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

(11) **EP 3 728 007 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
06.10.2021 Bulletin 2021/40

(21) Application number: **18830958.7**

(22) Date of filing: **17.12.2018**

(51) Int Cl.:
B62K 5/027 *(2013.01)* ***B62K 5/10*** *(2013.01)*

(86) International application number:
PCT/IB2018/060179

(87) International publication number:
WO 2019/123205 (27.06.2019 Gazette 2019/26)

(54) A TILTING MOTOR CYCLE WITH THREE WHEELS AND A RIGID REAR AXLE

NEIGBARES MOTORRAD MIT DREI RÄDERN UND EINER STARREN HINTERACHSE

CYCLE À MOTEUR BASCULANT À TROIS ROUES ET UN ESSIEU ARRIÈRE RIGIDE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **22.12.2017 IT 201700149321**

(43) Date of publication of application:
28.10.2020 Bulletin 2020/44

(73) Proprietor: **Piaggio & C. S.P.A.**
56025 Pontedera Pisa (IT)

(72) Inventor: **RAFFAELLI, Andrea**
56025 Pontedera, Pisa (IT)

(74) Representative: **Mitola, Marco**
Jacobacci & Partners S.p.A.
Piazza Mario Saggin, 2
35131 Padova (IT)

(56) References cited:
WO-A1-2005/095195 **WO-A1-2006/002590**
JP-A- 2004 131 027

EP 3 728 007 B1

Description

FIELD OF APPLICATION

[0001] The present invention relates to a tilting motor cycle with at least three wheels and a rigid rear axle.

BACKGROUND

[0002] Tilting motor cycles are known with at least three wheels and a rigid rear axle, designed to carry loads placed at the rear end of the frame.

[0003] In particular, such vehicles comprise a rear end having an engine group and a rigid axle provided with a couple of rear wheels; the rear end is hinged to the frame in order to allow a rolling of the frame about a rolling axis and a pitching of the rear end about a pitching axis; the rear end is further connected to the frame by means of a suspension system.

[0004] The main connection between the rear end and the frame is carried out by means of the interposition of a joint, which allows both the rolling and the pitching between the frame and the rear end.

[0005] From a structural point of view, in this type of vehicles, it is attempted to limit the passage of loads through the joint to a maximum, hence the positioning of the suspension on the vertical of the axis of the rear wheels.

[0006] However, in this way, by connecting the engine to the frame by a damper during the rolling, instead of following a circular trajectory around the rolling axis, the upper fixing thereof tends to follow a smaller arc of a circle with the center in the lower fixing thereof.

[0007] This condition is shown, for example, in figure 1, wherein the circular trajectory around the rolling axis is indicated with reference 2, while the effective trajectory with the center in the lower fixing is indicated with reference 3.

[0008] Since the damper cannot extend, if the load, which compresses it does not decrease (and indeed increases on the bend), the rear part of the vehicle will tend to lower, thus increasing the incidence and the front wheel trail of the front end of the motor cycle.

[0009] Such increases can be measured geometrically and have the effect of making the drive heavier and the vehicle less reactive to the rotation of the handlebars. Document WO2005095195A1 shows the preamble of claim 1.

PRESENTATION OF THE INVENTION

[0010] Thus, the need is felt to overcome the drawbacks and limitations stated with reference to the prior art.

[0011] Such need is satisfied by a tilting motor cycle according to claim 1.

DESCRIPTION OF THE DRAWINGS

[0012] Further features and advantages of the present invention will become clearer from the description below of preferred, non-limiting embodiments thereof, wherein:

- figure 1 represents a schematic view of a tilting motor cycle of the prior art;
- figure 2 represents a perspective view of a tilting motor cycle according to one embodiment of the present invention;
- figure 3 represents a detailed perspective view of the enlarged detail III in figure 2;
- figure 4 represents a schematic side view of a tilting motor cycle according to one embodiment of the present invention;
- figures 5a,5b,5c represent constructional diagrams of possible embodiments of the present invention;
- figures 6-7 represent views of a possible embodiment of a motor cycle according to the present invention;
- figures 8-9 represent views of a further possible embodiment of a motor cycle according to the present invention;
- figure 10 represents a perspective view of a further embodiment of the present invention.

[0013] Elements or parts of elements in common between the embodiments described below will be indicated with the same numerical references.

DETAILED DESCRIPTION

[0014] With reference to the aforesaid figures, an overall schematic view of a tilting motor cycle according to the present invention is globally indicated with reference 4.

[0015] The tilting motor cycle 4 comprises at least three wheels, including at least one front wheel 8 and two rear wheels 12, 14.

[0016] The motor cycle 4 further comprises a frame 16, comprising a front end 18 and a rear end 20. The rear end 20 comprises an engine group 24 and said couple of rear wheels 12, 14.

[0017] The rear end 20 is typically a rear end with a rigid rear axle.

[0018] The rear end 20 is hinged to the frame 16 in order to allow a rolling of the frame 16 about a rolling axis R-R and a pitching of the rear end 20 about a pitching axis B-B. For example, as shown better in figure 3, the tilting motor cycle 4 comprises an articulated joint 22 arranged between the frame 16 and the rear end 20 to cause said rolling and pitching of the frame 16.

[0019] According to a possible embodiment, the articulated joint 22 comprises a *Neidhart* joint (figure 3).

[0020] Such *Neidhart* joint rotatably connects the two axes to each other, in this case integral with the frame 16 and the engine group 24 respectively, to allow not

only a relative rotation but also slight misalignments between the axes themselves. These misalignments can be obtained by the elastic deformation of rollers (cylindrical or conical) made of elastic material, typically of rubber, which act as elastically yielding bearings.

[0021] The rear end 20 is further connected to the frame 16 by means of a suspension system, shown in different configurations in figures 5a, 5b e 5c, which comprise a couple of uprights 26, 28 connected at the bottom by means of two first hinges 32, to the engine group 24, at least one first crosspiece 36 hinged, at the distal ends 40, 42 thereof, to the uprights 26, 28.

[0022] In particular, the uprights 26,28 are arranged between opposite sides and the first crosspiece 36 extends between said pair of opposing uprights 26,28. The crosspiece 36 is rotatably connected at the distal ends 40, 42 to the uprights 26, 28

[0023] The center C of the first crosspiece 36 is connected to the frame 16 directly or indirectly by means of a transmission element 44.

[0024] The uprights 26, 28 or the transmission element 44 comprise a suspension 48 to dampen the rear end 20 with respect to the frame 16.

[0025] The suspension 48 comprises at least one spring and/or a damper yielding according to a longitudinal axis L-L of the suspension 48.

[0026] The type of spring and/or damper is irrelevant for the purposes of the present invention.

[0027] According to one embodiment, the first crosspiece 36 is shaped as a triangle so that the center C and the distal ends 40, 42 of the first crosspiece 36 are arranged in a triangle, and the apex of the triangle coincides with the center C of the first crosspiece 36 and is situated at a predetermined distance D from the baseline T, which joins the distal ends 40, 42.

[0028] The distance K between said rolling axis R-R and a line S, which joins said two first hinges 32 substantially coincides with said predetermined distance D.

[0029] Due to this correspondence between the distances D and K an overall neutral rolling suspension is obtained, wherein the kinematic variation in the rolling angle does not require a variation in the length of the suspension, which can be seen schematically in figure 5a.

[0030] In fact, from a geometric point of view, the correspondence between the distances D and K means that the kinematic rotation of the suspension is perfectly centered in the rolling axis; in this way, the simple rolling movement of the frame 16 neither involves nor requires a lengthening or shortening of the suspensions 48. Consequently, the simple rolling movement does not cause a lifting or a lowering of the vehicle at the rear end and nor does it require any geometrical variation in the angle of incidence and the front end.

[0031] In other words, due to the described kinematic mechanism, the suspension 48 is allowed to work as though it were fixed on a through point for the rolling axis (Fig.4) with all of the advantages described above.

[0032] Furthermore, the use of an articulated quadrilateral allows the load transfers to be balanced and consequently, the compressions and extensions of the suspensions of the uprights, which maintain the same length both in static conditions and dynamic conditions.

[0033] Figure 5a schematically illustrates the kinematic behavior of the articulated quadrilateral. In particular, the first lower hinges 32 stay still because they are associated with an engine group 24 with a rigid axle. A virtual crosspiece is sketched at the bottom of the figure whose center line advantageously passes through the rolling axis R-R. In the event of rolling, the virtual lower crosspiece stays still, while the first crosspiece 36 rotates (i.e. rolls) parallel to the virtual crosspiece, which remains still due to the mechanical connection given by the uprights 26, 28. In fact, the articulated quadrilateral allows the upper crosspiece, i.e. the first crosspiece 36, to rotate, always keeping the parallelism with the lower 'virtual' crosspiece.

[0034] Preferably, the first hinges 32, the uprights 26,28, the center C of the first crosspiece 36 and the distal ends 40,42 of said first crosspiece 36 lie on a common suspension plane.

[0035] According to one embodiment, said common suspension plane is perpendicular to the rolling axis R-R. This condition facilitates the rolling movement of the frame and allows smaller misalignments between the movable elements and consequently, reduced friction during the compression of the suspensions and the rotations of the uprights 26, 28.

[0036] There are also advantages in terms of overall size. In fact, the two suspensions incorporated in the uprights 26, 28 tilt by the same angle as the single suspension, but they remain displaced towards the center line; in the case of a narrow motor cycle lane this difference can be decisive.

[0037] In this regard, the difference in size between the solution in figures 6-7 and the solution in figures 8 and 10 is shown in figure 9.

[0038] According to a first embodiment (figures 5a, 8), the distal ends 40, 42 of the first crosspiece 36 are hinged to upper ends 50, 52 of the uprights 26, 28, and the center C of the first crosspiece 36 is directly hinged to the frame 16. Each of the uprights 26, 28 comprises a suspension 48 to dampen the rear end 20 with respect to the frame 16. This embodiment classically comprises the use of two equal suspensions, one at each upright 26, 28. It is also possible to arrange a spring at one of said uprights 26, 28 and a damper at the other upright 28, 26. This solution offers the advantage of considerably containing the overall size in a transverse direction, i.e. perpendicular to the rolling axis R-R. The containment of the size is schematized in figure 9, in which, with the same rolling angle, the transverse size of a quadrilateral provided with only one first crosspiece 32 and two uprights (each provided with suspensions 48) is compared to a quadrilateral having a couple of crosspieces 32, 56, which is described better below.

[0039] The advantage in terms of size lies in the fact that the two suspensions tilt by the same angle, but remain displaced towards the center or center line: in the case of a narrow lane, this can be decisive in terms of size.

[0040] In particular, in a second embodiment (figures 5b, 6, 7), the motor cycle 4 comprises a second crosspiece 56, besides the first crosspiece 36. Each of the uprights 26, 28 is hinged to the engine group 24 in a first lower end 60, 62.

[0041] The uprights 26, 28 are hinged to the first crosspiece 36 in an opposite upper end 50, 52 and to the second crosspiece 56 in an intermediate position 64 between the lower 60, 62 and upper ends 50, 52.

[0042] In other words, starting from the top, the uprights 26, 28 are hinged to the first crosspiece 36, to the second crosspiece 56 and to the engine group 24 respectively. In turn, the second crosspiece 56 is hinged centrally to a lower end 68 of the transmission element 44. The transmission element 44 is hinged, in turn, in an intermediate position, to the first crosspiece 36 and at an upper end to the frame 16. Advantageously, the transmission element 44 further comprises a suspension 48 provided, for example, with a spring and a damper (fig. 10).

[0043] This solution allows the use of a single suspension 48, but it also requires the use of a second crosspiece 56. In terms of transverse size, as seen, this is increased with respect to the solution with two suspensions at the uprights 26, 28. However, this solution allows the exclusion of potential manufacturing flaws of the two suspensions in the first embodiment, which would result in the asymmetric working of the rolling system.

[0044] According to a third embodiment (figures 5c, 10), the transmission element 44 is hinged to the frame 16 to allow an oscillation of the transmission element about a transverse axis F-F parallel to the pitching axis B-B of the motor cycle 4. Furthermore, the distal ends 40, 42 of the first crosspiece 36 are hinged to upper ends 50, 52 of said uprights 26, 28, and the center C of the first crosspiece 36 is hinged to the transmission element 44. In turn, the transmission element comprises a suspension 48 connected to the frame.

[0045] This solution allows the overall size of the suspension to be limited further: in particular, in the part comprised between the wheels, it is possible to replace the two suspensions with two struts and thus place a single suspension 48 at the top, which can consequently work under compression. In this case, too, the solution allows the exclusion of potential manufacturing flaws of the two suspensions in the first embodiment, which would result in the asymmetric working of the rolling system. According to one embodiment, the rotation axes of the lower hinges 32 of the first crosspiece 36 and the hinges of the uprights 26, 28 are parallel to the rolling axis R-R.

[0046] This condition facilitates the rolling movement of the frame and allows slighter misalignments between the movable elements and consequently reduced friction during the compressions of the suspensions and the rotations of the uprights 26, 28. As can be appreciated from the description, the present invention allows the drawbacks of the prior art to be overcome.

[0047] In particular, the present invention defines a neutral rolling suspension, wherein the simple geometric variation in the rolling angle does not require a variation in the length of the suspension.

[0048] In this way, the stability of the vehicle is improved significantly with respect to the solutions of the prior art since the rear part of the vehicle tends not to lower, thus increasing the incidence and consequently the front wheel trail of the front end of the motor cycle.

[0049] At the same time, the size of the suspension of the present invention is contained and therefore allows the rear end to bear caissons, also with considerable dimensions.

[0050] A person skilled in the art can make various modifications and changes to the motor cycles described above to satisfy specific and contingent needs, all of which are contained in the scope of the invention as defined by the following claims.

Claims

1. Tilting motorcycle (4) with at least three wheels comprising:

a frame (16),

- at least one front wheel (8),
- a rear end (20) comprising an engine group (24) and a pair of rear wheels (12, 14), wherein said rear end (20) is hinged to the frame (16) so as to allow a rolling of the frame (16) around a rolling axis (R-R) and a pitching of the rear end (20) around a pitching axis (B-B),

wherein said rear end (20) is further connected to the frame (16) by means of a suspension system comprising:

- a pair of uprights (26, 28) connected at the bottom by two first hinges (32) to the engine group (24),
- at least a first crosspiece (36),
- the centre (C) of said first crosspiece (36) being connected to the frame (16) directly or indirectly by a transmission element (44),
- said uprights (26, 28) or transmission element (44) comprise a suspension (48) to dampen the rear end (20) with respect to the frame (16), **characterized in that** said at least first crosspiece (36) is hinged at its distal ends (40, 42) to the uprights (26, 28).

2. Tilting motorcycle (4) with at least three wheels according to claim 1, wherein the uprights (26,28) are arranged between opposite sides and the first crosspiece (36) extends between said pair of opposing uprights (26,28).

3. Tilting motorcycle (4) with at least three wheels according to claim 1, wherein said centre (C) and said distal ends (40, 42) of the first crosspiece (36) are arranged in a triangle so that the apex of the triangle coincides with the centre (C) of the first crosspiece (36) and is situated at a predetermined distance (D) from the baseline (T) joining said distal ends (40, 42).

4. Tilting motorcycle (4) with at least three wheels according to claim 3, wherein a distance (K) between said rolling axis (R-R) and a line (S) which joins said first two hinges (32) coincides substantially with said predetermined distance (D).

5. Tilting motorcycle (4) with at least three wheels according to any of the claims from 1 to 4, wherein said first hinges (32), said uprights (26, 28), the centre (C) and the distal ends (40, 42) of said first crosspiece (36) lie on a common suspension plane.

6. Tilting motorcycle (4) with at least three wheels according to claim 5, wherein said suspension plane is perpendicular to said rolling axis (R-R).

7. Tilting motorcycle (4) with at least three wheels according to any of the preceding claims, wherein the distal ends (40,42) of the first crosspiece (36) are hinged to upper ends (50,52) of said uprights (26,28) and the centre (C) of the first crosspiece (36) results directly hinged to the frame (16), each of said uprights (26.28) comprising a suspension (48) to dampen the rear end (20) with respect to the frame (16).

8. Tilting motorcycle (4) with at least three wheels according to any of the claims from 1 to 6, wherein the motorcycle comprises a second crosspiece (56) in addition to said first crosspiece (36), each of said uprights (26,28) being hinged to the engine group (24) at a first lower end (60,62), to said first crosspiece (36) at an opposite upper end (50,52) and to said second crosspiece (56) in an intermediate position (64) between said lower (60,62) and upper end (50,52).

9. Tilting motorcycle (4) with at least three wheels according to claim 8, wherein the second crosspiece (56) is centrally hinged to a lower end (68) of said transmission element (44), in turn hinged in an intermediate position to the first crosspiece (36) and at an upper end to the frame (16) said transmission element (44) comprising a suspension (48).

10. Tilting motorcycle (4) with at least three wheels according to any one of the claims from 1 to 6, wherein said transmission element (44) is hinged to the frame (16) so as to allow an oscillation of the transmission element (44) about an axis parallel to the pitching axis (B-B) of the motorcycle (4),

said distal ends (40, 42) of said first crosspiece (36) are hinged to upper ends (50, 52) of said uprights (26, 28) and the centre (C) of the first crosspiece (36) is hinged to the transmission element (44),
the transmission element (44) comprising said suspension (48) connected to said transmission element.

11. Tilting motorcycle (4) with at least three wheels according to any of the preceding claims, wherein the rotation axes of the hinges of said first crosspiece (36) and of the hinges of the uprights (26, 28) are parallel to the rolling axis (R-R).

12. Tilting motorcycle (4) with at least three wheels according to any of the preceding claims, wherein said suspension (48) comprises at least a spring and a damper yielding along a longitudinal axis (L-L) of the suspension (48).

13. Tilting motorcycle (4) with at least three wheels according to any of the preceding claims, comprising an articulated joint (22) placed between the frame (16) and the rear end (20) to achieve said rolling and pitching of the frame (16).

14. Tilting motorcycle (4) with at least three wheels according to claim 13, where said articulated joint (22) comprises a *Neidhart* joint.

Patentansprüche

1. Neigemotorrad (4) mit zumindest drei Rädern, umfassend:

- einen Rahmen (16),
- zumindest ein Vorderrad (8),
- ein hinteres Ende (20) umfassend eine Motorgruppe (24) und ein Paar Hinterräder (12, 14), wobei das hintere Ende (20) an dem Rahmen (16) angelenkt ist, um ein Wanken des Rahmens (16) um eine Wankachse (R-R) und ein Nicken des hinteren Endes (20) um eine Nickachse (B-B) zu erlauben,

wobei das hintere Ende (20) ferner mit dem Rahmen (16) mittels eines Aufhängungssystems verbunden ist, umfassend:

- ein Paar Pfosten (26, 28), die unten bzw. am Boden durch zwei erste Scharniere (32) mit der Motorgruppe (24) verbunden sind,
- zumindest ein erstes Querstück (36),
- wobei die Mitte (C) des ersten Querstücks (36) mit dem Rahmen (16) direkt oder indirekt durch ein Übertragungselement (44) verbunden ist,
- wobei die Pfosten (26, 28) oder das Übertragungselement (44) eine Aufhängung (48) umfassen, um das hintere Ende (20) in Bezug auf den Rahmen (16) zu dämpfen, **dadurch gekennzeichnet, dass** das zumindest erste Querstück (36) an bzw. mit seinem distalen Enden (40, 42) an den Pfosten (26, 28) angelenkt ist.

2. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 1, wobei die Pfosten (26, 28) zwischen gegenüberliegenden bzw. entgegengesetzten Seiten angeordnet sind und sich das erste Querstück (36) zwischen dem Paar gegenüberliegender bzw. entgegengesetzter Pfosten (26, 28) erstreckt.

3. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 1, wobei die Mitte (C) und die distalen Enden (40, 42) des ersten Querstücks (36) in einem Dreieck angeordnet sind, so dass der Scheitel des Dreiecks mit der Mitte (C) des ersten Querstücks (36) zusammenfällt und sich in einem vorbestimmten Abstand (D) von der Basislinie (T) befindet, welche die distalen Enden (40, 42) verbindet.

4. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 3, wobei ein Abstand (K) zwischen der Wankachse (R-R) und einer Linie (S), welche die ersten beiden Scharniere (32) verbindet, im Wesentlichen mit dem vorbestimmten Abstand (D) zusammenfällt bzw. übereinstimmt.

5. Neigemotorrad (4) mit zumindest drei Rädern nach einem der Ansprüche 1 bis 4, wobei die ersten Scharniere (32), die Pfosten (26, 28), die Mitte (C) und die distalen Enden (40, 42) des ersten Querstücks (36) auf einer gemeinsamen Aufhängungsebene liegen.

6. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 5, wobei die Aufhängungsebene senkrecht zu der Wankachse (R-R) ist.

7. Neigemotorrad (4) mit zumindest drei Rädern nach einem der vorhergehenden Ansprüche, wobei die distalen Enden (40, 42) des ersten Querstücks (36) an den oberen Enden (50, 52) der Pfosten (26, 28) angelenkt sind und die Mitte (C) des ersten Querstücks (36) direkt an den Rahmen (16) angelenkt resultiert, wobei jeder der Pfosten (26, 28) eine Aufhängung (48) umfasst, um das hintere Ende (20) in Bezug auf den Rahmen (16) zu dämpfen.

8. Neigemotorrad (4) mit zumindest drei Rädern nach einem der Ansprüche 1 bis 6, wobei das Motorrad zusätzlich zu dem ersten Querstück (36) ein zweites Querstück (56) umfasst, wobei jeder der Pfosten (26, 28) an der Motorgruppe (24) an einem ersten unteren Ende (60, 62), an dem ersten Querstück (36) an einem gegenüberliegenden bzw. entgegengesetzten oberen Ende (50, 52) und an dem zweiten Querstück (56) in einer Zwischenposition (64) zwischen dem unteren (60, 62) und dem oberen Ende (50, 52) angelenkt ist.

9. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 8, wobei das zweite Querstück (56) zentral an einem unteren Ende (68) des Übertragungselementes (44) angelenkt ist, wiederum in einer Zwischenposition an dem ersten Querstück (36) und an einem oberen Ende des Rahmens (16) angelegt, wobei das Übertragungselement (44) eine Aufhängung (48) umfasst.

10. Neigemotorrad (4) mit zumindest drei Rädern nach einem der Ansprüche 1 bis 6, wobei das Übertragungselement (44) an dem Rahmen (16) angelenkt ist, um eine Schwingung des Übertragungselements (44) um eine Achse parallel zu der Nickachse (B-B) des Motorrads (4) zu erlauben,

wobei die distalen Enden (40, 42) des ersten Querstücks (36) an den oberen Enden (50, 52) der Pfosten (26, 28) angelenkt sind und die Mitte (C) des ersten Querstücks (36) an dem Übertragungselement (44) angelenkt ist,
wobei das Übertragungselement (44) die Aufhängung (48) umfasst, die mit dem Übertragungselement verbunden ist.

11. Neigemotorrad (4) mit zumindest drei Rädern nach einem der vorhergehenden Ansprüche, wobei die Drehachsen der Scharniere des ersten Querstücks (36) und der Scharniere der Pfosten (26, 28) parallel zu der Wankachse (R-R) sind.

12. Neigemotorrad (4) mit zumindest drei Rädern nach einem der vorhergehenden Ansprüche, wobei die Aufhängung (48) zumindest eine Feder und einen Dämpfer umfasst, die entlang einer Längsachse (L-L) der Aufhängung (48) nachgeben.

13. Neigemotorrad (4) mit zumindest drei Rädern nach einem der vorhergehenden Ansprüche, umfassend eine Gelenkverbindung (22), die zwischen dem Rahmen (16) und dem hinteren Ende (20) platziert ist, um das Wanken und Neigen des Rahmens (16) zu erzielen.

14. Neigemotorrad (4) mit zumindest drei Rädern nach Anspruch 13, wobei die Gelenkverbindung (22) ein

Neidhart-Gelenk umfasst.

Revendications

1. Motocyclette basculante (4) ayant au moins trois roues comprenant :

un cadre (16),

- au moins une roue avant (8),
- une extrémité arrière (20) comprenant un groupe moteur (24) et une paire de roues arrière (12, 14),

dans laquelle ladite extrémité arrière (20) est montée sur charnière sur le cadre (16) de façon à permettre un roulis du cadre (16) autour d'un axe de roulis (R-R) et un tangage de l'extrémité arrière (20) autour d'un axe de tangage (B-B), dans laquelle ladite extrémité arrière (20) est en outre reliée au cadre (16) au moyen d'un système de suspension comprenant :

- une paire de montants (26, 28) reliés, au niveau de leur partie inférieure, par deux premières charnières (32) au groupe moteur (24),
- au moins une première traverse (36),
- le centre (C) de ladite première traverse (36) étant relié au cadre (16) directement ou indirectement par un élément de transmission (44),
- lesdits montants (26, 28) comprennent ou ledit élément de transmission (44) comprend une suspension (48) pour amortir l'extrémité arrière (20) par rapport au cadre (16), **caractérisée en ce que** ladite au moins une première traverse (36) est montée sur charnière, au niveau de ses extrémités distales (40, 42), sur lesdits montants (26, 28).

2. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 1, dans laquelle les montants (26, 28) sont agencés entre des côtés opposés et la première traverse (36) s'étend entre ladite paire de montants (26, 28) opposés.

3. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 1, dans laquelle ledit centre (C) et lesdites extrémités distales (40, 42) de la première traverse (36) sont agencés en un triangle de sorte que le sommet du triangle coïncide avec le centre (C) de la première traverse (36) et soit situé à une distance prédéterminée (D) de la ligne de base (T) joignant lesdites extrémités distales (40, 42).

4. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 3, dans laquelle une distance (K) entre ledit axe de roulis (R-R) et une ligne (S) qui joint lesdites deux premières charnières (32) coïncide sensiblement avec ladite distance prédéterminée (D).

5. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications 1 à 4, dans laquelle lesdites premières charnières (32), lesdits montants (26, 28), le centre (C) et les extrémités distales (40, 42) de ladite première traverse (36) se situent sur un plan de suspension commun.

6. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 5, dans laquelle ledit plan de suspension est perpendiculaire audit axe de roulis (R-R).

7. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications précédentes, dans laquelle les extrémités distales (40, 42) de la première traverse (36) sont montées sur charnière sur les extrémités supérieures (50, 52) desdits montants (26, 28) et le centre (C) de la première traverse (36) est en conséquence monté sur charnière sur le cadre (16), chacun desdits montants (26, 28) comprenant une suspension (48) pour amortir l'extrémité arrière (20) par rapport au cadre (16).

8. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications 1 à 6, dans laquelle la motocyclette comprend une seconde traverse (56) en plus de ladite première traverse (36), chacun desdits montants (26, 28) étant monté sur charnière sur le groupe moteur (24) au niveau d'une première extrémité inférieure (60, 62), sur ladite première traverse (36) au niveau d'une extrémité supérieure (50, 52) opposée et sur ladite seconde traverse (56) dans une position intermédiaire (64) entre lesdites extrémités inférieure (60, 62) et supérieure (50, 52).

9. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 8, dans laquelle la seconde traverse (56) est montée sur charnière de manière centrale sur une extrémité inférieure (68) dudit élément de transmission (44), à son tour monté sur charnière dans une position intermédiaire sur la première traverse (36) et au niveau d'une extrémité supérieure sur le châssis (16), ledit élément de transmission (44) comprenant une suspension (48).

10. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications 1 à 6, dans laquelle ledit élément de transmission (44) est monté sur charnière sur le châssis (16) de façon à permettre une oscillation de l'élément de transmis-

sion (44) autour d'un axe parallèle à l'axe de tangage (B-B) de la motocyclette (4), lesdites extrémités distales (40, 42) de ladite première traverse (36) sont montées sur charnière sur les extrémités supérieures (50, 52) desdits montants (26, 28) et le centre (C) de la première traverse (36) est monté sur charnière sur l'élément de transmission (44), l'élément de transmission (44) comprenant ladite suspension (48) reliée audit élément de transmission.

11. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications précédentes, dans laquelle les axes de rotation des charnières de ladite première traverse (36) et des charnières des montants (26, 28) sont parallèles à l'axe de roulis (R-R).

12. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications précédentes, dans laquelle ladite suspension (48) comprend au moins un ressort et un amortisseur se déformant le long d'un axe longitudinal (L-L) de la suspension (48).

13. Motocyclette basculante (4) ayant au moins trois roues selon l'une quelconque des revendications précédentes, comprenant un raccord articulé (22) placé entre le cadre (16) et l'extrémité arrière (20) pour accomplir lesdits roulage et tangage du cadre (16).

14. Motocyclette basculante (4) ayant au moins trois roues selon la revendication 13, où ledit raccord articulé (22) comprend un raccord Neidhart.

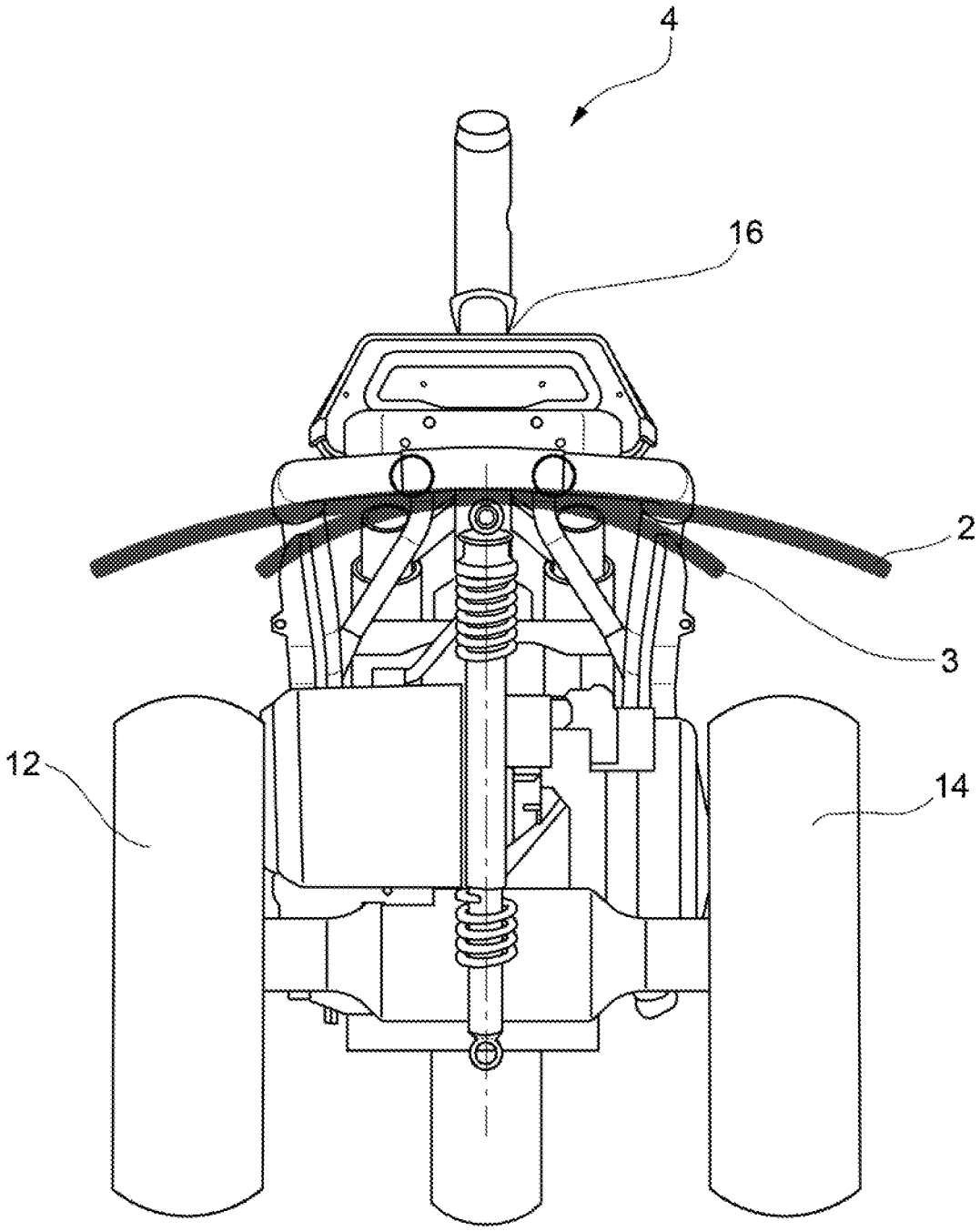

FIG.1
(ARTE NOTA)

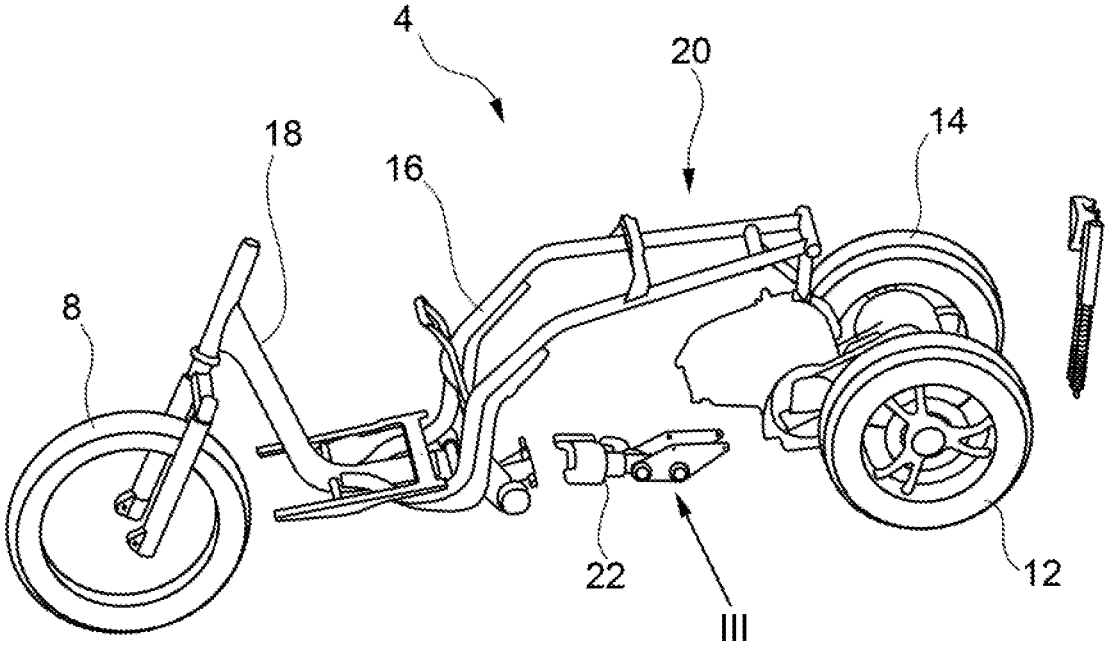

FIG.2

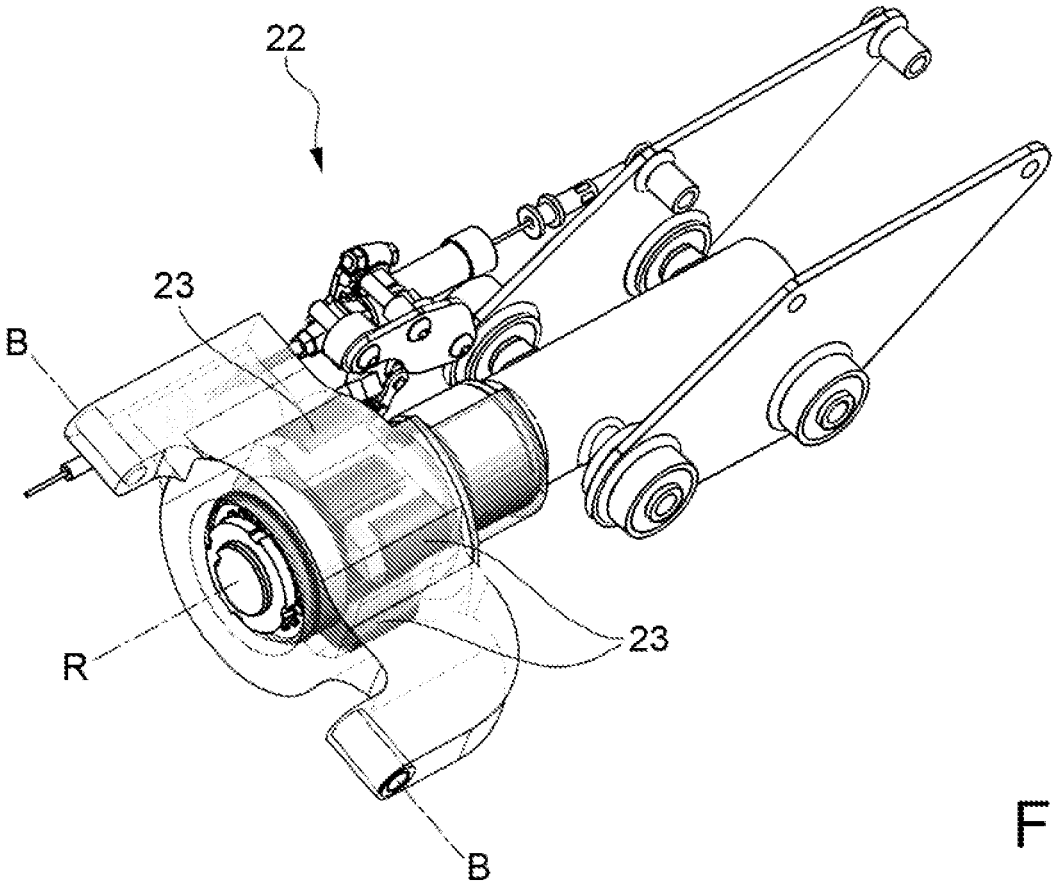

FIG.3

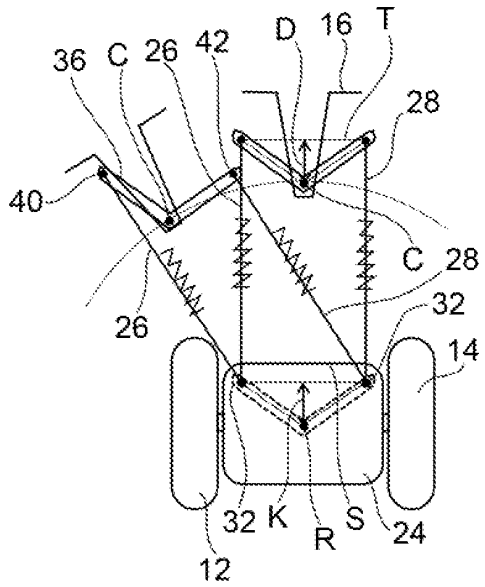

FIG.5a

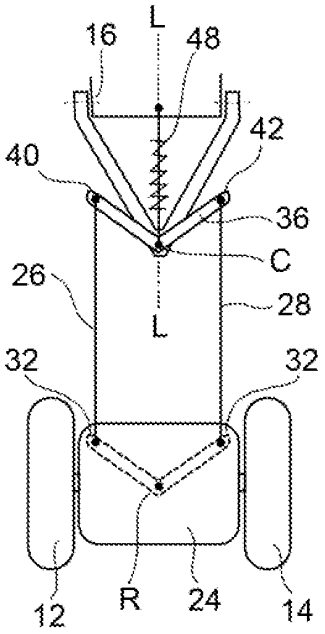

FIG.5c

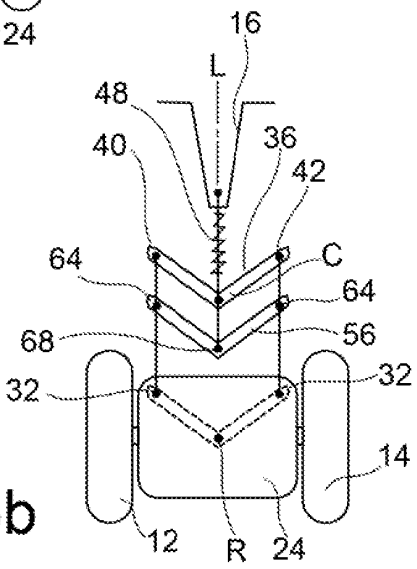

FIG.5b

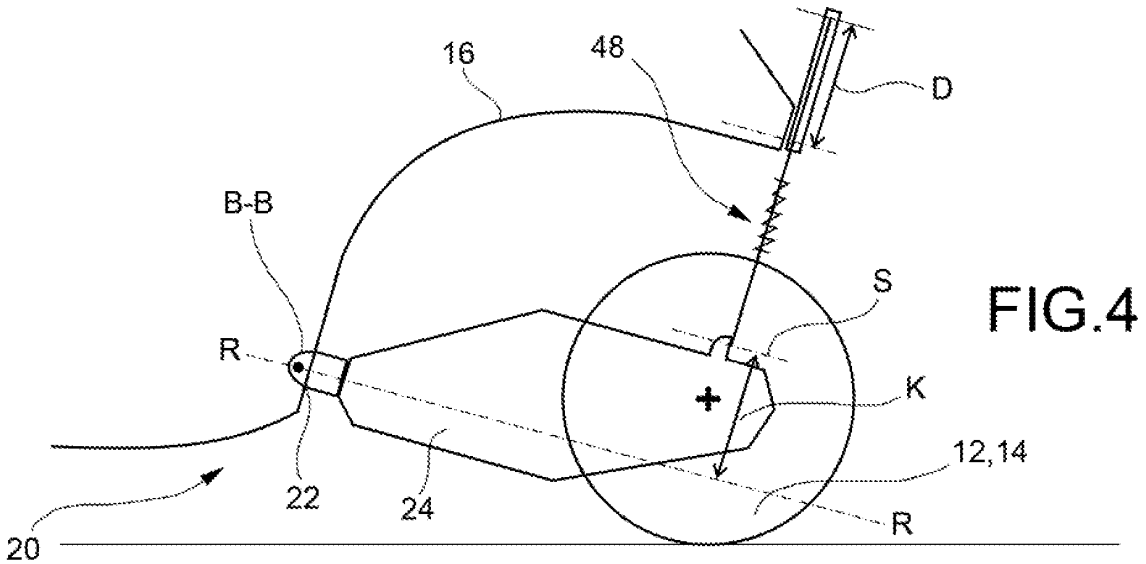

FIG.4

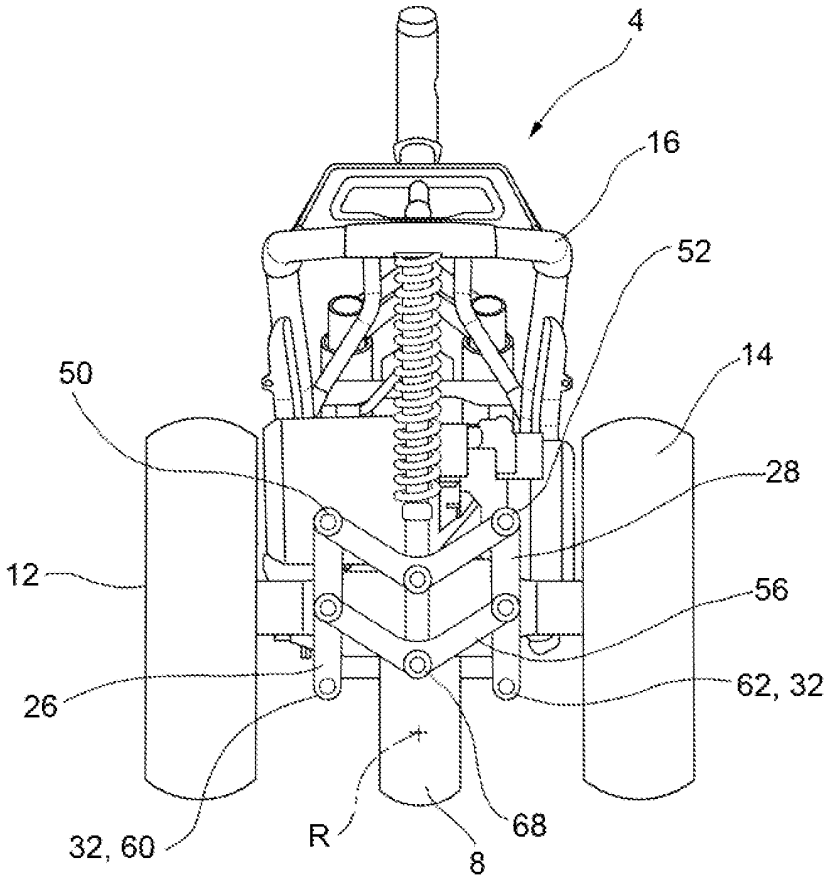
4
16
52
14
50
28
12
56
26
62, 32
32, 60
R
68
8

FIG. 6

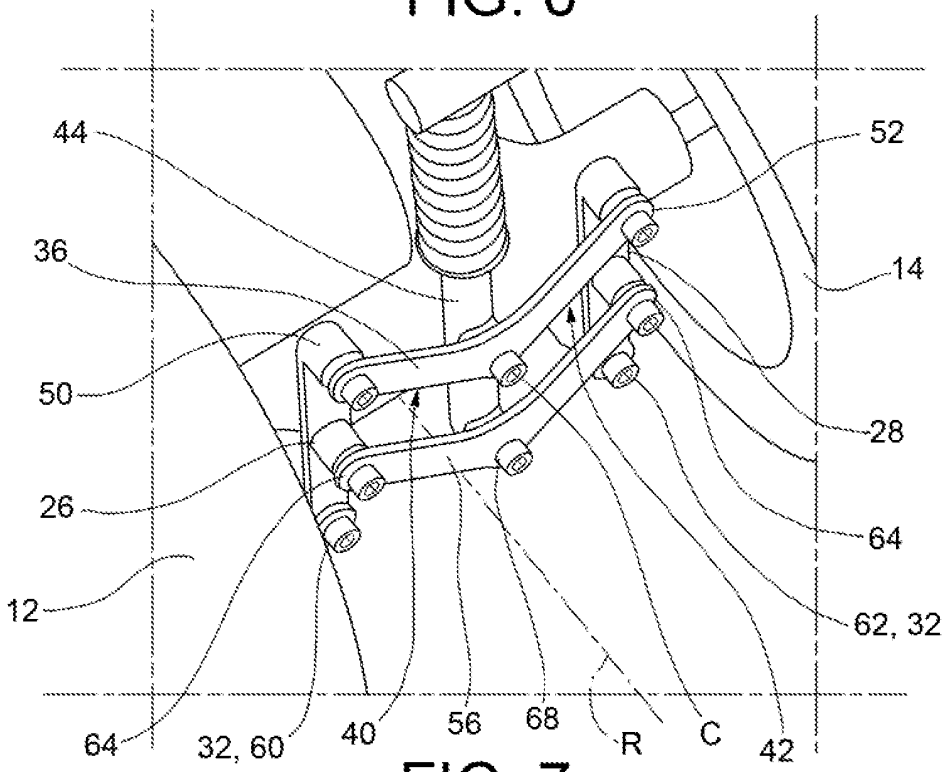
44
52
36
14
50
28
26
64
12
62, 32
64
32, 60
40
56
68
R
C
42

FIG. 7

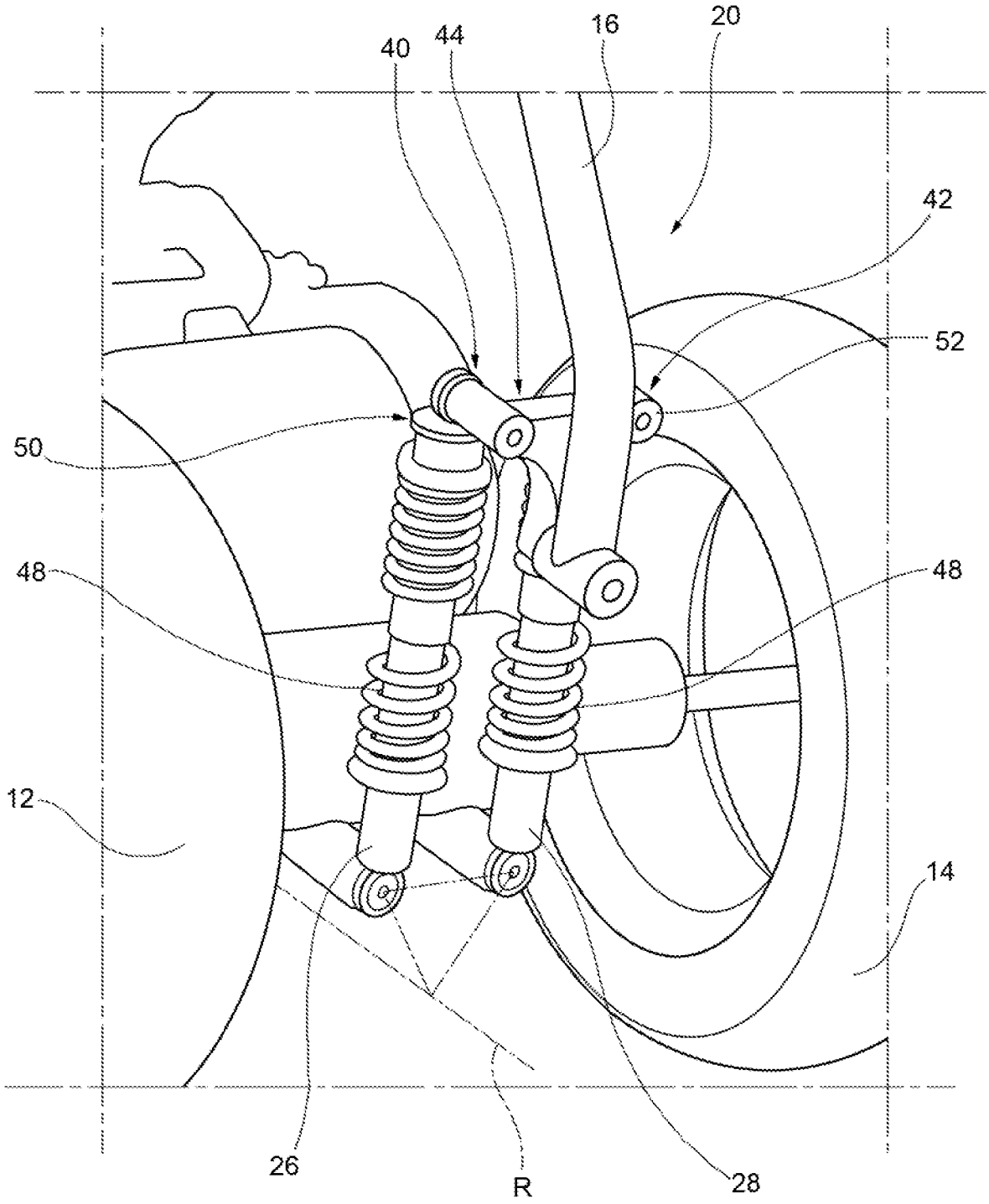

FIG. 8

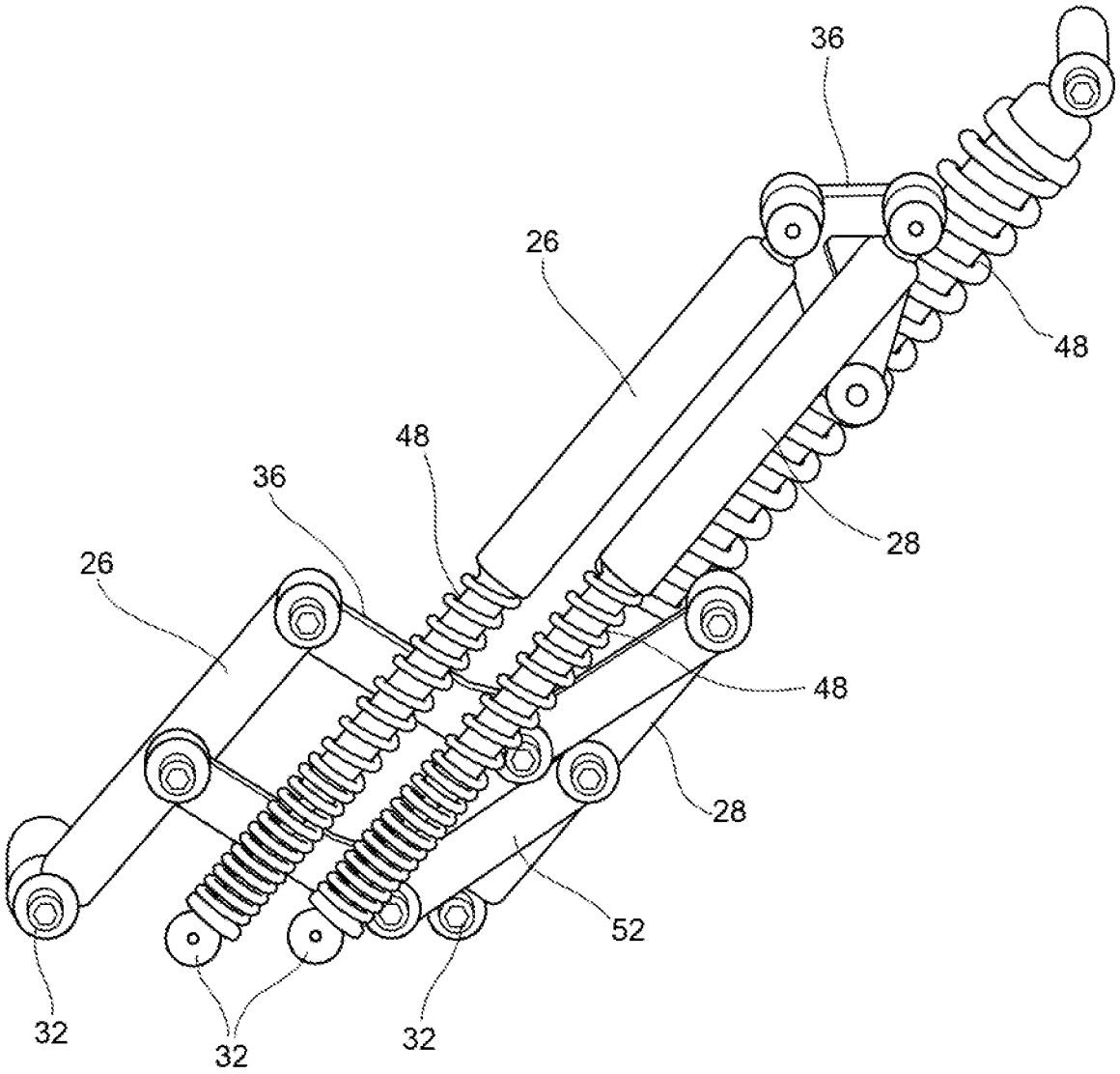

FIG. 9

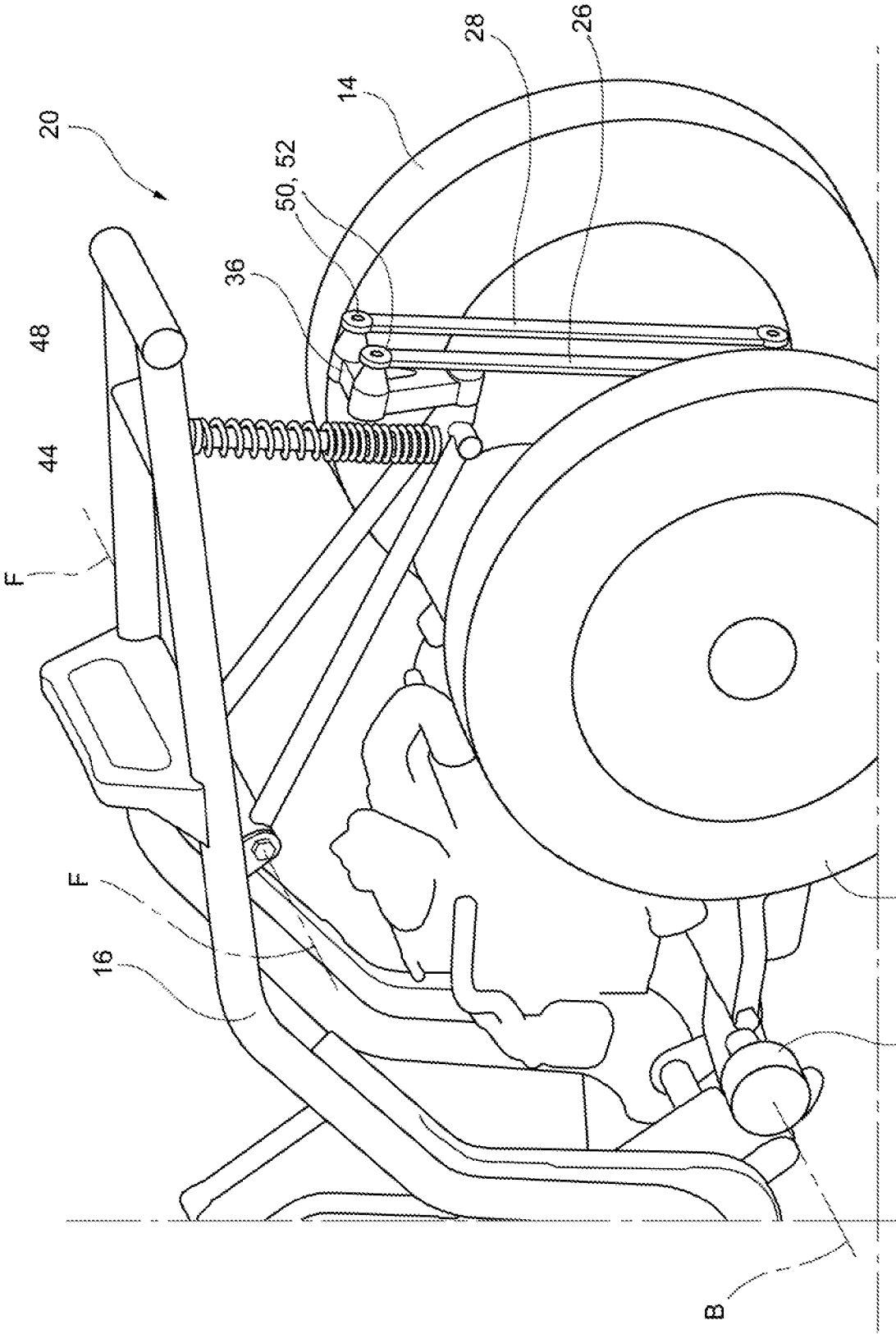

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2005095195 A1 **[0009]**