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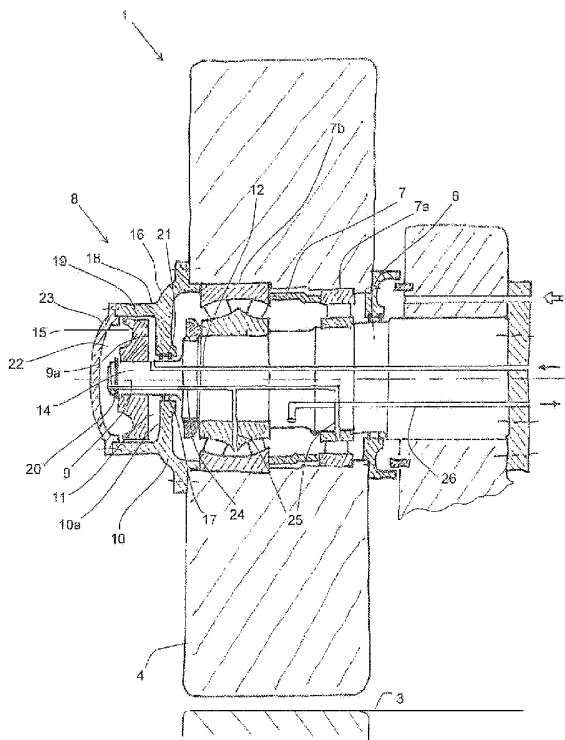
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(54) **Title:** ROLLER MILL FOR GRINDING PARTICULATE MATERIAL



(57) **Abstract:** A description is given of a roller mill (1) for grinding particulate material such as cement raw materials, cement clinker and similar materials. The roller mill comprises a force device (8) for at least partial absorption of an axial force originating at least from the roller and acting in the longitudinal direction of the roller shaft (6). Said force device (8) comprising a first part (9) and a second part (10), where the first and second part (9, 10) comprise opposing pressure surfaces (9a, 10a) which both forming between them a compartment (11) where the pressure surface (9a) on the first part is provided so that it is oriented in the opposite direction to the axial force acting in the longitudinal direction of the roller shaft, and means (12) for introducing a pressurized viscous medium into the compartment between the opposing pressure surfaces. Hereby is obtained an efficient and adjustable force device for relieving the axial force exerted on the roller bearing which may thus be constituted by commercially available bearings.

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Description

Title of Invention: ROLLER MILL FOR GRINDING PARTICULATE MATERIAL

- [1] The present invention relates to a roller mill for grinding particulate material such as cement raw materials, cement clinker and similar materials, said roller mill comprising a substantially horizontal grinding table, at least one roller operating interactively therewith which is configured for rotation about its centreline by means of a roller bearing and being connected with a roller shaft.
- [2] Roller mills of the aforementioned kind are generally known. In connection with the operation of such kind of roller mill, the roller bearing is subjected to an outwardly directed axial force which is normally absorbed for example by forming the roller bearing as a spherical rolling bearing. However, for some mill configurations the axial force may be so substantial as to prevent the utilization of ordinary types of rolling bearings. This problem is particularly pronounced in large roller mills and particularly in roller mills where the roller or rollers rotate about a vertical central axis since this means that the centrifugal force will contribute quite substantially to the axial force which in such roller mills may be more than tenfold greater than that occurring in roller mills in which there is no rotation of the roller or rollers about such a vertical central axis.
- [3] It is the purpose of the present invention to provide a roller mill by means of which the aforesaid disadvantage is eliminated or significantly reduced.
- [4] This is obtained by a roller mill of the kind mentioned in the introduction and being characterized in that it comprises a force device for at least partial absorption of an axial force originating at least from the roller and acting in the longitudinal direction of the roller shaft, said force device comprising a first part which is mounted on a machine component which is stationary relative to the longitudinal direction of the roller shaft, and a second part which is mounted on a machine component rotating about the centreline of the roller and co-rotating therewith, where the first and second part comprise opposing pressure surfaces which both extend substantially perpendicular to the longitudinal direction of the roller shaft, and forming between them a compartment where the pressure surface on the first part is provided so that it is oriented in the opposite direction to the axial force acting in the longitudinal direction of the roller shaft and the pressure surface on the second part is provided so that it is oriented in the same direction as the axial force acting in the longitudinal direction of the roller shaft, and means for introducing a pressurized viscous medium into the compartment between the opposing pressure surfaces.

- [5] Hereby is obtained an efficient and adjustable force device for relieving the axial force exerted on the roller bearing which may thus be constituted by commercially available bearings. The reason for this is that the introduction of a viscous medium, such as oil, into the compartment will result in a pressure build-up in this compartment which may be so adapted to the relevant axial force and pressure surface area, that the roller bearing is relieved completely or partially in the axial direction.
- [6] The force device may in principle be configured in any suitable manner. Thus in a simple embodiment the pressure surfaces of the force device may consist of two plane disc-shaped surfaces where, for example, the oil is introduced centrally and discharged at the peripheral gap. However, it is preferred that the force device is formed as a piston in a cylinder so as to allow the two pressure surfaces to migrate relative to one another without influencing the oil pressure in the compartment. In principle it is of secondary importance which of the two parts of the force device constitutes the piston and the cylinder, respectively.
- [7] The first part of the force device may in principle be mounted on any machine component which is stationary in the longitudinal direction of the roller shaft. In embodiments of the roller mill in which the roller shaft is stationary and the roller rotates about the latter, it is preferred, however, that the first part is mounted on the roller shaft. Likewise, the second part of the force device may in principle be mounted on any machine component rotating about the centreline of the roller together with the roller. However, it is preferred that the second part is mounted on the roller.
- [8] In a preferred embodiment of the force device the first part comprises a shaft journal protruding axially from the roller shaft and comprising at its extreme free end a piston section with an inwardly orienting pressure surface, and the second part comprises an inner cover part with an outwardly orienting pressure surface, said cover part being formed with a central hole for lead-through of the shaft journal of the first part and an outwardly orienting cylinder section encompassing the piston section of the first part. In such an embodiment a gap will exist between the peripheral edge of the piston section and the inner wall of the cylinder section, the size of which gap will be a co-determinant of the pressure which can be built up in the compartment between the two pressure surfaces in order to relieve the axial force on the roller bearing.
- [9] The piston section on the shaft journal of the first part may be integrally formed with the shaft journal which in turn may be integrally formed with the roller shaft or it may be a part which is mounted on the roller shaft. The piston section may also take the form of a ring-shaped disc which is firmly attached to the shaft journal for example through shrinkage and/or by means of a locking ring.
- [10] The central hole in the cover part of the second part may be provided with a number of oil sealing rings to prevent or restrict the amount of oil passing through the hole. Al-

ternatively, a gap may be formed between the central hole and the shaft journal which is led through the hole to allow a smaller amount of oil to pass into an oil sump, where appropriate, at the roller bearing.

[11] The oil may be introduced into the compartment between the two opposing pressure surfaces in any suitable manner. Hence the oil may be introduced into the compartment via one or several through-going openings in the pressure surface of the first part. However, it is preferred that the oil is fed to the compartment via at least one duct provided in the roller shaft and the shaft journal and terminating in the compartment.

[12] The oil which is discharged from the compartment between the two pressure surfaces may in a simple embodiment be collected in a vessel which is located below the compartment. However it is preferred that the oil which is discharged from the compartment via the gap between the piston section of the first part and the cylinder section of the second part are collected in a chamber which is bounded by the outer side of the piston section of the first part and a lid which is attached at the extreme end of the cylinder section of the second part. In the latter embodiment the collected oil may be returned from the chamber via a duct provided in the roller shaft and the shaft journal. The returned oil may either be directed directly to an oil tank for possible recycling or via a number of ducts in the roller shaft it may be directed to the roller bearing for lubrication hereof, and from there be directed onward to the oil tank via a further duct in the roller shaft.

[13] The invention will now be explained in further details with reference to the drawing being diagrammatical, with its only figure showing a sectional view of an embodiment of the roller mill according to the invention.

[14] The figure illustrates an embodiment of a roller mill 1 according to the invention which comprises a horizontal grinding table 3 and a roller 4 operating interactively therewith. The roller 4 rotates about a roller shaft 6 by means of a roller bearing 7 which in the shown embodiment is constituted by a radial rolling bearing 7a and a spherical rolling bearing 7b. The roller bearing itself 7 is not part of the present invention and may be differently configured, for example incorporating a slide bearing.

[15] In order to obtain an efficient and adjustable force device for relieving the axial force on the roller bearing 7 to allow the latter to be constituted by a commercially available bearing, the roller mill according to the invention comprises a force device 8 which comprises a first part 9 which is mounted on the roller shaft 6, and a second part 10 which is mounted on the roller 4, and co-rotating with the latter. The first part 9 and the second part 10 comprise opposing pressure surfaces 9a, 10a, both extending substantially perpendicular to the longitudinal direction of the roller shaft 6. Between them the two pressure surfaces 9a and 10a form a compartment 11 in which the pressure surface 9a on the first part 9 is provided at the extreme end and facing inwards towards

the roller 4 and the pressure surface 10a on the second part 10 is provided in innermost position and facing outwards away from the roller 4. The roller mill further comprises means 12 for introducing pressurized oil to the compartment 11 between the opposing pressure surfaces 9a, 10a. By introducing oil into the compartment 11 it will be possible to build up a pressure in this compartment 11 which is so adapted to the relevant axial force and pressure surface area, that the roller bearing 7 is relieved completely or partially.

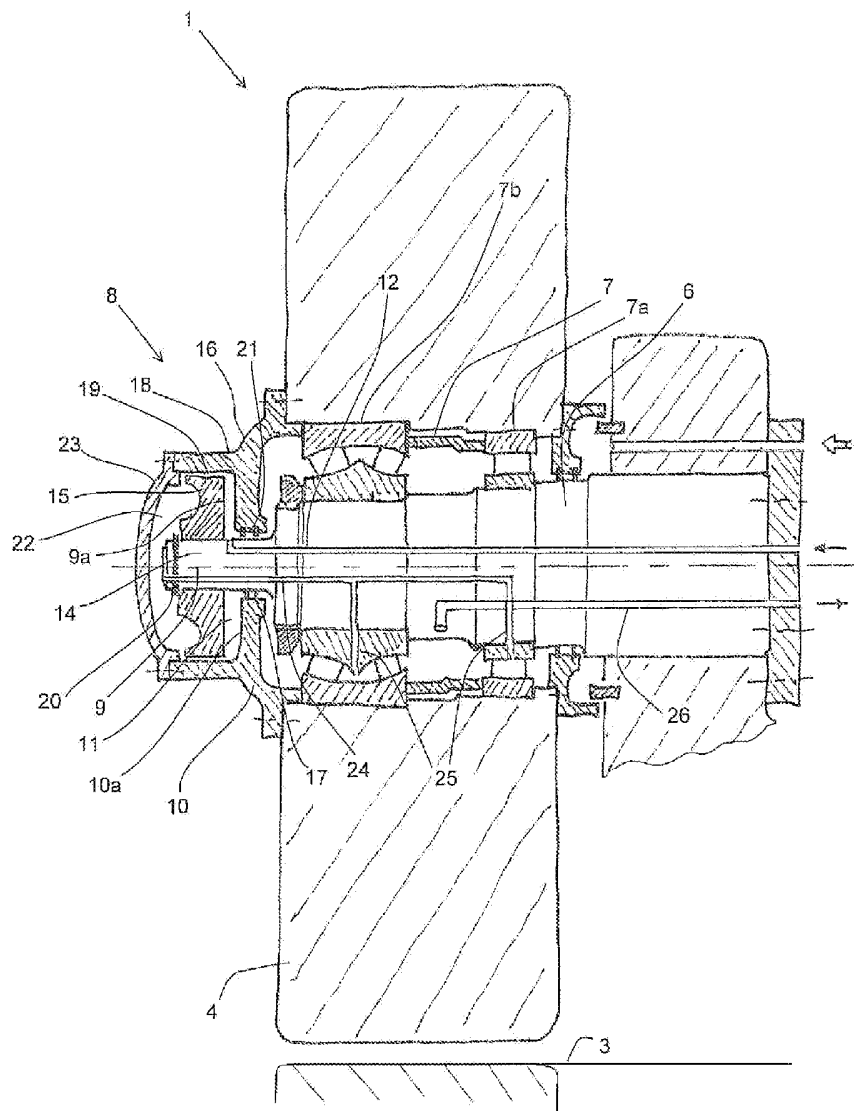
- [16] In the shown preferred embodiment of the force device 8, the first part 9 comprises a shaft journal 14 which protrudes axially from the roller shaft 6, and a piston section 15 with an inwardly facing pressure surface 9a, whereas the second part 10 comprises an inner cover part 16 with an outwardly facing pressure surface 10a and a central hole 17 for lead-through of the shaft journal 14 and an outwardly orienting cylinder section 18 encompassing the piston section 15. A gap 19 exists between the peripheral edge of the piston section 15 and the inner wall of the cylinder section 18. The gap 19 is a co-determinant of the pressure which can be built up in the compartment 11 in order to relieve the axial force on the roller bearing.
- [17] As illustrated in the figure, the piston section 15 consists of a ring-shaped disc which is firmly attached to the shaft journal 14 by means of a locking ring 20.
- [18] The central hole 17 in the cover part 16 is in the shown embodiment provided with a couple of oil sealing rings 21 in order to reduce the amount of oil passing through the hole 17.
- [19] The oil is introduced, as shown, into the compartment 11 via a duct 12 provided in the roller shaft 6 and the shaft journal 14 and terminating in the compartment 11.
- [20] In the shown embodiment the oil is discharged from the compartment 11 via the gap 19 between the piston section 15 and the cylinder section 18 and it is collected in a chamber 22 which is bounded by the outer side of the piston section 15 and a lid 23 which is fixed at the extreme end of the cylinder section 18 of the second part. From here the collected oil is directed via a duct 24 and a number of ducts 25 in the roller shaft 6 to the roller bearing 7 for lubrication hereof prior to being directed via a further duct 26 in the roller shaft 6 to an oil tank, not shown, for possible recycling.

Claims

- [Claim 1] A roller mill (1) for grinding particulate material such as cement raw materials, cement clinker and similar materials, said roller mill comprising a substantially horizontal grinding table (3), at least one roller (4) operating interactively therewith which is configured for rotation about its centreline by means of a roller bearing (7) and being connected with a roller shaft (6), **characterized in** that it comprises a force device (8) for at least partial absorption of an axial force originating at least from the roller and acting in the longitudinal direction of the roller shaft (6), said force device (8) comprising a first part (9) which is mounted on a machine component which is stationary relative to the longitudinal direction of the roller shaft (6), and a second part (10) which is mounted on a machine component rotating about the centreline of the roller and co-rotating therewith, where the first and second part (9, 10) comprise opposing pressure surfaces (9a, 10a) which both extend substantially perpendicular to the longitudinal direction of the roller shaft (6), and forming between them a compartment (11) where the pressure surface (9a) on the first part (9) is provided so that it is oriented in the opposite direction to the axial force acting in the longitudinal direction of the roller shaft (6) and the pressure surface (10a) on the second part (10) is provided so that it is oriented in the same direction as the axial force acting in the longitudinal direction of the roller shaft (6), and means (12) for introducing a pressurized viscous medium into the compartment (11) between the opposing pressure surfaces (9a, 10a).
- [Claim 2] A roller mill according to claim 1, **characterized in** that the force device (8) is formed as a piston (15) in a cylinder (18).
- [Claim 3] A roller mill according to claims 1 or 2, **characterized in** that the first part (9) of the force device (8) is mounted on the roller shaft (6) and in that the second part (10) is mounted on the roller (4).
- [Claim 4] A roller mill according to claims 1, 2 or 3, **characterized in** that the first part (9) of the force device (8) comprises a shaft journal (14) protruding axially from the roller shaft (6), and comprising at its extreme free end a piston section (15) with an inwardly orienting pressure surface (9a), and the second part (10) of the

force device (8) comprises an inner cover part (16) with an outwardly orienting pressure surface (10a), said cover part (16) being formed with a central hole (17) for lead-through of the shaft journal (14) of the first part and an outwardly orienting cylinder section (18) encompassing the piston section (15) of the first part.

- [Claim 5] A roller mill according to claim 4, **characterized in** that a gap (19) is provided between the peripheral edge of the piston section (15) and the inner wall of the cylinder section (18).
- [Claim 6] A roller mill according to claim 4, **characterized in** that the piston section (15) is constituted by a ring-shaped disc which is firmly attached to the shaft journal (14) through shrinkage and/or by means of a locking ring (20).
- [Claim 7] A roller mill according to claim 4, **characterized in** that the central hole (17) in the cover part (16) of the second part (10) is provided with a number of oil sealing rings (21).
- [Claim 8] A roller mill according to claim 4, **characterized in** that the viscous medium is supplied to the compartment (11) via at least one duct (12), which is provided in the roller shaft (6) and the shaft journal (14), and terminating in the compartment (11).
- [Claim 9] A roller mill according to claim 5, **characterized in** that the viscous medium which is discharged from the compartment (11) via the gap (19) between the piston section (15) of the first part and the cylinder section (18) of the second part is collected in a chamber (22), which is bounded by the outer side of the piston section (15) of the first part and a lid (23) which is attached at the extreme end of the cylinder section (18) of the second part.
- [Claim 10] A roller mill according to claim 9, **characterized in** that the collected oil is returned from the chamber (22) via a duct (24) provided in the roller shaft (6) and the shaft journal (14).
- [Claim 11] A roller mill according to claim 10, **characterized in** that the returned oil via a number of ducts (25) in the roller shaft (6) is directed to the roller bearing (7) for lubrication hereof, and from there is directed onward through a further duct (26) in the roller (6).



INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
INV. B02C15/00

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)
B02C

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 practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 004 953 A (BABCOCK AG) 11 April 1979 (1979-04-11) figure 1	1
X,P	WO 2009/000577 A1 (SMIDTH AS F L [DK]; HANGHOEJ SOEREN [DK]; FOUGNER ANDERS [DK]) 31 December 2008 (2008-12-31) page 3, line 16 - page 5, line 4; figures 1,3	1-6,9-10

 Further documents are listed in the continuation of Box C. See patent family annex.

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"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.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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