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(54) **MILLING INSTALLATION FOR SAND OR GRAVEL**

(57) Vertical separator mill for triturating with fine particle separation, which allows fine particles to be removed from the milling chamber (1) and also to carry out the drying of the material in the drier mill unit, having a rotor (5) with a vertical axis and a rigid wall (6) surrounding said rotor, a static or dynamic separator (2), and after said separator, a cyclone (3) and a sleeve filter (4). An ascending air current is made to pass through the milling chamber (1) which is then directed through the static separator (2). For the recovery, a cyclone (3) and sleeve filter (4) are provided wherein the fine particles dragged by the air current are deposited.

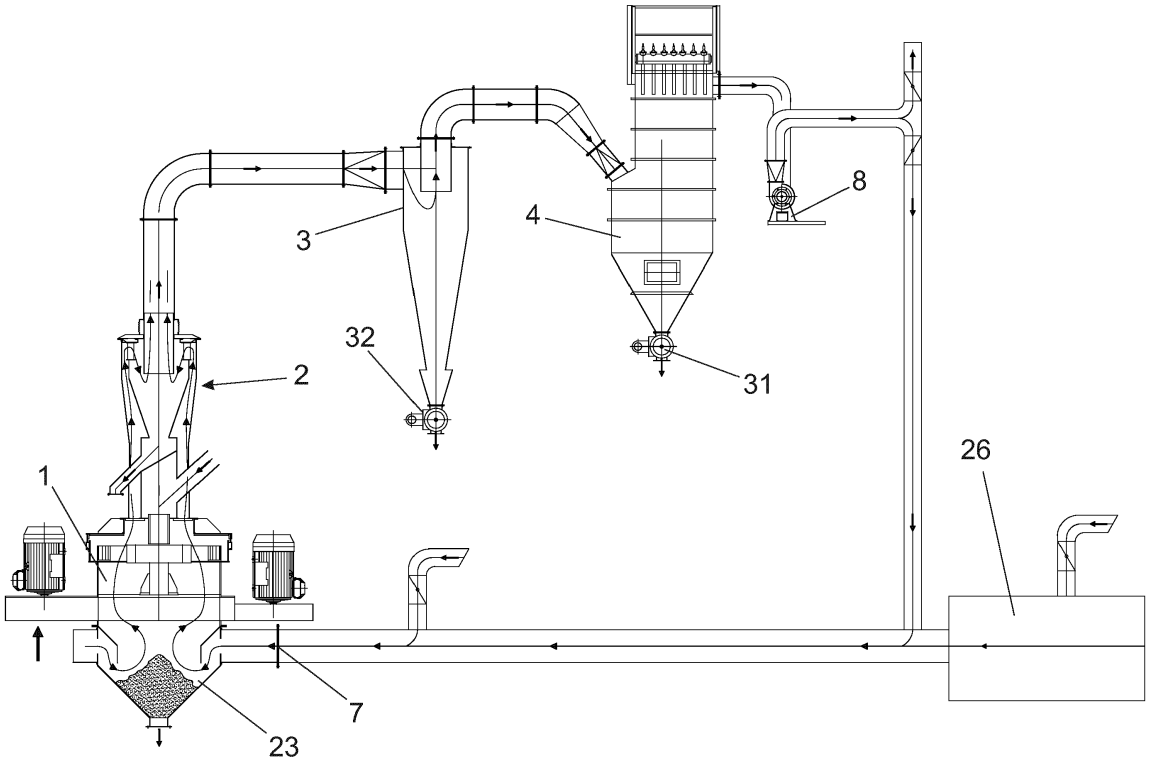

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to a milling installation for arid, especially arid originating from gravel pits and quarries, which includes a mill that has a milling chamber with a rotor with a vertical axis and a rigid wall coaxially surrounding said rotor.

Background of the invention

[0002] Milling installations are already known which include mills of the type indicated, intended to triturate arid originating from quarries and gravel pits, in whose mills the material is supplied in a vertical manner in the center of the rotor which rotates at high speed, such that the supply material that enters into the same is accelerated radially and is projected towards the outside through the channels of the rotor. Said material impacts at a high speed the rigid wall that is coaxial to the rotor, which can have different configurations and be formed by a crown of impact plates or a wall formed by the material itself. These impacts produce the milling of the material which is discharged through the lower part of the mill to a hopper and from which it is sent to the sieving process, such that the fraction that has not been sufficiently reduced in size can be returned once again to the mill together with the new supply of material.

[0003] The performance of the milling installation described depends on various factors, such as the speed of the rotor, the type of rotor (open or closed) and the presence/absence of the arrangement of the crown of impact plates.

[0004] In mills of the type stated which are included in milling installations, all the triturated product is discharged through the lower part of the mill, including arid and particles of different sizes including fine particles with particle sizes lower than 600 microns. The triturated arid, together with the fine particles produced, should be led to classification installations for their selection and separation wherein said fine particles constitute the fractions that are most difficult to sieve.

[0005] The (sand) material obtained after classification must be suitable to be used in the manufacture of concrete, asphalt, mortars and for other uses.

[0006] The excess of fine particles, material up to 63 microns, may cause this sand to be unsuitable for use and it may be necessary to carry out a subsequent process to eliminate these fine particles by means of washing in a wet process or pneumatic separation.

[0007] The moisture of the product makes the triturating process and subsequent classification difficult.

[0008] If the product has to be dry, a drying installation is required before or after the mill.

Description of the invention

[0009] The object of the present invention is to eliminate the stated problems by means of a separator mill that includes a mill of the type indicated to which the required elements are added in order to carry out the separation of fine particles in said mill, such that they do not accompany the extracted arid through the lower part of the milling chamber.

[0010] Thus, four objectives are achieved: the first one is to clear the milling chamber of small particles that do not aid the milling effect by way of collision; the second objective is the fine particles not to pass with the rest of the arid into the sieving and selection installation but rather to be removed directly from the mill which will mean that subsequent sieving of the arid will be more effective given that the smaller particles forming the fine particles are the most difficult to sieve, especially in the presence of moisture; the third objective is the sand obtained to be suitable for use for the manufacture of concretes, asphalts, mortars and for other uses; the fourth objective is all the material to be dry.

[0011] The eliminated fine particles can be used in different fields of industry, supply, etc. in accordance with their chemical characteristics.

[0012] A separator mill is designed such that the conventional mill is modified, installing on the same a static or dynamic separator adapted to the configuration and geometry of the conventional mill, such that it allows the passage of an air current ascending through the milling chamber which drags the fine particles from the said chamber through the separator where the classification is carried out. The fine particles are subsequently gathered into two different sizes in a cyclone and in a sleeve filter.

[0013] The air current can be at room temperature during the times at which drying is not required or can be formed by the hot gases produced by a gas generator which can be included in these types of installations during the times at which it is necessary to dry the fine particles and the rest of the material.

[0014] According to the invention, the separator mill has an air inlet located on the lower part of the milling chamber of said separator mill, below the rotor and below the transmission belt housing thereof. The installation will include means for making an air current circulate in an ascending direction through the milling chamber of the separator mill from said air inlet, the current of which will be capable of dragging the fine particles produced into said milling chamber. The installation will be supplemented with means for recovering fine particles, through which the air current will be made to pass and which will drag the fine particles.

[0015] The element that makes the air current circulate through the milling chamber of the mill and the means for separating fine particles will be formed by a suction fan arranged at the end of the installation and after the means for recovering fine particles.

[0016] These elements for separating fine particles comprise a static or dynamic separator which is arranged on top of the milling chamber of the mill. A cyclone and a final sleeve filter are arranged after the separator.

[0017] The variable air current circulating in an ascending direction through the milling chamber of the mill and the fine particles dragged by said current are made to pass consecutively through the static or dynamic separator, cyclone and sleeve filter, said fine particles being decanted or separated successively according to size.

[0018] The static separator is formed by two coaxial walls, an internal wall and another external wall, with a cylindrical part and a conical part. Two chambers, a central chamber and an annular chamber are delimited between the two walls. The central chamber is subdivided into two areas, an upper and a lower one. The lower area leads, at the bottom, into the milling chamber and the material to be milled is supplied through said chamber. The annular chamber leads, at the bottom, into the milling chamber and, at the top, it is connected to the upper area of the central chamber by way of a crown of vanes that can be pivoted for control. This upper area has a lower outlet through which the extraction of a first fraction of decanted particles is carried out by gravity and it has an upper outlet from which a pipe starts leading the air current and non-decanted fine particles to the cyclone.

[0019] When a dynamic separator is installed on the upper part, the vanes are eliminated by way of said dynamic separator.

Brief description of the drawings

[0020] An exemplary embodiment is shown in the attached drawings, in which:

- Figure 1 schematically shows the milling installation of the invention.
- Figure 2 shows a section of the mill assembly that forms part of the installation of Figure 1.

Detailed description of an embodiment

[0021] Figure 1 shows the general construction of the installation which includes a separator mill comprising a milling chamber (1) and a static or dynamic separator (2) arranged on the milling chamber (1) and means for making an air current circulate in an ascending direction through the separator mill. The installation is supplemented with a cyclone (3) and a sleeve filter (4) through which the air current with the fine particles also passes for its recovery.

[0022] As can be better observed in Figure 2, the milling chamber (1) of the mill comprises a rotor (5) with a vertical axis and a rigid wall (6) coaxially surrounding the rotor (5).

[0023] The means for making the ascending air current circulate comprise an air inlet (7) in the lower part of the milling chamber (1) which can be connected to a hot gas generator (26) and an outlet after the sleeve filter (4) which is connected to a main suction fan (8).

[0024] The air penetrates through an inlet drawer (9) situated below the transmission belt housing (10), ascends between the rotor (5) and the rigid wall (6) and passes through the static separator (2), cyclone (3) and sleeve filter (4), dragging the fine particles produced during the milling.

[0025] A refrigeration system is provided for the belt housing and bearings as well as for the lubrication oil.

[0026] The static separator (2) is formed by two coaxial walls, one internal wall (11) and one external wall (12) with a circular contour and section decreasing in a descending direction, forming two coaxial cones which delimit a central chamber (13) and an annular chamber (14). The central chamber (13) is subdivided into two independent areas, one lower area (15) and one upper area (16). The lower area (15) leads into the milling chamber (1) and has a lateral inlet (17) which passes through the annular chamber (14) and serves for the supply to the mill of the material to be milled, which falls through a central passage (18) into the milling chamber (1). The upper area (16) has a lower outlet (19) for the extraction of a first fraction of fine particles.

[0027] The annular chamber (14) leads, at the bottom, into the milling chamber (1) and is connected, at the top, to the upper area (16) by way of a crown (20) of pivotable blades. The upper area has a second central upper mouth (21) from which a pipe (22) as, for example a telescopic pipe, starts leading the ascending air current to the cyclone (3), Figure 1.

[0028] The ascending air current has the function of removing as many particles as possible milling chamber (1) from those which have reached a sufficiently reduced size, which we call fine particles, from the milling chamber (1) and carrying them to the static separator (2).

[0029] Thus, two objectives are achieved: the first one is to clean the milling chamber (1) of small particles which aid, to a lesser extent, the effect of milling by collision. The second objective is said particles not to pass together with the rest of the production to the sieving process, but instead to be removed directly in the static separator.

[0030] This should help the sieving process to be more effective given that the smaller particles are the most difficult to sieve, especially in the presence of moisture. The rest of the milled material is discharged through the lower part by way of an outlet hopper (23) and is sent to the sieving process, the fraction with a size greater than the objective size returning to the supply of the material.

[0031] In terms of the drying process, when hot gases are used, this process is initiated in the milling chamber (1) itself since the supply material enters into direct contact with the hot gases which come from the gas generator (26) at the required temperature, the heating of the material and a rapid cooling of the gases being produced.

[0032] Both the main fan (8) of the suction circuit, located after the sleeve filter (4) and the rest of the elements of the same, static separator (2), cyclone (3) and sleeve

filter (4), are designed as a function of the intended milling capacity since this defines the quantity of material which is intended to be removed from the milling chamber (1) when the air current passes. Said quantity of material determines the required air flow rate in the circuit and this, in turn, determines the dimensions of the rest of the components of the circuit such that the speeds and load losses envisaged in the circuit are obtained.

[0033] The quantity of material to be processed in the installation and the maximum envisaged moistures of the material in the inlet and outlet will determine the dimensions of the gas generator (26).

[0034] As it has been indicated, a static separator (2) with a double cone is installed directly on the mill. The supply of the material to the mill is carried out through the central part of the separator via the central area of the rotor (5) thereof, which must be done to prevent the inlet of fresh air. The flow of air to drag the material will circulate, from the milling chamber (1), between the interior wall (11) and the exterior wall (12) of the static separator (2).

[0035] The ascending air (or hot gas) current, which should have sufficient speed, enters through the lower part of the mill, below the transmission belt housing (10), passes through the milling area, between the rotor (5) and the rigid wall (6) which defines the impact area, dragging the smaller particles, carrying them to the static separator (2) towards the cone formed by the exterior wall (12).

[0036] In this ascending circulation process, the coarser particles which are dragged by the air current will end up falling once again towards the milling area while the rest of the particles will reach the upper area of the annular chamber (14), pass through the crown (20) of pivotable vanes present in said chamber (14) and enter into the upper area (16). A cyclone effect is produced in this area such that the larger particles fall to the lower part of this area to be extracted as finished material through the first discharge mouth (19).

[0037] The coarse fraction which is extracted through the first discharge mouth (19) will vary as a function of the characteristics of the material and of the adjustments carried out on the available control elements. The smaller particles will be dragged through the upper outlet pipe (22) of the separator to the cyclone (3) installed after the static separator (2) in which the coarser particles should, in turn, be separated from the fine particles in order to be extracted through a third mouth (32).

[0038] The finer particles will be deposited in the sleeve filter (4) and extracted through a fourth mouth (31).

[0039] The static separator (2), despite its simplicity, has various control systems for carrying out a determined adjustment of the size of the particles separated therein. The first one is the actual variation of the flow rate of the tail fan (8) which will have a frequency changer since the speed of the air current through the mill and the separator (2) will vary in this way and, with it, the size and quantity of the particles which can be dragged from the mill. This control is limited since minimum parameters must be maintained for the operation of the unit.

[0040] The second control system is the crown (20) of pivotable vanes of the upper area of the separator whose position influences the passage speed to the upper area (16) and therefore the size of the particles which passes to the same and influences the separation effect which is produced therein. Lastly, the depth of the telescopic outlet pipe (22) can also be adjusted, which will affect the drag effect produced on the same, as well as the size of the particles that pass towards the subsequent cyclone (3). By means of these control systems, the grain size of the material that passes through the static separator (2) is adjusted. The quantity of material removed in the lower part of the static separator will depend on the characteristics and behavior of the material itself during the milling and also on the control and process parameters.

[0041] The static separator (2), in addition to the indicated function, also plays an important role in the drying process, working with hot gases, since the smaller particles circulating through it, in conditions of negative pressure, high speed and intense contact with the gas current, are dried at high speed similar to how a flash dryer functions.

Claims

1. A milling installation for arid, which includes a vertical mill which has a milling chamber (1) with a vertical axis rotor (5) and a rigid wall (6) coaxially surrounding said rotor (5), **characterized in that** it comprises an air inlet (7) located in the lower part of the milling chamber (1) of the mill, means to make an air current circulate in an ascending direction through the milling chamber (1), from said air inlet (7), with capacity to drag into the milling chamber (1) the fine particles produced milling chamber (1) and means for separating the fine particles dragged by the air current through which the air current and fine particles dragged by said air current are made to pass; the air inlet (7) being located below the rotor (5) of the milling chamber (1) of the mill; and means for making the air current circulate consisting of a suction fan (8) arranged after the means for separating fine particles; and means for separating fine particles comprising a static separator (2) arranged on top of the milling chamber (1) of the mill, after which a cyclone (3) and a sleeve filter (4) are located in which the successive separation of fine particles is carried out according to decreasing sizes of dragged particles.

2. The installation according to claim 1, **characterized in that** the air inlet (7) is located below a transmission belt housing (10) of the milling chamber (1) of the mill.

3. The installation according to claim 1, **characterized in that** the static separator (2) comprises two coaxial

walls, one internal wall (11) and one external wall (12) between which a central chamber (13) and an annular chamber (14) are delimited; the central chamber (13) being subdivided into two independent areas, one lower area (15), which leads into the milling chamber (1) and through which the supply of material to be milled is carried out, and one upper area (16) which is not connected to the milling chamber (1), has a lower outlet (19) for the extraction of a first fraction of particles and has an upper outlet from which a pipe (22) starts leading to the cyclone (3); and the annular chamber (14) of which leads, at the bottom, into the milling chamber (1) and is connected, at the top, to the upper area (16) of the central chamber (13) by way of a crown (20) of pivotable vanes.

4. The installation according to claim 3, **characterized in that** the internal wall (11) and the external wall (12) have a circular contour with a decreasing section in the descending direction, defining two conical coaxial chambers.

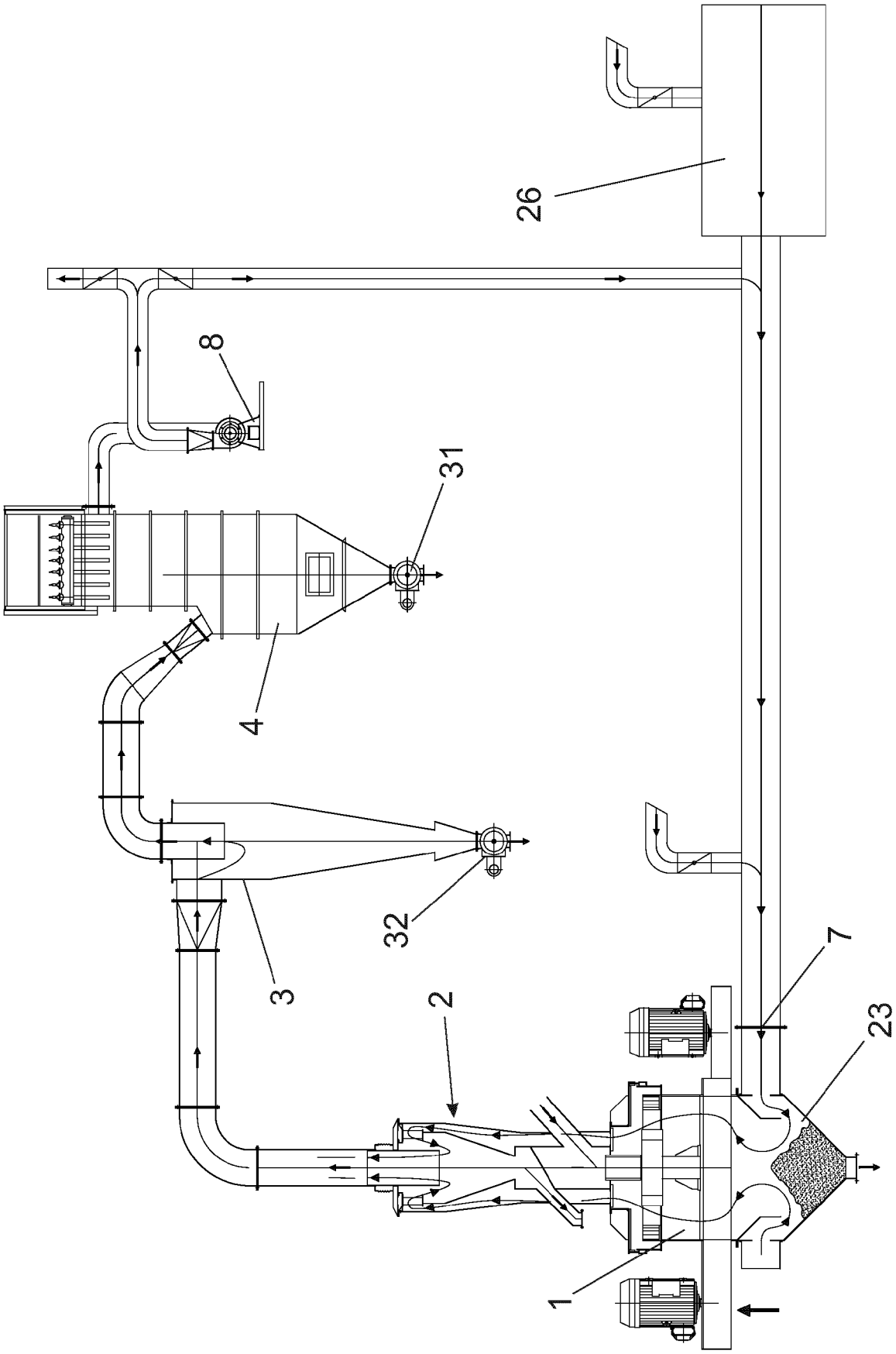

Fig. 1

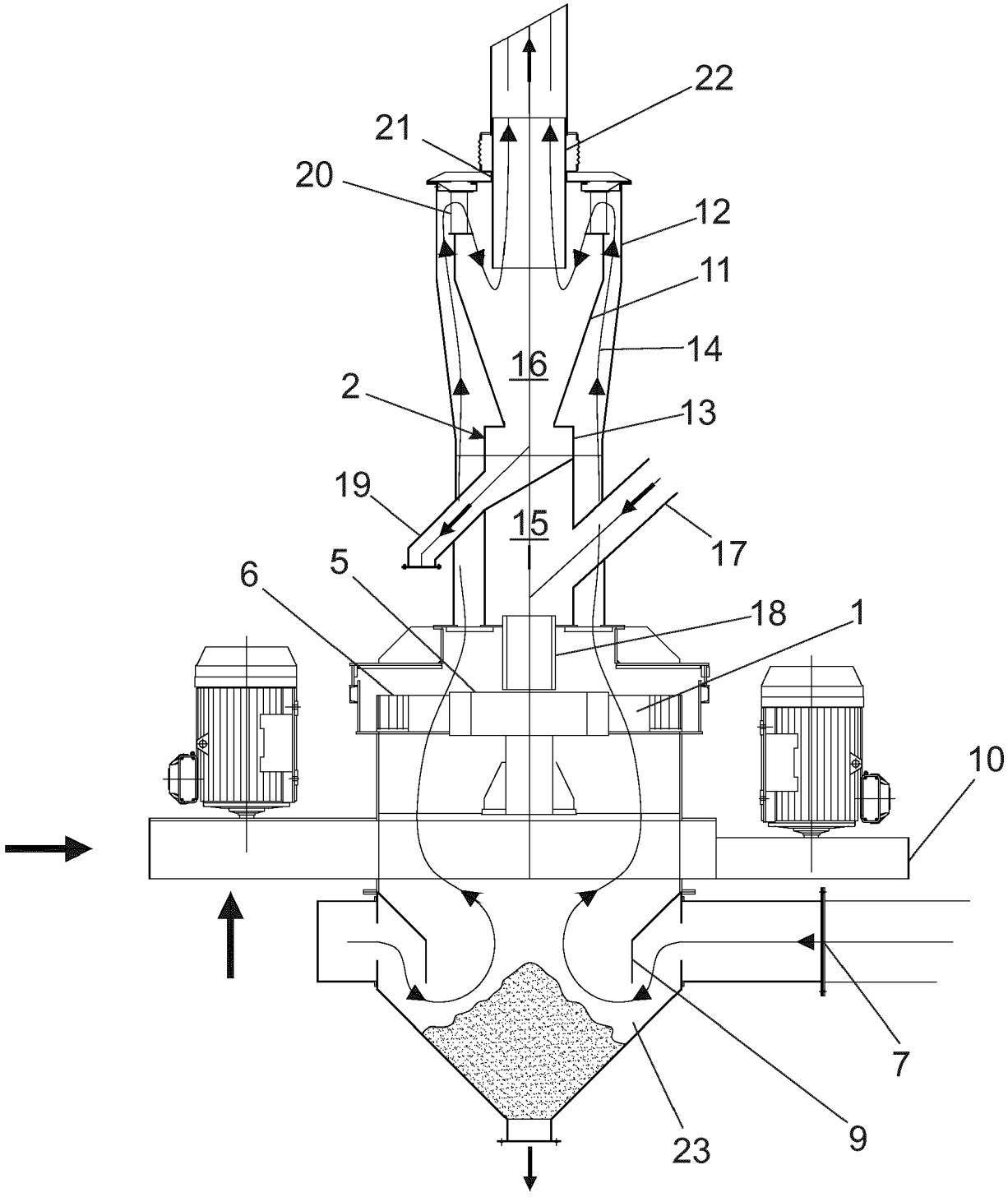

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 5714

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2013/048767 A1 (BUCHANENKO MICHAEL [DE]) 28 February 2013 (2013-02-28)	1	INV. B02C13/14 B02C23/14 B02C23/30
Y	* paragraphs [0027] - [0035]; figure 1 *	2-4	
Y	US 3 155 326 A (RHODES RICHARD E) 3 November 1964 (1964-11-03) * column 2, line 9 - column 3, line 73; figure 1 *	2-4	
A	US 2 092 307 A (GAFFNEY JOSEPH B) 7 September 1937 (1937-09-07) * page 3, column 2, line 19 - page 4, column 2, line 11; figures 1,3 *	1-4	

TECHNICAL FIELDS SEARCHED (IPC)
B02C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 August 2017	Iuliano, Emanuela

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 16 5714

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16-08-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013048767 A1	28-02-2013	CN 102939163 A	20-02-2013
		DE 102010018046 A1	27-10-2011
		DK 2427271 T3	24-02-2014
		EP 2427271 A1	14-03-2012
		ES 2448819 T3	17-03-2014
		JP 5450817 B2	26-03-2014
		JP 2013500931 A	10-01-2013
		KR 20120085657 A	01-08-2012
		MY 154299 A	29-05-2015
		TW 201200241 A	01-01-2012
		US 2013048767 A1	28-02-2013
		WO 2011131278 A1	27-10-2011
US 3155326 A	03-11-1964	NONE	
US 2092307 A	07-09-1937	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82