M. W. SINDING.

Treating Pyritous and other Sulphur Ores.

No. 39,684. Patented Aug. 25, 1863.

Fig: 4.

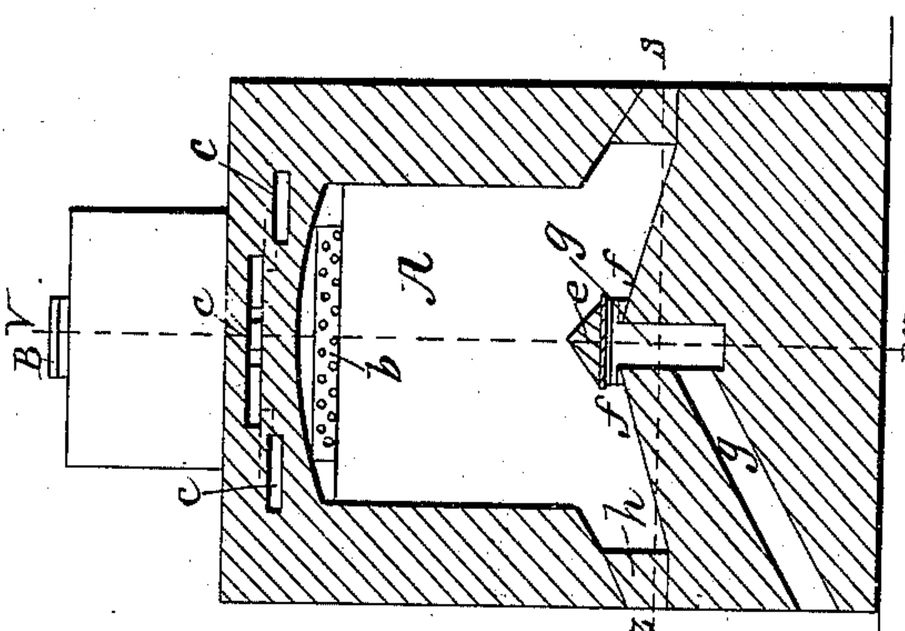


Fig: 2.

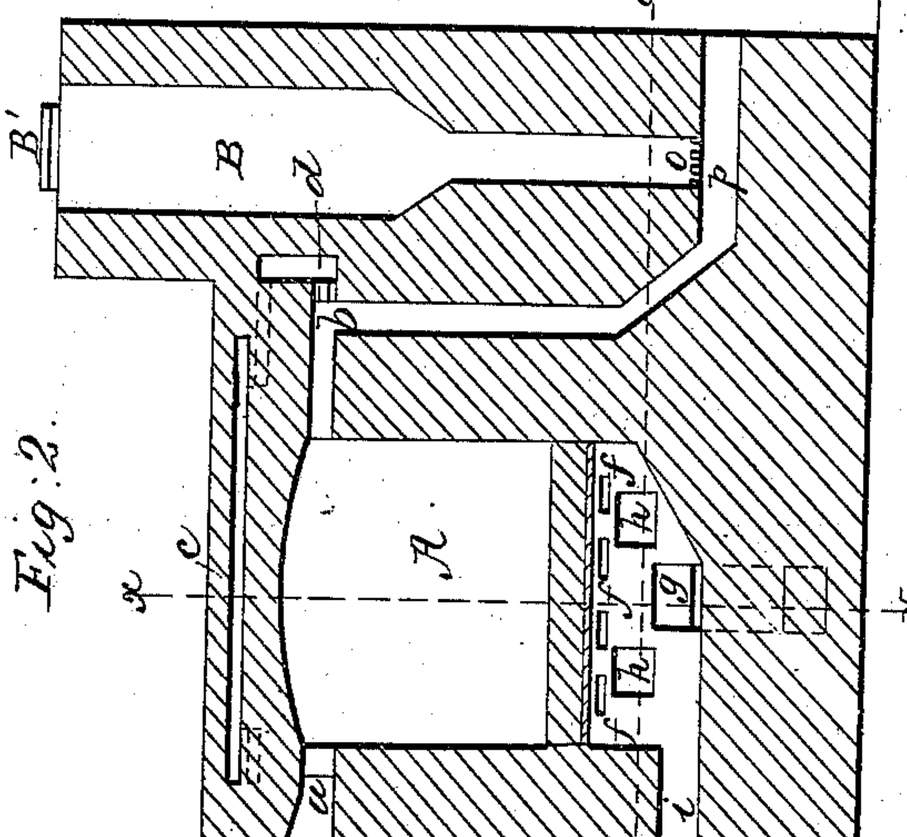


Fig: 3

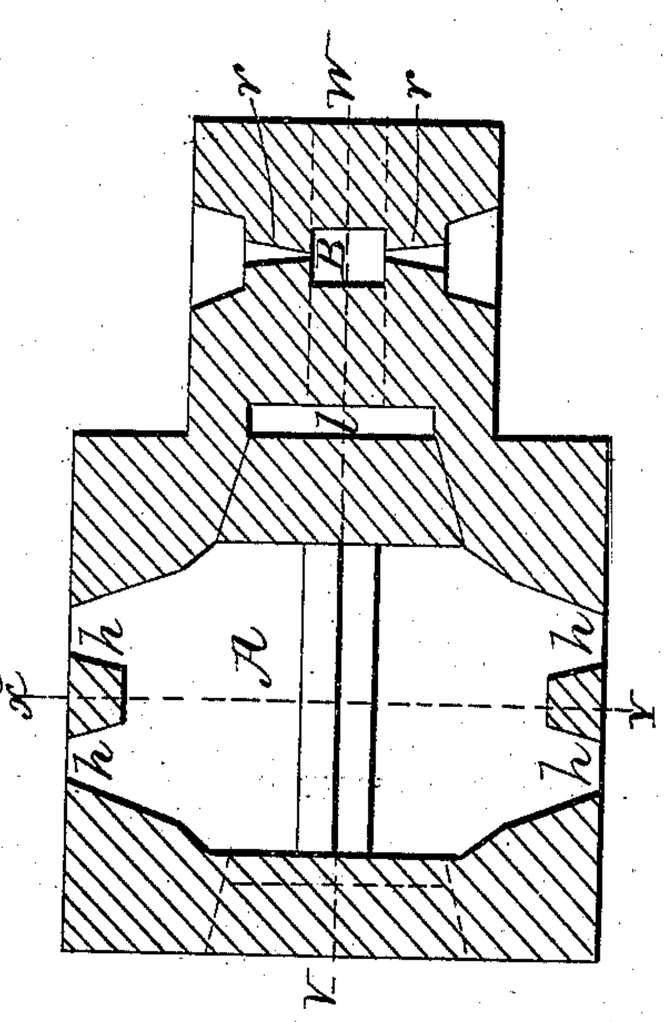


Fig: 1.

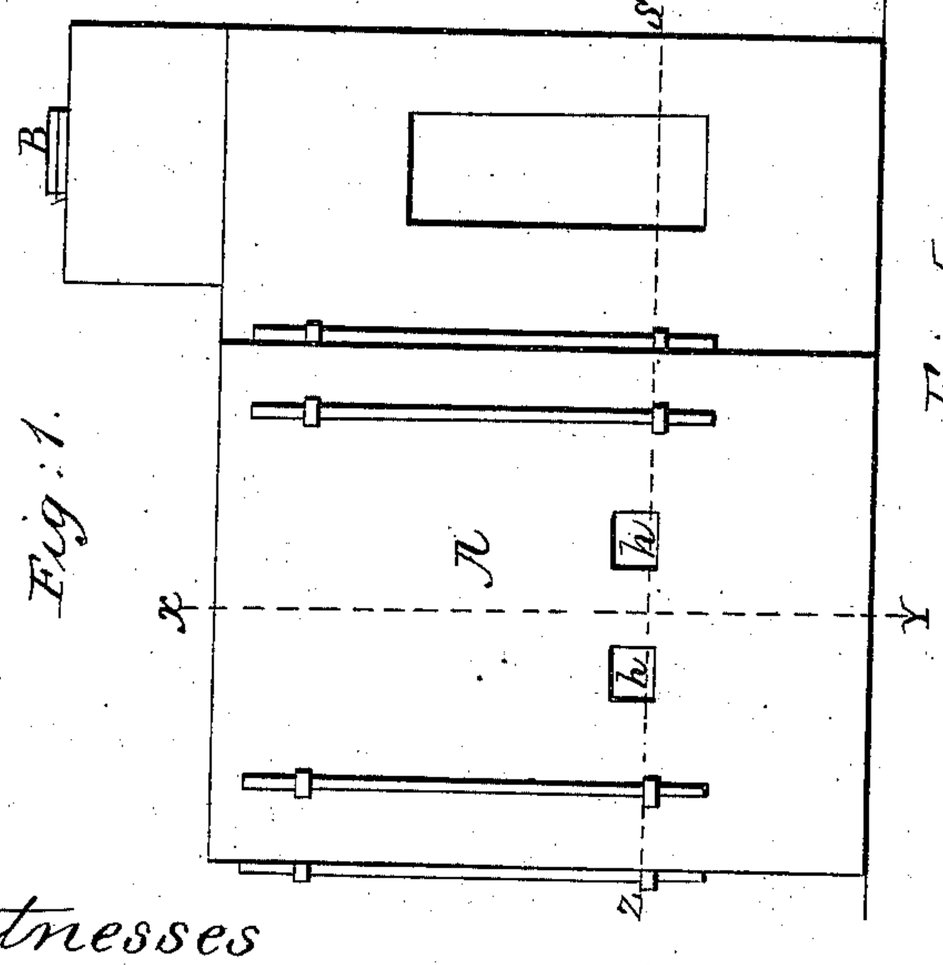
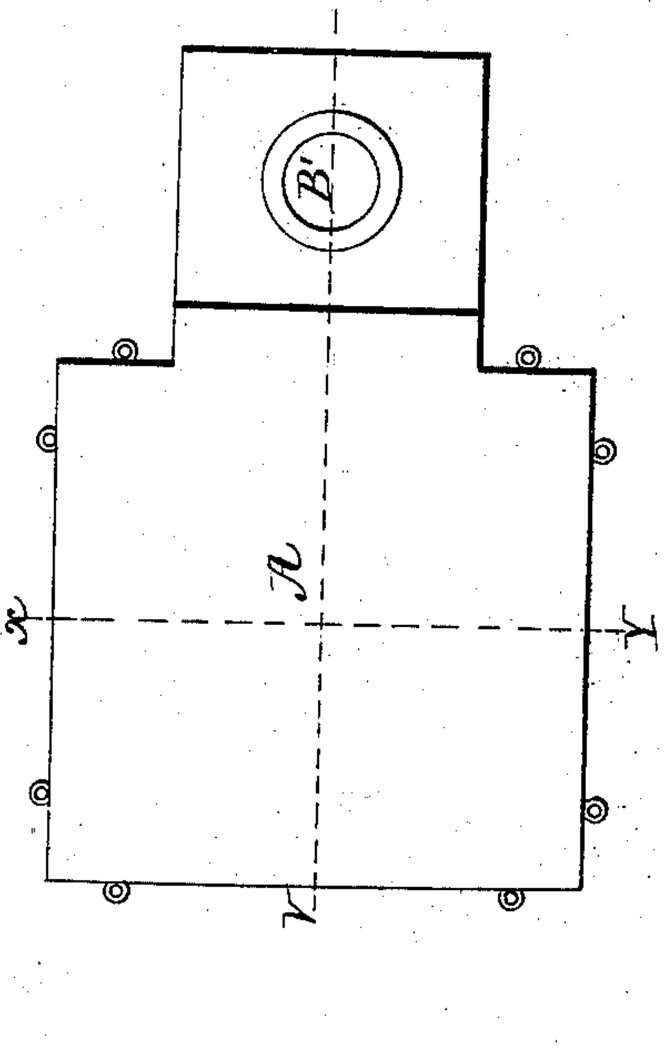


Fig: 5.



Witnesses

A. Landgraff
J. Thorsteman

Inventor

M. W. Sinding

UNITED STATES PATENT OFFICE.

MATTHIAS W. SINDING, OF LINLEHAMMER, NORWAY.

IMPROVEMENT IN TREATING PYRITOUS AND OTHER SULPHUR ORES.

Specification forming part of Letters Patent No. **39,684**, dated August 25, 1863.

To all whom it may concern:

Be it known that I, MATTHIAS WILHELM SINDING, now residing at Linlehammer, in the Kingdom of Norway, a subject of Norway, have invented or discovered new and useful improvements in treating pyrites and ores containing sulphur in obtaining sulphureted hydrogen and in precipitating copper from solutions; and I, the said MATTHIAS WELHELM SINDING, do hereby declare that the nature of my said invention and in what manner the same is to be performed are fully described and ascertained in and by the following statement thereof, reference being had to the drawings hereunto annexed, and to the figures and letters marked thereon—that is to say:

The nature of my invention consists in a mode of treating pyritous ores, so as to obtain as useful products sulphur, sulphureted hydrogen, and metallic copper, and in effecting which I prefer an apparatus which I have arranged therefor and have described herein.

Sheet 1, Figure 1, shows a side view; Fig. 2, a vertical section through V W; Fig. 3, a horizontal section through Z S; Fig. 4, a vertical section through X Y, and Fig. 5 is a plan view of the furnace.

A is the furnace charged with the ore, and B the gas-generator. This apparatus is constructed for wood, peat, and wood-charcoal.

For obtaining sulphur I charge the apparatus with ore containing sulphur by the door *a*, and the desulphurized ore is drawn out by the doors *h h*. The ridge *e*, formed of fire-clay or iron plates, protects the holes *f f*, communicating with the gas-canal *g*, which leads the evaporated sulphur to the condensing-chambers, where the vapor of sulphur is condensed by means of water into the state of a fine powder, commonly known under the name of "flowers of sulphur." The opening *i*, generally closed with bricks, serves to clean the gas-canal *g*, in case the same should be filled with condensed sulphur. The tubes *c c* consist either of clay, brick-work, or iron, and serve to heat the blast by the waste heat of the furnace previous to its being introduced into the furnace through the canal *d* and numerous small holes in the back of the fire-bridge *b*. The blast introduced into the furnace serves to consume the inflammable gases produced in the gas-generator and passing the canal *l* on their way to the furnace. The gas-generator B produces inflammable gases from fuel which is charged through the charging-hole B′ on the top of the generator. The charging-hole can be closed gas-tight. The blast to produce inflammable gases in the generator is introduced through the tuyeres *r r*. The grate *o* prevents the fuel from dropping into the ash-pit *p*, which is closed by dry sand, and easily accessible when it wants cleaning from ashes and cinders.

The mode of working the apparatus is, in general, the same as with any other gas-furnace. The gas-generator being charged with fuel and the blast introduced, the inflammable gases thus produced are forced into the furnace and there consumed. The first inflammation of these gases in the beginning of a new operation must be done with caution. The quantity of gases produced in a certain time in the generator depends upon the quantity of blast introduced through the tuyeres, which can be regulated by a valve or cock in the wind-pipes which lead the blast from the blowing-machine to the generator, and the more or less complete consumption of the gas depends upon the quantity of blast introduced into the furnace over the fire-bridge, which can also be regulated by another valve or cock between the blowing-machine and the blast-heating apparatus.

I here have to remark that instead of hot blast cold blast may be used, though with less advantage. When I treat pyrites or other ores containing sulphur, in order to evaporate sulphur, I regulate the consumption of the inflammable gases, so that the same be as complete as practically possible, and that this be done I judge from the appearance of the flame. The same must then have a white color, but not be too short, as this would indicate an excess of blast. The furnace is generally charged from two to four times in twenty-four hours, each charge consisting of one to three tons of ore, which is introduced when the desulphurized ore is withdrawn from the furnace. The gas-generator is generally filled once in two hours with fuel, and requires per charge from eighty to one hundred and sixty pounds of the same, according to its quality, and I find that coal, wood, peat, and charcoal, either separate or mixed with each other in various proportions, answer the purpose. The gases produced by the consumption pass the pyrites or ore (charged into the furnace in pieces of from

the size of a man's fist to that of a walnut) on their way downward through the holes *f f* to the gas-canal *g*, where they heat the ore containing sulphur, and cause the latter to pass with them in the gaseous state to the condensing-chambers, where the vapor is condensed, while the other gases escape into the atmosphere. The condensed sulphur is then collected, dried, and can, by melting and casting into molds, be converted into cane sulphur or any other shape.

I will now describe the way which I follow to produce sulphureted-hydrogen gas instead of sulphur from iron pyrites or ores containing sulphur by means of the same apparatus.

The improvements in producing sulphureted-hydrogen gas from pyrites or ores consist in applying hydrogen gas or carbureted-hydrogen gas, produced from fuel in the gas-generator, to sulphur in the state of vapor, when the latter combines most energetically with the hydrogen to form sulphureted-hydrogen gas, thus decomposing the carbureted hydrogen gas. For the purpose of producing sulphureted hydrogen with the above-described apparatus, I prefer to use such fuel as will give out much hydrogen and carbureted hydrogen—such as coal, wood, and peat, either alone or mixed with each other in various proportions, or with coke and charcoal. The gas-generator producing thus inflammable gases containing much hydrogen and carbureted hydrogen is worked in a similar manner to that above described, and requires for an apparatus of the dimensions shown upon the drawings per charge sixty to eighty pounds of coal, or one hundred and forty to one hundred and fifty pounds of a mixture consisting of one-third charcoal and two-thirds dry wood, or two hundred and thirty to two hundred and fifty pounds dry peat of good quality. However, the quantity of fuel required depends necessarily upon its quality. The furnace being charged with from one to two tons pyrites or ore in twelve hours, I regulate the blast introduced into the furnace so that the consumption of the inflammable gases remains imperfect, and I judge this from the appearance of the flame. In this case the flame is red, dark, and smoky, and the gases of combustion charged with unburned hydrogen gas and carbureted-hydrogen gas pass the hot pyrites or ore on their way to the gas-canal *g*, when they are for some time in the most intimate contact with vapor of sulphur deriving from the pyrites. The result is, by combination of sulphur with hydrogen and decomposition of the carbureted hydrogen, a mixture of gases charged with sulphureted-hydrogen gas, applicable for many chemical purposes.

I have now described the method of obtaining sulphur and sulphureted hydrogen from pyrites or ore containing sulphur by means of the described apparatus, and will now proceed to explain another way of producing the said gas, which may be used as hereinafter described for precipitating copper. This mode consists in the application of sulphur, instead of pyrites or ore, by means of a retort apparatus, as hereinafter described.

The retort apparatus consists of two parts—namely, the retorts for producing hydrogen and carbureted hydrogen and those where the named gases in contact with sulphur produce sulphureted-hydrogen gas. The first part consists of two iron or clay retorts, of size and shape similar to common gas-retorts, which serve alternately to produce hydrogen gas and carbureted-hydrogen gas from fuel or other substance containing these gases by the so-called process of dry distillation. In order to execute this process, the retorts are filled with the substance from which the hydrogen and carbureted hydrogen is to be extracted, then closed and heated from outside. The heating of the retorts is continued until the gases escaping from the same show, when lighted, a blue flame, which color indicates that all the carbureted hydrogen and hydrogen is developed, when the retorts are discharged and filled again with fresh material. The working of both retorts might be so regulated that one is at full work when the other is discharged and refilled. The second part of the retort apparatus consists of a furnace provided with fire-place and four to six retorts of similar shape and size as the above. They are so arranged as to be heated all over as equally as possible, and are so connected with each other by bent tubes that they form a serpentine. These retorts are filled with porous matters—such as calcined pyrites, ore, or coke—and supplied with a constant stream of melted sulphur, which, flowing slowly over the porous matters, comes in intimate contact with the hydrogen gas and carbureted-hydrogen gas produced from fuel or other substances, and conducted in a continuous serpentine-line course through these retorts. The result is the development of sulphureted hydrogen, produced by combination of sulphur with hydrogen and decomposition of carbureted hydrogen. Instead of using fuel for producing carbureted hydrogen and hydrogen in the retort apparatus, I also apply other organic matters—such as tar, pitch, resins, stearine, or fatty oils—in the same way as is well known in the manufacture of gas for illuminating purposes from such organic matters. The sulphureted-hydrogen gas thus produced in the retort apparatus is of much greater strength and purity—that is to say, not mixed with other gases in such a proportion as the gas obtained by means of the apparatus before described, and is therefore preferable for many purposes.

Having hereinbefore explained the modes of obtaining sulphureted-hydrogen gas by causing an intimate contact of hydrogen gas and carbureted-hydrogen gas either with vapor of sulphur or sulphur in the liquid state at a high temperature, I also obtain it by treating such matters as tar, pitch, resin, stearine, oils, or other fatty animal or vegetable substances in

the following manner: The mode of treating such matters with sulphur for producing sulphureted hydrogen is this: In a cast-iron retort of such shape and construction as is generally used in distilleries for spirits of wine, I charge the organic matter with a surplus of sulphur, so that the retort is about half filled. I then begin slowly to heat the retort until the sulphur and the organic substance melt, raising the heat slowly to the boiling-point of these organic animal or vegetable substances, being themselves or containing carbureted hydrogen. The result of the action of the sulphur upon the carbureted hydrogen in liquid state is the decomposition of the latter, the formation of sulphureted hydrogen, and the deposition of carbon. The development of the sulphureted hydrogen is in the beginning generally very strong, and requires therefore the usual caution. After some time the same decreases, and the heat must be slowly raised to the evaporating temperature of the sulphur. The operation is with this degree of heat finished. All the carbureted hydrogen is decomposed, and in the retort remains only carbon mixed with some sulphur. The retorts are then discharged and ready again for a new operation. The sulphureted hydrogen thus produced is generally very pure, especially if it is passed through a vessel filled with water, and is applicable for many purposes where the same gas or the sulphides of sodium and potassium have been hitherto used.

Having thus explained the methods which I adopt for producing sulphur and sulphureted hydrogen, I will now proceed to describe the last part of the invention or process—that is, the application of sulphureted hydrogen for the extraction of copper from copper ores, as follows:

A quantity of ore containing copper in the state of sulphide is calcined in common calcining-furnaces, or in heaps in the open air, as is well understood, the object of the calcining operation being to convert the sulphide of copper into sulphate of copper or blue vitriol, which, as is well known, is very soluble in water. After the calcination is completely done I lixiviate the calcined ore with hot or cold water upon water-tight platforms, or in tanks or basins to dissolve out from the calcined ore all the copper which is in a soluble state. The result of the lixiviating process is a solution containing, chiefly, sulphates of copper and iron, from which I precipitate the copper in the state of sulphide of copper by means of sulphureted-hydrogen gas. The precipitating apparatus which I use for this purpose consists of a system of gas and water tight chambers filled with pieces of wood and communicating with each other. The gas-stream containing the sulphureted-hydrogen gas is introduced into the apparatus and passes several times up and down, circulating in a serpentine line before it reaches the atmosphere. The top of the precipitating-chambers is covered with a tank whose bottom is pierced with numerous holes, which allow the copper solution pumped up into this tank to fall down into the chambers as a fine rain, when the copper, coming thus into the most intimate contact with the sulphureted-hydrogen gas forced into the chambers, is precipitated in the state of sulphide of copper. This process of precipitating the copper from the solution is continued until all the copper formerly in the state of sulphate is converted into sulphide. That this be completely done, I judge from the smell of the solution, which indicates, when it contains free sulphureted hydrogen, when the precipitation is finished. The whole liquid is then drawn upon filters, where the precipitated sulphide of copper remains, while the clear solution, free of copper, runs away. The precipitate is then washed, pressed, dried, and smelted into rich regulus, which may be worked for fine copper by any one of the well-known methods.

What I claim as my invention, and desire to secure by Letters Patent, is—

The process herein described for treating pyritous ores, so as to obtain as useful products sulphur, sulphureted hydrogen, and copper.

M. W. SINDING.

Witnesses:
A. LANDGRAFF,
I. THORSTENSEN.