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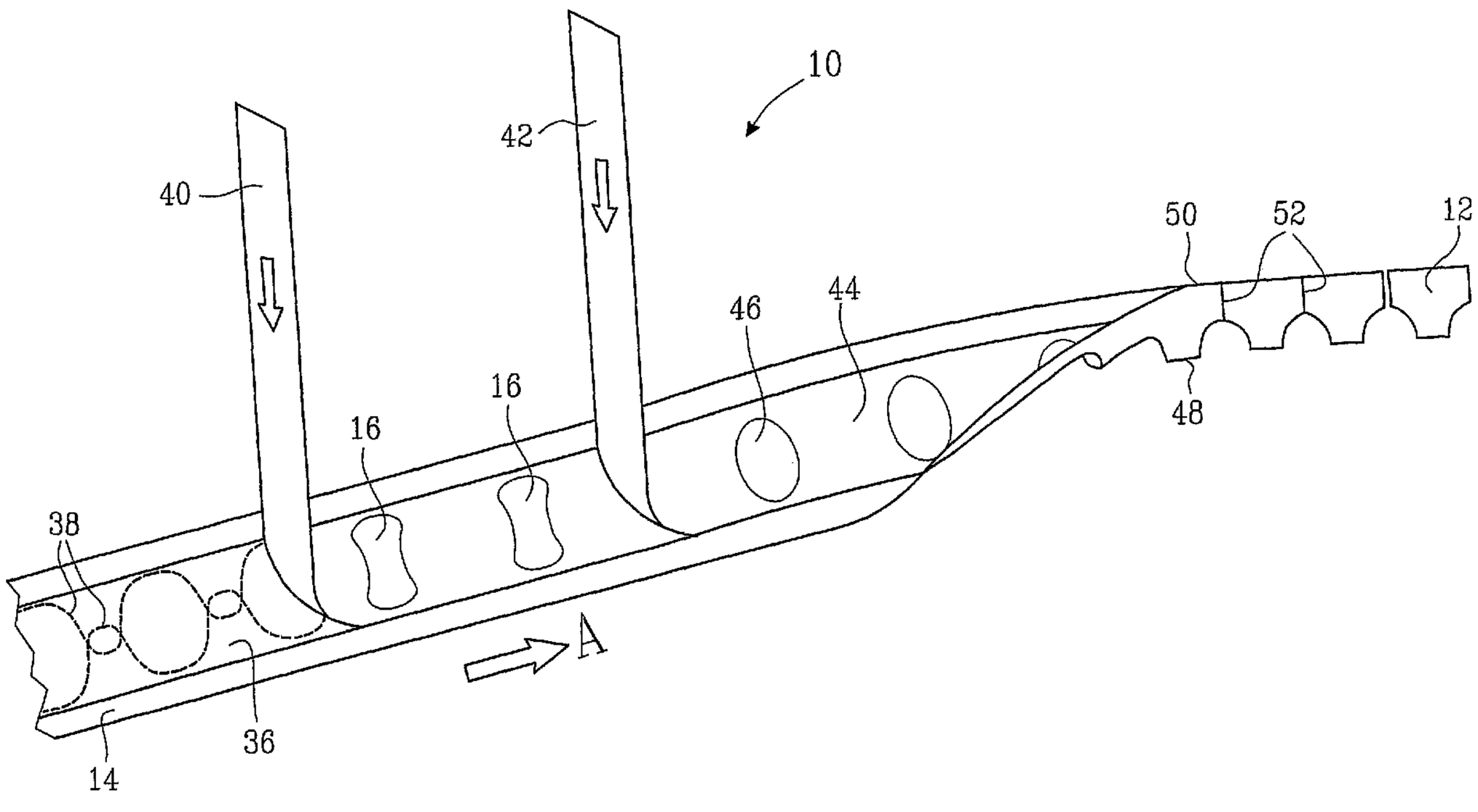
(54) Title: METHOD FOR PRODUCTION OF DISPOSABLE ABSORBENT ARTICLES



(57) Abrégé/Abstract:
A method for production of disposable hygienic absorbent articles (12) in which each article has a substantially homogenous elastic laminate web (14) having a maximum elastic extensibility in a first direction of at least 40 %, preferably at least 60 %, and most preferably at least 80 %, under a peak load F_p, and an absorbent core (16) attached to the elastic laminate web. The method comprising the steps of providing a continuous length of the elastic laminate web (14); advancing the continuous length of the elastic laminate web in a direction of travel (A) corresponding to the first direction; attaching individual absorbent cores (16) to the continuous length of the elastic laminate web at spaced intervals, and forming individual articles (12) from the thus assembled individual absorbent cores and the continuous length of said elastic laminate web. The continuous length of the elastic laminate web (14) is maintained under a tensioning load F_t in the direction of travel during the advancing, with the tensioning load F_t satisfying the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

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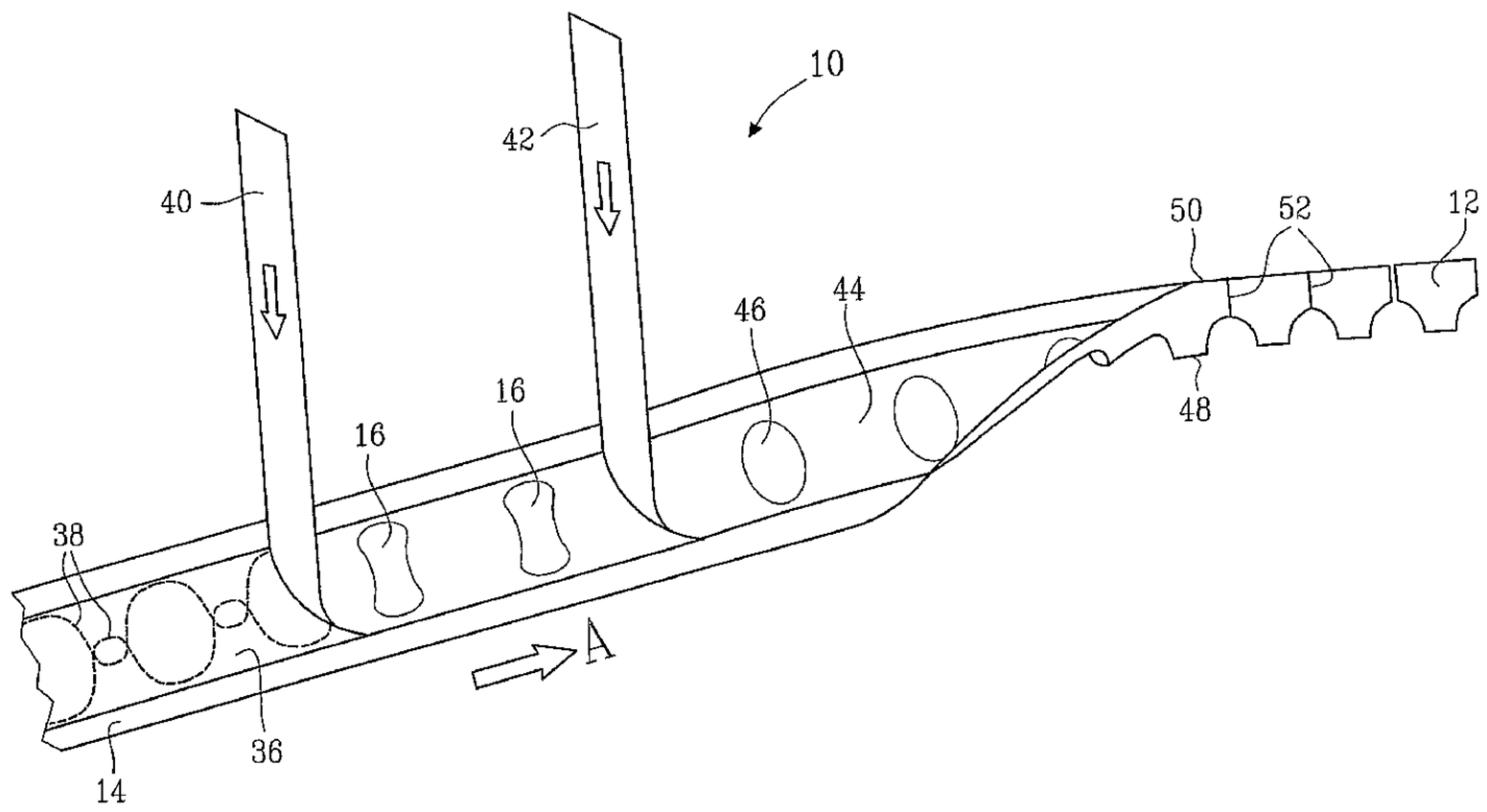
(54) **Title:** METHOD FOR PRODUCTION OF DISPOSABLE ABSORBENT ARTICLES



(57) **Abstract:** A method for production of disposable hygienic absorbent articles (12) in which each article has a substantially homogenous elastic laminate web (14) having a maximum elastic extensibility in a first direction of at least 40 %, preferably at least 60 %, and most preferably at least 80 %, under a peak load F_p, and an absorbent core (16) attached to the elastic laminate web. The method comprising the steps of providing a continuous length of the elastic laminate web (14); advancing the continuous length of the elastic laminate web in a direction of travel (A) corresponding to the first direction; attaching individual absorbent cores (16) to the continuous length of the elastic laminate web at spaced intervals, and forming individual articles (12) from the thus assembled individual absorbent cores and the continuous length of said elastic laminate web. The continuous length of the elastic laminate web (14) is maintained under a tensioning load F_t in the direction of travel during the advancing, with the tensioning load F_t satisfying the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

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Method for production of disposable absorbent articles

TECHNICAL FIELD

The present invention relates to a method for production of disposable hygienic absorbent articles such as pants-type absorbent articles.

BACKGROUND OF THE INVENTION

In order to improve comfort and fit, disposable hygienic articles, and particularly those which are intended to be worn around the waist of a user, are commonly provided with elastic components in selected regions of the article. In a pants-type absorbent article, i.e. an article which is pulled on in the same manner as a traditional pair of pants, the selected regions comprise the waist opening and the leg openings. Conventionally, the elastic components used in these regions are in the form of elastic threads or bands which are secured to a substrate, e.g. the outer cover of the article, in a stretched state under a tensioning force. When the tensioning force is released, the elastic components contract and thereby gather the substrate to which they are secured. In this manner, an otherwise substantially inelastic material web can be provided with elastic properties.

The above-described manner of providing elasticised regions on an absorbent article suffers from several drawbacks. For example, securing the elastic components to a running material web in a continuous process is relatively complicated. The elastic components are generally secured to the material web with adhesive, for example hot-melt adhesive or thermosetting adhesive. To ensure that the elastic components do not release from the material web during the production process, it is necessary to ensure that the elastic components bear against the material web until the adhesive has set, dried or hardened. Problems may also arise in synchronizing the tensioning of the different elastic components and in achieving uniform tensioning of the different elastic components independently of the speed of the running web material. Since the extent of elasticity of the thus elasticised material web is directly proportional to the degree to which the elastic components are tensioned, typically 100%, when attached to

the material web, during production the articles occupy an area which is substantially greater than that occupied by the finished articles in a relaxed state. This implies that the production facility takes up an undesirably large area. In addition, the production equipment has to be dimensioned to accommodate the tensioning force. A further difficulty is that of handling the finished articles once they have been severed from the running material web, since the articles assume an irregular three-dimensional shape as soon as the tensioning of the elastic components ceases. Folding and packaging of the finished articles have additionally proven to be very difficult steps because of their creased and three-dimensional shape.

Although such elasticised disposable absorbent articles may provide satisfactory comfort and fit, the thus gathered material web can impart a bulky, creased appearance to the article. This implies that it may be difficult to conceal the article under normal clothing. This is particularly problematic for adult users of disposable absorbent pants.

To overcome at least some of these drawbacks, rather than using an elasticised material in disposable absorbent articles, it has been proposed to make at least some regions of disposable absorbent articles of elastic material *per se*, for example an elastic nonwoven or elastic laminate. By using such material, there is no need to secure a tensioned elastic component to a gatherable substrate. As such, theoretically at least, it is possible to manufacture disposable absorbent articles in a process in which the constituent elastic components are substantially unstretched. Indeed, in WO-A-03/070140 it is proposed to stretch the elastic material web during production to a maximum of 5%.

The present inventors have found that, in order to ensure accurate control of the elastic material web during production, it is necessary to subject the web to a certain minimum tensioning load. On the other hand, to enjoy as many as possible of the advantages that, at least theoretically, are available using an elastic material web vis-à-vis an elasticised web, it is important that the tensioning load be significantly less than the load to attain maximum elastic extensibility of the elastic material web.

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SUMMARY OF THE INVENTION

Some embodiments of the invention may provide a method of production of disposable hygienic absorbent articles which permits rational production of the articles.

Some embodiments disclosed herein relate to the method in which a disposable hygienic absorbent article is produced in a process in which the elastic material web is a substantially homogenous elastic laminate web having a maximum elastic extensibility in a first direction of at least 40%, preferably at least 60%, and most preferably at least 80%, under a peak load F_p. The elastic laminate web is advanced in a direction of travel corresponding to the first direction while being maintained under a tensioning load F_t satisfying the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

Some embodiments disclosed herein relate to a method for production of disposable hygienic absorbent articles, each article comprising: a substantially homogenous elastic laminate web having a maximum elastic extensibility in a first direction of at least 40%, preferably at least 60%, and most preferably at least 80%, under a peak load F_p, and an absorbent core attached to said elastic laminate web, said method comprising the steps of: providing a continuous length of said elastic laminate web; advancing said continuous length of said elastic laminate web in a direction of travel corresponding to said first direction; attaching individual absorbent cores to said continuous length of said elastic laminate web at spaced intervals, and forming individual articles from the thus assembled individual absorbent cores and said continuous length of said elastic laminate web, whereby said continuous length of said elastic laminate web is maintained under a tensioning load F_t in said direction of travel during said advancing, said tensioning load F_t satisfying the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

For the purposes of this disclosure, an elastic laminate web is to be regarded as substantially homogenous if the properties of the web at any two sections of the web are essentially the same in the same direction.

Elastic extensibility here refers to the lengthening of the elastic laminate web in the direction of applied load which the web permits without plastically deforming or rupturing. For a material to be deemed to be elastically extensible it must also strive to recover its original length once the tensioning load is removed. For present purposes, a laminate web is deemed to be elastically extensible if it can be extended in at least one direction to at least 130% of its initial length, and will revert to at most 120%, preferably no more than 110%, of its original length upon removal of the tensioning load, while still meeting the requirement of maximum elastic extensibility outlined above.

Due to the non-linear load/elongation property of elastic laminate webs caused by the inter-engagement of fibres of the less elastic layer or layers of the laminate, the %-elongation per unit load decreases at higher values of elongation. By selecting the tensioning load F_t so as to satisfy the condition $0.03\ F_p \leq F_t \leq 0.25\ F_p$, adequate extension of the web is assured at the same time that the production equipment is not subjected to unnecessarily large forces.

Under certain circumstances, it may be preferable to increase the elongation of the laminate during production. As such, in a preferred embodiment, the tensioning load F_t may be selected so as to satisfy the condition $0.05\ F_p \leq F_t \leq 0.25\ F_p$. Similarly, where it is desirable to keep the load on the laminate as low as possible, F_t may be selected so as to satisfy the condition $0.03\ F_p \leq F_t \leq 0.20\ F_p$. In a further preferred embodiment, F_t may be selected so as to satisfy the condition $0.05\ F_p \leq F_t \leq 0.20\ F_p$.

Preferably, the elastic laminate web comprises at least one nonwoven layer affixed to a film layer. The film layer is preferably an apertured three-layer PE/styrene-based film/PE elastomeric film.

Further embodiments of the present invention are detailed in the remaining dependent claims.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in the following in greater detail by way of example only and with reference to the attached drawings, in which:

FIG. 1 is a schematic perspective view of a length of a production line for the production of a disposable hygienic absorbent article in accordance with the method according to the present invention;

FIG. 2 is a schematic graphic representation showing load vs. strain for an elastic laminate;

FIG. 3 is a graph showing load vs. strain for an elastic laminate comprising 25 gsm nonwoven material;

FIG. 4 is a graph showing load vs. strain for an elastic laminate comprising 20 gsm nonwoven material;

FIG. 5 is a graph showing load vs. strain for an elastic laminate comprising 18 gsm nonwoven material, and

FIG. 6 is a cross-sectional view through an elastic laminate web for use in the method according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In Fig. 1, reference numeral 10 generally denotes length of a production line for the production of a disposable hygienic absorbent article 12. In the present example, the absorbent article is a pull-up pants-type diaper.

The various components of the absorbent article are united on a (not shown) continuous conveyor belt running in a direction of travel denoted by arrow A. In the broadest form of the invention, a continuous length of a substantially homogenous elastic laminate web 14 is placed on the conveyor belt and maintained under a tensioning load F_t. The elastic laminate web has a maximum extensibility in a first direction corresponding to the direction of travel denoted by arrow A of at least 40%, preferably at least 60%, and most preferably at least 80%, under a peak load F_p. The continuous length of the elastic laminate web 14 is advanced in the direction of travel A to a station at which individual absorbent cores 16 are attached to the continuous length of the elastic laminate web 14 at spaced intervals. Individual articles 12, in this case pull-up pants-type diapers, are thereafter formed from the thus assembled individual absorbent cores 16 and the continuous length of the elastic laminate web.

In accordance with the present invention, the continuous length of the elastic laminate web 14 is maintained under a tensioning load F_t in the direction of travel during the advancing, with the tensioning load F_t satisfying the condition: $0.03 F_p \leq F_t \leq 0.25 F_p$.

In order to carry out the above described method, it is necessary to determine the peak load F_p, i.e. the load under which the elastic laminate web enjoys displays elastic extensibility. The peak load is determined using the ASTM D 882 tensile strength test method. The tensile strength and elongation of a well-defined test piece is tested by means of a tensile tester.

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Apparatus: Instron 4301

Tensile tester connected to a computer

Crosshead speed: 500mm/min

Clamp distance: 50mm

Sample preparation: Test samples are cut from the entire width of the material. The width of the sample shall be 25.4mm and the length at least 50mm longer than the clamp distance if possible. It is of importance that the edges of the sample are even and without break notches. The samples are conditioned for at least 4h in 50%RH ± 5% RH and 23°C ± 2°C before testing.

Procedure: The tensile tester is calibrated according to the apparatus instructions and set to zero. The sample is mounted and it is ensured that it is not obliquely or unevenly fastened. The material is prevented from slipping by using clamps covered with galloon or similar material. The tensile tester is started, and stopped after the material has broken (if not automatically controlled). Measurements resulting from premature failures (I.e. the sample breaks at the clamp, or is damaged during preparation) are ignored if possible.

The following results are expressed by the tensile tester/computer:

Maximum force, N/25.4mm

Elongation at maximum force, %

Break force, N/25.4mm

Elongation at break force, %

Knee point, N/%

Fig. 2 is a schematic representation of the behaviour of an elastic laminate web for use in the method according to the present invention under stretching at a constant strain. The laminate web comprises 25 gsm Sofspan™ NW from BBA on both sides of a 40 gsm apertured elastic film, where one face is glue-laminated with approximately 5 gsm glue.

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From zero strain, the elastic laminate web exhibits substantially elastic behaviour in region (A) up to around a "knee point" (B), after which, the load increases rapidly through region (C). The knee point (B) is defined as the first point on the load-strain curve at which the gradient becomes greater than 0.3N/%. The laminate web shown is elastic up to about 80% strain. The applied load eventually reaches a maximum (the "peak load") at point (D), at which the gradient of the load-strain curve is zero. The load then drops through region (E) as the material fails. Complete failure of the laminate web occurs at point (F).

The peak load F_p is the applied load at point D. In the method of the present invention, the elastic laminate web is maintained under a tensioning load F_t which satisfies the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

Figs. 3 to 5 show the actual behaviour of elastic laminate webs having a 40 gsm apertured elastic film, though glue-laminated with approximately 3 gsm glue to Sofspan™ NW of different basis weights. Thus, in Fig. 3 the basis weight of the nowwoven webs is 25 gsm, in Fig. 4 it is 20 gsm and in Fig. 5 it is 18 gsm. In all cases, the "knee point" (B) lies within the range $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

Under certain circumstances, it may be preferable to increase the elongation of the laminate during production. As such, in a preferred embodiment, the tensioning load F_t may be selected so as to satisfy the condition $0.05\ F_p \leq F_t \leq 0.25\ F_p$. Similarly, where it is desirable to keep the load on the laminate as low as possible, F_t may be selected so as to satisfy the condition $0.03\ F_p \leq F_t \leq 0.20\ F_p$. In a further preferred embodiment, F_t may be selected so as to satisfy the condition $0.05\ F_p \leq F_t \leq 0.20\ F_p$.

Fig. 6 is a cross-section through an elastic laminate web 14 for use in the method of the present invention. The elastic laminate web comprises a first nonwoven layer 26 affixed to a first surface 28 of a film layer 30. Advantageously, the elastic laminate web further comprises a second nonwoven layer 32 affixed to a second surface 34 of the film layer 30.

Preferably, the film layer comprises an elastic film having a basis weight from about 20 g/m^2 to about 100 g/m^2, preferably between 20 and 60 g/m^2. The film layer may be selected from the group consisting of low crystallinity polyethylenes, metallocene-catalyzed low crystallinity polyethylene, ethylene vinyl acetate copolymers (EVA), polyurethane, polyisoprene, butadiene-styrene copolymers, styrene block polymers such as styrene/isoprene/styrene (SIS), styrene/butadiene/styrene (SBS), styrene/ethylene-butadiene/styrene (SEBS) block copolymer and blends thereof.

To increase the breathability of the elastic laminate web, the film layer 30 may be provided with apertures 36. In a preferred embodiment, the film is an apertured three-layer PE/styrene-based film/PE elastomeric film.

Each of the first and second nonwoven layers may a basis weight of from about 10 g/m^2 to about 40 g/m^2, preferably from about 12 g/m^2 to about 30 g/m^2, most preferably from about 15 g/m^2 to about 25 g/m^2, and may comprise a a spunbond or carded material selected from the group consisting of: polypropylene, polyethylene, polyester and other polyolefin homopolymers and copolymers.

In order to provide the individual articles 12 with desirable properties, the basic production method outlined above may be complemented by one or more of the following steps.

In the production of a pants-type diaper, adhesive 36 may be applied, for example by spraying or coating, to the elastic laminate web 14, after which elastic members 38 in the form of continuous elastic bands or threads are secured in a curved pattern across the laminate web. These elastic members 38 will form elasticised leg openings in the completed article 12. Alternatively, the adhesive may be applied directly to the elastic members themselves.

A second material web 40 of liquid barrier material, such as an elastic plastic film, may thereafter be applied over the elastic laminate web 14 and the elastic members 38. The second material web may be provided with adhesive on its surface facing the first web 14 to ensure its adequate adhesion thereto.

In the illustrated embodiment a third material web 42 is placed over the elastic laminate web 14 and the second material web 40 and secured over the absorbent cores 16. The third elastic material web will constitute the topsheet of the completed absorbent article. As such, it can consist of a nonwoven material, e g spunbond, meltblown, carded, hydroentangled, wetlaid etc. Suitable nonwoven materials can be composed of natural fibers, such as woodpulp or cotton fibres, manmade fibres, such as polyester, polyethylene, polypropylene, viscose etc. or from a mixture of natural and manmade fibres. The topsheet material may further be composed of tow fibres, which may be bonded to each other in a bonding pattern, as e.g. disclosed in EP-A-1 035 818. Further examples of topsheet materials are porous foams, apertured plastic films etc. The materials suited as topsheet materials should be soft and non-irritating to the skin and intended to be readily penetrated by body fluid, *e.g.* urine or menstrual fluid. Advantageously, the third material web will have elastic properties. Before the third material web is applied to the second material web, the third elastic web may be coated with an adhesive on its surface directed towards the second material web.

In an alternative production method, the second material web 40 of liquid barrier material may be omitted. Instead, nonwoven material may be placed over the elastic members 38. Liquid barrier material may then be incorporated in an absorbent packet comprising a plastic film, an absorbent core and a nowoven surface layer. Although in Fig. 1 the elastic members 38 as laid out on the elastic laminate web comprise crotch elastic, it is to be understood that the crotch elastic may be incorporated in the thus-described absorbent packet instead.

Each of the above-described assembly of components constitutes a production web 44. Leg openings 46 are cut out from the production web and the production web is then folded double in the production direction so that a fold edge 48 and an open edge 50 are formed. The folded production web 44 is then welded intermittently transverse to the production direction along weld lines 52 extending from the open edge 50 to the edge at each leg opening 46. The welded production web 44 is then divided by being severed along each weld line 52 so that individual pants-type diapers 12 are separated from the production web 44. The individual diapers can then be subjected to further processing steps such as folding and packing.

The elastic laminate web 14 of the thus-produced pants-type diapers 12 constitutes the outer cover of the diapers. In a similar manner, the elastic laminate web may also constitute the outer cover of many types of disposable hygienic absorbent articles, such as conventional diapers, incontinence garments, sanitary napkins and panty liners. It is to be understood that the elastic laminate web 14 need not cover the entire outer surface of such articles. Instead, in certain circumstances it may be desirable to have a non-elastic region of the outer cover. Thus, for example, the crotch region of a diaper may have an outer cover region which is constituted by a strip of non-elastic nonwoven material bounded on either side by an elastic laminate web. In this manner, front and rear panels of the diaper will enjoy elastic properties.

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CLAIMS:

1. A method for production of disposable hygienic absorbent articles, each article comprising:

a substantially homogenous elastic laminate web having a maximum elastic extensibility in a first direction of at least 40%, preferably at least 60%, and most preferably at least 80%, under a peak load F_p, and

an absorbent core attached to said elastic laminate web,

said method comprising the steps of:

providing a continuous length of said elastic laminate web;

advancing said continuous length of said elastic laminate web in a direction of travel corresponding to said first direction;

attaching individual absorbent cores to said continuous length of said elastic laminate web at spaced intervals, and

forming individual articles from the thus assembled individual absorbent cores and said continuous length of said elastic laminate web,

whereby said continuous length of said elastic laminate web is maintained under a tensioning load F_t in said direction of travel during said advancing, said tensioning load F_t satisfying the condition: $0.03\ F_p \leq F_t \leq 0.25\ F_p$.

2. The method as claimed in claim 1, whereby said tensioning load F_t satisfies the condition: $0.05\ F_p \leq F_t \leq 0.25\ F_p$.

3. The method as claimed in claim 1, whereby said tensioning load F_t satisfies the condition: $0.03\ F_p \leq F_t \leq 0.20\ F_p$.

4. The method as claimed in claim 1, whereby said tensioning load F_t satisfies the condition: $0.05\ F_p \leq F_t \leq 0.20\ F_p$.

5. The method as claimed in any one of claims 1 to 4, whereby said elastic laminate web comprises a first nonwoven layer affixed to a first surface of a film layer.

6. The method as claimed in claim 5, whereby said elastic laminate web further comprises a second nonwoven layer affixed to a second surface of said film layer.

7. The method as claimed in claim 5 or claim 6, whereby said film layer comprises an elastic film having a basis weight from about 20 g/m^2 to about 100 g/m^2, preferably between 20 and 60 g/m^2.

8. The method as claimed in claim 7, whereby said film layer is selected from the group consisting of low crystallinity polyethylenes, metallocene-catalyzed low crystallinity polyethylene, ethylene vinyl acetate copolymers (EVA), polyurethane, polyisoprene, butadiene-styrene copolymers, styrene block polymers such as styrene-isoprene-styrene (SIS), styrene-butadiene-styrene (SBS), styrene-(ethylene-butadiene)-styrene (SEBS) block copolymer and blends thereof.

9. The method as claimed in claim 8, whereby said film layer is an apertured three-layer PE-(styrene-based film)-(PE elastomeric film).

10. The method as claimed in any one of claims 5 to 9, whereby one of said first and said second nonwoven layer has a basis weight of from about 10 g/m^2 to about 40 g/m^2.

11. The method as claimed in any one of claims 5 to 9, whereby one of said first and said second nonwoven layer has a basis weight of from about 12 g/m^2 to about 30 g/m^2.

12. The method as claimed in any one of claims 5 to 9, whereby one of said first and said second nonwoven layer has a basis weight of from about 15 g/m^2 to about 25 g/m^2.

13. The method as claimed in any one of claims 5 to 9, whereby said first and said second nonwoven layer has a basis weight of from about 10 g/m^2 to about 40 g/m^2.

14. The method as claimed in any one of claims 5 to 9, whereby said first and said second nonwoven layer has a basis weight of from about 12 g/m^2 to about 30 g/m^2.

15. The method as claimed in any one of claims 5 to 9, whereby said first and said second nonwoven layer has a basis weight of from about 15 g/m^2 to about 25 g/m^2.

16. The method as claimed in claim 10, whereby one of said first and said second nonwoven layer comprises a spunbond or carded material selected from the group consisting of: polypropylene, polyethylene, polyester and other polyolefin homopolymers and copolymers.

17. The method as claimed in claim 10, whereby said first and said second nonwoven layer comprises a spunbond or carded material selected from the group consisting of: polypropylene, polyethylene, polyester and other polyolefin homopolymers and copolymers.

18. The method as claimed in any one of claims 1 to 17, whereby said elastic material web constitutes an outer cover of said disposable hygienic absorbent articles, said articles being selected from the group consisting of diapers, pants-type absorbent articles, incontinence garments, sanitary napkins and panty liners.

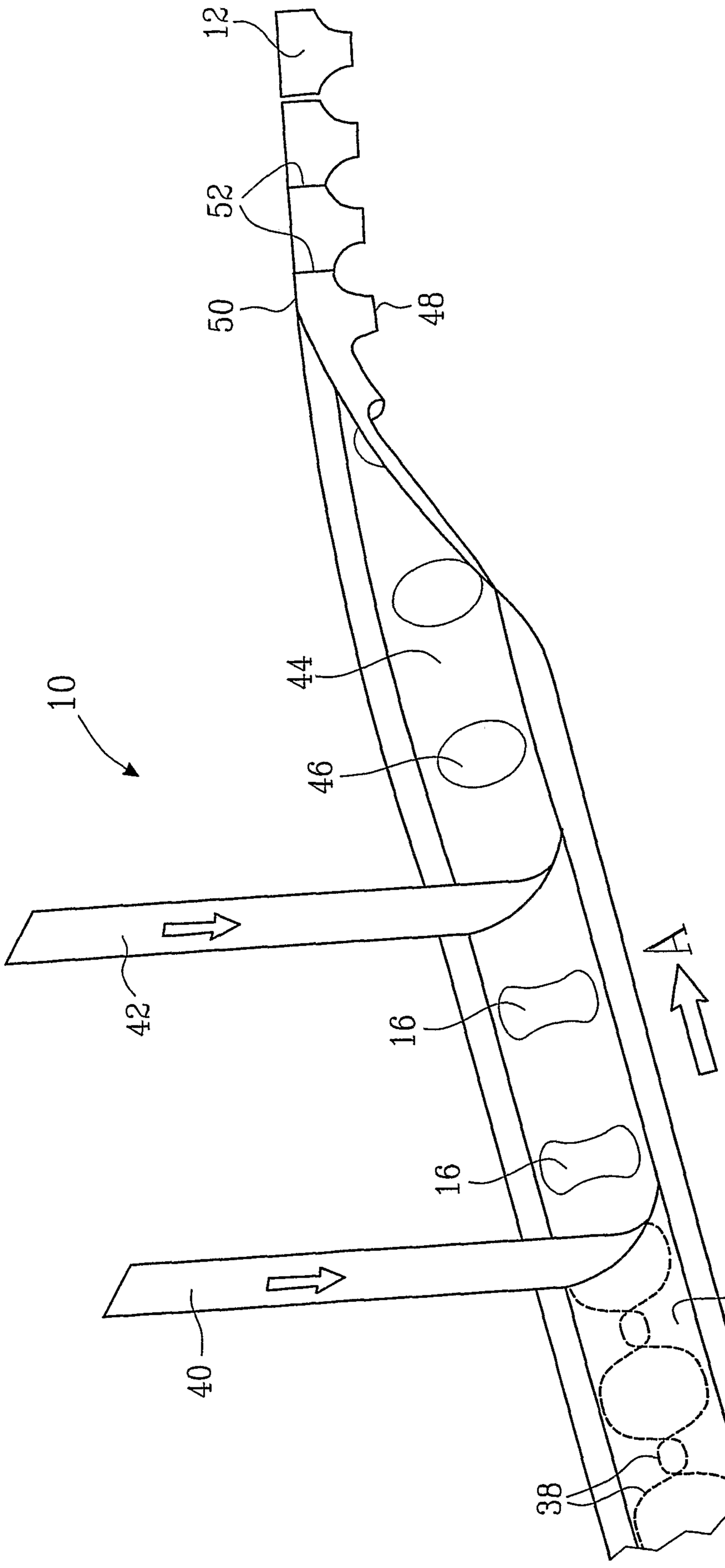


Fig. 1

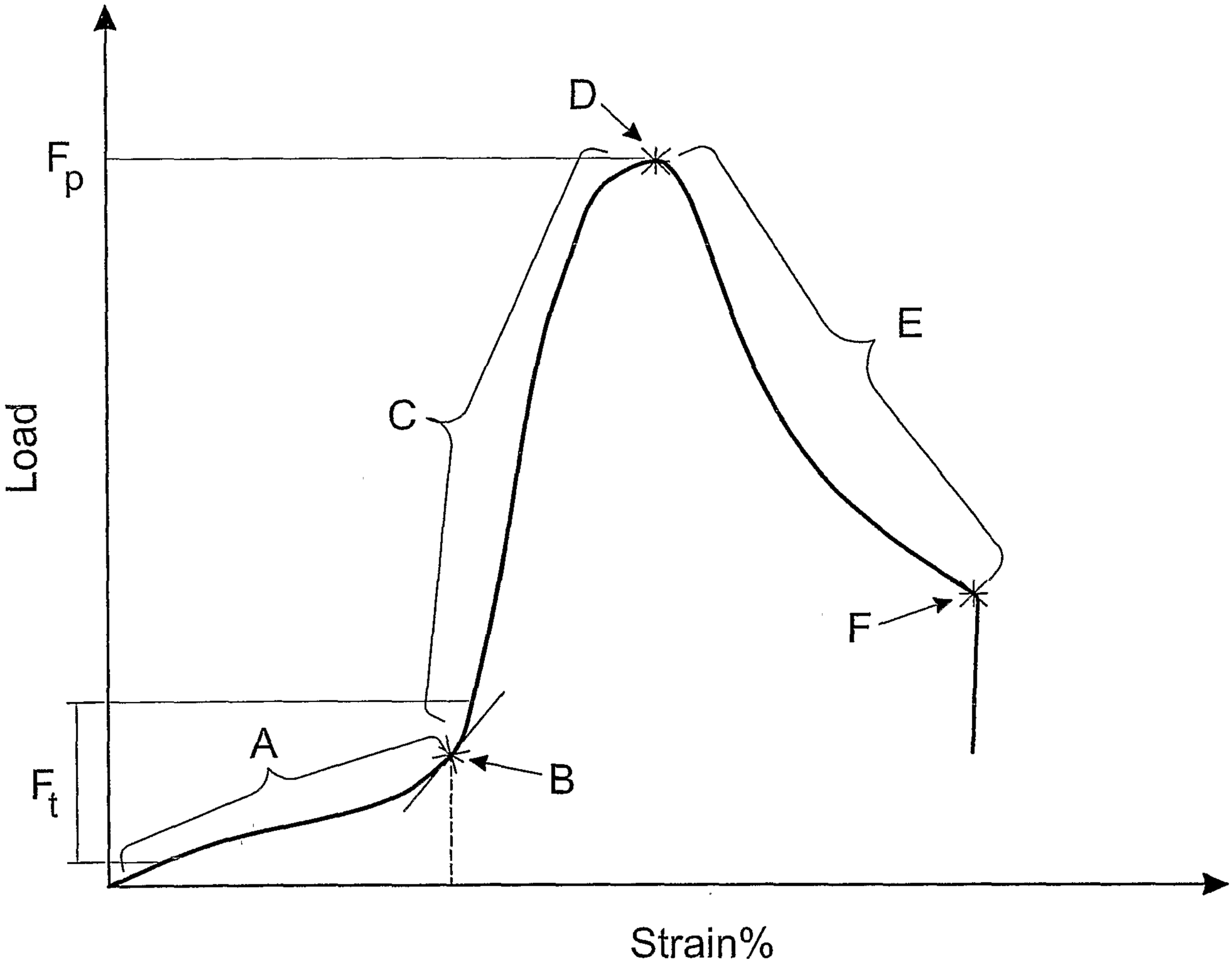
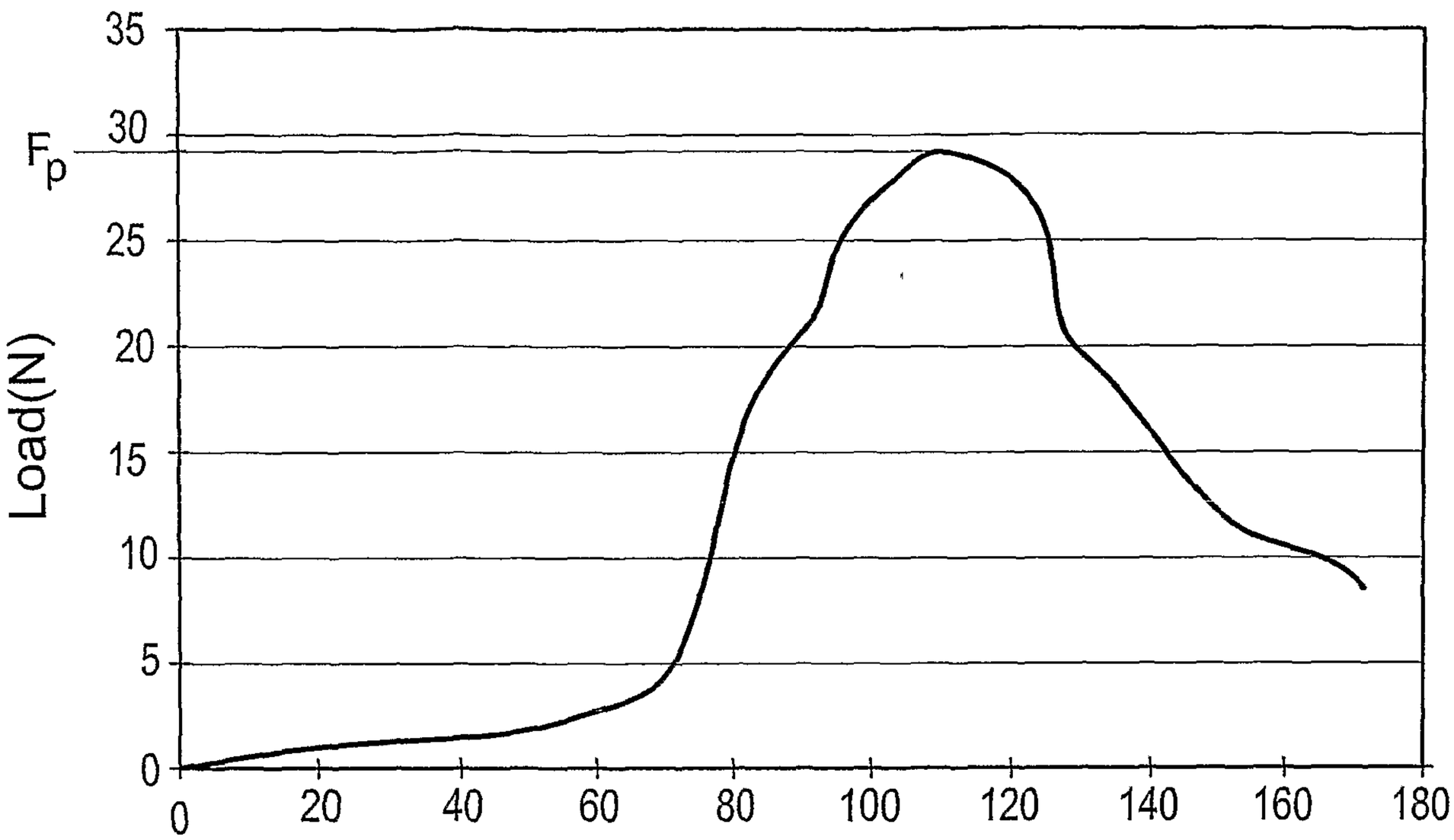


Fig.2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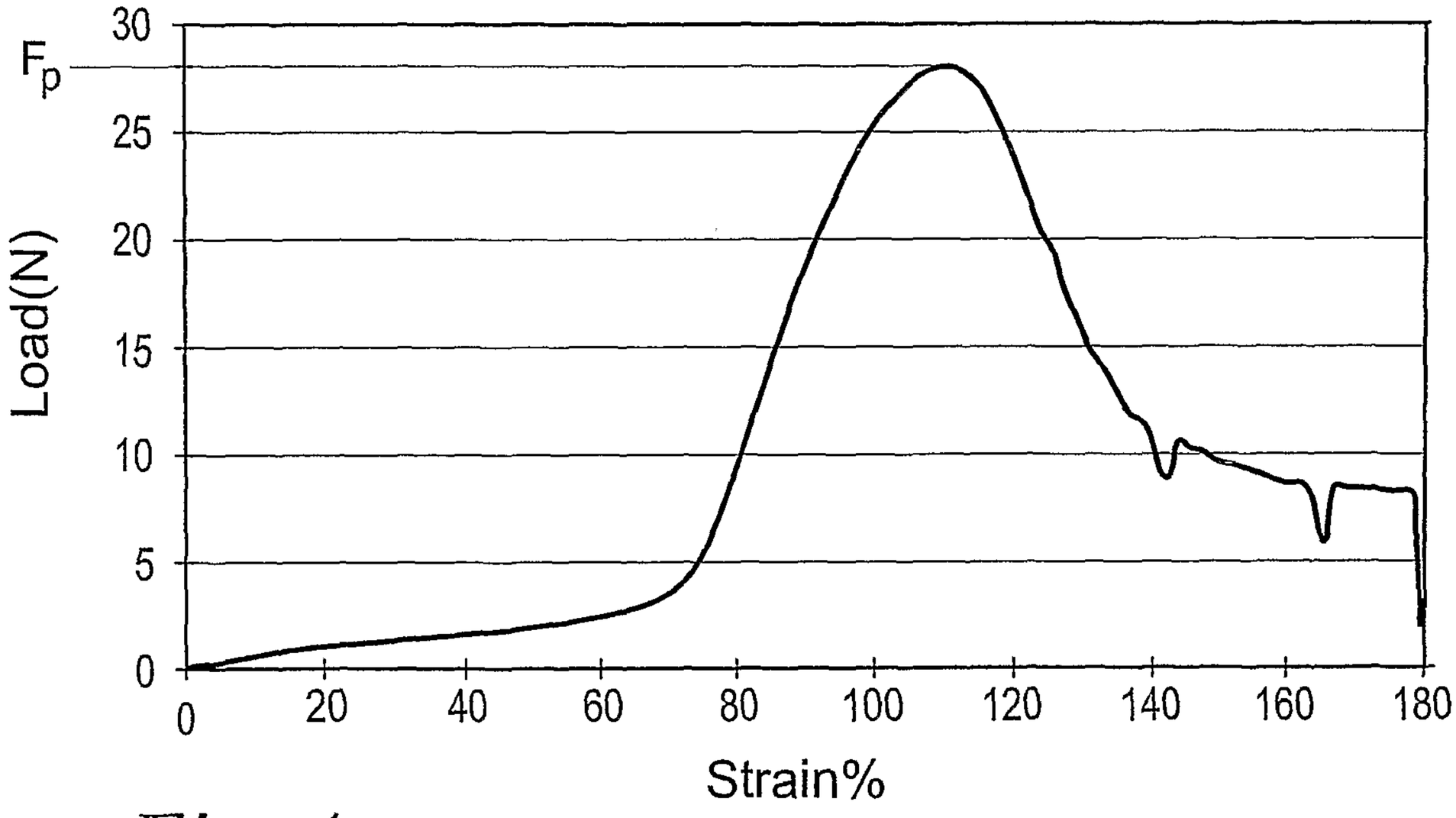
20
15
10
5
0
F_p
Load(N)
0
20
40
60
80
100
120
140
160
180
Strain%

Fig.3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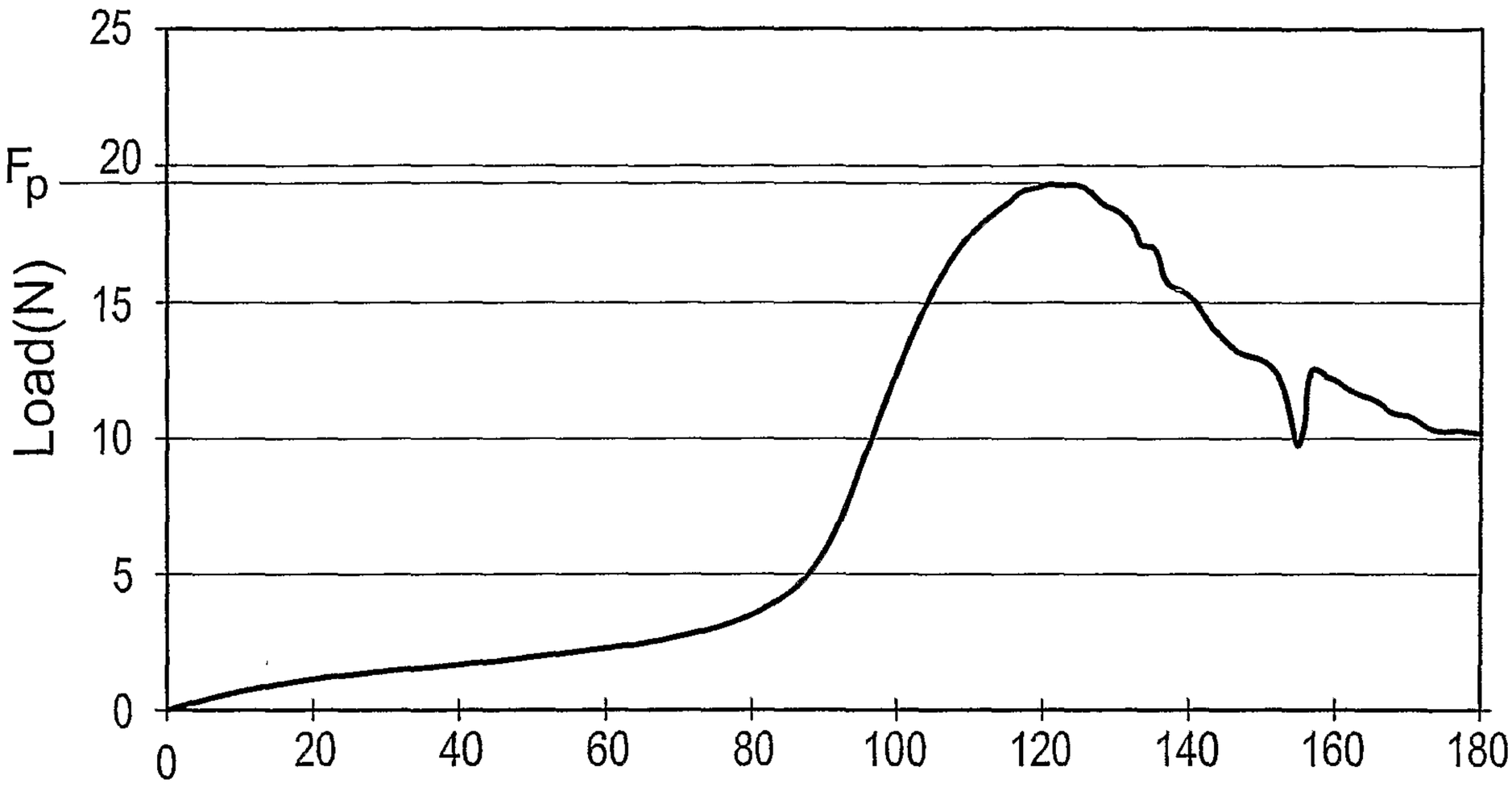
160
180
Strain%

Fig.4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Strain%

Fig.5

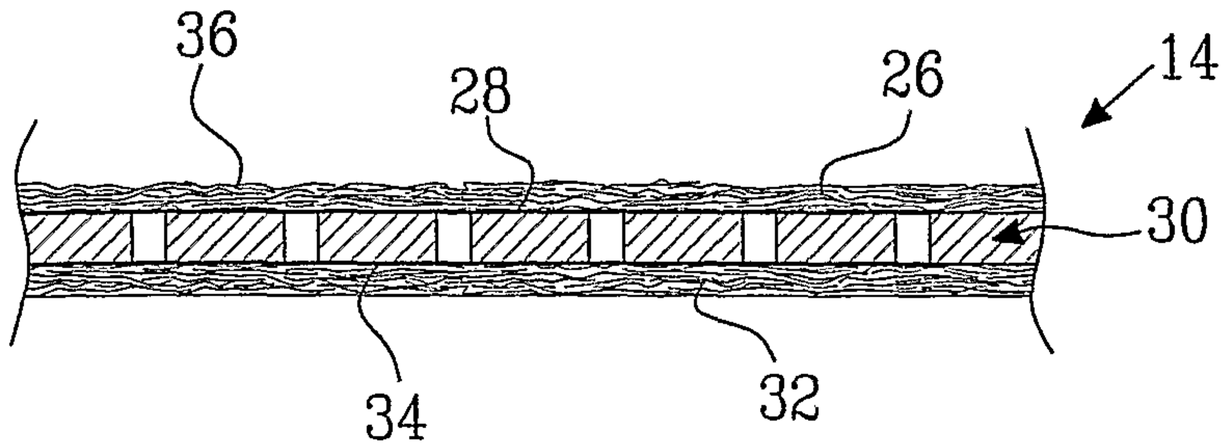
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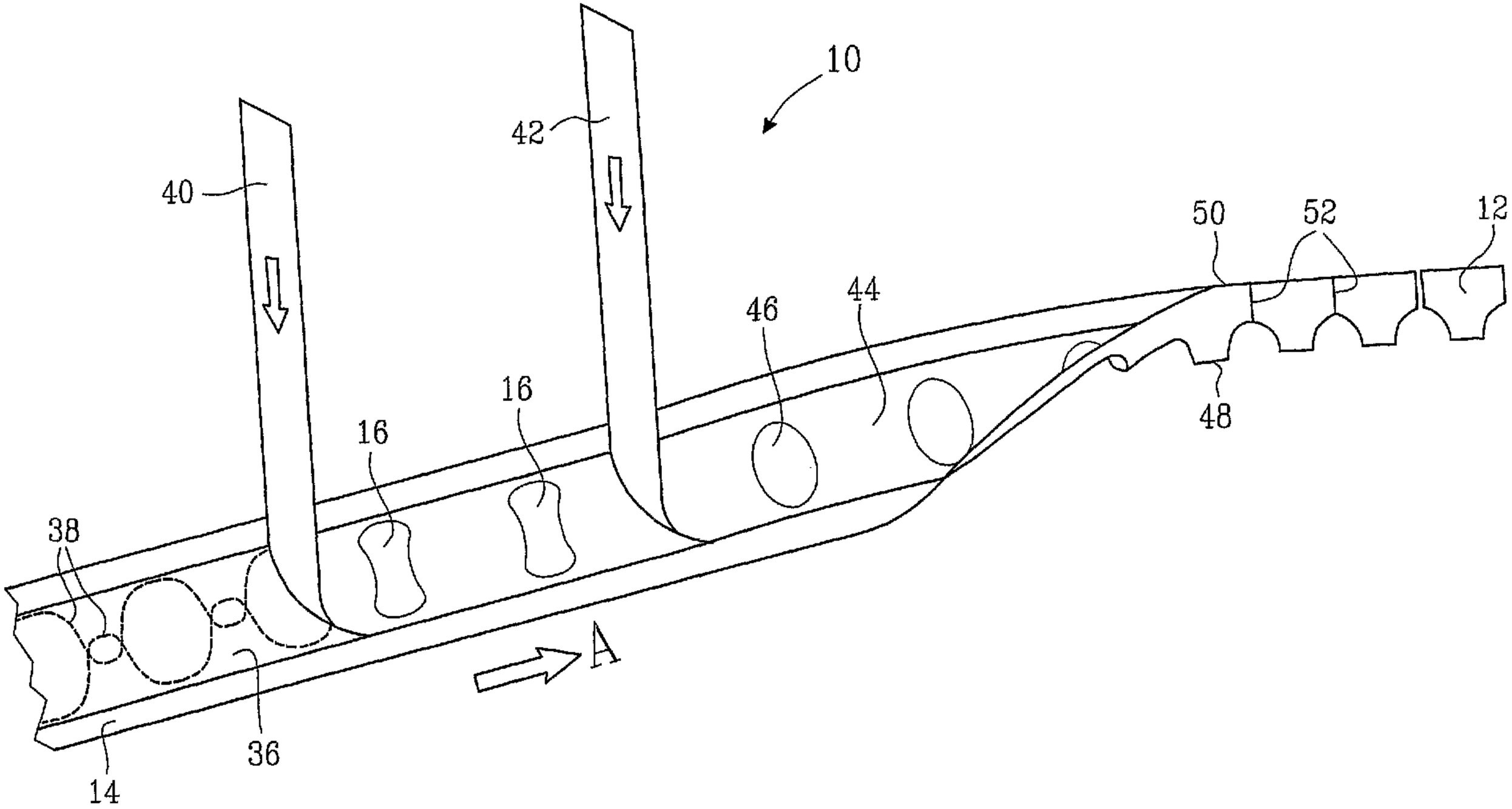
Fig.6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