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(54) Title: AN AERODYNAMIC BICYCLE FRAME TUBE AND AN AERODYNAMIC BICYCLE FRAME

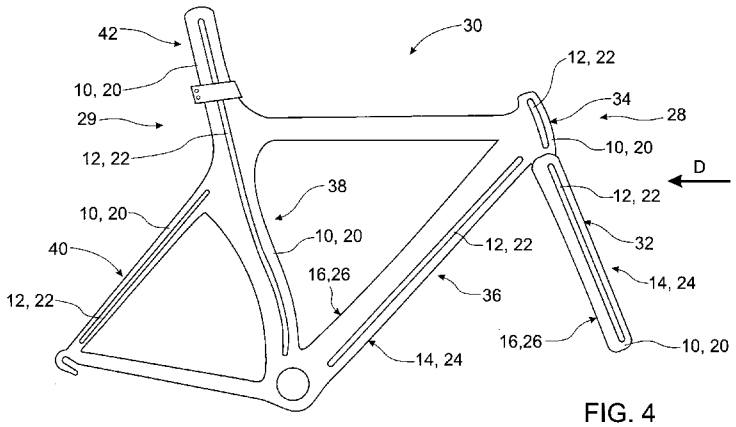

FIG. 4

(57) Abstract: An aerodynamic bicycle frame includes aerodynamic bicycle frame tubes having longitudinally extending vortex generating formations. The vortex generating formations are in the form of either ridges or depressions. The bicycle frame tube is any of a front fork, head tube, down tube, seat tube, seat stay, seat post or handle bar of the bicycle frame. The ridges or depressions along the sides of the tubes assist air flowing over the tubes to stick to the boundary layer of the tubes for longer, making the bicycle frame tubes more aerodynamic.

AN AERODYNAMIC BICYCLE FRAME TUBE AND AN AERODYNAMIC BICYCLE FRAME

FIELD OF THE INVENTION

This invention relates to an aerodynamic bicycle frame tube and to an aerodynamic bicycle frame including the bicycle frame tube.

BACKGROUND TO THE INVENTION

Competitive cyclists demand the best in aerodynamic performance from their bicycles and specifically their bicycle frames. This is particularly so for the discipline of time trial where drafting of competitors is not allowed and any aerodynamic advantage for the cyclist translates directly into a competitive advantage.

To make bicycles more aerodynamic (also referred to as "slippery"), designers have resorted to symmetrical aerofoil profile design for some of the tubes of the bicycle frame. A symmetrical aerofoil profile has a lower coefficient of drag than a round profile of the same frontal surface area. Although advances have been made in the aerodynamics of bicycle frame tubes, designers continue to strive for even more slippery designs and designs which work in the varying conditions experienced by the cyclist on the road or track.

OBJECT OF THE INVENTION

It is an object of the invention to overcome or at least alleviate one or more of the above problems and/or provide the consumer with a useful or commercial choice.

It is a preferred object of the invention to provide a bicycle frame tube and a bicycle frame having improved aerodynamics.

It is yet a further preferred object of the invention to provide a bicycle

frame tube and a bicycle frame having improved aerodynamics in varying wind conditions.

SUMMARY OF THE INVENTION

In one form, although it need not be the only or indeed the broadest form, the invention resides in an aerodynamic bicycle frame tube having a longitudinally extending vortex generating formation along at least one side of the bicycle frame tube.

The vortex generating formation may be a ridge. Alternatively, the vortex generating formation may be a depression. The ridge and depression is preferably continuous.

Preferably, the bicycle frame tube has a leading edge and a trailing edge, and the vortex generating formation is substantially parallel to the leading edge and the trailing edge.

Preferably, the bicycle frame tube has a generally symmetrical aerofoil profile in cross section, with either opposite ridges or depressions located at sides of the profile.

In one form, the bicycle frame tube has the vortex generating formation integrally formed thereon. In another form, the bicycle frame tube includes a releasably applied transfer including the vortex generating formation. The transfer may be in the form of a sticker.

The ridge may be generally convex and the depression generally concave.

The bicycle frame tube may be either a hollow tube or a solid tube. The bicycle frame tube may be of any material, including but not limited to: steel, aluminium, titanium, plastics, carbon fibre or other composites.

In another form, the invention resides in an aerodynamic bicycle frame including the bicycle frame tube defined and described hereinabove, wherein the bicycle frame tube is orientated in the bicycle frame substantially transverse to the regular flow of air over the bicycle frame.

The bicycle frame tube may be any one or more of the front fork, head

tube, down tube, seat tube, seat stay, seat post or handle bar of the bicycle frame.

BRIEF DESCRIPTION OF THE DRAWINGS

By way of example only, preferred embodiments of the invention will be described more fully hereinafter with reference to the accompanying figures, wherein:

FIG. 1 is a cross-sectional profile of a prior art aerodynamic bicycle frame tube;

FIG. 2A is a cross-sectional profile of one embodiment of a bicycle frame tube in accordance with the invention;

FIG. 2B is a cross-sectional profile of another embodiment of a bicycle frame tube in accordance with the invention;

FIG. 3 is a cross-sectional profile of yet another embodiment of a bicycle frame tube in accordance with the invention;

FIG. 4 is a side view of one embodiment of a bicycle frame in accordance with the invention, comprising the bicycle frame tubes of FIG's 2 and 3;

FIG. 5 is a top view of a handlebar of a bicycle frame, comprising the bicycle frame tubes of FIG's 2 and 3;

FIG's 6 A-C show the aerodynamic effect of the different bicycle frame tubes of FIG's 1 to 3;

FIG's 7 A-C show the aerodynamic effect of the different bicycle frame tubes of FIG's 1 to 3 in a cross wind;

FIG. 8 shows a perspective view of a sticker having a ridge for application to a bicycle frame tube; and

FIG. 9 shows a perspective view of a sticker having a longitudinally extending depression for application to a bicycle frame tube.

DETAILED DESCRIPTION OF THE DRAWINGS

The present invention relates to aerodynamic bicycle frame tubes and to aerodynamic bicycle frames including the bicycle frame tubes. Elements of the invention are illustrated in concise outline form in the drawings, showing only those specific details that are necessary to understanding the embodiments of the present invention, but so as not to clutter the disclosure with excessive detail that will be obvious to those of ordinary skill in the art in light of the present description.

In this patent specification, adjectives such as first and second, left and right, top and bottom, etc., are used solely to define one element or method step from another element or method step without necessarily requiring a specific relative position or sequence that is described by the adjectives. Words such as "comprises" or "includes" are not used to define an exclusive set of elements or method steps. Rather, such words merely define a minimum set of elements or method steps included in a particular embodiment of the present invention.

FIG. 1 shows a cross-sectional profile of a prior art aerodynamic bicycle frame tube 8. The tube 8 has a symmetrical aerofoil profile which has proven to be more aerodynamic than a round tube with the same frontal area. This type of frame tube design is well known for use in bicycle frames.

FIG. 2A shows a cross-sectional profile of one embodiment of an aerodynamic bicycle frame tube 10 in accordance with the invention. The tube 10 profile is a generally symmetrical aerofoil design in cross section with longitudinally extending vortex generating formations in the form of ridges 12 on opposite sides of the tube 10. The ridges 12 are opposite each other. The tube 10 has a leading edge 14 and a trailing edge 16. The ridges 12 extend longitudinally along the length of the tube 10 and are generally parallel to the leading edge 14 and the trailing edge 16. The ridge 12 is continuous along the length of the tube 10. The ridges 12 are spaced approximately one third of the way from the leading edge 14 to the trailing edge 16. The ridges

12 are generally convex. The ridges 12 are integrally formed with the tube 10.

FIG 2B shows a cross sectional profile of another embodiment of a bicycle frame tube 10. The bicycle frame tube 10 of FIG. 2B is similar to the bicycle frame tube 10 of FIG. 2A, with the only difference being that the bicycle frame tube 10 of FIG. 2B is hollow having a surrounding wall. The bicycle frame tube 10 of FIG. 2B may be formed of aluminium, steel or titanium tubing. The bicycle frame tube 10 of FIG. 2A is solid and may be of composite materials such a carbon fibre.

FIG. 3 shows another embodiment of an aerodynamic bicycle frame tube 20 in accordance with the invention. The tube 20 is similar to the tube 10, with the only difference being that instead of a ridge along the sides of the tube 20, longitudinally extending vortex generating formations in the form of depressions 22 are formed along each the sides of the tube 20. The depressions 22 are grooves. The tube 20 has a leading edge 24 and a trailing edge 26. The depressions 22 extend longitudinally along the length of the tube 20 and are generally parallel to the leading edge 24 and the trailing edge 26. The depressions 22 are continuous along the length of the tube 20. The depressions 22 are opposite each other on opposite sides of the tube 20. The depressions 22 are spaced approximately one third of the way from the leading edge 24 to the trailing edge 26. The depressions 22 are generally concave.

The tubes 10, 20 may be of any material, including but not limited to: steel, aluminium, titanium, plastics, carbon fibre or other composites. The tubes 10, 20 may be either hollow or solid as depicted in FIG. 2A and FIG. 2B, respectively.

Referring to FIG. 4, either of the tubes 10 or 20 are used as structural tubes of an aerodynamic bicycle frame 30 in accordance with one embodiment of the invention. The bicycle frame 30 has a front end 28 and a rear end 29. The tubes 10, 20 have opposite ends and a longitudinal axis of the tubes 10, 20 extends between the opposite ends. The tubes 10, 20 are

specifically used as tubes which are generally transverse to the direction "D" of the regular flow of air over the frame 30 as the frame 30 travels forward. Regular flow of air over the frame 30 is from the front end 28 to the rear end 29. The ridges 12 and depressions 22 are parallel to a symmetric plane of the bicycle which extends from the front end 28 to the rear end 29. The tubes 10, 20 are used for the front fork 32, head tube 34, down tube 36, seat tube 38, seat stay 40 and seat post 42. As will be appreciated, either of the tubes 10 or 20 may be used for any of the described tube sections. As such, the ridges 12 and depression 22 are simultaneously indicated as the same feature in FIG. 4 for ease of reference.

Referring to FIG. 5, either the tubes 10 or 20 are used as a cross bar 47 (also called a wing) for the handle bar 44 of a bicycle frame. The handle bar 44 further includes handles 45 to be gripped by the cyclist in various aerodynamic positions during riding. The handle bar 44 is part of a frame of a bicycle.

The frame tubes 10, 20 are designed to be as aerodynamic as possible in order to minimize drag, while still retaining the necessary structural qualities to be used as load bearing members in a bicycle frame. The ridges 12 and depressions 22 along the sides of the tubes 10, 20 assist air flowing over the tubes 10,20 to stick to the boundary layer of the tubes 10,20 for longer. The applicant believes that the ridges 12 or depression 22 act as a vortex generator along the sides of the tubes 10,20 which delay air flow separation from the boundary layer along the side of the tubes 10,20. This makes the tubes 10,20 relatively more aerodynamic than the prior art tube 8. Importantly, the aerodynamic benefits of the tubes 10,20 are maintained even in cross-winds which are often encountered during road cycling.

The aerodynamic benefits of the tubes 10,20 when compared to the prior art tube 8 are illustrated in FIG's 6 and 7. The trailing wakes in FIG's 6 and 7 indicate turbulent air. The more turbulent the air behind the tubes, the

less aerodynamic the tubes are.

FIG. 6A shows the prior art tube 8 of FIG.1, illustrating the wake 46 formed behind the tube 8, as air impinges squarely on the leading edge of the tube 8. FIG 6 B and C shows the tube profiles 10, 20 and illustrates the thinner wake 48 these tubes create in the same air flow conditions when compared to the prior art tube 8. The thinner the wake, the more aerodynamic or "slippery" the tubes are.

FIG's 7 A-C shows the wake effect on the tubes 8,10, and 20 in side-wind conditions. In these drawings flowing air impinges at an angle of approximately 30 degrees on the profiles of the respective tubes 8,10,20. FIG. 7A shows the prior art tube 8 of FIG. 1, illustrating the wake 50 formed behind the tube 8, as the tube 8 moves through air with a side-wind. FIG's 7 B and C show the tube 10, 20 profiles and illustrates the thinner wake 52 these tubes 10,20 create when compared to the prior art tube 8 in the same air flow conditions. It is significant that the depression 22 and ridge 12 on the lee side of the tubes 10, 20 in the side-wind are effective to attach the air to the boundary layer even in the side-wind conditions. This makes the tubes 10, 20 well suited to real world cycling conditions.

The above description of various embodiments of the present invention is provided for purposes of description to one of ordinary skill in the related art. It is not intended to be exhaustive or to limit the invention to a single disclosed embodiment. As mentioned above, numerous alternatives and variations to the present invention will be apparent to those skilled in the art of the above teaching.

For example, although aerodynamic bicycle tube frames of the generally symmetrical aerofoil profile is described, the longitudinally extending ridges or depressions may be applied to any bicycle tube frame profile including, but not limited to generally round and oval profiles. In another example, the ridges 12 are not integrally formed with the tube 10, but are applied as part of transfers in the form of stickers as shown in to FIG's 8

and 9.

FIG. 8 shows a sticker 60 having a rectangular base 62 and a longitudinally extending ridge 64. The base 62 has an underside 66 having an adhesive for applying the sticker 60 to a bicycle frame tube. The Applicant envisages that the sticker 60 will be applied to a bicycle frame tube such as the tube 8 shown in FIG. 8, so that the combination of frame tube 8 and two applied stickers 60 is similar to the tube 10 shown and described with reference to FIG. 2A.

FIG. 9 shows a sticker 70 having a rectangular base 72 and a depression in the form of a groove 74 formed in the base. The base 72 has an underside 76 having an adhesive for applying the sticker 70 to a bicycle frame tube. The Applicant envisages that the sticker 70 will be applied to a bicycle frame tube such as the tube 8 shown in FIG. 8, so that the combination of frame tube 8 and two applied stickers 70 is similar to the tube 20 shown and described with reference to FIG. 3.

Accordingly, while some alternative embodiments have been discussed specifically, other embodiments will be apparent or relatively easily developed by those of ordinary skill in the art. This patent specification is intended to embrace all alternatives, modifications and variations of the present invention that have been discussed herein, and other embodiments that fall within the spirit and scope of the above described invention.

CLAIMS

1. An aerodynamic bicycle frame tube having a vortex generating formation extending longitudinally along at least one side of the bicycle frame tube.

2. The bicycle frame tube as claimed in claim 1, wherein the bicycle frame tube has a generally symmetrical aerofoil profile in cross section.

3. The bicycle frame tube as claimed in claim 1 or claim 2, including two vortex generating formations located opposite each other on opposite sides of the bicycle frame tube.

4. The bicycle frame tube as claimed in any one of the preceding claims, wherein the vortex generating formation is a ridge.

5. The bicycle frame tube as claimed in claim 4, wherein the ridge is generally convex.

6. The bicycle frame tube as claimed in any one of claims 1 to 3, wherein the vortex generating formation is a longitudinally extending depression.

7. The bicycle frame tube as claimed in claim 6, wherein the depression is generally concave.

8. The bicycle frame tube as claimed in any one of the preceding claims, wherein the bicycle frame tube has a leading edge and a trailing edge, the vortex generating formation being substantially parallel to the leading edge.

9. The bicycle frame tube as claimed in any one of claims 1 to 7, wherein the bicycle frame tube has a leading edge and a trailing edge, and the vortex generating formation being substantially parallel to the trailing edge.

10. The bicycle frame tube as claimed in claim 8 or claim 9, wherein the vortex generating formation is substantially parallel to the leading edge and substantially parallel to the trailing edge.

11. The bicycle frame tube as claimed in any one of the preceding claims, wherein the bicycle frame tube has the vortex generating formation integrally formed thereon.

12. The bicycle frame tube as claimed in any one of claims 1 to 10, wherein the bicycle frame tube includes an applied transfer including the vortex generating formation.

13. The bicycle frame tube as claimed in claim 12, wherein the transfer is in the form of a sticker.

14. The bicycle frame tube as claimed in any one of the preceding claims, wherein the bicycle frame tube is hollow.

15. The bicycle frame tube as claimed in any one of claims 1 to 13, wherein the bicycle frame tube is solid.

16. The bicycle frame tube as claimed in any one of the preceding claims, wherein the bicycle frame tube is any of a front fork, head tube, down tube, seat tube, seat stay, seat post or handle bar.

17. An aerodynamic bicycle frame including the bicycle frame tube claimed in any one of claims 1 to 15.

18. The bicycle frame as claimed in claim 17, wherein the bicycle frame tube is any of a front fork, head tube, down tube, seat tube, seat stay, seat post or handle bar of the bicycle frame.

19. The bicycle frame as claimed in claim 17 or claim 18, wherein the bicycle frame tube is orientated in the bicycle frame substantially transverse to the regular flow of air over the bicycle frame.

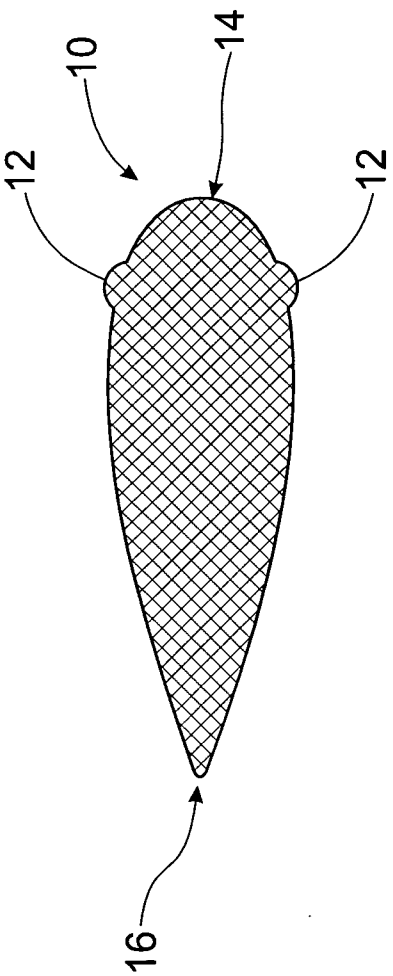

FIG. 2A

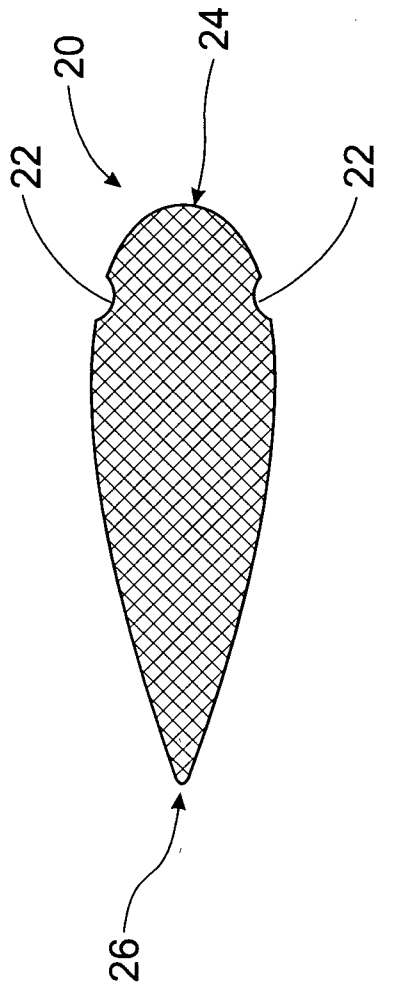

FIG. 3

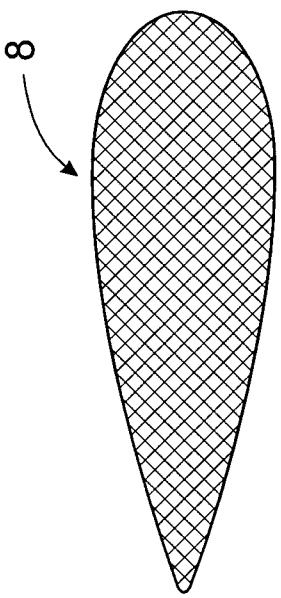

FIG. 1
(Prior Art)

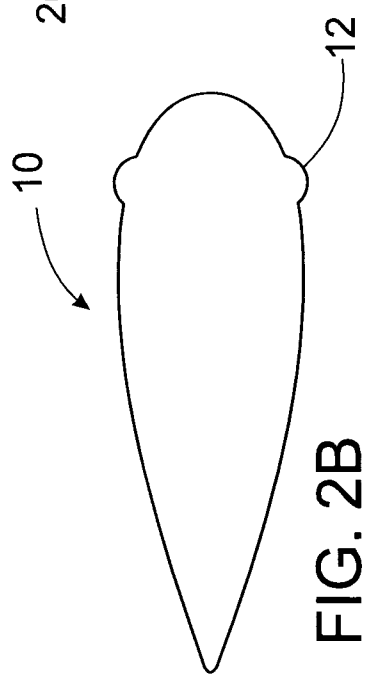

FIG. 2B

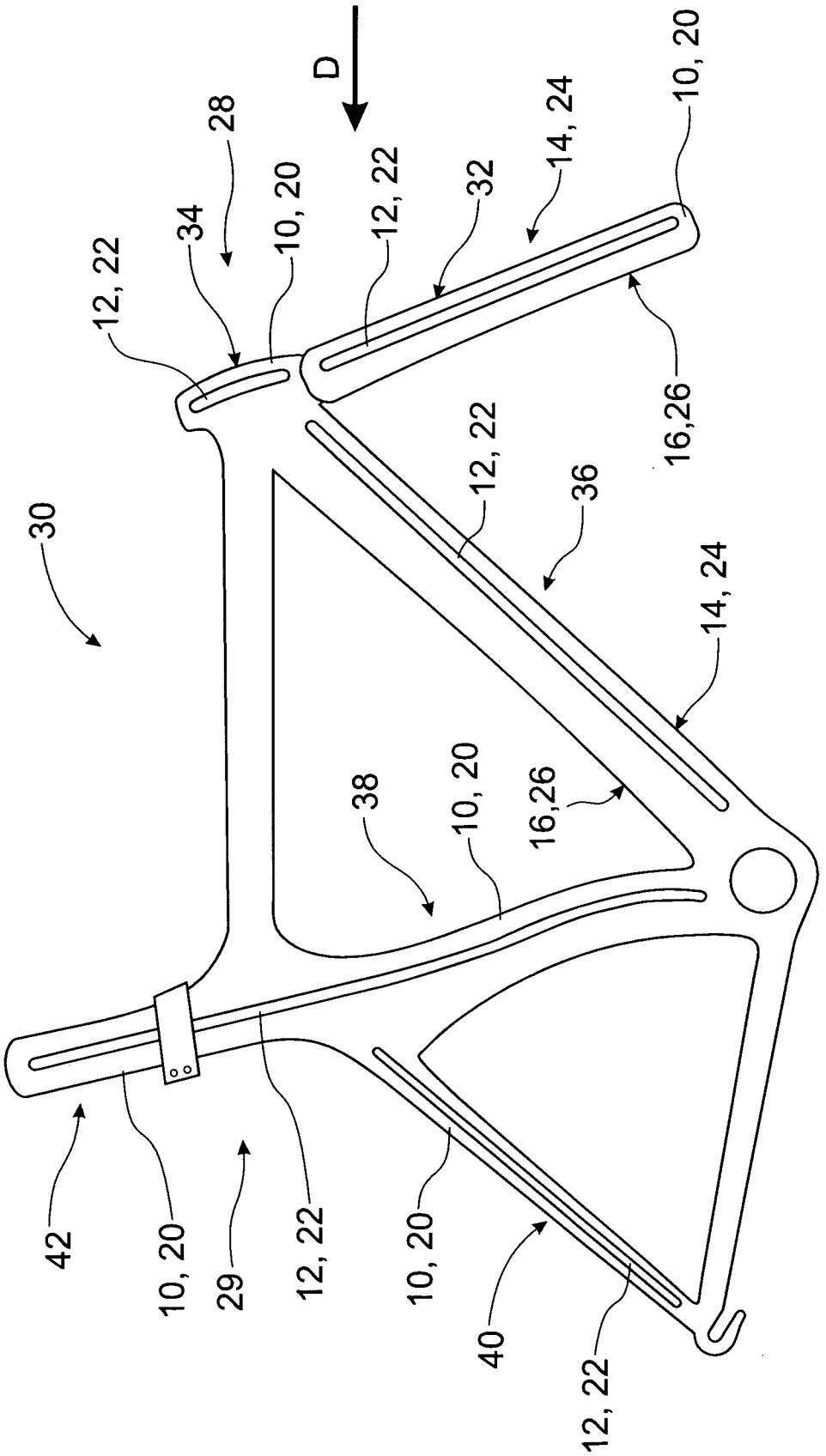
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FIG. 4

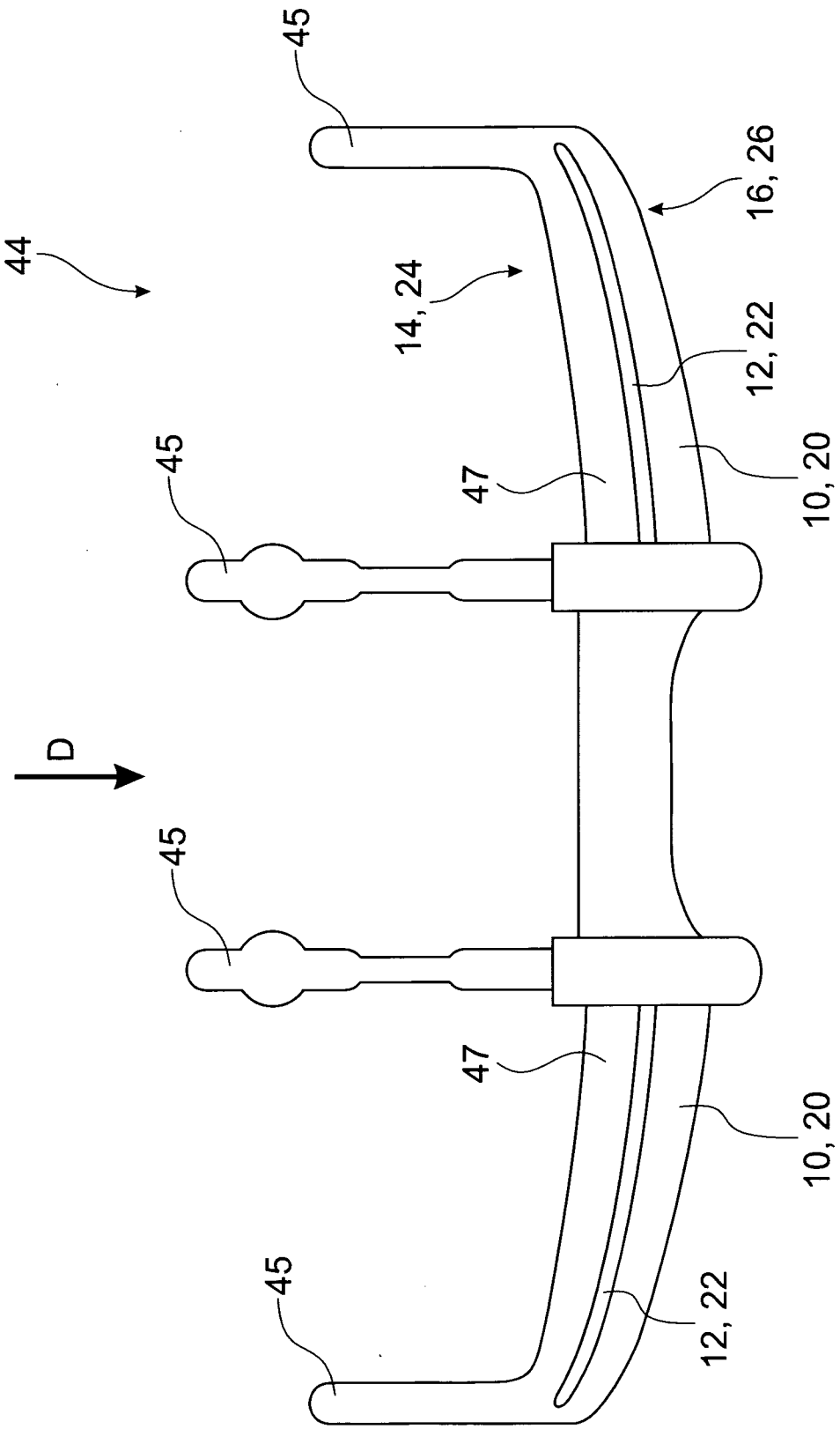

FIG. 5

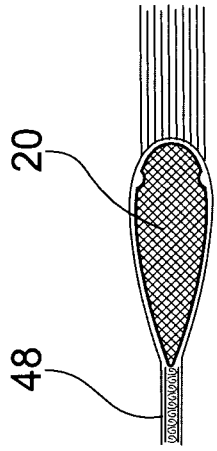

FIG. 6C

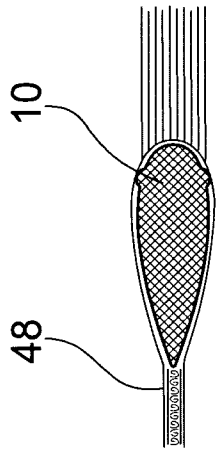

FIG. 6B

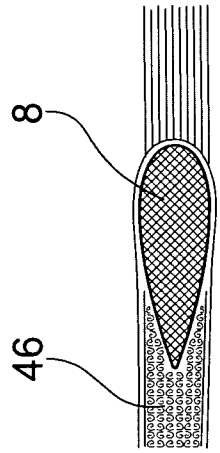

FIG. 6A

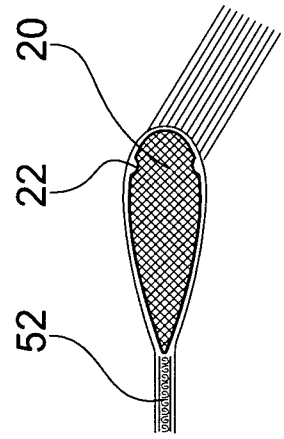

FIG. 7C

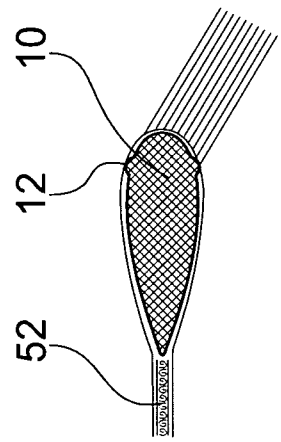

FIG. 7B

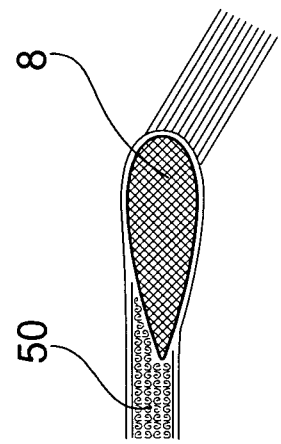

FIG. 7A

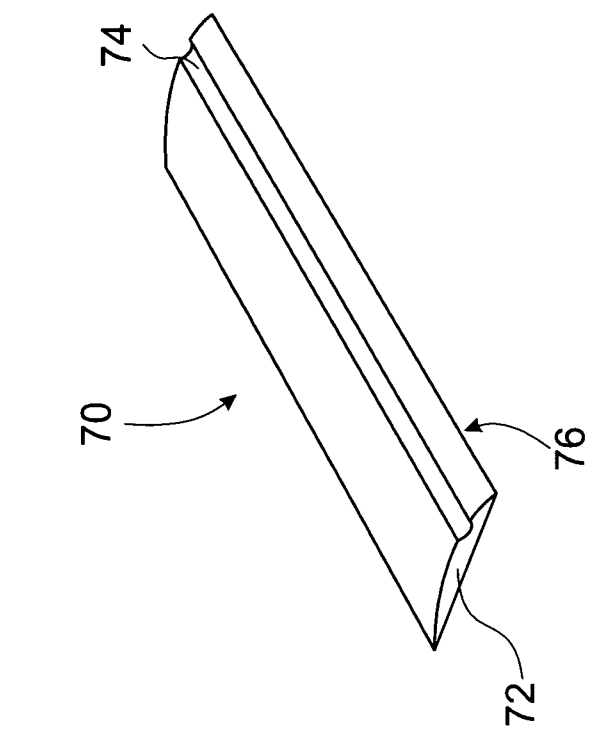

FIG. 9

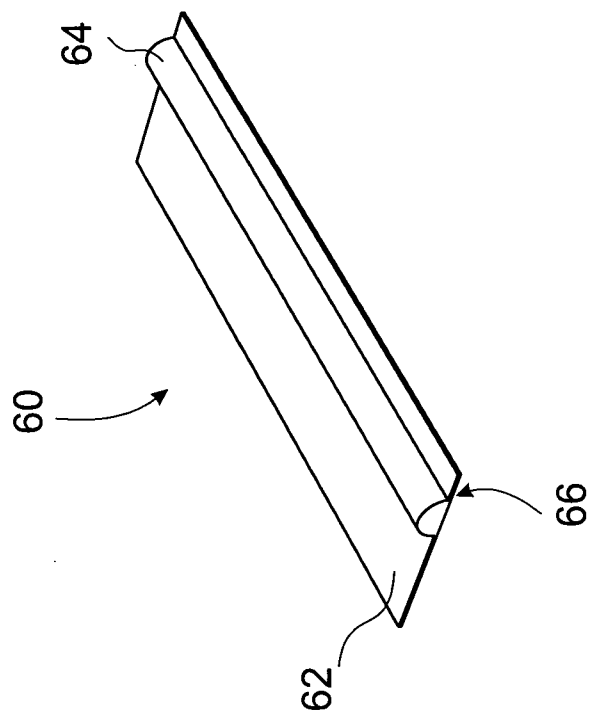

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2010/001213

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. ***B62K 3/02*** (2006.01) ***B62K 19/02*** (2006.01) ***F15D 1/12*** (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)
WPI, EPODOC. Keywords : Aerodynamic, streamlined, drag, boundary layer, aerofoil and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5909782 A (PLUFF ET AL.) 08 June 1999 column 2, lines 49-55, column 4, lines 38-59, figures 6, 11, 12	1-11, 14, 16-19
X	US 2001/0041629 A1 (HIRATA) 15 November 2001 paragraphs [0024], [0030], [0048], claim 12, figure 2	1-4, 8-14, 16-19
X	US 2007/0284848 A1 (BROWNLIE) 13 December 2007 paragraphs [0007], [0008], [0027], [0035] figures 2A-2D	1-3, 8-14, 16-19
P, X	US 2010/0225090 A1 (CUSACK ET AL.) 09 September 2010 paragraphs [0030], [0037], [0064], [0065], figures 1, 11, 12	1-11, 14-19

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
10 November 2010	16 NOV 2010
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **Naveen De Silva** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2429

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2010/001213

This Annex lists the known "A" publication level 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 Cited in Search Report		Patent Family Member					
US	5909782	CA	2225476				
US	2001041629	JP	2000288140	US	2002072432	US	6609981
US	2007284848	WO	2007140083				
US	2010225090	NONE					

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

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