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(71) Applicant: **PIAGGIO & C. S.P.A.** [IT/IT]; VIALE RINALDO PIAGGIO, 25, I-56025 Pontedera (PI) (IT).

(72) Inventor: **SAVINO, Emanuele**; c/o PIAGGIO & C. S.P.A., VIALE RINALDO PIAGGIO, 25, I-56025 Pontedera (PI) (IT).

(74) Agent: **CARANGELO, Pierluigi** et al.; c/o Jacobacci & Partners S.p.A., via Tomacelli, 146, I-00186 Roma (IT).

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(54) Title: ROLLING THREE-WHEELS VEHICLE PROVIDED WITH AN ANTI-TILTING SYSTEM

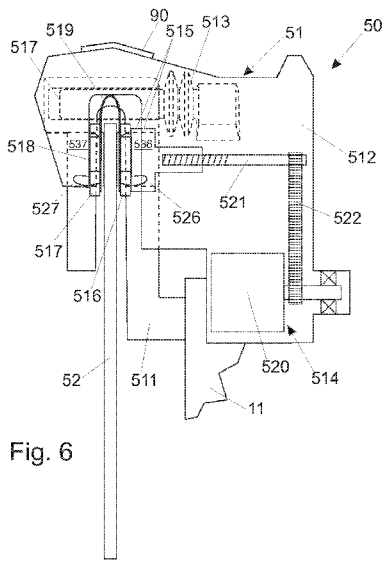

Fig. 6

(57) Abstract: A rolling three-wheels saddle riding type vehicle (100) comprising: - a frame (10) configured to tilt leftward and rightward; - two front steerable wheels (21, 22); - one rear driving wheel (23) arranged between the left and right front wheels (21, 22) when the vehicle (100) is seen in a front-rear direction (F-R), and located behind the left and right front wheels (21, 22) according to said front-rear direction (F-R) of the vehicle (100); - a propulsion motor (30) configured to drive the rear driving wheel (23); - a rolling mechanism (40) rotatably supported by a front portion (11) of the frame (10) and configured to connect the left and right front wheels (21, 22) to each other so as to allow them to tilt together with the frame (10) and steer with respect to the frame (10), said rolling mechanism (40) comprising: at least one upper crossbar (41) rotatably supported by the front portion (11) of the frame (10); at least one lower crossbar (42) rotatably supported by the front portion (11) of the frame (10); a left upright element (43) rotatably connecting respective left ends of the upper and lower crossbars (41, 42); a right upright element (44) rotatably connecting respective right ends of the upper and lower crossbars (41, 42); wherein said left and right front wheels (21, 22) are rotatably supported by the left and right upright elements (43, 44), respectively, so as to steer about respective left and right steering axes (S', S"); - an anti-tilting system (50) comprising: a stopping device (51) rigidly supported by the front portion (11) of the frame (10); a movable element (52), preferably arc-shaped, rigidly supported by one of: an upper crossbar (41), a lower crossbar (42), a left upright element (43), and a right upright element (44); wherein said stopping device (51) is configured to selectively clamp the movable element (52) so as to lock the rolling movement of said rolling mechanism (40) with respect to the frame (10); said stopping device (51) comprising: a fixed portion (511) rigidly supported by the front portion (11) of the frame (10); a movable portion

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(512) slidably connected to the fixed portion (511) so as to move frontward and rearward with respect to the fixed portion (511); an electric actuator (514) supported by the movable portion (512) and configured to move a piston (515) frontward and rearward with respect to the movable portion (512); frictional pads (516, 517) slidably supported by the fixed portion (511) so that a first frictional pad (516) can be pushed by said piston (515) and a second frictional pad (517) can abut against a region (518) of the movable portion (512), and so that the movable element (52) is arranged between said first and second frictional pads (516, 517); a pad spring (519) arranged between the first and second frictional pads (516, 517) and configured to move the frictional pads (516, 517) away from each other; wherein the movable element (52) is clamped by said first and second frictional pads (516, 517) when the electric actuator (514) moves the piston (515) to push the first frictional pad (516) against a first side of the movable element (52) and the movable portion (512) moves away from the fixed portion (511), dragging the second frictional pad (517) against a second side of the movable element (52).

TITLE

ROLLING THREE-WHEELS VEHICLE PROVIDED WITH AN ANTI-TILTING SYSTEM

DESCRIPTION

TECHNOLOGICAL FIELD

[001] The present invention relates to the field of rideable-saddle rolling vehicles. In particular, three-wheels vehicles provided with two rolling and steerable front wheels. Specifically, the present invention relates to a vehicle provided with a controllable anti-tilting system.

BACKGROUND ART

[002] The prior art comprises different rolling three-wheels vehicles provided with anti-tilting systems. One of the most known examples is described in the Applicant's Patent EP1561612B1. Document WO2020128946A1 also describes a rolling three-wheels vehicle provided with an anti-tilting system with a stopping device comprising a fixed portion fastened to the frame and a movable portion, the movement of which allows locking the tilting. The anti-tilting system of this patent provides for the use of an electric actuator and a mechanical caliper connected to the frame, which are operatively connected to each other by means of a hydraulic system or mechanical cable. Upon an activation of the actuator, the caliper tightens a half-disc connected to an element of a roll quadrilateral configured to allow the front wheels to tilt. The anti-tilting system thus devised allows the driver to keep the vehicle straight without the need to place their feet on the ground. The three-wheels vehicle is indeed stable if the tilting of the front wheels thereof is prevented. This anti-tilting system has now become known and appreciated by the market due to the employment thereof for the first time on the Piaggio MP3 vehicle. Drivers of rolling three-wheels vehicles appreciate the possibility of parking the vehicle without the need to use the stand, or stopping at a stoplight without the need to vertically support the vehicle.

[003] There is also known in the prior art a similar anti-tilting device described in Patent EP3578449B1, which trivially places the actuator directly on the body of the mechanical caliper and connects them operatively by means of linkages. Inside the device there is a piston driven by the actuator by means of the linkages, which pushes frictional pads against a plate connected to the roll quadrilateral to lock the tilting.

[004] In both these known solutions, the tilting is unlocked when the caliper opens and the half-disc or plate becomes free again to move with respect thereto. In order to allow this, the anti-tilting

device of patent EP3578449B1 includes attaching the frictional pads to supports which in turn are attached to the caliper body and the movable piston of the caliper, respectively. Thereby, when the piston moves away from the plate, the frictional pads also move away from the plate, thus ensuring a sure unlocking of the tilting. In the MP3 vehicle, a sensor instead detects if the actuator has actually unclamped the caliper, and therefore the tilting. The solution known from document JP2014190347 describes a brake caliper provided with elastic return elements of the movable portion of the caliper.

[005] A failed unclamping of the tilting system is indeed a potentially deadly problem for the driver of the vehicle. It is indeed known that rolling vehicles utilize the tilting of the vehicle to balance the centrifugal force and prevent the vehicle from overturning when cornering. Should the anti-tilting system of the rolling vehicle remain clamped, the vehicle would tip over at the first curve, with serious consequences for the driver.

[006] In this respect, it is very important for the manufacturers of rolling three-wheels vehicles to be certain that the anti-tilting system is actually unclamped when the vehicle is moving at a given speed.

SUMMARY

[007] It is a first object of the present invention to solve the aforesaid drawbacks of the prior art by means of a rolling three-wheels saddle riding type vehicle comprising: a frame configured to tilt leftward and rightward; two front steerable wheels; a rear driving wheel; a propulsion motor configured to drive the rear driving wheel; a rolling mechanism rotatably supported by a front portion of the frame and configured to connect the left and right front wheels to each other so as to allow them to tilt together with the frame and steer with respect to the frame. The rear wheel is arranged between the left and right front wheels when the vehicle is seen in a front-rear direction, and is arranged behind the left and right front wheels according to said front-rear direction of the vehicle. Said rolling mechanism comprises: at least one upper crossbar rotatably supported by the front portion of the frame; at least one lower crossbar rotatably supported by the front portion of the frame; a left upright element rotatably connecting respective left ends of the upper and lower crossbars; a right upright element rotatably connecting respective right ends of the upper and lower crossbars. Said left and right front wheels are rotatably supported by left and right upright elements, respectively, so as to steer about respective left and right steering axes. The vehicle further comprises an anti-tilting system comprising: a stopping device rigidly supported by the front portion

of the frame; a movable element, preferably arc-shaped, rigidly supported by one of: an upper crossbar, a lower crossbar, a left upright element, and a right upright element. Said stopping device is configured to selectively clamp the movable element so as to lock the rolling movement of said rolling mechanism with respect to the frame. Said stopping device comprises: a fixed portion rigidly supported by the front portion of the frame; a movable portion slidably connected to the fixed portion so as to move frontward and rearward with respect to the fixed portion; elastic means arranged between the fixed and movable portions configured to approach the movable portion to the fixed portion; an electric actuator supported by the movable portion and configured to move a piston frontward and rearward with respect to the movable portion; frictional pads slidably supported by the fixed portion so that a first frictional pad can be pushed by said piston and a second frictional pad can abut against a region of the movable portion, and so that the movable element is arranged between said first and second frictional pads; a pad spring arranged between the first and second frictional pads and configured to move the frictional pads away from each other. The movable element is clamped by said first and second frictional pads when the electric actuator moves the piston to push the first frictional pad against a first side of the movable element and the movable portion moves away from the fixed portion dragging the second frictional pad against a second side of the movable element. The vehicle thus devised ensures that when the stopping device is brought to the unclamped position, the frictional pads release the movable portion, ensuring the unlocking of the anti-tilting system.

[008] Advantageously, said stopping device can comprise elastic means arranged between the fixed and movable portions configured to approach the movable portion toward the fixed portion.

[009] The electric actuator can comprise: an electric motor; a worm screw which drives the piston; a transmission which connects the electric motor to the worm screw. Preferably, the transmission can be a belt transmission. This type of actuator is very compact and thus able to be arranged on the movable portion of the stopping device.

[0010] In particular, each frictional pad can comprise tabs for facilitating the sliding thereof in grooves of the fixed portion. These tabs, preferably metal tabs, reduce the friction when the frictional pad slide in the grooves of the fixed portion.

[0011] Advantageously, the pad spring can incorporate the tabs. A single element can thus ensure that the frictional pads move away from each other and slide with respect to the fixed portion of the stopping device.

[0012] The vehicle can also comprise a control unit and a command configured to provide a lock/unlock signal to the control unit. The control unit is configured to control the stopping device so as to clamp/unclamp the movable element, respectively, by means of the stopping device. The control unit allows a programmable or command-operated manual management of the stopping device.

[0013] Advantageously, the vehicle can comprise an acoustic and/or optic warning configured to inform the driver if the movable element is clamped or unclamped by the stopping device. This warning allows the driver to be informed of the condition in which the stopping device is found.

[0014] In particular, the stopping device can comprise an instrument configured to detect if the stopping device is clamping the movable element. This instrument allows detecting any blockages of the stopping device and excluding false system unlock signals.

[0015] Preferably, the control unit can limit the propulsion motor if the instrument detects that the movable element is clamped despite the command having provided an unlock signal to the control unit. This functionality prevents the vehicle from restarting if a system malfunction prevents the stopping device from being unclamped.

[0016] Advantageously, the pad spring can comprise two side portions interconnected to each other by means of an interconnection portion. The side portions can be shaped as a fork with two tines. This shape of the spring is particularly useful for simplifying the positioning of the spring on the stopping device and ensuring the positioning even when the vehicle is in use.

[0017] In particular, the tines of each side portion can be spaced apart from each other by a greater distance than the width of the frictional elements of said frictional pads. This shape of the side portions allows preventing a lateral movement of the spring with respect to the frictional pads so as to further contribute to keeping the spring in position. Further, since the tines act on two opposite side ends of each frictional pad, the frictional pads are more stable and less subject to rotations during use. Finally, since the tines laterally engage the frictional elements, the shape thereof is not limited to the shape of the spring.

[0018] These and other advantages will become more apparent from the following description of an embodiment thereof, given by way of non-limiting indication, with reference to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

[0019] In the drawings:

Figure 1 shows a front view of the vehicle according to the present invention;

Figure 2 shows a diagrammatical front view of the anti-tilting system according to the present invention;

Figure 3 shows a side view of a portion of the vehicle according to the present invention;

Figure 4 shows an axonometric view of the vehicle according to the present invention;

Figure 5 shows a diagrammatical isometric view of the front of the vehicle according to the present invention;

Figure 6 shows a diagrammatical side view of the anti-tilting system according to the present invention, in a rolling locked position;

Figure 7 shows a diagrammatical isometric view of a spring for the frictional pads of the anti-tilting system of the present invention;

Figure 8 shows a diagrammatical isometric view of a spring and the related frictional pads of the anti-tilting system of the present invention;

Figure 9 shows a diagrammatical side view of the anti-tilting system according to the present invention, in a rolling unlocked position;

Figure 10 shows an isometric view of a further embodiment of the spring for the frictional pads of the anti-tilting system of the present invention.

DETAILED DESCRIPTION

[0020] The following description of one or more embodiments of the invention refers to the accompanying drawings. The same reference numerals in the drawings identify identical or similar elements. The object of the invention is defined by the appended claims. The technical details, structures, or features of the solutions described below can be mutually combined in any manner.

[0021] Figures 1, 3, 4, 5 show Cartesian axes adapted to illustrate the frontward-rearward direction, indicated by an arrow and letters “F” and “B”, the right-left direction, indicated by an arrow and letters “R” and “L”, and the up-down direction, indicated by an arrow and letters “T” and “D”.

[0022] With reference to Figures 1, 3, 4, 5, they show a three-wheels rideable saddle vehicle indicated in the drawings by reference numeral 100. Vehicle 100 comprises a saddle 87, diagrammatically shown in Figure 4.

[0023] Vehicle 100 has two front wheels, a right one 21 and a left one 22, and one rear wheel 23. The front wheels 21, 22 are steerable wheels, while the rear wheel 23 is driving and is driven by a

motor 30, which is diagrammatically shown in Figure 4. Vehicle 100 further comprises a handlebar 86 configured to control the steering of the front wheels 21, 22 by means of a steering bar 88.

[0024] In the example in Figures 1, 3, 4, 5, the front wheels 21, 22 are connected to the rolling mechanism 40 by means of respective wheel supports 83, 84. The front wheels 21, 22, together with the wheel supports 83, 84, rotate about respective steering axes S', S'' to allow steering the vehicle 100. A steering bar 88 is hinged so as to allow for both a rolling movement and a steering movement of both the steering tube 82 and the wheel supports 83, 84. The steering tube 82 is in turn rigidly constrained to the handlebar 86. The wheel supports 83, 84 are hinged to the upright elements 44, 43 of the rolling mechanism 40. By rotating the handlebar 86, the steering tube 82 rotates, which moves the steering bar 88 transmitting the motion of handlebar 86 to the wheel supports 83, 84, and therefore to the front wheels 21, 22.

[0025] The steering system shown in the drawings is only indicative and other variants are possible and however fall within the scope of protection of the present invention.

[0026] The rolling mechanism 40 comprises an articulated quadrilateral consisting of an upper crossbar 41, a lower crossbar 42, a left upright element 43, and a right upright element 44. The articulated quadrilateral thus devised is hinged to the front portion 11 of frame 10 by means of hinges connecting the front portion 11 to the crossbars 41, 42. Alternatively, the rolling mechanism 40 can comprise two articulated quadrilaterals (not shown), one for the right wheel 21 and one for the left wheel 22. Likewise, the front wheels 21, 22 can be connected to the upright elements 43, 44 in a different manner from that shown in the drawings; for example, they can lie to the side of the upright elements and not below them (solution not shown).

[0027] By deforming, the rolling mechanism 40 allows the front wheels 21, 22 to tilt in a known manner. The crossbars 41, 42 are hinged at the ends thereof, by means of rolling hinges, to respective ends of the upright elements 43, 44 so as to obtain said articulated quadrilateral.

[0028] Vehicle 100 further comprises a suspension system which allows for the vertical travel range of the front wheels 21, 22 and the rear wheel 23 to mitigate the ground roughness.

[0029] Vehicle 100 further comprises a motor 30, which can be an electric internal combustion or hybrid motor, which transmits the motion to the rear wheel 23 by means of a transmission 85, as shown diagrammatically in Figure 4.

[0030] There are two front wheels 21, 22 and one rear wheel 23 in the vehicle 100 of the present invention. Alternatively, the vehicle can comprise two rear wheels (not shown).

[0031] Vehicle 100 is a rolling vehicle, i.e., capable of tilting sideways like a two-wheel motorcycle.

[0032] Advantageously, a three-wheels vehicle has three resting points on the ground. This makes the vehicle potentially stable. In reality, a rolling vehicle like the one of the present invention would be unstable like a two-wheel motorcycle, and therefore tend to tip over sideways, if it were upheld up by the driver or middle stand.

[0033] To avoid tipping, vehicle 100 is provided with an anti-tilting system 50 adapted to lock the rolling of vehicle 100. The anti-tilting system 50 comprises a component integral with an element of the rolling mechanism 40 and a component integral with the frame 10 of vehicle 100. Specifically, the anti-tilting system 50 comprises a stopping device 51, e.g., a caliper, and a movable element 52, e.g., a disc sector, as shown in Figures 1, 3, 4, 5.

[0034] By clamping the anti-tilting system 50, vehicle 100 is stable and, excluding the rolling due to the vehicle suspensions, does not tip over when system 50 begins operating.

[0035] The anti-tilting system 50 is configured to take two discrete operating positions: rolling locked and rolling unlocked. When the anti-tilting system 50 is in the rolling locked position, the stopping device 51 clamps the movable element 52, thus interrupting the deformation of the rolling mechanism 40, and thus the rolling movement of vehicle 100. When the anti-tilting system 50 is in the unlocked position, the movable element 52 can move with respect to the stopping device 51, and thus the rolling of vehicle 100 is free.

[0036] The stopping device 51 is controlled by a control unit 60 which determines the switching thereof from one operating position to the other.

[0037] The control unit 60 is connected to or incorporates the motor control unit. The control unit 60 is therefore configured to control and acquire signals from the motor indicative of the number of revolutions.

[0038] The control unit 60 is also connected to a command 70 installed on the handlebar 86. Command 70 allows the driver the lock or unlock the anti-tilting system 50. When unlock rolling is selected on command 70, command 70 sends an unlock signal to the control unit 60 and the latter actuates the stopping device 51 in order to bring it to the unlocking operating position. Vice versa, when lock rolling is selected on command 70, command 70 sends a lock signal to the control unit 60 and the latter actuates the stopping device 51 in order to bring it to the locking operating position and clamp the movable element 52.

[0039] In order to inform the driver of the operating condition of the stopping device 51, there is an acoustic and/or optic warning 80 on the handlebar, preferably on the dashboard of vehicle 100,

for visually or acoustically warning of any locking or unlocking that took place, as shown in Figures 1, 3, 4.

[0040] When, due to an anomaly, the stopping device 51 does not function correctly, the control unit 60 is configured to command the unlocking of the stopping device 51 and limit the number of revolutions of motor 30.

[0041] The stopping device 51 of the present invention is of the electro-mechanical type and comprises an electric actuator 514 therein.

[0042] The stopping device 51 comprises two portions, a fixed one 511 which is rigidly connected to the front portion 11 of frame 10, and a movable portion 512, which can slide frontward and rearward with respect to the fixed portion 511. The movable portion 512 comprises two pins 517 which slide in respective recesses of the fixed portion 511, as shown in Figures 2, 6, 9. In addition to supporting the movable portion 512 with respect to the fixed portion 511, the pins 517 allow for a mutual sliding. When seeing the movable portion 512 from the side, as in Figures 6, 9, the movable portion 512 is arc-shaped. The fixed portion 511 is also arc-shaped, when seen from the side. These arcs serve to allow the sliding of the movable element 52.

[0043] Between the fixed portion 511 and the movable portion 512, there can be elastic return means 513 configured to approach the fixed and movable portions 511, 512 to each other.

[0044] The electric actuator 514 is installed in the movable portion 512 and actuates a piston 515 which comes out of the movable portion 512 on the side on which the fixed portion 511 is located, as shown in Figures 6, 9.

[0045] The electric actuator 514 comprises in turn an electric motor 520, which is fed by means of an energy source on board vehicle 100 and connected to the control unit 60. The electric motor 520 is connected to a worm screw 521 by means of a transmission 522 of the belt type. When the electric motor 520 rotates, the worm screw 521 also rotates. The worm screw 521 engages a piston 515, the movement of which is controlled by the electric motor 520. The worm screw 521, as piston 515, has a screw coupling with a small pitch so as to make the motion irreversible when the electric motor 520 is inactive.

[0046] As shown in Figure 6, piston 515 can come out of the movable portion 512 according to the actuation imparted by the electric motor 520. When piston 515 comes out of the movable portion 512, it pushes a first frictional pad 516 toward the movable element 52 of the anti-tilting system 50. Once the first frictional pad 516 comes into contact with the movable element 52, piston 515, coming out of the movable portion 512, moves the movable portion 512 with respect to the fixed

portion 511. An abutment region 518 comes into contact with the second frictional pad 517, which is then pushed against the other side of the movable element 52. At this point, the movable element 52 of the anti-tilting system 50 is clamped between the two frictional pads 516, 517 and the movement of the movable element 52 with respect to the stopping device 51 is prevented. Under this condition, the locking of the rolling is implemented.

[0047] As shown in Figure 9, when, vice versa, piston 515 retracts into the movable portion 512, the distance between the abutment region 518 of the movable portion 512 and the front surface of piston 515 increases, freeing the frictional pads 516, 517 to be disconnected from the movable element 52.

[0048] However, since the frictional pads 516, 517 are no longer glued or constrained to piston 515 and the abutment region 518 of the movable portion 512, the frictional pads 516, 517 do not move automatically away from the movable element 52. In order to allow the frictional pads 516, 517 to move away from each other, a pad spring 519 is arranged therebetween.

[0049] As shown in Figures 7, 8, 10, spring 519 is an elastic element suitably shaped and arranged so as to push back one frictional pad with respect to the other one.

[0050] Spring 519 has two side portions 5191, 5192, as shown in Figures 7, 10, connected to each other by means of an interconnection portion 5193. The interconnection portion 5193 can be narrow, as shown in Figure 10, or wide, as shown in Figure 7.

[0051] The side portions 5191, 5192 of spring 519 comprise two tines 5194. Therefore, the side portions 5191, 5192 are arc-shaped, as shown in Figures 7, 10.

[0052] The frictional pads 516, 517 comprise a support shaped so as to slide with respect to the fixed portion 511 of the stopping device 51 and the respective frictional elements 5161, 5171, as better shown in Figure 8.

[0053] The side portions 5191, 5192 of spring 519 are shaped so that the tines 5194 laterally straddle the frictional elements 5161, 5171 of respective frictional pads 516, 517, as shown in Figure 8. In essence, the distance between the inner edges of the tines 5194 of the same side portion 5191, 5192 is slightly greater than the width of the frictional elements 5161, 5171. A lateral movement of spring 519 is thus prevented with respect to the frictional pads 516, 517.

[0054] Spring 519 is also arranged so that the interconnection portion 5193 faces the bottom of the arc present in the movable portion 512, as shown in Figures 6, 9. Spring 519 is thus clamped at the top and cannot come out of the stopping device 51.

[0055] The frictional pads 516, 517 comprise two metal tabs 526, 527 shaped so as to form slides which facilitate the frontward and rearward sliding of the frictional pads 516, 517. The frictional pads 516, 517 slide, due to the tabs 526, 527, within grooves 536, 537 of the fixed portion 511, as shown in Figures 2, 6, 9.

[0056] As shown in Figure 10, spring 519 can incorporate the tabs 526, 527, thus forming a single component. The tabs 526, 527 are shaped so as to clamp the frictional pads 516, 517. The assembly is thus facilitated.

[0057] In a particular embodiment of the invention, the stopping device 51 can comprise an instrument 90 adapted to detect if the movable element 52 is clamped by the stopping device 51. Instrument 90 can be a strain gauge, for example, arranged on the upper wall of the movable portion 512 so as to detect compressions or extensions of the movable portion 512 when the piston 515 pushes the movable element 52. Alternative forms for measuring the mutual distance between the movable portion 512 and the fixed portion 511 are possible.

[0058] Should instrument 90 detect that the movable element 52 is clamped by the stopping device 51 despite the unlocking command imparted by the control unit 60, the instrument 90 emits an anomaly signal to the control unit 60 which automatically limits the number of revolutions of motor 30, making the vehicle 100 safe.

[0059] Spring 519 can take shapes other than those shown in Figures 7, 10 provided that the spring 519 serves the function of pushing back the frictional pads 516, 517 approaching each other.

[0060] In conclusion, it is apparent that the invention thus devised is susceptible to several modifications or variations, all falling within the invention; moreover, all details are replaceable with technically equivalent elements. In essence, the amounts may be varied according to the technical needs.

[0061] List of reference signs:

10 frame

11 front frame portion

21 right front wheel

22 left front wheel

23 rear wheel

30 motor

40 rolling mechanism

41 upper crossbar

42 lower crossbar

43 left upright element

44 right upright element

50 anti-tilting system

51 stopping device

52 movable element

60 control unit

70 command

80 acoustic and/or optic warning

82 steering tube

83 right front wheel support

84 left front wheel support

85 transmission

86 handlebar

87 saddle

88 steering bar

90 instrument

100 vehicle

511 fixed portion

512 movable portion

514 electric actuator

513 elastic return means

515 piston

516 first frictional pad

517 pin

5161 frictional element (of the first frictional pad)

517 second frictional pad

5171 frictional element (of the second frictional pad)

518 abutment region (of the movable portion)

519 spring (of the frictional pads)

5191, 5192 side portions (of the spring)

5193 interconnection portion (of the spring)

5194 tine (of the side portion of the spring)

520 electric motor

521 worm screw

522 transmission

526, 527 tabs

536, 537 grooves (of the fixed portion)

S' right steering axis

S'' left steering axis

F frontward

B rearward

R right

L left

T up

D down

CLAIMS

1. A rolling three-wheels saddle riding type vehicle (100) comprising:

- a frame (10) configured to tilt leftward and rightward;

- two front steerable wheels (21,22);

- one rear driving wheel (23) arranged between the left and right front wheels (21,22) when the vehicle (100) is observed in a front-rear direction (F-R), and located behind the left and right front wheels (21,22) according to said front-rear direction (F-R) of the vehicle (100);

- a propulsion motor (30) configured to drive the rear driving wheel (23);

- a rolling mechanism (40) rotatably supported by a front portion (11) of the frame (10) and configured to connect each other the left and right front wheels (21,22) so as to allow them to tilt together with the frame (10) and to steer with respect to the frame (10), said rolling mechanism (40) comprising:

  - at least one upper crossbar (41) rotatably supported by the front portion (11) of the frame (10);

  - at least one lower crossbar (42) rotatably supported by the front portion (11) of the frame (10);

  - a left upright element (43) rotatably connecting respective left ends of the upper and lower crossbars (41,42);

  - a right upright element (44) rotatably connecting respective right ends of the upper and lower crossbars (41,42);

  wherein said front left and right wheels (21,22) being respectively rotatably supported by left and right upright elements (43,44) so as to steer about respective steering left and right steering axes (S',S'');

- an anti-tilting system (50) comprising:

  - a stopping device (51) rigidly supported by the front portion (11) of the frame (10);

  - a movable element (52), preferably arc-shaped, rigidly supported by one among: the upper crossbar (41), lower crossbar (42), left upright element (43), and right upright element (44);

  wherein said stopping device (51) is configured to selectively clamp the movable element (52) so as to lock the rolling movement of said rolling mechanism (40) with respect to the frame (10);

  said stopping device (51) comprising:

- a fixed portion (511) rigidly supported by the front portion (11) of the frame (10);
- a movable portion (512) slidably connected to the fixed portion (511) so as to move frontward and rearward with respect to the fixed portion (511);
- elastic means (513) arranged between the fixed and movable portions (511,512) configured to approach the movable portion (512) to the fixed portion (511);
- an electric actuator (514) supported by the movable portion (512) and configured to move frontward and rearward a piston (515) with respect to the movable portion (512);
- frictional pads (516,517) slidably supported by the fixed portion (511) so that a first frictional pad (516) can be pushed by said piston (515) and a second frictional pad (517) can abut against a region (518) of the movable portion (512), and so that the movable element (52) is arranged between said first and second frictional pads (516,517);
- a pads spring (519) arranged between the first and second frictional pads (516,517) and configured to push the frictional pads (516,517) each other away;

wherein the movable element (52) is clamped by said first and second frictional pads (516,517) when the electric actuator (514) moves the piston (515) to push the first frictional pad (516) against a first side of the movable element (52) and the movable portion (512) moves away from the fixed portion (511) dragging the second frictional pad (517) against a second side of the movable element (52);

wherein the pads spring (519) comprises two side portions (5191,5192) interconnected each other via an interconnection portion (5193), wherein the side portions (5191,5192) are shaped like a fork with two tines (5194); and the tines (5194) of each side portions (5191,5192) are spaced from each other of a distance that is greater than the width of frictional elements (5161,5171) of said frictional pads (516,517).

2. The vehicle (100) according to claim 1, wherein the electric actuator (514) comprises:
- an electric motor (520);
- a worm screw (521) driving the piston (515);
- a transmission (522) connecting the electric motor (520) to the worm screw (521).

3. The vehicle (100) according to claim 1, wherein each frictional pad (516,517) comprises tabs (526,527) for easing sliding of frictional pad (516,517) into grooves (536,537) of the fixed portion (511).

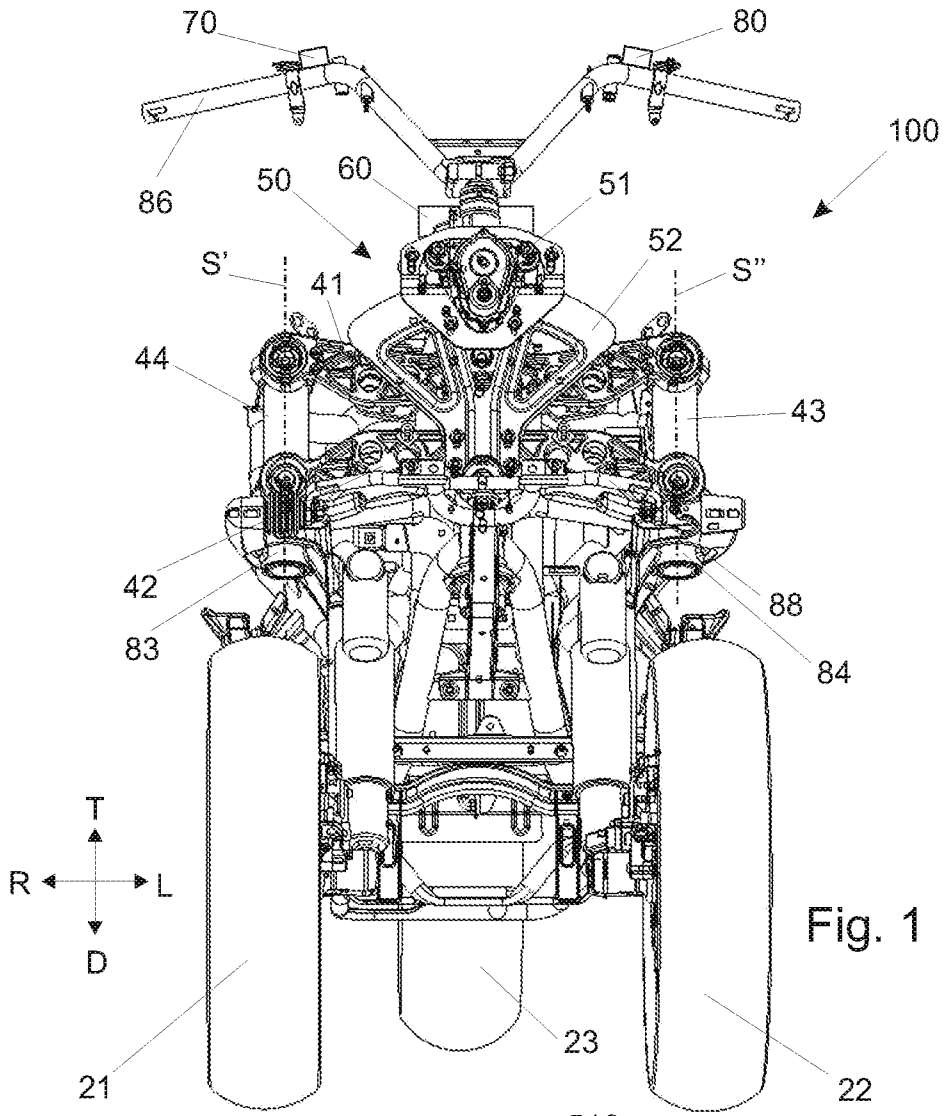
4. The vehicle (100) according to claim 3, wherein the pads spring (519) incorporates the tabs (526,527).

5. The vehicle (100) according to any one of preceding claims, comprising a control unit (60) and a command (70), configured to provide a lock/unlock signal to the control unit (60), wherein the control unit (60) is adapted to control the anti-tilting system (50) so as to respectively clamp/unclamp the movable element (52) by means of the stopping device (51).

6. The vehicle (100) according to claim 5, comprising an acoustic and/or optic warning (80) configured to inform the driver if the movable element (52) is clamped or unclamped by the stopping device (51).

7. The vehicle (100) according to any one of preceding claims, wherein the stopping device (51) comprises an instrument (90) configured to measure if the stopping device (51) is clamping the movable element (52), preferably the instrument (90) is a strain gauge arranged on the movable portion (512).

8. The vehicle (100) according to claims 5 or 6 and 7, wherein the control unit (60) limits the propulsion motor (30) if the instrument (90) measures that the movable element (52) is clamped despite the command (70) has provided an unlock signal to the control unit (60).


70
80
100
86
50
60
51
52
S'
S"
41
44
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42
83
88
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T
R
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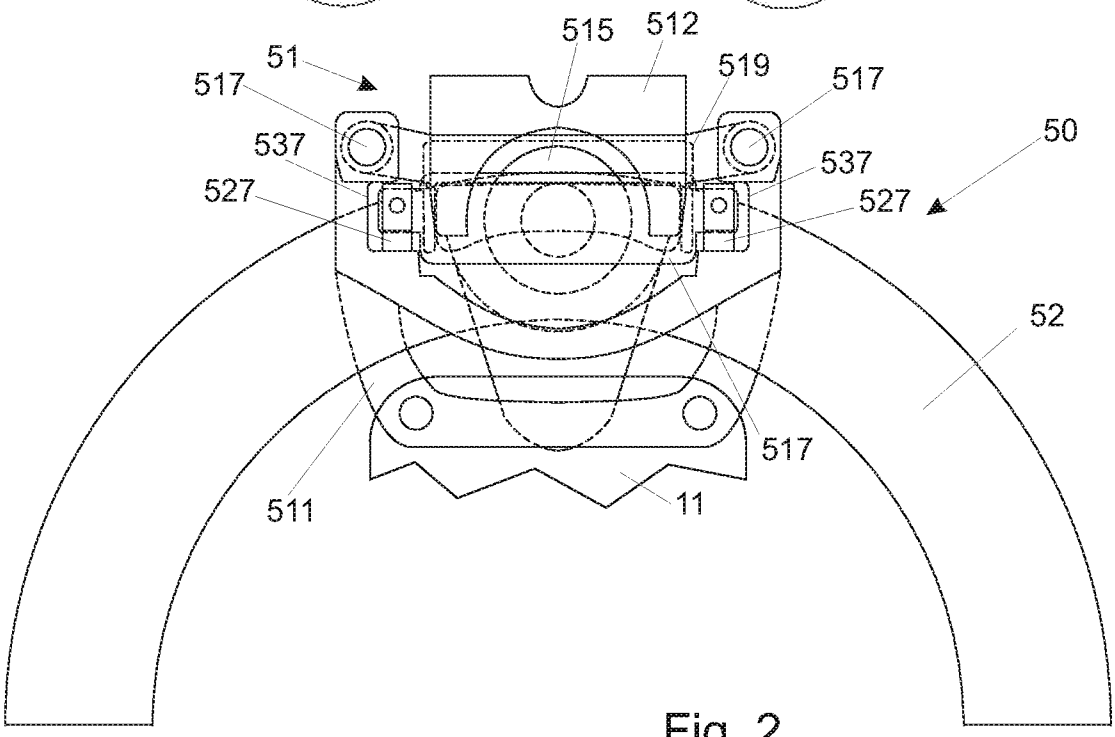
D
21
23
22

Fig. 1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512
51
519
517
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537
50
537
527
527
52
517
511
11

Fig. 2

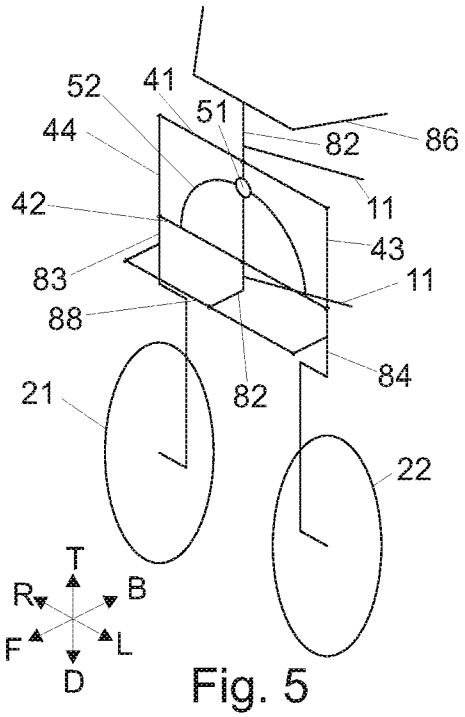
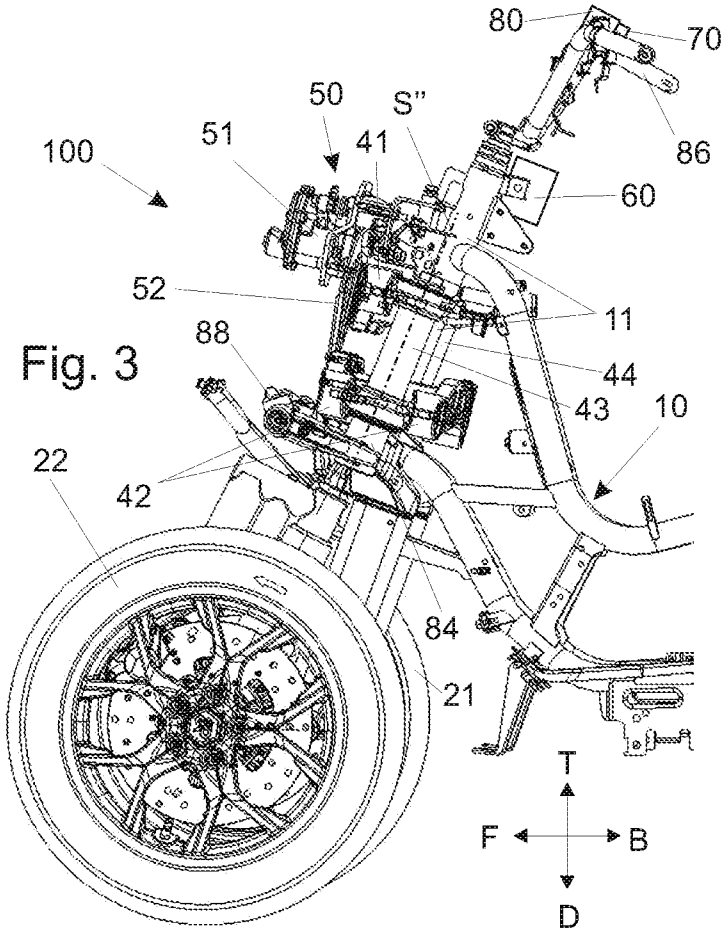


Fig. 5



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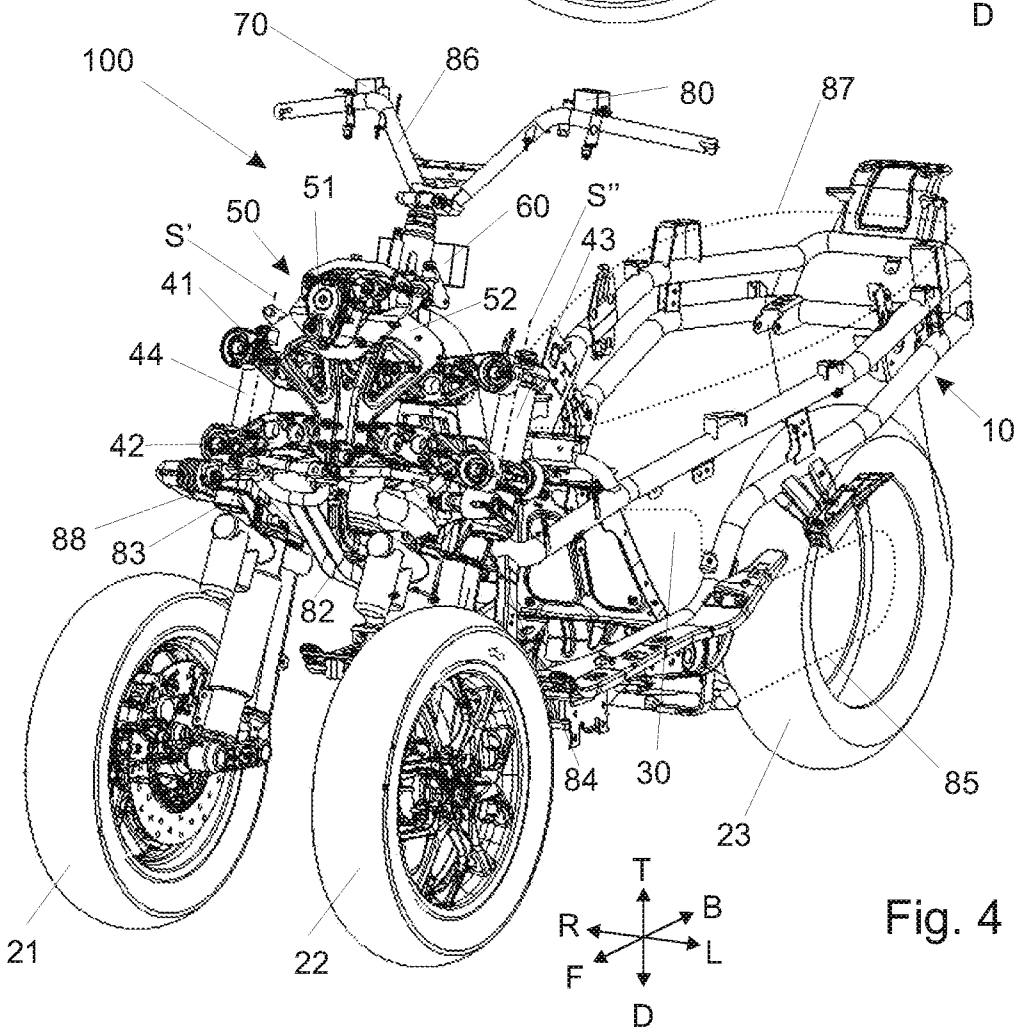
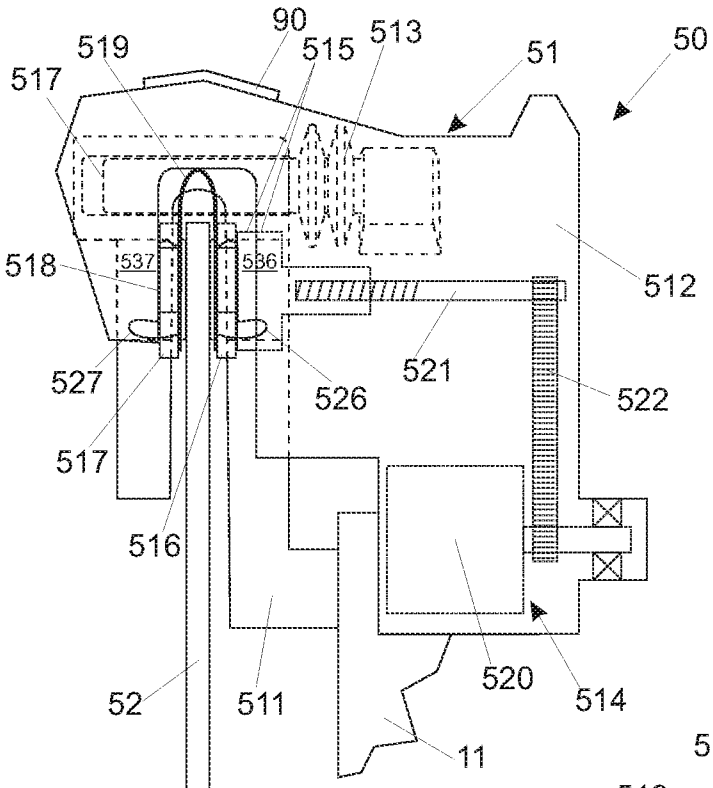


Fig. 4



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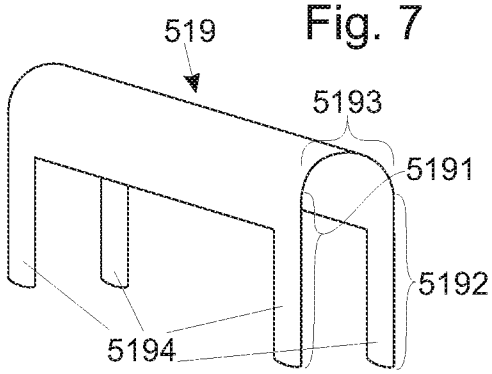

Fig. 7

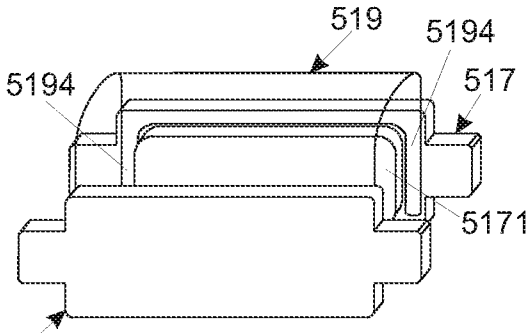

Fig. 8

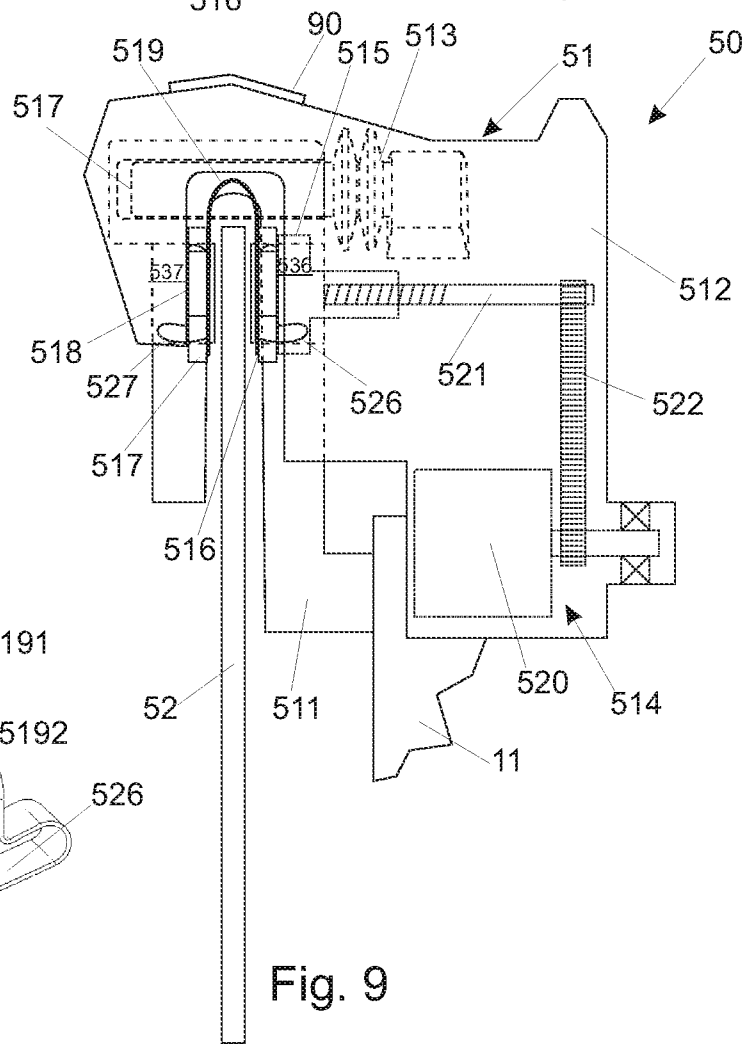

Fig. 9

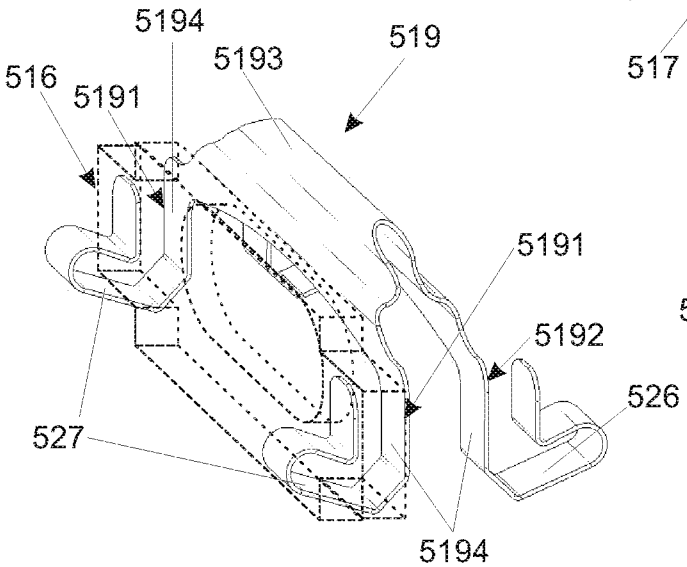

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/052675

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60G17/017 B60K5/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60G B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2020/245712 A1 (PIAGGIO & CO S P A [IT]) 10 December 2020 (2020-12-10) the whole document	1-8
A	JP 2014 190347 A (AKEBONO BRAKE IND) 6 October 2014 (2014-10-06) the whole document	1
A	WO 2020/128946 A1 (FRENI BREMBO SPA [IT]) 25 June 2020 (2020-06-25) the whole document	1
A	WO 2007/127783 A1 (VECTRIX CORP [US]; HUGHES PETER S [US] ET AL.) 8 November 2007 (2007-11-08) the whole document	1

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 June 2024	09/07/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Savelon, Olivier

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/052675

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2021/168512 A1 (WEISS NOMINEES PTY LTD [AU]) 2 September 2021 (2021-09-02) the whole document	1
A	US 2019/338816 A1 (DENHARD WERNER [DE] ET AL) 7 November 2019 (2019-11-07) the whole document	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2024/052675

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2020245712 A1	10-12-2020	CN 114174162 A	11-03-2022
		EP 3976454 A1	06-04-2022
		IL 288605 A	01-02-2022
		JP 2022535826 A	10-08-2022
		TW 202100399 A	01-01-2021
		WO 2020245712 A1	10-12-2020
JP 2014190347 A	06-10-2014	NONE	
WO 2020128946 A1	25-06-2020	CN 113195922 A	30-07-2021
		US 2022056969 A1	24-02-2022
		WO 2020128946 A1	25-06-2020
WO 2007127783 A1	08-11-2007	CY 1114431 T1	31-08-2016
		CY 1114447 T1	05-10-2016
		DK 2019772 T3	07-10-2013
		DK 2345576 T3	07-10-2013
		EP 2019772 A1	04-02-2009
		EP 2345576 A1	20-07-2011
		ES 2433468 T3	11-12-2013
		ES 2435478 T3	19-12-2013
		HK 1160084 A1	10-08-2012
		PT 2019772 E	18-11-2013
		PT 2345576 E	18-11-2013
		TW 200815231 A	01-04-2008
		US 2010044977 A1	25-02-2010
		WO 2007127783 A1	08-11-2007
WO 2021168512 A1	02-09-2021	AU 2021228369 A1	15-09-2022
		US 2023088275 A1	23-03-2023
		WO 2021168512 A1	02-09-2021
US 2019338816 A1	07-11-2019	BR 112019010885 A2	01-10-2019
		CN 110291306 A	27-09-2019
		CN 117553082 A	13-02-2024
		DE 102017222639 A1	02-08-2018
		DE 202018006377 U1	17-03-2020
		EP 3577365 A1	11-12-2019
		JP 2020503480 A	30-01-2020
		KR 20190112762 A	07-10-2019
		US 2019338816 A1	07-11-2019
		WO 2018141734 A1	09-08-2018