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(71) Applicant *(for all designated States except US)*: VALMET CORPORATION [FI/FI]; Panuntie 6, FIN–00620 Helsinki (FI).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: LESKINEN, Arto [FI/FI]; Vanha Hämeentie 892, FIN–05450 Nukari (FI).

(74) Agent: FORSSEN & SALOMAA OY; Yrjönkatu 30, FIN–00100 Helsinki (FI).

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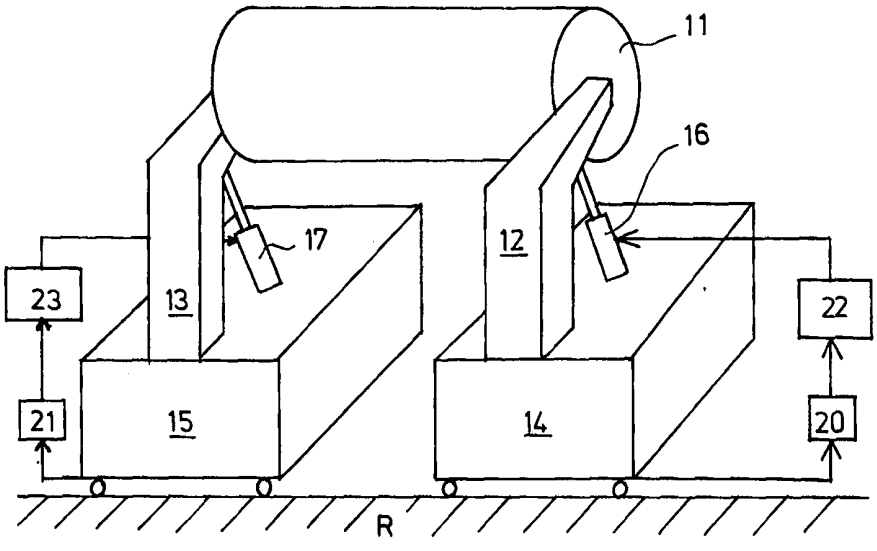
(54) Title: METHOD IN WINDING OF A WEB



(57) Abstract

A method of winding of a web, wherein the roll (11) that is being formed is supported in the direction of the axis of the roll by means of a first (12) and a second (13) support member placed at both sides of the roll. In the method, the shape of the end of the roll that is being formed is measured by means of indirect or direct measurement, and the relative positions of the support members in relation to one another are regulated based on the measurement. As indirect measurement, it is possible to measure forces (20) in the axial direction of the roll, and as direct measurement, it is possible to measure the side line of a roll end directly by means of contact measurement or contact–free measurement. Based on the measurements, the relative positions of the support members in relation to one another are regulated (22), in which connection any defects of shape in the ends of the roll that is being formed can be prevented.

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Method in winding of a web

The invention concerns a method in winding of a web as defined in the preamble of claim 1.

In the applicant's *FI Patent Application No. 942451* a method and a device in winding of a web are described. In the method, the web is wound onto a spool on support of a support roll and through the nip formed between the support roll and the roll that is being produced. The spool is supported at least partly by means of a support member fitted in the centre of the spool. The spool and the roll are supported and/or loaded by means of a device whose position can be varied. In the initial stages of winding, the loading and support units of said device are shifted substantially in a plane passing through the axes of the support roll and of the roll that is being produced in order to load and/or to support the roll that is being produced in the winding position. When the winding makes progress, the loading and support units of the device are shifted downwards along a path substantially parallel to the circumference of the roll, and in the final stages of winding, the roll that is being completed is supported by means of said unit from underneath. By means of the invention described in the above FI publication, it is possible to wind rolls of large size without faults, which rolls have a diameter of even more than 1.5 metres and a width of even more than 3 metres.

However, in all centre-drive winders, dishing of the roll occurs, in particular with larger roll diameters. Herein dishing is understood as a fault of the shape of the roll which arises from the fact that the web layers on the roll are shifted during winding in the axial direction of the roll. Owing to this, the ends of the roll are shaped with a form different from a plane shape, i.e. become convex or concave. When such lateral shifting starts, as a rule, it tends to intensify itself and ultimately has the consequence that the roll end becomes convex unless correcting operations are

carried out early enough. The phenomenon arises from the fact that, between the surface layers of the roll, during winding, a slight extent of gliding always takes place as a result of forces applied to the web in the nip. Owing to this gliding of the surface layers of the roll, the roll tightness is increased, and if these forces that increase the tightness are out of balance, for example, owing to uneven tension profile or thickness profile of the incoming web, the layers of web also tend to be shifted in the axial direction of the roll spool. Also, faults in the alignment of the roll supports cause a similar error of shape, and so does an uneven distribution of the nip force. Such an error of shape in a roll is undesirable because of the problems of unwinding that it causes.

The object of the present invention is to provide a method by whose means this error of shape, which occurs in particular in large rolls, can be counteracted.

The principal characteristics of the method in accordance with the invention come out from the characterizing part of claim 1.

The method in accordance with the invention can be utilized in all such winding methods in which the direction of arrival of the web to be wound onto the roll can be regulated in relation to the axis of the roll or in which the winding is carried out by means of a winding nip in which the distribution of loading in the direction of width of the nip can be regulated. Thus, the method is also suitable for nip-free centre-drive winding in which the tension of the web on the roll is regulated exclusively by means of the torque of rotation applied to the shaft of the web roll.

In the method in accordance with the invention, it is possible to use indirect or direct measurement, on whose basis it is concluded whether an error of shape is being formed in the roll. Direct measurement is understood as measurement in which the side line of the roll end is measured directly by means of a measurement free of contact or with contact. On the other hand, indirect measurement is understood as measurement in which changes in the side line of the roll end are measured indirect-

ly from some other such quantity as is affected by changes in the side line of the end of the roll.

The invention will be described in the following with reference to the figures in the accompanying drawings, in which a preferred embodiment of the method in accordance with the invention is illustrated, the invention being, however, not supposed to be confined to the details of said embodiment alone.

Figure 1 is a schematic axonometric view of a centre-drive winder in which the method in accordance with the invention can be applied.

Figure 2 is a schematic side view of the centre-drive winder shown in Fig. 1.

Figure 3 illustrates a mode of regulation of the nip line, in which an actuator has been fitted in connection with the suspension of a wheel of a sledge.

Figure 4 illustrates the change in direction produced by the actuator shown in Fig. 3 in the nip line between the roll that is being formed and the support roll.

Fig. 1 is a schematic axonometric view, and Fig. 2 a side view of a centre-drive winder. Figs. 1 and 2 also illustrate a mode in accordance with the present invention for regulation of the nip line between the roll 11 that is being formed and the support roll 50 in the centre-drive winder. Herein a centre-drive winder is understood in particular as a winder type used in connection with a slitter-winder, in which the rolls formed out of component webs are supported, each of them separately, from the ends of their roll spools and at least from one point at the side of the web roll by means of a support roll or an equivalent support member.

In Fig. 1, the roll 11 that is being formed is supported from both of its ends by means of winding arms 12,13 coupled with the roll spool. The first winding arm 12 is coupled with a first sledge 14 by means of an articulated joint 30 (Fig. 2), and the second winding arm 13 is coupled with a second sledge 15 in a similar way by

means of an articulated joint. The first 14 and the second sledge 15 have been fitted on the frame R of the centre-drive winder so that they can be displaced in relation to said frame R depending on the length of the reel spool and on the location of the point of feed of the web to be wound. To the first winding arm 12, from one end, a first loading cylinder 16 has been attached by means of an articulated joint 40 (Fig. 2), and similarly, to the second winding arm 13, a second loading cylinder 17 has been attached from one of its ends by means of an articulated joint. The other end of the first loading cylinder 16 has been attached by means of an articulated joint 41 to the first sledge 14, and the other end of the second loading cylinder 17 has been attached similarly by means of an articulated joint to the second sledge 15. By means of the loading cylinders 16,17, the roll 11 that is being wound can be loaded in the desired way against the support roll 50.

In connection with the first sledge 14, a first force metering detector 20 has been fitted, and similarly, in connection with the second sledge 15, a second force metering detector 21 has been fitted. The force metering detectors 20,21 can be placed, for example, between the sledges 14,15 and their brakes. Alternatively, the force metering detectors 20,21 can be placed in connection with the support seats of the roll 11 that is being formed. The force metering detectors 20,21 meter the force acting in the direction of the axis of the roll spool, which force is transferred from the roll spool to the winding arms 12,13 and further to the sledges 14,15.

The signal received from the first force metering detector 20 is passed to the first regulator 22, and the signal received from the second force metering detector 21 is passed to the second regulator 23. By means of the first regulator 22, the hydraulic system of the first loading cylinder 16 is controlled, and by means of the second regulator 23, the hydraulic system of the second loading cylinder 17 is controlled. The signals of the force metering detectors 20,21 can also be passed to a separate computer or to a computer that controls the whole winding process, in which case the control of the regulators 22,23 takes place by means of said computer. In such a case, the information obtained in connection with winding can be used as a part of

the data connected with the roll 11, which data can be used later in connection with unwinding of the roll 11, for example in a printing machine.

At the beginning of winding, the axial press forces applied to the ends of the roll spool are reset to zero, in which case the total metering signal of the force metering signals 20,21 is zero. After this, if a force parallel to the axis of the roll spool occurs in the web that is being wound onto the roll 11, which force, thus, attempts to shift the layers of the web in the direction of its effect, the force is also detected as a change in the metering signal given by the force metering detectors 20,21. The force at the metering detector 20,21 in whose direction the roll 11 is dishing is increased, and the force measured at the metering detector 20,21 placed at the opposite side is reduced. The reel spool presses the winding arm 12,13 towards which the web is shifting and produces a force signal in the respective force metering detector 20,21. This signal gives an impulse to the respective regulator 22,23, which gives a command to the hydraulic system to correct the position of the loading cylinder 16,17. When said loading cylinder 16,17 raises or lowers one of the winding arms in relation to the other winding arm, the nip force profile between the roll 11 and the carrying drum 50 is changed, and the nip line is inclined. By means of such a correction, the force that is applied to the roll 11 that is being formed and that diverts the web layers can be eliminated, in which case the web layers do not attempt to move in the axial direction of the roll spool, and dishing of the roll 11 is prevented.

Fig. 3A illustrates a second mode of regulation of the nip line in accordance with the present invention, which regulation takes place by means of an actuator fitted in connection with the suspension of a wheel 60 of the sledge. Thus, in this embodiment, the regulators 22,23 control an actuator fitted in connection with the rear wheels 60 of the sledges 14,15. Here, the actuator consists of the rear support wheels 60 of the sledge 14, which have been mounted revolving on an eccentric shaft 61 by means of a bearing 62 in the way shown in Fig. 3B. When the eccentric shaft 61 is rotated, the rear edge of the sledge 14 can be raised in relation to its forward edge, which causes a rotation of the sledge 14 around the axis of its front

wheel 70. Owing to the rotation, the support point 12a of the roll 11 on the support arm 12 attached to the sledge 14 is shifted by the angle α, and when the other sledge 15 remains stationary, the direction of the axis of the roll 11 is altered in relation to the running direction of the web that is being fed onto the roll, and the axial force in the interior of the roll 11 is compensated for, in which case formation of an error of shape in the roll 11 is prevented.

Also in the case of Fig. 3, the force detectors 20,21 can be placed, for example, between the sledges 14,15 and their brakes, or in connection with the support seats of the roll 11 that is being formed. Likewise, the signals of the force detectors 20,21 can be passed to the computer, which again controls the regulators 22,23.

Fig. 4A illustrates the direction of movement produced by the actuator at one end of the roll 11 as an axonometric illustration, and Fig. 4B illustrates the effect of the regulation on the position of the winding nip on the face of the roll 11 and, at the same time, the effect on the relative direction of arrival of the web in relation to the axis of the roll 11. When one end of the roll 11 is shifted in the way indicated by the arrow S while the other end of the roll 11 remains in its place, the nip line N_1 between the roll 11 and the support roll 50 is changed into the nip line N_2. At the stationary roll 11 end, the nip lines N_1 and N_2 come together, and at the roll 11 end that is shifted the nip lines N_1 and N_2 are placed at the distance Δx from one another. By means of such an arrangement, axial shifting of the web wound onto the roll 11 can be prevented, so that the ends of the roll 11 to be wound become planar.

In stead of metering of the transverse forces applied to the sledges 14,15, the side plane of the roll 11 can also be measured directly, e.g., by means of photocells, an ultrasound detector, or by means of capacitive or contact measurement. Compared with these direct measurements, said metering of lateral forces is, however, preferable, because by its means it is possible to see considerably earlier indirectly when such a force arising from the winding nip or from profile errors in the web is applied to the roll 11 as attempts to divert the web layers to be wound onto the roll 11 from their desired position, and measures of correction can be initiated earlier.

In the following, the patent claims will be given, and the details of the invention can show variation within the scope of the inventive idea defined in said claims and differ from what has been stated above by way of example only.

Claims

1. A method in winding of a web, wherein the roll (11) that is being formed is supported in the direction of the axis of the roll (11) by means of a first (12) and a second (13) support member placed at both sides of the roll (11), **characterized** in that the shape of the end of the roll (11) that is being formed is measured by means of indirect or direct measurement, and the relative positions of the support members (12,13) in relation to one another are regulated based on the measurement, in which connection any defects of shape in the ends of the roll (11) that is being formed can be prevented.

2. A method as claimed in claim 1, **characterized** in that, as an indirect method of measurement, the force applied in the axial direction of the roll (11) that is being formed is metered at least in connection with the support member (12,13) that supports one end of the roll, and the relative positions of the support members (12, 13) are regulated based on said metering.

3. A method as claimed in claim 1, **characterized** in that the axial force applied to the roll (11) that is being formed is metered in connection with the support members (12,13) at both ends of the roll, and the relative positions of the support members (12,13) are regulated based on said metering.

4. A method as claimed in claim 3, **characterized** in that the resultant of the axial forces applied to the roll (11) that is being formed is determined as the difference between the metered support forces, and the relative positions (12,13) of the support members are regulated based on said metering.

5. A method as claimed in any of the claims 1 to 4, **characterized** in that the relative positions of the support members (12,13) of the roll (11) that is being formed are regulated based on the data obtained from the metering by increasing or reducing the load applied to the roll (11) that is being formed through one support member (12,13).

6. A method as claimed in any of the claims 1 to 5, **characterized** in that the relative positions of the support members (12,13) of the roll (11) that is being formed are regulated based on the data obtained from the metering by shifting one of the support members (12,13) so that the running direction of the web that is passed onto the face of the roll (11) that is being formed in relation to the axis of the roll (11) that is being formed is changed.

7. A method as claimed in claim 1, **characterized** in that the location of the web layers that are the topmost layers, at each particular time, on the roll (11) that is being formed is measured in the axial direction of the roll (11) by means of a contact-free method of measurement, and the relative positions of the support members (12,13) are regulated based on the measurement.

8. A method as claimed in claim 1, **characterized** in that the location of the web layers that are the topmost layers, at each particular time, on the roll (11) that is being formed is measured in the axial direction of the roll (11) by means of a method of measurement with contact, and the relative positions of the support members (12,13) are regulated based on the measurement.

9. A method as claimed in claim 7 or 8, **characterized** in that the relative positions of the support members (12,13) of the roll (11) that is being formed are regulated based on the data received from the measurement by increasing or reducing the load applied through one of the support members to the roll (11) that is being formed.

10. A method as claimed in any of the claims 7 to 9, **characterized** in that the relative positions of the support members (12,13) of the roll (11) that is being formed are regulated based on the data received from the measurement by shifting one of the support members (12,13) so that the running direction of the web passed onto the face of the roll (11) that is being formed in relation to the axis of the roll (11) that is being formed is changed.

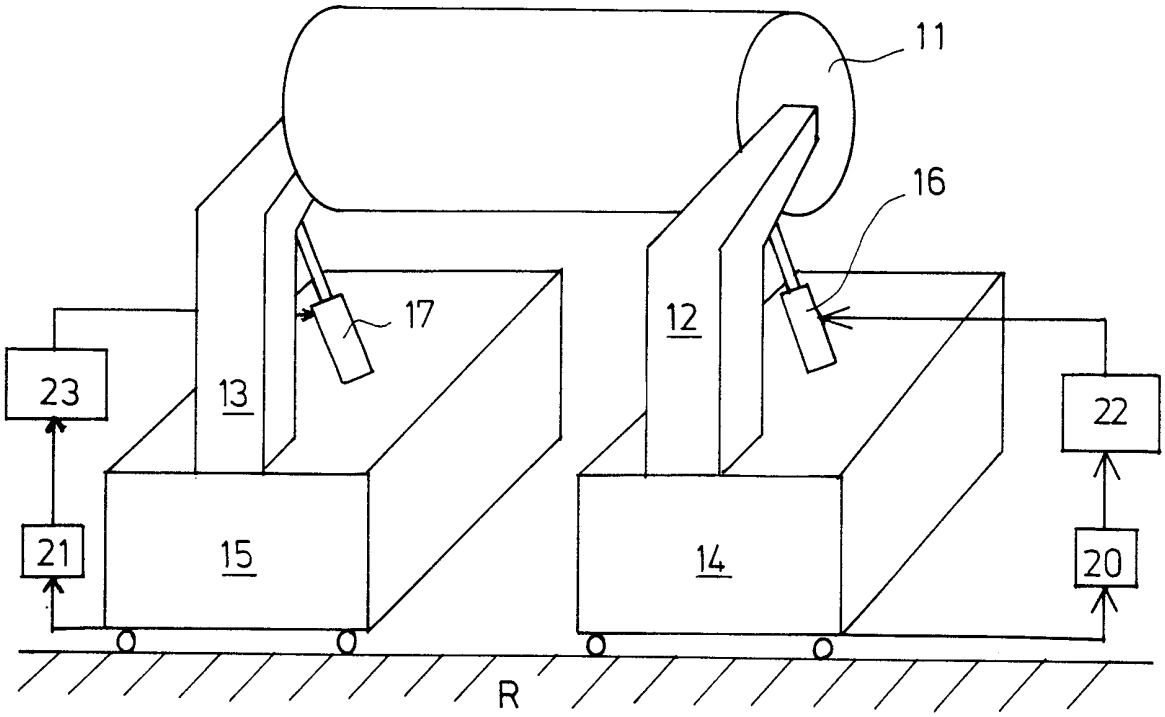

FIG. 1

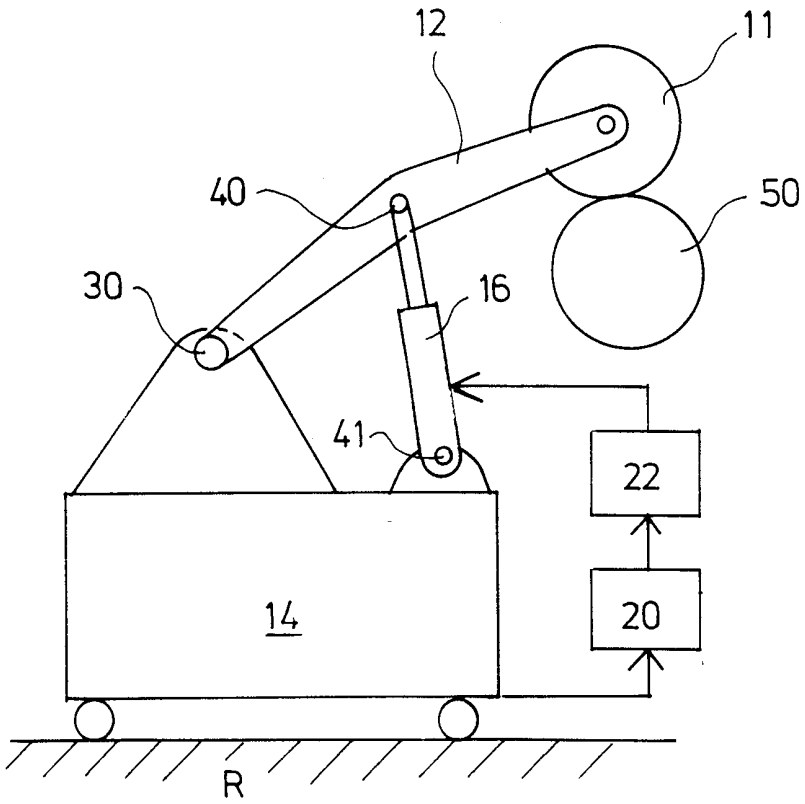

FIG. 2

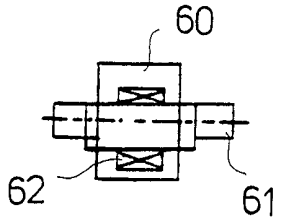

FIG. 3B

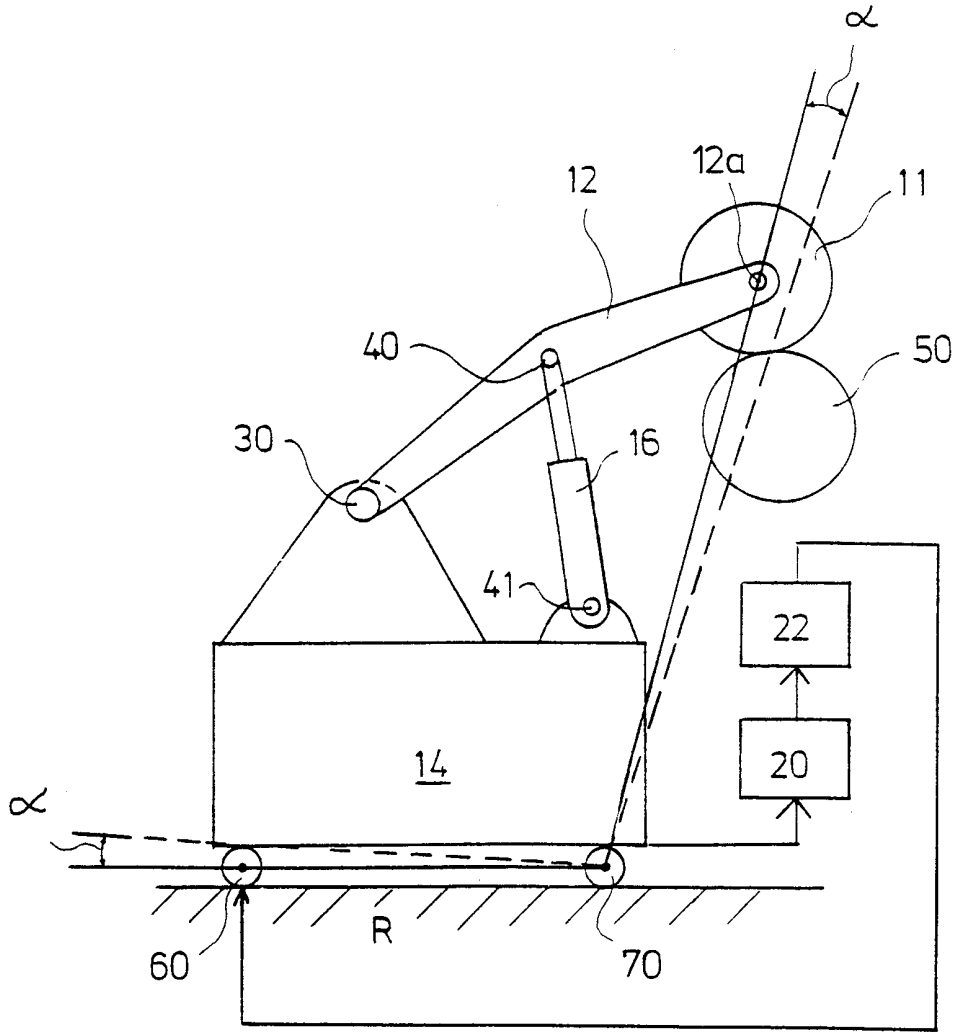

FIG. 3A

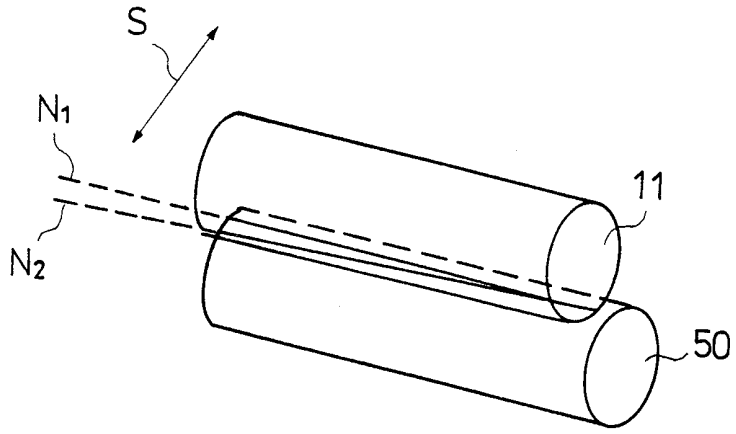

FIG. 4A

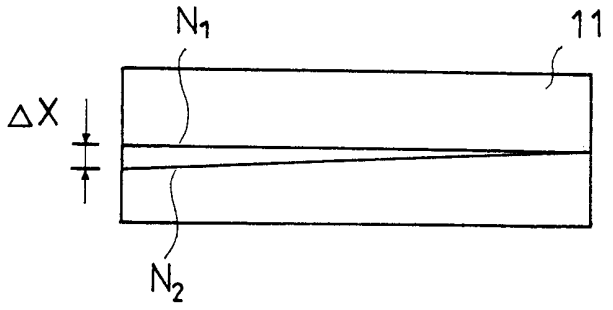

FIG. 4B

INTERNATIONAL SEARCH REPORT

Interr nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65H18/02 B65H23/032

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65H

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 08 863 A (KAMPF GMBH & CO MASCHF) 21 September 1995 see the whole document ---	1
A	DE 12 19 576 B (COTINENTAL ELEKTROINDUSTRIE AG) 23 June 1966 see the whole document ---	1
A	EP 0 410 093 A (JAGENBERG AG) 30 January 1991 see the whole document ---	1
A	DE 37 21 969 A (REIFENHAEUSER MASCH) 19 January 1989 see the whole document ---	1
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☒ Patent family members are listed in annex.

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12 May 1999	25/05/1999

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Information on patent family members

Interr nal Application No
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