(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 914 848 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.05.1999 Bulletin 1999/19

(51) Int. Cl.[6]: **A63C 17/00**

(21) Application number: **98119053.1**

(22) Date of filing: **08.10.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **09.10.1997 IT BO970606**

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(54) Steering device for at least two-wheel vehicles

(57) A steering device (1) interposed between the front wheel (4) and the frame (3) of a vehicle (2) having at least two wheels (4, 5) resting on the ground; the device having a supporting element (7) hinged to the frame (3) so as to oscillate about an axis (A) parallel to the rotation axis (B) of the rear wheel (5); an elastic damping element (8) interposed between the frame (3) and the supporting element (7) to maintain the supporting element (7) in a given position with respect to the frame (3); and a fork (9) fitted to the supporting element (7) so as to rotate about a given rotation axis (C); the front wheel (4) being fitted to the fork (9) so as to rotate about a rotation axis (D) not intersecting the rotation axis (C) of the fork (9); and the device having an elastic reaction element (10) for maintaining the fork (9) in a rest position in which the front wheel (4) is aligned with the rear wheel (5).

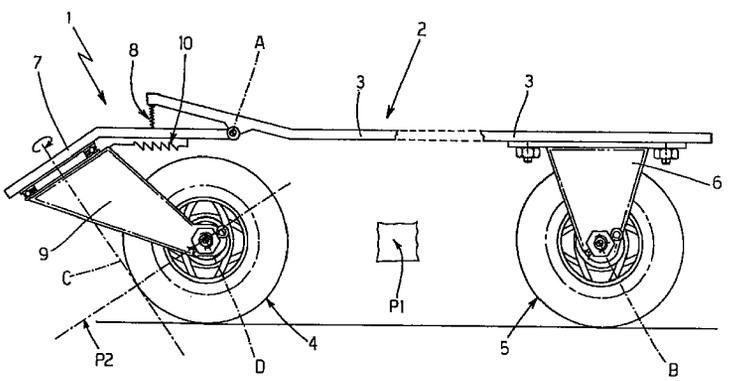

Fig.1

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Description

[0001] The present invention relates to a steering device for at least two-wheel vehicles.

[0002] At present, the market offers no two-wheel vehicles, preferably but not necessarily sports vehicles, which can be driven by axially moving the vehicle frame and varying the weight distribution on the vehicle to achieve the same dynamic performance as skis.

[0003] It is an object of the present invention to provide a vehicle comprising at least two wheels, and wherein steering of the front wheel, normally parallel to the rear wheel, is controlled by axial rotations of the vehicle frame and by varying the weight distribution on the wheels.

[0004] According to the present invention, there is provided a steering device for vehicles comprising at least two wheels resting on the ground; the vehicle comprising a frame, a front wheel, and at least one rear wheel; said steering device being interposed between said front wheel and said frame, and being characterized by comprising a fork supporting the front wheel and fitted, so as to rotate about a first axis, to a supporting element carried by the frame; and elastic reaction means for maintaining said fork in a rest position in which the front wheel is substantially aligned with the rear wheel; said first axis being inclined with respect to the ground, and lying in a first reference plane substantially perpendicular to the rotation axis of the rear wheel and substantially through the center of gravity of the rear wheel; the front wheel being fitted in rotary manner to said fork so that the rotation axis of the front wheel lies in a second reference plane perpendicular to said first axis.

[0005] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a side view, with parts in section and parts removed for clarity, of a two-wheel vehicle featuring a steering device in accordance with the teachings of the present invention;

Figures 2, 3 and 4 respectively show a plan view, a front view and a side view of the Figure 1 vehicle during steering;

Figure 5 shows a side view of a particular embodiment of the Figure 1 vehicle.

[0006] Number 1 in Figure 1 indicates as a whole a steering device for fitment to a vehicle 2 comprising a frame 3 and at least two wheels resting on the ground and fitted in rotary manner to frame 3. In the following description, the term "ground" is intended to mean the surface of the terrain on which the wheels of vehicle 2 rest and run.

[0007] More specifically, vehicle 2 comprises a front wheel 4 and at least one rear wheel 5; and steering device 1 provides for varying the position in space of front wheel 4 as a function of the axial rotation of, and the weight distribution on, frame 3. In the example shown, rear wheel 5, on the other hand, is connected to frame 3 by a fork 6 integral with frame 3.

[0008] With reference to Figure 1, steering device 1 comprises a supporting plate 7 having one side hinged to frame 3 so as to oscillate about an axis A parallel to the rotation axis B of rear wheel 5; an elastic element 8 interposed between frame 3 and plate 7 to keep supporting plate 7, in the absence of external stress, in a given position with respect to frame 3; and a fork 9 fitted to supporting plate 7 so as to rotate about an axis C and via the interposition of a known thrust bearing. Axis C is inclined with respect to the ground and lies in a plane P1 perpendicular to axis B and intersecting axis B at the center of gravity of rear wheel 5.

[0009] Fork 9 supports front wheel 4, and is so formed that the rotation axis D of front wheel 4 does not intersect axis C and lies in a plane P2 perpendicular to axis C. In the example shown, front wheel 4 is so located as to be tangent to axis C.

[0010] Steering device 1 also comprises an elastic reaction element 10, which, in the absence of external stress, maintains fork 9 in a rest position (Figure 1) in which front wheel 4 is aligned with rear wheel 5. More specifically, in the rest position, front wheel 4 lies in plane P1 with axis D parallel to and at a minimum distance from axis B.

[0011] In the example shown, elastic element 10 is defined by an extension spring, which has a first end integral with fork 9 and a second end integral with frame 3 or supporting plate 7, is of minimum extension when fork 9 is in said rest position, and is preferably, but not necessarily, pretensioned.

[0012] With reference to Figures 1, 2, 3 and 4, in actual use, steering device 1 is designed to keep front wheel 4 aligned with rear wheel 5 as long as vehicle 2 moves with frame 3 so positioned as to maintain plane P1 perpendicular to the ground (Figure 1). Upon frame 3 of vehicle 2 being rotated axially to tilt plane P1, forces are generated in steering device 1, which rotate fork 9 to turn front wheel 4 and impose on vehicle 2 a curved trajectory with the concavity facing the axial rotation direction of frame 3 (Figures 2, 3 and 4).

[0013] Elastic reaction element 10 obviously opposes said forces with gradually increasing intensity to bring steering device 1 into a state of equilibrium in which a given inclination of plane P1 corresponds to a given angle of rotation of fork 9 with respect to the rest position.

[0014] When cornering, the above performance is further modified by varying the weight distribution on frame 3. In particular, for a given inclination of plane P1, an increase in the weight on front wheel 4 increases the forces rotating fork 9 and so increases the steering angle of front wheel 4. Similarly, for a given inclination of plane P1, a reduction in the weight on front wheel 4 reduces the forces rotating fork 9 and so reduces the steering angle of front wheel 4.

[0015] The response of steering device 1 to axial rotation of frame 3 and to changes in weight distribution on frame 3 depends of course on the geometry of the device, and in particular on the inclination of axis C with respect to the ground and the distance between axes C and D.

[0016] For a given geometry, on the other hand, the response of steering device 1 substantially depends on the characteristics of elastic reaction element 10 and of elastic element 8 when provided. In particular, the stiffness coefficient of elastic element 10 directly affects the ratio between the inclination of plane P1 and the steering angle of front wheel 4, while the stiffness coefficient of elastic element 8 directly affects the geometry of steering device 1 as a function of the variation in weight distribution on frame 3.

[0017] Before illustrating the function of elastic element 8, it should be pointed out that, in a steering device 1 in which axis C always maintains the same inclination with respect to the ground, each inclination of plane P1 corresponds to a maximum rotation angle of fork 9, which depends exclusively on the inclination of axis C with respect to the ground, and on the geometry of fork 9. The stiffness coefficient of elastic element 10 only determines the value of the weight on front wheel 4 resulting in said maximum rotation angle, while any further increase in the weight on front wheel 4 has no effect whatsoever on the position of fork 9.

[0018] To overcome the above drawback, elastic element 8 provides for dynamically adjusting the inclination of axis C with respect to the ground as a function of the weight distribution on frame 3, so as to increase the maximum rotation angle of fork 9 for each angle of inclination of plane P1. More specifically, since the maximum rotation angle of fork 9 increases alongside an increase in the inclination of axis C with respect to the ground, elastic element 8 provides for gradually straightening axis C as the weight on front wheel 4 increases, and so gradually increasing the maximum rotation angle of fork 9. This provides for increasing the sensitivity of steering device 1 to variations in weight distribution on frame 3.

[0019] Elastic elements 8 and 10 may of course be so sized that elastic element 8 comes into effect when elastic element 10 is no longer effective.

[0020] In the example shown, elastic element 8 comprises a compression spring having a first end on frame 3 and a second end on supporting plate 7; and possibly a known shock absorber (not shown) having a first end connected to frame 3 and a second end connected to supporting plate 7.

[0021] Preferably, but not necessarily, elastic element 8 may comprise one or more precompressed springs (not necessarily similar) so as to only modify the geometry of steering device 1 when the weight on front wheel 4 exceeds a given value.

[0022] In a first variation not shown, steering device 1 has no elastic element 8, and supporting plate 7 is integral with frame 3.

[0023] In a second variation not shown, supporting plate 7 is integral with frame 3, but is made of elastically deformable material so as to oscillate with respect to frame 3 and, when deformed, permit variations in the inclination of axis C. In this case, steering device 1 may dispense with elastic element 8.

[0024] In a third variation not shown, elastic reaction element 10 comprises two extension springs having different stiffness coefficients, and which act on fork 9 when steering device 1 curves to the right and left respectively, so as to achieve a different performance of vehicle 2 as a function to the steering direction.

[0025] In the Figure 5 embodiment, frame 3 of vehicle 2 is designed to enable a user to fit a vehicle 2 to each foot.

[0026] Clearly, changes may be made to the steering device as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. A steering device (1) for vehicles (2) comprising at least two wheels resting on the ground; the vehicle (2) comprising a frame (3), a front wheel (4), and at least one rear wheel (5); said steering device (1) being interposed between said front wheel (4) and said frame (3), and being characterized by comprising a fork (9) supporting the front wheel (4) and fitted, so as to rotate about a first axis (C), to a supporting element (7) carried by the frame (3); and elastic reaction means (10) for maintaining said fork (9) in a rest position in which the front wheel (4) is substantially aligned with the rear wheel (5); said first axis (C) being inclined with respect to the ground, and lying in a first reference plane (P1) substantially perpendicular to the rotation axis (B) of the rear wheel (5) and substantially through the center of gravity of the rear wheel (5); the front wheel (4) being fitted in rotary manner to said fork (9) so that the rotation axis (D) of the front wheel lies in a second reference plane (P2) perpendicular to said first axis (C).

2. A steering device as claimed in Claim 1, characterized in that said supporting element (7) is hinged to the frame (3) so as to oscillate about an axis (A) substantially parallel to the rotation axis (B) of the rear wheel (5); and the steering device comprises elastic damping means (8) interposed between the frame (3) and the supporting element (7) and for maintaining the supporting element (7) and the fork (9) in a given position with respect to the frame (3); said given position varying as a function of the weight on said front wheel (4).

3. A steering device as claimed in Claim 1, characterized in that said supporting element (7) is angularly

integral with the frame (3).

4. A steering device as claimed in Claim 1, characterized in that said supporting element (7) is integral with said frame (3) and is made of elastically deformable material so as to oscillate with respect to the frame (3).

5. A steering device as claimed in Claim 4, characterized by comprising elastic damping means (8) interposed between the frame (3) and the supporting element (7); said elastic damping means (8) maintaining the supporting element (7) and the fork (9) in a given position with respect to the frame (3); and said given position varying as a function of the weight on said front wheel (4).

6. A steering device as claimed in Claim 2 or 5, characterized in that said elastic damping means (8) comprise at least one compression spring having a first end on said frame (3) and a second end on said supporting element (7).

7. A steering device as claimed in Claim 6, characterized in that said compression spring (8) is precompressed.

8. A steering device as claimed in Claim 2 or 5, characterized in that said elastic damping means (8) comprise at least one shock absorber having a first end connected to said frame (3) and a second end connected to said supporting element (7).

9. A steering device as claimed in any one of the foregoing Claims, characterized in that said elastic reaction means (10) comprise at least one extension spring (10) having a first end integral with said fork (9) and a second end integral with said frame (3) or said supporting element (7); said extension spring (10) being of minimum extension when the fork (9) is in said rest position.

10. A steering device as claimed in Claim 9, characterized in that said extension spring (10) is pretensioned.

11. A vehicle having at least two wheels and comprising a steering device as claimed in Claims 1 to 10.

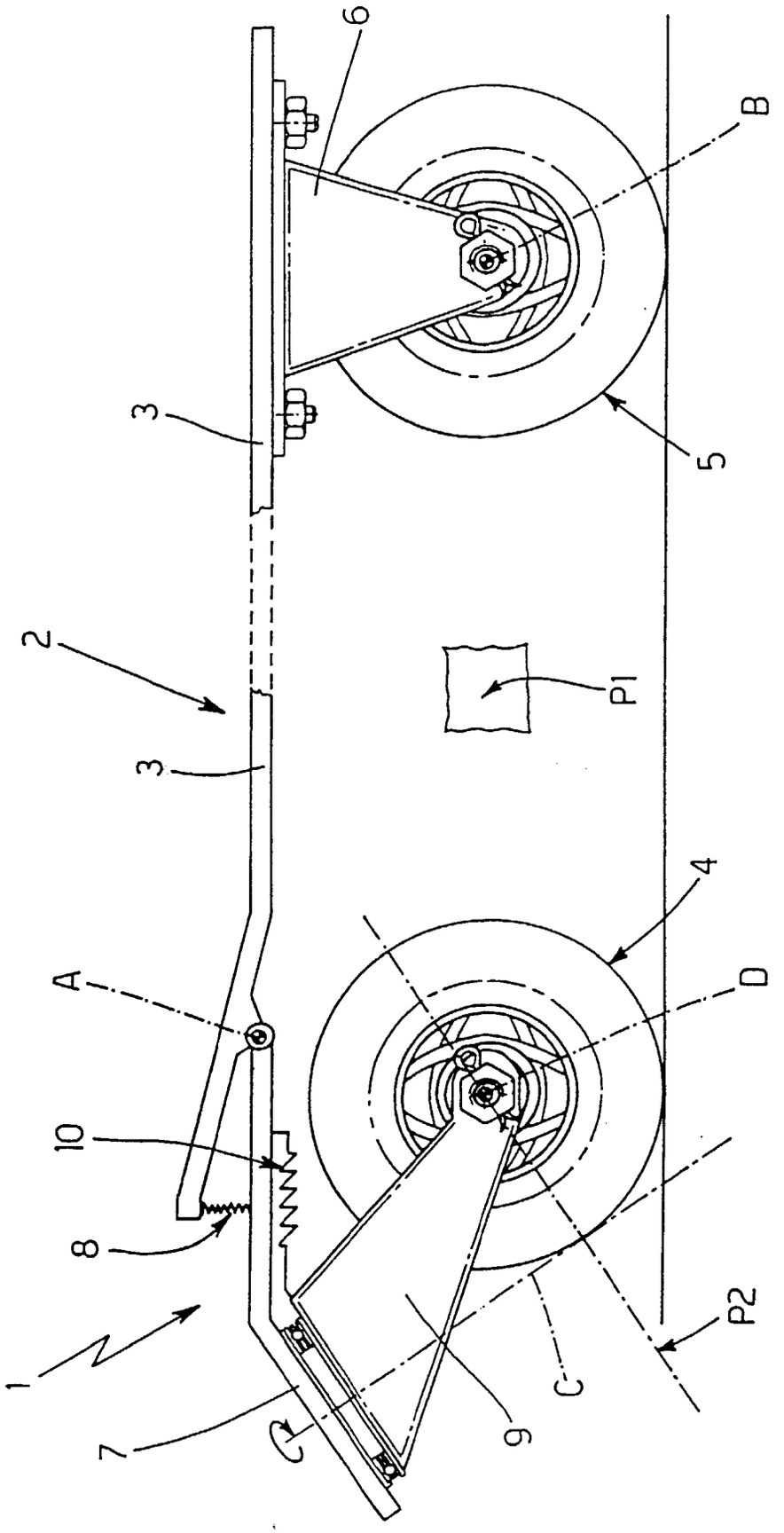

Fig.1

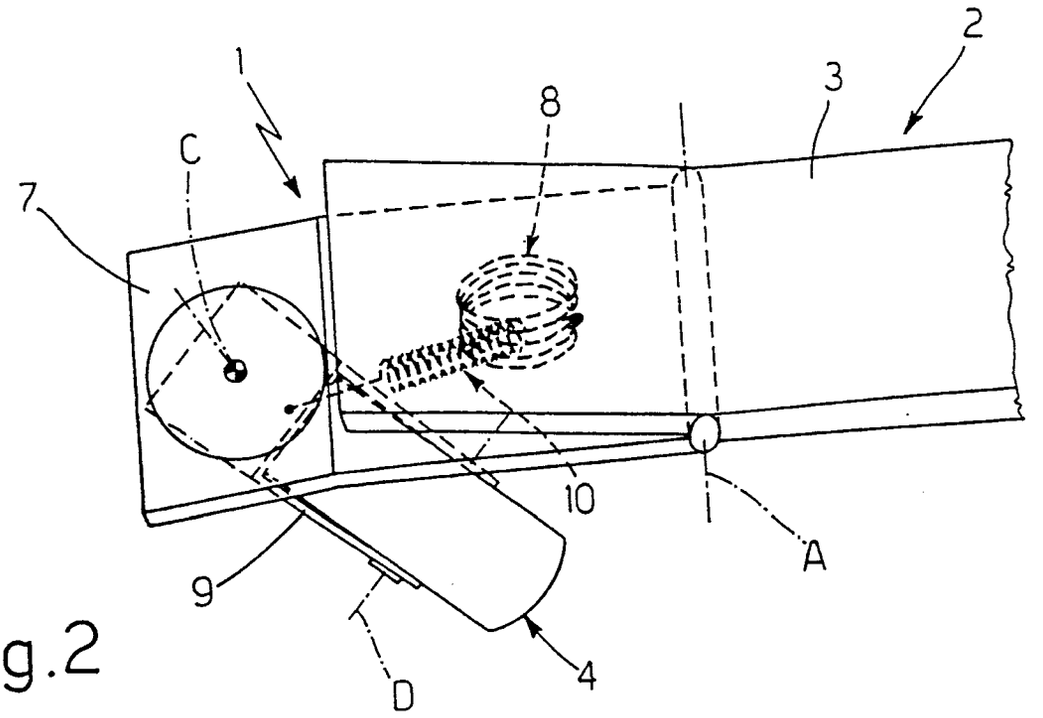

Fig.2

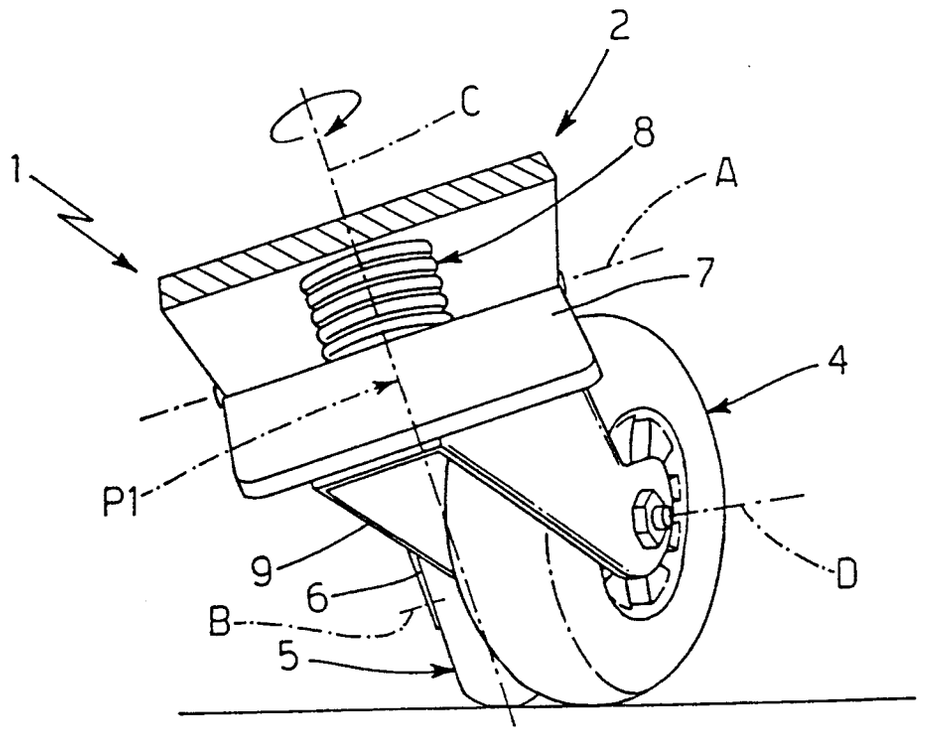

Fig.3

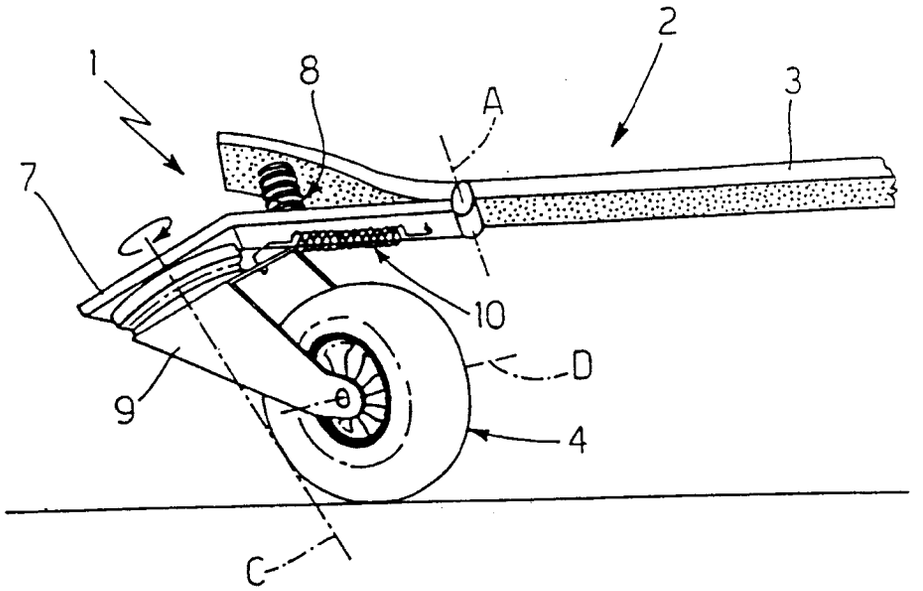

Fig.4

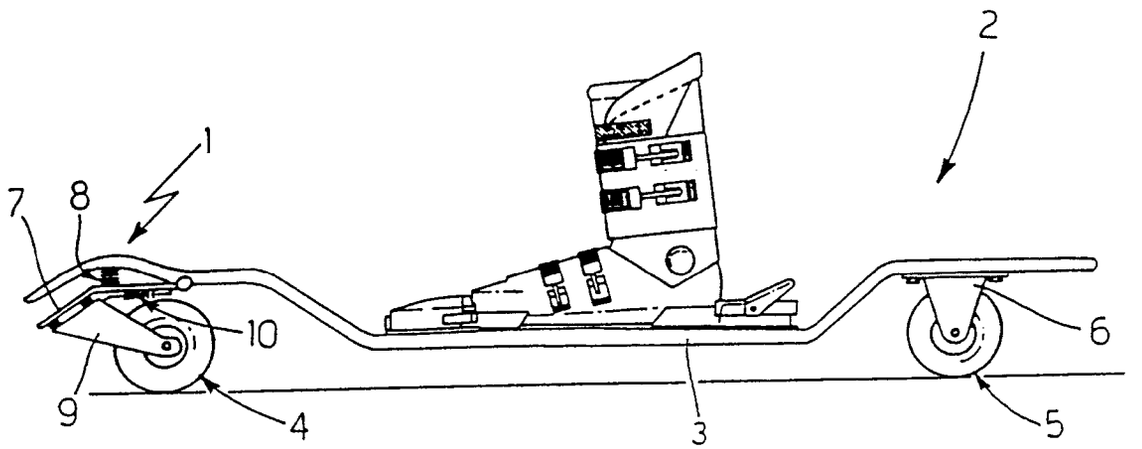

Fig.5