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Weinstein

[11] **3,825,274**

[45] **July 23, 1974**

[54] **SKI BINDING WITH AUTOMATIC BOOT-TO-SKI RETURN**

[75] Inventor: **Burton Alan Weinstein,** New York, N.Y.

[73] Assignee: **National Recreation Industries, Inc.,** Stamford, Conn.

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[21] Appl. No.: **255,375**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 90,361, Nov. 17, 1970, abandoned.

[52] **U.S. Cl.** ..... **280/11.35 N**

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

[58] **Field of Search** ..... 280/11.35 N, 11.35 R, 280/11.35 C, 11.35 K, 11.35 T

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Primary Examiner—David Schonberg
Assistant Examiner—Milton L. Smith
Attorney, Agent, or Firm—Fulwider, Patton, Rieber, Lee & Utecht

[57] **ABSTRACT**

A safety-type binding in which spring-actuated drums are rotatably mounted on the ski adjacent the heel and toe to pay out and retract elongated, flexible leashes connected to the boot. In a skiing phase of operation, the binding yieldably holds the boot in the normal skiing position and permits limited shock-absorbing movement in which the leashes are payed out slightly under decreasing resistance. If forces in excess of a preselected safe level are applied and cause relative movement beyond the shock-absorbing range, the binding shifts to a release phase to permit more of the leashes to be payed off of their respective drums and the boot and ski to move relatively freely away from one another, while the ski remains leashed to the boot. The leashes are retracted and the boot and ski are drawn back together when the separation forces have abated and, once they are proximate one another, the binding automatically shifts back to the skiing phase to further retract the leashes and bring the boot back into the skiing position.

27 Claims, 12 Drawing Figures

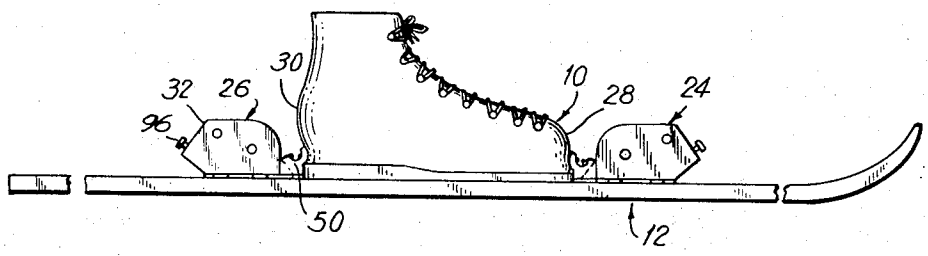
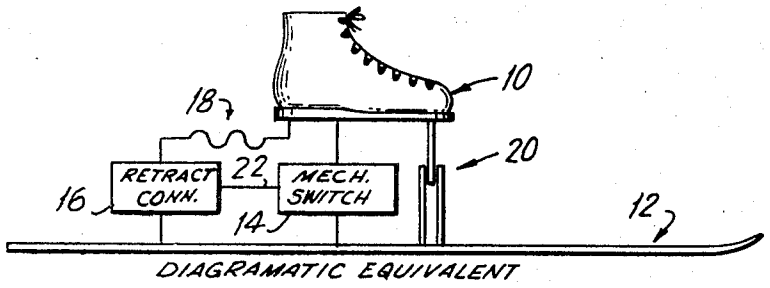


FIG. 1



DIAGRAMATIC EQUIVALENT

FIG. 3

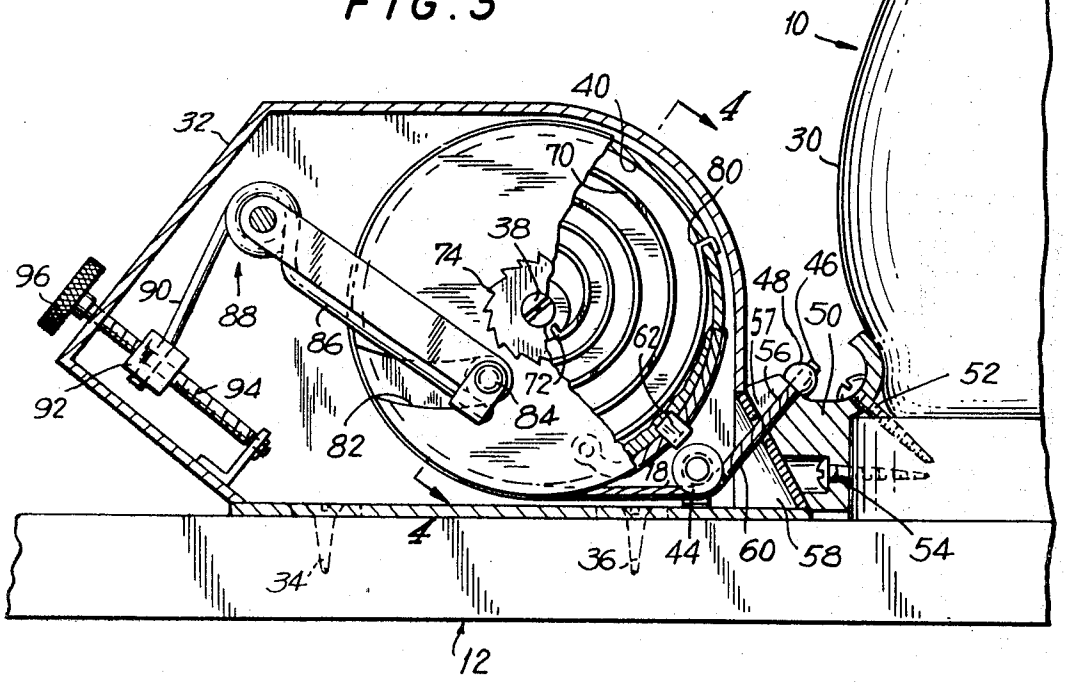


FIG. 2

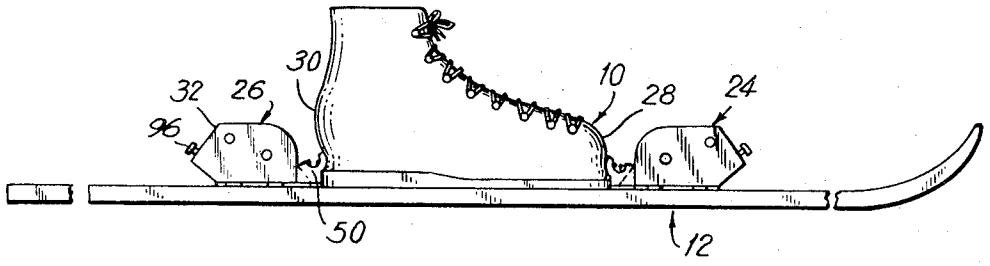


FIG. 4

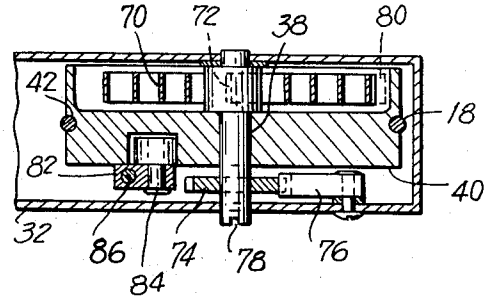
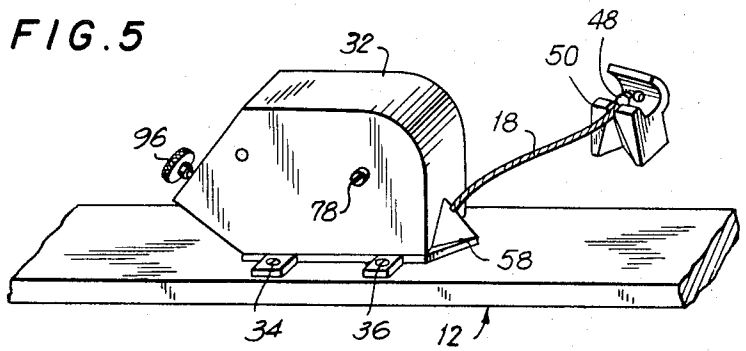


FIG. 5



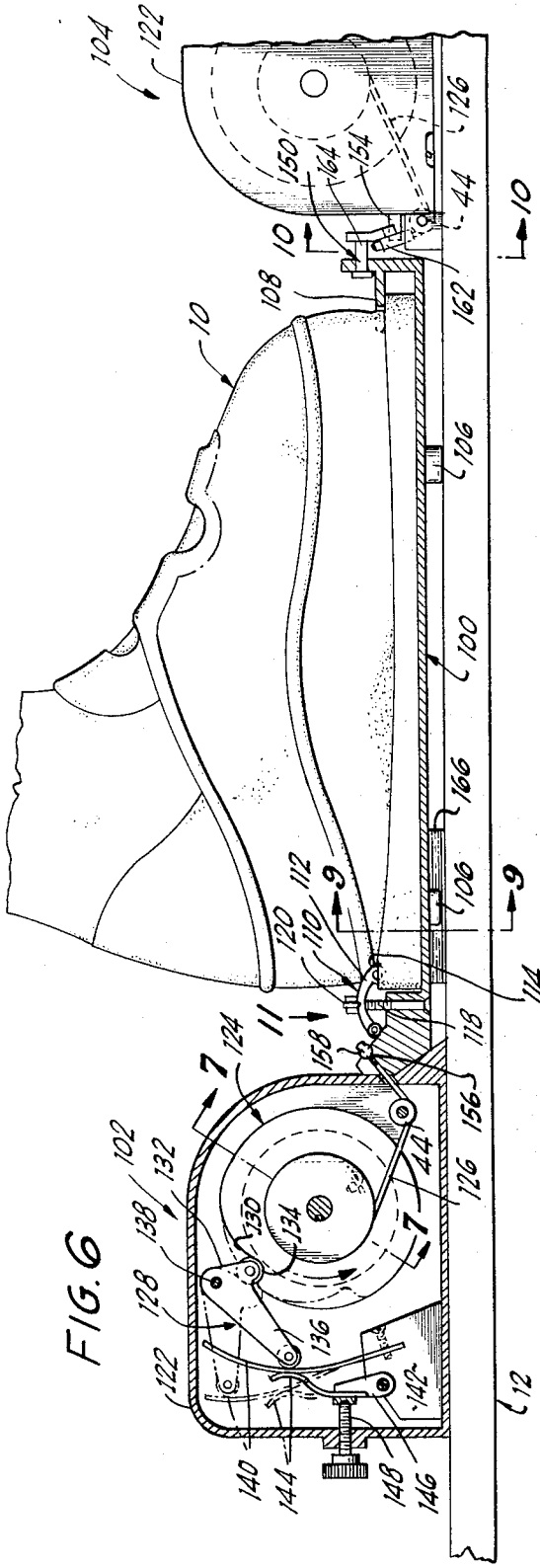


FIG. 6

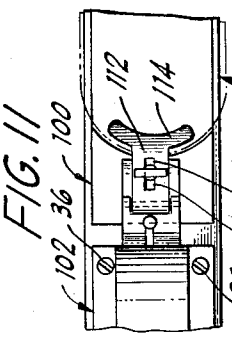


FIG. 11

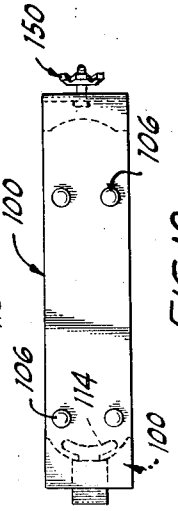


FIG. 12

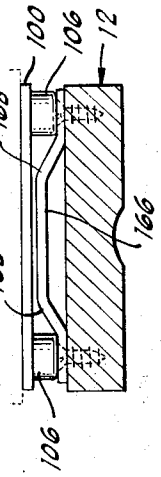


FIG. 9

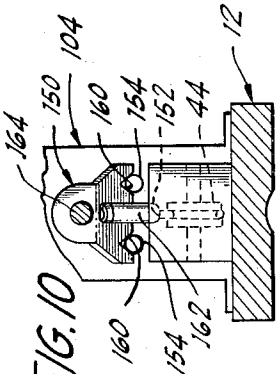


FIG. 10

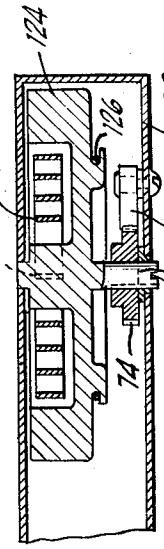


FIG. 7

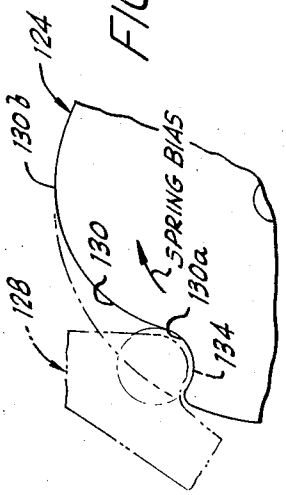


FIG. 8

SKI BINDING WITH AUTOMATIC BOOT-TO-SKI RETURN

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of my copending application, Ser. No. 90,361, filed Nov. 17, 1970 and now abandoned, entitled "Ski Binding With Automatic Boot-To-Toe Return".

BACKGROUND OF THE INVENTION

This invention relates to a safety-type ski binding adapted to release a boot from skiing position on a ski in response to forces applied to one or both in excess of a safe level.

Safety bindings are now widely accepted and significantly aid in preventing skiing injuries. Such bindings serve to hold the boot on and in alignment with the ski in the normal skiing position during normal conditions and to release the boot in response to excessive lateral or vertical forces that might result in injury. A substantial holding or coupling force is required because of the nature of the equipment and the maneuvers made in skiing. Provision should be made for limited movement between the boot and ski to allow for absorption of shock without release of the boot. Typically, slight shock-absorbing movements are permitted at both the heel and at the toe. When an abnormal or break-out force in excess of a predetermined safe level is applied, as a result of a fall or otherwise, the boot quickly moves beyond the shock-absorbing range and release occurs to prevent the application of further force which could result in injury.

Such bindings typically are adjustable not only for boot size but also to adapt them, insofar as release is concerned, to the physical characteristics and condition of the given skier. This latter adjustment serves to vary the force level at which release will occur.

It is also desirable from a safety standpoint, as well as for practical convenience, that the ski be retained in association with the boot after release. To accomplish this, conventional practice has been to provide an elongated leash which is connected between the ski and the boot to allow the ski to separate from the boot while preventing complete escape. A wide variety of types of leaches have been provided, the most common comprising a single strap fixed at one end to the ski and adapted for detachable connection to the boot at the other. There also have been elastic leashes and extendible-retractable leashes mounted on spring-actuated drums so that separation of the boot and ski following release is yieldably resisted. The latter type of leashes are intended to urge the ski and boot toward one another following release by the main binding and, thereby, avoid so-called "cartwheeling" or uncontrolled movement of the ski, which pose a risk of injury. A characteristic of all the leashes heretofore available is that they are auxiliary units that are separate for the main force-applying link between the boot and ski.

From the convenience standpoint, it is important that the boot be engaged in the binding relatively easily. Coupling of the boot to the ski is accomplished manually with many bindings. Others have been provided with a "step-in" capability which permits the skier to couple the boot to the ski by placing the boot in the binding and forcing it toward the ski.

Thus, after emergency release, it has been necessary to follow essentially the same procedure preparatory to resuming skiing that was necessary to engage the boot initially in the binding. This required either the actuation of clamps or the like by hand, or the positioning of the boot in the binding prior to pressing it toward the ski with sufficient force to actuate the binding to grip the boot. Since release often occurs on steep and slippery slopes or in deep powder snow, such recoupling has posed a real inconvenience.

SUMMARY OF THE INVENTION

The binding of the present invention meets the safety and operational criteria set forth above and has many important advantages not present in prior devices including, significantly, an automatic recoupling capability. It functions in two phases of operation. In a first or skiing phase, the boot is yieldably held on the ski in skiing position by connecting means and associated force-exerting actuating means in such a manner as to permit only slight shock-absorbing range of movement. The actuating means is responsive to the application of forces in excess of a safe level to permit relative movement of the boot and ski. Continued application of excessive forces resulting in such relative movement beyond the shock-absorbing range, operate the actuating means to a second or release phase. In this latter phase, the force on the connecting means resisting separation is reduced so as to permit the boot and ski to move apart more easily and free them for relative movement away from one another, thereby protecting the skier against injury. While the boot and ski are then relatively free of one another, they continue to be retained in association by the connecting means to prevent the escape of the ski.

After this separation during the release phase and after the forces causing separation have abated, the actuating means operates to draw the boot and ski back together. Once they are proximate one another, the actuating means shifts back into its skiing phase and acts to restore the preselected force and cause the boot to be forcefully drawn into skiing position and yieldably maintained there. By virtue of this return capability, the binding of the invention avoids the problems inherent in recoupling the boot and ski under difficult conditions with equipment heretofore available.

Another more detailed aspect of the invention is that the connecting means, which may conveniently comprise an elongated, flexible leash, serves as the sole force-applying link between the boot and ski. Because of this, the binding may be made relatively simple in construction yet reliable in operation. Moreover, detachably engaging the boot with the ski in initially preparing the ski and detaching it when through may be quickly and easily accomplished.

In the illustrative embodiments of the invention, two substantially identical binding units are mounted on the ski, one operatively associated with the heel and the other operatively associated with the toe. The actuating means of each unit comprises a spring-actuated drum mounting connecting means in the form of the elongated, flexible leash. The drums rotate to pay out and retract the leashes to permit the slight shock-absorbing movement in the skiing phase, and to permit the boot and ski to move a substantial distance away from one another to assume a relatively "free-floating" relationship and to draw them back toward one another during

the release phase. The spring force acts to rotate the drums so as to retract the leashes or, conversely, to resist rotation in the opposite directions in which the leashes are payed out. Such force is high during the skiing phase and relatively low during the release phase.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of a diagrammatic equivalent of an illustrative embodiment of the invention;

FIG. 2 is a side elevational view illustrating a cooperating pair of binding units constructed in accordance with the invention and in their skiing phases mounting a boot in skiing position on a ski;

FIG. 3 is a view on an enlarged scale, partly in section and partly in elevation, illustrating the rear or heel binding shown in FIG. 2;

FIG. 4 is a partial sectional view taken along the lines 4—4 in FIG. 3;

FIG. 5 is a perspective view of the binding illustrated in FIG. 3 mounted on a ski but in its release phase with the connecting means extended;

FIG. 6 is a view similar to FIG. 7, partly in elevation and partly in section, illustrating another embodiment of the invention;

FIG. 7 is a partial sectional view taken along the lines 7—7;

FIG. 8 is a fragmentary elevational view on an enlarged scale of the cam surface on the drum shown in FIG. 6, with certain cooperating parts being shown in phantom lines;

FIG. 9 is a sectional view taken along the lines 9—9 of FIG. 6;

FIG. 10 is a sectional view taken along the lines 10—10 of FIG. 6;

FIG. 11 is a top plan view of a portion of the binding unit shown at the left end of FIG. 6; and

FIG. 12 is a bottom view on a reduced scale of a boot-receiving sole plate assembly shown in FIG. 6.

DETAILED DESCRIPTION

Referring to the drawings, the invention is embodied in a ski binding for coupling a boot 10 on a ski 12 in skiing relation, and having release and automatic return capabilities. Mounting elements are provided on the boot and ski and are joined by connecting means. Actuating means carried by one of the elements and coupled to the connection means, act on the latter to achieve the desired retention, release and return functions.

For purposes of providing a further understanding of the function of the binding, and referring more particularly to the diagrammatic representation of FIG. 1, the binding of the invention involves a mechanical switch 14, which functions, in a first or skiing phase, to retain the boot 10 on the ski 12 in skiing relationship despite the application of substantial force below a preselected magnitude on one or both of these members. Mechanical switch 14 permits slight displacement of the boot relative to the ski as might result from normal shocks encountered in skiing. When the preselected magnitude of force and/or displacement is exceeded, the binding shifts to a second or release phase and the boot assumes a "free-floating" relationship with respect thereto. The relationship is free floating in the sense that the force resisting separation is substantially reduced and the boot may move in a variety of angles and directions relative to the ski so as to prevent injury. A retractable connection 16 assures that the boot 10 does not become completely disconnected from the ski 12 and, as will be shown, includes an elongated, flexible leash diagrammatically indicated at 18 for this purpose. The mounting of this permanent connection, however, is such as not to interfere with the free floating relationship indicated above.

Referring still to FIG. 1, the leash 18 is extendible and retractable and extends during relative movement of the boot 10 and ski 12. The retractable connection 16 stores energy as the boot becomes displaced relative to the ski, this stored energy being effective upon abating of the separating forces to retract the leash 18, thereby drawing the boot 10 back towards the ski 12. To assure that the boot moves into proper attitude and alignment on the ski, a guiding structure 20 is provided, the details of which will be indicated hereinafter. When the boot and ski are drawn proximate one another, the binding shifts back to its skiing phase. This results in the boot 10 being forcefully drawn into and again yieldably held in skiing position under the influence of the preselected force.

A coupling 22 is indicated in FIG. 1 between the switch 14 and the retractable connection 16, this merely indicating that this element 16 is effective to store energy during all displacements of the boot 10, including those displacements which are permitted by switch 14. As will be seen, the coupling 22 is not always essential inasmuch as within a certain range of proximity of the boot 10 to the ski 12, the switch 14 may assume the coupling function and bring the boot 10 into homing relationship on the ski 12 and yieldably retain it there.

The structure for coupling the boot to the ski in the cases of both the switch 14 and the retractable connection 16 comprises connecting means and, as will appear, may advantageously constitute a single link, namely, the leash 18. Also, the sensing and force-applying functions of the switch 14 and the connection 16 may be considered as being carried out by actuating means, and may physically comprise separate elements or, as in the illustrative form, embody common elements.

Referring to FIG. 2, a pair of bindings 24 and 26 constructed in accordance with the invention are shown mounted in a cooperating arrangement on ski 12 to releasably retain or couple the boot 10 in skiing relationship. The binding 24 is mounted on the ski 12 adjacent toe portion 28 of the boot 10, and binding 26 is mounted on the ski adjacent the heel portion 30. The mode of operation and the details of bindings 24 and 26 will be more clearly understood from an examination of FIGS. 3 and 4, which show the details of the heel binding 26, the binding 24 being similar in construction and operation.

In FIGS. 3 and 4, a casing 32 is shown mounted on the ski 12 by screws 34 and 36. The casing 32 rotatably supports a shaft 38 on which is rotatably mounted a drum 40. The leash 18, here comprising a wire cable, is wound upon the drum 40 and is preferably accommodated within a groove 44 and has a free end 46 provided with a bead 48 thereon.

A guide section 50 is connected to the boot 10 by means of screws 52 and 54. This guide section is provided with an opening through which the leash 18 extends, the bead 48 providing for connection of the leash 18 to guide section 50. Preferably, although not

necessarily, the opening **56** has a top opening (FIGS. **3** and **5**) slot **57** through which the cable may be removed to free the boot, which in this instance carries guide section **50** to enable the boot, if desired, to be completely detached from the ski. A cooperating guide section **58** is provided on the ski, the section **58** being provided with a bore **60** through which the leash **18** also extends. Thus, it may be seen that guide sections **50** and **58** are mating male and female connecting and guiding elements having suitable configurations for guiding the boot into a predetermined attitude relative to ski **12.** The shapes of the mating surfaces of elements may be conical or pyramidal or the like; and, as is hereinafter explained, shaped so as to obtain a desired variation in the external forces applied to the boot and/or ski to extend the leash **18** depending upon the direction of application.

A fixture **62** is connected to the leash **18** and limits the amount of leash **18** which can be payed off the drum **40,** since the fixture **62** cannot pass beyond the pulley **44.** The drum **40** therefore constitutes a displaceable element in the rotational sense, and the fixture **62** limits this displacement to less than one rotation.

A spiral spring **70** is provided in operative association with the drum **40** and arranged to bias the drum in a direction to retract the leash **18.** The spring **70** has an end **72** engaged with the shaft **38.** Mounted on the shaft **38** is a ratchet **74** adapted for engagement by a pawl **76,** whereby the strength of the spring **70** can be adjusted by insertion of an appropriate tool in a slot **78** provided in one end of shaft **38.** The other end **80** of the spring **70** may be connected to an end of the leash **18,** or to the periphery of the drum **40,** as shown in FIG. **3.** As is apparent, the shaft **38** is rotated to effect adjustment of the spring force, but remains stationary during rotation of the drum **40** in paying out and retracting leash **18.**

A force substantially greater than that exerted by spring **70** is exerted on the leash **18** by a second spring **88** which also acts on the drum **40** to urge it in a direction to retract the leash. The spring **88** is active during the skiing phase to draw forcefully the boot into skiing position and yieldably retain it there and is disabled during the release phase. This spring is active over a relatively small range of movement which may be considered as a shock-absorbing range. As may be seen in FIGS. **3** and **4,** the drum **40** is provided with an outwardly opening slot or cam cut **82** which accommodates a pin **84** on one arm **86** of the spring **88,** another arm **90** of which is connected to a nut **92** on an adjustment screw **94.** Adjustment of head **96** of the screw **94** operates through the nut **92** to alter the strength of spring **88.** In this manner, adjustment of the preselected force may be accomplished.

By appropriate shaping of the slot **82** and choice of the spring **88,** the resistance to extension of the leash **18** may be programmed in a desired fashion. Preferably, the resistance is maximum when the leash **18** is fully retracted and the boot **18** is in skiing position, and then progressively decreases fairly rapidly over the first phase as the leash extends. With such an arrangement, a force in excess of the preselected magnitude must be applied to the leash **18** before any extension occurs. The binding is then responsive to extension of the leash to reduce the resistance in the indicated manner. Finally, the resistance is at a relatively low level during the second phase, for example, at less than one-half of the maximum. It will be understood that there need be no marked variation in the rate of change of resistance in transitioning from the first to the second phase. In fact, a smooth transition between phases, without any sharp break in the force-distance curve, is preferable.

As may be seen in FIG. **3,** the pin **84** moves progressively farther from the center of rotation of the drum **40** as the latter rotates to pay out the leash **18.** Thus, the movement arm becomes progressively larger and, in this manner, the desired progressive decrease in resistance during the skiing phase is achieved. While there is some increasing resistance exerted by the spring **88** as it is torqued, it is not enough to overcome the effect of the progressive increase in length of the movement arm.

Assuming that forces are exerted on the boot **10** and/or ski **12** which tend to displace the boot **10** from its skiing position illustrated in FIG. **3** relative to ski **12,** these forces and the resulting displacement will be yieldably resisted by the spring **88** and by the pin **84** riding in groove or slot **82.** In other words, during this first or skiing phase of operation, a slight shock-absorbing displacement of the boot **10** will be permitted against the yieldable opposition of spring **88.** The spring **70** also acts during this phase, but its effect is relatively insignificant.

Responsive to a force acting on the leash **18,** which is in excess of the preselected level, and extension of the leash **18** beyond the shock-absorbing range, the drum **40** rotates sufficiently to allow the pin **84** to escape from the slot **82.** The spring **88** will no longer resist rotation of the drum **40,** and the binding then enters its second or release phase of operation in which the only resistance to displacement of the boot **10** is offered by the spring **70** to the limit permitted by the position of fixture **62** on leash **18.** The resistance is light relative to that initially imposed and the boot **10** may move under this reduced resistance a substantial distance away from the ski **12,** and is then in the free floating relationship with respect to the ski **12** and can move into various, generally unlimited, attitudes relative to the ski **12.** During this period, the spiral spring **70** is storing energy, being wound by the paying out of the leash **18** and the accompanying rotation of the drum **40.**

When the separating forces have abated, the spring **70** will commence returning to its original position of rest. In so doing, it rewinds the leash **18** on the drum **40** and draws the boot **10** towards the ski **12** or vice versa. When the leash **18** has been retracted sufficiently, the pin **84** enters into the slot **82** and the spring **88** takes over all or greatly supplements the rewinding function of the spring **70.** The guide section **50** engages with the guide section **58** and boot **10** is pulled into desired attitude atop the ski **12** in alignment therewith and yieldably retained there.

It will be appreciated that with the binding of the invention, relative displacement of the boot and ski may occur in the skiing phase which do not result in shifting to the release phase. Once the force acting to extend the leash drops below the retracting force at that position, retraction commences. Thus, the pin **84** may ride back and forth, repeatedly, in the slot **82** during skiing without exiting from it. Within this relatively small range of movement, the skier maintains control over

the ski. Moreover, it is even possible in practice for the binding to enter the release phase and, assuming the separating forces sufficiently reduce, to shift back to the skiing phase without the skier ever losing control of the ski.

An alternate embodiment of the invention is illustrated in FIGS. **6–12.** This embodiment differs from the former in the manner in which it is connected to the boot **10.** A detachable sole plate assembly **100** carrying mounting and guiding means is provided for this purpose in operative association with substantially similar toe and heel bindings **102** and **104.** In addition, it differs in the detailed construction of the actuating means for controlling operation of the binding during the skiing phase of operation.

Referring to FIG. **6,** the sole plate assembly **100** comprises an elongated member extending along the full length of the boot under the sole and having antifriction pads on its underside. For purpose of detachably receiving the boot **10,** the plate assembly **100** may be of conventional construction. By way of illustration, it is shown to include a rearwardly projecting lip **108** at its toe end for engagement with a projecting portion of the boot and a clamp assembly **110** at the heel and engageable with the heel portion of the boot. The clamp assembly includes an arm **112** pivoted at one end and formed with a bulbous opposite end **114** which engages in an upwardly facing recess in the boot heel, such as is conventionally provided on boots for mounting purposes. For clamping the arm **112** in place, it is slotted centrally as at **116** in FIG. **11** and receives a threaded end portion of an upwardly projecting post **118** which, in turn, mounts a removable wing nut **120.**

As indicated, the bindings **102** and **104** are of substantially similar construction and only heel unit **102** is shown in detail. It embodies a casing **122** rotatably mounting a spring-biased drum **124** for paying out and retracting a leash **126.** The mounting of the drum **124** and the manner in which it is spring-biased by an adjustable, spiral spring are the same as with the previously described embodiment. Accordingly, such parts are not again described, but rather identical parts are identified with the same numerals.

During the first or skiing phase of operation, the drum **124** rotates under the influence of a spring-actuated bell crank assembly **128** which engages a cam surface **130** on the periphery of the drum. In the second or release phase, the crank assembly engages the circular periphery of the drum so that it imposes relatively no resistance and rotation is under the reduced influence of only the spiral spring **70.**

The cam surface is illustrated on an enlarged scale in FIG. **8** and may be seen to curve progressively outwardly from an initial position **130a** in which contact with the crank assembly is made at a location closest to the axis of rotation of the drum to a terminal location **130b** in which it merges with the circular drum periphery. The crank assembly has a relatively short arm **132** which carries a follower roller **134** engageable with the cam surface **130** and a relatively long arm **136** carrying a similar roller. During rotation of the drum **124** and paying out the leash **126,** the crank assembly **128** swings about a pivot **138** between the full line position in FIG. **6** to the phantom line position.

Movement of the arm assembly between its full and phantom line positions in FIG. **6** is yieldably resisted by a main leaf spring **140** fixed at its lower end in a support block **142.** Adjustment of the spring force is achieved by means of a second leaf spring **144** bearing against the spring **140** and carried by a rocker arm **146** pivoted on the support block **142.** The arm **146** is adjustably positioned by an adjustment screw **148** accessible externally of the casing **122.**

As the drum **124** is rotated to pay out the leash **126,** the roller **134** on the arm **132** of the crank assembly rides along the cam surface **130** and moves progressively, radially outwardly, thus increasing the moment arm. Accordingly, as with the prior embodiment, the resistance to drum movement is at a maximum when the leash is in a fully retracted condition (FIG. **6**) and progressively decreases until the follower roller **134** passes the location **130b** and onto the circular drum periphery. As the drum **124** rotates back in retracting the leash **126,** the retracting force is progressively increased as the roller **134** again engages the cam surface and moves toward the location **130a.** Adjustment of the spring force on the bell crank assembly **128** by rotating the screw **148** varies the preselected maximum resistive force on the leash **126** during the first phase. On the other hand, adjustment of the tension on spiral spring **70** alters the level of reduced resistance during the second phase. Thus, operation of the binding units **102** and **104** is essentially the same as that of units **24** and **26.**

The desired force characteristics, insofar as the rate of change of resistance to leash movement during the first phase is concerned and the amount of leash extension permitted during such phase, may be established by appropriate shaping of the cam surface **130.** The first phase of operation here corresponds to extension and retraction of the leash **126** in which the roller **134** is engaged with the cam surface **130.** During the second phase of operation, the roller **134** is on the circular periphery of the drum **124** so that the drum movement is essentially under the influence of only the spring **70.**

The free ends of leashes **126** of the binding units **102** and **104** are connected to the sole plate assembly **100** through mounting elements, or fixtures, which, in this instance, are formed integrally with the plate assembly. Since the plate assembly detachably mounts the boot in the case of this embodiment, the free ends of the leashes **126** may be fixedly secured thereto. In the case of the toe unit **102,** this is achieved with a fixture **150** carried by the plate assembly which mates with cooperating means including an upwardly facing socket **152** and spaced centering pins **154** (FIGS. **6** and **10**) on the rearward side of its casing. The heel unit **102** has its leash extending through a bore **156** in a projecting block on the rearward end of the sole plate assembly **100** and locked thereto by a bead **158** on the terminal end of the leash.

It is desirable for both safety and performance reasons to have the binding initially permit relative lateral movement between the boot **10** and ski **12** in response to externally applied lateral forces of lower magnitude than those required to produce relative movement normal to the surface of the ski. For example, considering the toe end of the boot and assuming that the sole plate assembly **100** is on the ski at proper alignment therewith so that the leash **126** is fully retracted and there is maximum resistance to movement, it is desired that a substantially lower force applied laterally, i.e., a twisting force on the foot or leg, initiate relative movement than would be required in order to lift the toe vertically

away from the surface of the ski. To accomplish this, the fixture **150** has a pair of spaced recesses **160** that seat on the pins **154** and bullet-shaped projection **162** which fixedly receives the leash end and seats in the socket. At a location spaced vertically above the recesses **160** and terminal end of projection **162,** the fixture **150** is pivotally connected to the sole plate assembly **100** by a pin **164** that is oriented longitudinally of and parallel to the surface of the ski **12.**

Referring to FIG. **10,** it may be seen that when the fixture **150** is in skiing relationship, the spacing between the socket **152** and pivotal axis defined by the pin **164** is greater than the spacing between the socket **152** and the centering pins **154.** Accordingly, the fixture **150** functions in the manner of a bell crank when forces are applied laterally to the sole plate assembly **100,** as occurs in actual practice. Force is transmitted through the pivot pin **164** and the fixture rocks or fulcrums about one or the other of the pins **154** to lift the bullet projection **162** out of its socket **152** and extend the leash **126,** the differences in length of the crank arms affording a movement advantage. Once the fixture **150** is free of the socket **152** and pins **154** then, of course, the advantage is removed, but the boot **10** is then relatively free of the ski **12** for rocking, tilting and other movements of generally unlimited attitude and direction.

Such a movement advantage is also desirable, although not to the same extent, at the heel end of the boot. In the case of the present embodiment, such an advantage is obtained by virtue of the cooperating structure illustrated in FIG. **9.** As may be seen in that figure, a guide plate **166** secured to the surface of the ski, as by screws **168,** has spaced load ramps **168** positioned just inwardly of the rearward anti-friction pads **106** on the underside of the sole plate assembly **100** when the boot **10** is in skiing position, as in the drawings. The ramps **168** incline upwardly toward the center of the ski. Thus, as a lateral force is applied, tending to slide the sole plate assembly **100** across the ski **12** at the heel, the plate assembly slides upwardly on the respective ramp withdrawing the leash **126** and according the desired initial movement advantage.

While certain embodiments of the invention have been illustrated and described in detail, it will be understood that this was only by way of illustration and that various changes in the details of the construction and arrangement of the various elements may be made without departing from the spirit and scope of the invention.

I claim:

1. A ski binding for releasably holding a ski boot on top of and in alignment with a ski in normal skiing position, comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in such skiing position;

an elongated, flexible leash extending between and secured to said elements, said leash being extendible and retractable;

and actuating means carried by one of said elements and coupled to said leash and exerting in a skiing phase a preselected approximate force on said leash yieldably holding said elements in said skiing relationship while permitting shock-absorbing relative movement, and operable in response to a force on said leash exceeding said preselected force to shift to a release phase and reduce the force on said leash and permit said elements to move away from one another beyond the range of said shock-absorbing movement, said actuating means being operable after such separation to draw said elements back toward one another and to restore said preselected force when said elements are proximate one another, thereby returning said actuating means to its skiing phase said actuating means including a rotatably mounted drum that receives said leash for extension and retraction thereof and first and second springs acting on said drum to rotate it in a direction to retract said leash,

said first spring being operable during said release phase to retract said leash toward its retracted condition, and said second spring exerting a force substantially greater than that asserted by said first spring and being operable during said skiing phase to yieldably resist extension of said leash and being disabled during said release phase.

2. A ski binding as in claim **1,** wherein said actuating means further includes adjustment means for varying the forces exerted by said first and second springs.

3. A ski binding for releasably holding a ski boot on top of and in alignment with a ski in normal skiing position, including:

a heel binding unit having cooperating first and second guide means mountable respectively on the boot and ski adjacent the heel end of the boot, and a toe binding unit having cooperating first and second guide means mountable respectively on the boot and ski adjacent the toe end of the boot, said first and second guide means of each of said units being engageable in a predetermined skiing relationship when the boot is on the ski in such normal skiing position; each of said units comprising:

an elongated, flexible leash for coupling the boot and the ski and operating in cooperative association with said first and second guide means, said leash being substantially longer than the spacing between the first and second guide means when the latter are in said predetermined skiing relationship, and being extensible to an extended condition to permit said first and second guide means to disengage and move a substantial distance away from one another to free the boot and ski for relative movement to non-aligned relative positions and retractable to a retracted condition in which said guide means are so engaged,

and actuating means acting on said leash and including means for applying a force to said leash for yieldably resisting extension thereof and urging said leash toward said retracted condition and means for controlling the resultant retraction force on said leash as a function of the extent of leash extension, the resultant retraction force being relatively high when said leash is substantially in said retracted condition and lower in said extended condition, said actuating means being responsive to the application to said leash of an extending force in excess of a preselected approximate force to permit such extension of said leash and being further responsive, after extension of said leash means from said retracted condition, to reduction of the extending force to

below the then existing resultant force on said leash to initiate retraction of said leash;

whereby said first and second guide means of each of said units are maintained yieldably in said skiing relationship and permitted to move out of such relationship under the influence of extending forces, and return automatically to such skiing relationship when such extending forces abate.

4. A ski binding for releasably holding a ski boot on top of and in alignment with a ski, in a normal skiing condition, comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in said normal skiing condition;

leash means extending between and connected to said first and second elements and being extensible in response to separating forces on said elements to an extended condition, to permit relative movement of said elements to a substantially separated condition, and being retractable to a retracted condition when the elements are in said predetermined skiing relationship;

and actuating means acting on said leash means and including

means for applying a force to said leash means for yieldably resisting extension thereof and urging said leash means toward said retracted condition,

and means for controlling the resultant force on said leash means as a function of the extent of leash extension, from a relatively high resultant force when said leash means is substantially in said retracted condition to a lower resultant force in said extended condition;

said actuating means being responsive to separating forces in excess of said relatively high resultant force to permit initial extension of said leash means, and being further responsive, after extension of said leash means from said retracted condition, to reduction of the separating force to below the then existing resultant force on said leash means, to initiate retraction of said leash means.

5. A ski binding as in claim **4,** wherein said actuating means further includes adjustment means for adjustably establishing the magnitude of the resultant force on said leash means when said leash means is in its retracted condition.

6. A ski binding as in claim **4,** wherein the resultant force on said leash means controlled by said controlling means is maximum when said leash means is substantially in said retracted condition, progressively reduces during initial extension of a relatively small extent and, thereafter, remains substantially constant over at least the major portion of further extension of relatively large extent in said extended condition.

7. A ski binding as in claim **4,** wherein said actuating means is operable automatically after extension of said leash means from said retracted condition to reduction of said separating force to below the then existing resultant force on said leash means, to initiate retraction of said leash means and continue such retraction so long as the separating force is below the resultant retraction force being then applied to said leash means, to return said leash means to its retracted condition.

8. A ski binding as in claim **4,** wherein said elements include cooperating means engageable to reduce the magnitude of force required to cause extension of said leash means when applied to said leash means through said elements in a lateral direction with respect to the ski as compared to that required to cause such extension when applied in a direction normal to the ski.

9. A ski binding as in claim **4,** wherein:

said leash means includes an elongated, flexible leash;

said means for applying a force to said leash means includes a rotatable drum on which said leash is at least partially wound and spring means urging said drum to rotate in a direction to retract said leash; and

said means for controlling the resultant force on said leash means varies said resultant force as a function of the radial distance between the point of separation of said leash from said drum, during leash extension, and the axis of rotation of said drum and as a function of the effective force exerted on said drum by said spring means.

10. A ski binding as in claim **9,** wherein the distance between the point of separation of said leash from said drum and said axis of rotation remains substantially constant and the effective force exerted on said drum by said spring means progressively reduces during at least an initial portion of leash extension.

11. A ski binding for releasably holding a ski boot on top of and in alignment with a ski in normal skiing position, comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in such skiing position;

an elongated, flexible leash extending between and connected to said elements and comprising the primary force-applying link between said elements, said leash being substantially longer than the spacing between said elements when the latter are in said predetermined skiing relationship;

leash-receiving means for retracting said leash to a retracted condition in which said elements are in said predetermined skiing relationship and permitting extension of said leash to an extended condition to enable said elements to move in leashed relationship a substantial distance away from one another;

means acting on said leash-receiving means to resist extension of said leash;

and control means for varying the resultant resistive force on said leash resulting from said means acting on said leash-receiving means, and producing a resultant force that is at a relatively high maximum when said elements are substantially in said skiing relationship and remaining relatively high at least until said elements have moved a predetermined distance away from each other that is a minor portion of such substantial distance and, thereafter, continually producing a resultant force no greater than said maximum during movement of said elements such substantial distance away from each other.

12. A ski binding as in claim **11,** wherein the resultant resistive force on said leash after said elements have moved more than said predetermined distance away from each other is substantially lower than the resultant force when said elements are in said skiing relationship.

13. A ski binding as in claim 11, wherein the resultant resistive force produced by said control means progressively decreases as said elements move said predetermined distance away from each other and, thereafter, remains at a reduced level for over at least the major portion of the movement of such elements such substantial distance away from each other, so as to free the boot and ski for movement to non-aligned relative positions.

14. A ski binding as in claim 11, wherein said means acting on said leash-receiving means comprises a spring which acts directly on said leash-receiving means;

and wherein said control means includes adjustment means for adjustably establishing the effective force exerted by said spring on said leash-receiving means, at least when said leash is in said retracted condition, thereby adjustably establishing the magnitude of said relatively high, maximum resultant force.

15. A ski binding for releasably holding a ski boot on top of and in alignment with a ski in normal skiing position, comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in such skiing position;

an elongated, flexible leash extending between and connected to said elements, said leash being substantially longer than the spacing between said elements when the latter are in said predetermined skiing relationship;

a rotatable leash-receiving member which rotates in one direction to retract said leash and in the opposite direction to permit extension thereof;

spring means acting on said leash-receiving member for urging it to rotate in said one direction and yieldably resisting rotation in the opposite direction;

control means for varying the effective force applied to said leash, by reason of said spring means acting on said leash-receiving means, as a function of leash extension,

said control means being responsive to the application to said leash of a force in excess of a preselected approximate force to permit initial extension of said leash and, thereafter, being responsive to further extension of said leash to decrease the effective force to less than said preselected approximate force.

16. A ski binding as in claim 15, including a soleplate adapted for detachable engagement with the boot, and a housing mounting said leash-receiving member, said spring means and said control means,

said housing being secured to one of said soleplate and said second element which is mountable on said ski.

17. A ski binding as in claim 15, wherein said control means includes a cam surface on said leash-receiving member, which is effective during rotation of said member corresponding to initial extension of said leash, for varying the moment arm with which the spring force is applied through said member to said leash.

18. A ski binding as in claim 15, further including cooperating first and second guides mountable respectively on the boot and ski which engage to guide said elements into said predetermined skiing relationship during such retraction of said leash.

19. A ski binding for releasably holding a ski boot on top of and in alignment with a ski, in a normal skiing condition, said binding comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in said normal skiing condition;

leash means extending between said connected to said first and second elements and being extensible in response to separating forces on said elements to an extended condition, to permit relative movement of said elements to a substantially separated, non-skiing condition in which the boot and ski are free for relative movement to non-aligned relative positions, and being retractable to a retracted condition in which said elements are in said predetermined skiing relationship;

and actuating means acting on said leash means and including

means for continually applying a retraction force to said leash means for yieldably resisting extension thereof and for urging the leash means toward said retracted condition, and

means for varying the effectiveness with which said retraction force is applied to said leash means, as a function of lash extension to control; the resultant retraction force on said leash means throughout the extension of said leash means and to establish it at a predetermined level when said leash means is substantially in its retracted condition,

said actuating means being responsive to separating forces on said leash means in excess of said predetermined level to permit extension of said leash means to its extended condition and, thereafter, being responsive to reduction of the separating force on said leash means of a magnitude below the resultant retraction force being then applied to said leash means to initiate retraction of said leash means toward its retracted condition and to continue such retraction so long as the separating force is below the retraction force being then applied to said leash means, until said leash means is in its retracted condition and said retraction force is restored to said predetermined level.

20. A ski binding as in claim 11, wherein:

said leash means includes an elongated, flexible leash;

said force-applying means includes a rotatably supported drum about which said leash is wound in said retracted condition, and a spring urging said drum in a direction to retract said leash to its retracted condition and applying a force yieldably resisting rotation of said drum in a direction to permit extension of said leash;

and said means for controlling the resultant force is incorporated on said drum to vary a moment arm with which the spring force is applied through said drum to said leash.

21. A ski binding as in claim 20, wherein said means for controlling the resultant force comprises a cam surface on said drum for progressively increasing the moment arm through which separating forces on said leash act through said drum on said spring, as the extent of

separation of said elements increases during at least a portion of the rotation of said drum.

22. A ski binding as in claim **21,** wherein said cam surface is carried by said drum, and curves progressively away from the axis of rotation thereof to increase said moment arm in response to rotation of said drum in a direction to extend said leash.

23. A ski binding as in claim **19,** wherein said first and second elements include cooperating guide means for guiding said elements into said skiing relationship as said leash means is retracted from its extended condition to its retracted condition.

24. A ski binding as in claim **19,** including a soleplate adapted for detachable mounting on the boot, said soleplate carrying said first element.

25. A ski binding as in claim **19,** including two substantially similar binding units, one of said binding units associated with and for controlling the toe end of the boot and the other associated with and for controlling the heel end, each of said units having said first and second elements, said leash means and said resistive means and said units being operable substantially independently of one another.

26. A ski binding for releasably holding a ski boot on top of and in alignment with a ski in normal skiing position, comprising:

first and second elements mountable respectively on the boot and the ski and disposed in a predetermined skiing relationship when the boot is on the ski in such skiing position;

connecting means extending between and secured to said elements;

and actuating means acting on said connecting means in a skiing phase in which said elements are in said skiing relationship and permitted a relatively small extent of shock-absorbing relative movement, and in a release phase in which said elements are permitted movement of a relatively large extent to a substantially separated, non-skiing condition in which the boot and ski are free for relative movement to non-aligned positions, said actuating means including

means for applying a force to said connecting means for yieldably resisting extension thereof,

and means for controlling the resultant force on said connecting means as a function of the extent of leash extension from a preselected, relatively high level when said actuating means is in said skiing phase, to a reduced level during said release phase to permit said elements to move to said substantially separated non-skiing condition.

27. A ski binding as in claim **26** wherein said connecting means comprises an elongated, flexible leash that serves as the sole force-applying connection between said first and second elements, said leash being extendible and retractable and being in a retracted condition during said skiing phase to hold the boot in such skiing position and in an extended condition during said release phase to permit the boot and ski to move to such non-aligned positions while retaining the ski in leashed relationship with the boot.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,825,274 Dated July 23, 1974

Inventor(s) Burton A. Weinstein

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

Col. 9, Line 34, delete "168" (First occurrence).

Signed and sealed this 4th day of February 1975.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,825,274 Dated July 23, 1974

Inventor(s) BURTON ALAN WEINSTEIN

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

Column 1, line 47, "leaches" should be --leashes--.

Column 1, line 53, "type" should be --types--.

Column 1, line 59, "for" should be --from--.

Column 2, line 54, "the" should be --to--.

Column 3, line 48, "connection" should be --connecting--.

Column 5, line 61, "18" should be --10--.

Column 7, line 19, after "pads" insert --106--.

Column 10, line 10, after "phase" insert --,-- (a comma)

Column 14, line 10, delete "said" and insert therefor --and--.

Column 14, line 29, delete "lash" and insert therefor --leash--; after "control" delete --;-- (a semicolon).

Column 14, line 49, delete "11" and insert therefor --19--.

Signed and sealed this 26th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents