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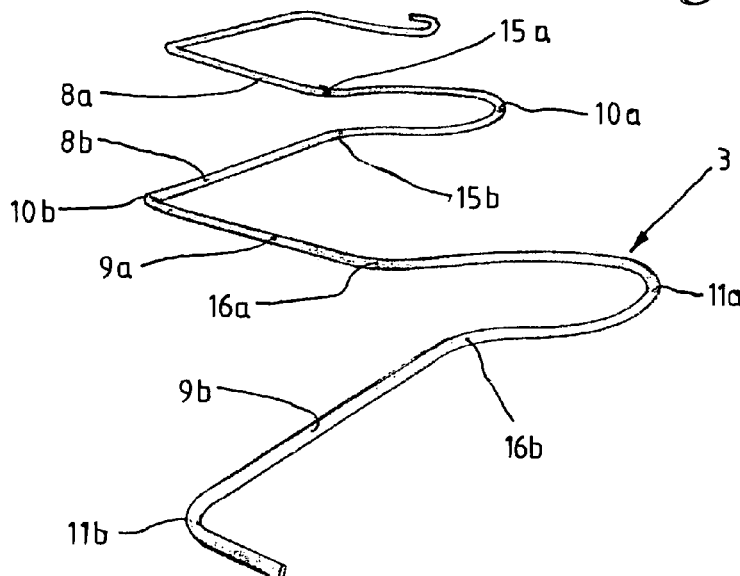
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(54) Title: NET, IN PARTICULAR FOR PROTECTION, SAFETY, WATER-REARING OR ARCHITECTURAL PURPOSES,
AND AN APPARATUS FOR PRODUCING THE NET

(54) Bezeichnung : NETZ, INSBESONDERE FÜR DEN SCHUTZ-, SICHERHEITS-, GEWÄSSERZUCHT- ODER
ARCHITEKTURBEREICH, SOWIE EINE VORRICHTUNG ZUR HERSTELLUNG DES NETZES

Fig. 2



(57) Abstract: A net, in particular for protection, safety, water-rearing or architectural purposes, is braided together from individual helically curved longitudinal elements (3) to form a braided structure. Individual longitudinal elements (3) curved into a cylinder or screw shape are twisted one inside the other with adjacent ones and compressed such that the braided structure is in more or less planar sheet-like form and the longitudinal elements (3) here each form more or less rectilinear limbs (8a, 8b; 9a, 9b) and curves (10a, 10b; 11a, 11b) therebetween. The curves (10a, 10b; 11a, 11b) between elongate limbs (8a, 8b; 9a, 9b) are inflected in kink form. This gives a net design with unexpectedly high strength values.

(57) Zusammenfassung: Ein Netz, insbesondere für den Schutz-, Sicherheits-, Gewässerzucht- oder Architekturbereich,

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- vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eingehen (Regel 48 Absatz 2 Buchstabe h)

ist aus einzelnen wendelförmig gebogenen Längselementen (3) zu einem Geflecht zusammengeflochten. Einzelne zu einer Zylinder- bzw. Schraubenform gebogenen Längselemente (3) sind mit benachbarten ineinandergedreht und derart zusammengedrückt, dass das Geflecht eine annähernd ebene Flächenform und die Längselemente (3) dabei jeweils annähernd geradlinige Schenkel (8a, 8b; 9a, 9b) und dazwischen Krümmungen (10a, 10b; 11a, 11b) bilden. Die Krümmungen (10a, 10b; 11a, 11b) zwischen den länglichen Schen- kein (8a, 8b; 9a, 9b) sind jeweils knickförmig ausgebildet. Damit ergibt sich eine Netzausbildung mit unerwartet hohen Festigkeitswerten.

Net, in particular for protection, safety, water-rearing or architectural purposes, and an apparatus for producing the net

1. FIELD OF THE INVENTION

The invention relates to a net, in particular for protection, safety, water-rearing or architectural purposes which is manufactured by pairwise interlacing / intertwining individual, helically or similarly bent longitudinal elements, such as wires, to form a woven structure. The individual longitudinal elements are curved into a cylinder or screw shape or similar, pairwise twisted one inside the other and are then flattened such that the woven structure forms a substantially planar sheet-like form, wherein the longitudinal elements each form substantially rectilinear limbs extending between curved returns (the returns are herein simply termed 'curves'). The invention also is concerned with an apparatus for producing the net.

2. BACKGROUND OF THE INVENTION

Protective nets of this type are characterised in that they have a high tear strength and good deformability, and on this basis can be stressed to a considerable extent. This type of protective net is disclosed in WO 2010/049089 which relates to a high-strength loosely woven structure composed of wire spirals twisted one inside the other and which are pressed flat to form three-dimensional rows of loops. This procedure enables inexpensive production of the woven structure.

It would enrich the state of the art if one were to improve the strength values of the net by way of simple structural measures while retaining the above mentioned advantages, and moreover to enable faultless production of such nets or loosely woven structures.

3. SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, there is provided a net, in particular for protection, safety, water-rearing or architectural purposes, comprising a plurality of wire-, strand- or cord-like longitudinal elements, shaped and coupled together to form a mesh structure in which adjacent ones of the initially helically bent individual longitudinal elements are twisted pairwise one inside the other such that curved portions of adjacent longitudinal elements interloop and the resulting weave of helically bent longitudinal elements is compressed into a substantially planar sheet-like form in which (a) each of the longitudinal elements exhibits a plurality of substantially elongate limbs alternating in orientation and extending between curves at each end of the elongate limbs, (b) the curves between the elongate limbs are kink-like deformed with a relatively small curvature radius by compressing the elongate limbs respectively adjacent the curves against one another transversely to their longitudinal extension and (c) in forming the planar sheet-like net, the elongate limbs remain outside a net surface in which the interlooped curves of the coupled longitudinal elements are located so as to maintain a small angle (α) of inclination with respect to said net surface.

In a further aspect, the present invention provides an apparatus for manufacturing nets, including stamps arranged in rows and which are adjustable in relation to one another transversely to the longitudinal extension of the longitudinal elements, each stamp including a guide groove for centering the longitudinal element on a front face side, the guide grooves running according to a gradient angle of the limbs. The stamps are movable between an initial position in which one of the bent longitudinal elements is turned or inserted in the guide grooves of the stamps, and a final position in which the longitudinal element is compressed. The respective kinked shape of the curves is produced by the elongate limbs being guided through the stamps over substantially their entire length and the longitudinal elements respectively only projecting out of the stamps at the curve.

The kinks in the limb regions according to the invention increase the flexibility of the net and to some extent loosen the geometry of the net, and in nature this leads to a visually advantageous camouflaging effect. Since these nets according to the invention are used above all in nature to counter natural hazards, this is an advantage with respect to conventional nets.

The kinks in the nets lead, moreover, to a loose, three-dimensional structure which for architectural applications achieves novel visual effects which can be used, for example, for large-scale façade coverings.

For the purpose of a mostly mirror-symmetrical design of the woven net structure, the invention makes provision such that the longitudinal elements are provided with kinks bent alternately in opposite directions transversely to the surface of the net. This measure is particularly advantageous if the longitudinal elements form diamond-shaped loops the limbs of which have kinks bent in opposite directions.

With regard to the use of the protective net in environmentally adverse conditions, the invention also makes provision such that the longitudinal elements are produced from wires, cords or strands made of corrosion-resistant, rust-proof and corrosion protection-coated steel. Advantageously the wires, cords or strands are produced from high strength steel with a strength of 1000 N/mm^2 to 3200 N/mm^2 .

For the purpose of flexible end connection of the longitudinal elements it is advantageous if the wires, cords or strands are knotted at the end to form loops by means of which they can be connected with one another in pairs to wire clips, wire hooks or similar connection elements.

In the following the invention will be described in more detail by means of exemplary, non limiting embodiments with reference to the drawings.

4. BRIEF DESCRIPTION OF THE DRAWINGS

- Fig. 1 illustrates a net according to the invention, shown in simplified form in the front view;
- Fig. 2 is a perspectively illustrated longitudinal element of the protective net according to Fig. 1,
- Fig. 3 and 4 show respective embodiments of the longitudinal element from Fig. 2, shown in the direction of arrow I in Fig. 1,
- Fig. 5 is a perspective diagrammatic view of two stamps of an apparatus according to the invention for the production of the net; and
- Fig. 6 to 8 each show two stamps respectively shown diagrammatically in a diagrammatic view and which are shown, collectively, in three different positions adjusted in relation to one another and which here are pressing flat a wire bent in helical form.

5. DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Fig. 1 shows part of a net 1 which can be used in particular as a net that protects against rock fall, landslides, avalanches, unstable embankments and similar natural hazards. Moreover, it can be used for safety purposes or for aesthetic purposes in architecture. For example, they are used as fencing systems, shut-off and safety barriers, shatter protection, break-in and break-out protection, thoroughfare blocks for vehicles or ships and for further safety-relevant net solutions. This type of net is also suitable, however, as a protective net for baskets or covers for the rearing of fish, mussels or molluscs in bodies of water.

The net 1 is made up of a wire mesh woven structure 2 that is produced from longitudinal elements 3 in the form of helically bent steel wires 4, 5, 6, 7 according to Fig. 5. The wires 4, 5, 6, 7 bent in the form of spirals are twisted one inside the other in pairs, are looped together and pressed flat such that at the end of the shaping process they obtain the form shown in Fig. 2 with regularly successive limbs 8a, 8b; 9a, 9b and curves 10a, 10b; 11a, 11b. The

wound longitudinal elements 3 are compressed in the limb regions 8a, 8b; 9a, 9b such that they are more or less rectilinear.

The wire mesh woven structure 2 produced in this way has diamond-shaped meshes 12 the flexible knots 13 of which define the net surface 14 drawn in by dots and dashes in Fig. 3 and Fig. 4 with an approximately planar sheet-like form A.

At their ends, the wires of the longitudinal elements 3 are bent or knotted to form loops 17a, 17b; 18, 18b which make it possible to connect the wires at the end by means of wire clips or wire hooks guided in pairs through the loops 17a, 17b and 18a, 18b or by means of similar elements at the end. The knotted wire ends additionally enable inexpensive connection to the adjacent net sections of the protective net. Needless to say other comparable end connections for the wire ends of the longitudinal elements can also be used instead of knots.

According to the invention, the helically wound longitudinal elements 3 are shaped into a more or less planar sheet-like form A in the net surface 14, the curves 10a, 10b; 11a, 11b respectively being produced in the form of kinks. These kink-like curves 10a, 10b; 11a, 11b are formed such that the radius of curvature is very small or almost zero on the inside of each respective curve 10a, 10b; 11a, 11b.

Moreover, within the framework of the invention, the longitudinal elements 3 are formed such that they are more or less planar in the net surface 14 and are each provided with a slight kink 15a, 15b; 16a, 16b, protruding transversely to the net surface 14, in the limb regions 8a, 8b, 9a, 9b. The effect of this simple measure is that the net has higher tensile and tear strength values and clearly greater deformability than without the kinks. In this way, if there is an impact from a heavy object it can absorb more kinetic energy.

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The kinks 15a, 15b; 16a, 16b are arranged approximately in the middle of the limbs 8a, 8b; 9a, 9b, alternately pointing in opposite directions transverse to the net surface 14. They have a height of at most a few millimetres which is advantageously determined dependently upon the diameter of the longitudinal elements 3.

It is also possible within the framework of the invention to provide a number of kinks in each limb running in the same or in opposite directions. Even very slight kinks enable advantageous elastic or plastic springing functions depending on the application.

As can be seen from Fig. 3 and Fig. 4, it is also possible within the framework of the invention to vary the geometry of the wire woven structure 2 provided its longitudinal elements 3 are more or less planar in the net surface 14 and the limbs 8a, 8b; 9a, 9b are provided with slight kinks transversely to the net surface 14. Depending on the conditions of use, a mesh structure made up of cords or strands can also be used instead of the wire mesh structure.

The flexible connections 13 where adjacent wires 3 interloop at the curved regions make it possible to roll up or fold up the net structure. This is advantageous for transportation and storage of the net.

Fig. 5 to Fig. 8 show diagrammatically two of the stamps 21, 22 of an apparatus according to the invention arranged in rows. These stamps 21, 22 are respectively provided with a guide groove 21', 22' receiving the wire 3 on the front face side and are arranged in relation to one another such that the guide grooves 21', 22' are alternately directed towards one another and run according to the gradient angle of the limbs 8a, 8b; 9a, 9b. These stamps 21, 22 can be adjusted here backwards and forwards transversely to the longitudinal extension of the helically bent longitudinal elements 3 a specific distance apart from one another by means of driveable rods.

Fig. 6 illustrates the initial position of two of the stamps 21, 22 arranged in rows which are spaced apart depending upon the gradient height of the

individual wire helix. Here, the helically bent wire 3 is turned along its longitudinal axis into the guide grooves 21', 22' similarly to screwing in and, moreover, is at the same time threaded into an adjacent wire that has already been pressed flat, but which is not detailed. In this way the net can be produced continuously.

Fig. 7 shows the two stamps 21, 22 in a position displaced in relation to one another and compressing the wire 3.

It emerges from the final position of the stamps 21, 22 according to Fig. 8 how the curves 10a, respectively made in a kink shape, of the longitudinal elements 3 are produced between the elongate limbs 8a, 8b. The elongate limbs 8a, 8b produced upon achieving the planar sheet-like form are guided more or less over their entire length by the stamps 21, 22, as can also be gathered from Fig. 5. Here the longitudinal elements 3 respectively only project from the stamps 21, 22 at the curves 10a, 10b.

The respectively adjacent limbs 8a, 8b are compressed against one another transversely to their longitudinal extension until achieving the planar sheet-like form A, hereby maintaining an additional angle α . With this over-expansion of the limbs the respective kink shape of the curves is additionally favoured because in this way a type of strength increase is brought about to a certain extent, this angle α , which is preferably between 10° and 30° , becoming smaller when the stamps are drawn back and the longitudinal element is released by the springing back of the limbs.

In order to produce the kinks 15a, 15b; 16a, 16b in the longitudinal elements 3 the stamps 21, 22 are equipped with pins 24, 25 that can also be moved backwards and forwards transversely to the longitudinal extension of the longitudinal elements 3, and which are preferably moved perpendicularly towards the limbs 8a, 8b in this end position of the stamps 21, 22 shown in Fig. 8 to such an extent that these permanent kinks are produced.

For nets made of such wire mesh structure high-strength wires with strengths of between 1000 N/mm^2 and 3200 N/mm^2 are preferably used which withstand particularly high loading.

Depending on the application and the desired deformation characteristics, however, applications in the nominal strength range of between 350 N/mm^2 and 1000 N/mm^2 are also advantageous.

In consideration of the conditions of use in the open air rust-proof, corrosion-resistant steels or steels coated with corrosion protection are preferred. When using these nets as baskets or covers in the rearing of fish or mussels they are provided with an anti-fouling layer which may contain, for example, copper. When using cords or strands it is not necessary for them to be made exclusively of high-strength wires with the nominal strength values specified above.

With the net according to the invention it is additionally made possible to produce round, cylindrically closed net elements which can, for example, be placed over mussel rearing elements. Cube-like bodies made up of individual net elements can also be produced.

The corresponding wire diameters for the net according to the invention are preferably in the range of between 0.5 mm and 5.0 mm. Instead of individual wires, strands (e.g. consisting of 2 to 7 wires) can also be used.

The invention is sufficiently demonstrated by the above exemplary embodiment. However, it could also be illustrated by other versions. Thus, for example, a number of or theoretically no kinks could be provided for each limb element depending on the application. Here, preferably an odd number of kinks is advantageous. Instead of the previously mentioned kink, similar shape elements also advantageously lead to improvements according to the invention. Such shape elements can, similarly to kinks, be made to be slightly elongated and/or oval in shape.

Depending on the intended use of the net, the individual longitudinal elements can in principle also be made with different strengths.

CLAIMS

1. A net, in particular for protection, safety, water-rearing or architectural purposes, comprising a plurality of wire-, strand- or cord-like longitudinal elements, shaped and coupled together to form a mesh structure in which adjacent ones of the initially helically bent individual longitudinal elements are twisted pairwise one inside the other such that curved portions of adjacent longitudinal elements interloop and the resulting weave of helically bent longitudinal elements is compressed into a substantially planar sheet-like form in which (a) each of the longitudinal elements exhibits a plurality of substantially elongate limbs alternating in orientation and extending between curves at each end of the elongate limbs, (b) the curves between the elongate limbs are kink-like with a relatively small curvature radius by compressing the respectively adjacent elongate limbs against one another transversely to their longitudinal extension and (c) in forming the planar sheet-like net, the elongate limbs remain outside a net surface in which the interlooped curves of the coupled longitudinal elements are located so as to maintain a small angle (α) of inclination with respect to said net surface.
2. The net according to Claim 1, wherein the longitudinal elements are formed with respectively at least one slight kink in the elongate limbs between the curves.
3. The net according to Claim 2, wherein the kinks in the elongate limbs respectively protrude transversely to the net surface and are arranged about the middle of the elongate limbs.
4. The net according to Claim 2 or 3, wherein the kinks protruding transversely to the net surface respectively have a maximum height of a few millimetres.
5. The net according to claim 4, wherein the maximum height is determined as a function of a diameter of the longitudinal elements.

6. The net according to any one of the preceding Claims 1 to 5, wherein the kinks in the elongate limbs of the longitudinal elements are bent alternately in opposite directions transversely to the net surface.
7. The net according to Claim 6, wherein the longitudinal elements form diamond-shaped meshes the limbs of which are provided with kinks bent in opposite directions.
8. The net according to any one of the preceding Claims, wherein the longitudinal elements are produced from wires, cords or strands made of corrosion-resistant, rust-proof or corrosion protection-coated steel.
9. The net according to any of the preceding Claims, wherein the wires, cords or strands are produced from high strength steel, preferably with a nominal strength of from 1000 N/mm^2 to 3200 N/mm^2 .
10. The net according to Claim 8 or 9, wherein the wires, cords or strands are knotted at opposite free ends thereof to form loops by means of which these can be connected flexibly to one another in pairs at their ends with connection elements including wire clips, wire hooks or similar connection elements.
11. An apparatus for the manufacture of a net according to any of Claims 1 to 10, comprising stamps arranged in rows and which can be adjusted in relation to one another transversely to the longitudinal extension of the helically bent longitudinal elements, each of the stamps provided on a front face side with a guide groove arranged for centring the longitudinal element, the guide grooves running according to a gradient angle of the elongate limbs, the stamps being displaceable to attain an initial position in which one of the helically bent longitudinal elements is able to be turned or inserted in the guide grooves of the stamps, and to attain a final position in which the longitudinal element is compressed, wherein the respective kinked shape of the curves of the elongate element being produced upon achieving the planar

sheet-like form in that only the elongate limbs are guided through the stamps over their entire length and the longitudinal elements respectively only projecting out of the stamps at the curves.

12. The apparatus according to Claim 11, wherein the elongate limbs are compressed by the stamps until achieving the planar sheet-like form and the kinks in the limbs protrude from the net surface.

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Fig. 1

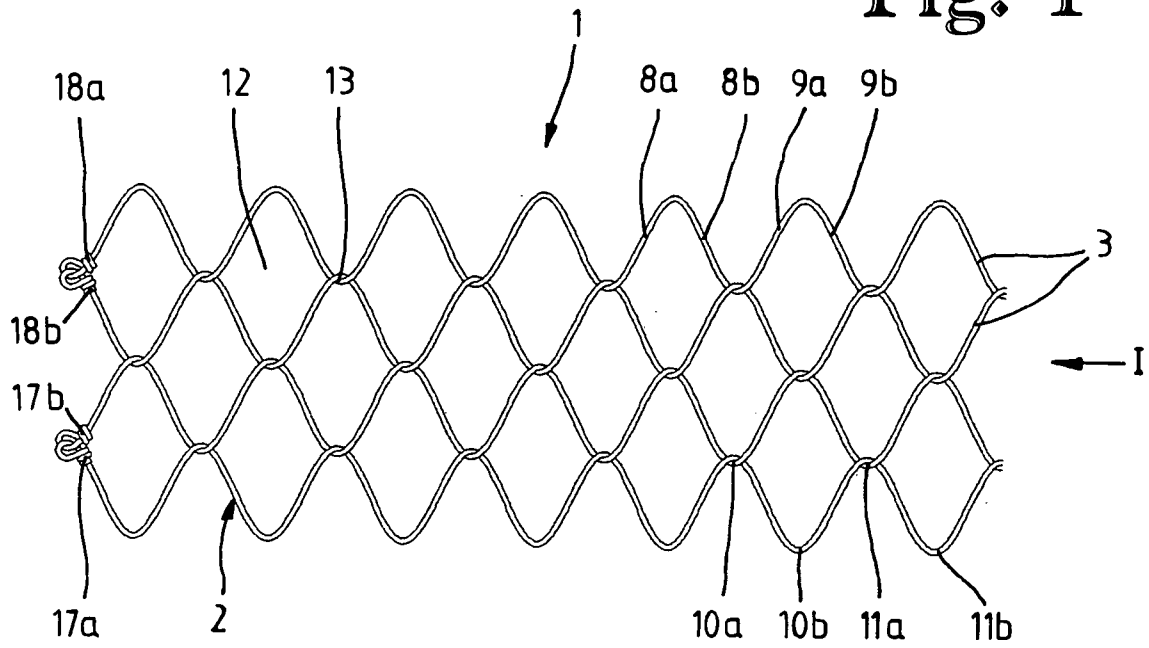


Fig. 2

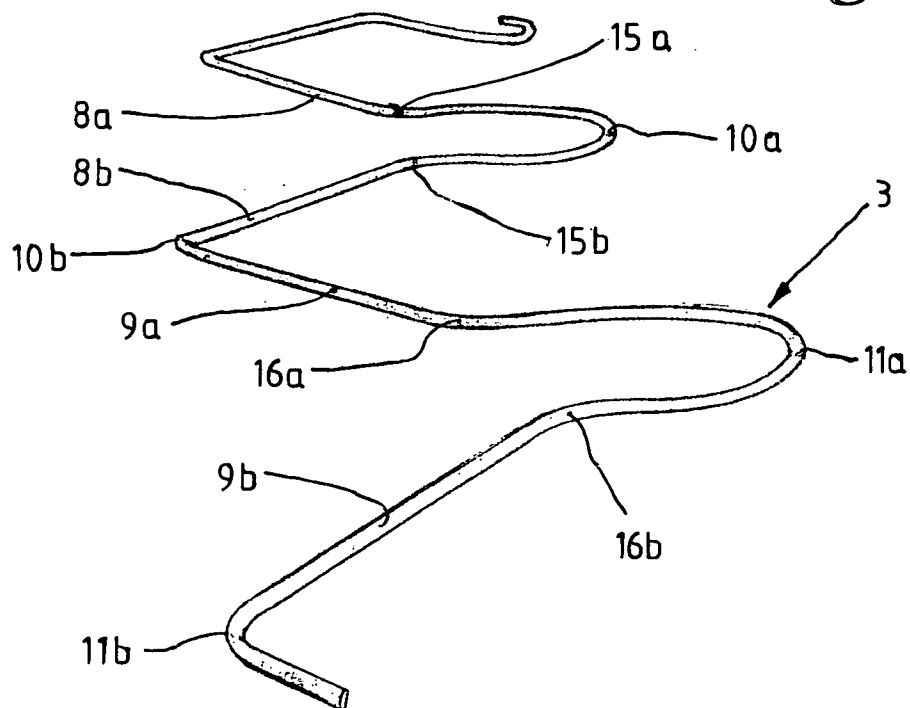


Fig. 3

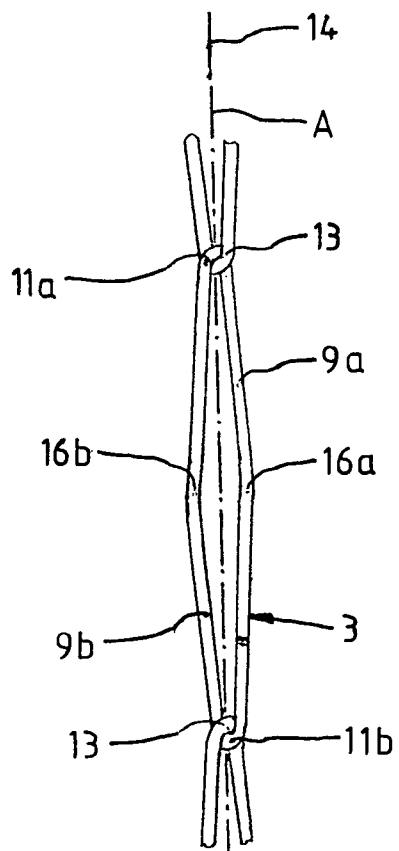


Fig. 4

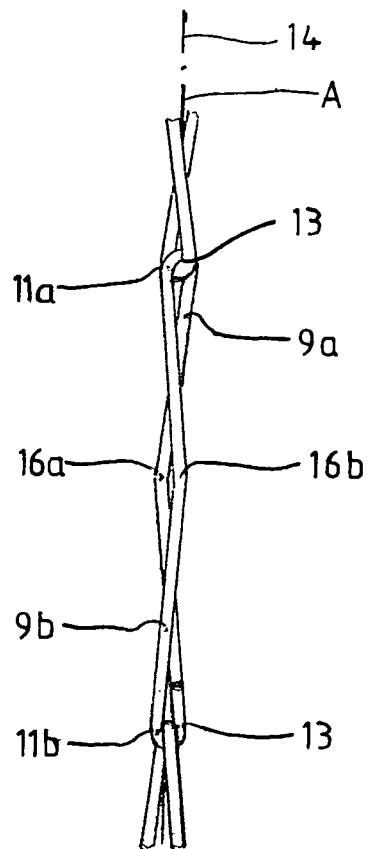


Fig. 5

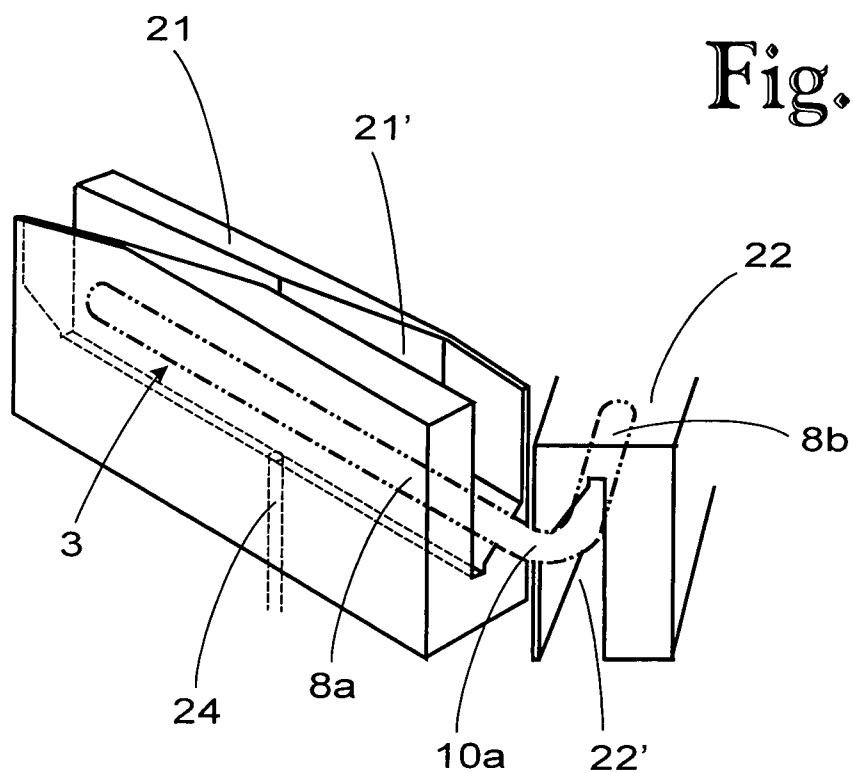


Fig. 6

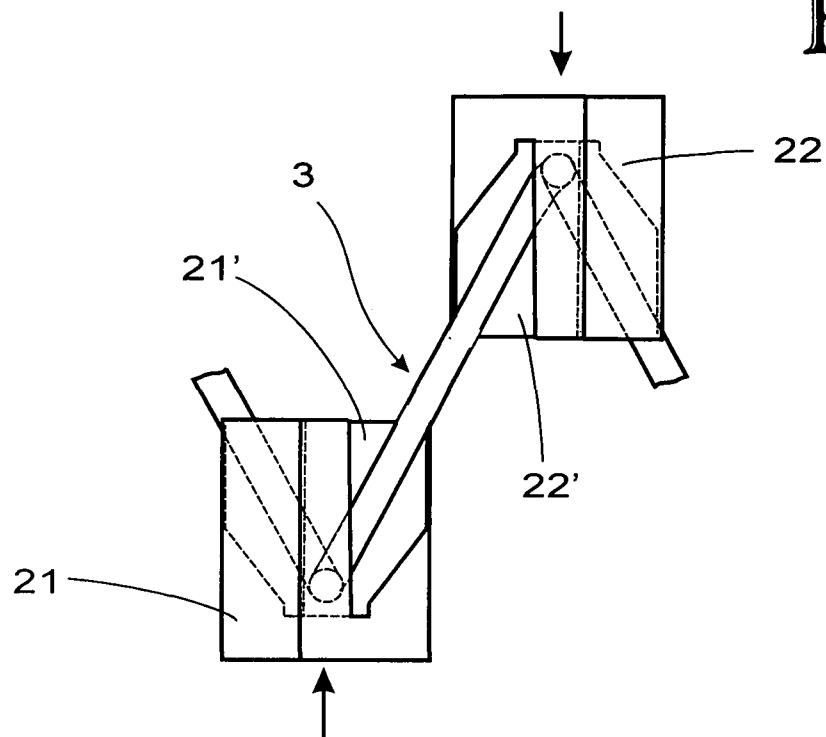


Fig. 7

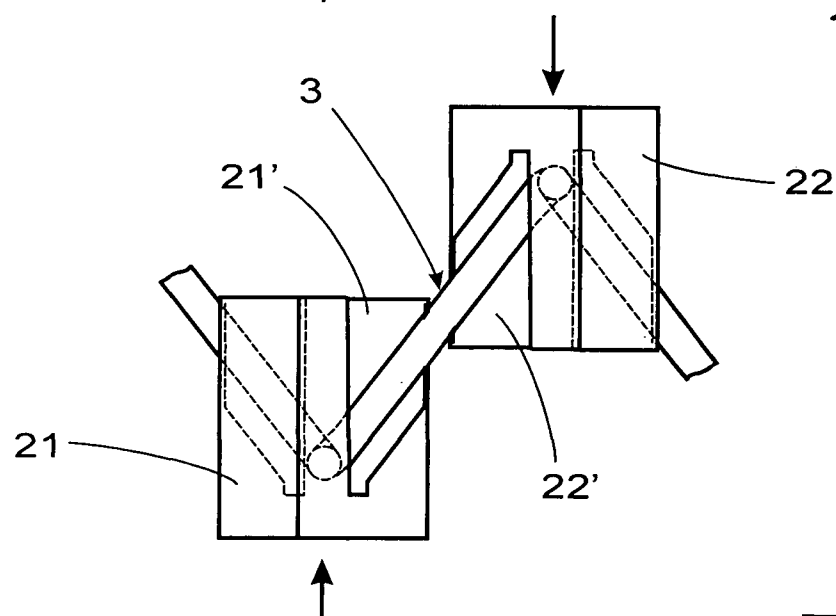


Fig. 8

