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P. O. ROSENQVIST ET AL
LINERS FOR BALL AND TUBE MILLS

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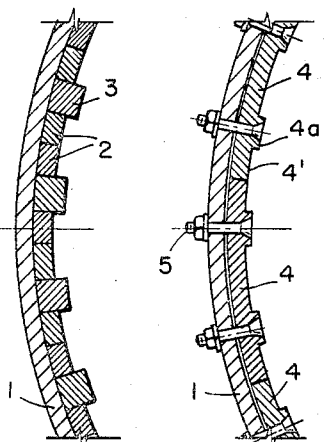


FIG. 2

FIG. 6

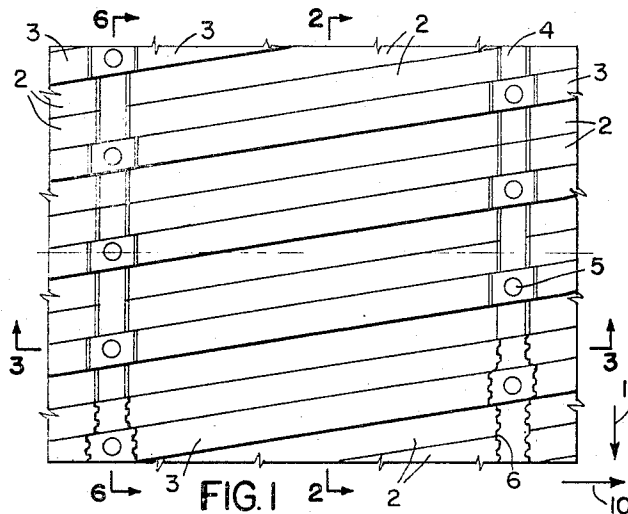


FIG. 1

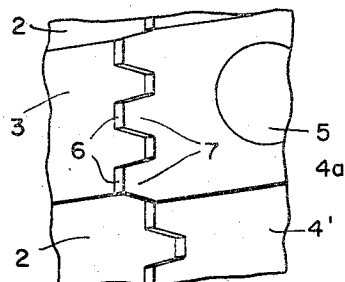


FIG. 7

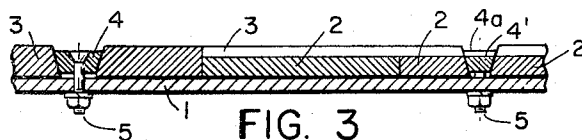


FIG. 3



FIG. 4

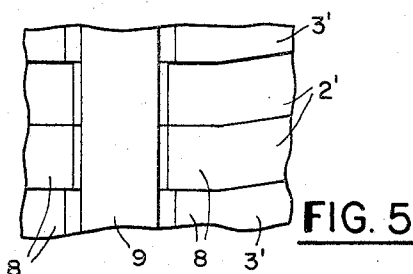


FIG. 5

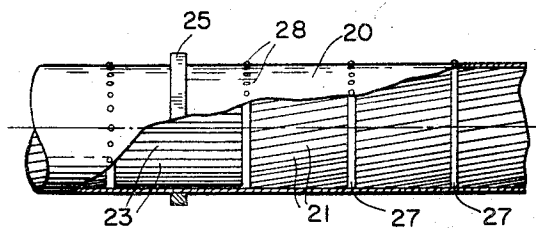


FIG. 8

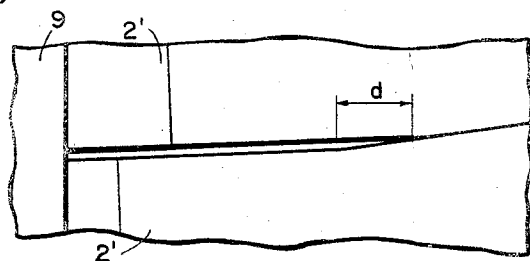


FIG. 5A

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LINERS FOR BALL AND TUBE MILLS

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3 Claims. (Cl. 241—183)

This invention relates to liners for ball and tube mills, used for crushing or pulverizing materials.

It is necessary to provide mills of the said type with replaceable liners, as the wear caused by the grinding bodies and the material to be ground is substantial.

One type of liner, which has been used extensively, consists of plates made of cast iron and having a length of the same order as the width. These plates are mounted inside the mill by means of bolts, generally two bolts for each plate.

Another type of liner consists of rod-shaped elements having a length several times their width. These elements are mounted side by side and are fastened to the mill casing by means of rings wedging the ends of the rods. The rings are fastened to the mill casing by means of bolts.

Thus the liner made of rods will need a smaller number of bolts than the liner of plates and will require less manual labor when being mounted.

Furthermore, as each hole for a bolt in the mill casing represents a drawback, especially with regard to the sealing problems, it will be understood that the liner made of rods has several advantages compared with that of plates.

However, the plate-type liners have hitherto had one advantage over the rod-type liners, viz, they can more easily be provided with a specially formed wearing surface. It is especially desired to provide screw-line-formed projections or depressions in the wearing surface, in order to obtain a sorting of the grinding bodies according to size as this will increase the capacity of the mill.

The object of the present invention is to provide a liner of the type having interior screw-formed projections and depressions in order to obtain a sorting according to the size of the grinding bodies and furthermore having the advantages of the rod-type liners. According to the invention, this is obtained by the liner being made of rods of different heights twisted to screw-line form, and mounted side by side along screw lines on the mill casing.

The rods may be made by drop-forging or by rolling of manganese steel or other types of alloy steel, in order to obtain the best possible resistance against wear from the grinding bodies and the material to be ground.

The liner according to the invention has one special advantage over the plate-type liners. Screw-line formed rods of one definite form may be used for mills of different diameters varying between, e.g. 1.7 and 2.9 meters. As a drop-forged or rolled product may be manufactured with an accuracy far better than that of a cast product, and has a greater tensile strength, the liner according to the invention can be made lighter and thus cheaper than the known types of cast iron liners.

In the drawings:

Figure 1 is a part of a mill casing lined with a liner according to the invention and viewed from the inside of the mill,

Figure 2, a section taken along line 2—2 of Figure 1,

2

at right angles to the mill axis of the part of the liner shown in Figure 1,

Figure 3, a section taken along line 3—3 of Figure 1, parallel to the mill axis of the part of the liner shown in Figure 1,

Figure 4, a rod of the type used in the liner in Figures 1—3,

Figure 5 a part of a liner comprising rods of a somewhat modified design,

Figure 5A is an enlarged fragmentary view of Figure 5 showing a different stage of the operation,

Figure 6 is a fragmentary sectional view taken along line 6—6 of Figure 1,

Figure 7 is an enlarged fragmentary plan view of certain parts of the present invention, and

Figure 8 is a side view with parts broken away, of a mill casing constructed in accordance with the present invention.

Referring to Figures 1—3, 1 designates a mill casing lined on its inner side with a great number of rods 2 and 3 preferably made of manganese steel and being of different heights in the directions of the mill diameters. Each rod 2 or 3 has a trapezoidal cross section and the rods are placed side by side, their ends being wedged by ring segments 4 placed at right angles to the mill axis and made in sections fastened to the mill casing 1 by means of bolts 5 extending through bosses 4a of the ring segments. The sides of the ring segments 4 are tapered towards the mill casing, and wedge against inclined end surfaces on the rods 2 and 3. In order to avoid a local increase of the wear of the liner near the ring segments 4, these are placed below the uppermost level of the rods and moreover provided with transversal cutouts 4', preferably corresponding to the level of lower rods 2, so that the grinding bodies in the mill are not prevented from passing the ring in the axial direction of the mill, while bosses 4a provide strength for supporting the securement bolts 5.

Each of the rods 2 and 3 accurately describe a screw line on the inside of the mill casing 1, and this screw line has a large pitch in relation to the length of the individual rods. Through this screw-line form of all the liner units, and through their varying heights, the liner on the whole obtains the screw-line ridges desired on the wearing surface, which has proved to give excellent grinding body sorting effect. The material to be ground will pass through the mill in the direction of the arrow 10 in case the mill is rotated in the direction indicated by the arrow 11.

In the liner now described, the rods 2 and 3 are screw-line formed in their entire lengths. In certain cases, this can involve problems, when it is a question of the securing of the rods between the ring segments 4, and it has therefore proved appropriate to provide at least some or preferably all of the rods in each ring-formed series with gear tooth-shaped recesses 6, in each end, and the corresponding ring sections with corresponding gear tooth shaped projections 7, which enter into the said recesses 6 and thereby prevent the rods from together turning around an axis running radially in relation to the mill drum, as they could then be disengaged from the ring segments 4.

Another means of avoiding such turning, in accordance with what is shown in Figure 5, is to give the rods 2' and 3' end sections 8 that deviate from the screw-line form, which run in the axial direction of the mill drum, and which at right angles run against the rings, in order to ensure guidance by these. Also in this case, the ends of the rods are inclined, so that they can be wedged into place by the ring segments 9.

The twist of the screw line followed by each of the rods with at least the major portion of their lengths can

of course be varied, as required, as well as the cross-section dimensions of the rods.

Rods 2' and 3' as shown in Fig. 5 should be considered as turning slightly. The areas 8 at a joining surface will then appear as shown in enlarged Figure 5A. The necessary axial displacement at the "knees" causes one knee to slide away from the other knee by a distance "d." This creates the space shown between rods, adding to the rod-to-rod circumferential pitch and consequently binding the whole assembly of rods outwardly against casing 1. As a result, further turning of the rods is discouraged.

The protruding, thicker rods will naturally become worn out earlier than the thin rods. However, it is possible to replace only the thicker rods and thus obtain a substantial decrease in the costs replacing worn out liner parts.

A mill 20 having sections of screw-formed lining rods 21 may also contain sections of straight rods 23 of the known type. It may e.g. be desired to have sections of straight rods 23 where the mill on its outer side is provided with bearing rings 25. The reason for this is that the straight bars 23 may be made extra long and thus the wedging rings 27 secured by bolts 28 may be mounted at a greater distance from the fastening means of the bearing rings.

It will be understood that the foregoing description of the invention and the example set forth are merely illustrative of the principles thereof. Accordingly the appended claims are to be construed as defining the invention within the full spirit and scope thereof.

What is claimed is:

1. A liner for ball and tube mills comprising, in combination, a plurality of generally longitudinally extending helical rods secured in side by side abutting relationship within a mill casing, each of said rods being twisted an equal amount about the longitudinal axis thereof and about the longitudinal axis of said casing, said rods being of different thicknesses and arranged in predetermined relationship to define a plurality of alternate sub-

stantially helical projections and depressions within the interior of said casing, each of said rods having parallel inner and outer surfaces and inclined ends whereby each said rod is of substantially trapezoidal longitudinal cross section, the facing inclined ends of an aligned pair of said rods defining a socket of trapezoidal configuration flaring inwardly of said liner toward the longitudinal axis of said casing and clamp means within each said socket securing the ends of each pair of said rods to said casing against rotation of each said rod about the individual longitudinal axis thereof.

2. A liner for ball and tube mills as set forth in claim 1, wherein each inclined end of said rods defines a plurality of tooth shaped recesses, and each said clamp means comprises a ring segment having inclined sides defining a plurality of tooth elements, each said ring segment extending partially around the interior of said casing across and overlying said inclined ends of each pair of said rods, and said tooth elements mating with said tooth shaped recesses preventing twisting of said rods relative to said segments.

3. A liner for ball and tube mills as set forth in claim 1, wherein both ends of each said rod are parallel to each other and to the longitudinal axis of said casing, the intermediate portion of each said rod being helically disposed within said casing, and each said clamp means comprising a ring segment extending partially around the interior of said casing and perpendicularly across said adjacent ends of a plurality of adjacent ones of said rods.

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