A resilient biasing element for a snowboard binding is disclosed. The biasing element provides a means of biasing an ankle or toe strap for a conventional snowboard binding towards an open position when the strap is unsecured, easing the insertion and removal of a boot from the binding. The binding may be used in combination with a conventional snowboard, or a snowboard incorporating impact plates to distribute loads and increase the structural integrity and life of the snowboard.
FIG. 3A

FIG. 3B
SNOWBOARD IMPACT PLATE AND BINDING RELEASE MECHANISM

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of snowboards and, more particularly, to a device for biasing a binding strap in an open position, when not fastened, to facilitate the insertion and removal of a boot into and out of the binding, as well as an imbedded impact plate to improve the structural integrity of a snowboard.

BACKGROUND OF THE INVENTION

[0002] Over the past 10 years, the stresses put on modern snowboarding equipment have increased dramatically as rider’s abilities have increased and ski areas have developed and maintained larger and larger obstacles in “terrain” parks. Jumps sending riders through the air for distances of over 100 feet are not uncommon, and are accessible by nearly any rider with a snowboard (or skis) who rides up the ski lift.

[0003] During riding, and especially during landings from aerial maneuvers, snowboard bindings transfer high, and often damaging, loads to the snowboard on which they are mounted. Specifically, the corners and toe and heel edges of the binding baseplate, due to their shape and placement, often become focus points that concentrate these loads as they transfer them onto the top surface of the board.

[0004] A common failure mode of a snowboard is when a load perpendicular to the top surface of the board (whether from a binding baseplate or not) is large enough to cause a compression failure of the core of the composite laminate that makes up the snowboard. Once the core of a snowboard compresses from one of these impacts, the laminate is usually compromised, and the bond between the top layers (plastic topsheet, reinforcing fiberglass, graphite fiber, etc.) and the core (wood, PU, Rohacell, honeycomb, etc.) which comprises the center of the laminate, fails. An early stage of this failure mode is often identified by dents in the top surface of the snowboard. Even though the snowboard might still appear to be fully functional, the separation between the reinforcement fiberglass and the core at the location of the core compression most often spreads with continued use of the snowboard, eventually leading to total failure (breakage) of the snowboard.

[0005] Remedies for this problem in the design of bindings have been tried and implemented with some limited success, by attempting to disperse these loads and spread them over a larger area of the binding footprint, but they have not eliminated the problem entirely. Additionally, board manufacturers cannot guarantee that bindings with an effectively designed load reducing baseplate will be used exclusively on their snowboards. This is the case even if a board manufacturer also produces one of these bindings under the some brand name as their boards, as often riders will use one brand of snowboard and another brand of binding.

[0006] Some manufacturers have previously used aluminum as a reinforcement laminate. Sheet aluminum alloys like Titanal have been used within the laminate of snowboards and skis for many years in several different ways. The most common use is one that is still used in the construction of some skis on the market, primarily in the design of very stiff skis for racers competing in the Super-G and Downhill disciplines. In this application, a sheet of aluminum alloy is used in place of the new typical fiberglass reinforcement laminate of the ski.

[0007] The tensile strength of a typical fiberglass reinforcement laminates (E glass tensile strength=3440) is 20 to 30 times higher than the tensile strength of common aluminum alloys (A16061 tensile strength=136 MPa). Because of the high bending displacement common on modern snowboards (particularly in the tips and tails), fiberglass is much preferred as a reinforcement laminate, as it is less likely to “yield” and fail due to over-stressing in extreme bending.

[0008] Skis are commonly stiffer than snowboards so skis built with aluminum alloy reinforcement laminates are less likely to reach the alloy’s material limits and permanently deform. However, it is still not uncommon to bend and permanently deform skis built in this manner.

[0009] Skis, and to a greater extent snowboards, made with aluminum alloy reinforcement laminates are very rare in today’s market but they do exist. Although not an optimal use of materials, depending on the type of alloy reinforcement, snowboards built this way could increase the resistance to core compression failures, but this is a limiting method with many negative impacts on the performance and even durability of the resulting snowboard. For example, the alloy reinforcement is susceptible to overstressing and permanent deformation of the snowboard, essentially re-introducing an old mode of failure that was eliminated with the introduction of fiber reinforcements. Other problems include the increased expense of alloy rather than fiber reinforcement material, and increased expense of manufacturing due to the difficulty in cutting the laminate to size and thoroughly coating the laminate with resin.

[0010] Aluminum plates have also been used as binding retention plates in skis and snowboards, where self tapping screw fasteners and epoxy glues are used to attach the bindings permanently to the ski or snowboard. The thicknesses of the plates needed to achieve sufficient retention strength for securely fastening bindings to the snowboard are typically in the 1.5 to 3 mm range. This mounting method has however been found to be insufficient to meet the demands modern riding places on snowboard equipment. Besides being thick and heavy, these plates were solid, continuous sheets of aluminum with no consideration for limiting their effect on the stiffness of the snowboard. As a result, the performance of a snowboard manufactured with these plates is severely diminished.

[0011] In the mid to late 1980’s nearly all snowboard manufacturers had replaced the above permanent mounting reinforcement plates in favor of laminating threaded inserts directly into the snowboard. Besides being a dramatically stronger binding attachment method than aluminum retention plates, inserts allowed for bindings to be attached, removed and re-positioned on the snowboard. Since the early 90’s, virtually all snowboard manufacturers have built snowboards with inserts for mounting bindings and some ski manufacturers have recently started moving in this direction as well.

[0012] Developing a way to increase resistance to the above described mode of failure through the snowboards construction (i.e. independent of the type of binding used),
while not negatively effecting the performance, flexibility, weight and cost of the snowboard, has been the objective of many snowboard manufacturers for several years. A practically indestructible snowboard using the common fiberglass and wood construction would require the use of excessively heavy glass reinforcement laminates and high density cores, which would likely negatively affect the performance, flex, weight and cost of the resulting snowboard.

[0013] The bindings themselves also play an essential part in the performance, comfort, and convenience to a snowboarder. Most snowboard bindings fall into two categories: plate bindings and strap bindings. Plate bindings consist of a hard baseplate and adjustable bails that are used in conjunction with a hard boot, and are generally preferred by snowboarders in situations requiring high-speed carving and riding on hard snow, such as in alpine racing. Strap bindings consist of a baseplate, highback plate, and straps. In this configuration, as the binding and straps give all the support needed, hard boots are not required to provide additional support, and the snowboard boots can remain soft and comfortable. These bindings are often preferred by "freestyle," trick oriented snowboarders and, as they offer excellent control, offer more options when it comes to boot-bindings combinations, and allow for the use of soft boots, are generally more common than other types of binding.

[0014] One problem with snowboard bindings is that any snow has to be removed from the binding, and the sole of the boot, before the boot can be inserted into the bindings. Snow between boot and binding can result in a bad or loose fit, and can also reduce the contact between rider and board, thus reducing the "feel" or feedback that the rider receives from the board. This is especially a problem in "powder" conditions, where loose snow can easily cover the bindings and make insertion of the boot more difficult and time consuming.

[0015] Inserting boots into strap bindings can be especially difficult and frustrating in these conditions, as a rider has to sweep the snow from the bindings prior to inserting a boot while also holding the bindings straps out of the way to facilitate cleaning the binding and inserting the boot. Finding a convenient method or apparatus for keeping the straps out of the way while the binding is open would leave the riders hands free to sweep snow from the bindings more quickly and efficiently, thus increasing the convenience to the snowboarder and also improving the contact between board and rider.

[0016] Previous methods of providing a mechanism for maintaining a strap in an open configuration have been disclosed in U.S. Pat. No. 6,679,515 to Carrasco, and European Patent No. EP1434626 to Messmer, the disclosures of which are incorporated herein by reference in their entirety. These straps describe the use of hinged elements connecting two separate pieces of strap and providing a bending mechanism at a discrete longitudinal position along the extent of the strap. However, requiring a separate hinged element to join two separate pieces of the strap could increase weight, affect the structural integrity of the strap and provide a weak point which, over time, may result in a failure of the strap. Requiring the separate hinged piece also makes it impossible to retrofit the bending means onto an already existing strap, and could increase the expense and time required to manufacture a new strap incorporating this feature.

[0017] One of the main problems with the hinged design is the mechanical complexity of their designs. Not only do they add to the cost of the strap assembly, they essentially create either a weak point in the strap system or, if engineered to address the weak link, add weight to the binding system. This additional weight can be highly unwelcome, as lightweight snowboard equipment is more desirable.

[0018] Additionally these systems when in the open position tend to flop over into the middle section of the snowboard between the bindings. When a rider is pushing (i.e. "skating") themselves along with their rear foot out of the bindings, needed at the bottom of the each run as they position themselves to get back on the ski-lift, the hinged straps tend to bounce up and down on the board. This can potentially scratch the surface of the snowboard, as well as cover the exact position that the rider will want to place their unsecured back foot as they glide off of the ramp when exiting at the top of the ski-lift. This can make positioning the foot difficult and even dangerous if the rider steps on the hinged strap assembly rather than the middle section of the snowboard.

[0019] As such, there is still a requirement for a simple and cost effective means of providing a biasing mechanism for a binding strap that may be easily manufactured and installed with minimal effect on the strength and structural integrity of the strap during use.

SUMMARY OF THE INVENTION

[0020] The current invention describes a method of increasing a snowboards resistance to breakage due to compression failure of the core without negatively impacting the performance, flex, weight and cost of the snowboard. The invention also relates to a resilient element for a strap of a snowboard strap binding that can bias the strap towards an open position when not secured.

[0021] Getting into conventional snowboard strap binding systems is often a very tricky procedure even for experienced snowboarders. Conventional binding's straps generally lay across the opening in the baseplate whereas the riders' foot needs to be placed. Pulling the straps out of the way in order to put your foot in the binding requires bending over while simultaneously coordinating sweeping the binding baseplate clear of debris (snow, ice, etc), and pulling the straps out of the opening with your hands while placing the foot into the baseplate. After the foot is placed in the binding baseplate the straps are then positioned over the rider's foot and securely engaged with a buckle or other similar fastening device. This is particularly difficult when there is fresh snow in the area where the board is being mounted, as the baseplate often repeatedly fills with snow before the foot can be placed into the baseplate.

[0022] The present invention helps to overcome these problems without adding significant costs or manufacturing issues to binding manufacture. Besides not compromising the strength of the strap system, as a continuous, solid strap for holding the riders foot in the binding is maintained, the present invention provides a tensioned, and even adjustably tensioned, substantially stable open position, where the
straps are held gently in one open position so as not to flop around while skating, etc. The present invention can also be designed and manufactured to be retrofittable to competitors’ conventional bindings already on the market much more easily than alternative designs, such as a hinged strap design, might be.

[0023] One embodiment of the invention includes a strap assembly for a boot binding. The strap assembly can include a continuous strap, and at least one resilient element attached thereto. The at least one resilient element attached to the strap is adapted to induce a change in curvature in at least a portion of a longitudinal extent of the strap. In different embodiments of the invention the at least one resilient element can be attached to the strap at at least two spaced locations, attached to the strap at a series of spaced locations, or substantially continuously attached to the strap along a longitudinal extent.

[0024] The strap can have an inner surface and an outer surface. In one example embodiment, at least one resilient element can be attached to the outer surface of the strap. In this configuration, the at least one resilient element can be maintained in tension. In an alternative embodiment, the at least one resilient element can be attached to the inner surface of the strap. In this configuration, the at least one resilient element can be maintained in compression. The at least one resilient element can be made from a thermoplastic polyurethane (TPU) material. Example thermoplastic polyurethane materials include, but are not limited to, Desmopan®, Elastollan®, Estane®, Utechlan®, and Texin®. Alternatively, any other material with appropriate strength, resilience, and elastic properties may be used. These materials may include, but are not limited to, other injection molded elastic materials, or natural or synthetic rubber.

[0025] Another embodiment of the invention includes a boot binding including a base plate and at least one strap assembly. The at least one strap assembly can include a continuous strap, and at least one resilient element attached thereto at at least two spaced locations along a longitudinal extent thereof. The strap may be moveable between a secured position and an unsecured position. The at least one resilient element can bias the strap towards the unsecured position.

[0026] In certain embodiments, the strap can move from the secured position substantially transverse to a longitudinal axis of the base plate to the unsecured position substantially parallel to the longitudinal axis of the base plate. The strap assembly can be attached to the binding by a rotary joint and can further include a biasing element. This biasing element can rotate the strap when unsecured about an axis substantially perpendicular to the longitudinal axis of the base plate. The biasing element can be selected from the group consisting of a spring, a resilient element, and a motor, or include some other appropriate mechanism for rotating the strap. The at least one strap assembly can be used as a toe strap, an ankle strap, or both.

[0027] These and other objects, along with advantages and features of the present invention herein disclosed, will become apparent through reference to the following description, the accompanying drawings, and the claims. Furthermore, it is to be understood that the features of the various embodiments described herein are not mutually exclusive and can exist in various combinations and permutations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The objects and features of the invention can be better understood with reference to the drawings described below, and the claims. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the drawings, like numerals are used to indicate like parts throughout the various views.

[0029] FIG. 1 is a schematic side view of a compression failure of the core of a standard prior art snowboard;

[0030] FIG. 2 is a schematic perspective view of a snowboard with imbedded impact plates, in accordance with one embodiment of the invention;

[0031] FIG. 3A is a schematic plan view of an example impact plate, in accordance with one embodiment of the invention;

[0032] FIG. 3B is a schematic elevation view of the impact plate of FIG. 3A;

[0033] FIG. 4A is a schematic plan view of snowboard, in accordance with one embodiment of the invention;

[0034] FIG. 4B is a schematic plan view of the snowboard of FIG. 4A, with impact plates imbedded in the board.

[0035] FIG. 5A is a schematic cross-sectional view of the snowboard of FIG. 4A taken along line A-A, in accordance with one embodiment of the invention;

[0036] FIG. 5B is a schematic cross-sectional view of the snowboard of FIG. 4B taken along line B-B, in accordance with one embodiment of the invention;

[0037] FIG. 6 is a schematic side view of an example snowboard strap binding, in accordance with one embodiment of the invention;

[0038] FIG. 7 is a schematic plan view of a pair of strap bindings positioned on a snowboard, in accordance with one embodiment of the invention;

[0039] FIG. 8A is a schematic top-view of a snowboard strap binding with attached release mechanism with ankle strap in open configuration, in accordance with one embodiment of the invention;

[0040] FIG. 8B is a schematic rear-view of the snowboard strap binding of FIG. 8A;

[0041] FIG. 9 is a schematic side view of a snowboard strap binding with resilient elements for both a toe strap and an ankle strap, in accordance with one embodiment of the invention;

[0042] FIG. 10A is a schematic side view of a resilient element for an binding strap in the open configuration, in accordance with one embodiment of the invention;

[0043] FIG. 10B is a schematic side view of the resilient element of FIG. 10A in a closed configuration;

[0044] FIG. 11A is a schematic side view of an alternative resilient element for an binding strap in the open configuration, in accordance with one embodiment of the invention;

[0045] FIG. 11B is a schematic plan view of the resilient element of FIG. 11A;
FIG. 12A is a schematic side view of a further alternative resilient element for a binding strap in the open configuration, in accordance with one embodiment of the invention;

FIG. 12B is a schematic plan view of the resilient element of FIG. 12A;

FIG. 13A is a schematic exploded perspective view of the resilient element of FIG. 12A;

FIG. 13B is a schematic perspective view of the assembled resilient element of FIG. 13A;

FIG. 14A is a schematic top-view of a snowboard strap binding with attached release mechanism including the resilient element of FIG. 12A with ankle strap and toe strap in open configuration, in accordance with one embodiment of the invention;

FIG. 14B is a schematic rear-view of the snowboard strap binding of FIG. 14A;

FIG. 15 is a schematic side-view of a binding including a rotary biasing element at the proximal end of an ankle strap, and;

FIG. 16 is an exploded perspective view of a rotary biasing element for attachment at the proximal end of a strap.

**DETAILED DESCRIPTION**

The purpose of the impact plates described in the present invention is to disperse potentially damaging loads before they reach the core by spreading them out over a wider surface area, and thereby reducing the peak force exerted on any one section of the core. As a result, compression strength of the core is increased, and the potential of lamination failure is reduced, without over-building the snowboard or the laminate.

A figure highlighting the separation of the laminate due to a compression failure in the core of a typical prior-art snowboard is shown in FIG. 1, wherein a cross-sectional portion of a standard snowboard suffering from a separation of the laminate is indicated. In this embodiment, the cross-section of a snowboard 10 includes a topsheet 20, a top reinforcement laminate 30, a core 40, a bottom reinforcement laminate 50, and a base 60, all bonded together by resin 70. Upon the application of a concentrated load 80 on the snowboard 10, there may be a compression failure of the core, resulting in a separation of the laminate 90. Repeated application of a load to the snowboard can cause the separation to spread and eventually lead to a total failure of the board.

It is preferable that the presence of the impact plates has little to no effect on the riding performance of the board. For this reason, in one example embodiment, very thin, flexible material with flex slots is used for the impact plates. This minimizes the plate's contribution to the overall stiffness of the laminate. On-snow testing of the resulting boards built with the impact plates has shown that the plates have no noticeable material difference on the ride performance of the board.

In one embodiment of the invention the impact plates consist of a thin flexible aluminum alloy of approximately 0.4 mm thickness. In an example embodiment, "Titanal" brand aluminum alloy can be used, with the stamped plates placed into a corresponding 0.4 mm deep recess in the top of the snowboard core before laminating the topsheet fiberglass into the snowboard. The size, shape, and location of each plate is determined by the potential footprint of the binding baseplates when mounted on the snowboard in any of the available stance locations.

There are several challenges to incorporating these plates into the snowboard as well as challenges in limiting the ability to see the plates in the finished snowboard. Although in one embodiment of the invention it might be desirable for the outline of the plates to be visible, or "telegraphed", through the topsheet of the snowboard for marketing purposes, in other embodiments of the invention it may be desired that the presence of the plates be invisible in the finished snowboard. This requires precise matching of the thickness of the plates and the recess in the core.

Although manufacturing plates of consistent thickness is relatively straightforward, manufacturing a recess in the wood core to closely match this thickness is more challenging. Initial machining of the recess with a CNC machine can be too inaccurate due to the varying thickness of the wood core profile from the tip of the board to the tail of the board. As a result, in one embodiment of the invention a hand router can be used to mill the recess after the core had been profiled. This allowed the depth from the top surface of the finished core to be registered, thus closely matching the recess to the thickness of the plate. In alternative embodiments of the invention, any other manual or pre-programmed method of machining the recess in the wood core to the required size and depth can be used.

Ensuring that the plates are a solid component of the entire snowboard laminate can also be critical, particularly as their primary objective is to make the board stronger. This requires that the plates be of a material that is compatible with, and bonds well to, the glue resin system being used to hold the composite laminate together, as well as the other components in the laminate that the plates come in contact with, such as the core and the top reinforcement laminate. As aluminum is not permeable by liquid, both sides of the plates can be coated thoroughly with resin to ensure that it bonds equally well to the core underneath it as well as the fiberglass above it. In one embodiment of the invention, Titanal is used as the material for the impact plates. The compression strength of a snowboard manufactured in this way can be measured using the Brinell Hardness Test. Typical test results for an industry standard Beech wood core yielded values in the range of BH 34. With the addition of the impact plates to a typical Beech wood core it is possible to obtain test result values 2.5 to 3 times higher (i.e. approximately BH 85 to BH 100).

In an alternative embodiment of the invention, Titanal could be replaced with another material, such as, but not limited to, a different metal or even a fiberglass or wooden plate. In further alternative embodiments, substituting a dense elastomeric material such as sheets of a dense rubber could also increase the core compression resistance. In the case of rubber sheets, or sheets from other materials with similar properties, the core compression resistance would be increased more by absorption of the loads than dispersion of the loads.

The impact plates described in this invention can also be adapted for use in skis or other flexible board-like
structures wherein there is a potential for a failure of the board as a result of repeated impact loads and stresses at well determined positions on the board surface. In one embodiment, impact plates can be inserted at positions along the length of a ski, such as, but not limited to, adjacent to the skis bindings, in order to improve the ski resistance to impact loads and even the structural performance of the ski during use.

[0063] An example embodiment of the impact plates mounted in a snowboard is shown in FIG. 2. In this embodiment, four impact plates 110 are imbedded in the snowboard 100 in groups of two. Each grouping of two impact plates 110 surround the threaded inserts 120 for the snowboard bindings, and are positioned to lie directly below the heel and toe of the bindings as mounted on the snowboard 100. In this embodiment, each impact plate 110 is curved around the threaded inserts 120 of the snowboard 100 located in the region of the central longitudinal axis 140 of the board. As a result, the plates will provide core compression resistance regardless of the orientation of the imbedded bindings. Arrows 130 indicate the insertion of an impact plate 110 into one of the required locations on the snowboard 100.

[0064] The impact plate 110 works by dispersing a load applied by over a localized region of the outer surface so as to limit the peak force applied to any one region of the inner core of the snowboard 100. High impact loads and forces are produced at the heel and toe regions of the bindings during snowboard 100 use. These loads produce forces on the outer surface of the snowboard 100 over a localized area underneath the portion of the binding producing the load. By imbedding a larger surface area plate underneath these impact locations, a force applied to a small area of the outer surface of the snowboard is applied to the impact plate 110 and dispersed, resulting in a lower force being applied over a larger region to the interior of the snowboard 100 than would be observed without the presence of the plate. By spreading the load produced by the bindings on the snowboard, the maximum force exerted on a specific localized area of the inner core is diminished and, thus, the danger of the snowboard 100 failing due to compression failure of the core is reduced.

[0065] FIGS. 3A and 3B depict a plan and elevation view of one possible embodiment of an impact plate 110. In this embodiment, the impact plate 110 comprises a nominally rectangular profile with one edge curved inwards 150 to allow the plates 110 to curve around the snowboards threaded inserts 120 (as described above). Thin slots, or flex channels 160, are cut into the impact plate 110 along the inner 150 and outer 170 edges of the plate and directed to run perpendicular to the central longitudinal axis 140 of a snowboard 100 upon being imprinted. The flex channels 160 increase the pliability of the plate and allow the impact plate 110 greater freedom to flex, bend or twist around its center. As a result, the properties and integrity of the plate can be maintained while minimizing the resultant impact on the stiffness of the snowboard 100.

[0066] Although any additional material laminated into a board 100 will have an impact on the resulting flex, the affect can be limited by minimizing the thickness of the impact plate 110 and effectively designing the flex channels into the plate. Further control of the stiffness on the resulting board 100 may be achieved through adjustment of the other materials incorporated in the board 100, for example by adjusting the thickness profile of the core. As a result it is possible to manufacture a board incorporating the impact plates 110 which mimics the performance characteristics of a board 100 without impact plates 110, and from the point of view of a user rides identically to a board 100 designed without imbedded plates 110.

[0067] In one example embodiment the impact plates 110 can be manufactured with a thickness of between 0.1 mm and 2 mm, a length of between 200 mm and 400 mm, and a width of between 50 mm and 150 mm. The width of the plate 110 at its center, i.e., the location of maximum curvature, can be from 20 mm to 130 mm. The width of the flex channels 160 can be from 0.5 mm to 5 mm. In alternative embodiments, the invention, larger or smaller dimensions than those mentioned above are envisioned, dependent upon the specific requirements of the board 100 and user. In one specific embodiment, the impact plate 110 can have a thickness of 0.4 mm, a length of 310 mm, a width of 100 mm at the largest extent and 88.1 mm at the smallest extent, and have flex channels 160 of width 2 mm.

[0068] In an alternative embodiment of the invention, the flex channels in the plates could be oriented in different ways, or shaped differently, to either further reduce or even increase their contribution to the stiffness of the snowboard, and therefore the affect the board’s performance, based on the requirements of a user. Additionally the thickness of the plates could be varied to yield similar effects on the performance of the snowboard. In an alternative embodiment of the invention the impact plates could be shaped to provide core compression resistance to different regions of the board, or shaped such that the required compression resistance can be provided by a smaller, or greater, number of plates.

[0069] Depending upon the material used and the design requirements for the plates, such as the required stiffness of the impact plates and snowboard, plates can be manufactured with differing lengths, thicknesses and numbers of flex channels. In an alternative embodiment of the invention, variations in the stiffness, and other properties, of the plates could be affected through the inclusion of different modifications to the basic plate. In one embodiment, in addition to the flex channels described herein, such as but not limited to perforations within the plate.

[0070] A plan view of an example snowboard 200 is shown in FIG. 4A. The snowboard 200 includes threaded inserts 210 for the attachment of bindings. A sectional cut A-A 220 is highlighted, with the cross-sectional view of the snowboard 200 at this location shown in FIG. 5A. A plan view of a snowboard 230 with impact plates 240 imbedded at two locations around each set of threaded inserts 210 can be seen in FIG. 4B. A sectional cut B-B 250 is highlighted, with the cross-sectional view of the snowboard 230 at this location shown in FIG. 5B.

[0071] FIG. 5A depicts a cross-sectional cut of a typical snowboard 200 without any impact plates. Here, the board 200 comprises a number of layers of material, namely a plastic topsheet 260, an upper reinforcement laminate 270, a core region 280, a lower reinforcement laminate 290, and a HDPE base sheet 300. FIG. 5B depicts one embodiment of the invention with impact plates 240 imbedded between the upper reinforcement laminate 270 and the core region 280 of
a snowboard 230. As described above, manufacturing techniques allow impact plates 240 of varying thicknesses to be accurately implanted, such that the upper surface of the impact plate 240 lies flush with the upper surface of the core region 280. As such, the plates can be mounted within a snowboard 200 without impacting the profile of the board, and thus be invisible to a user.

[0072] In an alternative embodiment of the invention, plates which would have a similar effect could be mounted within or adjacent to different layers of the board, such as, but not limited to, between the binding and the board or adhered to the topsheet of the board in the binding mounting area.

[0073] FIG. 6 shows a side view of an example snowboard strap binding 400 and parts thereof. The binding includes a baseplate 410, a toe strap 420, an ankle strap 430, and a hightack plate 440. As a snowboarder adjusts her balance during maneuvering, jumping, performing tricks, and/or reacting to a bump or other change in terrain, loads are transferred between the snowboard and the snowboarder through the bindings. These loads tend to be focused towards the heel region 450 and toe region 460 of the binding 400. As a result, for maximum performance of the impact plates, they should be located below the heel region 450 and toe region 460 of each binding, corresponding to the regions of the binding which produce the greatest loads on a snowboard during use.

[0074] FIG. 7 shows a standard position for the bindings 400 on a typical snowboard 470, with each binding positioned such that a line between the heel and toe of each binding runs nominally perpendicular to the lengthwise axis of the board 470. It should be noted that the actual angle at which each binding 400 is mounted with respect to the lengthwise axis can be adjusted, and varies dependant upon the requirements of an individual user. These angles can be anywhere from exactly perpendicular to the lengthwise axis to any smaller angle, generally greater than 45 degrees from the lengthwise axis. The multiple threaded inserts 480 also allow the bindings 400 to be located at various locations along the length of the board 470, again depending upon the individual requirements of a user. The impact plates are positioned such that they correspond to the heel 450 and toe locations 460 of each binding 400, thus providing core compression resistance at locations of high load and stress on the board.

[0075] The present invention also includes a mechanism to ease entry of a boot into a strap binding. This can be important in reducing the time, energy, and irritation involved in securing a users boots into the bindings of a snowboard, especially in high powder conditions where a significant amount of snow can cover the bindings and reduce the contact between a boot and the board.

[0076] FIG. 8A shows a plan view of an example binding 500 including a biasing element 510 for the ankle strap assembly 520, in accordance with one embodiment of the invention. The binding includes a toe strap 530, an ankle strap 520, a baseplate 540, and a hightack plate 550. This biasing element 510 provides a force to the binding strap 520 to pull the strap 520 away from the binding 500 when not secured in a closed position, thus improving the ease of access for a boot, into and out of the binding 500, upon release of the strap's locking mechanism 560. A rear view of the binding and strap arrangement of FIG. 8A is shown in FIG. 8B.

[0077] The strap 520 for the binding 500 is generally made from a plastic or metal band 570 that extends around the upper of the boot and is fixedly attached at its proximal end to a portion of the baseplate 540, and/or hightack plate 550, or a separate piece joining these parts of the binding 500. The band 570 can be a single continuous element that extends from a base at the heel of the binding 500 to a distal end that attaches to the far side of the heel of the binding 500, or to another strap 580 attached to the far side of the heel of the binding 500. Alternatively, the band 570 may extend from a base at the heel of the binding 500 to a separate connected piece, or number of pieces, that will extend over the boot and to the other side of the heel of the binding 500. This separate piece, such as a paddled “front” of the strap, may be connected to the band 570 in any number of appropriate ways. This band can include a means of adjusting the length of the strap, such that boots of different size and shape can be comfortably fitted into the bindings. The locking mechanism 560 can include a means of securely connecting the distal end of the strap to the other side of the binding, or securely connecting the strap to a second band 580 extending from the other side of the binding 500. The strap 520 is releasable attached at its distal end to the other side of the binding 500, such that, when secured, the strap 520 provides a substantially rigid means of holding a boot in the binding 500. Padding 590 is attached to the strap 520 at its lower or inner surface to provide a cushion between the strap 520 and the boot and thus provide added comfort for the snowboarder and distribute retention loads.

[0078] While the strap's plastic or metal band 570 will maintain a certain limited degree of flexibility, even when closed, it must be rigid enough to hold the boot firmly within the binding 500 so as to provide a secure attachment between snowboard and snowboarder. As such, the strap 520 is generally designed so that it will not stretch when loaded, and will only bend to a limited extent. Even when open, the strap 520 will generally maintain its curvature, conforming to the curvature of the upper of a boot. However, when unsecured at its distal end, the strap 520 is flexible enough to be bent back from the binding at its proximal end in order to allow a boot to be easily inserted or removed.

[0079] In one embodiment of the invention, the mechanism comprises an elasticized compliant resilient element 510 connected to the binding strap 520 at its proximal end (or base) 525, located at the heel of the binding 500, and at an intermediate location 535 along the length of the strap 520. When the binding strap 520 is in a closed position the elasticized resilient element 510 is maintained under tension. Upon release of the strap’s locking mechanism, the elasticized resilient element 510 is free to contract, thus applying a compressive or bending force to the binding strap 520. The result of this force is to pull the distal end 545 of the binding strap 520 away and outwards from the binding 500. As a result, the distal end 545 of the strap 520 is maintained clear of the binding 500, easing the access and egress of a boot in and out of the binding 500.

[0080] FIG. 9 shows a side view of a binding 500 with a biasing element 510 attached to both a toe strap 530 and an
ankle strap 520, with both straps in a closed position. As can be
seen, each biasing element 510 is attached at a proximal
to the binding 500 at substantially the same point as the
strap to which it is attached. In an alternative embodiment,
the biasing element 510 can be attached at a different
location along the straps, or in certain embodiments multiple
biasing elements 510 can be attached along discrete or
contiguous portions of the length of a strap.

[0081] Close-up views of the elasticized element in the
straps open and closed position can be seen in FIGS. 10A
and 10B respectively. As shown, the elasticized biasing
element 510 comprises a strip of material fixed at one end to
the base of the binding strap 520 at the heel of the binding
600. The other end of the elasticized element is fixed at an
appropriate intermediate point 610 along the length of the
strap 520. The elasticized biasing element 510 is free to
rotate, along with the strap 520 itself, around the straps base
600. The length of the elasticized element 510 is fixed such
that upon closing the binding strap, the element is main-
tained under tension, but does not affect the working of the
binding strap while closed.

[0082] By adding the biasing element on the top or outer
external surface of the main body of a strap, the invention
provides a means of biasing the strip without effecting the
structural integrity and/or strength of the strap itself. The
biasing element can be attached in parallel with a single,
continuous length of strap, and does not require a hinged,
pinned, or otherwise joined connection between two sepa-
rate pieces of strap. As a result, there is little or no additional
points of weakness or possible fatigue added to the strap by
addition of this biasing element.

[0083] In some embodiments, a closure mechanism 620,
such as, but not limited to, a slotted or latched arrangement,
can be included on the strap to adjust the length of the strap.
In other alternative arrangements this mechanism 620 may
not be required. In some example embodiments, the elasti-
cized biasing element 510 can be configured to be releasably
attached to a binding strap. As a result, these biasing
elements can be retrofitted to any appropriate bind-
ing strap by simply connecting them to the binding at the
base of the strap and attaching the distal end to a portion of
the strap an appropriate distance along its length using a
connection mechanism (such as a clasp, clip or other appro-
priate means). This can result in standard strap bindings
being adapted to provide this helpful opening mechanism
with minimal cost and effort.

[0084] In one example embodiment of the design the
material used for the elasticized biasing element is a TPU
(Thermoplastic Polyurethane) made under the trade name
Utechlan®. This material has the advantage of being
extremely cold temperature tough and has 700% elongation
with 100% return to its original shape. Other example
thermoplastic polyurethane materials that may be used in
alternative embodiments include, but are not limited to
Elastollan®, Estane®, Desmopan®, and Texin®. Alternat-
evely, any other material with appropriate strength, resil-
ience, and elastic properties may be used. These materials
may include, but are not limited to, other injection molded
elastic materials, or natural or synthetic rubber and combi-
nations thereof.

[0085] In an alternative embodiment other mechanisms
for providing a tensile force to a strap may be employed.
These mechanisms may for example include a spring
attached at two locations along the length of a strap, a coil
spring located at the proximal end of the strap and attached
by wire to a location along the strap, a spring loaded
telescoping element biased towards a contracted position, or
other appropriate forcing mechanism. These biasing mech-
nisms can be constructed from any appropriate material that
can provide the required stiffness, resilience and elastic
properties.

[0086] In an alternative embodiment of the invention the
tensile force applied to the binding strap may be adjusted
throughout adjusting the length of the binding strap in its
unloaded position. This may be achieved though the addition
of holes along the length of the elasticized element, allowing
the element to be fixed at the base through any of the number
of holes. The use of other length adjustment mechanisms,
such as, but not limited to, slotted grooves allowing adjust-
ment of the length, are also envisioned.

[0087] FIG. 11A is a schematic side view of an alternative
resilient element for an binding strap in the open configura-
tion. A corresponding plan view of this embodiment can be
seen in FIG. 11B. Here, the band of a strap 700 is connected
at its proximal end to the heel portion of a snowboard
binding (not shown) through a threaded screw 710. A
proximal end of a resilient biasing element 720 is then
attached through the screw 710 to the heel of the binding
at the same location as the strap 700. A clip 730 can attach
the resilient biasing element 720 to the strap 700 at a number
of different locations. This allows the tension provided by
the biasing element 720, and the actual position of the strap
700 when in the open configuration, to be adjusted, depending
on the specific requirements of the user. In this example
embodiment a connection mechanism, in this case a
threaded screw 740 mounted on the clip 730 which is in turn
attached to the strap 700, can engage any one of a series of
holes 750 in the biasing element 720. This will effectively
change the length of the biasing element 720, and thus
change the tension applied to the strap 700, as well as change
its stable default position when open.

[0088] In an alternative embodiment, a clasp arrangement
that can fixably engage the biasing element 720 without the
need for holes 750 may be employed. Any other appropriate
means of fixedly positioning a distal portion of the biasing
element 720 at a given location on the strap 700 is also
envisioned. In a further alternative embodiment, the prox-
imal end of the biasing element 720 can be located at a
position along the length of the strap 700, with an adjust-
ment means, such as the series of holes 750 being positioned
at the base of the heel of the binding so as to engage the
screw 710, or other appropriate engagement mechanism.

[0089] FIG. 12A is a schematic side view of a further
alternative resilient element for a binding strap in the open
configuration. A corresponding plan view of this embodi-
ment can be seen in FIG. 12B. In this embodiment, a
resilient biasing element 800 is affixed within the proximal
end of the strap 810, on its outside surface. The strap and
biasing element 800 are anchored at their proximal end by
a screw 820, pin, or other appropriate means, to the heel of
the binding (not shown).

[0090] A slotted arrangement 830, or other appropriate
means, such as, but not limited to, a plurality of holes or
teeth, is placed at the distal end of the strap 810 to provide
a means of connecting the strap to a further element (such as a padded section), or to a connector on the far side of the heel of the binding. In this example embodiment the slotted arrangement 830 is inserted within a region beyond the distal end of the biasing element 800. In an alternative embodiment, the biasing element 800 can be designed to extend around the slotted arrangement, or in further alternative arrangements the biasing element 800 can be designed to include a slotted, holed, or other arrangement for connecting the distal end of the strap 810. In certain embodiments it may also be advantageous to include a plurality of biasing elements 800 within a single strap.

[0091] The resilient biasing element 800 can be anchored into the strap 810 at a plurality of locations, be molded permanently onto the strap, or into a cavity in the strap, or bonded to the strap by an appropriate adhesive. The biasing element 800 is attached to the strap 810 while in tension. This provides a differential strain over the thickness of the strap 810 which will result in it being biased to curve towards the side of the strap 810 holding the biasing element 800. As a result, unless the strap is forced closed and locked in position, the strap 810 will remain substantially stable in the open position.

[0092] In an alternative embodiment, a biasing element can be attached in any of the above manners to the inside surface of any of the straps described herein and maintained in compression. This will provide a similar differential strain over the thickness of the strap as described above, and again bias the strap towards an open position, in this case by curving the strap away from the side holding the biasing element. Alternative embodiments of the strap could include both at least one biasing element in tension and one biasing element in compression on either side of the strap. In further alternative embodiments, the strap may be configured to be biased towards a closed position, by either placing a biasing element in tension on the inside surface of the strap, or placing a biasing element in compression on the outside surface of the strap.

[0093] A schematic exploded perspective view of the resilient element 800 and strap 810 is show in FIG. 13A. In this embodiment, the resilient element 800 is a molded piece that can be inserted into a cavity 840 in the strap 810 such that upon insertion the resilient element 800 is anchored to the strap 810 at a plurality of locations 850. As described above, in alternative embodiments the resilient element 800 can be attached to the strap 810 in a number of manners, including through adhesion or molding, or by pinning, screwing, or otherwise attaching the resilient element 800 to a plurality of locations on the strap 810. A schematic perspective view of the assembled resilient element of FIG. 13A is shown in FIG. 13B.

[0094] FIG. 14A shows a schematic top-view of a snowboard strap binding 900 including an imbedded resilient element in both an ankle and toe strap. The ankle strap 910 is shown in a stable, open configuration, with the arrow 920 indicating the direction of bias resulting from the resilient element 930. A second strap 915 is located on the far side of the binding from the strap 910 to engage a locking element 925 at the distal end of strap 910. The toe strap is indicated in both a closed 940 position and an open 950 position, with an arrow 960 indicating the direction of bias resulting from the resilient element 970. A second strap 945 is located on the far side of the binding from the strap 940, 950 to engage a locking element 955 at the distal end of strap 940, 950. As before, the binding also includes a baseplate 980 and a highback plate 990. A rear-view of this binding 900, showing only the ankle strap 910 is shown in FIG. 14B.

[0095] In one embodiment of the invention, a strap assembly for mounting on a strap binding can further include a rotary joint at the anchoring position at the proximal end of the strap (i.e. where the strap is connected to the baseplate and/or highback plate. This rotary element allows the strap to rotate about is anchor point, thus allowing the strap to adjust its position for different sized and shaped boots, and also provide a level of adjustment as the rider crouches and stands up while riding.

[0096] In certain embodiments, this rotary joint can further include a biasing element, which can help the resilient biasing element described above move the strap clear of the binding when open. In this embodiment, a first biasing element on the strap will move the strap out from the binding in a direction from the secured position substantially transverse to a longitudinal axis of the base plate to the unsecured, or open, position substantially parallel to the longitudinal axis of the base plate. The second biasing element in the rotary joint can then rotate the strap about the rotary joint to move the strap completely clear of the opening of the binding.

[0097] An example of the motion provided by a rotary biasing element within the rotary joint can be seen in FIG. 15. This shows a binding 1000 with the toe strap removed. Again, the binding includes a baseplate 1010, and a highback plate 1020. The ankle strap is shown in two locations, i.e. prior to the rotary biasing element acting on the strap 1030, and after the rotary biasing element has acted on the strap 1040. An arrow 1050 indicated the direction of bias provided by the rotary biasing element. This motion occurs after, or in conjunction with, the motion provided by the first biasing element 1060, which moves the strap out from the binding to a position substantially parallel with a longitudinal axis of the baseplate of the binding.

[0098] An exploded perspective view of an example rotary biasing element for attachment at the proximal end of a strap is shown in FIG. 16. In this embodiment, the rotary element assembly 1100 includes a screw 1110, a washer 1120, a coil spring 1130, and the strap 1140, which is all mounted on a base 1150 and nut 1160 to attach the assembly to the binding 1170. In alternative embodiments of the invention the rotary biasing element can include a spring, a resilient element, a motor, or any other appropriate means of providing a rotational bias to the strap.

[0099] It should be noted that all of the above embodiments of the invention are equally applicable to both a toe and ankle strap, and may also be applied to any other intermediate or alternative strap used in snowboarding. The straps may also be employed for use in skiing, windsurfing, or any other sport in which a means of releasably strapping a boot or foot to a surface is desired. In further embodiments, the strap may be used in construction applications or commercial fishing applications, where again there may be situations where a worker's boots need to be releasably attached to the floor.

[0100] The invention may be embodied in other specific forms without departing from the spirit or essential charac-
teristics thereof. The foregoing embodiments, therefore, are to be considered in all respects illustrative rather than limiting the invention described herein. Scope of the invention is thus indicated by the appended claims, rather than by the foregoing description, and all changes that come within the meaning and range of equivalency of the claims are intended to be embraced therein.

What is claimed is:
1. A strap assembly for a boot binding, comprising:
   a continuous strap; and
   at least one resilient element attached thereto, wherein the at least one resilient element is adapted to induce a change in curvature in at least a portion of a longitudinal extent of the strap.
2. The strap assembly of claim 1, wherein the at least one resilient element is attached to the strap at at least two spaced locations.
3. The strap assembly of claim 1, wherein the at least one resilient element is attached to the strap at a series of spaced locations.
4. The strap assembly of claim 1, wherein the at least one resilient element is substantially continuously attached to the strap along a longitudinal extent.
5. The strap assembly of claim 1, wherein the strap has an inner surface and an outer surface, and wherein at least one resilient element is attached to the outer surface of the strap.
6. The strap assembly of claim 5, wherein the at least one resilient element is maintained in tension.
7. The strap assembly of claim 1, wherein the strap has an inner surface and an outer surface, and wherein at least one resilient element is attached to the inner surface of the strap.
8. The strap assembly of claim 7, wherein the at least one resilient element is maintained in compression.
9. The strap assembly of claim 1, wherein the at least one resilient element comprises a thermoplastic polyurethane.
10. A boot binding comprising a base plate and at least one strap assembly, the at least one strap assembly comprising:
   a continuous strap; and
   at least one resilient element attached thereto at at least two spaced locations along a longitudinal extent thereof, wherein the strap is moveable between a secured position and an unsecured position, and wherein the at least one resilient element biases the strap towards the unsecured position.
11. The boot binding of claim 10, wherein the strap moves from the secured position substantially transverse to a longitudinal axis of the base plate to the unsecured position substantially parallel to the longitudinal axis of the base plate.
12. The boot binding of claim 11, wherein the strap assembly is attached thereto by a rotary joint and further comprising a biasing element, wherein the biasing element rotates the strap when unsecured about an axis substantially perpendicular to the longitudinal axis of the base plate.
13. The boot binding of claim 12, wherein the biasing element is selected from the group consisting of a spring, a resilient element, and a motor.
14. The boot binding of claim 10, wherein the at least one strap assembly comprises a toe strap.
15. The boot binding of claim 10, wherein the at least one strap assembly comprises an ankle strap.

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