March 27, 1951 W. C. WOLF 2,546,247

PROCESS OF RECOVERING BARITE FROM ITS NATIVE MATERIALS

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FIG. 1.

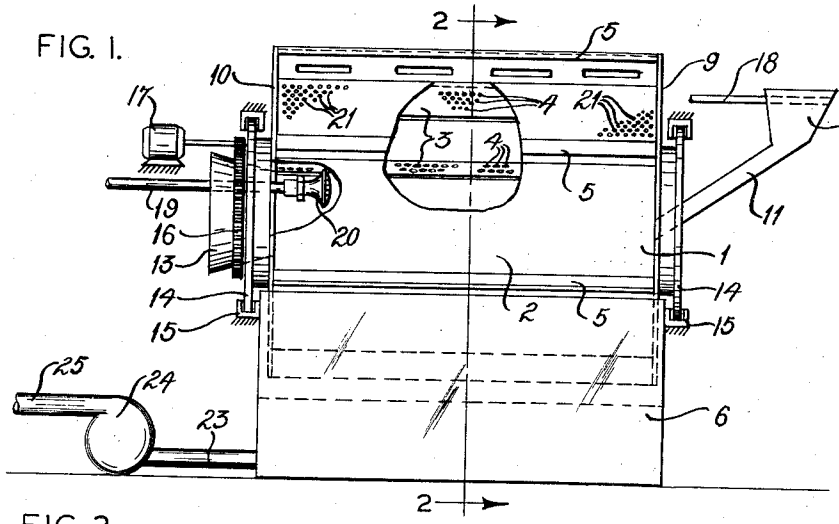


FIG. 3.

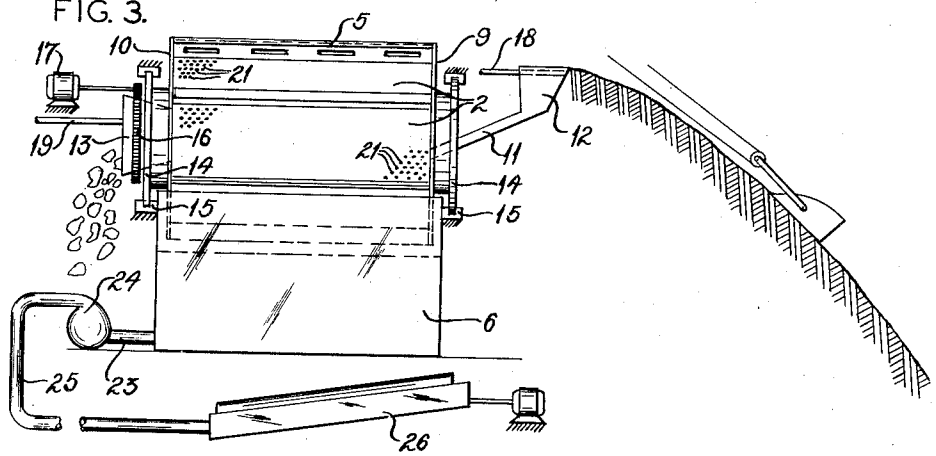
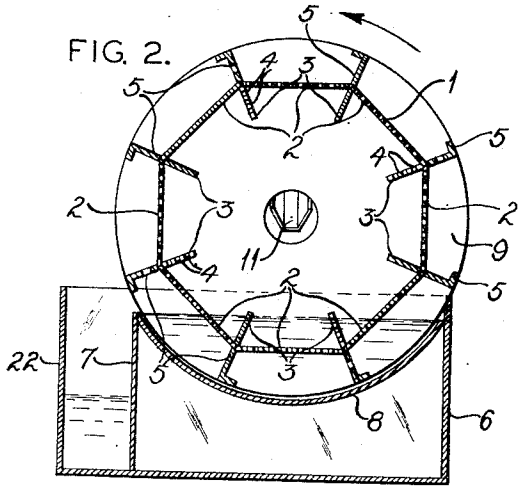


FIG. 2.



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PROCESS OF RECOVERING BARITE FROM ITS NATIVE MATERIALS

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2 Claims. (Cl. 241—14)

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This invention relates generally to the recovery of barite from native minerals and particularly to a process and apparatus for separating barite from the material with which it is found in nature.

Heretofore, in the mining of barite or "tiff," as it is colloquially called, it has been the practice to truck or tram large quantities of clay, sand, and rock (such as flint, sandstone, or limestone), with such barite as may be present in nature, from the "diggin's" to the mill site whereat the barite is, by series of operations, recovered from the native materials. It is common practice that the milling be done several miles from the point at which the mining operation took place and consequently a great array of transportation equipment has been necessary.

In the usual procedure of recovering barite from the native materials at the mill, the large rocks are separated by hand from a given batch of barite, clay, sand, rock, etc., and any large pieces of barite are broken, generally by hand sledge, in order to reduce the mixture of dirt, gravel, sand, and barite to a fineness suitable for being handled by the familiar log washer. In the latter apparatus, the barite is separated from the other materials.

The object of the present invention generally stated is to improve and expedite recovery of barite from its native materials.

A particular object of the present invention is to provide a process suitable for reducing barite, while mixed with native materials, to a pumpable fineness without reducing any substantial part of the native rock to such pumpable fineness.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings in which:

Figure 1 is a view in side elevation of an apparatus constructed in accordance with the present invention for the treatment of barite with native dirt and rock and for reducing the same to a pumpable fineness;

Figure 2 is a sectional view taken along line 2—2 of Figure 1; and

Figure 3 is a diagrammatic view showing the disposition of the apparatus of Figures 1 and 2 in connection with other apparatus for the processing of barite.

According to the present invention generally stated, the run of mine barite ore (including clay, sand, barite and other rock) is deposited in an apparatus capable of reducing the barite to a pumpable fineness of for example three-quarters of an inch without, however, reducing any substantial proportion of the other rock present to such pumpable fineness. The apparatus not only selectively reduces the particle

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size of the barite present but separates all material of pumpable fineness from the material of larger size and hence separates the rock from the barite, clay, gravel, and sand. During the process of treatment in said apparatus, the latter fraction of the raw ore is incorporated with copious quantities of water so as to constitute a slurry capable of being conducted through pipe lines. Where the solids in the slurry are all of size such as to pass a ¾" screen, the product may be treated in the usual log washer and jigs without further reduction.

Given a generous water supply at the mining site, the above mentioned breaking and separation apparatus is preferably located in such proximity to the ore pits that the ore may be treated immediately as it is taken from the earth. The resulant slurry may then be pumped to a remotely situated mill. If desired, the breaking and separation apparatus may be semi-portable so as to follow the progress of digging with appropriate extension of the slurry pipe lines. If desired, the breaker may be elevated so that the slurry may flow by gravity to a nearby log washer thus eliminating the necessity for a pump between the breaker and the log washer.

Referring now to the drawings for an illustrative embodiment of the invention, a drum 1 is mounted for rotation about a substantially horizontal axis. The drum 1 is of diameter such that a piece of barite falling from the top to the bottom thereof gains sufficient kinetic energy that upon impact at the bottom of the drum the same will fracture. Barite is relatively brittle and of very high specific gravity, being on the order of 4.5. The other native rock is not only, as a rule, considerably harder than barite, but invariably of a specific gravity on the order of about half that of barite. Consequently, the idea diameter for the drum 1 is such that while a piece of barite (larger than pumpable size) dropped across the diameter thereof will fracture, a piece of native rock (of the same size) dropped the same distance will not fracture. Consequently, by repeating the dropping of the mixture of barite and native rock across such diameter, the barite particle size is reduced, while that of the native rock is not reduced in any substantial measure. In the latter connection, it may be pointed out that, while relatively large pieces of native rock may fracture and be reduced from a size of, say, a foot in diameter to sizes of four or five inches, and some fines will, of course, result from such reduction of the rock, the reduction of the particle size of the barite nonetheless continues below the four to five inch size and down to minus three-quarter inches or even less.

In the embodiment shown, the drum 1 is fabricated of eight peripheral plates 2 so that the drum is octagonal in cross section, as shown in Figure 2.

At the junction between the respective plates 2, ribs 3 extend radially inward for a substantial distance. The ribs 3 are preferably vented, as shown at 4, but the vents in adjacent ribs are preferably staggered in the axial direction.

Opposite each of the ribs 3 and extending radially outward from the plates 2 is a bucket 5. The radial walls of buckets 5 may be cut out to reduce the quantity of slurry carried up by them. The ribs 3 and the buckets 5 extend for the full length of the drum 1 on the interior and exterior thereof, respectively. In the embodiment shown, the drum 1 has a diameter on the order of seven feet. The ribs 3 extend interiorly of the drum walls for a distance on the order of six inches and the buckets 5 extend radially outward for a distance of six inches. The dimensions just given will be found advantageous for the treatment of barite ore as mined in Washington County, Missouri, but it will be understood that the conditions peculiar to barite ores from other localities may dictate some change in the dimensions just indicated.

Arranged below the drum 1 and embracing the lower segment thereof is a tank 6 provided with a weir 7 extending upwardly for a distance sufficient to control the water level in tank 6 so that the internal ribs 3 when in their lowermost position will be immersed, save for the upper extremities thereof. If desired, the tank 6 may be provided with a false bottom 8 built on a radius slightly greater than the maximum radius of the buckets 5. In practice, however, the material being treated will settle in tank 6 and form its own bottom having the contour generally indicated for false bottom 8. Consequently, whether the false bottom 8 is incorporated as a piece of the apparatus or not will depend upon the economies of each particular operation.

The drum 1 is provided with end plates 9 and 10, each of which has a central aperture. Through the central aperture in the plate 9 a chute 11 extends from a hopper 12 so as to admit the raw ore (clay, sand, barite, and rock) into the apparatus. The central aperture in end plate 10 may be provided with a skirt 13 for guiding the rock which discharges from apparatus through the central aperture in end plate 10.

The drum 1 may be mounted for rotation about a horizontal or substantially horizontal axis in any suitable way. In the form shown in the drawings, each of the end plates 9 and 10 is provided with a guide ring 14 mounted in suitable trunnions 15, which latter may be supported on any suitable framework preferably on the exterior tank 6. One of the guide rings is provided with a ring gear 16 arranged to be driven by a motor 17 so as to rotate the drum about a substantially horizontal axis at the desired speed which is preferably on the order of six revolutions per minute.

During the treatment of the raw material in the drum 1 copious quantities of water are introduced. Part of the water is preferably introduced through a pipe 18 having outlets within hopper 12 so that as the raw material descends chute 11 it is very wet. For example, if the raw material is fed to hopper 12 at the rate of one cubic yard per minute, as much as 100 to 200 gallons of water per minute may be introduced through the pipe 18. At the discharge end of the drum 1 another pipe 19 having a spray head 20 is provided for continuous spraying of the material undergoing treatment within drum 1. More water per unit of material treated is preferably introduced

through pipe 19 than through pipe 18. In the case of the treatment at the rate of one cubic yard of raw material per minute as much as 200 or 300 gallons of water per minute is preferably introduced through pipe 19.

Each of the plates 2 is perforated with a great multiplicity of apertures 21. In the embodiment illustrated the apertures 21 are flared toward the outside and have an inside diameter of approximately three-quarters of an inch which is to say that the apertures 21 will pass material of a minus-three-quarters size.

The arrangement of the tank 6 beneath the drum 1 is such that the tank catches all of the material, water, and solids which pass through the apertures 21. The tank 6 extends at one side (the left as seen in Figure 2) beyond the drum 1 so that solid material (barite, gravel, clay, or sand) which has passed apertures 21 and deposited itself in one of the buckets 5 will be dropped from the bucket when during rotation of the drum, the bucket reaches the upper left quadrant (as seen in Figure 2). The solid material thus dropped from the bucket 5 will be caught by that portion 22 of the tank, which is located on the left of weir 7.

From section 22 of tank 6 a discharge line 23 extends to a centrifugal pump 24, the operation of which is adjusted to withdraw the slurry from tank 6 at a rate such that the level in section 22 of tank 6 is maintained substantially below the level to the right of weir 7.

By maintaining the fluid level in tank 6 so as to substantially immerse the ribs 3 the perforations 21 in the plates 2 are efficiently kept clear. It is only during the period during which a given aperture 21 is immersed that material will travel in any substantial degree from the interior to the exterior of the drum 1. Since during this time the aperture 21 which is being traversed is immersed in fluid there is little tendency for the aperture to become clogged and such tendency as exists is effectively relieved by the movement of that aperture in the 5 o'clock position (as seen in Figure 2) where a counterflow from the exterior to the interior is induced. Moreover, as the buckets 5 rise out of the bath contained in tank 6 they are laden with slurry. Continued ascent of the buckets permits the slurry to drain back to the interior of the drum thus dislodging any particles which may have become seated in the apertures 21.

From the pump 24 the slurry consisting of, for example, 1.5 parts by volume of water to each part of solids (clay, sand and minus three-quarters barite, together with any gravel of minus three-quarters size) is conveyed through a pipe line 25 to a separating apparatus such as a log washer 26 which may be situated at a remote point. The pipe line 25 is of a size such that the flow of slurry through the same is at a relatively rapid rate. For example, where the pipe line is required to discharge 500 gallons of water together with one cubic yard of solids per minute, a six inch pipe line is preferable. In such a situation, the velocity of the slurry stream through pipe line 25 is sufficient to transport the heavy particles of barite without loss by settling. The viscosity of the slurry, due to the presence of the clay, facilitates the transportation of the barite through the pipe line and to some extent reduces the tendency of the latter to settle, but it should be pointed out that when operation of the apparatus is interrupted it is desirable to continue the injection of water through pipes 18 and 19 and

continue the operation of pump 24 for some minutes in order to assure that the pipe line 25 is cleared. If, on the contrary, the slurry were permitted to become static in pipe 25, settling would occur to an extent which might result in clogging the pipe line.

In the operation of the apparatus, the charge from chute 11 is deposited in the bottom of drum 1, but as the latter rotates the charge is elevated by ribs 3 until in the upper right quadrant (as seen in Figure 2) the ribs are tilted inwardly so that the mass is released from its "shelf." Thereupon, the material cascades toward the bottom of the drum. During such fall large pieces of barite gain sufficient kinetic energy to equal the work of fracturing them. Consequently, when a given piece of barite (of plus three-quarter inch) falls and strikes the free edge of a blade 3 the same will fracture whereas a piece of flint of the same size would not fracture. This is not only because of the greater impact strength of the flint but also because of the barite's greater mass per unit of volume, and follows from the physical law that kinetic energy of a freely falling body $=\frac{1}{2}Mv^2$.

From the foregoing description those skilled in the art should readily understand that the invention accomplishes its objects and provides an apparatus which not only eliminates the undesirable rock from the ore but concurrently reduces the barite to a pumpable fineness and at the same time incorporates the same into a slurry of clay and water, so as to enable transportation through pipe lines to a gravity separating apparatus situated at a remote point.

While the invention has been described with particular reference to the recovery of barite from native materials, it should be understood that the invention is not limited to the treatment of barite ores. On the contrary, the invention is applicable to the treatment of any ore wherein the value is of a specific gravity much higher than that of the other native materials and where the value as well as the native rock may come in large pieces. While one complete embodiment of the invention has been disclosed in detail, it is to be understood that the invention is not limited precisely thereto nor to the dimensions which were given hereinbefore for the purpose of illustration. Those skilled in the art will readily understand that the apparatus disclosed is subject to many and varied modifications without departing from the spirit of the invention, and consequently it is to be understood that the invention is not limited to the embodiment described or otherwise, save as indicated in the appended claims.

Having thus described the invention, what is claimed is:

1. In the recovery of barite from unsized native materials composed of lumps of barite and lighter rock over a predetermined size together with fine material under the predetermined size, the process of selectively comminuting the over-size barite particles and separating the over-size lumps of lighter rock which comprises, providing a screen sized to pass material under the predetermined size, submerging part of said screen in a body of liquid, charging the unsized material into the body of liquid above the submerged part of said screen, repeatedly elevating the unsized material from and dropping the same into the body of liquid above the submerged part of said screen from an elevation which provides a free fall for a distance such that the kinetic energy gained by freely falling lumps just larger than said predetermined size is sufficient to fracture such lumps of barite upon impact with a rigid body adjacent the surface of said body of liquid but insufficient to fracture such lumps of lighter rock, and continuously passing the under-size material through the submerged part of said screen.

2. The process of claim 1 wherein the liquid is periodically flowed through said screen in the direction opposite that in which the under-size material is passed.

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