TOE- OR HEEL-HOLDING DEVICE FOR SAFETY SKI BINDINGS

Inventors: Hans Otto Frisch, Bernd Payrhammer, both of Farchant, Germany

Assignee: Hannes Marker, Garmisch-Partenkirchen, Germany

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Primary Examiner—Benjamin Hersh
Assistant Examiner—Robert R. Song
Attorney—Fleit, Gipple & Jacobson

ABSTRACT

At least one soleholder member is automatically movable against the resistance presented by at least one resistance element from a locking position to a release position. The resistance presented by the resistance element or elements is a function of the potential energy and kinetic energy. A final control element is provided, which controls the resistance element in response to control signals depending on the kinetic energy.

5 Claims, 6 Drawing Figures
TOE- OR HEEL-HOLDING DEVICE FOR SAFETY SKI BINDINGS

The present invention relates to toe- and heel-holding devices for safety ski bindings, which devices comprise at least one soleholder member which is automatically movable against the resistance presented by at least one resistance element from a locking position to a release position, the resistance presented by the resistance element or elements being a function of the potential energy and kinetic energy.

Known devices of that kind comprise a hydraulic shock absorber presenting a resistance in addition to the resistance element which determines the force required for a release. In these toe- and heel-holding devices, the shock absorber is designed so that its shock work absorption capacity is lower by a sufficiently large safety margin than that of the leg of the skier. This requirement must be met if the safety ski binding should accomplish its object to protect the skier from typical skiing injuries. Any shocks having an energy in excess of the predetermined shock work absorption capacity of the toe- or heel-holding device will automatically result in a release.

The present invention is based on the recognition that it is significant whether the shock is transmitted to the device by the ski or by the boot. This fact has not been taken into account in the known toe- and heel-holding devices. For instance, if the shock is applied to the boot, the shock work absorption capacity of the shock absorber must not exceed that of the leg of the skier because the shock absorber is connected in parallel to said leg in that case. This fact determines the limiting value for the known devices. On the other hand, if the shock is applied to the ski, the shock work absorption capacity of the shock absorber is inherently insignificant if it is ensured that the shock absorber cannot transmit more shock energy to the skier's leg than the same can take up because in this case the shock absorber is connected to the leg in series rather than parallel thereto.

It has been found in practice that most shocks, particularly the excessively strong shocks, are applied to the ski rather than to the leg or boot of the skier. For this reason it is an object of the present invention to provide for safety ski bindings a toe- or heel-holding device which is of the kind described first hereinbefore and which is designed to have a shock work absorption capacity which depends on the magnitude and direction of the kinetic energy. As a result, the device can take up excessively strong shocks which are applied to the ski but are harmless to the skier's leg whereas these shocks previously resulted in undesired premature releases so that the risk of typical skiing injuries was increased.

In a toe- or heel-holding device for safety ski bindings, which device comprises at least one soleholder member which is automatically movable against a resistance presented by at least one resistance element from a locking position to a release position, the resistance presented by the resistance element or elements being a function of the potential energy and kinetic energy, this object is accomplished according to the invention by the provision of a final control element, which serves to control a resistance element in response to control signals depending on the kinetic energy.

Depending on the principle on which the design and function of the device is based, the final control element may be a part of an electrical or electronic automatic control system or a part of a pneumatic and/or hydraulic automatic control system. A mechanical automatic control system may also be used. In the latter case, the final control element may be a pendulum arm, which may carry a bob, if desired, and which is mounted on a part that is fixed to the ski at least when the device is in its locking position.

Particularly in toe- or heel-holding devices which comprise a soleholder member that is pivotally movable about an axis, the resistance controlled by the final control element may be produced by a friction coupling.

In an embodiment of the toe- or heel-holding device according to the invention which comprises a mechanical automatic control device, the pendulum arm is movable in the plane of movement of the sole-holder member or, even where the soleholder member is constrained to describe a non-spherical path, in a plane of movement which is parallel to the plane of movement of the soleholder member. When this feature of the invention is applied to a toe-holding device, the pendulum arm may be bipartite and its first part may be pivoted to the device and form an abutment for a spring, whereas the second part is connected to the first part and carries a bob and is movable relative to the first part against the force of the spring.

Particularly in the manufacture it has been found desirable to use in such arrangement a helical compression spring and a pendulum arm in which the first part consists of a spring cage, the second part of the pendulum arm consists of a headed pin having a head which forms the second spring abutment and also having a shank which extends through the spring the first spring abutment and which at its free end carries the bob, and the head of the pin acts on the soleholder member or on the means for locking the latter. If in such toe-holding device the sole-holder member forms the coupling link of a four-bar linkage, a simple and reliable arrangement will be obtained if the two levers of the four-bar linkage extend beyond the pivotal connections of the soleholder member and are angled inwardly, the direction of action of the spring in the locking position of the device extends through the pivot of the pendulum arm, and the head of the bolt acts on the angled end portions of the levers.

An embodiment of the invention will now be explained in detail and by way of example with reference to the accompanying drawings, in which FIG. 1 is a central longitudinal sectional view showing a toe-holding device,

FIG. 2 is a top plan view showing the device of FIG. 1,

FIG. 3 is a top plan view which is similar to that of FIG. 2 but shows the device in an instantaneous position resulting from the application of a shock to the ski,

FIG. 4 is another top plan view showing the device in another instantaneous position,

FIG. 5 is a top plan view which is similar to FIG. 2 but shows the device in an instantaneous position resulting from a shock transmitted to the device by the boot, and

FIG. 6 is a top plan view showing the toe-holding device in an open position.
The illustrated toe-holding device according to the invention comprises a baseplate 1, which is secured to a ski 3 by screws 2. The baseplate is provided with a pivot pin 4, which is shown in FIG. 1 and on which a carrier 5 is pivoted, which held against axial displacement by a disc 6. The latter is secured to the pivot pin by a screw 7. Two levers 10, 11 are connected to the carrier at pivots 8, 9 and form a four-bar linkage together with a soleholder member 12, which is connected to the levers at pivots 13, 14. The soleholder member 15 proper is mounted on the soleholder member for a free vertical sliding movement for adaption to boot soles differing in thickness and is adapted to be fixed in different positions by a locking pin 16.

Those arms 17 and 18 of the two-armed levers 10, 11 which do not carry the soleholder member constitute locking elements, which cooperate with an anti-friction bearing 19, which serves as a stop that is fixed to the baseplate. The anti-friction bearing 19 is mounted on a carrying pin 20, which is riveted to the baseplate 1 (see FIG. 1). When the soleholder member 12 is in its normal position, each locking member holds the carrier 5 against a pivotal movement toward the respective side. A correspondingly curved slot 21 would otherwise enable such a movement of the carrier.

The carrier 5 is provided with a U-shaped retaining member 22, which extends across the carrier. The U-shaped retaining member and the carrier are each provided with a vertical pivot pin 23 or 24. In the normal position of the device, these pivot pins 23, 24 are coaxially superimposed in the central vertical plane of the device. A laterally open U-shaped member 25 is pivotally mounted on these pivot pins near the free limb ends of the member 25 and constitutes a spring cage for a helical compression spring 26. The web of the U-shaped member 25 forms a spring abutment. The second spring abutment consists of the head of a headed pin 27, which has a shank that extends through the spring and through the web of the U-shaped member 25. The shaft shank has a screw-threaded free end portion on which a pendulum 28 is threaded. A fixing screw, not shown, may be provided to hold the pendulum against rotation. Those arms of the levers 10, 11 which carry the soleholder member 12 are provided at their free ends with respective noses 29 and 30, which are engaged by the headed pin 27 under the action of the helical compression spring 26 to hold the soleholder member 12 in its normal position.

FIGS. 1 and 2 show the toe-holding device in its normal position, in which the carrier 5 is held against a pivotal movement on the baseplate 1 because those arms 17, 18 of the levers 10, 11 which serve as locking members have a curved outer end face which is centered on the respective pivotal axis 8 or 9 and extend close to the anti-friction bearing 19, which constitutes a stop that is fixed to the baseplate. As has been mentioned hereinbefore, the four-bar linkage is centered and held in position by the head pin 27, which is under the action of the helical compression spring 26. The latter is more or less prestressed as may be required.

When a shock acting, e.g., in the direction of the arrow 31 is applied to the ski 3, the inertia of the masses will cause the parts to perform a relative movement as shown in FIG. 3, where it is assumed that the soleholder member 12 is under the influence of the skiing boot, not shown. Pressure is applied to the helical compression spring 26 from both ends at the same time because the movement of the four-bar linkage causes the nose 29 to force the headed pin 27 to the left in the drawing and the spring cage 25 performs a pivotal movement to the right in the drawing. Hence, the movement of the four-bar linkage from its normal position is opposed by different resistances corresponding to the shocks of different energies. These resistances are consequently a function of the shock energy, because depending upon the strength of the shock energy, the pendulum 28 and the U-shaped member or spring cage 25 will perform movements of different extent relative to the ski 3. Hence, very strong shocks, which are nevertheless harmless to the skier's leg, will not cause the toe-holding device to open. When the shock has been terminated, the helical compression spring 26 returns the moving parts to their normal position shown in FIG. 2.

When the shock is succeeded by a force acting on the soleholder member 12 transversely to the longitudinal direction of the device, e.g., in the direction of the arrow 32 in FIG. 4, and said force overcomes the initial stress of the helical compression spring, the spring cage 25 will perform a pivotal movement from the position shown in FIG. 3 to the position shown in FIG. 4 under the influence of the helical compression spring, which is slightly relaxed in this operation. The carrier 5 remains in its normal position during the movements described above because the free end of the arm 18 of the lever 11 still contacts the anti-friction bearing 19.

On the other hand, if kinetic or quasi-static energy is applied to the toe-holding device by means of the soleholder member 12, the four-bar linkage will initially assume the instantaneous position shown in FIG. 5. The eccentric engagement of the noses 29, 30 of the levers 10, 11 with the headed pin 27 causes the spring cage 25 to move toward the same side of the ski as the soleholder member 12 until the nose 29 then acting on the headed pin 27 moves through the longitudinal center line of the device. During the succeeding movement to the instantaneous position shown in FIG. 4, the point where the nose engages the headed pin, the pivotal connection between the spring cage 25, on the one hand, and the carrier 5 and U-shaped retaining member 22, on the one hand, and the point where the helical compression spring 26 abuts the spring cage, are all aligned. Because some time elapses until the parts have assumed the position in FIG. 4, the energy which still acts on the soleholder member 12 is virtually only potential energy. Upon a decrease of the force which produces that energy, the helical compression spring 26 will return the soleholder member to its normal position shown in FIG. 2. If a force which exceeds the predetermined force required for a release acts on the soleholder member not only as a shock, the four-bar linkage will move to the position shown in FIG. 4. After a slight pivotal movement to a position which is determined by the design of the device, the outer end face of the arm 18 of the lever 11 disengages the anti-friction bearing 19 so that the carrier 5 is unlocked and can move about the pivot pin 4 to the position shown in FIG. 6. During that movement, the soleholder member virtually suddenly releases the toe portion of the skiing boot.
In the embodiment shown by way of example, the stress of the helical compression spring 26 is not increased during that last movement so that a seizing of the skiing boot on the ski in oblique position is reliably avoided. Because the stress of the spring is not increased during the pivotal movement of the carrier 5 relative to the baseplate 1, the carrier must be swung back to its normal position by hand when it is desired to return the device to a position for skiing. Upon this return of the carrier, the helical compression spring 26 automatically returns the four-bar linkage.

In this embodiment, a resistance is presented only by the helical compression spring 26. This feature results in a toe-holding device according to the invention in an embodiment which is particularly simple and reliable. The work absorption capacity of the device may be varied, e.g., by the substitution of the helical compression spring 26 by another and/or by a change of the initial stress of said spring. Besides, the shock work absorption capacity may be varied by changing the position of the pendulum 28 threaded on the headed pin 27.

What is claimed is:

1. A toe-or heel-retaining device for safety ski bindings comprising a soleholder means in operative relationship with a resistance element (26) which, upon overcoming the resistance of said resistance element, automatically moves from a lock setting to a release setting, the resistance of said resistance element being a function of potential and kinetic energy, said device further including an elastically borne setting element (25, 27, 28) constructed as a pendulum weight in operative relationship with said resistance element for, in dependence upon the momentary deflection of the pendulum weight from a central rest position by forces of mass inertia, influencing said resistance element to oppose movement of said soleholder means, said setting element including a pendulum arm (25, 27) and a pendulum (28) carried by said pendulum arm, said pendulum arm being bipartite, its first part (25) being pivoted to the device and its second part (27) carrying the pendulum, said first and second part operatively forming abutments for said resistance element, and means connecting said second part to said first part such that the second part is movable longitudinally and laterally relative to the first part against the force of the resistance element.

2. A toe-or heel-holding device according to claim 1 characterized in that said resistance element controlled by the setting element includes a friction coupling.

3. A toe- or heel-holding device according to claim 1, characterized in that the pendulum arm (25, 27) is movable in the plane of movement of the soleholder member (12) or, even where the soleholder member is constrained to describe a non-spherical path, in a plane of movement which is parallel to the plane of movement of the soleholder member.

4. A toe-holding device according to claim 1, characterized in that the resistance element comprises a helical compression spring (26), the first part of the pendulum arm comprising a spring cage (25), the second part of the pendulum arm comprising a headed pin (27) having a head which forms a second spring abutment and also having a shank which extends through the spring and the first spring abutment and which at its free end carries the pendulum (28), and wherein the head of the pin is in operative relationship with the soleholder member (12) for locking the soleholder member.

5. A toe-holding device according to claim 4, in which the soleholder member forms a coupling link of a four-bar linkage, said linkage comprising pivoted connections (13, 14) and two levers (10, 11) having angled end portions (29, 30) of the four-bar linkage extending beyond the pivotal connections (13, 14) of the soleholder member (12) and angled inwardly, said device further including pendulum arm pivot (23, 24), the direction of action of the spring (26) in the locking position of the device extending through the pivot (23, 24) of the pendulum arm (25, 27), and, wherein the head of the pin (27) acts on the angled end portions (29, 30) of the levers.