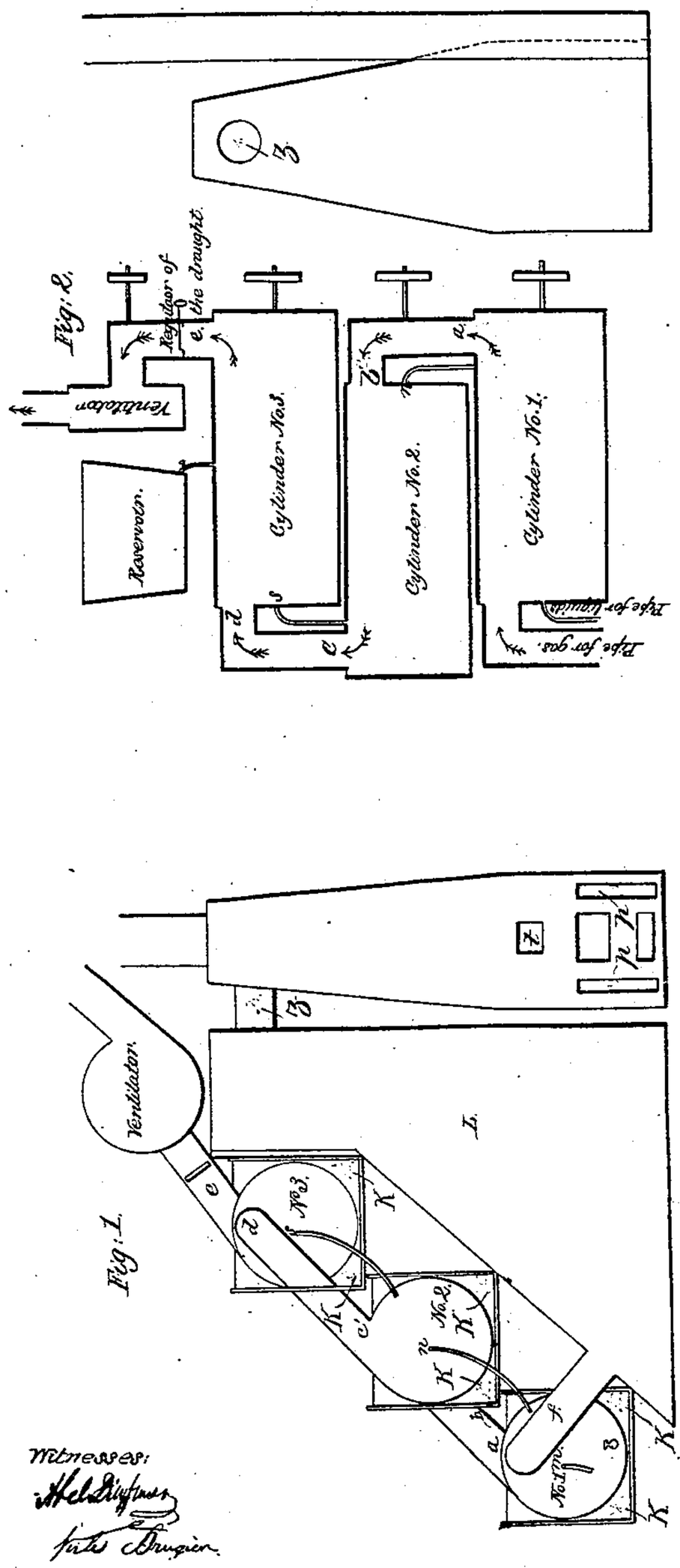
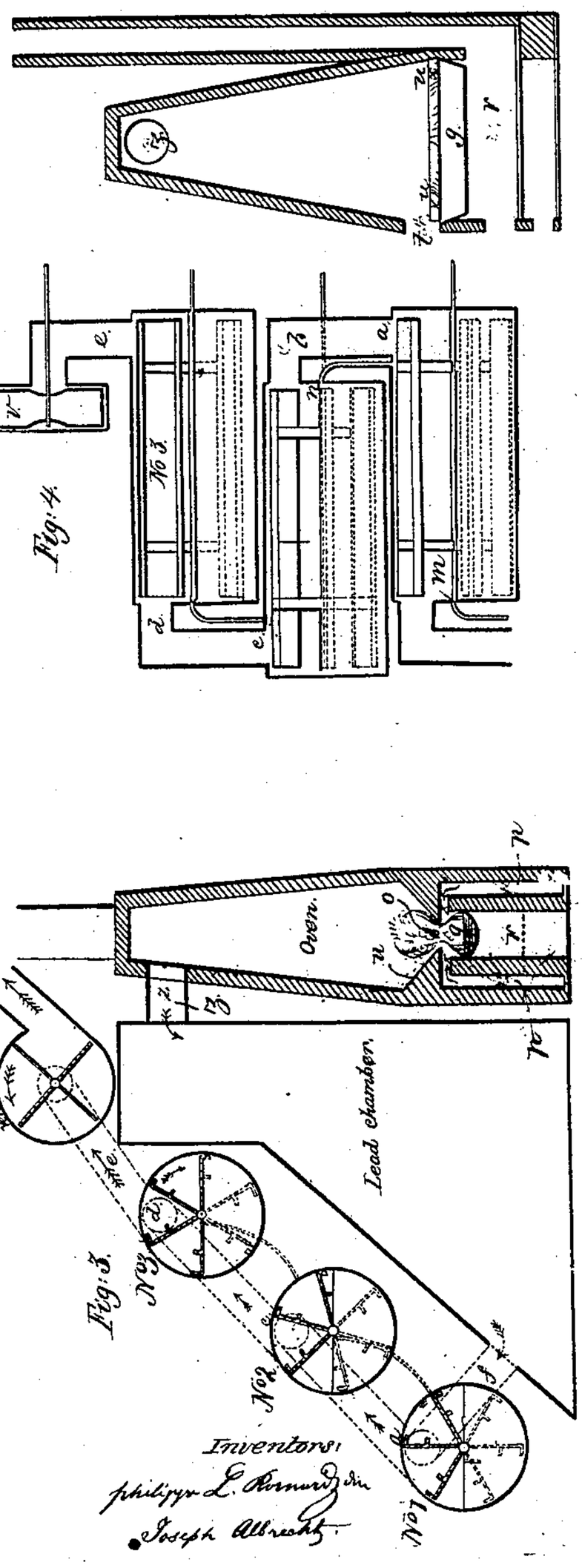
3 Sheets—Sheet 1.

BERNARD & ALBRECHT.

Manufacture of Acid Sulphate of Lime.

No. 13,632. Patented Oct. 9, 1855.





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BERNARD & ALBRECHT.

Manufacture of Acid Sulphate of Lime.

No. 13,632. Patented Oct. 9, 1855.

Fig: 1. A.

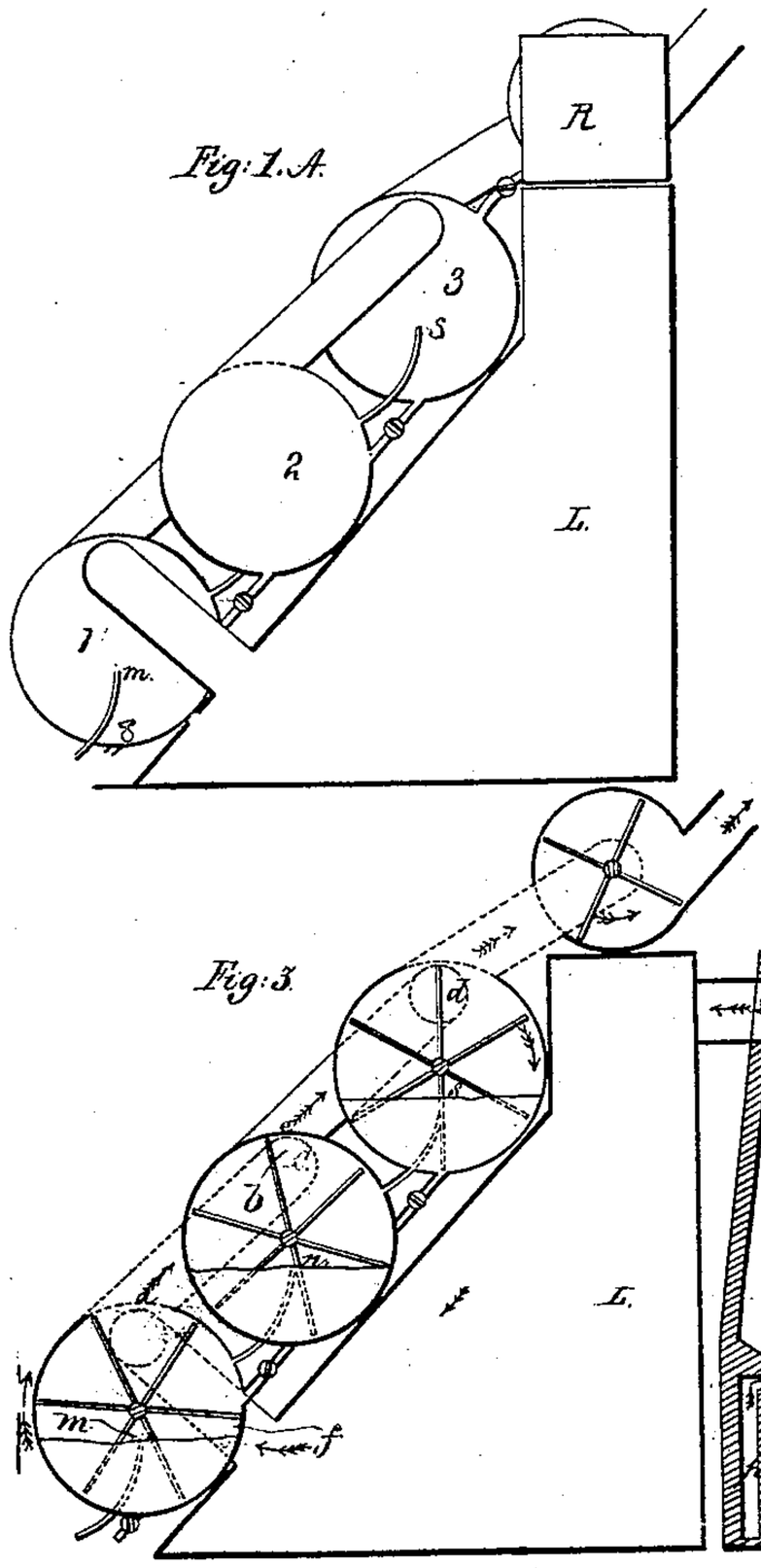


Fig: 1. B.

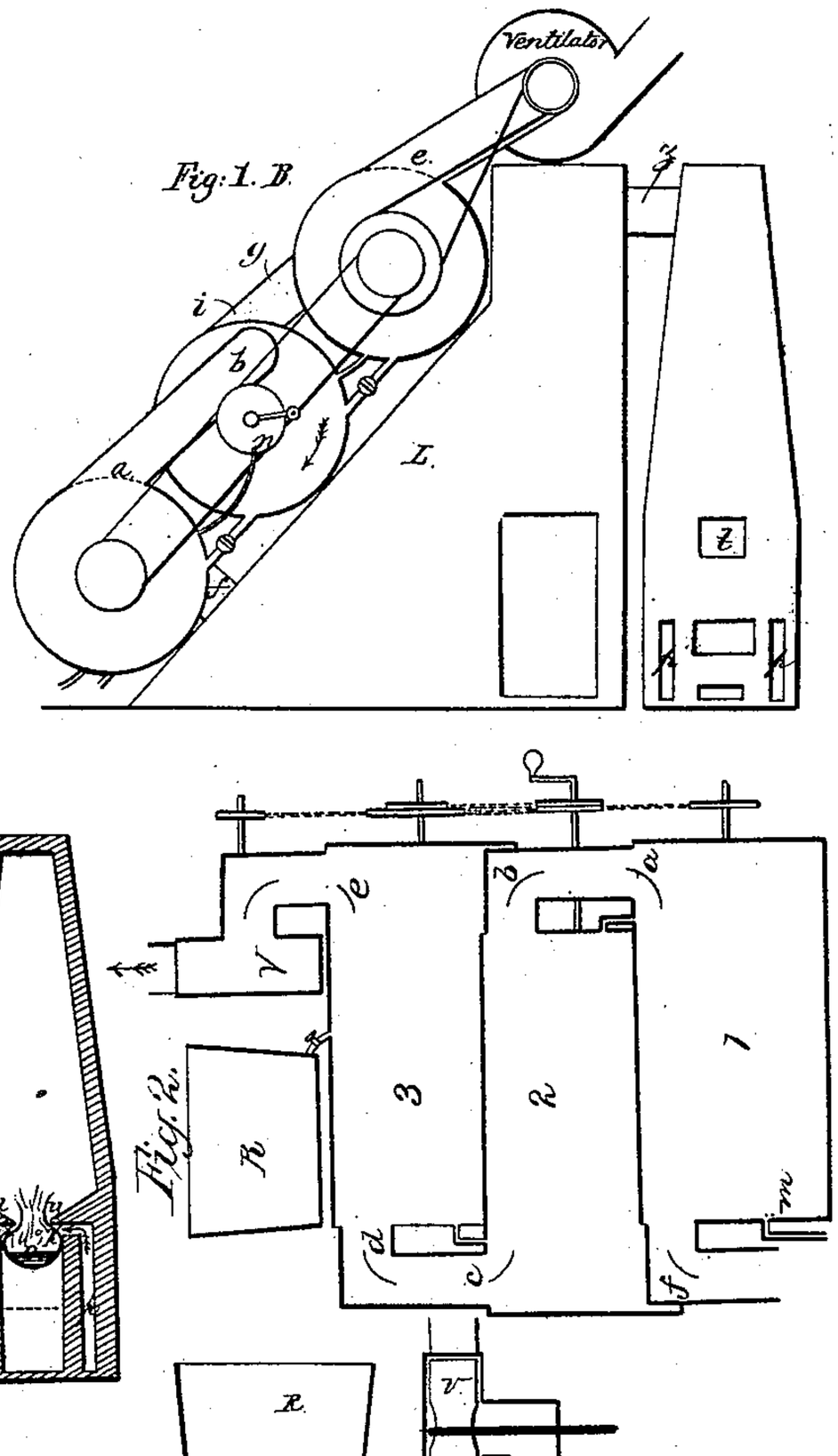
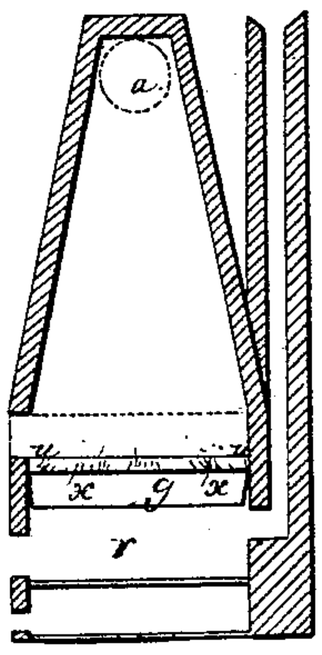
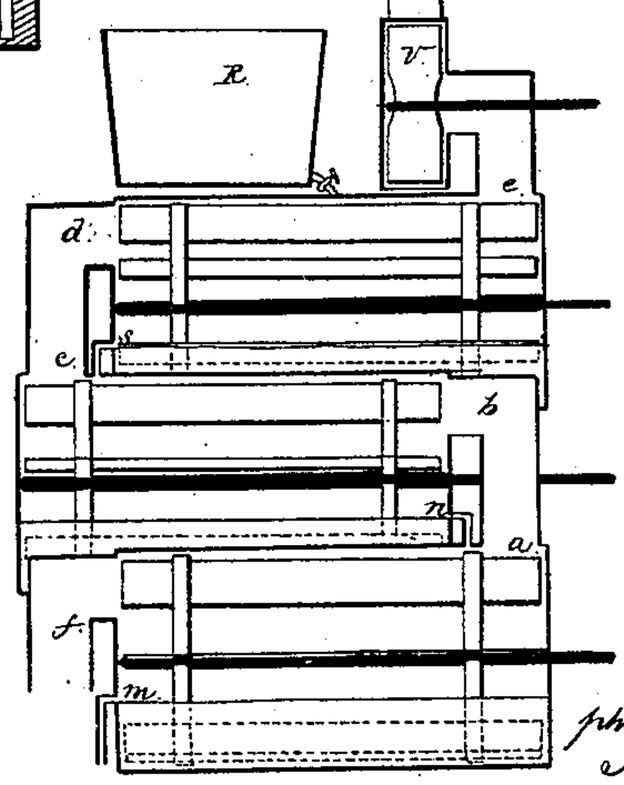


Fig: 3.

Fig: 2.

Fig: 4.





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3 Sheets—Sheet 3.

BERNARD & ALBRECHT.

Manufacture of Acid Sulphate of Lime.

No. 13,632. Patented Oct. 9, 1855.

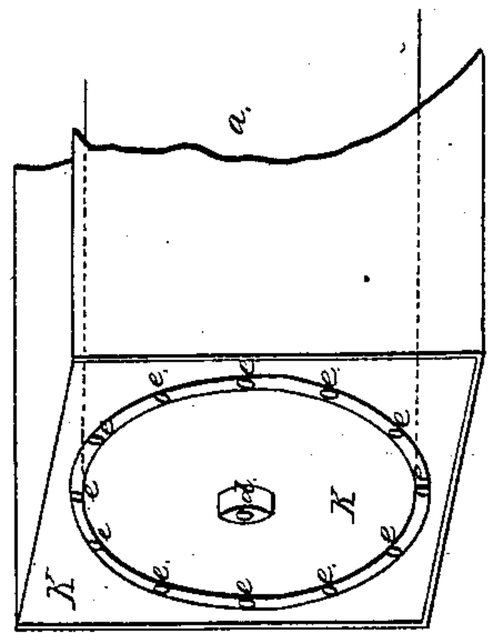
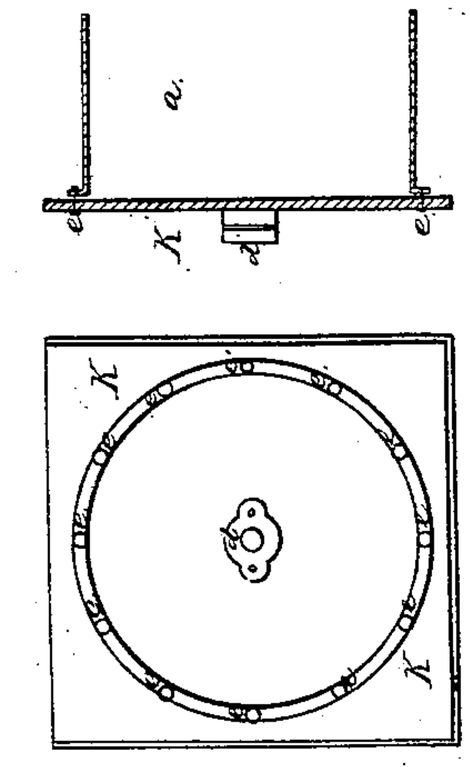


Fig: 5.



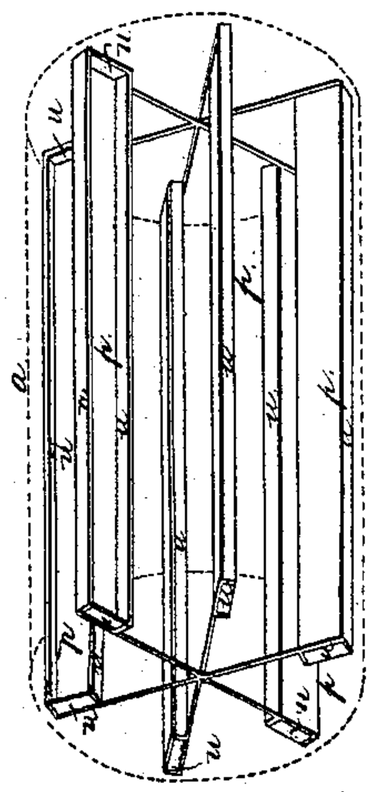
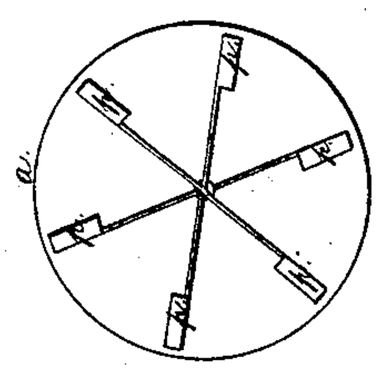


Fig: 6.



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UNITED STATES PATENT OFFICE.

PHILIPPE L. BERNARD AND JOSEPH ALBRECHT, OF NEW ORLEANS, LOUISIANA.

IMPROVEMENT IN THE MANUFACTURE OF ACID SULPHITE OF LIME.

Specification forming part of Letters Patent No. **13,632,** dated October 19, 1855.

To all whom it may concern:

Be it known that we, PHILIPPE LUCIEN BERNARD, medicine doctor, and JOSEPH ALBRECHT, apothecary, both of New Orleans, in the State of Louisiana, have invented a new Mode of Manufacturing Bi-sulphite or Acid Sulphite of Lime, or any other sulphite for which our apparatus may be used, and a new and useful machine therefor; and we do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making part of this specification, in which—

Figure I is the front view; Fig. II, the longitudinal elevation; Fig. III, the transverse section of the front view, and Fig. IV the transverse section of the longitudinal elevation.

To enable others skilled in the art to make and use our invention, we will proceed to describe its construction and operation.

Our apparatus consists of two distinct parts, first, the oven to generate sulphurous acid, and, secondly, the absorbing apparatus to combine the acid with lime or any other alkali.

The oven O, Fig. I, II, III, and IV, consists of the generator *g*—a thick cast-iron tray or basin of a nearly half-cylindrical form, four feet long, fifteen inches across, and ten inches deep, of about three cubic feet capacity. This generator is destined to receive and evaporate the sulphur. It is heated from the fire-hearth *r* below, with convenient doors to regulate the fire. Three inches above the margin of the generator is a kind of cornice *u* and *u*, of strong cast-iron, projecting three inches over the generator on each side, reducing the opening *o* of the inner part of the oven to nine inches. These two apertures *x* and *x*, three inches wide and four feet long on each side of the generator, communicate with the air-holes *p* and *p*. They have doors to regulate the draft. Great care must be taken that these air-holes have no communication with the fire-hearth within, as these holes are only destined to bring the atmospheric air to the vapors of the sulphur over the generator. From the cornices *u* and *u* upward the oven is of brick-work. It widens first for a short distance, and then gradually becomes narrow in a pyramidical form to the height of eight feet, as is shown in the drawings.

Z is a pipe of cast-iron, fifteen inches in diameter, which communicates with a chamber called the "lead-chamber." (Marked with L in the drawings.)

t is a door to provide the generator with brimstone and to observe its combustion. The lead-chamber is made of strong boards lined with sheet-lead. Its function is to receive the sulphurous-acid gas from the oven and to deposit the sulphur if some should have escaped unburned for want of air. A well-constructed oven with large air-holes will prevent the combustion of sublimated sulphur.

The absorbing apparatus consists of three horizontal superposed hollow cylinders containing agitators in the shape of paddle-wheels, and lastly of a ventilator.

Nos. 1, 2, and 3 in the drawings represent three cylinders of strong sheet-copper, well coated inside with lead in the manner tinning is done. Their covers may be of cypress wood, properly bolted on. They are three feet in diameter and seven feet ten inches long, and contain from four hundred to four hundred and fifty gallons each. Every one of them is surrounded by a wooden trough, which we call the "cooler," in which cold water can be admitted and renewed at pleasure. This we illustrated in Fig. I, where K K K is a front view of the square wooden troughs. They are not illustrated in Figs. II, III, and IV for fear of embroiling clearness. In our case the two ends of the copper cylinders are bolted on the two front side boards of these troughs, so that they form (the front side boards) at the same time the covers for the cylinders, as is better shown in Fig. V in the additional amended drawings annexed hereto.

Fig. V represents the manner in which the copper cylinders are bolted against the front side boards of these troughs in front and side view and in perspective. *t* is a part of a trough; K K, one front side board; *a a*, the copper cylinder; *l l*, the bolts, and *d* the stuffing-box. These cylinders have paddle-wheels with hollow paddles, as shown in *i*, Fig. III, and which traverse the whole length of the cylinders. Each paddle is a board

eight inches broad by seven feet six inches long. On the edge of these paddles wooden laths are fastened, which project two and one-half inches on the side which has to plunge first into the liquid. It is evident that by these projecting flanges a cavity of the depth of two and one-half inches is formed, which, being brought horizontally below the surface of the liquid, must force its contents of gas into it. A front view of these paddles is given in Fig. I I I of the additional drawings; but for their better understanding we give an amended illustration of one of them in perspective, where *u u*, &c., represent the laths which form the raised flanges round the paddles *p p*, &c., and produce in this manner a concavity. The shafts, cross-pieces, and paddles must be made of good wood and firmly constructed, their stuffing-box centers secured by gasket. The shafts are prolonged on one side of the cylinder to receive the circular movement. These three cylinders communicate together in the following manner: The cylinder 1 has at *f* a round hole twelve inches in diameter, which admits a cast-iron pipe coming from the lead-chamber. Opposite this pipe in *a* there is another tube similar to the one just mentioned, which establishes communication with the cylinder 2 in *b*. Cylinder 2 is, through the pipe *c d*, with cylinder 3 connected, and this in *e* with the ventilator. In a like manner small-sized leaden pipes are put inside, which connect the cylinders together on the same side that the larger tubes are, as can be seen in *s*, *n*, and *m*.

From the above-mentioned it is evident that the larger tubes are intended for the gases to be carried up to the ventilator, and the smaller leaden tubes have to lead the liquid part downward from the third cylinder to the second, and from the second to the first cylinder, and from this in *m* to any convenient vessel, where it (the liquid bisulphite) is permitted to settle before it is drawn off in barrels. This mode of transvasation of the liquid in a continuous stream shows the necessity of superposing one cylinder over another.

We consider the superposition of the cylinders as an important point in the construction of our apparatus, which never has been applied before. The dissolved alkalies take through this improvement just the opposite course of the sulphurous-acid gas, and a perfect saturation of the alkalies with this acid must be effected.

The ventilator is made of wooden boards three feet in diameter and from ten to twelve inches broad, and capable of drawing and ejecting four cubic feet of air or gas in a second. It is provided with a door *v e*, Fig. II, to regulate the draft.

A reservoir is placed on the top of the cylinders, in which lime and water are mixed in the prescribed proportion, from whence the cylinders are filled. A few words will now suffice to explain its *modus operandi*. The reservoir is filled with a mixture of two hundred gallons of water and fifty-six pounds of quicklime. Then a cock is opened, fixed for that purpose, through which the mixture runs down into the third cylinder. This being half-filled, another portion of the mixture is allowed to run down, which through S finds its way into cylinder 2. A third portion will half-fill the first cylinder and the mixture will appear at *m*.

It must be understood that the cylinders can only be filled to half their capacity and that any additional quantity finds its outlet through the lead pipes. The other part, which is empty, remains free for the passage of the gases.

The paddle-wheels, as well as the ventilator, are set in motion by wheels or straps connected with a steam-engine of five horse-power. The paddle-wheels have to make twenty-or twenty-five revolutions in a minute and the ventilator thirty revolutions. At the same time the generator or basin, containing about one hundred pounds of brimstone, is heated. The brimstone first melts, then begins to evaporate while forming yellow vapors. The vapors are ignited and they will continue to burn until all the sulphur is consumed. The atmospheric air is forced by the projection of the cornices *u* and *u* to play over a part of the generator and squeezes itself with the vapors of the sulphur through the diminished opening O, which remarkably facilitates the complete combustion of the sulphur. The sulphurous acid thus obtained goes into the lead-chamber L. From this it finds its way through the pipe *f* into the cylinder No. 1; from this through the pipe A C into the cylinder No. 2. Passing through this cylinder, it (the gas) escapes through the tube *c d*. Passing through cylinder 3, the gas is attracted by the ventilator V, and finally ejected by the ventilator's centrifugal power into the open air. This sulphurous-acid gas is not pure, but mixed with nearly four times its bulk of nitrogen gas derived from the atmospheric air; but as nitrogen is not absorbed by the alkalies it is thrown by the ventilator after having passed through the three cylinders. On the other hand is the sulphurous acid, by means of the concave form of the paddles, obliged to plunge under the surface of the limy liquid, and through the violent combination of the gaseous and liquid substances immediately combined with the lime, and so perfect is its absorption that not a particle of it will come into the second cylinder before the lime is neutralized and neutral sulphite is formed. From this moment till the complete formation of the sour salt the absorption becomes more and more languishing and requires twice or thrice the time the neutral sulphite requires. Therefore we have added a second and even a third cylinder, through which the gases have to pass successively, and in which they are entirely

deprived of their last particle of sulphurous acid before they reach the ventilator.

Another important point, which ought not to be neglected, is to have the cylinders 1, 2, and 3 plunged in as cold water as can be procured and renewed from below the troughs in a continuous stream. Owing to this very cause, we did fail in manufacturing in the beginning bisulphite of lime any higher than 4° Baumé. It must be borne in mind that the rapid and copious absorption of the sulphurous-acid gas, say over three hundred cubic feet of gas to a barrel of forty gallons of bisulphite of lime at eight per cent., disengages such a quantity of heat that it would entirely prevent any further absorption.

We will here allude to the great advantage of horizontal cylinders and agitators with concave paddles, which bring the gases below the surface of the liquids and mix them so well and so powerfully that their absorption is facilitated to the greatest perfection. All other apparatus used for the manufacture of bisulphite of lime fail in this respect.

Standing cylinders or cisterns with agitators to prevent the lime from settling and the sulphurous-acid gas forced in with pumps can never accomplish a saturated produce without a great loss of sulphurous acid, which endangers the health of those working in the factory, and its destroying effect upon vegetation in its neighborhood is two well known to need comment, independently of the pecuniary loss.

Our paddle-wheel with concave paddles performs at the same time two functions—those of an agitator and of a pump.

From time to time a small quantity of the now produced bisulphite is taken out of cylinder No. 1. Its undissolved matters will have settled in a few minutes, and when its specific gravity is from 1.05 to 1.07 or from 8° to 10° on Baumé's hydrometer its greatest density is obtained. At this moment the cock on the reservoir R is opened and the lime-milk permitted to run out at the rate of three gallons per minute, and so it may continue for any length of time. This continuous stream requires great attention on the part of the manufacturer. His attention requires to be principally directed that the adequate quantity of sulphur be consumed. Sixteen pounds of sulphur and fourteen pounds of line and forty gallons of water will produce one barrel of bisulphite. Therefore for each barrel sixteen pounds of sulphur must be burned. If less is burned, the bisulphite has not its required strength or concentration, and ought to be put back into the reservoir. The fire below the generator must be increased or the stream of fluid diminished, or both the latter alternatives must be adopted.

Should, notwithstanding the above-alluded-to consumption of sulphite, the bisulphite of lime not attain the density of eight degrees and show no tendency to reach those degrees, then the mixture of lime and water has become so hot from absorption that we may term it in this instance "condensation of sulphurous-acid gas," so that any further absorption is prevented unless the temperature of the mixture is brought down to +50° Fahrenheit or below that. Therefore there can never be too much cold water in the trough in which the cylinders are bathed, and it has to be renewed in a continual stream.

Another important point consists in the properly regulating the ventilator. It should eject two and two-thirds cubic feet of air and nitrogen in a second. If it ejects more it would carry the gaseous sulphurous acid too quick through the cisterns and not permit, it time enough to combine with the lime. Should it, on the other hand, eject less than eight-thirds cubic feet, there would not be the necessary draft for the complete combustion of the sulphur, nor the necessary quantity of sulphurous acid generated to produce a certain quantity of bisulphite in a given time. The door which shuts or opens the wind-pipe of the ventilator gives to the manufacturer the means to regulate the draft.

Theory of the Process.—Sixteen pounds of sulphur combine by combustion with sixteen pounds of oxygen gas and form thirty-two pounds of sulphurous acid, which again combines with fourteen pounds of quicklime to forty-six pounds of bisulphite of lime; but as the ingredients brimstone and lime are not of chemical purity and other losses are sustained, that in fact only from thirty to thirty-two pounds of the pure salt is obtained, which, when dissolved in forty gallons of water, forms the product which we manufacture. Sixteen pounds of oxygen correspond with sixty-seven pounds of atmospheric air containing fifty-one pounds of nitrogen gas, equal to about seven hundred cubic feet. According to this theory there should be only a little less than a cubic foot of nitrogen gas ejected by the ventilator per second; but there is nearly an equal quantity of atmospheric air drawn along with it, which increases the above-named quantity of useless gas to nearly two cubic feet per second.

The advantages of our invention consist in a cheap and easy production of sulphurous acid and a new and cheap mode to combine it with lime, potassa, soda, or any alkaline substance dissolved or mixed with water.

As these preparations are manufactured out of the crude mineral itself, and as a rapid and complete absorption is effected, it is apparent that our machine presents greater advantages than others invented until now for the production of bisulphite: first, on account of the cheapness of its production; secondly, perfect safety to the operator; thirdly, rapid and complete combination of the sulphurous acid with the lime and the production of a continuous stream of very saturated bisulphite; fourthly, facility of having our apparatus built of every size desired, pro-

ducing from forty gallons to six or seven thousand gallons a day, provided the different proportions, as stated in this specification, are adhered to.

Our above-described apparatus yields from forty to fifty barrels a day, each barrel containing forty gallons.

As the several distinct parts of our apparatus—the generator, the combining-cylinders, and the ventilator—are destined to achieve but one object, and as they cannot be easily separated, what we claim as our invention, and desire to secure by Letters Patent, is—

The apparatus for the manufacture of sulphite and bi (or acid) sulphite of lime, consisting of the oven *g r u e*, &c., the three superposed cylinders Nos. 1, 2, and 3, and the ventilator V, each of said parts constructed, furnished, and arranged substantially as described, and for the purposes specified.

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