(No Model.) 2 Sheets—Sheet 1.

J. D. DARLING.

METHOD OF AND APPARATUS FOR MANUFACTURING SULFURIC ACID AND BY-PRODUCTS.

No. 541,597. Patented June 25, 1895.

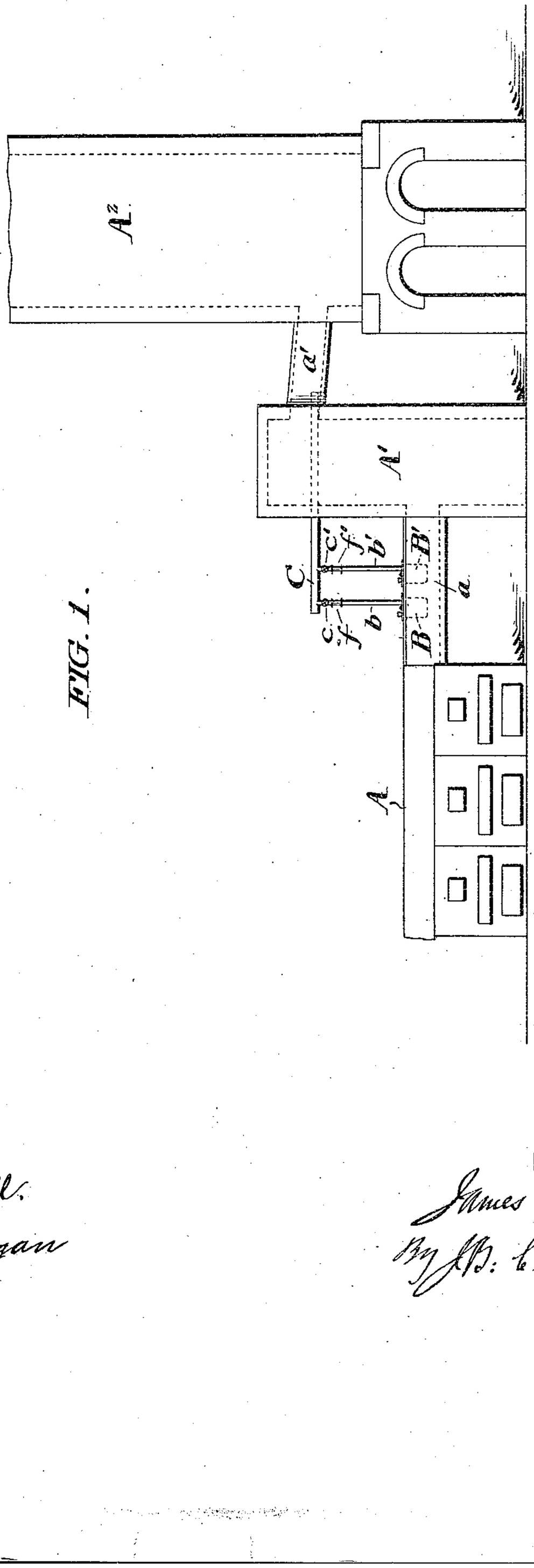

FIG. 1.

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(No Model.) 2 Sheets—Sheet 2.

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FIG. 2.

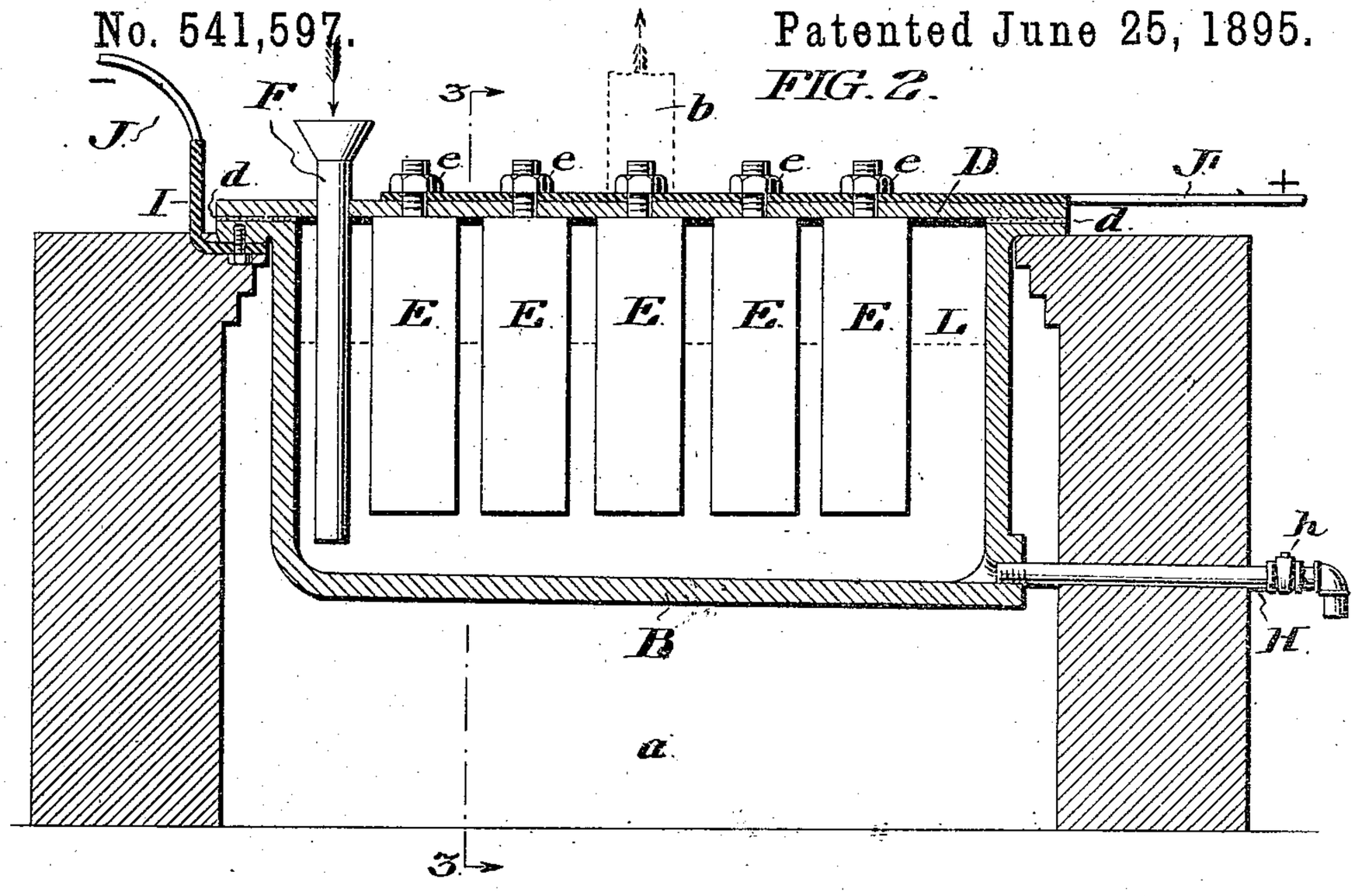
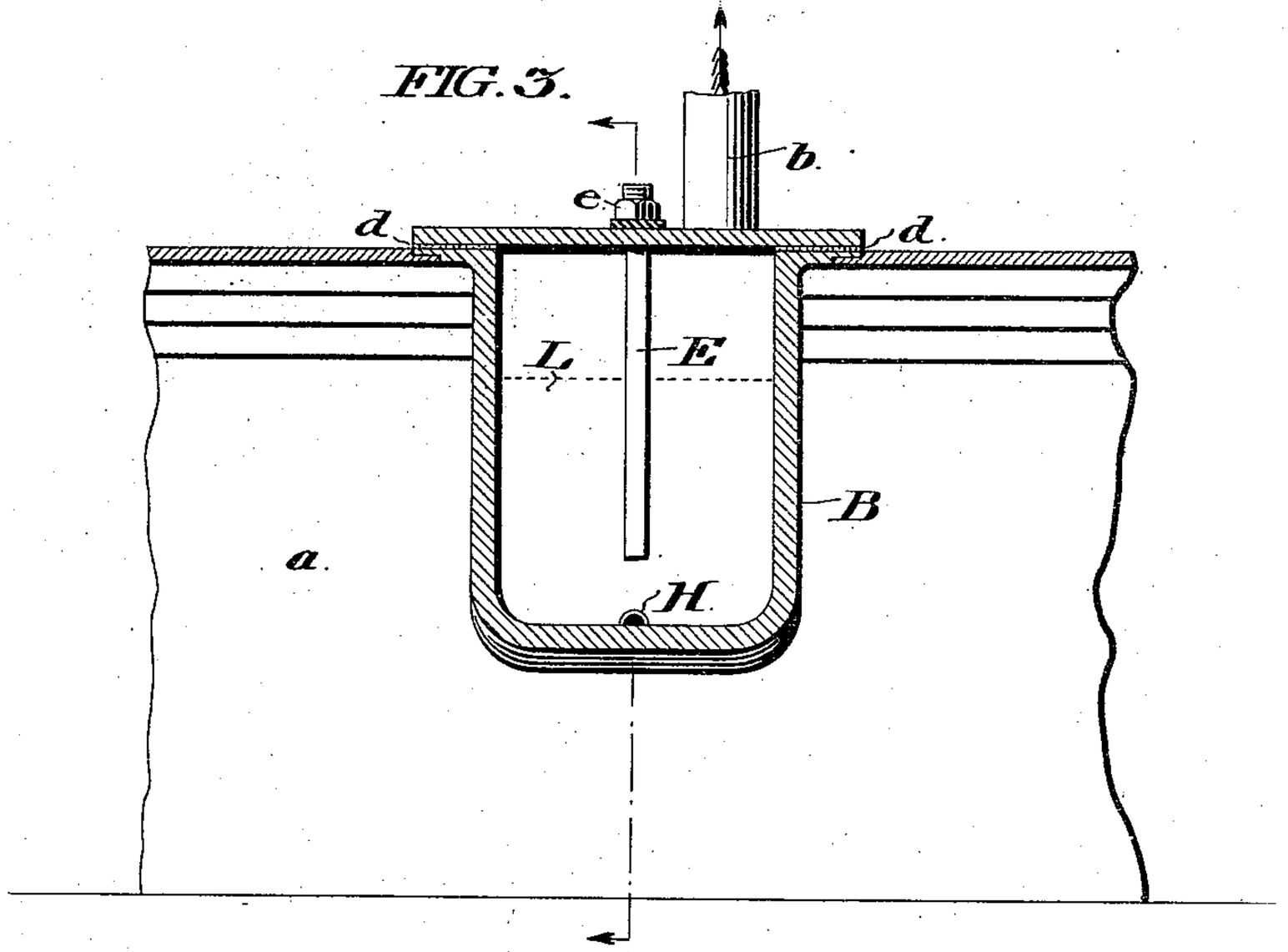


FIG. 3.



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METHOD OF AND APPARATUS FOR MANUFACTURING SULFURIC ACID AND BY-PRODUCTS.

SPECIFICATION forming part of Letters Patent No. 541,597, dated June 25, 1895.

Application filed January 8, 1895. Serial No. 534,197. (No model.)

To all whom it may concern:

Be it known that I, JAMES D. DARLING, a resident of the city of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in the Manufacture of Sulfuric Acid and By-Products and in Apparatus Adapted to such Manufacture, whereof the following is a specification, reference being had to the accompanying drawings.

My invention is addressed to the economical manufacture of sulphuric acid, by so producing one of the necessary reagents for the general process as to incidentally develop a by-product of high commercial value. I also organize the required apparatus in such manner as to facilitate continuous and uniform working.

The usual method of supplying the nitrogen compounds required in the commercial manufacture of sulphuric acid is to decompose nitrate of soda, or nitrate of potash, by heating it with sulphuric acid to liberate the nitric acid gas, (NHO_3) which is then passed, as such, into the Glover tower and there decomposed and utilized in the necessary reaction. The by-product of this portion of the process is an acid sulphate of soda or potash, (usually called niter cake,) having little commercial value.

I have found that by electrolytically decomposing nitrate of soda or nitrate of potash, the liberated gases (NO_2+O) may, without conversion into nitric acid, or further modification, be directly conveyed to the Glover tower and serve the necessary purpose for the development of sulphuric acid, while at the same time the by-product of such electrolytic action can be obtained in a condition which gives it a high commercial value.

I will now proceed to describe the process in connection with a typical apparatus, some of whose features are of themselves new and the subject of my invention.

In the accompanying drawings, Figure 1 indicates, without detail, certain general features of a sulphuric-acid plant, shown in side elevation. Fig. 2 is a vertical central section through one of the vessels in which the electrolytic action, characteristic of my process, is effected. Fig. 3 is a transverse vertical section on the line 3 3 of Fig. 2 through said vessel. The scale of these last two figures is obviously much enlarged as compared with that of Fig. 1.

Referring to the general view, A indicates a portion of the group of pyrites kilns communicating, by means of a horizontal flue, a, with the upright stack or dust chamber, A′, which in turn communicates by a transverse flue, a', with a Glover tower, A^2. Within the flue, a, I place the vessel in which the electrolytic decomposition of the nitrate is to be effected, thus utilizing the heat of the gases from the pyrites kilns for maintaining, in a fused condition, the nitrate which is to be utilized.

I prefer to employ a plurality of decomposing vessels, in order that the process may be practically a continuous one, and in the general view have indicated two. Any number, however, may be used which the circumstances of the case render desirable. These vessels, B and B′, communicate by means of pipes, b, b', respectively, with a common duct, C, leading to the flue, a', and thus discharging into the interior of the Glover tower, A^2. Communication between the several vessels and the duct, C, is controlled by means of valves, as c, c'. A portion of the pipes, b, b, may be of glass, as indicated at f, f', to permit inspection of the interior at those points.

Referring now to the detail views shown in Figs. 2 and 3, a description will be given of one of the decomposing vessels as typical of the rest.

The vessel, B, is preferably made of cast iron and is substantially rectangular in form, having an opening at one end of the bottom for a discharge pipe, H, controlled by a cock, h. A removable cover, D, is secured upon the top of the vessel, being, however, insulated electrically therefrom by a layer of refractory non-conducting material, indicated at d. A series of cast iron plates, E, depend downwardly from the cover to near the bottom of the vessel, B, said plates being removably secured by means of screw bolts passing through the cover and provided with nuts, e. A strip, or plate, K, of metal, having less electrical re-

sistance than cast iron may be advantageously inserted between the cover, D, and the nuts, *e*, to facilitate the passage of the electric current. A supply pipe, F, extends through the cover to a point near the bottom of the vessel, B, and the discharge pipe, *b*, for the escape of liberated gasses, leads out from the top. The vessel, B, is electrically connected by means of the wire, J, with the negative pole of any suitable source of electricity, while the plates, E, are similarly connected by means of the wire, J', with the positive pole thereof. The vessel itself thus serves as the negative electrode, and the plates, E, as the positive electrode for the electrolytic action upon the contents.

In practice the vessel is filled with nitrate of soda to the level indicated by the dotted lines, L. Assuming that the pyrites kilns are in operation, and discharging the hot sulphurous acid gas, the latter passes through the flue, *a*, into the dust stack, A', where it deposits its dust, and thence passes into the Glover tower, A^2. The nitrate which is maintained in a fused condition within the vessel, B, is decomposed by the passage of the electric current, giving off nitrogen per-oxide and oxygen (NO_2—O). These gases pass through the pipe, *b*, into the duct, C, and thence are discharged, as such, into the Glover tower, A^2, without conversion into nitric acid. The nitrogen per-oxide there acts directly in the general reaction necessary for the production of sulphuric acid, the process in this respect differing as a whole from those in which acid fumes (NHO_3) are supplied to the Glover tower, since in this latter case the decomposition of the nitric acid and the development of nitrogen per-oxide must first be effected, while by my process the necessary nitrogen peroxide is developed and introduced in the first instance.

The electrolytic decomposition is continuous within the vessel, B, as long as nitrogen peroxide is given off. The duration of this action may be ascertained by observing the color of the gas in the glass portion, *f*, of the tube, *l*.

When the nitrogen peroxide ceases to come over, as will be evident by the glass tube becoming clear, the current is switched on to another vessel, such as B', similarly constructed, and the process repeated. In the meanwhile the residuum within the vessel, B, (consisting mainly of sodium monoxide if nitrate of soda has been used, or the corresponding salt in other cases,) is run off through the outlet pipe, H, and a fresh charge of nitrate of soda is supplied, ready to be utilized as soon as the action in the vessel, B', is complete.

The monoxide of sodium, or similar residuum from the vessels, is dissolved in a limited quantity of water to form a hydrate, and the undecomposed nitrates, if any exist, can readily be separated therefrom, leaving a pure caustic solution, which may be concentrated, by boiling, into caustic soda, in the usual manner.

Having thus described my invention, I claim—

1. The hereinbefore described process for the manufacture of sulphuric acid and by-products, which consists in electrolytically decomposing a fused nitrate, directly conducting the disengaged gases, without further conversion, to the Glover tower, and recovering the basic residuum of the electrolytic action, substantially as set forth.

2. In a sulphuric acid plant comprising pyrites kilns, a Glover tower and an intermediate flue, the combination with said flue of a closed vessel forming a negative electrode, a positive electrode situated within said vessel, a discharge pipe leading from said vessel to a point of communication with said tower, and a source of electricity in circuit with said electrodes, substantially as set forth.

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