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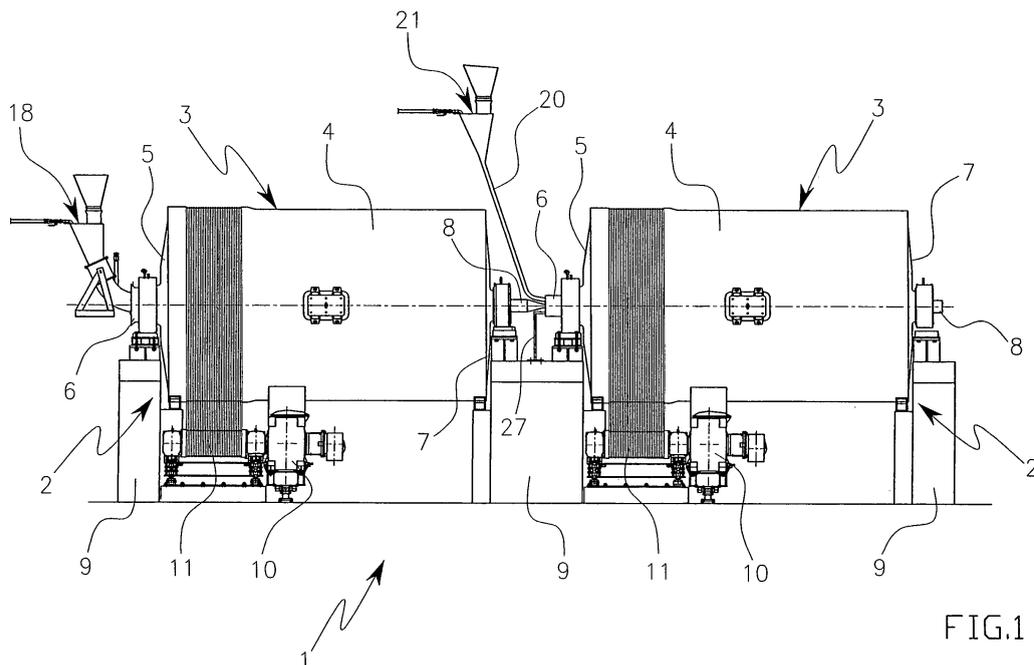
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(54) **Connection system between in-series, continuous mills of a milling plant**

(57) A milling plant (1) comprising a plurality of continuous mills (2) provided with a loading mouth (6) of the material and a discharge mouth (8) of the casting slip, which are placed in series by means of a connection body (19) which, associated with an input device (20, 21), connects the discharge mouth of one mill with the loading mouth of the contiguous mill. Said connection body (19)

comprises a connection disk (22), which is coaxially inserted within the loading mouth (6) and is provided with two distinct through holes, including a first central through hole within which the discharge mouth (8) is coaxially inserted, and a second hole connected to the input device (20, 21); both discharge (8) and loading (6) mouths being rotatably associated with said connection disk (22), which is fixed in rotation by constraining means (27).



Description

[0001] The present invention generally refers to a milling plant particularly even if not exclusively intended to be employed in the preparation of ceramic mixtures. Such mixtures, indeed, are generally prepared by means of the moist pulverisation of the raw materials (silica, feldspar, clay) and the addition of specific additives, until a homogenous casting slip having the desired granulometry of the powders in suspension.

[0002] As is known, one such plant normally comprises at least one grinding mill, which is provided with a rotating cylinder, at whose interior the pulverisation operation of the raw materials is carried out by the collisions, and in any case mutual actions, between the raw materials themselves and a set of generally spherical grinding bodies.

[0003] The known grinding mills are subdivided into continuous and discontinuous mills, according to which the steps of loading the material inside the rotating cylinder and discharging of the casting slip occur in a continuous manner during the operation of the mill, or in discontinuous manner, requiring the temporary interruption of the productive process and the stopping of the rotating cylinder.

[0004] The present invention refers in particular to a milling plant comprising mills of continuous type.

[0005] According to the prior art in the ceramics field, the process of pulverisation of the raw materials foresees a set of successive steps, beginning with a crushing step and ending with a refining step. For the different steps, the grinding bodies must have different and decreasing sizes passing from the crushing to the refining and, consequently, for each of said steps there exists a rotation speed of the rotating cylinder which optimises the processing effectiveness, the execution time and the energy consumption of the grinding mill.

[0006] For these reasons, plants are known comprising a plurality of continuous grinding mills placed in series, in which the rotating cylinder of each mill contains the grinding bodies, and is adapted to rotate at a speed independent from the others in order to be able to execute in optimal manner one of the aforementioned steps of the pulverisation process.

[0007] A similar plant is described in detail in the Italian patent application RE2003A000013 by the same applicant, to whose text one may refer for additional details.

[0008] In particular, each rotating cylinder of the aforementioned plant is provided with a loading mouth of the material to be processed and a discharging mouth of the casting slip which, fixed on opposite parts of the cylinder and arranged along the rotation axis of the same, are adapted to rotate integral with it, facilitating the continuous advancement of the input material and output casting slip.

[0009] Furthermore, the discharge mouth of an intermediate rotating cylinder is connected to the loading mouth of the successive cylinder by means of a tubular

connection element, which is in turn associated with an input device adapted to introduce grinding bodies and appropriate additives (for example colorants) directly inside the downstream cylinder.

[0010] One drawback of these known plants lies in the fact that said tubular connection element, unlike the discharge and loading conduits which rotate integral with the respective rotating cylinders, must be integral with the input device and, consequently, fixed.

[0011] For this reason, the material which advances between one rotating cylinder and the next, when crossing the connection element, tends to stop, blocking the connector itself and thus compromising the operation of the entire plant.

[0012] Object of the present invention is that of overcoming the mentioned drawback, within the scope of a simple, rational solution with limited cost.

[0013] Such object is realised by means of a continuous milling plant comprising a plurality of continuous mills provided with a loading mouth of the material and a discharge mouth of the casting slip, which are placed in series by means of a connection body which, associated with an input device, connects the discharge mouth of one mill with the loading mouth of the subsequent mill.

[0014] Said connection body comprises a connection disk, which is coaxially inserted inside the loading mouth and is provided with two distinct through holes, including a first central hole within which the discharge mouth is coaxially inserted, and a second hole which is connected to the input device.

[0015] In particular, both the loading and discharge mouths are rotatably associated with the aforementioned connection disk which, in turn, is fixed by means of appropriate constraining means.

[0016] Thanks to this solution, the discharge mouth of the upstream mill may lead directly inside the loading mouth of the downstream mill, and the material which passes between the two mills, as with that fed by the input device, may therefore advance without encountering difficulties.

[0017] In accordance with the invention, so that the discharge mouth of the upstream mill and the loading mouth of the downstream mill are free to rotate with respect to the connection disk, the connection body comprises two additional coaxial rings, respectively inner and outer, of which the inner ring is inserted in the central hole of the connection disk, while the outer ring encircles the connection disk itself. In particular, the inner ring is intended to be inserted and locked on the discharge mouth, while the outer ring is intended to be inserted and locked within the loading mouth.

[0018] According to the invention, between each ring and the connection disk sealing means are interposed, adapted to advantageously avoid that losses of material occur by the milling plant.

[0019] According to an embodiment of the invention, during the rotation of the mills, said inner and outer rings are adapted to rotate, sliding along connection disk, and

therefore may be realised with a material with a low friction coefficient.

[0020] An additional embodiment of the invention foresees, finally, that said inner and outer rings were respectively substituted by an inner rolling bearing and an outer rolling bearing, of which the first bearing has the inner ring integral with the discharge mouth and the outer ring integral with the connection disk, while the second bearing has the inner ring integral with the connection disk and the outer ring integral with the loading mouth. In this case, in order to ensure the sealing of the plant, it may be foreseen that said bearings are provided with sealing means.

[0021] Further characteristics and advantages of the invention will be clear from the reading of the following description provided as exemplifying and not limiting, with the aid of the figures illustrated in the attached tables, in which:

- figure 1 shows a schematic view of the continuous milling plant according to the invention;
- figure 2 shows a detail of figure 1 in longitudinal section.

[0022] With reference to the attached figures, the milling plant of the present invention, indicated in its entirety with 1, comprises a plurality of continuous mills 2 placed in series.

[0023] Each mill 2 comprises a rotating cylinder 3, which is formed by a horizontal axis cylindrical body 4, closed at one end by a first bottom 5 provided with an axial mouth 6 for the loading of the material, and closed at the opposite end by a bottom 7 provided with an axial mouth 8 for the discharging of the casting slip.

[0024] The rotating cylinder 3 is supported at each of the ends by a suitable structure 9, and is operated by an appropriate control system 10 through a belt system 11.

[0025] Inside the rotating cylinder 3, a grinding chamber is defined, at whose interior both the grinding bodies and the raw materials which compose the casting slip are fed, or rather essentially water, silica, feldspar and clay. The grinding bodies are typically in silica or aluminium and during the operation of the plant are worn until they are mixed with the casting slip being processed.

[0026] In figure 1 it is seen that the first upstream continuous mill 2 is provided with a *per se* known normal loading system 18 of the raw materials, and that the loading mouth 6 of the second mill, and possible subsequent mills, is connected both to the discharge mouth 8 of the preceding mill and to an input conduit 20 which is associated with an additional loading device 21.

[0027] Advantageously, said input conduit 20 permits separately reintegrating the grinding bodies for each of the continuous mills 2 and separately introducing materials, or water, constantly permitting mixture correction and thus guaranteeing an optimal composition.

[0028] Each of the continuous mills 2 of the milling plant 1, being operatively independent from the others, is sized

and optimised in geometric terms, in the dimensions of the grinding bodies as well as in the rotation speed, for the specific pulverisation step to which it is assigned, and the processing casting slip continuously passes from one rotating cylinder 3 to the next without interrupting the process, until the desired granulometry of the powders in suspension is obtained.

[0029] In detail, as illustrated in figure 2, the release of the refined casting slip from the operative chamber of a rotating cylinder 3 is assigned to normal *per se* known means 13 which, therefore, are not described further. Nevertheless, it should be underlined that, despite the fact that said release means 13 are adapted to advance the casting slip towards the rotating cylinder 3 placed downstream, such advancement is also permitted, and therefore made effective, by the rotation of the discharge mouth 8 and the loading mouth 6, which are integral with respective rotating cylinders 3.

[0030] As illustrated in figure 2, the discharge mouth 8 and the input conduit 20 have a terminal section of decidedly lesser size with respect to the loading mouth 6, such that both may be partially inserted inside the latter, where they are coupled to a connection body 19 comprising a connection disk 22 and two rotating rings, respectively inner 23 and outer 24, which are coaxial and coplanar to said connection disk 22.

[0031] In detail, the connection disk 22 is contained inside the outer ring 24, and is provided with a first central hole of circular form, within which the inner ring 23 is inserted.

[0032] Between each inner 23 and outer 24 ring, and the connection disk 22, a sealing ring is interposed, respectively 25 and 26, which is engaged in a corresponding seat made on the surface of the disk 22, facing the respective outer 23 or inner 24 ring.

[0033] As may be inferred from figure 2, the outer ring 24 of the connection organ 19 is coaxially inserted and locked inside the loading mouth 6, while the inner ring 23 is inserted and locked on the discharge mouth 8, such that this leads directly inside the loading mouth 6.

[0034] On the other hand, the connection disk 22 is fixed to the support structure 9 by means of a support bar 27, and is provided with a second through hole, distinct from the first central hole, within which the terminal section of the input conduit 20 is engaged, so that it too leads directly into the loading conduit 6.

[0035] During the operation of the plant 1, said connection disk 22 is therefore fixed with respect to the discharge 8 and loading 6 mouths, which may rotate independently from each other thanks to the inner 23 and outer 24 rings, thus permitting both the passage of the material between the rotating cylinders 3 and the feeding of new grinding bodies and additives through the input conduit 20.

[0036] In accordance with a particular embodiment of the invention, the discharge 8 and loading 6 mouths may be conical, for example both diverging in the advancing direction of the material, in order to further facilitate the

downflow of the same. In this case, correspondingly, it is foreseen that the inner side surface of the ring 23 and the outer side surface of the ring 24 are also conical and, in particular, have the same taper respectively of the discharge conduit 8 and the loading conduit 6, so to be perfectly coupled with them

[0037] Of course, there may be modifications or improvements to the plant thus described, suggested by contingent or particular motivations, without departing from the scope of the invention as claimed below.

Claims

1. Milling plant (1) comprising a plurality of continuous mills (2) provided with a loading mouth (6) of the material and a discharge mouth (8) of the casting slip, which are placed in series by means of a connection body (19) which, associated with an input device (20, 21), connects the discharge mouth (8) of one mill with the loading mouth (6) of the contiguous mill, **characterised in that** said connection body (19) comprises a connection disk (22), which is coaxially inserted within the loading mouth (6) and is provided with two distinct through holes, including a first central through hole within which the discharge mouth (8) is coaxially inserted, and a second hole connected to the input device (20, 21); both discharge (8) and loading (6) mouths being rotatably associated with said connection disk (22), which is fixed in rotation by constraining means (27).
2. Plant (1) according to claim 1, **characterised in that** said connection body (19) comprises two rotating rings (23, 24), coaxial with the connection disk, including an outer ring (24) which encircles the connection disk (22) and an inner ring (23) which is inserted inside the central hole of the connection disk (22) itself; the inner ring (23) being in turn inserted and locked on the discharge mouth (8), while the outer ring (24) being inserted and locked within the loading mouth (6).
3. Plant (1) according to claim 2, **characterised in that** each between each inner (23) and outer (24) ring, and the connection disk (22), sealing means (25, 26) are interposed.
4. Plant (1) according to claim 3, **characterised in that** between the connection disk (22) and the inner ring (23) at least one sealing ring (25) is interposed which is engaged in a seat made in the surface of the disk (22) facing the inner ring (23), and between the connection disk (22) and the outer ring (24) at least one sealing ring (26) is interposed which is engaged in a seat made in the surface of the disk (22) facing the outer ring (24).
5. Plant (1) according to claim 1, **characterised in that** said connection body (19) comprises two rolling bearings, coaxial with the connection disk (22), including an outer bearing which encircles the connection disk, and an inner bearing which is inserted in the central hole of the connection disk itself; the inner bearing being in turn inserted on the discharge mouth (8), while the outer bearing being inserted inside the loading mouth (6).
6. Plant (1) according to claim 5, **characterised in that** said bearings are equipped with sealing means.
7. Plant according to claim 1, **characterised in that** the constraining means comprise a support (27) which unites the connection disk (22) with a fixed structure (9) of the plant (1) itself.

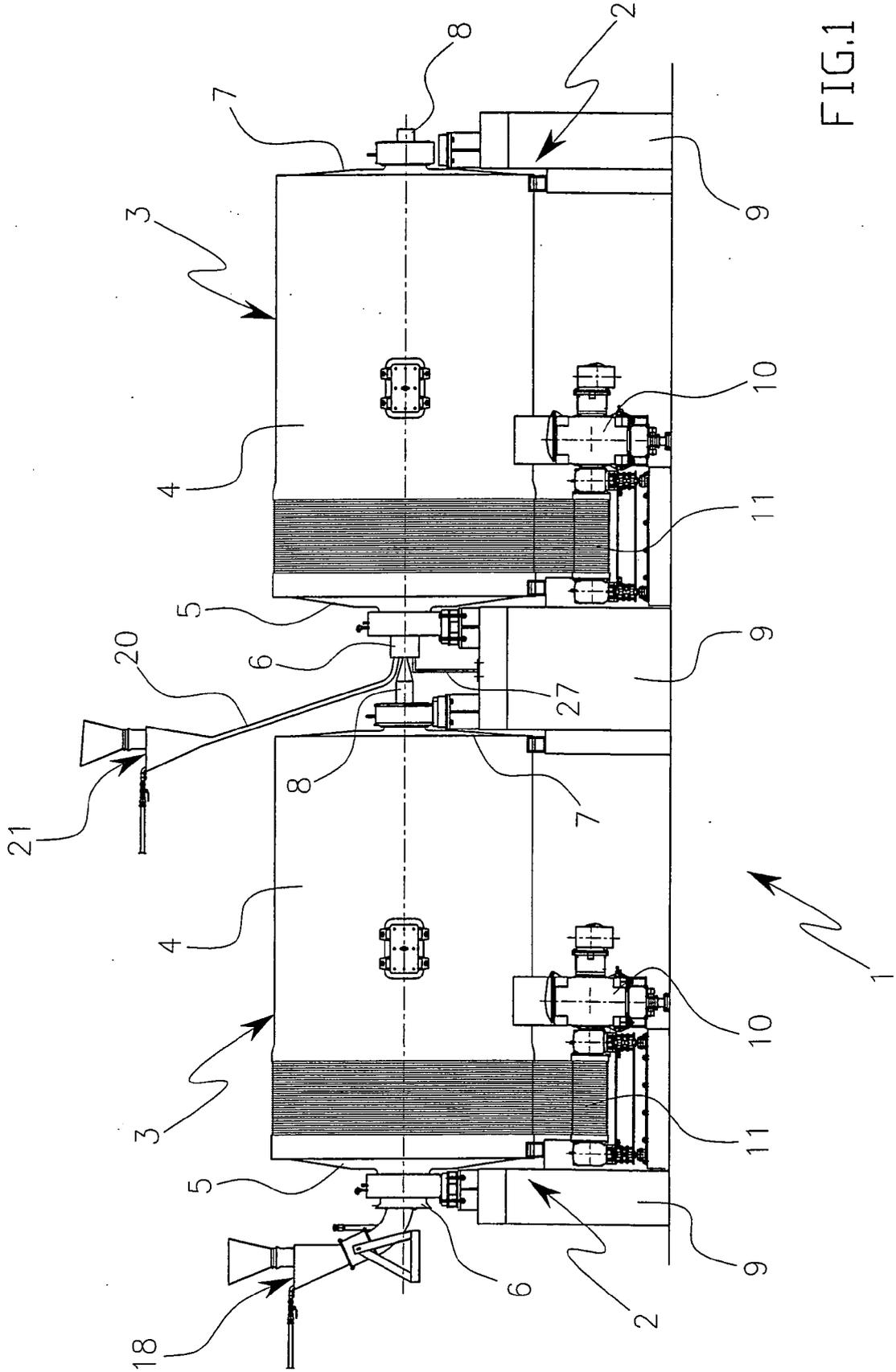
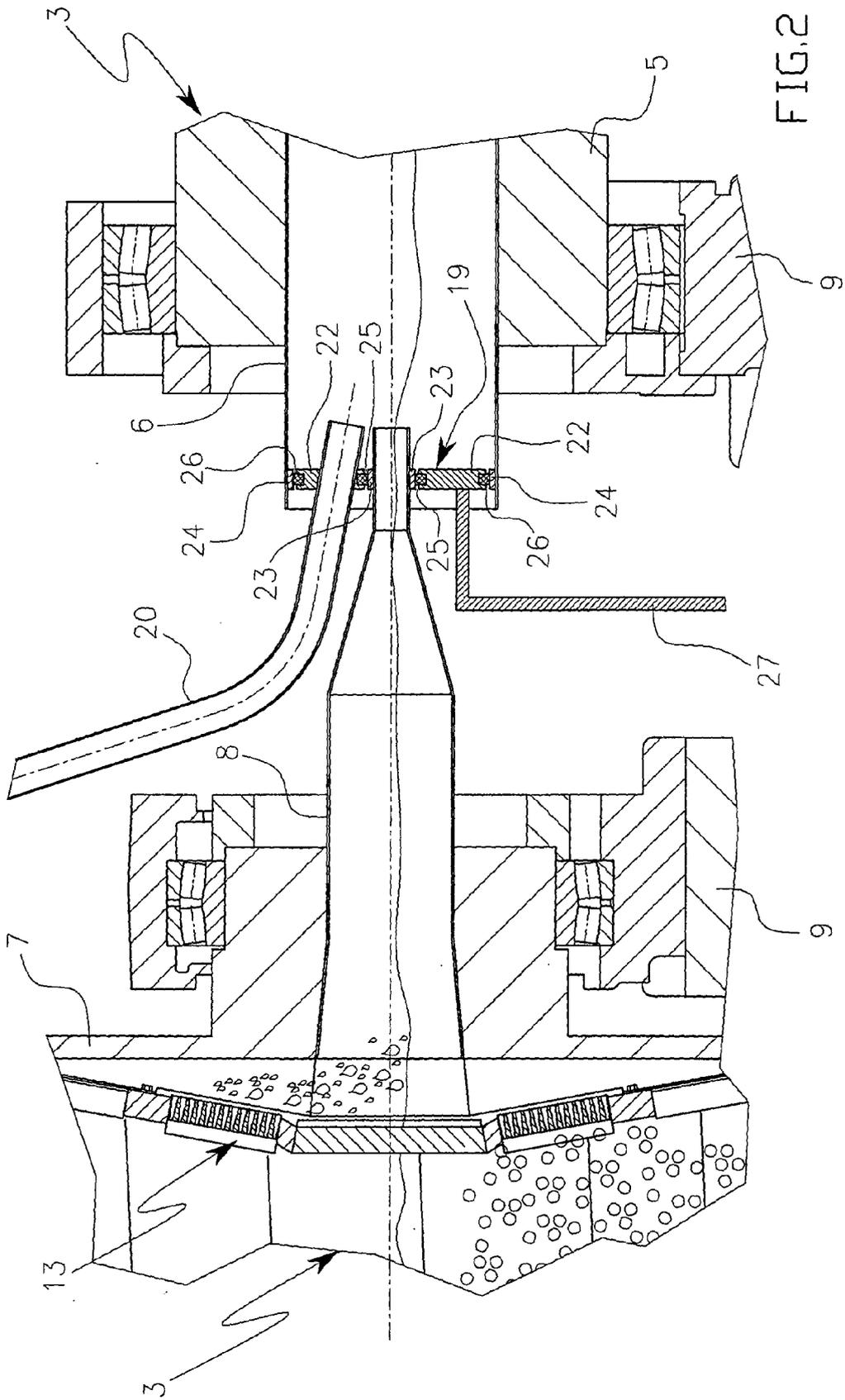


FIG.1





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	US 3 942 727 A (FAHLSTROM ET AL) 9 March 1976 (1976-03-09) * abstract; figure 1 * -----	1	B02C21/00 B02C17/18
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 March 2006	Examiner Strodel, K-H
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	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 06 07 5046

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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