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(54) **Title:** QUICKLY RELEASABLE LINER BOLT

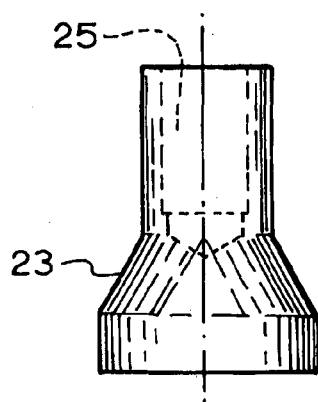


Fig. 3.

(57) **Abstract:** A nut (23) and a re-usable liner bolt (17) for a grinding mill is disclosed. The nut is shaped to be received in the recess (5) of a mill liner plate (3), this being the recess which normally receives the head of a conventional liner bolt. The nut is provided with a blind threaded hole (25). The re-usable bolt has a stepped shank (18) and a thread (20) on its free end. The bolt (17) is inserted from the exterior of the mill and engages the nut (23). The tines produced during grinding cement the nut to the liner but do not cement the bolt to the liner or the bolt to the nut. The head of a conventional liner bolt is located within the mill and its conventional nut is located exterior of the mill, whereas the re-usable bolt (17) has its head exterior of the mill and its nut (23) interior of the mill. Methods of assembly and dis-assembly of the bolt (17) and nut (23) are also disclosed.



Quickly Releasable Liner Bolt

Field of the Invention

The present invention relates to grinding mills and, in particular to the liner bolts used
5 to secure the sacrificial liners of such mills.

Background Art

Grinding mills are used in a wide range of mining activities such as the milling of
hard rock ores, including copper ore, the production of cement, and other such
10 activities. Typically the mill consists of a hollow steel cylinder which is rotated about
its longitudinal axis. The interior of the cylinder is lined with the sacrificial liner.
Inside the liner are the lumps of ore and the grinding bodies, such as steel balls. As the
mill is rotated, so the grinding bodies grind the lumps of ore up into a fine powder
which is then utilised in the next stage of the process.

15 During routine maintenance, it is necessary to replace the sacrificial lining with a new
lining. Since the sacrificial lining is bolted to the mill body, this replacement task
normally requires the bolts holding the lining in place to be knocked out by means of
hydraulic hammers, pneumatic hammers, manually operated hammers, or suspended
20 hammering devices similar to a battering ram. Approximately 30% of the time spent
in doing a re-line of a grinding mill is spent in removing the liner bolts holding the
worn liner in place. Typically 4-6 personnel are employed in this job.

Genesis of the Invention

25 The genesis of the present invention is a desire to reduce the amount of effort required
to change the sacrificial lining.

Summary of the Invention

In accordance with a first aspect of the present invention there is disclosed a liner nut
30 having an exterior surface and a blind threaded hole, said exterior surface being
shaped to mate with a recess in a grinding mill liner plate to thereby prevent rotation
of said nut relative to said recess.

In accordance with a second aspect of the present invention there is disclosed a liner bolt having a substantially conventional head, a shank extending from said head, and a threaded portion of said shank adapted to threadably engage with the threaded blind hole of the abovementioned liner nut.

5

In accordance with a third aspect of the present invention there is disclosed the combination of the above-mentioned liner nut and liner bolt.

According to another aspect of the present invention there is provided a method of assembling a liner plate having a shaped recess therein to a mill wall having a through aperture, said method comprising the steps of:

aligning said recess and aperture,
inserting a liner nut as defined above into said recess,
inserting the shank of a liner bolt as defined above into said aperture,
15 and threadably engaging the thread of said shank with the thread of said blind hole in said liner nut.

According to a still further aspect of the present invention there is provided a method of disassembling a liner plate from a mill wall having a through aperture, said liner plate being held against said wall by means of a liner nut as defined above, being retained in a recess of said liner plate, and a liner bolt as defined above extending through said aperture and into said liner nut, said method comprising the steps of :

rotating the head of said liner bolt to disengage the threaded shank thereof from the thread of the blind hole of said liner nut,
25 discarding said liner plate and liner nut, and
retaining said liner bolt for use in the subsequent assembly of a new liner plate to said mill wall.

Brief Description of the Drawings

30 A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is an exploded cross-sectional view taken through the cylindrical wall of a prior art grinding mill and showing a prior art nut and bolt which retains the liner in place,

Fig. 2 is an end elevation of the head of the bolt of Fig. 1;

Fig. 3 is a cross-sectional view equivalent to Fig. 1 but in accordance with a preferred embodiment of the present invention;

Fig. 4 is an end elevation of the nut of Fig. 3; and

5 Fig. 5 is a combined side elevation and end view of a bolt of a second embodiment.

Detailed Description

As seen in Figs. 1 and 2, a mill wall 1 has an aperture 2 therethrough. A liner plate 3
10 and rubber backing sheet 6 are positioned adjacent the mill wall 1. The liner plate 3
and has a shaped recess 5 which opens towards the interior of the mill. The recess 5
extends through the liner plate 3 and is aligned with the aperture 2. A liner bolt 7 has a
shank 8 and a head 9. The tip of the shank 8 is threaded in conventional fashion. The
head 9 has a generally oval shape and mates with the recess 5 so as to stop the liner
15 bolt 7 rotating within the recess 5.

In order to secure the liner plate 3, the liner bolt 7 is passed into the recess 5 and
through the aperture 2, a rubber washer 11 and a steel washer 12 are then passed over
the shank 8, and a conventional nut 13 secured to the thread. Tightening the nut 13
20 clamps the liner plate 3 against the mill wall 1.

After several months, when the liner plate 3 comes to be replaced, the nut 13 and
washers 11, 12 are removed from the liner bolt 7. Then the bolt 7 is knocked out of
the aperture 2 and liner plate 3. This is a very time-consuming task which requires
25 manually guided hammers and numerous people. Since the threaded portion of the
shank 8 protrudes from the nut 13, the threads on the shank 8 become corroded due to
their exposure to the elements, and thus the nut 13 quite often requires cutting off with
an oxyacetylene torch, rather than being removed with a pneumatic wrench, or
similar. In addition, due to wear and peening the bolt can become deformed from the
30 hammer impacts, thus making the bolts 7 difficult to remove and also causing damage
to the apertures 2 in the mill wall 1.

Turning now to Figs. 3 and 4, the mill wall 1, liner plate 3, rubber backing sheet 6,
and washers 11, 12 are as before. However, the liner bolt 17 has its orientation

reversed. The liner bolt 17 has a shank 18 and a head 19 and a threaded portion 20 which is of reduced diameter relative to the shank 18. A liner nut 23 has an exterior shape (for example oval when viewed end on) designed to exactly match the recess 5 and thus corresponds in shape to the head 9 of the conventional liner bolt 7. As a consequence, the liner nut 23 cannot rotate within the recess 5. The liner nut 23 is also provided with a blind hole 25 which is threaded with a thread which matches that of the threaded portion 20.

During installation, the liner plate 3 has the recess 5 aligned with the corresponding aperture 2, the liner nut 23 is positioned into the recess 5, the shank 18 of the liner bolt 17 is inserted into the aperture 2 and the liner bolt 17 is rotated, preferably using an impact gun or similar, to engage the threaded portion 20 with the blind hole 25 in the liner nut 23. This engagement brings the liner plate 3 into contact with the mill wall 1 and holds the liner plate 3 in a stable position.

The liner bolt 17 and liner nut 23 are designed so that there is no need to knock out the liner bolt 17 prior to removal of the liner plate 3 during routine maintenance. As the male thread of the threaded portion 20 and the female thread of the blind hole 25 are both protected, this eliminates the possibility of them becoming seized, for example because of fines or ore dust entering the thread. Thus there is no need for any cutting equipment. Instead, the liner bolt 17 can be undone using a conventional pneumatic wrench, for example.

There is no need to remove the liner nut 23 from the liner plate 3 since the liner plate 3 is to be discarded. The liner nut 23 will normally be "cemented" into the recess 5 by the penetration of fine ore dust around the liner nut 23. It is this "cementing action" which requires the conventional liner bolt 7 to be hammered out of the recess 5. However, the reversal of the direction of the liner bolt 17 overcomes the problems caused by this "cementing action".

Furthermore, the liner bolt 17 is reusable. Although the liner bolt 17 and the liner nut 23 can both be manufactured of the same grade steel, if the liner bolt 17 is manufactured with a higher grade steel, it is reusable on more occasions.

As seen in Fig. 5, an alternative form of liner bolt 27 has a head 29 an internal square drive recess 30.

The foregoing describes only some embodiments of the present invention and
5 modifications, obvious to those skilled in the mining arts, can be made thereto without departing from the scope of the present invention. For example, the axial length of the liner bolt 17 and liner nut 23 can be varied to suit the thicknesses of the mill wall 1 and the liner plate 3. Preferably, the shank 18 and blind hole 25 are provided with 6 threads per inch, however, this can be modified depending upon the mill structure
10 thickness and clamping force required the different sized wear liners. In addition, the nut 23 can be of any shape with the recess 5 of the mill liner plate 3 having a corresponding complementary shape.

The term “comprising” (and its grammatical variations) as used herein is used in the
15 inclusive sense of “including” or “having” and not in the exclusive sense of “consisting only of”.

CLAIMS

1. A liner nut having an exterior surface and a blind threaded hole, said exterior surface being shaped to mate with a recess in a grinding mill liner plate to thereby prevent rotation of said nut relative to said recess.
2. The liner nut as claimed in claim 1 wherein said exterior surface has the shape of the head of a conventional liner bolt.
3. The liner nut as claimed in claim 1 or 2 wherein said exterior surface is substantially oval.
4. A liner bolt having a substantially conventional head, a shank extending from said head, and a threaded portion of said shank adapted to threadably engage with the threaded blind hole of the liner nut as claimed in any one of claims 1-3.
5. The liner bolt as claimed in claim 4 and having a head with an internal drive recess.
6. The combination of a liner nut as claimed in any one of claims 1-3 and a liner bolt as claimed in claim 4 or 5.
7. A method of assembling a liner plate having a shaped recess therein to a mill wall having a through aperture, said method comprising the steps of:
 - aligning said recess and aperture,
 - inserting a liner nut as claimed in any one of claims 1-3 into said recess,
 - inserting the shank of a liner bolt as claimed in claim 4 or 5 into said aperture, and
 - threadably engaging the thread of said shank with the thread of said blind hole in said liner nut.
8. A method of disassembling a liner plate from a mill wall having a through aperture, said liner plate being held against said wall by means of a liner nut

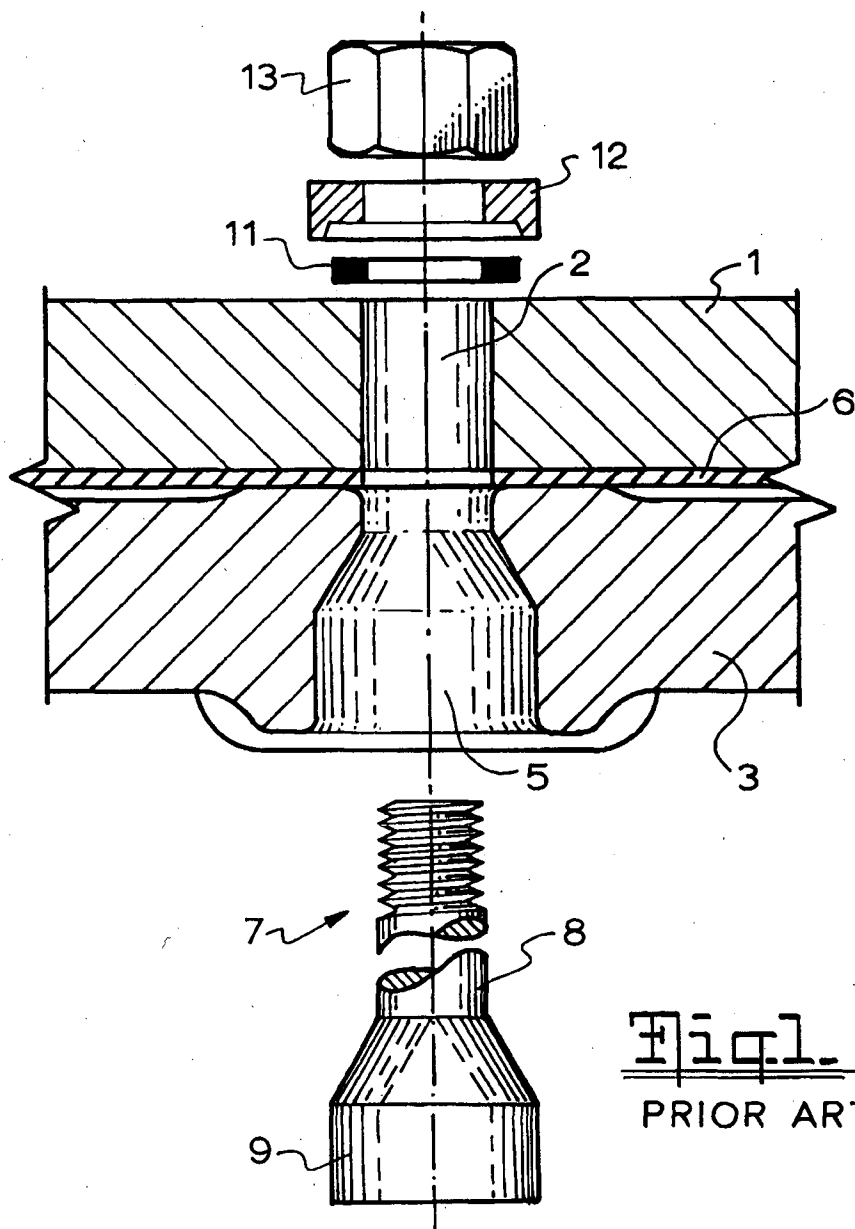
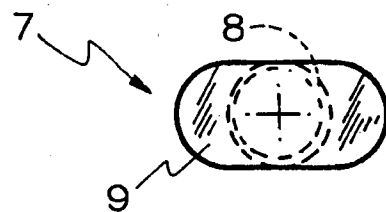
as claimed in any one of claims 1-3 being retained in a recess of said liner plate, and a liner bolt as claimed in claim 4 or 5 extending through said aperture and into said liner nut, said method comprising the steps of :

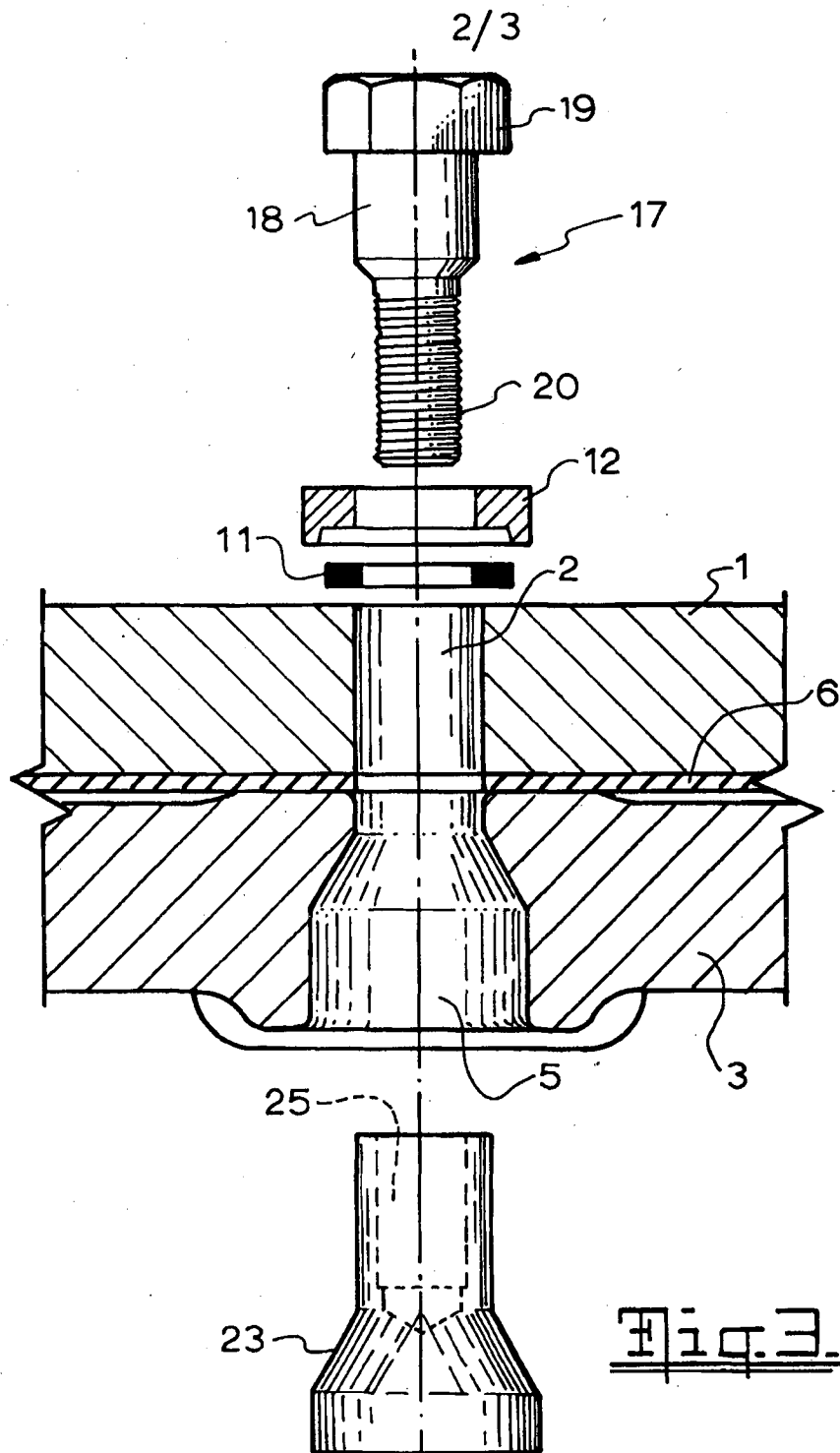
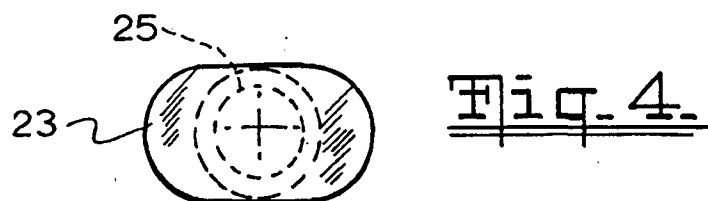
rotating the head of said liner bolt to disengage the threaded shank thereof from the thread of the blind hole of said liner nut,

discarding said liner plate and liner nut, and

retaining said liner bolt for use in the subsequent assembly of a new liner plate to said mill wall.

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3/3

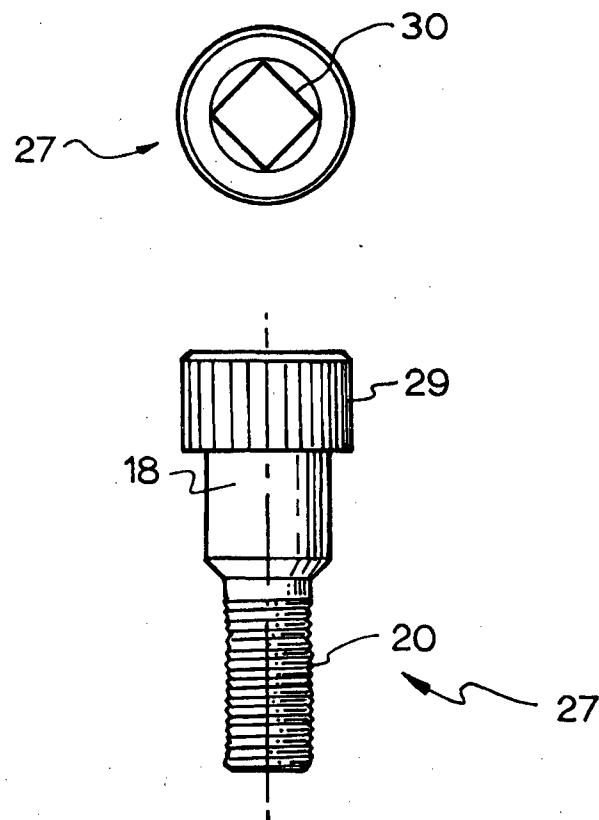


Fig. 5.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/000093

A. CLASSIFICATION OF SUBJECT MATTER

B02C 17/22 (2006.01) B02C 23/00 (2006.01) B02C 17/18 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Derwent WPI, EPODOC: B02C17/22 OR B02C17/18 OR B02C2/005 OR B02C23/00 OR B07B OR B65G OR E02F OR F16B37 OR F16B35 OR F16B17 OR E21B43/10 and keywords: liner, lining, wear plate, nut, socket, fasten, thread, screw, blind, and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 2 April 2013	Date of mailing of the international search report 02 April 2013
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au Facsimile No.: +61 2 6283 7999	Authorised officer David Lee AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832107

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2013/000093
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6082646 A (CLARKE et al) 04 July 2000 Figures 4-6, 9-12	1-4, 5, 6-8
A	US 3804346 A (NORMAN) 16 April 1974	1-8

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2013/000093	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
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		WO 0103839 A1	18 Jan 2001
US 3804346 A	16 Apr 1974	AU 6020473 A	20 Mar 1975
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End of Annex			