May 12, 1970 M. DEL PEDRO 3,511,089

TEST APPARATUS FOR ENABLING ACCURATE ADJUSTMENT OF THE FORCE NECESSARY FOR RELEASING SAFETY SKI BINDINGS

Filed Jan. 3, 1968 2 Sheets-Sheet 1

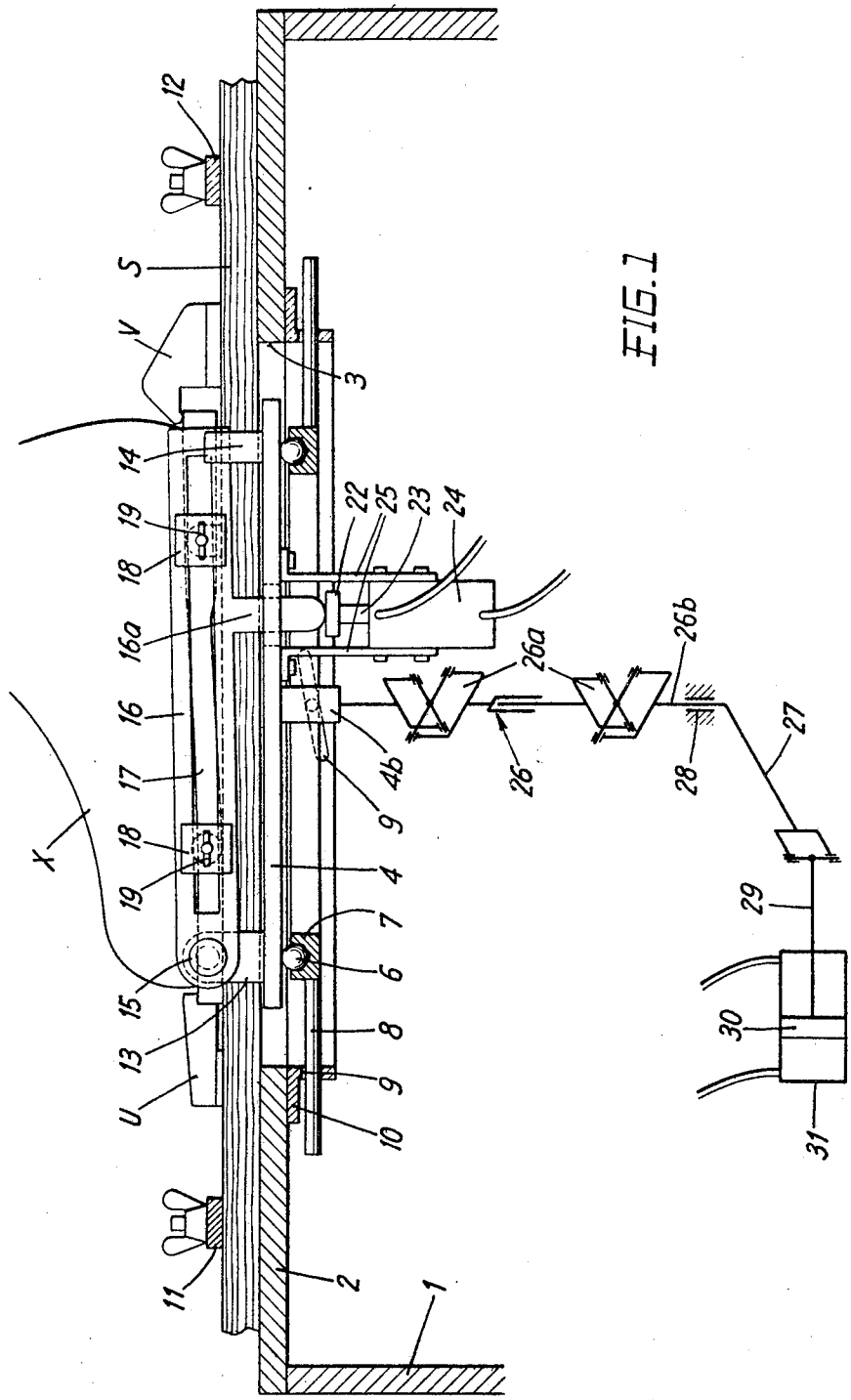

FIG. 1

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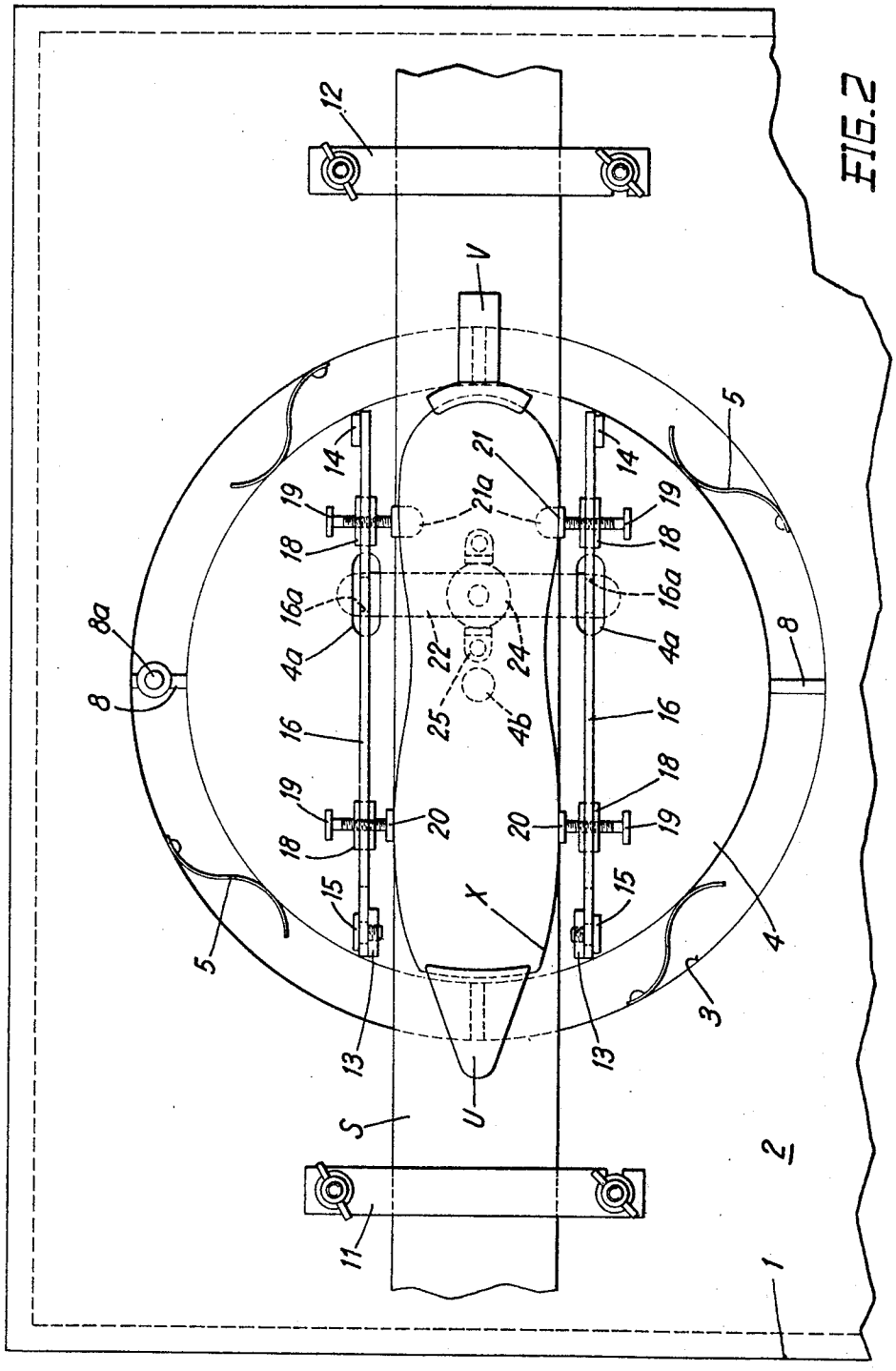

FIG. 2

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United States Patent Office 3,511,089
Patented May 12, 1970

3,511,089

TEST APPARATUS FOR ENABLING ACCURATE ADJUSTMENT OF THE FORCE NECESSARY FOR RELEASING SAFETY SKI BINDINGS

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Filed Jan. 3, 1968, Ser. No. 695,457
Claims priority, application Switzerland, Jan. 11, 1967, 355/67
Int. Cl. G01l 5/03
U.S. Cl. 73—133 16 Claims

ABSTRACT OF THE DISCLOSURE

A test apparatus for enabling accurate adjustment of the force necessary for releasing safety ski bindings which includes at least one support means defining a surface lying in a horizontal plane and mounted to be free to move in all horizontal directions. Means are associated with such support means for securing thereto a ski boot held by such bindings to a ski and means are provided for exerting an adjustable and measurable pure torque on the support means while leaving the latter free to move in all horizontal directions.

BACKGROUND OF THE INVENTION

The invention relates to a test apparatus enabling a quick and accurate adjustment of the ski bindings, such that the latter release the boot when a force of the desired magnitude is applied thereto.

Methods are known in the prior art that are intended to enable adjustment of the bindings to release the boot laterally when a predetermined force is exerted on the boot; but they have not proved satisfactory because the methods, as well as the equipment employed to effect the methods, permit of only a very inaccurate consideration of the force relationships that exist at the moment that the bindings release the boot sideways.

The lateral freeing of the boot from the binding depends not only on the torque M_A offered by the respective part of the bindings, but also on a resisting moment M_W which is composed partly of the resistance offered by parts of the bindings that engage the rear of the boot, and partly of the friction between the boot and the upper surface of the ski which friction is usually attributable to the skier's weight and the force with which the bindings press the boot against the ski.

Using test equipment, a boot is laterally freed of its bindings when the moment M_P exerted on the boot by the equipment is exactly equal to the sum of M_A and M_W.

In none of the known test equipment is consideration given to the frictional component M_W, although the value of this component is by no means small. Moreover, in none of the known equipment is the moment M_P so applied as to do justice to the actual force relationships present on the boot when skiing. Besides, in that equipment which obtains the moment M_P by merely applying a lateral force to the front part of the ski boot, the lever arm—the distance from the line of application of the lateral force to the inherent point of rotation of the boot—is unknown, or, at best, determined only with great difficulty and much loss of time. Herein lies an additional cause of faulty testing and improper adjustment of the bindings.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide test apparatus for ski bindings that will avoid the aforementioned disadvantages of the prior art.

An object of the invention is to provide test apparatus for enabling adjustment of the force necessary for releasing safety ski bindings in which there is applied to the boot to free it laterally a pure torque of adjustable and measurable magnitude.

Another object of the invention is to provide such a test apparatus in which testing and adjustment of the bindings are carried out while the skier is standing in his boots.

A further object of the invention is to provide test apparatus so constructed as to enable adjustment of the bindings including means for applying to the boot to free it in a forward direction an upward force of adjustable and measurable magnitude.

Preferably this upward force for freeing the boot in the forward direction is applied simultaneously with the pure torque for freeing the boot in the lateral direction

A further object is to provide a construction for such test apparatus will enable it to be used in connection with all the various types and constructions of ski bindings which are in use and on the market.

These and further objects will be apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described with reference to the figures of the accompanying drawing, wherein:

FIG. 1 is a side view in section of the test apparatus, with a schematic, isometric illustration of the drive shaft; and

FIG. 2 is a top view of the apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the figures of the drawing, the test apparatus includes a box-like housing **1** with a detachably fastened cover **2**, which incorporates two circular openings **3**, of which only one is illustrated. A support plate **4**, in the shape of a circular disc, is held more or less precisely coaxial with respect to each opening by means of leaf springs **5**, which are secured to the side wall of each opening **3**. The support plate **4** is freely movable in all horizontal directions. The underside of each support plate rests upon ball bearings **6**, which are located in the groove of a ring or ball-bearing race **7** for each respective opening **3**. Each ring **7** incorporates several—e.g. four—rods **8**, which extend radially from the ring and project through respective helical openings **9** that are provided in the depending wall of a ring **10** which is L-shaped in cross section and suitably fastened to the underside of the cover **2**. One of the rods **8** has a hand grip **8***a* which projects upwardly in the space between the plate **4** and the edge of the opening **3**. The grip enables the ring **7** to be rotated, whereby, in consequence of the helically shaped openings **9**, the plate **4** can be raised or lowered.

The ski boot X is in part secured to the ski S by a conventional toe iron U, which grips the welt at the toe of the boot and permits a lateral freeing of the boot, and by a heel iron V, which grips the welt at the boot's heel and permits the boot to free itself in a forward direction. The cover **2** is further provided with means **11** and **12**, respectively located in front and behind each opening **3**, for securely holding the ski S on the cover.

Two vertical projections **13**, symmetrically located on respective sides of a diameter of the support plate **4** near the toe of the boot, and two vertical projections **14**, similarly symmetrically located with respect to the same diameter near the heel of the boot, are mounted on the plate **4**. A pin **15** is secured to each projection **13** for pivotally mounting a lever **16**. The two pins **15** define a common axis of rotation for the levers **16**. Each lever incorporates a longitudinal opening **17** in which two blocks **18** can be moved. Each of the four blocks **18** has a clamping screw **19**, which latter incorporate clamping jaws **20** or **21**. The jaws **21** are each provided with a tongue **21***a*, for engaging the bottom surface of the heel part of the ski boot sole. Each lever **16** further incorporates a tongue **16***a* which projects through an opening **4***a* in the support plate **4** and is acted upon in an upward vertical direction by a cross bar **22**, which is mounted intermediate its ends to the upper end of the rod **23** of a piston that operates in a hydraulic cylinder **24**. Angle irons **25** mount the latter on the plate **4**.

The plate **4** further incorporates a driving hub **4***b*, which is rigidly connected to the upper end of a telescopic drive shaft **26**, having two Cardan joints **26***a*. Only the lower end of the shaft is mounted in a radial ball bearing **28**. A laterally extending arm **27** is secured to the lower end of the shaft. The construction of the drive shaft in no wise hinders the free movement of the support plate **4** in all horizontal directions. The free end of arm **27** is connected to the rod **29** of a piston **30** operating in a double acting cylinder **31**, which is mounted in the housing **1** in any suitable manner, not shown.

Each of the cylinders **24** and **31** is connected to a common pump or to respective pumps that is (are) motor or hand operated, whereby a pressure of adjustable and measurable magnitude can be exerted on the fluid in the cylinder **24** and/or **31**. In this connection, further explanation is unnecessary, since the matter is well understood by the specialist and since, moreover, the apparatus employed has been described in Swiss pat. 394,005.

There will be now described the manner in which the test apparatus of the invention operates.

The skier who desires to have the toe and/or heel iron, U and/or V, of his bindings tested stands with his skis S on the top of the cover **2**, as shown. The skis are fixed to the cover by the means **11** and **12**, and, also as part of the preliminary adjustments, the height of each plate **4** is so adjusted with respect to the thickness of the ski and of the ski boot sole that the clamipng jaws **20** and **21**, when the lever **16** is in its horizontal position, are located opposite the boot sole and the tongue **21***a* of a jaw **21** engages the underside of the heel part of the boot sole. The screws **19** are then turned to clamp each boot between the jaws **20** and **21**.

The toe iron U is tested and adjusted by operating the cylinder **31**, which, together with the lateral arm **27**, acts as a torquer that exerts a measurable torque which is proportional to the fluid pressure on the drive shaft **26**. The torque on the shaft is transmitted via the plate **4**, levers **16**, and jaws **20** and **21** to the soles of the ski boots X. Since the plate **4** and, of course, all members mounted on it are free to move in any horizontal direction, a pure torque is exerted on the boot sole.

If the rear of the ski boot is held only by the heel iron V (as is actually the case), the magnitude of the force acting on the toe iron U to free the boot laterally can be precisely determined, and is the quotient of the torque mentioned above divided by the spacing between where the toe and heel irons U and V grip the welt.

The value of the force at which the toe iron is released (whether inwardly or outwardly, depending on the rotational direction in which the torque is applied) is set in a known manner by adjusting the iron U, in accordance with the skier's physique. The weight of the skier plays no role, since it is automatically taken into account during the test.

The testing and adjusting of the heel iron V can be combined with those of the toe iron, or carried out separately. The combining of the two tests is rendered possible by the fact that the means for producing and transmitting the force for raising the rear of the boot and causing release of the heel iron are all mounted on the support plate **4**. These means comprise the hydraulic cylinder **24**, the cross bar **22**, the levers **16**, and the rear clamping screws **19** with their jaws **21** and tongues **21***a*. The operation of these parts does not affect the previously described testing and adjustments of the toe iron U.

The force exerted on the heel iron V is equal to that applied to the cross bar **2** by the piston in cylinder **24**, multiplied by the distance between the line of application of the two levers **16**, and divided by the distance from this axis to where the heel iron V grips the welt. The size of the ski boot will vary, of course, in accordance with the size of the skier, but this will have virtually no affect on the test, provided that the distance from the common axis of rotation of the levers **16** to where the iron V grips the welt is always the same. This provision can be facilitated by marking the upper face of the plate **4**, or the top of the cover **2**, to indicate the correct position of the ski boot heel.

It is anticipated that sooner or later bindings will be employed, of which both the toe and heel irons will permit a lateral and also an upward releasing of the boot. The test apparatus of the invention is immediately useable for correctly adjusting the irons for proper lateral and upward release. For example, if the upward releasing of the iron U is to be tested, the skier stands facing in the opposite direction, so that the toe iron U now takes the position occupied by the heel iron V in FIG. 1.

As will be recognized by specialists in the art, the invention, of which only one exemplary embodiment has been described, admits of various modifications which fall within its purview. For instance, the simple clamping screws can be replaced by quick-acting clamps, similar to those employed in bench vises; and/or the Cardan jointed drive shaft can be replaced by a flexible drive shaft.

It should be apparent from the foregoing detailed description, that the objects set forth at the outset to the specification have been successfully achieved.

What is claimed is:

1. Test apparatus for enabling accurate adjustment of the force necessary for releasing safety ski bindings, including at least one support means defining a horizontal plane and mounted to be free to move in all horizontal directions, means associated with said support means for securing thereto a ski boot held by the bindings to the ski, and means for exerting an adjustable and measurable pure torque on said support means while leaving the latter free to move in all horizontal directions.

2. The test apparatus is defined in claim **1**, wherein said last-mentioned means includes a drive shaft incorporating two Cardan joints, a torquer for driving said shaft, and a driving hub for connecting said shaft to said support means.

3. The test apparatus as defined in claim **2**, including means for producing and exerting on the boot an adjustable and measurable force for causing release of the boot in a forward direction.

4. The test apparatus as defined in claim **3**, including two spaced parallel levers located to lie along respective sides of the boot, respective means mounting said levers on said support means to pivot about a common axis, at least one pair of jaws between which the boot is clamped, one of each jaw being mounted on a respective said lever and movable therealong, force producing means, and means incorporated in each said lever for receiving and transmitting the force of said last-mentioned means to cause release of the boot in a forward direction.

5. The test apparatus as defined in claim 1, wherein said last-mentioned means includes a flexible shaft, a torquer for driving said shaft, and a driving hub for connecting said shaft to said support means.

6. The test apparatus as defined in claim 1, including means for producing and exerting on the boot an adjustable and measurable force for causing release of the boot in a forward direction.

7. The test apparatus as defined in claim 6, including two spaced parallel levers located to lie along respective sides of the boot, respective means mounting said levers on said support means to pivot about a common axis, at least one pair of jaws between which the boot is clamped, each jaw of said pair being mounted on a respective lever and movable therealong, force producing means, and means incorporated in each said lever for receiving and transmitting the force of said last-mentioned means to cause release of the boot in a forward direction.

8. The test apparatus as defined in claim 7, including a housing, a horizontal cover for said housing, at least one opening in said cover, a horizontal further support means mounted on said cover below said opening, means for raising and lowering said further support means, means associated with said further support means for mounting thereon said support means in said opening for movement in all horizontal directions, and means for resiliently centering said support means in said opening.

9. The test apparatus as defined in claim 8, including a depending wall attached to the underside of said cover and at least partly surrounding the periphery of said opening, at least one helical opening in said wall, a ball bearing race located within the confines of said wall, a plurality of rods extending from said race and projecting through said helical opening for supporting the race, and ball bearings in said race for bearing said support means.

10. The test apparatus as defined in claim 7, wherein each jaw has a tongue which engages the underside of the boot.

11. The test apparatus as defined in claim 10, wherein said pair of jaws clamps the rear part of the boot, and further including a second pair of jaws between which

the forward part of the boot is clamped, each jaw of said second pair of jaws being mounted on a respective lever and movable therealong.

12. The test apparatus as defined in claim 7, including means for bringing each jaw into and out of engagement with the boot.

13. The test apparatus as defined in claim 1, including a housing, a horizontal cover for said housing, at least one opening in said cover, a horizontal further support means mounted on said cover below said opening, means for raising and lowering said further support means, means associated with said further support means for mounting thereon said support means in said opening for movement in all horizontal directions, and means for resiliently centering said support means in said opening.

14. The test apparatus as defined in claim 13, including a depending wall attached to the underside of said cover and at least partly surrounding the periphery of said opening, at least one helical opening in said wall, a ball bearing race located within the confines of said wall, a plurality of rods extending from said race and projecting through said helical opening for supporting said race, and ball bearings in said race for bearing said support means.

15. The test apparatus as defined in claim 13, including two said openings, one for each ski.

16. The test apparatus as defined in claim 13, including means on said cover for securing the ski against movement with respect to said support means.

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