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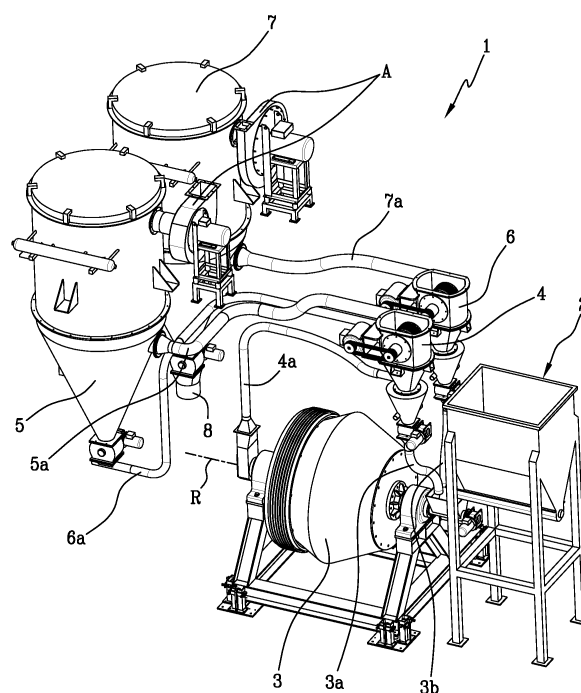
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(54) **A GRINDING PLANT FOR THE PRODUCTION OF PRODUCTS FOR CERAMICS**

(57) The grinding plant (1) for production of products for ceramics comprises: - a hopper (2) for inserting raw material to be ground; a mill (3) with grinding bodies arranged downstream of the hopper (2) and configured for receiving and grinding said raw material; - a first separating device (4, 4') of the product obtained by grinding in the mill (3) and arranged downstream of the mill (3); a first filtering device (5) arranged downstream of said first separating device (4, 4') and configured for at least partly separating the product from air; a second separating device (6, 6') of the product obtained by grinding in the mill (3) and arranged downstream of said first separating device (4, 4').

Fig.1



Description

[0001] The present invention relates to a grinding plant for the production of products for ceramics, such as for example pigments and colourants in the form of powder or grit.

[0002] Known grinding plants typically comprise mills with spherical grinding bodies for the reduction of raw materials into products.

[0003] The known mills are generally constituted by a hollow body having a cylindrical shape, comprising a multiplicity of grinding balls, which body is supplied with raw materials via a hopper and activated in rotation, enabling shaking of the balls and, consequently, the grinding operation.

[0004] At present, plants enabling finely grinding the raw materials to obtain determined grain sizes operate a first dry grinding and a following wet grinding, as dry grinding alone does not allow for obtaining especially fine products.

[0005] However wet grinding is an expensive process and the fine products obtained require further long drying processes so as to be able to store the products obtained and use them in following processing operations.

[0006] In this context, the technical task underpinning the present invention is to provide a grinding plant for the production of products for ceramics which obviates the drawbacks of the prior art as cited above.

[0007] The set technical task and aims are substantially attained by a grinding plant for the production of products for ceramics, comprising the technical characteristics set out in one or more of the appended claims.

[0008] Further characteristics and advantages of the present invention will become clearer from the indicative, and therefore non-limiting, description of a preferred but not exclusive embodiment of a grinding plant for the production of products for ceramics, as illustrated in the attached drawings, in which:

- figure 1 is a schematic perspective view of a first embodiment of the grinding plant for the production of products according to the present invention,
- figure 2 is a further schematic perspective view of the plant of figure 1;
- figure 3 is a perspective view of a second embodiment of the grinding plant for the production of products according to the present invention;
- figure 4 is a perspective view of a further embodiment of the plant of the invention.

[0009] With reference to the appended figures, 1 denotes in its entirety a grinding plant for the production of products for ceramics.

[0010] The plant 1 is configured to realise products, such as micronized powdery pigments, grits or the like.

[0011] The plant 1 comprises a hopper 2 for inserting raw material to be ground. The raw material preferably comprises chromophore oxides (having mean grain size

$\leq 5\text{mm}$) or is constituted by frits.

[0012] The plant comprises a mill 3 with grinding bodies, arranged downstream of the hopper 2 and configured for receiving and grinding said raw material to be reduced at least partially into powder form.

[0013] The mill 3 is preferably designed for the use of grinding bodies constituted by balls, which are available on the market in various sizes and materials, on the basis of the specific application, and comprises a hollow body able to house the raw material to be ground and the balls.

[0014] In the embodiments illustrated in appended figures 1-3, the mill 3 is preferably axial-symmetric, still more preferably it comprises two substantially frustoconical portions joined at the respective major bases, and is provided with an axis of symmetry that coincides with the axis of rotation R. In use, the axis about which the hollow body of the mill 3 rotates is arranged horizontally.

[0015] In a possible further embodiment according to the present invention, not illustrated in the appended figures, the mill 3 can have a cylindrical shape.

[0016] The hopper 2 is preferably connected to the mill 3 by means of a respective delivery connection tube or sleeve, not visible in the appended figures.

[0017] The plant 1 comprises a first separating device 4, 4' of the product obtained by grinding in the mill 3 arranged downstream of the mill 3 and configured to separate/sift the product at least partially. The mill 3 is preferably connected to the first separating device 4, 4' by means of a first delivery conduit 4a, 4'a.

[0018] The plant 1 comprises a first filtering device 5 arranged downstream of said first separating device 4, 4' and configured for at least partly separating the product from the air, preventing the product under processing from exiting from the plant 1 together with the air.

[0019] Therefore the first filtering device 5 advantageously separates the air moving towards the product suction system, which product preferably falls onto the bottom of the suction device 5.

[0020] The first filtering device 5 is preferably connected to a suction device A, defining the product suction system of the plant 1.

[0021] Note that the filtering device 5 is a suction sleeve filter, while the separating device 4, 4', 6, 6' is an air separator.

[0022] The first separating device 4 is preferably connected to the first filtering device 5 by means of a respective connecting hose 5a.

[0023] The ground and sucked product is collected from the first separating device 4, 4' which is driven by the first filtering device 5.

[0024] The first separating device 4, 4' advantageously carries out a first separation of the product so as to separate the larger particles from the finer particles, according to design requirements.

[0025] Further, the plant 1 advantageously comprises a second separating device 6, 6' arranged downstream of the first separating device 4, 4' and thus located in series therewith. In particular, the second separating de-

vice 6, 6' carries out a second separation so as to further separate the larger particles from the finer particles.

[0026] According to the present invention, therefore, the two separating devices 4, 4', 6, 6' are arranged in series and it is therefore advantageously possible to configure the two devices in such a way as to supply the first separating device 4, 4' with a product flow rate that is greater than the inlet flow rate in the second separating device 6, 6'.

[0027] In a first embodiment of the plant 1, illustrated in figures 1 and 2, the first separating device 4 is activated with a first rotation speed that is greater than a second rotation speed with which the second separating device 6 is activated. In other words, the first separating device 4 carries out the separation with a lower power than the power of the second separating device 6.

[0028] Thus the first separating device 4 advantageously carries out a "slow separation" and is able to manage a large quantity of material in inlet, while performing a rough separation of it with respect to the separating capacity of the second device 6, so as to avoid inefficiency but managing, overall, a significant flow rate; while the second separating device 6 performs a "fast separation" so that the already-separated product coming from the first separating device 4 is further sifted in a more efficient way so as to obtain a finer product, thus guaranteeing a continuity of production, able to increase the efficiency of the plant 1.

[0029] Therefore, with the present invention it is possible to obtain particles with an average grain size of lower than a micron-metre with a good yield and without reducing the flow rate of raw material in inlet into the plant 1 with a continuous operation, i.e. without clogging, which would happen if a single separating device were used with a high rotation speed, for example in the order of 10,000 rpm.

[0030] The first separating device 4 is preferably activated with a first rotation speed that is comprised between 2000 rpm and 3000 rpm, preferably 2800 rpm.

[0031] With the first rotation speed values described in the foregoing it is indeed advantageously possible to best manage a high flow rate of powder in inlet into the first separating device 4 and to carry out a first coarse separation, so that in the second separating device 6 there is less powder to be managed and a fine separation can be carried out that is more rapid and effective.

[0032] The second rotation speed of the second separating device 6 is preferably comprised between 10,000 rpm and 12,000 rpm.

[0033] Therefore, the second separating device 6 can advantageously carry out a more rapid separation and thus enable extraction of finer particles with respect to the first separating device 4 and at the same time it does not have to manage all the material in arrival from the mill 3, as this has already been at least partially roughly separated by the first separating device 4.

[0034] Further, in the first embodiment illustrated, the first filtering device 5 is preferably arranged between the

first separating device 4 and the second separating device 6.

[0035] In particular the first filtering device 5 is connected to the second separating device 6 by means of a respective connecting tube 6a.

[0036] The plant 1 preferably further comprises a second filtering device 7 arranged downstream of the second separating device 6, still more preferably connected by means of a respective connecting tube 7a.

[0037] The second filtering device 7 is connected to a suction device A, alike to all the other filters cited in the present description.

[0038] The plant 1 preferably further comprises at least one from among:

- a first return conduit 3a arranged as a connection between the first separating device 4 and the mill 3 and configured for at least partly returning the product into the mill 3;
- a second return conduit 3b arranged as a connection between the second separating device 6 and the mill 3 for at least partly returning the product into the mill 3.

[0039] In particular, preferably according to the first embodiment, the plant 1 is configured so that:

- the first separating device 4 enables at least partly separating the product so that: the particles having a grain size ≤ 0.015 mm are sent through the first suction device 5 to the second separating device 6, while the particles having a grain size ≥ 0.015 mm are returned into the mill 3 to be reground;
- the second separating device 6 enables at least partly separating the product so that: the particles having a grain size ≤ 0.003 mm are sent through the second suction device 7 to a storage station arranged at a valve 8 arranged on the bottom of the second suction device 7, while the particles having a grain size ≥ 0.003 mm are returned into the mill 3 to be reground.

[0040] Therefore thanks to the plant 1 and the presence of a second separating device 6 having a high rotation speed it is advantageously possible to obtain very fine powder having a grain size ≤ 0.003 mm.

[0041] The grinding plant 1 thus works only dry, thus enabling obtaining a reduction below a micron-metre of the starting materials.

[0042] The ground product extracted from the mill 3 because of the depression created internally of the connecting tube 4a is conveyed to the first separating device 4, internally of which a first separation of the product occurs, in which the coarse part (adjustable) is sent via the first return conduit 3a to the mill 3, the fine part is instead conveyed into the second separating device 6 internally of which a further grain size selection is made, in which the fine product (finished product) is collected in the second suction device 7.

[0043] According to a variant of the first embodiment, the plant 1 includes a single filtering device 5, common to both separating devices 4, 6.

[0044] In this case, an outlet of the first separating device 4 is directly connected to the inlet of the second separating device 6 so as to feed thereto a coarsest part (or "waste") of the product, while the second separating device 6 unloads the coarsest part into the mill 3. The finest separated by both the separating devices 4, 6 is collected in the single filter 5.

[0045] Note that the rest of the architecture of the plant illustrated in figure 4 can be alike to that of figures 1 and 2.

[0046] This variant enables having another mode of productivity, i.e. that of separating a large quantity of product in the unit of time.

[0047] Therefore, with the plant 1 configured in this way, it is possible to obtain particles with an average grain size of lower than a micron-metre with a good production and without reducing the flow rate of raw material in inlet into the plant with a continuous operation.

[0048] In this way, the performance of the plant is raised in terms of both quantity of product processed and in terms of grain size quality.

[0049] In still greater detail, in a hypothesis that a grain size separation to be made is 2 micron, the first separating device 4, appropriately adjusted, will carry out the separation typically with a yield of 35-40%.

[0050] In other words, only the above-cited percentage will contain the correct grain size fraction, which has the characteristic of being 97% smaller than 2 micron.

[0051] The remaining part of powder will be instead sent to the second separating device 6, in this way obtaining the recovery of a majority of the already-ground material, thus increasing the performance of the plant.

[0052] With reference to the second embodiment of the plant 1, illustrated in figure 3, the second separating device 6 is preferably a sieve, for example a vibrating sieve or a nutation vibrating sieve and the plant 1 is configured for grinding ceramic "frits" in order to obtain "micro-grits".

[0053] In particular, in accordance with the second embodiment, the plant 1 comprises at least one or more from among:

- a first bucket elevator 9 arranged between the hopper 2 and the mill 3 and configured for transferring, by means of a respective connecting tube 9a, at least said raw material to be ground to the mill 3;
- a first delivery conduit 10 arranged as a connection between the first separating device 4' and the second separating device 6' and configured for at least partly sending the product to the second separating device 6';
- a third return conduit 3c arranged as a connection between the second separating device 6' and the first bucket elevator 9 and configured for at least partly returning the product into the mill 3 via the first bucket elevator 9;

- a second bucket elevator 11 arranged downstream of the second separating device 6', connected thereto by means of a relative connecting tube 11a and configured for at least partly transferring the product to a weighing hopper 12, by means of a respective connecting tube 12a.

[0054] In particular, preferably in accordance with the second embodiment, the plant 1 is configured so that:

- the hopper 2 is adapted to receive in inlet raw material in the form of "frits";
- the first separating device 4' enables at least partly separating the product so that: the finest particles having a grain size ≥ 0.045 mm are sent to the first filtering device 5 to be stored as waste, while the particles having a grain size ≤ 0.045 mm are sent to the second separating device 6' to be further separated;
- the second separating device 6' enables at least partially separating the product so that: the particles having a grain size ≤ 0.18 mm are sent to the second bucket elevator 11 which drops them into the weighing hopper 12, which is used to dose the finished product, also known as "grits", by means of a respective valve 13, while the particles having a grain size ≥ 0.018 mm are returned into the mill 3, preferably passing via the first bucket elevator 9 in order to be reground.

[0055] In other terms, the ground product is extracted from the mill 3 due to the depression created internally of the connecting tube 4'a, through which the product is conveyed to the first separating device 4' in which a first selection takes place of the fine part that is conveyed into the first filtering device 5 while the coarse grain size fraction is sent to the second separating device 6' internally of which a further grain size selection is carried out, so that the larger grain size fraction is returned to the mill 3 through the first bucket elevator 9.

[0056] Therefore thanks to the plant 1 and the presence of a second separating device 6' arranged in series to the first separating device 4' it is advantageously possible to obtain powder of the desired grain size while feeding the hopper 2 continuously and without clogging.

[0057] Lastly, the plant 1 can further preferably comprise an iron separator, not illustrated in the appended figures, arranged downstream of the second separating device 6, 6' and configured for removing iron particles from the powder.

[0058] Owing to the presence of the iron separator, it is advantageously possible to prevent the products obtained from being contaminated by ferritic material, coming for example from the erosion and wear on the plant 1, so that the ferrous material does not alter the chromatic capacity of the grit.

[0059] The present invention achieves the proposed aims obviating the reported drawbacks in the prior art

and making available to the user a plant 1 for the production of products for ceramics, structurally simple and able to increase the efficiency of the production process while improving the operating flexibility and versatility of use thereof.

Claims

1. A grinding plant (1) for production of products for ceramics, comprising:

- a hopper (2) for inserting raw material to be ground;
- a mill (3) with grinding bodies arranged downstream of said hopper (2) and configured for receiving and grinding said raw material;
- a first separating device (4, 4') of the product obtained by grinding in the mill (3) and arranged downstream of said mill (3);
- a first filtering device (5) arranged downstream of said first separating device (4, 4') and configured for at least partly separating the product from air;

characterised in that it comprises a second separating device (6, 6') of the product obtained by grinding in the mill (3) and arranged downstream of said first separating device (4, 4').

2. The plant (1) according to claim 1, wherein the first separating device (4) is activated with a first rotation speed that is greater than a second rotation speed with which the second rotation device (6) is activated.
3. The plant (1) according to claim 2, wherein the first rotation speed is comprised between 2000 rpm and 3000 rpm and wherein the second rotation speed is comprised between 10,000 rpm and 12,000 rpm.
4. The plant (1) according to claim 2 or 3, wherein said first filtering device (5) is arranged between said first separating device (4) and said second separating device (6).
5. The plant (1) according to one or more of claims 2-4, comprising at least one from among:

- a first return conduit (3a) arranged as a connection between the first separating device (4) and the mill (3) and configured for at least partly returning the product into the mill (3);
- a second return conduit (3b) arranged as a connection between the second separating device (6) and the mill (3) for at least partly returning the product into the mill (3).

6. The plant according to at least one of the preceding

claims, comprising a single filtering device (5), common to both separating devices (4, 6), wherein an outlet of the first separating device (4) is directly connected to the inlet of the second separating device (6) so as to feed thereto a coarse part of separated product.

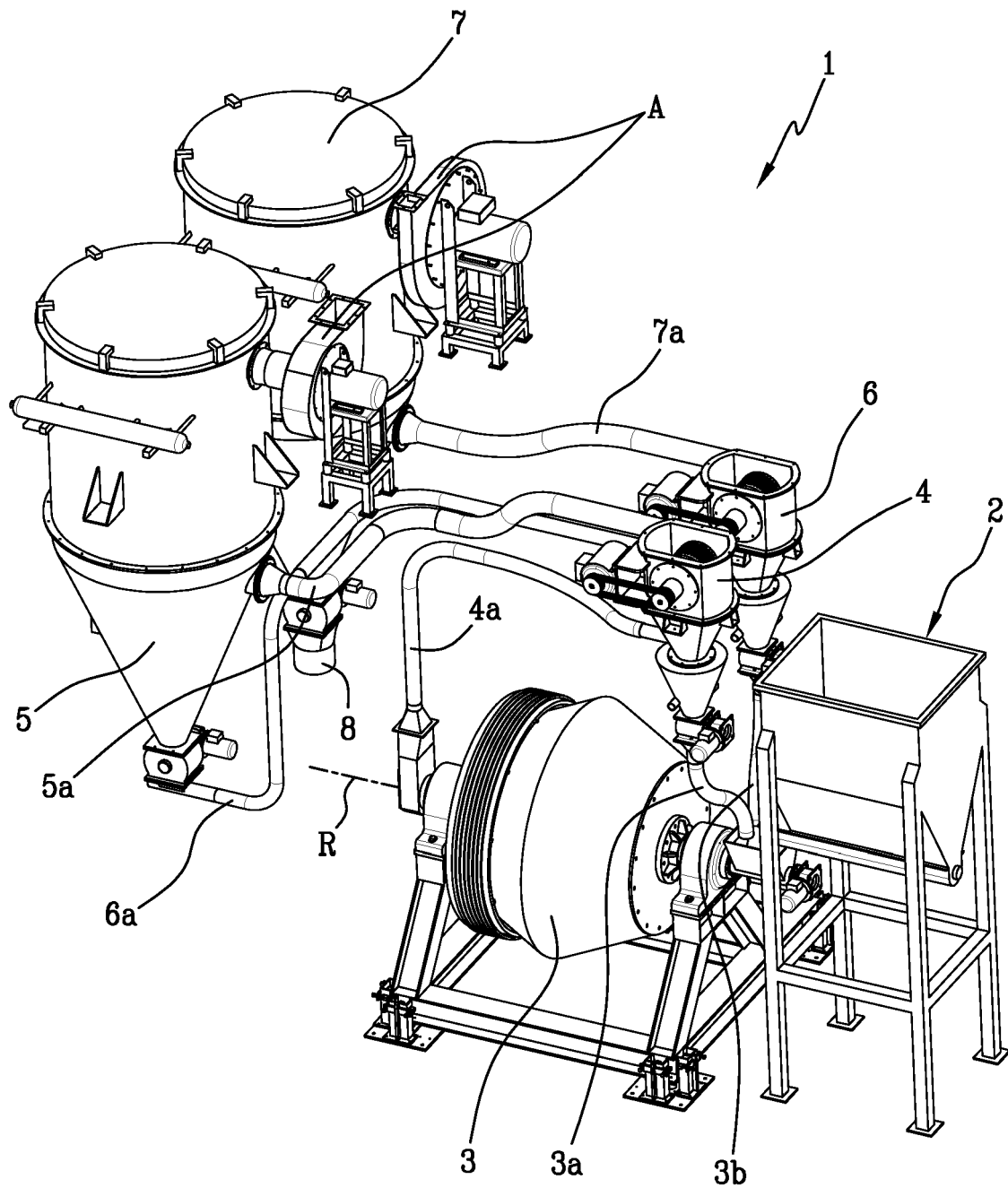
7. The plant (1) according to one or more of claims 2-5, comprising a second filtering device (7) arranged downstream of the second separating device (6).

8. The plant (1) according to claim 1, comprising at least one or more from among:

- a first bucket elevator (9) arranged between the hopper (2) and the mill (3) and configured for transferring at least said raw material to be ground to the mill (3);
- a first delivery conduit (10) arranged as a connection between the first separating device (4') and the second separating device (6') and configured for at least partly sending said powder to the second separating device (6');
- a third return conduit (3c) arranged as a connection between the second separating device (6') and the first bucket elevator (9) and configured for at least partly returning the product into the mill (3) via the first bucket elevator (9);
- a second bucket elevator (11) arranged downstream of the second separating device (6') and configured for at least partly transferring said powder to a weighing hopper (12).

9. The plant (1) according to claim 1, comprising an iron separator arranged downstream of said second separating device (6, 6') configured for removing iron particles from said powder.

Fig.1



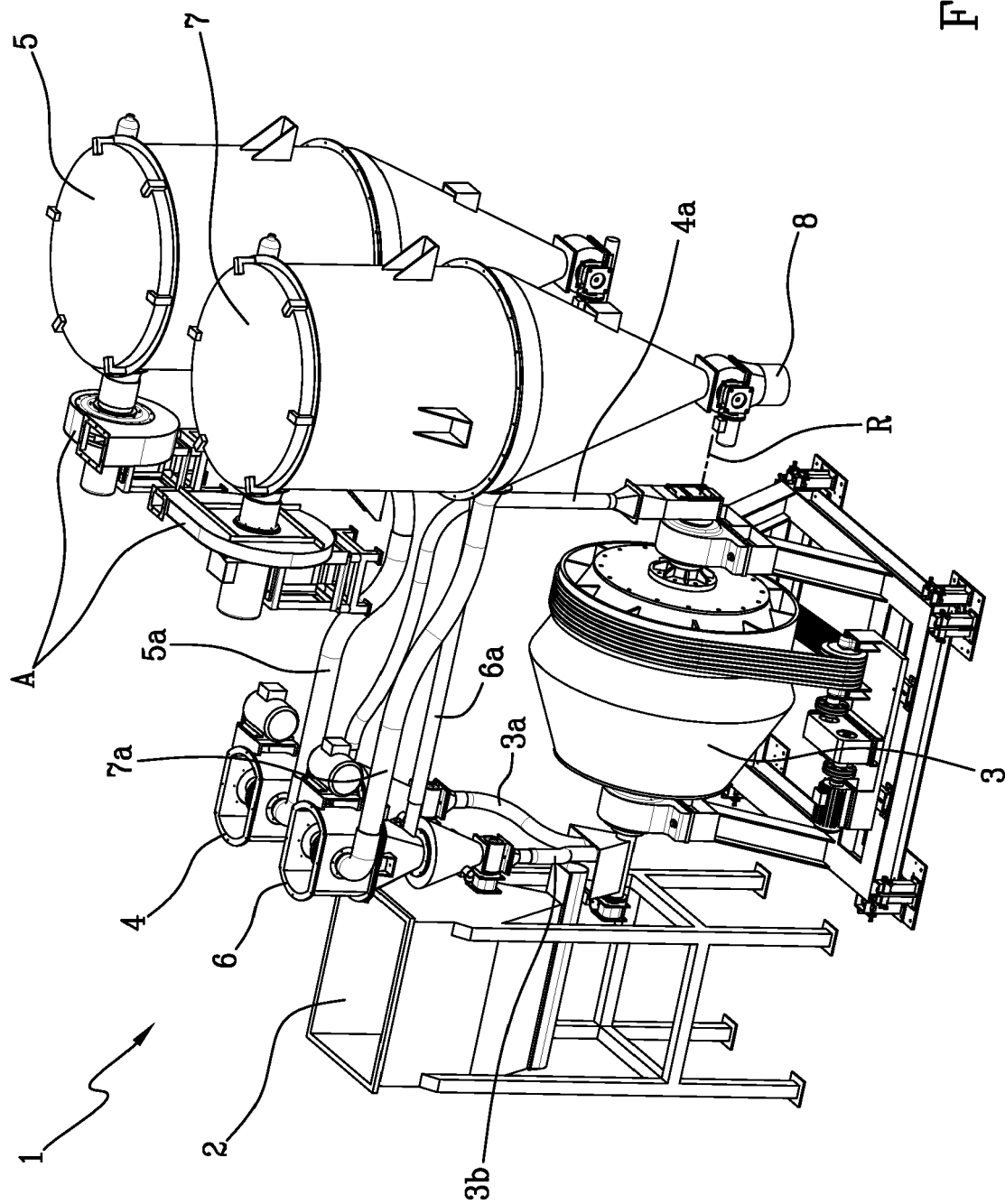


Fig. 2

Fig.3

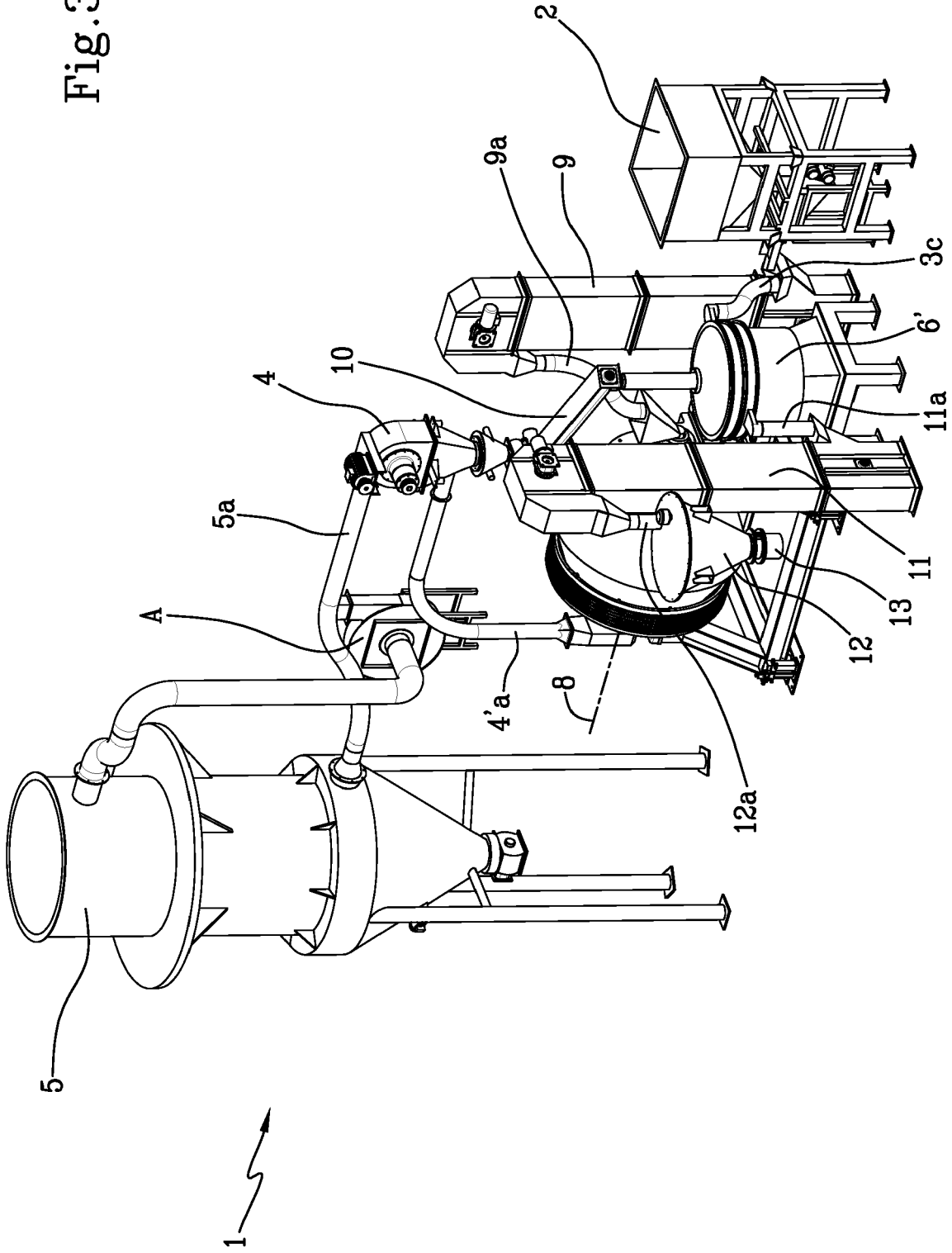
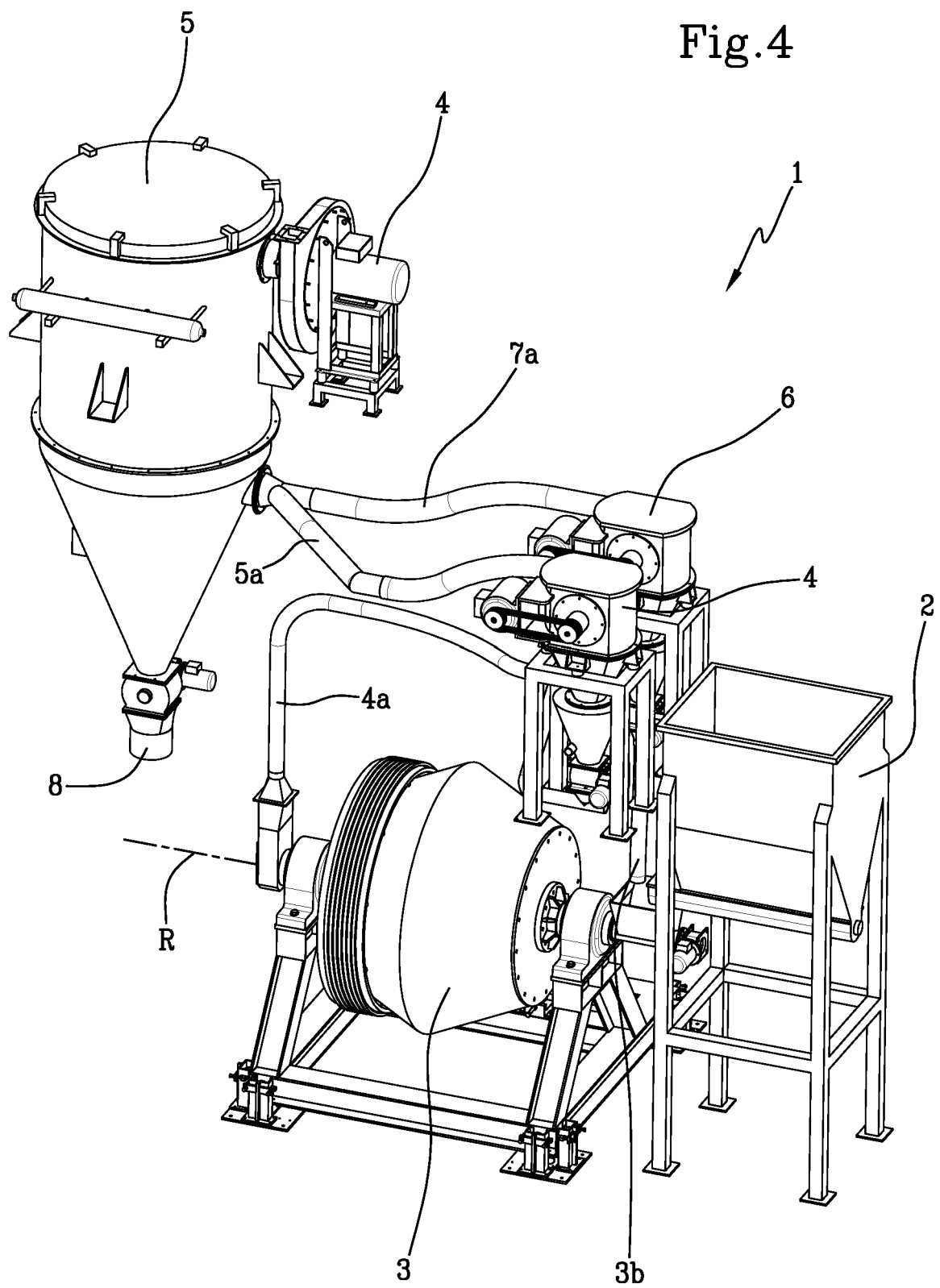


Fig.4





EUROPEAN SEARCH REPORT

Application Number
EP 18 17 8293

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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 June 2018	Examiner Swiderski, Piotr
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 18 17 8293

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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