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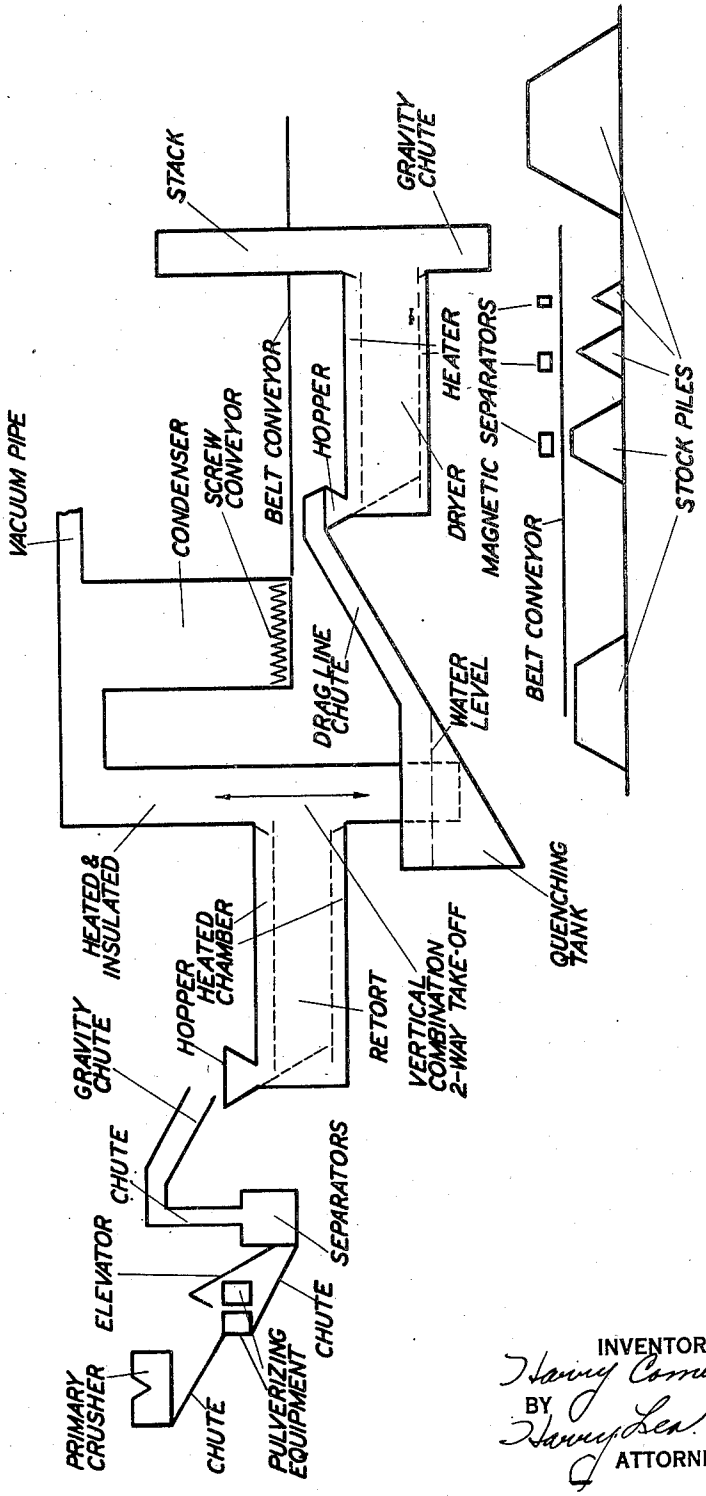

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METHOD OF UNLOCKING ORE BODIES TO EXTRACT SULPHUR AND IRON THEREFROM

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My method is designed especially for the purpose of extracting sulphur and iron from pyrites and recovering pure sulphur and a very fine quality of sponge iron. It will be obvious from a study of the process as hereinafter described that it may also be used on other types of rock. The object of my invention is to provide a method or process which when employed, will permit the recovery of finely divided sulphur and sponge iron from pyrites which, absent my invention, could not be handled advantageously.

In order to show clearly the various steps of my method, I have illustrated diagrammatically the process in the accompanying drawing of a flow sheet which is hereunto annexed and made a part of this specification. This sheet is supplied with appropriate legends, an inspection of which, in connection with the hereinafter contained specification, will afford a clear exposition of my invention.

It is to be understood that the flow sheet is furnished solely for illustrative purposes for my method does not require any specific type of apparatus for its practice so long as it will function to obtain the necessary result.

The first step in my method or process of unlocking ore bodies to permit the recovery of sulphur and iron is to pulverize the ore until it is sufficiently fine to pass through a screen of 200 mesh. I have found in practice that this is essential for if the ore is in large pieces the sulphur will remain locked in the rock. On the other hand if the particles are minute the sulphur will escape from the ore.

This is established by an examination of the iron under a microscope, after processing, which will disclose that the iron has a sponge like appearance brought about by the escape of the sulphur.

The pulverized ore is then introduced into a retort which is of a standard or well known construction from which air is excluded. It should be understood that the heating may be carried out in any known type of heater such as rotary retorts, or various other types of mechanical heaters. For convenience, I hereinafter employ the term "heater" to describe any form of apparatus in which the heating operation is carried on.

Heat is supplied to the retort preferably by electricity, gas, oil or coal, in the order named, for while either form of heating may be utilized the ease of controlling the temperature of the retort will vary with the kind of heating medium employed. The temperature of the retort is raised to the critical temperature at which it starts operation. This is approximately 600° F. at which point the sulphur will begin to be converted into a vapor. The temperature is increased until it reaches 900° F. at which degree the operation will be complete for nearly all ores, although in practice I have carried it as high as 2100° F. for some classes of ore.

One of the vital differences in my method of recovering sulphur is that in the usual production of sulphur it forms a gas (SO_2) which is a gas at normal temperatures while my process forms a vapor (S) which is a solid at normal temperatures. In the past, in the treating of pyrites, sulphur has always been produced in the presence of oxygen. Hence the sulphur is converted into sulphur dioxide (SO_2) and the iron may be partially or wholly oxidized, dependent upon the amount of oxygen present.

During the heat treatment it is necessary that the pulverized material in the retort must be kept in constant agitation. This may be done by revolving the retort, or by the use of rabbles, shelves, or other desirable forms of agitators operating within the retort. This is very important because it has been found in practice even with the fine pulverization of the material the same degree of recovery cannot be secured as the heat will not penetrate the ore body because it does not possess sufficient thermal permeability.

The next step in my method is drawing the vapor off into a tank in which it is condensed.

There are three ways in which this may be done and that means which is best adapted to the particular situation may be employed.

First the changing from a solid to a vapor in the retort sets up a pressure in the retort and this pressure may be used to drive the vapor into the tank condenser. This movement is facilitated by the condensation in the tank which sets up a vacuum pull on the vapor line.

The second way is to employ a so-called vacuum or suction connection through a water or other seal to produce a reduced pressure in the condenser by the use of any of the common well known standard devices employed for this purpose. In practice I have found with most ores the operating pressure need only be equivalent to the atmospheric pressure at the point of operation, being of the order of 14.7 pounds per square inch plus or minus, in accordance with elevation with respect to sea level, the vacuum merely serving as a mechanical aid.

The third method is to introduce a stream of heated inert gas such as carbon dioxide (CO_2).

This must be preheated to approximate the maximum temperature of the sulphur vapor as otherwise it would chill the vapor. The introduction of this heated inert gas will create a draft which will aid in passing the vapor to the tank condenser.

The connection from the retort to the condenser tank must be by way of a two way vertical take-off. This take-off should be insulated to preserve the heat in the vapor. In some cases it may be necessary to heat the take-off. When this condition exists the flue gas may be utilized for this purpose, if electricity is not being used for heating the retort, thus it may be done at a minimum of expense.

The height and the cross section area of the take-off must be in direct proportion to the ore being treated, and should be so proportioned as to prevent the dust particles from the rock from carrying over into the condensing tank or the recovery of pure sulphur will be prevented. In practice I have found this height to be four or five times the diameter of the retort, and the cross section area sufficiently so as not to act as an impedance to vapor flow. This insures a low velocity of the vapor and allows sufficient lapse of time for the mechanical separation of any dust particles which may be carried by the vapor. In this manner I avoid the production of impure sulphur. I thus mechanically maintain the vapor pure. It will be clear to those skilled in the art, that its chemical purity is maintained by keeping it from contact with oxygen.

The next step is to pass the residue of iron and rock remaining in the retort through the lower portion of the take-off into a tank where it is quenched with water. A water seal must be provided for this tank to prevent any air from reaching the iron while it is hot. The residue is then conveyed through driers, this must be done promptly to avoid oxidization. This drying must not be done by a blast of air but preferably in the absence of air.

When electricity is not used for heating the retort, the flue gases may also be used to furnish heat for the driers. The dried residue is then carried past a plurality of magnetic separators of standard construction to recover the iron from the remaining non-magnetic ores. In practice I have found at least three are required to get rid of all impurities.

The residue of rock remaining after the iron is removed is then ready to be treated for noble metals by well known methods. If copper is present by electrolytic or other methods; for lead or other minerals by well known methods, etc. By this method I have not only recovered sulphur from pyrites in paying qualities but it is of the purest form. While the iron is that form known as sponge iron which is conceded to be of the highest grade.

Having described my invention what I regard as new and desire to secure by Letters Patent is:

1. The method of unlocking ore bodies to produce sulphur and sponge iron, which consists of continuously and completely agitating the ore which is sufficiently fine to pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore to a temperature of 900° F. for a sufficient length of time to dissociate the same into iron and sulphur.

2. The method of unlocking ore bodies to produce sulphur and sponge iron, which consists of continuously and completely agitating the ore which is sufficiently fine to pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions to coincidentally dissociate the same into iron and sulphur.

3. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally which consists of continuously and completely agitating the ore pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore until it is thoroughly permeated by the heat and thereby dissociating the ore into sulphur vapor and sponge iron.

4. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally, which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore to 900° F. until each molecule is permeated with the heat whereupon the ore will be dissociated into sulphur vapor and sponge iron.

5. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of the oxidizing conditions, heating said ore to a temperature from 900° to 2100° F. until each molecule is permeated with the heat whereupon the ore will be dissociated into sulphur vapor and sponge iron.

6. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore to a temperature of from 600° to 900° F. until each molecule is permeated with the heat whereupon the ore will be dissociated into sulphur vapor and sponge iron.

7. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally, which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore until each molecule is permeated with the heat, whereupon the ore will be dissociated into sulphur vapor and sponge iron, discharging the sulphur and iron from said chamber into a two-way vertical take-off, the sulphur passing upwardly while the iron passes downwardly.

8. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore until each molecule is permeated with the heat, whereupon the ore will be dissociated into sulphur vapor and sponge iron, discharging the sulphur and iron from said chamber into a two-way vertical take-off, the sulphur passing upwardly into a condenser while the iron passes downwardly.

9. The method of unlocking ore bodies to produce sulphur and sponge iron coincidentally which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore to 900° F. until each molecule is permeated with the heat at which the ore will be dissociated into sulphur vapor and sponge iron, disintegrating the reduced ore with water and thereafter drying the

residue of ore in the absence of oxidizing conditions.

10. The method of coincidentally unlocking ore bodies to produce sulphur and sponge iron which consists of continuously and completely agitating the ore, pulverized so that it will pass through a 200 mesh screen, in a chamber in the absence of oxidizing conditions, heating said ore until each molecule is permeated with the heat for a sufficient length of time to dissociate the sulphur and iron, leading the resulting sulphur vapor into a condensing chamber where instantaneous condensation takes place, connecting said condenser to a source of reduced pressure to increase the velocity of the vapor passing from the heating chamber to the condenser.

11. In the process of claim 2, the step of discharging the sulphur under vacuum conditions.

12. In the process of claim 2, the step of discharging the sulphur by means of an inert gas.

13. In the process of claim 3, the step of discharging the sulphur under vacuum conditions.

14. In the process of claim 3, the step of discharging the sulphur by means of an inert gas.

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