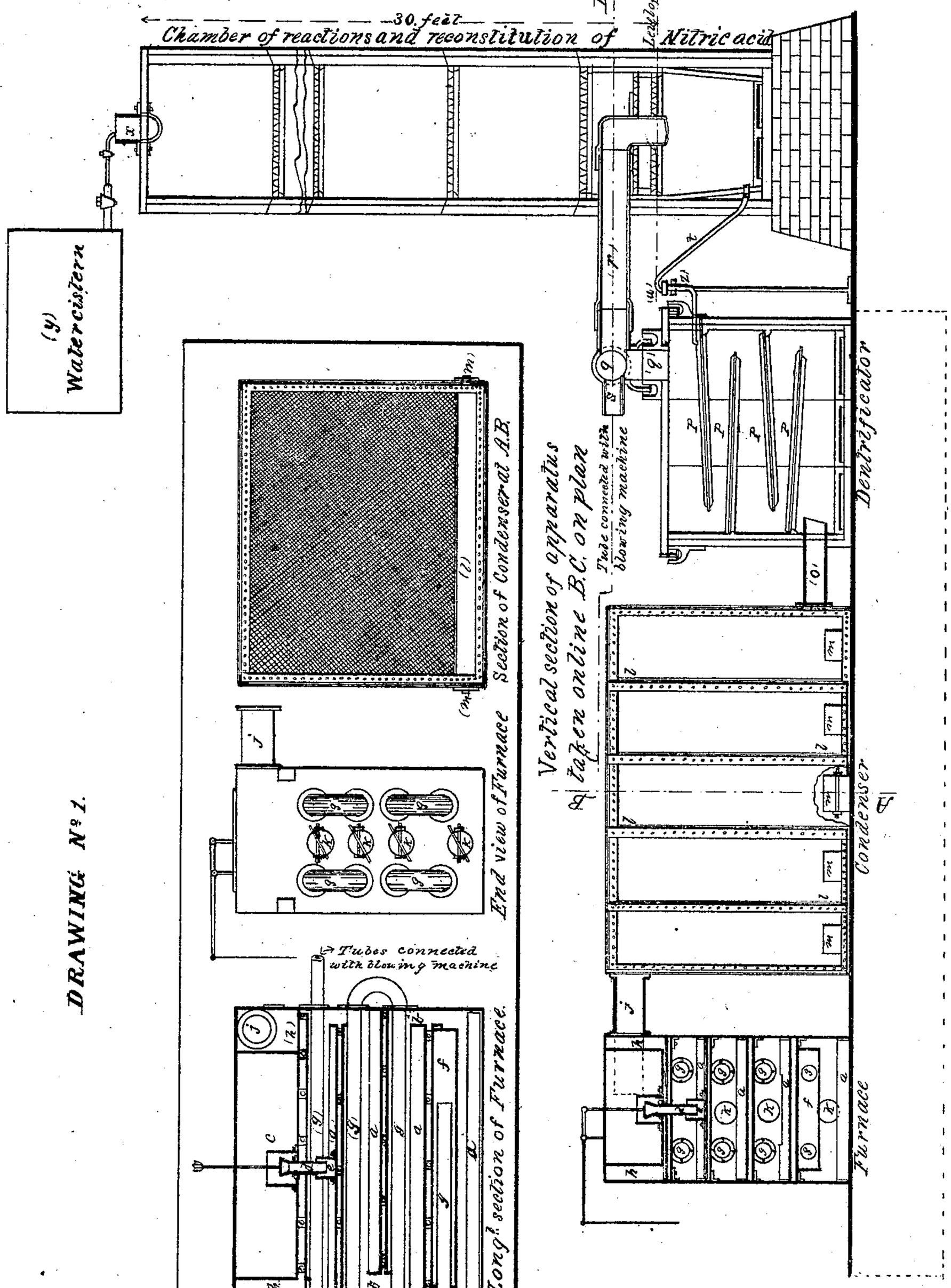
2 Sheets--Sheet 1.

D. JACKSON.

Improvement in the Manufacture of Sulphuric Acid.

No. 130,432. Patented Aug. 13, 1872.

DRAWING No. 1.



Witnesses

Geo Pitt

D Barnard

Inventor

David Jackson

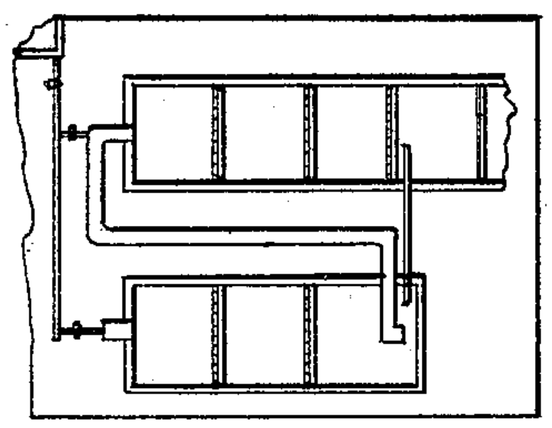
2 Sheets--Sheet 2.

D. JACKSON

Improvement in the Manufacture of Sulphuric Acid.

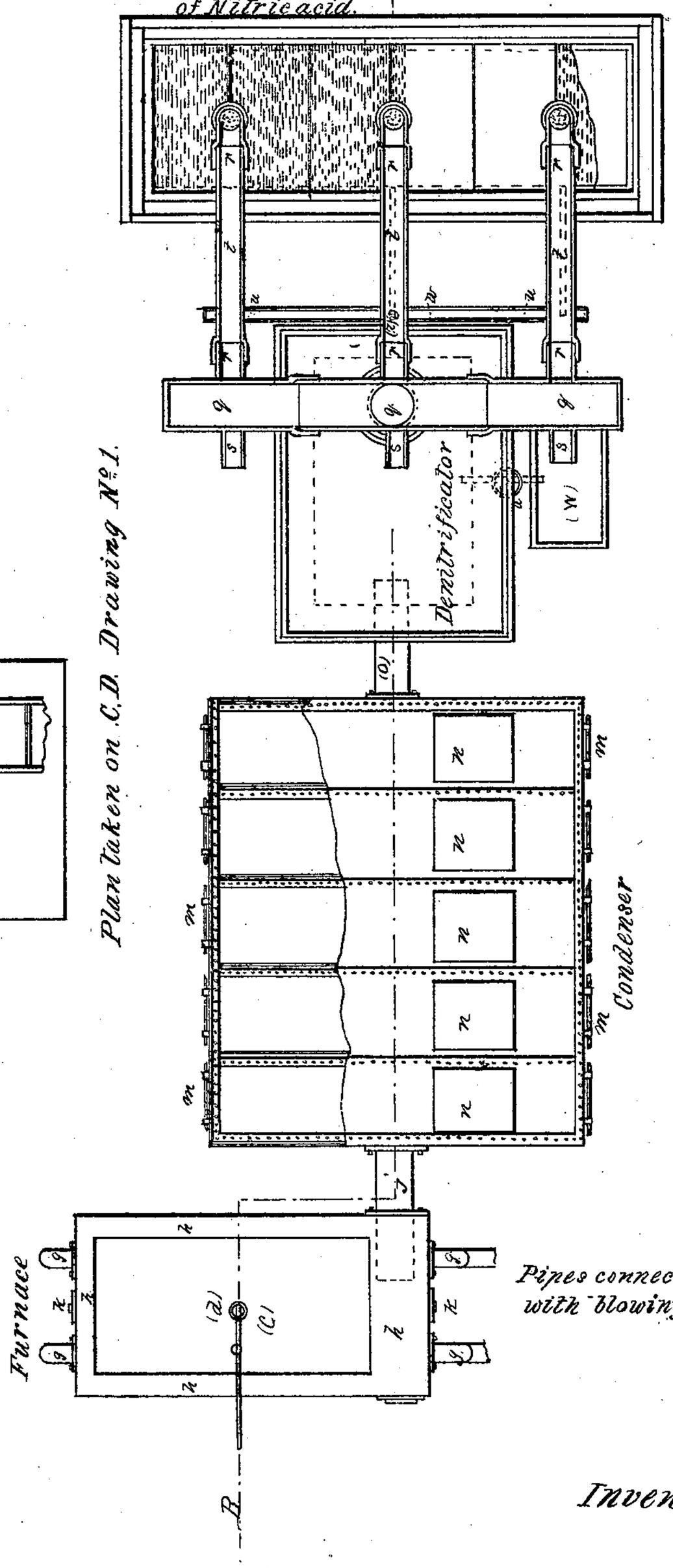
No. 130,432. Patented Aug. 13, 1872.

DRAWING No 2



Sketch shewing a prolungation of the Chamber

Plan taken on C.D. Drawing No 1.



Witnesses

Geo. Pitt

D. Carmael

Inventor

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UNITED STATES PATENT OFFICE.

DAVID JACKSON, OF WALWORTH, ASSIGNOR TO WALTER JOHN CHARLES CUTBILL AND ULYSSES DE LUNGOS, OF LONDON, ENGLAND.

IMPROVEMENT IN THE MANUFACTURE OF SULPHURIC ACID.

Specification forming part of Letters Patent No. **130,432**, dated August 13, 1872.

To all to whom it may concern:

Be it known that I, DAVID JACKSON, of 17 Manor Road, Walworth, in the county of Surrey, England, a subject of the Queen of Great Britain, have invented or discovered new and useful "Improvements in the Manufacture of Sulphuric Acid and in the apparatus used therein;" and I, the said DAVID JACKSON, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof—that is to say:

The object of my invention is to improve the process and simplify the apparatus employed in the manufacture of sulphuric acid, dispensing especially with the costly leaden chambers and pans hitherto in use, utilizing and so preventing the dispersion of the acids of sulphur, nitrogen, &c., by these and by other means, increasing the quantity and improving the quality of the acid produced, and diminishing generally the time, labor, and space, and, consequently, the capital employed in the manufacture.

The apparatus is composed of four distinct parts—viz.: First, the furnace for the combustion of the sulphur; second, the condenser or chamber for the purification of the sulphurous-acid gas by deposit of the sulphur in flour; third, the denitrificator or chamber for the denitration of the sulphuric acid; fourth, the chamber for the reactions and for the reconstitution of the nitric acid.

The entire apparatus is shown on the accompanying drawing on two sheets, the description of which is as follows:

The furnace is formed of an outer rectangular case, in boiler-iron, hermetically closed, into the bottom of which is fitted a shallow pan, *a*, covering the entire area; and above this, at certain distances apart, three others, *a' a'' a'''*, destined for the reception and combustion of the sulphur. Between the outer case and the three upper pans apertures are left, *b' b'' b'''*, alternately, to the right and left, for the passage of the gases and the overflow of the melted sulphur. Over these pans is placed the reservoir for the crude sulphur *c*, which is kept in a liquid state by the heat of the burning sulphur in the pans below. The pans are supplied from the reservoir by means of a tube, *d*, which is firmly fixed into the bottom of the same, and somewhat elevated above the level to avoid carrying off the impure deposits. This penetrates into an iron cup, *e*, of about twice its diameter, which is fixed upon the bottom of the pan *a'''* containing the upper stratums of sulphur. This tube is closed by a plug, the handle of which is carried through the cover of the reservoir, on raising which the liquid sulphur falls from the reservoir in any desired quantity through the tube into the cup below, and thence overflows into the pan. As each of the pans, except the bottom one, has an overflow at the end, toward the open space, of about half an inch in depth, as soon as the liquid sulphur arrives within this distance from the upper edge of the pans the sulphur overflows into the one below, and so on to the bottom one. Immediately above the lowermost pan is an air-chest, *f*, with a perforated bottom, through which is forced by a blowing-machine a current of air averaging about seventy cubic feet for every pound of sulphur consumed, for the purpose of supporting and accelerating the combustion. This air is conducted through two or more iron pipes, *g g' g'' g'''*, passing parallel to each other and in a serpentine direction over each pan, and, in its passage over the burning sulphur becoming highly heated, escapes through the pierced bottom already mentioned to aliment, first, the inferior layer, and in succession those lying above, ultimately passing, in combination with the products of the combustion, through the flue *h h* surrounding the reservoir, and by the pipe *j* into the upper part of the condenser or second part of the apparatus. The combustion of the sulphur in each pan is attended to from the circular apertures *k k' k'' k'''*, closed with the usual air-tight doors employed in gas-retorts. The total area of the pans for the combustion of the sulphur requires to be about ninety feet superficial for every ton of sulphur burnt per day.

The condenser is a rectangular chamber formed of light boiler-iron strengthened with angle-iron. It is hermetically closed, and divided into compartments by means of perforated metallic wire-gauze or horse-hair partitions with meshes of various degrees of fineness, leaving

alternately above and below *l l l l* a passage for the sulphurous-acid gas and vitiated air arising from the furnace. Here the gases, mechanically mixed with particles of sulphur in traversing the compartments, deposit the sulphur in excess, and thus several qualities of flour of sulphur may, if desired, be collected for commerce, for which purpose apertures *m m′ m″ m‴*, &c., are inserted in the compartments, and closed by air-tight doors, and, for the convenience of cleaning or visiting the interior, man-holes *n n n*, &c., are inserted in the roof.

The gases, after passing slowly through this chamber, enter by a stone-ware pipe, *o*, into the denitrificator or third part of the apparatus.

In the case of employing the products of any of the metallic suphurets or pyrites they are roasted by any of the ordinary methods, and the gases forced into a cistern of water at a depth of five feet or more below the surface, where, being liberated, they bubble up and pass through three or four perforated plates, arranged at short distances from each other, under and near the surface of the water, thus causing them in their passage to abandon the arsenical acids and other impurities, so that the sulphurous-acid gas and deoxidized air alone will, after being freed from the aqueous particles by passing through a spiral tube, enter into the denitrificator.

The denitrificator is composed of a stout rectangular case, in wood, lined internally with stone-ware slabs, which are attached thereto by means of the composition hereinafter described. The cover is moveable, and when in operation is hydraulically closed by means of sulphuric acid contained in a water-lute surrounding the four sides of the vessel. The sulphurous-acid gas entering by the pipe *o*, connected with the condenser, passes first over a stratum of sulphuric acid contained in the bottom, and travels in a serpentine direction over a series of plates, *p p′ p″ p‴*, in earthenware or glass, slightly inclined alternately in contrary directions, and escapes through the earthenware tube *q*, at right angles to which are attached smaller tubes *r r r*, terminating in a rose-head, and communicating with the chamber of reactions. The gases, previous to entering into this chamber, combine with a current of air averaging about thirty-five cubic feet for every pound of sulphur consumed, forced by a blowing-machine through the tube *s*, supplying the complement of oxygen required for the reactions. The gases purged in their passage through the condenser and denitrificator, after combining with the pure air, pass through the perforated heads of the pipes, already mentioned, under the surface of a body of weak nitric acid deposited in the chamber of reactions to the depth of two or three inches, when the sulphurous-acid gas and the greater part of the oxygen of the atmosphere are absorbed on contact with the dilute nitric acid and pass immediately to the state of sulphuric acid, at the same time producing, by various causes, physical and chemical, a high degree of heat, and thence the generation of aqueous vapor. The sulphuric acid, as it generates by its superior weight, gravitates to the bottom of the chamber, and, so long as the liquid surpasses a certain height, overflows by the articulated-tube *t* into the channel *u*, and runs from thence into the bent funnel *z* to the denitrificator, where, after presenting its surface to the action of the warm sulphurous-acid gas in its passage down the inclined plates, already described, and thus giving up every trace of nitric acid, falls into the prover *v*, which is furnished with an aerometer, and thence into the recipient *w* for its final concentration in the ordinary way.

The chamber of reactions and reconstitution of the nitric acid is formed of stout well-seasoned oak plank, slightly carbonized on the inner surface, and painted over with a thick coat of a composition of finely powdered shellac and a solution of caoutchouc in naphtha, mixed while warm; this composition will permanently withstand the action of the acids and bear, without softening, a degree of heat far superior to that engendered by the reactions. The lower part of the chamber for the reception of the dilute nitric acid is lined with acid-proof stone-ware slabs. These are laid on while warm, and thus become, by the intervention of the above-named composition, firmly cemented to the wood. The joints throughout are then well secured by molten sulphur. The height of the chamber should be from twenty-five to thirty feet from the level of the liquid, as at thirty feet nearly-pure aqueous vapor would be found. The width should not be less than three feet. The chamber is constructed in compartments, each of from three to four feet high, and a water-lute may be employed at one or two of the lowermost junctions, the remainder being simply beveled toward the interior. One or two tiers of perforated disks in stone-ware or other acid-proof material are placed around the nozzle of the rose-head pipes conducting the gases under the surface of the liquid, and in the remainder of the chamber, at certain distances, as at each junction of the compartments, are placed similar perforated slabs, in both cases covering the entire area of the chamber, upon which is placed a thick layer of light coke or pumice-stone, in order to subdivide and commingle the rising gases, causing them to react in an atmosphere thus warm and loaded with aqueous vapors. At the summit of the chamber short open tubes *x* are inserted at intervals; and at the under side of the cover runs a minutely-perforated channel, in earthenware, the whole length of the chamber, for the reception of the water supplied from the cistern *y*, (averaging about three hundred and eighty gallons per ton of sulphur burnt,) causing it to descend in a minutely-divided state for its ready combination with the gases. The cubic capacity required in the chamber for the pro-

ducts of each ton of sulphur is about thirty-four cubic yards, and, as about nine thousand cubic yards of gases are produced in the combustion of every ton of sulphur, it follows that thirty-four cubic yards of these gases remain in the chamber for a period of from six to seven minutes, subjected to all the most favorable conditions possible for the reactions and the reconstitution of the nitric acid, during which time they are brought into intimate contact by passing through the perforated plates and superincumbent layers of coke or pumice-stone, meeting with a highly-heated atmosphere and an abundance of aqueous vapor besides the reconstituted dilute nitric acid descending in a minutely-divided state, so that the gases constantly diminish in density until ultimately they pass out of the chamber deprived of the whole of their acids, and consequently of no further value.

Note.—Where height is required to be economized or ulterior condensation needed, additional lengths may be placed at a lower level, making a communication from the summit of one to the base of the other by means of earthenware pipes placed about three feet apart. (See sketch on Drawing No. 2.)

Instructions for Working the Apparatus.

Commence by filling the prover *v*, into which is inserted the discharging-tube of the denitrificator with sulphuric acid of the density of about 1.70, and with the like acid the cover of the denitrificator is hydraulically closed. Pour also into the chamber of reactions weak nitric acid, of the density of about 1.16, to a height of about twenty-eight inches, or until the rose-head of the pipes conducting the gases from the denitrificator is immersed two or three inches in the liquid. Otherwise, and more economical, two-thirds of sulphuric acid may be first poured in and the remainder filled up with the weak nitric acid so that it floats. The combustion may then be commenced in the various stages of sulphur in the furnace, previously liquefying the charge in the reservoir, and the blowing-machine put in motion. There then remains only to attend to the supply of air and water strictly necessary.

I claim—

The improvements in the manufacture of sulphuric acid and in the apparatus used therein, substantially as herein described.

DAVID JACKSON.

Witnesses:

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WILMER M. HARRIS,
Both of No. 17 Gracechurch Street, London.
JOHN HARRISON,
Notary Public, London.