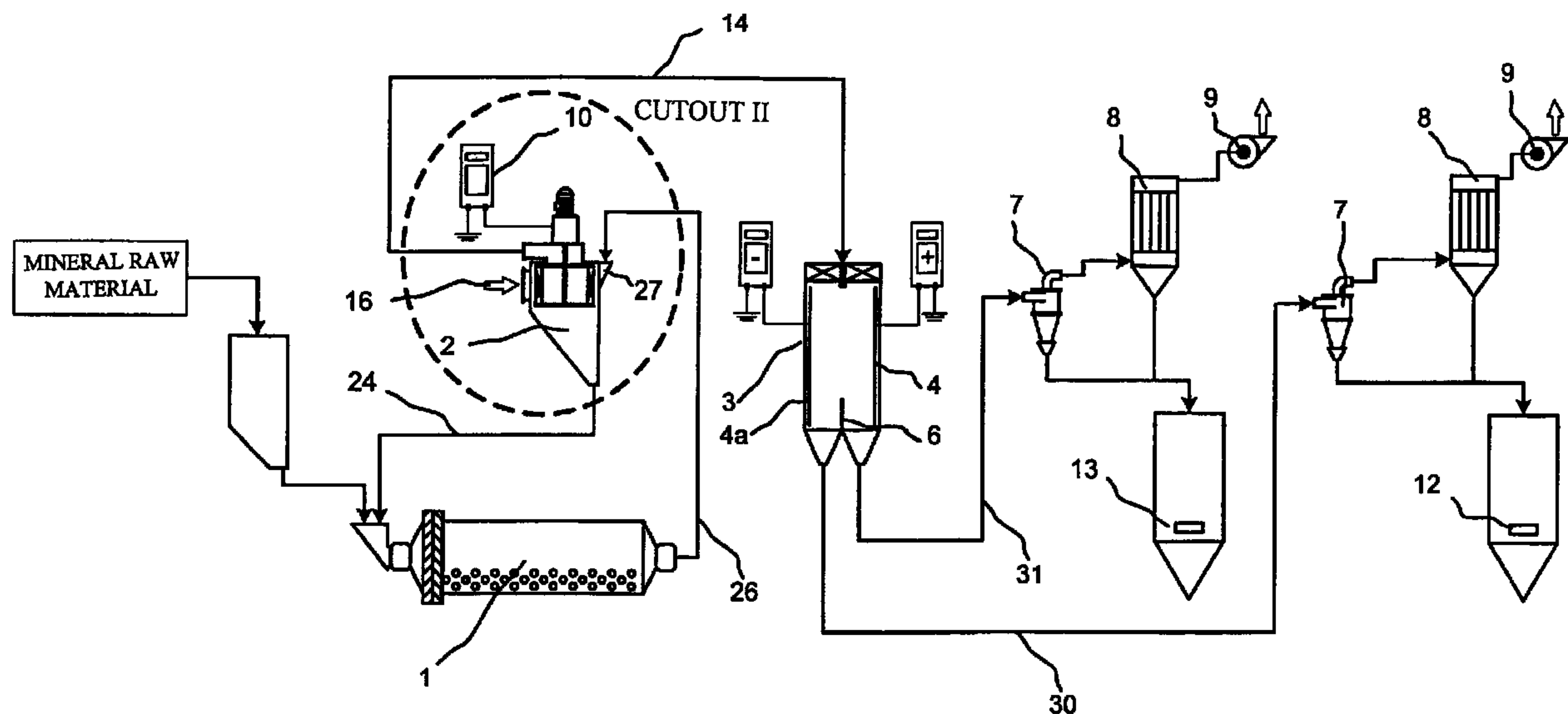




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(54) Titre : PROCEDE ET DISPOSITIF DE PRODUCTION DE PRODUITS MINERAUX DISPERSES
(54) Title: METHOD AND DEVICE FOR MANUFACTURING DISPERSED MINERAL PRODUCTS



(57) Abrégé/Abstract:

The invention relates to a method for manufacturing dispersed mineral products by grinding the mineral raw material, sizing the same in a flow classifier, sorting the same in dispersion in air, and eliminating the dispersion air. Also disclosed are devices and installations for carrying out said method.



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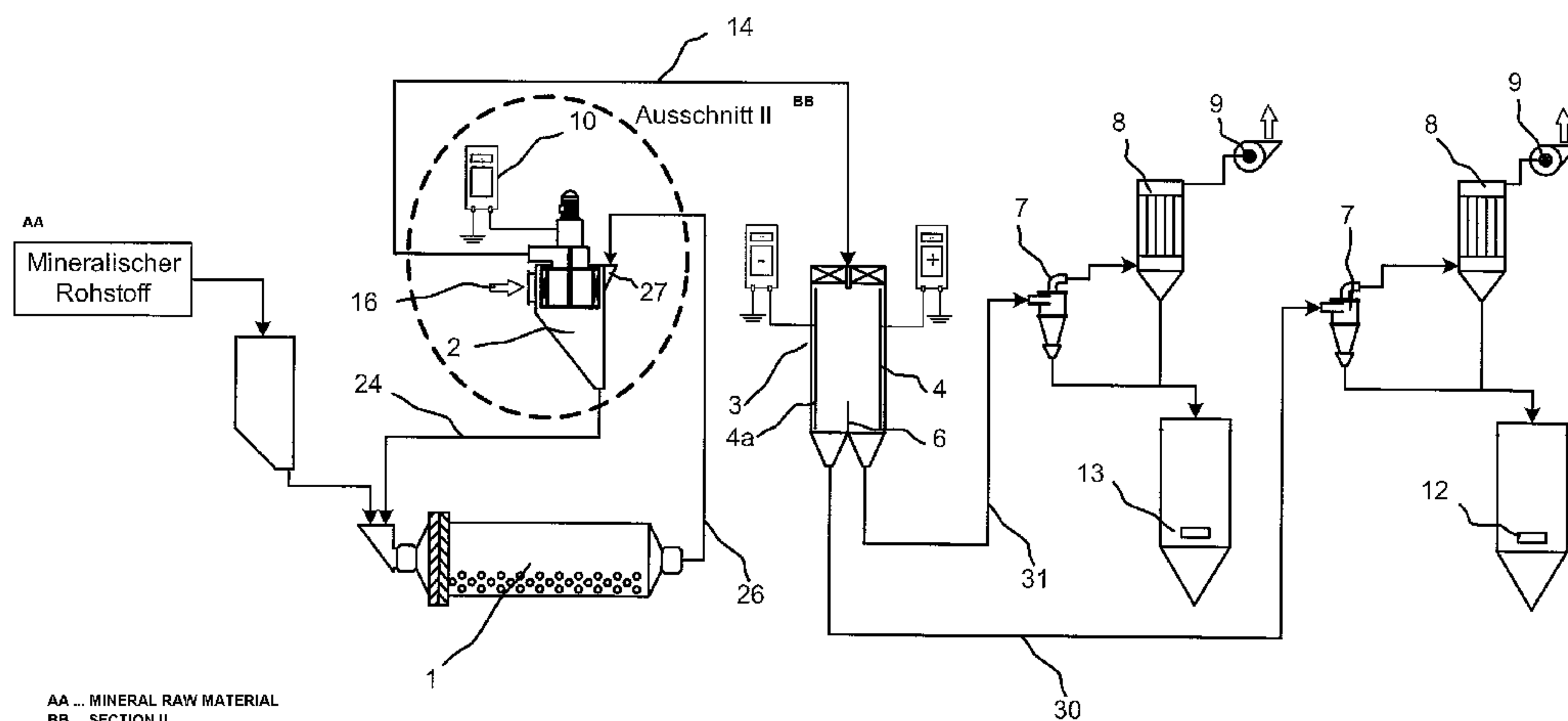
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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(54) Title: METHOD AND DEVICE FOR MANUFACTURING DISPERSED MINERAL PRODUCTS

(54) Bezeichnung: VERFAHREN UND VORRICHTUNG ZUR HERSTELLUNG DISPERSER MINERALISCHER PRODUKTE

AA ... MINERAL RAW MATERIAL
BB ... SECTION II

(57) Abstract: The invention relates to a method for manufacturing dispersed mineral products by grinding the mineral raw material, sizing the same in a flow classifier, sorting the same in dispersion in air, and eliminating the dispersion air. Also disclosed are devices and installations for carrying out said method.

(57) Zusammenfassung: Die Erfindung betrifft ein Verfahren zur Herstellung disperser mineralischer Produkte durch Mahlung, Klassierung in einem Strömungsklassierer und Sortierung des mineralischen Rohstoffes in Dispersion in Luft und Abscheidung der Dispersions-Luft, sowie Vorrichtungen bzw. Anlagen zur Durchführung des Verfahrens.

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Method and Device for manufacturing dispersed mineral products

15 Natural deposits of mineral raw materials consist
out of a mixture of different materials. The mineral
materials mined for particular applications, are nor-
mally contaminated by a number of different accompany-
ing minerals.

The higher the enrichment and the purity of the resource material are in a mineral product, the more valuable it is. This is in particular true for the use of mineral raw materials as high quality fillers in the paper, colour, lacquer, plastics and pharmaceutical industry. The quality of mineral fillers in these application areas is related in the first place to the chemical and mineralogical purity of the products. Accordingly, either very pure deposits of mineral raw materials have to be used for manufacturing fillers, or

correspondingly complicated technological conditioning methods for enrichment and purification of the raw materials have to be used.

5 In case a technological wet-conditioning process is used, the grinded mineral raw material is enriched and purified in an aqueous suspension by flotation, by magnetic separation or by means of density sorting. After purification has been effected, the mineral filler is fine-milled in aqueous suspension, and it is sold as
10 a suspension, as a so called "slurry". From a wet-processed mineral material, also a dry powder could be manufactured, however, the material would have to be drained and thermally dried which, however, is very energy consuming and costly.

15 For manufacturing of dry, dispersed mineral products, therefore, generally conditioning processes are used in which the mineral raw material is grinded and classified by dry-milling and separation.

Flow classifiers for classifying the mineral products are used in the milling and separation circular
20 flow. The particles produced by milling have to be dispersed in the air and separated for classification in order to achieve an efficient classifying effect in the flow classifier. The products produced by the flow
25 classifier are separated from the air in dust separation installations provided down stream.

Within installations for milling and classifying of mineral materials, therefore, a complete particle dispersion and de-dusting system is installed.

30 Herein, the raw material could, however, not or only very ineffectively be cleaned up to now. Therefore, for manufacturing high quality, dispersed mineral products, in particular fillers, only very pure and

high quality starting raw materials could be used which, however, are available only to a limited extend.

The invention is, therefore, based on the object to provide a method and a device for manufacturing disperse mineral products, in which the mineral raw material is effectively cleaned from foreign particles such that, for manufacturing of high quality, dispersed mineral products, in particular fillers, also less pure starting raw materials can be used.

The solution of this object consists, according to the invention, in that, in between the flow classifier and the air separation system, an electrostatic separation chamber for the separation of foreign particles which are triboelectrically charged in the flow classifier, is installed.

More particularly, according to a preferred embodiment, the invention relates to an installation for manufacturing disperse mineral products comprising a mill, a flow classifier and a system for separating a dispersion air, characterized in that, in between the flow classifier and an air separator system, an electrostatic separator chamber is installed for separating foreign particles triboelectrically charged in the flow classifier.

In another context, in connection with other materials and purposes, the electrostatic separation is known *per se*.

In the Patent US 5 885 330 a method for separating unburned carbon material from flue ash is described. Therein, coarse particles are separated from the flue ash by means of a centrifugal force separator, and they are taken up in a separate container. The fine material flow is charged in a separate tribocharging unit which may be constructed in different ways, but, in any case, charges the carbon material particles and the flue ash particles differently. This dispersion containing the differently charged particles falls downwards in a down flow channel between a negatively charged copper plate and a positively charged copper plate. By means of the electrical field between the differently charged plates, the particles, *i.e.* the carbon material on the one hand and the flue ash on the other hand, which have

been charged differently in the tribocharging unit before hand, are separated from each other. By means of cyclones, the separated particles are separated from the gas and are taken up in containers.

5 According to EP 1,251,964 = WO 01/52998, plastics waste is electro-statically separated. Therein, a mixture of plastic particles are electrically charged in air in a rotating drum and transferred through sieve
10 holes in the periphery of the drum into a down flow channel in which, on both sides of the downward flow path, plus-/minus-electrodes are provided for the electrostatic separation of the particles according to their different charge.

 In both of the above mentioned patents, a separate
15 additional device for the electrostatic charging is necessary after the milling. Furthermore, they are concerned with totally different materials.

 In contrast thereto, in the installation of the invention, for charging the particles, the triboelectric
20 charging is used which results from the intensive friction of the solid state particles between one another and the parts of the classifier, in particular the rotor and stator parts of a centrifugal force separator, whereupon the charged particle dispersion, for
25 the electrostatic separation of the contamination from the valuable particles, are directed through an electrostatic separation chamber which is provided in between the flow classifier and the air separation system in the course of the procedure.

30 Furthermore, for amplifying the charging different construction portions of the classifier, in particular housing portions on the one hand and the rotor on the other hand, can be connected to different poles of a

direct current source.

Furthermore, the connecting tube between the flow classifier and the electrostatic separation chamber can consist out of electrically conductive material or can be lined or coated therewith, and the electrically conductive parts can be connected to a pole of a direct current source.

The electrostatic separation chamber may be inserted into the fine material flow or the coarse material flow of the flow classifier.

Apart from the subsequent electrostatic sorting, the electrostatic charging is also already advantageous for the separation procedure itself since the electrostatically charged particles are dispersed in the air stream more uniformly. For a further improvement of the selective charging of the discrete components of the mixture of the mineral material, a part or several movable or static parts of the flow classifier may be made out of a special material or may be coated therewith.

The choice of the material depends on the electron separation force of the mineral material components to be separated, and materials like steel, copper, brass, polytetrafluorethylene, polyvinylchloride, aluminium or ceramic materials may be included.

The electron separation force is the force which is necessary to remove an electron out of the uppermost energy band of a solid state atom; it is equal to the difference of the potential energies of an electron between the vacuum level and the Fermi level.

The vacuum level is, therein, equal to the energy of a electron at rest in a larger distance from the surface; the Fermi level is the electrochemical poten-

tial of the electrons in a solid state body.

Upon contact of two materials having a different electron separation force, the material with the higher electron separation force (acceptor) is charged negatively, and the material with the lower electron separation force (donator) is charged positively. Therefore, in order to generate a selective charging of different particles of a mineral mixture of raw material, materials with a higher or a lower electron separation force may be used on purpose.

For example, for separating of quartz from calcium-carbonate, the rotor of the classifier may be out of steel, copper or brass since the quartz, because of its higher electron separation force, is charged negatively upon friction contact with steel, copper or brass, and since, on the other hand, the calcium-carbonate, because of its lower electron separation force, is charged positively upon friction contact with steel, copper or brass.

The milling machine is preferably a ball mill, however, also a rod mill, an autogenous mill, a semi-autogenous mill, a roller container mill, a pin mill, an impact mill, a hammer mill, a swing mill, a jet mill, an agitator mill or any other corresponding milling machine may be provided.

For the classification and the triboelectric charging of the grinded mineral material particles, preferably a centrifugal force separator is provided, however, any other kind of flow classifier may be used, for example: an oblige flow separator, a zig-zag separator, a dispersion plate wind separator, an impinging flow separator, a spiral wind separator.

The solid state particles to be separated may,

therein, be of any kind, contour, size and source, as long as they are small enough in order to be put into a flow classifier and to be classified therein and to be triboelectrically charged. The separateable solid state particles should have a grain size range of smaller than 10 mm, where, preferably, the average grain size should lay in the range between larger than 2 μ m to smaller than 1 mm.

The mineral material powder to be separated may be composed of an arbitrary number and an arbitrary mixture of different mineral material components (valuable materials and contaminations).

The invention is explained in the following in more detail in connection with the drawings with reference to two embodiments of installations:

Fig. 1 shows an embodiment in which the electrostatic separation chamber is implemented into the fine material flow of the flow classifier and the coarse material flow is directed back to the inlet of the mill.

Fig. 2 shows a separator with reference to an enlarged section II of Fig. 1, which separator is connected to a direct current source for amplifying the charging.

Fig. 3 is an enlargement of Fig. 2 and shows some insulating parts more clearly.

Fig. 4 shows an embodiment in which the separation chamber is implemented into the coarse material flow of the flow classifier.

The installation according to Fig. 1 contains a ball mill 1 for milling and disintegration of the mineral raw material and a centrifugal force separator 2 which serves, apart from the classification, simultaneously for the triboelectric charging of the grinded

mineral material particles according to the invention.

In order to achieve a better triboelectric charging and a higher charge density of the particles flowing through the flow classifier 2, an external electrical direct voltage 10 may be connected to one or several rotating or stationary parts of the flow classifier 2.

This is shown in more detail in fig. 2 and fig. 3.

The separator basket 15 is connected to the driving motor 18 by means of a rotor shaft 25 and a coupling 19. At the rotor shaft 25, there is applied a collector ring 20 which is connected to a pole of a direct current source 10 by means of two coal brushes 17 whereas the other pole is grounded. The electrical voltage output from the direct current source 10 is transferred through the carbon brushes 17 and the commutation ring 20 to the rotor shaft 25 consisting out of an electrically conductive material, and further on to the separator basket 15 conductively fixed to the rotor shaft.

For avoiding an uncontrolled transfer of current from the rotor shaft 25 to the fine material output tube 14, the rotor shaft 25 is covered by the bushing 22 out of electrically non-conductive material in the area of penetration through the fine material output tube 14.

The fine material output tube is furthermore protected through the electrical insulating layer 37 against uncontrolled current transitions.

At the side of the motor, the rotor shaft 25 subjected to a direct voltage, is separated from the driving motor 18 by means of the electrically insulated coupling 19 and the electrical insulation layer 36.

The parts carrying voltage, in the area of the bearing of the rotor shaft 25 and the commutation ring 20 are separated from the surrounding by means of an electrically non-conductive protective housing 23.

5 The fine material output tube 14 of the separator is also insulated from the separator housing 23 by means of an electrically non-conductive insulation layer 29.

10 The separation air is input through the separation air inlet 16 and the grinded mineral powder 26 is input through the input opening 27 into the separation space, and is dispersed by the turbulent air flow present in the separation space.

15 The particles dispersed in the air, follow the air flow in the separation space and have to flow through the separator basket 15 which is rotating fast. Thereby, an intensive contact and friction of the particles with respect to the blades of the separator basket 15 and, thereby, the triboelectrostatic charging of
20 the mineral material powder occurs. Coarse mineral particles cannot flow through the separator basket 15 but are rejected thereby. Therein, also an intensive contact and a friction with the separator basket 15 and the separator housing 23 and, thereby, also a tribo-
25 electric charging of the coarse mineral material particles 24 occurs which are discharged from the separator through the coarse material outlet 28.

30 In a further embodiment (not shown here) for amplifying the triboelectric charging of the material particles and the contaminations, the separator basket 15 is covered with a material the electron separation force of which lies in between the electron separation force of the material and that of the contamination. In

the same way, the fine material output tube 14 may be made out of a material the electron separation force of which lies in between the electron separation force of the material and that of the contamination.

5 Furthermore, also the connecting tube 11 between the flow classifier to and the separation chamber 3 may be connected to the pole of the direct current source 10.

10 The charged fine material flow 32 gets to an electrostatic separation chamber 3 which is preferably arranged vertically and which is provided with separation electrodes 4, 4a.

15 In the electrostatic separation chamber 3, the charged fine material dispersion is separated into a dispersion flow 30 containing the purified product, and the dispersion flow 31 containing the separated foreign particles.

20 The two separated dispersion flows 30 and 31 are directed through a system each for separating the air. These two air separation systems consist for example out of a separator cyclone 7 and/or a dust filter 8 and a blower 9 which generates the required air flow for the dispersion and transport of the mineral material particles through the flow classifier by means of a sub-pressure.

25 The purified mineral powder gets into container 12, the separated foreign particle powder gets to another container 13.

30 Fig. 4 shows an embodiment in which the fine material flow of the separator 2 is the final product whereas the coarse material flow 24 of the flow classifier is directed to an electrostatic separation chamber 3 upon supplying the required air 33.

Therein, the coarse material dispersion is divided up into two partial flows of which one partial flow 34 containing the valuable particles, is directed back to the input of the mill whereas the other partial flow 35 containing the foreign particles, is - after separation of the dispersion air - further processed as waste or by product.

As to the rest, Fig. 4 corresponds essentially to Fig. 1, the same parts being provided with the same reference signs.

WHAT IS CLAIMED IS:

1. Installation for manufacturing disperse mineral products comprising a mill, a flow classifier and a system for separating a dispersion air, characterized in that, in between the flow classifier (2) and an air separator system (7, 8, 9), an electrostatic separator chamber (3) is installed for separating foreign particles triboelectrically charged in the flow classifier.
2. Installation according to claim 1, characterized in that, for amplifying the triboelectric charging of the particles, at least a part of the flow classifier (2) is connected to a pole of a direct current source (10).
3. Installation according to claim 2, in which the flow classifier is a centrifugal force separator, characterized in that, for amplifying the charging, at least a rotor part of the separator, or at least a stator part of the separator, or at least a rotor part of the separator and at least a stator part of the separator is/are connected to the pole of a direct current source.
4. Installation according to claim 2 or 3, characterized in that a connecting tube (11) between the flow classifier (2) and the electrostatic separation chamber (3) consists of an electrically conductive material or is lined or coated (29), respectively therewith, and electrically conductive parts are connected to the pole of a direct current source (10).
5. Installation according to claim 1, characterized in that the separation chamber (3) is inserted into a fine material flow (14) of the flow classifier (2).
6. Installation according to claim 1, characterized in that the separation chamber is inserted into a coarse of material flow (24) of the flow classifier (2).
7. Installation according to one of claims 1 to 6, characterized in that, for the further improvement of the selective charging of individual components of a mineral material mixture, at least a movable or static part of the flow classifier is made out of

materials or is covered therewith, the materials being selected according to an electron separation force of the individual components of the mineral material mixture.

Fig. 1

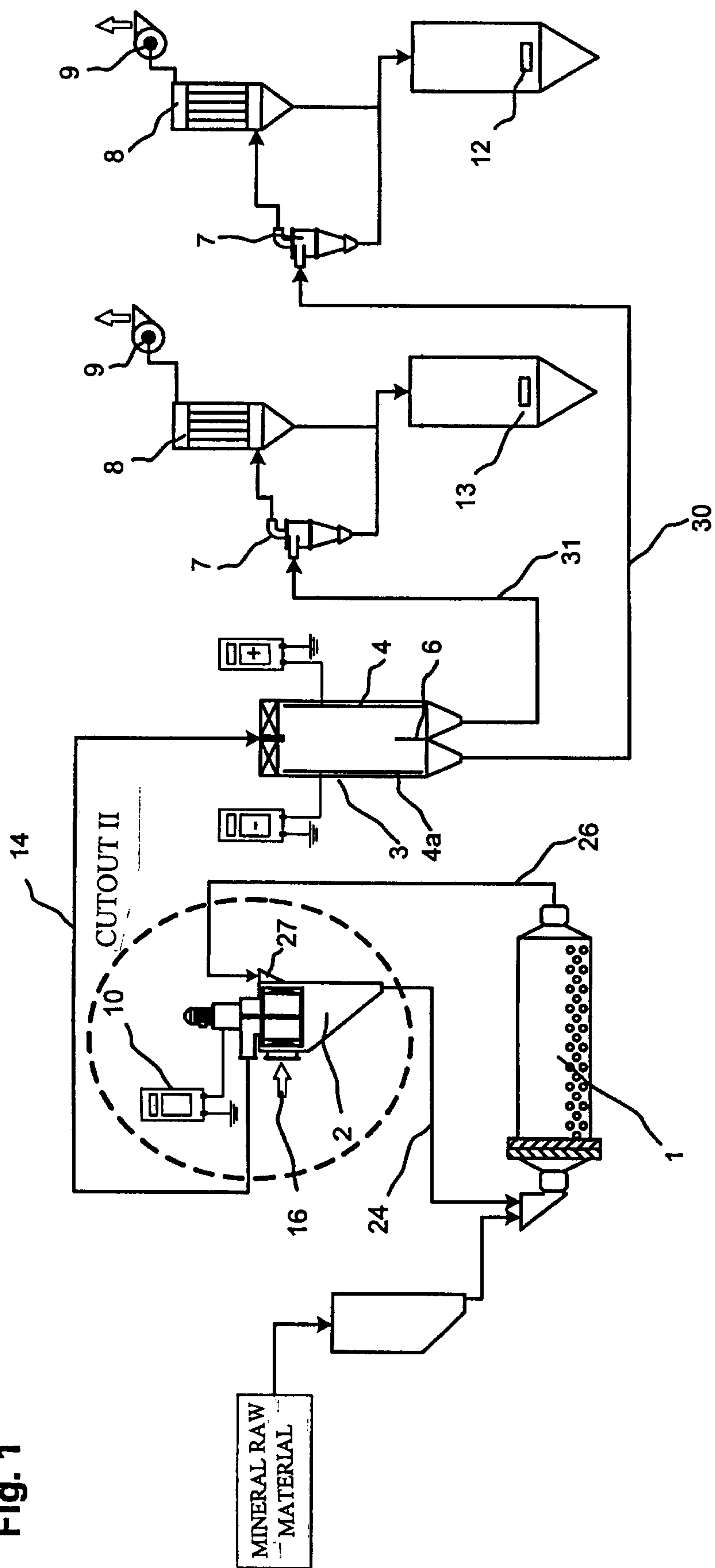


Fig. 2
(CUTOUT II
FROM FIG. 1)

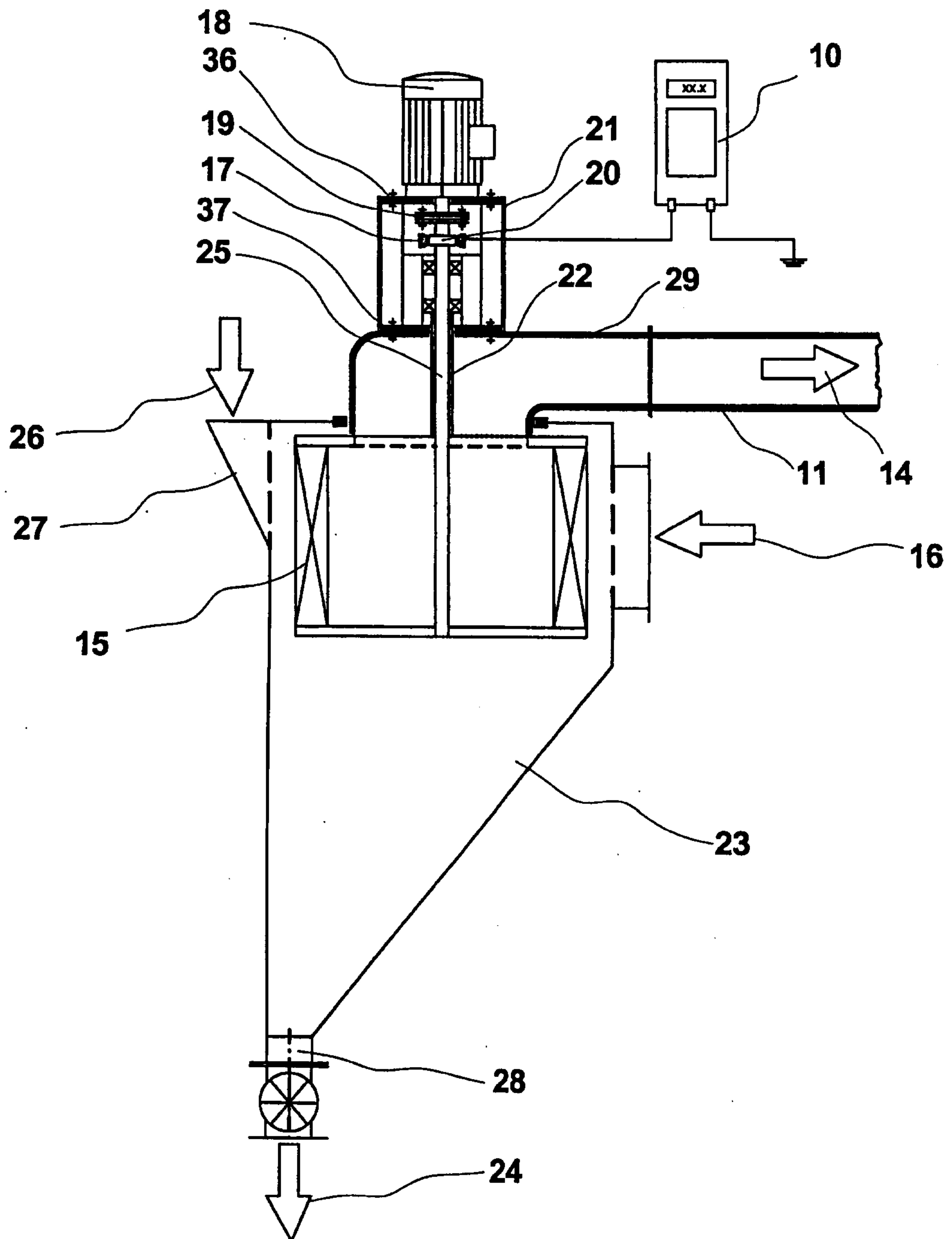


Fig. 3

(FIG. 2 ENLARGED)

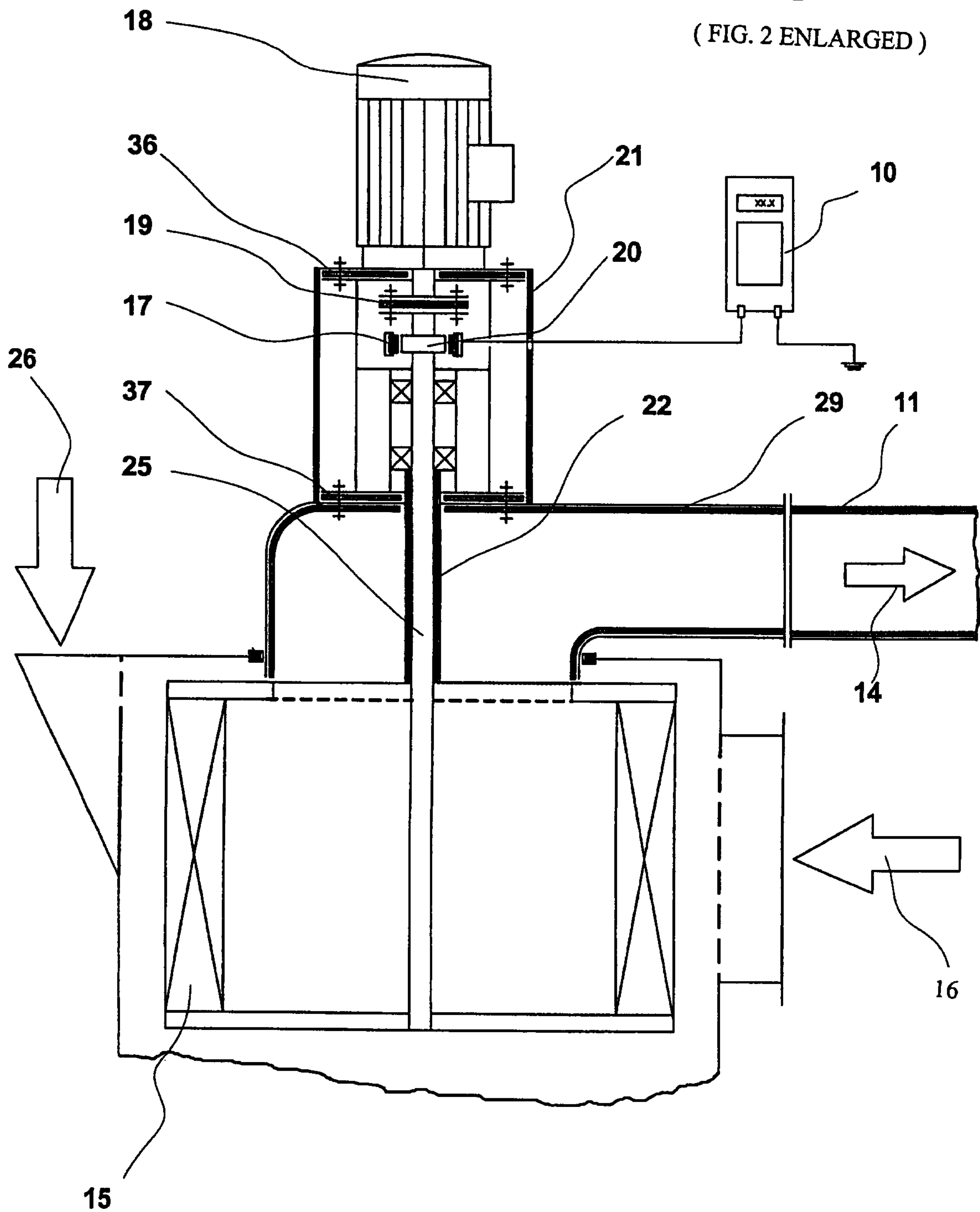


Fig. 4

