F. J. FALDING.

APPARATUS FOR MAKING SULFURIC ACID.

APPLICATION FILED DEC. 31, 1908.

932,771.

Patented Aug. 31, 1909.

2 SHEETS—SHEET 1.

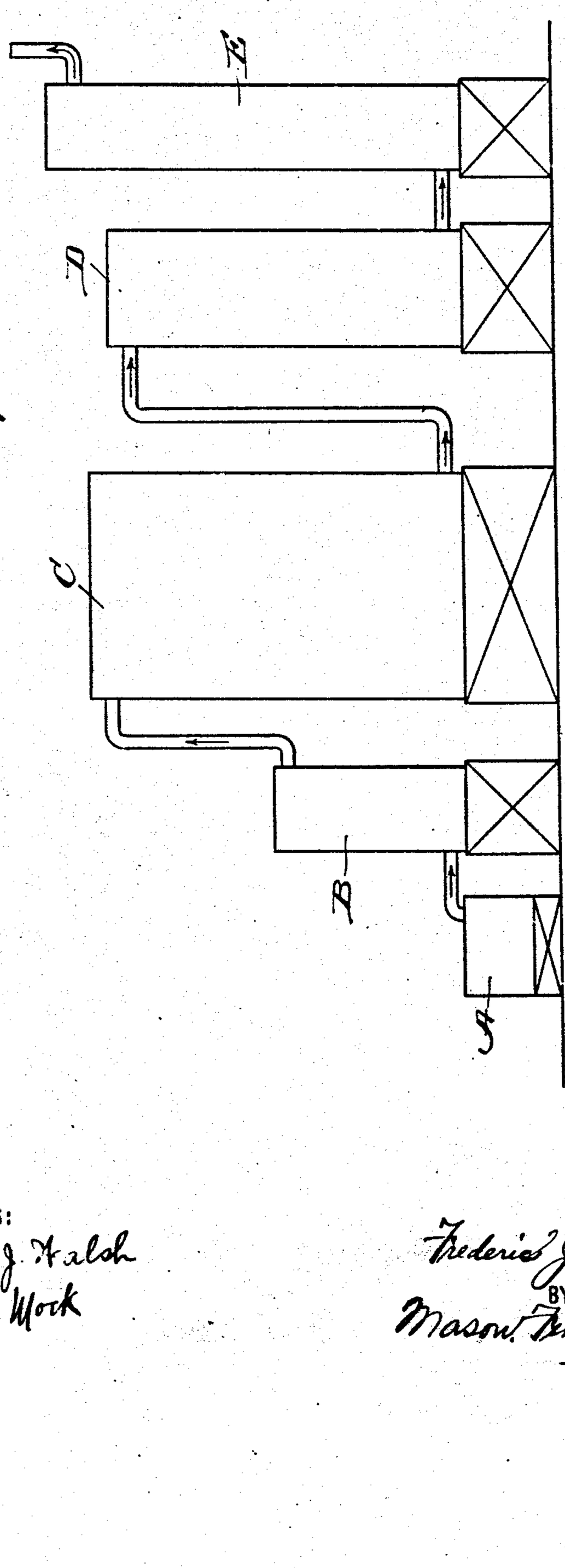

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 3.

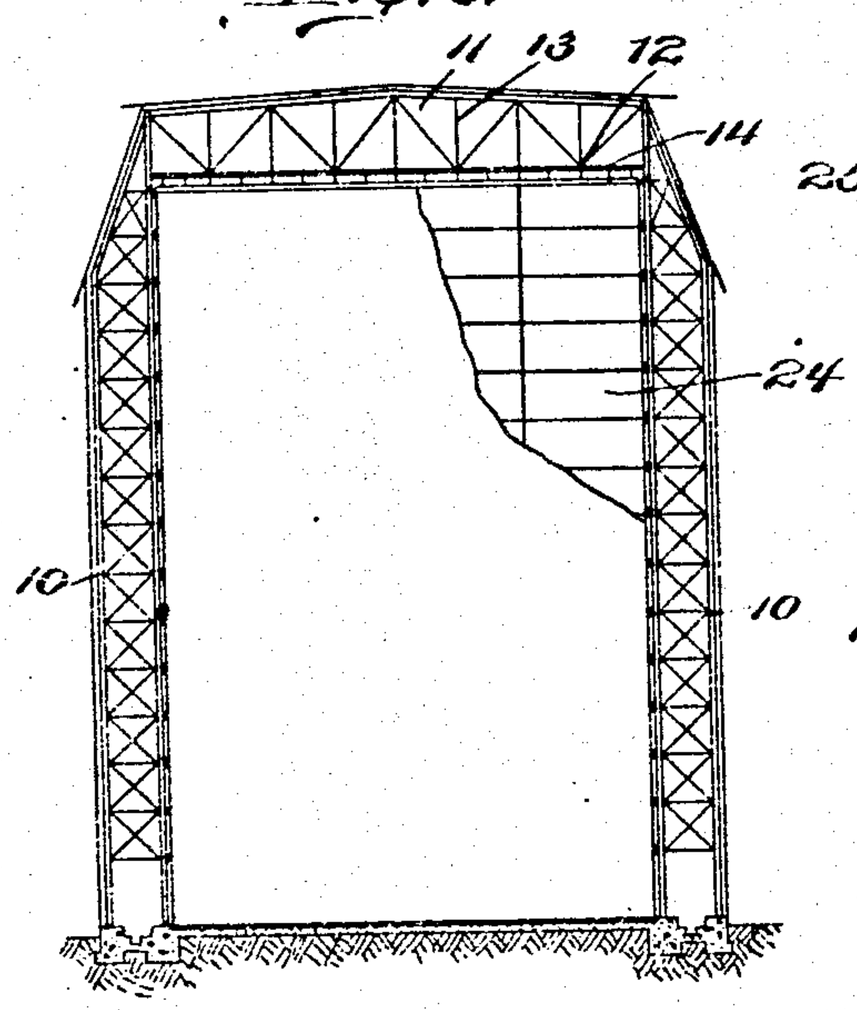


Fig. 2.

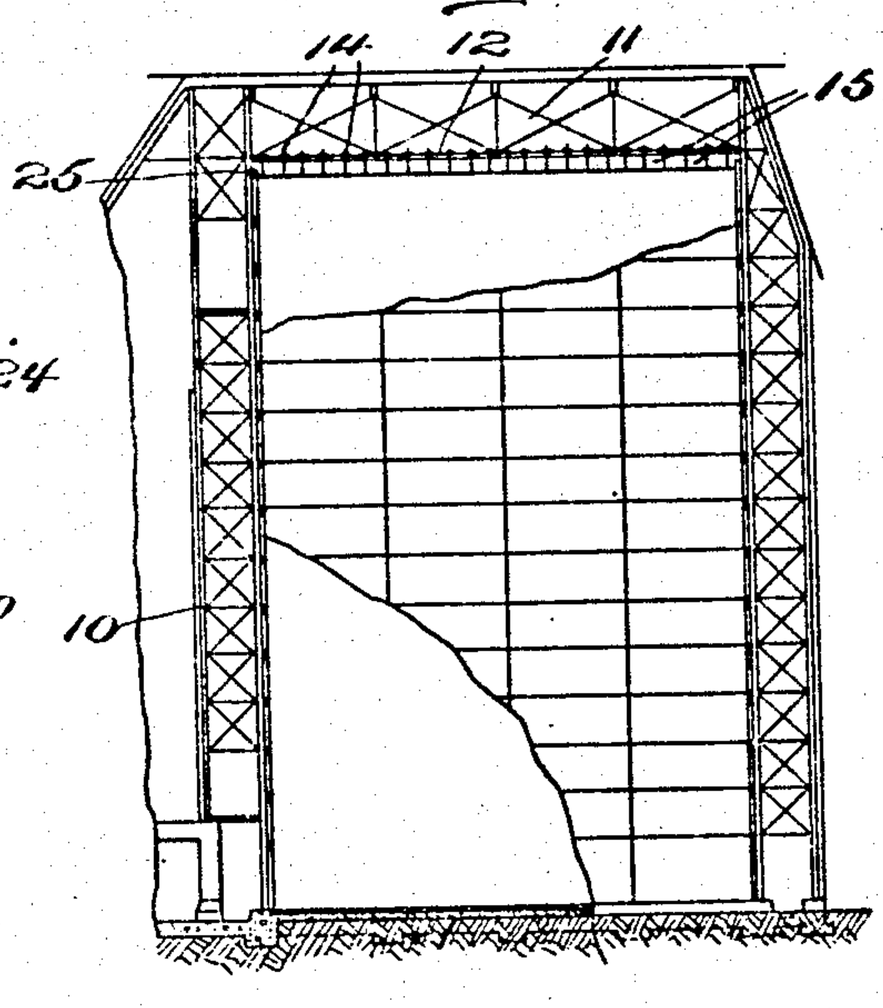


Fig. 5.

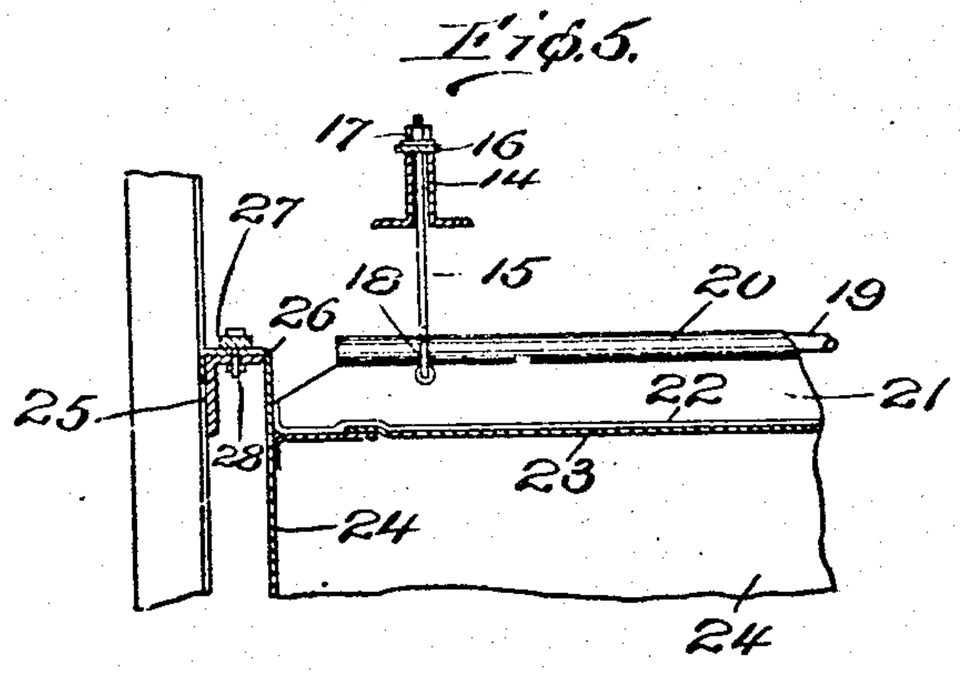


Fig. 4.

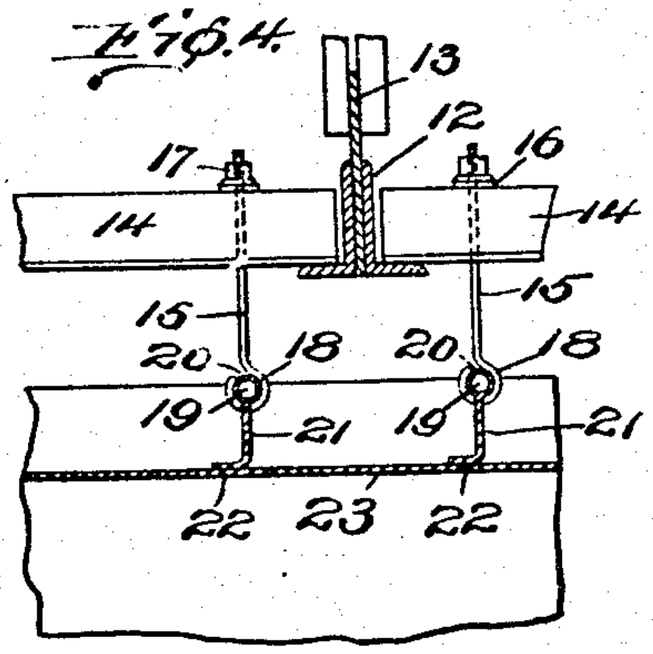
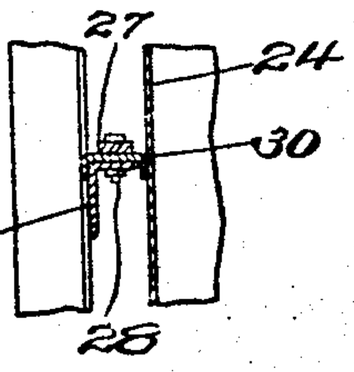


Fig. 6.



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UNITED STATES PATENT OFFICE.

FREDERIC J. FALDING, OF NEW YORK, N. Y.

APPARATUS FOR MAKING SULFURIC ACID.

932,771. Specification of Letters Patent. Patented Aug. 31, 1909.

Application filed December 31, 1908. Serial No. 470,189.

To all whom it may concern:

Be it known that I, FREDERIC J. FALDING, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Apparatus for 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.

My invention relates to the chamber process of making sulfuric acid. In the manufacture of acid by this method, the materials used are the following:—1. SO_2 derived by burning sulfur, by roasting pyrites or from any other suitable source. 2. Oxids of nitrogen which are usually obtained from sodium nitrate. 3. Water in the form of steam. 4. Air, the nitrogen of which takes no part in the reactions involved and must be continuously removed.

The apparatus usually employed is, besides the source of the sulfur gases, a Glover tower into which the sulfur gases mixed with air are first introduced, a series of lead chambers in which the gases are introduced after passing through the Glover tower and in which, mixed with nitrogen oxids and steam, the principal reaction takes place; and a Gay-Lussac tower from which the gases make their final exit. A series of these lead chambers are generally employed, the reaction in each being qualitatively the same but quantitatively different, the reaction in the first chamber usually being much greater than in that of any succeeding chamber and the reaction in the last chamber the least. These lead chambers are commonly made representing in their sections a longitudinal flue; their individual length being from 50 to 200 feet with a width of from 10 to 40 feet and a height varying from 6 to 40 feet. The average cross section is from 20 to 30 feet wide and from 18 to 24 feet high. The relation of the width to the height has generally been considered immaterial being more generally dictated by problems of mechanical construction rather than by any reference to the effect of their dimensions on the working of the chambers in practical operation. In fact it has generally been recognized that a plurality of lead chambers has been necessary regardless of the individual dimensions of each lead chamber.

I have found in practice by the alteration of the dimensions of the lead chamber from that commonly employed that I am able to secure an approximately complete reaction in a single lead chamber, so that I secure in a single chamber results which have previously necessitated the use of two or more chambers in series. I accomplish this result by increasing the height of the chamber relative to its length and breadth so that in my improved chamber the height is greater than the horizontal cross section in the proportion of about 3 to 2 so that the height will be half as great again as the diameter or cross section of the chamber.

In the lead chambers as commonly constructed, no adequate opportunity is given for the law of the convection of gases to operate so that gases in different parts of the chamber are approximately at the same temperature and the process of manufacture being necessarily a continuous one, the gases are commonly drawn off from each chamber before the reaction is complete. In my improved lead chamber the hot gases ascend by convection to the top of the chamber, whereas the lower zone of the chamber is relatively cold compared to the reaction zone and the mixture of gases may be drawn off from the bottom of the single chamber with the reaction practically quantitatively complete. As shown in the drawings, the gases are introduced at the top of the chamber and are withdrawn from near the bottom of the same, though I do not consider it material at what particular part of the chamber the gases are introduced, as in a chamber of the proper proportions the mixture of hot gases and steam will form a hot reaction zone at the top regardless of the point at which they are introduced into the chamber.

Where I wish to increase the capacity of the plant additional chambers may be used but these are not run in series with other chambers but each exists as a complete unit for the production of sulfuric acid, each chamber taking its supply of gas from the Glover tower direct so that all chambers, if more than one is employed, are run parallel and not in series.

Figure 1 is a conventional view in side elevation of a sulfuric acid plant embodying the present invention. Fig. 2 is a view of a

vertical transverse section through the lead chamber forming a part of the sulfuric acid plant and taken on the longest horizontal axis. Fig. 3 is also a vertical transverse sectional view of the lead chamber taken at right angles to the plan of Fig. 2. Fig. 4 is a detail view showing the upper framing and means for connecting the upper or roofing lead sheets to the supporting truss work. Fig. 5 is a view in detail of the means for supporting the roofing lead sheets taken at right angles to Fig. 4. Fig. 6 is a detail view of a vertical section showing the means for attaching the side sheets to the truss work.

Like characters of reference designate corresponding parts throughout the several views.

Fig. 1 of the drawings represents a plant embodying my improved lead chamber. A is the roaster which is represented as the source of the SO_2 employed. B represents the Glover tower, through which the sulfur gases in their upward passage serve to separate from the acid running in the opposite direction through same the nitrogen oxids absorbed in the Gay-Lussac tower which will be hereinafter referred to. C represents my improved lead chamber which is shown in more detail in Figs. 2 to 6 inclusive showing the method by which the lead lining of the side and top of the tower is held in place, these means forming another novel feature of the form of lead chamber I employ. D represents a cooling tower in which the gases after emerging from the lead chamber C are cooled preparatory to their passage into the Gay-Lussac tower E. In this tower free nitrogen oxids are absorbed by the acid running through same, these nitrogen oxids being again liberated by the incoming sulfur gases in the Glover tower.

It is to be understood that the conventional plant shown at Fig. 1 does not represent a complete producing plant in all of its details and to be further understood that said plant is similar in all principles of operation with an up-to-date sulfuric acid producing plant and that the novelty of the present invention resides in the lead chamber, both as to its form, proportions and manner of construction.

As hereinbefore mentioned the lead chamber shown at C in Fig. 1 is in the form of tower, that is to say a chamber whose vertical axis is greater than any horizontal axis preferably in the proportion as above stated of 3 to 2 although it is to be understood that the invention is not limited to such exact proportions.

In construction the lead chamber is supported by any approved form of framing which as here shown and preferably employed is of truss construction having towers or upright truss standards 10 of any approved number and relating one to the other and jointed on their upper extremities by means of horizontal trusses 11 which may be of substantial usual roof truss construction. As shown in Figs. 2 and 3 the roof trusses 11 are arranged at right angles to each other and of any approved number to support the roofing lead sheets as hereinafter described. Extending along parallel with one axis of the chamber here shown as the longer axis are a plurality of commercial metal beams 12 shown at Fig. 4 as composed of associated angle irons, although the particular form of such beams is immaterial. The beams 12 are supported from the roof truss by any approved construction as the rods or hangers 13, such beams 12 being spaced apart and disposed in parallelism. Between the beams 12 and disposed at right angles thereto are a plurality of other beams 14 here shown also as composed of angle irons, although the particular form of such beams is immaterial. The ends or extremities of the beams 14 rest upon the outwardly extending flanges of the beams 12 and between the component members of the beams 14 are secured hangers 15 in any approved manner as by the use of a washer 16 bearing upon the adjacent edges of the members of the beam 14 and with nuts 17 upon the ends of such hangers 15 bearing upon the washers 16. The hangers 15 are provided at their lower ends with hooks or eyes 18 which embrace rods 19 which said rods are incased in rolls 20 which are formed along the edges of lead strips 21. The lead strips 21 have their lower edges bent at right angles incased to form portions 22 which are secured to the top or roofing lead sheets 23. It will be noted that strips 21 and their supporting hangers are spaced at intervals along the lead sheets as shown at Figs. 2 and 3. The side lead sheets 24 are suspended at their upper edges from angles 25 adjacent to the upper extremities of the towers 10 and running horizontal thereupon, the said edges being turned as at 26 to pass over the said angles 25 and secured thereon by strips of washers 27 and bolts and nuts 28. Spaced vertically along the uprights 10 are a plurality of other angles 29 to which the side sheets 24 are also secured by means of lead strips 30 secured to such sheets and similarly passing over the angles 29 to which they are secured in like manner to strips 27 and bolts 28. It will thus be seen that both the roof sheets and the side sheets are suspended practically clear of all obstruction and are in contact with no surfaces except the comparatively narrow suspended strips 21 and 30 giving free access to the atmosphere of the exterior surfaces of the lead sheets for cooling purposes. It will further be noted that the lead lining, both top sheets and side sheets contact with and are suspended only by lead suspending means.

What I claim is:—

1. In an apparatus for the manufacture of sulfuric acid the combination of a source of sulfurous acid, a Glover tower, a lead chamber having its vertical axis considerably exceeding any horizontal axis, cooling means for the reaction products and a Gay-Lussac tower, as substantially described.

2. In an apparatus for the manufacture of sulfuric acid the combination of a source of sulfurous acid, a Glover tower, a lead chamber having its vertical axis in the proportion of 3 to 2 for any horizontal axis, cooling means for the reaction products and a Gay-Lussac tower, as substantially described.

3. In an apparatus for the manufacture of sulfuric acid a source of SO_2, a Glover tower, a lead chamber having a height so far exceeding its length and breadth so as to allow relative zones of reaction and inaction to be formed therein, cooling means for the products of such reaction and a Gay-Lussac tower, substantially as described.

4. In an apparatus for the manufacture of sulfuric acid, a source of sulfurous acid, a Glover tower, a lead chamber having its vertical axis in the proportion of about 3 to 2 over any horizontal axis and a Gay-Lussac tower, as substantially described.

5. In an apparatus for the manufacture of sulfuric acid, a lead chamber having its vertical axis substantially in the proportion of 3 to 2 over any horizontal axis.

6. In an apparatus for the manufacture of sulfuric acid, a single lead chamber having its vertical axis greater than any horizontal axis.

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

FREDERIC J. FALDING.

Witnesses:
L. L. Morrill,
Hugo Mock.