United States Patent

Wilkes

[15] **3,687,470**

[45] **Aug. 29, 1972**

[54] **SKI BINDINGS**

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[73] Assignee: **Rolamite Incorporated**, San Francisco, Calif.

[22] Filed: **March 18, 1970**

[21] Appl. No.: **20,646**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 717,114, March 29, 1968, which is a continuation-in-part of Ser. No. 3,463, Jan. 16, 1970.

[52] **U.S. Cl.** ....**280/11.35 T**
[51] **Int. Cl.**..**A13c 9/00**
[58] **Field of Search** ....280/11.35 T

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Primary Examiner—Benjamin Hersh
Assistant Examiner—Robert R. Song
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[57] **ABSTRACT**

Ski binding units for fasting a ski boat at the toe and heel of the boat. The toe binding unit applies cantilever loading to the toe of the boot through an abutment which overlaps the toe of the boot. The abutment is hinged to the base which is secured on the ski. A shear wire temporarily prevents the abutment from swinging vertically relative to the base. The heel binding unit supports the heel on roller bearings and yieldably clamps the heel against the bearings by means of a snap action spring blade. The heel unit releases the heel of the boot laterally while the toe pivots about the toe unit, when a predetermined lateral force is applied. Both the toe unit and heel unit are capable of releasing vertically when predetermined forces are applied to the respective units.

16 Claims, 19 Drawing Figures

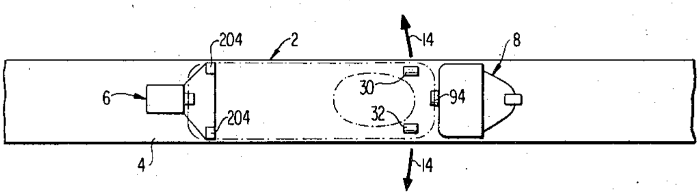
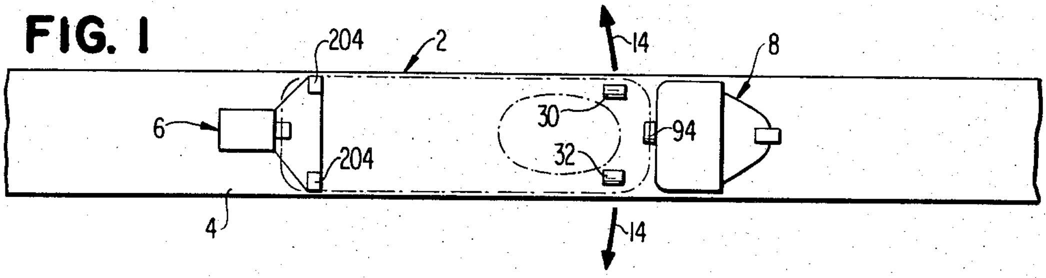


FIG. 1



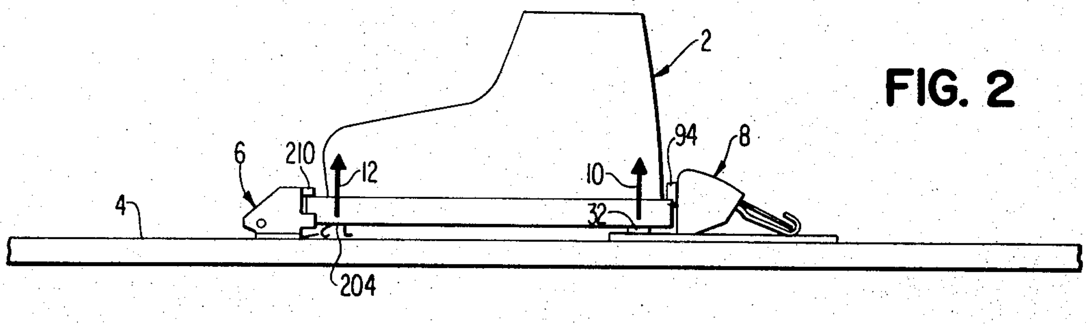


FIG. 2

FIG. 3

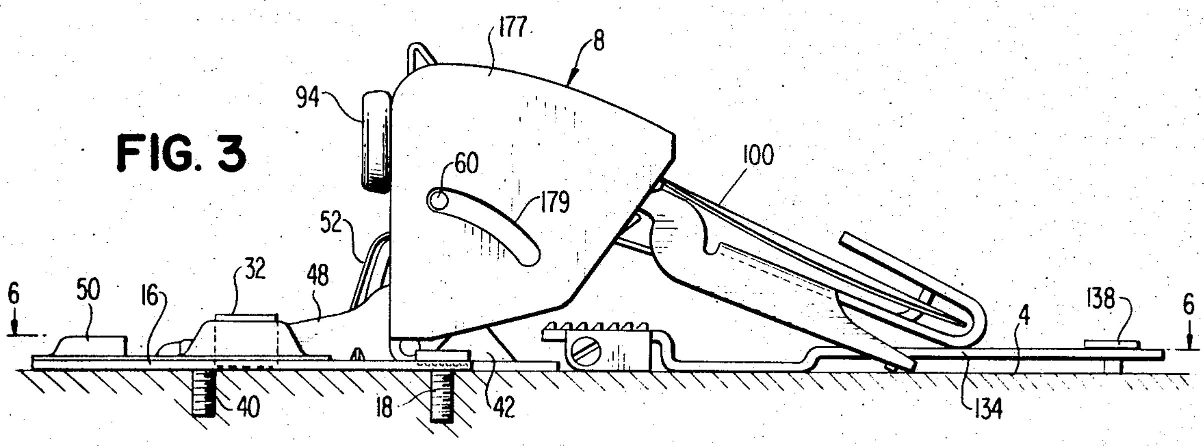
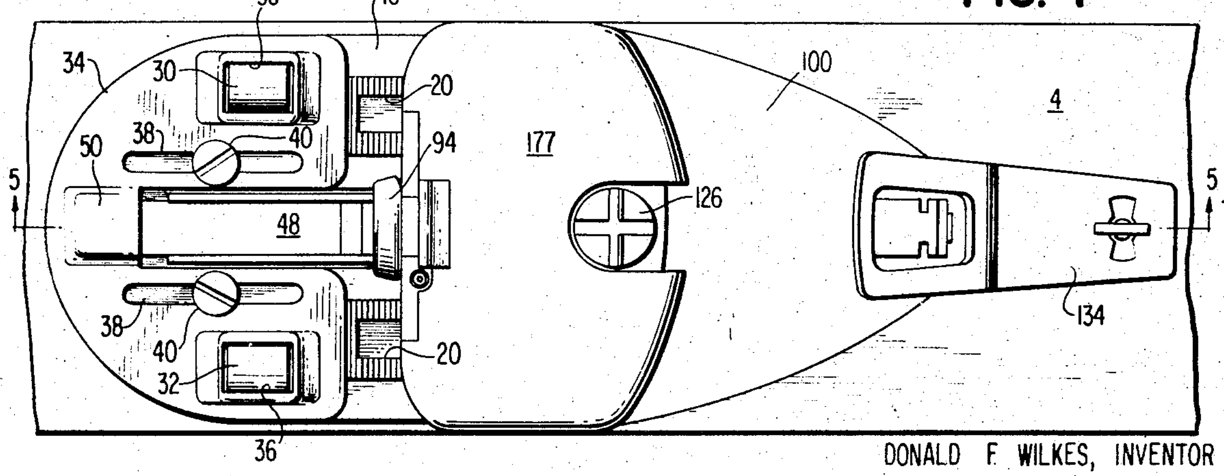


FIG. 4



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ATTORNEYS

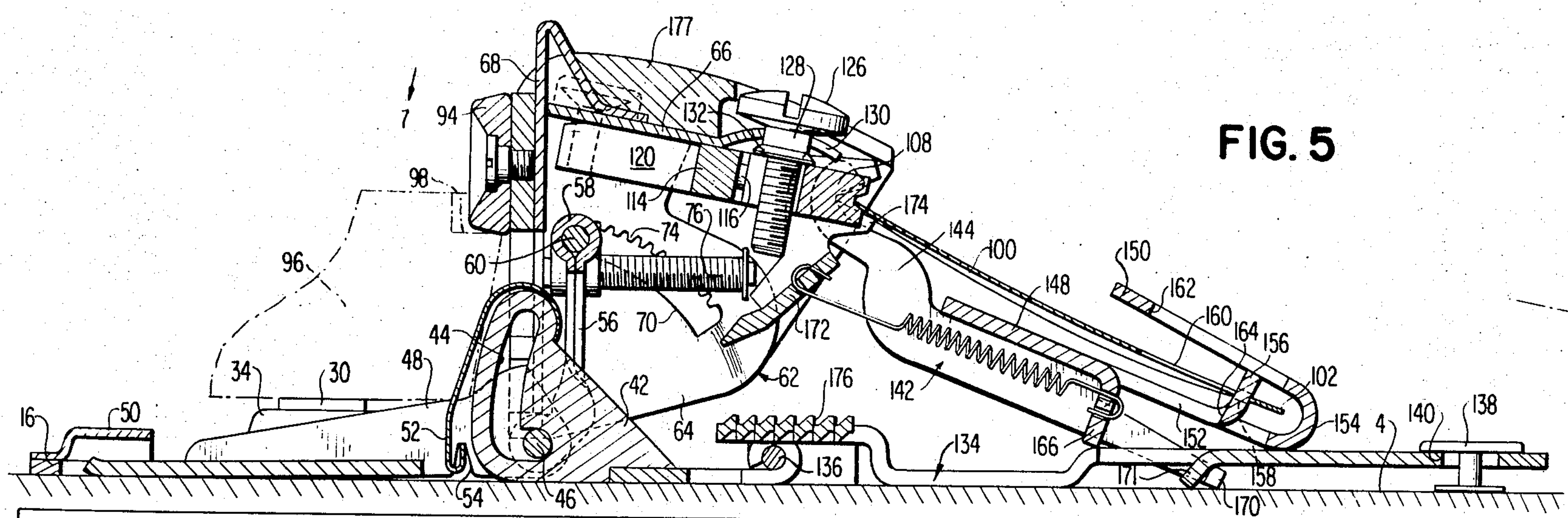
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FIG. 5

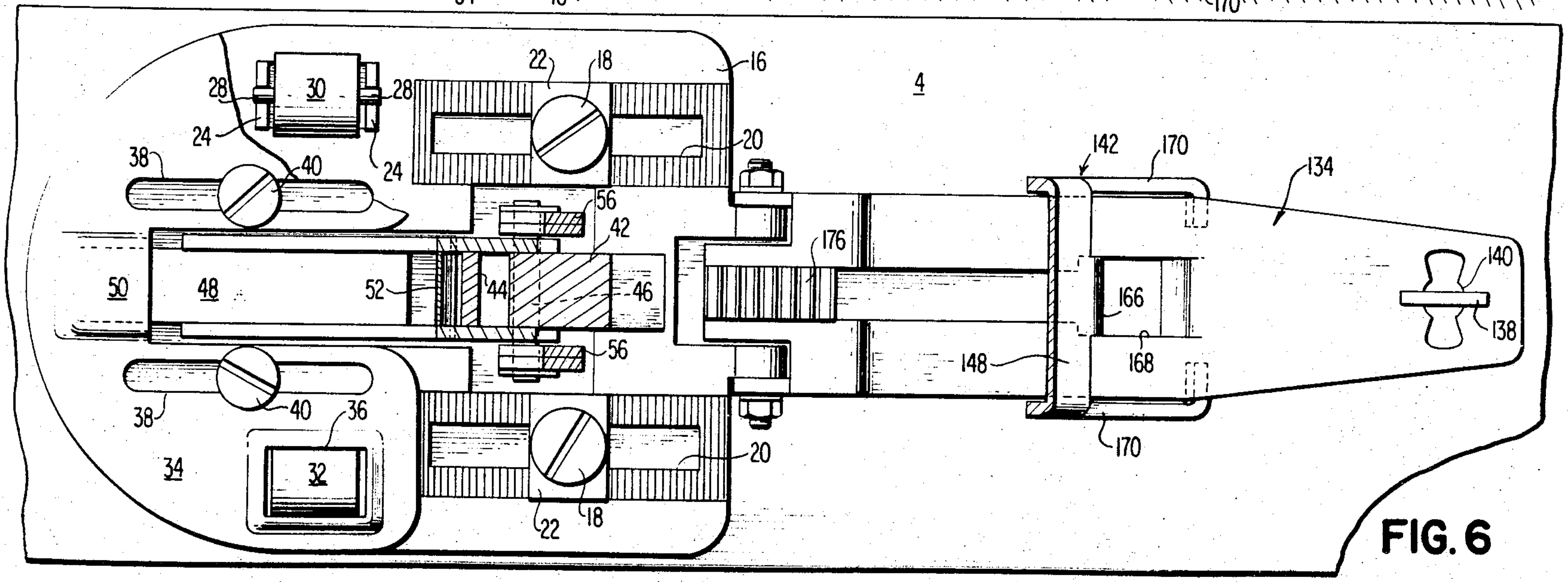
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FIG. 6

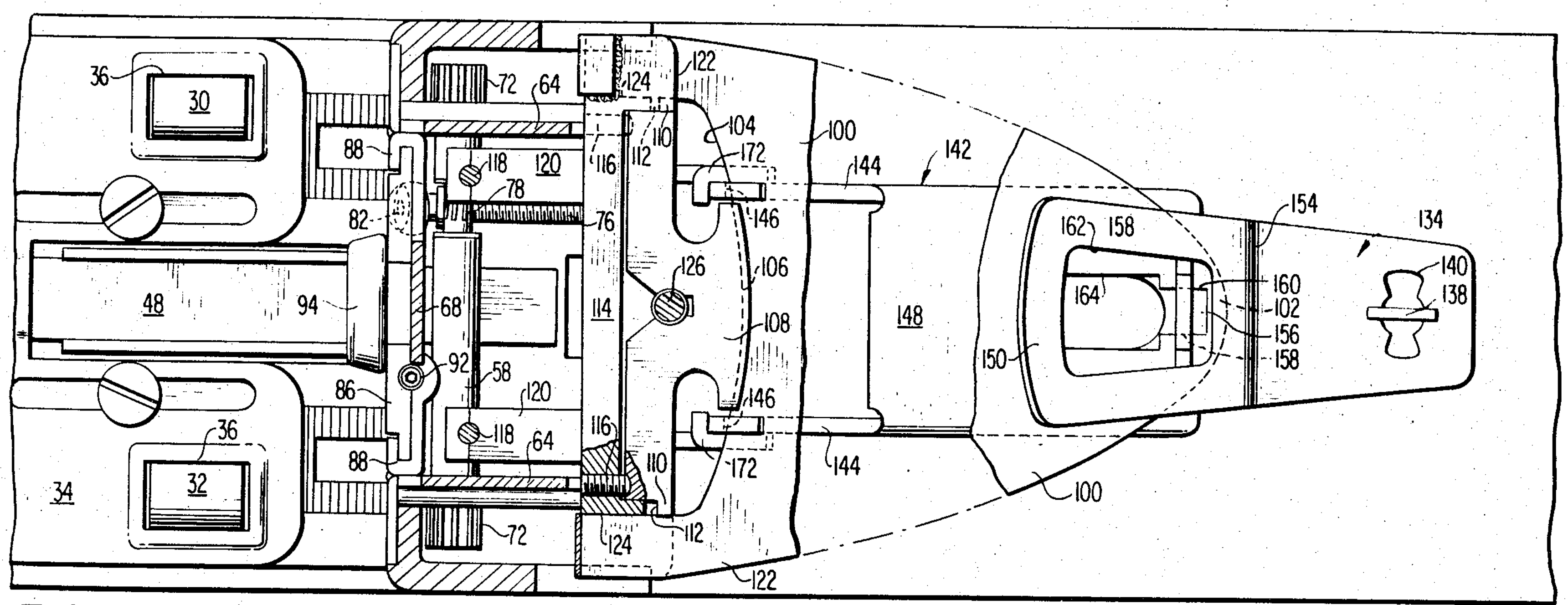

FIG. 7

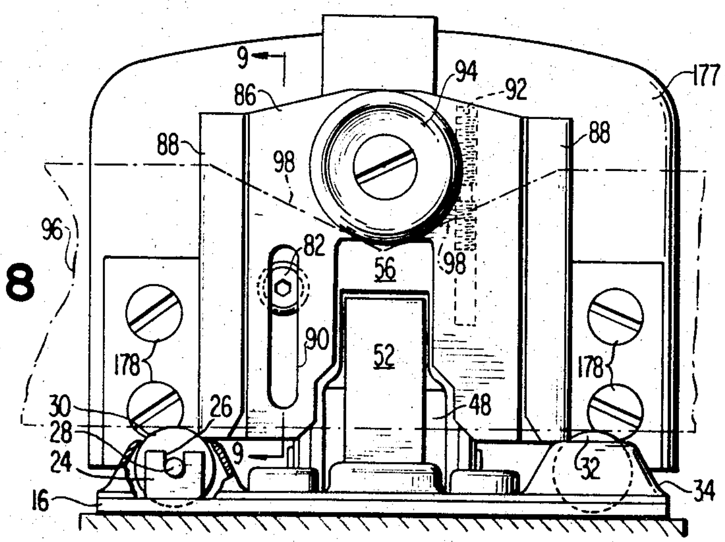

FIG. 8

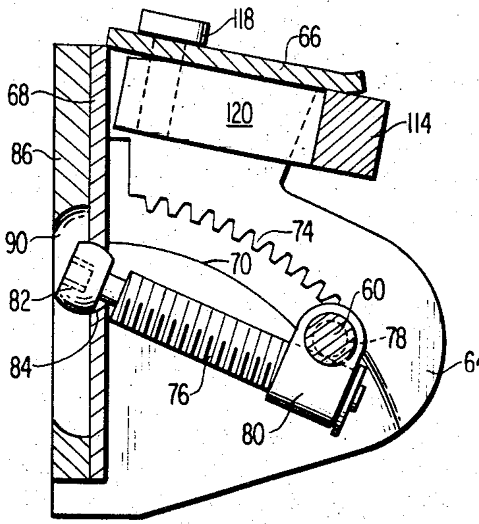

FIG. 9

FIG. 10

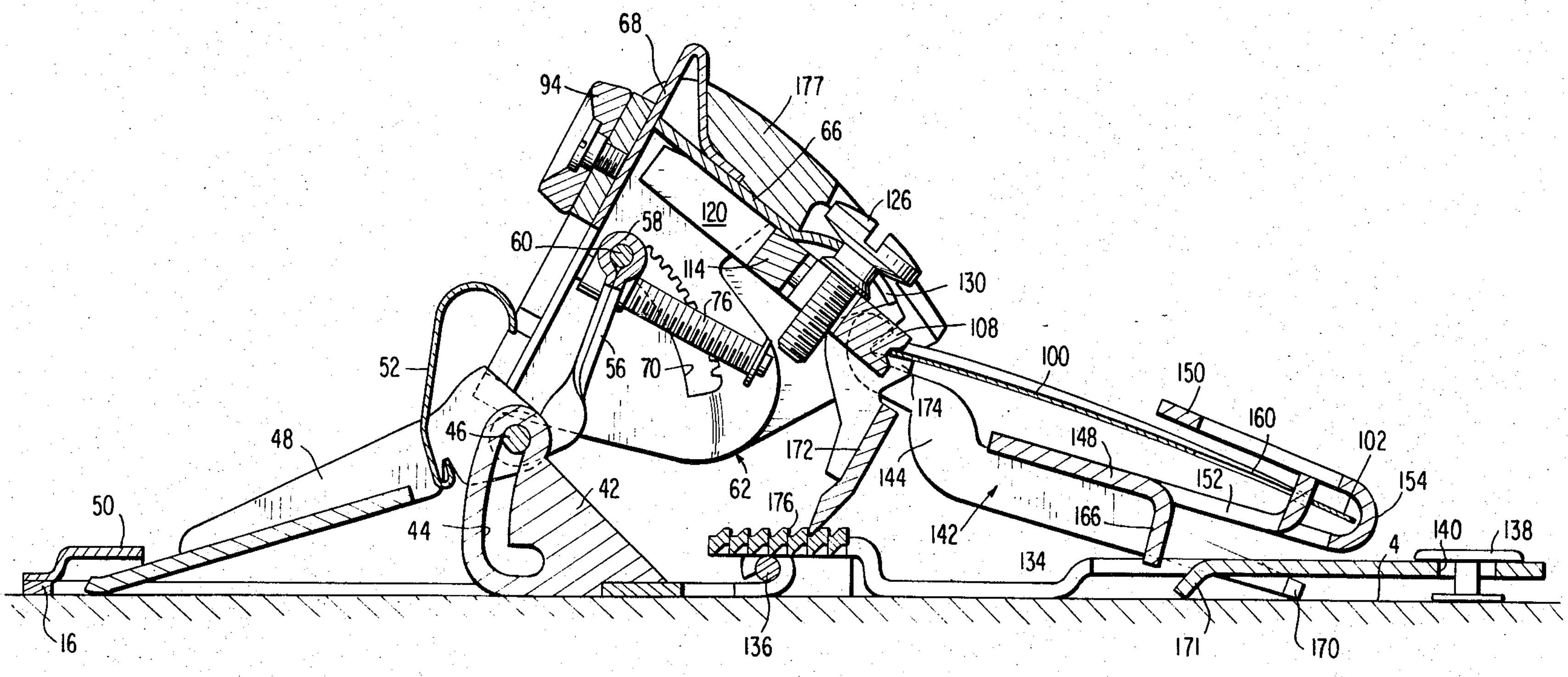
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FIG. 11

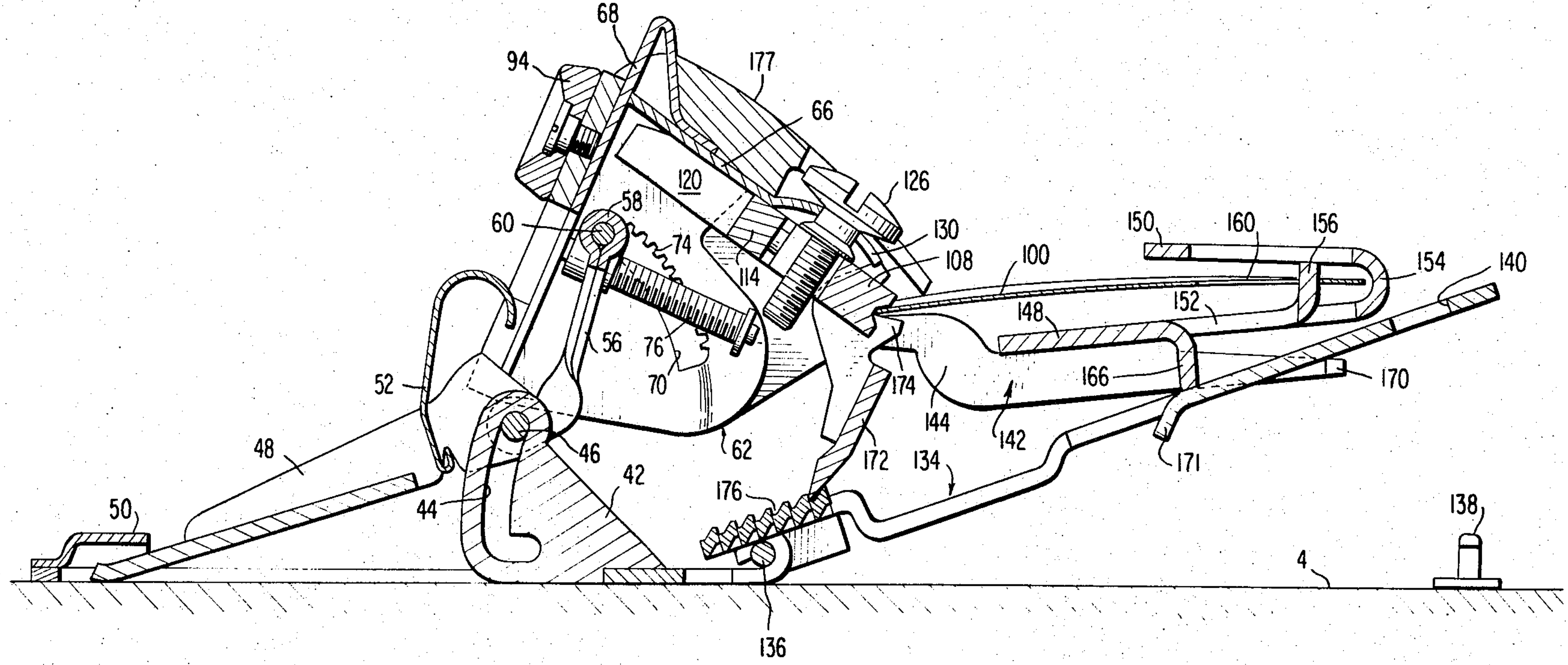
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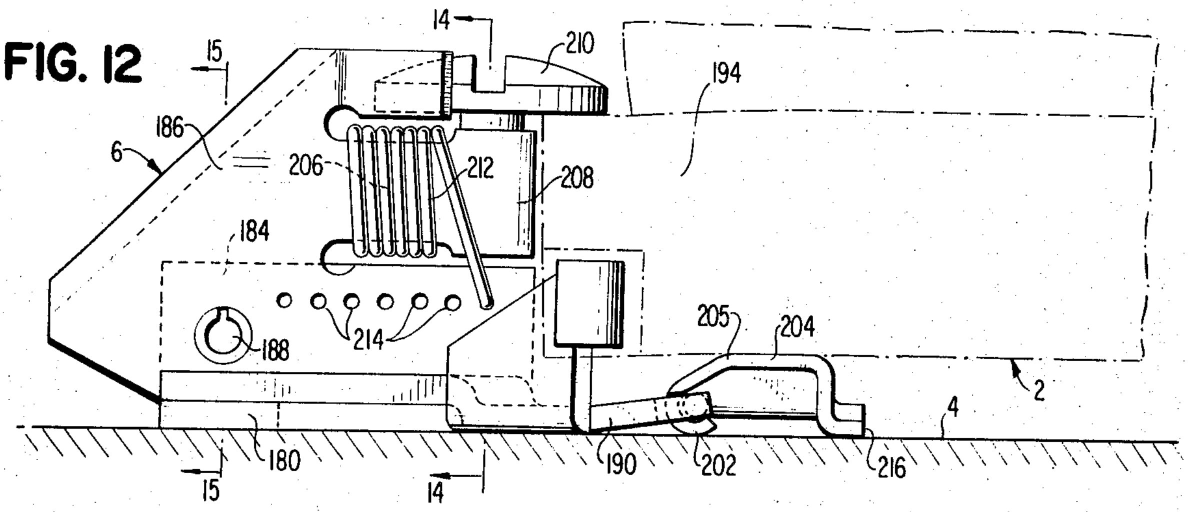
FIG. 12



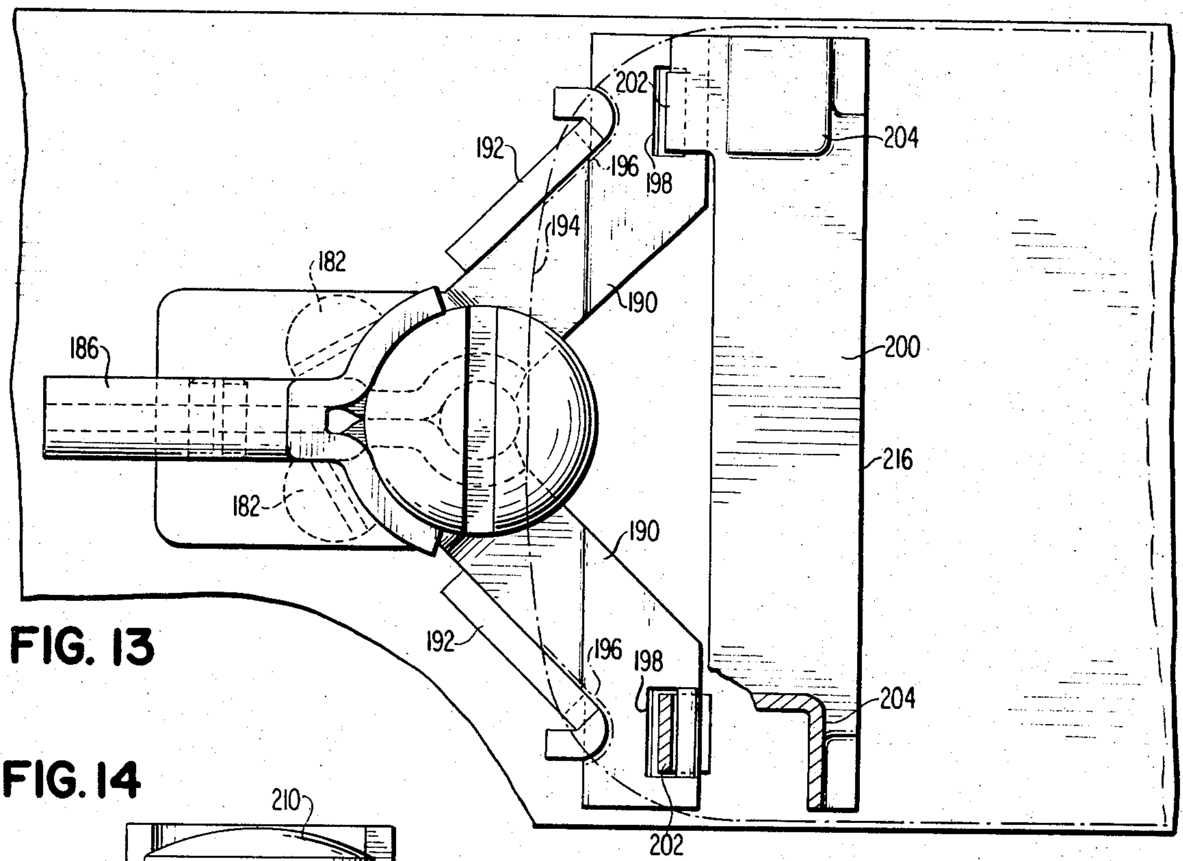


FIG. 13

FIG. 14

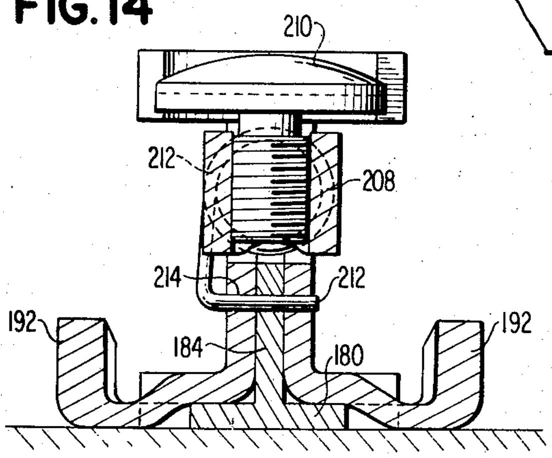


FIG. 15

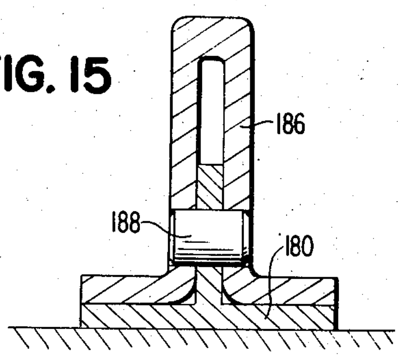


FIG. 16

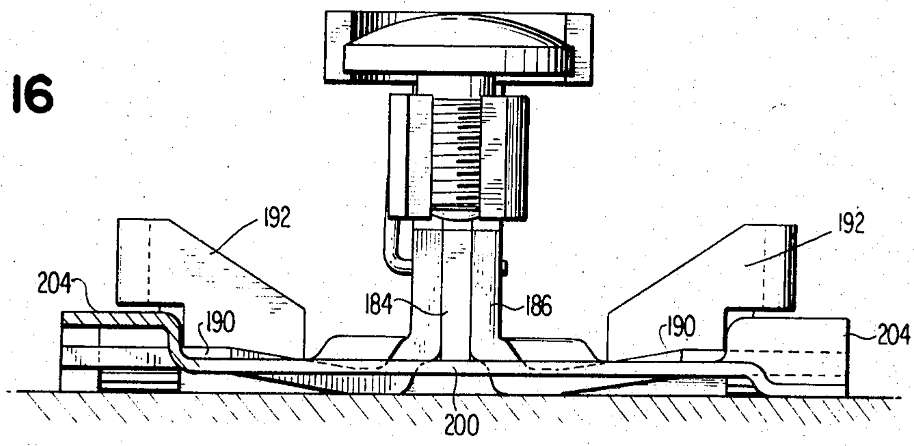


FIG. 17

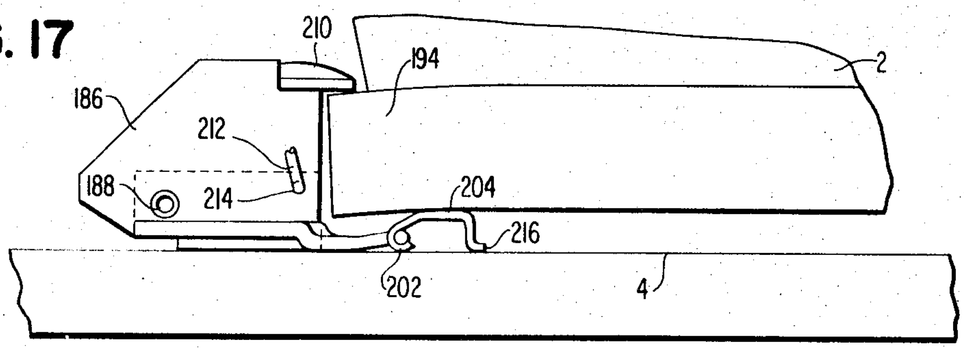


FIG. 18

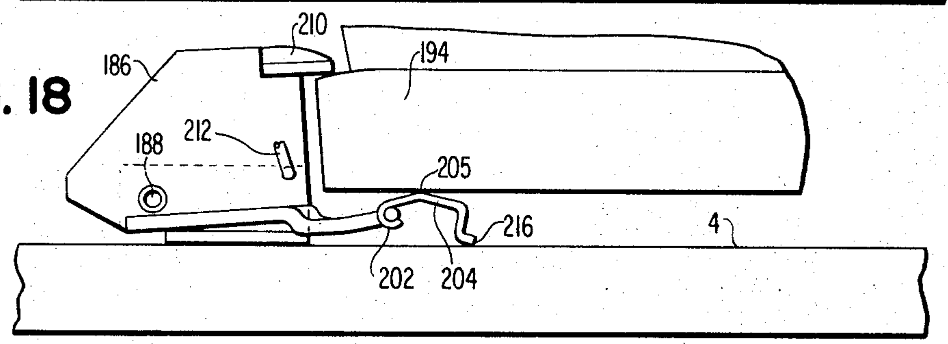
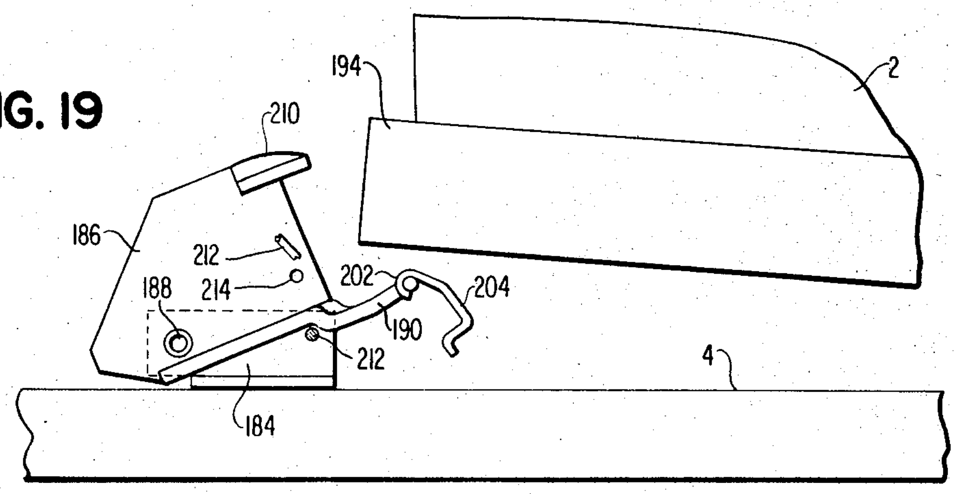


FIG. 19



SKI BINDINGS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Ser. No. 717,114, filed Mar. 29, 1968, entitled "Snap Action Apparatus"; and is a continuation-in-part of my copending application Ser. No. 3,463, filed Jan. 16, 1970, entitled "Ski Bindings."

BACKGROUND OF THE INVENTION

This invention relates to ski bindings, and more particularly to releasable bindings which allow the boot to separate from the ski when predetermined forces are applied to the skier's foot.

The principle purpose of a ski binding is to hold the boot firmly on the ski so that the movement of the skier's foot controls the position of the ski relative to the ground. If the skier encounters an obstacle, such as a slalom pole, or an exposed root, or if the skier experiences a severe fall, his foot may be twisted or flexed with such force that bones may be broken. Therefore, ski bindings are designed to release the boot at a force level that is less than that required for breaking any bones or injuring muscles or tissue.

The maximum forces that a skier's feet and legs can tolerate in the various directions are generally proportional to the weight of the skier. For example, large men skiers are capable of withstanding greater forces than are small women skiers. It is therefore necessary to provide adjustability of the force required for release. It is also necessary to allow limited vertical displacement of the heel relative to the ski. If the skier is a novice or engaged in cross-country racing, large vertical displacement is desirable, while an expert down-hill skier wants the boot closely coupled to the ski and very little vertical displacement is desirable. The bindings, therefore, must be adjustable for vertical displacement at the heel, but also for the maximum allowable force.

Toe bindings have been proposed previously which allow the toe to release laterally in response to a predetermined force to avoid torsional injuries. Typically, bindings of this type utilize a spring biased detent which releases the boot toe laterally when lateral force overcomes the spring force. Bindings of this type do not reliably release at a selected force level because typically the boot must slide relative to the binding, but the variation in the frictional resistance between the boot and the binding is so great that the force required for lateral displacement is unpredictable.

Similarly, at the heel, lateral release with conventional bindings is uncertain because it is necessary for the heel of the boot to slide across the platform on which it is supported and the frictional resistance to lateral sliding varies greatly. For example, when the full weight of the skier is applied to the platform the frictional resistance would be relatively large, but if the ski is hitting the ground laterally while the skier is falling, it is possible that none of his weight is applied to the platform and the frictional resistance is much less. Typically, heel bindings that provide for lateral release operate by means of springs and the spring force adjustment for release does not take into account the variations in weight or load of the skier on the ski at the time when release is required.

A skier should be able to adjust the force and displacement limits for release of the bindings according to the conditions that he expects to encounter. These adjustments preferably should be accomplished without the use of any special tools. Also, the bindings should allow the skier to readily fasten the boot into the bindings and the bindings should be capable of being released manually with very little effort.

SUMMARY OF THE INVENTION

It is an object of this invention to provide improved devices for binding boots to skis.

Another object of this invention is to provide ski bindings which effectively and reliably release the boot from the ski when a predetermined force is applied to the boot either laterally or perpendicularly with respect to the ski.

It is a further object of this invention to provide ski bindings which do not have irregular release characteristics caused by variations in frictional forces between the boot and the bindings.

A still further object of this invention is to provide bindings that can be readily fastened on the boot and manually released with a minimum of effort.

A further object of this invention is to provide ski bindings which can be adjusted without the use of special tools.

These objects are accomplished in accordance with preferred embodiments of the invention by a front binding unit and a rear binding unit which are secured on a ski. The front binding unit has a platform and an abutment which overlaps the top edge of a boot sole. The platform is spaced rearwardly toward the heel from the abutment, so that the sole is flexed in an cantilever arrangement when the heel is fastened in the heel binding unit.

The heel binding unit includes a resiliently flexible blade that is stressed to assume a transverse curvature which progressively increases toward one end of the blade. A clamping roller on the heel binding engages a V-shaped shoulder on the sole to urge the sole against a platform spaced above the surface of the ski. The sole at the heel is supported on rollers which allow lateral movement of the heel relative to the longitudinal axis of the ski. By a lever system, the spring blade acting through the clamping roller urges the boot heel against the platform rollers.

Release at the front binding unit in a direction perpendicular to the surface of the ski is accomplished by a system of levers which overcomes the clamping force and subsequently causes a shear wire to break releasing the toe of the boot. Release of the heel in a perpendicular direction is accomplished by progressively deflecting the outer end of the blade until the blade snaps over to its opposite position thereby releasing the heel, Lateral release at the heel is accomplished by progressively camming the clamping roller upwardly along the V-shaped shoulder on the heel until deflection of the outer end of the blade ultimately causes the blade to snapover and to release the heel. A shoulder on the front binding unit engages the front edge of the toe of the boot to cause the toe to slide from beneath the toe abutment as the heel rolls across the platform for lateral release, thus both the toe and the heel are released approximately simultaneously. The spring force of the blade and the allowable deflection of the blade in the heel binding are adjustable manually without the use of special tools. Also, after breakage the shear wire in the toe binding can be replaced and the binding can be adjusted for different release forces without the use of tools.

DETAILED DESCRIPTION OF THE DRAWINGS

This preferred embodiment is illustrated in the accompanying drawings in which:

FIG. 1 is a top plan view showing schematically a ski boot fastened on a ski by toe and heel binding units in accordance with this invention;

FIG. 2 is a side elevational view showing schematically a ski boot fastened on a ski as in FIG. 1;

FIG. 3 is a side elevational view of the heel binding unit of this invention;

FIG. 4 is a top plan view of the heel binding unit;

FIG. 5 is an enlarged cross sectional view of the heel binding unit along the line 5—5 in FIG. 4;

FIG. 6 is an enlarged cross sectional view of the heel binding unit along the line 6—6 in FIG. 3;

FIG. 7 is a cross sectional view of the heel binding unit along the line 7—7 in FIG. 5;

FIG. 8 is a front elevational view of the heel binding unit;

FIG. 9 is a cross sectional view of the heel binding unit along the line 9—9 in FIG. 8;

FIG. 10 is a longitudinal cross sectional view of the heel binding unit as in FIG. 5, but showing the unit adjusted for automatic cocking from the released position;

FIG. 11 is a longitudinal cross sectional view as in FIG. 5, but showing the heel unit adjusted for manual cocking from the released position;

FIG. 12 is a side elevational view of a toe binding unit in accordance with this invention;

FIG. 13 is a top plan view of the toe binding unit;

FIG. 14 is a cross sectional view of a toe binding unit along the line 14—14 in FIG. 12;

FIG. 15 is a cross sectional view of the toe binding unit along the line 15—15 in FIG. 12;

FIG. 16 is a rear elevational view of the toe binding unit;

FIG. 17 is a side elevational view, partially schematic of the toe binding unit showing a boot fastened to the ski by the toe unit;

FIG. 18 is a side elevational view as in FIG. 17, but showing the toe binding unit immediately prior to shearing of the shear wire; and

FIG. 19 is a side elevational view of the toe binding unit as in FIG. 17, but showing the unit immediately after release of the boot.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, a ski boot 2 is fastened to the upper surface of a ski 4 by a toe binding unit 6 and a heel binding unit 8, which are illustrated schematically. An important purpose of safety bindings is to maintain the boot closely coupled to the ski for maximum control of the ski, while allowing the boot to be released, if a force is applied by the ski to the boot in a direction and with sufficient magnitude to injure the skier. For example, if the body of the skier suddenly is thrown forward in a fall, the boot should release upwardly at the heel as indicated by the arrow 10 in FIG. 2. When the skier is riding on a chair lift, it is possible for the tip of the ski to be caught in the snow, so that the tail of the ski is thrown against the back of the chair. In this situation, the toe of the boot should release upwardly as shown by the arrow 12 in FIG. 2 to avoid injury. Also, the bindings should allow release of the boot laterally, as shown by the arrows 14 in FIG. 1 if the ski should be suddenly deflected, for example by an exposed root or tree limb.

The heel binding unit, as shown in FIGS. 3 to 11, includes a base plate 16 which is secured to the surface of the ski 4 by a pair of screws 18. The screws 18 extend through slots 20 in the base plate 16 and the surface of the plate surrounding the slots 20 has transverse serrations which cooperate with corresponding serrations on the bottom surface of a washer 22 to hold the base plate at a selected position longitudinally on the surface of the ski 4, as shown in FIGS. 5 and 6.

The base plate has a pair of upright brackets 24 struck from the plate 16, as shown in FIGS. 6 and 8. The brackets 24 have aligned slots 26 for receiving and journaling shafts 28 projecting outwardly from opposite ends of a roller 30. A second roller 32 is similarly supported on the base plate 16 at the opposite side, as shown in FIG. 6. The rollers 30 and 32 are retained in place by a cover plate 34 which is welded or otherwise secured to the base plate 16. The cover plate 34 includes rectangular openings 36 through which the upper portions of the respective rollers extend. As shown in FIG. 8, the edges of the opening 36 fit closely against the surface of the rollers 30 and 32, so that as the roller rotates, any snow or foreign material is scrapped from the surface of the roller.

The cover plate 34 also has a pair of longitudinal slots 38 which are aligned with corresponding slots in the base plate 16. Attachment screws 40 extend through the slots 38 and into the ski 4 to secure the base plate and cover plate to the ski.

The base plate 16 also includes an upright boot stop 42. The boot stop 42 has a guide slot 44 with a horizontal leg adjacent the surface of the ski and an upwardly curved leg. A rod 46 extends through the slot and is movable along the slot. The rod 46 also extends through aligned holes in a step lever 48 which projects forwardly. The base plate 16 has an opening around the lever 48 so that the forward end of the lever rests on the surface of the ski 4. The cover plate 34 has a raised shield 50 for retaining the outer end of the lever adjacent the surface of the ski. A boot stop spring 52 is secured in a pair of notches 54 in the lever 48 and extends upwardly to engage the top of the boot stop 42 when the lever is in the position shown in FIG. 5. The spring 52 is spaced from the front surface of the boot stop 42 and resiliently urges the heel of the boot forwardly toward the toe binding unit.

As shown in FIGS. 5, 6 and 7, a yoke 56 is pivotally mounted on opposite ends of the rod 46. The yoke 56 has a sleeve 58 at its upper end and a shaft 60 is supported for rotation in the sleeve 58. The shaft 60 supports a housing 62 (FIG. 5) which includes opposite side walls 64, a top wall 66, and a front wall 68. The shaft 60 extends through arcuate slots 70 in each side wall 64. As shown in FIG. 7, the outer ends of the shaft

60 are provided with pinions 72. The side walls 64 are offset outwardly and arcuate racks 74 on the upper side of the slots 70 are engaged with the pinions 72 while the shaft 60 bears against the lower edge of the slots 70.

The position of the shaft 60 relative to the housing 62 is controlled by means of a worm 76 which meshes with a gear 78 formed on the shaft 60. A saddle 80 is supported on the shaft 60 and wrapped under the worm 76, as shown in FIG. 9. The worm 76 has a head 82 with a spherical outer surface which is received in a corresponding socket 84 in the front wall 68 of the housing. The head 82 is retained in the socket 84 by a slide 86 which is secured to the front wall 68. The slide 86 has flanges along opposite sides which are received in channels 88 formed in the front wall 68 of the housing. The slide 86 has a longitudinal slot 90 with spherical side walls which correspond to the size and shape of the head 82. Thus, as the worm 76 swings from the position shown in FIG. 5 to the position shown in FIG. 9, the spherical shape of the head and the corresponding socket 84 and slot 90 allow the worm to swing while resisting longitudinal displacement of the worm. The front of the slot 90 is wide enough to allow the insertion of a wrench for rotating the worm 76, as shown in FIG. 8. The slide 86 is displaced relative to the channels 88 by means of a screw 92. The screw is journaled along one side on the front wall 68 of the housing and meshes with screw threads formed in the inner surface of the slide 86. Rotation of the screw 92 displaces the slide 86 upward or downward relative to the front wall 68.

The slide 86 supports a clamping roller 94 for rotation. A boot heel 96 is shown in phantom lines in FIGS. 5 and 8. The upper surface of the heel has a V-shaped cam surface 98 which is engaged by the roller 94. The bottom of the heel 96 rests on the surface of the rollers 30 and 32. The height of the roller 94 is adjusted by means of the screw 92 to accommodate the thickness of the boot heel when the roller is centered between the cam surfaces 98.

Spring bias for resisting displacement of the clamping roller 94 away from the support rollers 30 by the boot heel 96, is provided by a resiliently flexible snap action blade 100. The blade when mounted in accordance with this invention has the characteristics of resisting deflection of the outer end of the blade 102 with progressively greater force until the blade snaps over from one bistable position to the other. The blade 100 thus is unlike conventional snap action devices in which resistance to deflection decreases as the blade approaches a midposition between both bistable positions. The characteristics of the snap action blade are described more fully in my copending applications Ser. No. 717,114, filed Mar. 29, 1968, entitled "Snap Action Apparatus" now U.S. Pat. No. 3,543,595 and Ser. No. 3,463, filed Jan. 16, 1970, entitled "Ski Bindings."

The blade 100 has an arcuate edge 104 which is received in the V-shaped, arcuate groove 106 in a reactor 108. Opposite ends of the reactor 108 have rectangular projections 110 which are received in corresponding grooves in an elongated tension bar 114. The grooves and projections cooperate to resist pivoting movement of the reactor 108 relative to the tension bar 114, but allow adjustment of the spacing between the reactor and the tension bar. This adjustment is accomplished by means of a pair of adjustment screws 116 which extend through the tension bar and engage the front side of the reactor 108. The tension bar 114 is attached to the top wall 66 of the housing by screws 118 which engage arms 120 projecting forwardly from the tension bar 114.

The blade 100 has a pair of tabs 122 extending forwardly at opposite ends of the arcuate edge 104. The tabs 122 each extend through a slot at the end of the tension bar 114 and the end of the tab 122 is bent up over the front edge of the bar 114 and welded to the top of the bar, as shown in FIG. 7. The blade 100 is stressed by turning the screws 116 to displace the reactor 108 relative to the tension bar to induce compressive stresses adjacent the center of the blade and tensile stresses adjacent the lateral edges, so that the blade assumes a transversely curved configuration in which the radius of the transverse curvature progressively increases from adjacent the reactor 108 toward the outer end 102.

The reactor 108 is connected with the top wall 66 of the housing by an adjusting screw 126. The screw has a shank portion 128 which is received in a slot 130 in the top wall 66 of the housing. A shoulder 132 on the screw bears against the under surface of the top wall 66 and cooperates with the head of the screw to prevent longitudinal displacement of the screw in the slot. The shank 128, however, is free to slide along the slot 130 to accommodate changes in the position of the reactor 108 and the tension bar 114. If necessary, suitable means can be provided on the screw 126 to resist accidental rotation of the screw due to vibration.

As shown in FIGS. 5 and 6, a base lever 134 is pivotally connected with the base plate 16 by a hinge 136. A latch 138 is provided on the surface of the ski 4 in alignment with a socket 140 in the base lever 134. The latch 138 includes a latch bar that rotates about its supporting post, so that when it is in the position shown in FIG. 6, the latch prevents the outer end of the base lever 134 from swinging away from the surface of the ski. When the latch bar is in the position shown in FIG. 11, it is aligned with enlarged portions of the socket 140 which allow the bar to pass freely through the base lever 134, so that the bar no longer restricts swinging movement of the lever 134 relative to the ski.

A release lever 142 has a pair of arms 144 that are provided with notches 146 in which the arcuate edge 104 of the blade 100 is received. The central portion 148 of the release lever extends outwardly from the arms 144 and is folded over adjacent the outer end to provide an upper section 150 and a lower section 152 above and below the blade 100. The curved end 154 of the release lever bears against the surface of the base lever 134. A tongue 156 extends upwardly from the lower section 152 of the lever. The tongue 156 has notches 158 along the opposite lateral edges and the blade 100 has a longitudinal key slot 160 of substantially the same width as the distance separating the notches 158. Thus, the notches in the tongue 156 support the outer end of the blade 102 and restrict its movement relative to the tongue 156.

As shown in FIG. 7, the upper section 150 of the release lever has an opening 162 which is aligned with the enlarged portion of the key slot 160 in the blade 100. The lower section 152 of the release lever has an opening 164 corresponding to the key slot in the blade.

A tab 166 extends downwardly from the central portion 148 of the release lever and is aligned with a slot 168 in the base lever 134. The tab 166 centers the release lever with respect to the base lever. Extensions 170 of the arms 144 project under the base lever 134 and retain the base lever between the extensions 170 and the curved end 154 of the release lever.

A prop 172 for temporarily supporting the blade for cocking is movable from an operative position to a retracted position by the blade. The prop 172 has a pair of arms 174 (FIG. 5) that bear against the lower surface of the blade 100. The arms 174 are secured to the blade by welding or other suitable means, so that when the blade snaps from the position shown in FIG. 5 to the position shown in FIG. 10, the prop 172 swings downwardly to engage a rack 176 provided on the upper surface of the base lever 134. Also, when the blade snaps back to the position shown in FIG. 5, the prop 172 is retracted. The prop 172 is shown in FIGS. 10 and 11 at the rearward end of the rack 176. This position corresponds to a low preload on the blade imposed by the screw 126. When the screw 126 is adjusted for a high preload, the prop 172 is positioned adjacent the forward end of the rack 176.

The housing 62 is enclosed by a cover 177. The cover has an opening through which the adjusting screw 126 is accessible, and the cover is secured on the housing by screws 178 (FIG. 8). An arcuate slot 179 is provided in the side of the cover through which the position of the shaft 60 can be observed.

The heel binding unit is capable of operating either in an automatic mode in which the snap action blade 100 is cocked by the movement of the step lever downwardly from the position shown in FIG. 10 to the position shown in FIG. 5; or in a manual mode in which the housing is displaced from the position shown in FIG. 11 while the step lever 48 moves downwardly to the position shown in FIG. 5. In the manual mode, the blade is cocked by swinging the base lever 134 downwardly to the position shown in FIG. 5.

When the heel binding unit is adjusted for automatic operation, the latch 138 is turned to the position shown in FIG. 6 to hold the base lever 134 against the surface of the ski. When the skier places the heel of his boot against the step lever 48, the spring 52 acts as a guide for the heel and downward displacement of the heel slides the bar 46 along the slot 44 toward the horizontal leg of the slot. Just as the bar moves into the horizontal leg, the upward force applied to the blade by the prop 172 and the downward displacement of the tension bar 114 causes the blade 100 to snap over from the released position shown in FIG. 10 to the clamping position shown in FIG. 5. As the blade snaps, the prop 172 swings upwardly out of engagement with the rack 174 and the bar 46 is displaced rearwardly to the position shown in FIG. 5 while the roller 94 engages the cam surfaces 98 on the heel of the boot.

For operation of the heel binding unit in its manual mode, the latch 138 is rotated 90 degrees from the position shown in FIG. 6 to align the latch bar with the enlarged portions of the socket 140, thereby allowing the base lever 134 to swing away from the ski surface. When the blade is in the released position, the components of the binding are initially in the position shown in FIG. 11. When the heel of the boot is applied to the step lever 48, the bar 46 moves downwardly along the slot 44 until it is positioned at the forward end of the horizontal leg. This movement brings the roller 94 into engagement with the cam surface 98 on the heel of the boot, but the spring force of the blade 100 is not applied to the boot because the lever 134 remains approximately in the position shown in FIG. 11, although the release lever 142 slides forwardly along the base lever 134 to accommodate swinging movement of the housing 62. The skier then places the end of his ski pole in the socket 140 and presses down, thereby causing the base lever 134 to rotate about the hinge 136 until the blade 100 snaps over to the position shown in FIG. 5.

The manual mode allows the skier to utilize a higher preload on the blade than is possible in the automatic cocking mode. As previously stated, the prop pole 172 is positioned at the forward end of the rack 176 when the screw 126 is adjusted for a high preload on the blade. Consequently, when the base lever 134 swings downwardly in response to the force applied by the skier at the outer end of the lever 134, the portion of the rack that overhangs forwardly of the hinge 136 swings upwardly. This movement of the rack is transmitted to the prop pole, and in turn is transmitted to the blade to provide sufficient displacement of the blade edge 102 relative to the blade tabs 122 to cause the blade to snap over to the clamping position, even though it has a high preload.

In either automatic mode or manual mode, the extensions 170 on the release lever slide along the opposite edges of the base lever 134, which, as shown in FIG. 6, are tapered outwardly. This allows lateral clearance between the release lever and the base lever so that the release lever moves freely along the base lever when the blade is snapped over to the released position, but when the blade is in the clamping position, the extensions 170 fit closely against the edges of the lever 134 as shown in FIG. 6.

The heel binding can be released manually from the clamping position, as shown in FIG. 5, by inserting the end of a ski pole through the opening 162 in the upper section of the release lever 142. The end of the pole passes through the key slot 160 in the blade and through the opening in the lower section 152. With the tip of the pole resting on the surface of the ski, a force can be applied tending to rotate the lever 142 about the end 154 in a counterclockwise direction, as viewed in FIG. 5, pulling forward on the upper end of the ski pole. The abutment 171 on the base lever 134 serves as the fulcrum for the pole and there is sufficient leverage to overcome the force of the spring blade 100 easily. This causes the binding to release and assume the position shown in FIG. 10 or FIG. 11, according to the position of the latch 138.

The pole socket in the release lever can also be used for cocking the spring blade. The pole bears against the tab 166 and against the tongue 156, and by swinging the upper end of the ski pole rearwardly, the blade snaps over to its clamping position. When cocking the unit in this manner, the prop 144 is not used. Manual cocking of the heel binding is necessary when high preload forces are imposed on the blade, and is a convenient way of attaching the bindings in soft snow, or where the ground conditions made it difficult to step on the lever 48 firmly enough to cock the unit.

A toe binding unit in accordance with this invention is illustrated in FIGS. 12 to 19. The toe binding unit 6 includes a base 180 which is secured to the ski 4 by a pair of screws 182. The base 180 has an upright center plate 184, and a clamping head 186 is hingedly supported on the center plate 184 by a pin 188. The clamping head 186 includes a pair of arms 190 which project diagonally rearward. Each arm has an upwardly projecting flange 192 that forms a guide for the toe portion 94 of the boot 2. As shown in FIGS. 12 and 13, the toe 194 has a pair of sockets 196 in which the flanges 192 are received. The flanges 192 hold the toe of the boot against lateral displacement relative to the toe binding unit and serve to center the toe of the boot on the ski.

At the outer end of each arm, there is a slot 198 and a toe support 200 is hingedly connected to the arms 190 by curved tabs 202 which are looped through the slots 198. As shown in FIG. 12, the tabs 202 rest on the surface of the ski 4. Support pads 204 are provided on the toe support 200. The pads are positioned at the extreme ends of the toe support 200 for stability. The pads have a transverse edge 205, from which the tabs 202 extend downwardly. As shown in FIG. 12, the sole of the boot 2 rests directly on the pads 204.

The clamping head 186 includes a rearwardly projecting shank portion which terminates in a sleeve 208. The sleeve 208 is internally threaded to receive a screw 210. As shown in FIG. 12, the screw 210 has an enlarged head which projects rearwardly to overlap the front edge of the toe portion 194 of the boot. By turning the screw 210, the height of the head relative to the pads 204 can be adjusted to accommodate boot soles of different thickness. A wire 212 is coiled on the shank 206. A series of holes 214 are provided in the clamping head 186, shown in FIG. 12, and these holes are aligned with corresponding holes in the mounting plate 184 for selective insertion of the wire 212 in one of the holes 214.

The toe binding unit 6 is capable of releasing the toe of the boot when the heel has been displaced laterally a sufficient distance for release at the heel. The toe binding unit 6 also releases when a force of predetermined magnitude is applied upwardly in the direction of the arrow 12 in FIG. 2.

When torsional forces are imposed between the ski 4 and the boot 2, they are resisted at the toe binding unit by the flanges 192 and at the heel by the roller 94 which is biased toward the center of the cam surfaces 98 (FIG. 8). As the heel is displaced laterally, it turns the rollers 30 and 32 which impose substantially no frictional resistance and it turns the roller 94 which is progressively displaced upwardly along one of the cam surfaces 98. If sufficient lateral force is applied at the heel, the spring bias of the blade 100 will be overcome and the heel binding will release the heel by swinging the roller 94 upwardly away from the cam surfaces 98. As the heel of the boot swings laterally, for example in the direction of the upper arrow 14 in FIG. 1, the toe of the boot pivots about the right-hand flange 192. Since the torsional force is applied at the heel, and the length of the boot is substantially greater than the distance separating the right-hand flange 192 from the left-hand pad 204, and the underside of the clamping screw 210, then whatever frictional resistance is imposed, is easily overcome. Since the engagement between the boot and the rear binding is entirely through rolling contact, there is substantially no frictional resistance to lateral displacement at the heel, and although there is frictional resistance at the toe, sufficient leverage is applied to overcome readily the frictional resistance. Thus, the toe and heel binding effectively and reliably release the boot when a torsional force of predetermined magnitude is applied, and since the release is uneffected by friction, the force level at which release occurs remains substantially constant regardless of changes in the weight applied by the skier on the supporting surfaces.

The toe binding is also capable of releasing vertically in the direction of the arrow 12 in FIG. 2. This action is illustrated schematically in FIGS. 17 to 19. The clamping screw 210 is preferably adjusted so that when the toe binding is in the position shown in FIG. 12, the vertical height between the surface of the pads 204 and the underside of the head of the screw 210 is less than the thickness of the boot toe 194. The boot toe is inserted into the toe binding before stepping on the lever 48 of the heel binding, and with the heel raised, the toe portion 194 fits between the head of the screw 210 and the pad 204. When the flanges 192 engage the sockets 196, the skier presses down with his heel on the step lever 48 of the heel binding which cocks the heel unit and moves the roller 94 to a clamping position against the cam surfaces at the heel. This movement of the boot heel applies cantilever loading at the toe of the boot between the forward edge 205 of the pad 204 and the head of the clamping screw 210. The deflection of the boot sole is exaggerated in the schematic illustrations of FIG. 12 and 17 to emphasize the cantilever loading feature. Ordinarily, the cantilever loading applied on the boot toe is substantially greater than the forces that would normally be applied to the boot in skiing with conventional bindings. The clamping force applied downwardly by the screw 210 would be of the order of twice the weight of the skier.

Since the heel of the boot is fastened in the heel binding units, the cantilever loading at the toe holds the toe portion of the boot firmly against the surface of the pad 204. The distance between the clamping screw 210 and the pivoted connection at the end of the arms 190 is selected to provide a net torque in a clockwise direction about the pin 188, as viewed in FIG. 12. Preferably, the net clockwise torque is about 4 percent greater than the torque applied at the clamping screw 210. This assures that a shear load will not be applied to the wire 212 until a substantial load in the vertical direction is applied to the screw 210. As shown in FIG. 17, the wire 212 is initially positioned in the aligned holes 214 through the clamping head and through the center plate on the base. The tab 202 on the support bar 200 rests on the surface of the ski and the rear edge 216 of the support bar also rests on the surface of the ski. As an upward force is applied in the direction of the arrow 212 in FIG. 2, the clamping head 186 begins to rotate about the pin 188 in a counterclockwise direction to the position shown in FIG. 18. In this position, a load is applied to the shear wire 212 and due to the linkage between the tab 202 and the forward edge of the pad 204, the clearance between the head of the screw 210 and the pad 204 increases as the clamping 186 head swings in a counterclockwise direction. Ultimately, the wire **212** is sheared off, as shown in FIG. **19** allowing the clamping head to swing freely in a counterclockwise direction as shown in FIG. **19**, thereby releasing the toe of the boot as the support bar **200** swings downwardly.

As shown in FIG. **12**, there are a series of holes **212** for receiving the wire **212**. By selecting an appropriate hole, the leverage between the shear wire and the hinge pin **188** can be changed to allow adjustment of the maximum force required for release. Also, when the wire **212** is sheared, it is merely necessary to return the clamping head **186** to the position shown in FIG. **12** and insert the end of the wire **212** endwise into one of the holes **214**. The coil of wire **212** progressively unwinds from the shank **206** as successive links of wire are broken off during the use of the binding.

It is apparent that frictional resistance to movement of the boot or heel relative to the binding does not vary with the load applied through the boot either to the heel binding or the toe binding, as it does in conventional ski bindings. In the heel binding, the rollers that support the heel of the boot are substantially free of friction and release occurs at a selected force setting regardless of the load applied. The cantilever loading of the toe binding imposes an initial load on the snap action blade **100** through the clamping roller **94** which further assist in improving the responsiveness and sensitivity of the bindings. The placement of the pads **204** and the rollers **30** and **32** adjacent the lateral edges of the ski also improves the stability of the support for the boot.

While this invention has been illustrated and described with respect to preferred embodiments, it is recognized that variations and changes may be made therein without departing from the invention as set forth in the claims.

WHAT IS CLAIMED IS:

1. In a ski binding of the type having a support surface for supporting the bottom of a ski boot and an abutment overlapping a shoulder on the boot for clamping said boot between said surface and said abutment, the improvement comprising roller means on said support surface, said roller means including a plurality of support rollers each having a rolling surface exposed for direct engagement by said boot, said support rollers being positioned in opposition to said abutment when the binding is in clamping position and each of said support rollers being journalled on trunnions for rotation about a fixed axis extending longitudinally of the ski binding, said trunnions having a smaller diameter than said rollers, whereby said rollers transmit clamping forces to said boot.

2. The ski binding according to claim **1**, wherein said support surface includes a base plate, a pair of said rollers being journaled for rotation about substantially parallel fixed axes spaced apart from each other, and including a cover having openings through which the rollers extend, the width of said openings being less than the diameter of said rollers, whereby a minor portion of said rollers project above said cover openings for supporting a ski boot and the edges of said openings scrape snow and ice from the rollers.

3. The ski binding according to claim **1**, wherein said abutment includes a roller journaled for rotation on said binding, the periphery of said roller being engageable with said boot shoulder.

4. A ski binding unit for temporarily clamping the heel of a boot on a ski comprising a base adapted for mounting on the surface of the ski, means on the base for engaging and supporting the bottom of a boot heel, a clamping member, means connecting said clamping member with said base, said clamping member including a clamping abutment movable into engagement with a corresponding shoulder on the heel of a boot when the boot is resting on said support surface, said connecting means including means for swinging said clamping member about an axis extending transversely of said support surface, means on said base for displacing said axis along a guided path relative to said base, a step lever hingedly secured on said connecting means for swinging movement about said axis, said path including a portion extending in a direction increasing the distance between said clamping abutment and said support surface, a release lever extending between said clamping member and said base, spring means connected with said clamping member and said release lever, said spring means being bistable and capable of snapping between one position yieldably urging said clamping abutment toward said support surface and the opposite bistable position yieldably biasing said clamping abutment away from said support surface, said release lever being movable relative to said base in response to displacement of said spring means.

5. The heel binding unit according to claim **4** wherein said base includes a base lever hingedly mounted on said base for pivoting movement about an axis substantially parallel to said connecting means axis, said release lever being connected with said base lever for sliding longitudinally of said base lever upon swinging of said base lever about its axis, whereby swinging of said base lever alters the effect of said spring bias means on said clamping member.

6. The heel binding unit according to claim **5** includes means for latching said base lever against swinging movement relative to said base, and means on said release lever for limiting displacement between said spring bias means and said base lever.

7. The heel binding unit according to claim **5** including a prop member, means for connecting said prop member with said clamping member, said base lever including a rack extending forwardly and rearwardly of said hinge axis, said spring means swinging said prop member into engagement with said rack upon snapping of said spring means to said release position, whereby said prop member temporarily supports said clamping member while snapping said spring means from said release position to a clamping position.

8. The heel binding unit according to claim **7**, wherein displacement of said clamping means axis along said path causes said spring bias means to snap from a release position to a clamping position, and includes means for temporarily disconnecting said spring bias means while in a release position, whereby movement of said step lever is ineffective for snapping said spring bias means to a clamping position.

9. The heel binding unit according to claim **8** including means for snapping said spring bias means from a release position to a clamping position independently of movement of said step lever.

10. The ski binding unit according to claim **4**, wherein said release lever includes means for selectively applying stress to said spring bias means to snap said spring bias means from a clamping position to a release position, whereby the heel binding unit can be released manually.

11. A ski binding unit for temporarily clamping the heel of a boot on a ski comprising a base, means providing a surface on said base for supporting the heel of a boot, a step lever, means mounting said step lever on said base for movement above and below said support surface, a movable abutment means above said surface, means connecting said step lever with said abutment means, said connecting means displacing said abutment means into engagement with the heel of a boot in response to movement of said step lever below said support surface, means on said base for latching said step lever at a position below said support surface, spring means biasing said abutment means against said heel when said step lever is in said latched position, said spring means when in clamping position progressively resisting displacement of said abutment means until a predetermined force overcomes the spring bias and said spring means then releases its bias on said abutment means, and means for selectively relieving the bias of said spring means on said abutment means, whereby said step lever may be depressed below said support surface and said abutment means may be positioned over said boot heel without imposing spring forces on the abutment means.

12. The heel binding unit according to claim **11** including means for independently applying bias by said spring means on said abutment means while said step lever is in said latched position.

13. The heel binding unit according to claim **11**, wherein said relieving means includes lever means operable by applying a force substantially less than said predetermined force.

14. In a ski binding of the type having a base with a support surface for supporting the bottom of a ski boot and abutment means overlapping a shoulder on the boot for clamping said boot between said surface and said abutment means, the improvement wherein said abutment means comprises:

a housing,

connecting link means between said housing and said base, said housing being journalled on said connecting link means for rotation about a first transverse axis and said connecting link means being journalled on said base for rotation about a second transverse axis,

a roller on said housing, and means mounting said roller for rotation about an axis extending longitudinally of the binding, said roller being positioned in opposition to said support surface when said binding is in clamping position, and

spring means biasing said housing to rotate about said first axis in a direction tending to move said roller closer to said support surface and said spring means biasing said connecting link means about said second axis in a direction tending to move said roller closer to said support surface when said binding is in clamping position.

15. The ski binding according to claim **14** wherein said support surface includes a pair of support rollers and means mounting said support rollers for rotation about a fixed axis extending longitudinally of the binding, said support rollers having a rolling surface exposed for direct engagement by said boot, whereby said support rollers and said abutment roller cooperate to clamp said boot between them when said binding is in clamping position.

16. The ski binding according to claim **15** wherein said support rollers are spaced apart transversely of said binding and said abutment roller is substantially equidistant from said support rollers, thereby providing stable support for said boot.

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