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Anderson

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[54] **RELEASABLE SKI BINDING DEVICE**

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[52] **U.S. Cl.** .... **307/116;** 280/11.35 M

[51] **Int. Cl.** **H01h 35/00**

[58] **Field of Search**.................... 307/116, 117, 118; 280/11.35 M, 11.35 R; 338/2; 324/158 R, 76 R; 73/9, 1 B, 1 D; 317/9 R; 340/17; 238/2

[56] **References Cited**

UNITED STATES PATENTS

3,826,509 7/1974 Smulka........................ 280/11.35 M

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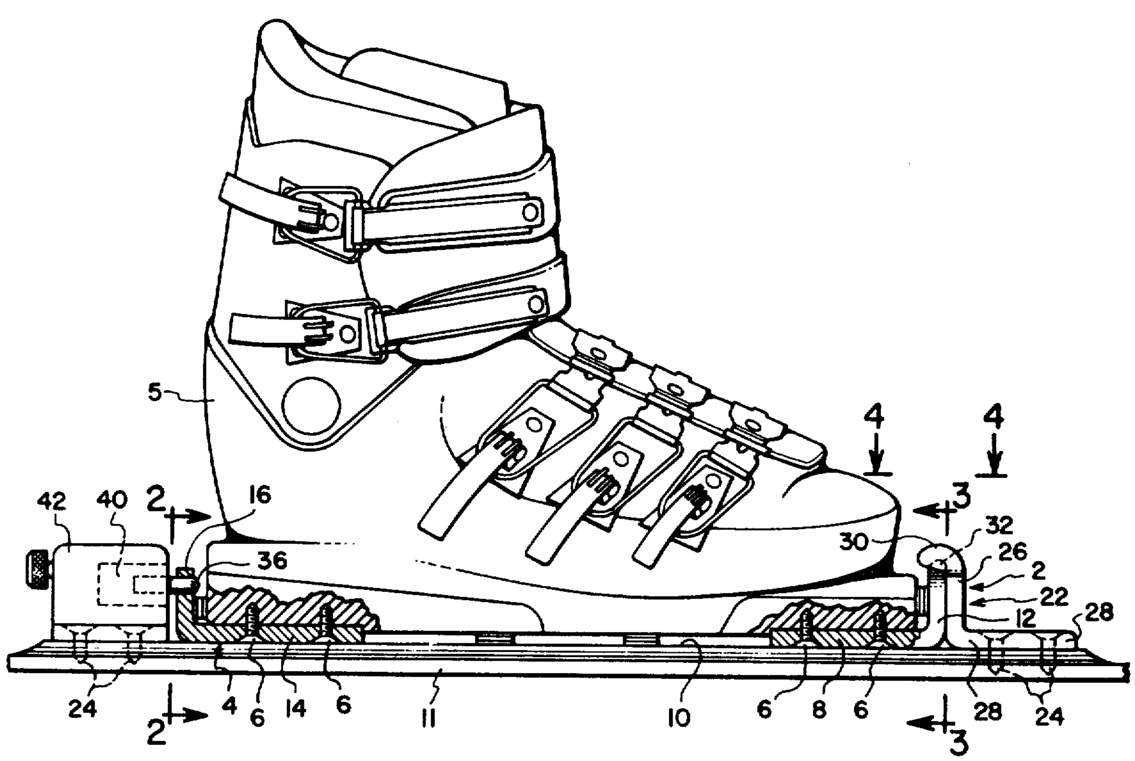
[57] **ABSTRACT**

A releasable ski binding device is disclosed whereby the release mechanism is electrically actuated by signals generated by a plurality of pressure sensor mounted in proximity to a ski boot. The binding device includes heel and toe engaging members and a solenoid actuated release mechanism having a learning system which automatically increases or decreases the pressure threshold point at which the release mechanism will be actuated. The device of this invention assures a skier that the ski binding will release only if excessive abnormal pressures are exerted and will not inadvertently release under conditions normal to the skier, even if the norm varies throughout the skiing day.

10 Claims, 8 Drawing Figures



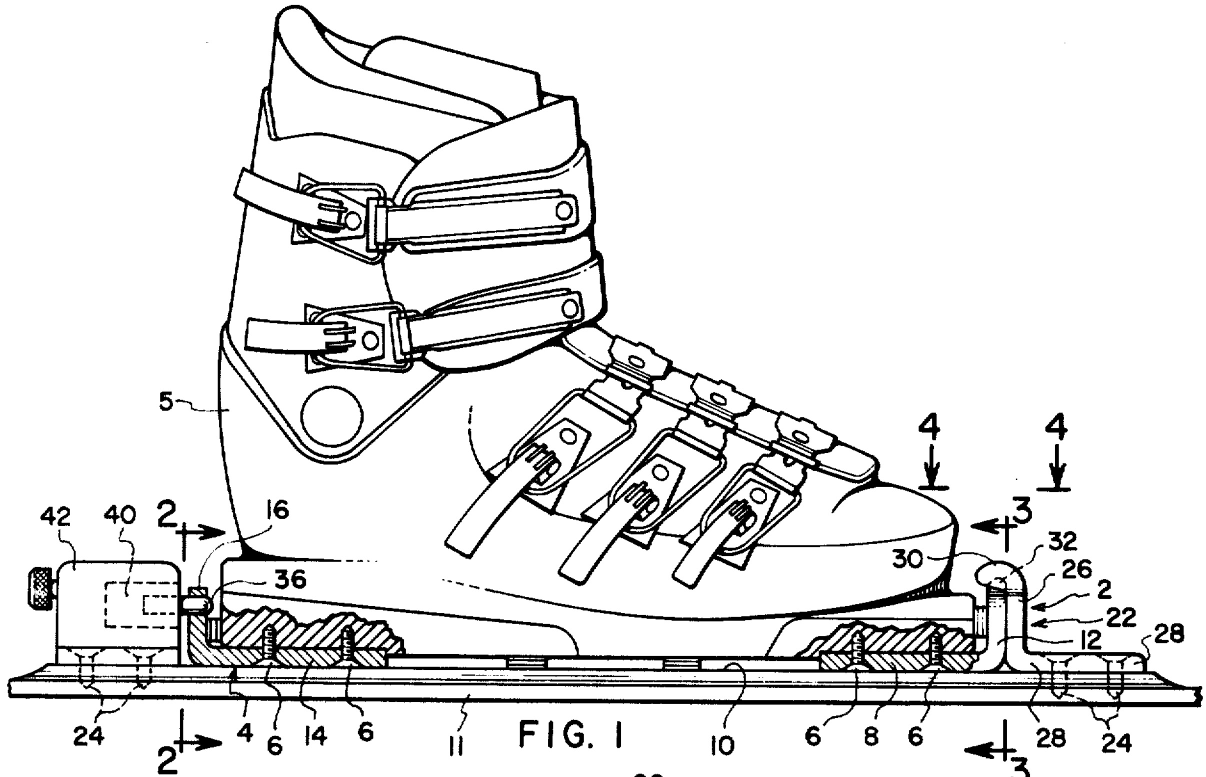


FIG. 1

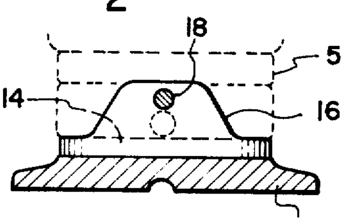


FIG. 2

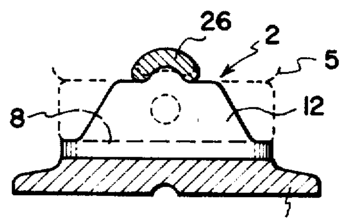


FIG. 3

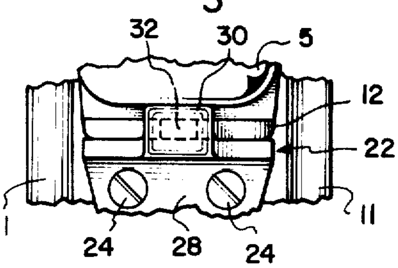


FIG. 4

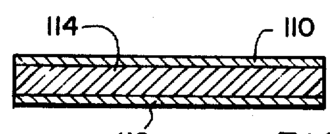


FIG. 8

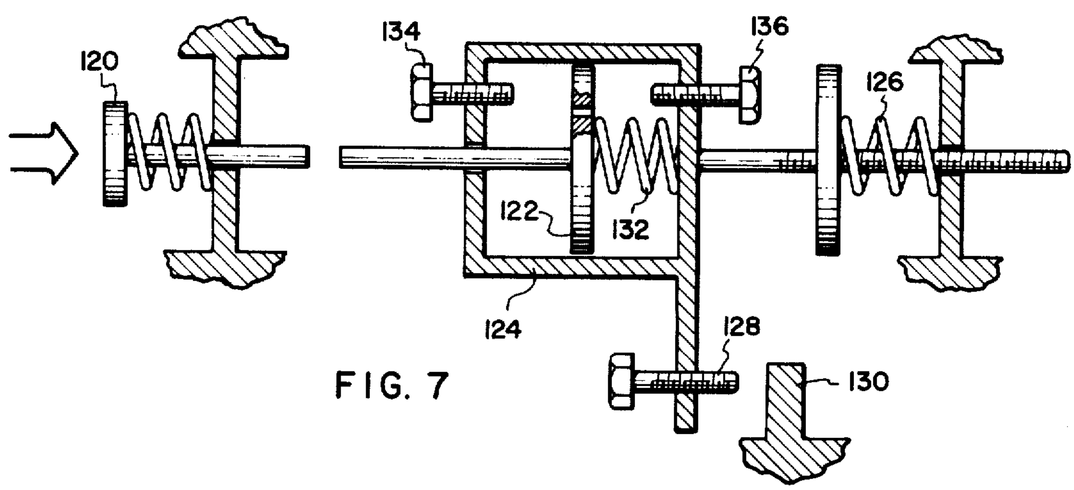
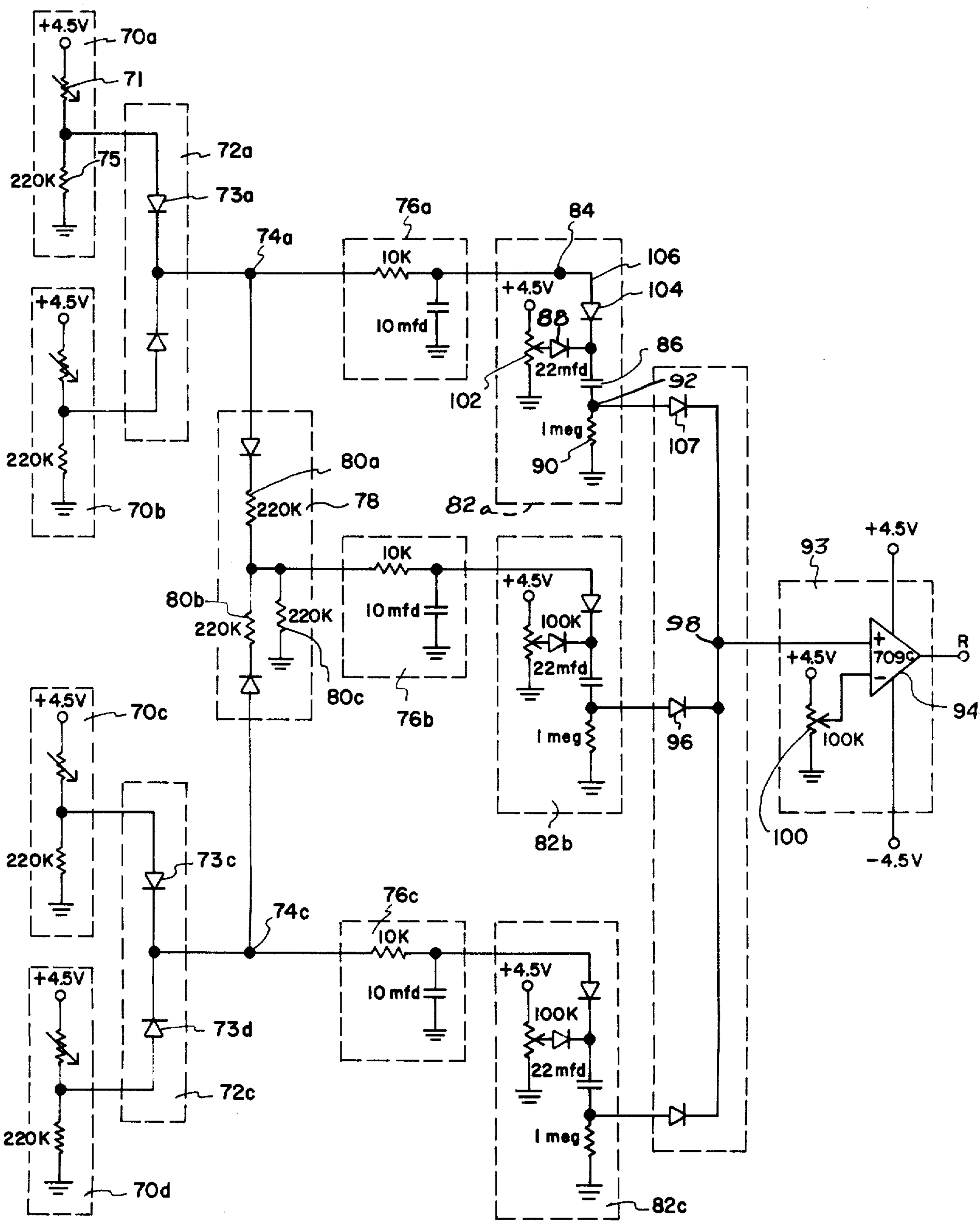


FIG. 7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70a
71
72a
75
220K
73a
74a
76a
10K
10 mfd
84
106
104
+4.5V
88
86
22mfd
102
92
1 meg
107
90
+4.5V
220K
70b
80a
78
220K
82a
10K
10 mfd
+4.5V
100K
22mfd
80b
220K
220K
80c
76b
98
96
1 meg
82b
93
+4.5V
+4.5V
709C
R
100K
94
100
-4.5V
+4.5V
70c
220K
73c
74c
76c
10K
10 mfd
+4.5V
100K
22 mfd
+4.5V
73d
72c
220K
1 meg
70d
82c

FIG. 5

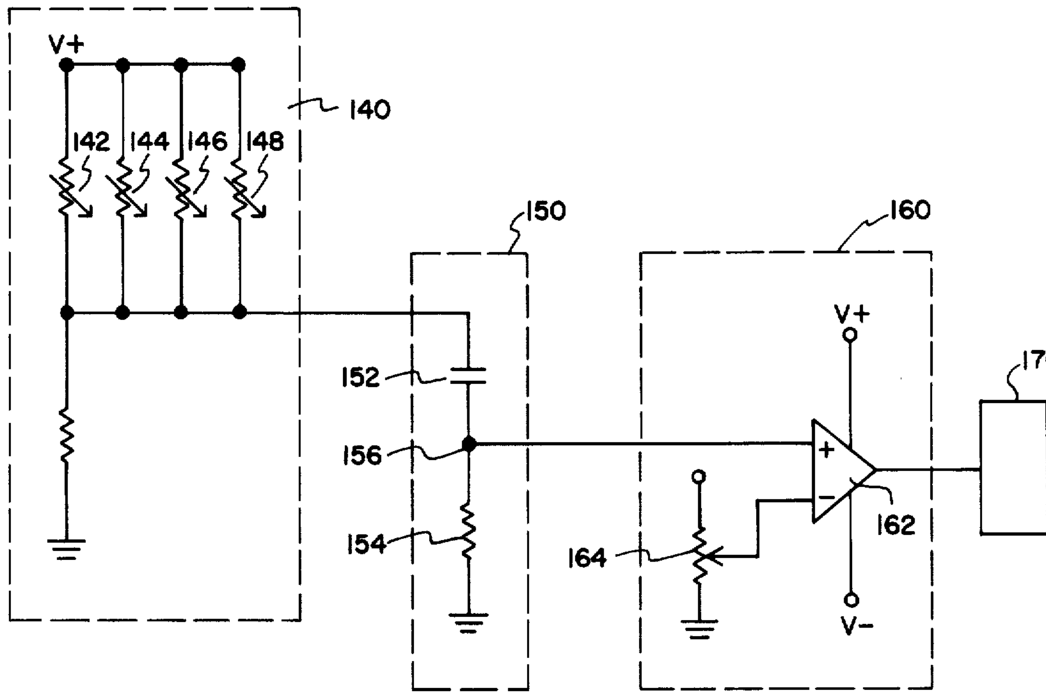

FIG. 6

RELEASABLE SKI BINDING DEVICE

BACKGROUND OF THE INVENTION

1. Field

This invention is directed to a release system responsive to pressure changes and particularly to a ski binding release mechanism which is electrically actuated whenever abnormal stress and pressure levels are reached.

2. State of the Art

Most all of the release systems and especially the devices that are currently available to a skier are spring loaded mechanical type devices capable of releasing at predetermined set stress level points. In all such devices, the set release point will release the binding when a predetermined stress force is exerted on the binding, even if such stress force occurs when controlled skiing is in progress. As is recognized by all skiers, an early or unscheduled release can cause serious injury to the skier if he is not anticipating the release. In addition, various environmental conditions leading to an accumulation of ice or snow on the ski binding can hamper a normal release. These changes in the bindings release characteristics are obviously undesirable and are potentially dangerous to the skier.

It is therefore an object of this invention to avoid the above shortcomings which are now inherently present in mechanical type ski bindings. Another object is to provide a ski binding which is not susceptible to changes in the environment. Another object is to provide a releasable ski binding which is electrically actuated. Still another object of this invention is to provide an electrically actuated ski binding which will automatically adjust its release point over a relatively broad range to compensate for and correspond to the skier's capability and/or the particular skiing conditions. A still further object is to provide a device which has a built-in delay which prevents a release whenever a controlled force is applied to the ski binding even though such force may momentarily exceed its release threshold.

SUMMARY OF THE INVENTION

The release system and particularly the ski binding of this invention is unique in that it is capable of automatically adjusting its release threshold in response to past skiing stresses. With the device of this invention, the stresses or pressures exerted by a skier are measured by a plurality of pressure sensing elements mounted in tangential proximity to the ski boot or in proximity to either the heel or toe engaging members. As normal pressures or stresses are exerted by the skier, signals are transmitted from the sensing elements to a filter network or spring circuit. Portions of the signals transmitted from the pressure sensing elements are combined by electrical resolution prior to entering the short term delay or spring circuits. From the delay or spring circuits the signal passes to a learning level detector, which is continuously establishing a current voltage release threshold. The output from the learning level detector enters a voltage comparator which, when an abnormally high stress or pressure is exerted by the skier, transmits a signal; and if such signal exceeds the threshold value, the ski binding will release by the actuation of a solenoid contained therein.

Important features of this invention are that the release mechanism is adapted with a delay or filtering mechanism which will permit actuation of the solenoid only if the stress or pressure exerted by the skier continues for a predetermined period of time and a learning mechanism which automatically adjusts to a higher or lower release threshold based upon past skiing stresses. Both of these features, either alone or in combination, produce a release system which minimizes, if not avoids, unscheduled releases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side perspective view with parts cut away for clarity showing generally a secured ski boot utilizing the ski binding of this invention.

FIG. **2** is a rear view of the heel plate taken along line **2—2** of FIG. **1.**

FIG. **3** is a front view of the toe plate taken along line **3—3** of FIG. **1.**

FIG. **4** is a top view of the toe engaging member taken along line **4—4** of FIG. **1.**

FIG. **5** is a schematic diagram of the electrical circuit utilized in the ski binding device.

FIG. **6** is a schematic diagram showing a simplified circuit utilizing pressure and learning systems.

FIG. **7** is a diagrammatic side cross-section of a mechanical learning level detector.

FIG. **8** is a side cross-section of a typical pressure sensor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. **1,** a toe plate **2** and a heel plate **4** are fastened to a ski boot **5** by means of screws **6.** The toe plate **2** is "L" shaped and includes a horizontal member **8** which lays on the top surface **10** of the ski **11** and an elongated vertical member **12** extending upward from the horizontal member. A protuberance **13** (see FIG. **3**) extends upward from the top edge of the vertical member **12.** The heel plate **4** is likewise "L" shaped, having a horizontal member **14** and a vertical member **16** adapted with an annular shaped opening **18** (see FIG. **2**).

The ski boot is held to the ski **11** by means of a toe member **22,** which is mounted to the top surface of the ski **11** by screws **24.** The toe member includes a vertical piece **26** to which are mounted a bottom horizontal member **28** and a top horizontal member **20** having a dimple **32.** The dimple **32** of top horizontal member **30** overrides and engages the protuberance **13** of vertical member **12** of the toe plate **2** holding the toe portion of the ski boot firmly to the surface of the ski. As indicated above, the underside of the top horizontal member **30** has a slight indentation or dimple **32** for engaging the protuberance **13** located about midway between the ends of the elongated vertical member **12.**

The heel portion of the ski boot is held in position by a solenoid piston **36** which, when deactuated, passes through the annular opening **18** of the vertical member **16** of the heel plate **4.** The boot is released from the ski binding by actuating solenoid **40** which moves the solenoid piston **36** into its housing. Surrounding the solenoid is the binding housing **42** which contains the batteries and electronic components for operating the ski binding mechanism of this invention. Although the mechanical aspects of the ski binding device above disclosed are of the basic variety, it is evident that a more sophisticated system could be readily adapted to the release principles of this invention. For example, cable release bindings and spring loaded toe and heel pieces could be easily modified to incorporate the electronic relay system hereinafter described.

Referring now to FIG. **5** it can be seen that a number of pressure sensors are positioned such that they are capable of measuring pressures or stresses from a number of directions. In addition, the number of sensors used could va.y from four to as many as twelve and possibly even more. With four sensors, presures exerted from the four basic directions; namely, up, down, right and left, can be easily detected. In addition, forces from an innumerable number of intermediate positions can likewise be detected and measured by introducing the signals received from the four basic directions into a combining circuit and then into a summing network prior to introducing this signal into the learning detector. The combining and summing network work in unison to resolve and integrate forces from two or more directions. In so doing, they provide a measurement of the resultant force which is then introduced into the learning detector.

Prior to introducing the signal into the learning detector, the signal passes through a time delay or filtering system which separates momentary high forces or pressures generated by sudden moves of the skier which creates a brief abnormal force. If this force should continue for less than a predetermined number of microseconds, such as would occur when the force is a result of a controlled, as opposed to an uncontrolled move, the time delay or filtering system will retain the impulse for a predetermined, designated number of microseconds before sending it on to the learning level detector. This filter or time delay system minimizes, if not fully eliminates any possibility that the release mechanism will release during normal skiing operations, even when, for a brief period of time, the skier may exceed the pre-established release threshold.

When the signal passes through the filter or time delay system and enters the learning level detector, the learned release threshold level is either increased, decreased or held constant, depending on the intensity of the force reported by the pressure sensor. If the sensed force is greater than that previously experienced by the learning detector, the level or threshold of force retained within the learning detector (in the form of a voltage drop across a capacitor) is increased. The increase in voltage is a function of both pressure and time and will vary accordingly.

The difference between the sensed and learned signal is then passed from the learning detector to the threshold detector or voltage comparator. If the difference in pressure or stress, (i.e., that amount of stress above the learned level) as measured by an input voltage varys substantially above the stress or pressure difference value set in the comparator, a signal will be transmitted to a solenoid which, when actuated, releases the ski binding. However, if the difference in stress or pressure does not exceed the difference set into the comparator, a signal will not be transmitted to the solenoid and no release occurs.

In FIG. **5** four pressure sensors **70***a*, 70*b*, 70*c* and **70***d* are shown for detecting up, down, right and left pressures respectively. All of the pressure sensors are identical and include a variable impedance means actuatable by pressure changes. Such a system can be schematically depicted by a variable resistor **71** and a fixed resistor **75** connected in series. A voltage of about 4.5 volts DC is continuously applied to the system by means of a battery now shown. The output from sensors **70***a* and **70***b* pass through a gated combination system **72***a* comprising a pair of diodes **73***a* and **73***b* while the output from sensors **70***c* and **70***d* pass through a similar gated combination system **72***c* comprising a pair of diodes **73***c* and **73***d*. Each pair of diodes steer the largest of the two signals received from each pair of sensors **70***a* and **70***b* and **70***c* and **70***d* to two junction points **74***a* and **74***c* respectively. The signals are then split with a portion of one feeding into a delay circuit **76***a* and the other portion to a delay circuit **76***c*. The remaining portions are combined in a second order combination circuit **78** which combines the output of two or more sensors of different directions of freedom to provide an algebraic sum output which is then fed into a third delay circuit **76***b*. The algebraic sum from the sensors may be weighted by altering the relative value of the resistors **80***a*, 80*b* and **80***c* of the combination circuit **78**.

The output from the above three delay circuits are then introduced into three learning detectors **82***a*, 82*b* and **82***c*. The learning detectors are designed such that if a voltage is applied, for example, at point **84** and if this voltage is larger than the voltage applied across capacitor **86**, a current will flow through the reverse diode **104**, the capacitor **86** and the resistor **90** causing a voltage at point **92**. This voltage is the difference between the voltage at point **84** and the voltage across capacitor **86**. The voltage at point **92** is gated to the positive side of a voltage comparator **94** in a comparing system **93** through an isolation diode **107**. The voltage at point **98** (same as voltage at point **92**) is compared to the voltage set by the delta set control **100**. If the voltage at point **98** exceeds the delta voltage, the solenoid will be actuated releasing the ski binding mechanism. If the voltage at point **98** does not exceed the delta voltage, the learning capacitor **86** will be charged through resistor **102** set by capacitor **86** and resistor **90**. With this arrangement, capacitor **86** " Learns" a time average of the peak voltage at point **84**. Preferably the applied voltages will be in the neighborhood of about 3 to 6 volts DC. However, higher or lower voltages may be used if desired.

The voltage across the capacitor **86** will relax over a period of time (15–30 minutes) by discharging at normal leakage rates. If the voltage at point **84** reduces its peak below that of the capacitor **86**, the capacitor will eventually discharge to the new peak average and stabilize. The reverse current diodes **104, 88** and **107** prevent discharge of the capacitor **86**. The initial level set into the learning detector through a variable resistor **102** establishes the initial voltage across capacitor **86**. Normally this is set at a minimum value to permit the learning mechanism to gradually increase the voltage across the capacitor. This will then set the release at a point of normal skiing stresses and pressures as independently determined by each skier's stress patterns. This allows the binding to release only when the normal skiing pressures are substantially increased as would occur when the skier runs into trouble or a fall is encountered. The learning mechanism **82b** and **82c** function in an identical manner to learning mechanism **82a**. All outputs from the three learning detectors feed into a single comparator **94**.

In FIG. **8** an inexpensive pressure sensor is shown comprising a top pressure plate **110** and a bottom pressure plate **112.** In between the two plates is a semiconducting material **114** such as paper saturated with dry India ink. The pressure plates also function as contactors for measuring the resistance of the carbon paper. When a pressure is exerted on the pressure plates the carbon in the ink is compressed causing a drop in resistance. Although paper impregnated with India ink and dried wherein the dried India ink comprises at least 10% by weight on a dry basis of the paper and ink, is described as the sensing element in the pressure sensors, any semiconducting material capable of exhibiting a resistance drop or increase when a force or pressure is exerted thereon may be used. Any sensing element capable of providing an electrical response in which the response is a function of stress may be used.

In FIG. **7**, a mechanical learning level detector is depicted which functions in a manner analogous to the electronic mechanism hereinabove described.

As shown, when a force is applied to plunger **120**, the force is sufficient to cause the plunger to contact a dashpot piston **122** and force the dashpot **124** against the learning rate spring **126** sufficiently far enough to cause the tip of the excess pressure control screw **128** to contact the release trigger mechanism **130** activating the release mechanism and causing the binding to release.

If the force applied is insufficient to cause release but is large enough to cause the plunger **120** to contact the dashpot **122** and push the dashpot mechanism inwardly, then the dashpot **122** will contract at a predetermined rate and the force applied by the plunger is diminished. Thus, a larger force on the plunger will be needed to release the binding. When there is an insufficient force on the plunger to cause contact with the dashpot, the dashpot will relax at a slow rate because of the dashpot spring **132.** Thus the mechanism will learn the peak forces over a period of time. It will also relax to adjust itself to lower force levels. The excess pressure control screw **128** is used to adjust the pressure release difference in the same manner as the delta set control was used in the electronic mechanism. The minimum release pressure control **134** and maximum release pressure control **136** are used to limit the excursion of the dashpot and thus set the minimum and maximum release pressures of the binding.

Referring now to FIG. **6**, a simplified circuit is shown utilizing a pressure sensing system **140**, a learning system **150** and a comparing system **160.** The pressure sensing system includes a number of pressure sensing means depicted by four variable resistors **142, 144, 146** and **148** respectively. However, it should be noted that the number of pressure sensing means used could be increased **20** to **40** fold without substantially changing the circuit shown. Although the pressure sensing means is preferably of the design shown in FIG. **8**, more sophisticated systems may be employed.

The output from the pressure sensing system **140** leads directly to a learning system **150** comprising, in series, a capacitor **152** and a resistor **154.** This learning system may include diodes of the type shown in FIG. **5** if a reduction in the normal rate of circuit leakage is desired.

The voltage output from the learning system **150** is transmitted to a comparing system **160** which includes a voltage comparator **162** and a variable resistor **164.** The positive side of the comparator is connected to point **156** with the negative side connected to the variable resistor **164.** The voltage drop at point **156** is between 3 to 6 volts and preferably about 4.5 volts DC.

The above described circuit is very similar to the circuit shown in FIG. **5** except for the elimination of the gating systems. The learning system **150** has the ability to learn and accomodate relatively slow pressure changes. However, if the change in pressure is relatively substantial; i.e., varies substantially from that set in the delta voltage control (variable resistor **164**), a response will be transmitted to a reporting system **170.**

The above basic circuit arrangement could be incorporated into an alarm system such as a burglar or fire alarm system. The pressure sensing cells could be placed in the flooring or along the support beams wherein changes in pressure (weight) could be detected. The advantage that this system would have over existing pressure detecting systems is that pressure changes resulting from changes in humidity, temperature or placement of furniture would be automatically compensated for by the learning system without in any way altering the system's sensitivity or causing a premature sounding of the alarm.

The above system could also be used as the sensing means for releasing the safety air bags now being used in automobiles. This system would avoid a premature release by learning and storing the stresses and pressures detected during normal driving and would cause a release only when a substantial and unlearned pressure or stress is detected.

Other systems wherein a learning period would be desirable could readily incorporate the above release system.

While the invention has been described with reference to certain specific embodiments, it is understood that changes may be made by one skilled in the art and would not thereby depart from the spirit and scope of the invention which is to be limited only by the claims appended hereto.

I claim:

1. A release system responsive to pressure changes comprising a pressure sensing means capable of transmitting a signal in response to a pressure change, a learning level means for setting a variable pressure release threshold point, said threshold point being based on past signals received from said pressure sensing means, and a release means actuatable by a signal received from said pressure sensing means which exceeds said pressure release threshold point.

2. The release system of claim **1** including a means for resolving signals received from two or more pressure sensing means prior to relaying said signals to said learning level means.

3. The release system of claim **2** including a time delay means for eliminating signals having a time period which does not exceed a set preselected time delay constant.

4. The release system of claim **1** including a comparator means for receiving a signal from said learning level means and comparing said signal to a preselected value set in said comparator means.

5. The release system of claim **4** including a means for permitting the transmission of a signal to said release means when said signal from said learning level means exceeds said value preset in said comparator means.

6. In a ski binding release mechanism having a ski boot release means and a learning release system comprising pressure sensing means, capable of transmitting a signal in response to a pressure change, a learning level means for establishing a pressure release threshold point and means for permitting the transmission of a signal to said ski boot release means when a signal received from said pressure sensing means exceeds said variable pressure release threshold point.

7. The ski binding release mechanism of claim **6** wherein said ski boot release means includes a comparator means for receiving a signal from said learning level means and comparing said signal to a preselected value set in said comparator means.

8. An electronic circuit comprising a pressure sensing system capable of transmitting an electronic signal in response to a pressure change, a learning level system for establishing an electrical threshold point based on signals received from said pressure sensing system and means for transmitting a signal to a receiving means

when said signal received from said pressure sensing system exceeds said electrical threshold point.

9. The electronic circuit of claim **8** including an electrical comparing system for comparing the signal received from said learning level system and permitting the transmission of a signal to said receiving means when said signal exceeds a value preset in said comparing system.

10. A method for detecting a pressure change comprising:

converting said pressure change into a corresponding electrical response;

establishing a variable pressure threshold point by assimilating the above electrical responses; and

transmitting a signal whenever said electrical response exceeds said pressure threshold point by a preselected value.

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