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(54) **UNDERWATER DIVING FIN WITH A HIGH PROPULSIVE CAPABILITY**

(57) The underwater diving fin (1) comprises a paddle (2) made of thermoplastic elastomeric material comprising a longitudinal underlayer (4, 5) of uniform thickness which comprises a propulsion flap (4), positioned on which there is an overlayer (15) configured to promote the simultaneous formation of opposite deflections on the propulsion flap (4) during kicking.

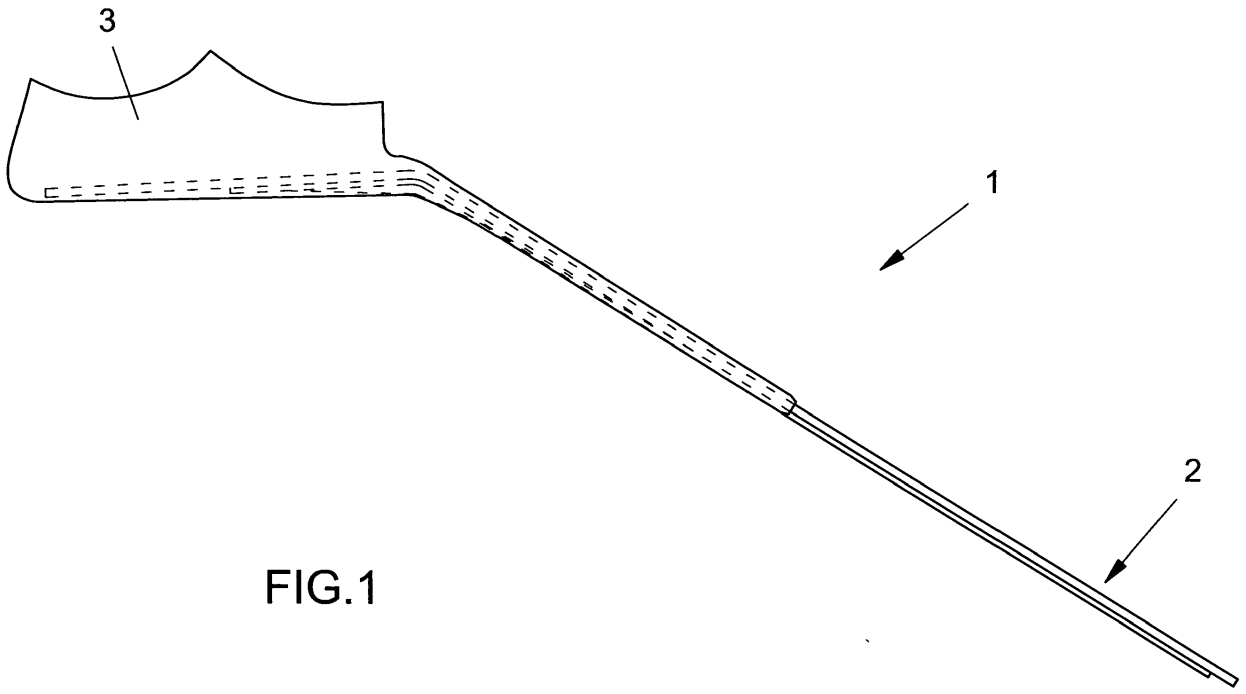

FIG.1

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Description

[0001] The present invention relates to an underwater diving fin with a high propulsive capability.

[0002] Underwater diving fins comprising a paddle made of thermoplastic elastomeric material and a replaceable rubber boot are known in the market.

[0003] In the professional or semi-professional realm, the fin must be designed to assure performances suited to even the most demanding free divers.

[0004] Various fin designs are known, aimed at optimising the propulsive yield; during kicking, they enable an excellent return of the paddle to be obtained.

[0005] During a kick, the paddle accumulates potential elastic energy by bending into an arch and then releases it, thus assisting the free diver's motor action.

[0006] However, there is a felt need to improve the structure and design of the known fins of the above-mentioned type in order to increase the propulsive yield.

[0007] The task of the present invention is thus to eliminate the drawbacks complained of in the prior art by providing a high-performance underwater diving fin .

[0008] Within the scope of this task, one object of the invention is to provide a simple underwater diving fin that combines high performance with great constructive simplicity.

[0009] The task and these and other objects, according to the present invention, are achieved by providing an underwater diving fin comprising a boot and a paddle made of thermoplastic elastomeric material having a Young modulus comprised between 800 MPa and 1200 MPa, said paddle having an angled underlayer, characterised in that said paddle has an overlayer, and in that:

- said angled underlayer has the shape and size of said paddle, it has a uniform thickness comprised between 2.5 mm and 3.0 mm, and it has a flexible longitudinal propulsion flap and a flap for the removable attachment of said boot, said propulsion flap having a length comprised between 0.5 m and 0.7 m, the angle formed between said propulsion flap and said attachment flap being secured by one or more ribs connecting between said propulsion flap and said attachment flap;
- said overlayer covers said propulsion flap selectively in a zone adjacent to said attachment flap, and has a maximum thickness of a value no greater than 1.8 mm. Thanks to the special structure and design of the paddle, the propulsion flap deforms during kicking, changing concavity in an intermediate cross section thereof.

[0010] The propulsion flap, in fact, has opposite deflections in the longitudinal zone thereof covered by the overlayer and in the adjacent longitudinal zone with no overlayer.

[0011] The paddle provides a new way of accumulating potential elastic energy and releasing the accumulated potential elastic energy, which assists, in an optimal manner, the motor action of the free diver's leg, thereby assuring an improvement in the propulsive yield.

[0012] With the same number of kicks, therefore, the free diver can cover a longer distance or can cover the same distance with fewer kicks.

[0013] In a possible solution, said overlayer extends continuously for at least most of the width of said propulsion flap.

[0014] In a possible solution said overlayer extends continuously for no more than half the length of said propulsion flap, starting from the vertex of said angle.

[0015] In a possible solution, said overlayer has a thickness decreasing from said maximum value to zero in the longitudinal direction of said underlayer towards the free end of said propulsion flap.

[0016] In a possible solution, said overlayer present over said propulsion flap has a quadrangular cross section and a triangular longitudinal section.

[0017] In a possible solution, said overlayer also extends over said attachment flap.

[0018] In a possible solution, said overlayer is in a rearward position relative to the perimeter edge of said underlayer.

[0019] In a possible solution, said connecting ribs are positioned above said overlayer.

[0020] In a possible solution the boot is co-moulded with the paddle.

[0021] Additional features and advantages will become more apparent from the detailed description of the underwater diving fin according to the invention, illustrated by way of example in the appended figures, of which:

figure 1 shows a side elevation view of the fin;
figure 2 shows a plan view of the fin paddle;
figure 3 shows a longitudinal sectional view of the fin paddle along the line A-A in figure 2;
figure 4 shows a cross sectional view of the fin paddle along the line B-B in figure 2; and
figure 5 schematically shows the fin paddle in a configuration of use.

[0022] With reference to the aforementioned figures, they show an underwater diving fin denoted in its entirety by the reference number 1.

[0023] The fin 1 comprises a paddle 2 and a boot 3, which, in the case shown, is removably fastened to the paddle 2 so that it can be replaced.

[0024] For example, in this regard, the paddle 2 is provided with holes 12 for fastening the boot 3.

[0025] The paddle 2 comprises an angled longitudinal underlayer 4, 5 of uniform thickness which has the shape and size of the paddle 2.

[0026] The angled underlayer 4, 5 has a flexible longitudinal propulsion flap 4 and a flap 5 for the removable attachment of the boot 3.

[0027] The obtuse angle Θ formed between the propulsion flap 4 and the attachment flap 5 is secured by

one or more ribs 6, 7 which connect together adjacent edges of the propulsion flap 4 and of the attachment flap 5.

[0028] The propulsion flap 4 has a length comprised between 0.5 m and 0.7 m, typical of a fin for which high performance standards are required.

[0029] Longitudinal anti-torsion ribs 8, 9, 10, 11 are provided along and/or adjacent to the slightly rounded longitudinal sides of the propulsion flap 4.

[0030] More precisely, a first pair of longitudinal anti-torsion ribs 8, 9 run parallel to the longitudinal sides of the propulsion flap 4 for most of the length of the propulsion flap 4 on the main face of the latter which forms the obtuse angle Θ.

[0031] The anti-torsion ribs 8, 9 originate at a certain distance from the vertex 13 of the angle Θ and stop at a certain distance from the free longitudinal end 14 of the propulsion flap 4.

[0032] A second pair of longitudinal anti-torsion ribs 10, 11 of a shorter length run along the longitudinal sides of the propulsion flap 4, but mainly serve as anchorage for the boot 3.

[0033] The second pair of anti-torsion ribs 10, 11 originate at a certain distance from the vertex 13 of the angle Θ and lie alongside a portion of the first pair of longitudinal anti-torsion ribs 8, 9.

[0034] The second pair of anti-torsion ribs 10, 11 extend orthogonally and symmetrically from both main faces of the propulsion flap 4.

[0035] Advantageously, the paddle 2 is entirely made of thermoplastic elastomeric material having a Young modulus comprised between 800 MPa and 1200 MPa and has an overlayer 15 covering the propulsion flap 4 selectively in a zone adjacent to the attachment flap 5.

[0036] The parts making up the paddle 2, i.e. the underlayer 2, the overlayer 15, and the various ribs 6, 7, 8, 9, 10, 11, can be produced in a single step of hot molding of the thermoplastic elastomeric material.

[0037] The underlayer 4, 5 has thickness of a value comprised between 2.5 mm and 3.0 mm, while the overlayer 15 has a maximum thickness of a value no greater than 1.8 mm.

[0038] The overlayer 15 extends continuously at least for most of the width of the propulsion flap 4.

[0039] Moreover, the overlayer 15 extends continuously for no more than half the length of the propulsion flap 4, starting from the vertex 13 of the angle Θ.

[0040] The overlayer 15 has a thickness decreasing from the maximum value to zero in the longitudinal direction of the underlayer 4, 5 towards the free end 14 of the propulsion flap 4.

[0041] In a preferred embodiment, the overlayer 15 that extends over the propulsion flap 4 has a quadrangular, preferably rectangular, cross section and a triangular longitudinal section.

[0042] The overlayer 15 preferably has a perimeter edge that is positioned rearward towards the centre of the propulsion flap 4 relative to the perimeter edge of the underlayer 4, 5.

[0043] Preferably, the longitudinal sides of the overlayer 15 run parallel and inside the longitudinal sides of the underlayer 4, 5.

[0044] The anti-torsion ribs 8, 9, 10, 11 extend in the space comprised between the longitudinal sides of the underlayer 4, 5 and the longitudinal sides of the overlayer 15.

[0045] Advantageously, the overlayer 15 has an extension 15a on the attachment flap 5 where the ribs 6, 7 connecting between the adjacent edges of the propulsion flap 4 and of the attachment flap 5 are positioned.

[0046] The extension 15a of the overlayer 15 preferably has a perimeter edge positioned rearward towards the centre of the attachment flap 5 relative to the perimeter edge of the underlayer 4, 5.

[0047] The thickness of the extension 15a of the overlayer 15 is preferably uniform and equal to the maximum thickness of the overlayer 15.

[0048] Thanks to the special design of the paddle 2, the propulsion flap 4, initially substantially flat, during use undergoes a deflection A in a zone thereof 4a proximal to the attachment flap 5 where the overlayer 15 is provided, and an opposite deflection B in a zone 4b thereof distal from the attachment flap 5 with no overlayer 15, the result being that the physical effort for kicking is reduced and the propulsive action is thus improved.

[0049] In one embodiment described solely by way of example, the paddle 2 has the folloflap features.

[0050] The thermoplastic elastomeric material is based on elastomerised polypropylene having a Young modulus equal to 1000 MPa.

[0051] The angle Θ between the propulsion flap 4 and the attachment flap 5 has a value of 141°.

[0052] The propulsion flap has a length of 0.6 m and width of 0.2 m.

[0053] The underlayer 4, 5 has a thickness of 2.8 mm.

[0054] The overlayer 15 on the propulsion flap 4 has a maximum thickness of 1.7 mm at the vertex 13 of the angle Θ and the thickness decreases linearly until taking on a value of zero at a distance d of 0.2 m from the vertex 13 of the angle Θ.

[0055] The longitudinal sides of the overlayer 15 on the propulsion flap 4 have a distance of 20.0 mm from the longitudinal sides of the underlayer 4,5.

[0056] The first pair of ribs 8, 9 have a height above the underlayer 4, 5 of 1.3 mm, a width of 7.0 mm and a length of 0.5 m.

[0057] The second pair of ribs 10, 11 have a height above and below the underlayer 4, 5 of 3.0 mm, a width of 2.0 mm and a length of 0.25 m.

[0058] Variants of the preferred embodiment described above are clearly possible, all falling within the scope of protection of the invention.

[0059] In particular, instead of mechanically removably fastening the boot to the paddle, it has been found advantageous also to provide for an indissoluble joining between the paddle and the boot, which can be co-moulded.

[0060] The materials used, as well as the dimensions, can be any whatsoever according to needs and the state of the art.

Claims

1. An underwater diving fin (1) comprising a boot (3) and a paddle (2) made of thermoplastic elastomeric material having a Young modulus comprised between 800 MPa and 1200 MPa, said paddle (2) having an angled underlayer (4, 5), **characterised in that** said paddle (2) has an overlayer (15), and **in that**:

   - said angled underlayer (4, 5) has the shape and size of said paddle (2), it has a uniform thickness comprised between 2.5 mm and 3.0 mm, and it has a flexible longitudinal propulsion flap (4) and a flap (5) for the removable attachment of said boot (3), said propulsion flap (4) having a length comprised between 0.5 m and 0.7 m, the angle (Θ) formed between said propulsion flap (4) and said attachment flap (5) being secured by one or more ribs (6, 7) connecting between said propulsion flap (4) and said attachment flap (5);
   - said overlayer (15) covers said propulsion flap (4) selectively in a zone adjacent to said attachment flap (5), and has a maximum thickness of a value no greater than 1.8 mm.

2. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) extends continuously at least for most of the width of said propulsion flap (4).

3. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) extends continuously for no more than half the length of said propulsion flap (4) starting from the vertex (13) of said angle (Θ).

4. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) has a thickness decreasing from said maximum value to zero in the longitudinal direction of said underlayer (4, 5) towards the free end (14) of said propulsion flap (4).

5. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) present above said propulsion flap (4) has a quadrangular cross section and a triangular longitudinal section.

6. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) has an extension (15a) on said attachment flap (5).

7. The underwater diving fin (1) according to claim 1, **characterised in that** said overlayer (15) is in a rearward position relative to the perimeter edge of said underlayer (4, 5).

8. The underwater diving fin (1) according to claim 1, **characterised in that** said one or more connecting ribs (6, 7) are positioned above said overlayer (15).

9. The underwater diving fin (1) according to any preceding claim (1), **characterised in that** said paddle and said boot are indissolubly joined, being co-moulded.

10. The underwater diving fin (1) according to claim 1, **characterised by** being configured for the simultaneous formation of opposite deflections on the propulsion flap (4) during kicking.

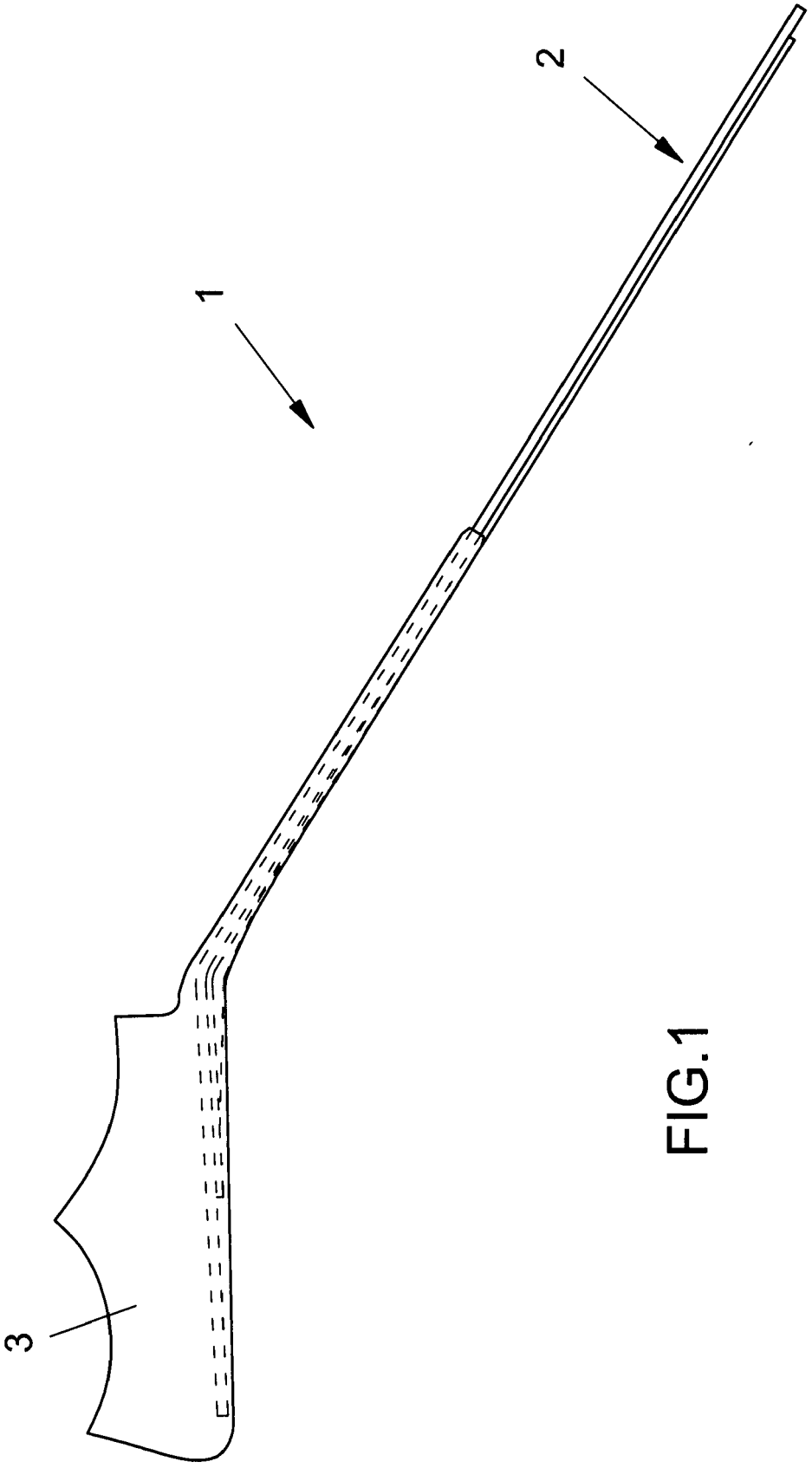

FIG.1

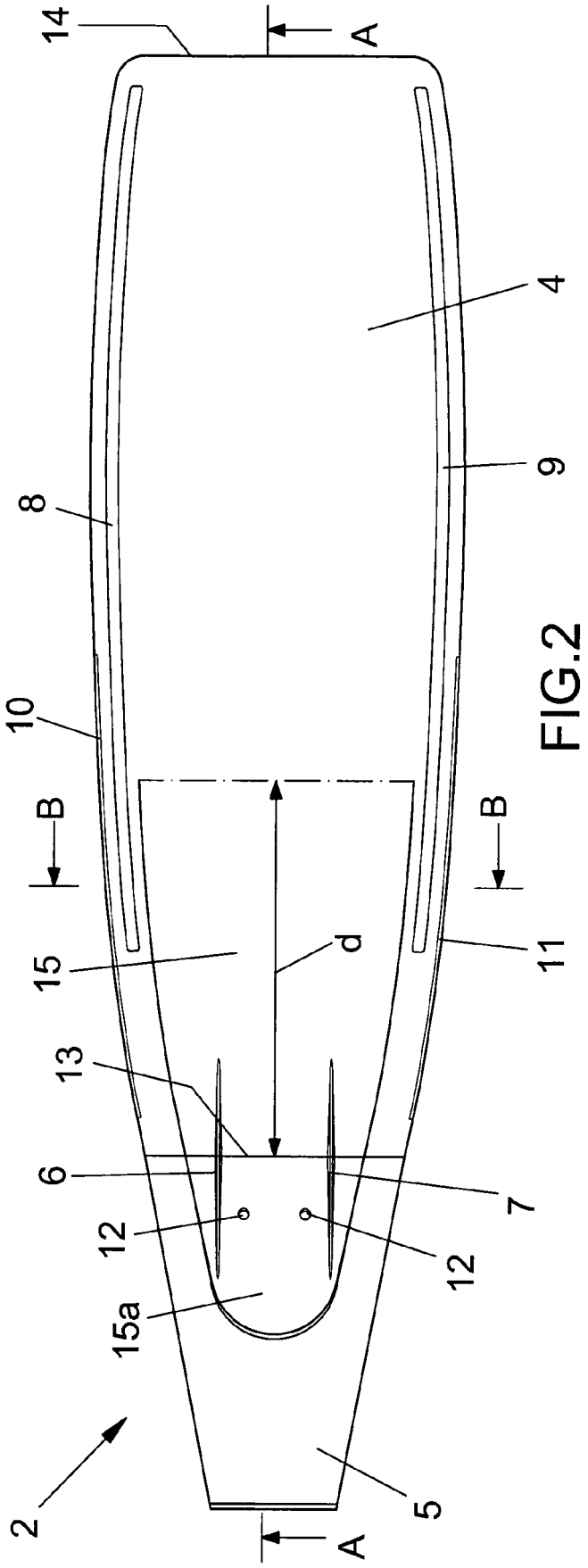

FIG.2

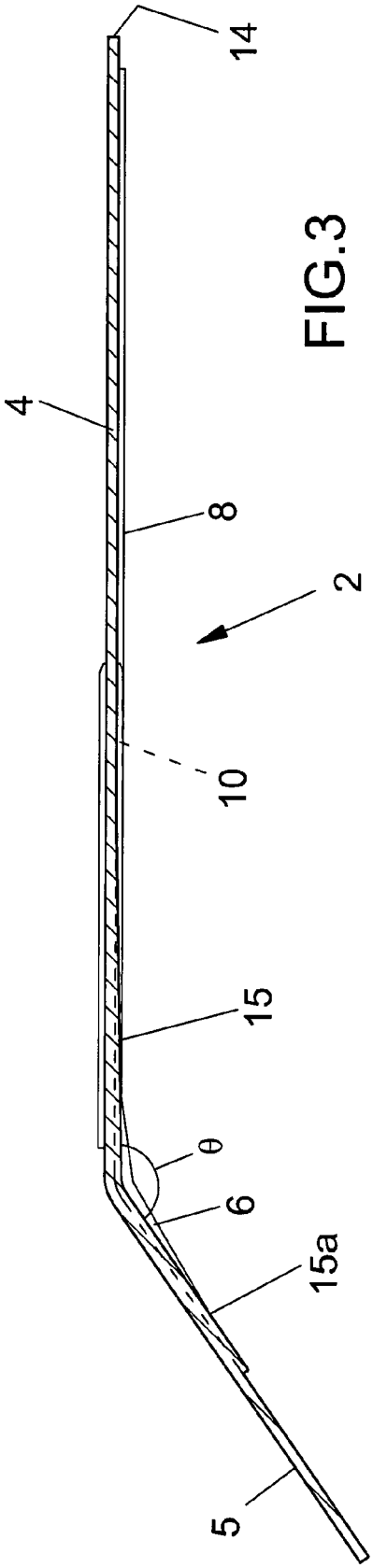

FIG.3

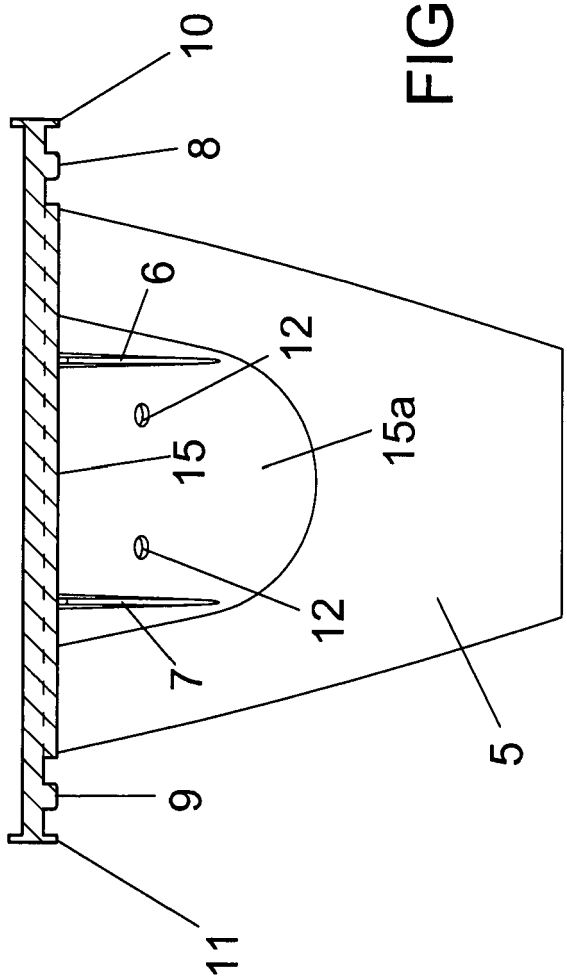

FIG.4

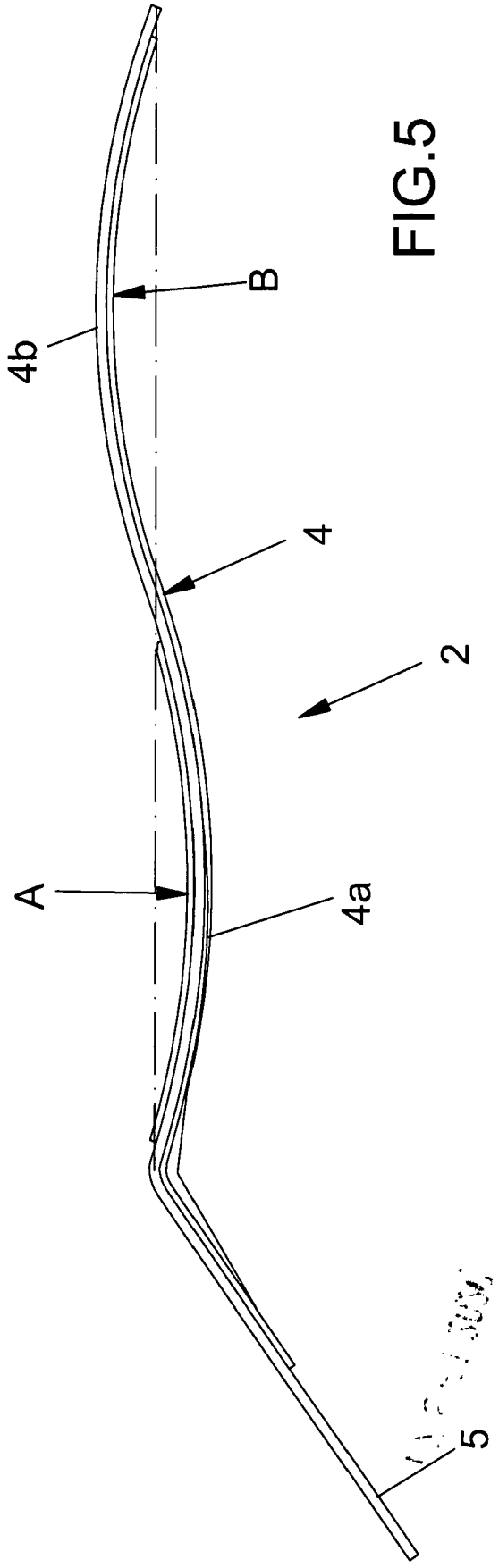

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 42 5036

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			TECHNICAL FIELDS SEARCHED (IPC) A63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 February 2021	Vesin, Stéphane

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