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(71) Applicant (for all designated States except US):
FLSMIDTH A/S [DK/DK]; Vigerslev Alle 77, DK-2500
Valby (DK).

(72) Inventor; and

(75) Inventor/Applicant (for US only): HELM, Alexander
[DK/DK]; Bakkevej 5, DK-3450 Allerød (DK).

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

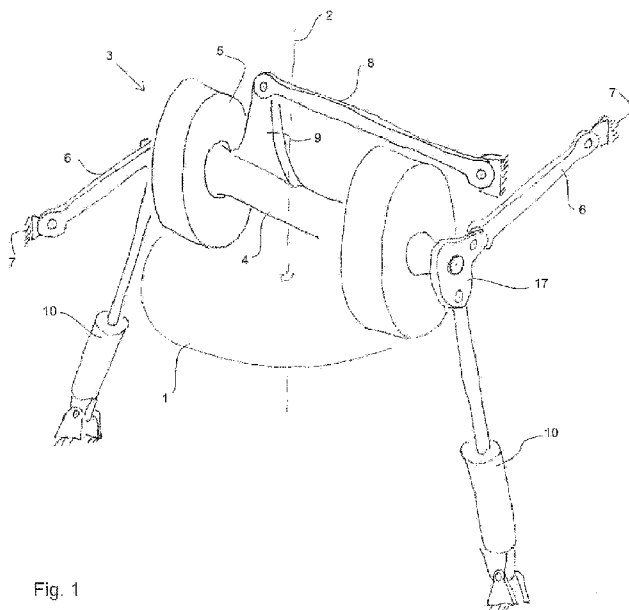


Fig. 1

(57) Abstract: A description is given of a roller mill for grinding particulate material, such as cement raw materials, cement clinker and similar materials, which roller mill comprises a grinding table (1) which is rotatable about a vertical axis (2), at least one roller set (3) comprising a shaft (4) and two rollers (5), which are rotatably mounted on the shaft (4), and two torque reaction arms (6) each of which are rotatably connected to the shaft (4) and frame (7) or foundation. The roller mill is peculiar in that the roller set (3) comprises a centering rod (8) extending substantially parallel to the roller shaft (4) and being at its one end rotatably connected to the roller shaft (4) and at its other end being rotatably connected to a machine element (4, 7) which is fixed or stationary in the longitudinal direction of the roller shaft. It is hereby obtained that the roller set is maintained in the longitudinal direction of the roller shaft so that the roller set will remain centered on the grinding table even after prolonged roller mill operation. This is ascribable to the negligible wear being incurred on the rotatable connections of the centering rod.

Description

Title of Invention: A 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, which roller mill comprises a grinding table which is rotatable about a vertical axis, at least one roller set comprising a shaft and two rollers which are rotatably mounted on the shaft, and two torque reaction arms each of which are rotatably connected to the shaft and frame or foundation.
- [2] Roller mills of the aforementioned kind are generally known. The roller set is usually maintained in the longitudinal direction of the roller shaft by means of appropriate sliding surfaces being provided at the roller shaft ends and permitting unimpeded movement of the roller shaft in a vertical plane. To ensure free upward and downward movement capability of the roller set the sliding surfaces must be plane-parallel, and to ensure tilting capability of the roller set, the end faces of the roller shaft must be spherical with the centre situated on the centreline of the roller shaft. This means that the pressure area surface will in principle become infinitesimally small. The disadvantage of this design is that the sliding surfaces will be subjected to wear exposure within a short period of time, thereby allowing the roller shaft to perform an increasingly axial movement which means that the roller set will not be centered on the grinding table. Also the design will entail difficulties with regard to the maintenance of the mill.
- [3] It is the purpose of the present invention to provide a roller mill by means of which the aforesaid disadvantages are eliminated or at least significantly reduced.
- [4] This is obtained by means of a roller mill of the kind mentioned in the introduction and being characterized in that the roller set comprises a centering rod extending substantially parallel to the roller shaft and being at its one end rotatably connected to the roller shaft and at its the other end being rotatably connected to a machine element, which is fixed or stationary in the longitudinal direction of the roller shaft.
- [5] It is hereby obtained that the roller set is maintained in the longitudinal direction of the roller shaft so that the roller set will remain centered on the grinding table even after prolonged roller mill operation. This is ascribable to the negligible wear being incurred on the rotatable connections of the centering rod.
- [6] In principle, the centering rod may be connected to the roller shaft at any location over the length of the roller shaft. In one embodiment, the centering rod may thus be connected to the roller shaft at one of its ends. However, it is preferred that the

centering rod is connected to the roller shaft at a location between the two rollers of the roller set, preferably in immediate proximity of one roller since this would increase the compactness of the roller mill. The centering rod may appropriately be connected to the roller shaft via a bracket which is mounted on the roller shaft and protruding perpendicularly therefrom.

- [7] In order to obtain a roller mill with a higher capacity rating, it is preferred that it comprises two or more roller sets. In a roller mill with two roller sets it is preferred that the roller sets are arranged so that their roller shafts intersect one another at an angle of 90°. In such an embodiment the centering rod of the first roller set may be rotatably connected to the roller shaft of the second roller set and vice versa due to the fact that the roller shaft in the second roller set is substantially stationary in the longitudinal direction of the roller shaft in the first roller set and vice versa.
- [8] In order to accommodate the intersecting roller shafts, the rollers in the two roller sets may be configured with different diameters so that one roller shaft may extend under the other roller shaft, or the roller shafts may be configured with a central curved part which will permit unimpeded passage of the roller shafts in relation to one another. A further possibility would be to form an appropriate linked connection at the point of intersection between the two roller shafts.
- [9] Such a linked connection must have the same degree of freedom as a ball moving inside a pipe, and may be formed, for example, of a first cylindrical part and a therein movable second part which comprises a rod, the end of which, protruding into the cylindrical part, is at least partially configured as a ball. The two parts have at their ends remote from one another preferably a flange facilitating mounting on the respective roller shafts. By employing a linked connection of this kind it will be possible for the two flanges and hence the two roller shafts to move freely upwards and downwards in relation to both one another and in relation to the grinding table, to tilt in both planes and to rotate relative to one another whereas they are prevented from being radially displaced relative to one another.
- [10] The force exerted by the rollers against the grinding table may be determined exclusively by the intrinsic weight of the roller sets. However, it is preferred that the roller sets are connected to force means forcing the rollers against the grinding table. Such force means may be centrally fitted in the roller mill, exerting a downwardly directed force against the roller shafts. However, the force means are preferably fitted at each end of the roller shafts, and may appropriately be formed of preferably hydraulic push/pull cylinders, each of which transmitting a force to the roller set via a push/pull rod which is rotatably connected to a roller shaft end.
- [11] To prevent the overturning of roller shaft with the flange mounted thereon, one of the torque reaction arms and/or one of the connecting links of the pull rods for each roller

set may be fitted in a bracket fixed to one of the protruding shaft ends. Hence a distance of suitable length will be formed between the centreline of the roller shaft and the point of application of the force acting in the torque reaction arm and/or the pull rod, so that a stabilizing and corrective torque in case of any tendency towards overturning is generated, thereby preventing unintended overturning of the roller shaft with flange.

[12] As an alternative to the above mentioned configuration, one of the torque reaction arms or pull rods for each roller set may be fixed to the protruding roller shaft end through the use of a forked link.

[13] The invention will now be described in further details with reference to the drawing, being diagrammatical, and where

[14] Fig. 1 shows a first embodiment of the roller mill according to the invention,

[15] Fig. 2 shows a second preferred embodiment of the roller mill according to the invention, and

[16] Fig. 3 shows an example of a linked connection for use in a roller mill according to the invention.

[17] In Fig. 1 is seen a roller mill comprising a grinding table 1, which is rotatable about a vertical axis 2, a roller set 3 comprising a shaft 4 and two rollers 5, which are rotatably mounted on the shaft 4, and two torque reaction arms 6 each being rotatably connected to the shaft 4 and frame 7. The shown roller mill also comprises a hydraulic pull cylinder 10 at each end of the roller shaft 4, which is rotatably connected to, respectively, the roller shaft 4 and a foundation not shown in any detail.

[18] In order to maintain the roller set 3 in the longitudinal direction of the roller shaft 4, so that it is centered on the grinding table 1, the roller set 3 comprises a centering rod 8 extending substantially parallel to the roller shaft 4. At one end the centering rod 8 is rotatably connected to a flange 9 fixed on the roller shaft 4. At its other end, the centering rod 8 is rotatably connected to frame 7 which is stationary relative to the longitudinal direction of the roller shaft 4.

[19] In Fig. 2 is seen a roller mill with two roller sets 3 being arranged so that their roller shafts 4 intersect one another at an angle of 90°. In the shown embodiment, the centering rod 8 of one roller set 3 is rotatably connected to the roller shaft 4 of the second roller set 3 and vice versa. Furthermore, the roller shafts 4 are configured with a central curved part 11 which permit unimpeded passage of the roller shafts 4 in relation to one another.

[20] In Fig. 3 is seen a linked connection 12 which is formed of a first cylindrical part 13 and a therein movable second part 14 which comprises a rod, the end 14a of which protruding into the cylindrical part, is partially ball-shaped. The two parts 13, 14 both have a flange 15, 16 to facilitate mounting to the respective roller shafts 4. The use of

the linked connection 12 allows the two flanges 15, 16 and hence the two roller shafts 4 to move freely upwards and downwards, to tilt in both planes and to rotate relative to one another, whereas they are prevented from being radially displaced in relation to one another.

[21] To prevent the overturning of the roller shaft 4 with the flange 9 mounted therein, one of the torque reaction arms 6 and/or one of the connecting links of the pull rods 10 for each roller set 3 may be fitted in a fixed bracket 17 mounted on one of the protruding shaft ends. Hence a distance having a suitable length is formed between the centreline of the roller shaft and the point of application of the force acting in the torque reaction arm and/or the pull rod, so that a stabilizing and corrective torque in case of any tendency towards overturning is generated, thereby preventing unintended overturning of the roller shaft 4 with flange 9.

[22] As an alternative to the above mentioned configuration, one of the torque reaction arms 6 or pull rods 10 for each roller set 3 may be fixed to the protruding roller shaft end by means of a forked link 18 as shown in Fig. 4.

Claims

- [Claim 1] A roller mill for grinding particulate material, such as cement raw materials, cement clinker and similar materials, which roller mill comprises a grinding table (1) which is rotatable about a vertical axis (2), at least one roller set (3) comprising a shaft (4) and two rollers (5), which are rotatably mounted on the shaft (4), and two torque reaction arms (6) each of which are rotatably connected to the shaft (4) and frame (7) or foundation, **characterized in that** the roller set (3) comprises a centering rod (8) extending substantially parallel to the roller shaft (4) and being at its one end rotatably connected to the roller shaft (4) and at its other end being rotatably connected to a machine element (4, 7) which is fixed or stationary in the longitudinal direction of the roller shaft.
- [Claim 2] A roller mill according to claim 1, **characterized in that** the centering rod (8) is connected to the roller shaft (4) at a location between the two rollers (5) of the roller set (3)
- [Claim 3] A roller mill according to claim 2, **characterized in that** the centering rod (8) is connected to the roller shaft (4) in immediate proximity of one roller (5).
- [Claim 4] A roller mill according to claim 1, **characterized in that** it comprises two or more roller sets (3).
- [Claim 5] A roller mill according to claim 4, **characterized in that** it comprises two roller sets (3) which are arranged so that their roller shafts (4) intersect one another at an angle of 90 °.
- [Claim 6] A roller mill according to claim 5, **characterized in that** the centering rod (8) of the first roller set (3) is rotatably connected to the roller shaft (4) of the second roller set (3) and vice versa.
- [Claim 7] A roller mill according to claim 5 or 6, **characterized in that** the roller shafts (4) are configured with a central curved part (11) permitting unimpeded passage of the roller shafts (4) in relation to one another.
- [Claim 8] A roller mill according to claim 5 or 6, **characterized in that** it comprises a linked connection (12) at the point of intersection between the two roller shafts (4), with said linked connection (12) having a degree of freedom corresponding to that of a ball moving inside a pipe.
- [Claim 9] A roller mill according to claim 8, **characterized in that** the linked connection (12) is formed of a first cylindrical part (13) and a therein movable second part (14) which comprises a rod, the end of which

protruding into the cylindrical part (13), is at least partially formed as a ball (14a) and in that the two parts (13, 14) at their ends remote from one another comprise a flange (15, 16) facilitating mounting to the respective roller shafts.

[Claim 10]

A roller mill according to any of the claims 1 to 9, **characterized in that** the roller sets (3) is connected to force means (10) which force the rollers (5) against the grinding table (1).

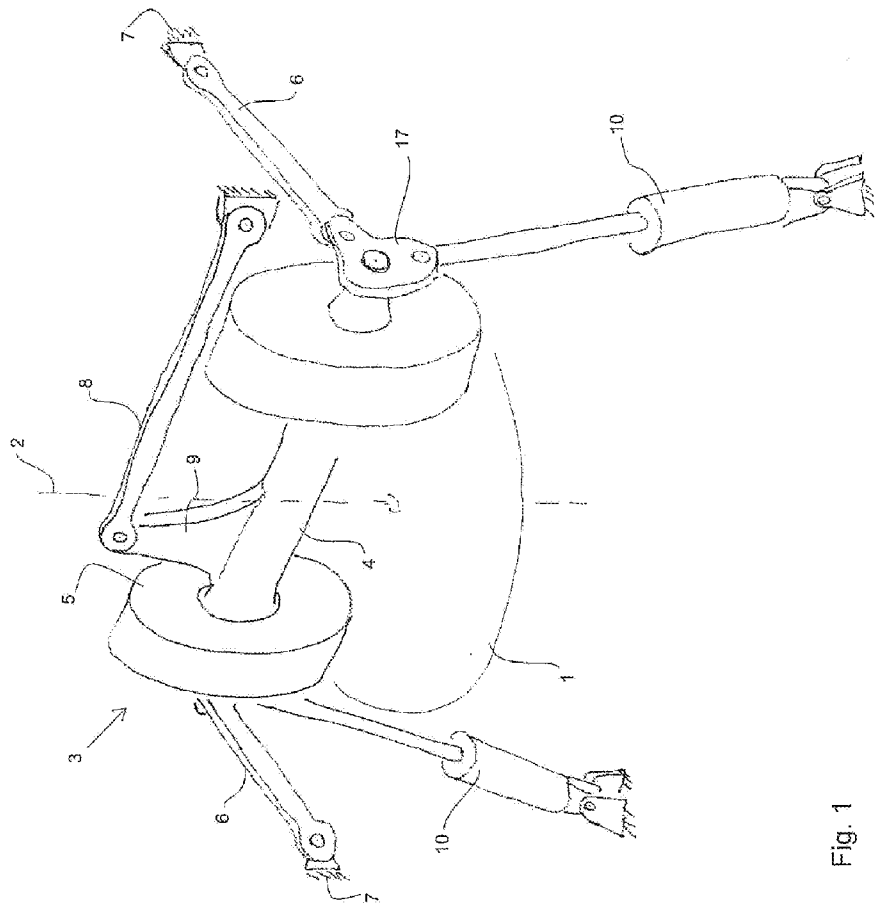


Fig. 1

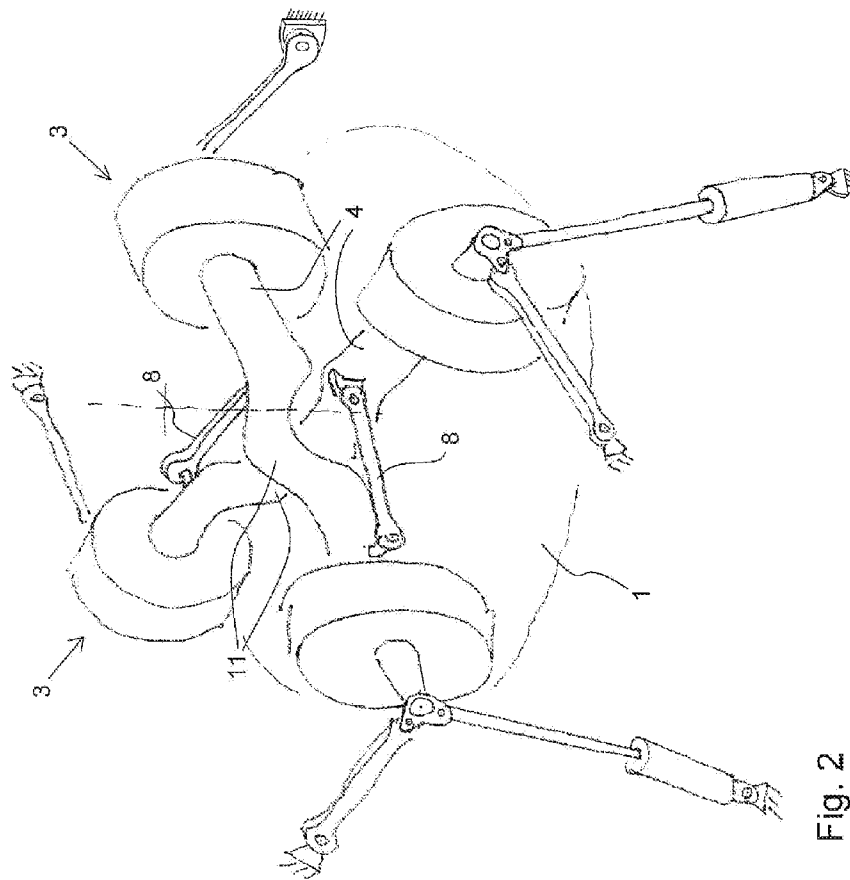


Fig. 2

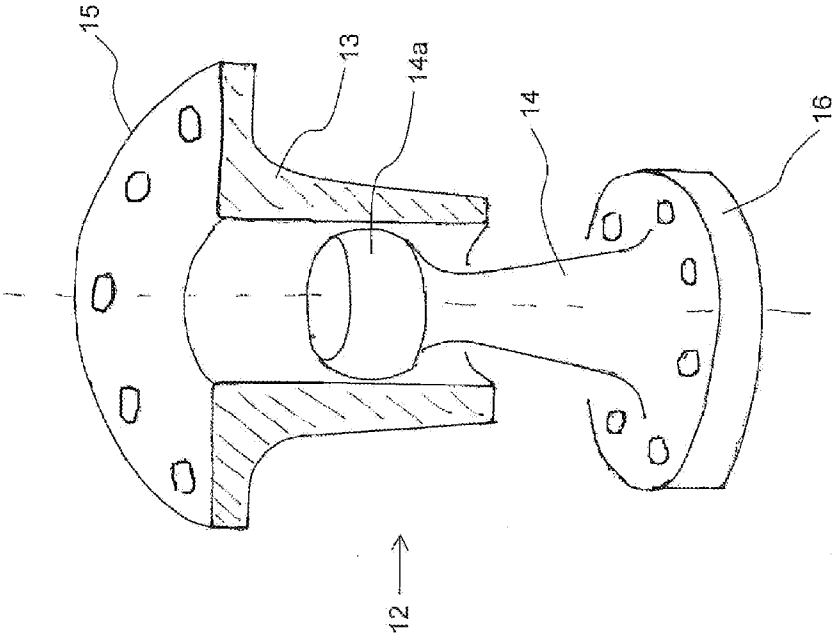
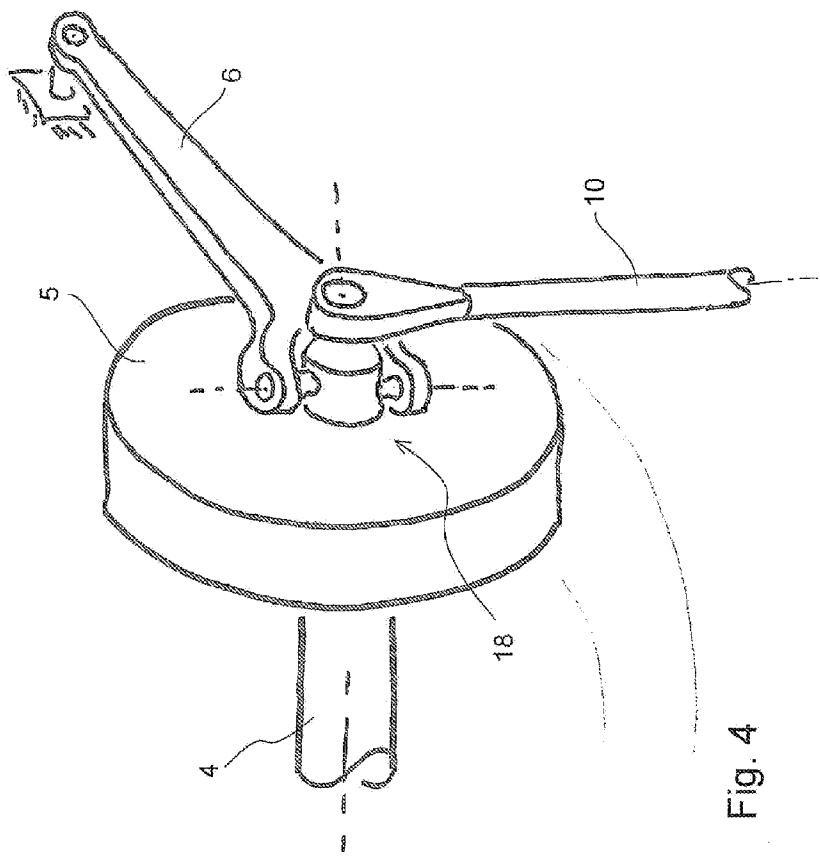


Fig. 3



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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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	EP 0 294 609 A2 (KRUPP POLYSIUS AG [DE]) 14 December 1988 (1988-12-14) page 1, lines 7-25 column 6, line 40 - column 7, line 39; claims 1,6,7,8; figures 4,7	1,10
A,P	DE 10 2007 031036 B3 (POLYSIUS AG) 30 April 2009 (2009-04-30) paragraphs [0002], [0039], [0040]; claims 1,2,7,8,11	1,4-5, 7-8,10



Further documents are listed in the continuation of Box C.



See patent family annex.

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NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Strodel, Karl-Heinz

INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0294609 A2	14-12-1988	DE 3718781 A1 US 4909450 A	15-12-1988 20-03-1990
DE 102007031036 B3	30-04-2009	NONE	