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METHOD OF AND APPARATUS FOR SIMULTANEOUS IMPACT CRUSHING OF SEPARATE STREAMS OF SIZED ROCK

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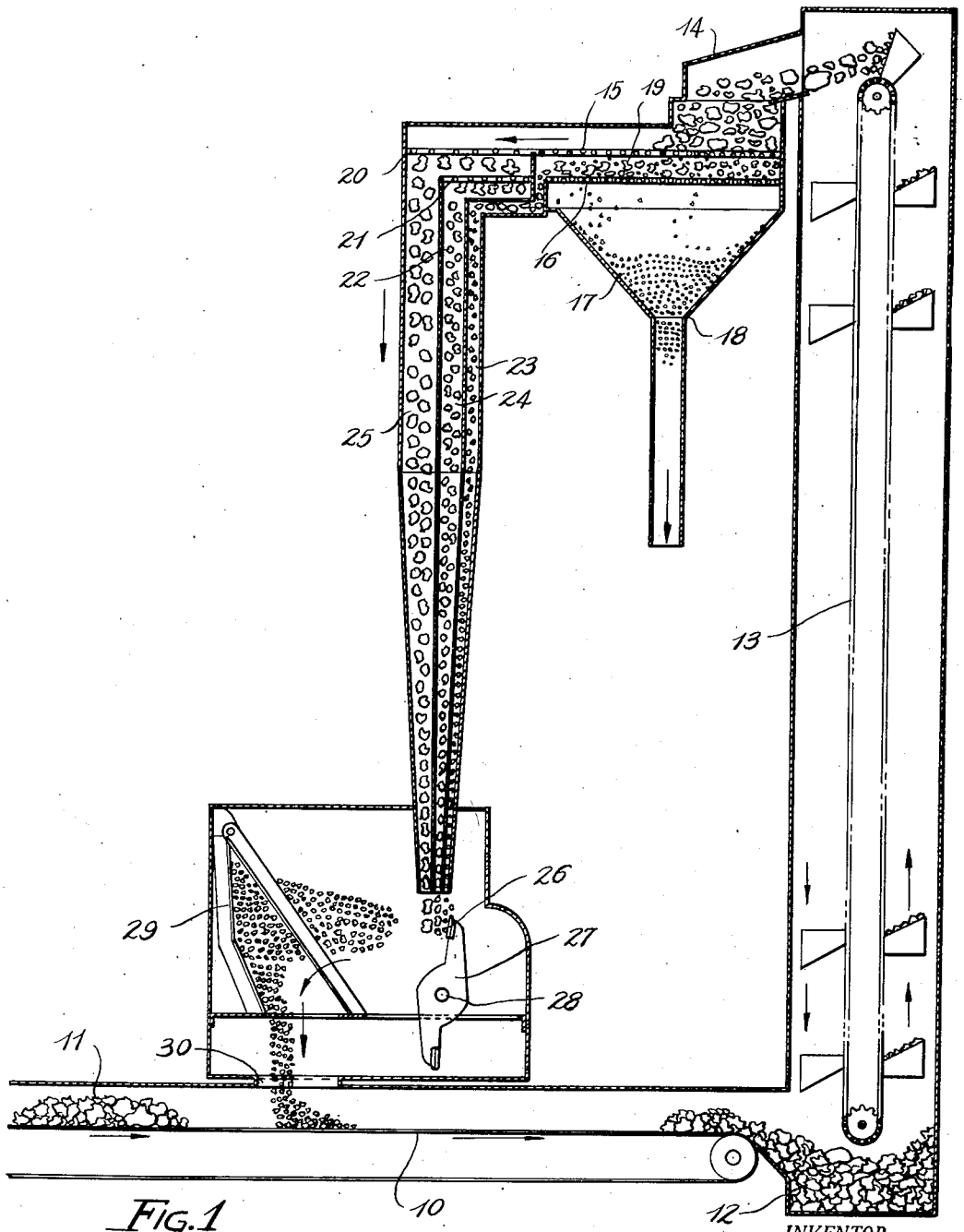

FIG. 1

INVENTOR.
JOHN BLAND

BY

Hazard & Miller

ATTORNEYS

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METHOD OF AND APPARATUS FOR SIMULTANEOUS IMPACT CRUSHING OF SEPARATE STREAMS OF SIZED ROCK

John Bland, Pacific Palisades, Calif.

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2 Claims. (Cl. 241—24)

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This invention relates to a method and apparatus for crushing or pulverizing various materials, and has been primarily devised for crushing or pulverizing hard or silicious rocks or ores although it may be used for other analogous purposes.

One object of the invention is to provide a method for crushing or pulverizing hard rocks wherein a stream of the rock to be crushed is fed into the path of impact shoes of a rotary impeller or hammer which strike the rock at a very high speed and practically instantaneously change its direction of movement. The speeds of the impact shoes employed may vary from 8000 linear feet per minute to 20,000 linear feet per minute, or more, and by their sudden impact and change of direction of movement of the rock impacted the rock is crushed or broken and in fact appears to virtually explode into small fragments. These fragments in turn may be thrown against an impact plate where at high speeds additional breaking or pulverizing may occur. Impact crushers of this general type have heretofore been used on soft or sedimentary rock wherein the impact crusher may operate at a comparatively low speed. Usually however attempts at using an impact crusher on hard or silicious rocks have been unsuccessful due to the failure or inability of the impeller to stand up under the severe shocks occasioned by the required use of high speeds and the encountering of the harder rock. To overcome this difficulty I employ an impeller that is largely a monolithic structure except for replaceable impact shoes, such monolithic structure either being formed by a single casting to which the shoes are attached or if fabricated its parts are welded together so as to thus be rendered an integral construction.

Another object of the invention is to provide a method and apparatus wherein the rock is fed into the path of the shoes on the rotary hammer or impeller so as to reduce wear thereon. Heretofore, in impact crushers of this general character it has been common practice to drop all of the rock to be crushed in a common stream or chute with all sizes mixed together into the path of the shoes. This enables the larger pieces of rock to fall into direct contact with the shoes resulting in a very rapid wearing away of their faces due to chipping, flaking, or pitting of the metal. The bringing of the larger pieces of rock into direct contact with the shoes also tends to limit the speed of revolution and the force of the crushing blow because of the limited capacity

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of the revolving structure to absorb such heavy shocks. The wear to which the shoes are subjected is essentially of two kinds, namely the rubbing or scratching away of the metal due to rubbing of the rock relative to the shoes occasioned by the rock tending to slide thereon when it encounters the shoes at an angle and the direct impact occasioned by large rocks being squarely struck by the shoes. The rubbing or scratching of the metal can to a large extent be reduced or eliminated by directing the rock into the path of the moving impact shoe so that the departure from the normal angle of incidence is as little possible. The use of a very high speed of impact will normally accomplish this. High speed, however, will increase the wear due to impact which results in the pitting, chipping, flaking, or breaking way of small pieces of the faces of the shoes.

An object of the present invention is to provide an improved method and apparatus wherein the impeller may be driven at high speed to thus reduce the rubbing or simple attrition and which makes provision for reducing the effect of the impact occasioned by large rocks being struck directly by the face of the impact shoes.

Still a further object of the invention is to provide a method and apparatus for crushing rock and like substances wherein there is a continuously flowing circulatory path for the rock into which is introduced new rock to be crushed and from which it is continuously extracted to crush rock wherein the rock is segregated into large and small sizes which are fed into the path of the shoes in such a manner that the smaller particles are interposed between the shoes and the large rocks thus protecting the shoes from wear occasioned by heavy impact. This arrangement of feeding the rock into the path of the impeller enables the rock to be crushed very much finer than has been heretofore accomplished by impact type crushers.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

The figure is a diagrammatic sectional view of an apparatus that may be employed to carry out the present invention.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, 10 indicates an endless conveyor belt on which new rock to be crushed

indicated at 11 may be conveyed to a sump or bin 12. A bucket elevator 13 or the equivalent serves to elevate this rock from the bin 12 and discharge it into an upper hopper 14 to be deposited on a vibrating screen 15. Beneath this vibrating screen there is a second and finer vibrating screen 16 which permits fine particles 17 to pass therethrough and to be deposited in a hopper 18. These fine particles which pass through the lower vibrating screen 16 may represent the finished product. The two screens may be vibrated in any suitable manner so as to cause the rock to pass thereover and the finer particles to pass therethrough. Those particles indicated at 18 which pass through the upper screen 15 and which are caught on screen 16 are relatively small but are not small enough to be regarded as the finished product. The rock which passes over the upper screen 15 ultimately passes onto a relatively coarse vibrating screen 20 which permits relatively large rocks to pass therethrough and if desired there may be a vibrating screen 21 positioned therebelow which will catch the largest rocks but permit rocks of intermediate size indicated at 22 to pass therethrough. The smallest rocks which are caught on screen 16 ultimately pass into a chute 23, the intermediate rocks through a chute 24, and the large rocks into a chute 25. These chutes feed these streams in consecutive order so that they will fall in front of shoes 26 on the rotary impeller 27 mounted on a shaft 28 and preferably rendered integral therewith. Shaft 28 may be driven at high speed by any suitable source of power.

An impact plate 29 is arranged opposite the impeller so that rock struck by the shoes is thrown thereagainst. When the rock strikes the impact plate 29 it may fall through passages 30 onto the conveyor belt 10 and which will be carried with the incoming rock to the sump or bin 12.

It will be noted from the above-described construction that the relatively small rock particles are fed into the path of the impact shoes 26 so that they are at first to be encountered by the shoes. The large rock particles which are fed through chute 25 are those which are most remote from the shoes. The intermediate particles occupy positions between the smallest particles and the largest particles. By operating the impeller at high speed sliding of the rock relatively to the shoes is to a large extent eliminated so that wear of the shoes by simple attrition or sliding or scratching is largely eliminated. The impact wear is also minimized due to the fact that the large rock particles do not come into direct engagement with the faces of the shoes. The intermediate and smaller particles prevent such direct engagement and as the smaller particles which drop directly against the faces of the shoes have little inertia, these particles do not tend to pit or break off or flake off the shoe faces. The speed of rotation of the shoes is maintained quite high normally ranging from 8000 linear feet per minute to 20,000 linear feet per minute. The falling rock which is encountered by the shoes has its direction changed almost instantaneously resulting in the large rock particles being broken into small fragments. These rocks fairly seem to explode under these conditions. The smaller rock particles are broken further by being thrown against and grinding against the larger rock particles as soon as suffering direct impacts from the shoes. The rock particles after striking the impact plate 29 and being somewhat further broken up descend and pass on the conveyor 10 with the incoming rock 11 into the sump. On being carried up by the elevator 13 those particles which are small enough to represent the finished product pass through screens 15 and 16 into the hopper 17. Those particles which are not quite small enough to represent the finished product are caught on screen 16 and pass into chute 23 to represent the smaller particles that serve to protect the faces of the shoes. The intermediate particles descend through chute 24 and the larger particles through chute 25.

It will, of course, be appreciated that the use of three chutes is not necessary. The screening of the rock merely into two sizes is quite feasible in which case, the smaller particles are fed into the path of the shoes 26 so that they will protect the faces of the shoes from coming into direct contact with the large rock sizes. It is likewise feasible to increase the number of chutes in excess of three in which case the large rock sizes will be fed into the path of the shoe most remote from the face thereof.

I find that with this construction a rotary impact crusher may be satisfactorily employed for crushing hard silicious rocks as distinguished from soft or sedimentary rocks. By employing a monolithic type impeller it will stand up under high speed and under the severe impacts occasioned thereby. The use of high speeds will alone minimize attrition or abrasion of the rock on the faces of the shoes. However, by feeding the rock in such a manner that the small particles are interposed between the large rock and the faces of the shoes impact wear on the faces of the shoes will likewise be minimized. It is not necessary to perform the improved method with the high speeds heretofore mentioned, although these speeds are desirable in crushing many types of hard rock. Where a coarser finished product is desired the impeller may be driven at materially lower speeds than 8000 linear feet per minute, and when slower speeds are used I find that the interposing of the smaller particles between the large rock and the shoe faces reduces abrasive wear on the shoes which would otherwise occur due to the slower speed employed.

It will be appreciated that the above-described method and apparatus that rock may be continuously fed to the apparatus and the finished product continuously withdrawn therefrom and that the same screening operation may be used to separate the finished product and to segregate the rock that is fed to the impeller into large and small sizes with the small sizes being utilized to protect the shoe faces from the heavy impacts of the large rocks.

The interposing of small rock between the large rock and the shoes also enables larger rock to be fed into the path of the impeller than would otherwise be possible. It also enables the finished product to be crushed to a much finer condition in that the fine particles which descend through chutes 23 are interposed between the impeller shoes and the larger rock particles. These fine particles which have small masses and consequently small inertia which are not conducive to their being broken by impact alone are thus interposed or trapped between the shoes and the large rock particles which have greater inertia. Consequently the small rock particles are effectively pounded by the shoes against the large rock particles and are pulverized therebetween to a greater extent than where the small rock particles are merely subjected to impact alone. In this way a finished product may be obtained

wherein the rock is finely ground or pulverized which is highly desirable in certain operations.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. The method of crushing rock which includes providing a circulatory path for rocks, introducing rock to be crushed into the path, segregating crushed rock from the path representing the finished product, classifying the rock to be crushed according to size and feeding the classified rocks in parallel paths into the path of a rotary impeller disposed in said circulatory path with the small rocks arranged to engage the impeller first, and returning the crushed rock to said path.

2. An apparatus for crushing rock comprising means providing a circulatory path, means for introducing rock to be crushed into said path, screening means for screening out crushed rock representing the finished product, screening means for segregating large rock from small rock to be crushed, a rotary impeller disposed in said path, and means for feeding the large rock and small rock in separate streams into the path of said rotary impeller so that the small rock will be directly engaged by the impeller and will be interposed between the impeller and the large rock, and means for reintroducing the crushed rock into the circulatory path providing means.

JOHN BLAND.

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