



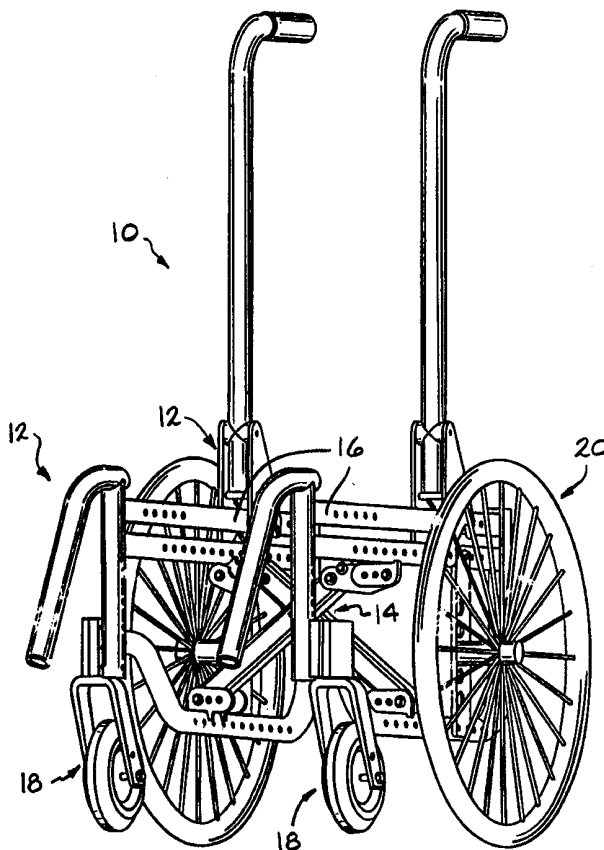
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(54) Title: WHEELCHAIR AND LINK ASSEMBLY FOR USE WITH A WHEELCHAIR

(57) Abstract

A wheelchair (10) includes side frame assemblies (12), seat frame bars (16), a cross-brace assembly (14), and link assemblies (44) for connecting the cross-brace assembly (14) to the side frame assemblies (12). The link assemblies (44) include an upper link assembly and lower link assembly attaching to each side frame assembly (12) and the cross-brace member (38). The link assemblies (44) enable the user to adjust the cross-brace member (38) relative to the side frame assemblies (12) at any one of a plurality of substantially horizontally spaced adjustment points (84). The adjustment points lack any substantial vertical adjustments. The horizontal points may be spaced a predetermined distance apart to enable a user to incrementally adjust the spacing between the side frame assemblies (12). Varying the spacing between the side frame assemblies (12) does not affect the height of the seat frame bars (16). The link assemblies (44) are interchangeable from one side frame assembly (12) to the other.



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WHEELCHAIR AND LINK ASSEMBLY FOR USE WITH A WHEELCHAIR

BACKGROUND OF THE INVENTION

1. Field of the Invention.

5 The present invention relates generally to land vehicles. More particularly, the present invention relates to wheelchairs. The present invention is specifically directed towards wheelchairs and link assemblies for use with wheelchairs which permits the width of a wheelchair to be varied without affecting its height.

10 2. Description of the Prior Art

 Wheelchairs are manufactured in various sizes to accommodate users of various sizes. Wheelchairs are generally manufactured in various fixed sizes or custom made to a fixed size. Such wheelchairs commonly have welded joints which permanently affix various frame portions together. Such wheelchairs are not readily amendable and
15 may require frequent replacement if the user of the wheelchair changes in size over a course of time, which is often the case of users who gain weight as a result of their incapacity, or children who grow and mature over the course of their use of a wheelchair. Such replacement may result in a tremendous financial burden on the user or the user's guardian, or on society which may ultimately suffers the cost for users
20 who are participants of medical assistance programs that receive funding from society.

 Accordingly, some wheelchairs are also manufactured to accommodate alterations in size as necessitated by physiological changes in the user to enable the user to use the wheelchair over a wide range of physiological development. Some wheelchair frames, for example, are manufactured to include modular frame
25 construction. In such wheelchairs, frame portions are replaceable as the user changes in size to require a wider wheelchair, a lengthier seat, a more extended back, or an increase in height. Wheelchairs manufactured to include replaceable frame portions may lack structural integrity in comparison to more conventional wheelchairs, which are generally rigidly constructed with non-replaceable parts. In addition, removed
30 frame portions tend to have little value since they are specifically designed for use

with particular chairs and to meet specific needs of a particular user. Moreover, advances in technology cause a discontinuation in the manufacture of various wheelchairs over a course of time, further making replaced modular frame portions and inventories of replacement parts more useless with time. Such parts result in economical waste as well as waste of our valuable material resources.

Other wheelchairs are manufactured to include varying parts of different sizes which are selectively mounted on conventional, full-size wheelchair frames. Some users, typically children, tend to be much smaller than the user for whom the conventional frame was designed, significantly affecting the use of such a wheelchair.

Wheelchairs are typically manufactured to include parts which are specifically designed for either the left side of the wheelchair or the right side of the wheelchair. That is to say, parts for the left side of the wheelchair are not interchangeable with the parts for the right side of the wheelchair, and vice versa. This lack of interchangeability of parts results in an increase in manufacturing cost and complexity, and an increase in inventory requirements. In the case of replaceable modular frame portions, separate inventories are necessary for frame portions for use on the left and right sides of the wheelchair.

Portable wheelchairs generally include a frame which is foldable for easily transporting, enabling the user of the wheelchair to conveniently travel to various locations. Conventional wheelchairs are usually of steel construction and are typically heavier than wheelchairs that are designed to be lightweight for improved maneuverability and handling. The lightweight wheelchair frame is often formed from a tubular material, such as a light-weight, high-strength aluminum tubing, to provide a light-weight, high-strength wheelchair. In a further effort to reduce the weight of wheelchairs, the number of component parts of which the wheelchair is comprised has been significantly reduced.

Portable wheelchairs commonly found in the prior art typically include opposed side frame assemblies having upper and lower horizontally extending bars, with the side frame assemblies joined together by a pair of centrally joined pivotal cross-brace members in an X-shaped configuration. Opposite ends of the cross-brace members are

pivotally mounted to corresponding upper horizontally extending seat frame bars with a linkage. The seat frame bars attached to the top of the cross-brace members are laterally spaced apart and support a flexible seat between the seat frame bars. When the wheelchair is deployed, the seat frame bars are supported by brackets carried by the upper horizontally extending bars of the opposingly disposed side frame assemblies. The seat frame bars are held in a superimposed position above the side frame assemblies. A wheelchair of this type is foldable for transporting by pivoting the cross-brace members relative to the side frame assemblies and one another, raising the seat frame bars and drawing the side frame assemblies toward one another.

Portable wheelchairs, like rigid wheelchairs, are also manufactured to accommodate alterations in size. For example, U.S. Patents No. 4,989,890, issued February 5, 1991, and 4,813,693, issued March 21, 1989, both to Walter G. Lockard et al., disclose a wheelchair having side frame assemblies and a foldable cross-brace assembly for interconnecting the side frame assemblies and for moving the side frame assemblies between folded and unfolded configurations. The cross-brace assembly is pivotally interconnected and is adjustable in length to vary the width of the wheelchair in its unfolded configuration. The cross-brace assembly includes upper and lower length adjusting means including telescopically received upper and lower tubular portions. The height of the seat frame bars, and the horizontal spacing between the left and right seat bars, may be varied by the upper length adjusting means of the cross-brace assembly and the horizontal spacing between the left and right horizontally extending bars of the side frame assemblies may be varied by the lower length adjusting means of the cross-brace assembly. The horizontal spacing between the left and right upper horizontally extending bars of the side frame assemblies may be varied by links telescopically connecting the upper horizontally extending bars of the side frame assemblies to corresponding upper ends of the cross-brace assembly. The links are telescopically connected to corresponding upper ends of the cross-brace assembly via a fastener. The fastener likewise connects the telescopically received upper tubular portions of the cross-brace assembly to the seat frame bar, thereby enabling the height of the seat frame bars to be changed. This requires the user to

insure that height of the seat frame bars are not varied upon varying the spacing between the side frame assemblies. In addition to the foregoing, the variation in the spacing between the side frame assemblies of Lockard et al. (set forth above) includes an adjustment comprising a vertical component as well as a horizontal component.

- 5 Varying the spacing between the side frame assemblies requires knowledge of the horizontal component independent of the vertical component or knowledge of basic trigonometry, or a potential for trial and error exists.

A wheelchair comprising side frame assemblies the spacing between which may be varied without detaching the seat frame bars would eliminate the risk of
10 inadvertent variation in the height of the seat frame bars. Moreover, a wheelchair having side frame assemblies the spacing between which may be varied horizontally, absent any vertical component, would eliminate the need for determining the horizontal adjustment component alone and would reduce the potential for trial and error in achieving a desired spacing.

15

SUMMARY OF THE INVENTION

The present invention is a wheelchair having spaced-apart side frame assemblies, a cross-brace assembly joining the side frame assemblies, and seat frame bars fixed relative to the side frame assemblies. The spacing between the side frame
20 assemblies may be varied without varying the height of the seat frame bars. More particularly, the present invention relates to link assemblies that enable the spacing between the side frame assemblies to be varied through a substantially horizontal adjustment. Although the link assemblies may be employed on more conventional rigid frame wheelchairs or on foldable wheelchairs, the ensuing discussion is more
25 directed towards foldable wheelchairs. Accordingly, a foldable wheelchair comprises side frame assemblies, a cross-brace assembly pivotally connected to the side frame assemblies by link assemblies, and a seat frame assembly which is integral with the side frame assemblies. The link assemblies include an upper link assembly and a lower link assembly for respectively connecting an upper horizontally extending bar
30 and a lower horizontally extending bar of the side frame assemblies to the cross-brace

assembly. The upper and lower link assemblies each include an end which is attached to respective upper and lower horizontally extending bars of the side frame assemblies and another end which is pivotally attached to respective upper and lower portions of the cross-brace assembly. The cross-brace assembly may be attached to each link
5 assembly at any one of a plurality of substantially horizontally spaced points along the link assembly. It is preferable that all the horizontally spaced points along the upper link assemblies lie in a common upper horizontal plane and all the horizontally spaced points along the lower link assemblies lie in a common lower horizontal plane. Each horizontally spaced point associated with each upper link assembly corresponds to a
10 horizontally spaced point associated with a lower link assembly. The upper and lower link assemblies enable a user to vary the spacing between the side frame assemblies by adjusting the cross-brace assembly relative to the upper and lower link assemblies attached to each side frame assembly along the corresponding horizontally spaced points. The link assemblies enable a user to vary the spacing between the side frame
15 assemblies by making an adjustment comprising only a horizontal component, absent any substantial vertical adjustment component. Moreover, the horizontal points may be spaced a predetermined distance apart which enables a user to easily identify incremental variations in width with corresponding incremental adjustments between horizontal points. To achieve uniformly spaced adjustments, the horizontal points
20 may be spaced equidistantly apart. It should be noted that the link assemblies are not connected directly to the seat frame bars of the wheelchair. Moreover, the width of the wheelchair is not varied by adjusting the length of the cross-brace assembly, as in more conventional wheelchairs. Hence, varying the spacing between the side frame assemblies does not affect the height of the seat frame bar. It should also be noted that
25 the upper and lower link assemblies are both interchangeable from one side frame assembly to the other which reduces manufacturing cost and complexity, and reduces inventory requirements.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment,
30 when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front perspective view of a wheelchair according to the present invention.

5 Fig. 2 is a partial side elevational view of the wheelchair shown in Fig. 1.

Fig. 3 is an enlarged partial side perspective view of side frame assemblies of the wheelchair interconnected with a cross-brace assembly by link assemblies.

Fig. 4 is an enlarged exploded perspective view of a lower link assembly according to the present invention.

10 Fig. 5 is an enlarged exploded perspective view of an upper link assembly according to the present invention.

Fig. 6 is a partial cutaway front perspective view of the wheelchair with the link assemblies adjusted to minimize the spacing between the side frame assemblies.

15 Fig. 7 is a partial cutaway front perspective view of the wheelchair with the link assemblies adjusted to maximize the spacing between the side frame assemblies.

Fig. 8 is a front elevational view of a link assembly according to the present invention for use with a conventional non-foldable wheelchair.

Fig. 9 is an enlarged front perspective view of a link assembly integral with the cross brace assembly.

20 Fig. 10 is an enlarged front perspective view of a link assembly including a single tab on a lower portion of the side frame assembly engageable with a yoke extending from a lower portion of the cross-brace assembly.

Fig. 11 is a front elevational view of a link assembly according to the present invention for use with a conventional non-foldable wheelchair having cross-brace assembly with a single cross-brace member.

Fig. 12 is an enlarged front perspective view of a link assembly arranged so that the bridge elements of the link assembly co-align.

Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated in Figs. 1 and 2 a wheelchair 10 comprising a pair of longitudinally disposed side frame assemblies 12 arranged in a horizontally spaced parallel relation to one another. A cross-brace assembly 14 interconnects the side frame assemblies 12. Seat frame bars 16 are integral with the side frame assemblies 12. A seat assembly (not shown) is supported by the seat frame bars 16. The length and height of the seat assembly may be adjustable. Adjustable foot rests (not shown) may be selectively mounted to the side frame assemblies 12 to support the user's feet. The side frame assemblies 12 are supported on a supporting surface by adjustable front wheel assemblies 18 and adjustable rear wheel assemblies 22.

Continuing with reference to Fig. 2, each side frame assembly 12 includes a forward frame portion 24 and a rearward frame portion 26. The forward frame portion may be telescopically received by the rearward frame portion to define an adjustable component (not shown) for adjusting the length of the side frame assemblies. The side frame assemblies 12 further include upper and lower portions. The upper and lower portions of the side frame assemblies may include an upper horizontally extending bar 28 and a lower horizontally extending bar 30. Although not shown in the drawings, forward upper and lower horizontally extending bars and seat frame bars may be telescopically received by rearward upper and lower horizontally extending bars and seat frame bars, respectively, to define the adjustable component for adjusting the length of the side frame assembly and seat frame bars. Forward portions of the upper and lower horizontally extending bars 28, 30 and seat frame bars 16 are connected by a generally vertical forward bar 32. Rear portions of the upper and lower horizontally extending bars 28, 30 and seat frame bars 16 are connected by a generally vertical rear bar 34. Although not shown in the drawings, a side frame assembly length adjustment may include apertures in forward and rear side frame assembly upper and lower horizontally extending bars and seat frame bars through which a fastener may extend to fix a desired degree of telescopic movement or adjustment. The apertures may be

set a predetermined distance apart to enable the side frame assemblies to be incrementally extended by the predetermined distance.

Now with reference to Fig. 3, the cross-brace assembly 14 shown is a folding mechanism including a first cross-brace member and a second cross-brace member, generally indicated as 38, connected by a pivot assembly 40. The side frame assemblies 12 are connected to the cross-brace assembly 14 by link assemblies 42, 44. Lower portions 46 of the first and second cross-brace members 38 are respectively connected to lower horizontally extending bars 30 of the side frame assemblies 12. Although a pivotal connection is shown between the cross-members and the lower link assemblies, it should be noted that a non-pivotal connection may be provided for non-folding wheelchairs (not shown). The position of the lower link assembly 42 on lower horizontally extending bar 30 of each side frame assembly 12 is fixed relative to the lower horizontally extending bar 30, such as by welding or in some other suitable fashion.

The first and second cross-brace members 38 further include upper portions 52. The upper portions 52 of the first and second cross-brace members 38 are connected to the upper horizontally extending bars 28 of the side frame assemblies 12 by upper link assemblies 44. The position of the upper link assembly 44 on upper horizontally extending bar 28 of each side frame assembly 12 is fixed relative to upper horizontally extending bar 28, such as by welding or in some other suitable fashion in a manner similar to that of the lower link assembly 42 described above. Although not shown, it should be noted that the first and second cross-brace members could include upper and lower telescopically received portions and apertures along the upper and lower portions for receiving fasteners to enable the length of the cross-brace members to be adjusted. Moreover, the focal point of the pivot assembly may be adjustable along the axis of each cross-brace member 38. However, according to the present invention, the spacing between the side frame assemblies can be varied without regard to any adjustability of the cross-brace assembly.

Now, with reference to Figs. 4, the lower link assemblies 42 include a first member or first tab 58 and a second member or second tab 60. The first and second

tabs 58, 60 are longitudinally spaced apart to provide a channel 62 between the first and second tabs 58, 60. The first and second tabs 58, 60 each include a first end 64 and a second end 66. The first end 64 of each tab 58, 60 is fixed to the lower horizontally extending bars 30, as described above. The second end 66 of each tab 58, 60 is provided with a plurality of horizontally spaced apertures 68. Although only three apertures are shown, any suitable number of apertures can be provided. The apertures 68 in the second end 66 of the first tab 58 co-align with the apertures 68 in the second end 66 of the second tab 60 to provide co-aligning pairs of apertures 68. Each co-aligning pair of apertures defines an adjustment point. The lower portions 46 of the cross-brace members 38 are received by the channel 62 formed between the tabs 58, 60. A cross-brace aperture 69 is provided in the lower portion 46 of each cross-brace member 38. A fastener 70 is received through a co-aligning pair of tab apertures 68 and the cross-brace aperture 69 in the lower portion 46 of each cross-brace member 38 to pivotally attach the cross-brace members 38 to the lower link assemblies 42. By changing the location of the lower portion 46 of each cross-brace member 38 relative to the first and second tabs 58, 60 of the lower link assemblies 42, the spacing between the side frame assemblies 12 between the lower horizontally extending bars 30 may be varied. The horizontal distance between the tab apertures 68 of the lower link assemblies 42 may be a predetermined distance to enable a user to vary the spacing between the side frame assemblies by a predetermined amount. Moreover, the distance between the tab apertures 68 of the lower link assemblies 42 may be uniformly spaced to enable the user to make uniformed incremental adjustments in the spacing between the side frame assemblies 12.

With reference now to Fig. 5, the upper link assemblies 44 include a first member or tab 72 and a second member or bridge element 74. The tab 72 includes a first end 76 and a second end 78, and the bridge element 74 includes a first end 80 and a second end 82. The tab 72 of the upper link assemblies 44 can be identical to the first and second tabs 58, 60 of the lower link assemblies 42. The first end 76 of each upper link assembly tab 72 is fixed to the upper horizontally extending bar 28 of each side frame assembly 12, as described above. The second end 78 of the upper link

assembly tab 72 is provided with a plurality of horizontally spaced upper tab apertures 84. Similar to that of the tab apertures 68 of the tabs 58, 60 of the lower link assemblies 42 described above, each upper tab aperture 84 defines an adjustment point. Although only three apertures are shown, any number of suitable apertures can be provided. The first end 80 of the bridge element 74 is provided with a single aperture 85 which may be positioned to co-align with one of the horizontally spaced upper tab apertures 84 in the second end 82 of the upper link assembly tab 72. A fastener 88 is releasably received through the co-aligning apertures 84, 85 to pivotally attach the first end 80 of the bridge element 74 to the second end 78 of the upper link assembly tab 72. In this way, the bridge element 74 is permitted to pivot about the fastener 88 and relative to the upper link assembly tab 72 and further, relative to the upper horizontally extending bar 28 of the side frame assemblies 12. The releasable fastener 88 may attach the bridge element 74 to the upper link assembly tab 72 through any one of the apertures 84, thus enabling the spacing between the side frame assemblies 12 between the upper horizontally extending bars 28 to be varied. As set forth above, the horizontal distance between the apertures 84 in the upper link assembly tab 72 can be a predetermined distance to enable a user to vary the spacing between the side frame assemblies 12 by a predetermined amount. Moreover, the distance between the apertures 84 in the upper link assembly tab 72 may be uniformly spaced to enable the user to make uniformed incremental adjustments in the spacing between the side frame assemblies 72.

The second end 82 of the bridge element 74 is likewise provided with a single aperture 87. The upper portion 52 of each cross-brace member 38 is provided with two apertures 89, 91 including an upper aperture 89 and an intermediate aperture 91.

The intermediate cross-brace aperture 91 in the upper portion 52 of the cross-brace members 38 is positioned to align with the single aperture 87 in the second end 82 of the bridge member 74. A fastener 98 is received through the co-aligned apertures 87, 91 to pivotally attach the cross-brace members 38 to the second end 82 of the bridge element 74 of each upper link assembly 42. A stop pin 100 extends through the upper aperture 89 in the upper portion 52 of the cross-brace members 38. The stop pin 100

engages the bridge element 74 upon unfolding the wheelchair 10 to restrict the travel of the cross-brace members 38. The second end 82 of the bridge element 74 can be provided with a circumferential surface 102. The fastener pivotally 98 attaching the cross-brace members 38 to the bridge element 74 defines a focal point for the radius of the circumferential surface 102. Upon folding and unfolding the wheelchair 10, the stop pin 100 travels along an arc about the circumferential surface 102. A first relief 104 is provided in an upper portion of the bridge element 74 proximate the second end 82 of the bridge element 74. The first relief 104 has a diameter which is suitable to receive the stop pin 100. A portion of the first relief 104 can be tangential to a portion of the outer circumferential surface 102. Upon unfolding the wheelchair 10, the stop pin 100 travels along the arc about the circumferential surface 102 into the first relief 104 which in part defines an abutment surface for the stop pin 100. The tangential portions of the first relief 104 and the circumferential surface 102 provide a smooth transition for the stop pin 100 to travel into and out of the first relief 104. It should be understood that the present invention is not limited to the use of a stop pin and that the travel of the cross-brace members 38 may be restricted by any suitable stop member.

A second relief 106 is provided in an upper portion of the bridge element 74 proximate the first end 80 of the bridge element 74. The second relief 106 has a diameter suitable to receive the upper horizontally extending bar 28. Moreover, the first end 80 of the bridge element 74 can have a circumferential surface 108 having a radius the focal point of which is the center of the aperture 85 in the first end 80 of the bridge element 74. The radius of the circumferential surface 108 at the first end 80 of the bridge element 74 is at least slightly less than distance between the focal point of the outermost aperture 84' in the upper link assembly tab 72 and the upper horizontally extending bar 28 to which upper link assembly tab 72 is attached. With the spacing between the side frame assemblies 12 minimized between the upper horizontally extending bar 28, that is to say, with the aperture 85 in the first end 80 of the bridge element 74 co-aligned with the outermost aperture 84' in the upper link assembly tab 72, and the releasable fastener 88 releasably fastened therethrough, as shown in Fig. 6, sufficient clearance is provided between the circumferential surface

108 and the upper horizontally extending bars 28 to enable the bridge element 74 to pivot about the upper horizontally extending bar 28. Moreover, the second relief 106 in the bridge element 74 receives the upper horizontally extending bar 28 upon folding the wheelchair 10 when the spacing between the side frame assemblies 12 is
5 minimized, as shown in Fig. 6. This should not be a concern when the spacing between the side frame assemblies 12 is maximized as shown in Fig. 7.

It should be noted that the link assemblies 42, 44 can be staggered forwardly and rearwardly, as is clearly shown in Fig. 2. That is to say, one of the upper link assemblies 44 can be fixed to an upper horizontally extending bar 28 forwardly of the
10 forward or first cross-brace member 38 and the other upper link assembly 44 can be fixed to the opposite upper horizontally extending bar 28 rearwardly of the rear or second cross-brace member 38'. Likewise, one of the lower link assemblies 42 can be fixed to a lower horizontally extending bar 30 forwardly of the forward or first cross-brace member 38 and the other lower link assembly 42 can be fixed to the opposite
15 lower horizontally extending bar 30 rearwardly of the rearmost or second cross-brace member 38'. This configuration does not interfere with the folding and unfolding of the cross-brace assembly 14.

Alternatively, as shown in Fig. 12, the link assemblies 42, 44 can be arranged so that the bridge elements 74 co-aligned with one another. That is to say, one of the
20 upper link assemblies 44 can be fixed to an upper horizontally extending bar 28 rearwardly of the forward or first cross-brace member 38 and the other upper link assembly 44 can be fixed to the opposite upper horizontally extending bar 28 forwardly of the rear or second cross-brace member 38'. Likewise, one of the lower link assemblies 42 can be fixed to a lower horizontally extending bar 30 rearwardly of
25 the forward or first cross-brace member 38 and the other lower link assembly 42 can be fixed to the opposite lower horizontally extending bar 30 forwardly of the rearmost or second cross-brace member 38'.

In operation, the spacing between the side frame assemblies 12 is varied by adjusting the link assemblies 42, 44 using horizontally spaced adjustment points in the
30 upper link assemblies 44 that correspond with horizontally spaced adjustment points

of the lower link assemblies 42. Although it should be noted that the spacing between the side frame assemblies 12 may be varied by adjusting the upper and lower link assemblies 44, 42 on one side, it is preferable that the upper and lower link assemblies 44, 42 on both sides be symmetrically adjusted. Because the upper link assemblies 44 are fixed to the upper horizontally extending bars 28 rather than the seat frame bar 16, the spacing between the side frame assemblies 12 may be adjusted without affecting the height of the seat assembly (not shown). It should also be noted that the spacing between the side frame assemblies 12 is not varied by adjusting the length of the cross-brace members 38, so as to vary the angle between the cross-brace members 38, as in conventional wheelchairs, but rather the spacing between the side frame assemblies 12 is varied by making an adjustment to the link assemblies 42, 44. Moreover, the adjustment substantially includes only a horizontal component, absent any substantial vertical adjustment component. Hence, the overall height of the wheelchair 10 remains unaffected by adjusting the width of the wheelchair 10.

It should be noted, as shown in Fig. 8, that a link assembly according to the present invention can be used on non-foldable wheelchairs 110. The link assembly can include opposed upper links 144 and opposed lower links 142. The lower links 142 can be attached to a lower portion 130 of the side frame assembly 112 and attached to one of the lower portions 146 of the cross-brace assembly 114. The upper links 144 can attach to an upper portion 128 of the side frame assembly 112 and attach to one of the upper portions 152 of the cross-brace assembly 114. The upper and lower links 144, 142 are each positionable substantially horizontally to vary the horizontal spacing between the side frame assemblies 112. No pivotal connection is required because the wheelchair 110 is a rigid or non-foldable wheelchair.

Alternatively, as shown in Fig. 11, a link assembly according to the present invention can be used on non-foldable wheelchairs 210 having a single cross-brace assembly 214. The link assembly can include a single pair of opposed links 244. The opposed links 144 can attach to a portion 228 of each side frame assembly 212 and attach to a upper portion 252 of the cross-brace assembly 214. The opposed links 144 are positionable substantially horizontally to vary the horizontal spacing between the

side frame assemblies 212. No pivotal connection is required because the wheelchair 210 is a rigid or non-foldable wheelchair.

One or more of the link assemblies 42, 44 and 142, 144, or a portion of the link assemblies 42, 44 and 142, 144, can be integral with the cross-brace assembly 14, 114 or the side frame assembly 12, 112. For example, as shown in Fig. 9, a plurality of substantially spaced apart apertures 260 are provided in the cross-brace assembly 214 and a single aperture 268 is provided in the tabs 258, 260. This configuration would vary the spacing between the side frame assemblies 212 without varying the height of the seat frame bars (not shown).

It should be understood that two lower tabs 58, 60 are not required. For example, a single tab 358, as shown in Fig. 10, will suffice to attach the cross-brace assembly 314 to the side frame assembly 312. The cross-brace assembly can be provided with a yoke 359 to engage the tab 358.

It should also be understood, with respect to the upper link 44, the tab 72 can be provided with a single aperture 84 and the bridge element 74 can be provided with a plurality of substantially horizontally spaced apertures 85 to accomplished the same horizontal adjustment set forth above.

It should further be understood that the upper links 44, 144 can be suitable for attaching a lower portion 46, 146 of a cross-brace assembly 14, 114 to a lower portion 130 of a side frame assemblies 12, 112 and the lower links 42, 142 can be suitable for attaching an upper portion 52, 152 of the cross-brace assembly 14, 114 to an upper portion 28, 128 of the side frame assembly 12, 112.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiment. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. A link assembly for connecting a cross-brace assembly of a wheelchair to horizontally spaced side frame assemblies of a wheelchair, the cross-brace assembly comprising an upper portion and a lower portion, the side frame assemblies each
5 having an upper portion and a lower portion, said link assembly comprising:

opposed upper links each attached to one of the upper portions of the side frame assemblies and attached to one of the upper portions of the cross-brace assembly, each said upper link further being positionable substantially horizontally to vary the horizontal spacing between the upper portions of the side frame assemblies; and

10 opposed lower links each attached to one of the lower portions of the side frame assemblies and attached to one of the lower portions of the cross-brace assembly, each said lower link further being positionable substantially horizontally to vary the horizontal spacing between the lower portions of the side frame assemblies.

15 2. A link assembly according to Claim 1, further including a stop member to restrict pivotal travel of the upper cross-brace assembly.

3. A link assembly for connecting a cross-brace assembly of a foldable wheelchair to horizontally spaced side frame assemblies of a wheelchair, the cross-
20 brace assembly comprising an upper portion and a lower portion, the side frame assemblies each having an upper portion and a lower portion, said link assembly comprising:

opposed upper links each attached to one of the upper portions of the side frame assemblies and pivotally attached to one of the upper portions of the cross-brace
25 assembly, each said upper link further being positionable substantially horizontally to vary the horizontal spacing between the upper portions of the side frame assemblies; and

opposed lower links each attached to one of the lower portions of the side frame assemblies and pivotally attached to one of the lower portions of the cross-brace

assembly, each said lower link further being positionable substantially horizontally to vary the horizontal spacing between the lower portions of the side frame assemblies.

4. A link assembly according to Claim 3, further including

5 a stop member to restrict pivotal travel of the upper cross-brace assembly.

5. A link assembly according to Claim 3, wherein each upper portion of the cross-brace assembly of the wheelchair includes a stop pin having an outside radius and which travels along an arc defined by a predetermined radius; and wherein

10 said upper link further comprises a circumferential surface having a predetermined radius, the radius of the arc of travel of the stop pin and said radius of said circumferential surface having a common focal point.

6. A link assembly according to Claim 5, wherein

15 said upper link further comprises a relief having an abutment surface for restricting the travel of the stop pin, said relief having a first portion having a radius complementary to the outside radius of the stop pin and a second portion having a radius having a terminal end tangential to a terminal end of said radius of said circumferential surface so as to provide a smooth transition for the stop pin when
20 traveling between said relief and said circumferential surface.

7. A link assembly according to Claim 3, wherein

each said upper link further comprises a relief having a shape complementary to a corresponding upper portion of the side frame assembly of the wheelchair proximate
25 where said upper link element is attached to the upper portion of the side frame assembly of the wheelchair, said relief for receiving the corresponding upper portion of the side frame assembly of the wheelchair upon folding the wheelchair.

8. A link assembly according to Claim 7, wherein each upper portion of each side frame assembly of the wheelchair is comprised of a tubular member having a predetermined outside radius, and wherein

each said relief is has an inside radius which is complementary to the outside
5 radius of a corresponding tubular member of the side frame assembly of the wheelchair.

9. A link assembly according to Claim 3, wherein

each said upper link further comprises a first member and a second member,
10 said first member of each said upper link being attached to an upper portion of a corresponding side frame assembly of the wheelchair, said second member of each said upper link being pivotally attached to a corresponding upper portion of the cross-brace assembly of the wheelchair, said first member of each said upper link being releasably and pivotally engageable with said second member of a corresponding one of said
15 upper links so as to form a point of engagement, said first member of each said upper link further being provided with a plurality of horizontally spaced apertures therein defining said plurality of horizontally spaced points, said apertures being disposed within a common substantially horizontal plane, said link assembly further including a releasable fastener for pivotally attaching said second member of each said upper links
20 to said first member of a corresponding one of said upper links through one of said plurality of horizontally spaced apertures.

10. A link assembly according to Claim 9, wherein

each said lower link element is further comprised of a first member and a second
25 member, said first member and said second member being spaced apart, each said member being provided with a plurality of substantially horizontally spaced apertures therein defining by said plurality of substantially horizontally spaced points, each one of said apertures in said first member being in co-alignment with a corresponding one of said apertures in said second member so as to form a plurality of sets of
30 corresponding apertures, each said set of corresponding apertures in said first member

and said second member and corresponding apertures of said first members of said upper link being arranged so as to lie in a common substantially vertical plane.

11. An link assembly according to claim 3, wherein

5 said opposingly disposed upper links each comprise a tab and a bridge element, said tab comprising a first end and a second end, said bridge element comprising a first end and a second end, said first end of said tab of each said upper link being attached to an upper portion of a corresponding side frame assembly of the wheelchair, said second end of said tab of each said upper link being releasably and pivotally attached
10 to said first end of said bridge element of a corresponding one of said upper links at one of said plurality of substantially horizontally spaced points defining adjustment points, said second end of said bridge element being pivotally attached to an upper portion of the cross-brace assembly of the wheelchair; and

 said opposingly disposed lower links comprising at least a first tab, said tab of
15 said lower link comprising a first end and a second end, said first end of said tab of each said lower link being attached to a lower portion of a corresponding side frame assembly of the wheelchair, said second end of each said lower link being releasably and pivotally attached to a corresponding lower portion of the cross-brace assembly of the wheelchair at one of a plurality of substantially horizontally spaced points defining
20 adjustment points, each one of said spaced points of said lower links corresponding with one of said spaced points of said upper links to provide a plurality of sets of corresponding points, each set of corresponding points being disposed on a common substantially vertical plane.

25 12. A folding wheelchair comprising:

 a cross-brace assembly comprising:

 an upper portion and a lower portion;

 two side frame assemblies each comprising:

 an upper portion and a lower portion; and

said link assembly connecting said cross-brace assembly to said two side frame assemblies, said link assembly comprising:

opposed upper links each attached to one of the upper portions of said side frame assemblies and pivotally attached to one of said upper portions of said cross-brace assemblies, each said upper link further being positionable substantially horizontally to vary the horizontal spacing between said upper portions of said side frame assemblies; and

opposed lower links each attached to one of said lower portions of said side frame assemblies and pivotally attached to one of said lower portions of said cross-brace members, each said lower link further being positionable substantially horizontally to vary the horizontal spacing between said lower portions of said side frame assemblies.

13. A foldable wheelchair according to Claim 12, wherein
said upper portion of each said side frame assembly includes an upper horizontally extending bar and a lower horizontally extending bar, said horizontally extending bars being vertically spaced and fixed relative to each other, each said upper link being attached to said upper horizontally extending bar of a corresponding one of said side frame assemblies and said lower links being attached to said lower horizontally extending bar of a corresponding one of said side frame assemblies.

14. A link assembly according to Claim 12, further including:
a stop member for restricting pivotal travel of the cross-brace assembly.

15. A foldable wheelchair according to Claim 12, wherein
each said upper portion of said cross-brace assembly includes a stop pin, said stop pin further traveling along an arc defined by a predetermined radius; and
said upper link further comprises a circumferential surface having a predetermined radius dimensioned so as to not interfere with said arc of travel of said

stop pin, said radius of said arc of travel of said stop pin and said radius of said circumferential surface having a common focal point

16. A foldable wheelchair according to Claim 15, wherein

5 said stop pin has an outside radius, and

said upper link further comprises a relief having an abutment surface for restricting the travel of said stop pin, said relief further having a first portion having a radius complementary to said outside radius of said stop pin and a second portion having a radius having a terminal end tangential to a terminal end of said radius of said
10 circumferential surface so as to provide a smooth transition for said stop pin when traveling between said relief and said circumferential surface.

17. A foldable wheelchair according to Claim 12, wherein

each said upper link further comprises a relief having a shape complementary to
15 said corresponding upper portion of said side frame assembly proximate where said upper link element is attached to said upper portion, said relief for receiving said corresponding upper portion of said side frame assembly upon folding said foldable wheelchair into a compact.

20 18. A foldable wheelchair according to Claim 17, wherein

each said upper portion of said side frame assembly is comprised of a tubular member having a predetermined outside radius and each said relief is comprised of an inside radius which is complementary to said outside radius of a corresponding one of said upper portion of said side frame.

25 19. A foldable wheelchair according to Claim 12, wherein

each said upper link element further comprises a tab and a bridge element, said tab of each said upper link being attached to an upper portion of a corresponding one of said side frame assemblies, said bridge element of each said upper link being pivotally
30 attached to a corresponding upper portion of said cross-brace assembly, each said tab of

each said upper link being releasably and pivotally engageable with said bridge element of each said upper link so as to form said pivot, said tab of each said upper link being provided with a plurality of horizontally spaced apertures therein defined by said plurality of substantially horizontally spaced points, said bridge element of each said upper link being provided with at least one aperture therein which may be positioned to co-align with one of said apertures in said tab,

said wheelchair further comprising:

a releasable fastener for engaging said aperture in said bridge element and one of said apertures in said tab which is in co-alignment with said aperture in said bridge element.

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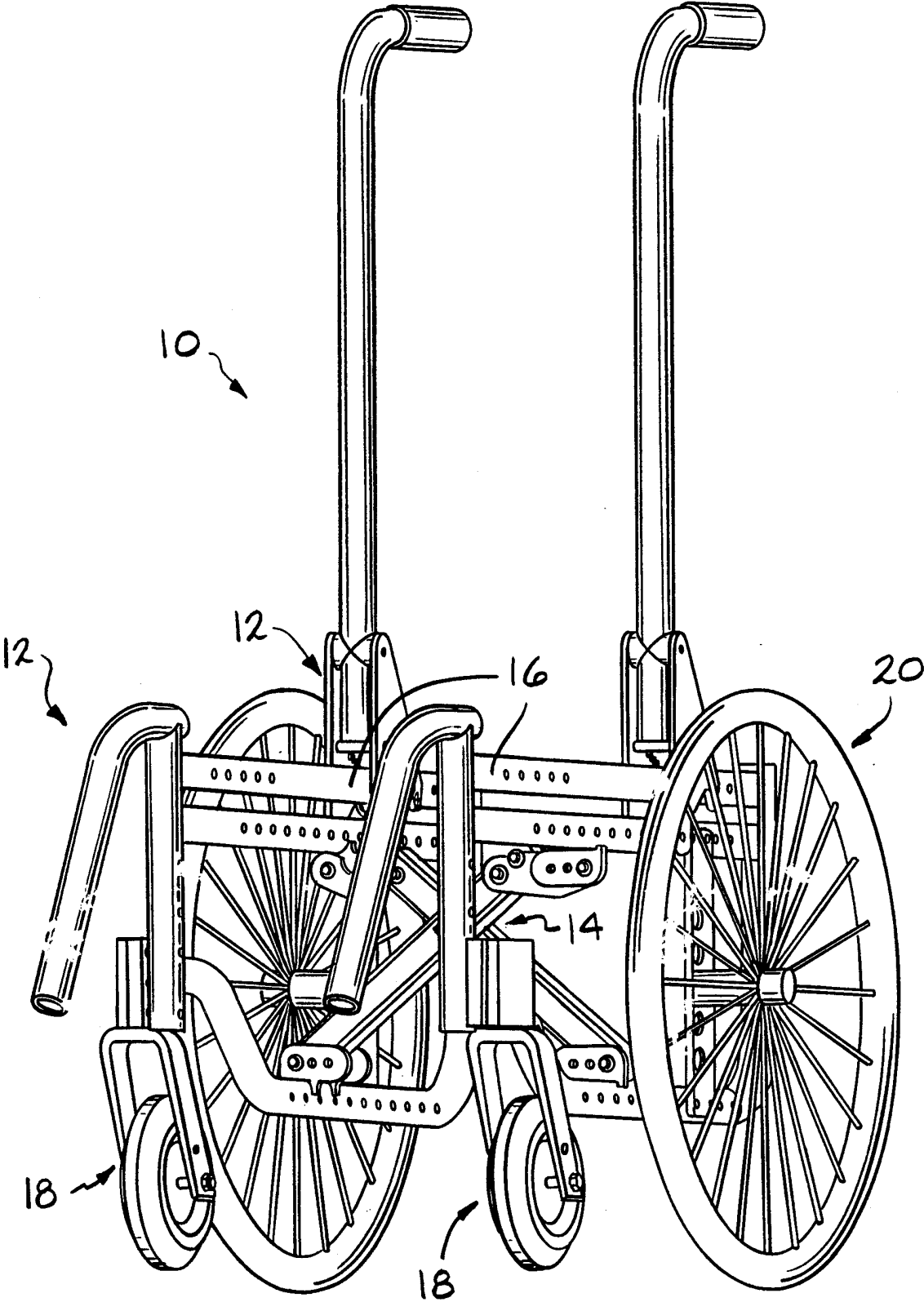


FIG. 1

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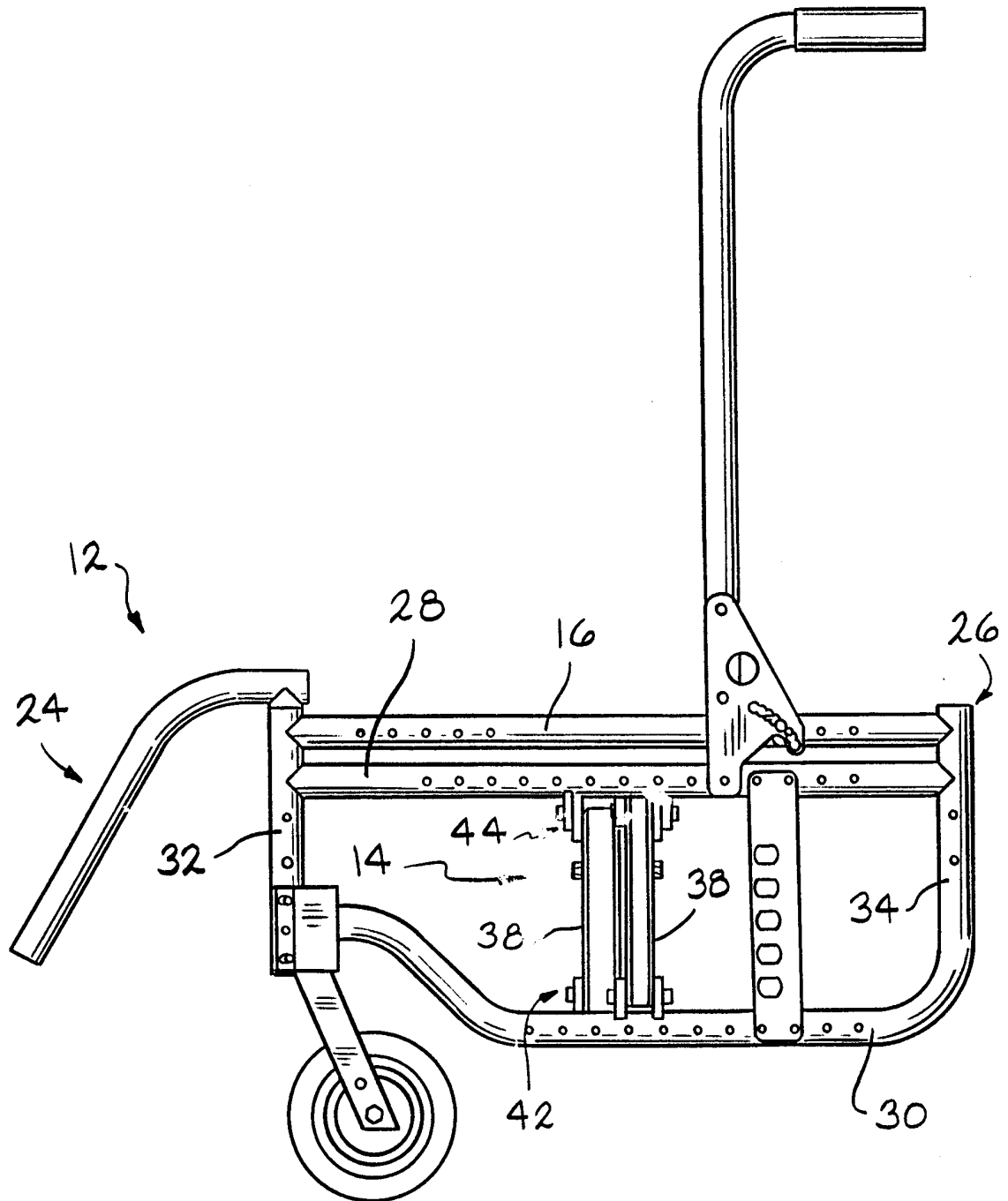
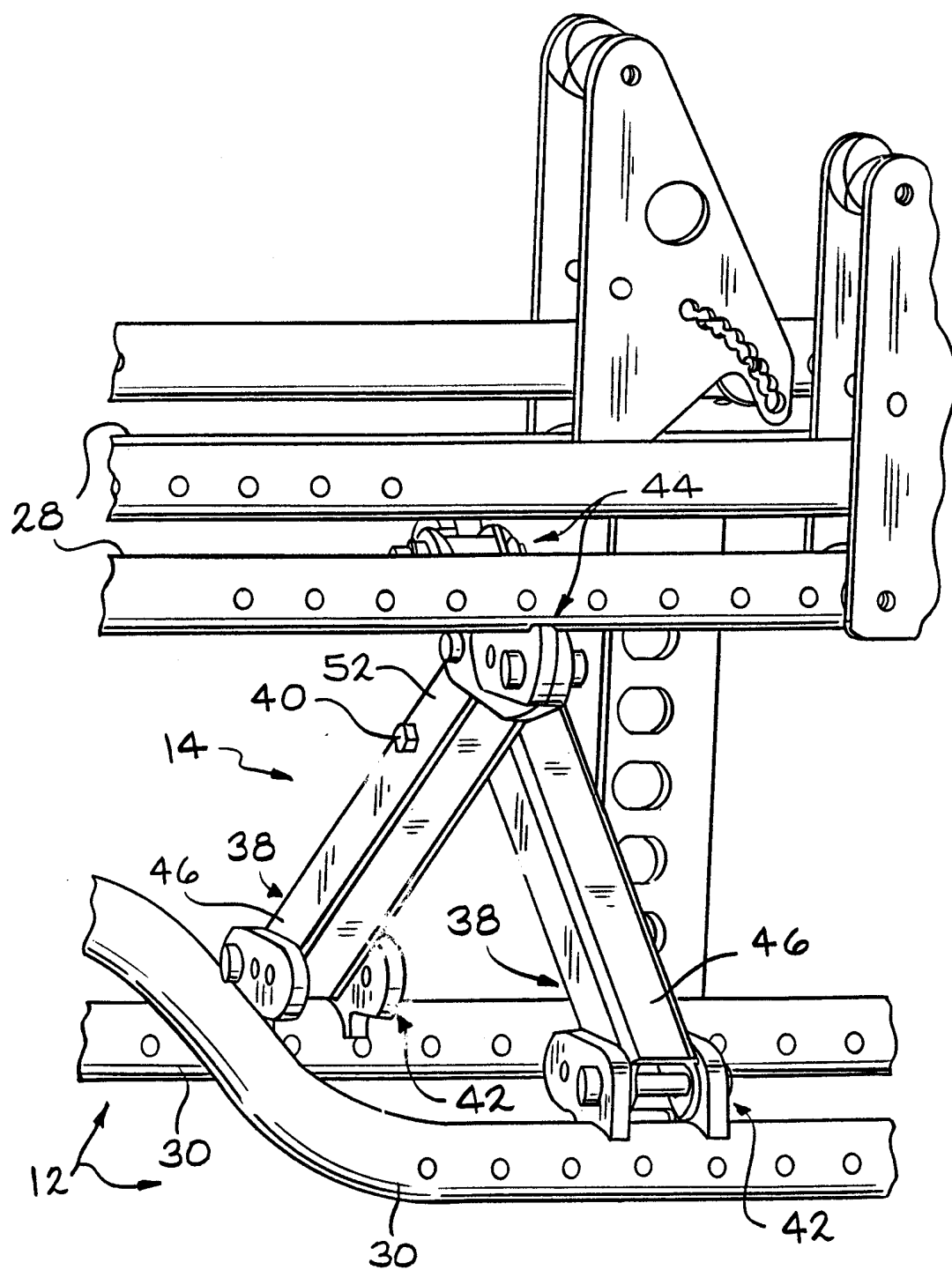


FIG. 2

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—FIG. 3

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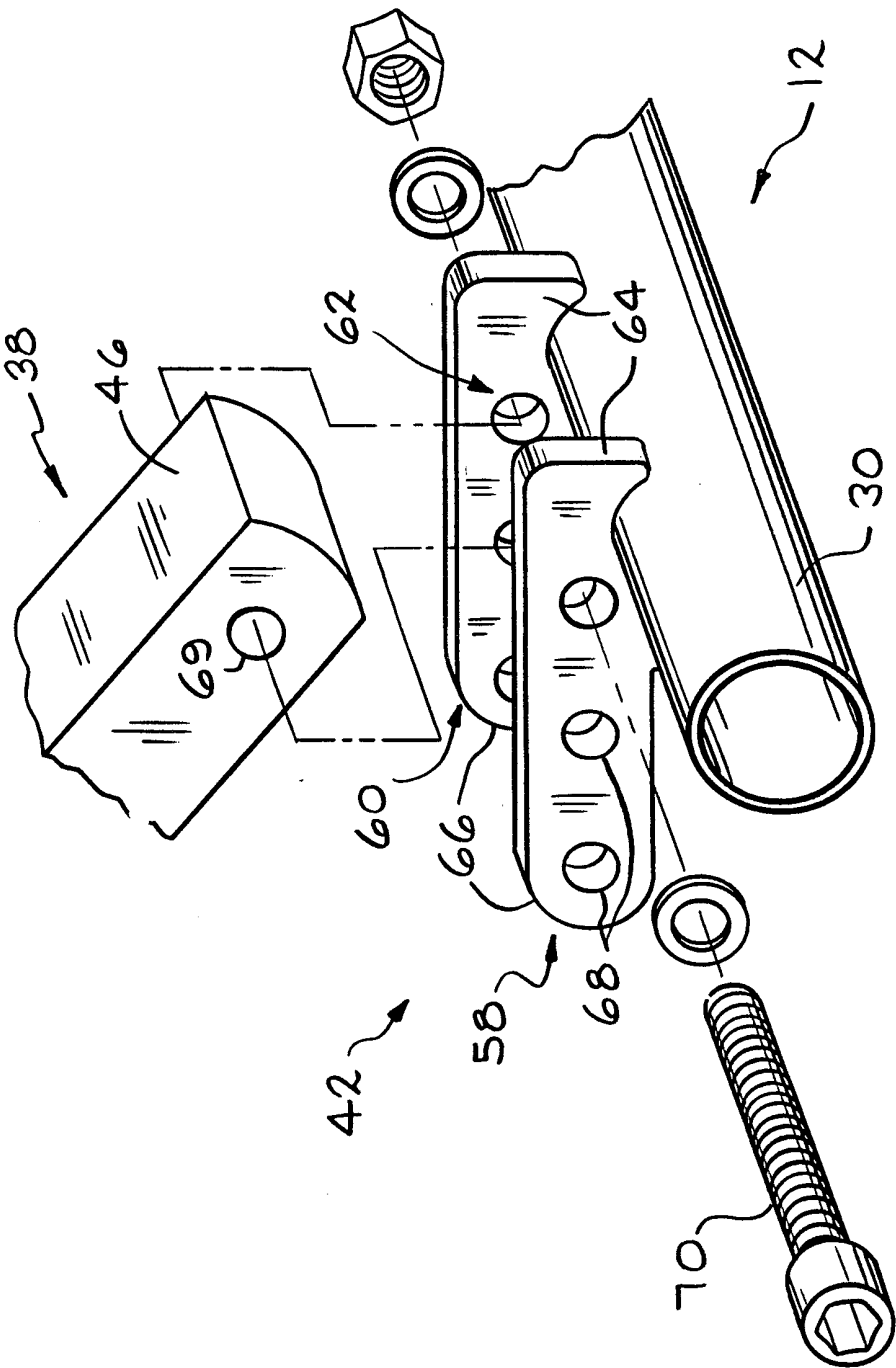
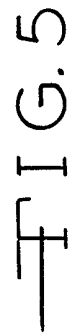


FIG. 4

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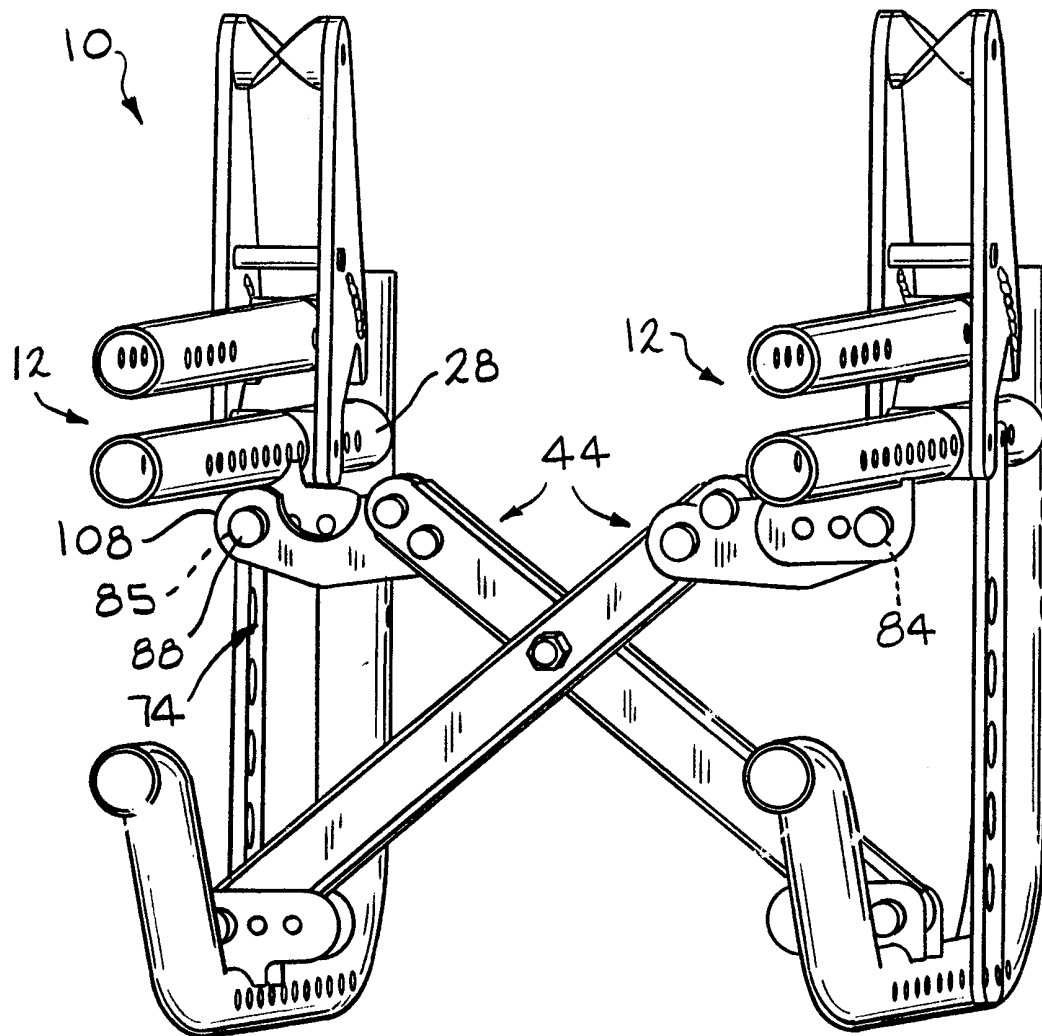


FIG. 6

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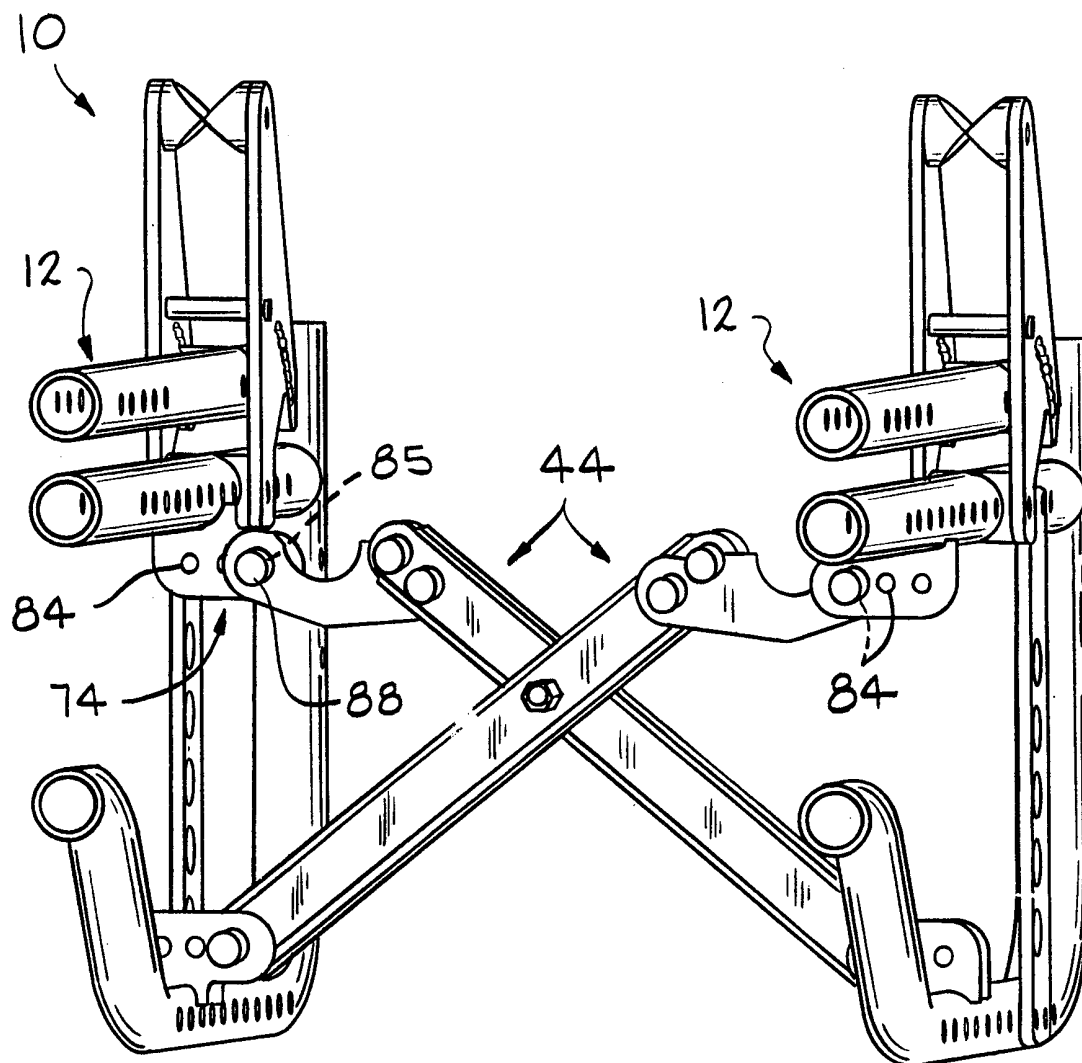


FIG. 7

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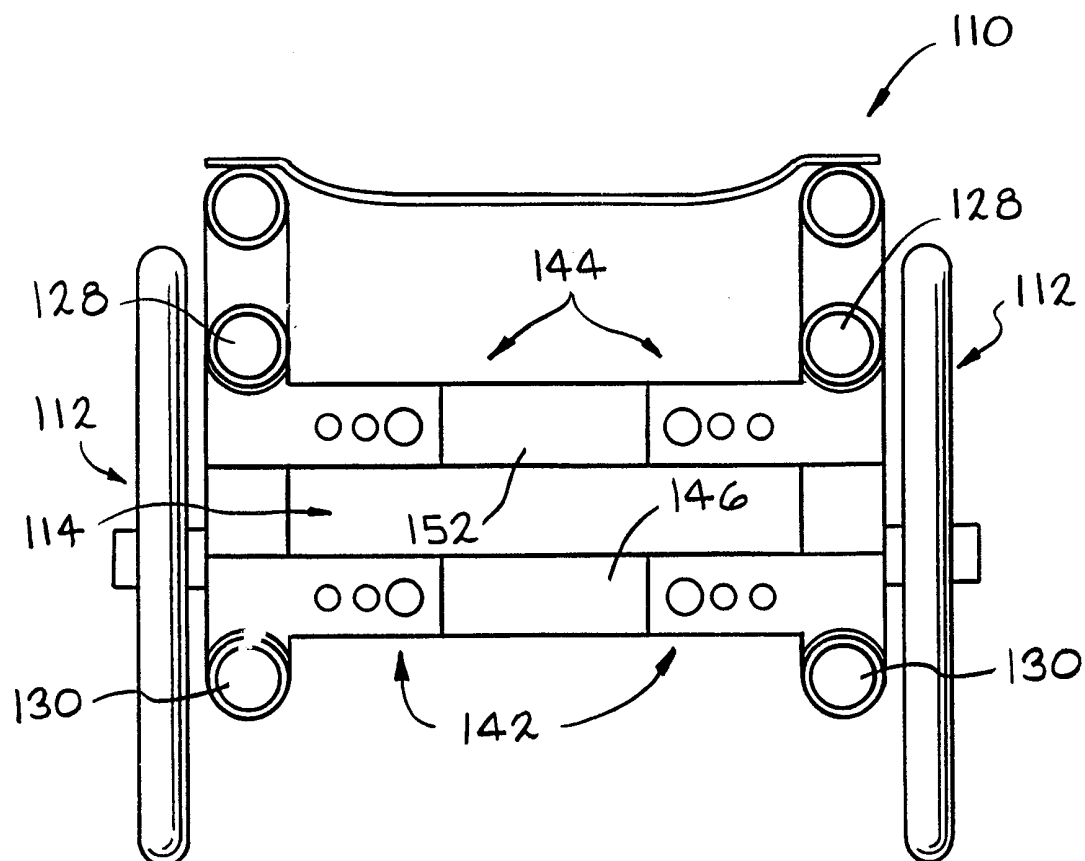


FIG. 8

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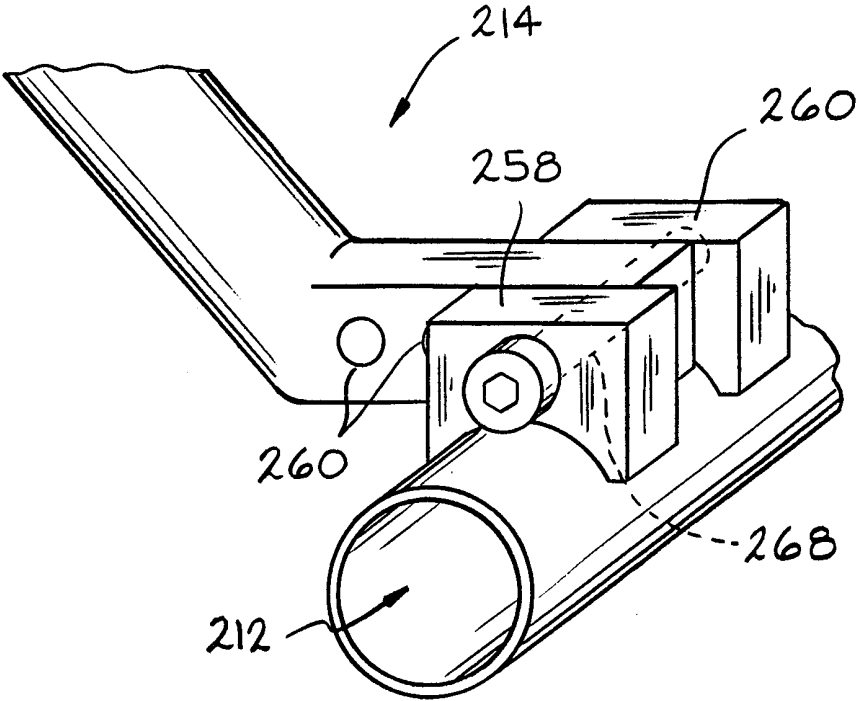


FIG. 9

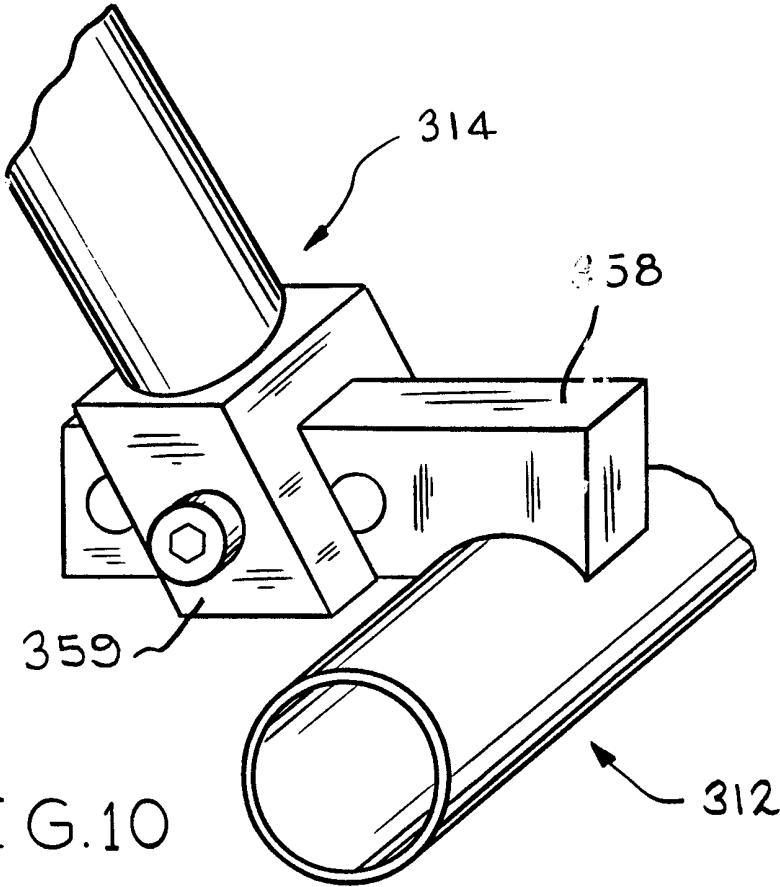


FIG. 10

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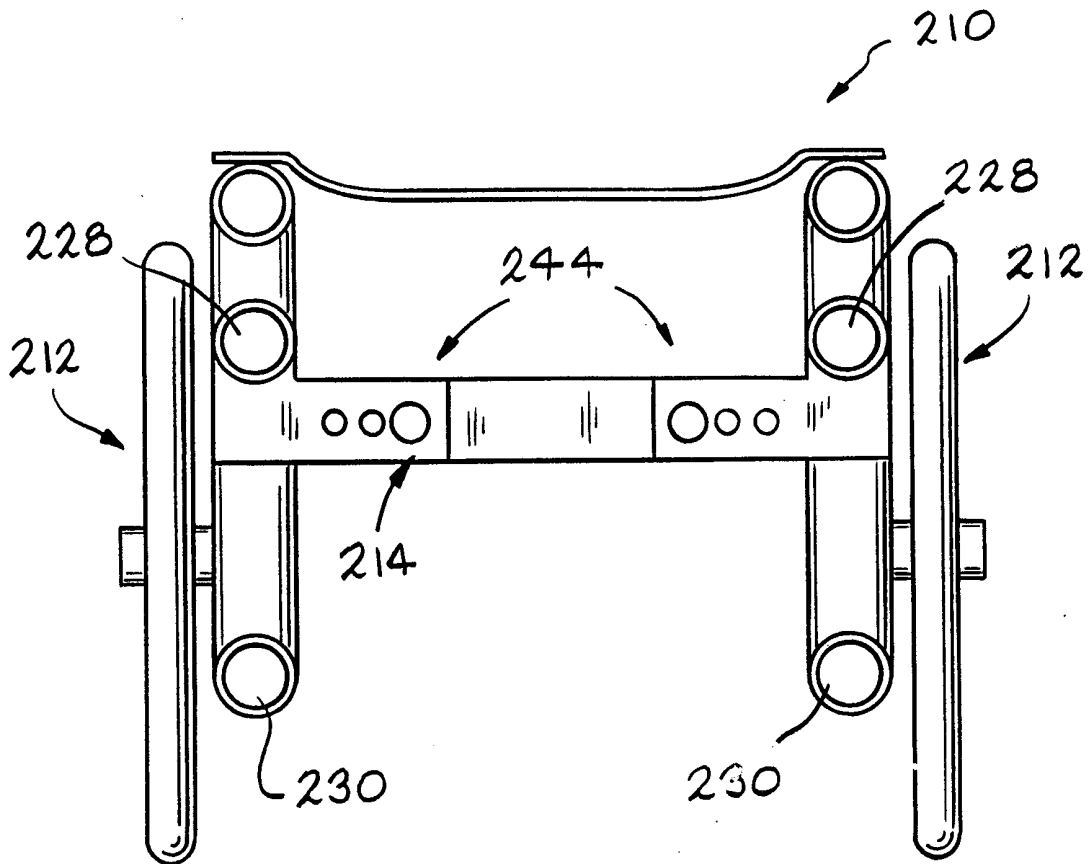


FIG. 11

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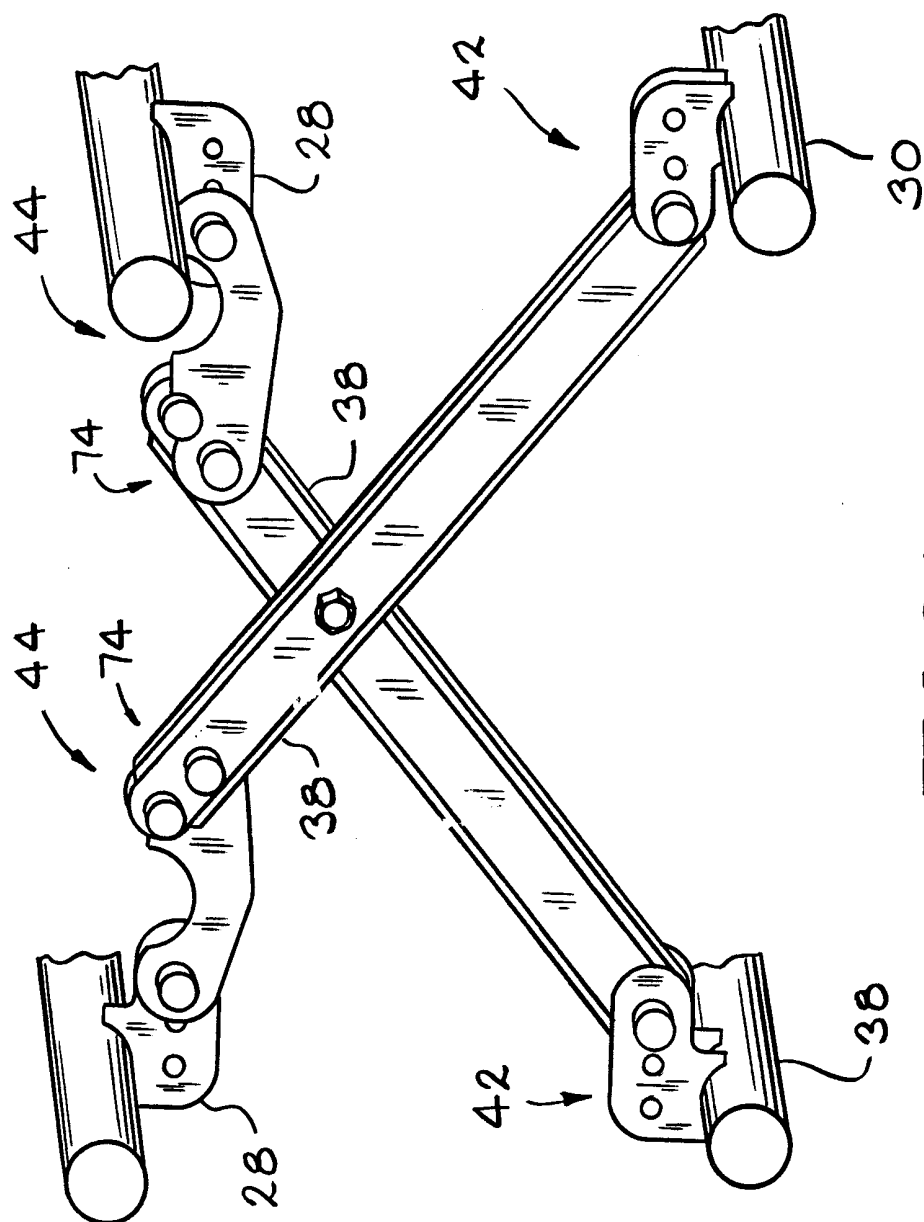


FIG. 12

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/03800

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B62B 1/04

US CL : 280/647, 649, 650, 250.1, 304.1; 297/Dig 4

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)

U.S. : 280/647, 649, 650, 250.1, 304.1; 297/Dig 4

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,813,693 A (LOCKARD et al) 21 March 1989, see entire document.	1-19
Y	US 5,328,183 A (COUNTS) 12 July 1994, see entire document.	1-19

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier document published on or after the international filing date	"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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"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	

Date of the actual completion of the international search

10 MAY 1999

Date of mailing of the international search report

25 MAY 1999

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