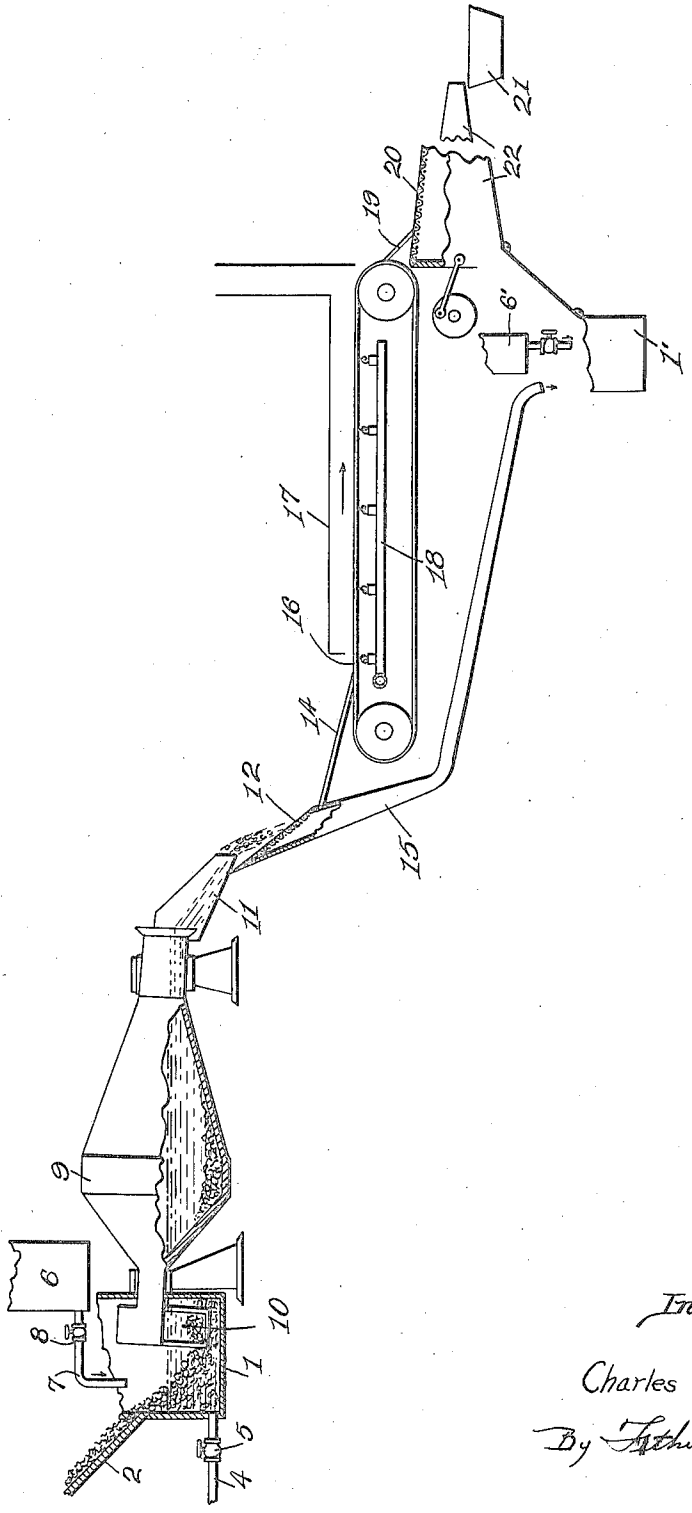
C. SPEARMAN.

FLOTATION PROCESS.

APPLICATION FILED JULY 22, 1918.

1,377,937. Patented May 10, 1921.



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FLOTATION PROCESS.

1,377,937. Specification of Letters Patent. Patented May 10, 1921.

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To all whom it may concern:

Be it known that I, CHARLES SPEARMAN, a subject of the King of Great Britain, and resident of the city of Westmount, in the Province of Quebec and Dominion of Canada, have invented certain new and useful Improvements in Flotation Processes, of which the following is a full, clear, and exact description.

This invention relates to a process of separating minerals by flotation and particularly to the process of separating graphite from the gangue with which it is associated.

For certain purposes, it is desirable to recover flake graphite in size and physical properties as nearly as possible as it occurs in nature, and one of the objects of my invention is to provide a method of separating this graphite in flakes from the gangue, so that the maximum amount of high grade product can be procured for use in the manufacture of crucibles and the like.

A further object is to provide a process in which practically all the remainder of the graphite can be recovered from the ore in a high state of purity, although in a more finely divided condition.

According to my invention, I grind the ore in any suitable apparatus, preferably a ball mill, the ore being mixed with a solution of water containing a very small percentage of a preferably non-frothing oil. By regulating the proportion of the aqueous solution used, I find that I can regulate the size of the graphite flakes and also of the masses of discrete particles of graphite produced, and these can be readily floated and separated from the gangue with a minimum amount of labor, apparatus and expense. I have also found that with certain kinds of ore, the flake graphite with any adhering gangue *in situ* may be retained in the grinding mill until all the gangue is removed by attrition without appreciable injury to the flakes, while with certain other kinds of ore, it is necessary to pass the flakes through rolls to remove this adhering gangue. In the latter case, the powdered residue, which has been screened from the flakes and which consists of powdered gangue with a percentage of graphite may be separated by a secondary separating operation.

The ore to be treated containing graphite in suitable proportion is mixed with water containing say less than one-half of one per cent. of oil or oily matter, the proportion of oil depending on the nature and the richness of the ore. An oil suitable for use with graphite and satisfying the commercial and practical requirements is common kerosene. The amount of the aqueous solution may be varied to produce graphite flakes of various sizes, but to recover the most desirable relatively large and distinct graphite flakes with the adhering masses of discrete particles of graphite, which will be caught on say an eighty or ninety mesh screen, I prefer to use approximately one ton and upward of the aqueous solution to one ton of ore. This mixture of the ore and aqueous solution is placed in a ball mill of the usual cylindrical or conical type and is there ground to the desired mesh. As the cylinder revolves, the material is carried up the sides of the cylinder and becomes sufficiently agitated with the solution to enliven the pulp. On liberation from the gangue, the larger graphite flakes with cohering fragments of graphite are raised to the top and are floated there by reason of the surface tension of the solution.

During this grinding and floating process, particles of finely powdered graphite, covered with a thin film of oil and thus having an affinity for each other, collect on the surface of the graphite flakes and cohere thereon, thus protecting the body of the flakes from attrition. This is of the utmost importance, as the flake graphite is not only thus protected from attrition and disintegration, but the powdered graphite in a highly pure and commercial form is at the same time separated from the gangue. The floated particles are then run off from the surface and pass through a suitable drying apparatus to remove the water and oil. On being dried, the powdered graphite falls away from the flakes and can be separated by screening. If any further particles of ore or gangue are still associated with the graphite flakes, these flakes are passed through rollers and then screened. The powdered graphite residue, which may be mixed with a relatively large proportion of powdered gangue, is then passed through a secondary separating process similar to the first, after which powdered graphite in a practically pure condition is obtained in like manner.

In the drawing the figure represents diagrammatically an arrangement of apparatus whereby the process may be practised. Referring to the parts thereof by the refer-

ence numerals applied, let it be understood that the numeral 1 designates a feed box into which the ore is fed by way of a chute 2, and into which water is supplied by way of a conduit 4 under control of a valve 5. The oil is supplied into the feed box 1 from the tank 6 by way of the pipe 7 under control of the valve 8. The oil, ore and water are fed together from the feed box 1 into the reducing mill 9, which is here shown as a conical ball mill, the feed being accomplished by means of the scoop 10 operated conjointly with the mill, or, of course, in any other well known suitable fashion. The proportion of oil and water mixture to ore depends, of course, upon the proportionate feed of oil, water and ore to the feed box 1. In the mill, which is rotated in any well known fashion, the ore is reduced in the presence of the oil and water mixture, the freed particles and flakes of the graphite being carried to the surface of the aqueous solution within the mill by the rotation of the mill, and being floated out by the flow of the aqueous solution through the mill, and hence it will be seen that the length of time that the freed particles remain in the mill will be regulated by the flow of the aqueous solution through the mill, the particles being reduced in size the longer they are permitted to remain in the mill. From the mill the material floated off is discharged on to a launder or distributer 11 which is effective to spread it out and discharge it upon a screen 12 by which the solid material is strained out of the water, the former being discharged on to a distributer 14 and the latter into a conduit 15. Any proportion of fine gangue engulfed in the water will be carried through the strainer 12 so that the material deposited on the distributer 14 will be the graphite flakes with their cohering coating of graphite particles. The distributer 14 is effective to properly dispose the material received thereon on to a conveyer 16, which is operated to carry the material through a drying apparatus. This is diagrammatically shown as an oven 17 suitably heated from a source 18. The heating is effective to drive out the water and the oil from the material so that the particles and flakes resume their discrete association, and from the conveyer 16 the material may be removed as by the scraper 19, which discharges it on to a screening device 20. This screening device is of proper mesh to hold the flake graphite and permit the passage of the powdered graphite and any other fine mesh material which may be mixed with it. The screening device is operated to thus effect the separation of different sorts of material, and deposit the flake material at the point of disposal 21 and discharge the fine material on to the chute 22. For the purpose of separating the powdered graphite out of any of the fine refuse material which may have accompanied it through the processing, it may be subjected to a second similar operation, upon being fed from the chute 22 into a second feed box 1′, which is supplied with oil from the tank 6′ and water from the mill discharged by way of the conduit 15.

By using this process, a maximum amount of graphite flakes in an essentially pure condition and of the required size to be held on say a ninety mesh screen can be produced from the ore with a minimum amount of apparatus, labor, time, space and cost; also the residue consisting of powdered graphite can be recovered, so that the proportion of recovered graphite is greater than by any other process used at the present time.

Having thus described my invention, what I claim is:—

1. A process of concentrating ore which consists in grinding the ore with an aqueous solution containing a small percentage of oil, and agitating the material to separate the desired values from the gangue and permit particles of the values to coalesce and float on the surface of the solution, and then destroying the adhesion of the coalesced particles and screening the values to separate the larger flakes from the powdered particles.

2. A process of recovering graphite from its ore, which consists in grinding the ore with an aqueous solution containing oil, then agitating the material and permitting the graphite to be carried by mechanical means to the top of the solution with adhering masses of discrete particles of graphite, and then collecting the graphite from the surface and drying it until the adhesive oil is driven off and screening same to separate the flakes from the powdered graphite.

3. A process of recovering graphite in flakes, which consists in grinding the ore with an aqueous solution containing an oil, then agitating the solution and raising the flakes to the surface of the solution by mechanical means until the flakes have become covered and protected by adhering masses of discrete particles of graphite, then destroying the adhesion between the discrete particles of the graphite, and then screening to separate the flakes from the powdered graphite.

4. A process of separating graphite from gangue, which consists in grinding the ore with an aqueous solution containing an oil, agitating the material in an upward direction until the graphite flakes are covered with protecting masses of powdered graphite and floated to the surface, then removing the graphite, destroying the adhesion between the flake and powdered particles and screening to separate the graphite flakes from the powdered graphite.

5. A process of separating graphite from gangue, which consists in grinding the ore with an aqueous solution containing an oil, agitating the material until the graphite flakes are covered with protecting masses of powdered graphite and in such a manner as to float same toward the surface, then removing the graphite, drying it to drive off the adhesive oil and screening to separate the graphite flakes from the powdered graphite.

6. The process of recovering graphite from its ore which consists in reducing the ore in the presence of an aqueous solution containing an oil having a preferential affinity for the graphite and treating the mixture to permit the accretion of small particles of graphite upon the free flakes thereof, floating off the values before the reduction of the flakes, and treating the recovered values to destroy the adhesive efficacy of the oil and separate the flakes from their accretions whereby to secure a recovery of the different sizes separately.

In witness whereof, I have hereunto set my hand.

CHARLES SPEARMAN.