STAIR CLIMBING WHEEL CHAIR

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This invention relates generally to stair climbing wheel chairs, and more particularly to such a wheel chair in which auxiliary foot wheels can be lowered and releasably locked into stair climbing position by a backward swinging linkage means, in combination with an adjustable pressure driving means which can be temporarily retracted for operation of said backward swinging linkage means.

A great variety of wheel chairs have been designed for the convenient transport of persons who suffer from some disability which prevents them from walking for an extended period of time, or from walking at all. A large and important category of wheel chair designs include a means of locomotion in which the user himself supplies the driving power. Many handicapped persons are handicapped only with respect to walking, and are equal to or superior to unhandicapped persons in the strength and dexterity of their arms and hands. Wheel chairs have, therefore, been designed with manually operated crank mechanisms, reciprocating drive levers and the like. Usually, such occupant-operated chairs are also provided with handles at the back so that they can be pushed by an attendant when the occupant does not wish to make the physical exertion required when he is supplying his own power of locomotion.

However, many highly handicapped persons do not want to rely upon the presence of an attendant, and prefer to travel alone almost as freely as if they were able to walk as well as the average unhandicapped person. Many excellent wheel chairs heretofore known have provided the handicapped person with complete mobility as long as he has restricted himself to horizontal or nearly horizontal services. Up to the present time, no wheel chair capable of climbing stairs has come into widespread use.

Various stair climbing wheel chairs have been proposed, but all have suffered from some major limitation which made them unattractive or impractical for most wheel chair users. Thus, some stair climbing wheel chair designs have involved such extensive and massive mechanism that only the most athletic of wheel chair users could apply the muscle power needed to operate them on stairs, or even on horizontal services. Other stair climbing wheel chairs have required electrical or gasoline power means.

Almost all widely used wheel chairs can be folded into a collapsed position. Experience has proven that this feature is a very important one, not merely for convenience in storage when the chair is not in use, but also for transporting the chair when the occupant travels by automobile or by public transportation methods, or when the occupant wishes to sit in a theater seat and temporarily store the chair in a space small enough to prevent it from blocking the passage of other people. Some previously proposed stair climbing wheel chairs have involved a construction inconsistent with collapsibility; consequently, such designs have never been accepted into general use.

It is an important object of the present invention to provide a stair climbing wheel chair construction which can be used in folding wheel chairs.

It is another important object of the present invention to provide a wheel chair in which the stair climbing mechanism is light, very strong, and readily operable on stairs by a person of average strength, without the aid of any auxiliary motor means.

It is important to note that in the achievement of these objects, it has been necessary to provide safety means to prevent any runaway of the wheel chair during the stair climbing operation. Also, the manual drive mechanism used during stair climbing has been made retractable so that ordinary hand rings can be used when traveling on the level.

Still another important feature of the present invention, which makes it substantially superior to previously known stair climbing designs, is that the wheel chair occupant is able to convert his wheel chair into stair climbing position, while at the same time lifting the weight of himself and his chair, by means of the linkage which enables him to apply the maximum strength of his arms.

The objects and advantages of the invention are achieved by means of a construction which will best be understood from a description of one preferred specific embodiment, which is illustrated in the accompanying drawings, in which:

FIGURE 1 is a right side elevational view of a wheel chair constructed according to the invention, with the stair climbing mechanism retracted and out of use, so that the chair can be conveniently moved over a horizontal surface by the occupant.

FIGURE 2 is a right side elevational view of the chair of FIGURE 1, but with the stair climbing mechanism lowered into stair climbing position.

FIGURE 3 is a plan view of the wheel chair as viewed in FIGURE 1, but showing the left manual driving wheel rotated into a retracted position.

FIGURE 4 is a perspective view of a fragmentary portion of the wheel chair, as seen from a point looking at the left rear vertical frame member, but with portions of the chair disassembled to reveal construction which would otherwise be concealed; and

FIGURE 5 is a detail perspective view of a latch employed for locking the stair climbing mechanism in retracted position as illustrated in FIGURE 1.

In the drawings, the wheel chair, indicated generally by the numeral 10, is seen to have all its essential parts mounted on a folding metal frame indicated generally by the numeral 11, and comprised of right and left side frame members 12 and 13, respectively, best seen in the plan view of FIGURE 5, and folding crossbar members 14 and 15.

The side frame members 12 and 13 are substantially identical in construction. The frames may be of standard types used in wheel chairs well known in presently used designs. For example, chrome plated steel tubing welded into the shape shown, or any convenient equivalent shape may be employed. In the particular embodiment illustrated, right side frame 12 (and also left side frame 13) is comprised of front and rear vertical members 20 and 21, and three horizontal members 22, 23, and 24, all welded together into an integral side frame structure. Upper horizontal member 22 serves as an arm rest; middle horizontal member 23 is a seat frame member; and the lower horizontal member 24 is a base member for the side frame 12.

As seen in FIGURE 3, the folding crossbar members 14 and 15 serve to hold the side frame members 12 and 13 parallel to each other and spaced from each other a distance corresponding to the width of the wheel chair seat.

The novelty of the present invention does not reside in the particular means by which folding is achieved, or in the particular construction of folding crossbars 14 and 15. The novelty resides in a combination which provides a stair climbing wheel chair, and in a stair climbing mechanism which, unlike many previously known stair
climbing mechanisms, can be incorporated in wheel chairs of the folding type. Thus, in the specific embodiment illustrated, the folding crossbars 14 and 15 are merely slotted as indicated at Z and 31, and are adjustable between the folding and open position by means of any suitable type of locking bolt 32; the crossbars 14 and 15 are rotatably connected by sleeves 33 and 34 on seat frame member 23 and base frame member 24, respectively, of the side frames 12 and 13. It will be understood, however, that any suitable folding mechanism may be used between the side frames 12 and 13 for holding them in erected position for wheel chair use, or folded together for storage.

The plan view of FIGURE 3 reveals that a readily foldable fabric seat 40 and fabric back 41 (shown partially broken away to illustrate the folding crossbars 14 and 15 in plan) are stretched between the side frames 12 and 13. Also, as is conventional in most folding wheel chairs, each of the side frames 12 and 13 is provided at the forward portion with foot support brackets 42 and 43, which support folding foot rests 44 and 45, respectively. Push handles 46 and 47 are provided at the rear of the wheel chair 10 on the upper ends of rear vertical members 30. Also, as will be described hereinafter, drive provided for rolling of the wheel chair are not the twenty-five inch hard-tire wheels usually found in most of the folding wheel chairs available on the market at the present time, but are larger, and use pneumatic tires. The main wheels, right and left main wheels 50 and 51, respectively, are rotatably mounted on right and left stub wheel shafts 52 and 53, respectively. The main wheels are provided with hand-propulsion rings 50a and 51a see in plan in FIG. 3, and partially broken away in FIGS. 1 and 2 for purposes of illustration of the stair climbing mechanism. The stub shafts 52 and 53 are integrally mounted on the rear verticals 21 of right and left side frames 12 and 13, usually a short space below the level of the seat frame members 23. Main wheels 50 and 51 are usually of a lightweight spoke and rim construction with inflated rubber tires 54. Also, the main wheels are usually of relatively large diameter, being between thirty inches by two inches in the specific embodiment, so as to provide the wheel chair user with a smooth rolling transport despite irregularities in ground surface, and also, so that an attendant may push or pull the wheel chair up the average stairway, which usually has treads and risers of about ten inches and seven inches, respectively.

The forward part of the wheel chair 10 is provided with rolling support by right and left identical swivel casters, typically illustrated by right caster 60. Preferably, the two swiveling casters 60 are mounted under the forward portions of side frames 12 and 13, respectively. It has been common in previously known wheel chairs to provide the occupant with crank-operated friction wheels with which to achieve self-locomotion. Right and left friction wheels 65 and 66, and their associated cranks 67 and 68, are illustrated as mounted on arm rest member 22 of the side frames 12 and 13. They are adapted, when in driving position as illustrated in FIGURES 1 and 2 for right friction wheel 65, to bear against the tread of tires 54, and thereby enable an occupant to drive the main wheels 50 and 51 by manual rotation of cranks 67 and 68. However, the friction wheels 65 and 66 in the illustrated specific embodiment of the present invention are mounted in a novel manner in order to coat with other components of the inventive combination which makes it possible to use the wheel chair of the invention for self-locomotion up a stairway.

It is a much preferred form of the present invention to make the friction wheels 65 and 66 retractable from a driving position as illustrated for right friction wheel in FIGURES 1, 2, and 3, and for left friction wheel in FIGURE 4, on the one hand, and, on the other hand, a retracted position illustrated in FIGURE 3 for left friction wheel 66. Also, as will be described hereinafter, it is much preferred to provide the right and left friction wheels with adjustable drive pressure means.

Before proceeding to a detailed description of the preferred form of retractable friction wheels 65 and 66, the principal stair climbing mechanism will be described. The wheel chair 10 is provided with right and left stair climbing wheels 70 and 71, which are mounted at the forward ends of arms 72 and 73, on stub shafts 74 and 75, respectively. Arms 72 and 73 are pivotally mounted to side frames 12 and 13, preferably in a simple and convenient way by being mounted on main wheel stub shafts 52 and 53, inboard of main wheels 50 and 51. Thus, the stair climbing wheels 70 and 71 may be selectively swung between a retracted position, as illustrated in FIGURE 1, when not in use; and a stair climbing position, as illustrated in FIGURE 2, when lowered for stair climbing use.

The right and left arms 72 and 73 may be braced to each other to form a rigid unitary frame structure by means of transverse brace 75, which is preferably hinged at the ends and midline as indicated by bolt 77, so as to be foldable with the wheel chair 10. A standard type of bolt 77, or any convenient type of relesssable locking means is provided on the transverse brace 75 to lock it into unfolded position.

As illustrated in FIGURE 5, a retractable spring latch 78 is mounted on the forward side of side frame 12 so as to provide releasable means for locking the arms 72 and 73 in the raised position illustrated in FIGURE 1.

The arms 72 and 73 are pulled downward into the stair climbing position of FIGURE 2 by means of right and left linkages, 80 and 81, respectively, which are pivotally mounted at fulcrums 82 and 83, respectively, in relatively massive fulcrum support bars 84 and 85, respectively, which are integral parts of right and left side frames 12 and 13, respectively.

The linkages 80 and 81 are identical, and are constructed as illustrated for linkage 80 in FIGURES 1 and 2. A bell crank 86 is mounted in the fulcrum 82. At its lower end, it is connected by pivot connection 87 to an arm link 88, which is in turn pivotally connected at 89 to arm 72. A locking stop 90 is welded to the upper end of arm link 88, so that it forms a rigid brace for arm 72 when the linkage 80 is pulled into the position illustrated in FIGURE 2.

Preferably, the upper end of valve crank 86 is provided with a folding lever ram 95, hinged to the bell crank 85 at 96. This folding nature makes it possible to fold the lever 95 downward and out of the way of the friction wheels 65 and 66, when the wheel chair 10 is traveling horizontally, and the stair climbing apparatus is out of use, as illustrated in FIGURE 1.

Although the operating levers 95 could be formed to by-pass the cranks 67 and 68, while the latter are in their normal outboard position, it is much preferred to make friction wheels 65 and 66 retractable, as illustrated for friction wheel 66 in FIGURE 3, by means to be described hereinafter, so that the seated occupant of wheel chair 10 will have a maximum of leverage with a minimum of effort for converting from horizontal travel position of FIGURE 1 to the stair climbing position of FIGURE 2.

In FIGURE 4, the arch of movement of the lever 95 is illustrated by the arrow 100. Also, it will be seen that a catch 101 is welded to the side frame 12 member 22 so as to catch lever arm 95 and retain the linkage 81 in stair climbing disposition. An identical construction is provided for the right side frame 12.

FIGURES 3 and 4 illustrate retraction and adjustment for the friction wheels 65 and 66. It will be understood that between the side frames 12 the friction wheel 66 in FIGURE 4, in order to better illustrate the vertical adjustment of friction wheel 65. As seen in FIGURE 4, friction wheel 66 carries an integral crank shaft
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110, which is journaled in an inverted adjustable yoke 111. Yoke 111 is vertically adjustable within an outer yoke 112, the sides of which are provided with vertical slots 113 to permit the vertical adjustment of friction wheel shaft 110.

Outer yoke 112 is welded integrally to a sleeve 114, which is journaled on an arm member 22, between an outboard driving position (as illustrated for right friction wheel 65 in FIGURE 3) and an inboard retracted position (as illustrated for left friction wheel 66 in FIGURE 3) to permit full swing of lever 95 along the arc indicated in FIGURE 4 by double arrow 110, for purpose of lowering arms 73 to stair climbing position illustrated in FIGURE 2. A latch 115 is provided for releasably locking the sleeve 114 in drive position.

Vertical adjustment of the drive wheels 65 and 66 is accomplished by means illustrated for drive wheel 66 in FIGURE 4. A small adjustment crank 120, with a threaded vertical shaft 121, is received in a threaded bore 122 in the upper portion of outer yoke 112, so that rotation of adjustment crank 120 can be used to force its lower end against the upper portion of inner yoke 111, thereby driving it downward into greater pressure of engagement with tires 54; or crank 120 can be rotated in an opposite direction to slightly relieve the driving engagement pressure.

A ratchet means, indicated generally by the numeral 130, is provided to prevent accidental runaway of the wheel chair 10 during the operation of said climbing. The ratchet means 130 is illustrated in FIGURE 1 in an inactive position, and in FIGURE 2 in an engaged position for providing safety against accidental runaway.

As seen in FIGURE 1, a ratchet wheel 131 is rotatable integral with main wheel 50 on right main wheel stub shaft 52, ratchet wheel 131 being formed with teeth 131a beveling in a direction to prevent clockwise movement when travelling in an upward direction, only, when engaged as shown in FIGURE 2. However, a ratchet pawl 132, at the lower end of pawl bar 133 is held out of engagement with the ratchet teeth 131a as illustrated in FIGURE 1, and lowered into engagement position during stair climbing, as illustrated in FIGURE 2. The pawl bar 133 is vertically reciprocable in brackets 134, 135, and 136, being urged downwardly by a spring 137 engaging a shoulder 138, integral with the bar 133. A catch 139, on the back of rear vertical member 21 is provided to hold bar 133 in its disengaged position. However, when bar 133 is lowered into its engaged position for stair climbing, the spring 137 acts to urge the pawl 132 downwardly into engagement with ratchet teeth 131a.

It will be seen from the foregoing description that I have provided a simple but effective stair climbing means of light weight, which can be varied to suit a variety of forms of construction without departing from the spirit of the invention. Also, it will be noted that my stair climbing mechanism is not restricted to the heavy, non-folding type of wheel chair, but may be used on wheel chairs both folding and non-folding. Indeed, in its preferred form, it is especially adapted because of its lightness in weight and folding features to be used in a light weight folding wheel chair intended for self-propulsion by the user.

Although no brake means is illustrated or described, any suitable brake means would be a desirable accessory. It will be understood that my invention is not restricted to the specific embodiment illustrated but is intended to comprehend all the variants obvious to those skilled in the art but falling within the scope of the following claims. For example, the simple catch 101 may be replaced by any suitable latch means. There is usually sufficient flexibility in lever 95 so that it can be released directly by a catch backward followed by a lateral deflection outward. However, more complex movable latch means, such as latch 78, illustrated in FIGURE 5, and used for holding up the arms 52 and 13, may be used on arm members 22 for locking lever 95 in the position shown in FIGURE 4.

Having thus described the invention, what is claimed as new in support of Letters Patent is:

1. In an occupant-propelled folding wheel chair of the type in which side frames are supported on folding crossbar means, each side frame having a front caster and a rear main wheel sufficiently large in diameter to roll over normal stair steps, and in which the occupant can propel the chair by hand-operated means for driving said main wheels, a stair climbing mechanism which includes: a pair of arms, one carried on each of said side frames, each said arm being pivoted at its rearward end coaxially with one of said main wheels to permit the forward end of said arm to swing between a raised and lowered position; a pair of stair-climbing wheels, one rotatably mounted on the forward end of each of said arms, said wheels having a diameter smaller than said main wheels but large enough to roll over normal stair steps; a transverse brace member between said side frames, said brace member being disposed sufficiently forward to clear the side frames of said wheel chair during swinging movement of said arms, and said brace member being foldable to cooperate with the folding of said wheel chair; a pair of linkage means, one on each of said side frames, each of said linkage means being pivotally mounted on one of said side frames and each said linkage means being adapted to be manually operated by an occupant of said wheel chair to move said arms from a raised position to a lowered position for stair climbing; a ratchet gear rotatable integrally with each of said main wheels; retractable pawl means for engaging said ratchet gear during stair climbing operation; and releasable latch means for holding said stair climbing mechanism in stair climbing position.

2. A stair climbing, folding wheel chair, which includes: a pair of side frames, each of said side frames including an arm rest member; foldable seat and back means between said side frames; a foldable transverse structure between said side frames, for holding said side frames a seat-width apart, or alternatively, in a position folded together; a front wheel means on each of said side frames; a main wheel rotatably mounted on each of said side frames near the rear thereof, each of said main wheels having sufficient radius to bring its rim into the vicinity of said shaft portion of said arm rests member; a manually-operated drive means for driving said main wheel on each of said arm rests, and rotatable between a drive position adjacent the rim of said main wheel, and a retracted position integral of said arm rests member; a pair of arms, one carried on each of said side frames, each said arm being pivotally attached to the rearward end of one of said side frames to permit the forward end of said arm to swing between a raised and lowered position; a wheel rotatably mounted on the forward end of each of said arms; a transverse brace member between said arms, said brace member being disposed sufficiently forward to clear the side frames of said wheel chair during swinging movement of said arms, and said brace member being foldable to cooperate with the folding of said wheel chair; a pair of linkage means, one on each of said side frames, each of said linkage means being pivotally mounted on one of said side frames, and each said linkage means being adapted to move said arms from a raised position to a lowered position for stair climbing; lever means for operating each of said linkage means, said lever means being movable from a position forward of said drive means carrier to a position aft of said drive means carrier when said carrier is retracted to an unloaded position; ratchet means integral with said main wheel; and pawl means engageable with said ratchet means for stair climbing, and retractable for horizontal engagement.

3. A stair climbing, folding wheel chair, which includes: a pair of side frames, each of said side frames including an arm rest member with a cylindrical shaft...
portion near the forward end; foldable seat and back means between said side frames; a foldable transverse structure between said side frames, for holding said side frames a seat-width apart, or alternatively, in a position folded together; a front wheel means on each of said frames; a main wheel shaft projecting laterally outward from each of said side frames, at the rear portion thereof; a main wheel rotatably mounted on each of said main wheel shafts, each of said main wheels having sufficient radius to bring its rim into the vicinity of said shaft portion of said arm rests member; a drive means carrier yoke including a sleeve rotatably carried on said shaft portion of each of said arm rests; and rotatable between a drive position adjacent the rim of said main wheel, and a retracted position inboard of said arm rest member; a locking means for locking each of said drive means carrier in drive position; a manually operated friction drive wheel mounted in each of said carrier yokes for driving said main wheels; a pair of arms, one carried on each of said side frames, each said arm being pivoted at its rearward end on one of said main wheel shafts to permit the forward end of said arm to swing between a raised and lowered position; a wheel rotatably mounted on the forward end of each of said arms; a transverse brace member between said arms, said brace member being disposed sufficiently forward to clear the side frames of said wheel chair during swinging movement of said arms, and said brace member being foldable to cooperate with the folding of said wheel chair; a pair of linkage means, one on each of said side frames, each of said linkage means being pivotally mounted on one of said side frames, and each said linkage means being adapted to move said arms from a raised position to a lowered position for stair climbing; lever means for operating each of said linkage means, said lever means being movable from a position forward of said drive means carrier to a position aft of said drive means carrier when said carrier is retracted to an unloaded position; ratchet means for preventing runaway of said wheel chair movement during stair climbing; and a releasable latch means on at least one of said arm rest members for holding said stair climbing mechanism in stair climbing position.

4. A stair climbing, folding wheel chair, which includes: a pair of side frames, each of said side frames including an arm rest member with a cylindrical shaft portion near the forward end; foldable seat and back means between said side frames; a foldable transverse structure between said side frames, for holding said side frames a seat-width apart, or alternatively, in a position folded together; a front wheel means on each of said side frames; a main wheel shaft projecting laterally outward from each of said side frames, at the rear portion thereof; a main wheel rotatably mounted on each of said main wheel shafts, each of said main wheels having sufficient radius to bring its rim into the vicinity of said shaft portion of said arm rest members; a pair of drive means carriers, one of said carriers being rotatably carried on said shaft portion of each of said side frames, and rotatable between a drive position adjacent the rim of said main wheel, and a retracted position inboard of said arm rest member; a locking means for locking each of said drive means carriers in drive position; an inverted yoke member vertically adjustable within each of said drive means carriers; friction wheels rotatably mounted in said inverted yokes, and engaging the rims of said main wheels; a pair of crank means for rotating said friction wheels and thereby driving said main wheels; adjustment means between said drive carrier and said inverted yoke for adjusting the pressure of said friction wheel against the rim of said main wheel; a pair of arms, one carried on each of said side frames, each said arm being pivoted at its rearward end on one of said main wheel shafts to permit the forward end of said arm to swing between a raised and lowered position; a wheel rotatably mounted on the forward end of each of said arms; a transverse brace member between said arms, said brace member being disposed sufficient forward to clear the side frames of said wheel chair during swinging movement of said arms, and said brace member being foldable to cooperate with the folding of said wheel chair; a pair of linkage means, one on each of said side frames, each of said linkage means being pivotally mounted on one of said side frames, and each said linkage means being adapted to move said arms from a raised position to a lowered position for stair climbing; lever means for operating each of said linkage means, said lever means being movable from a position forward of said drive means carrier to a position aft of said drive means carrier when said carrier is retracted to an unloaded position; first releasable latch means for retaining said stair climbing mechanism in stair climbing position, and second releasable latch means for holding it in a raised inoperative position.

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