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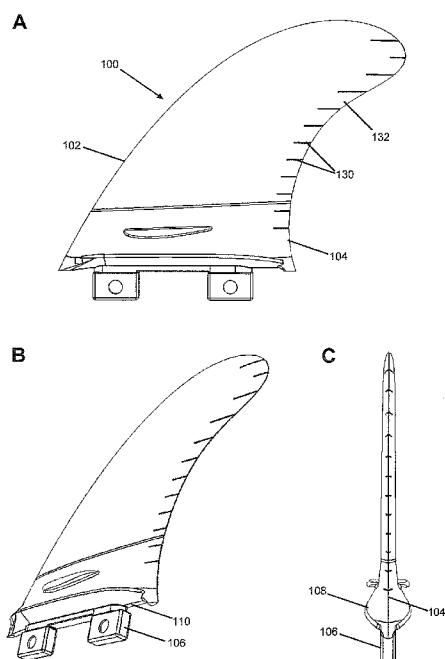
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Figure 7



(57) Abstract: The invention provides a fin for a surfboard or another watercraft, the fin comprising a plurality of resiliently flexible flaps in the trailing edge for reducing lacerations to a person upon contact with the fin and to reduce trailing vortices during use.



## Safety Fin

### Technical Field

[0001] The present invention relates to a fin for a surfboard having a plurality  
5 of resiliently flexible flaps in the trailing edge. More particularly, the invention  
relates to a fin for a surfboard having a plurality of resiliently flexible flaps in the  
trailing edge for reducing lacerations to a person upon contact with the fin in  
addition to reducing trailing vortices.

### Background Art

10 [0002] The following discussion of the background art is intended to facilitate  
an understanding of the present invention only. The discussion is not an  
acknowledgement or admission that any of the material referred to is or was  
part of the common general knowledge as at the priority date of the application.

[0003] A surfboard, stand-up paddleboard (SUP), or similar type of board for  
15 use in water sports and other activities can be viewed in one sense as a  
summation of hydrodynamic surfaces. The surface of the bottom of the board  
in contact with water generates lift and affects speed. More importantly though,  
it is the fins working in collaboration with rail and bottom contour that most  
influence the feel of the board when changing direction. Since the form shape  
20 of surfboards including the rails and bottom surface has undergone finer and  
finer adjustments over the past few decades, the largest gains that can still be  
made to a board's performance is in fin modification.

[0004] Predominant factors that influence the effect of the fins include (i) foil  
shape, and the curve from leading to trailing edge as it changes from base to  
25 tip; (ii) template shape, which is the combination of depth, width, and rake that  
make up the profile of the fin; and (iii) fin placement, which comprises tow and  
camber of the fins, the distance between the fins, and the distance of the fins  
from the rear of the board.

[0005] Foils comprise surfaces which affect lift and drag. Where one surface of a foil is curved and the other, predominantly flat (a 'flat foil'), it takes less effort (drag) for liquid to flow past the flat surface as the path of least resistance than the curved surface. As a result, more water will flow past the flat surface of the foil creating an area of high pressure. Conversely, an area of low pressure is created adjacent to the curved surface of the foil. This difference in pressure creates lift towards the curved side of the foil. The more curve a foil has, the more drag it induces over the curved surface which means that a foil with greater curvature will have more lift at lower speeds. The problem is at higher speeds that additional drag will develop turbulence and stall the flow across the foil. Side fins on a surfboard are usually flat foils which are oriented with the flat face of the foil facing towards the centre or stringer of the board. The resulting pressure differential assists to pull the board fins and rail of the surfboard down into the water. Therefore, thicker, more curved foils are preferred by surfers for slow waves, and flatter, finer foils for faster waves.

[0006] Template shape affects stability and control. The template of the fin is usually considered as the overall shape of the fin from a side view. As an example, fins that are deeper, with a wider base and more rake provide greater stability and control as a result of a relatively large surface area. However, more surface area causes greater drag and slows a board down. As a generalisation known amongst surfers, fins with a greater surface area are more preferred for steep and heavy waves, choppy and irregular conditions, for heavier surfers, and/or surfers with a flowing style. Alternatively, fins with less surface area are more preferred for sloped, clean and glassy waves, for lighter surfers, and/or surfers that exercise extreme and radical manoeuvres.

[0007] The particular shape and template of these foils used to form surfboard fins typically include sharp edges to minimise the creation of drag along their leading and trailing edges which can reduce the speed of the board when riding a wave. However, these sharp edges have resulted in countless lacerations to surfers from fins on their own board, and also from the fins of other surfers' boards in the 'line up'.

[0008] Dr. Andrew T. Nathanson, a clinical associate professor in the Department of Emergency Medicine at Alpert Medical School of Brown University, USA, identified that surfers sustain lacerations more than any other injury. In a study in 2014 of a cohort of professional surfers during a 6-year  
5 period, Nathanson established that of the acute injuries that prevented surfers from going to work or school for more than 1 day, lacerations accounted for 42% of injuries. Of the lacerations sustained by the athletes, 24% were to the face, 17% were to the head and 20% were to the foot. These lacerations were usually caused by the fins of the surfboard, an instance that accounted for 41% of  
10 lacerations. Lacerations were expected to be far greater in number amongst less experienced amateur surfers.

[0009] More serious lacerations that sever an artery such as the femoral artery have led to numerous fatalities as victims suffer extensive blood loss in the water or on the beach before medical professionals have time to assist.

15 [0010] Fin development over the last few decades has focused on the foil shape, rake, template, and materials which has led to the commonly used thruster fin setup with sharp plastic or resin fins mounted on the tens of millions of shortboards worldwide. While rubber fins attached to soft foam surf boards have been used by children and learners for many years, little has been done  
20 to address the safety issues around these sharp fins used by every other surfer, except with the use of, for example, helmets to reduce lacerations and other injuries to the surfer's head. The rest of the surfer's body, however, and those other persons close by, remain exposed.

### **Summary of the Invention**

25 [0011] The present invention provides a safety fin for use on a surfboard or another watercraft, the fin comprising:

a leading edge and a trailing edge; and

at least one resiliently flexible flap at the trailing edge formed by at least two cuts through a portion of the fin from the trailing edge.

[0012] In a preferred embodiment, the invention provides a fin for a surfboard or another watercraft, the fin comprising:

two outer fin surfaces which meet at a leading edge and a trailing edge;

one or more mounting means for mounting the fin onto a surfboard

5 at least three resiliently flexible flaps at the trailing edge, wherein two cuts through a portion of the fin from the trailing edge form each flap at the trailing edge.

[0013] A desire to reduce lacerations to surfers from surfboard fins led the inventor to develop the present invention. A key difficulty was in arriving at a  
10 solution that provided safety against lacerations but without affecting the shape, template and hydrodynamics of the fin which would lead to inferior performance characteristics, and therefore would not be taken up by surfers. The present invention actually improves the in-water performance characteristics of a fin due to the reduction of trailing vortices as described herein, but at the same time  
15 significantly reduces the potential for laceration from the trailing edge of the fin.

[0014] Contact of a resiliently flexible flap on the trailing edge with an object, for example, a body part of the surfer or another person, will cause the flap to bend away from the object it has contacted to either side of the trailing edge. Thus, the sharp portion of trailing edge on the flap is directed away from a body  
20 part that is contacted, therein reducing the potential for a laceration. Upon removal of contact of the flap to the object returns the flap to its previous unbent position.

[0015] For the purpose of describing the invention, a 'cut' also includes a slit, tear, slot, incision or other similar types of openings that can be formed or  
25 created in a fin or upper fin section to enable the formation of a flap at the trailing edge. The cut is more preferably a lateral, substantially straight cut that, when the fin is mounted to a surfboard, lies substantially parallel to the bottom surface of the surfboard. Alternatively, the cut may comprise one or more curves. Thus, each flap at the trailing edge is made from part of the fin due to the cuts in the  
30 fin at the trailing edge, and construction of the fin from flexible, and preferably

resiliently flexible material, at least at the trailing edge; the flap is not a separate part which is attached to another portion of the fin.

[0016] The distance between one cut and an adjacent cut, that is the height of a flap measured at the trailing edge, is between approximately 0.1 mm and 35 mm in a preferred embodiment of the invention. More preferably, distance between one cut and an adjacent cut, that is the height of a flap measured at the trailing edge, is between approximately 3 mm and 20 mm. Even more preferably, distance between one cut and an adjacent cut, that is the height of a flap measured at the trailing edge, is between approximately 5 mm and 15 mm.

[0017] The length of the cuts, measured from the trailing edge, is preferably between approximately 1 mm to 40 mm long, more preferably between approximately 3 mm and 25 mm, and even more preferably between approximately 5 mm to 15 mm long. The cuts in a fin or upper fin section are preferably the same length. However, the cuts may be of variable lengths, and the height of the flaps may be different, to create different sized and shaped flaps. The length of a cut may vary depending on the composition and materials used in the fin and the desired flexibility and size of the resiliently flexible flaps in the trailing edge.

[0018] The number of cuts in a fin according to the invention is at least three resiliently flexible flaps at the trailing edge. In another embodiment, the number of cuts in a fin according to the invention is at least six resiliently flexible flaps at the trailing edge. In another embodiment, the number of cuts in a fin according to the invention is at least ten resiliently flexible flaps at the trailing edge. In another embodiment, the number of cuts in a fin according to the invention is at least twenty resiliently flexible flaps at the trailing edge. In another embodiment, the number of cuts in a fin according to the invention is at least forty resiliently flexible flaps at the trailing edge. In a further embodiment, the flaps comprise numerous bristle-like flaps at the trailing edge.

[0019] In an aspect of a fin according to the invention, the fin comprises an upper fin section attached to a fin base portion, the base portion comprising one

or more mounting means ("mounts") for mounting to a surfboard. The upper fin section preferably comprises at least one, or more preferably three resiliently flexible flaps at the trailing edge. Preferably the cuts are substantially parallel to the base of the fin base portion that contacts the surfboard to which it is mounted. The one or more mounting means are preferably mounting blocks capable of attaching to commercially available fin plug and fin box systems.

[0020] An advantage of this aspect is that during manufacture of fins according to the invention, a variety of upper fin sections having different templates and other characteristics may be attached to, for example, a specific type of fin base portion. Therein manufacturing costs can potentially be reduced and upper fin sections and fin base portions may be manufactured by the same or different manufacturers. A fin section may be permanently attached to a fin base portion during manufacture, or releasably attached to a fin base.

[0021] In a preferred embodiment, the fin or upper fin section comprises:

15 a core;

a resiliently flexible overmoulding covering at least a portion of the core;  
and

the core and overmoulding, or overmolding alone, forming the two outer fin surfaces which meet at the leading edge and the trailing edge.

20 [0022] The core preferably comprises titanium or titanium alloy. The fin base also preferably comprises titanium or titanium alloy.

[0023] The core preferably comprises holes, apertures, and/or cavities which are filled with overmoulding which assists with attachment of the overmoulding to the core.

25 [0024] An important characteristic of the overmoulding is that it can attach to the core, and particularly titanium or titanium alloy and not separate during normal use of the fin or upper fin section of the invention while in normal use on a surfboard. The overmoulding preferably covers the entire core except where

the core attaches to the fin base or mounting means. The overmoulding may comprise a variety of different colours and may be opaque, or substantially clear so that the core is able to be viewed.

[0025] In a further embodiment, the overmoulding at the leading edge and tip  
5 of the fin or upper fin section comprises a cushion layer below the surface of the overmoulding. This cushioning layer of a softer polymer or other material including those materials described herein, provides a 'suspension effect' when the leading edge or tip of the fin or upper fin section contacts an object, for example, the surfer or another person. This suspension effect can limit the  
10 damage to a person from laceration or bruise, who contacts the leading edge or tip of a fin according to the invention.

#### Additional Safety

[0026] For the purpose of maintaining the safety of users of one or more fins of the invention on a surfboard, the fin of the invention may further comprise a  
15 weak portion. In one embodiment, the weak portion may comprise perforations through the titanium alloy of the fin adjacent to the mounting means or fin base that can more easily be broken than the remaining portion of the titanium alloy portion of the fin. Under strong forces acting on a fin according to the invention, for example, heavy contact of: a reef, the surfer, another surfer, another board,  
20 or rocks, amongst others, the fin can break at the weak portion. The purpose of the breakage is to (i) reduce the potential damage to a person the fin comes into contact with, or (ii) reduce or minimise damage to the board to which the fin is mounted which can occur if a fin gets torn out of the board due to catching on a reef or rock, as some non-limiting examples.

25 [0027] In addition, overmoulding, if used in an embodiment of the fin of the invention, provides protection for the surfer and other persons nearby covering the potentially sharp edges of the titanium alloy core.

#### Mounting Means

[0028] The mounting means for a fin (wherein "mounting means" described  
30 herein may also be referred to as a "mount") according to the invention as herein

described may comprise a variety of means known for mounting or attaching a fin to a surfboard.

[0029] In a preferred embodiment, the mounting means comprises one or more mounting blocks for attaching to one or more surfboard fin plugs and/or fin boxes. The one or more mounting blocks are preferably compatible with, and capable of attaching to commercially available fin plug and/or fin box systems. Preferably, the one or more mounting blocks (comprising the “mount”) can be mounted to commercially available FCS<sup>®</sup> fin plugs and/or Futures<sup>®</sup> fin boxes.

[0030] In another preferred embodiment, the mounting means comprises a base attachment surface and an adhesive wherein the adhesive directly and fixedly secures the base attachment surface to the external bottom surface of the surfboard. The adhesive can maintain an adhesive connection between a fin of the invention and a surfboard, particularly when exposed to water. Preferably, one or more screws or another type of fastener additionally secure the adhered base attachment surface to the surfboard.

#### Board Type

[0031] The fin of the invention according to an aspect as herein described may be mounted to any one of the boards in the group comprising: surfboard, shortboard, kneeboard, longboard, minimal, soft board, kiteboard or a board used for kite surfing, wind surfer, stand up paddleboard, wakeboard, rescue board, bodyboard, or another board used in surface water sports or activities. Importantly, reference herein to a ‘surfboard’ is also meant to include reference to any one of these other boards or similar types of watercraft.

#### Fin Arrangement

[0032] More than one safety fin of the invention according to an embodiment as described herein may be mounted to a surfboard. For example, a thruster fin setup on a surfboard may comprise up to three fins of the invention as described herein.

[0033] Various combinations are possible for using various embodiments of fins of the invention as described herein, exclusively, or in combination with other types of fins on a surfboard.

#### Process for Mounting a Fin of the Invention

5 [0034] The present invention further provides a process of mounting a fin of the invention as herein described, to any one of the boards in the group comprising: surfboard, shortboard, kneeboard, longboard, minimal, soft board, kiteboard, wind surfer, stand up paddleboard, wakeboard, rescue board, bodyboard, or another board used in surface water sports or activities. The  
10 present invention also provides a process of mounting a fin of the invention to a surfboard by mounting the fin using a mounting means as described herein.

#### Process for Manufacturing a Fin of the Invention

[0035] The present invention also provides a process of manufacturing a fin of the invention or an upper fin section of a fin according to the invention as  
15 hereinbefore described.

[0036] In a preferred embodiment of the invention, part of, or the entire fin base, and/or base portion of the fin, core, and mounting means are constructed from, or comprise, a metal or a metal alloy, and preferably titanium or titanium alloy.

20 [0037] The titanium alloy referred to herein is preferably Titanium Alloy Ti 6Al-4V such as produced by Carpenter® which comprises approximately 6% aluminium and 4% vanadium. More preferably, the titanium alloy comprises between approximately 3.5% to 4.5% vanadium, and between approximately 5.5% to 6.75% aluminium.

25 [0038] The inventor discovered that titanium and titanium alloy has the preferred flexibility, strength, weight, and resilience for use in the core of the fin of the invention. That is, a key requirement for the core is a thickness less than the common thickness of a surfboard fin (and preferably less) and at this width, the core must be sufficiently flexible. Thus, the invention may also comprise a

core made from a metal other than titanium, or another material with these or similar characteristics of flexibility, resilience, weight and strength and incapable of rusting or significant corrosion.

[0039] The overmoulding may comprise a variety of different materials that have already been used to construct surfboard fins; or may comprise materials unique to surfboard fin manufacture. In a preferred embodiment, the overmoulding comprises a soft type polymer. In some non-limiting examples, the overmoulding may comprise one or more compounds from the following group: thermoplastic elastomers, which includes styrenic block copolymers (TPE-s), thermoplastic olefins (TPE-o), elastomeric alloys (TPE-v or TPV), thermoplastic polyurethanes (TPU), thermoplastic copolyester, thermoplastic polyamides, or thermally conductive epoxy. Primers and/or adhesives may be used to assist the bonding of the overmoulding to the titanium or titanium alloy. However, current available overmoulding techniques generally do not require the use of primers or adhesives.

[0040] In some embodiments of the invention, the safety fin of the invention may comprise no core but is constructed from plastic, resin, overmolding, or some other material that possess some flexibility and resilience at or at least adjacent the trailing edge of the fin where the fin is commonly at its thinnest. The material used to construct the fin may also comprise more than one material or blended materials with a gradient rigidity across the fin becoming less rigid and more resiliently flexible towards the trailing edge of the fin to enable the flexibility of the trailing edge flaps. Preferably, the flaps at the trailing edge comprise a flexible, and more preferably, resiliently flexible material from which they are constructed.

### **Brief Description of Drawings**

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1. illustration showing (A) a side view of a preferred embodiment of an upper fin portion according to the invention, and (B) a fin base

portion to which the upper fin portion of (A) can be attached to form a complete fin.

- Figure 2. illustration showing (A) a side view, and (B) an exploded side view, of a preferred embodiment of an upper fin portion  
5 according to the invention.
- Figure 3. illustration showing an exploded side view of an alternative preferred embodiment of an upper fin portion according to the invention.
- Figure 4. illustrations showing different views of the trailing edge of an  
10 upper fin portion according to a preferred embodiment of the invention contacting the arm of a person.
- Figure 5. illustration showing (A) a side view, and (B) an exploded rear perspective view, of a preferred embodiment of an upper fin portion according to the invention attached to a fin base portion  
15 to form a safety fin according to the invention.
- Figure 6. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.
- Figure 7. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a  
20 safety fin according to the invention.
- Figure 8. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.
- 25 Figure 9. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.

- Figure 10. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.
- 5 Figure 11. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.
- Figure 12. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.
- 10 Figure 13. illustration showing (A) a side view, (B) a rear perspective view, and (C) a rear view, of a further preferred embodiment of a safety fin according to the invention.

### Description of Preferred Embodiments

15 [0041] Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications. The invention also includes all of the steps, features, compositions and compounds referred to or indicated in the specification,  
20 individually or collectively and any and all combinations or any two or more of the steps or features.

[0042] The present invention is not to be limited in scope by the specific embodiments described herein, which are intended for the purpose of exemplification only. Functionally equivalent products, compositions and  
25 methods are clearly within the scope of the invention as described herein.

[0043] Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be

understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0044] Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout. Unless otherwise  
5 defined, all other scientific and technical terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which the invention belongs.

[0045] Features of the invention will now be discussed with reference to the following preferred embodiments.

10 [0046] A preferred embodiment of an upper fin section 10 of a safety fin according to the invention is shown in Figure 1A. The upper fin section 10 comprises a leading edge 12 and a trailing edge 14 and outer fin surfaces 16 of which only one is visible in the side view of Figure 1.

[0047] One of a number of different types of fin base portions 20 that could  
15 attach to the upper fin portion to form a surfboard fin for use on a surfboard is shown in Figure 1B. The upper fin section 10 can be attached to the fin base portion 20 at the base attachment surface 22 via a variety of means such as the base attachment tabs 24 shown.

[0048] Lateral cuts 30 through the upper fin section 10 begin at the trailing  
20 edge 14 and are substantially parallel to the base attachment surface 22. The cuts 30 form resiliently flexible trailing edge flaps 32. In one embodiment, the base portion 20 also comprises such cuts in the trailing edge of the base portion 20.

[0049] In the preferred embodiment of the upper fin section 10 of a fin  
25 according to the invention, the upper fin section 10 comprises a core 40 of titanium or titanium alloy as shown in Figure 2. The titanium or titanium alloy core 40 provides the fin with both strength and resilience. The core 40 in the preferred embodiment comprises a plurality (wherein a 'plurality' means two or more) of circular or oval apertures ("holes") 42. A first purpose of these holes  
30 42 is to assist the flexibility of the titanium or titanium alloy core 40. In this

regard, the holes 42 are relatively small adjacent to the leading edge 12 and are larger in size towards the trailing edge 14. This creates a stronger and stiffer core 40 in the vicinity of the leading edge 12 and enables greater flexibility of the core 40 adjacent the trailing edge. The largest holes 42 in the core 40 are within the trailing edge flaps 32 which provides this region of the upper fin section with the greatest flexibility. An additional benefit is a reduction in the weight of the core (although the titanium and titanium alloy core is not heavy relative to the other materials fins are usually constructed from), as well as a reduction in the amount of costly titanium or titanium alloy required to form the core 40.

[0050] Covering the core 40 is a flexible overmoulding 50. The flexible overmoulding 50 covers the core 40 and forms the template of the upper fin section 10. A portion of overmoulding 50 at the leading edge 12 and fin tip 15 covers the core 40 to maintain the safety of the surfboard rider and other persons that could potentially come into contact with the leading edge 12 or fin tip 16 of the flexible fin of the invention when in use. At the trailing edge 14 of the upper fin section 10, the cuts 30 form resiliently flexible trailing edge flaps 32.

[0051] As shown in the exploded view of the preferred embodiment of the upper fin section in Figure 2B, the overmold 50 comprises a leading edge overmoulding piece 52. The leading edge overmoulding piece 52 comprises a core or cushioning layer of softer overmold polymer or other material under the exterior of the overmold to provide additional cushioning or suspension effect upon contact with, for example, the surfer or another person, as an additional safety feature. However, by maintaining the hardness of the exterior of the overmold in the leading edge overmoulding piece 52, the leading edge does not deform during normal use which would attract additional forces of drag slowing the fin down in the water.

[0052] In an alternative preferred embodiment of the upper fin section shown in Figure 3, the overmold 50 does not comprises a leading edge overmoulding piece.

[0053] In the preferred embodiment of the fin section 10, the overmoulding 50 does not cover the base attachment surface 22, base attachment tabs 24, or any other base attachment means. Instead the core 40 attaches to the fin base portion 20.

- 5 [0054] A second purpose for the holes 42 in the core 40 is that they are filled with overmoulding 50 providing strong attachment between the core 40 and overmoulding 50.

[0055] The trailing edge flaps 32 play an important role to maintain the safety of the surfboard rider and other persons that come into contact with the trailing  
10 edge 14 of a fin according to the invention. A common misconception is that most injuries to persons from a surfboard fin should come from the leading edge of the fins. However, this is not the case since (i) surfers generally are skilled enough to avoid surfing over the top of others in the water, and (ii) if there is contact with the surfer or another person, it is more often contact with the front  
15 or large base of the board. Instead, a high proportion of serious lacerations from surfboard fins are actually from the trailing edge contacting a body part. One reason for this is due to the position of the fins at the rear of the board where the trailing edge is more exposed. More importantly, the second reason is that the surfer is attached to the rear of the surfboard by a leash that is elastic. When  
20 a surfer loses control on a wave and falls, is thrown, jumps off, or just 'ditches' their board, they are separated from their board. When the elastic leash stretches to its maximum elastic length, it causes the board to return, often at high speed, back towards the surfer through the water or air, tail of the board first (where the leash is attached). The surfboard has become a fast moving  
25 projectile with the sharp trailing edges of the fins aiming straight towards the surfer as it returns at high speed. It is at this time that most fin lacerations or other injuries occur when they contact a body part of the surfer.

[0056] In the preferred embodiment, the trailing edge 14 comprises cuts 30 in the overmold 50 which form trailing edge flaps 32. These trailing edge flaps are  
30 resiliently flexible but hold their shape forming the trailing edge 14 of the surfboard fin, until they contact an object. Upon contact with, for example, the

arm, leg, or head of the surfer or another person, the trailing edge flaps 32 bend away in either direction as shown in Figure 4, therein presenting a substantially flat surface contacting the body part, and reducing the chance of a laceration. After contacting a body part or another object, the resiliently flexible trailing edge  
5 flaps 32 return to their original position to form the trailing edge of the fin.

[0057] A further preferred embodiment of an upper fin section 10 according to the invention, attached to a fin base portion 20 (different to the fin base portion 20 in Figure 1B), is shown in Figure 5.

[0058] A further preferred embodiment of a safety fin 100 according to the  
10 invention is shown in Figure 6. The fin 100 comprises a leading edge 102, a trailing edge 104, mounting means 106 comprising twin mounting blocks which can be mounted in a FCS® fin plugs to the bottom surface of a surfboard, and a caudal peduncle keel configuration 108 adjacent the base 110 of the safety fin 100. A plurality of lateral cuts 130 along the trailing edge 104 of the safety fin  
15 100 from the fin tip 112 to adjacent the base 110 produce a plurality of trailing edge flaps 132, bristle-like, between adjacent lateral cuts 130. The trailing edge flaps 130 can flex against water pressures and upon contact with objects such as humans and other animals but are intended to be resilient and return to their original position after such flexing through use of flexible and resilient materials.  
20 The lengths of the lateral cuts 130 measured from the trailing edge 104 are approximately between 5 mm and 15 mm, and more preferably approximately 10 mm. The distance between lateral cuts 130, otherwise known as the height of the trailing edge flaps 132 is between approximately 1 mm and 5 mm.

[0059] A further preferred embodiment of a safety fin 100 according to the  
25 invention is shown in Figure 7. Similar to the safety fin in Figure 6, the safety fin 100 comprises a leading edge 102, a trailing edge 104, mounting means 106 comprising twin mounting blocks which can be mounted in a FCS® fin plugs to the bottom surface of a surfboard, and a caudal peduncle keel configuration 108 adjacent the base 110 of the safety fin 100. A plurality of lateral cuts 130 along  
30 the trailing edge 104 of the safety fin 100 produce a plurality of trailing edge flaps 132, between adjacent lateral cuts 130. The lengths of the lateral cuts 130

measured from the trailing edge 104 are approximately between 5 mm and 15 mm, and more preferably approximately 10 mm. The distance between lateral cuts 130, otherwise known as the height of the trailing edge flaps 132 is between approximately 5 mm and 15 mm.

5 [0060] A further preferred embodiment of a safety fin according to the invention is shown in Figure 8. Similar to the safety fin in Figure 7, the safety fin 100 comprises a leading edge 102, a trailing edge 104, and a caudal peduncle keel configuration 108 adjacent the base 110 of the safety fin 100. However, the mounting means 106 in this embodiment comprises a flat base for attaching to  
10 the bottom surface of a surfboard. Also, a knob 136 can be turned unlocking the fin from the mounting means 106, allowing the position of the mounting means 106 to be adjusted relative to the fin 106 towards the leading edge 102 or trailing edge 104, and re-locked in position by returning the knob 136 to the original locked position. A plurality of lateral cuts 130 along the trailing edge 104 of the  
15 safety fin 100 produce a plurality of trailing edge flaps 132, between adjacent lateral cuts 130. The lengths of the lateral cuts 130 measured from the trailing edge 104 are approximately between 5 mm and 15 mm, and more preferably approximately 10 mm. The distance between lateral cuts 130, otherwise known as the height of the trailing edge flaps 132 is between approximately 5 mm and  
20 15 mm.

[0061] A further preferred embodiment of a safety fin according to the invention is shown in Figure 9. Similar to the safety fin in Figure 8, the safety fin 100 comprises a leading edge 102, a trailing edge 104, a knob 136, and a caudal peduncle keel configuration 108 adjacent the base 110 of the safety fin 100.  
25 However, the mounting means 106 in this embodiment comprises a single mounting block which can be mounted in a Futures® fin plug to the bottom surface of a surfboard. Also, this embodiment of the safety fin 100 comprises a core 140 covered by a flexible overmoulding 150. A plurality of lateral cuts 130 along the trailing edge 104 of the safety fin 100 produce a plurality of trailing  
30 edge flaps 132, between adjacent lateral cuts 130. The lengths of the lateral cuts 130 measured from the trailing edge 104 are approximately between 5 mm and 15 mm, and more preferably approximately 10 mm. The distance between

lateral cuts 130, otherwise known as the height of the trailing edge flaps 132 is between approximately 5 mm and 15 mm.

[0062] A further preferred embodiment of a safety fin according to the invention is shown in Figure 10. Similar to the safety fin in Figure 7, the safety fin 100 comprises a leading edge 102, a trailing edge 104, mounting means 106 comprising twin mounting blocks which can be mounted in a FCS® fin plugs to the bottom surface of a surfboard, but it does not comprise a caudal peduncle keel configuration adjacent the base 110 as this embodiment of the safety fin 100 is a standard 'flat' fin configuration. A plurality of lateral cuts 130 along the trailing edge 104 of the safety fin 100 from the fin tip 112 to adjacent the base 110 produce a plurality of trailing edge flaps 132, between adjacent lateral cuts 130. The lengths of the lateral cuts 130 measured from the trailing edge 104 are approximately between 5 mm and 15 mm, and more preferably approximately 10 mm. The distance between lateral cuts 130, otherwise known as the height of the trailing edge flaps 132 is between approximately 5 mm and 15 mm.

[0063] A further preferred embodiment of a safety fin according to the invention is shown in Figure 11. The safety fin 100 is the same as the fin in Figure 10 except the mounting means 106 comprises a single mounting block which can be mounted in a Futures® fin plug to the bottom surface of a surfboard.

[0064] A further preferred embodiment of a safety fin according to the invention is shown in Figure 12. The safety fin 100 is the same as the fin in Figure 9 except the mounting means 106 in this embodiment comprises a flat base for attaching to the bottom surface of a surfboard. In addition, there is also an extended lateral cut 160 in the trailing edge 104 and positioned above the knob 136 which enables the entire top of the fin section to resiliently flex which the water forces.

[0065] A further preferred embodiment of a safety fin according to the invention is shown in Figure 13. The safety fin 100 is the same as the fin in Figure 9 except the core cannot be seen underneath an opaque overmold.

[0066] Importantly, while other surfboard fin modifications may also improve safety from lacerations, the present invention has the added benefit of the resiliently flexible trailing edge flaps disturbing the vortices (areas of high and low pressure) that are naturally formed behind the trailing edge of a surfboard fin while surfing a wave. These vortices are naturally created behind objects moving through water and create a 'sucking' action and drag resulting in loss of speed for the object. Accordingly, many species of fish have small cavities, 'cuts' or microscopic hairs at the trailing edge of their scales, particularly ctenoid scales, which disturb these trailing vortices and reduce the associated 'sucking' forces to avoid losses in speed or effort required to maintain their velocity. Similarly, the trailing edge flaps on the safety fin of the invention may also comprise: flaps that are considerably smaller, thinner, and/or shorter than those shown in the examples herein; very thin or narrow flaps, bristles, and/or hair like structures; flaps of varying dimensions and shapes; and flaps with deformities, cavities, and/or holes or apertures at the trailing edge. Further, different sized trailing edge flaps may be present in the same safety fin trailing edge by different length cuts in the trailing edge, and/or with different distances between cuts.

[0067] A long vortex is created behind the trailing edge of a typical surfboard fin mounted on a surfboard as it travels through water during normal use, reducing the overall speed of the board. However, the trailing edge flaps on the safety fin according to the invention assist by vibration or other movement, and the presence of the cuts, to create turbulence adjacent the trailing edge which collapses or 'caves in' the trailing vortex behind the fin. This significantly reduces the length and size of the trailing vortex and thereby reduces the sucking action, associated drag, and loss of speed.

**The Claims Defining the Invention are as Follows**

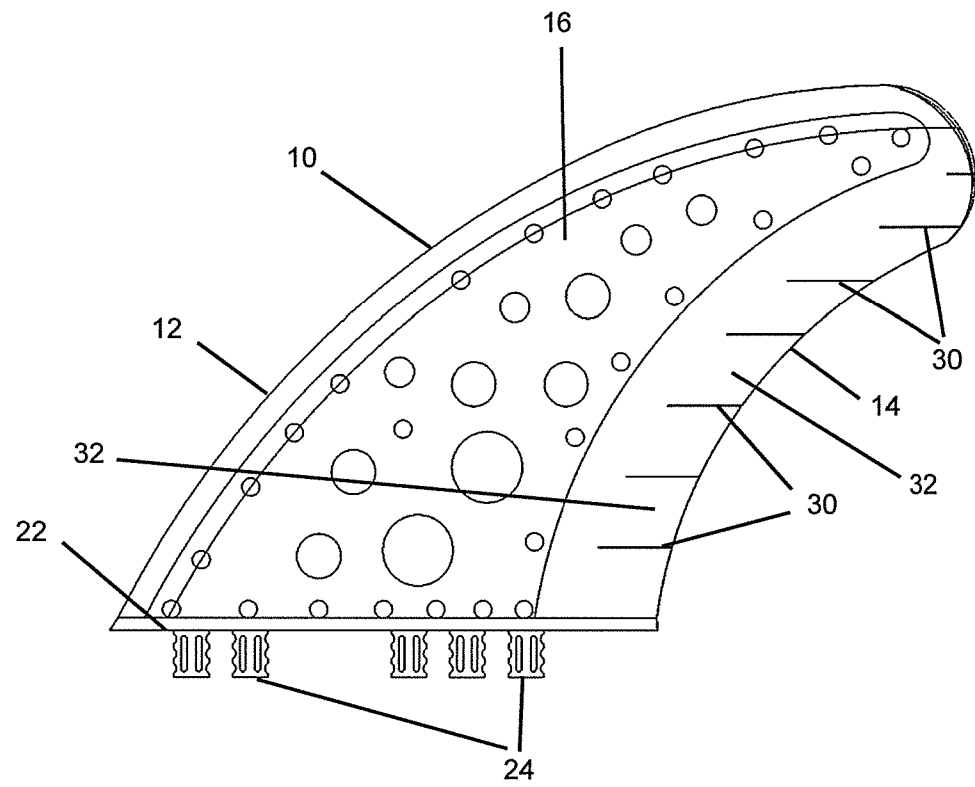
1. A fin for a surfboard, the fin comprising:
  - two outer fin surfaces which meet at a leading edge and a trailing edge;
  - 5 one or more mounting means for mounting the fin onto a surfboard
  - at least three resiliently flexible flaps at the trailing edge, wherein two cuts through a portion of the fin from the trailing edge form each flap at the trailing edge.
- 10 2. A fin according to claim 1, comprising at least six resiliently flexible flaps at the trailing edge.
3. A fin according to claim 1, comprising at least twenty resiliently flexible flaps at the trailing edge.
4. A fin according to claim 1, comprising at least forty resiliently flexible flaps at the trailing edge.
- 15 5. A fin according to any one of claims 1 to 4, wherein the cuts are substantially straight, lateral cuts through the fin from the trailing edge.
6. A fin according to any one of the previous claims, wherein the length of the cuts through the fin measured from the trailing edge are between approximately 1 mm and 40 mm.
- 20 7. A fin according to any one of claims 1 to 6, wherein the height of a flap measured as the distance at the trailing edge between one cut and an adjacent cut is between approximately 0.1 and 35 mm.
8. A fin according to any one of claims 1 to 6, wherein the height of a flap measured as the distance at the trailing edge between one cut and an adjacent cut is between approximately 3 mm and 20 mm.
- 25

9. A fin according to any one of claims 1 to 6, wherein the height of a flap measured as the distance at the trailing edge between one cut and an adjacent cut is between approximately 5 mm and 15 mm.
- 5 10. A fin according to any one of the preceding claims, wherein the fin comprises a resiliently flexible material, at least adjacent the trailing edge.
11. A fin according to any one of the preceding claims, wherein the flaps comprise a resiliently flexible material.
- 10 12. A fin according to any one of the preceding claims, wherein the fin comprises an upper fin section attached to a base portion, the base portion comprising the one or more mounting means, and the upper fin section comprises the at least three resiliently flexible flaps at the trailing edge.
- 15 13. A fin according to any one of the preceding claims, the fin comprising:  
a core;  
a resiliently flexible overmoulding covering at least a portion of the core; and  
the core and overmoulding, or overmolding alone, forming the two outer fin surfaces which meet at the leading edge and the trailing  
20 edge.
14. A fin according to claim 13, wherein the core comprises holes, apertures, and/or cavities which are filled with overmoulding.
15. A fin according to claim 13 or claim 14, wherein the core comprises titanium or titanium alloy.
- 25 16. A fin according to claim 15, wherein the titanium alloy comprises between approximately 3.5% to 4.5% vanadium, and between approximately 5.5% to 6.75% aluminium.

17. A fin according to any one of the previous claims, wherein the one or more mounting means are mounting blocks capable of attaching to commercially available fin plug and/or fin box systems.
18. A fin according to any one of the previous claims, wherein contact of a resiliently flexible flap to an object bends the flap away from the object, and removal of contact of the flap to the object returns the flap to its previous unbent position.
19. A fin according to claim 18, wherein the object is a body part of a person.
20. A fin according to any one of the preceding claims, for mounting to any one of the boards in the group comprising: surfboard, shortboard, kneeboard, longboard, minimal, soft board, kiteboard, wind surfer, stand up paddleboard, wakeboard, rescue board, bodyboard, or another board used in surface water sports or activities.
21. A process comprising the step of mounting a fin according to any one of claims 1 to 20, to any one of the boards in the group comprising: surfboard, shortboard, kneeboard, longboard, minimal, soft board, kiteboard, wind surfer, stand up paddleboard, wakeboard, rescue board, bodyboard, or another board used in surface water sports or activities.
22. A process of manufacturing a fin according to any one of claims 1 to 20.

Figure 1

**A**



**B**

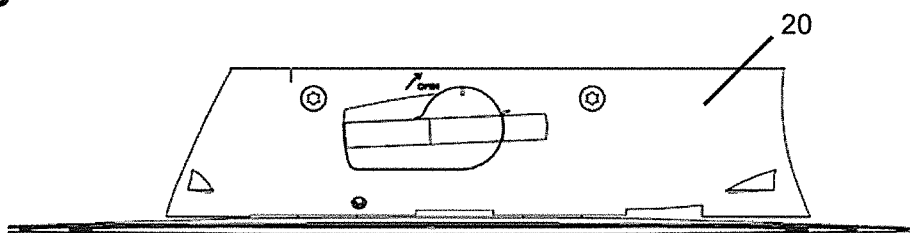


Figure 2

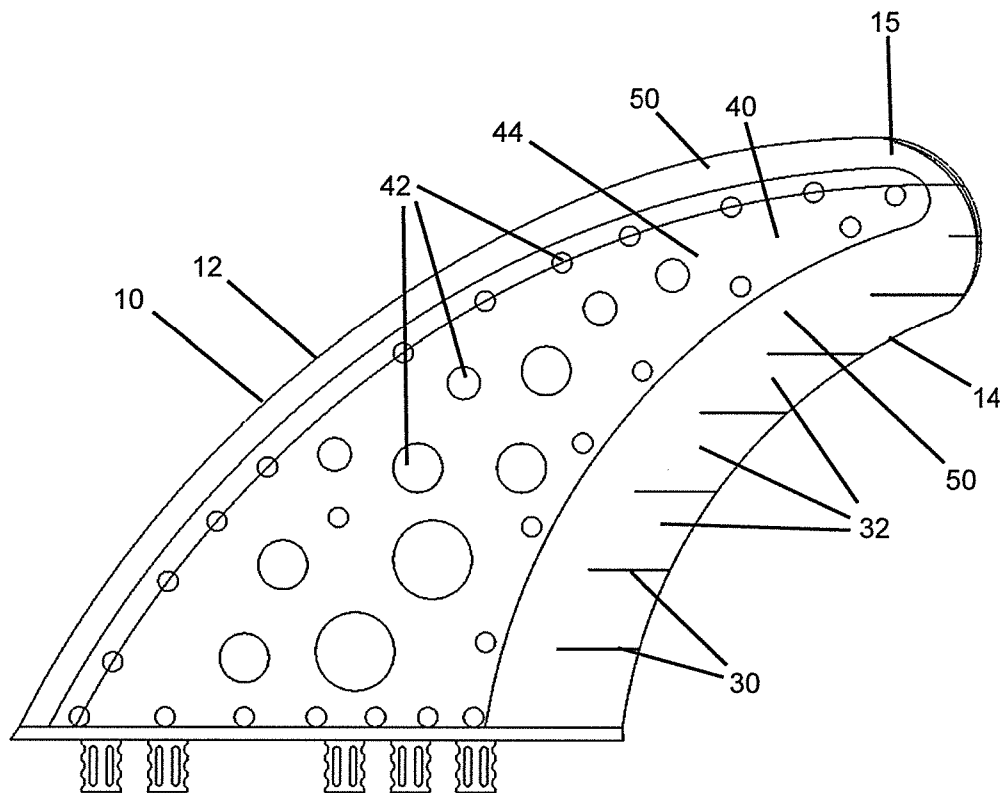
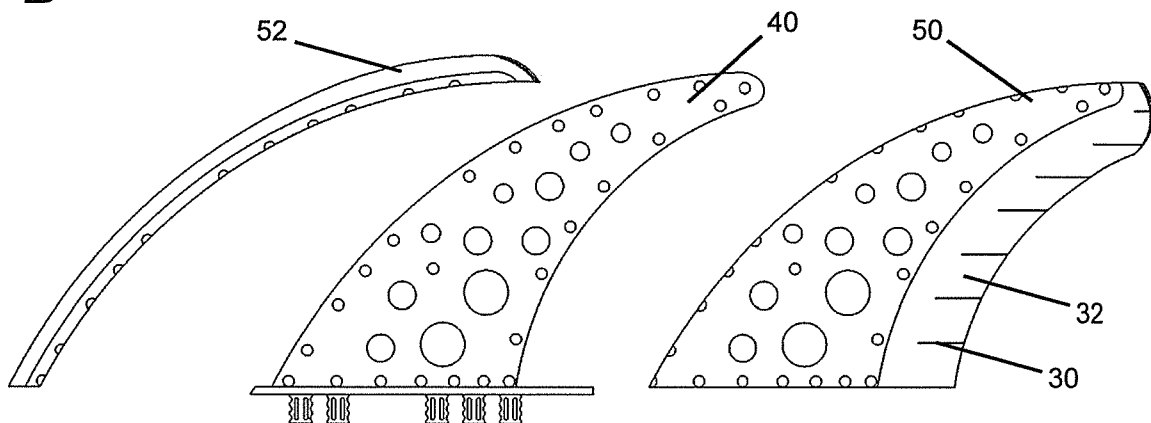
**A****B**

Figure 3

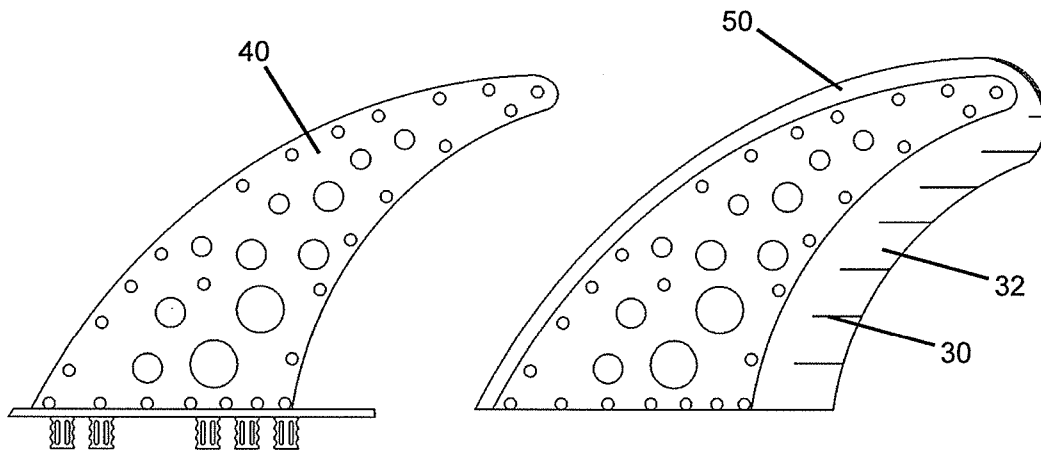


Figure 4

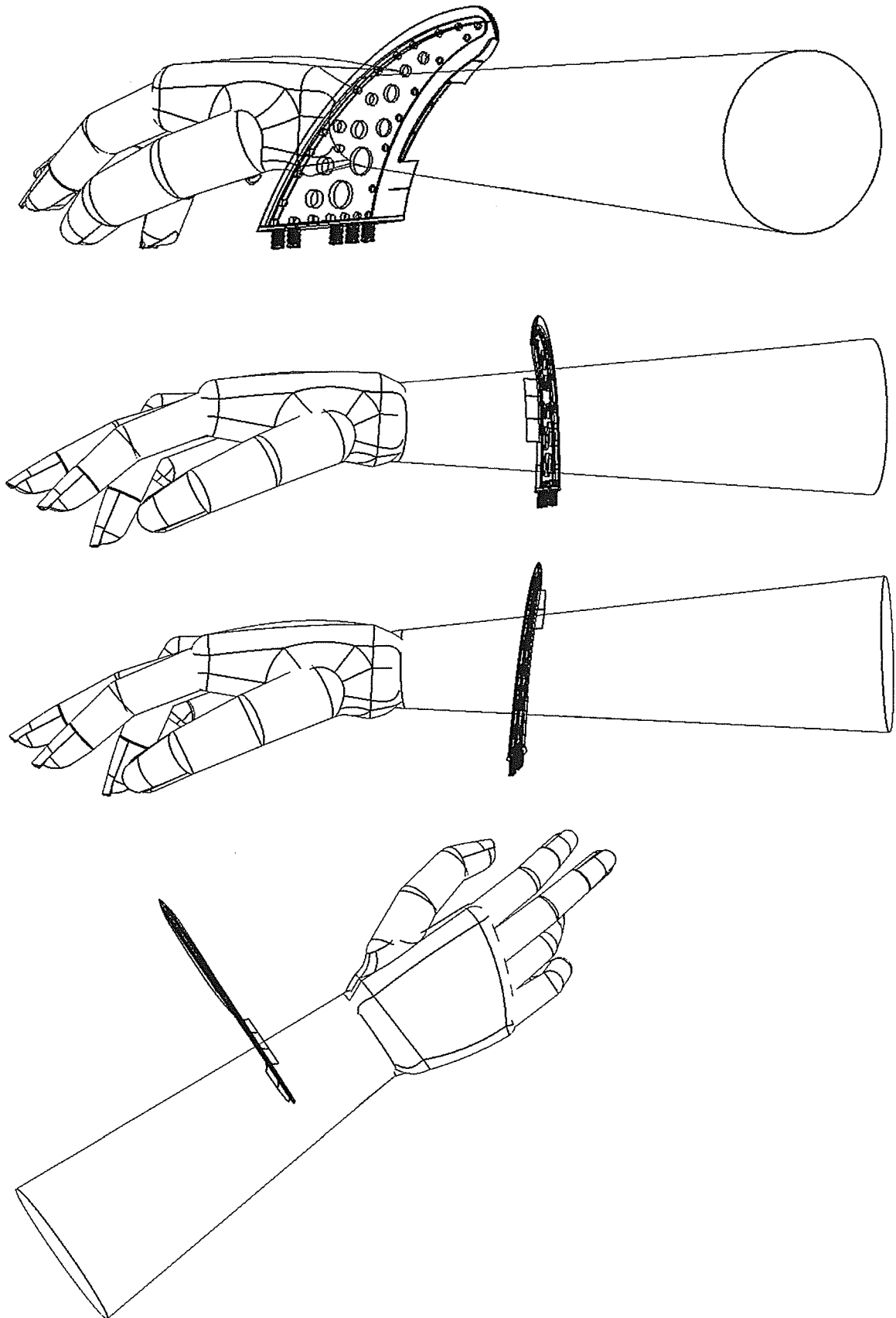
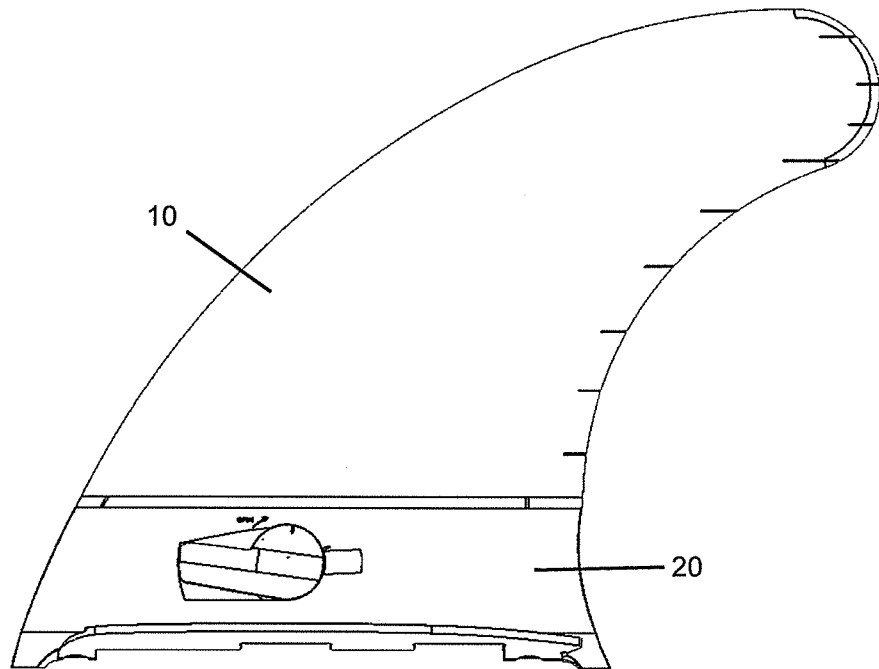


Figure 5

A



B

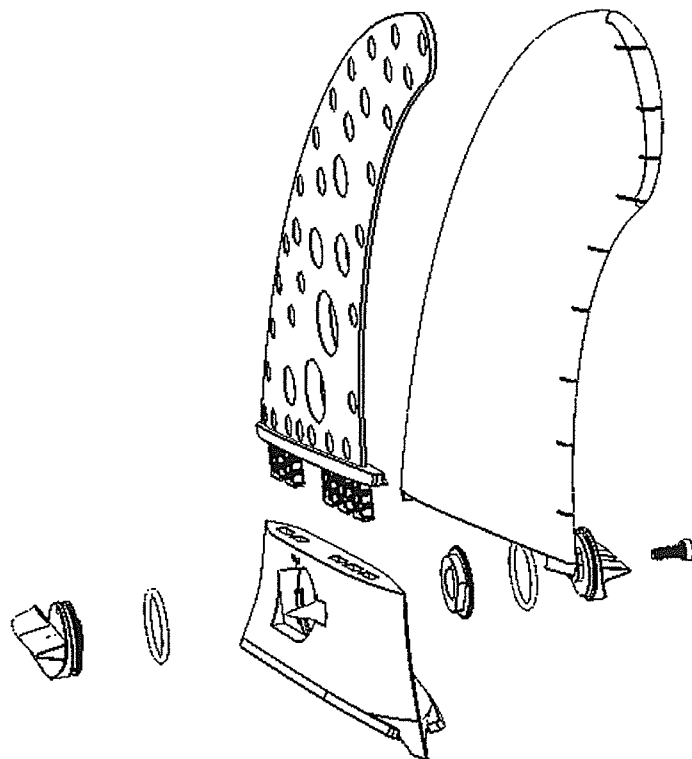


Figure 6

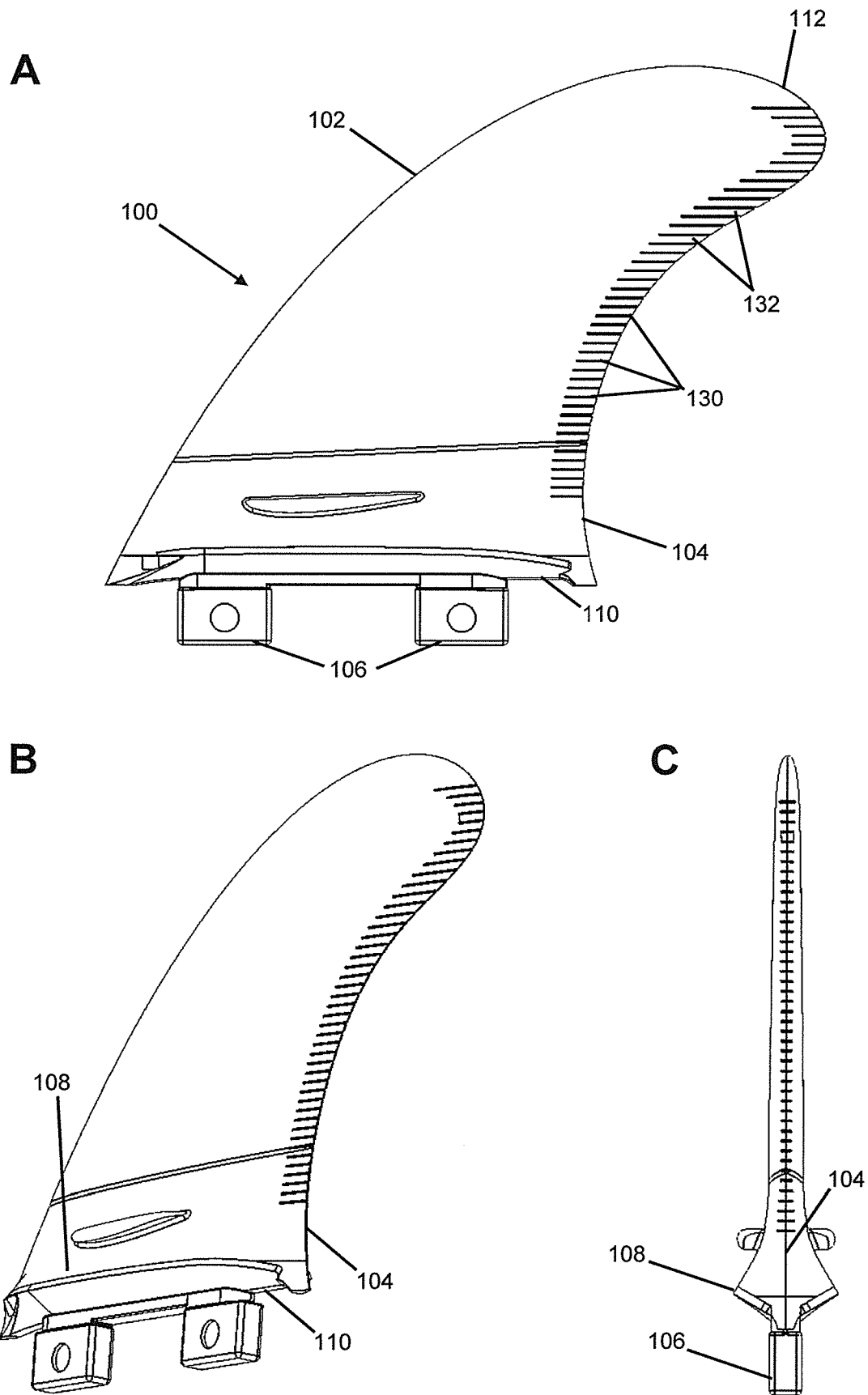
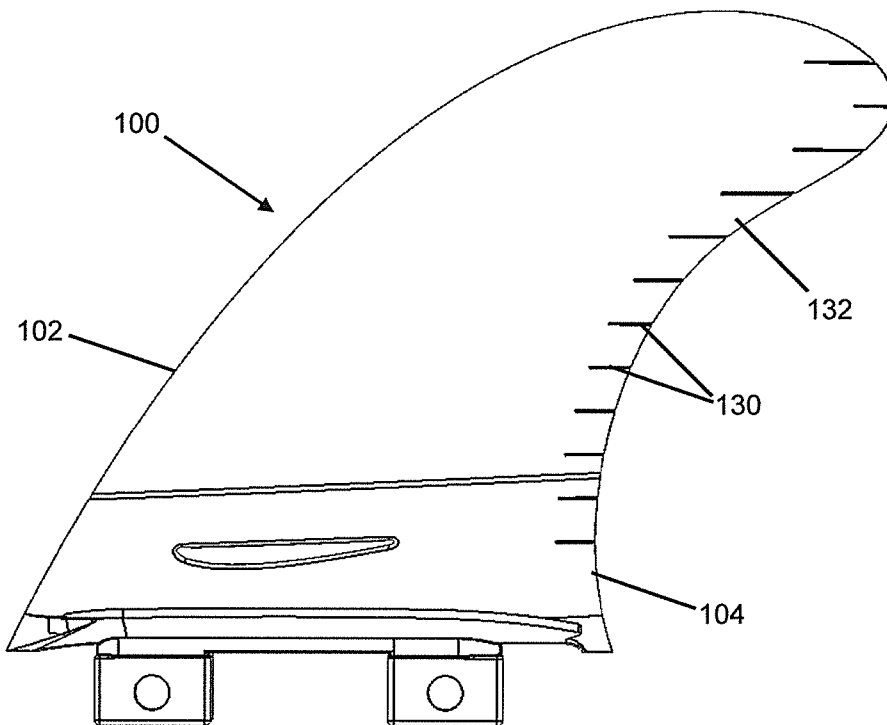
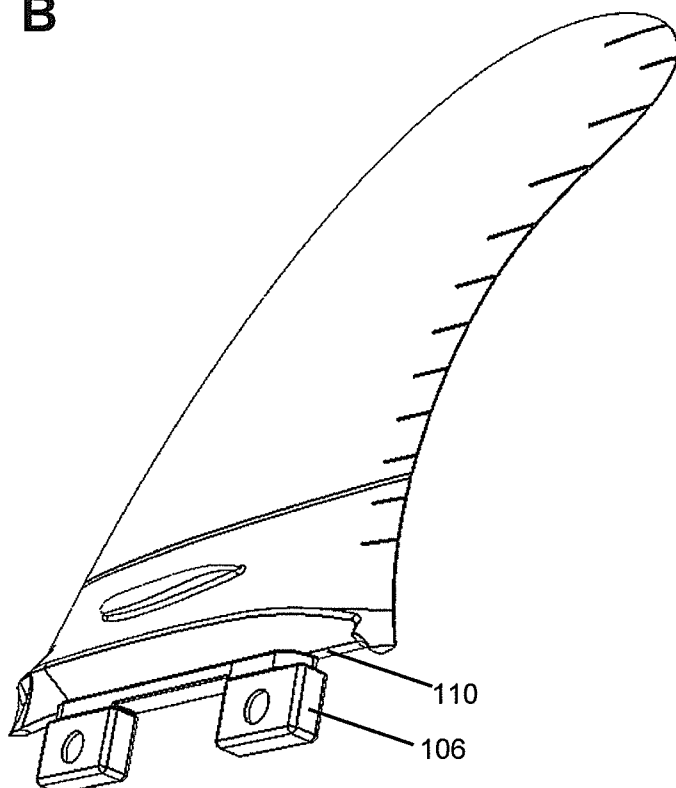


Figure 7

**A**



**B**



**C**

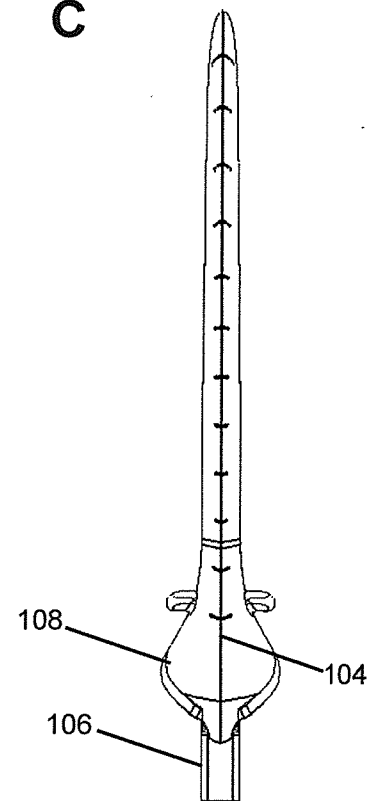


Figure 8

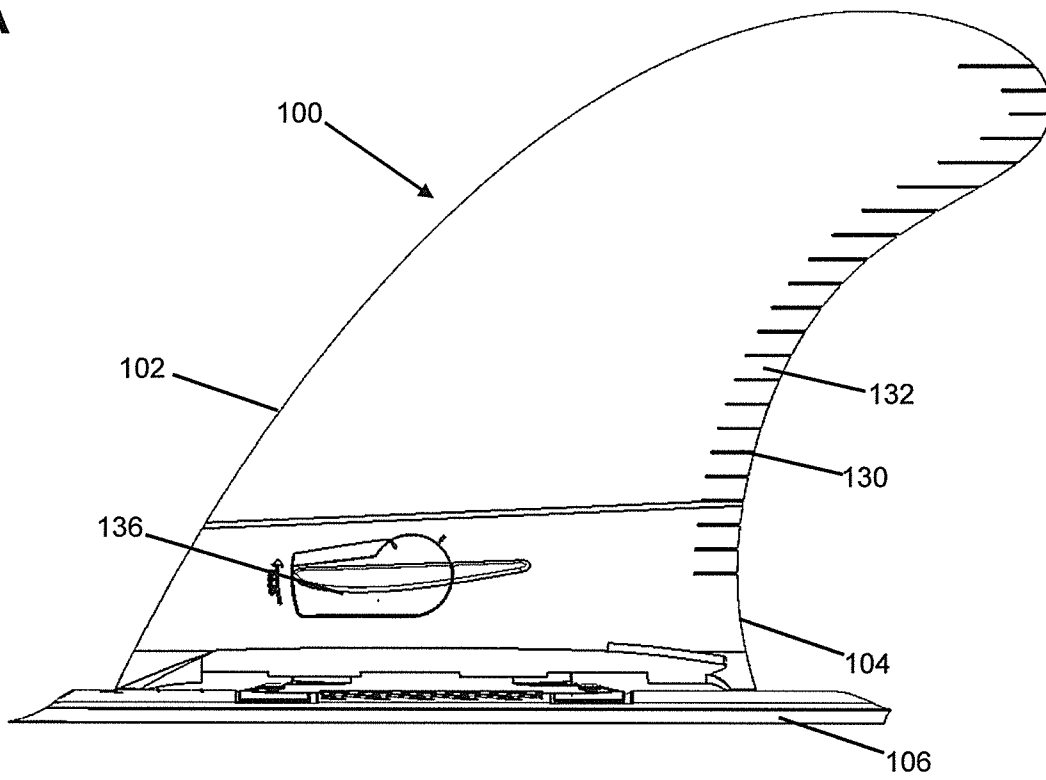
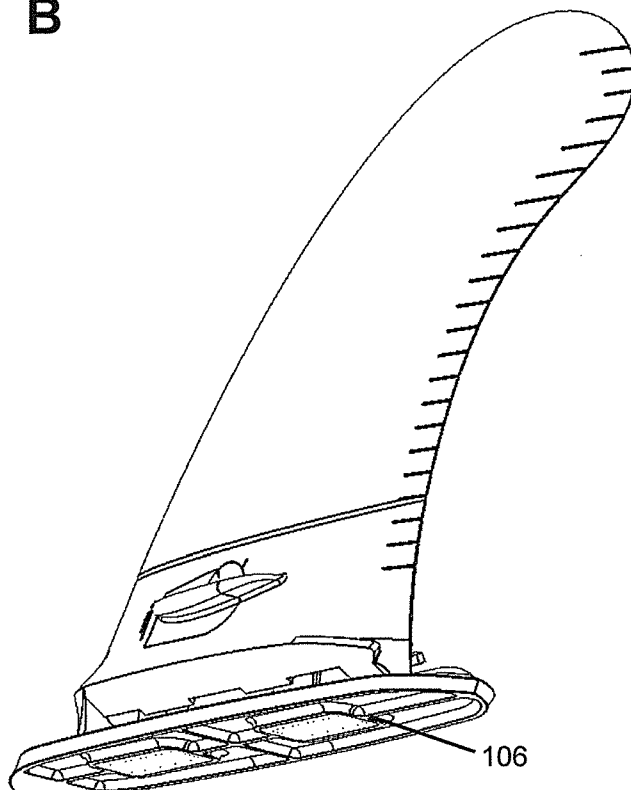
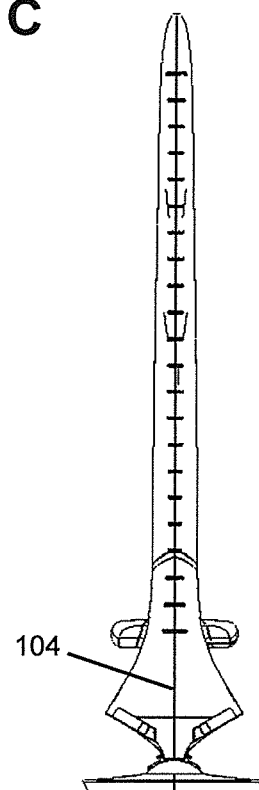
**A****B****C**

Figure 9

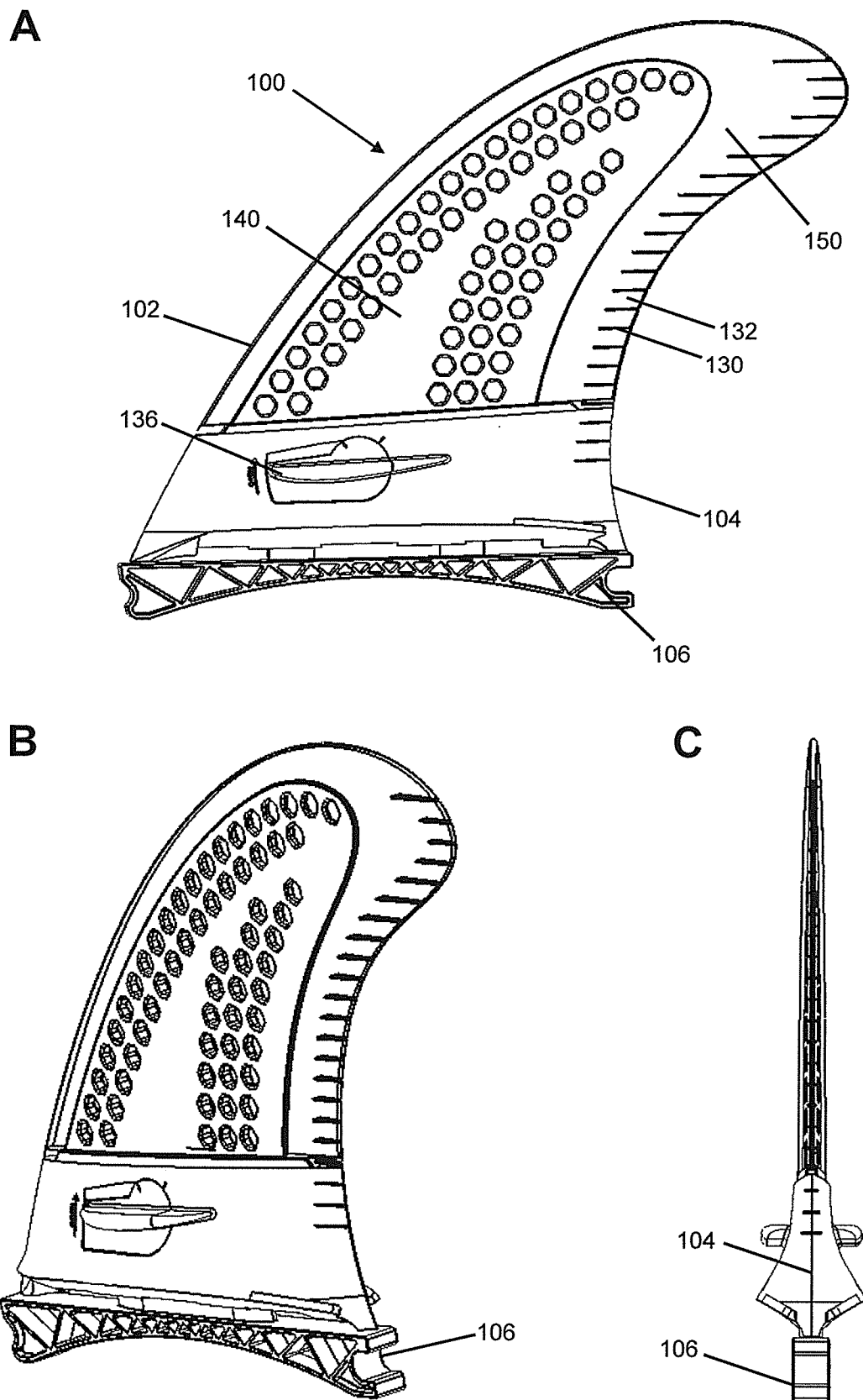


Figure 10

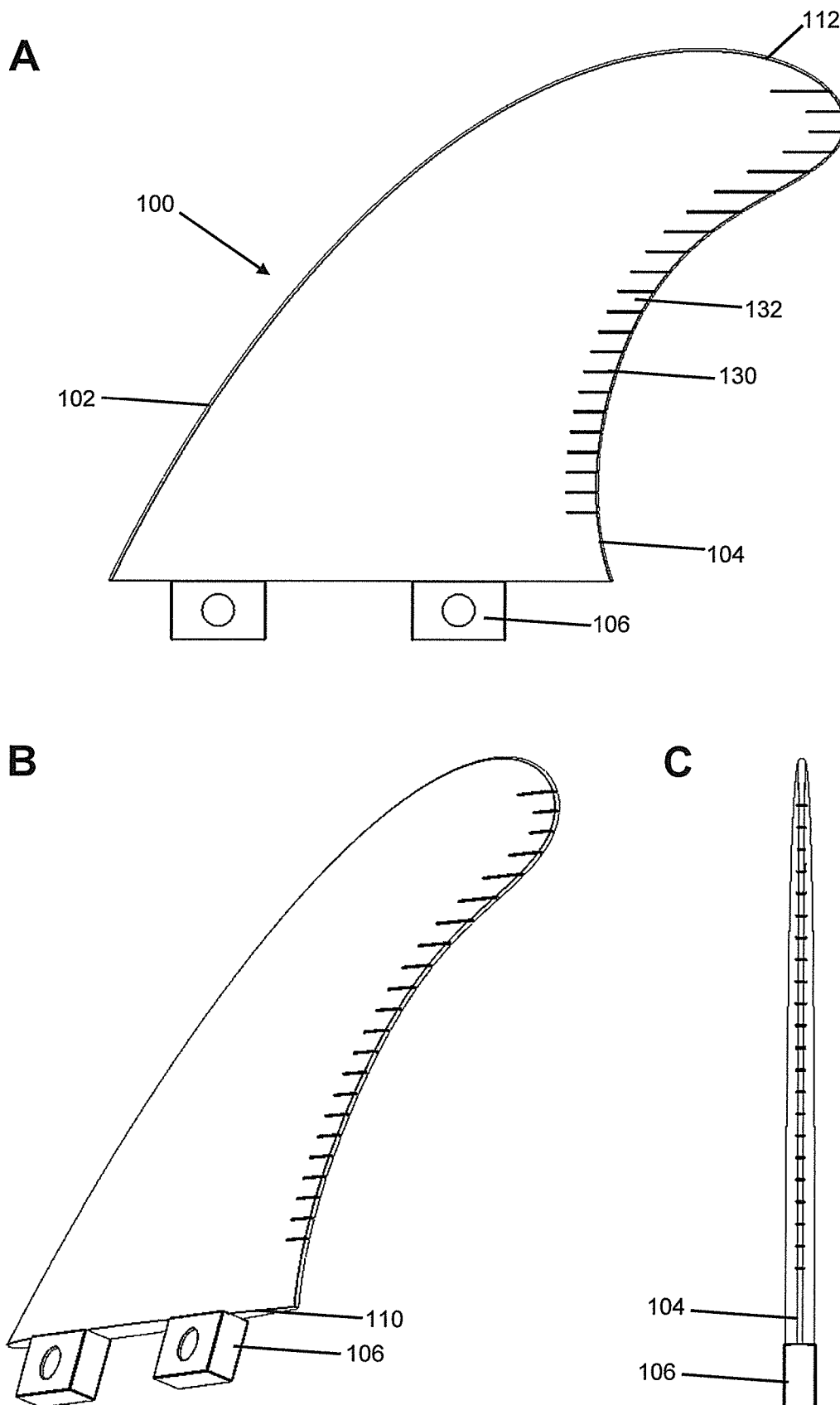


Figure 11

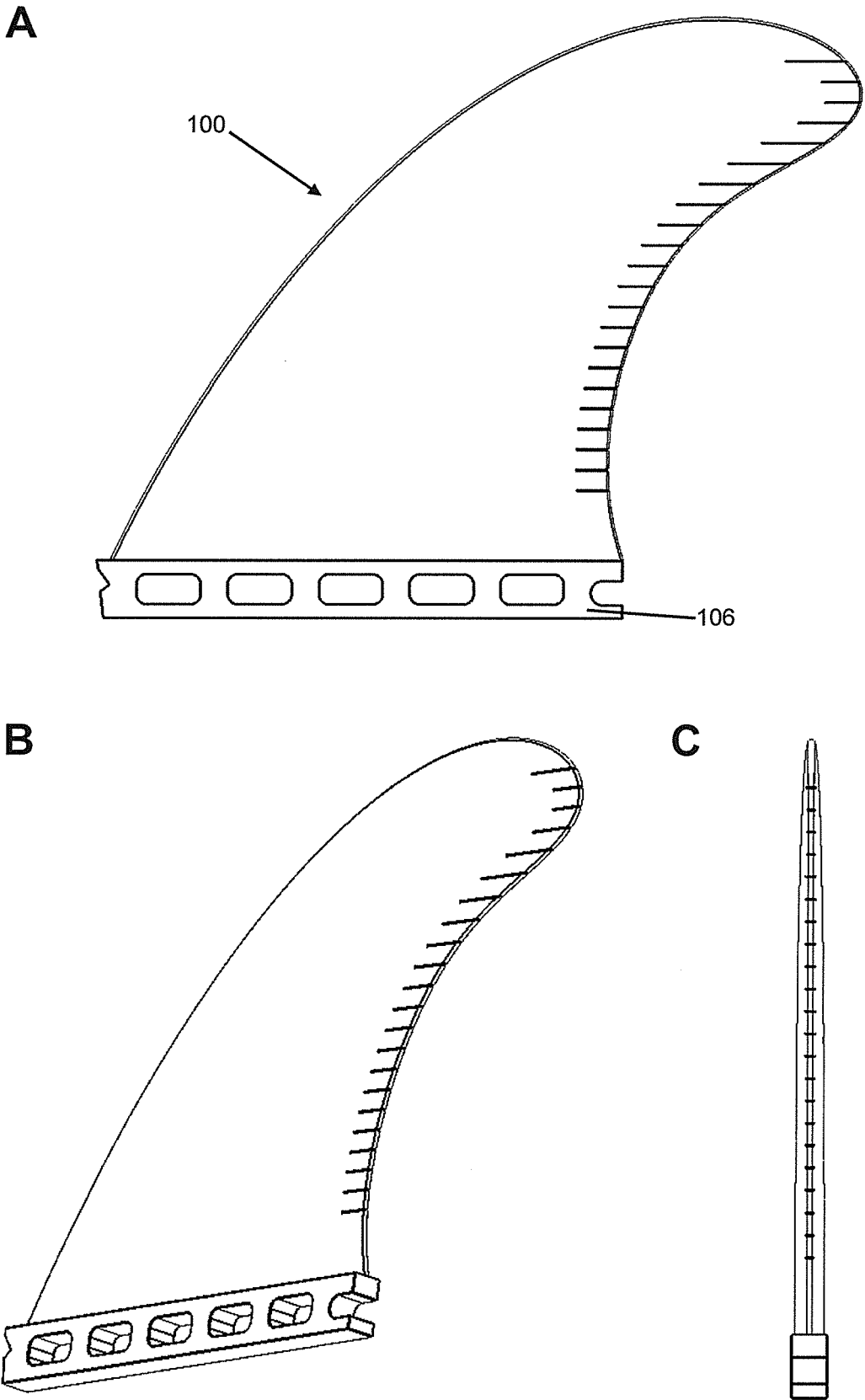
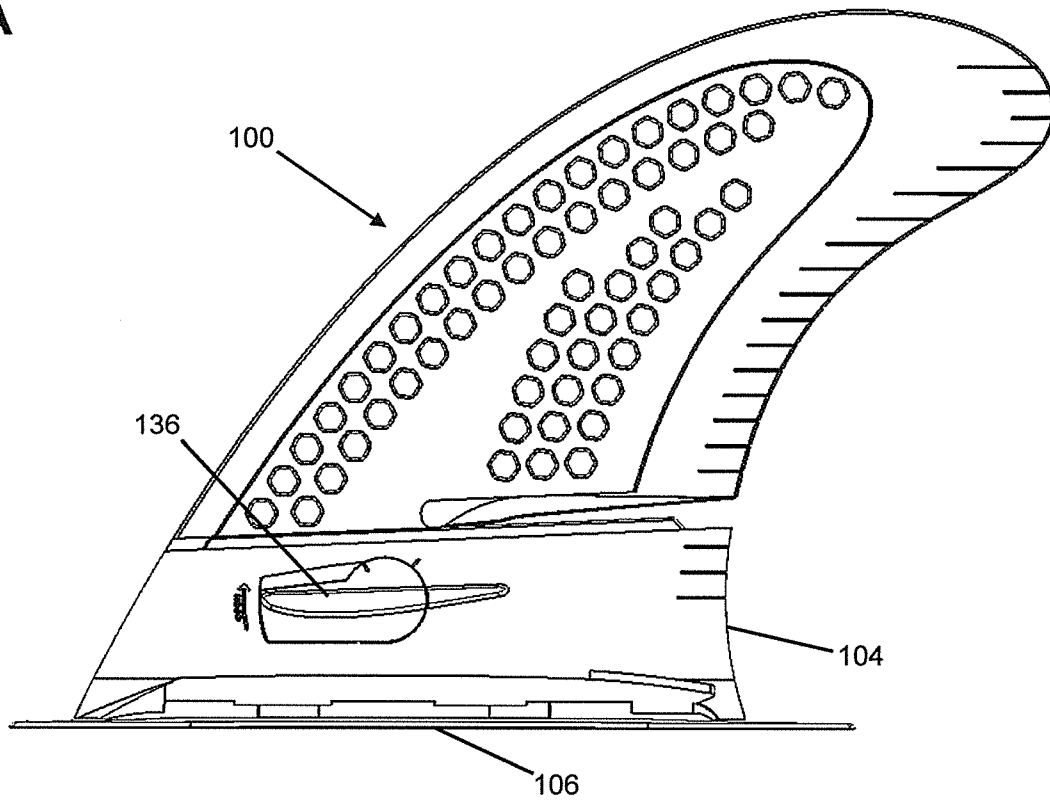
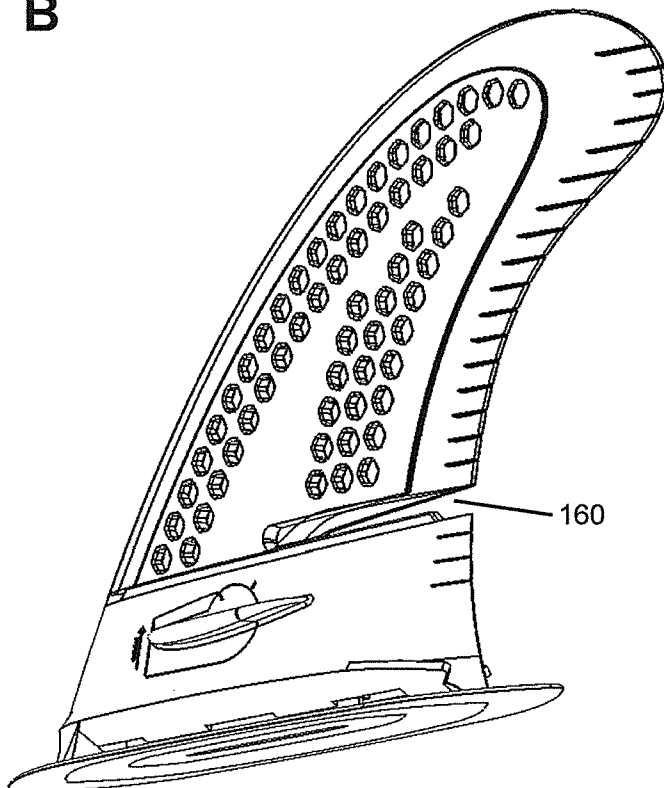


Figure 12

**A**



**B**



**C**

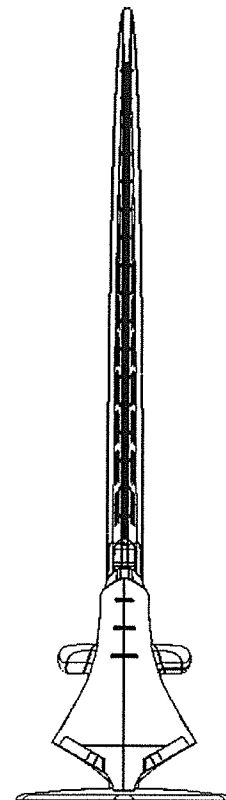
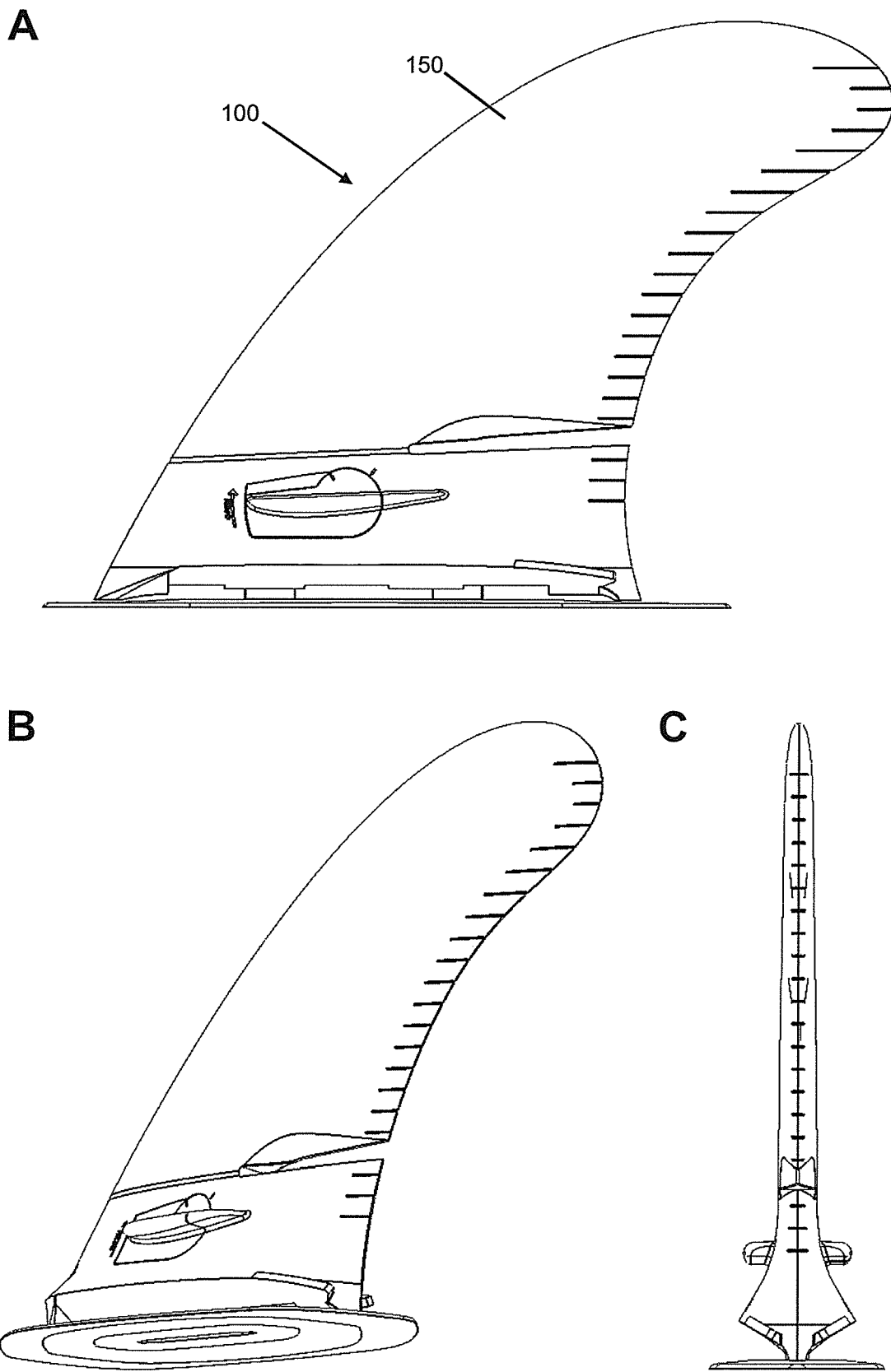


Figure 13



## INTERNATIONAL SEARCH REPORT

 International application No.  
**PCT/AU2017/051125**

## A. CLASSIFICATION OF SUBJECT MATTER

**B63B 3/38 (2006.01) B63B 35/79 (2006.01)**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**Databases: EPODOC, WPIAP, TXTE, PATENW - IPC/CPC marks: B63B3/38 or B63B35/79 Keywords: Safety, injury, flap, trailing, edge, fin and similar terms**
**Database: AusPat, Espacenet - Keywords: Safety, injury, flap, trailing, edge, fin and similar terms**
**Database: Google Patents, Google - Keywords: Safety, injury, flap, trailing, edge, fin and similar terms**
**Applicant name also searched on Espacenet, AusPat and internal databases provided by IP Australia.**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
|           | Documents are listed in the continuation of Box C                                  |                       |



Further documents are listed in the continuation of Box C



See patent family annex

|          |                                                                                                                                                                     |     |                                                                                                                                                                                                                                              |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| *<br>"A" | Special categories of cited documents:<br>document defining the general state of the art which is not considered to be of particular relevance                      | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                                              |
| "E"      | earlier application or patent but published on or after the international filing date                                                                               | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                                                                     |
| "L"      | document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "O"      | document referring to an oral disclosure, use, exhibition or other means                                                                                            | "&" | document member of the same patent family                                                                                                                                                                                                    |
| "P"      | document published prior to the international filing date but later than the priority date claimed                                                                  |     |                                                                                                                                                                                                                                              |

|                                                                                                                                                                |                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Date of the actual completion of the international search<br>12 February 2018                                                                                  | Date of mailing of the international search report<br>12 February 2018                                                                      |
| <b>Name and mailing address of the ISA/AU</b><br><br>AUSTRALIAN PATENT OFFICE<br>PO BOX 200, WODEN ACT 2606, AUSTRALIA<br>Email address: pct@ipaustalia.gov.au | <b>Authorised officer</b><br><br>Alex Stone<br>AUSTRALIAN PATENT OFFICE<br>(ISO 9001 Quality Certified Service)<br>Telephone No. 0262832643 |

| <b>INTERNATIONAL SEARCH REPORT</b><br>C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                  | International application No.<br><b>PCT/AU2017/051125</b> |
|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Category*                                                                                   | Citation of document, with indication, where appropriate, of the relevant passages                                                               | Relevant to claim No.                                     |
| X                                                                                           | US 4537143 A1 (GAIDE) 27 August 1985<br>Abstract, figure 7 and column 4                                                                          | 1-22                                                      |
| X                                                                                           | US 20080261470 A1 (JONES) 23 October 2008<br>Abstract, figures 3 and 6, and paragraphs [0088-0099]                                               | 1-22                                                      |
| X                                                                                           | US 5273472 A1 (SKEDELESKI et al.) 28 December 1993<br>Abstract, figure 1 and column 5                                                            | 1-22                                                      |
| X                                                                                           | US 5951347 A1 (HUDSON et al.) 14 September 1999<br>Abstract, figure 1 and column 4                                                               | 1-22                                                      |
| X                                                                                           | US 6896570 B1 (O'KEEFE et al.) 24 May 2005<br>Abstract, figure 2 and column 5                                                                    | 1-22                                                      |
| P,X                                                                                         | WO 2017165915 A1 (FLYING FIN SYSTEMS PTY LTD) 05 October 2017<br>Abstract, figure 13, and paragraphs [0001], [0029], [0014-0016] and [0055-0060] | 1, 5, 6 and 10-22                                         |

| <b>INTERNATIONAL SEARCH REPORT</b><br>Information on patent family members                                                                                                                                                                                            |                         | International application No.<br><b>PCT/AU2017/051125</b> |                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------|-------------------------|
| This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information. |                         |                                                           |                         |
| <b>Patent Document/s Cited in Search Report</b>                                                                                                                                                                                                                       |                         | <b>Patent Family Member/s</b>                             |                         |
| <b>Publication Number</b>                                                                                                                                                                                                                                             | <b>Publication Date</b> | <b>Publication Number</b>                                 | <b>Publication Date</b> |
| US 4537143 A1                                                                                                                                                                                                                                                         | 27 August 1985          | None                                                      |                         |
| US 20080261470 A1                                                                                                                                                                                                                                                     | 23 October 2008         | US 2008261470 A1                                          | 23 Oct 2008             |
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|                                                                                                                                                                                                                                                                       |                         | WO 2006135256 A1                                          | 21 Dec 2006             |
|                                                                                                                                                                                                                                                                       |                         | ZA 200710831 B                                            | 25 Mar 2009             |
| US 5273472 A1                                                                                                                                                                                                                                                         | 28 December 1993        | None                                                      |                         |
| US 5951347 A1                                                                                                                                                                                                                                                         | 14 September 1999       | None                                                      |                         |
| US 6896570 B1                                                                                                                                                                                                                                                         | 24 May 2005             | US 6896570 B1                                             | 24 May 2005             |
| WO 2017165915 A1                                                                                                                                                                                                                                                      | 05 October 2017         | WO 2017165915 A1                                          | 05 Oct 2017             |
| <b>End of Annex</b>                                                                                                                                                                                                                                                   |                         |                                                           |                         |
| <div>             Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.<br/>             Form PCT/ISA/210 (Family Annex)(July 2009)           </div>                                              |                         |                                                           |                         |