIG. 6

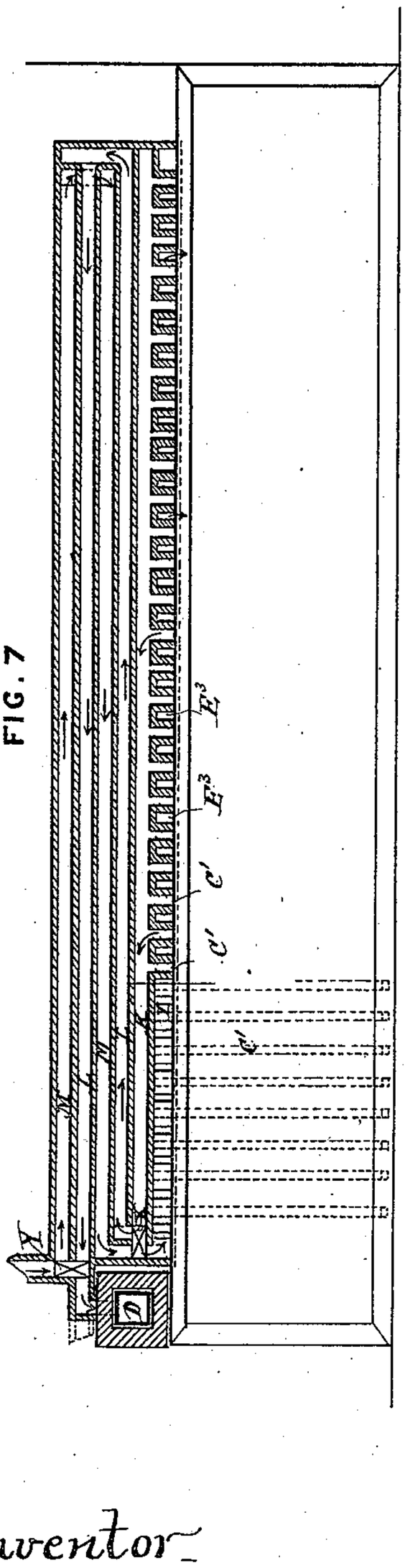


FIG. 7

Attest:

Edw.d H. Downs.

F. W. Howard

Inventor

François Carves

C. S. Whitman.

Atty.

(No Model.)

7 Sheets—Sheet 4.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.

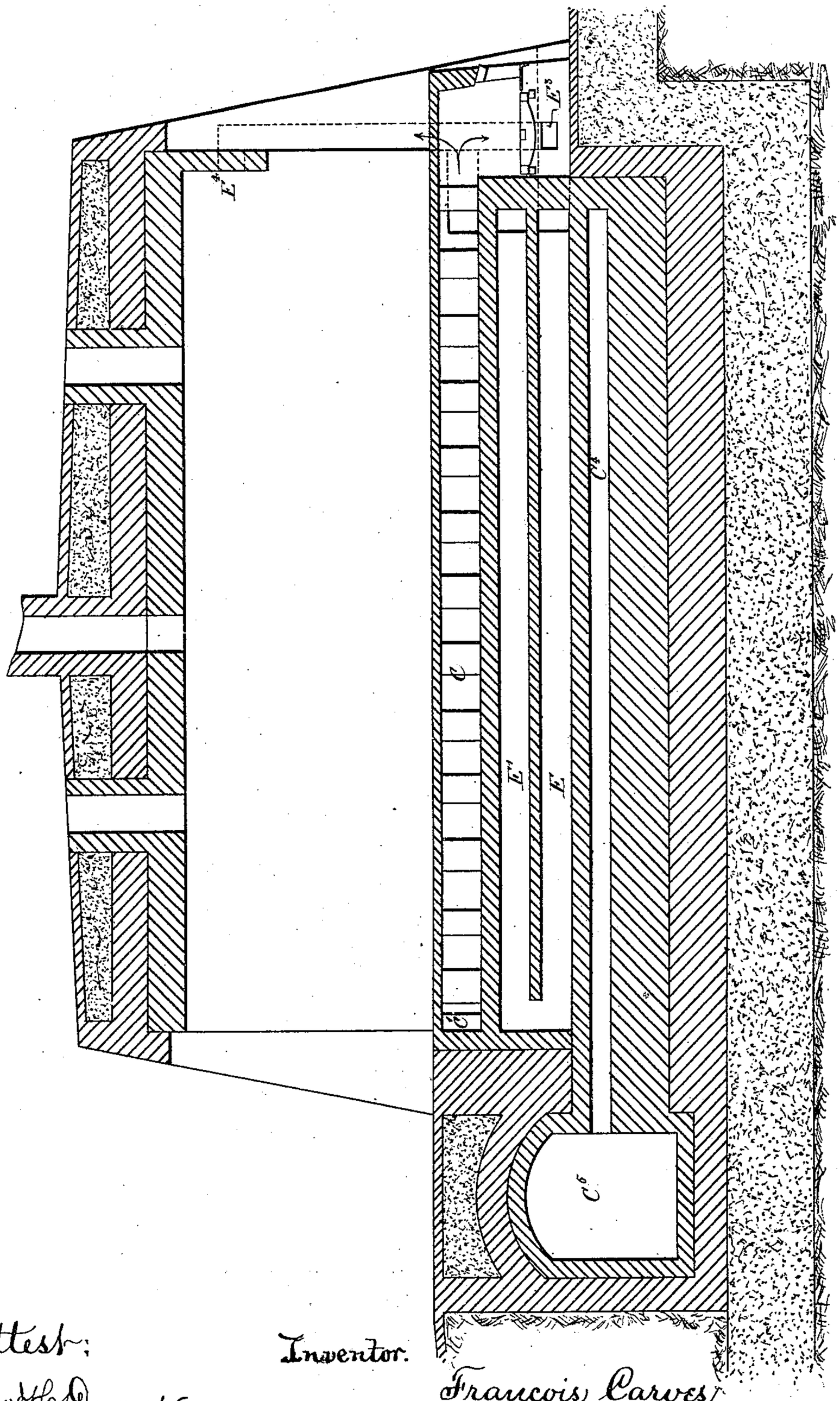


FIG. 8.

Attest:
Edw.d H. Downs.
F. W. Howard

Inventor.
François Carves
C. S. Whitman
Atty.

(No Model.)

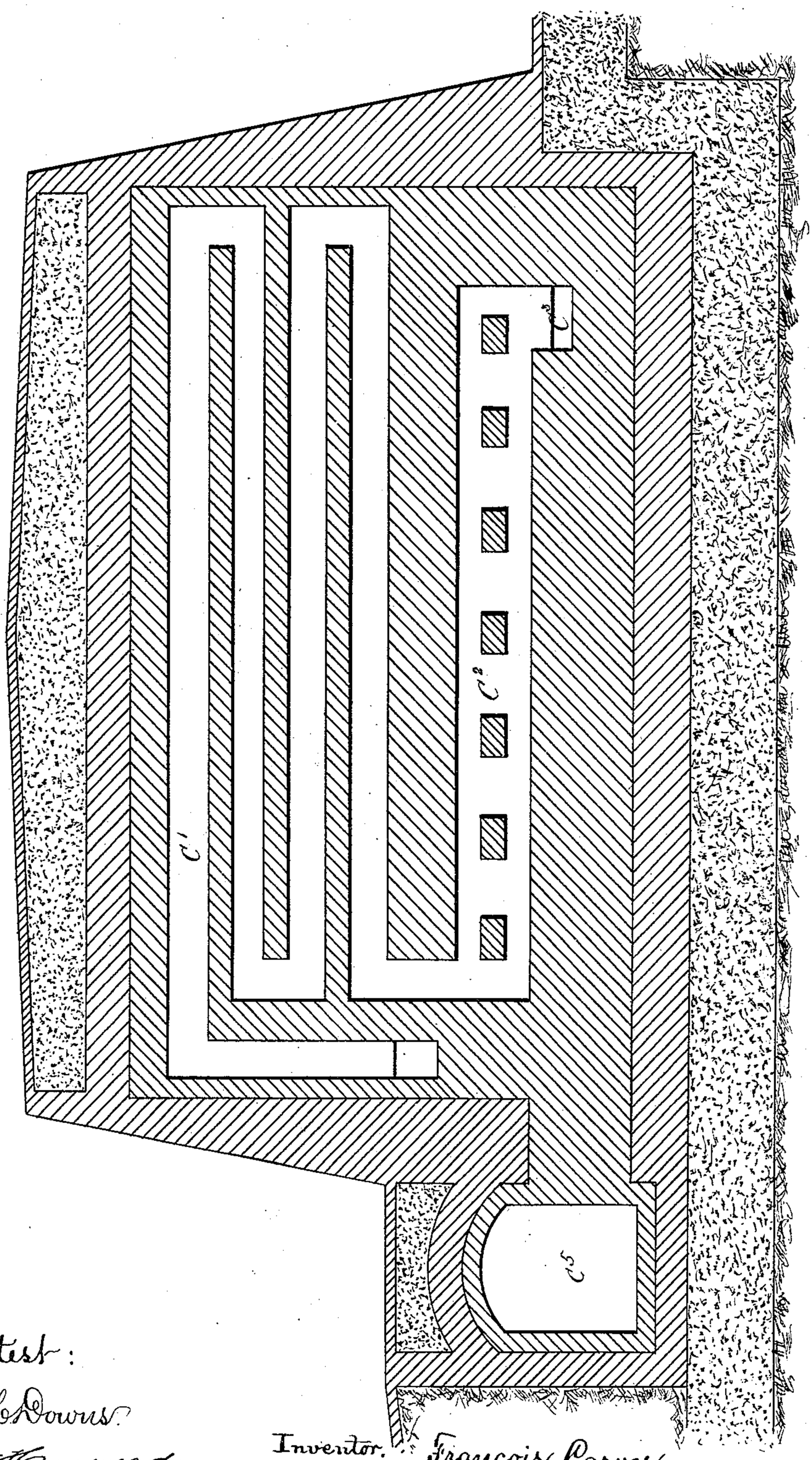
7 Sheets—Sheet 5.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.

FIG. 9



Attest:

Edw.d H. Downs.

F. W. Howard.

Inventor. Francois Carves.

C. S. Whitman
Atty

(No Model.)

7 Sheets—Sheet 6.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.

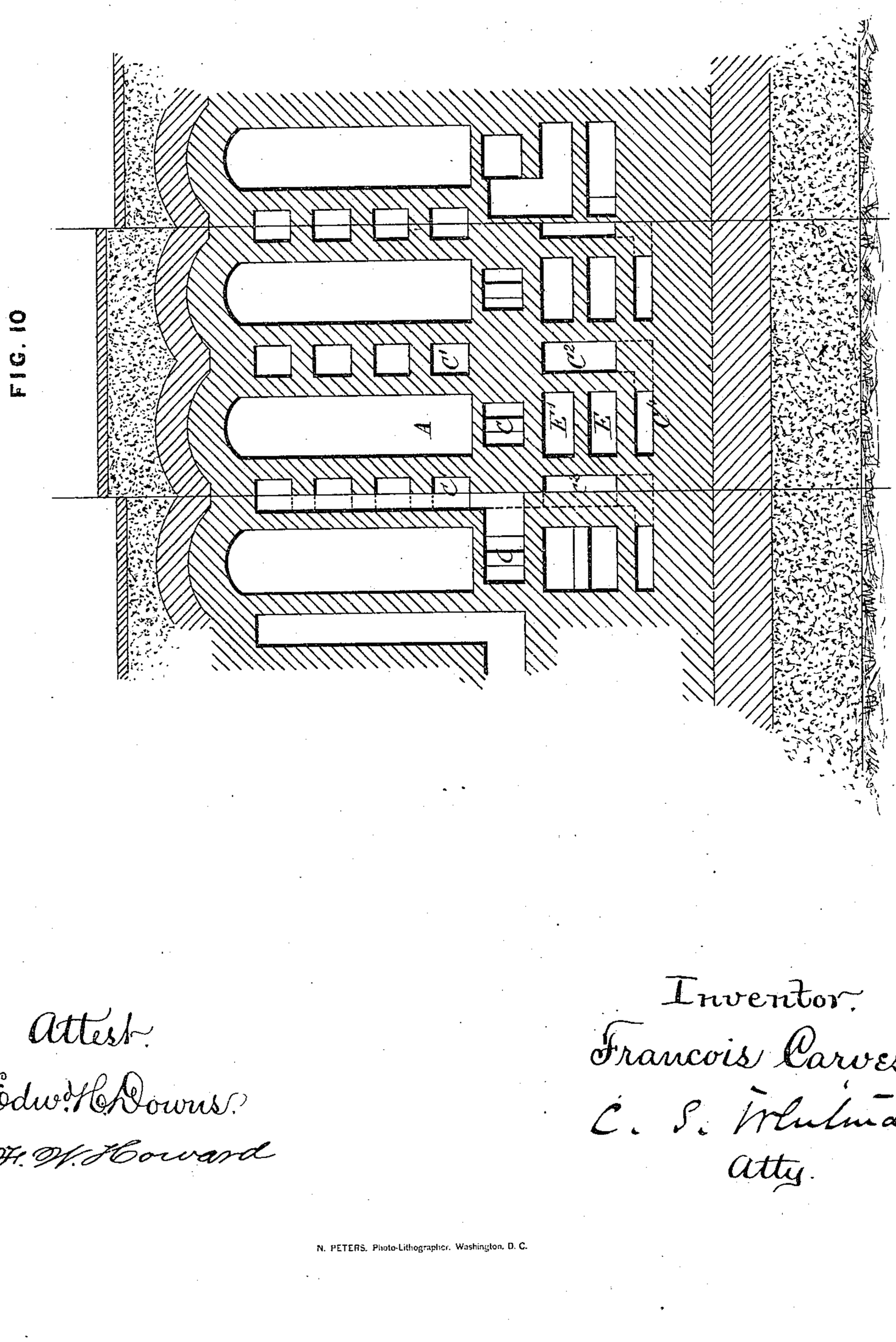


FIG. 10

Attest:
Edw.d H. Downs.
H. W. Howard

Inventor:
François Carves.
C. S. Whitman
Atty.

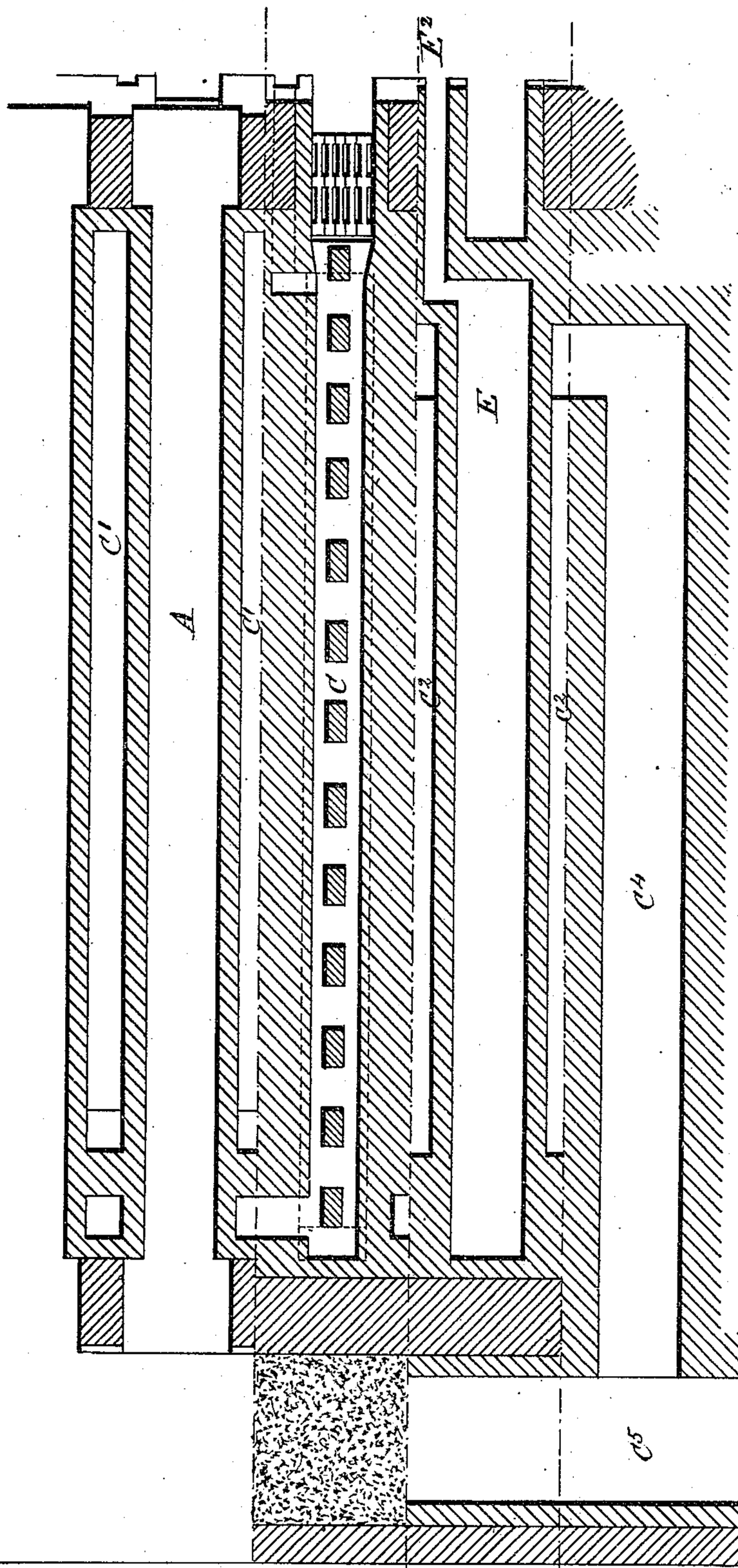
(No Model.) 7 Sheets—Sheet 7.

F. CARVES.

COKE OVEN.

No. 308,133. Patented Nov. 18, 1884.

FIG. II



Attest
Edwd. H. Downs.
H. W. Howard

Inventor.
Francois Carves
C. S. Whitman
atty

UNITED STATES PATENT OFFICE.

FRANÇOIS CARVES, OF SAINT-ETIENNE, FRANCE.

COKE-OVEN.

SPECIFICATION forming part of Letters Patent No. 308,133, dated November 18, 1884.

Application filed May 9, 1883. (No model.) Patented in England February 1, 1883, No. 554.

To all whom it may concern:

Be it known that I, FRANÇOIS CARVES, a citizen of France, residing at Saint-Etienne, department de la Loire, France, have invented new and useful Improvements in Coke-Ovens and Apparatus Employed in Connection Therewith, (for which provisional protection has been obtained in Great Britain, No. 554, dated February 1, 1883,) of which the following is a specification.

My invention relates to an improved construction and arrangement of coke-ovens and apparatus connected therewith, whereby the coking of the coal is more completely and economically effected than in coke-ovens of ordinary construction, while the tar, ammoniacal and other products of the distillation of the coal are separated from the combustible gases given off, and are collected in a condition which renders them available for use.

In an application of equal date herewith I have described a construction of coke-ovens heated by an external fire the combustion gases from which are led, first, through flues beneath the bottom of the coking-chamber, and then through a series of zigzag flues formed in the side walls of the chamber, so as to utilize to a great extent the heat of the combustion gases in imparting it to the bottom and side walls of the coking-chamber.

The main feature of my present invention consists in still further utilizing the heat of such combustion gases, in causing them on their way to the chimney to impart a great part of their remaining heat to the air- and gas supply for combustion in the furnace or flues of the ovens, or to air-supply alone, while a still further portion of the heat may, if desired, be utilized by causing the gases before escaping up the chimney to heat retorts for the manufacture of gas, steam-boilers, puddling-furnaces, ovens, or furnaces for ceramic ware, for the manufacture of glass, and the like.

Figures 1 to 5 of the accompanying drawings show one arrangement of a series of coke-ovens and apparatus for carrying out my said invention. Fig. 1 shows a longitudinal section through a coking-chamber and cross-section through the external air and smoke-flues on line 1 1, Fig. 3. Fig. 2 shows a longitudinal section through the partition-wall of the coking-chamber on line 2 2, Fig. 3. Fig. 3 shows a part plan and part sectional plan of the coking-chambers and flues, and Fig. 4 shows a part front elevation and part cross-section of the coking-chambers, and Fig. 5 shows a sectional plan to a smaller scale of the external smoke-flues and air-heating flues.

The coking-chambers A A, which, in order to effect the coking process in the most advantageous manner, are made of small width, (from eighteen to twenty inches by preference,) have below their floors a fire-place, B, with flue C, leading thence under the floor of the coking-chamber to the opposite end, where it passes laterally into the flue C′ in the side wall of the chamber, which flue first ascends to the upper part of the wall and then descends in a zigzag direction, as shown at Fig. 2, so as to cause the combustion gases passing through the same to effect the heating of the coking-chamber in the most uniform manner, as described in my aforesaid application for Letters Patent.

From the lower part of the flue C′ the gases pass down the inclined flue C^2 into the external smoke-flues, C^3 C^4. These two flues, as will be seen from the plan, Fig. 5, extend along the whole range of coke-chambers, each flue being closed at one end and communicating with a chimney, D D′, at the other end.

The flues C′ of the ovens communicate alternately with the flues C^3 C^4, as shown, so that the combustion gases of one half of the range of ovens are discharged into the flue C^3 and those of the other half into C^4, and it will be observed that the flow of such gases toward the chimneys D D′ will take place in contrary directions in the two flues. An air-flue, E, extends, first, along the outer side of the flue C^4, then passes at E′ along between the two flues, and again returning passes at E^2 along the other side of the flue C^3. From this part of the air-flue branches E^3 pass off to each coking-chamber and extend beneath the flue C to the fire-place B, with which they communicate through openings E^4 E^5. Thus it will be seen that atmospheric air entering the flue E at E^6 passes along the same in contact with the hot wall of the flue C^4 and through E′, where it is in contact with the hot walls of both C^4 and C^3, and, lastly, through E^2, where it comes in contact with the other wall of C^3, and finally

it passes in a highly-heated condition through the branch flues E^3 to the fire-places of the several ovens, in order there to enter into combustion with the solid or gaseous fuel employed.

It will be seen that in E the air flows in the contrary direction to the current of the combustion gases in C^4, and also in E′ it flows in the contrary direction to that of the gases in C^3, so that the coldest air in each case comes in contact with the cooler part of the smoke-flues, and thus the heat is taken up by the air in the most effective manner. When gaseous fuel is employed for heating the ovens, the hot air is made to enter the fire-place through the opening E^5 in close proximity to the inlet-nozzle F for combustible gas supplied through the pipe F′. If, on the other hand, solid fuel be used, the air enters at E^4 below the fire-grate, or both at E^4 and at E^5. The hot-air flue is also by preference extended up in the front wall of the oven, as indicated at E^7, in order to communicate at E^8 with the uppermost part of the flue C′, so that a portion of the hot air entering there may effect the combustion of any unconsumed combustible gases that may have passed away from the fire-place. The combustible gaseous constituents distilled off from the coking-chambers escape through the flue G, and are led through suitable pipes or hydraulic mains to any suitable known apparatus for condensing the tar and removing from the gas other condensable and useful constituents, and the gas, after such purification, is then by preference utilized in whole or in part as fuel for heating the coke-ovens, for which purpose it may either be led directly to the fire-place B through the pipe F′ and nozzle F, or it may also be previously heated by first passing it through a pipe or flue situated within or in close contiguity to the smoke-flues C^4 C^3. As, however, the quantity of gas consumed is small in proportion to the air-supply, the advantage gained in heating it is in most cases not sufficiently great to justify the additional expenditure for pipes and apparatus for heating it.

As shown at Fig. 5, the combustion gases may, before escaping up the chimneys D D′, be made to pass through the flues H of steam-boilers or of ovens or kilns, in order still further to utilize the heat contained in such gases.

Fig. 6 shows a sectional plan of another modification, in which there is only one external smoke-flue, C^3, into which the flues of all the ovens open, and on each side of which is an air-flue, E E′, so arranged that the external air entering at E^6 first passes along E in the contrary direction to the current of the combustion gases in C^3, and then passes through the branches E^3 to the furnace of each coking-chamber. As in the previous arrangement, the combustion gases may be led through the flues H of a boiler, &c., before escaping up the chimney D.

According to another modification, instead of having separate air-supply and smoke flues, as in the previous arrangements, the same flues are made to serve alternately for taking up the heat from the combustion gases and imparting such heat to the air-supply, the flues being thus made to serve as "regenerators" of well-known construction. Fig. 7 shows a sectional plan of such an arrangement. The smoke-flues C′ of the ovens all open into the flue K, while the air-flues E^3 leading to the fire-places all open into the flue I. Both the flues I and K are made to communicate at X by means of reversing-valves of known construction alternately with the regenerator-flues L M. These flues extend first from the end X to the opposite end of the range of ovens and then return again, and are at Y provided with reversing-valves of known construction, whereby they are made alternately to communicate with the chimney D and with the outer air. The reversing-valves at X and Y are connected and are worked simultaneously, so that when those at Y are moved into position for admitting air into M and for allowing the products of combustion to pass from L to the chimney, those at X are brought into position for making the air-flue I communicate with M and the smoke-flue K communicate with L, while when the valves are reversed the above communications are also reversed. Assuming the communications to be established as first described, then the combustion gases will pass from K through L L, giving off their heat to the surfaces of these flues, which surfaces are by preference made of considerable extent either by forming tortuous passages in the flues or by providing these with "filling," such as is ordinarily used in furnace-regenerators. At the same time atmospheric air will enter the flue M M at Y, and in passing along the same will take up the heat that has been previously given off to its surfaces by the passage of the combustion gases, these surfaces being increased by filling or tortuous passages, as in L. On the reversal of the valves the combustion gases will escape through M M and the air will enter through L L.

Figs. 8 to 11 show another modification, in which the heating of the air, instead of being effected in flues external to the ovens, is effected in flues extending beneath the bed of the oven, arranged in close contiguity to other flues, through which the combustion gases are made to pass before escaping into the outer flue. Fig. 8 shows a vertical section through a coking-chamber and the flues beneath the same. Fig. 9 shows a vertical section through the flues in the partition-walls. Fig. 10 shows a cross section through two coking-chambers and their flues, and Fig. 11 shows a sectional plan taken at different levels through the several flues. The combustion gases pass, as in the first described arrangement, from the flue C beneath the floor of the coking-chamber to the top of the zigzag flue C′, in the partition-wall, and thence into a lower flue, C^2, from

which they pass at C^3 into a flue, C^4, and thence into the external flue, C^5.

Between the flues C, C^2, C^2, and C^4 is arranged a flue, E E′, which is consequently heated on all four sides by the combustion gases, and into which the external air enters at E^2, and after passing along the lower part, E, returns through the upper part, E′, and issues in a heated state through the openings E^3 and E^4 into the fire-places, and, if necessary, into the smoke-flue, as previously described.

It is found that with the several above-described improved constructions of ovens, special fires in grates, such as are required in the arrangement described in my other application, are no longer necessary, and consequently not only is the fuel saved, but the attention heretofore required of special stokers or attendants and the consequent expense is much reduced.

I am aware that it has already been proposed to heat the air-supply by leading it through flues under the bed of the oven, so as to take up heat from the oven itself, but it is found very objectionable to abstract any heat whatever from any part of the oven itself, and according to my invention I abstract heat only from such parts of the flues which are traversed by the products of combustion of the gases used for heating the ovens. The reason of the above objection is that it is desirable to have as elevated a temperature as possible in the coking process, and I therefore consider it wrong in principle to abstract through the walls of the oven any heat whatever for elevating the temperature of the air of combustion. On the other hand, the using of the waste heat of the products of combustion for the temperature of the air required for the combustion of the gas around the oven raises the temperature considerably. In cases when the heat under the sole of the oven should become too great, I only admit a reduced quantity of air at that spot and admit the remainder of the air necessary for complete combustion at any other convenient spot—say in the side flues, as described—thus more equally dividing the heat over the outside of the retort or oven. In cases where the draft through the flues is not sufficient, I employ fans, exhausts, pumps, injectors, ejectors, and similar apparatus for accelerating it.

I am aware that in coke-ovens as heretofore constructed the air-supply has been heated, but this has generally been done at the expense of the heat of the coke-oven itself. According to my invention, however, I take up the heat either from the smoke-flues entirely external to the coke-ovens, or when the air-flue is in the body of the oven I surround it on all sides with flues through which the products of combustion are passing off, so that the heat is only abstracted from the products of combustion, and not from the mass of brickwork.

Having thus described the nature of my invention and the best means I know of carrying the same into practical effect, I claim—

1. The coking-chamber having flues C leading under their floors and flues C′ in the side walls, which ascend to the upper part of the wall and then descend in a zigzag direction, in combination with external smoke-flues, C^3 C^4, extending along the whole range of the coke-chambers, and the flues E E′ E^2, each flue being closed at one end and communicating with a chimney at the other end.

2. The combination of the flues C^3 C^4, the air-flues E E′ E^2, the air-flue branches E^3, and the coking-chamber, as and for the purposes described, whereby the air is made to flow in a contrary direction to the current of combustion gases.

3. In combination with a range of coke-ovens heated by external firing, one or more external horizontal smoke-flues extending along the range of ovens with the firing places of which it or they communicate, and one or more air-flues arranged alongside of the said smoke-flues, through which air-flues the air-supply to the said firing places is made to pass, so as to take up the heat given off to the walls of the smoke-flues by the combustion gases.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 16th day of April, A. D. 1883.

FRANÇOIS CARVES.

Witnesses:
JACQUES MAULINT,
RENÉ SAVOY.