United States Patent

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[33] **Germany**
[31] **P 17 03 787.5**

[54] **SKI SAFETY BINDING**
13 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** ..... **280/11.35 D**

[51] **Int. Cl.** **A63c 9/08**
[50] **Field of Search** 280/11.35

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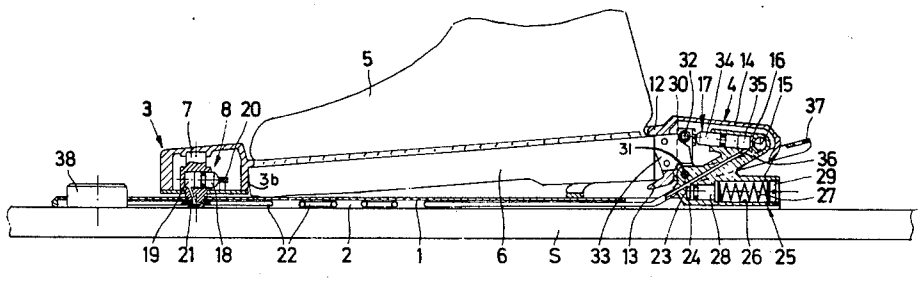
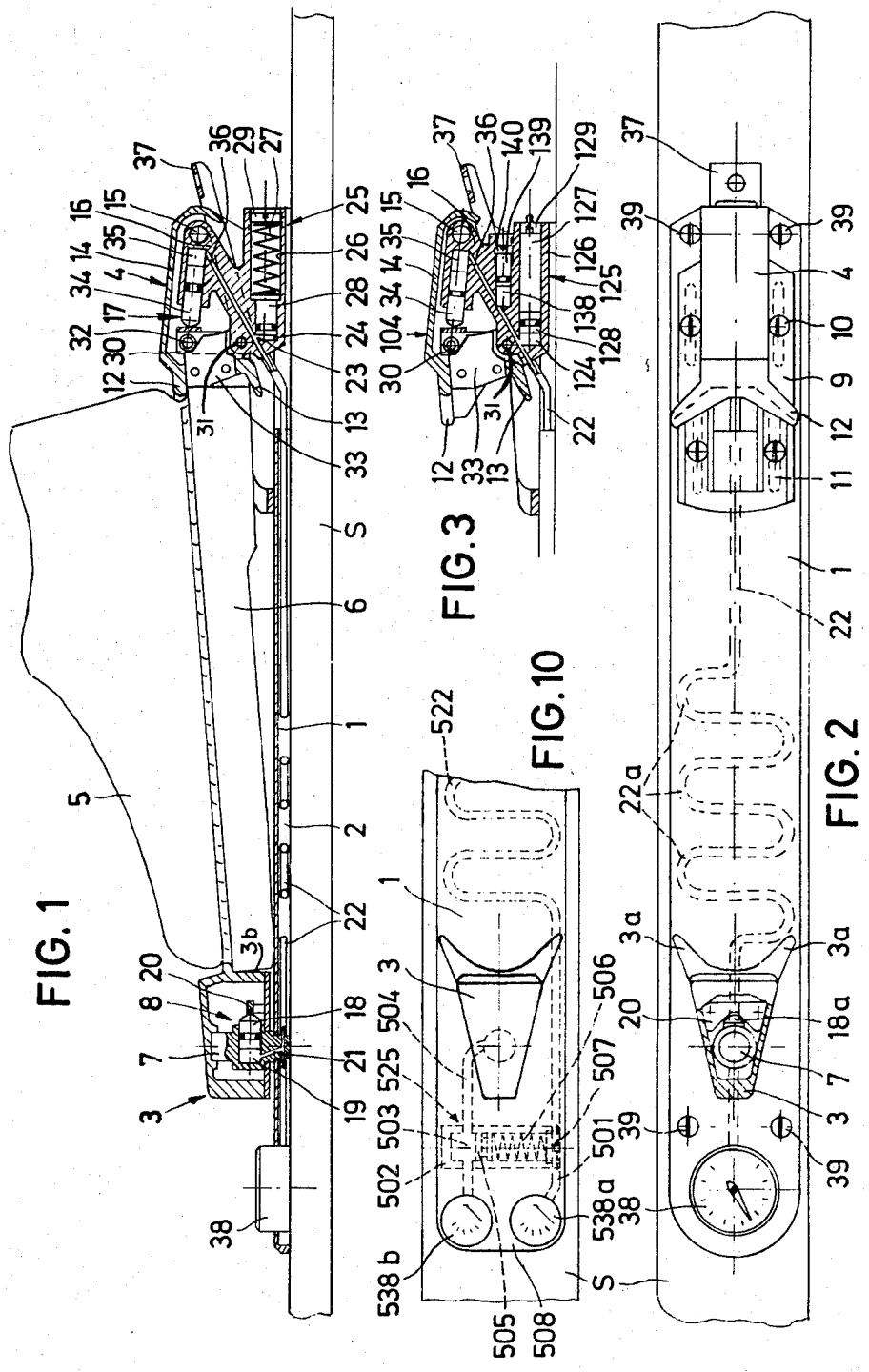
ABSTRACT: A ski safety binding having a hydraulically operated element to transmit a clamping pressure to secure a ski boot to the ski.





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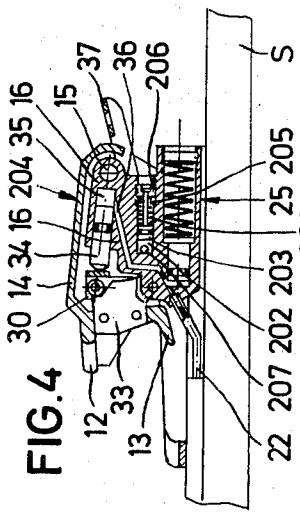

FIG. 4

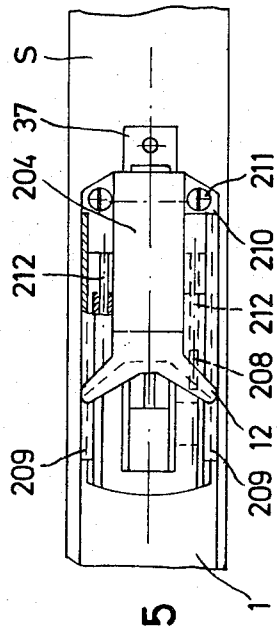

FIG. 5

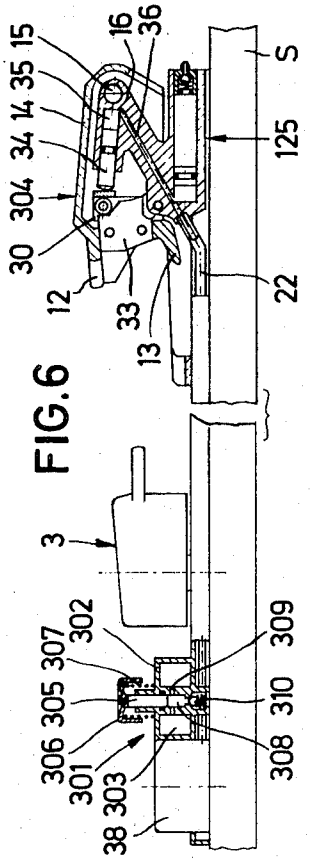

FIG. 6

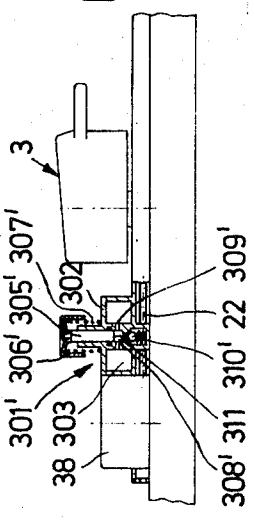

FIG. 7

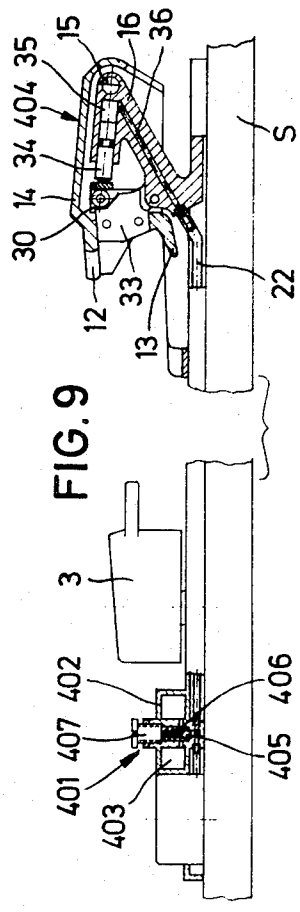

FIG. 9

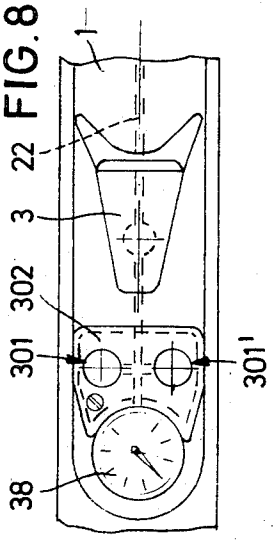

FIG. 8

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SKI SAFETY BINDING

The invention relates to a ski safety binding.

In modern ski safety bindings one tries to manufacture all functions with mechanical means, like lever systems, locks which are directly spring-tensioned, etc., as compactly as possible. However, there exists the difficulty that for a front jaw and rear jaw of a ski safety binding a basic form is already provided and the possibilities are thus relatively limited for arranging functionally important parts, like spring elements, adjustment members and indicating means, in direct mechanical connection within a small area. Even where in the modern ski binding development there are provided newer and more complicated ways to arrange the single operating elements as compactly as possible, such development in the direction of more complicated binding construction is not satisfactory. It results in a very complicated mechanical construction with correspondingly high manufacture costs and unavoidable trouble.

The basic purpose of the invention is to find a new manner of construction to avoid these difficulties. Thus, a new path is adapted which is to use the means which have been known in other branches of industry for a long time, namely the hydraulic transmission of force, also in the field of the safety ski binding.

Accordingly, a ski binding of the invention is characterized by at least one hydraulic operating element.

This operating element can for example connect at least two operating parts of the binding as a hydraulic pressure transmitting member. In this manner it is made possible to arrange approximately one locking part of the ski binding and a spring element exactly at the point of the ski binding which is the most favorable functionally without the likelihood of structural difficulties arising from the drive connection between these two elements. Hydraulic channels can for example be constructed easily into the baseplate of a ski safety binding and can be guided through connections to any desired operating part of the ski safety binding. One also obtains the considerable advantage that the hydraulic pressure transmitting members are not temperature sensitive and do not get dirty or ice up if they are suitably constructed, because said pressure transmitting means are protected by nature and do not require any mounting space, lubricating means or the like.

A further advantage is that one can connect one single hydraulic pressure transmitting system to several operating parts of the ski safety binding, for example, such connections can be made to an operating part, like a locking part, both of a front jaw at the same time and of a rear jaw of the ski safety binding. One can thereby adjust and if desired indicate at a single location the release strength of the front jaw and rear jaw of the ski safety binding. Further, in using a pressure-indicating device, for example a manometer, an exact indication of the release strength is obtained without any reference to an arbitrary calibration which changes from binding to binding.

The hydraulic pressure transmitting means can be connected like a mechanical linkage to a mechanical spring element. In a mechanical-hydraulic spring element, there exists, for example, the advantage of an optimum adjustment of the pressure transmission and spring strength depending on the requirements. Alternatively, it is possible to use a pneumatic-hydraulic spring element which opens up completely new structural possibilities for the spring element of a safety binding.

All spring elements have a certain spring path in common which can, as desired, be made relatively short or relatively long. Sometimes there also exists the desire to achieve a completely rigid fit without any spring deformation; then the invention opens up the possibility of working in a new manner completely without a spring element and instead of using a pressure release valve adjusted to the desired release strength. This pressure release valve can then discharge the hydraulic medium of the hydraulic system into a storage chamber from where it can be pumped upon a renewed closing of the safety binding again into the hydraulic linkage.

The hydraulic connection can also be easily used for adjusting movable operating parts of the safety binding. For this purpose, as in the release of the safety binding, a volume adjustment of the hydraulic medium or, alternatively, a pure movement of the hydraulic medium, can be provided.

Finally, it is not necessary in the mechanical springs invention to mechanically engage the spring of the spring element for adjusting the spring strength. Instead, according to the invention, it is necessary only to provide an adjustment device for the pressure of the hydraulic means.

Exemplary embodiments of the invention are illustrated in the drawings, in which:

FIG. 1 is a longitudinal cross-sectional view of a ski safety binding of the invention,

FIG. 2 is a top view of the ski safety binding of FIG. 1 with a partially cut-open front jaw,

FIG. 3 is a vertical cross-sectional view of the release heel-clamping means of a modified embodiment of the ski binding of the invention,

FIG. 4 is a vertical cross-sectional view of the release heel-clamping means of a further embodiment,

FIG. 5 is a top view of the release heel-clamping means of FIG. 4,

FIG. 6 is a partial vertical cross-sectional view of a further embodiment of a ski safety binding of the invention,

FIG. 7 is a vertical cross-sectional view of a modified embodiment,

FIG. 8 is a top view of the front part of the binding according to FIG. 7,

FIG. 9 is a vertical cross-sectional view of a modified embodiment, and

FIG. 10 is a partial top view of a last embodiment of the safety ski binding of the invention.

The ski safety binding according to FIGS. 1 and 2 has a baseplate 1 which forms a recess 2 in the bottom part thereof. A pivotal front jaw 3 and a release heel-clamping means 4 are supported on the baseplate 1. A ski shoe 5 with its sole 6 is inserted between the front jaw and the heel-clamping means.

The front jaw 3 is pivotable about a vertical pivot 7. On its side facing the ski shoe 5, the front jaw 3 is provided with common sole-holding wings 3*a* underneath which there is provided an abutment surface 3*b* for the front edge of the sole 6 of the ski shoe. The front jaw 3 is held in its illustrated locking position by means of a releasable locking element 8 which will be described in detail later on. If an excessive torsional force occurs at the foot of the skier, the locking element 8 is overcome and sets free the pivot jaw 3 to pivot about the pivot 7 so that the shoe 5 can slide laterally out of the ski binding.

The release heel-clamping means 4 is mounted on the baseplate with a base portion 9. Clamping screws 10 engage for this purpose elongated slots 11 of the baseplate 1. Through this, the release heel-clamping means can be adjusted in longitudinal direction of the ski indicated at S.

The release heel-clamping means comprises a sole clamp 12 which engages over the rear, upper edge of the sole 6 of the ski shoe and also a step plate 13 for receiving the lower edge of the sole. The parts 12 and 13 are mounted within a cup-shaped housing 14 which is supported pivotably about a transverse axis 15 on a support 16 which is rigidly connected to the baseplate 9. The cup-shaped housing 14 is maintained in the illustrated locking position by a locking element which is generally illustrated at 17 and will be described more in detail later on. If an excessive, upwardly directed force occurs, the locking element 17 sets free the housing 14 to pivot about the transverse axis 15 in clockwise direction so that the shoe is releasable from the release heel-clamping means 4.

The locking element 8 has a piston 18 which is guided in a cylinder chamber 19. The cylinder chamber 19 is built into the pivot 7. The piston 18 engages with a rounded-off head 18*a* a cam element 20 which is rigidly connected to the pivot jaw 3. The cam element 20 is constructed in such a manner that the piston 18 at a rotation of the pivot jaw 3 from the illustrated locking position about the pivot 7 is pressed into the cylinder

chamber 19. The cylinder chamber 19 is filled with a hydraulic fluid, for example oil, and is connected to a passageway 22 through a small connecting opening 21. The passageway is provided in the recess 2 of the baseplate 1 and is connected at 23 to a cylinder chamber 24 of a mechanical-hydraulic spring element 25 which is positioned in a stepped opening 26 of the support 16 of the release heel-clamping means 4. The spring element includes a coil spring 27 and a piston 28 biased by said coil spring and also a spring abutment 29 which is adjustable by screwing in longitudinal direction of the coil spring 27. The cylinder chamber 24, like the passageway 22, is filled completely with hydraulic fluid.

The locking element 17 of the release heel-clamping means 4 has a pivot arm 30 which is pivotable about a transverse pivot 31 of the support 16 and engages a cam piece 33 with a roller 32 supported on said pivot arm. The cam piece 33 is formed in such a manner that it presses the pivot arm 30 rearwardly when the housing 14 is pivoted upwardly about the transverse axis 15. The pivot arm 30 is engaged rearwardly by the rounded-off head of a piston 34 which is received in a cylinder chamber 35 of the support 16 which cylinder chamber is filled with hydraulic fluid. The cylinder chamber 35 is connected through a connecting opening 36 of small diameter to the passageway system 22 and thus also to the cylinder chamber 24 of the mechanical-hydraulic spring element 25.

A release lever 37 which is operable by a ski pole is connected to the pivot arm 30, which release lever makes it possible to move the pivot arm 30 rearwardly when the release heel-clamping means is to set free the shoe 5.

The passageway system 22 is at the front end connected to a pressure-indicating device 38 at which it can be read which pressure exists in the passageway system 22 and the various cylinder chambers connected thereto.

The passageway system forms a number of loops 22*a* between the pivot jaw 3 and the release heel-clamping means 4. Said loops 22*a* receive an extension or contraction of the passageway system when the release heel-clamping means 4 is adjusted along the baseplate 1 which is secured on the ski S by means of screws 39. Thus, the passageway system 22 can be constructed as a metal passageway and is still sufficiently deformable to permit a longitudinal adjustment of the release heel-clamping means.

The safety ski binding according to FIGS. 1 and 2 operates as follows:

By adjusting the spring abutment 29, the spring 27 is adjusted to a certain compressive stress. Same loads the piston 28 which in turn applies pressure to the hydraulic fluid in the cylinder chamber 24. The pressure passes through the passageway system 22 and the connecting openings 21 and 26 into the cylinder chambers 19 and 35. Through this the pistons 18 and 34 of the locking elements 8 and 17 abut the cam element 20 or the back side of the pivot arm 30 with a corresponding force.

During a turning fall, the shoe 5 attempts to rotate the pivot jaw 3 about the pivot 7. Through this the piston 18 abutting the cam element 20 is urged into the cylinder chamber 19. The hydraulic fluid driven therefrom is received in the cylinder chamber 24. The piston 28 is thus urged back against the force of the coil spring 27. Thus, the adjustment of the force of the coil spring 27 determines the locking force against which the front jaw 3 is to be pivoted.

During a frontal fall, the ski shoe 5 attempts to pivot the housing 14 upwardly about the transverse axis 15. The cam piece 33 thereby tends to swing the pivot arm 30 rearwardly. Said pivot arm urges the piston 34 into the cylinder chamber 35. The hydraulic fluid driven therefrom is also received in the cylinder chamber 24, so that in this case also the piston 28 must be moved back against the force of the spring 27. The spring 27 thus also determines the locking force of the release heel-clamping means 4.

Of course, both pistons 18 and 34 must be limited in their movement out of the cylinder chambers 19 and 35 so that they cannot be expelled by the pressure of the hydraulic fluid from the cylinder chambers when the binding is open.

The relation of the locking force on the front jaw 3 and the locking force on the release heel-clamping means 4 can be controlled by providing that the cross sections of the pistons 18 or 34 have a selected relationship to one another. This relation can, for example, be 1:4.

One can read on the pressure-indicating device 38 to which locking force the ski binding parts is adjusted. The pressure-indicating device is thereby advantageously provided with a scale which indicates certain locking steps.

FIG. 3 illustrates a release heel-clamping means 104 which corresponds in many parts to the release heel-clamping means 4 of FIGS. 1 and 2. The corresponding parts are identified with the same reference numerals as in FIGS. 1 and 2. In place of a mechanical-hydraulic spring element 25, a pneumatic-hydraulic spring element 125 is provided in the release heel-clamping means 114. A piston 128 is freely movably arranged in an opening 126 of the bearing part 16 in this spring element 125. The piston 128 separates one cylinder chamber 124 from a further cylinder chamber 127. The cylinder chamber 124 is, like in the above exemplary embodiment, filled with hydraulic fluid and is connected to the passageway system 22. Air, nitrogen or another gas is provided in the cylinder chamber 127. The cylinder chamber 127 is sealed rearwardly by means of a plug 129.

The operation is the same as in the exemplary embodiment of FIGS. 1 and 2. Only the pressure of the spring 27 is replaced by a force originating from the gas locked in the cylinder chamber 127. This force is formed because the gas is compressed in the chamber 127 and is even more compressed at a displacement of the pressure fluid into the cylinder chamber 124.

In order to be able to adjust the pressure in the hydraulic system and thus the locking forces at the front jaw and at the heel-clamping means, a pressure adjusting cylinder 138 is provided which is filled with hydraulic fluid and is connected to the opening 36. A piston 139 is guided in the pressure adjusting cylinder 138, the position of said piston being variable in the cylinder chamber by means of a screw 140. Due to a more or less screwing-in of the screw 140, more or less pressure fluid is pumped from the cylinder chamber 138 into the remainder of the hydraulic system. The piston 128 is correspondingly urged more or less far into the gas-filled cylinder chamber 127 so that the gas compressed therein again causes more or less pressure in the hydraulic system.

The embodiment of FIGS. 4 and 5 again corresponds in important parts to those of FIG. 1. In as far as the parts of the release heel-clamping means 204 illustrated in FIGS. 4 and 5 correspond to the parts of FIGS. 1 and 2, again the same reference numerals are used. However, the release heel-clamping means 204 is provided with a hydraulic device in order to urge it forwardly in direction of the front jaw and thus to assure the longitudinal advance which is desired in many cases for locking (holding) the shoe. This device has a cylinder opening 201 in the support 16. Said cylinder opening 201 forms a cylinder chamber 202 which is filled with hydraulic fluid and is limited by a piston 203. The piston is supported on a pressure spring 205, the tension of which can be adjusted by means of an adjusting screw 206. The cylinder chamber 202 is connected to further lateral cylinder chambers 208 in the support 16 through transverse openings 207. The entire support is movable in longitudinal guides 209 relative to a baseplate 210 which in turn is mounted to the baseplate 1 by means of screws 211. Push rods 212 are rigidly connected to the baseplate 210, said push rods extending into the cylinder chambers 208.

If the release heel-clamping means 204 is urged rearwardly, then the push rods 212 penetrate further into the cylinder chambers 208 and drive the hydraulic fluid contained therein through the transverse openings 207 into the cylinder chamber 202. Through this, the piston 203 is urged back against the force of the pressure spring 205. Thus, the pressure

spring 205 tries at all times to urge the release heel-clamping means 204 resiliently forwardly through the hydraulic fluid in the system 202, 207, 208. The force with which this is done can be adjusted at the adjusting screw 206.

FIGS. 6–8 illustrate an embodiment of the invention, the release heel-clamping means 304 of which corresponds substantially to the one of FIG. 3. Again the same parts are identified with the same reference numerals. The release heel-clamping means 304 does not show the parts 138 to 140 of the release heel-clamping means of FIG. 3. These parts are used to vary the pressure in the hydraulic system. For this purpose, in the embodiment of FIGS. 6–8, there is provided a pump generally identified at 301 in front of the pivot front jaw 3 which corresponds to the one of FIGS. 1 and 2. This pump is arranged in a housing 302 which contains a storage chamber 303 for hydraulic fluid. The pump 301 comprises a pump push rod 305 which can be driven downwardly by means of a push-button 306 against the force of a pressure spring 307 supported on the surface of the housing 302. For this, the ski pole point can for example be inserted into the concavely curved surface of the pushbutton 306. The pump push rod 305 is guided in a cylinder chamber 308 which is connected to the storage chamber 303 through transverse openings 309. The cylinder chamber 308 opens downwardly into the passageway system 22 through a check valve 310.

By pressing down the pump push rod 305 any desired number of times, hydraulic fluid can be pumped from the storage chamber 303 which contains an air cushion above the fluid through the check valve 310 into the hydraulic system of the ski binding. This increases the pressure in the hydraulic system. This pressure can again be indicated on the pressure-indicating device 38. The locking force at the front jaw and at the release heel-clamping means responds to said pressure, as has already been mentioned above. In order to reduce said pressure, a discharge valve 301' is provided in the housing 302, the parts of said discharge valve corresponding substantially to those of the pump 301. Corresponding parts are identified with the same reference numerals with primes added. The arrangement is here such that the push rod 305 acts with the pressure pin 311 onto the ball of the check valve 310' and is able to lift said ball from its seat. This permits the pressure fluid to flow from the passageway system 22 through the cylinder chamber 308' and the transverse openings 309' into the storage chamber 303. This reduces the pressure in the hydraulic system and the locking forces become correspondingly smaller.

The embodiment of FIG. 9 comprises a pivot front jaw 3 which again is identical to the one illustrated in FIGS. 1 and 2. The release heel-clamping means 404 corresponds also substantially in its parts which are provided with the same reference numerals to the parts illustrated in FIGS. 1 and 2. The heel-champing means 404, however, does not have a mechanical-hydraulic spring element 25. Instead, a safety valve generally identified at 401 is connected in front of the front jaw 3 to the passageway system 22. The safety valve 401 is arranged in a housing 402 with a pressure means storage chamber 403. The safety valve is constructed as a ball valve, the valve ball 405 of which is urged against the valve seat by a pressure spring 406. The pressure can be adjusted by means of an adjusting screw 407. If the pressure in the pressure means system exceeds a certain maximum value which defines the locking forces, the valve 401 opens and pressure means flows into the storage chamber 403 containing an air cushion. The operation of this embodiment of the binding of the invention can be compared with known ski bindings having ball locking devices. The release of the shoe occurs more or less suddenly when the locking force is exceeded while in the above-described embodiments both front jaw and heel-release clamping means can move an appreciable distance out of the locking position without shoe being released.

FIG. 10 illustrates a top view of an embodiment in which the pivot front jaw 3 is associated with its own mechanical-hydraulic spring element 525. The release heel-clamping means remains in this case unchanged with respect to the embodiment of FIGS. 1 or 3. A passageway system 522 corresponding to the passageway system 22 of FIGS. 1 and 2 is connected to its own pressure-indicating device 538*a* which indicates the adjustment of the release heel-clamping means. The line 501 which connects the indicating device 538*a* to the passageway system 522 runs through underneath the spring element 525 and is not connected to same. The spring element 525 has a cylinder 502, in the cylinder chamber 503 of which there is provided a pressure fluid. The cylinder chamber 503 is connected to the cylinder chamber of the hydraulic locking element of the front jaw 3 through a line 504. Furthermore, a second pressure-indicating device 538*b* is connected to the cylinder chamber 503, from which pressure indicating device the adjustment of the pivot front jaw can be read. A piston 505 is arranged in the cylinder 502, which piston is loaded by a spring 506 on its side opposite the cylinder chamber 503. The spring tension is adjustable by means of a screw 507. Thus its adjustment determines the pressure in the cylinder chamber 503 and thus the locking force for the pivot jaw 3.

As illustrated in the drawing, both indicating devices 538*a* and 538*b* are inserted together in a housing 508.

In all exemplary embodiments it can also be provided that in the path of pressure fluid between the hydraulic locking element and the mechanical-hydraulic spring element or the safety valve a restrictor is arranged which acts to hole the clamp effective. Through this, the binding is not opened in the case of short, hard force applications but a longer lasting force effect which is dangerous for the foot of the skier causes a release.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A safety ski binding having spaced front and rear jaws releasably holding a ski boot to a ski, comprising:

a hydraulic fluid and closed fluid circuit means for containing same, said closed fluid circuit means including variable chamber means for preventing a substantial buildup of pressure on said hydraulic fluid beyond a predefined magnitude;

at least one of said jaws having a cylinder and a piston slidably supported therein, one side of said piston being connected to boot-engaging means and responsive to movements of said boot relative to said ski;

means defining a passageway connecting the other side of said piston to said closed fluid circuit means and said variable chamber means, said passageway means being of a sufficient size to prevent a restriction of the flow of hydraulic fluid therethrough so that said piston is immediately displacable relative to said cylinder whenever a force is applied by said boot to said boot-engaging means wherein the magnitude of said force creates a pressure on said hydraulic fluid which is equal to or greater than said predefined magnitude, said variable chamber means being directly and immediately responsive to the application of said force to said piston so that said safety ski binding will immediately release whenever said applied force creates said fluid pressure which is equal to or greater than said predefined magnitude.

2. A safety ski binding according to claim 1, wherein said variable chamber means comprises a cylinder having a piston slideably supported therein, one side of said piston being connected in fluid circuit with said passageway means and said closed circuit means, the opposite side of said piston being connected to resilient means for urging said piston against said hydraulic fluid to define the magnitude of said predefined force required to release said ski binding.

3. A safety ski binding according to claim 2, including means for adjusting the magnitude of said predefined force required to effect a release of said ski binding.

4. A safety ski binding according to claim 3, wherein said adjusting means comprises an adjusting screw for adjusting the amount of compression of said resilient means.

5. A safety ski binding according to claim 3, wherein said adjusting means comprises manually operated pressure creating and pressure relieving means connected in fluid circuit with said fluid circuit means to control the pressure of said hydraulic fluid and thereby the magnitude of said predefined force required to release said ski binding.

6. A safety ski binding according to claim 2, wherein said resilient means is a compressible gas.

7. A safety ski binding according to claim 2, wherein said resilient means is a spring.

8. A safety ski binding according to claim 2, including pressure-indicating means for measuring the force at which said piston is urged against said hydraulic fluid; and

including means for adjusting the pressure on said hydraulic fluid.

9. A safety ski binding having spaced front and rear jaws releasably holding a ski boot to a ski, comprising:

a hydraulic fluid and closed fluid circuit means for containing same, said closed fluid circuit means including variable chamber means for preventing a substantial buildup of pressure on said hydraulic fluid;

locking means on said front and rear jaws for locking said jaws in a position to hold said boot on said ski, said locking means on said front and rear jaws being movable to a boot release position upon the application of a predefined force thereto and both being adapted to simultaneously displace a quantity of said hydraulic fluid upon said movement, said variable chamber means being directly and immediately responsive to said application of force to both of said locking means so that said safety ski binding will immediately release whenever a force is applied wherein the magnitude of said force is equal to or greater than said predefined force.

10. A safety ski binding according to claim 9, wherein said locking means for said front jaw is adjusted to a constant relation of, for example, 1:4, to the locking force at the release of said locking means for said rear jaw.

11. A safety ski binding having spaced front and rear jaws releasable holding a ski boot to a ski, comprising:

a hydraulic fluid and first closed fluid circuit means for containing same, said first closed fluid circuit means including variable chamber means for preventing a substantial buildup of pressure on said hydraulic fluid;

at least one of said jaws having movable locking means thereon locking one of said jaws in a position for holding said boot to said ski, said locking means being movable to a boot release position upon the application of a predetermined force thereto and to simultaneously displace a quantity of said hydraulic fluid upon said movement, said variable chamber means being directly and immediately responsive to said application of said predefined force to said locking means so that said safety ski binding will immediately release whenever a force is applied wherein the magnitude of said force is equal to or greater than said predefined force;

means supporting said rear jaw for movement longitudinally of said ski; and

second closed fluid circuit means including a cylinder having a piston slidably disposed therein, one side of said piston being connected in fluid circuit with said second closed fluid circuit means, the opposite side of said piston being connected to resilient means for urging said piston against said hydraulic fluid.

12. A safety ski binding having spaced front and rear jaws releasably holding a ski boot to a ski, comprising:

a hydraulic fluid and closed fluid circuit means for containing same, said closed fluid circuit means including variable chamber means mounted on said ski adjacent said rear jaw for preventing a substantial buildup of pressure on said hydraulic fluid;

a front jaw having locking means thereon locking said front jaw in a position for holding said boot to said ski, said locking means being movable to a boot release position upon the application of a predefined force thereto and adapted to simultaneously displace a quantity of said hydraulic fluid upon said movement;

means defining a passageway connecting one side of said piston to said variable chamber means and extends between said front jaw and said rear jaw, said variable chamber means being directly and immediately responsive to said application of said predefined force to said locking means so that said safety ski binding will immediately release whenever a force is applied wherein the magnitude of said force is equal to or greater than said predefined force.

13. A safety ski binding having spaced front and rear jaws releasable holding a ski boot to a ski, comprising:

a hydraulic fluid and closed fluid circuit means for containing same, said closed fluid circuit means including variable chamber means for preventing a substantial buildup of pressure on said hydraulic fluid;

said rear jaw having movable locking means thereon locking said rear jaw in a position for holding said boot to said ski, said locking means being movable to a boot release position upon the application of a predefined force thereto and adapted to simultaneously displace a quantity of said hydraulic fluid upon said movement, said variable chamber means being directly and immediately responsive to said application of said predefined force to said locking means so that said safety ski binding will immediately release whenever a force is applied wherein the magnitude of said force is equal to or greater than said predefined force.

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