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Zoor

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[54] **SAFETY SKI BINDING**

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[51] **Int. Cl.**[2] **A63C 9/08**

[58] **Field of Search** .... 280/11.35 T

[56] **References Cited**

UNITED STATES PATENTS

3,768,822	10/1973	Kanno	280/11.35 T
3,773,341	11/1973	Mimeur	280/11.35 T
3,788,660	1/1974	Smolka	280/11.35 T
3,810,644	5/1974	Beyl	280/11.35 T

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[57] **ABSTRACT**

A ski binding holding and release mechanism for engaging the sole and/or heel of a ski boot includes a sole hold-down device which occupies one of two stable positions corresponding to the open and closed conditions, respectively, of the release mechanism. These stable positions are associated with the extrema of a spring loaded knee-joint which snaps from one position to the other. A pivoting tab connects the knee-joint to the sole hold-down device through a pin and slot mechanism. The form of the slot is so designed that the force bearing on the sole hold-down device during the process of opening the release mechanism can change in a desired manner; in particular, it may remain constant during the initial portion of the opening process.

10 Claims, 2 Drawing Figures

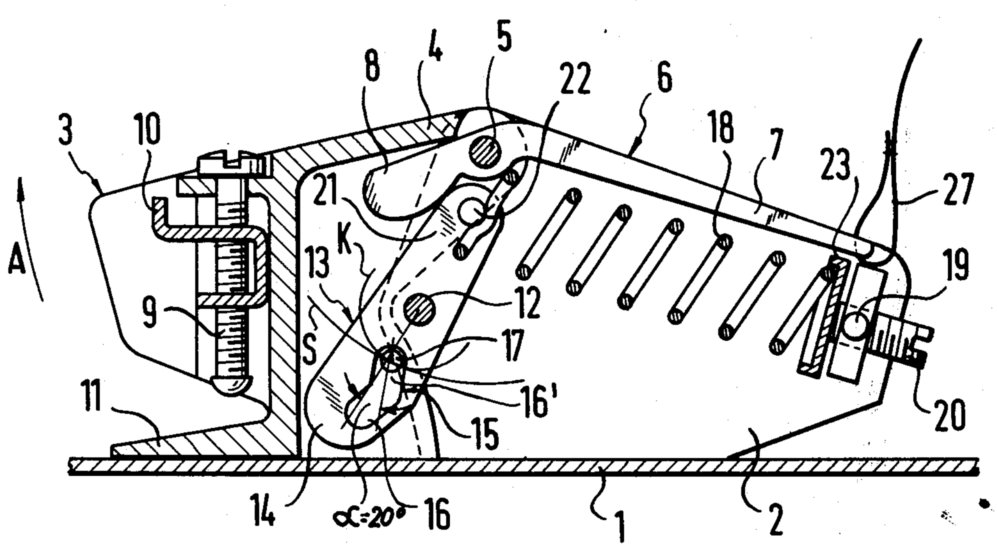

Fig.1

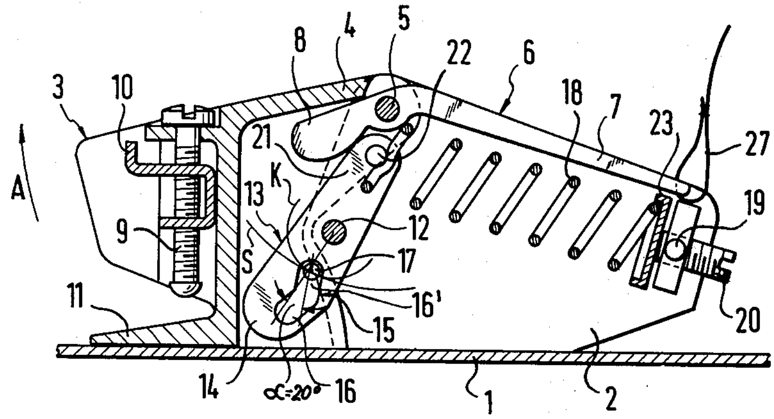
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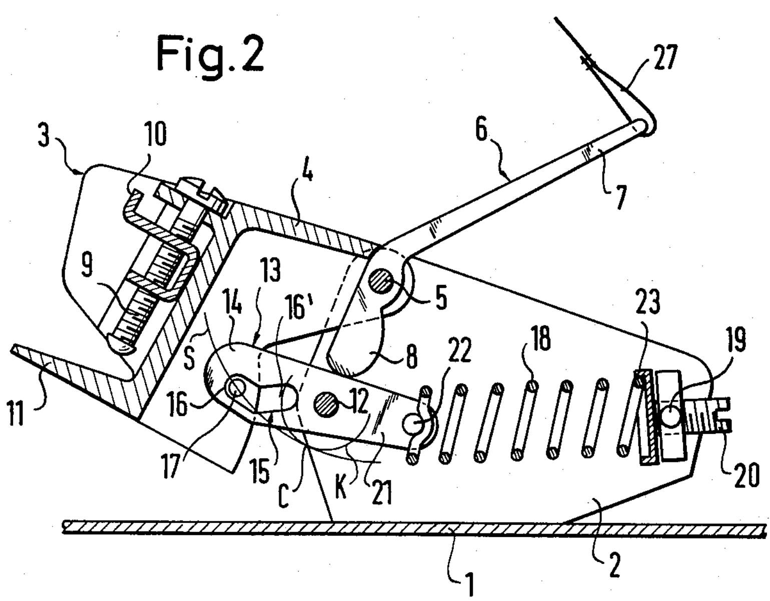
Fig.2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SAFETY SKI BINDING

BACKGROUND OF THE INVENTION

This invention relates to safety ski binding with a sole hold-down device loaded by a release mechanism where the hold-down device is moved in the open position either by an overload substantially perpendicular to the ski surface or else by actuation of a release member wherein the release mechanism comprises a two-armed pivot tab whose one lever arm is loaded by a spring and forms a pivoting knee-joint therewith, whereas the other lever arm is operatively connected with the sole hold-down device by a control pin disposed thereon, which engages a control slot within the pivot tab and wherein it is displaced during the opening or closing of the release mechanism.

In a known safety ski binding of this kind, illustrated in German OS (Laid Open Patent Application) 1,479,151 FIGS. 4–6, the sole hold-down device is guided by pins in two slots affixed to the skis where the lower slot extends perpendicular to the ski surface and the upper slot is bent and first extends obliquely upward and to the rear and then extends substantially horizontally toward the rear end of the ski. The upper control pin cooperates with the upper slot and influences the motion of the sole hold-down device, by engaging a straight, elongated hole within a double arm pivot tab fixedly mounted to the housing. The free end of the pivot tab is engaged by a spring whose other end engages a further pivot tab attached to the ski and also provided with an elongated slot that is engaged by the lower pin guided within the lower slot. In the closed position, the upper pin is located at a point of the elongated hole which is farthest away from the pivotal axis of the pivot tab. During the opening motion of the sole hold-down device, the pin is guided in the upper, locally fixed slot and travels in the direction of the pivotal axis of the pivot tab. As a result, the load arm, i.e., that lever arm of the pivot tab engaged by the load on the sole hold-down device, continually shortens by comparison with the power arm, i.e., the lever arm engaged by the spring. For this reason, in the beginning of the opening phase, the load bearing on the sole hold-down device compresses the spring approximately three and a half times as much as at the termination of the opening motion. Thus, the resistance of the sole hold-down device to pivotal motion is much smaller at the beginning than at the end of the opening phase, i.e., before the pivoting knee-joint mechanism consisting of the pivot tab and the spring has reached its dead center position. After exceeding that center position, the knee-joint mechanism urges the sole hold-down device in the sense of the opening motion. It is possible to improve this unfavorable force-path diagram somewhat by means of the second pivot tab associated with the lower pin and engaged by the other end of the spring. However, the change in the lever arm ratio is relatively small so that the force-path diagram which governs the release process remains unfavorable in spite of the increased expenditure. In the description of the known embodiment, mention is made of control pin and control slot but only because, due to the disposition of the elongated hole, referred to as a slot (and which is unconditionally required because otherwise the control pin guided in the locally fixed slot could not be in operative connection with the pivoting tab), there is a certain, albeit unfavorable, effect on the sole hold-down device which varies during the opening process and thus tends to influence and control the opening process. The force-path diagram in a safety ski binding of this type, many also be altered by changing the locally fixed slots in which the sole hold-down device is guided but such a change alters the opening motion of the sole hold-down device and this is not desirable.

Furthermore, the friction within the relatively long, straight elongated hole in the upper pivot tab, which is already fairly high, is augmented by friction in the elongated hole of the lower pivot tab which adversely affects the release process and increases wear. Increased wear makes the release process imprecise. Finally, the known embodiment has a relatively great constructional height because the spring between the pivotal axes of the two pivot tabs is disposed substantially vertically,

OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to provide a safety ski binding of the type described above wherein any desired and reasonable force-path diagram can be achieved with simpler means while producing less friction, and less wear and tear.

This object is attained, according to the invention in a ski binding, in that, when the sole hold-down device is in its closed position, the control pin is located at the starting point within the control slot, nearest the pivotal axis of the pivot tab and that, during the opening motion, the pivotal axis of the pivot tab as well as the sole hold-down device are moved in such a way that the motional path of the control pin and the path of the starting point in the control slot continuously move away from one another and from the mutual point they both occupy in the closed position. During the opening motion, the control pin recedes from the pivotal axis and during the closure motion it approaches it.

The fact that the paths of the control pin and of the starting point in the control slot recede from one another during the opening process guarantees that the control pin is always moved in the same single direction and does not stop at some particular point within the control slot nor reverse its direction; this would be the case if these two motional paths were to meet again or intersect during the opening process except at their common starting point. The uni-directional motion of the control pin within the control slot results in a precisely defined and unambivalent release process and presents increased wear at some particular place within the control slot. In the closed position of the sole hold-down device, the control pin is located at the starting point of the control slot, adjacent to the pivotal axis of the pivot tab, hence its distance to the pivotal axis, i.e., the load arm of the pivot tab, continuously increases during the opening motion. Thus, in spite of the increasing spring compression, the opening force applied to the sole hold-down device need not be increased. During the opening process, the lever ratio in the two-armed pivotal path, i.e., the ratio of the power arm, engaged by the spring, to the load arm, engaged by the control pin thus changes from some predetermined and selectable value to a smaller value, also selectable within wide limits. Once a particular construction, i.e., a particular geometrical mutual disposition of the various pivotal axes, a particular angle of the pivot tab in its closed position, a particular angle of the spring with respect to the pivot tab, etc., are chosen, the variation in the force acting on the sole hold-down device depends on the form of the control slot. The construction characteristics will first be determined by an expert, who will consider, for example, the height of the binding, the path of motion of the sole hold-down device with respect to the boot, the path of the spring up to the dead-center position, the residual spring path reserved for setting the spring stiffness and other parameters. Starting with a favorable disposition of these individual elements, he would than obtain the desired force-path diagram by choosing a particular form for the control slot. The choice of a particular form of control slot makes it possible to obtain a force-path diagram in which, after a steep onset of the force, immediately at the beginning of the opening motion, the force acting upon the sole hold-down device remains substantially constant during the further opening motion until the dead-center position of the knee-joint mechanism is reached, after which the force will decrease again. Thus, the heel encounters substantially the same resistance during the entire opening path of the release process. Thus, it is made possible to change the resistance exerted by the spring on the sole hold-down device during the opening process by using a correspondingly formed control slot without having to provide supplementary pivot tabs as is the case in the known ski binding. In these known bindings, the guide slots for the sole hold-down device would have to be altered if a similar influence by means of the second pivoting tab is no longer possible. However, by changing the guide slots, the opening motion of the sole hold-down device is changed, and this is not desirable. In the present invention, on the other hand, the force-path diagram may be changed by merely changing the form of the control slot without altering the path of motion of the sole hold-down device during the opening process.

The ski binding according to the invention is particularly simple in its construction due to the fact that it includes only a single pivot tab to influence the opening process of the sole hold-down device yet, nevertheless, makes possible the realization of any desired reasonable force-path diagram since that merely requires changing the form of the control slot.

A preferred embodiment of the invention is characterized in that the control slot has a first region adjacent to the pivotal axis of the pivot tab, which region either extends in the direction of the line connecting the attack point of the spring and the pivotal axis or else extends obliquely along one of the possible directions and it further has a second region, which is inclined with respect to the first region in a direction such as to accelerate the motion of the sole hold-down device while the motion of the pivot tab remains constant. Depending on the inclination of the first region of the control slot adjacent to the pivotal axis, the control pin will travel a shorter or longer path from its starting point in the control slot before the dead-center of the knee-joint mechanism is reached. For example, if the first or inner region of the control slot is inclined in the direction of the opening pivotal motion of the pivot tab, then the control pin travels farther on its track than if the first or inner region of the control slot is inclined opposite to the pivotal motion of the load arm of the pivot tab, assuming, of course, that the same conditions prevail at the power arm of the pivot tab. By choosing the inclination of the inner region of the control slot, it is therefore possible, when the conditions remain the same at the power arm of the pivot tab, to change the elasticity as a function of height, i.e., unitl the dead-center of the knee-joint mechanism has been reached, the control pin and hence the sole hold-down device travel a shorter path in the one case and a longer path in the other. If the second or outermost region of the control slot is inclined, with respect to the first region of the control slot, in the direction of the pivotal motion of the pivot tab during the opening process, then, because the tracks of the control pin and of the starting point in the control slot continuously move away from one another, one gets an acceleration of the control pin in its track for a constant pivotal velocity of the pivot tab. Thus, it is apparent that any reasonable type of motion of the sole hold-down device can be achieved by appropriate choice of the angles of the two regions of the control slot. It is in this preferred form of the control slot, with two mutually inclined regions, that the intitially posed condition, according to which the tracks of motion of the control pin and of the starting point in the control slot continuously move away from one another, is particularly important, because this condition insures that the control pin always moves in one direction during the opening process. If this condition were not met, then the control pin would stop or might even reverse its motion and this could have a disadvantageous consequence if this reversal of motion takes place at the precise moment when the control pin is at the inflection point of the control slot because this would block the entire mechanism since, after traversing the inflection point, the control pin cannot return to the first region during the opening process.

Preferably, the control slot is embodied as an appropriately formed elongated hole within the pivot tab because this is the cheapest form of making a control slot, but in principle it could also be formed by milling a groove in a pivot tab of appropriate thickness or by providing raised limiting walls on the tab.

A particularly simple embodimental form of the safety ski binding results if the sole hold-down device and the pivot tab are each mounted pivotably about an axis running transverse to the longitudinal direction of the ski because fixed pivoting by means of a pivotal axis is less expensive than if the sole hold-down device and the pivotal axis of the pivot tab are guided in corresponding guides which, according to the invention, could in principle be used under the condition that the tracks of the control pin and of the starting point in the control slot, beginning from a mutual point shared in the closure position of the sole hold-down point, continually move away from one another during the opening process and that, in this process, the control pin continuously moves away from the pivotal axis of the pivot tab.

When mounting the sole hold-down device and the pivot tab by means of an axis running transverse with respect to the longitudinal direction of the ski, it is recommended to provide a relative disposition of the pivotal axes, the control pin and the control slot such that the track, i.e., the path of motion of the starting point in the control slot runs in the same direction as the track of the control pin but is curved more sharply than the latter. This means that the pivotal axis of the pivot tab lies beneath the pivotal axis of the sole hold-down device, resulting in a low profile construction for the ski binding which makes it usable not only for holding the heel but also suitable, in cooperation with a lateral pivotability, for holding the tip of the boot, which creates the possibility that the front binding releases the ski boot even during a backward fall.

It is recommended to define the tracks of motion of the innermost starting point in the control slot and of the control pin as well as the form of the control slot itself in such a way that the ratio of the two lever arms of the two-armed pivot tab, i.g., the power arm which is engaged by the spring, and the load arm which is engaged by the control pin, is preferably 2:1 in the closure position and changes to approximately 1:1 in the open position. When the spring compression which increases up to the dead-center is taken into consideration, one achieves a releases characteristic which is especially favorable for the skier because the resistance to the opening of the binding is nearly constant until it is completely released. Because of the favorable release characteristic achieved by the invention, it is possible to use a much smallerr retaining force than any which could be dangerous to any part of the leg of the skier.

In one embodimental form of the invention, the pivotal axis of the pivot tab lies below the pivotal axis of the sole hold-down device and is located between that device and the heel of the boot, whereas the support point of the spring is located in a housing fixed to the ski which also contains the pivotal axes, and lies at approximately the same height as the pivotal axis of the pivot tab. Furthermore, the load arm of the pivot tab is inclined downwardly in the closure position of the sole hold-down device, whereas the spring points obliquely upward from its suppport point in the housing.

To permit the arbitrary opening of this ski binding, a second, two-armed lever, serving as a release member is pivotably mounted in the housing which contains the release mechanism and one of its lever arms engages the pivot tab, whereas the other lever arm is preferably equipped with a pulling means, for example, a grappling rope.

A preferred embodiment provides that the second lever arm serving for arbitrary actuation forms a part of the housing. The second lever arm which can be engaged by the pulling means, extends beyond the spring of the ski binding and thus forms the cover of the housing, thereby reducing the expense.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal section through the safety ski binding, according to an exemplary embodiment of the invention, in the closure position of the sole hold-down device, i.e., in its opeational position; and

FIG. 2 shows the safety ski binding in the open position of the sole hold-down device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A base plate **1** is to be screwed on a ski and, adjustably mounted thereon in the longitudinal direction of the ski is a housing **2** in the form of a slide which can be secured in the adjusted position. At the upper end of the housing **2**, nearest the boot, a sole hold-down member **3** with an extension **4** is pivotably mounted about a pivotal axis **5** lying perpendicular to the longitudinal direction of the ski. Pivotable about the same axis is a release member **6** further described below, which has two lever arms **7, 8** of unequal length. The sole hold-down device **3** includes a sole holding wind **10,** mounted adjustable in height on a perpendicular, threaded bolt **9** and including a heel plate **11.** Also mounted within the housing **2** is a double-armed pivot tab **13,** pivoting about a second horizontal pivot axis **12** which lies below pivot axis **5** but closer to the boot. The pivot tab **13** points obliquely downward in the closed position of the sole hold-down device, as may be seen in FIG. **1.** The load arm **14** of pivot tab **13,** which, in this position, is the lower arm of pivot tab **13,** is provided with a control slot **15** embodied as an elongated hole, whose outer region **16** is angled in the direction of opening of the sole hold-down device **3,** identified by the arrow A, with respect to the inner region **16'** of the control slot **15.** Engaging the control slot **15** is a control pin **17,** fixedly connected with the sole hold-down device **3.** The pivot tab **13** is acted upon by a compressed spring **18** whose one end is supported on a set screw **20,** pivotably mounted on a further horizontal transverse axis **19** fixed to the housing and whose other end is supported on an axis **22** located at the free end of the power arm **21** of pivot tab **13,** whereby the spring **18** and the pivot tab **13** together form a knee-joint mechanism which pivots from one inflection position to another inflection position after overcoming a dead-center position. During this pivotal motion, the control pin **17** travels from it starting position at the starting point C in the inner region **16'** of the control slot **15** up to the cross-over point of the control slot at which the dead-center of the knee joint mechanism is reached, and into the second region **16.** After traversal of the dead-center position, the sole hold-down device **3** is pushed into the open position by the effect of the spring. The set screw **20** and/or its spring support **23** are so designed that turning the screw causes an axial motion of the spring support **23** and hence a change of the degree of compresion of the spring.

The angled release member **6** has a short lever arm **8** which engages the power arm **21** of pivot tab **13** and a longer lever arm **7** with a loop **27** at its end for actuating the release member **6.**

The ski binding described above functions in the following way: At departure, the sole hold-down device **3** is in the closed position shown in FIG. **1** in which the knee-joint formed by pivot tab **13** and spring **18** points upwardly and the control pin **17** is located in the inner region **16'** of the control slot **15** at the starting point adjacent to the pivotal axis **12.** In this position, the sole hold-down device, whose sole holdiing wind **10,** which is adjustable in height, abuts the sole of the ski boot, can exert a certain predetermined pressure. If however, the sole is moved in the direction of the arrow A during the occurrence of an overload, then the control pin **17** describes an arcuate track S about the pivotal axis **12** in the clock-wise sense as seen in the drawing where the radius of the track S is equal to the distance between the pivotal axis **5** and the control pin **17.** Since the starting point C in the inner region **16'** moves along a circular arc K with the pivotal axis **12** as its center and whose radius of the circular arc S, the result is that, starting at the common point C in the closure position of the sole hold-down device, the two tracks move away from one another and hence the lever ratio changes continuously with respect to the point of attack of spring **18** at the pivot tab **13,** because, during the opening period, the control pin **17** starts from the starting point of the control slot **15** in the inner region **16'** and nearest the pivotal axis **12** and moves beyond the cross-over point into the outer region **16**. The construction is such that the knee-joint mechanism is in its dead-center position when the control pin **17** reaches the crossover point of the control slot **15**. From the dead-center position, the knee-joint mechanism flexes into its lower position while the pivot tab **13** has rotated only by a relatively small angle. In this phase of the motion, the control pin travels within region **16** of the control slot **15**. Since the outer region **16** of the control slot **15** is inclined, with respect to the inner region **16'**, in the direction of motion of the pivot tab, the control pin **17** and hence the sole hold-down device **3** are moved by a relatively large amount in spite of the small pivotal motion of pivot tab **13** and this amount is greater than it would be if the control pin **17** were within the inner region **16'**, for the same angular motion of the pivot tab. This has the advantage that when one steps down on the sole hold-down device, the spring offers only a relatively small resistance to the motion from the open position into the closed position and this has the effect that the binding can be closed even in deep snow, because a relatively large pivotal motion of the sole hold-down device results in only a relatively small pivotal motion of the pivot tab, namely, from the lower inflection position to the dead-center position and hence a relatively small compression of spring **18**. Once the control pin **17** has reached the cross-over point of the control slot **15**, the knee-joint mechanism snaps into its upper inflection and the sole hold-down device **3** is then located in the closure position shown in FIG. **1**.

In the embodimental form shown, the lever ratio of the power arm **21**, whose length corresponds to the distance between the point of attack **22** of spring **18** and the pivotal axis **12**, with respect to the constantly varying length of the load arm, corresponding to the distance between the pivotal axis **12** and the control pin **17**, is 2:1 in the closure position of the sole hold-down device and 1:1 in the open position shown in FIG. **2**. By employing a construction according to the invention, it is possible to control the force of spring **18** acting on the boot during the opening process by selecting the form of the control slot **15**. This choice is also aided by the position of transverse axis **19**, which is located further away from the boot than the pivotal axes **5** and **12** and is closer to the ski than the pivotal axis **5** but slightly farther from the ski than the pivotal axis **12**.

Naturally, several constructional changes can be made within the framwork of the invention. Numerous variations and other embodiments are possible within the spirit and scope of the invention, the scope being defined in the appended claims. For example, it is possible to form the control slot **15** without any angles. Furthermore, it is possible to provide a telescope-like quide bolt within spring **18**. Moreover, it is possible to provide, instead of the release member shown, another element which acts upon the knee-joint mechanism and may itself be actuated either by hand or by means of the top of the ski pole.

What is claimed is:

1. A safety ski binding, comprising, in combination:

a. a housing adapted to be affixed to a base plate;

b. means defining a first pivotal axis, attached to said housing and extending transversely to the longitudinal direction of said housing;

c. a sole hold-down device mounted for movement about the first pivotal axis, and including a laterally protruding pin; and

d. a release mechanism including means defining a second pivotal axis, attached to said housing substantially parallel to and below said first pivotal axis, a pivot tab means mounted for movement about said second pivotal axis, said tab including two lever arms, one of which contains an opening, and a spring, pivotably mounted on said housing, one end of said spring engaging one of said lever arms so as to form a knee-joint and the opening within the other of said lever arms being engaged by said laterally protruding pin;

whereby said sole hold-down device can move between two spring-loaded, stable angular positions, corresponding to an open and a closed condition of the release mechanism.

2. A safety ski binding as defined in claim **1**, wherein said means defining the first pivotal axis and said means defining the second pivotal axis are so located in said housing, and said protruding pin and said opening are so located with respect to the pivotal axes that the circularly arcuate track of said pin about the first pivotal axis and the circularly arcuate track described by that point of the opening nearest the second pivotal axis about the second pivotal axis diverge from one another during opening motion of said release mechanism while said protruding pin continuously recedes from the second pivotal axis, whereas, during the closing motion of said release mechanism, said protruding pin continuously approaches said second pivotal axis.

3. A safety ski binding as defined in claim **2**, wherein the radius of curvature of the circularly arcuate track followed by the protruding pin is greater than the radius of curvature of the circularly arcuate track followed by the point of the opening in the pivot tab lying nearest the second pivotal axis, whereas both tracks are cured in the same sense.

4. A safety ski binding as defined in claim **2**, wherein said first and second pivotal axes extend transversely to the longitudinal extent of the ski.

5. A safety ski binding as defined in claim **2**, wherein said opening in the pivot tab is a slot comprising a first region adjacent to the second pivotal axis and a second region adjoining said first region and inclined thereto in such a way that the motion of the protruding pin in the second region and hence also the motion of the sole hold-down device is accelerated while the pivotal motion of the pivot tab remains constant.

6. A safety ski binding as defined in claim **5**, wherein the power-arm of the pivot tab, defined as the distance between the second pivotal axis and the point of attack of the spring and the load-arm of the pivot tab, defined as the variable distance between the second pivotal axis and the center of the protruding pin, are so related that the ratio of the power-arm to the load-arm is preferably approximately 2:1 in the closed condition of the release mechanism and changes continuously to a value of approximately 1:1 in the open condition of the released mechanism.

7. A safety ski binding as defined in claim **6**, wherein the second pivotal axis lies at a smaller perpendicular distance from the surface of the ski than the first pivotal axis and lies nearer to the heel of a normally placed ski boot than does the first pivotal axis.

8. A safety ski binding as defined in claim **7**, wherein the spring is supported within the housing at approximately the same perpendicular distance from the ski as the location of the second pivotal axis and wherein, in the closed condition of the release mechanism, the load arm of the pivot tab points obliquely downwardly and the longitudinal axis of the spring points obliquely upward from the point of support on the housing.

9. A safety ski binding as defined in claim **1**, the combination further comprising a two armed release lever pivotably mounted in the housing, whose first lever arm engages the pivot tab means and whose second lever arm is preferably provided with a pulling means.

10. A safety ski binding as defined in claim **9**, wherein said second lever arm is a part of the housing.

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