United States Patent

[11] 3,592,282

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[54] **STAIR-TRAVERSING WHEELCHAIR APPARATUS**
5 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** ..... **180/8 A,** 280/5.28
[51] **Int. Cl.** **B62b 5/02**
[50] **Field of Search** ..... 180/8 A; 280/5.28

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Primary Examiner—Leo Friaglia
Attorney—Cushman, Darby & Cushman

ABSTRACT: An apparatus adapted to carry a wheelchair comprises a frame having side members between which the wheelchair is mounted which frame members carry adjustable support means for raising and lowering the frame means and the wheelchair mounted therein. The adjustable support means of the apparatus comprises four pairs of jacks which are carried on the frame members with the four pairs of jacks being longitudinally spaced relatively to each other and with the jacks of each pair being transversely spaced relative to each other on the side frame members. Drive means are provided for extending and retracting the jacks with control elements regulating the drive means so that the jacks of each pair can be operated in unison to effect the simultaneous extension or retraction of any selected pair of jacks. In addition, means are provided to propel the apparatus horizontally whereby through the extension and/or retraction of selected pairs of jacks and the propulsion of the apparatus in the horizontal direction, the apparatus can ascend or descend a stair flight.

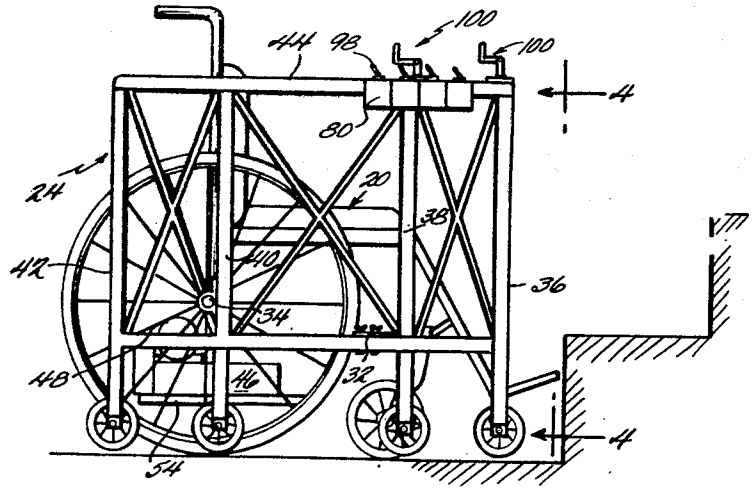

Fig. 1

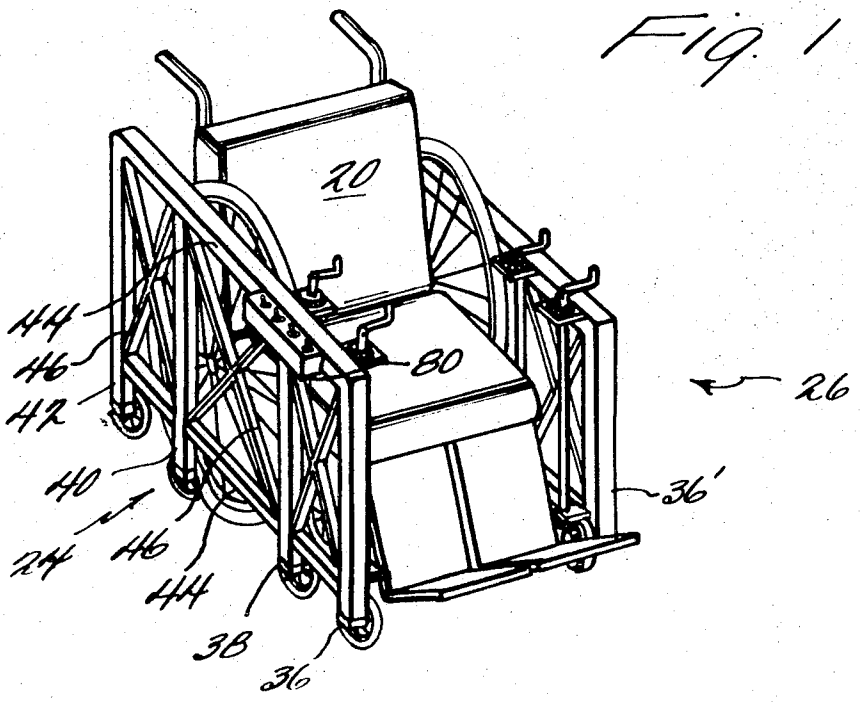

Fig. 6

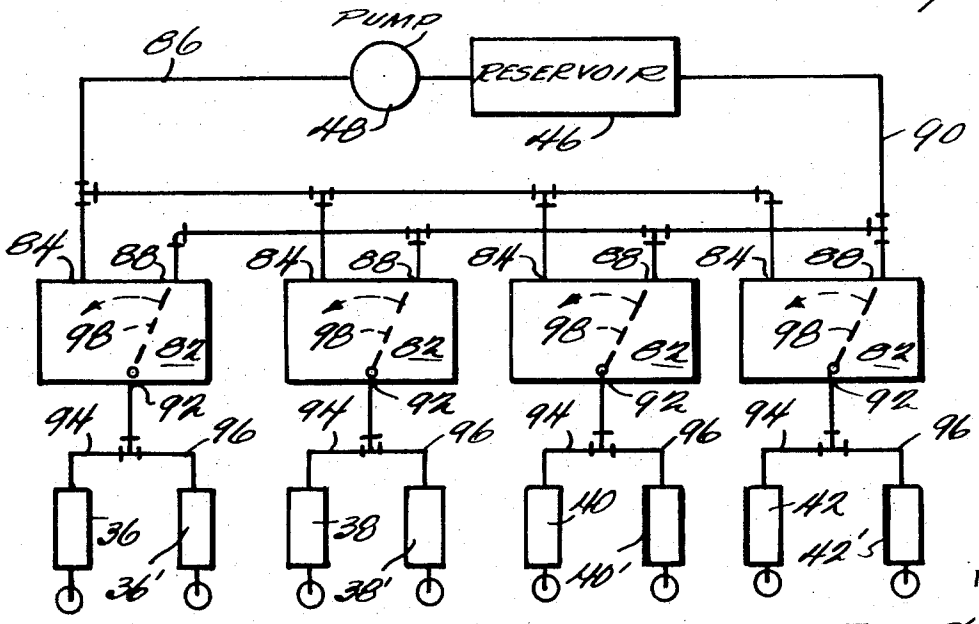

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Fig. 2

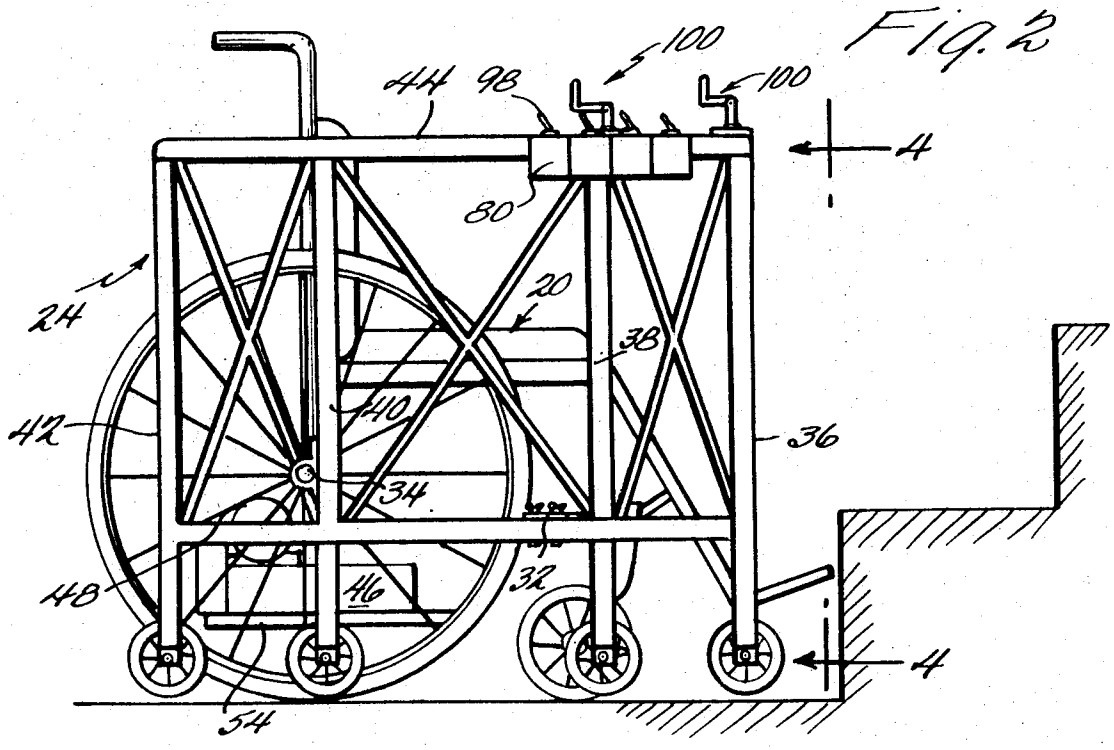

Fig. 3

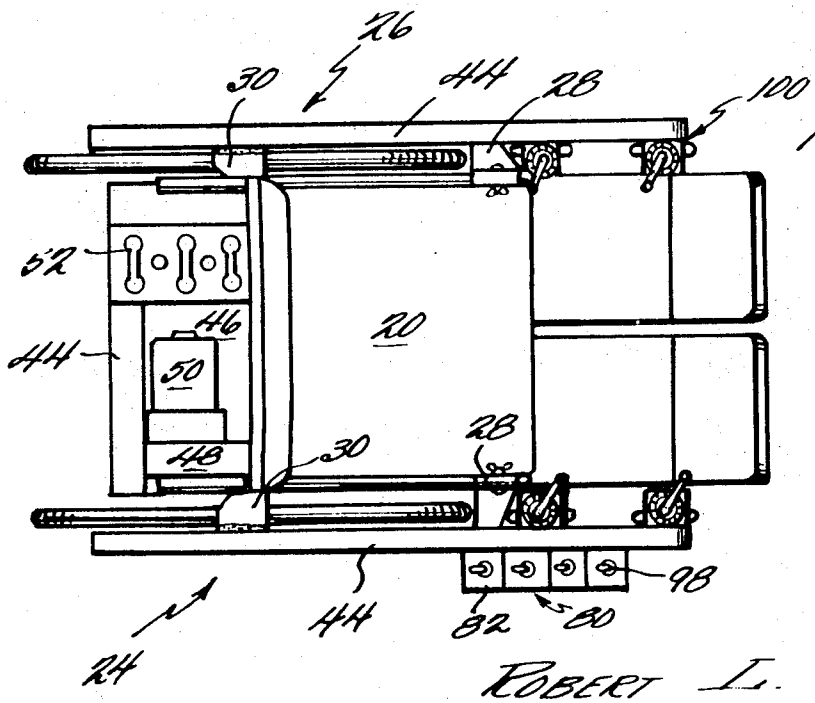

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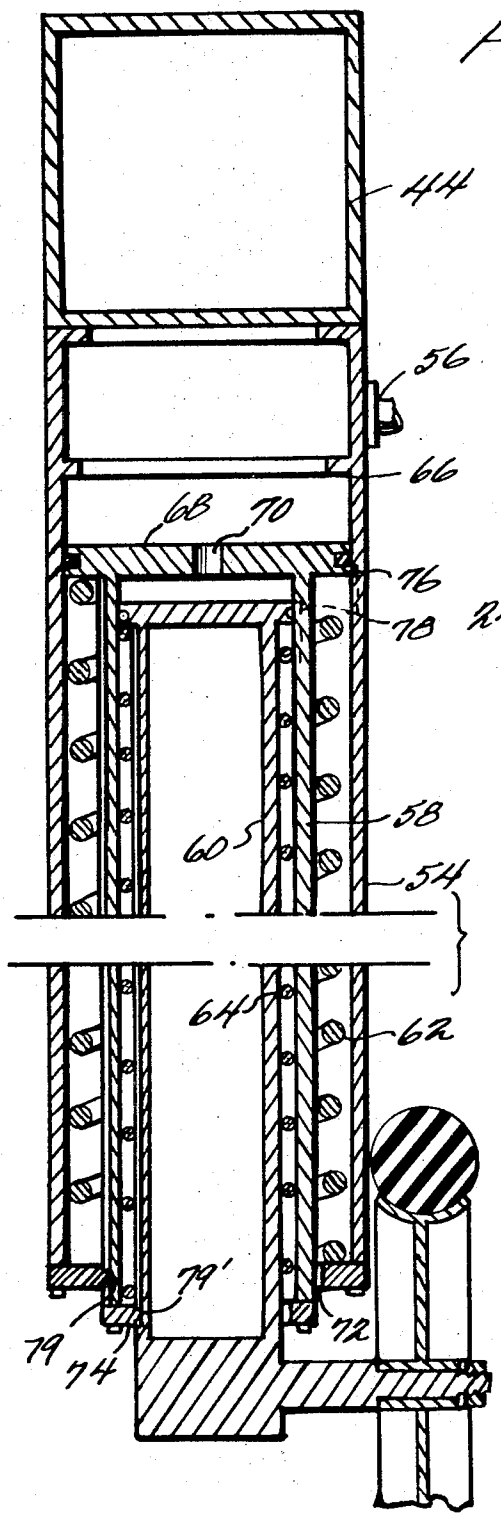
Fig. 5



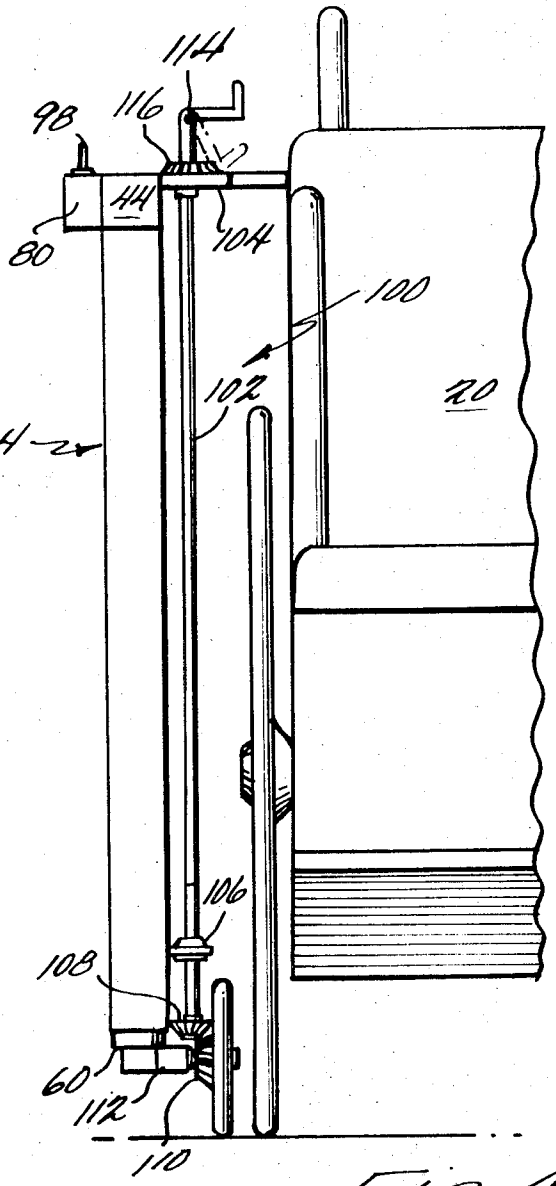


Fig. 4

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Fig. 7

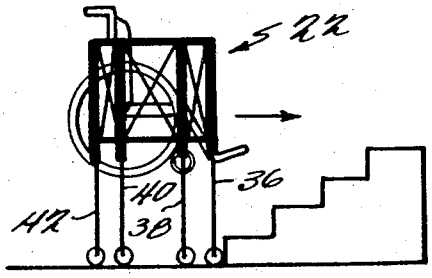


Fig. 11

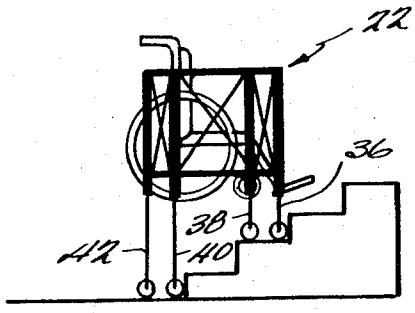


Fig. 8

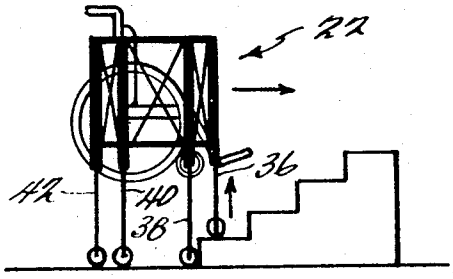


Fig. 12

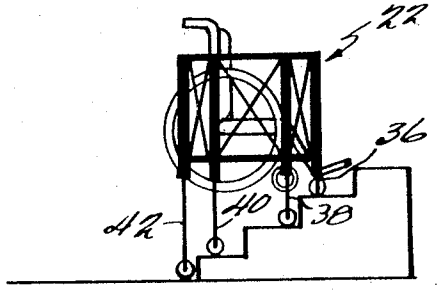


Fig. 9

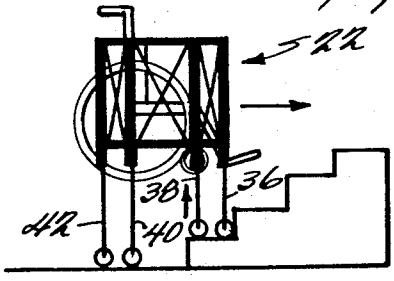


Fig. 13

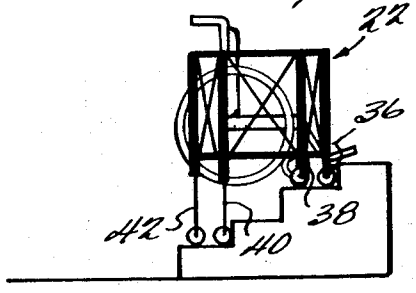
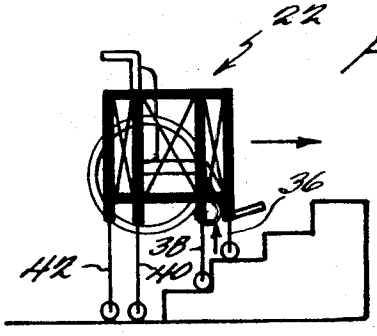


Fig. 10



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STAIR-TRAVERSING WHEELCHAIR APPARATUS

BRIEF DESCRIPTION OF THE INVENTION

In general, the present invention relates to an attachment for a wheelchair which will enable the height of the wheelchair to be adjusted and allow the wheelchair to be propelled in a horizontal direction regardless of the height of the wheelchair.

A primary object of the present invention is to provide apparatus which can be readily attached to a conventional wheelchair which will enable the chair to ascend or descend steps, stair flights or other obstacles such as curbs while the chair is kept level and stable so as not to jeopardize the operator in the wheelchair.

It is a further object of the present invention to provide an apparatus exhibiting the above characteristics which will permit a person in a wheelchair to elevate himself to the approximate height of a standing person so that the operator will be able to reach medicine cabinets, kitchen cabinets and other items which are located at a height within the reach of a person able to stand but normally out of reach for a person confined to a wheelchair.

Briefly, the preferred embodiment of the present invention comprises two side frame members which are provided with brackets for securing the frame members to a conventional wheelchair so that the wheels of the wheelchair can be spaced above the ground level and the wheelchair completely supported by the frame members. The frame members are provided with four pairs of hydraulic telescoping jacks with the pairs of telescoping jacks being longitudinally spaced along the side frame elements at selected intervals with respect to each other so that the chair can ascend and descend stair flights and with the telescoping jacks of each pair being laterally spaced with respect to each other on either side of the wheelchair which is mounted between the side frame members. The frame carries a suitable hydraulic reservoir, a pump and drive means which can either be manual or mechanized such as battery-driven electric motors. Conventional control valves are located intermediate the telescoping jack assemblies and the pump and reservoir to regulate the flow of hydraulic fluid to and from the telescoping jack assemblies to selectively adjust the elevation of the individual pairs of telescoping jacks as required for traversing a flight of stairs or raising the wheelchair to a desired level. In addition, the wheelchair is provided with means for propelling the frame in a horizontal direction such as handcranks which enable the apparatus to be manually propelled through suitable gear trains on the wheels of the frame that are driven by the turning of the handcrank. The above objects and advantages of the present invention will be better understood and other objects and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view from above of the apparatus of the present invention with a wheelchair mounted therein;

FIG. 2 is a side elevational view of the apparatus of the present invention with a wheelchair mounted therein;

FIG. 3 is a plan view from above of the apparatus of the present invention with a wheelchair mounted therein;

FIG. 4 is a fragmentary view taken substantially along lines 4–4 of FIG. 2 illustrating one of the drive trains for propelling the apparatus;

FIG. 5 is a sectional view of a conventional telescoping jack assembly which can be utilized in the present invention;

FIG. 6 is a schematic view of the hydraulic system of the present invention; and

FIGS. 7 to 13 are diagrammatic views illustrating the manner in which the present invention can be utilized for ascending or descending a stair flight.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and, in particular, to FIGS. 1 to 3, a conventional wheelchair **20** is shown mounted in a

preferred form of the wheelchair apparatus of the present invention **22**. The frame of the apparatus comprises side frame members **24, 26** which are affixed to the wheelchair by pairs of brackets or clamps **28, 30, 32** and **34** which can be readily adjusted to facilitate the attachment or detachment of the frame members **24, 26** from the wheel chair **20**. Any type of conventional clamp can be utilized for joining the tubular members of the wheelchair to the frame members **24, 26**, such as C-clamps which can be welded to the frame members **24, 26** and provided with bolts or other means for adjusting the distance between the clamp jaws to thereby affix the frame members to the wheelchair.

The side frame members **24, 26** each have four vertically extending telescoping jack assemblies **36, 38, 40, 42** and **36', 38', 42'** respectively which are joined together by upper and lower horizontal struts **44** and cross bracing **46**. The struts **44** and cross bracing **46** lend needed strength to the side frame members **24, 26** and assure the proper longitudinal spacing between the pairs of jack assemblies **(36,36') (38,38') (40,40')** and **(42, 42')**.

The longitudinal spacing between the pairs of jack assemblies **(36,36') (38,38') (40,40')** and **(42,42')** and the size of the wheels on the jack assemblies can be adapted to fit a stair tread of a particular width. The standard width of stair treads is 12 inches and, for such a stair tread, 4 inch wheels can be used on the jack assemblies with the spacing between telescoping jacks **36,36'** and **38,38'** being 8 inches, the spacing between telescoping jacks **38,38'** and **40,40'** being 16 inches and the spacing between telescoping jacks **40,40'** and **42,42'** being 8 inches. It is also contemplated that the spacing between these pairs of jacks could be 6 inches, 16 inches and 6 inches, respectively. The spacing between the two front pairs of telescoping jacks **36,36', 38,38'** and the spacing between the two rear pairs of telescoping jack assemblies **40,40', 42,42'** must be such that the wheels of these jack assemblies can rest on the same tread and the spacing between the telescoping jack assemblies **38,38'** and **40,40'** must be such that the distance between the wheels of these jack assemblies is greater than the width of a stair tread. As indicated above, the spacing between the various pairs of telescoping jack assemblies depends on the width of the treads. While the apparatus, as shown, does not illustrate a frame wherein the side frame members **24, 26** can be longitudinally adjusted to adapt the apparatus for treads of different widths, a frame with horizontally extending telescoping struts and suitable cross bracing to permit the selected adjustment of the distance between the pairs of telescoping jack assemblies can be provided for the present invention.

As best shown in FIGS. **2** and **3**, a **44** is provided for the reservoir **46**, pump **48**, motor **50** and battery **52** of the present invention which are utilized to provide pressurized hydraulic fluid to the telescoping jack assemblies **36,36', 38,38', 40,40'**, and **42,42'**. Platform **44** is bolted, clamped or otherwise suitably affixed to frame members **54** of the wheelchair so that the platform with the components **46, 48, 50** and **52** mounted thereon can be removed when the apparatus **22** is not in use. The pump **48**, motor **50** and battery **52** are all conventional in nature. Therefore, they will not be discussed in detail.

As shown in FIG. **5**, one form of telescoping jack assembly which can be used in the present invention comprises an outer cylinder **54** with an inlet-outlet port **56** adjacent its uppermost end and telescoping pistons **58, 60**. The pistons **58, 60** are urged by springs **62** and **64**, respectively, toward their normally retracted position with an annular flange **66** on cylinder **54** acting as a stop to prevent inlet-outlet port **56** from being covered. The pistonhead **68** of the outer piston **58** is provided with a port **70** to permit the passage of pressurized hydraulic fluid therethrough into or out of the chamber formed between the pistons. With this construction, the pressurized hydraulic fluid supplied to the assembly can act on the upper surface of the inner piston **60** to extend the inner piston. While the pressurized hydraulic fluid works on both the upper and lower surfaces of the pistonhead **68** of outer piston **58**, due to the

greater surface area of the upper surface when compared to the lower surface, the pressurizing of the upper chamber and the chamber formed between the inner pistons causes the upper piston to be extended. Suitable vents **72**, **74** are provided in the bottoms of the telescoping pistons to permit the expulsion of air when the pistons **58**, **60** are driven down and suitable piston rings **76**, **78** are provided to prevent the leakage of hydraulic fluid between the pistonheads and the cylinder walls of the jack assemblies. In addition, plates on the bottoms of cylinder **54** and piston **58** are provided with extensions **79**,**79'** which are received in keyways in pistons **58** and **60** to prevent relative rotation between the telescoping members.

When one particular form of telescoping jack assembly has been shown, it is to be understood that other forms of telescoping jack assemblies or double-acting piston assemblies can be utilized along with appropriate hydraulic systems to effect the extension or retraction of the telescoping jack assemblies. In addition, although the present invention is shown with a motor-driven system for pressurizing the hydraulic fluid, manual systems can also be used. Furthermore, it is contemplated that entirely mechanical systems utilizing screwjacks or the like can be substituted for the hydraulic system illustrated.

FIG. **6** is a diagrammatic illustration of one form of hydraulic system which can be utilized in the present invention with the telescoping jack assembly of FIG. **5**. The hydraulic controls **80** of the apparatus, which are shown mounted on side frame member **24**, are illustrated as four separate valve elements **82** each of which has an inlet port **84** leading from a common supply line **86** connected to the pump **48** of the hydraulic system. Each of these valve elements **82** is also provided with an outlet port **88** which communicates with the reservoir through a common return line **90**. In addition, each of the valves is provided with an inlet-outlet port **92** which leads through lines **94**, **96** to one of the pairs of telescoping hydraulic jack assemblies (**36**,**36'**) (**38**,**38'**) (**40**,**40'**) or (**42**,**42'**). With this arrangement, the pairs of telescoping jacks can be selectively adjusted or adjusted in unison by the control levers **98** of controls **80** which adjust the valve elements so that the desired telescoping jack assemblies are in communication with the supply line **86** for raising, the return line **90** for lowering, or out of communication with either the supply or return line when the lever is in its normal at rest position to thereby maintain the telescoping jack assemblies at a selected level.

Turning now to FIG. **4**, a fragmentary view of the apparatus with a wheelchair therein is shown which illustrates one of the drive and brake assemblies **100** of the attachment. Four of these assemblies **100** are provided to drive the wheels on jack assemblies **36**,**36'** and **38**,**38'** to propel the wheelchair apparatus along and to provide a suitable brake, to maintain the wheelchair and apparatus in a fixed position when desired. Each assembly comprises a square telescoping drive rod **102** having its upper end mounted in a bearing **104** secured to strut **44** and the lower end mounted in a bearing **106** secured to the lower end of piston **60** of the jack assembly. Affixed to the lower terminal end of the telescoping rod is a bevel gear **108** which meshes with a bevel gear **110** affixed to the jack wheel. The jack wheel is rotatably mounted on the axle **112** of the jack assembly and the axle **112** is affixed to the lowermost end of piston **60** so that the rotation of the rod **102** causes the jack wheel to rotate and propel the apparatus.

The upper end of each of the telescoping drive rods **102** is provided with a hinged arm crank **114** which enables the drive rod to be turned by hand. In addition, a notched collar **116** is provided which is affixed to the frame of the wheelchair so that the crank arm can be pivoted down into one of the notches to lock the crank arm in the particular position and prevent rotation of the crank arm, the telescoping rod and jack wheel. This provides a means for preventing the rotation of the jack wheel and maintaining the apparatus in a fixed position when desired or necessitated during the use of the apparatus.

The operation of the apparatus for ascending or descending a stair flight is shown in FIGS. **7** through **13**. The operation of the apparatus will be described in detail for ascending a flight of stairs. However, it is to be understood that essentially the same operation is carried out in reverse when descending a stair flight.

When the wheelchair apparatus **22** approaches the first stair riser, all of the telescoping jack assemblies are actuated to raise the chair to three times the height of the stair riser. The apparatus is then propelled forward by means of the drive trains **100** for the wheels of telescoping jack assemblies **36**,**36'** or **38**,**38'** until the wheels of the jack assemblies **36**,**36'** touch the first stair riser as shown in FIG. **7**.

The telescoping jack assembly **36**,**36'** are then retracted until the wheels of these assemblies are raised to the height of the first stair tread. Next, the entire assembly is propelled forward by means of the drive trains associated with jack assemblies **38**,**38'** until the wheels of jack assemblies **38**,**38'** touch the first stair riser as shown in FIG. **8**.

The crank arms of the drive trains for jack assemblies **36**,**36'** are then pivoted down to lock the wheels of jack assemblies **36**,**36'** against movement while the wheels of jack assemblies **38**,**38'** are raised to the height of the first tread. Next, the apparatus is propelled forward by means of the drive trains for telescoping jack assemblies **36**,**36'** until the apparatus reaches the position shown in FIG. **9** wherein the wheels of jack assemblies **36**, **36'** and **38**, **38'** rest on the first tread with the wheels of jack assemblies **36**,**36'** in contact with the second riser.

The wheels of telescoping jack assemblies **38**,**38'** are then locked against rotation while the wheels of telescoping jack assemblies **36**,**36'** are raised to the level of the second tread. The apparatus is then propelled forward by means of the drive trains for the jack assemblies **38**,**38'** until the wheels of jack assemblies **38**,**38'** contact the second riser as shown in FIG. **10** with the wheels of jack assemblies **36**,**36'** resting on the second tread.

With the wheels of telescoping jack assemblies **36**,**36'** locked against movement, the wheels of telescoping jack assemblies are raised to the height of the second tread after which the apparatus is propelled forward by means of the drive assemblies associated with jack assemblies **36**,**36'** until the wheels of jack assemblies **36**, **36'** contact the third riser, the wheels of jack assemblies **40**,**40'** contact the first riser, and the wheels of jack assemblies **38**,**38'** rest on the second tread as shown in FIG. **11**.

With the wheels of jack assemblies **38**,**38'** locked against movement, the wheels of jack assemblies **36**,**36'** are raised to the height of the third tread and the wheels of jack assemblies **40**,**40'** are raised to the height of the first tread. The apparatus is then propelled forward by means of the drive trains associated with jack assemblies **38**,**38'** until the wheels of jack assemblies **38**, **38'** contact the third riser and the wheels of telescoping jack assemblies **42**,**42'** contact the first riser as shown in FIG. **12**. In this position, the wheels of telescoping jack assemblies **36**,**36'** and **40**,**40'** rest on the first and third treads respectively.

With the wheels of telescoping jack assemblies **36**,**36'** locked against rotation, the wheels of jack assemblies **38**,**38'** and **42**,**42'** are raised to the height of the third and first treads respectively. Then the apparatus is propelled forward by the drive trains associated with telescoping jack assemblies **36**,**36'** until the wheels of telescoping jack assemblies **36**,**36'** contact the fourth riser and the wheels of telescoping jack assemblies **40**,**40'** contact the second riser as shown in FIG. **13**. In this position, the wheels of telescoping jack assemblies **38**,**38'** and **42**,**42'** rest on the third and first treads respectively.

The above outlined operation is continued until the stair flight has been traversed after which the wheels of the telescoping jack assemblies can be retracted above the level of the wheelchair wheels to permit the occupant to propel the apparatus **22** along by means of the wheelchair wheels. Of course, if desired, the telescoping jack assemblies can remain

extended to a certain extent so that the wheelchair and apparatus 22 can be propelled along by means of the drive assemblies associated with the telescoping and jack assemblies 36,36' or 38,38'.

A similar procedure is followed for descending a flight of stairs whereby the jack assemblies are selectively actuated to maintain the wheelchair in a horizontal position while the chair descends the stair flight. Of course, when descending a stair flight, the wheelchair is only initially raised enough to insure that the wheels of the wheelchair do not contact the stairs of the stair flight.

While the preferred form of the invention has been shown and described, it is to be understood that all suitable modifications and equivalents may be resorted to which fall within the scope of the invention.

What I claim is:

1. Wheelchair apparatus for ascending and descending stair flights comprising:

frame means for supporting a wheelchair, said frame means having side frame members between which a wheelchair can be mounted;

adjustable support means for raising and lowering said frame means, said adjustable support means comprising four pairs of jack means carried by said frame means with said four pairs of jack means being longitudinally spaced relative to each other and with the jack means of each pair being transversely spaced relative to each other and carried on said side frame members;

means for actuating the jack means of each pair in unison to effect the simultaneous extension or retraction of a selected pair of jack means when traversing a stair flight; and

means for propelling said frame means.

2. In the wheelchair apparatus of claim 1:

said four pairs of jack means comprising two forward pairs of jack means and two rearward pairs of jack means;

said forward pair of jack means being longitudinally spaced a selected distance relative to each other so that said forward pair of jack means can rest on the same stair tread;

said rearward pair of jack means being longitudinally spaced a selected distance relative to each other so that said rearward pair of jack means can rest on the same stair tread; and

said forward and rearward pairs being longitudinally spaced relative to each other a distance greater than either of said selected distances.

3. In the wheelchair apparatus of claim 1:

said jack means comprising telescoping hydraulic jacks.

4. In the wheelchair apparatus of claim 1:

said means for propelling said frame means comprising means for driving wheels of two forward pairs of said jack means.

5. In the wheelchair apparatus of claim 1:

said means for propelling said frame means comprising manual means for driving wheels of two forward pairs of said jack means.