May 4, 1937. S. L. MILLER ET AL 2,079,221

DISCHARGE FOR GRINDING MILLS

Filed Sept. 9, 1935 2 Sheets-Sheet 1

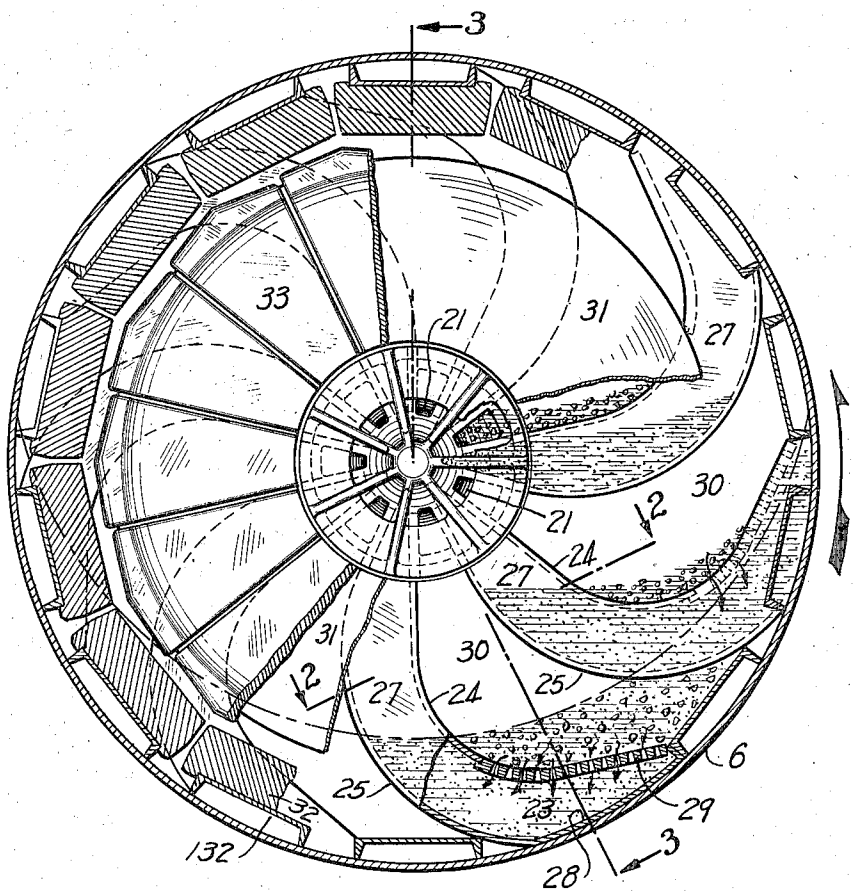

Fig 1

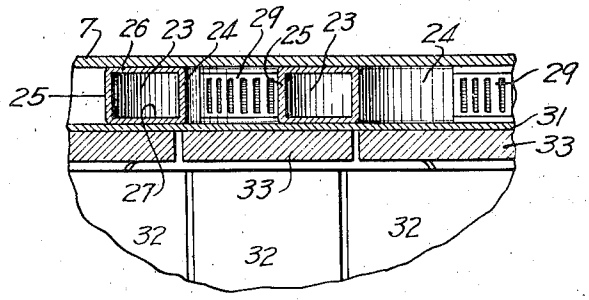

Fig 2

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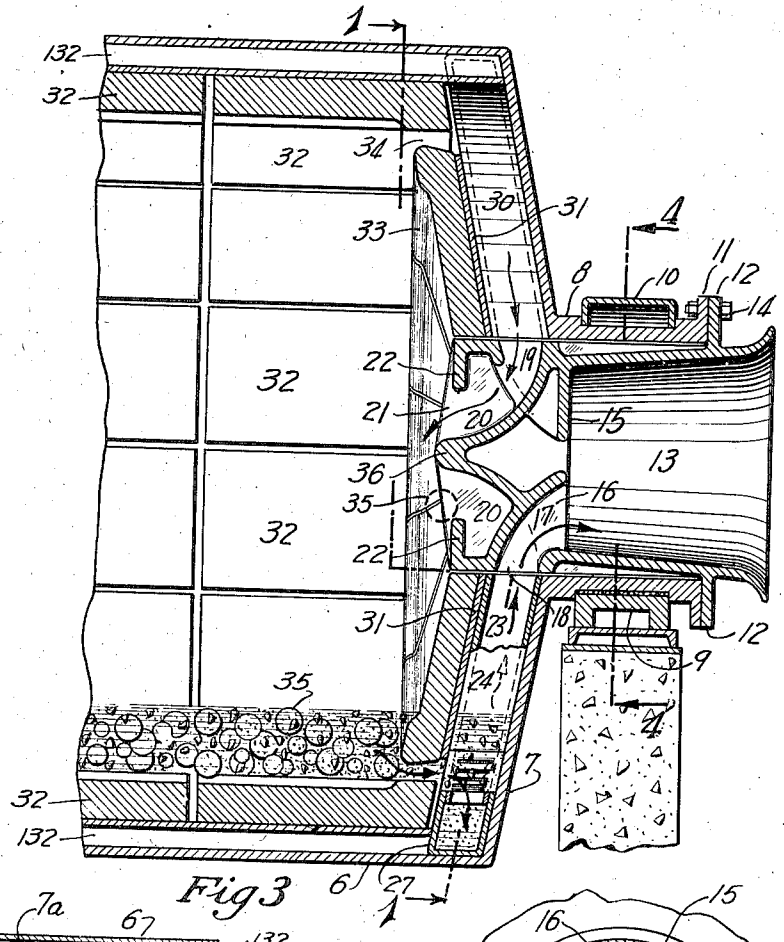

Fig 3

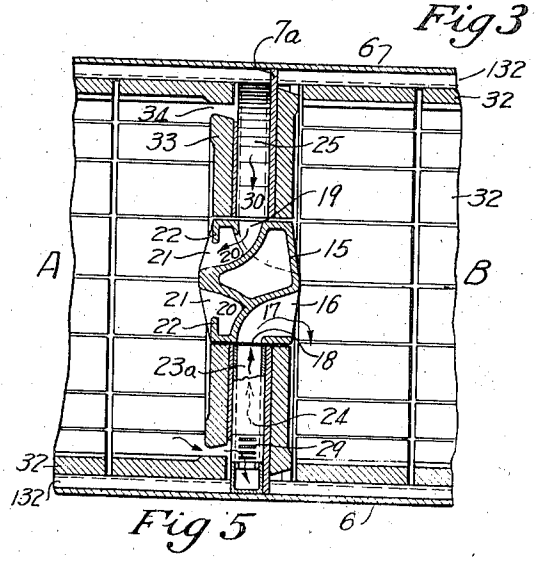

Fig 5

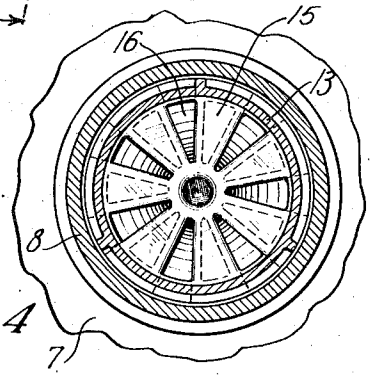

Fig 4

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UNITED STATES PATENT OFFICE

2,079,221

DISCHARGE FOR GRINDING MILLS

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Application September 9, 1935, Serial No. 39,763

3 Claims. (Cl. 83—9)

This invention relates to improvements in grinding mills of the type usually referred to as ball mills, and has reference more particularly to an improved discharge.

It is the object of this invention to produce a ball mill of such construction that efficient grinding, either wet or dry can be effected with a comparatively small number of attrition members and a small quantity of ore.

Another object of this invention is to produce a discharge of such construction that the material will be subjected to a separating action, and which passes the material below a certain size to the discharge trunnion, while the oversize material is returned to the mill at or near its center of rotation.

A still further object of the invention is to produce a grinding mill of the ball type in which the inner end of the discharge trunnion shall be so constructed that it will impart to any attrition member that comes in contact therewith, a force that tends to direct it inwardly into the center of the mill.

The above and other objects that may become apparent as the description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail, and reference for this purpose will be had to the accompanying drawings in which the invention has been illustrated in its preferred form, and in which—

Figure 1 is a section taken substantially along line 1—1, Figure 3, parts being broken away to better disclose the construction;

Figure 2 is a fragmentary section taken on line 2—2, Figure 1;

Figure 3 is a section taken on line 3—3, Figure 1;

Figure 4 is a section taken on line 4—4, Figure 3; and

Figure 5 is a diametrical section, similar to that shown in Figure 3, but which shows the discharge arranged to feed into a tandem mill.

In the drawings, reference numeral 6 designates the shell which is usually cylindrical, and numeral 7 designates the head at the discharge end. Head 7 is provided with a discharge trunnion 8 which is mounted for rotation on a bearing 9, and whose upper surface is protected by a cover 10. The outer end of trunnion 8 is provided with a flange 11 which cooperates with a similar flange 12 carried by the trunnion liner 13.

The flanges 11 and 12 are usually connected by bolts 14. The liner 13 fits the cylindrical opening in trunnion 8, and projects into the interior of the mill a considerable distance. The inner end of the trunnion liner is separated from the outer frusto-conical portion thereof by a wall 15 that, in the example shown, is provided with several sector-shaped openings 16 which are connected by curved passages 17 with corresponding openings 18 in the outer surface of the liner.

Openings 19, which alternate with the openings 18, are connected by passages 20 with openings 21 in the inner end of the liner. An annular wall 22 extends inwardly and its inner end forms the radial boundary of openings 21.

Located along the inside of the head 7 are a plurality of curved conduits whose interior chambers have been designated by reference numerals 23; these conduits have curved walls 24 and 25 joined by an outer wall 26 and an inner wall 27. The outer wall has an arcuate portion 28 that fits against the inner surface of the shell 6. Wall 24 has an opening which is closed by a grate 29.

As best shown in Figure 1, each wall 24 turns abruptly adjacent the opening in which the grates 29 are fitted so that each grate ranges laterally from the remainder of wall 24. This arrangement is effective for retaining some liquid against wall 24 which doesn't pass through grate 29 while any given conduit is in an ascending position, with the result that such liquid is utilized in effecting a return of oversize from the grates to the grinding chamber during the continued ascension of the conduit.

It will also be noted in Figure 1 that the outer ends of liners 33 are so constructed that when they are in their fixed position in the mill, in spaced relation to the raised surfaces of liners 32, the space between the aforesaid liners is narrowest adjacent the side wall of each liner 33 in the forward position with respect to the direction of rotation, and progressively widens rearwardly to the opposite side wall of each liner 33. In Figure 3 the relative positions of liners 32 and 33 have also been shown and it will be noted that the narrowest space between the liners is nearest the inside of the mill.

From the foregoing, it is apparent that if material from the mill enters the space between the liners 32 and 33 it will not become lodged and block the passage as the natural movement of such material is rearwardly with respect to the direction of rotation and outwardly toward the end of the mill, and in each of these directions the space progressively widens.

The inner ends of the passages 23 are arranged in register with the openings 16 in the trunnion

liner and communicate with the discharge end of the trunnion liner through passages 17 and openings 18 in the manner shown in Figure 3.

It will be observed from Figure 3 that open spaces 30 are formed between the walls 24 and 25 of adjacent conduits. An annular plate 31 of frusto-conical shape surrounds the inner end of the trunnion liner and is held in position thereby and rests against the walls 27.

The plate 31 is covered interiorly of the mill by end-liners 33 which are mounted on and surround the inner periphery of the lining and both the plate 31 and the liners 33 are spaced from the interior liners 32 of the shell 6 of the mill, which are supported on channeled girders 132. The space between the end-liners covering the plate 31 and the shell-liners of the mill, provides an annular opening 34 through which material may enter the chambers 30.

The opening 34 is too small for the attrition members 35 to enter, and the openings 21 should be sufficiently wide to permit of a ready passage of the oversize, irrespective of the size of the attrition members which may be smaller than the openings. The chambers 30 are in communciation at their inner ends with the openings 19 in the wall of the trunnion lining 13 so that the oversize material that enters the chambers 30 will re-enter the mill through the passages 20 and the openings 21.

When the mill is in operation, it rotates in a counter-clockwise direction when viewed as in Figure 1, and the curved walls 24 serve to elevate the material, causing it to flow first over the grates 29, where the material below a certain size passes into the conduits 23. As the mill continues to rotate, the oversize material will follow the walls 24 and will finally be returned to the mill through the opening 21, while the material that passes thru the grates will be delivered to the passages 17 and will be discharged into the trunnion lining 13 thru the openings 16.

In Figure 3, an attrition member 35 has been indicated by dotted lines and shown as positioned in one of the openings 21. The wall 22 serves as a barrier or deflecting member to prevent general ease of entry of the larger attrition members and to direct the members toward the center 36 which forms the extreme inner end of the trunnion lining and the combined action of the wall 22 and the end 36 serves to direct the members inwardly toward the center of the mill.

It will be observed from an inspection of Figure 3 that the attrition members and the ore form only a comparatively thin layer over the lowermost part of the inner surface of the mill, and by reason of the fact that the opening 34 is adjacent the inner surface of the lining 32, the ore pulp or the ore that has been ground fine enough to pass through the opening 34 can enter the chambers 30, where the separating action, above described, takes place, and from which the oversize is returned for further grinding. The ore is usually ground wet, but with the machine above described, it can also be ground dry.

In Figure 5 a tandem mill has been shown, and the rough grinding mill has been designated by A, while the regrinding mill has been designated by B.

The two mills are separated by a wall 7*a* which corresponds to the head 7 in Figure 3, and arranged along the left hand side of the head 7*a* are conduits 23*a* that correspond in every particular with those already described, with this exception, that those above described fit against a frusto-conical head 7, while those shown in Figure 5 fit against the plane head 7*a*.

Since the material from mill A is delivered to the mill B for further grinding, that portion of the trunnion lining 13 that is located outside of the wall 15 is unnecessary, and has been omitted, but in other respects, the construction is the same, and the parts have therefore been designated by the same reference numerals.

When a tandem mill is employed, the material that passes through the grates 29 is reground in mill B, and it is evident that as many mills can be connected in tandem as desired.

One of the important advantages of the construction above described is that the pulp line can be kept very low and a correspondingly small number of attrition members used, and this reduces the power required to operate the mill. The conduits, by means of which the separation is effected, are of simple construction, and can be made without difficulty, and since they are alternately duplicates, they may be made interchangeable and independently replaceable, or they may be made a part of the head-assembly.

Having described the invention, what is claimed as new is:

1. In a grinding mill mounted for rotation and having a head provided with a discharge opening, a hollow liner in the opening, the end of the liner projecting beyond the inner surface of the head, the liner having a plurality of passage ways from the periphery to one end and a plurality of passages leading in a reverse direction to a common opening, which latter opening extends to the other end of the cylindrical liner, a plurality of radially extending conduits located adjacent the inner surface of the head with their inner ends in communication with the passages in the liner that open outside of the mill, the walls of the conduits on the sides facing in the direction of rotation having openings forming a grate, the spaces between the conduits communicating with the passages in the liner that open within the mill, a removable cover forming an inner wall for the spaces, the cover terminating a short distance from the inner periphery of the mill whereby openings are provided between the interior of the mill and the outer ends of the spaces between the conduits, and through which material may enter said spaces when the mill rotates.

2. In a grinding mill mounted for rotation, and having a head provided with a central discharge opening, a cylindrical liner in the opening, the end of the liner projecting beyond the inner surface of the head, the liner having a plurality of passage ways from the periphery to one end and a plurality of passages leading in a reverse direction to a common opening, which latter opening extends to the other end of the cylindrical liner, a plurality of separate curved conduits located adjacent the inside surface of the head and radially arranged, the inner ends of the conduits communicating with the passages in the liner which open on the outside, the spaces between the conduits communicating with the other passages, the concave walls of the conduits having openings forming grates, means for holding the conduits from moving relative to each other and relative to the head, and an annular cover for the conduit assembly extending from the liner to a point spaced from the inside of the mill, whereby the spaces between the conduits

form chambers connected at their inner and their outer ends with the interior of the mill.

3. A grinding mill comprising a shell having one end closed by a head provided with a hollow discharge trunnion, a liner in the trunnion, one end of the liner extending into the mill, the liner having a transverse partition intermediate its ends, the inner end of the liner having a plurality of passages, alternate passages extending from the periphery to the outside of the transverse partition and the others extending from the periphery to the inside of the mill, a plurality of separate radially extending conduits having their inner ends in communication with the passages that open on the outside of the mill, the conduit walls on the side facing in the direction of rotation having openings forming a grating, means for holding the conduits from moving relative to each other and relative to the head, a removable cover for the spaces between the conduits, the inner ends of the spaces between the conduits being in communication with the passages in the liner that open within the mill, there being openings from the interior of the mill to the spaces between the conduits, said openings being adjacent the inner periphery of the mill.

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