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(54) Titre : NON TISSES A FORT POUVOIR ABSORBANT DE LIQUIDE ET A STRUCTURE ORDINAIRE, ET METHODE DE FABRICATION ET D'UTILISATION

(54) Title: NON-WOVENS WITH HIGH LIQUID ABSORBENCY AND REGULAR STRUCTURE, METHOD FOR THEIR MANUFACTURE AND USE

(57) Abrégé/Abstract:
A three dimensionally structured laminate with high liquid absorbency of at least 5 g of liquid per g of laminate is disclosed which includes elevations and depressions which regularly occur and alternate relative to the plane of the laminate. The laminate includes at least one nonwoven layer and a shrunken web connected therewith. The connection between the nonwoven and the shrunken web is thereby achieved by hot melt bonding and the hot melt bonding is in the form of regularly positioned lines extending at least perpendicular to the direction of the strongest shrinkage of the shrunken web. Furthermore, spaces are formed between the nonwoven layer and the shrunken web at the alternatingly occurring elevations and depressions, which spaces promote the liquid absorption of the laminate. The laminates in accordance with the invention can be used especially as wiper cloth, wet wipe cloth or as a liquid dispenser for the cleaning or for application of liquids.

ABSTRACT

A three dimensionally structured laminate with high liquid absorbency of at least 5 g of liquid per g of laminate is disclosed which includes elevations and depressions which regularly occur and alternate relative to the plane of the laminate. The laminate includes at least one nonwoven layer and a shrunken web connected therewith. The connection between the nonwoven and the shrunken web is thereby achieved by hot melt bonding and the hot melt bonding is in the form of regularly positioned lines extending at least perpendicular to the direction of the strongest shrinkage of the shrunken web. Furthermore, spaces are formed between the nonwoven layer and the shrunken web at the alternatingly occurring elevations and depressions, which spaces promote the liquid absorption of the laminate. The laminates in accordance with the invention can be used especially as wiper cloth, wet wipe cloth or as a liquid dispenser for the cleaning or for application of liquids.

NON-WOVENS WITH HIGH LIQUID ABSORBENCY AND REGULAR STRUCTURE, METHOD FOR THEIR MANUFACTURE AND USE

FIELD OF THE INVENTION

The present invention relates to highly absorbent nonwovens for use as wiper cloths and the like, methods of manufacture, and uses therefor.

BACKGROUND ART

Commercially available wiper cloths exist in different variants. Common types are papers or nonwovens which are often used as wet cloths or are intended to absorb liquids. Such wiper cloths are used as wet wipes or as liquid absorbing wipes, for example, in baby care, in the field of cosmetics, for example, for acne treatment, for the removal of dirt in the household, in the bathroom or for building cleaning, for the application of treatment or cosmetic substances onto the skin or the removal therefrom, for the application or removal of medical substances, or for intimate care. Their structures for this intended use normally have a high water or liquid absorbency. Apart from water, those structures often include various lotions on the basis of oils, or oil/water mixtures and/or chemical substances which promote cleaning, separate from the fibre surface. Since those products are often manually used, the products are offered in voluminous, bulky or folded from or are bulked up during their use so that they can be simpler and more comfortably handled during use.

Three-dimensional structures for use as wiper cloths are known from WO-A-00/108,998 and WO-A-99/107,273. Composites of at least one or two nonwovens and extruded, biaxially stretched nettings, for example, of polypropylene, are known, which after the lamination, for example, by partial bonding by way of pressure and heat, develop three-dimensionally elevated structures by shrinking and are therefor more voluminous. These elevations are, because of the shrinking in both directions, which means in longitudinal and transverse direction of the monofilaments of the stretched PP-netting, relatively uneven and optically not particularly pleasing. The connection between the non-woven layers occurs across the netting by point form or patterned hot melt bonding in a calendar under pressure and heat.

A nonwoven is known from the EP-A-814,189 which consists of at least one uni-directionally stretched spunbond and a staple fibre nonwoven mechanically connected therewith. The laminate is distinguished by high volume and good grip.

Three-dimensionally structured fibrous web structures are themselves known. Three-dimensionally structured combinations of endless and staple fibre layers thermally hot melt bonded with one another in the form of a regular pattern are known from DE-A-199 00 424. The development of the three-dimensional structure is achieved by the use of fibre layers with differential shrinkability. By initiation of the shrinking, the staple fibre layer is imparted with a three-dimensional structure. However, it has been shown that the thereby generated three-dimensional structure is irregular, since the sequence of elevations and depressions extends in a rather random pattern.

Examples for such laminates are fibrous webs of at least one or two nonwovens and extruded, biaxially stretched nettings, for example of polypropylene (in the following referred to as "PP"). After the lamination, elevated three-dimensional structures are developed by shrinking. Because of the shrinking in both directions, among other reasons, which means in the longitudinal and transverse direction of the monofilaments of the stretched PP netting, these elevations are relatively uneven and optically not particularly pleasing. The connection of the two nonwoven layers is normally achieved across the netting by point form or patterned hot melt bonding in a calendar under pressure and at elevated temperatures.

SUMMARY OF THE INVENTION

Starting from this prior art, it is an object of the invention to provide three-dimensionally structured fibrous web structures which have a significantly increased liquid absorbency and are at the same time distinguished by a regular three-dimensional pattern. Thus, strongly liquid absorbing fibrous webs with even structuration and high volume or bulking are to be produced, which means by certain measures in accordance with the invention, a high water absorbency and at the same time the structure of the three-dimensional elevations, or depressions is to be predetermined and the randomness and the structural irregularities connected therewith are thereby to be prevented.

This object is achieved in accordance with the present invention by a three-dimensionally structured voluminous and bulked fibrous web with a liquid absorbency of at least 5 g of liquid per g of fibrous web, a thickness of at least 0.8mm, preferably at least 1mm, most preferably 1-5mm, and regular, with respect to the web plane alternatingly occuring protrusions and depressions. The fibrous web includes at least one nonwoven layer and a shrunken web connected therewith, whereby the connection between the nonwoven layer and the shrunken web is achieved by hot melt bonding in the form of regularly positioned lines extending at least perpendicular to the direction of the strongest shrinkage of the shrunken web, preferably in the form of regularly positioned and uninterrupted lines. Spaces are formed between the nonwoven layer and the shrunken web at the alternatingly appearing protrusions and depressions, which promote the liquid absorbency of the laminate.

The laminate in accordance with the invention has a high relative and absolute water absorbency. The high absolute water absorbency can be achieved in that the fibrous web structures after the shrinkage into a three dimensional structure have a higher surface weight and therefore can absorb more water. This is easily understood by the person skilled in the art. However, such three-dimensionally structured web structures also have a significantly higher percentage water absorption, which is independent from the surface weight used. A higher percentage liquid absorbency is achieved by the shrinkage into the third dimension and at the same time a regular three-dimensional and voluminous pattern is produced.

Viscose fibres are normally used as major or minor components in water absorbing structures in order to achieve a high water absorbency. This measure is generally respected in the art and practice. It will be shown with the present invention that the relative water absorbency of viscose containing products can be significantly increased by the measures in accordance with the invention. It will even be shown that materials totally without any viscose portion also have a very high relative and absolute water absorbing capacity. It is therefore possible to achieve three dimensionally structured webs with high absorption capacity which do not need any use of viscose fibres. Viscose fibres are normally of higher cost than fibres on the basis of polypropylene or polyester and at humidity have the tendency to promote odor generation. These can be avoided by the use of a nonwoven structure without viscose or related polymers.

The nonwovens used in the laminates in accordance with the invention preferably include apart from fibres of thermoplastic polymers, such as polyolefins and/or polyesters, or semi-synthetic fibres, such as viscose fibres or viscose related fibres, such as lyocell, also fibres of renewable raw materials or mixtures of those fibres.

In a further preferred embodiment, the laminates in accordance with the invention include liquids, especially water and/or oil/water emulsions.

The laminate in accordance with the invention preferably includes at least one layer of nonwoven and at least one layer of a further web which is constructed so that it has a tendency to shrink or to undergo a surface reduction under the action of humid or dry heat.

The nonwovens used in accordance with the invention, which do not shrink or shrink only very little under the manufacturing conditions, can consist of any fibre type and have the most different titre ranges, for example a titre of 0.5-50 dtex. In order to guarantee a sufficient softness, fibre titres of < 5dtex, preferably ≤ 3.5 dtex most preferably ≤ 3.3 dtex are preferred for the outer nonwoven layers of the laminate in accordance with the invention. Apart from homophilic fibres, heterophilic fibres or mixtures of the most different fibre types can be used. Apart from spunbond nonwovens, staple fibre nonwovens, most preferably unbonded staple fibre nonwovens are preferably used.

In a preferred embodiment, the three-dimensionally structured fibrous web in accordance with the invention includes three layers, whereby the two nonwoven layers which three dimensionally cover the shrunken web, consist of staple fibres, and whereby the covering nonwoven layers have the same or different fibre orientations and/or the same or different fibre structure.

Typically, the unconsolidated precursors of the nonwoven layers (fibre mats) have surface weights of 5-100 g/m^2, preferably 10-90 g/m^2.

The fibrous web in accordance with the invention typically has a shrink bulking (as defined further below) of at least 100%, preferably of 150-400%.

Especially preferably, three-dimensional fibrous webs with small total surface weights of 20-100 g/m^2 are used after the hot melt bonding and before the shrinking. Especially light weight and at the same time highly absorbent laminates can be manufactured from these fibrous webs by shrinking.

In an especially preferred embodiment, the three-dimensionally structured web in accordance with the invention includes three layers and has surface weights of 40-300 g/m^2.

The shrinkage can occur in only a preferred direction or in both or more than two directions. The degrees of shrinkage for multiple directions, such as in both directions, which means in machine direction and at a right angle thereto, can be the same or totally different. For setting the binding pattern for fixation of the fibre mat or nonwoven layer which under process conditions is not or only slightly shrinkable onto the shrinkable web, their ratio in longitudinal and transverse direction should be similar, preferably the same. For example, when the shrinkable web shrinks exclusively in longitudinal direction and thus has no transverse shrinkage, the line pattern for the hot melt bonding of nonwoven and shrinkable web is to be selected perpendicular to the longitudinal direction. For example, an engraved calendar roller is used which has protrusions which are oriented at 100% in transverse direction, which means it must have continuous lines for the hot melt bonding.

The hot melt bonding between the fibre mat and/or the nonwoven layer and the shrunken or shrinkable web of the laminate in accordance with the invention is preferably carried out under heat and pressure in a calendar nip and/or with ultrasound.

It has been found that the spacing of these lines and the linear degree of shrinkage are responsible for the shape of the protrusions and depressions; which means the shape of those parts of the fibrous web which extend out of the plane is exactly set by the course of the hot melt bonding pattern lines.

The shrinking or shrunken web can be of any type. It can thereby be a shrinkable fibrous web, for example, a fabric, a knitted fabric, nettings, laid fabrics, parallel extending monofilaments or staple fibre or multifilament yarns or a nonwoven, or it can be a shrinkable foil. The shrinkable fibrous web can consist of stretched, linearly oriented and mutually parallel yarns or threads. The stretched or extended threads or monofilaments can consist of other stretched or nonstretched or less stretched threads/monofilaments or yarns oriented at an angle to the former. The intersecting fibres, threads or monofilaments can be bonded at the cross-over points to the others by auto-bonding, for example by mechanical bonding or hot melt bonding. However, the bonding can also be achieved by binder agents, such as aqueous dispersions.

The three-dimensionally structured fibrous web in accordance with the invention bonded into a laminate preferably consists of a shrunken web and a nonwoven which is not, or under process conditions less, shrunken. The shrunken web can however also be covered on both sides by a nonwoven either symmetrically or asymmetrically, which means the weights of both nonwoven layers can be different or the same. Both nonwoven layers, as far as they even have a tendency to shrink, can have the same or different degrees of shrinkage. However, at least one of the two nonwoven layers must be less shrunken than the shrunken web positioned in the middle.

The shrinkable or shrunken web of the laminate can consist of a uniaxially or biaxially stretched foil. The foil can be produced according to known production methods, for example by a blow molding process, which means stretched in tube form. However, it can also be formed by extrusion through a wide slot nozzle and expanded by mechanical stretching in machine direction or transverse to the machine direction by a tensioning frame, or stretched in machine direction by passing through an inter-engaging pair of rollers with grooves.

The normal stretching ratio of the foil is up to 5:1 in one or both stretching directions. One understands under stretching ratio the length ratio of the foil after and before the stretching.

The extrudate of the foil can be provided with known fillers or structure formers, for example with inorganic particles, such as chalk, talcum or kaolin. A microporous structure can thereby be produced in a generally known manner by stretching with the advantage of a better breathability.

However, the foil can also be perforated before the stretching with generally known methods, so that the perforations after the stretching are expanded into larger perforations.

The foil can also have been slitted prior to stretching so that, especially by stretching at a 90° angle to the longitudinal extent of the slits, the latter are expanded into perforations.

The foil can also be weakened in a pattern prior to the stretching so that the weakened locations are expanded into perforations during the stretching. The patterned weakening of the foil can also be achieved by a calendar roller passage, which means with heat and pressure, or with an ultrasound treatment.

The foil can, independent of whether perforated, weakened in a pattern or slitted, be made of a single layer or by coextrusion of several layers, which means at least two. One of the two or both outer layers of the coextruded foil can consist of lower melting thermoplastics than the other or central layer. The fibres of the nonwoven layers surrounding the shrinkable foil can be bonded exclusively to the lower melting layer or layers of the coextruded foil and not to the central layer.

By using a foil as shrinkable or shrunken web of the laminate, a certain strength increase of the laminate is achieved. At the same time, the foil prevents the migration of the applied lotions from upper laminate layers to lower layers, when the nonwoven laminate is packaged in a stack, for example offered on the market as wet wipe.

The shrinkable or shrunken web of the laminate can consist of a loose fibre mat of 100% shrinkable, which means strongly stretched fibres, which was formed according to known nonwoven laying techniques. The fibres can be laid down isotropically or in a preferred direction, which means anisotropically. The fibre mat can be preconsolidated prior to the lamination with at least one non-shrinking fibrous nonwoven layer according to known methods, whereby the consolidation conditions are controlled such that the shrinkability is not or only insignificantly affected. The mat consisting of shrinkable fibres can consist of the same or different titres of the same fibre. The titre of these fibres is normally in the range of about 0.5 dtex to about 50 dtex, preferably however in the range of 0.8 to 20 dtex. The fibres forming the shrinkable or shrunken nonwoven or mat can be made of the most different fibres, for example, of homophilic fibres, but also of 100% bicomponent fibres, or a mixture of bicomponent fibres and homophilic fibres, with the proviso that the higher melting polymer of the bicomponent fibre is identical to that of the homofilament fibre, as for example in the fibre mixture DP-homophilic with PP/PE side by side or sheath core bicomponent fibre (PE=polyethylene). In the latter case, the sheath component consists of PE and functions as binder substance for the fastening of 1 or 2 nonshrinking fibrous webs on one or both sides of the shrink fibre layer.

The shrinking or shrunken mat or nonwoven layer can have been perforated with known methods or can have a net-like structure.

Those methods of perforation or structure forming are preferred which are based on the principle of a patterned pushing aside of the fibres. Such non material destroying processes are described in EP-A-919,212 and EP-A-789,793.

The perforation processes described above for the foil can also be used.

Uni- or biaxially stretched extruded plastic nettings can also be used as the shrinkable or shrunken layer of a composite structure. The degree of stretch in both directions can be the same or different. However, at least one preferred direction is more strongly stretched. A strong degree of stretching or extending is understood to be a stretching ratio of at least 3:1.

The thickness of the threads is generally 150-2000μm. Extruded plastic nettings are understood to be webs with a grate structure formed by crossing first, parallel extending monofilament groups with second, also parallel extending monofilament groups, the groups intersecting each other at a specific constant angle and being auto-bonded with one another at the crossover points. In plastic nettings, the two monofilament groupings are normally made of the same polymer. The thickness and the degree of stretch of the two filament groupings can however be different.

Laid fabrics can also be used as shrinkable or shrunken webs, which are differentiated from plastic nettings or gratings in that the intersecting filament groups at their crossover points are not bonded by auto-bonding but by a binder application, for example, aqueous polymer dispersions. In that case, the two parallel oriented monofilament groupings can be made of different polymers. Laid fabrics are in general only then suited for use in the present invention when at least one of the two filament groupings is present in extended form. In laid fabrics, both extended monofilament threads as well as homofilaments can be used. The angle of intersection of the filament groups principally can be arbitrary. However, for practical reasons, an angle of 90° is preferred. The filament groupings of the laid fabrics or plastic netting are preferably parallel oriented in machine direction and the second filament groupings transverse which means at an angle of 90° to the machine direction. The spacing between the first parallel filaments oriented in machine direction is normally in the range of about 0.5 to 20mm, preferably 2 to 10mm, and the one of at the second parallel oriented filament groupings of 3 to 200 mm. The first filament groupings contribute normally over 50% and up to 100%, preferably 70-100% and most preferably 100% of the total surface shrinkage. In the last case exactly formed undulations or corrugations are formed.

The second filament groupings generally contribute 0-50%, preferably 0-30% and most preferably 0% to the total surface shrinkage.

Apart from the already described shrinkable or shrunken webs, fabrics and knitted fabrics can be used with the provision that at least one of the two preferred directions, which means in the fabric the warp or woof, consists of shrinkable or shrunken fibres.

The nonwoven used for shrinkage can be subjected to lengthening process prior to its lamination into a composite. Preferably the nonwoven is lengthened by mechanical forces in machine direction and – in-so-far as it consists of fully stretched fibres – accordingly shortened in transverse direction, which means it suffers a loss in width.

Such so called neck and stretch processes lead to a significant reorientation of the fibres in the nonwoven in direction of the lengthening carried out. Such a reorientation can be facilitated during the elongation process in that bonds within the nonwoven are broken or strongly loosened by elevated temperature and the reorientation of the fibres is conserved by cooling to room temperature. Such reorientation of the fibres is then preferred when initially an isotropic nonwoven is present or one with only a minor preferred orientation of the fibres or when the shrinking is preferred in only one direction and a clear undulation of the nonwoven is desired.

For determination of the water absorbency of the laminate in accordance with the invention the so-called water retention capacity is determined according to DIN53923 with the basket test. The associated test apparatus is further described in DIN53923. A stamped-out nonwoven sample is therefor weighed to 1/100g (dry weight), placed in the associated wire basket and loaded with a plate 10 x 10cm. The sample remains 30 seconds under load and 30 seconds without a load. After the soaking time, the sample is removed from the water with pincers for dripping off and hung by a corner by way of a metal clamp. After 120 seconds of drip off time, the sample is weighed to 1/100 g (wet weight).

The absolute water absorbency is calculated as follows:

Absolute water absorbency [g/m^2] = (wet weight – dry weight) x 100 [g/m^2].

Relative water absorbency [%] = (absolute water absorbency [g/m^2] / surface weight [g/m^2]) x 100.

As a measure for the volume and/or the bulking of the laminate in accordance with the invention and thereby the volume gain which occurs after the shrinking to alternating elevations and depressions, the bulking (B) of the material in the unshrunken and shrunken condition is determined and the shrink bulking (SB) determined thereby. The thickness of the material is determined with a test finger with dial and at a contact pressure of 8 g/cm^2.

Bulking (B) = thickness of the material (mm) / surface weight (g/m^2)

Shrink bulking (SB) = [bulking after the shrinking / bulking before the shrinking] x 100%.

The invention also relates to a process for the manufacture of the above defined water absorbing three-dimensionally structured fibrous web including the steps of:

a) combining at least one fibre mat and/or nonwoven with a shrinkable web,

b) hot melt bonding the fibrous mat and/or nonwoven to the shrinkable web with a pattern of bonding lines, preferably by heat and calendaring pressure and/or by ultrasound, whereby the line pattern extends at least perpendicular to the direction of the strongest shrink of the shrinkable web,

c) heating of the obtained laminate to such a temperature that the shrinkage of the shrinkable web is initiated so that regular elevations and depressions are formed which alternate with respect to the plane of the laminate and whereby the extent of the shrinkage is selected such that spaces are formed between the nonwoven layer and the shrunken web, which promote liquid absorption of the web and the density of the nonwoven is decreased and its volume and bulk increased thereby.

The hot melt bonding of fibre mat or nonwoven and shrinkable web can be carried out in any way, for example by calendaring with an embossment calendar, one roller of which has a regular line pattern, or by hot melt bonding with ultrasound or with infrared radiation which respectively act in a predetermined pattern on the nonwoven.

The laminate in accordance with the invention is distinguished by its low surface weight and high thickness, which means low density, at a simultaneously high water absorption. The alternatingly occurring elevations and depressions create spaces for the uptake of low viscosity to high viscosity liquids, preferably water or water/oil mixtures of liquid multiphase systems, such as emulsions. These liquids fill the spaces between the alternatingly occurring elevations and depressions completely or partially and also provide a cover layer on the surface of the laminate in accordance with the invention.

The laminate in accordance with the invention is especially useful in the fields of wet wipes, for example in the field of baby care, cosmetics, skin care, for dust or dirt removal in the household or industry, as liquid dispenser for cleaning, or for the application of liquids, for example of medical substances or cosmetics. These applications also form part of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described by way of example only and with reference to the attached drawings, wherein

Figure 1 illustrates the shape of the corrugations (hills/undulations) of the preferred laminate of the invention;

Figures 2a, 2b and 2c represent details from Figure 1;

Figures 3a, 3b, 4a and 4b describe the surface of a calendar roller;

Figures 5a and 5b respectively illustrate the case of shrinkage of about 50% in machine direction and transverse to the machine direction;

Figures 6a and 6b show a laminate in accordance with the invention with linear shrinkage transverse to the machine direction;

Figures 7a and 7b show a laminate in accordance with the invention with linear shrinkage in machine direction;

Figures 8a and 8b describe a laminate in accordance with the invention with linear shrinkage in both transverse and machine direction; and

Figure 9 is a perspective view of the laminate illustrated in Figure 8b.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

One of the numerous variants of the fibrous web in accordance with the invention is schematically illustrated in Figure 1. In that case, the laminate consists of a total of three nonwoven layers.

Layers 1 and 2 are respectively an unshrunk fibrous mat or nonwoven layer which was heat melt bonded under pressure and heat or by ultrasonic hot melt bonding in the form of uninterrupted bonding lines onto the fibrous mat of a third nonwoven positioned in the middle of the laminate, before the shrinking treatment. The three fibrous mats or nonwoven layers are closely bonded to one another at the bar shaped or line shaped mutually parallel hot melt bonding locations.

In the laminate described in Figure 1, the fibre mixtures as well as the surface weights of the two nonwoven layers 1 and 2 are identical, so that after the shrinking of the nonwoven layer 7 an exactly mirror image double wave, in cross-section, is generated with equal amplitudes 10 and 11. The term amplitude here refers to the maximum distance of the undulation peak from the center of the laminate. In the region of the peaks 3 and 4 of the mirror image undulations, the fibres of the nonwoven layers 1 and 2 are least densified. The densification continuously increases from the peak 3 or 4 to the location of hot melt bonding 5 where it reaches its absolute maximum. In the middle 7a between the bar shaped hot melt bonds 5 the shrunken nonwoven layer 7 is bonded the weakest while it is bonded most strongly within the hot melt bonds 5.

Of course, the fibrous mats or nonwoven layers 1 and 2 can also be of different construction and have different surface weights. The shrinking in the case of Figure 1 occurred exclusively in direction along the line 9---9, whereby this direction is identical to the machine direction (longitudinal direction). Mirror image positioned hollow spaces 12 and 13 are created by the wave shaped elevations of the nonwoven layers 1 and 2.

The upper half of the mirror image undulation is shown in cross-section, which means along the line 9---9, in Figures 2a, 2b and 2c. The undulation extends, as shown in Figure 2a, from one hot melt bonding location 5 through the peak 3 to a second hot melt bonding location 5. The turning point of the undulation (c1) and the second turning point (d1) and thereby the "bulginess" of the undulation strongly depend from the drapability or the deformability of the nonwovens 1 and 2. A nonwoven with higher stiffness (lower drapability) than in Figure 2b is shown in Figure 2a. At very similar nonwoven weights with very weak bonding within the nonwoven layer or preferably only point form bonding, it can occur that the peak 14 of the undulation collapses because of insufficient stiffness, as is shown in Figure 2c. Two new peaks 13 are formed as a result, which in the ideal case are located symmetrical to the center axis and are of the same shape.

The ration a/0.5b of the height a of the undulations to half distance b(b/2) between two adjacent hot melt bonding lines 5 and the drapability of the two nonwoven layers 1 and 2 essentially determine the shape of the undulation. The height a in relation to b/2 is determined by the ratio of the distance of the hot melt bonding regions 5 before and after the shrinking. The larger the ratio (b before) to (b after) the larger the ratio a/0.5(b after). The surface portion in the laminate which is covered by undulations or hills, relative to the total surface after the shrinking also depends from the surface portion of the surfaces not bonded to 7 before the shrinking, which means after the consolidation to a laminate, and also on the degree of the surface reduction by shrinking. The number of the undulations or hills/m^2 is also determined by the amount of surface shrinkage. The size of the undulation or hills or their distance b after the shrinkage is also determined by the size of the surfaces not bonded by the hot melt bonding regions 5, and the ratio of the surfaces before and after the shrinkage.

The shape of the elevations or rises in the shrunken laminate or their deformation after the shrinkage depends on the shape of the surfaces not connected with the center layer 7 at the hot melt bonding or bond surfaces 5, the total surface shrinkage and the ratio of the shrinkage in machine direction and transverse to the machine direction. In the case of strongly stretched mono or multifilaments embedded in the laminate panel and in machine direction (or in general in a preferred direction) a so-called linear shrinkage occurs, which is understood to be the shrinkage exclusively in this preferred direction.

In the various embodiments of the invention, the fibres or portions of the fibre mixture of the non-shrinking nonwoven outer layers of the three layered composite are to be more or less adapted to the shrinking central layer. The softness or stiffness of these three-dimensionally structured outer layers can be varied within a wide range by appropriate selection of the fibres used. The construction of these three-dimensional (3D) nonwoven layers depends mainly on the demanded properties, or the applications demanding them.

For the construction of the two outer layers of the laminate deformed into three structures and their structural integrity it is of special importance whether the shrink causing central layer is a porous, dense, or impermeable structure, which means whether it consists of fibres, nettings, laid fabrics or impermeable foils.

When foils are used, the separation force between the 3D nonwoven layers and the foil is determined exclusively by the quality of the bonding between the fibres and the foil at the interface to the foil. The foil acts as separating layer for the upper and lower 3D nonwoven layers. For the achievement of sufficient separating forces/bonding forces between foil and 3D nonwoven layer, it is preferable when the foil and the fibres (at least a portion of a fibre mixture) are mutually bonding compliant. This is achieved, as already known, in that foil and fibre or a fibre portion of bicomponent fibres or fibre portions of the fibre mixture consist of chemically similar or equally constructed polymers. For example, when a PP-foil (PPO-foil) biaxially stretched by blow forming is used, for example, as the shrink causing foil, it is preferable with a view to a good bonding, when at least high percentage portions (of at least 20-30% per weight) of the nonwoven layer deformed into the 3D structure also consist of polyolefin or polyolefin copolymer homofilament fibres or, when the bonding, lower melting component consists of polyolefin bicomponent fibres.

Examples of such fibres bonding well to PP-film are fibres of PP, PP-copolymer, PE or PE-copolymer or bicomponent fibres the core of which consists, for example, of polyester and the sheath of PP, PE or copolymers thereof. The fibre polymer functioning as binding component can also be admixed with a tackyfier. For a destruction free or non-damaging action during the hot melt bonding with ultrasound or heat and pressure of the fibre mat or mats onto the foil, the melt or thermoplastic softening point of the lower melting fibre components should not be higher than that of the stretched foil or preferably at least 5-10° C below that of the foil.

A further possibility for protecting the foil or the core of the foil from mechanical destruction or weakening, is the use of a so-called two sided or one sided co-extruded, stretched foil. This refers within the framework of this description to a 2-3 layer foil the core of which consists of a thermally more permanent polymer than the polymer which forms the one or both outer layers. Examples herefore are a three-layered, stretched foil with PPO as core and two (mostly of lower weight) outer layers of polyethylene, polyolefin copolymers, or EVA (copolymer of ethylene and vinyl acetate).

When stretched nettings or laid fabrics are used in accordance with the invention as shrink causing layers, the adaptation of the polymer composition of the fibre of the nonwoven deformed into the 3D structure to that of the shrinking middle layer for the purpose of nonwoven/netting bonding, plays a much smaller role and possibly no role at all. The surface coverage by the oriented monofilaments in longitudinal and transverse direction in a laid fabric/netting is negligibly small compared to the total surface. The bonding of the two nonwoven layers above and below the laid fabric/netting essentially occurs through the open, not filament covered surfaces. It is advantageous for a sufficient bonding adhesion, when the upper 3D nonwoven layer is made of chemically equal or similar, which means compatible, binder fibers to the fibres forming the laid fabric/netting, whereby their proportions in the two nonwoven layers can be the same or different.

The stretched netting can be coextruded just like the foil, whereby the use of a coextruded netting for the above mentioned reasons does not make any significant contribution to the laminate adhesion.

It has proven advantageous to carry out the step of manufacturing the 2 or 3 layered laminate separate from the step of shrinking it into the laminate of 3D structure. It is further advantageous to select the binder fibres which lead to the laminate adhesion for structural integrity improvement in such a way that their softening or hot melt adhesion range is about at least 10°C, preferably at least 15°C below that of the shrink causing layer. The generation of 3D structures in accordance with the invention by shrinkage has proven advantageous for the process control, the evenness of the surface shrinkage and the formation of the quality of the 3D structure in 2 separate steps. Although a combining of the two process steps in the case of a lamination with heat and pressure is principally possible in the calendar nip or by looping the material around a heated calendar roller for the purpose of increasing the residence time of the material, this is not recommended since it will lead to a drastic reduction in production speed.

The surface of a calendar roller with recesses in the shape of an equilateral hexagon is shown in top view in Figure 3a. The equilateral hexagon is principally already clearly defined by its surface 17 and edge length 19. In addition, the length 20 from the upper to the lower point, which means in machine direction 27, and the width transverse to the machine direction of the hexagon is identified in Figure 3a for a photo definition of the hexagon. The two shortest distances 16 and 18 between the equilateral hexagons are identical and represent the frame of the hexagon and thereby the uninterrupted hot melt bonding lines or hot melt bonding pattern with honeycomb structure in the unshrunken laminate, heat bonded by heat and pressure or by ultrasound.

The case of a laminate exclusively shrunken in machine direction 27 with a linear shrinkage of 50% is illustrated in Figure 3b. Such a shrinkage occurs, for example, when an extruded netting is used as the shrinking web, which was only stretched in machine direction.

Due to this 50% shrinkage in only one preferred direction (for example the machine direction) the distance 20 in the laminate is shortened by half to the distance 26 and the edge length 19 is also shortened by half to the edge length 25, while the distance 21 remains unchanged before and after the shrinking. The surface 17 of the equilateral hexagon is reduced to the surface 23 and an unequilateral hexagon stunted by 50% in machine direction results from the equilateral hexagon before the shrinking. This results after the shrinking in the uneven spacings 22 and 24 from the even spacings 16 and 18 before the shrinking, whereby 24 > 22.

The same surface of a calendar roller as shown in Figure 3a is illustrated in Figure 4a.

The case of a laminate shrunken exclusively transverse to the machine direction 27 with a linear shrinkage of 50% is illustrated in Figure 4b. Such a shrinkage occurs, for example, when an extruded netting is used as the shrinking web which was stretched only perpendicular to the machine direction.

Due to this 50% shrinking in only one preferred direction, the distance 21 in the laminate is reduced by ½ to the distance 28, while the distance 20 remains unchanged before and after the shrinking. The surface 17 of the equilateral hexagon is reduced to the surface 29 and an unequilateral hexagon stunted by 50% in machine direction results after shrinking from the equilateral hexagon before shrinking. This results in the uneven distances 30 and 31 after shrinking from the even distances 16 and 18 prior to the shrinking whereby 31 > 30.

The case of a shrinking of respectively 50% in machine direction and transverse to the machine direction is illustrated in Figures 5a and 5b. The total shrinkage is 75%. In this case, the equilateral hexagons are shrunken correspondingly and remain equilateral. The shortest distances between the sides are reduced by 50%. The highly enlarged top view of a laminate before the shrinking treatment is shown in Figure 6a. The laminate is bonded over the whole material width 34 with spaced apart parallel lines or bars of thickness 33, the surface 32 and the spacing 35 by heat and pressure or by ultrasound. This embossment bonding is in the present description referred to by LS (linear seal).

The condition shown in Figure 6b is created after shrinking by about 25% exclusively transverse to the machine direction (NLR). The material width 34 in Figure 6a is therefore reduced by 25% from the material width 38 in Figure 6b. Since no shrinkage occurs in MLR, the thickness of the bars remains unchanged, which means 33 corresponds to 37 and the distance thereof to one another also remains constant, which means 35 corresponds to 39.

Figure 7a and 7b again illustrate the highly enlarged top view of an LS bonded laminate before and after shrinking. In this case a shrinkage of 23% has occurred exclusively in MLR 48. The material width correspondingly remains unchanged (under the assumption that no distortion occurs) and therefore also the length of the bars which means 42 corresponds to 46. The surface 40 of the bars before the shrinking is reduced by 23% to the surface 44 and also the spacing 43 of the bars before the shrinking is reduced by 23% to the spacing 47 after the shrinking and correspondingly the bar width 41 before the shrinking is reduced to the bar width 45 after the shrinking.

The three layer laminate illustrated in top view in Figures 7b with exclusively linear shrinkage in the MLR results in a perspective view as shown in Figure 1 with clearly formed undulations, whereby the height 11 of the undulations at their peak 3 along the line 49 is constant over the whole material width.

The case of a shrinkage of a three layered laminate, for example of nonwoven/shrink foil/nonwoven is illustrated in Figure 8a and 8b, which means both the bar bonding surface 52 as well as the bar spacing 53 are reduced corresponding to the shrinking transverse to MLR and in MLR after the shrinkage to 54 or 55.

Figure 9 is a perspective view of the laminate illustrated in Figure 8b, whereby the cross-section of the perspective view along line 55 and the condition along line 54 are illustrated.

One can thereby see that the height of the undulations along line 54 is not always the same over the whole material width, but because of the transverse shrinkage itself also again includes a micro-undulation 56.

The invention is further described by the following examples without limiting the invention thereto.

Example 1

A carding machine with transverse doffer (referred to by K1), a carding machine above the fibre collecting conveyor (referred to by K2) with deposition of the staple fibres in machine direction and again a carding machine with transverse doffer (referred to by K3) are used for the sliver laying. The desired three-layer composite construction of the nonwoven was realized therewith. The fibre sliver layers laid down by K1, K2 and K3 are referred to by F1, F2 or F3.

The fibre composition, the fibre orientation as well as the fibre mat weights of F1 and F3 were identical. Details of the makeup of the surface weights and the fibre types can be extracted from Table 1 (Examples 1a, 1b). The three layer composite constructed from the three mats F1, F2 and F3 was slightly densified by passage of two steel compression rollers which were heated to a temperature of 80°C, before it was fed to the calendar roller pair.

The calendar roller pair consisted of a smooth roller and an engraved steel roller. The engraved steel roller had spaced apart parallel straight lines or strips oriented transverse to the machine direction with a web width of 1mm. The hot melt bonding surface was 25%. The elevations of the strips were cone shaped. The engraving depth was 0.9mm. The distance of the parallel strips, respectively measured from center to center was 4.0mm.

Both rollers were heated to a temperature of 130°C. The line pressure was 65 N/mm. Because of the symmetrical construction of the three-layer composite, which means because of the fact that F1 was identical to F3, it is unimportant which of the two had contact with the engraved roller during passage through the calendar.

The material consolidated in this manner by heat and pressure was thermally treated. After the shrinking of the middle fibre layer F2 of the three layer nonwoven composite in an oven and at 160°C for 90 seconds, the undulations illustrated in Figure 1 were created on both sides, oriented in the third dimension. Despite the completely symmetrical construction of the composite of F1, F2 and F3, the peak points of the undulations on the side of the engraved roller were marginally higher than those which were opposite the smooth steel roller during the calendaring. These differences in peak height to both sides of the shrunken fibre layer F2 proved smaller the higher the engraving depth.

The measurement results of the tests carried out on the material of Example 1 as well as the shrinkage longitudinally and transverse to the material and in the plane thereof are listed in Table 1. The surface weight was measured as well as the absolute and relative water absorption according to the basket test in accordance with DIN53923, respectively before and after the shrinking process, as well as the shrink bulking (SB) and the thickness of the material.

Table 1

	EXAMPLE 1A	EXAMPLE 1B
Fibre mat	65% viscose, dtex 1.4 Staple length 40mm 35% polypropylene/copolypropylene homocomponent fibre dtex 2.2 Staple length 51mm	80% viscose, dtex 1.4 Staple length 40mm 20% polypropylene/polyethylene- bicomponent fibre dtex 1.7 Staple length 51mm
Fibre mat F2	100% polypropylene fibre dtex 6.7 Staple length 90mm	100% polypropylene fibre dtex 6.7 Staple length 90mm
Fibre mat F3	65% viscose, dtex 1.4 Staple length 40mm 35% polypropylene/copolypropylene homocomponent fibre dtex 2.2 Staple length 51mm	80% viscose, dtex 1.4 Staple length 40mm 20% polypropylene/polyethylene bicomponent fibre dtex 1.7 Staple length 51mm
Weight before shrinking	38g/m^2	55/m^2
Weight after shrinking	90 g/m^2	124 g/m^2
Absolute water absorbency before shrinking	340 g/m^2	810 g/m^2
Absolute water absorbency after shrinking	980 g/m^2	1254 g/m^2
Relative water absorbency before shrinking	895%	810%
Relative water absorbency after shrinking	1090%	1254%
Shrink bulking (SB)	208%	175%
Thickness after shrinking (mm)	2.2	1.5

Example 2

For the manufacture of the composite described in Example 3, two carding machines were used while the first of which laid down the fibre mat F1 in machine direction (MD) and the second one the fibre mat F3. Both fibre mats were of identical composition in this example. A PP-netting which was fully stretched exclusively in machine direction with a mesh size of 3.3 * 8.5mm and a surface weight of about 30 g/m^2 was inserted between the two mats. The three strata or layers S1, S2 and S3 after a warm prepressing were guided as in Example 1 for the purpose of consolidation to the calendar nip, consisting of the rollers already mentioned in Example 1. The calendaring was carried out at a line pressure of 65 N/mm. Subsequently, the sample was maintained without delay for 30 seconds in the drying oven at a temperature of 150°C. The measurement results of the testing carried out on the material of Example 2 are listed in Table 2. The surface weight was measured as was the absolute and relative water absorbency according to the basket test in accordance with DIN53923, respectively before and after the shrinking process, as well as the shrink bulking (SB) and a thickness of the material.

Example 3

Example 3 is distinguished from Example 2 only in that a monoaxially stretched foil was inserted between the two fibre mats F1 and F2. The measurement results of the testing carried out on the material Example 3 are listed in Table 2. The surface weight was measured as was the absolute and relative water absorbency according to the basket test in accordance with DIN53923, respectively before and after the shrinking process, as well as the shrink bulking (SB) and a thickness of the material.

Table 2

	EXAMPLE 2	EXAMPLE 2
Fibre mat F1 = S1	80%viscose, dtex 1.4 Staple length 40mm 20 % polypropylene/polyethylene bicomponent fibre dtex 1.7 Staple length 51mm	80% viscose, dtex 1.4 Staple length 40mm 20% polypropylene/polyethy- lene- bicomponent fibre dtex 1.7 Staple length 51mm
Intermediate layer = S2	PP-laid netting, monoaxially stretched	15µm PPO foil monoaxially stretched
Fibre mat F3 = S3	80% viscose dtex 1.4 Staple length 40 mm 20% polypropylene/poly- ethylene bicomponent fibre dtex 1.7 Staple length 51mm	80% viscose dtex 1.4 Staple length 40 mm 20% polypropylene/poly- ethylene bicomponent fibre dtex 1.7 Staple length 51mm
Weight before shrinking	45 g/m^2	55 g/m^2
Weight after shrinking	94 g/m^2	124 g/m^2
Water absorption before shrinking	272 g/m^2	810 g/m^2
Water absorption after shrinking	1034 g/m^2	1254 g/m^2
Relative water absorption before shrinking	605%	810%
Relative water absorption after shrinking	1100%	1254%
Shrink bulking (SB)	185%	362%
Thickness after shrinking (mm)	1.7	2.0

CLAIMS

1. A three dimensionally structured laminate, comprising at least one nonwoven layer and a shrunken web connected therewith, whereby the nonwoven layer is hot melt bonded to the shrunken web, the hot melt bonding being a pattern of regularly positioned lines extending at least perpendicular to the direction of strongest shrinking of the shrunken web whereby between the nonwoven layer and the shrunken web and at the alternatingly occurring elevations and depressions spaces are formed which promoting the liquid absorbency of the web laminate, the laminate having a liquid absorbency of at least 5 g of liquid per gram of web, a thickness of at least 0.8mm and elevations and depressions which regularly alternate with respect to the plane of the web.

2. The three-dimensionally structured laminate according to claim 1, wherein the bonding pattern for the fastening of the nonwoven layer onto the shrunken web is in the form of regularly positioned and uninterrupted lines.

3. The three-dimensionally structured laminate according to claim 1, wherein the hot melt bonding is achieved by at least one of heat and calendar pressure and ultrasound.

4. The three-dimensionally structured laminate according to claim 1, wherein the shrunken web is selected from the group consisting of fabrics, knitted fabrics, nettings, fibre mats, parallel extending monofilaments, staple fibre or multifilament yarns, nonwovens and foils.

5. The three-dimensionally structured laminate according to claim 4, wherein the shrunken web is selected from the group consisting of a nonwoven and a foil.

6. The three-dimensionally structured laminate according to claim 5, wherein the shrunken web is derived from a uniaxially or biaxially stretched foil.

7. The three-dimensionally structured laminate according to claim 1, wherein the laminate includes the shrunken web and at least one nonwoven which under process conditions is less shrunken or not shrunken at all.

8. The three-dimensionally structured laminate according to claim 1, wherein the shrunken web is covered on both sides with a nonwoven which under process conditions is shrunken less or not at all, whereby the covering nonwovens have either the same or different surface weights.

9. The three-dimensionally structured laminate according to claim 1, wherein the nonwoven layer is made of staple fibres.

10. The three-dimensionally structured laminate according to claim 1, having a surface weight of 30-300 g/m^2.

11. The three-dimensionally structured laminate according to claim 1, wherein the nonwoven includes fibres of renewable raw materials in addition to fibres made of a material selected from the group of thermoplastic polymers, polyolefin, polyester, viscose fibres, viscose similar fibres, and mixtures thereof.

12. The three-dimensionally structured laminate according to claim 1, further comprising liquids selected from the group of aqueous liquids, oil based liquids, water oil/water emulsions, and mixtures thereof.

13. The three-dimensionally structured laminate according to claim 1, wherein the bonding pattern between the nonwoven layer and the shrinkable web is in the form of regularly positioned lines or bars extending in a direction selected from the group perpendicular to the machine direction, in machine direction and both directions.

14. The three-dimensionally structured laminate according to claim 13, wherein the lines are uninterrupted.

15. The three-dimensionally structured laminate according to claim 1, wherein the bonding pattern between the nonwoven layer and the shrinkable web is in the form of regularly positioned lines shaped as a hexagon on the surface of the nonwoven.

16. Process for the manufacture of a three dimensionally structured laminate according to claim 1, comprising the steps of:

a) combining at least one fibre mat and/or nonwoven with a shrinkable web

b) hot melt bonding the fibre mat and/or nonwoven to the shrinkable web with a bonding pattern in the form of spaced apart lines extending at least perpendicular to the direction of strongest shrinkage of the shrinkable web,

c) heating the resulting laminate to a temperature for initiating shrinkage of the shrinkable web to form regular elevations and depressions alternating relative to the plane of the web, whereby the degree of shrinking is selected such that between the nonwoven layer and the shrunken web at the alternatingly occurring elevations and depressions spaces are formed which promote the liquid absorption of the laminate, thereby reducing the density of the nonwoven and increases its volume and bulk.

17. Use of the three-dimensionally structured laminate according to claim 1 as one of a wiper cloth, a wet wipe cloth, a liquid dispenser for cleaning, a cloth for the application of liquids, application of medical substances or cosmetics.

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Figures: 1 2(a-b-c)

Pages: 1

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Fig. 3a

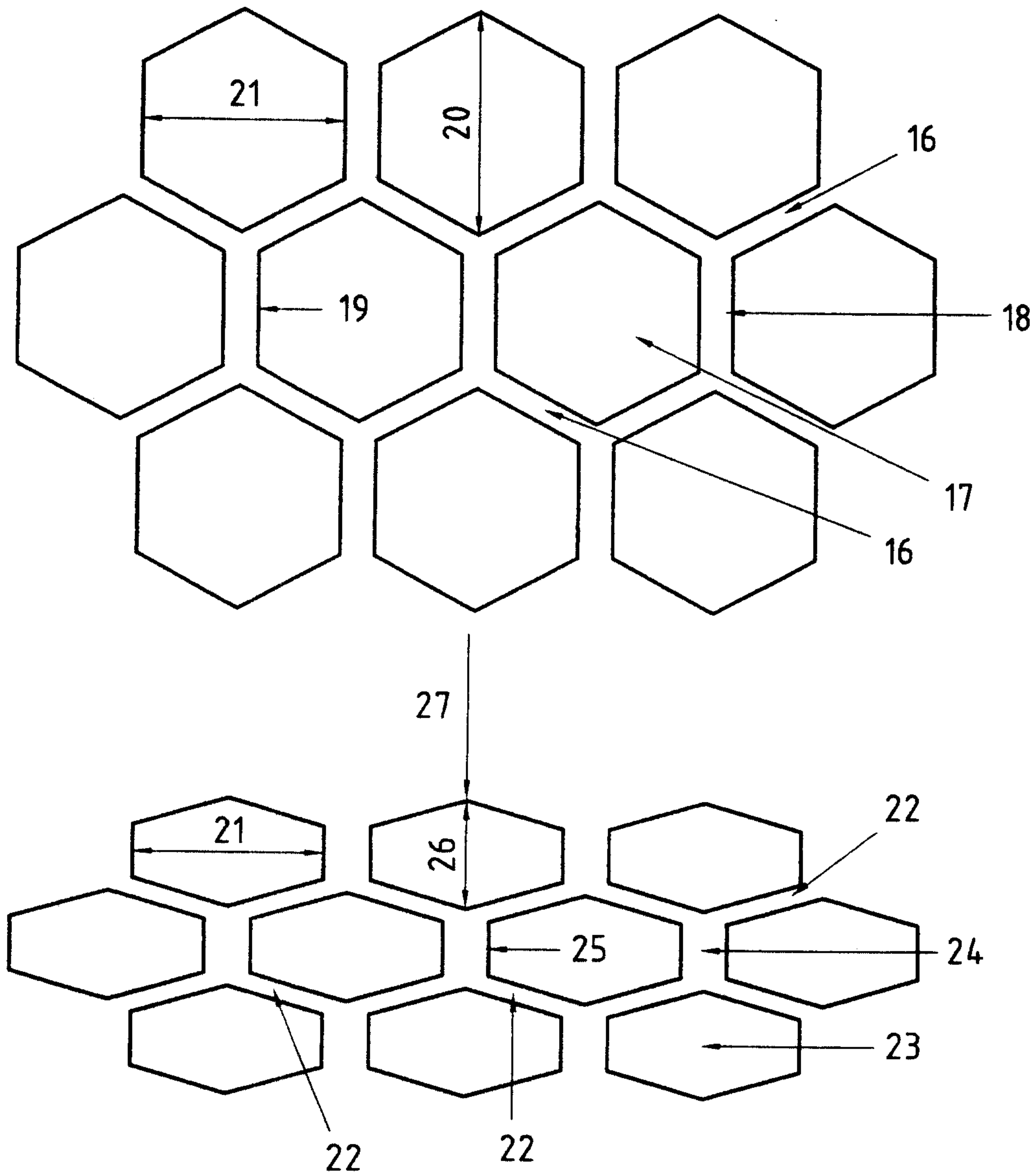

Fig. 3b

Fig.4a

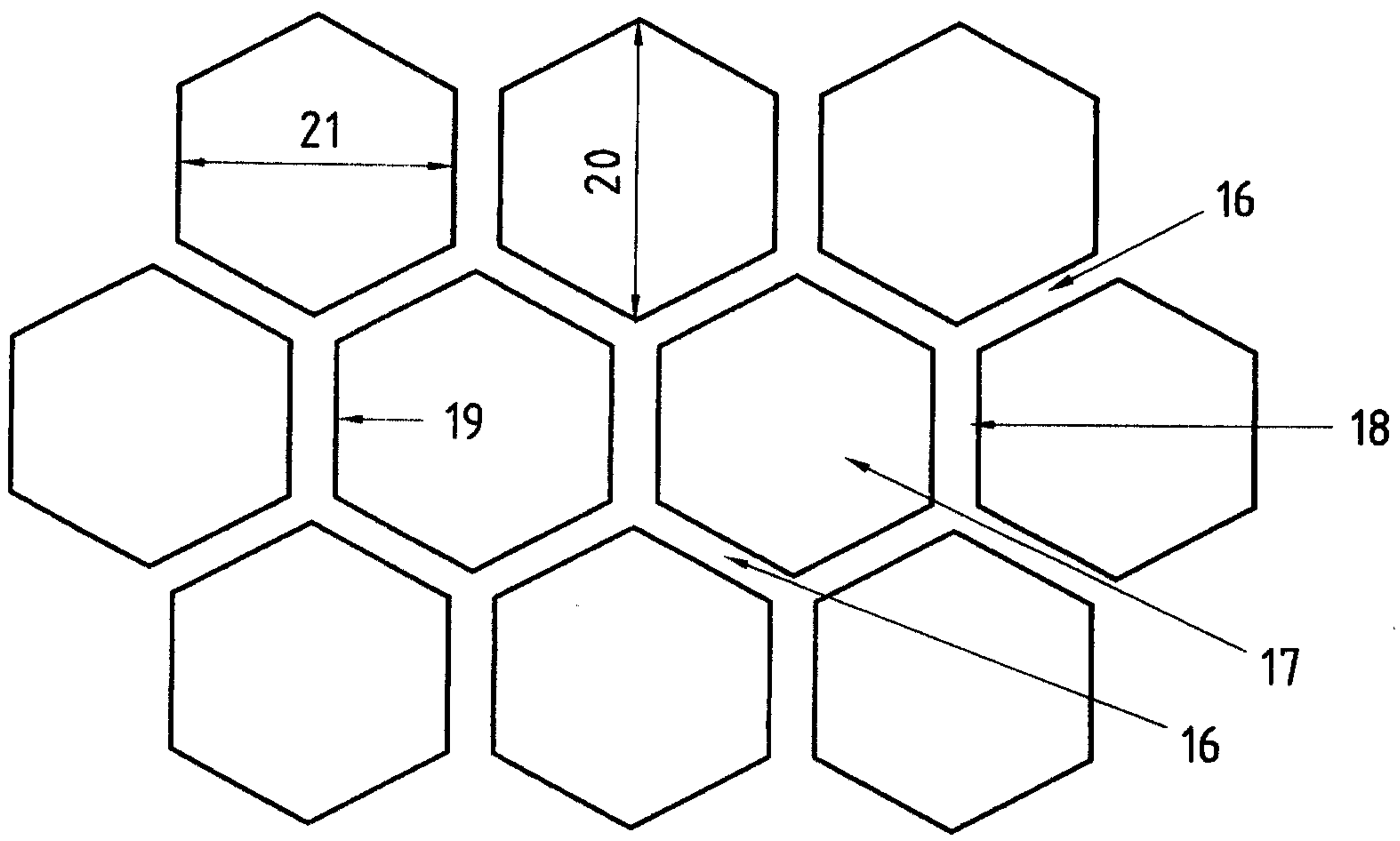

Fig.4b

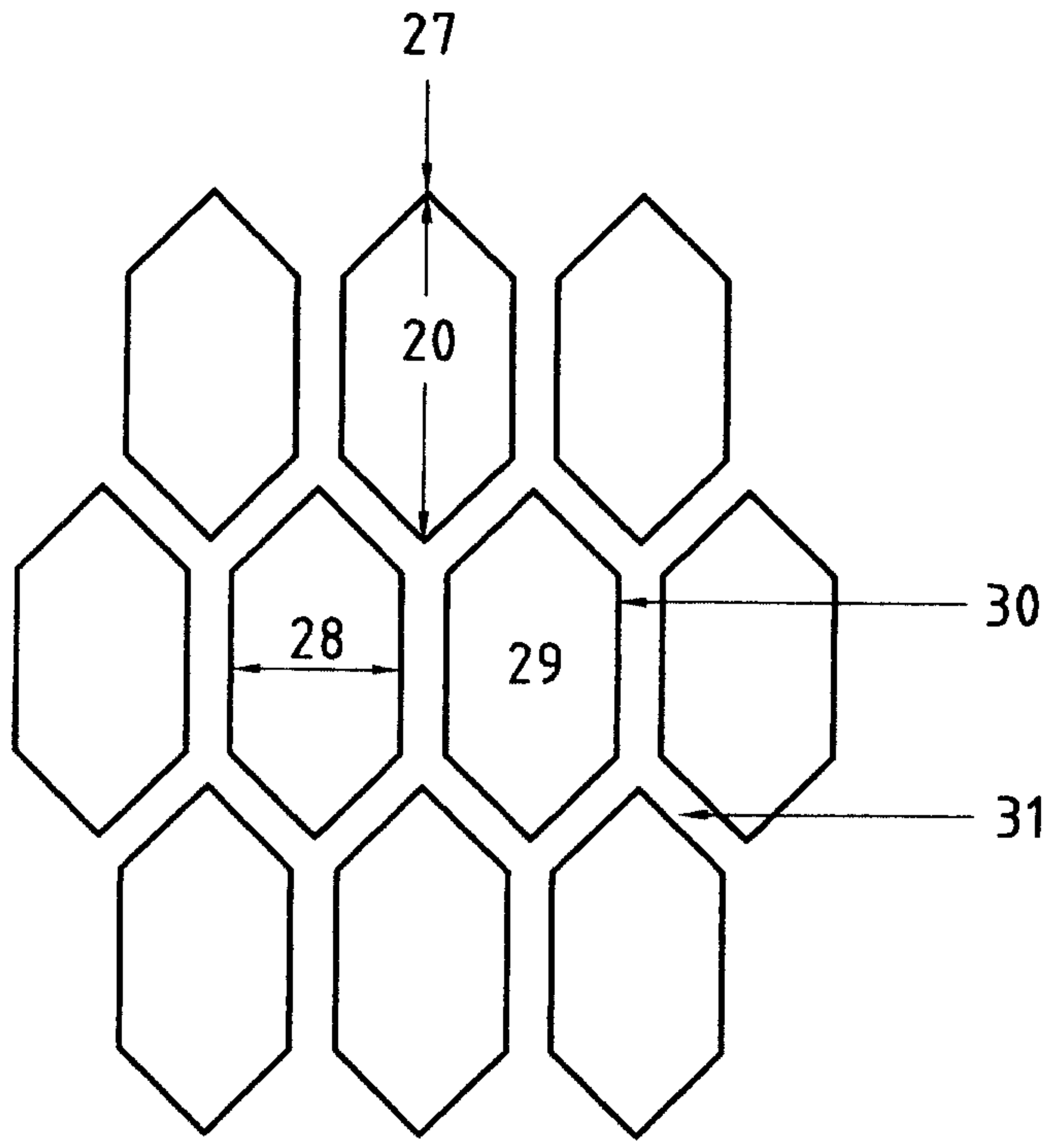

Fig.5a

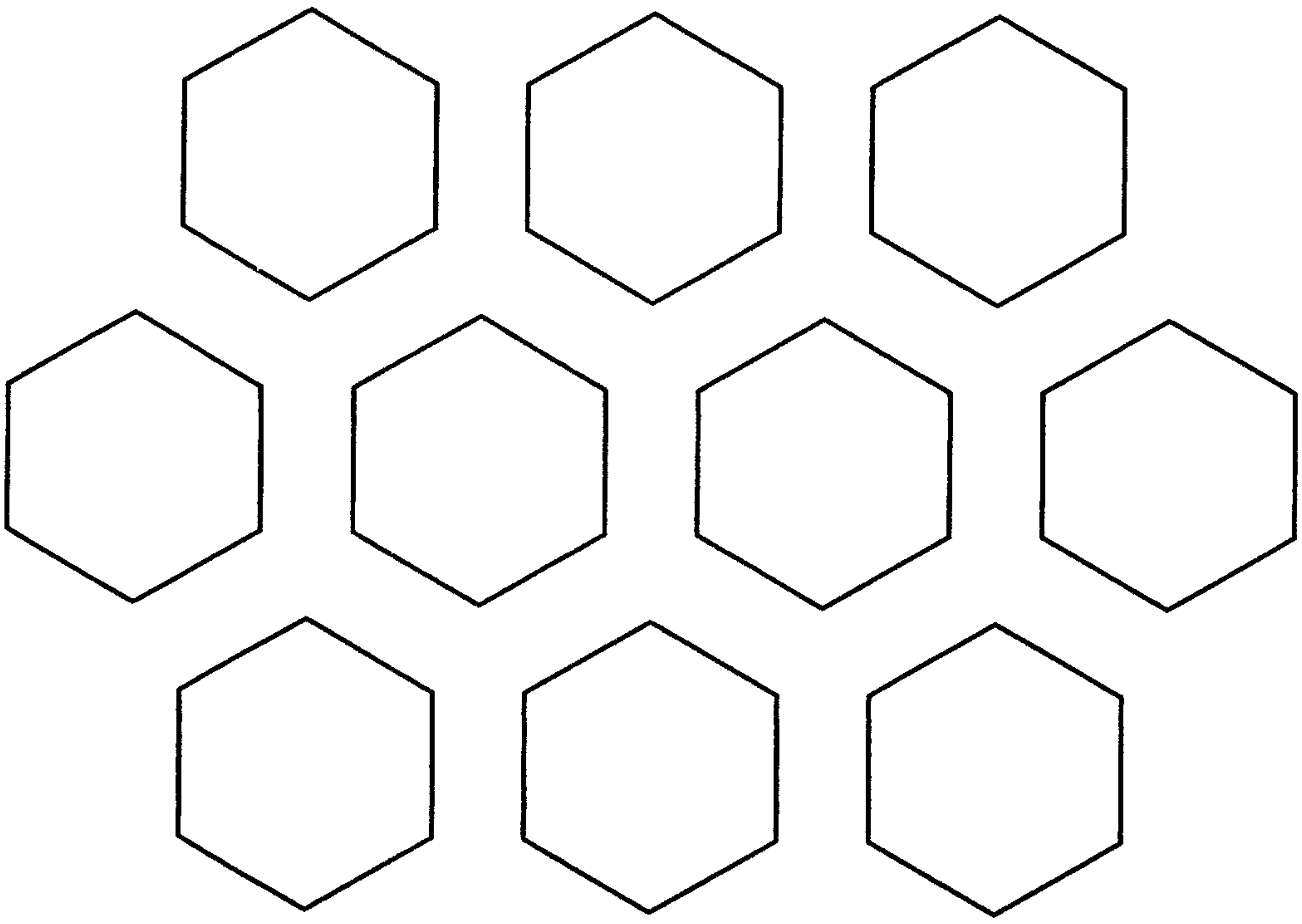

Fig.5b

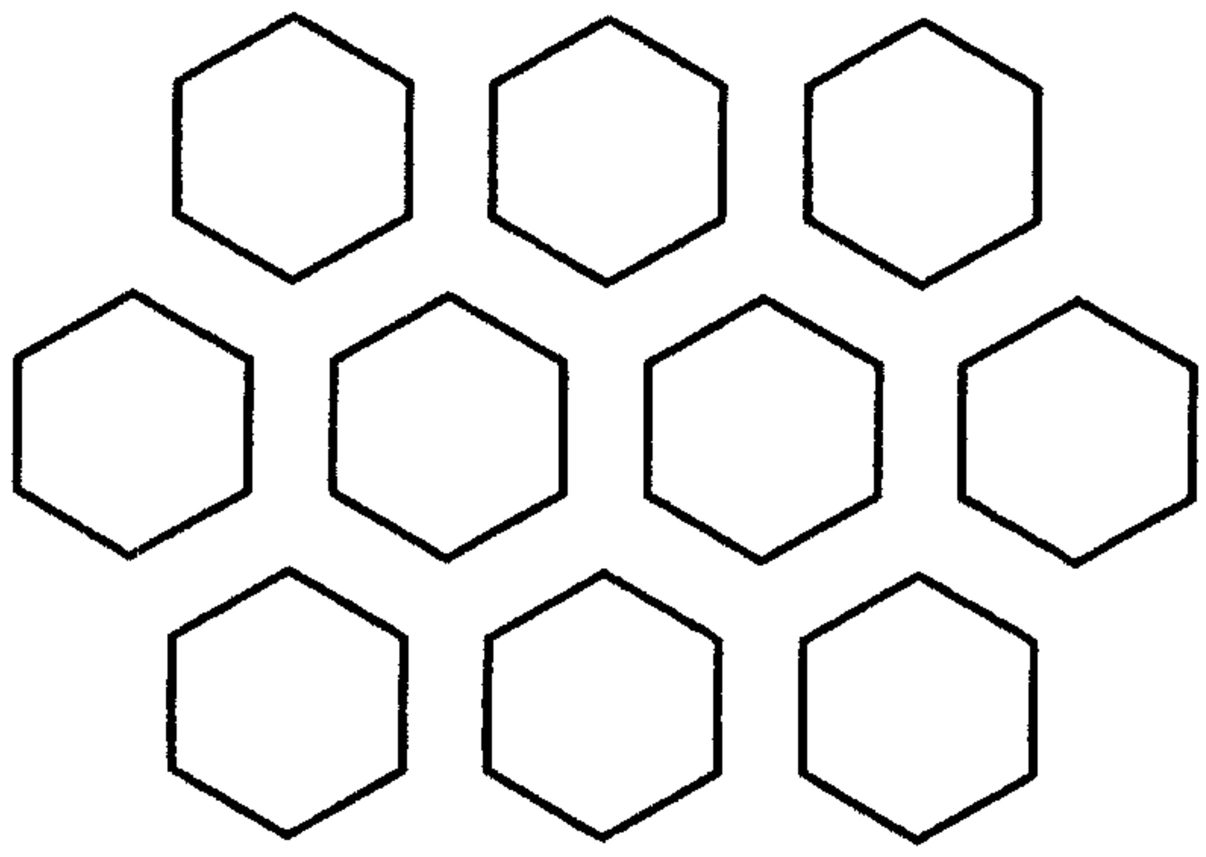

Fig.6a

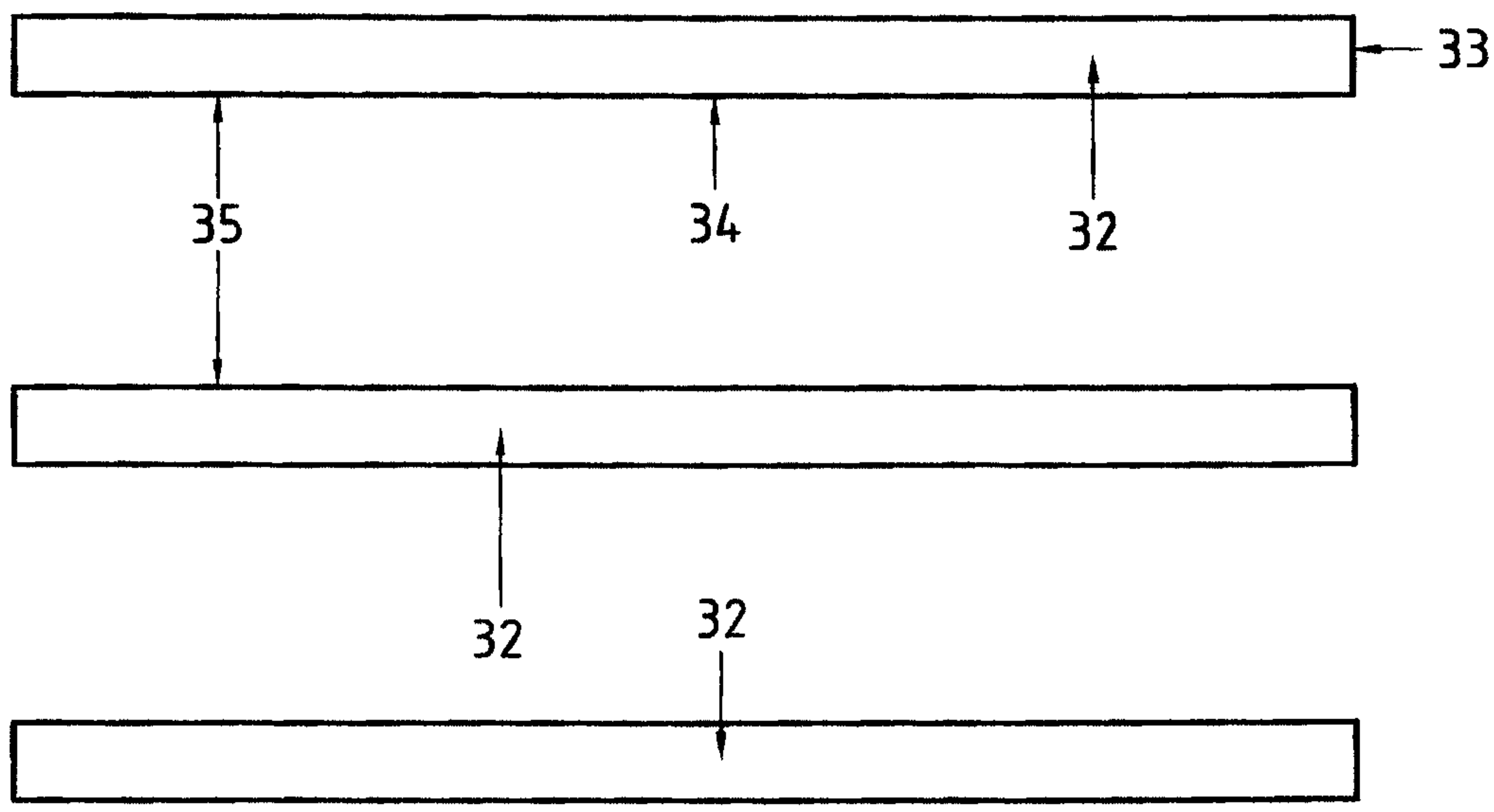

Fig.6b

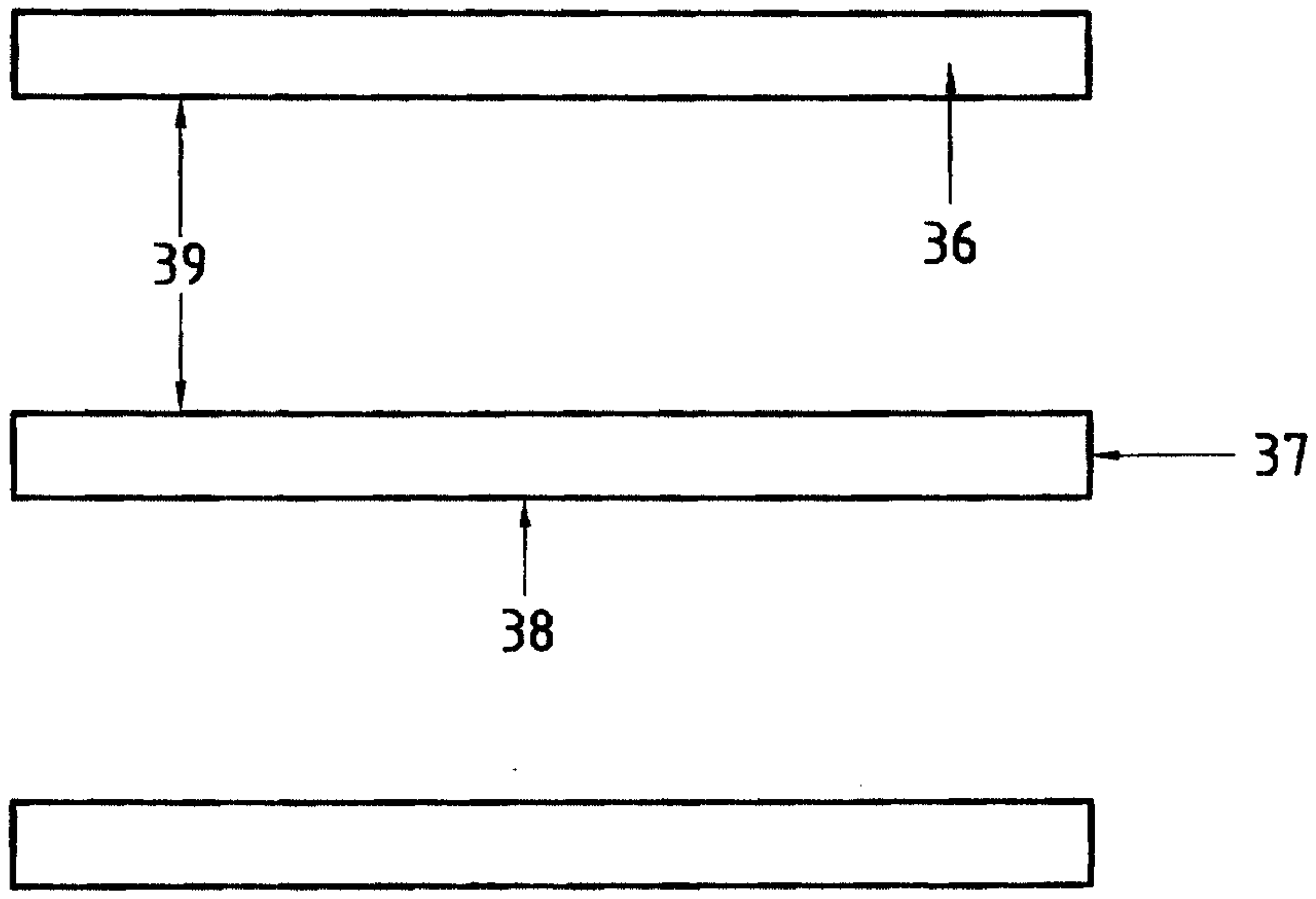

Fig.7a

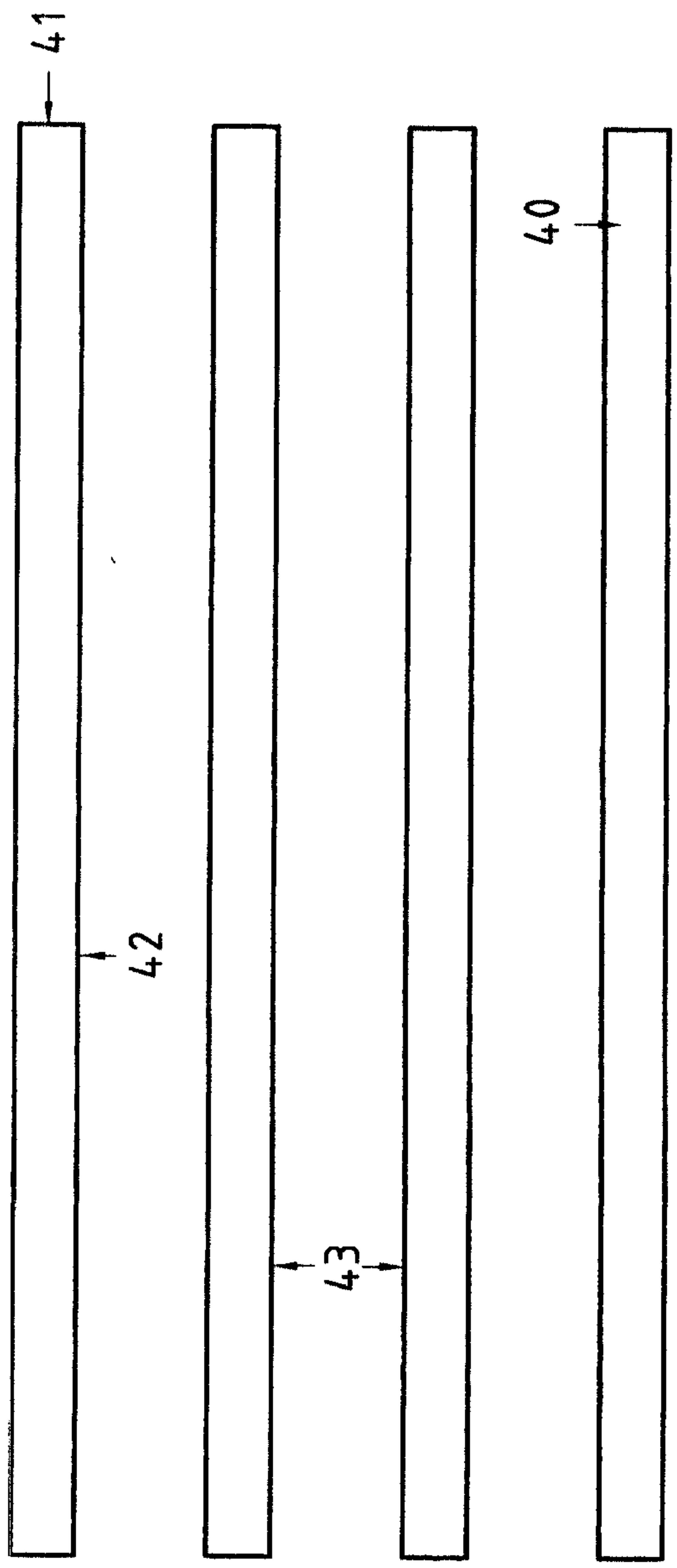

Fig.7b

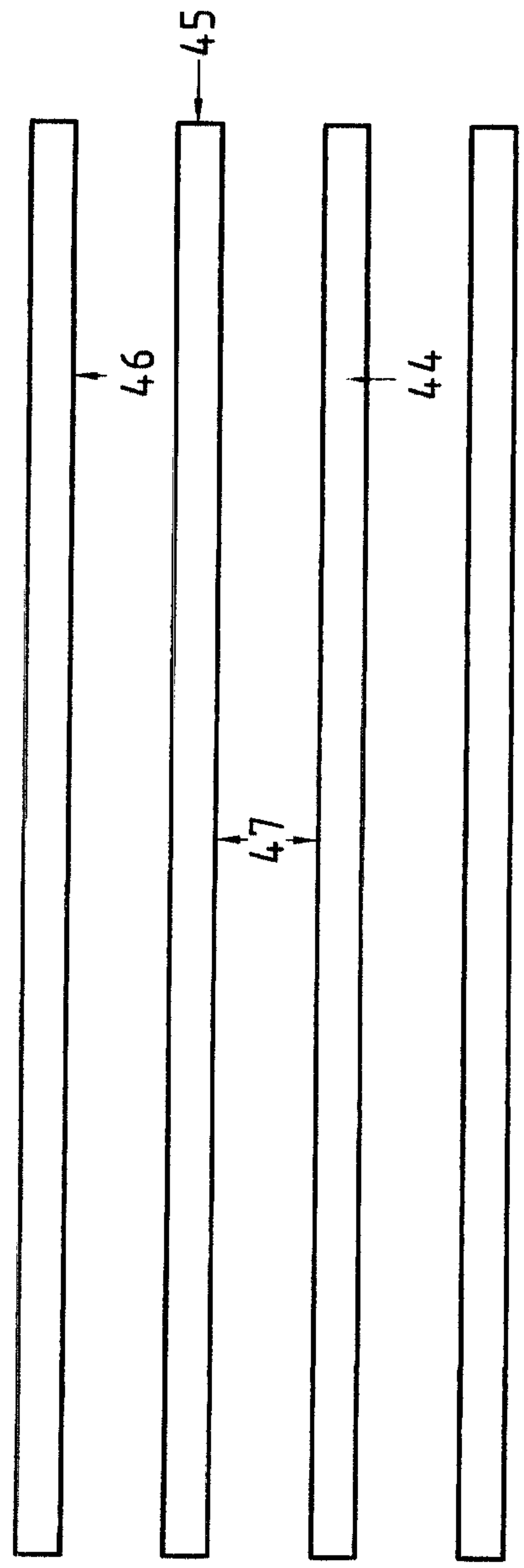

Fig.8a

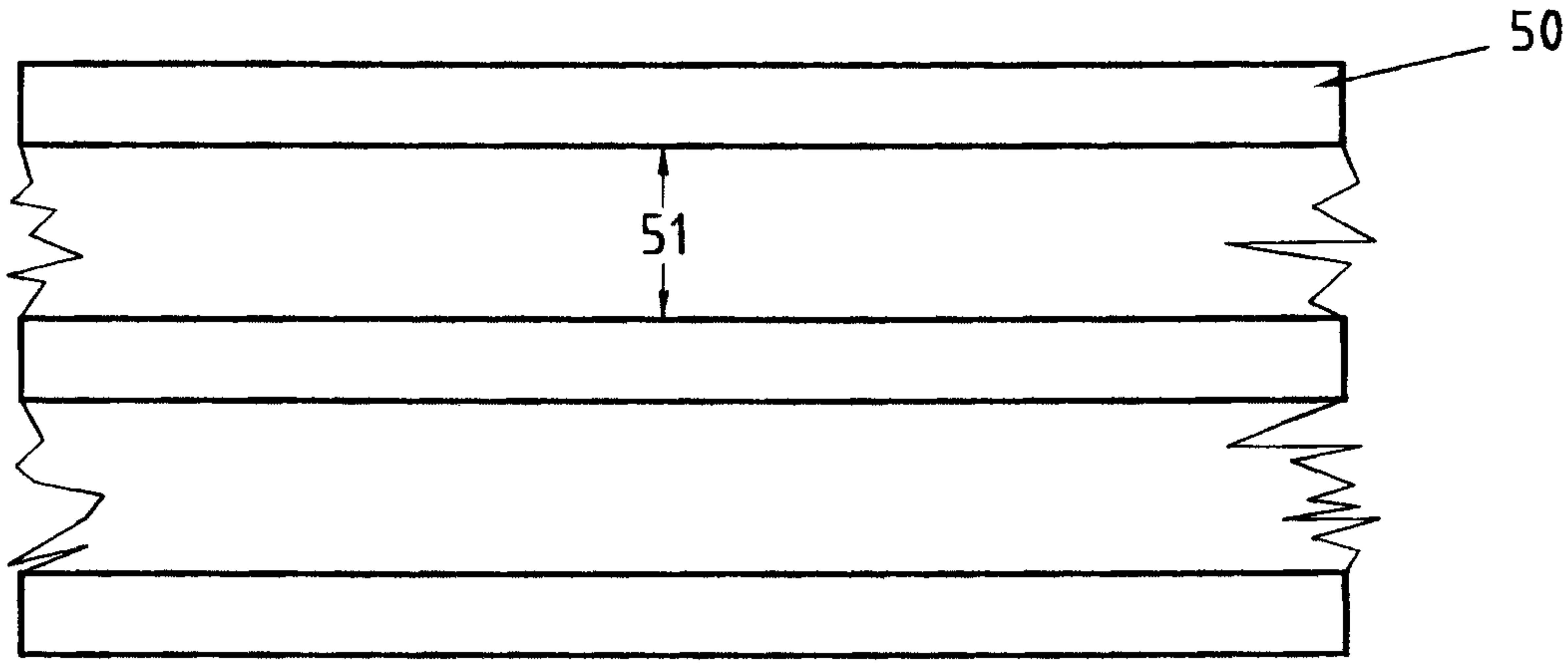

Fig.8b

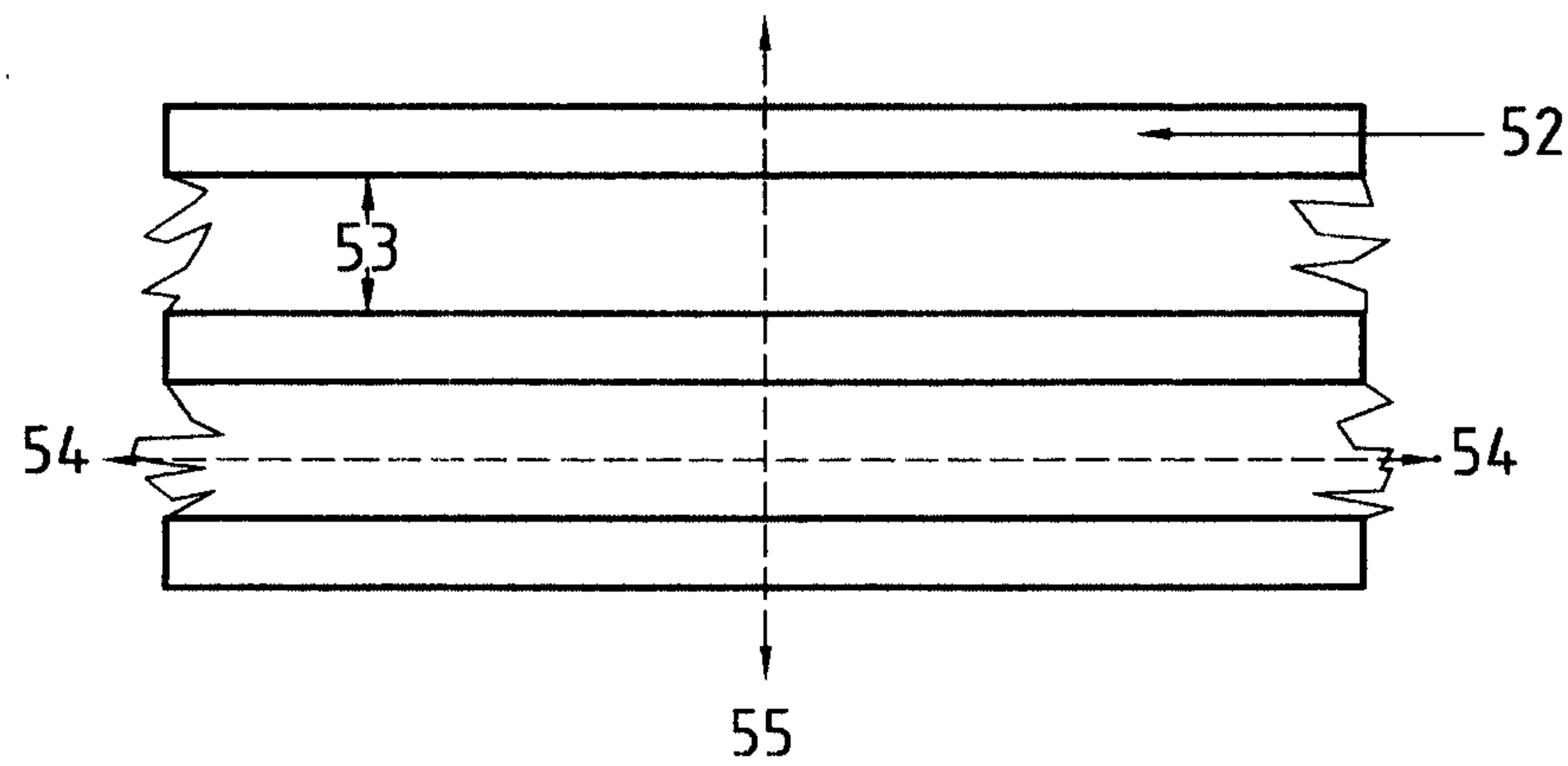

Fig.9