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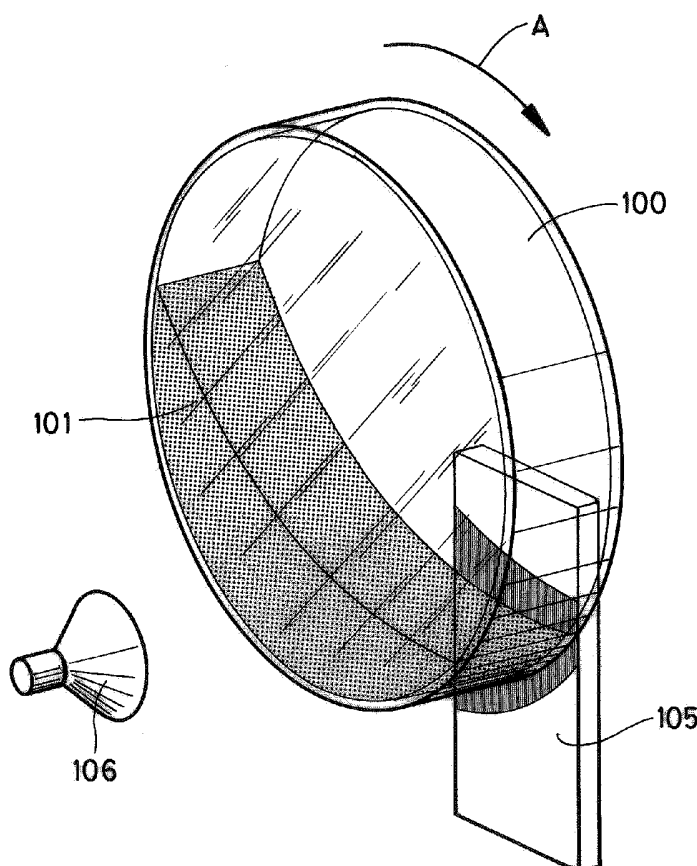
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[Continued on next page]

(54) Title: TWO-SIDED PRINTING PROCESS IN COMBINATION WITH A TONER SUITABLE FOR APPLICATION IN THIS PROCESS



(57) Abstract: The invention relates to a printing process comprising two image-forming units, each containing an image medium on which a powder image may be formed and an intermediate medium contactable with the image medium for transferring the powder image, both intermediate media together forming a nip for substantially simultaneously printing the powder images on two separate sides of a receiving medium, in combination with a toner for the formation of the powder images, where the toner has a flowability, measured using the API flowability tester, of 6 or higher. The invention also relates to a printer and a method for selecting a toner that is suitable for this printer.

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TWO-SIDED PRINTING PROCESS IN COMBINATIO  
WITH A TONER SUITABLE FOR APPLICATION IN THIS PROCESS

5

The invention relates to a printing process comprising two image-forming units, each containing an image medium on which a powder image may be formed and an intermediate medium contactable with the image medium for transferring the powder image, the intermediate media together forming a nip for substantially simultaneously  
10 printing the powder images on two separate sides of a receiving medium, in combination with a toner for the formation of the powder images. The invention also relates to a printer containing this combination and a method for selecting a toner that is suitable for this printer.

15 A printing process and toner of this kind are known from American patent US 5,970,295. In this method, each of the image-forming units contain a writing head for producing an electrostatic latent image on a photoconductive image medium and means to develop this image into a visible image by application of toner. The image thus developed will then be transferred onto an intermediate medium in the form of an endless rubber-  
20 coated belt. The two intermediate media of the image-forming units meet at the level of the transfer nip. By feeding a sheet of receiving medium through this transfer nip, both the front and back of this medium may be printed simultaneously. In this way, the advantage is achieved that the sheet does not need to be turned over when both sides require printing. Thus the feeding process of the receiving medium is simplified and  
25 recording errors may be prevented or at least reduced. The process is not only suitable for loose sheets (*cut sheet*) but also for endless media (*continuous feed*).

A process of this kind is particularly suitable for producing documents with double-sided printing. A consequence of the presence of two image-forming units is that two adjacent  
30 pages in a document will normally be printed by two different image-forming units. Practice shows that the human eye is very sensitive to differences in the image-forming process of one image-forming unit compared to another image-forming unit. The presence of such differences adversely affects the quality of the printed document. This problem may in theory be resolved by applying two identical image-forming units in the  
35 printing process. However, in practice, this solution is not achievable at economically

justifiable costs.

The object of the invention is to obviate the problem described above. According to this invention, a toner with a flowability of 6 or higher, measured according to the API  
5 flowability tester, should be applied. Surprisingly, it has been established that application of a toner with a relatively poor flowability compared to other toners designed to be applied in a printing process using an intermediate medium leads to the set objective being achieved. The reason for this is not entirely clear. The effect established may well be linked to the fact that the parameters which have a major  
10 impact on the toner's flowability – particularly the particle size distribution, density, surface characteristics and particle shape – also have a major impact on the development and transfer behaviour of this toner. Apparently, a relatively poor flowability, which is generally not the desired result, is linked to development behaviour in such a way that any differences in the physical assembly and design of both image-  
15 forming units are compensated and masked.

According to one embodiment, a toner is used in the combination, which has a flowability not exceeding 30. Practice shows that no special measures are required in this embodiment to ensure the adequate transportation of the toner within the printer  
20 itself, particularly the transportation from the toner reserve to the development unit and the feeding of the toner within the development unit itself to the image medium. Furthermore, practice shows that the stability of the toner, i.e. the resistance of this toner to clogging of individual toner particles, is sufficiently effective in this embodiment to allow this toner to be kept for a long time in a toner reserve compartment, such as a  
25 development unit or a transport bottle.

In one embodiment, the toner has a loss compliance ( $J''$ ) of  $1E-07/Pa$  at a temperature between  $70$  and  $85^{\circ}C$  at a deformation frequency of  $400$  rad/second. Practice has shown that a toner according to this embodiment further improves the print quality. This  
30 seems to be linked to the fact that the transfer nip is formed between two relatively soft intermediate media. Practice has shown that if the toner has the above-mentioned loss compliance at a temperature below  $70^{\circ}C$ , then the transfer output within the nip is too low to generate an acceptable colouring of the receiving medium. If this compliance materialises at a temperature over  $85^{\circ}C$ , then the transfer output will indeed be high,  
35 typically higher than  $97\%$ , but it will be relatively easy to mechanically remove the toner

from the receiving medium (e.g. by scraping or erasing using a rubber). Practice has shown that a transfer nip can be formed using a toner according to this embodiment, which will lead to a high transfer output and sufficient adhesion of the toner particles to the receiving medium. According to another embodiment, the toner has a loss compliance ( $J''$ ) of  $1E-07/Pa$  at a temperature between 75 and 80°C. Practice has shown that this toner provides more flexibility in the choice of materials to be used for the intermediate media as well as the temperatures to be used in the transfer nip. Therefore, the design of the process and the embodiment thereof have greater flexibility in this embodiment.

Apart from the combination described above, the invention also relates to a printer that comprises this combination as well as a method for selecting a toner for application in a printer of this kind. The invention will now be further explained with reference to the following figures and examples.

Fig. 1 is a diagram showing a printer comprising two image-forming units.

Fig. 2 is a diagram showing the API flowability tester.

Fig. 3 is a diagram showing an assembly suitable for testing the toner's loss compliance.

Example 1 shows a number of toners that are suitable for application in the present invention, as well as a number of commercially available toners.

Example 2 shows a number of toners for use in a preferred embodiment of the present invention.

### **Figure 1**

Figure 1 is a diagram showing a printer 100 comprising two image-forming units 6 and 8. This printer is known from American patent US 6,487,388. In this embodiment, the printer is equipped to print an endless receiving medium 48. To this end, the printer is equipped with clamping elements 44 and 46. In another embodiment (not shown), the printer has been modified to print loose sheets of a receiving medium. The image-forming units 6 and 8 may be used to form images on the front 52 and back 54 respectively of the receiving medium 48, said images being transferred onto this medium at the level of the single transfer nip 50.

Image-forming unit 6 comprises a writing head 18 consisting of a row of individual printing elements (not shown), in this embodiment a row of so-called *electron guns*. By application of this writing head, a latent electrostatic charge image may be produced on the surface 11 of image medium 10. A visible powder image is developed on this charge image, using a toner inside this development terminal 20. This toner consists of individual toner particles which have a core that is based on a plastically deformable resin. In this embodiment, the toner particles also comprise a magnetic pigment that is dispersed within the resin. The particles are coated on the outside in order to control their charging. At the level of a primary transfer nip 12, the visible powder image is transferred onto intermediate medium 14. This medium is a belt that consists of silicon rubber supported by a tissue. Toner residues on the surface 11 are removed by application of cleaning terminal 22, following which the charge image is erased by erasing element 16. Corresponding elements of image-forming unit 8 are indicated using the same reference numbers as the elements of unit 6 but increased by 20 units (as described in detail in the patent mentioned).

The images that are formed on the intermediate media 14 and 34 are transferred onto the receiving medium 48 at the level of the transfer nip 50. To this end, both intermediate media are printed on the receiving medium by application of the print rollers 24 and 25, where the images are transferred onto and fused with medium 48 as a result of this pressure, heat and shearing stresses. To this end, the receiving medium is preheated in terminal 56 and the intermediate media themselves will be heated by heating sources located in rollers 24 and 25 (not shown). Beyond transfer nip 50, the intermediate media are cooled down in cooling terminals 27 and 47. This is to avoid the intermediate media becoming too hot at the level of the primary transfer nips 12 and 32 respectively. When the printer is on standby, the temperature of the intermediate media is lower than for a proper transfuse step in nip 50. As soon as it is known when the next receiving medium needs to be printed, a signal will pass to the heating elements located in the rollers 24 and 25 to heat the corresponding intermediate medium.

As is known from US 5,970,295, both images in the feed-through direction of the receiving medium 48 are brought into register with one another by checking the writing moments of both writing heads 18 and 38, as well as the rotating speeds of image media 10 and 30, and the intermediate media 14 and 34.

In the embodiment shown, the intermediate media are driven via rollers 26 and 46. The rotating speeds of the intermediate media 14 and 34 will thus be controlled and kept

equal. Image media 10 and 30 do not have their own drive facility and are driven by the mechanical contact between the intermediate media in the transfer nips 12 and 32 respectively. As both sets of intermediate media and image media are never exactly the same length, the time that elapses between writing a latent image using writing head 18 and transferring the corresponding toner image in the secondary transfer nip 50 for the drive shown will always be different to the time that elapses between writing a latent image using writing head 38 and transferring the corresponding toner image in the secondary transfer nip 50. This time difference can be compensated by adapting the writing moment of either writing head.

### **Figure 2**

Figure 2 is a diagram showing the API Aeroflow tester (obtained from Amherst Process Instruments, Hadley MA, version 1.02b, 1<sup>st</sup> May 1998). The operation of this tester is described in full detail in AAPS PharmSciTech. 2000; 1 (3): article 21 (Lee YSL, Poynter R, Podczec F, Newton JM) in the paragraph entitled "Determination of avalanching behaviour".

The tester comprises a transparent rotatably assembled drum 100, in which a quantity of powder 101 is placed in order to be investigated. Behind the drum, a photocell array 105 is located, lit by light originating from lamp 106. The powder is located between the lamp 106 and array 105 and therefore blocks part of the light. By rotating the drum in the given direction A, the powder is forced upwards against the drum wall. As a result, less light is blocked, causing the photocell to produce a higher output. However, as soon as avalanching causes the powder to flow back down, more light will again be blocked. Thus, the time between two avalanches can easily be determined. The period between subsequent avalanches is a measure of the powder's flowability. The longer this time, the worse the flowability of the investigated powder will be under the circumstances in question.

When investigating the suitability of toners for application according to the present invention, a 150mm diameter acrylate drum is used. The light source is a 10-Watt wolfram halogen bulb. The drum is filled with 50 grams of toner powder that has been acclimatised in the test area prior to testing (21°C, 50% relative humidity). The drum is rotated at a speed of 1 revolution every 240 seconds. The sampling rate of the photocell is 5 per second. Measuring is stopped after 20 minutes. The average time (in seconds)

between avalanches for the last three rotations is the figure that is used as the rate for the flowability.

A powder's flowability is dependent on many parameters and may therefore be  
5 influenced in many ways. For example, the geometric shape of the individual powder  
particles is important for flowability, but flowability is also affected by other  
characteristics of the powder particles, such as their intrinsic density. In respect of the  
shape, for example, it will be understood that needle-shaped particles generally produce  
a very different flowability compared to perfectly round particles. In particular, the  
10 surface characteristics of the powder particles are also important. If this surface consists  
of a relatively sticky material, then the flowability will be much worse than if the surface  
consists of a hard material. Coatings are often applied to mask the sticky nature of the  
powder particles. Thus, silicon powders are often applied as an additive to improve the  
flowability of toners (the particles of which consist in large measure of relatively soft  
15 resin). The silicon particles are precipitated on the surface of the toner particles so that  
there is less interaction. The type of coating (inorganic/organic, monomer/polymer,  
particles/smooth layer, etc.) in turn also affects the flowability. The ultimate flowability is  
determined jointly by a combination of all these factors. As these factors also affect one  
another, it is virtually impossible to predict the flowability prior to creating a powder. A  
20 (seemingly) small variation in one or more of the factors referred to may have a major  
impact on the flowability. The desired flowability will therefore usually be obtained  
through trial and error, where the flowability may be monitored during the production  
process.

25

### **Figure 3**

Figure 3 is a diagram showing an assembly suitable for testing the toner's loss  
compliance ( $J''$ ). Loss compliance  $J''$  is a dynamic compliance that is generally known in  
the specialist area of rheology. A detailed description on how to determine this loss  
30 compliance may be found in Chapter 5 (Dynamic Tests) of the manual entitled  
Rheological Techniques by R.H. Whorlow of the Department of Physics, University of  
Surrey, published by Ellis Horwood Ltd in 1980 (ISBN 0-85312-078-1) and distributed by  
John Wiley & Sons Inc. To this end, in this example, a rheometer is used, which is made  
by Rheometrics Corporation (now TA Instruments Ltd), i.e. the ARES Rheometer.  
35 Figure 3 is a diagram showing this rheometer. Oven 110 is shown, comprising a



measuring chamber 111 and pipes 112 and 113 through which hot air is blown into the chamber. The chamber is thermically isolated by application of isolation wall 114. The ARES Rheometer comprises a drive shaft 116 which may impose an oscillating deformation onto sample 125, said sample being clamped between plates 121 and 120.

5 The latter plate is connected to torsion shaft 115. The plates have a diameter of 25mm and are spaced 1.7mm apart (+/-0.2mm).

Sample 125 must be homogenous and free from air bubbles. To this end, a quantity of the toner powder to be measured is kneaded at a temperature of typically 110°C prior to measuring. To this end, the sample may be kneaded in the AEV-153 type Z-kneader

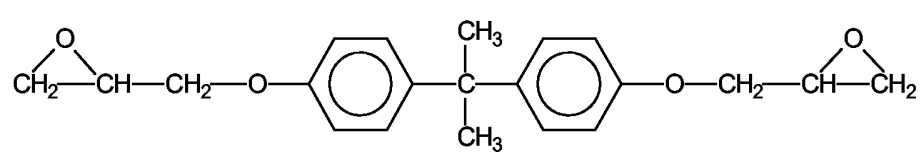
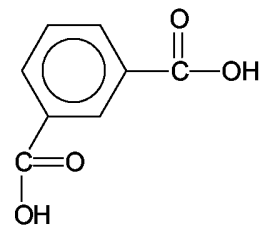
10 (from Brabender, Germany) for 15 minutes. Once the homogenised mixture has cooled down, it is ground using a mortar to produce particles of a diameter between 1 and 5mm. These particles are then compressed, using a pill press by application of heat (typically 100°C), into a homogenous pill with a diameter of 25mm and a thickness of between approximately 2 and 3mm. This pill is placed between the rheometer plates,  
15 following which the chamber is heated (typically to 100°C). As soon as an equilibrium temperature has been reached, the plates are bent towards one another until they are spaced 1.7mm apart. Thus, the excess material of the considerably softened sample is squeezed out from between the plates and the sample settles successfully onto the plates 120 and 121. The part of the sample that has been squeezed out from between  
20 the plates is cut away after the measuring assembly has cooled down. The actual measuring takes place by allowing shaft 116 to oscillate (indicated by B in the figure) at a frequency of 400 rad/sec, where the imposed deformation (strain) of the sample is 1%. The temperature of the sample may be set and controlled by application of hot air as described above. The temperature is generally 55°C at the start and then increased  
25 steadily to 100°C, where loss compliance  $J''$  is determined at each temperature.

### ***Example 1***

This example shows how toners may be made which are suitable for application in  
30 accordance with the present invention. Furthermore, figure 1 shows a number of commercially available toners, together with the printer types with which they may be used.

The fusible components for use when composing toners for application in accordance  
35 with the present invention may for example be prepared using the following basic

compounds (table 1).

Code	Structure Formula
X1	
X2	

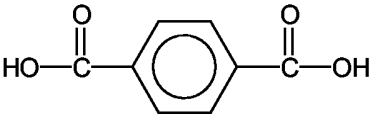
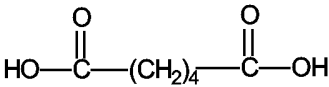
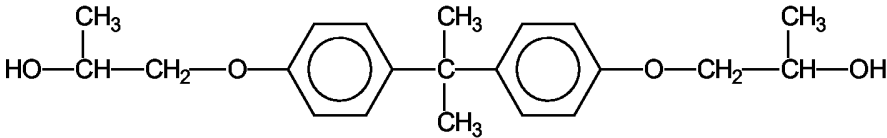
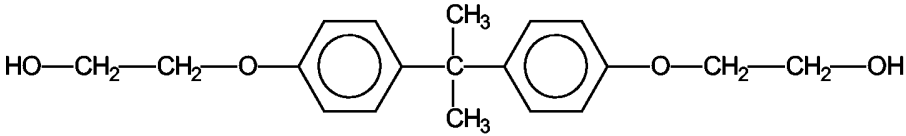
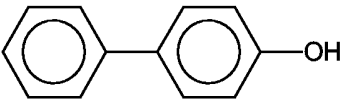
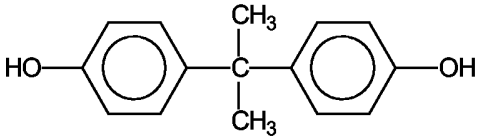
Code	Structure Formula
X3	
X4	
X5	
X6	
X7	
X8	

Table 1. Basic compounds for composing fusible components.

Component X1 is a compound based on Bisphenol A (see X8) and has two terminal epoxy groups. These groups are very reactive and may, for example, be blocked by reacting with alcohol. Component X2 is isophthalic acid. Component X3 is known as terephthalic acid. Component X4 is adipic acid. Components X5 and X6 are divalent alcohols based on Bisphenol A. X7 is known as para-phenylphenol, and X8 as Bisphenol A.

By reaction of these components, resins may be formed which are highly suitable as fusible fraction, i.e. a fraction that may be softened to a deformable mass by heating, to be used as toner powder. Table 2 shows a number of such reaction products (resins 1 to 4), as well as some additional compounds which are known to be suitable for composing a toner.

Fusible Component	Composition
Resin 1	Reaction product of X1 with X7 (0.8eq.)
Resin 2	Reaction product of X3, X4 and X6 (mol. ratio 36:12:52)
Resin 3	Reaction product of X2, X4 and X5 (mol. ratio 35:15:50)
Resin 4	Reaction product of X1 with X7 (0.8eq.) and X8 (0.2eq.)
PEO	Polyethylene oxide, $M_w$ $10^5$ g/mol
Kunstharz SK (Hüls)	Reduced acetophenone-formaldehyde condensation product Tg 89°C, $M_w$ 1350 g/mol (compared to polystyrene standards)

Table 2. Fusible components for composing fusible fraction of toner particles.

10

Resin 1 is formed by reaction of basic compound X1 with compound X7, where for each epoxy group, 0.8 equivalents of X7 are used. As a result, the epoxy groups are not fully blocked by reaction with phenol, resulting in a small chain extension. This leads, among other things, to two molecules X1 coupling together, producing an average 10% chain extension.

15

Resin 2 is a reaction product of basic compounds X3, X4 and X6 in the ratio shown. This resin has modal softening characteristics.

Resin 3 is a reaction product of basic compounds X2, X4 and X5 in the ratio shown. This produces a resin that only becomes softenable at a relatively high temperature.

20

Resin 4 is the reaction product of X1 with 0.8 equivalents of X7 and 0.2 equivalents of X8. Thus, all epoxy groups of X1 may be blocked by reaction with an alcohol. Chain extension hardly occurs and a resin is produced which is softenable at a relatively low temperature.

PEO and Kunstharz SK are compounds known for their application in toners.

25

Table 3 shows how a toner may be composed by application of the fusible components shown in table 2. Apart from the fusible fraction, each of the toners comprises a quantity

of magnetic pigment homogenously divided into the fusible fraction (the fusible fraction is added to the quantity of pigment indicated to achieve 100 mass %). This pigment, Bayoxide, originates from LanXess (Germany). The toners are coated with Carbon Black originating from Degussa (Germany). The quantity of coating is indicated in grams per 100 grams of the homogenous mixture of fusible fraction and pigment (indicated as *parts per hundred*, abbreviated to *phr*).

Toner	Fusible Fraction [Mass %]	Pigment [Mass %]	Coating, Cell Resistance [Ohm * m]
A	45% Resin 1, 55% Resin 2	44% Bayoxide	1.8phr Carbon Black, $1 * 10^8$
B	35% Resin 1, 65% Resin 2	40% Bayoxide	1.9phr Carbon Black, $1 * 10^7$
C	10% Resin 2, 90% Resin 3	49% Bayoxide	1.6phr Carbon Black, $3,5 * 10^7$
D	72% Resin 1, 28% Resin 2	38% Bayoxide	1.7phr Carbon Black, $9 * 10^6$
E	93% Resin 4, 7% PEO	46% Bayoxide	2.0phr Carbon Black, $5 * 10^6$
F	40% Resin 1, 4% PEO, 44% Kunstharz SK, 12% SiO <sub>2</sub>	42% Bayoxide	1.3phr Carbon Black, $5 * 10^8$

Table 3. Composition of toners for use in accordance with the invention.

10

Each of these toners is produced by mixing the magnetic pigment with the fusible components in a heater extruder (co-kneader, available from Buss Co. Ltd) until a homogenous mass has been produced. Once this mass has cooled down to room temperature, it is ground and sifted (Hosokawa Alpine TSP classifier, available from Hosokawa Micron). Next, post-sifting takes place in order to obtain the desired particle size (Elbow-jet, available from Nittetsu Mining Co.). For the toners shown, the desired sizes are as follows:

15

- 10.5 - 20 (Toner A)
- 11 - 21 (Toner B)
- 9 - 25 (Toner C)
- 9 - 18 (Toner D)
- 5 - 9 - 18 (Toner E)
- 12 - 22 (Toner F)

Here, the limits are indicated in micrometers below which (d<sub>5</sub>) and above which (d<sub>95</sub>) respectively, 5% of the toner mass is found. Toner coating takes place in a Cyclomix  
10 coater (Hosokawa Micron) until the desired resistance, in combination with a desired flowability, is reached. The resistance may be measured in a manner generally known, by measuring the dc resistance of a compressed powder column. In the example given, a cylindrical cell is used to this end, having a base surface area of 2.32cm<sup>2</sup> (steel base) and a height of 2.29cm. The toner powder is forcibly compressed by repeatedly adding  
15 toner and tapping the cell 10 times on a hard surface between each addition. This process is repeated until the toner will not compress any further (typically after adding and tapping 3 times). Next, a steel conductor having a surface area of 2.32cm<sup>2</sup> is applied to the top of the powder column and a voltage of 10V is applied across the column, following which the intensity is measured of the current that is allowed through.  
20 This determines the resistance of the column in the Ohmmeter. The toner's flowability is measured by application of the API Aeroflow Tester as shown in figure 2. For the toners shown in this example, this has produced resistances as indicated in table 3.

Table 4 shows the flowability of these toners, as well as of a number of commercially  
25 available toners. For the latter toners, a printer type is also indicated for which these toners are offered on the market. The flowability is measured as indicated in figure 2.

Toner (corresponding Commercial Printer)	Flowability
Toner A (-)	14.7
Toner B (-)	21.0
Toner C (-)	6.4
Toner D (-)	26.2
Toner E (-)	12.3
Toner F (-)	6.1
Océ B1 (7050)	1.9
Océ C1 red (CPS 900)	4.9
Océ C1 yellow (CPS 900)	3.9
Xerox 6R975 (Docucolor 2060)	1.5
Xerox 6R1049 (Docucolor 12)	2.2
KM 960903 (ColorFORCE 8050)	2.9
HP C9720A (CLJ 4600)	5.2

Table 4. Flowability of various toners.

- 5 Research into the application of each of these toners in a printing process according to the preamble of this description has shown that toners A to F, which exhibit a slightly inferior flowability, are highly suitable for producing documents in which the differences between the left and right-hand pages are negligible.

10

**Example 2**

- This example shows how toners may be found for use in a preferred embodiment of the present invention. To this end, the loss compliance  $J''$  is measured for the toners which have a flowability of 6 or higher in the Aeroflow tester, at an increasing range of
- 15 temperatures as indicated in figure 3. Next, it is determined at which temperature this toner has a loss compliance equal to  $1 \cdot 10^{-7} \text{ Pa}^{-1}$ . Table 5 shows the results for toners A to F.

Toner	Temperature at which $J'' = 1\text{E-}07/\text{Pa}$
Toner A	77°C
Toner B	79°C
Toner C	84°C
Toner D	68°C
Toner E	62°C
Toner F	89°C

Table 5. Temperature at which loss compliance is 1E-07/Pa for various toners.

- 5 Research has shown that toners A, B and C are specifically preferable for application in a printing process according to the preamble of this description. Toners A and B give the best results.



**CLAIMS**

1. A printing process comprising two image-forming units, each containing an image medium on which a powder image may be formed and an intermediate medium  
5 contactable with the image medium for transferring the powder image, the intermediate media together forming a nip for substantially simultaneously printing the powder images on two separate sides of a receiving medium, in combination with a toner for the formation of the powder images, characterised in that the toner has a flowability, measured using the API flowability tester, of 6 or higher.
- 10 2. A printing process in combination with a toner according to claim 1, characterised in that the flowability of the toner is not higher than 30.
3. A printing process in combination with a toner according to either one of the  
15 preceding claims, characterised in that the toner has a loss compliance ( $J''$ ) of  $1\text{E-}07/\text{Pa}$  at a temperature between  $70$  and  $85^\circ\text{C}$  at a deformation frequency of  $400$  rad/second.
4. A printing process in combination with a toner according to any one of the preceding claims, characterised in that the toner has a loss compliance ( $J''$ ) of  $1\text{E-}07/\text{Pa}$  at a  
20 temperature between  $75$  and  $80^\circ\text{C}$  at a deformation frequency of  $400$  rad/second.
5. A printing process in combination with a toner according to one of the preceding claims, characterised in that the toner is coated with Carbon Black.
- 25 6. A printer comprising the combination according to any one of the preceding claims.
7. A method for selecting a toner for application in a printer using a printing process comprising two image-forming units, each containing an image medium on which a powder image may be formed and an intermediate medium contactable with the image  
30 medium for transferring the powder image, the intermediate media together forming a nip for substantially simultaneously printing the powder images on two separate sides of a receiving medium, in combination with a toner for the formation of the powder images, characterised in that the toner is selected such that it has a flowability, measured using the API flowability tester, of 6 or higher.

8. Selecting a toner according to claim 7, characterised in that the toner is selected if it is coated with Carbon Black.

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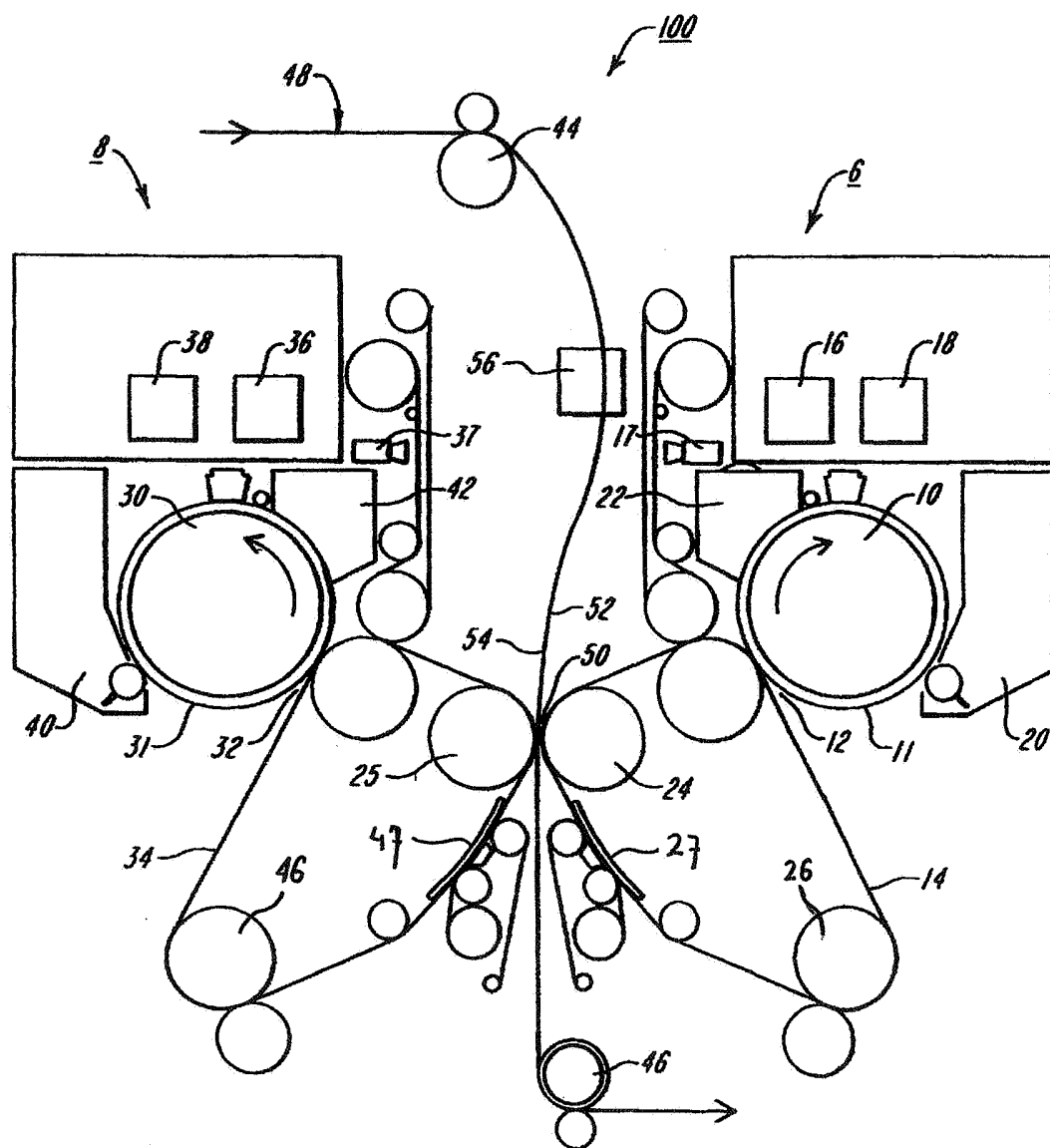


FIG. 1

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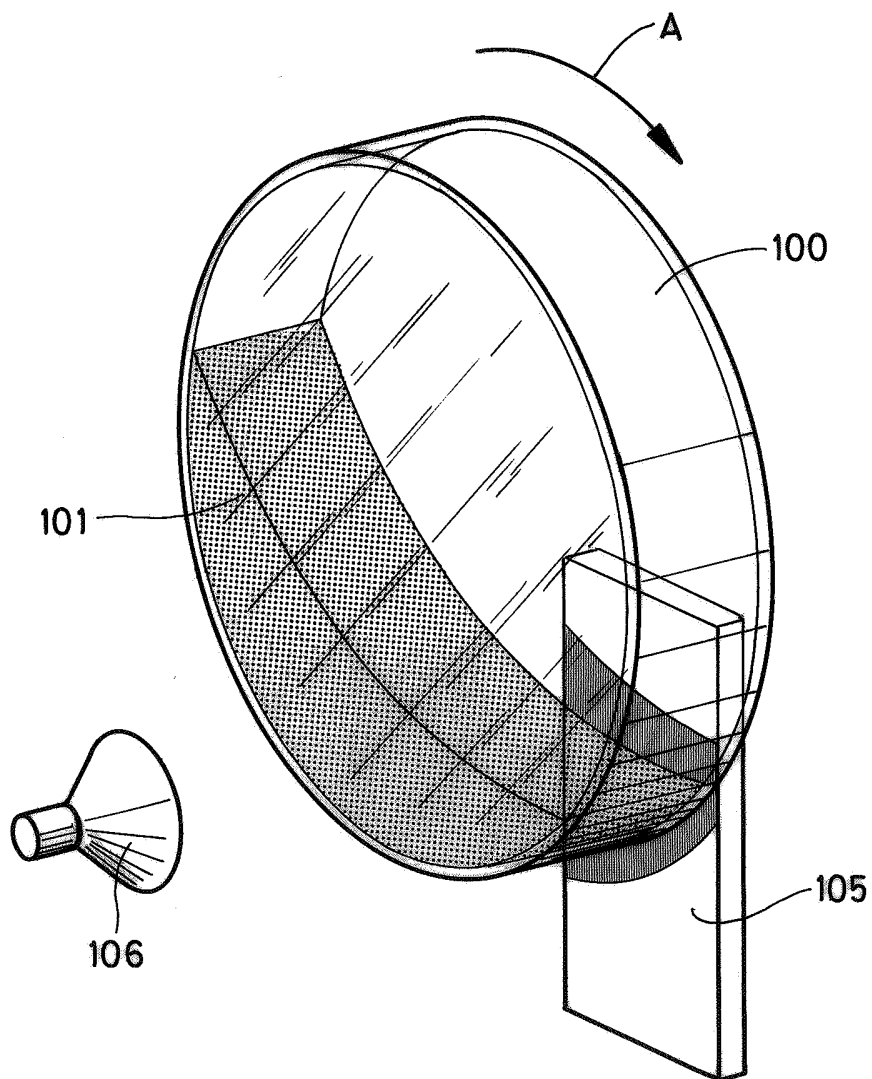


FIG. 2

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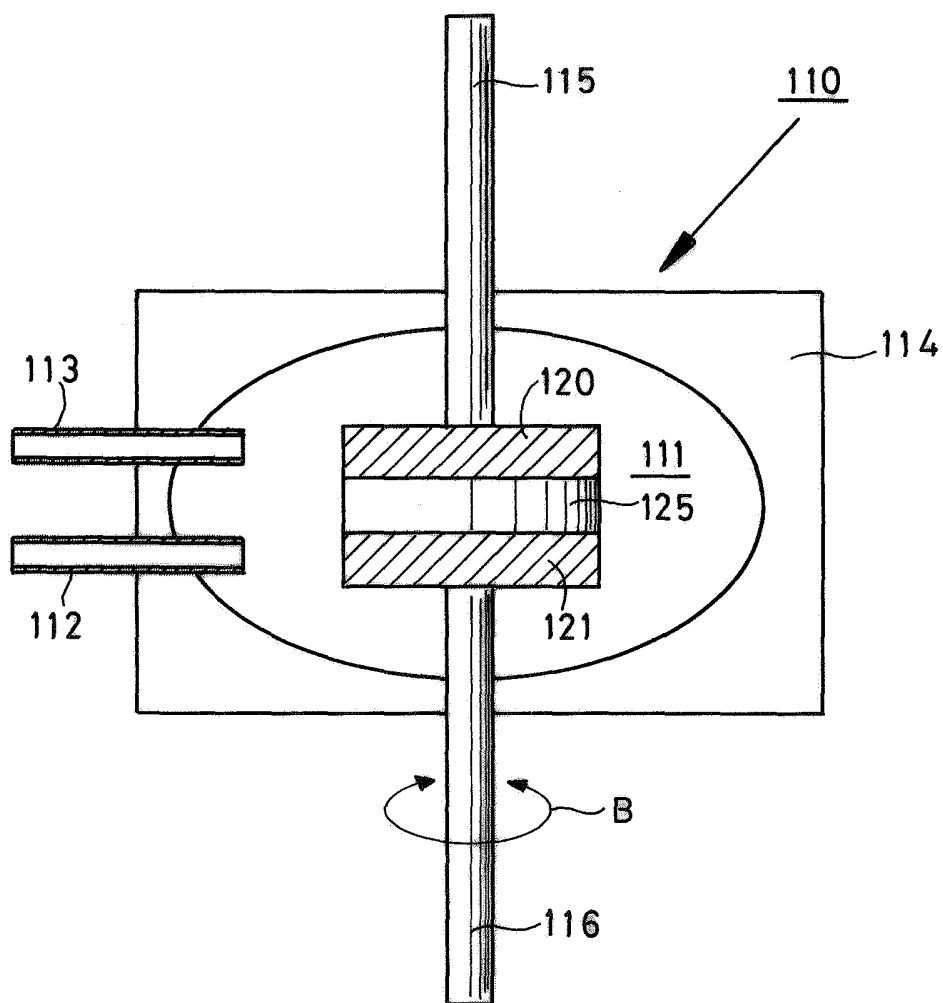


FIG. 3

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2006/062614

## A. CLASSIFICATION OF SUBJECT MATTER

INV. G03G15/23 G03G9/08 G03G15/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G03G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1 296 195 A (RICOH COMPANY, LTD) 26 March 2003 (2003-03-26) paragraphs [0022], [0023], [0027], [0032], [0041], [0052] -----	1-8
Y	EP 1 396 762 A (RICOH COMPANY LTD; RICOH COMPANY, LTD) 10 March 2004 (2004-03-10) paragraphs [0048], [0049], [0061], [0165], [0172]; examples 1-5; tables 1,2 -----	1-8
A	EP 1 227 374 A (XEROX CORPORATION) 31 July 2002 (2002-07-31) cited in the application figure 1 ----- -/--	1-8

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

### \* Special categories of cited documents :

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- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* & \* document member of the same patent family

Date of the actual completion of the international search

11 August 2006

Date of mailing of the international search report

22/08/2006

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## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2006/062614

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 1 403 723 A (CANON KABUSHIKI KAISHA) 31 March 2004 (2004-03-31) paragraph [0198]; table 1 -----	1,6,7
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International application No

PCT/EP2006/062614

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