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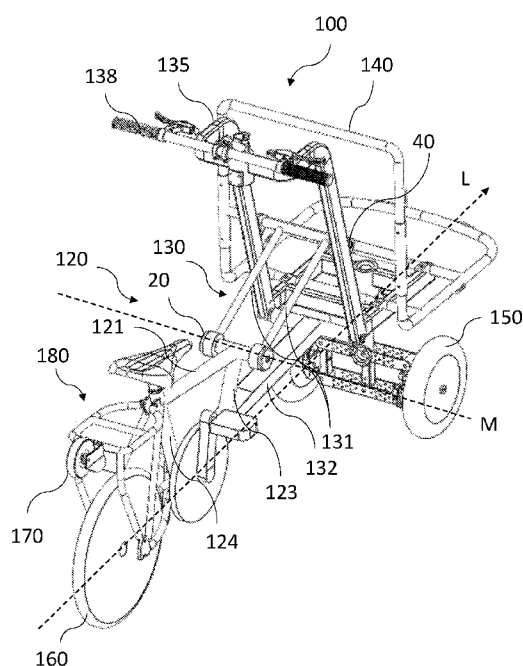


FIG. 2

(57) Abstract: The present invention discloses a collapsible cargo bicycle comprising: a front frame segment pivotably connected to a rear frame segment via a first hinge and a second hinge; a rear sub-frame including at least one rear wheel and a at least one support wheel; a steering frame pivotably connected to the front frame segment via a third hinge and a fourth hinge; a cargo frame, at least one front wheel; the cargo bicycle is adjustable between a travelling state and a folded state in which a forward force on the rear sub-frame in the travelling state causes the hinges rotate about a transverse axis to cause the first and second hinges to move upwards and the at least one rear wheel to move towards to lose contact with the ground and the at least one support wheel to contact the ground in the folded state.



A COLLAPSIBLE CARGO BICYCLE

Technical Field

[0001] The present disclosure generally relates to a cargo bicycle. More particularly, it relates to a cargo bicycle with a collapsible frame for carrying a load.

Background

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general knowledge in any jurisdiction as at the priority date of the application.

[0003] Small electric vehicles like scooters and bicycles are typically designed for personal mobility and lack extra storage for carrying heavy loads. Even when retrofitted with additional storage, the vehicle may still need to be parked and unloaded for the last mile, which is not only inconvenient but also increases the risk of theft when unattended. This means that the user may have to inconveniently deliver goods or load as the "last mile" task. In addition, leaving the parked vehicle unattended outside a restricted area further increases the risk of theft.

[0004] Cargo bicycles have emerged as a sustainable and efficient solution for last mile delivery in urban areas. With the increase in e-commerce and the growing demand for same-day and on-demand deliveries, traditional delivery methods such as trucks and vans have become less practical due to traffic congestion, parking restrictions, and environmental concerns. Cargo bicycles, on the other hand, offer a cost-effective and eco-

friendly alternative that can navigate narrow streets and bike lanes, make quick stops, and deliver packages directly to the customer's doorstep. From food delivery to courier services, cargo bicycles have proven to be a versatile and reliable mode of transportation for the last mile delivery. However, cargo bicycles are too long, having a large turning radius and are not suitable for crowded cities.

[0005] Cargo bicycles, however, are more vulnerable to theft than motorized vehicles due to their ease of access. Delivery riders may need to leave their bicycles unattended during deliveries, which increases the risk of theft. It can also be challenging to secure packages on a cargo bicycle, particularly in high-traffic areas or crowded urban environments.

[0006] Therefore, the present invention attempts to overcome at least in part some of the aforementioned disadvantages and to provide for an improved approach for addressing the foregoing challenge.

Summary of the Invention

[0007] According to various embodiments, there is provided a collapsible cargo bicycle comprising a front frame segment, a rear frame segment pivotably connected to the front frame segment via a first hinge and a second hinge, a rear sub-frame connected to the rear frame segment wherein the rear sub-frame includes at least one rear wheel and at least one support wheel, a steering frame pivotably connected to the front frame segment via a third hinge and a fourth hinge, a cargo frame supported by the steering frame, at least one front wheel positioned below the cargo frame wherein the cargo bicycle is adjustable between a travelling state and a folded state in which an application of a forward force on the rear sub-frame in the travelling state causes the first hinge, the second hinge, the third hinge and the fourth hinge to cooperate with one another and rotate about a transverse axis

to cause the first hinge and the second hinge to move vertically upwards in the direction of the steering frame and the at least one rear wheel to move towards the at least one front wheel to lose contact with the ground and the at least one support wheel to contact the ground in the folded state.

[0008] In some embodiments, the steering frame includes a steering axis that is not aligned with a vertical axis of the at least one front wheel.

[0009] In some embodiments, the first hinge includes a first vertical plane and the second hinge includes a second vertical plane, wherein the first vertical plane is located in front of the second vertical plane in the travelling state.

[0010] In some embodiments, the first hinge includes a first vertical plane and the second hinge includes a second vertical plane, wherein the second vertical plane is located in front of the first vertical plane in the folded state.

[0011] In some embodiments, the third hinge and the fourth hinge includes a third vertical plane and a fourth vertical plane respectively, wherein the third vertical plane and the fourth vertical plane remain fixed in position during the transition between the travelling state and the folded state.

[0012] In some embodiments, the transverse axis is substantially perpendicular to the longitudinal axis of the cargo bicycle.

[0013] In some embodiments, the front frame segment comprises a front upper frame segment and a front lower frame segment, and the rear frame segment includes a rear upper frame segment, a connector segment and a rear lower frame segment, wherein the front upper frame segment is pivotably connected to the rear upper frame segment and the connector segment via the first hinge and the front lower frame segment is pivotably connected to the rear lower frame segment and the connector segment via the second hinge.

[0014] In some embodiments, each of the first hinge and the second hinge comprises a locking lever configured to move between a lock position and an unlocked position, wherein the unlocked position releases the hinge for allowing the transition of the bicycle from the travelling state to the folded state and vice versa.

[0015] In some embodiments, each of the first hinge and the second hinge includes a first knob and a second knob including a lever at each end of a horizontal tube, wherein a first shaft is connected to the first knob and a second shaft is connected to the second knob, and the first shaft and second shaft are located within the horizontal tube.

[0016] In some embodiments, the first shaft is fixed in position, and the second shaft is rotatable about the transverse axis within the horizontal tube.

[0017] In some embodiments, the first shaft includes a first face at an end of the first shaft, and the second shaft includes a second face at an end of the second shaft, wherein the first face and the second face abut each other in a plane at an angle relative to the transverse axis.

[0018] In some embodiments, the first face includes an opening on a longitudinal axis of the first shaft, and the second face includes a locking pin protruding from the second face on a longitudinal axis of the second shaft, wherein the opening is configured to receive the locking pin.

[0019] In some embodiments, the second knob includes a lever for a user to rotate the second knob to cause the second shaft and the locking pin to rotate relative to the plane to transition the locking releasing or locking the first hinge and the second hinge.

[0020] In some embodiments, the second shaft is biased towards the first shaft through a spring mechanism to maintain the second knob in position.

[0021] In some embodiments, a lateral and a rotating clockwise force applied in a direction away from the horizontal tube causes the second shaft to be pulled away from the horizontal tube and the locking pin to be rotated out of its locked position to the unlocked position.

[0022] In some embodiments, the second face of the second shaft and the first face of the first shaft are no longer aligned along the same plane.

[0023] In some embodiments, a rotating anti-clockwise force applied on the lever causes the second shaft to be pulled towards the direction of the first shaft, and the

locking pin to be received by the opening thereby causing the second face and the first face to abut each other and into the locked position.

Brief Description of the Drawings

[0024] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. The dimensions of the various features or elements may be arbitrarily expanded or reduced for clarity. In the following description, various embodiments of the invention are described with reference to the following drawings, in which:

[0025] Fig. 1 is a side view of a cargo bicycle in a travelling state in accordance with embodiments of the present invention;

[0026] Fig. 2 is a rear perspective view of a cargo bicycle in a travelling state in accordance with embodiments of the present invention;

[0027] Fig. 3 is a front perspective view of a cargo bicycle in a travelling state in accordance with another embodiment of the present invention;

[0028] Fig. 4 is a front perspective view of a cargo bicycle in a travelling state in accordance with yet another embodiment of the present invention;

[0029] Fig. 5 is a rear perspective view of a cargo bicycle in a transition state in accordance with embodiments of the present invention;

[0030] Fig. 6 is a side cross-sectional view of a first hinge or second hinge in accordance with embodiments of the present invention;

[0031] Figure 7 is a side view of the cargo bicycle in a folded state in accordance with various embodiments of the present invention; and

[0032] Figure 8 is a rear perspective view of the cargo bicycle in in accordance with various embodiments of the present invention.

Detailed Description

[0033] Reference will now be made in detail to an exemplary embodiment of the present invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the embodiment, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications, and equivalents, which may be included within the spirit and scope of the invention as defined by the appended description. Furthermore, in the following detailed description of embodiments of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be recognized by one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the embodiments of the present invention.

[0034] In the specification the term “comprising” shall be understood to have a broad meaning similar to the term “including” and will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps. This definition also applies to variations on the term “comprising” such as “comprise” and “comprises”.

[0035] The term “coupled” (or “connected”) herein may be understood as electrically coupled or as mechanically coupled, for example attached or fixed or attached, or just in contact without any fixation, and it will be understood that both direct coupling or indirect coupling (in other words: coupling without direct contact) may be provided.

[0036] Certain terminology used in the description is for convenience in reference only and shall not be limiting. For example, up, down, front, rear, side, right, and left refer to the disclosed subject matter as orientated in the view being referred to. The terminology will include the words specifically mentioned, derivatives thereof, and words of similar meaning. Like references numbers denote like features, components, or elements throughout the various embodiments.

[0037] To achieve the stated features, advantages and objects, the present invention is directed to a bicycle or electric-powered bicycle that features a cargo frame serving as a multi-purpose load carrier for various purposes. The cargo frame is supported by the front wheel axis that is offset from the steering axis to keep the load centered on the bicycle for improved control and maneuverability.

[0038] There are two modes of usage: a travelling state (or unfolded state) and a folded state or a pushing state. In the travelling state, the bicycle is extended like a conventional bicycle for travelling long distances. The cargo frame can be utilized for various applications. In the folded state or the pushing state, the bicycle is folded, and one or more support wheels are deployed so that the bicycle can stand upright. The user may then walk and push the bicycle with the cargo load on the cargo frame for different applications.

[0039] With reference to the figures, wherein like numerals indicate like parts throughout several views, Figure 1 is a side view of a collapsible cargo bicycle in an unfolded position or in a travelling state. In the travelling state, the cargo bicycle is operated by a seated user (not shown) and may support cargo, for example, groceries, goods, food deliveries, parcels, briefcase, or any other type of cargo. In the folded state or the pushing state, the bicycle may be pushed and/or pulled to transport the aforesaid cargo, for example, the bicycle may operate as a trolley. In various embodiments, the cargo remains on the bicycle while the bicycle is folded from the travelling state to the folded state.

[0040] With reference to Figure 1, the bicycle 100 includes a frame assembly 110 including a front frame segment 130 and a rear frame segment 120. The front frame segment 130 includes a front upper frame segment 131 and a front lower frame segment 132, both of which are hingedly connected to the rear frame segment 120 at each end of the front upper frame segment 131 and a front lower frame segment 132. The front upper frame segment 131 and the front lower frame segment 132 are hingedly connected to a steering frame 135 at each opposed end of the front upper frame segment 131 and the front lower frame segment 132. The front frame segment 130 and the rear frame segment 120 are each elongated along a longitudinal axis L. The rear frame segment 120 includes a connector segment 123, a rear upper frame segment 121, a rear lower frame segment 122 and a seat segment 124. In various embodiments, each segment of the rear frame segment 120 is integrated in a single piece to form the rear frame segment. In various embodiments, a rear sub-frame 190 extends from the rear frame segment 120. The rear sub-frame 190 includes a sub-frame that holds at least one rear wheel 160 that is in contact with the ground in the travelling state and at least one support wheel 170 that is not in contact with the ground in the travelling state. In some embodiments, the rear sub frame includes a plurality of support wheels for providing support to the cargo bicycle when it is in the folded state or pushing state.

[0041] Figure 2 shows a rear perspective view of the collapsible bicycle in a travelling state according to various embodiments. A first hinge 20 connects the front upper frame segment 131, the rear upper frame segment 121 and one end of the connector segment 123. In some embodiments, the front upper frame segment 131 includes a pair of tubes extending from the first hinge 20 to the steering frame 135. In some embodiments, the front upper frame segment 131 includes a forked frame comprising a pair of tubes extending from the first hinge 20 to the steering frame. In various embodiments, a second hinge 30 connects the front lower frame segment 132, a rear lower frame segment 122 and the opposed end of the connector segment 123. In some embodiments, the front lower frame

segment 131 includes a pair of tubes or a forked frame comprising a pair of tubes extending from the second hinge 30 to the steering frame 135. In various embodiments, the first hinge 20 and the second hinge 30 are configured to be fixed in the travelling state and a locking lever (not shown) is provided for each hinge for fixing and releasing the hinge. Details of the locking lever will be provided later. A third hinge 40 connects the opposed end of the front upper frame segment 131 to the steering frame 135. A fourth hinge 50 connects the opposed end of the front lower frame segment 132 to the steering frame 135. With reference to figure 1, in the travelling state, the vertical plane X of the first hinge 20 is in front of the vertical plane Y of the second hinge 30 in the direction of travel or the forward direction.

[0042] In various embodiments, the steering frame 135 includes the handlebar 138 at one end and is connected to a cargo frame 140 at the opposed end. The steering frame 135 allows a user to control the steering of the bicycle with the handlebar 138. The cargo frame 140 allows a user to place a load on the cargo frame 140. In other embodiments, the cargo frame 140 provides a space for a basket or box to be detachably connected to the cargo frame for easy portability of the cargo. The cargo frame 140 includes at least one transport wheel 150 positioned below the underside of the cargo frame 140. In some embodiments, the transport wheels 150 are attached to an end portion of the steering frame or the portion of the steering frame 135 that supports the cargo frame 140. The steering frame 135 has a steering axis W which is an imaginary line running through the longitudinal axis of the steering frame. In some embodiments, a pair of front wheels 150 is located below a cargo frame 140. The pair of front wheels 150 has a vertical axis V that is offset from the steering axis W of the steering frame.

[0043] In various embodiments, the first hinge 20, the second hinge 30, the third hinge 40 and fourth hinge 50 may be of any suitable type. In some embodiments, the first hinge (representative of all other aforesaid hinges) may include a shaft (not shown) rotatably engaging the rear frame segment 120 and the front upper frame segment 131. The shaft is

enclosed within rear frame segment 120 and the front upper frame segment 131. In other words, the shaft rotates about a transverse axis M of the bicycle. The transverse axis M is substantially perpendicular to the longitudinal axis L. Similarly, each of the second hinge, the third hinge and the fourth hinge includes a shaft rotatably engaging with the segments that it is connected to and rotates about the transverse axis M of the bicycle. For example, the third hinge 40 connecting the front upper frame segment 131 to the steering frame 135 rotates about the transverse axis M of the bicycle. In other words, each of the hinges rotate about the axis transverse to the longitudinal axis L of the bicycle. Alternatively, each of the hinges may be of any suitable type that allows the segments it is connected to rotate about the transverse axis M or the axis transverse to the longitudinal axis L of the bicycle. Details of the shaft will be provided hereinafter.

[0044] Fig. 3 is a front perspective view of a cargo bicycle in a travelling state in accordance with another embodiment of the present invention. The components of the cargo bicycle are similar to the components described in Figure 1 above. In this embodiment, the rear sub-frame 190 includes a sub-frame that holds two rear wheels 160 that is in contact with the ground in the travelling state and at least one support wheel 170 (not shown) that is not in contact with the ground in the travelling state.

[0045] Fig. 4 is a front perspective view of a cargo bicycle in a travelling state in accordance with yet another embodiment of the present invention. The components of the cargo bicycle are similar to the components described in Figure 1 above. In this embodiment, the rear sub-frame 190 includes a sub-frame that holds one rear wheel 160 that is in contact with the ground in the travelling state and two support wheels 170 that is not in contact with the ground in the travelling state.

[0046] Figure 5 shows a rear perspective view of the cargo bicycle in a transition state according to various embodiments. With reference to figures 1 and 3, and when a user

wishes to convert the bicycle from a travelling state to a folded state, the user will first apply a forward force (i.e. in the direction of travel) on the rear frame segment so that the first hinge 20, second hinge 30, third hinge 30 and fourth hinge 50 cooperate with one another and rotate about the transverse axis M to cause the first hinge 20 and the second hinge 30 to move vertically upwards in the direction N and the rear wheel to move towards the one or more front wheel in the direction O (or towards the direction of travel). When the bicycle is in a transition state, the application of force on the rear frame segment will cause the first hinge 20 and the second hinge 30 to move vertically upwards towards the direction of the handlebar. The movement of the first hinge 20 and the second hinge 30 will in turn cause the front upper frame segment and the front lower frame segment to correspondingly pivot about the third hinge 40 and the fourth hinge 50 respectively, such that the front upper frame segment and the front lower frame segment pivots towards the steering frame.

[0047] When a user wishes to convert the bicycle from transition state to a travelling state, the user will first apply a force in the opposite direction of travel or a reverse direction on the rear frame segment so that the first hinge 20, second hinge 30, third hinge 30 and fourth hinge 50 cooperate with one another and rotate about the transverse axis M to cause the first hinge 20 and the second hinge 30 to move vertically downwards in the direction N and the rear wheel to move away from the one or more front wheels in the reverse direction (or opposite direction of travel). When the bicycle is in a transition state (which will subsequently move into the folded state), the application of force on the rear frame segment will cause the first hinge 20 and the second hinge 30 to move vertically downwards towards the direction of the ground. The movement of the first hinge 20 and the second hinge 30 will in turn cause the front upper frame segment and the front lower frame segment to correspondingly pivot about the third hinge 40 and the fourth hinge 50 respectively, such that the front upper frame segment and the front lower frame segment pivots away from the steering frame.

[0048] Figure 6 shows a side cross-sectional view of the locking lever according to various embodiments. As mentioned previously, the first hinge and the second hinge include a locking lever for fixing and releasing each of the hinges so that the bicycle can transition from a travelling state to a folded state and vice versa. With reference to figure 4, the first hinge 20, which is similarly applied to the second hinge 30, includes a first knob 21 and a second knob 22 at each end of a horizontal bar 125. In various embodiments, the horizontal bar 125 may be a part of the rear frame segment or rear upper frame segment of the bicycle. The horizontal bar 125 is substantially parallel to the transverse axis M. A first shaft 23 is connected to the first knob 21 at one end of the first shaft 23 within the horizontal bar 125. In various embodiments, the first shaft 23 is fixed in position and is not rotatable. The opposed end of the first shaft 23 includes a first face 25 and an opening 26 within the first face 25 that is configured to receive a locking pin 27 protruding from a second shaft 24 connected to the second knob 22. The second shaft 24 has a second face 28 that abuts the first face 26 when the locking pin 27 is received by the opening 26. The first face 25 and the second face 28 abut each other in a plane Q that is at an angle relative to the transverse axis M. In various embodiments, the second shaft 24 and the locking pin 27 is rotatable about the transverse axis M and is rotatable relative to the plane Q. In various embodiments, the second knob 22 includes a lever (not shown) to allow the user to rotate the second knob 22 such that the rotation of the second knob 22 causes the second shaft 24 and the locking pin to rotate relative to the plane Q and to either move the locking pin away from a locked position to an unlocked position or from the unlocked position to the locked position. In various embodiments, the second shaft 24 is biased towards the first shaft via a spring mechanism (not shown). This ensures that the second knob 22 will always remain attached and rotatable within the horizontal bar and cannot be removed from the horizontal bar.

[0049] When the user wishes to convert the bicycle from a travelling state to a transition state or folded state, the user will unlock the first hinge 20 and the second hinge

30 or vice versa, in a sequential manner. For each hinge, a lateral force in the direction P and a rotating force S in a clockwise direction such that the second shaft 24 can be pulled towards direction P momentarily and the locking pin 27 can be rotated out of its locked position to the unlocked position. When the lateral force in the direction P is applied, the second knob moves towards direction P causing the locking pin 27 to disengage from the opening 26 of the first shaft 23. A subsequent rotating force S applied by the user in a clockwise direction will subsequently cause the second face 28 of the second shaft 24 and the first face 25 of the first shaft to no longer abut each other and to no longer be in the same plane Q. At any point when the first face 25 and the second face 28 are not in the same place Q, the second knob 22 is in an unlocked position and the user can then apply a force on the rear segment of the bicycle to fold the bicycle to a transition state and folded state.

[0050] When the user wishes to convert the bicycle from a transition state or folded state to the travelling state, the user will do the aforesaid action in reverse. The user will first lock the first hinge 20 or the second hinge 30 in a sequential manner by moving the second knob 22 to the locked position. For each of the first hinge and the second hinge, a rotating force S in an anti-clockwise direction is applied to the lever of the second knob 22. As the second knob 22 is biased towards the first shaft 23, the anti-clockwise rotation of the second shaft 22 will cause the second shaft 24 can be pulled towards the direction of the first shaft. At this point, the first face 25 and the second face 28 of the second shaft are not aligned with each other and remain in a non-abutting position. As the second knob 22 is rotating, there will be a point when the second face 28 will come into alignment with the first face 25 and both faces abut each other. It is at this point that the locking pin 27 engages with the opening 26 and inserts into the opening into the locked position and the travelling state.

[0051] In various embodiments, the locking pin 27 received within the opening 26 is designed as a stop positioned within the first hinge 20 or the second hinge 30 to prevent relative rotation of the front frame segment 130 in a downwards direction when the bicycle is in a travelling state. In other words, the first hinge 20 prevents the relative rotation of the front upper frame segment in a downwards direction (i.e. towards the ground) when the bicycle is in a travelling state, and the second hinge 30 prevents the relative rotation of the front lower frame segment in a downwards direction (i.e. towards the ground) when the bicycle is in a travelling state. The stops within the first and second hinges are designed to prevent the bicycle from collapsing towards the ground when the bicycle is in a travelling state, and is configured to withstand the weight of the user up to a predetermined weight.

[0052] Figure 7 shows a side view of the cargo bicycle in a folded state according to various embodiments. Figure 8 shows a rear perspective view of the cargo bicycle in a folded state according to various embodiments. When the user is in the process of delivering goods on the cargo bicycle, the cargo bicycle can be used as a last mile delivery of goods when in the folded state by using the cargo bicycle as a trolley to transport the load right up to the door of the customer. This means that the user does not have to look for a parking spot for the cargo bicycle, lock the bicycle and carry the load to the door of the customer in order for the load to be delivered to the customer. This provides the advantage of saving time and potential loss and theft of the cargo bicycle if left unattended during the process of delivering the load to the customer.

[0053] With reference to figure 7, when the user converts the bicycle from a travelling state to the folded state, once the locking levers of the first hinge 20 and the second hinge 30 have been released, the user applies a forward force (i.e. in the direction of travel or direction L) on the rear frame segment 120 or the rear sub-frame 190 so that the first hinge 20, second hinge 30, third hinge 30 and fourth hinge 50 cooperate with one another and rotate about the transverse axis M to cause the first hinge 20 and the second hinge 30 to

move vertically upwards in the direction N and the rear wheel to move towards the one or more front wheel in the direction L (or towards the direction of travel). When the bicycle is in the folded state, the application of force on the rear frame segment will cause the first hinge 20 and the second hinge 30 to move vertically upwards towards the direction of the handlebar. The movement of the first hinge 20 and the second hinge 30 will in turn cause the front upper frame segment and the front lower frame segment to correspondingly pivot about the third hinge 40 and the fourth hinge 50 respectively, such that the front upper frame segment and the front lower frame segment pivots towards the steering frame. At its final resting position in the folded state, the front upper frame segment and the front lower frame segment will rest against the steering frame 135 and the rear wheel 160 will be lodged below the steering frame and lifted above the ground. The support wheel 170 on the rear sub-frame 190 will now be in contact with the ground in the folded state. In the folded state, the vertical plane Y of the second hinge 30 is now in front of the vertical plane X of the first hinge 20 in the direction of travel.

[0054] The folding design of the cargo bicycle offers advantages over conventional folding bicycles. The folding design allows a quick, intuitive and easy folding or unfolding. The folding design also offers better structural rigidity compared to conventional folding bike hinges. Additionally, the handlebar 135 is linked to the one or more transport wheels 150 via an electrically actuated steering system in which the steering can be both electrically and mechanically controlled by a cable wire. In other embodiments, the handlebar is linked to the one or more transport wheels via steer-by-wire technology. This allows the offset transport wheels to carry the load in a more optimal position, and to allow more compact folding of the cargo bicycle.

[0055] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and

scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

CLAIMS

1. A collapsible cargo bicycle comprising:
 - a front frame segment;
 - a rear frame segment pivotably connected to the front frame segment via a first hinge and a second hinge;
 - a rear sub-frame connected to the rear frame segment, wherein the rear sub-frame includes at least one rear wheel and at least one support wheel;
 - a steering frame pivotably connected to the front frame segment via a third hinge and a fourth hinge;
 - a cargo frame supported by the steering frame,
 - at least one front wheel positioned below the cargo frame;
 - wherein the cargo bicycle is adjustable between a travelling state and a folded state in which an application of a forward force on the rear sub-frame in the travelling state causes the first hinge, the second hinge, the third hinge and the fourth hinge to cooperate with one another and rotate about a transverse axis to cause the first hinge and the second hinge to move vertically upwards in the direction of the steering frame and the at least one rear wheel to move towards the at least one front wheel to lose contact with the ground and the at least one support wheel to contact the ground in the folded state.
2. The collapsible cargo bicycle according to claim 1, wherein the steering frame includes a steering axis that is not aligned with a vertical axis of the at least one front wheel.
3. The collapsible cargo bicycle according to claim 1, wherein the first hinge includes a first vertical plane and the second hinge includes a second vertical plane, wherein the first vertical plane is located in front of the second vertical plane in the travelling state.

4. The collapsible cargo bicycle according to claim 1, wherein the first hinge includes a first vertical plane and the second hinge includes a second vertical plane, wherein the second vertical plane is located in front of the first vertical plane in the folded state.

5. The collapsible cargo bicycle according to claim 1, wherein the third hinge and the fourth hinge includes a third vertical plane and a fourth vertical plane respectively, wherein the third vertical plane and the fourth vertical plane remain fixed in position during the transition between the travelling state and the folded state.

6. The collapsible cargo bicycle according to claim 1, wherein the transverse axis is substantially perpendicular to the longitudinal axis of the cargo bicycle.

7. The collapsible cargo bicycle according to claim 1, wherein the front frame segment comprises a front upper frame segment and a front lower frame segment, and the rear frame segment includes a rear upper frame segment, a connector segment and a rear lower frame segment, wherein the front upper frame segment is pivotably connected to the rear upper frame segment and the connector segment via the first hinge and the front lower frame segment is pivotably connected to the rear lower frame segment and the connector segment via the second hinge.

8. The collapsible cargo bicycle according to claim 1, wherein each of the first hinge and the second hinge comprises a locking lever configured to move between a lock position and an unlocked position, wherein the unlocked position releases the hinge for allowing the transition of the bicycle from the travelling state to the folded state and vice versa.

9. The collapsible cargo bicycle according to claim 8, wherein each of the first hinge and the second hinge includes a first knob and a second knob including a lever at each end of a horizontal tube, wherein a first shaft is connected to the first knob and a second shaft

is connected to the second knob, and the first shaft and second shaft are located within the horizontal tube.

10. The collapsible cargo bicycle according to claim 9, wherein the first shaft is fixed in position, and the second shaft is rotatable about the transverse axis within the horizontal tube.

11. The collapsible cargo bicycle according to claim 10, wherein the first shaft includes a first face at an end of the first shaft, and the second shaft includes a second face at an end of the second shaft, wherein the first face and the second face abut each other in a plane at an angle relative to the transverse axis.

12. The collapsible cargo bicycle according to claim 11, wherein the first face includes an opening on a longitudinal axis of the first shaft, and the second face includes a locking pin protruding from the second face on a longitudinal axis of the second shaft, wherein the opening is configured to receive the locking pin.

13. The collapsible cargo bicycle according to claim 12, wherein the second knob includes a lever for a user to rotate the second knob to cause the second shaft and the locking pin to rotate relative to the plane to transition the locking releasing or locking the first hinge and the second hinge.

14. The collapsible cargo bicycle according to claim 10, wherein the second shaft is biased towards the first shaft through a spring mechanism to maintain the second knob in position.

15. The collapsible cargo bicycle according to claim 12, wherein a lateral and a rotating clockwise force applied in a direction away from the horizontal tube causes the second

shaft to be pulled away from the horizontal tube and the locking pin to be rotated out of its locked position to the unlocked position.

16. The collapsible cargo bicycle according to claim 15, wherein the second face of the second shaft and the first face of the first shaft are no longer aligned along the same plane.

17. The collapsible cargo bicycle according to claim 12, wherein a rotating anti-clockwise force applied on the lever causes the second shaft to be pulled towards the direction of the first shaft, and the locking pin to be received by the opening thereby causing the second face and the first face to abut each other and into the locked position.

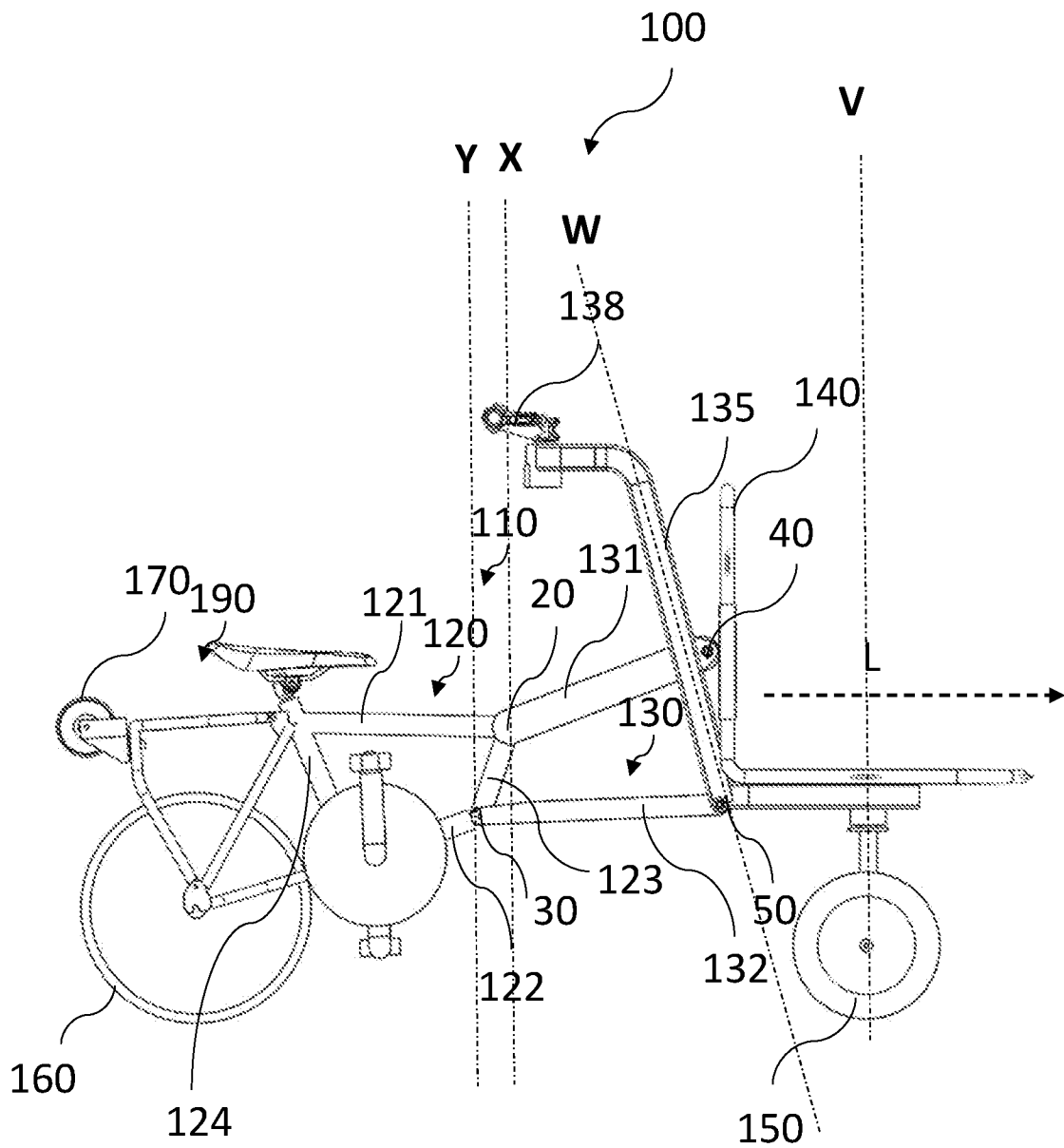


FIG. 1

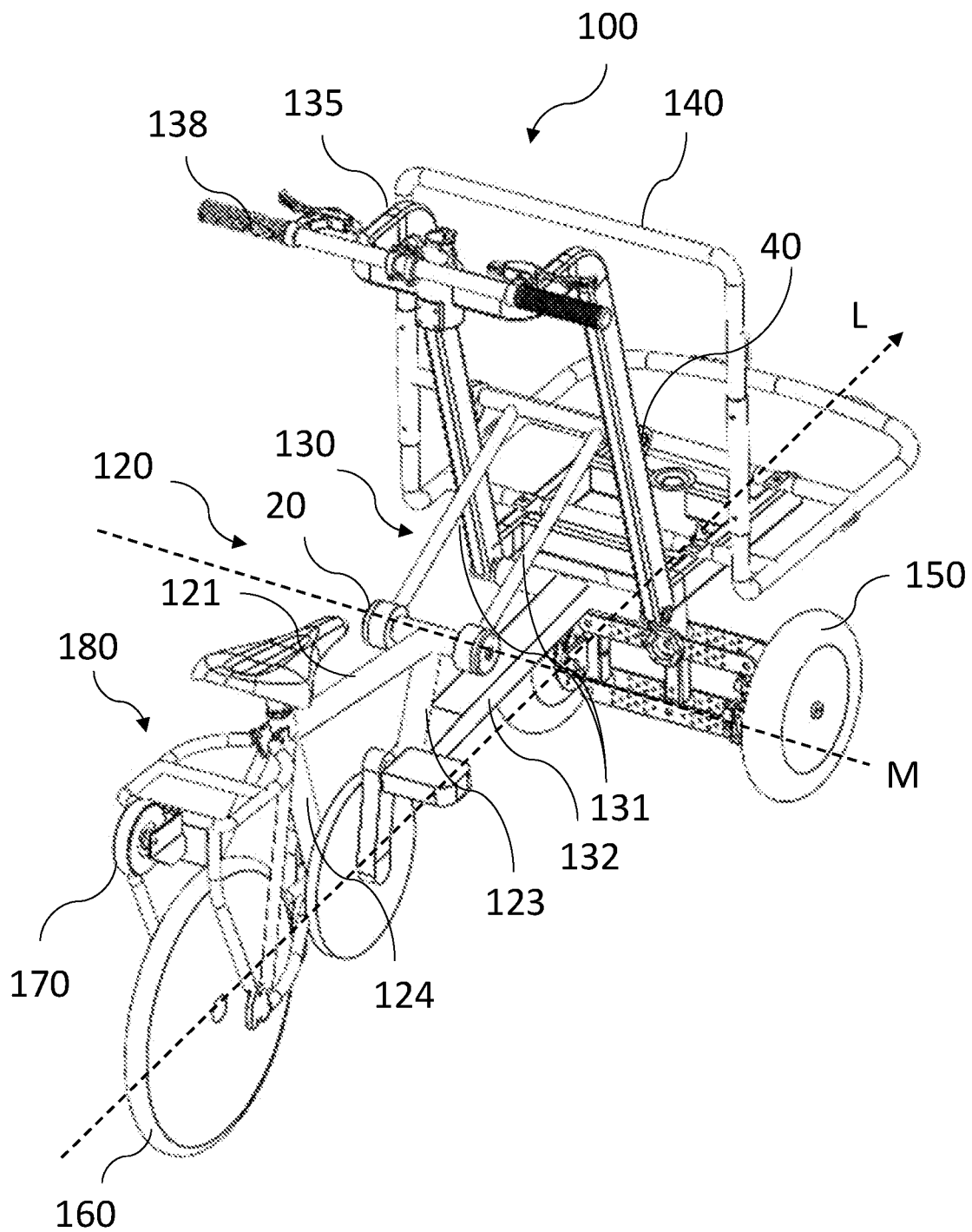


FIG. 2

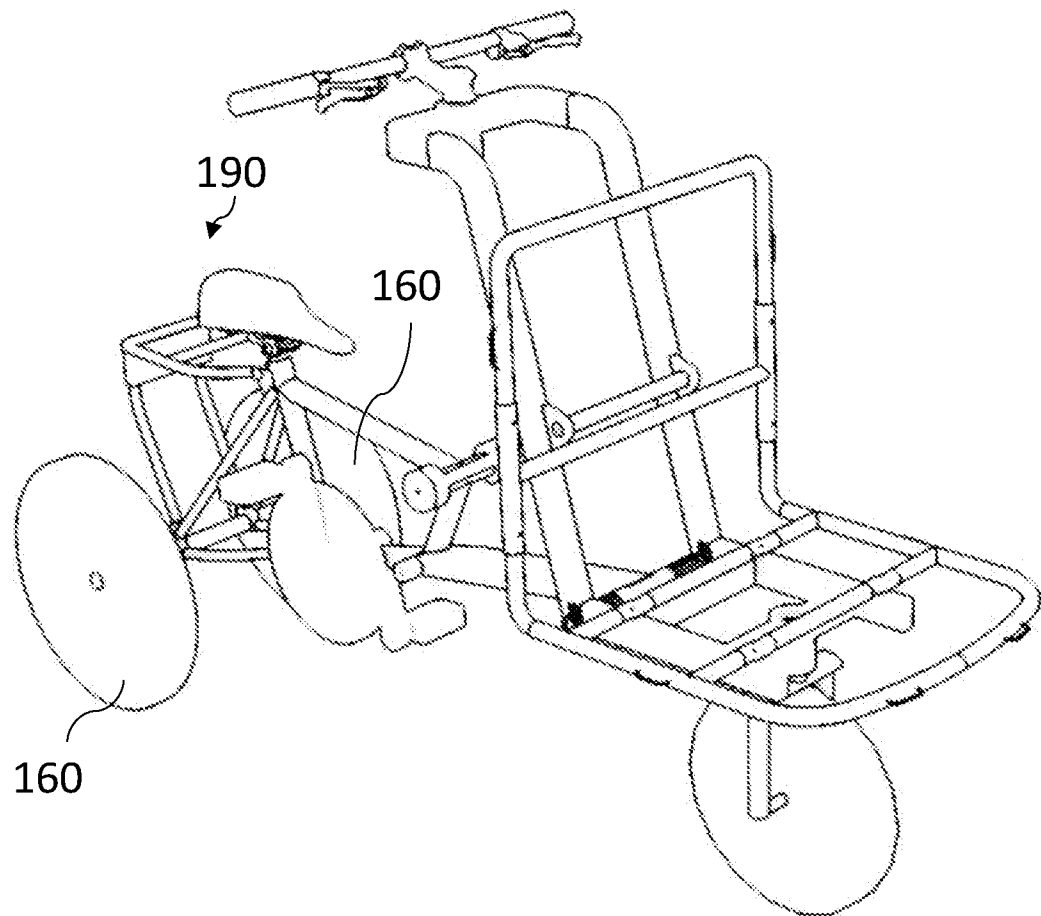


FIG. 3

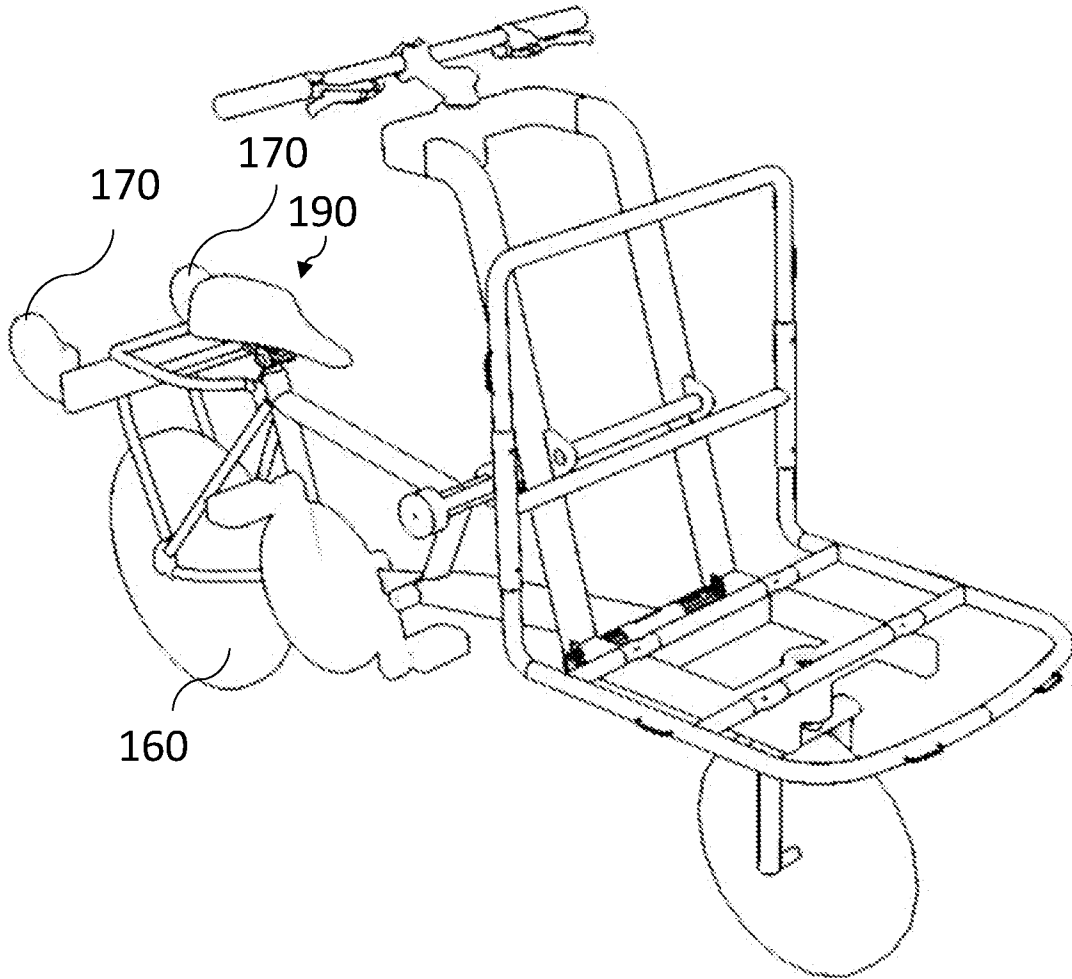


FIG. 4

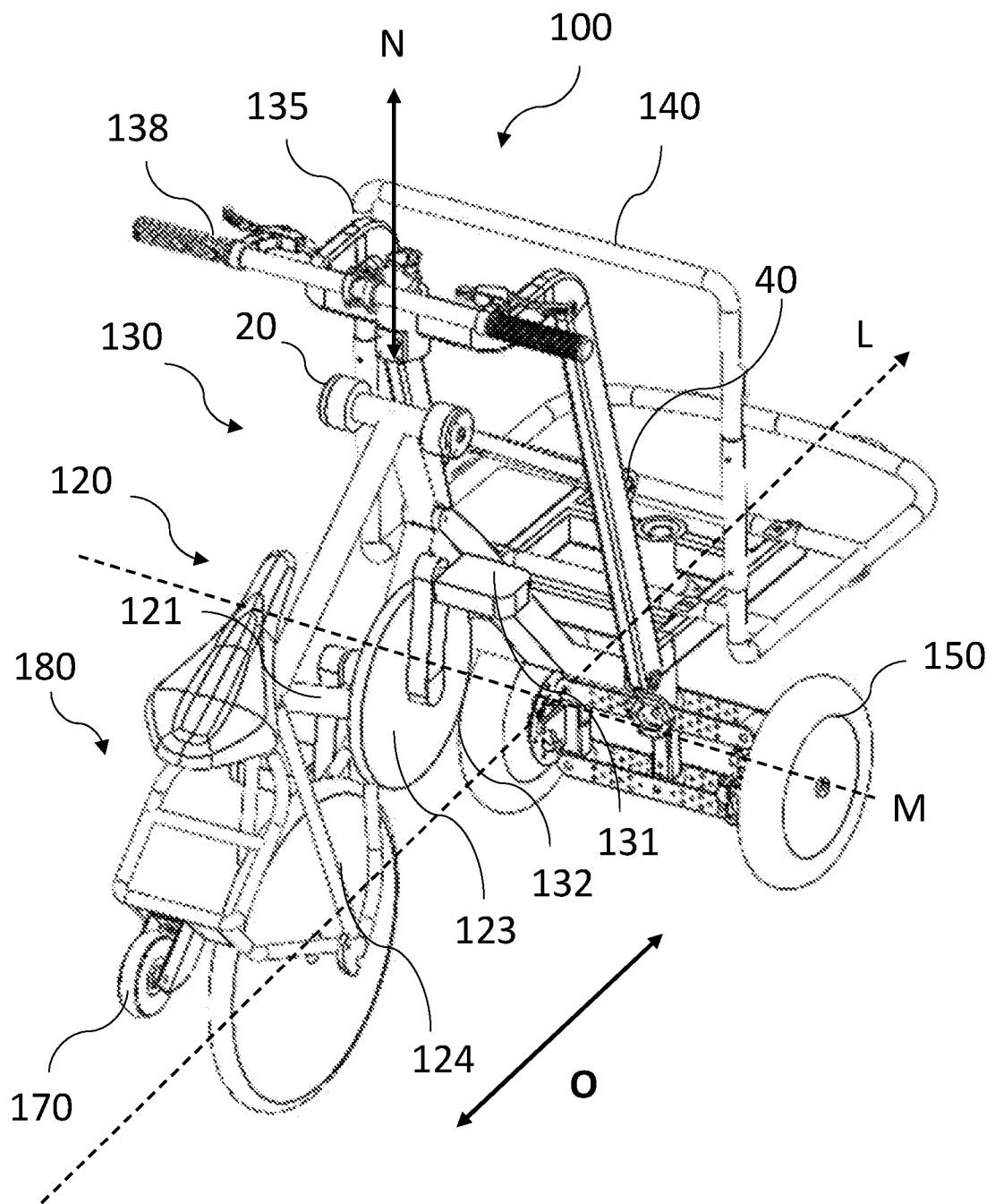


FIG. 5

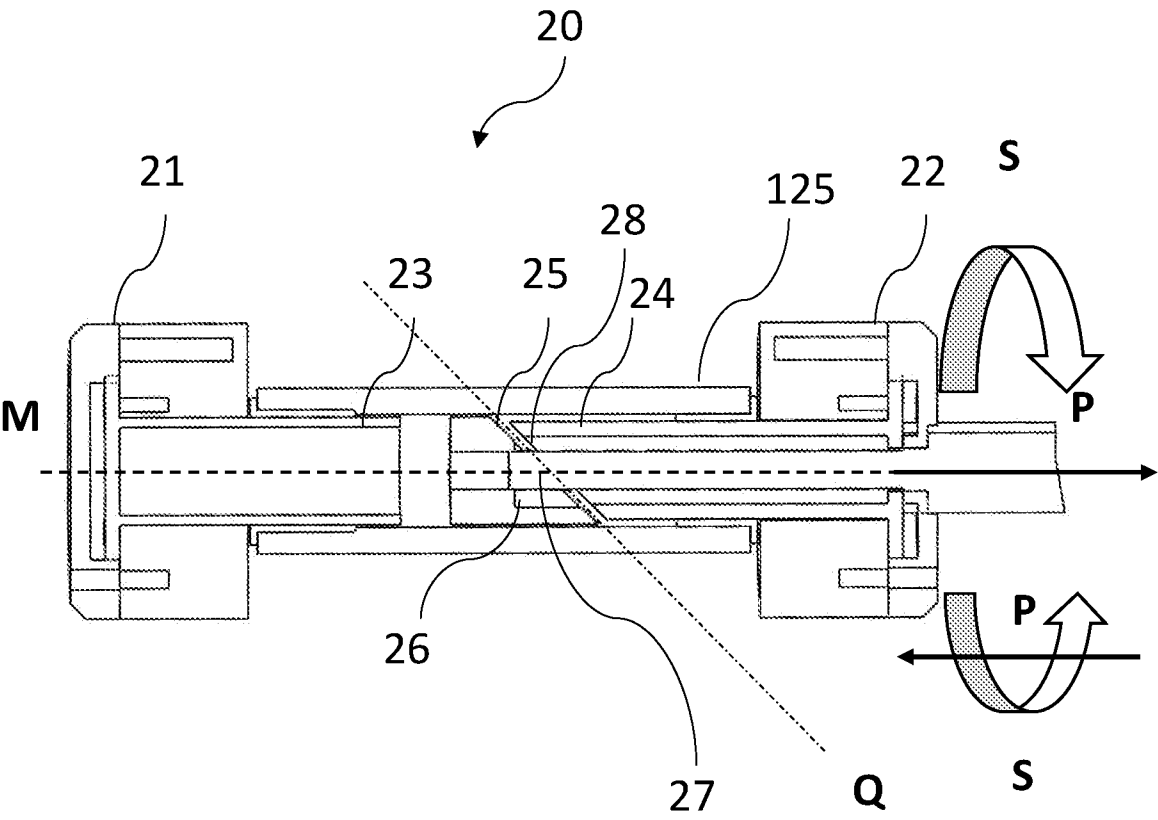


FIG. 6

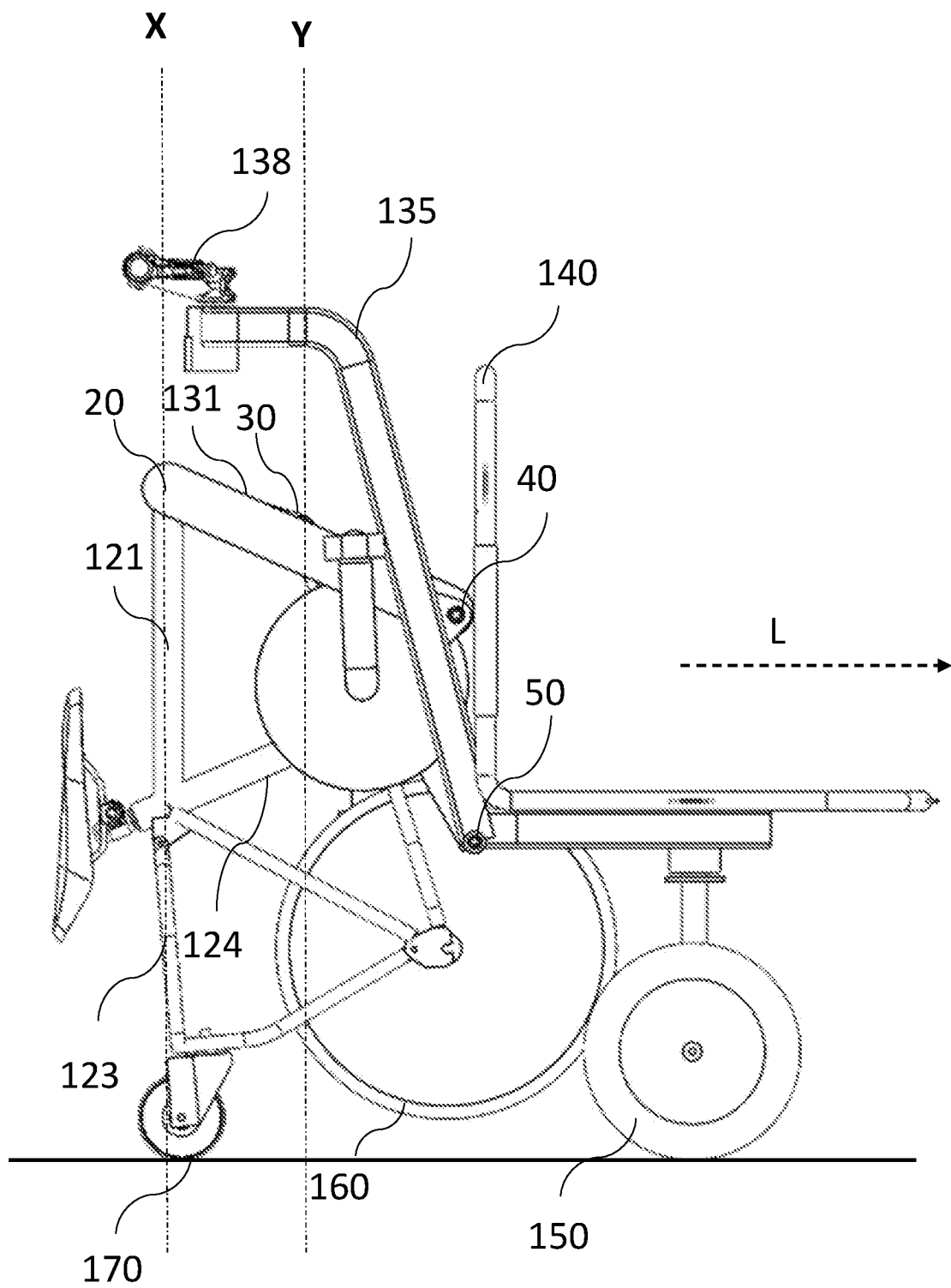


FIG. 7

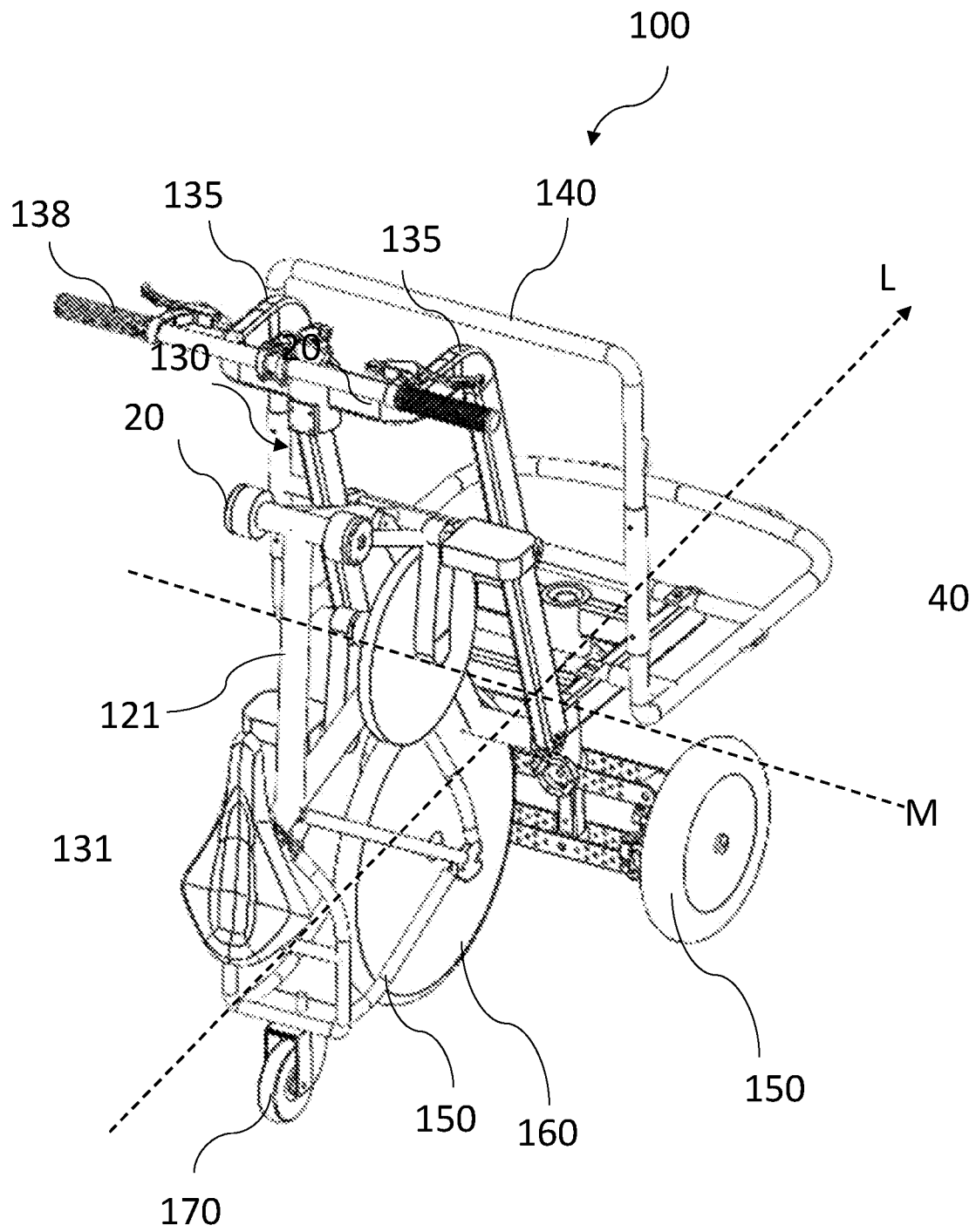


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SG2023/050408

A. CLASSIFICATION OF SUBJECT MATTER**B62K 15/00 (2006.01)** B62K 13/00 (2006.01) B62K 7/04 (2006.01)

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B62K; B62B

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)

FAMPAT: collapsible, foldable, cargo, load-carrying, cycle, hinge, pivot, support wheel, 折叠, 自行车, 推车 and related terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2015/014751 A1 (CHIKE GMBH & CO KG) 5 February 2015 Figs. 1, 8; para. [0041]-[0053] of the machine translation	1-17
A	CN 201914380 U (WENJING ZHOU) 3 August 2011 Whole document of the original non-English language document (a machine translation is enclosed only for your reference)	
A	JP 2009-143340 A (UNIV OSAKA SANGYO) 2 July 2009 Whole document of the machine translation	
A	WO 2022/243594 A1 (CABANAS BALLBE SERGI) 24 November 2022 Whole document of the machine translation	

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"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

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Date of the actual completion of the international search

18/01/2024

(day/month/year)

Date of mailing of the international search report

19/01/2024

(day/month/year)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG2023/050408

Note: This Annex lists known patent family members relating to the patent documents cited in this International Search Report. This Authority is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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CN 201914380 U	03/08/2011	NONE	
JP 2009-143340 A	02/07/2009	NONE	
WO 2022/243594 A1	24/11/2022	ES 1272994 U	06/07/2021