Jan. 1, 1935. A. M. READ 1,986,530

GRINDING MILL

Filed Sept. 10, 1932

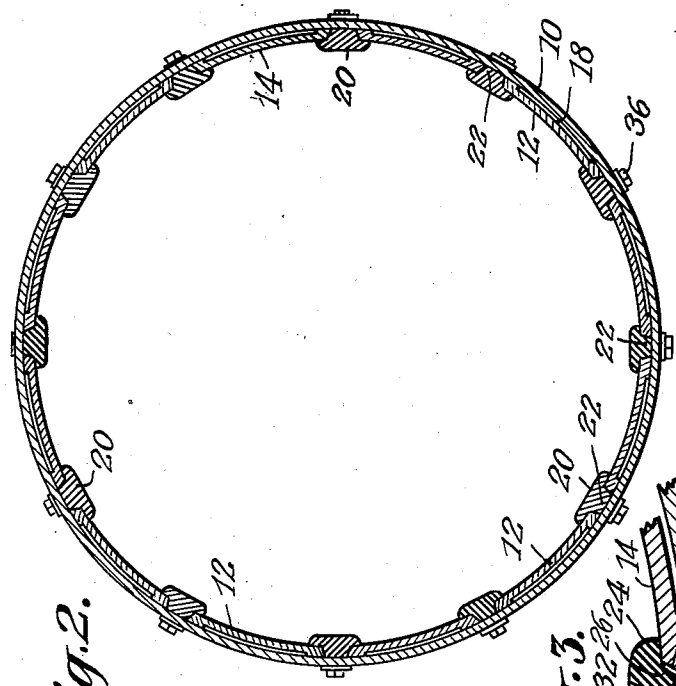


Fig. 2.

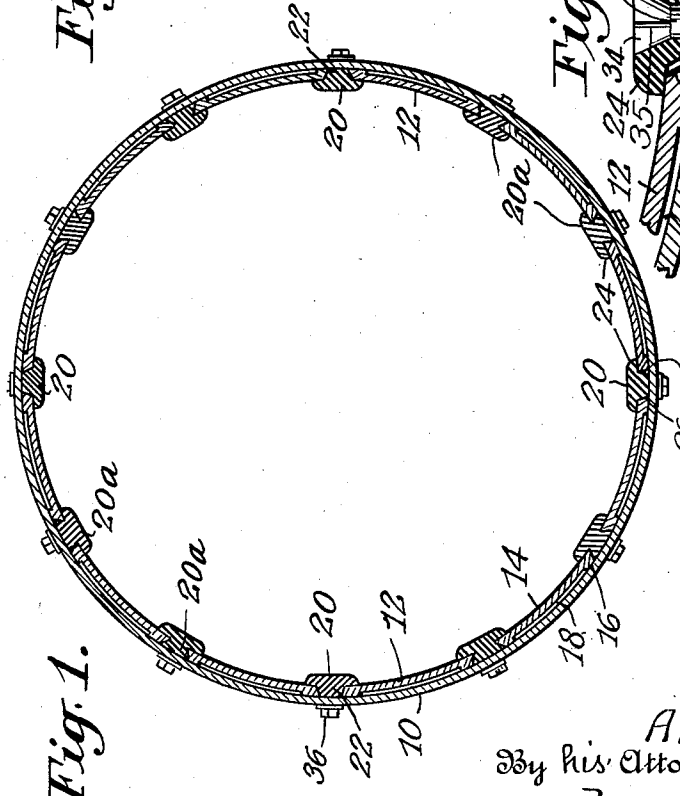


Fig. 1.



Fig. 6.



Fig. 5.

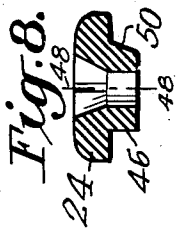


Fig. 8.



Fig. 7.

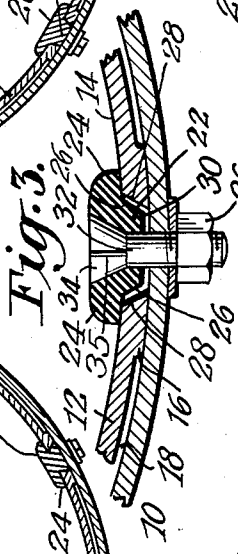


Fig. 3.

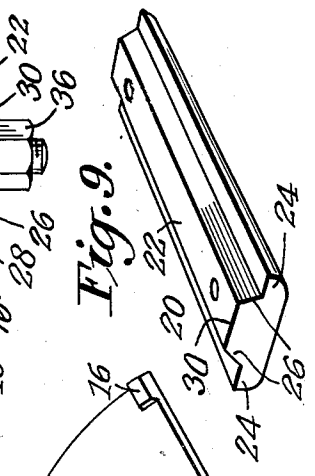


Fig. 9.

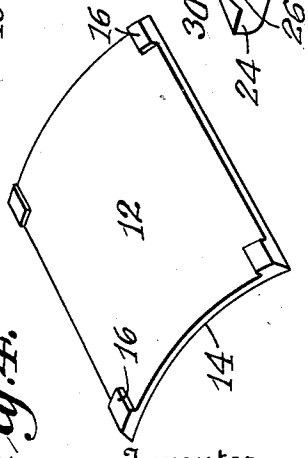


Fig. 4.

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UNITED STATES PATENT OFFICE

1,986,530

GRINDING MILL

Alexander M. Read, Johnstown, Pa.

Application September 10, 1932, Serial No. 632,583

5 Claims. (Cl. 83—9)

This invention relates generally to grinding mills and aims to provide an improved type of renewable lining and a combined lifting bar and holding means for such renewable lining. The invention is applicable to so-called tube mills, ball mills and the like, which are used in various industries such as the cement industry, copper industry, fertilizer manufacturing and so forth, in which the material to be comminuted is introduced into a rotating mill having grinding media therein such as balls of different sizes, or rods, the grinding media comminuting the material through percussion and attrition on and against the metal linings of the mills, and between the grinding media.

It is customary in this art to provide renewable lining sections for the grinding mills. However, the liners of the prior art, so far as I am informed, are universally formed of cast metal such as white iron, chilled cast iron, manganese steel and the like and the castings are formed with integrally cast raised portions adapted to assist in lifting the grinding media to a higher angle of repose as the mill rotates than would be the case if the lining were smooth. These raised up portions also serve to prevent slippage of the load of material to be ground as well as to prevent slippage of the grinding media.

An object of my invention is to provide specific improvements in the lining sections heretofore used and in the means for lifting the material as the mill rotates, the latter means serving also to secure the lining sections in place.

Another object of my invention is to provide a lining plate which will be relatively lighter in weight than the plates heretofore used, thereby facilitating the handling of the plates when renewal is necessary, and through reducing the total load on the bearings of the mill cutting down the power required to rotate the mill, also through making the portion of the lining which receives the most wear, that is the lifting bar, renewable without replacing the main body of the lining, effect economies in saving of useful metal which now must be scrapped.

A further object is to provide lining plates formed of rolled metal as distinguished from cast metal, which rolled metal is of substantially uniform thickness throughout. Another object is to provide lining sections of hardened or heat treated rolled steel plates and a further object is to provide holding means for the lining plates which also serve as lifting bars, these lifting bars being formed with tongues adapted to be disposed between the edges of adjacent plates and having integral lugs or projections which overlap the edges of adjacent plates. The above and further features of the invention will be fully apparent from the following specification when read in connection with the accompanying drawing and will be defined with particularity in the appended claims.

In the drawing—

Fig. 1 is a cross sectional view of the shell of the tube mill having lining sections and lifting bars embodying my invention, the supporting means and rotating means of the mill being omitted as they are well known in the art and form no part of the invention;

Fig. 2 is a view similar to Fig. 1 illustrating an alternative embodiment of the invention;

Fig. 3 is an enlarged detail view showing the contiguous ends of adjacent lining plates and my improved lifting bar interposed therebetween and secured to the shell of the mill;

Fig. 4 is a detail perspective view of one of the renewable lining plates of my invention;

Figs. 5, 6, 7 and 8 are detail cross sectional views of modified forms of lifting bars;

Fig. 9 is a perspective view illustrating the preferred form of lifting bar, such as shown in cross section in Fig. 3.

Referring in detail to the drawing, 10 represents the outer shell of any conventional form of grinding mill. This mill is lined on its interior with a plurality of detachably secured steel plates 12. These plates, as shown, have an inner surface 14 which is substantially parallel or concentric with the inner surface of the shell 10 and said plates are of substantially uniform thickness and cross sectional area at all points. They are, however, provided with separately formed bearing pads 16 at the corners, as indicated in Fig. 4, these pads being welded or otherwise secured to the outer surfaces of the plate.

The only point of contact which the plates make with the shell is where these pads engage the inner surfaces of said shell. This permits of certain manufacturing tolerances and facilitates assembling curved or other shaped plates inside of the shell 10, the bearing pads allowing clearance, such as indicated at 18. This also provides for a certain amount of elasticity or give in the plates, adding through the spring effect of the rolled plate to the clamping effect of the renewable lifting bar shown at Fig. 9 on the drawing.

The lining plates of my invention are comparatively much thinner than the cast plates heretofore used and they are also much lighter

in weight. Preferably I employ lining plates formed of rolled metal as distinguished from cast metal linings heretofore used. While not limited thereto, I preferably employ high carbon steel lining plates which are hardened or heat treated. Such a steel plate can be economically rolled to the desired shape to fit the mill and being of substantially uniform thickness throughout it can be readily heat treated by passage through a continuous heating furnace. The separately formed bearing pads 16 are usually welded or secured to the plates prior to the heat treatment and their thickness is so slight that no undesirable unequal internal stresses are set up due to non-uniformity of the cross section of the metal.

For holding the renewable lining plates in place in the shell, I provide a novel means of renewing a partial or complete lining with large percentages in saving of total tonnage of metal used, which also functions as a lifting bar to carry the included load of material to be ground and grinding media, upwardly as the mill rotates. These combined lining holders and lifting bars may take different forms. As illustrated in Fig. 1, I provide a plurality of lifting bars 20, which have outwardly converging tongues 22 and overhanging lugs 24. The tongues 22, as clearly shown in Fig. 3, have bevelled faces 26—26 which converge outwardly. These tongues are adapted to fit between the correspondingly bevelled edges 28—28 formed on the edges of the adjacent lining plates 12. The lugs 24—24 of the lifting bars overlap the marginal portions of the adjacent lining plates and therefore adequately cover and protect the edges of the adjacent plates. This overlapping and protection is of importance because it tends to prevent the grit or dirt, occasioned by grinding, from filtering in between the plates and the shell. The bars are so proportioned that there is a slight clearance between the tongues 22 and the bevelled surfaces 28. There is also a slight clearance between the outermost surface 30 of the tongue and the inner surface of the shell. These clearances provide an arrangement whereby the overlapping lugs 24 can be drawn tightly into engagement with the marginal surfaces of the lining plates. Thus, and also with reduction of longitudinal clearances in my rolled plate lining, there is less likelihood of material to be ground finding its way into the space between the lining plates and the shell, reducing undesirable wearing action on the inside of the shell of the mill.

It is not possible in practice to prevent some of the extremely finely ground material from filtering into spaces of even the very smallest possible clearances, therefore, after the rolled plate lining is placed in a mill, I pour molten lead, zinc, or spelter into the clearances between the bevelled edges of the plates, and along the width of the plates. Or, grout can also be used for this purpose.

For drawing the overhanging lugs 24 of the lifting bars tightly into engagement with the lining plates, I provide suitable fastening devices such as bolts 32, which have flared heads 34 fitting in suitably tapered holes in the lifting bars. The heads of these bolts have fins 35, which engage grooves 37 so as to prevent them from turning. The shanks of the bolts extend through the shell and carry suitable fastening nuts 36 as shown.

In the embodiment of the invention illustrated in Fig. 1, four of the lifting bars, indicated at 20 are arranged at diametrically opposite points. These all have the outwardly tapered tongues 22 such as shown in the larger view of Fig. 3. In some cases, certain of the lifting bars will have tongues of dove-tailed form, such as shown in the enlarged view of Fig. 5. Such lifting bars as this are indicated at 20^a in Fig. 1. At points where these are used the lining plates will have their edges bevelled to suit the outwardly flaring or dove-tailed tongues such as indicated at 38 in Fig. 5. This assembly of bars, some of which have dove-tailed tongues and others of which have outwardly converging tongues, is but one of many possible variations which may be employed. Where the dove-tailed tongues are used, in order to permit the ready removal of sections it is necessary that certain of the lifting bars be provided with outwardly converging tongues so as to permit ease of removal.

In the embodiment of the invention illustrated in Fig. 2, all of the lifting bars are provided with outwardly converging tongues. Instead of using lifting bars having the tongue contours shown in Figs. 1 to 3 inclusive, I also may provide other forms. For example, as shown in Fig. 6, I may provide a lifting bar, in which the surfaces 40 of the tongue are substantially parallel. Or, as shown in Fig. 7, the tongue may have outwardly converging surfaces 42 which merge into parallel surfaces 44. Or, as shown in Fig. 8, the tongue may have one longitudinally extending surface 46, which is parallel to the radial center line 48—48 passing through the center of the tongue and this tongue may have another surface 50 which converges outwardly with respect to the surface 46. Regardless of which form of tongue is employed, I deem it important that all of the lifting bars be provided with the overhanging integral lugs 24, which as above mentioned are adapted to be drawn into tight engagement with the marginal surfaces of the extremities of the adjacent lining plates.

The lifting bars will usually be made of heat treated high carbon steel, chrome nickel steel, manganese steel or white cast iron.

From the foregoing, it will be apparent that my improved construction provides a lining which will be much lighter in weight than the cast metal linings heretofore used. Conservatively estimated, I believe that the decrease in weight in favor of my construction will be from twenty to forty per cent. The high carbon heat treated steel plate can be produced for about the same or perhaps less cost than the cast plates heretofore used and it will have the advantage of giving a much longer life and service than it is possible to secure with the cast liner plates heretofore used.

While I have described quite specifically certain details of the embodiment of the invention herein illustrated, it is not to be construed that I am limited thereto since various modifications and substitutions of equivalents may be made without departing from the invention as defined in the appended claims.

What I claim is:—

1. A grinding mill having a rotatable shell, a renewable lining therefor of material other than cast metal, comprising a plurality of imperforate arcuate rolled metal plates of substantially uniform thickness throughout their entire area and spaced from the inner surface of the shell intermediate their ends and parallel thereto, and lift-

ing bars extending longitudinally of said shell between said plates and having tongues wedgingly interposed between adjacent plates, and respective securing means for each of said lifting bars.

2. A grinding mill having a rotatable shell, a renewable lining therefor of material other than cast metal, comprising a plurality of imperforate arcuate rolled metal plates of high carbon heat treated steel of uniform thickness and whose inner surfaces are substantially parallel to the inner surface of said shell and whose outer surfaces are spaced from the shell intermediate their ends and lifting bars disposed between the plates and wedgingly and detachably securing said plates to said shell.

3. A grinding mill having a rotatable shell, a renewable lining therefor of material other than cast metal comprising a plurality of arcuate rolled steel plates of substantially uniform thickness throughout their entire area and concentric with the shell and separately formed bearing pads secured at spaced intervals to the outer surfaces of said plates adjacent the ends thereof and adapted to space the outer faces of the plates a short distance away from the inner surface of the shell and lifting bars disposed between the plates for detachably securing the plates to said shell.

4. A grinding mill having a rotatable shell, a renewable lining therefor of material other than cast metal, comprising a plurality of imperforate rolled steel plates of uniform thickness whose inner surfaces are non-undulating and substantially concentric with said shell and whose outer surfaces for the major portions of their intermediate areas are spaced from said shell and lifting bars having tongues interposed between all adjacent plates and lugs integral with said tongues overlapping the plates and respective means detachably securing each of said lifting bars to the shell.

5. A grinding mill having a rotatable shell, a renewable lining therefor of material other than cast metal, comprising a plurality of imperforate rolled steel plates whose inner and outer surfaces are arcuate and concentric and substantially parallel to said shell and spaced therefrom intermediate their ends, the longitudinal edges of said plates being bevelled, lifting bars detachably secured to said shell and having tongues bevelled to fit the edges of the plates and lugs on said lifting bars overlapping and protecting the bevelled edges of said plates.

ALEXANDER M. READ.