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Frisch et al.

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[54] **TOE-OR HEEL-HOLDING DEVICE FOR SAFETY SKI BINDINGS**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 38,053, May 18, 1970, Pat. No. 3,692,322.

[30] **Foreign Application Priority Data**

July 4, 1969 Germany 1934060

[52] **U.S. Cl.** ..... **280/11.35 M,** 280/11.35 T

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

[58] **Field of Search** 280/11.35 M, 11.35 T, 11.35 A, 280/11.35 D, 11.35 K, 11.35 C, 11.35 E, 11.35 R

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[57] **ABSTRACT**

A toe-or heel-holding device for safety ski bindings having a soleholder member and means in operative relationship with the soleholder member for resisting movement by the soleholder member relative to the ski and wherein the resistance means include an electric-electronic, hydraulic, or friction clutch automatic control system.

11 Claims, 6 Drawing Figures

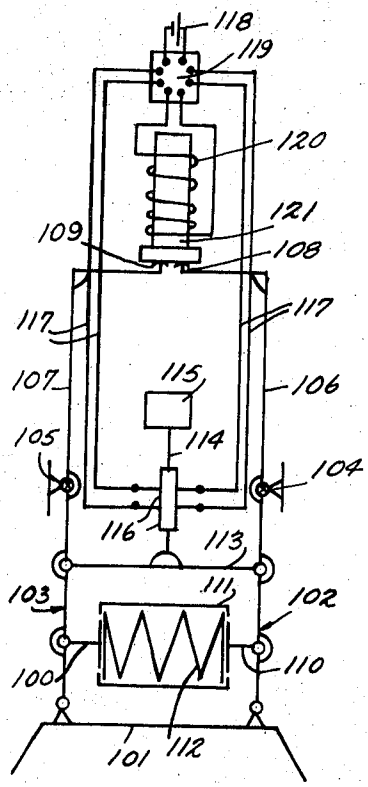


Fig. 1.

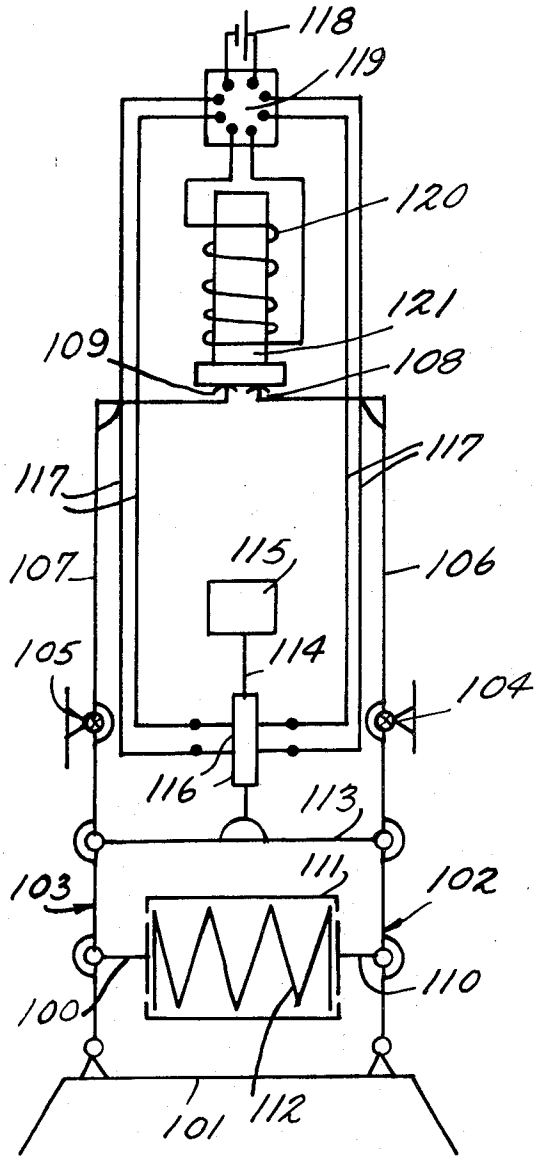

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Fig. 2.

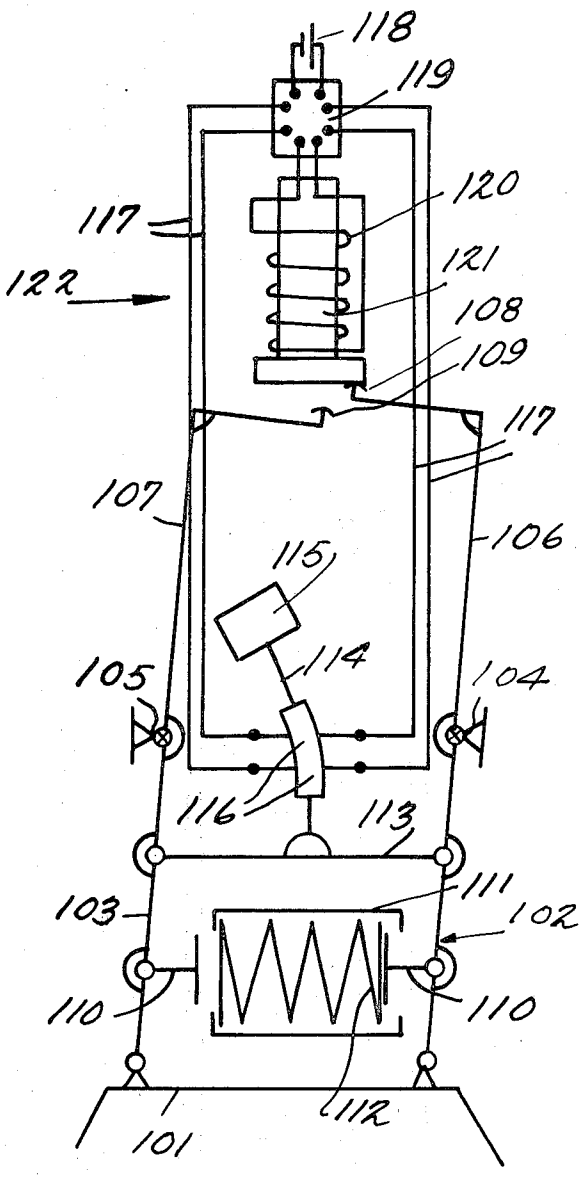

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Fig. 3.

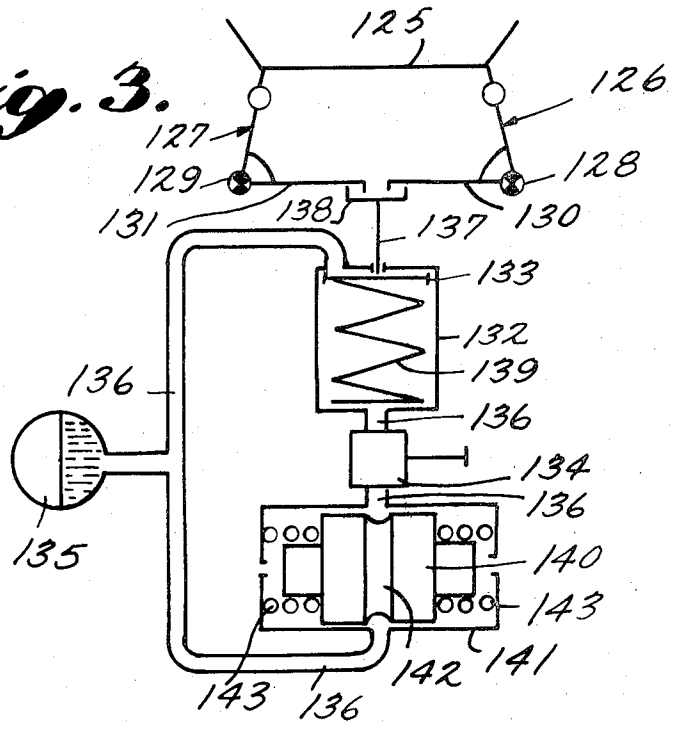

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Fig. 4.

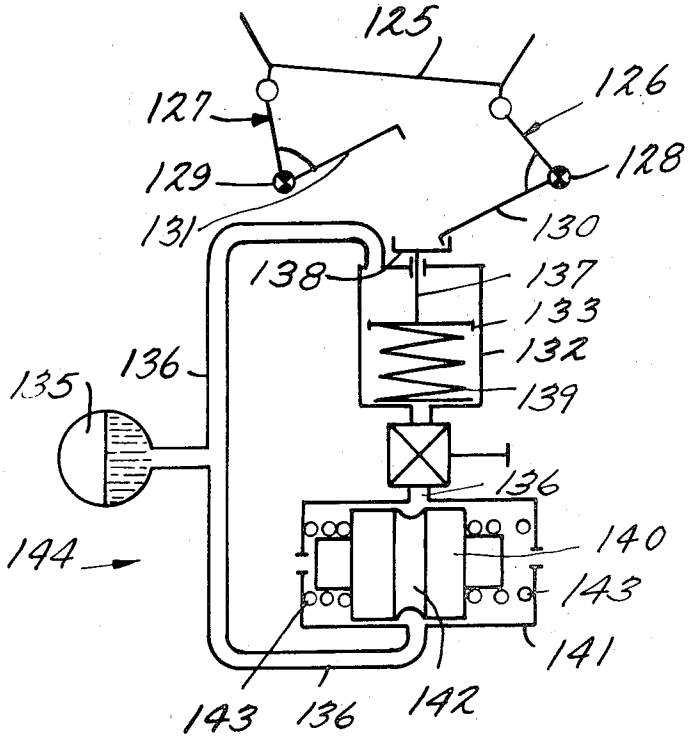

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Fig. 5.

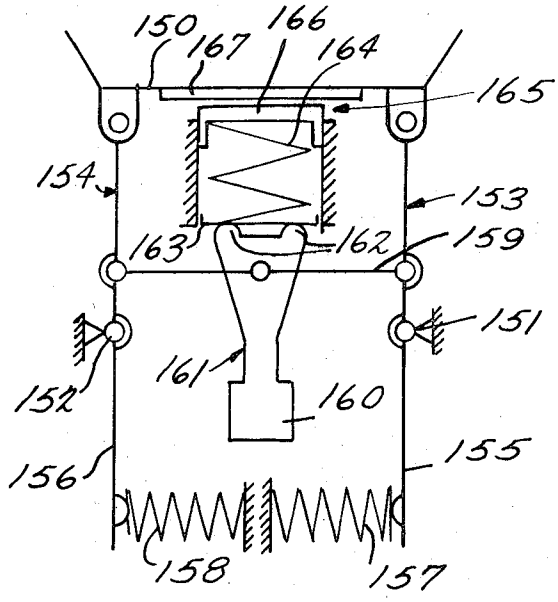
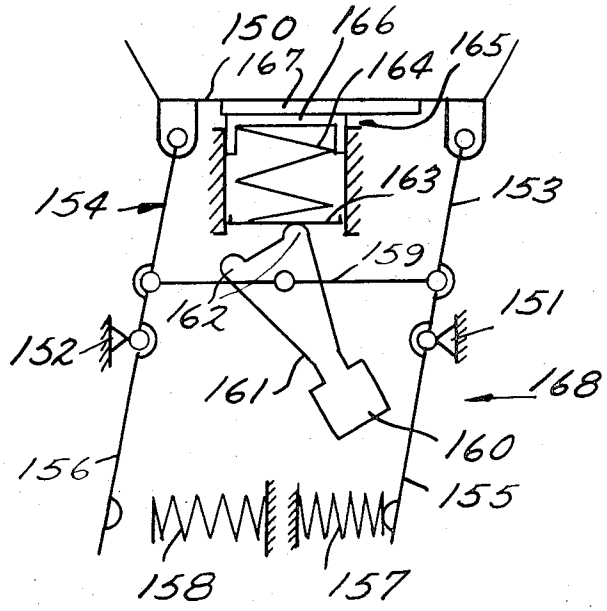

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Fig. 6.


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TOE-OR HEEL-HOLDING DEVICE FOR SAFETY SKI BINDINGS

This application is a continuation-in-part application of application Ser. No. 38,053, filed May 18, 1970 and now Pat. No. 3,692,322, issued Sept. 19, 1972, for 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.

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 diagrammatic top plan view showing a toe-holding device;

FIG. 2 is a diagrammatic top plan view similar to FIG. 1 but which shows the device in an instantaneous position resulting from the application of a shock to the ski;

FIG. 3 is a diagrammatic top plan view of an alternative toe-holding device in accordance with this invention;

FIG. 4 is a diagrammatic top plan view similar to that of FIG. 3 but which shows the device in an instantaneous position resulting from the application of a shock to the ski;

FIG. 5 is a diagrammatic top plan view illustrating another toe-holding device embodiment of this invention; and

FIG. 6 is a diagrammatic top plan view that is similar to FIG. 5 but which shows the device in an instantaneous position resulting from a shock transmitted to the device by the ski.

FIGS. 1 and 2 show a point holder arrangement according to the characteristics of the invention, in which the correcting element is part of an electrical-electronic regulating system.

The sole-holding part **101** is the couple of a four-link mechanism, the levers **102** and **103** of which rest pivotably on two linkage-axles **104** and **105.** These linkage-axles **104** and **105** of the two-branched levers **102** and **103** may be held in the locked position, at the least, of the arrangement, in a ski-fastened part not shown. The branches (or arms) **106** and **107,** which do not carry the sole-holding part **101,** and belong to levers **102** and **103,** are bent at their free ends towards the middle of the skis and are equipped with pressure guides **108** and **109.** A supporting member **110** is articulately linked to each of the lever arms **102** and **103** supporting the sole-holding part **101**; the supporting member **110** is supported by a helical pressure spring **112** which lies orthogonally to the longitudinal ski direction in a ski-fastened housing **111** as shown in the normal position in FIG. **1**; the spring **112** opposes the motion of the four-link mechanism and hence also the motion of the sole-holding part **101.**

The two levers **102** and **103** are additionally connected by a cross tie rod **113,** in articulate manner, to which is rigidly fastened a leaf spring **114,** extending in

the longitudinal ski direction and flexible transversely to the longitudinal ski direction, and equipped with a balance weight **115** at its free end. A strip **116** for measuring deflection is mounted on both sides of the leaf spring **114** that may be bent. These deflection-measuring strips **116** are connected by wirings **117** to an amplifier **119** supplied by battery **118.** A coil **120** is hooked to amplifier **119,** a soft iron core **121** being movably located inside the coil. Pressure guides **108** and **109,** shown in the normal position in FIG. **1,** rest on the soft iron core **121,** pressure guides **108** and **109** being part of the bent-off lever arms **106** and **107.**

If now an impact is exerted in the direction **122** of the arrow of FIG. **2** on the ski (not shown), then the arrangement moves as shown in FIG. **2,** the balance weight momentarily retaining its original position on account of inertia. This bends leaf spring **114,** and therefore control-currents depending in magnitude on the amount of bending will be set up between the measuring strips **116** and the amplifier **119,** and will be fed to the coil **120,** which builds up a magnetic field which in turn will tend to maintain the soft iron core **121** in a central position with more or less force. This restraining force on the soft iron core must be overcome when levers **102** and **103** do move; the restraining force adds to that of spring **112,** so that the resistance acting against the motion of the soleholder increases correspondingly.

In the case of static or quasi-static loading, the balance weight **115** may practically follow the motion of the arrangement instantly, so that leaf spring **114** will not be bent and therefore no control currents will flow to amplifier **119** that might excite magnetically the coil **120,** so that in this case there is no additional force opposing the motion of the sole-holding part **101.**

FIGS. **3** and **4** show diagramatically a point-holder arrangement, in which, according to the invention, the correcting element is part of a hydraulic regulating device.

The sole-holding part **125** of the point-holding arrangement represents the couple of a four-link mechanism, of which the levers **126, 127** and two hingeable axles **128, 129** are pivotably supported, and these in turn are mounted solidly on the ski in a part, not shown, of the arrangement, at least in the locked position. Levers **126** and **127** are in the form of angle levers, which are acted upon by the opposing resistance from the hydraulic regulator on the germane arms **130** and **131** that do not carry the sole-holding part **125,** in response to the motion of sole-holding part **125.**

The regulation system comprises a hydraulic cylinder **132** with a hydraulic piston **133,** an arbitrarily adjustable throttle valve **134,** and a compensation container **135** — all of which are interconnected by pipe conduits **136.** One piston rod **137** of piston **133** leads out of cylinder **132** and is provided with a support plate **138** at its free end for the arms **130** and **131** of the angular levers **126** and **127,** the arms being non-supporting of the sole-holding part **125.** By means of a spring **139** opposing release, the hydraulic piston **133** will normally be held in the position shown in FIG. **3.** The correcting element **140** is inserted in the closed hydraulic circuit. Within housing **141,** the correcting element **140** forms a cylindrical slide elastically supported and transversely located to the longitudinal ski direction, the slider being provided on its periphery with an annular tee-slot **142.** In its normal position, the slide will be held in place by two weak spiral pressure springs **143,** and extends between the mouths of two pipe conduits connected to the housing **141,** thus permitting unhampered flow of the fluid.

If for instance an impact is exerted on the ski (not shown) in the direction of the arrow **144,** see FIG. **4,** then the arrangement moves as indicated in FIG. **4,** the correcting element **140** momentarily retaining its normal position due to inertial forces. Because of this relative shift between housing **141** and correcting element **140,** the flow of fluid through housing **141** is hampered by the correcting elements **140** at least partially shutting off the pipe conduit; this can be seen in FIG. **4;** in this manner is increased the opposing resistance to the motion of piston **133** and hence to that of the sole-holding part.

FIGS. **5** and **6** show a point holder arrangement in which a friction clutch is used as the resistance regulated by the correcting element.

Again, the sole-holding part **150** of this point holder arrangement forms the couple of a four-link mechanism with the ski-fastened support-axles **151** and **152,** of which levers **153** and **154** are made two-armed. Two helical pressure springs **157** and **158** act upon levers **153, 154** arms **155, 156** that do not support the sole-holding part **150;** springs **157** and **158** oppose the motion of the four-link mechanism and therefore also that of sole-holding part **150.** Those arms of levers **153** and **154** that do support the sole-holding part **150** are further interconnected by a cross tie **159,** and hingeably so, cross tie **159** being hinged to a pendulum rod **161** supporting the balance weight **160.** The pendulum rod **161** rests in its normal position as illustrated in FIG. **5** on two cams **162** and through these on a piston **163;** piston **163** is guided along the longitudinal ski direction and serves as a bearing bracket for a spiral pressure spring **164** the other end of which rests on a second movable piston **165.** This piston **165** is provided with a friction lining **166** on its front end. A second friction lining **167** is provided at the sole-holding part **150,** opposite the front end just mentioned; spring **164** will push friction lining **166** of piston **165** against friction lining **167.**

If now an impact acts in the direction of the arrow **168,** see FIG. **6,** upon the ski (not shown), then the arrangement moves as indicated in FIG. **6;** pendulum rod **161** moves piston **163** by means of one of its cams **162** and thus increases the prestressing of spring **164.** This in turn increases the stopping force of the friction linings **166** and **167.** This frictional force is added to the force from spring **157,** so that the resistance opposing the sole-holding part is increased.

The invention in its broader aspects is not limited to the specific details shown and described and departures may be made from such details without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A toe-or heel-holding device for safety ski bindings comprising a soleholder member, a resistance means in operative relationship with said soleholder member for resisting movement by said soleholder member relative to the ski, said soleholder member, upon overcoming the resistance of said resistance means, being automatically movable from a locking position to a release position, an inertial mass for automatically controlling the resistance of said resistance means and for opposing

movement of said soleholder member as a function of the kinetic energy applied to the ski, said inertial mass being mounted in a rest position and being subject to momentary deflection by forces of mass inertia, and means cooperating with said inertial mass and acting on said resistance means for causing said resistance, means to oppose the movement of said soleholder member in dependence upon said momentary deflection of said inertial mass.

2. A device as in claim **1** wherein said means for cooperating with said inertial mass and acting on said resistance means is an electrical automatic control system including:

means operatively connected to said inertial mass and to said soleholder member for deflecting in response to movement of said soleholder member in a substantially transverse direction with respect to the ski;

deflection-measuring means positioned adjacent said deflection means for determining the degree of deflection of said deflecting means;

a coil in electrical circuit relationship with said deflection-measuring means for passing an electrical current of a magnitude proportional to the amount of deflection of said deflection means;

lever arms connected to said soleholder member; and

a core member located within said coil and maintained in position by a magnetic field created by said current passing through said coil, at least one of said lever arms bearing against said core member to oppose movement of the soleholder member in a transverse direction relative to the ski.

3. A device as in claim **2** further including an amplifier in circuit between said deflection-measuring means and said coil.

4. A device as in claim **2** further including a pressure spring mounted with its axis transverse to the ski and supporting members connected to the soleholder member for acting against the pressure spring to oppose movement of the soleholder member in a direction transverse to the ski.

5. A device as in claim **1** wherein said resistance means is a hydraulic automatic control system, said system including:

levers connected to said soleholder member and movable in response to movement of the soleholder member relative to the ski;

a hydraulic cylinder;

a piston positioned within said cylinder and movable within the cylinder in response to movement of the soleholder member and said levers;

a hydraulic circuit externally of said cylinder and connecting opposite ends of the cylinder in hydraulic circuit relationship; and

said inertial mass comprising a correcting element in circuit relationship with said hydraulic circuit and mounted for movement transversely of the ski for reducing the flow of fluid from within said cylinder to oppose movement of the piston and to oppose movement of the soleholder member relative to the ski.

6. A device as in claim **5** further including springs positioned to hold the correcting element in a predetermined position.

7. A device as in claim **6** wherein said correcting element is substantially cylindrical in form and includes an annular slot in normally fluid circuit relationship with said cylinder.

8. A device as in claim **5** further including a spring within the cylinder for holding the piston in a predetermined normal position and for opposing movement of the piston within the cylinder.

9. A device as in claim **5** further including an adjustable throttle valve in said hydraulic circuit.

10. A device as in claim **1** wherein said resistance means is a friction clutch automatic control system, said system including:

levers connected to said soleholder member and movable in response to movement of the soleholder member relative to the ski;

arms extending from said levers;

spring means fixedly mounted relative to the ski and positioned to oppose movement of said arms;

a first friction lining mounted on said soleholder member;

another friction lining positioned to selectively engage said first friction lining and to oppose movement of said soleholder member relative to the ski and means in cooperating relationship with said inertial mass for moving said friction linings into engagement with each other when said inertial mass moves relative to the ski.

11. A device as in claim **10** wherein said moving means include a cross tie interconnected between said levers, a pendulum rod hingedly mounted on said cross tie, said inertial mass comprising a balance weight supported by said pendulum rod, cams located on said pendulum rod, a piston normally resting against both of said cams, a guideway fixedly positioned relative to said ski, and a pressure spring positioned between said piston and said other friction lining whereby movement of said soleholder member relative to said ski results in movement of said pendulum rod and compression of said pressure spring to cause said friction linings to engage and to oppose said movement of said soleholder member.

* * * * *