Aug. 28, 1962 H. F. STAUFFER 3,051,399

GRINDING MILL TRUNNION

Filed Nov. 10, 1959 4 Sheets-Sheet 1

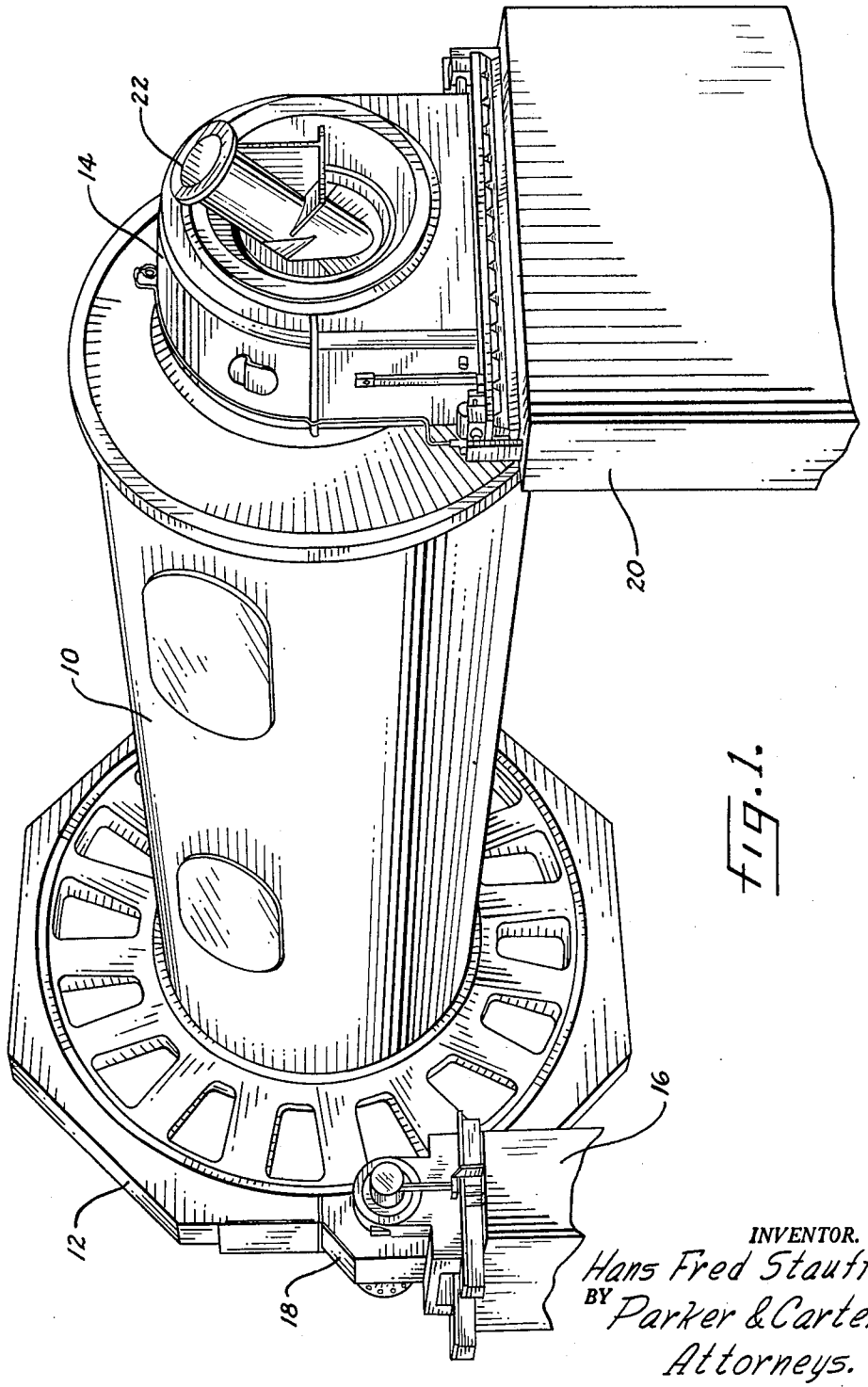



Fig. 1.

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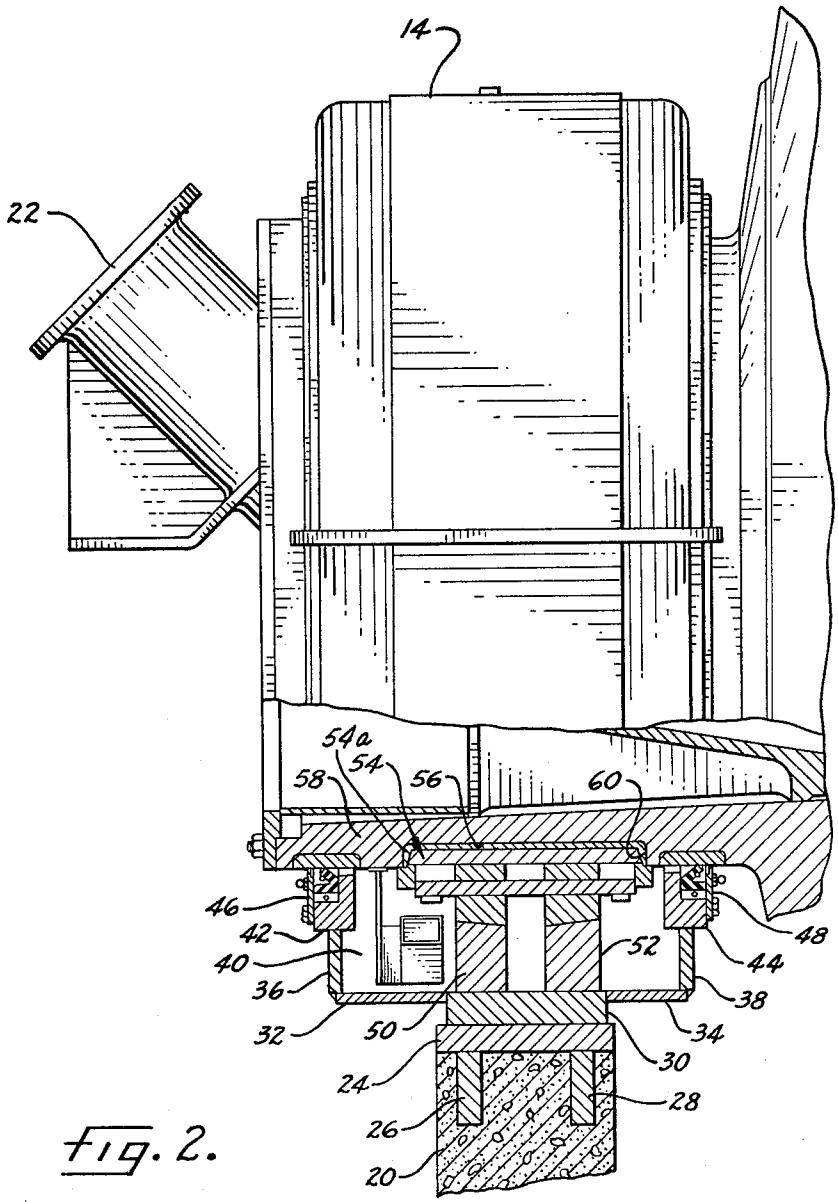



Fig. 2.

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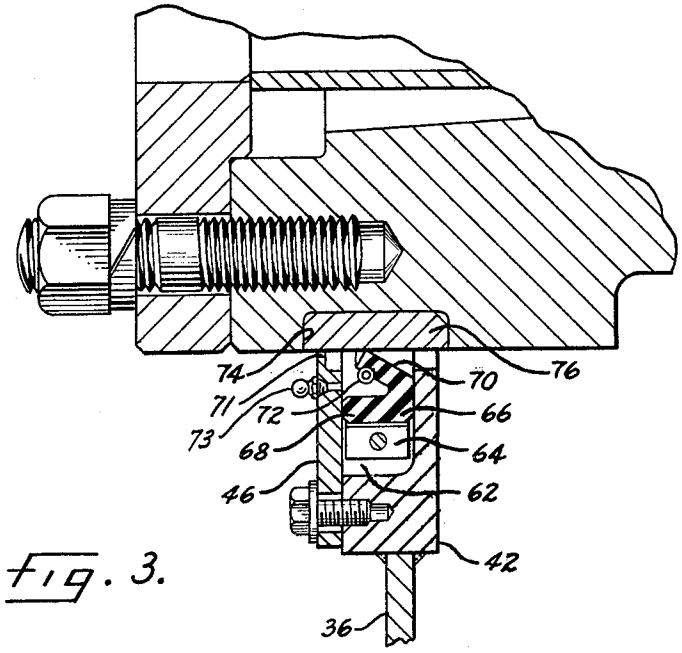



Fig. 3.

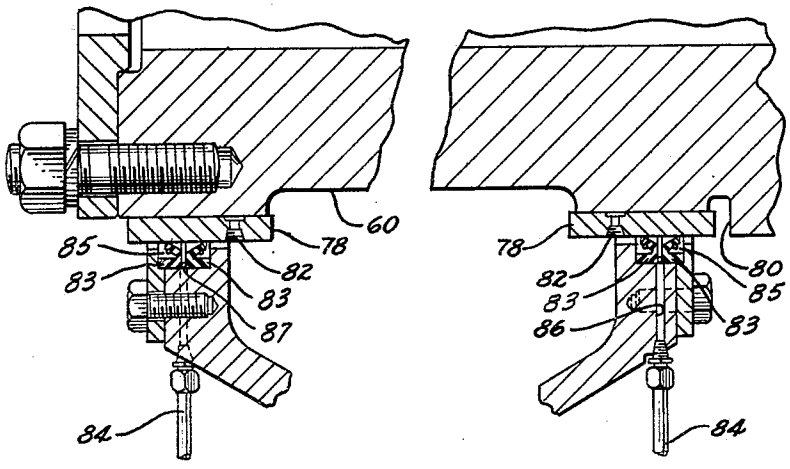



Fig. 4.

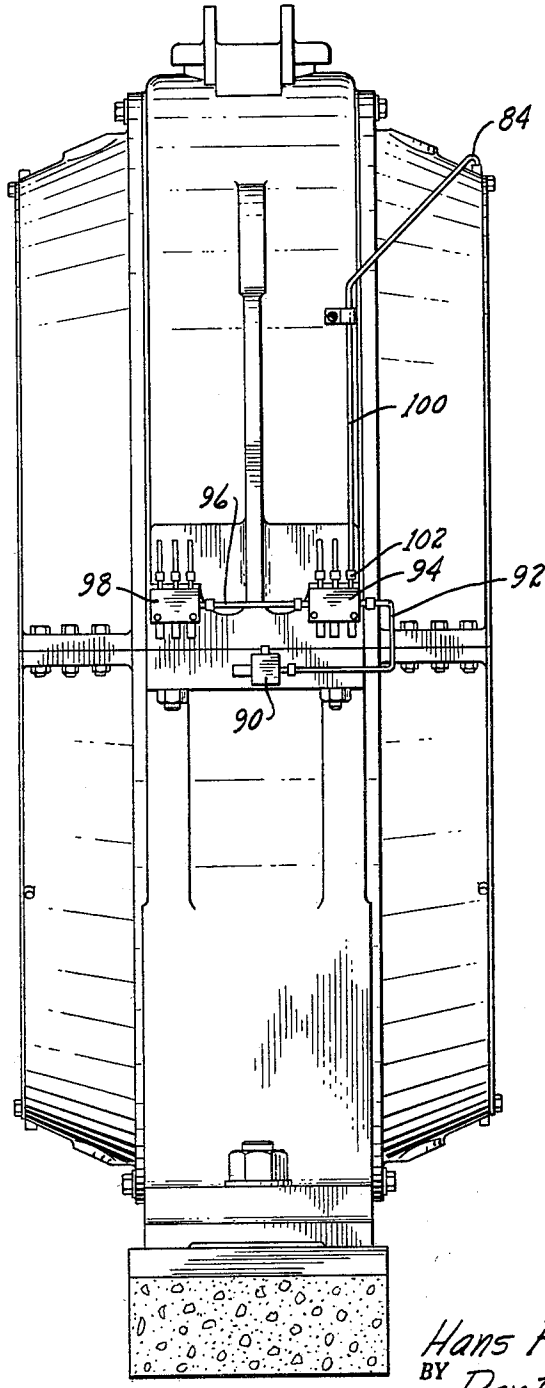
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Fig. 5.




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3,051,399

# GRINDING MILL TRUNNION

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This invention relates to a grinding mill trunnion bearing.

One purpose of this invention is an improved trunnion bearing for a grinding mill wherein the mill head is provided with a hard metal band to prevent grooving of the head by the bearing seal.

Another purpose is an improved wear-resistant seal for a trunnion bearing.

Another purpose is a grinding mill head having improved wear-resistant qualities.

Another purpose is an improved grinding mill head which may be either the "free" or "held" end of the grinding mill.

Another purpose is a standardized grinding mill head having improved wear-resistant qualities.

Another purpose is a trunnion bearing including means for greasing the bearing seals while the machine is operating.

Other purposes will appear in the ensuing specification, drawings and claims.

The invention is illustrated diagrammatically in the following drawings wherein:

FIGURE 1 is a perspective view of a grinding mill,

FIGURE 2 is an enlarged side view, in part section, of a grinding mill head and trunnion bearing,

FIGURE 3 is an enlarged section showing the details of the improved trunnion bearing seal disclosed herein,

FIGURE 4 is an enlarged section showing a further form of improved trunnion bearing seal, and

FIGURE 5 is an enlarged side view of a grinding mill head and trunnion bearing having improved greasing means included thereon.

In FIGURE 1, a grinding mill tank or drum **10** has a conventional drive structure **12** at one end and a housing and bearing structure **14** at the opposite end. A suitable concrete foundation **16** supports a drive motor **18** which rotates the drum **10** upon its supports. The bearing and housing structure **14** is suitably supported by a concrete foundation or the like **20**. The housing **14** has a suitable feed pipe or the like **22** which directs the incoming material to be ground into the interior of the drum **10**.

Each end of the drum **10** is supported for rotation in a trunnion bearing or the like which is more particularly described hereinafter. Trunnion bearings are conventional in this type of machine and are constructed so that they will withstand extreme loads while providing smooth rotational support for the mill. Whereas the invention is described in connection with a grinding mill it should be realized that the particular improvements embodying the invention have many other applications. The principles disclosed herein are applicable to any trunnion bearing, regardless of the machine, as it is the general purpose of the invention to provide a trunnion bearing arrangement having improved sealing characteristics and improved wear-resistant qualities.

Turning now to FIGURE 2, the support structure is shown to comprise the foundation **20** upon which is seated a plate **24** suitably welded to two vertical plates **26** and **28** extending down into the concrete foundation. A second plate **30**, seated upon the plate **24**, has a pair of horizontally extending lower housing plates **32** and **34** welded thereto. Vertical plates **36** and **38** may be welded to the plates **32** and **34** to define an oil chamber



or the like **40** which contains lubricant for the bearing. Suitably welded to the plates **36** and **38** are generally L shaped seal support members **42** and **44** which define a pocket or the like for the annular seal rings hereinafter described in detail. Cover plates **46** and **48** are secured by bolts or the like to the outside of the L-shaped blocks **42** and **44** to form the outer side of the pockets containing the annular seal rings.

Positioned within the oil chamber **40** are two spaced vertical support members **50** and **52** which are seated upon the plate **30**. The support members **50** and **52** in turn support the bearing structure indicated generally at **54** which provides a bearing surface **56** upon which mill head **58** rotates. The head **58** has a circumferential groove **60** which receives a portion of the bearing structure **54**. The details of the bearing structure heretofore described are conventional and not essential to the invention.

FIGURE 3 shows the details of the improvements comprising the invention herein. A pocket **62**, defined by the L-shaped block **42** and cover plate **46**, contain an adjustable band **64** upon which is seated an annular seal ring **66**, which as shown herein has a lower or body portion **68** and an angular lip **70** biased by a coil spring or the like **72** into bearing relationship with the mill head. Both the angular lip and the coil spring **72** extend around the complete circumference of the mill head and the lip will bear against the head generally throughout the circumference or length thereof.

Seal ring **70** has a dual purpose in that it both prevents dirt or other foreign matter from entering the oil chamber **40** and contaminating the lubricant and prevents lubricant from escaping out of the chamber. When dirt or other foreign matter enters the small chamber formed between the lip **70** and the cover plate **46** through gap **71** between the head and plate **46**, the grease therein forms a lapping compound with the dirt. This lapping compound will cause the lip of the rubber seal ring to wear grooves in the mill head. As these grooves become deeper they will permit oil to leak around the seal and out of the oil chamber.

A grease fitting **73** is used to force fresh grease into the cavity formed by the seal ring **70**, cover plate **46** and the mill head. When new grease is forced in, the old grease, along with any foreign matter, is forced out gap **71**. Although a small amount of grease may work out of gap **71** during operation, most of the old grease will be forced out by the addition of fresh grease through the fitting **73**.

A circumferential groove or recess **74** is formed in the head opposite the annular seal ring. Positioned within the circumferential groove is a metal band **76**, which is formed of a material harder than the cast mill head. Thus is provided a hard surface against which the lip **70** of the seal ring may bear. The hard surface of the metal band **76** will not groove or wear as will the somewhat softer surface of the cast mill head. The steel band **76** may be welded in place before the mill head is finish turned and then is finish machined at the same time as the head. The metal band **76**, which is preferably a hard steel, provides an extremely hard wearing surface for the lip **70**.

It will be noted that the seal is self-centering around the shaft whenever the shaft drops due to wear on babbitt **54*a*** forming a part of the bearing structure **54**. The body portion **68** of the seal ring **70** is tightly pressed between the cover plate **46** and the L-shaped block **42** so that as the babbitt gradually wears away during operation of the machine the mill head will move closer to the lower portion of the seal ring and move further away from that portion of the seal ring at the top of the trunnion bearing. In order to center the seal ring so that it

once again bears equally against the metal band **76** throughout its length it is only necessary to loosen cover plates **46** and permit the seal rings to center themselves on the mill head.

In addition to the advantages described above in connection with placing wear bands **76** against the seal rings, the spaced grooves receiving the metal bands **76** change the stress pattern in the mill head. Normally the groove **60** which receives the bearing structure is a point of stress concentration. By placing grooves on each side of the bearing groove, the stress lines are dampened out. The groove placed on the inside of the mill head is effective to change the stress pattern between the trunnion and the main part of the head, thus preventing failures on the inside of the bearing. In other words, a smaller groove may be termed a "breakwater" which dampens out what would otherwise be a sharp change in the stress pattern caused by the bearing groove. The smaller groove causes a gradual change in the stress pattern. Whereas the bearing has been shown and described as primarily a weldment, it should be understood that the details of the bearing are not important to the invention and it might be executed or made by conventional processes other than welding.

In FIGURE 4 a further form of the invention is shown. Adjacent each side of the circumferential groove or recess **60** in the head **58** is an annular steel band **78**, such as that shown in FIGURE 3. Grooves similar to that shown in FIGURE 3 may be formed to receive the steel bands or the bands may be positioned on the outside of the mill head as shown at the left in FIGURE 4. The steel band shown at the right of FIGURE 4 is positioned in a circumferential groove **80**. It should be noted however that the distance between the edge of the groove **60** and the edge of the groove **80** receiving the band **78** is greater than the width of the band. This same space arrangement is shown at the left side of FIGURE 4 wherein the distance from the edge of the head to the groove **60** is greater than the width of the band. Each of the steel bands **78** have an inlet or opening or port **82** formed therein. These ports are adapted to be connected to a source of hydraulic pressure, grease, oil or otherwise. When hydraulic pressure is introduced into the openings the steel bands will be circumferentially expanded or moved away from tight engagement with the mill head and can thereby be axially or laterally moved with relative ease.

At this point it should be explained that in the normal grinding mill or other type of device which is supported on trunnion bearings such as shown herein, it is conventional to have one "held" trunnion bearing and one "free" bearing. In other words, during operation, the heat generated in the machine will cause a small amount of expansion. In order to compensate for this expansion it is necessary that one end of the machine, known as the "free" end, be permitted a small amount of lateral or axial movement. Accordingly, it is one purpose of this invention to provide a standardized mill head such that all of the steel bands provided herein will be capable of slight lateral movement to compensate for any small amount of expansion of the mill head during operation. Hydraulic ports have therefore been formed in the bands to provide means for introducing pressure behind the steel bands to permit circumferential expansion thereof. The expanded band may be axially or laterally moved along the head. The bands shown in FIGURE 4 may be positioned in an axially oversized groove or they may be positioned on the outside of a mill head and securely mounted thereto. Either form is satisfactory.

FIGURE 4 shows a further form of the invention wherein two annular seal rings **83** are positioned in a pocket **85** directly opposite the steel band **78**. The rings shown in the pocket are generally similar to the ring **66** described above in that they each have a lower or body portion and an angular lip biased by a coil spring or the like against the head. By positioning two annular seal rings in the pocket and by directing the lips so that they point in opposite directions, I have provided an improved sealing arrangement. The double seal provides one lip which points to the outside of the trunnion housing to prevent dirt from getting into the seal and a second lip which points to the inside of the trunnion housing to prevent oil from passing around the seal. To provide adequate lubrication and additional dust arresting means, an external source of grease, indicated at **84**, supplies grease through passage **86** into the area between the two seal rings.

A small coiled spring or garter spring **87** may be placed between the seal rings **83** as shown in FIGURE 4. The spring **87** is a continuous spring which is generally larger than the mill head and therefore is held out away from the bands **78** and at a position between the seal rings **83**. By using a coil spring as a spacer the incoming grease from grease fitting **84** can easily flow between the space formed by the spring turns.

FIGURE 5 shows a further embodiment of the invention. The trunnion bearing shown may be similar to that described before or it may be slightly modified. The important thing in the embodiment shown in FIGURE 5 is to provide a generally central source of grease to supply grease to each of the individual grease fittings **84** during operation of the grinding mill. The conventional trunnion bearing arrangement shown in FIGURE 5 has an inlet block **90** preferably positioned adjacent the center, both axially and vertically, of the trunnion. A small pipe or tube **92** connects the inlet block to a manifold block or junction box **94** positioned slightly above the inlet block **90**. A second tube or pipe **96** connects manifold block **94** with a second manifold block **98**, also spaced slightly above the inlet block **90** and at the opposite side of the trunnion centerline. A small pipe or tube **100** is suitably connected to manifold block **94** and is adapted to convey grease from the block **94** to one of the grease fittings **84** positioned around the circumference of the trunnion bearing. The pipe **100** connects into a plug or the like **102**, of which there are six shown in the drawings. Only one pipe has been shown as connecting to the plug **102**, however, it should be understood that pipes may also run from the other plugs to the grease fittings positioned circumferentially around the trunnion. Although six plugs and two manifold blocks are shown herein, the number of plugs is not essential to the invention. It is only necessary that a sufficient number of plugs be provided so that there is an individual pipe or tube, similar to pipe **100**, for each of the grease fittings positioned around the trunnion.

The structure shown in FIGURE 5 provides a means whereby an operator may simultaneously provide grease to each of the grease fittings positioned around the trunnion bearing while the machine is operating. The operator may either use a grease gun or the like to provide grease for the inlet block **90** or there may be a source of grease at this point which the operator need only actuate. The grease is conveyed from the inlet block to the manifold blocks and from there through the various pipes and tubes to the grease fittings **84**. Whereas a single inlet block has been shown in the drawings, it should be realized that the opposite side of the trunnion may have a similar inlet block so that it is not necessary to run the pipes completely around the trunnion. The pipes or tubes **100** may run to grease fittings, such as fittings **84**, or they may carry grease to grease fittings similar to fittings **73**. The type of grease fitting is not essential.

The use, operation and function of the invention are as follows:

Shown and described herein is an improved sealing means for a grinding mill trunnion bearing which includes not only improved means for keeping dirt out of the oil and the oil from leaking to the outside of the bearing but in addition provides a seal which is wear-resistant. In

the conventional trunnion bearing sealing arrangement, dirt may contaminate the seal and combine with the grease in the seal to form a lapping compound. This compound will cause the seal lip to groove the mill head. The grooves formed by the lapping compound permit oil to leak out of the bearing oil chamber. When there is an oil leak the mill head must be refinished, a costly and time-consuming operation. By providing a steel band which is formed of a material harder than the somewhat softer cast surface of the mill head an extremely hard surface is formed to receive the annular seal rings. As shown in the drawings I have positioned two such bands because there are two annular seal rings provided in the particular trunnion bearing arrangement shown herein. It should be realized that as the invention may be applied to other types of machinery employing trunnion bearings, only one band may be necessary in some applications.

In the conventional grinding mill or other machine processing ore the heat of operation may cause a slight expansion of the machine. In order to compensate for this expansion and in addition to provide a standardized mill head which may be either the "held" or the "free" end of the machine I have provided a means whereby the annular steel bands may be laterally or axially moved by applying hydraulic pressure to circumferentially expand the band. By providing all of the steel bands at both ends of the machine with expansion means, the mill heads will be interchangeable in that there will be a standardized head which can be either the "free" or "held" end of the grinding mill.

As a further means for providing an improved sealing arrangement for trunnion bearings a dual or double seal ring is provided in the grease pocket. By using two annular seal rings, with their lips oppositely directed, one ring will normally keep dirt and other material from the interior of the bearing whereas the opposite ring will keep oil from flowing out of the oil chamber. A lubricating passage opens into the area between the seal rings to provide lubrication for the rings and in addition to provide additional dust arresting means.

A further feature of the invention is the centrally disposed greasing means shown in FIGURE 5. The machine operator may either actuate the central source of grease if one is provided or may apply a grease gun or the like to the inlet block. The grease is carried through the pipes to each of the individual grease fittings positioned around the trunnion. Thus is provided a means for greasing the bearing seals during operation of the machine.

Whereas the preferred form of the invention has been described and shown herein, it should be realized that there are many substitutions, modifications and alterations thereto within the scope of the following claims.



I claim:

1. A grinding mill comprising a rotating drum having a generally cylindrical head at one end, a trunnion bearing for supporting said head including a bearing housing mounting said head for rotation therein, an annular grease pocket in said housing adjacent said head, an annular steel band, formed of a material harder than the head, mounted on said head to move through said grease pocket, an annular elastic seal ring mounted in said grease pocket to bear against said band generally throughout its length, and a spring biasing said seal ring toward said band.

2. The structure of claim 1 further characterized by hydraulic expansion means for circumferentially expanding said band to permit axial movement thereof.

3. The structure of claim 1 further characterized by an annular groove in said head having a width greater than the width of said band, said band being positioned in said groove, and hydraulic expansion means for circumferentially expanding said band to permit axial movement thereof within said groove.

4. The structure of claim 3 further characterized in that said groove has a depth generally equal to the thickness of said band so that said head and band form a smooth surface.

5. The structure of claim 1 further characterized by two spaced elastic seal rings positioned in said grease pocket, each of said seal rings having an annular lip bearing against said band generally throughout the length thereof, and a spring biasing each of said lips toward said band.

6. The structure of claim 1 further characterized by a plurality of grease fittings circumferentially positioned around said housing and opening into said pocket, a passage connecting said fittings to a central source of grease so that each of said fittings may receive grease from the central source during operation of the grinding mill.

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