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Woolley

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(54) **FLYING SKI**

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This patent is subject to a terminal disclaimer.

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(22) Filed: **Mar. 14, 2001**

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- (63) Continuation of application No. 09/404,236, filed on Sep. 23, 1999.
(51) Int. Cl.⁷ **B63B 1/00**
(52) U.S. Cl. **441/65; 441/72; 441/79; 114/253; 114/280**
(58) Field of Search **441/65, 68, 72, 441/79; 114/253, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283**

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(57) **ABSTRACT**

The improved flying ski is designed to be towed behind a conventional powered watercraft utilizing a standard ski tow rope or similar device having a handle that can be held by a human rider. In use, the rider is seated on the seat of the flying ski and towed by the watercraft. The improved flying ski comprises an elongate board and a seat that extends generally perpendicular to and upward from the board to support the seated rider's buttocks. The rider's legs extend toward the front of the board and are secured by a pair of foot holders that attach to the board. An elongate strut extends generally perpendicular to and downward from the board and couples the seat to a planing blade. The planing blade advantageously has a front blade and a rear blade interconnected by a fuselage. The improved flying ski accommodates a variety of rider skill levels by incorporating a mechanism and system that allows the rider to selectively adjust performance characteristics of the ski. In particular, the rider can control stability, lift and maneuverability ski characteristics to accommodate the rider's particular skill level and the particular challenge that the rider seeks. The improved flying ski also provides for quick and easy attachment and detachment of component parts of the ski. This feature allows the ski to be more easily transported when not in use and reduces the risk of accidentally dropping or otherwise damaging the ski.

9 Claims, 15 Drawing Sheets

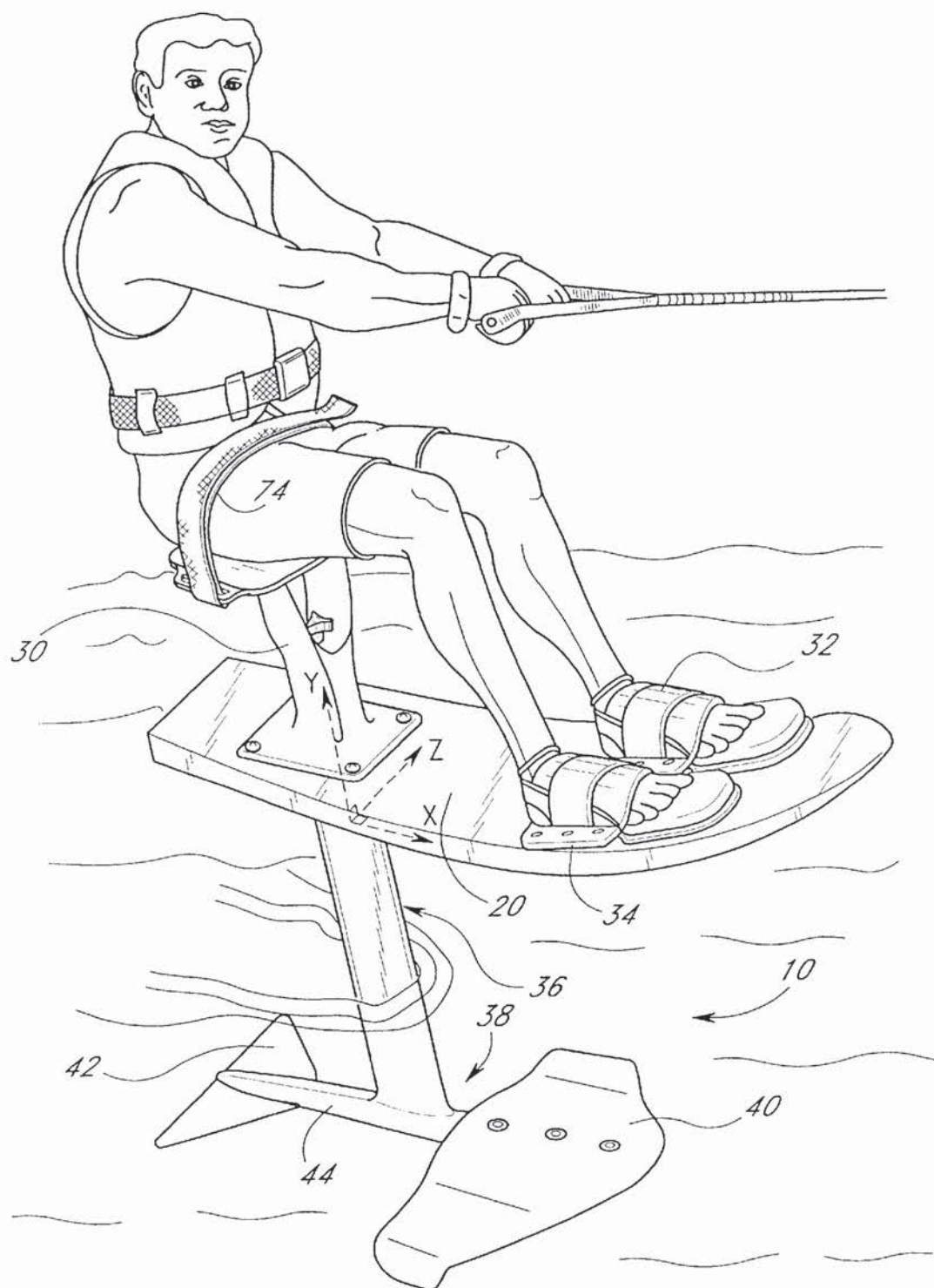


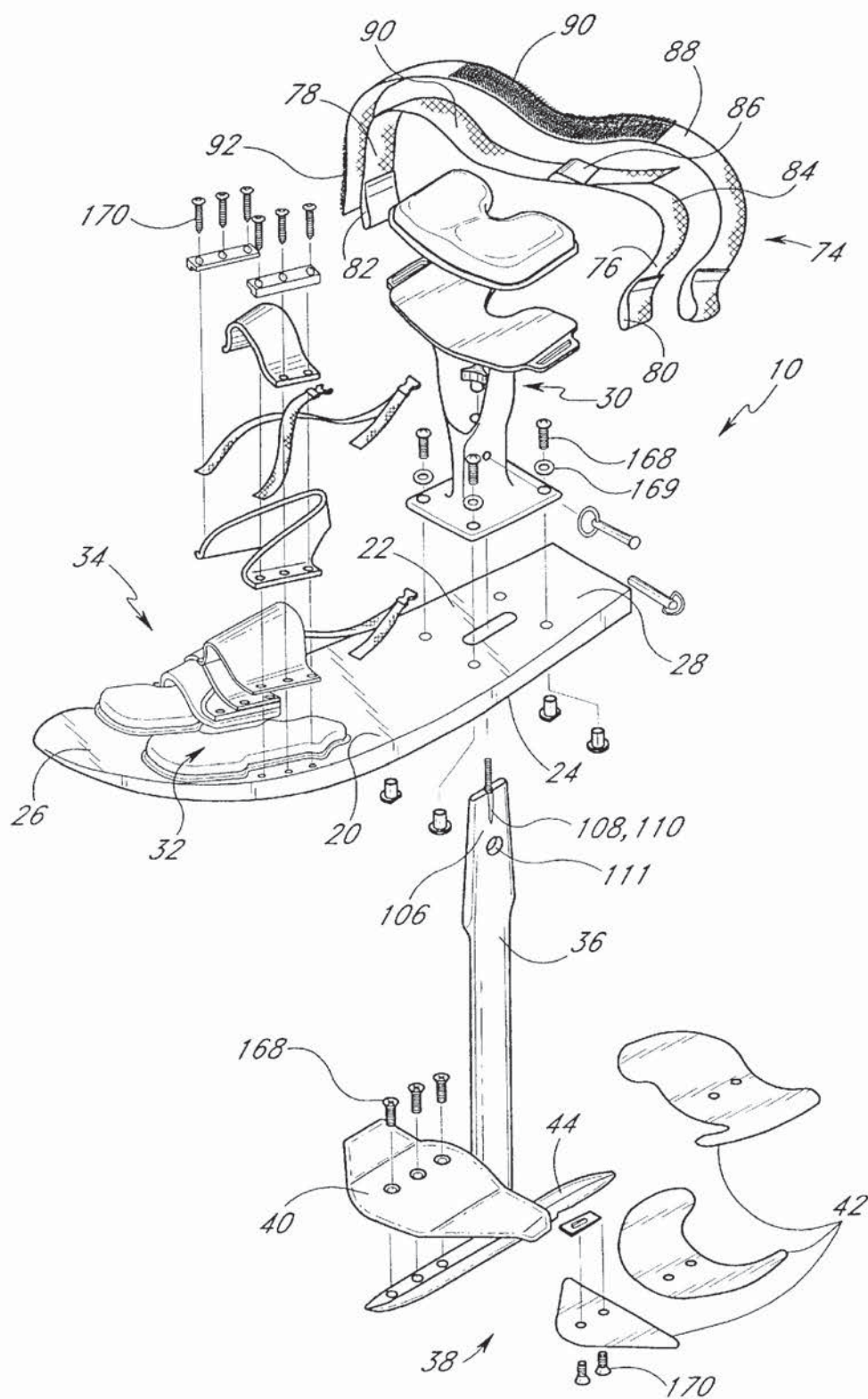
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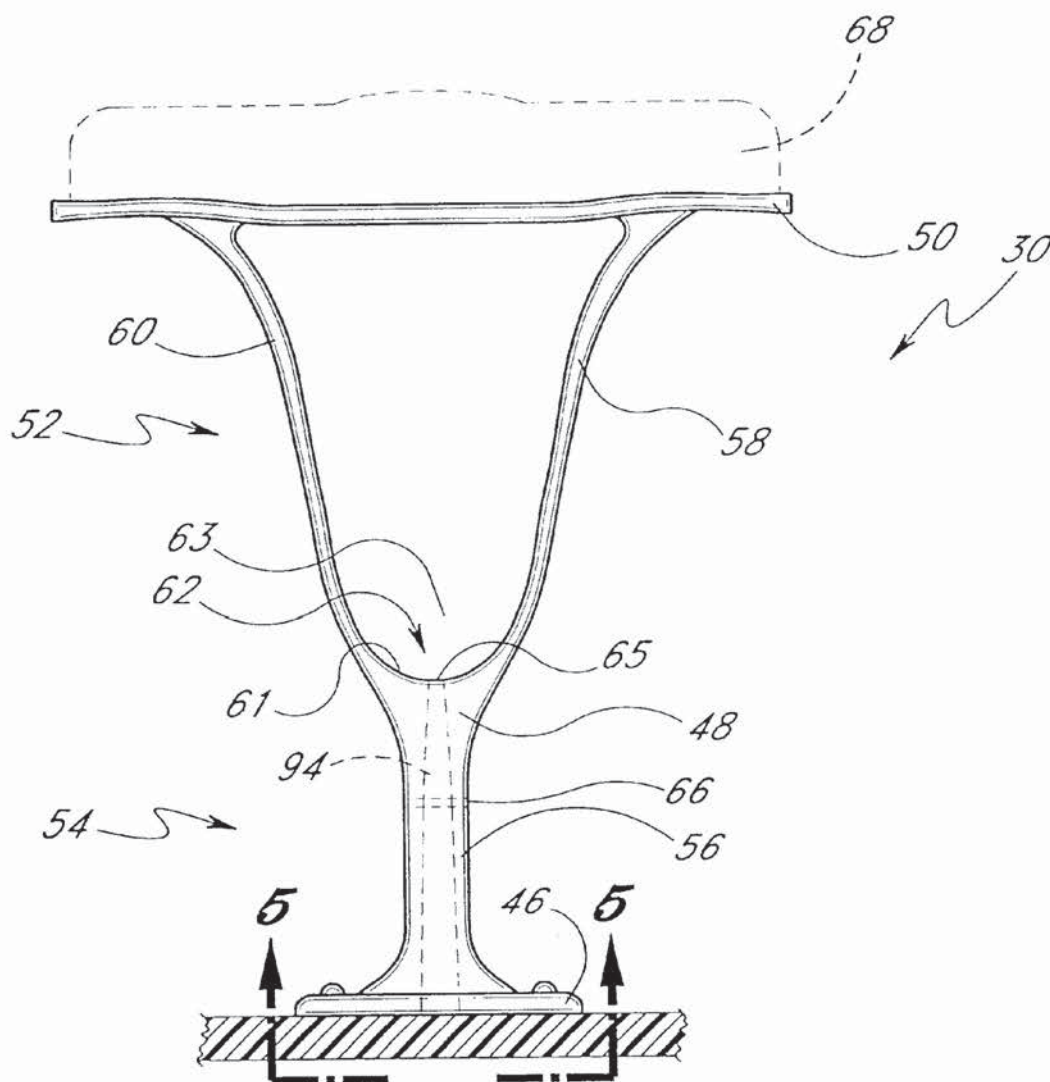
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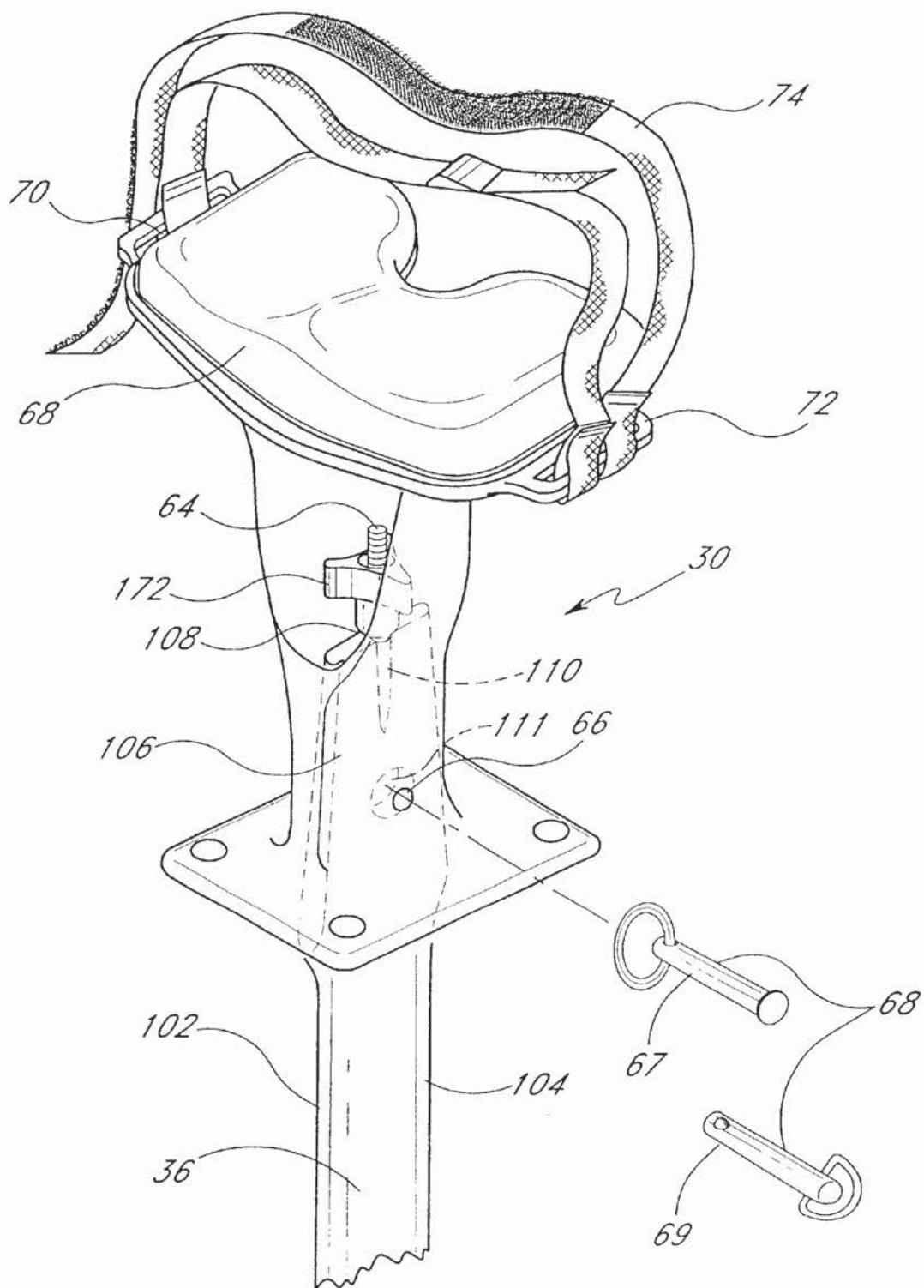
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**FIG. 1**

**FIG. 2**

**FIG. 3**

**FIG. 4**

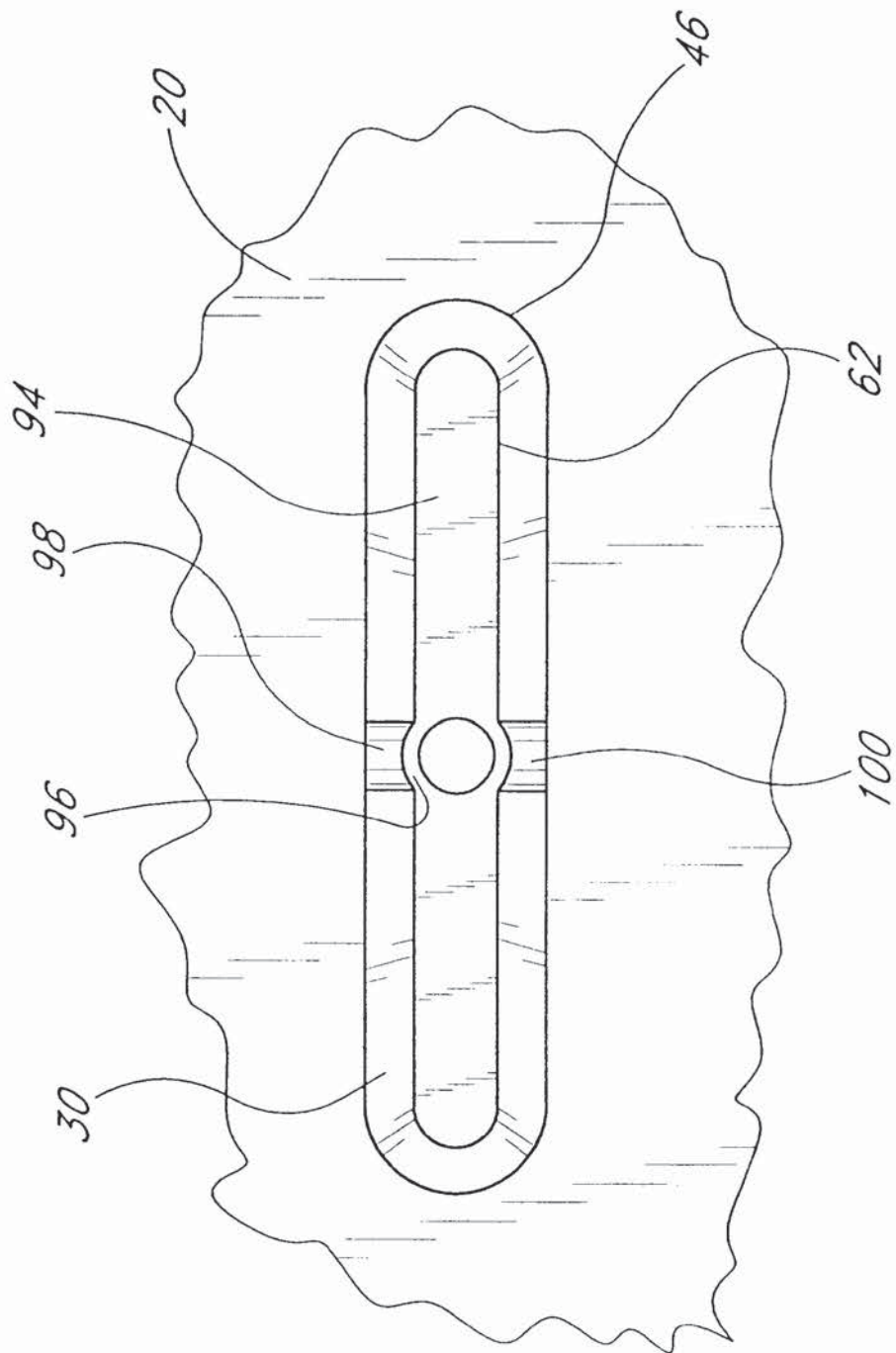


FIG. 5

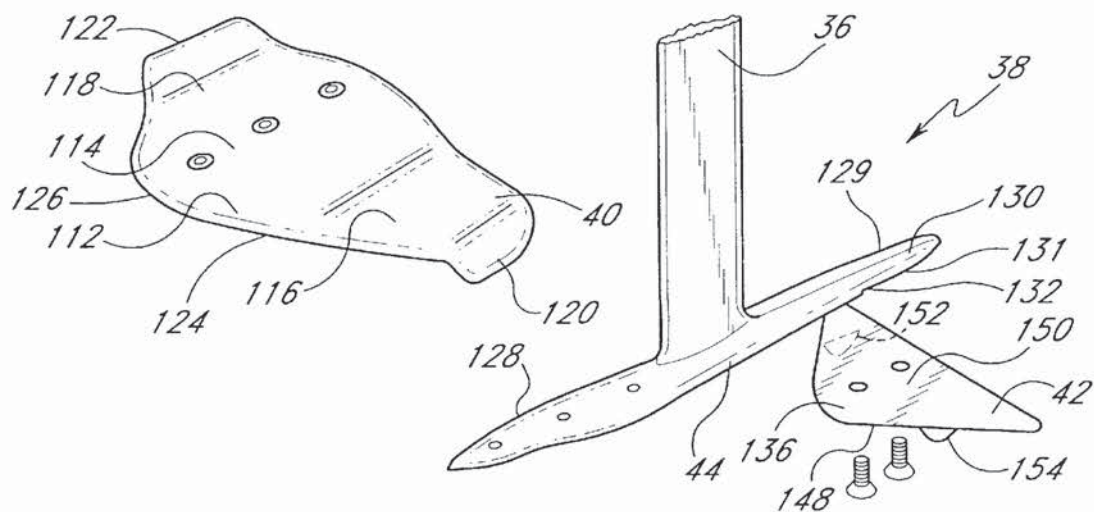


FIG. 6A

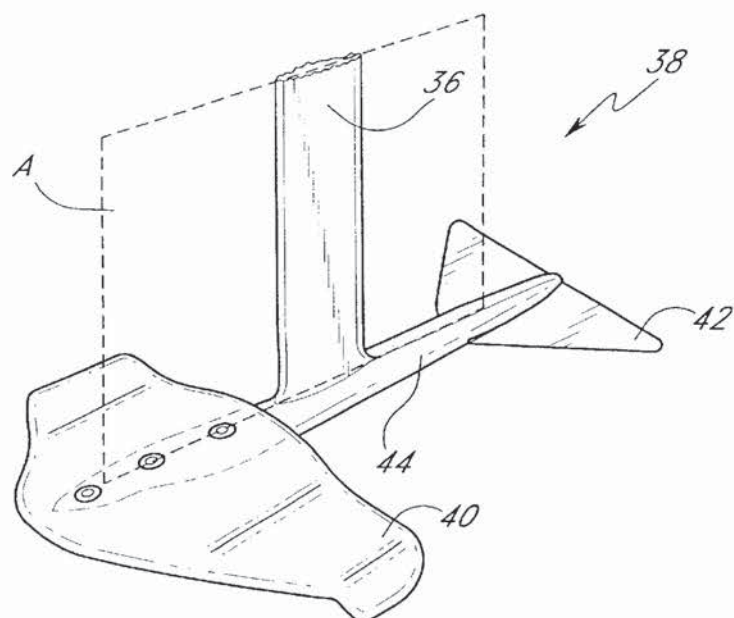
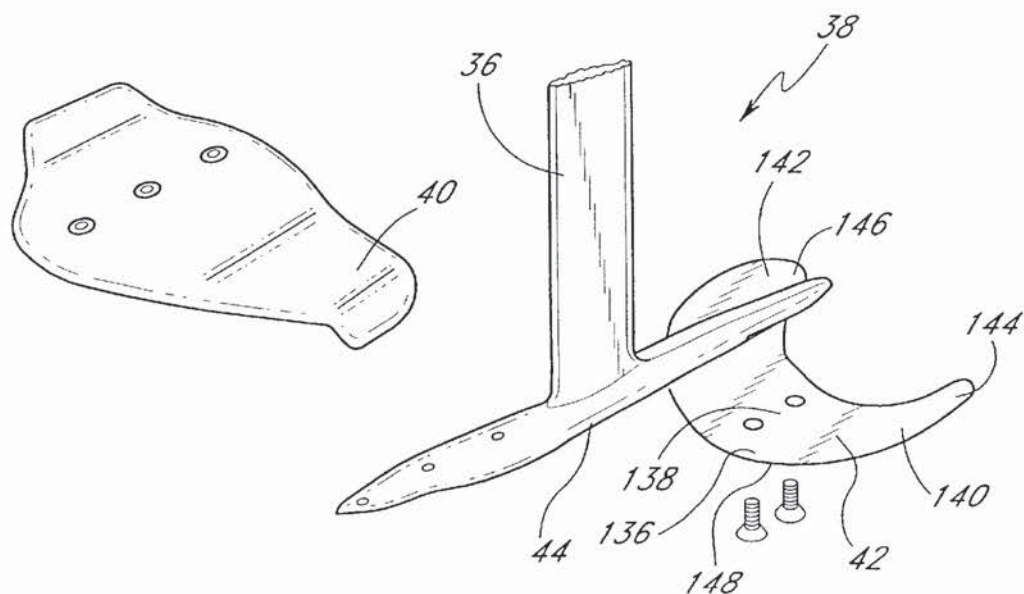
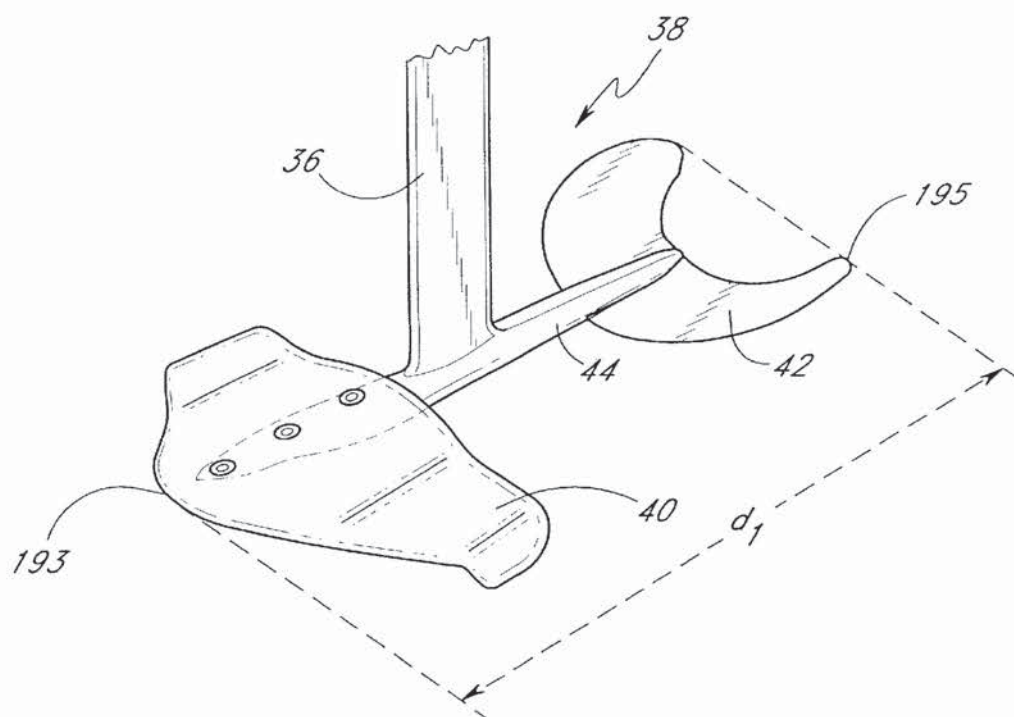
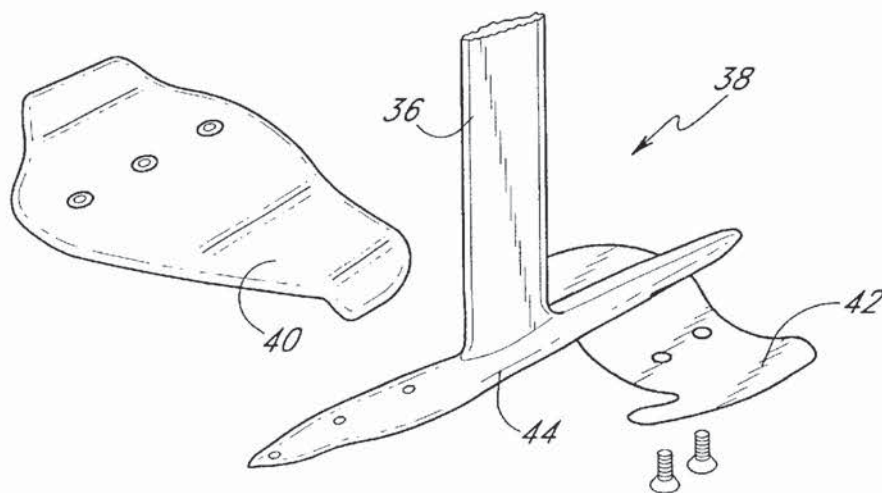
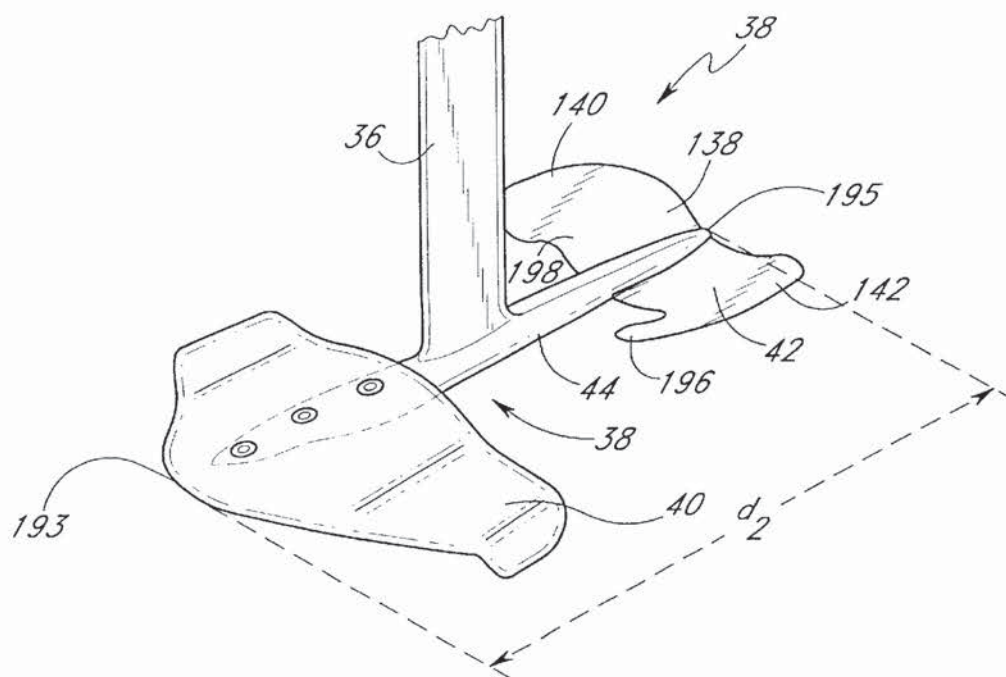


FIG. 6B

**FIG. 7A****FIG. 7B**

**FIG. 8A****FIG. 8B**

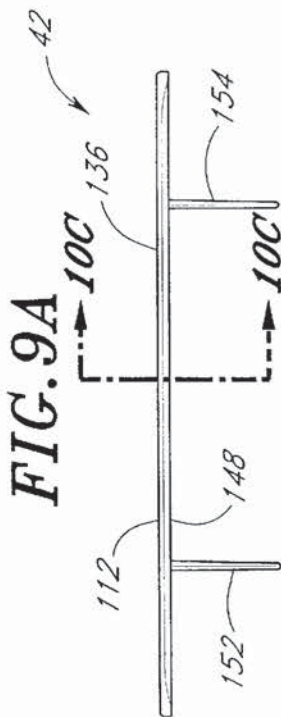
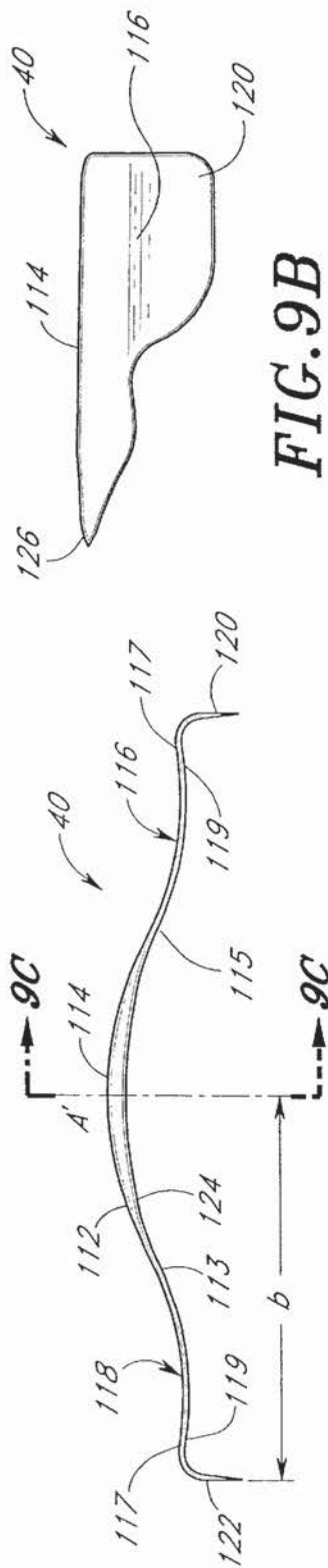


FIG. 10A

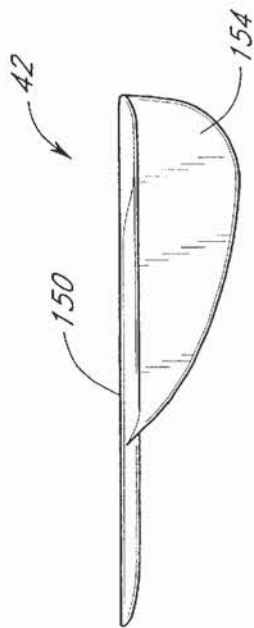


FIG. 10B



FIG. 11B

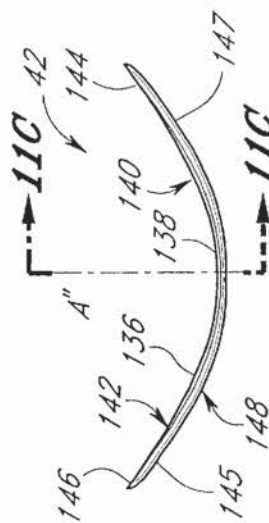
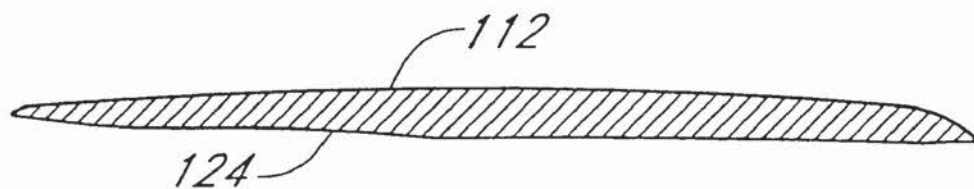
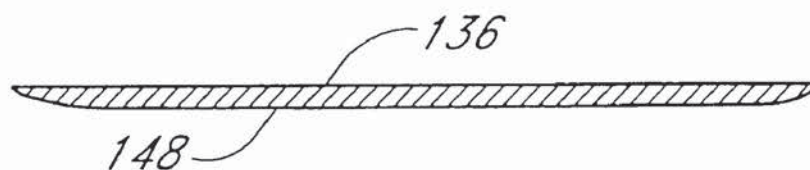
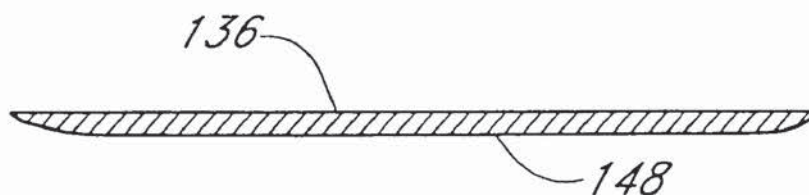
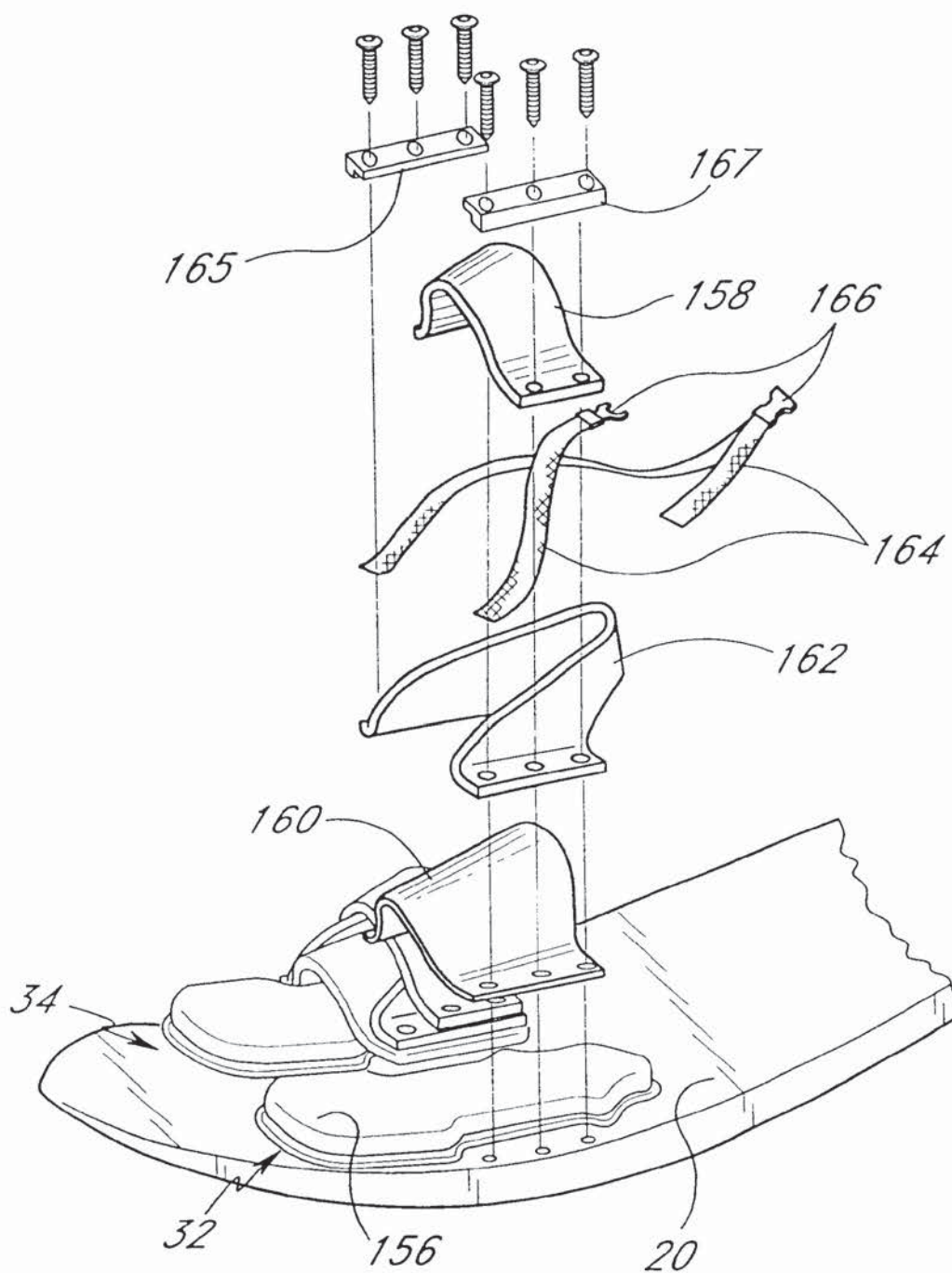


FIG. 11A

*FIG. 9C**FIG. 10C**FIG. 11C*

**FIG. 12**

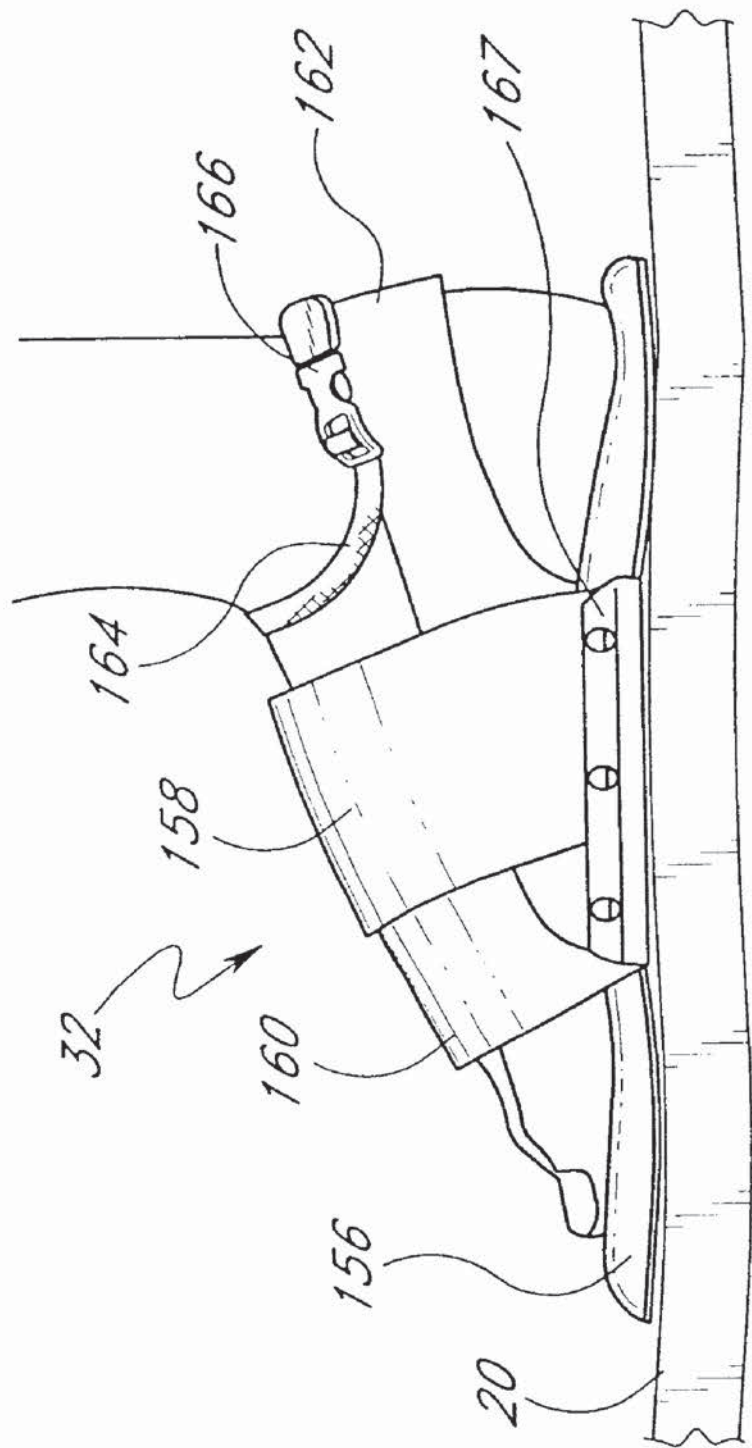


FIG. 13

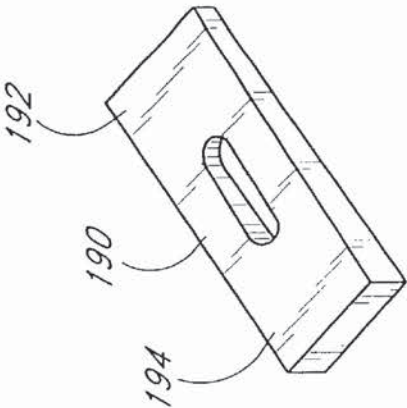


FIG. 16

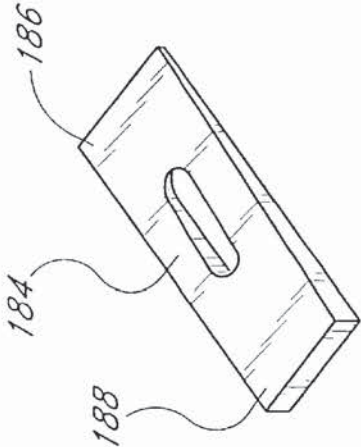


FIG. 15

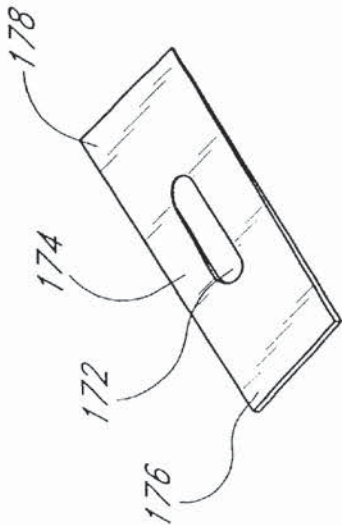
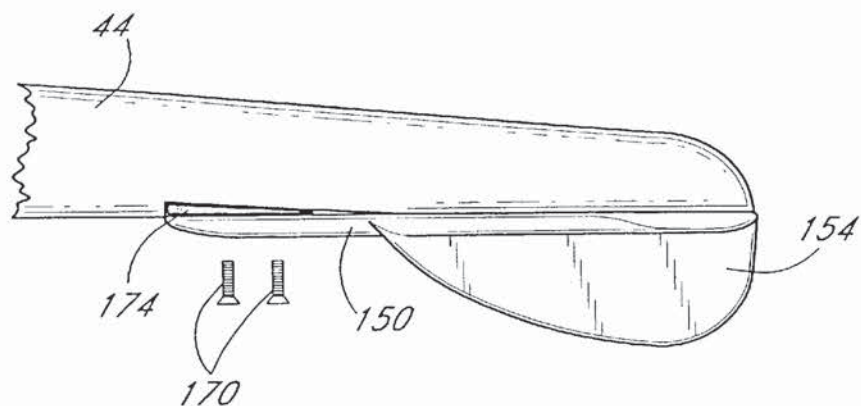
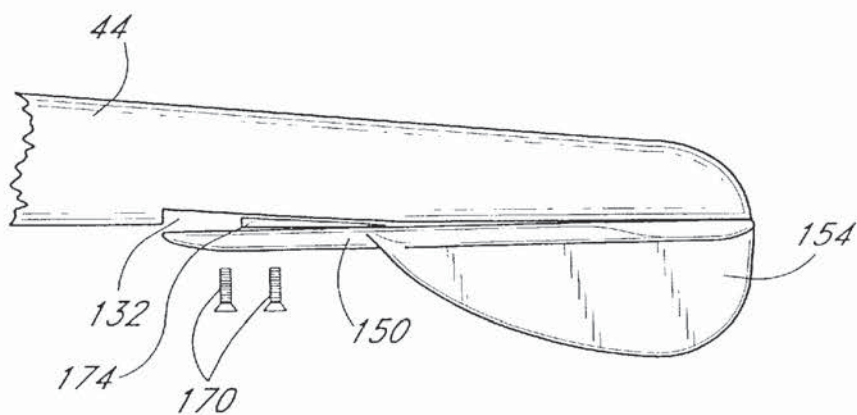
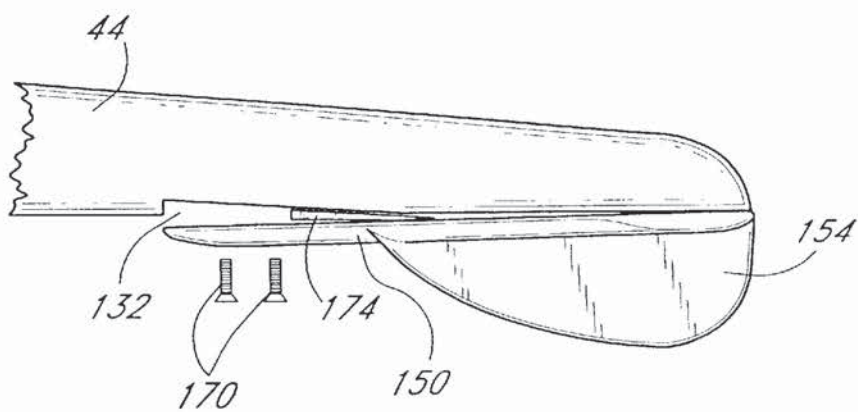
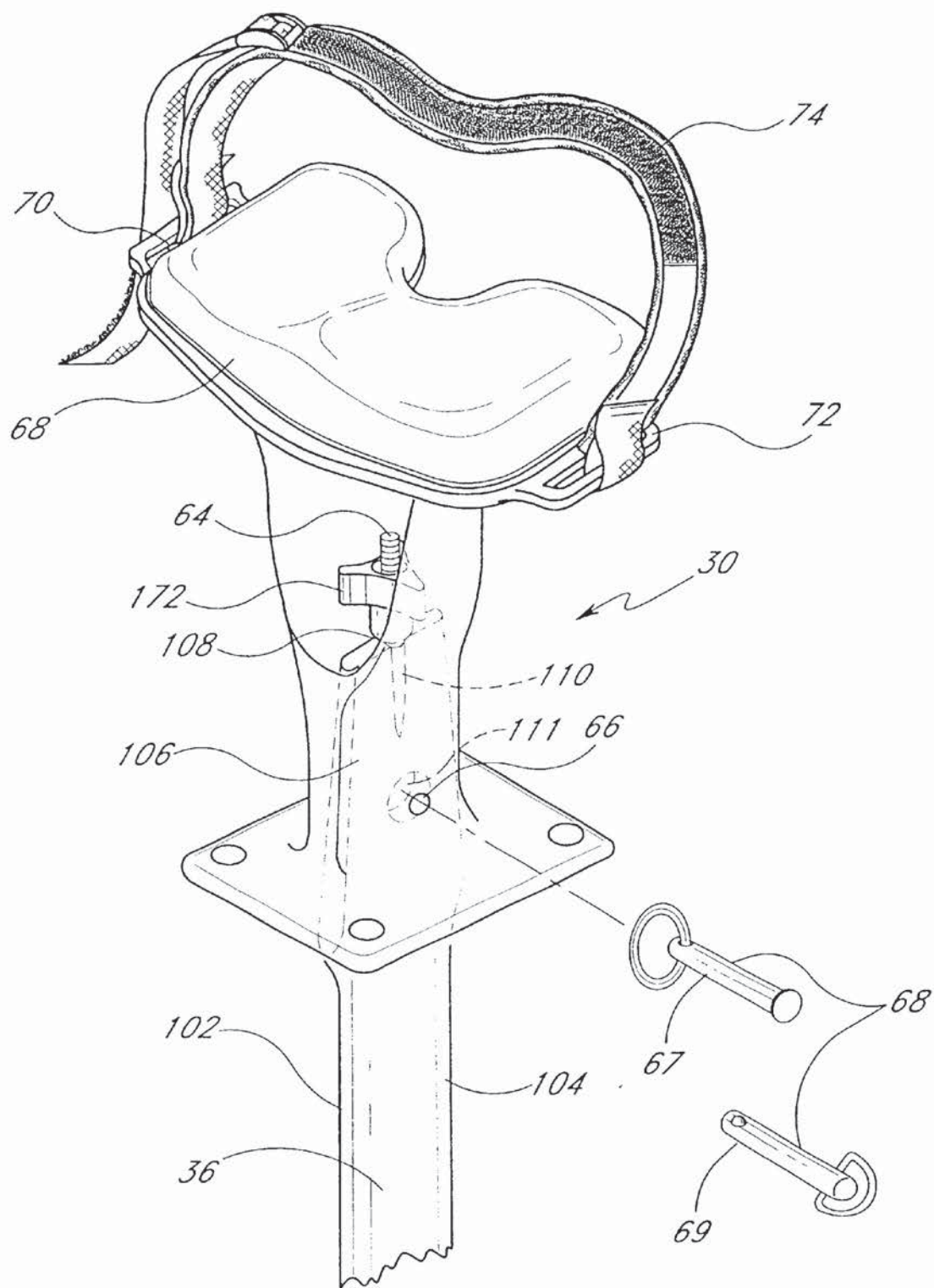


FIG. 14

**FIG. 17A****FIG. 17B****FIG. 17C**

**FIG. 18**

FLYING SKI

This application is a continuation of prior application Ser. No. 09/404,236 filed Sep. 23, 1999.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to recreational water equipment and, in particular, to an improved flying ski and method of use.

2. Description of the Related Art

U.S. Pat. Nos. 5,100,354 and 5,249,998 disclose an apparatus known as a flying ski. The flying ski is a device adapted to be towed behind a powered watercraft in a manner similar to a water ski. In contrast to a water ski, however, the rider sits on a seat spaced above the ski board and primarily rides on a blade structure that is spaced below the ski board by a vertical strut. When the ski is in use, the rider, seat and board are above the water surface and the blade structure is submerged below the water surface. The flying ski disclosed in the above-identified patents was a pioneering recreational water device.

As flying ski popularity has increased, it has been observed that beginning riders with low skill levels tend to find the flying ski relatively difficult to operate and can become frustrated to the point that they do not attempt to use the ski again. It has also been observed that advanced riders with high skill levels tend to find the flying ski too easy to operate and insufficiently challenging.

A need therefore exists for an improved flying ski.

SUMMARY OF THE INVENTION

The present invention provides an improved flying ski that accommodates a variety of rider skill levels by incorporating a mechanism and system that allows the rider to selectively adjust performance characteristics of the ski. In particular, ski stability, lift and maneuverability can be controlled by the rider to accommodate the rider's particular skill level and the particular challenge that the rider seeks.

The improved flying ski must be appreciated in the context of the conditions to which it is subjected and the environment within which it is used. Flying skis can be used to jump over twenty feet in the air. Landing impacts from such jumps are very large. Accordingly, the ski structural configuration must be adapted to withstand these forces. Additionally, it is highly desirable that the ski configuration be adapted to minimize the transfer of these forces to the spine of the rider. Finally, riders of different skill levels will often be riding in the same boat and wish to use the same flying ski. Accordingly, it is highly desirable that the flying ski be easily and reliably adjustable to accommodate the various skill levels. The ski configuration should also require a minimum of parts and disassembly thereof, to avoid the risk of parts falling overboard or being lost.

One aspect of the present invention involves a recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft. This recreational device comprises an elongated board having a front end and a back end, a seat, a strut which depends from one of the board and the seat and defines a plane of symmetry, and a blade assembly secured to the strut.

The seat extends from the board for supporting the buttocks of the seated rider at a position spaced above the board.

The blade assembly has a front blade and a rear blade connected by a fuselage. The front blade includes a first

portion defining a first surface on a first side of the plane of symmetry. The front blade also includes a second portion defining a second surface on a second side of the plane of symmetry. The first surface and the second surface direct water toward the plane of symmetry upon landing of the front blade on water.

The front blade has a leading edge and the rear blade has a first edge and a second edge. The rear blade is mountable on the fuselage in a first position wherein the first edge defines a trailing edge of the blade assembly. The rear blade is mountable on the fuselage in a second position wherein the second edge defines a trailing edge of the blade assembly. In one embodiment, the greatest perpendicular distance between the leading edge and the first edge when the rear blade is in the first position is longer than the greatest perpendicular distance between the leading edge and the trailing edge when the rear blade is in the second position.

The rear blade may include a first portion defining a first surface on a first side of the plane of symmetry and a second portion defining a second surface on a second side of the plane of symmetry wherein the first surface and the second surface directed water away from the plane of symmetry upon landing of the rear blade on water.

The front blade may further comprise a first depending fin on the first side of the plane of symmetry at a first outer side of the front blade and a second depending fin on the second side of the plane of symmetry at a second outer side of the front blade. These first and second fins may be angled toward the plane of symmetry from front to back.

The front blade may further comprise a third portion which defines a third surface on the first side of the plane of symmetry which directs water away from the plane of symmetry upon landing of the front blade on water as well as a fourth portion which defines a fourth surface on the second side of the plane of symmetry which directs water away from the plane of symmetry upon landing of the front blade on water.

In accordance with the present invention, the front blade may have an upper surface that is curved such that the pressure exerted on said front blade from above is lower than the pressure exerted on the front blade from below.

The rear blade may include a first upwardly curved portion defining a first surface on a first side of the plane of symmetry and a second upwardly curved portion defining a second surface on a second side of the plane of symmetry. In this embodiment, the first surface and the second surface direct water away from the plane of symmetry upon landing of the rear blade on water.

Another aspect of the present invention also involves a recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft. This recreational device comprises an elongated board having a front end and a back end, a seat, a strut depending from either the board or the seat and defining a plane of symmetry, and a blade assembly secured to the strut.

The seat extends from the board and supports the buttocks of the seated rider at a position spaced above the board.

At least a portion of the strut is submerged underwater when the device is in use.

The blade assembly has a front blade and a rear blade connected by a fuselage. The front blade has a leading edge and the rear blade has a first edge and a second edge. The rear blade is mountable on the fuselage in a first position wherein the first edge defines a trailing edge of the blade

3

assembly. The rear blade is mountable on the fuselage in a second position wherein the second edge defines a trailing edge of the blade assembly. The greatest perpendicular distance between the leading edge and the first edge when the rear blade is in the first position is longer than the greatest perpendicular distance between the leading edge and the trailing edge when the rear blade is in the second position.

The recreational device may further comprise a blade support mounted between the fuselage and the rear blade. The blade support has a first position in which the blade support cooperates with the fuselage to position the rear blade so as to have a first angle of attack. The blade support has a second position in which the blade support cooperates with the fuselage to position the rear blade so as to have a second angle of attack. A fastener may selectively secure both the rear blade and the blade support in a fixed position.

Another aspect of the present invention involves a kit which can be assembled to form a recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft. The kit comprises an elongated board having a front end and a back end, a seat, a strut which is securable to one of the board and the seat and which defines a plane of symmetry, a blade assembly, and a plurality of blade supports.

The seat extends from the board for supporting the buttocks of the seated rider at a position spaced above the board.

The blade assembly is securable to the strut. The blade assembly has a front blade and a rear blade connected by a fuselage. The front blade has a leading edge and the rear blade has a first edge and a second edge. The rear blade is mountable on the fuselage in a first position wherein the first edge defines a trailing edge of the blade assembly. The rear blade is mountable on the fuselage in a second position wherein the second edge defines a trailing edge of the blade assembly. The greatest perpendicular distance between the leading edge and the first edge when the rear blade is in the first position is longer than the greatest perpendicular distance between the leading edge and the trailing edge when the rear blade is in the second position.

Each of the blade supports are alternatively mountable between the fuselage and the rear blade. Each of the plurality of blade supports are sized and shaped to cooperate with the fuselage to position the rear blade so as to have an angle of attack.

Another embodiment of the invention is directed to a blade for use with a flying ski type recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft. The blade defines a plane of symmetry and includes a first portion defining a first surface on a first side of the plane of symmetry and a second portion defining a second surface on a second side of the plane of symmetry. The first surface and the second surface direct water toward the plane of symmetry upon landing of the blade on water.

This embodiment includes a first depending fin on the first side of said plane of symmetry at a first outer side of the blade as well as a second depending fin on the second side of the plane of symmetry at a second outer side of the blade.

The first and second fins can be angled toward the plane of symmetry from front to back.

The blade may further comprises a third portion which defines a third surface on the first side of the plane of symmetry which directs water away from the plane of symmetry upon landing of the blade on water as well as a

4

fourth portion which defines a fourth surface on the second side of the plane of symmetry which also directs water away from the plane of symmetry upon landing of the blade on water.

This blade may define between 69 and 114 square inches. Alternatively, this blade may define between 82 and 101 square inches.

Another aspect of the invention involves a method of varying the attack angle of a planing blade for use with a flying ski type recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft. The method comprises providing a fuselage that removably attaches to any one of a plurality of rear planing blades and selecting one rear planing blade and attaching the selected rear planing blade to the fuselage.

The step of selecting one rear planing blade may include selecting one rear planing blade with a generally planar surface or one with a curved rear planing blade. A curved rear planing blade that has a pair of spaced apart upswept wings may be selected. The curved rear planing blade may be detached from the fuselage and the orientation of the curved rear planing blade reversed so that the curved rear planing blade has a pair of spaced apart frontswep wings. The rear planing blade is then reattached to the fuselage.

The method also may comprise the steps of detaching the rear planing blade from the fuselage, placing a blade support in a cut-out formed in the fuselage and reattaching the rear planing blade to the fuselage.

Further aspects, features, and advantages of the present invention will become apparent from the detailed description of the preferred embodiment of the present invention that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features of the invention will now be described with reference to the accompanying drawings which are intended to illustrate, but not limit, the concepts of the invention. The drawings contain like reference numerals to designate like parts throughout the figures thereof, and wherein:

FIG. 1 is a perspective view an improved flying ski in accordance with a preferred embodiment of the present invention, illustrating the general orientation of the ski when in use and supporting a seated human rider being towed behind a powered watercraft (not shown);

FIG. 2 is an exploded perspective view of the ski of FIG. 1, illustrating component parts of the ski;

FIG. 3 is a front elevational view of a seat for the ski of FIG. 1, illustrating the components thereof;

FIG. 4 is a perspective view of a strut and the seat for the ski of FIG. 1, illustrating interengagement between the strut and an internal passageway formed within the seat;

FIG. 5 is a bottom plan view of the internal passageway of the seat;

FIG. 6A is an exploded perspective view of a preferred embodiment of a planing blade for the ski of FIG. 1;

FIG. 6B is an assembled perspective view of the planing blade of FIG. 6A;

FIG. 7A is an exploded perspective view of another preferred embodiment of a planing blade for the ski of FIG. 1;

FIG. 7B is an assembled perspective view of the planing blade for the ski of FIG. 7A;

FIG. 8A is an exploded perspective view of another preferred embodiment of a planing blade for the ski of FIG. 1;

5

FIG. 8B is an assembled perspective view of the planing blade for the ski of FIG. 8A;

FIG. 9A is a front elevational view of a front planing blade for the ski of FIG. 1;

FIG. 9B is a side elevational view of the front planing blade for the ski of FIG. 9A;

FIG. 9C is a sectional view along the line 9C-9C of FIG. 9A;

FIG. 10A is a front elevational view of a rear planing blade for the ski of FIG. 1;

FIG. 10B is a side elevational view of the rear planing blade for the ski of FIG. 10A;

FIG. 10C is a sectional view along the line 10C-10C of FIG. 10A;

FIG. 11A is a front elevational view of another rear planing blade for the ski of FIG. 1;

FIG. 11B is a side elevational view of the rear planing blade for the ski of FIG. 11A;

FIG. 11C is a sectional view along the line 11C-11C of FIG. 11A;

FIG. 12 is an exploded perspective view of a footholder for the ski of FIG. 1;

FIG. 13 is an assembled side elevational view of the footholder for the ski of FIG. 12;

FIG. 14 is a perspective view of a first shim for use in connection with varying the attack angle of the planing blade.

FIG. 15 is a perspective view of a second shim for use in connection with varying the attack angle of the planing blade;

FIG. 16 is a perspective view of a third shim for use in connection with varying the attack angle of the planing blade;

FIG. 17A is a side elevational view of a portion of the planing blade of FIG. 6A, illustrating the first shim placed within a cut-out of the fuselage and between the fuselage and the rear planing blade to alter the angle of attack of the rear planing blade;

FIG. 17B is a side elevational view of a portion of the planing blade of FIG. 17A, illustrating the first shim moved from within a cut-out of the fuselage towards the rear end of the planing blade to increase the angle of attack of the rear planing blade; and

FIG. 17C is a side elevational view of a portion of the planing blade of FIG. 17B, illustrating the first shim moved further towards the rear end of the planing blade to further increase the angle of attack of the rear planing blade.

FIG. 18 is a perspective view of the strut and an alternative seat and seatbelt for a flying ski.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present embodiments of the improved flying ski are disclosed in the context of the types of flying ski disclosed in U.S. Pat. Nos. 5,100,354 and 5,249,998, each of which are incorporated by reference in their entirety herein. The principles of the present invention, however, are not limited to the types of flying ski in those disclosures. Instead, it will be understood by one of skill in the art, in light of the present disclosure, that the improved types of flying ski disclosed herein can also be successfully utilized in connection with other types of flying skis, both presently known and later developed, as well as other recreational water and nonwater

6

devices. One skilled in the art may also find additional applications for the improvements disclosed herein. However, the invention described herein is particularly advantageous in connection with the types of flying ski disclosed in the incorporated patents.

The improved flying ski described herein is especially adapted to accommodate a variety of rider skill levels and to provide quick and easy assembly and disassembly of component parts.

With reference to FIGS. 1 and 2, the improved flying ski 10 comprises an elongate board 20 having an upper face 22 and a lower face 24, and a front end 26 and a rear end 28. A seat 30 extends generally perpendicular to and upward from the upper face 22 of the board 20 to support the seated rider's buttocks. The rider's legs extend toward the front end 26 of the board 20 and are secured by a pair of foot holders 32, 34 that attach to the board 20. An elongate strut 36 extends generally perpendicular to and downward from the board 20 and couples the seat 30 to a planing blade 38. The planing blade 38 advantageously has a front blade 40 and a rear blade 42 interconnected by a fuselage 44.

To assist in the description of the components of the flying ski 10, the following coordinate terms are used. Referring to FIG. 1, a "longitudinal axis" ("X") is generally parallel to the longest dimensional section of the elongate board 20 and bisects the strut 36 laterally. A "lateral axis" ("Z") is normal to the longitudinal axis, is generally parallel to the width of the elongate board 20 and bisects the board 36 vertically. A "transverse axis" ("Y") extends normal to both the longitudinal and lateral axes, vertically from the planing blade to the elongate board to the seat and intersects the intersection of the X and Z axis. In addition, as used herein, "the longitudinal direction" refers to a direction substantially parallel to the longitudinal axis; "the lateral direction" refers to a direction substantially parallel to the lateral axis; and "the transverse direction" refers to a direction substantially parallel to the transverse axis. Also, the terms "proximal" and "distal", which are used to describe the present flying ski 10, are used consistently with the description of the exemplary application. Thus, proximal and distal are used in reference to the center of the seated rider's body. A detailed description of the flying ski 10, and associated method of use, now follows.

With reference to FIG. 1, the improved flying ski 10 is desirably towed behind a conventional powered watercraft (not shown) utilizing a standard ski tow rope or similar device having a handle that can be held by the human rider (illustrated at a point spaced above the rider's knees for rider comfort). In use, the rider is seated on the seat of the flying ski and towed by the watercraft.

COMPONENTS

As noted above, the types of flying ski disclosed in the prior art are relatively insensitive to riders with different ability levels and thus beginning riders tend to become frustrated while advanced riders tend to maximize the capabilities of the ski. The present invention incorporates significant changes and modifications to both individual components of the ski 10 as well as to the overall ski 10 itself to accommodate a variety of rider skill levels and to allow the ski to be more easily assembled and disassembled.

The various components of the improved flying ski 10 will now be described in greater detail.

Elongate Board

Referring to FIG. 2, the elongate board 20 is configured generally similar to the board of the incorporated patents.

The improved board **20** has a longitudinal length of about 0.5 to 5 m, more preferably about 1 to 2 m and most preferably about 1.3 m. The front portion of the board is curved upward at an increasing rate toward the front end **26** of the board **20**. That is, the rear end **28** of the board **20** is substantially planar in the longitudinal direction while the front end **26** has approximately one foot of rise. This rise is greater than that of prior flying skis to improve performance characteristics of the ski **10**, including easing impact on the rider when landing. The lateral width of the board **20** is generally bullet shaped, with the rear end **28** width about 200 mm, a midsection width of about 300 mm, and a front end **26** nose width of about 20-40 mm.

The board **20** is advantageously constructed from hot melt unidirectional and continuous strand glass with epoxy resin. The board desirably has a foam core and nylon backing plates to reinforce the attachment of the bindings. However, the board **20** can be constructed from any of a variety of other suitable materials, such as wood, plastic, fiberglass, metal, composites and the like and combinations thereof, both presently known or later developed.

The board **20** is preferably manufactured by compression molding. However, in other embodiments the board **20** can be manufactured through a variety of other suitable manufacturing techniques, both presently known or later developed.

Seat

Referring to FIGS. 2 and 3, the seat **30** advantageously has a unitary one-piece construction so that the ski **10** can respond to the rider's actions (e.g. shifting body weight in one particular direction) with minimal "play" that could otherwise exist if the seat **30** comprised separate component parts that shifted relative to one another in response to the rider's actions. However, less preferred embodiments of the seat **30** could have multi-piece construction, so that the seat **30** comprises a plurality of components that interconnect to form the seat **30**.

The seat **30** includes a base portion **46**, an intermediary portion **48**, and a buttocks-receiving portion **50**. The illustrated base portion **46** has a generally rectangular cross-sectional shape to fit within the elongate confines of the board **20**, although, the base portion **46** can be any of a variety of other shapes such as square, circular, oval, triangular, curvilinear and the like. The base portion **46** attaches the seat **30** to the rear end **28** of the board **20**, as described below.

The intermediary portion **48** interconnects the base portion **46** to the buttocks-receiving portion **50**. The intermediary portion **48** has an upper section **52** and a lower section **54**, with the lateral width of the upper section **52** advantageously wider than the lateral width of the lower section **56**. This lateral configuration allows the buttocks-receiving portion **50** to accept a variety of riders' buttocks while allowing the base portion **46** to maintain a smaller footprint and fit within the confines of the board **20**, if desired and as illustrated. However, the upper section **54** may have the same or smaller lateral width than that of the lower section. The illustrated embodiment shows the intermediary portion **48** being generally Y-shaped. This particular shape, as well as other alternative shapes (e.g. inverted triangle, rectangle, cylinder etc.) affords an internal passageway **94** for connecting the seat **30** to the strut **36**, described below.

The exemplary generally Y-shaped intermediary portion has a brace **56** and a pair of upper extensions **58, 60**, each having a generally oval cross-sectional shape with the major

axis in the longitudinal direction and the minor axis in the lateral direction. The brace **56** has a minor axis thickness of at least about 5 mm for structural strength but less than the lateral width of the elongate board **20** for aerodynamic efficiency, hydrodynamic efficiency and reduced weight. The extensions **58, 60** are preferably symmetrical about the brace **56** and taper away from each other to support opposing ends of the buttocks-receiving portion **50** of the seat **30**, each extension **58, 60** having a minor axis thickness of about 2-10 mm and more preferably about 4 mm for structural strength.

Referring to FIGS. 3 and 4, a Y-junction site **62**, accommodates the lateral distance between the joined bottom of the extensions **58, 60** and has a sufficient surface area **61** to accept at least a portion of a fastener, such as a bolt **64** as well as a sufficient area **63** above the bolt **64** to accept a turn knob **172** with interior threads, nut or other device that interengages with the fastener. The bolt **64** extends through a Y-junction hole **65** in the seat **30** and, in cooperation with the turn knob **172**, provides for quick and easy interconnection between the strut **36** and seat **30**, as explained below. The illustrated Y-junction site **62** has a surface area with a transverse width of about 5-50 mm and more preferably about 10-30 mm, and a lateral width generally similar to that of the brace **56**. The surface area **63** of Y-junction site **62** can be curved, as illustrated, planar or a combination thereof.

A through-hole **66** is arranged through the brace **56** and is designed to accept a conventional safety pin **68**, such as a clevis pin **67** or a ball-lock pin **69**. The safety pin **68** and through-hole **66** provide a redundant coupling structure for securing the strut **36** to the seat **30**. The illustrated through-hole has **66** a diameter of about 5 mm.

The buttocks-receiving portion **50** of the seat **30** is sized and configured to accommodate and support the buttocks of a variety of human riders, whether the particular rider is an adult or child, and irrespective of the weight, proportions or size of the rider. The illustrated buttocks-receiving portion **50** lies generally parallel to the rear end **28** of the board **20** and is supported by the extensions **58, 60**. The illustrated buttocks-receiving portion **50** is generally rectangular shaped and laterally extends beyond the extensions **58, 60**. A lateral width of about 300 mm and a longitudinal length of about 150 mm has been found suitable to perform the intended function of the buttocks-receiving portion **50**, however, a variety of other dimensions and geometric configurations could easily be used.

A cushion **68** is advantageously placed over the buttocks-receiving portion **50** for rider comfort. The cushion **68** may be contoured similar to the contours of the seated riders' buttocks and may be constructed of any of a variety of soft, pliable, water-resistant materials such as neoprene, rubber, gel, silicone, plastic and the like for additional rider comfort. The illustrated cushion **68** is generally U-shaped with a pair of depressions formed therein.

Referring to FIGS. 2 and 4, a pair of openings **70, 72** are advantageously incorporated along the lateral ends of the buttocks-receiving portion **50** to secure opposing ends of a seat belt **74**. The openings **70, 72** allow the seat belt **74** to be permanently attached to the seat **30** so that the seat belt **74** cannot be accidentally misplaced or lost. A variety of particular configurations can be used to achieve this purpose. For example, the illustrated seat belt **74** incorporates ends **76, 78** that are passed through the respective openings **70, 72** and then stitched to a portion of the seat belt **30** near the respective ends **76, 78** of the seat belt **74** to form loops **80, 82**.

A primary lap strap **84** and a buckle **86** cooperate to secure the rider to the seat **30** in a manner similar to that found in

an airplane or automobile. However, the seat belt **74** has a supplemental lap strap **88** to inhibit unintentional loosening of the primary lap strap **84** which may otherwise occur during use as a result of the appreciable movement of the rider. The supplemental lap strap **88** extends over the primary lap strap **84** and buckle **86** and can be configured and used in a wide variety of ways. For example, and as illustrated, the supplemental lap strap **88** can be placed over the primary lap strap **84** (thereby exposing Velcro hook fasteners **90** attached to a portion of the supplemental lap strap **88**), looped through one of the openings **70** and then backtracked over itself (thereby aligning Velcro loop fasteners **92** attached to a portion of the supplemental lap strap **88**, that interlock with the Velcro hook fasteners **90**). Of course, a variety of other seat belt and seat belt type securement devices could be used to secure the rider to the seat **30** and to inhibit unintentional loosening of the primary lap strap **84**.

Referring to FIGS. **3**, **4** and **5**, at least a portion of the seat **30** interior is hollow and forms a passageway **94** through which a portion of the strut **36** extends. The passageway **94** is advantageously sized and configured to form a keyway groove **96** that accepts and form-fits with the strut **36**. This configuration reduces "play" caused by attachment of these parts **30**, **36**. The illustrated keyway groove **96** extends through the base and intermediary portions **46**, **48** of the seat **30** and is generally oval shaped like the brace **56**. Of course, a variety of other shapes can be used to form the keyway groove **96**. Importantly, the keyway groove **96** is tapered such that the smallest cross-section of surfaces defining the groove is near the Y-junction site **62** and the largest cross-section of the surfaces defining the groove is near the base portion **46**, the particular taper shown being a Morse taper. The keyway groove **96** also has a pair of opposing tracks **98**, **100** recessed into the seat body **30**. The tracks **98**, **100** further reduce "play" and allow the keyway groove **96** and strut **36** to form-fit.

The illustrated unitary seat **30** is preferably constructed from cast aluminum and particularly **365A** aluminum for strength, cost, hydrodynamic efficiency, and ease of manufacture. However, the seat **30** can be constructed from any of a variety of other suitable materials, such as wood, plastic, fiberglass, metal, composites and the like and combinations thereof, both presently known or later developed.

Strut

Referring to FIGS. **2**, **4** and **6**, the strut **36** extends in the transverse direction and couples the planing blade **38** to the seat **30**. The strut **36** defines a plane of symmetry **A** that runs through the planing blade **38**.

The illustrated strut **36** is formed in unity with at least a portion of the planing blade **38** and, like the seat **30**, is constructed from **365A** cast aluminum. However, the strut **36** can be formed as a stand-alone component part of the ski and comprise any of the materials identified above.

The strut **36** has a transverse length of about 0.3–2 m and preferably about 0.9 m to provide a suitable distance between the board **20** and planing blade **38**. If the board **20** and planing blade **38** are too close or too far apart, performance characteristics of the ski tend to decrease. In cross-section, the strut **36** has a generally oval-shaped hydrodynamically efficient configuration that reduces drag and turbulent waterflow and around the strut **36**, the major axis extending in the longitudinal direction and the minor axis extending in the lateral direction. More particularly, the lateral thickness of the strut **36** is oblong with a forward end

102 thickness of about 2–5 mm before tapering to a rounded point, and a rearward end **104** thickness of about 1–4 mm before tapering to a rounded point.

A tongue **106** extends from the upper end of the strut **36** and is sized and configured to form-fit with the keyway groove **96** of the seat **30**. The illustrated tongue **96** has a Morris taper with a centered stainless steel bolt **64** extending therefrom and reinforcing ears **108**, **110**. A portion of the bolt **64** is cast into the tongue **106** about 20–50 mm and preferably about 35 mm for strength and so that it will not break off from the strut **36**. The portion of the bolt **64** that is not cast in the tongue **106** extends from the tongue **106** for a transverse height of about 20–50 mm and preferably about 35 mm, and has a diameter of about 3–7 mm and more preferably about 5 mm to secure the strut **36** to the seat **30**. The ears **108**, **110** laterally surround and reinforce the bolt **64** so the bolt **64** will not break off from the strut **36**, and provide a mating structure that form-fits with the tracks **98**, **110** of the keyway groove **96** of the seat **30** to assist in reducing "play." Ears **108**, **110** having a lateral thickness of about 3–10 mm and longitudinally tapering uniformly along the front and rear ends have been found suitable for this purpose.

A void **111** is arranged through the tongue **106** and aligns with the through-hole **66** in the brace **56** of the seat **30** to enable the safety pin **68** to pass through the strut **36** and seat **30**. As explained above, this provides a redundant coupling structure for these components **30**, **36**.

Planing Blade

Referring to FIGS. **6**–**10**, the planing blade **38** provides stability, lift and responsiveness performance characteristics to the ski **10**. Components of the planing blade **38** are advantageously interchanged to vary these performance characteristics, as discussed below. The ski **10** can thereby accommodate a variety of rider skill levels.

The planing blade or blade assembly **38** advantageously has a front blade **40** and a rear blade **42** interconnected by a fuselage **44**. Each of these components can be each configured in a variety different sizes and shapes to provide different stability, lift and responsiveness characteristics. The unassembled ski **10** advantageously provides a plurality of each of these components **40**, **42**, **44** and can be made commercially available as a kit. Thus, various planing blade components **40**, **42**, **44** when assembled can be selectively interchanged with the other various planing blade components **40**, **42**, **44** when assembled (and subsequently repeatedly disassembled and reassembled) to alter the performance characteristics of the ski **10** as often as the rider prefers. The kit may alternatively comprise a plurality of one-piece unitary planing blades **38** but preferably comprise planing blades **38** having two or four or more components to accomplish the purpose of varying ski performance characteristics easily with a minimum of materials and cost.

The planing blade **38** components are preferably constructed of **365A** cast aluminum, but, like the seat **30** and strut **36**, can be constructed of a variety of other materials. Also, each embodiment of the front and rear blades **40**, **42** has a thickness sufficient to resist breaking or chipping when the ski **10** is used and when the blades **40**, **42** are accidentally dropped or mishandled when not in use. The thickness, however, need not be uniform along the entire dimension of the front and rear blades **40**, **42** and can range from about 1–20 mm. Each embodiment of the fuselage **44** similarly has a thickness sufficient to resist breaking or chipping when the ski **10** is used and when it is accidentally dropped or

mishandled when not in use. The thickness also need not be uniform along the entire dimension of the fuselage 44 and can range from about 1–50 mm.

Front Blade

Referring to FIGS. 6 and 9, in the illustrated embodiment, the front blade 40 comprises an undulated hydrodynamically efficient member designed to provide lift and responsiveness characteristics to the ski 10. This configuration further provides reduced resistance to water when compared to the front planing blade disclosed in the prior art.

The illustrated front blade 40 comprises an upper surface 112 having a central hill 114 with first and second valleys 116, 118 symmetrically arranged on opposing lateral sides of the hill 114. The front blade 40 is symmetric about a plane of symmetry A', which corresponds to the plane of symmetry A defined by the strut 36. The valleys 116, 118 terminate into stabilizing fins 120, 122 that extend downward and away from the seated rider. The fins 120, 122 may be angled toward the plane of symmetry A from front to back. The greatest perpendicular distance between the edge of the blade and the plane of symmetry A defined by the strut 36 corresponds to a distance b that is about 191 mm. The relatively large distance of the edge of the blade from the plane of symmetry A increases the moment created by water acting on the surface of the blade. A lower surface 124 is shaped generally as a mirror image of the upper surface 112. The front blade 40 has a thickness that tapers from about 5–20 mm and preferably about 10–15 mm along the upper surface 112 of the central hill 114 to about 2–10 mm and preferably about 3–7 mm along the upper surface 112 of the valleys 116, 118 and fins 120, 122.

The perimeter edges of the front blade 40 are advantageously tapered so that the upper and lower surfaces 112, 124 meet along a smooth rounded edge having a thickness of about 1–5 mm and preferably about 1–3 mm for improved hydrodynamic efficiency. Preferably, the surface area on the upper surface 112 of the front blade 40 is greater than the surface area on the lower surface 124. With this design, the path that water follows over the front blade 40 is longer than the path that the water must follow beneath the front blade. Thus, the front blade 40 functions like the wing of a plane. The pressure exerted on the front blade 40 from above is lower than the pressure exerted on the front blade from below. The net result is lift.

The lateral pivot point of the front blade 40 advantageously runs along the longitudinal length of the top of the central hill 114. Because the valleys 116, 118 define rising surfaces toward the central hill 114, the pivot point provides mechanical advantage.

The front blade 40 has a nose 126 that extends from the central hill 114 in the longitudinal direction and is generally squared-off in the rear. Thus, the central hill 114 has a longitudinal length longer than that of valleys 116, 118 or fins 120, 122. A longitudinal hill 114 length of about 200–250 mm, has been found suitable.

The fins 120, 122 are advantageously toed out toward the rear blade 42 at an angle of about 2–5° and preferably about 3°. This slight angle assists in catching and packing water toward the rear blade 42. This increases the velocity of water past the rear blade 42 and enhances maneuverability.

Various other aspects of the shape of the front blade also provide significant advantages. Each of the valleys 116, 118 define generally planar upper and lower support surfaces 117, 119 respectively proximate the outer fins. Because the support surfaces are spaced downward from the portion of

the front blade which mates with the fuselage, the length of the moment arm is increased. Similarly, the relatively large spacing of these surfaces from the plane of symmetry A of the strut 36 also increases the moment created by water acting on these surfaces.

Another important improvement is that the curved underside of the inner portion of the valleys directs water toward the plane of symmetry A defined by the strut 36. This action greatly diminishes the force communicated to the spine of the rider when the rider lands from a jump. In particular, surfaces 113 and 115 on curved underside of the inner portion of the valleys direct the water toward the plane of symmetry A. Similarly, the lower outer support surfaces 119 are curved so as to direct the water somewhat away from the plane of symmetry A of the strut 36, again reducing the force communicated to the rider. This is in stark contrast to a flat blade in which most of the force is directed upward upon reentry into the water after a jump. Importantly, the center portion of the blade along the axis of symmetry is thick enough to withstand any impact forces exerted on it and the blade continually tapers as it extends outward thereby reducing the weight of the blade.

The front blade is desirably between 46 and 137 square inches, is more desirably between 69 and 114 square inches and most desirably is between 82 and 101 square inches. If the blade is larger, the ski is very difficult to maneuver. If the blade is smaller, the blade does not sufficiently break the impact of the ski upon reentry into the water after a jump.

In another embodiment (not shown), the front blade 40 defines a generally planar member designed to increase stability characteristics. This configuration is generally similar to that disclosed in the prior art front blade but includes a taper along the perimeter edges of the front blade 40 so that the upper and lower surfaces meet along a smooth rounded edge having a thickness of about 1–5 mm and preferably about 1–3 mm.

Fuselage

Still referring to FIG. 6, the fuselage 44 spaces apart the front and rear blades 40, 42 so that the blades 40, 42 can perform their intended functions. The fuselage 44 also assists in varying the performance characteristics of the ski 10.

In the illustrated embodiment, the fuselage 44 comprises a streamlined hydrodynamically efficient member designed to provide lift and responsiveness characteristics to the ski 10. This configuration also provides reduced resistance to water when compared to the fuselage disclosed in the prior art.

The fuselage 44 has a slightly twisted cylindrical-oval or serpentine shape with a longitudinal length of about 0.3–1 m and preferably about 0.6 m, a lateral width of about 10–30 mm and preferably about 20 mm, and a transverse height of about 25–45 mm and preferably about 35 mm. The front end 128 of the fuselage 44 tapers to a rounded point, with the upper surface 129 tapering more sharply than the lower surface 131. The rear end 130 of the fuselage 44 also tapers to a rounded point, however, the upper surface tapers less sharply than the bottom surface.

A notch or cut-out 132 is formed on the lower surface 131 of the fuselage 44, longitudinally aligned with the attachment point(s) to the rear blade 42. The cut-out 132 is sized and configured to accept a wedge or shim 174 (FIGS. 14–16) and is illustrated as having a generally elongated L-shape to accept a generally rectangular shim 174 with a varied thickness. The cut-out 132 and shim 174 cooperate to vary

of the attack angle of the rear blade 42 and thereby vary the performance characteristics of the ski 10, as described below. The fuselage desirably has cast in stainless steel threads for receiving and retaining the bolts securing the blades 40, 42 thereto.

In another embodiment (not shown), the fuselage comprises a generally linear tubular-oval member designed to provide stability characteristics to the ski. The fuselage has a longitudinal length, a lateral width, and a transverse height similar to the previous embodiment. Both the front and rear ends of the fuselage symmetrically taper to a smooth rounded point.

Rear Blade

Referring to FIGS. 6 and 10, in the illustrated embodiment, the rear blade 42 defines a generally planar member 150 designed to provide stability characteristics to the ski 10. This configuration is generally similar to that disclosed in the prior art rear blade but further includes a taper along the perimeter edges so that the upper and lower surfaces 136, 148 meet along a smooth edge having a thickness of about 1–5 mm and preferably about 1–3 mm. Preferably, the rear blade 42 is designed such that the surface area on the lower surface 148 is greater than the surface area on the upper surface 136. More specifically, the lower surface 148 of the generally planar member 150 is curved while the upper surface 136 is flat. With this design, the path that water follows over the rear blade 42 is shorter than the path that the water must follow beneath the rear blade. Thus, the rear blade 42 functions like an inverted wing of a plane. The pressure exerted on the rear blade 42 from above is higher than the pressure exerted on the rear blade from below. The result is that the rear blade 42 is forced downward. At the same time, the front blade 40 is being forced upward. The combination of opposing forces on the front and rear blades 40, 42 makes the ski 10 especially suitable for jumping.

Stabilizing fins 152, 154 are symmetrically spaced about 70–90 mm from the longitudinal centerline of the rear blade 42 that is defined by the intersection of the rear blade and the plane of symmetry A. These fins 152, 154 have a transverse height of about 20 to 40 mm that tapers into the lower surface 148 of the rear blade 42 in the longitudinal direction. The rear blade 42 is desirably between 15 and 44 square inches, is more desirably between 22 and 37 square inches and most desirably is between 26 and 32 square inches.

When the generally planar surface 150 of the rear blade 42 operates together with the elliptical planing surface of the front blade 40, these surfaces battle and counteract each other, providing the desired stability characteristics. Specifically, these surfaces resist the turning of the ski from side-to-side or up and down, which is very desirable for beginners.

In another embodiment, illustrated in FIGS. 7 and 11, the rear blade 42 defines a curved hydrodynamically efficient member designed to provide lift and responsiveness characteristics to the ski 10. Significantly, elliptical planing surface of the curved rear blade 42 cooperates with the elliptical planing surface of the front blade 40 greatly enhancing responsiveness. In addition, the curved planing surface of the curved rear blade 42 significantly reduces the amount of impact felt by a rider when reentering the water after a jump. The curved underside of the rear blade 42 directs the water away from the plane of symmetry A. Directing the water away from the plane of symmetry A diminishes the force communicated to the spine of the rider when the rider lands from a jump.

The rear blade 42 includes an upper surface 136 having a central valley 138 with a pair of upswept wings 140, 142 symmetrically arranged on opposing lateral sides of the valley 138. The rear blade 42 is symmetric about a plane of symmetry A", which corresponds to the plane of symmetry A defined by the strut 36. The upswept wings 140, 142 extend transversely above and longitudinally beyond the valley 138, and terminate as curved protuberances 144, 146. A valley 138 length of about 50–150 mm in the longitudinal direction has been found suitable.

The lower surface 148 is configured generally as a mirror image of the upper surface 136. Surfaces 145, 147 on the curved underside of the upswept wings 140, 142 direct the water away from the plane of symmetry A upon landing of the rear blade 42 on the water.

The rear blade 42 is desirably between 10 and 30 square inches, is more desirably between 15 and 25 square inches and most desirably is between 18 and 22 square inches.

The rear blade 42 has a thickness that tapers from about 5–15 mm and preferably about 10–15 mm.

The perimeter edges of the rear blade 42 are tapered so that the upper and lower surfaces 136, 148 meet along a smooth edge having a thickness of about 1–5 mm and preferably about 1–3 mm. Preferably, the rear blade 42 is designed such that the surface area on the lower surface 148 is greater than the surface area on the upper surface 136. More specifically, the lower surface 148 of the rear blade 42 curves toward the perimeter edges while the upper surface 136 is not curved toward the perimeter edges as seen from a cross-section of the rear blade 42 taken parallel to the plane of symmetry A". With this design, the path that water follows over the rear blade 42 is shorter than the path that the water must follow beneath the rear blade. Thus, the rear blade 42 functions like an inverted wing of a plane and is forced downward as water flows past the blade. This downward force in conjunction with the upward force imposed on the front blade 40 makes the ski 10 especially suitable for jumping.

Foot Holder

Referring to FIGS. 12 and 13, a pair of foot holders 32, 34 are shown attached to the upper face 22 of the board 20 near its front end 26. Each foot holder 32, 34 has a similar size and configuration to house and secure a respective rider's foot. Alternatively, one holder sized and configured to house both rider's feet could also be used although this is less preferred because a relatively wide base assists the rider in controlling and acting on the ski 10. Secure housing of the rider's feet is desired so the rider can precisely act on and control the ski 10 (e.g. by pushing or pulling on the board via his or her feet) and thereby maneuver the ski 10.

The illustrated foot holders 32, 34 are preferably identical for ease of manufacture and assembly and only the exploded foot holder 32 is detailed for descriptive convenience, although it is understood that the other footholder 34 is constructed, assembled and operates in a similar manner as the below-described foot holder 32. The foot holder 32 has an orthopedic foot bed 156 configured similar to the bottom of a person's foot to provide rider comfort and help secure the rider's foot within the foot holder 32. The foot bed 156 is sized to accommodate a variety of human riders, whether the riders are adults or children, and irrespective of the proportions or size of the rider. The foot bed 156 is preferably constructed of a soft, resilient, water-resistant material such as foams, gels, neoprene, silicon and the like or combinations thereof. The foot bed 156 may also have a slip

15

resistant surface and/or be ridged or scalloped (not shown) to further inhibit movement of the rider's foot relative to the foot bed 156.

A binding 158 extends laterally across the foot bed 156 with a dome-like transverse height sufficient to accept and house the rider's foot thereunder. Like the foot bed 156, the binding 158 is preferably constructed of a soft, resilient water-resistant material and may also have a slip resistant surface and/or be ridged or scalloped. Additional binding layers can also be incorporated into the foot holders 32 for any of a variety of particular purposes, such as using a foam inset layer 160 closest to the rider's foot for additional rider comfort.

A heel strap 162 further inhibits the rider's foot from sliding out the rear of the foot holder 32. The heel strap 162 is advantageously moveable relative to the foot bed 156 and/or binding 158 to accommodate a variety of foot sizes and shapes. This moveable feature can be achieved in a variety of ways. For example and as illustrated, the heel strap 162 can comprise a resilient material, such as neoprene, rubber or silicon. For another example, the heel strap 162 can use Velcro hook and loop fasteners to interconnect opposing portions of the heel strap.

An ankle leash 164 is connected to the foot holder 32 to prevent to the rider's foot from significantly separating from the foot holder 32. The leash 164 comprises an elongated flexible material with sufficient length to circumnavigate the rider's ankle. The ankle leash 164 length is advantageously adjustable to accommodate various ankle sizes and thickness and to allow a variety of separation distances between the rider's foot and the foot holder 32, 34 before the ankle leash 164 engages. The leash 164 also has a conventional quick-release buckle 166 for easy engagement and disengagement. The illustrated leash 164 has first and second ends that interconnect via the buckle 166.

A pair of elongated brackets 165, 167 having an inverted ledge are positioned along opposing lateral sides of the foot holder 32. At least a portion of the binding 158, insert layer 160, heel strap 162, and ankle leash 164 are all secured under the bracket ledges 165, 167 to form the foot holder 32, as further described below.

ASSEMBLY

As noted above, the flying ski 10 is advantageously constructed from several separately manufactured components for ease of manufacture. Some of the component parts may be assembled by the manufacturer, particularly those designed for permanent or semi-permanent attachment to other components. Permanent or semi-permanent attachment by the manufacturer is advantageous when there is little likelihood that the components will be detached and thus the manufacturer can help assure that the components are properly assembled.

Other components of the ski are advantageously removably attached to each other and/or specifically designed for repeated quick and easy attachment and detachment. This removable feature allows the ski to be disassembled into component parts when not in use and more easily carried.

Although some of the components are advantageously permanently, semi-permanently or removably attached, any and all of the components can be permanently, semi-permanently or removably attached to each other. Moreover, any and all of the components can be formed as a larger unitary member.

Referring to FIG. 2, the seat 30 is preferably permanently mounted to the board 20 by four allen bolts 168 and washers

16

169 placed on opposing corners of the base portion 46 of the seat 30 and plugs. However, the seat 30 can be permanently, semi-permanently or removably attached to the board 20 by other suitable means, such as screws, nails, clamps, clips, fasteners, adhesives, magnets, Velcro and the like or combinations thereof.

The foot holders 32, 34 are preferably connected to the board 20 by three screws 170 on one side of the foot holder 32, 34 and three screws 170 on the opposite side of the foot holder 32, 34. Like the seat 30, the foot holders 32, 34 can be attached to the board 20 by a variety of other suitable fastening devices. The illustrated footbed 156 is preferably separately attached to the board 20 by an adhesive glue, although there is no requirement for separate attachment or use of glue.

Referring to FIGS. 3, 4, and 5, the strut 36 connects to the seat 30 through the internal passageway 94 and advantageously can be repeatedly connected and disconnected in a quick and easy manner so that these two components 30, 36 can be detached and easily carried when the ski 10 is not in use. Specifically, the bolt 64 that extends from the tongue 106 of the strut 36 is advanced through the keyway groove 96 in the strut 36 and into the Y-junction site 62 of the seat 30. The Morris taper and outwardly extending ears 108, 110 of the tongue 106 form-fit into the keyway groove 96. The threaded turn knob 172 is then attached to the bolt 64 to secure the strut 36 to the seat 30. This configuration provides for quick and easy repeated connection and disconnection of these components 30, 36. That is, to connect the strut 36 to the seat 30, a person merely places the board 20 (with seat 30 attached thereto) over the strut 36, aligns the passageway 94 and the tongue 106, then lowers the passageway 94 onto and through the tongue 106 (or vice-versa) so that the bolt 64 extends into the Y-junction site 62, and then attaches the turn knob 172 to the exposed bolt 64. Similarly, to disconnect the strut 36 from the seat 30, a person merely detaches the turn knob 172 from the exposed bolt 64 and then removes the tongue 106 from the passageway 94. The opposing end of the strut 36 is preferably formed in unity with the fuselage 44, however, as explained above, this connection can be provided by other permanent, semi-permanent or removable configurations.

Referring back to FIG. 2, the front and rear planing blades 40, 42 are attached to the fuselage 44. Although a variety of attachment devices can be used, the particular device used preferably does not alter the performance characteristics of the particular planing blade components 40, 42, 44 coupled thereto. The illustrated embodiment shows the front planing blade 40 attached to the top of the fuselage 44 by three bolts 168 laterally centered along internal stainless steel insets cast into the fuselage and corresponding to the attachment location of the central hill 114 of the planing blade and extending in the longitudinal direction. The illustrated embodiment shows the rear planing blade 42 attached to the bottom of the fuselage 44 by two bolts 170 laterally centered along internal stainless steel inset threads cast into the central fuselage and received in countersunk holes in the valley 138 of the planing blade and extending in the longitudinal direction.

ALTERING PERFORMANCE CHARACTERISTICS OF THE SKI

As noted above, one of the improvements of the flying ski 10 of the present invention relates to a method and system for altering the performance characteristics of the ski 10. That is, the improved flying ski 10 can be readily adapted for

use with beginning and intermediate riders such that the ski provides a substantially stable, steady ride while being relatively unresponsive to rider actions (such as swaying from side to side). In this mode, ski responsiveness is generally analogous to a conventional jet ski. The improved flying ski 10 can also be readily adapted for use with advanced riders such that the ski provides a generally stable ride while promptly responding to rider actions. In this mode, ski responsiveness is generally analogous to a conventional water ski. The improved flying ski 10 can further be readily adapted for use with professional riders such that the ski provides an action-packed extremely responsive ride while immediately responding to rider actions and being capable of such maneuvers as jumping up to about 10 m in the air or performing a series of continuous somersaults.

A variety of methods can be used to alter the performance characteristics of the flying ski 10, such as shortening the distance between the planing blades or increasing the size differential between the planing blades (a smaller rear blade will enhance performance). Preferably, however, it has been found that varying the hydrodynamic configuration of the planing blade 38 and varying the attack angle of the planing blade 38 provides a suitable range of performance characteristics while requiring few additional components or modifications to the overall flying ski 10. More specifically, it has been found that selectively using a rear planing blade 42 with either a generally planar member 150 (FIGS. 6 and 10), a curved member with rearwardly extending upswept wings 140, 142 (FIGS. 7 and 11), or a curved member with frontwardly extending upswept wings 196, 198 (FIGS. 8 and 11), and/or varying the attack angle of the rear planing blade 38 by placing a shim 174 between the rear blade 38 and the fuselage 44, allows the ski 10 to provide sufficiently varied performance characteristics so as to be enjoyed by beginning, intermediate, advanced and professional riders, as described below. While the disclosed blades are strongly preferred, the planing blade 38 could have a variety of other shapes. Similarly, the attack angle could be varied in other ways, such as by an adjustment screw. Moreover, methods and systems other than by selectively using a rear planing blade 42 with either a generally planar member 150, a curved member with upswept wings 140, 142, or a curved member with frontwardly extending wings 196, 198 and/or varying the attack angle of the rear planing blade 38 by placing a shim 174 between the rear blade 38 and the fuselage 44 can be used to alter the performance characteristics of the flying ski 10. However, the disclosed shim arrangement is preferred in that it provides strength, reliability, few parts and permits the blades to be adjusted without removal of the blade or shim, speeding adjustment and reducing the risk of lost parts. This is particularly important in a water setting.

Beginning and Intermediate Modes

Referring to FIGS. 6A and 6B, in beginning mode, the board 20, seat 30, foot holders 32, 34, fuselage 44 and undulated front planing blade 40 are attached as described above. The rear planing blade 42 having the generally planar member 150 is similarly attached to the fuselage as described above. When so configured, the ski 10 provides a significantly stable, steady boat-like ride that is relatively dampened response to rider actions.

Referring to FIG. 17A, as the rider's skills increase, the generally planar rear blade 150 can be detached from the fuselage 44 and a first blade position support or shim 174 (FIG. 14) placed within the cut-out 132 of the fuselage 44 and between the rear planing blade 42 and the fuselage 44. The first shim 174 is sized and configured to be accepted into

the cut-out 132 and is shaped in continuity with the fuselage 44. The first shim 174 has an elongated oval opening 172 that extends along the shim 174 in the longitudinal direction through which the fastener (e.g. screw 170) that couples the fuselage 44 to the rear blade 42 can extend and the shim 174 sandwiched therebetween. Accordingly, the fasteners function to secure both the rear blade 42 and the blade support 174 in a fixed position. The first shim 174 has a longitudinal length of about 30–70 mm, a lateral width that varies from about 20–30 mm at one end 176 of the shim to a lateral width of about 15–25 mm at the opposite side 178 of the shim 174, and a transverse height that varies linearly from about 0.5–1 mm at one end 176 of the shim 174 to a thickness of about 1–3 mm at the opposite end 178 of the shim 174. So positioned, the first shim 174 increases the attack angle of the rear blade 42 about 0.5°. An increased attack angle increase the downward force on the rear blade 42, which, in turn, provides increased performance characteristics.

Referring to FIG. 17B, as the rider's skills further increase, the generally planar rear blade 150 can be again detached from the fuselage 44 and the first shim 174 moved out of or along the cut-out 132 and advanced in the longitudinal direction toward the rear of the fuselage 44. The rear blade 150 can then be reattached to the fuselage 44. Moving the first shim 174 toward the rear of the fuselage 44 further increases the attack angle greater than about 0.5° which further provides increased performance characteristics and the first shim 174 can be repeatedly and incrementally moved in the longitudinal direction toward the rear of the passageway (e.g. FIG. 17C) to vary the attack angle of the rear blade 42 from about 0.5° to about 10°.

As the rider's skills continue to increase, the generally planar rear blade 150 can be detached from the fuselage 44 and the first shim 174 replaced by a second blade support or positioning shim 184 (FIG. 15) that is placed between the rear planing blade 42 and the fuselage 44. Like the first shim 174, the second shim 184 is sized and configured to be accepted into the cut-out 132 of the fuselage 44 and is shaped in continuity with the fuselage 44. The second shim 184 has a longitudinal length and lateral width similar to the first shim 174 and a transverse height that varies from about 1–3 mm at one longitudinal end 186 of the shim 184 to a thickness of about 3–5 mm at the opposite longitudinal end 188 of the shim 184. The second shim 188 increases the attack angle of the rear blade 42 to about 10° when arranged in within the cut-out 132. However, like the first shim 174, the second shim 184 can be repeatedly moved towards the rear of the fuselage 44 to further increase the attack angle of the rear blade 42 along a continuum of about 10°–20°.

As the rider's skills still further increase, the generally planar rear blade 150 can be detached from the fuselage 44 and the second shim 184 replaced by a third blade positioning support or shim 190 (FIG. 16) that is placed between the rear planing blade 42 and the fuselage 44. Like the first and second shims, 174, 184 the third shim 190 is sized and configured to be accepted into the cut-out 132 of the fuselage 44 and is shaped in continuity with the fuselage 44. The third shim 190 has a longitudinal length and lateral width similar to the first and second shims 174, 184 and a transverse height that varies from about 3–5 mm at one longitudinal end 192 of the shim 184 to a thickness of about 5–9 mm at the opposite longitudinal end 194 of the shim 184. The third shim 190 increases the attack angle of the rear blade 42 to about 20° when arranged within the cut-out 132. However, like the first and second shim 174, 184, the third shim 190 can be repeatedly moved towards the rear of the fuselage 44 to further increases the attack angle of the rear blade 42 along a continuum of about 20°–30°.

Advanced mode

Referring to FIGS. 7A and 7B, in advanced mode, the board 20, seat 30, foot holders 32, 34, fuselage 44, and undulated front planing blade 40 are attached as described in connection with the beginning and intermediate modes. However, rather than using the rear planing blade 42 with the generally planar member 150, the rear planing blade 42 with upswept wings 140, 142 is used and attached to the fuselage 44 as described above. When so configured, the ski 10 provides a generally stable ride while promptly responding to rider actions. The rear planing blade 42 with upswept wings 140, 142 enhances the hydrodynamic nature of the planing blade 38, which, in turn, provides increased performance characteristics.

In the advanced mode, the blade assembly 38 has a longitudinal length d_1 that is larger than that of the configuration designed for professional riders. As shown in FIG. 7B, the front blade 40 has a leading edge 193 and rear blade has a trailing edge 195 that correspond to the foremost front and rear edges of the planing blade 38. The longitudinal length d_1 is the greatest perpendicular distance between the leading edge 193 and the trailing edge 195. As the distance between the front edge 193 of the front blade and the rear edge 195 of the rear blade is increased, there is a longer effective moment arm and thus, a larger moment generated by the resistance of the water on the blades.

As the rider skills increase, and in a similar manner as described in connection with the beginning and intermediate modes, a series of shims 174, 184, 190 (FIGS. 14-16) can be used to modify the attack angle of the rear planing blade 42 and thereby further increase the performance characteristics of the ski 10.

Professional Mode

Referring to FIGS. 8A and 8B, in professional mode, the board 20, seat 30, foot holders 32, 34, fuselage 44, and undulated front planing blade 40 are attached as described in connection with the beginning, intermediate and advanced modes. Like the advanced mode, the rear planing blade 42 with upswept wings 140, 142 is used rather than the rear planing blade 42 with the generally planar member 150. However, the rear planing blade 42 with upswept wings 140, 142 is rotated 180° to form a rear planing blade 42 with frontswept wings 196, 198 that is attached to the fuselage 44 as described above. The frontswept wings 196, 198 act like canards. When so configured, the ski 10 provides an action-packed ride while immediately responding to rider actions. The rear planing blade 42 with frontswept wings 196, 198 significantly enhances the hydrodynamic nature of the planing blade 38, which, in turn, provides increased performance characteristics.

In the professional mode, the blade assembly 38 has a longitudinal length d_2 that is shorter than the longitudinal length d_1 used in the advanced mode where the upswept wings 140, 142 are employed. As above, the longitudinal length d_2 is defined as the greatest perpendicular distance between the leading edge 193 and the trailing edge 195.

As the rider skills increase, and in a similar manner as described in connection with the beginning, intermediate and advanced modes, the series of shims 174, 184, 190 (FIGS. 14-16) can be used to modify the attack angle of the rear planing blade 38 and thereby further increase the performance characteristics of the ski 10. It has been observed that thicker wedges that provide an increased attack angle are desirable to vary ski performance when the frontswept wings 196, 198 are used because the frontswept

wings 196, 198 are closer to the front blade 40, which decreases the mechanical leverage of the overall planing blade 38. That is, in the professional mode, the distance between the front edge 193 of the front blade 40 and the rear edge 195 of the rear blade 42 is reduced, so there is a shorter effective moment arm and thus, a smaller moment generated by the resistance of the water on the blades. The rear blade 42 also has a fixed angle of attack which pulls the rear of the fuselage downward. In the professional mode, this angle of attack is greater to compensate for the decreased effective movement arm of the rear blade.

Use of a limited number of shims to vary the angle of attack to less than about 30° is preferred in order to reduce the number of component parts used in connection with the ski 10 and because this particular system embodiment provides a sufficient continuum of varied performance characteristics to satisfy beginner, intermediate, advanced and professional riders. Similarly, the disclosed device is preferred in that only two types of rear planing blades 38 can be used to vary the hydrodynamic nature of the ski 10 for use with beginner, intermediate, advanced and professional riders.

SKI MAINTENANCE

It has been observed that when the planing blade 38, strut 36 and seat 30 are constructed from the preferred aluminum material, this material tends to tarnish and lose its original smooth, shiny finish. The smooth finish is preferred, particularly in connection with the submerged planing blade 38 and strut 36, because it decreases water resistance and otherwise improves ski performance.

A variety of techniques can be used to maintain the preferred smooth, shiny surface. For example, conventional metal cleaners, such as MOTHER'S magnesium and aluminum polish, are suitable for this purpose when the manufacture's directions are followed. Importantly, however, the performance of the cast strut and blades is greatly enhanced if the polished surface is also sealed. Conventional aluminum sealants are suitable for this purpose when applied to the components 30, 36, 38 as follows. First, the sealant is applied by a rag or towel and allowed to turn generally cloudy. After about 1-3 minutes, the sealant is wiped off. Through this application procedure, the sealant has been found to inhibit tarnishing for up to about 1 month.

Although this invention has been described in terms of a certain preferred embodiment and suggested possible modifications thereto, other embodiments and modifications apparent to those of ordinary skill in the art are also within the scope of this invention. It is also understood that various aspects of one or several embodiments or components can be used in connection with another or several embodiments or components. Accordingly, the scope of the invention is intended to be defined only by the claims that follow.

What is claimed is:

1. A recreational device that supports a seated human rider while the rider and the device are towed behind a powered watercraft, comprising:

- an elongated board having a front end and a back end;
- a seat extending from the board for supporting the buttocks of the seated rider at a position spaced above the board;
- a strut depending from one of the board and the seat, said strut defining a plane of symmetry;
- a blade assembly secured to the strut, the blade assembly having a front blade and a rear blade connected by a fuselage,

21

wherein said front blade includes a first portion defining a first surface on a first side of said plane of symmetry and a second portion defining a second surface on a second side of said plane of symmetry, and

wherein said rear blade includes a first portion defining a first surface on a first side of said plane of symmetry and a second portion defining a second surface on a second side of said plane of symmetry, said first surface and said second surface directing water away from said plane of symmetry upon landing of said rear blade on water

wherein said device is configured such that said entire rear blade is normally completely submerged beneath the surface of the water when the device is in contact with the water and being towed behind a watercraft.

2. The recreational device of claim 2, wherein said rear blade comprises a pair of upswept wings defining a central valley therebetween, said upswept wings symmetric about said plane of symmetry.

22

3. The recreational device of claim 2, wherein said pair of upswept wings are forward sweeping.

4. The recreational device of claim 2, wherein said pair of upswept wings are rearward sweeping.

5. The recreational device of claim 2, wherein said rear blade comprises between about 10 to 30 square inches of surface area.

6. The recreational device of claim 5, wherein said rear blade comprises between about 15 to 25 square inches of surface area.

7. The recreational device of claim 6, wherein said rear blade comprises between about 18 to 22 square inches of surface area.

8. The recreational device of claim 2, wherein said central valley has a length between about 50 to 150 millimeters from front to back.

9. The recreational device of claim 8, wherein said rear blade has a thickness between about 5 to 15 millimeters.

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