SPORT AND TRANSPORT DEVICE

Inventor: Roland Bertiller, Schramberg (DE)

Correspondence Address:
NATH & ASSOCIATES
112 South West Street
Alexandria, VA 22314 (US)

Assignee: GTI, Waukesha, WI (US)

Appl. No.: 10/333,508

PCT Filed: Jul. 18, 2001

PCT No.: PCT/EP01/08255

§ 371(c)(1), (2), (4) Date: Mar. 8, 2007

Publication Classification

Int. Cl.
A63C 17/00 (2006.01)

U.S. Cl. 280/87.042; 74/469; 74/500.5;
74/502.2; 74/640

ABSTRACT

The invention relates to a sport and transport device comprising at least one top panel (2), at least two wheels, and at least one drive device (2.4, 3). The top panel (2) is connected to a frame (1) in such a way that it can pivot about at least one pivot axis and the frame is connected to the wheels. The device (2, 3) is actuated by the movement of the top panel (2) about the pivot axis in order to drive at least one of the wheels (6). The invention is characterized in that the actuating means (5, 11) are disposed on the top side of the top panel (2), enabling devices provided on the frame (1) or the wheels (6) to be actuated in each position of the top panel (2). The device also comprises a specially designed suspension system between the front axle (10) and the frame (1).
SPORT AND TRANSPORT DEVICE

[0001] The invention relates to a sport and transport device.

[0002] A plurality of devices are known in the area of sport and transport devices. Skateboards and snowboards, for example, are both used depending on the type of terrain. These devices have the disadvantage that they can be propelled, accelerated, or braked only by the slope of the surface on which they are used, or by the physical exertion of the user—for example, by removing a foot from the device and pressing down on the surface.

[0003] German Patent 196 25 948 A1 describes a sport and transport device with a stand-on board, at least three road wheels, and a steering apparatus in which shifting the body weight from one leg to the other causes a motion that sets at least one wheel in motion through an appropriate kinematic drive unit, thus effecting motion.

[0004] Similar sport and transport devices with a stand-on board are known from German Patent 88 08 3 66 U1, German Patent 692 00 850 T2, and from WO 92/06753 A1. These devices also have an actuating apparatus above the top panel for a foot of the person riding on the device. A common feature of these known actuating devices is the fact that the person riding the device must move his foot in a vertical direction relative to the top panel or the stand-on panel.

[0005] The goal of the invention is to create a sport and transport device that may be ridden safely, is easy to steer, yet is of simple design.

[0006] This goal is achieved by a sport and transport device with the features of claim 1.

[0007] Modifications of the invention are the subject of the subclaims.

[0008] By providing actuating means on the top side of the top panel according to the invention, the invention allows the rider or user of the device to operate this top panel when underway without removing his feet from the top panel.

[0009] Due to the drive function of the top panel, i.e., the pivoting of the top panel about the pivot axis, the top panel occupies ever-changing positions. In order to permit operation of the apparatus, which may be provided on the frame or on the wheels, during the entire course of travel, i.e., independently of the current position of the top panel, the actuating means and corresponding apparatus are preferably connected by Bowden cables.

[0010] In an embodiment of the sport and transport device according to the invention, the apparatus and associated actuating means form a gearshift system. Using the gearshift system, different gear speeds may be generated in one gear system by which at least one of the wheels is driven. The gear system is preferably attached to the frame. Use of the gearshift enables the rider to adjust the handling characteristics of the device to the driving surface conditions, specifically to the grade.

[0011] The gearshift system may comprise a derailleur, a toothed-belt gearshift, or a slide-type gearshift. In this last case, the gear system may comprise a shift cage. Depending on the type of transmission between the gear system and the wheel driven by it, i.e., the chain or toothed belt, at least two speeds may be actuated by an appropriate gearshift system.

[0012] In another embodiment, the apparatus and associated actuating means may be a braking system. In this embodiment, the advantages of the inventive design of the sport and transport device are particularly apparent, since in order to ensure the safety of the rider and other riders, the rider must be able to operate the brake at any time and in any position of the top panel, and this brake must engage reliably. The brake system may be designed in various ways. Preferably, it has the following principal components:

[0013] one brake plate
[0014] one rotary bushing
[0015] two brake nipples
[0016] two Bowden cables
[0017] two thrust bearings
[0018] one sleeve

[0019] The design concept also encompasses equipping the sport and transport device with an electric motor that drives at least one wheel. This motor may be integrated into the gear system. The motor may be employed, as desired, to transmit power directly to the drive wheel or provide a power boost to the motion generated by the pivot motion of the top panel. Electric power may be supplied by a battery that may be accommodated in the frame of the device.

[0020] Controlling the direction of the sport and transport device according to the invention is effected by the rider’s shifting his weight in a lateral direction. To this end, the frame preferably includes a steerable front axle. This axle may be flanged onto a main support tube of the frame and is preferably designed as a spring element so as to enhance riding comfort.

[0021] The wheels of the sport and transport device are preferably connected detachably to the frame. This detachable connection feature provides the sport and transport device according to the invention with a high degree of flexibility in terms of the area of utilization. The device may thus easily be converted to a winter sports device. To make this change, the wheels must simply be removed and replaced by runners or by wheels with spikes.

[0022] A modification of the sport and transport device has an elastomer suspension apparatus that elastically couples the wheel axle to the frame of the device. The suspension here is selected so that the turn-in of the axle, i.e., the steering angle, is directly determined by a connection angle located between the front axle and the tubular joint axis.

[0023] The following discussion describes the invention based on the attached figures which show embodiments of the subject of the invention.

[0024] FIG. 1 is a side view of an embodiment of the sport and transport device according to the invention;
[0025] FIG. 2 is a perspective top view of an embodiment of the sport and transport device according to the invention;
[0026] FIG. 3 is a perspective bottom view of an embodiment of the sport and transport device according to the invention;
A tubular frame 1 serves as the base that includes a main support tube 1.3 and forms a fork 1.1, 1.2 in the rear section. Tubular frame 1 is bent, at least in the area of main support tube 1.3. A steerable front axle 10 is slanted on at the front end of main support frame 1.3, i.e., at the end opposite fork 1.1, 1.2. The principle of the front axle 10 corresponds to that of the front axles of known skateboards. Due to the fact that only one steerable axle is present, however, the steering angle has been doubled. The geometry of axle 10 was designed to achieve a corresponding suspension effect even over rough terrain. In addition, the wheels of front axle 10 have been mounted with a camber to enhance the handling stability. The camber may, for example, be 5°.

The embodiment of the sport and transport device shown has three wheels, with only one wheel acting as the drive wheel 6. This wheel is mounted at the other end of main support tube 1.3 in fork 1.1, 1.2. That section of the drive apparatus which is a drive gear system 3 is also mounted in fork 1.1, 1.2. Drive wheel 6 is mounted and braced in fork 1.1, 1.2.

As described above, fork 1.1, 1.2 functions as the receiving apparatus for the positive-engagement support of gear system 3, and also as the support for drive wheel 6. This embodiment has the advantage that gear system 3 is supported by positive engagement, and thus does not require any additional attaching elements. In addition, the simultaneous use of fork 1.1, 1.2 as the support for drive wheel 6 represents a simplification in design. Wheel 6 and gear system 3 by which wheel 6 is driven are attached by the same component 1.1, 1.2 in this design—with the result that no relative displacement may occur between wheel 6 and gear system 3 that might cause failures such as breakage of the chain.

Drive wheel 6 is preferably driven by a chain or toothed belt 7 through drive gear system 3.

Top panel 2, which may have the shape of a skateboard for example, is pivotably connected to tubular frame 1. This connection may, for example, be of the design shown in FIGS. 1 through 5. Here a joint plate 2.1 is attached to the bottom side of top panel 2. Top panel 2 is pivotably attached at joint bushing 1.4 to main support tube 1.3 by joint plate 2.1. Tubular frame 1 preferably has a bent shape so as not to inhibit top panel 2 from pivoting about this axis.

In addition, top panel 2 may have a shape in which a kink 2.2 is provided in the area of the pivot axis and, as a result, top panel 2 extends from this kink 2.2 upward to the respective ends of panel 2. In addition to this V-shaped design, the top panel may, for example, also have two kinks (not shown) between which an initially horizontal surface extends, with the panel extending upward at a slight angle to the horizontal surface from the kinks to the ends. The shape of top panel 2 is selected based on ergonomic requirements such as stability under load, steerability, braking and shifting of the device, as well as the input of power. Kinking top panel 2 enhances its stiffness and provides the necessary means for the input of power. The panel is preferably designed with concave sides, which design enhances the stiffness of the board and saves weight.
[0053] A means 2.4 is attached on the underside of top panel 2 in the area, in the installed condition, above gear system 3; this means forming a drive apparatus along with gear system 3. In the embodiment shown, this means is a rack 2.4. As a result of the seesawing motions of top panel 2, rack 2.4 alternately descends into and emerges from drive gear system 3, thereby driving gear system 3. Gear system 3 will be explained more precisely below referring to FIGS. 9 through 17. However, this system is preferably designed such that output wheel 6 is caused to rotate permanently, i.e., in a forward direction, as the rack moves up and down.

[0054] FIG. 8 shows an embodiment of the sport and transport device according to the invention in which the front wheels are replaced by runners and drive wheel 6 is provided with spikes. The remainder of the device design corresponds to that shown in FIGS. 1 through 5 and described above.

[0055] Gear system 3 is mounted by positive engagement between forks 1.1 and 1.2. Retention is provided by a gear system housing which preferably has two gear system shells 3.1, 3.2. Projections may be provided on gear system housing 3.1, 3.2 which match the shape of the fork 1.1, 1.2. In addition, gear system 3 has a drive shaft and counter-rotating shaft. The drive shaft and counter-rotating shaft are mounted in gear system shells 3.1 and 3.2 on pivots 3.5 and 3.6. The drive shaft is mounted in housing sections 3.1 and 3.2 by bearings 3.18.

[0056] The function of gear system 3 engaged by rack 2.4 engages will be described in more detail with reference to FIGS. 9 through 11. As FIG. 9 shows, rack 2.4 runs by positive engagement between two pinions 3.7, 3.8 which are interconnected by a toothed belt 3.11, thereby driving these forward and backward. As is evident from FIG. 10, pinions 3.7 and 3.8 are each supported on pivots 3.5 and 3.6. Two synchronizer rotors 3.9 and 3.10 are also located opposite on the two pivots 3.5 and 3.6, and are interconnected by toothed belt 3.11. Synchronizer rotor 3.10 and pinion 3.8 are rigidly interconnected on the counter-rotating shaft and supported on pivots 3.6 by needle bearings. The output rotor 3.14 is connected by friction with the bearing sleeve so as to transmit the driving power. Synchronizer rotor 3.9 and pinion 3.7 are supported on bearing sleeve 3.15 by freewheels 3.16 and 3.17.

[0057] A toothed belt 7 or chain 7 runs via output rotor 3.14 to drive wheel 6 on a synchronizer rotor 6.2 or a sprocket 6.2 (see FIGS. 2, 3, and 5), thereby transmitting and converting the up and down motion imparted by rack 2.4 to gear system 3, into a rotational motion of drive wheel 6.

[0058] Wheel 6 is supported by roller bearings on rear axle 6.3. The drive axle is force-fitted into the wheel body, with a synchronizer rotor or sprocket 6.2 with a freewheel being supported on said axle, thereby receiving the transmission of power. Propulsion is effected by toothed belt 7 or chain 7 via the drive shaft of the gear system.

[0059] In the embodiment shown, the drive wheel is the rear wheel of the device. By modifying the freewheel arrangement, however, the drive direction may also be reversed so that the drive wheel is not in front and the steered axle in back. The drive function through the top panel remains unchanged here.

[0060] In a preferred embodiment, the sport and transport device may have a gearshift. A gear system with gearshift is shown in FIGS. 12 through 14.

[0061] FIG. 12 illustrates one option for a shift function, namely a derailleur. Synchronizer rotor 3.14 is replaced by chain wheels 4 and 5. Toothed belt 3.11 is replaced by a chain 7. Chain 7 drives drive wheel 6 through chain wheels 4 and 5 via a sprocket 6.2. Different transmission ratios are possible based on the different diameters of the chain wheels 4 and 5 on which chain 7 is shifted by a shift unit.

[0062] The aforementioned shift unit comprises a tumbler 8 (see FIG. 6) which is displacably mounted on fork 1.1 and 1.2. Tumbler 8 is actuated by a two-arm shift lever 9 which is rotatably mounted in top panel 2 about rotational axis 13. Tumbler 8 is actuated by two shift nipples 11 through a Bowden cable. Shift nipples 11 are preferably of a pin-type design and are attached to the top side of shift lever 9.

[0063] Tumbler 8, the Bowden cable, and shift nipples 11 are interconnected by friction. Shift nipples 11 of shift lever 9 project upward through curved grooves 12 from top panel 2. Actuating shift nipples 11 with the front foot (heel or toes) on which the rider is standing, i.e., by moving nipples 11 within grooves 12, rotates the shift lever, thereby shifting the corresponding drive transmission ratio. Shift lever 9 itself is designed as a spring element acting against the shift direction. This means that the user may step on shift nipples 11 without wanting to shift. These are pressed down without causing any shift action. Shift lever 9 is attached at its end position by a bead.

[0064] As a result, the gearshift may be actuated by the foot at any time, or in any position occupied by top panel 2. No riding operation, propulsion operation, or steering operation need be interrupted or changed.

[0065] FIGS. 13, 13a and 14, 14a show another possible type of two-stage gearshift. The rack here consists of two different tooth segments arranged in tandem and spaced. The segments have different widths and may be interconnected by a cross brace to enhance stability. The rack is attached to top panel 2 as in the embodiment described previously. FIG. 13 shows a first shift position. A shift cage 14, in which four pinions are integrated—of which two each have a smaller diameter 16 and two each have a larger diameter 17, is displaceable on the drive and gear system axle. Shifting, or displacement of the shift cage, occurs in precisely the same way as with the derailleur. In other words, when shift cage 14 is in the position shifted to the rear shown in FIGS. 13 and 13a, the smaller rack segment, the width of which matches the distance between the two larger pinions 15, engages the two larger pinions 15 mounted on opposite pivots. If shift cage 14 is moved by the Bowden cable in the direction of the arrow, the resulting position is that shown in FIGS. 14, 14a in which the larger rack segment, the width of which matches the distance between the two smaller pinions 16, engages the two smaller pinions 16, while the smaller rack segment no longer engages larger pinions 15.

[0066] FIGS. 15 through 17 show an embodiment in which an electric motor is integrated into the gear system. Through a speed-reduction gear system, the electric motor along with the motor pinion engages the counter-rotating shaft via an intermediate gear, thus driving this shaft. Just as with the manual drive, power is transmitted to the drive shaft.
by toothed belts through the toothed rotor of the counter-rotating shaft, and thereby transmitted to drive wheel 6.

[0067] Since it must be possible when riding to apply the brake at any time, and since top panel 2 occupies ever-changing positions due to its drive function, no rigid type of brake unit can be selected. For this reason, a brake system was developed which duplicates all the motions of top panel 2.

[0068] Specific features of the brake system are found in FIGS. 7 and 2. The brake system is integrated into top panel 2. It has a symmetrical design so that the device may be operated at different riding positions (left foot back or right foot back) without any additional components.

[0069] The brake system consists of the following principal components:

- brake plate (5.1)
- rotary bushing (5.2)
- brake nipple (5.3)
- Bowden cable (5.5)
- thrust bearing (5.6)
- sleeve (5.7)

[0070] Two holes 2.4 to accept rotary bushings 5.2 are incorporated symmetrically into top panel 2. Sleeve 5.7 is installed in one of these two holes as a pivot bearing for brake plate 5.1. The other side is free. Brake plate 5.1 is installed along with both rotary bushings 5.2 in top panel 2 from above and secured from below. Brake plate 5.1 rests flat on top panel 2. Due to the one free hole, brake plate 5.1 may be either rotated or displaced as a function of the freedom of movement. Brake nipple 5.3 is frictionally installed in brake plate 5.1, into which brake plate Bowden cable 5.5 is inserted. This cable is supported by thrust bearing 5.6 attached to top panel 2 and routed to the brake 4.1 on the brake wheel. Drive wheel 6 is preferably equipped with a drum brake which is controlled by the brake system. The wheel brake function may also be achieved by various rim-based and tire-based brake systems. The user stands on the brake plate, which is equipped with support ribs 5.4 for the foot arrangement, and is able to rotate brake plate 5.1 with brake nipple 5.3 by rotating his foot. This initiates the braking action and achieves the braking effect in accordance with the amount of torsional force.

[0071] Although the above discussion speaks in terms of rotating brake plate 5.1, brake plate 5.1 may also be simply laterally displaceable. In this case, brake plate 5.1 is moved by the rider’s foot in the appropriate direction to achieve the braking effect.

[0072] FIGS. 18 through 24 show a second embodiment of a sport and transport device according to the invention with a top panel 2. In contrast to the embodiment shown in FIGS. 1 through 17, the mechanical linkage between frame 1 and front axle 10 is achieved in this device in a special way by means of a suspension system using elastomers.

[0073] FIG. 18 is a perspective view seen obliquely from below, with the device facing the viewer from its front axle 10. The reference numerals explained above continue to apply to the same components. The center segment of frame 1 is connected through a suspension system 100 to front axle 10, on the left and right ends of which are attached road wheels 6. The center segment of Y-shaped frame 1 is rigidly connected to a tubular joint 104. At its front end facing front axle 10, this tubular joint 104 has a square hole in which a suspension apparatus using elastomers rests, this apparatus being explained more fully below. The front segment of tubular joint 104 is designed with a downward bend of angle \( \alpha \) relative to the road surface. A connection component 102 is attached to front axle 10. This connection component 102 rests flat on the top free surface of the front section of tubular joint 104. Front axle 10 is movably connected to frame 1 by this connection component 102 through suspension system 120 and tubular joint 104.

[0080] The mechanical coupling of frame 1 and front axle 10 by suspension system 120 is especially evident in the cross-sectional diagrams of FIG. 20 and FIG. 24.

[0081] A bolt 122 sits stationary in a hole of connection component 102. The stationary connection may, for example, be achieved simply by a screwed connection indicated by reference numeral 142. This bolt 122 is attached in connection component 102 such that this component extends rearward at an oblique angle as seen from the direction of travel. Bolt 122 sits rotatably movable in a slide bushing 140 of tubular joint 104. Bolt 122 has a square cross section. A square tube 136 sits on this square cross section of bolt 122. An outer square tube 130 is located with a certain clearance around inner square tube 136. The square tube 136 simultaneously contacts the outer wall of suspension system 120. Elastomer strips 138 sit offset at 90° angles between outer square tube 130 and inner square tube 136. Suspension system 120 is closed by a cover plate 142 and retained by nuts 144 which are screwed onto the end of bolt 122 pointing away from connection component 102.

[0082] The functional principle of the suspension system is as follows.

[0083] Tilting the Y-tube of frame 1 via top panel 2 causes tubular joint 104 and front axle 10 to rotate toward each other. At the same time, bolt 122 also rotates with its square component, which is rigidly connected to front axle 10, thereby also rotatably carrying along inner square tube 136. Since outer square tube 130 is mounted in the square hole of tubular joint 104 and thus cannot rotate, front axle 10 is oriented in the resting state at right angles to the center tube of frame 1, namely, \( \beta \) equals 90°.

[0084] When the sport and transport device is tilted to the left or right via top panel 2 by shifting weight, suspension system 102 experiences a load by which front axle 10 is adjustable for a defined steering. The possible steering angle \( \beta \) is a direct function of connection angle \( \alpha \) between tubular joint 104 and front axle 10 of the device. The larger angle \( \alpha \), the smaller is steering angle \( \beta \), and visa versa. The angle \( \alpha \) may be adjusted here for the specific design of the device, depending on the area of utilization for the device, whether on outdoor terrain, on smooth ground, for competition, or other areas of utilization.

[0085] It must be mentioned in this regard that the described articulated axle system with suspension system 100 using elastomers, while extremely advantageous, does not necessarily have to be employed. Other suspension systems are also possible for coupling frame 1 to front axle 10.
Suspension system 120 may be advantageously designed to be interchangeable. In this way, suspension systems 120 having different elasticities may be employed, namely, an operator may at any time exchange the suspension system 120 in order to adjust the handling and steering characteristics of the device to his specific wishes or his physical requirements, such as body weight and riding skill. The aforementioned elastomers 138 are inserted prestressed between square tube 136 and outer square tube 130.

1. Sport and transport device which has at least one top panel (2), at least two wheels (6), and at least one actuating means (5.1) located above the top panel (2) for one foot of a person operating the device; characterized in that the actuating means (5.1) is designed as an actuating plate supported on the top panel (2), which actuating plate has a device for a foot arrangement and which is displaceable in a horizontal direction relative to the surface of the top panel (2).

2. Sport and transport device according to claim 1, characterized in that the actuating means (5.1, 11) and the respective apparatus are connected by Bowden cables.

3. Sport and transport device according to claim 1, characterized in that the apparatus and associated actuating means are a gearshift system.

4. Sport and transport device according to claim 3, characterized in that the gearshift system comprises a derailleur.

5. Sport and transport device according to claim 3, characterized in that the gearshift system comprises a toothed-belt gearshift.

6. Sport and transport device according to claim 3, characterized in that the gearshift system comprises a slide-type gearshift.

7. Sport and transport device according to claim 5, characterized in that the gearshift system has a shift cage 14.

8. Sport and transport device according to claim 1, characterized in that the apparatus and associated actuating means are a brake system.

9. Sport and transport device according to claim 1, characterized in that the device comprises an electric motor which drives at least one wheel (6).

10. Sport and transport device according to claim 1, characterized in that the frame (1) comprises a steerable front axle (10).

11. Sport and transport device according to claim 1, characterized in that the wheels are detachably connected to the frame (1).

12. Sport and transport device according to the preamble of claim 1, characterized in that a wheel axle (10) is coupled by a suspension system (120) to a frame (1) of the device, the suspension system (120) having elastomer elements (138) as spring elements which are gripped between square tubes (130, 136).

13. Sport and transport device which comprises at least one top panel (2), at least two wheels, and at least one drive apparatus (2.4, 3) wherein the top panel (2) is pivotably attached to a frame (1) which is connected to the wheels, and the drive apparatus (2.4, 3) is actuated by movement of the top panel (2) about the pivot axis in order to drive at least one of the wheels (6), characterized in that the drive apparatus (2.4, 3) has a rack (2.4) which is provided on opposite sides with teeth, the first teeth engaging a first gear (3.8) and the second teeth engaging another gear (3.8).