(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 775 135 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.04.2007 Bulletin 2007/16

(51) Int Cl.:
B41J 2/325 *(2006.01)*

(21) Application number: **05292186.3**

(22) Date of filing: **17.10.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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(54) Printing apparatus

(57) It is proposed in a printing apparatus for transferring toner (9) from a toner-bearing film element (1) to an image receiver (4) to be printed by locally heating the film element (1), with film transport means (2) being provided for transporting the film element (1) relative to the image receiver (4) along a first direction (3) of transport, and with image receiver transport means (5) being provided for transporting the image receiver (4) relative to the film element (1) along a second direction (6) of transport, for achieving a high resolution with simple means that the first direction (3) of transport is arranged substantially normal to the second direction (6) of transport.

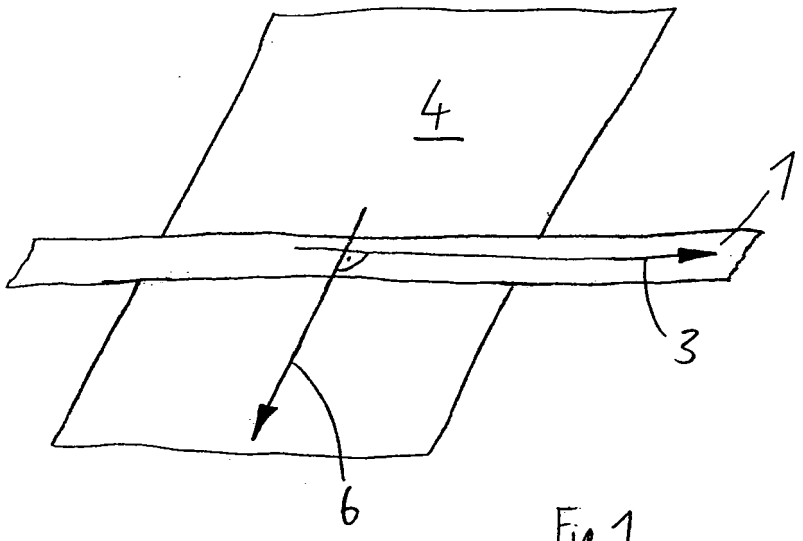

Fig. 1

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Description

[0001] The invention relates to a printing apparatus for transferring toner from a toner-bearing film element to an image receiver to be printed by locally heating the film element, with film transport means being provided for transporting the film element relative to the image receiver along a first direction of transport, and with image receiver transport means being provided for transporting the image receiver relative to the film element along a second direction of transport.

[0002] Thermal printers are known in which a film comprising a toner is guided close to a surface area to be printed and is heated locally in the regions or pixels which are to be printed. As a result, the solid toner on the film is molten or sublimed. The same therefore changes directly from the solid into the gaseous aggregate state and is transferred to the surface area to be printed. Thermal resistance elements can be provided for heating the film.

[0003] Since the thermal resistance elements are fixedly arranged in the printers, it is necessary to move the surface area to be printed, which is therefore usually the paper. In known printers the surface area to be printed is therefore guided on a transport roller. It is provided for in such printers that in a first printing process the components of a color are applied to the entire surface to be printed. Thereafter, the surface area to be printed is returned to the starting position and a further color component is applied. Three or four color components are thus typically applied. The film with the toner comprises several successive regions with toner of the color to be printed in such embodiments and is moved forward in a respective fashion when a new color is to be printed. The film is pressed as so-called endless material with successive regions of differently colored toner by a press roller against the surface to be printed, with the film having the width of the surface area to be printed and the axes of the transport roller and the press roller being substantially parallel.

[0004] The disadvantageous aspect in such a printer is that the surface area to be printed needs to be newly positioned after the application of each color and the positioning of the surface area to be printed needs to be made with a substantially higher precision than the print resolution to be achieved, because it is necessary for the sharp reproduction of individual color pixels that the successively applied coloring pigments need to be applied at the predetermined position of the surface area to be printed.

[0005] It is therefore the object of the present invention to provide a printing apparatus of the kind mentioned above with which the mentioned disadvantages can be avoided and with which a high resolution can be achieved with simple means.

[0006] This is achieved in accordance with the invention in that the first transport direction is arranged substantially normal relative to the second transport direction.

[0007] By transporting the film element substantially normal to the image receiver it is possible to print in all provided colors in a region of the width of the film element of the image receiver. It is merely necessary that the heating of the individual regions or pixels of the film element requires the printing precision, which is necessary anyway for achieving a printing precision. As a result of the width of the film element, it is possible to print not only a line but a strip which is complete in all colors. The image receiver then only needs to be forwarded by the width of the film element or by the width of the part of the image applied to the image receiver, with the printing precision being merely sufficient for this purpose. A complex repositioning of the surface area to be printed is thus no longer necessary.

[0008] It can be provided for in a further development of the invention that a strip-like film element is provided. It is thus possible to print an area which is large relative to a single line, whereas the area in which the film is heated and thus the area in which a thermal unit needs to be positioned can be kept small.

[0009] According to a further embodiment of the invention it can be provided that film transport means comprise at least one unreeling apparatus and a reeling apparatus. This enables a simple feed of the film.

[0010] According to another embodiment of the invention it can be provided that a separation apparatus is provided for separating the film element from the image receiver. This ensures maintaining an even distance of the film from the image receiver, as a result of which the print resolution can be kept constant.

[0011] In this connection it can be provided in a further development of the invention that the separation apparatus comprises a rail element movable over the width of the image receiver. An especially simple, stable and effective separation apparatus can thus be formed.

[0012] A variant of the invention can be that the separation apparatus comprises at least two rail elements delimiting a current printing area. The film is thus guided in an especially stable manner.

[0013] It can be provided in a further embodiment of the invention that at least one laser writing unit for locally heating the film element is provided, especially in the region of the image receiver. A predeterminable area or a pixel can thus be heated in a simple and precise manner. The heat source can be positioned simply and can be focused precisely. The printing speed can be increased substantially by several laser writing units.

[0014] It can be provided for in a further development of the invention at least one laser writing unit for local heating of the film element, especially in the region of the image receiver, is provided for each color and/or layer intended for printing. The printing speed can thus be increased in addition, because several colors can be applied in parallel.

[0015] The invention further relates to a printer with a printing apparatus in accordance with the invention. As

a result, all advantages of a printing apparatus in accordance with the invention can be achieved in a printer.

[0016] The invention further relates to a method for printing an image receiver, especially for a printing apparatus in accordance with the invention and/or a printer in accordance with the invention, with toner being transferred from a film element by local heating to a printing area of the image receiver which is opposite of the film element.

[0017] The printing of an image element as is applied in known printers or printing apparatuses has a number of disadvantages as already explained above.

[0018] It is therefore the object of the present invention to provide a method for printing an image receiver of the kind mentioned above, with which the mentioned disadvantages can be avoided and with which a high resolution can be achieved in a simple manner.

[0019] This is achieved in accordance with the invention in such a way that the printing area is printed in successive printing processes in several colors when the image receiver is stationary, with the film element being transported between the printing processes along a first direction of transport which is substantially normal to a second transport direction of the image receiver.

[0020] By transporting the film element substantially normal to the image receiver, the image receiver can be printed with all provided colors in a region of the width of the film element. Merely the heating of the individual regions or pixels of the film element must have the printing precision, which is necessary anyway for achieving a printing precision. As a result of the width of the film element, it is possible to print not only a line but a strip complete in all colors. The image receiver must merely be moved forward by the width of the film element or by the width of the portion of the image applied to the image receiver. Printing precision is then merely required for this purpose. Complex repositioning of the area to be printed is no longer necessary.

[0021] According to a further embodiment of the invention it can be provided that the image receiver is moved forward along the second transport direction by a printing width of the film element. An image can thus be printed broken down into partial images substantially independent from its size.

[0022] The invention is described in closer detail by reference to the enclosed drawings showing especially preferred embodiments, wherein:

Fig. 1 shows the principle of the invention in a highly schematic illustration;

Fig. 2 shows an illustration of the color application in a printing apparatus in accordance with the invention;

Fig. 3 shows a schematic illustration of an especially preferred arrangement of a printing apparatus in accordance with the invention;

Fig. 4 shows a schematic representation of a specially preferred embodiment of a separation apparatus;

[0023] Figs. 1 to 4 show simplified representations or parts of a printing apparatus for transferring toner 9 from a toner-bearing film element 1 to an image receiver 4 to be printed by local heating of the film element 1, with film transport means 2 being provided for transporting the film element 1 relative to the image receiver 4 along a first transport direction 3, and with image receiver transport means 5 being provided for transporting the image receiver 4 relative to the film element 1 along a second transport direction 6, with the first transport direction 3 being arranged substantially normal to the second transport direction 6.

[0024] By transporting the film element 1 substantially normal to the image receiver 4, the image receiver 4 can be printed in all provided colors in a region of the width of the film element 1. Merely the heating of the individual regions or pixels of the film element 1 must have the printing precision, which is necessary anyway for achieving a predeterminable printing precision. The width of the film element 1 allows printing not only a line but a strip complete in all colors. The image receiver 4 then only needs to be forwarded by the width of the film element 1 or by the width of the part of the image applied to the image receiver 4, with the printing precision being sufficient alone for this purpose. A complex repositioning of the surface area to be printed is thus no longer necessary.

[0025] The printing apparatuses in accordance with the invention can concern a printing apparatus for use in any kind of printer and/or printing machine such as compact printers, office printers, special photographic printers and/or large-scale printing installations.

[0026] The printing apparatuses in accordance with the invention are provided for printing an image receiver 4. This can concern any type of material which is temporarily substantially solid such as paper, cardboard, metal, fabric, wood, plastic, composite materials, rubber, glass, solidified and/or frozen liquids, or a combination of the same, or other materials.

[0027] The application of an image of a picture is provided for in an image receiver 4 in a printing apparatus in accordance with the invention. This may concern both "images" as well as text. The image is produced on the image receiver 4 by application of toner 9, with the toner 9 being thermally detached from a toner-bearing film element 1 and being deposited on an image receiver 4.

[0028] During the operation of the printing apparatus, a region of the film element 1 overlaps a region of the image receiver 4. An image can be produced on the image receiver 4 in this region of temporary overlapping, which is why this region is designated as the printing area or as the current printing area.

[0029] As is shown schematically in Fig. 2, a film element 1 for a printing apparatus in accordance with the invention comprises a carrier layer 14 and a toner layer

15. It is also possible that several layers are provided.

[0030] A printing apparatus in accordance with the invention further comprises an image receiver transport means 5 for transporting the image receiver 4. Since an application of the image may not be possible, or only within certain limits, in a single printing process in most of the cases, it may be provided that the image receiver is movable relative to the printing area. As a result of the image receiver transport means 5, a transport of the image receiver 4 relative to the film element 1 is possible or provided along a second transport direction 6.

[0031] The image receiver transport means 5 can comprise any kind of means for the movement of an image receiver 4, especially any kind of roller and/or linear guide means. In the especially preferred embodiment according to Fig. 3, the image receiver means 5 comprise a substantially planar receiving table 16, on which the image receiver 4 is held. Means (not shown) for fixing the image receiver 4 on the receiving table 16 can be provided such as clamps and/or a vacuum suction system. The receiving table 16 and/or the image receiver 4 can be moved with means (not shown) at least in the entered second transport direction 6. A movement or adjustment of the receiving table 16 and/or the image receiver 4 can also be provided in other directions, e.g. perpendicular and/or horizontal substantially normal to the second transport direction 6.

[0032] As an alternative to a preferred embodiment according to Fig. 3 it is possible to provide an image receiver support which is roller-shaped at least in sections, with the radius of the roller or roller section preferably being so large that the same is negligible in the current printing area. It can also be provided that the film element 1 is deformed in an arc-shaped manner in the printing area, so that the same is parallel to the surface of the image receiver 4 in the printing area and has a substantially equal distance to the surface of the image receiver 4 at each point of the film element 1. An image receiver 4 which is roller-shaped in sections comes with the advantage that the same can be swivelled about an axis, which thus leads to an especially simple manner of the transport of the image receiver 4 along the second transport direction 6.

[0033] Printing apparatuses in accordance with the invention are provided for use with toner-bearing film elements 1. During the printing process, the toner 9 is detached from the film element 1, thus leading to toner-free regions on the film element 1. Film transport means 2 for transporting the film element 1 relative to the image receiver 4 along a first transport direction 3 are provided in a printing apparatus in accordance with the invention in order to provide regions of the film element 1 with toner 9 during the printing process. It is provided for in accordance with the invention that the first transport direction 3 is arranged substantially normal to the second transport direction 6, which thus leads to the advantages as already described above.

[0034] In a preferred embodiment of the film transport means 2 it is provided that the same comprise at least one unreeling apparatus 7 and a reeling apparatus 8, which thus allows using a film element 1 in the form of so-called "endless material". Such an unreeling apparatus 7 can comprise a reel which is rotatably held about an axis. A reeling apparatus 8 can also comprise a rotatably held reel. It can be provided in particular that the reel of the reeling apparatus 8 can be driven in a predeterminable manner. The control unit of the reeling apparatus 8 can be part of the control unit of the printing process and/or can cooperate with the same. It can also be provided that the unreeling apparatus 7 is driven in order to prevent excessive tensile stresses in the film element 1 and thus to avoid any stretching or tearing of the same.

[0035] For printing reasons it can be advantageous when there is the most constant distance between the surface of the toner layer 15 of the film element 1 facing the image receiver 4 and the image receiver 4 per se. It can therefore be provided in preferred embodiments of printing apparatuses in accordance with the invention that a separation apparatus 11 is provided for separating the film element 1 from the image receiver 4. Such a separation apparatus 11 can comprise a rail element 12 which is movable approximately over a width of the image receiver 4. It is provided in an especially preferable way that the separation apparatus 11 comprises at least two rail elements 12 delimiting a current printing area. Fig. 4 shows two rail element 12 which guide a film element 1 which is strip-like in this preferred embodiment and ensure a constant distance to the image receiver 4. It is also possible to provide an elevation such as a web or a number of knob-like elevations which are arranged directly on the film element 1, which webs or knob-like elevations border the film element 1 on either side. It can preferably be provided that the distance of the film element 1 relative to the image receiver 4 is approx. 3 μm to 50 μm.

[0036] A local heating of the film element 1 is provided for transferring the toner 9 from the film element 1 to the image receiver 4. Any kind of heat source can be provided for reaching this local heating. Thermal resistor elements can be provided for this purpose. It can preferably be provided that at least one laser writing unit 10 is provided for locally heating the film element 1, especially in the region of the image receiver 4. Fig. 2 shows a film element 1 adjacent to an image receiver 4 as well as a laser writing unit 10. The broad illustrated arrow 13 symbolizes the energy flow from the laser writing unit 10 to the film element 1. Clearly shown is the toner 9 extracted from the toner layer 15 under the influence of energy, which toner was transferred to the surface of the image receiver 4. It is also possible to provide a heating of the film element 1 through the image receiver 4.

[0037] Fig. 3 shows a schematic representation of a preferred embodiment of a printing apparatus in accordance with the invention with a laser writing unit 10. The energy flow from the laser writing unit 10 to the film element 1 is also illustrated by the broad arrow 13. Such a

laser writing unit 10 can be provided for moving or adjusting and focussing over a wide area, especially the entire printing area. The possible mobility and adjustability is symbolized by the illustrated arrows 17. It is also possible that several laser writing units 10 are provided. The printing area can also be divided into partial areas which are each allocated to at least one laser writing unit 10. The laser writing units 10 must be adjusted or focussed with the print resolution or precision.

[0038] When printing several colors it can be provided in particular that a film element 1 is provided which comprises regions of differently colored toner 9. In accordance with the invention, a printing area is printed with toner 9 of a first color when the image receiver 4 is stationary, thereafter the film element 1 is moved further along a first transport direction 3 until a region of a second toner 9 of a different color comes to lie above the printing area and the printing process is carried out for this second color component. This is repeated until all color components have been used up. It is also possible to apply a layer which is substantially transparent and/or is provided all over. It can be provided in particular that toner 9 of the colors cyan, magenta, yellow and/or black are provided. The toner 9 could be provided with any other color such as fluorescent or ultraviolet colors.

[0039] After the application of all colors on the printing area, the film element 1 is moved further in the first transport direction 3 until a region of the next desired toner 9 is arranged opposite of the printing area, and the image receiver 4 is moved further along the second transport direction 6 by a printing width of the film element 1, with the first transport direction 3 being arranged substantially normal to the second transport direction 6.

[0040] When printing an image receiver 4 with several colors and/or layers, it can also be provided that for each color and/or layer intended for printing there is provided at least one laser writing unit 10 for locally heating the film element 1, especially in the region of the image receiver 4.

[0041] In preferred embodiments of printing apparatuses in accordance with the invention it is possible to provide strip-like film elements 1. A printing area can thus be achieved with advantageous width without any movement of the image receiver 4 and with minor movements or adjustments of the thermal writing unit.

[0042] Further embodiments in accordance with the invention can merely comprise a part of the described features, but every combination of features can be provided.

Claims

1. A printing apparatus for transferring toner (9) from a toner-bearing film element (1) to an image receiver (4) to be printed by locally heating the film element (1), with film transport means (2) being provided for transporting the film element (1) relative to the image receiver (4) along a first direction (3) of transport, and with image receiver transport means (5) being provided for transporting the image receiver (4) relative to the film element (1) along a second direction (6) of transport, **characterized in that** the first direction (3) of transport is arranged substantially normal to the second direction (6) of transport.

2. A printing apparatus according to claim 1, **characterized in that** a strip-like film element (1) is provided.

3. A printing apparatus according to claim 1 or 2, **characterized in that** the film transport means (2) comprise at least one unreeling apparatus (7) and one reeling apparatus (8).

4. A printing apparatus according to claim 1, 2 or 3, **characterized in that** a separation apparatus (11) is provided for separating the film element (1) from the image receiver (4).

5. A printing apparatus according to claim 4, **characterized in that** the separation apparatus (11) comprises a rail element (12) which can be moved over the width of the image receiver (4).

6. A printing apparatus according to claim 4 or 5, **characterized in that** the separation apparatus (11) comprises at least two rail elements (12) delimiting a current printing area.

7. A printing apparatus according to one of the claims 1 to 6, **characterized in that** at least one laser writing unit (10) is provided for locally heating the film element (1), especially in the region of the image receiver (4).

8. A printing apparatus according to claim 7, **characterized in that** at least one laser writing unit (10) for the local heating of the film element (1), especially in the region of the image receiver (4), is provided for each color and/or layer intended for printing.

9. A printer with a printing apparatus according to one of the claims 1 to 8.

10. A method for printing an image receiver (4), especially for a printing apparatus according to one of the claims 1 to 8 and/or a printer according to claim 9, with toner (9) being transferred from a film element (1) by means of local heating onto a printing area of the image receiver (4) opposite of the film element (1), **characterized in that** the printing area is printed in successive printing processes in several colors when the image receiver (4) is stationary, with the film element (1) being transported between the printing processes along a first direction (3) of transport

which is substantially normal to a second direction (6) of transport of the image receiver.

11. A method according to claim 10, **characterized in that** the image receiver (4) is moved further along the second direction (6) of transport by one printing width of the film element (1).

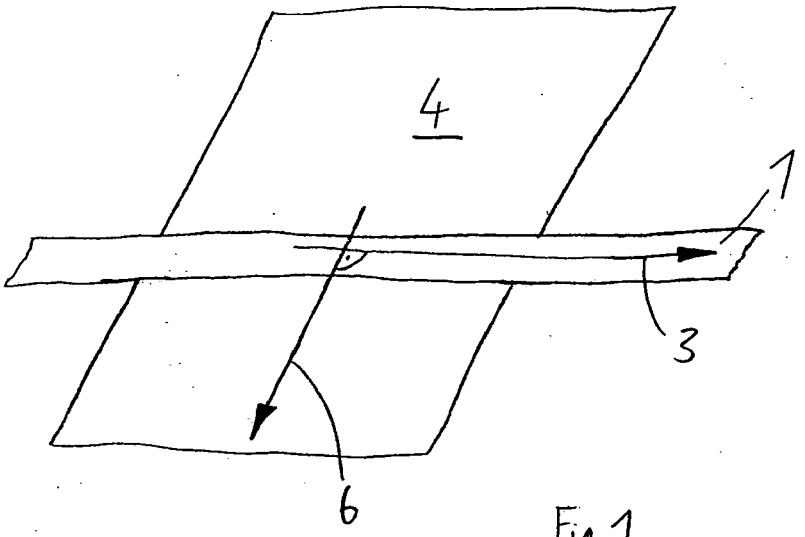

Fig. 1

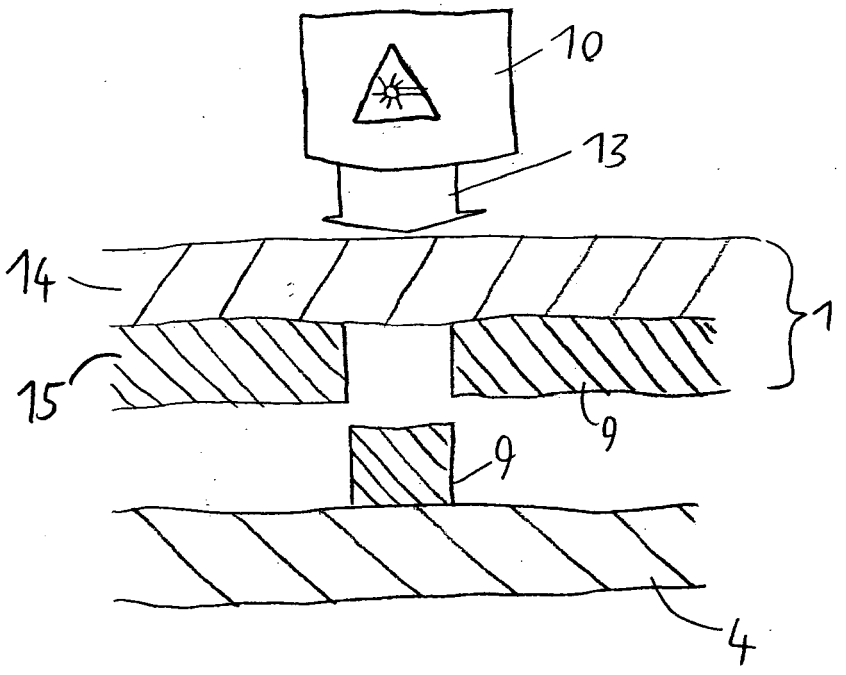

Fig. 2

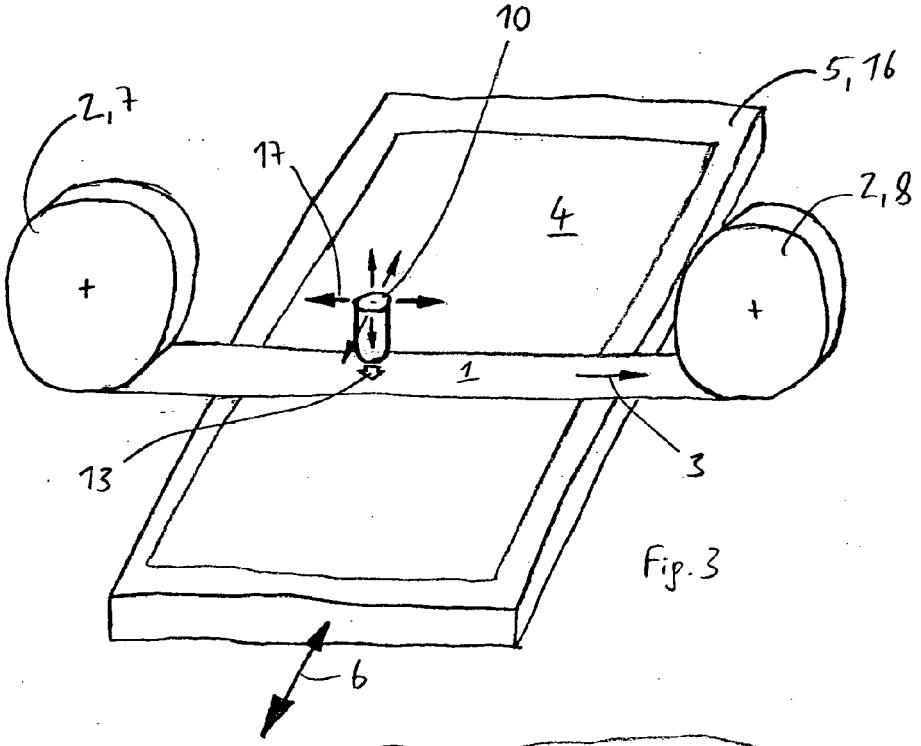

Fig. 3

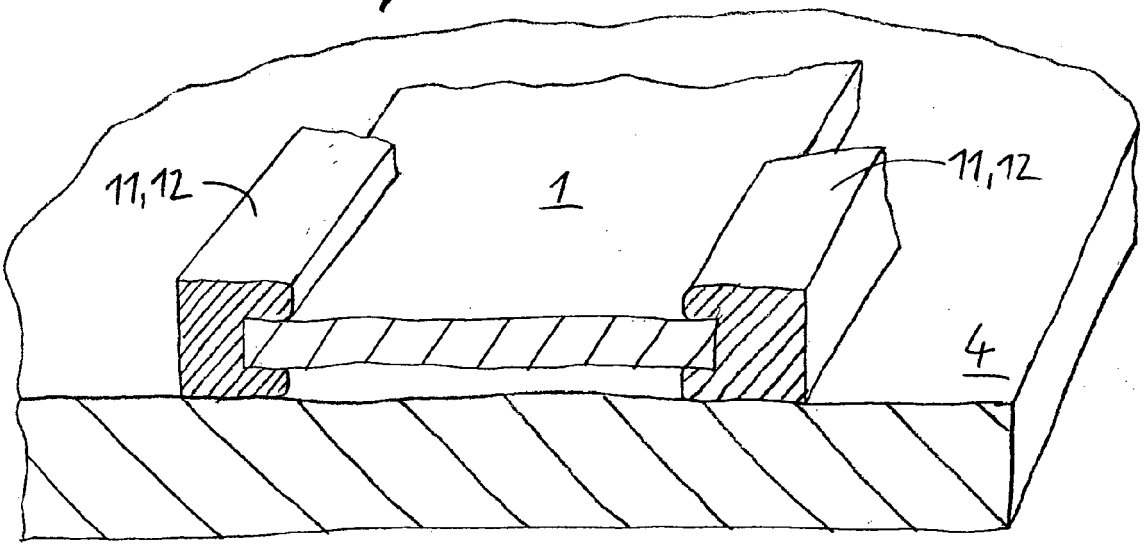

Fig. 4

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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	15 March 2006	Didenot, B

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