SAFETY DEVICES FOR REDUCING FRICTION BETWEEN
A SKI AND A SKIER'S BOOT SOLE
Filed June 21, 1967

INVENTORS
MITCHELL H. CUBBERLEY
GORDON C. LIPPE
BY
ATTORNEYS
SAFETY DEVICES FOR REDUCING FRICTION BETWEEN A SKI AND A SKIER'S BOOT SOLE

Devices for use in conjunction with automatically releasable heel and/or toe ski bindings which reduce friction between the sole of a ski boot and the ski in the area beneath the ball of the skier's foot, thus preventing failure of the toe binding to release the ski boot in response to an abnormally strong lateral pull caused by a fall or other skiing mishap. The new devices include friction reducing means having two superposed elements, the upper one being slidable laterally relative to the lower one, and means for mounting the devices on a ski. Flexible sheet members, base plates and intermediate lubricants facilitate sliding relative movement of the upper element over the lower element. A lubricant encased in a sealed envelope or other types of relatively slideable elements having plastic or plastic coated surfaces and oil-bronze bearing surfaces may be employed.

Background of the invention

In recent years skiers have become increasingly safety conscious and consequently, a wide variety of automatically releasable ski bindings are now available which securely fasten a skier's boot to the ski under normal skiing conditions, but which release the skier's boot in response to abnormally strong pulling forces caused by the lever action of the skis during a fall or other skiing mishap. Injuries most frequently occur when a poorly controlled maneuver results in the two skis moving in different directions. When this happens, unless the binding releases before the resulting stress in the skier's legs becomes too great, one or both legs may suffer a twist sufficiently severe to strain muscles, tear ligaments or fracture bones. Prevention of this type of injury requires lateral release of the toe unit of the ski binding to permit the skier's boot to move laterally out of the binding. When a force exerted from either side of the boot becomes strong enough it overcomes the spring force in the toe binding and the boot pivots on its heel and moves out of the heel binding and off the ski. Therefore, the degree of lateral force required to overcome the spring force of the toe binding is critical, since it must be less than the force which would cause serious injury to the leg of the skier.

While commercially available toe bindings are adjustable to permit presetting of a release force safe for the individual skier, it has been found that such bindings frequently fail to release at the pre-set force under actual use conditions and, therefore, do not prevent injuries as intended. It has been discovered that this is due to the fact that when a skier shifts his weight further forward onto the balls of his feet in turning down, for example, the increased friction under his foot tends to prevent lateral movement of the toe of the boot across the ski to permit release of the toe binding when an accident occurs during such a maneuver. This increase in friction, moreover, greatly increases the force required to overcome the spring force of the toe binding at the very time when such release is required. It has been found that as much as 50% greater force is required to release the toe binding when the skier is on the balls of his feet as otherwise, and the increase in the operable release force is even greater if grit beneath the sole of the boot further increases the friction.

It is apparent, therefore, that a need has existed in the art for means to prevent toe bindings from failing to release under actual use conditions at the predetermined safe release force.

Brief summary of the invention

The present invention meets the need of the prior art for assuring operation of automatically releasable toe bindings at the predetermined safe release force by providing devices mounted on the ski in the area beneath the ball of the skier's foot, which substantially reduce added frictional resistance to lateral movement due to the skier's weight on the ball of his foot and/or to the presence of sand, grit or other friction-increasing material between the boot and the ski. The devices of the invention comprise a friction-reducing means and means for mounting the device on the top of the ski. The friction reducing means consist of two opposed elements disposed one over the other, the lower element being fixedly attached to the ski and the upper element, although attached to the ski, being capable of sliding easily over the lower element even under the full weight of the skier. The upper element is a flexible, and preferably resilient sheet member. The lower element may be a similar sheet member or equivalent, or a rigid base plate. Reduction in friction is achieved by proper selection of the materials of the two opposed elements or by the use of suitable lubricants therebetween. The upper and lower opposed elements also may both be part of a sealed envelope containing lubricant. The new safety devices are mounted on the ski by mechanical or adhesive means.

Brief description of the drawings

The invention will now be described in greater detail in conjunction with the accompanying drawings wherein like reference numerals denote like parts, and in which:

FIG. 1 is a top plan view of a safety device of the present invention mounted on a ski by means of screws between automatically releasable toe and heel bindings for a skier's boot so as to be positioned beneath the ball of the skier's foot when the ski is in use;

FIG. 2 is a side elevational view of the safety device, ski and ski bindings of FIG. 1;

FIG. 3 is a cross sectional view through the safety device and ski of FIG. 1;

FIG. 4 is a cross sectional view through a ski and another embodiment of the invention in which the safety device is mounted on the ski by adhesive means;

FIG. 5 is a cross sectional view through a ski and still another embodiment of the invention in which the safety device embodies a sealed envelope containing a lubricant; and

FIG. 6 is a cross sectional view through a ski and yet another embodiment of the invention in which the safety device comprises a porous bronze plate and lubricating oil.

Detailed description of the invention

Referring to the drawings in greater detail, and in particular to FIGS. 1 and 3, a safety device 10 of the invention is shown mounted on top of a ski 11 by means of screws 12 between a toe binding 13 and a heel binding 14. The device is located in an area directly below the ball of a skier's foot when the ski is in use as indicated by the position of a skier's boot 15 shown in broken lines. The safety device 10 consists of a friction-reducing means and mounting means; in this case the mounting means are the aforementioned screws 12, and the friction-reducing
means consists of a base plate 16, an upper flexible sheet member 17 and an intermediate lubricant 18. Two opposite sides of the flexible sheet member 17 are folded under to provide anchoring portions 19, which are held securely between the upper surface of the ski and the base plate 16 when the safety device is mounted on a ski 11 and the base plate 16 is drawn tight by the screws 12. The flexible sheet member 17 may be composed of any suitable flexible materials, but is preferably made of a material such as neoprene rubber-coated fabric which is not only flexible but resilient. When a flexible, resilient material such as neoprene rubber-coated fabric is used, the folded edges of the sheet member 17 may be creased permanently by vulcanization, for example, to provide creases 20 which tend to stabilize the position of the sheet member 17 above the base plate and ski by spring-like action to return the sheet member 17 to its normally central position after deformation. It should be noted that the base plate 16 is substantially coextensive with the width of the ski, although its width is preferably slightly less than that of the ski, in order to avoid projecting edges which might tend to catch on objects passed by the ski. It should also be noted that the folded edge portions of the flexible sheet member 17 and the creases thereof preferably extend outwardly from the edges of the base plate somewhat and may even overhang the edges of the ski. The extent of the overhang of the folded edge portions of the sheet member 17 above the base plate 16 determines the limit of lateral travel of the area of the flexible sheet member 17 between the two creases 20 in each direction across the width of the ski under laterally directed forces deforming the flexible sheet member.

It will be seen by reference to FIG. 2, that for clarity of illustration the sole of the ski boot 15 is very slightly spaced from the upper surface of the flexible member 17 of the safety device. In actual use, when the weight of the skier is acting downwardly on the ski boot, the sole of the boot 15 is normally in contact with the safety device 16 under the ball of the skier's foot and the plate on the toe of the boot may actually be spaced slightly above the base plate of the toe binding 13, due to the normally slightly bowed shape of the sole of the ski boot. This is, of course, definitely the case in an emergency situation which requires release of the binding, since, as explained above, in such a situation the skier's weight is heavily on the ball of his foot, thus assuring contact of the boot sole with the safety device.

As noted above, any suitable flexible material may be employed for the flexible sheet member 17, although it is preferred to use a resilient material. The base plate 16 may be composed of any suitable material such as plastic or metal. Suitable metals include aluminum and aluminum alloys, among others; the preferred material being steel and especially stainless steel. The base plate may, of course, be made in one piece or in several pieces, if desired, and one, two or more plates, one on top of the other, may be employed to achieve the desired thickness or for other reasons. The means for reducing friction may also take any suitable form, e.g., the base plate may be composed of "Teflon" (trademark of E.I. du Pont de Nemours and Co. for its brand of polytetrafluoroethylene plastic), or it may be a metal or other plate coated with "Teflon," polyethylene or polypropylene, for example, or any other suitable material which has frictional properties such that there is relatively little friction between the base plate and flexible sheet members even under the full weight of a heavy skier. A "Teflon" coating 21 is shown on the metal plate 16 in FIG. 4, for example, in conjunction with a flexible sheet 17 composed of a material capable of sliding easily over "Teflon." Although as just noted, by proper selection of the materials of the base plate, it is possible to achieve adequately reduced friction, it is generally preferred to employ a suitable lubricant for this purpose. Such lubricants include any of the well-known oils and greases and other types of lubricants which are compatible with the materials of the base plate and flexible sheet member, and which have viscosity characteristics such that they retain their lubricity at the temperatures prevailing where skis are used, i.e., about 32° F. down to about 0° F. or, if necessary, even at the subzero temperatures prevailing in certain parts of the world. Particularly suitable lubricants include commercially available constant viscosity silicone greases. Oils may also be employed, but it is generally preferred to use, with the embodiment of FIG. 5 and porous plate type embodiment of FIG. 6, as will be explained below.

Turning now to the embodiment of the invention shown in FIG. 4, it will be seen that the friction-reducing means consists of a metal base plate 16a having a "Teflon" coating 21 on its upper surface, a flexible sheet member 17 composed of a material having good slippage with respect to "Teflon" and no added lubricant as in the embodiment of FIG. 3. It will also be seen that in the embodiment of FIG. 4 the mounting means is an adhesive 22 which replaces the screws 12 of FIG. 3. The adhesive 22 may be any suitable commercially available adhesive capable of securely bonding the metal or plastic base plate 16 and fabric, plastic or coated fabric flexible sheet 17 to the wooden, plastic or metal ski body 11; the latter being shown as wood. The adhesive 22 may be applied to either or both of the surfaces to be joined and is cured by conventional techniques applicable to the particular adhesive employed. The adhesive mounting means may also be a coating of pressure-sensitive adhesive applied to the lower surface of a base plate-flexible sheet member assembly held together by the common adhesive coating or by auxiliary adhesive between the base plate and folded-under anchoring portions 19 of the flexible sheet member 17. A suitable backing sheet, not shown, may be employed to protect the layer of pressure-sensitive adhesive 22 prior to removal of the backing sheet and application of the assembly to the top of the ski by pressing it against the proper area. In this way safety devices of the invention may be made available in a form suitable for quick and easy installation without tools, or for quick replacement on the ski slopes under use conditions.

Another embodiment of the invention is illustrated in FIG. 5 in which the ski binding includes a sealed envelope 23, the upper surface of which corresponds to the flexible sheet member 17 of the other embodiments of the invention. The sealed envelope 23, which is of generally flat construction, contains a suitable lubricant 18, which may be any of the lubricants mentioned above, including the oils or other liquid-phase lubricants which are less practical with the open-sided embodiments of the invention shown in FIGS. 1, 2, 3, 4 and 6. The envelope 23 may be mounted on the ski by any suitable means, but it is generally preferred to use adhesive rather than mechanical means in order to preserve the integrity of the envelope against leakage of lubricant. Therefore, a layer of adhesive 22 is shown on the under side of the envelope 23. A base plate 16 is also shown in FIG. 5. Such a base plate serves to stiffen and strengthen the envelope 23 before application to the ski and facilitates installation of the friction-reducing means on the ski, since it provides a firm surface to be pressed against the firm surface of the ski. A second layer of adhesive 22 is shown between the optional base plate 16 and the upper surface of the ski body 11. Either or both of the layers of adhesive 22 may be laminated to the envelope, or, if desired, separate layers of adhesive may be employed. Additional adhesive layers may be employed to provide adequate bonding of the various members mentioned above or they may be pressure-sensitive adhesives as described above in connection with the embodiment of FIG. 4.

It should be noted that the envelope 23 has a structure similar to that of the flexible sheet shown in FIGS. 1, 2, 3, 4 and 6, except that it is provided with a lower sheet member 24 and intermediate side walls 25. The lower sheet member 24 is identical with the upper sheet member 23.
and sheet members 17, except that in this embodiment it performs the function of providing a supporting surface for the lubricant, which function is performed by the base plate 16 in the other embodiments of the invention. In the preferred forms of the embodiment of FIG. 5, the envelope 23 has a circular or oval configuration, when viewed from the front view, rather than the generally rectangular configuration illustrated. The front and back side walls 25 of the envelope 23, whether the envelope is of circular, oval, rectangular or other configuration, i.e., the side walls extending laterally across the ski, are preferably more flexible or elastic than the side walls 25 extending parallel to the edges of the ski. This may be achieved, for example, by molding the envelopes in such a way that the front and back side walls 25 are thinner than the other side walls. In this way the front and back side walls 25 offer less resistance to the lateral deformation of the envelope 23 under emergency conditions when the ski boot is being released from the binding and the ball of the skier’s foot is moving generally laterally or radially with respect to the longitudinal axis of the ski.

In FIG. 6, another embodiment of the invention is illustrated which is similar to that of FIG. 4 except that the spring 16a is a base plate 16b composed of porous bronze which is saturated with a suitable oil according to known techniques for producing an oil-bronze bearing surface.

The safety devices of the present invention may be employed in conjunction with virtually any of the commercially available, automatically releasable ski bindings. Such bindings, in general, may or may not include a heel binding, which serves to hold the heel of a skier’s boot down firmly against the top of the ski but in case of an emergency, such as a serious fall, permit the heel of the skier’s boot to be released vertically or to be twisted out of the binding by radial movement of the boot with the heel binding acting as the pivot point, in response to an abnormally strong pull in such directions. Such heel bindings may be used in conjunction with the essential toe binding which serves to securely anchor the toe of the skier’s boot in proper position on the ski during normal use conditions, but which permits vertical, lateral or rolling release of the toe of the skier’s boot in response to an abnormally strong pull in such directions due to a fall or similar mishap. Vertical release of the toe binding might be occasioned by the skier falling backward under conditions such as to apply a force downward to the toe. Roll release of the toe binding would be occasioned by a sideward fall of the skier. While important, vertical release and roll release are seldom needed to prevent serious injury to the skier and, in fact, some popular toe bindings do not provide for roll release. The principal function of an automatically releasable toe binding, therefore, is to prevent serious injury by releasing the toe of the skier’s boot in response to an abnormally strong lateral pull, since it is such lateral release which prevents the very serious bone-splintering injuries caused by torsional stresses set up in the skier’s legs by the lever action of the ski in a tumbling fall.

As noted above, it is of paramount importance that the toe binding permit lateral release in either direction in response to a pull of predetermined strength depending upon the build, weight, strength and ability of the skier. While it is not possible to state with exactitude the minimum predetermined release force for safety for every skier, experience has shown that for a novice skier the toe binding should release the toe of the skier’s boot in response to a pull equivalent to about 25% of the skier’s weight exerted normal to the toe post of the binding. Assuming for purposes of discussion that the skier’s boot is pivoted at the heel, that there is negligible frictional drag under the ball of the skier’s foot, and that the skier’s foot is about one foot in length, then for a 100 lb. skier, the release force should be about 25 foot-pounds. Similarly, the safe release force for a 150 lb. novice skier would be about 37.5 foot-pounds, and for a 200 lb. skier, about 50 foot-pounds. These figures will serve as a guide for selecting appropriate safe release forces for other skiers. Children, women and men of relatively light build should, of course, set their toe bindings to release at proportionately lower values, while more advanced and experienced skiers may exceed, with reasonable safety, the above values in proportion to their strength and ability.

Most of the available toe bindings are provided with means for adjusting the force required to permit lateral release of the toe of the skier’s boot and devices are also available for force measurement for release at any particular setting. A particularly suitable device of this type, the Lipre release check, is commercially available from Beconat, Inc.

Although they do not form part of the present invention, typical commercially available toe and heel bindings with which the new safety devices are useful are illustrated in the drawings. The spring loaded-pivoted toe binding is adapted to permit release of the toe of a skier’s boot in response to any upward, radial or lateral pull applied to the boot, which is sufficient to actuate the pivotable member of the binding despite the restraining influence of the spring. The spring-loaded heel binding is illustrated with the heel of a skier’s boot firmly down on a ski under normal use conditions but to permit the heel of the boot to be released under the influence of abnormally strong upward or radial pulls lifting or twisting the boot heel. Ski bindings of this type are described in greater detail in Mitchell H. Cubberley U.S. Patents 2,573,955 and 2,616,714 and in C. G. Blackwell, Jr., U.S. Patent 3,007,707. The toe binding and modified heel bindings, one of which permits pivotal movement of the heel of the boot upon release of the toe binding, are described in Mitchell H. Cubberley U.S. Patents 3,155,028 and 3,272,524. It is noted that means are provided for adjusting the tension in the springs of the bindings in order to preset the desired safe release force.

As noted above, it has been found that during an actual emergency situation such as in a serious fall, the skier’s weight is often distributed so that most of it is on the ball of the foot. It has been discovered that due to the substantial proportion of the skier’s weight which acts at the ball of his foot, that the resulting resistance to lateral movement of the forward part of the skier’s boot over the upper surface of the ski due to friction between the ski and boot sole is so great that the actual lateral force required to release the boot from the toe binding may be 50% greater than the predetermined value. Moreover, in the event that any sand, grit or other similar material is present between the ski and the sole of the skier’s boot at the ball of the foot, the frictional resistances to lateral movement and, consequently, the actual force required for release of the boot, is even greater. For this reason, even though a skier may have adjusted his toe binding to release in response to a lateral pull of a value which would normally be safe for him under ideal conditions, the binding may fail to release when the abnormal pull reaches the predetermined value due to the frictional drag under the ball of the skier’s foot resisting lateral or radial movement of the skier’s boot. In this case the torque applied to the skier’s leg by the lever action of the ski may well seriously injure the skier’s leg, possibly tearing ligaments and fracturing bones.

It will be apparent to those skilled in the art that such injuries will be prevented by the safety devices of the present invention which greatly reduce frictional resistance to lateral or radial movement of the toe of the skier’s boot in response to an abnormally strong pull and thus obviate failure of the toe binding to operate when the predetermined release force is applied.

Not only do the safety devices of the present invention insure greatly reduced friction beneath the ball of the skier’s foot by providing opposed surfaces composed of low friction materials or by introducing suitable lubricants...
between opposed surfaces to facilitate lateral sliding movement, but they also greatly reduce or eliminate the added frictional resistance to lateral movement which may be caused by the pressure of said flexible sheet member between opposed surfaces to facilitate lateral sliding movement, but they also greatly reduce or eliminating the possibility of sand or grit finding its way between the opposed sliding surfaces of the base plate and flexible sheet member. In the embodiment of FIGS. 5 in which the sliding surfaces are completely enclosed within envelope 23 there is no opportunity whatever for grit to be introduced between the sliding surfaces. It will be seen, therefore, that the safety devices of this invention reduce the frictional forces which have previously prevented operation of releasable toe bindings in the past and permit such devices to operate as intended in response to abnormal pulls of safe magnitude, thus preventing or mitigating injuries which would otherwise result.

It will be apparent to those skilled in the art that the present invention is susceptible of many modifications in addition to those specifically described above and shown in the drawings, which are given by way of illustration only and are not to be construed as limiting the scope of the invention.

What is claimed is:

1. A safety device for use in conjunction with an automatically releasable ski binding for releasably attaching a skier's boot to a ski which comprises, a flexible sheet member for contacting the sole of a skier's boot at least when the skier's weight is largely on the ball of his foot, means for mounting said flexible sheet member on the top of a ski in the area below the ball of said skier's foot when said ski is in use so that at least a portion of said flexible sheet member is free to move relative to the top of said ski, and a lubricant, said lubricant being disposed between said moveable portion of said flexible sheet member and the top of a ski when said safety device is in use, said flexible sheet member being adapted to slide on said lubricant to facilitate lateral movement of the skier's boot with respect to a ski on which the device is mounted.

2. A safety device for use in conjunction with an automatically releasable ski binding for releasably attaching a skier's boot to a ski which comprises, an upper flexible sheet member, a base plate substantially coextensive with the width of a ski, means for mounting said flexible sheet member above the top of a ski in the area below the ball of a skier's foot when the ski is in use so that at least a portion of said flexible sheet member overlaps said base plate and is free to move relative thereto, and a lubricant, said lubricant being disposed between the upper surface of said base plate and the lower surface of said flexible sheet member when said safety device is in use, said flexible sheet member being adapted to contact the sole of a skier's boot at least when the skier's weight is largely on the ball of his foot, and being adapted to slide over said base plate on said lubricant to facilitate lateral movement of the skier's boot with respect to a ski on which the device is mounted.

3. A safety device for use in conjunction with an automatically releasable ski binding for releasably attaching a skier's boot to a ski which comprises, means for reducing friction between the sole of a skier's boot and a ski to which such a boot is attached, and means for mounting said friction-reducing means on the top of a ski in the area below the ball of the skier's foot when said ski is in use, said friction-reducing means comprising an upper flexible, resilient, sheet member having two opposite sides thereof folded under and creased along the folded edges, a base plate substantially coextensive with the width of a ski, and a lubricant disposed between the upper surface of said base plate and the lower surface of said flexible sheet member in the area between the creases in the folded edges thereof, said flexible sheet member having the folded under portions thereof disposed under said base plate extending inwardly from the opposite edges of the top of a ski on which said safety device is mounted with the creased folded edges thereof projecting outwardly from the adjacent edges of said base plate, whereby the area of said flexible sheet member between the creases in the folded edges thereof is adapted to contact the sole of a skier's boot at least when the skier's weight is largely on the ball of his foot and to slide over said base plate on said lubricant to facilitate lateral movement of the skier's boot with respect to said ski, said creased folded edges portions of said flexible sheet member, due to the resiliency of said member, acting to restore the area of the flexible sheet between said creases in the folded edge portions to its normal central position above said base plate when no forces are acting to distort said member.

4. A safety device according to claim 3, wherein the means for mounting said device on the top of a ski in the area under the ball of a skier's foot when the ski is in use comprises, a plurality of holes in said base plate and an equivalent number of screws adapted to extend through said holes in the base plate and into said ski.

5. A safety device according to claim 3, wherein the means for mounting said device on the top of a ski in the area under the ball of a skier's foot when the ski is in use comprises, adhesive means for bonding said base plate to the top of said ski.

6. A safety device according to claim 5, wherein the adhesive is a coating of pressure-sensitive adhesive adhered to the bottom of said base plate.

7. A safety device according to claim 3 wherein said base plate is composed of porous bronze and the lubricant is oil.

8. A safety device for use in conjunction with an automatically releasable ski binding for releasably attaching a skier's boot to a ski which comprises, means for reducing friction between the sole of a skier's boot and a ski to which such a boot is attached, and means for mounting said friction-reducing means on the top of a ski in the area below the ball of the skier's foot when the ski is in use, means for reducing friction comprising a sealed envelope of flexible sheet material containing a lubricant, said envelope being generally flat and substantially coextensive with the width of a ski, and wherein said mounting means comprises an adhesive.

9. A safety device according to claim 8, wherein the walls of the front and back edges of the envelope, which are intended to be disposed laterally across the width of the ski, are more flexible than the material of the remainder of the envelope, thus facilitating lateral deformation of the envelope with respect to the longitudinal axis of the ski.

10. A safety device according to claim 8, wherein said envelope is adhesively mounted on a base plate substantially coextensive with the width of a ski, said envelope projecting outwardly from the edges of said base plate intended to be disposed parallel to the edges of the ski, and said base plate being adapted to be mounted on a ski by said adhesive.

11. A safety device according to claim 8, wherein said adhesive means is a coating of pressure sensitive adhesive on said friction reducing means.

References Cited

UNITED STATES PATENTS

2,350,130 5/1944 Runklen.
2,745,672 5/1956 Meyer.

LEO FRIAGLIA, Primary Examiner.
MILTON L. SMITH, Assistant Examiner.