

Oct. 24, 1967

H. MARKER

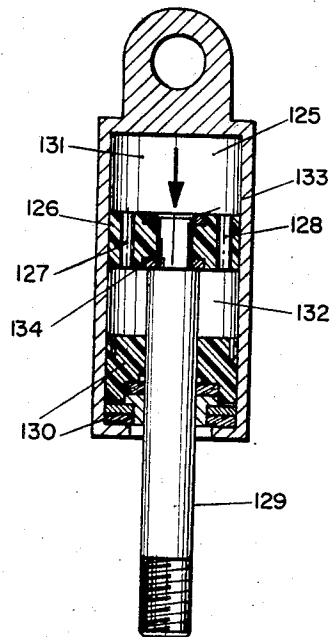
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SAFETY TOE IRON FOR SKI BINDINGS

Filed June 17, 1966

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Fig. 1



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Fig. 2

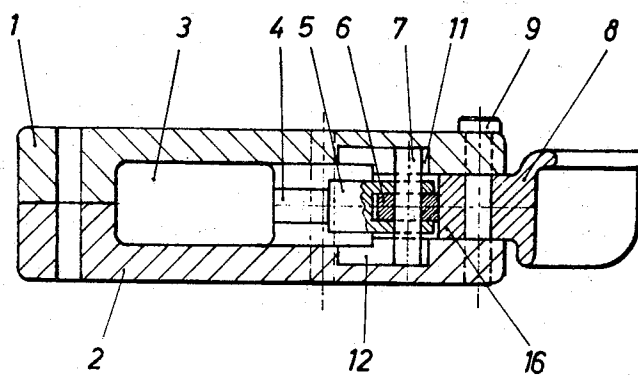
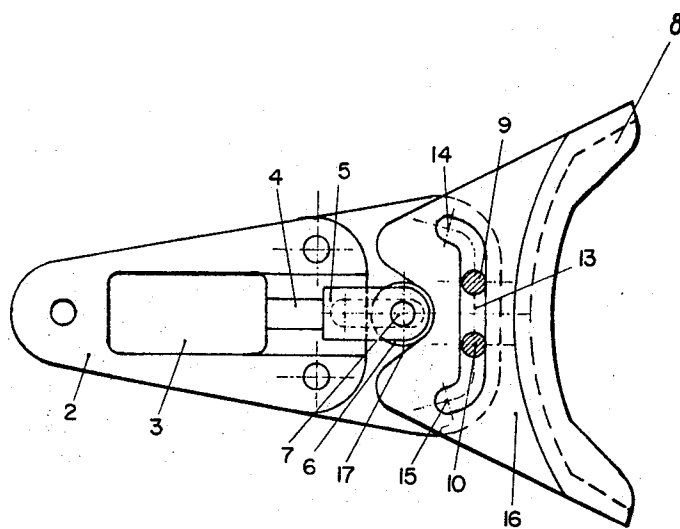


Fig. 3



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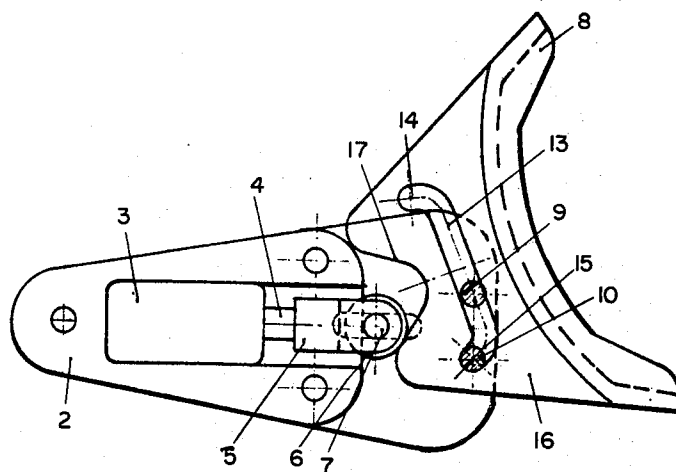
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Fig. 4



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Fig. 5

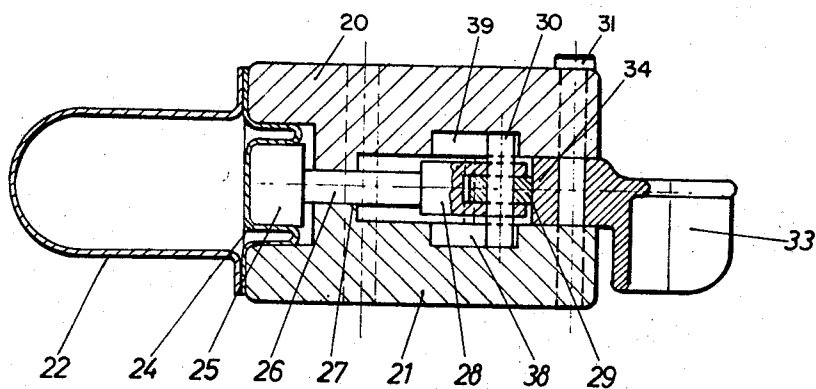
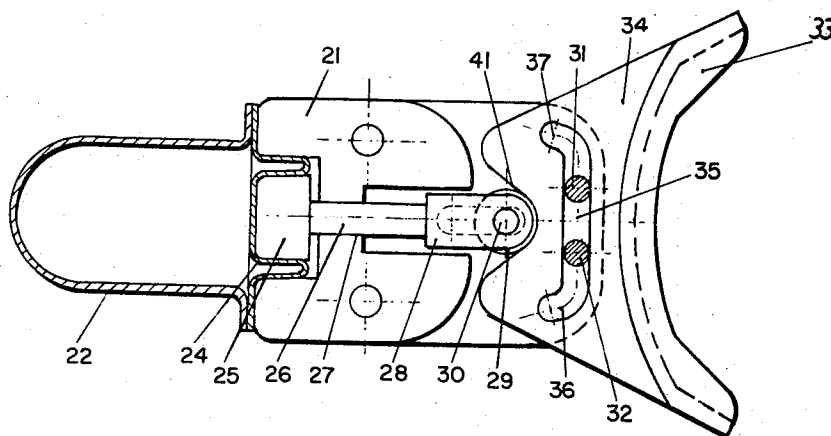


Fig. 6



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Fig. 6

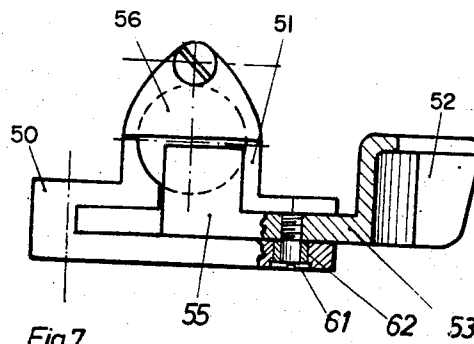
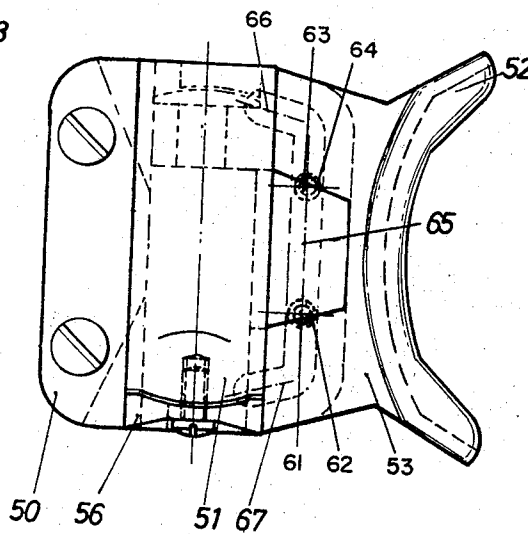
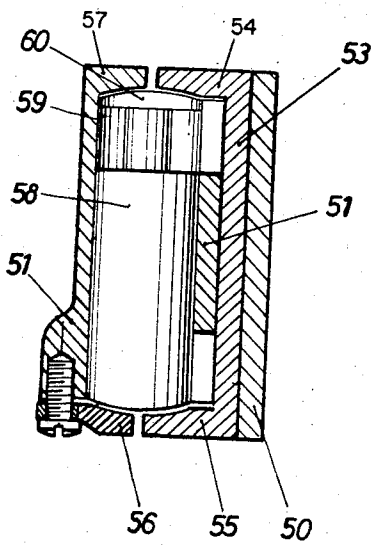


Fig. 9

Fig. 7



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Fig. 11

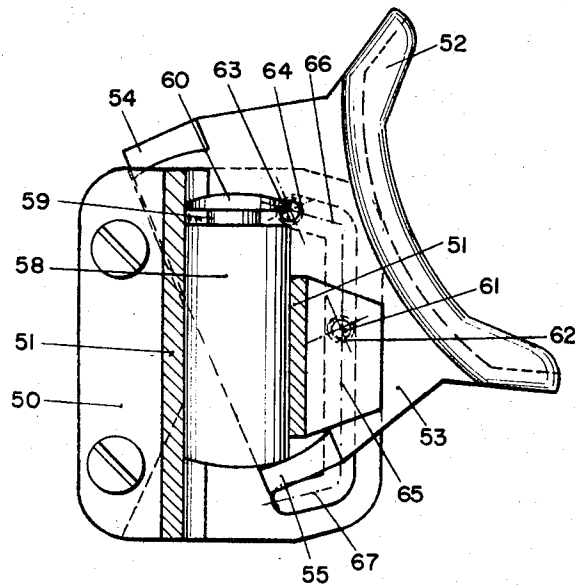
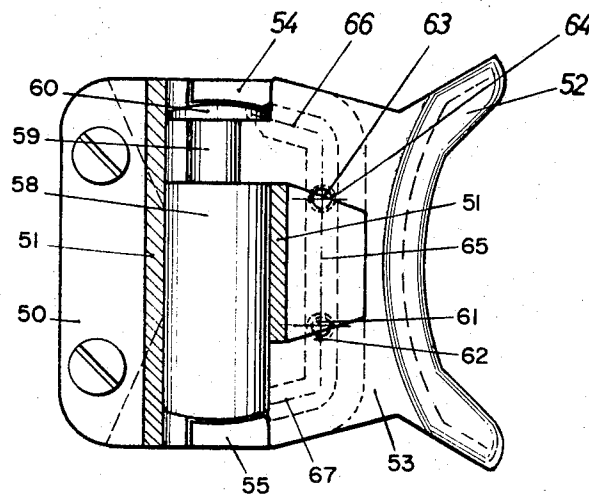


Fig. 10



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Fig. 12

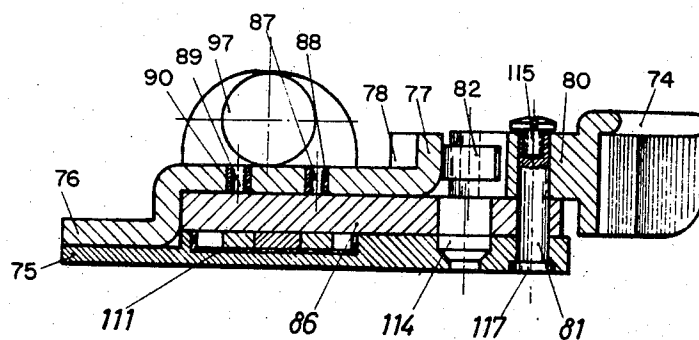
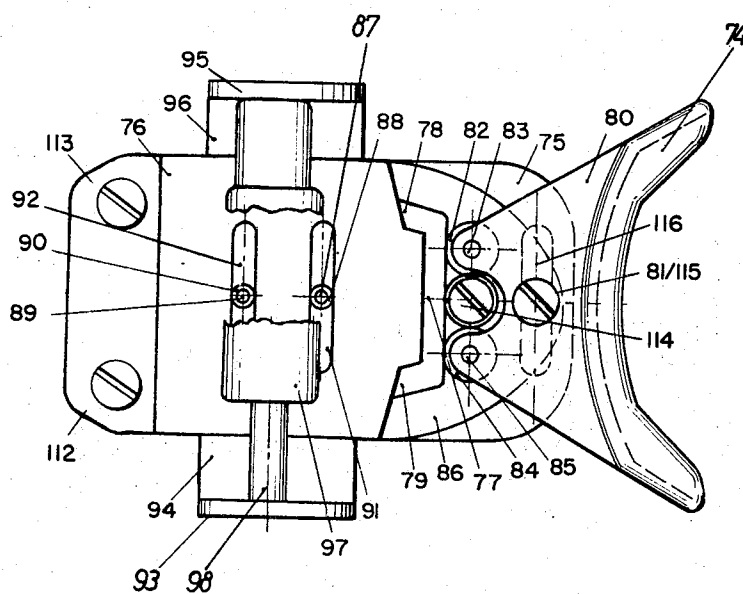


Fig. 13



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Fig. 14

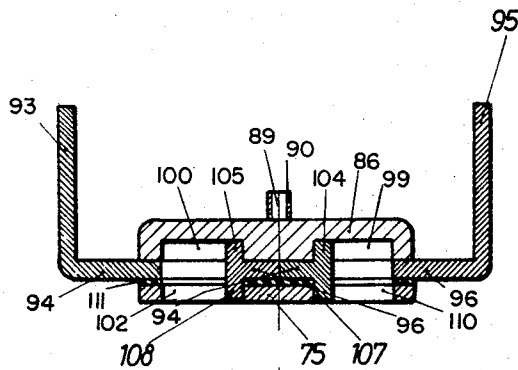
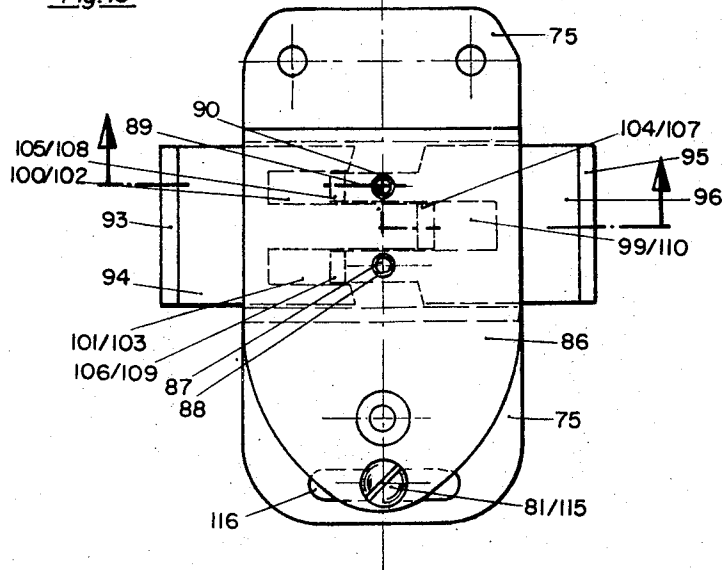


Fig. 15



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SAFETY TOE IRON FOR SKI BINDINGS

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Claims priority, application Germany, June 21, 1965, M 65,665

6 Claims. (Cl. 280-11.35)

It is an object of the invention to provide in ski bindings a safety toe iron which resiliently absorbs by a large cushioning movement the forces which occur transversely to the longitudinal direction of the ski so that slight lateral shocks, as often occur during skiing, do not cause an unintended release whereas the stronger forces acting on the leg during a twisting fall overcome the cushioning resistance so that the foot is released. The toe iron according to the invention should be designed so that an adjustment of the spring force is not required, a firm hold of the foot is ensured even in the normal position, and there is no undesirable interaction between the cushioning spring of the toe iron and the spring of the tightener, which urges the foot in the longitudinal direction of the ski against the toe iron.

This object is accomplished according to the invention by a safety toe iron which is characterized by a combination of the following features:

(1) The sole holder of the toe iron is movable only transversely to the longitudinal direction of the ski for a large distance until the release position has been reached and is then capable of a guided forward movement;

(2) A return spring tends to return the sole holder to its normal position in any position of the sole holder;

(3) The return spring consists of a container for a compressed gas, which container has a volume which is variable by a plunger, which is operated in response to a displacement of the sole holder, the change in volume between the two limiting positions of the plunger being small compared to the total volume of the container for compressed gas.

The use of the return spring arrangement which is suggested according to the invention ensures a sufficiently strong spring resistance even during the initial movement of the sole holder from its normal position because the gas pressure which opposes the relative movement of the two parts of the return spring arrangement does not substantially change during the displacement. The resistance of the spring does not substantially increase throughout the cushioning movement. The foot is not held by a relatively small force in its intermediate position, as in the known toe irons, where the spring resistance increases greatly before the release and must be only so high that even this higher spring resistance can be overcome during a fall. As the toe iron is not rotated about an axis which is at right angles to the surface of the ski, but is displaced transversely to the longitudinal direction of the ski, the force of the tightener does not urge the foot forwardly during lateral movements. In this case, the return spring would have to act against the tightener spring. The mounting of the sole holder for a movement in a transverse direction ensures also that it is not necessary to push the foot back against the resistance of the tightener spring when the release movement is initiated, as with the known toe irons, which rotate about an axis at right angles to the ski. The large cushioning movement and the low spring rate of the compressed-gas return device which is used according to the invention eliminate the need for an adjustment of the spring force because the relatively high initial force ensures that even a fairly strong skier is sufficiently held in the binding whereas the large cushioning movement and the flat spring rate enable a move-

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ment beyond the cushioning distance and a release of the foot even in the case of very light persons.

The considerations which have led to the invention are based on the recognition that the power which is absorbed or applied by an ordinary toe iron and which corresponds to the product of large force $\times$ short distance $\times$ short time can also be applied by a toe iron which opposes the lateral forces only with a small force so that large lateral forces cannot become effective or, in other words, cannot act suddenly on the foot. To ensure that the retaining performance of the toe iron is as good as that of the known toe irons and the foot is not actually released from the binding unless the lateral forces are as large as those required for a release with the known toe irons, the cushioning distance must be large enough with the toe irons according to the invention.

In the following description, the invention will be explained with reference to the drawing, which shows illustrative embodiments. In the drawing

FIG. 1 is a sectional view showing a commercially available gas spring element,

FIG. 2 a sectional side elevation showing an embodiment of the invention with a gas spring according to FIG. 1,

FIG. 3 a top plan view showing the embodiment of FIG. 2,

FIG. 4 a view similar to FIG. 4 in release position, without top part,

FIG. 5 a sectional side elevation showing a second embodiment,

FIG. 6 a top plan view showing the embodiment of FIG. 5 without top part,

FIG. 7 a top plan view showing another embodiment of the invention having a gas spring element,

FIG. 8 a side elevation showing the embodiment of FIG. 7,

FIG. 9 another sectional side elevation showing the embodiment of FIGS. 7 and 8,

FIG. 10 a horizontal sectional view showing the embodiment of FIGS. 7 to 9,

FIG. 11 the release position in a view similar to FIG. 10,

FIG. 12 a sectional side elevation showing another embodiment of the invention comprising a gas spring,

FIG. 13 a top plan view showing the same embodiment.

FIG. 14 the gas spring mounting of the embodiment of FIGS. 12 and 13 with base and slide plates, and

FIG. 15 a top plan view showing the details of FIG. 14.

FIG. 1 is a sectional view showing a gas spring element. A piston 126 having a piston rod 129 is slidably arranged in a gas spring cylinder 125. Cylinder 125 is sealed against piston rod 129 by a sealing system 130, which serves also for guiding the piston rod 129. The closed cylinder space 125 is divided by piston 126 into two chambers 131 and 132 and is under a high internal gas pressure. As the two chambers 131 and 132 communicate with each other by axial bores 127, 128 in the piston, the same pressure prevails in both chambers and the piston does not serve as a sealing and compressing element but only as a plunger. Connecting bores 127, 128 provide for an immediate equalization of pressure in both chambers upon a displacement of the piston. As the top face 133 of the piston is larger by the cross-sectional area of the piston rod than the bottom face 134 of the piston, a force corresponding to the product of pressure and of the area of the cross-section of the piston rod acts constantly in the direction of the arrow on the piston. As a result, the piston is always urged towards its lower dead center position, in which it engages the sealing system 130.

When piston rod 129 and the piston 126 are urged into cylinder 125, they must overcome the force which is determined by the pressure and the cross-sectional area of the piston rod. As the internal pressure remains virtually unchanged because the volume of cylinder 125 is only slightly changed by the entrance of piston rod 129 into cylinder space 125, the force by which the spring element opposes a displacement of the piston remains approximately constant whereas this force progressively increases in the known spring elements. It is sufficient to provide connecting bores 127 and 128 which have a sufficiently large cross-section so that the equalization of pressure between chambers 131 and 132 can take place immediately even upon a rapid displacement.

FIGS. 2 to 4 show an embodiment of a safety toe iron according to the invention, in which a commercially available gas spring according to FIG. 1 is used as a spring element. A gas spring 3 lies along the axis of the ski between a top part 1 and a bottom part 2. Parts 1 and 2 are secured to the ski. An extension 16 of a sole holder 8 is guided and held between parts 1 and 2 by pins 9 and 10, which enter the slot 13 of extension 16. A cam 17 of a sole holder 8 is engaged by a piston rod 4 of gas spring 3. A yoke 5 is secured to this piston rod and by means of a pin 7 carries a rotatably mounted roller 6. When forces directed transversely to the longitudinal axis of the ski occur, the design of cam slot 13 initially permits only of a strictly transverse movement of sole holder 8 while roller 6 rolls along cam 17 so that the piston rod of the gas spring performs a longitudinal movement. To ensure a transmission of the effective lateral forces through cam 17 to roller 6 and to piston rod 4 only in a longitudinal direction, pin 7 is additionally guided in groove 11 of top part 1 and in groove 12 of bottom part 2. When the foot has reached a predetermined angular position, forwardly inclined cam slot branches 14 and 15 enable an additional pivotal movement of sole holder 8 so that a sudden release of the foot in response to excessive transverse forces is ensured. This position is shown in FIG. 4.

FIGS. 5 and 6 show another embodiment of the invention, in which a different spring element is used. The toe iron comprises a top part 20 and a bottom part 21, which are secured to the surface of the ski. A chamber 22 forms together with a flexible diaphragm 24 a container for compressed air and is firmly screwed to parts 20 and 21. Diaphragm 24 acts also as a sealing element. Piston 25 acts on diaphragm 24 and engages cam 41 of sole holder 33 by a piston rod 26, mounted in a bearing 27, and a yoke 28 mounting a roller 29 by means of a pin 30. As in the embodiment of FIGS. 2 and 3, sole holder 33 has an extension 34, which is mounted between parts 20 and 21. Sole holder 33 is held and guided in a slot 35 of extension 34 by pins 31 and 32. Owing to the design of cam slot 35, a lateral movement of sole holder 33 can be performed initially transversely to the longitudinal direction of the ski. Upon such movement, the rolling movement of rollers 29 on cam 41 imparts to piston 25 a longitudinal movement so that piston 25 is forced by diaphragm 24 into the container 22 for compressed air. As the movement of the plunger results only in a relatively small change in volume of chamber 22, the pressure within chamber 22 is hardly changed from the pressure in the normal position of the plunger. As a result, there is only a slight increase of the back-pressure, which equals the product of the pressure within chamber 22 and the piston area. To avoid a bending stress on the piston rod by the lateral forces acting through a cam 41 on roller 29, the piston rod is additionally guided by pin 30 in a groove 39 of top part 20 and a groove 38 of bottom part 21. In this case too, the forwardly directed cam slot branches 36 and 37 enable an additional pivotal movement of the sole holder to release the foot when the same has reached a predetermined angular position.

FIGS. 7 to 11 show a further embodiment of the invention comprising a gas spring element. In this embodiment, a gas spring 58 is transverse to the longitudinal axis of the ski and is longitudinally slidably mounted in a mounting 51 of a baseplate 50, which is fixedly screw-connected to the ski. The gas spring 58 bears on abutments 56, 57 of the holder 51 and on abutments 54, 55 of an extension 53 of the sole holder. For the mounting of gas spring 58, e.g., one of the lateral abutments 54, 55 is screw-connected to mounting 51 after the spring 58 has been introduced into the mounting. Extension 53 of sole holder 52 engages the mounting 51 and gas spring 58 from below and is held and guided in cam groove 65 of baseplate 50 by rollers 62, 64 mounted on pins 61, 63, which are secured in extension 53. When forces occur which are transversely to the longitudinal direction of the ski, sole holder 52 and its extension 53 are capable of a lateral movement, which is only transverse to the longitudinal direction of the ski. Owing to the design of cam groove 65, this movement is only transverse to the longitudinal direction of the ski within a predetermined angle of the movement of the foot. The sole holder acts on gas spring 28 by one of its abutments 54, 55 at a time. During a movement of sole holder 52 to the right in the drawing, a mushroom-shaped head 60 of piston rod 59 bears on the stationary abutment 57 of mounting 51 and the abutment 55 displaces the gas spring cylinder in mounting 51. During a movement of sole holder 52 to the left, the gas spring cylinder bears on the stationary abutment 56 of mounting 51 and longitudinal displacement is imparted to the piston of the gas spring by the mushroom-shaped head 60 of piston 59 and by abutment 54 of sole holder 52. It has already been described that the gas spring has an approximately constant spring rate so that the transverse movement of sole holder 52 is opposed by the same spring force virtually in any position. When the foot has been moved through a predetermined angle, the sole holder can perform a forward movement toward the tip of the ski so as to release the foot because one of guide rollers 62, 64 can yield in one of cam slot branches 66, 67 extending forwardly toward the tip of the ski. The release position is shown in FIG. 11.

Another embodiment comprising a gas spring element is apparent from FIGS. 12 to 15. A gas spring 97 lies also transverse by the longitudinal direction of the ski between angled spring mountings 93, 95, which have interdigitating, forked guides 94, 96 and are slidably mounted in baseplate 75. Extensions 107, 108, 109 of the guides are disposed in recesses 102, 103, 110 of baseplate 75 and supported by said baseplate. During a displacement of spring mountings 93 and 95, cams 107, 108, 109 provide an additional guidance for said mountings. The forked guides 94, 96 have extensions 104, 105, 106, which engage recesses 99, 100, 101 of a slide plate 86, which is connected by a pin 81 to sole holder 74. The slide plate 86 is held and guided in cam grooves 91, 92 of cover plate 76 by rollers 88, 90, which are mounted on pins 87, 89 secured in slide plate 86. The cover plate 76 and baseplate 75 are firmly secured to the ski by screws 112, 113. This prevents a lifting of spring mountings 93, 95 and of slide plate 86 and sole holder 74. Further means to prevent lifting comprise a third screw 114 for fixing the baseplate 75 and a shoulder pin 81 for guiding the sole holder 74 in groove 116 of baseplate 75. An axial movement of pin 81 is prevented by its shoulder 117 and a lock screw 115. Sole holder 74 is provided by pin 81 to slide plate 86 and bears on the cam 77 of cover plate 76 by rollers 82, 84 mounted on pins 83, 85, which are secured to the extension 80 of the sole holder.

When forces occur which are transverse to the longitudinal direction of the ski, guides 77, 91, 92, 116 enable a movement of sole holder 74 and slide plate 86 in a lateral direction, which is transverse to the longitudinal axis of the ski. During a pivotal movement of the foot

or a lateral movement of sole holder 74 and slide plate 86 to the right, slide plate 86 causes by means of an extension 104, which is disposed in recess 99 of slide plate 86, a guidance of spring mounting 93 in an inward direction toward the longitudinal center line of the ski so that a longitudinal movement is imparted to piston rod 98 and to the piston of gas spring 97. At this time, the gas spring 97 bears on spring mounting 95. The extensions 108, 109 of the latter are disposed in recesses 102, 103 and engage the baseplate 75 so that the mounting 95 remains rigid. Inverse conditions are obtained during a lateral movement of sole holder 74 to the left so that the piston gas spring 97 bears with its piston rod 98 against the mounting 93, which is now rigid whereas the displaceable mounting 95 imparts a longitudinal movement to the gas spring cylinder. To facilitate the displacement of spring mountings 93, 95, a friction-reducing layer 111, e.g., of plastic material, is provided between mountings 93, 95 and the baseplate.

As the gas spring 97 has an almost constant spring rate, the force which opposes the pivotal movement of the foot is practically constant in all positions. When the foot has been pivotally moved through a predetermined angle, one of the backing rollers 82, 84 of sole holder 79 slides from cam 77 into cam slot branches 78, 79, which are directed forwardly toward the tip of the ski so that the sole holder 74 is additionally capable of a pivotal movement to release the foot. As the gas spring 97 remains in engagement in this position too, an automatic return of the sole holder from any angular position is ensured. Gas spring 97, which is not shown in FIGS. 11 and 12, can be secured by rigid connections between piston rod 98 and mounting 93 and between the spring cylinder and mounting 95. Alternatively, the gas spring 97 must be longitudinally slidably mounted on the cover plate 76.

What is claimed is:

1. A toe iron for safety ski bindings comprising a base means attached to a ski, said base means being formed with a guide surface extending transversely to the longitudinal direction of the ski, the length of which corresponds approximately to the range of foot-twist occurring during harmless lateral jolts, and terminating in guide faces which are inclined sharply forwardly to said transverse guide surface, a sole-retaining member carried by said base means, said sole-retaining member being positioned for movement along said guide surface and being biased by a return spring means carried by said base means and acting upon said sole-retaining member in every position to bias the sole-retaining member towards its normal sole-retaining position, said return spring means comprised of a container for a compressed gas, a plunger carried by said container, the volume of said container being variable by said plunger which is positioned for engagement by said sole-retaining means and is operated in response to a displacement of the sole-retaining member,

the change in volume between the two limiting positions of the plunger being small compared to the total volume of the container for compressed gas.

2. A toe iron according to claim 1, characterized in that said spring means comprises a cylinder filled with compressed gas, a piston guided on the inside surface of the cylinder, and a piston rod attached to one end of the piston, the piston having bores for the passage of gas and the piston rod being sealedly and slidably guided in one end of the cylinder.

3. A toe iron according to claim 1, characterized in that said container has a wall part in the form of a flexible diaphragm, and the plunger bears on the outside of the diaphragm.

4. A toe iron according to claim 1, characterized in that the sole-retaining member has a return cam surface and is guided by means of a slot, which extends transversely to the longitudinal direction of the ski and has forwardly curved end positions, and which cooperates with pins, which extend at right angles to the surface of the ski and are secured to said base means, and the container for compressed gas is mounted rigid with respect to the ski and the plunger bears against the return cam face of the sole-retaining member.

5. A toe iron according to claim 2, characterized in that each of the cylinder and piston rod ends of the return spring means bears partly on an abutment face which is rigid with respect to the ski and partly on an abutment face which is movable with the sole-retaining member.

6. A toe iron according to claim 1, characterized in that the sole-retaining member includes a sole-retaining element pivotally mounted to a drive plate, which is displaceable transversely to the longitudinal direction of the ski, and the sole-retaining element in normal position bears with two backing rollers on an abutment surface formed on said base means, one of said backing rollers clearing said abutment surface upon a transverse displacement of a predetermined extent, the return spring means being mounted between two abutment plates, each of which is provided on an angle member, one of the abutment plates being caused to follow a movement of the sole-retaining member, the other abutment plate being held in its initial position, said angle members extending parallel to the surface of the ski and being forked and interdigitated.

References Cited

UNITED STATES PATENTS

3,079,164	2/1963	De Place	280—11.35
3,224,786	12/1965	Tosalli	280—11.35

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