No. 652,687. Patented June 26, 1900.

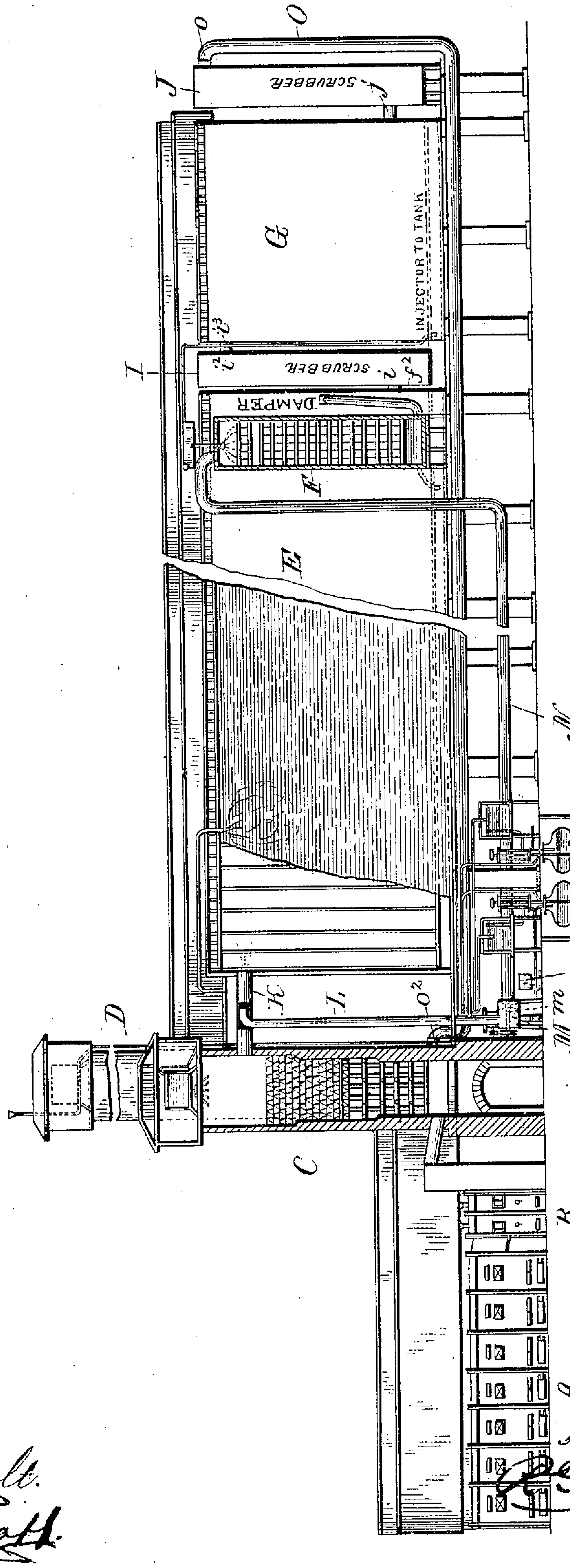
N. P. PRATT.

APPARATUS FOR MAKING SULFURIC ACID.

(Application filed Oct. 30, 1896.)

(No Model.) 2 Sheets—Sheet I.

Fig. I.



Witnesses:

F. S. Belt.

R. M. Elliott.

Inventor:

Nathaniel P. Pratt,

by R. S. Dyrenforth.

his attorney.

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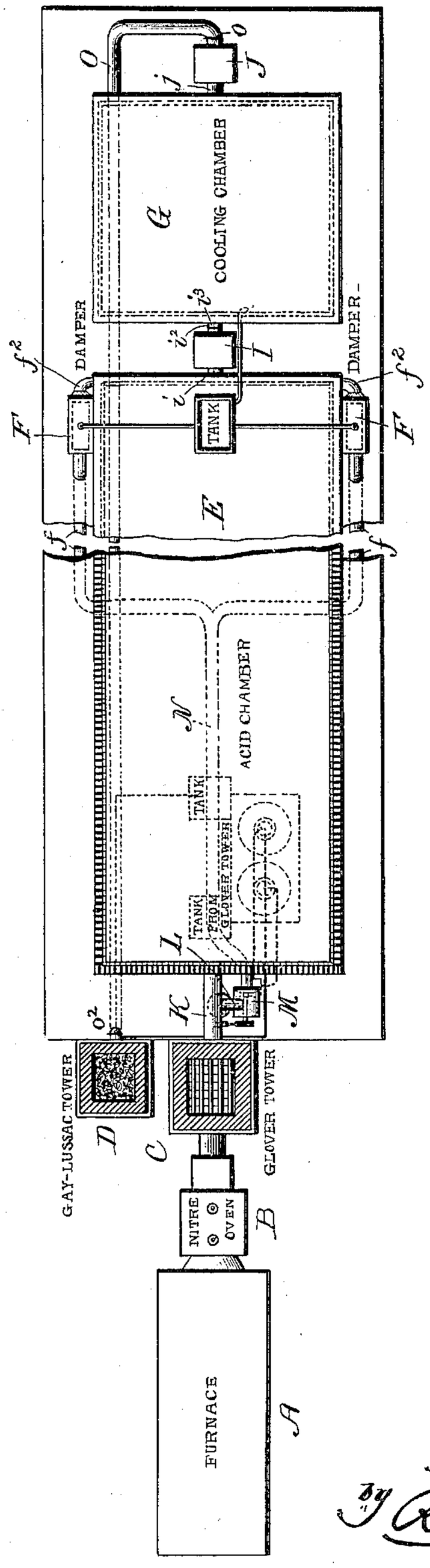

Fig. 2.

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UNITED STATES PATENT OFFICE.

NATHANIEL P. PRATT, OF ATLANTA, GEORGIA.

APPARATUS FOR MAKING SULFURIC ACID.

SPECIFICATION forming part of Letters Patent No. 652,687, dated June 26, 1900.

Application filed October 30, 1896. Serial No. 610,619. (No model.)

To all whom it may concern:

Be it known that I, NATHANIEL P. PRATT, a citizen of the United States, residing at Atlanta, in the county of Fulton and State of Georgia, have invented certain new and useful Improvements in the Manufacture of Sulfuric Acid; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the manufacture of sulfuric acid.

In a United States patent granted to me September 17, 1895, No. 546,596, for a process of and apparatus for making sulfuric acid I show, among other details of construction, mechanical appliances for inducing and maintaining a rapid and constant mixing of the acid-making materials, in connection with which I employ a continuous circulation throughout the entire acid-producing space of the plant. By this procedure I effect a thorough mixing of the acid-making materials and pass them onward toward the rear of the apparatus and by circulation withdraw a portion of the gases, &c., from any point toward the rear, but before they reach the Gay-Lussac tower and reintroduce the materials, not retained, into the front of the apparatus at a point and in such manner as to cause their presentation to the draft and their direct mixture mixed directly with the freshly entered or entering gases, &c., and at the same time to effect acceleration of their entry into the chamber. These results are accomplished by connecting the rear of the apparatus, by suitable flues or conduits, with the front thereof and by employing suitable exhaust mechanism, as a fan or blower, in conjunction with the flues or conduits to discharge into the flue connecting the Glover tower and the acid-chamber. I have found in practice where the fan or blower discharges into the acid-chamber below the flue from the Glover tower that the draft on the furnace and Glover tower is only slightly augmented and that I cannot put an appreciable pressure on the acid-chamber. To overcome these objections, I find that by discharging the exhauster directly into the flue from the Glover tower or the furnace or into any connecting-flues of the system I can obtain a direct pull or suction on the furnace and Glover tower or on either, and that I am enabled to put a positive and very advantageous pressure on the remainder of the system by thus sucking the gases and driving them into the chamber, this pressure being more or less under the control of the operator by closing or opening dampers, such as those in the exit-flues in the Gay-Lussac tower. I can secure these advantages by withdrawing the gases from any part of the system—top, sides, bottom, or ends of either chambers, flues, &c.—and reintroducing them into the lead chamber under a strong blast from the exhauster or fan, either passing them first through a converter or converters, or using a flue or flues alone without connection with converters.

The objects of my invention, therefore, are to increase or augment the draft or suction on the furnace, or the Glover tower, or any prior chamber, and at the same time to put a direct and advantageous pressure on the remainder of the system; furthermore, to accelerate the chemical action in, and thus increase the effective working capacity of, a given acid-producing space by projection, with resulting agitation and mixture, of the gases therein throughout the whole extent of this space.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate corresponding parts, I have illustrated one of many ways of carrying my invention into effect, and in the drawings—

Figure 1 is a view in elevation, partly in section, showing the most important elements of an ordinary sulfuric-acid plant together with my improvements. Fig. 2 is a view in plan, showing, more particularly, the connection between the respective parts of the apparatus.

Referring to the drawings, A designates the furnaces; B, the niter-oven, arranged, by preference, in rear of and connected with the furnace; C, the Glover tower; D, the Gay-Lussac tower; E, the acid-chamber; F, the converters; G, the cooling-chamber; H, the compressors, and I and J the scrubbers. As these

parts may be of any of the well-known or preferred constructions in ordinary use, a detailed description of them further than to show their connection and coöperation is deemed unnecessary.

The acid-chamber E, which may be either a single chamber, as shown, or a number of communicating chambers, is connected by a flue K with the Glover tower, and opening into this flue and having its discharge end pointing in the direction of the draft from the furnace is a flue or pipe L, which connects with the casing M of a blower or fan located contiguous to the chamber and driven by any suitable mechanism, as by an ordinary engine, as shown. The fan and its casing may be constructed of any suitable acid-resisting material, such as lead, and the shaft *m* of the fan of steel or iron, that portion of the shaft within the casing being covered with lead or the like to prevent corrosion. In this instance a single fan is shown; but it is to be understood that, if desired, two or more fans may be employed or any other mechanical appliance, such as a steam-injector, capable of causing an artificial draft on the furnace, consequent pressure on the chamber-system, and a progressive mixing or circulation within the acid-chamber.

Opening into the fan-casing M is a flue or pipe N, which connects with branch pipes *f*, leading from the converters F, at or near the tops thereof, and connecting with the bottom portion of the converters are pipes or flues f^2, which lead from the sides of the acid-chamber for conveying the acid-making materials to the converters. These converters are each furnished with a packing composed of any suitable acid-resisting material or materials, as are also the scrubbers I and J, which will allow spaces for draft and surfaces for precipitation, conversion, and decomposition. Instead of arranging the converters and scrubbers upright, as shown, they may be arranged horizontally, or in lieu of them any part of the flues N or f^2 may be packed with acid-resisting materials, allowing spaces for draft and surfaces for precipitation, &c.

As here shown, the scrubbers I and J are located, respectively, between the rear end of the acid-chamber and the cooling-chamber and at the rear of the cooling-chamber and are connected with these parts by pipes or flues *i*, i^2, and *j*, respectively, suitable dampers i^3 *o* at the rear portion of the flue O connecting the scrubber J with the Gay-Lussac tower, and o^2 in this flue adjacent to the tower being provided for the purpose of controlling the draft.

While I have shown but one fan and a single flue leading thereto, it is to be understood that I may employ two fans and have the flues therefrom connect with a single flue L, leading into the flue K from the Glover tower, or I may have each fan provided with a flue connecting with the flue K. As the remaining portions of this device operate in substantially the same manner as that described in connection with my patent referred to, a detailed description of them is deemed unnecessary.

The operation of the apparatus is as follows: The plant being in operation—that is to say, the generation of sulfurous acid having begun—my process commences. By mechanical means—such as fans, blowers, or other like draft-inducing means—the gases, &c., are mixed thoroughly and continuously throughout the whole extent of the "acid-producing portion" of the apparatus, by which name I denominate the apparatus, or any part thereof, from and including the furnace or sulfurous-acid generator, up to and as far as the Gay-Lussac tower. At the same time from near the rear of the acid-producing portion most of the suspended gases, vapors, and misty particles not precipitated before reaching that point are drawn through the flues into the bottom of the converters and pass upward through the spaces between the packing thereof. In this passage, by projection against the packing, most of the sulfuric acid entering in a state of suspension from the acid-producing portion is precipitated. Also most of any nitro-sulfuric acid entering in a state of suspension from the acid-producing portion, upon meeting water or dilute sulfuric acid showered through the packing at the top of the converters, splits up into sulfuric acid and nitrous anhydrid. The sulfuric acid, which is immediately precipitated, joins the other precipitated sulfuric acid and passes through a pipe to the receiving pan or tanks. Also most of any sulfurous acid which has escaped conversion in the acid-producing portion combines with the nitrogen acids and water, forming nitro-sulfuric acid, which immediately splits up into sulfuric acid and nitrous anhydrid, the resulting sulfuric acid being disposed of in the manner described. All the residual gases, such as the nitrous anhydrid, the oxygen excess, the inert nitrogen present, and any of the before-mentioned, or other compounds, which have escaped retention in the converters, are returned through the flues f^2 and N to the fan-casing, thence through the flue L to the flue K, leading from the Glover tower, and thence in direct contact with the freshly-entering acid-making materials from the generator, back to the acid-chamber. From the rear of the main chamber, or the last of the front chambers, the gases not returned to the front of the chamber pass through a flue into the scrubber I, thence into a small or cooling chamber, wherein precipitation is effected of any small quantity of sulfuric acid which may be mechanically carried over into it, and thence by the flue *j* to the scrubber J, where most of any remaining sulfuric acid is precipitated, caught, and returned, along with the acid from the scrubber I and cooling-chamber G, to the chamber-pan. By this procedure there is a saving of practically the entire body of sulfuric acid, any portion escaping to the Gay-

Lussac tower being there absorbed by the strong sulfuric acid showered down upon the gases passing thereto, as already described.

As stated, the discharge end of the flue L points in the direction of the draft from the furnace or Glover tower, and as the draft created by the discharge of the products from the fan is very strong it follows that a direct and powerful pull or suction is exerted on the furnace and on the Glover tower, besides a strong and very advantageous pressure on the chamber system, thereby increasing to an enormous extent the capacity of a given furnace to produce sulfurous acid or of a given generator to present sulfurous acid, also to increase the draft capacity of the Glover and the Gay-Lussac towers and their flues. By the manner of presentation set forth all the gases and compounds reintroduced are, at the same time, intimately mixed with the freshly-entering gases from the furnace or generators thereof before their initial entry into the acid-producing portion. The operations described are continuous and very rapid and are additional to and independent of the action of the ordinary draft. This mixing and circulation may be repeated through the acid-producing portion of the apparatus, converters, and scrubbers as many times as the fans or blowers have power to do it, or, in other words, the rapidity and effectiveness of these operations are limited only by the capacity of the fan and the auxiliary apparatus. I thus present to the converters and scrubbers not only the compounds freshly made and unprecipitated, but also those which have passed through them one or more times.

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

1. In a sulfuric-acid plant, an acid-chamber having an entrance for supplying acid-making materials and an exit-opening, in combination with a blast device discharging through the said entrance and mouthing toward the exit-opening, for projecting the matter toward the exit-opening, and a return for reintroducing a portion of the uncombined gases, substantially as described.

2. In a sulfuric-acid plant, an acid-chamber having an entrance for supplying acid-making materials and an exit-opening, in combination with a blast device opening into the said entrance and mouthing toward the exit-opening, for projecting the matter toward the exit-opening, and a return for reintroducing a portion thereof at or toward the entrance, substantially as described.

3. In a sulfuric-acid plant, an acid-chamber having an entrance for supplying acid-making materials thereto, and an exit-opening, in combination with blast mechanism, a conduit opening from a portion of the system into the blast mechanism, and a conduit directly connecting the blast mechanism and the said entrance, whereby to bring the returned materials into direct contact with the freshly-entering materials and project the whole together into the acid-chamber and, at the same time, to increase the draft of the system, substantially as described.

4. In a sulfuric-acid plant, an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, and a flue or conduit including blast mechanism, directly connecting the converter and the supply-conduit, substantially as described.

5. In a sulfuric-acid plant, the combination of an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, a flue or conduit, including blast mechanism, connecting the converter and the supply-conduit, and a scrubber in communication with the acid-chamber, substantially as described.

6. In a sulfuric-acid plant, the combination of an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, a flue or conduit, including blast mechanism, connecting the converter and the supply-conduit, and a cooling-chamber in communication with the acid-chamber, substantially as described.

7. In a sulfuric-acid plant, the combination of an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, a flue or conduit, including blast mechanism, connecting the converter and the supply-conduit, and a cooling-chamber and scrubbers in communication with the acid-chamber, substantially as described.

8. In a sulfuric-acid plant, the combination of an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, a flue or conduit, including blast mechanism, connecting the converter and the supply-conduit, a cooling-chamber and scrubbers in communication with the acid-chamber, and a conduit between the apparatus and a Gay-Lussac tower, substantially as described.

9. In a sulfuric-acid plant, the combination of an acid-chamber having a conduit for supplying acid-making materials thereto, a converter connecting with the chamber, a flue or conduit, including blast mechanism, connecting the converter and the supply-conduit, a cooling-chamber, and scrubbers in communication with the acid-chamber, a conduit between the apparatus and a Gay-Lussac tower, and means for controlling the pressure on the system, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

NATHANIEL P. PRATT.

Witnesses:
T. G. CUNNINGHAM,
S. M. WALL.