No. 744,667. PATENTED NOV. 17, 1903.

B. ZWILLINGER.

PROCESS OF CARBONIZING.

APPLICATION FILED FEB. 28, 1901. RENEWED JUNE 5, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

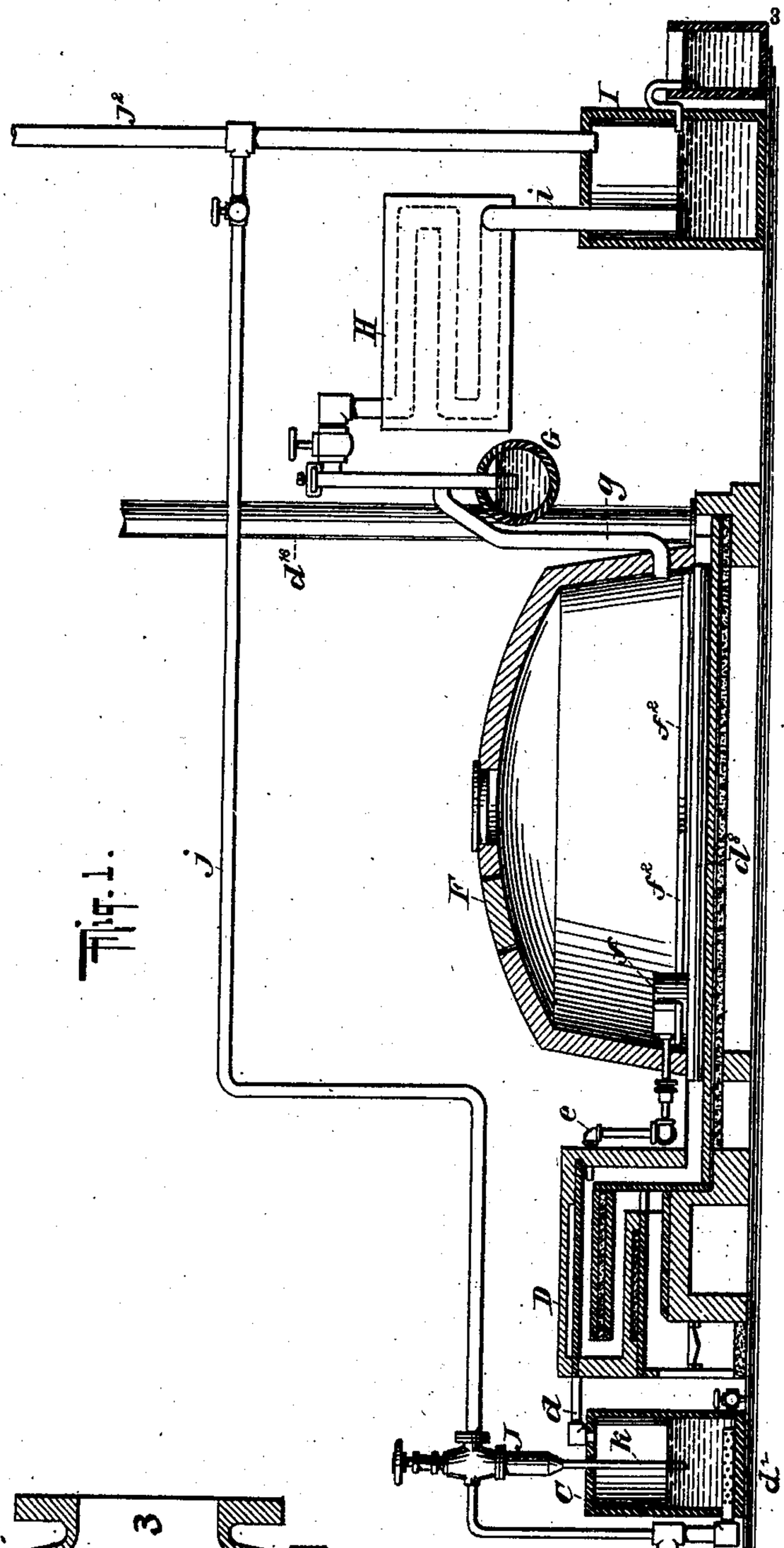
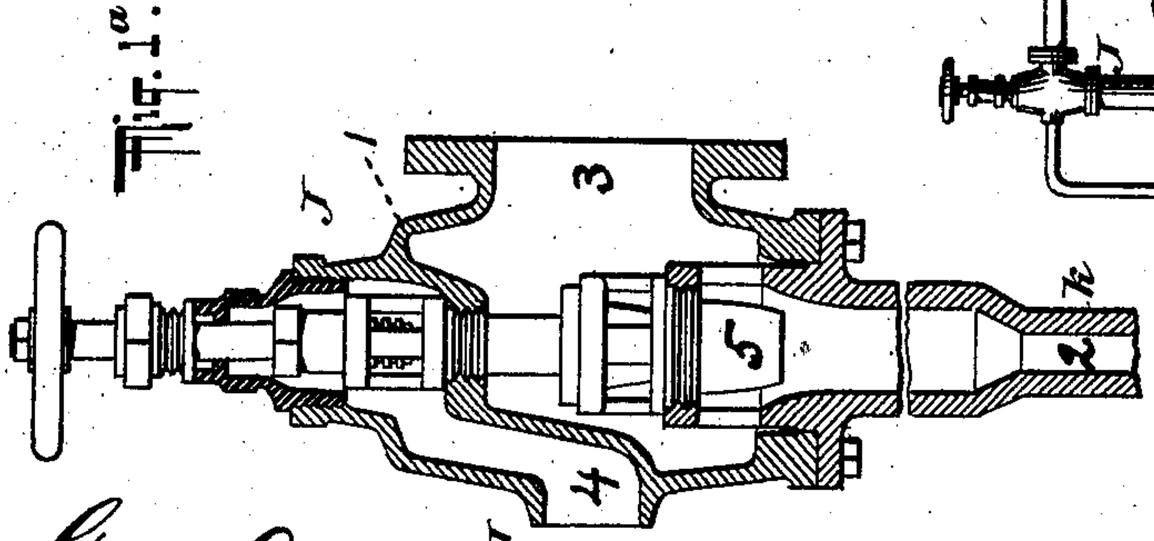


Fig. 1ª.



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NO MODEL. 3 SHEETS—SHEET 2.

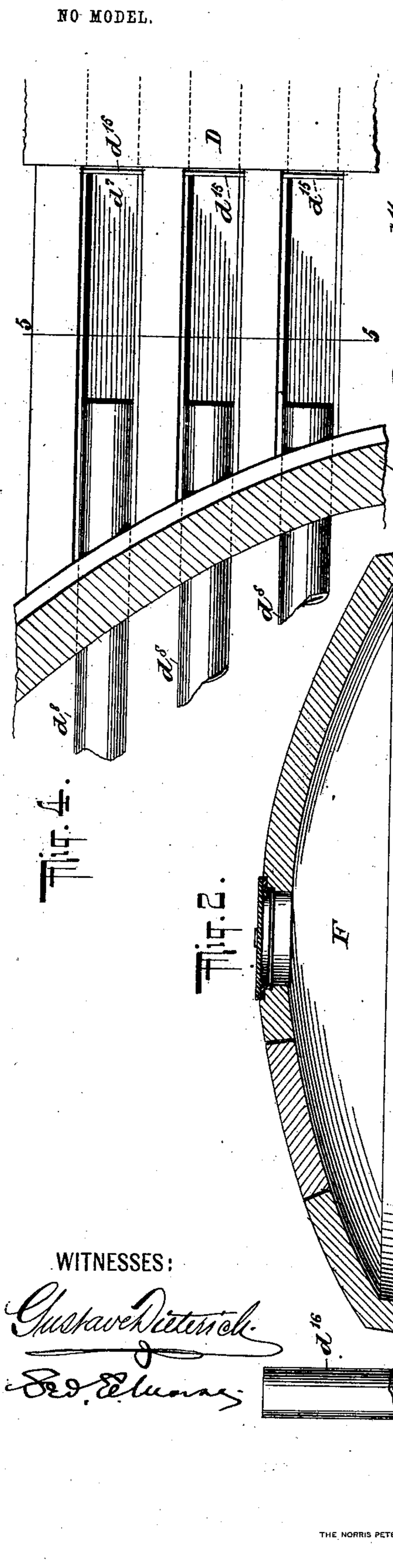

Fig. 4.

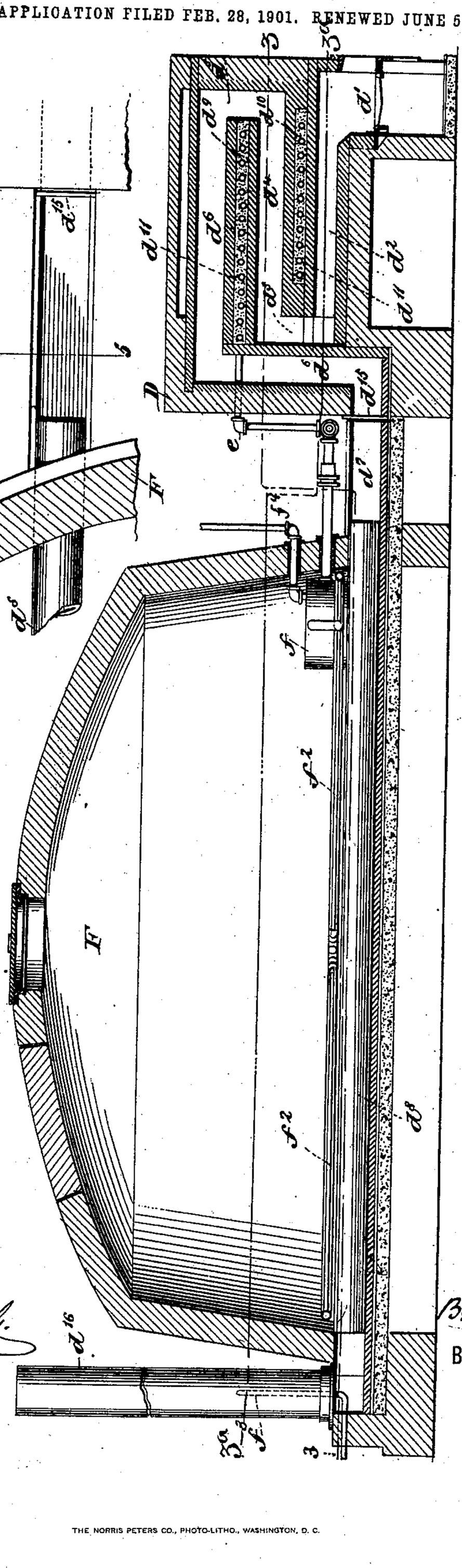

Fig. 2.

Fig. 3.

Fig. 5.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

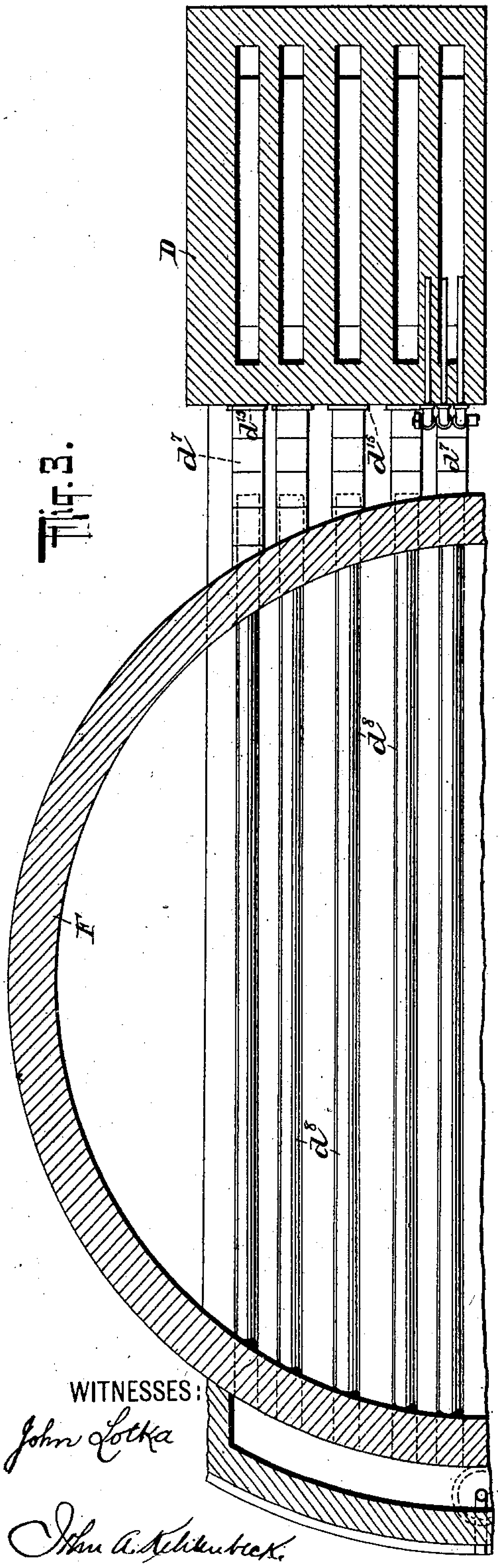
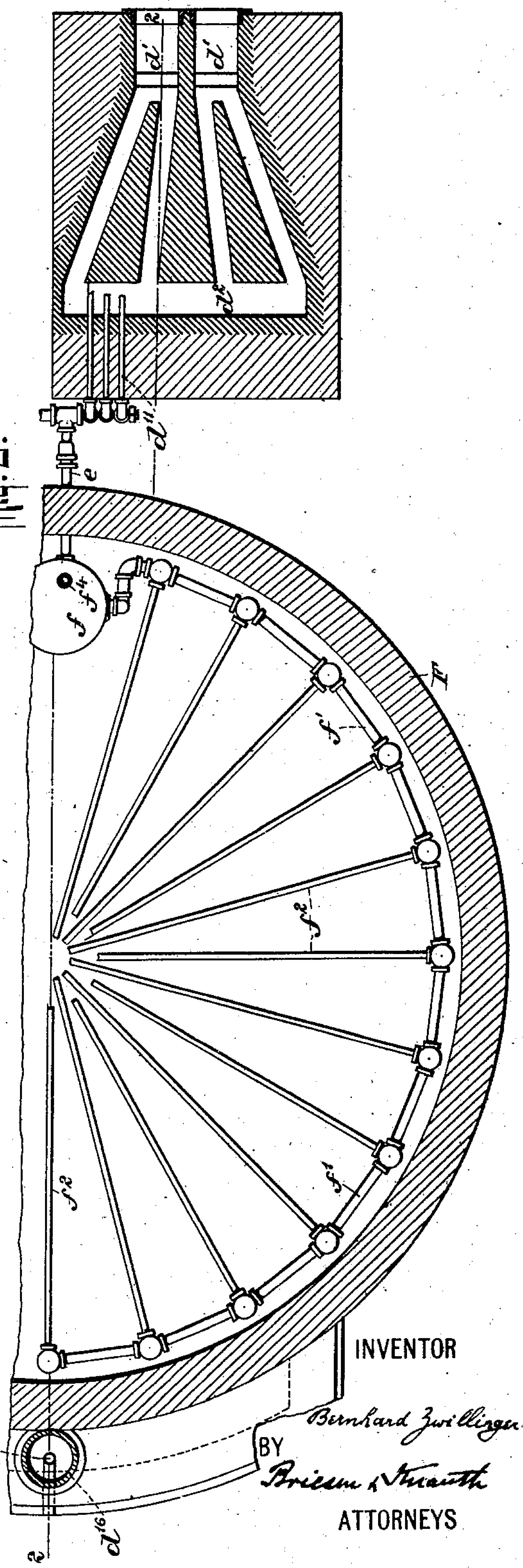


Fig. 3a



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No. 744,667. Patented November 17, 1903.

UNITED STATES PATENT OFFICE.

BERNHARD ZWILLINGER, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO AMERICAN FUEL AND DISTILLATION COMPANY, A CORPORATION OF NEW JERSEY.

PROCESS OF CARBONIZING.

SPECIFICATION forming part of Letters Patent No. 744,667, dated November 17, 1903.

Application filed February 28, 1901. Renewed June 5, 1903. Serial No. 160,263. (No specimens.)

To all whom it may concern:

Be it known that I, BERNHARD ZWILLINGER, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Process of Carbonizing, of which the following is a full, clear, and exact description.

My invention relates to a process of carbonizing material, such as wood, and has for its object to produce a thorough and even carbonization of the material and to obtain the greatest possible yield of by-products.

My invention has for its further object to produce the carbonization and the cooling of the carbonized material more quickly than heretofore.

The apparatus shown and described in the present application is claimed in another application for patent filed by me in the United States Patent Office on February 28, 1901, Serial No. 49,282.

In the accompanying drawings I have shown as an example an apparatus suitable for carrying out my invention, it being understood that I do not desire to limit myself to the use of the construction shown nor, in fact, to any particular construction.

In the drawings, Figure 1 is a sectional elevation of an apparatus for carrying out my process. Fig. 1ª is a detail sectional view of an injector forming part of the apparatus. Fig. 2 is a sectional elevation, upon an enlarged scale, taken through the kiln and the heater for the gases substantially on line 2 2 of Fig. 3ª and looking in the direction opposite to that in which Fig. 1 is taken. Figs. 3 and 3ª are sectional plans of the structure shown in Fig. 2, taken on the lines 3 3 and 3ª 3ª, respectively, of Fig. 2. Fig. 4 is an enlarged detail plan view of the connections intervening between the kiln and the heater for the gases; and Fig. 5 is a section on the line 5 5 of Fig. 4, showing the means for cooling down the conduit intervening between the heater and the kiln for the purpose of cooling down the charge after carbonization has been effected.

In the drawings, A represents a suitable air-compressor, which is preferably connected by piping B with an accumulator C, in which the atmospheric air and the permanent gases are thoroughly commingled. One branch of the pipe B enters the lower part of the accumulator C, and the other branch communicates with an injector J. D is the heater for the gases which aid in effecting the carbonization. A pipe d leads from the accumulator to the heater, and a pipe e connects the heater with a suitable drum f in the kiln F. A pyrometer f^4 (see Fig. 2) is connected with this drum. Leading from the bottom of the kiln F is a pipe g, which communicates with a suitable hydraulic main G, from which a pipe leads to a condenser H, provided with an outlet-pipe i, leading to one or more vessels I in the nature of Wulff bottles. From these vessels or tanks a suitable pipe j leads back to the injector J, having its outlet k connected with the accumulator C. This injector, which may be of any suitable construction, preferably consists of an outer casing 1, having an outlet 2, connected with the outlet-pipe k, an inlet 3 for the permanent gases, and an inlet 4 for the air or other fluid supplied from the compressor A. This injector, which is preferably of the ordinary Körting type shown, is provided with the usual injecting elements 5.

The heater D is preferably constructed as shown in the drawings, although this is not essential. This heater consists of an ordinary furnace or fire-box d', which discharges its smoke and products of combustion through a rearwardly-projecting flue d^2, thence upward through a flue d^3, forward through a flue d^4, upward through a flue d^5, and finally rearward and downward through a flue d^6. It will of course be understood that there are several of these chambers or flues, which communicate, respectively, with the flues d^7, intervening between the heater D and the kiln F, said passages being connected with flues d^8, arranged beneath the kiln and connected at their outlet ends with a stack d^{16}, in which there may be arranged a draft device, such as a steam or gas jet nozzle f^3. Intervening between the chambers or flues d^2 and d^4 and between the flues d^4 and d^6 are floors or partitions d^9 d^{10}, within which are

placed coils of piping d^{11}. It will be understood that the air and permanent gases which pass from the accumulator traverse the coils of piping d^{11} and become highly heated.

By reference to Figs. 4 and 5 it will be observed that the passages or flues d^7 between the heater D and the kiln F are provided with removable plates d^{12}, which may be lifted up at the end of the carbonizing process, so as to prevent the products of combustion from the heater D from passing through the flues d^8, so that the kiln will cool down much more rapidly owing to the passage of cool air through the flues d^8, the draft for this purpose being obtained or at least increased by the use of a steam-jet f^3 or its equivalent.

The kiln, which is best shown in Figs. 2, 3, and 3^a, may be of any suitable construction; but preferably it is of circular shape. Communicating with the drum f in the kiln is a pipe f', which runs around the entire kiln on the floor thereof and is provided with perforated branch pipes f^2, which extend from the wall of the kiln to or about the center thereof, the said pipes being preferably placed radially with respect to the circumference of the kiln. The function of these pipes is to thoroughly distribute the mixture of air and permanent gases throughout the charge contained in the kiln. The stack d^{16}, with or without the draft appliance f^3, secures a rapid removal of the products of combustion from the heater D.

Before describing the detailed operation of the apparatus I will first explain the general principles upon which my invention is based.

The leading idea of inserting or introducing a gas into the kiln is to check combustion and to produce a thorough carbonization of the material, and thereby securing the highest possible percentage of by-products. The so-called "permanent" gases which are derived from the dry distillation of wood are generally composed of from fifty-eight to sixty-four per cent. of carbonic acid, carbon monoxid, marsh-gas or methane, ethylene, and hydrogen, and these are sucked by the injector J, operated by the air-compressor A, into the accumulating vessel C, and at the same time the atmospheric air which produces the injection is forced into this vessel, say, in about the proportions of one part of gas to about one and three-fourths parts of air, so that the air and permanent gases are thoroughly mingled before they enter the kiln. An additional amount of air may be forced into the accumulator directly from the compressor A by means of a pipe d^2. The mingling of the gases and air produces a mixture which passes through the heater D. In the system the proportion of oxygen of the air introduced will be reduced to about five to seven per cent.—that is to say, of each twenty-one parts of oxygen introduced only five to seven remain uncombined, the other sixteen to fourteen parts having united with the combustible gases—or, in other words, from one-third to one-half more air is introduced than is necessary to consume the combustible gases. The mixture of air and gases passes through the accumulator C, which is half filled with water and which performs, among others, the following two important functions: First, the mixture of gases will be saturated with water-vapors, so that the water will prevent the heating-coils d^{11} from being damaged by the heat; second, the water in the accumulator will serve as a sort of deposit medium for the permanent gases, which carry over mechanically a certain amount of tar from the vessel or vessels I. The mixture of gases goes through the coils d^{11} and is heated to about 650° Fahrenheit before it enters the kiln, the pipes in the kiln serving to thoroughly distribute the gas mixture to all parts of a charge. It will be understood that the functions performed by the water in the accumulator are such that it is not necessary to run the supply of water continuously, and the water may be allowed to remain in the accumulator until it has become too turbid for properly performing its functions as a depository. It is then replaced by fresh water; but I wish it distinctly understood that there need be constant supply of water and desire to clearly distinguish from apparatuses in which a continuous supply of water is employed for the purpose of deoxygenation.

By the process so far described I greatly reduce the time necessary for carbonization and obtain a very much higher percentage of by-products than hitherto. Ordinarily under a supply of gases of from three hundred to five hundred cubic feet per minute and employing a charge of one hundred and twenty thousand pounds of wood, figuring a cord at four thousand pounds of air-dried wood, I can dispose of one charge in as short a time as sixty hours, and will then obtain over twenty-five per cent. of very best charcoal, one to two per cent. of ninety-five-per-cent. methyl alcohol, four to five per cent. of one-hundred-per-cent. acetic acid, and seven per cent. of tar. These percentages refer to the whole amount of the charge as standard, or one hundred. The time of carbonization can be greatly reduced by increasing the gas-pressure. The gases which are derived from the glowing mass in the kiln do not go directly into the air, but are removed from the kiln, at the bottom thereof, (see Figs. 1 and 2,) by the pipe g. While the location of said pipe need not be as shown, I prefer to lead it from the bottom of the kiln, because this is the most efficient construction, as the draft is downward in kilns of this description, thereby producing a more thorough and even carbonization and preventing objectionable decomposition of the by-products. The advantage of thus proceeding will be obvious when it is realized that a very small percentage of acetone is produced by me, whereby I avoid the detrimental effect of a large per-

centage of acetone, which is very injurious to the wood-alcohol. Recent results have shown only one-hundredth of one per cent. of acetone in the raw wood-alcohol.

The gases emanating from the kiln are led into the condenser H, where the by-products are condensed and pass with the permanent gases into the receptacle or vessel I, which, as before described, is in the nature of a Wulff bottle. The permanent gases are ordinarily returned immediately to the injector J and the accumulator C; but, if desired, they may be led off by a small pipe j^2 to a suitable gas-holder.

When the carbonizing process in the kiln is completed, the kiln is cooled, the supply of gas thereto being shut off, and the flues d^8, which run beneath the kiln, being disconnected from the heating-channels of the heater D, so that the hot products of combustion will no longer pass under the kiln. To interrupt the connection, I provide a plate d^{15}, and it will be understood that as the draft is maintained in the flues d^8 by the draft appliance f^3 in the stack d^{16} I can secure a passage of cool air through the flues d^8 by raising or taking off the plates or covers d^{12}, which normally close the connection of the flues d^8 with the surrounding air. By thus proceeding I am enabled to cool down the kiln in about thirty-six hours, whereas formerly six to seven days were required to secure the same result.

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

The herein-described carbonizing process which consists in mixing an excess of air with combustible gas, heating the mixture under the exclusion of further atmospheric air in a confined space bringing the resultant gases into contact with material to be carbonized under the exclusion of atmospheric air so as to carbonize the material partly by the heat of the gases, partly by the combustion of the hot combustible gases introduced and partly by the combustion of the gases given off from the material being carbonized.

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Witnesses:
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