United States Patent

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[54] **VARIABLE RATIO ROTARY DRIVE MECHANISM AND WHEEL CHAIR EMBODYING SAME**
2 Claims, 6 Drawing Figs.

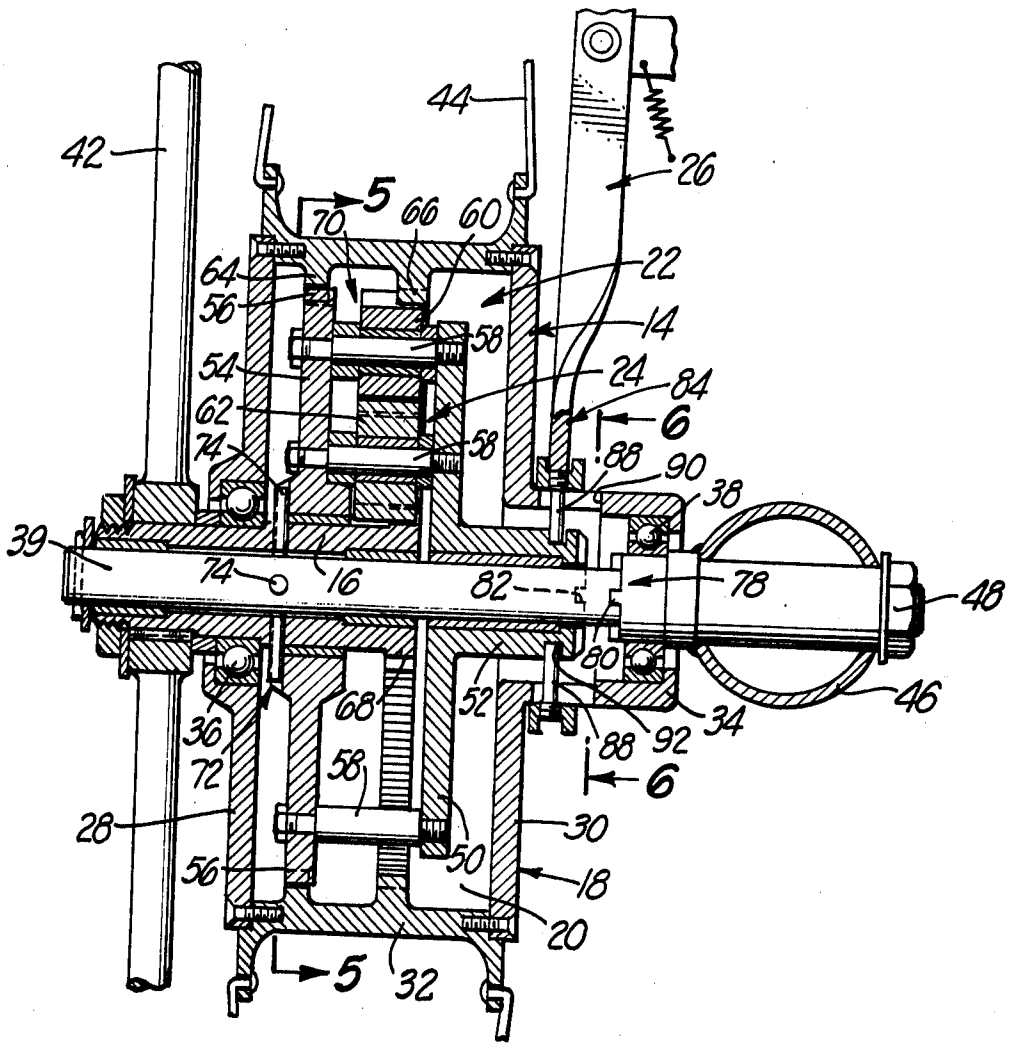
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[51] **Int. Cl.** **B62m 1/16,** B62m 11/16; F16h 57/10
[50] **Field of Search** 74/789; 280/242, 248, 236, 238, 230, 249

[56] **References Cited**
UNITED STATES PATENTS

605,530	6/1998	Way	280/238
617,647	1/1999	Eisenhuth	74/789
922,634	5/1909	Sherman	74/789
1,192,777	7/1916	Fisher	74/789
2,479,654	8/1949	Warburton	74/789
2,575,522	11/1951	McFarland	74/789X
3,231,293	1/1966	Loustaunau	280/242X

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ABSTRACT: A variable ratio rotary drive mechanism is provided for wheel chairs and other uses. The drive mechanism has a pair of concentric driving and driven members defining an intervening annular space containing a variable ratio gear train which drivably couples the members, whereby rotation of the driving member drives the driven member in rotation. A shift lever is provided for operating the gear train to vary its ratio and thereby the mechanical advantage of the drive mechanism. A wheel chair is provided having wheel assemblies embodying the rotary drive mechanism to permit adjustment of the force which the occupant of the chair must exert on the wheels to propel the chair.



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SHEET 1 OF 2

FIG. 3.

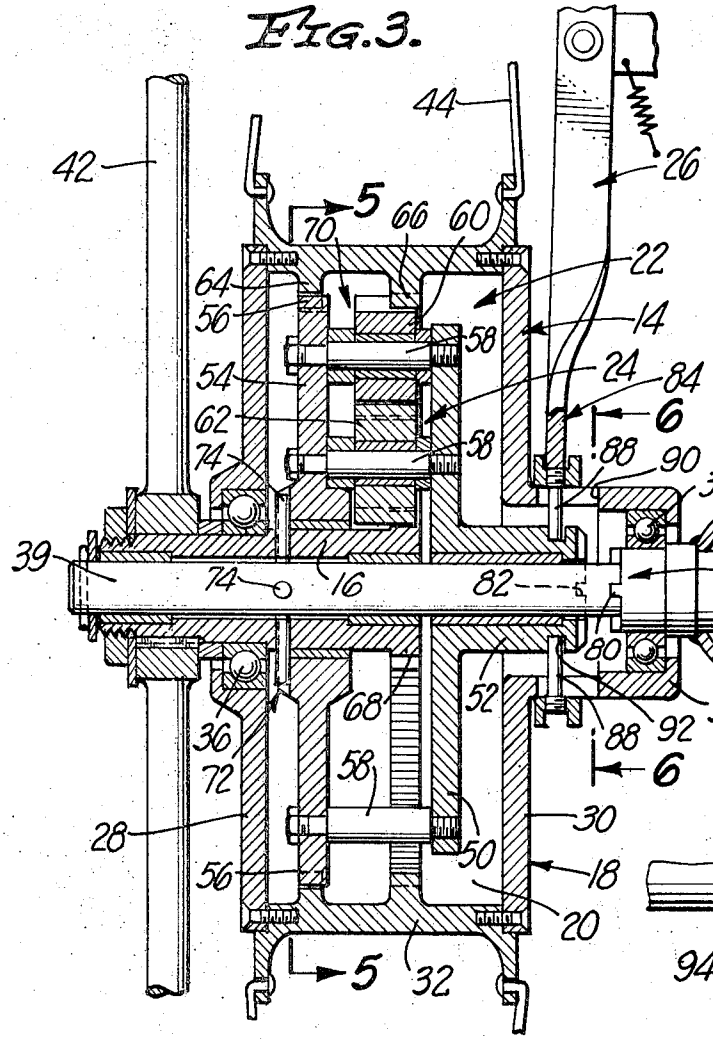


FIG. 1.

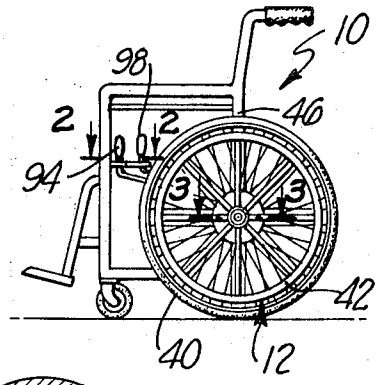


FIG. 2.

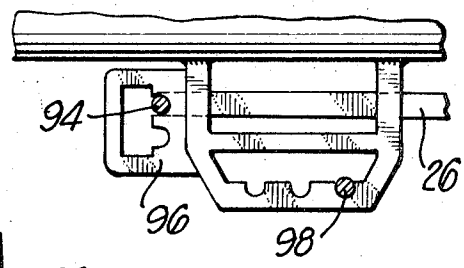
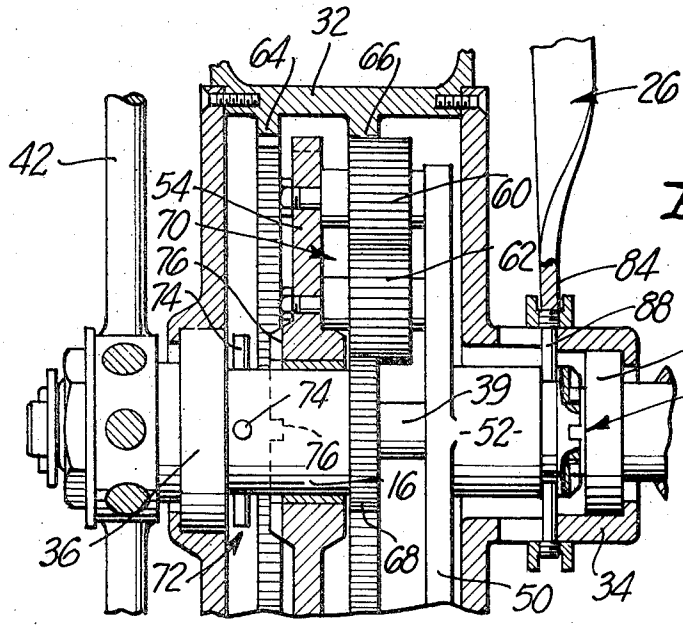
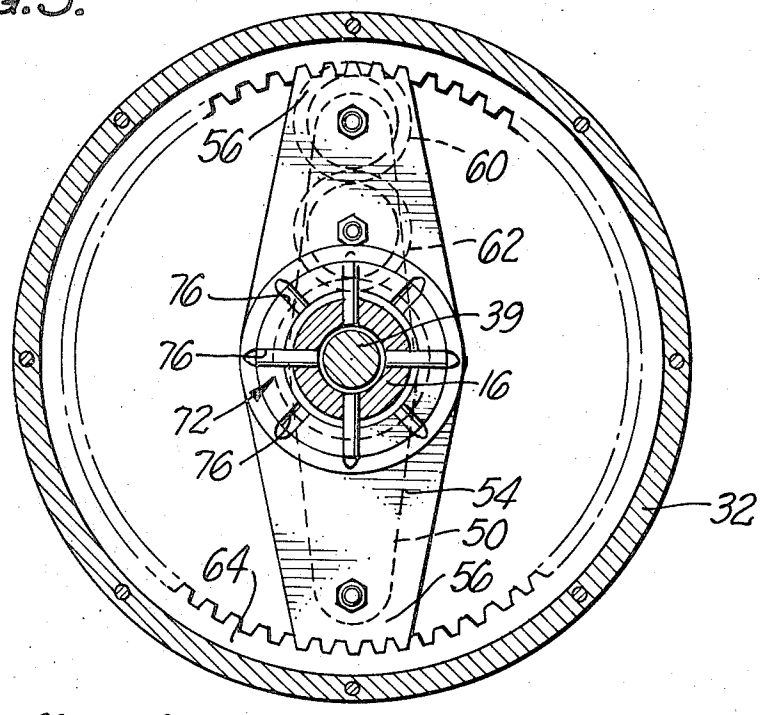


FIG. 4.



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FIG. 5.



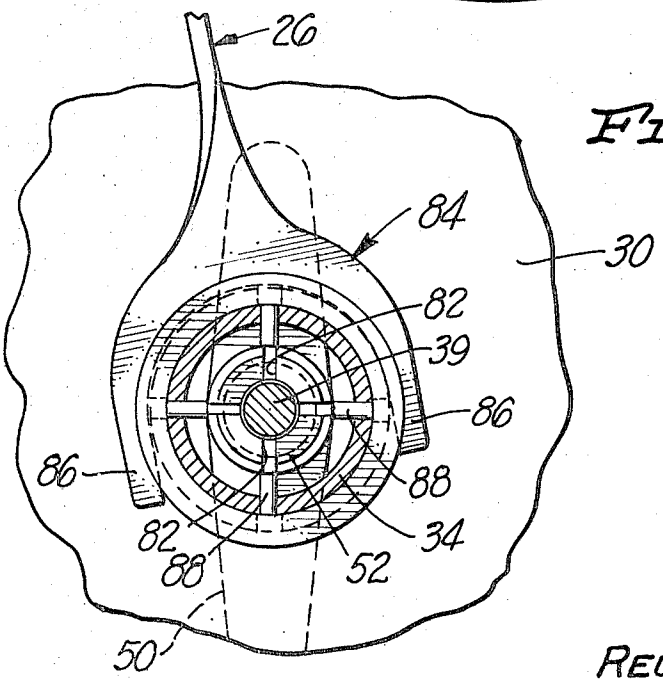


FIG. 6.

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VARIABLE RATIO ROTARY DRIVE MECHANISM AND WHEEL CHAIR EMBODYING SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to rotary drive mechanisms and more particularly to a novel variable ratio rotary drive mechanism. The invention relates also to a wheel chair and chair wheel assembly embodying the drive mechanism.

2. Prior Art

As will appear from the ensuing description, the rotary drive mechanism of the invention is capable of various uses and applications. However, the drive mechanism is designed primarily for use in a wheel chair and will be described in this connection. Wheel chairs are widely used as a means of transportation by persons afflicted with a great variety of different physical impairments. In some cases, while the affliction may require the patient to use a wheel chair, it may not appreciably affect the strength of the patient's arms and hands. In other cases, the patient's arms and/or hands may be so weakened by his particular physical impairment as to render it extremely difficult or impossible for the patient to propel himself in a conventional wheel chair because of the substantial force which the patient must exert on the wheels of the chair to move the latter.

Wheel chairs have been devised to alleviate this problem. For example, some wheel chairs are motor driven. Such motor driven chairs, however, are costly, need frequent servicing, and are otherwise deficient. Other wheel chairs for the purpose have wheel driving mechanisms which provide a mechanical advantage but reduces the force which the occupant in the chair must exert to propel the chair. These latter chairs, then, permit the patient to propel himself in a wheel chair with greater ease, although at slower speed. The present invention is concerned with wheel chairs of this latter class.

SUMMARY OF THE INVENTION

The present invention provides a variable ratio rotary drive mechanism having concentric driving and driven members defining an intervening annular space containing a variable ratio gear train. This gear train drivably couples the members, whereby rotation of one member drives the other member in rotation. According to an important feature of the invention, a shift lever is provided for adjusting the ratio and hence mechanical advantage of the gear train.

The disclosed embodiment of the invention is a wheel chair having ground wheel assemblies each embodying a present variable ratio rotary drive mechanism. In this case, the outer member of the rotary drive mechanism in each wheel assembly is a driven cylindrical hub. The inner member is a rotary driving shaft. Each wheel assembly further includes a ground wheel and a hand wheel. The ground wheel concentrically surrounds and is secured to the driven hub. The hand wheel is secured to one end of the driving shaft. In use of the wheel chair, the occupant rotates the hand wheels to drive the ground wheels and thereby propel the chair forwardly or rearwardly, depending upon the direction of rotation of the hand wheel, with a mechanical advantage determined by the ratio of the gear train in the drive mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a wheel chair having ground wheel assemblies which embody rotary drive mechanisms according to the invention;

FIG. 2 is an enlarged section taken on line 2–2 in FIG. 1;

FIG. 3 is an enlarged section taken on line 3–3 in FIG. 1 and illustrates the rotary drive mechanism adjusted for one speed ratio;

FIG. 4 is a fragmentary section similar to FIG. 3 illustrating the drive mechanism adjusted for another speed ratio;

FIG. 5 is a section taken on line 5–5 in FIG. 3; and

FIG. 6 is a section taken on line 6–6 in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to these drawings, there is illustrated a wheel chair **10** having a pair of ground wheel assemblies **12** (only one shown) each embodying a variable ratio rotary drive mechanism **14** according to the invention. Turning to FIG. **3**, it will be observed that the present rotary drive mechanism **14** comprises concentric inner and outer members **16** and **18** defining an intervening annular space **20**. Members **16** and **18** are drivably coupled by a variable ratio transmission **22** including a variable ratio gear train **24** contained within the annular space **20**. Accordingly, rotation of one member drives the other member in rotation at a speed, and with a mechanical advantage, determined by the ratio of the gear train. The variable ratio transmission **22** also includes a shift lever **26** which is operable to vary the ratio of the gear train **24** and thereby the mechanical advantage of the variable ratio transmission.

In the particular embodiment of the invention which has been selected for illustration, the inner member **16** of the rotary drive mechanism **14** is a tubular rotary driving shaft and the outer member **18** is a rotary driven cylindrical hub. This hub has annular sidewalls **28** and **30** joined about their perimeter by an intervening cylindrical rim **32**. Extending centrally from the sidewall **30** is a cylindrical boss **34**. Hub **18** is rotatably supported by bearings **36** and **38** on an axle **39**. Bearing **36** is mounted within a central opening in the hub wall **28**. Bearing **38** is mounted within the hub wall boss **34**. Shaft **16** is rotatable on the outer end of the axle **39** and extends through the outboard bearing. Axle **39** has a length greater than the axial dimension of the hub **18** and is axially positioned so that the ends of the axle project beyond the hub sidewalls **28** and **30**, as shown.

In addition to the rotary drive mechanism **14**, each wheel assembly **12** of the wheel chair **10** embodies a ground wheel **40** and a hand wheel **42**. The ground wheel **40** surrounds, in concentric relation, the hub **18** and is mounted on the hub by means of spokes **44**. The hand wheel **42** is keyed on and rigidly secured to the outer end of the shaft **16**. The inner end of the axle **39** extends through aligned holes in a tubular member **46** of the chair frame and is secured to the frame by a nut **48**. It will be understood that the two wheel assemblies **12** of the wheel chair **10** are located on a common axis and at opposite sides of the chair.

Briefly, in use of the wheel chair **10**, the occupant of the chair rotates the hand wheels **42** to drive the ground wheels **40** through the variable ratio gear trains **24** with a mechanical advantage determined by the setting of the variable ratio transmissions **22**. In the inventive embodiments illustrated, each variable ratio transmission has two settings. In one setting, the driving shaft **16** is effectively keyed directly to the driven hub **18**. The drive mechanism **14** then has a one to one drive ratio. In the other setting, the driving shaft **16** is coupled to the driven hub **18** through the gear train **24**. The drive mechanism then has a speed reduction ratio, whereby rotation of the shaft is effective to drive the hub with a mechanical advantage.

Referring now in greater detail to the variable ratio transmission **22**, the latter comprises a mounting plate **50** having a central hub **52** which is slideable and rotatable on the wheel axle **39**, just outwardly of the inboard wheel hub bearing shaft **16** is rotatably supported on the axle **39** just outboard of the mounting plate **50** and extends outwardly along the axle through the outboard wheel hub bearing **36** for attachment to the hand wheel **42**. Slideable and rotatable on the inboard end of the driving shaft **16** is a wheel drive plate **54**. This drive plate has the elongate shape best shown in FIG. **5** and is formed at its diametrically opposed tips with gear sectors **56**. Mounting plate **50** and drive plate **54** are rigidly joined by a number of connecting bolts or pins **58** to form a carriage. Two of these pins serve as journals for meshing pinions **60** and **62**. Inwardly formed on the inner wall of the cylindrical wheel hub rim **32** are a pair of internal ring gears **64** and **66**. An external

gear 68 is integrally formed on the inner end of the tubular driving shaft 16. The radially outer pinion 60 meshes with the wheel hub ring gear 66. The radially inner pinion 62 meshes with the driving shaft gear 68.

The mounting plate 50, drive plate 54, connecting pins 58, and pinions 60, 62 collectively provide a gear assembly 70. This gear assembly is slideable and rotatable on the wheel axle 39. Gear assembly 70 is movable axially relative to the wheel hub 18 between the positions illustrated in FIGS. 3 and 4. For reasons which will appear presently, the position of the gear assembly shown in FIG. 3 is hereinafter referred to as its low ratio or direct drive position. The position illustrated in FIG. 4 is referred to as its high ratio or slow speed position. During movement of the gear assembly between its direct drive and slow speed positions, the pinions 60, 62 slide back and forth relative to but remain in meshing engagement with the wheel hub ring gear 66 and the driving shaft gear 68. In the direct drive position of the gear assembly 70, the gear sectors 56 on the drive plate 54 mesh with the wheel hub ring gear 64. The drive plate is then locked against rotation relative to the driving shaft 16 by clutch means 72. This clutch means comprises drive pins 74 which are rigid on the driving shaft 16 and engage in notches 76 in the drive plate 54. It is obvious that in this direct drive mode of the variable ratio transmission 22, the driving shaft 16 and hand wheel 42 are effectively keyed directly to the wheel hub 18. Accordingly, rotation of the hand wheel drives the ground wheel 40 with a direct, one to one drive ratio.

In the slow speed position of the gear assembly 70 shown in FIG. 4, the pinions 60, 62 remain in meshing engagement with the wheel hub ring gear 66 and the driving shaft gear 68. The drive plate 54, however, is shifted to the right, out of engagement with the wheel hub ring gear 64. The mounting plate 50, and hence the drive plate 54, are locked to the axle, and thus against rotation, by clutch means 78. This clutch means comprises clutch keys 80 rigid on the axle which engage in notches 82 in the mounting plate hub 50. Under these conditions, rotation of the hand wheel 42 drives the ground wheel 40 at reduced speed through the gear train 68, 62, 60, 66 and with a mechanical advantage determined by the ratio of the gear train.

The gear assembly 70 is shifted back and forth between its direct drive and slow speed positions by the shift means 26. To this end, the shift means comprises a yoke 84 having arms 86 which straddle the inner end 34 of the wheel hub 18. Mounted on these arms are pins 88 which project through slots 90 in the hub and engage in a circumferential groove 92 in the mounting plate hub 52. Shift yoke 84 is pivoted on the wheel chair frame and is connected to a handle 94 in such a way that the gear assembly 70 may be shifted between its direct drive and slow speed positions by means of the handle. A bracket 96 is provided on the wheel chair frame for locking the shift handle in its two positions.

It will be understood that the two wheel assemblies 12 of the wheel chair 10 are substantially mirror images of one another. Accordingly, the foregoing description may be considered as applying equally well to both wheel assemblies. Each wheel assembly may be equipped with a brake operated by a second handle 98.

It is now obvious, therefore, that the occupant of the wheel chair 10 may propel the latter forwardly and rearwardly by grasping the hand wheels 42 and rotating the latter in one direction or the other. The variable ratio transmissions 22 embodied in the wheel assemblies 12 of the wheel chair may be set to permit propulsion of the chair with a direct drive from the hand wheels or at a reduced speed with a resultant mechanical advantage.

While the invention has been disclosed in connection with a particular physical embodiment thereof, it will be recognized by those versed in the art that various modifications of the invention are possible within the spirit and scope of the following claims.

We claim:

1. A wheel assembly for a wheel chair comprising:
an axle, hub rotatable on said axle;
a ground wheel surrounding and mounted on said hub;
said axle having an end projecting beyond one end of said hub for rigid attachment to the frame of said wheel chair;
a tubular driving shaft rotatable on said axle and having one end projecting beyond the opposite end of said hub;
a hand wheel fixed to said one end of said driving shaft;
a variable ratio gear transmission; and
said transmission comprising first and second axially spaced internal ring gears in said hub, a sun gear rigid on said driving shaft, a carriage rotatable on and movable along said axle including a toothed drive plate. Planetary pinion means rotatable on said carriage, said carriage being movable along said axle between a direct drive position wherein the teeth on said drive plate mesh with said second ring gear and a slow speed position wherein said drive plate is disengaged from said second ring gear and said pinion means mesh with said sun gear and first ring gear, first clutch means on said carriage and driving shaft against relative rotation in said direct drive position, and second clutch means on said carriage and axle for locking said carriage and axle against relative rotation in said slow speed position, and shift means connected to said carriage including a handle accessible at the side of said wheel assembly adjacent said projecting end of said axle for shifting said carriage between said positions.

2. A wheel chair comprising:
a chair frame;
a pair of wheel assemblies at opposite sides, respectively, of said frame each including an axle having an inner end rigidly secured to said frame, a hub rotatable on said axle, a ground wheel surrounding and mounted on said hub, a tubular drive shaft rotatable on said axle and having an outer end projecting beyond the outer end of said hub, a hand wheel fixed to the outer end of said drive shaft, a variable ratio transmission within said hub drivably coupling said drive shaft and hub, and shift means accessible at the inner side of the respective wheel, assembly for adjusting the ratio of said transmission;
each transmission comprising first and second axially spaced internal ring gears in said hub, a sun gear rigid on said driving shaft, a carriage rotatable on and movable along said axle including a toothed drive plate, planetary pinion means rotatable on said carriage, said carriage being movable along said axle between a direct drive position wherein the teeth on said drive plate mesh with said second ring gear and a slow speed position wherein said drive plate is disengaged from said second ring gear and said pinion means mesh with said sun gear and first ring gear, first clutch means on said carriage and driving shaft against relative rotation in said direct drive position, and second clutch means on said carriage and axle for locking said carriage and axle against relative rotation in said slow speed position;
said shift means for each transmission comprising a handle connected to the respective carriage for shifting the latter between its direct drive and slow speed positions; and the transmissions of said wheel assemblies being adjustable to provide said transmissions with equal first ratios and equal second ratios differing from said first ratios.