June 29, 1965 D. J. DRINKWATER ETAL 3,191,874

DISINTEGRATORS

Filed July 30, 1963 2 Sheets-Sheet 1

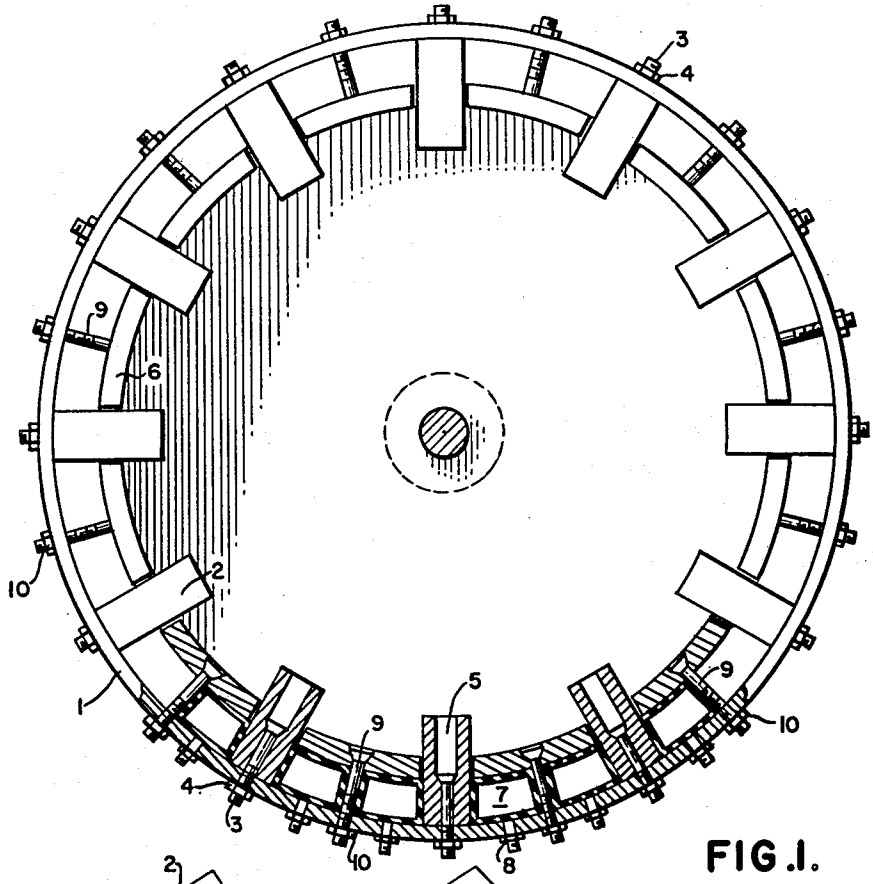


FIG. 1.

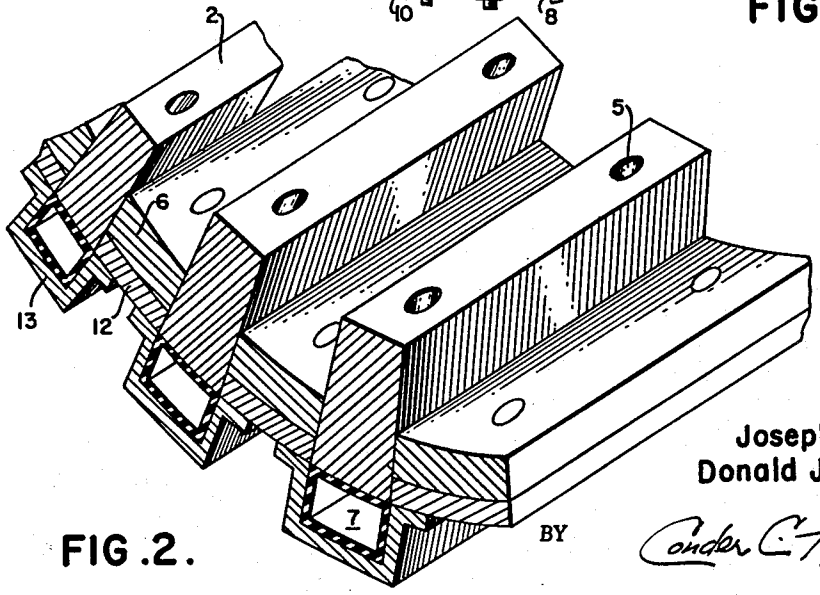


FIG. 2.

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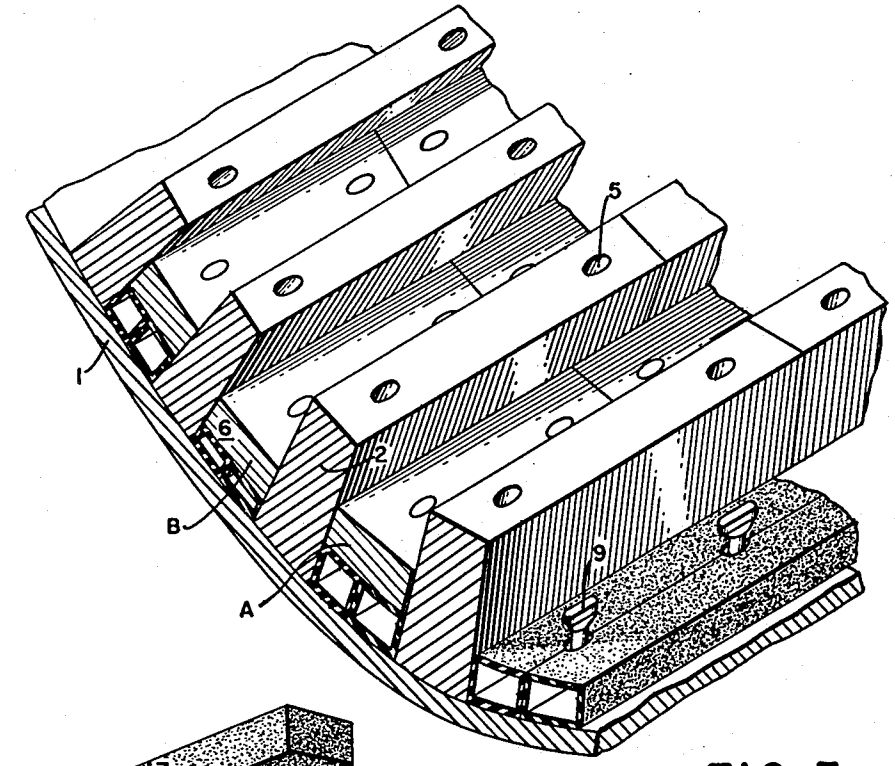


FIG. 3.

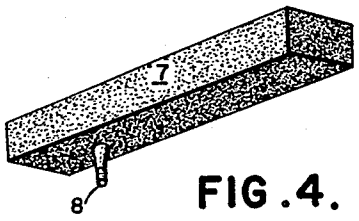


FIG. 4.

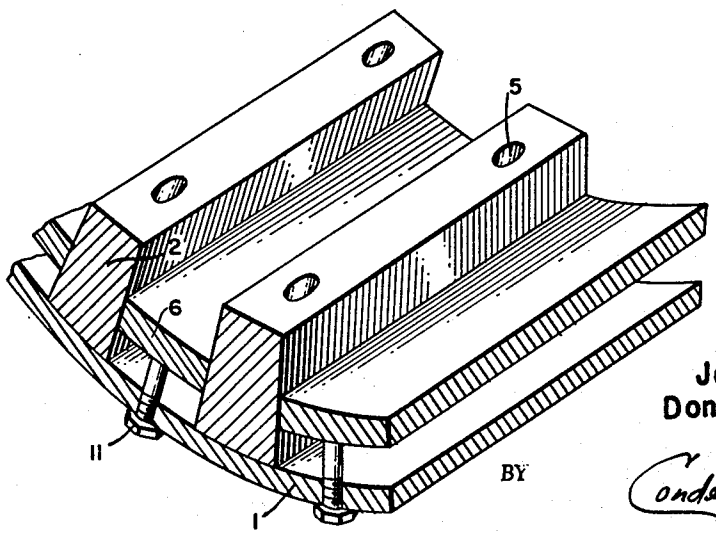


FIG. 5.

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Filed July 30, 1963, Ser. No. 298,702
7 Claims. (Cl. 241—183)

This invention relates to improvements in disintegrators of the kind known as rod or ball mills which are provided with wear plates. Such mills are adapted to reduce hard substances such as cement, clinkers, rock, ore, coal and other similar substances to relatively small particles or to pulverize the same. A brief description of the structure and operation of such mills is deemed desirable in order to show wherein our invention lies.

It is known to the art that material of the kind mentioned can be reduced in a revolvable metallic cylindrically shaped shell or drum containing a plurality of comparatively large and heavy metal balls or rods which are intermittently lifted as the drum rotates and dropped on the material to be crushed in the lower part of the drum. An improvement over this method of reduction is called autogenous grinding. In recent years it was found that the rods or balls could be dispensed with and the crushable material itself used as the grinding media, i.e., chunks of such material could be lifted as the drum rotates and dropped on the material remaining in the lower part of the drum and thereby perform the same function as the metallic rods or balls. But whatever media is used to effect the grinding, some means must be provided to lift or assist in lifting such grinding media. Otherwise, the crushable material would simply slide down the inner side of the drum as it rotates. One such means, and one commonly employed, is the utilization of longitudinally extending lift or wear bars positioned radially on the inside of the shell and bolted or otherwise secured thereto. These bars aid in carrying the grinding media up with the ascending side of the drum as the latter rotates about its longitudinal axis.

In operation, rod or ball mills gradually lose efficiency because the lifter bars wear down in height which results in a progressive loss of lift. By "lift" is meant the distance measured radially between the tops of the bars and the liner plates where the latter are used. When the bars are worn away to such an extent as to provide little or no lift, grinding virtually ceases. Thereupon it becomes necessary to shut down the mill, remove the worn lifters and replace them with new ones. The rate of wear on the lifters, particularly in autogenous grinding, is very high, sometimes requiring replacements every two or three months depending on the time the mill is in operation and the kind of material being crushed. Because of the gradual wear on the bars and the lack of means for compensating for the same, the efficiency of the mill is unnecessarily impaired. Also, because of the manner of securing the bars in place and the procedures necessary to be employed for replacing them, the replacement of the bars not only consumes a great deal of time but also results in an excessive amount of scrap loss, sometimes as much as 40%, because of the fact that much of the material remaining in the drum must be discarded as well as the worn bars themselves, the latter of which are capable of further use by the employment of our invention as will appear.

The present application sets forth certain improvements on the generic invention disclosed in the companion application of one of the joint inventors, Serial No. 298,710, filed July 30, 1963, entitled Disintegrators.

One of the features of our invention is the adjustment of lift in rod or ball mills by pneumatic means. Another

feature of the invention resides in the adjustment of the "lift" by adjustment not of the lift bars themselves, but of the liner plates whereby adjustment of the effective lift is accomplished. Other purposes will reveal themselves as the description proceeds.

Referring to the attached drawings, which are merely illustrative of embodiments of our invention,

FIG. 1 is a cross-sectional view of a rod or ball mill wherein the lift is adjusted by raising or lowering the liner plates by means of inflatable air tubes;

FIG. 2 is a perspective view in partial section of the inside of a rod or ball mill showing the liner plates in fixed position and the lift bars adjustable in height by means of inflatable air tubes;

FIG. 3 is a view in perspective and in partial section of a portion of the assembly illustrated by FIG. 1;

FIG. 4 is a perspective view of one of the air tubes, and

FIG. 5 is a perspective view in partial section showing the lift bars in non-adjustable positions and the liner plates adjustable by means of set screws.

In the drawings like reference characters designate the same parts in all of the views.

The preferred species of our invention is illustrated by FIGS. 1 and 3. From those figures, it will be seen that on the inside of the shell or drum **1** of a rod or ball mill elongated lift bars **2** are provided. These bars are spaced apart from each other in parallel relationship and are secured in non-adjustable positions to the drum by bolts **3** having nuts **4** screwed to the ends thereof on the outside of the drum, the heads of the bolts being countersunk in the bars as indicated at **5**.

Interposed between each pair of bars are wear or liner plates **6** supported in predetermined vertical adjusted positions on air cushions provided by inflatable flexible tubes **7** fabricated of rubber or like material and having air valves **8** projecting therefrom and extending to the outer surface of the drum. To keep the liners from falling to the bottom of the drum as the latter rotates, they are mechanically attached to the drum by elongated bolts **9** having nuts **10** screwed to the ends thereof which extend through the drum. These bolts are interposed between pairs of tubes as illustrated by FIG. 3, although it will be understood that one or any number of tubes or bags may be employed and that such bolts may be inserted at such places as will not interfere with the inflation of the tubes.

Instead of using air cushions to adjust the height of the liner plates, we also contemplate adjusting the plates by set screws **11** as illustrated by FIG. 5.

A third modification of our invention is illustrated by FIG. 2. In this modification the drum is made up of longitudinal sections **12** spaced apart from each other and joined together by elongated troughs **13** having open upper sides welded or otherwise secured to adjoining sections. In these troughs are placed inflatable tubes **7** on which are seated the lift bars **2**, such bars being held in place by countersunk through bolts **9** as previously described. The liner plates are firmly fixed to the drum. By this means the lift bars themselves are adjusted to secure the desired lift.

From the foregoing, it will be seen that the lift may be adjusted in two ways, viz, by adjusting the height of the liner plates and by adjusting the height of the lifter bars and that the height of the liner plates may be adjusted by pneumatic or by mechanical means. There is indicated in FIG. 3 the normal adjustment of the liner plates where inflatable tubes are employed. When the lifter bars wear down to such an extent as to require adjustment or replacement, the tubes are partially deflated whereupon the liner plates under the force of gravity will fall to their reset positions. Then the bolts holding the plates to the drum are tightened to limit the height of the plates

from the interior surface of the drum and more air may be injected into the tubes to exert a greater outwardly directed force against the plates to hold them firmly pressed against the plate bolt heads **9**. The reset position of the plates is indicated by B in FIG. 3. On the other hand, if the mechanical means is employed to lower the plates, all that is necessary to be done is to tighten up on the bolts or set screws **11** shown in FIG. 5 to thereby lower the plates in order to secure the desired adjustment.

Similarly, when the inflatable tubes are used to elevate the lifter bars as shown by FIG. 2, the procedure is to loosen up on the nuts holding the bars in place and inflate the tubes.

Unexpected advantages flow from the use of pneumatic tubes behind the liner plates. Such tubes not only cushion the liner plates and thus lessen the wear to which they are normally subjected but also seal the voids behind the plates and thereby materially lessen what is known as pulp grinding, i.e., grinding of those portions of the drum itself under the plates. But more importantly, we estimate saving in scrap loss due to bar replacements of approximately 14 percent.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is set forth in the following claims:

1. A disintegrator comprising a drum; lifter bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for adjusting the height of said liner plates to secure a predetermined lift of said bars, said lifter bars extending radially a substantial distance into the interior of said drum beyond the limits of said liner plates at all times during normal operation of the disintegrator.

2. In a disintegrator, a drum; lifter bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for adjusting the vertical distance said plates are spaced from the interior of said drum to secure a predetermined lift of said bars, said lifter bars extending radially a substantial distance into the interior of said drum beyond the limits of said liner plates at all times during normal operation of the disintegrator.

3. In a disintegrator, a drum; lifter bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for adjusting the vertical distance said plates are spaced from the interior of said drum to secure a predetermined lift of said bars, said means comprising pneumatic instrumentalities positioned under said plates.

4. In a disintegrator, a drum; lifter bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for adjusting the vertical distance said plates are spaced from the interior of said drum to secure a predetermined lift of said bars, said means comprising inflatable flexible tubes positioned under said plates.

5. In a disintegrator, a drum; lifter bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for adjusting the vertical distance said plates are spaced from the interior of said drum to secure a predetermined lift of said bars, said means comprising set screws extending through said drum and attached to said plates.

6. In a machine of the class described, a drum; lift bars disposed in said drum; liner plates disposed between said bars, and means associated with said drum for vertically adjusting said bars to increase their lift, said means associated with said drum for vertically adjusting said bars comprising inflatable containers positioned under said bars.

7. The combination set forth in claim **6** wherein said inflatable containers comprise inflatable flexible tubes.

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