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(54) **Fluorocarbon lubricated printer toner particles**

Fluorkohlenwasserstoffgeschmierte Tonerteilchen für Drucker

Particules de toner fluorocarbonées lubrifiées pour imprimante

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Description

This invention relates to electrophotography and, more particularly, to electrophotographic toners that are subjected to high wear environments.

In electrophotography, an electrostatic charge image is formed on a dielectric surface, particularly the surface of a photoconductive drum. Development of this image is commonly achieved by contacting it with a two component developer comprising a mixture of toner particles and magnetically attractable particles known as carriers. The carrier particles serve as sites against which the nonmagnetic toner particles can impinge and acquire a charge that is opposite to that of the electrostatic image. During contact between the electrostatic image and the combined carrier/toner, the toner particles are stripped from the carrier particles by the relatively strong electrostatic forces associated with the charge image.

Prior art developer materials, especially those employed in automatic copying machines, have experienced carrier filming problems due to the recycling of the carrier particles over many cycles. Such recycling produces many collisions between the carrier particles themselves and between the carrier particles and various parts of the copier. The attendant mechanical friction causes some toner material to form a physically adherent film on the surfaces of the carrier particles. To alleviate such carrier filming problems, the prior art has suggested the coating of carrier particles with fluoropolymers such as poly tetrafluoroethylene. Such coated particles are taught in U.S. Patents 3,922,382 to Kukla et al.; 3,947,271 to Munzel et al.; 4,546,060 to Miskins et al. and 4,263,389 to Ciccarelli. In each of the aforementioned references, it is noted that the fluoropolymer coating increases the abrasion resistance of the carrier particles.

The use of automated character readers to examine printed documents is seeing wider use. Many such readers pass a scanner over the text of a document, the scanner being in direct contact with the surface of the document and exerting an abrasive force on the printed characters. If a document is subjected to more than one scan, it often occurs that the friction between the scanner and the document surface causes substantial damage to the printed characters.

The prior art has employed encapsulated toner compositions in pressure fixing environments. For instance, in U.S. Patent 5,023,159 to Ong et al., encapsulation of toner particles is taught by interfacial polymerization between a core polymer resin, an organo silicon compound, a colorant, and shell-forming monomers. Ong et al. indicate that good image density was achieved and that image smear and image ghosting was avoided. The procedures employed by Ong et al. to accomplish encapsulation of their toner particles involve a number of steps and require long heating durations.

JP-57016460 relates to the treatment of a toner surface in which a powdery toner is mixed with an organic fluorine which is dissolved in fluorocarbon. The toner particles are not treated to improve a printed character wear characterisitic without affecting the toner's ability to adhere to a photoconductive surface. There is no mention concerning the amounts of fluorocarbon oil and solvent.

JP-1091141 relates to a toner for developing an electrostatic latent image according to which the toner includes a binding resin powder and fine powder particles having a diameter smaller than that of the powder of the binding resin. There is no mention concerning the amounts of fluorocarbon oil and solvent and as to the use of a solvent in combination with the fluorocarbon oil.

It is the object of the present invention to provide a method of coating toner particles for applying a lubricating coating to the toner particles so that the toner particles exhibit increased wear resistance, that the lubricity and wear resistance of printed characters is improved, and that the flow characteristics of a toner in an elctrophotographic printer is improved.

This object is achieved by a method according to claim 1.

The Fig. illustrates apparatus for carrying out the method of the invention.

Toner particles are coated with a fluorocarbon lubricant, preferably a perfluoro poly propoxy-methoxy oil. Such an oil is marketed by the Ausimont Company, 44 Whippany Road, Morristown, New Jersey 07962. The trade name for their fluorocarbon oil is Fomblin Y and it is a perfluoronated poly ether. Fomblin Y has a low surface tension and, therefore, creates a very thin coating on the toner particles. Furthermore, the fluorocarbon oil exhibits a low vapor pressure, is a good lubricant and is a liquid that can be easily applied to toner particles.

The process further employs a solvent for the fluorocarbon oil. The chosen solvent must not attack the toner particles, and must exhibit a low boiling point. A preferred solvent is perfluoro alkane, a non-polar solvent that does not attack polar surfaces of toner particles and is a good solvent for fluorocarbon oils. The 3M Company, Commercial Chemicals Division, 223-6S-04 3M Center, Saint Paul, Minnesota 55144-1000 markets a perfluoro alkane solvent called "Fluorinert" which was employed in the development of the invention. The preferred solvent is Fluorinert (FC-72) which is a C8 perfluoro alkane.

The mechanism used to carry out the invention was a "Rotavapor" system such as is shown in the Fig. A mixture of toner particles, fluorocarbon lubricant and a perfluoro alkane solvent was emplaced in a flask 10 that was attached to a vacuum/drive system 12. Flask 10 was immersed in a heating bath 14 that enabled an elevation of the temperature of the mixture contained in flask 10. The elevated temperature is sufficiently high to enhance volatilization of the solvent, but must not exceed the melting temperature of the toner particles.

Flask 10 is rotated by drive system 12 while simul-

taneously, a vacuum is applied to flask 10. During operation, the elevated temperature of flask 10 causes volatilization of the perfluoro alkane solvent, which solvent enters the cooling system 16 via tube 18. Within cooling system 16, the solvent condenses and precipitates into receiving flask 20.

EXAMPLE

A magnetic ink character recognition (MICR) toner, e.g. a MICR toner that is a styrene-based monocomponent-type toner, obtained from the Canon Corporation, Japan was coated with perfluoro poly propoxy-methoxy oil (Fomblin Y). The coating was accomplished by adding either 15 or 300 micro liters of Fomblin Y to 200 mL of perfluoro alkane solvent (3M FC72). One hundred grams of the monocomponent toner was added to a 500 mL round bottom flask 10 (see Fig.). A mixture of the solvent and fluorocarbon lubricant was added to the flask. Contents of the flask were mixed and agitated by causing rotation of flask 10, after it was attached to a Bucki Rotavapor. A vacuum was applied to the flask while it was being rotated (insert level of vacuum). The flask's contents were temperature regulated to 38° C by immersion in a heated bath 14. After the solvent was stripped from the toner, it was found that fluorocarbon oil coated the toner particles. The toner was loaded into a printer cartridge, when dry, and printing was accomplished in the normal fashion.

The fluorocarbon oil was found to be stable and nonvolatile. The toner operated successfully in the printer and the perfluoro alkane solvent used did not degrade the toner. The print quality was equal to noncoated toner particles.

It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

Claims

1. A method of coating styrene-based monocomponent polar toner particles with a thin coating of a fluorocarbon oil, said toner particles suitable for use in an electrostatic printer, the method comprising the steps of:

   a) combining said toner particles with a mixture of a fluorocarbon oil and a non-polar perfluoro alkane solvent, said fluorocarbon oil and perfluoro alkane solvent being present in said mixture in a ratio of fluorocarbon oil to solvent within a range of 15 to 300 microliters of said oil per 100 ml of said solvent all per 100g of toner particles;

   b) heating the mixture combination of step (a) to an elevated temperature in an evacuated environment, said temperature being less than the melting temperature of said toner particles; and

   c) agitating said mixture during said heating step to cause a coating of said toner particles with said fluorocarbon oil, while said heating causes volatilization of said perfluoro alkane solvent.

2. The method as recited in claim 1 wherein said fluorocarbon oil is perfluoro poly propoxy-methoxy oil.

3. The method as recited in claim 1 wherein said toner is a magnetic ink character recognition toner.

4. The method as recited in claim 1 wherein said perfluoro alkane solvent is C8 perfluoro alkane.

Patentansprüche

1. Ein Verfahren zum Beschichten von auf Styren basierenden polaren Monokomponenten-Tonerpartikeln mit einer dünnen Beschichtung eines Fluorkohlenstofföls, wobei die Tonerpartikel zur Verwendung in einem elektrostatischen Drucker geeignet sind, wobei das Verfahren folgende Schritte aufweist:

   a) Kombinieren der Tonerpartikel mit einem Gemisch aus einem Fluorkohlenstofföl und einem nicht-polaren Perfluor-Alkan-Lösungsmittel, wobei das Fluorkohlenstoff-01 und das Perfluor-Alkan-Lösungsmittel in dem Gemisch in einem Verhältnis von Fluorkohlenstofföl zu Lösungsmittel in einem Bereich von 15 bis 300 Mikrolitern des Öls pro 100 ml des Lösungsmittels vorliegen, jeweils pro 100 Gramm Tonerpartikel;

   b) Erwärmen der Gemischkombination aus dem Schritt (a) auf eine erhöhte Temperatur in einer evakuierten Umgebung, wobei die Temperatur geringer ist als die Schmelztemperatur der Tonerpartikel; und

   c) Bewegen des Gemisches während des Erwärmungsschritts, um eine Beschichtung der Tonerpartikel mit dem Fluorkohlenstofföl zu bewirken, während die Erwärmung eine Verflüchtigung des Perfluor-Alkan-Lösungsmittels bewirkt.

2. Das Verfahren gemäß Anspruch 1, bei dem das Fluorkohlenstofföl ein Perfluor-Poly-Propoxy-Methoxy-Öl ist.

3. Das Verfahren gemäß Anspruch 1, bei dem der Toner ein magnetischer Tintenzeichenerkennungstoner ist.

4. Das Verfahren gemäß Anspruch 1, bei dem das Perfluor-Alkan-Lösungsmittel ein C8-Perfluor-Alkan ist.

Revendications

1. Un procédé pour appliquer sur des particules de toner polaire à monocomposant, à base de styrène, un mince revêtement d'une huile fluorocarbonée, ces particules de toner étant appropriées pour être utilisées dans une imprimante électrostatique, le procédé comportant les étapes:

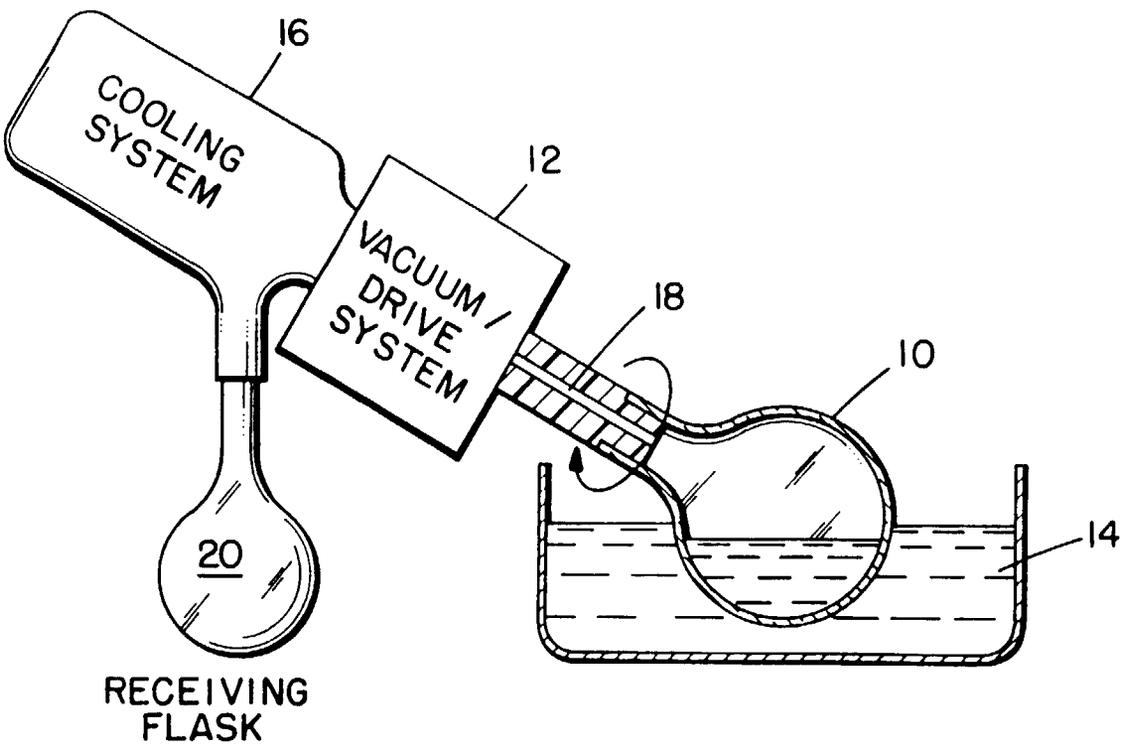
   a) combiner lesdites particules de toner avec un mélange d'une huile fluorocarbonée et d'un solvant non-polaire du type perfluoro-alkane, ladite huile fluorocarbonée et ledit solvant du type perfluoro-alkane étant présent dans ledit mélange selon un rapport de l'huile fluorocarbonée au solvant se situant dans une gamme de 15 à 300 microlitres de ladite huile pour 100 ml dudit solvant, le tout par 100 grammes de particules de toner;
   b) de chauffer la combinaison de mélange de l'étape (a) à une température élevée dans un environnement sous vide, cette température étant inférieure à la température de fusion desdites particules de toner; et
   c) d'agiter ledit mélange pendant ladite étape de chauffage afin de réaliser sur lesdites particules de toner un revêtement au moyen de ladite huile fluorocarbonée, tandis que ledit chauffage provoque l'évaporation dudit solvant du type perfluoro-alkane.

2. Le procédé tel que spécifié dans la revendication 1, dans lequel ladite huile fluorocarbonée est une huile perfluoro-polypropoxy-méthoxy.

3. Le procédé tel que spécifié dans la revendication 1, dans lequel ledit toner est un toner de reconnaissance de caractères magnétiques.

4. Le procédé tel que spécifié dans la revendication 1, dans lequel ledit solvant de type perfluoro-alkane est un perfluoro-alkane en C8.

FIG. 1.


16
COOLING SYSTEM
12
VACUUM / DRIVE SYSTEM
18
10
14
20
RECEIVING FLASK