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(54) Twisting machine for producing artificial grass

(57) A twisting machine (100) for producing artificial grass starting from a tape (BND).

The twisting machine (100) comprises:

(c1) a control unit (110) which exchanges information among the various appliances;

(c2) an extrusion apparatus (120), suitable to produce a tape (BND) ;

(c3) a storing unit (130) of the tape (BND) ; and

(c4) a twisting unit (140) of the tape (BND) for producing the desired synthetic grass. The twisting machine (100) is characterized in that the storing unit (130) is able to store the tape (BND) coming directly from the extrusion apparatus (120), and is also able to feed, directly and at the same time, the tape (BND) to the twisting unit (140).

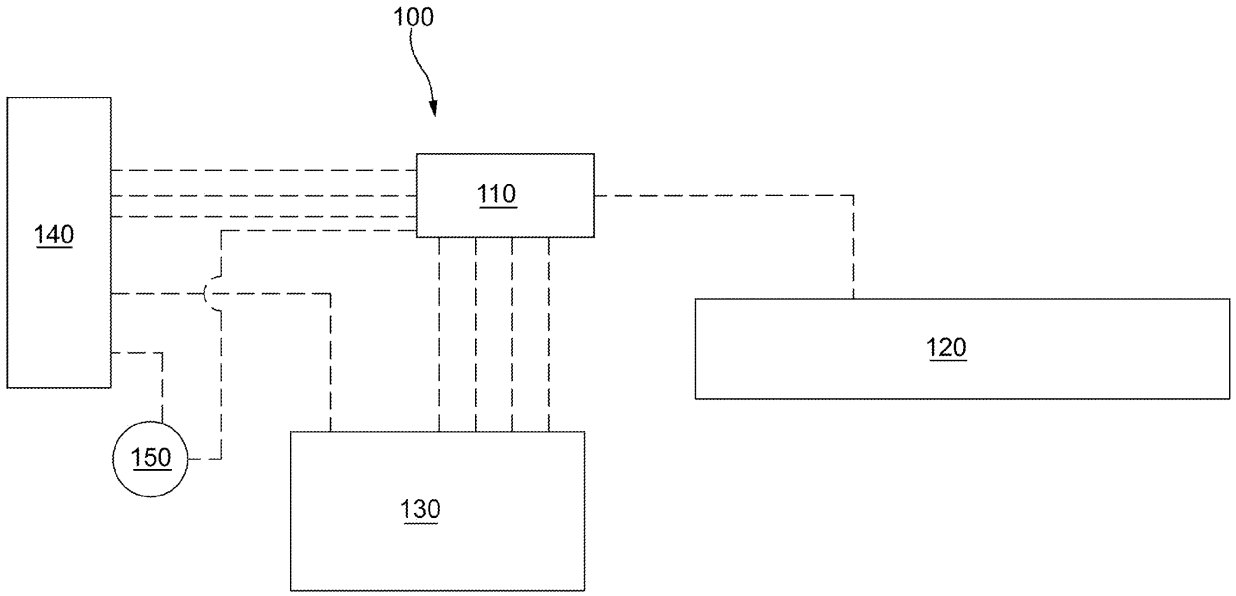

FIG.1

EP 2 360 300 A1

Description

[0001] The present invention relates to a twisting machine for producing artificial grass. The present invention also relates to an in-line method for twisting polymeric material to obtain bobbins of twisted artificial grass.

[0002] As is known, bobbins of twisted artificial grass are obtained by means of twisting one or more tapes (bundles) coming from an extrusion plant.

[0003] A twisting machine of this type normally comprises the following components:

- an extrusion apparatus for producing one or more tapes (bundles) in plastic material (normally PP or PE, fibrillated or not);
- a storing unit of a bundle of tapes coming from the extrusion apparatus; and
- a twisting unit of the bundle to produce the desired bobbin of twisted synthetic grass.

[0004] The process of twisting synthetic grass is normally performed as an off-line process in which each extruded tape is collected on a single independent storing unit. This unit is physically separate from both the extrusion apparatus, which is arranged upstream, and the twisting unit, which is downstream.

[0005] When a full bobbin of tape has been produced this is fed (the number of tapes depends on the desired final dimensions) to the twisting unit, so that the tapes are transformed into synthetic grass as they pass through said twisting unit.

[0006] However, manually loading the bobbin onto the twisting unit takes up a considerable amount of time, which has negative repercussions on the industrial cost of the finished product, i.e. on the end cost of the manufactured synthetic grass.

[0007] Therefore, the main object of the present invention is to provide a twisting machine and a relative twisting method, that overcome the drawbacks described above and, at the same time, are easy and inexpensive to produce.

[0008] The twisting machine that is the main object of the present invention has been conceived to perform in-line twisting of artificial grass (for use in decorative applications and sports areas) coming from extrusion plants, where the term artificial grass refers to a twisted PP/PE tape (fibrillated or not) or a PP/PE monofilament of different shapes and sizes (flat, with central ribbing on one side only, diamond-shaped, etc.).

[0009] These tapes, or monofilaments, are then gathered in groups of 4, 6 or 8 depending on the desired final dimensions (normally between 6,000 and 16,000 den).

[0010] The tape/monofilament can have the following characteristics:

- tenacity = 2-3 g/den
- elongation = 50-70%.

[0011] The bundle of tapes/monofilaments is twisted from a minimum of 28 torsions per meter (for bundles with larger dimensions) to a maximum of 35 torsions per meter (for bundles with smaller dimensions).

[0012] The twisting machine according to the present invention has been conceived to produce bobbins with a maximum diameter of 10.5", and a maximum width of 10.5" with an approximate weight of 6 kg, so that the bobbin contains approximately 4500 meters. In view of the fact that the twisting machine must be installed in series with an extrusion line with a maximum end speed of 150 m/min, and considering a range of torsions that includes the working torsions (thus between 25 and 40 T/m), the maximum number of torsions within the unit of time is 150x40=6,000 T/min (with 40 T/m).

[0013] We have considered a 15 percent safety margin which brings the maximum number of torsions within the unit of time to 7,000 T/min and at a maximum speed of 170 m/min.

[0014] The storing unit must therefore be of an appropriate size to hold at least 500 meters of bundles of monofilaments or fibrillated tape.

[0015] Moreover, the bobbin of twisted grass must be particularly soft and free of defects; for that reason the twisting machine according to the present invention also comprises an electric braking unit so that the raw material to be twisted is subject to a constant tension without stretching it beyond the yield point. In addition to the electric braking unit, certain other devices have also been included to reduce rubbing and stretching of the tape/monofilament to a minimum.

[0016] According to the present invention there are thus provided a twisting machine, a relative twisting plant, and a relative twisting method as claimed in the appended independent claims, and preferably in any one of the claims depending directly or indirectly on the independent claims.

[0017] In order to better understand the present invention, a number of non-limiting preferred embodiments thereof will now be described by way of example with reference to the accompanying drawings, in which:

- figure 1 is a logic diagram of the control/operation of a twisting machine according to the present invention;
- figure 2 is a front view of a twisting machine according to the invention;
- figure 3 is a side view of the twisting machine in figure 2; and
- figure 4 illustrates a twisting plant comprising a plurality of twisting machines of the type illustrated in figures 2 and 3.

[0018] In figure 1, designated as a whole by number 100 is a logic diagram of the control/operation of a twisting machine 100 (also see figures 2, 3) according to the teachings of the present invention.

[0019] The twisting machine 100 according to the

present invention comprises the following electronically connected devices:

(1) a control unit 110 which exchanges information (via signals) among the various devices (see below);
(2) an extrusion apparatus 120 provided with suitable devices to send electronic information to the control unit 110; in particular the information received by the control unit 110 from the apparatus 120 relates to the speed of production of a tape (BND) of plastic material;
(3) a storing unit 130, having a horizontal axis, for storing the tape coming from the extrusion apparatus 120; in particular the information exchanged between the control unit 110 and the storing unit 130 relates to the speed at which the tape (BND) is gathered on at least one spindle of said storing unit 130;
(4) a vertical twisting unit 140 for twisting the tape (BND) to produce the desired synthetic grass; in particular the information exchanged between the twisting unit 140 and the control unit 110 relates to the speed of twisting of the tape (BND) coming from the storing unit 130; and
(5) an automatic braking unit 150 arranged between the storing unit 130 and the twisting unit 140; the braking unit 150 may advantageously, but not necessarily, be an electric braking unit, and it too exchanges electronic information with the control unit 110 to gauge the tension of the tape (BND) according to the requirements of the storing unit 130 and of the instantaneous tension exerted by the twisting unit 140 on said tape (BND).

[0020] As illustrated in figure 2, when the tape (END) leaves the extrusion apparatus 120 it is diverted by a first guiding roller 121 towards the storing unit 130.

[0021] The linear speed of the tape (BND) is measured, by means of a speed measuring device that is not illustrated, at a point (PNT) (figure 2) before entering the storing unit 130. The data relating to the instantaneous speed of the tape (BND) at the point (PNT) are sent to the control unit 110 for reprocessing if necessary (see below).

[0022] When the tape (BND) enters the storing unit 130 it is diverted again by a second guiding roller 131.

[0023] Moreover, in a conventional manner, the storing unit 130 comprises a motor 132 which, by means of a conventional device 133 of the type comprising a belt and two pulleys, turns a shaft 134 to which a traditional spindle 135 is keyed. The tape (BND) is wound round the spindle 135 before being fed towards the braking unit 150.

[0024] The spindle 135 is also provided with at least two sensors (not illustrated) which indicate the level of filling of said spindle 135.

[0025] In particular the spindle 135 is provided with:

- an "overflow sensor" (not illustrated); and
- an "underflow sensor" (not illustrated).

[0026] When the "overflow sensor" (not illustrated) is tripped this means that too much tape (BND) is being wound onto the spindle 135; when the control unit 110 receives the signal from the "overflow" sensor it sends a signal to the twisting unit 140, so that said twisting unit 140 increases the speed of production of the synthetic grass; or, alternatively, but only in very rare cases, the control unit 110 reduces the speed of production of the tape (BND) by the extrusion apparatus 120.

[0027] It is, in fact, easier to adjust the production of artificial grass by the twisting unit 140 than to adjust the speed of production of the extruded tape (BND) by the extrusion apparatus 120.

[0028] If, on the other hand, the "underflow sensor" (not illustrated) is tripped the control unit 110 makes the twisting unit 140 slow down the speed of production of synthetic grass.

[0029] Under normal conditions, the speed of twisting of the tape (BND) to produce the artificial grass is nominally equal to the output speed of the extrusion plant 120 and measured at the point (PNT) as described previously (figure 2).

[0030] Figures 2, 3 illustrate an arrangement in which the twisting unit 140 is vertical and the storing unit 130 is horizontal, the latter standing on the floor (GR).

[0031] The braking unit 150 can be of the electric type described in a previous patent application filed by this same applicant. The application number is EP 09170068.2 (S.I.M.A.) (corresponding to Italian application BO2008A000551) and is to be deemed an integral part of the description herein.

[0032] This document describes a yarn twisting machine that comprises a yarn-braking system wherein the braking action, according to the twisting conditions, is exerted by an electric motor instead of a traditional hydraulically operated device. As stated previously, said braking unit 150 is also provided with an electronic device (not illustrated) that exchanges electronic information with the control unit 110 to gauge the tension of the tape (BND) according to the requirements of the storing unit 130 and of the instantaneous tension exerted by the twisting unit 140 on said tape (BND).

[0033] The twisting unit 140 is of the conventional type and is therefore not described in detail. However, one particular characteristic thereof, as mentioned previously, is that it comprises an electronic device (not illustrated) which exchanges information with the control unit 110. Said information generally relates to the speed of twisting of the tape (BND) coming from the braking unit 150.

[0034] Moreover, in correspondence with the bobbin of twisted tape on the structure of the twisting unit 140 there is an opening (not illustrated) from which said bobbin can be removed.

[0035] Said opening can be opened and closed manually or operated by conventional means (electrically, pneumatically or hydraulically controlled).

[0036] Figure 4 illustrates a twisting plant 1000 comprising a series of eight twisting machines 100 of the type described herein with reference to figures 1-3.

[0037] The same extrusion plant (not illustrated in figure 4) feeds all the twisting machines 100 by means of a device called a "tape guide", which conveys the groups of tapes in the desired number (groups of 4-6 or 8) towards each twisting machine 100.

[0038] The present invention also relates to a method for twisting an element made of plastic material to produce artificial grass.

[0039] Said method comprises the following steps:

(f1) - extruding a plastic material in the form of a tape or of filaments;
(f2) - collecting said plastic material on a spindle of a storing unit suitable to store the tape, or the filaments, coming directly from the extrusion apparatus; and sending, directly and at the same time, the tape, or the filaments, from the storing unit to the twisting unit;
(f3) - generating, and exchanging with an electronic control unit, electronic signals concerning:

- the output speed of the tape from the extrusion operation;
- the "overflow" and the "underflow" of the tape, or of the filaments, collected on the spindle; and
- the speed, and other parameters, referring to the twisting operation.

[0040] Moreover, according to an alternative embodiment of the present invention which is not illustrated the twisting machine comprises a horizontal twisting unit connected to a storing unit with a vertical axis.

[0041] According to a further possible alternative arrangement of the two units, both have a horizontal axis.

[0042] Whichever axis arrangement is chosen for the two units 130, 140, said axes may be perpendicular in relation to one another, for instance as illustrated in the embodiment shown in figures 1, 2.

[0043] The main advantage of the twisting machine and of the relative method of twisting described above consists of the fact that the bobbin does not have to be loaded onto the twisting unit manually; this saves a considerable amount of time with positive consequences in terms of the cost of the finished product (artificial grass).

[0044] Moreover, the artificial grass produced with the present method and using the twisting machine according to the present invention is particularly soft and free of defects.

Claims

1. Twisting machine (100) for producing artificial grass starting from one or more tapes (BND);
twisting machine (100) comprising:
(c1) a control unit (110) which exchanges information among the various appliances;
(c2) an extrusion apparatus (120) provided with suitable devices to send electronic information to the control unit (110);
(c3) a storing unit (130) of a bundle composed of tapes (BND) coming from the extrusion apparatus (120), said storing unit (130) also being provided with suitable devices to exchange electronic information with the control unit (110); and
(c4) a twisting unit (140) of said tape (BND) to produce the desired synthetic grass; said twisting unit (140) also being provided with suitable devices to exchange electronic information with the control unit (110) ;
twisting machine (100) **characterized in that** said storing unit (130) is able to store the tape (END) coming directly from the extrusion apparatus (120), and is also able to feed, directly and at the same time, said tape (BND) to said twisting unit (140).

2. Twisting machine (100) according to Claim 1, **characterized in that** it further comprises an automatic braking unit (150) placed between the storing unit (130) and the twisting unit (140); the braking unit (150) being of the electric kind.

3. Twisting machine (100) according to any one of the preceding Claims, **characterized in that** said storing unit (130) has a horizontal axis (4), and said twisting unit (140) is of the vertical kind.

4. Twisting machine (100) according to any one of Claims 1, 2, **characterized in that** said storing unit (130) has a vertical axis, and said twisting unit (140) is of the horizontal kind.

5. Twisting machine (100) according to any one of Claims 1, 2, **characterized in that** both units (130, 140) have a horizontal axis.

6. Twisting machine (100) according to any one of the preceding Claims, **characterized in that** the axes of the storing unit (130) and, respectively, of the twisting unit (140) are mutually orthogonal.

7. Twisting plant (1000) **characterized in that** it comprises at least a twisting machine of the kind claimed in at least one of Claims 1-6.

8. Method for twisting an element made of plastic material for producing artificial grass; method **characterized in that** it comprises the following steps:

(f1) - extruding a plastic material in the form of a tape or of filaments;
(f2) - collecting said plastic material on a spindle

of a storing unit able to store the tape, or the filaments, coming directly from the extrusion apparatus; and sending, directly and at the same time, the tape, or the filaments, from said storing unit to the twisting unit; and

(f3) - generating, and exchanging with an electronic control unit, electronic signals concerning:

- the output speed of the plastic material from the extrusion operation;
- the "overflow" and the "underflow" of the plastic material collected on the spindle; and
- the speed, and other parameters, referring to the twisting operation.

9. Method according to Claim 8, **characterized in that** it comprises a further step wherein signals, concerning the thread braking on the way from the storing unit to the twisting unit, are produced and sent to the electronic control unit.

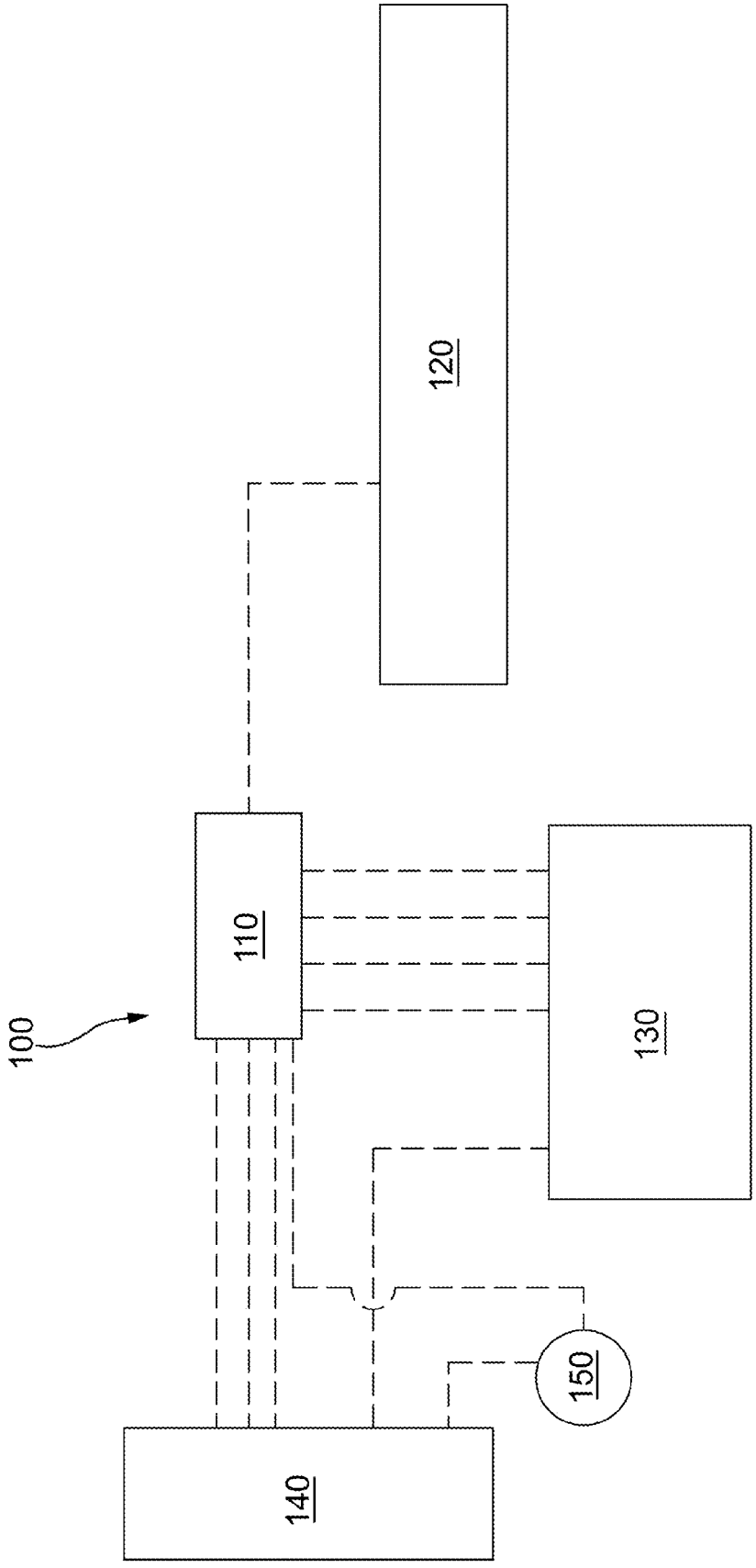

FIG.1

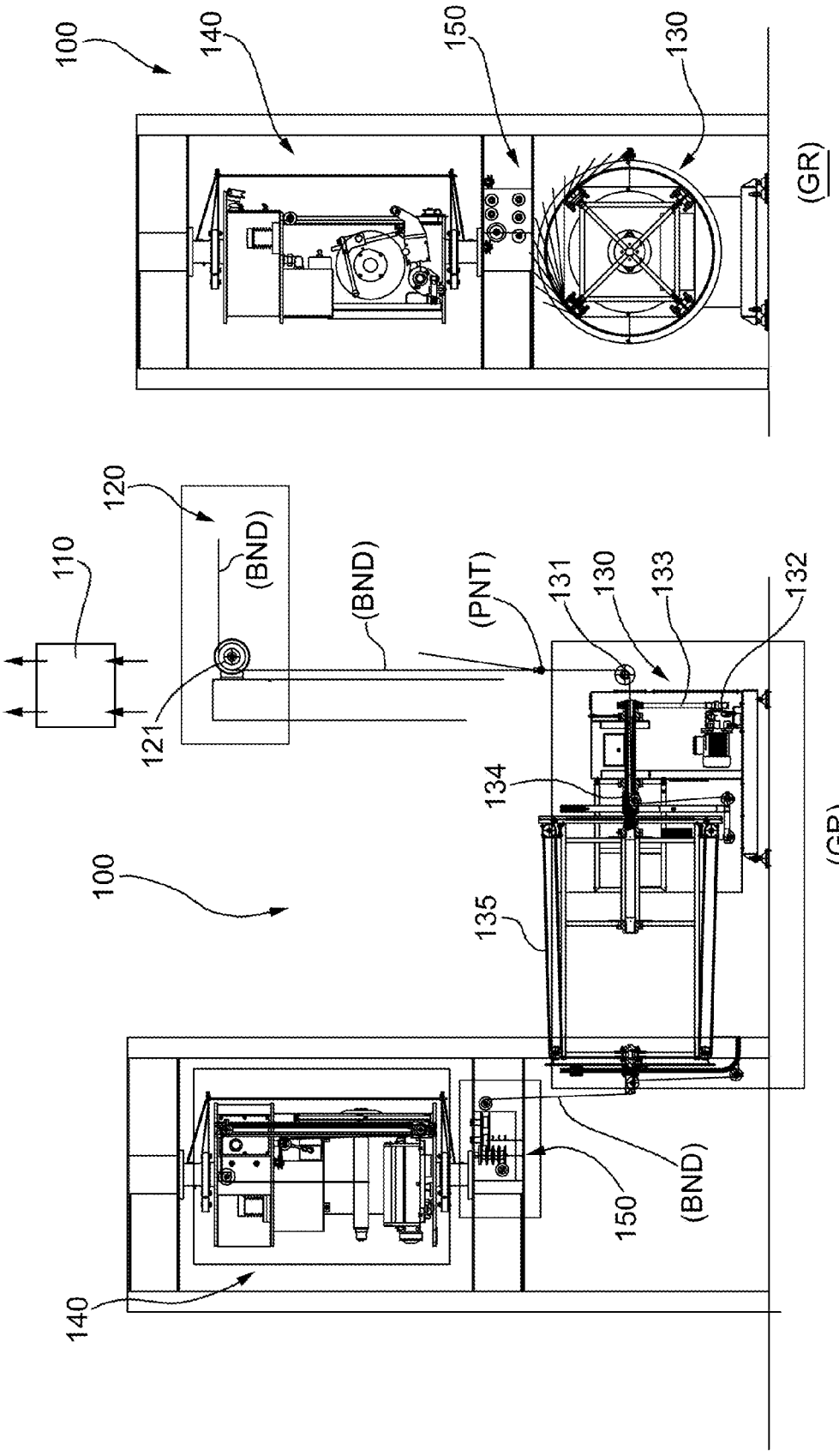
100
110
120
121
(BND)
(BND)
(PNT)
131
130
133
132
134
135
100
140
150
(BND)
(GR)

FIG.2

100
140
150
130
(GR)

FIG.3

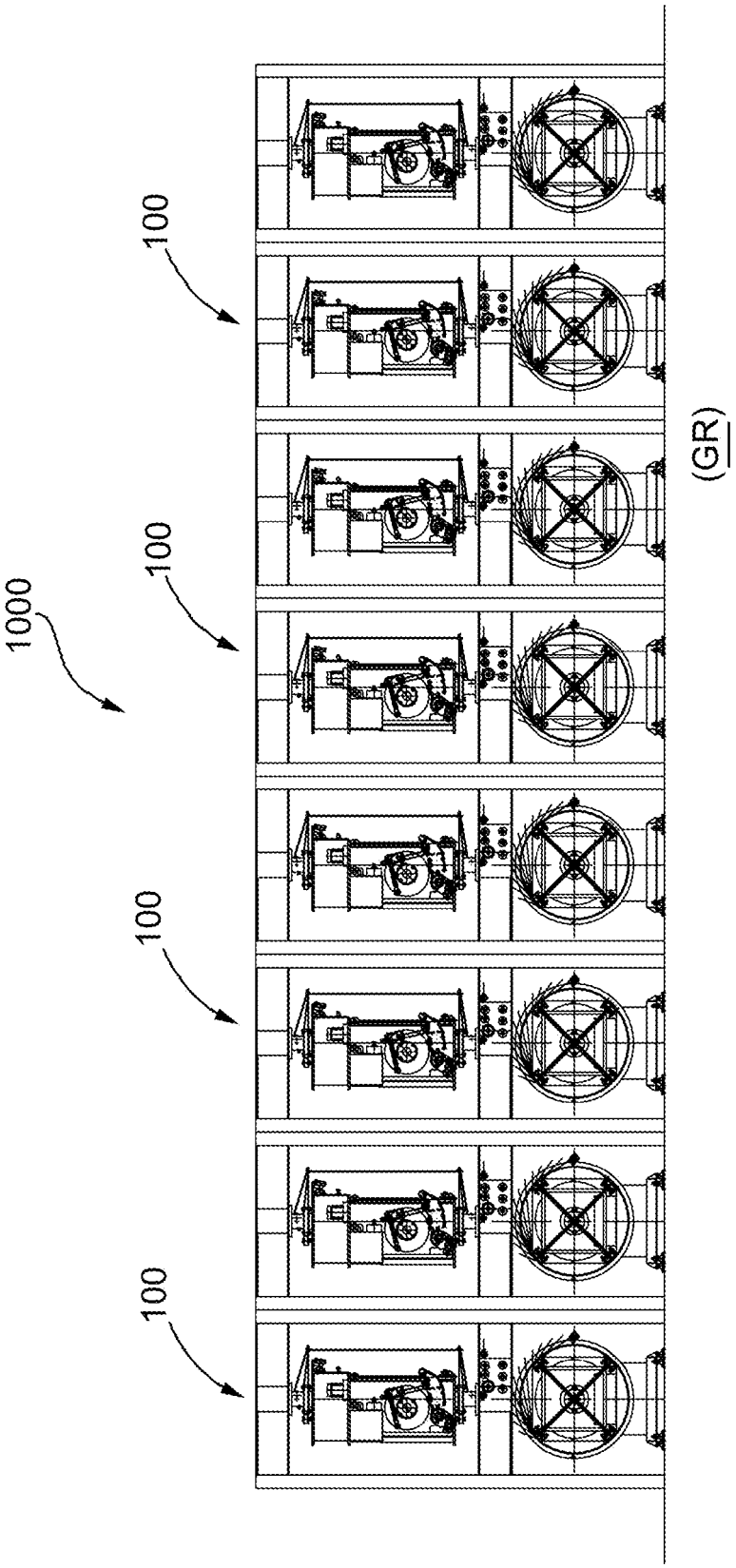

FIG.4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 15 4258

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2006/261510 A1 (PROULX RICHARD A [US] ET AL) 23 November 2006 (2006-11-23) * paragraphs [0055] - [0058]; figures 1-7 *	1,8	INV. D01H1/00 D01D5/20 D01F6/30 D02G3/44
A,D,P	EP 2 166 135 A1 (S I M A SOCIETA IND MECCANICHE [IT]) 24 March 2010 (2010-03-24) * abstract *	1,8	
A	EP 0 648 868 A1 (DESSEAUX H TAPIJTFAB [NL]) 19 April 1995 (1995-04-19) * the whole document *	1,8	
A	EP 1 728 902 A1 (DIETZE & SCHELL [DE]) 6 December 2006 (2006-12-06) * the whole document *	1,8	

TECHNICAL FIELDS SEARCHED (IPC)
D01H
D01D
D01F
D02G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 June 2011	Dreyer, Claude

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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08-06-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006261510 A1	23-11-2006	US 2010225021 A1	09-09-2010
EP 2166135 A1	24-03-2010	NONE	
EP 0648868 A1	19-04-1995	AT 151475 T	15-04-1997
		DE 69402504 D1	15-05-1997
		DE 69402504 T2	17-07-1997
		DK 648868 T3	21-07-1997
		ES 2099534 T3	16-05-1997
		JP 7197308 A	01-08-1995
		NL 9301798 A	16-05-1995
		NZ 264629 A	26-09-1995
EP 1728902 A1	06-12-2006	DE 102005020884 A1	09-11-2006

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 09170068 A **[0031]**
- IT BO20080551 A **[0031]**