Curb Climbing Wheel Chair

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5
CURB CLIMBING WHEEL CHAIR

Leon Bennett, Bronx, and Herbert Tramposch, Brooklyn, N. Y., assignors to National Foundation for Infantile Paralysis Incorporated, New York, N. Y., a corporation of New York

Application June 23, 1954, Serial No. 438,665

15 Claims. (Cl. 155—30)

This invention relates to wheel chairs such as are used by invalids who are unable to walk. If the invalid has the use of his arms, as is often the case, he can propel himself from place to place in the wheel chair by means of hand rims attached to the front wheels of the chair. It has been found, however, that the invalids 20 have hand rims which are placed closer to the ground, and that when patients 25 come to a step, such as a curb, the wheel chair will not climb the step. Various devices have been suggested for making wheel chairs capable of climbing curbs; but these devices have been complicated and impractical, and they have required wheel chairs of special construction.

It is an object of this invention to provide an improved wheel chair which has simple and practical means for causing it to climb a step or curb, and with lifter operating mechanism that is actuated by the occupant of the chair. Another object of the invention is to provide lifter means for making a wheel chair climb a curb, and with the lifter construction such that it can be attached to wheel chairs of conventional construction. One feature of the invention relates to a combination of front and back lifters for the wheel chair with a pivoting operating mechanism that extends the lifters at one end of the chair while it retracts the lifters at the other end of the chair. In the prior construction, the front lifters have a substantially longer stroke than the rear lifters and they are connected with the chair in such a way that they slope rearwardly toward their lower ends to develop a forward component of thrust when they lift the front wheels from the ground. These front lifters are pivotally connected to the frame of the wheel chair so that they can swing rearwardly about the pivot connections as the chair moves forwardly across the top of the step or curb.

Other features of the invention relate to simple and rugged operating mechanisms for the lifters including cables which wrap around drums operated by cranks which are manipulated by the occupant of the wheel chair. The invention includes several safety features, one of which is an automatic lock for preventing operation of the lifters except when the occupant of the chair is manipulating the actuating mechanism of the lifter operating mechanism. Another safety feature relates to an automatic lock for preventing the rear wheels of the chair from casting when the front wheels of the chair are lifted from the ground.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawings, forming a part hereof, in which like reference characters indicate corresponding parts in all the views:

Figure 1 is a side elevation of a wheel chair embodying this invention and with the wheel chair shown at the foot of a curb which it could not climb without the aid of this invention;

Figure 2 is a view similar to Figure 1, but showing the first sequence in the operation of the invention to climb the curb;

Figures 3—5 are views similar to Figures 1 and 2 but showing successive stages in the operation of the invention in raising the wheel chair up over the curb;

Figure 6 is an enlarged view of the wheel chair shown in Figures 1—5;

Figure 7 is a front view of the wheel chair shown in Figure 6, but on a slightly reduced scale;

Figure 8 is a fragmentary view showing the caster wheel of Figure 6 with its locking means in the position occupied when the front end of the wheel chair is raised from the ground;

Figure 9 is a detailed view showing a development of the caster locking jaws;

Figure 10 is a greatly enlarged sectional view through one of the front lifters of the wheel chair;

Figure 11 is a sectional view through the front lifter shown in Figure 10 but with the section taken at right angles to that of Figure 10;

Figures 12 and 13 are sectional views taken on the lines 12—12 and 13—13, respectively, of Figure 11; and

Figure 14 is an enlarged view partly in sections showing the mechanism by which the occupant of the chair actuates the lifters.

Figure 1 shows a wheel chair 20 having a carriage frame 21 with front wheels 23 and rear wheels 25. The frame 21 has a seat 27, arms 28, a back 29 and handles 30 by which the wheel chair can be pushed when occupied by a person unable to propel himself. The front wheels 23 have hand rims 33 by which an occupant of the chair can propel the chair, if he has the full use of his arms and hands.

The rear wheels 25 are caster wheels, but have special mounting so that they can be locked against castering movement while the chair is climbing a curb; this construction will be described more fully in connection with Figures 6 and 8. The wheel chair is shown with a brake 32 on the front wheels operated by handle 36 in accordance with conventional construction.

The chair has two front lifters 38, one on each side of the chair frame 21, and has two rear lifters 39, one of which is on each side of the chair but spaced close enough together so as not to interfere with the operation of the caster wheels 25. In the preferred embodiment of the invention, each of the lifters 38 and 39 includes a housing 40 and a pivot mounted collaboratively in the housing 40, and which is thrust outwardly from the lower end of the housing 40 to extend the lifter when the wheel chair is to be raised.

The construction of the lifters 38 and 39 will be explained fully in connection with Figures 10—13, and for the present it is sufficient to understand that the housings 40 are pivotally connected at their upper ends to the frame 21 of the chair, and that the push rods 42 are operated to thrust them downwardly from the housings to extend the lifters when the wheels of the chair are to be raised from the ground. The lifters 38 and 39 are operated by rotating shafts 45, one of which is shown in Figures 1—6, and each of which has its upper end extended horizontally to provide a crank 46 having a handle 47 at its outer end.

When the occupant of the chair wishes to actuate the lifters 38 and 39, he moves the handle 47 into an upwardly extending position and uses it to rotate the shaft 45. Rotation of the shaft 45 in one direction causes the front lifters 38 to be extended while the rear lifters 39 are being retracted. Rotation of the shaft 45 in the opposite direction causes the front lifters 38 to retract and causes the rear lifters 39 to be extended.

Figure 1 shows the wheel chair 20 in the position which it occupies when it first comes into contact with a curb 51. The lifters 38 and 39 are shown with their push rods 42 in the positions in which they extend the front wheels of the chair when the wheel chair is in use on level ground. The push rods of the front lifters 38 are retracted almost all the way, whereas the push rods of the rear lifters 39 are retracted only slightly.

The first operation in climbing the curb 51 is for the occupant of the chair to turn the handle 47 up into position to rotate the shafts 45 in directions which will extend the front lifters 38. These front lifters 38 slope toward the rear at their lower ends so that they are extended, and lift the front wheel 23 from the ground, thereby making the wheel chair climb over the curb 51.

The occupant of the chair propels the chair forward at the new level on which rear wheels 23 are located, and this brings the wheel chair into the position shown in Figure 3. The front lifters 38 are free to swing about their pivotal connections to the frame 21, which
connections are indicated by the reference character 52. This free swinging movement prevents the front lifters from interfering with the advance of the wheel chair along the high ground at the level of the top of the curb 51. Each of the front lifters 38 causes the rear lifters 40 to retract so that the push rods 42 of the front lifters 40 clear the curb 51 as indicated in Figure 3. The next operation is for the occupant of the chair to rotate the shaft 45 in a reverse direction so as to retract the front lifters 38 and to extend the rear lifters 39. This causes the rearward end of the wheel chair to be lifted so that the caster wheels 25 are raised to the level of the curb 51 as shown in Figure 4.

The rear lifters 39 slope forwardly with respect to their upper ends when the chair is in the position shown in Figure 3. Each rear lifter 39 is against the frame 21, however, so that it cannot swing forwardly and move the wheel chair back in what would be a reverse of the operation of the forward lifter 38 in thrusting the wheel chair forward between the positions shown in Figures 1 and 2. It should also be noted that when the wheel chair is in a substantially level position, as shown in Figure 4, the rear lifter 39 is in a substantially vertical position, but it can swing rearwardly, about its pivot connection 52 with the frame, as the occupant of the chair moves the wheel chair 23 to move the carriage from the position shown in Figure 4 to that shown in Figure 5. During this movement, the chair is raised upwardly, and its point of contact with the ground. As the rear lifter 39 moves into an angular position, it permits the rear of the wheel chair to move down and it is desirable, therefore, to have the rear lifters 39 swing forwardly and move the chair in the position shown in Figure 4.

After the rear wheels 25 are on the high level, the occupant of the chair retracts the push rod of the rear lifter 29 so that it no longer touches the ground and the lifters are then in the position shown in Figure 5, which are the normal positions occupied by the push rods of the lifters when the chair is being used to travel along a level surface. The handle 47 in Figure 5 now moves into its lowered position, parallel to the arm 28 of the wheel chair; and there is a cam 55 on the lower end of the handle 47 in position to raise the cranks 46 to a position higher than the top of the curb 51 when the wheel chair is in the position shown in Figure 4.

In the drawing, the push rod 42 is shown in retracted position with the block 94 at the upper end of its stroke. In the drawing, the push rod 42 is shown in retracted position with the block 94 at the upper end of its stroke.
There is a sheave 100 rotatable on an axle 101 carried by the block 94. There are other sheaves 103 and 104 on axles secured to the housing 40. A cable 107 is con-
nected at each end of the cable 100 to a bracket 117. From this anchored end 108, the cable 107 extends upwardly in the housing 40, around the sheave 100, then downwardly again around 103, and then upwardly again around the housing 40, and then upwardly and over the sheave 104 from which the cable 107 passes through an opening in the upper end of the housing 40 and to a cable drum which will be described with Figure 96.

From this construction it will be apparent that when the cable 107 is pulled from outside the housing 40, this pull on the cable will cause the block 94 to be pulled down. 

The push rod 42 will be thrust from the lower end of the housing to extend the lifter. The sheaves 100, 103 and 104 provide a pulley system, and a mechanical advantage of two to one, gaining force, is obtained because of the fact that the sheave 100 serves as a movable pulley of the system. This mechanical advantage makes it easier for the occupant of the chair to raise his own weight, and that of the chair, when operating it from the ground or not.

Figures 12 and 13 show sectional views through the block 94. This block slides freely in the housing 40 as a guide bearing; and there are grooves in the block providing a guide for the return cable 107.

The sheaves 100, 103 and 104 avoid wear on the cable 107 such as might result if there were no definite grooves for its passage and a groove provided in which the push rod 42 could sometimes bear against the cable depending upon the direction of thrust against the lifter. Although the block 94 provides a bearing at the upper end of the push rod 42, there is ample bearing support for the lower end of the push rod in the bearing surface provided by a head 110 at the lower end of the housing 40. The push rod 42 never moves far enough down to bring the block 94 close to the head 110. This prevents excessive bending moments on the push rod 42, and provides ample space for compression of the spring 96.

Figure 14 shows a drum housing 115 secured to the frame 41 by a bracket 117. The drum housing 115 has upper and lower heads designated by the reference characters 121 and 122, respectively, and the shaft 45 rotates in bearings in the heads 121 and 122 of the drum housing 115. There is a collar 125 secured to the shaft 45 by a pin 127. A spring 130 is compressed between the collar 125 and the bearing in the lower head 122. This compression spring urges the shaft 45 outwardly. Another collar 133, secured to the shaft 45, carries a stud 135 which engages in a recess 136 in the head 121 of the drum housing when the shaft 45 is thrust upwardly by the spring 130. There are angularly spaced around the shaft 45 so that it is not necessary for the collar 133 to rotate to any large angle before the stud 135 is in position to engage one or the other of the recesses 136. When the occupant exerts a downward thrust on the handle 47, and through this handle and crank 46, on the shaft 45 to compress the spring 120, this spring will lift the shaft 145 and carry the stud 135 into engagement with one of these recesses 136 to lock the operating mechanism for the lifters. This automatic locking occurs whether the lifters are in extended or retracted position and whether the chair has any of its wheels retracted.
guide means to a drum, and the lifter operating mechanism includes a drum on which the cable winds, mechanism for rotating the drum, and connections from said mechanism to the rear lifters and through which the rear lifters are retracted when the operating mechanism moves in a direction to extend the front lifters.

5. The chair described in claim 1 characterized by two lifters at the front of the frame and two lifters at the rear of the frame, each of the lifters including a housing which is connected with the frame and a push rod slideable axially in the housing, a sheave at the top of the push rod, a cable anchored at one end to the lower portion of the housing and extending upwardly around said sheave, and then downwardly again into the housing, guide means over which the cable passes from the housing, and the lifter operating mechanism includes two drums on either side of the carriage frame, one of the drums being in position to wrap the cable from the front lifter on that side of the frame and the other drum in position to wrap the cable from the rear lifter on that side of the frame, common operating mechanism for both of the drums on one side of the carriage and other common operating mechanism for both of the drums on the other side of the carriage, the cables being wrapped on the drums in a direction that causes one cable to wrap on its drum while the other cable unwraps when the drums are rotated by the common operating mechanism.

6. A curb climbing wheel chair comprising a carriage frame, large wheels supporting the front of the frame, smaller caster wheels supporting the rear of the frame, automatic locking means operated by the lifting of the front end of the carriage to prevent castering of the rear wheels, lifters connected to the forward end of the carriage and extendable to lift the forward end of the carriage, a curb, and operating mechanism for the lifters located in position to be actuated by an occupant of the chair.

7. The wheel chair described in claim 6 characterized by a linkage by which the load carried by the caster wheels hangs from axles of the caster wheels, locking jaws, and motion transmitting means operated by tilting of the upper end of the linkage rearwardly with respect to the supporting thrust on the caster wheels for engaging the locking jaws to hold the rear wheels against castering movement.

8. A wheel chair including front wheels, rear caster wheels, means for locking the caster wheels against castering movement, the locking means including elements operated by a change in the angular relation between the down force on the caster wheels and an upward force, and the wheel chair characterized by the front end of the carriage being in a horizontal position and the rear wheel being elevated with respect to the carriage when the wheelchair is in a horizontal position.

9. A wheel chair for invalids including a carriage frame, front wheels, rear wheels, lifters connected to the front of the frame, other lifters connected to the rear of the frame, and lifter operating mechanism in position to be actuated by an occupant of the chair, the lifter operating mechanism including a portion of the mechanism which is common to both the front and rear lifters and that operates the lifters at one end of the frame to raise the carriage while the lifters at the other end of the frame are operating in a direction to lower the carriage.

10. A wheel chair for invalids including, in combination, front wheels, rear wheels, lifters connected to the front of the chair, other lifters connected to the rear of the chair, said lifters being extendable to raise the wheels of the chair from the ground, cables that operate the lifters including different cables for the front and rear lifters, and lifter operating mechanism including at least a portion of the mechanism which is common to both the front and rear lifters, said mechanism including a drum on which the rear lifter cable wraps, another drum of different diameter on which the front lifter cable wraps, and a common shaft for rotating both of the drums, the cables being wound on the drums in a direction to cause one cable to wrap when the operating mechanism is moved in a direction to cause the other cable to unwrap.

11. The wheel chair described in claim 10 characterized by lifter operating mechanism having automatic locking means for preventing the drums from rotating when the lifter operating mechanism is not actuated, and in which the common operating mechanism includes a vertical shaft having a crank at its upper end and lock mechanism at one side of the wheel chair in position to be rotated by the occupant of the chair, a spring that urges the vertical shaft upwardly to operate the automatic lock for preventing rotation of the drums, said automatic lock being released by downward movement of the vertical shaft against the pressure of said spring, and lost motion connections between the vertical shaft and at least one of the drums so that the first part of the rotation of the vertical shaft in a direction to reverse the rotation of the drum is free movement not imparted to the drum.

12. A wheel chair for invalids including, in combination, front wheels, rear wheels, lifters carried by the chair in position to raise the front wheels from the ground, other lifters carried by the chair in position to raise the rear wheels from the ground, each of the lifters comprising a housing and a push rod movable axially in the housing, a cable that pulls the push rod in a direction to thrust in the housing to lift the wheel chair, a spring in each housing in position to urge the push rod back into the housing to retract the lifter when the pull on the cable is relaxed, and lifter operating mechanism actuated by the occupant of the chair, a curb, and automatic locking means on which the cables from the lifters wrap in opposite directions so that rotation of the drum means pulls the curb in the opposite direction and the common operating mechanism common to both the front and rear lifters and rotatable in opposite directions to selectively extend the front and rear lifters, and vice versa, and a lost motion connection between the common operating mechanism and the drum means.

References Cited in the file of this patent

UNITED STATES PATENTS
865,514 Mullenmeister Oct. 9, 1907
2,608,258 Jenkins Aug. 26, 1952
FOREIGN PATENTS
657,835 Great Britain Sept. 26, 1951