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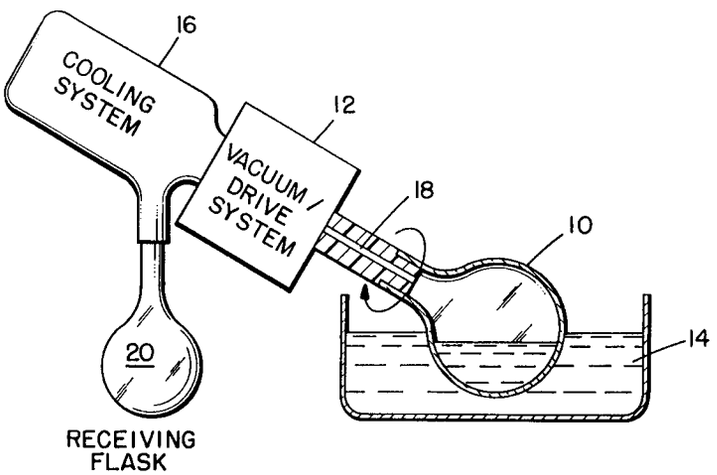
(54) Fluorocarbon lubricated printer toner particles.

(57) A method of coating toner particles with a fluoropolymer is described that comprises the steps of: mixing polar toner particles with a mixture of a fluorocarbon oil and a perfluoro-alkane non-polar solvent; heating the mixture to an elevated temperature in an evacuated container having an outlet, the temperature being less than the melting temperature of the toner particles; and agitating the mixture during the heating step to cause a coating of the particles with the fluorocarbon oil while the heating causes volatilization of the solvent.

FIG. 1.



EP 0 594 945 A1

Field Of The Invention

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

BACKGROUND OF THE INVENTION

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.

Accordingly, it is an object of this invention to provide an improved toner composition that exhibits increased wear resistance.

It is another object of this invention to provide an improved toner that incorporates a lubricating coating.

It is yet another object of this invention to provide a simple method for applying a lubricating coating to toner particles.

It is still another object of this invention to improve the lubricity and wear resistance of printed characters.

It is a further object of this invention to improve the flow characteristics of a toner in an electrophotographic printer.

SUMMARY OF THE INVENTION

A method of coating toner particles with a fluoropolymer is described that comprises the steps of: mixing polar toner particles with a mixture of a fluorocarbon oil and a perfluoro-alkane nonpolar solvent; heating the mixture to an elevated temperature in an evacuated container, the temperature being less than the melting temperature of the toner particles; and agitating the mixture during the heating step to cause a coating of the particles with the fluorocarbon oil while the heating causes volatilization of the solvent.

DESCRIPTION OF THE DRAWINGS

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

DETAILED DESCRIPTION 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 simultaneously, 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 toner particles with a fluoro polymer, the method comprising the steps of:
   a) combining toner particles with a mixture of a fluorocarbon oil and a perfluoro alkane solvent;
   b) heating the mixture combination of step (a) to an elevated temperature in an evacuated environment, said temperature being less than a 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 perfluoro alkane solvent is non-polar.

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

4. The method as recited in claim 1 wherein said combination recited in step a, comprises a ratio of fluorocarbon oil to solvent within a range of 15 micro liters of said oil per 200 mL of said solvent, to 300 micro liters of oil to 200 mL of said solvent, all per 100 grams of toner particles.

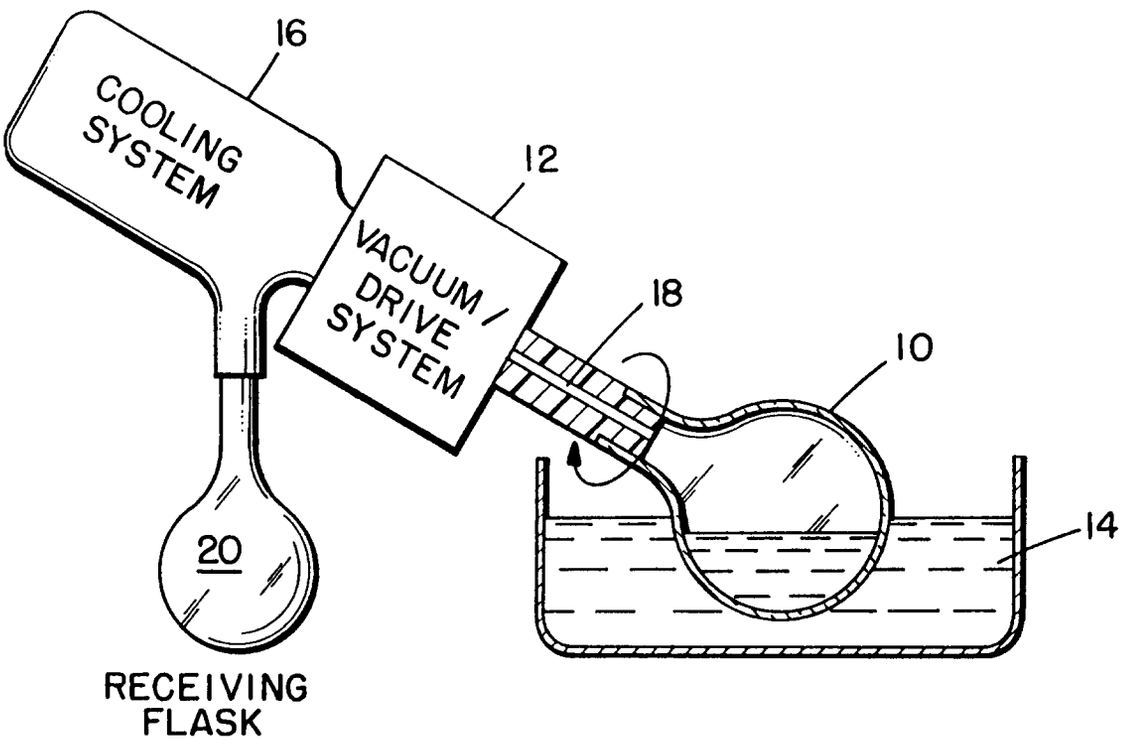
5. The method as recited in claim 1 wherein said toner is a magnetic ink character recognition toner.

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

7. A toner particle having a fluorocarbon oil coating.

8. The toner particle of claim 7 wherein said fluorocarbon oil is perfluoro poly propoxy-methoxy oil.

FIG. 1.


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

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 0126

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	DE-A-29 40 907 (KONISHIROKU PHOTO INDUSTRY CO., LTD.) * page 7, line 6 - line 18 * * page 22, line 9 - line 36; claims 1-5 *	1-8	G03G9/097 G03G9/087
A	FR-A-2 386 847 (MITA INDUSTRIAL COMPANY LIMITED) * page 6, line 9 - page 8, line 24; claims 1-11; example 1 *	1-8	
A	EP-A-0 303 266 (E.I. DU PONT DE NEMOURS AND COMPANY) * claims 1-25 *	1-4,6-8	
A	DATABASE WPI Week 8210, Derwent Publications Ltd., London, GB; AN 82-18389E (10) & JP-A-57 016 460 (SAKATA SHOKAI) 27 January 1982 * abstract *	1-8	
A	DATABASE WPI Week 8920, Derwent Publications Ltd., London, GB; AN 89-147803 & JP-A-1 091 141 (KONICA CORP.) 10 April 1989 * abstract *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.5) G03G G03F
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 269 (P-1059)(4212) 11 June 1990 & JP-A-02 077 759 (SEIKO EPSON CORP.) 16 March 1990 * abstract *	1	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 February 1994	Hindia, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 0126

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	US-A-4 369 240 (MICHAEL G. FICKES) * column 5, line 50 - line 58; claim 1 * -----	1-4,6-8	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 February 1994	Hindia, E

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