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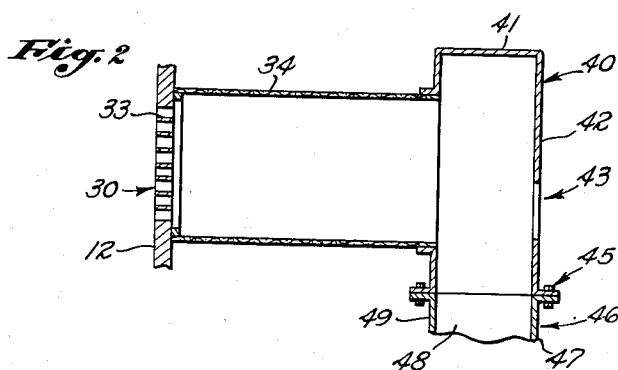
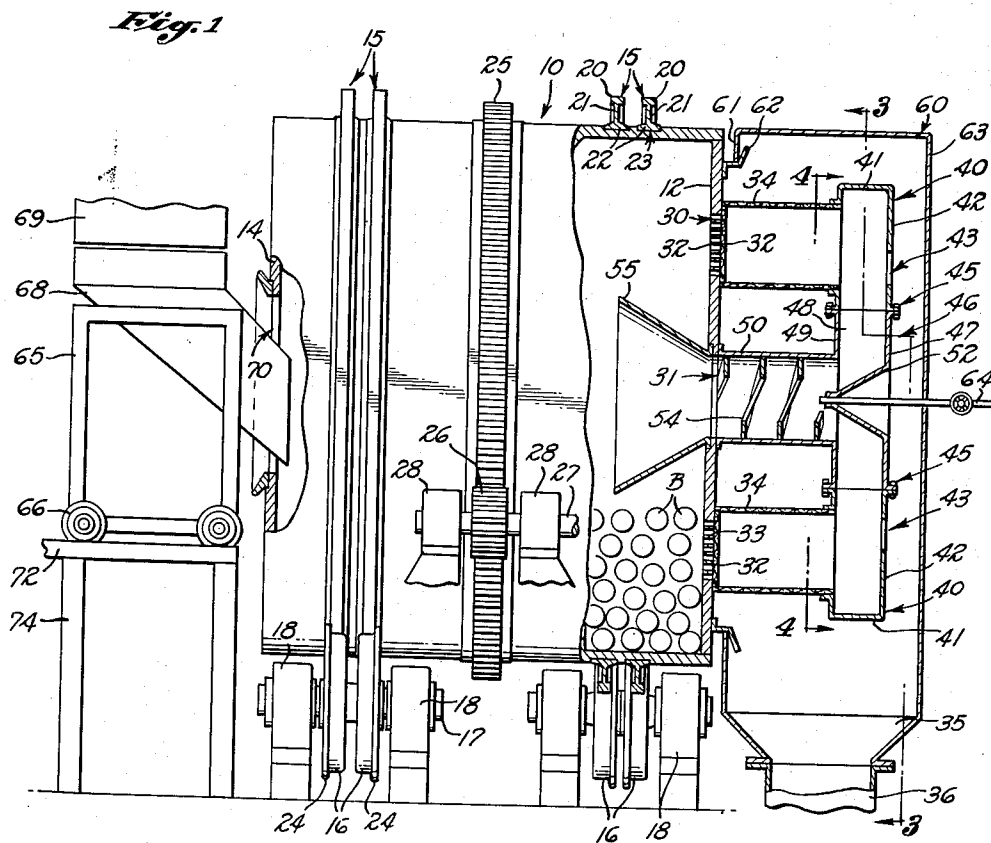
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SCREENING DISCHARGE DEVICE FOR ROD AND BALL MILLS

Filed May 29, 1950

2 Sheets-Sheet 1



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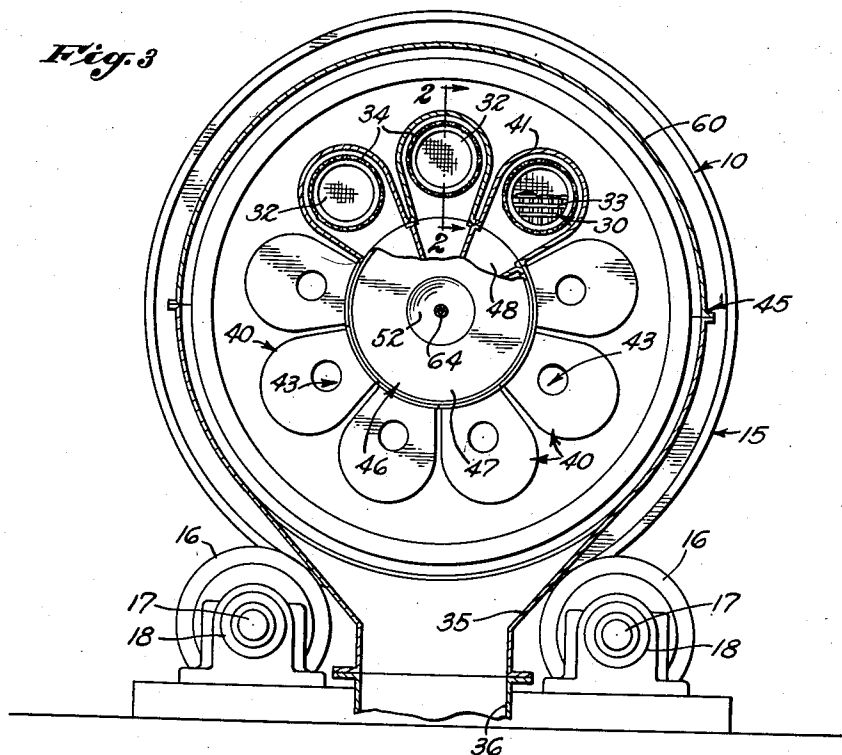
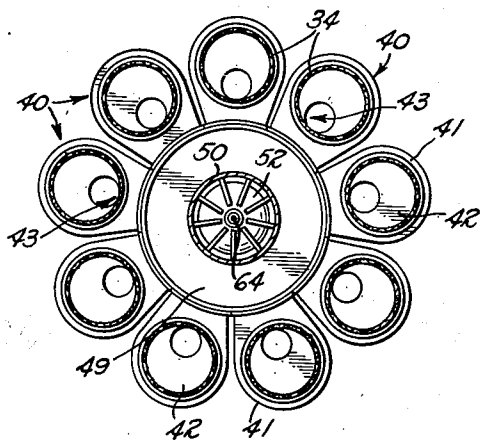


Fig. 4



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UNITED STATES PATENT OFFICE

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SCREENING DISCHARGE DEVICE FOR ROD
AND BALL MILLS

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This invention relates to rotary mills of the rod mill and ball mill type, which work upon horizontal axes, and applies more particularly to screening means employed at the discharge end of grinding mills of the indicated type.

It is a particular object of this invention to provide rod and ball mills with means for receiving ground materials from the discharge end of such mills, classifying the received material, and returning to the mill those portions of the discharge which have not been sufficiently ground.

It is also an object of the invention to remove from the discharge end of a grinding mill suitably ground materials at as early a stage as possible in order to reduce the load imposed by adequately ground materials where such ground materials would otherwise accumulate in the mill until they reach a centrally located discharge lip.

Another object of the invention is to provide a discharge controlling structure which will be effective to increase the capacity of a grinding mill by reason of the fact that properly ground materials are removed as fast as produced.

It is a more specific object of the invention to provide means at the discharge end of a grinding mill which is adapted to receive properly ground material with some accompanying oversize material, screen out and deliver the properly ground material, and return to the mill through the medium of the rotating action of the mill those oversize materials which have been separated so that they may be again subjected to grinding. A further object is to provide plural pocket means to which oversize materials may be delivered following screening, such pocket means serving during rotation to elevate oversize particles and during passage over or adjacent top center to drop them into return means leading back into the mill.

A further object of the invention is to provide appropriate feed means by which cement clinker or similar feed material being supplied to a grinding mill may be substantially continuously fed to the mill so that the feed may keep up with the rapid discharge of the ground material by way of the previously indicated classifying device, even where batches of feed material are required to be brought up to the mill from remote loading locations.

Other objects of the invention together with the various features of construction thereof will become apparent to those skilled in the art upon reference to the following specification and the accompanying drawings wherein certain embodiments of the invention are illustrated.

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In the drawing:

Fig. 1 is a side elevation of a ball mill embodying various inventive features hereof, portions being broken away to illustrate internal construction;

Fig. 2 is a fragmentary vertical section on an enlarged scale showing a portion of the screening and returning mechanism, this section corresponding with a portion seen in Fig. 1 and being taken from the line 2—2 of Fig. 3;

Fig. 3 is a transverse, vertical section and elevation as indicated by the line 3—3 of Fig. 1; and

Fig. 4 is a vertical transverse section taken on the line 4—4 of Fig. 1.

The drawings illustrate a more or less conventional ball mill working upon a horizontal axis and comprising a cylindrical shell 10 which conventionally receives a quantity of grinding balls B, the shell 10 having a discharge head 12 at one end and a feed head 14 at the other end. The shell 10 is shown as being provided with pairs of rails 15 supported upon flanged wheels 16 carried upon an axle 17 journaled in appropriate bearings 18. In the particular form illustrated, the rails 15 are generally in the form of conventional railroad rails having heads 20, webs 21, and flanges or bases 22 which are inset into annular grooves 23 formed on the outer wall of the shell 10. The wheels 16 may be standard railroad car wheels provided with flanges 24 which engage sides of the rails 15 in such a manner as to prevent axial shift of the mill. The contacting faces of the rail heads 20 and the treads of the wheels 16 conform with one another so that the lines of contact are of maximum length. The mill is rotated through the medium of a ring ear 25 secured around the shell 10 and a pinion 26 mounted on a drive shaft 27 carried in appropriate bearings 28.

For the purpose of classifying the ground material leaving the mill through the discharge head 12 and also for reducing the load of ground material as rapidly as possible, the discharge head 12 is provided with a plurality of screened discharge openings 30, preferably arranged in a circular series as best indicated in Figs. 3 and 4, and disposed intermediately of the peripheries of the shell 10 and the head 12 and a central opening 34 through which oversized material may eventually be returned. These openings 30 are provided with appropriate screening material, such as typical screens 32 indicated at the top of Fig. 1, or gratings 33 such as indicated in Fig. 2, or both as indicated at the bottom of Fig. 1. Secured against the outer face of the discharge head 12 around each of the openings 30 is a

tubular, preferably cylindrical screening device 34. The screens 32 and gratings 33 are adapted to pass not only material which has been sufficiently ground but also some material that is slightly oversize, while serving at the same time to prevent the passage of materials which are greatly oversize and similarly to prevent the passage of the grinding balls B. The cylindrical screening devices at 34 are of mesh suitable to pass materials ground to a fineness appropriate for the final product. Such ground materials are adapted to drop into a hopper 35 which communicates with a discharge chute 36 or the like whereby the ground materials are conducted to any place of storage or for other disposition. The screens 32, gratings 33, and screening devices 34 thus serve as classifiers which act to remove appropriately ground materials as quickly as possible, the initial discharge taking place below the uppermost grinding balls.

The oversize material which is passed by the screen 32 or gratings 33, but is too coarse to be passed by the screening devices 34, is discharged from the outer ends of the cylindrical screening devices 34 into respective pockets 40 whose peripheral walls 41 and outer side walls 42 may be imperforate except for peepholes 43 as indicated. These pocket members 40, which are somewhat pear-shaped with rounded outer ends and truncated inner ends, are provided with flanges at their inner ends, which are bolted as indicated at 45 to a correspondingly flanged, circular, central member generally indicated at 46. The member 46 has an outer wall 47 which is connected by means of throat-forming radiating partitions 48 to an inner wall 49 of annular shape and in turn connected with an inwardly extending solid walled, cylindrical sleeve 50 fixed at its inner end to the outer face of the discharge head 12 about the central opening 31. The inner ends of the partitions 48 are connected to a conical, inwardly directed, deflecting wall 52 which feeds oversized materials, falling from elevated pockets 40 approaching top center position, into the outer end of the cylindrical sleeve 50 which serves as a conductor for such oversized materials and is provided with an internal screw blade 54 that acts to advance the received materials inward through the opening 31 to the interior of the mill. An inwardly directed flaring lip 55 feeds such oversized material back into the mill an appropriate distance from the discharge openings 30.

The rotating screening, classifying, and returning devices 34, 40, and 50 are enclosed by a stationary hood 60 connected with the top of the previously mentioned hopper 35 and its discharge chute 36, the inner wall 61 of the hood 60 being in the form of a flange which engages behind an annular flange 62 carried by the outer face of the discharge head 12. These flanges 61 and 62 provide a sufficiently tight joint between the rotating and nonrotating parts. For the purpose of introducing an adequate supply of water to the interior of the mill, the outer wall 63 of the hood 60 is provided with an appropriate water supply pipe 64 which extends through an opening in the apex of the conical deflecting wall 52, whereby to inject a water stream centrally through the sleeve 50 and its spiral screw blade 54 into the interior of the mill. In wet mill operations, this water supply will aid in preventing clogging of the device by moist material being handled. In dry mill operations, the water supply will, of course, be cut off.

From the foregoing description, it will be apparent that ground materials passing through the screens 32 and gratings 33 at the discharge openings 30 are appropriately sifted by the screening devices 34 as the mill rotates, the desired finely ground materials passing through the screening devices 34 and falling into the hopper 35 at the bottom of the hood 60, the annular rotating flange 62 serving to deflect materials passing through the adjacent ends of the screening devices 34. By providing for passage of materials through the screens 32 or gratings 33 which are somewhat oversize, the load of adequately ground material in the mill may be more rapidly and efficiently reduced, the accompanying oversized materials being subsequently returned for further grinding. As an illustration of these relationships, the screens 32 or gratings 33 may pass material as large as $\frac{1}{8}$ inch, whereas screening devices 34 may pass material no longer than $\frac{3}{8}$ inch.

By employing the rails 15 and flanged wheels 16 for supporting the mill, as previously described, the discharge end of the mill is left unobstructed so that the present form of screening and discharge means may be readily placed and used which would be impossible with trunnion supports at the axis of the mill.

For the purpose of feeding unground material to the mill I may employ the portable chute device illustrated at the left of Fig. 1. This comprises a framework 65 carried upon wheels 66 and supporting a discharge chute 68 which is normally disposed below any materials source 69 and is adapted to be directed into an intake opening 70 in the feed head 14 of the mill. The wheels 66 travel upon appropriate rails 72 carried upon any suitable substructure 74. Thus the framework 65 and the chute 68 may be moved away from the feed opening 70 for access to the interior of the mill whenever necessary.

Inasmuch as other variations of the generic invention disclosed will become apparent to those skilled in this art, it is intended to cover all such modifications as fall within the scope of the patent claims.

I claim as my invention:

1. In a discharge head structure for a grinding mill, the combination of: a head adapted for disposition in a vertical plane, said head having a central opening and a plurality of discharge openings disposed between said central opening and the periphery of said head; screen means disposed across the respective discharge openings; a plurality of cylindrical screening devices connected to said head and disposed on horizontal axes about the respective discharge openings to receive from said screen means and directed outward from said head and providing screen surfaces throughout their peripheries; a plurality of receiving pocket means disposed at and connected respectively with the outer ends of said tubular cylindrical screening devices to receive oversize materials from such devices and having discharge means to dump such oversize materials during rotation: a tubular return device connected to said head about said central opening to receive dumped oversize materials from said pocket means and feed such oversize materials through said central opening back into the mill; and connecting means leading from portions of said pockets directed toward the axis of said head to said return device for supplying oversize material from said tubular screen-

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ing devices to said return device, and thence through said central opening.

2. A combination as in claim 1 wherein partition means are provided between said pocket means whereby to return oversize material to said return device as said pockets approach a top center position above said return device.

3. In a combination in a discharge head construction for a grinding mill rotatable on a substantially horizontal axis: a vertical discharge head having a return opening disposed adjacent its axis of rotation and a plurality of discharge openings disposed in a series around said axis between said return opening and the periphery of the head; a plurality of tube-like horizontal screening devices mounted on said head and disposed respectively about said discharge openings to receive therefrom at one end and open at their opposite ends to pass radially therethrough adequately ground particles while separately discharging oversize particles horizontally therefrom at their open ends; a plurality of pockets disposed horizontally beyond said screening devices and communicating respectively with the open oversize discharge ends of said screening devices, said pockets having discharge throats extending radially inward to dump oversize particles when said pockets are successively moved by mill rotation to elevated positions; and a return device communicating with said throats and with said return opening to pass oversize particles through said return opening into said mill.

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4. A combination as in claim 3 wherein said return device includes sloping deflector means at the inner ends of said throats and a conveyor tube leading from said deflector means to said return opening.

5. A combination as in claim 4 including conductor means communicating with said conveyor tube on the opposite side of said return opening and head and extending a substantial distance beyond said opening to feed returned material back into the mill beyond said discharge openings.

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