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(54) **Printer comprising an endless belt as intermediate medium**

(57) The invention relates to a printer provided with a unit (1-11) for forming an image and an endless intermediate belt (12) trained under tension around rollers (14,15) in such manner that the belt (12) can rotate over

the rollers (14,15), said intermediate belt (12) being operatively connected to the said unit (1-11) for transfer of the image from the unit (1-11) to a receiving material, wherein the belt (12) comprises a fabric of threads as a support.

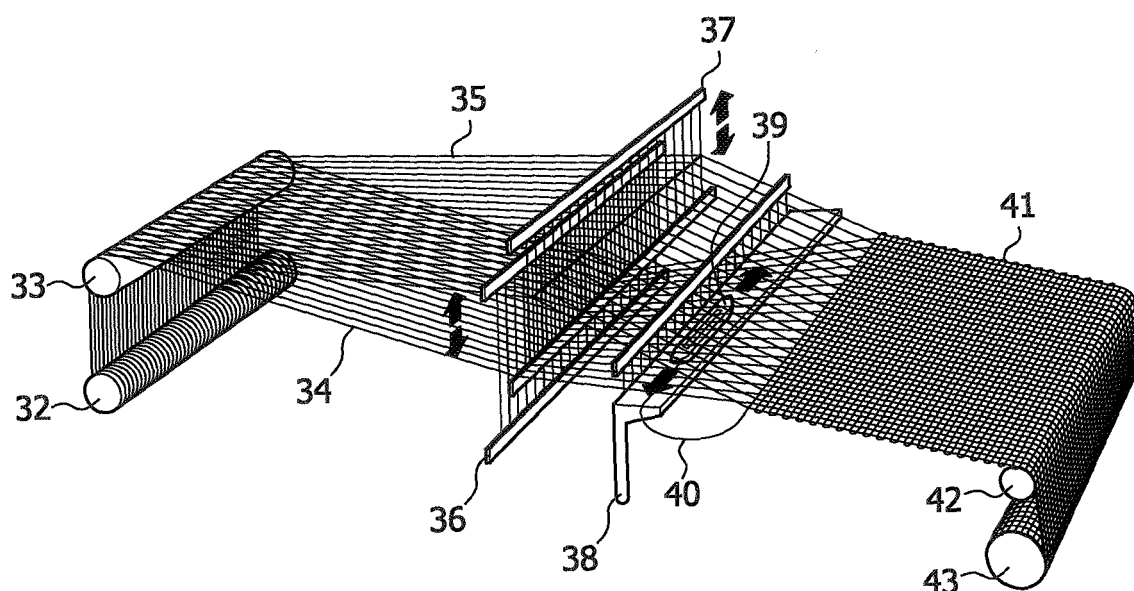


FIG. 2

Description

[0001] The invention relates to a printer provided with a unit for forming an image and an endless intermediate belt trained under tension around rollers in such manner that the belt can rotate over the rollers, said intermediate belt being operatively connected to the said unit for transfer of the image from the unit to a receiving material, wherein the belt comprises a fabric of threads as a support.

[0002] A printer of this kind is known from European patent application EP 1 462 871 A1. The image-forming unit of this printer comprises an endless photoconductor on which an image of toner particles can be formed by successively charging the photoconductor, exposing it image-wise and developing the resulting latent image with toner. This image is then transferred in a first transfer step to an endless intermediate belt. This belt comprises a woven fabric in which the warp threads are made of polyethylene terephthalate (PET) and the weft thread is made of polyether-etherketone (PEEK). A 2 mm thick silicone rubber top layer is applied to the fabric. The belt is trained under tension around a number of rollers, one of which serves as a drive roller. Using the drive roller, the belt can be rotated over the rollers so that the image can be transported to a following transfer location. Here the belt is brought into contact with a receiving material, the image being transferred under the influence of temperature and pressure from the belt to the receiving material. Any residues of the image on the intermediate belt are removed by means of one or more cleaning rollers. Although the application of known fabric as intermediate belt is commonly technically satisfying, the known fabric also has several drawbacks. A major drawback of the known fabric is that the known fabric is relatively expensive, and hence economically not attractive.

[0003] It is an object of the invention to provide a printer which is provided with an intermediate enabling adequate imaging and being economically relatively attractive.

[0004] This object can be achieved by providing a printer according to the preamble, characterised in that at least one thread of the fabric contains a polyarylene sulphide material (i.e. a material comprising polyarylene sulphide polymer) or a derivate thereof. It has been found that polyarylene sulphide (PAS) is technically suitable for the manufacturing of a fabric (textile) serving as an intermediate belt for a printer, and, moreover, that PAS is substantially less expensive than PEEK, as a result of which the cost price of the fabric can be reduced significantly. Hence, the fabric and the printer comprising such a fabric can be manufactured beside in a technically satisfying manner, also in an economically attractive manner. PAS is an aromatic polymer (thermoplastic resin) having predominant repeating units of arylene sulphide represented by the formula $[-Ar-S-]$ in which Ar represents an arylene group. In European patent EP 1 058 706 an elaborate description of PAS polymers is given (e.g. in paragraph [0002] in conjunction with paragraph

[0018]) as well as methods of their preparation (paragraphs [0006], [0007], [0008], [0009], and [0014]). Instead of PAS itself also one or more derivatives of PAS may be used to manufacture the woven fabric. The PAS may e.g. be partially oxidized (commonly at the sulphon bridges) or may have a branched or cross linked structure.

[0005] In an embodiment at least one thread of the fabric contains a polyphenylene sulphide (PPS) material (i.e. a material containing polyphenylene sulphide polymer) or a derivate thereof. PPS is considered as a representative of PAS, and has excellent properties to counterbalance temperature stress within the fabric, as a result of which the dimensioning of the fabric can be held relatively constant. Consequently, the belt tension and hence the image registering can be held substantially constant which is in favour of the quality of the image transfer of the intermediate belt onto the receiving material within the printer according to the invention. In example 4 of the above mentioned European patent 1 058 706 a method is described for preparing a polyphenylene sulphide material.

[0006] The fabric used is preferably a monofilament fabric. An advantage of the application of a monofilament fabric is that this fabric allows a relatively accurate registering of images on the receiving material. Moreover, due to the nature of their weave, whether plain or a special weave, precision monofilaments have an exceptionally narrow pore size distribution, which is deemed favourably for printing purposes.

[0007] In an embodiment the fabric comprises a weft thread containing a PAS material or a derivate thereof. By manufacturing the weft thread (and not necessarily also the warp thread) of PAS already an economically attractive fabric can be obtained. Moreover, applying a weft thread made of PAS in the fabric will provide sufficient strength to the fabric to be applied in the printer according to the invention. Hence, the warp thread may be made of a material being economically (even) more attractive than PAS, such as for example polyester, preferably polyethylene terephthalate.

[0008] In another preferred embodiment, wherein the fabric comprises one or more threads which extend substantially in the peripheral direction of the belt, said one or more threads extend over a length L equal to the periphery of the belt in the axial direction over a distance D equal at maximum to three percent of the length L. A conventional type of fabric consists of a set of threads extending in the axial direction, being situated at substantially identical distances from one another (warp threads) and one thread which extends substantially in the peripheral direction of the belt and runs as a helix from one side of the belt to the other side of the belt (weft thread). As a variant of this, there may be a set of threads extending substantially in the peripheral direction, at identical distances from one another. There is therefore not a single thread present in helix form in the peripheral direction, but a large set of individual threads, substan-

tially parallel to one another, which set starts with a first thread at one side of the belt and terminates with a last thread on the other side. It has been found that the thread or threads extending in the peripheral direction of the fabric during one revolution around the fabric, i.e. equal to the length L of the belt, extend more in the axial direction than might be expected because of their theoretical positioning. An extension of this kind occurs, for example, if a thread over its entirety deviates from its theoretical position, for example because said thread is skewed with respect to the peripheral direction. Such skewing can occur during the weaving process by the weft thread insertion direction not being accurately adjusted. It may also be that a thread has a deviation to a varying degree in the axial direction locally, for example because of an irregularity in the fabric. A local deviation of this kind might be the result of a weaving error but also of positioning processes in the loom, which are inherent in the type of fabric. If, for example, use is made of one weft thread, it will always have to turn time and time again during the weaving process. The point where the thread turns in the fabric belt may result in a local deviation of the thread in the axial direction. Such deviations are often referred to as the "skewing" of threads in the fabric. Applicants have found that this skewing is combined with a tension-dependent oscillation and hence a loss of registration and/or image distortion. If, however, the fabric is such that said one or more threads extend axially over a distance D equal at most to 3% of said length L during one revolution around the belt, i.e. over a length L, then there may be said to be a substantially tension-independent deviation of the belt.

[0009] In another embodiment, the distance D is between 0.1 % and 1% of the said length L. It has been found a further reduction of the distance D results in an improvement of the register and reduction of image distortion. However, it has surprisingly been found that a very small distance D, namely less than 0.1 %, in turn results in a deterioration of the belt behaviour. In other words, if the thread or threads extending in the peripheral direction have practically a theoretical position (an exact helix in the case of one weft thread or threads which are situated perfectly in the peripheral direction), it appears that the behaviour of a belt carried by this fabric is not optimal. It has been found that the behaviour of the belt deteriorates in the course of time. Even under loads of just some tens of thousands of revolutions of the belt it has been found that the latter is frequently damaged at the side, for unexplainable reasons, so that the belt running and hence register and/or image distortion are adversely affected. In this embodiment, in which there is therefore a specific minimum deviation of the threads in the axial direction, this problem can be obviated.

[0010] The invention also relates to a fabric for use in a printer according to the invention, wherein the fabric is at least partially manufactured from polyarylene sulphide. Advantages and preferred embodiments of the fabric have been elucidated above in a comprehensive

manner.

[0011] The invention will further be illustrated by means of the following non-limitative examples, wherein:

5 figure 1 diagrammatically indicates a printer according to the invention,
figure 2 diagrammatically illustrates a loom for manufacturing a fabric according to the invention, and
10 figure 3 diagrammatically illustrates a fabric belt according to the invention.

[0012] Figure 1 diagrammatically indicates a printer according to the invention, the printer being provided with a unit for forming a toner image, said unit comprising an endless photoconductive belt 1. This belt is rotated in the indicated direction at a uniform speed using drive and guide rollers 2, 3 and 4. In the embodiment illustrated, the printer comprises analogue means in order to project on to the photoconductor 1, using flash lights 6 and 7, lens 8 and mirror 9, an image of an original (not shown) placed on the easel 5. Prior to this imaging, the photoconductor is electrostatically charged by means of a corona unit 10. The optical imaging of the original on the charged photoconductor results in the formation of a latent charge image on said conductor, as is adequately known from the prior art. This charge image is developed with toner powder transferred to the photoconductor with the use of a developing unit 11, comprising a magnetic brush. This results in the formation of a toner image on said photoconductor. In a first transfer zone this image is brought into contact under pressure with an endless intermediate belt 12, which is trained around the rollers 15 and 14 under tension. This belt comprises a fabric of threads as a support and is provided with a soft and heat-resistant elastomer layer applied thereto, for example a silicone, EPDM or PFPE rubber. As a result of the contact in the first transfer zone, which takes place at a temperature of typically 40 to 70 DEG C, the toner image is transferred from the photoconductor 1 to the intermediate belt 12. After this transfer, any remaining toner particles are removed from the photoconductor 1 using a cleaner roller 13. The photoconductor is then ready for re-use. The intermediate belt 12 is trained under tension over the rollers 14 and 15, the image being passed from the first transfer zone to a second transfer zone where the intermediate belt 12 is in contact with a pressure-application belt 22. Belt 22 is trained over rollers 23 and 24. Roller 24 is placed under pressure in the direction of belt 12. In this transfer zone, a receiving material (not shown) originating from tray 18 and guided by rollers 19 and 20, is brought into contact with the intermediate belt 12, the receiving material being so guided that it is situated in register with the toner image on the intermediate belt 12. At the second transfer zone the temperature of the intermediate belt is such, by the use of heating element 17, that the toner particles are to some extent tacky and readily deformable. As a result of this also, the toner particles transfer from the intermediate belt 12 to the receiving

material and are also rigidly combined with said material. After the image has been transferred, the printed receiving material is deposited in the output tray 25 intended for the purpose. Any residues of toner particles on the intermediate belt are removed by the use of a cleaner roller 30 which has a surface 31 which picks up toner particles. A roller of this kind is known, for example, from US 4,607,947. The intermediate belt 12 in the printer according to this example is constructed with an endless fabric belt 12 of which the weft thread is manufactured of polyarylene sulphide, preferably polyphenylene sulphide, and of which the warp threads are manufactured of polyester, preferably polyethylene terephthalate, with, applied thereto, a 2 mm thick layer of a peroxide-hardened silicone rubber. A top layer of 50 μm of a softer silicone rubber is applied to said 2 mm thick layer. The production of such a belt may be based on the production of known belts as disclosed e.g. in US Patent 3,554,836. The printer of this example is provided with analogue means in order to image an original on the photoconductor. It should be clear that other means than those illustrated, for example digital means which can use a page-width printhead provided with light emitting diodes (LED's) may be suitable for creating a charge image on the photoconductor. Also, an image-forming unit using a photoconductor may be dispensed with. The important feature is that an image is formed and that this image is transferred in any way whatsoever to the intermediate belt. In the example illustrated, there is only one intermediate belt 12. It is obvious that use can also be made of a plurality of intermediate belts or other means, in addition to the intermediate belt, to transfer images in order finally to transfer the image to the receiving material. The form of transfer of the image as illustrated, by means of contact transfer, is one of the many possibilities. Other techniques are possible, for example contactless techniques, in which particles are transferred by the use of an electric field.

[0013] Figure 2 diagrammatically illustrates a loom for manufacturing a fabric according to the invention, with which it is possible to make fabric which can serve as a support for an intermediate belt of a printer. A loom of this kind comprises a roller 32 on which threads are wound which are spaced equal distances from one another on said roller. These threads, which are termed the warp threads, are passed on via guide roller 33 to holders 36 and 37. Two such holders are provided in this loom and separate the warp threads into a first set of threads 34 and a second set 35. The holders create a space between these two sets and in this space a shuttle 40 can move over a sley 38. A weft thread 40 is fixed to said shuttle. When the shuttle moves from a first side of the loom to a second side, the weft thread is woven between the two sets of warp threads. After that movement, the holders change place, so that set 34 changes places with set 35. The shuttle then makes a return movement, the weft thread again being woven between the two sets. In this way a fabric 41 is formed which is wound on the

collecting roller 43 via guide roller 42. An endless fabric belt can be made from such a fabric, for example by welding the two ends of a strip of said fabric. In a fabric belt of this kind, the warp threads are situated in the peripheral direction of the belt. A disadvantage of this process is that a weld seam forms so that there is a discontinuity in respect of properties. Another way of making an endless fabric belt is to weave a tubular fabric, this being possible by using four holders (instead of two) as is sufficiently known from the weaving art. By cutting off a part of the tube, an endless fabric belt is obtained which can serve as a support for an intermediate belt for a printer. In a fabric belt of this kind, the weft thread is situated in the peripheral direction of the belt, said weft thread forming a helix which extends from one side of the belt to the other. In this case the warp threads are in the axial direction of the belt.

[0014] Figure 3 diagrammatically illustrates a fabric belt according to the invention, in which only a very small number of threads is indicated. The drawing shows how it is possible to determine the distance D, which is an indication of the oscillation of the thread which extends substantially parallel to the peripheral direction of the belt. The drawing shows an endless and non-welded fabric belt pressed flat in the drawing plane. The width of this flattened belt is equal to W, which is also the actual width of said belt in the axial direction. The length of this flattened belt is $1/2L$, i.e. half the length of said belt in the peripheral direction. The drawing thus shows two layers of fabric situated one upon the other. The top fabric layer consists of the polyester warp threads 44 and 45 (which extend in the axial direction) and those parts of the PPS weft thread 46 which are indicated by the double arrows A (from the bottom to the top in the drawing). The PPS material in this case is the material which can be provided in accordance with example 4 of EP 1 058 706. It will be seen that the weft thread extends substantially parallel to the peripheral direction of the belt. The bottom fabric layer consists of the polyester warp threads 44' and 45', and those parts of the weft thread 46 which are indicated with the single arrows B (from top to bottom in the drawing). At the outermost warp threads, i.e. where the weft thread changes direction, the top layer of fabric merges into the bottom layer. In order to determine the distance D over which the weft thread extends axially over a length L equal to the periphery of said belt, the following procedure is adopted. First of all, the weft thread 46 is marked over a distance L (hence over one revolution around the belt), in this example using a dark-coloured marker. In the drawing this is indicated by the dark-marked part of the weft thread 46 which extends between the starting point of the marking 47 and the end point 48. Those points of this marked part are then determined which are situated at a minimum distance from the side 49 and at a maximum distance from said side. In this example these are points X (at a distance indicated as 50 from the side 49) and Y (at a distance 51 from the side 49). The difference between the distances at which these points are

situated from the side 49 is equal to D. This distance can be determined for any arbitrary part of the weft thread having a length equal to L. In one embodiment this distance is at least equal to 0.1 % of the length L of the belt and equal at maximum to 1 % of said length L.

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Claims

1. A printer provided with a unit for forming an image and an endless intermediate belt trained under tension around rollers in such manner that the belt can rotate over the rollers, said intermediate belt being operatively connected to the said unit for transfer of the image from the unit to a receiving material, wherein the belt comprises a fabric of threads as a support, **characterised in that** at least one thread of the fabric contains a polyarylene sulphide material or a derivate thereof. 10
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2. A printer according to claim 1, **characterized in that** the at least one thread of the fabric is contains a polyphenylene sulphide material or a derivate thereof. 25
3. A printer according to claim 1 or 2, **characterized in that** the fabric is a monofilament fabric. 30
4. A printer according to claim 3, **characterized in that** the fabric comprises a weft thread containing a polyarylene sulphide material or a derivate thereof. 35
5. A printer according to claim 4, **characterized in that** the fabric comprises a warp thread containing a polyester material. 40
6. A printer according to one of the foregoing claims, wherein the fabric comprises one or more threads which extend substantially in the peripheral direction of the belt, **characterised in that** said one or more threads extend over a length L equal to the periphery of the belt in the axial direction over a distance D equal at maximum to three percent of the length L. 45
7. A printer according to claim 6, **characterised in that** the distance D is between 0.1 % and 1 % of the said length of L. 50
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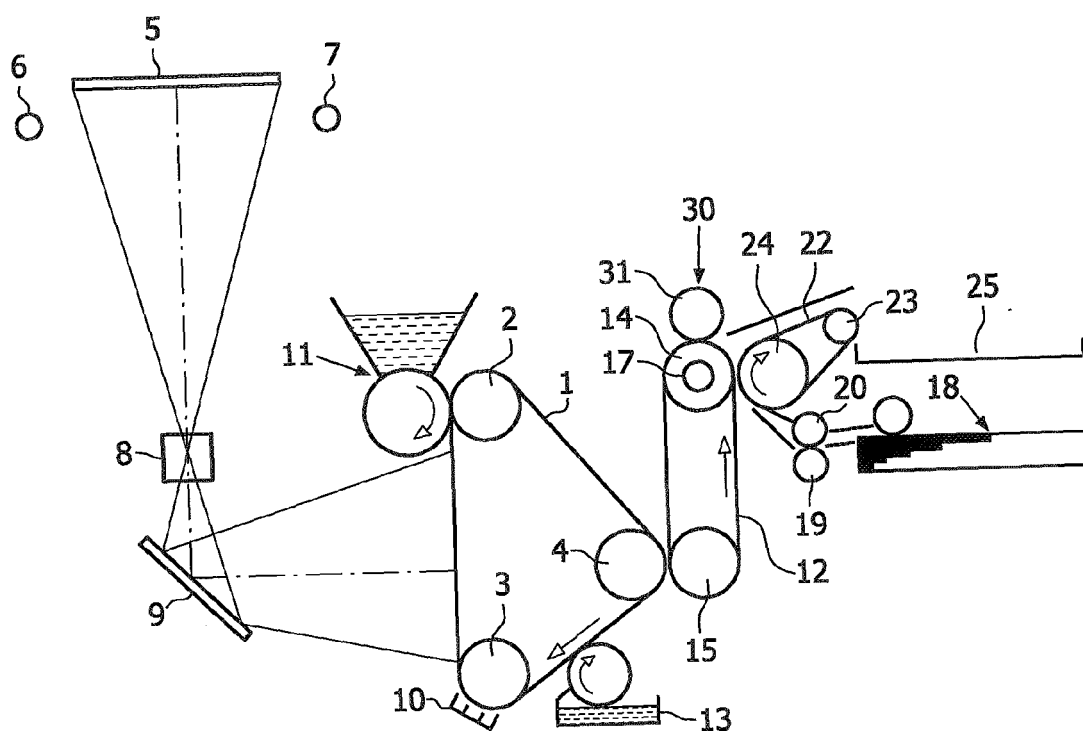


FIG. 1

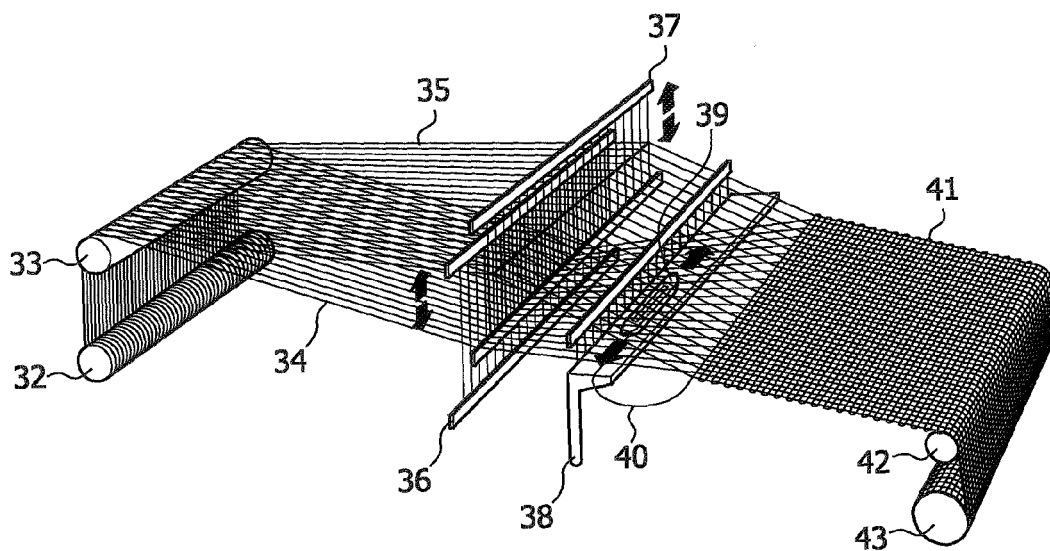


FIG. 2

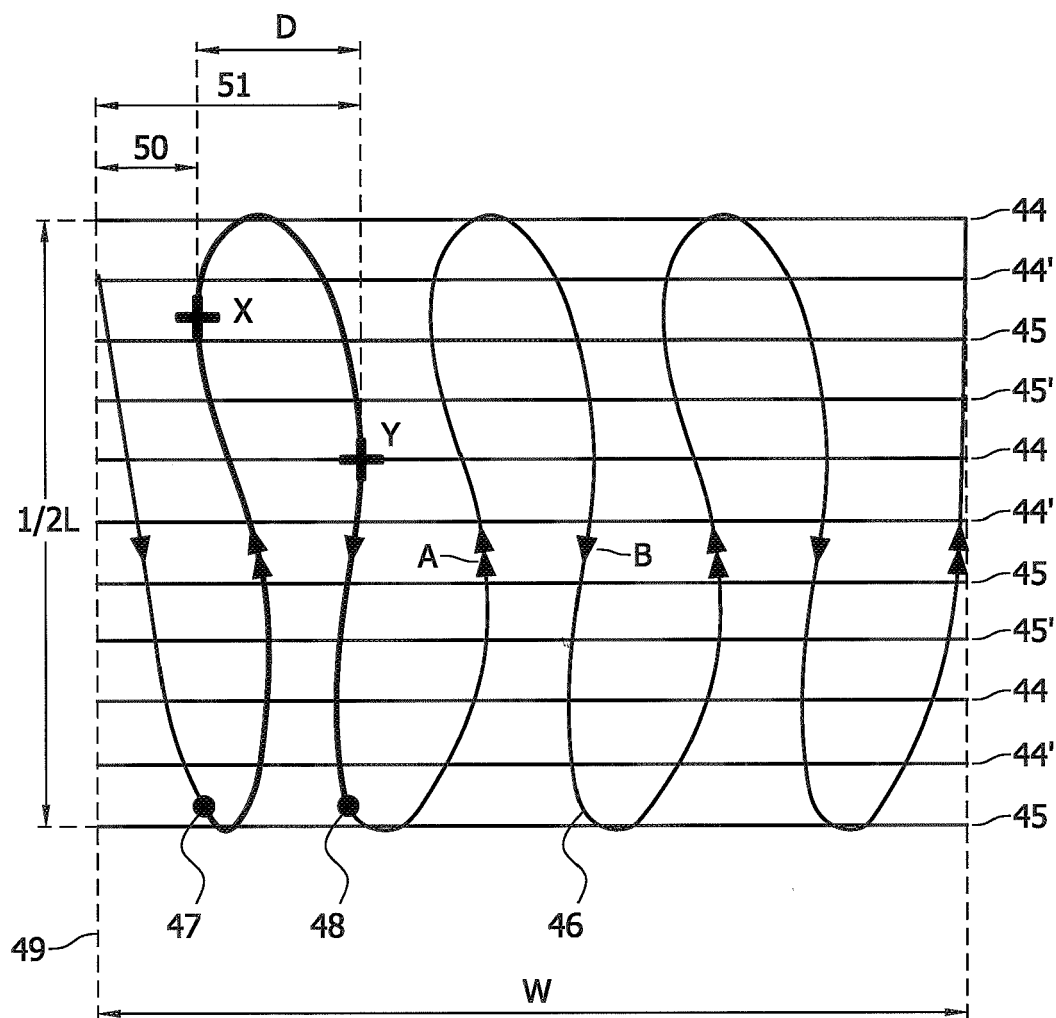


FIG. 3



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 06 12 2742

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 054 304 A1 (XEROX CORP [US]) 22 November 2000 (2000-11-22)	1,2	INV. G03G15/16
Y	* paragraphs [0016] - [0029], [0036] - [0041]; figures 1,2,4 *	3-5	
D,Y	EP 1 462 871 A (OCE TECH BV [NL]) 29 September 2004 (2004-09-29) * paragraphs [0014], [0015], [0019], [0022], [0023]; figures 1,3,5 *	1-7	
Y	EP 0 496 590 A2 (HOECHST CELANESE CORP [US]) 29 July 1992 (1992-07-29) * page 3, line 8 - page 4, line 39 *	1-7	
Y	US 5 298 956 A (MAMMINO JOSEPH [US] ET AL) 29 March 1994 (1994-03-29) * column 2, line 58 - column 3, line 12 * * column 3, line 29 - column 4, line 38 * * column 10, line 39 - line 41 *	3-5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			G03G C08G
Place of search		Date of completion of the search	Examiner
Munich		19 January 2007	Billmann, Frank
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 12 2742

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The members are as contained in the European Patent Office EDP file on
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19-01-2007

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1054304	A1	22-11-2000	DE 60009384 D1	06-05-2004
			DE 60009384 T2	19-08-2004
			JP 2000356914 A	26-12-2000
			US 6295434 B1	25-09-2001

EP 1462871	A	29-09-2004	JP 2004295096 A	21-10-2004
			NL 1023029 C2	30-09-2004
			US 2004190962 A1	30-09-2004

EP 0496590	A2	29-07-1992	AT 159992 T	15-11-1997
			CA 2058915 A1	24-07-1992
			DE 69222961 D1	11-12-1997
			DE 69222961 T2	05-03-1998
			JP 3021904 B2	15-03-2000
			JP 4308222 A	30-10-1992
			US 5162151 A	10-11-1992

US 5298956	A	29-03-1994	US 5409557 A	25-04-1995

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1462871 A1 [0002]
- EP 1058706 A [0004] [0005] [0014]
- US 4607947 A [0012]
- US 3554836 A [0012]