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[54] TOE IRON FOR SAFETY SKI BINDINGS

[75] Inventor: **Bernd Payrhammer,** Farchant, Germany

[73] Assignee: **Hannes, Marker, Garmisch-Partenkirchen,** Germany

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[52] **U.S. Cl.** .....280/11.35 T
[51] **Int. Cl.**.....A63c 9/00
[58] **Field of Search** .....280/11.35 T

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Primary Examiner—Kenneth H. Betts
Assistant Examiner—Ronert R. Song
Attorney—Felit, Gipple & Jacobson

[57] **ABSTRACT**

The toe iron is suitable for downhill and cross-country runs and comprises two carrying levers, which are pivoted on vertical pivots to a toe iron member that is fixed to the ski. At their free ends, the carrying levers carry respective soleholders. In their normal position, the carrying levers are pulled by a spring against a stop, which is fixed to the ski. The spring is connected at its ends to the carrying levers for a movement toward the tip of the ski. The carrying levers are adapted to be swung out against the force of the ski. A locking member is held on a toe iron member that is fixed to the ski. The locking member indirectly or directly forms a guideway for each end of the spring and prevents a movement toward the tip of the ski of that end of the spring which is associated with the carrying lever performing a pivotal movement at a time until the carrying levers have performed a pivotal movement through a predetermined angle, whereas the other end of the spring, which is associated with the carrying lever performing no pivotal movement at a time, is held in its normal position by the locking member.

15 Claims, 5 Drawing Figures

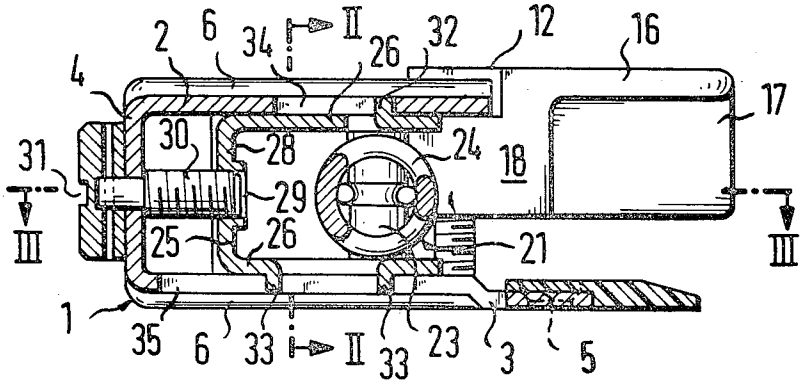


Fig.1

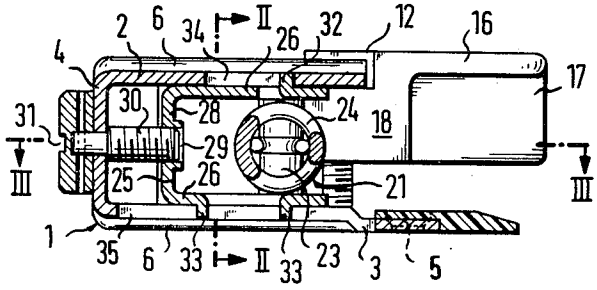


Fig. 2

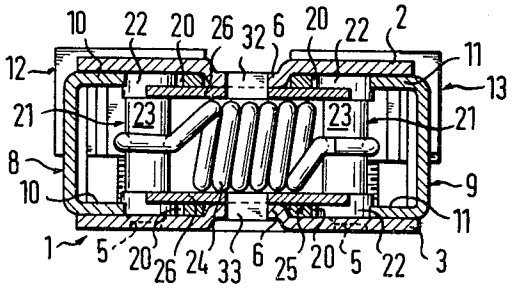
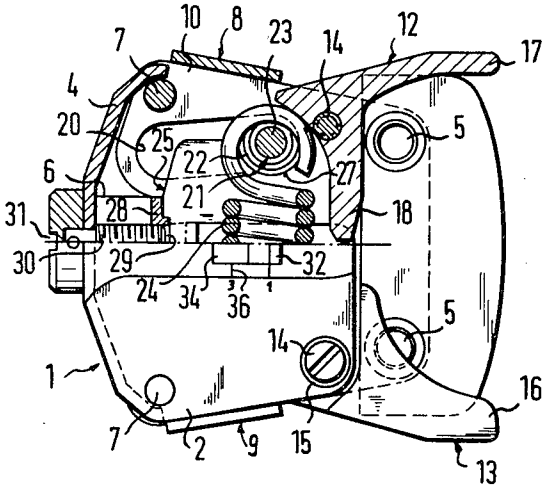


Fig. 3



INVENTOR:

Bernd Payrhammer

BY:

Fleit, Gipple & Jacobson

Attorneys

Fig.4

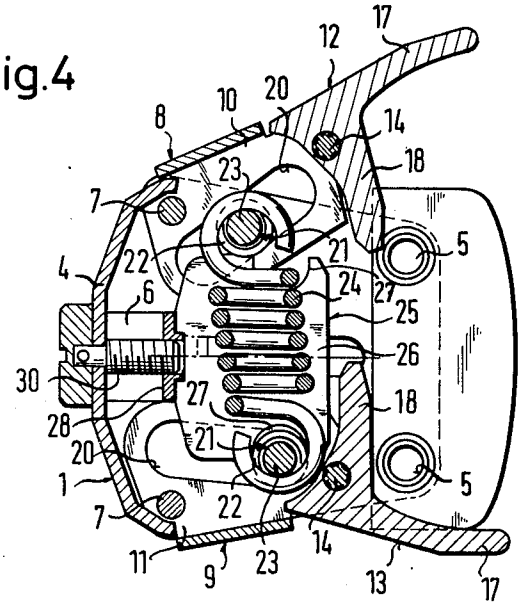

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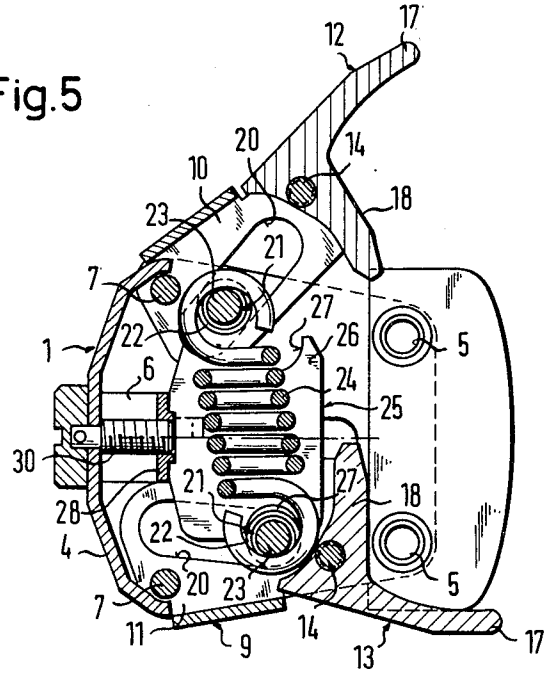
Fig.5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TOE IRON FOR SAFETY SKI BINDINGS

This invention relates to a toe iron for safety ski bindings, which toe iron is suitable for downhill and cross-country runs and comprises two carrying levers, which are pivoted on vertical pivots to a toe iron member that is fixed to the ski and which at their free ends carry respective soleholders, and in their normal position are pulled by a spring against a stop, which is fixed to the ski, said spring being connected at its ends to the carrying levers for movement toward the tip of the ski, and said carrying levers being adapted to be swung out against the force of the spring.

A toe iron which is used in practice comprises two carrying levers, which are pivotally movable independently of each other about respective pivots, which are at right angles to the surface of the ski and carry respective soleholders and are interconnected by a tension spring and in their normal position are pulled by said tension spring toward a stop that is fixed to the ski, the ends of said tension spring being received by notches formed in the carrying levers and said tension spring having such a strength that the soleholders may be the only means for engaging the toe portion of the skiing boot whereas the carrying levers are not spread forwardly by the contact pressure exerted by the heel-holding device. That toe iron has the important disadvantage that the resistance presented by the spring increases steadily during the outward pivotal movement of a soleholder until the skiing boot is released. As a result, during a movement beyond a desired elastic range, within which the toe iron is expected to return the skiing boot automatically to its initial position, the spring force continues to increase greatly until the spring presents a maximum resistance, when the skiing boot has reached the position in which it is released from the soleholder. In that case, the skiing boot must virtually squeeze out of the binding against that large resistance. Besides, the skiing boot may become seized in a position between the limit of the elastic range and the release position unless the force acting on the soleholder overcomes said maximum resistance. Such seizing may result in an apparently inexplicable fall of and atypical skiing injuries to the skier.

Another toe iron of the kind defined first hereinbefore has become known so far only from a printed publication and also comprises two carrying levers, which are pivoted on vertical pivots to a toe iron member that is fixed to the ski and carry the soleholders and under the influence of a tension spring are held in their normal position. In the last-mentioned toe iron, the considerable disadvantages of the toe iron described immediately hereinbefore are eliminated in that the carrying levers in their normal position diverge outwardly from the points where the spring is connected to them toward their centers of gravity and that the spring is suspended from the carrying levers by means of rollers to be movable in the longitudinal direction of said carrying levers. With that design, a pivotal movement of a soleholder against the force of the spring results in a shifting of the points where said spring is connected to the carrying levers as the outwardly directed pivotal movement proceeds because the rollers move toward the centers of gravity. If the soleholder swings out to such an extent that the divergent portions of the carrying levers are parallel or even converge, the resistance presented by the spring will not increase further but will remain virtually constant. As a result, the resistance presented by the spring no longer reaches a peak, as in the toe iron described immediately hereinbefore, so that the skiing boot when subjected to excessive forces which are dangerous to the skier's leg can be more easily disengage the soleholder and the risk of a seizing of the skiing boot is much reduced.

That toe iron, however, has still the disadvantage that the variation of the resistance presented by the tension spring to the outward pivotal movement of the soleholders depends on the coefficient of friction between the carrying levers and the rollers. For instance, the coefficient of friction may be increased after a relatively long period of non-use by an oxidation of the carrying levers or during skiing by a deposition of foreign matter or ice so that the rollers do not move toward the centers of gravity of the soleholders until the soleholders have performed a pivotal movement through an angle which is larger than desired. In this case, the undesired peak resistances can occur again and may create a risk of an injury to the skier.

It is an object of the present invention so to improve and design a toe iron of the kind described first hereinbefore that the disadvantages and drawbacks of the known toe irons of this kind are avoided in a simple manner.

In a toe iron for safety ski bindings, which toe iron is suitable for downhill and cross-country runs and comprises two carrying levers, which are pivoted on vertical pivots to a toe iron member that is fixed to the ski and which are their free ends carry respective soleholders, and in their normal position are pulled by a spring against a stop which is fixed to the ski, said spring being connected at its ends to the carrying levers for a movement toward the tip of the ski, and said carrying levers being adapted to be swung out against the force of the spring, the above object is accomplished according to the invention by the provision of a locking member, which is held on a toe iron member that is fixed to the ski and which indirectly or directly forms a guideway for each end of the spring and prevents a movement toward the tip of the ski of that end of the spring which is associated with the carrying lever performing a pivotal movement at a time until the carrying levers have performed a pivotal movement through a predetermined angle, whereas the other end of the spring, which is associated with the carrying lever performing no pivotal movement at a time, is held in its normal position by the locking member. As a result, the corresponding end of the spring cannot move along the carrying lever toward the tip of the ski until the carrying lever has performed a pivotal movement through the predetermined angle so that the inclination of the path for the movement of the end of the spring along the carrying lever to the longitudinal axis of the toe iron greatly exceeds the angle of friction between the end of the spring and the carrying lever. At the limit of the elastic range, when the carrying lever has performed a pivotal movement through the predetermined angle, this design ensures that the end of the spring will reliably move toward the tip of the ski, as desired, regardless of the friction conditions which prevail at the time. As a result, the stress of the spring is not or only slightly increased and the effective lever arm presented by the carrying levers to the spring force is reduced. An exact release position is thus determined for the toe iron and the latter will reliably release the skiing boot and with-

out seizing in response to a movement beyond said position.

It has proved particularly desirable to suspend the spring from the carrying levers in known manner by means of rolling elements and to provide each guideway with a portion which extends approximately transversely to the longitudinal direction of the toe iron and forms of a laterally outwardly open cam slot and which accommodates the associated rolling element when the corresponding carrying lever is in its normal position. This arrangement will reduce the internal friction of the toe iron mechanism and will improve the guidance of the ends of the spring during an outward pivotal movement of the levers.

To improve the protection of the rolling elements from external influences, the same may be mounted on the carrying levers in respective cam slots, which extend at least approximately in the longitudinal directions of the carrying levers. The slots are desirably arranged to converge toward the tip of the ski so that a movement of the rolling element in the slot results in a further increase of the difference between the inclination of the slot to the longitudinal axis of the toe iron and the angle of friction and, as a result, the spring force does not increase or increases only slightly beyond the elastic range.

In a particularly desirable embodiment of the subject matter of the invention, each carrying lever consists of a substantially channel-shaped sheet metal element having flanges which are parallel to the surface of the ski and extend toward the longitudinal axis of the toe iron, each flange has a slot, said slots are congruent, each slot receives and guides a roller, said rollers are interconnected by a vertical axle and form a rolling element, and the ends of the spring engage the axles of the rollers. This design results in a toe iron which is lighter in weight and in which the rolling elements are guided with a higher stability at the carrying levers. For the same reason, the locking member consists suitably also of a channel-shaped sheet metal element having flanges which are parallel to the surface of the ski and extend toward the rear end of the ski, the flanges of the locking member extend between the flanges of the carrying levers, and the spring is disposed between the flanges of the locking member.

To facilitate an adjustment of the force required for a release of the toe iron, the locking member my be mounted to be arbitrarily displaceable in the longitudinal direction of the toe iron. A displacement of the toe iron in the longitudinal direction of the toe iron changes the effective lever arm presented by the carrying levers to the spring force and the torque and force required for a release. If the inwardly and outwardly directed forces required for a release should differ, the locking member may consist of two parts spaced in the longitudinal direction of the toe iron and each part of the locking member may be held to be displaceable independently of the other.

If the toe iron mechanism is enclosed by a housing, the locking member or each part thereof is desirably provided with a vertically upwardly extending projection, which extends into an aperture formed in the top wall of the housing and extending in the longitudinal direction of the toe iron so that the locking member is guided in the longitudinal direction of the toe iron as it is displaced. A particularly simple design of the projection will be obtained if the same consists of a lanced tongue. Alternatively, the projection may consist of a roller, which is guided in the aperture in the housing wall and freely rotatably mounted on a vertical axle which is secured to the locking member.

To enable a check of the set force required for a release, the projection may be used as an indicator which cooperates with a scale provided along the edges of the aperture in the top wall of the housing to indicate the set force required for a release.

According to another feature of the invention, a bell-crank lever constituting a soleholder and known per se is pivoted to the free end of each of the carrying levers and has a horizontal extension overlying the sole of the skiing boot and further has an arm that extends at least approximately in the longitudinal direction of the ski and engages the side of the sole of the skiing boot and an arm which extends at least approximately transversely to the longitudinal direction of the ski and serves to engage the forward edge portion of the skiing boot. Due to this arrangement, the skiing boot will be reliably held by the soleholders in its normal position and within the elastic range and the release of the skiing boot in response to the action of excessive forces, which are dangerous to the skier's leg, will not be obstructed by the soleholders because they can swing outwardly.

To ensure that the soleholders can at least approximately follow the movement of the boot during a pivotal movement of the carrying levers so that the spring provided in the heel-holding device and exerting the forward contact pressure cannot relax in this range and cannot obstruct a return of the skiing boot from a position in said range to its normal position, the pivotal axes of the soleholders are suitably at a larger distance from the longitudinal axis of the toe iron than the pivotal axes of the carrying levers when the levers are in their normal position.

To prevent a rocking of the soleholders in the form of bell-crank levers when a skiing boot has not been inserted into the binding, a leaf spring may be secured to each carrying lever and may have a free end acting on the corresponding soleholder and tending to swing it in-wardly and to urge said soleholder against a stop that is fixed to the ski when no skiing boot is inserted.

An embodiment of the invention wild be described more fully and by way of example with reference to the accompanying drawings, in which

FIG. 1 is a central longitudinal sectional view showing the toe iron according to the invention,

FIG. 2 is a transverse sectional view taken through the toe iron on line II—II in FIG. 1,

FIG. 3 is a top plan view partly in a section taken on line III—III in FIG. 1 and shows the toe iron,

FIG. 4 is a sectional view taken on line III—III in FIG. 1 and showing the toe iron in a position which differs from FIG. 3 in that the toe iron is shown in a position at the limit of the elastic range under the action of a force which acts transversely to the longitudinal direction of the toe iron and which is upwardly directed in the drawing.

FIG. 5 is a sectional view similar to FIG. 4 but shows the toe iron in a position to release the boot.

The toe iron which is shown comprises a housing 1, which consists substantially of a channel-shaped sheet metal element having flanges 2 and 3, which extend horizontally in the longitudinal direction of the toe iron, and a web 4 serving as a forward vertical bound-

ary element of the toe iron. The lower flange 3 of the housing is adapted to be connected to a ski by screws extending through screw holes 5. Each flange 2 and 3 of the housing also comprises an inwardly projecting bead 6, which extends in the longitudinal direction of the toe iron. Each bead 6 serves as an inner stop for two carrying levers 8, 9, which are pivotally movable between the flanges 2 and 3 of the housing about respective vertical pivot pins 7 (see particularly FIG. 3). The carrying levers consist also of substantially U-shaped sheet metal elements and have flanges 10 and 11, which are parallel to the surface of the ski and extend toward the longitudinal axis of the toe iron (see particularly FIG. 2). Each carrying lever 8 or 9 is provided at its end opposite to the pivot 7 with a vertical screw 14, which is rotatably and axially non-displaceably mounted in the flanges 10, 11 of the carrying levers and forms a pivot for a soleholder 12 or 13. The screws 14 are at a smaller distance from the longitudinal axis of the toe iron than the pivots 7. The heads of the screws 14 are accessible by means of a screwdriver through respective circular openings 15 in the upper flange 2 of the housing. The screws 14 can be rotated to adjust the height of the soleholders 12, 13 relative to the carrying levers 8, 9 in dependence on the thickness of the sole. The soleholders 12, 13 consist of bell-crank levers, which have a horizontal extension 16 (see particularly FIGS. 1 and 3) overlying the sole of the skiing boot. That arm 17 of each bell-crank lever 12 or 13 which extends approximately in the longitudinal direction of the toe iron engages the side of the sole of the boot which has been inserted whereas the other arm 18 extends transversely to the longitudinal direction of the toe iron and serves as a forward member for engaging the forward edge portion of the skiing boot.

Each flange 10 or 11 of each carrying lever 8, 9 is formed with a slot 20 (see FIGS. 2 to 5). These slots are congruent and converge toward the forward end of the toe iron. A rolling element 21 (see particularly FIG. 2) is guided in the slots 20 of each carrying lever and consists of two guide rollers 22 and an axle 23 connecting said rollers. A tension spring 24 has ends which are pivoted to the axles 23 of the rolling elements and pulls the rolling elements 21 toward each other and normally pulls the carrying levers 8, 9 against the stops formed by the side walls of the bead 6. To prevent a forward rolling of the rolling elements 21 in the slots 20 under the influence of the spring force when the toe iron is in its normal position, a locking member 25 is provided, which is also channel-shaped and has flanges 26, which are parallel to the surface of the ski (see particularly FIG. 1) and extend between the flanges 10, 11 of the carrying levers. The locking member 25 is provided with two laterally outwardly open cam slots 27, which extend transversely to the longitudinal axis of the toe iron (see particularly FIGS. 3 and 5) and are associated with respective rollers 22 of the rolling element 21. Said cam slots embrace the periphery of those portions of the rollers 22 which extend out of the slots 20.

The locking member 25 is mounted in the toe iron housing 1 to be arbitrarily displaceable in the longitudinal direction of said housing. For this purpose, the web 28 of the locking member 25 is provided with a tapped hole 29, which is in threaded engagement with the threaded shank of a screw 30, which is rotatably and axially non-displaceably mounted in the toe iron housing 1. The head of the screw 30 is disposed outside of the toe iron housing and formed with a transverse slot 31, which is engageable by a tool.

The upper flange 26 of the locking member 25 is formed with a lanced and upturned tongue 32, and the lower flange 26 of the locking member is formed with two lanced and downturned tongues 33. These tongues 32, 33 serve to guide the locking member 25 as it is displaced and to hold it in position relative to the toe iron housing 1. For this purpose, the tongues 32, 33 extend into two slots 34, 35, which are formed in the upper and lower housing flanges 2, 3 and which extend in the longitudinal direction of the toe iron. The tongue 32 extending into the slot 34 in the upper housing wall 2 forms a pointer which is movable along a scale 36 (see FIG. 3) provided along the edges of the slot 34 to indicate the set force required for a release.

The toe iron is used and operates in the following manner. The skier places the tip of the ski pole between the lateral arms 17 of the soleholders 12, 13 and moves the heel-holding device to its operative position. The heel-holding device forces the skiing boot forwardly so that the forward edge of the sole is forced against those arms 18 of the soleholders 12, 13 which extend transversely to the longitudinal axis of the toe iron. As a result, the arms 17 firmly engage the sides of the skiing boot and center the latter on the ski.

When the soleholder 12 is subjected during skiing to a force which acts transversely to the longitudinal direction of the toe iron, e.g., upwardly in FIG. 4 of the drawing, and said force overcomes the initial stress of the tension spring 24, the soleholder 12 and the carrying lever 3 will perform an outward pivotal movement. The corresponding rolling element 21 in the slots 20 of the carrying lever 8 tends to follow this movement. The rollers 22 of the rolling element 21 are constrained by the cam face 27 of the locking member 25 to prevent initially a forward movement of the rolling element relative to the slots 20. When the acting force is not as large as the force required for a release or if it acts only for a short time and decreases before the rolling element 21 has disengaged the cam slot 27, the spring 24 pulls the carrying lever 8, the soleholder 12 and the skiing boot back to their initial position.

If a force which is dangerous to the skier's leg and which is directed transversely to the longitudinal direction of the toe iron acts on the soleholder 12 for more than a short time, the soleholder 12 will first swing to the position shown in FIG. 4, which is reached when the acting force is equal to the set force required for a release. Upon a continued pivotal movement of the soleholder 12 and of the carrying lever 8, the rolling element 21 disengages the cam face 27 and rolls in the slots 20 of the carrying lever 8 toward the tip of the ski whereas the other rolling element 21 held in the carrying lever 9 remains in its position. During this operation, the stress of the spring 24 is only slightly increased whereas the force required for an outward pivotal movement of the carrying lever 8 and the soleholder 12 decreases virtually suddenly below the value required for a release because the effective lever arm presented by the carrying lever 8 to the spring force is reduced as well as the moment which is the product of the spring force and its effort arm. When the carrying lever 8 has reached the position shown in FIG. 5, the skiing boot can freely disengage the soleholder 12. This unobstructed disengagement of the skiing boot is promoted

by the fact that the soleholders are freely rotatably mounted on the carrying levers.

Because the stress of the spring **24** is slightly increased even when the rolling elements **21** have disengaged the cam slot **27**, the toe iron is automatically returned to its initial position when the skiing boot has been released.

It is emphasized that the tension spring **24** obviously can be replaced by a spring block which comprises a compression spring or by another suitable spring element.

What is claimed is:

1. A toe iron for safety ski bindings which is suitable for downhill and cross-country runs, comprising: a toe iron member adapted to be fixed to a ski; two vertical pivots mounted on opposite sides of the longitudinal axis of said toe iron; a carrying lever pivotally mounted on each of said vertical pivots; a soleholder carried by each of said carrying levers and adapted to move pivotally outward with said carrying levers; a spring cooperating with each of said carrying levers and exerting a force on each of said carrying levers which opposes their outward pivotal movement, each end of said spring being journaled to respective one of said carrying levers and movable along the longitudinal axis thereof; locking means mounted on said toe iron member and having guideways for cooperating with said each end of said spring, one of said guideways cooperating with said spring during the outward pivotal movement of one of said carrying levers to prevent the forward movement of the end of said spring which cooperates with said pivoting carrying lever until said pivoting carrying lever has pivoted through a predetermined angle and the other of said guideways cooperating with the other end of said spring to maintain it in its normal position.

2. A toe iron according to claim **1**, in which a rolling element cooperates with each of said carrying levers and with said spring and in which each of said guideways has a portion which extends approximately transversely to the longitudinal direction of the toe iron and forms of a laterally outwardly open cam slot which accommodates one of said rolling elements when the carrying levers are in their normal position.

3. A toe iron according to claim **2**, in which said rolling elements are mounted in the carrying levers in cam slots which extend generally in the longitudinal direction of said carrying levers.

4. A toe iron according to claim **3**, in which said slots converge toward the tip of the ski.

5. A toe iron according to claim **3**, in which each carrying lever consists of a substantially channel-shaped sheet metal element having flanges which are parallel to the surface of the ski and extend toward the longitudinal axis of the toe iron and in which each flange has a slot, said slots are congruent, and each slot receives and guides one of said roller elements and in which said roller elements have opposed rollers interconnected by a vertical axle, and in which the ends of said spring engage the axles of said roller elements.

6. A toe iron according to claim **5**, in which said locking member comprises a channel-shaped sheet metal element having flanges which are parallel to the surface of the ski and extend toward the rear end of the ski, said flanges of said locking member extend between said flanges of said carrying levers and said spring is disposed between said flanges of said locking member.

7. A toe iron according to claim **1**, in which said locking member is displaceable in the longitudinal direction of said toe iron.

8. A toe iron according to claim **7**, in which said locking element consists of two parts which are spaced apart in the longitudinal direction of said toe iron and each part of said locking member is displaceable independently of the other.

9. A toe iron according to claim **7**, in which said toe iron member is enclosed by a housing and said locking member is provided with a vertically upwardly extending projection which extends into an aperture formed in the top wall of said housing and extending in the longitudinal direction of said toe iron.

10. A toe iron according to claim **9**, in which said projection consists of a tongue which has been lanced by said locking member.

11. A toe iron according to claim **9**, in which said projection consists of a roller which is guided in the aperture in said housing wall and freely rotatably mounted on a vertical axle which is secured to said locking member.

12. A toe iron according to claim **9**, in which said projection cooperates with a scale provided along the edges of said aperture in said top wall of said housing to indicate the set force required for a release.

13. A toe iron according to claim **1**, in which said soleholder comprises a bell-crank lever pivoted to the free end of said carrying levers and having a horizontal extension overlying the sole of the skiing boot and having an arm that extends generally in the longitudinal direction of the ski and engages the side of the sole of the skiing boot and having an arm which extends generally transversely to the longitudinal direction of the ski and serves to engage the forward edge portion of the skiing boot.

14. A toe iron according to claim **13**, in which the pivotal axes of said soleholders are at a greater distance from the longitudinal axis of said toe iron than the pivotal axes of said carrying levers.

15. A toe iron according to claim **13**, in which a leaf spring is secured to each of said carrying levers and has a free end acting on one of said soleholders and tending to swing it inwardly and to urge said soleholder against a stop that is fixed relative to the ski when no skiing boot is inserted.

* * * * *