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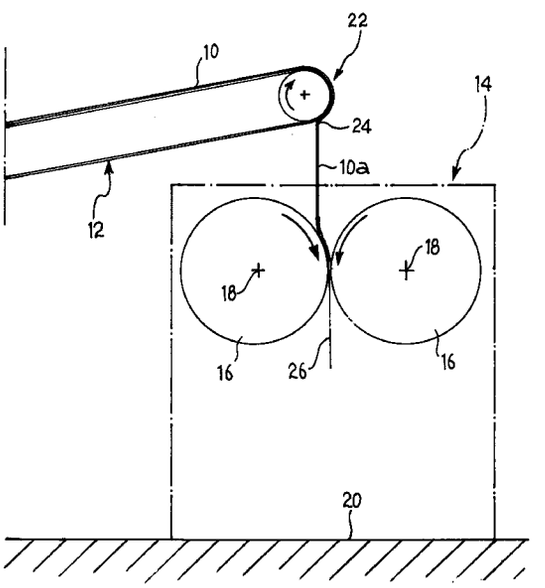
(54) A method and apparatus for producing mechanically compacted non-woven fabric

(57) In a method and apparatus for producing mechanically compacted non-woven fabric, a web of non-compacted fibres (10) is supplied by means of a conveyor belt (12) to a calender (14) having a pair of heated compacting rollers (16). The web (10) is supplied to the compacting rollers (16) downwardly from above.

FIG. 2
PRIOR ART



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Description

The present invention relates to a method and to apparatus for producing mechanically compacted non-woven fabric. More precisely, the invention relates to systems for producing non-woven fabric in which a web of non-compacted fibres is subjected to a thermal compaction step by being passed through a calender having at least one pair of contrarotating, heated compacting rollers.

The method of producing non-woven fabric by thermal compaction provides, in a first step, for the formation of a web of non-compacted fibres, for example, by means of carding machines. This web may be formed from short or medium fibres or from continuous thread. The web of non-compacted fibres has very poor or even non-existent dimensional stability and has to be supported during its supply to the compacting rollers. These rollers are heated to a temperature close or equal to the softening point of the fibres being processed.

The compacting rollers are also pressed against one another along a generatrix of contact by a pressure which is variable according to the type of fibres being processed. Heat sealing takes place as a result of the passage through the compacting rollers, binding the fibres together and mechanically stabilizing the web.

Figure 1 of the appended drawings shows schematically the stage in which the compacting of the web of fibres takes place in conventional apparatus. In this drawing, a pair of contrarotating, heated compacting rollers is indicated 2, the axes of rotation of the rollers being contained in a vertical plane. A web 4 of non-compacted fibres is supplied to the compacting rollers 2 by means of a conveyor belt 6. The output portion of the conveyor belt is placed as close as possible to the point of contact of the compacting rollers 2. Despite attempts to have the minimum distance between the detachment point 8 and the insertion point 10, owing to the size of the rollers 2, there is nevertheless a clear space in which the portion 4a of the web is neither supported nor accompanied during its supply travel.

The main disadvantage of known apparatus of the type described above consists of the fact that the calendering step imposes quite strict limits on production speed. The limitations on the maximum calendering speed of the web are due essentially to the lack of mechanical stability of the portion of the web which extends from the point of detachment from the conveyor belt to the point of entry between the compacting rollers. The problems of dimensional stability of the web are aggravated by the heat which comes from the lower compacting roller and which falls on the unsupported portion of web.

Since the web of non-compacted fibres cannot support itself, the portion of the web downstream of the conveyor belt is supported by being stretched, which is achieved by an increased speed of rotation of the compacting rollers relative to the speed of advance of the conveyor belt. This speed difference increases proportionally with increases in production speed. The speed differences are considerable and give rise to appreciable tensions in the web.

In view of these factors, to prevent alteration of the morphological structure of the upper or lower surface of the web, the production speed must be limited.

Another problem of known apparatus is that any damage to the web upstream of or in the clear space causes the web to collapse. The broken web could form a binding on one of the compacting rollers which would result in considerable economic damage.

The object of the present invention is to provide a method and apparatus for producing non-woven fabric which overcome the aforementioned problems.

According to the present invention, this object is achieved by a method and apparatus having the characteristics forming the subject of the claims.

The present invention proposes a different arrangement of the conveyor belt and of the calender which carries out the thermal compaction of the web of fibres. According to the invention, the compacting rollers of the calender are arranged with their axes of rotation contained in a plane which is arranged at an angle to the vertical and the output portion of the conveyor belt is situated above the compacting rollers. The web of non-compacted fibres is thus supplied to the compacting rollers by a downward movement from above in an oblique or vertical direction.

The web of non-compacted fibres is thus subjected by gravity to a force in the direction of advance rather than to a force perpendicular to the web. This overcomes the problems connected with the lack of support of the portion of web between the output portion of the conveyor belt and the compacting rollers and enables the production speed to be increased in comparison with conventional systems whilst the qualitative characteristics of the final product are maintained.

The compacting rollers are preferably arranged in a manner such that their axes of rotation are contained within a substantially horizontal plane.

According to a variant of the present invention, a pair of conveyor rollers is disposed between the output portion of the conveyor belt and the compacting rollers.

Further characteristics and advantages of the present invention will become clear in the course of the following detailed description, given purely by way of non-limiting example, with reference to the appended drawings, in which:

- Figure 1 (already described above) is a diagram showing the compaction stage in known apparatus,
- Figure 2 is a diagram showing the compaction stage in apparatus according to the present invention,
- Figure 2a is a diagram showing a variant of the apparatus of Figure 2,

- Figure 3 shows a version of the apparatus according to the invention having conveyor rollers, and
- Figures 3a and 3b show two variants of the apparatus of Figure 3.

Figure 2 shows schematically the portion of apparatus for producing non-woven fabric in which the compaction of a web of non-woven fibres, indicated 10, takes place. The web 10 is prepared by known machinery, for example, carding machines, which deposit the web of non-compacted fibres 10 on a conveyor belt 12.

Beneath the conveyor belt 12 there is a calender, generally indicated 14, comprising a pair of contrarotating compacting rollers 16. The outer surfaces of the rollers 16 are heated to a temperature close to the softening point of the fibres. The axes of rotation 18 of the compacting rollers 16 are contained in a plane which is arranged at an angle to the vertical.

In the embodiment shown in Figure 2, the plane containing the axes of rotation 18 is parallel to the floor surface 20 and is thus arranged at 90° to the vertical. However, for the purposes of the present invention, the plane containing the axes 18 could be arranged differently, provided that it is arranged at an angle to a vertical plane. The rollers 16 are urged against one another with a contact pressure which is variable according to the type of fibres being processed.

The output portion 22 of the conveyor belt 12 is arranged above the compacting rollers 16. The web 10 of non-compacted fibres comes off the conveyor belt 12 at the point indicated 24 and is supplied between the rollers 16 vertically downwardly from above. A compacted web of non-woven fabric, indicated 26, emerges downstream of the rollers 16.

By virtue of this arrangement, the portion 10a of the web of non-compacted fibres which extends from the conveyor belt 12 to the compacting rollers 16 is subjected to a gravitational force which acts in the direction of advance of the web. This prevents the problems due to the lack of dimensional stability of the web in the space in which it is not supported by the conveyor belt 12.

In the variant shown in Figure 2a, the output portion 22 of the conveyor belt 12 is displaced horizontally from the vertical plane passing through the contact line between the compacting rollers 16. The portion 10a of the web 10 therefore extends obliquely rather than vertically.

Tests carried out by the Applicants have shown that the arrangements shown in Figures 2 and 2a enable faster production speeds to be achieved than conventional systems, without subjecting the web of non-compacted fibres to excessive stretching. The increase in production speed is not therefore detrimental to the qualitative characteristics of the final product.

The relative positions of the conveyor 12 and of the calender 14 are preferably adjustable both vertically and horizontally, as indicated schematically by the arrows A and B of Figure 2a, in order to adapt the path of the portion of web 10a to the speed and the characteristics of the web.

Figures 3, 3a,and 3b show further variants of the apparatus according to the present invention; elements identical to those described above are indicated by the same reference numerals.

In the version of Figures 3, 3a and 3b, a pair of motor-driven conveyor rollers 28 is disposed between the conveyor belt 12 and the compacting rollers 16 and collects the web of non-compacted fibres which is supplied downwardly from above by the conveyor belt 12. The conveyor rollers 28 have the purpose of supplying the web of non-compacted fibres 10 to the compacting rollers 16. The axes of rotation of the conveyor rollers 28 are preferably contained in a plane parallel to the plane containing the axes of rotation 18 of the compacting rollers 16.

The conveyor rollers 28 may be cold and, in this case, also act as a heat shield above the heated compacting rollers 16, preventing excessive softening of the portion 10a of the web 10. Alternatively, the conveyor rollers 28 may be heated in order to carry out preliminary compaction of the web.

In the versions shown in Figures 3 and 3a, the vertical plane tangential to the conveyor cylinders 28 substantially coincides with the vertical plane tangential to the compacting rollers 16. Alternatively, as shown in Figure 3b, the vertical plane tangential to the compacting rollers 28 may be spaced horizontally from the vertical plane tangential to the compacting rollers 16.

Claims

1. A method of producing mechanically compacted non-woven fabric in which a web (10) of non-compacted fibres is supplied by means of a conveyor belt (12) to a calender (14) having at least one pair of heated compacting rollers (16), characterized in that the web (10) is supplied to the compacting rollers (16) downwardly from above.

2. A method according to Claim 1, characterized in that, in the space between an output portion (22) of the conveyor belt (12) and the compacting rollers (16), the web (10) follows an at least partially vertical path.

3. A method according to Claim 1, characterized in that, in the space between an output portion (22) of the conveyor belt (12) and the compacting rollers (16), the web (10) follows an at least partially oblique path.

4. A method according to any one of Claims 1 to 3, characterized in that, before it is supplied to the compacting rollers (16), the web of non-compacted fibres (10) is passed between a pair of conveyor

rollers (28) disposed above the compacting rollers (16).

5. Apparatus for producing mechanically compacted non-woven fabric, comprising a conveyor belt (12) for supplying a web of non-compacted fibres (10) to a calender (14) having at least one pair of contrarotating, heated compacting rollers (16), characterized in that the axes of rotation (18) of the compacting rollers (16) are contained in a plane which is arranged at an angle to the vertical, and in that an output portion (22) of the conveyor belt (12) is arranged farther from the ground than the compacting rollers (16).

6. Apparatus according to Claim 5, characterized in that the plane containing the axes of rotation (18) of the compacting rollers (16) is substantially horizontal.

7. Apparatus according to Claim 5 or Claim 6, characterized in that it comprises a pair of conveyor rollers (28) arranged between the output portion (22) of the conveyor belt (12) and the compacting rollers (16).

8. Apparatus according to Claim 7, characterized in that the vertical plane tangential to the conveyor rollers (28) substantially coincides with the vertical plane tangential to the compacting rollers (16).

9. Apparatus according to Claim 7, characterized in that the vertical plane tangential to the conveyor rollers (28) is spaced horizontally from the vertical plane tangential to the compacting rollers (16).

10. Apparatus according to Claim 5, characterized in that the output portion (22) of the conveyor belt (12) is disposed vertically above the region of contact between the compacting rollers (16).

11. Apparatus according to Claim 5, characterized in that the output portion (22) of the conveyor belt (12) is displaced horizontally from a vertical plane extending through the line of contact between the compacting rollers (16).

12. Apparatus according to Claim 7, characterized in that the output portion (22) of the conveyor belt (12) is disposed vertically above the region of contact between the conveyor rollers (28).

13. Apparatus according to Claim 7, characterized in that the output portion (22) of the conveyor belt (12) is spaced horizontally from a vertical plane extending through the line of contact between the conveyor rollers (28).

FIG. 1

PRIOR ART

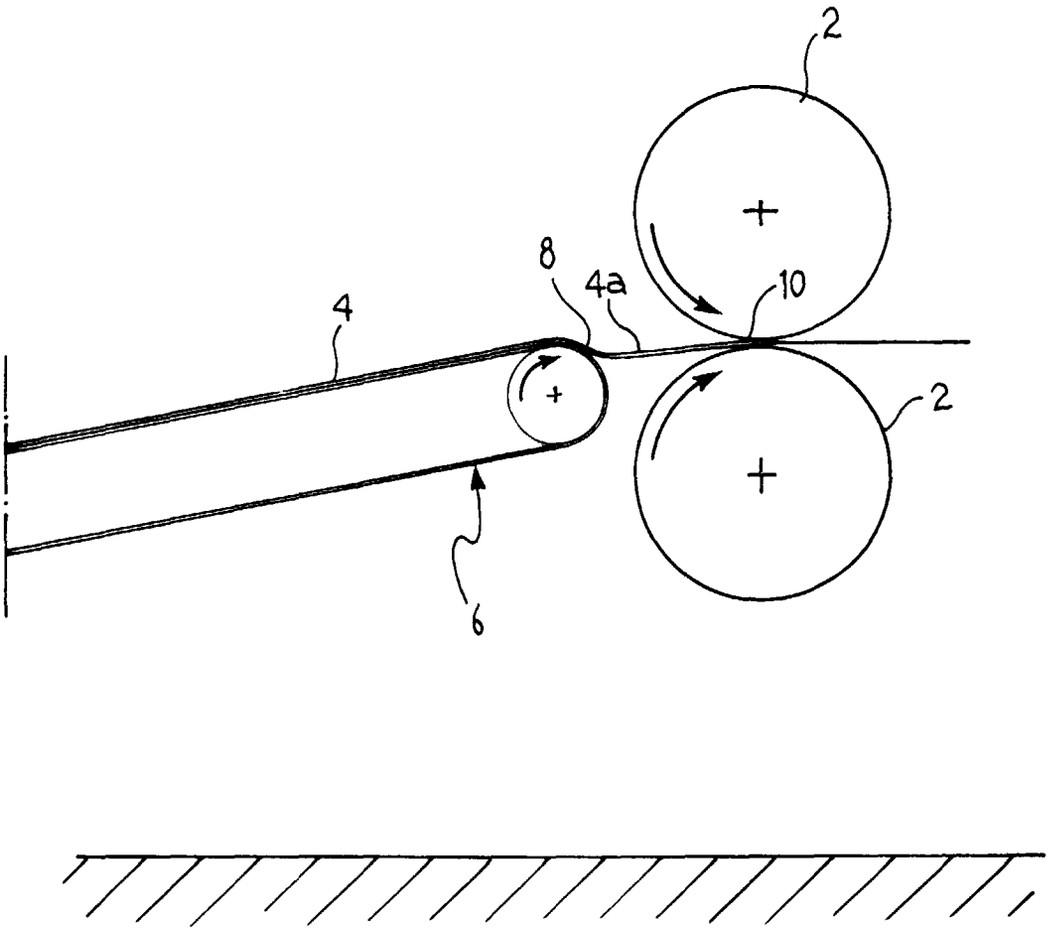


FIG. 2

PRIOR ART

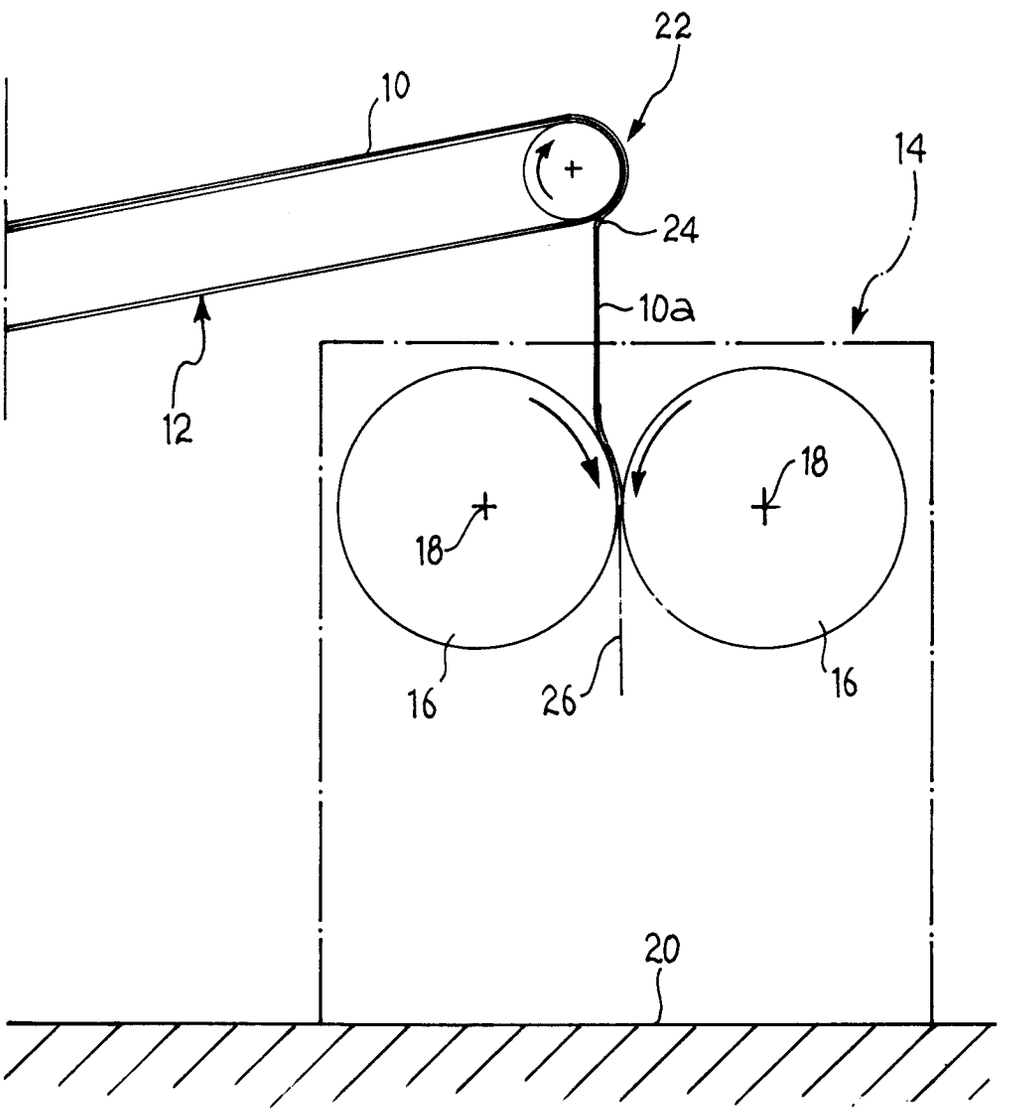


FIG. 2a

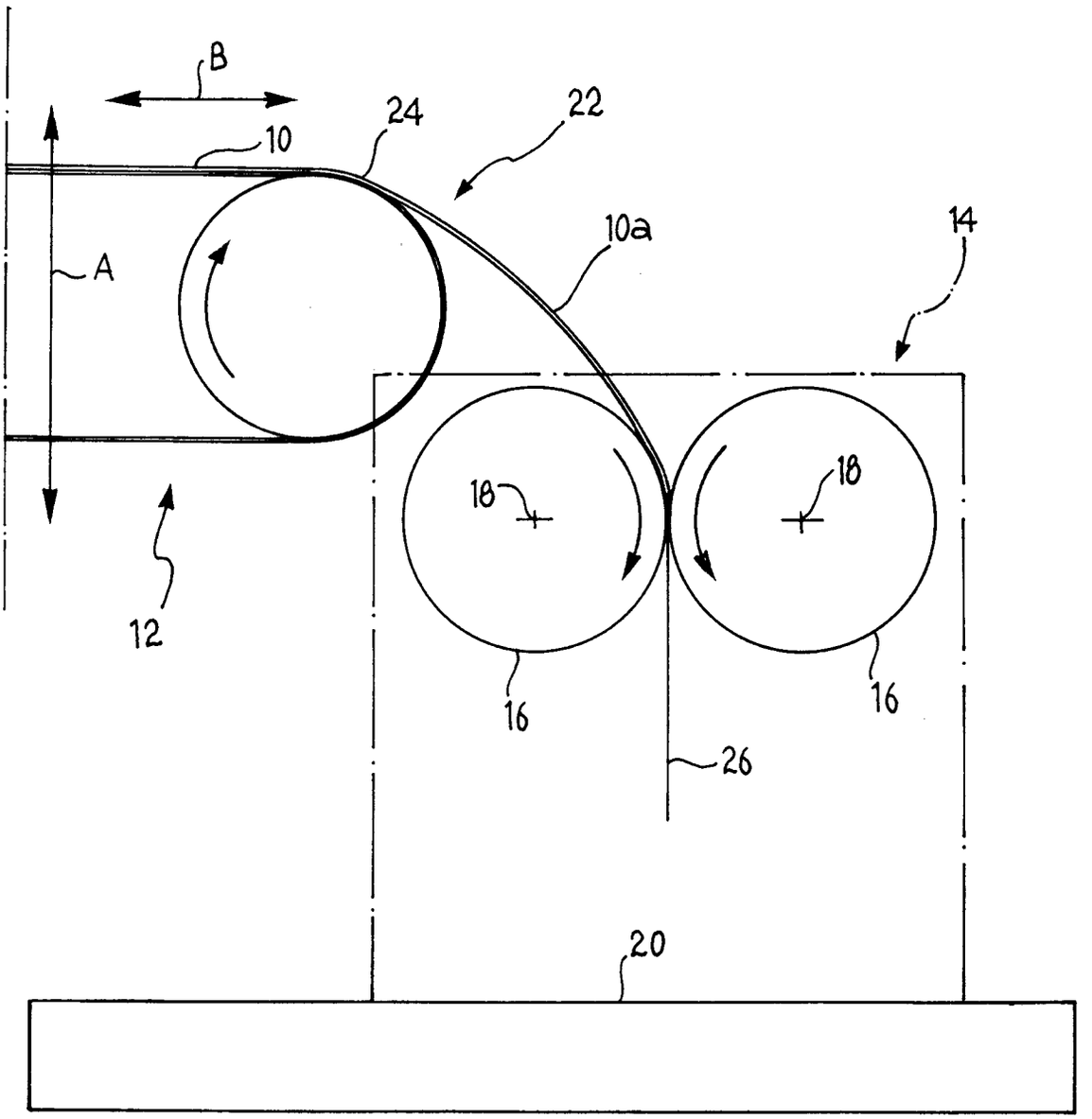


FIG. 3

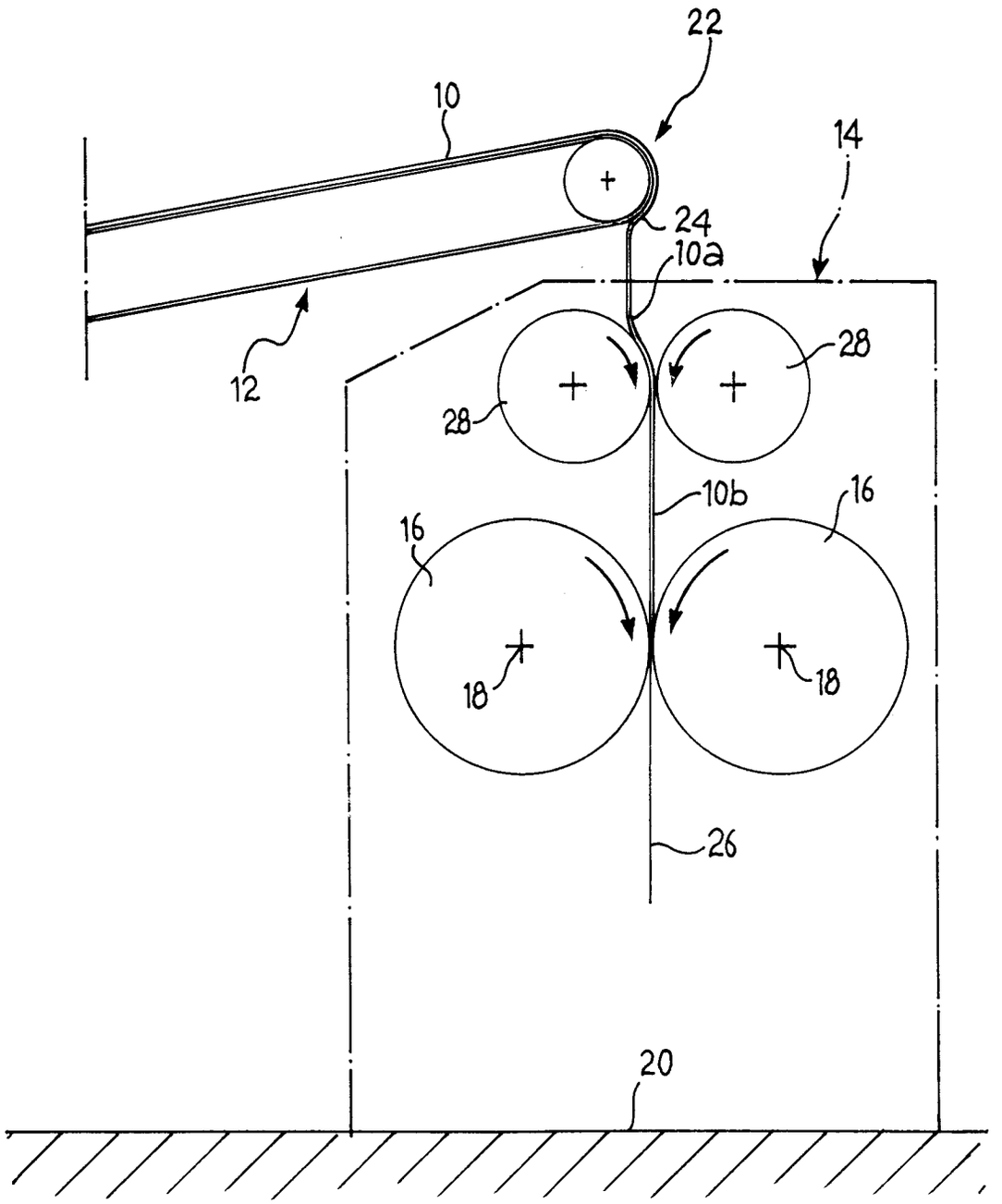


FIG. 3a

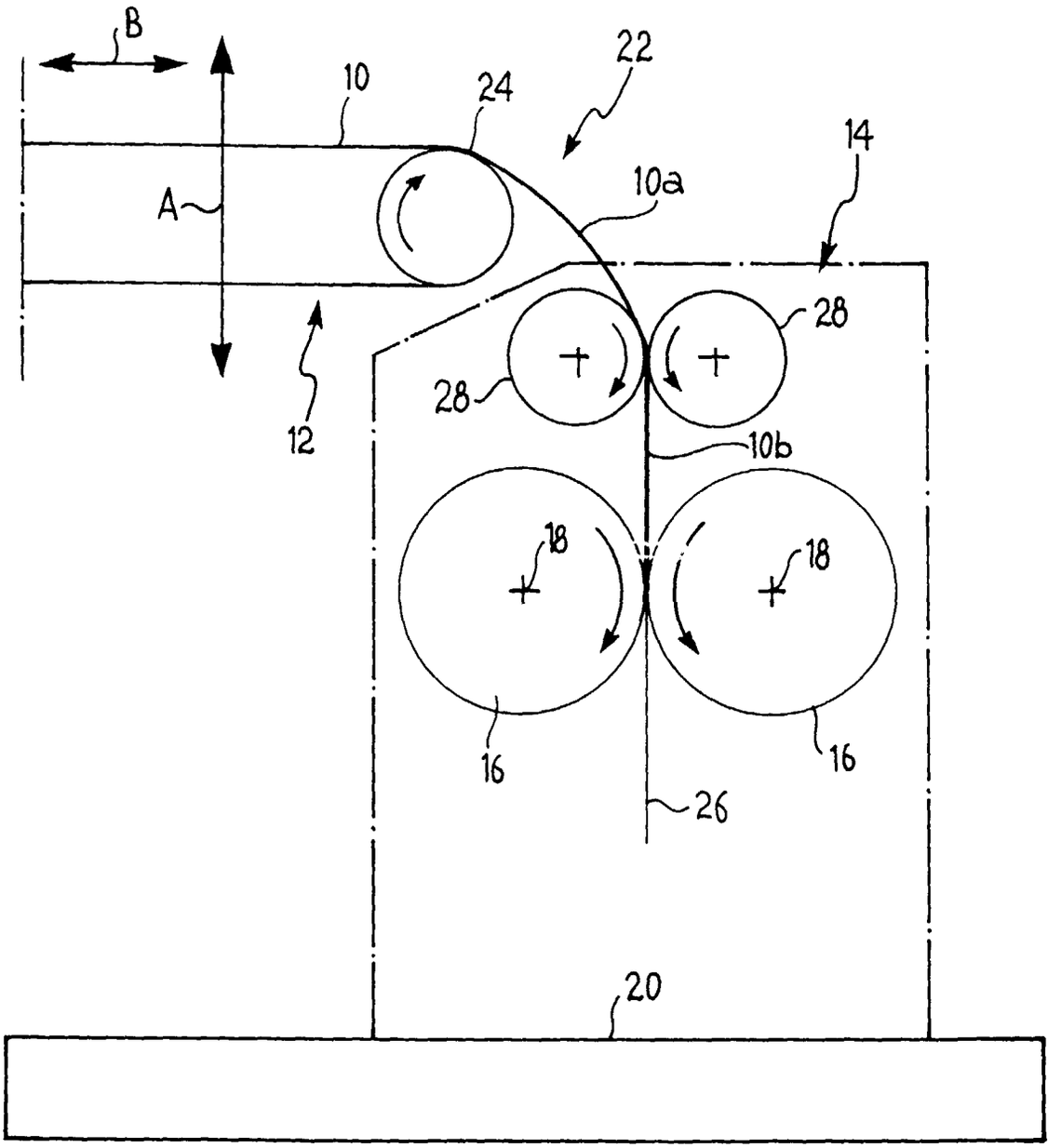
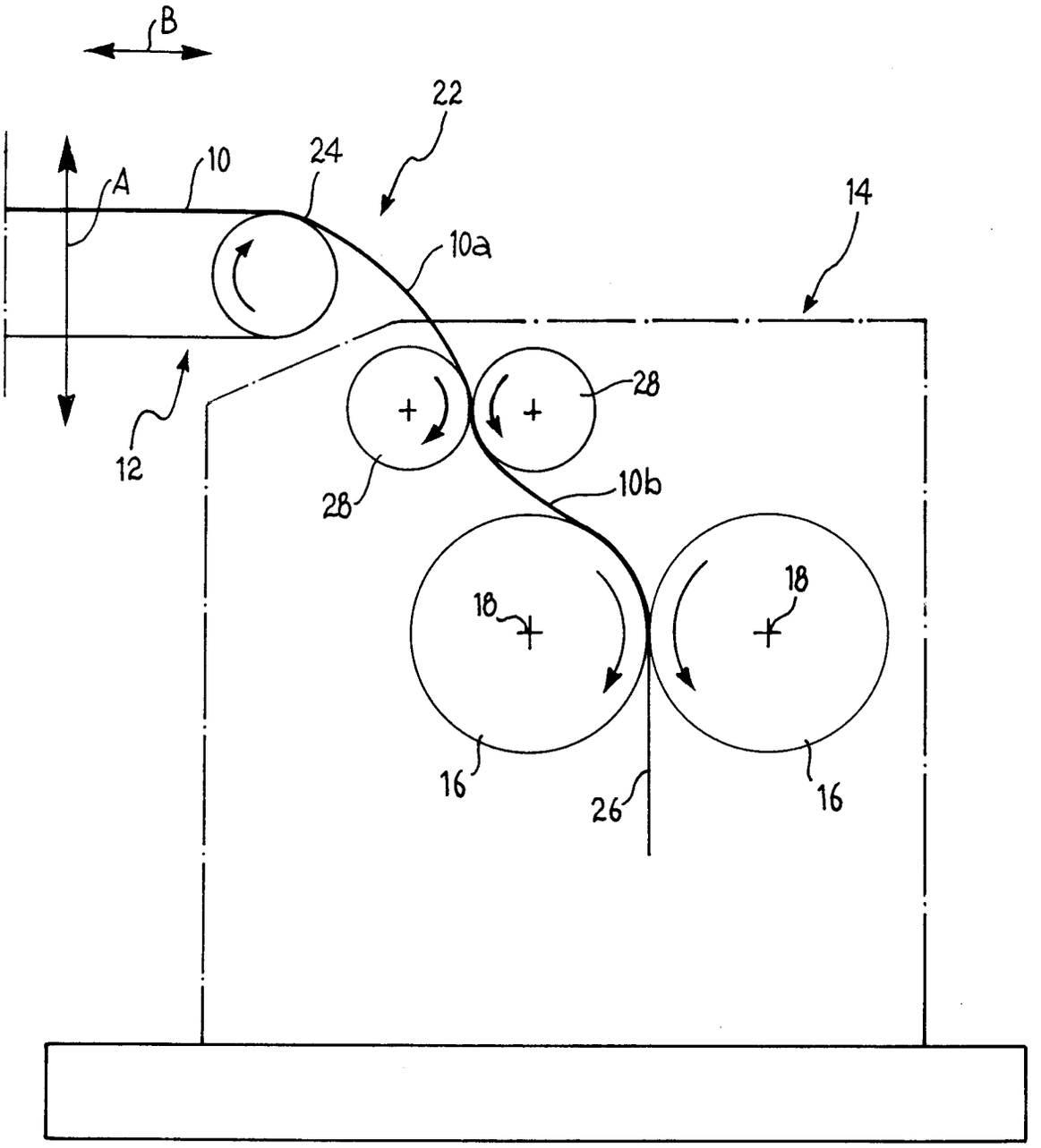


FIG. 3b



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EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0146

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.6)
Y	US 4 091 161 A (DESVERCHERE JEAN) 23 May 1978 * column 8, line 9 - line 14; figure 1 *	1-3,5,6, 10-13	D04H1/54 D06C15/02
Y	GB 2 241 968 A (HUNT AND MOSCROP LIMITED) 18 September 1991 * page 2, line 2 - line 6; figures *	1-3,5,6, 10-13	
A	US 4 096 016 A (POHL GERHARD) 20 June 1978 * figure 1 * * column 10, line 24 - line 34 *	1-13	
A	US 5 298 097 A (ZANFERRARI ROBERTO) 29 March 1994 * figure 1 *	1-13	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D04H
D06C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 September 1997	Barathe, R

CATEGORY OF CITED DOCUMENTS

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