

[54] **SKI BINDING APPARATUS**

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[51] Int. Cl. .... **A63c 9/08**

[58] Field of Search **280/11.35 C, 11.35 K, 11.35 M, 280/11.35 Y**

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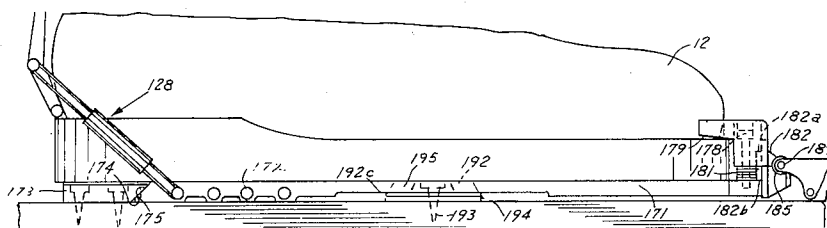
Primary Examiner—David Schonberg  
Assistant Examiner—David M. Mitchell

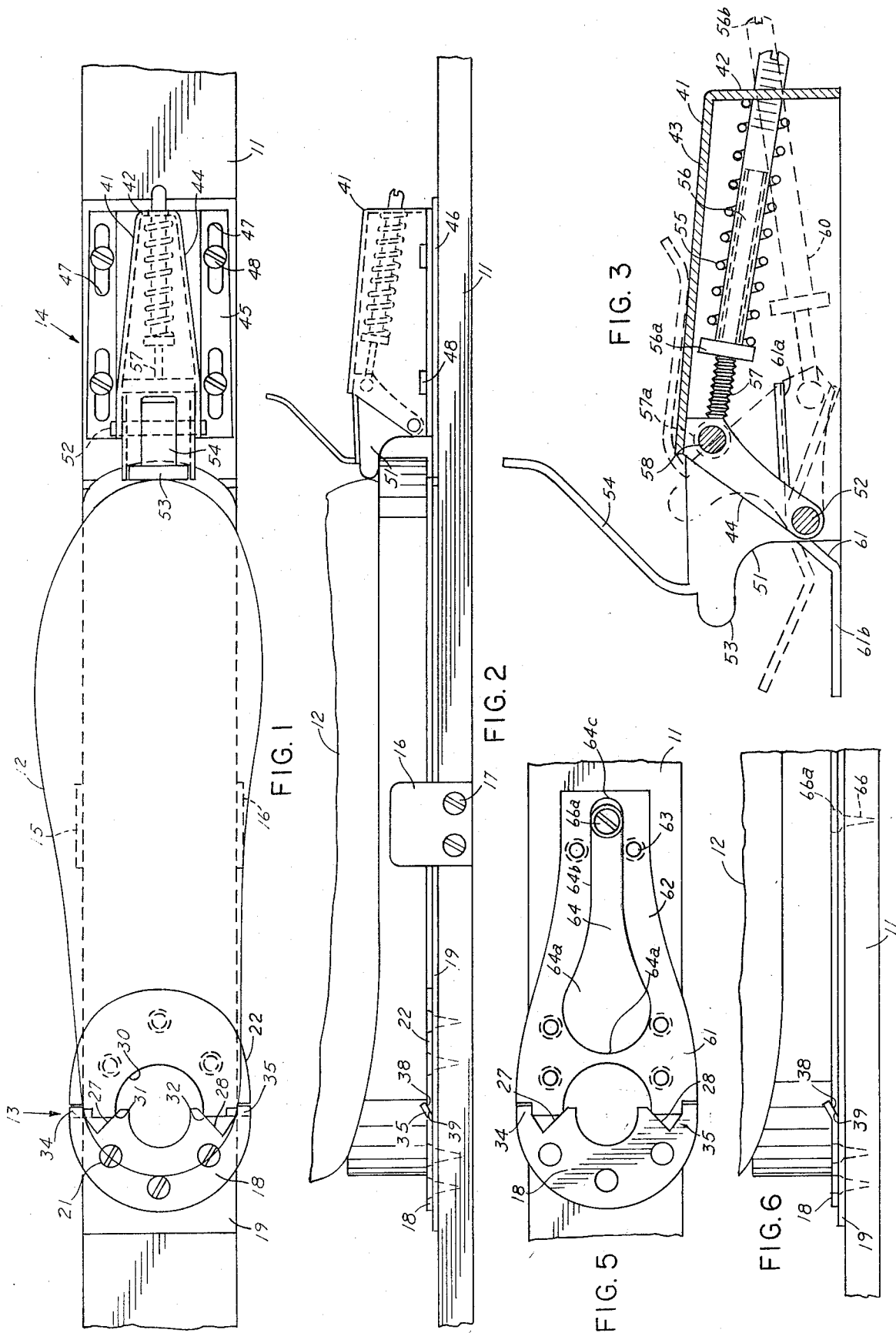
[57]

**ABSTRACT**

In ski binding apparatus, cam surfaces are engaged by bearing surfaces movable with the ski boot arranged to afford lateral restraint yet allow the ski boot to move along the ski. A heel binding has inclined cam surfaces engaged by bearing surfaces movable with the ski boot to afford vertical restraint for the heel of the ski boot. The bearing surfaces pass the extremities of an associated cam surface to release the ski boot upon the application of a selected amount of lateral or vertical thrust to the ski boot in cooperation with a forwardly yieldable toe binding which allows the ski boot to slide forwardly for release at the heel, the toe binding having an adjustable force-applying means resisting forward movement of the ski boot to regulate the amount of thrust required to release at the toe and at the heel. An intermediate support between the toe and heel may also be utilized to provide lateral movement restraint for the ski boot and establish a pivot about which the ski boot will turn to reduce the strain on the leg. In an alternate form, a step-in carrier for the ski boot is releasably secured to the ski by toe and heel bindings together with an intermediate support for establishing a pivot for the carrier and ski boot between the toe and heel without altering or adding structure to the ski boot.

**35 Claims, 30 Drawing Figures**





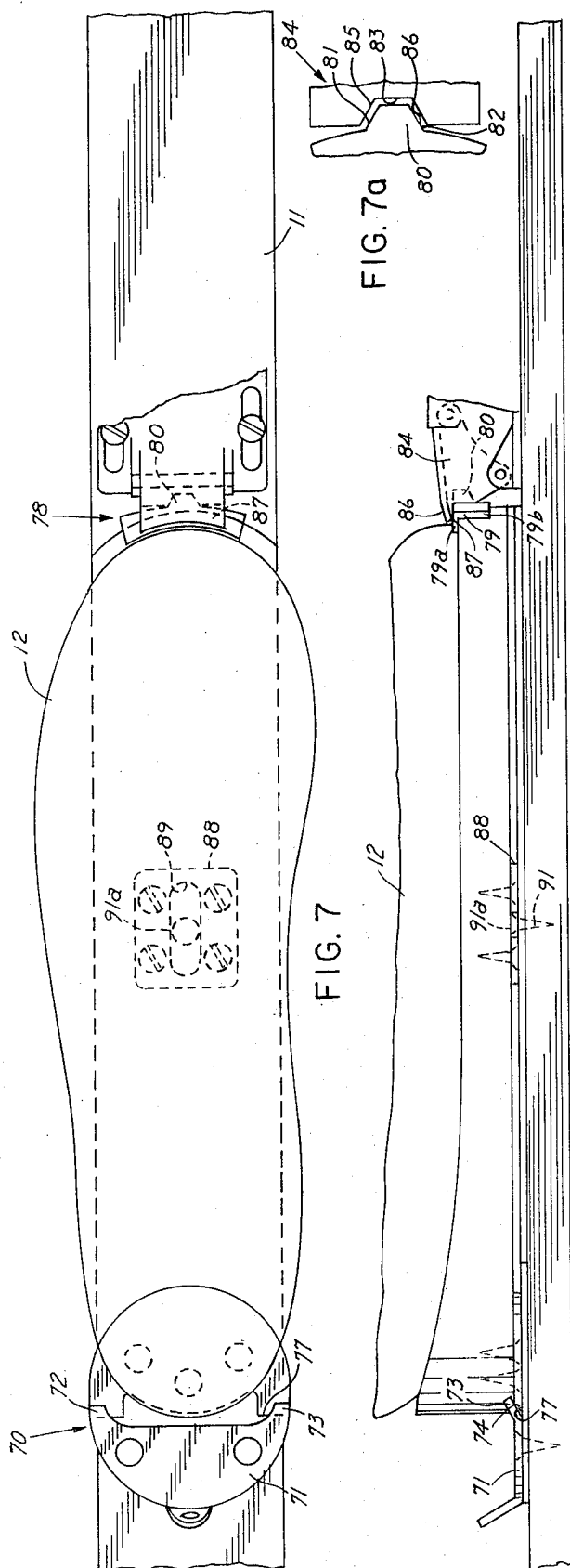


FIG. 7a

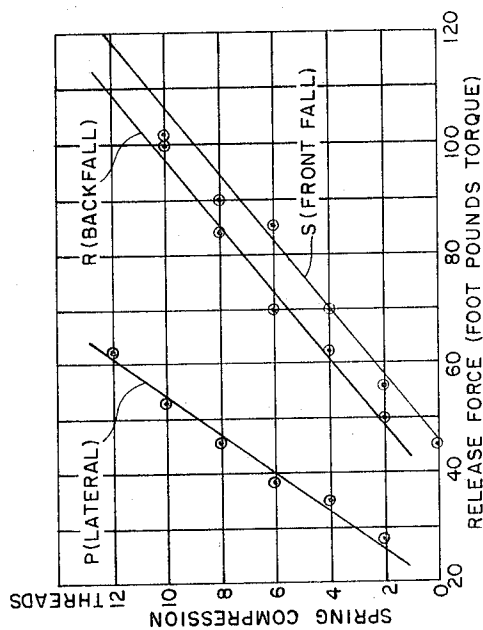
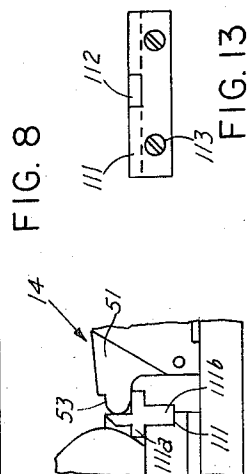


FIG. 4



F/G. 8

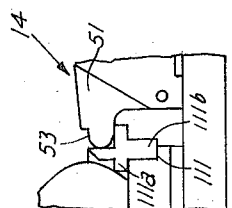


FIG. 11

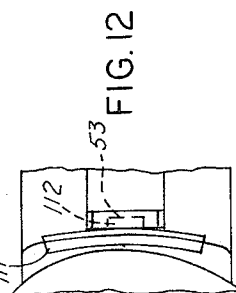


FIG. 12

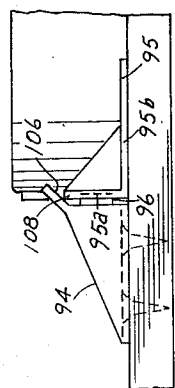


FIG 9

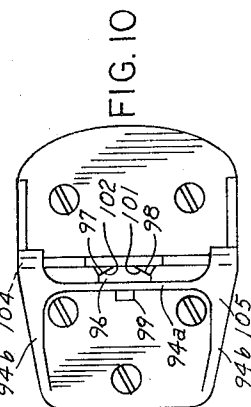


FIG. 10

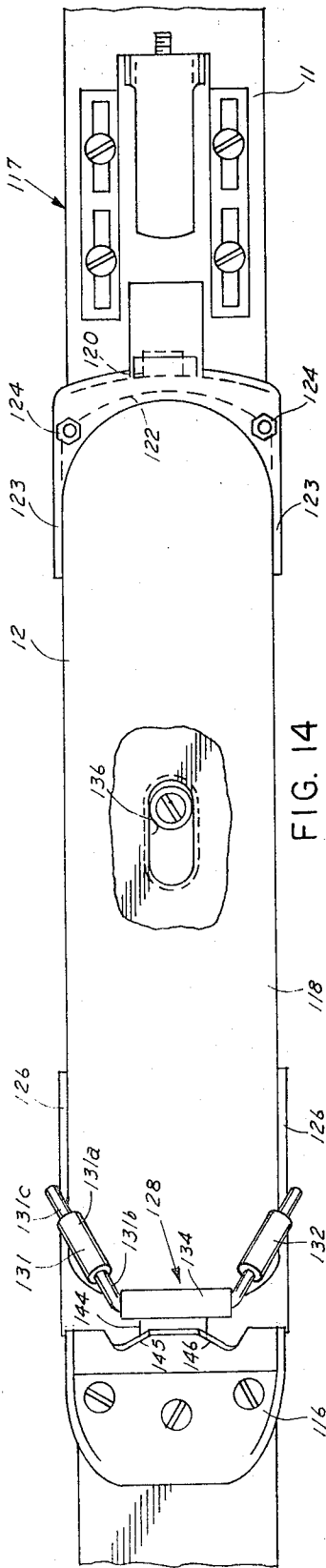


FIG. 14

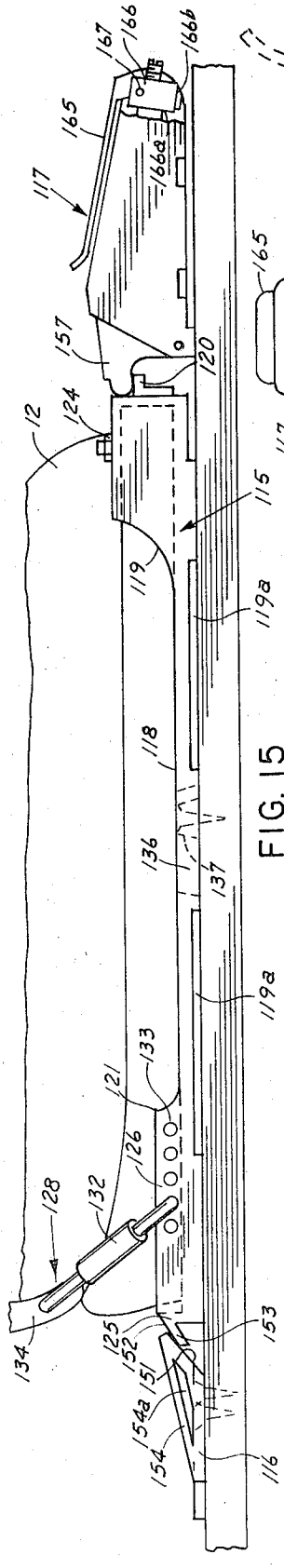


FIG. 15

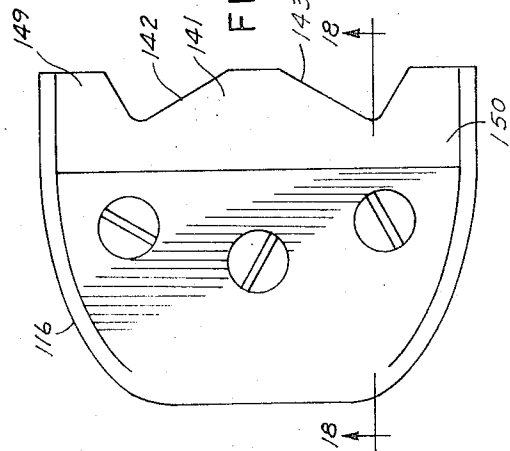


FIG. 17

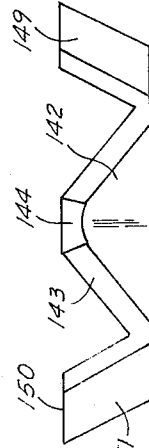


FIG. 18

FIG. 19

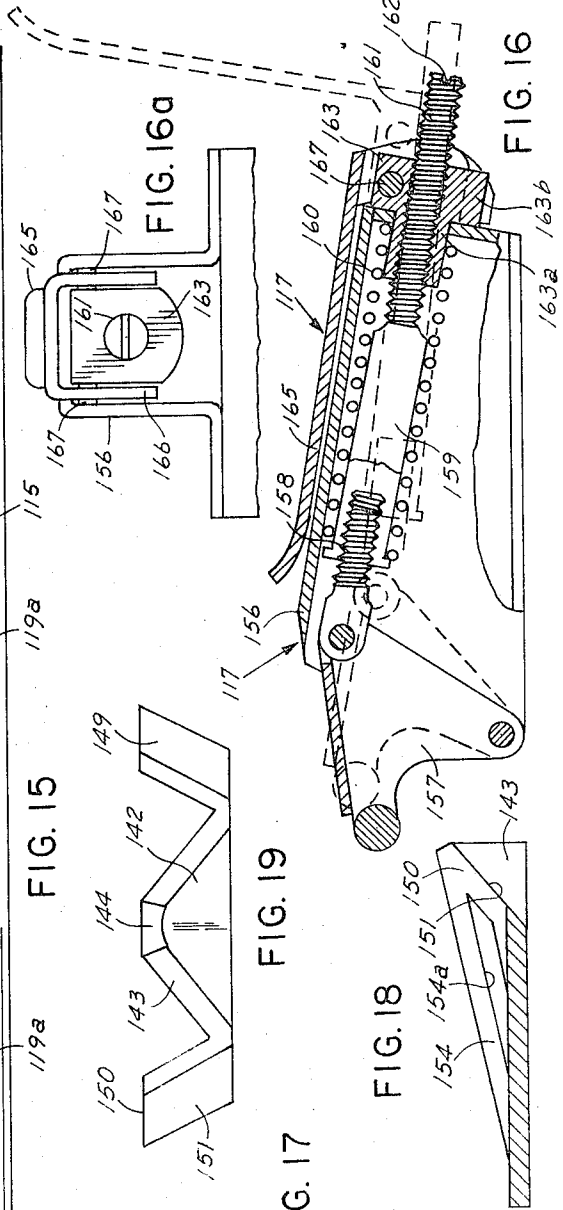


FIG. 16

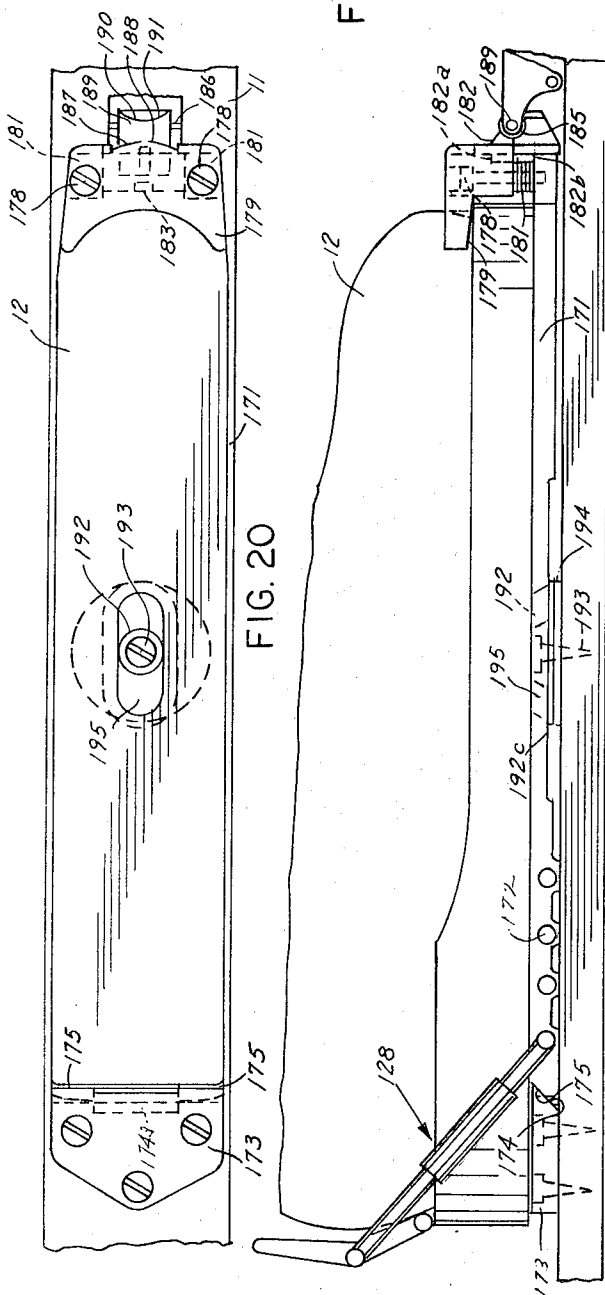


FIG. 20

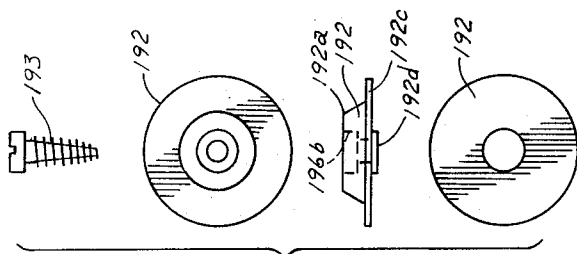


FIG. 22

FIG. 21

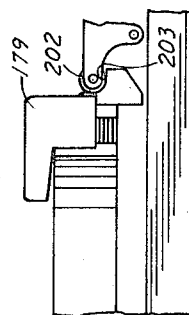


FIG. 23

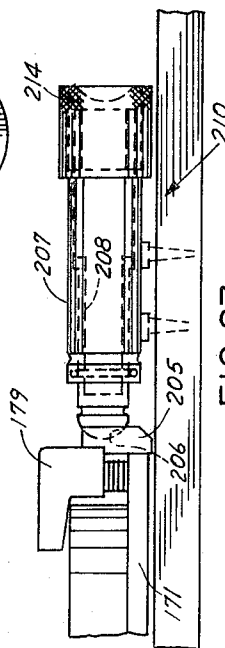


FIG. 25

FIG. 27

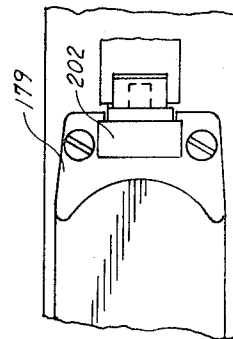


FIG. 24

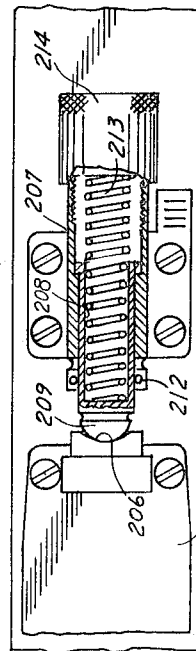


FIG. 26

FIG. 28

## SKI BINDING APPARATUS

### BACKGROUND OF THE INVENTION

This invention relates to improvements in safety ski bindings and more particularly to a novel and improved safety ski binding apparatus wherein the lateral, vertical and forward release forces may be adjusted to meet specific user requirements.

In the design and manufacture of ski bindings it has been the practice to utilize devices which automatically release when excessive vertical, forward or laterally directed thrusts are applied to the ski boot to avoid injury to the skier. The vertical thrusts will occur at the heel on front fall and at the toe on a back fall. The lateral thrusts occur when the leg is being twisted in either direction. In my earlier filed application entitled Safety Ski Binding Apparatus, Ser. No. 39,927, filed May 22, 1970 now U.S. Pat. No. 3,731,946, there is shown and described intermediate supports restraining lateral movement between the toe and heel which were found to be highly effective in reducing the forces on the leg due to falls or abrupt stops and a forwardly yieldable and automatically releasable toe binding which will release when the ski strikes an immovable object. The present application is directed to improved ski binding apparatus in which the release forces for the bindings may be adjusted using cam surfaces at the heel or toe in combination with a forwardly yieldable and adjustable force applying means as well as improved, forwardly yieldable toe bindings; and the foregoing may be employed independently or in combination with an intermediate carrier for the ski boot which eliminates the necessity of modifying or adding structure to a ski boot to establish an intermediate pivot.

### SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide a novel ski binding apparatus which will enable the release of the ski boot laterally of the ski when a preselected amount of lateral thrust is applied to the ski boot.

Another object of this invention is to provide novel ski binding apparatus wherein the toe binding is forwardly releasable and settable for a preselected release force and a heel binding relying on forward movement of the boot and a preselected angle of laterally inclined cam surfaces for controlling the amount of thrust required to release forwardly and laterally of the ski.

Still a further object of the invention is to provide a novel heel binding characterized by having cam surfaces which in cooperation with a yieldable force applying member on a toe binding control the amount of lateral and/or vertical thrust required to release the ski boot laterally and/or vertically of the ski.

Yet another object of this invention is to provide a novel ski binding apparatus in which an auxiliary carrier is adapted to accommodate ski boot of a variety of sizes and is releasably held on a ski by novel heel and toe bindings, and wherein an intermediate support member is associated with the carrier and ski to establish a pivot about which the carrier and ski will rotate.

In accordance with the present invention in the preferred forms shown there is provided a binding usable at the toe or heel of the ski boot having cam surfaces engaged by bearing surfaces movable with the ski boot either on a plate attached to the ski boot or a carrier supporting the ski boot to restrain lateral movement at the heel or toe. With the application of a preselected

amount of lateral thrust, the bearing surfaces are moved past the extremities of the associated cam surfaces for release of the ski boot. A forwardly yieldable toe binding allows the ski boot to slide forwardly a slight distance relative to the ski for release. The toe binding has a compression spring which is adjustable to resist the forward movement of the ski boot with a preselected amount of force. An intermediate pivot support member between the toe and heel of the ski boot provides lateral movement restraint for the ski boot and establishes a pivot about which the ski boot will turn to reduce the strain on the leg. The intermediate step-in carrier is releasably secured to the ski at the ends by toe and heel bindings and an intermediate support means associated with the carrier and ski which establishes the intermediate pivot about which the ski boot and ski will turn without requiring structure attached to the ski boot.

### BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top plan view of the ski binding apparatus for releasably securing a ski boot to a ski;

FIG. 2 is a side elevational view of the ski binding apparatus shown in FIG. 1;

FIG. 3 is an enlarged side elevation view of the toe binding shown in FIGS. 1 and 2 with portions broken away to show interior parts and with the released position shown in dashed lines;

FIG. 4 is a graph showing the relationship of the various thrusts on the heel and toe bindings required for release in relation to a range of spring settings.

FIG. 5 is a top plan view of another form of heel binding modified to include a part of the intermediate pivot support member.

FIG. 6 is a side elevation view of the modified heel binding shown in FIG. 5.

FIG. 7 is a top plan view of another form of ski binding apparatus having lateral restraint at the toe and no lateral restraint at the heel;

FIG. 7A is an enlarged fragmentary view of the toe binding of FIG. 7 showing in more detail the cooperating bearing and cam surfaces.

FIG. 8 is a side elevation view of the ski binding apparatus of FIG. 7;

FIG. 9 is a side elevation view of another form of heel binding with both lateral and vertical restraint at the heel;

FIG. 10 is a top plan view of the heel binding shown in FIG. 9;

FIG. 11 is a side elevation view of a toe plate attached to the toe portion of the sole of the ski boot, the toe plate being clamped to the ski;

FIG. 12 is a top plan view of the toe plate shown in FIG. 11;

FIG. 13 is a front elevation view of the toe plate shown in FIGS. 11 and 12;

FIG. 14 is a top plan view of another form of ski binding apparatus using an auxiliary step-in carrier between the ski boot and ski with alternate forms of toe and heel bindings being used therewith;

FIG. 15 is a side elevation view of the ski binding apparatus shown in FIG. 14;

FIG. 16 is an enlarged side elevation view of the toe binding shown in FIGS. 14 and 15 with portions broken away to show interior parts;

FIG. 16A is a front end view of the toe binding shown in FIG. 16;

FIG. 17 is an enlarged top plan view of the rear cam plate of FIGS. 14 and 15;

FIG. 18 is a sectional view taken along lines 18—18 of FIG. 17;

FIG. 19 is an end elevation view of the rear cam plate looking toward the rear;

FIG. 20 is a top plan of another form of ski binding apparatus using another form of step-in carrier between the ski boot and ski;

FIG. 21 is a side elevation view of the apparatus shown in FIG. 20;

FIG. 22 is an exploded view showing the parts of the intermediate support structure for the ski binding apparatus of FIGS. 21 and 22;

FIG. 23 is a side elevation of a modified form of heel binding for the apparatus of FIG. 20 and 21;

FIG. 24 is a top plan view of the heel binding shown in FIG. 23;

FIG. 25 is a side elevation view of a modified form of toe binding for the apparatus of FIGS. 20 and 21 for use on conjunction with the heel binding shown in FIGS. 23 and 24;

FIG. 26 is a top plan view of the toe binding shown in FIG. 25;

FIG. 27 is a side elevation view of another form of toe binding;

FIG. 28 is a top plan view of the toe binding shown in FIG. 27.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, the intermediate portion of a ski 11 is shown in FIGS. 1 and 2 having a ski boot represented at 12 releasably secured to the top of the ski by a heel binding 13, a toe binding 14 and intermediate pivot support structure in the form of side plates 15 and 16 secured on opposite sides of the ski by screw fasteners 17 between the heel and toe bindings. The ski boot 12 shown is of the molded type with straight sole sides and having approximately the same width as that of the ski.

The heel binding 13 shown in FIGS. 1 and 2 comprises a rear cam plate 18 positioned on an antifriction plate 19 on the top of the ski 11 and is secured thereto with screw fasteners 21 together with a forward bearing plate 22 secured to the bottom of the ski boot at the heel. The rear cam plate 18 has a forwardly tapered male end portion with tapered left and right side edges providing cam surfaces 27 and 28 respectively, disposed on opposite sides of the longitudinal axis through the center of the ski 11. The forward bearing plate 22 has a female rear end portion provided by a semicircular slot 30 formed in the rear end with beveled or tapered inside corners defining a pair of left and right side bearing surfaces 31 and 32, respectively, the cam surfaces 27 and 28 being received in the bearing surfaces 31 and 32 in an overlapping relation and allowing relative movement of the bearing plate 22 along the ski relative to the cam plate 18. When a lateral thrust is applied to the heel of the ski boot such as when the ski boot is rotated or twisted in one direction at the heel, one of the bearing surfaces moves against the opposite cam surface, the cam surface resisting lateral movement of the ski boot causing it to move in a generally forwardly direction along the ski until the rear end of the bearing surfaces pass the forward extremity of an

associated cam surface whereupon the ski boot is laterally released at the heel.

The rear cam plate 18 also has a pair of laterally spaced forwardly and upwardly inclined left and right side fingers 34 and 35 disposed outwardly of the bearing surfaces and separated therefrom by a space or slot, the fingers providing a pair of laterally spaced downwardly facing, forwardly and upwardly inclined cam surfaces 38 overlaying an associated beveled bearing surface 39 along the rear upper edge and on opposite sides of the forward bearing plate 22. When a vertical thrust is applied to the heel of the ski boot, the bearing surfaces 39 move upwardly and forwardly along the associated opposite cam surfaces 38 and the ski boot moves forwardly along the ski until the rear extremities of the bearing surfaces 39 pass the forward extremities of the cam surfaces 28 whereupon the ski boot is released vertically at the heel.

In the form shown, the angle of the cam surfaces 27 and 28 relative to a line normal to the longitudinal axis of the ski is about 35° and the angle of the cam surfaces 38 relative to a horizontal plane is about 40°. Of course, the angle of the cam surfaces may be varied to control the amount of lateral or vertical thrust required to release the ski boot.

The toe binding shown in FIGS. 1-3 comprises a casing or housing 41 having a top wall 42, a front wall 43 and forwardly tapered, opposed side walls 44 terminating at the bottom in outwardly projecting side flanges 45 with flat bottom surfaces positioned on a base plate 46 on the top of the ski 11 and having the front end open. Each side flange 45 has a forward and rear elongated slots 47 through which screw fasteners 48 extend to fasten the toe binding to the ski.

A boot restraining member in the form of a release lever 51 is pivotally mounted at a lower end portion of the housing with a transverse pivot member 52 which extends through the opposed sides of the housing and the opposed sides of the release lever 51. The release lever 51 has a generally U-shaped transverse cross-section and is received between the sides of the housing at the front open end. The release lever 51 further has a contact portion 53 extending between the opposed sides thereof with a circular transverse cross-section and is positioned to engage the top of the sole of the toe portion of the ski boot 12. A handle 54 extends upwardly and forwardly from the back of the release lever 51 and is used for manually setting the release lever in the clamped or unclamped position.

The release lever 51 is urged rearwardly by a force-applying assembly including a compression spring 55 on a support sleeve 56 and is held against axial movement by a flange 56a at its rear end and by the front wall 42 of the housing. The front end portion of the sleeve 56 extends through the slides freely in an aperture in the front wall of the housing and terminates in a screwdriver slot 56b at its forward end. The rear end of the sleeve is internally threaded and threads into a T-shaped connecting member 57 having a transverse head portion 57a journaled around and rotatable on a cross-pin 58 secured to the front upper end portion of the lever 41 at its ends. The connecting member 57 has external threads which thread into the internal threads in the support sleeve to 56 to adjust the compression forces on the spring 55. In the clamping position, the contact portion 53 is located forwardly and above the fulcrum or pivot member 52 and the cross-pin 58 is rearward and above the pivot member 52.

With this arrangement the lever 51 is forwardly yieldable to allow the ski boot to slide a short distance along the ski in response to a longitudinal thrust on the ski boot. The contact portion 53 is urged downwardly and rearwardly into engagement with the top of the boot sole by the force of the spring being held under compression between wall 42 and flange 56a. The compression on the spring is changed by rotating the sleeve thereby changing space between the flange 56a and front wall 42 and as the spring is compressed more threads are visible on connecting member 57.

In the operation of the toe binding 14, the release lever 51 pivots between a toe engaging position shown in full lines and released position shown in dashed lines at 60. In the released position, the rear end of the sleeve 56 swings down about a point of support by the forward wall to a lower position at the bottom of the housing and the toe-engaging portion 53 moves upwardly and forwardly away from the boot toe. The cross-pin 58 swings down to approximately the same height as the lower pivot 52 in the released position.

A trigger member 61 is mounted on the pivot 52 and has a forward portion 61a offset from a rear portion 61b with a common intermediate hub-like head portion 57a as above-described, pivoted on pivot member 52. The forward and rear portions are arranged relative to one another so that when the lever 51 is in the forward released position it rests on the forward portion 61a and the rear portion 61b is rearwardly and upwardly inclined on an angle. A downward force is applied to the rear portion 61b when the ski boot is put in place on the ski such as when the skier steps into the binding and this urges the forward portion 61a upwardly against the underside of the lever 51 causing it to be raised and be urged back to the ski boot fastening position. Alternatively, a force may be applied to handle 54 to move the lever to the clamping position. Again, when a preselected amount of forward thrust is applied to the toe of the boot as with a forward fall, or with a vertical thrust at the toe as with a back fall, the lever 51 is moved forwardly against the forces of the spring 55 which will yield forwardly and when sufficient forward thrust is applied to the ski boot, it pivots forwardly toward the released position, as shown in dotted form in FIG. 3, shown in dashed lines. The amount of forward thrust required to effect release is adjusted by rotating the sleeve to adjust the compression forces of the spring 55.

The compression of the spring 55 also controls the amount of lateral thrust required to release the heel binding above-described. Again, when a lateral thrust is applied to the heel of the ski boot during skiing a bearing surface on the forward bearing plate 22 moves against the opposite cam surface on the rear cam plate causing the ski boot to slide forwardly against the forces of the spring. When the lateral thrust is sufficient to overcome the resistance of the cam surface and the spring forces, the bearing surface will clear the extremity of the cam surface and the binding will release laterally at the heel. The intermediate support plates 15 and 16 provide lateral restraint between the heel and toe and establish an intermediate pivot centered approximately under the weight of the skier whereby to reduce the torque or twist on the leg as is also described in my copending earlier-filed application.

The graph or diagram shown in FIG. 4 illustrates the relationship of the several types of release forces to the

spring compression forces applied by the spring 55 rearwardly against the lever 51. The diagram was plotted using an upright arm placed in a ski boot on a ski to simulate the leg and foot and applying a torque thereto which would simulate back-fall thrust and twist or lateral thrust which are applied to the ski boot during skiing. The heel binding 13 above-described was given a cam angle of about 35° to a line normal to the longitudinal axis at the ski, and the pull-out angle was 40° to the horizontal. Intermediate support plates 15 and 16 established an intermediate pivot centered about 5 inches from the heel and about 5½ inches from the toe.

In the graph of FIG. 5, the spring compression is indicated by a number of exposed threads on the connecting member 52 which increases along the y-axis and the release thrust in foot pounds of torque applied to the ski boot in the ski boot which increases in value along the x-axis. The graph has a line P showing the relation of spring compression to release forces applied to the ski boot in foot pounds torque. The line P shows that when the spring compression is approximately at a minimum for a position of two exposed threads only about 28 foot pounds of force is required to laterally release the heel binding. However, as the spring is further compressed and additional threads are exposed and for example when six threads are exposed, about 40 foot pounds is required to laterally release the ski boot at the heel. The graph has a line R showing the relation of back fall, which is a vertical force at the toe, and spring compression. Line R shows that at a setting of two exposed threads about 50 foot pounds is required at toe to release the toe binding and when the compression forces are increased about six threads are exposed and about 73 foot pounds is required for a back fall vertical release at the toe. The line S for front fall which is a heel pull-out vertical release shows that a two thread setting requires about 58 foot pounds to release the heel binding and the six thread setting requires about 83 foot pounds of thrust to release the heel binding. Accordingly, the graph illustrates that all of the release forces for the ski boot may be adjusted to selected values for a particular skier's requirements by adjusting the compression forces of the spring 55.

Referring now to FIGS. 5 and 6, there is again shown rear cam plate 18 mounted on the ski 11 as in FIGS. 1 and 2 with a modified form of forward bearing plate 61. The rear portion of the bearing plate 61 is the same as plate 22 and it cooperates with the cam surfaces of the rear cam plate 18 to control the lateral and vertical release of the ski boot as above described. The forward end of plate 61 is modified by providing a front extension 62 with additional apertures receiving screw fasteners 63 to further secure to the bottom of the sole of the ski boot. The forward extension 62 has an elongated intermediate slot 64 formed therein having an enlarged rear end portion 64a and a narrowed forward end portion 64b which terminates in a rounded forward end portion 64c. A pivot support member 66 is secured to the ski and has a circular head 66a disposed above the top surface of the anti-friction plate 19 and is located in the forward end portion 64c of the slot to provide restraint against lateral movement of the ski boot relative to the ski and further provides an intermediate pivot about which the ski boot will turn when twisting forces are applied to the ski boot.

In the ski binding apparatus shown in FIGS. 7 and 8, a heel binding 70 is modified from that shown in FIGS. 1 and 2 to the extent that a rear cam plate 71 shown secured to the ski has only a pair of laterally spaced forwardly and upwardly inclined left and right side fingers 72 and 73, respectively, providing forwardly and upwardly inclined cam surfaces 74 which cooperate with opposed beveled bearing surfaces 77 on rear extensions of a forward bearing plate 76 attached to the bottom of the heel of the ski boot to restrain the heel against a pull-out. In this form there is substantially no lateral restraint at the heel of the ski boot but rather lateral restraint is provided at the toe by means of a modified toe binding structure generally designated by numeral 78. Toe binding structure 78 includes a top plate 79 attached to the toe of the ski boot by screw fasteners or the like. The toe plate 79 has an essentially right angle transverse cross-section with an upper leg 79a on the top surface of the boot sole and a lower leg 79b on the forward face of the boot sole. The toe plate 79 is further contoured or shaped along its length to conform to the contour of the toe of the ski boot. The toe plate 79 has a forwardly projecting tapered male end portion 80 providing left and right side bearing surfaces 81 and 82 which extend into a female portion 83 formed in a modified toe lever 84 providing opposed tapered cam surfaces 85 and 86. The toe lever 84 has generally the same shape as lever 51 shown in FIGS. 1 and 2 although the handle 54 has been removed for clarity. Lever 84 is pivoted about a lower pivot or fulcrum and is urged rearwardly by a compressed spring as is lever 51. The lever 84 is modified from that of lever 51 in that in place of contact portion 53 there is a flat rearwardly and downwardly inclined segment 86 with the lower corner edge forming a contact portion 87 bearing down against the top of the male arcuate inclined portion to restrain both vertical and lateral forces.

There is further provided another form of intermediate support for the ski binding apparatus of FIGS. 7 and 8 in the form of a pivot plate 88 fastened to the bottom of the ski boot with an elongated slot 89. A pivot member 91 is mounted on the ski and has a head 91a disposed in the slot to restrain lateral movement while allowing horizontal movement for the ski and provide an intermediate pivot for the ski boot. The operation of this form shown in FIGS. 7 and 8 is similar to that of FIGS. 1 and 2 except that the lateral restraint is at the toe rather than at the heel. When a lateral force is applied to the toe of the ski boot, there is relative movement between the cam surfaces and bearing surfaces until the forward extremities of the bearing surfaces clear the cam surfaces. Again, the release forces are adjustably controlled by the setting of the compression spring in the toe binding.

Another form of heel binding shown in FIGS. 9 and 10 comprises a rear cam plate 94 mounted on the ski and a forward bearing plate 95 secured to the heel of the ski boot with suitable screw fasteners. The rear cam plate 94 has an upstanding front wall 94a and upstanding opposed side walls 94b and has a male member 96 projecting forwardly of the forward wall 94a which is tapered forwardly and provides left and right side cam surfaces 97 and 98. The male cam member 96 is removably fastened to the cam plate by a screw 99. The cam surfaces are received in a tapered female portion at the rear of the bearing plate providing a pair of tapered bearing surfaces 101, and 102. The rear cam

plate further has forwardly and upwardly inclined left and right side fingers 104, and 105 respectively, outside the cam surfaces 97 and 98, which are extensions of the upstanding front and side walls so that they are elevated substantially above the top surface of the ski. The side fingers 104 and 105 provide cam surfaces 106 along the undersides thereof.

The forward bearing plate 95 has an essentially right angle transverse cross-section to fit the contour of the back and bottom faces of the heel of the ski boot and includes an upright leg portion 95a and inturned lower leg 95b. The upper edge of the upright leg 95a is disposed under the fingers 104 and 105 and provides bearing surfaces 108 at opposite sides of the heel. Again, when a vertical force is applied to the heel of the boot, the bearing surfaces 108 ride along the cam surfaces 106 and release when the bearing surfaces 108 pass the extremities of the cam surfaces 104 and 105. The principal advantage of this form is that the cam and bearing surfaces are elevated substantially above the top surface of the ski to be free from snow, ice and the like.

Referring now to FIGS. 11, 12, and 13, there is shown a toe plate 111 which is suitable for use with the heel bindings above described to provide lateral restraint at the heel. This toe plate 111 provides no lateral restraint and has an essentially right angle transverse cross-section with an upper leg 111a extending over the top of the sole and a depending lower leg 111b extending along the forward face of the sole. The toe plate is contoured or shaped along its length to conform to the contour of the forward portion of the sole of the boot. The toe plate 111 is provided with a forwardly projecting flat-sided male portion 112 with a flat upper surface against which the contact portion 53 of the releasable lever is urged. The lower leg 111b has apertures through which screw fasteners 113 extend to fasten the toe plate to the ski boot. The use of a toe plate as shown in FIGS. 7, 8 and 11-13 affords a more positive clamping action of the lever of the toe binding against the ski boot and a more effective release than by clamping directly against a ski boot sole.

Referring to FIGS. 14 through 19, there is shown another form of ski binding apparatus wherein there is provided an intermediate step-in carrier 115 sized and shaped to receive a lower portion of the sole of the ski boot. The carrier 115 rests on the ski 11 and is releasably held thereon by a rear cam plate 116 fastened to the ski and an alternative form of toe binding 117. The step-in carrier 115 has a relatively flat base portion 118 with side edges parallel to and substantially the same width as the ski, a raised toe portion 119 and a raised heel portion 121. The base has recessed portions 119a in the bottom thereof. The toe portion 119 has an overhanging lip 122 and opposed sides 123 defining a cavity sized and shaped to receive the front of the sole of the boot and inhibits forward and lateral movement of the ski boot relative to the carrier. Lock nuts 124 may be threaded down through the opposite sides of the lip 122 to bear against opposite sides of the sole of the ski boot so as to compensate for varying thicknesses in the sole of the ski boot. A forwardly projecting male portion 120 with a flat upper surface is releasably engaged by the contact portion of the toe binding 117. The heel portion 121 has a back portion 125 and opposed sides 126 defining a recessed area sized and shaped to receive the heel of the boot and hold the ski boot against

lateral movement and rearward relative to the carrier.

A releasable heel fastening mechanism 128 is provided to releasably fasten the ski boot to the carrier at the heel thereof. The heel fastening mechanism 128 comprises a pair of opposed adjustable connecting arms 131 and 132 having inturned lower end portions which are releasably inserted into a selected one of a plurality of opposed apertures 133 located at spaced intervals in the upstanding carrier sides 126. The connecting arms 131 and 132 have inturned upper end portions which are pivotally connected to a pivot lever 134 between the upper and lower end thereof, the lower end of the lever bearing down against the heel of the boot to apply a holding pressure thereto. In use, the ski boot is inserted into the carrier 115 and slipped under the screws 124 and the lever 134 is brought into engagement with the heel to hold it down. The spaced apertures 133 facilitate adjustment of the mechanism, and the length of the connecting arms is adjustable by raising a sleeve 131a which threads over upper and lower link portions 131b and 131c, respectively.

In order to establish an intermediate lateral restraint and a pivot for the carrier there is provided an elongated tapered slot 136 formed in the underside thereof to receive a tapered head 137 fastened to the ski establishing a pivot about which the carrier will turn as the ski boot is twisted. An advantage of this carrier is that no pivot structure or modification is required for the ski boot.

The rear cam plate 116 shown in FIGS. 14-19 has a forwardly tapered male end portion 141 providing a pair of forwardly and inwardly inclined cam surfaces 142 and 143 which cooperate with a female end portion 144 provided at the rear of the step-in carrier defining a pair of opposed bearing surfaces 145 and 146 which receive and overlap cam surfaces 141 and 142, respectively to provide for lateral restraint of the rear end of the carrier relative to the ski. The rear cam plate 116 further has forwardly and upwardly inclined left and right side fingers 149 and 150 providing a pair of cam surfaces 151 at opposite sides of the plate 116 which overlie associated bearing surfaces 152 on a rearwardly and downwardly extending male projection 153 on the carrier. The rear cam plate 116 has upstanding sides 154 with a slot 154a to receive a strap hook. This structure serves to provide lateral restraint and vertical restraint for the carrier at the heel of the ski boot in the same manner as with respect to the previously described forms of heel bindings shown in FIGS. 1, 2, 5, 6, 9 and 10.

The toe binding shown in FIGS. 14, 15 and 16 has a housing 156 fastened to the ski and pivotally supporting a lever 157 about a lower pivot together with a T-shaped connecting member 158, a sleeve 159 and a compression spring 160 of similar construction, arrangement and operation as that shown in FIGS. 1 and 4. The forward end of the sleeve 159 terminates in an externally threaded end section 161 having a screw-driver slot 162 at the end.

A nut 163 threads over the threaded section 161 and has a rear section 163a of a reduced diameter which extends rearwardly through an aperture in the forward wall of the housing 156 with the forward larger section 163b being restrained against movement into the housing. An actuating handle 165 has laterally spaced, depending side arms 166 which extend outwardly of outer

flat sides of the nut 163 and the handle is pivotally mounted on the nut, the pivot being above the threaded section 161 and established by transverse pivot pins 167. In use, the handle 165 is moved upwardly and forwardly away from the top of the housing, the lower rear corner of 166a of the side arms bear against the front wall of the housing and forces the nut 163, sleeve 159, and lever 157 to move forwardly. As the handle is pivoted further, the bottom edge 167b of the side arm engages the front wall of the housing and this holds the lever in the released position against the forces of the spring until the handle is urged rearwardly and the spring forces return the handle to the prone position. The operation of the toe binding 117 in restraining the ski boot is substantially the same as that above described with reference to FIGS. 1 and 3.

The ski binding apparatus shown in FIGS. 20, 21 and 22 includes another form of step-in carrier 171 having a flat-surfaced base with straight sides and having a lesser width than that of ski 11. This carrier also has a series of opposed holes 172 in opposite sides of the rear portion adapted to receive the inturned lower end portions of a release mechanism 128 like that above described for releasably fastening the heel of the boot thereto. The rear end of the carrier 171 is flat and terminates at its rear end substantially forwardly of the rear end of the boot leaving room for a rear cam plate 173 to fit under the rear end of the heel portion of the ski boot. The rear cam plate 173 has a forwardly and upwardly inclined cam surface 174 on opposite sides separated by an intermediate cam section 174a made of Teflon or the like. The cam surface 174 overlays rearwardly and downwardly inclined bearing surfaces 175 formed at opposite sides at the rear end of the carrier 171. Preferably the cam surface 174 is formed by providing a coating or an insert body of Teflon. This heel binding arrangement affords vertical restraint against the heel pull-out but not the same degree of lateral restraint in the same manner as above described with reference to FIG. 7 and 8.

The step-in carrier 171 has a vertically adjustable boot restraining assembly secured at the forward end thereof comprising an upper boot clamp-down member 179 with an arcuate contour to conform to the toe of the boot which bears down against the top of the sole of the ski boot and is fastened thereto by a pair of screw fasteners 178 which thread down into the base of the carrier. The boot clamp-down member 179 is adjustable relative to carrier by means of a selected number of spacer washers 181 between the bottom of the clamp-down member and the carrier base through which the screw fasteners 178 extend. The washers 181 are added or removed to accommodate ski boot soles of different thicknesses. The boot restraining assembly further has forwardly projecting member 182 having an upper step 182a along the rear end received in a stepped recess in the clamp-down member 179 and a lower step 182b received between the upper surface of the carrier base and the front of the clamp-down member. The projecting member 182 is releasably fastened to clamp-down member 179 by a screw 183. The projecting member 183 has forwardly projecting portion extending beyond the carrier body 171 with a convex socket area 185 as viewed from the side at the forward upward end thereof. As best seen in the top plan view of FIG. 20, the socket area is concave to provide a pair of opposed tapered bearing surfaces 187 and 188

and may be of Teflon or the like. The lever on the toe binding for this form has a pair of intumed pins 186 which support a roller 189 with a concave periphery providing cam surfaces 190 and 191 supported by the ski. Among the advantages of the auxiliary step-in carrier are that no alteration of the boot is required, particularly for the intermediate pivot, no attachments to the boot are required which might cause slipping when walking on ice or the like. The carrier permits precise adjustments in the ski shop and permits use with a wide variety of ski boots. The carrier is made of a material which affords its own anti-friction action. A preferred construction for the carrier body is aluminum or other suitable material covered with a molded anti-friction plastic or the like. Moreover, the carrier has its own pivot slot so that nothing is carried by the ski boot and covers the intermediate support to prevent collection of ice, snow and the like in the slot.

The intermediate pivot support for the carrier shown in FIGS. 20 and 21 comprises a disc-like member 192 having an upwardly and inwardly tapered head portion 192a with a recessed central area 192b sized to receive the head of a fastening screw 193 together with a flat-surfaced washer-like base portion 192c with a bottom ring-like flange 192d. The flat base portion 192c rests on an anti-friction plate disc or washer 194 made of Teflon or the like. This disc-like member 192 is disposed in a tapered slot 195 in the bottom of the carrier and serves as a lateral movement restraining member and an anti-friction device. During the normal course of skiing when an abnormal thrust occurs, there is likely to be more weight on one side edge of the ski than the other. This center pivot arrangement will cause the rotating disc-like member 192 to act as a roller bearing and facilitate movement of the boot fore and aft. The angle or incline of the head portion 192b serves to regulate the release force. The heel binding shown in FIGS. 23 and 24 is similar to that described in FIGS. 20 and 21 but it further has a centrally disposed forwardly tapered male portion 196 providing opposed cam surfaces 197 and 198 which are received by a rearwardly projecting female portion 199 formed in the rear of the carrier providing opposed bearing surfaces 200 and 201 to provide lateral restraint at the heel. The toe binding shown in FIGS. 25 and 26 may be used in conjunction with the heel binding of FIGS. 23 and 24 and utilize a flat-sided roller 202 on the lever on the release lever and a complementary flat concave surface 203 on the toe member.

Yet a further form of toe binding structure shown in FIGS. 27 and 28 comprises a boot restraining portion 179 releasably fastened to the carrier body with a projecting member 205 having concave semi-circular area 206 forming a socket part of a ball and socket joint. The toe binding has a unit 210 attached to the ski including a cylinder 207 with a plunger 208 slidable in the cylinder and terminating in a ball portion 209 at the rear end adapted to engage socket 206. A compression spring 213 held between the front end of the cylinder and a cap 214 threaded on the end of the cylinder yieldably urges the ball against the socket. An O-ring 212 is provided in the recess of the cylinder to seal the cylinder from the plunger. The spring is compressed by turning the rear cap 214 for a particular compression setting. The angles of the anti-friction material under the ball of the plunger is used to establish the correct lateral and vertical thrusts for release. In the operation

of this form, the ball will yield forwardly upon the application of a thrust along the ski and will release vertically when the socket clears the ball upon the application of a preselected amount of forward thrust. A bellows cuff may be used between the cylinder and plunger as an alternative to the O-ring 212.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.

What is claimed is:

1. In ski binding apparatus for releasably securing a ski boot to a ski, the combination comprising:

a binding at one end of the ski boot, said binding being yieldable to permit movement of the ski boot along the ski,

intermediate lateral movement restraining means for the ski boot establishing a pivot between the toe and heel of the ski boot about which the ski boot will turn and supporting said ski boot for controlled longitudinal sliding movement relative to the ski, and

lateral movement restraining means at the end of the ski boot opposite to said binding including cam surfaces, there being bearing surfaces opposite said cam surfaces associated with and movable with the movement of the ski boot while maintaining engagement with said cam surfaces, said cam surfaces being arranged along the ski and inclined at an angle to the length of the ski to direct the ski boot to move along and laterally outwardly upon the application of a lateral twist to the ski boot, the bearing surfaces being movable laterally past the extremities of the cam surfaces to release the ski boot laterally upon the application of a preselected amount of lateral twist to the ski boot.

2. In ski binding apparatus as set forth in claim 1 wherein said binding is at the toe of the ski boot and said lateral movement restraining means is at the heel of the ski boot.

3. In ski binding apparatus as set forth in claim 1 wherein additional lateral movement restraining means is at the toe of the ski boot.

4. In ski binding apparatus as set forth in claim 1 wherein said cam surfaces are constructed of teflon material.

5. In ski binding apparatus as set forth in claim 1 wherein additional cam surfaces are formed on a roller arranged transversely to the ski having a concave peripheral surface located at the toe of the ski boot.

6. In ski binding apparatus as set forth in claim 1 further including a toe binding for the ski boot having yieldable, forward movement restraining means adapted to permit the ski boot to advance forwardly upon the application of a preselected amount of forward thrust to the ski boot.

7. In ski binding apparatus as set forth in claim 1 further including an auxiliary carrier for the ski boot positioned on the ski, said binding releasably connecting said step-in carrier to said ski.

8. In ski binding apparatus as set forth in claim 1, including an intermediate step-in carrier releasably connected to the ski and ski boot, said carrier having a rear end portion defining said bearing surfaces.

9. In ski binding apparatus as set forth in claim 7 wherein said cam and bearing surfaces are under the ski boot.

10. In ski binding apparatus as set forth in claim 1 wherein a pair of opposed cam surfaces are arranged on opposite sides of a longitudinal line along the center of the ski to restrain lateral thrust to either side.

11. In ski binding apparatus as set forth in claim 10, wherein said cam surfaces include a plate secured to the ski having a male end portion with tapered side edges.

12. In the ski binding apparatus as set forth in claim 10 wherein said bearing surfaces include a plate secured to the ski boot at the heel thereof, said plate having a female rear end portion with tapered opposed side edges.

13. In ski binding apparatus as set forth in claim 1 wherein said binding further includes vertical movement restraining means including second cam surfaces on the ski and second bearing surfaces movable with the vertical movement of the ski boot relative to the cam surfaces, the second bearing surfaces being movable along the ski and past the extremities of the second cam surfaces to release the ski boot vertically upon the application of a preselected amount of vertical thrust to ski boot.

14. In ski binding apparatus as set forth in claim 13 wherein said first and second cam surfaces are on a common plate secured to the ski.

15. In ski binding apparatus as set forth in claim 13 wherein said first and second bearing surfaces are formed on a common plate.

16. In ski binding apparatus as set forth in claim 13 wherein said second bearing and cam surfaces are disposed at the upper end of a plate having an upright portion spaced substantially above the top of the ski.

17. In ski binding apparatus according to claim 1 wherein said toe binding includes a movable boot restraining member at the toe of the ski boot and yieldable force applying means associated with the boot restraining member for yieldably resisting forward movement of the ski boot to permit the ski boot to move along the ski a limited distance upon the application of a preselected amount of forward thrust to the ski boot for release at the heel of the ski boot, said force applying means being adjustable to regulate the amount of thrust required to move the boot restraining member and ski boot.

18. In ski binding apparatus as set forth in claim 17 wherein said boot restraining member includes a ball portion carried by a piston movable in the cylinder, said ball portion being yieldably urged into a socket movable with the ski boot to yieldably resist forward movement of the ski boot.

19. In ski binding apparatus as set forth in claim 17 including a toe plate attached to the ski boot having a flat bearing surface engaged by boot restraining member of the toe binding.

20. In ski binding apparatus as set forth in claim 17 wherein said boot restraining member includes a lever pivoted at a lower end portion and having a rear contact portion above the pivot, said lever being urged forwardly by a spring held under compression.

21. In ski binding apparatus as set forth in claim 20 wherein the compression on said spring is adjustable to change the amount of thrust required to release said lever.

22. In ski binding apparatus as set forth in claim 20 including a handle pivoted to move the lever between a clamping position and a released position.

23. In ski binding apparatus as set forth in claim 22 wherein said toe binding has a handle attached to the rear of the lever forwardly of the contact portion and extending forwardly therefrom.

24. In ski binding apparatus as set forth in claim 22 wherein said toe binding has a housing with a forward wall, a sleeve in the housing on which said spring is supported, said sleeve having a threaded extension extending through said forward wall with a nut threaded thereon forwardly of the forward wall and a handle with depending sides pivotally mounted on the nut, said sides being urged against the forward wall of the housing to move the lever to a released position as the handle is pivoted forwardly.

25. In ski binding apparatus as set forth in claim 1 wherein said intermediate lateral movement restraining means is in the form of a pair of side plates attached to the sides of the ski and engaging the sides of the sole of the ski boot.

26. In ski binding apparatus as set forth in claim 25 wherein said lateral movement restraining means is in the form of a slot carried by the ski boot and a pin portion above the ski disposed in the slot carried by the ski.

27. In ski binding apparatus as set forth in claim 26 wherein a common plate attached to the bottom of the ski boot includes said bearing surfaces and said slot.

28. In ski binding apparatus as set forth in claim 26 wherein said slot is formed in the bottom of an intermediate step-in carrier for the ski boot.

29. In ski binding apparatus for releasably securing a ski boot to a ski including a toe binding at the toe of the ski boot being yieldable to permit movement of the boot along the length of the ski and a heel binding at the heel of the ski boot including means to resist lateral forces, the combination comprising:

a carrier releasably secured to the ski boot and releasably secured on the ski by said toe and heel bindings, and

lateral movement restraining means for the carrier between the toe and heel bindings establishing a pivot for the carrier and ski boot between the toe and heel about which the carrier and ski boot will turn to reduce strain on the skier's leg while supporting the carrier and ski boot for controlled longitudinal sliding movement relative to the ski.

30. In ski binding apparatus as set forth in claim 29 wherein said carrier has a flat base portion and a boot toe contact member adjustable vertically relative to the base portion to clamp the toe of the ski boot down against the base portion and a plurality of apertures along the opposite sides at the rear thereof adapted to receive the ends of a heel clamp mechanism to clamp the heel of the ski boot down against the base portion.

31. In ski binding apparatus as set forth in claim 30 wherein said toe contact member has a forwardly projecting portion against which the contact portions of a toe binding is urged to releasably fasten the carrier to the ski.

32. In ski binding apparatus as set forth in claim 29, wherein said carrier has a base portion, a raised front portion with a socket area shaped to receive the forward sole portion of the ski boot and a raised rear por-

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tion having a plurality of apertures along the sides of said rear raised portion, and a pair of side arms having end portions inserted into a selected of said holes and a release mechanism adapted to engage the boot heel to releasably receive the ski boot in the carrier.

33. In ski binding apparatus as set forth in claim 32 wherein said raised front portion has a forwardly directed second socket area and wherein said toe binding includes a cylinder member, a ball portion carried by a piston movable in the cylinder member, said ball portion being yieldably urged into said second socket area which is movable with the carrier and the boot to yieldably resist forward movement of the boot.

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34. In ski binding apparatus as set forth in claim 32 wherein said carrier has a longitudinally extending recess in the bottom face between the ends thereof, and a support mounted on the top of the ski positioned in the recess to provide lateral restraint and to establish an intermediate pivot for the carrier.

35. In ski binding apparatus as set forth in claim 34 wherein said support is in the form of a disc-like member having an upwardly tapered head and a flat base portion, said head being longitudinally slidable in said recess, said base portion being rotatable on an anti-friction plate.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,845,964 Dated November 5, 1974

Inventor(s) Ralph S. Johnson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Columns 9, 10, 11 and 12 missing from Certified Letters Patent.

In the Specification:

Column 1, line 17, cancel "3,731,946" and substitute  
-- 3,731,945 --.

Column 5, line 34, cancel "portin" and substitute -- portion --.

Column 10, line 56, cancel "providing".

In the Claims:

Column 13, line 57, after "by" add -- said --.

Signed and sealed this 15th day of April 1975.

(SEAL)  
Attest:

RUTH C. MASON  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents  
and Trademarks