

Ski Simulator of Igor Koshutin

For demonstrating and helping the novice skiers/racers
to learn the essential constituent parts of skiing

The invention relates to the field of sport, in particular to ski training simulators, particularly devices for exercises and slalom skills, as well as devices for entertainment.

There are a number of known methods of teaching and training for skiers, snow-boarders and water-skiers out of real tracks, as well as devices that implemented such solutions. As an example, there is a well-known way of teaching and training of skiers implemented in a device (patent US 3524641 A63V 69/18, 1970), where turn movements are simulated by moving the skier's feet left and right while standing on a platform, and the skier balances using poles planted on the floor or ground.

One shortcoming of known method is the inadequacy of the feet and body movements to simulate conditions in terms of changing the direction of skis due to a technical solution with the only translatory/linear motion of the carrying element with the platform.

Also, there are ways of teaching and training skiers implemented in devices, where a rotating platform with the supporting surface for feet, skis or snowboard moves plane-parallel left-right, rectilinearly (see US patent 5078389, A63V 69/18, 1992) or along arc on the supporting unit (see. US 69/3511499, A63V 18, 1965; FR 1486082, A63V 69/18, 1967) or along arc on the supporting unit made as a beam (NL 8702665, A63V 69/18, 1989; US 4 A63V 69/846463, 18, 1989).

In such ways of teaching and training the feet with skis are able to take any position, in which the skis can be oriented in any direction, and it is also possible to simulate the change of direction.

However, these ways are ineffective for the trainees, who wish to improve skiing technique, and who don't have the correct skills yet, and don't know how to properly position their feet (longitudinal axis of the skis) during the left-right motion.

In such methods, an impact on the skier doesn't reproduce the real situation and there is no way to repeat the exercises multiple times in order to generate correct skills, because at the skiing surface is independent from the location on the motion path left-right.

The closest, in terms of a technical solution, to the patentable Simulator is the slalom simulator that includes a base platform with ski bindings, which have the ability to move left and right and simultaneously rotate clockwise and counterclockwise (patent RU 2276615 "Method of teaching and training of skier and slalom simulator, A63B 69/18, 20.05.2006).

Shortcomings of known method are incomplete simulation of all movements of a skier and lack of imitation of centripetal acceleration. As a result, the real conditions of skiing are not fully simulated.

The foundation of the present invention is based on providing conditions for the full simulation of the skier's movement on a real skiing/slalom track by installing additional platforms, each of which imitates an axis of movement of the slope, skis, or skier's body.

The main goal of the simulator is to demonstrate and help the novice skier/racer learn the essential constituent parts of skiing such as tipping, flexing, extending, transition, counterbalancing and

counteracting, upper body position and motions, etc. and put the trainee's body in the correct positions and provide him/her with muscle memory to remember these positions and motions as much as possible before he/she gets to the real slope.

Direction of the slope in a simulator should not be static; otherwise there would be further complications with the suspension and design of the simulator. Therefore, in the design of the claimed simulator, the direction of the slope is changing not only relative to the body, because the body constantly rotates left and right, but relative to the main lower platform 1 as well, so the direction of the slope becomes dynamic.

The purpose of the simulator is to simulate the position of the body, rather than the position or direction of the slope; therefore the platform is rotating. The body's inclinations are simulated by lateral movement of the platform left-right along the arced guides/rails. The radius and length of the arc are defined depending on real conditions, or special conditions for various categories of skiers: beginners and more experienced skiers; slalom or giant slalom, and others.

The objective is achieved by different platforms, located between the main platform 1 and the rotating left-right platforms 9 and 10 with ski bindings. The different platforms are installed with the possibility of rotation around their axis, each of which imitates the position of the slope, position or movement of skis, or the skier's body. And the skier has a harness connected with a dynamic suspension.

The said features have the following specific design solutions:

Construction and mounting of the platform 1 provides movement that simulates an angular movement of the body during the turns.

Construction and mounting of the platforms 2 and 3 provides movement simulating change in the direction of the slope " α " relative to the body of a skier. Mounting of the platforms 2 and 3 provides the change of inclination angle simulating changing angle of the ski slope " β " relative to the horizon.

Construction and mounting of the platform 4 provides movement simulating change of ski center location relative to a direction perpendicular to direction of the slope.

The platforms 5 and 6 for the left and right skis are mounted on the top of the platform 4. Construction and mounting of the platforms 5 and 6 provides movement that simulates an increased distance between the centers of the skis during the turns.

The platforms 7 and 8 are installed on the platforms 5 and 6 respectively with the possibility of rotation around their axis, perpendicular to the surface of the platforms 5 and 6 simulating rotation skis (boots) around the vertical axes perpendicular to the slope during the turns.

The platforms 9 and 10 are installed on the platforms 7 and 8 respectively. They can be made in the form of real skis with possibility of rotation around two axes parallel to the skis and located on the left and right edge of the skis simulating tipping of the skis during the turns.

The axis of rotation of the platforms 2, 3 and 4 are located at a distance from each other so when a skier inclines, his/her body applies pressure to the left or right side and the platforms rotate respectively and platform 1 moves along the guides/rails.

Each platform is equipped with a system of elastic/spring elements that return a platform to the neutral position when the pressure releases.

Stiffness/resistance of the spring elements is determined so that by the increasing pressure from the skier platforms begin to move in a certain sequence: platform with a greater stiffness/resistance rotates after the platform with a lesser stiffness.

Platform mounted on top of each other using a set of coasters or bearings, for example, cylindrical bearings of various diameters, such as a "Lazy Susan".

Suspension is connected with counterweights, or springs, or bungee cords, through the pulleys. Weights or resistance are determined depending on the weight of the skier.

A harness is mounted on the body of a skier's center of gravity and connected to the ceiling or frame through the pulleys and elastic elements.

Listed above are new features (additional platforms that simulate positions of the ski slope, body of a skier, harness coupled with a dynamic suspension) in collaboration with well-known features (base platform, platform with ski bindings) provide identification of the new features of the invention and achieving the technical result of the invention - the multiple repetition of the cyclical movements of the body, legs, and feet of a skier in the conditions simulated by the ski simulator. The proposed design of the simulator allows getting consumer properties relating to the technical result, which is the impact on a skier, as are maximal close/similar, taken together, to the impact in real conditions of slalom runs with the relevant skills and experience.

The drawings illustrate the structure and work of the Simulator:

Fig. 1 - Simulator, back view;

Fig. 2 - Simulator, plan view;

Fig. 3 - Simulator, side view;

Fig. 4 - Simulator, side view with tilting platform3;

Fig. 5 - Diagram of a rotating platform 2 and tilting platform 3;

Fig. 6 - Diagram of rotation of the platform 2, 3 and 4 to the left during a right turn;

Fig. 7 - Diagram of rotation of the platform 2, 3 and 4 to the right during a left turn;

Fig. 8 - Platforms 5, 6, 7, 8, 9, and 10 in neutral position with ski bindings;

Fig. 9 - Diagram of sliding platforms 5 and 6, imitating increasing distance 21 between skis during the turns;

Fig. 10 - Diagram of sliding platforms 9 and 10, imitating increasing distance 21 between skis during the turns, back view;

Fig. 11 - Diagram of tilting platforms 9 and 10 imitating tilting of skis during the right turn;

Fig. 12 - Diagram of tilting platforms 9 and 10 imitating tilting of skis during the left turn;

Fig. 13 - Diagram of the mechanism synchronizing the rotation angle of skis, neutral position;

Fig. 14 - Diagram of the mechanism synchronizing the rotation angle of skis, right turn;

Fig. 15 - Diagram of the mechanism synchronizing the rotation angle of skis, left turn;

Fig. 16 - Harness;

Fig. 17 - Diagram of connection of the suspension to the harness and ceiling or frame;

Fig. 18 - Diagram of mounting of the harness on skier's body;

Fig. 19 - General view of a skier with a harness connected to suspension with a spring as an elastic element;

Fig. 20 - General view of a skier with a harness connected to suspension with a bungee cord as an elastic element;

The ski simulator consists of several platforms rotating around their axis, location on each other, and imitating the appropriate motions:

1. Lateral motion of the base platform 1 that holds other platforms 2, 3, 4, 5, 6, 7, 8, 9, and 10 (Fig. 1) along the arced guides/rails 11 (left-right) – simulates an angular movement of the body during the turns (Fig. 2).

2. Rotating platform 2 is located on the base platform 1 and mounted by the bearing 12, for example, the supporting axis with a set of coasters or bearing type "Lazy Susan". A rotating of the platform 2 around the vertical axis imitates changing of the direction of the slope " α " relatively to the skier's body (Fig. 3).

3. The platform 3 is mounted to the platform 2 using hinges so it can change the angle " β " between the platforms 2 and 3 – it imitates an angle of the ski slope (Fig. 4, 5). At the beginning and ending of the training the platform 3 has to be in horizontal position, because in the inclined position it would be difficult to stand on it and secure the ski boots without any additional supporting devices. The angle " β " can be changed through a special mechanism, for example, with an electric motor and remote control (wired or wireless).

4. The platform 4 is located on the tilting platform 3 and mounted by the bearing 12, for example, "Lazy Susan" type bearing. Rotating of the platform 4 on the platform 3 with the angle " γ " around an axis perpendicular to the platform 3 simulates the changing of the positions of skis' centers (ski bindings, boots) relatively to direction perpendicular to direction of the slope. The angle " γ " is equal to the angle between line " $a-a$ " passing through the skis' centers and the line " $b-b$ " perpendicular to the direction of the slope " α ", which is simulated by the tilt of the platform 2. The angle " γ " changes during the turns. In the neutral position left and right skis are equally positioned to the direction of the slope (Fig. 2). During a left turn (Fig. 6), the left foot (ski) is slightly forward in relation to the right ski in the direction of the slope. And, conversely, during a right turn (Fig. 7).

5. On the platform 3 are mounted two platforms 5 and 6 - for left and right skis, which can move progressively and laterally along the bearing device 3. They imitate the increasing distance "J" between centers ski skis during the turns (Fig. 8, 9, 10).

6. The platforms 7 and 8 are mounted on the platforms 5 and 6, respectively, which are secured by the bearings 14, for example, "Lazy Susan" type bearings of the smaller diameter. The platforms 7 and 8 rotate around their axis perpendicular to the platforms 5 and 6 and imitate rotation of skis or boots around the vertical axes perpendicular to the slope during the turns.

7. The platforms 9 and 10 are mounted on the platforms 7 and 8 that can be executed in the form of skis and rotating each around two axes parallel to the plane of the skis and matching with the left and right edge of the skis, using hinges to simulate skis and their tilting (Figs. 11, 12).

8. Ski bindings 15 are mounted to the platforms 9 and 10.

The axes of rotation of the platforms 2, 3, and 4 (Fig. 3) are shifted in relation to each other at certain distances “H” and “I” so that when the skier inclines to the left or right during the turns and applies pressure to the left or right, the platform 1 moves along the arced guides/rails 11, and the platforms 2, 3, and 4 rotate in the appropriate direction. Each platform is equipped with a system of elastic/spring elements that return a platform to the neutral position when the pressure releases. Stiffness/resistance of the spring elements is determined so that by the increasing pressure from the skier platforms begin to move in a certain sequence: platform with a greater stiffness/resistance rotates after the platform with a lesser stiffness.

Beginners can use the mechanism that synchronizes the rotation angle of skis around a vertical axis so that they are always parallel to each other even while the distance between them is increasing (Fig. 13, 14, 15). It consists of the longitudinal bar 16, located on the center between the ski and parallel to them. The rear end of the bar 16 is jointed to the rear end of left ski with a bar 17, and the front end is jointed to the right ski with a transversal bar 18. The axis of rotation 19 of the bar 16 is located at its center and perpendicular to the platform 4. It is mounted on the platform 4 so that it can progressively move left and right along a vertical plane passing through the centers of the skis. If the skis are turning without increasing the distance between them, the axis 19 remains motionless. While distance between skis is increasing at “J”, axis moves at the distance “K”, thereby allowing the skis to remain parallel to each other during turns and spreading (Fig. 14, 15).

One of the challenges the novice skier/racer faces is to overcome the psychological barrier that prevents the body from leaning forward during the flexing, but which allows you to perform more edgy and sharp turns along the arc of the smaller radius. When skiing along the arcs the centrifugal force and centripetal acceleration keep the skier’s body in the inclined position. That is, it would be impossible to keep the body in the same position standing on the ground without movement, and, of course, it would fall. Instructors often use ski poles or other supporting devices trying to demonstrate a correct position of the body and reproduce its inclination during the real skiing/racing, but it is difficult without movement. Position of the body supported by the poles resembles the correct position, but is still far from it. After a static demonstration using ski poles or other supports instructors usually move to a dynamic demonstration on the run. Typically that part of the coaching is the most challenging and lengthy.

Before a trainee will begin to learn the correct skiing/racing technique, it takes quite long time - it could be hours, days, weeks, depending on the various factors, such as physical training, attitude, desire, weather, congestion of the ski slope, instructor’s experience, and many other factors. The instructor has to not only demonstrate the correct technique, but also watch, analyse, identify mistakes, and give recommendations. An instructor cannot stop the trainee at some point on the go and “fix the bugs”. This process involves many repetitions, the ups and downs, and even crashes and injuries that may interrupt the learning process for a long time and even discourage a trainee from further training. The cost of the ski lessons is an important factor as well.

It should be noted that skiers usually do not use poles on the run. The poles are used during moving on the flat ground or climbing up to the hill. That is, any kind of supporting devices in the ski simulators move them away from the real situation.

As it was noted above, it is impossible to reproduce the centrifugal force and centripetal acceleration in any device without a real movement. The main purpose of the simulator is reproduction of movement, body position, and work of certain muscle groups as close as possible to the real conditions.

In order to free hands, just like during real skiing/racing, a harness 20 (Fig. 16) with a suspension (Fig. 17) is used in the simulator. The suspension must be dynamic, i.e. it must be always in tension. The body moves continuously and changes its position. Thus, the distance between the attachment point on the body and the attachment point on the ceiling or frame is changing continuously as well. Vertical amplitude is small, but it still exists, so there should be no slack. Hence, a suspension through pulleys 21 is connected to the springs 22, or bungee cords 23, or counterweights.

A harness 20 should be worn so that it doesn't impede the trainee's movements; the mounting points 24 should be in the center of body gravity, or a little lower and behind in the area of the hips, closer to the buttocks (Fig. 18, 19, 20). The suspension connected to the harness at the rear side of the body would not hamper the motions. That feature distinguishes this type of harness from all known harnesses (used by climbers, steeplejacks, etc.) that are specially designed in such a way to keep body hanging vertically, i.e. mounting points must be far above the center of gravity of the body.

The distance "L" between attachment points on the ceiling or frame of each pair of suspension approximately equals to the amplitude of the horizontal movement of the trainee's body. This distance can be adjusted depending on height, weight, training level, trainee's aggressiveness, etc., because different people would incline, flex, extend, move left-right with different amplitudes.

So, this type of suspension and attachments achieve three objectives:

First, elastic elements with lesser stiffness can be utilized. That is, by using pulleys the workload applied to elastic elements decreases. A suspension can stretch twice more than amplitude of the body motion and at the same time, tension changes are negligible, so it might be assumed that it remains the same.

Secondly, when the body moves left and right, a direction of tension remains almost the same as well.

Thirdly, when the body moves left and right, the pulleys, and hence, the attachment points on the harness, remain roughly at the same level.



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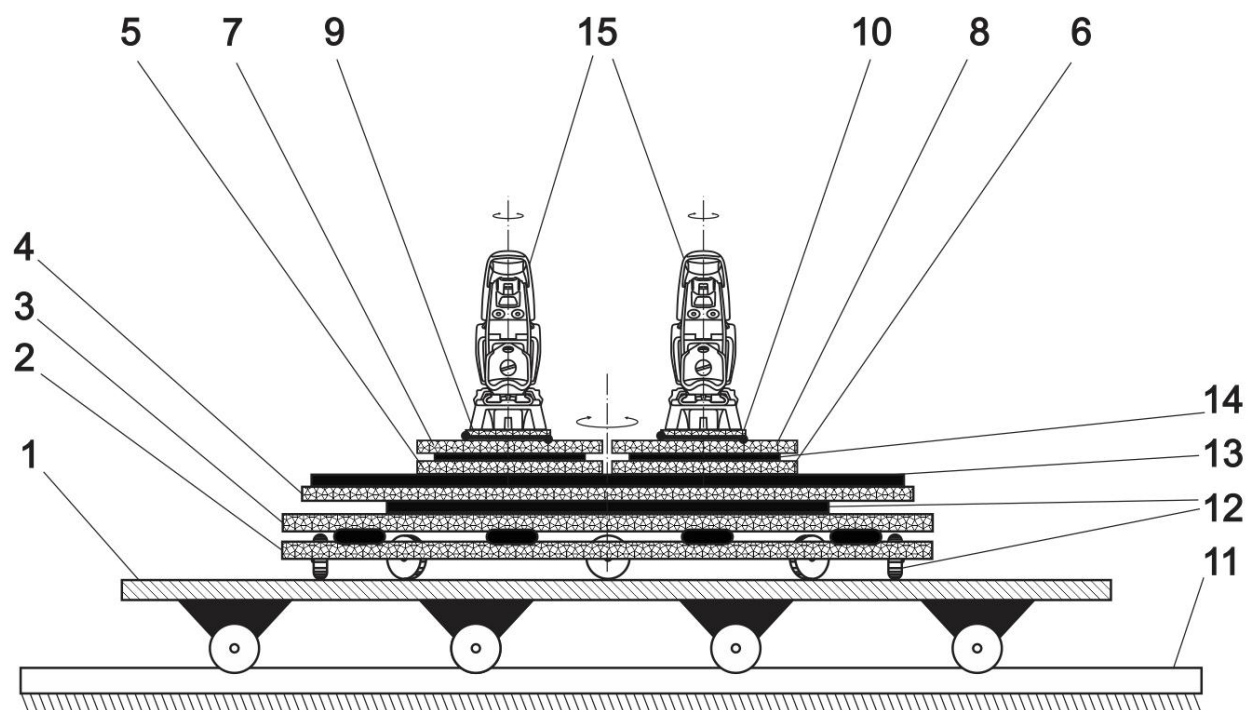
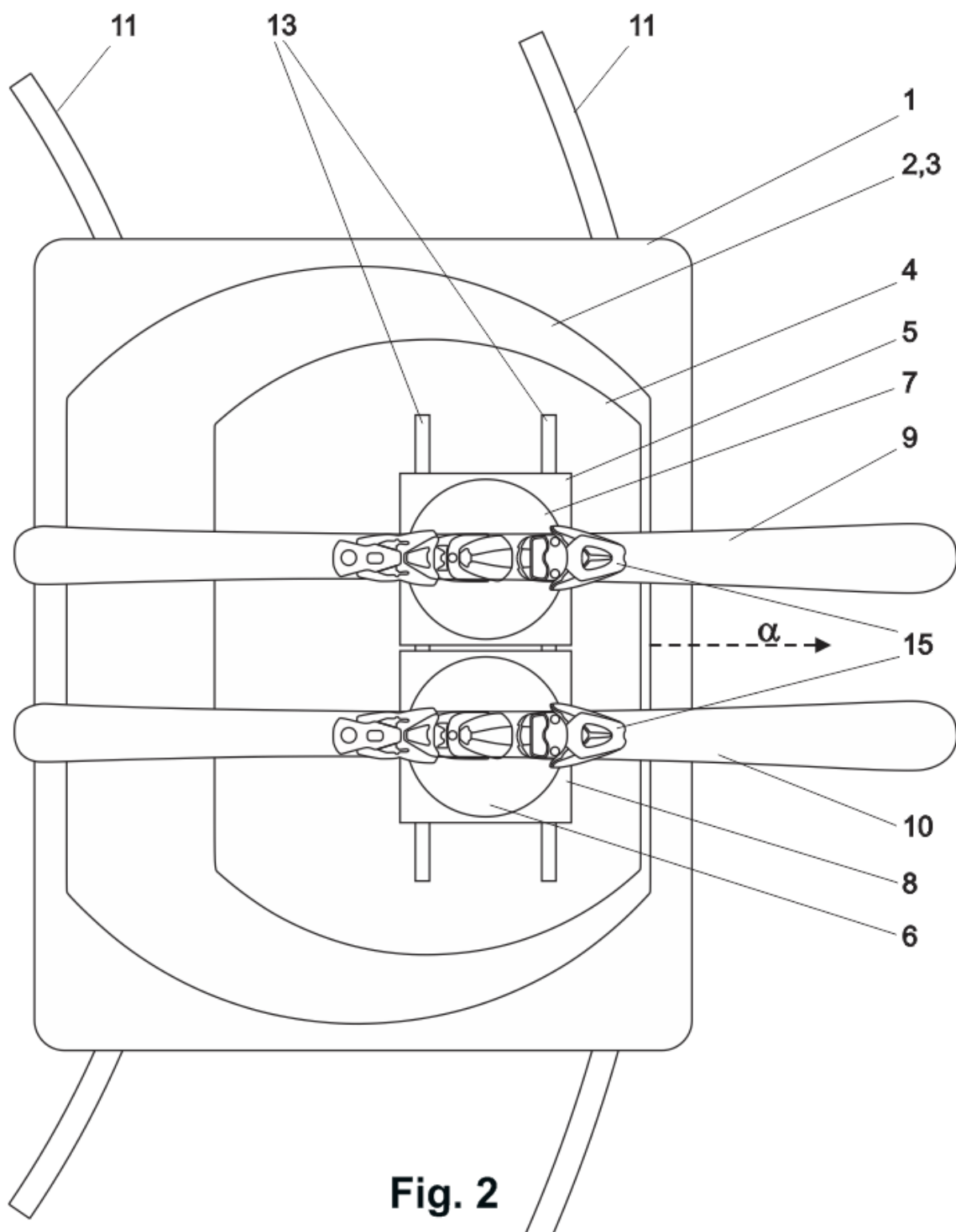


Fig. 1



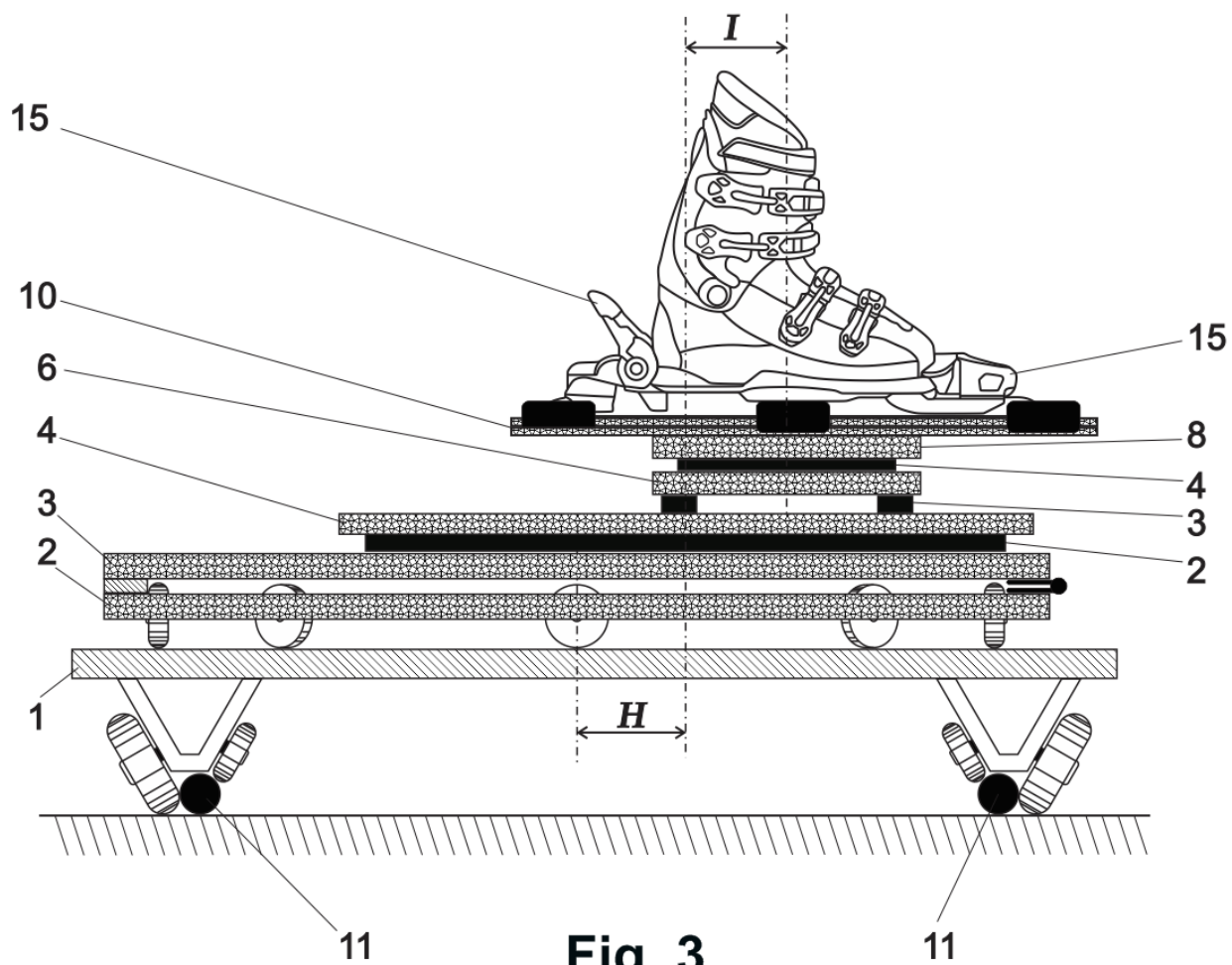


Fig. 3

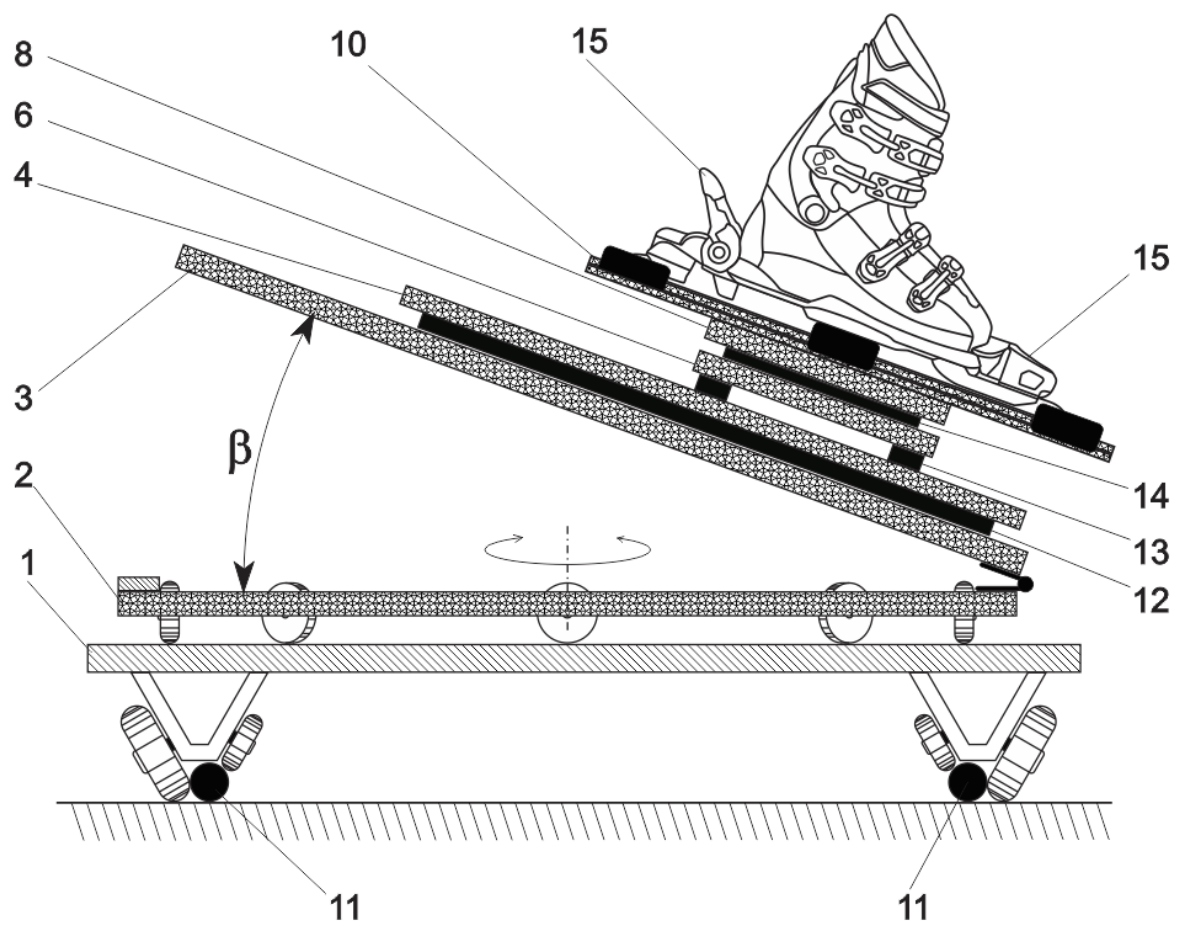


Fig. 4

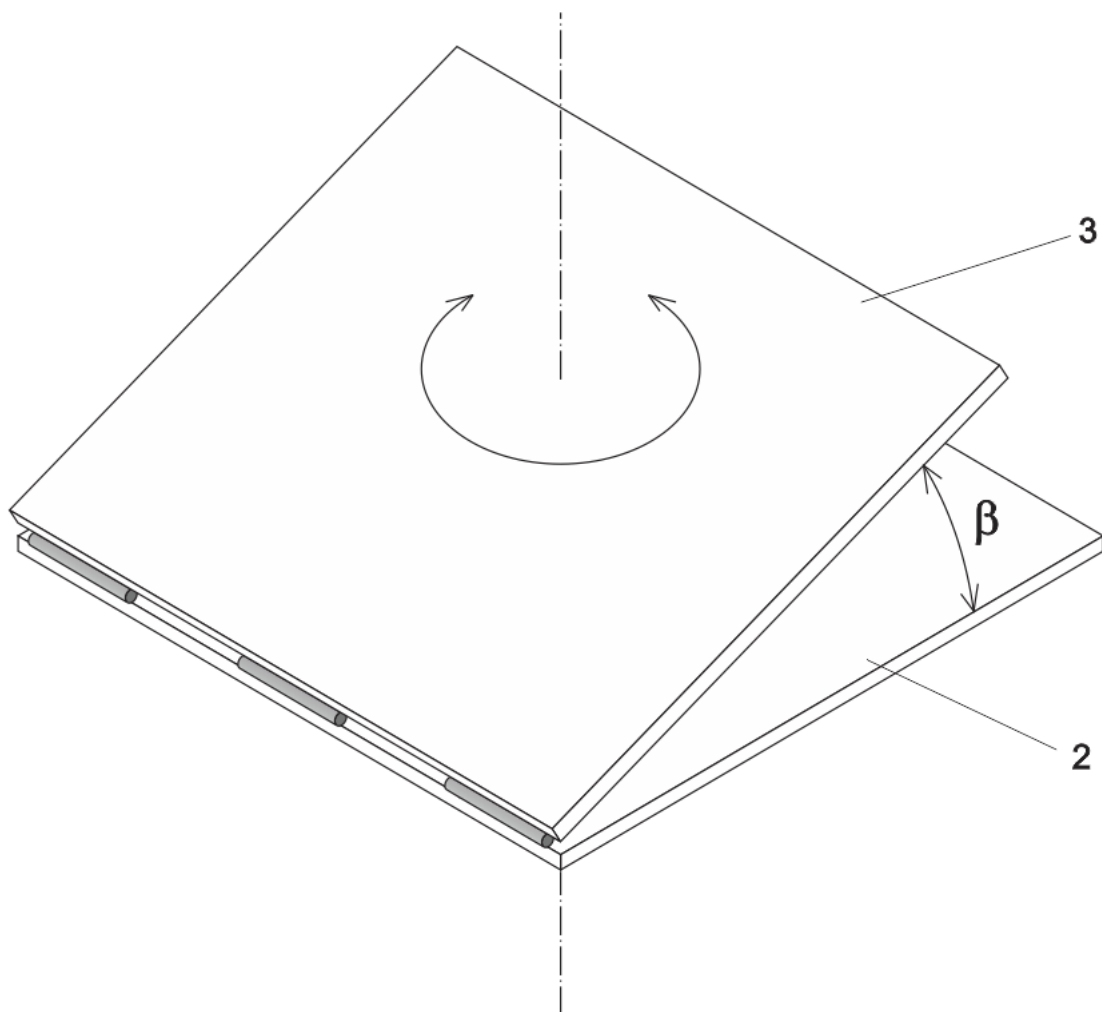
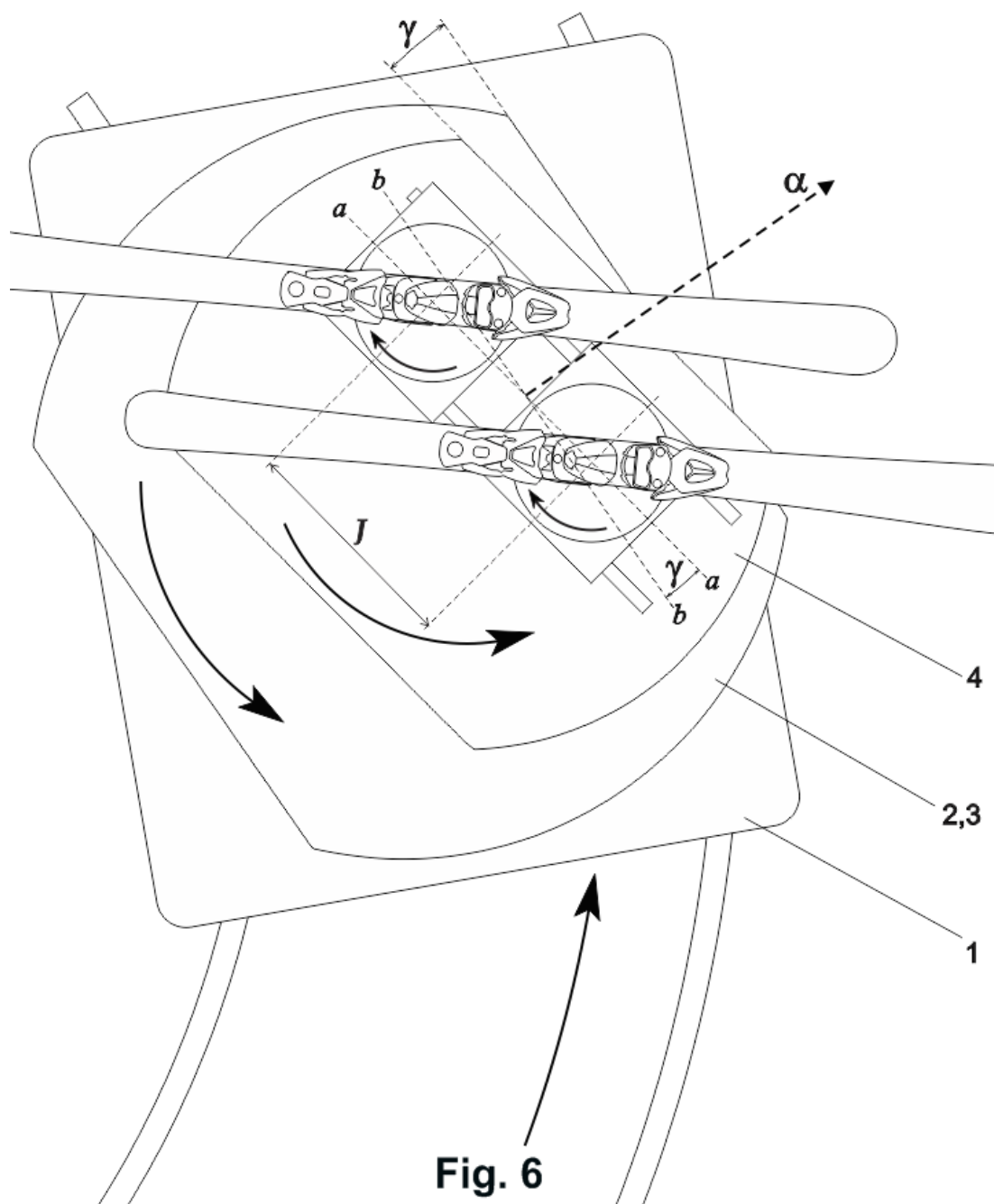


Fig. 5



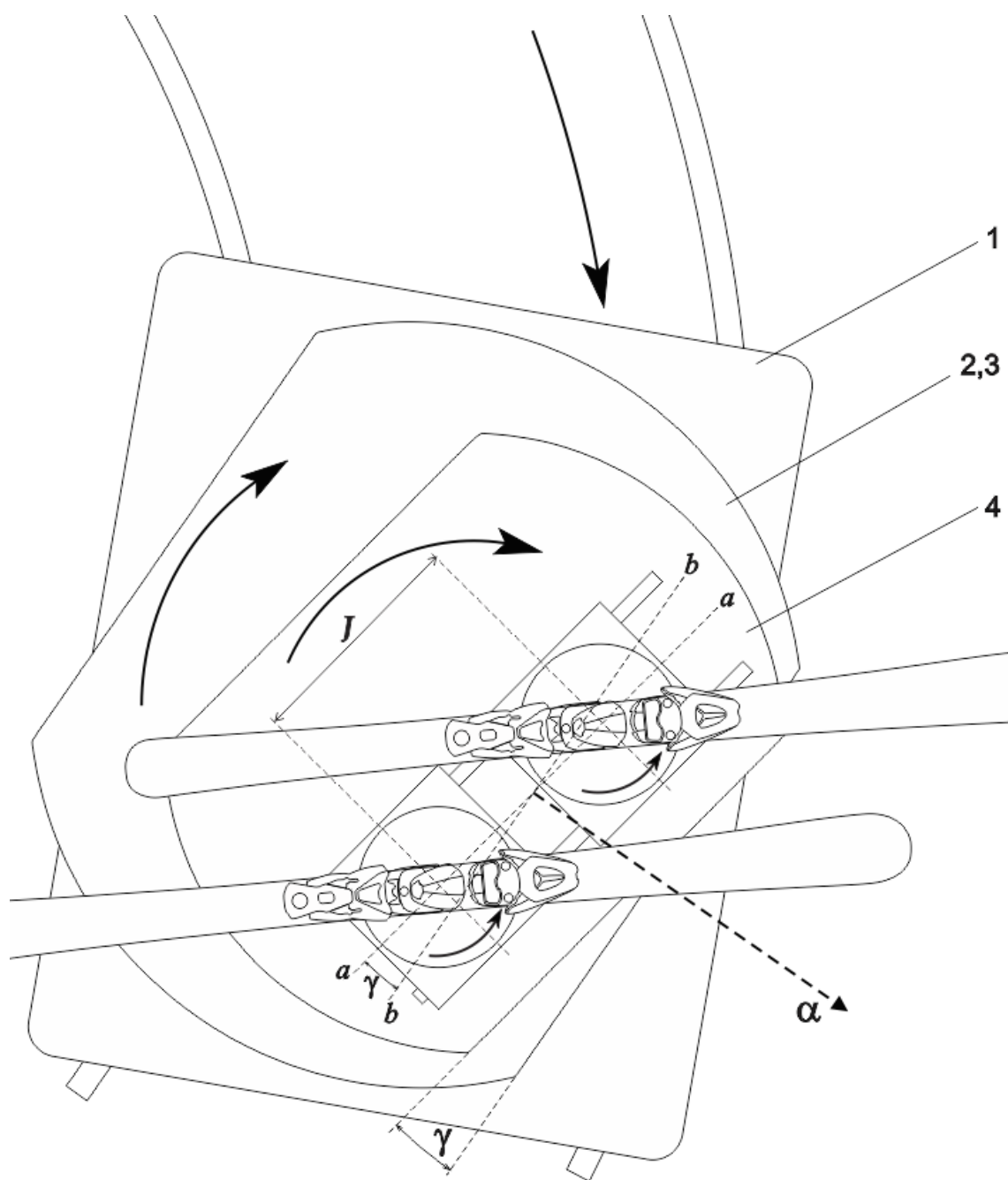
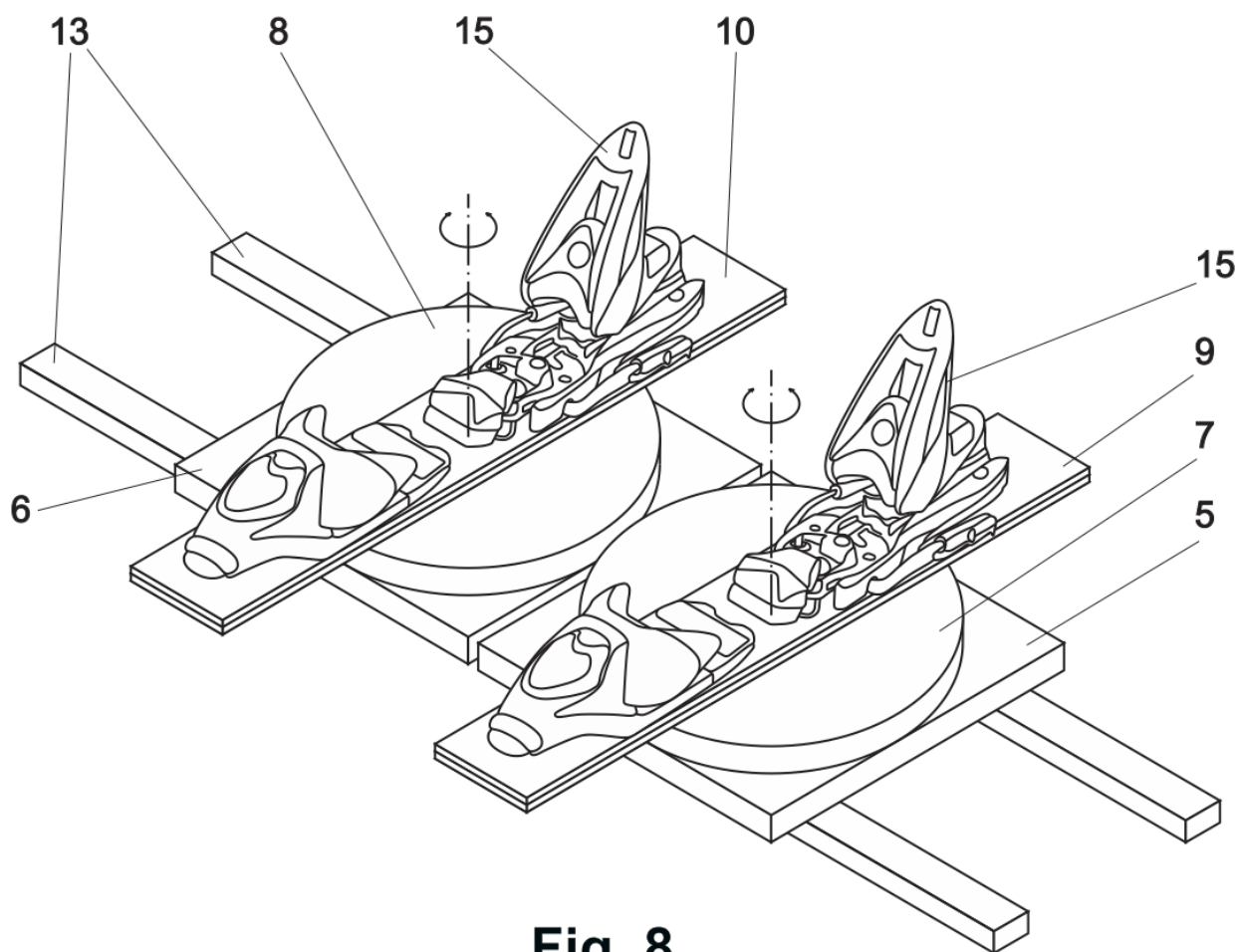


Fig. 7



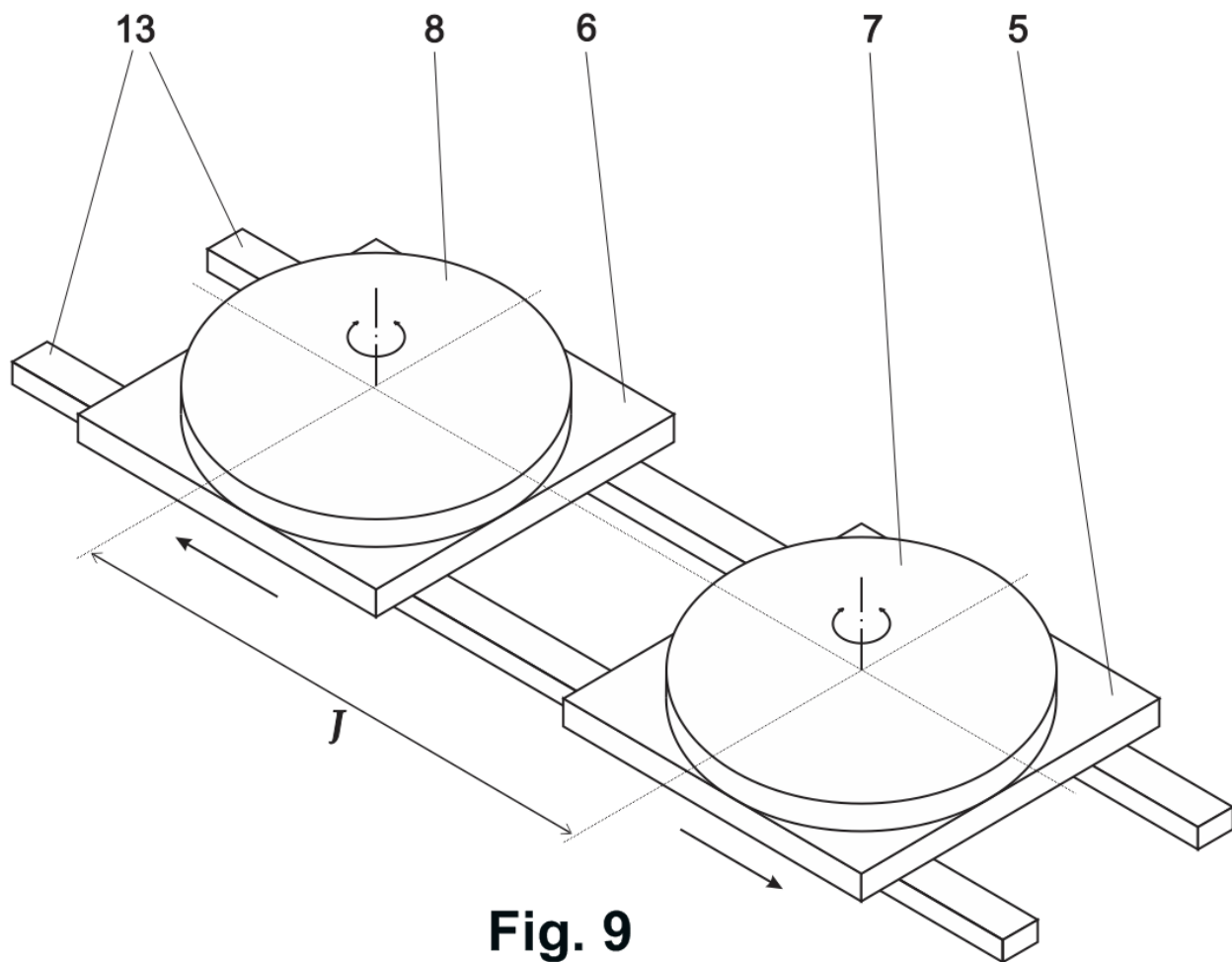
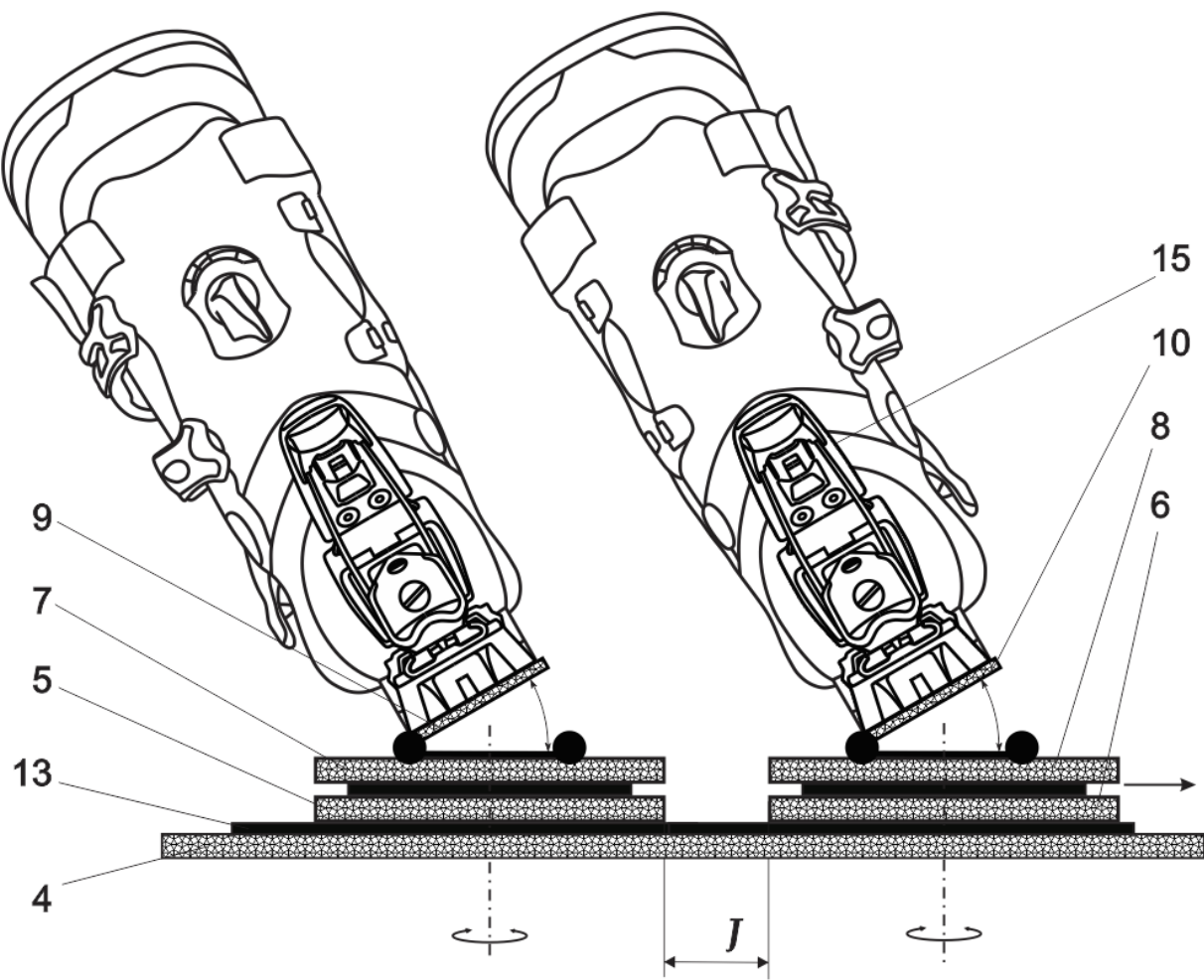


Fig. 9



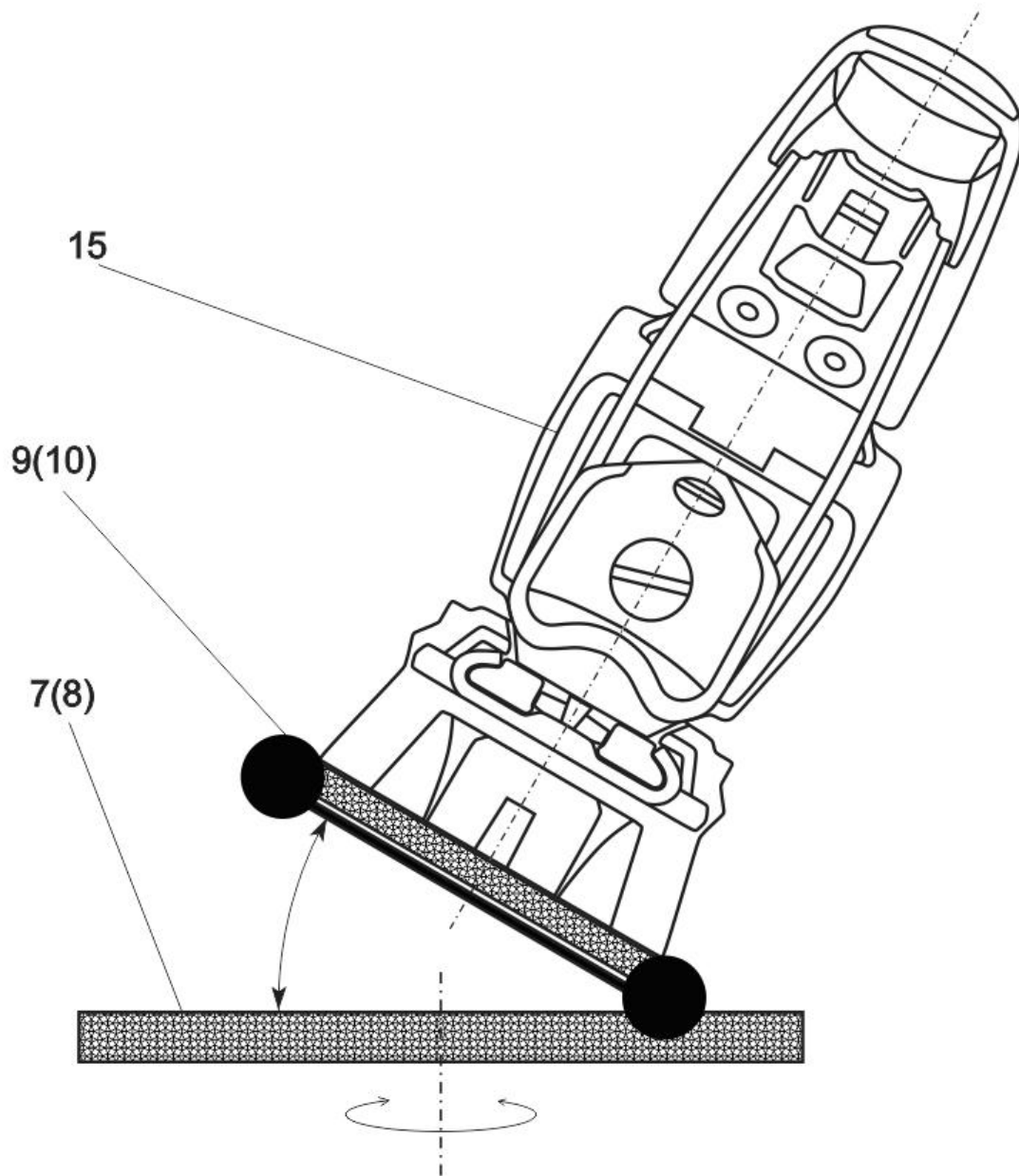


Fig. 11

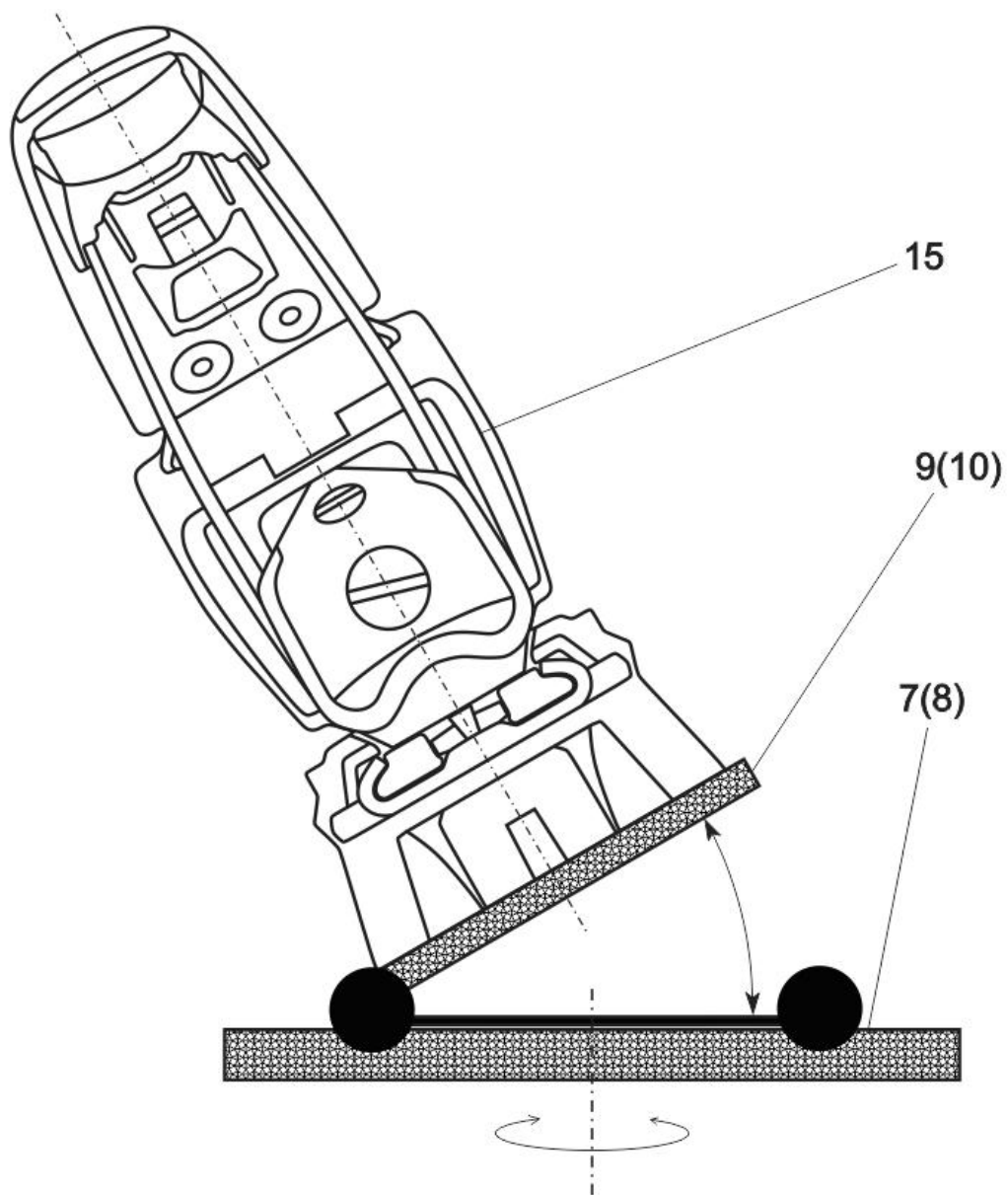


Fig. 12

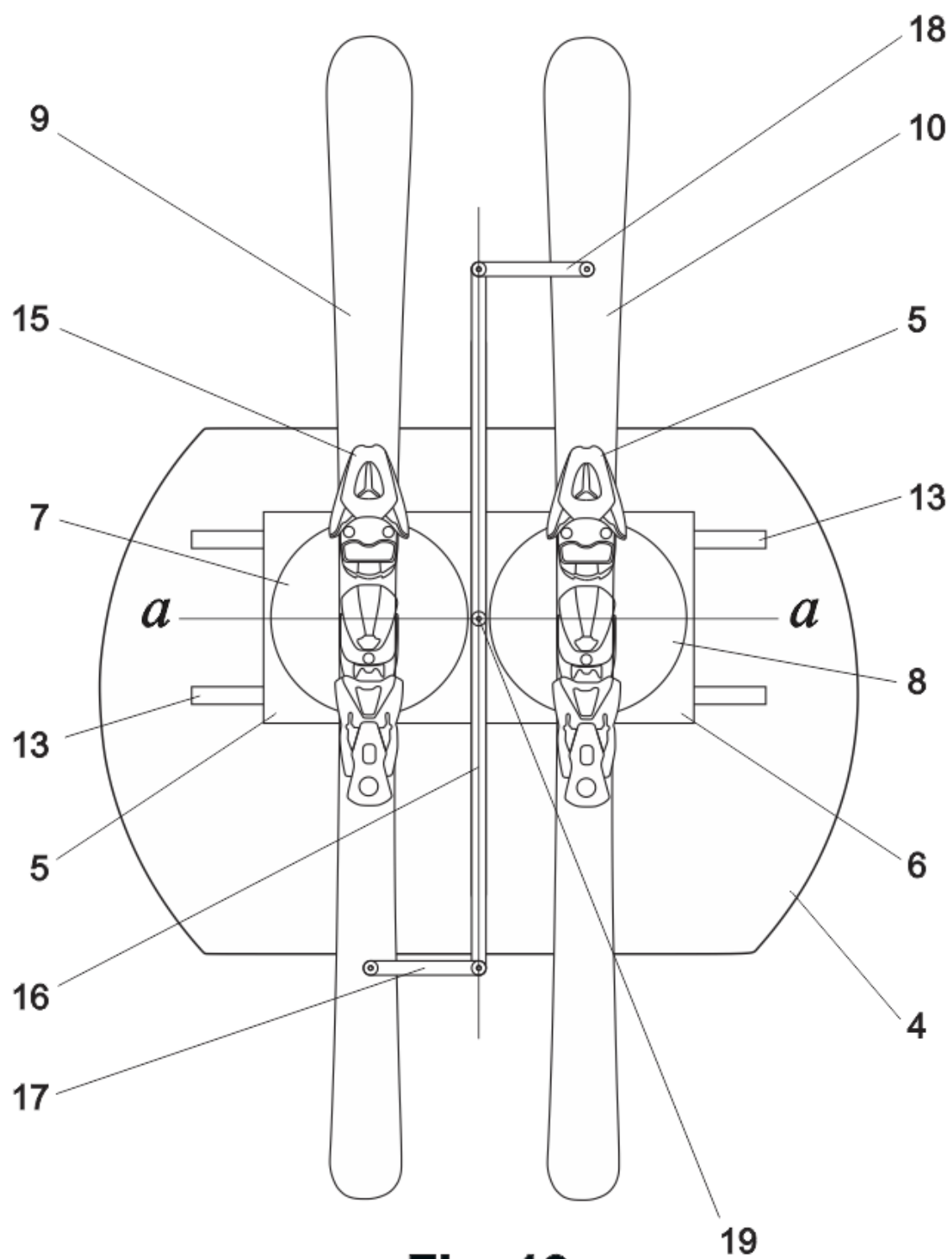


Fig. 13

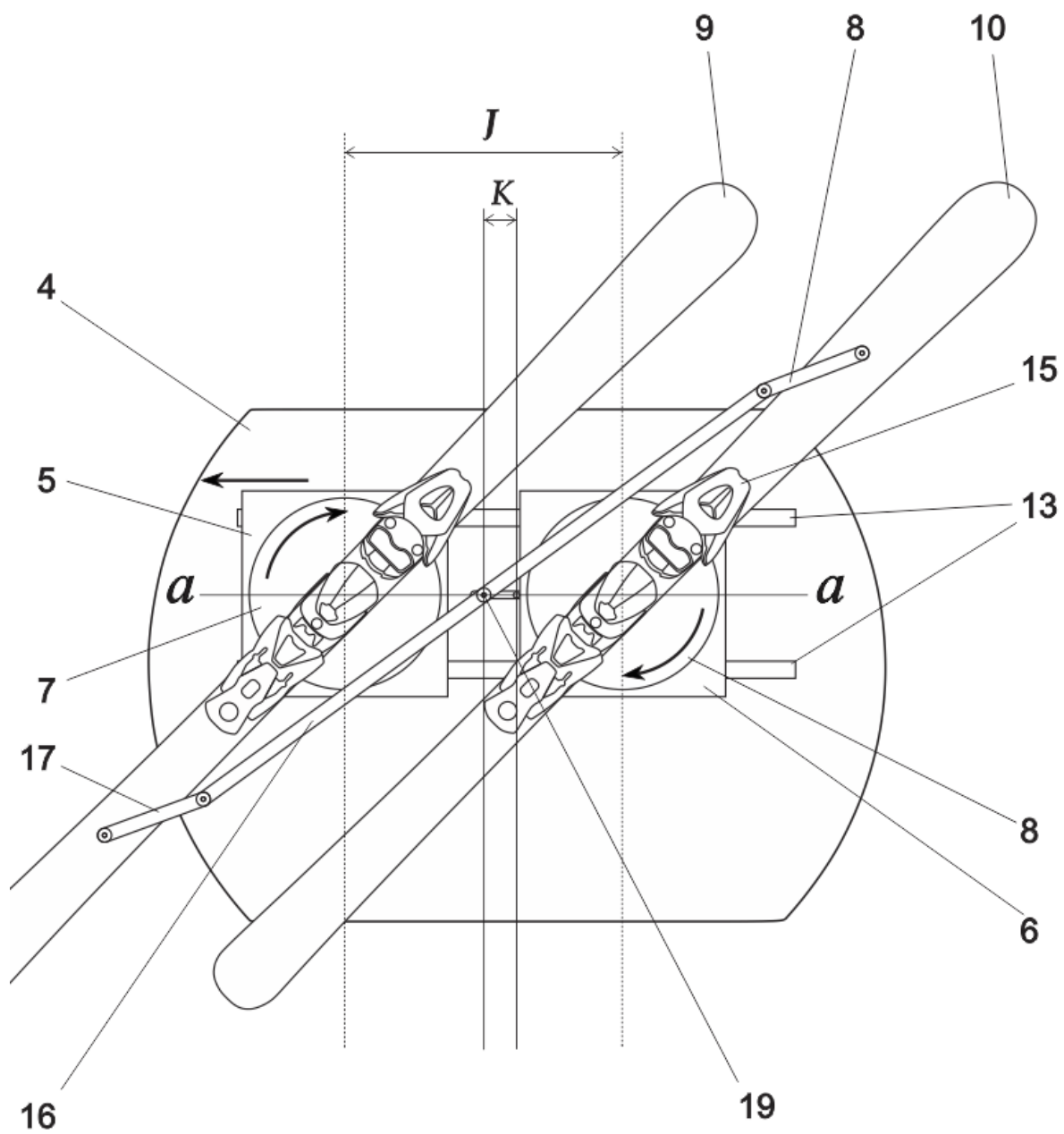


Fig. 14

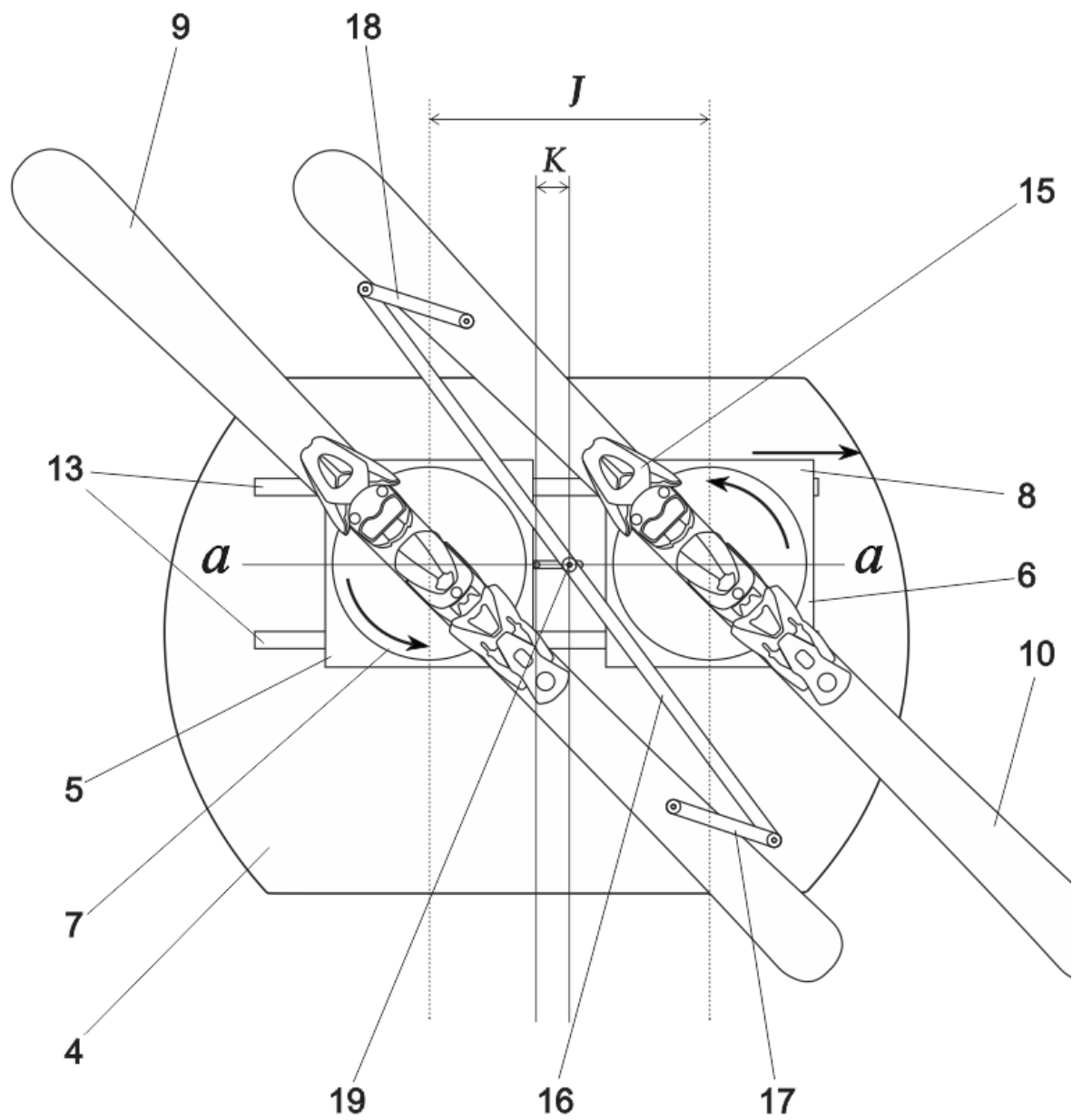


Fig. 15



Fig. 16

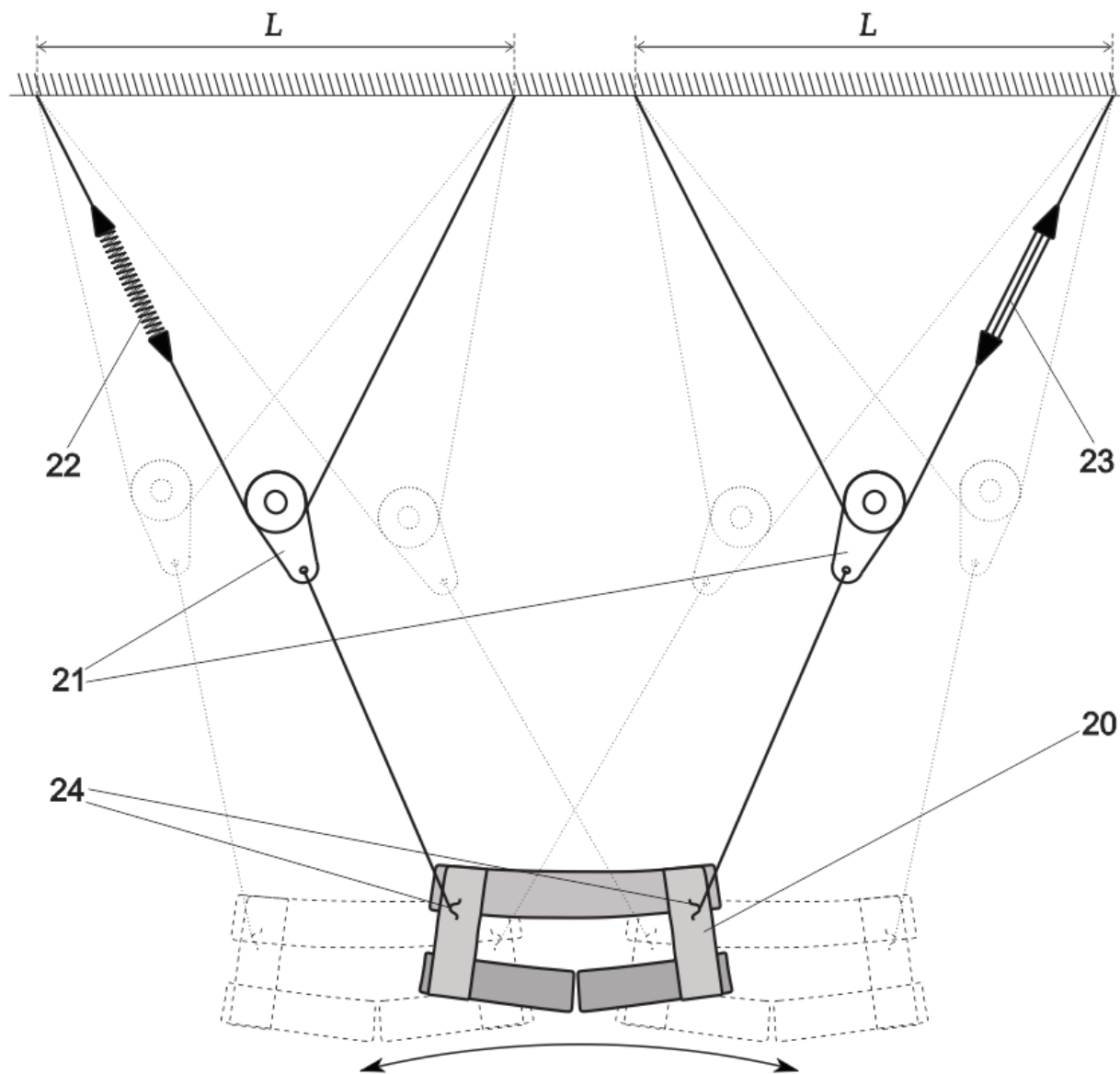


Fig. 17

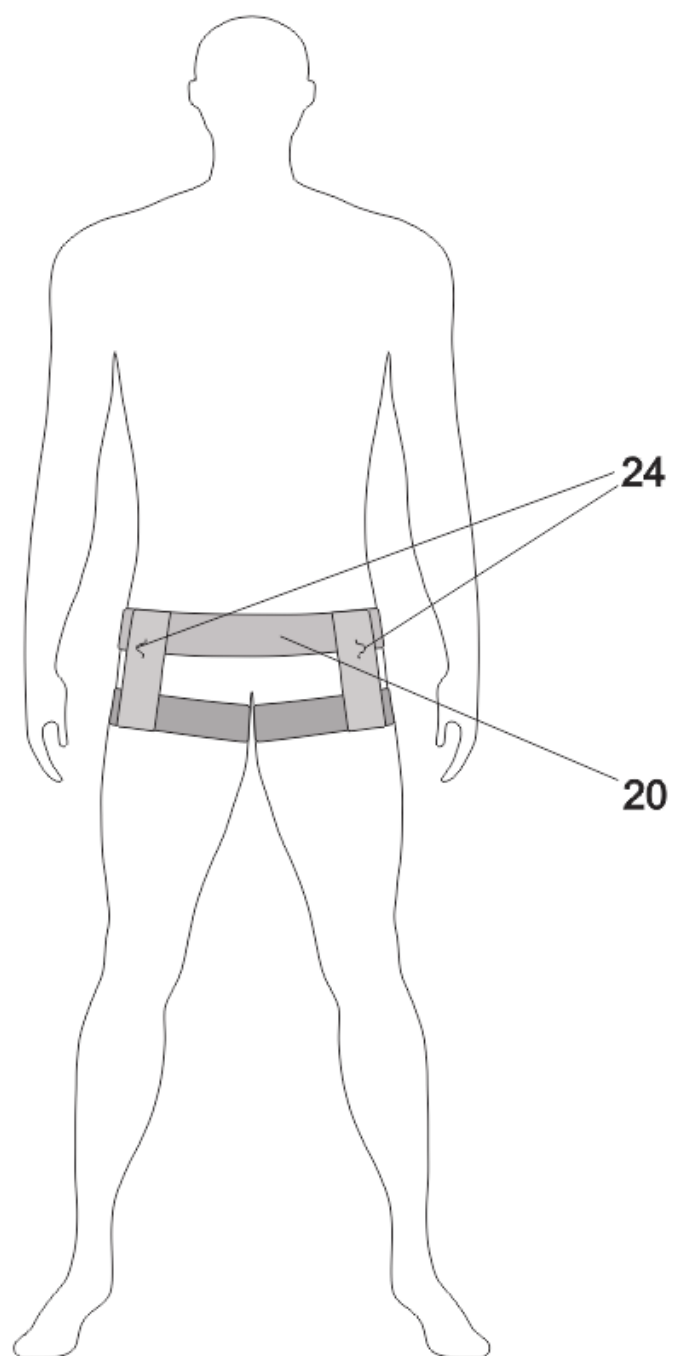


Fig. 18

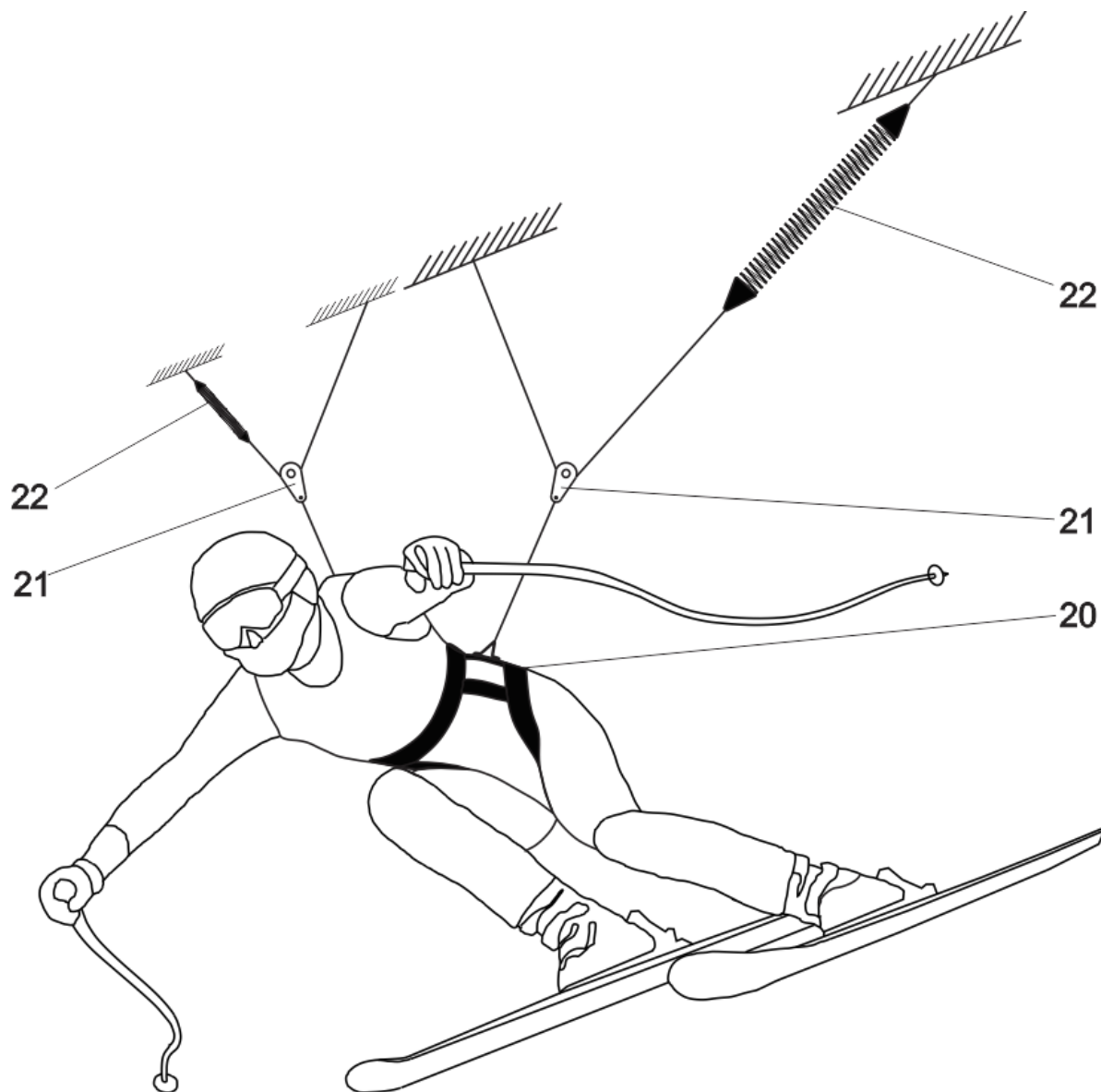


Fig. 19

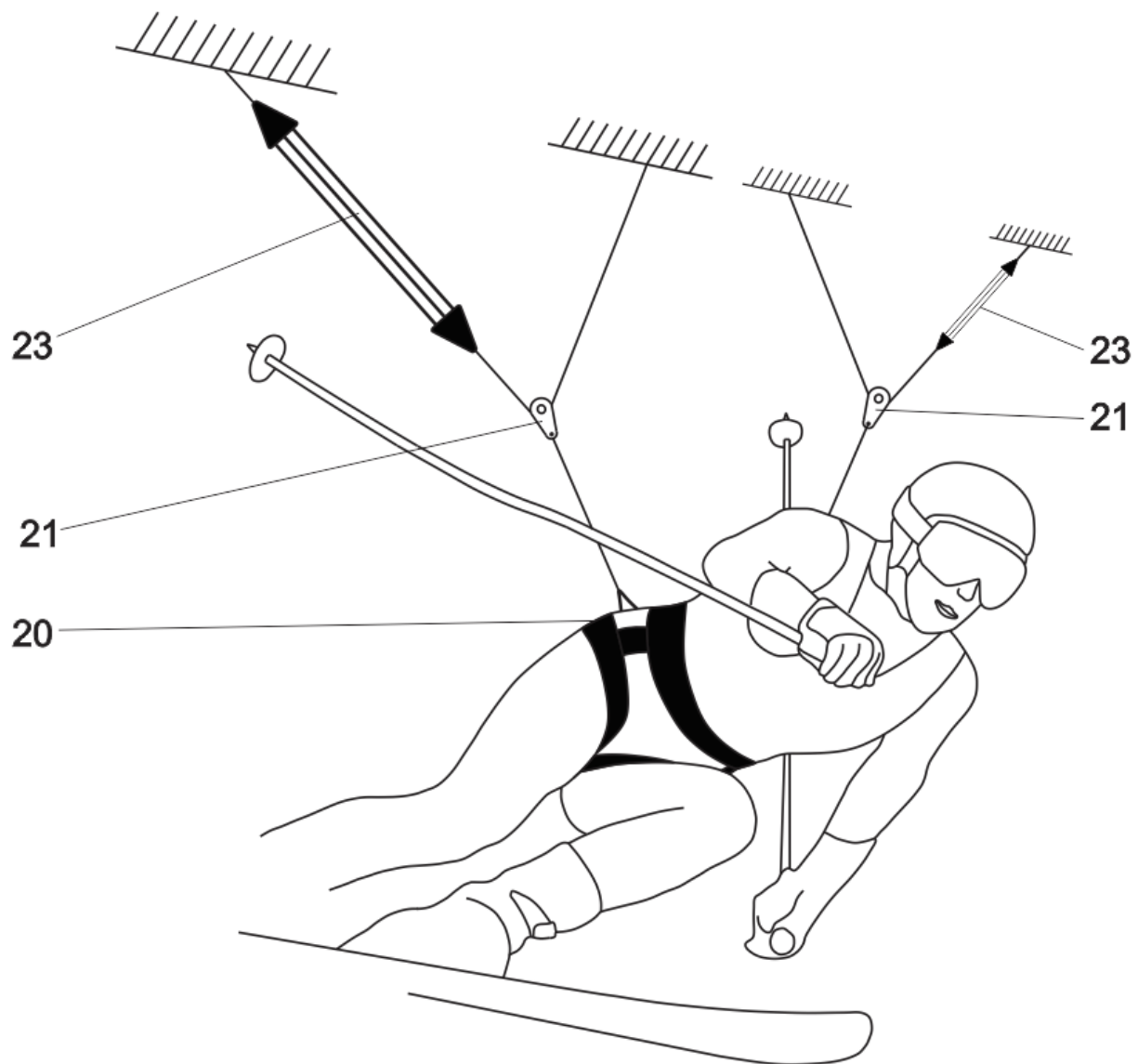


Fig. 20

