



- (51) International Patent Classification:
B04B 7/12 (2006.01) *B04B 1/04* (2006.01)
B04B 7/18 (2006.01)
- (21) International Application Number:
PCT/IB2014/059338
- (22) International Filing Date:
28 February 2014 (28.02.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
PA 2013 70118 28 February 2013 (28.02.2013) DK
- (71) Applicant: FLSMIDTH A/S [DK/DK]; Vigerslev Allé 77,
DK-2500 Valby (DK).
- (72) Inventor; and
- (71) Applicant (for AU only): GARDINER, Michael J.
[AU/AU]; 17 Dianella Place, Capalaba, queensland 4157
(AU).

(72) Inventor: CARSELDINE, Peter R.; 1210 Oakey Flat
Road, Narangba, queensland 4504 (AU).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

[Continued on next page]

(54) Title: DURABLE WALL CONFIGURATION FOR A CENTRIFUGE

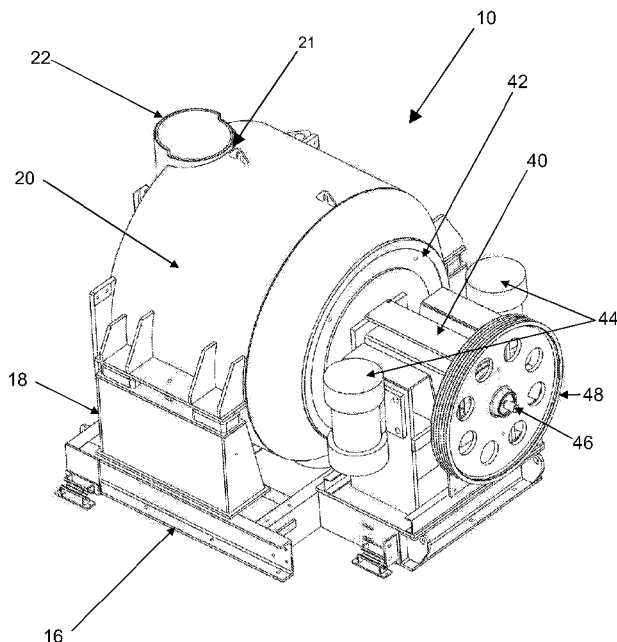


FIG. 1

(57) Abstract: A centrifuge (10) includes an inlet (22') for re-
ceiving a slurry and a basket (28) for separation of solids and
liquids from the slurry. An outlet region (34) enables chan-
nelling the solids leaving the basket (28) to an outlet chute
(32). The outlet region (34) includes: a first wall (36) com-
prising a first material and a second wall (38) comprising a
second material, the second material positioned on a high
wear area of the outlet region (34).



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

— *of inventorship (Rule 4.17(iv))*

Declarations under Rule 4.17:

Published:

— *as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii))*

— *with international search report (Art. 21(3))*

DURABLE WALL CONFIGURATION FOR A CENTRIFUGE

FIELD OF THE INVENTION

5 The present invention relates to a centrifuge. In particular, the present invention relates, but is not limited, to improved wall configurations in the outlet region of a centrifuge.

BACKGROUND TO THE INVENTION

10

Reference to background art herein is not to be construed as an admission that such art constitutes common general knowledge in Australia or elsewhere.

15 Centrifugal separators are often used for the separation of solids and liquids from slurry. For example, US patent 6,109,453 shows such a separator. Such separators are used for separating coal solids from a coal slurry that includes water. These centrifuges typically have an inlet where slurry is deposited and then conveyed to a rotational basket. The slurry next traverses the rotational basket, with the liquids being expelled outwards through the basket and the
20 solids being carried down tapered sides of the basket.

When solids reach an outermost edge of the basket, the solids leave the outermost edge of the basket at speed and strike the walls of an outlet region of the centrifuge. The solids are then channelled by the walls of the outlet region to
25 an outlet chute.

When the solids leave the outermost edge of the basket and are channelled to the outlet chute, the solids may wear and/or damage the walls of the outlet region. The walls of the outlet region of the centrifuge will typically have
30 protective tiling to help reduce this wear and/or damage. However, the protective tiling is damaged or worn more quickly in some areas of the outlet region than others, for example near the outlet chute. This increased damage and/or wear

increases maintenance costs including costs for repair and/or replacement of the protective tiles in these areas.

A portion of the inlet of the centrifuge where the inlet chute crosses the outlet region may also sustain increased damage and/or wear from the solids. For example, damage and/or wear to the inlet may cause liquids to leak through the inlet to the outlet chute impairing the function of the centrifuge. Also, the increased damage and/or wear to the inlet can increase maintenance costs because the inlet may need to be replaced regularly.

OBJECT OF THE INVENTION

It is an aim of this invention to provide an improved centrifuge which overcomes or ameliorates one or more of the disadvantages or problems described above, or which at least provides a useful alternative.

Other preferred objects of the present invention will become apparent from the following description.

SUMMARY OF INVENTION

According to a first aspect of the invention, there is provided a centrifuge, comprising

an inlet for receiving a slurry;

a basket for separation of solids and liquids from the slurry; and

an outlet region for channelling the solids leaving the basket to an outlet chute;

wherein the outlet region includes:

a first wall comprising a first material; and

a second wall comprising a second material, the second material positioned on a

high wear area of the outlet region.

Preferably, the centrifuge further comprises a shield adjacent the inlet, the shield comprising the second material.

Preferably, the second material is more durable to abrasion than the first material.

- 5 Preferably, the second material is more durable to impact than the first material.

Preferably, the second material comprises siliconised silicon carbide.

- 10 Preferably, the first wall comprises a tile of the first material and the second wall comprises a tile of the second material, the tile of the second material having a larger surface area than the tile of the first material.

Preferably, the second wall is in an area of the outlet region that is not concentrically matched to the basket.

15

Preferably, the shield is moulded to fit around the inlet.

Preferably, the basket comprises tapered sides.

- 20 Preferably, the shield defines an annular guard around the inlet.

Preferably, the first material is included in a plurality of rectangular tiles.

Preferably, the second material is included in a plurality of rectangular tiles.

25

Preferably, the first material covers a majority of a surface area of the outlet region.

- 30 Preferably, the first material is included in a plurality of tiles and the second material is included in only a single tile.

Preferably, the slurry comprises a coal slurry.

Further features and advantages of the present invention will become apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

5

By way of example only, preferred embodiments of the invention will be described more fully hereinafter with reference to the accompanying figures, wherein:

10 Figure 1 is a perspective view of a centrifuge for use with an embodiment of the invention;

Figure 2 is a side cross sectional view of the centrifuge illustrated in figure 1;

15 Figure 3 is a perspective view of the centrifuge illustrated in figure 1 showing the drive components of the centrifuge;

Figure 4 is a perspective view of a lower internal portion of the separation housing of a centrifuge, for example the centrifuge illustrated in figure 1.

20

Figure 5 is a perspective view of an upper internal portion of the separation housing of the centrifuge illustrated in figure 4.

DETAILED DESCRIPTION OF THE DRAWINGS

25

Figures 1, 2 and 3 illustrate a centrifuge 10 to which the present invention may be applied.

Figure 1 shows a centrifuge 10 having a separation housing 20 mounted to a
30 base 16. The separation housing 20 has an inlet in the form of a chute 22 by which material to be separated, such as slurry, is conveyed inside the separation housing 20.

Figure 2 illustrates the internal components of the centrifuge, particularly of the separation housing 20. An inlet end 22' of the inlet chute 22 sits in a rim 21 of the separation housing 20. The rim 21 is typically semi-circular. Within the separation housing 20, the inlet chute 22, comprising the inlet end 22' and an outlet end 22'', conveys the material to be separated from a source (not shown) to a separation screen in the form of a rotating basket 28. The basket 28 has a circular cross-section and is tapered such that the radius of the circular cross-section increases from where the material enters the basket to an outermost edge of the basket 28'.

The separation housing 20 has a liquid outlet 30 which allows material separated by the centrifuge 10, namely material that passes through apertures in the basket 28, to be removed from the centrifuge 10. An outlet chute 32, adjacent to an outlet region 34, allows the solids that do not pass through the apertures in the basket 28 to also be removed from the centrifuge 10. The basket 28 is engaged with, and rotates with, a drive shaft 46.

Figure 3 illustrates the drive portion of the centrifuge 10. The drive shaft 46 is rotated by a drive pulley 48 driven by an external power source in the form of a drive motor 60 mounted on the base 16. The drive motor 60 has a drive wheel 62 which engages with a belt 64 which engages with the drive pulley 48 such that rotation of the drive wheel 62 rotates the drive pulley 48, which in turn rotates the drive shaft 46 that is fixed to the centre of the drive pulley 48. The drive portion also has unbalanced motors 44 which provide an axial vibration to the basket 28.

During operation of the centrifuge 10, a material to be separated, such as slurry being a combination of solids and liquids, is fed into the inlet end 22' of the inlet chute 22 where it is conveyed to the outlet end 22'' inside the basket 28. The material to be separated then hits the sides of the basket 28, which has apertures. Rotation of the basket 28 applies "centrifugal force" to the material. The centrifugal force causes the liquid component of the slurry to pass through the apertures in the basket 28, while the solid component cannot.

The liquids, which are usually undesirable, are then drained down the liquid outlet 30 for further processing and/or disposal. The solid component, which cannot pass through the basket 28, traverses the inclined walls of the basket 28 under centrifugal force. The axial vibration provided by the unbalanced motors 44
5 assists in movement of the solids axially along basket 28 and prevents, or at least minimises, build up of solid material on the inner surface of the basket 28. When the material reaches the outermost edge 28', it primarily comprises the solid component of the material as the liquid component has been removed. Some of the solids may leave the outermost edge 28' of the basket 28
10 tangentially and retain much of the velocity they had while being rotated in the basket 28.

Figure 4 shows the outlet region 34 of the centrifuge 10 where solids leaving the outermost edge 28' of the basket 28 will be captured and channelled to an outlet
15 chute 32. The outlet region 34 is coaxial to the basket 28 and has a substantially circular cross-section of larger radius than the outermost edge 28' of the basket 28. The substantially circular cross-section of the outlet region 34 is concentric with the circular cross-section of the basket 28 around most of the circumference of the outermost edge 28' of the basket 28. This concentric matching allows the
20 solids that leave the outermost edge 28' tangentially to impact the walls of the outlet region 34 at a shallow angle of incidence. These solids are then channelled along the inner walls of the outlet region 34 to the outlet chute 32, where they are then removed from the centrifuge 10.

25 The outlet region 34 comprises a first wall 36 comprising a first material to protect the outlet region 34 from wear, such as by abrasion and/or impact from the solids. For example, the first material may be alumina or another suitably durable material. The first material may be in the form of tiles as illustrated in figure 4. These tiles are typically rectangular, though other shapes are also envisioned.
30 The first material may cover a majority of a surface area of the outlet region 34.

The outlet region 34 comprises a second wall 38 comprising a second material. The second wall 38 is in a high wear area of the outlet region 34 where prior art

centrifuges that do not include the second material have shown increased tile wear or damage. The second material is used on the second wall 38 to protect the outlet region 34 from damage and/or wear. For example, the second wall 38 may be in an area of the outlet region 34 where the outlet region 34 is not concentrically matched to the outermost edge 28' of the basket 28.

The second material may be siliconised silicon carbide or another suitably abrasion and/or impact durable material. The second material may be in the form of a single large tile or a plurality of smaller tiles, though other forms are also envisioned. The tiles of the second material are typically rectangular, though other shapes are also envisioned.

Figure 5 shows the rim 21 where the inlet chute 22 is mounted on the centrifuge 10. A shield 23 is provided adjacent the inlet chute 22 to protect the inlet chute 22 from abrasion or impact from the solids. The shield 23 may be moulded to fit around the inlet chute 22 and define an annular guard around the inlet. The shield 23 may also comprise the second material to make the shield 23 more durable to wear, for example by abrasion and/or impact.

The second material may be more durable to impact than the first material to better protect the second wall and/or the inlet chute from heavy abrasion and/or impact.

The first wall 36 will usually be tiled with tiles of the first material. The second wall 38 will usually be tiled with a single tile or multiple tiles of the second material. The tile or tiles of the second material on the second wall 38 will usually have a larger surface area than the tiles of the first material on the first wall 36. The larger surface area of the tiles of the second material on the second wall 38 helps to minimise joins or spaces between the tiles where, in some circumstances, heavy abrasion and/or impact of the solids can chip the edges of the tiles or erode under the tiles and strip the tiles off the second wall 38. Smaller surface area tiles of the first material are usually more appropriate for the first wall 36 for

simplicity and to allow the tiling to more easily conform to the shape of the outlet region 34.

5 The centrifuge 10 and the workings of the centrifuge 10 described herein are provided merely as an example of a centrifuge to which the invention of the claims may be applied. The specification does not suggest that the invention of the claims is limited to or applies only to this centrifuge.

10 In this specification, adjectives such as first and second, and the like may be used solely to distinguish one element or action from another element or action without necessarily requiring or implying any actual such relationship or order. Where the context permits, reference to an integer or a component or step (or the like) is not to be interpreted as being limited to only one of that integer, component, or step, but rather could be one or more of that integer, component,
15 or step etc.

The above description of the present invention is provided for purposes of description to one of ordinary skill in the related art. It is not intended to be exhaustive or to limit the invention to a single disclosed embodiment. As
20 mentioned above, numerous alternatives and variations to the present invention will be apparent to those skilled in the art of the above teaching. Accordingly, while some alternative embodiments have been discussed specifically, other embodiments will be apparent or relatively easily developed by those of ordinary skill in the art. The invention is intended to embrace all alternatives,
25 modifications, and variations of the present invention that have been discussed herein, and other embodiments that fall within the spirit and scope of the above described invention.

In this specification, the terms 'comprises', 'comprising', 'includes', 'including', or
30 similar terms are intended to mean a non-exclusive inclusion, such that a method, system or apparatus that comprises a list of elements does not include those elements solely, but may well include other elements not listed.

Claims

1. A centrifuge comprising:
 - an inlet (22') for receiving a slurry;
 - 5 a basket (28) for separation of solids and liquids from the slurry; and
 - an outlet region (34) for channelling the solids leaving the basket to an outlet chute (32);wherein the outlet region (34) further comprises:
 - a first wall (36) comprising a first material; and
 - 10 a second wall (38) comprising a second material, the second material positioned on a high wear area of the outlet region (34).
2. The centrifuge of claim 1 further comprising:
 - a shield (23) adjacent the inlet, the shield (23) further comprising the second
 - 15 material.
3. The centrifuge of claim 1 or 2, wherein the second material is more durable to abrasion than the first material.
- 20 4. The centrifuge of any of the preceding claims, wherein the second material is more durable to impact than the first material.
5. The centrifuge of any of the preceding claims, wherein the second material comprises siliconised silicon carbide.
- 25 6. The centrifuge of any of the preceding claims, wherein the first wall (36) further comprises a tile of the first material and the second wall (38) comprises a tile of the second material, the tile of the second material having a larger surface area than the tile of the first material.
- 30 7. The centrifuge of any of the preceding claims, wherein the second wall (38) is in an area of the outlet region (34) that is not concentrically matched to the basket (28).

8. The centrifuge of claim 2, wherein the shield (23) is moulded to fit around the inlet.

5 9. The centrifuge of any of the preceding claims, wherein the basket comprises tapered sides.

10. The centrifuge of claim 2, wherein the shield (23) defines an annular guard around the inlet.

10

11. The centrifuge of any of the preceding claims, wherein the first material is included in a plurality of rectangular tiles.

12. The centrifuge of any of the preceding claims, wherein the second material is
15 included in a plurality of rectangular tiles.

13. The centrifuge of any of the preceding claims, wherein the first material covers a majority of a surface area of the outlet region.

20 14. The centrifuge of claim 1, wherein the first material is included in a plurality of tiles and the second material is included in only a single tile.

15. The centrifuge of any of the preceding claims, wherein the slurry comprises a coal slurry.

25

1/5

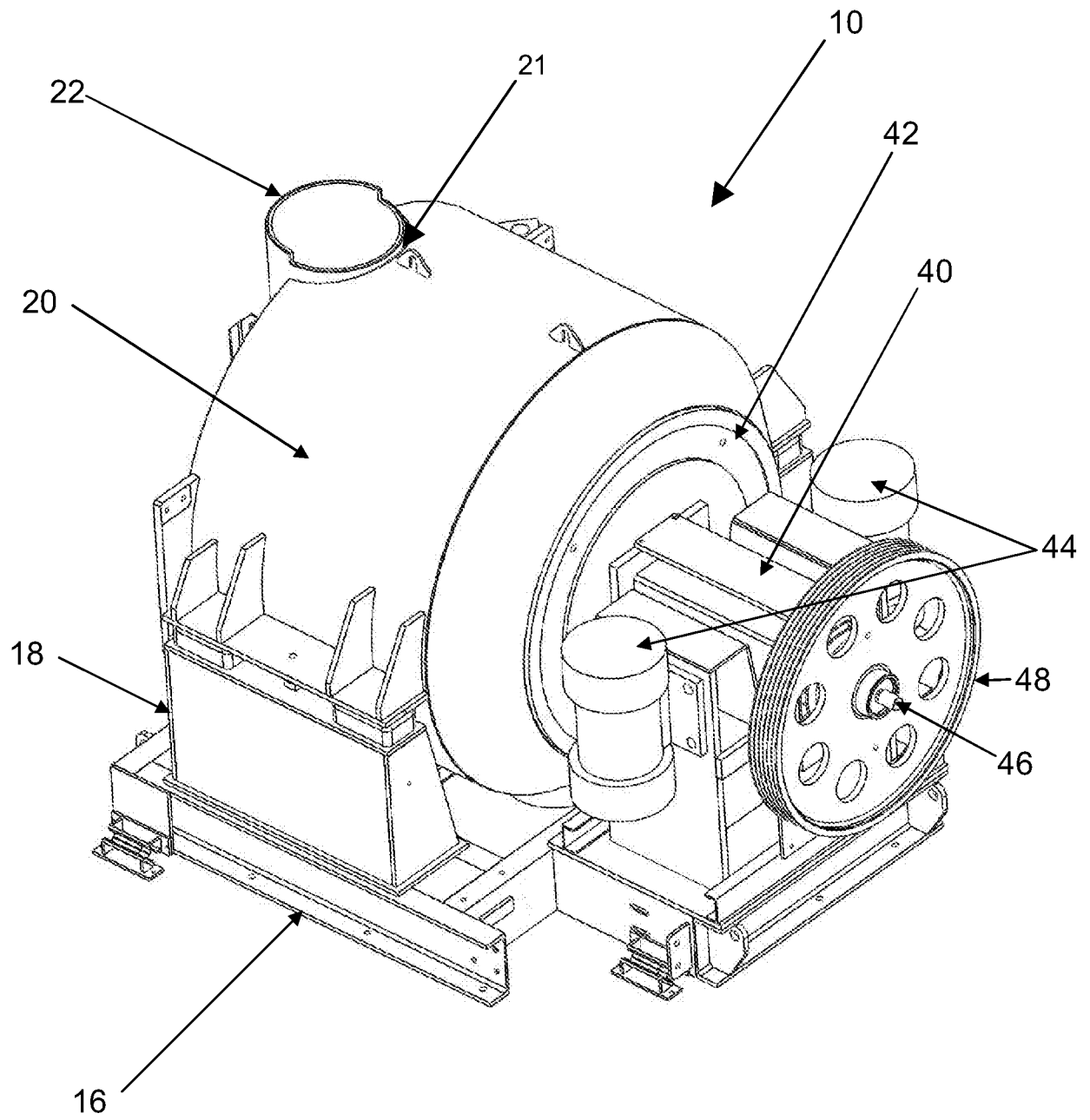


FIG. 1

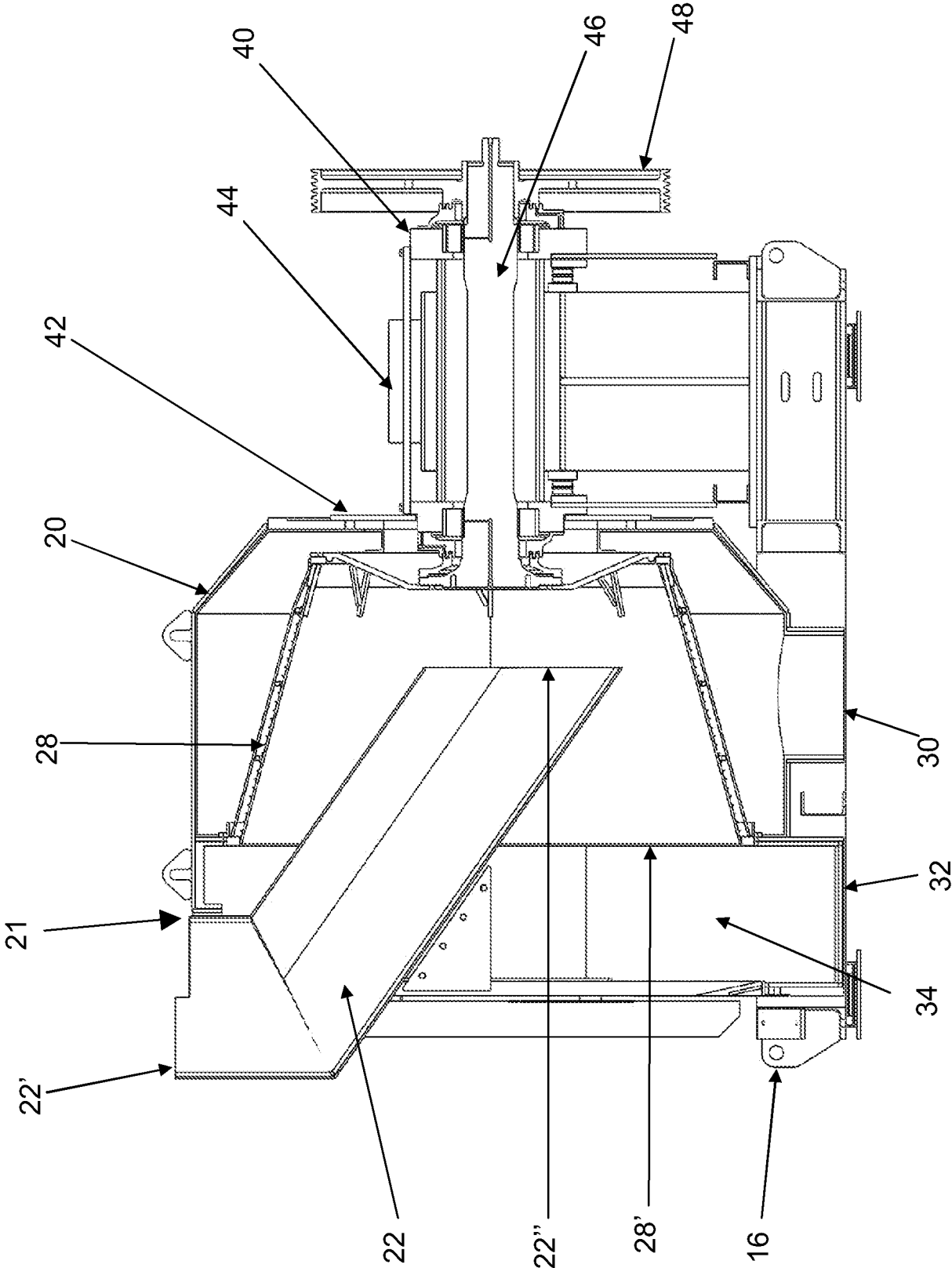


FIG. 2

3/5

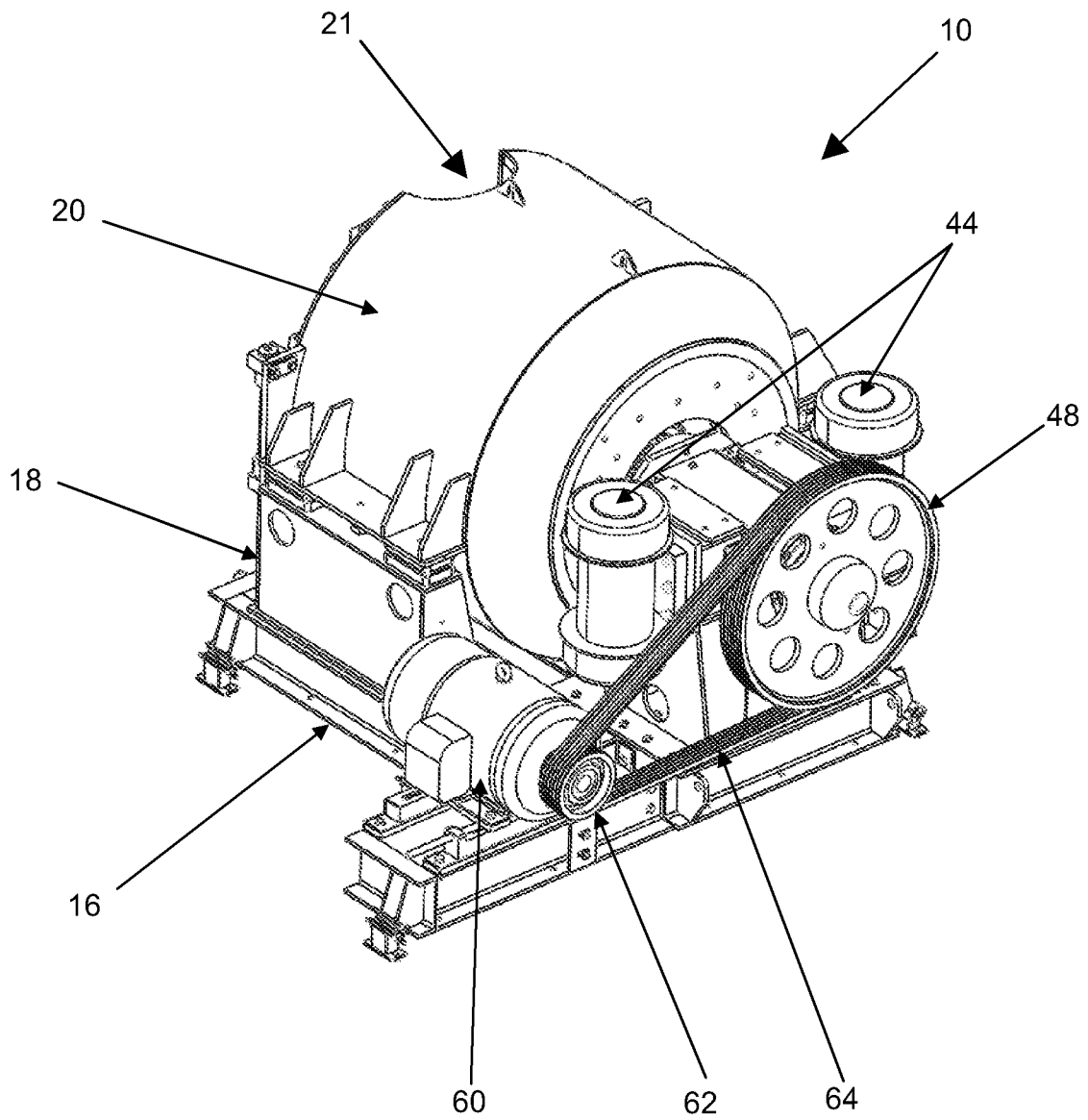


FIG. 3

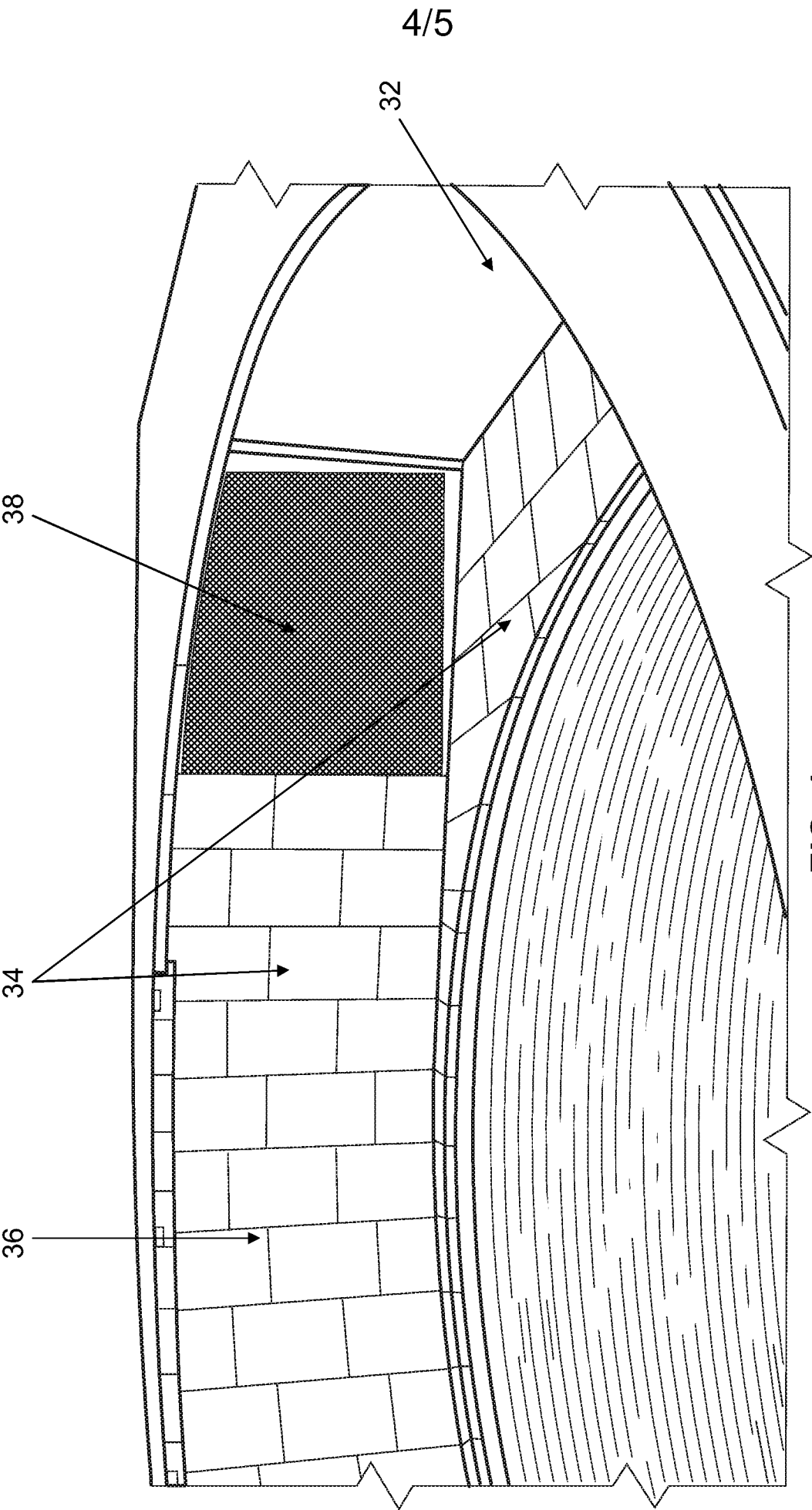
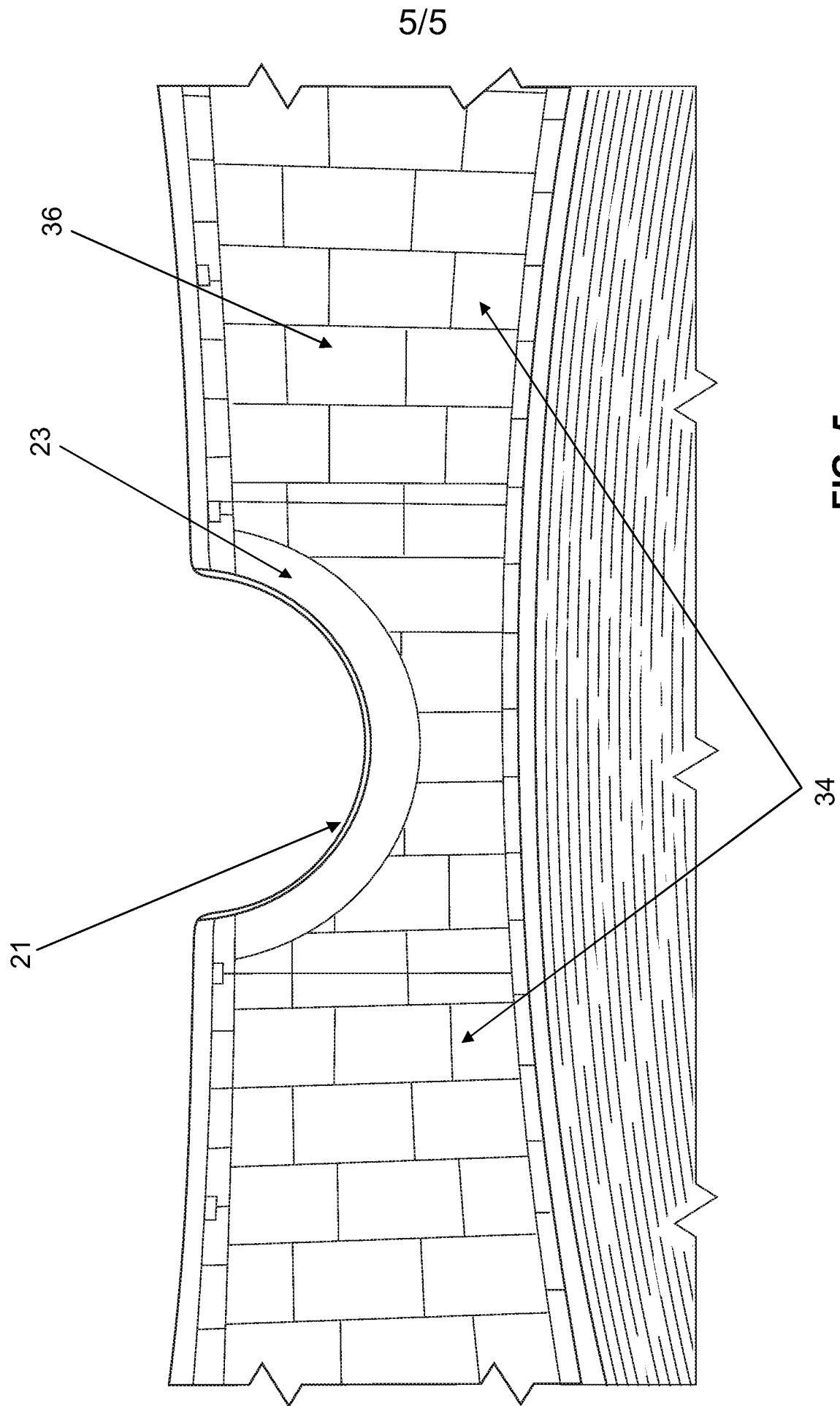


FIG. 4



INTERNATIONAL SEARCH REPORT

 International application No.
PCT/IB2014/059338

A. CLASSIFICATION OF SUBJECT MATTER

B04B 7/12 (2006.01) B04B 7/18 (2006.01) B04B 1/04 (2006.01)

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)

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 practicable, search terms used)

TXTAU1, TXTCA1, TXTEP1, TXTGB1, TXTSG1, TXTUS0, TXTUS1, TXTUS2, TXTUS3, TXTUS4, TXTUS5, TXTWO1, WPI, EPODOC; IPC and CPC marks: B04B7/LOW, B04B1/04, B04B1/2008 using keywords such as: basket, wear, resistant, slurry, tile and their similar keywords. Also Google Patents, Espacenet were searched using keywords such as: centrifuge, bowl, tile, coal, silicon carbide and their similar keywords.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 13 June 2014		Date of mailing of the international search report 13 June 2014	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaaustralia.gov.au		Authorised officer Abdulla Al-Motin AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262837965	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/IB2014/059338
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6033564 A (KIRKER et al.) 07 March 2000 (Abstract, claims, figures 6-20)	1-4, 6-7 and 11-15
Y	(Abstract, claims, figures 6-20)	5
X	US 5380434 A (PASCHEDAG) 10 January 1995 (Abstract; figures 1-4; column 6, line 39-column 7, line 45; claims)	1-4 and 6-15
Y	(Abstract; figures 1-4; column 6, line 39-column 7, line 45; claims)	5
Y	US 5429581 A (MICHAUD et al.) 04 July 1995 (Abstract, column 5, line 39-column 6, line 53).	5

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/IB2014/059338	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 6033564 A	07 March 2000	AU 5100999 A	01 Feb 2000
		EP 1097000 A1	09 May 2001
		EP 1097000 B1	15 Nov 2006
		WO 0002663 A1	20 Jan 2000
		US 6312610 B1	06 Nov 2001
US 5380434 A	10 January 1995	None	
US 5429581 A	04 July 1995	AU 1346795 A	14 Sep 1995
		CA 2143704 A1	08 Sep 1995
		EP 0746518 A1	11 Dec 1996
		JP H09509916 A	07 Oct 1997
		WO 9524352 A1	14 Sep 1995
End of Annex			