

Description

FIELD OF THE INVENTION AND RELATED ART

5 The present invention relates to a process and an apparatus for producing a toner having a predetermined particle size for developing electrostatic images, by effectively pulverizing and classifying solid particles containing a binder resin.

In image forming processes such as electrophotography, electrostatic photography and electrostatic printing, a toner is used to develop an electrostatic image.

10 For a process for producing a final product by pulverizing and classifying starting solid particles in the production of a toner for developing an electrostatic image in which the final product is required to be of very fine particles, in general, a process as shown in a flow chart of Figure 6 is conventionally adopted. This process involves melt-kneading starting materials such as a binder resin and coloring agent (e.g., dye, pigment or magnetic material), cooling the kneaded mixture for solidification followed by pulverization of the
15 solidified product, thereby obtaining pulverized solid particles as a pulverized product from the starting materials. The pulverized product is continuously or successively fed into first classifying means and classified therein, and the coarse powder consisting primarily of a group of the classified particles having a particle size greater than a defined range of sizes is fed into pulverizing means and pulverized therein, and then recycled to the first classifying means. The powder consisting primarily of other particles having particle sizes respectively falling within and smaller than the defined range is transferred to second classifying means and classified into a medium powder consisting primarily of a group of particles having a particle size within the defined range and a fine powder consisting primarily of a group of particles having a particle size smaller than the defined range.

For example, in order to provide a group of particles having a weight average particle size of 10 to 15
25 μm and containing 1 % or less of particles having a particle size smaller than 5 μm , a feed material is pulverized for classification in pulverizing means, such as an impact-type or jet-type pulverizer provided with a first classifying mechanism for removing a coarse powder until a predetermined average particle size is achieved, and the pulverized product free of the coarse powder removed is passed to another classifier to remove fine powder, thus providing a desired medium size powder.

30 The weight average particle size used herein is an expression of the results of measurements, for example, by a Coulter counter available from Coulter Electronics, Inc. (U.S.A.). The weight-average particle size will be sometimes simply referred to as an "average particle size" hereinafter.

Such conventional processes are accompanied by the following problems. It is necessary to supply the second classifying means with particles substantially completely free of coarse particles having sizes
35 exceeding a prescribed range, so that the pulverization means is subjected to a large load and the throughput thereof is lowered. In order to completely remove coarse particles exceeding a prescribed particle size range and not to have the coarse particles coming into particles supplied to the second classifying means, some extent of excessive pulverization cannot be obviated. This leads to a problem that the yield of the medium size powder having a desired particle size obtained through a subsequent second classifying means for removing fine powder is lowered.

40 In the second classifying means for removing fine powder, the aggregate constituted of extremely fine particles may be produced in some cases and are difficult to remove as fine powder. In such a case, the aggregate may be incorporated in a final product, resulting in a difficulty to produce a product having an exquisite distribution of particle sizes, while the aggregate may be broken in the resultant toner to form
45 extremely fine particles, causing a degradation in quality of image. In the conventional processes, even if a desired product having an exquisite distribution of particle size could be obtained, unavoidable disadvantages are encountered such as complication of procedure, reduction in classifying yield and in efficiency of production, and increase in cost. The smaller the predetermined particle size, the more remarkable such tendency will be.

SUMMARY OF THE INVENTION

50 It is an object of the present invention to provide a process for producing a toner for developing electrostatic images, wherein the above mentioned various problems found in the prior art processes are
55 overcome.

It is another object of the present invention to provide a process for effectively producing an electrostatic image-developing toner having an accurate distribution of particle sizes.

It is a further object of the present invention to provide a process for effectively producing an

electrostatic image-developing toner having a good quality and smaller particle size (e.g., of 2 to 8 microns).

It is a yet further object of the present invention to provide a process for effectively producing a product of fine particles (for use as a toner) having an accurate distribution of particle sizes with a good yield from solid particles, as a feed material, which has been produced by melt-kneading a mixture comprising a binder resin, a coloring agent and various additives, cooling the kneaded mixture, and then pulverizing it.

According to the present invention, there is provided a process for producing a toner for developing electrostatic latent images, comprising:

melt-kneading a composition comprising at least a binder resin and a colorant, cooling and solidifying the kneaded product and pulverizing the solidified product to prepare a pulverized feed material;

introducing the pulverized feed material to a first classifying means to classify the feed material into a coarse powder and a fine powder;

introducing the classified coarse powder into a pulverization step and recycling the resultant pulverized product to the first classification means;

introducing the classified fine powder into a multi-division classifying chamber divided into at least three sections by partitioning means so that the particles of the fine powder fall along curved paths due to the Coanda effect, wherein a coarse powder fraction comprising primarily particles having a particle size above a prescribed range is collected in a first divided section, a medium powder fraction comprising primarily particles having a particle size within the prescribed range is collected in a second divided section, and a fine powder fraction comprising primarily particles having a particle size below the prescribed range is collected in a third divided section; and

introducing the collected coarse powder fraction into the first classifying means together with the pulverized feed material.

According to another aspect of the present invention, there is provided an apparatus for producing such a toner, comprising: metering feeder means for metering and feeding a pulverized feed material for a toner, first classifying means for classifying the pulverized feed material into a fine powder and a coarse powder, pulverizing means for pulverizing the coarse powder classified in the first classifying means, introduction means for introducing the pulverized powder from the pulverizing means into the first classifying means, multi-division classifying means having a Coanda block for classifying the fine powder from the first classifying means into at least a coarse powder fraction, a medium powder fraction and a fine powder fraction through the Coanda effect, and introduction means for introducing the coarse powder fraction from the multi-division classifying means to the metering feeder means.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a process according to the present invention;
 Figures 2 and 3 are a front sectional view and a sectional perspective view, respectively, of an apparatus embodiment for practicing multi-division classification according to the present invention;
 Figures 4 and 5 are respectively a schematic view illustrating a classification apparatus system for practicing the process according to the present invention; and
 Figure 6 is a flow chart of a prior art process.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the process of the present invention, a pulverized material is used as a feed or raw material, and Figures 1 and 4 are a block diagram and a process flow chart illustrating an embodiment of the process. In the process, a feed material is first supplied to a first classifying means having a function of removing a coarse particle region, and the classified coarse particles are fed to an appropriate pulverization means and after the pulverization recycled to the first classifying means. The feed particles from which the coarse particles have been removed are fed into a multi-division classification chamber or zone where they are classified into at least three particle size fractions: a larger particle size fraction (coarse powder consisting primarily of coarse particles), a medium particle size fraction (medium powder consisting primarily of particles having a particle size falling within a defined range) and a small particle size fraction (fine powder consisting primarily of particles having a particle size smaller than the defined range). The particles of the large particle size fraction are again introduced into the first classifying means together with the feed

material and a coarse part thereof is pulverized by the pulverization means. On occasion, a part of the particles of the large particle size fraction can be recycled to a melting step in a process for producing the feed material.

The particles of the medium particle size fraction having a particle size within the defined range and the particles of the smaller particle size fraction having a particle size smaller than the defined range, are withdrawn from the multi-division classifying chamber by proper take-off means, respectively. The particles of the medium particle size fraction has a suitable distribution of particle sizes and can be used as a toner as they are. On the other hand, the particles of the smaller particle size fraction may be reutilized by recycling them to a melting step. It is preferred that the true specific gravity of the powder to be classified is about 0.5 - 2, particularly 0.6 - 1.7.

In order to obtain as the medium powder a product (toner powder) having a weight-average particle size of $11\ \mu$ (containing 0.5 wt. % of particles having a particle size of below $5.04\ \mu\text{m}$ and a substantially negligible amount (less than 0.1 wt. %) of particles having a particle size of above $20.2\ \mu\text{m}$), for example, it is preferred to effect pulverization so as to supply the multiple-division classification chamber with particles containing 15 wt. % or less, preferably 3 - 10 wt. %, having a particle size above $20.2\ \mu\text{m}$ from the viewpoints of good pulverization efficiency and an increased classification efficiency.

An embodiment for providing the above-mentioned multi-division classifying means may for example be a multi-division classifier as shown in Figure 2. (sectional view) and Figure 3 (perspective view). Referring to Figures 2 and 3, the classifier has side walls 22, 23 and 24, and a lower wall 25. The side wall 23 and the lower wall 25 are provided with knife edge-shaped classifying wedges 17 and 18, respectively, whereby the classifying chamber is divided into three sections. At a lower portion of the side wall 22, a fine powder supply nozzle 16 opening into the classifying chamber is provided. A Coanda block 26 is disposed along the lower tangential line of the nozzle 16 so as to form a long elliptic arc shaped by bending the tangential line downwardly. The classifying chamber has an upper wall 27 provided with a knife edge-shaped gas-intake wedge 19 extending downwardly. Above the classifying chamber, gas-intake pipes 14 and 15 opening into the classifying chamber are provided. In the intake pipes 14 and 15, a first gas introduction control means 20 and a second gas introduction control means 21, respectively, comprising, e.g., a damper, are provided; and also static pressure gauges 28 and 29 are disposed communicatively with the pipes 14 and 15, respectively. The locations of the classifying wedges 17, 18 and the gas-intake wedge 19 may vary depending on the kind of the feed material to be classified and the desired particle size. At the bottom of the classifying chamber, exhaust pipes 11, 12 and 13 having outlets are disposed corresponding to the respective classifying sections and opening into the chamber. The exhaust pipes 11, 12 and 13 can be respectively provided with shutter means like valve means.

The fine powder supply pipe 16 comprises a flat rectangular pipe section and a tapered rectangular pipe section, and it is preferred in order to obtain an appropriate introduction speed that the ratio between the internal size of the flat rectangular pipe section and the narrowest part of the tapered rectangular pipe section is 20:1 to 1.1:1, particularly 10:1 to 2:1.

A classifying operation is effected by using the above described multi-division classifying chamber or zone as follows. The classifying chamber is sucked or evacuated to a reduced pressure through at least one, preferably all, of the exhaust pipes 11, 12 and 13. A feed fine powder is supplied to the classifying chamber through the feed supply nozzle 16 along with a gas stream flowing at a high speed of 50 - 300 m/sec. At that time, the first gas stream introduction control means 20 and the second gas stream introduction control means 21 are preferably driven so that the absolute value of a static pressure (gauge pressure, i.e., a difference from the atmospheric pressure) P_1 at a position in the intake pipe 14 upstream of the inlet (downstream end of the pipe) opening into the classifying chamber is 150 mm.aq. or above, preferably 200 mm.aq. or above, further preferably 210 to 1000 mm.aq.; the absolute value of a static pressure P_2 (gauge pressure) at a position in the intake pipe 15 upstream of the inlet opening into the classifying chamber is 40 mm.aq. or above, preferably 45 to 400 mm.aq., further preferably 45 to 70 mm.aq.abs.; and the absolute values $|P_1|$ and $|P_2|$ satisfy the relation:

$$|P_1| - |P_2| \geq 100\ (\text{mm.aq.}).$$

This is preferred because the classification accuracy is increased thereby. The pressures are measured downstream of the gas stream control means 20 and 21.

When $|P_1| - |P_2| < 100\ (\text{mm.aq.})$, there results in a tendency that the classification accuracy is lowered and it becomes impossible to accurately remove the fine powder fraction, so that the resultant classified product is caused to have a broad particle size distribution. The control of the static pressures P_1 and P_2 means the control of the flow rates of gaseous stream flowing through the intake pipes 14 and 15. When the

fine powder is supplied to the classifying chamber at a rate below 50 m/sec, the aggregation of the fine powder cannot be sufficiently disintegrated, thus lowering the classification yield and the classification accuracy. When the fine powder is supplied to the classifying zone at a rate of above 300 m/sec, the toner particles can be pulverized because of collision therebetween to newly produce fine particles, thus tending to lower the classification accuracy.

The feed toner particles thus supplied are caused to fall along curved lines 30 due to the Coanda effect given by the Coanda block 26 and the action of the streams of a gas such as air, so that larger particles (coarse particles) fall along an outward gas stream to form a fraction outside (on the left side of) the classifying wedge 18, medium particles (particles having sizes in the prescribed range) form a fraction between the classifying wedges 18 and 17, and small particles (particles having sizes below the prescribed range) form a fraction inward (on the right side) of the classifying wedge 17. Then, the large particles, the medium particles and the small particles are withdrawn through the exhaust pipes 11, 12 and 13, respectively. The classifying conditions are preferably adjusted so that the particles classified into the second fraction region will have an average particle size of about 1 - 15 μm .

The above process may be generally operated by using a system in which the classifier is connected with other apparatus by communicating means such as pipes. A preferred embodiment of such an apparatus system is shown in Figure 4. The apparatus system shown in Figure 4 comprises a three-division classifier 1 as explained with reference to Figures 2 and 3, a metering feeder 2, a metering feeder 10, a vibration feeder 3, a collecting cyclone 4, a collecting cyclone 5, a collecting cyclone 6, a collecting cyclone 7, a pulverizer 8 and a first classifier 9 connected through communication means.

In the above apparatus system, the feed material 61 is supplied through the metering feeder 2 to the first classifier 9 where a coarse powder fraction is removed from fine powder. The fine powder is then supplied through the collecting cyclone 7 to the metering feeder 10, and then introduced through the vibration feeder 3 and the supply nozzle 16 into the three-division classifier 1 at a high speed. The coarse particles separated by the first classifier are supplied to the pulverizer 8, pulverized there and then introduced into the first classifier 9 together with a freshly charged feed material. For the purpose of introduction into the three-division classifier 1, the fine powder is introduced at a high speed of 50 - 300 m/sec under the action of a suction force exerted by the collecting cyclones 4, 5 and/or 6. Such introduction under the action of a suction force is preferred because less strict sealing of the apparatus system is acceptable.

As the size of the classifying zone or chamber in the classifier 1 is generally on the order of (10 - 50 cm) $\times$ (10 - 50 cm), the feed particles can be generally classified into three or more particle size fractions in a short period of 0.1 sec to 0.01 sec or less. In the three-division classifier 1, the feed toner material is divided into the large particles (coarse particles), the medium particles (particles with sizes in the prescribed range) and the small particles (particles with sizes below the prescribed range). The large particles are then sent through an exhaust pipe 11 and the collecting cyclone 6 to the metering feeder 2 containing the pulverized feed material 61.

The medium particles are withdrawn out of the system through an exhaust pipe 12 and collected by the collecting cyclone 5 to be recovered as a medium powder for providing a toner product. The small particles are withdrawn out of the system through an exhaust pipe 13 and collected by the collecting cyclone 4 to be recovered as minute powder 41 with sizes outside the prescribed range. The collecting cyclones 4, 5 and 6 function as suction and reduced pressure-generation means for introducing the feed material through the nozzle 16 into the classifying chamber.

For the pulverizer 8, pulverizing means such as an impact pulverizer or a jet pulverizer may be used. A commercially available embodiment of the impact pulverizer may be Turbomil mfd. by Turbo Kogyo K.K. and commercial available example of the jet pulverizer may include Supersonic Jet Mill PJM-I mfd. by Nihon Pneumatic Kogyo K.K. Furthermore, the multi-division classifier used in the present invention may be classifying means having a Coanda block for utilizing the Coanda effect including Elbow Jet mfd. by Nittetsu Kogyo K.K. as a commercially available example.

Figure 5 shows an embodiment wherein a pressurized gas 101 is introduced through a shutter valve 100 to the nozzle 16. The pressurized gas 101 may be compressed air. In case where fine powder is introduced through a vibration feeder 3 under the action of the pressurized gas 101 into a three-division classifier 1, air-tightness of the respective stages and communication means connecting the stages is required.

In a pulverization-classification process wherein a conventional classifier having a purpose of removing only fine particles in the final classification step, it is required to completely remove coarse particles having sizes exceeding a prescribed particle size range from the feed powder having passed through the pulverization. In order not to allow coarse particles to flow into the final classification step, it is required to

suppress the formation of coarse particles in the pulverization step. This leads to a tendency of over-pulverization and lowering in pulverization efficiency.

On the other hand, in the process of the present invention, coarse particles and fine particles outside a prescribed range are simultaneously removed by a specific multi-division classifying means. As a result, even if the feed particles having passed through pulverization contains a proportion of coarse particles having particle sizes exceeding a prescribed range, the coarse particles are removed substantially completely in the multi-division classifying means in the subsequent step, so that the pulverization step is suffered from less restriction and allowed to utilize the capacity of the pulverizer to the maximum, thus resulting in good pulverization efficiency and less tendency of over-pulverization. As a result, the formation of fine powder is suppressed and aggregates of fine powder are disintegrated due to introduction at a high speed, so that the removal of fine powder is also accomplished very effectively to provide a well improved classification efficiency.

In the conventional classification step for separating a medium powder region and a fine powder region, it is liable that aggregates of fine particles causing fog in a developed image are formed as the residence time in the classification step is long. And, if aggregates are formed once, it is difficult to remove them from the medium powder region. In the process of the present invention, even if aggregates are commingled in the pulverized feed material, they are disintegrated because of the Coanda effect and/or impact accompanying high-speed movement to be fine powder for removal, and even if some aggregates remain, they are simultaneously removed as coarse particles. As a result, aggregates are effectively removed.

A toner for developing electrostatic images may be generally prepared by melt-kneading the starting materials including a binder resin such as a styrene type resin, a styrene-acrylic acid ester type resin or a polyester type resin; a colorant such as carbon black or phthalocyanine blue and/or a magnetic material; an antioffset agent such as low-molecular weight polyethylene or low-molecular weight polypropylene; and a positive or negative charge control agent, followed by cooling, pulverization and classification. Ordinarily, with respect to 100 wt. parts of a binder resin, 0.1 to 30 wt. parts of a colorant (or/and 20 to 150 wt. parts of a magnetic material), 0.5 to 10 wt. parts of an anti-offset agent and 0 to 5 wt. parts of a charge control agent may be used. In case where a colorant functioning also as a charge control agent is used, the colorant may preferably be used in an amount of 0.5 to 10 wt. parts.

In case where it is difficult to obtain a uniform melt dispersion of the starting materials in the kneading step, the pulverized particles can include particles which are not suitable as toner particles commingled therein, such as those free of a colorant or magnetic particle or comprising an individual particle of a single starting material. In the conventional process involving a long residence time in the classification stage such unsuitable particles are liable to aggregate with each other and it is difficult to remove the resultant aggregates, so that toner characteristics are remarkably impaired thereby. In contrast thereto, in the process of the invention, the feed particles after the first classification are introduced into a classification chamber at a high velocity and classified into three or more fractions instantaneously so that such aggregates are not readily formed, and even if formed, they can be disintegrated or removed into the coarse particle fraction. As a result, a classified product (used as a toner) comprising particles of a uniform mixture and having an accurate particle size distribution is obtained.

In the present invention, the pulverized feed material may preferably have a weight-average particle size of 10 - 200 μm , and the fine powder classified in the first classification step may preferably have a weight-average particle size of 3 - 30 μm . The coarse powder from the first classification step may preferably be pulverized to have a weight-average particle size of 7 - 100 μm . The classified fine powder may be further classified by the multi-division classifier into a coarse powder fraction having a weight-average particle size of 7 - 40 μm , a medium powder fraction having a weight-average particle size of 3 - 15 μm and a fine or minute powder fraction of a weight-average particle size of 10 μm or smaller. In this instance, it is preferred that the medium powder fraction has a weight-average particle size which is larger than that of the fine powder fraction by 1 - 7 μm and smaller than that of the large particle size by 2 - 30 μm . It is important to satisfy the above conditions in order to obtain high production efficiency and classification yield of toner powder.

A toner produced from the product powder of the process of the present invention has a stable triboelectric charge provided by friction between the toner particles, and between the toner and a toner carrying member such as a sleeve or carrier. Development fog and scattering of toner around the edge of a latent image, which have not been fully solved heretofore, are extremely reduced, and a high density of image is achieved, leading to a good reproducibility of half tone. Even in the continuous use of a developer including the toner over a long period, an initial performance can be maintained and high quality images can be provided over a long period. Further, even in the use of the toner under environmental conditions of a high temperature and a high humidity, the triboelectric charge of the developer is stable and little vary as

compared with that when used under normal temperature and normal humidity, because the presence of extremely fine particles and the aggregate thereof are reduced. Therefore, the fog and decrease in density of image are reduced, enabling the development of images faithful to latent images. Moreover, the resulting toner images have an excellent transfer efficiency to a transfer material such as a paper. Even in the use of the toner under the conditions of a low temperature and a low humidity, a distribution of triboelectric charge is little different from that in the use at normal temperature and normal humidity, and because the extremely fine particle component having an extremely large charge per unit weight has been removed, the toner produced by the process of the present invention has such characteristics that there occur little reduction in density of image and little fog, and roughening and scattering during transfer hardly occur.

In producing a toner powder having a smaller particle size (e.g., an average particle size of 3 to 7 μm), the process of the present invention can be carried out more effectively than the prior art process is.

The present invention will now be described in detail by way of Examples.

Example 1

Styrene-acrylic acid ester resin (weight ratio of styrene to the acrylic ester 7:3, weight-average molecular weight of about 300,000)	100 wt.parts
Magnetite (particle size: about 0.2 μm)	60 wt.parts
Low molecular weight polyethylene (weight-average molecular weight of about 3,000)	2 wt.parts
Negatively chargeable control agent (Bontrone E81)	2 wt.parts

A toner feed material of a mixture having the above prescription was melt-kneaded at 180°C for about 1.0 hour, and cooled for solidification. The resulting mixture was roughly pulverized into particles of 100 to 1,000 μm in a hammer mill and then moderately pulverized into a weight-average particle size of 100 μm in a mechanical pulverizer (ACM Pulverizer available from Hosokawa Micron K.K.). The true density of the pulverized material 61 thus obtained was about 1.4. The pulverized material 61 was charged in a metering feeder 2 and introduced at a rate of 1.3 kg/min into a first fixed wall-type gas stream classifier (Gas-Stream Classifier DS-10 VR mfd. by Nippon Pneumatic Kogyo K.K.). The coarse powder from the classifier was pulverized by a jet mill pulverizer (Hypersonic Jet Mill PJM-I-10, mfd. by Nippon Pneumatic Kogyo K.K.) and then recycled to the first classifier. The particle size distribution of the fine powder classified from the first classifier was measured whereby the fine powder was found to have a weight-average particle size of about 12.5 μ (containing 5.5 wt. % of particles having a particle size below 5.04 μ and 8.2 wt. % of particles having a particle size of above 20.2 μm). The thus obtained fine powder was charged in a metering feeder 10 and introduced through a vibration feeder 3 at a rate of 1.3 kg/min into a multi-division classifier 1 as shown in Figures 2 and 3 for classification into three fractions of a coarse powder fraction, a medium powder fraction and a fine powder fraction by utilizing the Coanda effect. As the multi-division classifier utilizing the Coanda effect, Elbow Jet EJ-45-3 available from Nittetsu Kogyo K.K. was used.

For effecting the introduction, the collecting cyclones 4, 5 and 6 communicated with the exhaust pipes 11, 12 and 13 were operated to generate a reduced pressure in the classification chamber, by which the pulverized material was introduced at a velocity of about 100 m/sec through the supply nozzle 16. At this time, the static pressure P_1 in the intake pipe 14 at a point upstream of the inlet to the chamber was controlled at -290 mm.aq., i.e. -290 mm H₂O (gauge), and the static pressure P_2 in the intake pipe 15 was controlled at -70 mm.aq. The introduced fine powder was classified in an instant of 0.01 second or less. A medium powder suitable as a toner was collected in a yield of 85 wt.% in the collecting cyclone 5 for collecting the classified medium powder, and had a weight-average particle size of 11.5 μ (containing 0.3 wt. % of particles having a particle size of below 5.04 μ and 0.1 wt. % or less, i.e., a substantially negligible amount, of particles having a particle size of above 20.2 μm). As used herein, the term "yield" refers to a percentage of the amount of the medium powder finally obtained based on the total weight of the pulverized feed material. Substantially no aggregate of about 5 μm or larger resulting from the aggregation of extremely fine particles was found by the observation of the obtained medium powder through an optical microscope.

The classified coarse powder fraction was collected by the collecting cyclone 6 and then supplied to the metering feeder 2.

The obtained medium powder was electrically insulating. The medium powder was used as a toner, and 0.3 % by weight of hydrophobic silica was mixed with the toner to prepare a developer. The prepared

developer was supplied to a copier NP-270 RE (available from Canon K.K.) to effect a copying test. The results showed that copied images having no fog and a good developing property for thin lines were provided.

Comparative Example 1

A pulverized material produced in the same manner as in Example 1 was, introduced at a rate of 2.0 kg/min and classified in an apparatus system as shown in Figure 6.

The pulverized feed material having a weight-average particle size of 100 μm was introduced into a first fixed wall-type gas stream classifier (Gas-Stream Classifier DS-10 VR mfd. by Nippon Pneumatic Kogyo K.K.). The coarse powder from the classifier was pulverized by a jet mill pulverizer (Hypersonic Jet Mill PJM-I-10, mfd. by Nippon Pneumatic Kogyo K.K.) and then recycled to the first classifier. The particle size distribution of the fine powder classified from the first classifier was measured whereby the fine powder was found to have a weight-average particle size of about 9.6 μm (containing 10.0 wt. % of particles having a particle size below 5.04 μm and 0.5 wt. % of particles having a particle size of above 20.2 μm). The thus obtained fine powder was introduced to a second gas stream classifier (DS-10 VR) to be classified into a medium powder and a fine powder.

The medium powder had a weight-average particle size of about 11.6 μm and was obtained at a classification yield of 70 wt. %. The observation of the medium powder through an optical microscope showed that aggregate of about 5 μm or more was present in dots, resulting from the aggregation of the extremely fine particles. The production efficiency was also inferior compared with Example 1.

The resultant medium powder was used as a toner, and 0.3 % by weight of hydrophobic silica was mixed with the toner to prepare a developer. The prepared developer was supplied to a copier NP-270RE to effect a copying test. The results showed that the duplicated images had increased fog as compared with those obtained in Example 1.

When a fine powder containing about 8 wt. % of particles having a particle size of above 20.2 μm was introduced to the second classifier, the resultant classified medium powder contained many coarse particles and could not be a practical toner product.

Examples 2 - 4

Example 1 was repeated by changing the respective conditions as shown in the following tables together with those in Example 1.

[Pulverized feed material]

	Feed material	
	Average particle size (μm)	True density
Example 1	100	1.4
2	80	1.4
3	50	1.4
4	30	1.5 *1

*1: The amount of magnetite was increased to 80 wt. parts per 100 wt. parts of the binder resin.

[First classification step]

	Feed rate (kg/min)	Fine powder after the first classification		
		Wt.-average particle size (μm)	Content of below 5.04 μ (wt.%)	Content of above 20.2 μ (wt.%)
Example 1	1.3	12.5	5.5	8.2
2	1.5	12.3	5.5	7.5
3	1.6	12.1	5.5	6.3
4	2.0	9.5	11.0	2.0

[Pulverization step]

	Wt.-average particle size of the pulverized product (μm)
Example 1	about 30
2	" 27
3	" 20
4	" 15

[Multi-division classification step]

(residence time: 0.1 - 0.01 sec)

	Fine powder		Static pressure (mm.aq.-gage)	
	charge rate (kg/min)	charge velocity (m/sec)	P ₁	P ₂
Example 1	1.3	100	-290	-70
2	1.5	100	-295	-70
3	1.6	95	-300	-70
4	2.0	120	-350	-70

[Classification product from multi-division classifier]

	Medium powder					Size (μm)	
	Ave. size (μm)	Content of below 5.04 μm (wt.%)	Content of above 20.2 μm (wt.%)	Aggregate of above 5 μm	Yield (wt.%)	Coarse powder	Fine powder
Example 1	11.5	0.3	<0.1	substan- tially no	about 85	25	7
2	11.0	0.3	<0.1	"	about 83	24	7
3	11.0	0.3	<0.1	"	about 82	24	7
4	11.0	0.6	<0.1	"	about 85	16	6

55 Comparative Examples 2 - 4

Comparative Example 1 was repeated by changing the respective conditions as shown in the following tables together with those in Comparative Example 1.

[Pulverized feed material]

	Feed material		Remarks
	Ave. size (μm)	Time density	
Comparative Example 1	100	1.4	The same as in Example 1
" 2	80	1.4	The same as in Example 2
" 3	50	1.4	The same as in Example 3
" 4	30	1.5	The same as in Example 4

[First classification step]

	Feed rate (kg/min)	Fine powder after the first classification		
		Wt. ave. particle size (μm)	Content of below 5.04 μm (wt.%)	Content of above 20.2 μm (wt.%)
Comparative Example 1	1.0*	9.6	10	0.5
" 2	1.1	9.6	10	0.5
" 3	1.3	9.6	10	0.5
" 4	1.5	8.5	13	0.2

*Note: In order to obtain a medium powder having a particle size substantially similar to that obtained in Examples, it was necessary to reduce the feed rate.

[Pulverization step]

	Wt. average particle size of the pulverized product (μm)
Comparative Example 1	about 27 *
" 2	" 25
" 3	" 18
" 4	" 14

*Note: In order to prevent coarse particles from coming into the feed to the second classification step, it was necessary to increase the intensity of pulverization.

[Second classification step]

(Feed speed: about 30 m/sec, Residence time: about 20 sec)

Product	Medium powder				Fine powder	
	Wt. average size (μm)	Content of below 5.04 μm (wt.%)	Content of above 20.2 μm (wt.%)	Aggregate of above 5 μm	Wt. average size (μm)	
Comparative Example 1	11.6	0.4	2	observed	6.5	
" 2	11.2	0.4	2	"	6.5	
" 3	11.2	0.4	2	"	6.5	
" 4	10.3	0.7	1	"	6.5	

The classification yields of the medium powders and developing characteristic of the toners obtained therefrom in the respective Examples and Comparative Examples are summarized in the following Table.

	Classification yield (%)	Developing characteristics*	
		Fog	Reproducibility of thin lines
Example 1	about 85	o	o
2	" 83	o	o
3	" 82	o	o
4	" 85	o	o
Comparative Example 1	about 70	Δ	Δ
2	" 68	Δ	Δ
3	" 67	Δ	Δ
4	" 70	x	x

*Note: The evaluation standards were as follows:

o: Very good

Δ: Good

x: Somewhat poor

A toner for producing electrostatic latent images is produced by classifying a pulverized feed material into a coarse powder and a fine powder in a first classifying means, pulverizing and recycling the coarse powder to the first classifying means, introducing the fine powder into a multi-division classifying chamber divided into at least three sections where the fine powder is classified into at least a coarse powder fraction, a medium powder fraction and a fine powder fraction. The medium powder fraction is recovered to provide a toner. The coarse powder fraction is recycled to the first classifying means.

Claims

1. A process for producing toner particles for developing electrostatic latent images, comprising:

melt-kneading a composition comprising at least a binder resin and a colorant, cooling and solidifying the kneaded product and pulverizing the solidified product to prepare a pulverized feed material;

introducing the pulverized feed material to a first classifying means (9) to classify the feed material into a coarse powder and a fine powder;

introducing the classified coarse powder into a pulverization step (8) and recycling the resultant pulverized product to the first classification means (9);

characterised by introducing the classified fine powder into a multi-division classifying chamber (1) divided into at least three sections by partitioning means (17,18) so that the particles of the fine powder fall along curved paths due to the Coanda effect, wherein a coarse powder fraction comprising primarily particles having a particle size above a prescribed range is collected in a first divided section (11), a medium powder fraction comprising primarily particles having a particle size within the prescribed



	Classification yield (%)	Developing characteristics*	
		Fog	Reproducibility of thin lines
Example 1	about 85	○	○
2	" 83	○	○
3	" 82	○	○
4	" 85	○	○
Comparative Example 1	about 70	Δ	Δ
2	" 68	Δ	Δ
3	" 67	Δ	Δ
4	" 70	x	x

*Note: The evaluation standards were as follows:

○: Very good

Δ: Good

x: Somewhat poor

A toner for producing electrostatic latent images is produced by classifying a pulverized feed material into a coarse powder and a fine powder in a first classifying means, pulverizing and recycling the coarse powder to the first classifying means, introducing the fine powder into a multi-division classifying chamber divided into at least three sections where the fine powder is classified into at least a coarse powder fraction, a medium powder fraction and a fine powder fraction. The medium powder fraction is recovered to provide a toner. The coarse powder fraction is recycled to the first classifying means.

Claims

1. A process for producing toner particles for developing electrostatic latent images, comprising:
 - melt-kneading a composition comprising at least a binder resin and a colorant, cooling and solidifying the kneaded product and pulverizing the solidified product to prepare a pulverized feed material;
 - introducing the pulverized feed material to a first classifying means (9) to classify the feed material into a coarse powder and a fine powder;
 - introducing the classified coarse powder into a pulverization step (8) and recycling the resultant pulverized product to the first classification means (9);
 - characterised by introducing the classified fine powder into a multi-division classifying chamber (1) divided into at least three sections by partitioning means (17,18) so that the particles of the fine powder fall along curved paths due to the Coanda effect, wherein a coarse powder fraction comprising primarily particles having a particle size above a prescribed range is collected in a first divided section (11), a medium powder fraction comprising primarily particles having a particle size within the prescribed



range is collected in a second divided section (12), and a fine powder fraction comprising primarily particles having a particle size below the prescribed range is collected in a third divided section (13); and

introducing the collected coarse powder fraction into the first classifying means (9) together with the pulverized feed material (61).

2. A process according to Claim 1, wherein the fine powder is introduced into the multi-division classification chamber (1) at a speed of 50 - 300 m/sec.
- 10 3. A process according to Claim 1, wherein the fine powder is introduced by suction into the multi-division classification chamber (1).
4. A process according to Claim 1, wherein the first classifying means (9) comprises a fixed wall-type gas stream classifier.
- 15 5. A process according to Claim 1, wherein the fine powder is introduced into the multi-division classification chamber formed in a multi-division classifier (1) having a Coanda block (26).
- 20 6. A process according to Claim 5, wherein the fine powder fraction is introduced by suction into the multi-division classification chamber (1) at a speed of 50 to 300 m/sec.
7. A process according to Claim 1, wherein the pulverized feed material (61) has a weight-average particle size of 10 to 200 μm .
- 25 8. A process according to Claim 1, wherein pulverized feed material (61) is classified into the coarse powder and the fine powder having a weight-average particle size of 3 to 30 μm by the first classifying means.
- 30 9. A process according to Claim 8, wherein the classified coarse powder is pulverized in the pulverized step (8) to a powder having a weight-average particle size of 7 to 100 μm .
- 35 10. A process according to Claim 7, wherein the classified fine powder is classified in the multi-division classification chamber (1) into the coarse powder fraction having a weight-average particle size of 7 to 40 μm , the medium powder fraction having a weight-average particle size of 3 to 15 μm and the fine powder fraction having a weight-average particle size of 10 μm or smaller, in which the weight-average particle size of the medium powder fraction is larger by 1 to 7 μm than that of the fine powder fraction and smaller by 2 to 30 μm than that of the coarse powder fraction.
- 40 11. A process according to Claim 1, wherein the pulverized feed material (61) has a true density of 0.5 to 2.
12. A process according to Claim 1, wherein the pulverized feed material (61) has a true density of 0.6 to 1.7.
- 45 13. A process according to Claim 1, wherein the fine powder is classified into the coarse powder fraction, the medium powder fraction and the fine powder fraction in the multi-division classification chamber (1) in a period of 0.1 s or less.
- 50 14. A process according to Claim 1, wherein the pulverized feed material (61) is obtained through the melt-kneading, cooling and pulverization of the composition comprising 100 wt. parts of the binder resin, 0.1 to 30 wt. parts of the colorant, 0.5 to 10 wt. parts of an anti-offset agent, and 0 to 5 wt. parts of a charge control agent.
- 55 15. A process according to Claim 14, wherein the binder resin is a thermoplastic resin selected from the group consisting of styrene-type resin, styrene-acrylic acid ester-type resin, styrene-methacrylic acid ester-type resin, and polyester-type resin.
16. A process according to Claim 1, wherein the pulverized feed material is obtained through the melt-kneading, cooling and pulverization of the composition comprising 100 wt. parts of the binder resin, 20



to 150 wt. parts of a magnetic material, 0.5 to 10 wt. parts of an anti-offset agent, and 0 to 5 wt. parts of a charge control agent.

17. A process according to Claim 16, wherein the binder resin is a thermoplastic resin selected from the group consisting of styrene-type resin, styrene-acrylic acid ester-type resin, styrene-methacrylic acid ester-type resin, and polyester-type resin.

18. An apparatus for producing a toner for developing electrostatic latent images, comprising: metering feeder means (2) for metering and feeding a pulverized feed material (61) for a toner, first classifying means (9) for classifying the pulverized feed material into a fine powder and a coarse powder, pulverizing means (8) for pulverizing the coarse powder classified in the first classifying means (9), introduction means for introducing the pulverized powder from the pulverizing means (8) into the first classifying means (9), characterised by multi-division classifying means (1) having a Coanda block (26) for classifying the fine powder from the first classifying means (9) into at least a coarse powder fraction, a medium powder fraction and a fine powder fraction through the Coanda effect, and introduction means (11) for introducing the coarse powder fraction from the multi-division classifying means (1) to the metering feeder means (2).

19. An apparatus according to Claim 18, wherein the pulverizing means (8) comprises an impact-type classifier or a jet-type classifier.

20. An apparatus according to Claim 18, wherein said multi-division classifying means (1) has exhaust pipes (11,12,13) for withdrawing the classified coarse powder fraction, medium powder fraction and fine powder fraction, respectively.

21. An apparatus according to Claim 20, wherein said multi-division classifying means (1) is communicative with collecting cyclones (4,5,6,7) through the exhaust pipes (11,12,13).

22. An apparatus according to Claim 18, wherein said multi-division classifying means (1) has at least two intake pipes (14,15) for introducing a gas to the classifying zone.

23. An apparatus according to Claim 22, wherein the intake pipes (14,15) respectively have gas introduction control means (20,21) for controlling the rate of gas passing through the pipes.

24. An apparatus according to Claim 18, wherein said multi-division classifying means (1) has a supply nozzle (16) for introducing the fine powder into the classification chamber, the supply nozzle (16) comprising a flat rectangular pipe section and a tapered rectangular pipe section.

Revendications

1. Procédé de production de particules de toner pour le développement d'images électrostatiques latentes comprenant :

le malaxage à l'état fondu d'une composition comprenant au moins une résine formant un liant et un colorant, le refroidissement et la solidification du produit malaxé et la pulvérisation du produit solidifié pour préparer une charge pulvérisée;

l'introduction de la charge pulvérisée dans des premiers moyens de classification (9) pour classifier la charge en une poudre grossière et une poudre fine;

l'introduction de la poudre grossière classifiée dans un étage de pulvérisation (8) et le recyclage du produit pulvérisé résultant vers les premiers moyens de classification (9),

caractérisé par l'introduction de la poudre fine classifiée dans une chambre de classification (1) à divisions multiples, divisée en au moins trois sections par des moyens de séparation (17, 18) de manière que les particules de poudre fine tombent le long de trajets incurvés en raison de l'effet Coanda, une fraction de poudre grossière comprenant surtout des particules ayant une dimension supérieure à une plage prescrite étant recueillie dans une première section divisée (11), une fraction de poudre moyenne comprenant des particules ayant surtout une dimension à l'intérieur d'une plage prescrite étant recueillie dans une seconde section divisée (12) et une fraction de poudre fine comprenant surtout des particules d'une dimension au-dessous de la plage prescrite étant recueillie dans une troisième section divisée (13), et l'introduction de la fraction de poudre grossière recueillie



- dans les premiers moyens de classification (9) en même temps que la charge pulvérisée (61).
2. Procédé selon la revendication 1, dans lequel la poudre fine est introduite dans la chambre de classification à divisions multiples (1) à la vitesse de 50 - 300 m/s.
 3. Procédé selon la revendication 1, dans lequel la poudre fine est introduite par aspiration dans la chambre de classification à divisions multiples (1).
 4. Procédé selon la revendication 1, dans lequel les premiers moyens de classification (9) comprennent un classificateur à courant de gaz du type à paroi fixe.
 5. Procédé selon la revendication 1, dans lequel la poudre fine est introduite dans une chambre de classification à divisions multiples formée dans un classificateur à divisions multiples (1) comportant un bloc Coanda (26).
 6. Procédé selon la revendication 5, dans lequel la fraction de poudre fine est introduite par aspiration dans la chambre de classification à divisions multiples (1) à la vitesse de 50 à 300 m/s.
 7. Procédé selon la revendication 1, dans lequel la dimension des particules de poids moyen de la charge pulvérisée (61) est comprise entre 10 et 200 μm .
 8. Procédé selon la revendication 1, dans lequel la charge pulvérisée (61) est classifiée en poudre grossière et en poudre fine ayant une dimension de particules de poids moyen comprise entre 3 et 30 μm par les premiers moyens de classification.
 9. Procédé selon la revendication 8, dans lequel la poudre grossière classifiée est pulvérisée dans l'étage de pulvérisation (8) en une poudre ayant une dimension de particules de poids moyen comprise entre 7 et 100 μm .
 10. Procédé selon la revendication 7, dans lequel la poudre fine classifiée est classifiée dans une chambre de classification à divisions multiples (1) en une fraction de poudre grossière ayant une dimension de particules de poids moyen comprise entre 7 et 40 μm , une fraction de poudre moyenne ayant une dimension de particules de poids moyen comprise entre 3 et 15 μm , et une fraction de poudre fine ayant une dimension de particules de poids moyen de 10 μm ou moins, la dimension des particules de poids moyen de la fraction de poudre moyenne étant supérieure de 1 à 7 μm à celle de la fraction de poudre fine et inférieure de 2 à 30 μm à celle de la fraction de poudre grossière.
 11. Procédé selon la revendication 1, dans lequel la charge pulvérisée (61) présente une densité vraie comprise entre 0,5 et 2.
 12. Procédé selon la revendication 1, dans lequel la charge pulvérisée (61) présente une densité vraie comprise entre 0,7 et 1,7.
 13. Procédé selon la revendication 1, dans lequel la poudre fine est classifiée en fraction de poudre grossière, en fraction de poudre moyenne et en fraction de poudre fine dans la chambre de classification à divisions multiples (1) pendant une période de 0,1 s ou moins.
 14. Procédé selon la revendication 1, dans lequel la charge pulvérisée (61) est obtenue par le malaxage à l'état fondu, le refroidissement et la pulvérisation de la composition comprenant 100 parties en poids de la résine formant le liant, de 0,1 à 30 parties en poids du colorant, de 0,5 à 10 parties en poids d'un agent anti-offset, et de 0 à 5 parties en poids d'un agent de contrôle de charge.
 15. Procédé selon la revendication 14, dans lequel la résine formant le liant est une résine thermoplastique choisie dans le groupe formé par une résine de type styrène, une résine de type ester styrène-acide acrylique, une résine de type ester styrène-acide méthacrylique et une résine de type polyester.
 16. Procédé selon la revendication 1, dans lequel la charge pulvérisée est obtenue par malaxage à l'état fondu, refroidissement et pulvérisation de la composition comprenant 100 parties en poids de la résine



formant le liant, 20 à 150 parties en poids d'un matériau magnétique, 0,5 à 10 parties en poids d'un agent offset, et 0 à 5 parties en poids d'un agent de contrôle de charge.

- 5 17. Procédé selon la revendication 16, dans lequel la résine formant le liant est une résine thermoplastique choisie dans le groupe formé par une résine de type styrène, une résine de type ester styrène-acide acrylique, une résine de type ester styrène-acide méthacrylique et une résine de type polyester.
- 10 18. Appareil pour la production d'un toner pour développer des images électrostatiques latentes comprenant: des moyens d'alimentation et de dosage (2) pour doser et alimenter une charge pulvérisée (61) pour un toner, des premiers moyens de classification pour classier la charge pulvérisée en une poudre fine et en une poudre grossière, des moyens de pulvérisation (8) pour pulvériser la poudre grossière classifiée dans les premiers moyens de classification (9), des moyens d'introduction pour introduire la poudre pulvérisée provenant des moyens de pulvérisation (8) dans les premiers moyens de classification (9), caractérisé par des moyens de classification (1) à divisions multiples comprenant un bloc Coanda (26) pour classier la poudre fine provenant des premiers moyens de classification (9) en au moins une fraction de poudre grossière, une fraction de poudre moyenne et une fraction de poudre fine par l'effet Coanda, et des moyens d'introduction (11) pour introduire la fraction de poudre grossière provenant des moyens de classification à divisions multiples (1) vers les moyens d'alimentation et de dosage (2).
- 20 19. Appareil selon la revendication 18, dans lequel les moyens de pulvérisation (8) comprennent un classificateur du type à impact ou un classificateur du type à jet.
- 25 20. Appareil selon la revendication 18, dans lequel lesdits moyens de classification à divisions multiples (1) comprennent des tuyaux d'échappement (11, 12, 13) pour éliminer la fraction de poudre grossière, la fraction de poudre moyenne et la fraction de poudre fine classifiées, respectivement.
- 30 21. Appareil selon la revendication 20, dans lequel lesdits moyens de classification à divisions multiples (1) communiquent avec des cyclones collecteurs (4, 5, 6, 7) par l'intermédiaire des tuyaux d'échappement (11, 12, 13).
- 35 22. Appareil selon la revendication 18, dans lequel lesdits moyens de classification à divisions multiples (1) comprennent au moins deux tuyaux d'admission (14, 15) pour introduire un gaz dans la zone de classification.
- 40 23. Appareil selon la revendication 22, dans lequel les tuyaux d'admission (14, 15) comprennent respectivement des moyens de commande d'introduction de gaz (20, 21) pour commander le débit du gaz qui passe par les tuyaux.
- 45 24. Appareil selon la revendication 18, dans lequel lesdits moyens de classification à divisions multiples (1) comprennent une buse d'alimentation (16) pour introduire la poudre fine dans la chambre de classification, la buse d'alimentation (16) comprenant une section de tube rectangulaire et plate et une section de tube rectangulaire effilée.

45 Patentansprüche

1. Verfahren zur Herstellung von Tonerteilchen zur Entwicklung elektrostatischer latenter Bilder indem man:
 - 50 eine Zusammensetzung, die mindestens ein Bindeharz und ein Färbemittel umfasst, schmelzketet, das geknetete Produkt abkühlt und verfestigt und das verfestigte Produkt zur Herstellung eines pulverisierten Beschickungsmaterials pulverisiert;
 - das pulverisierte Beschickungsmaterial in eine erste Klassifizierungsvorrichtung (9) zur Klassifizierung des Beschickungsmaterials in ein grobes Pulver und ein feines Pulver einbringt;
 - das klassifizierte grobe Pulver in einen Pulverisierungsschritt (8) einbringt und das entstehende pulverisierte Produkt in die erste Klassifizierungsvorrichtung (9) zurückführt;
 - 55 dadurch gekennzeichnet, daß man das klassifizierte feine Pulver in eine mehrfach unterteilte Klassifizierungskammer (1), die in mindestens drei Abteilungen durch Abtrennungsvorrichtungen (17,18) unterteilt ist, einbringt, so daß die Teilchen des feinen Pulvers entlang gekrümmter Bahnen, gemäß



dem Coanda-Effekt fallen, wobei eine Fraktion groben Pulvers, die hauptsächlich Teilchen mit einer Teilchengröße über einem vorgeschriebenen Bereich umfasst, in einer ersten abgetrennten Abteilung (11) gesammelt wird, eine Fraktion mittleren Pulvers, die hauptsächlich Teilchen mit einer Teilchengröße innerhalb des vorgeschriebenen Bereiches umfasst, in einer zweiten abgetrennten Abteilung (12) gesammelt wird und eine Fraktion feinen Pulvers, die hauptsächlich Teilchen mit einer Teilchengröße unter dem vorgeschriebenen Bereich umfasst, in einer dritten abgetrennten Abteilung (13) gesammelt wird; und

die gesammelte Fraktion groben Pulvers in die erste Klassifizierungsvorrichtung (9) zusammen mit dem pulverisierten Beschickungsmaterial (61) einbringt.

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2. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das feine Pulver in die mehrfach unterteilte Klassifizierungskammer (1) mit einer Geschwindigkeit von 50 bis 300 m/s eingebracht wird.

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3. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das feine Pulver durch Ansaugkraft in die mehrfach unterteilte Klassifizierungskammer (1) eingebracht wird.

4. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß die erste Klassifizierungsvorrichtung (9) ein Gasstromklassiergerät vom Typ mit fester Wand umfasst.

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5. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das feine Pulver in die mehrfach unterteilte Klassifizierungskammer, die in einem mehrfach unterteilten Klassiergerät (1) mit einem Coanda-Block (26) gebildet wird, eingebracht wird.

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6. Verfahren nach Anspruch 5 **dadurch gekennzeichnet**, daß die Fraktion feinen Pulvers durch Ansaugkraft in die mehrfach unterteilte Klassifizierungskammer (1) mit einer Geschwindigkeit von 50 bis 300 m/s eingebracht wird.

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7. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial (61) eine gewichtsbezogene, mittlere Teilchengröße von 10 bis 200 μm hat.

8. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial (61) in das grobe Pulver und das feine Pulver mit einer gewichtsbezogenen, mittleren Teilchengröße von 3 bis 30 μm in der ersten Klassifizierungsvorrichtung klassifiziert wird.

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9. Verfahren nach Anspruch 8 **dadurch gekennzeichnet**, daß das klassifizierte grobe Pulver in dem Pulverisierungsschritt (8) zu einem Pulver mit einer gewichtsbezogenen, mittleren Teilchengröße von 7 bis 100 μm pulverisiert wird.

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10. Verfahren nach Anspruch 7 **dadurch gekennzeichnet**, daß das klassifizierte feine Pulver in der mehrfach unterteilten Klassifizierungskammer (1) in die Fraktion groben Pulvers mit einer gewichtsbezogenen, mittleren Teilchengröße von 7 bis 40 μm , die Fraktion mittleren Pulvers mit einer gewichtsbezogenen, mittleren Teilchengröße von 3 bis 15 μm und die Fraktion feinen Pulvers mit einer gewichtsbezogenen, mittleren Teilchengröße von 10 μm oder kleiner klassifiziert wird, wobei die gewichtsbezogene, mittlere Teilchengröße der Fraktion mittleren Pulvers um 1 bis 7 μm größer als die der Fraktion feinen Pulvers und 2 bis 30 μm kleiner als die der Fraktion groben Pulvers ist.

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11. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial (61) eine wahre Dichte von 0,5 bis 2 hat.

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12. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial (61) eine wahre Dichte von 0,6 bis 1,7 hat.

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13. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das feine Pulver in der mehrfach unterteilten Klassifizierungskammer (1) in einem Zeitraum von 0,1 s oder weniger in die Fraktion groben Pulvers, die Fraktion mittleren Pulvers und die Fraktion feinen Pulvers klassifiziert wird.

14. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial (61) durch Schmelzkneten, Abkühlung und Pulverisierung der Zusammensetzung gewonnen wird, die



100 Gewichtsteile des Bindeharzes, 0,1 bis 30 Gewichtsteile des Färbemittels, 0,5 bis 10 Gewichtsteile eines Antiabsetzmittels und 0 bis 5 Gewichtsteile eines Ladungssteuerungsmittels umfasst.

15. Verfahren nach Anspruch 14 **dadurch gekennzeichnet**, daß das Bindeharz ein thermoplastisches Harz ist, ausgewählt aus einem Harz vom Styroltyp, vom Styrol-Acrylsäureestertyp, vom Styrol-Methacrylsäureestertyp und vom Polyestertyp.
16. Verfahren nach Anspruch 1 **dadurch gekennzeichnet**, daß das pulverisierte Beschickungsmaterial durch Schmelzkneten, Abkühlung und Pulverisierung der Zusammensetzung gewonnen wird, die 100 Gewichtsteile des Bindeharzes, 20 bis 150 Gewichtsteile eines magnetischen Materials, 0,5 bis 10 Gewichtsteile eines Antiabsetzmittels und 0 bis 5 Gewichtsteile eines Ladungssteuerungsmittels umfasst.
17. Verfahren nach Anspruch 16 **dadurch gekennzeichnet**, daß das Bindeharz ein thermoplastisches Harz ist, ausgewählt aus einem Harz vom Styroltyp, vom Styrol-Acrylsäureestertyp, vom Styrol-Methacrylsäureestertyp und vom Polyestertyp.
18. Vorrichtung zur Herstellung eines Toners zur Entwicklung elektrostatischer latenter Bilder, die folgendes umfasst: eine Dosier-Aufgabevorrichtung (2) zur Dosierung und Beschickung eines pulverisierten Beschickungsmaterials (81) für einen Toner, eine erste Klassifizierungsvorrichtung (9) zur Klassifizierung des pulverisierten Beschickungsmaterials in ein feines Pulver und ein grobes Pulver, eine Pulverisierungsvorrichtung (8) zur Pulverisierung des in der ersten Klassifizierungsvorrichtung (9) klassifizierten groben Pulvers, eine Einleitungsvorrichtung zur Einbringung des pulverisierten Pulvers aus der Pulverisierungsvorrichtung (8) in die erste Klassifizierungsvorrichtung (9) **gekennzeichnet durch eine mehrfach unterteilte Klassifizierungsvorrichtung (1) mit einem Coanda-Block (26) zur Klassifizierung des feinen Pulvers aus der ersten Klassifizierungsvorrichtung (9) in mindestens eine Fraktion groben Pulvers, eine Fraktion mittleren Pulvers und eine Fraktion feinen Pulvers durch den Coanda-Effekt und eine Einleitungsvorrichtung (11) zur Einbringung der Fraktion groben Pulvers aus der mehrfach unterteilten Klassifizierungsvorrichtung (1) in die Dosier-Aufgabevorrichtung (2).**
19. Vorrichtung nach Anspruch 18 **dadurch gekennzeichnet**, daß die Pulverisierungsvorrichtung (8) ein Klassiergerät vom Aufpralltyp oder ein Klassiergerät vom Strahltyp umfasst.
20. Vorrichtung nach Anspruch 18 **dadurch gekennzeichnet**, daß die mehrfach unterteilte Klassifizierungsvorrichtung (1) Austrittsrohre (11, 12, 13) jeweils zur Entfernung der klassifizierten Fraktion groben Pulvers, mittleren Pulvers und feinen Pulvers hat.
21. Vorrichtung nach Anspruch 20 **dadurch gekennzeichnet**, daß die mehrfach unterteilte Klassifizierungsvorrichtung (1) mit Sammelzyklonen (4, 5, 6, 7) durch die Austrittsrohre (11, 12, 13) in Verbindung steht.
22. Vorrichtung nach Anspruch 18 **dadurch gekennzeichnet**, daß die mehrfach unterteilte Klassifizierungsvorrichtung (1) mindestens zwei Einleitungsrohre (14, 15) zur Einleitung eines Gases in die Klassifizierungszone hat.
23. Vorrichtung nach Anspruch 22 **dadurch gekennzeichnet**, daß die Einleitungsrohre (14, 15) jeweils eine Vorrichtung zur Steuerung der Gaseinleitung (20, 21) zur Steuerung der Geschwindigkeit des Gases, das durch die Rohre fließt, haben.
24. Vorrichtung nach Anspruch 18 **dadurch gekennzeichnet**, daß die mehrfach unterteilte Klassifizierungsvorrichtung (1) eine Zuführungsdüse (16) zur Einbringung des feinen Pulvers in die Klassifizierungskammer hat, wobei die Zuführungsdüse (16) einen ebenen, rechtwinkligen Rohrabschnitt und einen konischen, rechtwinkligen Rohrabschnitt umfasst.