SAFETY SKI BINDING

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ABSTRACT

A ski binding for releasably retaining a ski boot on a ski including a sole plate mountable on, and slightly spaced apart from the upper surface of a ski, a ski boot engaging member including a release plate insertable between the sole plate and the upper surface of the ski to retain a ski boot in position on the sole plate, and retaining members for engaging appropriate edge contours of the release plate to prevent the release plate from moving in the lateral or longitudinal directions but to allow the release plate to pivot about a predetermined pivot point to release the ski boot engaging member from the ski. The ski boot engaging member may be in the form of a rigid or semi-rigid shell which engages the medial or "inside" lateral surface of the exterior of the ski boot and extends around the lateral "outside" surface of the heel to provide a portion of the necessary support for the skier's heel and ankle and thus allow the skier to wear a lighter, softer, more comfortable and inexpensive ski boot. The ski boot engaging shell may be canted outward to provide improved control of the ski edges. A heel block having a grooved pattern which mates with complementary grooves on the heel of the ski boot may be provided to afford increased control of the ski.

20 Claims, 6 Drawing Figures
SAFETY SKI BINDING

This invention relates to a safety ski binding, and, more particularly, to a safety ski binding having a novel release system which provides improved skiability and releasability characteristics.

Despite the nearly universal adoption of safety ski bindings of one form or another, the great increase in the popularity of recreational skiing in recent years has brought about a roughly corresponding increase in the number of skiing injuries. By far the largest portion of skiing injuries are caused by the failure of the safety ski binding to release the skier's boot from the ski before the ski can operate as a dangerously long lever against the skier's leg. The number of such skiing injuries is currently estimated to be in the neighborhood of 100,000 per year.

Conventional safety ski bindings typically include a toe piece which engages the toe of the ski boot and is intended to release the boot in a lateral direction in response to a certain threshold force. A mechanism is usually provided for adjusting the threshold force level required to release the ski boot from the toe piece. In addition, some conventional safety ski bindings incorporate an anti-shock feature which is intended to prevent inadvertent release due to relatively brief lateral "shock" forces normally encountered in high-speed skiing conditions while allowing the binding to release in response to more sustained forces of the type that are encountered during a fall and which are dangerous to the skier.

In addition, several types of conventional safety ski bindings also include a heel piece which provides for release of the heel of the ski boot in a vertical direction in response to a certain threshold force. Generally, a mechanism is provided for adjusting the threshold force level of the heel piece. While the vertical release heel piece contributes somewhat to overall safety, it is far less significant than the lateral-release toe piece in terms of reducing the probability of serious injury to the skier.

There are several factors which contribute to the failure of the conventional lateral release toe piece to reliably release the skier's boot from the ski under injury-causing conditions. One factor is the misadjustment of the ski bindings. Conventional ski bindings typically have one or more adjustable features, each having a range of adjustment which affects, to a greater or lesser degree, the threshold force level required to release the ski boot from the ski. The mere fact that conventional ski bindings are typically adjustable into a dangerous range makes it a statistical certainty that some skiers will misadjust them and be injured as a result. This problem is aggravated by the fact that inadvertent releases are more likely to occur if the toe piece of the conventional ski binding is adjusted so that the threshold level of force required to release the binding is in the safe range. Hence, skiers tend to adjust their bindings into the dangerous range in attempt to avoid inadvertent releases.

Another factor which contributes to unreliability of conventional safety ski bindings arises from friction between the ski boot and the upper surface of the ski and/or the ski binding. Effectively, the friction force adds to the threshold force level required to release the binding. For an adult skier, the threshold force level provided by the binding alone is typically in the range from 30 to 80 pounds. Under unfavorable circumstances such as pronounced forward lean which is likely to occur at the very moment when release is desired, frictional forces of up to 100 pounds are not uncommon. Thus, lateral forces in excess of those which would be required to release the binding under ski shop test conditions might not be sufficient to release the binding in a typical practical situation when release is required in order to avoid injury to the skier.

A third factor which contributes to the lack of reliability of conventional safety ski bindings is the fact of compressive forces between the ski boot and the toe piece of the ski binding. Typically, a potentially injury-producing fall may be preceded or accompanied by sharp deceleration of the ski which causes the ski boot to be jammed against the toe piece of the binding by the momentum of the skier. The resulting compressive forces tend to inhibit the toe piece from releasing the ski boot as intended to prevent injury to the skier. This problem represents a serious design weakness of conventional safety ski bindings which cannot be readily overcome by minor improvements such as, for example, anti-friction devices.

It is therefore an object of the present invention to provide a novel safety ski binding which obviates the problems of the prior art ski bindings.

More particularly, it is an object of this invention to provide a safety ski binding incorporating a novel release mechanism.

It is also an object of this invention to provide a safety ski binding incorporating the novel release mechanism the operation of which is not substantially effected by the compressive forces encountered in potentially injurious falls.

It is another object of this invention to provide a safety ski binding the operation of which is not substantially inhibited by unwanted friction between the ski boot and the ski binding or ski.

It is still another object of this invention to provide a ski binding which cannot be readily misadjusted into a dangerous range.

It is a further object of this invention to provide a novel ski binding which will reliably release a ski boot in response to potentially injury-causing torques, but will not inadvertently release the ski boot in response to the lateral shocks encountered in normal high-speed skiing.

Another development which has contributed to skiing injuries in recent years has been the increasing usage of higher stiffer ski boots. Skiers prefer such high, stiff ski boots because they provide a greater degree of control over the ski edges and thus facilitate high-performance skiing. However, the increasing usage of such high, stiff ski boots has resulted in the increasing incidence of a more serious type of skiing injury, sometimes called "boot top fractures", in which both bones of the lower leg are broken just above the top of the boot. By comparison, the fracture is more likely to occur, if at all, in the region of the ankle when the somewhat softer boot is used. In effect, the stiff, high boot serves to transfer the location of the break from the ankle to a point just above the boot top. While fractures in the region of the ankle often require several weeks in a cast in order to heal, "boot top fractures" often require several months in a cast.

It is therefore a further object of this invention to provide an improved ski binding which enables the
Referring to FIG. 1 of the drawings, there is shown a side elevation view of a ski boot 1 which is mounted on a ski 2 by means of a safety ski binding according to the present invention. The ski binding includes a sole plate 3 which is mounted on the ski 2 by any suitable means, such as, for example, screws 4. At least a portion of the sole plate 3 is spaced above the upper surface of the ski 2 so as to allow the release plate 5 to be inserted between the sole plate 3 and the upper surface of ski 2. Sole plate 3 is preferably made of a rigid material, such as, for example, steel, which is sufficiently strong to support the weight of the skier with acceptable deflection.

Referring to FIG. 2 of the drawings, it is seen that the release plate 5 is rigidly connected to a boot engaging shell 6 which is preferably made of a rigid or semi-rigid material such as, for example, polypropylene plastic, cellular vinyl, fiberglass, or the like. In the preferred form of the present invention, the shell 6 engages substantially the entire inner, or medial, surface of the ski boot 1 and extends around the heel to engage the rear portion of the outer, or lateral, surface of the ski boot 1. The rear contour 16 of shell 6 preferably slants forward as shown in FIG. 1 to help hold the heel of ski boot 1 in firm contact with the heel block 17. The heel enclosing portion 13 of shell 6 presses inward firmly against the heel of the ski boot 1 to prevent the heel from moving outward laterally with respect to ski 2.

While the boot engaging shell 6 may be of uniform stiffness or rigidity, it is advantageous to provide a shell 6 having various rigidity properties in various areas. For example, the shell 6 should be most rigid or stiff in the region including the medial surface of the ankle down to the medial surface of the heel and around to the lateral surface of the heel in order to provide the maximum degree of edge control. The shell 6 should be least rigid in the area of its forward edge 9 where the straps 7 and 8 are attached so that this portion of shell 6 will accommodate itself more readily to the contours of the ski boot 1. Other areas of the shell 6 may be of intermediate rigidity.

The ski boot 1 is retained within shell 6 by straps 7 and 8 which are attached to the forward edge 9 of shell 6 by suitable means such as, for example, rivets 10 shown in FIG. 2. The rearward end of strap 7 is provided with a ring 11 which cooperates with a buckle 12 mounted on the heel enclosing portion 13 of shell 6. Similarly, the rearward end of strap 8 is provided with a ring 14 which cooperates with buckle 15 mounted on heel enclosing portion 13. The straps 7 and 8 are preferably made of heavy rubber or other elastic material to allow the ski boot to move forward somewhat or to twist in a clockwise direction with respect to ski 2 when subjected to a level of stress which might otherwise be injurious to the skier, thus providing an additional measure of safety. It will be appreciated, however, that straps 7 and 8 may be made of inelastic material if desired.

Buckles 12 and 15 may be of the type conventionally used on buckle ski boots and preferentially have a number of teeth 16 (shown in FIG. 3) for engaging rings 11 and 14, respectively, so as to provide the desired tension on straps 7 and 8 to securely, but comfortably, retain the ski boot 1 within shell 6. Alternatively, buckles 12 and 15 may be of a type which is designed to release automatically when subjected to a level of tension from
straps 7 and 8 which might otherwise be injurious to the skier.

A heel block 17 is mounted on the ski 2 by suitable means such as adhesive cement or screws or the like, not shown. Heel block 17, which supports the heel 18 of ski boot 1, may be an integral part of sole plate 3 or a separate element as desired. In the preferred form of ski binding according to the present invention, the heel block 17 is provided with a groove pattern 19 which mates with a complementary groove pattern on the heel 18 of ski boot 1. The groove pattern 19 is preferably primarily longitudinal in order to resist side to side movement of the heel of the ski boot relative to the ski and thus provide improved edge control for high performance skiing.

The semi-rigid shell 6 which engages the ski boot 1 provides support for the skier's heel and ankle and positively transmits the movements of the skier's ankle via release plate 5 to the ski 2 so as to provide the precise edge control needed for high performance skiing.

If desired, the shell 6 may be canted outward a few degrees, as shown in FIG. 3, to afford the skier improved control over the inside edge of his ski which is of great importance to good skiing technique. By improving the skiability of the binding, such canting of the boot engaging shell 6 provides an additional measure of safety. It will be appreciated that, if shell 6 is canted outward, sole plate 3 should be canted a corresponding amount as shown in FIG. 2. Alternatively, the sole of ski boot last 1 may be canted to correspond to shell 6.

Because the shell 6 provides much of the needed support, the ski boot 1 may be made more flexible, more comfortable, lighter and less expensive than the very stiff and expensive ski boots used with conventional safety ski bindings. For example, the ski boot 1 used in conjunction with the present ski binding may be similar to a conventional cross-country ski boot.

The relatively light flexible boots which are preferably used in connection with the ski binding of the present invention have certain advantages over conventional stiff heavy ski boots. For example, light flexible boots are more comfortable for walking when the skis are removed and provide an additional safety factor in that they would allow a lone skier who has lost a ski to walk a considerably longer distance to find shelter. Further, a skier using light, flexible boots should be somewhat less susceptible to injury resulting from slow speed falls and, if injury should occur, it would be likely to be less serious than the "boot top fracture" associated with high, stiff ski boots.

Referring to FIG. 3 of the drawings, there is shown a plan of a right ski binding according to the present invention viewed from the bottom and showing the details of the release plate 5. FIG. 4 is a plan of the right ski binding viewed from the top showing the sole plate 3, retaining members 21 and 22 and release plate 5 partially shown in phantom. FIG. 5 is a plan of the right ski binding showing the release plate 5 partially pivoted toward the released condition with the sole plate 3 partially broken away to show the retaining members 21 and 22 and engaging the appropriate contoured edges of portion 5a of release plate 5. FIG. 6 is a perspective view of the preferred form of right ski binding according to the present invention, with the sole plate 3 partially broken away to show the release plate 5 and retaining members 21 and 22. The operation of the ski binding of the present invention can best be understood by considering FIGS. 3-6 together.

In the preferred form of ski binding shown in FIGS. 3-6, the release plate 5 is designed to pivot about a point 23 where the projection 24 of release plate 5 contacts the portion 25 of sole plate 3. More particularly, as viewed from the top (FIGS. 4 and 5), the release plate 5 pivots in a counterclockwise direction relative to sole plate 3 and ski 2 to release the ski boot engaging portion of the binding from the sole plate 3 and ski 2. As the counterclockwise pivoting action continues beyond the condition shown in FIG. 5, the ski boot engaging portion of the binding, including release plate 5, shell 6 and the ski boot 1 itself, will be completely freed from the ski 2. Under skiing conditions, such a release would occur in a fall in which the right ski tip is swept outward in the clockwise direction with respect to the relatively stationary right ski boot. Similarly, a left ski binding according to the present invention would release during a fall in which the left ski tip is swept outward in the counterclockwise direction with respect to the relatively stationary left ski boot, thus causing the release plate of the left ski binding to pivot in a clockwise direction with respect to the ski and the sole plate. It is estimated that approximately three-quarters of all skiing injuries are caused by faulty operation of conventional bindings in falls of this type.

Referring again to FIGS. 3-6, it will be seen that the ski boot engaging portion of the present ski binding may be mounted on the ski 2 by pivoting the ski boot engaging shell 6 in a clockwise direction about a vertical axis extending through point 23 so as to insert the release plate 5 between the sole plate 3 and the upper surface of the ski 2. Normally, the ski boot engaging portion is mounted on the ski 2 before the ski boot 1 is fastened into the shell 6 by means of straps 7 and 8 and buckles 12 and 15.

When the ski boot engaging portion of the present ski binding is properly aligned with the ski 2 as shown in FIGS. 3, 4 and 6, it is prevented from moving in the longitudinal and lateral directions by retaining members which engage the appropriate edge contours of release plate 5. For example, the release plate 5 is prevented from moving in the lateral direction by the retaining member 22, which may be a screw, for example, which engages the sides 26a and 26b of arcuate slot 26 in portion 5a of release plate 5. Release plate 5 is additionally prevented from moving to the right by projection 24 of release plate 5 which engages the portion 25 of sole plate 3, and by the forward end 27 of release plate 5 which engages the side of sole plate 3. Release plate 5 is prevented from moving forward by retaining member 21, which may also be a screw, for example, which engages the arcuate edge contour 28 of portion 5a of release plate 5. Rearward movement of release plate 5 is prevented by retaining member 22 which engages the end of slot 26.

While the action of retaining members 21 and 22 against the edge contours 28 and 26, respectively, of release plate 5 serves to prevent the release plate 5 from moving longitudinally or laterally with respect to sole plate 3, the shape of arcuate edge contour 28 and slot 26 permits the release plate 5 to pivot about point 23. Specifically, in the preferred form of ski binding shown in FIGS. 3-6, the edge contour 28 is in the form of a circular arc having its center of curvature at the pivot point 23. Similarly, the sides 26a and 26b of slot
In the preferred form of the present invention, the under surface of sole plate 3 is provided with a dimple 32a and the upper surface of portion 5b of release plate 5 is provided with a complementary bump 32b which cooperate to locate the release plate 5 in proper alignment with the sole plate 3.

While the principles of the present invention have been illustrated by reference to a preferred embodiment of ski binding in which the skier's right foot is released in a counterclockwise direction only and his left foot is released in the clockwise direction only, it will be appreciated that the present invention contemplates a ski binding in which each foot is releasable in both the clockwise and counterclockwise directions. Such a ski binding would include a ski boot engaging shell and release plate for each side of each ski boot. The sole plates would be spaced above the upper surfaces of the skis by a sufficient amount to allow the two release plates for each boot to overlap. One release plate would provide for release in the clockwise direction and the other release plate would provide for release in the counterclockwise direction. In this embodiment the inner boot would be released from between the two shells.

It will be apparent to those skilled in the art that other modifications and adaptations of the present ski binding may be made without departing from the spirit and scope of the present invention which is set forth with particularity in the appended claims.

What is claimed is:

1. A ski binding for releasably retaining a ski boot on a ski, comprising:
   a sole plate fixedly mountable on the upper surface of a ski for supporting a ski boot, at least a portion of said sole plate being raised apart from the upper surface of the ski;
   ski boot engaging means for removably engaging a ski boot, said ski boot engaging means including a release plate insertable between said raised portion of said sole plate and the upper surface of the ski to retain said ski boot engaging means on the ski; and
   retaining means disposed between said raised portion of said sole plate and the upper surface of the ski for engaging said release plate for preventing said ski boot engaging means from moving laterally or longitudinally with respect to said sole plate, said ski boot engaging means being pivotable about a pivot axis extending through the ankle of the skier to release said release plate from said retaining means and thereby free said ski boot engaging means from said sole plate and the ski in response to a torque about said pivot axis.

2. The ski binding of claim 1, wherein said pivot axis is located at a distance from the heel of the ski boot in the range from 30 to 45 percent of the ski boot length.

3. The ski binding of claim 2, wherein said pivot axis is located substantially over the inside edge of the ski.

4. The ski binding of claim 3, wherein said ski boot engaging means of the left ski binding is pivotable in the clockwise direction about said pivot axis, and the ski boot engaging means of the right ski binding is pivotable in the counterclockwise direction about said pivot axis.

5. The ski binding of claim 4, further comprising a pivot member mountable between said sole plate and
the upper surface of the ski at said pivot axis for engaging said release plate.
6. The ski binding of claim 1, further comprising:
   friction means tending to restrain the pivotal movement of said release plate relative to said sole plate.
7. The ski binding of claim 6, wherein said friction means comprises:
   means for urging a portion of the upper surface of said release plate into frictional engagement with
   the lower surface of said sole plate.
8. The ski binding of claim 7, wherein said means for urging said release plate into frictional engagement
   with said sole plate comprises a leaf spring mountable on the upper surface of the ski.
9. The ski binding of claim 7, wherein said portion of said release plate and said sole plate include complimentary features which mate when said portion of said release plate and said sole plate are aligned for skiing.
10. The ski binding of claim 1, wherein said release plate includes a curved edge, a portion of said curved edge extending substantially laterally of the ski and having its center of curvature substantially coincident with said pivot axis; and
    wherein said retaining means comprises a first retaining member extending between said sole plate and
    the upper surface of the ski for engaging said laterally extending portion of said first curved edge of
    said release plate so as to retain said release plate against longitudinal movement with respect to said
    sole plate and the ski but to permit said release plate to pivot around said pivot axis to release said
    ski boot engaging means from said sole plate and the ski.
11. The ski binding of claim 10, wherein said release plate further includes a second curved edge, at least a
    portion of said second curved edge extending substantially longitudinally of the ski and having its center
    of curvature substantially coincident with said pivot axis; and
    wherein said retaining means further comprises a second retaining member extending between said sole
    plate and the upper surface of the ski for engaging said longitudinally-extending portion of said second
    curved edge so as to restrain said release plate from lateral movement with respect to the ski but
    to permit said release plate to pivot around said pivot axis to release said ski boot engaging means
    from said sole plate and the ski.
12. The ski binding of claim 1, wherein said ski boot engaging means further comprises a substantially rigid
    shell extending upward from the medial edge of said release plate for engaging a substantial portion of the
    medial surface of a ski boot so as to transmit canting movements of the ski boot through said release plate to
    said sole plate and the ski.
13. The ski binding of claim 12, wherein said shell engages substantially the entire medial surface of a ski
    boot and extends around the rear of the ski boot to engage a portion of the lateral heel surface thereof.
14. The ski binding of claim 13, wherein said ski boot engaging means further comprises a releasable strap
    extending between the forward edge of the medial portion of said shell and the lateral portion of said shell
    to retain a ski boot in engagement with said shell.
15. The ski binding of claim 14, wherein said strap is made of an elastic material.
16. The ski binding of claim 1, further comprising a heel block mounted on the upper surface of the ski to
    the rear of said sole plate, the upper surface of said heel block having a grooved pattern for engaging a complimentary grooved pattern on the heel of a ski boot.
17. The ski binding of claim 16, wherein said grooved pattern extends primarily in the longitudinal direction
    so as to inhibit lateral movement of the heel of the ski boot.
18. The ski binding of claim 12, wherein said shell is canted toward the outside edge of the ski from a line
    perpendicular to the running surface of the ski.
19. The ski binding of claim 18, wherein said sole plate is canted outward by an amount corresponding to
    said shell so that said sole plate is substantially perpendicular to said shell.
20. A safety ski binding for releasably retaining a boot on a ski comprising:
    boot engaging means for removably engaging a boot, said boot engaging means including a substantially rigid upstanding shell for engaging substantially the entire medial surface of the boot and extending around the rear of the boot to engage a portion of the lateral heel surface thereof so as to firmly hold and support the boot, and
    a releasable strap extending between the forward edge of the medial portion of said shell and the lateral
    portion of said shell to retain the boot in engagement with said shell; and
    releasable retaining means having first and second mating parts, said first mating part being rigidly connected to the lower medial edge of said shell and extending under the sole of the boot and the second mating part being fixedly mountable on the upper surface of a ski, said first and second mating parts cooperating to prevent said boot engaging means from moving laterally or longitudinally with respect to the ski but to free said boot engaging means from the ski when said boot engaging means is pivoted about an axis extending vertically through the ankle of the skier.
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