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(54) NET AND METHOD OF PRODUCING SAME

(71) We, BEGHIN-SAY, a French Body Corporate, of 18 rue Vaneau, Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a net and a method of producing same. In particular the invention relates to a net derived from a film or sheet.

Nets either derived from film or formed directly at the exit of an extrusion die are at present mainly used as reinforcement in paper articles or cheap textiles, e.g. in sanitary paper articles, paper cloth and heavy duty bags, and non-woven upholstery fabrics. They are further used, or have been suggested used, independently as window curtains, decorative net, wrapping material, mosquito net, protective gardening nets against insects or birds, backing for growing of grass or plants, sport nets, light fishing nets, and filter materials.

The nets formed directly at the exit of an extrusion die have the drawbacks or limitations that the mesh is relatively big, that orientation of the cross-points is difficult and that the nets can generally not be made finer than about 20 grams per sq. m.

One type of net derived from film consists of two or more cross-laminated layers of uniaxially oriented film which have each been fibrillated to net form. This involves the need for a lamination process after fibrillation and at this stage lamination is generally complicated. For reinforcement in sanitary paper a fineness of 5 grams per sq. m. or finer is usually needed, and it is practically impossible to obtain this when two layers have to be laminated after fibrillation.

In a modification of this type of net,

lamination can be avoided, as reinforcement filaments of a non-splitting polymer is incorporated in the splittable film, which is oriented at an angle to the incorporated filaments and then fibrillated at random. However, the randomness of the mesh is usually a drawback, and the randomly fibrillated material is relatively weak, as special admixtures are used to facilitate the random fibrillation.

Another type of net derived from film is formed by slitting a pattern of intermittent lines, and expanding the slit film while stretching biaxially. This process produces nets of a big mesh and with weak cross-points.

A third type of net derived from film is formed by embossment of the film in a suitable pattern followed by biaxial stretching under conditions which fibrillate the thin areas of the film at the same time as the material is expanded. Dependent on the pattern of the embossment different properties can be obtained, but the net is generally weak as the bosses remain unoriented.

A fourth type also makes use of embossment, but the bosses are formed as transverse stems which are subsequently oriented and form the main direction of strength. The thin, linear areas of the embossed film are oriented and split generally in the longitudinal direction and form relatively weak bridges between the transverse stems. For most uses this net has to be cross-laminated with another net or web, and this again involves the limitation that it is very difficult to produce the very low sq. m. weights required for reinforcement in sanitary articles.

Finally, it is known that net structures can be produced by extruding alternate streams of different polymers, and joining the streams in the extrusion die, which contains moving parts that turn the streams

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to a transverse direction at the same time as they draw the streams to thin structures named "lamellae". Still in the die, one or both boundaries of the fluid sheet pass over a comb which drags longitudinal "tentacles" from the edges of the lamellae and the tentacles are collected in bundles. After solidification, the sheet is mechanically disrupted in accordance with the layered and fibrous structure produced in the die, and hereby a fabric is achieved with two interconnected thread directions. However, the fabrics produced by this method are several times heavier than the abovementioned usual requirements for nets in sanitary articles.

The present invention aims to provide an entirely new technique, generally speaking by a combination of side-by-side extrusion of streams, transversal embossment, and splitting. By means of the present invention there is obtained a particularly fast and reliable process whereby the desirable weight of about 5 grams per sq. m. or lower can be achieved without difficulty. Further there is conceived a novel and advantageous structure.

According to the present invention there is provided an embossed fibrillated film product in the form of a net comprising a regular array of transverse stems of a polymer material and a regular array of longitudinal fibrous structures of a different polymer material interconnecting said stems, said longitudinal fibrous structures being ribbon-like filaments which are embedded in said stems at their intersections, there being no bond between said filaments and said stems.

Hereby is achieved a net structure which comes very close to a woven structure and consequently has similar good properties.

In order to facilitate the embedding of the filaments in the stems, without causing damage to the filaments, the latter should preferably be formed of a polymer substance with higher melting point than the polymer matter of which the stems are formed. Due to the ribbon-form of the filaments the embedding produces only a small notch-effect in the stems.

In order to further reduce this notch effect, the ribbon-formed filaments are preferably tapered at their edges.

The filaments are embedded in slipping relation with their embodiment. During the production of the net, this is easily obtained when the filaments and the stems (or at least those portions of the stems which contact the filaments) are formed of mutually incompatible polymer substances, that is substances which do not stick or bond together in the solidified state. By this slipping relationship the diagonal flexibility

is increased, and further the orienting at the cross-points is facilitated.

The filaments are preferably oriented, and the stems are preferably also oriented.

In another embodiment of the net according to the present invention the stems are formed of several layers of different polymer substances. Such layered arrangement can easily be formed in connection with the embodiment, as it will be described later, and important effects can be obtained in this manner.

Thus, when the net is used for reinforcement in sheets of cellulosic fibres, at least one surface layer of each stem can with advantage be formed of olefin copolymer capable of producing an adhesive bond with cellulose, e.g. ethylene-acrylic acid copolymer, ethylene-metacrylic acid copolymer, or an ionomer, that is a polymer the molecule of which contains metal ion, while the main portion of the stems is formed of essentially homopolymer olefin. The latter is used on account of its low price and relatively high strength.

As mentioned above, the filaments should preferably be formed of a polymer substance with higher melting point than the polymer matter of which the stems are formed, and a suitable choice is that said filaments are formed of polyamide, e.g. nylon 6 or nylon 66, or of polyethyleneterephthalate, and said stems are formed of polyolefin.

While the longitudinal filaments must always be ribbon-formed to avoid a notch effect in the transverse stems, the latter may have different forms. Thus, if relatively high stiffness is desirable, e.g. to obtain a suitable drape effect of light weight fabrics, the stems are preferably of generally circular to squared shape.

If, on the other hand, high softness is desirable, e.g. in sanitary articles such as surface netting on napkins, the stems are preferably of substantially flat shape.

As mentioned above, important effects can be obtained by forming the stems in a layered structure of different polymers. One application of such a layered structure has been described. It can further be used to obtain a bulky net, and for this purpose said layers are in a state of differential shrinkage producing a curling of the stem. In this case the filaments should preferably be considerably spaced apart from one another.

The method for producing the net described above is described and claimed in the present applicants' co-pending Patent Application No. 37499/72. (Serial No. 1445981).

The method comprises the steps of forming a film or sheet consisting of a regular array of continuous, longitudinal,

ribbon-formed filaments of a higher melting polymer substance (A) which are spaced apart from one another and which are each embedded in a matrix of lower melting polymer matter, subsequently impressing said film or sheet at a temperature at which the matrix is molten to semimolten, and (A) is pronouncedly more solid, and at a pressure adapted to collect at least the main portion of said lower melting polymer matter in a regular pattern of transverse stems, but leaving said filaments substantially undamaged, and subjecting the lower melting polymer matter to splitting between the filaments of (A) in said impressed areas.

In the method at least those portions of said matrix which are brought in direct contact with (A) by said embedding consist of polymer substance(s) which are incompatible with (A). The filaments and the stems will hereby form a slipping type of join with each other with the advantages which have been described above.

The embedding of the filaments in the matrix can be carried out in many different ways, however the most expedient procedure found is to produce said embedding by extruding an intermediary layer formed of streams of (A) interspersed with another polymer substance (B), the streams of (B) being part of the matrix, and forming the rest of the matrix by co-extruding on either side of said intermediary layer surface layers of (B) and/or of other polymer substances).

A way of carrying out the method is further characterised in that at least one of the surface layers is formed integral with said interspersed streams of (B) preferably by means of a profiled orifice for (B). This is a particularly simple way of producing the embedded arrangement. Instead of by use of such profiled die, the integral formation of a surface layer can also be achieved by merging the streams of (B) beyond one side of each stream of (A), e.g. by extruding the streams of (A) and of (B) into a common chamber, while the extrusion orifices for (B) fill a greater part of the chamber width than the extrusion orifices for (A).

In another way of carrying out the method, still based on the described interspersed co-extrusion of (A) and (B), at least one of the surface layers is formed of a distinct stream extruded independently of said interspersed streams of (B). This allows for variations of the layer thicknesses and the spacing-apart of the filaments, these variations being independent of each other.

Usually there is no particular advantage in placing the filaments right in the middle of the matrix or varying both surface thicknesses, and consequently the above

features can with advantage be combined by forming a major (i.e. thicker) surface layer of a distinct stream extruded independently of said interspersed streams of (B), while the opposite, minor (i.e. thinner) surface layer is formed integral with said interspersed streams of (B). Suitable relative values of layer thicknesses are indicated later in this description.

In order to obtain high longitudinal strength it is preferable to intersperse only small amounts of (B) with the streams of (A) in the intermediary layer. E.g. the filaments should occupy about 2/3 or more of the intermediary layer.

With a view to the adhesion to cellulose fibres and the economical advantages of using polyolefins, an embodiment of the invention is characterised in that a major surface layer is formed of essentially homopolymer olefin and a minor surface layer is formed of an olefin copolymer capable of producing an adhesive bond with cellulose, e.g. ethylene-acrylic or ethylene methacrylic acid copolymer or an ionomer.

As regards a suitable choice of polymer for the filaments in relation to the choice of polymer for the matrix, hereunder considering differences in melting point and economical features, an embodiment of the invention is characterized in that (A) consists of polyamide, e.g. nylon 6 or 66, or of polyethyleneterephthalate, and the matrix consists, at least mainly of polyolefin(s).

The impression according to a transverse pattern need not be perpendicular, or nearly perpendicular, to the machine direction, but if the net is intended for use in lamination it may be carried out under a pronouncedly acute angle, e.g. 45°.

Well known procedures of impression may be applied, for example the use of an embossed roller and a smooth roller as counter part. The application of a vibrating edge and a flat or cylindrical anvil has also been suggested and can be used in connection with this invention. In any case it is preferable to take advantage of the conveying action of the relatively solid filaments and therefore to produce an effect more vigorous than otherwise possible.

Thus, a preferred way of carrying out the method is characterised in that said depression is carried out by means of an embossed preferably hard roller engaged with a smooth preferably hard roller, the two rollers carrying the film (sheet) in the same direction, but being rotated at different circumferential velocities, so as to increase the impression effect by means of shearing, the smooth roller being preferably the faster one.

When carrying out this procedure of

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impressing, it is preferred to feed the film (sheet) onto the smooth roller which is kept at a temperature adapted to bring the polymer substances in the aforesaid states for impression, while the embossed roller is kept at a lower temperature to avoid the material sticking thereto.

Whenever the assembly of an embossed roller and a smooth counter roller is used in connection with the present invention, the best conveying action of the filaments is obtained when using a film or sheet having the filaments of (A) embedded closer to one surface than to the other surface, and in which the surface closest to the filaments is brought in contact with the embossed roller.

Both the longitudinal ribbons and the transverse bosses are preferably oriented by stretching. For the sake of regularity of the structure the longitudinal filaments of (A) are preferably oriented subsequently to co-extrusion and prior to impression. However, it is usually also advantageous to finalize the orientation of said filaments subsequently to the impression. Hereby the weight per sq. m. is reduced, and the spacing between the stems is increased. This increase is often required as the best impression appears to be obtained with a division not more than about 1 to 2 mm between the bosses or teeth of the roller.

When the stems are oriented, as usually required (except if they are made of elastomeric material) this orientation is carried out subsequently to the impression by cross-stretching preferably by means of a tenter frame.

The cross-stretching is usually carried out at a ratio between 5 to 10:1 and hereby the longitudinal ribbons are spread apart accordingly. The ribbons should therefore normally be extruded with a division as small as practically possible, e.g. about 1 mm, but a still smaller division may be desirable. An expedient way to obtain a close arrangement of the longitudinal filaments of (A) is achieved by stretching the film (sheet) subsequently to the co-extrusion and prior to the impression while allowing cross-wise contraction of the film (sheet). This stretching may be the same as the above-mentioned orientation, but may also fully or partly be carried out while the filaments are molten or semi-molten, whereby they will not become substantially oriented.

The embossment will normally produce stems of generally circular to square shape. This should be understood as a very approximate indication. When—in order to produce a softer product—flat stems are desirable, the stems can be flattened by calendering subsequently to the impression and preferably prior to the cross-stretching.

This calendering may be carried out at an elevated temperature.

As mentioned, the conveying effect of the longitudinal filaments highly facilitates the step of impressing the film (sheet), in particular when the surface layer adjacent to the embossed roller is then and when only small amounts of (B) are interspersed between the filaments. However, a still higher conveying effect and thereby still higher production rates can be obtained when the polymer substance interspersed with (A) and a polymer substance forming a minor surface layer are blends containing relatively small portions of an incompatible polymer having higher melting point, whereas the major surface layer is formed of a substantially homogeneous polymer substance, longitudinal fibrillation of said blended component(s) being carried out subsequently to the impression in the impressed areas. In this connection said blended component(s) can with advantage consist for the major part of polyolefin, the admixture being polyamide or polyethyleneterephthalate in a percentage about or below 25%.

The above-mentioned fibrillation of the blended component(s) will usually occur sufficiently simply by the cross-stretching step by which the stems are oriented

In similar way other types of impressed film or sheet material according to the invention, when not split during the impression, can often be split to the desired net form by cross-stretching alone. However, splitting (fibrillation) can also be carried out as an independent step between the impression and the stretching of the stems. A convenient way to obtain this is to carry out the impression in a pattern at bias, e.g. about 60° to 75° to the machine direction and to deflect the sheet so that the angle between the filaments and the stems is increased, preferably to about 90°.

As regards the embedding of the longitudinal, ribbon-formed filaments in the matrix, in the foregoing the emphasis has been put on the co-extrusion process where different polymer substances are interspersed with one another and surface layers are formed in the same extrusion die. Although this has been found to be a particularly suitable process, there are also other ways to form said embedded arrangement. Thus a film (sheet) of interspersed streams can be formed in a first process step, while the surface layers are extruded or calendered hereon by a separate process step.

As a third way of forming the embedded arrangement, the longitudinal ribbon-formed filaments can be produced and arranged as an array by slitting and drawing of a film, and the matrix can thereafter be

applied to both sides of the array and joined between the ribbons in a calendar. Instead of by slitting of a film, the filaments can also be formed by ordinary extrusion from a row of orifices.

Finally, as regards apparatus required, a particularly simple way of forming the embedded arrangement yielding, however, a somewhat lower strength in the final product, is by forming an ordinary film (sheet) of three or more layers with the substance (A) as an interior layer, and the matrix substance(s) on either side of this layer. Subsequently this composite film (sheet) is slit to an array of ribbons which are normally drawn, and thereafter the matrix substance(s) are squeezed from either surface of the ribbons and joined in the spaces between the ribbons. This squeezing can be carried out simultaneously with the formation of the stems by the above-described impression, or there can preferably be a prior calendaring at a suitable temperature.

The invention will now be described in more detail with reference to the accompanying drawings in which:—

Figure 1 is a cross-section, taken on the line I—I of Figure 2, of an extrusion die for carrying out of the invention;

Figure 2 is a longitudinal section taken on the line II—II of Figure 1, of the same die;

Figure 3 is a cross-section of the structure of a film which is an intermediate product in the production of the net according to the invention, and is produced by the die shown in Figures 1 and 2;

Figures 4 and 5, which correspond to Figures 1 and 2, respectively, show a modification of the die;

Figure 6, which corresponds to Figure 3, shows the film structure produced by the die shown in Figures 4 and 5;

Figure 7, which also corresponds to Figure 3, shows another modification of the film structure; and

Figure 8 is a schematic, perspective view of all the apparatus necessary to produce the net of the invention.

In Figures 1 and 2, a higher melting polymer substance A and two lower melting polymer substances B and B₁ are extruded from separate extruders and distribution channels (not shown) into three slot-formed conduits as shown by the three arrows.

B and B₁ can be identically the same polymer substances, but still fed independently, or different modifications of the same polymer, or two polymers which are chemically different, but capable of forming a strong adhesive bond with each other, A is preferably incompatible with B and B₁.

The die is formed of an internal part 1 and two external parts 2 and 3. The slot-

formed conduit for A is divided out on a large number of parallel channels at zone 4 in this part. As it appears particularly from Figure 2, part 1 ends in a comb-formed profile, and the channels for A pass through each "tooth" of the "comb". In the chamber 5, A, B and B₁ join to a composite sheet. A is extruded into this chamber from a row of separate orifices, while B is extruded from a comb-formed orifice and B₁ is extruded from a straight slot. Hereby the structure shown in Figure 3 is formed, except that the streams (filaments) of A are not yet ribbon-formed.

The composite stream is narrowed and extruded through the exit slot 6, and thereafter the fluid sheet is drawn down, whereby the filaments of A become ribbon-formed. The relative layer thicknesses and the proportion between the width and the spacing-apart of the ribbon-formed filaments are determined by the relative extrusion throughputs and by the relative dimensions in the tooth-formed orifice for B.

Due to smearing-out, the ribbon-formed filaments have a tendency to become tapered at the edges, as shown. This form is advantageous and can be promoted by a suitable shaping of the channels for A.

In Figures 4 and 5, the die has been modified to form two surface layers of a third polymer substance C, applied from a third extruder. C can be, for example, a polymer capable of forming a bond with cellulose. The film C must form a strong adhesive bond with B and B₁, but not necessarily with A. Consequently, there is no need to cover one of the surfaces of the ribbon-formed filaments with B, but B is only interspersed with A as a large number of separate streams as shown in Figure 6.

To achieve this, B is extruded into the common chamber 5 from a row of orifices interspersed with the orifices for A instead of being extruded from a comb-formed orifice.

On the other hand it can also be advantageous to intersperse both component B and component B₁ between the streams of A so as to form the structure shown in Figure 7. To achieve this, die-part 1 is supplied with grooves on the side which in Figure 2 is shown straight, so as to make the orifice for B₁ comb-formed like the orifice for B.

In Figure 8, the film is co-extruded of components A, B, and B₁ in a die 9, which is the die shown in Figures 1 and 2. The heating elements are neither shown here, nor in Figures 1 and 2. The film is cooled first by air (not shown) then by haul-off and cooling roller 10. All rollers shown in Figure 8 are driven rollers. Hereafter the film is stretched in a first longitudinal

stretching process in zone 13 between a set of nip-rollers 11—12, which hold against the stretching, and roller 14 which pulls in conjunction with an embossed roller 16 and its smooth counter roller 15. Roller 12 is heated to a temperature suitable for the stretching. This process has two objectives. One is partly to orient the filaments (a second longitudinal stretching following after the impression) another to bring the filaments closer together. Therefore the length of the stretching zone should be sufficient to allow an almost free contraction of the film, e.g. about 3—4 times the width of the film.

The roller 15 is heated to a temperature suitable for the impression of the film, i.e., to a range where component A is generally solid while B and B₁ are semi-molten to molten—preferably semi-molten—at a temperature in the lower end of their melting range. In order to increase the heat transfer to the film and thereby enable a faster process, roller 14 is also heated, but to a lower temperature where the film has no tendency to stick to the roller. The embossed roller 16 is cooled by water in order to facilitate the release of the net after the impression.

As already mentioned, the cooling of the embossed roller facilitates the release of the net. Further for this purpose, the cross-section of each tooth may advantageously be of trapezoid shape. The hot counter-roller 15 having a smooth surface, the net can usually be released from this surface without special precautions being taken, however, if a sticky surface component is used in the film, it may be necessary to apply a release agent to this roller. The product is pulled off from the embossed roller and its counter-roller at a very small draw ratio by means of nip-rollers 24 and 25, and is finally drawn in the longitudinal direction between these nip-rollers 26 very near to roller 25, a lateral contraction of the net is almost prevented, and the straight perpendicular position of the stems is maintained. The net is then fed into a tenter-frame 28 both to orient the stems and to perform splitting. Further, if flat stems are desirable, the net is calendered at a suitable temperature prior to the cross-stretching.

It is usually advantageous to produce a strong orientation in both filaments and stems. If the filaments consist of polyamide or polyester, the total longitudinal stretch ratio should preferably be between 3.5:1 and 6:1. If the stems consist of polypropylene or high density polyethylene, the transverse stretch ratio should preferably be between 5:1 and 10:1.

All longitudinal orientation can be carried out before the embossment (impression) but then the spacing between the stems in the final product will be smaller, and it will be difficult to reach the extreme low square meter weights. On the other hand it is also possible to carry out all longitudinal orientation after the impression, but then it is difficult to maintain the rectilinear arrangement of the stems. It is usually advisable to carry out about half of the orientation before and half of it after the impression.

WHAT WE CLAIM IS:—

1. An embossed fibrillated film product in the form of a net comprising a regular array of transverse stems of a polymer material and a regular array of longitudinal fibrous structures of a different polymer material interconnecting said stems, said longitudinal fibrous structures being continuous ribbon-like filaments which are embedded in said stems at their intersections, there being no bond between said filaments and said stems.

2. A net according to claim 1, wherein the polymer material forming the filaments has a melting range higher than the polymer material forming the stems thereof.

3. A net according to any of claims 1 and 2, wherein said ribbon-like filaments are tapered at their edges.

4. A net according to any preceding claim, wherein said filaments are molecularly oriented.

5. A net according to any preceding claim, wherein said stems are molecularly oriented.

6. A net according to any preceding claim, wherein each of said stems is formed of several layers of different polymer materials.

7. A net according to claim 6, wherein at least one surface layer is formed of an olefin copolymer capable of producing a band with cellulose, while the main portion of the stems is formed essentially of an olefin homopolymer.

8. A net according to claim 6 and 7, wherein at least one surface layer is formed of an ionomer, while the main portion of the stems is formed essentially of an olefin homopolymer.

9. A net according to any of claims 6 to 8, wherein said layers are in a state of differential shrinkage causing a curling of the stems.

10. A net according to any of claims 1 to 5, wherein said filaments are formed of a polyamide, or of polyethylene-



stretching process in zone 13 between a set of nip-rollers 11—12, which hold against the stretching, and roller 14 which pulls in conjunction with an embossed roller 16 and its smooth counter roller 15. Roller 12 is heated to a temperature suitable for the stretching. This process has two objectives. One is partly to orient the filaments (a second longitudinal stretching following after the impression) another to bring the filaments closer together. Therefore the length of the stretching zone should be sufficient to allow an almost free contraction of the film, e.g. about 3—4 times the width of the film.

The roller 15 is heated to a temperature suitable for the impression of the film, i.e., to a range where component A is generally solid while B and B₁ are semi-molten to molten—preferably semi-molten—at a temperature in the lower end of their melting range. In order to increase the heat transfer to the film and thereby enable a faster process, roller 14 is also heated, but to a lower temperature where the film has no tendency to stick to the roller. The embossed roller 16 is cooled by water in order to facilitate the release of the net after the impression.

As already mentioned, the cooling of the embossed roller facilitates the release of the net. Further for this purpose, the cross-section of each tooth may advantageously be of trapezoid shape. The hot counter-roller 15 having a smooth surface, the net can usually be released from this surface without special precautions being taken, however, if a sticky surface component is used in the film, it may be necessary to apply a release agent to this roller. The product is pulled off from the embossed roller and its counter-roller at a very small draw ratio by means of nip-rollers 24 and 25, and is finally drawn in the longitudinal direction between these nip-rollers 26 very near to roller 25, a lateral contraction of the net is almost prevented, and the straight perpendicular position of the stems is maintained. The net is then fed into a tenter-frame 28 both to orient the stems and to perform splitting. Further, if flat stems are desirable, the net is calendered at a suitable temperature prior to the cross-stretching.

It is usually advantageous to produce a strong orientation in both filaments and stems. If the filaments consist of polyamide or polyester, the total longitudinal stretch ratio should preferably be between 3.5:1 and 6:1. If the stems consist of polypropylene or high density polyethylene, the transverse stretch ratio should preferably be between 5:1 and 10:1.

All longitudinal orientation can be carried out before the embossment (impression) but then the spacing between the stems in the final product will be smaller, and it will be difficult to reach the extreme low square meter weights. On the other hand it is also possible to carry out all longitudinal orientation after the impression, but then it is difficult to maintain the rectilinear arrangement of the stems. It is usually advisable to carry out about half of the orientation before and half of it after the impression.

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2. A net according to claim 1, wherein the polymer material forming the filaments has a melting range higher than the polymer material forming the stems thereof.

3. A net according to any of claims 1 and 2, wherein said ribbon-like filaments are tapered at their edges.

4. A net according to any preceding claim, wherein said filaments are molecularly oriented.

5. A net according to any preceding claim, wherein said stems are molecularly oriented.

6. A net according to any preceding claim, wherein each of said stems is formed of several layers of different polymer materials.

7. A net according to claim 6, wherein at least one surface layer is formed of an olefin copolymer capable of producing a band with cellulose, while the main portion of the stems is formed essentially of an olefin homopolymer.

8. A net according to claim 6 and 7, wherein at least one surface layer is formed of an ionomer, while the main portion of the stems is formed essentially of an olefin homopolymer.

9. A net according to any of claims 6 to 8, wherein said layers are in a state of differential shrinkage causing a curling of the stems.

10. A net according to any of claims 1 to 5, wherein said filaments are formed of a polyamide, or of polyethylene-

terephthalate, and said stems are formed of polyolefin.

11. A net according to any preceding claim, wherein said stems are of substantially circular or square cross-section.
- 5 12. A net according to any of claims 1 to 10, wherein said stems are flat.

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