(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 November 2007 (22.11.2007)

PCT

(10) International Publication Number
WO 2007/133062 A1

(51) International Patent Classification:
B23P 15/00 (2006.01) *B21D 53/14* (2006.01) *F16G 5/16* (2006.01)

(21) International Application Number: PCT/NL2006/000251

(22) International Filing Date: 16 May 2006 (16.05.2006)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **ROBERT BOSCH GMBH** [DE/DE]; Postfach 30 02 20, D-70442 Stuttgart (DE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **PENNINGS, Bert** [NL/NL]; Zonnedauw 30, NL-5052 CH Goirle (NL).

(74) Agent: **PLEVIER, Gabriël, Anton, Johan, Maria**; Van Doorne's Transmissie B.V., Postbus 500, NL-5000 AM Tilburg (NL).

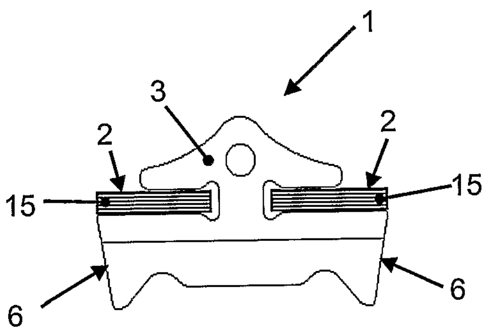
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** MANUFACTURING METHOD FOR A LAMINATED SET OF METAL RINGS FOR A PUSHBELT



(57) Abstract: The invention relates to a method for manufacturing a laminated set (2) of radially nested metal rings (15) for a pushbelt (1) that comprises at least one such ring set (2) and a multitude of transverse metal elements (3) slideably incorporated on the ring set (2), including the steps of preparing an elongated steel sheet (11), a lengthwise oriented central part (P2-P4) of the steel sheet (11) being defined in-between lateral side edges (P1 ; P5) thereof. Wherein the radially innermost ring (15) of the ring set (2) is produced from material located at the central part (P2-P4) of the steel sheet (11).

WO 2007/133062 A1

MANUFACTURING METHOD FOR A LAMINATED SET OF METAL RINGS FOR A PUSHBELT

The present invention relates to a manufacturing method for a laminated set of rings for a pushbelt as defined by the preamble of the following claim 1. The pushbelt as such is generally known in the art and is described in detail in, for example, EP-A 1 403 551. The belt is mainly used as a means for power transmission between two adjustable pulleys in the well-known continuously variable transmission that is applied in motor vehicles.

The known pushbelt is composed of a multitude of relatively thin transverse metal elements that are provided on one or more such laminated set(s) of radially stacked metal rings, slideably along the circumference thereof. These rings are usually produced from a precipitation hardening steel composition, such as a Maraging steel, that combines a/o the properties of great tensile strength and resistance against tensile and bending stress fatigue with a relatively favourable possibility to process it from raw base material towards the desired shape and properties of the rings.

In the typical manufacturing method for such a set of rings the following process steps are comprised:

- preparing an ingot of a metal composition desired as ring base material;
- cutting, forging and/or rolling the ingot into an elongated steel sheet having a minimal thickness in relation to its width and length dimensions;
- sheet material composition quality control
- separating a plate section from the steel sheet
- bending and welding the plate into a cylindrical shape or tube
- separating ring sections from the tube

Usually the thus formed rings are subjected to several further process steps, as is exemplified in, for instance, the European patent application EP-A 1 055 738 to form the end product pushbelt ring component. Also as a part of the known manufacturing method, several such rings are mutually nested in radial direction, i.e. concentrically stacked, with a defined radial play being provided between adjacent rings to form each set of rings of the pushbelt.

It is a well known fact that the operational lifespan of the pushbelt is limited a/o by the ultimate fatigue fracture of one of the ring components thereof. Hereby, the fatigue strength of the rings is largely determined by the size and abundance of non-metallic inclusions such as metal oxides, -nitrides and -carbides that are embedded therein, because such inclusions work as internal stress raisers such that a (fatigue) crack can initiate at or near such inclusion even though the overall (average) stress load does not exceed the nominal fracture stress of the rings. Thus, by limiting the size and abundance of inclusions that are formed in its production process, the fatigue fracture of the ring components can be favourably delayed at a given load, improving the operation lifespan of the pushbelt as a whole. However, such improvement can generally be realised only at great cost and effort in the production process, which effectively limits the practically, i.e. economically, maximum attainable purity and associated fatigue strength of the rings. These principles have been discussed and are quantified in relation to the pushbelt ring component in a/o EP-A 1 243 812, which provides for a Maraging steel having a defined a non-metallic inclusion size distribution that shows a remarkable fatigue strength while still being economically producible.

The present invention aims to further improve on the fatigue strength, c.q. resistance against fatigue crack, of the pushbelt ring component without modifying the composition of the ring base material as such. According to the invention such aim is realised by the manufacturing method according to claim 1.

Underlying the present invention are measurements performed on the elongated steel sheet, which revealed that at least the number of inclusions per unit of volume, i.e. the local relative abundance of inclusions or local inclusion density, varies along the width of the steel sheet, i.e. in a direction transversely to the rolling direction of the preceding process step of rolling. In particular it was observed that at or near the lateral side edges of the steel sheet the inclusion density is highest as compared to a central part or parts of the sheet extending between the lateral edges thereof.

Based on the above insight, it is presently suggested to at least produce the radially innermost ring of the set of rings from such central part(s) of the sheet. This innermost ring typically being the most heavily fatigue loaded ring in the set of rings during operation of the pushbelt. Preferably also the radially outermost ring of the set of rings is produced from such central part(s) of the sheet, since also this ring is loaded more during operation as compared to so-called in-between rings, i.e. rings of the set rings that are positioned in-between the radially innermost and the radially outermost ring thereof.

Further, it is suggested to either discard the said lateral side edges of the steel sheet from the manufacturing process altogether, or to use the material concerned solely for the production of at least one of the said in-between rings. If it is chosen to discard these lateral side edges, the material concerned can be recycled, i.e. be added to the molten steel composition from which the ingot of the ring base material is prepared in the first process step of the present manufacturing method. In the later case, the removal of a strip of material of more than 2%, preferably up to 6% of the total, i.e. overall width of the steel sheet -or of the length of the tube to be formed there from- at each lateral side edge thereof suffices to realise a noticeable improvement, i.e. reduction, in the maximum inclusion density in the rings. The above values amount to the width of 1 to 3 ring sections of approximately 10 mm to be separated from the tube ends and subsequently discarded of a typical tube having a length of approximately 0.5 m.

In a preferred embodiment of the invention at least the said radially innermost ring, but preferably also the said radially outermost ring is separated from the tube at a position that is removed from its axial ends, preferably by at least 10% of its total length, which tube length corresponds to the width of the steel sheet and plate sections, more preferably by 25% of its length. It was found that typically already in the central 80% part, but with great certainty in the central 50% part of the total width of the sheet 11, c.q. of the tube length, the inclusion density is considerably lower than at or near the lateral side edges of the sheet, c.q. the plate section, c.q. the tube, and, moreover, that along the said central part the inclusion density is comparatively constant.

According to the present invention, as an alternative to or possibly in addition to the above-described novel manufacturing methods, the process step of quality control of the sheet material composition, which step generally includes a measurement of the inclusion density -or a parameter that is directly thereto- and the subsequent comparison of the measured density with an upper tolerance limit therefor, is performed on a material sample taken at or near a lateral edge of the steel sheet or the plate section cut there from. This allows the quality of the sheet material to be assessed accurately and quickly, i.e. with as few as possible measurements being required. Preferably, a sample is taken for inclusion density measurement from each lateral side of the sheet. Thus, according to the invention, no material samples are taken from the central part of the steel sheet for inclusion density measurement, since it has been established that in this region the inclusion density will be lower, i.e. more favourable, than near the lateral edges of the sheet, which should satisfy, i.e. be lower than, the said upper tolerance limit anyway.

The above-described basic features of the invention will now be elucidated by way of example, along a drawing in which:

Figure 1 is a schematic illustration of the pushbelt the present invention relates to and of the transmission in which such belt is applied;

Figure 2 is an illustration of the manner in which a laminated tensile means and a transverse element are mutually oriented within the pushbelt;

Figure 3 figuratively represents the presently relevant process steps in the known method for manufacturing a laminated set of rings for a pushbelt; and

Figure 4 provides a graph that was obtained by performing several inclusion density measurements on a steel sheet used in the known manufacturing method.

Figure 1 shows schematically a continuously variable transmission (CVT) with a drive belt 1 wrapped around two pulleys 4 and 5, which belt 1 is made up of two sets 2 of mutually stacked, thin metal rings 15 and an essentially continuous array of transverse elements 3 that are mounted along the circumference of the laminated ring sets 2 and which may freely slide there along. This type of drive belt 1 is commonly referred to as pushbelt 1. Both the pushbelt 1 and the continuously variable transmission as a whole are well known per se.

Figure 2 depicts, in a longitudinal cross-section of the belt 1, a front view of a transverse element 3 and a cross section of the ring sets 2. The transverse element 3 laterally shows side faces 6 by which it engages the conical sheaves of the transmission pulleys 4, 5. The rings 15 are made of a high quality steel, e.g. a nitrided and precipitation hardened Maraging steel, and typically have a thickness of about 0.18 mm, a width of about 10 mm and a circumference length of around 500 to 750 mm. It is known that the fatigue strength of the rings 15 is of primary importance to the performance of the pushbelt as a whole, which fatigue strength is largely determined by the size and abundance of non-metallic inclusions, such as metal oxides, -nitrides and -carbides present in the rings. Thus, in practice the rings are produced not only in accordance with a narrowly specified material composition, but also with a well defined non-metallic inclusion size distribution. For the presently applied Maraging steel this means that at least the number of Titanium-nitride inclusions per unit of volume must be less than a predefined upper tolerance limit therefor. In a more sophisticated approach, it is known to also take account of the size of the inclusions, such that the upper tolerance limit is higher as the inclusion size is smaller, and/or other types of inclusions, such as metal-oxide and carbide particles.

In the figure 3, the separate process steps of the manufacturing method for a laminated ring set 2 for a pushbelt 1 are schematically indicated, identified by way of Roman numerals.

In a first process step I an ingot 10 is made from a molten steel alloy of desired composition. This ingot is subsequently, in a second process step II, cut, forged and rolled into an elongated steel sheet 11 having a minimal thickness in relation to its width and length dimensions. For ease of transport, the steel sheet 11 is often coiled up lengthwise into a spiral shape (not shown). Thereafter, in a third process step III a plate section 12 is separated from the -uncoiled- steel sheet 11, which plate section 12 is subsequently bent into a cylindrical shape and the adjoining plate ends 13 are welded together in a fourth process step IV to form a tube 14. In a fifth process step V the tube 14 is annealed. Then, in a sixth process step VI the tube 14 is separated into a number of annular hoops or rings 15, which are subsequently -process step seven VII- rolled and elongated to a required length and/or thickness. The rings 15 are subjected to a further annealing process step VIII to remove the internal stresses introduced during rolling and in a ninth process step IX, the rings 15 are calibrated, i.e. they are mounted around two rotating rollers and stretched to a predefined circumference length of the end product. In a subsequent tenth process step X the rings 15 undergo a heat treatment. Usually, the heat treatment includes at least two phases: in the first phase the rings 15 are precipitation hardened, i.e. aged, (indicated by the letter "A") and, in the second phase, the rings 15 are nitrided (indicated by the letter "N"), to provide additional hardness as well as a compressive stress to the outer surface layer of the rings 15.

Usually, the quality of the sheet material composition is checked, as part of the above manufacturing method, by measuring the number of non-metallic inclusions, at least Titanium-nitride inclusions, embedded in a material sample of defined volume in relation to their size. Such inclusion size distribution being predictive of the ultimate fatigue strength of the pushbelt 1 and should therefore satisfy specified requirements.

From a number of thus processed rings 15 the ring set 2 is formed by radially stacking, i.e. nesting, a number of purposely selected rings 15, as is further indicated in figure 3. To obtain the required number of rings 15 suited for forming one set 2, a representative dimension of each processed ring 15, e.g. its circumference length, is measured in an eleventh process step XI, wherein the rings 15 are classified and stocked by such length. Subsequently, in a twelfth and final process step XII the set 2 of rings 15 is assembled by mutually nesting a required number of suitably dimensioned rings 15 from such stock of classified rings 15.

Departing from the above known manufacturing method the present invention aims to further improve on the fatigue strength, c.q. resistance against fatigue crack, of the pushbelt ring component 15, without modifying the ring material composition as such. Thereto, it is relied on the presently revealed variation of the number of Titanium-nitride inclusions per unit of volume along the width of the steel sheet 11, i.e. in a direction transversely to the rolling direction, after the said second process step II has been concluded, which variation is illustrated in the graph of figure 4.

In figure 4 both curves A and B, each representing a different location along the length of the steel sheet 11, connect the number of Titanium-nitride inclusions per unit of volume, hereinafter denoted inclusion density INDY, as measured at five separate positions P1-P5 along the width of the steel sheet 11, respectively of the plate section 12 separated there from, which positions are indicated by way of illustration in figure 3, process step III. Positions P1 and P5 are placed near the respective lateral (i.e. left and right) edges of the sheet 11 or plate section 12, i.e. removed from the respective lateral edge by approximately 2% of the total width of the sheet 11, whereas position P3 is placed essentially at its midpoint. Positions 2 and 4 are placed essentially halfway a respective lateral edge P1, P5 of the sheet 11 and its midpoint P3, i.e. essentially at ¼ and ¾ of its total width.

From figure 4 it appears that, as seen along the width of the steel sheet 11, the highest inclusion density INDY occurs near its lateral side edges, i.e. at positions P1 and P5. In the central part of the sheet 11, i.e. at positions P2, P3 and P4, such inclusion density INDY was consequently (i.e. reproducibly) found to be lower by a considerable margin relative to the inclusion density INDY at the local side edges. Between these latter three positions P2-P4, located at the central part of the sheet 11, the inclusion density INDY varies relatively little, but no special, reproducible relationship appears to exist there between in terms of the inclusion density INDY.

Based on the above phenomenon and in accordance with the present invention, it is considered advantageous to at least produce the radially innermost ring 15 of each the ring set 2 from such central part P2-P4 of the steel sheet 11, c.q. the plate section 12, c.q. the tube 14, since such innermost ring 15 typically is the most heavily loaded. Preferably also the radially outermost ring 15 of each ring set 2 is produced from the central part P2-P4 of the sheet 11, c.q. the plate section 12, since also this outermost ring 15 is loaded more during operation as compared to the so-called in-between rings 15 of the set 2 that are positioned in-between the said radially innermost and outermost rings 15 thereof.

In a preferred embodiment of the invention at least the said radially innermost ring 15, but preferably also the said radially outermost ring 15 is separated from the tube 14 at a position that is removed from its axial ends by at least 10% of its total length, which tube length corresponds to the width of the steel sheet 11 and plate section 12, preferably by more than 25% of its length.

More in particular, according to the present invention, the said lateral side edges P1 and P5 of the steel sheet 11 are either discarded from the manufacturing process altogether, or the material concerned is used solely for the production of the said in-between rings 15.

Further according to the present invention, a process step of quality control of the sheet material composition, which step generally includes a measurement of the inclusion density INDY -or a parameter that is directly thereto- and the subsequent comparison of the measured density INDY with an upper tolerance limit therefor, is at least randomly performed on a material sample taken at or near a lateral edge P1, P5 of the steel sheet 11 or plate section 12. This allows the quality of the sheet material to be assessed accurately and quickly, i.e. with as few as possible measurements being required. Thus, according to the invention, no material samples for inclusion density measurement need to be taken from the central part P2-P4 of the steel sheet 11, which should satisfy, i.e. be lower than, the said upper tolerance limit anyway, since it has been established that in this latter region P2-P4 the inclusion density INDY will be lower, i.e. more favourable, than near the lateral edges P1 and P5 of the steel sheet 11. Preferably, however, a sample is taken for the inclusion density measurement from both lateral sides P1 and P5 of the sheet 11, since between these two positions P1 and P5 the inclusion density INDY may diverge considerably as illustrated in figure 4.

The invention, apart from the preceding description and all details of the drawing that may not be described, however immediately and unambiguously evident to a person skilled in the art, further relates to all details of the following set of claims.

CLAIMS

1. Method for manufacturing a laminated set (2) of metal rings (15) for a pushbelt (1) that comprises at least one such ring set (2) and a multitude of transverse metal elements (3) slideably incorporated on the ring set (2), which method includes the process steps of:
- separating a plate section (12) from an elongated steel sheet (11), a lengthwise oriented central part (P2-P4) of the steel sheet (11) being defined in-between lateral side edges (P1; P5) thereof,
- bending the plate section (12) and welding adjoining ends (13) of the bend plate section (12) to form a tube (14),
- separating rings (15) from the tube (14), and of
- radially nesting a number of rings (15) to form the ring set (2),
characterised in that the radially innermost ring (15) of the ring set (2) is produced from (material located at) the central part (P2-P4) of the steel sheet (11).

2. Ring manufacturing method according to claim 1, characterised in that the radially innermost ring (15) of the ring set (2) is produced from essentially the midpoint (P3) of the steel sheet (11).

3. Ring manufacturing method according to claim 1 or 2, characterised in that also the radially outermost ring (15) of the ring set (2) is produced from the central part (P2-P4) of the steel sheet (11).

4. Ring manufacturing method according to claim 1, 2 or 3, characterised in that the lateral side edges (P1; P5) of the steel sheet (11) are discarded from the manufacturing process, i.e. that the material concerned is not used for producing the rings (15).

5. Ring manufacturing method according to claim 1, 2 or 3, characterised in that at least one of the rings (15) of the ring set (2) located between the radially outermost and the radially innermost ring (15) thereof is produced from one of the lateral side edges (P1; P5) of the steel sheet (11).

6. Ring manufacturing method according to any of the preceding claims, characterised in that the lateral side edges (P1; P5) of the steel sheet (11) are defined to have a width of more than 2%, preferably more than 6%, more preferably more than 10%, and less than 25% of the total width of the steel sheet (11).

7. Method for manufacturing a laminated set (2) of metal rings (15) for a pushbelt

(1) that comprises at least one such ring set (2) and a multitude of transverse metal elements (3) slideably incorporated on the ring set (2), which method includes the process steps of:

- separating a plate section (12) from an elongated steel sheet (11),
- bending the plate section (12) and welding adjoining ends (13) of the bend plate section (12) to form a tube (14),
- separating rings (15) from the tube (14),
- radially nesting a number of rings (15) to form the ring set (2) and of
- ring material quality control, in which process step at least the number of a non-metallic inclusion per unit of volume is sampled in relation to the inclusion size,

characterised in that the quality control is performed exclusively on a material sample taken at or near a lateral edge, preferably both lateral edges of the steel sheet (11), plate section (12) or tube (14).

8. Ring manufacturing method according to claim 7, characterised in that the ring material is a Maraging steel and in that the sampled non-metallic inclusion is a Titanium-nitride inclusion.

9. Ring manufacturing method according to any of the preceding claims, wherein the steel sheet (11) has been formed by cutting, forging and/or rolling of an ingot of a base material for producing the rings (15).

10. Ring manufacturing method according to any of the preceding claims, wherein the steel sheet (11) is provided with a minimal thickness in relation to its width and length dimensions.

11. Ring manufacturing method according to any of the preceding claims, which method further includes processing the rings (15) that are separated from the tube (14) to obtain the dimensions and material characteristics required for their use as a ring component (15) of the pushbelt (1).

12. Pushbelt (1) provided with a ring set (2) that is produced in accordance with a ring manufacturing method according to any one of the preceding claims.

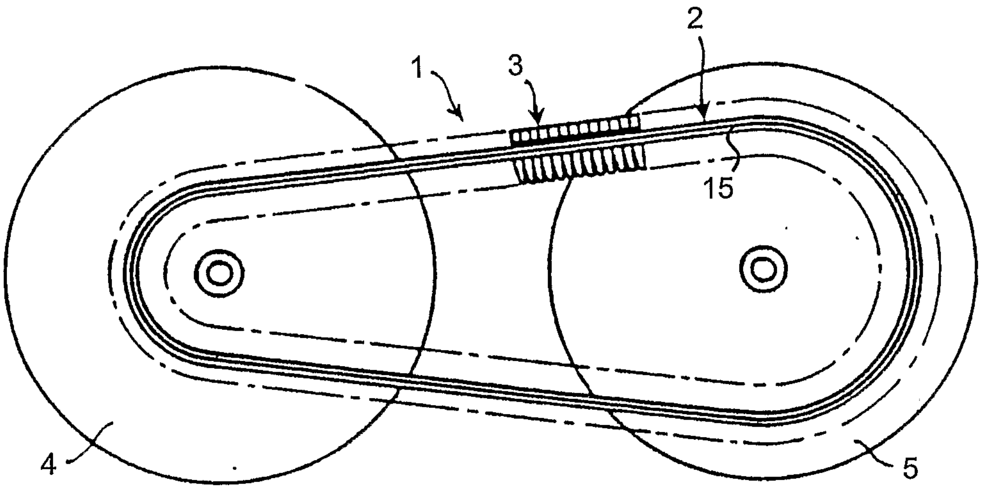


FIG. 1

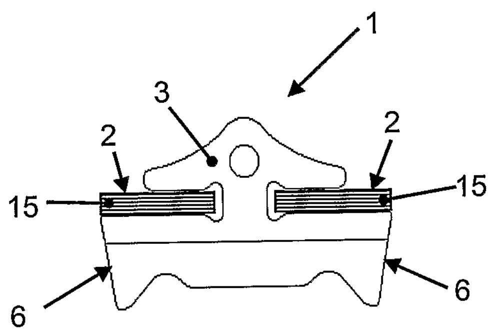


FIG. 2

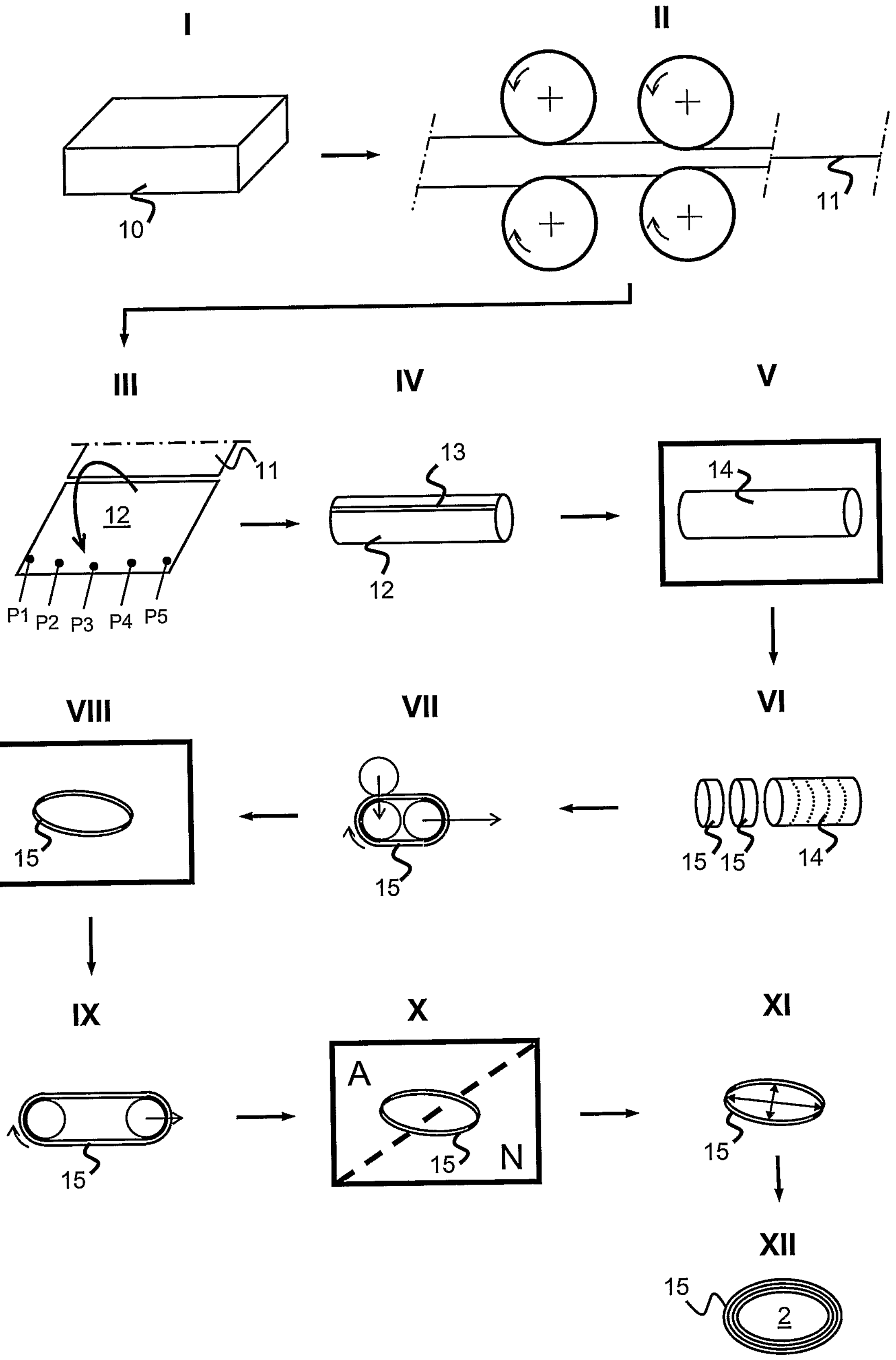

I
II
10
11
III
IV
V
11
12
13
14
P1 P2 P3 P4 P5
12
VIII
VII
VI
15
15
15 15
14
IX
X
XI
A
N
15
15
15
XII
15
2

FIG. 3

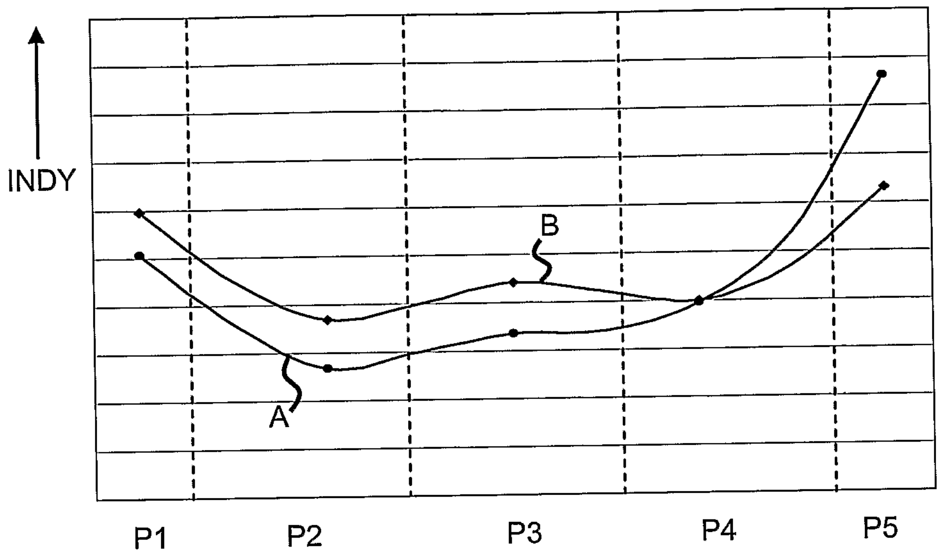


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2006/000251

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23P15/00 F16G5/16 B21D53/14

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)
B23P F16G B21D

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 055 738 A (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 29 November 2000 (2000-11-29) cited in the application	12
A	paragraphs [0001], [0005], [0014], [0019]; claim 1; figure 1 -----	1-6,9-11
X	EP 0 964 184 A (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 15 December 1999 (1999-12-15)	12
A	paragraphs [0006] - [0009], [0015]; figure 1 -----	1-6,9-11
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2006	17.01.2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	SERGIO DE JESUS, E

12

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2006/000251

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 011, no. 213 (M-605), 10 July 1987 (1987-07-10) -& JP 62 028548 A (KOBE STEEL LTD), 6 February 1987 (1987-02-06)	12
A	abstract	1-6,9-11
A	PATENT ABSTRACTS OF JAPAN vol. 013, no. 028 (M-788), 23 January 1989 (1989-01-23) -& JP 63 238963 A (HITACHI LTD), 5 October 1988 (1988-10-05) abstract	1-6,9-12
A	EP 1 243 812 A (VAN DOORNE'S TRANSMISSIE B.V) 25 September 2002 (2002-09-25) cited in the application paragraphs [0004], [0005], [0017], [0022]; figures	1-6,9-12

12

International application No.
PCT/NL2006/000251

INTERNATIONAL SEARCH REPORT

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-6,9-12.

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6,9-12

   directed to a method (claims 1-6 and 9-11 as far as the later are dependent from claim 1) for manufacturing a laminated set of rings for a pushbelt departing from a steel sheet, wherein the radially innermost ring is produced from the central part of the steel sheet, and to a pushbelt (claim 12) provided with a ring set produced with the method according to claim 1.

   ---

2. claims: 7-12

   directed to a method (claims 7,8 and 9-11 as far as the later are dependent from claim 7) for manufacturing a laminated set of rings departing from a steel sheet, wherein a ring material quality control is performed exclusively on a sample taken at or near a lateral edge of the steel sheet, plate section or tube and to a pushbelt (claim 12) provided with a ring set produced with the method according to claim 7.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2006/000251

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
EP 1055738	A	29-11-2000	US	6631542	B1	14-10-2003
EP 0964184	A	15-12-1999	DE	69912023	D1	20-11-2003
			DE	69912023	T2	19-05-2004
			JP	3524766	B2	10-05-2004
			JP	11351334	A	24-12-1999
			US	6123637	A	26-09-2000
JP 62028548	A	06-02-1987	NONE			
JP 63238963	A	05-10-1988	NONE			
EP 1243812	A	25-09-2002	AT	298850	T	15-07-2005
			DE	60111718	D1	04-08-2005
			DE	60111718	T2	04-05-2006
			JP	2002327801	A	15-11-2002
			US	2002132691	A1	19-09-2002