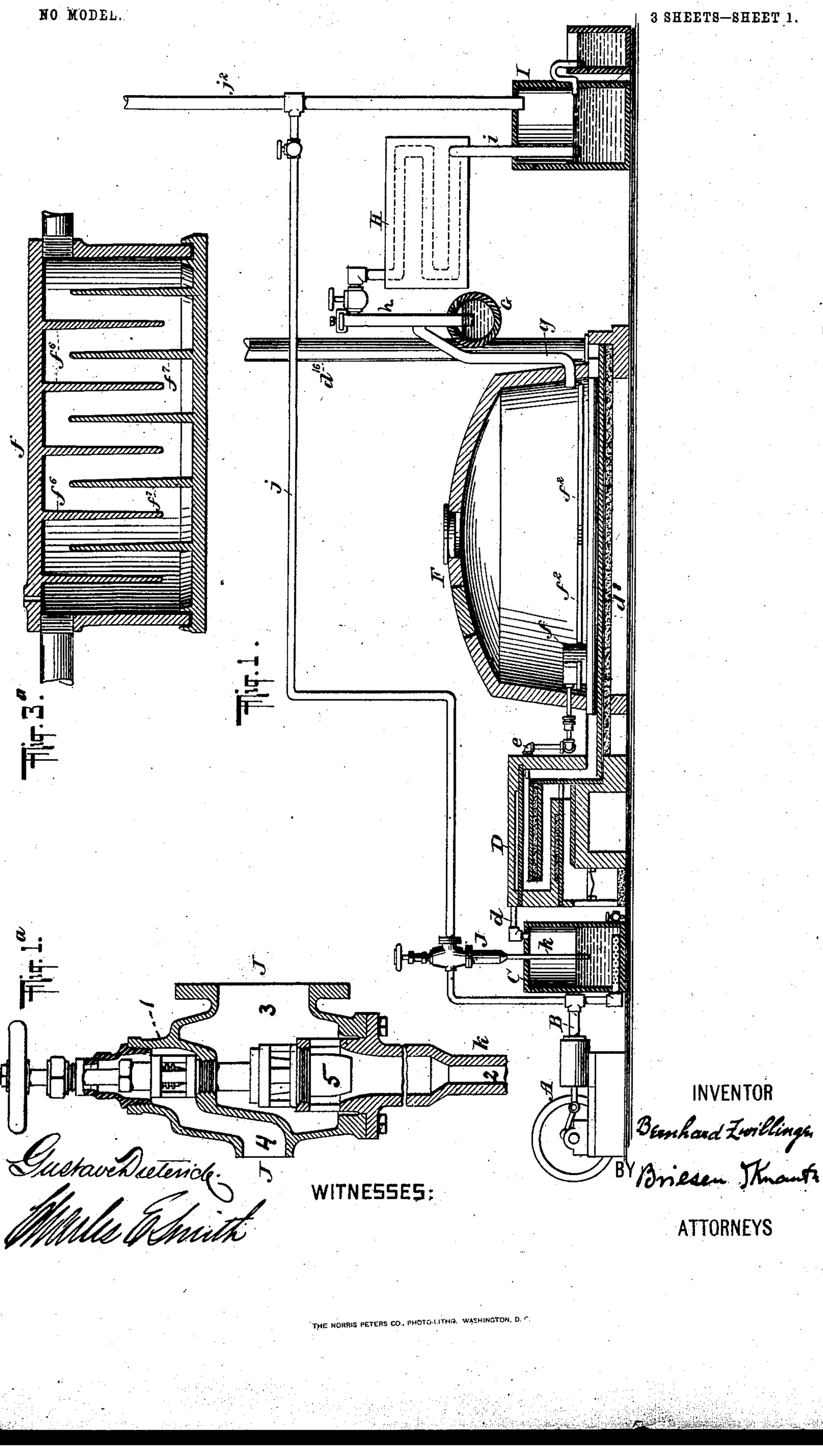
No. 744,668. PATENTED NOV. 17, 1903.

B. ZWILLINGER.

APPARATUS FOR CARBONIZING.

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

NO MODEL. 3 SHEETS—SHEET 1.



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NO MODEL. 3 SHEETS—SHEET 2.

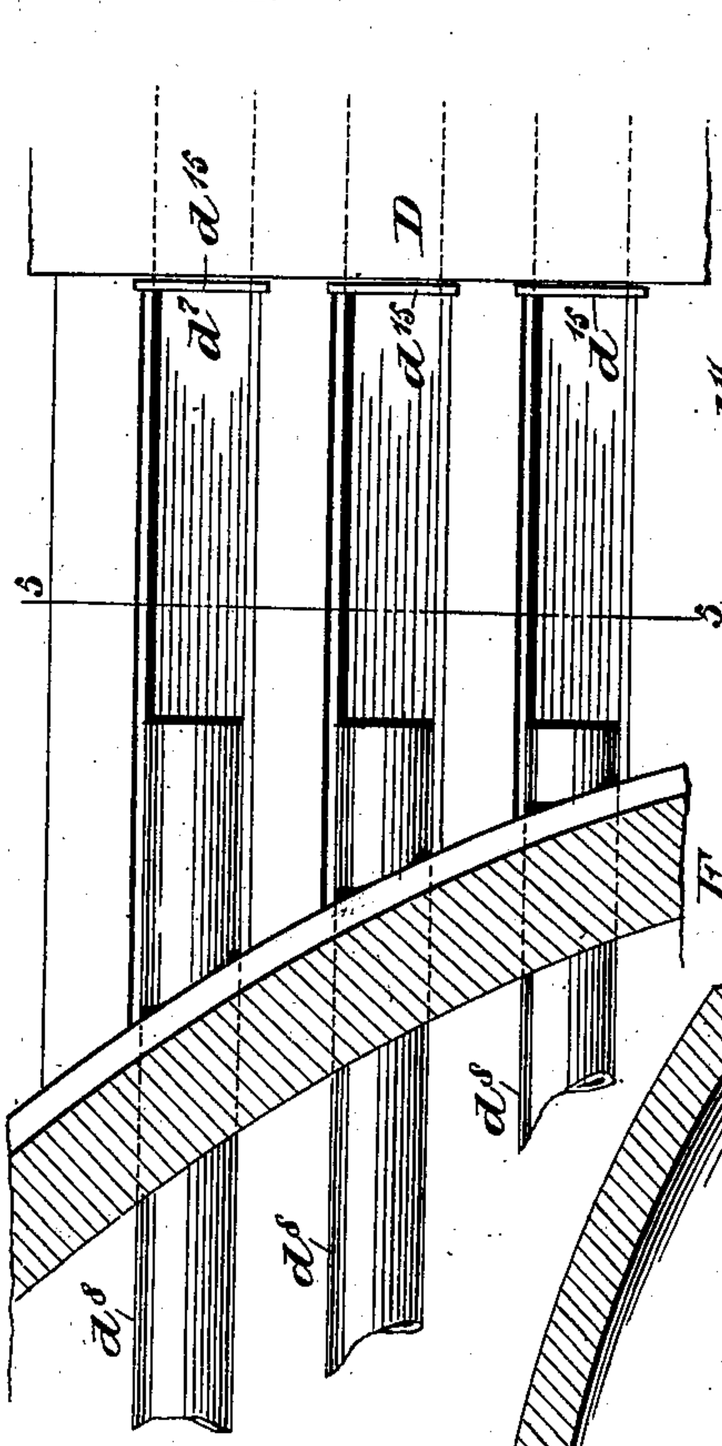

Fig. 4.

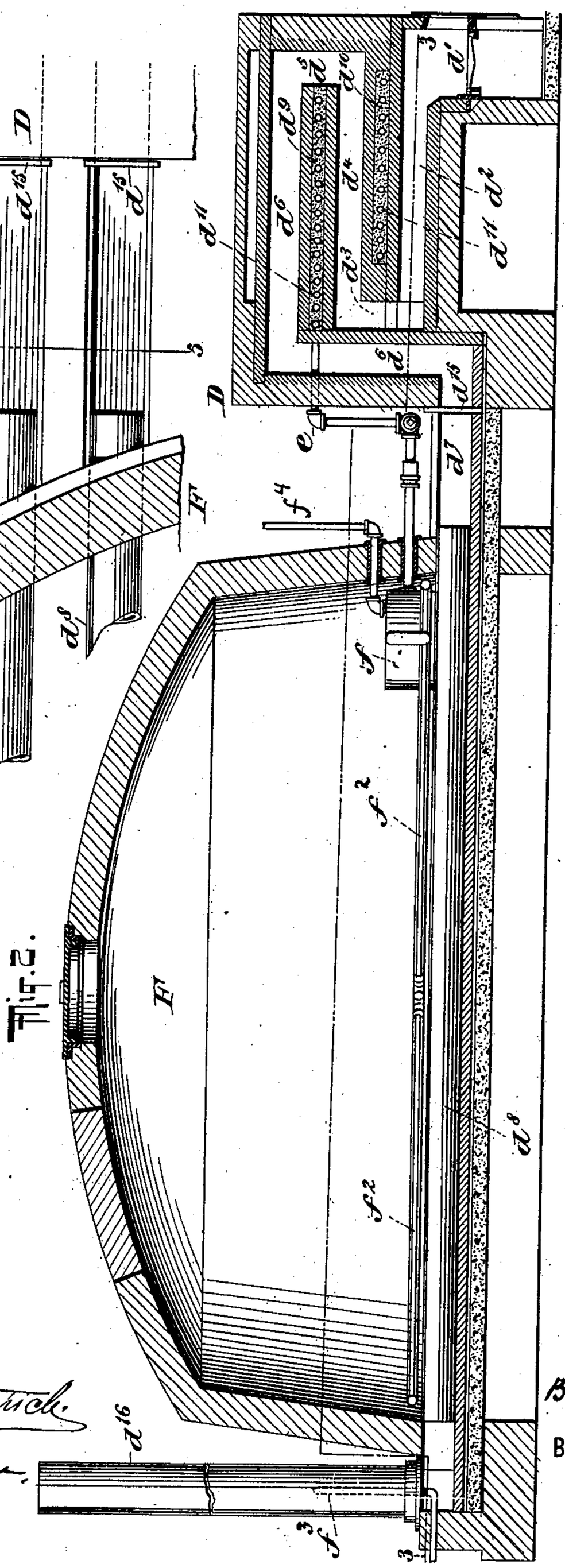

Fig. 2.

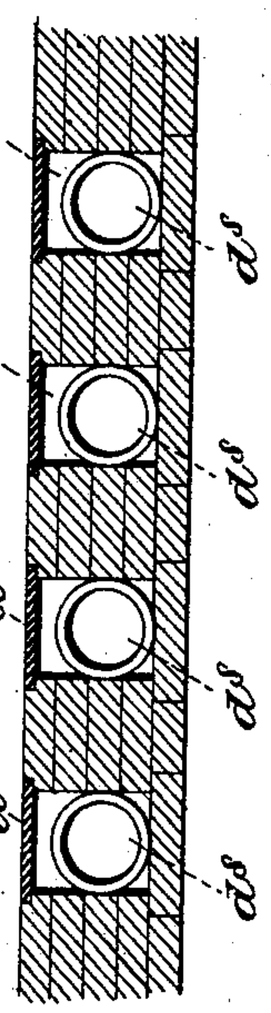

Fig. 5.

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ATTORNEYS

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NO MODEL. 3 SHEETS—SHEET 3.

FIG. 3.

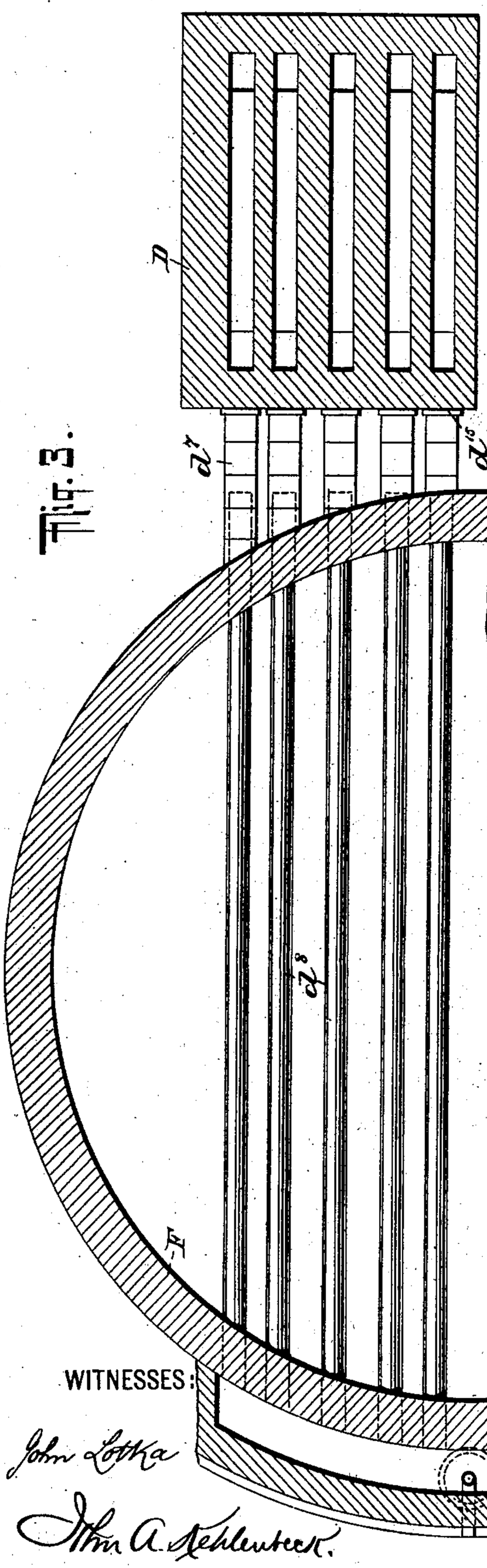
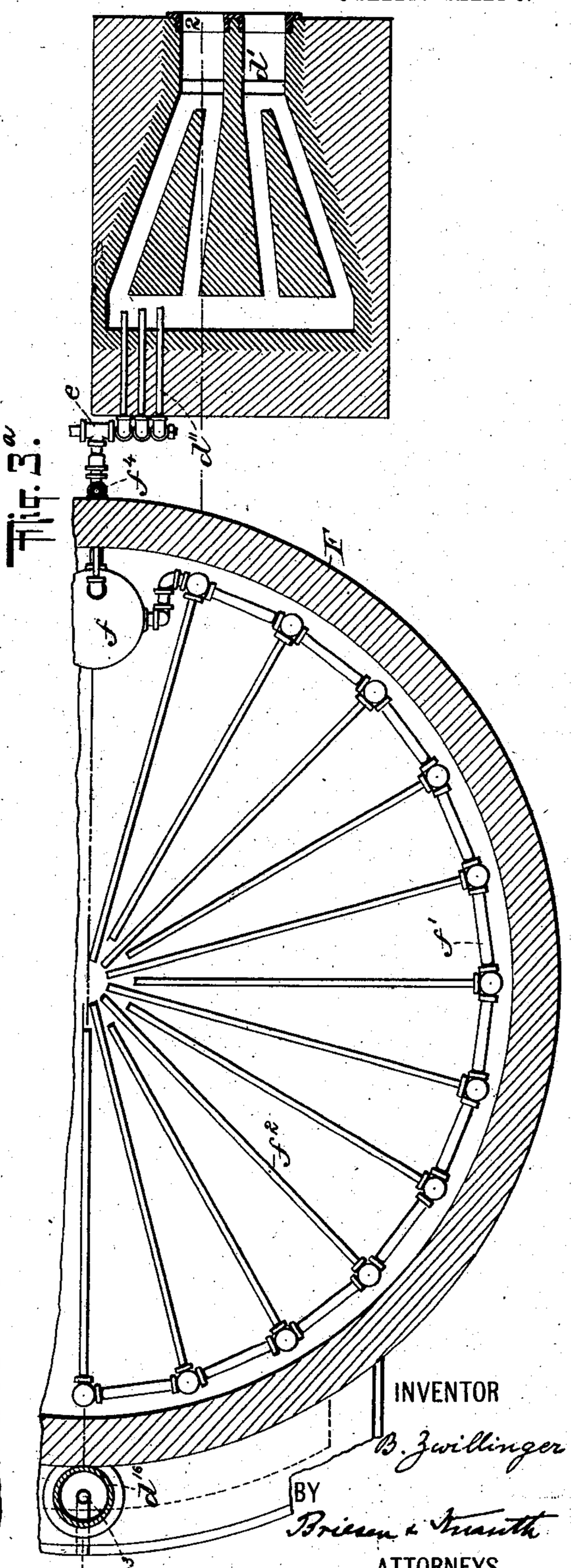


FIG. 3a.



WITNESSES:

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No. 744,668. 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.

APPARATUS FOR CARBONIZING.

SPECIFICATION forming part of Letters Patent No. 744,668, dated November 17, 1903.

Application filed February 28, 1901. Renewed June 5, 1903. Serial No. 160,264. (No model.)

To all whom it may concern:

Be it known that I, BERNHARD ZWILLINGER, a citizen of the United States, residing in the city, county, and State of New York, have invented a new and Improved Apparatus for Carbonizing, of which the following is a specification.

My invention relates to an apparatus for carbonizing carbonizable material, and has for its object to produce an apparatus which will effect a thorough and even carbonization of the material and which will at the same time produce a very large yield of by-products.

My invention further has for its object to effect the carbonization and subsequent cooling down of the carbonized material in the shortest possible time.

My invention will be described with reference to the accompanying drawings, in which I have shown an apparatus in which my invention is embodied.

It will be understood, however, that this apparatus is only one of many forms which may be employed and that I do not limit myself to such apparatus.

In the drawings, in which like reference characters indicate like parts, Figure 1 is a sectional elevation of an apparatus embodying my invention. Fig. 1ª is a section of a suitable injector. Fig. 2 is a sectional elevation, on an enlarged scale, taken through the kiln and the heater. Fig. 3 is a sectional plan of the structure shown in Fig. 2, taken on the line 3 3 of Fig. 2. Fig. 3ª is a similar sectional plan taken at different levels. Fig. 3ᵇ is a section through the drum of the kiln. Fig. 4 is an enlarged detailed plan view of the connections intervening between the kiln and the heater; and Fig. 5 is a section on 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.

In the drawings, A represents a suitable air-compressor, which is preferably connected by piping B with an air and gas mixer C, wherein the atmospheric air and the permanent gases are thoroughly mingled.

D is the heater, which will be described more fully in detail. The piping *d* leads from the mixer to the heater, and pipe *e* connects the heater with a suitable drum *f* in the kiln F. Leading from the bottom of the kiln F is a pipe *g*, which communicates with a suitable hydraulic main G, from which a pipe *h* leads to a condenser H, from which condenser a pipe *i* leads to a vessel I in the nature of a Wulff bottle. From the Wulff bottle a suitable pipe *j* leads back to an injector J, from which injector a pipe *k* leads into the mixer. The heater, which may be of any suitable or preferred construction, is preferably constructed as shown herein. This heater consists of an ordinary furnace-grate d', which discharges its smoke and products of combustion through a rearwardly-projected flue d^2, thence upward through a flue d^3, thence forwardly through a flue d^4 and upwardly through a flue d^5, and rearwardly and downwardly 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 passages d^7, which intervene between the heater and kiln and pass beneath the kiln by means of pipes d^8 to a stack d^{16}. Intervening between the chambers or flues d^2, d^3, d^4, and d^6 are floors or partitions d^9 d^{10}, within which are placed coils of pipes d^{11}. It will be understood that the air and permanent gases which pass through the mixer traverse the coil of pipe d^{11} and become highly heated.

By referring to Figs. 4 and 5 it will be observed that the passages or flues d^7 between the heater and the kiln are provided with removable plates d^{12}, which may be elevated at the end of the carbonizing process, so as to prevent the products of combustion from the heater from passing through the pipes d^8, so that the kiln will thereby be cooled down much sooner.

The kiln, which is best shown in Figs. 2 and 3 and which may be of any suitable construction, is preferably of the form shown in the said figures—namely, circular. Communicating with the drum *f* in kiln is a pipe f', which pipe runs around the interior of the

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 radially placed with respect to the circumference of the kiln. The function of these pipes is to distribute the mixture of air and permanent gases thoroughly to the charge in the kiln in order to promote a uniform carbonization, and to have a rapid circulation of fresh air after the carbonization is finished a suitable draft-producing appliance f^3 is provided in the stack d^{16}. This draft-producing appliance is preferably a gas or steam jet.

In Fig. 3^b the drum f, which is shown in Fig. 2 as located within the kiln, is shown as provided with baffle-partitions f^6 f^7 to effect a more thorough commingling of the gases.

Before describing the detailed operation of the apparatus I will first describe the general principles upon which the invention depends.

The leading idea of inserting or introducing a gas into the kiln is to produce a thorough carbonization of the material, while at the same time preventing combustion, and thereby yielding the highest possible per cent. of by-products. The so-called "permanent gases," which are derived from the dry distillation of wood, are generally composed of fifty-eight to sixty-four per cent. carbonic acid, carbon monoxid, marsh-gases, ethylene hydrogen and are sucked by means of an injector, which is operated by the air-compressor, into the mixing-vessel, and at the same time the atmospheric air which produces the injection is forced into this vessel, so that the air and permanent gases are thoroughly commingled before they enter the kiln. This commingling produces a dilution of the air. In this manner the air will be mixed with such a volume of combustible gas that after combustion of the mixture, which takes place in the kiln, a large part of the oxygen in the air will be used up in such combustion. Thus of the twenty-one per cent. of oxygen contained in the air only from five to seven per cent. will remain. The mixture passes through the mixer, which is half-filled with water and which performs two functions: First, the mixture of gases will be saturated with water-vapor so as to prevent the heating-coils from being damaged by the intense heat, and, second, to serve as a sort of deposit medium for the permanent gases which carry over mechanically a certain amount of tar from the Wulff bottles. This mixture of gases goes through the heating-coils and is heated up to about 650° Fahrenheit. Before it enters the kiln the pipes in the kiln serve to thoroughly distribute the gas mixture to the charge. It will be understood that the functions performed by the water in the mixer are such that it is unnecessary to renew the supply of water continuously, and the water remains in the mixer until it has become too turbid to properly perform its functions as a depository, when it is replaced by fresh water; but I wish it distinctly understood that there is no constant supply, and I wish to clearly distinguish from an apparatus which purports to employ a constant supply of water for the purpose of deoxygenizing. By this process so far described I reduce the time necessary for carbonization and obtain a greater percentage of by-products than heretofore. 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 I need operate on one charge not more than sixty hours, thereby producing about 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 five to seven per cent. of tar. The time of carbonization can be greatly reduced by increasing the gas volume. The gases and vapors which are derived from the glowing mass in the kiln are removed from the kiln at the bottom thereof (see Figs. 1 and 2) by the pipe g. It will be understood, however, that while I have shown the pipe g as leading from the bottom of the kiln this pipe may within the limits of my invention be otherwise located. I have shown it leading from the bottom of the kiln because that is the most efficient construction, as the draft is downward in kilns of this description, thereby producing a very thorough and even carbonization to avoid at the bottom of the kiln a residue of slightly-carbonized wood, commonly called "brands," and preventing objectionable decomposition of the by-products. Some of the advantages 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 the large percentage of acetone in the wood-alcohol. Recent results have shown generally only one 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 passed, with the permanent gases, into the Wulff bottles I. The necessary amount of permanent gases is preferably returned immediately to the injector J of the mixer, whereas the surplus may be led off by a pipe j^2 to a suitable gas-holder or be directly burned under the steam-boilers. This injector is shown as consisting of a shell 1, having ports 2, 3, and 4, and a valve 5. When the carbonizing in the kiln is complete, the kiln is cooled down, the gas-supply to the kiln being shut off and the pipes d^8 running beneath the kiln being deprived of their heat. The latter function is effected by raising the plates or covers d^{12} of the pipes or flues and blocking or shutting off the combustion-chamber of the heater by means of a plate d^{15}, and the steam or gas jet is set in operation to create an intense draft, so that the kiln will rapidly cool down. By thus proceeding I can

cool down the kiln in about forty hours, whereas formerly it required six to seven days to effect a thorough cooling.

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

1. In a carbonizing apparatus, the combination of a kiln, a heater for gases connected with said kiln, a gas-conveying device connected with the said heater to supply a gaseous mixture thereto and channels located under the kiln and connected with a draft device to aid in cooling the kiln at the end of the operation.

2. In a carbonizing apparatus, the combination of a kiln, a heater for gases having two separate channels, channels located under the kiln, and connection from one of the channels of the heater to said channels under the kiln, a cut-off device located in said connection, a device located in said connection between the cut-off device and the kiln for connecting the channels under the kiln with the atmosphere at their supply end, or closing said channels to the atmosphere at said end, a draft device connected with the outer end of the channels under the kiln, means for conveying a gaseous mixture to the outer channel of the heater, and a connection through the outlet of said outer channel to the interior of the kiln.

3. The combination of a kiln, a heater for gases, a drum located within the kiln and provided with baffle-partitions, means for supplying a gaseous mixture to the heater, a connection from the outlet of said heater to the inlet of the drum, and a discharge-pipe connected with the outlet of the drum and located within the kiln.

4. The combination of an air-compressor, a mixer having a direct connection to said air-compressor, an injector connected with said air-compressor and with the mixer, and with a source of permanent gases, a heater for gases connected with the mixer, and a kiln connected with the outlet of the heater.

5. In combination, a kiln, a heater for gases which has two sets of separate passages or channels, means for passing a heating fluid through one of said channels, means for supplying a gaseous mixture to the other channel, a connection from the last-named channel to the interior of the kiln, channels located beneath the kiln and connected with the heating-channel of the heater and means intervening between the heating-channels of the heater and the kiln for shutting off the flow of the heating medium and for producing a flow of fresh air beneath the kiln to cool the same.

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Witnesses:
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OTTO V. SCHRENK.