ABSTRACT: In a rotary grinding mill or the like the inlet and discharge trunnions of the mill are respectively provided with a liner assembly comprising a radially outer or primary liner and a radially inner or secondary liner. The primary liner normally remains permanently installed and is provided with a pair of axially spaced track slots of T-shaped cross section. The secondary liner is adapted for easy installation or removal and is secured to the primary liner by boltlike fastening means which are received in the T-shaped track slots of the primary liner. Instead of using a primary liner having track slots therein, the track slots may be formed directly in the trunnion, and the liner is secured by fasteners to the track slots.
TRUNNION LINER ASSEMBLY FOR ROTARY GRINDING MILL OR THE LIKE

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to rotary grinding mills or the like and more particularly to a liner assembly for a trunnion of a rotary grinding mill or the like.

2. Description of the Prior Art
Large grinding mills of the type utilized for grinding ore, cement, or the like such as ball mills, rod mills or mills of the autogenous type are all conventionally provided with inlet and discharge trunnions at the feed end and discharge end, respectively of the rotary grinding mill. It is conventional to provide such inlet and discharge trunnions respectively with a liner formed of a hard wearing material, such as a suitable steel alloy, to protect the softer material of the trunnion itself, such as cast iron or the like, from the abrasive wear of the material being processed.

It is also known in the art to provide a liner for the liner. For clarity in description in the specification and claims which follow, the radially outer liner which is secured to the trunnion will be referred to as the “primary liner” while the “liner liner” which is secured to and lies radially inwardly of the primary “primary liner” will be referred to as the “secondary liner.” It will be understood, of course, that when the primary liner is lined with a “secondary liner” the material being processed when passing through the trunnion contacts only the surface of the secondary liner and hence the secondary liner must be constructed of a material having a good wear characteristic, such as a suitable alloy steel.

As previously mentioned, while it has been known to use inner or secondary liners in conjunction with outer or primary liners for lining the trunnions of grinding mills or the like, several types of arrangements heretofore used for mounting a secondary liner onto a primary liner of which I am aware have proved unsatisfactory. For example, in one such prior art arrangement for securing an inner or secondary liner to an outer or primary liner, a through slot large enough to receive the narrower dimension of the head of a T-bolt has been provided in the inner liner and a shank receiving passage has been provided in the outer liner. In such prior art arrangement the head end of the T-bolt is inserted in a radially outward direction through the slotlike passage of the outer liner, and the bolt is then turned so that the shorter dimension of the head portion of the bolt is transverse of the through slot in the outer liner to prevent unintended return movement of the bolt. Such arrangement is commonly known in the art as a “gun lock” type fastening and has the disadvantage that while it permits removal of the inner liner without removing the outer liner, it also permits leakage of the material being processed through the bolt-receiving passages just described into direct contact with the surface of the trunnion casting, thereby defeating the purpose of the trunnion liner arrangement. In the other construction with which I am familiar for securing the inner liner to the outer liner, conventional bolting means are used for bolting the inner liner to the outer liner, which requires that the entire liner assembly including both the outer and inner liners be removed from the trunnion to permit replacement of the inner liner. The necessity of removing the entire liner assembly in order to replace the inner or secondary liner is inconvenient, particularly in the case of grinding mills having center-type drives since in center-type drive mills, the drive coupling must be disconnected in order to remove the liner assembly in the second example just given.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a liner assembly for a trunnion of a rotary grinding mill or the like and a combination of such liner assembly with the rotary grinding mill or the like, having economic and operational advantages over the apparatus of the prior art.

It is another object of the invention to provide a liner assembly for the trunnion of a rotary grinding mill or the like, and the combination of such liner assembly with a rotary grinding mill or the like, which is characterized by ease of installation or of replacement, and requiring a minimum of “down time” of the mill.

It is another object of the invention to provide a liner assembly for the trunnion of a rotary grinding mill or the like and the combination of such liner assembly with a rotary grinding mill or the like which includes an outer or primary liner secured to the trunnion and an inner or secondary liner secured to the outer liner, so constructed as to provide simplicity and ease of assembly of the inner liner relative to the outer liner and so constructed as to permit easy replacement of the inner liner without the necessity of removing the outer liner from the trunnion.

It is a further object of a modified embodiment of the invention to provide a trunnion liner arrangement for a grinding mill or the like in which the trunnion is especially adapted to permit an easy attachment or detachment of the liner relative to the trunnion.

In achievement of these objectives, there is provided in accordance with this invention a liner assembly for the trunnion of a rotary grinding mill or the like, and the combination of such a liner assembly with a rotary grinding mill or the like, comprising a radially outer or primary trunnion liner secured to the trunnion and a radially inner or secondary trunnion liner formed in arcuate segments which are secured to the primary liner by means of boltlike fastener means which engage a T-shaped cross section track slot in the primary liner. A further feature of the construction is the provision of a “dam” or barrier at a predetermined location in the track slot which serves to prevent circulation of processed material in the track slot. Instead of using a primary liner having track slots therein, the track slots may be formed directly in the trunnion, and the liner is secured by fasteners to the track slots of the trunnion.

Further objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawing in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in longitudinal section of a rotary grinding mill having a trunnion assembly in accordance with the invention;

FIG. 2 is an enlarged view in longitudinal section of a trunnion provided with a trunnion liner assembly of the invention;

FIG. 3 is an end view of the trunnion in FIGS. 1 and 2 showing the attachment of the trunnion liner assembly to the trunnion;

FIG. 4 is a partial view taken along line IV—IV of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and more particularly to FIG. 1, there is shown a grinding mill generally indicated at 10 including a shell generally indicated at 12 comprising a cylindrical shell plate 14 to the respective opposte axial ends of which are rigidly attached shell flanges 16 and 18. Shell flange 16 and 18 have ribs 18 rigidly secured thereto or integral therewith. Shell flange 16 is rigidly secured as by bolts 20 and nuts 21 to the end plate or head 22 which is integral with the trunnion 24 upon which the mill 10 is supported for rotation by bearing 26. The shell flange 16 is similarly secured to the end plate or head 22 at the discharge end of the mill. The trunnion 24 at the left-hand end of the view of FIG. 1 is hollow and constitutes the feed end trunnion of the mill, and the trunnion 24 at the right-hand end of the view of FIG. 1 is hollow and serves as the discharge trunnion of the grinding mill.

The grinding mill is provided at the feed end thereof with a wear plate and lifter assembly generally indicated at 30. At the discharge end of the mill, the mill is provided with a discharge diaphragm assembly generally indicated at 32 comprising a grate and wear plate subassembly 33 and a discharge casting.
subassembly 37 which cooperates with a discharge cone assembly generally indicated at 34 and with a ring liner 38 to define a discharge passage generally indicated at 36 through which the material after being ground passes outwardly to the discharge trunnion 24'.

The feed trunnion 24 and the discharge trunnion 24' are each respectively provided with a liner assembly constructed in accordance with the invention. The trunnion liner assembly at the discharge end of the mill will be described in detail as exemplary of the trunnion liner assemblies at both the feed and discharge ends of the mill. Referring now to FIGS. 1, 2 and 3, the outer or primary liner generally indicated at 40 is seated inside the trunnion 24'. The outer trunnion liner 40 in the illustrated embodiment is of fabricated construction and includes an axially inner ring portion 42 and an axially outer ring portion 44 which are joined by a connecting member 46. The connecting member 46 is welded at its axially inner end to ring member 42 and at its axially outer end to ring member 44.

The ring liner 38 projects radially inwardly beyond the radially inner peripheral surface of trunnion 24' and terminates flush with the radially inner surface of ring portion 42 of outer or primary trunnion liner 40. The axially inner ring portion 42 of outer or primary trunnion liner 40 is in abutting relation to the axially outer surface of ring liner 38. Ring portion 42 of outer trunnion liner 40 is provided with an annular recess 48 contiguous ring liner 38. Recess 48 receives rib portion 45 of trunnion 24' and a suitable packing material 47 is also positioned in recess 48.

In accordance with an important aspect of the construction, the inner ring portion 42 of outer liner 40 and outer portion 44 of outer liner 40 are respectively provided with slotlike recesses or track slots each indicated at 49. Each of the track slots 49 extends for 360° of the periphery of the respective ring members 42 and 44. Each of the slotlike recesses or track slots 49 is of the shape in hollow cross section. Each track slot includes a radially outer head portion 51 and a radially inner neck portion 53. As will be explained in more detail hereinafter, head portion 51 of the track slot normally receives the head end of a fastening bolt while neck portion 53 of the track slot normally receives the shank portion of the fastening bolt.

The axially outermost ring member 44 is provided with a flange portion 50 which extends in a 360° arc and is suitably secured to the trunnion 24'. If the trunnion itself is provided with a cooperating flange portion as shown in the drawings the flange portion absorbs the wear from the load of processed material passing through the trunnion. A typical material of which the secondary liner 60 might be constructed would be 0.85 percent carbon chrome—moly alloy steel. The secondary liner segments when assembled into a 360° arc define a truncated conical form which is of larger diameter at the discharge or right-hand end of the view of FIG. 2 than at the left-hand of the view of FIG. 2. The primary liner 40 is of similar shape to that of the secondary liner. Each of the liner segments 61 is provided adjacent the opposite end thereof with a countersunk bolt hole such as that indicated at 62 in FIG. 2.

An important feature of the construction is the provision in each of the slot tracks 49 of a dam 64 (FIGS. 3 and 5) at a predetermined location in each of the respective track slots. The dam 64 is an abutment and closure which extends transversely across both head portion and neck portion of the slot track 49 and which serves to prevent "racing" of processed material which gets into track slot 49 since dam 64 serves as a barrier which prevents 360° rotation of processed material in track slot 49. It is inevitable that processed material will get into track slot 49 and will become packed therein. However, by stopping 360° sliding movement of such material in the track slots, abrasive wear on the track slots is prevented. It will be noted that the abutting circumferential ends of contiguous segments such as 61a and 61b are preferably provided with a stepped configuration or overlap to prevent leakage of the processed material through the joint between adjacent segments of the secondary liner and into contact with the face of the primary trunnion liner 40. A suitable packing material 63 is preferably provided between the abutting edges of contiguous segments 61 at the joint thereof. While abutting circumferential ends of contiguous segments such as 61a and 61b are preferably overlapped as just described such abutting circumferential ends do not have to be so overlapped but may instead be butt jointed.

The bolt 66 is provided with a head portion 67 of rectangular shape which is so dimensioned that the dimension a of the bolt head is less than the transverse width (in a direction axially of the trunnion) of the neck portion of the T-shaped slot, while dimension b of the bolt head is greater than the transverse width of the neck portion of the T-shaped slot. Hence, it can be seen that if the bolt 66 is inserted head first into the neck portion of the T-shaped slot with the bolt head positioned with the (longer) dimension thereof extending in the lengthwise or circumferential direction of the T-shaped slot and with the (shorter) dimension of the bolt extending in the direction of the transverse dimension of the neck portion of the T-slot that the bolt head can be inserted through the neck portion of the T-slot and into the larger head portion of the slot. With the head portion of the bolt in the head portion of the slot, the bolt can then be turned about its axis so that the (longer) dimension of the bolt head is substantially transverse of the neck portion of the T-slot. With the bolt 66 so positioned in the T-slot, and with the shank portion of the bolt extending through an aperture in a secondary liner segment such as 61a, the nut 70 can be tightened to secure the respective secondary liner segment to the primary liner 40. The head portion 67 of the bolt head is preferably so dimensioned that when the bolt is turned to the position in which the b dimension of the bolt head when in the head portion of the T-slot extends transverse of the neck portion of the T-slot as shown in FIG. 4, the diagonally opposite end corners of the b dimension of the bolt head butt against the opposite walls of the head portion of the T-slot.

To assemble the secondary liner segments 61 relative to the primary liner 40, a first one of the secondary liner segments such as 61a is positioned in overlying relation to the primary liner 40, with the shank end of a bolt 66 received in each of the respective passages 62 of the given liner segment and with the head end 67 of each bolt having the b dimension thereof aligned with the circumferential direction of the neck portion of the T-slot of primary trunnion liner 40. The head end of the given secondary liner segment thus positioned is inserted through the neck portion of the T-slot and the head end of a bolt is engaged with the head end of a track slot 49 at each respective end of the primary trunnion liner. With the bolt 66 so positioned, and with the head end 67 of the bolt received in head portion 51 of track slot 49 and the shank portion of the bolt lying in neck portion 53 of the track slot, the bolt is rotated about its axis as previously described to cause the larger or b dimension of the head end of the bolt to lie transverse of the circumferential dimension of the neck portion of the T-slot.
The first secondary liner segment 61 to be so installed is positioned at a location relative to track slot 49 in which its oppositely disposed bolts 66 abut against the respective dam 64 in each of the respective track slots 49. After the first secondary liner segment such as 61a has been positioned as just described, the remaining segments 61 are then placed into position in sequence. Orienting the first secondary liner segment 61a relative to dam 64 as just described insures that the last liner segment to be installed will not be so positioned as to have the bolt 66 thereof lie in radial alignment with dam 64 in the assembled position of the segments 61, the abutting end edges of contiguous segments 61 overlap as shown in FIG. 3.

After the respective segments 61 have been positioned in assembled relation as shown in the view of FIG. 3, the nuts 70 which secure the respective secondary liner segments 61 tightly in position are tightened onto the threaded shank portion of the respective bolts 66, the nuts 70 being received in countersunk openings 62 in the radially inner face of the respective secondary liner segments.

It can be seen that if it is necessary to remove the secondary liner 60 as, for example, for the purpose of replacing a worn secondary liner with a new secondary liner, that the reverse procedure to that just described is followed.

It should be noted that in the foregoing that there is provided in accordance with this invention an improved liner assembly for the trunnion of a grinding mill or the like which permits quick and easy installation of the secondary trunnion liner onto a primary trunnion liner, the primary liner remaining a permanent installation insofar as normal operation of the grinding mill is concerned. Furthermore, the construction hereinbefore described permits quick and easy removal of an existing secondary liner for purposes of replacement or the like without removal of the primary liner, thereby saving a great deal of “down time” of the grinding mill or the like. The mounting arrangement of the secondary liner on the primary liner is such that no leakage occurs of the processed material onto the surface of the trunnion. A further advantage of the subject construction is that on center type drives for grinding mills or the like, the coupling never has to be broken to remove a worn secondary trunnion liner of the type hereinbefore described since removal of the secondary trunnion liner hereinbefore described does not require removal of the primary trunnion liner, the removal of which would require un-coupling of the center type drive.

It is also within the scope of this invention to provide slot-like recesses such as slot tracks 49a directly in the trunnion, as embodied in the trunnion portion 24a of the feed trunnion 24 at the left-hand end of the view of FIG. 1, rather than in a primary liner, and to mount the segmented liner members directly onto the trunnion portion 24a by means of fasteners similar to the previously described fasteners 66 which are secured in the track slots 49a. Each track slot 49a is also provided with a dam such as the dam 64 previously described.

It will be understood that the modified embodiment just described in which the track slots 49a are provided directly in the trunnion is similar in principle to although less desirable in certain respects, than the previously described embodiment in which the track slots 49 are provided in a primary liner 40 which is secured in the trunnion 24, and that the segmented liner members 60a are secured to the track slots 49a on trunnion portion 24a in substantially the same manner as described in connection with the mounting of the secondary liner segments 61 relative to primary liner 40.

Either liner assembly construction, namely, that shown at the feed end or that shown at the discharge end, may be used at either end of the grinding mill or the like.

From the foregoing detailed description of the present invention, it has been shown how the objects of the invention have been obtained in a preferred manner. However, modifications and equivalents of the disclosed concepts such as readily occur to those skilled in the art are intended to be included within the scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A rotary grinding mill or the like comprising a trunnion, a track slot positioned within and carried by said trunnion and extending through an arc of substantially 360° relative to said trunnion, said track slot being of substantially T-shape in transverse cross section and including a radially outer head portion and a radially inner neck portion, a liner carried by said trunnion, and fastener means extending through said liner and received in said track slot, said fastener means including a head end positioned in said head portion of said slot and a shank positioned in said neck portion of said slot, whereby to secure said liner to said trunnion.

2. A rotary grinding mill or the like as defined in claim 1 in which said liner is formed of a hard material having good wear characteristics.

3. A rotary grinding mill as defined in claim 1 in which said liner is formed of a plurality of arcuate segments, each of said segments being secured by fastener means to said track slot.

4. A rotary grinding mill or the like as defined in claim 1 in which said track slot is provided with a dam at one region thereof.

5. A rotary grinding mill or the like as defined in claim 3 in which adjacent ends of contiguous arcuate segments are overlapped.

6. A rotary grinding mill or the like comprising a trunnion, a primary liner secured to said trunnion, a track slot extending through an arc of substantially 360° relative to said trunnion, said track slot being of substantially T-shape in transverse cross section and including a radially outer head portion and a radially inner neck portion, a secondary liner positioned in superposed relation to said primary liner radially inwardly of said primary liner, fastener means extending through said secondary liner and received in said track slot of said primary liner, said fastener means including a head end positioned in said head portion of said slot and a shank positioned in said neck portion of said slot, whereby to secure said secondary liner to said primary liner.

7. A rotary grinding mill or the like as defined in claim 6 in which said secondary liner is formed of a hard material having good wear characteristics.

8. A rotary grinding mill or the like as defined in claim 6 in which said track slot is provided with a dam at one region thereof.

9. A rotary grinding mill or the like as defined in claim 9 in which adjacent ends of contiguous arcuate segments are overlapped.

10. A rotary grinding mill or the like as defined in claim 9 in which adjacent ends of contiguous arcuate segments are overlapped.

11. A trunnion liner assembly adapted to be mounted in the trunnion of a rotary grinding mill or the like, comprising a primary liner adapted to be secured to said trunnion, a track slot in said primary liner, said track slot extending through an arc of substantially 360° relative to said trunnion, said track slot being of substantially T-shape in transverse cross section and including a radially outer head portion and a radially inner neck portion, a secondary liner positioned in superposed relation to said primary liner radially inwardly of said primary liner, fastener means extending through said secondary liner and received in said track slot of said primary liner, said fastener means including a head end positioned in said head portion of said slot and a shank positioned in said neck portion of said slot, whereby to secure said secondary liner to said primary liner.

12. A trunnion liner assembly as defined in claim 11 in which said secondary liner is formed of a hard material having good wear characteristics.

13. A trunnion liner assembly as defined in claim 11 in which said secondary liner is formed of a plurality of arcuate segments, each of said segments being secured by fastener means to said track slot.

14. A trunnion liner assembly as defined in claim 11 in which said track slot is provided with a dam at one region thereof.

15. A trunnion liner assembly as defined in claim 13 in which adjacent ends of contiguous arcuate segments are overlapped.