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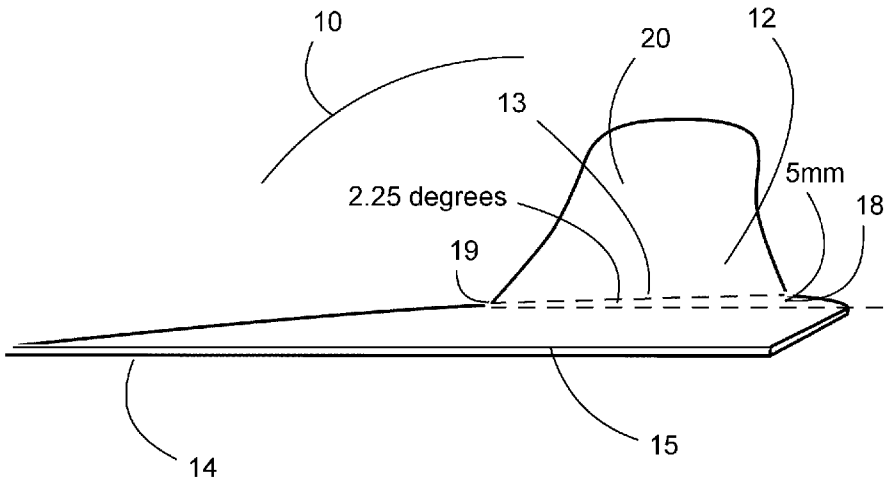

Figure 1

(57) Abstract: A fin blade for free diving or swimming or scuba diving is described, which has a cross section at one end angled about a yaw, or longitudinal, axis relative to the cross section at the other end. The arrangement is such that a lateral line at a proximal end is disposed at an angle relative to a lateral line at a portion spaced from the proximal end. The advantage is that the fin blade is more closely aligned with the ergonomic complexities of the human body, such that during finning the fin blade provides greater comfort and/or propulsion. A fin blade is also described which includes a reinforced zone in one portion of the fin blade, such that one portion of the blade at the distal end is relatively increased in flexibility to provide a catch zone at one portion of the distal end of the fin blade.

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A NEW FIN AND FIN BLADE

Technical Field

1. The present technology relates generally to diving fins, including scuba diving fins, free diving fin assemblies, scuba diving fin assemblies, scuba diving fin blades and free diving fin blades.

Background

2. Diving is very popular. The sense of peace and freedom to be found when underwater is highly rated among participants. The present technology finds efficient application in any form of diving. The remainder of the specification, however, will discuss freediving. Freediving in particular, is an underwater multi-discipline sport that is characterised by breath-holding diving; while freediving, divers do not use scuba equipment to provide air while underwater. Freediving includes spearfishing, underwater hockey, underwater rugby, snorkelling, apnea and competitive apnea.

3. Competitive apnea takes a myriad of forms: Constant weight apnea, dynamic apnea, jump blue, variable weight apnea. In these competitions, divers look for maximum efficiency from their fins.

4. There is a myriad array of fins available. Basically there are those of unified construction, in which all components may be glued together or moulded together as one unit, and those of multi-part construction, in which the fin may be readily disassembled into its component parts by use of a screwdriver or Allen key or like tool. Disassembly may even be tool-less.

5. Component parts of fins include foot pocket and blades. In the multi-part fin designs, the blades are detachable from, or at least insertable into, the fin pocket. The blades fit into the foot pocket by insertion of a tongue, and the tongue is held in the foot pocket by fastening screws, even glue. The tongue can be angled, usually downwards, to provide certain advantages of finning efficiency, perhaps when a diver is on the surface, and even to provide a particular ergonomic advantage when finning horizontally or vertically.

6. The present technology seeks to ameliorate one or more of the above mentioned disadvantages, and/or to provide a finning efficiency improvement over known fins and fin blades, by seeking to provide a closer alignment of the fin to the mechanics of a diver's body.

Summary

7. Broadly, the present technology provides a free diving fin blade which is angled and/or twisted about a yaw, or longitudinal, axis.

8. Broadly, the present technology provides a free diving fin which includes a blade angled and/or twisted about a yaw, or longitudinal, axis.

9. Advantageously, it is believed that the present technology provides a free diving fin which is more closely aligned with the ergonomic complexities of the human body than known fins, such that during finning (the diving term for kicking along, up or down, with the legs while wearing fins on the feet) the blade provides greater comfort and/or propulsion than known fins.

10. In accordance with one aspect of the present invention there is provided a free diving fin blade including a main portion twisted from one end to the other about a yaw, or longitudinal, axis.

11. In accordance with another aspect of the present invention there is provided a free diving fin blade where the fin blade cross section at one end is disposed at an angle relative to the cross section at the other end.

12. In accordance with yet another aspect of the present invention there is provided a free diving fin blade wherein a lateral line at a proximal end is disposed at an angle relative to a lateral line at a portion spaced from the proximal end.

13. In accordance with still another aspect of the present invention there is provided a free diving fin blade wherein a line from rail to rail at one end is disposed at an angle relative to a line from rail to rail at the other end.

14. In accordance with a yet further aspect of the present invention there is provided a free diving fin which includes a blade which is twisted about a longitudinal or yaw axis.

15. In one embodiment the blade includes a tongue for connecting a main blade portion to a foot pocket.

16. In one embodiment the main blade portion is angled downwardly relative to the tongue to facilitate comfort when finning on the water surface and for ergonomic comfort generally underwater, finning up, down or along.

17. In one embodiment the tongue is angled downwardly, (about a roll axis or substantially lateral line) relative to the main blade portion for increased comfort and efficiency when finning.

18. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 1 and 45 degrees.

19. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 20 degrees.

20. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 22 degrees.

21. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 23 degrees.

22. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 26 degrees.

23. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 3 and 30 degrees.

24. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 3 and 33 degrees.

25. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 3 and 35 degrees.

26. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 30 degrees.

27. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 10 degrees.

28. In one embodiment the main blade portion is angled relative to the tongue downwardly by between 2 and 5 degrees.

29. In one embodiment the main blade portion is angled relative to the tongue downwardly by about 2.25 degrees.

30. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 1 and 50mm.

31. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 2 and 20mm.

32. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 5 and 10mm.

33. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 2 and 35mm.

34. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 3 and 15mm.

35. In one embodiment the lateral line at the proximal end is elevated from one side to the other by between 5 and 10mm.

36. In one embodiment the lateral line at the proximal end is elevated from one side to the other by about 5mm.

37. In one embodiment the lateral line at the proximal end is elevated from one side to the other by about 4mm.

38. In one embodiment the lateral line at the proximal end is elevated from one side to the other by about 3mm.

39. In one embodiment the lateral line at the proximal end is elevated from one side to the other by about 10mm.

40. In one embodiment the main blade portion is substantially planar in shape.

41. In one embodiment the main blade portion includes rails to inhibit vortices forming, or simply to channel water along the blade more effectively for greater efficiency of finning. The rails also facilitate increased stiffness of the main blade portion.

42. In one embodiment the blade twist commences at a lateral join between the tongue and the main blade portion.

43. In one embodiment the blade twist is twisted inwards to suit certain divers' ergonomic mechanics.

44. In one embodiment the blade twist is twisted outwards to suit certain divers' ergonomic mechanics.

45. In one embodiment the lateral line between the tongue and the main blade portion is disposed at an angle about an axis normal to the main blade surface.

46. In one embodiment the angle of the lateral line is between about 5 and 45 degrees.

47. In one embodiment the angle of the lateral line is 2.25 degrees.

48. In one embodiment the angle of the lateral line is 1.5 degrees.

49. In one embodiment the angle of the lateral line is 2.5 degrees.

50. In one embodiment the angle of the lateral line is 3 degrees.

51. In one embodiment the angle of the lateral line is 4 degrees.

52. In one embodiment the angle of the lateral line is 5 degrees.

53. In one embodiment the angle of the lateral line is 6 degrees.

54. In one embodiment the angle of the lateral line is 7 degrees.

55. In one embodiment the angle of the lateral line is 8 degrees.

56. In one embodiment the angle of the lateral line is 9 degrees.

57. In one embodiment there is a radius on the lateral edges of the blade to reduce stresses. In one embodiment the radius is about 50mm.

58. In one embodiment the tail end of the main blade portion is a fish tail shape.

59. In one embodiment the tail end of the main blade portion is a jet tail shape.

60. In one embodiment the tail end of the main blade portion is a swallowtail shape.

61. In one embodiment the tail end of the main blade portion is rounded.

62. In accordance with another aspect of the present invention there is provided a fin blade for freediving which includes a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal a foot pocket and adjacent at least a portion of an edge of the proximal region.

63. In an embodiment the reinforced zone is disposed adjacent at least a portion of an outer edge of the proximal region.

64. In an embodiment the reinforced zone is disposed adjacent at least a portion of an inner edge of the proximal region.

65. In an embodiment the main blade portion includes a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal both a foot pocket and extending along at least a portion of an outer rail.

66. In an embodiment the main blade portion includes a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal both a foot pocket and extending along at least a portion of an inner rail

67. In an embodiment the reinforced zone is disposed in a substantially triangular region at a proximal end near a foot pocket, bounded by a line from an inner end of a proximal region to an intermediate point along an outer edge of the main blade portion.

68. In an embodiment the reinforced zone is disposed in a substantially triangular region at a proximal end near a foot pocket, bounded by a line from an outer end of a proximal region to an intermediate point along an inner edge of the main blade portion.

69. In an embodiment the substantially triangular region of the reinforced zone includes curved edges.

70. In an embodiment there is provided a flexible catch zone, adjacent the reinforced zone, which is generally comprised of only the flexible matrix.

71. In some embodiments the reinforced zone includes a layup of about an additional 200g balance strength carbon fibre matting to provide the reduced flex in the outer zone along the outer edge and proximal the location of the outer toes would be in the fin assembly when fitted to a user.

72. In some embodiments the reinforced zone includes a layup of about an additional 200g balance strength carbon fibre matting to provide the reduced flex in the inner zone along the inner edge and proximal the location of the inner toes would be in the fin assembly when fitted to a user.

Clarifications

73. In this specification, where a document, act or item of knowledge is referred to or discussed, this reference or discussion is not an admission that the document, act or item of knowledge or any combination thereof was at the priority date:

(a) part of common general knowledge; or

(b) known to be relevant to an attempt to solve any problem with which this specification is concerned.

74. It is to be noted that, throughout the description and claims of this specification, the word 'comprise' and variations of the word, such as 'comprising' and 'comprises', is not intended to exclude other variants or additional components, integers or steps.

Brief Description of the drawings

75. In order to enable a clearer understanding, a preferred embodiment of the technology will now be further explained and illustrated by reference to the accompanying drawings, in which:

76. Figure 1 is a tail or distal end elevation view of a prototype fin blade with lateral construction lines showing the twist in the blade;

77. Figure 2 is an isometric view from underneath and the distal or tail end of two free diving fin blades, one closest to the viewer being the fin blade of an embodiment of the present technology, having twist about a longitudinal or yaw axis, and the fin blade underneath with its edges only shown, being a known embodiment with no blade twist;

78. Figure 3 is an isometric view from the proximal or tongue end of the two fins shown in Figure 2;

79. Figure 4 is a tail elevation view of the fin blade shown in Figure 1, but shown with the other one in the pair. The lift on the inside edge of the fin blade at the tongue end can be seen, which causes the main blade portion to twist;

80. Figure 5 is a side elevation section view of the proximal end of the blade, showing the comparison between the known and the new embodiments, with one lateral edge adjacent the tongue being higher than the other lateral edge in the new blade, by 5mm;

81. Figure 6 a plan view of two different sizes of the two blades of an embodiment of the present technology. Figure 6a is a shorter fin blade, about 500mm long, and Figure 6b is a longer blade, about 635mm long;

82. Figure 7 is an isometric view from underneath of a pair of fin blades in accordance with an embodiment of the present invention, showing construction of strengthened zones for increased stiffness, and weaker zones for increased catch;

83. Figure 8 is a perspective view from the tail end of two fin blades shown in Figure 7, showing the strengthened (outer) and relatively weakened zones (inner);

84. Figure 9 is a perspective view from the tail end of two fin blades, similar to those shown in Figures 7 and 8, but which have been flipped, so that the strengthened zones are proximal the inner edges;

85. Figure 10 is a perspective view of a pair if foot pockets with frames for receiving the fin blades;

86. Figure 11 is a detail of a fin frame rail which shows the profiled section for receiving the fin blades;

87. Figure 12 is a partial exploded view of a pair of fin blades, adjacent the fin frame rails; and

88. Figure 13 is a perspective view of an assembled pair of fins wherein the foot pockets and frames from Figure 10 are joined to the fin blades from the other Figures.

Detailed description of an example embodiment

89. Referring to the drawings there is shown an embodiment of free diving fin blade generally indicated at 10. The fin blade 10 is angled and/or twisted along at least a portion of its length about a yaw, or longitudinal, axis as shown in at least Figure 1. The fin blade 10 is configured to fit into a foot pocket 90 of a fin frame so as to form a complete fin assembly shown in Figure 13. The fin blade 10 may be glued or otherwise fastened into place in rails 99 of a foot pocket 90, or the fin blade 10 may be moulded to form a unified fin which cannot be disassembled.

90. The fin blade 10 includes a tongue 20 integral with or connected to a main blade portion 22. The tongue 20 when the fin blade 10 is assembled into the foot pocket 90, fits under the foot receiver 92.

Yaw angle - twisted main blade

91. It can be seen in the Figures that the free diving fin blade 10 has a cross section at the proximal end 12 which is disposed at an angle relative to the cross section at the distal end 14. To make this more clear, it can be seen that a lateral line 13 which extends across the fin blade 10 at the proximal end 12, is disposed at an angle relative to a lateral line 15 extending across the fin blade 10 at the distal end 14. Again, in a hope to make it even more clear, it should be understood that the lateral line 13, 14 may be disposed anywhere along the blade, and as long as the two lateral lines 13,14 are spaced some distance apart, the twist may occur anywhere along the blade 10, for any suitable length.

92. The main blade portion 22 may be twisted such that the two lateral lines 13 and 14 are angled relative to each other by between 0.5 and 45 degrees. Most usefully it seems that the twist angle is about 2.25 degrees as shown in the Figures, but depending on the ergonomics of the user, the twist angle may be between 2 and 20 degrees, or between 10 and 20 degrees, or between 15 and 20 degrees, or by between 25 and 30 degrees, or between 0.5 and 1 degrees, or between 1 and 2 degrees, or between 2 and 3 degrees. The twist angle may be 2, 2.25, 2.25, 2.75, 3, 3.5, 4, 4.5, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 degrees depending on the ergonomics of the intended user.

93. It can be seen that the 2.25 degree twist shown in the Figures results in one end 18 of the lateral line 13 at the end adjacent the tongue 20 (or proximal end) is elevated relative to the other end 19 of the lateral line 13 by about 5mm. This does depend on the width of the main blade portion 22. In other embodiments, although not shown, it is to be understood that good performance and comfort can be obtained when the elevation is between 1 and 50mm, or between 2 and 35mm, or between 5 and 10mm. The elevation of the end 18 of the lateral line may therefore be 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 or 30mm to provide good comfort and performance depending on the ergonomics of the intended user.

94. It is believed that at least the abovementioned twist angle, and/or the features described below, of the free diving fin blade 10 of the embodiment shown provides a fin which is more closely aligned with the ergonomic complexities of the human body, such that during finning (the diving term for kicking along, up or down, with the legs while wearing fins on the feet) the blade provides more comfort and/or greater propulsion than known fins.

Construction of fin blade

95. Turning to Figures 7 and 8, an example construction of fin blades 10 is shown.

96. The blades are constructed from carbon fibre, but they may equally well be constructed from polymer or fibreglass or other suitable material.

97. The fin blades 10 in the embodiment shown are constructed from carbon fibre, and includes a carbon fibre matrix 38 with a reinforced zone 40 and a catch zone 45, which is more flexible. The reinforced zone 40 is disposed in a region generally encompassing the tongue 20, and extending into an outer zone of the fin blade proximal the outer toes, and along at least a portion of an outer edge 23 of each fin blade 10.

98. Generally speaking, an inner edge 25 is free from reinforcement, and includes only the matrix 38, which is a blade of flexible carbon fibre mat with suitable resin. In this way, it is considered that the inner edge 25 should be more flexible than the outer edge 23 so that the inner region at the tail or distal end 14 functions as a catch zone. In this manner the whole blade is believed to operate more efficiently than known blades where the whole blade flexes and catches evenly across the whole width of the blade.

99. In some constructions the reinforced zone 40 includes a layup of additional 200g balance strength carbon fibre matting to provide the reduced flex in the outer zone along the outer edge 23 and proximal where the outer toes would be in the fin assembly at 19, when fitted to a user. This construction, stiffer on the outer, proximal end (towards 19 and 23), contributes to a more efficient catch and propulsion over known fin blades. In combination with the twisted angle, there is believed to be increased ergonomic matching, comfort and power when finning.

100. The reinforced zone 40 on the main blade portion 22 is confined substantially in the embodiment shown to a triangular area bounded by a line from 18 to an intermediate point 27 along the outer edge 23 of the main blade portion 22. The intermediate point 27 may be any suitable distance from the distal end 14, say 10mm, 20mm, 30mm, 40mm, 50mm, 60mm, 70mm, 80mm, 90mm, 100mm, 110mm, 120mm, 130mm, 140mm, 150mm, 160mm, 170mm, 180mm, 190mm, 200mm, 210mm, 230mm, 240mm, 250mm, 260mm, 270mm, 280mm, 290mm or 300mm.

Roll angle - tongue/blade

101. It can be seen from the drawings that the tongue 20 is also angled (about a roll axis or substantially lateral line, say, line 13 in the drawings) relative to the main blade portion 22 for increased comfort and efficiency when finning. The main blade portion 22 is angled downward relative to the tongue 20 to facilitate finning on the surface, and for ergonomic finning when ascending or descending.

102. The main blade portion 22 may be angled relative to the tongue upwardly or downwardly by between 1 and 45 degrees. While the Figures show about 30 degrees is probably optimal, the roll angle may be 2, 5, 6, 7, 8, 9, 10, 13, 15, 17, 20, 22, 25, 27, 30, 35, 40 or 45 degrees, depending on the technique of the proposed user.

Fin assembly

103. The tongue 20 and main blade portion 22 are substantially planar in shape, for ease of fitment into a fin pocket 90.

104. The main blade portion 22 is configured to be inserted into frame rails 99 which have some height above the planar surface of the main blade portion 22, to inhibit vortices forming, or simply to channel water along the blade more effectively for greater efficiency of finning. The rails 99 also facilitate increased stiffness of the main blade portion.

Further clarifications

105. Modifications and improvements to the invention will be readily apparent to those skilled in the art. Such modifications and improvements are intended to be within the scope of this invention.

Advantages

106. Advantageously, embodiments of the apparatus provide improved matching of the fin to suit the ergonomic mechanics of selected divers for greater efficiency of finning.

107. The triangle shape of the reinforced zone is one way of naturally providing a gradient of stiffness from relatively strong at the proximal end line 13 to less strength at the distal end line 14. It is believed that a torsion force is provided by the arrangement from the proximal end line 13 to to the fin tip line 14 to let the soft part catch more water.

108. The fin blade pair can be arranged in the fin pocket 90 so that the reinforced area is on the outer edge, and this suits a small kick, allowing a user to kick for longer time at increased efficiency. The swing of the body from left to right is bigger, so the fin's functional surfaces also bigger, then it's more efficient.

109. When the blade pair is arranged in the fin pocket 90 so that the reinforced area is disposed on the inner edge, this is suitable for a more powerful kick. The swing from left to right on the body during a finning stroke, can be lower, which lets the user place more focus on their kick to push the performance. This also mimics mono fin training but provides more flexibility of movement than monofin training, freeing up the legs and reduces the claustrophobia and uncertainty associated with monofin training.

Claims

1. A fin blade suitable for free diving wherein a lateral line adjacent a proximal end is disposed at an angle relative to a lateral line at a portion spaced from the proximal end.

2. The fin blade in accordance with claim 1 wherein the lateral lines extend from rail to rail so that substantially the whole cross section of the blade is twisted at one end relative to the other.

3. The fin blade in accordance with claim 1 or 2 wherein the blade includes a tongue for connecting a main blade portion to a foot pocket.

4. The fin blade in accordance with any one of claims 1 to 3 wherein the fin blade includes a main blade portion which is angled downwardly relative to the tongue between 1 and 45 degrees to facilitate comfort when finning on the water surface and for ergonomic comfort generally underwater, finning up, down or along.

5. The fin blade in accordance with any one of claims 1 to 4 wherein the lateral line at the proximal end is elevated from one side to the other by between 1 and 50mm.

6. The fin blade in accordance with any claim 4 wherein the lateral line at the proximal end is elevated from one side to the other by about 5 or 10mm.

7. The fin blade in accordance with any one of claims 1 to 6 wherein the main blade portion is substantially planar in shape.

8. The fin blade in accordance with any one of claims 1 to 7 wherein the main blade portion includes rails to inhibit vortices forming, or simply to channel water along the blade more effectively for greater efficiency of finning.

9. The fin blade in accordance with any one of claims 1 to 8 wherein the proximal lateral line extends laterally at a lateral join between the tongue and the main blade portion.

10. The fin blade in accordance with any one of claims 1 to 9 wherein the lateral line elevation at the one end causes the main blade portion to twist inwards to suit certain divers' ergonomic mechanics.

11. The fin blade in accordance with any one of claims 1 to 10 wherein the lateral line elevation at the one end causes the main blade portion to twist outwards to suit other divers' ergonomic mechanics.

12. The fin blade in accordance with any one of claims 1 to 11 wherein the elevation of the lateral line at the one end causes the relative angle of the lateral lines to be between about 2 and 45 degrees.

13. The fin blade in accordance with any one of claims 1 to 12 wherein the angle of the lateral line is about 2.25 to 6 degrees.

14. The fin blade in accordance with any one of claims 1 to 13 wherein the main blade portion includes a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal both a foot pocket and extending along at least a portion of one edge, extending towards the distal end.

15. The fin blade in accordance with any one of claims 1 to 14 wherein the reinforced zone is disposed in a substantially triangular region at a proximal end near a foot pocket, bounded by a line from one end at one edge of a proximal region to an intermediate point along the other edge of the main blade portion.

16. The fin blade in accordance with any one of claims 1 to 15 wherein the substantially triangular region of the reinforced zone includes curved edges.

17. The fin blade in accordance with any one of claims 1 to 16 wherein there is provided a flexible catch zone, adjacent the reinforced zone on the distal end thereof, which is generally comprised of only the flexible matrix.

18. The fin blade in accordance with any one of claims 1 to 17 wherein the flexible catch zone is disposed in an inner edge region of the distal end when in a pair.

19. The fin blade in accordance with any one of claims 1 to 18 wherein the flexible catch zone is disposed in an outer edge region of the distal end when in a pair.

20. The fin blade in accordance with any one of claims 1 to 19 wherein the reinforced zone includes a layup of about an additional 200g balance strength carbon fibre matting to provide the reduced flex in the reinforced zone.

21. A fin or fin assembly for free diving which includes a fin blade in accordance with any one of claims 1 to 20, the fin blade fastened to or integral with a fin pocket.

22. A fin blade for freediving which includes a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal a foot pocket and adjacent at least a portion of an outer edge of the proximal region.

23. A fin suitable for free diving including a foot receiver and a blade, wherein a lateral line adjacent a proximal end of the blade is disposed at an angle relative to a lateral line at a portion spaced from the proximal end of the blade.

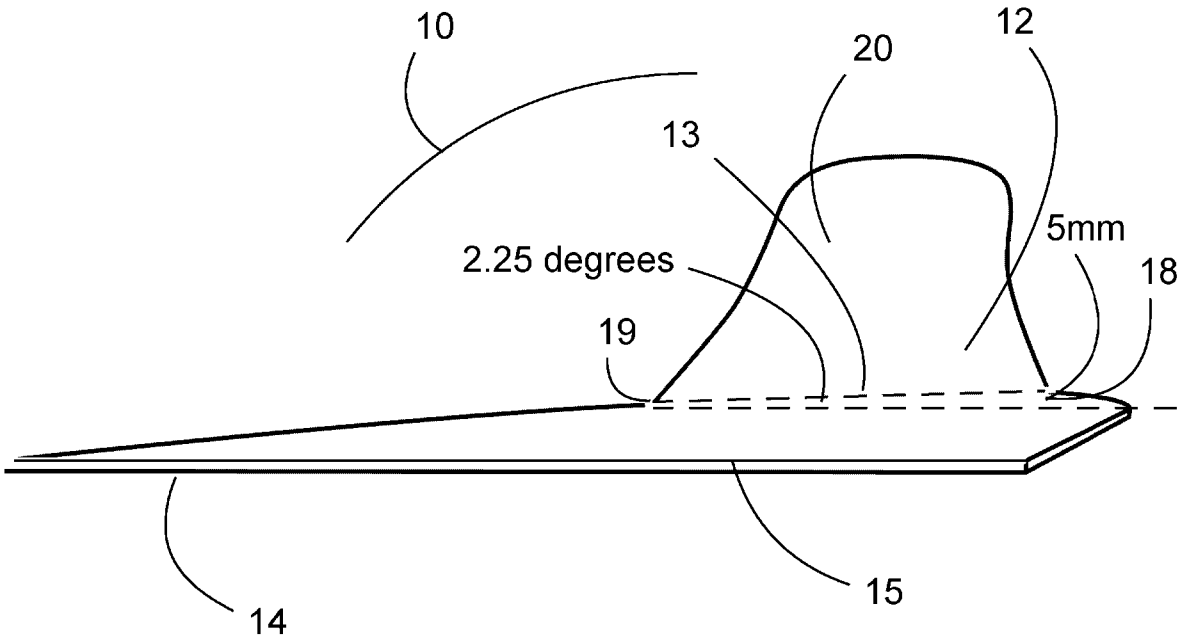

Figure 1

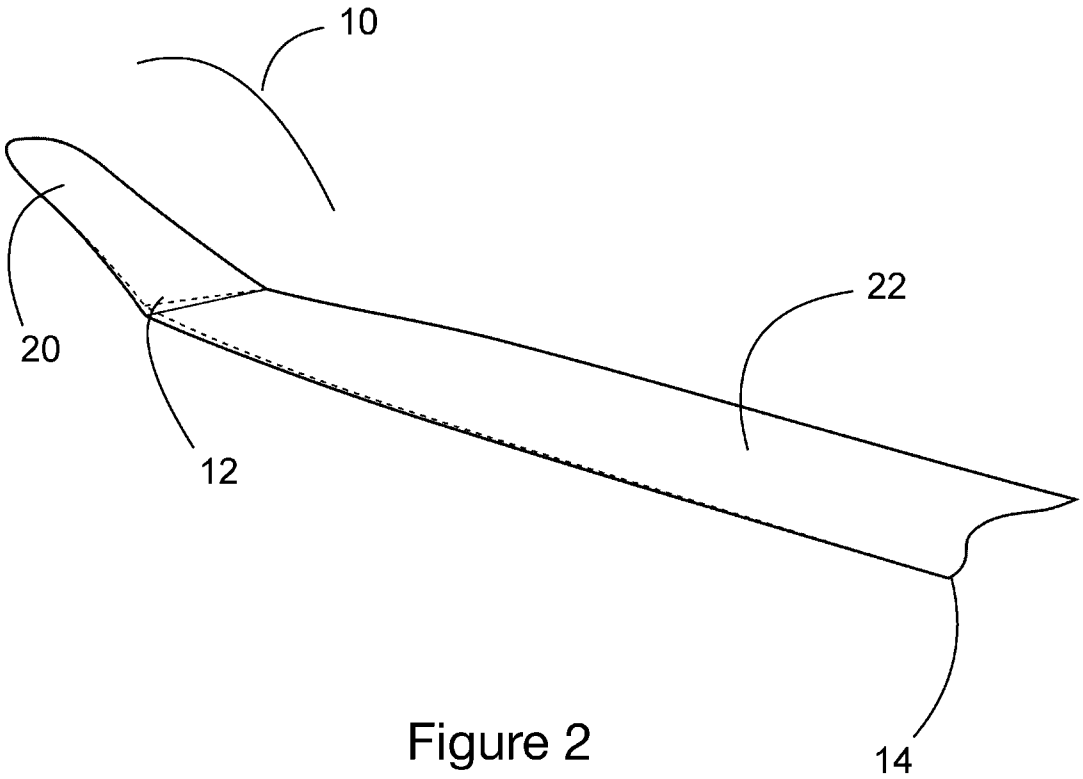

Figure 2

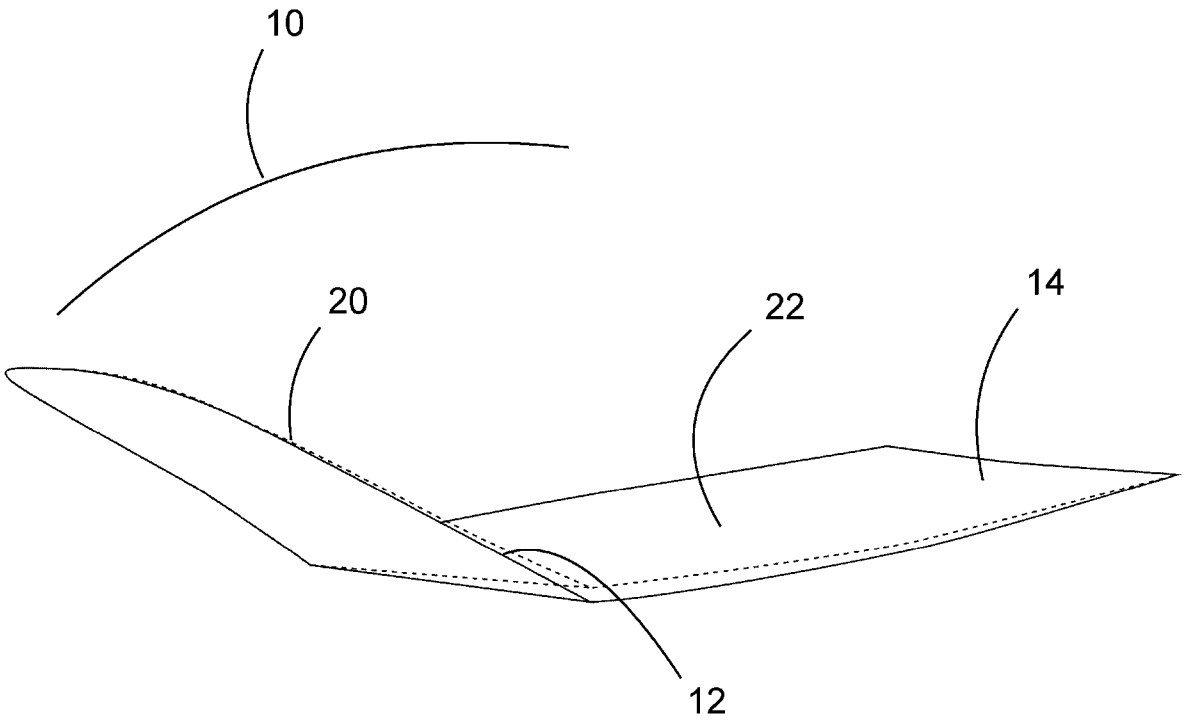

Figure 3

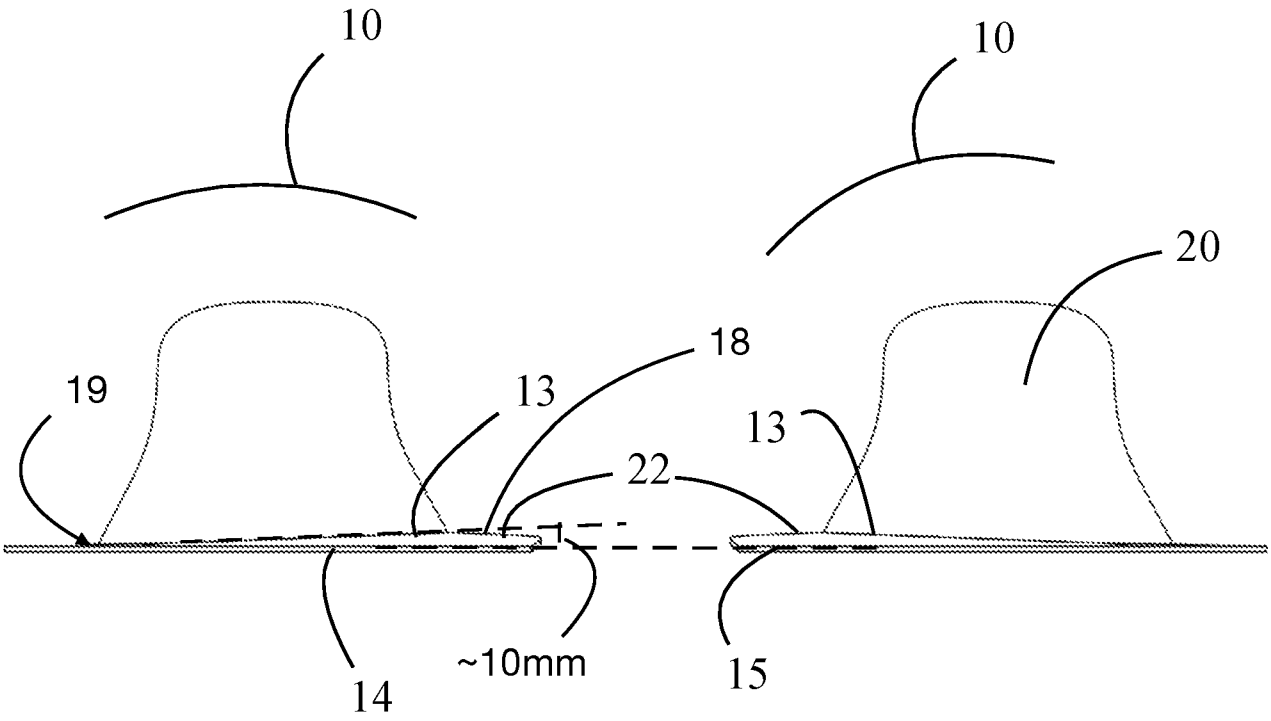

Figure 4

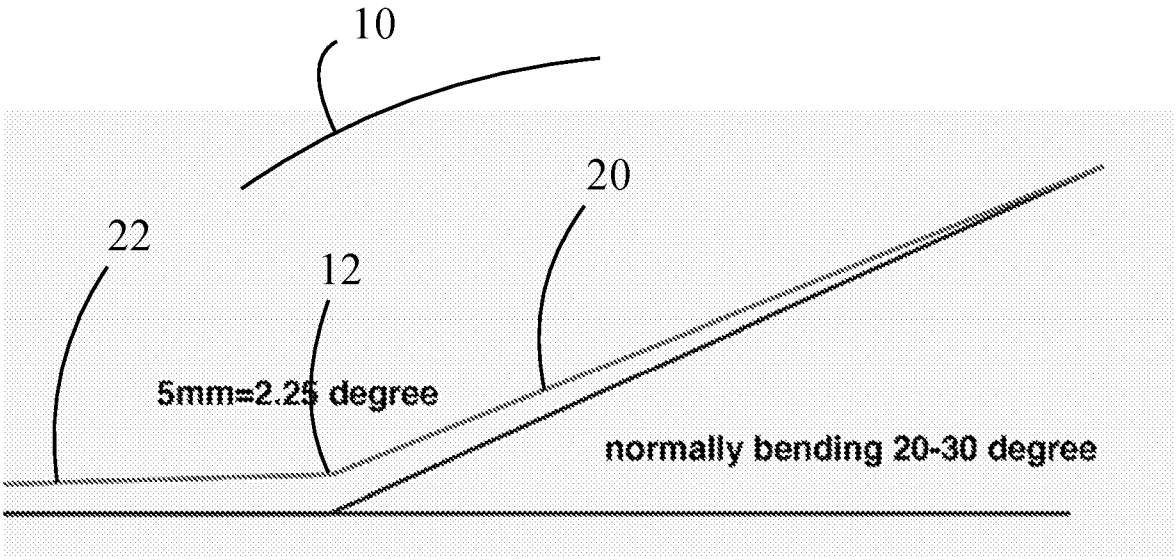

Figure 5

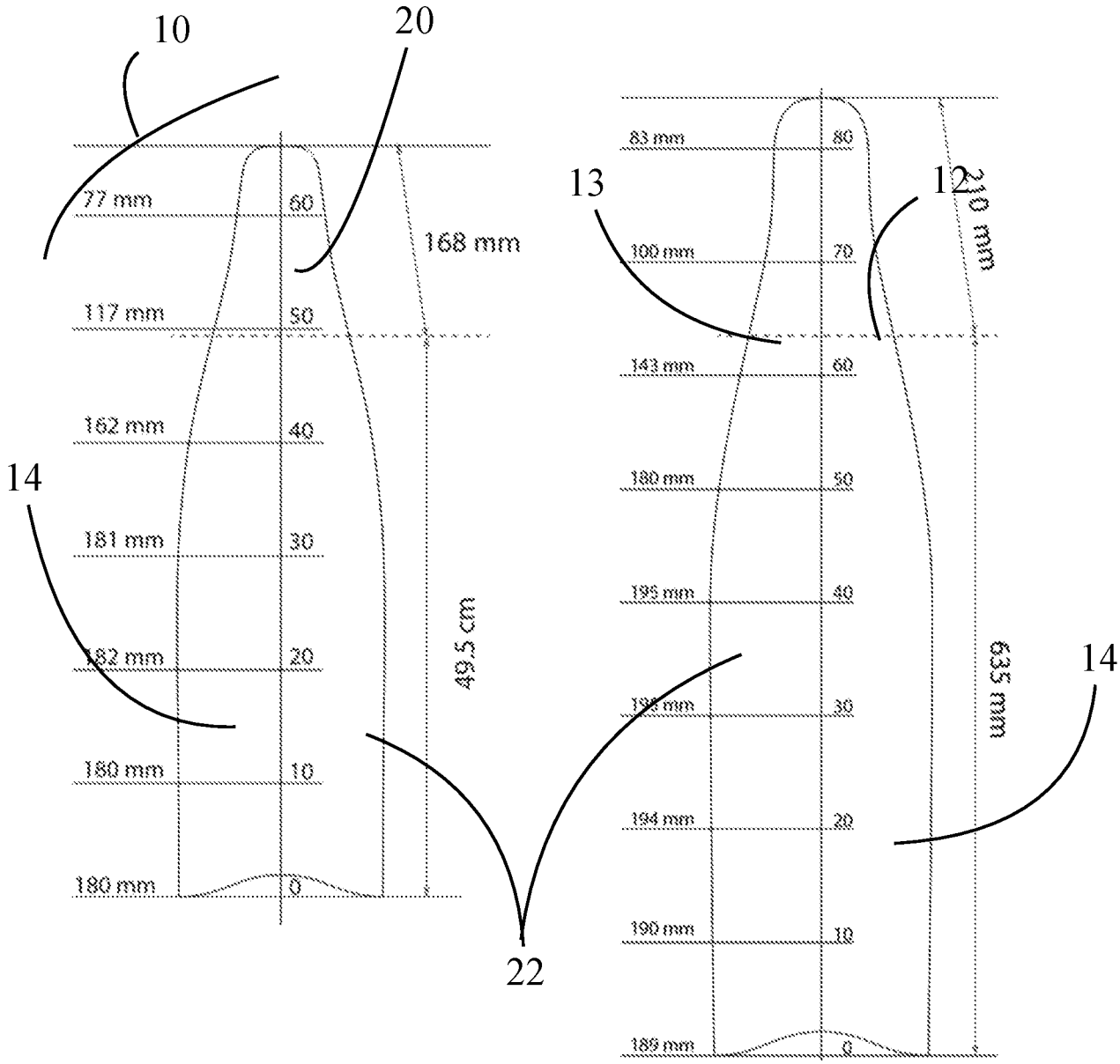
10
20
77 mm
60
168 mm
117 mm
50
162 mm
40
14
181 mm
30
182 mm
20
49.5 cm
180 mm
10
180 mm
0
22
83 mm
80
13
12
210 mm
100 mm
70
143 mm
60
180 mm
50
196 mm
40
635 mm
14
30
194 mm
20
190 mm
10
189 mm
0

Figure 6

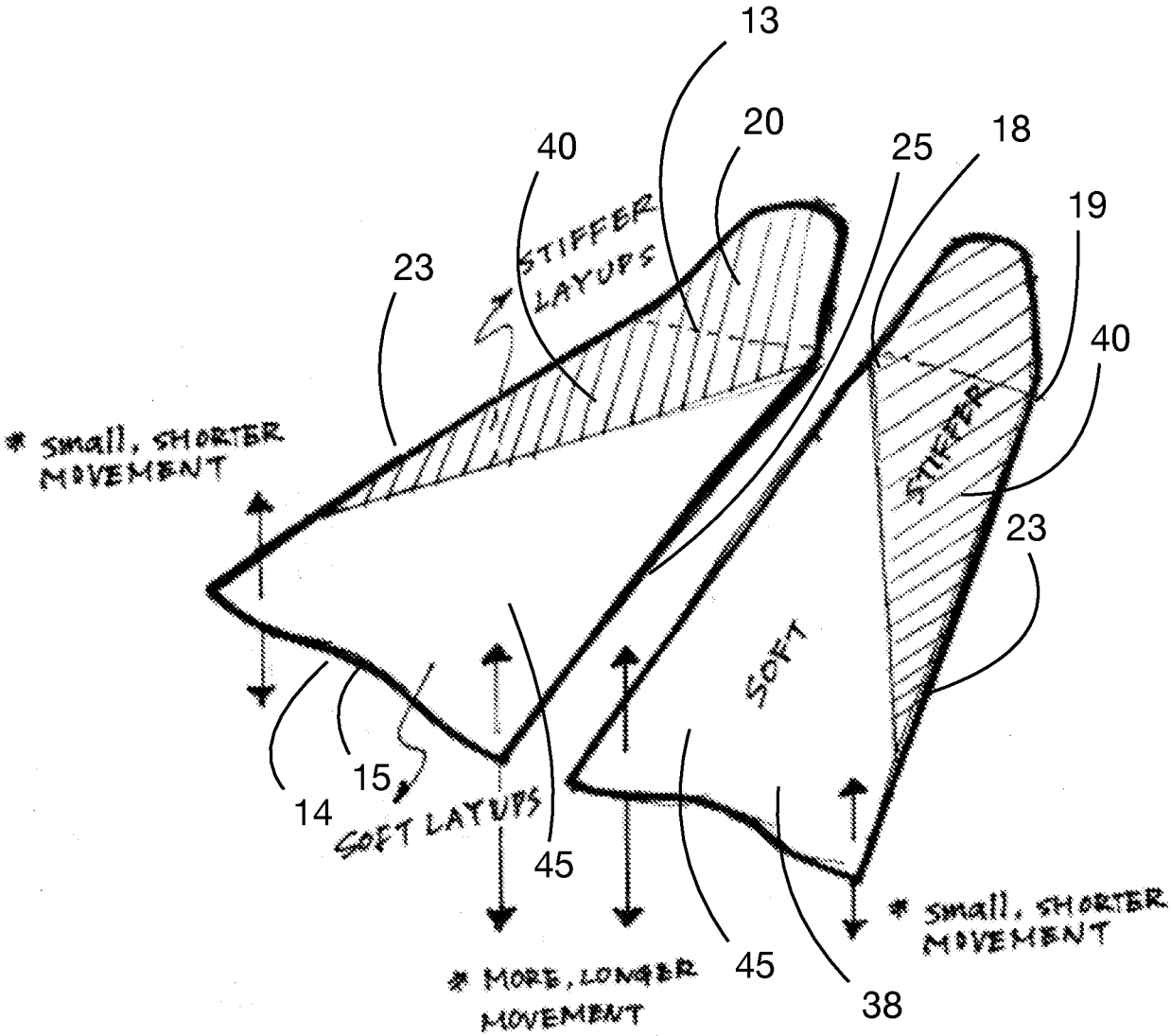
13
20
40
25
18
19
STIFFER LAYUPS
23
40
* small, SHORTER MOVEMENT
STIFFER
23
SOFT
15
14
SOFT LAYUPS
45
* small, SHORTER MOVEMENT
45
* MORE, LONGER MOVEMENT
38

Figure 7

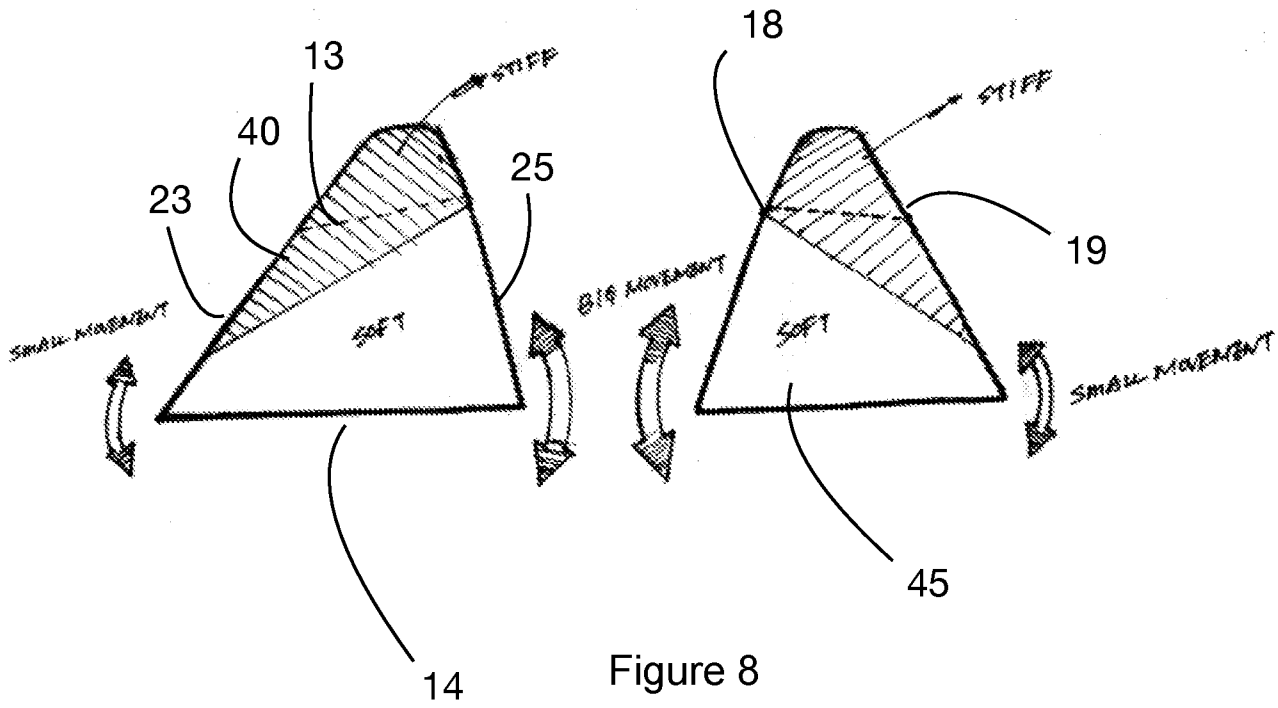

Figure 8

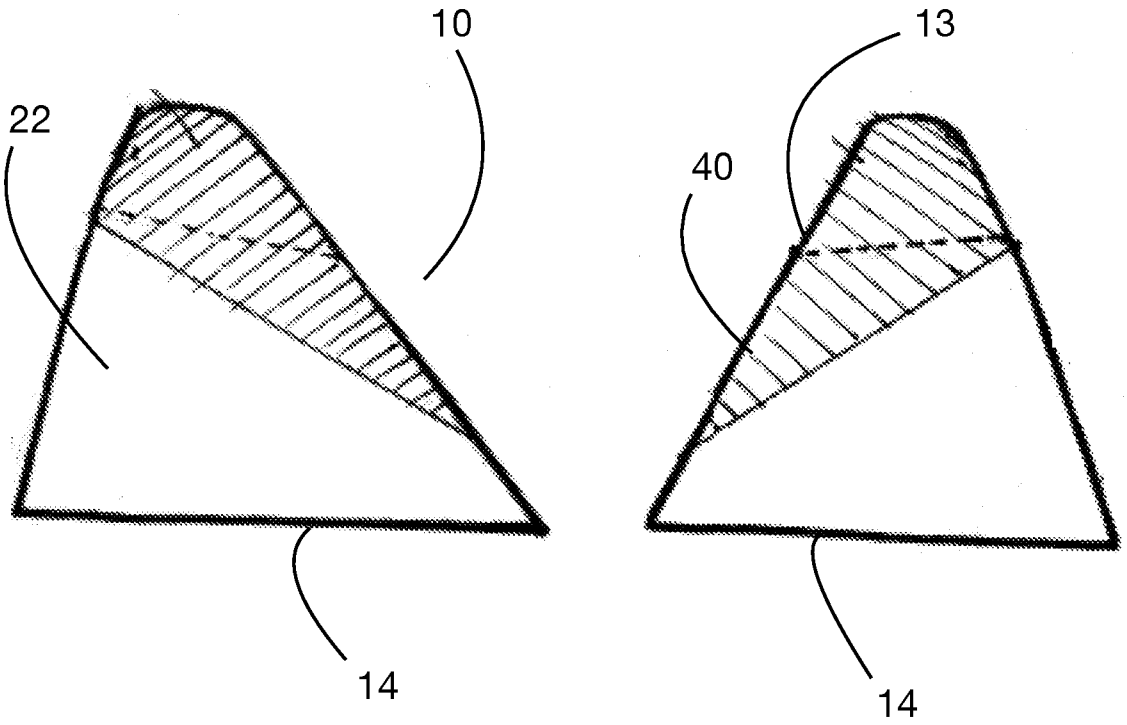

Figure 9

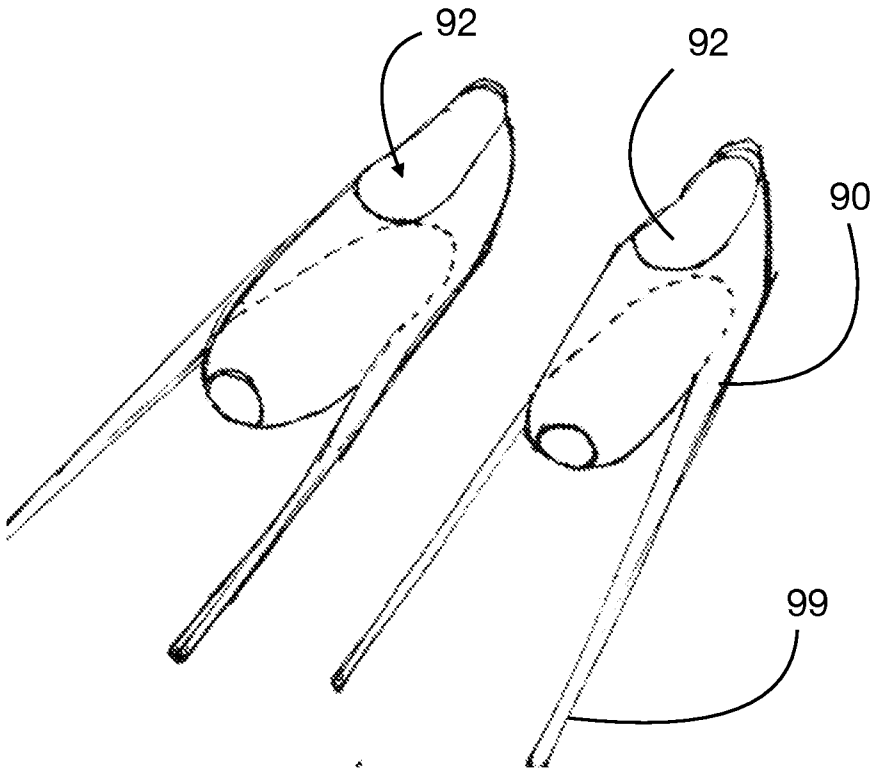

Figure 10

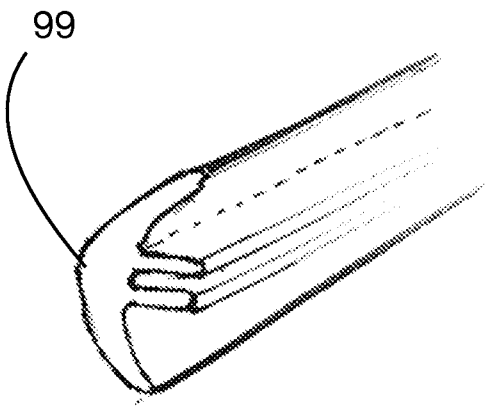

Figure 11

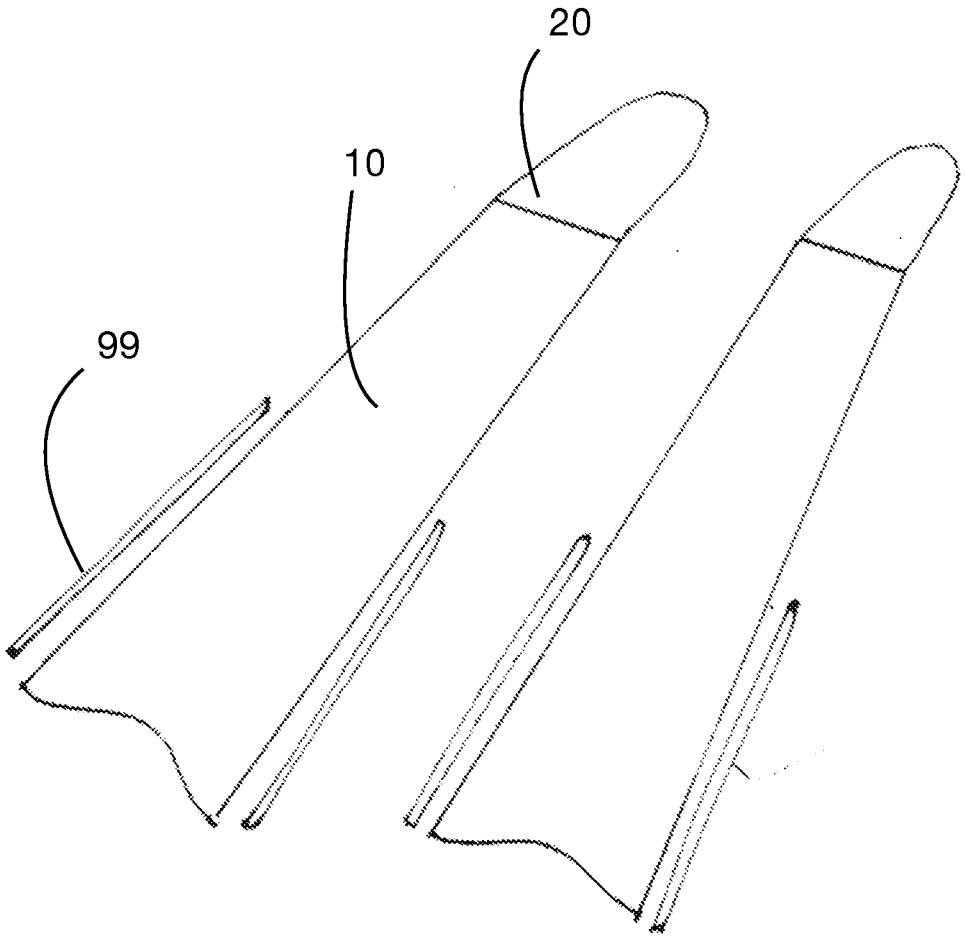

Figure 12

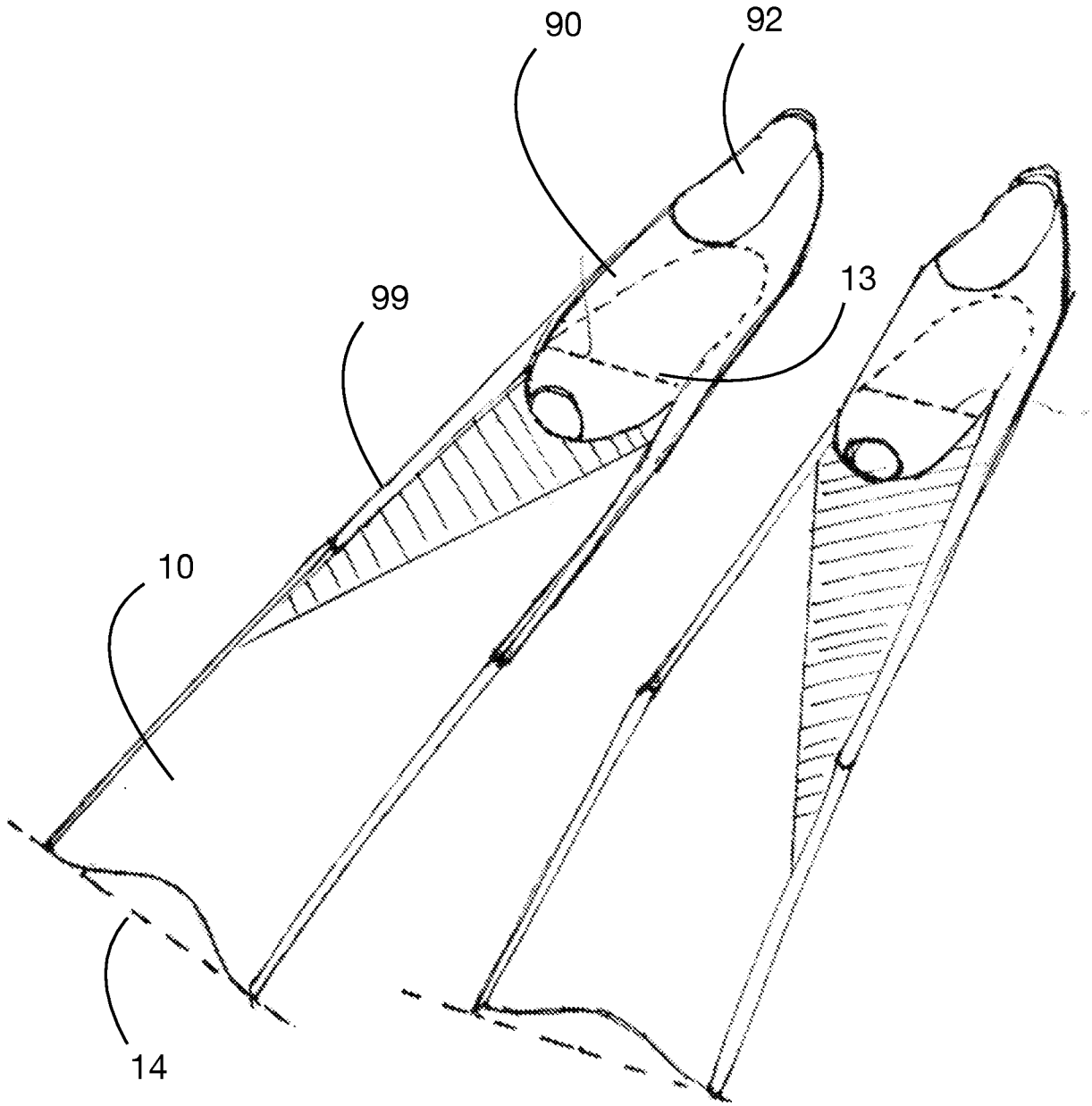

Figure 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2021/050345

A. CLASSIFICATION OF SUBJECT MATTER

A63B 31/11 (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)

PATENW: IPC & CPC: A63B31/11, B63H1/36, A63B2244/20; Keywords – blade, fin, angle, yaw, cross section, side, effective, propel, diving, carbon, foot pocket and like terms.

Google, Google Patents and Google Scholar: angle, fin, longitudinal, diving, cross section, asymmetric, twist, flexible and similar keywords.

Applicant/Inventor name searches were performed in Google & Espacenet websites 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	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 July 2021	20 July 2021

Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2021/050345**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2001/0044246 A1 (MCCARTHY) 22 November 2001 Abstract, Figure 1, Para [0328], [0333], [0339]-[0340], [0368]	1-23
X	US 4521220 A (SCHOOFS) 04 June 1985 Abstract, Figure 1, Col 1, ln 66 – Col 2, ln 2; Col 2, ln 10-12	1-23
X	US 7223141 B1 (SHIUE) 29 May 2007 Figure 5, Col 1, ln 6-8	1-23
A	Zvaritch, K, A Guide To Choosing Your Freediving Fins, Deeper Blue, Published 23 May 2018, [retrieved from internet on 4 June 2020] <URL: https://www.deeperblue.com/a-guide-to-choosing-your-freedivingfins/> Whole Document	
A	Kennedy, K, Best Freediving Fins 2020, Idiveblue, Published 28 November 2019, [retrieved from internet on 4 June 2020] <URL: https://www.idiveblue.com/best-freediving-fins/> Whole Document	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2021/050345

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-21 and 23 are directed to a fin blade suitable for free diving. The features of a lateral line adjacent a proximal end is disposed at an angle relative to a lateral line at a portion spaced from the proximal end are specific to this group of claims.

- Claim 22 is directed to a fin blade for freediving. The feature of a flexible matrix, and a reinforced zone disposed on the flexible matrix in a region proximal a foot pocket and adjacent at least a portion of an outer edge of the proximal region are specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is is a fin blade.

However this feature does not make a contribution over the prior art because it is disclosed in:

D1 (Abstract, Fig. 1) and D2 (Abstract, Fig. 1).

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

Please note, although lack of unity has been established, the search was carried out for all groups of claims as no significant additional effort was required to justify invitation for additional search fees.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2021/050345**

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.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 2001/0044246 A1	22 November 2001	US 2001044246 A1	22 Nov 2001
		US 6482059 B2	19 Nov 2002
		AU 1573697 A	01 Aug 1997
		AU 732970 B2	03 May 2001
		CA 2240851 A1	17 Jul 1997
		CA 2615635 A1	17 Jul 1997
		CA 2791379 A1	17 Jul 1997
		EP 0880379 A1	02 Dec 1998
		JP 2000503216 A	21 Mar 2000
		JP 2008068101 A	27 Mar 2008
		TW 357096 B	01 May 1999
		US 5746631 A	05 May 1998
		US 5881594 A	16 Mar 1999
		US 6050868 A	18 Apr 2000
		US 6146224 A	14 Nov 2000
		US 6371821 B1	16 Apr 2002
		US 2002115362 A1	22 Aug 2002
		US 6497597 B2	24 Dec 2002
		US 2002155768 A1	24 Oct 2002
		US 6585548 B2	01 Jul 2003
		US 6607411 B1	19 Aug 2003
		US 2003153220 A1	14 Aug 2003
		US 6719599 B2	13 Apr 2004
		US 2004248481 A1	09 Dec 2004
		US 7101240 B2	05 Sep 2006
		US 2007173143 A1	26 Jul 2007
		WO 9725109 A1	17 Jul 1997
US 4521220 A	04 June 1985	US 4521220 A	04 Jun 1985
US 7223141 B1	29 May 2007	US 7223141 B1	29 May 2007

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2021/050345**

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.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.