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MEANS AND METHOD OF REFINING ORE

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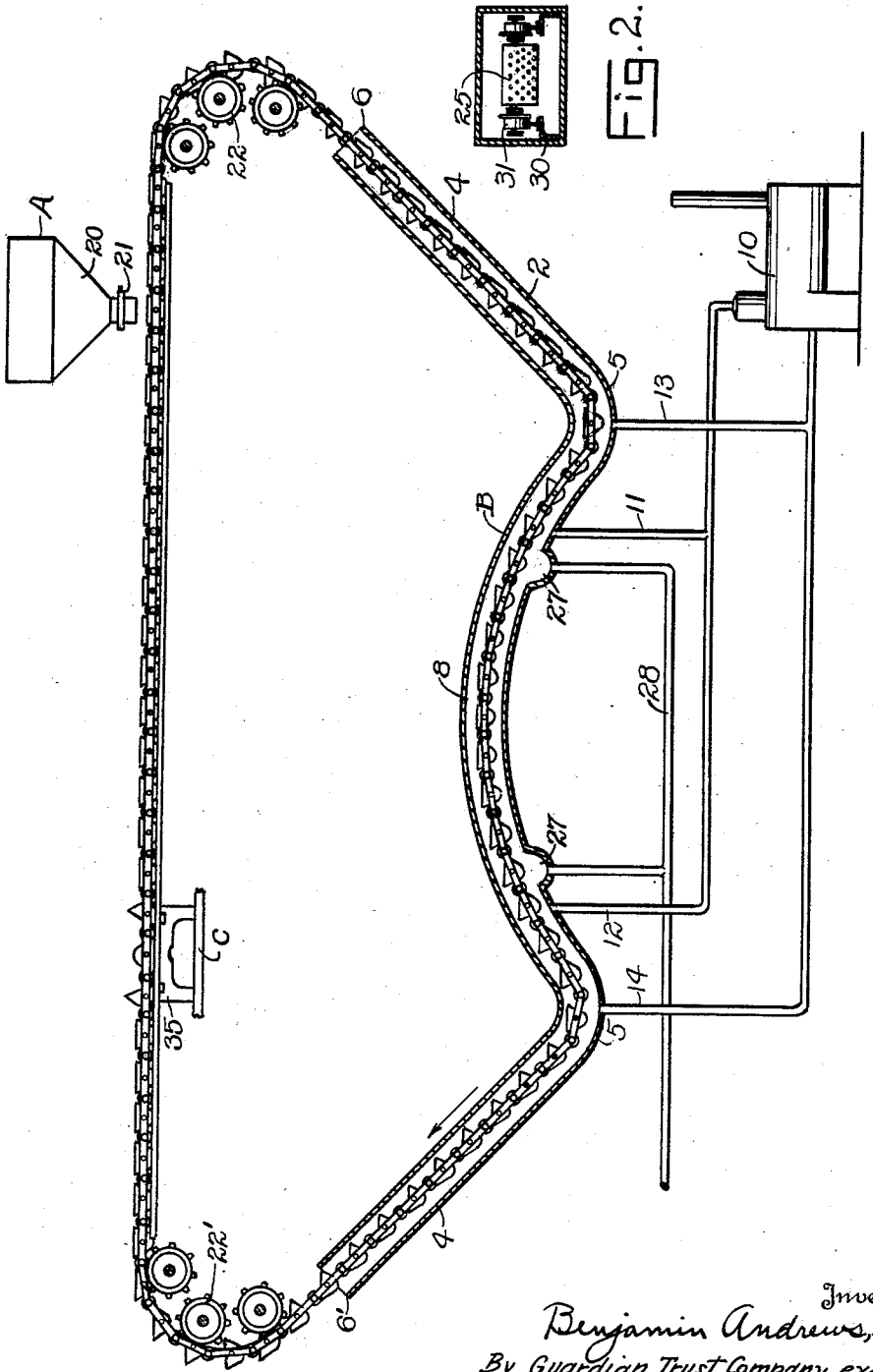


Fig. 2.

Fig. 1.

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MEANS AND METHOD OF REFINING ORE

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This invention relates to means and method for refining by heat treatment ores such as that of sulphur.

In various localities of the United States and elsewhere deposits of sulphur exist on the surface of the ground or in subterranean dry formation where it is not possible to employ the well known Frasch process of mining sulphur.

Sulphur as it usually occurs in nature is found in heterogeneous mixtures of inorganic matter consisting principally of gypsum. Sulphur is a solid at temperature below 239° Fahr. but above that temperature it melts and takes the form of a slightly viscous fluid. It is, therefore, possible by heating sulphur-bearing rock-like ores to a temperature above 239° Fahr. to melt the sulphur and separate it from the rock and other foreign substances. The method now employed for winning sulphur from these surface beds is to dig out the ore by hand or machinery, after which the ore or mixture must be treated.

The most effective system of treatment is by melting the sulphur out of the dross by means of steam or hot water, but as the melting point of sulphur is approximately 239° Fahr. the water or steam has to be kept under a pressure exceeding the vapor tension at that temperature which is approximately 25 pounds per square inch absolute.

In practice the plan generally employed is to load the ore into cars which are run into a large cylinder, retort or gigantic auto-clave such as is used for creosoting timber. The auto-clave is sealed by bolting onto the ends removable heads or doors. The auto-clave is then filled with hot water which entirely envelops the ore and the cars. The water is then further heated by injecting live steam directly into the auto-clave or by means of steam in closed coils. The auto-clave and contents are thus raised to the desired temperature. Usually a steam pressure of 100 lbs. is used which brings the internal temperature of the auto-clave to about 340° Fahr. Such an operation obviously cannot be carried out continuously, but the auto-clave must be charged and discharged treating the ore in batches. Much time and labor is required to close and seal the auto-clave; further time is required to raise the temperature of the autoclave to the necessary temperature. After the sulphur is melted out of the ore much time is required to cool down the autoclave and contents so that the doors may be opened. Taking all in all the operation is extremely slow and tedious to say nothing of being wasteful in heat units.

It is the object of the invention to provide a means and apparatus for treating the sulphur in an autoclave whereby the raw ore may be subjected to the heat treatment and the sulphur removed and the remaining slag withdrawn from the water in a continuous operation and wherein the desired pressure upon the water in contact with the sulphur ore is maintained by means of the force of gravity, thus making it possible to introduce and remove the ore from the autoclave without the use of a cumbersome door system and its contingent tedious, slow and expensive operation.

Other and further objects of the invention involving the feeding of the raw ore, dumping of the slag from the conveyors and the maintenance of the entire apparatus will be readily apparent to those skilled in the art.

It is obvious that the improved means and method may take various forms. However, for purposes of illustration, it is shown diagrammatically herewith only in one form for conveying the ore to and from the treating apparatus. It is not desired to be limited to this particular form, but it is merely illustrated for the purposes of description. Neither is it desired to limit the use of the invention to the production of sulphur, but it may be used for many purposes where it is desired to treat by continuous process material which requires submersion in liquids or their vapors raised to temperatures which indicate vapor tensions higher than normal atmospheric pressure.

Fig. 1 is a diagrammatic elevation and layout of such apparatus as may be utilized in connection with the improved method and shows an endless train of buckets passing through a double inverted tube siphon con-

taining water heated above the melting temperature of sulphur.

Fig. 2 is a sectional view taken through the tube and showing one form of track construction which may be used to support the conveyor.

The buckets are filled at A, pass through the siphon B where the sulphur is melted and separated, and are finally dumped of their depleted gangue at C.

It will be noted that the tube 2 as shown consists of a double inverted siphon. With this structure it is possible to maintain the desired temperature in the central portion 8 by taking advantage of nature's physical phenomena, as here described.

Inasmuch as the density of water above 40° Fahr. decreases materially with temperature, as soon as water is heated it immediately tends to flow to the highest point possible.

Inasmuch as water is an extremely poor heat conductor heat applied to water has no effect whatever of heating the water below the level at which the heat is applied.

Referring to the drawings, it is the intention to introduce the steam or hot water adjacent to 27; this will cause the heated water to rise and all of the water inside of the tube above that level in time will be heated uniformly by convection, but as stated above, no water below 27—27 will be heated. The temperature of the water may be raised to any degree desired providing a vapor tension is not reached sufficient to form steam in the upper space at 8 and thus force the hot water down below the lowest point of the siphon at 5 and allow the hot water to escape into the legs 4.

In the operation of the apparatus hot water may be introduced into the legs 4—4 intentionally either by increasing abnormally the temperature in 8 or by forcing a surplus of hot water into 8 and thus displacing its contents into the legs of the tube, or by injecting steam or hot water directly therein. It will be understood, however, that under no circumstances can the temperature in the legs of the tube exceed that of boiling water, because the top is open to the atmosphere.

It is desirable to have the legs of the apparatus as hot as possible so that the material may be pre-heated before entering the melting chamber 8. Under some circumstances, for heat economy sake, it will be found an advantage to run the apparatus in one direction for awhile and then reverse the operation and run it in the other. It may also be found expedient to use two siphons in series, the second one providing means for dumping the buckets under temperature sufficient to keep the sulphur melted; as the small amounts of waste sulphur still adhering to the gangue under some conditions if cold and solidified will be sufficient to cause trouble in dumping by sticking to the sides of the bucket.

The method contemplates arranging a tube in the form of a double inverted siphon such as indicated at 2 in Fig. 1. This tube will have considerable length but may be arranged in any desired form, preferably or approximately shaped like an elongated **W** as shown in Fig. 1. It may be rectangular in cross section as shown in Fig. 2, or round if so desired. The tube, however, will be arranged in such a manner so as to be filled with water. The wings of the **W** indicated at 4 will have a considerable elevation, so that the vertical distance from the point indicated at 5 to that indicated at 6 or 6' will be sufficient to maintain the desired liquid heat or pressure upon the central or heat treating portion shown at 8. It is readily apparent that when the tube is filled with water that the gravitational pressure of the water from 5 to 6 will be exerted upon the portion at 8. In this manner, if it is desired to maintain a pressure of say 100 lbs. per sq. inch on the portion at 8, it will be necessary to have an elevation difference between 8 and 6 of at least 240 feet.

The tube when fully constructed will therefore occupy a considerable area and may be arranged upon a hillside or in a small valley or other depression in the earth; it may be constructed as a tunnel, or, if desired, a suitable derrick-like supporting structure may be arranged.

A boiler is shown indicated generally at 10 and having inlet pipes 11 and 12 leading into the tube. These pipes may open directly into the tube so that the heated fluid, water or steam, may flow into the tube, but if desired these pipes may encircle the tube or be placed within it and merely convey the heat of the steam in the pipe to the contents of the tube by conduction and not by direct flow. The inventor has shown pipes at 13 and 14 as a means of completing the circulation of the fluid through the boiler 10. Such a plan may be advisable where there is a dearth of water as is the case where some of the sulphur deposits exist. This layout, however, is optional, and other forms may be used if desired.

In order to convey the ore into the tube an endless track conveyor having a plurality of buckets thereon is used. It is obvious, however, that an endless belt or train of cars or any other type of conveyor may be used without departing from the spirit of my invention. A hopper shown at 20 having a suitable valve 21 is shown diagrammatically in Fig. 1 as a means of feeding the ore into the buckets. From this point the buckets pass over any suitable guide means at 22 and enter the tube at the point 6.

By referring to Fig. 2 it will be seen that the buckets have perforation such at 25 therein and thus permit the molten sulphur to drop

from the bucket. The tube 2 is arranged with a trap at 27 to receive the molten sulphur as it flows along the tube. Any suitable outlet means such as the pipes 28 may be used to withdraw the melted refined sulphur whereby it may be pumped to a bin or settling basin for cooling. After the buckets pass out of the central portion 8 and into the left hand wing at 4 a considerable amount of heat which they contain will be transferred to the water in this wing of the tube, thus to a considerable extent some of the heat units are not dissipated as they are absorbed by the water from the heated buckets. After the buckets pass around the guide members 22 or 22′ they are engaged by a discharging apparatus shown at 35 which may consist in any desired form of mechanism which will rotate the bucket upon its pivot pin in order to discharge the slag and other foreign material which remains therein. It will be seen that the buckets assume an upright position due to gravity and are then adapted to receive another charge of ore from the hopper 20. Fig. 2 also shows suitable tracks such as 30 upon which wheels 31 are adapted to travel. In this manner buckets will progress smoothly through the tube and the motive power may be applied to the rollers as at 22 to propel the endless conveyor.

From the foregoing it will be apparent that the inventor was enabled to refine the sulphur by a continuous operation and to avoid the use of a sealed container and the contingent loss of heat units he was not required to maintain a pressure by mechanical means. This is a material advance in the art over the means and method now generally in use.

Having thus described the invention, what is claimed is:

1. In the treatment of materials under heat and pressure in an autoclave, the process of providing free ingress to and egress from said autoclave, comprising providing openings to said autoclave and maintaining a gradually increasing pressure from said openings by a liquid static head to the central portion of the autoclave.

2. A method of subjecting materials to a hydrostatic pressure treatment in a continuous process, including passing the material through an autoclave wherein the pressure is maintained by a gravity head.

3. A method of providing a continuous cycle of hydrostatic heat and pressure treatment for materials, including passing the material through a heat and pressure area, wherein the pressure is maintained by a gravity head.

4. A method of subjecting materials to a heat and pressure treatment including passing the material through a heated body of liquid, wherein a portion of the liquid is under the hydrostatic pressure of the remainder thereof.

5. In a process of refining material the steps of passing the material continuously through an open ended container where it is subjected to heat and pressure, the pressure in the container being that of the hydrostatic head of the liquid in the container.

6. A method of treating sulphur ore having foreign substances therein, including arranging a water column to obtain a pressure which will prevent vaporization thereof at the melting temperature of sulphur, passing the loose sulphur ore through the water column to melt the sulphur, and withdrawing the refined sulphur and the foreign substances separately from the water column.

7. A method of refining sulphur including passing ore through a column of water heated to at least the melting temperature of sulphur; and maintaining a gravity pressure on the heated water sufficient to prevent vaporization.

8. A device for refining sulphur including a tube having the ends thereof and the center elevated, a conveyor arranged to pass sulphur ore through said tube, means to maintain heated liquid in the center of said tube whereby the sulphur is melted from the ore.

9. A sulphur treating apparatus including in combination an irregular enclosed passage open at both ends, said ends being at an elevation above the remainder of said passage, a central portion of said passage elevated above the part intermediate said ends whereby fluid placed in said passage will exert a gravity pressure in said central portion, means to convey ore through said passage, and means to maintain said central portion heated to at least the melting temperature of sulphur.

10. A device for melting sulphur including a passage adapted to be filled with water, means to heat a portion of the water to the melting temperature of sulphur, said passage being arranged so that gravity pressure of the water in the central portion of said passage will prevent vaporization of the water at the melting temperature of sulphur.

11. An ore refining apparatus including in combination an ore conveying mechanism, a tube through which said mechanism is adapted to pass, said tube being characterized by the fact that when filled with water a static pressure at least sufficient to prevent vaporization of water at 239° F. will be exerted upon a portion of said tube, means to heat said portion and mean to draw off the melted sulphur.

12. A method of treating ore by a continuous cycle of operation including feeding the raw ore into a body of liquid in an open receptacle, conveying the ore to a point in the receptacle where the hydrostatic head is greater than the vapor tension of the liquid and passing the slag from the liquid and receptacle.

13. The process of treating ore by subjecting it to temperature and pressure including passing the ore in a cycle through a body of liquid under the required pressure due to its own hydrostatic head.

14. The process of treating ore by subjecting it to heat and pressure including passing the ore in a cycle thru a body of liquid maintained at a temperature and pressure exceeding that at which it would normally vaporize.

In testimony whereof, I hereunto affix my signature this the 6th day of December, A. D. 1929.

WALTER BROWNE BAKER,
Vice President of Guardian Trust Co., Executor of Benjamin Andrews, Deceased.