E. W. LAWLER.

LINING FOR TUBE MILLS.

APPLICATION FILED DEC. 10, 1917.

1,315,025.

Patented Sept. 2, 1919.

2 SHEETS—SHEET 1.

Fig. 1.

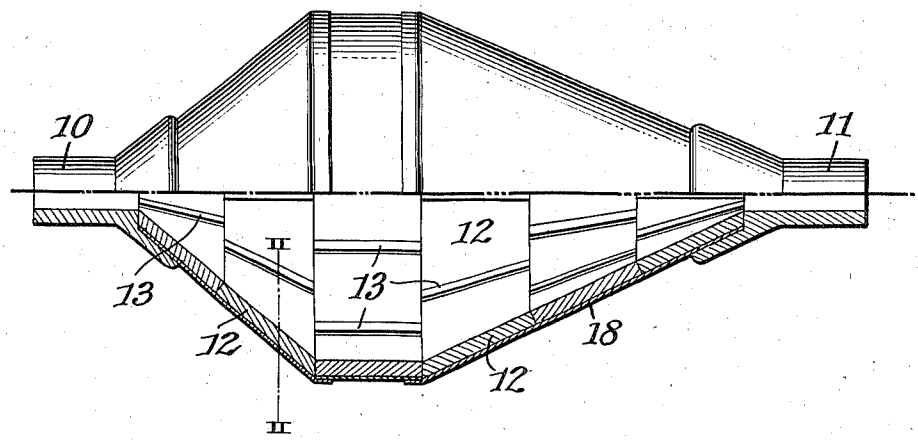
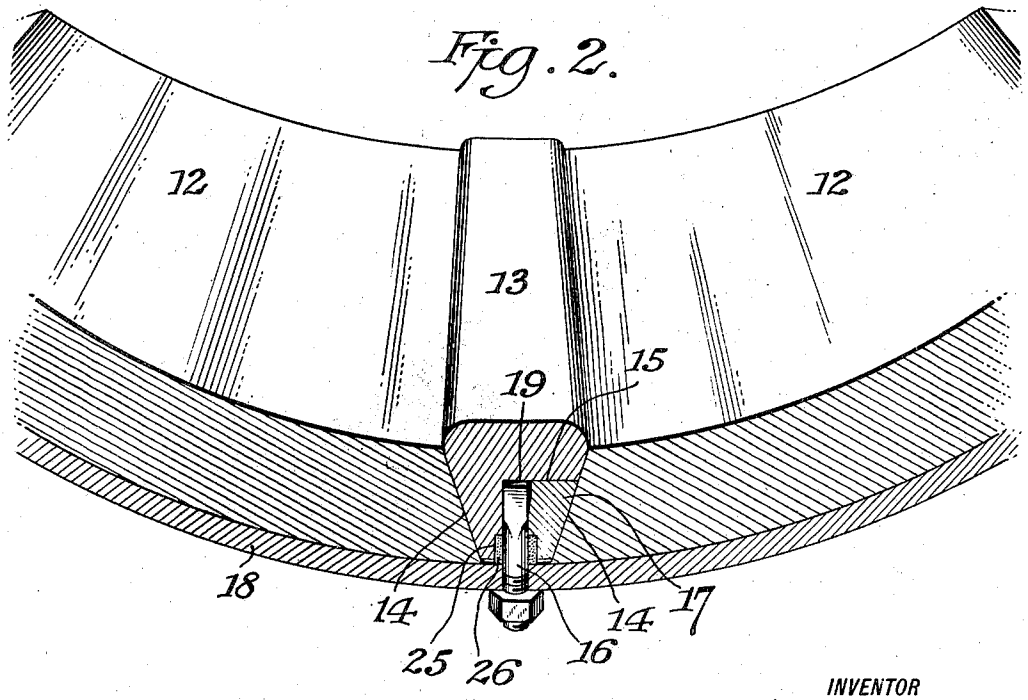


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

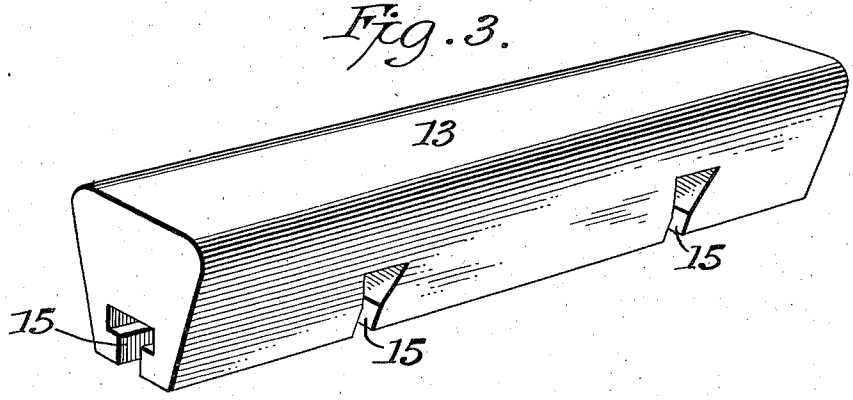


Fig. 4.

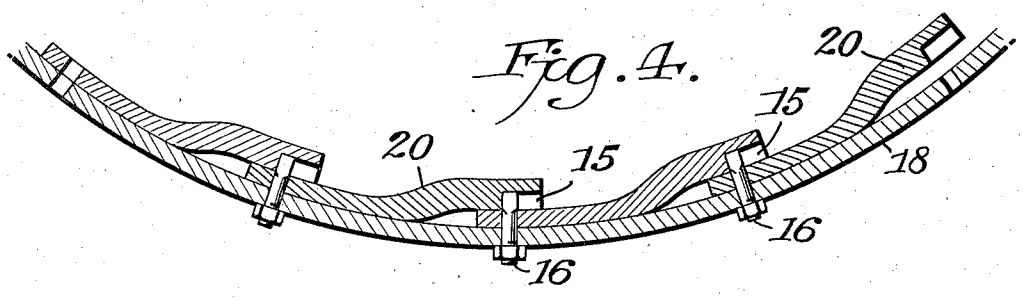


Fig. 3a.

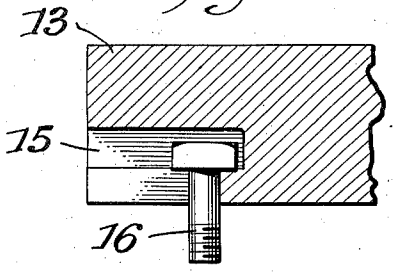


Fig. 6.

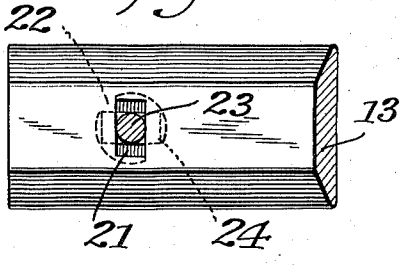


Fig. 5.

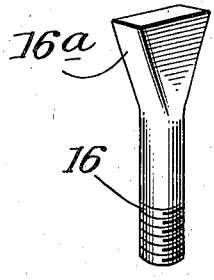
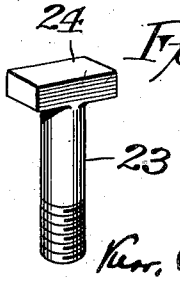


Fig. 7.



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UNITED STATES PATENT OFFICE.

EDWARD W. LAWLER, OF BAYONNE, NEW JERSEY, ASSIGNOR TO HARDINGE CONICAL MILL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

LINING FOR TUBE-MILLS.

1,315,025. Specification of Letters Patent. Patented Sept. 2, 1919

Application filed December 10, 1917. Serial No. 206,408.

To all whom it may concern:

Be it known that I, EDWARD W. LAWLER, a citizen of the United States, residing at Bayonne, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Linings for Tube-Mills, of which the following is a full, clear, and exact description.

In grinding apparatus of the so-called tubemill type, in which the ore (or other material) is passed through a rotating drum, usually containing balls, pebbles or rods, the inner surface of the drum suffers rapid wear, and it is therefore customary to provide the drum with a renewable lining to take the wear and thus protect the outer shell or body. The lining can be fastened in place by various means, but considerable difficulty has heretofore been experienced in keeping the lining plates tight on the shell, especially after they have undergone any material amount of wear. If the plates are bolted to the shell, which is the simplest method, the boltheads wear off quickly and the plates are then free.

It is accordingly the object of my present invention to provide an improved lining composed of plates and fastening devices which can undergo wear almost down to the shell itself without becoming detached. A further object is to provide a lining of the kind mentioned, in which any loose plates can be readily tightened from the outside, thereby obviating the necessity of emptying the drum. Another object is to provide a lining in which the bolts or other devices by which the lining elements are secured to the shell are entirely covered or protected on the inside of the mill. Another object is to provide a lining in which the fastening devices will serve also to roughen the inner surface of the drum, thereby giving the ascending side of the drum greater lifting action. To these and other ends the invention consists in the novel features and combinations hereinafter described.

One form of the invention is illustrated in the accompanying drawings, in which—

Figure 1 is a side view, partly in longitudinal section, of the barrel or drum of a conical mill.

Fig. 2 is a detail section on line II—II of Fig. 1, but on a much larger scale.

Fig. 3 is a perspective view of one of the lining elements, showing the recesses provided to receive the bolts or rivets by which the lining element is fastened to the shell.

Fig. 3ª is a longitudinal sectional view showing the use of a bolt with a flat head bearing on the side and end flanges of the recess.

Fig. 4 is a sectional view similar to Fig. 2 but showing the invention applied to another type of lining element.

Fig. 5 is a perspective view of the preferred form of bolt used to fasten the lining elements.

Fig. 6 is an under plan view of a lining element having a modified form of recess for the bolt head.

Fig. 7 is a perspective view of a bolt suitable for use with the recess illustrated in Fig. 6.

The drum shown in Fig. 1 is of the now well known conical type, consisting, in the form shown, of two cones connected at their bases to a short cylindrical portion. At the ends of the axis are inlet and outlet trunnions 10, 11, on which the drum is supported for rotation. My improved lining is designed particularly for mills of this type, but it can be used advantageously with cylindrical tubemills as well, containing balls, pebbles, rods or other grinding media.

The lining of the mill, in the embodiment illustrated in Figs. 1 and 2, consists of a plurality of lining elements in the form of heavy metal plates, 12, usually iron or steel castings, curved to conform to the curvature of the barrel, a plurality of lining elements in the form of wedge-bars 13. In a conical mill the plates are tapered, as indicated, and are usually arranged in several circumferential courses, the number of courses and the circumferential width of the plates depending largely upon the size of the drum. Preferably the plates are arranged so as to "break joints".

The plates are secured in place by means of the wedge-bars 13, each a one-piece element, the sides of which are inclined to give the bar an outward taper, that is, outward relatively to the drum, as clearly shown in Fig. 2. By reference the side edges of the plates 12 are correspondingly beveled, as shown at 14, to leave V-shaped spaces between them, into which the bars are fitted. The bars are provided with recesses 15, extending into the bars from one or both side-edges or both end-edges, as indicated in Fig. 3. The bolts are passed laterally into the recesses, which may be T-shaped for use with flat-headed bolts 16, Fig. 3ª, or flared to fit taper-headed bolts such as 16ª, Fig. 5. If desired, the open portion of the recess, remaining after the bolt is in place, can be filled by means of a filler or filling block 17, Fig. 2. The bolts project through suitably spaced holes in the shell 17 of the drum, so that the nuts can be readily set up from the outside. The fastening bars 13 preferably extend radially inward beyond the surface of the plates 12 and overlap the edges of the latter, as shown in Fig. 2. The bars thus constitute roughening bars, to aid in carrying the ore or other material up with the ascending side of the drum as the latter rotates about its longitudinal axis. The recesses 15 are short enough, measured radially of the drum, to be well below the inner surface of the plates 12, so that the entire lining can suffer considerable wear without exposing the bolt-heads.

When the nuts on the outside of the drum are screwed up, the wedging bars are drawn down into the spaces between the lining plates, thereby exerting pressure on the plates both radially and laterally. The plates are thus bound together and held firmly upon the shell. It will also be seen that wear of the exposed surface of the lining cannot make the plates loose until the wear has reached a point where the bolt-heads are worn off. If the pounding, to which the drum is subjected in use, should cause the nuts to unscrew, thereby loosening the wedging bars and the plates, the same can be tightened merely by setting up the nuts with an ordinary wrench. The effects of the pounding are minimized by making the bolt-heads shorter than the recesses so as to leave a space above the bolts, as indicated at 19, Fig. 2, thereby avoiding direct transmission of blows from the bar to the bolts. Even when the parts are quite loose there is no danger of any of them falling out of place, but small pieces of ore or pebble may get behind the plates or into the joints, and prevent the lining from fitting properly when the nuts are set up, unless the plates and wedging-bars are first taken out and the drum cleaned. The difficulty is readily obviated by trying the nuts often enough to keep them tightly set up. Wedging-bars between the end-edges of the plates are, in general, unnecessary, especially in conical mills. The circumferential expansion of each course as its wedging-bars are drawn down toward the shell causes the course to bear firmly on the next larger course, and there is thus no tendency for any course to shift toward the apex of its cone.

In the embodiment shown in Fig. 4, all the lining elements are in the form of overlapping plates, 20, with bolt-recesses 15 in the thicker edges thereof. These recesses may also be provided with filling pieces like those shown at 17, Fig. 2.

In the form shown in Fig. 6 the recess in the lining element (in the present instance a wedge-bar) opens in the bottom of the bar in the form of a slot 21. The inner portion of the recess is enlarged, as indicated by the dotted line at 22. The bolt 23, Fig. 7, has a flat, elongated head 24, which is passed into the slot and is then given a quarter-turn to the position shown in broken lines in Fig. 6, the bolt-head then bearing against the angular shoulders or stops formed in the enlargement to prevent rotation of the bolt when the nut on the outside is set up.

To prevent leakage of water through the bolt-holes in the shell of the mill the recess 15 and filler 17 in the lining element may be provided with a rabbet or stuffing-box 25, as in Fig. 2, filled with a suitable packing 26, so that when the element is drawn down the packing will be compressed upon the shell around the bolt.

It is to be understood that the invention is not limited to the exact construction herein described but can be embodied in other forms without departure from its spirit as defined by the appended claims.

I claim:—

1. In a grinding mill, the combination with a rotary drum, of a lining therefor having a plurality of longitudinally extending members with edges provided with edge-recesses opening below the inner surface of said members, and bolts seated in said recesses and extending out through the wall of the drum for securing said members thereto.

2. In a grinding mill, the combination with a rotary drum, of a lining therein comprising a plurality of plates arranged in circumferential series, outwardly tapering wedging bars between the plates and having edge-recesses opening below the inner surface of the plates, and bolts seated in the said recesses and extending out through the wall of the drum for securing the wedging bars thereto, the said recesses being closed to the interior of the drum and the bolt-heads wholly inclosed in the recesses.

3. In a grinding mill, the combination with a rotary drum, of a lining therein comprising a plurality of plates arranged in circumferential series, outwardly tapering wedging bars between the plates and having recesses, bolts seated in the said recesses and extending out through the wall of the drum for securing the wedging bars thereto, and filling pieces fitting in and closing said recesses, the bolt heads being wholly inclosed in said recesses.

In testimony whereof I hereunto affix my signature.

EDWARD W. LAWLER.