ABSTRACT

A gyratory crusher is provided with a labyrinth seal between its eccentric drive and its crusher cone comprising upper and lower sealing casings extending into each other and a grease filling the gap between these casings. The outermost sealing casing is provided with a plurality of vertically spaced annular channels communicating with at least one grease supply nipple and the inside of this outermost casing is provided with a series of apertures uniformly spaced around the entire circumference of the outermost sealing casing and connecting the annular channels with the gaps between the sealing casings.

7 Claims, 6 Drawing Figures
FIG. 3

[Diagram of a complex circular structure with labeled parts 25, 26, 27, 28, 29, 30, 32, 33, 34]
The invention relates to a gyratory crusher provided with a labyrinth seal between its eccentric drive and the crushing cone, whereby the upper half of the seal is connected with the crusher cone, and the lower half of the seal is connected with the eccentric drive, and wherein the gaps formed in the seal are filled with grease.

It has been suggested heretofore to provide the labyrinth seal of a gyratory crusher with labyrinth casings connected to the eccentric drive and the crusher cone, respectively, and filling the same with grease to prevent the entrance of dust into the interior of the crusher. The introduction of the grease into the seal takes place through an aperture provided in the outermost labyrinth casing. The width of the gap, particularly in the outer labyrinth casings, has to be however relatively narrow in order to prevent firstly, the entrance of dust into the interior of the labyrinth seal and secondly, for the purpose of avoiding too great a loss of grease from the labyrinth gap. Since, however, in the mentioned gyratory crusher, the introduction of the grease takes place through an aperture in the outermost labyrinth casing, it is not possible to distribute the grease uniformly in the outer labyrinth gap, nor is it possible to obtain a sufficient seal of this labyrinth gap against the entrance of dust into the interior of the crusher. Furthermore, this type of grease lubrication of the outer labyrinth gap requires a relatively long period of time and is expensive, the more so, since the introduction of grease into the labyrinth gap through a single aperture takes a relatively long time during which the crusher must be kept out of operation.

It is an object of the invention to overcome the above mentioned disadvantages and to obtain a uniform distribution of the grease along the entire circumference of the outer labyrinth gap. In order to obtain this advantage the outermost labyrinth casing is provided with apertures which are uniformly distributed along the circumference of the labyrinth casing, and these apertures are connected with annular channels which are in communication with one or a plurality of grease supply points. In this manner, on one hand the annular gap may be sufficiently supplied with grease along its entire outer circumference of the labyrinth casing between apertures arranged therein from one or two grease points arranged on the outer side of the labyrinth casing. On the other hand, the labyrinth chambers may be securely sealed against the outer atmosphere and may be closed in a dust-sealing manner. Furthermore, the time period for lubricating the seal and the interruption of the operation of the gyratory crusher connected therewith may be shortened appreciably compared with the heretofore suggested lubricating device. Finally, the lubrication of the outer labyrinth gap is substantially simplified since only one or two lubricating nipples need to be supplied with grease, whereby these lubricating nipples may be arranged so as to be easily accessible on the outer labyrinth casing.

It is also an object of the invention to provide annular channels extending from the grease supply channels to the apertures in the labyrinth casing which are all of the same length and have also the same cross-section as the apertures. Owing to this construction of the annular channels, the introduction of grease into the same and from there into the outer labyrinth gap through each aperture in the labyrinth casing insures that the same amount of grease is supplied and introduced into the labyrinth gap.

According to another embodiment of the invention, the apertures in the labyrinth casing are uniformly distributed, cross-shaped, star-shaped or ring-shaped. In this manner, a uniform distribution of the grease over a larger area of the outer labyrinth gap is obtained.

The invention will now be described with reference to the accompanying drawing which illustrates, by way of example, one embodiment of the labyrinth seal for a gyratory crusher.

**IN THE DRAWINGS**

FIG. 1 illustrates a longitudinal sectional view of the gyratory crusher provided with the labyrinth seal of the invention;

FIG. 2 illustrates a partial sectional view of the upper portion of the crusher cone and illustrates furthermore the labyrinth seal with the annular channels on an enlarged scale;

FIG. 3 illustrates diagrammatically the annular channels of the labyrinth seal of the invention.

FIG. 4 shows a section on line IV—IV of FIG. 5;

FIG. 5 is a right-hand side view of FIG. 4, and

FIG. 6 is a view similar to FIG. 5 and showing in its left and right portions two different channel arrangements.

Referring to FIG. 1, the illustrated cone crusher has a lower housing portion 1 to which is attached a hollow conical crusher body 2 provided in its interior with a conical crusher shell 3. Inside the crusher shell 3 is arranged a crusher cone 4 with a crusher shell 5 thereon. This crusher cone 4 is mounted with a downwardly extending cylindrical extension 4a on an eccentric sleeve 6 which, in turn, is slidably mounted on a hollow cylindrical shaft 7. At the lower end of the eccentric sleeve 6 is mounted a bevel gear 8 which meshes with a bevel gear 9 on a horizontally disposed drive shaft 10. The drive shaft 10 is driven by a motor which is not illustrated in the drawing. The crusher cone 4 rests upon a spherical segment 11 which is slidably mounted in a spherical cup 12. The spherical cup 12 is attached to the upper end of a piston 13 which is centrally mounted in the crusher. This piston 13 is slidably arranged in the hollow cylindrical shaft 7 and rests with the lower end on the upper end of a spring 14 which serves as a safety device and protects the crusher cone against injury due to overloads. In the lower range of the gyratory crusher is arranged within the hollow cylindrical shaft 7, a piston cylinder unit 15, 16 whose piston 15 engages the lower end of the spring 14. This piston cylinder unit 15, 16 is used for adjusting the width of the gap of the gyratory crusher, namely, the width between the two crusher shells 3 and 5.

In order to prevent the entrance of dust into the interior of the crusher, a labyrinth seal is provided whose details are illustrated in FIG. 2. This labyrinth seal comprises a lower half with two labyrinth casings 17 and 18 and an upper half with the labyrinth casings 19 and 20. These labyrinth casings extend one into the other, having cylindrical shape and are concentrically arranged with respect to the axis of the crusher cone 4.

The lower labyrinth casings 17 and 18 are secured with their lower ends to an annular supporting body 21
which, in turn, is indirectly secured to the eccentric sleeve 6. The labyrinth casings 19 and 20 of the upper half of the shell are connected with their upper ends to a supporting flange 22 which is secured to the crusher cone 4. In order to protect this labyrinth seal against injury caused by material discharged by the crushe gap, a frustoconical jacket 23 is provided which is secured to the supporting flange 22 and extends in an inclined position downwardly so as to cover at least the upper portion of the labyrinth seal.

As also shown in FIG. 2, the outer upper labyrinth casing 19 has attached to its lower end a ring 24 made of two concentric parts. This ring 24 is provided with vertically spaced annular channels 25, 26 and 27. These annular channels are in communication with apertures 28 which are provided in the interior of the ring 24 and are uniformly distributed over the entire circumference of the ring 24. At the exterior of the ring 24 are arranged grease supply channels 29 and 30, as shown in FIG. 3. These channels 29 and 30 may also consist of grease supply nipples. In addition, the outermost labyrinth casing 19 is provided at its upper end with a grease supply nipple 35 through which the grease is introduced for filling the labyrinth chambers or the inner gaps in the labyrinth seal. In order to prevent the introduction of dust-laden grease, it is advisable to arrange in the gap formed between the labyrinth casings 17 and 20 a sealing ring 36 consisting of wear-resistant material.

FIG. 3 illustrates diagrammatically the distribution and the passage of the lubricant in the individual annular channels. For a clearer illustration and a better understanding of the invention, FIG. 3 illustrates that the annular channels 25, 26 and 27 are arranged in spaced relation, one next to the other. In actual practice, however, these annular channels 25, 26 and 27 have the same diameter and are arranged as shown in FIG. 2, in spaced relation one above the other in the annular ring 24. Referring again to FIG. 3, one will notice that the lubricant is introduced by the supply channels 29, 30 into the outer annular channels 25. From the latter, the lubricant passes through the openings 32 into the annular channels 26. From the annular channels 26, the lubricant or grease passes through the apertures 33 into the annular channels 27 and finally is conducted by the apertures 28 into the outer annular gap 31 formed between the labyrinth casings 18 and 19. (FIG. 2). For the purpose of limiting each one of the circumferential lengths of the channels 25, 26 and 27, these channels have placed in the same, the partitions 34. The arrangement of partitions 34 in the annular channels is so that the paths of the lubricant from its point of introduction into the individual channel to the point of discharge are all of the same length. FIG. 3 illustrates also that all annular channels and all the supply apertures leading to the channels have the same cross-section. This feature of the annular channel lubricating system of the invention has the advantage that during the introduction of the grease through the supply channels 29, 30 or the grease nipples, respectively, into the annular channels at each lubricating point or at each aperture 28, the same amount of grease is discharged and is introduced into the outer annular gap 31 of the labyrinth seal. In accordance with the illustrated embodiment of the invention, the apertures 28 in the labyrinth shell or in the ring 24 are uniformly distributed along its entire circumference in a single plane. This arrangement of the apertures in the ring causes the formation of a grease ring when the grease is introduced by these apertures into the annular gap 31, so that the entrance of dust into the interior of the labyrinth chamber is prevented. It may, however, also be of advantage to arrange the apertures 28 in the labyrinth casing or the ring 24, respectively, in a cross-shape, star-shape or ring-shape along the circumference uniformly distributed.

Examples of such arrangements are illustrated in FIGS. 4, 5 and 6. In the outermost labyrinth casing 19 there are provided radial channels 37 and 38 in communication with communication channels 39, 40 and 41 in said casing 19. In FIG. 5 said communication channels 39, 40, 41 are arranged in the form of a cross. The radial channel 37 is the grease supply means and the radial channels 38 open into the annular space 31. Since the labyrinth casings are cylindrical, the communication channels 39, 40 and 41 can readily be cut in the form of grooves and sealed on the outside by means of an annular member 42. The radial channels 37 and 38 are simply drilled holes.

In FIG. 6 communication channels 43 and 44 are shown which in the lefthand portion of the Figure are arranged in star formation and in the righthand portion in ring formation.

Through this arrangement of cross-shaped, star-shaped or ring-shaped distributed apertures in the labyrinth casing or ring 24, a uniform distribution of the grease in the labyrinth gap is obtained over a greater range than when all the apertures are arranged in a single plane. The supply of the outer ring gap 31 of the labyrinth seal with grease in the above-described manner is not only substantially simplified, but the sealing action is substantially improved owing to the uniform distribution of the grease in the outer labyrinth gap. Furthermore, the introduction of the grease according to the invention into the outer annular gap 31 of the labyrinth seal produces also then a safe seal when in the highest position of the crusher cone in the crushe housing only a small coverage of the labyrinth casings remains. Also in this position of the crusher cone, the grease lubrication of the invention prevents safely the entrance of dust into the interior of the cone crushe and into the oil circulating system of the crushe. Accordingly, the drive elements of the cone crushe and also all other rotatable and slidable parts are protected against excessive wear. Furthermore, a reliable operation of the drive device of the cone crushe is assured.

What we claim is:

1. In a gyratory crushe, an eccentric drive sleeve, a crushe cone concentrically mounted on said drive sleeve for rotation therewith and for axially sliding movement in relation thereto, and a labyrinth seal between said drive sleeve and said crushe cone, said labyrin seal comprising
   a. concentric upper sealing casings secured to said crushe cone,
   b. concentric lower sealing casings secured to said drive sleeve and extending upwardly into the spaces between said upper sealing casings in variable overlapping relation thereto,
   c. the outermost of said sealing casings being provided with a plurality of substantially radial channels distributed thereover and opening toward the inside thereof, said outermost sealing ring also being provided with a plurality of communication channels interconnected said radial channels, and
5. supply means for supplying grease to said communication channels.

2. The gyratory crusher according to claim 1, in which the communication channels connecting said grease supply means with said radial channels are of equal length.

3. The gyratory crusher according to claim 1, in which said communication channels are provided in an annular member secured to the end of said outermost sealing casing.

4. The gyratory crusher according to claim 1, in which said radial channels are uniformly spaced from each other and arranged in one and the same transverse section of said outermost sealing casing.

5. The gyratory crusher according to claim 2, in which said radial channels are so distributed that said connecting communication channels form a cross.

6. The gyratory crusher according to claim 2, in which said radial channels are so distributed that said connecting communication channels form a star.

7. The gyratory crusher according to claim 2, in which said radial channels are so distributed that said connecting communication channels form a circumferential ring channel.

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