H. F. WIERUM.

PROCESS OF DESULFURIZING ORES.

APPLICATION FILED SEPT. 15, 1913. RENEWED SEPT. 15, 1916.

1,222,252. Patented Apr. 10, 1917.

Fig. 1.

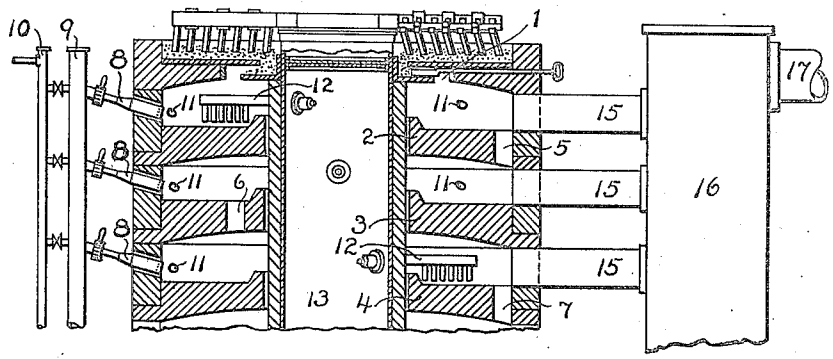
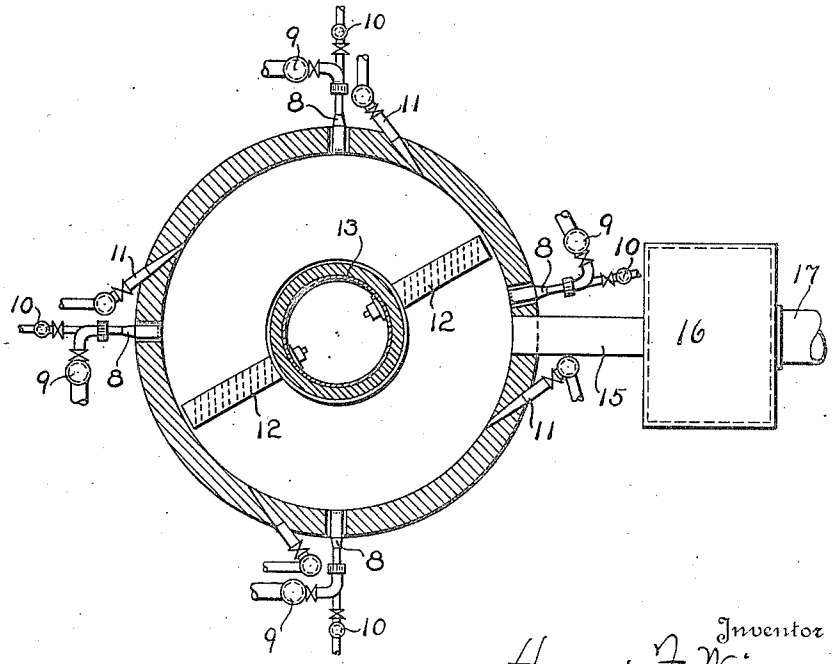


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

HOWARD F. WIERUM, OF UPPER MONTCLAIR, NEW JERSEY, ASSIGNOR TO THE SULPHUR SYNDICATE LIMITED, OF LONDON, ENGLAND, A CORPORATION OF ENGLAND.

PROCESS OF DESULFURIZING ORES.

1,222,252. Specification of Letters Patent. Patented Apr. 10, 1917.

Application filed September 15, 1913, Serial No. 789,921. Renewed September 15, 1916. Serial No. 120,423.

To all whom it may concern:

Be it known that I, HOWARD F. WIERUM, a citizen of the United States, residing at Upper Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes of Desulfurizing Ores, of which the following is a specification.

A process has been described by William A. Hall in *Engineering and Mining Journal* for July 5, 1913, page 35, in which sulfid ore, such as copper bearing pyrites or pyrrhotite is heated to a temperature of between 700 and 900° C. by means of a reducing flame, and in the presence of a small amount of steam.

The present invention is an improvement on said Hall process, and consists essentially in mixing a small amount, say 2 or 3% or even 5% of a carbonaceous fuel, such as coal or coke, or lamp black, (should the same be available) with the fine ore under treatment. When thus using a solid carbonaceous fuel in admixture with the sulfid ore, it is not necessary to maintain a reducing flame, since while the flame may be oxidizing, the presence of the carbonaceous fuel converts the effective surfaces of the flame, into a reducing or non-oxidizing flame.

Steam is admitted into the furnace, and the ore is continuously rabbled, and the temperatures are maintained between 700 and 900° C., all substantially as in said process of W. A. Hall.

This process overcomes the somewhat difficult problem of maintaining the combustion of a reducing flame, particularly in the upper compartments of the furnace, if a furnace of the Wedge, McDougall or Herreshoff type is employed, since it is very much easier to maintain regular and even combustion in an oxidizing flame than it is in a reducing flame in the present process, since the atmosphere present in the working compartment of the furnace contains considerable amounts of vaporized sulfur, products of combustion, steam and sulfur compounds, and very little free oxygen.

The presence of the steam aids in preventing the formation of large amounts of SO_2, and of carbonyl sulfid or carbon oxysulfid, (and decomposes any of the latter that may be found), also if considerable steam is employed, and particularly if the temperature is rather low, say in the vicinity of 700° C., considerable H_2S may be produced by the interaction of the sulfid ore and the steam, as in the Hall process, above referred to, which amount of H_2S may be in some instances, very much more than sufficient to reduce the small amount of SO_2 formed on some other hearth of the furnace. In order to oxidize the excess of H_2S to elemental sulfur, I may purposely generate a considerable amount of SO_2 in the lowermost compartment, or compartments, since as soon as all of the carbonaceous fuel has been burned by the oxidizing flames, and particularly in the absence of material amounts of steam, the bulk of the sulfur present in the ores under treatment will be converted into SO_2.

Ordinarily in this part of the process I introduce very little, or no steam, into the furnace, since the main object is to produce SO_2 rather than H_2S, and to bring down the sulfur content of the roasted ore to as sweet a roast as possible. However if steam is also admitted, considerable H_2S may be produced in this part of the process, either with a sufficient amount of SO_2 for producing sulfur therefrom, or with even less SO_2. In this case the gases leaving the furnace will contain an excess of H_2S, which may be utilized, or gotten rid of, in any suitable manner.

In place of using steam in the upper compartments, or in all the compartments, I may use a fuel gas containing considerable quantities of hydrogen, such as water gas, or more particularly oil gas, which hydrogen, upon combustion, will produce a sufficient amount of steam for the purpose mentioned. Other hydrogen containing fuel may, of course, also be employed for this purpose.

I am familiar with the patents to Stickney, 475,825, May 31, 1892; 493,193, March 7, 1893; 512,235, Jan. 2, 1894, and 587,068 July 27, 1897, in which sulfid ores are roasted, under conditions which are said to produce free sulfur, by first converting substantially all of the sulfur existing in the ore as "fixed atom" into SO_2 and H_2S, which interact to produce free sulfur. There might also be a certain amount of distillation of the "feeble atom" of sulfur if pyrites or similar ore were employed in the process of the Stickney patent. I accordingly disclaim anything shown or described in said patents. I desire to call especial attention to the fact that in my process most of the sulfur of the sulfid ore never gets into the

form of either H_2S or SO_2, but is driven out by direct distillation, as free sulfur, and this applies equally to the "fixed" and "feeble" atoms.

The gases and vapors leaving the furnace may be led to a suitable gas washer, or other device for removing or recovering the sulfur, most of which is in the form of free sulfur, and any H_2S or SO_2 or both, which is in the gases leaving the furnace may be suitably converted into free sulfur, or otherwise treated.

While the furnace used in carrying out this process may be the ordinary type of mechanical ore roaster, provided with suitable blast lamps for introducing the flames, I find that in some instances it is much better to withdraw the gases separately from each compartment, and lead them to a common flue, through which the gases are conveyed to any suitable type of apparatus for removing and for recovering the free sulfur in the gases, in this manner the difficulty likely to be encountered in trying to produce substantially complete combustion, in the atmosphere in the upper compartments, which atmosphere contains very large amounts of free sulfur, products of combustion, steam, and sulfur compounds is largely avoided, and also since the vaporized sulfur does not come into contact with the flames to so great an extent there is usually less of the vaporized sulfur converted into SO_2, than when using the ordinary type of furnace, in which the gases and vapors travel upwardly through the several compartments.

As above stated by the introduction of steam, a portion of the sulfur of the sulfid ore, is converted into hydrogen sulfid, and this hydrogen sulfid may be sufficient in amount to reduce substantially all of the SO_2, formed by the combustion of sulfur due to the presence of the oxidizing flames.

I also desire to call attention to the fact that this process is not only applicable to ores, such as above stated, but also to the treatment (desulfurization) of mattes, or other sulfid material. The term "ores" as used in the appended claim is accordingly intended to cover the treatment of matte, and other similar material.

The process forming the subject matter of my invention may be carried out in the apparatus illustrated in the accompanying drawing, in which Figure 1 shows a vertical section of the upper part of the furnace, and Fig. 2 shows a cross section of such a furnace.

In said drawings the ore is preferably fed in at 1, by means of a particular structure of drying top, which has been found to give excellent results in metallurgical furnaces, the ore passes successively over the hearths 2, 3, 4, etc., by means of openings, 5, 6, 7, etc., until it reaches the bottom of the furnace, where it is discharged in the usual manner.

At 8 I have shown Bunsen burners or blast lamps, which are suitably connected with a gas supply pipe 9 and an air supply pipe 10, whereby the flames may be projected onto the layer of ore on each of the hearths of the furnace. At 11 is shown a tangential steam inlet, for introducing the steam with which the ores are to be treated. 12 illustrates any suitable form of rabbles, and 13 the shaft carrying the rabbles, which is preferably a hollow shaft, in order to allow for cooling, and the rabbles may of course be air-cooled or water-cooled if desired.

From each of the ore compartments leads a substantially horizontal pipe 15 leading to a large vertical flue or dust chamber 16, wherein flue dust may settle out from the gases in the usual manner. 17 represents the pipe leading to the gas washers, or other form of apparatus for separating the sulfur from the gases.

What I claim is:—

1. A process of desulfurizing sulfid ores and mattes, which comprises mixing the same with a carbonaceous material, and heating said mixture to a temperature of 700 to 900° C. by the direct action of a flame, in the presence of steam in amount sufficient to decompose any carbon oxysulfid formed, and while agitating said mixture.

2. In the process of desulfurizing sulfid ores and mattes, the step of subjecting a mixture of said sulfid in the form of fines, and a carbonaceous material, to a temperature of between 700 and 900° C. while in the presence of steam, and while agitating said mixture.

3. In the process of desulfurizing finely divided sulfid ores and mattes, the step of subjecting a layer of a mixture of said material with a carbonaceous fuel, to the action of a heating flame, at a temperature at which substantially all the sulfur content thereof will distil in elemental form, and while agitating said layer.

4. A process of desulfurizing sulfid ores and mattes, which comprises subjecting the same at a temperature of from 700 to 900° C. to the action of a flame in the presence of a carbonaceous fuel, and in the presence of steam, and continuing said flame treatment after said carbonaceous fuel has substantially all been eliminated.

5. A process of desulfurizing pyrrhotite or other sulfid ores or mattes, which comprises subjecting the same to the action of a flame in the presence of a carbonaceous fuel at a temperature of between 700 and 900° C. while agitating the same in the presence of steam, and continuing said flame

treatment after substantially all said fuel has burned away.

6. A process of desulfurizing metal sulfids, which comprises producing a mixture of said sulfids in a finely divided condition and a carbonaceous fuel, subjecting a layer of said mixture to the action of a reverberatory flame, while maintaining said mixture at a temperature of 700–900° C. and while periodically agitating said mixture, and while in the presence of steam.

In testimony whereof I affix my signature in presence of two witnesses.

HOWARD F. WIERUM.

Witnesses:
C. W. LEININGER,
ELIZABETH SCAMMON.