July 25, 1967 K. P. ROSENBERG 3,332,695

MAGNETIC SKI BINDINGS

Filed Jan. 26, 1965

Fig. 1.

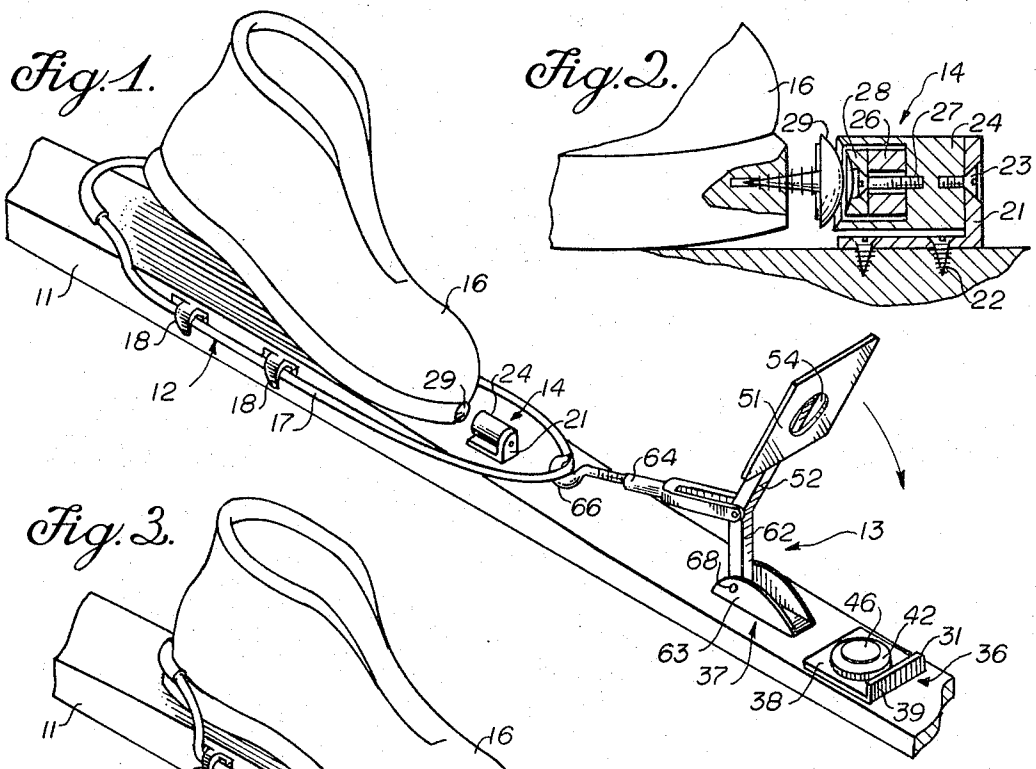


Fig. 2.

Fig. 3.

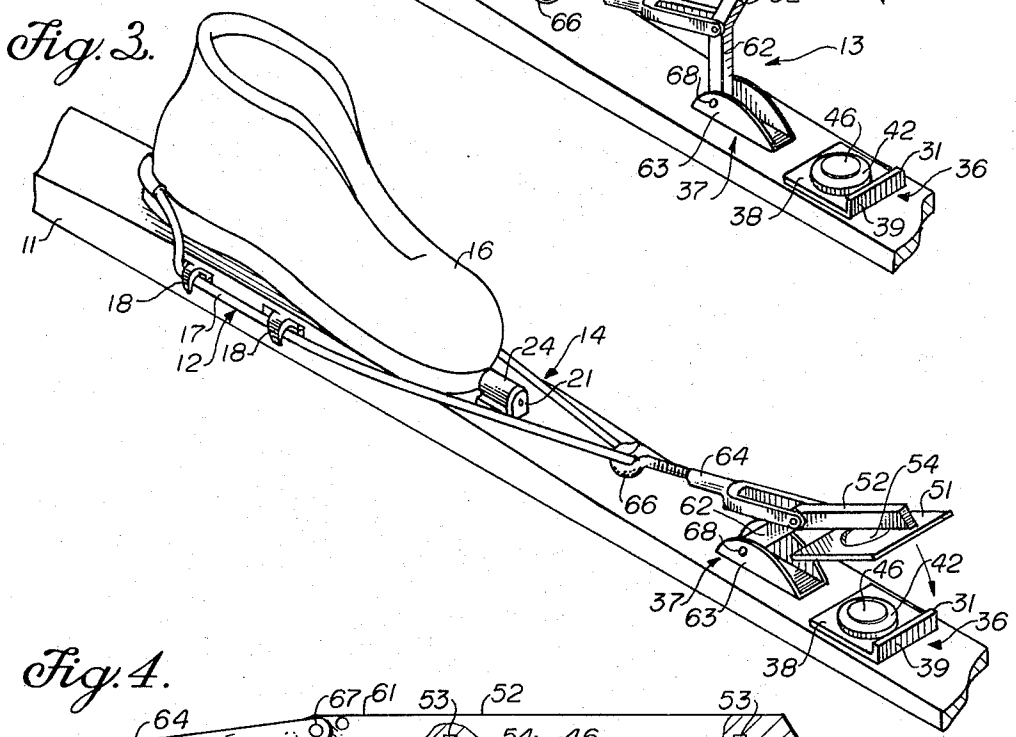
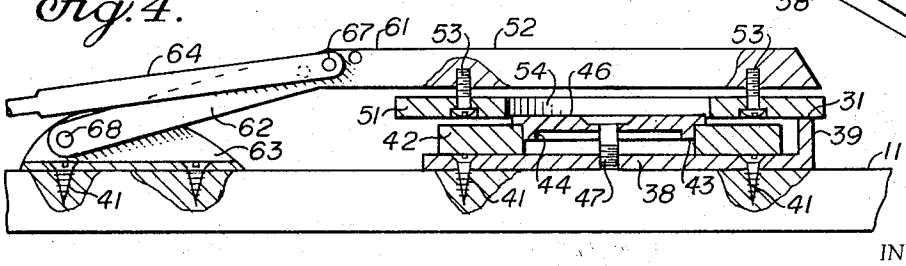


Fig. 4.



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United States Patent Office 3,332,695 Patented July 25, 1967

3,332,695

MAGNETIC SKI BINDINGS

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Filed Jan. 26, 1965, Ser. No. 428,124
5 Claims. (Cl. 280—11.35)

The present invention relates to ski bindings and more particularly to safety ski bindings employing magnetic latching means.

The ideal ski binding is one which secures the skier's boot to the ski in a manner which prevents all relative movement therebetween until the skier falls at which time the binding completely releases the boot from the ski. For downhill skiing purposes it is essential for the skier's boot to be securely held to the ski so that the ski and boot are integral. Only in this way can the skier apply his weight to the ski for controlling the direction of the skis. When a binding fails to so secure a boot to the ski and relative movement between the boot and the ski, such as heel lift, is allowed, the skier's ability to control his skis is impaired and the binding fails to perform a vital function. It is not uncommon for expert skiers to strap their boots directly onto their skies to absolutely prevent relative motion between the ski and the boot. In doing so, however, they completely abandon the safety feature of a ski binding which releases the boot when the skier falls.

The wide variety of available ski bindings which are sold and used by skiers throughout the world evidences the fact that no single safety ski binding now known in the art functions in the ideal manner described above.

Most safety ski bindings include several hinged members and at least one spring member. These bindings allow heel lift, and are subject to malfunction due to the introduction of snow and ice during operation. Ski bindings of this general description are not easily operated under any conditions and are often very difficult to operate in the adverse conditions which exist on the slopes of a mountain. Thus a fallen skier who tries to re-secure his boots to his skis while on a slope is often confronted with a frustrating task.

Some ski bindings require special brackets and plates to be secured to the skier's boots thus preventing the skier from using those boots with any other type of ski binding. Other ski bindings not only require modification to the boot but also place unusual forces on the boot and thus greatly reduce the life of the boot.

The present invention teaches a ski binding which securely holds the skier's boot to the ski, releases the boot when the skier falls, regardless of the direction of the fall, is easily operated, does not include complicated parts subject to malfunction, does not require modification of the skier's boot or place unusual strains on the boot, is long lasting and able to operate with all standard ski boots.

Further, the present invention teaches a ski binding employing a magnetic latching means.

In the present invention the skier's boot is secured to the face of the ski by means of a binding cable which grasps the heel of the skier's boot and forces it down onto the ski. A magnetic latching mechanism is connected to the cable and supplies the holding force. The latching mechanism is designed to supply a holding force which is variable to accommodate the varying needs of skiers of different weight and skiing capabilities while the cable makes it possible for the binding to accommodate all standard ski boots. The magnetic latching mechanism is designed to have a minimum number of moving parts and be unaffected by the presence of ice or snow. The latching mechanism also operates without any springs which suffer relatively large parameter changes due to the varying temperature conditions which skiers encounter during skiing. Thus, when the binding as taught by the present invention is adjusted to provide a certain holding force this force will remain constant regardless of temperature conditions. The elimination of a spring as the main force producing means also eliminates heel lift which is characteristic of spring actuated safety bindings. The absence of heel movement is a result of the inverse square law under which the magnet operates: the magnetic attraction varies inversely as the square of the distance increases from the poles.

The present invention also teaches the use of a magnetic toe locator which is exceptionally advantageous when rebinding skis while on a slope.

Accordingly, it is an object of the present invention to provide an improved safety ski binding having all of the features desired of a ski binding.

A further object of the present invention is to provide a ski binding which secures the skier's boot to a ski in a manner which prevents relative movement therebetween but releases the boot completely when a force is applied to the binding which indicates that the skier is falling.

Further objects of the present invention include the provision of a ski binding which is simple in construction and not subject to malfunction due to the introduction of ice and snow, a ski binding which releases in response to the application of a force greater than a preselected force regardless of the direction in which that force is applied, a magnetic latching means which eliminates the use of springs and a magnetic toe locator of a novel design.

Further objects and advantages of the present invention will be made apparent in the following specification wherein a preferred form of the invention is described by reference to the accompanying drawing.

In the drawing:

FIG. 1 is an isometric illustration of the ski binding of the present invention together with a boot just prior to the boot toe being located on the ski;

FIG. 2 is an enlarged view of the toe locator with certain portions shown in section;

FIG. 3 is a view similar to FIG. 1 but with the boot located on the ski; and

FIG. 4 is an enlarged view of the magnetic latching means in its latched condition with certain portions shown in section.

Referring now to FIG. 1, a ski **11** is equipped with a safety binding comprising a cable means **12**, a magnetic latching means **13** and a toe locator **14**, for releasably securing a boot **16**. Cable means **12** includes a conventional ski binding cable **17** attached to the ski by means of cable guides **18** which prevent the cable from falling off of the ski while allowing the cable to move longitudinally along the ski. The guides are disposed along the side edges of the ski at locations relative to toe locator **14** which position the cable for urging the boot downwardly so as to prevent the boot heel from lifting off of the ski.

To secure boot **16** to ski **11** the latching mechanism **13** is released and the cable **17** is urged toward the rear of the ski so that when the boot is initially located in the toe locator **14** the cable **17** completely surrounds the boot. The cable **17** is then urged against the heel of the boot **16** and the latching mechanism **13** closed drawing the cable **17** taut with a force which has been preselected to suit the particular skier.

When a skier falls, a force is applied through his boot to the securing cable which directs the force to the latching mechanism. The force applied against the cable due to a fall exceeds any force applied against the cable during normal skiing conditions. Thus by adjusting the latch-

ing mechanism to open when normal skiing forces on the cable are exceeded, the binding is made to release the boot when the skier falls but hold the boot securely to the ski during normal skiing. Since the normal skiing forces applied against the cable vary with the weight and skiing experience of each individual skier, the release force of a ski binding must be variable to operate properly for different skiers.

The toe locator **14** performs several functions. It locates the boot on the ski relative to cable **17** to insure that the boot is secured to the ski with the same force each time the binding is operated. It acts as a reaction member to prevent the horizontal component of the force applied against the boot from changing the location of the boot on the ski. And it acts as a temporary binding to assist in putting on the ski.

The locating mechanism **14** (see FIG. 2) includes an L-shaped aluminum mounting bracket **21** secured to the ski as by screws **22**. Secured to the upstanding portion of bracket **21** by stainless steel screw **23** is a cylindrical magnetic pole piece **24**. Secured within the interior of pole piece **24** by screw **27** is a toroidal permanent magnet **26**. The abutting relationship between magnet **26** and pole piece **24** operates to magnetize the pole piece and give it a polarity which is the same as the polarizing of the face of magnet **26** which it contacts. A concave pole piece **28** is secured to the opposing face of magnet **26**, also by screw **27**, and like pole piece **24**, has a magnetic polarity consistent with the face of the magnet to which it is secured. The concave pole piece **28** is physically disposed within pole piece **28** but at a distance from all portions thereof so that there is no contact between the pole pieces. Since each pole piece is associated with a different face of magnet **26**, they are of opposite polarity. The shape and placement of the pole piece operate to effectively place the opposite faces of the magnet in closer relationship to one another for more efficient flux linkage therebetween. The magnet **26** and pole pieces **24** and **28** thus constitute a magnetic circuit which directs flux from one face of magnet **26** to pole piece **24**, from pole piece **24** to pole piece **28** (thorugh a small air gap), and through pole piece **28** to the opposite face of magnet **26**.

Secured to the toe of boot **16** is a hemispherical toe keeper **29** formed from a magnetic material. The dimensions of keeper **29** are made dependent on the radius of curvature of pole piece **28** and the diameter of pole piece **24**. When toe keeper **29** is inserted into the locator **14** it contacts both pole piece **24** and pole piece **28** magnetically short circuiting the flux path therebetween, whereby the toe keeper is magntically held to the locator. The force with which keeper **29** is retained in locator **14** is a function of the size and strength of magnet **26** and the flux linkage between the pole pieces. The toe locator **14** thus provides more than a locator and reaction member. The force with which the toe keeper **29** is secured to the locator is sufficient to form a temporary binding between the boot and ski which greatly simplifies the task of rebinding skis on a slope.

The locator **14** and toe keeper **29** also cooperate to produce a force on the cable **17** whenever the toe of the boot is urged out of the locator, as when a skier falls. When the skier falls and the toe tends to disengage the locator **14** it is necessary, due to the spherical configuration of the locator and toe keeper, for the boot to move toward the back of the ski. This results in a force on the cable **17** which, as explained above, causes the latching mechanism **13** to release, thereby releasing the boot from the ski. In this way the binding responds to all forces caused by a fall, regardless of the direction or type of fall, to release the boot.

Referring now primarily to FIGS. 3 and 4, the magnetic latch mechanism **13** includes a first portion **36** which is immovably secured to the ski and a second portion **37** which is movably secured to the ski and designed to engage the first portion **36**. The cable **17** connects to the second latching portion **37** and acts to transmit to the boot the force with which the second latching portion engages the first latching portion.

The first latching portion **36** includes a pole piece **38** having an upstanding front portion **39**. Pole piece **38** is secured to the ski **11** by stainless steel screws **41** and acts as a mounting bracket for a permanent magnet **42**. In order to prevent possible short circuiting of the magnetic circuit of the latch mechanism, it is advantageous to place a coating of epoxy sealant on the surface of pole piece **38** which surrounds magnet **42**. The permanent magnet **42** provides the latching force for the binding of the present invention and is located and secured onto pole piece **38** by an aluminum clamping member **43**. Clamping member **43** has a cylindrical body portion **44** which fits into the center opening of the permanent magnet **42** and an integral flange forming top member **46** which rests on the top surface of the magnet. When the body portion **44** of clamping member **43** is disposed in the inner opening of annular magnet **42** and secured to the pole piece **38** by a stainless steel screw **47** the magnet is automatically disposed in its proper location relative to the second latching portion **37**.

The first portion **36** of latching member **13** as described above is seen to have no moving parts which can malfunction and has a potential service life which is virtually unlimited (the theoretical life of magnet **42** which is advantageously selected to be of the dustproof ceramic variety is something in the neighborhood of 600 years).

The second portion of magnetic latch **13** comprises a keeper plate **51** which is secured to an aluminum support arm **52** as by stainless steel screws **53**. When the latch **13** is closed, the keeper plate **51**, which is of a magnetic material, engages the upper surface **31** of upstanding portion **39** of pole piece **38**. Since pole piece **38** contacts one face of magnet **42**, it has the same magnetic polarity as that face. Flux thus passes from magnet **42** through pole piece **38** and back to magnet **42** after traversing a small air gap. When keeper plate **51** contacts surface **31**, it assumes a magnetic polarity opposite to that of the face of magnet **42** with which it is in facing relation. Keeper plate **51** thus becomes part of the magnetic circuit and is magnetically held to surface **31**.

The keeper plate **51** has a central hole **54** which is somewhat larger than the largest diameter of the flange of clamp member **46** and approximately coaxial therewith when the latch is closed. In this way it is possible for the keeper plate **51** to engage the pole surface **31** without interference from aluminum clamp member **43**. The height of the upstanding portion **39** of pole piece **38** is approximately .015 of an inch greater than the height of the upper surface of magnet **42** whereby the keeper plate **51** and magnet **42** are not in physical contact. They are close enough however to insure a complete magnetic circuit. Thus, all of the force available from magnet **42** for holding keeper **51** is brought to bear on the surface **31**.

The height of flange **46** is greater than the distance between the upper surface of magnet **42** and the keeper **51** when the latch is closed. Thus, the flange extends into the hole **54** in keeper **51** and forms a loose coupling therewith. This coupling performs the important function of preventing movement of the keeper in a direction transverse to the ski, when the latch is closed. By providing means at a distance from hinge **63** for preventing lateral movement of keeper **51**, possible damage to the hinge is prevented, as is improper latch release.

To insure that the keeper plate **51** securely engages the surface **31**, the screws **53** do not force the keeper plate against the support arm but rather form a loose connection. This allows the plate to rock relative to the arm and thereby align itself with the surface **31** of the pole piece.

This loose connection between keeper **51** and arm **52** also enables the latch to be opened manually, as when a skier wishes to remove his skis. When one edge of keeper **51** is urged upwardly it is relatively easy to release the keeper from the pole piece **39**. In fact, this operation is performed most advantageously with a ski pole, thereby eliminating the need to bend over.

Referring to FIG. 4, the support arm **52** includes a generally horizontal portion **61** to which keeper plate **51** is secured as described above, and an integral downwardly angled portion **62** which is hingedly secured at its end to a bracket **63**. Bracket **63** is secured to the upper surface of the ski between the pole piece **38** and toe locator **14**. Accordingly, the second portion **37** of the magnetic latch **13** is movably secured to the ski **11** and thus can be positioned at a distance from the first portion **36** of the latch without being detached from the ski itself.

The cable **17** is connected to the arm **52** by a clevis **64** and a hook **66**. The clevis **64** is hingedly secured to the arm **42** at a location near the point where the horizontally extending portion **61** and downwardly angled portion **62** join. The portion of support arm **52** between the pin joint **67**, which secures clevis **64** to arm **62**, and the pin joint **68** which secures the end of arm **62** to bracket **63**, forms a moment arm for moving plate **51**. When a force is applied to the hook **66**, it acts through the clevis and aforementioned moment arm to rotate arm **62** upwardly. Thus, the magnetic force which secures keeper plate **51** to pole piece **38** acts against forces from the cable which urge the hook **66** toward the back of the ski. The force established in cable **17** necessary to disengage keeper plate **51** from pole piece **38** is a function of the length of the moment arm (vertical distance between pin joint **67** and pin joint **68**) and the angle of the clevis **64** when the latch is closed. Accordingly, the amount of force which must be applied to the cable **17** in order to break loose the latch **13** and release the boot **16** can be varied by simply varying the position of the pin joint **67**. This is made possible by the holes provided in arm **52**. Another adjustment which governs the amount of force necessary to release the binding is made possible by the threaded connection between the hook **66** and clevis **64** whereby the initial tension placed on cable **17** can be adjusted.

One of the several oustanding features of the present invention is the complete elimination of any spring members. Springs necessarily change their characteristics when subjected to significant temperature variations, and in doing so change the holding force of the binding. This can result in premature release, or even worse, failure to release, with resulting physical harm. The elimination of spring members also eliminates the initial movement necessary in a spring member before it can apply a force to release the binding. By obviating the necessity of an initial spring movement, unwanted heel lift, which has heretofore been reluctantly accepted as a necessary part of almost all ski bindings, is eliminated.

In the present invention the latch **13** remains closed until the force applied through cable **17** to arm **62** is sufficient to disengage the keeper plate **51** from the pole piece **38** at which time the latch opens completely and the boot is released. At no time prior to complete release is there a member which extends or otherwise moves to allow the heel of the boot to rise. Another important feature of the present invention is the relative simplicity of the design together with the complete elimination of all but two moving parts. Other than the pin joints **67** and **68** there are no moving parts which can become frozen or rendered inoperative due to the introduction of ice or snow.

What is claimed is:

1. A safety binding for releasably securing a ski boot to a ski comprising in combination:

a binding cable secured to the ski and operative when pulled to apply a force to the boot which urges the boot against the ski; and

magnetic latching means secured to the ski and operatively associated with said cable, said means operative when closed to pull said cable and thereby urge the boot to the ski, and operative when open to release said cable from the boot whereby the boot is free to leave the ski wherein said latching means comprises in combination:

a magnetic pole piece secured to the ski;

a permanent magnet secured to said pole piece;

a keeper hingedly secured to said ski, connected to said cable and disposed to engage and be magnetically held to said pole piece while pulling said cable, said keeper providing no pull on said cable when disengaged from said pole piece.

2. The binding of claim **1** wherein said keeper comprises a support arm of non-magnetic material hinged at one end to the ski and hinged to said cable at a location remote from the hinged end, and a keeper plate of magnetic material secured to said support arm and disposed to engage said pole piece.

3. The binding of claim **2** wherein said support arm has a plurality of different hinge locations for connection with said cable.

4. The binding of claim **2** wherein said keeper plate is loosely secured to said support arm for movement about a horizontal axis.

5. The binding of claim **2** further comprising means disposed at a distance from the hinged end of said arm for preventing lateral movement of said keeper plate when said keeper plate engages said pole piece.

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