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# (54) A printing apparatus

(57) A printing apparatus comprises a media supporting axis (60) for a roll (3) of printing media (M); the axis (60) can rotate in a first direction (A) to allow feeding said printing media (M) past a printhead (1) in an advance direction during a printing operation, and the apparatus comprises means (80) for rotating said axis (60) in a second direction (B) opposite to said first direction (A).

Said axis (60) may be arranged around an inner axis (70) which is supported in the apparatus, and the means for rotating said axis (60) may comprise a torsion spring (80) arranged between axis (60) and axis (70).

Media waste can be avoided in certain circumstances, by allowing pulling back media reliably towards the printer.

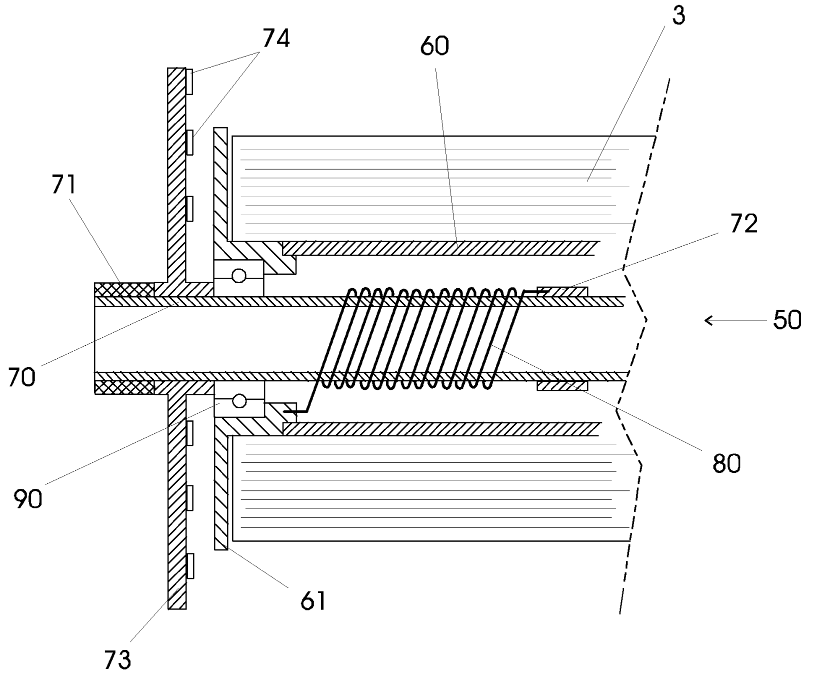



FIG. 2

EP 1 733 894 A1

## Description

**[0001]** The present invention relates to a printing apparatus comprising a media supporting axis for a roll of printing media.

**[0002]** In a printing apparatus, for example an inkjet printer, a printing media travels in an advance direction under a printhead, which deposits ink on the media. In the case of an i nkj et printer the media advance may be stepwise, the pri nt head ej ecti ng drops of ink on the underlying media while the latter remains stationary.

**[0003]** The printing media may be a web, which is fed from a feed roll arranged in the printing apparatus upstream of the printhead and on which several different plots are printed one after the ot her.

**[0004]** In some cases it is desirable to pull media back into the printer, i.e. to cause a length of media to travel in a direction opposite the advance direction.

**[0005]** This operation may be convenient for avoiding a waste of media when a length of blank media has been outputted from the printer in the advance direction; this may happen, for example, when a further operation is performed on the media downstream of the printing device, such as described in US-2004036755-A, which is owned by the present applicant and relates to a printing apparatus comprising a laminator to which the media outputted by the printer isfed in an integrated operation.

**[0006]** In this case, after printing one plot it may be necessary to output blank media from the printer until the laminating operation is finished. This may be because the lamination process cannot be stopped in the middle of a plot without causing defects.

**[0007]** Once the laminating operation on the plot is finished, the blank media previously outputted may be pulled back into the printer, in order to avoid a waste of media. To this end, the media driving means are reversed and the media is caused to travel backwards into the printer.

**[0008]** However, pulling the media back into the printer may cause a number of drawbacks, for example: the media may remain loose in the region upstream of the driving means; or the media may be damaged due to unexpected contact with a surface of the printing apparatus itself or of other external elements. Such a contact and damage may cause a significant loss in production due to the need of lengthy user intervention; and of course a lot of media might then be wasted.

**[0009]** Another problem may arise due to the fact that some printers, in particular some large format printers, are designed to control the accurate positioning of the media during printing and advance by means of back tension, i.e. applying a force in a direction opposite to the advance direction to keep the media slightly tensioned upstream of the printhead. This is done for example using a passive friction brake on the media feed roll.

**[0010]** If media is pulled back into the printer it will remain loose upstream of the pri nt head, and once pri nti ng is resumed t here wi ll be no back tension on the media unti all the loose media has advanced. The lack of back tension may allow a sideways displacement of the media, causing skew problems.

**[0011]** Furthermore when all the loose media has advanced and media is pulled again from the feed roll, there will be a sudden increase in the back tension, due to the weight of the roll and the passive friction brake, which may cause media slippage; since this occurs when pri nti ng has already started, it may cause defects in the printed plot.

**[0012]** The present invention seeks to provide a printing apparatus i n which a waste of media can be avoided in certain circumstances, for example when an operation to be performed downstream of the printing apparatus requires advancing blank media through the printer, and in which at the same time the drawbacks mentioned above are at least reduced.

**[0013]** According to a first aspect, the present invention relates to a printing apparatus comprising a media supporting axis for a roll of printing media, wherein said media supporting axis can rotate in a first direction to allow feeding said printing media past a printhead in an advance direction during a printing operation, and wherein said apparatus comprises means for causing rotation of said media supporting axis in a second direction opposite to said first direction.

**[0014]** By means of the rotation of the media supporting axis in said second direction it is possible to avoid media waste by pulling back blank media reliably towards the printer when this is convenient.

**[0015]** This allows the printer to work in modes which require that a significant amount of media travels back towards the printer, for example when it is in combination with a downst ream device, such as a laminator.

**[0016]** Said means for causing rotation of the media supporting axis in said second direction may comprise driving means, which may be passive driving means; the provision of passive driving means allows proving a cost-effective and relatively simple devi ce.

**[0017]** In the present specification, the expression "passive" driving means is applied to a device that can provide a driving force without simultaneously consuming power from the mains; this may be achieved generally by powering the device, i.e. loading it with energy, during another stage of the operation of the apparatus, e.g. upon rotation or displacement of another element.

**[0018]** According to another aspect, the present invention relates to a media delivery assembly for feeding printing media to a printing apparatus, comprising a media supporting axis for a roll of printing media, wherein said media supporting axis can rotate in a first direction to allow feeding said printing media in an advance direction, and wherein said spindle further comprises means for causing rotation of said media supporting axis in a second direction opposite to said first direction.

**[0019]** Particular embodiments of the present invention will be described in the following, only by way of non-limiting example, with reference to the appended drawings, in which:

figure 1 is a schematic view showing a media feed roll in a printing apparatus;
figure 2 shows in cross section one end of a spindle for supporting a media feed roll, according to an embodiment of the present invention;
figure 3 is a graph showing as a function of time the tension of the spring of the spindle of figure 2; and
figures 4a to 4c are schematic views showing a detail of the spindle of figure 2 in three different steps of operation.

**[0020]** In a printing apparatus, a media Mto be printed travels under a print head 1 in an advance direction shown by arrow A, driven by a media advance system 2.

**[0021]** The printing media M is here a web of media, which is fed from a media feed roll 3; between the feed roll and the advance system 2 the media travels around an idle roller 4.

**[0022]** The media feed roll 3 is supported by a media delivery assembly 50 according to an embodiment of the present invention, such as a spindle, which is shown in more detail in figure 2.

**[0023]** The spindle 50 comprises a media supporting axis 60, on which the feed roll 3 is mounted, an inner axis 70 coaxial to the media supporting axis 60, and a torsion spring 80 arranged between the two axes, i.e. with one end attached to the inner axis 70 and the other end attached to the media supporting axis 60.

**[0024]** The inner axis 70 is mounted at each end in the printing apparatus by means of a friction sleeve 71, which is integral in rotation with said axis and is arranged in a suitable housing or support (not shown) foreseen in the structure of the printing apparatus, such that the cooperation of the housing and the friction sleeve 70 performs a braking action opposing the rotation of the inner axis 70. The friction sleeves 71 constitute passive braking means.

**[0025]** The media supporting axis 60, provided with corresponding side flanges 61, is mounted around the inner axis 70 by means of roller bearings 90; the media feed roll 3 is supported on axis 60 so as to be integral in rotation therewith.

**[0026]** The torsion spring 80 is coiled around the inner axis 70, and it has one end attached to the media supporting axis 60, e.g. to one of the side flanges 61 as shown in figure 2, and the other end attached to a sleeve 72 which is rigidly attached to the inner axis 70.

**[0027]** The spring 80 has the function of storing energy during normal printing operation, when the media travels in the advance direction and the media supporting axis 60 rotates accordingly, in the direction shown by arrowsAin figure 1.

**[0028]** When some of the media is pulled back into the printer by the printer driving system 2, in the direction of arrows B in figure 1, the pulling force of the media on the spindle ceases, and the spri ng 80 provides the stored energy for causing rotation of the media supporting axis 60 in a direction opposite the media advance direction, as shown by arrow B, such that the media is recoiled on the feed roll 3. During this recoiling step, the inner axis 70 remains stationary.

**[0029]** The spring 80 constitutes a passive driving means for the media supporting axis 60: it is not powered or driven by a motor, but it stores energy for rotating the axis 60 in a direction opposite to the advance direction, when required.

**[0030]** The spring 80 is designed and arranged such that the maximum force it can exert is smaller than the friction force between the inner axis 70 and the printer, i.e. between the friction sleeves 71 and the printer housing. Thus, the inner axis 70 will not rotate with respect to the printer housing unless the spring 80 is fully loaded.

**[0031]** It is apparent from figure 2 that the spring 80 is coiled around the inner axis 70 and housed i n its entirety inside the axis 60, t hereby avoiding the risk t hat a person may unintentionally touch the spring; this reduces the risk of injures to users and damages to the apparatus.

**[0032]** The operation of a printer provided with a spindle 50 such as described, bearing a media feed roll 3, will be explained in the following, with reference to figures 1 to 4.

**[0033]** Figure 3 shows a graph of the force of the spring 80 as a function of time. In the graph $t_0$, $t_1$, $t_2$, .....are instants in time, and F represents the force of the spring in each instant, $F_b$ being the maximum force the spring can exert, when it is fully st ret ched.

**[0034]** Figures 4a to 4c show schematically the spindle 50 in side view during some steps of the operation: more particularly, figure 4a shows the spindle at an instant between to and $t_1$; figure 4b shows the spindle at an instant between $t_1$ and $t_2$; and figure 4c shows the spindle at an instant between $t_2$ and $t_3$.

**[0035]** At the beginning (to) of a printing operation in which the media travels under the pri nt head in the advance direction (arrow A), the spring 80 is not under tension; the media supporting axis 60 of the spindle 50 is drawn in motion by the media itself and starts rotating wit h respect to the inner axis 70, as shown in figure 4a; the inner axis 70 at this stage is kept stationary by the friction between the friction sleeves 71 and the printer housi ng.

**[0036]** As a result of the relative rotation between axes 60 and 70, the spring 80 elongates and its force gradually increases, as shown by the slope in the graph between to and $t_1$, such that the spring stores potential energy. The back tension to which the media issubject also increases.

**[0037]** At instant $t_1$, the spring reaches its fully stretched state and its maximum force $F_b$, and the inner axis 70 of the spindle starts rotating together with the media support i ng axis 60, because it is drawn by the spri ng 80.

**[0038]** From this point, while the media advance continues, either for normal printing or because blank media is caused to advance through the printer, the spring 80 remains tensioned with a force $F_b$ and the two parts 60, 70 of the spindle 50 rotate together in the direction of arrow A, as shown in figure 4b.

**[0039]** If the media advance is stopped, and at instant $t_2$ and the advance system 2 is inverted to pull media back towards the printer, then the media will cease to exert a pulling force on the media supporting axis 60, which will then start to rotate in the direction of arrow B, opposite to the advance direction, drawn by the force of the spring 80. As a consequence, the media pulled back towards the pri nt er by the advance syst em 2 will recoil on the media supporting axis, as shown in figure 4c.

**[0040]** During this step, and until the pulling back of the media is stopped at instant $t_3$, the force of the spring 80 will gradually decrease as it delivers the stored energy to recoil the media, as shown by the slope of the graph of figure 3 between $t_2$ and $t_3$.

**[0041]** If at a later instant $t_4$ the normal printing operation is resumed, the media supporting axis 60 will start rotating again in the direction of arrow A, while inner axis 70 remains stationary, until the spring 80 has reached again its fully tensioned state, at instant $t_5$. At this point, the spring exerts its maximum force and inner axis 70 starts rotating together with the media supporting axis 60, drawn by the spring.

**[0042]** It will be appreciated that the provision of a passive driving means such as spring 80 in the spindle 50 allows pulling back media into the printer in a reliable way, by reducing the risk that the media contacts the printer surfaces or other unwanted elements.

**[0043]** On the other hand, when the printing operation resumes after pulling back some media towards the printer and recoiling it on the spindle 50, the media is subject to a degree of back tension provided by the spring 80, and this back tension increases gradually until the spring is subject to its maximum force and the inner axis starts rotating. Thus, the increase in back tension during printing is not so abrupt, and defects can be avoided or at least reduced.

**[0044]** The length of media that can be recoiled on the spindle 50 depends on the design of the spindle, and especially on the features of the spring 80; the skilled man is able to provide in each particular case a design suited to the desired length of media to be recoiled.

**[0045]** The spindle has been described with a torsion spring 80 between the media supporting axis 60 and the inner axis 70, but different configurations are also possible:

for example, more than one spring may be arranged between the two axes, or a different type of resilient element may be provided linking the two axes 60 and 70 in order to perform a similar function.

**[0046]** The passive means for driving a media supporting axis in a direction opposite to the media advance direction may also be embodied by devices other than resilient elements but that are suitable for storing energy during the advance of the media and delivering said energy when the media is pulled back towards the printer, such as mechanic or pneumatic systems.

**[0047]** As seen in figure 2, according to an embodiment the spindle 50 may also be provided with a preload disk 73. This is a disk that is keyed to the inner axis 70 at one end of the spindle 50, such that a user can manually rotate the inner axis 70 while maintaining stationary the media supporting axis 60, in order to load the spri ng 80 with a desired degree of force.

**[0048]** This pre-loading operation may be carried out when loading a roll of media on the spindle; thus, the media may be subject to an appropriate back tension right from the beginning of the printing operation on a new roll of media. As mentioned before, such back tension is useful for improving the media advance and controlling its lateral travelling.

**[0049]** For a better hand grip, the preload disk is provided with grip tabs 74 near its peri phery.

**[0050]** In the above example, the spindle 50 has been described associated to a printer. However, it should be noted that a spindle according to an embodiment of the invention could also be provided as a separate part to be used in existing printer; for example, the design of the spindle that has been described by way of example, having a spring arranged between the two axes, is compatible with several existing inkjet printers. The incorporation of such a spindle in other kinds of printing apparatus is also possible.

**[0051]** Furthermore, the spindle may be provided with a suitable support or housing, and be used as an independent accessory for feeding printing media to a printing apparat us.

**[0052]** On the other hand, a media delivery assembly such as claimed in the present application could of course be structurally different from the spindle described herein by way of example.

## Claims

1. A printing apparatus comprising a media supporting axis (60) for a roll (3) of printing media (M), wherein said media supporting axis (60) can rotate in a first direction (A) to allow feeding said printing media (M) past a printhead (1) in an advance direction during a printing operation, and wherein said apparatus comprises means (80) for causing rotation of said media supporting axis (60) in a second direction (B) opposite to said first direction (A).

2. A printing apparatus as claimed in claim 1, wherein said means for causing rotation of the media supporting axis (60) in said second direction (B) comprise driving means (80).

3. A printing apparatus as claimed in claim 2, wherein said driving means (80) are passive.

4. A printing apparatus as claimed in any of claims 1 to 3, wherein said means for causing rotation of the media supporting axis (60) in said second direction (B) comprise at least one energy storage member (80) which can store energy as a consequence of the rotation of the media supporting axis (60) in said first direction (A) and thereafter can deliver the stored energy for causing rotation of the media supporting axis (60) in said second direction (B).

5. A printing apparatus as claimed in claim 4, wherein said energy storage member is a resilient member (80).

6. A printing apparatus as claimed in any of claims 1 to 5, wherein said media supporting axis (60) is mounted on an inner axis (70) and is freely rotatable about said inner axis (70), and wherein said means (80) for causing rotation of said media supporting axis (60) in a second direction (B) opposite to said first direction (A) act to rotate said media supporting axis (60) with respect to said inner axis (70).

7. A pri nt i ng apparatus as claimed i n cl ai m 6, wherein said means for causing rotation of said media supporting axis comprise a resilient member (80) attached between said media supporting axis (60) and said inner axis (70).

8. Aprintingapparatusasclaimed in claim 7, wherein said resilient member is a torsion spring (80) housed inside said media supporting axis (60).

9. A printing apparatus as claimed in any of claims 6 to 8, wherein said inner axis (70) is rotatably mounted in the printing apparatus.

10. A printing apparatus as claimed in claim 9, wherein brake means (71) are provided between said inner axis (70) and the printing apparatus.

11. A printing apparatus as claimed in claim 10, wherein said brake means comprise passive brake means (71).

12. A printing apparatus as claimed in any of claims 4 to 11, further comprising means (73) for loading said energy storage member (80) while maintaining stationary the media supporting axis (60).

13. A printing apparatus as claimed in claim 12, wherein said means for loading said energy storage member (80) comprise means (73) for manually rotating said inner axis (70).

14. A media delivery assembly (50) for feeding printing media (M) to a printing apparatus, comprising a media supporting axis (60) for a roll (3) of printing media (M), wherein said media supporting axis (60) can rotate in a first direction (A) to allow feeding said printing media (M) in an advance direction, and wherein said media delivery assembly (50) further comprises means (80) for causing rotation of said media supporting axis (60) in a second direction (B) opposite to said first direction (A).

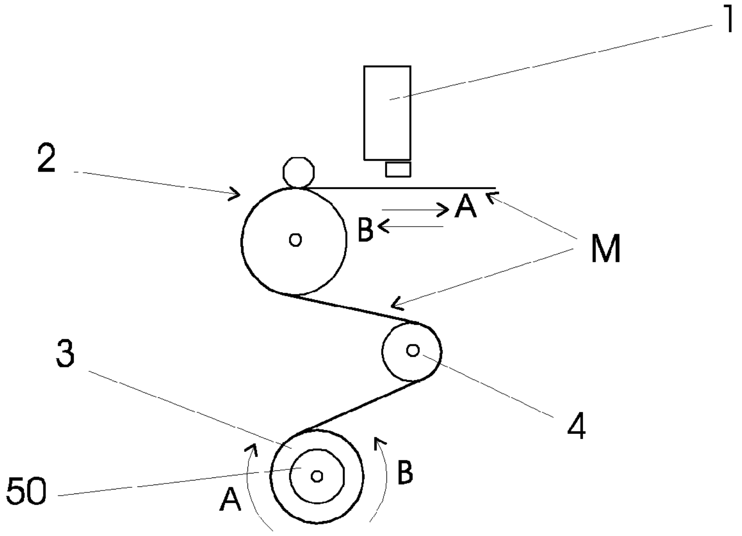
15. An assembly as claimed in claim 14, wherein the means (80) for causing rotation of said media supporting axis (60) in a second direction (B) comprise driving means.

16. An assembly as claimed in claim 15, wherein said driving means (80) are passive.

17. An assembly (50) as claimed in any of claims 14 to 16, wherein said means for causing rotation of the media supporting axis (60) in said second direction (B) comprise at least one energy storage member (80) which can store energy as a consequence of the rotation of the media supporting axis (60) in said first direction (A) and thereafter can deliver the stored energy for causing rotation of the media supporting axis (60) in said second direction (B).

18. An assembly (50) as claimed in claim 17, further comprising an inner axis (70) rotatably mounted on a support structure, wherein said media supporting axis (60) is mounted freely rotatable about said inner axis (70), and wherein said energy storage member (80) is attached between said inner axis (70) and said media supporting axis (60).

FIG. 1



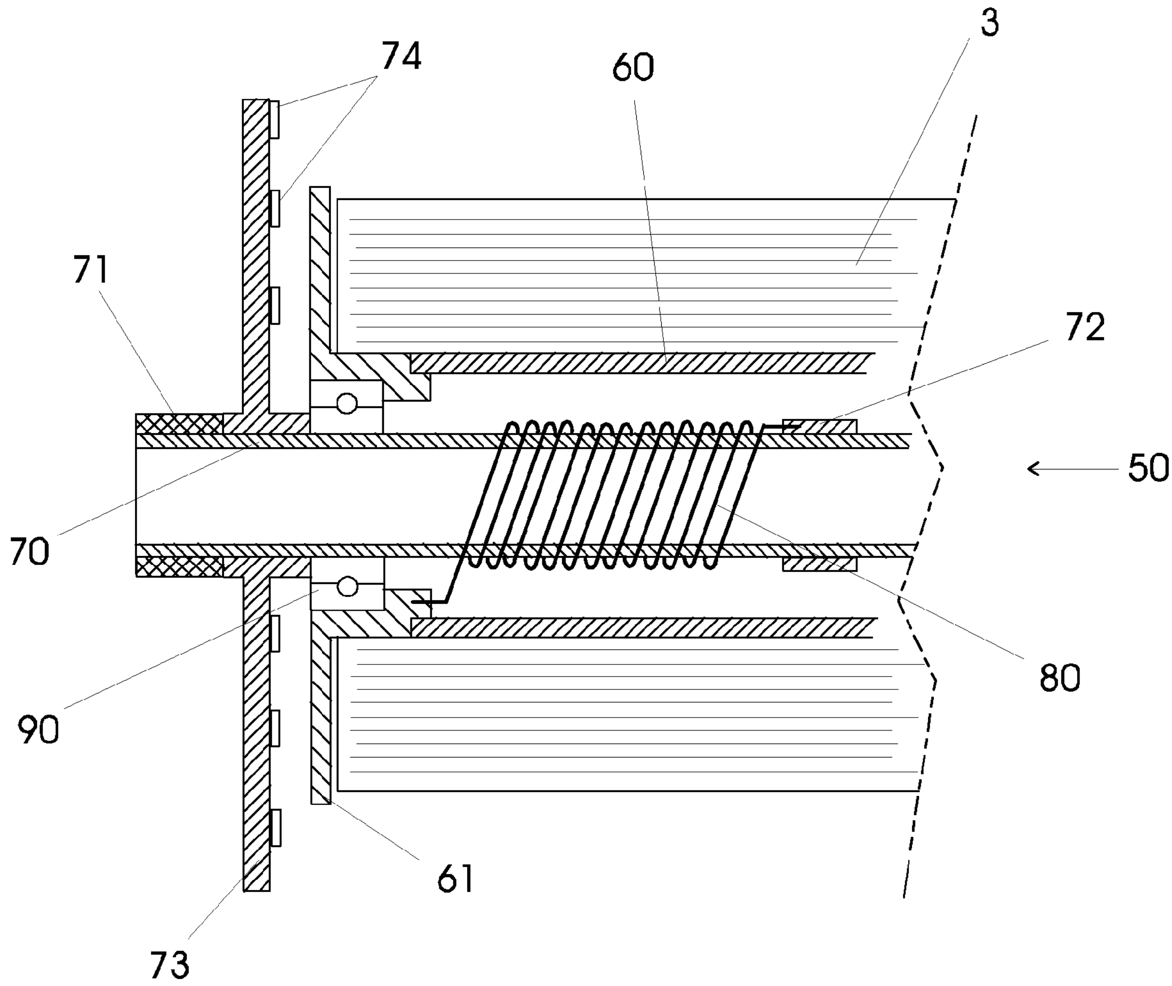




FIG. 2

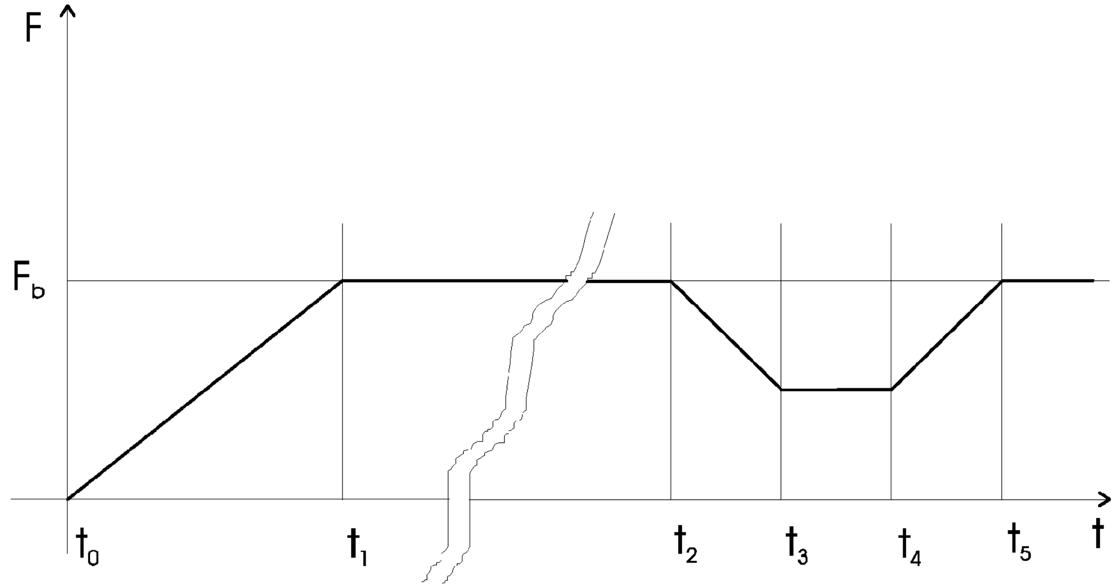



FIG. 3

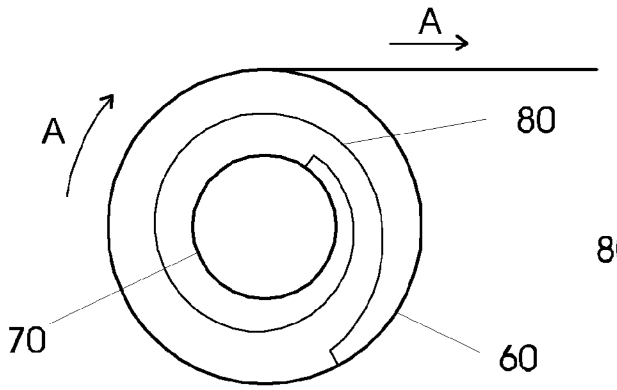



FIG. 4a

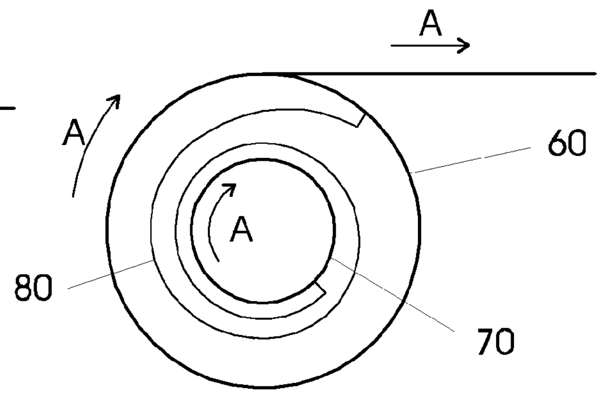



FIG. 4b

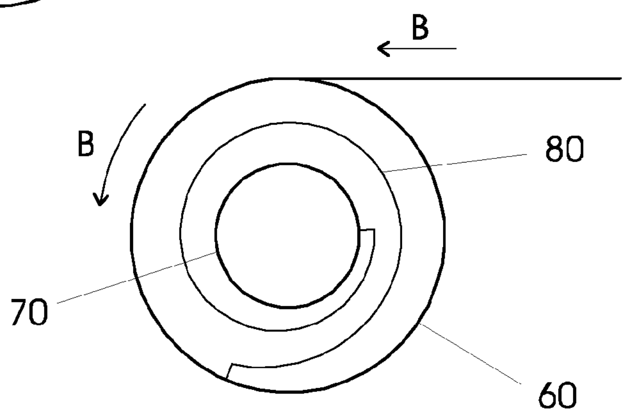



FIG. 4c

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# EUROPEAN SEARCH REPORT

Application Number
EP 05 10 5364

## 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<br><br>Y | EP 0 780 725 A (NORITSU KOKI CO., LTD)<br>25 June 1997 (1997-06-25)<br>* column 3, line 18 - column 4, line 56; figure 3 *<br>----- | 1-8,<br>14-18<br>9-13 | B41J15/16<br>B65H23/06 |
| Y | PATENT ABSTRACTS OF JAPAN<br>vol. 010, no. 315 (M-529),<br>25 October 1986 (1986-10-25)<br>& JP 61 125875 A (MATSUSHITA ELECTRIC IND CO LTD), 13 June 1986 (1986-06-13)<br>* abstract *<br>----- | 9-11 | |
| X | US 4 570 870 A (ITO ET AL)<br>18 February 1986 (1986-02-18)<br>* claim 1; figures 1,2 *<br>----- | 1-5,<br>14-17 | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 009, no. 139 (M-387),<br>14 June 1985 (1985-06-14)<br>& JP 60 018373 A (FUJI XEROX KK),<br>30 January 1985 (1985-01-30)<br>* abstract *<br>----- | | TECHNICAL FIELDS SEARCHED (IPC)<br>B41J<br>B65H |
| Y | WO 00/47508 A (EXPAND INTERNATIONAL AB; MOBERG, GUNNAR)<br>17 August 2000 (2000-08-17)<br>* abstract *<br>----- | 12,13 | |

The present search report has been drawn up for all claims

1

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 25 November 2005 | Joosting, T |

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25-11-2005

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 0780725 A | 25-06-1997 | CN 1515953 A | 28-07-2004 |
| | | CN 1515954 A | 28-07-2004 |
| | | CN 1515955 A | 28-07-2004 |
| | | CN 1157938 A | 27-08-1997 |
| | | DE 69629443 D1 | 18-09-2003 |
| | | DE 69629443 T2 | 08-04-2004 |
| | | JP 2803612 B2 | 24-09-1998 |
| | | JP 9171231 A | 30-06-1997 |
| | | KR 235576 B1 | 15-12-1999 |
| | | US 5769350 A | 23-06-1998 |
| JP 61125875 A | 13-06-1986 | NONE | |
| US 4570870 A | 18-02-1986 | DE 3468094 D1 | 28-01-1988 |
| | | DE 143256 T1 | 05-12-1985 |
| | | EP 0143256 A1 | 05-06-1985 |
| | | JP 60072438 U | 22-05-1985 |
| | | KR 8701991 Y1 | 03-06-1987 |
| JP 60018373 A | 30-01-1985 | NONE | |
| WO 0047508 A | 17-08-2000 | AU 2956100 A | 29-08-2000 |
| | | CN 1359351 A | 17-07-2002 |
| | | SE 516151 C2 | 26-11-2001 |
| | | SE 9900453 A | 12-08-2000 |

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## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 2004036755 A **[0005]**