Nov. 9, 1926. 1,606,545

P. E. VAN SAUN

TUBE MILL

Filed July 7, 1923

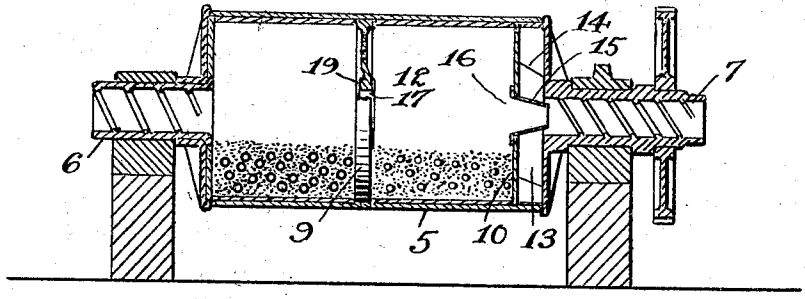


Fig. 1.

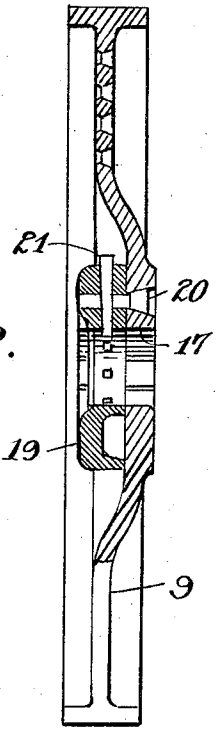
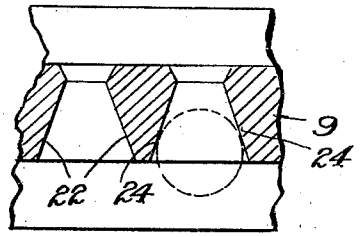


Fig. 2.

Fig. 4.



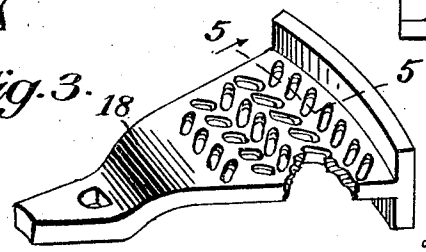


Fig. 3.

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UNITED STATES PATENT OFFICE.

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TUBE MILL.

Application filed July 7, 1923. Serial No. 650,053.

This invention relates to tube mills in which to comminute material, such as ore, rock, cement and the like, utilizing a revoluble cylinder separated into chambers by a perforated screen partition, each chamber having freely moving grinding balls of hardened steel therein to subject material in the chambers to a crushing action by the revolving of the cylinder. One of the chambers constitute a primary reduction chamber and as the material is reduced to a predetermined size, which is controlled by the size of the perforations in the screen partition, the material passes from said chamber to the adjacent chamber through said perforations. To prevent the clogging of material in and the choking of the perforations in the screen partitions it is the usual practice to incline the walls of the perforations at a vertex angle from one surface of the partition to the opposite surface providing openings of variable cross sectional area with the portion of the opening of less area opening into the primary grinding chamber and constituting the entrance end of the opening. The balls in the primary grinding chamber are relatively larger in diameter than the balls in the succeeding adjacent chamber, and as the portions of the perforations having the largest opening or greatest area and constituting the outlet end open into said chamber having the smaller balls such balls during the revolving of the drum and the grinding action become wedged in the perforations choking up said openings and preventing the passage of the material from one chamber to an adjacent chamber. Furthermore, in such an arrangement of the walls of the perforations the edge portion of the walls of the opening of less area and opening into the chamber having the larger balls therein is subjected to a peening action by the balls striking against edge portion of the same during the movement thereof in the revolving of the cylinder with the result that said openings are closed or reduced to such a size as to prevent the entrance of the material thereto.

It is the object of the present invention to overcome the above disadvantages by arranging the walls of the perforations extending from the surface of the partition within the chamber with the smaller balls or from the outlet end at such an angle that a ball entering a perforation will be prevented from wedging therein, and to further arrange the walls of the perforations so that such inclined walls meet wall portions extending from the surface of the partition within the primary grinding chamber or from the entrance end and inclining or diverging in an opposite direction.

In the drawing accompanying and forming a part of this specification, Figure 1 is a longitudinal sectional view of the cylinder of a tube mill with my improved partition applied thereto.

Figure 2 is an enlarged cross sectional view of a partition for the cylinder.

Figure 3 is a perspective view of a section of the partition, partly broken away to show the arrangement of the walls of the perforations therein; and

Figure 4 is an enlarged cross sectional view of a portion of the screen partition to show the arrangement of the walls of the perforation and the manner of preventing a ball from becoming wedged therein.

Similar characters of reference designate like parts throughout the different views of the drawing.

In the drawing there is shown an embodiment of the invention in connection with a tube mill comprising a cylinder 5 having hollow trunnions 6, 7 axially at opposite ends whereby the cylinder or drum is rotatably supported, the trunnions 6 constituting a charging opening for the cylinder and the trunnion 7 a discharge opening for the cylinder. The cylinder is rotated through a gear 8 fixed on the trunnion 7 from a suitable source of power.

The cylinder is separated by perforated transverse screen partitions 9, 10 into chambers 11, 12 and 13. The material to be disintegrated or comminuted is delivered into the chamber 11, which is in the nature of a primary reduction chamber, the material in said chamber being subjected to the action of freely moving hardened steel crushing balls 14 to reduce the material to a size to permit it to pass through the perforations

of partition 9 to chamber 12 wherein the material is subjected to the attritive action of freely moving balls of a smaller size than the balls in chamber 11 to reduce the material to its final degree of fineness or of a fineness to pass through the perforations in the partition 10 into chamber 13, said perforations in partition 10 being of comparatively small size relative to the openings in partition 9. From the chamber 13 the material is picked up by blades 14 and carried up from below the axis of the cylinder to a point above the axis thereof and delivered on to a conical chute 15 by which it is directed into the discharge opening in the trunnion 7. While I have described one form of mill in connection with which my improved screen partition may be utilized wherein material is advanced through and delivered from the mill mechanically, the disintegrated or comminuted material may be delivered from the mill by pneumatic means for which purpose the partitions are arranged with enlarged axial openings 16, 17 to provide an unobstructed passage axially through the cylinder from the charging to the delivery end for the sweep of an air suction through the cylinder. To facilitate the mounting of the screen partitions in the cylinder they are made up of sections 18 as shown in Figure 3 and secured together by an annulus 19 to extend to the central opening to which the segments are connected by keys 20 engaging in perforations in the segments and annulus and locked in position by keys 21.

The present invention resides particularly in the construction and arrangement of the perforations in a partition or partitions which separate the cylinder into chambers in which the material is reduced to successive degrees of fineness. The walls of these perforations are arranged at the vertex angle, as shown at 22 in Figure 4, to extend from one surface of the partition to the opposite surface, that is from the surface of the partition within the chamber 12 containing the smaller balls with the portion of the perforations of greatest cross sectional area in said chamber, said inclination of the walls of the perforations being such so that as a ball entering into the perforation will have contact with the wall of the opening at one side of a line extending diametrically through the ball, as shown at 23 in Figure 4, causing the ball to tend to gravitate from the opening and thereby preventing the ball from becoming wedged in the opening clogging and preventing of the passage of material from one chamber into the adjacent chamber. In practice it has been found that by arranging the walls of the perforations at a vertex angle of not less than twenty-six degrees will operate efficiently.

Should the walls of the perforations extend through the entire thickness of the partition with the inclination of the wall at the same angle the end thereof will be of considerably less area than the remaining portion of the perforation and form a thin bevel edge at said opening, and it has been found that the impinging or striking of the balls in chamber 11 against said edge portions will peen and upset said thin edge portion of the material about said openings causing the material to spread and close the openings. To obviate this the inclined walls 22 of the perforations extend through the greater portion of the thickness of the wall of the partition from the outlet end to adjacent the opposite partition surface meeting wall portions 24 of the perforations extending at a vertex angle opposite to the angle of the walls 22. By this arrangement the portion of the perforations of less area or the entering end is located at a point within the thickness of the partition with a wall of considerable thickness at the apex of the wall portions 22, 24, as shown at 25, with the possibility of the ball striking against the same and peening or spreading the material thereof reduced to a minimum.

The perforations in the partition are arranged in concentric rows 26 and are preferably of greater length than width with the perforations of one row extending in a direction opposite to the perforations in an adjacent row as clearly shown in Figure 1.

Having thus described my invention, I claim:

1. Screen partitions for tube mills, comprising plates having perforations therein the walls of which perforations converge from one surface of the plates and extend through the major portion of the thickness thereof and meeting wall portions diverging to the opposite surface of the plates.

2. In a tube mill, a revoluble cylinder, a transverse screen partition in said cylinder separating the same into chambers having freely moving balls therein, and said partition having perforations therein the walls of which perforations converge from one surface of the partition and extend through the major portion of the thickness of the partition at an angle relative to the diameter of the balls whereby a ball entering a perforation will have a line contact with the wall of the perforation at one side of the greatest diameter of the ball and prevent the ball from wedging in the perforation, and said converging wall portions of the perforations meeting wall portions within the thickness of the partition diverging to the opposite surface at the same angle as the converging wall portions.

3. In screen partitions for the cylinder

of tube mills, a plate having perforations therein the walls of which perforations converge from one surface of the plate in a direction toward and adjacent to but within the opposite surface of the plate at an angle of not less than twenty-six degrees and meeting wall portions diverging to the opposite surface of the plate at the same angle as the converging wall portions.

Signed at the city of New York, in the county of New York and State of New York this 29th day of June, 1923.

PETER EDWIN VAN SAUN.