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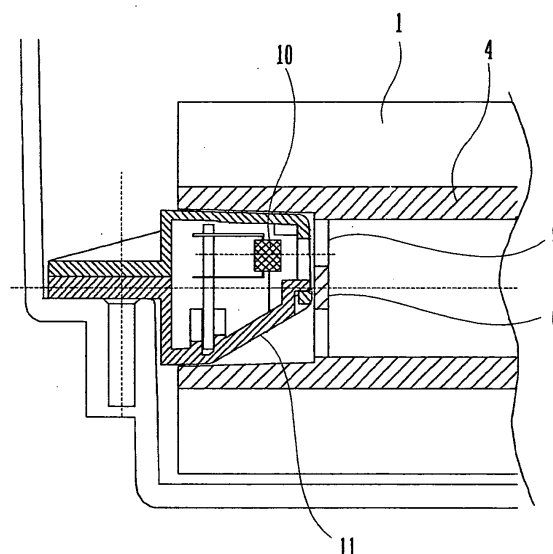
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(54) **Compact arrangement to detect the amount of unused ink ribbon**

(57) A ribbon support device for rotatably supporting a rolled ink ribbon (1) includes a partitioning disk (6) mounted in a terminal part of a ribbon core (4) on which the ink ribbon (1) is wound, the partitioning disk (6) having a plurality of slits (9) formed therein, and a reflection-type photoelectric sensor (10) for detecting the slits, the sensor (10) being located at a position facing the slits (9). Each rotation of the ribbon core (4) is detected when the reflection-type photoelectric sensor (10) has detected all the slits (9) formed in the partitioning disk (6). The length of the ink ribbon (1) supplied by one rotation of the ink ribbon is calculated by counting the amount of feed (or the number of steps) of a ribbon feeding stepping motor per rotation of the ribbon core (4).

FIG.2



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates generally to an image printing apparatus, such as a facsimile machine or a printer, using a rolled ink ribbon. More particularly, the invention is concerned with a compact and low-cost arrangement which can detect the amount of an unused portion of an ink ribbon and whether the ink ribbon is securely mounted in an image printing apparatus.

2. Description of the Related Art

[0002] FIG. 4 shows a commonly known structure employed in an image printing apparatus, such as a facsimile machine or a printer, using a rolled ink ribbon. The structure of FIG. 4 includes a supply spool on which an unused portion of the ink ribbon is wound and a take-up spool on which a used portion of the ink ribbon is wound.

[0003] The image printing apparatus includes a thermal head and a platen roller located in a surrounding area of the ink ribbon for transferring ink from the ink ribbon to printing paper. Typically, the image printing apparatus is constructed in such a fashion that the platen roller feeds the printing paper while pressing the printing paper and the ink ribbon tight against each other and the take-up spool is turned at a speed matched to printing speed to continuously wind up the used portion of the ink ribbon during a print job.

[0004] In order to determine the amount of the unused portion of the ink ribbon, it is necessary to detect the amount of the used portion of the ink ribbon in one way or another.

[0005] A conventional arrangement as disclosed in Japanese Laid-open Patent Application Nos. H04-331178 and 2001-47717, for example, employs an encoder including a disk in which a plurality of slits are formed and a sensor for detecting rotation of a ribbon spool, the disk being disposed outside but on a common axis with the ribbon spool (supply or take-up side). This encoder counts the amount of rotation of the ribbon spool, and the amount of the unused portion of the ink ribbon is calculated based on the counted amount of rotation of the ribbon spool. FIG. 5 is a schematic sectional view showing a typical structure of the aforementioned conventional arrangement. As shown in FIG. 5, a rotating amount detecting device (encoder) including a disk 13 in which a plurality of slits 3 are formed and a sensor 2 for detecting rotation is installed in an apparatus body 5 which is separate from a ribbon core 4 on which an ink ribbon 1 is wound.

[0006] Another conventional arrangement for detecting the amount of an unused portion of an ink ribbon is shown in Japanese Laid-open Patent Application Nos. H06-47977 and H10-244724. Although this arrange-

ment also employs an encoder like the one used in the aforementioned arrangement of Japanese Laid-open Patent Application Nos. H04-331178 and 2001-47717, this second arrangement detects the amount of the unused portion of the ink ribbon based on a change in the period of rotation of a ribbon spool.

[0007] Since the aforementioned conventional arrangements employ the rotating amount detecting device (encoder), there is the need for an extra space in an image printing apparatus for installing such components as the disk in which a plurality of slits are formed and the sensor for detecting the slits. Accordingly, the conventional arrangements have a problem that the image printing apparatus becomes unnecessarily large. Another problem of the conventional arrangements is that incorporation of the rotating amount detecting device (encoder) results in an increase in the manufacturing cost of the apparatus because the provision of the aforementioned components increases the number of constituent elements and these components are expensive high-precision parts.

SUMMARY OF THE INVENTION

[0008] In view of the foregoing, it is an object of the invention to provide a compact and low-cost arrangement which can detect the amount of an unused portion of an ink ribbon. It is a more specific object of the invention to provide a compact and low-cost ribbon support device in which the amount of ribbon feed per a specific number of rotations of an ink ribbon varies as the ink ribbon is used, so that the amount of an unused portion of the ink ribbon can be detected based on the amount of ribbon feed per the specific number of rotations of the ink ribbon.

[0009] According to the invention, a ribbon support device for rotatably supporting a rolled ink ribbon includes a partitioning disk mounted in a terminal part of a ribbon core on which the ink ribbon is wound, the partitioning disk having openings or projections used for detecting rotation of the rolled ink ribbon, and a sensor element for detecting the openings or the projections, the sensor element being mounted inside a spool element supporting the ribbon core.

[0010] Since the sensor element (e.g., a photoelectric sensor or a switch) disposed in the spool element detects the openings or the projections formed in the partitioning disk mounted in the terminal part of the ribbon core, it is possible to easily detect rotation of the ink ribbon. Therefore, if provision is made to feed the ink ribbon by means of a stepping motor, for instance, it is possible to easily know the amount of ribbon feed attained by a specific number of rotations (e.g., a single rotation) of the rolled ink ribbon. When the amount of ribbon feed is known, the current outside diameter of the rolled ink ribbon can be determined. The amount of an unused portion of the ink ribbon can be calculated from the current outside diameter of the rolled ink ribbon thus ob-

tained.

[0011] The ribbon support device of the invention makes it possible to easily determine the amount of the unused portion of the ink ribbon with a simple structure, without the need for separately providing a disk having a plurality of slits formed therein on the outside of the ribbon core. With the ribbon support device of the invention, it is possible to definitely determine the amount of the unused portion of the ink ribbon based on the amount of feed (or the number of steps) of the stepping motor per the aforementioned specific number of rotations of the rolled ink ribbon. Therefore, the ribbon support device of the invention is advantageous in that it is possible to determine the amount of the unused portion of the ink ribbon even when the ink ribbon is once removed from an apparatus body and mounted again.

[0012] According to the invention, a structured ink ribbon unit includes a ribbon core, a rolled ink ribbon wound around the ribbon core, and a partitioning disk mounted in a terminal part of the ribbon core, the partitioning disk having openings or projections used for detecting rotation of the rolled ink ribbon. With the structured ink ribbon unit thus constructed, it is not necessary to provide a separate component to be used for detecting rotation of the rolled ink ribbon, so that the construction of the ink ribbon unit and of the ribbon support device can be simplified.

[0013] Furthermore, the ribbon support device can not detect the openings or the projections formed in the partitioning disk for detecting rotation of the rolled ink ribbon if the ribbon core is not correctly installed. The image printing apparatus can notify a user of an abnormal situation by producing a warning if the ribbon core is not correctly installed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is a sectional view of a ribbon support device and a structured ink ribbon unit according to a preferred embodiment of the invention;

FIG. 2 is an enlarged sectional view of the ribbon support device of FIG. 1 particularly showing a portion around a sensor;

FIG. 3 is a side view of an ink ribbon mounted on the ribbon support device of FIG. 1;

FIG. 4 is a sectional view showing the structure of a conventional ribbon support device and ribbon spools;

FIG. 5 is a schematic sectional view showing an ink ribbon mounted in the conventional ribbon support device; and

FIG. 6 is a graph showing the relationship between the number of feeding steps of a stepping motor and the amount of an unused portion of an ink ribbon.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

[0015] A ribbon support device and a structured ink ribbon unit according to a preferred embodiment of the invention intended for use in an image printing apparatus are now described in detail with reference to the appended drawings. FIG. 1 is a sectional view of the ribbon support device and the structured ink ribbon unit, and FIG. 2 is an enlarged sectional view showing part of the ribbon support device.

[0016] The structured ink ribbon unit includes a hollow ribbon core 4 and a rolled ink ribbon 1 which is wound around the ribbon core 4 in a cylindrical form. On the inside of the ribbon core 4, there is mounted a partitioning disk 6 at a specific distance from one end of the ribbon core 4. There are formed a large number of radially arranged narrow openings, or slits, 9 in the partitioning disk 6. On the outside of the partitioning disk 6, there is provided a ribbon core spool element 11 which fits into a cylindrical hole in the ribbon core 4 and supports the ribbon core 4, the ribbon core spool element 11 incorporating a reflection-type photoelectric sensor 10 for detecting rotation of the partitioning disk 6. At the other end of the ribbon core 4 opposite to the ribbon core spool element 11, there is provided a detachable ribbon core spool element 8 as shown in FIG. 1.

[0017] Referring to FIG. 2, the outside diameter of the ribbon core spool element 11 is made approximately equal to the inside diameter of the ribbon core 4, and the sensor 10 incorporated in the ribbon core spool element 11 is located at a point slightly offset from a geometrical center of the partitioning disk 6. Since the sensor 10 is located between the end of the ribbon core 4 and the partitioning disk 6 on the inside of the ribbon core spool element 11, the provision of this sensor 10 does not cause any increase in the overall size of the ribbon support device. Since a large number of radial slits 9 are formed in the partitioning disk 6 along a rotating direction thereof, each rotation of the ribbon core 4 is detected when the sensor 10 has detected all the slits 9 formed in the partitioning disk 6. For just detecting the single rotation of the ribbon core 4, the number of slits 9 formed in the partitioning disk 6 need not be so large. For detecting a specific amount of rotation of the ribbon core 4, the number of slits 9 formed in the partitioning disk 6 should preferably be made as large as possible to achieve high accuracy.

[0018] FIG. 3 shows the shape of the partitioning disk 6 having the slits 9 as view from one side thereof. When using the ribbon support device of the embodiment, a user first inserts the ribbon core spool element 8 into the cylindrical hole in the supply-side ribbon core 4 from which the ink ribbon 1 is supplied. Next, the user fits the ribbon core 4 carrying the rolled ink ribbon 1 on the ribbon core spool element 11 incorporating the sensor 10 which is fixed to an apparatus body. During a print job when the ink ribbon 1 is consumed, the ink ribbon 1 is

fed from the supply-side ribbon core 4 at a specific rate by a ribbon feeding mechanism 12 including a ribbon feeding stepping motor. At this time, the sensor 10 verifies whether the ribbon core 4 rotates by detecting the slits 9 formed in the partitioning disk 6 which is mounted in the rotating ribbon core 4. If an output of the sensor 10 alternates between ON and OFF states, the ink ribbon unit currently used is a correct standard product. If the output of the sensor 10 does not alternate between the ON and OFF states, the ink ribbon unit currently used is a wrong, or nonstandard, product or not correctly mounted. In the latter case, the ribbon support device produces an audible or visual warning to alert the user to an abnormal situation. As the sensor 10 counts the number of slits 9, the ribbon support device determines whether the counted number of slits 9 has reached a value corresponding to one rotation of the ribbon core 4, or the rolled ink ribbon 1.

[0019] According to the invention, the partitioning disk 6 may have a number of projections instead of the slits 9. Also, the ribbon support device may employ a transmission-type sensor or a switch instead of the aforementioned reflection-type photoelectric sensor 10.

[0020] With the aforementioned arrangement of the ribbon support device, it is possible to calculate the length L of the ink ribbon 1 supplied by one rotation of the ink ribbon 1 by counting the amount of feed (or the number of steps) of the ribbon feeding stepping motor per rotation of the ink ribbon 1.

[0021] Thus,

$$L = (\text{number of steps (amount of feed)}) \times (\text{amount of feed per step of motor}) \quad (1)$$

[0022] Here, the outside diameter D of the ink ribbon 1 is given by the following equation:

$$D = L/\pi \quad (2)$$

[0023] If the outside diameter D of the ink ribbon 1 is known, it is possible to calculate the amount of an unused portion (or remainder) LL of the ink ribbon 1 from a commonly known equation for calculating the length of a rolled product. A commonly applicable equation for calculating the length LL of the remainder of the ink ribbon 1 is shown below for reference:

$$LL = (\pi (D^2 - d^2) / 4) / t \quad (3)$$

where D is the outside diameter of the ink ribbon 1, d is the outside diameter of the ribbon core 4, and t is the thickness of the ink ribbon 1.

[0024] The ribbon support device determines the

length LL of the remainder of the ink ribbon 1 in the aforementioned manner. When the length LL of the remainder of the ink ribbon 1 becomes equal to or smaller than a specified amount, the ribbon support device notifies the user by producing a buzzer sound or a visual indication. In this embodiment, the length LL of the remainder of the ink ribbon 1 can be definitely determined based on the amount of feed (or the number of steps) of the ribbon feeding stepping motor per rotation of the ink ribbon 1. The aforementioned arrangement of the embodiment is advantageous in that it is possible to determine the length LL of the remainder of the ink ribbon 1 even when the structured ink ribbon unit is once removed from the apparatus body and mounted again.

[0025] The ribbon support device is applicable to a known image printing apparatus for printing an image on paper by use of an ink ribbon. A CPU of the image printing apparatus also functioning as a ribbon remainder calculator calculates the amount of the unused portion LL. The CPU detects whether the ink ribbon is correctly mounted by detecting the rotation of the openings or the projections. The image printing apparatus has an indicator for indicating the amount of the unused portion LL calculated by the CPU, thereby allowing a user to confirm when the ink ribbon should be changed. The indicator gives a warning when the ink ribbon is not correctly mounted.

[0026] As an alternative to the aforementioned calculation-based method, the amount of a used portion or an unused portion of the ink ribbon 1 may be determined based on an experimentally obtained relationship between the amount of the used portion or the unused portion of the ink ribbon 1 and the number of feeding steps of the ribbon feeding stepping motor. According to this alternative method, the experimentally obtained relationship between the amount of the used portion or the unused portion of the ink ribbon 1 and the number of feeding steps of the stepping motor is graphed as shown in FIG. 6, for example. The amount of the used portion or the unused portion of the ink ribbon 1 is determined based on the accumulated number of feeding steps of the stepping motor using a graph thus obtained. In the example of FIG. 6, the horizontal axis represents the accumulated number of feeding steps of the stepping motor while the vertical axis represents the length of the remainder of the ink ribbon 1.

[0027] If it is desired to indicate the amount of the unused portion of the ink ribbon 1 when the length of the remainder of the ink ribbon 1 has reached 10 m, for example, such an indication is given when the accumulated number of feeding steps of the stepping motor has reached a value corresponding to a point on the graph where the length of the remainder of the ink ribbon 1 is 10 m. The ribbon support device of the foregoing embodiment is applicable to any kinds of apparatuses as a device for supporting a rolled ink ribbon or rolled printing paper. When applied to such apparatuses, the ribbon support device can detect the amount of an unused

portion of the ink ribbon or the printing paper with high accuracy. A facsimile machine, for example, employs a stepping motor which feeds an ink ribbon at a rate of 1/7.7 mm to 1/15.4 mm per step of the stepping motor. Since this ribbon feeding length per step of the stepping motor is sufficiently small compared to the length of a printable area on each sheet of printing paper, the ribbon support device applied to the facsimile machine can precisely detect the amount of the unused portion of the ink ribbon.

detecting rotation of the openings or the projections.

5. The image printing apparatus according to claim 3, **characterized by** further comprising an indicator for indicating the amount of the unused portion of the ink ribbon.
6. The image printing apparatus according to claim 4, wherein the indicator gives a warning when the ink ribbon is not correctly mounted.

Claims

1. A ribbon support device for rotatably supporting a rolled ink ribbon, said ribbon support device **characterized by** comprising:

a partitioning disk mounted in a terminal part of a ribbon core on which the ink ribbon is wound, the partitioning disk having openings or projections used for detecting rotation of the rolled ink ribbon; and
a sensor element for detecting the openings or the projections, the sensor element being mounted inside a spool element supporting the ribbon core.

2. A structured ink ribbon unit **characterized by** comprising:

a ribbon core;
a rolled ink ribbon wound around the ribbon core; and
a partitioning disk mounted in a terminal part of the ribbon core, the partitioning disk having openings or projections used for detecting rotation of the rolled ink ribbon.

3. An image printing apparatus **characterized by** comprising:

the ribbon support device according to claim 1; and
a ribbon remainder calculator for determining whether the rolled ink ribbon has rotated a specific number of times by detecting the openings or the projections by means of the sensor element and for calculating the amount of an unused portion of the ink ribbon based on the outside diameter of the ink ribbon wound on the ribbon core obtained from the amount of ribbon feed per said specific number of rotations of the ink ribbon.

4. The image printing apparatus according to claim 3, wherein the ribbon remainder calculator detects whether the ink ribbon is correctly mounted by de-

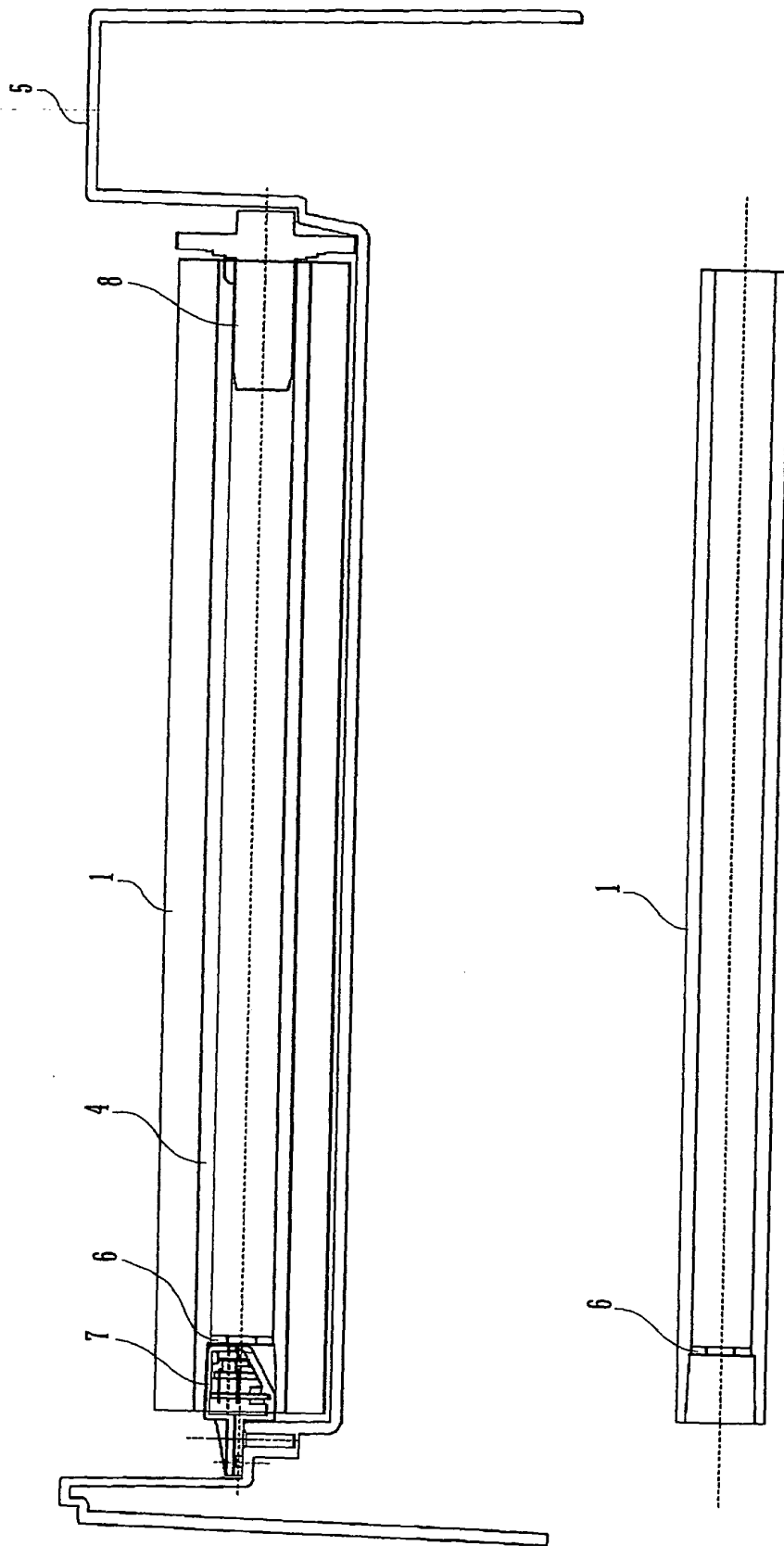
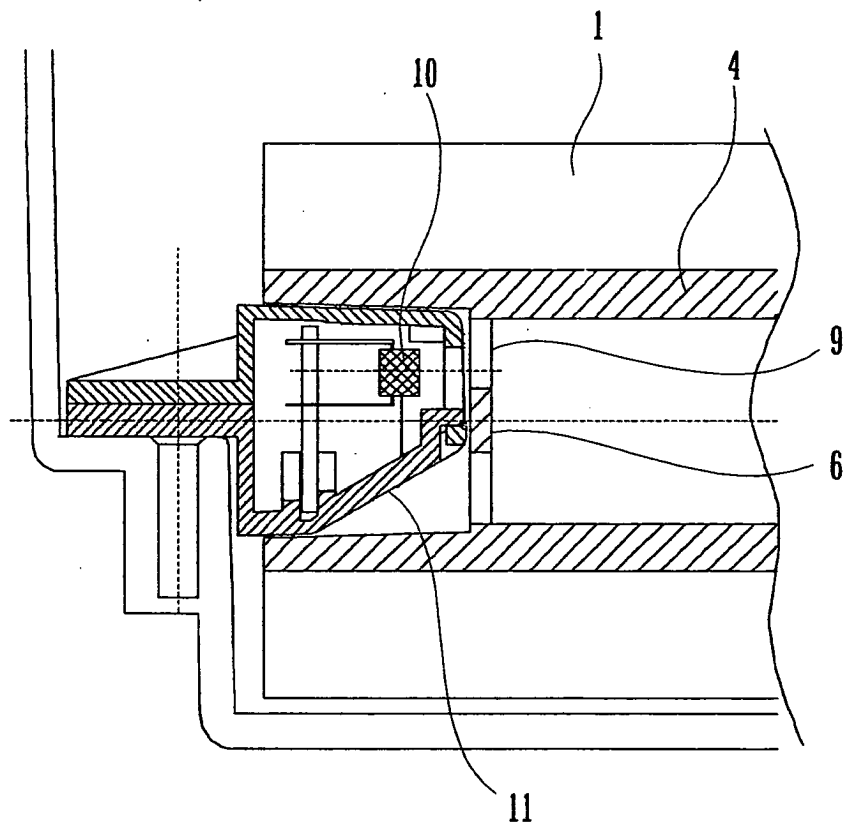


FIG.1

FIG.2



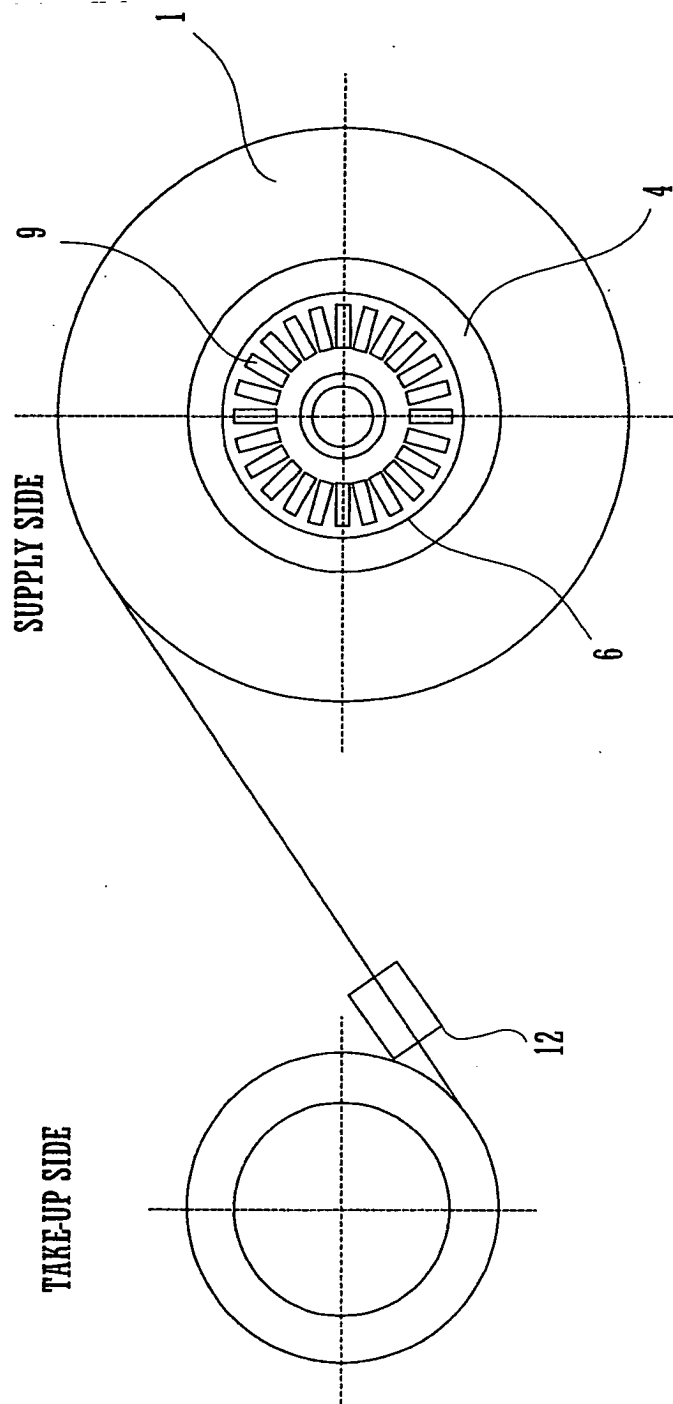


FIG.3

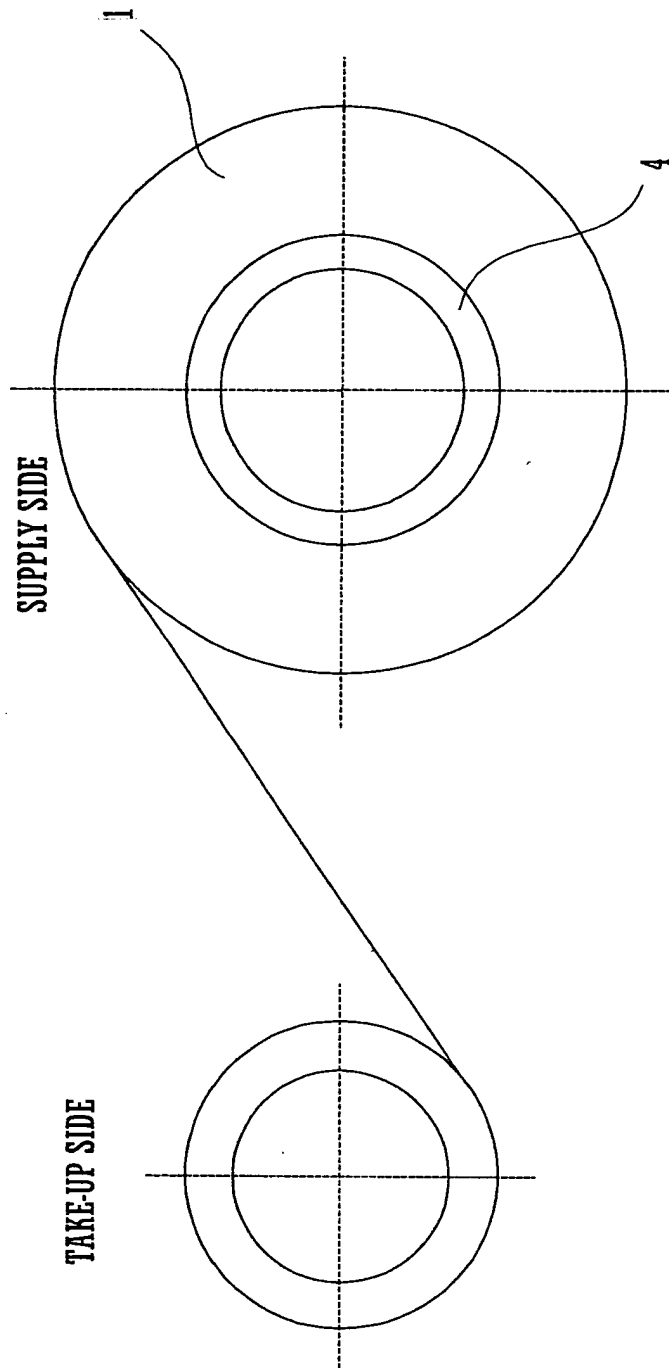


FIG.4

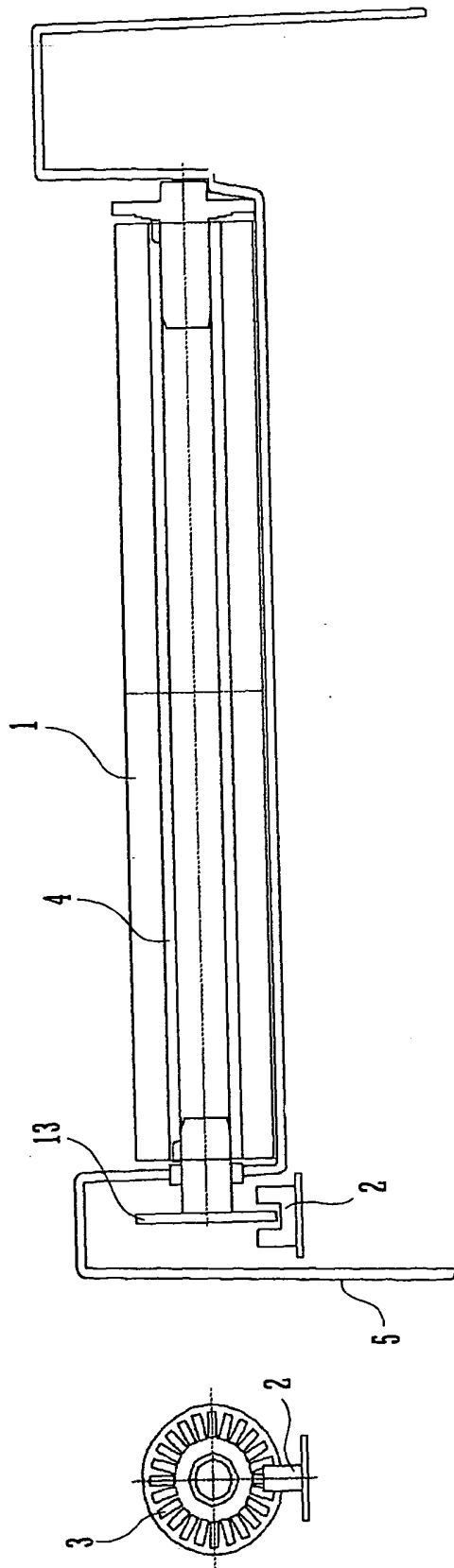


FIG.5

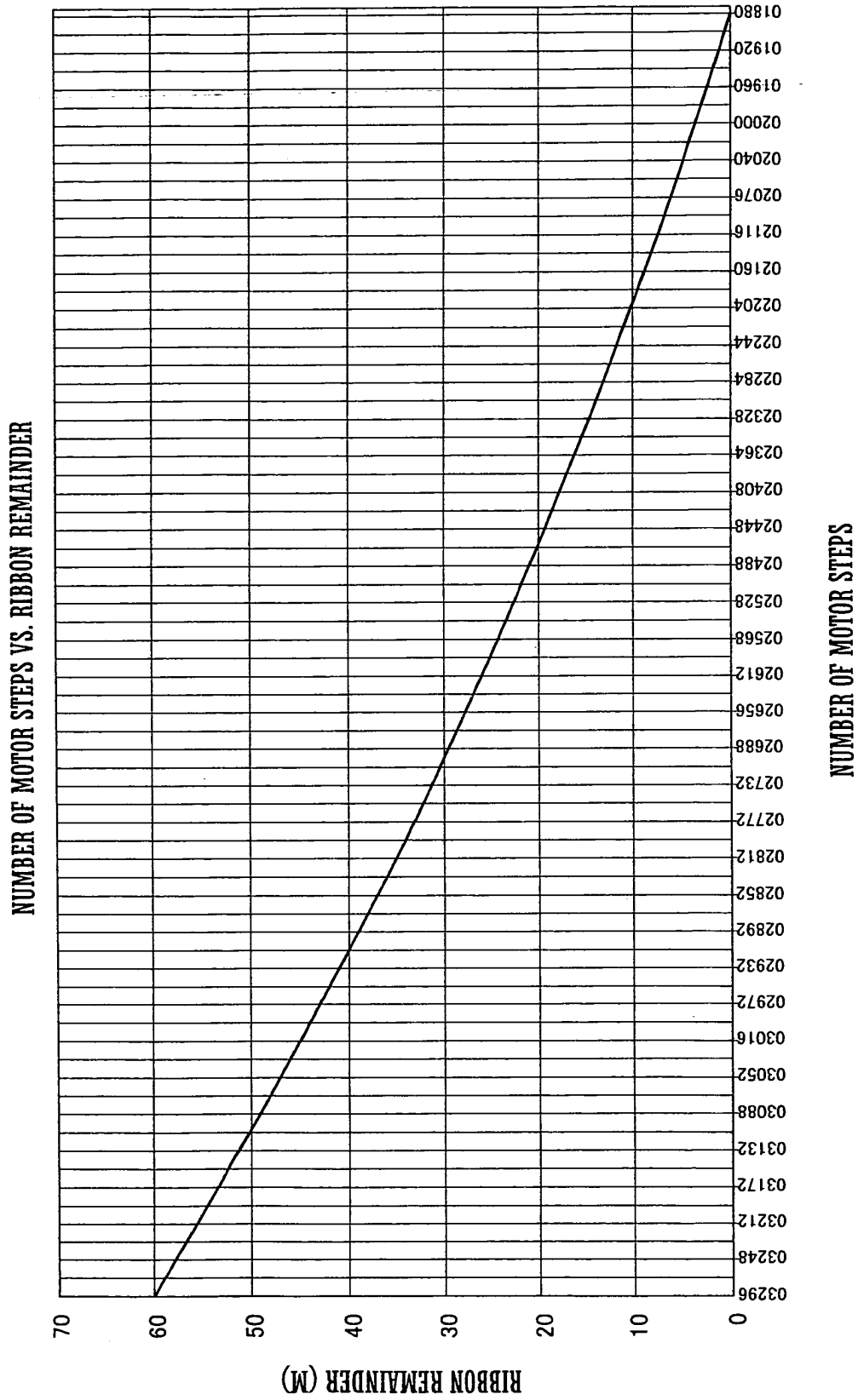


FIG. 6



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 04 01 6457

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 November 2004	Examiner De Groot, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 01 6457

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16-11-2004

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