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E. POSSELT

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LINER CONSTRUCTION FOR GRINDING MILLS

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FIG. 1.

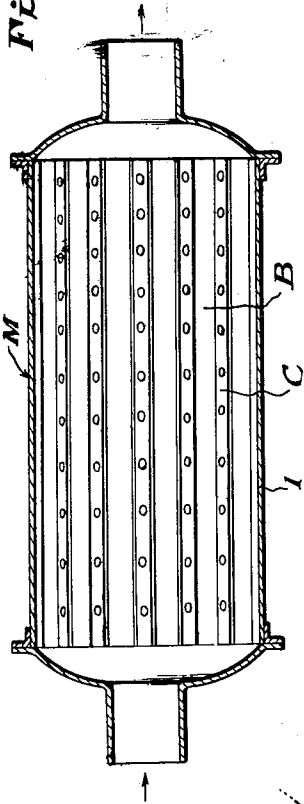


FIG. 2.

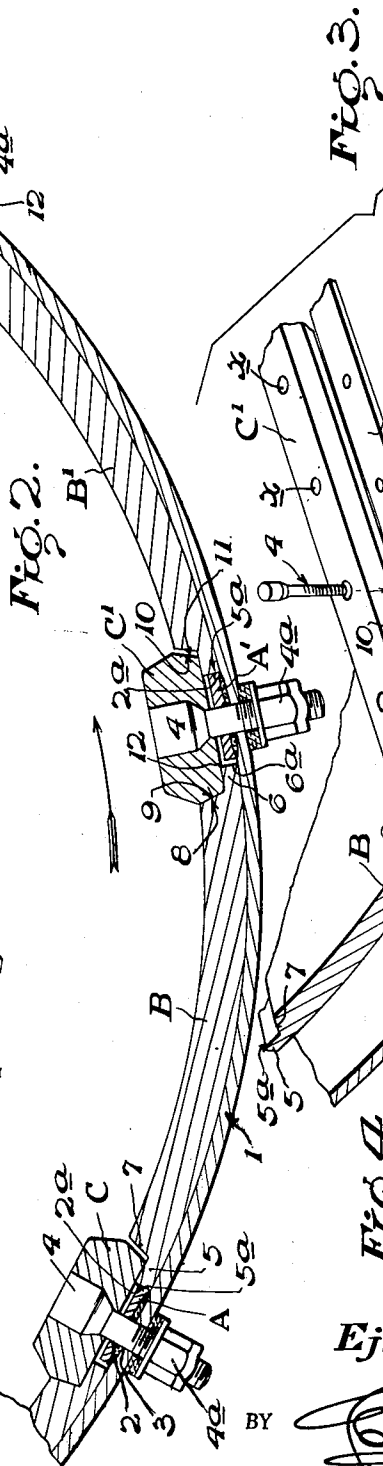


FIG. 3.

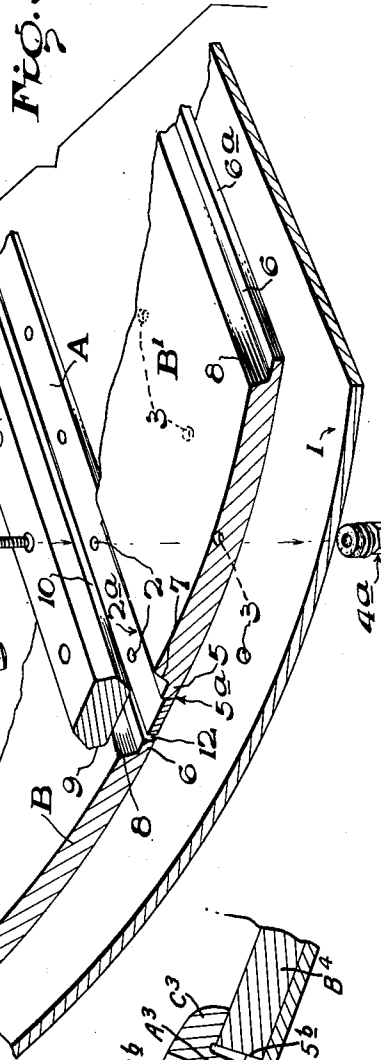
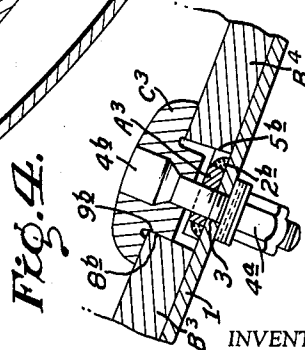


FIG. 4.



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LINER CONSTRUCTION FOR GRINDING MILLS

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6 Claims. (Cl. 241—183)

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This invention relates to grinding machines known as ball mills, tube mills or combination mills, and more particularly to an improvement in the grinding or lining plate assemblies.

The lining of mills of the type referred to must serve the dual purpose of protecting the interior of the mill while at the same time providing means for agitating the grinding media, with which the mill is charged, in such manner as to produce the best grinding effect.

Linings of conventional design now in general use are of two types, generally styled as wedged or bolted. Wedge-type linings are generally cast and depend on wedging effect against the shell to keep them in place. This practice requires a substantial thickness of the linings, making the individual liner plates heavy and at the same time reducing the effective working diameter of the mill. On the other hand, liners of the type which may be bolted to the shell have the advantage that they can be made lighter, and take up less room, but the holes for the bolts tend to weaken the shell, and the successive circumferential shocks or hammer blows against the bars and plates by the moving grinding media also causes lateral stress on the bolts and makes it difficult to keep them tight. Thus, frequent servicing is required to maintain the mill in efficient running condition.

The present invention relates to a lining of the type which may be bolted to the shell, with its attendant advantages, but which overcomes the objections above noted by providing a construction wherein the shell is not weakened and the bolts or other fastenings are relieved from lateral shearing stress incident to the shock caused by the grinding media during the operation of the mill, thereby making it possible to keep the bolts tighter over a longer period of time and reducing this major maintenance factor to a minimum.

Accordingly, one of the objects of the invention is to provide a construction wherein the shell is provided with reinforcing abutment strips welded thereto and having bolt holes registering with holes in the shell, each of said strips being adapted to be engaged at one edge by an edge of a liner plate which is held in circumferentially abutting relation to the strip by a lifter bar secured in position at the location of an adjacent abutment strip. Thus, when a given liner plate is radially clamped to the shell by a pair of lifter bars secured to the shell by bolts passing through the bars and their related reinforcing abutment strips, one edge of the liner plate is circumferentially held in engagement with an abutment strip

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by the lifter bar of the pair which is most remote from the said edge. With this arrangement, the bolts of each lifter bar are only in tension and are relieved of lateral shearing stress because the lifter bar itself is held against lateral shifting due to the fact that it is circumferentially locked against the liner plate engaging the abutment strip.

Another object of the invention is to provide a sectional lining which may be firmly attached to the shell, and whose sections may be easily removed so that worn parts may be replaced while other parts remain in position.

A further object of the invention is to provide a liner construction which will obviate the practice of zincing and prevent wear or scouring by material that would otherwise enter between or behind the plates and slide between them and the inner face of the shell.

With the above and other objects in view which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully disclosed and claimed.

A preferred and practical embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a more or less diagrammatic longitudinal sectional view of a mill illustrating the present invention.

Fig. 2 is an enlarged sectional view of a portion of the mill shell having the liner plates and lifter bars positioned thereon.

Fig. 3 is a detail exploded perspective view illustrating the parts of the assembly in three dimensions.

Figure 4 is a detail view of a modification wherein cooperating edges on the lifter bars and liner plates are radial to the axis of the mill.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

The mill designated generally as M includes the tubular shell 1 having a plurality of reinforcing and liner plate abutment strips A arranged at spaced intervals about the inner face of the shell; the liner plates are designated as B and the lifter bars are indicated at C. The plates B and bars C are interchangeable and reversible, and may be made of rolled or cast metal. Moreover, it will be understood that the plates B and lifter bars C may be of any appropriate or selected cross sectional shape so long as one bar radially holds down the adjacent edges of adjoining plates, and

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also holds one of the plates in circumferentially abutting relation to an abutment strip. For convenience in description, the duplicated parts A, B and C may be hereinafter used with suitable exponents such as A'—A², B'—B², and C'—C², according to their relative positions.

As previously set forth, the distinctive feature of the invention resides in providing a construction wherein the liner plates designated generally as B are fixed against circumferential movement relative to the shell 1 by the abutment strips A, and the manner of effecting this desirable result will now be described.

As will be seen from Fig. 2 of the drawing, wherein the shell 1 is provided in the direction of the arrow the shell 1 is provided at suitably spaced locations with the reinforcing and abutment strips A—A', etc., which are welded to the shell in any appropriate manner. The said strips extend longitudinally of the inner circumference of the shell and are each provided with fastening receiving holes 2 registering with openings 3 in the shell. The holes 2 in the abutment strips are located to one side of the center of the strip so as to insure one edge of the strip, for example the leading edge 2^a, acting as an abutment shoulder for the trailing edge 5^a of the related liner plate B or B' as will presently appear. The holes 2 and openings 3 register with the holes x in the lifter bar to receive the lifter bar clamping bolts 4, or their equivalent, whose principal function is to radially hold the bars and liner plates to the shell. The holes in the lifter bars for the bolts 4 are disposed in the longitudinal center line of the bars so that said bars will be reversible and interchangeable.

Each liner or plate is formed with a body of any suitable cross-sectional shape and thickness, and of the required length, but of a maximum width less than the space between any given pair of adjacent abutment strips A. In the embodiment shown, in Figure 2, each plate, for example the plate B, is formed so as to be provided with marginal flange portions 5 and 6 of less thickness than the body of the plate thereby presenting edges or shoulders 7 and 8 at opposite sides of the plate, said shoulders being located equal distances inwardly of the outer edges of the flanges 5^a and 6^a, respectively, of the flanges 5 and 6. In this arrangement, one of the edges or shoulders, for example the leading shoulder 8, serves as a lifter bar abutment so that when the lifter bar C' is in position, the edge 9 of said bar will flushly engage the leading edge or shoulder 8 of the plate B and hold the trailing edge 5^a of the flange 5 rigidly against the leading edge 2^a of the abutment strip A which is upstream of strip A'.

Since the liner plates B, B', etc., having edges 5^a and 6^a and shoulders 7 and 8, and the lifter bars C—C' etc. having edges 9 and 10 are both symmetrical about the line of the openings 3 across the shell, and each of the abutment strips A, A', etc. has its holes offset relative to said line of openings 3 so that the leading edge 2^a of the abutment strip is offset relative to the plane of symmetry of the openings 3 and bolts 4, the said leading edge 2^a of the strip will abut the plate. Likewise, shoulder 8 and edge 9, respectively, on the plate B and bar C' (and similar plates and bars) are in abutting relation. On the other hand, the leading edge 10 and trailing shoulder 7, respectively on the bar C' and plate B', are spaced apart as shown at 11. The effect

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of this arrangement is to also have the leading edge 6^a of each liner plate B, B', etc., spaced slightly away from the adjacent or trailing edge of the related abutment strip as indicated at 12.

The liner plates B and lifter bars C are symmetrical in the sense that they may be reversed edge for edge and the tolerance in holes 2 and openings 3 around bolts 4 will be sufficient to allow edge 9 of the lifter bar to rest against the edge 8 of plate B and, at the same time, provide clearances 11 and 12. Once the bolts 4 connecting the lifter bars to the shell have been tightened up, the lifter bars as well as the plates will remain in a fixed position, subject only to the action of the grinding media against the lifter bars which would tend to force trailing edge 9 against leading shoulder 8 and trailing edge 5^a against the upstream abutment strip A.

The cooperating parts 8 and 9 may be radial to the axis of the mill as shown in Figure 4 or they may be tapered or inclined, as shown in the preferred arrangement. That is to say, Figure 4 illustrates how the cooperating parts 8 and 9 may be radial to the axis of the mill. In this figure, the leading edge 2^b of the abutment strip A³ engages with the trailing edge 5^b of the plate B⁴ while the leading edge 8^b of the liner plate B³ engages with the trailing edge 9^b of the lifter bar C³. The lifter bar C³ has portions for overlying the adjacent edges of the plates B³ and B⁴ so that said bar may be secured to the shell 1 by the fastenings 4^b. In this arrangement, as in Figures 1-3, when the fastenings are secured to the shell, the trailing edge 9^b of each lifter bar will engage with the leading edge 8^b of the adjacent liner plate and bear thereagainst to transmit tangential components of forces from the lifter bars through the liner plates to the leading abutment edge of the next adjacent upstream abutment strip of the series and to the shell to relieve the fastenings 4^b of shearing stress.

Each lifter bar C—C' has its bottom edge or base overlying the flanges 5 and 6 of adjacent liner plates and the spaces 11 and 12 provide sufficient tolerance for fitting the plates in place. Owing to the flanges 5 and 6 and the overlapping portions of the lifter bars, it will be seen that an effective seal is provided between the bars and plates so that the material being ground cannot work its way beneath the lifter bars and the flanges to get behind the liner plates B.

It may also be pointed out that the bolts 4 which clamp the bars against the plates, and the latter in turn against the shell, have head portions mating with sockets, with tapered base portions in the lifter bars so as to seal the space between the head of the bolts and the bar. The heads of the bolts 4 are flush with or counter-sunk below the upper face of the lifter bar C, and their outer ends are provided with nuts 4^a for engaging the center surface of the shell.

The arrangement described obviates the necessity of using zinc or other material to grout the joints between the lifter bars and the liner plates, and increases the heat conductivity from the inside of the mill to the outside of the shell, thus maintaining cooler operating conditions.

From the foregoing it will be seen that circumferential continuity of contact is provided between the strips A, liner plates B and lifter bars C, so that as the mill operates in the direction of the arrow, the force of the impact of the moving contents of the mill will always be imparted to the plurality of reinforcing and

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abutment strips A to not only distribute these forces throughout the shell, but insure maximum tightness of the lining and relieve the bolts of the lifter bars from shearing stress.

I claim:

1. A liner construction for grinding mills, comprising, in combination, a tubular shell, a plurality of shell reinforcing and liner abutment strips disposed in spaced relation longitudinally of the inner face of the shell and welded thereto, said strips and casing having registering holes therein, the axes of the holes in the strips being to one side of the longitudinal center of the strip to offset one edge of the strips relative the axes of the holes in the shell, liner plates each having opposite edge portions spaced closer together than the distance between the facing edges of adjacent abutment strips, a lifter bar engaging shoulder formed inwardly of one edge of each of the liner plates, lifting bars arranged between the liner plates, said bars having one edge engaging said lifter bar engaging shoulder of the liner plate to hold the edge of the plate opposite said shoulder against the offset edge of an adjacent strip, and fastenings passing through the lifting bars, abutment strips and shell, radially to clamp the liner plates to the shell and maintain the liner plates in circumferential engagement with said offset edge of the abutment strips.

2. A liner construction for grinding mills, comprising, in combination, a tubular shell, a plurality of shell reinforcing and liner abutment strips disposed in spaced relation longitudinally of the inner face of the shell and welded thereto, said strips and shell having registering holes therein, a liner plate positioned between a pair of said abutment strips and having marginal flanges of less thickness than the body of the plates and providing shoulders on said body above the flanges, the width of the plate of the flanges being less than the space between the adjacent edges of the abutment strips, and one of said shoulders providing a lifter bar abutting shoulder, lifter bars disposed in clamping relation to the juxtaposed flanges of adjacent liner plates and having one side thereof engaging the bar abutting shoulder of the liner plate, and fastenings passing through the lifter bar and the openings in the abutment strips and shell for drawing the bar toward the shell to cause the bar to engage the bar abutment shoulder of the plate and force the edge of the flange of the plate opposite the bar into engagement with the adjacent abutment strip whereby shearing stress imposed on the bar incident to material in rotation in the shell will be transferred to the abutment strip instead of the bar fastenings.

3. A liner construction for grinding mills, comprising, in combination, a tubular shell having a plurality of rows of lifter bar fastening receiving holes therein, liner plates having marginal flanges and shoulders inwardly of the edges of said flanges, abutment strips welded to the shell between the edges of said flanges, said strips having openings closer to one edge than the other and registering with said holes in the shell, whereby the edge of the strip farthest from the openings projects closer to one edge of the lifter bars than the other to provide a plate abutment, lifter bars having side portions symmetrical to the axis of the fastening receiving holes therein, fastenings passing through the holes in the bars, strips, and shell and radially clamping the plates at the flanges to the shell and causing one of said

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side portions of the bars to engage a shoulder on the adjacent plate to circumferentially hold the edge of the plate opposite said shoulder against the plate abutment edge of the adjoining abutment strip downstream of the material movement.

4. In a liner construction for grinding mills, a shell having rows of fastening receiving openings, liner plates reversible end for end and having a body including shoulders located inwardly of the opposite edges of marginal flange portions, lifter bars reversible end for end and having fastening receiving openings located in the longitudinal center thereof and adapted to register with the openings in the shell, abutment strips welded to the shell in the zone of the holes thereof and having openings closer to one edge than the other and registering with the openings in the shell and bars whereby one edge of the strips is offset in the direction of travel of the shell, fastenings passing through the lifter bars and the holes in the strips and shell and causing the bars to force the plates against the offset edges of the abutment strips.

5. In a liner construction for grinding mills, the combination, including, a tubular outer shell, a plurality of circumferentially spaced longitudinally disposed abutment strips welded to the inner face of the shell to provide liner plate engaging edges and also having fastening receiving holes offset to one side of their longitudinal center line to provide a greater width of strip to one side of said holes than the other; liner plates each of less width than the distance between facing liner plate engaging edges of said strips and having strip abutment edges, inclined lifter bar abutment shoulders formed on each plate inwardly of said abutment edges, a lifter bar having a wedging abutment edge for engaging with an adjacent abutment shoulder on the plate, said bar having fastening receiving holes along its longitudinal center line, fastenings for entering the holes in the bar and the offset holes in the abutment strips, whereby, when the fastenings draw the bars toward the shell the wedging abutment edge on the bar will engage the adjacent abutment shoulder on the plate and circumferentially shift the plate away from the edge of the strip adjacent said bar and into abutting engagement with the adjacent strip.

6. In a liner construction for grinding mills, the combination including, a tubular outer shell having circumferentially spaced rows of longitudinally aligned fastening receiving openings, a series of abutment strips also having fastening receiving holes registering with said aligned openings of the shell, said strips welded to the inner face of the shell and the leading edge of each strip providing a liner plate abutment shoulder, liner plates each of less width than the distance between adjacent abutment strips and each having a trailing abutment strip engaging edge at one side and a leading lifter bar abutment edge at the other side, lifter bars each having a portion overlying the edges of adjacent liner plates and also having a trailing liner plate abutting edge for engaging with the said leading lifter bar abutment edge of an adjacent liner plate, said lifter bars each having fastening receiving holes registering with the openings in the shell and the holes in the abutment strips, fastenings in the said registering openings and holes, whereby, when the fastenings are secured to the shell, the said trailing liner plate abut-

ment edge of each lifter bar will engage with the leading abutment edge of the adjacent liner plate and bear thereagainst to transmit tangential components of forces from the lifter bars through the liner plates to the leading liner plate abutment shoulder of the next adjacent upstream abutment strip and to the shell to relieve the said fastenings for the lifter bars of shearing stress.

EJNAR POSSELT. 10

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