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(54) Method for producing toner for electrostatic development

Verfahren zur Herstellung von elektrostatischen Tonern

Procédé pour la fabrication de toner de développement électrostatique

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method for producing a toner for electrostatic image development and, more specifically, it relates to an economically advantageous method for producing a toner for electrostatic image development, causing less fogging and capable of providing a satisfactory image quality, in use.

[0002] A toner for electrostatic image development (hereinafter simply referred to as "toner") comprises resin particles having particle size of 1 to 50 µm, preferably, an average classified diameter of 3 to 15 µm in which a colorant and, if required, toner property-imparting agents (for example, a charge controlling agent and magnetic particles) are dispersed in a thermoplastic resin as a binder resin. The toner is used as a one-component developer containing the toner alone or as a two-component developer containing a mixture of the toner with a carrier.

[0003] Generally, the toner is produced by mixing starting toner materials, kneading them in a melt extruder or the like and then cooling and grinding them. In production of the toner, the grinding process is a particularly important step for giving an influence on the characteristics of the toner. Namely, an excessively ground toner causes fogging, whereas an insufficiently ground toner deteriorates image quality.

[0004] The grinding process for producing the toner usually comprises three steps, namely, coarse crushing step, medium crushing step and fine pulverizing step. Such grinding process is proposed, for example, in Japanese Patent Application Laid-Open (Kokai) No. 58-42057 (1983). In the grinding process as described in the publication, a toner material extruded from a melt extruder into a plate shape and then cooled to solidify is at first crushed by a hammer crusher, then crushed to a medium size by an impact crusher and then further pulverized finely by a jet pulverizer. Subsequently, a classifying treatment is applied to recover a toner.

[0005] However, since the grinding process described above consumes much energy in the medium crushing step and the fine pulverizing step, it can not be considered as an economically advantageous method. Further, in the pulverization using the jet pulverizer, an over-pulverized toner is formed by as much as 15 to 40% by weight and, accordingly, the over-pulverized toner tends to intrude into final toner products and the productivity becomes poor because the over-pulverized toner has to be removed and, in addition, an additional energy is required for re-using the over-pulverized toner once removed.

[0006] In view of the above, the present inventors have found that by using a specific pulverizer, a toner for electrostatic charge development, causing less fogging and capable of providing satisfactory image quality can be produced with less occurrence of over-pulverized toner, at a satisfactory productivity and with an economical advantage. The present invention has been accomplished based on the finding.

[0007] The present invention provides a method for producing an electrostatic toner comprising a resin and a colorant and having a particle size of from 2 to 15 µm, comprising the steps of melting, kneading, cooling and crushing the toner material and then pulverizing the crushed toner material by use of an impact pulverizer including a pulverizing section formed between an outer surface of a rotor and an inner surface of a stator and a discharge opening, each of the outer surface and the inner surface having ridges of a triangular waveform, and a gap between the ridges of the rotor and of the stator in the pulverizing section in which two flanks form each triangular waveform ridge, a first flank located on a front side in the case of the rotor and on a rear side in the case of the stator when viewed in the direction of rotation of the rotor having an angle of 20 to 70° relative to a tangent line of the rotor or stator, and a second flank located on the rear side in the case of the rotor and on the front side in the case of the stator when viewed in said direction having an angle of 45 to 140° relative to said tangent, the latter angle being larger than the former angle.

Fig. 1 is a cross sectional view for an embodiment of an impact pulverizer according to the present invention;
Fig. 2 is a cross sectional view taken along line A-A in Fig 1.
Fig. 3 is a schematic cross sectional view for an embodiment of an impact pulverizer having a tapered rotor and a tapered stator;
Fig. 4 is a schematic cross sectional view for an embodiment of an impact pulverizer having a stepped rotor and a stepped stator.

DETAILED DESCRIPTION OF THE INVENTION

[0008] In the present invention, starting toner materials are generally at first mixed, kneaded and extruded into a plate shape or the like, for example, in a melt extruder and then cooled to solidify. As the starting toner materials, at least a binder resin and a colorant are used as essential ingredients and, if necessary, a charge controlling agent or the like may also be used.

[0009] As the resin, various kinds of known resins suitable to the toner can be used. There can be mentioned, for example, styrene resins, vinyl chloride resins, rosin-modified maleic acid resins, phenol resins, epoxy resins, polyesters, polyethylenes, polypropylenes, ionomer resins, polyurethanes, silicone resins, ketone resins, ethylene-ethyl acrylate resins, xylene resins, polyvinyl butyral resins and polycarbonate resins.

[0010] The styrene resin is a homopolymer or a copolymer including styrene or substituted styrenes. Specifically there can be mentioned polystyrene, chloropolystyrene, poly-α-methylstyrene, styrene-chlorostyrene copolymer, sty-rene-propylene copolymer, styrene-butadiene copolymer, styrene-vinyl chloride copolymer, styrene-vinyl acetate copolymer, styrene-acrylic acid ester copolymer (for example, styrene-methyl acrylate copolymer, styrene-ethyl acrylate copolymer, styrene-butyl acrylate copolymer, styrene-octyl acrylate copolymer and styrene-phenyl acrylate copolymer), styrene methacrylic acid ester copolymer (for example, styrene-methyl methacrylate copolymer, styrene-ethyl methacrylate copolymer, styrenebutyl methacrylate copolymer, styrene-octyl methacrylate copolymer and styrene-phenyl methacrylate copolymer), styrene-α-methyl chloroacrylate and styrene-acrylonitrileacrylate copolymer.

[0011] Among the resins described above, particularly, styrene resins, saturated or unsaturated polyesters and epoxy resins are usually used. Further, crosslinked binder resins as described in Japanese Patent Publication (Kokoku) No. 51-23354 (1976) and Japanese Patent Application Laid-Open (Kokai) No. 50-44836 (1975) and non-crosslinked binder resins as described in Japanese Patent Publication (Kokoku) No. 55-6895 (1980) and Japanese Patent Publication (Kokoku) No. 63-32180 (1988) can also be used. Two or more of such resins may be used in combination.

[0012] As the colorant, for example, carbon black, nigrosines, benzidine yellow, quinacridone, rhodamine B and phthalocyanine blue can be used suitably. The colorant is used usually from 0.1 to 30 parts by weight and, preferably, 3 to 15 parts by weight based on 100 parts by weight of the resin.

[0013] As the charge controlling agent, there can be mentioned a positive charge controlling agent, for example, a quaternary ammonium salt, a nigrosine dye, a triphenyl methane dye, styrene-aminoacrylate copolymer and a polyamine resin, and a negative charge controlling agent such as a monoazo metal complex salt. The charge controlling agent is used preferably from 0.1 to 10 parts by weight based on 100 parts by weight of the resin.

[0014] Further, in the present invention, various kinds of toner property-imparting agents can also be used. For instance, polyethylene wax or polypropylene wax can be used for preventing offset. Further, inorganic fine particles, for example, of titania, alumina and silica can be used for improvement of the flowability and anti-coagulation property. The toner property-imparting agent can be used preferably from 0.1 to 10 parts by weight based on 100 parts by weight of the resin.

[0015] Moreover, additives such as magnetic particles can be added as necessary. As the magnetic particles, alloys or compounds containing ferromagnetic elements such as iron, cobalt and nickel, for example, ferrites and magnetites can be mentioned. The magnetic particles are used at a ratio usually from 20 to 70 parts by weight based on 100 parts by weight of the resin.

[0016] Then, in the present invention, the cooled and solidified toner material is ground. The grinding process according to the present invention comprises at least two steps. In the first grinding step, the toner material is crushed by a coarse crusher such as a hammer crusher. The degree of the crushing is suitably within a range from 100 to 1000 μm expressed as a weight average particle diameter. The weight average particle diameter is a median particle diameter of particle diameter-weight distribution, which can be measured, for example, Coulter counter manufactured Coulter Electronics Co The main feature of the present invention lies in the second grinding step in which the crushed toner material is pulverized by an impact pulverizer having a specific pulverizing section.

[0017] Heretofore, several pulverizers have been proposed as a pulverizer capable of finely pulverizing an usual solid material into fine particles of from several microns to several tens micron order. For instance, Japanese Patent Application Laid-Open (Kokai) No. 59-105853 (1984) proposes a vertical pulverizer capable of pulverizing an usual solid material into fine particles of from several microns to ten and several microns order, having a pulverizing section in which a stator having a plurality of ridges of a triangular waveform on an inner surface and a rotor having a plurality of ridges of a rectangular convex shape on an outer surface are disposed at a gap. Also, the above mentioned publication describes, as a prior art, a pulverizer in which both of ridges of the stator and the rotor are in a rectangular convex shape, and a vertical pulverizer in which the ridges of the stator are in a rectangular convex shape and the ridges of a rotor is formed by embedding flat plates. The vertical pulverizer having the similar pulverizing section to that described in the above-mentioned laid-open publication is also proposed by Japanese Patent Application Laid-Open (Kokai) Nos. 59-189944 (1984) and 59-196751 (1984).

[0018] Further, Japanese Patent Application Laid-Open (Kokai) No. 59-127651 (1984) proposes, as a pulverizer capable of easily pulverizing fibrous plant or vegetable substance such as wood dust or saw dust or soft material such as rubber into a size of several tens micron order, a vertical pulverizer having a pulverizing section in which a stator having a plurality of ridges each having a pulverizing blade of an extremely acute angle at an inner surface and a rotor having a plurality of ridges each having a pulverizing blade of an extremely acute angle at an outer surface are disposed at a gap. A triangular waveform and an inverted trapezoidal shape have been disclosed as the shape of the ridges.

[0019] Further, Japanese Patent Application Laid-Open (Kokai) No. 63-104658 (1988) proposes, as a vertical pulverizer capable of finely pulverizing a usual solid material into fine particles, a vertical pulverizer having a pulverizing section in which ridges of both of a stator and a rotor are formed each in a rectangular convex shape, a pulverizing section in which ridges of a stator are in a rectangular convex shape and ridges of a rotor is formed by embedding flat plates, or a pulverizing section in which both of ridges of a stator and a rotor are in a triangular waveform, in the same manner as proposed in Japanese Patent Application Laid-Open (Kokai) No. 59-105853 (1984) described above.

[0020] In the present invention, it is necessary to use a pulverizer (impact pulverizer) having a pulverizing section in which a stator having a plurality of ridges of a triangular waveform on an inner surface and a stator having a plurality of ridges of a triangular waveform on an outer surface are disposed at a gap between the ridges of the stator and of the rotor.

[0021] While pulverizing sections having ridges of various shapes have been proposed by laid-open publications described above, it has unexpectedly found according to the present inventors that by using not the pulverizing section in the pulverizer proposed as a pulverizer capable of suitably pulverizing into fine particles from several micron meters to ten and several micron meter order but using a pulverizer having the pulverizing section defined above, a toner causing less fogging and capable of providing a satisfactory image quality can be produced by using only one pulverizing step instead of the medium crushing step and the fine pulverizing step in the conventional method.

[0022] Fig. 1 is a cross sectional view for an embodiment of an impact pulverizer used in the present invention and Fig. 2 is a cross sectional view taken along line A-A in Fig. 1.

[0023] The impact pulverizer used in the present invention is not restricted to the vertical pulverizer as described in Japanese Patent Application Laid-Open (Kokai) No. 59-127651 (1984) but it may be a horizontal one. The horizontal pulverizer basically comprises a pulverizing section 4 formed between a rotor 1 supported by a horizontal rotating shaft 2 and having a plurality of ridges 3 along a generatrices of an outer surface thereof, and a stator 6 fitted at a gap to the rotor and having a plurality of ridges 5 along generatrices of an inner surface thereof. Each of the rotor 1 and the stator 6 usually has a cylindrical shape. A feed opening 7 and a discharge opening 8 are usually disposed, respectively, to an upper left and upper right sections of a casing constituting the stator 6. Further, agitating blades 9 and 10 rotating integral with the rotor 1 at high speed are secured to the right and left sides of the rotor 1, respectively, but the agitating blades may be omitted depending on the case.

[0024] In the impact pulverizer used in the present invention, it is important that both of the ridges 5 of the stator 6 and the ridges 3 of the rotor 1 are formed each in a triangular waveform (in the cross section). The triangular waveform ridge 5 can be constituted by forming concaves 5a and convexes 5b each substantially in a triangular shape successively, while the triangular waveform ridge 3 can be constituted by forming concaves 3a and convexes 3b successively.

[0025] Two flanks forming a triangular waveform ridge have (as stated above) angles relative to a tangent line of the rotor or stator of 20 to 70° and 45 to 140°, respectively [the latter is larger than the former]. An angle at the top end of a ridge constituted with the two flanks is usually from 30 to 90°. Further, the distance from the top end of the convex to the bottom of the concave is usually from 1 to 10 mm and the ridge pitch is usually from 1 to 10 ridges/cm.

[0026] The crushed toner material is treated by the above-mentioned pulverizer as described below. The crushed toner material is supplied from the feed opening 2, sent into a pulverizing section 4 by an air stream caused by the rotor 1, pulverized therein and then discharged by an air stream caused by the rotor 1.

[0027] Operation conditions for the impact pulverizer are properly selected and an atmospheric temperature is preferably within a range from 30 to 50°C and a circumferential speed of the rotor 1 is preferably within a range from 100 to 200 m/s. The rotating direction of the rotor 1 is preferably determined in the direction shown by an arrow in Fig. 2, that is, in such a direction that an acutely-sloped flank of each ridge 5 of the stator 6 does not meet against that of each ridge 3 of the rotor 1, in other words in such a direction that an obtuse-sloped flank of the triangular ridge 3 of the rotor 1 leads when the rotor 1 rotates, and faces to that of the triangular ridge 5 of the stator 6. The rotor rotates relatively to the stator and it is not always necessary that the stator is stationary as shown Fig. 1. Further a gap (t) disposed between the ridges of the rotor 1 and of the stator 6 (gap between the ridge tops of the rotor 1 and the ridge tops of the stator 6) is properly selected, for example, depending on a desired average particle diameter and it is usually from 1.1 to 3 mm.

[0028] The toner materials treated in the impact pulverizer described above and discharged from the discharge opening 8 preferably have a weight average particle diameter of 2 to 15 µm. Further, the toner is preferably applied with classifying treatment. Then, only the toner within a range of a desired particle diameter is recovered. The weight average particle diameter of the classified toner is preferably within a range from 3 to 15 µm. There is no particular restriction on the classifying device and various kinds of classifiers, for example, air classifier or multi-divisional classifier utilizing Coanda effect can be adopted. Then, a slight amount of coarse toner can be circulated to and re-crushed in the impact pulverizer described above, while an over-pulverized toner can be circulated to a melt extruder.

[0029] In the method for producing the toner according to the present invention, if it is required for a toner of particularly small particle diameter (for example, weight average particle diameter of 2 to 12 µm), it is preferred that the crushed toner material is once pulverized in the upstream portion of the pulverizing section having a larger gap between the ridges of the rotor and of the stator and, subsequently, pulverized in the downstream portion of the pulverizing section with a smaller gap. As an embodiment of the pulverization, there can be mentioned a method of serially connecting two or more impact pulverizers, and setting the gap in the pulverizing section of the impact pulverizer at or after the second stage is made smaller than the gap in the pulverizing section of the impact pulverizer at the first stage. As an another embodiment, there can be mentioned a method of pulverizing by using an impact pulverizer in which the gap in the pulverizing section on the side of the discharge opening is made smaller than the gap in the pulverizing section on the side of the feed opening. As a further preferred embodiment, there can be mentioned a method of pulverizing by an impact pulverizer in which the gap in the pulverizing section is decreased continuously or stepwise from the feed opening to the discharge opening as shown in Fig. 3 and Fig. 4.

[0030] Fig. 3 is a schematical, vertical cross sectional view of the impact pulverizer in which the rotor 1 and the stator 6 are continuously tapered such that they increase their thickness from the feed opening 7 to the discharge opening 8 (tapered rotor and stator). On the other hand, Fig. 4 shows a rotor and a stator each having two or more steps, in which each of the rotor 1 and the stator 6 has the thickness increased stepwise from the feed opening 7 to the discharge opening 8.

[0031] Accordingly, the present invention also provides an impact pulverizer comprising a feed opening for a material to be pulverized, a pulverizing section formed between an outer surface of a rotor and an inner surface of a stator and a discharge opening, each of the outer surface and the inner surface having ridges of a triangular waveform, and a gap between the ridges of the rotor and of the stator in the pulverizing section on the side of the discharge opening being smaller than that between the ridges of the rotor and of the stator in the pulverizing section on the side of the feed opening.

[0032] Use of the impact pulverizer can provide an effect of transporting a crushed toner material supplied from the feed opening to pulverizing sections of gradually decreased gap and capable of conducting efficient pulverization. Particularly, use of the impact pulverizer having the stepped rotor and the stepped stator as shown in Fig. 4 provides an advantageous effect, in addition to the effect described above, of rebounding coarse particles and pulverizing them repeatingly, thereby producing a pulverized toner material having a sharp particle size distribution.

[0033] As the impact pulverizer used in this embodiment, an impact pulverizer in which only one of the stator and the rotor is tapered or stepped can also be used suitably in addition to the impact pulverizer having the pulverizing section as shown in Fig. 3 and Fig. 4. Further, a combination of a tapered stator and a stepped rotor or a tapered rotor and a stepped stator may also be used.

[0034] The gap (X) in the upstream portion of the pulverizing section (a portion of the pulverizing section with a larger gap) and a gap (Y) in the downstream portion of the pulverizing section (a portion of the pulverizing section with a smaller gap) can be selected properly depending on the particle diameter of the supplied material to be pulverized and a desired particle diameter of the pulverizate. X is preferably from 0.3 mm to 3 mm, more preferably, from 0.5 mm to 2.5 mm, while Y is preferably from 0.1 mm to 2.5 mm and more preferably, 0.2 mm to 2 mm. The X to Y ratio is preferably as: $1 < (X/Y) \leq 10$.

[0035] In the above, the term "gap" means a distance between the top of the ridge of the rotor and the top of the ridge of the stator.

[0036] The method for producing the toner in this embodiment may include a step of separation by disposing a classifying means before supplying the crushed toner material to an impact pulverizer or by disposing a classifying means between a pulverizing section with a large gap and a pulverizing section with a small gap. Further, in a case of serially connecting three or more impact pulverizers, or in a case of disposing three or more-stepped stators, there is no particular restriction on the gap in the pulverizing section at or after the third stage and this can be properly selected depending on the pulverizing conditions and, preferably, it is efficient to make the gap smaller than the gap in the pulverizing section at the second stage.

[0037] According to the present invention, there can be provided a method for producing a toner for electrostatic charge development causing less fogging (a phenomenon in which black spots are formed in the white area of images) and providing a satisfactory image quality that causes less over-pulverized toner, which shows satisfactory productivity and is economically advantageous. The present invention is of a significant industrial value.

EXAMPLE

[0038] Description will now be made more in details to the present invention referring to examples but it should be noted that the present invention is not limited to the following examples unless it exceeds the scope of the present invention.

<u>Example 1</u>

[0039] One hundred (100) parts by weight of a styrene-acrylate copolymer (softening point: 145°C, glass transition point: 64°C), 6 parts by weight of carbon black ("MA 100", Mitsubishi Kasei Co.), one part by weight of a low molecular weight polypropylene ("VISCOLE 550P", Sanyo Kasei Co.), and 2 parts by weight of a charge controlling agent ("BONTRON P51": quaternary ammonium salt, Orient Chemical Co.) were blended, kneaded in a melt extruder, extruded into a plate-shape on a cooling belt to cool and solidify, to obtain a toner material.

[0040] Then, after crushing the toner material by a hammer mill to an weight average particle diameter of about 300 μm, it was supplied at a rate of 150 kg/hr to a horizontal impact pulverizer having a structure as shown in Fig. 1 with a gap of about 2 mm between ridges of a rotor and of a stator, and pulverized under operation conditions at an atmospheric temperature of not more than 50°C and a circumferential speed of the rotor at 150 m/s.

[0041] Then, the toner obtained by pulverizing was classified by a classifier to recover a toner of an average classified diameter of 8.0 μm. The rate of the toner over-pulverized to not more than 4 μm of average classified diameter was 20 wt%. Further, the electric power consumption in the pulverizing and classifying steps were about 2,500 KWH per one ton of the toner.

[0042] Four parts by weight of the toner and 100 parts by weight of a carrier using a ferrite powder as a core material were mixed to prepare a developer and an actual copying test was conducted using a copying machine having an organic photoconductor as a light sensitive material. The same toner as that used for the developer was used as a supplementing toner in the actual copying test. As a result of the actual copying test, there was no fogging, the copy density was appropriate and the actual copying quality was satisfactory. In addition, there were no other disadvantages in view of practical use.

Example 2

[0043] At first, 100 parts by weight of a styrene-acrylate copolymer (softening point 145°C, glass transition point 64°C), 5.5 parts by weight of carbon black ("#30", Mitsubishi Kasei Co.), 2 parts by weight of a low molecular weight polypropylene ("VISCOLE 550P", Sanyo Kasei Co.), and 2 part by weight of a charge controlling agent ("BONTRON P51": quaternary ammonium salt, Orient Chemical Co.) were blended, kneaded in a melt extruder, extruded into a plate-shape on a cooling belt to cool and solidify, to obtain a toner material.

[0044] Then, after crushing the toner material by a hammer mill to a weight average particle diameter of about 300 μm, it was supplied at a rate of 200 kg/hr to the same horizontal impact pulverizer as in Example 1 and pulverized under operation conditions at an atmospheric temperature of not more than 50°C and a circumferential speed of the rotor at 138 m/s.

[0045] Then, the toner obtained by pulverizing was classified by a classifier to recover a toner of an average classified diameter of 10.0 μm. The rate of the toner over-pulverized to not more than 6 μm of average classified diameter was 15 wt%. Further, the electric power consumption in the pulverizing and classifying steps were 2,500 KWH per one ton of the toner.

Comparative Example 1

[0046] At first, a coarsely crushed toner material of the same composition as in Example 1 was put to medium crushed by an impact crusher and further pulverized finely by an jet pulverizer. An impact crusher in which ridges of a stator were of a rectangular convex shape and ridges of a rotor formed by embedding flat plates ("TURBOMILL T400", Turbo Industry Co.) was used as the impact crusher, and a supersonic jet mill ("I-10", Nippon Pneumatic Industry Co.) was used as the jet pulverizer. Then, the coarsely crushed toner material was supplied at a rate of 50 kg/hr to the impact crusher and medium crushed under conditions at an atmospheric temperature of not more than 50°C and a circumferential speed of the rotor at 115 m/s.

[0047] Then, after pulverizing by the jet pulverizer, the toner obtained by pulverizing was classified by a classifier to recover a toner of an average classified diameter of 10.5 μm. The rate of the toner over-pulverized to not more than an average classified diameter of 6 μm was 40 wt%. Further, the electric power consumption in the pulverizing and classifying steps was 5,000 KWH per one ton of the toner.

Comparative Example 2

[0048] From the same crushed toner material as that in Example 3, a toner of an average classified diameter about 5.0 μm was obtained by using a jet pulverizer (Jet Mill I-10, Nippon Pneumatic Industry Co.). Under the pulverizing conditions, the yield was poor as the rate of the over-pulverized toner was 55 wt%. Further, the necessary amount of electric power per one ton of the toner was as high as 30,000 kWH, and the energy efficiency worsened.

Claims

1. A method for producing an electrostatic toner comprising a resin and a colorant and having a particle size from 2 to 15 μm, comprising the steps of melting, kneading, cooling and crushing the toner material and then pulverizing the crushed toner material by use of an impact pulverizer including a pulverizing section formed between an outer surface of a rotor and an inner surface of a stator and a discharge opening, each of the outer surface and the inner surface having ridges of a triangular waveform, and a gap between the ridges of the rotor and of the stator in the pulverizing section; in which two flanks form each triangular waveform ridge, a first flank located on a front side in the case of the rotor and on a rear side in the case of the stator when viewed in the direction of rotation of the rotor having an angle of 20 to 70° relative to a tangent line of the rotor or stator, and a second flank located on the rear side in the case of the rotor and on the front side in the case of the stator when viewed in said direction having an angle of 45 to 140° relative to said tangent, the latter angle being larger than the former angle.

2. A method according to claim 1, wherein the gap is from 1.1 to 3 mm.

3. A method according to claim 1 or 2, wherein a circumferential speed of the rotor is from 100 to 200 m/s.

4. A method according to claim 1, 2 or 3, wherein a weight average particle diameter of the toner material when crushed is from 100 to 1000 μm.

5. A method according to any preceding claim, wherein the pulverizing is carried out in an upstream portion of the pulverizing section and, subsequently, in a downstream portion of the pulverizing section having a gap smaller than that in the upstream pulverizing section.

6. A method according to claim 5, wherein the gap is tapered from the inlet to the outlet ens thereof or is reduced stepwise.

7. A method according to claim 5 or 6, wherein the gap (X) in the upstream portion of the pulverizing section and the gap (Y) in the downstream portion of the pulverizing section satisfy the following relations:

$$0.3\text{ mm} \leq X \leq 3\text{ mm}$$

$$0.1\text{mm} \leq Y \leq 2.5\text{ mm}$$

$$1 < (X/Y) \leq 10.$$

Patentansprüche

1. Verfahren zum Herstellen eines elektrostatischen Toners, der ein Harz und ein Färbungsmittel umfasst bzw. enthält und eine Teilchengröße von 2 bis 15μm hat, umfassend die Schritte des Schmelzens, Knetens, Kühlens und Zerkleinerns des Toner-Tonermaterials und dann des Pulverisierens des zerkleinerten To-Tonermaterials unter Verwendung eines Stoßpulverisierers, der einen Pulverisierabschnitt, welcher zwischen einer äußeren Oberfläche eines Rotors und einer inneren Oberfläche eines Stators ausgebildet ist, sowie eine Entladungsöffnung aufweist, wobei jede der äußeren und inneren Oberflächen Rippen von einer dreieckigen Wellenform und einen Spalt zwischen den Rippen des Rotors und des Stators in dem Pulverisierabschnitt hat, wobei zwei Flanken jede Rippe von dreieckiger Wellenform bilden, wobei eine erste Flanke, welche an einer Vorderseite im Fall des Rotors und an einer Rückseite im Fall des Stators, in der Rotationsrichtung des Rotors betrachtet, angeordnet ist, einen Winkel von 20 bis 70° relativ zu einer Tangente des Rotors oder des Stators besitzt, und wobei eine zweite Flanke, welche an der Rückseite im Fall des Rotors und an der Vorderseite im Fall des Stators, in der Rotationsrichtung des Rotors betrachtet, angeordnet ist, einen Winkel von 45 bis 140° relativ zu der Tangente besitzt, wobei der letztgenannte Winkel größer als der vorher genannte Winkel ist.

2. Verfahren gemäß Anspruch 1, worin der Spalt von 1,1 bis 3mm ist.

3. Verfahren gemäß Anspruch 1 oder 2, worin eine Umfangsgeschwindigkeit des Rotors von 100 bis 200m/s ist.

4. Verfahren gemäß Anspruch 1, 2 oder 3, worin ein gewichteter mittlerer Teilchendurchmesser des Tonermaterials, wenn es verkleinert ist, von 100 bis 1000μm ist.

5. Verfahren gemäß irgendeinem vorhergehenden Anspruch, worin die Pulverisierung in einem stromaufwärtigen Teil des Pulverisierabschnitts und nachfolgend in einem stromabwärtigen Teil des Pulverisierabschnitts, der einen Spalt hat, welcher kleiner als jener in dem stromaufwärtigen Pulverisierabschnitt ist, ausgeführt wird.

6. Verfahren gemäß Anspruch 5, worin der Spalt von dem Einlass- zu dem Auslassende desselben sich verjüngend oder schrittweise vermindert ist.

7. Verfahren gemäß Anspruch 5 oder 6, worin der Spalt (X) in dem stromaufwärtigen Teil des Pulverisierabschnitts und der Spalt (Y) in dem stromabwärtigen Teil des Pulverisierabschnitts die folgenden Beziehungen erfüllt:

$$0{,}3\text{mm} \leq X \leq 3\text{mm}$$

$$0{,}1\text{mm} \leq Y \leq 2{,}5\text{mm}$$

$$1 < (X/Y) \leq 10.$$

Revendications

1. Procédé pour fabriquer un toner électrostatique comprenant une résine et un colorant et possédant des particules d'une taille comprise entre 2 et 15 μm, comprenant les étapes consistant à faire fondre, à malaxer, à refroidir et à broyer le matériau du toner, et à pulvériser le matériau du toner broyé en

utilisant un broyeur à chocs incluant une section de pulvérisation formée entre une surface extérieure d'un rotor et une surface intérieure d'un stator et une ouverture de décharge, la surface formée par la surface extérieure et la surface intérieure possédant des nervures ayant une forme d'ondes triangulaire, et un interstice entre les nervures du rotor et du stator dans la section de pulvérisation; selon lequel deux flancs situé chaque nervure de forme d'onde triangulaire, un premier flanc situé sur un côté avant dans le cas du rotor et sur un côté arrière dans le cas du stator, vu dans le sens de rotation du rotor, faisant un angle compris entre 20 et 70° par rapport à la droite tangente au rotor ou au stator, et un second flanc sur le côté arrière dans le cas du rotor et sur le côté avant dans le cas du stator, vu dans ladite direction, faisant un angle compris entre 45 et 140° par rapport à ladite tangente, l'angle indiqué en dernier étant supérieur à l'angle indiqué en premier.

2. Procédé selon la revendication 1, dans lequel l'interstice est compris entre 1,1 et 3 mm.

3. Procédé selon la revendication 1 ou 2, dans lequel une vitesse circonférentielle du rotor est comprise entre 100 et 200 m/s.

4. Procédé selon la revendication 1, 2 ou 3, selon lequel le diamètre en moyenne pondérée des particules du matériau du toner à l'état broyé est compris entre 100 et 1000 μm.

5. Procédé selon l'une quelconque des revendications précédentes, selon lequel la pulvérisation est exécutée dans une partie amont de la section de pulvérisation et ensuite dans une partie aval de la section de pulvérisation possédant un interstice inférieur à celui présent dans la section de pulvérisation amont.

6. Procédé selon la revendication 5, selon lequel l'interstice est rétréci depuis son extrémité entrée vers son extrémité de sortie ou est réduit d'une manière étagée.

7. Procédé selon la revendication 5 ou 6, selon lequel l'interstice (X) dans la partie amont de la section de pulvérisation et l'interstice (Y) dans la partie aval de la section pulvérisation satisfont aux relations suivantes:

$$0,3 \text{ mm} \leq X \leq 3 \text{ mm}$$

$$0,1 \text{ mm} \leq Y \leq 2,5 \text{ mm}$$

$$1 < (X/Y) \leq 10.$$

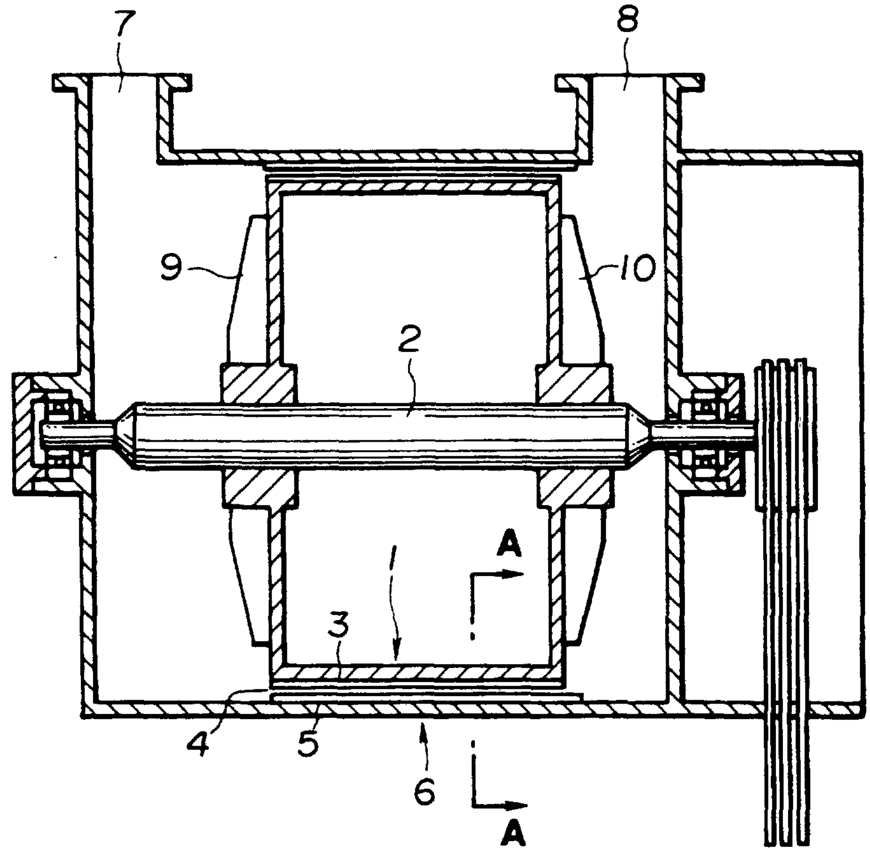

FIG.1

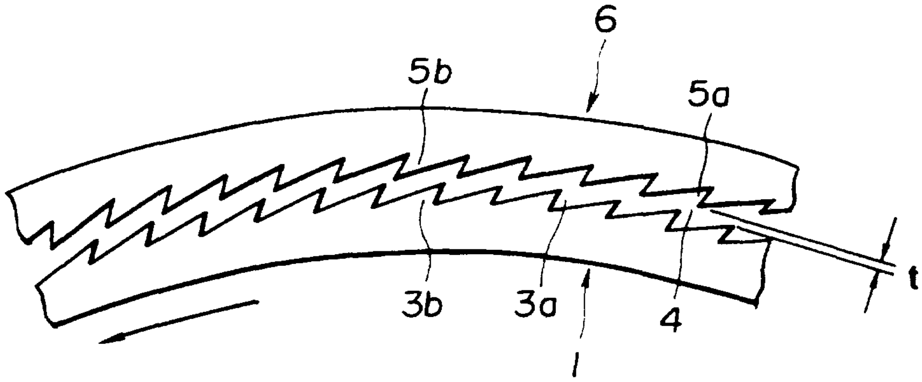

FIG.2

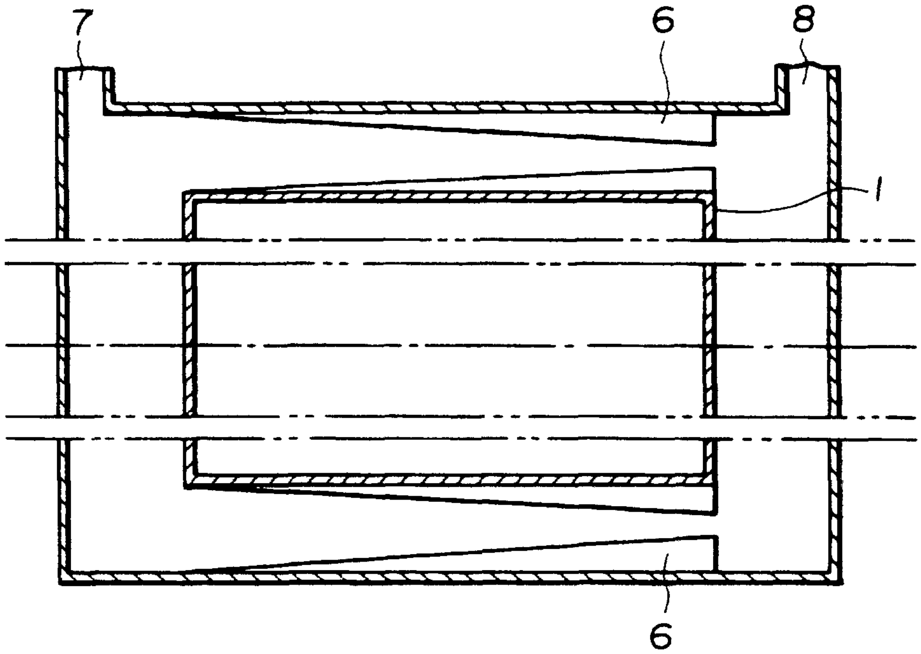

FIG.3

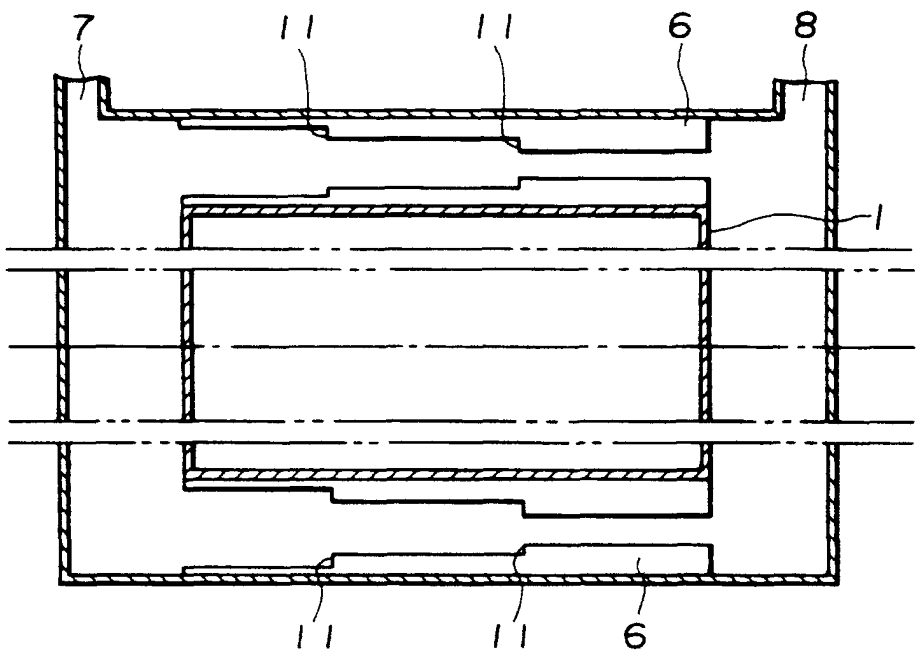

FIG.4