



## Description

**[0001]** The present invention relates to a sealing assembly for use in a rolling mill and to the seal element used in the assembly.

**[0002]** A rolling mill may be operated under wet conditions in which water is fed over the roll. A certain amount of water is inevitably dispersed into the direction of the roll neck and the lubricated areas of the bearing assembly. A sealing assembly may be used on the tapered section of the roll neck in order to maintain a liquid barrier between the roll and the bearing assembly.

**[0003]** A conventional sealing assembly is described in US-A-4586720 (Simmons et al). This particular sealing assembly comprises a flexible, circular seal element mounted directly on the rotatable tapered section of the roll neck and located at the interface of the roll and lubricated contact surface of the bearing assembly, in order to prevent leakage of lubricant from the bearing assembly to the roll and leakage of water from the roll to the bearing assembly. For this purpose, the circular seal element comprises an annular main body which is provided with various flanges and lips. More particularly, two outwardly disposed radial flanges provided on the annular body impinge upon a surface of the fixed portion of the bearing assembly by means of flexible peripheral lips on the flanges.

**[0004]** In general, there is a need to avoid premature wear of the seal element which may lead to oil losses, risk of damage to the bearing surface and possible contamination of the finished product on the rolling mill. In this regard, it is known to use graphitic seal elements to improve lubricity and withstand premature wear. In addition, the seal end plate upon which the seal element impinges is generally a ceramic-based material.

**[0005]** The present invention is based primarily on the recognition that there are certain advantages in mounting the seal element of the sealing assembly on the stationary part of the bearing assembly. For example, by positioning the seal element on the fixed bearing element rather than on the rotatable bearing element the seal element may be mounted more robustly.

**[0006]** Thus viewed from one aspect the present invention provides a sealing assembly for use in conjunction with the rotatable tapered section of a roll neck which is part of a roll in a rolling mill, said sealing assembly having a first bearing element mounted on said rotatable tapered section and at least partially opposing a fixed second bearing element to define a contact surface therebetween which is adapted to receive lubricant, wherein said fixed second bearing element comprises a flexible seal element positioned between the contact surface and the roll and provided with liquid barrier means for substantially preventing liquid passage between the contact surface and the roll.

**[0007]** In accordance with the invention, the liquid barrier means is adapted to substantially prevent undesirable

lubricant leakage from the contact surface to the roll and water leakage from the roll to the contact surface.

**[0008]** Preferably, the seal element comprises a substantially annular body. Preferably the liquid barrier means comprises one or more (preferably two) circumferential lips inwardly disposed from the substantially annular body. Particularly preferably, the or each inwardly disposed circumferential lip is angularly disposed. Especially preferably, the or each circumferential lip is attached at the central section of the substantially annular body. For example, each circumferential lip may be attached by shoulders radially raised on the inner surface of the annular body and conveniently axially spaced apart. Preferably the seal element is substantially axially symmetrical. A lantern ring may be incorporated in the seal element to drain out any oil which does penetrate the seal element.

**[0009]** In the preferred embodiment, the or each circumferential lip is provided with an enlarged peripheral end. Preferably, the enlarged peripheral end is multi-faceted. For example, the enlarged peripheral end may comprise five annular faces. Preferably the enlarged peripheral end is provided with a reduced point arranged to contact the first bearing element in use.

**[0010]** In use, the circumferential lips of the flexible seal element may be deformable in order to adopt a stressed state. The force acting in opposition to the stressing may improve the seal between the peripheral end of the lips and the contact surface. The peripheral end may be conveniently provided with a cut-away portion for encapsulating a garter spring which may further improve the seal.

**[0011]** The fixed second bearing element may comprise a rigid seal support means (eg seal end plate) upon which the seal element is mounted. For example, the rigid seal support means may comprise a recess (eg an annular recess) in which at least the annular body of the seal element is located. On the roll side, the rigid seal support means may be provided with a clamp for retaining the seal element in the recess. One inner face of the clamp advantageously forms the outer face of the recess in which the seal element is located thereby permitting easy access to the recess for installation/removal of the seal element and visual checking of the seal element. The clamp may be provided with an appropriate fastener for ease of removal.

**[0012]** In the preferred embodiment of the invention, the peripheral end of the or each circumferential lip is seated on the first bearing element of the sealing assembly. For this purpose, the first bearing element may be provided with a carrier ring mounted on the tapered portion of the roll neck and providing a substantially horizontal running surface. Preferably, the carrier ring is coated with a metal coating, particularly preferably a chrome coating which acts as the horizontal running surface. This is advantageous over conventional ceramic-based coatings which have been found to lead

to significant deterioration of the seal element and which are unable to remove the significant amounts of heat which are generated. In the latter regard, chrome possesses excellent heat dissipation properties.

**[0013]** In accordance with the invention, the first bearing element preferably comprises a sleeve mounted on the rotatable roll neck. The fixed second bearing element preferably comprises a fixed bushing carried in a bearing chock. The sleeve is conveniently provided with an outer surface which is adapted to be rotatable within an inner surface of the fixed bushing thereby defining the contact surface at the axial side of the seal element opposite to the roll side. Lubricant (eg oil) is fed to the contact surface and an extended portion of the chock conveniently serves as an oil reservoir for drainage and recirculation purposes. The rigid seal support means may be mounted adjacent and attached to the chock on the non-roll side.

**[0014]** In a further preferred embodiment, the fixed second element of the assembly comprises a downwardly depending deflector attached on the roll side to withstand liquid (eg water) passage from the roll to the seal element. The deflector may be conveniently mounted on the rigid seal support means. The deflector preferably comprises a coolant seal.

**[0015]** An important advantage of the sealing assembly of the invention is that the seal element is readily accessible for repair and replacement and for visual inspection.

**[0016]** Contrary to conventional wisdom, it has been found that the incorporation of large amounts of graphite in the seal element does not in fact increase lubricity but has the opposite effect. Thus in a preferred embodiment, the present invention comprises a substantially non-graphitic seal element. For example, the seal element is substantially polymeric and may be an elastomer. Particularly preferably, the seal element comprises one or more garter springs to retain positioning and for added strength.

**[0017]** Viewed from a further aspect the present invention provides a seal element as hereinbefore described being a component of a sealing assembly for use in conjunction with the rotatable tapered section of a roll neck which is an integral part of a roll in a rolling mill. Preferably the seal element comprises:

- a substantially annular body; and
- a plurality of (eg two) circumferential lips inwardly-disposed from the substantially annular body.

**[0018]** A benefit of the seal element of the invention over the seal element of for example US-A-4586720 (Simmons *et al*) is its simple configuration. For example, it lacks the numerous flanges and lips which render the configuration of the prior art seal element somewhat complex. The simple configuration makes the seal element more straightforward to manufacture.

**[0019]** Preferably each inwardly disposed circum-

ferential lip is angularly disposed. Particularly preferably, each circumferential lip is attached at the central section of the substantially annular body. For example, each circumferential lip may be attached by shoulders radially raised on the inner surface of the annular body and conveniently axially spaced apart. Preferably the seal element is substantially axially symmetrical. A lantern ring may be incorporated in the seal element to drain out any oil which does penetrate the seal element.

**[0020]** In the preferred embodiment, each circumferential lip is provided with an enlarged peripheral end. Preferably, the enlarged peripheral end is multi-faceted. For example, the enlarged peripheral end may comprise five annular faces. Preferably the enlarged peripheral end is provided with a reduced point arranged to contact the first bearing element in use.

**[0021]** In use, the circumferential lips of the flexible seal element may be deformable in order to adopt a stressed state. The force acting in opposition to the stressing may improve the seal between the peripheral end of the lips and the contact surface. The peripheral end may be conveniently provided with a cut-away portion for encapsulating a garter spring which may further improve the seal.

**[0022]** In a preferred embodiment, the seal element is substantially non-graphitic. For example, the seal element is polymeric eg an elastomer.

**[0023]** The present invention will now be described in a non-limitative sense with reference to the accompanying Figures in which:

Figure 1 illustrates a preferred embodiment of the seal assembly of the invention in cross-sectional view; and

Figure 2 illustrates a preferred embodiment of the seal element of the invention in cross-section.

**[0024]** Figure 1 illustrates a roll neck internal sealing assembly in cross-sectional view designated generally by reference numeral 2. The assembly is positioned adjacent to the tapered section 3 of a roll neck 4 in a rolling mill. Roll 1 is illustrated in truncated form.

**[0025]** The sealing assembly 2 mounted on the rotatable roll neck 4 comprises a first bearing element. The first bearing element comprises sleeve 5 and moulded seal carrier ring 6 made of a nitrile compound. The moulded seal carrier ring 6 is mounted on the tapered section 3 of roll neck 4 and is adapted to provide a horizontal running sleeve 7 for seal element 13 made of stainless steel with a thin dense chrome surface coating. The outer flange of the moulded seal carrier ring 6 is provided with a garter spring 8.

**[0026]** The fixed second bearing element of the assembly 2 comprises bushing 10 carried in chock 9. The bushing 10 and sleeve 5 are at least partially opposed to define contact surface 11. In use, the contact surface 11 between rotating sleeve 5 and fixed bushing 10 is oil-filled. The end of the chock 9 provides

a reservoir 12 in which oil may be collected for drainage purposes and recirculation.

**[0027]** The fixed second bearing element includes seal element 13 described in greater detail with reference to Figure 2 and made of an elastomer compound. Figure 2 shows the seal element designated generally by reference numeral 21 and comprising two circumferential lips 22a, 22b angularly disposed from the central section of the annular main body 27. Each lip terminates in a multi-faceted, enlarged peripheral end 28a, 28b having five annular faces. Each lip 22a, 22b is attached to the annular main body 27 by means of shoulders 24a radially raised on the inner surface of the annular body and axially separated by lantern ring 23. Enlarged peripheral ends 28a, 28b are each provided with a reduced contact point 26a, 26b which in use is seated on the chrome running surface 7 of carrier ring 6 which rotates. The lip 22b on the roll side of the assembly acts as a barrier to splashes of water from the roll when it is used under wet conditions. Equally lip 22a on the non-roll side of the assembly prevents leakage of oil to the roll side. The lip 22a acts as a mechanical barrier which deflects lubricant from contact area 11 into reservoir 12. Each peripheral end 28a, 28b is provided with a garter spring 25a, 25b in a cut-away portion.

**[0028]** The annular main body of seal element 13 is located in a suitably shaped recess 17a in rigid seal support means 17 which is made of mild steel. The outer face of the recess is provided by a face of separate clamping means 14 removable by cap head screw 15. This arrangement permits easy access to the recess 17a for removal/installation of seal element 13 and makes the seal element 13 visible for inspection purposes. Thus for installation of the assembly, seal element 13 is fitted onto seal support means 17 in recess 17a. Moulded carrier ring 6 is then fitted and the clamp plate 14 retains seal element 13 in position.

**[0029]** Downwardly dependent coolant seal 16 is attached at the lower end of the fixed second bearing element on the rigid seal support means 17 to deflect water away from the seal element.

## Claims

1. A sealing assembly for use in conjunction with the rotatable tapered section of a roll neck which is part of a roll in a rolling mill, said sealing assembly having a first bearing element mounted on said rotatable tapered section and at least partially opposing a fixed second bearing element to define a contact surface therebetween which is adapted to receive lubricant, wherein said fixed second bearing element comprises a flexible seal element positioned between the contact surface and the roll and provided with liquid barrier means for substantially preventing liquid passage between the contact surface and the roll.

2. A seal assembly as claimed in claim 1 wherein the liquid barrier means is adapted to substantially prevent lubricant passage from the contact surface to the roll and water passage from the roll to the contact surface.
3. A seal assembly as claimed in claim 1 or 2 wherein the seal element comprises a substantially annular body.
4. A seal assembly as claimed in claim 3 wherein the liquid barrier means comprises one or more circumferential lips inwardly disposed from the substantially annular body.
5. A seal assembly as claimed in claim 4 wherein the liquid barrier means comprises two circumferential lips inwardly disposed from the substantially annular body.
6. A seal assembly as claimed in either of claims 4 or 5 wherein the or each inwardly disposed circumferential lip is angularly disposed.
7. A seal assembly as claimed in any of claims 4, 5 or 6 wherein the or each circumferential lip is attached at the central section of the substantially annular body.
8. A seal assembly as claimed in any of claims 4, 5, 6 or 7 wherein the or each circumferential lip is attached by a shoulder radially raised on the inner surface of the annular body.
9. A seal assembly as claimed in claim 8 wherein the shoulders are axially spaced apart.
10. A seal assembly as claimed in any preceding claim wherein the seal element is substantially axially symmetrical.
11. A seal assembly as claimed in any of claims 4 to 10 wherein the or each circumferential lip is provided with an enlarged peripheral end.
12. A seal assembly as claimed in claim 11 wherein the enlarged peripheral end is multi-faceted.
13. A seal assembly as claimed in claim 12 wherein the enlarged peripheral end comprises five annular faces.
14. A seal assembly as claimed in any of claims 11 to 13 wherein the enlarged peripheral end is provided with a reduced point arranged to contact the first bearing element in use.
15. A seal assembly as claimed in any of claims 4 to 14

wherein the circumferential lips of the flexible seal element are deformable in order to adopt a stressed state.

a substantially annular body; and  
two circumferential lips inwardly disposed from the substantially annular body.

16. A seal assembly as claimed in any preceding claim 5  
wherein the fixed second bearing element comprises a rigid seal support means upon which the seal element is mounted.
17. A seal assembly as claimed in claim 16 wherein the 10  
rigid seal support means comprises an annular recess in which at least the annular body of the seal element is located.
18. A seal assembly as claimed in either of claims 16 or 15  
17 wherein on the roll side the rigid seal support means is provided with a clamp for retaining the seal element in the recess.
19. A seal assembly as claimed in claim 18 wherein 20  
one inner face of the clamp forms the outer face of the recess in which the seal element is located.
20. A seal assembly as claimed in any of claims 4 to 19 25  
wherein the peripheral end of the or each circumferential lip is seated on the first bearing element of the sealing assembly.
21. A seal assembly as claimed in claim 20 wherein the 30  
first bearing element is provided with a carrier ring mounted on the tapered portion of the roll neck and providing a substantially horizontal running surface.
22. A seal assembly as claimed in claim 21 wherein the 35  
horizontal running surface comprises a chrome coating.
23. A seal assembly as claimed in any preceding claim  
wherein the fixed second element of the assembly comprises a downwardly depending deflector 40  
attached on the roll side.
24. A seal assembly as claimed in claim 23 wherein the 45  
deflector is mounted on the rigid seal support means.
25. A seal assembly as claimed in either claim 23 or 24  
wherein the deflector comprises a coolant seal.
26. A seal assembly as claimed in any preceding claim 50  
wherein the seal element is a substantially non-graphitic seal element.
27. A seal element as defined in any of claims 1 to 26. 55
28. A seal element as claimed in claim 27 consisting essentially of:

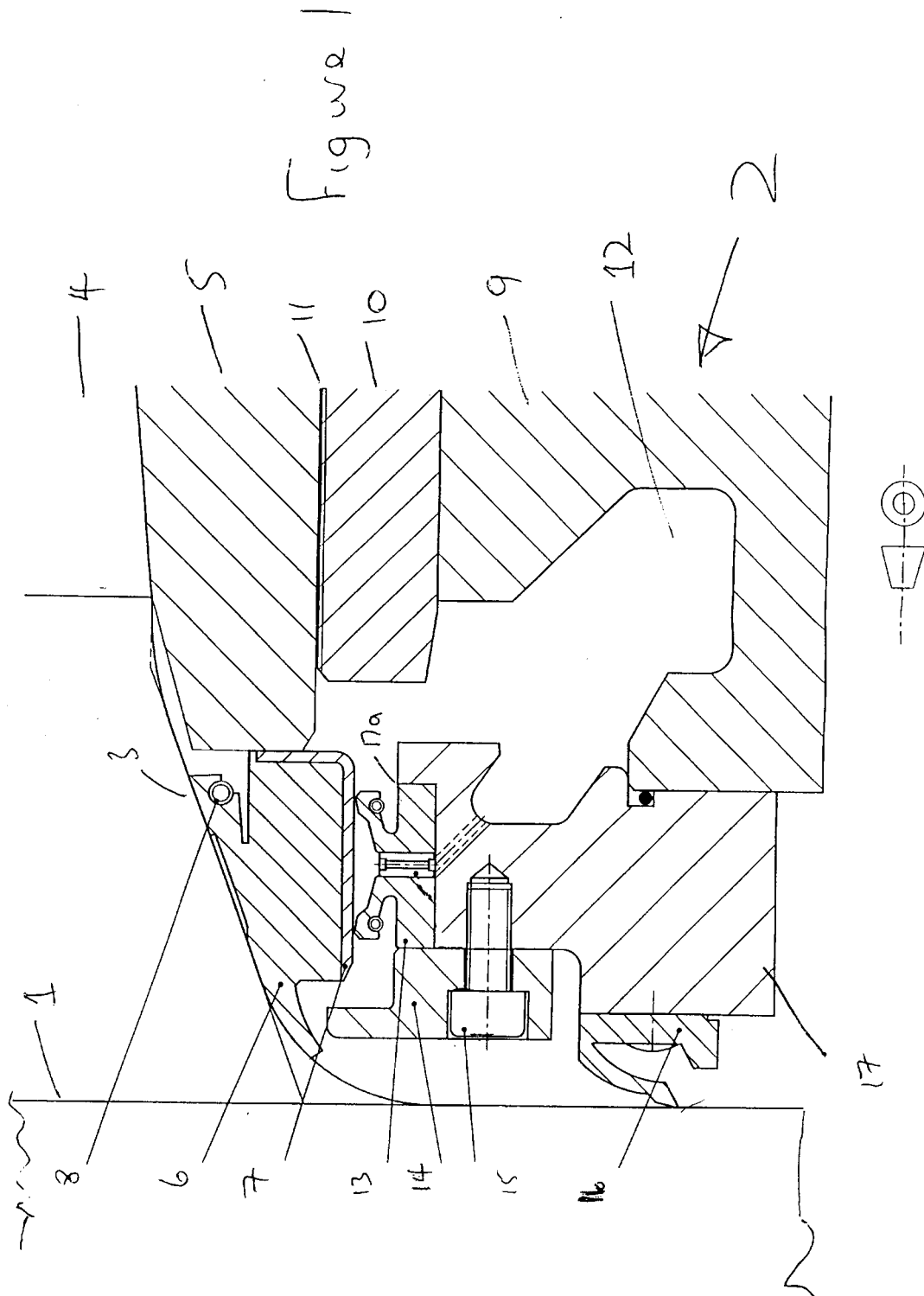


Figure 2

