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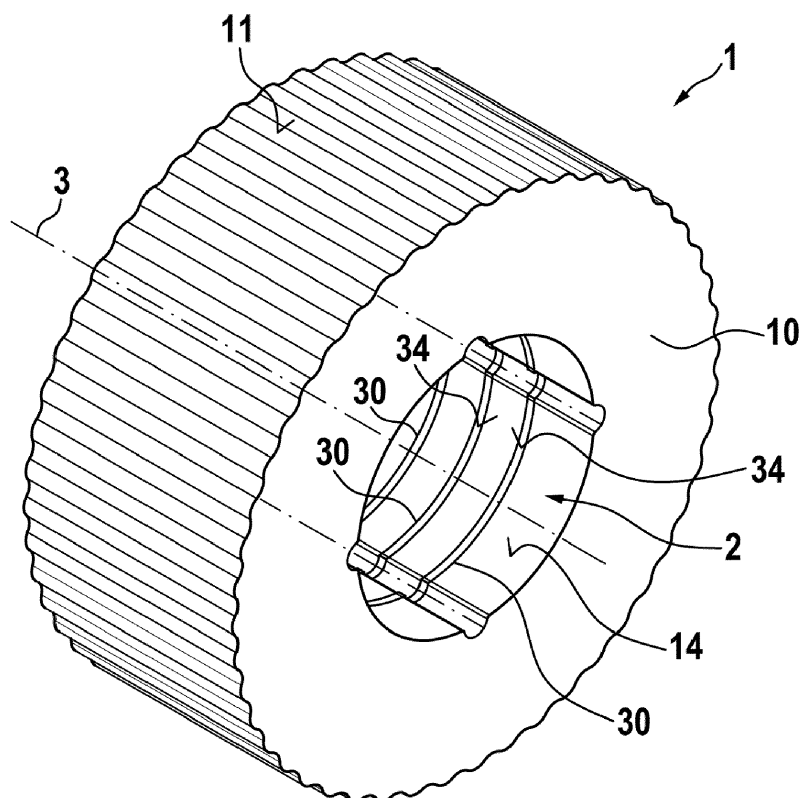
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(54) **Crusher for calciner fall through**

(57) A crushing ring with low wear and excellent heat resistance may be obtained by casting a crushing ring body of ceramic material with an embedded reinforcement structure which comprises or better consists of sheet metal pieces.

Fig. 1



Description

Field of the invention

[0001] The invention relates to a crusher for a cement clinker production line, in particular to a crushing ring of said crusher.

Description of the related art

[0002] Cement clinker (briefly 'clinker') is usually produced in a rotary kiln by calcining and sintering raw meal at temperatures of typically 1350°C to 1450°C. The clinker is discharged from the hot end of the rotary kiln onto a cooling grate of a clinker cooler. Hot flue gas leaves the kiln at the opposite side, i.e. at the cold end side and is often provided to a calciner. The calciner is typically a tubular reactor for pre-calcining preheated raw meal, which is provided to the input side of the calciner. From the input side the raw meal is pneumatically transported upwards and subsequently downwards, i.e. the calciner resembles an inverted "U" with its free ends pointing downwards.

[0003] The discharged clinker on top of the cooling grate is cooled by a gas or a mixture of gases, usually air. The gas is in turn strongly heated, at least in the area close to the kiln. This strongly heated gas has a temperature of approximately 750-1300°C and carries a high amount of clinker dust. The heated gas is extracted from the clinker cooler at the kiln hood and/or the cooler roof and fed via a so-called tertiary air duct to a calciner. The heated gas is referred to as tertiary air and provided by a mostly slightly inclined tertiary air duct to the input side of the calciner.

[0004] The heated flue gas and the tertiary air mix (briefly 'gas mix') transport the raw meal through the calciner to dust removal means, mostly a cyclone. In the calciner heat is transferred from the gas mix to the raw meal and calcination takes place. The dust removal means separate the pre-calcined raw meal from the gas mix and provide it to the kiln for further calcination and sintering.

[0005] EP 1 899 070 B1 discloses a roller crusher for crushing hot clinker. The roller crusher has two crushing rolls being driven in opposite directions to comminute the hot clinker provided on top of the crushing rolls. Each crushing roll has a drive shaft supporting a multiplicity of crushing rings. The crushing rings are of cast iron and have crushing projections on their crushing surfaces. The crushing projections are of sintered hard metal, to better withstand the harsh crushing conditions. The crushing projections are attached to the crushing surface by deposit welding or composite casting.

[0006] Comminution is distinguished by the hardness of the material to be comminuted, by the required particle size and the accordingly selected comminution process. Here, we will refer only to crushing or milling using roller crushers or roller mills, respectively. There is no concep-

tual difference between roller crushers or roller mills, thus, we will not further distinguish between them. An introduction of comminution of bulk material is provided by Dr.-Ing. Habil Dr. h.c. Karl Höffl Zerkleinerungs- und Klassiermaschinen (Schlütersche Verlagsanstalt Hannover, 1984). An introduction to "Hard Comminution" is provided by Karl Mittag Die Hartzerkleinerung, Maschinen, Theorie und Anwendung in verschiedenen Zweigen der Verfahrenstechnik (Springer-Verlag Berlin 1953).

Summary of the invention

[0007] The invention is based on the observation that raw-meal fall through takes place in the calciner. This means, that a part of the raw meal and clinker dust from the tertiary air flow agglomerate in the calciner until the agglomerate is too heavy for being pneumatically transported by the flow of the gas mix through the calciner. Accordingly this hot agglomerate falls down, is removed from the calciner via a fall-through outlet and is collected in a container at the input side of the calciner. The content of the container is hot (~800-900°C) and toxic. Full containers are replaced by empty ones.

[0008] The problem to be solved by the invention is to continuously feed the calciner fall through (briefly fall through), i.e. the hot material back into the cement clinker line without cooling it down to thereby reduce expensive energy losses and waste disposal costs.

[0009] A solution to this problem is provided by a crushing ring of claim 1. The dependent claims relate to further improvements of the invention. The crushing ring enables to crush or mill the hot and highly abrasive agglomerates to particle sizes that can be transported pneumatically, i.e. by a gaseous flow. This gaseous flow carrying the crushed fall through can be provided e.g. to a raw meal preheater or directly to the calciner again. The crushing ring provides low wear and excellent heat resistance and may be manufactured at low costs by cast moulding a crushing ring body of ceramic material with an embedded reinforcement structure, which comprises or better consists of sheet metal pieces. Thus, the expensive metal moulding and deposit welding of sinter hard metal can be avoided. Use of the crushing ring is not limited to crushing calciner fall through, the crushing ring can as well be used e.g. to crush or mill cement clinker being passed from a clinker cooler stage to a another clinker cooler stage, clinker leaving the clinker cooler or even for raw meal production. Other, non-clinker related applications are as well possible.

[0010] The crushing ring has a crushing surface and a recess for a drive shaft of a roller crusher. The crushing ring is a composite of a ceramic body and a metallic reinforcement structure.

[0011] The ceramic body is a ring with an outer ring surface, as well referred to as lateral surface. The outer ring surface is at least a part of the crushing surface and accordingly faces away from the ring axis. The ceramic body further has an inner ring surface, i.e. that part of the

shell surface facing towards the ring axis. The parts of the surface shell facing essentially parallel to the ring axis are referred to as front and rear sides. The crushing ring further has a metallic reinforcement structure. The metallic reinforcement structure is incorporated in said ceramic body. This composite crushing ring can be manufactured at very low costs and provides an excellent heat and wear resistance.

[0012] Only to avoid ambiguities, the term surface shell denotes the surface of a part defining its 3D-form. Thus, a surface shell of a ring with a box like cross section has a front and a rear side facing parallel to the ring axis, an outer ring surface facing radially away from the ring axis and an inner ring surface facing towards the ring axis.

[0013] The ceramic body may be a sintered ceramic comprising for example Silicium Carbide (SiC), Aluminium Oxide (Al₂O₃), Silicium Oxide (SiO₂) and the like. These ceramics provide a very high wear resistance and very high compressive strengths at rather high temperatures of up to 1500°C. The flexural strength of the crushing ring, however, is provided by the metallic reinforcement structure.

[0014] The metallic reinforcement structure is preferably (at least in part) made of sheet metal, which can be cut and bent with remarkable precision at very low costs. Expensive metal casting is not necessary. For example, the reinforcement structure may comprise at least one, e.g. two, three or more first sheet metal rings for example of steel (e.g. of European Standard Steel Grade (EN 10027-2) No. 1.4841, 1.4828 or the like). Each first sheet metal ring has a lateral surface (which is the outer ring surface) and an inner ring surface. The sheet metal rings may be axially spaced from each other and are preferably coaxially to the ceramic body. These first sheet metal rings enable to transfer high driving torques from the drive shaft into the ceramic body. To this end, the first sheet metal rings may comprise holes in their front sides extending parallel to the ring axis. The holes may be through holes. When casting the crushing ring, ceramic slurry, usually referred to as slip or ceramic slip, enters the (through) holes and after hardening of the ceramic body the first sheet metal rings and the ceramic body are connected in positively-locking manner. The first metal rings are spaced from each other. Ceramic material of the ceramic body is between the first metal rings.

[0015] The front and rear sides of the first sheet metal rings may correspond to the front and rear side of a sheet metal, e.g. a band- or panel shaped semifinished material. The radially pointing sides (inward or outward), i.e. the inner and outer ring surfaces of the first sheet metal rings are surfaces being cut out of the sheet metal.

[0016] Preferably, the inner diameter d_i of at least one of the first sheet metal rings is smaller or equal to the inner diameter D_i of the ceramic body ($d_i \leq D_i$), even more preferred the inner diameter d_i of at least one of the first sheet metal rings is smaller than the inner diameter D_i of the ceramic body ($d_i < D_i$) and has means for positive-locking with the drive shaft. By the suggested relation of

the diameters the torque is transferred from the drive shaft to the crushing ring via the first sheet metal rings only. This results in less wear of the shaft and in particular to a higher longevity of the ceramic body, as ceramics in general has a low flexural strength and is not suited to withstand shear stress as occurring when transferring torque by positive-locking. The torque is transferred to the ceramic body by the first metal ring(s) via a large area which at least in part is further away from the rotational axis, which is typically the ring axis. Thus in turn the flexural and shear stress peaks in the ceramic body are reduced.

[0017] The means for positive-locking of the crushing ring with the drive shaft may be realized by recesses and/or protrusions which are preferably complementary to protrusions and/or recesses of the drive shaft.

[0018] The reinforcement structure may comprise at least one second sheet metal ring. The second sheet metal ring may surround the first metal ring(s). For example, the inner ring surface of the second sheet metal ring may be attached to the lateral surface of the first sheet metal ring(s). The inner and outer ring surfaces of the second sheet metal ring correspond to the front (or rear) side of the sheet metal. The surfaces being formed by cutting the sheet metal thus point in the axial direction and/or to the surface at the opposite side of the sheet metal ring. The first and second sheet metal rings can be connected to each other, e.g. by welding, gluing, riveting or the like. So to speak, the second sheet metal ring can be considered as a band or strip of metal wound around the first sheet metal ring(s). Like the first sheet metal ring(s) the second sheet metal ring may have holes. Preferably, the holes extend in radial direction, this simplifies manufacturing of the second sheet metal ring. Again the holes may be through holes. When casting the crushing ring, the slip enters the (through) holes and after curing of the ceramic body the first sheet metal ring(s) and the ceramic body are connected in positively-locking manner. The second sheet metal ring and the ceramic body engage with another.

[0019] The first sheet metal rings may have pins extending radially out-ward through recesses in the second sheet metal ring to thereby obtain a positive-locking of the first and second rings. These pins may even extend over the second metal ring to thereby enhance torque transmission from the first metal ring to the ceramic body with low shear stress.

[0020] Preferably, the reinforcement structure comprises a ring cage enclosing at least one of said first sheet metal rings. The ring cage may as well enclose the optional second sheet metal ring(s). Like the second sheet metal ring, the ring cage is preferably fully enclosed in the ceramic body. The ring cage comprises cage bars. These cage bars or at least a leg of the cage bars may extend parallel to the crushing surface. In particular in case the crushing surface is corrugated or provides crushing protrusions, the cage bars or at least said leg may extend parallel to a cylinder surface enclosing the

crushing surface. For simplicity it is not further distinguished between these cases of a corrugated crushing surface, a crushing surface with crushing protrusions and an even crushing surface. For simplicity, it is referred to a cylindrical crushing surface with a circular base ('even crushing surface'). However, this even crushing surface is to be understood only as an example.

[0021] For example, the cage bars may be arranged parallel to each other and one besides of the other with slits in between. The cage bars may have a longitudinal direction extending parallel to the ring axis. The cage bars may be positioned in the ceramic body and between the first metal rings and the crushing surface. The ring cage reduces shear stress of the ceramic body when crushing material.

[0022] The cage bars may be supported by at least one, preferably two parallel cage rings which is (are) preferably coaxial to the crushing surface of the ceramic body. In case of two cage rings, the cage bars may be connected at both ends to one of said cage rings.

[0023] For example, the cage bars may comprise a center leg in between of two side legs which are each angled towards the radial direction and which are attached to one of said cage rings. A cross section of the cage along the ring axis thus resembles to two 'U's with their free ends facing radially inwardly, and thus towards each other. The middle section or leg of the 'U' is parallel to the crushing surface and/or said cylinder surface and preferable in the vicinity of the crushing surface. 'Vicinity' means that the distance between the crushing surface and the grate bars is preferably between 0,25cm and 5cm (more preferred between 0,5cm and 2.5cm).

[0024] The cage bars may be connected by struts. For example, the cage bars or a center leg of the cage bars may extend parallel to the ring axis and the struts may extend in circumferential direction between the cage bars. The cage bars may be evenly spaced and the distance d_s between two neighboured struts may correspond to the distance d_c between two cage bars (e.g. $0.75 \cdot d_s \leq d_c \leq 1.25 \cdot d_s$; preferably $0.9 \cdot d_s \leq d_c \leq 1.1 \cdot d_s$). The struts may thus as well be evenly spaced along the cage bars. The above explained cage bars can thus be considered as first cage bars, being connected by second cage bars, i.e. said struts.

[0025] The ring cage may be manufactured very efficiently from a sheet metal by first cutting the cage bars and optionally the struts (i.e. removing the material in between of the later cage bars and eventual struts) and subsequently expanding the mesh and enclosing at least one of said first sheet metal rings and if realized as well the second metal ring(s).

[0026] In case the first metal ring(s) have radial pins, these pins may extend over the crushing surface of the ceramic body, to thereby enhance steady material intake. The pins may thus extend through the cage bars and/or struts.

[0027] The ceramic body may comprise a microstructure of elongate metal pieces. The metal pieces may have

the form of a slab, rod, cylinder, needle or the like. The length of the metal pieces may vary. Good results were obtained with elongate metal pieces having a length of 0.25cm to 1.5cm, preferably 0.75cm to 1.25cm and a diameter of 0.25mm to 4mm, preferably 0.5mm to 2mm. The metal pieces are preferably of steel (e.g. of European Standard Steel Grade (EN 10027-2) No. 1.4841, 1.4828 or the like) or another temperature resistant metal. The elongate metal pieces form a mesh or grid further enhancing the tensile strength of the ceramic body. In particular the elongate metal pieces may engage with holes and/or recesses in at least one of said sheet metal rings and/or the optional ring cage and thereby enable to transmit even higher torques from the drive shaft to the ceramic body. So to speak, the reinforcement structure comprises a macro structure of first sheet metal ring(s) and optionally of the at least one second sheet metal ring and/or the ring cage. The reinforcement structure may additionally comprise a micro structure of said elongate metal pieces. The microstructure can be inserted into the ceramic body by simply adding the elongate metal pieces to a slip prior to drying and or curing the slip as explained below in more detail. The microstructure engages with macrostructure, if at least one of the elements of the macrostructure has holes and/or recesses.

[0028] As already indicated above, the crushing ring is preferably mounted with its recess on a drive shaft of roller crusher. Torque transmission between the drive shaft and the crushing ring may be obtained by at least one protrusion in the recess of the crushing ring and a complementary recess in the drive shaft (or vice versa). Favourably, the roller crusher has at least one set of two counter-rotating drive shafts, each being equipped with at least one of said crushing rings.

[0029] A roller crusher with the above described composite crushing rings enables to crush calciner fall through, although it is hot and hard. The crushed material may be provided by a pneumatic flow to almost any suited place in the cement clinker line, e.g. to a raw meal pre-heater, the calciner inlet and/or the clinker cooler and/or the kiln.

[0030] The intake of the roller crusher may be connected to a calciner fall through outlet of a calciner.

[0031] The crushing ring may be manufactured at significantly lower costs than the prior art crushing rings of cast metal. To this end the metallic reinforcement structure is positioned in a casting mould (at least the macro structure). The casting mould has the negative intended form of the crushing ring and provides space for a slip that later forms the ceramic body of the crushing ring. A slip is typically an aqueous suspension of the ceramic's raw materials, e.g. a composition comprising at least one of Silicon Carbide (SiC), Aluminum Oxide (Al_2O_3), Silicon Oxide (SiO_2) and the like.

[0032] Next the ceramic slip is inserted in the casting mould. The ceramic slip encloses the metallic reinforcement structure (more precisely the macro structure). The casting mould and/or the slip may be subjected to vibra-

tions to thereby release air bubbles. The slip may comprise elongate metal pieces for providing a micro structure which will be enclosed in the ceramic body. Preferably, the elongate metal pieces are added to the ceramic slip prior to filling in the ceramic slip into the casting mould, to thereby obtain a homogenous distribution of the elongate metal pieces in the later ceramic body.

[0033] The slip may be dried and subsequently cured and/or fired to convert it into ceramics. Depending on the heat resistance of the casting mould, the crushing ring may have to be removed prior to conversion of the dried slip into ceramics. For example, the slip may be cured at low temperatures (e.g. ambient temperature to 100°C) which are within the specification of typical casting mould materials. After curing, the semi finished crushing ring can be demoulded and subsequently subjected to heat as required for sintering the ceramics. This is what is usually referred as 'firing' the ceramics. Optionally tempering may be appropriate. Thus, the casting mould may be manufactured at a low cost, as it does not need to withstand the high temperatures as required for sintering and/or tempering the ceramic body, e.g. simple silicon moulds may be used.

[0034] The ceramic body may comprise additional aggregates to further enhance its tensile strength for example the elongate metal pieces, as explained above.

[0035] The term torque as used above describes the tendency of a force to rotate an object about an axis. Synonyms of 'torque' are moment of force or briefly moment.

Description of Drawings

[0036] In the following the invention will be described by way of example, without limitation of the general inventive concept, on an example of an embodiment with reference to the drawings.

Figure 1 shows a perspective view of a crushing ring.

Figure 2 shows a longitudinal section of the crushing ring of Fig. 1

Figure 3 shows a semi-transparent side view of the crushing ring of Fig. 1

Figure 4 shows a perspective view of the reinforcement structure of the crushing ring of Fig. 1

Figure 5 shows a perspective view of a partially assembled reinforcement structure of Fig. 4.

[0037] The preferred embodiment as shown in Fig. 1 is a crushing ring 1 with an outer ring surface 11, which is the crushing surface. The crushing surface 11 is a cylinder with a corrugated surface. The crushing ring 1 has a recess 2, being defined by the inner ring surface 14 of a ceramic body 10 and the inner ring surfaces 34 of first

sheet metal rings 30.

[0038] As can be best seen in Fig. 2 and Fig. 3, the crushing ring has a ceramic body 10 with a metallic reinforcement structure 20. The reinforcement structure 20 is depicted in Figure 4. The metallic reinforcement structure 20 is embedded in the ceramic body 10 and comprises a set of first sheet metal rings 30 (as example three first sheet metal rings are shown, other numbers are possible as well). The first sheet metal rings 30 can be cut from a sheet metal band or sheet metal plates which is much cheaper than metal casting. The former front and rear sides of the sheet metal form the axially facing front sides of the first sheet metal rings 30. The first sheet metal rings 30 may have pins 32 pointing radially away from the ring axis (as shown). The pins 32 enhance torque transfer from the first sheet metal rings 30 to the ceramic body by mainly compressive forces, i.e. low shear stress and low bending forces on the ceramic body. The inner ring surfaces 34 of the first sheet metal rings are adapted to a drive shaft. In the particular example, they are cylindrical, and have four recesses 35 (other numbers are as well possible) into which complementary protrusions of a cylindrical drive shaft may engage to transfer torque from the drive shaft to the first sheet metal rings 30. Through holes 36 may extend in axial direction through the ring surface to enhance the engagement of the first sheet metal rings 30 with the ceramic body 10.

[0039] A band of sheet metal may be bent to form a second sheet metal ring 40 with an outer ring surface 41 and an inner ring surface 44. The inner ring surface 44 may be wound around the outer ring surfaces 31 of the first sheet metal rings as can be seen in Fig. 2 to Fig. 5. The second sheet metal ring 40 may have holes into which the pins 32 of the first sheet metal rings 30 engage. Preferably, the first and second sheet metal rings 30, 40 are connected with each other by welding or the like. The second sheet metal ring 40 may have radial through holes 46 to enhance engagement of the second sheet metal ring 40 and the ceramic body 10

[0040] The structure being formed by the first and second sheet metal rings 30, 40 may be enclosed in axial direction and radially outward in a ring cage 50 as shown in Fig. 2 to Fig. 4. The ring cage 50 may be an expanded metal grille or mesh. The ring cage 50 has first cage bars 55 connecting cage rings 60. The cage rings 60 may be spaced from the first and second sheet metal rings 30, 40 but are preferably fully enclosed in the ceramic body 10 as shown in Fig. 2. The space between the cage rings 60 and the sheet metal rings 30, 40 is filled with ceramic material of the ceramic body 10. The first cage bars 55 may have a center leg 56 extending parallel to the crushing surface 11 of the ceramic body 10 (Fig. 2 and Fig. 3) and preferably (but not necessarily) in axial direction. At both sides of the center legs 56 may be side legs 57, which can be bent radially inward and which may be each connected with a cage ring 60. In other words, the first cage bars 55 may comprise a center leg 56 in between two side legs 57 which may be each angled towards the

radial direction and are attached to one of said cage rings 60. The cross section of the cage 50 along the ring axis as depicted in Fig. 2 thus resembles to two 'U's with their free ends facing radially inwards, and thus towards each other. The middle section or leg 56 of the 'U' is parallel to the crushing surface 11 and positioned in the ceramic body between the crushing surface 11 and the first and/or second sheet metal rings 30, 40. The first cage bars 55 are preferably connected by second cage bars 58, as well referred to as struts 58. These optional struts 58 extend in circumferential direction and further strengthen the ceramic body 10. Different from the figures, the pins 32 of the first sheet metal rings 30 may extend through gaps between the struts 58 of the ring cage.

List of reference numerals

[0041]

1	crushing ring	
2	recess	
3	ring axis	
10	ceramic body	
11	crushing surface	
14	inner ring surface	
20	reinforcement structure	
30	first sheet metal ring(s)	
31	outer ring surface of the sheet metal ring(s) 30	
32	pins	
34	inner ring surface of the sheet metal rings(s) 30	
35	recesses for torque transmission	
36	through holes	
40	second metal ring	
41	outer ring surface of the second metal ring 40	
42	recesses for pins 32	
44	inner ring surface of the metal ring 40	
46	through holes	
50	ring cage	
55	first cage bars (extending at least essentially in axial direction)	
56	center leg	
57	side leg	
58	strut (cage bars extending in circumferential direction)	
60	cage ring	
d_i	inner diameter of first sheet metal rings 30	
D_i	inner diameter of the ceramic body (10)	

Claims

1. A crushing ring (1), in particular for a roller crusher for crushing raw-meal fall-through of a calciner of a cement clinker line, with a crushing surface (11) for crushing bulk material and with a recess (2) for a drive shaft of the roller crusher
characterized in that,
the crushing ring (1) is a composite of at least

- a ceramic body (10), wherein the ceramic body (10) is a ring and has an outer ring surface (11) being at least a part of the crushing surface (11) and an inner ring surface (14); and
- a metallic reinforcement structure (20) being incorporated in said ceramic body (10).

2. The crushing ring of claim 1,
characterized in, that
the reinforcement structure (20) comprises at least one first sheet metal rings (30) each with an outer ring surface (31) and an inner ring surface (34) wherein the sheet metal rings (30) are axially spaced and coaxially to the ceramic body (10).
3. The crushing ring of claim 2,
characterized in that
the inner diameter (d_i) of at least one of the first sheet metal rings (30) is smaller or equal ($\leq$) to the inner diameter (D_i) of the ceramic body (10), i.e. $d_i \leq D_i$ and provides means for positive-locking with the drive shaft.
4. The crushing ring of claim 2 or 3,
characterized in, that
the reinforcement structure (20) comprises at least one second sheet metal ring (40), wherein the inner ring surface (44) of the second sheet metal ring (40) is attached to the outer ring surface (31) of the first sheet metal rings (30).
5. The crushing ring of claim 4,
characterized in, that
the first sheet metal rings (30) have pins (32) which extend radially outward through recesses (42) in the second sheet metal ring (40).
6. The crushing ring of one of claims 1 to 5
characterized in that
the reinforcement structure (20) comprises a ring cage (50) enclosing at least one of said first sheet metal rings (30), wherein the ring cage (50) comprises at least two parallel cage rings (60) which are coaxial to the ceramic body (10) and connected by cage bars (55) which extend parallel to the crushing surface (11).
7. The crushing ring of claim 6
characterized in that
the cage bars (55) comprise a centre leg (56) in between of two side legs (57), said side legs being each angled towards the radial direction and attached to one of said cage rings (60).
8. A roller crusher with at least one drive shaft,
characterized in that
the drive shaft extends through the recess (2) of the crushing ring (1) of claim 1.

9. A cement clinker line, with a kiln, a clinker cooler and a calciner, **characterized in that**,
the inlet of the roller crusher of claim 8 is connected to a raw-meal fall-through outlet of a calciner. 5
10. The cement clinker line of claim 9
characterized in that
the cement clinker line comprises a duct connecting the outlet of the roller crusher with the inlet of the calciner and/or the tertiary air duct and/or a raw meal preheater and/or the kiln and means for providing a gaseous flow through said duct to transport crushed raw meal fall trough via the duct to the calciner and/or the tertiary air duct and/or a raw meal preheater and/or the kiln. 10 15
11. Method for manufacturing a crushing ring (1) for a roller crusher, comprising at least the steps of:
- positioning a metallic reinforcement structure (20) in a casting mould providing an annular space, 20
 - filling said annular space with a ceramic slip, wherein said slip encloses the metallic reinforcement structure (20), 25
 - curing the slip thereby obtaining a semifinished composite crushing ring of the cured slip with the embedded reinforcement structure (20)
 - removing the semifinished crushing ring from said casting mould, and 30
 - heating the semifinished crushing ring to convert the cured slip into ceramics.
12. Method of claim 11
characterized in that 35
the ceramic slip comprises elongate metal pieces.

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Fig. 1

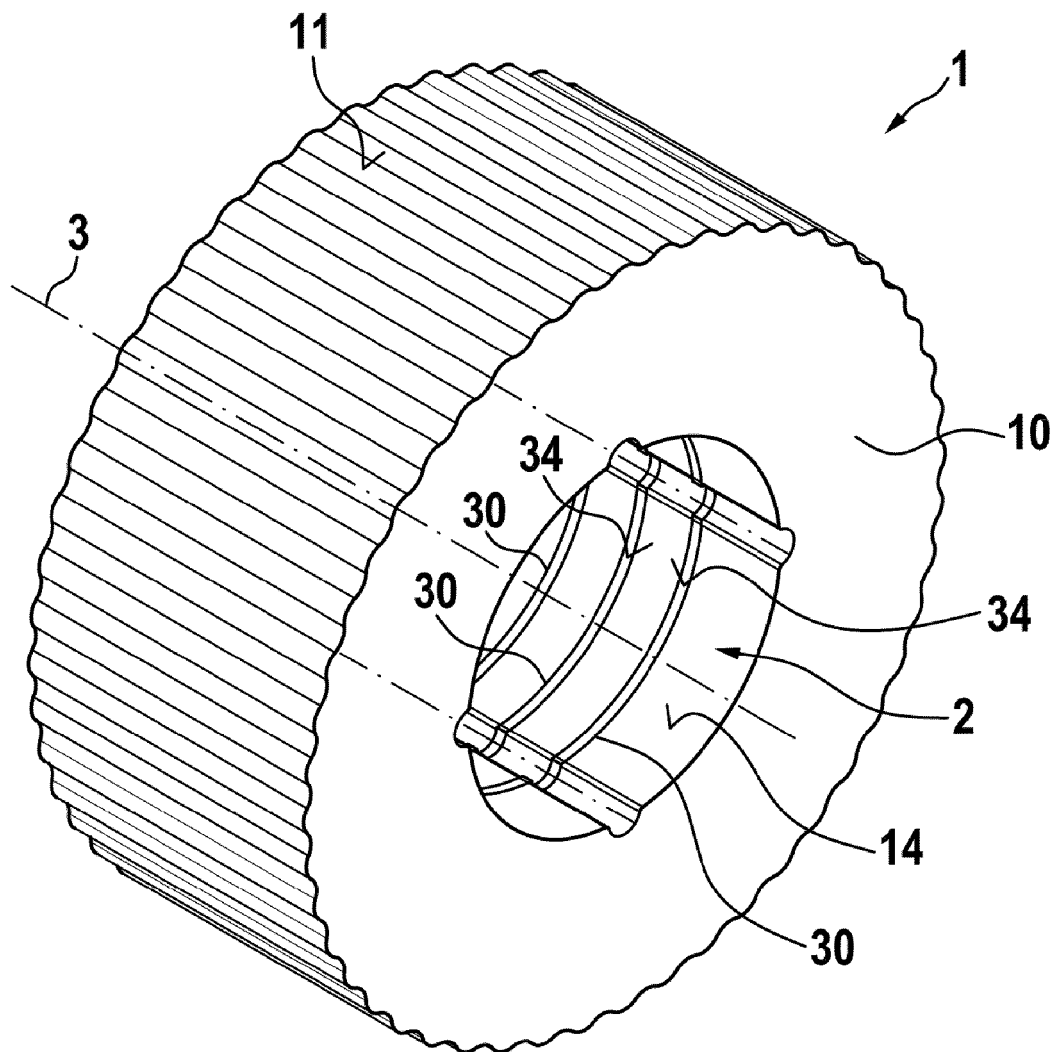


Fig. 2

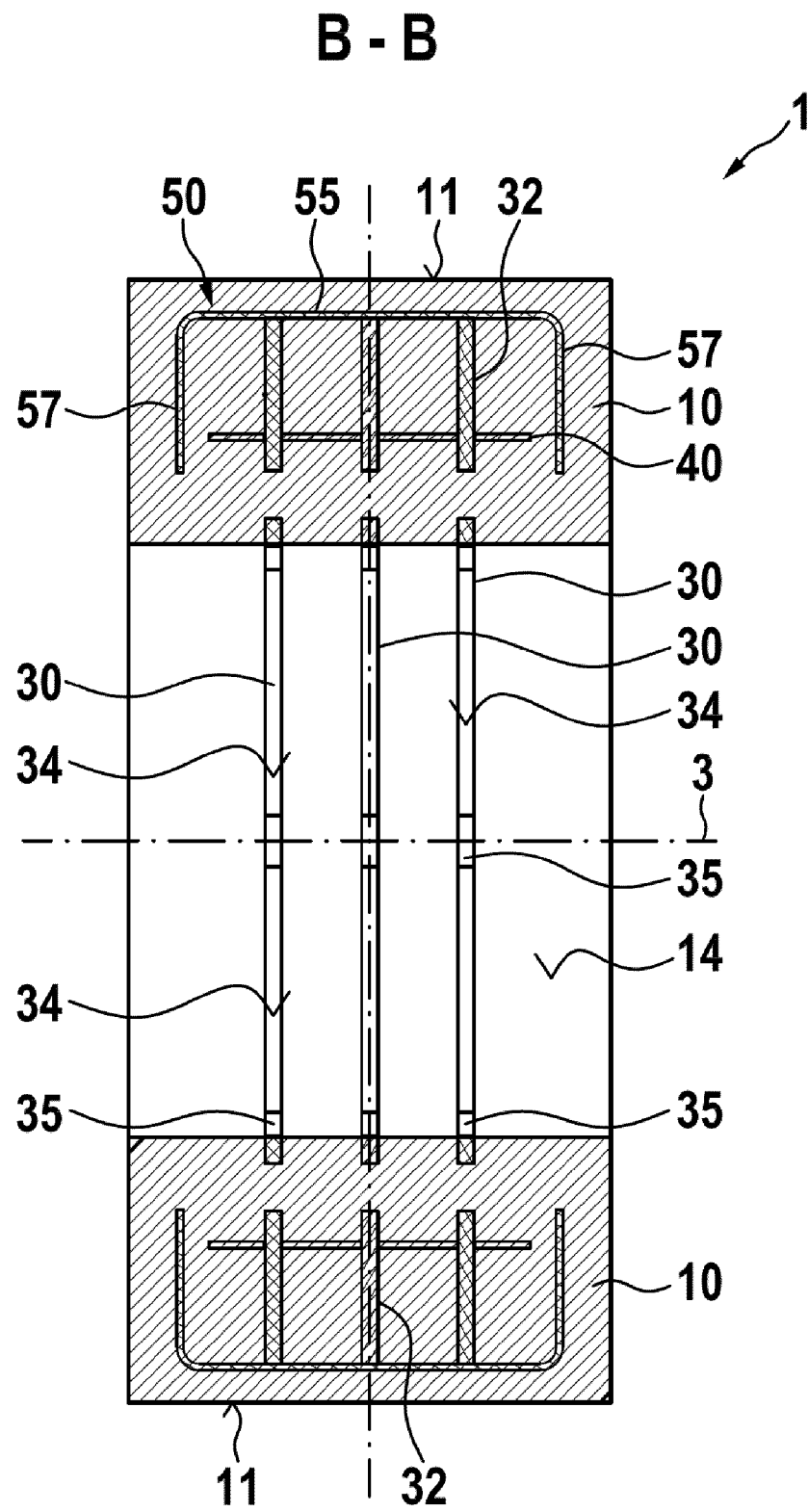


Fig. 3

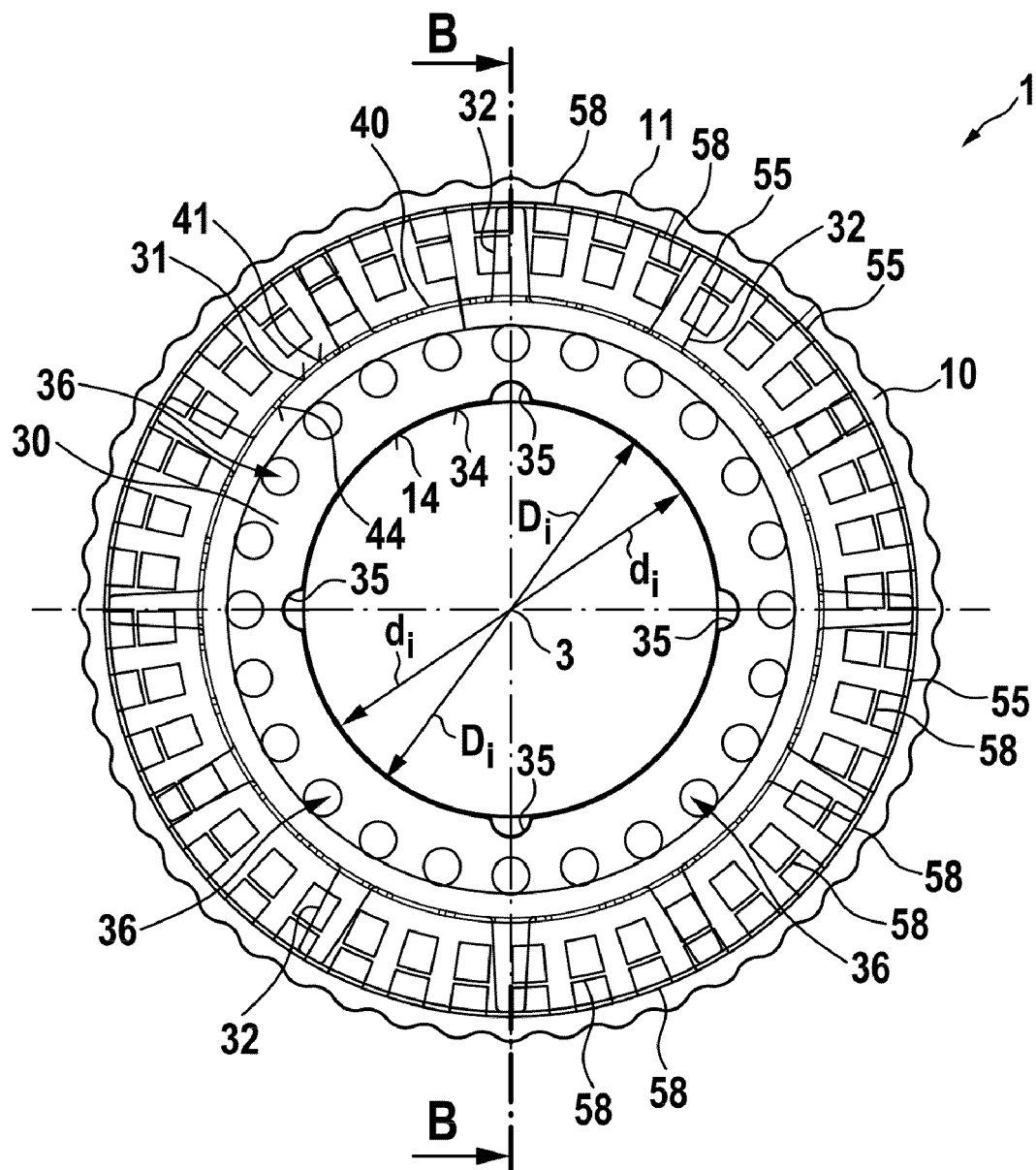


Fig. 4

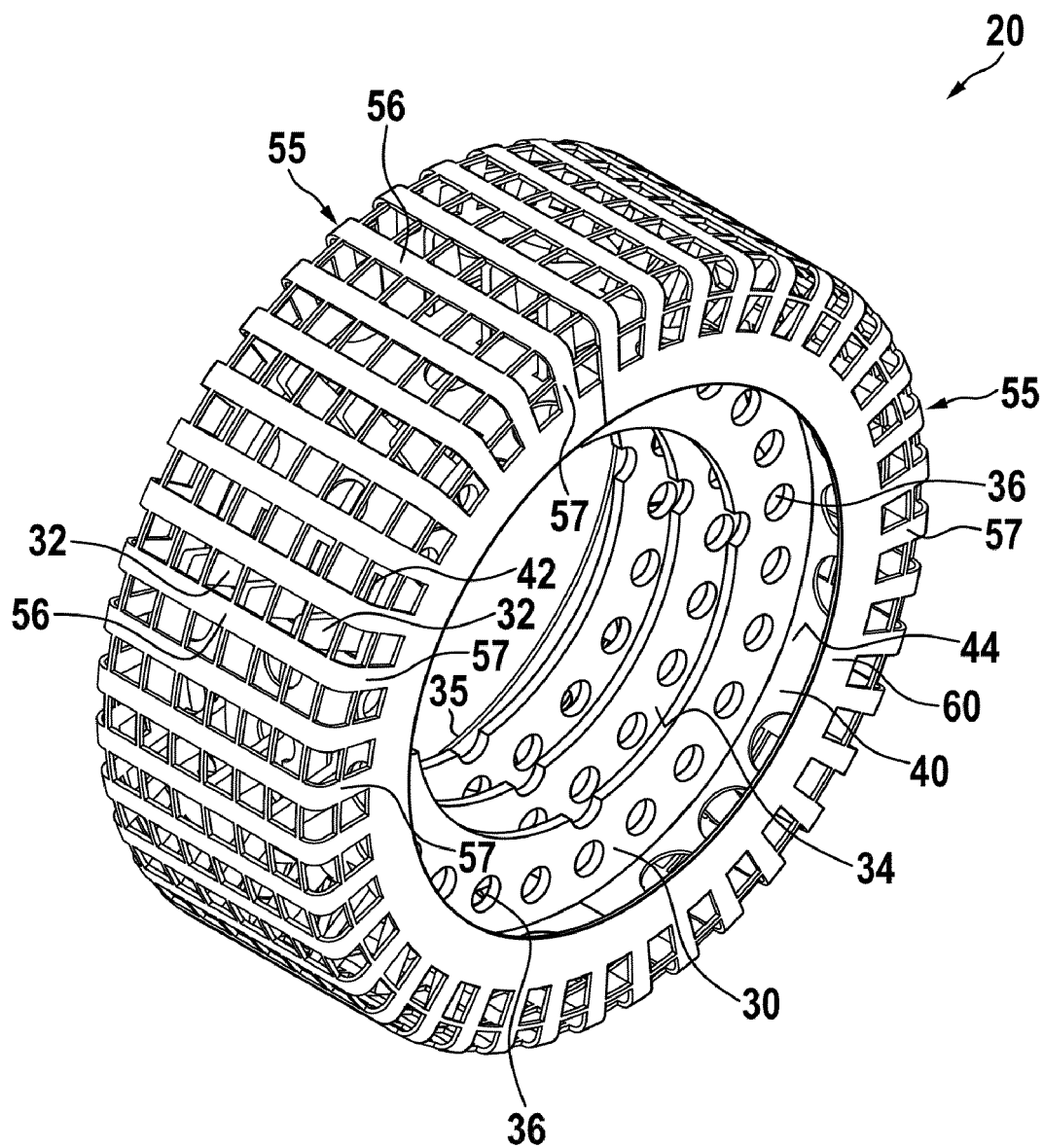
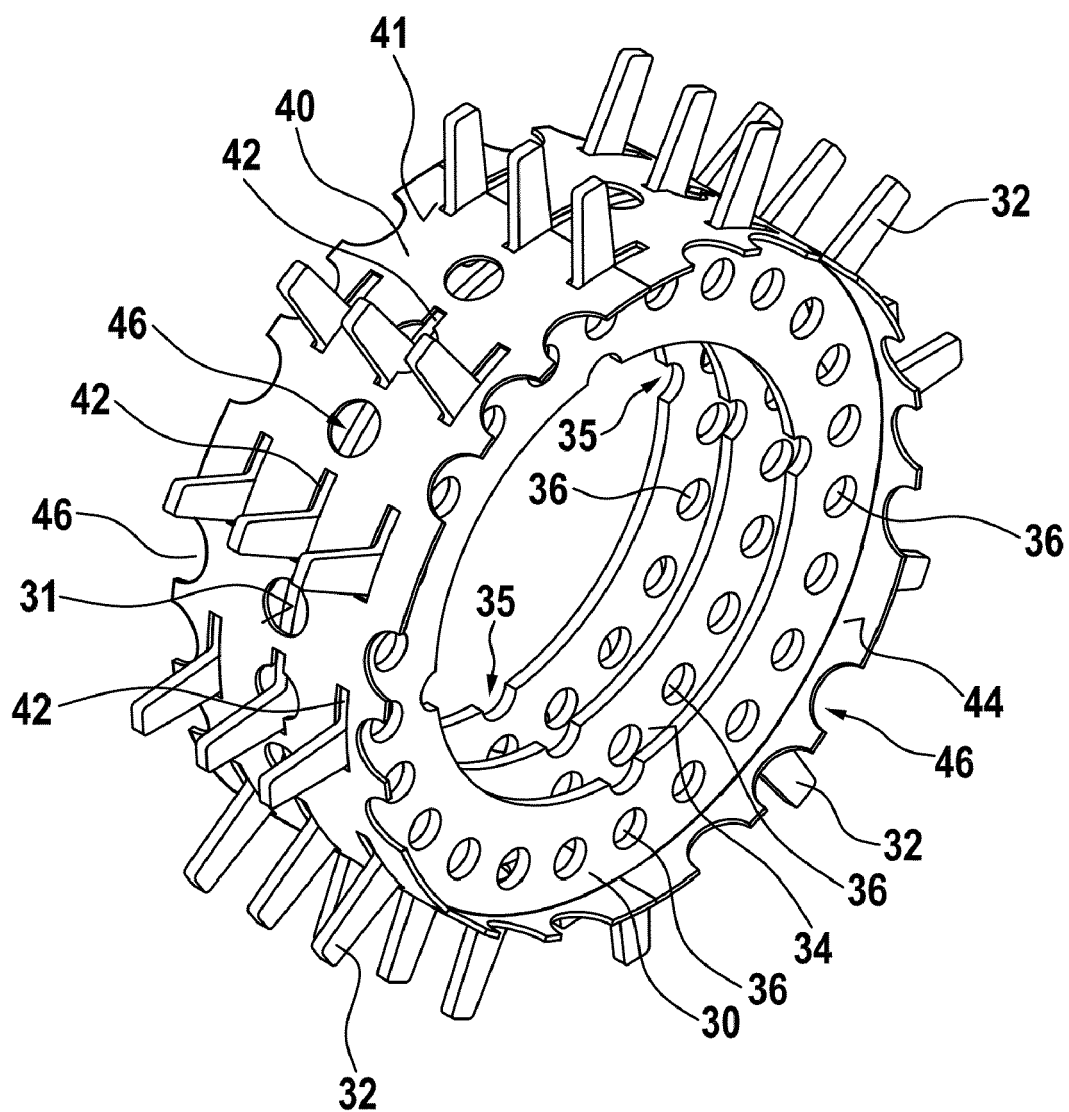


Fig. 5





EUROPEAN SEARCH REPORT

Application Number
EP 14 19 6606

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 468 408 A2 (KELLER HCW GMBH [DE]) 27 June 2012 (2012-06-27) * figure 2c *	1-12	INV. B02C15/00 B02C4/30
A	EP 1 899 070 A1 (KHD HUMBOLDT WEDAG GMBH [DE]) 19 March 2008 (2008-03-19) * the whole document *	1-12	
A	US 5 027 491 A (SIDNEY JR GEORGE L [US] ET AL) 2 July 1991 (1991-07-02) * the whole document *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			B02C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 May 2015	Examiner Kopacz, Ireneusz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 19 6606

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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