

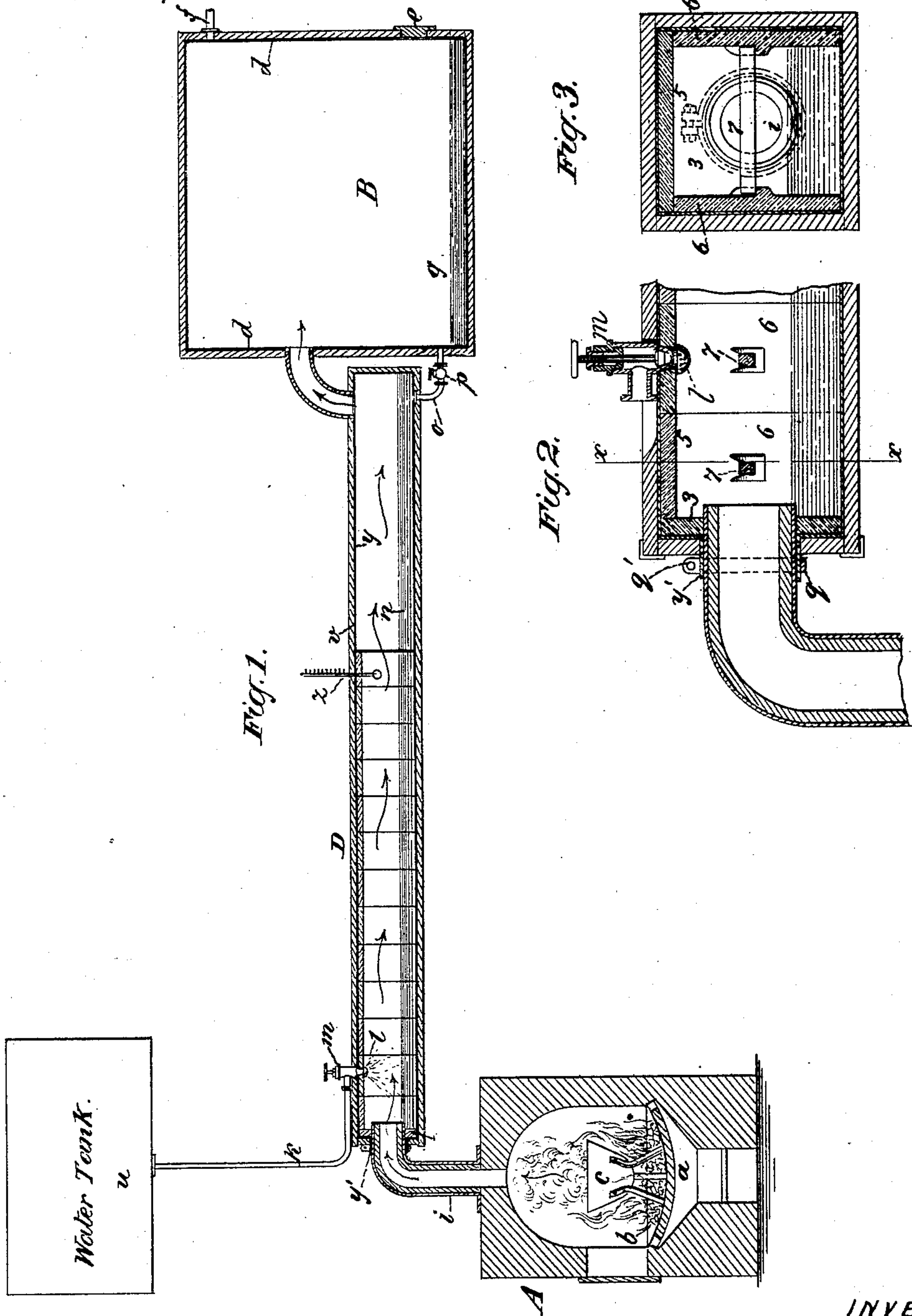
(No Model.)

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APPARATUS FOR MAKING SULPHURIC ACID.

No. 353,222.

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WITNESSES.

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APPARATUS FOR MAKING SULPHURIC ACID.

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To all whom it may concern:

Be it known that I, JOHN HUGHES, of Stapleton, Richmond county, New York, have invented an Improved Apparatus for the Manufacture of Sulphuric Acid, of which the following is a specification.

The object of my invention is to provide a sulphuric-acid apparatus in which the heat of the burning sulphur will be utilized to vaporize the water necessary to combine with the sulphur and niter fumes to form the acid, and in which a more perfect mixture of the gases and more rapid condensation will be insured, thereby simplifying the apparatus and reducing cost of manufacture. To these ends I arrange the sulphur-furnace to discharge its fumes into an intermediate mixing-chamber or elongated conduit flooded with water to a certain depth, and into which a water-spray is injected, the fumes being projected or impinged against the spray or the body of water, or both, whereby the water is vaporized by the hot fumes, forming steam to unite with the fumes, which union takes place in the passage of the gas over the water in said conduit, thus producing sulphuric-acid vapor, which is then passed into a condensing-chamber into which the conduit discharges, where said vapors rapidly condense.

My invention, therefore, consists in the features here outlined, and also in the special combination and arrangement of parts, as hereinafter fully set forth.

In the drawings annexed, Figure 1 presents a longitudinal section of my improved sulphuric-acid apparatus. Fig. 2 is an enlarged fragmentary section at the initial end of the vaporizing or mixing chamber or conduit, where the sulphur-furnace discharges therein against the water-spray. Fig. 3 is a cross-section of the conduit on line *x x*.

In the drawings, A indicates the sulphur-furnace at one end of the apparatus, which is presumed to be of the ordinary construction, *a* being the hearth or "sole," in which the burning sulphur *b* and the niter-pot *c* are supported.

B indicates the large chamber at the opposite end of the apparatus, which chamber is presumed to be constructed in the usual manner of sulphuric-acid chambers, being lined with lead, as indicated at *d*, provided with

one or more man-holes, as at *e*, and with an outlet-pipe, as at *f*, to connect to an exhaustor, condenser, or draft-flue, to insure a draft or circulation in the chamber. A layer of weak sulphuric acid, *g*, is also placed on the floor of the chamber, as usual, but no steam-pipes connect to or discharge into the chamber, as is usually the case.

Now, *i* indicates the discharge-pipe from the sulphur-furnace, which conveys the sulphur and nitric fumes therefrom; but this pipe, instead of discharging into the acid-chamber B, as usual, discharges into a preliminary vaporizing and mixing trunk or conduit, D, placed intermediate between the furnace and the chamber, as shown. The furnace-pipe *i* discharges directly into the initial end of the conduit D, while the terminal end of the conduit discharges through the elbow-pipe *s* into the chamber B, at or about the middle thereof, as shown.

In a practical apparatus I prefer to have the conduit D about four feet square and fifty feet long, the chamber B being eighteen feet high, twenty-two feet wide, and one hundred feet long, while the pipe *i* is about eighteen inches in diameter and the pipe *s* about two feet in diameter, the furnace A being made, of course, of proportionate capacity; but these dimensions or proportions may of course be varied.

A water-supply pipe, *k*, discharges into the conduit D, near the initial end thereof, in front of the mouth of the furnace-pipe *i*, said water-pipe proceeding from an elevated water-tank, *u*, or other water-supply, and connecting to a rose or spraying device, *l*, in the conduit, and being provided with a valve, *m*, so that a shower or spray of water may be injected into the conduit in front of the furnace-pipe *i*, and across the stream of hot gases issuing therefrom. The furnace-pipe *i* opens into the conduit D, some distance above the floor thereof, so as to allow a layer of water, *n*, to accumulate on the floor thereof to the depth of six or seven inches, as illustrated. Near the terminal end of the conduit an overflow-pipe, *o*, extends from the base of the conduit, and discharges into the chamber B, and is provided with a valve, *p*, which may be so regulated as to allow the accumulated water (which will eventually become weak acid) to flow into the

chamber at any rate desired, usually at such a rate as will maintain a constant level in the conduit.

The general construction of the apparatus having been now set forth, the operation will be made apparent. The chamber B being connected by pipe *f* with the flue, condenser, or exhauster, so as to establish a draft through the apparatus, the overflow-valve *p* is closed and the water-valve *m* is opened, so as to flood the bottom of the conduit and inject a spray of water into the conduit in advance of the furnace-pipe *i*. The sulphur-furnace A is now started, so as to produce the usual sulphurous and nitric fumes in the ordinary manner, and these fumes in an intensely-hot state will then rise through the pipe *i* and discharge into the conduit D, being thus projected over and against the surface of the water layer *n* and into and against the water-spray falling from the sprinkler *l*. The intense heat of the fumes will, therefore, at once vaporize a large portion of the water, against which they are thus projected, thereby forming steam, which, with the fumes, will reverberate and flow along the conduit over the water, and finally mix and chemically unite to form sulphuric-acid vapor, part of which will condense in the conduit or become absorbed by the water *n*, while the major part will enter the large chamber B, and be condensed therein in the usual manner, and which, thus trickling down the sides of the chamber, will accumulate in the base thereof, from which it may be removed for concentration, as required.

As soon as the apparatus commences working, as described, the valve *p* is opened to the required extent, to allow the surplus liquid to flow into the acid-chamber. The layer of liquid *n* will consist of nearly-pure water on the top and acid at the bottom, as the acid formed in the conduit will gravitate to the bottom of the water, where it will be constantly removed through the pipe and valve *o p*, so as to keep the water-level constant, or nearly so. If on testing the acid which is being condensed in the chamber A it is found below the correct density, then the flow of water at the valve *m* may be reduced, so that by regulating said valve *m*, and also the valve *p*, and urging the furnace A more or less, the production of the acid in the chamber B may be regulated as desired, and the operation will be continuous.

It is not absolutely necessary that the water be supplied in a spray into the conduit D across the orifice of the pipe *i*, as it will suffice to keep up a fresh supply in the conduit in any suitable way and project the hot fumes against said water; but the spray, as shown, is considered much more efficient.

The furnace-pipe *i* is preferably made of cast-iron, lined with fire-brick *j*, and this pipe passes with a right-angled bend or elbow directly into the end of the conduit D.

The conduit D is made of a wood casing, *v*, with a lead lining, *y*, and the lining at the end

is made with a lead neck, *y'*, which projects over the furnace-pipe and is clamped gas-tight about the same by the split clamping-ring *q* and its bolt *q'*, as shown by full and dotted lines in Figs. 2 and 3, an asbestos packing being introduced between the neck and the pipe. The discharge end of the furnace-pipe projects through a perforated tile, 3, in the end of the conduit, which tile thus protects the extreme end of the box from the intense heat and corrosive action of the fumes. The top and sides of the conduit are protected in a similar way by a layer of tiles, 5 6, which extend for about twenty feet from the initial end of the conduit. These tiles 3 5 6, being all fire and acid proof, thus effectually protect the sides of the conduit from the intense action of the fumes when they first enter the conduit, after which they become cooled and combined with the water to form the sulphuric-acid vapor, which passes through the unprotected part of the conduit into the chamber B. As shown in the drawings, the tiling does not extend over the bottom of the conduit, as the same is covered by the water, and is thereby protected, as will be understood.

Referring to Figs. 2 and 3, it will be seen that the top tiles, 5, are supported on the side tiles, 6, and that these are held rigidly in place against the sides of the conduit by the tile cross-bars 7, which are dropped into notched bosses on the face of the tiles 6 6. The pipe *s* is preferably made of lead. A thermometer, *z*, with its bulb in the conduit and its scale projecting on the exterior, indicates the temperature in the conduit.

It may now be observed that my improved apparatus dispenses entirely with the use of the steam-boiler heretofore employed, and therefore with the cost of fuel and attendance therefor. It may also be noted that as the heat of the sulphur fumes generates steam directly from the water against which they are projected, and as the acid vapor is produced in the preliminary vaporizing or mixing conduit before it reaches the acid-chamber, the vapors hence enter said chamber in a perfectly mixed or combined condition, and at a much lower temperature than usual, and are therefore in a condition to become rapidly and perfectly condensed. This expedites the production of the acid and prevents waste, and it also subjects the acid-chamber to less strain, renders it more durable, and prevents "foul working" or "subliming" in the chamber. Such foul working usually occurs from a too-high temperature in the chamber and an imperfect mixture of the gases, which occurs frequently in the old system where the sulphur-fumes are discharged directly into the chamber in connection with jets of steam, but which is not likely to occur in my apparatus, for the reasons stated.

My invention has, therefore, the advantages of simplifying the apparatus and attendance, reducing cost of manufacture, and expediting production, which thus presents a material improvement in the art.

In this application I limit my claims to the apparatus illustrated, having made the process herein disclosed the subject of a separate application, patented as No. 345,140, July 6, 1886.

5 What I claim as my invention is—

1. An improved sulphuric-acid apparatus, formed by the combination, with the sulphur-furnace, of an intermediate vaporizing or mixing chamber, a source of fresh water discharging into the same, a pipe or flue extending from the sulphur-furnace and discharging into said chamber and arranged to project its fumes against the water-supply therein, and a condensing-chamber into which said mixing-chamber discharges, substantially as shown and described.

2. The combination, with the furnace A and acid-chamber B, of the intermediate conduit D, with a water-duct, *k*, discharging into said conduit, the furnace-pipe *i*, discharging into the initial end of said conduit over or against the water supplied thereto, and with the terminal end of said conduit discharging into the chamber B, substantially as shown and described.

3. The combination, with the sulphur-furnace A, of the vaporizing chamber or conduit D, a water-spraying device, *l*, discharging therein, a source of water connected to said

device, and furnace pipe or flue *i*, discharging into the conduit in proximity to said spraying device, and a condensing-chamber into which said conduit discharges, substantially as set forth.

4. The combination, with furnace A and chamber B, of the conduit D, connected at one end with the furnace and at the other end with the chamber, and constructed to hold a layer of water in the base thereof, with a source of water discharging into said conduit, and a regulable outflow for said water from said conduit, whereby the water-level may be maintained uniform therein, or nearly so.

5. The combination, with furnace A and chamber B, and conduit D extending between the two, of water-duct *k*, discharging into said conduit, and regulable outflow *o p*, discharging from said conduit into said chamber.

6. The combination, with the sulphur-furnace A and condensing-chamber B, of the vaporizing and mixing conduit D and furnace-pipe *i*, discharging into the initial end of said conduit, and acid and fire proof lining 3 5 6, at the initial end of said conduit.

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Witnesses:

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