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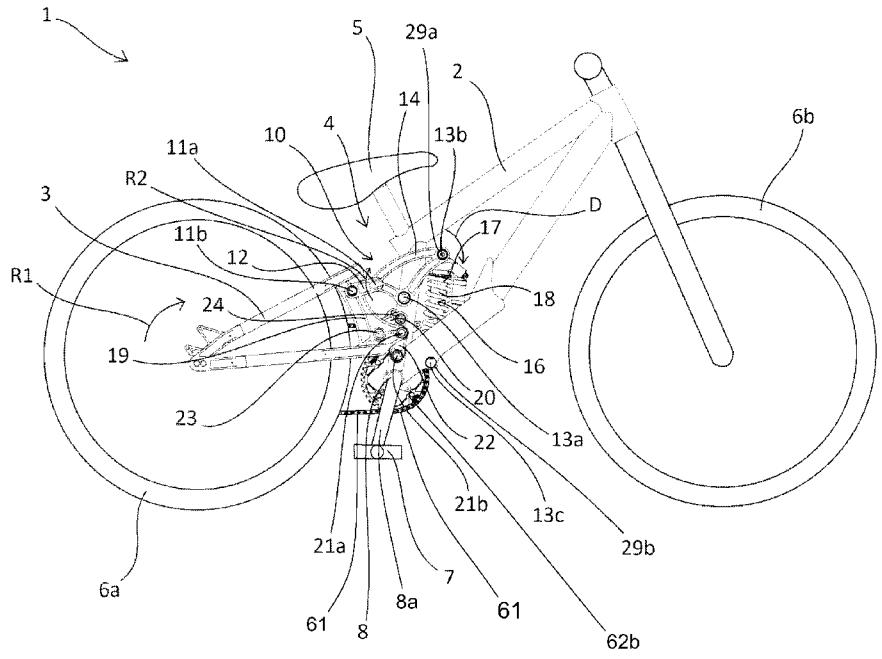


FIG. 1

(57) **Abstract:** A bicycle (1) has an instant centre (IC) and including separate front and rear frames (2,3). The front frame (2) is supported by a front wheel (6b) and the rear frame (3) is supported by a rear wheel (6a) rotatable about a rear hub (9). A set of pivoting members (4) connect the front and rear frames (2,3) through pivotal connections (11a-b,13a-c,21a-b,23-24) and a biased dampening device (16). The pivoting members (4) include a lower member (22) extending from a first lower join (21) a to a second lower join (21b), and a mid member (20) extending from a forward mid pivot (24) to a rear mid pivot (23). The forward mid pivot (24) and the second lower join (21b) are connected to the front frame (2) at pivots 21b, (24) with fixed axes relative to the front frame (2). The instant centre (IC) moves rearwardly and downwardly from a first resting position to a second activated position, through a path (50) intersecting the forward mid pivot (24) and a substantially horizontal cylindrical footprint corresponding to the axial bore of the forward mid pivot (24).

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BICYCLE LINKAGE

FIELD OF INVENTION

This invention relates to a bicycle linkage.

BACKGROUND ART

The following references to and descriptions of prior proposals or products are not intended to be, and are not to be construed as, statements or admissions of common general knowledge in the art. In particular, the following prior art discussion should not be assumed to relate to what is commonly or well known by the person skilled in the art, but to assist in the inventive process undertaken by the inventor and in the understanding of the invention.

Bicycle linkages have been described in which the stroke length of a bias means is effectively lengthened (US6,164,676 to Wilcox) or the instant centre of a bicycle with rear suspension is adapted to move upwardly and rearwardly of a lower link proximal to the pedal shaft (US7,815,207 to Curry). However, these systems still experience pedal kickback and undesirable anti-squat performance.

An object of the present invention is to ameliorate one or more of the aforementioned disadvantages of the prior art or to at least provide a useful alternative thereto. More particularly, this invention may provide a bicycle linkage adapted to create favourable anti-squat, anti-rise and/or reduced pedal kickback.

STATEMENT OF INVENTION

The invention according to one or more aspects is as defined in the independent claims. Some optional and/or preferred features of the invention are defined in the dependent claims.

Accordingly, in one aspect of the invention there is provided:

A bicycle having an instant centre and including separate front and rear frames, the front frame supported by a front wheel and a rear frame supported by a rear wheel rotatable about a rear hub, a set of pivoting members connecting the front and rear frames through pivotal connections and a biased dampening device, the pivoting members including:

a lower member extending from a first lower join to a second lower join; and

a mid member extending from a forward mid pivot to a rear mid pivot,

wherein:

the forward mid pivot and the second lower join are connected to the front frame at pivots with fixed axes relative to the front frame;

in a first resting position in which the rear hub lies below the instant centre:

the forward mid pivot and the second lower join lie in a substantially upright plane;

the first lower join lies in a substantially lateral plane; and

the rear mid pivot is positioned below the lateral plane,

in a second activated position in which the biased dampening device is actuated and the rear hub is raised above the instant centre:

the lower member rotates so that the first lower join travels rearwardly through the upright plane; and

the mid member rotates so that the rear mid pivot travels upwardly through the lateral plane.

The instant centre preferably moves rearwardly and downwardly from the first position to the second position. The instant centre preferably travels through a path intersecting the forward mid pivot. The instant centre preferably travels through a path intersecting a substantially horizontal cylindrical footprint corresponding to the axial bore or bolt of the forward mid pivot.

Preferably, the path of the instant centre follows a rearward and downwardly inclined trajectory at an angle theta. The angle theta may be between about 25 – 40 degrees, and preferably 30 – 35 degrees relative to a horizontal plane, assuming both front and rear wheels are at rest on a flat surface.

Preferably, the extent of travel or maximum distance of the instant centre pathway is less than the spacing between the rear mid pivot and the forward mid pivot.

In this specification the instant centre (IC) is a centre or focus of an arc of a path of movement of a centre of the rear hub relative to the front frame. The instant centre may change as the rear frame moves relative to the front frame. The arc is an arc of a set of points which include the centre of the rear hub, are on the path of movement of the centre of the rear hub and which are infinitesimally close to each other or within 1mm from each other.

ALTERNATIVES, OPTIONS AND PREFERMENTS

The bicycle is preferably a two wheeled vehicle and may be powered by a human operator. The two wheeled vehicle may be powered by an electric

motor or a fuel powered engine. Preferably, the two wheeled vehicle is powered by a human operator with pedals. The two wheeled vehicle may be a road bike, a mountain bike, a downhill mountain bike, a hybrid road/mountain bike or a powered bicycle. Preferably, the two wheeled vehicle is a downhill mountain bike.

The front frame and rear frame may be made of metal such as aluminium or stainless steel. The front frame and rear frame may be made of a composite material such as carbon fibre or fibreglass. The front frame and rear frame may be made of wood. The front frame and rear frame may be made of a combination of different materials. Preferably, the front frame and rear frame are made of aluminium or stainless steel. The front frame and rear frame may be a single length, a triangular structure, or another truss-like structure with multiple members. Preferably, the front frame and rear frame are triangular structures. The front frame and rear frame may include hollow bars, flat supports and other supporting structures. Preferably, the front frame and rear frame include hollow bars and other supporting structures. The other supporting structures forming the front and rear frames may include webbed ribs or other supporting structures such as beam sections in the shape of the letter I. Preferably, the supporting structures forming the front and rear frames include webbed ribs. The front frame may be positioned on both sides of a front wheel. The front frame may be positioned on one side of the front wheel. Preferably, the front frame is positioned on both sides of the front wheel.

The rear frame may be positioned on both sides of a rear wheel. The rear frame may be positioned one side of the rear wheel. Preferably, the rear frame is positioned on both sides of the rear wheel.

There may be duplicates of some or all of the pivoting members on the two wheeled vehicle. There may be symmetrical duplicates of the pivoting members positioned on each side of a vertical plane intersecting the centre of the front and rear wheel hubs. Preferably, there are symmetrical duplicates of the pivoting members positioned on each side of the vertical plane intersecting the centre of the front and rear wheel hubs. Some or all of the pivoting members may be positioned between members of the front frame. Some or all of the pivoting members may be positioned outside the front frame. Preferably, all the pivoting members are positioned outside the front frame. Some or all of the pivoting members may be positioned between members of the rear frame. Some or all of the pivoting members may be positioned outside the rear frame. Preferably, some of the pivoting members are positioned in between members

of the rear frame and some of the pivoting members are positioned outside the rear frame.

Pivot joints connecting pivoting members may include ball bearings. Pivot joints connecting pivoting members may include lubricated rods. Pivot joints connecting pivoting members may include bolts. Preferably, the pivot joints include ball bearings.

The pivoting members may be made of materials including metal or composite materials, including polymeric material. Preferably, the pivoting members are made of aluminium or stainless steel. The pivoting members may include hollow bars, solid bars, triangular or truss support members or other structural shapes. Preferably, the pivoting members include solid bars. The solid bars forming the pivoting members may have sections in the shape of the letter I, L or T. Preferably, the bars forming the pivoting members have sections in the shape of the letter I.

The second upper member may be bars arranged in a triangular shape with pivot joints at each vertex. The second upper member may be a solid plate or other structural shape. The second upper member may be a T or L shaped bar. Preferably, the second upper member is bars arranged in a triangular shape with pivot joints at each vertex.

The spring device may include a metal spring or spring made of other materials. The spring device may include compressed air in a cylinder. Preferably, the spring device includes a metal spring. The dampening device may include a cylinder and piston in which fluid or air is forced in and out of an opening. The dampening device may include other typical dampening devices. Preferably, the dampening device includes a cylinder and piston in which air is forced through an opening between two chambers.

The biased dampening device may include a metal spring, spring made of other materials, compressed air in a cylinder, a cylinder and piston in which fluid or air is forced in and out of an opening or other typical dampening devices. Preferably, the biased dampening device includes a metal spring and a cylinder and piston in which fluid is forced in and out of an opening.

Lines or planes intersecting or approximately intersecting pivots may be intersecting or approximately intersecting a bore or cylindrical shaft of the pivot or may be intersecting or approximately intersecting a point directly in the centre of the pivot. Preferably lines or planes intersecting or approximately intersecting pivots is lines or planes intersecting or approximately intersecting a

bore or cylindrical shaft of the pivot.

The bicycle may include a drivetrain. The drivetrain may include at least one chain. Preferably, the drivetrain includes a chain wrapped around and engaged with a set of sprockets. The set of sprockets may include first sprockets which may be concentric with and fixed to the rear hub (rear wheel hub). The first sprockets may include multiple sprockets. The first sprockets may include between 1 and 15 sprockets. The set of sprockets may include a second sprocket fixed to and engaged with a pedal shaft. The pedal shaft may be adapted to rotate in bearings attached to the front frame. Pedal arms may extend from the pedal shaft and pedals may be attached to and rotate relative to the pedal arms.

The drivetrain may further include a derailleur and an idler pulley. The idler pulley may be attached to the rear frame. A centre of the idler pulley may not move relative to the rear frame. The idler pulley may include a third sprocket. In the first resting position a centre of the third sprocket may be vertically higher than a centre of the first sprockets. Preferably, in the first resting position an upper most point of the third sprocket is vertically higher than an upper most point of the largest sprocket of the first sprockets. In the first resting position, a first line may extend between the uppermost point of the any one of the first sprockets and the uppermost point of the third sprocket. In the first resting position, an angle "beta" is an angle between the first line and horizontal. The angle beta may be above 1 degree. The angle beta may be between 1° and 20°, more preferably between 1° and 13°, still more preferably between 2° and 10°, and most preferably between 2° and 9°.

The uppermost point of the third sprocket may be within 80 millimetres (mm), more preferably 50mm, still more preferably 30mm, and most preferably 25mm, of the instant centre over a full travel of the rear frame relative to the front frame.

Therefore, advantageously, the idler pulley may be positioned on the rear frame relative to the first sprocket such that pedal feedback of the bicycle is removed and/or reduced and anti-squat of the bicycle is reduced compared to having no idler pulley.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be better understood from the following non-limiting description of preferred embodiments, in which:

Figure 1 is a side view of a bicycle having a bicycle linkage according to

a first embodiment of the invention;

Figure 2 is a side view of the bicycle linkage shown in Fig. 1;

Figure 3 is a rear view of a bicycle having a bicycle linkage according to a first embodiment of the invention;

Figs. 4a-c and 5 are side views of the bicycle shown in Fig. 1 showing the pivoting members rear frame, biased dampening device and linkages in first and second positions;

Figure 5 is a side view of the bicycle linkage shown in Fig. 1in which movable members are designated with the suffix "a" in the first position, and with the suffix "b" in the second position;

Figures 6a – 6e are schematic views showing screen captures of a CAD testing program in relation to the first embodiment of the invention in which IC is shown as it transitions from the first position shown in Fig. 6a through to the second position shown in Fig. 6e;

Figures 7a – 7e are schematic views showing screen captures of a CAD testing program in relation to the first embodiment of the invention in which IC is shown as it transitions from the first position shown in Fig. 7a through to the second position shown in Fig. 7e; and

Figure 8 is a schematic view of the idler pulley, first sprockets and a pedal according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Preferred features of the present invention will now be described with particular reference to the accompanying drawings. However, it is to be understood that the features illustrated in and described with reference to the drawings are not to be construed as limiting on the scope of the invention.

A bicycle 1 having an instant centre IC and including separate front and rear frames 2,3, the front frame 2 supported by a front wheel 6b and the rear frame 3 supported by a rear wheel 6a rotatable about a rear hub 9, a set of pivoting members 4 connecting the front and rear frames 2,3 through pivotal connections 11a-b,13a-c,21a-b,23-24 and a biased dampening device 16, the pivoting members 4 including:

a lower member 22 extending from a first lower join 21a to a second lower join 21b; and

a mid member 20 extending from a forward mid pivot 24 to a rear mid pivot

23,

wherein, the forward mid pivot 24 and the second lower join 21b are connected to the front frame 2 at pivots 21b,24 with fixed axes relative to the front frame 2;

in a first resting position (see Fig. 4a) in which the rear hub 9 lies below the instant centre IC:

the forward mid pivot 24 and the second lower join 21b lie in a substantially upright plane U;

the first lower join 21a is located in a substantially lateral plane L; and

the rear mid pivot 23 is positioned below the lateral plane L,

in a second activated position (see Fig. 4b) in which the biased dampening device 16 is actuated and the rear hub 9 is raised above the instant centre IC:

the lower member 22 rotates so that the first lower join 21a travels rearwardly through the upright plane U; and

the mid member 20 rotates so that the rear mid pivot 23 travels upwardly through the lateral plane L.

The instant centre IC moves rearwardly and downwardly from the first resting position to the second activated position. The instant centre IC travels through a path 50 intersecting the forward mid pivot 24. The instant centre IC travels through a path 50 intersecting a substantially horizontal cylindrical footprint corresponding to the axial bore or bolt of the forward mid pivot 24.

The path 50 of the instant centre IC extends in a rearward and downward inclined trajectory at an angle theta. The angle theta may be between about 25 – 40 degrees, and preferably 30 – 35 degrees relative to a horizontal plane H, as assessed when both front and rear wheels 6a-b are at rest on a flat surface.

The extent of travel or maximum distance of the instant centre pathway 50 is less than the spacing between the rear mid pivot 23 and the forward mid pivot 24.

A bicycle 1 including a front and a rear frame 2, 3 connected with pivoting members 4, the pivoting members 4 including an upper member set 10, a mid member 20 and a lower member 22, the upper member set 10 including a spring and dampening device 16,

wherein:

the mid and lower members 20, 22 are connected to the front and rear frames

2, 3,

the spring and dampening device 16 shortens and extends with the relative movement of the rear frame 3;

the mid member 20 has a rear mid pivot 23 connected to the rear frame 3 and a forward mid pivot 24 connected to the front frame 2,

the lower member 22 has a first lower join 21a connected to the rear frame 3 and a second lower join 21b connected to the front frame 2,

in a first resting position, when no forces are applied to the bicycle 1:

the mid member 20 is orientated between 30 to 40 degrees from the horizontal;

the lower member 22 is orientated between 70 to 80 degrees from the horizontal;

the forward mid pivot 24 is located above the rear mid pivot 23 and closer to a front wheel 6b than the rear mid pivot 23;

the first lower join 21a is above the second lower join 21b and closer to the front wheel 6b than the second lower join 21b;

a horizontal line through the rear mid pivot 23 would intersect an axially extending projection of a bore of a cylindrical shaft of the first lower join 21a;

a vertical line through the forward mid pivot 24 would intersect an axially extending projection of a bore of a cylindrical shaft of the second lower join 21b;

the joins 11b, 11a, 13a, 13b, 13c, 23, 24, 21a, 21b between the pivoting members 4 are pivot joins; and

an instant centre of the bicycle 1 moves a distance less than the distance between the rear mid pivot 23 and the forward mid pivot 24 relative to the front frame 2 as the front frame 2 and the rear frame 3 move relative to each other.

The two wheeled vehicle in the form of a bicycle 1 includes a front frame 2 and a rear frame 3 connected with pivoting members 4. The rear frame 3 includes webbed ribs 19 to provide structural support around the rear pivot point 11b, rear mid pivot 23 and the first lower join 21a. The rear frame 3 is substantially symmetrical on both sides of the rear wheel 6a. The pivoting members 4 including an upper member set 10, a mid member 20, a lower member 22, a

back upper member set 30, a back mid member 40 and a back lower member 42. The upper member set 10, mid member 20 and lower member 22 are on the opposite side of the front frame 2 to the back upper member set 30, back mid member 40 and back lower member 42. The upper member set 10 including a first upper member 12, a second upper member 14 and a spring and dampening device 16.

The other side of the set of pivoting members 4 includes a back upper member set 30. The back upper member set 30 is located on the other side of a bi-lateral plane extending along the bicycle 1 and includes a back first upper member 32 that mirrors the first upper member 12 and operates in a corresponding manner to the first upper member 12. The back upper member set 30 also includes a back second upper member 34. The first upper member 12 joins the rear frame 3 to the second upper member 14. The back first upper member 32 joins the rear frame 3 to the back second upper member 34.

In the first resting position, the first upper member 12 and the back first upper member 32 are orientated approximately 15.5 degrees from the horizontal wherein the first upper pivot point 11a is above the rear pivot point 11b and the back first upper pivot point 31a is above the back rear pivot point 31b.

The first upper pivot point 11a is closer to the front wheel 6b than the rear pivot point 11b and the back first upper pivot point 31a is closer to the front wheel 6b than the back rear pivot point 31b. The first upper member 12 and the back first upper member 32 have a substantially I-shaped cross section which may assist to increase strength and reduce weight due to the lateral flanges and the interior cavities so formed. The second upper member 14 is connected to the front frame 2, the first upper member 12 and the spring and dampening device 16. The back second upper member 34 is a mirror of the second upper member 14 and is also connected to the front frame 2 and the spring and dampening device 16. The back second upper member 34 is also connected to the back first upper member 32.

In the first resting position, a line from the third upper join 13b to the first upper pivot point 11a is around 24 degrees from the horizontal wherein the third upper join 13b is above the first upper pivot point 11a, wherein, the third upper join 13b is closer to the front wheel 6b than the first upper pivot point 11a.

In the first resting position, a line from the back third upper join 33b to the back first upper pivot point 31a is around 24 degrees from the horizontal, wherein the back third upper join 33b is above the back first upper pivot point

31a. The back third upper join 33b is closer to the front wheel 6b than the back first upper pivot point 31a.

In the first resting position, a line from the second upper pivot point 13a to the first upper pivot point 11a is around 26 degrees from the horizontal, wherein the first upper pivot point 11a is above the second upper pivot point 13a. The second upper pivot point 13a is closer to the front wheel 6b than the first upper pivot point 11a.

In the first resting position, a line from the back second upper pivot point 33a to the back first upper pivot point 31a is around 26 degrees from the horizontal, wherein the back first upper pivot point 31a is above the back second upper pivot point 33a. The back second upper pivot point 33a is closer to the front wheel 6b than the back first upper pivot point 31a.

In the first resting position, a line from the second upper pivot point 13a to the third upper join 13b is around 49 degrees from the horizontal, wherein the third upper join 13b is above the second upper pivot point 13a. The third upper join 13b is closer to the front wheel 6b than the second upper pivot point 13a.

In the first resting position, a line from the back second upper pivot point 33a to the back third upper join 33b is around 49 degrees from the horizontal, wherein the back third upper join 33b is above the back second upper pivot point 33a. The back third upper join 33b is closer to the front wheel 6b than the back second upper pivot point 33a.

The second upper member 14 includes three bars joined at pivot points 11a, 13b and 13a, wherein the bars have a cross section substantially in the shape of the letter I. The back second upper member 34 includes three bars joined at pivot points 31a, 33b and 33a wherein the bars have a cross section substantially in the shape of the letter I.

The spring and dampening device 16 is connected to the front frame 2 wherein the spring and dampening device 16 shortens and extends linearly with a movement restricted by a spring 17 and a dampener 18. The spring and dampening device 16 is orientated at approximately (+- .5 degrees) 83.5 degrees from the horizontal in the first resting position, wherein the third upper join 13b is above the lower dampener join 13c and the third upper join 13b is closer to the front wheel than the lower dampener join 13c.

The third upper join 13b is connected to the back third upper join 33b through an upper dampener shaft 29a and the lower dampener join 13c is connected to the back lower dampener join 33c through a lower dampener shaft 29b. The

mid member 20 is connected to the rear frame 3 and the front frame 2.

The back mid member 40 is a mirror of the mid member 20 and is also connected to the rear frame 3 and the front frame 2. The mid member 20 has a cross section substantially in the shape of the letter I which may be effective to increase strength and to reduce weight. The back mid member 40 also has a cross section substantially in the shape of the letter I.

Both the mid member 20 and back mid member 40 are orientated from the horizontal (in the first resting position) approximately 25 - 45°, more particularly 30 - 40°, and most particularly 35.5 degrees (+/- 0.5 degrees), wherein the forward mid pivot 24 is above the rear mid pivot 23 and the back forward mid pivot 44 is above the back rear mid pivot 43. The forward mid pivot 24 is closer to the front wheel 6b than the rear mid pivot 23 and the back forward mid pivot 44 is closer to the front wheel 6b than the back rear mid pivot 43.

The lower member 22 is connected to the rear frame 3 and the front frame 2. The back lower member 42 is a mirror of the lower member 22 and is also connected to the rear frame 3 and the front frame 2. The lower member 22 has a cross section substantially in the shape of the letter I. The back lower member 42 also has a cross section substantially in the shape of the letter I.

In the first resting position, both the lower member 22 and the back lower member 42 are orientated from the horizontal approximately 60 - 90°, more particularly 70 - 85°, still more particularly 75 - 80°, and most particularly 78 degrees (+/-0.5 degrees), wherein the first lower join 21a is above the second lower join 21b and the back first lower join 41a is above the back second lower join 41b. In the first resting position, the first lower join 21a is closer to the front wheel 6b than the second lower join 21b and the back first lower join 41a is closer to the front wheel 6b than the back second lower join 41b. All the joins between all pivoting members 4 are pivot joins.

When the bicycle 1 goes over a bump or other forces are applied to the seat 5, the wheels 6a, 6b or the pedals 7, the front frame 2 and rear frame 3 may move relative to each other. This reduces the magnitude of sudden forces on the operator and/or the bicycle 1. For example, when force is applied downwards onto the seat 5, and upwards onto the base of the rear wheel 6a, such as may occur when riding a bump, the rear frame 3 moves in a clockwise motion in a first rotational direction R1 relative to the front frame 2. During this motion, the first upper pivot point 11a moves upwards in a second rotational direction R2. The first lower join 21a, the back first lower join 41a, the rear mid pivot 23

and the back rear mid pivot 43 moves left. The third upper join 13b and the back third upper join 33b moves downwardly in a third direction D, causing the spring and dampening device 16 to compress and shorten. Since the spring and dampening device 16 has a spring 17 and a dampener 18, the motion in directions R1,R2 and D has resistance. This resistance reduces the magnitude of sudden forces on the operator and/or the bicycle 1.

Furthermore, as the front frame 2 and rear frame 3 move relative to each other the instant centre (IC) of the bicycle 1 moves a distance horizontally and vertically less than the distance between the forward mid pivot 24 and the rear mid pivot 23 relative to the front frame 2. The IC is the intersection of two lines drawn through the pivot points of the mid member 20 and the lower member 22. One line intersects the rear mid pivot 23 and the forward mid pivot 24 and the other line intersects the first lower join 21a and the second lower join 21b. Fig. 2 shows the range of locations of the IC of the bicycle 1 represented by the line 50 as the bicycle 1 moves from the first resting position to the second activated position.

With reference to Figs. 6a – e and 7a - e, the pivoting members 4 are represented schematically. These drawings demonstrate the path of travel T of the rear hub 9 between the first resting position respectively shown in Figs. 6a and 7a and the second activated position respectively shown in Figs. 6e and 7e. The locations of the IC at five positions on the path of travel T are also shown in Figs. 6a – e and 7a - e, respectively. The anti-squat percentages of the bicycle at positions along the path of travel T are shown in a graph on the left side of each of Figs. 6a – e. The pedal kickback values are shown in a graph on the left side of Figs. 7a – e. The advantageous effect of the pivoting members 4 is that they result in desirable anti-squat percentages, anti-rise values and low pedal kickback.

The bicycle 1 further includes a drivetrain 60. The drivetrain 60 includes a chain 61 wrapped around and engaged with a set of sprockets 62a-e. The set of sprockets 62a-e includes first sprockets 62a which are concentric with and fixed to the rear hub 9 (rear wheel hub). The first sprockets 62a include multiple sprockets. The first sprockets 62a may include between 1 and 15 sprockets. The first sprockets 62a shown in Fig. 3 includes 6 sprockets. The bicycle 1 is adapted to engage the chain 61 with one of the first sprockets 62a at a time. A derailleur 63 is adapted to move the chain 61 from one of the first sprockets 62a to another one of the first sprockets 62a. The set of sprockets 62a-e include a second sprocket 62b which is fixed to and engaged with a pedal

shaft 8. The pedal shaft 8 is adapted to rotate in bearings attached to the front frame 2. Pedal arms 8a extend from the pedal shaft 8 and pedals 7 are attached to and rotate relative to the pedal arms 8a.

The drivetrain 60 may further include a derailleur 63 and an idler pulley 64. The idler pulley 64 may be attached to and rotate relative to the rear frame 3. The idler pulley 64 includes a third sprocket 62c, which is attached to the rear frame 3. The position of a centre of the third sprocket 62c does not move relative to the rear frame 3. An uppermost point of the third sprocket 62c is within 25mm of the instant centre IC over the full travel of the rear frame 3 relative to the front frame 2, which includes the first resting position and the second activated position. In the first resting position an upper most point 62ci of the third sprocket 62c is vertically higher than an upper most point 62ai of a largest 62aii of the first sprockets 62a. In this specification, an upper contact point of one of first sprockets is a location which does not move relative to the rear frame 3 and which the one of the first sprockets passes through when it first contacts the chain 61 coming from the third sprocket 62c. It is noted that the upper contact point may be different for different sprockets of the first sprockets 62a. In this specification, an upper contact point of the third sprocket 62c is a location which does not move relative to the rear frame 3 and which the third sprocket 62c passes through when the chain 61 last contacts the third sprocket 62c as it leaves the third sprocket 62c and moves towards the one of the first sprockets 62a.

First lines 66 may extend between the upper contact point of any one of the first sprockets 62a and the upper contact point of the third sprocket 62c at any position of the rear frame 3 relative to the front frame 2. The first lines 66 may be within 10 degrees of tangent to the path of travel T at a point of intersection of each of the respective first lines and the path of travel T. The first line may be within 5 degrees of tangent to the path of travel T at the point of intersection of the first line and the path of travel T. The first line may be within 2 degrees of tangent to the path of travel T at the point of intersection of the first line and the path of travel T. Preferably, the first line is within 1 degree of tangent to the path of travel T at the point of intersection of the first line and the path of travel T. It is noted that the first line may extend linearly past the uppermost point of any one of the first sprockets 62a to intersect the path of travel T. A feedback distance is between the uppermost point of any one of the first sprockets and the upper most point of the third sprocket. At any position of the rear frame 3 relative to the front frame 2, distances between one of the first sprockets and the upper most point of the third sprocket may be within 10% of each other. At

any position of the rear frame 3 relative to the front frame 2, distances between one of the first sprockets and the uppermost point of the first sprockets. In the first resting position, a second line 65 extends between the uppermost point 62ai of the largest 62aii of the first sprockets 62a and the uppermost point 62ci of the third sprocket 62c. In the first resting position, an angle "beta" α and angle between the first line 65 (following the chain 61 shown in Fig. 3) and horizontal. The angle α is between 1 degrees and 5 degrees. Therefore, advantageously, the idler pulley 64 is positioned on the rear frame 3 relative to the first sprocket 62a such that pedal feedback of the bicycle 1 is removed and/or reduced and anti-squat of the bicycle 1 is reduced compared to having no idler pulley 64 with the same bicycle 1. Pedal feedback (pedal kickback) in this specification is the resulting rotation of the pedal arms 8a and pedal shaft 8 due to movement of the rear frame 3 relative to the front frame 2. More pedal feedback results in more oscillation and/or more movement of the pedal arms 8a, advantageously removing or reducing pedal feedback.

The following equations are used to calculate pedal kickback using the variables shown in Fig. 8. In Fig. 8, the "crank" is a pedal 7 and the "chain guide" is the idler pulley 64.

$$Pedal\ kickback = dAlpha1 * rCG + dAlpha2 * rCrank$$

$$Pedal\ kickback = \left(dA1 * \left(\left(\frac{rRearCogs}{rCG}\right) - 1\right)\right) * rCG +$$

$$(dA2 * \left(\left(\frac{rCG}{rCrank}\right) - 1\right) * rCrank$$

Where:

dAlpha1 is an angle which the idler pulley 64 rotates as a direct response to the rear frame 3 moving relative to the front frame 2;

dAlpha2 is an angle which the pedal 7 rotates as a direct response to the rear frame 3 moving relative to the front frame 2;

rCG is a maximum radius of the idler pulley 64 which is from a centre of the idler puller 64 to the uppermost point 62ci of the third sprocket 62c or idler pulley 64;

rCrank is a maximum radius of the second sprocket 62b;

dA1 is a distance which a centre of the rear hub 9 moves relative to the front frame 2 as the rear frame 3 moves relative to the front frame 2;

dA2 is a distance which the uppermost point 62ci of the third sprocket 62c moves relative to the front frame 2 as the rear frame 3 moves relative to the front frame 3; and

rRearCogs is a radius of a first sprocket 62a which the chain 61 is wrapped around.

DEFINITIONS

The meaning of descriptive, precise or absolute terms such as "flexed", "normal", "parallel", "horizontal", "vertical" or "fully" includes the preceding qualifier "substantially or almost", unless the context or contrary is expressly indicated.

Qualifying words, such as "negligible", "relatively", "sufficiently", "near", "almost" or "substantially", may be taken to indicate a variation in an absolute value of between 0° and 10° or between 0% and 10%, relative to the absolute value. For example, "near horizontal" may be taken to mean any orientation between 0° and 10° relative to the horizontal. "Negligible distance" may be taken to mean "non-material", not discernible to the eye, or a distance of less than 5%, preferably less than 2%, of the distance between the mid-member and the lower member.

Without intending to be an exhaustive definition, "anti-squat" is a term used to describe the extent of the mechanical resistance of a suspension mechanism to suspension compression forces applied by a rider to the pedals. "Pedal kick back" is a term that refers to a change in chain length which applies force to the crank against pedalling movement and can tend to affect rider stability.

Throughout the specification and claims the word "comprise" and its derivatives are intended to have an inclusive rather than exclusive meaning unless the contrary is expressly stated or the context requires otherwise. That is, the word "comprise" and its derivatives will be taken to indicate the inclusion of not only the listed components, steps or features that it directly references, but also other components, steps or features not specifically listed, unless the contrary is expressly stated or the context requires otherwise.

In the present specification, object terms such as "apparatus", "means", "device", "linkage" and "member", or similar terms, may refer to singular or plural items and are terms intended to refer to a set of properties, functions or characteristics performed by one or more items or components having one or more parts. It is envisaged that where the object term is described as being a unitary object, then a functionally equivalent object having multiple

components is considered to fall within the scope of the object term, and similarly, where the object term is described as having multiple components, a functionally equivalent but unitary object is also considered to fall within the scope of the object term, unless the contrary is expressly stated or the context requires otherwise.

Where the word "for" is used to qualify a use or application of an object term, the word "for" is only limiting in the sense that the device or component should be "suitable for" that use or application.

Orientational terms used in the specification and claims such as vertical, horizontal, top, bottom, upper and lower are to be interpreted as relational and are based on the premise that the component, item, article, apparatus, device or instrument will usually be considered in a particular orientation, typically with the second upper linkage 14,34 uppermost.

A guide table of references to features shown in the drawings is provided below:

Ref.	Description	Ref.	Description
1	bicycle	10	upper member set
2	front frame	11a	rear pivot point
3	rear frame	11b	first upper pivot pint
4	pivoting members	12	first upper member
5	seat	13a	second upper pivot point
6a,b	rear & front wheels	13b	third upper pivot
7	Pedals	13c	lower dampener pivot
8	pedal shaft	14	second upper member
8a	pedal arms		
9	rear hub	30	Back upper member set
16	spring/dampener device	31a	Back first upper pivot point
17	spring	31b	Back rear pivot point
18	dampener	32	Back first upper member
19	Webbed ribs	33a	Back second upper pivot point
20	mid member	33b	Back third upper join
21a	first lower join	33c	Back lower dampener join
21b	second lower join	29a	Upper dampener shaft
22	lower member	29b	Lower dampener shaft
23	rear mid pivot	50	instant centre pathway
24	Forward mid pivot	60	drive train
34	Back second upper member	61	chain
40	Back mid member	62a-e	set of sprockets

Ref.	Description	Ref.	Description
41a	Back first lower join	62a	first sprockets
41b	Back second lower join	62b	second sprocket
42	Back lower member	62ai	upper most point of 1st sprocket
43	Back rear mid pivot	62aii	largest first sprocket
44	Back forward mid pivot	62c	third sprocket
T	Travel of rear hub	62ci	upper most point of 3rd sprocket
IC	Instant centre	63	derailleur
ICas	line corresponding to anti-squat	64	idler pulley
ICl	line corresponding to IC	65	second line
R1	upward clockwise direction	66	first lines
R2	upward clockwise direction		

Claims:

1. A bicycle having an instant centre and including separate front and rear frames, the front frame supported by a front wheel and a rear frame supported by a rear wheel rotatable about a rear hub, a set of pivoting members connecting the front and rear frames through pivotal connections and a biased dampening device, the pivoting members including:

a lower member extending from a first lower join to a second lower join; and

a mid member extending from a forward mid pivot to a rear mid pivot,

wherein:

the forward mid pivot and the second lower join are connected to the front frame at pivots with fixed axes relative to the front frame;

in a first resting position in which the rear hub lies below the instant centre:

the forward mid pivot and the second lower join lie in a substantially upright plane;

the first lower join lies in a substantially lateral plane; and

the rear mid pivot is positioned below the lateral plane,

in a second activated position in which the biased dampening device is actuated and the rear hub is raised above the instant centre:

the lower member rotates so that the first lower join travels rearwardly through the upright plane; and

the mid member rotates so that the rear mid pivot travels upwardly through the lateral plane.

2. A bicycle as claimed in Claim 1, wherein the instant centre moves rearwardly and downwardly from the first position to the second position relative to the front frame.

3. A bicycle as claimed in Claims 1 or 2, wherein the instant centre travels through a path intersecting the forward mid pivot relative to the front frame.

4. A bicycle as claimed in Claim 3, wherein the path intersects a substantially horizontal cylindrical footprint corresponding to the axial bore or bolt of the forward mid pivot.

5. A bicycle as claimed in Claim 3 or 4, wherein the path follows a

rearward and downward inclined trajectory at an angle theta relative to the front frame.

6. A bicycle as claimed in Claim 5, wherein the angle theta is 30 – 35 degrees relative to a horizontal plane, when both front and rear wheels are at rest on a flat surface.

7. A bicycle as claimed in any one of Claims 3 to 6, wherein the length of the pathway is less than the spacing between the rear mid pivot and the forward mid pivot.

8. A bicycle as claimed in any one of Claims 1 to 7, wherein the bicycle further includes a drivetrain and an idler pulley, the drive train including a chain wrapped around and engaged with a set of sprockets, a first sprocket of the set of sprockets is coaxial with and fixed to the rear hub, a second sprocket of the set of sprockets is fixed to a pedal shaft, pedal arms extend from the pedal shaft and pedals are attached to free ends of the pedal arms, the idler pulley including a third sprocket of the set of sprockets and the chain is engaged with and extends between the second sprocket and the third sprocket and the third sprocket and the first sprocket and in the first position.

9. A bicycle as claimed in Claim 8, wherein an upper most point of the third sprocket is vertically above an uppermost point of the first sprocket.

10. A bicycle as claimed in Claims 8 or 9, wherein an uppermost point of the third sprocket is within 30 millimetres of the instant centre.

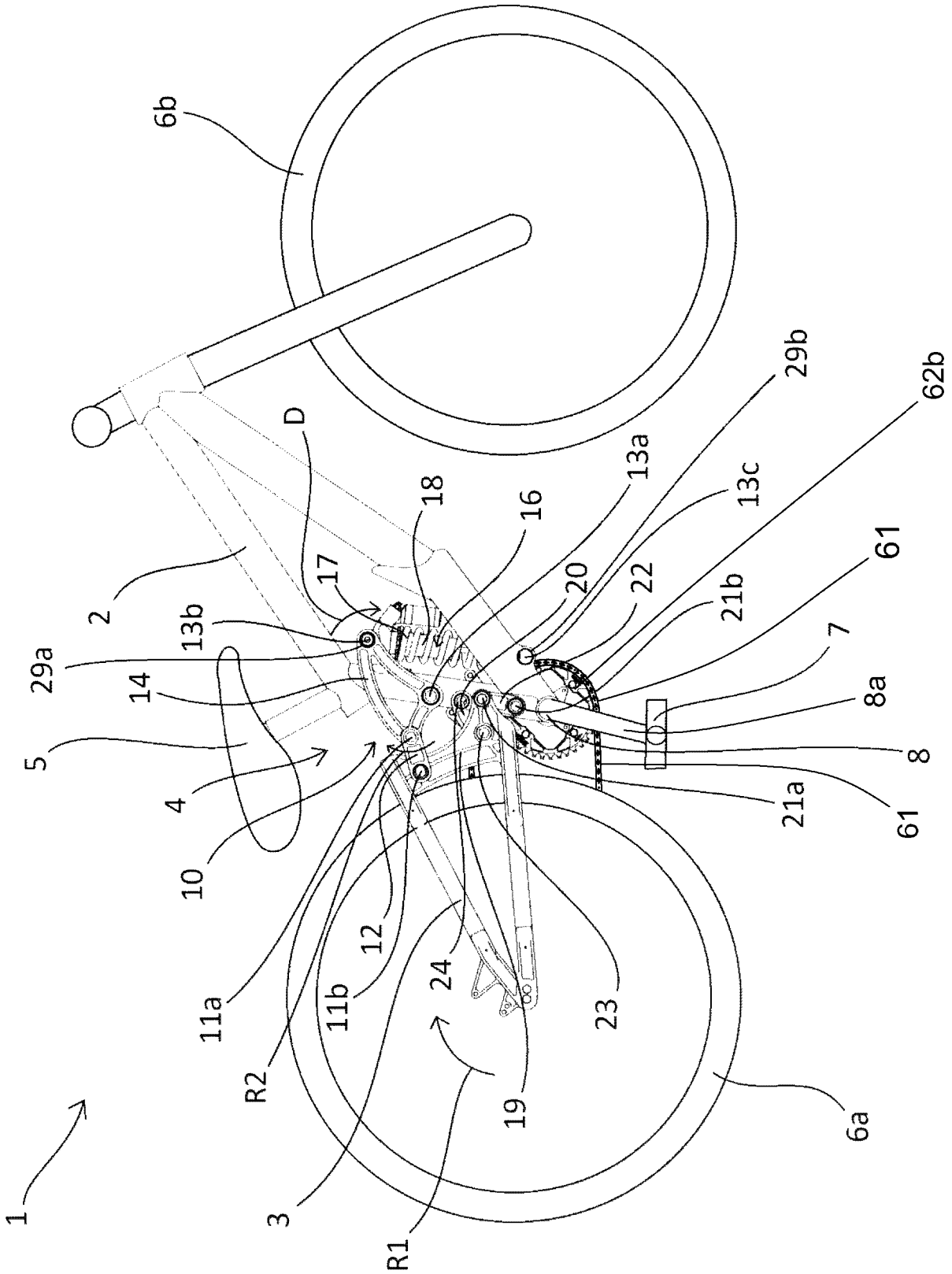

6b
D
2
17
18
16
13a
29b
62b
13c
61
29a
13b
20
22
21b
7
14
8a
5
4
8
10
21a
61
11a
11b
12
24
23
R2
19
6a
3
R1
1

FIG. 1

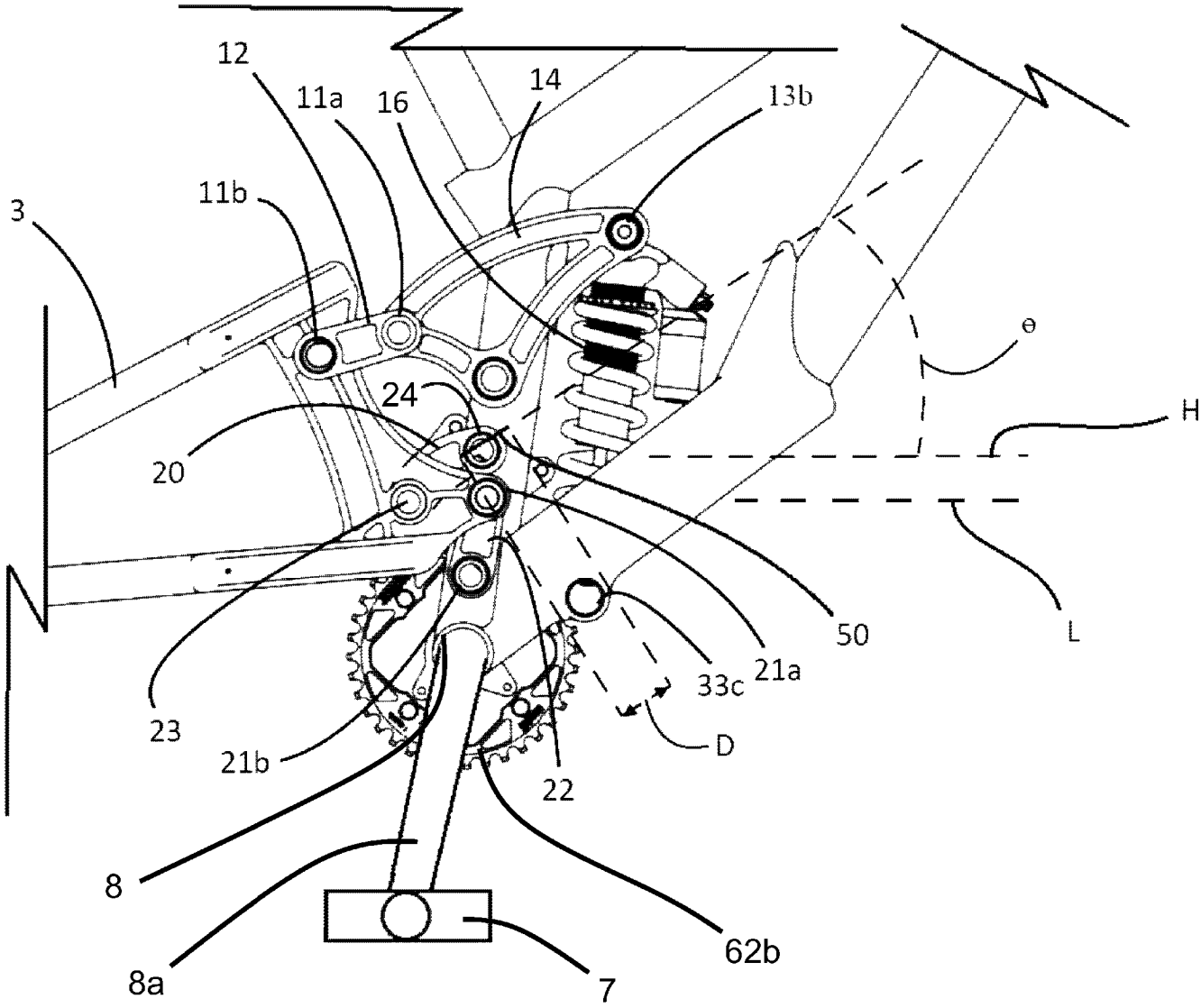


Fig. 2

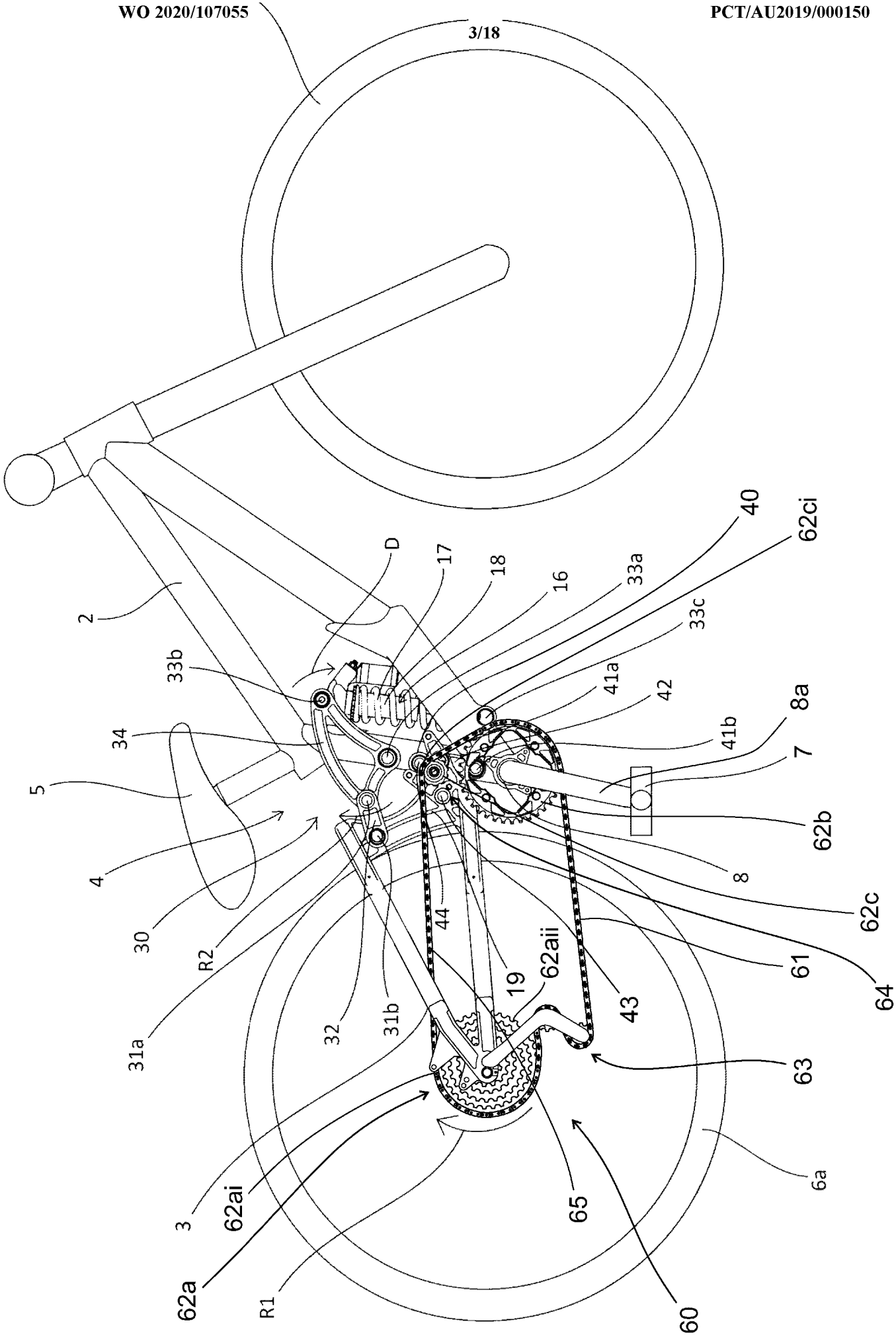

2
D
17
18
16
33a
40
62ci
33b
33c
41a
42
8a
34
41b
7
5
62b
4
8
62c
30
R2
44
61
64
31a
32
31b
19
62aii
43
63
3
62ai
65
6a
62a
R1
60

Fig. 3

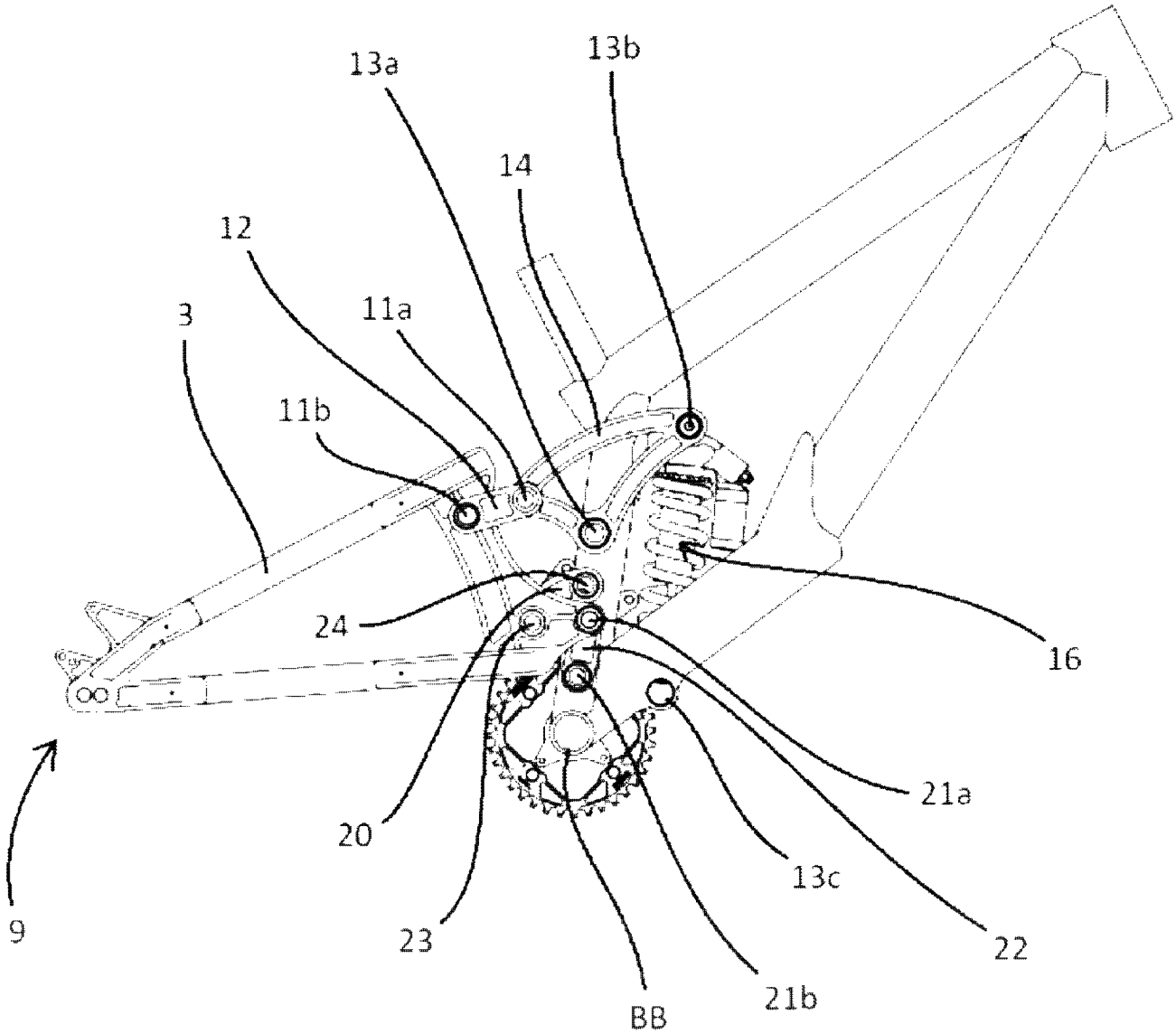


Fig. 4a

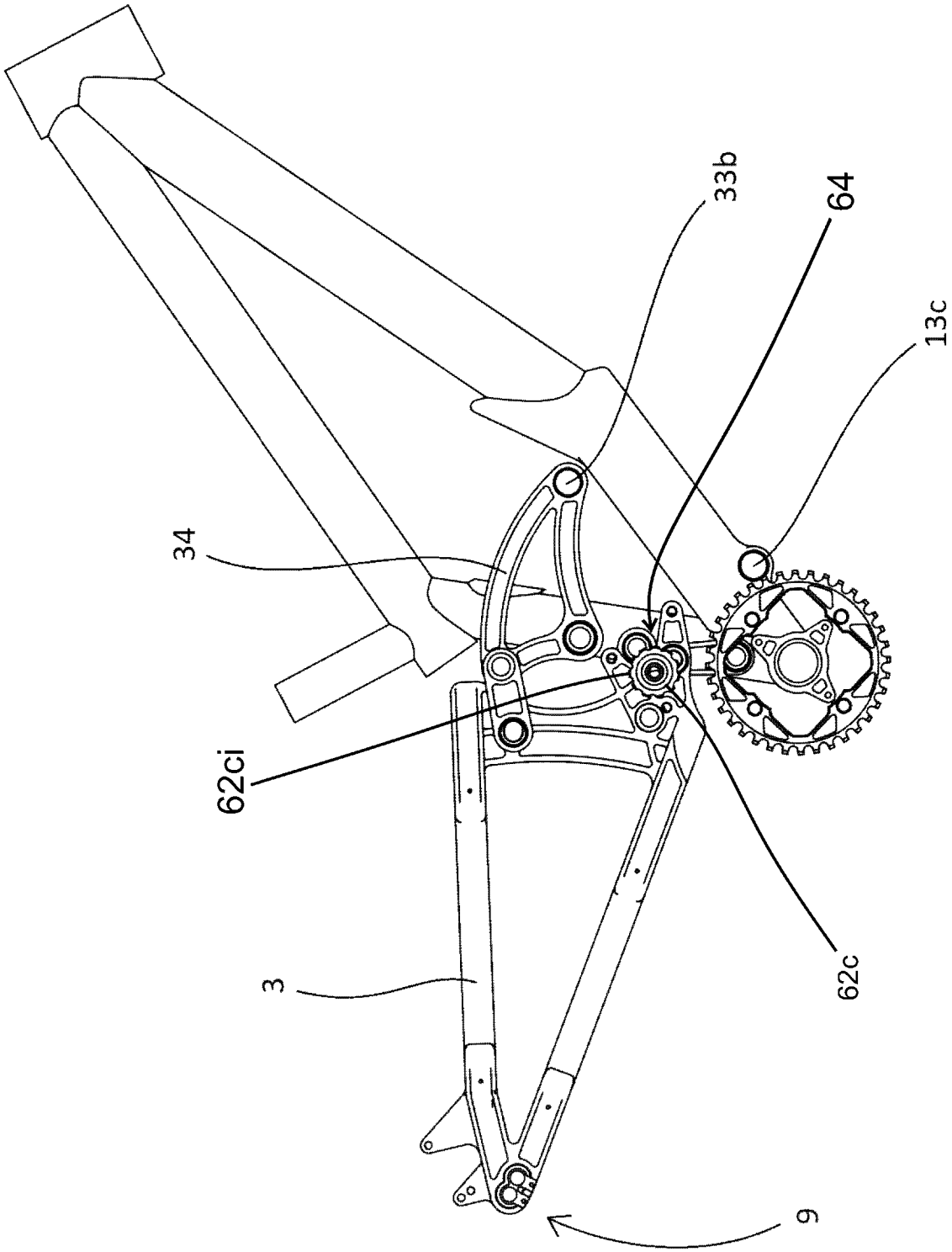


Fig. 4b

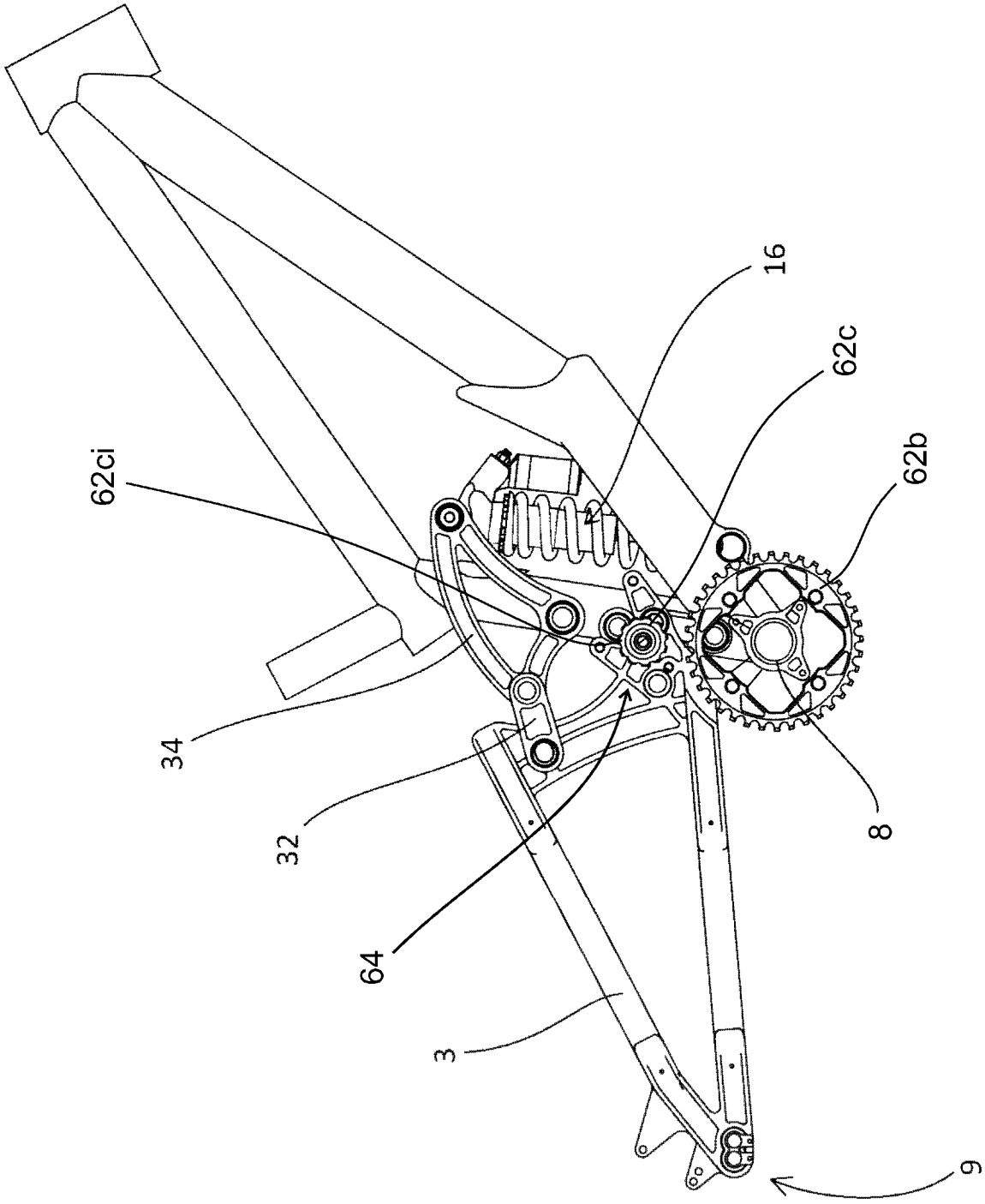


Fig. 4c

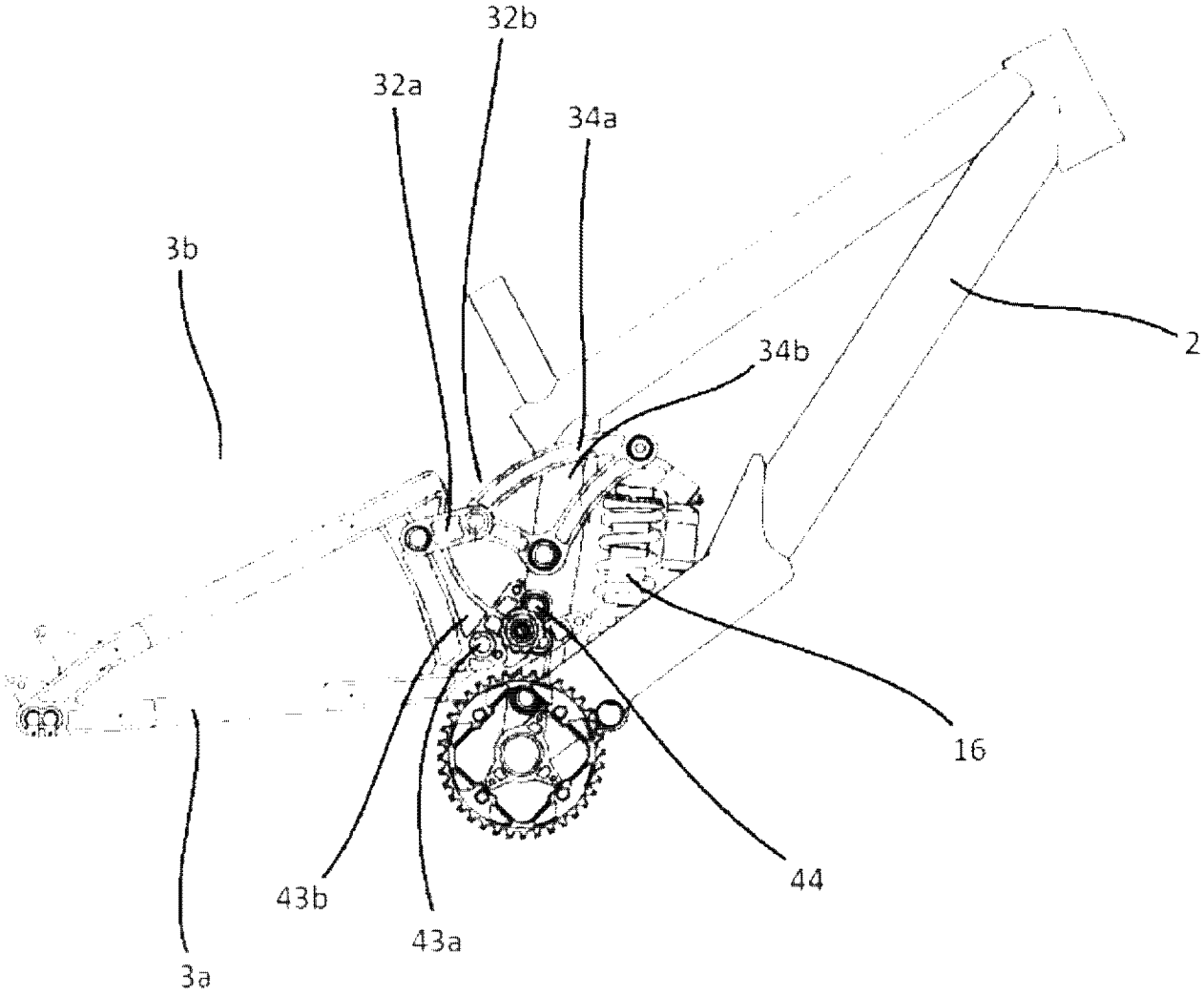


Fig. 5

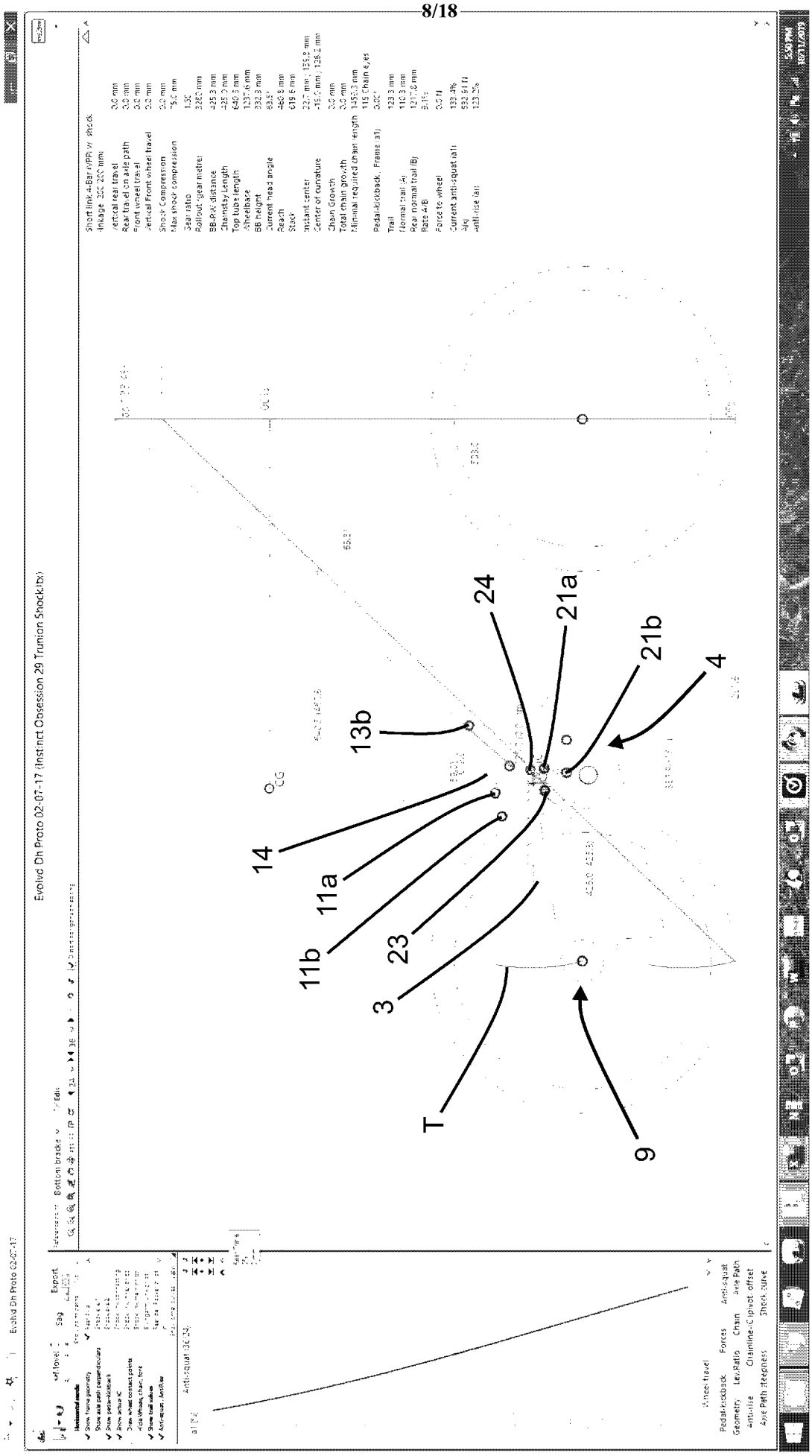

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14
11b
11a
13b
3
23
24
21a
21b
4
T
9

Fig. 6a

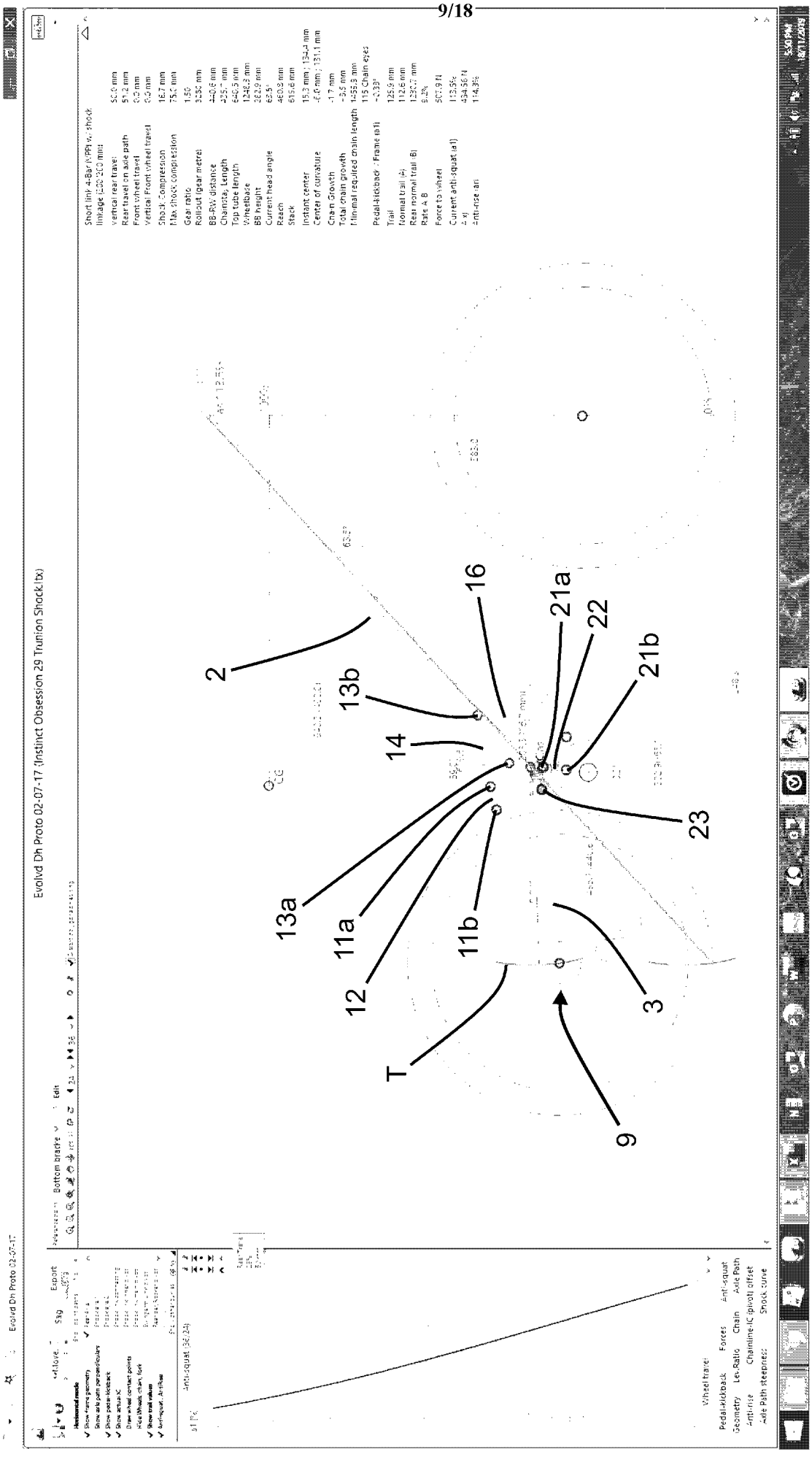


Fig. 6b

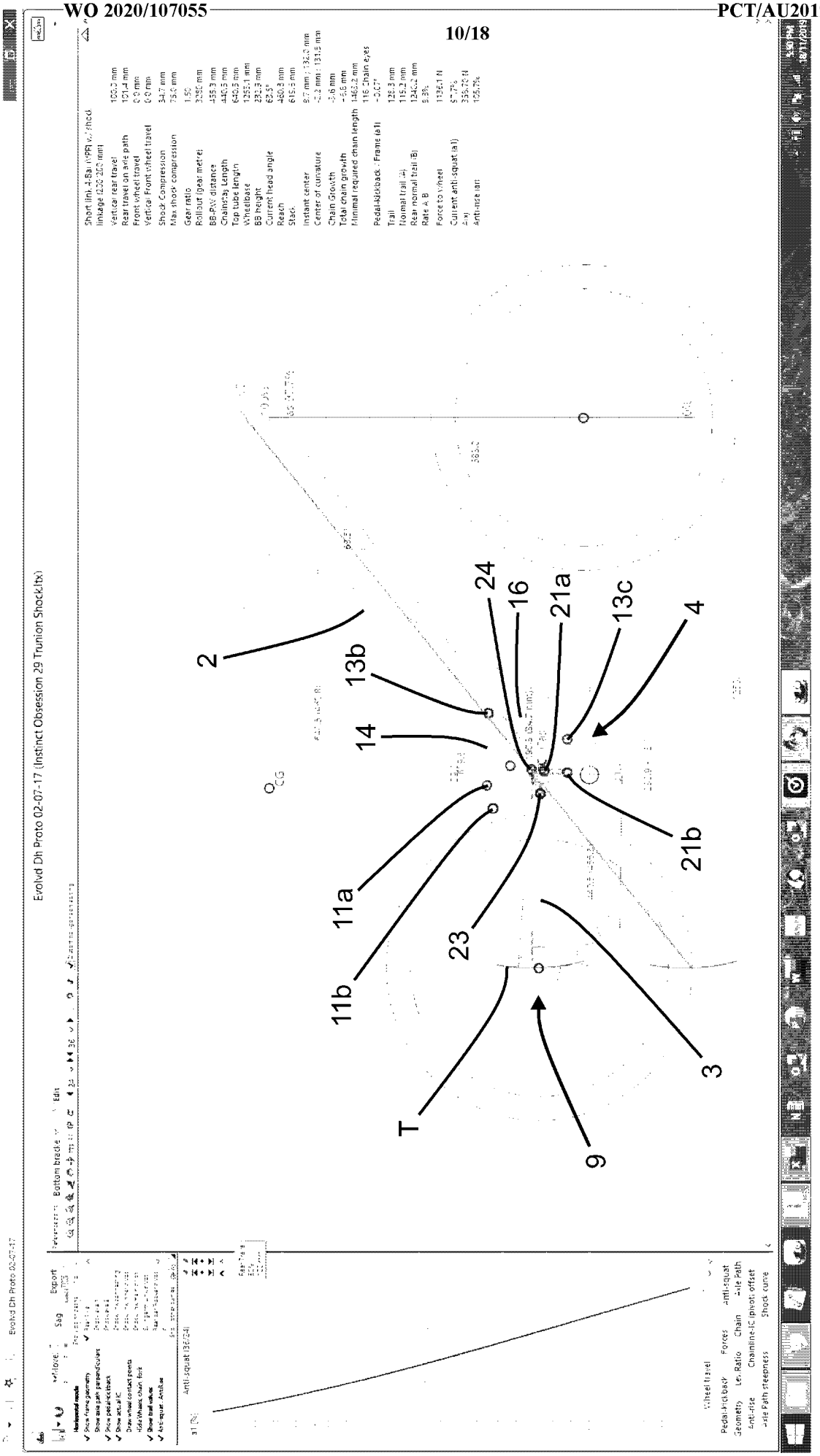


Fig. 6c

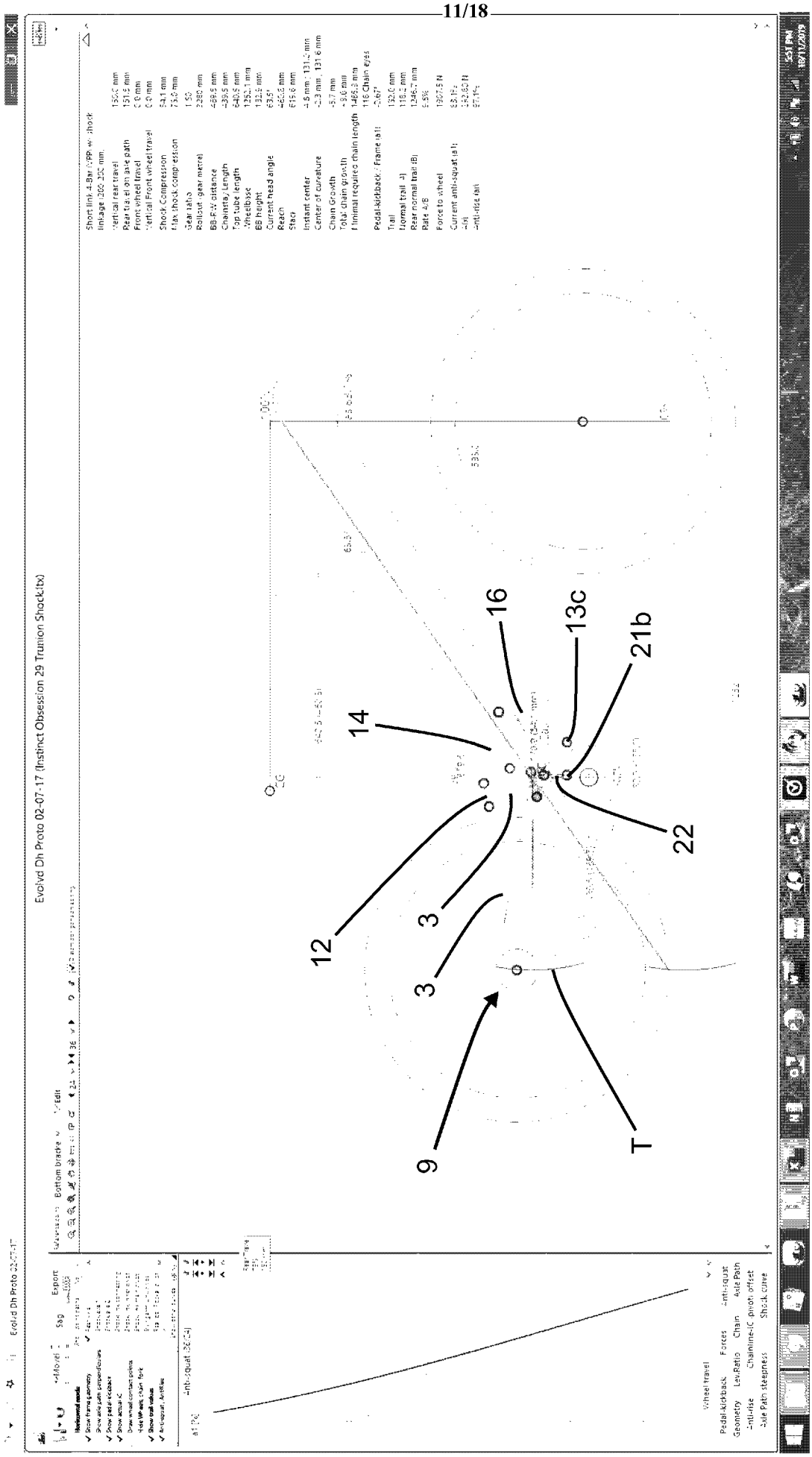

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14
3
3
16
13c
21b
22
9
T

Fig. 6d

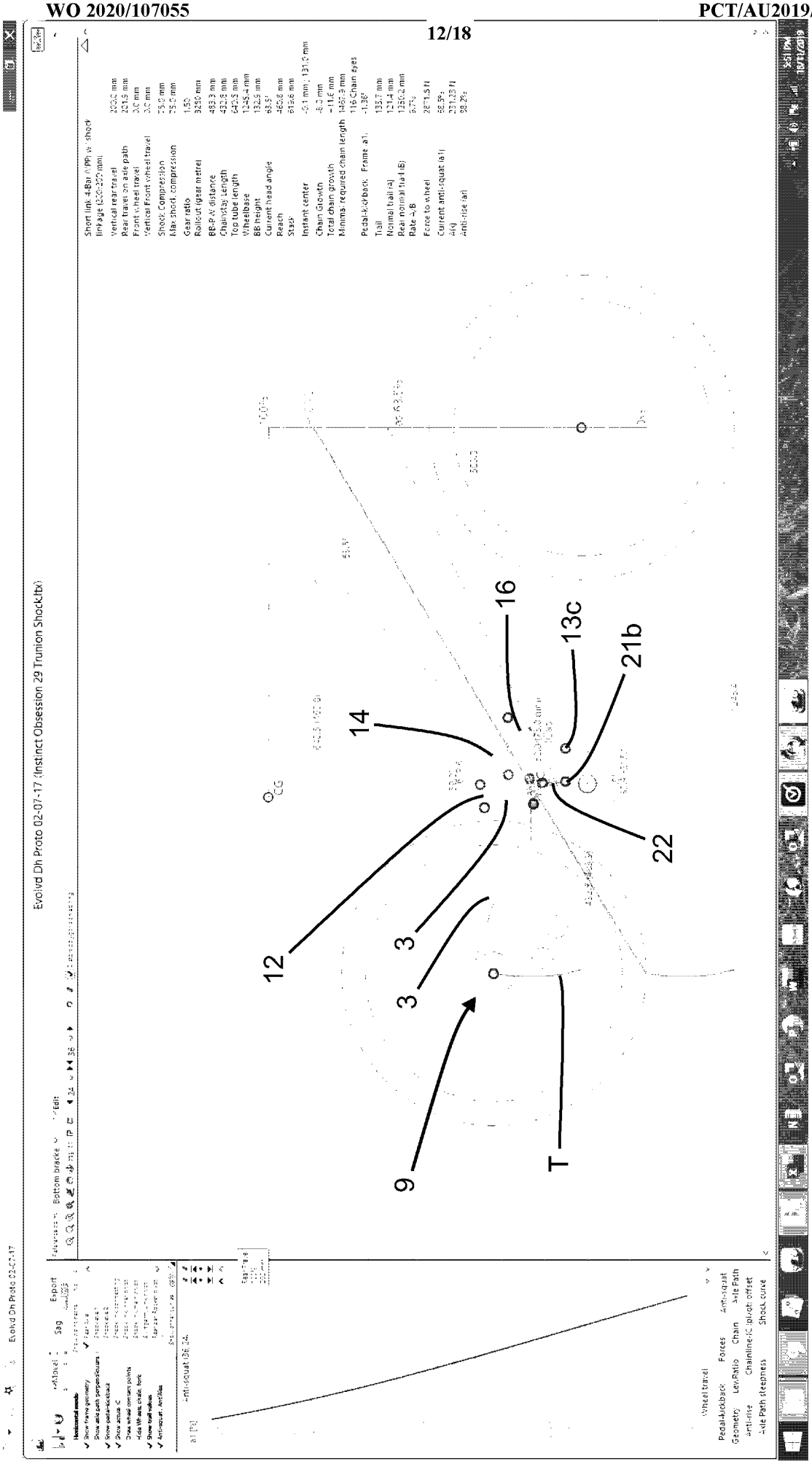

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14
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3
3
13c
21b
22
9
T

Fig. 6e

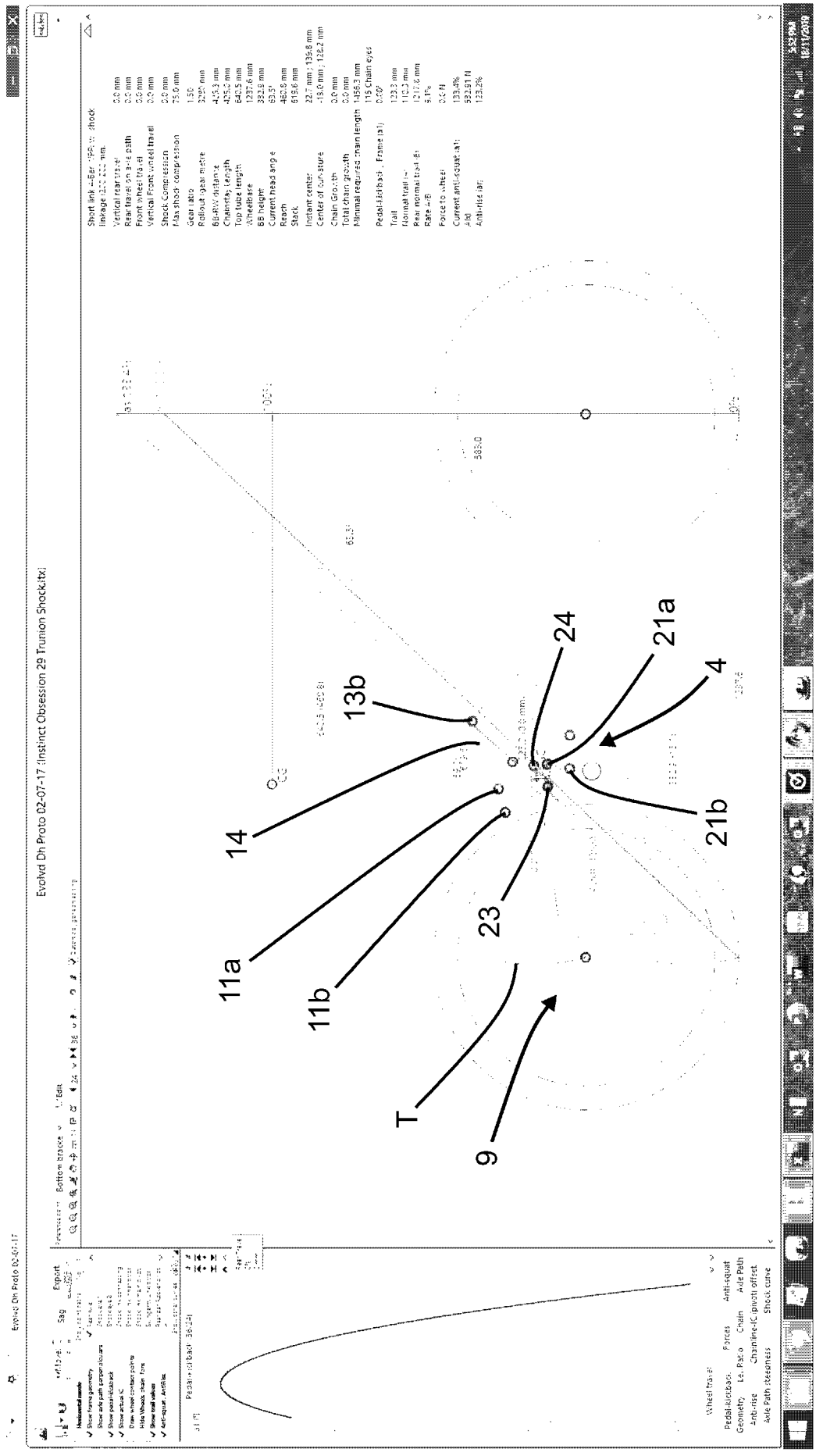


Fig. 7a

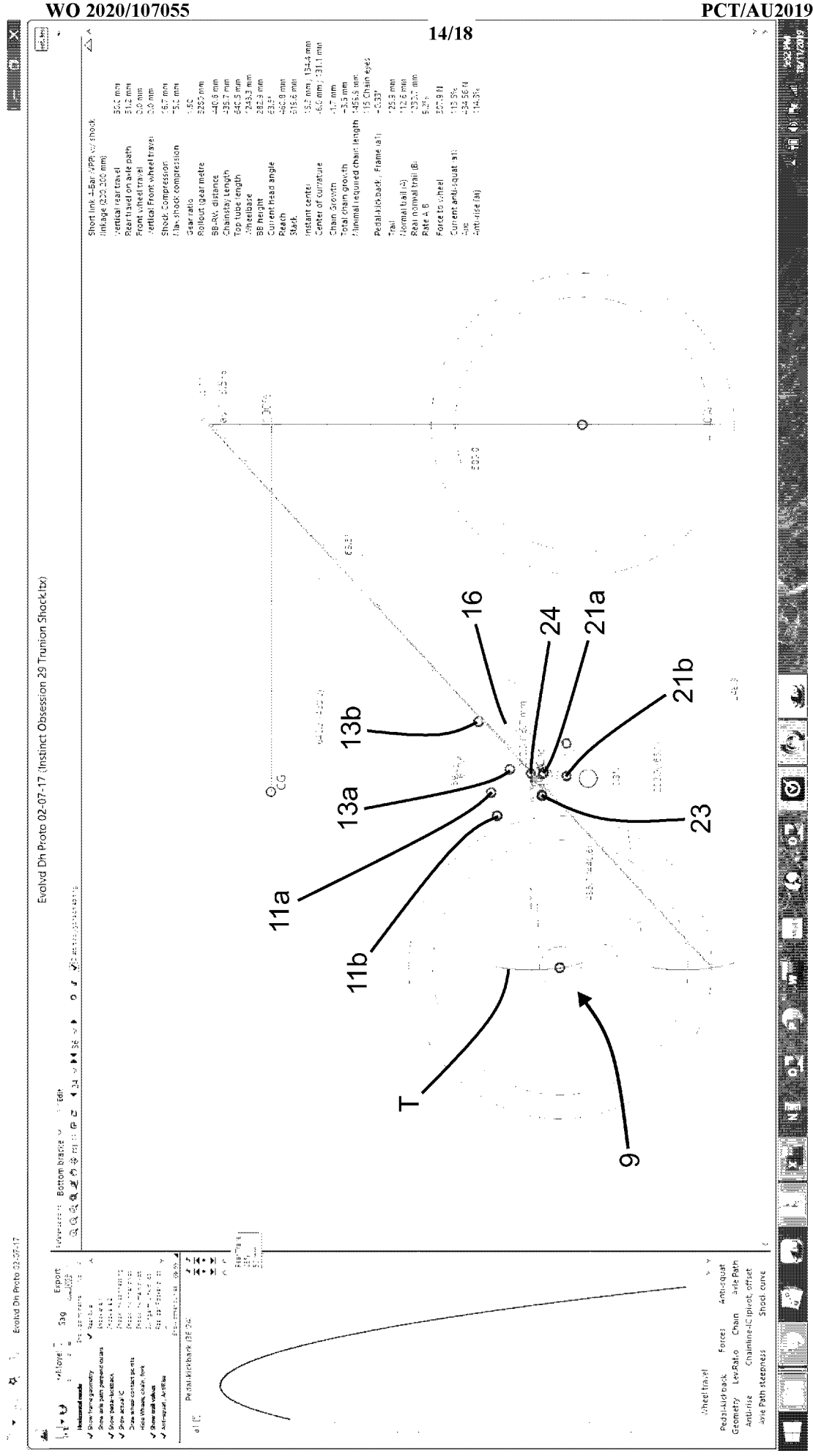

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11a
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13b
16
24
21a
21b
11b
23
T
9

Fig. 7b

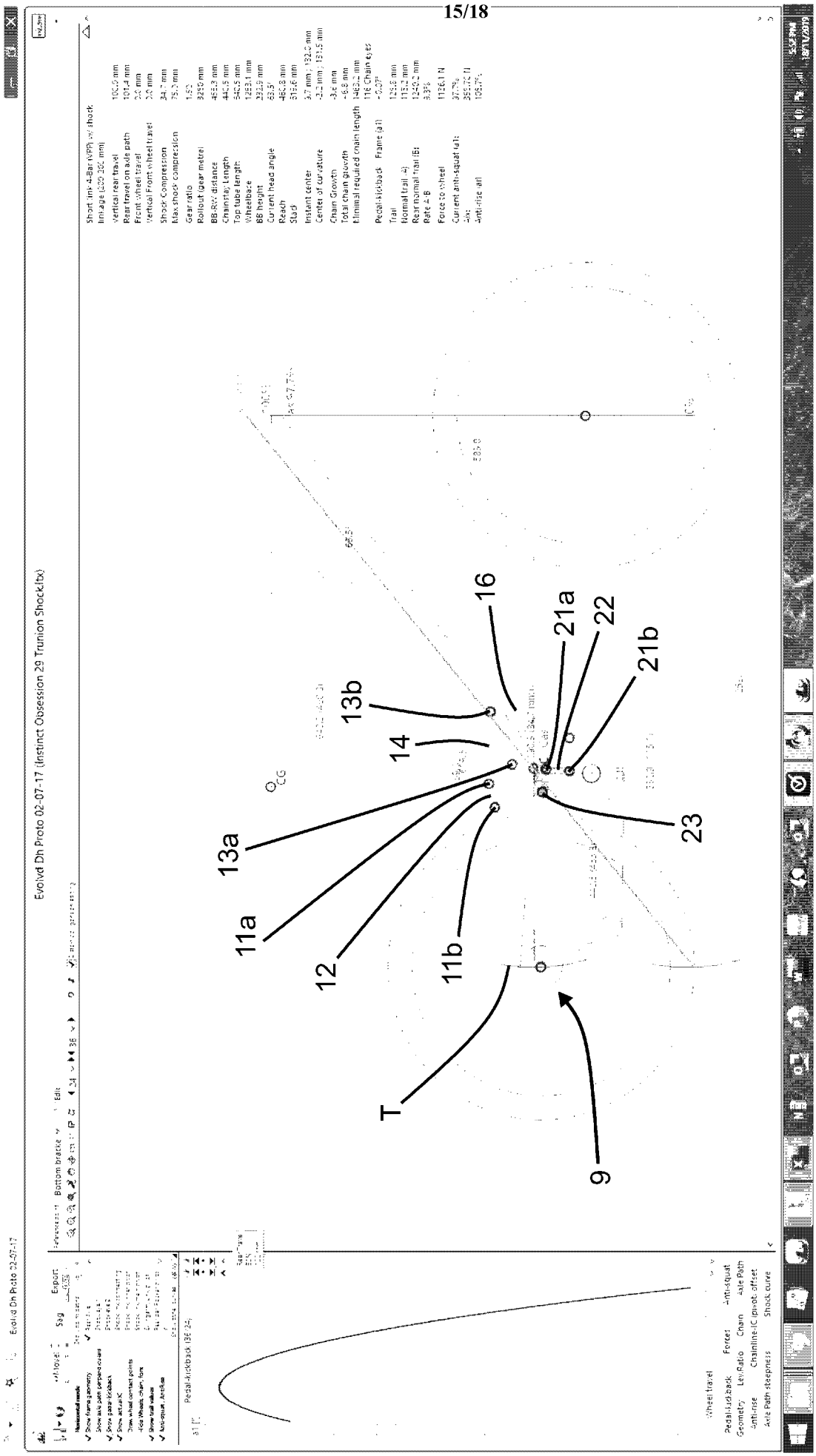

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12
11b
T
9
13b
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16
21a
22
21b
23
OCG

Fig. 7c

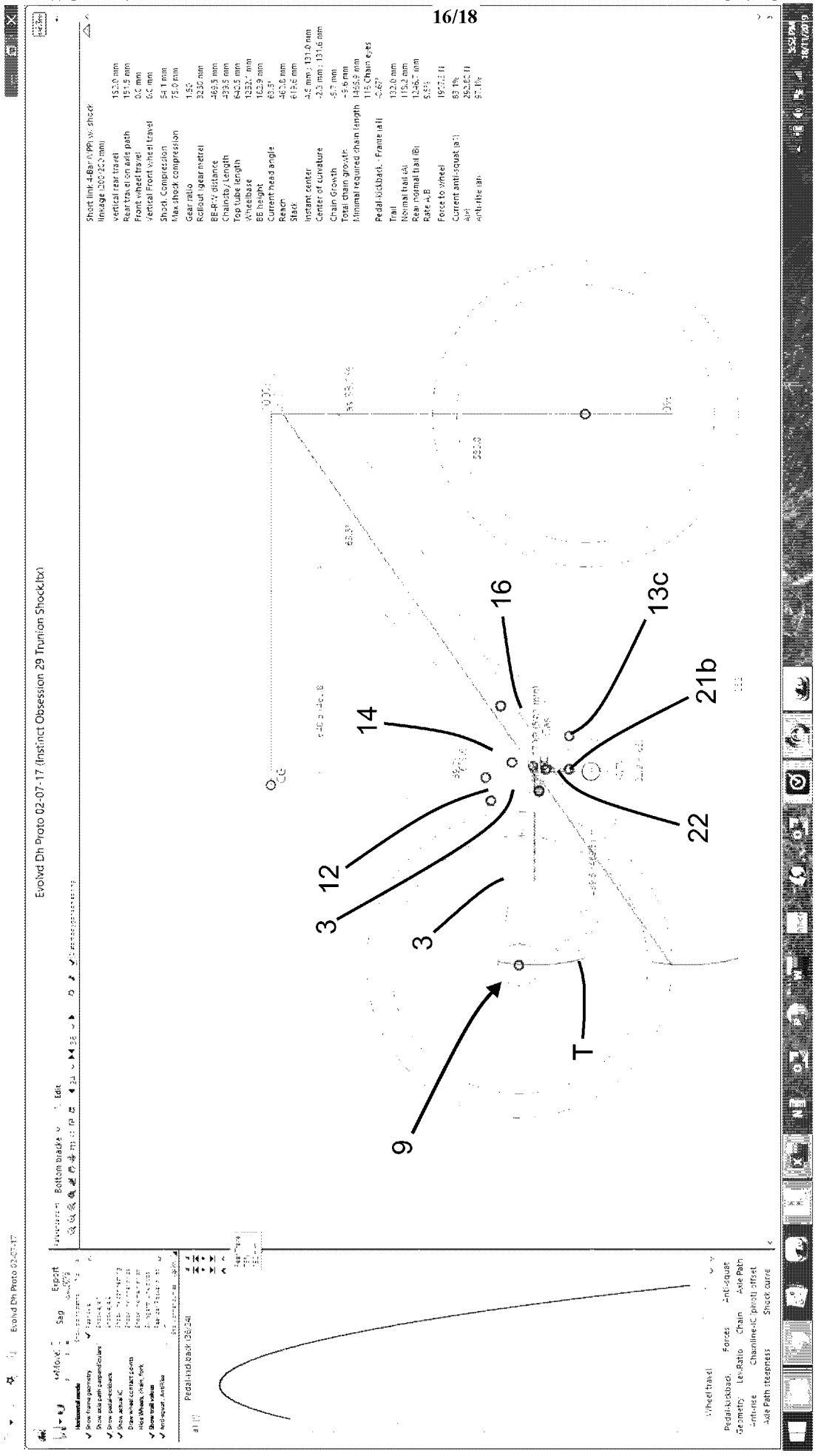

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21b
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9
T

Fig. 7d

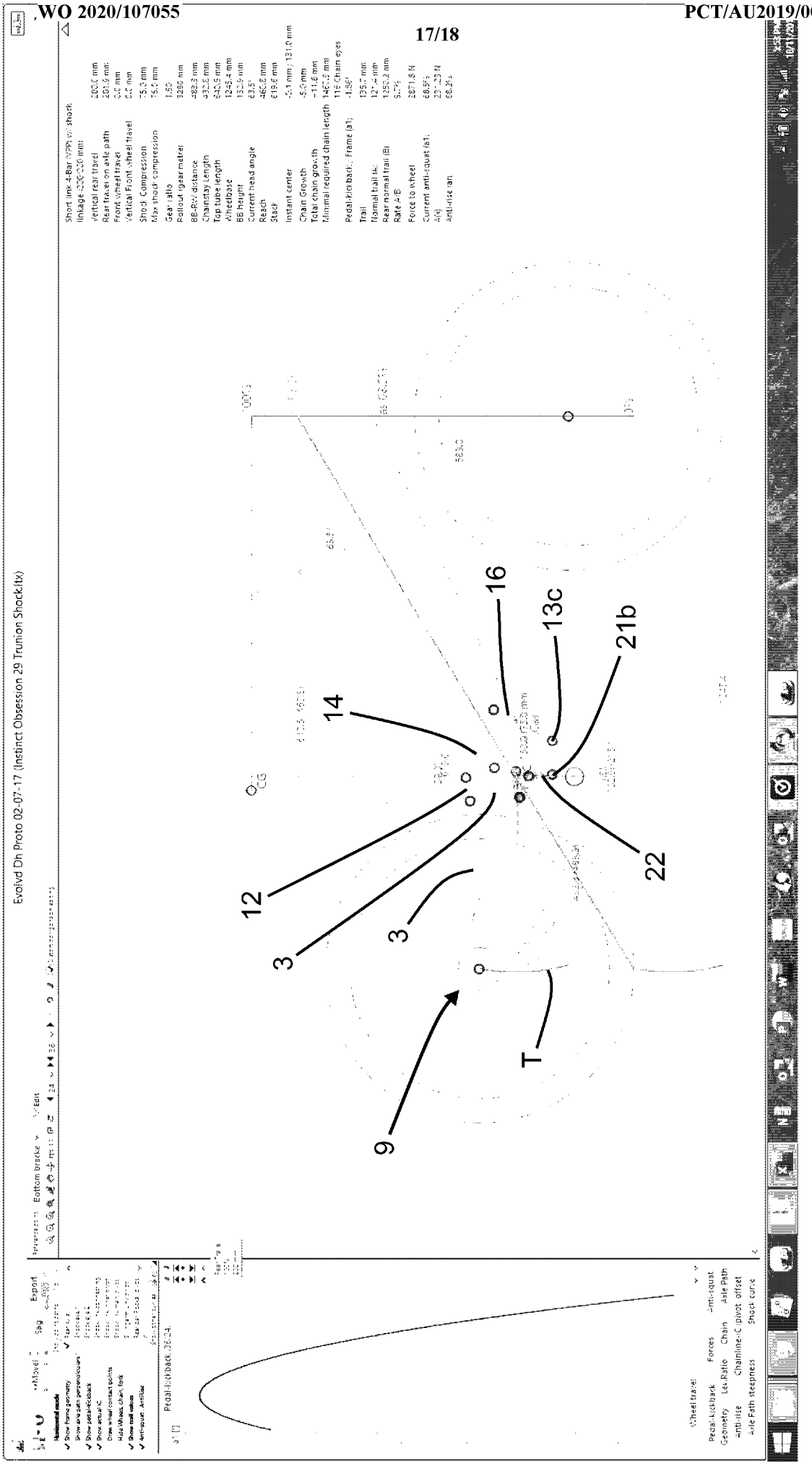

Evolvd Dh Proto 02-07-17 (Instinct Obsession 29 Trunion Shock.ttx)
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14
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16
13c
21b
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9
T

Fig. 7e

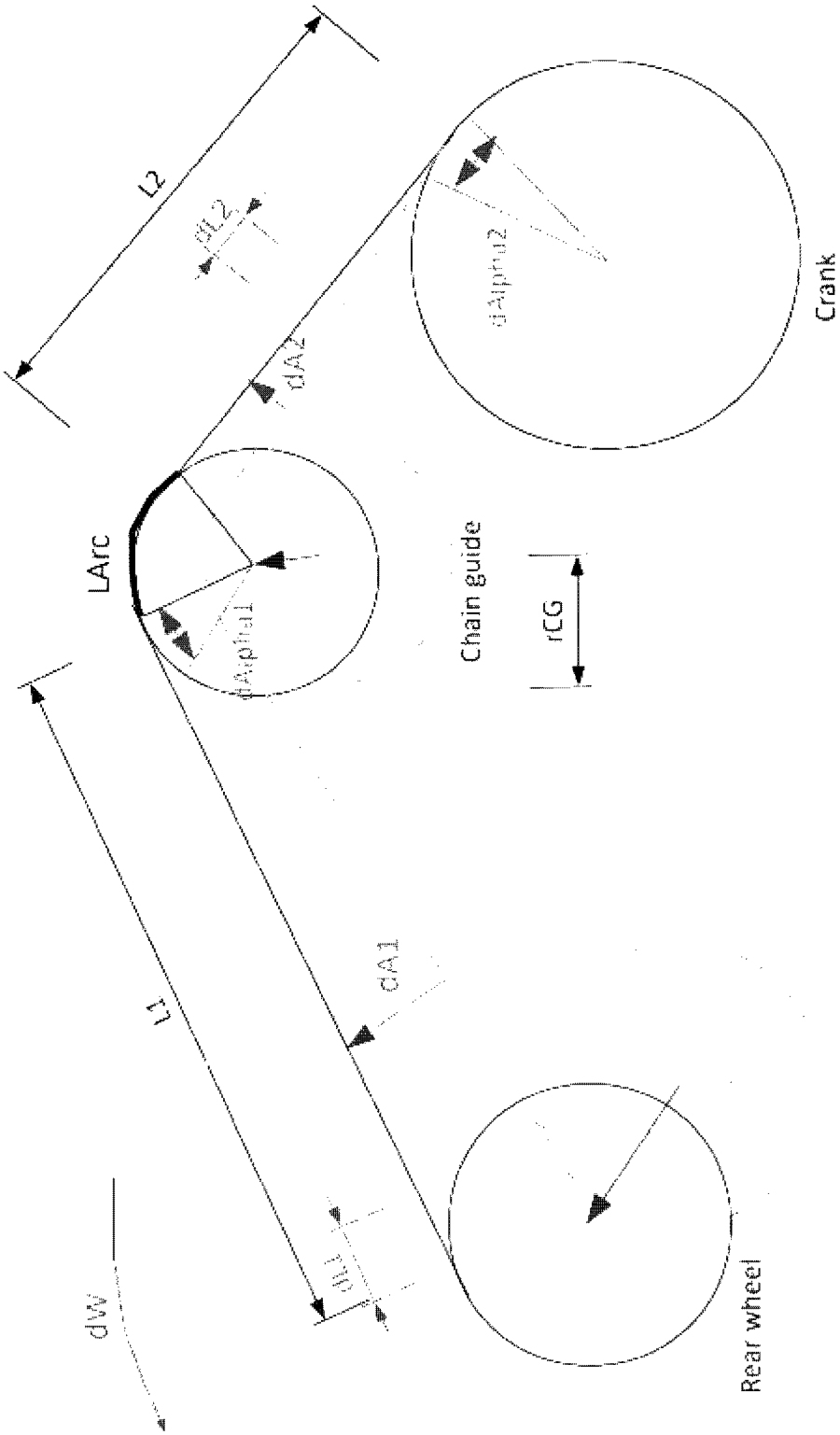

L2
dL2
dA2
dAptrn2
Crank
LArc
dAptrn1
Chain guide
rCG
L1
dA1
dL1
dW
Rear wheel
dX

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2019/000150

A. CLASSIFICATION OF SUBJECT MATTER

B62K 25/00 (2006.01) B62K 5/00 (2013.01) B62M 1/00 (2010.01) B62M 11/00 (2006.01)

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)

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)

Databases B62K25/286, B60G2204/421, B60G2300/12, B62K25/04, B62K19/30, B62K3/00, B62K5/00, B62M1/00, B62M11/00 and keywords instant, centre, pivot, virtual, derailleur, suspension, linkage, first, rest, idle, position, damp, shock, spring, kick back, anti rise, anti squat and like terms.

Applicant(s)/Inventor(s) name searched in Google Patents, Espacenet, Auspat and other internal databases provided by IP Australia.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

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

[X] See patent family annex

* Special categories of cited documents:

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"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 January 2020	16 January 2020
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Behzad Vafa AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262256132

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2019/000150**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2012/024697 A1 (ZAWISTOWSKI) 23 February 2012 Abstract, figures 1-14, page 1 line 11 - page 3 line 34, page 12 line 1 page 20 line 36 Abstract, figures 1-14, page 1 line 11 - page 3 line 34, page 12 line 1 page 20 line 36	1-7 8-10
Y	US 2009/0322055 A1 (ARRAIZ) 31 December 2009 Abstract, figures 1-7, paragraphs [0026] - [0036]	8-10
A	US 2006/0181053 A1 (HUANG et al.) 17 August 2006 Abstract, figures 1-12, paragraphs [0049] - [0052]	1-10
A	WO 2016/097433 A1 (PISÀ CANYELLES ROGER) 23 June 2016 & English abstract and translation retrieved from Espacenet and Google Patents. English abstract, figures 8A - 8B	1-10
A	WO 2018/175517 A1 (VOSS) 27 September 2018 Abstract, figure 10, page 18 line 3 - page 25 line 7	1-10

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/000150**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2019/000150**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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End of Annex

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