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Hansen et al.

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(54) **MANUAL WHEELCHAIR SYSTEM FOR IMPROVED PROPULSION AND TRANSFERS**

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B62M 1/14 (2006.01)
A61G 5/02 (2006.01)

(52) **U.S. Cl.**
CPC ***A61G 5/024*** (2013.01); ***A61G 5/026*** (2013.01); ***A61G 5/027*** (2013.01); *Y10T 74/20834* (2015.01); *Y10T 74/20864* (2015.01)

(58) **Field of Classification Search**
CPC A61G 5/022; A61G 5/024; A61G 5/026
USPC 280/250.1, 304.1; 74/552, 557
See application file for complete search history.

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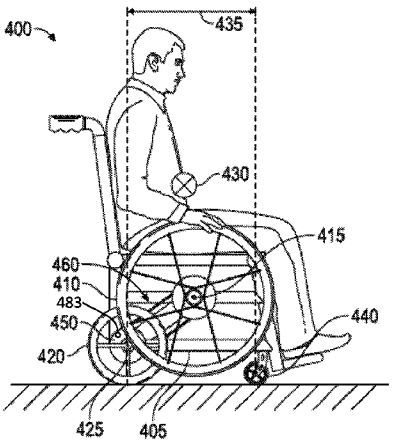
(74) *Attorney, Agent, or Firm* — Procopio, Cory, Hargreaves & Savitch LLP

(57) **ABSTRACT**

A manual wheelchair including a frame, a drive wheel connected to the frame, having a first axis of rotation and configured to rotate relative to the frame, a push rim connected to the frame, having a second axis of rotation extending substantially parallel to the first axis of rotation of the drive wheel and configured to rotate relative to the frame, wherein the second axis of rotation of the push rim is offset from the first axis of rotation of the drive wheel in a direction orthogonal to the first axis of rotation of the drive wheel, and a transmission configured to transmit rotation of the push rim to rotation of the drive wheel. Additionally, the wheelchair may also include multispeed fixed-gear hubs for propulsion on different terrain and removable or rotatable push rims for easier transfers.

17 Claims, 10 Drawing Sheets



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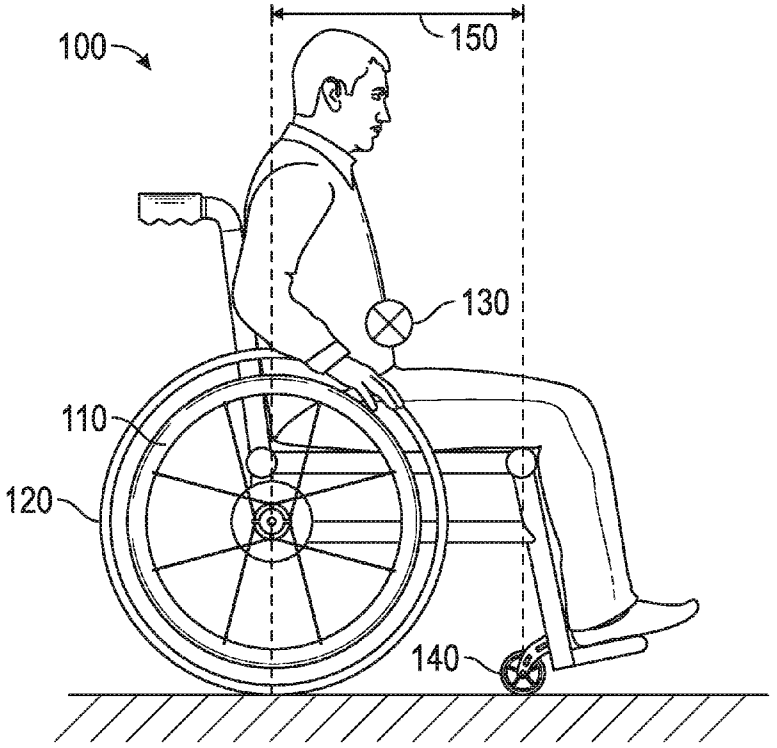

FIG. 1
(Related Art)

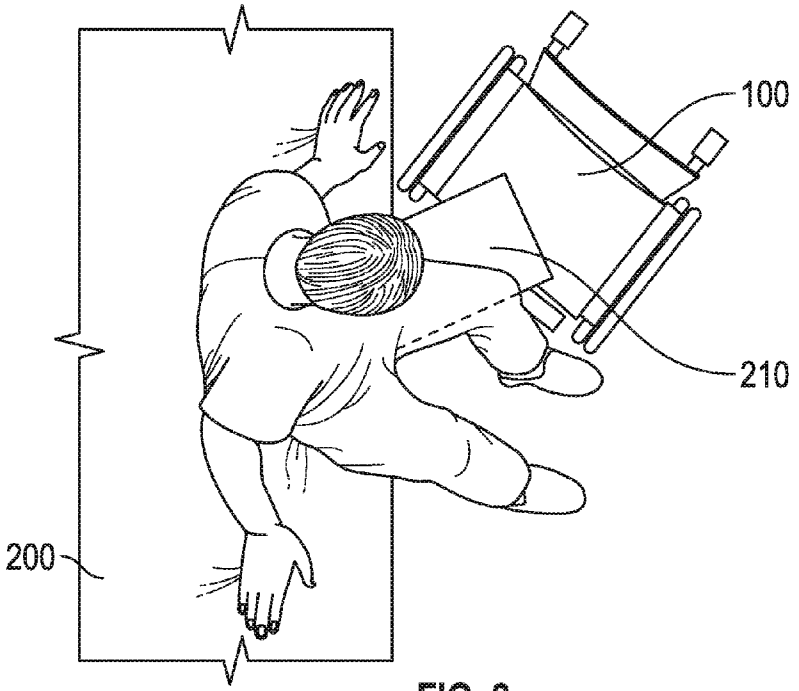

FIG. 2
(Related Art)

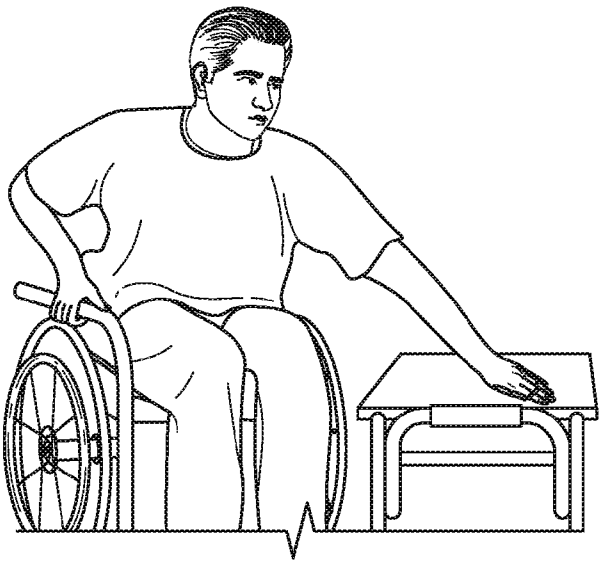

FIG. 3A
(Related Art)

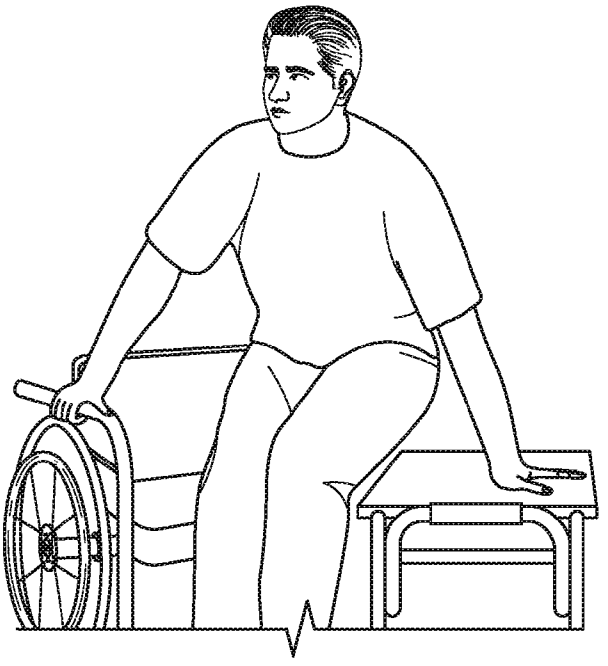

FIG. 3B
(Related Art)

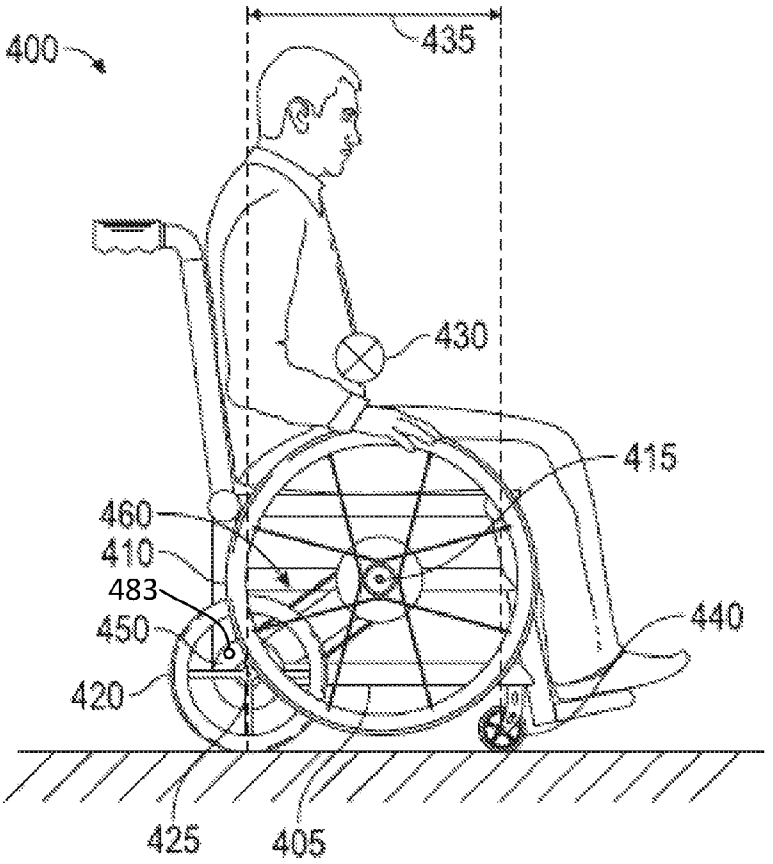
400
435
430
415
460
410
483
450
440
420
425
405

FIG. 4A

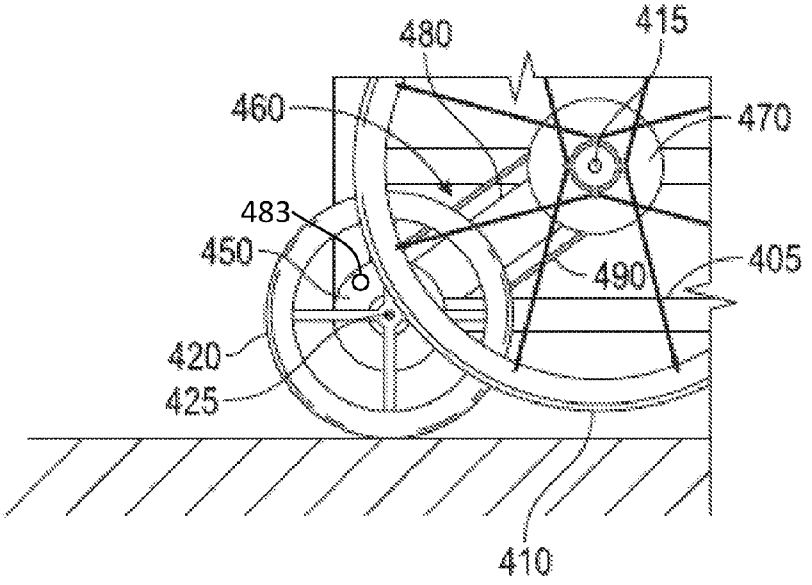
480
415
460
470
483
450
490
405
420
425
410

FIG. 4B

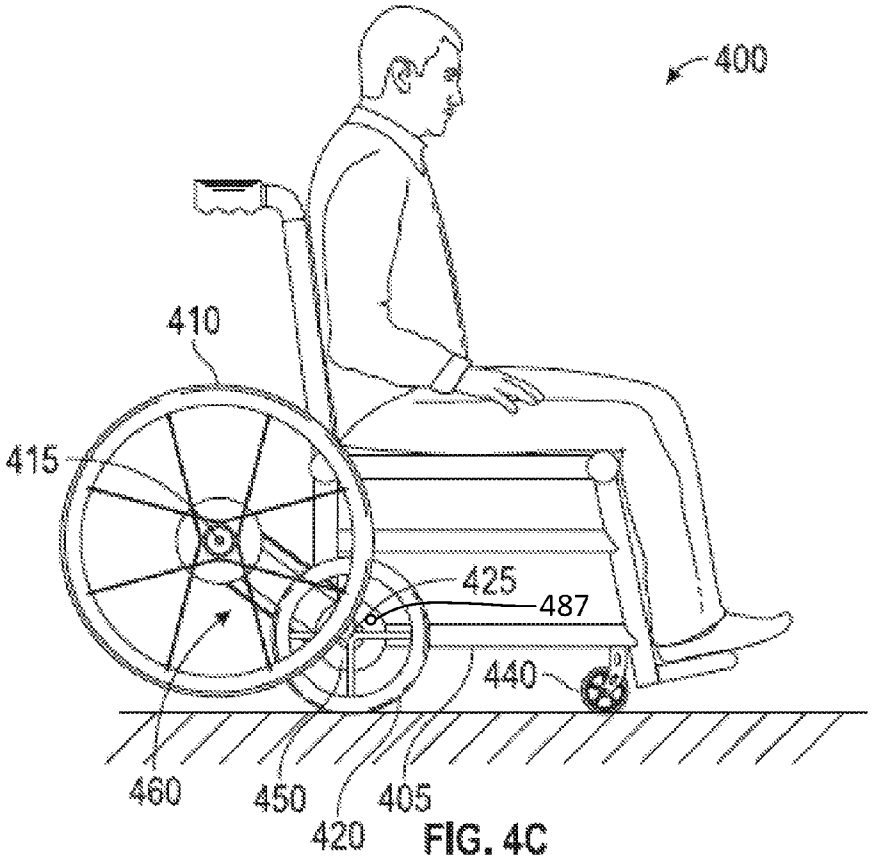
400
410
415
425
487
440
460
450
405
420

FIG. 4C

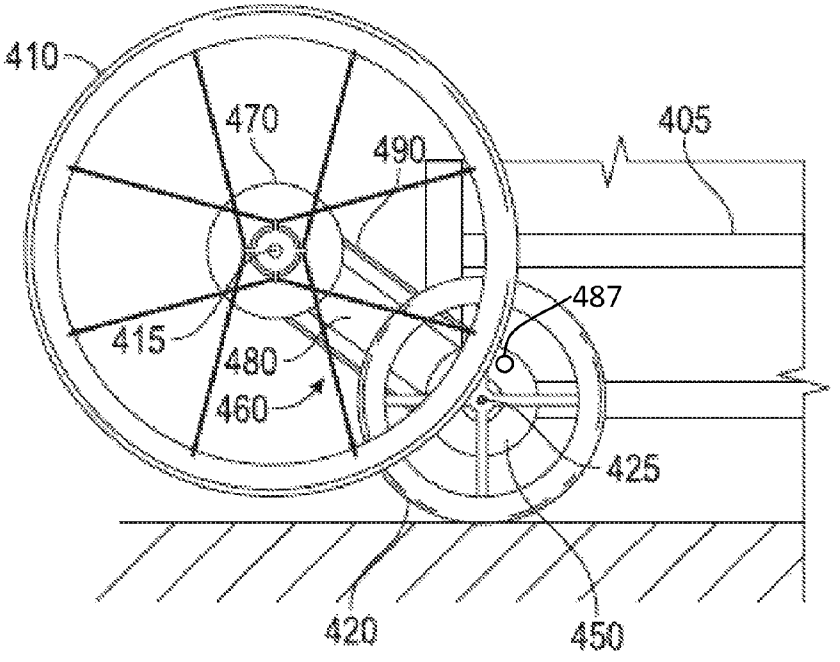
410
470
490
405
487
415
480
460
425
420
450

FIG. 4D

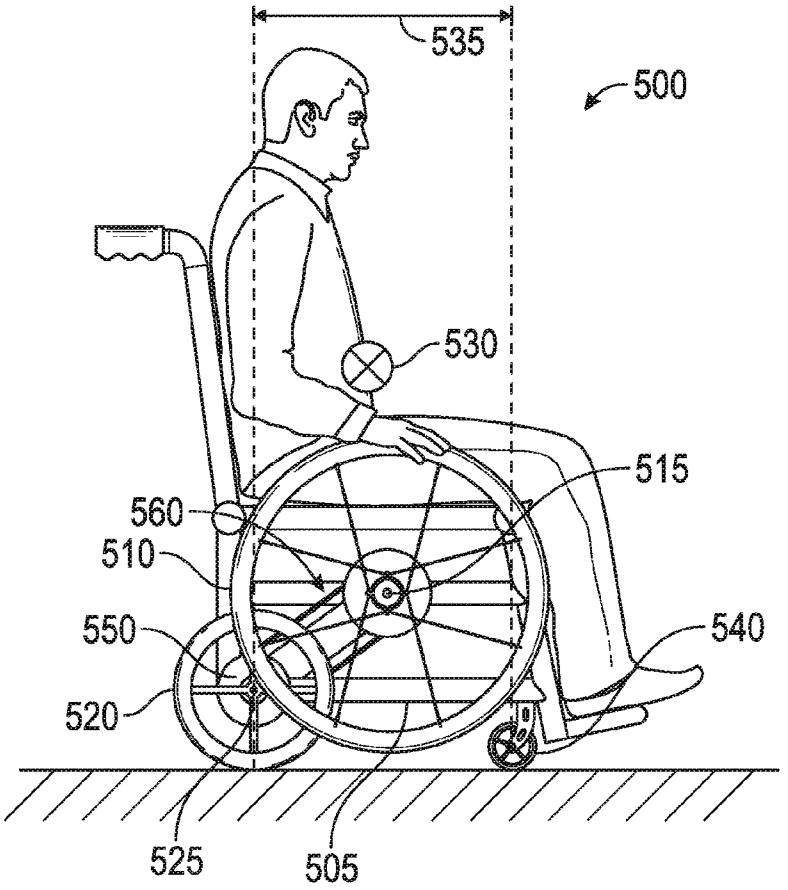
535
500
530
515
560
510
550
540
520
525
505

FIG. 5A

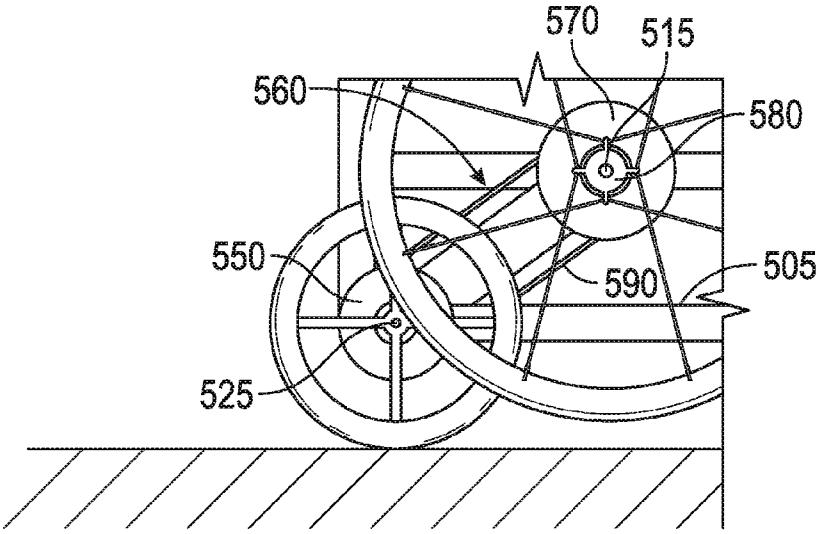
570
515
560
580
550
590
505
525

FIG. 5B

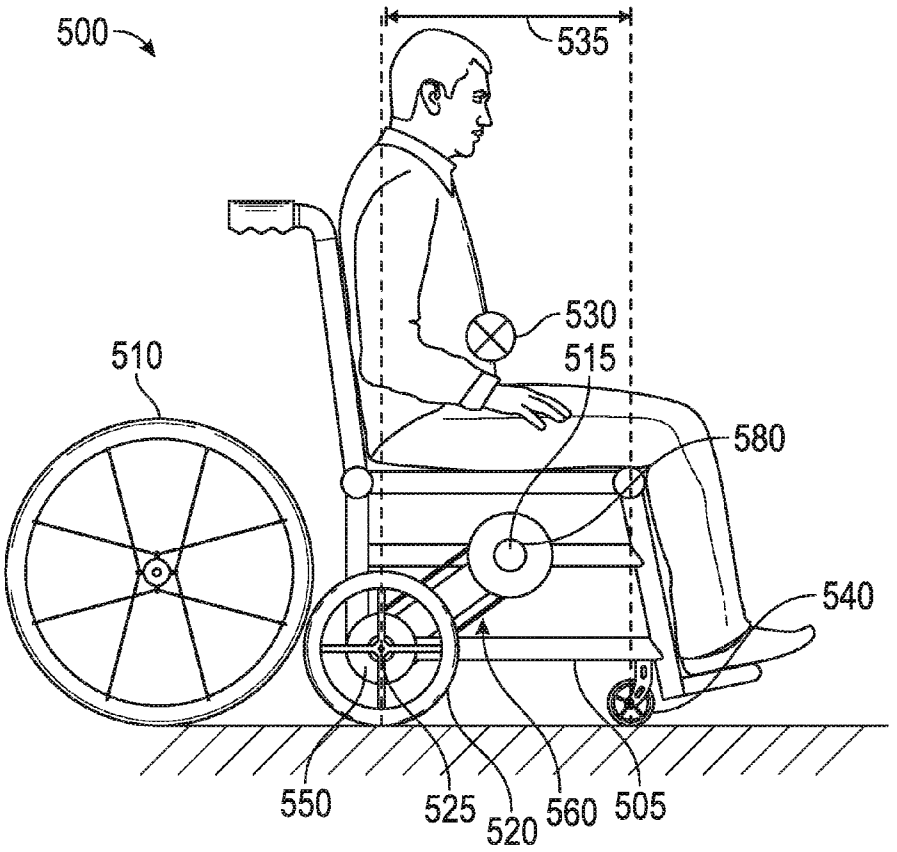
500
535
530
515
510
580
540
550
525
520
560
505

FIG. 5C

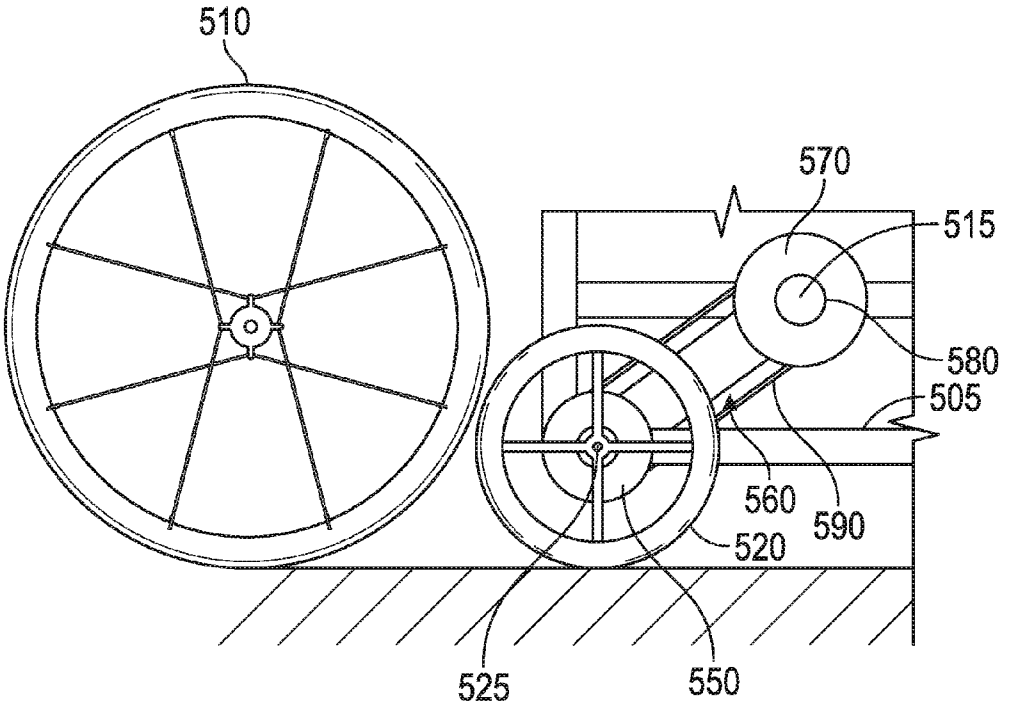
510
570
515
580
505
560
590
520
525
550

FIG. 5D

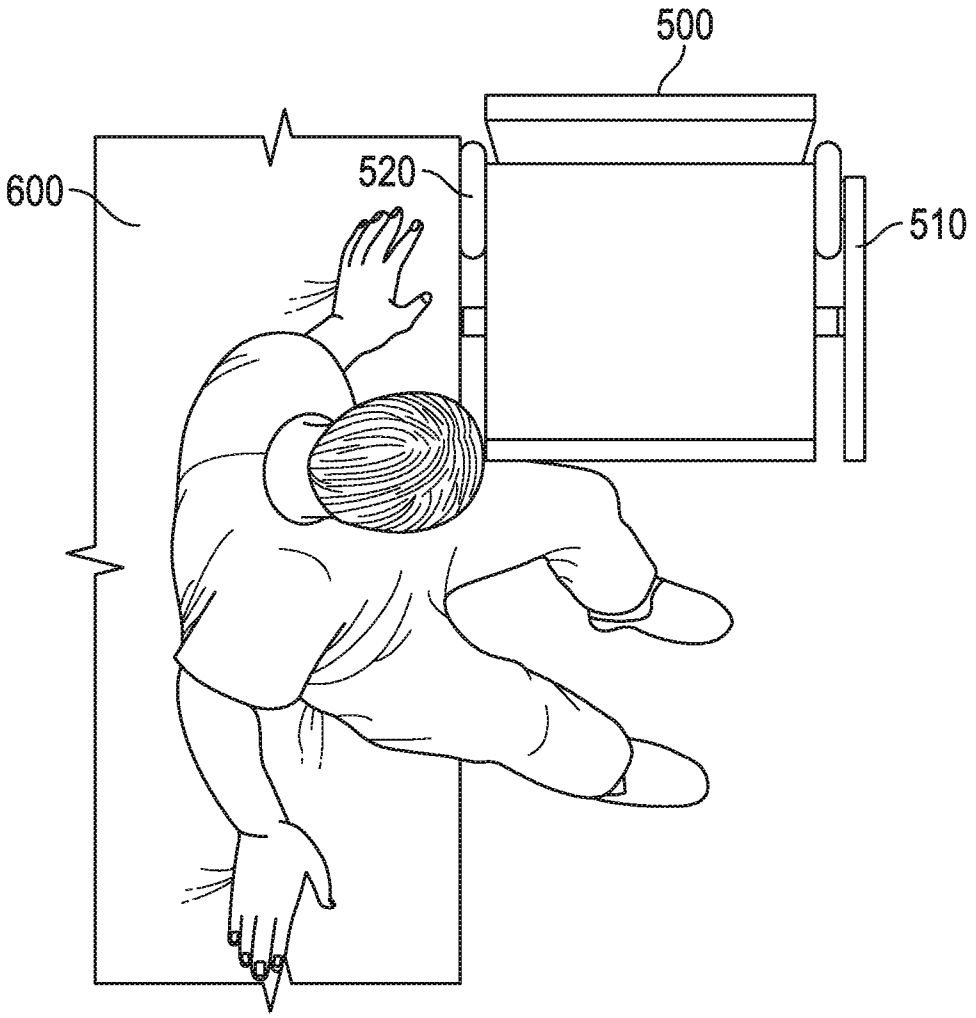

FIG. 6

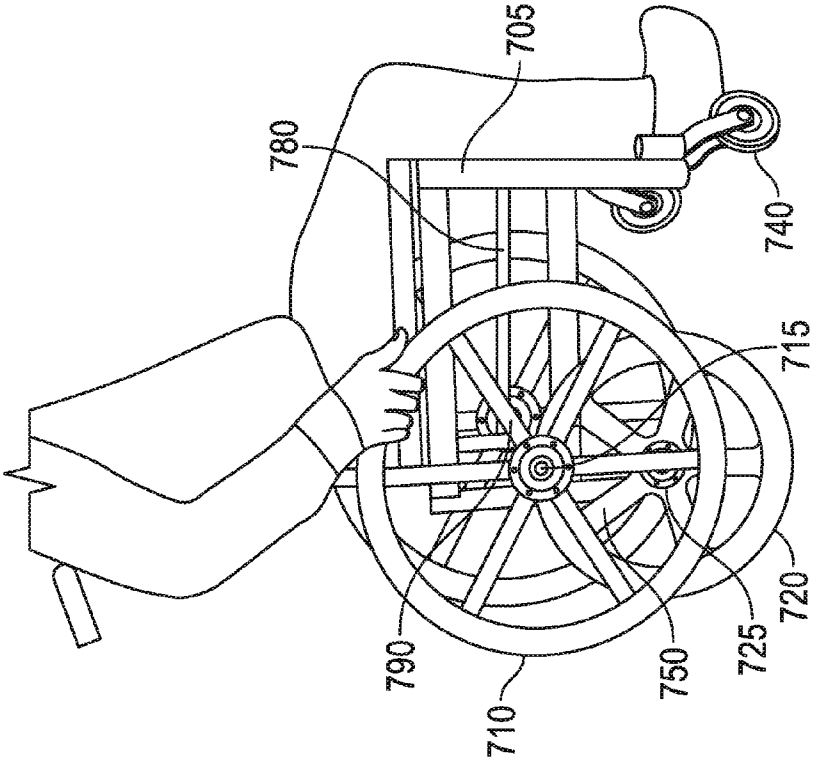
705
780
740
715
720
725
750
790
710

FIG. 7B

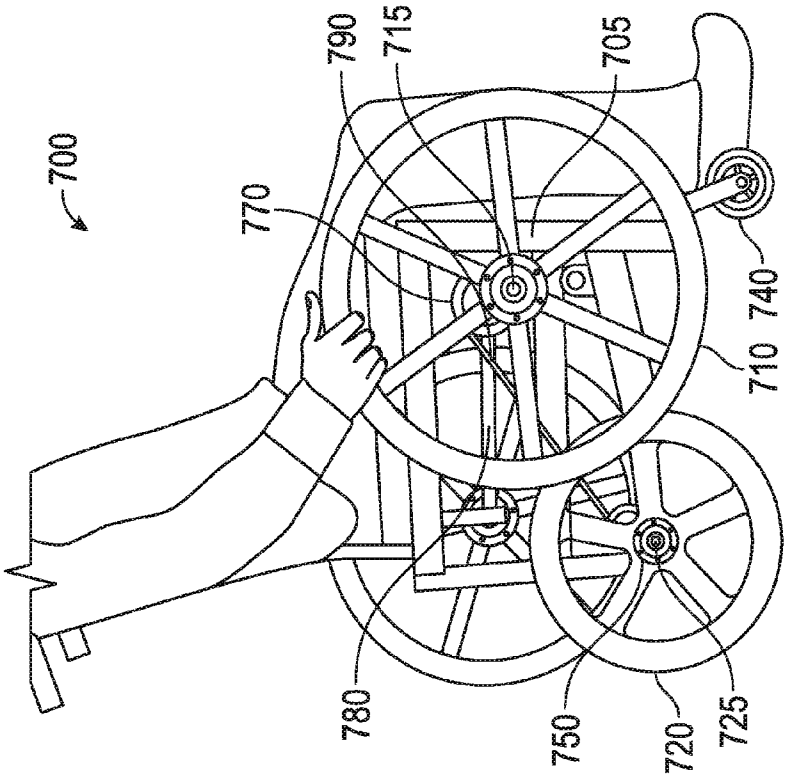
700
790
715
705
770
740
710
780
750
720
725

FIG. 7A

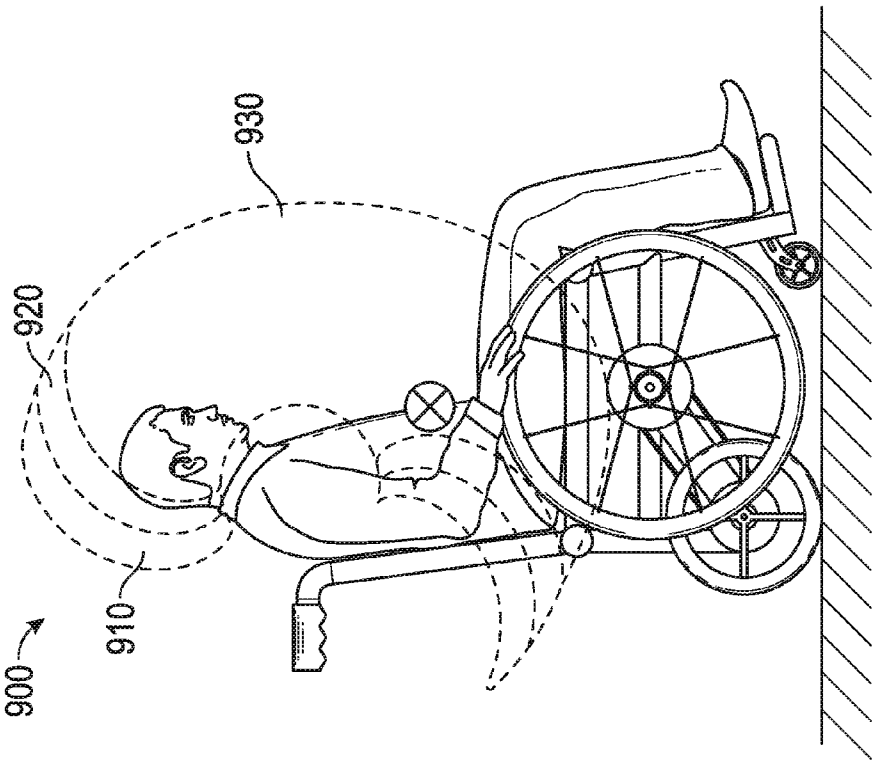

FIG. 9

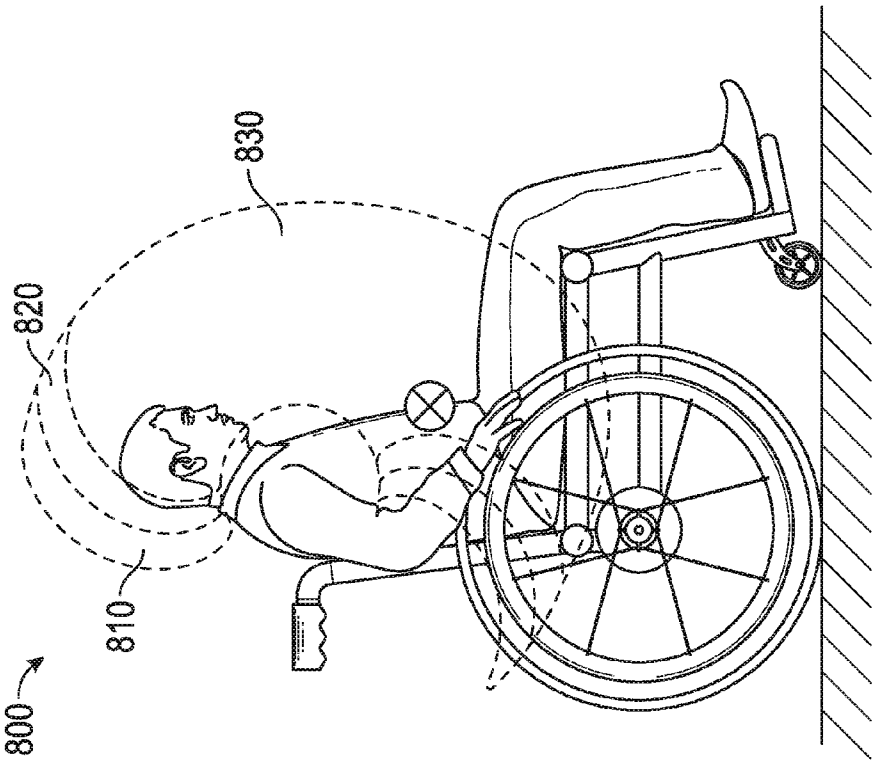

FIG. 8
(Related Art)

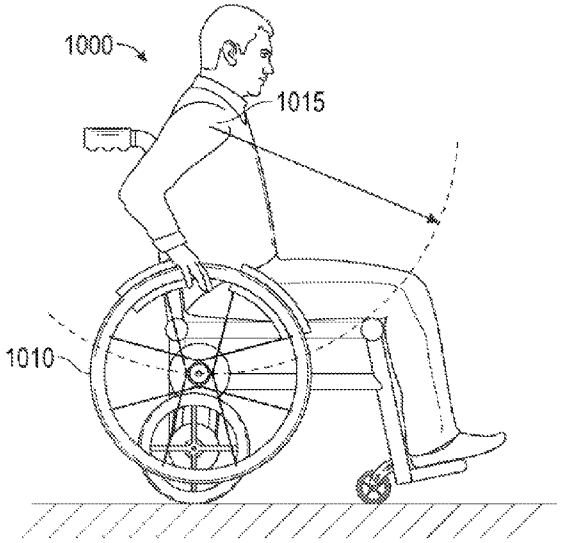

FIG. 10A

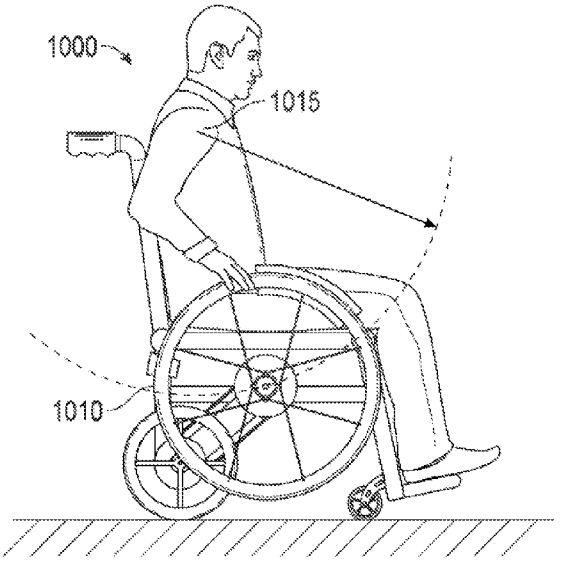

FIG. 10B

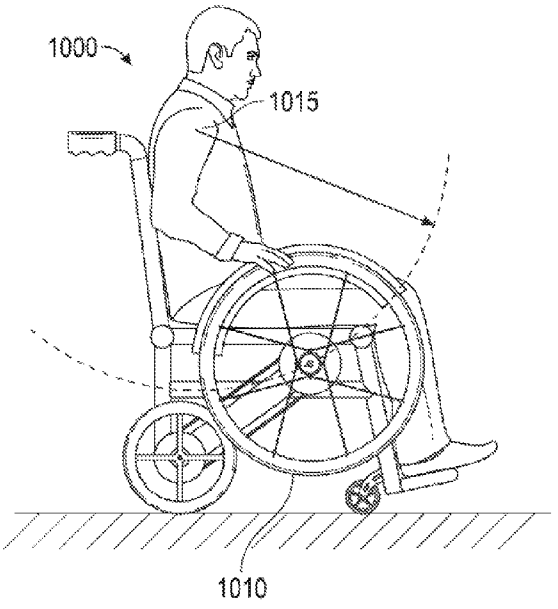

FIG. 10C

MANUAL WHEELCHAIR SYSTEM FOR IMPROVED PROPULSION AND TRANSFERS

BACKGROUND

1. Field of the Invention

The purpose of the invention is to provide a wheelchair system that allows for independent positioning of the push rims and drive wheels, allowing for improved stability and improved shoulder biomechanics. The approach also allows for the addition of multispeed fixed-gear hubs for improved propulsion on sloped surfaces and allows for removal or repositioning of the push rims out of the way for easier transfers in and out of the wheelchair.

2. Related Art

The most common form of a manual wheelchair **100** utilizes a push rim **110** connected directly to the drive wheels **120** as shown in FIG. **1**. The wheelchair user is able to propel the wheelchair **100** by pushing the push rims **110** with their hands, thereby rotating the wheel an equal angle and translating the chair forward. The common wheelchair is elegant in its simplicity. However, the inherent mechanical coupling of the push rim **110** and the wheel **120** require that they be placed in the same fore-aft position, which may lead to reduced stability of the wheelchair and/or shoulder problems. In setup of the common wheelchair, the clinician must balance concerns of shoulder biomechanics and stability of the wheelchair. On one hand, the clinician would like to move the push rims forward to promote a better positioning of the shoulders for propulsion. On the other hand, the axle of the wheels **120** must remain behind the center of gravity **130** to reduce the likelihood the wheelchair **100** will tip over backward. A common approach is to move the push rim/wheel combination **110**/**120** as far forward as possible while still maintaining a stable base **150** of support of the wheelchair by positioning the drive wheel **120** and front casters **140** to frame the center of gravity **130** in fore/aft directions.

The positioning of the push-rim/wheel **110**/**120** combination in common wheelchairs leads to difficulties in transfers (transferring in and out of the wheelchair **100**). For example, the user must position the wheelchair at an angle with a bed **200** or other transfer surface in order to use a transfer board **210** (see FIG. **2**). Without a transfer board, the person must elevate their body a significant distance to clear the wheel of the wheelchair (FIGS. **3**A, **3**B).

Therefore, what is needed is a system and method that overcomes these significant problems found in the conventional systems as described above.

SUMMARY

Described herein is a new manual wheelchair system that decouples the push rims from the drive wheels of the wheelchair and reconnects the push rims to the drive wheels using a belt drive or chain drive, thus allowing for optimal stability and better shoulder positioning for propulsion. The push rims are also removable or rotatable for easier transfers. The wheelchair can also include multispeed fixed-gear hubs for easier propulsion on different terrain. The wheelchair advantageously reduces shoulder problems that are common in persons who use manual wheelchairs while maintaining optimal stability.

Other features and advantages of the present invention will become more readily apparent to those of ordinary skill in the art after reviewing the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The structure and operation of the present invention will be understood from a review of the following detailed description and the accompanying drawings in which like reference numerals refer to like parts and in which:

FIG. **1** is a diagram illustrating an example related art wheelchair;

FIG. **2** is a diagram illustrating an example related art wheelchair transfer with a transfer board;

FIGS. **3**A and **3**B are diagrams illustrating an example related art wheelchair transfer without a transfer board;

FIGS. **4**A-**4**D are diagrams illustrating an example wheelchair with a push rim capable of being rotated backward and out of the way for transfers according to a first implementation of the present application;

FIGS. **5**A-**5**D are diagrams illustrating an example wheelchair with a push rim capable of being removed and placed out of the way for transfers according to a second implementation of the present application;

FIG. **6** is a block diagram illustrating an example transfer of a patient from a bed to a wheelchair according to an embodiment of the invention.

FIGS. **7**A-**7**B are diagrams illustrating an example wheelchair with a push rim capable of being translated backward and out of the way for transfers according to a third implementation of the present application;

FIG. **8** is a diagram illustrating a user's range of motion laid over a diagram of an example related art wheelchair;

FIG. **9** is a diagram illustrating a user's range of motion laid over a diagram of a wheelchair according to an implementation of the present application;

FIGS. **10**A-**10**C are diagrams illustrating placement of a push rim at different positions along a wheelchair according to an implementation of the present application.

DETAILED DESCRIPTION

Certain implementations disclosed herein provide for a manual wheelchair that allows for optimization of stability and shoulder biomechanics for individual wheelchair users. For example, one apparatus disclosed herein provides a wheelchair having a drive wheel rotatable about a first axis of rotation, a push rim rotatable about a second axis of rotation, which is offset from the first axis of rotation, and a transmission coupling the push rim to the drive wheel.

Additionally, some implementations disclosed herein provide for a manual wheelchair that allows for the positioning of the push rim to allow transfer into and out of the wheelchair. For example, one apparatus disclosed herein provides a wheelchair having a push rim repositioning mechanism that allows the push rim to be rotated between a propulsion position and a transfer position.

After reading this description it will become apparent to one skilled in the art how to implement the invention in various alternative embodiments and alternative applications. However, although various embodiments of the present invention will be described herein, it is understood that these embodiments are presented by way of example only, and not limitation. As such, this detailed description of various alternative embodiments should not be construed to limit the scope or breadth of the present invention as set forth in the appended claims.

FIGS. **4**A-**4**D are diagrams illustrating an example wheelchair with a push rim capable of being rotated backward and out of the way for transfers according to a first implementation of the present application. More specifically, FIG. **4**A

illustrates the wheelchair with the push rim rotated forward into a propulsion position. Further, FIG. **4**B illustrates an enlarged view of the push rim relocation mechanism in the propulsion position. Further, FIG. **4**C illustrates the wheelchair with the push rim rotated backward into a transfer position. Further, FIG. **4**D illustrates an enlarged view of the push rim relocation mechanism in the transfer position.

In this implementation, the wheelchair **400** includes a frame **405**, a rotatable push rim **410** connected to the frame **405** and a drive wheel **420** connected to the frame **405**. The wheelchair **400** may also include caster wheels **440** located in front of the drive wheel **420**. The caster wheels **440** and the drive wheels **420** collectively form the base of support **435** of the wheelchair. In order to provide a stable ride for the user, it may be preferable that caster wheels **440** and the drive wheels be positioned such that the user's center of gravity **430** is located directly above the base of support **435**, rather than in front of or behind the base of support **435**.

As shown in FIGS. **4**A-**4**D, the axis of rotation **425** of the drive wheel **420** is offset from the axis of rotation **415** of the push rim. Thus, instead of being directly coupled to each other, the push rim **410** and drive wheel **420** are connected by a transmission **460**. The transmission **460** may include a drive gear/hub **450** coupled to drive wheel **420**, a push rim gear/hub **470** coupled to the push rim **410**, and a chain or belt **490** connected to the drive gear/hub **450** and the push rim gear/hub **470**.

Thus, de-coupling the fore-aft position of the push rims **410** and drive wheels **420** may allow a clinician to place the drive wheels **420** in their optimal position to provide a stable base of support **435** while still allowing the person to do "wheelies" if needed (to go over curbs and other thresholds). Also, the position of the push rims **410** can be set to promote the best positioning of the wheelchair **400** user's shoulders. A potential aspect of this more forward positioning of the push rims **410** is a reduction in shoulder pain resulting from manual propulsion of the wheelchair. In other words, de-coupling of the push rims **410** and drive wheels **420** may allow the clinician to place the push rims **420** in front of the user's center of gravity **430** as shown in FIGS. **4**A-**4**D, potentially improving mechanical efficiency without sacrificing wheelchair stability.

Additionally, the use of the transmission **460** with the belts or chains **490** may allow the wheelchair to also incorporate into one or both of the drive gear/hub **450** and the push rim gear/hub **470** a multispeed fixed-gear hub such as the Sturmey-Archer S3X fixed-gear hub. In such implementations, the ability to switch to higher or lower speeds may allow the wheelchair user to go faster on smooth even terrain and to require less torque and forces on the shoulders to go up inclined terrain.

Additionally, in some implementations, the wheelchair **400** also includes a push rim repositioning member **480** that allows the push rim **410** to be repositioned to allow a user to transfer into and out of wheelchair **400** without having to lift himself over the push rim as shown in FIGS. **3**A and **3**B above. In FIGS. **4**A-**4**D, the repositioning member **480** is a swing arm rotatably mounted to the frame **405** and configured to rotate about the axis of rotation **425** of the drive train. As shown, the push rim gear/hub **470** and push rim **410** are located at a first end of the swing arm **480** and the drive wheel gear/hub **450** is located at a second end of the swing arm **480** and the belt/chain **490** extends along the length of the swing arm. As shown in FIGS. **4**A and **4**B, the swing arm **480** can be rotated forward to position the push rim **410** forward of a user's shoulders to allow the propulsion of the wheel chair by the user (known as the propulsion position). As shown in FIGS. **4**C and **4**D, the swing arm **480** can be rotated backward to position the push rim **410** behind a user's shoulders to allow the user to transfer into and out of the wheelchair.

Additionally, in some embodiment, a locking mechanism **483** may be provided to releasably hold the push rim repositioning member **480** (swing arm) in the propulsion position shown in FIGS. **4**A and **48**. Further, a second locking mechanism **487** or hard stop may also be provided to releasably hold or limit the rearward rotation of the push rim repositioning member **480** (swing arm) in the transfer position shown in FIGS. **4**C and **40**.

Though various aspects of this embodiment are shown in the figures and discussed above, implementations of this application are not limited to these aspects and alternative implementations are discussed below.

FIGS. **5**A-**5**D are diagrams illustrating an example wheelchair with a push rim capable of being removed and placed out of the way for transfers according to a second implementation of the present application. More specifically, FIG. **5**A illustrates the wheelchair with the push rim attached to the wheelchair in a propulsion position. Further, FIG. **5**B illustrates an enlarged view of the push rim relocation mechanism with the push rim attached in the propulsion position. Further, FIG. **5**C illustrates the wheelchair with the push rim disconnected from the wheelchair and repositioned for a transfer. Further, FIG. **5**D illustrates an enlarged view of the push rim removed for a transfer.

As with the implementation discussed above, in this implementation the wheelchair **500** includes a frame **505**, a rotatable push rim **510** connected to the frame **505** and a drive wheel **520** connected to the frame **505**. The wheelchair **500** may also include caster wheels **540** located in front of the drive wheel **520**. Again, the caster wheels **540** and the drive wheels **520** collectively form the base of support **535** of the wheelchair. In order to provide a stable ride for the user, it may be preferable that caster wheels **540** and the drive wheels be positioned such that the user's center of gravity **530** is located directly above the base of support **535**, rather than in front of or behind the base of support **535**.

As shown in FIGS. **5**A-**5**D, the axis of rotation **525** of the drive wheel **520** is offset from the axis of rotation **515** of the push rim **510**. Thus, instead of being directly coupled to each other, the push rim **510** and drive wheel **520** are connected by a transmission **560**. The transmission **560** may include a drive gear/hub **550** coupled to drive wheel **520**, a push rim gear/hub **570** coupled to the push rim **510**, and a chain or belt **590** connected to the drive gear/hub **550** and the push rim gear/hub **570**.

Again, de-coupling the fore-aft position of the push rims **510** and drive wheels **520** may allow a clinician to place the drive wheels **520** in their optimal position to provide a stable base of support **535** while still allowing the person to do "wheelies" if needed (to go over curbs and other thresholds). Also, the position of the push rims **510** can be set to promote the best positioning of the wheelchair **500** user's shoulders. A potential aspect of this more forward positioning of the push rims **510** is a reduction in shoulder pain resulting from manual propulsion of the wheelchair. In other words, de-coupling of the push rims **510** and drive wheels **520** may allow the clinician to place the push rims **520** in front of the user's center of gravity **530** as shown in FIGS. **5**A-**5**D, potentially improving mechanical efficiency without sacrificing wheelchair stability.

Again, the use of the transmission **560** with the belts or chains **590** may allow the wheelchair to also incorporate into either one or both of the drive gear/hub **550** and the push rim

gear/hub **570** a multi-speed fixed-gear hub such as the Sturmey-Archer S3X fixed-gear hub, for example. In such implementations, the ability to switch to higher or lower speeds may allow the wheelchair user to go faster on smooth even terrain and to require less torque and forces on the shoulders to go up inclined terrain.

Additionally, in some implementations, the wheelchair **500** also includes a push rim repositioning member **580** that allows the push rim **510** to be repositioned to allow a user to transfer into and out of wheelchair **500** without having to lift himself over the push rim as shown in FIGS. **3**A and **3**B above. In the implementation shown in FIGS. **5**A-**5**D, the repositioning member **580** is release mechanism that allows the push rim **510** to be disconnected from the frame **505**. For example, a quick release mechanism could be used to allow the push rim **510** to be removably attached to the frame **505**. As shown in FIGS. **5**A and **5**B, the release mechanism (push rim repositioning member **580**) holds the push rim **510** forward of a user's shoulders to allow propulsion of the wheelchair by the user (known as the propulsion position). As shown in FIGS. **5**C and **5**D, the release mechanism (push rim repositioning member **580**) allows the push rim **510** to be disconnected from the frame **505**, and once disconnected, the push rim **510** can be placed behind a user's shoulders to allow the user to transfer into and out of the wheelchair.

Though various aspects of this embodiment are shown in the figures and discussed above, implementations of this application are not limited to these aspects and alternative implementations are discussed below.

FIG. **6** is a block diagram illustrating an example transfer of a patient from a bed to a wheelchair according to an embodiment of the invention.

By incorporating a push rim reposition member, such as shown in the implementations of FIGS. **4**A-**4**D and FIGS. **5**A-**5**D, the wheelchair **500** can now be placed directly next to the bed **600** or other transfer surface, reducing the distance to transfer and also reducing the height to elevate the body since the user no longer needs to clear the wheel **520** or the push rim **510** or the combination.

FIGS. **7**A-**7**B are diagrams illustrating an example wheelchair with a push rim capable of being rotated backward and out of the way for transfers according to a third implementation of the present application. More specifically, FIG. **7**A illustrates the wheelchair with the push rim to the wheelchair located in a propulsion position. Further, FIG. **7**B illustrates the wheelchair with the push rim repositioned into a transfer position.

This implementation shown in FIGS. **7**A and **7**B may include features and elements similar to those discussed above with respect to the first and second implementations. Thus redundant descriptions thereof may be omitted. As with the implementations discussed above, in this implementation the wheelchair **700** includes a frame **705**, a rotatable push rim **710** connected to the frame **705** and a drive wheel **720** connected to the frame **705**. The wheelchair **700** may also include caster wheels **740** located in front of the drive wheel **720**.

As shown in FIGS. **7**A-**7**B, the axis of rotation **725** of the drive wheel **720** is offset from the axis of rotation **715** of the push rim. Thus, instead of being directly coupled to each other, the push rim **710** and drive wheel **720** are connected by a transmission (not specifically labeled in FIGS. **7**A and **7**B; individual components labeled). The transmission may include a drive gear/hub **750** coupled to drive wheel **720**, a push rim gear/hub **770** coupled to the push rim **710**, and a chain or belt **790** connected to the drive gear/hub **750** and the push rim gear/hub **770**.

Again, de-coupling the fore-aft position of the push rims **710** and drive wheels **720** may allow a clinician to place the drive wheels **720** in their optimal position to provide a stable base of support while still allowing the person to do "wheelies" if needed (to go over curbs and other thresholds). Also, the position of the push rims **710** can be set to promote the best positioning of the wheelchair **700** user's shoulders. A potential aspect of this more forward positioning of the push rims **710** is a reduction in shoulder pain resulting from manual propulsion of the wheelchair. In other words, de-coupling of the push rims **710** and drive wheels **720** may allow the clinician to place the push rims **720** in front of the user's center of gravity as shown in FIGS. **5**A-**5**D, potentially improving mechanical efficiency without sacrificing wheelchair stability.

Again, the use of the transmission with the belts or chains **790** may allow the wheelchair to also incorporate a multi-speed fixed-gear hub to provide the ability to switch to higher or lower speeds and thereby allow the wheelchair user to go faster on smooth even terrain and to require less torque and forces on the shoulders to go up inclined terrain.

Additionally, in some implementations, the wheelchair **700** also includes a push rim repositioning member **780** that allows the push rim **710** to be repositioned to allow a user to transfer into and out of wheelchair **700** without having to lift himself over the push rim as shown in FIGS. **3**A and **3**B above. In FIGS. **7**A-**7**B, the repositioning member **580** is a guide rail extending along the frame **705** that the push rim **710** can be slid along. Thus, the push rim **710** may be slidingly mounted to the guide rail (push rim repositioning mechanism **780**) and repositioned at different portions along the length of the guide rail (push rim repositioning mechanism **780**). As shown in FIG. **7**A, the push rim **710** has been slid forward along the guide rail (push rim repositioning mechanism **780**) to be located forward of a user's shoulders to allow the propulsion of the wheel chair by the user (known as the propulsion position). As shown in FIG. **7**B, the push rim **710** has been slid backward along the guide rail (push rim repositioning mechanism **780**) to be located behind or even with a user's shoulders to allow the user to transfer into and out of the wheelchair.

Additionally, in some implementations, a locking mechanism (not shown) may be provided to releasably hold the push rim **710** (swing arm) in the propulsion position located in front of the user's shoulders as shown in FIG. **7**A. Further, a second locking mechanism (not shown) or hard stop may also be provided to releasably hold or limit the rearward movement of the push rim **710** in the transfer position shown in FIG. **7**B. Additionally, in some embodiments, the transmission of the wheel chair may also include an idler sprocket (not shown), which can be used to maintain a fixed tension in the belt or chain **790**.

Though various aspects of this embodiment are shown in the figures and discussed above, implementations of this application are not limited to these aspects and alternative implementations are discussed below.

FIG. **8** illustrates the reachable workspace of a user's wrist for different shoulder ranges of motion laid over a diagram of an example related art wheelchair **800** and FIG. **9** illustrates the reachable workspace of a user's wrist for different shoulder ranges of motion laid over a diagram of a wheelchair **900** according to an implementation of the present application. As discussed above, a problem with conventional wheelchairs relates to the positioning of the drive wheel/push rim assembly relative to the user's shoulders. Rearward placement of the drive wheel/push rim assembly can improve stability, but such placement can

require a user to continually reach backward with shoulder extension and sometimes shoulder abduction. Use of the shoulders in excessive extension and in abduction are thought to be damaging for repeated use. Also, some users may have experienced reduced range of motion that can limit the propulsive force that can be generated by the user. FIGS. **8** and **9** illustrate a hypothetical user's range of motion laid over diagrams of a related art wheelchair **800** and a wheelchair **900** according to an implementation of the present application. Specifically, in FIGS. **8** and **9**, regions **810**, **910** represent a user with a full range of motion, regions **820**, **920** represent a user with a slightly reduced range of motion, and regions **830**, **930** represent a reduced range of motion. As shown in FIG. **8**, in order to achieve and maximize the arc of propulsion by starting the application of torque at the upper surface of the push rim of the conventional wheel chair, the user needs to take his shoulders into large angles of extension (i.e. into region **810**). However, by moving the push rims forward in an implementation according to the present application, the user may be able to apply a maximum arc of propulsion with less shoulder extension (i.e. outside region **910**, and into regions **920**, **930**).

In the implementations discussed above, the push rim was shown being movable between a propulsion position and a transfer position. However, implementations of the present invention need not have only two positions. Instead, a wheelchair according to the present application may include a push rim repositioning mechanism configured to allow customizable placement of the push rim based on a user's specific physical dimensions and/or physical capabilities and/or the activities that the patient is involved in. FIGS. **10**A-**10**C illustrate placement of a push rim at various positions along a wheelchair according to an implementation of the present application based on a user's range of motion. FIG. **10**A illustrates the push rim **1010** of the wheelchair **1000** in position even with the user's shoulders **1015**. FIG. **10**B illustrates the push rim **1010** of the wheelchair **1000** rotated forward by 15 degrees with respect to the user's shoulders **1015**. FIG. **100** illustrates the push rim **1010** of the wheelchair **1000** rotated forward by 15 degrees with respect to the user's shoulders **1015**.

Those of skill in the art will appreciate that skilled persons can implement the described functionality in varying ways for particular applications, but such implementation decisions should not be interpreted as causing a departure from the scope of the invention. Also, in the various embodiments described above, the improvements to the push rim and drive wheels can be implements for a single side of the wheelchair or on both sides of the wheelchair.

The above description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles described herein can be applied to other embodiments without departing from the spirit or scope of the invention. Thus, it is to be understood that the description and drawings presented herein represent a presently preferred embodiment of the invention and are therefore representative of the subject matter which is broadly contemplated by the present invention. It is further understood that the scope of the present invention fully encompasses other embodiments that may become obvious to those skilled in the art and that the scope of the present invention is accordingly not limited.

The invention claimed is:

1. A manual wheelchair comprising:
- a frame;
- a drive wheel connected to the frame, having a first axis of rotation and configured to rotate relative to the frame;
- a push rim connected to the frame, having a second axis of rotation extending substantially parallel to the first axis of rotation of the drive wheel and configured to rotate relative to the frame,
- wherein the second axis of rotation of the push rim is offset from the first axis of rotation of the drive wheel in a direction orthogonal to the first axis of rotation of the drive wheel;
- a transmission configured to transmit rotation of the push rim to rotation of the drive wheel; and
- a push rim repositioning mechanism configured to allow the push rim to be repositioned relative to the drive wheel, the push rim repositioning mechanism comprising a guide rail attached to the frame and a push rim axle connected to the guide rail and configured to be movable along the guide rail,
- wherein the push rim is connected to the push rim axle and configured to rotate relative to the frame.

2. The manual wheelchair of claim **1**, wherein the transmission comprises:
- a first gear coupled to the drive wheel,
- a second gear coupled to the push wheel, and
- at least one of a belt or chain connecting the first gear to the second gear to transmit rotation of the second gear to the first gear.

3. The manual wheelchair of claim **1**, wherein the push rim repositioning mechanism comprises a quick release mechanism configured to allow the push rim to be disconnected from the frame.

4. The manual wheel chair of claim **1**, wherein the push rim repositioning mechanism comprises a swing arm connected to the frame at a first end and rotatable relative to the first axis of rotation, wherein the push rim is connected to a second end of the swing arm.

5. The manual wheel chair of claim **4**, wherein the transmission comprises:
- a first gear coupled to the drive wheel and disposed proximate the first end of the swing arm,
- a second gear coupled to the push rim and disposed proximate the second end of the swing arm, and
- at least one of a belt or chain connecting the first gear to the second gear to transmit rotation of the second gear to the first gear.

6. The manual wheelchair of claim **1**, further comprising a locking mechanism configured to releasably lock the push rim axle in a fixed position along the guide rail.

7. The manual wheelchair of claim **1**, wherein the transmission comprises:
- a first gear coupled to the drive wheel;
- a second year coupled to the push rim axle and the push rim; and
- at least one of a belt or chain connecting the first gear to the second gear to transmit rotation of the second gear to the first gear.

8. The manual wheelchair of claim **7**, wherein the transmission further comprises an idler sprocket to maintain fixed tension in the at least one belt or chain during movement of the push rim axle along the guide rail.

9. A method for configuring a manual wheelchair, the manual wheelchair comprising a frame, a drive wheel connected to the frame, a push rim connected to the frame and

offset from the drive wheel, and a transmission configured to transmit rotation of the push rim to rotation of the drive wheel, and a push rim repositioning mechanism including a guide rail attached to the frame and a push rim axle connected to the push rim and the guide rail, the push rim axle configured to move along the guide rail, the method comprising:

activating the push rim repositioning mechanism to release the connection between the push rim and the frame;

moving the push rim axle along the guide rail to move the push rim from a propulsion position to transfer position.

10. The method of claim **9**, wherein activating the push rim repositioning mechanism comprises removing the push rim from the frame and placing the push rim proximate to the wheelchair.

11. The method of claim **10**, wherein activating the push rim repositioning mechanism comprises releasing a locking mechanism to allow the push rim to move relative to the frame.

12. The method of claim **11**, wherein moving the push rim comprises rotating the push rim relative to the drive wheel.

13. The method of claim **9**, wherein the propulsion position of the push rim is determined based on a shoulder position of a user of the wheelchair.

14. The method of claim **13**, wherein the propulsion position of the push rim is positioned to be located in front of the user's shoulders by a predetermined angle.

15. A manual wheelchair comprising:

a frame;

a drive wheel connected to the frame;

a push rim connected to the frame and configured to rotate relative to the frame, and

means for repositioning the push rim relative to the drive wheel comprising a guide rail attached to the frame and a push rim axle connected to the push rim and the guide rail, the push rim axle configured to move along the guide rail.

16. The manual wheel chair of claim **15**, further comprising a transmission configured to transmit rotation of the push rim to rotation of the drive wheel.

17. The manual wheelchair of claim **16**, wherein the transmission comprises:

a first gear coupled to the drive wheel;

a second gear coupled to the push rim; and

at least one belt or chain connecting the first gear to the second gear to transmit rotation of the second gear to the first gear.

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