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Post

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[54] **LEVER-TYPE SKI BOOTS**

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[21] Appl. No.: **284,481**

[52] **U.S. Cl.** .... **36/2.5 AL**
[51] **Int. Cl.** **A43b**
[58] **Field of Search** .... 36/2.5 R, 2.5 AL

[56] **References Cited**

UNITED STATES PATENTS

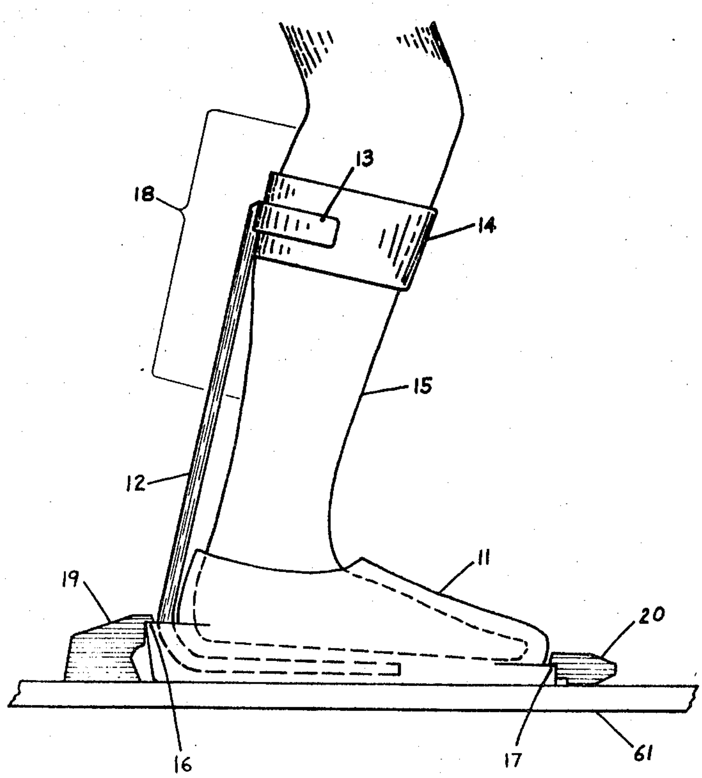
3,665,619	5/1972	Gray	36/2.5 AL
3,678,603	7/1972	Kaufman et al.	36/2.5 AL

Primary Examiner—Patrick D. Lawson
Attorney—Karl W. Flocks

[57] **ABSTRACT**

A ski boot for association with a ski, providing enhanced ski control, safety and comfort, comprising a lever element extending upwardly from a foot holder to the upper portion of the skier's lower leg and operatively associated with said leg to restrict both lateral and longitudinal motion of said lever with respect to said lower leg, whereby motion of said lower leg during skiing is virtually completely transferred to the ski without immobilizing the ankle joint.

21 Claims, 17 Drawing Figures



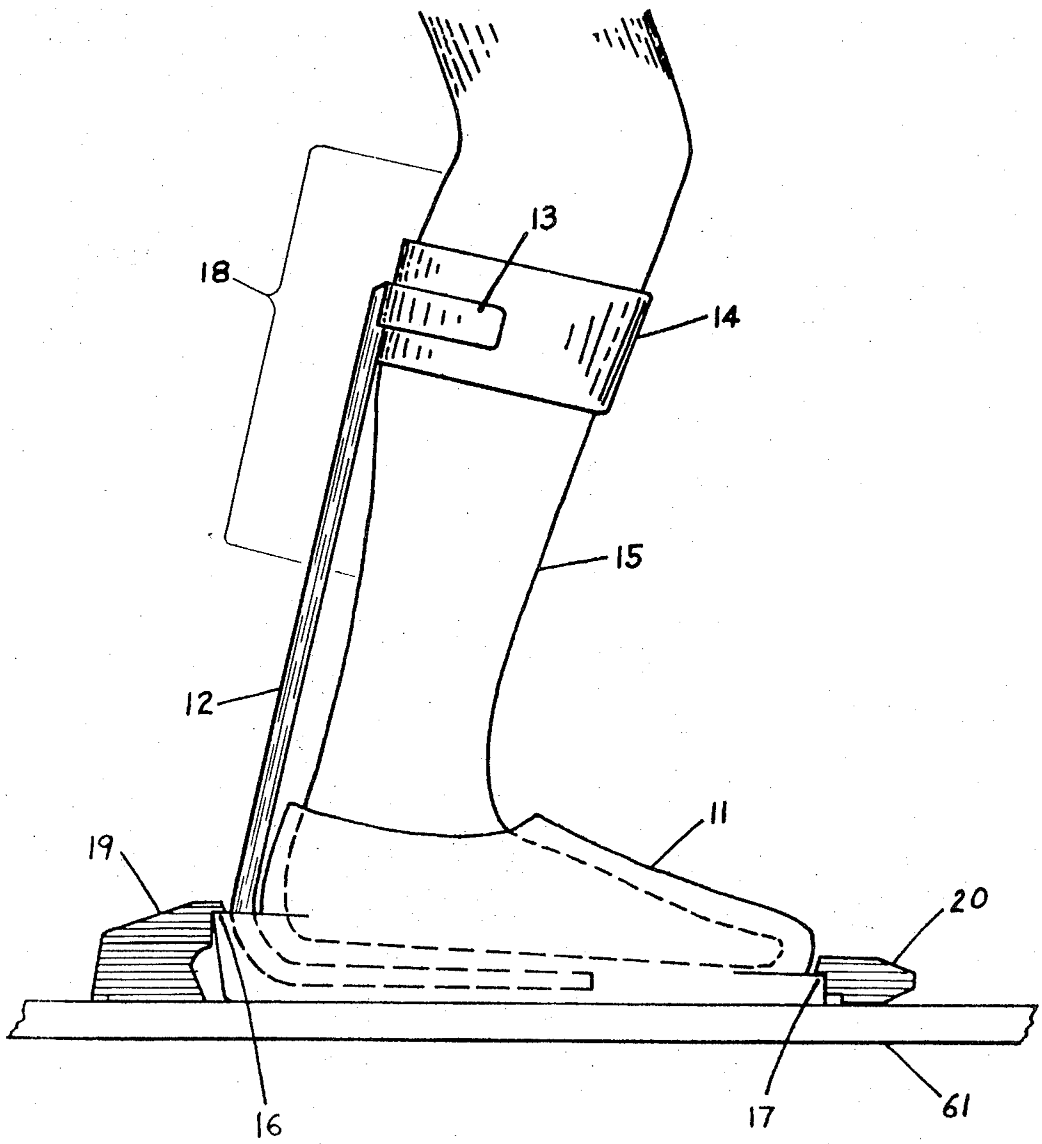


Fig. 1

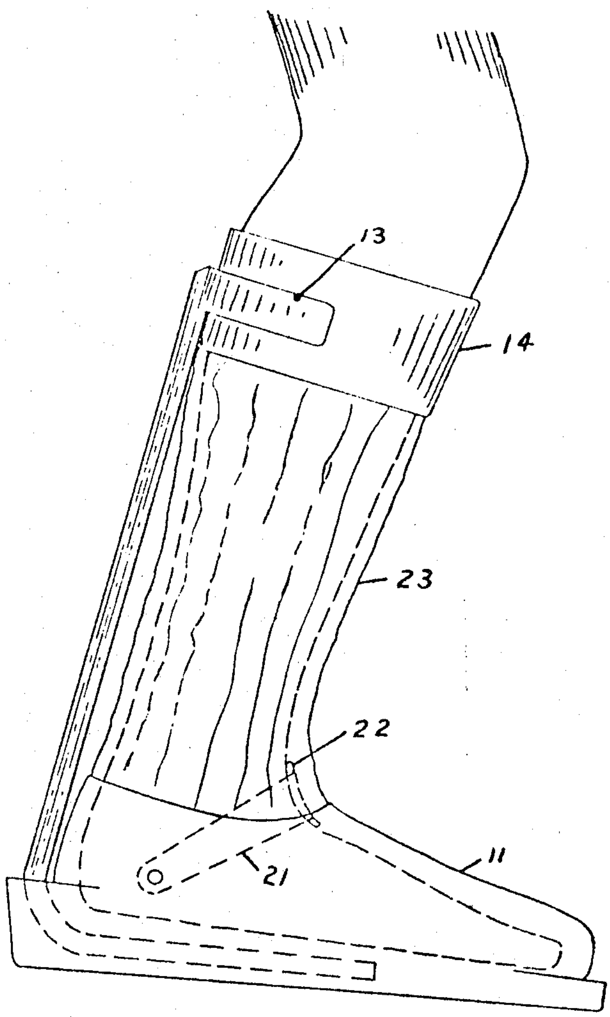


Fig. 2

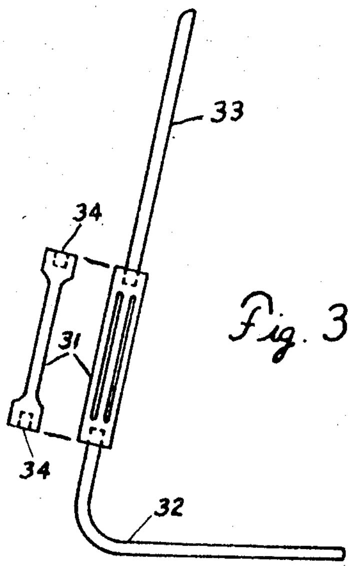


Fig. 3

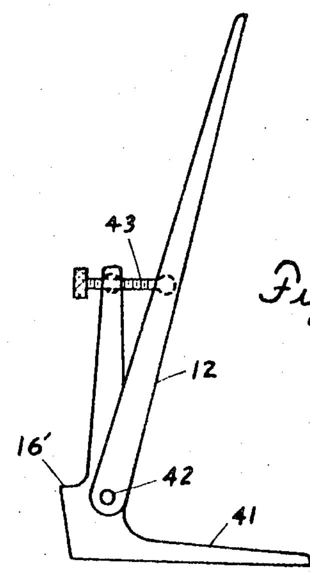


Fig. 4

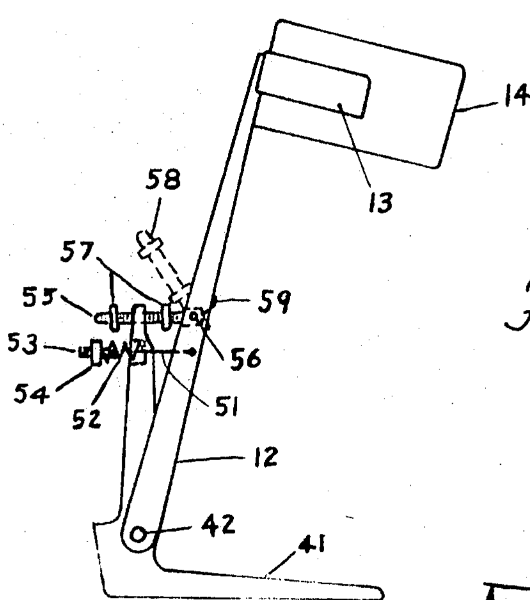


Fig. 5

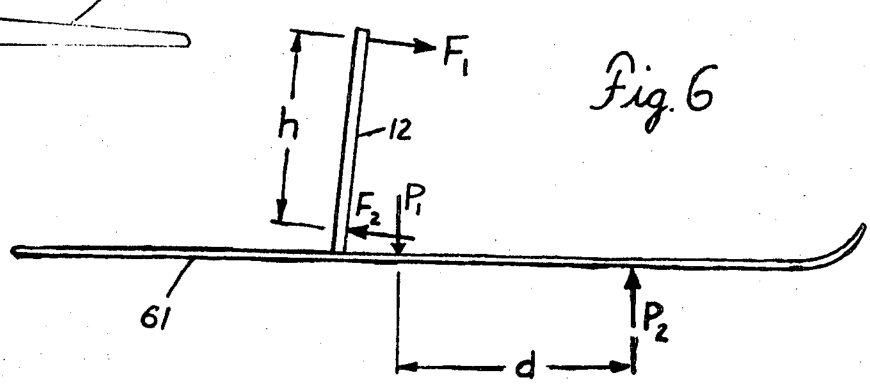


Fig. 6

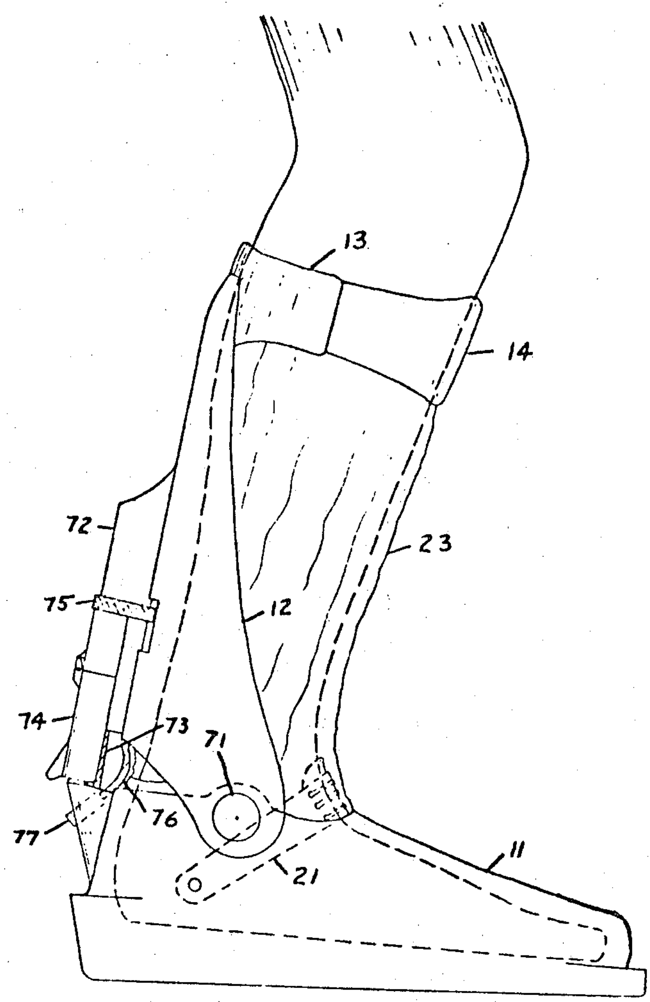


Fig. 7

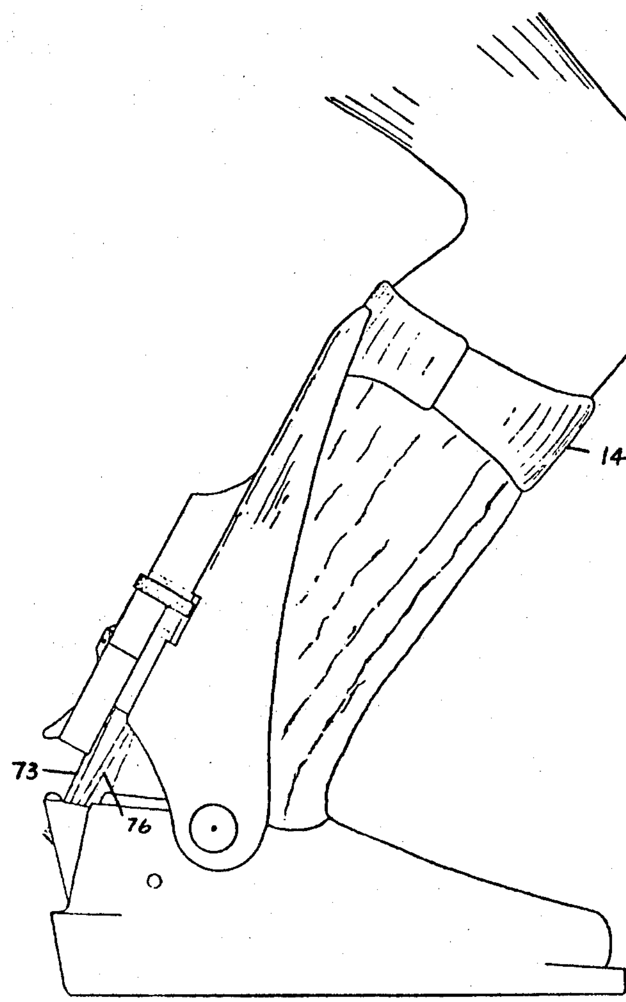


Fig. 8

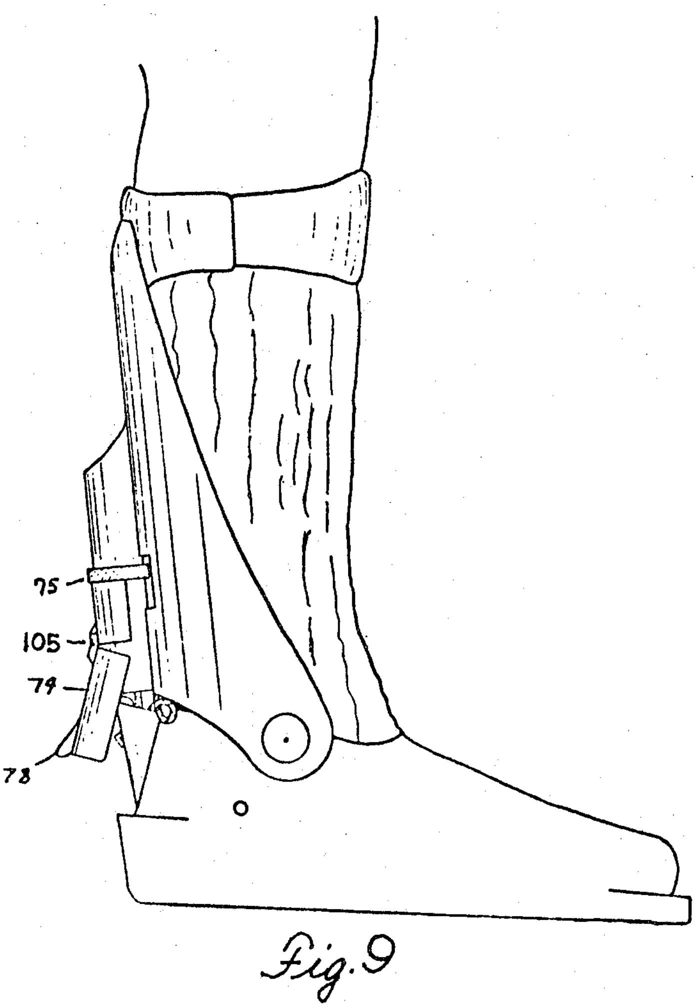


Fig. 9

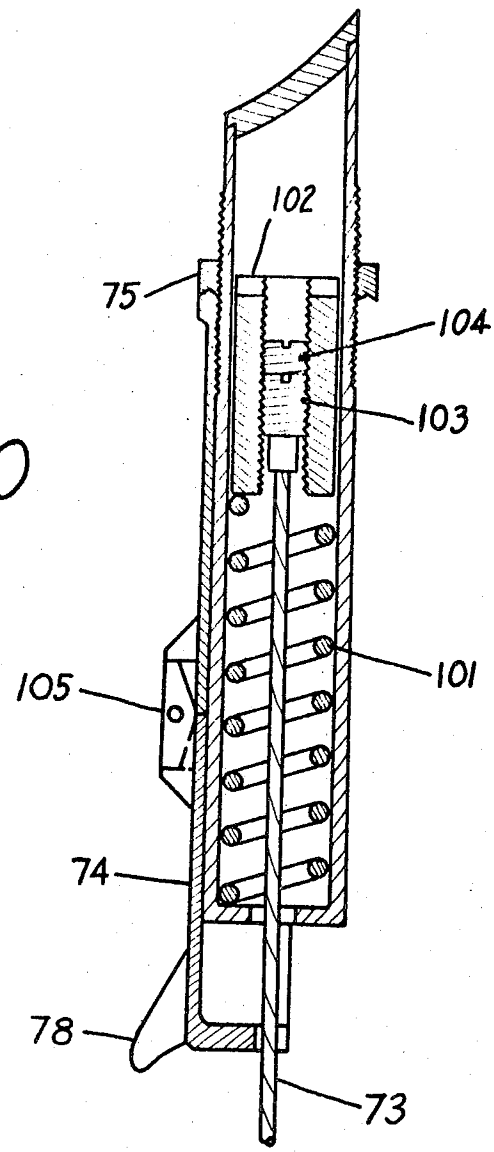


Fig. 10

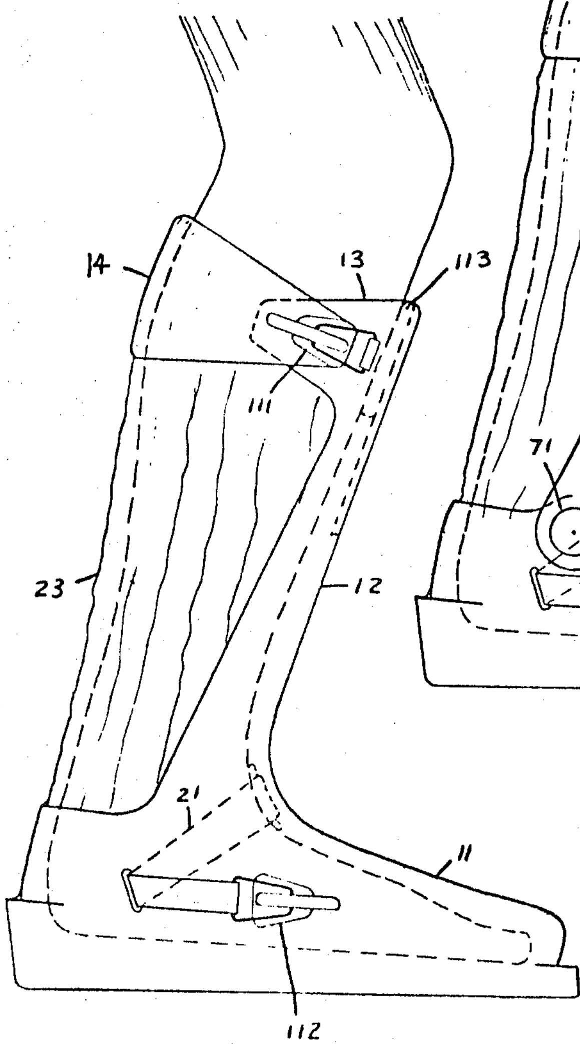


Fig. 11

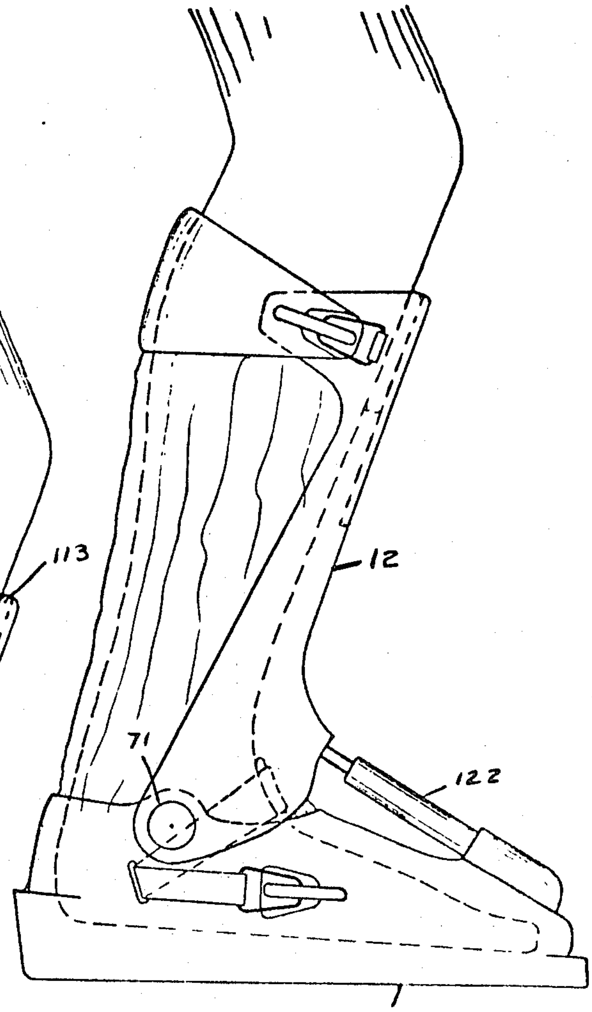


Fig. 12.

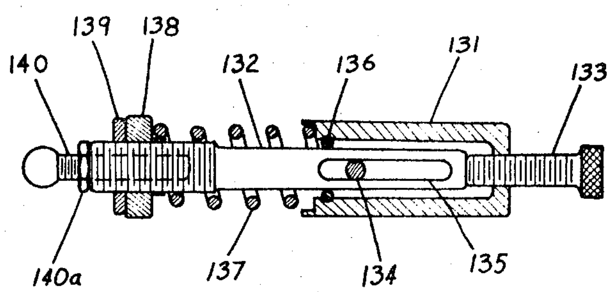
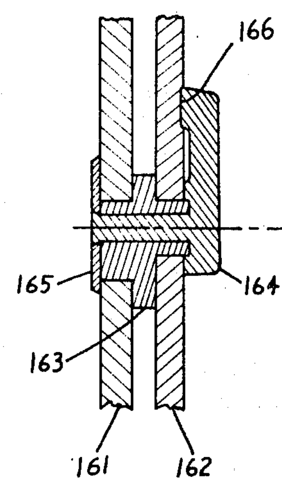


Fig. 13



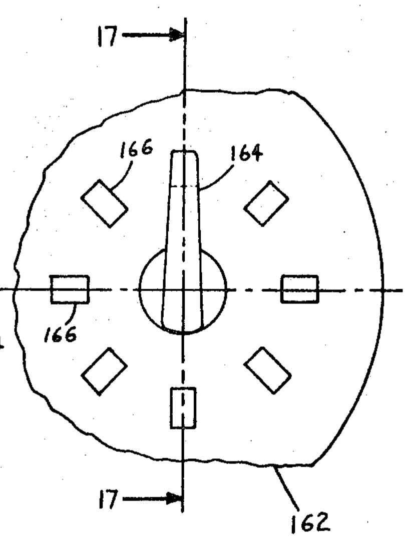


Fig. 17

Fig. 16

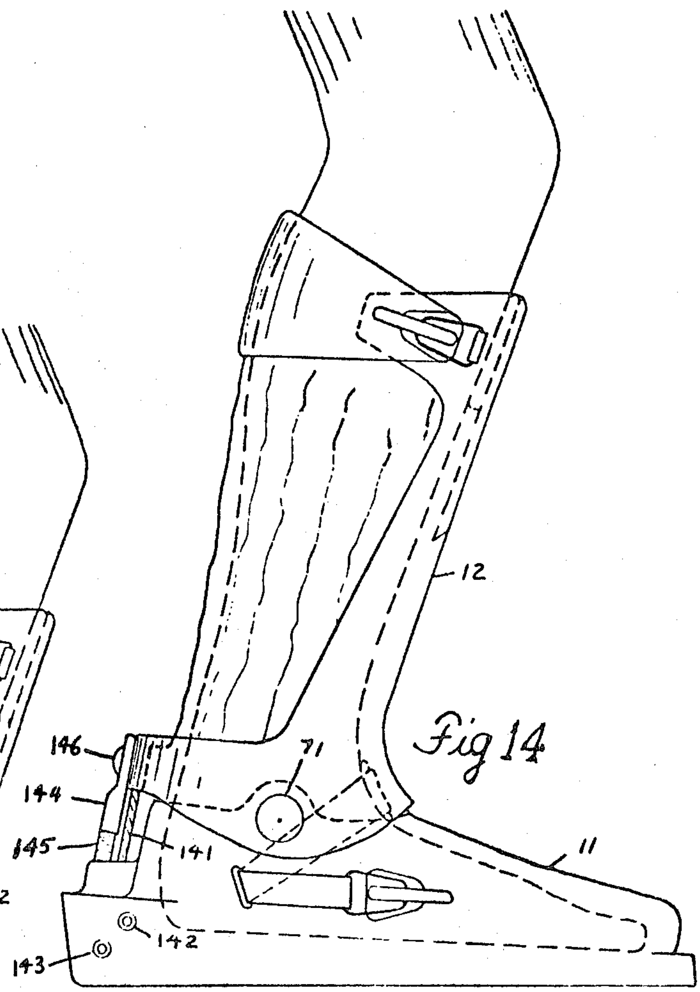


Fig 14

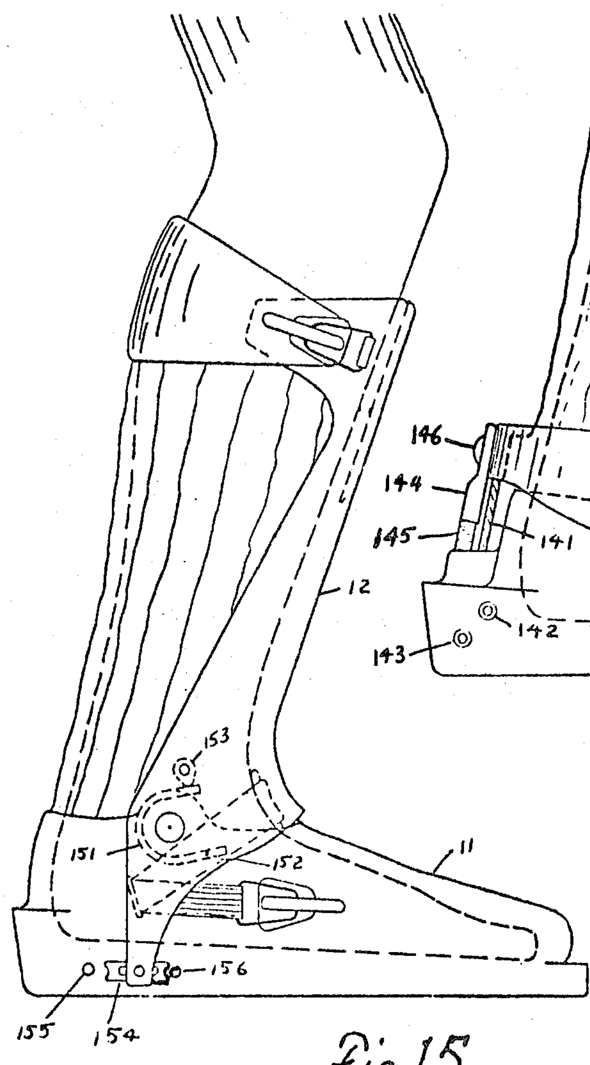


Fig 15

LEVER-TYPE SKI BOOTS

BACKGROUND OF THE INVENTION

This invention teaches concepts for the design of ski boots of unprecedented performance, safety and comfort. In contrast to the history of the prior art, in which presentday boot designs for alpine skiing evolved from a succession of modest changes grandually generated over a period of years, this invention introduces a radical departure from current ski boot technology.

Two distinct classes of boots may be recognized in the evolution of the prior art. The first is boots of early design which were comparatively low and flexible. These could be made to offer relatively good comfort and they allowed substantial mobility of the ankle joint — a condition that is highly desirable for leg safety. Their flexibility, however, was a disadvantage from the standpoint of ski control.

The second class includes most of the ski boots currently available. They are very stiff and are often called "rigid." They employ stiff ankle cuffs that are relatively high, sometimes extending nearly half way up the lower leg. These boots virtually immobilize the twisting motion and the lateral flexure normally available in the ankle joint. Most boots in this class severely limit forward and rearward flexure of the ankle joint, too, while some utilize pivoted ankle cuffs that offer less restraint to forward flexure.

The primary benefit of the rigid boot is improved skiing performance. Since lateral flexure of the boot is minimized, the lateral angle of the ski follows the angulation of the lower leg with good fidelity. This leads to controlled "edging" of the skis, which is vitally important for skier control. In addition, the boot's resistance to forward and rearward flexure helps the skier transfer weight to the front or rear of his skis to perform maneuvers that would be much more difficult with flexible ski boots.

While the rigid boots grossly improve skiing performance, they sacrifice skier comfort. Sore shins, resulting from pressure against the front of the ankle cuff, is a common complaint. Advanced skiers often buckle their boots as tightly as possible in order to minimize movement of the ankle with respect to the boot, and while this enchances transfer of lower leg motions to the skis, the tight boots are usually uncomfortable. Tight boots also restrict blood circulation, causing cold feet. Expensive techniques to spread the pressure and thus minimize discomfort, including boot linings individually molded to the contours of the skier's feet, have been partially successful. Another very significant discomfort is felt when walking in these rigid ski boots, since the ankle is virtually immobilized, and furthermore, it is fixed in a particularly unnatural position for walking.

The rigid boot design has also sacrificed skier safety for skiing performance. Statistics show that serious leg injuries have been gradually replacing the less serious ankle injuries since the advent of rigid ski boots.

The now common boot-top fractures are spiral or flexural fractions of the tibia and fibula, the main bones of the lower leg. They are usually multiple fractures, involving both bones, with one or more breaks in each, and located in the general vicinity of the top of the ankle cuff. Treatment usually requires immobilization for three months by a heavy plaster cast extending from the foot to the thigh, followed by a long period of restricted use and muscle regeneration. The common type of injuries previously encountered with flexible ski boots were ankle sprains and simple fractures. The latter usually involved a four to six week recovery period, with much less patient discomfort and much more patient mobility.

SUMMARY OF THE INVENTION

The present invention provides virtually complete transfer of motion of the lower leg to the ski, without immobilizing the ankle joint. The result is unprecedented ski control with greatly enhanced skier comfort and safety. This may be accomplished by using a low shoe in conjunction with a lever, yoke and strap, that connects the shoe to the upper portion of the leg. The ankle cuff of prior art ski boots is eliminated, and with it immobilization of the ankle joint is eliminated.

While the combination of shoe, lever, yoke and strap provides the basic configuration for enhanced control, comfort and safety, several refinements are introduced for additional improvements. Such refinements include:

1. means for articulation of the lever.
2. means for adjustable forward lean.
3. means for adjustable longitudinal stiffness or resilience of the lever.
4. means for adjustable lateral stiffness of the lever.
5. means for a free-hinged or floating mode of the lever for comfortable walking.
6. means to minimize lift and forward motion of the heel relative to the shoe.
7. means to adjust lateral cant of the foot.
8. thermal insulation, waterproofing and decorative means.
9. means for safety release.

BRIEF DESCRIPTION OF THE DRAWINGS

The figures, which illustrate a basic configuration and configurations incorporating certain refinements, are described briefly below.

FIG. 1 illustrates a ski boot configuration incorporating the basic elements of shoe, lever, yoke and strap;

FIG. 2 illustrates the same configuration with the added refinements of an insulating and waterproofing jacket and a heel retention strap;

FIG. 3 illustrates a lever configuration with an exchangeable leaf-spring insert enabling changes of longitudinal and lateral flexibility;

FIG. 4 illustrates a lever configuration with adjustable forward lean angle;

FIG. 5 illustrates a lever configuration with adjustable longitudinal resilience, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 6 illustrates forces acting on the combination of a ski and a lever affixed to the ski;

FIG. 7 illustrates a ski boot configuration with adjustable longitudinal resilience of the lever, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 8 illustrates the boot of FIG. 7 in its maximum forward lean position;

FIG. 9 illustrates the boot of FIG. 7 in its free-hinged mode for comfortable walking;

FIG. 10 illustrates one configuration of a mechanism that can be used in conjunction with the boot of FIG. 7 to provide the means for adjustable longitudinal resilience of the lever, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 11 illustrates another ski boot configuration incorporating the basic elements of shoe, lever, yoke and upper leg strap, and the refinements of a jacket and heel retention strap;

FIG. 12 illustrates another ski boot configuration with adjustable longitudinal resilience of the lever, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 13 illustrates one configuration of a mechanism that can be used in conjunction with the boot of FIG. 12 to provide the means for adjustable longitudinal resilience of the lever, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 14 illustrates still another ski boot configuration with adjustable longitudinal resilience of the lever, adjustable maximum and forward lean angles and free-hinging capability;

FIG. 15 illustrates yet another ski boot configuration with adjustable longitudinal resilience of the lever, adjustable maximum and minimum forward lean angles and free-hinging capability;

FIG. 16 illustrates a configuration of an eccentric pivot device that can be used in conjunction with pivoted levers to provide for adjustable lateral cant of the foot; and

FIG. 17 is a view taken along line **17—17** in FIG. **16.**

DETAILED DESCRIPTION OF THE DRAWINGS

Basic elements of the invention are illustrated in FIG. 1. They are a shoe **11** which encloses the foot, a lever **12** attached to the shoe and extending to the upper portion **18** of lower leg **15**, a yoke **13** attached to the lever and designed to restrain lateral motion of the leg with respect to the lever, and a strap **14** that restrains longitudinal motion of the leg with respect to the lever. Projections **16** and **17**, or other means provided for firm attachment of the boot to the ski, may be integral parts of the shoe as illustrated. They may alternatively be integral parts of the lever, or both. Projections **16** and **17** are engaged by safety release binding elements **19** and **20**, respectively, the bindings being permanently afixed to ski **61**, front and rear ends of which are broken away. The lever is a stiff element and may be made from metal, fiberglass or other stiff material. The yoke, too, is relatively stiff, while the strap and upper portion of the shoe may be flexible, made for example from woven fabric or leather. The shoe may be of the low quarter type or extend above the ankle. The sole of the shoe may be either stiff or flexible, depending upon the type of bindings used to attach the boot to the ski.

Added refinements are shown in FIG. **2.** Part **21** is a strap designed to retain the heel of the foot firmly in the corresponding portion of the shoe; **22** is a pad designed to distribute the pressure of strap **21** over a sufficiently large area of the foot for comfort. Strap **21** may be located inside the shoe as shown, or it may be outside the shoe, or it may be partly inside and partly outside; it may tie or buckle or otherwise fasten either inside or outside the shoe. Jacket **23** is a waterproofing and insulating covering for the leg; it may be made of a highly flexible material and would usually be designed such that it is attached to shoe **11** at the bottom and to yoke **13** or strap **14** at the top. The jacket may be designed with a closure, such as a zipper or other means, or it may be sufficiently wide to allow direct entry of the foot. Similarly, strap **14** would usually be designed with an adjustable closure, such as a buckle.

The lever design shown in FIG. **3** consists of three parts, wherein **31** is an exchangeable leaf-spring member fitted firmly to parts **32** and **33** by means of sockets **34** at its ends. Spring **31** may be selected by the skier from several interchangeable springs of different longitudinal and lateral flexibilities.

The lever mechanism of FIG. **4** comprises part **41** firmly attached to the shoe and lever **12** connected thereto through hinge **42** and captive adjusting screw **43.** With this device the skier may adjust his forward lean position, that is, he may adjust the angular position of his leg with respect to the ski. Projection **16'** is shown here as an integral part of member **41** and provides means for engagement of a ski binding part to the ski boot.

Additional refinements are illustrated in FIG. **5,** wherein the mechanism comprising cable **51,** spring **52,** screw **53** and nut **54** provides adjustable resilience for lever **12.** In use, the skier increases his forward lean by pressing with his leg against strap **14** and simultaneously increases the load on the front of the ski. Increased resilience is achieved by tightening nut **54,** thus increasing the preload on the spring. Spring **52** may be a metal compression spring of conventional design, it may be an elastomeric block such as rubber, or it may be some other elastic member. A skier may also choose to adjust nut **54** such that there is no spring preload, or by backing off further to provide a zone of free-hinging action before the spring affects the lever. Another device, consisting of a screw **55** pivoted at **56** and two nuts **57,** acts as an adjustable forward and rearward stop. These control the maximum and minimum forward lean during skiing. For comfortable walking, the device may be disengaged by pivoting it to position **58,** where it is held in place by toggle spring **59.**

FIG. **6** illustrates schematically a ski **61** with a lever **12** firmly attached to it. When the skier presses his leg forward against strap **14** (see FIG. **1**), force F_1 is transmitted to the lever. An equal reactive force F_2 is applied by the foot to the back of the shoe and in turn the force is transferred to the lever. The weight of the skier and any other vertical force is exerted by the foot on the shoe and transmitted to the ski as P_1. P_2 is the resultant force (neglecting friction) of the pressure of the snow against the ski. The figure shows that the lever is aptly named, since the effect of the snow on the ski depends upon force F_1 times lever arm h. In comparison, the forces acting on a conventional ski boot under the same circumstances would extend continuously along the front of the ankle cuff and top of the shoe and could not be represented by a force times a well-defined lever arm.

FIG. **7** introduces designs in which the lever is hinged about an axis near the ankle joint. This hinge location minimizes vertical motion between strap **14** and the leg, increasing comfort. Again the basic elements of the invention are evident, namely shoe **11,** lever **12,** yoke **13** and strap **14.** Refinements include heel retention strap **21;** waterproofing and insulating jacket **23;** pivot **71** for articulation of the lever with respect to the shoe; mechanism **72** to provide for adjustable longitudinal resilience of the lever by the action of a spring connected to the shoe through cable **73;** adjustable angle of minimum forward lean by means of member **74,** the position of which is adjusted by nut 75; adjustable angle of maximum forward lean through the action of cable 76 and adjusting screw 77. In sit-back maneuvers, padded yoke 13 resists the rearwards force of the leg and distributes the pressure over a sufficiently large area for comfort; the lever itself does not engage the leg.

The boot design of FIG. 7 is shown in its maximum forward lean position in FIG. 8. Here, cable 76 is straightened and extended to its maximum length, so as to act as a stop on the pivoting of the lever with respect to the shoe. The forward lean force, applied by the leg to strap 14, increases with forward lean angle until the maximum lean is attained. Then, still larger forward lean forces may be applied to the strap, but without further increase of lean angle. The maximum forward lean angle may be adjusted to suit individual skiing styles. However, the lean angle cannot be made so large as to exceed the natural mobility of the ankle, thus protecting the ankle joint and Achilles' tendon from damage.

FIG. 9 shows the same boot in its free-hinged mode, achieved by moving stop 74 into its non-working position. Projection 78 is provided so that stop 74 may be lifted to this position with the ski pole. The comfort of walking is greatly enhanced in the free-hinged mode, since the angular motion of the lever relative to the shoe is unrestricted over the range of angles employed in most natural walking situations.

A cross-sectional view of one design for mechanism 72 and stop 74 is shown in FIG. 10. The force exerted by spring 101 is transmitted to cable 73 through slider 102. The effective length of the cable is adjusted by means of screw 103 and locked by 104, thereby providing means to adjust the preload on the spring. As preload is increased, the force necessary to displace the lever in forward lean is correspondingly increased. Hinge 105 provides means to disengage stop 74 into its non-working position.

FIG. 11 illustrates a ski boot of another physical configuration but it is equivalent to the configuration of FIG. 2. Here, the shoe 11, the lever 12 and the yoke 13 may be separate parts that are fastened together firmly, or they may be constructed as one continuous piece. In the latter case, a relatively stiff material such as a metal, a composite such as fiberglass, or a hard plastic would be suitable. Strap 14, which engages the upper part of the calf of the leg, can be designed with an adjustable buckle 111 or equivalent closure. The leg presses against the lever through pad 113, but does not engage the lever below the pad. Jacket 23 would again be made of waterproofing and insulating material, and it can have a closure at the rear, such as a slide fastener (zipper). Heel retention strap 21 would be most satisfactory when designed with an external adjustable lock, such as illustrated by 112.

Additional refinements are applied in FIG. 12. Lever 12 is connected to shoe 11 through pivot 71, which is located near the ankle joint of the foot. Mechanism 122 is firmly attached to the shoe at the front end and attached to the lever at the other end through a quick-release ball and socket device. This mechanism provides adjustable longitudinal resilience of the lever and adjustable stops for maximum and minimum forward lean angles; disengagement allows free-hinging action.

A design suitable for mechanism 122 is shown in FIG. 13. Cylinder 131 is attached firmly to the shoe. Connecting rod 132 travels freely within the cylinder, with longitudinal limits set by adjustable stop 133 for forward motion and fixed pin 134 engaging the right end of slot 135 for rearward motion. Elastomeric O-ring 136 functions as a guide for lateral position of the connecting rod. Spring 137 is compressed between cylinder 131 and adjusting nut 138 to provide adjustable resilience; tightening the nut increases the preload and resilience. Locknut 139 functions to maintain the adjustment. Extension 140 is threated into connecting rod 132 and is provided with a ball on the other end to engage the lever; 140*a* acts as a locknut. For use, the minimum forward lean angle is adjusted by screwing extension 140 in or out of the connecting rod; maximum forward lean angle is adjusted next by turning stop 133; and spring preload is adjusted by means of nut 139.

FIG. 14 illustrates another variation of the pivoted lever design. Again lever 12 is in front of the leg, and articulated with respect to shoe 11 at pivot 71. A mechanism is housed within the rear portion of the shoe, comprising a reel and torsional spring. Cable 141 is attached to the lever member as indicated and to the reel. The torsional spring engages the reel so as to apply torque to the reel and tension to the cable. Adjusting screw 142 engages the reel and acts as an adjustable stop to limit the maximum forward lean angle of the lever. Adjusting screw 143 engages the spring and varies the initial torque, which in turn varies the preload on cable 141. Bar 144 acts as a stop by engaging adjusting screw 145, so as to limit the minimum forward lean of the lever. In addition, bar 144 may pivot about fastener 146 into a non-working position to allow free-hinging of the lever for comfortable walking.

FIG. 15 illustrates yet another variation of the pivoted lever in front of the leg. Curved leaf-spring or torsion spring 151 is firmly fixed to shoe 11 at its lower end 152. Adjustable cam 153 is fastened to lever 12 and it abuts and presses against spring 151 to provide longitudinal resilience of the lever. Spring preload is adjusted by rotating and then locking cam 153. Adjustable stop 154 engages fixed pin 155 to limit the maximum forward lean and engages retractable pin 156 to limit minimum forward lean. Free-hinging action for comfortable walking is obtained by retracting pin 156 into shoe 11; retraction may be actuated automatically by removing the ski boot from the ski, or it may be actuated manually by moving a handle on the boot.

FIGS. 16 and 17 illustrate one type of device that can be used in conjunction with pivoted levers to provide an additional special feature, namely lateral cant of the foot. In this design, 161 represents the wall of the shoe and 162 the wall of the lever. The eccentric cam device is made in three parts, the eccentric cam 163, the handle 164 which engages the cam by a spline shaft or other non-rotating shaft, and washer 165. Whereas a pivot would normally be arranged to maintain the axis of the hinge parallel to the sole of the shoe, this device allows adjustable deviation from that parallelism to compensate for bow and other deformities of a skier's legs. In operation, handle 164 would be rotated until the correct lateral cant is achieved and then moved to the nearest detent groove 166 preformed in lever 162.

ADDITIONAL REFINEMENTS

In applications of the invention, numerous additional refinements and alternatives may be incorporated in specific designs. For example, pad 22, used in conjunction with heel retention strap 21, may be in the form of a flexible pneumatic bag; or it may be a liquid filled bag; or it may be filled with non-packing solid particles. Pad **22** may also be a semi-rigid material contoured to bear primarily on each side of the front of the ankle, thus avoiding a concentration of pressure on the tendon.

As an alternative to direct connection of the lever to the shoe, the lever may be connected to an auxiliary device which may be a frame, platform or other external structure into which a shoe may be inserted and clamped or otherwise fastened. Then the skier may wear comfortable shoes or flexible hiking boots, and still achieve excellent ski control from the action of the lever and attached parts. In addition, said auxiliary device may contain safety release mechanisms, called safety release bindings, for attachment to the ski. Said device that accepts the shoe may itself be enclosed with waterproofing and insulating material.

In designs utilizing a direct connection between lever and shoe, safety release bindings may also be incorporated as integral parts of the boot, for example in the sole of the shoe.

PERFORMANCE ENHANCEMENT

In modern skiing techniques, the vitally important aspects of ski control are edging, or the ability to control the lateral angle of the ski with respect to the snow surface; weighting of the ski tips, or the ability to control the location of the center of pressure between the front of the ski and the snow; and sit-back stability, or the ability to maintain a stable position of the lower leg relative to the ski while the center of gravity of body weight is behind the foot.

Most ski boots available today are designed to be very snug fitting and very stiff, so as to transfer motion of the lower leg to the ski with good fidelity. Ski boots made according to the present invention accomplish this transfer of motion still more effectively and efficiently.

The effectiveness is inherent in the lever-yoke-strap system. The lever, yoke and strap are indirectly — but firmly — attached to the ski. Since the lever and yoke are stiff members, lateral angular motion of the lower leg is completely transferred to the ski. The result is an unprecedented positive control of edging.

Forward lean against the strap (or against the yoke for some designs) results in an unprecedented positive and consistent transfer of force to the front of the skis. FIG. **6** illustrates the forces applied by the skier's body to the lever-ski system. As the skier causes F_1 (and therefore F_2) to increase by his forward lean, that is by pressing against strap **14**, the overturning moment increases proportionately. As a result P_2 moves forward, increasing distance d, and thus maintaining the moment of P_1 and P_2 equal to the moment of F_1 and F_2. Hence, a skier's adjustment of forward lean controls the location of the force of the snow against the front of the ski — or in popular skiers' language, it controls the load or weight on the front of the skis. This effect is uniquely consistent, since the distance between F_1 and F_2 does not vary.

The lever provides unprecedented support to the lower leg for sit-back maneuvers. The lever establishes and firmly holds the leg in the minimum lean position, without regard to the rearward displacement of center of gravity.

The ski boots of this invention achieve control objectives with much greater efficiency than conventional boots, inasmuch as the forces that must be applied near the top of the lever are much smaller. Indirect advantages for control are substantial. For example, with conventional boots forward lean is often limited by the pain of localized boot forces; the greater lean consistent with improved skiing — or with the demands of an instructor — is not attempted.

Similarly, pain of conventional boots often impedes control in another way, especially for beginners. To compensate for localized pressures, a skier will often loosen his boots, permitting large relative motion between foot and boot with resultant loss of control. This would not be encountered with ski boots of the present invention, since forces are minimized and painful pressure points are eliminated.

Another important performance attribute of hinged boots of this invention is a shock absorption feature. On deeply undulating terrain a skier should try to maintain his center of gravity in a smooth line of motion, while his skies and feet travel the undulating path. In those designs with a lever having longitudinal flexibility, the legs flex and accommodate the bumps. On the other hand, with boots that severely limit longitudinal flexure of the ankle, the upper leg is used alone to produce the desired up and down motion of the body; then, a subsidiary and undesirable backwards and forwards displacement of the center of gravity is produced.

Significantly, too, in designs having levers with longitudinal resilience, the energy stored in the springs on a downwards body motion is returned to the skier in the upwards motion. The downwards motion is assisted by gravity, but the upwards motion is resisted by gravity. The result of upwards assist by the boots is quicker reactions and reduced fatigue.

SAFETY ENHANCEMENT

The primary burden of skier safety rests on his safety release bindings. However, instances in which bindings do not perform their intended function do occur and then, safety aspects of ski boots becomes important. With popular boots of current design, nearly all twisting motion of the ankle joint is eliminated by the rigid, tight fitting boot. Nearly all the twisting motion available in the lower leg is restricted to the portion above the boot. Only a very small angle of twist can be sustained by this part of the leg before torsional (spiral) fracture of the bones occurs.

With boots of this invention, twisting of the foot at the ankle joint is very much less restricted than with conventional rigid boots. As a result, a large angle of twist of the ski relative to the body can be sustained without damage. Therefore, the impulse and energy that the leg can absorb before damage by twisting occurs is enormously increased. In addition, the time interval between the onset of the twisting force and the development of maximum resisting force in the leg is greatly increased, allowing attentuation of inertial forces. Under these circumstances, the leg has a very much greater tolerance to twisting encountered in both dynamic and quasi-static falls.

In a forward fall with conventional stiff boots, flexural fracture of the lower leg bones occurs near the boot-top. This is the zone of maximum bending moment applied to the bones. The maximum bending moment is the forward thrust at the top of the tibia times the distance to the reactive force near the boot-top. With the lever, the maximum bending moment is the same forward thrust times the much smaller distance to the strap. The result is several-fold increase of resistance to flexural failure of the leg.

In a backwards fall, there is no risk of leg failure since flexure is accommodated by the hinging action of the knee.

As an additional safety feature, the positive stop that limits forward lean prevents excessive longitudinal flexure of the ankle and eliminates the serious problem of damage to the Achilles' tendon.

COMFORT ENHANCEMENT

Currently, the design criteria for boots emphasizes those features that enhance ski control, with resultant compromise of boot comfort. By this invention, control is achieved through a means separate from the foot enclosure, and the design criteria can emphasize simplicity and comfort; warmth and comfort can be achieved without sacrificing control. Awkward boot entry, tight boots and shin pressure can be made a thing of the past!

The unnatural walking motion required by ordinary boots is very discomforting. In addition, it leads to increased accidents through falling on slippery pavements and on steps. With boots of this invention, however, with the lever in its free-hinged mode, walking is a relatively natural motion. Walking either on or off the skis becomes enormously more comfortable, and safer too.

VERSATILITY

The ski boot of this invention is effective for all ability levels. The beginner would especially profit from the easy edging control and the enforced lean. The object of the familiar plaintive cry of the ski instructor, "bend the knees" is automatically achieved! The advanced skier would take advantage of the ease and certainty in loading the ski tips and the great support for sit-back maneuvers. All skiers would gain from their relative safety and comfort.

The adjustable qualities of the ski boot allows for a broad range of skiing styles and conditions. For example, steep terrain would normally call for an increased minimum forward lean; heavily moguled terrain would call for increased spring preload for greater lever resilience. Certain racing techniques would call for a locked lever. These variations and many others can be accommodated.

PREFERRED IMPLEMENTATION

Preferred implementations are illustrated by FIGS. 14 and 15. They incorporate the basic components of shoe, lever, yoke and strap, together with numerous refinements described previously. In addition, they have the advantages of extremely easy foot entry, shin protection, effective snow shielding and attractive design. It is to be understood that while the above has been indicated as preferred implementations, numerous variations or modifications therein may occur to those having skill in this art and what is intended to be covered herein is not only the illustrated forms of the invention, but also any and all modified forms thereof as may come within the spirit of said invention.

What is claimed is:

1. A ski boot for association with a ski, providing enhanced ski control, safety and comfort, comprising
   - a lever extending to the upper portion of the lower leg of a skier,
   - a first means connected to the lower portion of said lever to hold the foot of said skier,
   - a second means connected to the upper portion of said lever to engage the upper portion of said leg to restrict lateral motion of said lever with respect to said leg,
   - a third means connected to the upper portion of said lever to engage the upper portion of said leg to restrict longitudinal motion of said lever with respect to said leg,
   - and a fourth means whereby a ski may be firmly secured to said boot,
   - characterized in that the portion of said leg between said first means and said second and third means is maintained substantially free of force-transmitting contact with structural elements.
2. The ski boot of claim 1 in which said second means is a yoke.
3. The ski boot of claim 1 in which said third means is a strap.
4. The ski boot of claim 1 in which said first means is a shoe.
5. The ski boot of claim 1 in which said first means is a structure with fastenings to hold the shoe of said skier.
6. The ski boot of claim 1 in which a heel retention strap is used in conjunction with said first means.
7. The ski boot of claim 1 in combination with a protective jacket fitted between said first means and said third means.
8. The ski boot of claim 1 in which said lever possesses longitudinal flexibility.
9. The ski boot of claim 1 in which said lever possesses lateral flexibility.
10. The ski boot of claim 1 in which said lever is connected to said first means by a hinge to provide variable angles of forward lean.
11. The ski boot of claim 10 in which adjustable locking means connects said lever and said first means to fix the forward lean at any desired angle.
12. The ski boot of claim 10 in which said lever is restrained by adjustable stops from assuming forward lean angles outside desired maximum and minimum forward lean angles.
13. The ski boot of claim 10 in which said lever is restrained by stops from assuming forward lean angles outside desired maximum and minimum forward lean angles.
14. The ski boot of claim 10 in which elastic means connects said lever and said first means to provide longitudinal resilience of the lever.
15. The ski boot of claim 10 in which adjustable elastic means connects said lever and said first means to provide adjustable longitudinal resilience of the lever.
16. The ski boot of claim 11 including switching means for changing said adjustable locking means to a non-working mode.
17. The ski boot of claim 12 including switching means for changing the adjustable stop controlling the minimum forward lean angle to a non-working mode.
18. The ski boot of claim 13 including switching means for changing the stop controlling the minimum forward lean angle to a non-working mode.

19. The ski boot of claim 1 in which said fourth means are projections and recesses to mate safety binding attached to the ski.

20. The ski boot of claim 1 in which said fourth means are safety bindings constructed as integral parts of said ski boot, and said safety bindings are provided with fittings to engage the ski.

21. The ski boot of claim 10 in which said hinge is provided with displacement means to cant said lever with respect to said first means.

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